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ZEBRA 2020 - NEARLY ZERO-ENERGY BUILDING STRATEGY 2020

D6.2: Strategies for nZEB market transition on national level

Technical References

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ECOFYS	Ecofys	Ecofys Germany GmbH
EURAC research	EURAC	EURAC research Institute for Renewable Energy
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About ZEBRA2020

Nearly Zero-Energy Building Strategy 2020

Sustainability of the European society and economy will be based on renewable energy and high resource efficiency. For the building sector, this implies the large scale deployment of low-energy buildings (so called nearly zero-energy buildings or nZEBs). ZEBRA2020 aims at creating an observatory for nZEBs based on market studies and various data tools and thereby generate data and evidence for policy evaluation and optimisation. European legislation (Energy Performance of Buildings Directive) makes nZEBs a standard by 2020. Therefore, the key objective of ZEBRA2020 is to monitor the market uptake of nZEBs across Europe and provide data as well as recommendations on how to reach the nZEB standard.

ZEBRA2020 covers 17 European countries and about 89% of the European building stock and population. Thus, it is actively contributing to meeting the ambitious target of 100%- share of nZEBs for new buildings from 2020 and a substantial increase of deep nZEB renovations.

Learn more at www.zebra2020.eu

1. INTRODUCTION

1.1 AIM OF THE REPORT

European legislation (Energy Performance of Buildings Directive) makes nZEBs a standard by 2020. Reliable data on current market activities is essential for policy-makers to evaluate the success of their policies and measures. Therefore, the key objective of ZEBRA2020 is to monitor the market uptake of nZEBs across Europe and provide data and input on how to reach the nZEB standard. This report presents information gathered for 17 European member states. The data presented in the report were collected and proved involving European research and academia and national decision makers. Based on the gathered information and analysis, the recommendations for a strategy towards a decarbonisation of the building stock were derived. This report provides data, results and recommendations and is structured as follows: (1) building performance market data presents statistics on renovation and new construction activities in the recent years and the selection of the high performance buildings showing technical specifications of these selected buildings in different countries (2) an analysis of Energy Performance Certificates (EPCs) and a survey among Real estate agents shows the impact of EPCs on the real estate market (3) the existing policy chapter summaries the national policy framework for the building sector (4) the nZEB-tracker presents harmonised criteria showing transformation and maturity of the national and the EU market for nearly zero-energy buildings (5) Scenarios show market transition to nZEB and its impact on the decarbonisation of the European building stock up to 2020, 2030 and 2050, and finally (6) Recommendations, which aim to support policy makers to set up ambitious goals for nZEBs and energy efficiency in the building stock.

1.2 BUILDING PERFORMANCE MARKET DATA

Selected high performance buildings

The ZEBRA2020 project consortium collected detailed data of recently constructed or renovated nZEBs (or high efficient buildings estimated to be at nZEB level) in order to discover possible peculiarities and distinctive features of certain MSs when renovating or constructing nZEBs. The nZEB features are displayed in the "nZEB buildings data tool" and analysed in the report "nZEB features, cost assessment and performance". The collected nZEBs provide information on:

- location and climate zone;
- year of construction;
- kind of construction;
- use of building;
- energy performance;
- envelope features (U-Values and insulating materials);
- passive cooling strategies;
- heating, cooling and mechanical ventilation technologies;
- use of renewable energy.

In total, data of 411 nZEBs have been collected in the 17 target countries. 333 out of the 411 nZEBs are new buildings and 78 are renovated buildings. Concerning the use of the buildings, 261 are residential buildings while 150 are intended for non-residential use.

To show a recent picture of the building market and detect possible solution trends, the collected nZEBs were mainly constructed or renovated within the last 5 years.

The use of one strategy, solution or technology rather than another is influenced by various factors. On the one hand national strategies, incentives and subsidies play an important role at national level, but on the other hand factors linked to a specific geographical area like building traditions, climate conditions and availability of sources, materials or technologies are also very relevant in the design process.

This document presents the results classified by countries, nevertheless, the analysis of the report "nZEB features, cost assessment and performance" has been focused on climatic zones due to its high influence. For this purpose, it was needed to developed a common methodology[1] to define the

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[1] Katerina Tsikaloudaki, Kostas Laskos and Dimitrios Bikas (2011). On the Establishment of Climatic Zones in Europe with Regards to the Energy Performance of Buildings. Energies 2012, 5, 32-44 (http://www.mdpi.com/1996-1073/5/1/32/pdf)

different climatic zones and to calculate homogeneously the Heating and Cooling Degree Days[2], as indicated in table 1.

Table 1 Climatic zones according to Heating and Cooling Degree Days

Climatic Zone	Heating and cooling degree day	Climate
Zone A	Buildings with Heating Degree Day >= 1962 Cooling Degree Day >= 525	Cold winters and warm summers
Zone B	Buildings with Heating Degree Day >= 1962 Cooling Degree Day < 525	Cold winters and mild summers
Zone C	Buildings with Heating Degree Day< 886 Cooling Degree Day >= 525	Warm winters and warm summers
Zone D	Buildings with Heating Degree Day between 886 and 1962 Cooling Degree Day < 525	Temperate winters and mild summers
Zone E	Buildings with Heating Degree Day between 886 and 1962 Cooling Degree Day >= 525	Temperate winters and warm summers

The figure 1 shows that most of the collected nZEBs are located in the climatic zone B, which is characterized by cold winters and mild summers.

Figure 1 Distribution map of the collected nZEB according to the climatic zone

This analysis is targeted to designers which can find suggestions and information of the most recurrent and recent nZEBs solutions and public authorities that can boost different technologies when defining tenders or local codes.

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[2] Within ZEBRA2020 project, it has been defined 15°C as base temperature for heating and 18,5°C as base temperature for cooling using the same calculation tool. http://www.degreedays.net

1.3 EPC´S AND REAL ESTATE AGENTS

The aim of the survey was to collect real estate agent's professional opinion **on what are the main factors that households consider when selecting properties to buy or rent. Additionally, the survey asked questions concerning impact of energy performance certification on the values of properties, exposure time of properties and a set of questions, which asses the problems with wider uses of EPCs in the daily practise.**

Many of statements regarding energy performance certification expressed by real estate agents are statistically slightly negative. However, a few answers showed positive opinions and the results vary among the countries. The results of the real estate agent`s survey provides significant recommendations on how to increase the impact of EPCs on the property value and how to overcome obstacles in wider use of EPC`s across EU. For instance, in some countries EPCs are not mandatory yet at all stages of real estate use (e. g. design, primary market release, secondary market transactions, and renovations). In those countries, where EPCs are already mandatory, this duty may be better respected, if EPCs would be also requested by lawyers/notaries as witnesses of real estate transactions. Bureaucratic hurdles in issuing EPCs shall be reduced while the evaluation of energy performance certificates in terms of reliability shall be improved. Improved training and qualifying of the certifiers and proper quality control would increase reliability and credibility of EPCs.

The survey has been conducted on the territory of 8 EU member states – Austria, France, Germany, Italy, Norway, Poland, Romania and Spain. The survey included 618 interviews in total, respectively in particular countries: Austria N= 50; France N= 70; Germany N= 90; Italy N= 136 Norway N= 90; Poland N= 71; Romania N= 43; Spain N= 68.

Real estate prices and EPC

The aim of this assessment is to obtain an estimation of price surpluses due to higher energy efficiency given in sales and rental markets. The energy rating level given in EPCs is used as indicator for the energy efficiency of a property. The following EU member states were chosen for analysis in this assessment: Austria, Czech Republic, Denmark, France, Germany, Luxembourg, The Netherlands, Norway, Slovakia, Spain, Sweden and United Kingdom. Details on Belgium and Italy can be found in the underlying study of De Graaf (2016). A regression has been carried out in the selected real estate markets; its main steps are explained in Figure 2:

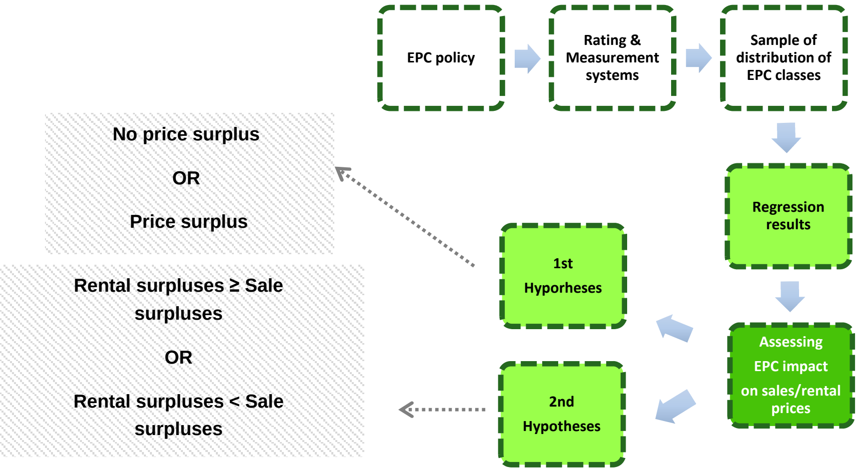


Figure 2 Summary of process adopted for assessing EPC impact on sales/rental prices in each country property market. Source: study of De Graaf (2016)

Data on the characteristics of dwellings in the selected countries (including EPC ratings) were collected from different estate agency websites. Data were collected for both, sales and rental transactions, in each country. In addition to EPC ratings and advertised prices, the useable area was collected for each dwelling and in most cases the construction year.

Anyway, cross-country comparisons must be made with caution due to different EPC systems, real estate markets and type of properties. In addition, the quality and size of samples vary between the analysed countries. On the other hand, data availability in this field is continually improving due to the increasing levels of implementation of the EU Energy Performance in Buildings Directive (EPBD), which requires EPCs to be advertised for rental and sales transactions. However, data limitations remain and a full report of the level of energy efficiency capitalisation in all EU and EEA member states is not yet possible. Thus, the collected data will be used as foundation for future investigations that can be performed periodically to assess changes in the level of capitalisation of energy efficiency, thereby providing information that can be used to assess the success of policies in the field, such as the success of energy performance certification.

1.4THE NZEB-TRACKER

The nZEB-tracker is an online Wiki-tool that has been developed to monitor and visualise the transformation and maturity of the national and the EU market for nearly zero-energy buildings over time based on ten criteria. Those criteria cover political, macro- and micro-economic aspects and are aggregated as outlined in the ZEBRA2020 report on the "Aggregation of nZEB monitoring criteria".

The ten criteria are:

- Criterion 1: Market penetration of nZEB
- Criterion 2: Ambition level and accuracy of national nZEB definition
- Criterion 3: National policies supporting the market development for nZEB
- Criterion 4: National progress towards cost-optimal building performance requirements
- Criterion 5: Level of industry involvement
- Criterion 6: Availability of nZEB-relevant components
- Criterion 7: Market penetration of nZEB-relevant components
- Criterion 8: Level of nZEB-relevant expertise of actors
- Criterion 9: Level of awareness / information / acceptance in the society
- Criterion 10: Dependency of property value/rent on the energy performance

The criteria 2, 5 and 7 have not been assessed due to a lack of data or low comparability among the ZEBRA2020 target countries.

The Criteria are expressed in scores between 0 and 1 as is the maturity of the national/EU nZEB market. The scores are calculated using data that have been derived within the different tasks of the ZEBRA2020 project and partly based on estimations of experts for the national building sectors.

Scores of 0 can be interpreted differently:

a) no data is available;
b) requirements for a criterion are not fulfilled;
c) the nZEB market is not developed

Scores of 1 can be interpreted as follows:

a) all requirements for a criterion are fulfilled
b) the nZEB market is mature

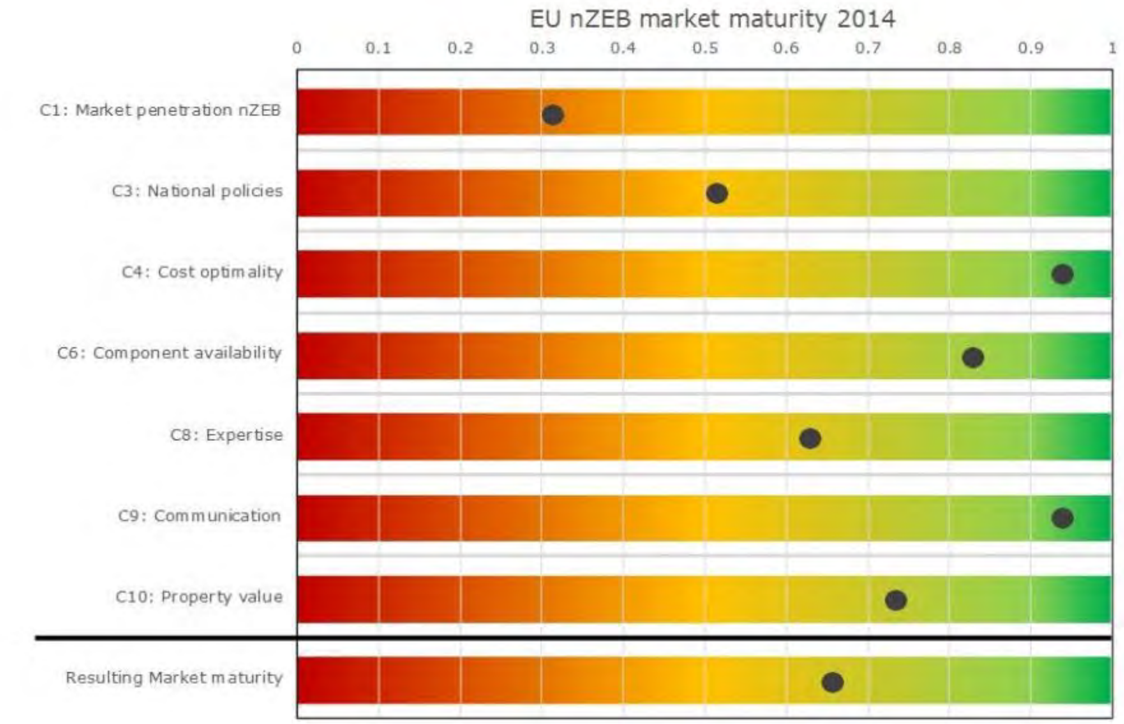


Figure 3 nZEB-tracker score for the European Union in 2014

1.5 SCENARIOS

In this part of the project ZEBRA2020, we analysed, how current building standards and other policy settings affect the building stock transition and corresponding energy demand targets of the building sector until 2050 and how more ambitious policies could change this transition. For this purpose, a current policy scenario and an ambitious policy scenario of the market transition to nZEB up to 2020, 2030 and 2050 were developed. The gap between these two scenarios shows the need for actions moving to a low carbon building stock.

The current policy scenario is driven by the existing policies including energy performance requirements, financial instrument and obligations for renewable sources in the buildings. These policies were surveyed in the project ZEBRA2020 (see section "Existing policies").

The ambitious policy scenario is based on more intensive policies which lead to higher renovation rates and depths, more efficient new building construction, higher share of renewable energy and corresponding CO_2 and energy savings.

The following policy instruments were investigated and implemented in the model (although not all of these instruments were analysed for each country):

- Building codes for new buildings and building renovation
- Financial and fiscal support policies/programmes
- Increase of renovation rate in public buildings
- Obligation to install renewable heating systems
- Compliance with regulatory policies
- CO2 Tax

Building codes for new buildings and building renovation

In order to compare the building construction and renovation activities between the investigated countries, the harmonised methodology for the calculation of energy needs and primary energy demand according to EN13790 are used. For this reason, the existing national building codes and national nZEB definition (if available) to define the categories for new building and building renovation are assessed. For the new building construction, we distinguished the policy requirements implemented in the period 2012 and 2020 and from 2021 to 2050. From 2012 to 2020, the current policies are in force and the model results indicate which share of the building stock is built according to following three new building standards:

- Building code, 2012: requirements for the new building construction defined in the national building code in 2012

- Better than building code, 2012: higher energy performance achievements compared to the building code in 2012
- Much better than building code, 2012: much higher energy performance achievements compared to the building code in 2012

From 2021 to 2050, the EPBD 2010 is implemented and the new building standard follows the nZEB requirements. Model results are shown for the following three standards:

- nZEB (building code, 2021): requirements as defined in the national nZEB definition for 2021 (please see the national nZEB definitions "www.zebra2020.eu, data tool)
- Better than nZEB requirements
- Much better than nZEB requirements

In the ambitious policy scenario, the building standard 2012 is updated in 2017 and higher energy performance of the new construction is required. The national nZEB requirements are also stronger in this policy scenario.

For the building renovation, the following renovation categories were defined in the current policy scenario:

- medium renovation which refers to the building codes
- light renovation meaning that in reality not all buildings fulfil the criteria set in the building legislation
- deep renovation reflecting the nZEB definition

In the ambitious scenario, from 2021 to 2050, all buildings fulfil at least the building standards meaning that the light renovation is not installed. There is an additional renovation level "deep plus" which means higher energy performance achievements compared to the deep renovation.

We want to emphasize that both for new building construction and for renovation we were not able to cover all aspects of country specific nZEB definitions in the model. Calculation of energy needs, definitions of nZEB indicators, system boundaries and national norms are too different to consider them in a detailed, comprehensive way in the modelling work of this project. Thus, there might be some deviations between our approach to model nZEB-Standards in the different countries and the correct, country specific calculation.

The share of the installed building construction level or renovation level mainly depends on the cost-effectiveness of the standard. However, if there is a certain obligation of a building standard in place, the selection of building components is restricted in the model. Building renovation and construction rate and depth are the main drivers for the total energy savings in the building sector.

Financial and fiscal support policies/programmes

In the current policy scenario, existing programmes are implemented and available by 2050 (see section "Existing policies" and the report D4.4 "Existing policies"). Financial and support programmes are implemented for energy efficiency investments and use of renewable energy sources (heating systems and building renovation). In the ambitious policy scenario, the public budget for these support instruments is increased by 50% compared to the current policy scenario.

Increase of renovation rate in public buildings

3% yearly renovation rate in public government buildings is implemented in both policy scenarios.

Obligation to install renewable heating systems in case of new buildings, building renovation or heating system replacement

In the current policy scenario, a certain minimum share of energy demand supplied by renewable energy sources is implemented from 2021 in all building categories in case of building renovation and new building construction. In the ambitious scenario, this minimum share of energy demand supplied by renewable energy sources is increased. Details are documented in the country chapters.

The gap between these two scenarios serves as a discussion basis for the need for actions moving to a low carbon building stock. The following main three indicators are assessed:

- Final energy demand for space heating, hot water production and space cooling
- Primary energy demand for space heating, hot water production and space cooling
- Related CO2-emission

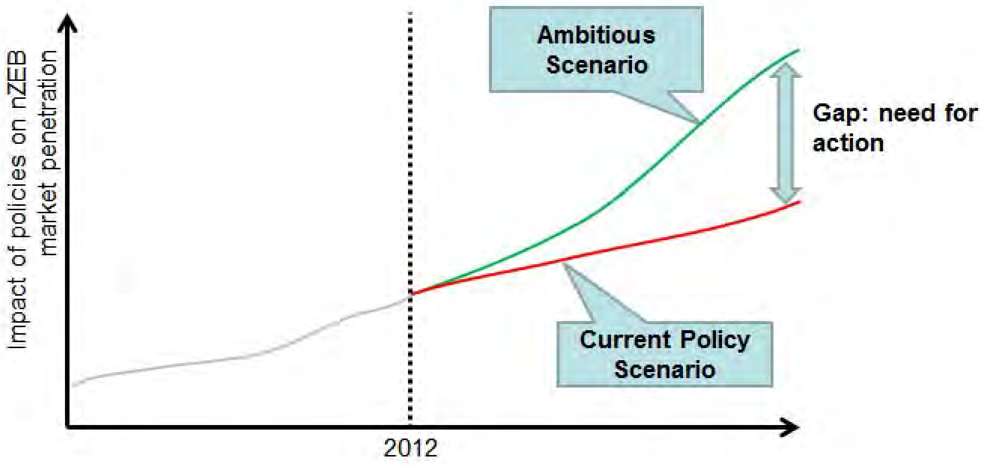


Figure 4: Indicative scenario development over time

The scenarios are modelled by using the disaggregated bottom-up building stock model Invert/EE-Lab. Invert/EE-Lab is a dynamic bottom-up simulation tool that evaluates the effects of different policies (in particular different settings of economic and regulatory incentives) on the total energy demand, energy carrier mix, CO_2 reductions and costs for space heating, cooling, lighting and hot water preparation in buildings. The basic idea of the model is to describe the building stock, heating, cooling and hot water systems on highly disaggregated level, calculate related energy needs and delivered energy, determine reinvestment cycles and new investment of building components and technologies and simulate the decisions of various agents (i.e. owner types) in case that an investment decision is due for a specific building segment. The core of the tool is a myopical, multinominal logit approach, which optimizes objectives of "agents" under imperfect information conditions and by that represents the decisions maker concerning building related decisions. More information is available on www.invert.at or e.g. in Müller, (2015), Kranzl et al., (2014b), Kranzl et al., (2013) or Müller et al., (2014b).

Not all countries have been covered in the same level of detail, according to the work programme. Consortium countries have been simulated in a more detailed way. A selection of other countries have been analysed with less detailed effort and without discussing results with national stakeholders.

1.6RECOMMENDATIONS

The building sector is entering a transition phase, transforming from passive energy demanding block to active nZEBs and beyond. Policy makers should aim to set up ambitious goals for nZEB and energy efficiency in the building stock, in order to utilizing the potential benefits from a faster nZEB transition – environmental, social and economic. In order to achieve this, a number of recommendations have been drafted for each target country. These have been derived from previous ZEBRA2020 outcomes and expertise, and the country specific framework for nZEB market uptake.

Before outlining the country specific recommendations, four foundational principles need to be mentioned. Without these, the nZEB transition won't be possible: (i) stakeholder involvement, (ii) long term strategies, (iii) continuous assessment and review and (iv) empowering the local level.

Following these overarching conditions, a number of country specific recommendations have been developed to help policy makers and stakeholders understand what action must be taken to boost the market uptake of nZEBs. The recommendations are distributed among six different, yet interdependent, categories: legislative & regulatory instruments, economic tools, communication, quality framework, new business models & innovation and social aspects. They are described here below:

Legislative and regulatory instruments are at the hearth of any policy-maker's authority. Setting clear goals, strengthening minimum building standards or reshaping public procurement processes to focus on energy efficiency requirements, can push nZEBs from the demonstration stage to become the new normal.

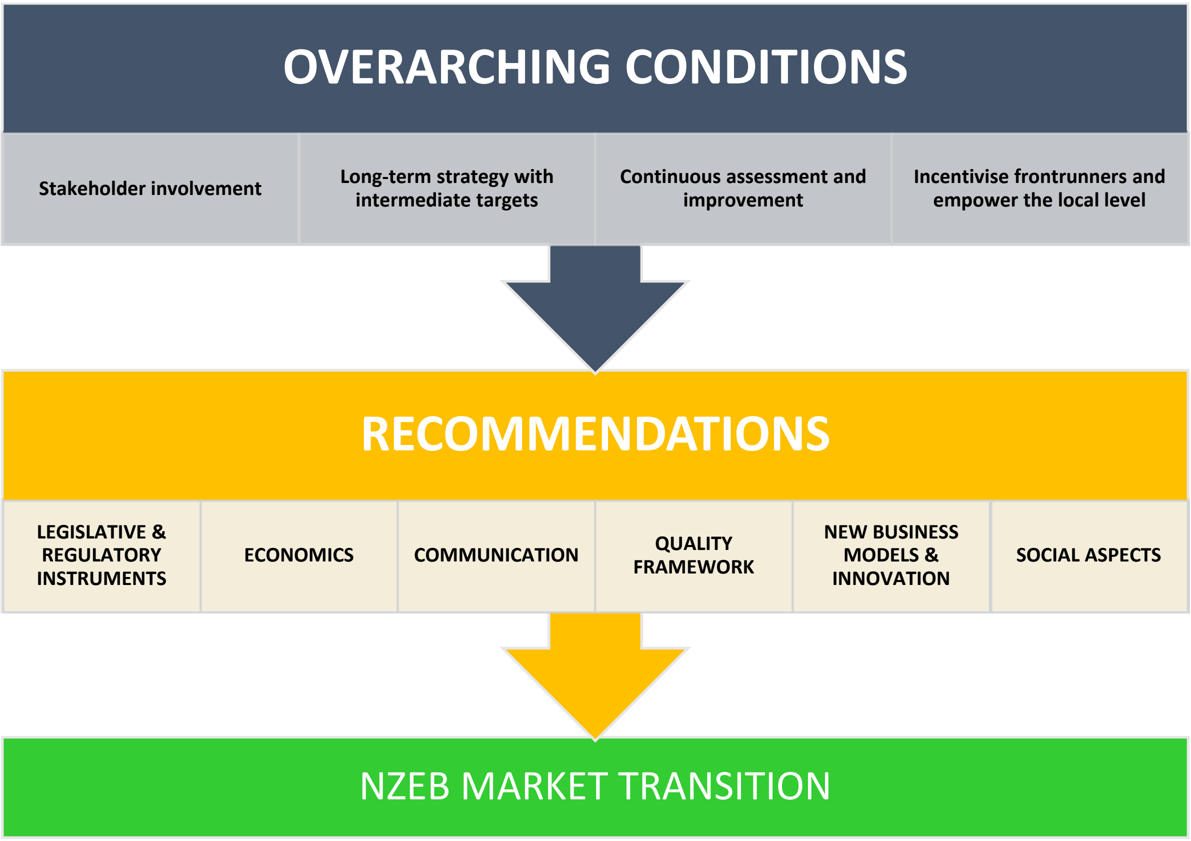
Although nZEBs are (mostly) cost-optimal over the total lifetime, the high up-front investment is often appointed as main barrier for transforming the building stock from energy demanding blocks to nZEBs. **Economic measures** are therefore a key enabler to increase investments in nZEB projects. While there are many financial programmes in place, the understanding of their overall effectiveness and interaction (or enforcement) with each other is unclear. The several financial instruments available should be bundled and since the investment funds required for the nZEB transformation cannot come solely from public sources, the private sector should be encouraged to get involved.

All Member States must succeed to raise awareness about the benefits of investing in nZEBs. Effective **communication** is a key in this regard. Too much energy and investments are wasted due to inadequate understandings and measures. With the current technologies, nZEB levels are technically and economically feasible. Furthermore, consumers should be able to rely on the skills of the building professional and get value for money, which means state-of-the-art information and advice, achieving the expected (energy) performance, a maximum operational lifetime and a safe and healthy building. This requires high **quality** in the nZEB chain – highly energy efficient products require the proper understanding from the installer etc.

The transition to high-energy performance levels runs along an experimental growth path. Innovation across the whole construction value chain is necessary so that different building elements are approached in an integrated method. Member States ought to alleviate legislative and procedural obstacles hampering the development of new business **models and well-needed innovation** in this sector.

Finally, **energy poverty** is a major problem for Europe, as between 50 and 125 million people are unable to afford a proper indoor thermal comfort. Despite the fact that there is no common European definition, with only four countries having an official energy poverty definition, the importance of the problem as well as the severe health impacts caused by energy poverty are widely recognized. Specifically, excess winter deaths, mental disability, respiratory and circulatory problems are adversely affected by fuel poverty.

The best policies and measures combines different categories. It is therefore essential that policy makers assess the interlinkages between new and assisting policies.



See the ZEBRA2020 report “Recommendations and best examples for fostering nZEB in EU MS” for a deeper explanation of the background and categories. The report includes 35 recommendations for other EU Member States, including best practices, pilot projects and EU projects.

2. AUSTRIA

2.1 BUILDING PERFORMANCE MARKET DATA

2.1.1 Construction and renovation activities

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for EU countries. Austria is one of the EU countries with the highest rate of new buildings: in 2014 more than 1.1% of the total building stock was newly built buildings, whereas the majority is multi-family dwellings.

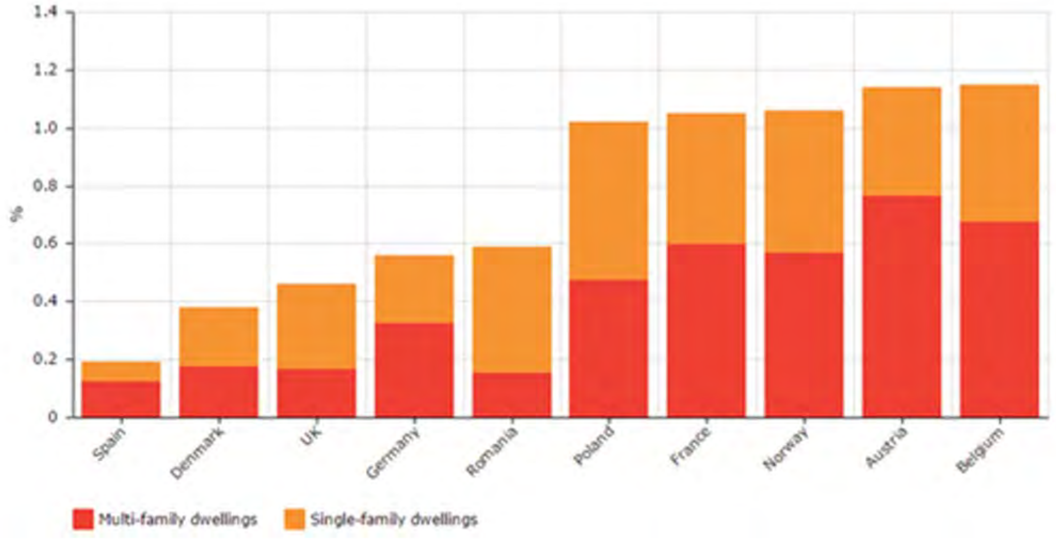


Figure 5: Share of new multi- and single-family dwellings in residential stock in 2014

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings
2. nZEB buildings according to national definitions
3. Buildings with an energy performance better than the national requirements in 2012
4. Buildings constructed/renovated according to national minimum requirements in 2012

The Austrian nZEB radar is based on the following methodology and assumptions. It builds on the official nZEB definition which is in force since 2012 and was refined in March 2015:

- The nine Austrian regions provide subsidies for building renovation and for new building construction. For two regions, data of supported buildings regarding floor area, achieved energy need for space heating etc was available for this report.
- Since all these buildings have to achieve better standards than the building code, we derived clusters of "better than building code", "national official nZEB definition" and "better than nZEB" from these data.
- We assumed that all buildings, which are not supported in the frame of these regional programmes are built according to building code.
- Non-residential: There is no detailed information available for the quality of non-residential building construction and renovation.

The majority of new buildings in Austria are better than the current building code, whereas the share of buildings fulfilling the future nZEB definition or going even beyond is constantly rising. This is due to a long tradition of highly efficient construction in Austria. On the other hand more than 60% of the new construction in 2014 did not fulfill the nZEB criteria of 2020 yet.

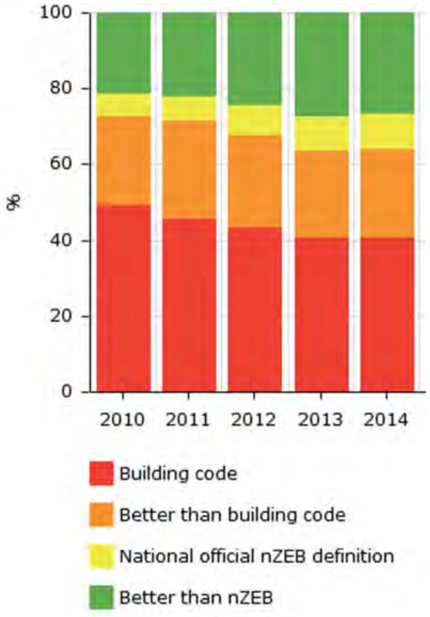


Figure 6: Distribution of new dwellings according to the nZEB radar graph – Austria, based on data from selected regions.

Due to the lack of an official European definition, ZEBRA2020 developed the indicator "major renovation equivalent" in order to simplify the comparisons between different EU countries. Three renovation levels have been defined by ZEBRA: "low", "medium" and "deep". However, these 3 levels are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

Based on a special evaluation from Statistics Austria, four renovation measures are considered (which are partly combined in renovation packages) and are defined by the type of measures implemented:

- Window replacement
- Boiler replacement
- Thermal renovation of façade
- Thermal renovation of ceilings

The average energy savings by each measure has been estimated from another study, taking into account that some measures are combined in renovation packages: 14% of energy savings for windows; 5% for boiler replacement; 34% for thermal renovation of façades and 13% for ceilings
The share and amount of renovation measures covers the period 2000-2012 and thus is just a rough indicator for the renovation activities in certain years. Based on these sources the Austrian major renovation equivalent is estimated at 1.8% in2012.

2.1.2 Selected high performance buildings

In Austria, data has been collected for 30 nZEBs or high energy efficient buildings which were constructed recently. 22 out of the 30 are new buildings and 8 are renovated buildings. 10 have a residential use, while 20 are intended for non-residential use.

Climate zones

Table 2 shows that the 30 buildings are located in the climate zone B, which is characterized by cold winters and mild summers.

Table 2 Building distribution by climate zones - Austria

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	22	8
C	Warm winters and warm summers		
D	Temperate winters and mild summers		
E	Temperate winters and warm summers		

Heating Demand

The average heating demand in new buildings is 10,8 kWh/m² a, while in renovated buildings it is 15,2 kW/m² a. Nevertheless, in renovated buildings the figure 2 shows that there is a dispersed value in renovated buildings which increases the average.

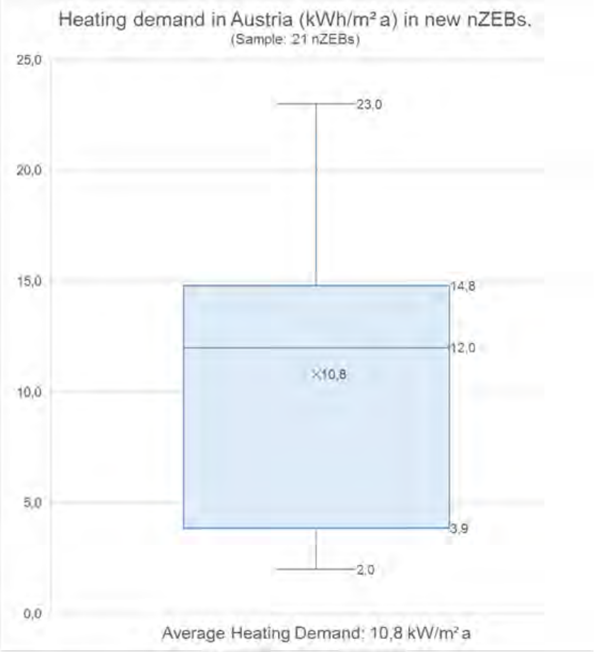


Figure 7. Box plot of heating demand in new nZEBs - Austria

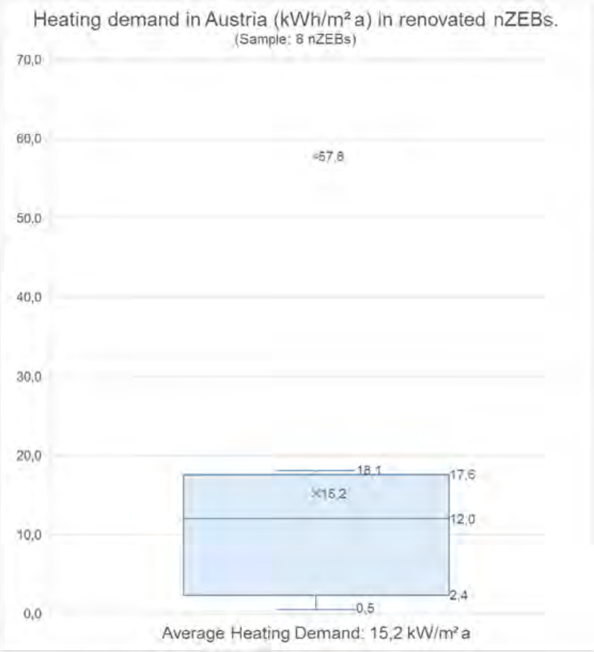


Figure 8. Box plot of heating demand in renovated nZEBs - Austria

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,15 and 0,11 in roofs, while in renovated buildings the average U-value in walls is 0,21 and 0,15 in roofs.

Concerning the insulating material, in most cases the insulating material is unknown in both new and renovated buildings.

In windows, the average Uwin-value is 0,9 in new buildings as well as in renovated buildings. The type of glass is mostly unknown and triple glass is the second most used answer.

Sunshade with a percentage of 32% is the most used passive cooling strategy in new building, while in renovated buildings 50% of the buildings do not use any passive cooling strategy and 25% of them use thermal mass to postpone the peak loads as passive cooling strategy.

Active solutions

Mechanical ventilation with heat recovery is the preferred option in both new (82%) and renovated (75%) buildings.

Concerning the heating system type, the favourite system is district heating with a share of 27% for new buildings and 38% for renovated buildings. In line with the heating system, district heating is the most used energy carrier for heating in new and renovated buildings.

For domestic hot water (DHW) in new buildings, a system partially depending on solar thermal collector is the most used system with 28% of share, while in renovated buildings the most used system is the same as the heating system (38%).

Nearly 85% of the selected buildings do not include cooling systems.

Renewable energies

In 10 out of the 22 new buildings, it is indicated the use of photovoltaic systems and in 5 the use of solar thermal systems.

In renovated buildings, the percentage of use of renewable energies is 25% in both photovoltaic and thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Austrian reports and realised projects.

Table 3 Costs of different renovation depths and new built according to nZEB standards – Austria

Costs (€/m2)	AT
Minor renovation (15% energy savings)	410
Moderate renovation (45% energy savings)	456
Deep renovation (75% energy savings)	484
NZEB renovation (95% energy savings)	524
New built according to nZEB standards	1824
Additional funds for nZEB construction compared to new built	280

2.2 EPCS AND REAL ESTATE AGENTS

2.2.1 Real Estate Agents Survey

1. The dominant form of EPC indicated by all real estate agents from Austria is mandatory certification.

2. In opinion of real estate agents from Austria, the main factors taken into account whilst selecting, purchasing or leasing real estate are mainly the location, size and price of the real estate.

A further important element was factor called various "nuisance" e.g.: a busy road, landing airplanes, landfill, a high-voltage line, etc. The cost of energy is indicated as very important factor by 10% and as important by 60% of real estate agents only.

3. The EPCs are in Austria very frequently required in concluding the purchase/lease contracts,

4. The real estate agents in Austria are in general quite satisfied with reliability of the data provided by the EPC.

5. Usefulness of EPCs in the professional activity of real estate agents in Austria is evaluated by them not very high. Only near 1/3 of the respondents indicates the usefulness of the certificate in their professional work.

6. The real estate agents in Austria do not rather see any connection between the EPC and the improvement of the energy performance of buildings.

7. Usually, real estate agents in Austria don`t confirm correlation between the high energy performance and high value of real estate.

8. Majority of real estate agents in Austria don`t observe that higher energy performance of buildings cause the growing interest in its purchase / lease in comparison to other buildings.

9. In opinion of real estate agents in Austria, the influence of having the higher EPC class on the exposure time of the real estate is rather low.

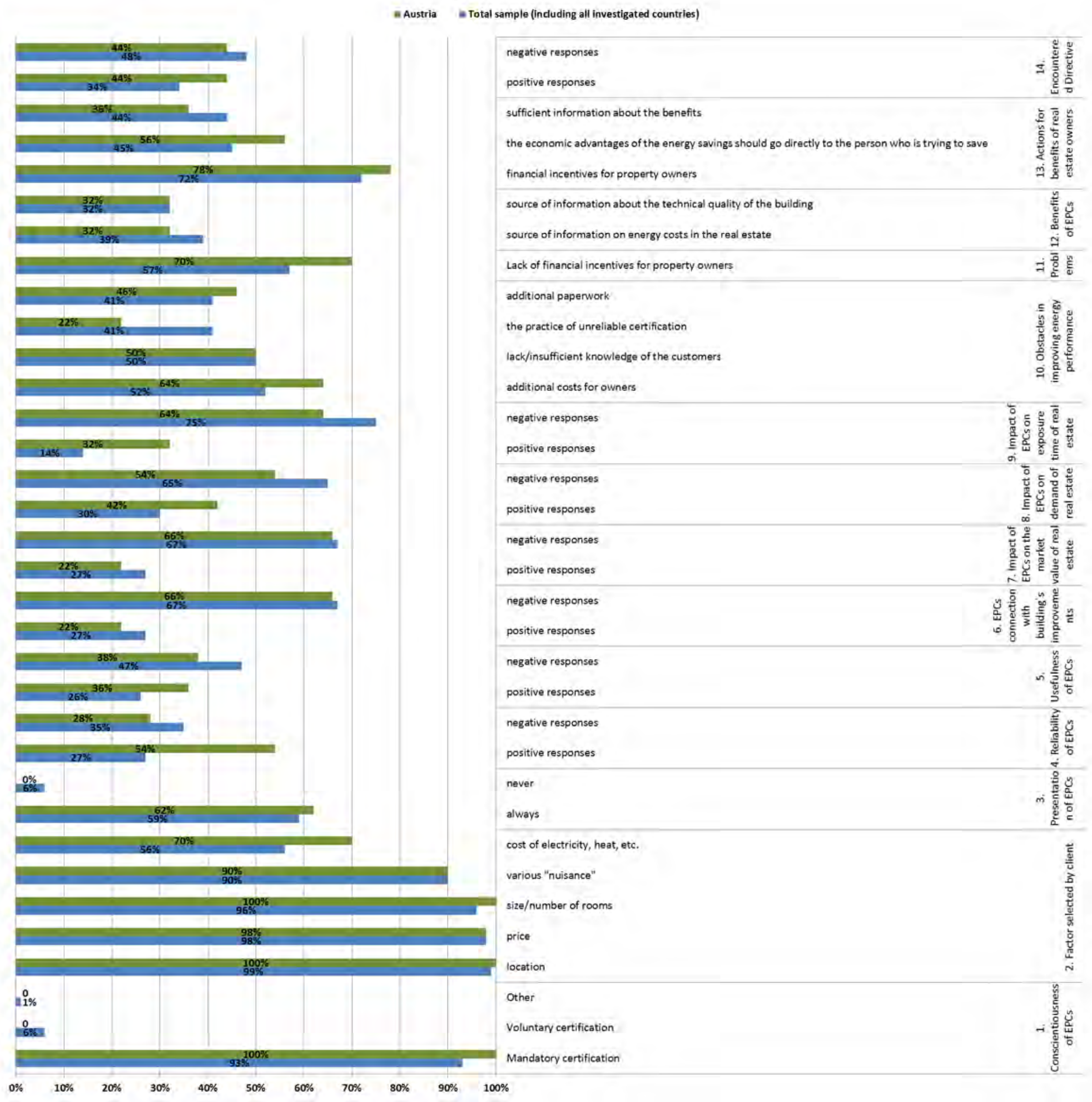
10. The main obstacles in improving the energy performance of buildings were indicated by real estate agents in Austria to be the following: financial matters (additional costs for owners), low social awareness in this subject, additional bureaucracy and the practice of issuing unreliable certificates.

11. Among the problems of implementing the improvement of the energy performance of buildings, the following has been mainly indicated by the real estate agents in Austria: the financial aspect, no incentive for the real estate owners.

12. The most important benefit of having the EPC indicated by the real estate agents in Austria is the source of information concerning the energy costs and technical condition of the building.

13. The most expected support that would influence the improvement of the energy performance of buildings, according to the respondents from Austria, is financial activity. Economic support directed to real estate owners and economic incentives for those that undertake such actions and sufficient information about the benefits.

14. The level of awareness and information about wording, requirements and settlements of the 2002/91/EC or 2010/31/EU Directive among the real estate agents in Austria is over average.



2.2.2 Real estate Prices and EPCs

The main indicator that is used to determine the energy efficiency of a home for Austrian EPCs is the total energy efficiency factor. This is calculated using a fixed-value method, which converts energy usage in kW/m2 into categories on a scale from A++ (most efficient) to G (least efficient). By 2011, it was estimated that 20% of the Austrian building stock had obtained valid EPCs (CA EPBD 2016b).

For the sales market, the statistically significant EPC coefficients follow the expected trend in the range between B- and G-rated dwellings. However, there is an unexpected opposite trend at the higher-end of the scale, between B- and A-rated dwellings, and again between A- and A+-/A++-rated dwellings. This may be a consequence of the small sample size in these best categories and should be taken with caution. The linear regression model suggests a price surplus of 18% for each one-letter improvement.

For the rental market, a positive correlation between price and EPC-rating is observed across the whole scale as tenants generally do not expect to bare the maintenance costs and hence will usually only consider bills in their energy-related considerations. The price surplus for each letter improvement is 5.2%.

2.3EXISTING POLICIES

Austria considered the current building code, and its trajectory until 2020, as nZEB compliant. Despite the many frontrunner projects, there are serious doubts whether the building codes in place are ambitious enough to achieve the requirements. The biggest weaknesses of the current policy framework, are the lack of information and training for craftsmen and the ineffective implementation of EPCs. Furthermore, cost-optimal levels for non-residential buildings have not been provided and the cost optimal report lacks trustworthy measures to alleviate current standards and the cost optimal level. It is also troublesome, that the 3% renovation rate for public buildings according to 2012/27/EU is implemented only for a small portion of public buildings in Austria.

The building sector and energy targets

Final energy targets for 2020, including interim targets for 2016. Unfortunately, no environmental targets or macro-economic goals are explicitly mentioned in Austria’s NEEAP.

Final energy targets in Austria

	2012	2016	2020
Primary energy consumption	1,308 PJ	1,314 PJ	1,320 PJ
Primary energy savings	74 PJ	96 PJ	240 PJ
Final energy consumption	1,096 PJ	1.098 PJ	1,100 PJ
Final energy savings	62 PJ	80 PJ	200 PJ

National Renovation Strategy

In short, the Austrian national renovation strategy leaves a lot to be desired. It only includes limited information on federal level policies. On forward looking perspectives, Austria’s NEEAP has some projections about renovation activities in the central government estate, which however, includes only a small portion of the Austrian building stock. On the bright side, several individual regions in Austria have some very ambitious renovation policies. One example is the demanding target in the Lower Austria region for renovated public buildings, which is as low as 30 kWh/m2/a for the final heating demand.

The main target for policies and measures in Austria is to reduce heating demand and consumption.

The energy saving potential for 2020 (target year) is estimated, in the Austrian renovation strategy, at 2,185 GWh/a for residential and 1,130 GWh/a for non-residential buildings, compared to 2013.

Energy Performance Requirements

The Austrian building code refers to residential and non-residential buildings. The building code is built mainly on four key benchmarks: (1) space heating energy needs, (2) total energy efficiency factor, (3) primary energy demand, (4) CO2 emissions. The indicators cover energy demand for space heating, cooling, ventilation, hot water, lighting, auxiliary energy demand and the household electricity demand (or operational electricity demand in case of tertiary buildings).

From 1 January 2016 onwards the primary energy demand was reduced to 180 kWh/m²a for new residential, 210 kWh/m²/yr for new non-residential, 220 kWh/m²/yr for residential renovation and 280 kWh/m²/yr for non-residential renovations as set out in the national nZEB plan. Further reductions for 2018 and 2020 are planned.

Energy performance requirements in Austria (2016)

		Residential buildings	Non-residential buildings
		Max	**Max**
New stock	Space heating energy need (HWB) (kWh/m^2/yr)	HWB = 16 (1+3/lc) ≤ 54.4	HWB = 16 (1+3/lc) ≤ 54.4
	Space cooling energy need (kWh/m^2/yr)	-	1
	Total primary energy respectively heating/cooling/hot water/lighting/ household and electricity demand (kWh/m^2/yr)	180	210
Renovated stock	Space heating energy need (HWB) (kWh/m^2/yr)	HWB = 23 (1+2.5/lc)	HWB = 23 (1+2.5/lc)
	Space cooling energy need (kWh/m^2/yr)	-	2
	Total primary energy respectively heating/cooling/hot water/lighting/ household and electricity demand (kWh/m^2/yr)	220	280

Compliance In Austria, the energy-related requirements are checked through the energy performance certificates (EPCs), which are randomly checked as part of the submission procedure to achieve a housing subsidy (in case that the EPC has been prepared for the new construction of renovation of a building). The obligation to submit an EPC as part of the housing subsidy submission procedure has been used as a quality control of the EPC. At the beginning, many EPCs were wrong and had to be rejected however, during the period 2008-2010 the quality of EPCs has improved substantially. The regions (Bundesländer) are responsible for the quality control of EPCs if a residential building subsidy is requested and in case of non-compliance the subsidy can be refused.

Renewable sources in the building sector

Many national and regional laws and measures for fostering RES in buildings are mentioned in the National Renewable Energy Action Plan (NREAP). With regards to the building codes, the OIB Directive 6 (March 2015) is the most important source. It sets minimum RES requirements that are met by one of the following measures under a) or b):

a) RES from outside the building:

- 50% biomass for space heating and DHW
- 50% from heat pump for space heating and DHW
- 50% district heating from renewable sources for space heating and DHW
- 50% district heating from high efficient CHP and/or waste heat for space heating and DHW

b) RES from inside the building:

- 10% solar thermal energy for the final DHW demand
- 10% PV electricity for the final electricity demand
- 10% of the final space heating energy demand delivered by heat recovery
- Reduction of the final energy efficiency factor for new buildings by 5% by a combination of solar thermal, PV and heat recovery

According to the national renewable energy action plan 2010 for Austria (NREAP-AT) following RES trajectory is expected:

	2005	**2010**	**2015**	**2020**
Residential buildings	24%	25%	26%	26%
Commercial buildings	8%	9%	10%	10%
Industrial buildings	1%	2%	2%	2%
Public buildings	1%	2%	2%	2%
All Buildings	33%	35%	38%	38%

2.4 NZEB-TRACKER

The nZEB-Tracker results for Austria are shown in the following figure for 2014, some key findings are highlighted below.

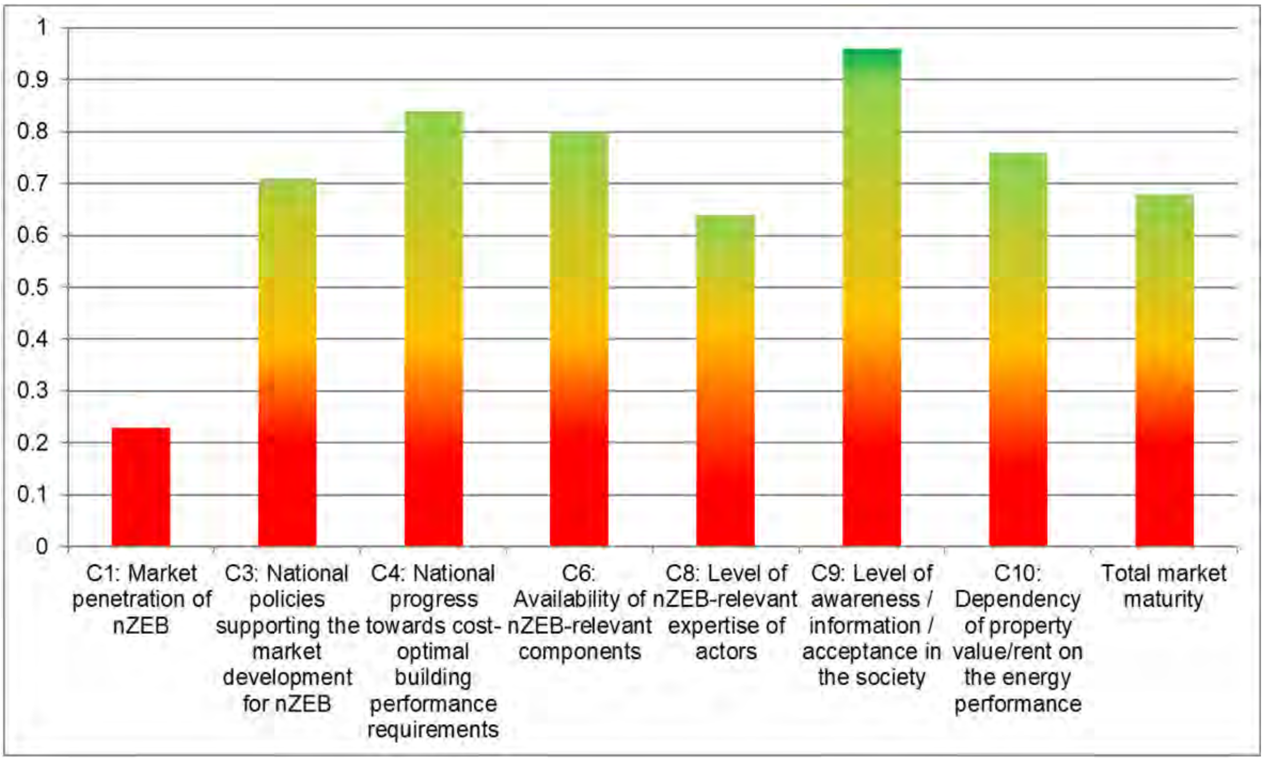


Figure 9: nZEB tracker score for Austria

C1: Market penetration of nZEB

- Austrian result: **0.23** ZEBRA average: **0.32**
- The share of nZEB buildings and buildings exciding the Austrian nZEB definition (of 2020) was growing from 27% in 2010 to 36% in 2014. Thus, the nZEB market penetration result for Austria was growing from 0.15 to 0.23 and it is expected to increase further. The high average is influenced by France, where the nZEB definition is already in force.

C3: National policies supporting the market development for nZEB

- Austrian result: **0.71** ZEBRA average: **0.52**
- Policies in Austria seemed to be sufficient to support the development of the market for residential and non-residential nZEB in 2014.

- There is some improvement potential with regards to energy performance certificates, supervision and compliance checks and training of building professionals, especially of craftsmen.

C4: National progress towards cost-optimal building performance requirements

- Austrian result: **0.84** ZEBRA average: **0.94**
- The Austrian nZEB definition is almost at the cost optimal building energy performance level.

C6: Availability of nZEB-relevant components

- Austrian result: **0.75** ZEBRA average: **0.83**
- This criterion is based in a survey among building professionals in Austria and it shows that nZEB components are mostly well available. On the other hand the Austrian score is somewhat lower than ZEBRA's country average, which is in opposition to Austria's leading position in constructing energy efficient buildings. This may come from the fact that the interviewed experts were more sceptical in Austria.

C8: Level of nZEB-relevant expertise of actors

- Austrian result: **0.64** ZEBRA average: **0.63**
- The level of nZEB-relevant expertise of building professionals remains almost constant since 2010. The availability of experts for planning was assessed to be good and for examination/certification sufficient, while the interviewees agree that there was a lack of expertise for the construction phase.

C9: Level of awareness / information / acceptance in the society

- Austrian result: **0.96** ZEBRA average: **0.94**
- Awareness for energy efficiency is assessed to be good.

C10: Dependency of property value/rent on the energy performance

- Austrian result: **0.76** ZEBRA average: **0.74**
- Compared to site, living quality, aesthetics and financial aspects, the energy performance was the least important aspect for customers' decision on renting/buying a real estate in Austria. Nevertheless, starting at low levels it is improving over time.

Resulting Maturity of the Austrian nZEB market in 2014

- Austrian result: **0.67** ZEBRA average: **0.66**
- The nZEB market seemed to be slightly better developed than the average of the ZEBRA countries. The political framework appeared sufficient in 2014, though the definition of the nZEB standard is not yet in force. High performance building components were easily available, while EPCs, compliance checks and the availability of qualified construction workers may limit the future development of the nZEB market. Overall Austria seems to be prepared for nZEBs and most of the remaining issues could be cleared in the next few years if respective action is taken without delay.

2.5 SCENARIOS

Market penetration of nZEB – new building construction

Figure 10 shows annual construction of conditioned floor area according to different standards. The results are shown for the historical development and in both policy scenarios, current and ambitious for the long term development from 2021 to 2050. For an explanation of the scenario framework of the current policy scenario and the ambitious policy scenario, see part "Introduction". Data on historical development of new building construction according to national standards were collected in the project, see part "Introduction" and are available on the project project´s data tool (http://www.zebra-monitoring.enerdata.eu/). The share of the new building construction according to the building code in 2012 was approximately 40% of the total new building floor area, the remaining construction are going beyond building code requirement (i.e. better than building code and better than nZEB). "According to building code" means that buildings are constructed according to national minimum requirements of the Austrian building code, OIB Richtline 6. By 2020, there a new regulation will be implemented, with better energy performance requirements for new buildings. This new standard is implemented in the model as national nZEB definition, 2021.

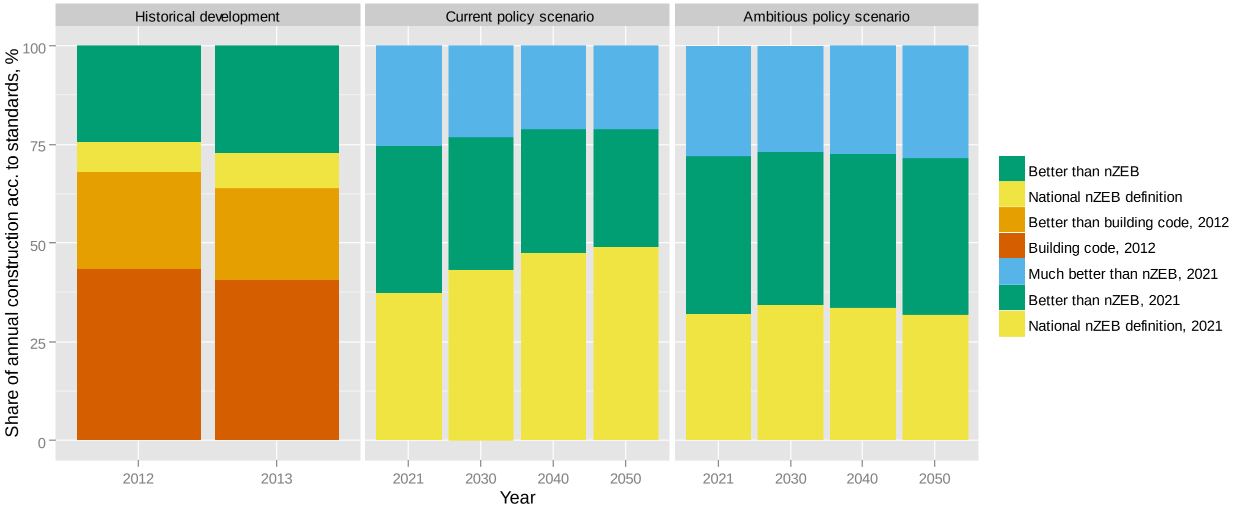


Figure 10 Share of annual construction of conditioned floor area built according to national standards

Building renovation activities

Figure 11 shows historical and future development in current and ambitious policy scenarios of annual renovation of conditioned floor area by renovation levels.

The following renovation categories were defined in the current policy scenario:

- light renovation meaning that in reality not all buildings fulfil the criteria set in the building legislation;
- medium renovation which refers to the building codes and;
- deep renovation reflecting the nZEB definition.

In the ambitious scenario, from 2021 to 2050, all buildings fulfil at least the building standards. There is an additional renovation level "deep plus" which means higher energy performance achievements.

In Austria, in the current policy scenario, the share of the light and medium renovation makes up a significant share on the total renovated building floor area from 2021 to 2050. In the ambitious policy scenario, which implements stringent measures on existing buildings, the share of the deep and deep plus renovation is increasing compared to the current policy scenario. In 2040, around 65% of the renovated building floor area will be renovated with a strong share of deep plus (40%) and deep renovation (25%), resulting in higher energy savings (Figure 11).

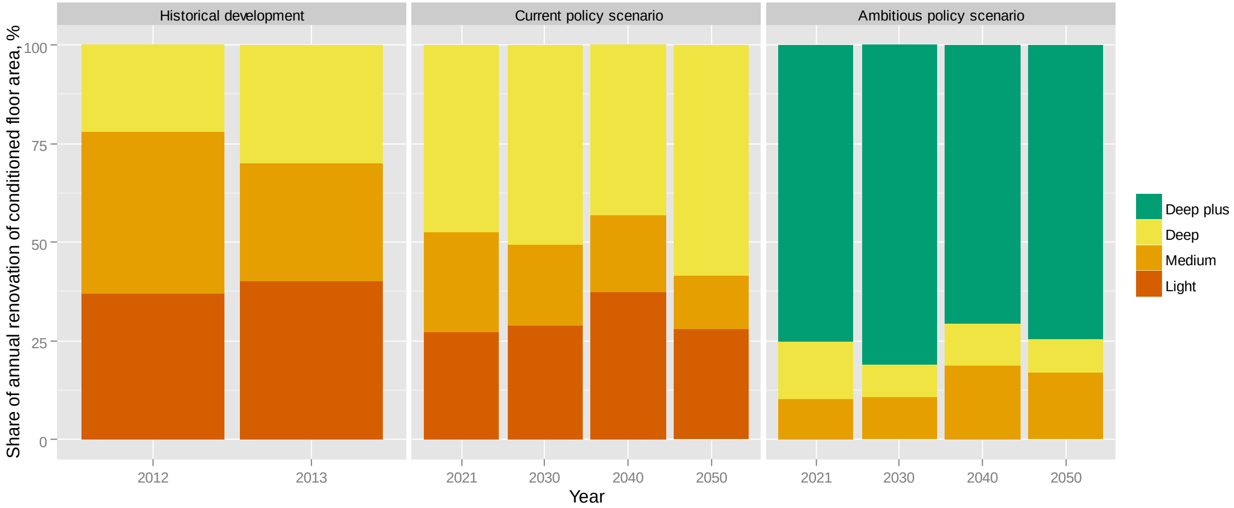


Figure 11 Share of annual renovation of conditioned floor area built according to national standards

Figure 12 shows the distribution of the specific energy need for space heating (energy need is calculated following EN13790 methodology) in the total building stock after building renovation by using the following renovation levels, light, medium, deep and deep plus. The specific energy needs are shown in a box-plot diagram. The median (middle quartile) marks the mid-point of the data and is shown by the line that divides the box into two parts while the diamond indicates the mean value. The data is represented for 2012 for not renovated buildings, light, medium and deep renovation. The deep plus renovation shows specific energy need for buildings being renovated after 2020. In Austria, medium renovation refers to the national building code. The specific energy need for space heating of light renovation is higher compared to the medium renovation, which means that in reality not all buildings fulfil the criteria set in the building legislation. Deep and deep plus renovations include envelope retrofitting and installation of the mechanical ventilation.

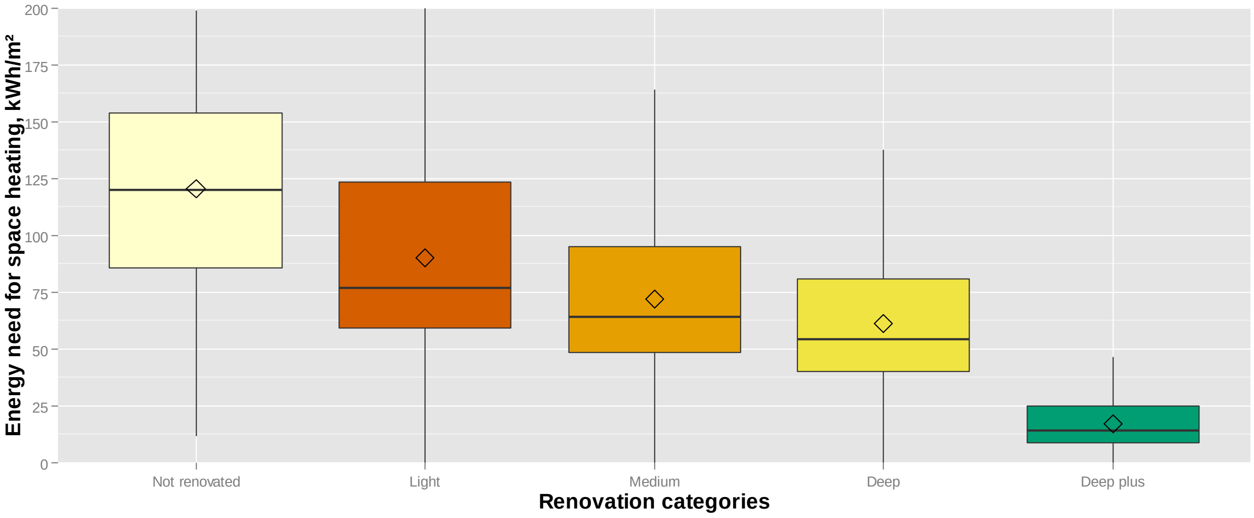


Figure 12 Distribution of the buildings specific energy need (norm-calculation) for space heating for not renovated buildings and after renovation

Economic indicators and national policies supporting the market development for nZEB

Figure 13 shows total yearly investments in the building envelope (thermal renovation) and in renewable heating systems from 2012 to 2050 in the current and ambitious policy scenarios. The investments are slightly higher in the ambitious scenario due to higher number of the renovated buildings, higher quality of the implemented thermal renovation and higher investments in the renewable systems. Figure 14 shows total yearly public budget for financial support of renewable heating systems and renovation of the building envelope. The yearly public budgets are higher in the ambitious policy scenario.

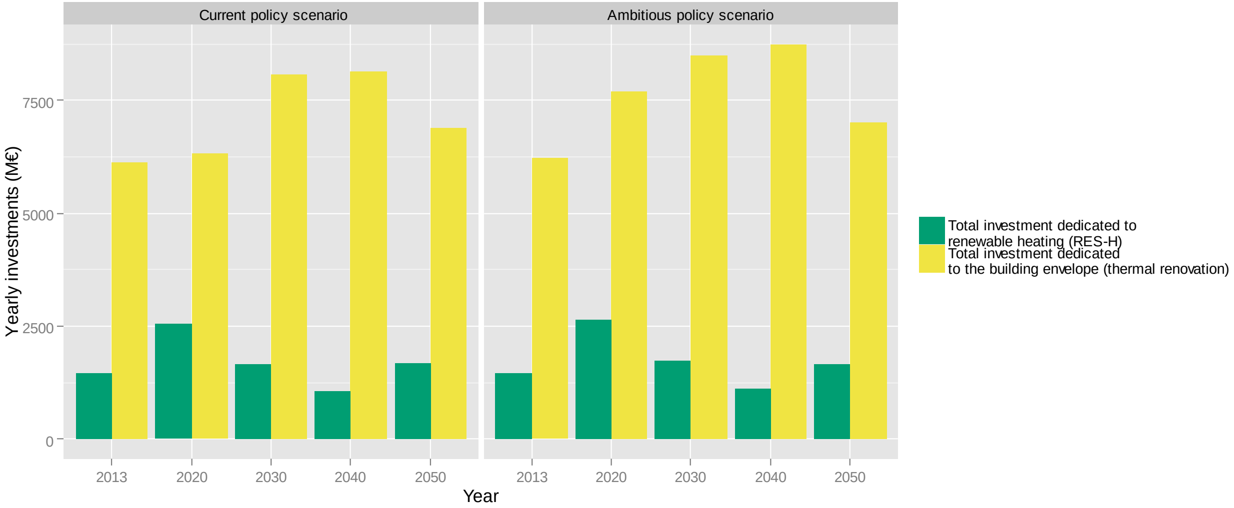


Figure 13Total yearly investments in renewable heating systems (RES-H) and renovation of the building envelope including public budget, 2013 to 2050, current policy and ambitious policy scenario

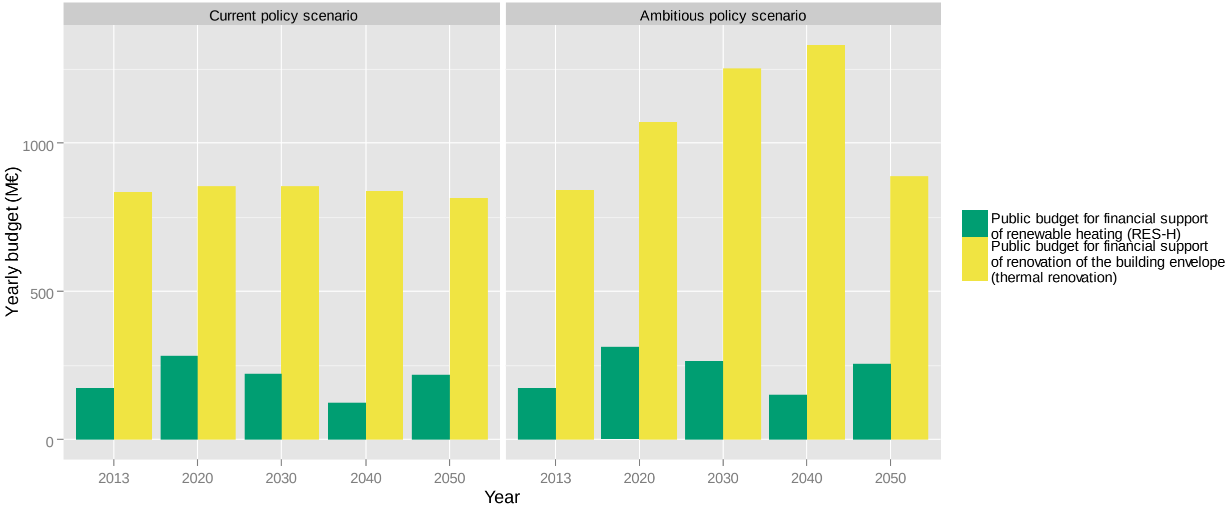


Figure 14Total yearly public budget for financial support of renewable heating systems (RES-H) and renovation of the building envelope, 2013 to 2050, current policy and ambitious policy scenario

Development of the building related energy demand

Figure 15 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Austrian building stock is 83 TWh in 2012. The scenario shows a steady slow-down of the energy demand of 3% (around 0.4% yearly) from 2012 to 2020. However, heating, cooling and hot water energy demand is decreasing over time by 38% in the current policy scenario in the long term development between 2012 and 2050 and by 40% in the ambitious policy scenario. The ambitious scenario implements a little more stringent measures and additional financial instruments on existing buildings.

In Austria, the share of energy demand supplied by district heating and biomass is 47% on the total energy demand for space heating and cooling in 2012, while fossil-fuel-based heating systems (natural gas, oil and coal) make up 43%. The fossil-fuel-based heating systems are slowly replaced with the renewable systems and especially district heating. The share of non-delivered energy (i.e. solar and ambient energy) is increasing over time from around 4% of final energy demand in 2012 to around 13% in current policy scenario and 17% in ambitious policy scenario in 2050.

Figure 16 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 58% in current policy scenario and around 63% in ambitious policy scenario. The reduction of the primary energy demand is around 41% and 43% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

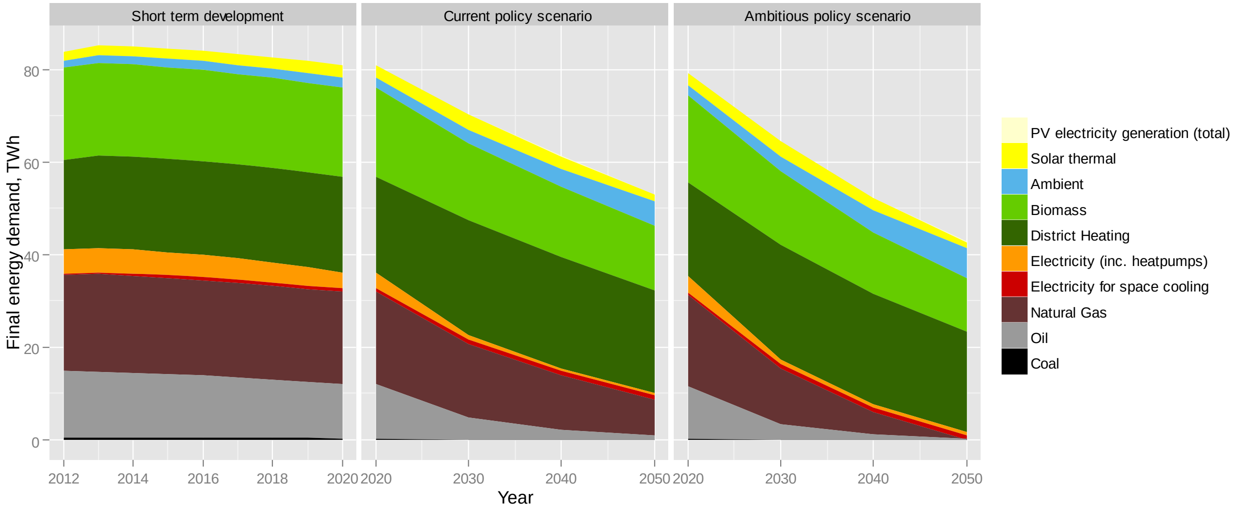


Figure 15 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

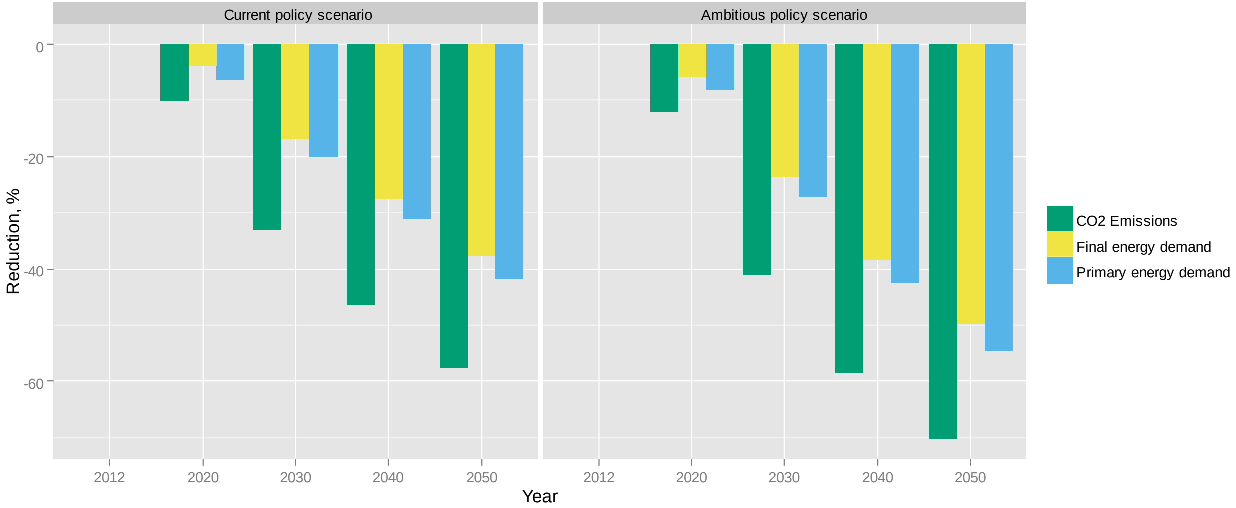


Figure 16 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

2.6 RECOMMENDATIONS

The Austrian policies for an efficient building stock – both regarding standards and support measures – are mainly in the competences of the nine regions. In addition, the federal government also introduced a support instrument for building renovation a few years ago. In general, there is a quite long tradition in Austria of efficient building construction and renovation which is reflected also in a quite high share of passive houses. However, there is still a lack of a clear, common, shared vision and targets for the energy demand and related CO2-emissions of the Austrian building stock. Moreover, currently there is no regulatory instrument in place to strongly enforce the renovation of buildings. In particular, there are still lock-in effects when it comes to step wise renovation which could be overcome e.g. by building specific renovation roadmaps. The support measures from the regions for efficient building construction and renovation are well established and in the past have led to an effective incentive for higher efficiency. However, at this stage it is not clear how the budgets of these programmes will develop further.

Based on this background, the following 14 recommendations have been derived for Austria:

AT1 - Visions, targets and pathways of regulatory framework developments beyond 2020 (towards 2050)

AT2 - Develop individual building renovation roadmaps

AT3 - Allow landlords to increase the rent after building renovation

AT4 - Establish a building renovation monitoring and consistent data collection procedure

AT5 - Introduce feasible but ambitious schemes for mandatory renovation that can lead to further uptake

AT6 - Extend and adapt energy efficiency obligation according to the Energy Efficiency Directive

AT7 - Budgets of support for residential building construction (Wohnbauförderung) and stronger focus on renovation

AT8 - Foster the uptake of industrialised renovation through increased market confidence

AT9 - Continue and extend Klima:aktiv campaign and promotion activities

AT10 - Continue and extend regional energy advice activities; extend them to comprehensive "renovation coaching", linked to the individual building renovation roadmap

AT11 - Visualize and compare existing building performance information via proper communication tools

AT12 - Further improve compliance with building codes for new building construction and building renovation; enhance training activities of craftsmen

AT13 - Specify and increase support measures for vulnerable target groups customized to their profile

AT14 - Shift from fuel subsidies into energy efficiency measures

***#AT1** - Legislative and Regulatory Instruments*

Visions, targets and pathways of regulatory framework developments beyond 2020 (towards 2050)

Currently, there is no clear and accepted vision and target of energy demand and GHG-emission reductions until 2050 of the Austrian building stock. Such a vision would be highly important to make sure that the overall GHG-emission targets according to the Paris agreement are also achieved in the different sectors, including the building stock.

Thus, the development of clear and widely accepted visions and targets of energy demand and GHG-emissions until 2050 for the building stock would be essential. Based on these targets, a concrete pathway beyond 2020 for the regulatory framework for new building construction, building renovation and heating system replacement should be developed.

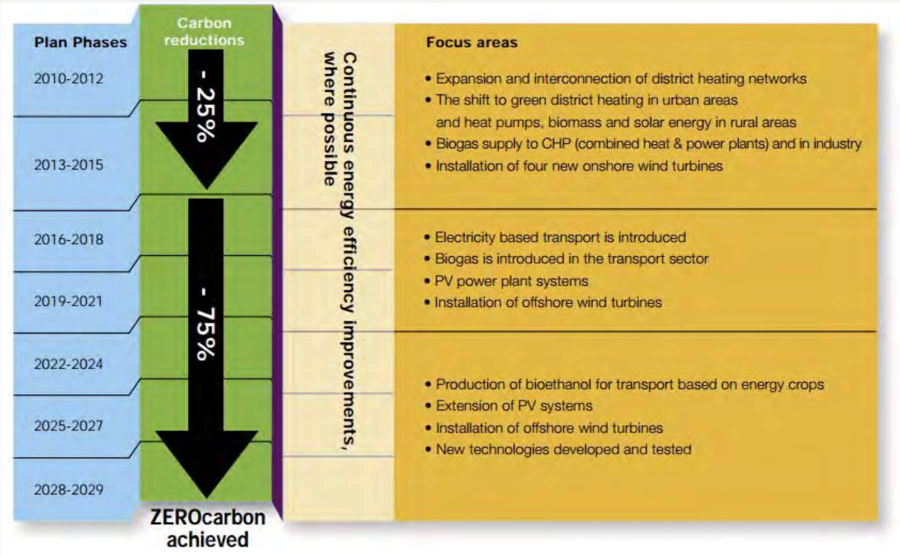
Such a pathway would create transparency for stakeholders, in particular industry regarding expected further requirements of components and performance of buildings.

Example: Germany

In Germany, a target of 80% reduction of non-renewable primary energy demand in the building stock until 2050 has been adopted. Currently, the federal ministry of environment examines pathways for 95% GHG-emission reduction in the overall economy and implications for the different sectors. However, a transparent pathway of building code enhancement is also missing.

Pilot case: Project Zero

ProjectZero is the vision of Sonderborg (a Danish municipality) to become carbon neutral no later than 2029. A Masterplan including "the overall, long-term strategy for achieving the defined development targets" has been developed together with stakeholders and research institutions. While nZEBs play a key role in Sonderborg's vision, their relationship with other elements in the energy system is also emphasised in this comprehensive strategy. The strategy includes clear targets and a realistic timetable, allowing long-term investments in building performance and energy efficiency.



#AT2 - Legislative and Regulatory Instruments

Develop individual building renovation roadmaps

In terms of energy efficiency, a comprehensive and extensive renovation is the best option, but this is very often not financially feasible. This is why renovations are often carried out in multiple stages. This frequently causes problems; sometimes individual renovation stages are executed in the wrong order, and other times future decisions are either improperly accounted for or are not taken into account at all. The so-called lock-in effect, which would effectively prevent the attainment of the 2030-2050 targets, must be avoided when carrying out extensive renovations. In order to mitigate lock-in effects, legislative measures need to make the least efficient alternatives (not compliant with nZEB standards) less attractive or forbidden.

The introduction of individual building renovation roadmaps may facilitate such deep step-wise renovation. The roadmap should be based on an in-depth audit of the building and include recommendations and a pathway of measures to be developed with the building owner (and user). The implementation of the roadmap and the measures could be made mandatory in case of some triggering events like real estate transactions.

Example: 2014: "Sanierungsfahrplan Baden-Württemberg"

The German state Baden-Württemberg provides an individual building renovation roadmap that summarises for the property owner coordinated packages of measures to achieve a deep energy renovation. Useful bundles of renovation measures are defined, which should be carried out simultaneously in line with the individual preferences of the building owner. It includes before-and-after comparison of energy costs and CO2 emissions as well as detailed description of the measures, such as preparatory measures, required U values, further co-benefits, possible funding and additional explanations (Pehnt et al. 2014) to avoid lock-in effect. For instance, if a roof is renovated, the roof overhang shall be designed in such a way that the future expected façade insulation can be smoothly applied.

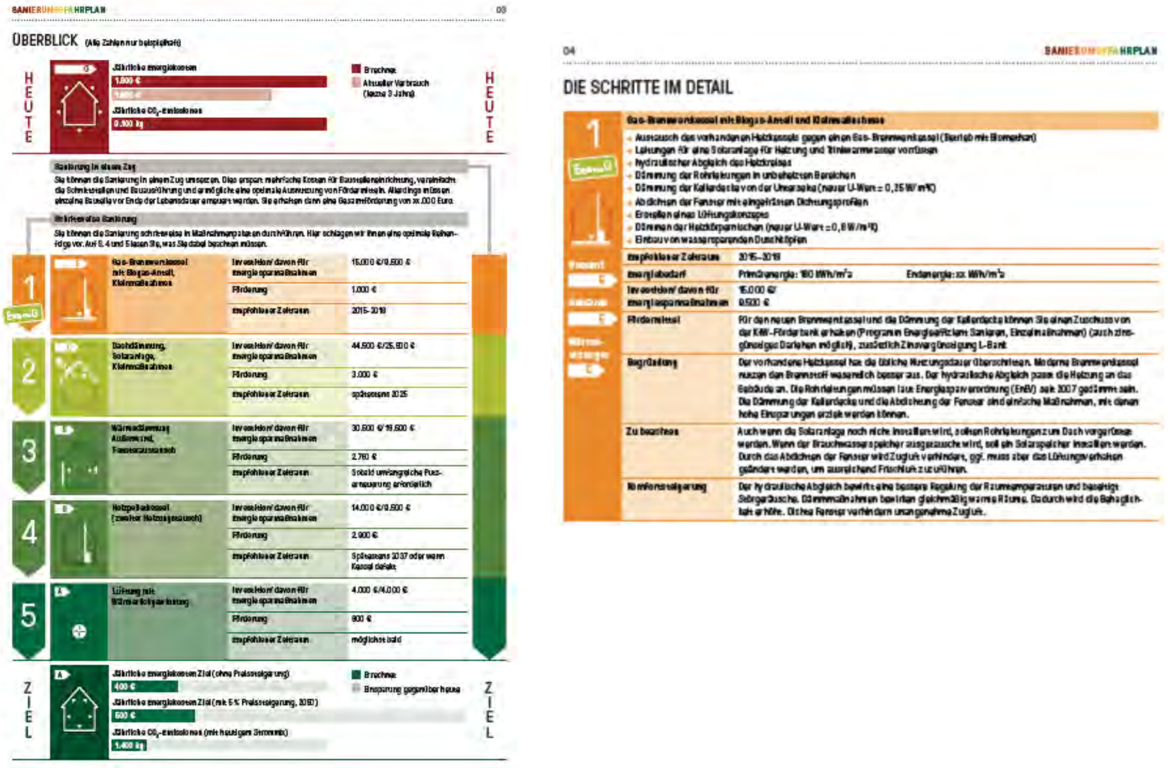


Figure 17: Example pages of the "Sanierungsfahrplan Baden-Württemberg" (Pehnt et al. 2014)[3]

#AT3 - Legislative and Regulatory Instruments

Allow landlords to increase the rent after building renovation

In the building sector, the most common problem of split-incentives is present between owner and tenant when the tenant pays the rent and the energy bill so the owner has no interest in investing in efficiency measures. It is also present among owners or tenants – typically when it is not possible to measure the usage of energy or services – or within the same organisation when the owner and tenant are different offices or departments with different goals (CA-EED, 2014).

Split-incentives are common barriers between building owners and tenants, hindering the uptake of energy efficiency investments, deep renovation and thus the transformation to nZEBs

An option to overcome these barriers is to allow landlords to increase the rent after building renovation, e.g. to the amount of (calculated) energy cost savings.

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[3] https://um.baden-wuerttemberg.de/de/energie/beratung-und-foerderung/sanierungsfahrplan-bw/

Example: Emilia Romagna

The Italian region of Emilia Romagna passed a law in 2013 that allows paying off investments costs for energy efficiency measures by using energy costs savings. Similar laws exist in several countries/regions and builds on the simple principle of aligning benefits of renovation with the investment cost. Building owners can renovate by borrowing from future energy bills while residents are rewarded with a higher-quality home.

#AT4 - Legislative and Regulatory Instruments

Establish a procedure for building renovation monitoring and consistent data collection

Availability and reliability of data on building (performance) vary across Member States and regions within Austria. Absence or a poor reliability of data hampers policy making at national and local level and makes comparison and benchmarking across boarders challenging or even impossible.In particular, data on building renovation activities are hardly available in Austria.

Standardised methodologies and formats for a building renovation monitoring and assessment as well as reporting of data are thereby essential. In addition, a centrally managed register for energy performance of buildings would help to monitor the improvements of energy performance of buildings over time and to design appropriate policies.

Example: The English Housing Survey

The English housing survey is a continuous national survey commissioned by the Department for Communities and Local Government (DCLG). It collects information about people's housing circumstances and the condition and energy efficiency of housing in England. It has two components: (1) a household interview and (2) a physical inspection of a sub sample of the properties. The standardized and transparent methods together with the ongoing surveying, make the database a useful source for policy-makers and researchers.

Data is collected on different aspects of the buildings, for example heating and insulation. Results from the extensive data gathering are available to the public in form of datasets and reports.

#AT5 - Legislative and Regulatory Instruments

Introduce feasible but ambitious schemes for mandatory renovation that can lead to further uptake

In the building sector, the most common problem of split-incentives is present between owner As experience has shown, reliance on purely voluntary measures does not result in the required level of building renovation, despite attractive financial support available to consumers.

In the first case of mandatory renovation introduced across the EU in the 2010 recast of the Energy Performance of Buildings Directive, Member States are required to introduce minimum energy performance standards whenever a building undergoes a major upgrade, defined as one affecting 25% of the building area or where the total cost is 25% or more of the building's value. Two years later, the Energy Efficiency Directive included a requirement for Member States to renovate 3% p.a. of the total floor area of buildings owned and occupied by the central government.

Whilst these are positive developments that begin to address the largest area of energy use in Europe, namely the existing building stock (40% of EU energy consumption), this legislation affects only a small proportion of Europe's buildings. There are no requirements to improve the vast majority of the existing building stock.

Example: France

In France, among the provisions in the energy transition law of green growth (approved in August 2015), there is a renovation obligation for private residential buildings whose primary energy consumption exceeds 330 kWh/m2a. This affects all buildings with an energy performance rating in either of the two lowest bands, F or G. These buildings, including rented and owner-occupied, will have to be renovated before 202511. This measure will accelerate the needed transformation of the existing building stock, and help achieve the ambition of bringing the entire building stock to low energy levels (levels "Bâtiment Basse Consommation"(BBC) or equivalent), by 2050, which is also part of the new law.[4]

The law includes a target to renovate 500,000 dwellings per year, starting from 2017, half of them occupied by vulnerable consumers.

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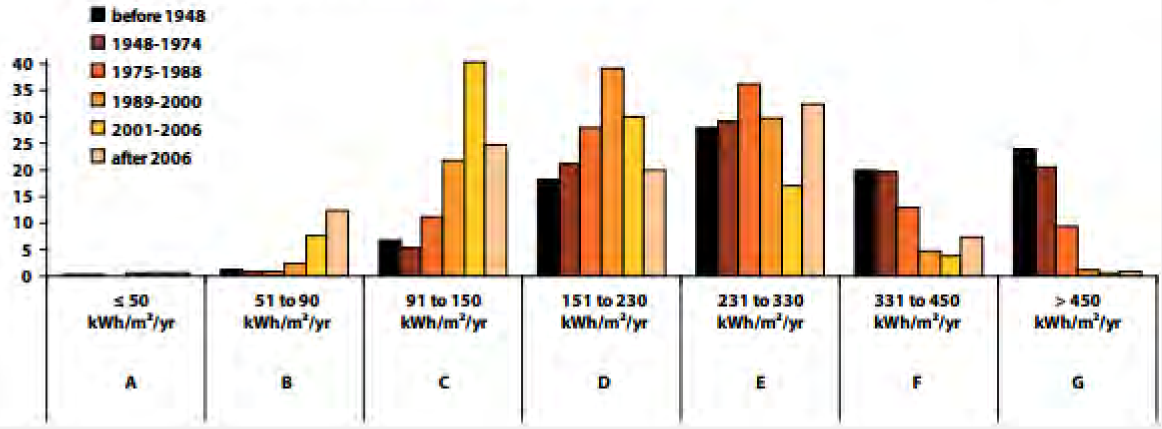
[4] http://bpie.eu/wp-content/uploads/2015/12/Renovation-in-practice_08.pdf

Distribution of residential EPC ratings according to building age and EPC rating (Source: Ministère de l'écologie, du développement durable et de l'énergie)[12]



#AT6 - Legislative and Regulatory Instruments

Extend and adapt energy efficiency obligation according to the Energy Efficiency Directive

The energy efficiency obligation which has been introduced in Austria according to the Energy Efficiency Directive in the Energie-Effizienz-Gesetz, provides incentives for efficiency improvements also in the building sector. However, due to the current implementation, deep renovation activities are rare in this context. Thus, an improvement of the corresponding regulation to incentivise deep renovation measures in the context of this law would be important.

#AT7 – Economic measures

Budgets for supporting residential building construction (Wohnbauförderung) and stronger focus on renovation

The instrument of the Wohnbauförderung has a long tradition in Austria with considerable impact also in energy performance of buildings. In particular due to the increasing standards in the building codes towards nZEBs, the focus should be even stronger on building renovation. For new building construction, the support should be limited to dwellings with a maximum size. The tendency of decreasing budgets should be reversed.

Economic support schemes could and should be stronger linked to the individual building renovation roadmap as described above.

#AT8 – Incentivize the market

Foster the uptake of industrialised renovation through increased market confidence

Build market confidence through different means like branding and quality assurance. Industrialised deep energy retrofits - where one contractor provides a turnkey renovation using mainly prefabricated modules - are still fairly new terrain within the construction sector. Today the majority of renovations happen in a staged approach combining multiple smaller local contractors. In the newly built segment this turnkey approach is more common and integrated.

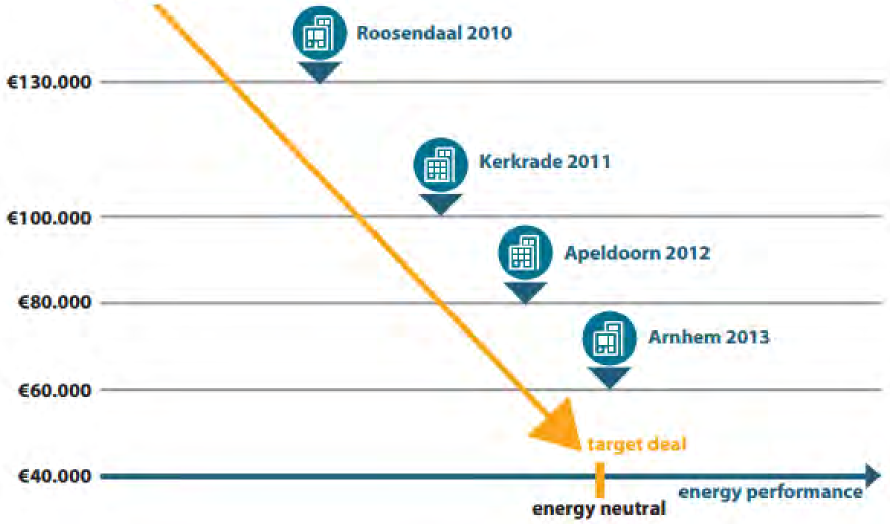
It is crucial to build consumer trust to allow for a much broader adoption of this approach in renovation as well. This could be done through branding or by developing an independent quality assurance mechanism for products, systems and companies. Actors will be more inclined to work with a company or institution that has an objective quality assessment. Government could play an important role in this mechanism as an objective third party (or as facilitators to set this up).

Example: Energiesprong

The Dutch Energiesprong project has demonstrated that the costs for a holistic net zero renovation of a terraced house can decrease from 130.000 euro at the first pilot-project in 2010 to 65.000 euro nowadays thanks to a combination of economy of scale and 3D designed prefabricated materials. On top, the on-site execution takes one week, limiting the burden for inhabitants, while at the same time increasing comfort and improving the look of the house. This state-of-the-art renovation programme is embedded in a holistic approach (targeting regulation, sales channels, Net-Zero retrofit, marketing, value uplift and finance), involving all relevant actors and leading to an upscale through an industrialised production process.

The Stroomversnelling project has benefitted from the lessons learned in previous Dutch initiatives to implement holistic renovations which have been undertaken in The Netherlands in recent years. In 2010, 134 houses in Roosendaal were targeted, realising a 72% energy reduction in heating and domestic hot water, at a cost of €130,000 each41. In 2011, 150 houses in Kerkrade were retrofitted to passive house levels at a cost of €100,000 each. Finally, in 2012, 188 zero energy dwellings were renovated in Apeldoorn at a cost of €80,000 per dwelling. These projects show how quickly the price/performance ratio is improving, as illustrated in below:

(Source: Energiesprong, 2014 revised by BPIE)



#AT9 – Communication

Continue and extend the klima:aktiv campaign and promotion activities

The programme klima:aktiv has contributed effectively to the promotion of a high building performance standard in Austria by highlighting front-runner projects and standards.

It will be important to continue these and similar activities in order to show that the current nZEB standard is not the maximum achievable standard.

The pathways of building code improvements as suggested above should be also linked and inspired by the klima:aktiv standards.

#AT10 – Communication

Continue and extend regional energy advice activities; extend them to comprehensive "renovation coaching", linked to the individual building renovation roadmap

Mainly regional energy advice activities have a crucial role in increasing the energy performance of the Austrian building stock. These advice activities should and could be stronger linked to the individual building renovation roadmap (see above) and thus could be more and more extended to a comprehensive renovation coaching, which goes beyond a one-shot energy advice.

#AT11– Communication

Visualize and compare existing building performance information via proper communication tools

nZEBs is still in the cradle phase in Europe and the knowledge of how to get to a zero-emission building stock is still underdeveloped. But the learning curve is steep and it can be even steeper with effective knowledge sharing. Knowledge sharing, best practices and benchmarking processes have a huge time and money saving potential. New technologies, or Internet of Things, and "big data" are enabling us to better monitor and learn from resident's and building's behaviour. Exchange of expertise and knowledge between the EU and the local level could fulfil an essential condition to develop nZEB on a national scale. A better use of data can enable more accurate policies and measures, and faster progress of building techniques and innovation. More visible building data, enabled by modern techniques, can increase awareness and demand for energy saving measures.

Example: Boston

Boston enacted the Building Energy Reporting and Disclosure Ordinance in 2013, requiring large buildings to report their annual energy and water use to the City. As of 2015, the requirements apply to all buildings greater than 50,000 square feet. The ordinance also requires the City to make the information public. By providing better information on building energy use, reporting and disclosure is enabling owners and tenants to become more aware of energy use, energy costs, and greenhouse gas emissions and opportunities to reduce all three.

The interactive map[5] below illustrates central Boston. All the green buildings have submitted a building energy report this year, blue buildings are municipality buildings, yellow are in the process and grey buildings have not yet reported. If you click on any of the buildings you will retrieve relevant energy information about it, including energy use, energy mix and GHG intensity.

Example: ECOCITIES

ECOCITIES is a private initiative supporting operators of building portfolios (building groups) in

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[5] City of Boston Energy Department –
http://boston.maps.arcgis.com/apps/webappviewer/index.html?id=049576c7287f4ee09bcb0a062e43b55c

deciding how present budget can be used most effectively to align the energy efficiency of their real estate to required political, economic and environmental objectives. It considers the thermal envelope, heating, cooling, alternative energy networks, photovoltaics, solar thermal and lighting. ECOCITIES also enables the efficient administration and maintenance of building groups resp. real estate portfolios. It proposes measures the minimum investment and energy costs and cause maximum CO2 reduction.

All building data is managed in a structured and centralized way. A map based view of all managed buildings allows a quick overview and a simple selection of any building. The web-based system allows decentralized access to this data based on a clearly defined access control model. Their innovative solutions utilize the building data, enabling a smarter energy use. ECOCITIES assesses the energy consumption of single buildings and the entire building group based on actual meter data. This enables the easy monitoring of energy consumption, and the retrospective evaluation of implemented energy efficiency measures. Their advanced data crunching allows for a better understanding of interdependencies, for example between different measures taken.

Initiatives like this exemplifies the value of knowledge sharing, new communication tools and comprehensive analyses.

#AT12 – Quality framework

Further improve compliance with building codes for new building construction and building renovation; enhance training activities of craftsmen

Compliance with building codes both for new building construction and for renovation is crucial, in particular with more and more tightened building codes. Stronger standards will have no effect if compliance is not ensured.

Training activities of professionals, architects, installers and all craftsmen are crucial and should be extended in all type of education levels.

Example: French quality framework for building airtightness

In the framework of the French RT2012 regulation, it is mandatory to assess the building airtightness. Two possibilities exist:

- a systematic testing of the airtightness of each building; such tests must be done by certified testers and the assessment also includes leakage detection;
- an overall quality framework at the level of the building companies involved; this approach requires the fulfilment of a series of procedures at company level, in combination with

testing of about 5% of all buildings. [6]

EU-projects: QUALICHeCK

QUALICHeCK, a EU funded project, aims to enhance the reliability of the Energy Performance Certificate and the quality of the building process. They are especially working on three different areas:

- identifying issues in respect to existing procedures
- highlighting best practices for easy access to reliable EPC input data, delivery of improved quality of the works, as well as more effective compliance frameworks ("lead people to do what they declare");
- raising awareness and engaging relevant stakeholders.[7]

***#AT13** – Social Issues*

Specify and increase support measures for vulnerable target groups customized to their profile

The society at whole, can benefit greatly from supporting poorer and more excluded groups of people. Additional to financial support, measures like energy audits and installation of energy efficiency measures in low-income households have proven effective in delivering energy savings and financial savings for households and government bodies providing public funds for energy subsidies.

Example: Habiter Mieux

The programmes "habiter mieux" (France), the "warmer homes scheme" (Ireland), the "warm front scheme" (England), the ERDF thermal renovation of block of flats for low income families in Romania, are some examples of the efforts that have been made to support energy efficiency measures in fuel poor households. However, in most cases such programmes are mostly not integrated in a strategy on national level with the objective to eradicate fuel poverty. The existing fuel poverty schemes are often valuable, but should be integrated in a broader national strategy.

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[6] http://www.epbd-ca.org/Medias/Pdf/CA_EPBD_BUS_interaction_report.pdf

[7] http://qualicheck-platform.eu/about/introduction/

***#AT14** – Social Issues*

Shift from fuel subsidies into energy efficiency measures

Fossil fuel subsidies (Heizkostenzuschuss) in the form of heating bill support-payments are used by governments as the main instrument to support vulnerable consumers. The social aspect of the payments disguises the fact that the subsidies encourage and prolong the use of fossil fuels. Besides having an adverse impact on the climate, the payments are an ineffective solution for supporting vulnerable households, as they require continuous and increasing funding without generating economic growth and result in wasteful energy consumption. It is striking that in Ireland the budget allocated to the National Fuel Scheme increased by 170% to €228 million from 2004 to 2010 and in Greece, €650 million were committed to oil subsidies for heating from 2010 to 2014 but only €548 million to energy improvements in houses.

Therefore, fossil fuel subsidies play a negative role on energy efficiency in buildings by supporting wasteful energy consumption and by spending every year big part of the public budget, which could have been allocated for energy efficiency measures. Thus, it is high time that policies and financing shifted from supporting inefficient and climate-damaging FFS to promoting energy efficiency measures, leading Europe to smart, sustainable and inclusive growth.

3. FRANCE

3.1 BUILDING PERFORMANCE MARKET DATA

3.1.1 Construction and renovation activities

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for UE countries. France is one of the UE countries with the highest rate of renewal of the building stock: in 2014 more than 1% of the building stock was renewed, compared to 0.2%/year in Spain for instance. The annual rate of new buildings is slowly declining as the annual building erection is decreasing: from 350.000 in 2010 to 300.000 in 2014. The majority of new buildings in France are multi-family dwellings.

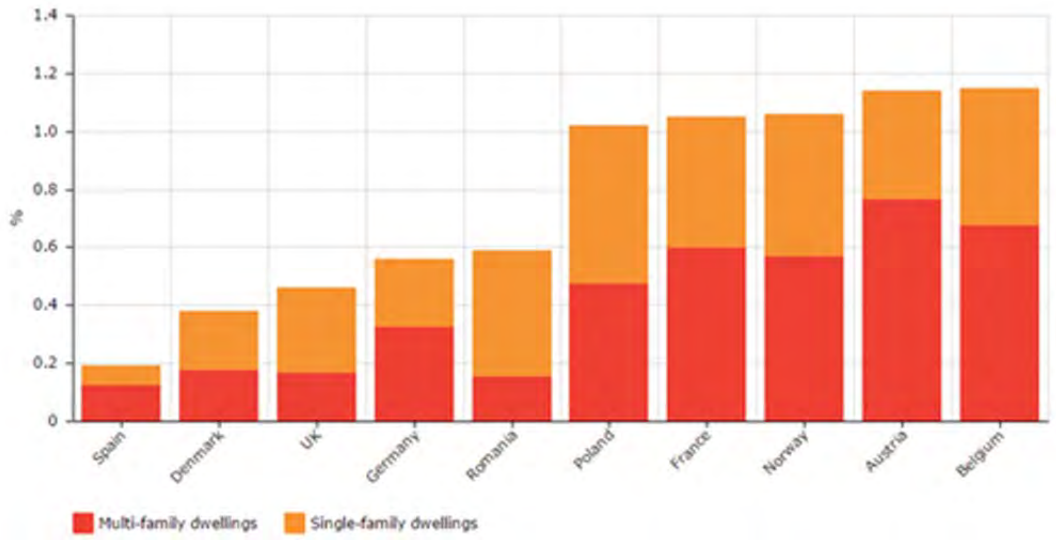

Figure 18 Regression results for the Danish rental market using the dummy variable model. P-values are given using the code in table 3 and t-statistics are given in parentheses

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar

combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings

2. nZEB buildings according to national definitions

3. Buildings with an energy performance better than the national requirements in 2012

4. Buildings constructed/renovated according to national minimum requirements in 2012

The radar graph levels used for France are shown in the table below and defined as such in the database. RT means the French thermal regulations. The previous regulation RT2005 was implemented up to 2012 and required a consumption less than 150 kWh/m²/year. The current regulation of 2012 (R2012), enforced in 2013 for dwellings and in 2012 for service sector buildings, requires a consumption less than 50 kWh/m2/year. Buildings or dwellings going beyond RT2012 (i.e. better than nZEB official definition) are labialised. And there are three main building labels:

- BBC-Effinergie: Buildings with low energy consumption; where the total consumption is around 50 kWh/m2/year (and corresponds to the level given by the nZEB national definition). This certification was given between 2007 and 2013.
- Effinergie +: Buildings with higher performance than BBC-Effinergie; so total consumption is strictly less than 50 kWh/m2/year (and corresponds to the level higher than nZEB national definition). This certification is given since 2012.
- BEPOS: BEPOS means positive energy buildings in French; there is a certification dedicated since 2013. The annual consumption is less than 20 kWh/m2 (and corresponds to the level higher than nZEB national definition).

Translating the definition of nZEB radar in the case of France gives:

1-Better than nZEB (net ZEB or positive house)	Plus energy buildings: any new building built starting from 2013 (the enforcement year of RT2012) with better energy performance than RT 2012. The buildings certified with BEPOS certification and Effinergie + are thus counted in this 1st category group.
2-National official nZEB definition	nZEB buildings according to national definitions: it corresponds to actual thermal regulation, i.e. RT2012 implemented since 2013. From 2008 to 2012, the buildings with BBC-Effinergie certification are counted.
3-Better than current building code	Better than current building code = Buildings with an energy performance better than the national requirements in 2012; this is not meaningful in the case of France, as already all buildings are nZEB with the RT2012. Hence, this category is empty since there is no relevant data.
4-According to building code	According to building code = Buildings constructed according to national minimum requirements of RT2005 between 2005 and 2012

Before 2013, the majority of new buildings were built according to previous building code (i.e. RT2005). Since 2013, the last update of building code enforces new building to be NZEB. The share of new buildings better than nZEB (BEPOS or Effinergie +) is increasing since the last 3 years, representing 8% in 2015.

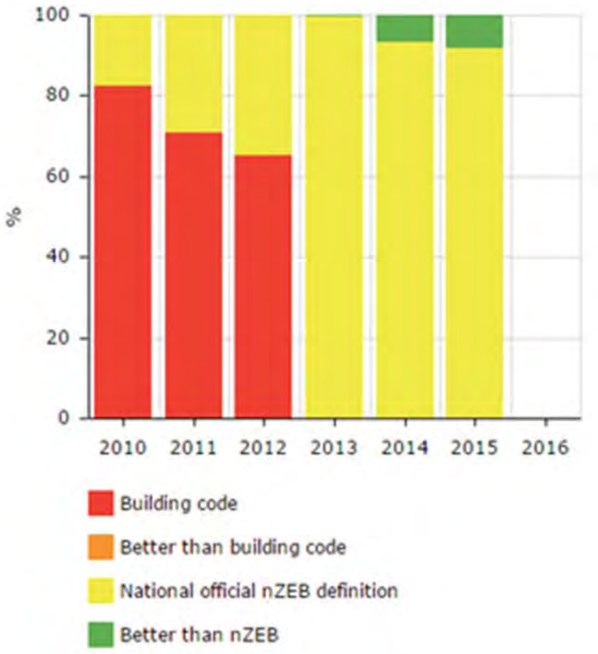

Figure 19 Distribution of new dwellings according to the nZEB radar graph – France

Source: ZEBRA

Because of the lack of an official European definition, to ease comparisons the EU ZEBRA2020 project developed the indicator of "major renovation equivalent". In ZEBRA, three renovation levels have been defined: "low", "medium" and "deep". However, these 3 levels definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

In France, the renovation rate (% of stock) is estimated with OPEN and different assumptions are used before 2014 and for 2014[8]. We calculated the expected energy savings for the medium and deep levels of renovations (levels 2 and 3) from a DGEC/Ministry of Energy study giving the expected savings by age band[9] (we averaged these saving at total stock level thanks to data from CEREN on the building stock composition).

Below are summarized the different levels for each period and the estimated energy savings:

		Thermal improvements implementation	Energy savings estimated
Before 2014	Level 1	no concrete thermal improvement	3%
	Level 2	one thermal measure	12%
	Level 3	at least three thermal measures	66%
After 2014	Level 1	light thermal improvement	5%
	Level 2	one thermal measure	12%
	Level 3	at least two thermal measures	26%
	Level 4	at least three thermal measures	46%

The equivalent major rate in France amounts to around 2% and is one of the highest among the UE countries. The data gap between 2013 and 2014 is explained by a modification in the renovation sampling definition, as explained before.

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[8] More details available here : http://www.zebra-monitoring.enerdata.eu/overall-building-activities/share-of-new-dwellings-in-residential-stock.html#equivalent-major-renovation-rate.html

[9] DGEC (Scénarios prospectifs Energie – Climat – Air pour la France à l'horizon 2035

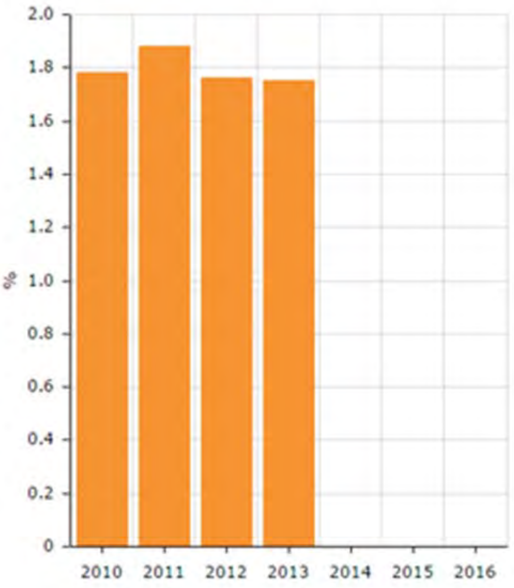


Figure 20: Equivalent major renovation rate – France

Source: ZEBRA

3.1.2 Selected high performance buildings

In France, it has been collected data of 30 nZEBs or high energy efficient buildings which were constructed recently. 23 out of the 30 are new buildings and 7 are renovated buildings. 17 have a residential use and 13 are intended for non-residential use.

Climate zones

As table 5 shows, the 5 buildings are located in the climate zone B, which is characterized by cold winters and mild summers, 23 buildings are located in climate zone D with temperate winters and mild summers and 2 buildings are located in climate zone E with temperate winters and warm summers.

Table 4 Building distribution by climate zones - France

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	19	5
C	Warm winters and warm summers		
D	Temperate winters and mild summers	5	2
E	Temperate winters and warm summers		

Heating Demand

The average heating demand for new buildings is 9,7 kWh/m² a, while in renovated buildings it is 16,8 kW/m² a but with a dispersed value.

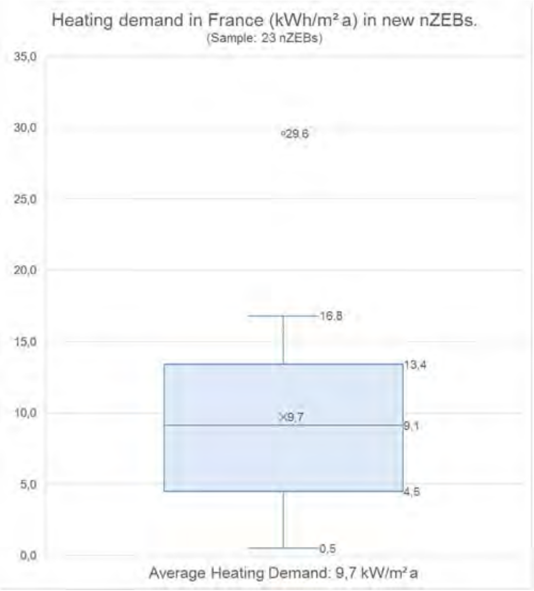


Figure 21 Box plot of heating demand in new nZEBs – France

Building envelope and passive solutions

In new buildings, the average U-value for walls is 0,16 and 0,11 for roofs, while in renovated buildings the average U-value in walls is 0,11 and 0,09 in roofs.

In new buildings, expanded polystyrene is the most used insulating material in walls with a percentage of 30%, while in roofs it is the polyurethane with a share of 26%. In renovated buildings, wood fibre is the most used in walls with a share of 29% and in roofs it is the cellulose fibre with 36% of share.

In windows, the average Uwin-value is 1,15 in new buildings and 1,07 in renovated. Concerning the type of glass, 52% of the selected new buildings use double glass, while in renovated buildings the preferred option is the use of triple glass (43%).

With respect to passive cooling strategies, most of the buildings did not report any strategy. Only in 3 new buildings it is reported the use of natural ventilation, sunshade and night cooling as passive cooling strategies.

Active solutions

Mechanical ventilation with heat recovery is by far the preferred option in both new (91%) and renovated (100%) buildings.

With regard to the heating system, condensing boiler and heat pumps are the most common options in new buildings with a percentage of 22% each, whilst in renovated buildings the most used heating system are heat pumps and stoves with a share of 29% each. Gas is the most used energy carrier for new buildings (26%), while wood chip is the most used in renovated buildings (43%).

A dedicated generation system for DHW is the most used option in new buildings with a percentage of 39%. In renovated buildings the options are equally distributed with a share of 29% the following DHW systems: use of the same heating system, dedicated generation system and partially depending on solar thermal together with the heating system.

Only in 1 of the 30 buildings it was indicated the use of cooling system.

Renewable energies

In 14 out of the 23 new buildings, it was mentioned the use of photovoltaic systems and in 6 the use of solar thermal systems.

In 2 out of the 7 renovated buildings it was reported the use of photovoltaic systems and only in 1 the use of solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on France reports and realised projects.

Table 5 Costs of different renovation depths and new built according to nZEB standards - France

Costs (€/m2)	FR
Minor renovation (15% energy savings)	130
Moderate renovation (45% energy savings)	195
Deep renovation (75% energy savings)	300
NZEB renovation (95% energy savings)	640
New built according to nZEB standards	1,750
Additional funds for nZEB construction compared to new built	150

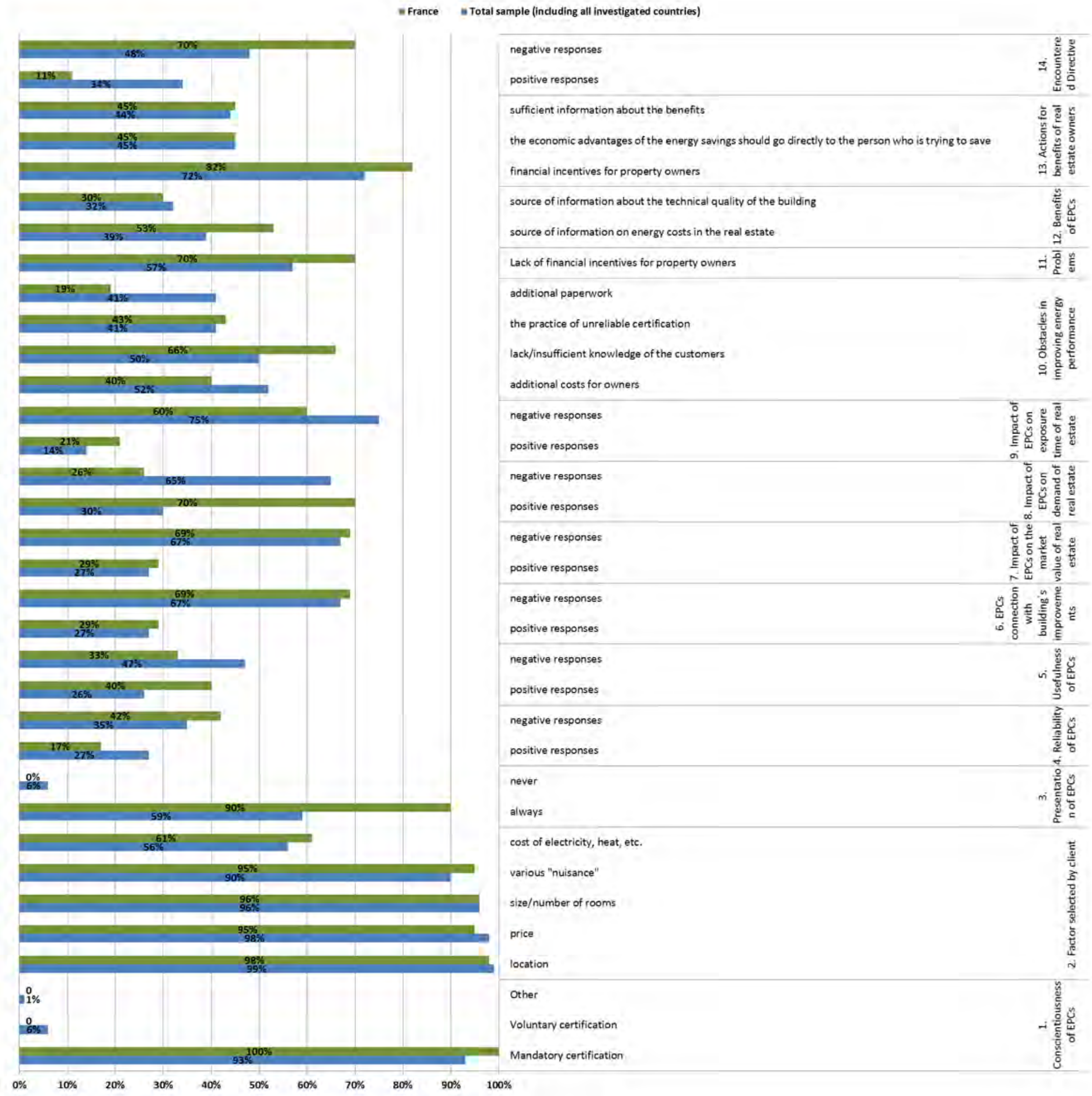
3.2EPCS AND REAL ESTATE AGENTS

3.2.1 Real Estate Agents Survey

1. The dominant form of EPC indicated by all real estate agents in France is mandatory certification.
2. In opinion of real estate agents from France, the main factors taken into account whilst selecting, purchasing or leasing real estate are mainly the location, size and the price of the real estate.

   A further important element was factor called various "nuisance" e.g.: a busy road, landing airplanes, landfill, a high-voltage line, etc. The cost of energy is indicated as very important factor by 20% and as important by 41% of real estate agents only.
3. The EPCs in France are almost always required in concluding the purchase/lease contracts.
4. The real estate agents in France are in general not satisfied with reliability of the data provided by the EPC.
5. Usefulness of EPCs in the professional activity of real estate agents in France is evaluated by them quite high. Around 40% of the respondents indicates the usefulness of the certificate in their professional work.
6. The real estate agents in France do not rather see any connection between the EPC and the improvement of the energy performance of buildings.
7. Usually, real estate agents in France do not confirm correlation between the high energy performance and high value of real estate.
8. Majority of real estate agents in France observe that higher energy performance of buildings cause the growing interest in its purchase / lease in comparison to other buildings.
9. In opinion of real estate agents in France, the influence of having the higher EPC class on the exposure time of the real estate is rather low.
10. The main obstacles in improving the energy performance of buildings were indicated by real estate agents in France to be the following: low social awareness in this subject, additional bureaucracy, financial matters (additional costs for owners) and the practice of issuing unreliable certificates.

11. Among the problems of implementing the improvement of the energy performance of buildings, the following has been mainly indicated by the real estate agents in France: the financial aspect, no incentive for the real estate owners.
12. The most important benefit of having the EPC indicated by the real estate agents in France is the source of information concerning the energy costs and technical condition of the building.
13. The most expected support that would influence the improvement of the energy performance of buildings, according to the respondents from France, is financial activity. Economic support directed to real estate owners and economic incentives for those that undertake such actions and sufficient information about the benefits.
14. The level of awareness and information about wording, requirements and settlements of the 2002/91/EC or 2010/31/EU Directive among the real estate agents in France is very low.



3.2.2 Real estate Prices and EPCs

EPCs are managed at the national level in France. The implementation process was updated in 2010 along with new regulations that have greatly improved the EPC procedure (CA EPBD 2016). The relevant indicator for energy efficiency is the primary energy consumption factor. Energy consumption is either calculated or measured, depending on the building type and the year of construction. This value is then compared to fixed-value bands that relate to a letter-scale, ranging from A (lowest energy consumption) to G (highest energy consumption). It was calculated in 2012 that 17% building stock was certified (CA EPBD 2016b). It is estimated that this number had grown to 20% by 2014 (CA EPBD 2016).

The French sales market is also observed to display the previously-discussed trend of a price surplus across the scale up until the highest shift (in this case between B- and A-rated dwellings) at which point a deficit is observed. The price surplus in the linear model is 9% per letter.

The extremely low adjusted R2 value for the rental market in France means that over 90% of price contributing-characteristics are not covered by the dummy variable regression model and corresponding data. As a result, caution must be made when using these results to make further inferences about the French rental market. The linear model suggests a surplus of 2% for a one-letter improvement.

3.3 EXISTING POLICIES

In France, present and future regulations appear to follow the nZEB requirements. Several economic incentives and related financing instruments have been established to support this development. However, there is a lack of clarity and simplicity that hampers a satisfying understanding of these measures.

The building sector and energy targets

The French NEEAP includes specific energy targets for the years 2020, 2030 and 2050.

Energy targets in France	**2020**	**2030**	**2050**
GHG emissions		-40% compared to 1990	-75% compared to 1990
Final energy consumption	131.4 Mtep	-20% compared to 2012	-50% compared to 2012
Primary energy consumption	236.3 Mtep	-30% compared to 2012 for fossil energy	

The French NEEAP is also referring to specific energy saving targets in the building sector. In France the building sector (residential and non-residential) represents **42% of final energy consumption** (2012) and is the sector with the greatest potential for energy savings.

The implementation of energy efficiency measures is supported by certain actions/measures:

- **Regulation:** The 2012 building code aims to improve the energy performance of new buildings and it is considered by the French administration as meeting the nZEB standard set by the EC.
- **Information:** The housing energy efficiency improvement plan (PREH) aims to accelerate the renovation of the existing housing stock, relying in particular on the network of Renovation Information Service Points (PRIS) and to achieve a better articulation of existing systems (e.g. sustainable development tax credit, interest-free eco-loan).
- **Energy poverty alleviation:** The fight against energy poverty through the actions of the French National Housing Agency (ANAH) and its "Habiter mieux – Living better" programme.

National Renovation Strategy

France in its national renovation strategy has set the goal to reduce the energy consumption of the existing dwelling stock by 38% by 2020 (compared to 1990). Furthermore, specific building related energy saving goals have been set in the low "Loi de transition énergétique":

- 400,000 renovations/yr from 2013, 500,000 renovations/yr from 2017 onwards
- 80,000 renovations of social houses by 2020
- -40% energy consumption in public buildings by 2020

The building renovation strategy integrated three interrelated action areas:

- Support to renovation decision by accompanying households though individual coaching with consultants in renovation
- Financing energy renovation of private building stock and social housing (e.g. by providing subsidies, grants, preferential loans, personal income taxes reduction)
- Mobilising/encouraging professionals to control costs and quality

Furthermore, France's strategy foresees that the quality of the renovation should be improved by: (i) Continuous training for building professionals. (ii) Support professionals to control costs. (iii) Establishment of a cross-compliance framework.

Energy performance requirements

In France for **new buildings** the building code reference document is the 2012 Thermal Regulation (RT) which replaced the former RT 2005. The new document strengthens requirements concerning the thermal performance of new buildings. All new buildings must have a specific energy consumption in primary terms (primary equivalent in kWhep) below a threshold of 50 kWhep/m2/year, (including space heating, cooling, lighting, domestic hot water and auxiliary equipment).

For **major renovation** of buildings more than 1000m², the global Thermal Regulation (RT Existant global) sets a global energy performance target for renovated buildings, built after 1948. The target is for dwellings to reach consumption between 80 and 165 kWh/m²/yr since 2010 compared to an average of 240 kWh/m²/yr for the existing stock. The range depends on the climate zone and the heating fuel. For non-residential buildings the savings should be of 30%.

For **minor renovation** of buildings less than 1,000m2, or buildings more than 1,000m² with minor renovation, the element-by-element Thermal Regulation sets a minimum performance level for elements replaced or installed: this concerns insulation, heating, hot-water production, cooling and ventilation equipment.

Compliance

Compliance is checked only for new buildings. The overall compliance monitoring is not defined in the building code requirements. The thermal regulation's compliance is done by the thermal contractors, architects or technical controllers.

The nZEB plan

The French government considers that its nZEB definition matches the present regulation RT2012. Therefore, since the 1st January 2013, all new constructions are nZEBs. For new residential buildings the RT 2012 requires a primary energy consumption of less than 50 kWh/m2/yr ("low-consumption buildings"/Bâtiments Basse Consommation or BBC), and for new non-residential buildings, a primary energy consumption lower than 70 kWh/m2/yr for buildings without air-conditioning and 110 kWh/m2/yr for buildings with air-conditioning.

France tries to gradually increase the penetration of nZEB through labels that go beyond the existing regulation and prepare the market for more stringent regulations.

Renewable sources in the building sector

In 2007, the "Grenelle de l'environnement" set the objective to increase the share of renewable energy to at least 23% of final energy consumption by 2020. According to the requirements of RT 2012, single family houses need to have renewable installations to meet the standard. In the future building codes the renewable energy production targets will be more binding.

The following measures may be included in the nZEB action plan:

- Financial measures: Sustainable Development Income tax credit, Reduced rate VAT, Zero rate eco-loan, ANAH aid, Plan for the renovation of social housing and public buildings, Heat Fund, Tariffs for the purchase of electricity produced from renewable energy sources, etc.
- Regulatory measures: Energy Saving, Certificates, Thermal Regulation 2012, Energy Performance certificate, Classification of district heating networks, Modification of administrative process, etc.
- Information measures: Energy Information Spaces, ADEME Campaigns.
- Planning measures: Regional Climate Air and Energy Plans.
- Grant measures: National Research Agency, Hubs of competitiveness.

3.4 NZEB-TRACKER

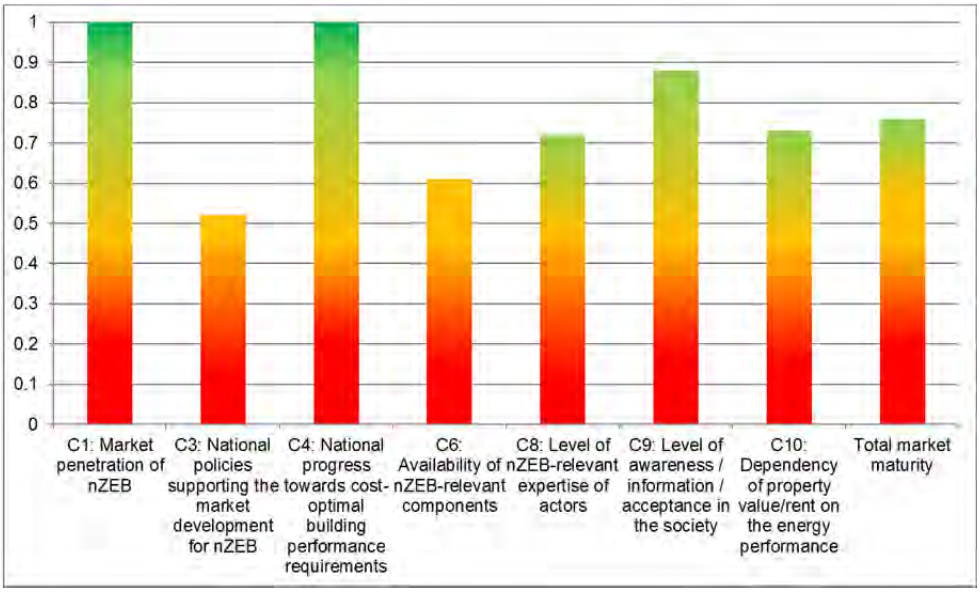


Figure 22 nZEB-tracker score for France

C1: Market penetration of nZEB in 2014

- French result: 1 ZEBRA average: **0.32**
- nZEB had a share of 100 % on new constructed floor area in France
- The share has been stable since 2013, i.e. since last implementation of the 2012 building code.

C3: National policies supporting the market development for nZEB in 2014

- French result: **0.52** ZEBRA average: **0.52**
- Policies targeting the existing stock in France seemed not enough sufficient to support the development of the deep renovation market for residential and non-residential nZEB in 2014.
- Need for adaptations may result from the non-existing or not clear definition of the nZEB standard in France for renovation.

C4: National progress towards cost-optimal building performance requirements in 2014

- French result: **1.00** ZEBRA average: **0.94**
- The French building code (RT2012) already matched the cost optimal building energy performance level.

C6: Availability of nZEB-relevant components in 2014

- French result: **0.8** ZEBRA average: **0.83**
- Energy efficient heating systems and other building components for nZEB were well or very well available in France.
- Building automation and control system seemed to be available only moderately.

C8: Level of nZEB-relevant expertise of actors in 2014

- French result: **0.72** ZEBRA average: **0.63**
- For the construction or new dwellings, the process is now quasi industrial, thus the network is existing and works well, professionals are experts in NZEB construction which is the standard in last building implementation. These professionals are highly qualified and aware of latest technologies.
- Although many policy instruments target professionals of thermal renovation, , concerning renovation there is a lack of qualification and skills of professionals.

C9: Level of awareness / information / acceptance in the society in 2014

- French result: **0.88** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings increased steadily thanks notably to the one-stop shop implementation in 2013 (PRIS-*Point Renovation Info Service*)

C10: Dependency of property value/rent on the energy performance in 2014

- French result: **0.73** ZEBRA average: **0.74**
- Compared to site, living quality, aesthetics and financial aspects, the energy performance was the least important aspect for customers' decision on renting/buying a real estate.

Resulting maturity of the French nZEB market in 2014

- French result: **0.78** ZEBRA average: **0.66**
- The nZEB market seemed to be better developed than the average of the ZEBRA countries. The political framework appeared sufficient in 2014, though the definition of the nZEB renovation standard is still missing.
- High performance building components were easily available.
- The availability of experts may limit the future development of the nZEB renovation market.
- People became more and more aware of the energy performance of buildings. Still it had a minor priority on buy/rent decisions.

3.5 SCENARIOS

Market penetration of nZEB – new building construction

Figure 23 shows annual construction of conditioned floor area according to different standards. The results are shown for the historical development and in both policy scenarios, current and ambitious for the long term development from 2021 to 2050. For an explanation of the scenario framework of the current policy scenario and the ambitious policy scenario, see part "Introduction". Data on historical development of new building construction according to national standards were collected in the project, see part "Introduction" and are available on the project project´s data tool (http://www.zebra-monitoring.enerdata.eu/). The share of the new building construction according to the building code in 2012 was approximately 72% of the total new building floor area, the remaining construction are going beyond building code requirement (i.e. nZEB). "According to building code" means that buildings are constructed according to national minimum requirements of RT2005. The French government considers that its nZEB definition matches the present regulation RT2012. Therefore, since the 1st January 2013, all new constructions, built according to the building code are nZEBs in France. By 2020, there will be the new regulation RT2020 implemented, with better energy performance requirements for new buildings. This new standard is implemented in the model as national nZEB definition, 2021. Hence, in 2013 the share of the new construction according to the nZEB is 100% of the total new building floor area. From 2030 to 2050, the share of stringent measures is increasing. In the ambitious scenario, the share of stringent measures is much higher due to the policy implication.

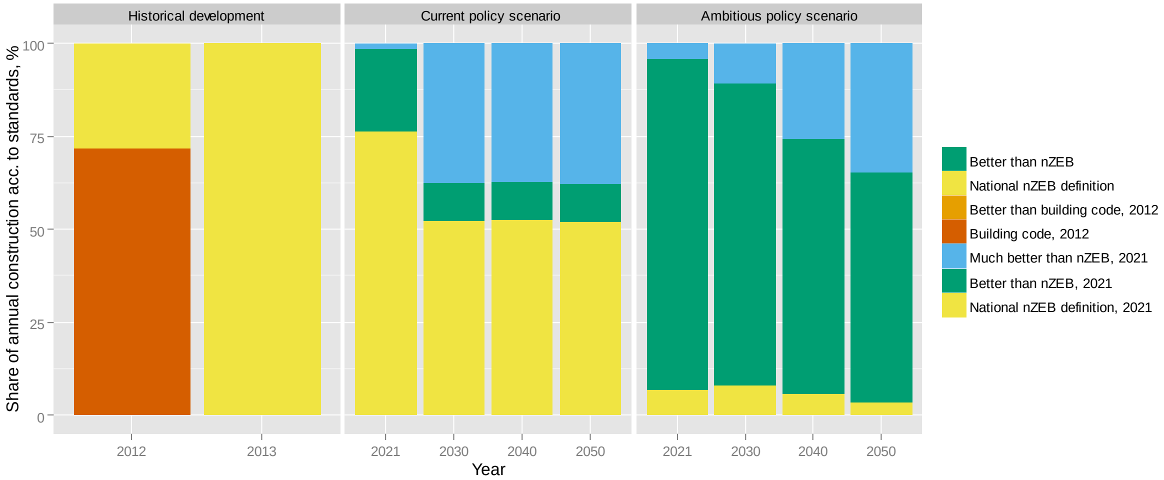


Figure 23 Share of annual construction of conditioned floor area built according to national standards

Building renovation activities

Figure 24 shows historical and future development in current and ambitious policy scenarios of annual renovation of conditioned floor area by renovation levels.

The following renovation categories were defined in the current policy scenario:

- light renovation meaning that in reality not all buildings fulfil the criteria set in the building legislation;
- medium renovation which refers to the building codes and;
- deep renovation reflecting the nZEB definition.

In the ambitious scenario, from 2021 to 2050, all buildings fulfil at least the building standards. There is an additional renovation level "deep plus" which means higher energy performance achievements.

In France, in the current policy scenario, the share of the light and medium renovation makes up a significant share on the total renovated building floor area from 2021 to 2050. In the ambitious policy scenario, which implements stringent measures on existing buildings, the share of the deep and deep plus renovation is increasing compared to the current policy scenario. In 2040, around 45% of the renovated building floor area will be renovated with a strong share of deep plus (16%) and deep renovation (29%), resulting in higher energy savings (Figure 28).

In France, in both scenarios, there is the mandatory thermal renovation in case of cleaning façade or roof which increases the future yearly renovated floor area compared to the historical development of the building renovation. In the ambitious policy scenario, there is an additional mandatory thermal retrofitting of the least efficient dwellings during real estate transactions and major transformations (when economically feasible). This instrument has a significant impact on the increased renovated building floor area.

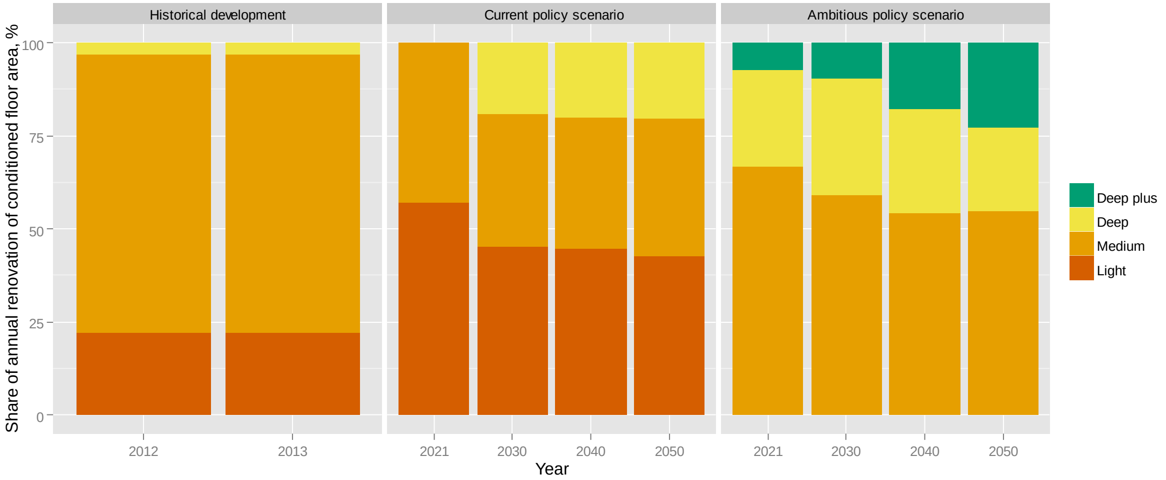


Figure 24 Share of annual renovation of conditioned floor areas by renovation levels in current and ambitious policy scenarios

Figure 25 shows the distribution of the specific energy need for space heating (energy need is calculated following EN13790 methodology) in the total building stock after building renovation by using the following renovation levels, light, medium, deep and deep plus. The specific energy needs are shown in a box-plot diagram. The median (middle quartile) marks the mid-point of the data and is shown by the line that divides the box into two parts while the diamond indicates the mean value. The data is represented for 2012 for not renovated buildings, light, medium and deep renovation. The deep plus renovation shows specific energy need for buildings being renovated after 2020. In France, medium renovation refers to the building code RT2012. The specific energy need for space heating of light renovation is higher compared to the medium renovation, which means that in reality not all buildings fulfil the criteria set in the building legislation. Deep and deep plus renovations include envelope retrofitting and installation of the mechanical ventilation.

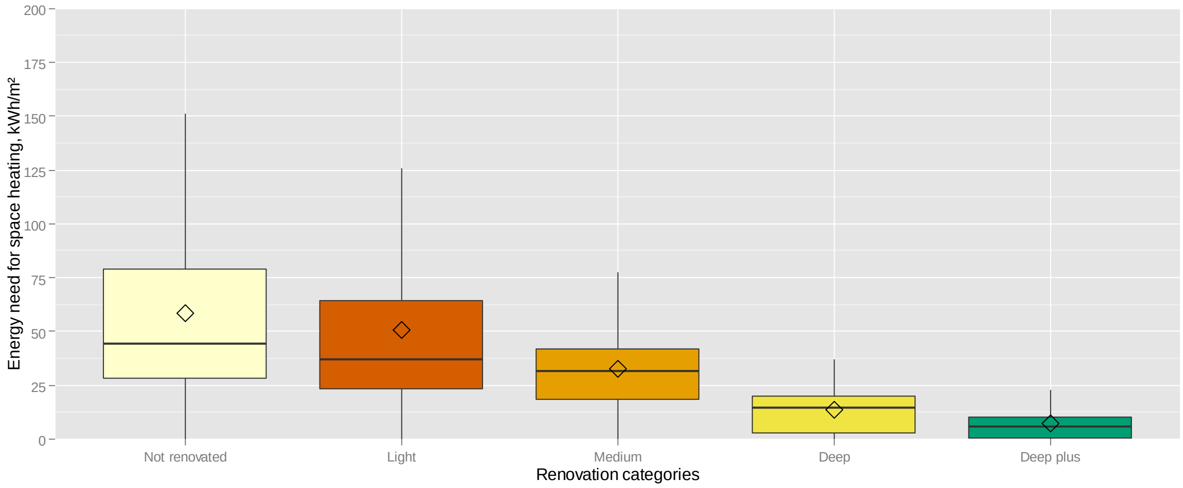


Figure 25 Distribution of the buildings specific energy need for space heating

Economic indicators and national policies supporting the market development for nZEB

Figure 26 shows total yearly investments in the building envelope (thermal renovation) and in renewable heating systems from 2012 to 2050 in the current and ambitious policy scenarios. The investments are slightly higher in the ambitious scenario due to higher number of the renovated buildings, higher quality of the implemented thermal renovation and higher investments in the renewable systems. Figure 27 shows total yearly public budget for financial support of renewable heating systems and renovation of the building envelope. The yearly public budgets are significantly higher in the ambitious policy scenario. The leverage effect of incentives is higher for thermal renovation compared to renewables as 1€ of public investment is leveraging higher private investments for thermal renovation (90€ in 2040 for the current policy scenario) compared to renewables (leveraging around 16€ of private investment).

In France, in the ambitious scenario, there is an implementation of a progressive energy or CO_2 tax reaching 100 €/t CO_2, with reallocation of the tax revenue as a priority to low income households to provide additional resources to subsidise energy efficiency investments, reduce fuel poverty and increase the cost-effectiveness of the investments.

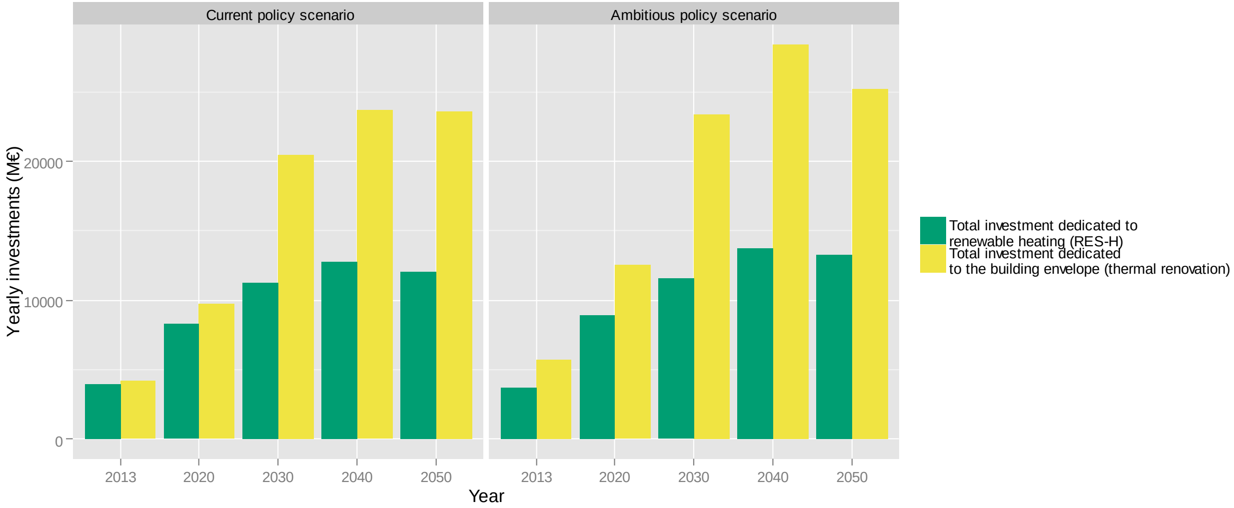


Figure 26 Total yearly investments in renewable heating systems (RES-H) and renovation of the building envelope including public budget, 2013 to 2050, current policy and ambitious policy scenario

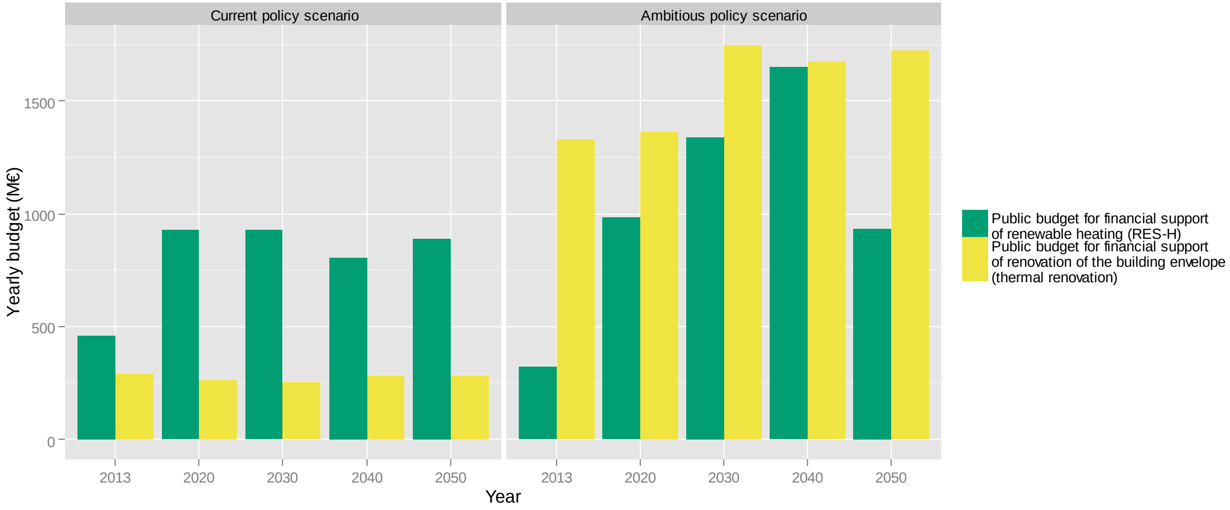


Figure 27 Total yearly public budget for financial support of renewable heating systems (RES-H) and renovation of the building envelope, 2013 to 2050, current policy and ambitious policy scenario

Development of the building related energy demand

Figure 28 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total French building stock is 510 TWh in 2012. The scenario shows a steady slow-down of the energy demand of

5% (around 0.6% yearly) from 2012 to 2020. However, heating, cooling and hot water energy demand is decreasing over time by 22% in the current policy scenario in the long term development between 2012 and 2050 and by 32% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In France, the share of fossil-fuel-based heating systems especially natural gas is significant in 2012. The fossil-fuel-based heating systems are slowly replaced with the renewable systems. The share of non-delivered energy (i.e. solar and ambient energy) is increasing over time from around 3% of final energy demand in 2012 to around 33% in current policy scenario and 35% in ambitious policy scenario in 2050.

Figure 29 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 64% in current policy scenario and around 71% in ambitious policy scenario. The reduction of the primary energy demand is around 50% and 59% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

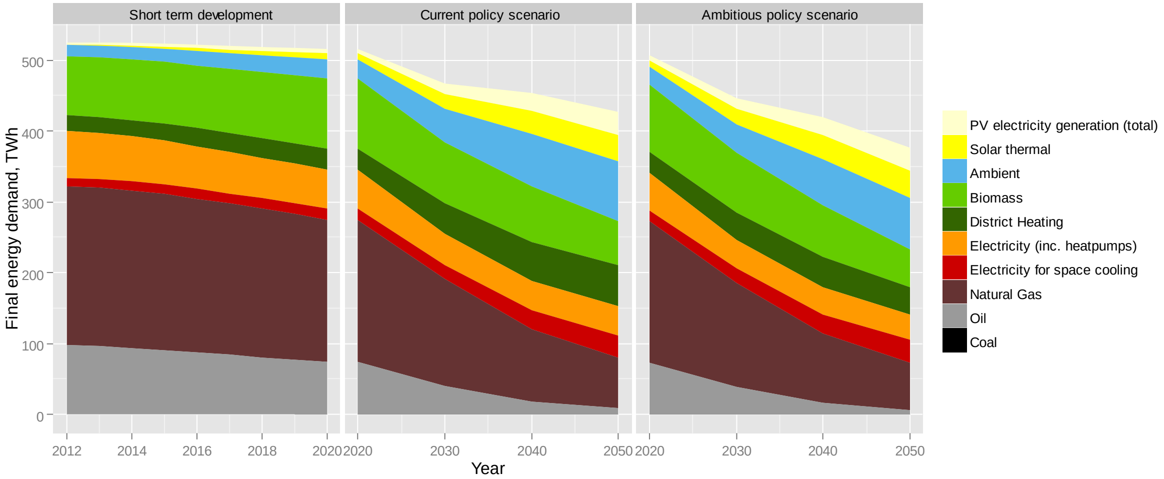


Figure 28 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

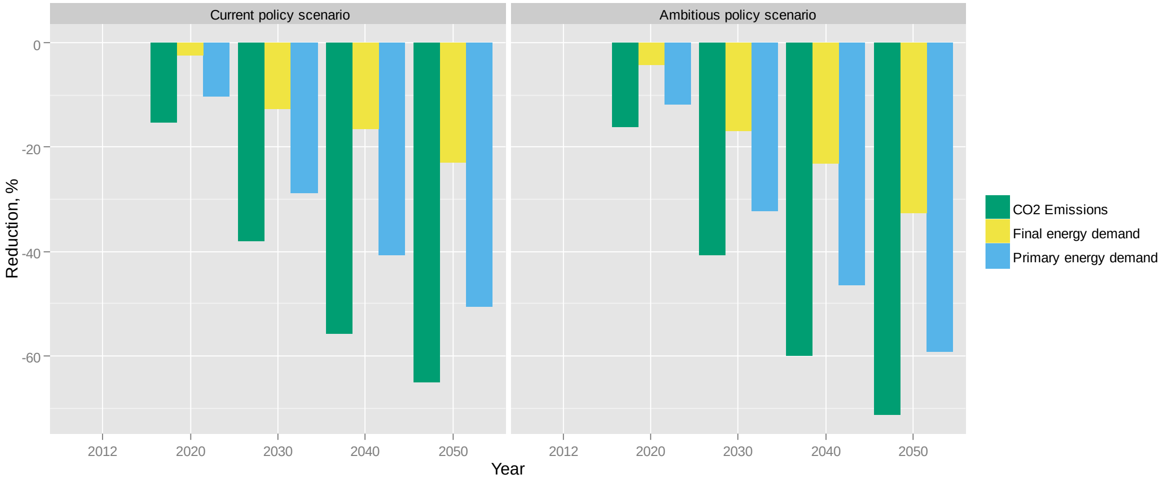


Figure 29 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

3.6 RECOMMENDATIONS

In France, three quarter of the building stock was built without building code (i.e. after the first implementation of the building code in 1974). As a result, the average performance of the stock in terms of energy consumption per m^2 is one of the worst in Europe[10]. Thus, the building sector is one of the top priority in the energy efficiency policy roadmap in France.

The current building codes (RT2012) implemented in 2013 enforces all new buildings to meet nZEB standard, and by 2020 all new buildings should be positive energy buildings (primary energy consumption inferior to on-site renewable energy production). Concerning renovation, the building code asks for building with a surface higher than $1000m^2$ to meet a global energy performance targets (set differently according to the date of construction); concerning other buildings the element-by-element thermal regulation sets a minimum performance level for elements replaced or installed (insulation, heating and cooling, hot water, ventilation, etc.).

The Energy Performance Certificate has been mandatory in France since 2007.

Additionally, among the provisions in the energy transition law of green growth (approved in August 2015), there is a decree on renovation obligation for private residential buildings whose primary energy consumption exceeds 330 kWh/m2. This affects all buildings with an energy performance rating in the two lowest bands, F or G (~15% of the stock). These buildings, including rented and owner-occupied, will have to be renovated before 2025. This measure will accelerate the needed transformation of the existing building stock, and help achieve the ambition of bringing the entire building stock to low energy levels (level "Bâtiment Basse Consommation" (BBC) or equivalent), by 2050, which is also part of the new law[11]. Other regulation asks for thermal regulation in case of maintenance work in multi-family buildings (for instance wall insulation in case of façade cleaning, etc.).

Besides the French environment regulation for building ("Grenelle") sets ambitious targets:

- 38% reduction of primary energy consumption in 2020 compared to 2005 level
- 500,000 existing dwellings retrofitted each year, of which halves should be occupied by vulnerable consumers.

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[10] Source ODYSSEE : a french household requires 60% more useful energy for space heating than the European bencmalr, namely The Netherlands.

http://bpie.eu/wp-content/uploads/2015/12/Renovation-in-practice_08.pdf

To meet these objectives, there is a diverse energy efficiency policy mix targeting buildings and more precisely promoting renovation activities in France:

- Label for high energy performance for retrofit or construction
- Tax credit (15% to 25%) (CITE)
- Tax exemption, lower VAT for EE works
- Zero interest rate loan of existing building
- White certificates
- R&D and demonstrators for buildings
- Training and qualification of practitioners
- One stop shop for EE work advices (PRIS)
- Etc.

Last but not the least, several measures are implemented to tackle energy poverty in France and to meet the ambitious abovementioned target of 250,000 dwellings retrofitted per year. Dedicated programs such as the "Habiter Mieux" have a budget allocated through the white certificate scheme to finance renovation in social housings; the eco-subsidy for low-income owner-occupiers and eco premium to help to carry out housing work, etc.

Despite these efforts, 40% of thermal renovations are light12.

In this context we recommend the 9 following measures or examples to promote energy efficiency in buildings in France:

NB: *recommendations target essentially the existing building stock due to the fact that the current building code set ambitious target for construction that are correctly enforced and are in line with the European nZEB standard. In addition, very few recommendations on information or awareness campaigns were selected as the one stop shop measure (PRIS) implemented since more than a decade now is a very efficient channel to communicate to end-users on renovation (both in terms of type of investments to be made + available incentives, etc). In addition, fuel poverty is not included in these recommendations as many instruments are already in place and do not face real difficulty in their implementation.*

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[12] Source : OPEN-ADEME http://www.ademe.fr/open-observatoire-permanent-lamelioration-energetique-logement-campagne-2015

FR1 - Set national renovation standards (including nZEB)	**FR2** - Structuring and improving data gathering and assessment	**FR3** - Provide building owners and investors with tailored advice according to specific renovation roadmap (renovation passport)
FR4 - Improving the usage of Energy Performance Certificate (EPC)	**FR5** - Improving the building passport	**FR6** - Better integration of split-incentives in policy implementation
FR7 - Define a long-term vision integrated in decentralised energy systems	**FR8** - Improve continuously training building professionals and structure bundle renovation	**FR9** - Change the approach to *"massify"* thermal renovations

#FR1 - Legislative and Regulatory Instruments

Set national renovation standards (including nZEB)

For buildings with a surface lower than 1000 m² the RT element does not set minimum global energy performance to reach. Hence the definition of nZEB or deep renovation is not clear or standardised.

The current French regulatory framework offers already some interesting enforcements to accelerate the diffusion of efficient buildings (including renovation obligations-see state of play below).

Besides "deep renovation" definition is not homogeneous from one public entity to another (different definition or interpretation according to ADEME or Ministry for instance) and make statistics such as renovation by label or nZEB tracking difficult.

Around 40% of annual building renovation are light (i.e. one measure maximum implemented) and the maintenance work are still too high; this lock-in effect is problematic and becoming a priority for policy maker: how to incentivise consumers to make a step toward thermal renovation?

Define different official renovation levels (set different global performance; including nZEB) to:

- Monitor and increase renovation activity by level- see #FR3;
- Make possible or recognise the step-by-step renovation to propose financial instruments according to these different steps (and level of ambition)-see #FR3. Financial supports should reward higher ambition and steer ambition towards the nZEB level in order to avoid the potential lock-in effect.
- For exiting stock, instruments should promote energy savings against predefined level of renovation (take example from the French initiative Habiter Mieux +25%)
- Complete the national target of annual renovation (500,000 renovation/year) with concrete objectives in terms of type of renovation (and thus share of nZEB renovation)

State of play

To tackle the above-mentioned lock-in effect, a new French governmental decree (May 2016) enforces thermal improvement work in case of clean façade, renovation of attic or roof during repair or during the transformation of attic or garage in living space in the dwelling.

Additionally, there is a decree on renovation obligation for private residential buildings whose primary energy consumption exceeds 330 kWh/m2. This affects all buildings with an energy performance rating in the two lowest bands, F or G (~15% of the stock). These buildings, including rented and owner-occupied, will have to be renovated before 2025.

#FR2 – Quality of action

Structuring and improving data gathering and assessment

In France many official and publically available observatories have been implemented to monitor building activities, such as Energy Performance Certificates (EPC)13, Renovation (OPEN14), energy poverty15, nZEB16, BBC 17(nZEB), etc.

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[13] http://www.observatoire-dpe.fr/

[14] http://www.ademe.fr/open-observatoire-permanent-lamelioration-energetique-logement-campagne-2015

[15] http://www.onpe.org/

However, these observatories are sometimes lacking of clear definitions in line with official targets (see FR#1). Few quantitative information is collected concerning the impact of renovation in terms of energy savings, maybe linked to the fact that there is very few control of the building code for renovation (thermal regulation element-by-element).

There is no control of the thermal regulation concerning the existing stock and the implemented renovations. Recommendations:

- Make available governmental tools that set-up financial instruments in accordance to the thermal actions to calibrate financial instruments (e.g. soft loans, period of mortgage, etc.).
- Control (of EPC or building passport) 3 years after construction/renovation to identify anomalies or divergence in terms between ex post and ex ante energy consumption (see #FR5).
- Take as reference the data included in the building passport (see FR#5)
- Anticipate and integrate the future flow of information stemming from the smart grids and smart meters.
- Gather all these observatories into one information system to avoid information dissemination and collect information from the one stop shop PRIS initiative.

Example: OPEN Observatory-Energy renovation of French residential buildings

The OPEN observatory has been set up by ADEME (L'Agence de l'Environnement et de la Maîtrise de l'Energie) and the French Ministry of Environment in order to measure changes in the market of energy renovation of housing, providing quantitative data and measuring the market penetration of energy efficient products and equipment. It also evaluates the impact of governmental and professional measures. The last report (OPEN Observatory-Energy renovation of French residential buildings in 2014) provides data, collected by OPEN ("Observatoire Permanent de l'amélioration ENergétique" des logements), on the energy renovation of French residential buildings, completed in 2014.

The study gives the number and type of energy retrofits in private dwellings (excluding works decided by condominiums' owners).

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[16] http://www.observatoirebbc.org/

[17] http://www.observatoirebbc.org/

More than 3.5 million housing renovations were completed in 2014, including 288,000 classified as high and very high energy performance. These renovations represent a total expenditure of nearly 35 billion euros, with an average expenditure per household of nearly € 10,000.

Renovation works on the building envelope (windows, walls, roof) are the most common. Other renovation measures involve heating or domestic hot water systems' replacement. The main motivations behind these works are the increase of thermal comfort, the reduction of the energy bill and the replacement of old or out of service equipment**18**.

#FR3 – Communication

Provide building owners and investors with tailored advice according to specific renovation roadmap (renovation passport)

Some financial instruments implemented in France are conditioned by the type and number of measures implemented (for instance eligibility of aids if at least two measures are implemented).

To meet nZEB standards, investment renovation costs are high and unfordable to owners/investors. The return of investment is difficult to evaluate: In France it is estimated that a deep renovation has a return of investment of 20 to 30 years while a dwelling has a new owner every 7 or 8 years on average. There is a temporal constraint that undermines incentives, releases of renovation, lowers the leverage effect of instruments and complicates the concrete actions (“passage à l’acte” in French).

Recommendations

Decision making process and financial instruments should:

- Be tailored according to the different type of actors: single versus multi-family dwellings; private versus social buildings; rural versus urban; etc. with a communication effort accordingly.
- Be adapted to evolve into building-specific renovation roadmaps and provide a “health check” on individual buildings and tailored advice to owners and investors on how to improve them. A building roadmap or renovation passport will allow building owners to have an overview of the full range of renovation options and easily identify each renovation step from the beginning to the end at the same time (step-by-step approach-see FR#1). Financial

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[18] http://www.ademe.fr/open-observatoire-permanent-lamelioration-energetique-logement-campagne-2015

instruments should be calibrated according to these different steps; this will increase the leverage effect of policy. Include this renovation passport in the building passport.

- Include this "renovation passport" with the id/passport of the building as presented in FR#5

Even if deep retrofitting shall be prioritised, financial instruments should permit step by step or successive investment with a short return of investment. Audit should explain and prioritize the actions to undergo to retrofit and meet nZEB standards.

Example 1-TEPOS

In November 2015, the French Ministry of Environment launched an experiment on thermal renovation passport (entitled in French "Tepos" or positive energy territories) for single-family dwellings built before the 1st January 2000. This passport is a decision-making tool that provides an in-depth audit of the building, recommendations on personalized renovation works in additional to the potential energy savings expected after the renovation. The experiment should lead to the achievement of 1,000 passports.

Example 2- Picardie Pass Rénovation

Picardie Pass Rénovation is an initiative from Picardie region of France (now integrated in a broader region called Hauts-de-France) to give technical and financial supports for renovation works. It provides technical supports thanks to a free diagnostic and a personalized project of works. When the project is accepted by the owner, a technician can help in the selection of craftsmen and can pilot the works. During five years after the renovation was conducted, the energy consumption is monitored.

In case of difficulties to finance the renovation project, the Picardie region lends the total investment amount needed with a reimbursement calibrated according to annual savings: the loan is reimbursed thanks to energy savings.

#FR4 - Legislative and Regulatory Instruments

Improving the usage of Energy Performance Certificate (EPC)

The EPCs have been successful in terms of communication. Most people in France has already seen an EPC and some online real estate agencies integrate the EPC label in their selection criteria.

A compliance effort has been made in 2010-2012 by the ministry, with the aim to increase control, and upgrade/homogenisation of methodology evaluation). But because of public budget constraint and low willingness to pay of end-use consumers, the EPC is not a "complete thermal audit" and the final quality of the diagnosis is often low or weak. There are several methods of EPC evaluation, and in particular the evaluation is different for buildings built before 1948.

Recommendations

- Implement a common methodology based on both a conventional audit + information on previous energy bills of the dwelling;
- Ask to energy utilities the energy bill as it is already done in overseas French Territories (DOM TOM);
- Improve the communication of the EPC label (the concept of primary energy used in French EPC is not understandable for consumers): in addition to energy consumption add economic features (equivalence in terms of expenses).
- Include a reference consumption of similar buildings (range estimate according to the number of inhabitant in the dwelling) with the same characteristics (year of construction (or renovation), type of heating, surface, equipment's, etc.) to benchmark the energy consumption of the dwelling.
- Improve the quality of EPC: include price according to the level of services/information
- Define the EPC as an exclusive informative tool (i.e. not including anymore recommendations) and create another tool for dwelling audit and preconisation such as the dwelling passport – see FR#5.

Example: The French DPE (EPC) Observatory

The EPC (DPE in French) Observatory is a tool elaborated by ADEME aiming at collecting data on EPC. The observatory has been designed to meet the requirements of the Decree n° 2011-807 (5 July 2011) asking for better transparency of real estate transactions. The tool offers the following services:

-the possibility to check the existence and the content of a EPC;

-the access to a database of certified diagnosticians;

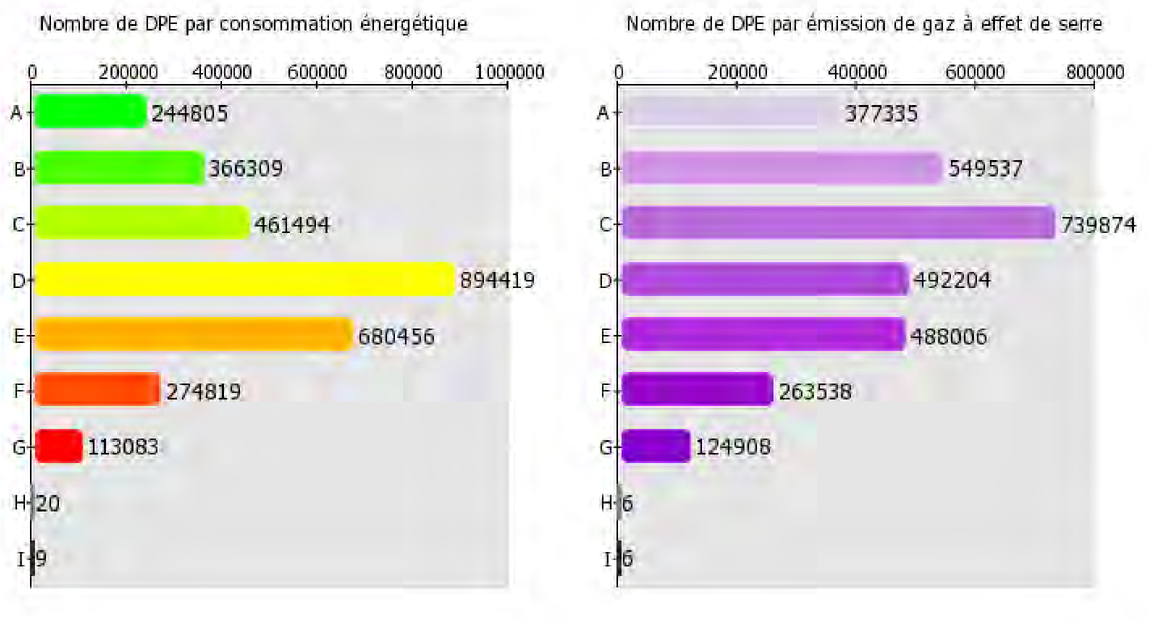
-the access to the statistics on the breakdown of EPC per label, per year of construction, per type of space heating and per type of building;

-the possibility for an owner or a tenant to simulate an EPC;

-the possibility to download a blank EPC document.

The data collection started in June 2013. At the end of August 2016, around 3.6 million EPC were collected. On average, 20,000 EPC are submitted each week.

Breakdown of EPC according to labels in France:



Source[19].

#FR5 - Legislative and Regulatory Instruments

Improving the building passport

In order to become drivers for renovation, the current Energy Performance Certificates (EPCs) should evolve into building-specific renovation roadmaps, or "building passports", accompanying a building through its life cycle and include improvement proposals and advice to owners and investors on how to improve the building towards becoming nearly-zero energy (in a step-by-step approach to energy renovation which avoids lock-in-effects and looks towards better solutions). Indeed, in order to become useful in individual buildings' improvement plans, EPCs should evolve towards more comprehensive and dynamic tools accompanying a building over its lifetime.

The Energy Performance Certificate (EPC) has a weak impact on the property value in France today. A building passport could make the building owners/buyers more aware of the

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[19] http://www.observatoire-dpe.fr/index.php/

building's energy performance and future benefits/costs.

There is also a scarcity of reliable information. Even if the EPC displays a label on energy consumption it is rather a rough estimate of energy consumption compared to a complete thermal audit.

Recommendations

Take the opportunity of the coming ID card or Passport of the building (decree implemented in 2016[20]) and enlarge its scope to:

1. Include the EPC, the sale or renting price, energy consumption, etc.
2. Include the renovation passport (described in FR#3):

- Include recommendations on thermal solution to implement to ensure a logical pathway of solutions (priority, step-by-step renovations)-see roadmap described in FR#3
- Describe the past renovation activity: elements renovated, global cost of renovation, expected and observed energy savings (EPC before and after renovation)
- List the available and eligible financial program helping to implement the recommendations

Including property value loss in case of status quo, i.e. without thermal improvement of the dwelling

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[20] http://competitivite.gouv.fr/documents/commun/Financements/Appels_a_projet/AAP%20PTNB%20Carnet%20numerique%20suivi%20entretien%20logement%2030%20Septembre%202016.pdf

#FR6 – Economic measures

Better integration of split-incentives in policy implementation

There are today very few incentives for landlords to implement thermal improvement solutions when the dwelling is rented. The leverage effect of financing programme targeting landlords is weak. In France, ESCO market concerns for the moment essentially the non-residential sector or big buildings such as condominiums. Energy Performance Contract (EPC) should be implemented or enlarged to all types of buildings, including isolated or small buildings.

In case of renting, if the landlord signs an EPC, the tenant will benefit from energy savings while landlords invest in thermal solutions (problem of gain sharing).

Recommendations:

- Attached the loan of the thermal investment to the buildings instead of the investor (take example from the Green deal in UK);
- Take advantage of the existing decree[21] setting minimum requirements on living conditions for rented dwellings and add restrictions concerning the energy performance of the building: Implement restriction or interdiction of renting for dwellings with an energy consumption above a certain threshold (i.e. 330 kWhep/m²) or in case of usage of outdated thermal equipment: for instance, each dwelling rented shall fulfil a certain number of points (points corresponding to criteria of eligibility), under a certain number of points the dwelling cannot be rented;
- Share investments between landlord and tenant in case of retrofitting, with a clear objective in terms of energy savings;
- Reinsure tenant about the health of the dwelling thanks to the building passport (see FR#5).

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[21] https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=LEGITEXT000005632175&dateTexte=20110729

#FR7 - Legislative and Regulatory Instruments

Define a long-term vision integrated in decentralised energy systems

Buildings are in a transition phase, moving from being unresponsive and highly-energy-demanding elements to becoming highly-efficient micro energy-hubs consuming, producing, storing and supplying energy, making the system more flexible and efficient.

Many pilot programmes on smart-grids and smart-cities have been launched in France and Europe on Ecocities

Smart meters will spread in all dwellings in France (e.g. from 2017 all multi-family dwellings connected to collective heating shall be equipped with individual meters).

Recommendations:

-Exemplarity role of local territories setting clear long-term targets in their long-term action plans

-Empowering actions at local level (cities/regions) to go beyond the set goals

-nZEB concept should be evaluated at the scope of the territories to favour for instance the development of huge renewable heating systems or district heating, that could represent a big scaling effect.

-Promote collective actions undertaken at district level on in these city pilot projects:

- Disseminate these pilot projects gathering different jobs (architect, thermal experts, etc.) to do nZEB constructions or renovation. These initiatives have a greater macroeconomic impact (job creations) and evaluate the global cost at the territory/city/district level.
- Make possible the economic interest of grouping renovation works of several dwellings located in the same neighbourhood on the demand side. And better structure the supply to propose prefabricated or chain renovation lowering global cost of work. (see FR#8)

-Better communication on financial aids available at local level (see best practice inserted in FR#3)

Example: Mur-Mur thermal insulation campaign in Grenoble

The target of the Mur-Mur campaign is the insulation of collective dwellings built between 1945 and 1975. These latter are the most "energy intensive" buildings and represent a burden on household’s expenses. This initiative was launched in the frame of two important long term strategic plans (environment and urbanism) set by the Grenoble city region.

To be eligible to grants, the thermal solutions must be chosen from three packages:

- Complete renovation: insulation of facades and gables, roofs and floors below.
- Exemplary renovation: complete renovation + replacing windows and ventilation treatment.
- Gradual renovation: insulation of facades and gables.

Exceptional financial assistance can be obtained by the Grenoble city region. Technical and administrative support is also provided by the campaign. The interested condominiums will be accompanied (free of charge) throughout the process by professionals. And will benefit from independent and personal advice financial simulations, the mobilization decision-making of the joint owners' initiatives, the constitution of the individual administrative records, technical assistance and consumption monitoring after completion of work.

#FR8 – Quality of action

Facilitate the continuous improvement of building professional skills and initiate the market of bundle renovation

For the construction or new dwellings, the process is now quasi industrial, thus the network is existing and works well. Professional are highly qualified and aware of latest technologies, etc. Concerning the existing stock, the supply is very diverse and the renovation intervention process is most of the time tailored according to configuration of each building.

Many policy instruments target these professionals:

-In France, consumers are eligible to many incentives under the condition that renovations are done by certified craftsmen (RGE national label);

-Several national programs/platforms are dedicated to train building professionals;

-But most of the time, the training sessions are based on theoretical studies and do not take focus on operational renovation/construction.

Recommendations

-Reinforce and secure the findings dedicated to trainings programs (improve information and communication according to thermal regulation updates and evolution of public financing programs)

-Implement training based on concrete case studies;

- Exchange feedbacks (good and bad practices) in existing platforms concerning the implementation of a new technologies/material or installation to avoid (or promote) at the maximum bad (or excellent) installation or usage;

-Favor the emergence of bundle supply of renovation to be in line with the building energy market:

- On the supply side: gathering several craftsmen
- On the demand side: Make possible the economic interest of grouping renovation works of several dwellings located in the same neighbourhood on the demand side. (see #7) with a unique contact to put in relation this bundle of demand and supply (see FR#7).

Example: The RGE qulity label- certification scheme for building professionals

RGE states for "Reconnu Garant de l'Environnement" is recognized as a guarantee for the environment. It is a set of quality labels for professionals.

The RGE (voluntary) scheme addresses several types of professionals:

- Installation of renewable energy equipments
- Energy efficiency works (new buildings / renovation)
- Studies, consulting, ..., related to EE.

The training program includes some module on the existing financing programs to which consumers can be eligible for; and other modules train the professional to the assessment of the global performance of the building (including identification of problems in other domains than their owns). The complete of RGE professional is accessible on line thanks to the PRIS one-stop-shop22.

Example: Thermorénov

Thermorénov is an association aiming at regrouping renovation craftsmen, and propose lead contractors for single-family house renovation works in France. Several single-family owners from the same neighborhood can pool to make thermal renovation works and send their request to a unique point, such as the Thermorenov.

Through a unique contact person and a global offer, the prices are lowered and the procedures are simplified. The renovation works are supervised by a unique contact person who is responsible for: the authorization procedures, the support on funding, financial aid and tax, the technical and energetic state-of-the-art, an objective offer which defines the priorities, the coordination and the management of the works23.

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[22] http://www.renovation-info-service.gouv.fr/

[23] http://www.renovationdemaison.net/

#FR9 – Quality of action

Change the approach to "massify" thermal renovations

Existing measures targeting buildings are "too" concentrated on the energy performance of the buildings. Although a significant amount of these renovations is embedded thanks large renovation projects (**i.e. thermal renovation embodied during an aesthetical improvement in the building**).

Besides French stakeholders are expecting a slow-down of renovation activities:

- the first wave of renovation was largely made of household's sensitive to issues related to environment
- How to incentive the other dwellings less sensitive or even reluctant?
- How to invest in renovation when its cost represents a significant share of the value of the building?
- Renovation in condominium is very difficult to implement.

Recommendations

-The renovation in existing buildings should not be limited to thermal actions (i.e. only energy criteria) to better correspond to the demand and propose a bundle of action including for instance energy savings + increase of comfort +home support, etc.

-Reinforce and secure existing financing programs (TVA5.5, CITE, ECO PTZ, CEE, etc) as well as the Habiter Mieux program that depends on energy tax revenue.

-Multiply the experience of pre-financing fund ("caisse de préfinancement") on thermal renovation to accelerate et facilitate actions ➔ a third party (facilitator-see FR#8) should come with households during the whole duration of the renovation process (from the audit to the upgrade)

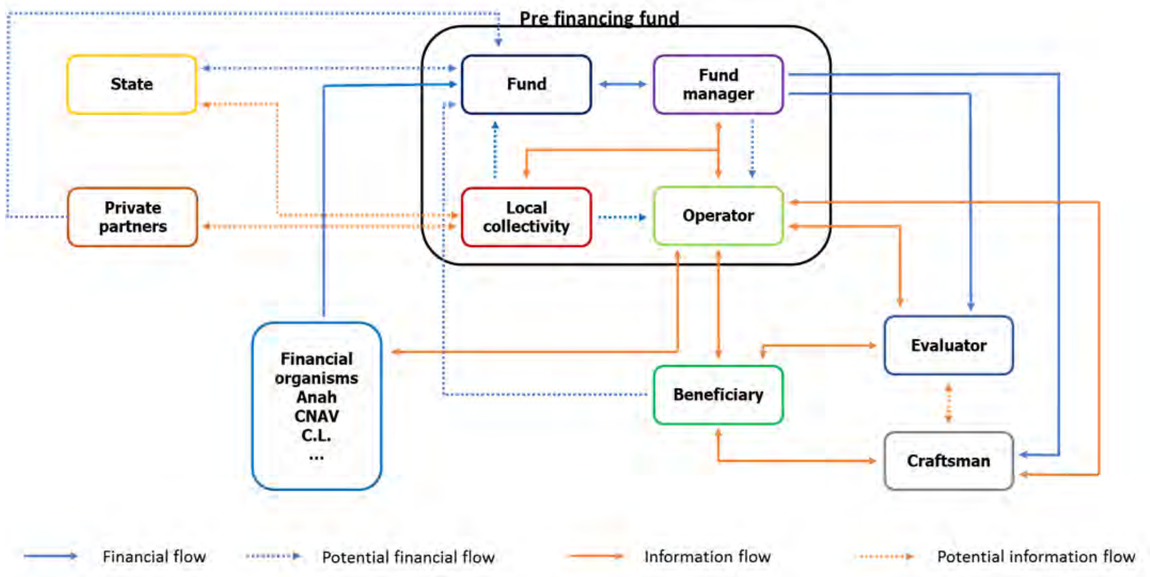
-Incentivize and facilitate the development of bundle renovation (seeFR#8)

Example: Caisse de Pré-financement

Because of several market barriers (e.g. too many financing programs conditioned to very diverse eligible criteria, split-incentive dilemma, non-cost-optimality of renovation work, etc), the main advantage of the pre-financing scheme (Caisse de Pré-financement) relies on the aggregation of demand by a sole certified operator. This aggregator will look for the existing financing tools, and according to the landlord's willingness he will propose a plan to finance the renovation and provide him this information in one single time. This simplification process can encourage the landlord to start renovation and facilitate the launch of work and secure the financing of operation.

In a massification logic of renovation activities, the « caisse d'avance » is not only a tool to easy (and secure financing) the initiation of work to owners (or people), but also a way to meet unexpressed or not identifiable demand. The following scheme describes the pre-financing programs proposed by CAPEN and targeting elder peoples.

Example of pre-financing program targeting the elder population



Source : CAPEB

4. GERMANY

4.1 BUILDING PERFORMANCE MARKET DATA

4.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for the EU countries. Germany has relatively low renewal rate with 0.56% compared to other EU countries in 2014. Germany has the fifth lowest renewal rate of the ZEBRA countries compared to 1.15%/year in Belgium. On the other hand, the annual rate of new buildings shows an increasing trend as the annual new construction of dwellings rose from 141.000 units in 2010 to 216.000 in 2014. The majority of new dwellings in Germany are realised in multi-family dwellings.

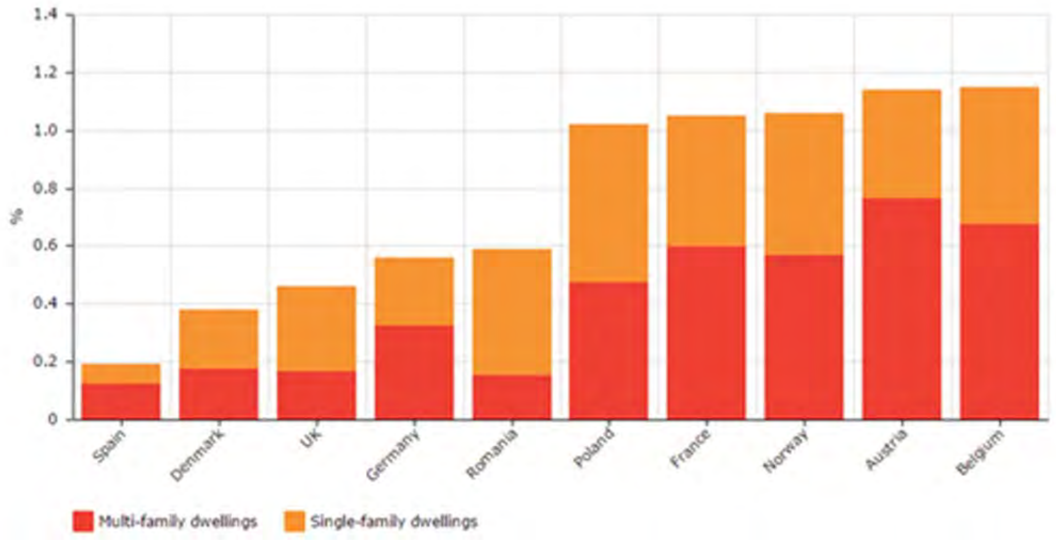


Figure 30 Share of new multi- and single-family dwellings in residential stock in 2014

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2, "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 proposes a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings
2. nZEB buildings according to national definitions
3. Buildings with an energy performance better than the national requirements in 2012
4. Buildings constructed/renovated according to national minimum requirements in 2012

The radar graph levels used for Germany are shown in the table below and defined as such in the database. EnEV stands for the Energy Saving Ordinance for Germany. The governmentally owned bank for reconstruction and development (KfW) supports the construction of buildings more ambitious than the German building code with different funding schemes according to different energy performance standards. In annual reports the amount of funding in the respective classes is published. However, not every new building will be funded by the KfW. Based on interviews with experts from the banking and the construction sectors the share of constructions funded without KfW support has been estimated. This allows to extrapolate the total constructions per performance class. This approach does not allow an estimation on constructions better than nZEB since there is no KfW supporting scheme on this.

Translating the definition of nZEB radar in the case of Germany gives:

1-Better than nZEB (net ZEB or positive house)	Zero Energy Building or Energy Plus House
2-National official nZEB definition	The nZEB standard is not defined officially, yet. Tendency: KfW Effizienzhaus 55, therefore containing the following standards: Passive house, KfW Effizienzhaus 40, KfW Effizienzhaus 55 (EnEV 2009):
3-Better than current building code	KfW Effizienzhaus 70 (EnEV 2009)*
4-According to building code	EnEV 2009*

*As of January 2016, tighter restrictions regarding the energy performance of new constructed residential buildings came into force. The new standard is equivalent to the KfW Effizienzhaus 70 level.

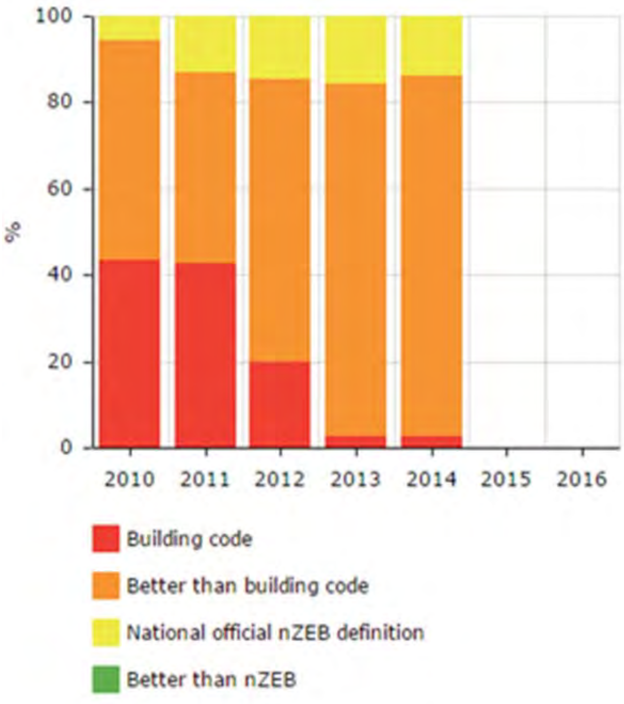


Figure 31 Distribution of new dwellings according to the nZEB radar graph – Germany

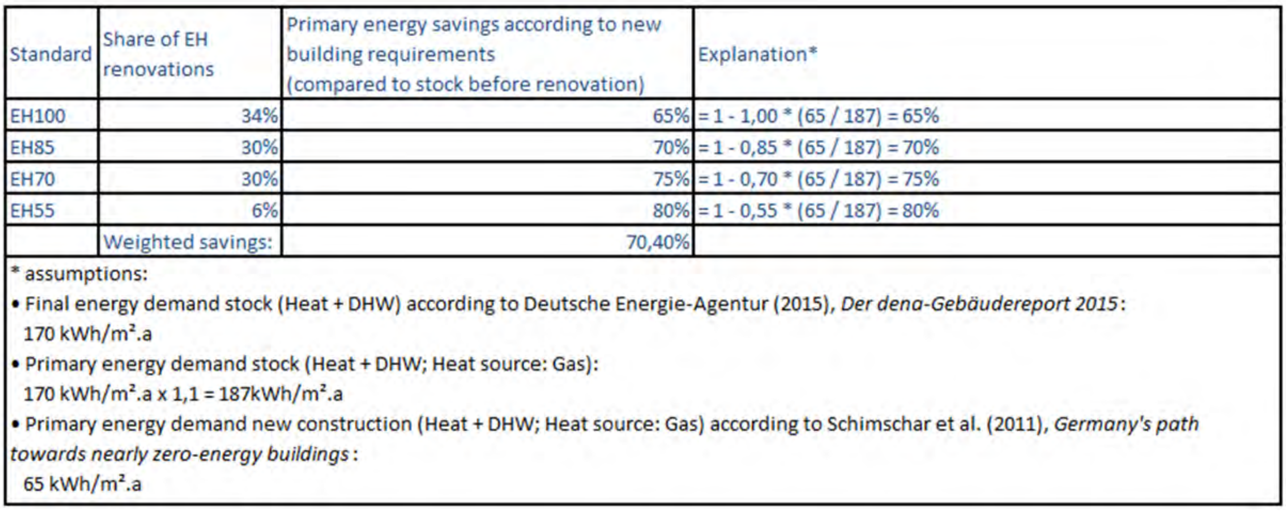
Source: ZEBRA

Because of the lack of an official European definition, to ease comparisons, the EU ZEBRA2020 project developed the indicator of "major renovation equivalent". In ZEBRA, three renovation levels have been defined: "low", "medium" and "deep". However, these 3 levels' definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

The German building code (EnEV) does not explicitly define what a major renovation is but it defines the trigger moment for energy related minimum requirements. When 10% of the area of one building component is changed or replaced, minimum U-values or a maximum allowed primary energy demand for the building applies (40% less ambitious than those for a new building). In addition, the EEWärmeG defines a major renovation as "any measure within a period not exceeding two years, by which a building has:
a) its boiler replaced or the heating system switched to another fossil fuel and;
b) over 20% of its envelope is renovated".

- We estimate that, in Germany, medium renovations achieve this major renovation level in terms of energy demand. Therefore the specific major renovation equivalent for the respective share of renovations is 1, resulting in ~51% energy savings .
-> Measures: Applying façade insulation (u-value 0,2), exchange windows (u-value 1,0) and installing a new boiler

- According to the definition of deep renovations used in the ZEBRA project, a deep renovation corresponds to energy savings between 60 and 90%. in Germany 65% savings, compared to an average building in the stock can be achieved with a KfW standard EH 100, 80% approximately with KfW EH 55. Average savings of 70% could already be achieved with a KfW EH 85, therefore we assume this standard as representative for deep renovations in Germany in terms of costs. As however the number of different renovated efficiency house standards varies and the KfW 70 and 55 standards have a larger share in renovations than EH 100, we assume that energy savings achieved by deep renovations are assumed to be slightly higher as those of EH 85 (meaning 70%). Based on the number of reported subsidised KfW EH renovations we weigh the saving effect as following:



Standard	Share of EH renovations	Primary energy savings according to new building requirements (compared to stock before renovation)	Explanation*
EH100	34%	65%	= 1 - 1,00 * (65 / 187) = 65%
EH85	30%	70%	= 1 - 0,85 * (65 / 187) = 70%
EH70	30%	75%	= 1 - 0,70 * (65 / 187) = 75%
EH55	6%	80%	= 1 - 0,55 * (65 / 187) = 80%
	Weighted savings:	70,40%	

* assumptions:
- Final energy demand stock (Heat + DHW) according to Deutsche Energie-Agentur (2015), *Der dena-Gebäudereport 2015*: 170 kWh/m².a
- Primary energy demand stock (Heat + DHW; Heat source: Gas): 170 kWh/m².a x 1,1 = 187kWh/m².a
- Primary energy demand new construction (Heat + DHW; Heat source: Gas) according to Schimschar et al. (2011), *Germany's path towards nearly zero-energy buildings*: 65 kWh/m².a

We therefore assume that deep renovations achieve energy demand reductions of ~70 % compared to a not renovated building.

Based on this assumption we calculated a specific major renovation equivalent for deep renovations of 1.37 % (70% / 51 % = 1.37 %)

The specific major renovation equivalents for low, medium and deep renovations have then been multiplied with the respective renovation rates. Hence, for 2014, we calculated a major renovation equivalent of 1.49 % for Germany.

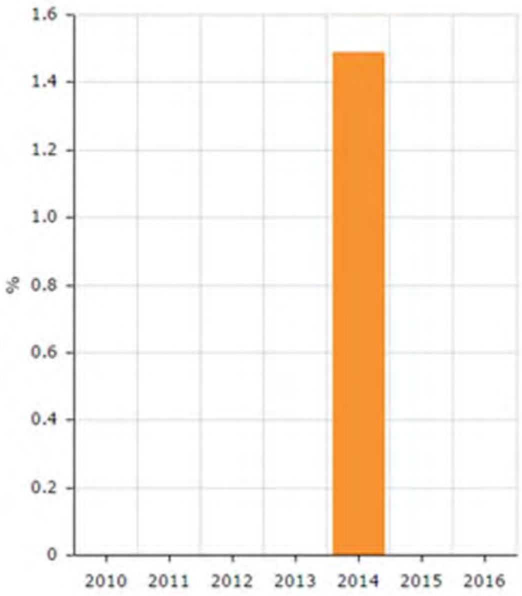


Figure 32 Equivalent major renovation rate – Germany

Source: ZEBRA

4.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Germany, it has been collected data of 31 nZEBs or high energy efficient buildings which were constructed recently. 24 out of the 31 are new buildings and 7 are renovated buildings. 15 have a residential use and 16 are intended for non-residential use.

Climate zones

As table 6 indicates, the 24 buildings are located in the climate zone B, which is characterized by cold winters and mild summers and 7 buildings are located in climate zone D with temperate winters and mild summers.

Table 6 Building distribution by climate zones – Germany

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	19	5
C	Warm winters and warm summers		
D	Temperate winters and mild summers	5	2
E	Temperate winters and warm summers		

Heating Demand

The average heating demand for new buildings is 12,7 kWh/m² a, while in renovated buildings it is 15,3 kW/m² a.

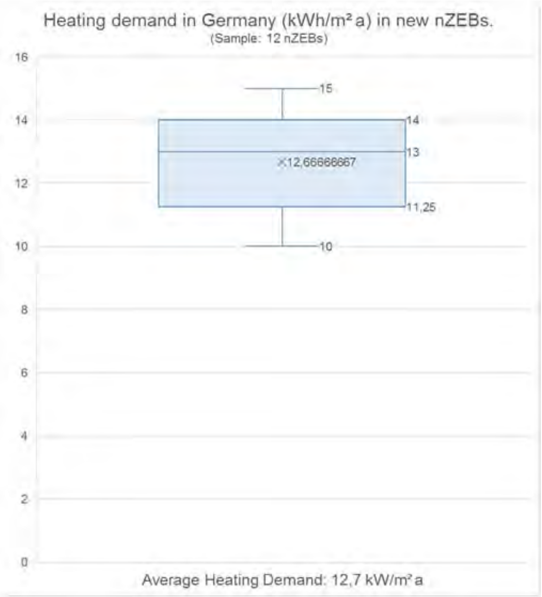


Figure 33 Box plot of heating demand in new nZEBs - Germany

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,15 and 0,12 in roofs, while in renovated buildings the average U-value in walls is 0,35 and 0,12 in roofs. Nevertheless, one of the selected renovated building has a relatively high U-value (1,4) in walls, which increases the average value in renovated buildings.

Expanded polystyrene is the most used insulating material in new buildings in both walls (42%) and roofs (33%). In renovated buildings, expanded polystyrene is also the most used insulation material in walls (43%), while stone wool is the preferred option in roofs with a percentage of 43%.

In windows, the average Uwin-value is 0,9 in both new and renovated buildings. The preferred type of glass is mainly triple glass with a share of 58% in new buildings and 86% in renovated buildings.

Concerning passive cooling strategies, almost all of the buildings do not use any strategy. Only in one new building it was indicated the use of sunshade as a passive cooling strategy.

Active solutions

Mechanical ventilation with heat recovery is the preferred option in both new (79%) and renovated (57%) buildings.

Heat pumps with a percentage of 38% is the most common heating systems in new buildings, as well as in renovated buildings with a share of 29%. Gas is the most used energy carrier for new buildings (25%) and wood pellets (29%) in renovated buildings.

Dedicated generation system and partially depending on solar thermal collectors and integration with the heating system (38% each) are the most common options for DHW in new buildings. While a dedicated generation system with a percentage of 43% is the most common option for DHW in renovated buildings.

Only in 4 new buildings it is reported the use of cooling system, which is mainly heat pump systems.

Renewable energies

In 11 out of the 24 new buildings, it is mentioned the use photovoltaic systems and in 9 the use of solar thermal systems.

In 3 renovated buildings it is indicated the use of photovoltaic systems and in 3 the use of solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Germany reports and realised projects.

Table 7 Costs of different renovation depths and new built according to nZEB standards - Germany

Costs (€/m2)	DE
Minor renovation (15% energy savings)	149
Moderate renovation (45% energy savings)	258
Deep renovation (75% energy savings)	456
NZEB renovation (95% energy savings)	860
New built according to nZEB standards	1601
Additional funds for nZEB construction compared to new built	169

4.2 EPCS AND REAL ESTATE AGENTS

4.2.1 REAL ESTATE AGENTS SURVEY

1. The dominant form of EPC indicated by almost all real estate agents in Germany is mandatory certification.

2. In opinion of real estate agents from Germany, the main factors taken into account whilst selecting, purchasing or leasing real estate are mainly the location, various "nuisance" e.g.: a busy road, landing airplanes, landfill, a high-voltage line, price and the size of the real estate.

The cost of energy is indicated as very important factor by 7% and as important by 57% of real estate agents in Germany.

3. The EPCs in Germany are very frequently required in concluding the purchase/lease contracts.

4. The real estate agents in Germany are in general not satisfied with reliability of the data provided by the EPC.

5. Usefulness of EPCs in the professional activity of real estate agents in Germany is evaluated by them very negatively. Only near 13% of the respondents indicates the usefulness of the certificate in their professional work.

6. The real estate agents in Germany observe connection between the EPC and the improvement of the energy performance of buildings.

7. Usually, real estate agents in Germany confirm correlation between the high energy performance and high value of real estate.

8. Majority of real estate agents in Germany rather don`t observe that higher energy performance of buildings cause the growing interest in its purchase / lease in comparison to other buildings.

9. In opinion of real estate agents in Germany, the influence of having the higher EPC class on the exposure time of the real estate is very low.

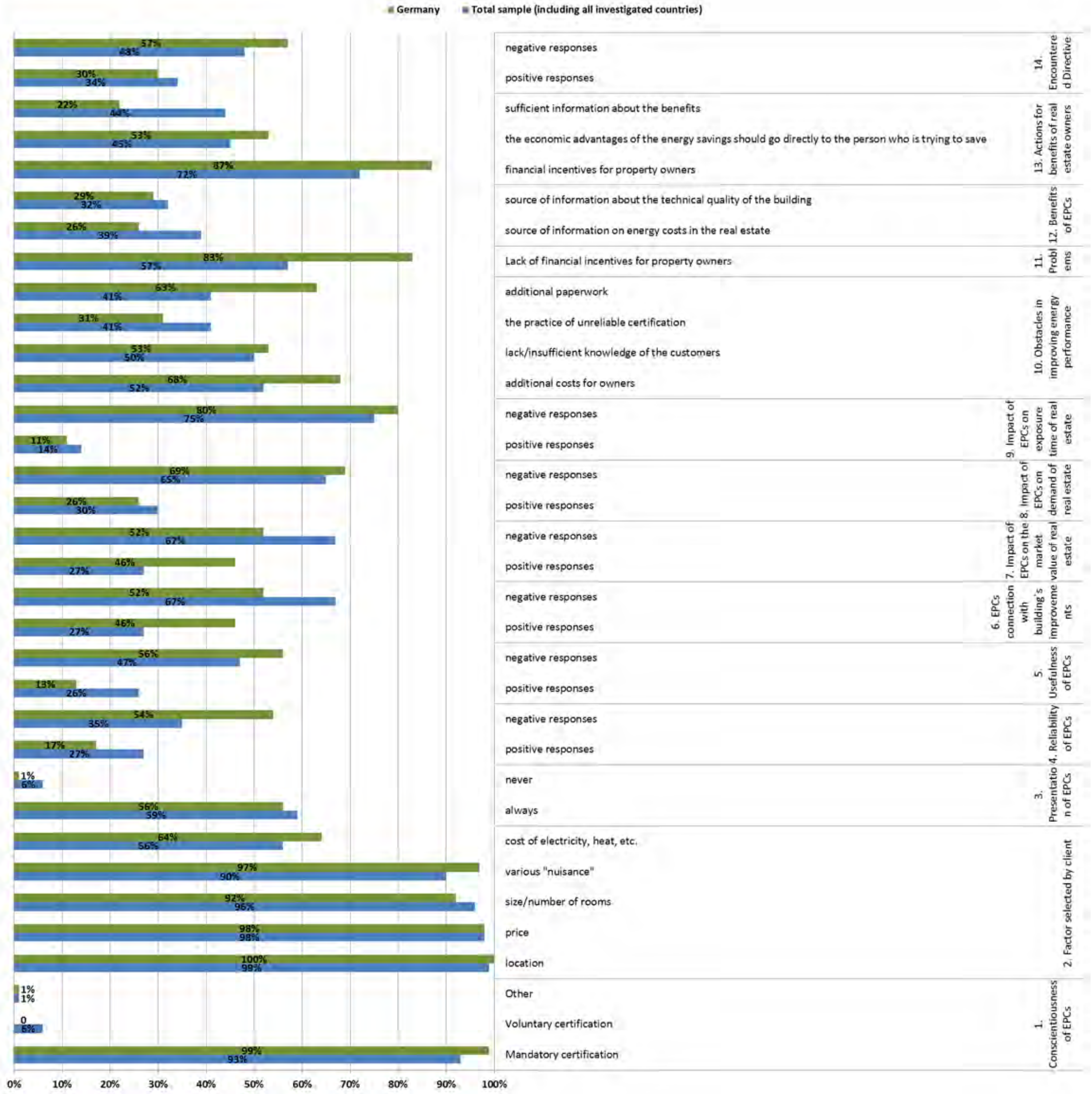
10. The main obstacles in improving the energy performance of buildings were indicated by real estate agents in Germany to be the following: financial matters (additional costs for owners), additional bureaucracy, low social awareness in this subject and the practice of issuing unreliable certificates.

11. Among the problems of implementing the improvement of the energy performance of buildings, the following has been mainly indicated by the real estate agents in Germany: the financial aspect, no incentive for the real estate owners.

12. The EPC as the source of information concerning the energy costs and technical condition of the building is not indicated by the real estate agents in Germany as very important benefit of having EPC.

13. The most expected support that would influence the improvement of the energy performance of buildings, according to the respondents from Germany, is financial activity. Economic support directed to real estate owners and economic incentives for those that undertake such actions and sufficient information about the benefits.

14. The level of awareness and information about wording, requirements and settlements of the 2002/91/EC or 2010/31/EU Directive among the real estate agents in Germany is on average.


Germany
Total sample (including all investigated countries)
14. Encountered Directive
negative responses 57% 48%
positive responses 30% 34%
13. Actions for benefits of real estate owners
sufficient information about the benefits 22% 44%
the economic advantages of the energy savings should go directly to the person who is trying to save 53% 45%
financial incentives for property owners 87% 72%
12. Benefits of EPCs
source of information about the technical quality of the building 29% 32%
source of information on energy costs in the real estate 26% 39%
11. Problems
Lack of financial incentives for property owners 83% 57%
10. Obstacles in improving energy performance
additional paperwork 63% 41%
the practice of unreliable certification 31% 41%
lack/insufficient knowledge of the customers 53% 50%
additional costs for owners 68% 52%
9. Impact of EPCs on exposure time of real estate
negative responses 80% 75%
positive responses 11% 14%
8. Impact of EPCs on demand of real estate
negative responses 69% 65%
positive responses 26% 30%
7. Impact of EPCs on the market value of real estate
negative responses 52% 67%
positive responses 46% 27%
6. EPCs connection with building's improvements
negative responses 52% 67%
positive responses 46% 27%
5. Usefulness of EPCs
negative responses 56% 47%
positive responses 13% 26%
4. Reliability of EPCs
negative responses 54% 35%
positive responses 17% 27%
3. Presentation of EPCs
never 1% 6%
always 56% 59%
2. Factor selected by client
cost of electricity, heat, etc. 64% 56%
various "nuisance" 97% 90%
size/number of rooms 92% 96%
price 98% 98%
location 100% 99%
1. Conscientiousness of EPCs
Other 1% 1%
Voluntary certification 0 6%
Mandatory certification 99% 93%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4.2.2 REAL ESTATE PRICES AND EPCS

The transposition of the EPBD in Germany took the form of an amendment to the existing Energy Saving Ordinance. A key change in EPC policy for non-residential buildings was the transition from a continuous number scale to a letter-rating system (BPIE 2016). Although EPC policy is controlled and implemented at the state-level, it is formulated nationally and hence it can be assumed that the EPC rating that a given dwelling receives is largely independent of the state in which it is located.

The dataset for Germany is unusual in comparison to the other datasets as it is possible to distinguish between the EPC entries that were implemented before and after the 2014 amendment that accounted for the 2010 EPBD recast. This is because of the transition from a number- to a letter-based rating system. By contrast, all of the other countries assessed in this report maintained the same rating scale before and after the implementation of the 2010 EPBD recast.

This feature of the German dataset enables a comparison between the new and old systems. However, it is necessary to limit this exercise is limited to a comparison of general trends rather than a comparison of numerical surpluses. This is because the new legislation for the energy efficiency requirements for buildings in 2014 resulted in a stricter scale, with H-rated buildings in the new regime relating to the entire lower half of the scale in the pre-2014 legislation. Figure 3 demonstrates how the primary- and end-energy of the same building are rated differently according to the different scales.

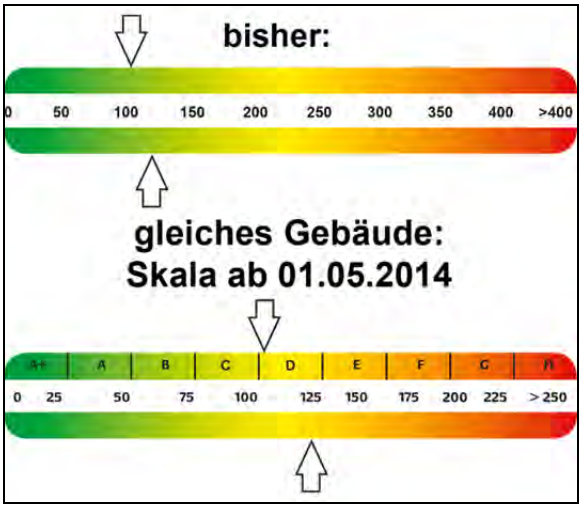


*Figure 34 A comparison between the EPC scales in Germany in the pre-2014 legislation (above) and the post-2014 legislation (below). 'Gleiches Gebäude' indicates the fact that the arrows for each scale relate to the ratings of the same buildings. The arrow above each scale indicates final energy demand (kWh/m^2*a) and the arrow below indicates primary energy demand (kWh/m^2*a) (Thermomess Wärmemessdienst AG 2014).*

A statistically significant price surplus due to EPC rating is observed for the pre-2014 number-rated data. A price surplus is also observed due to the letter-based EPC ratings in the sales market for all statistically significant, adjacent letter shifts, with the exception of the shift between B- and A-rated dwellings, where a deficit is observed. The low adjusted R2 value (just above 0.11) suggests that it is highly likely that the explanation is connected to an omitted variable bias. More data covering a wider number of explanatory variables would be necessary to further explore this potential explanation.

The results for the section of the rental dataset with number-rated EPCs demonstrate a statistically significant deficit due to EPC rating, which directly contradicts this studies' hypothesis. By contrast, the rental results for letter-rated EPCs display the expected price surplus for shifts in letter ratings above the D hold-out category. The linear model was applied for the post-2014 EPC system with a surplus of 7.9% in the sales market and 4.4% in the rental market.

4.3 EXISTING POLICIES

The German nZEB standard is intended to be implemented with the amendment of the Energy Saving Ordinance (EnEV) in 2016. However, there are several public funding schemes that already promote investments in energy efficient buildings, with the KfW efficiency house schemes being the most prominent one.

The building sector and energy targets

Even before the Directive was adopted, Germany had a wide range of instruments for increasing energy efficiency and is one of the few countries to have managed a visible decoupling of energy consumption and economic growth.

The increase in energy efficiency, with the associated energy savings, is a key pillar of the "energy transition" (Energiewende) in Germany. In its communication of 11 June 2013, the German Government informed the European Commission of its indicative national energy efficiency target (EED, Article 3), referring also to the significant additional contribution towards the achievement of the European energy efficiency target being made by Germany in implementing the energy concept:

- Reducing primary energy consumption by 20% by 2020 and 50% by 2050 compared to 2008 Greenhouse gas emissions are to be cut by the following rates (compared to 1990 levels): 40% by 2020, 55% by 2030; 70% by 2040 and 80-95% by 2050.

National Renovation Strategy

The German government aims to increase the renovation rate. Germany expects the majority of savings until 2020 to be achieved through the Energy Saving Ordinance and the various KfW financial support schemes.

Germany has been working towards the goal of increasing energy efficiency in buildings focusing on the voluntary nature and cost-efficiency of measures and on a balanced mix of instruments according to the formula "demand, incentivise and inform - strengthen market forces". Some of these instruments that are suggested in the renovation strategy are:

- EnEV: majority of savings to 2020 to be achieved through the Energy Saving Ordinance (EnEV) and the various KfW financial support schemes.
- EEWärmeG: requires that a proportion of the heating and cooling demand in new builds as well as in existing public non-residential buildings undergoing deep renovation needs to be covered by renewable energy

- Tenancy law: provides for effective incentives for energy modernisation of the rental housing stock.
- Funding: The goals of the energy concept require deep changes to the building stock and its energy supply in a relatively short space of time compared to the long renovation cycles.
- Affordable housing: Affordable but nonetheless high-quality housing must be provided for households on low income too.
- Tax relief on renovation work: Owner-occupiers can claim tax relief for services provided by builders and craftsmen as long as they are not claiming public subsidies for this work
- Information - advice, planning and construction: Information and advice must be provided in order to drastically raise the level of acceptance of energy saving measures and also to enable planners, investors and companies implementing the measures to initiate renovation work and structural changes at the required level of quality

Energy performance requirements

In Germany the maximum permissible primary energy demand according to EnEV for heating, hot water, ventilation and air-conditioning is determined using a reference building approach under reference conditions. Regarding the energy performance requirements for renovations, in Germany:

- There are component requirements for all types of energy-related renovations (minimum U-values in case of renovation).
- In case of major renovations (definition according to EPBD) minimum U-value requirements apply and in addition total primary energy requirements for the whole building based on a reference building.

Compliance

Compliance with energy-related requirements is controlled through:

- Energy Performance Certificates
- Inspection by experts and chimney sweeps:

In case there are structural changes of existing buildings that require compliance with the EnEV, the client must confirm compliance with the requirements by a thermal protection expert.

- Air conditioning (AC) and ventilation systems:

Operators of installed air conditioning systems in the building with a cooling capacity of more than 12 kilowatts must have energy inspections of these systems performed by authorised persons.

Building authorities which are organised on regional level can request all details of the respective measures as a random sample and information is then checked for plausibility. Compliance check can be done in each stage as a random sample (within 5 years) and violations of the EnEV can be punished by the authorities as a misdemeanour and punished accordingly.

The nZEB plan

All requirements for energy performance of buildings refer to the EnEG and EnEV. The EnEG contains different permissions for the German government for issuing necessary ordinances in order to transpose European directives, etc. Thus, the EnEG is also the basis for the Energy Saving Ordinance—the EnEV.

The specific definition of the nearly zero-energy building standard is under development by the Federal Government with scientific support and having regard to economic considerations. In this regard, the focus is on the "KfW efficiency houses" which are currently funded in Germany under the label of KfW Efficiency House 40, 55 and 70 (in the case of refurbishment, as KfW Efficiency House 55 and 70).

Energy consulting, communication and public relations by federal, state and other actors (e.g. BAFA, dena, etc.):

- Pilot projects "Existing nearly zero-energy buildings"
- Pilot projects "Roadmap to the Energy Efficiency Plus Building"
- Efficiency Building Plus with electro-mobility
- Pilot projects "Construction of new non-residential buildings as part of the municipal and social infrastructure"
- Pilot project "Zero-energy building for the Federal Environmental Agency (Umweltbundesamt) in Berlin-Marienfelde"

Renewable sources in the building sector

The EEWärmeG affects new buildings with a useful floor area of more than 50m2 and which require heating or cooling. The requirements are clearly defined for each type of renewable energy source (technology). These have to cover a certain share of the total energy demand for heating and cooling and are defined as follows:

- Solar energy: 15%
- Gaseous biomass: 30%
- Liquid/solid biomass: 50%
- Geothermal energy and ambient heat: 50%

4.4 NZEB-TRACKER

This section highlights the key findings from the nZEB tracker for Germany in 2014.

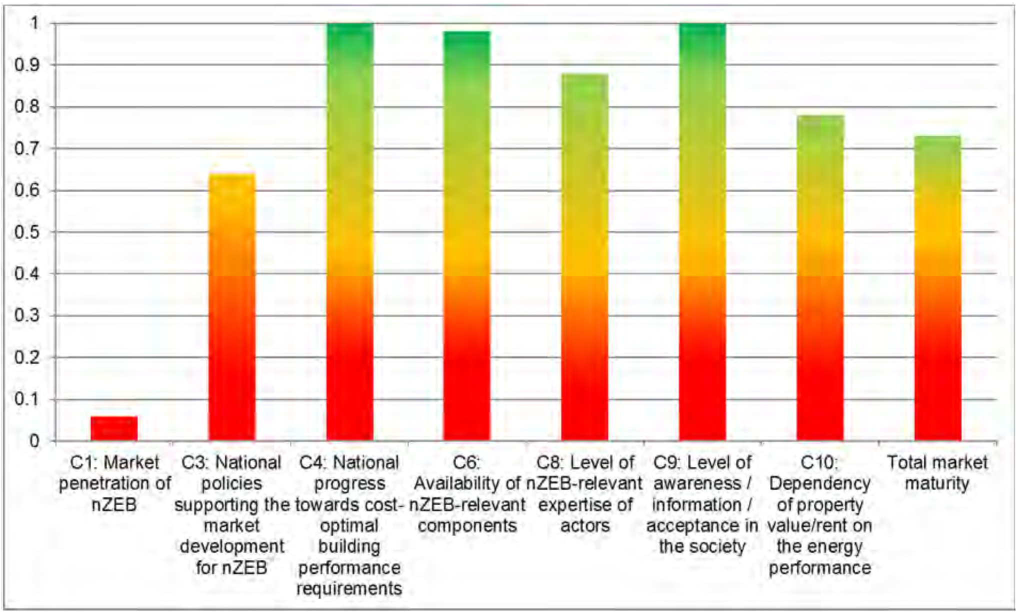


Figure 35 nZEB-tracker score for Germany in 2014

C1: Market penetration of nZEB

- German result: **0.06** ZEBRA average: **0.32**
- nZEB had a share of only ~6 % on new constructed floor area in Germany
- The share has been stable over the past years

C3: National policies supporting the market development for nZEB

- German result: **0.64** ZEBRA average: **0.52**
- Policies in Germany seemed to be sufficient to support the development of the market for residential and non-residential nZEB in 2014.
- Need for adaptations may result from the final definition of the nZEB standard in Germany that is expected in early 2017.

C4: National progress towards cost-optimal building performance requirements

- German result: **1.00** ZEBRA average: **0.94**
- The German building code (EnEV 2014) already matched the cost optimal building energy performance level.

C6: Availability of nZEB-relevant components

- German result: **0.91** ZEBRA average: **0.83**
- Energy efficient heating systems and other building components for nZEB were well or very well available in Germany.
- Building automation and control system seemed to be available only moderately.

C8: Level of nZEB-relevant expertise of actors

- German result: **0.56** ZEBRA average: **0.63**
- There were different pictures regarding the availability of experts for the three phases.
- Whereas the availability of experts for planning was assessed sufficient and for examination/certification even good, the interviewees agree that there was a lack of expertise for the construction phase.

C9: Level of awareness / information / acceptance in the society

- German result: **1.00** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings increased steadily.

C10: Dependency of property value/rent on the energy performance

- German result: **0.78** ZEBRA average: **0.74**
- Compared to site, living quality, aesthetics and financial aspects, the energy performance was the least important aspect for customers' decision on renting/buying a real estate.

Resulting Maturity of the German nZEB market in 2014

- German result: **0.66** ZEBRA average: **0.66**
- The nZEB market seemed to be slightly better developed than the average of the ZEBRA countries. The political framework appeared sufficient in 2014, though the final definition of the nZEB standard is still pending.
- High performance building components were easily available.
- The availability of experts may limit the future development of the nZEB market.
- People became more and more aware of the energy performance of buildings. Still it had a minor priority on buy/rent decisions.

4.5 SCENARIOS

Market penetration of nZEB – new building construction

Figure 36 shows annual construction of conditioned floor area according to different standards. The results are shown for the historical development and in both policy scenarios, current and ambitious for the long term development from 2021 to 2050. For an explanation of the scenario framework of the current policy scenario and the ambitious policy scenario, see part "Introduction". Data on historical development of new building construction according to national standards were collected in the project, see part "Building performance market data" and are available on the project project´s data tool (http://www.zebra-monitoring.enerdata.eu/). The share of the new building construction according to the building code in 2012 was app. 20% of the total new building floor area. According to building code means that buildings are constructed according to national minimum requirements valid in 2012. The share of the new construction according to the assumed nZEB standard was 15% of the total new building floor area in 2012. From 2030 to 2050, the share of stringent measures expected to increase. In the ambitious scenario, the share of stringent measures is much higher due to the policy implication.

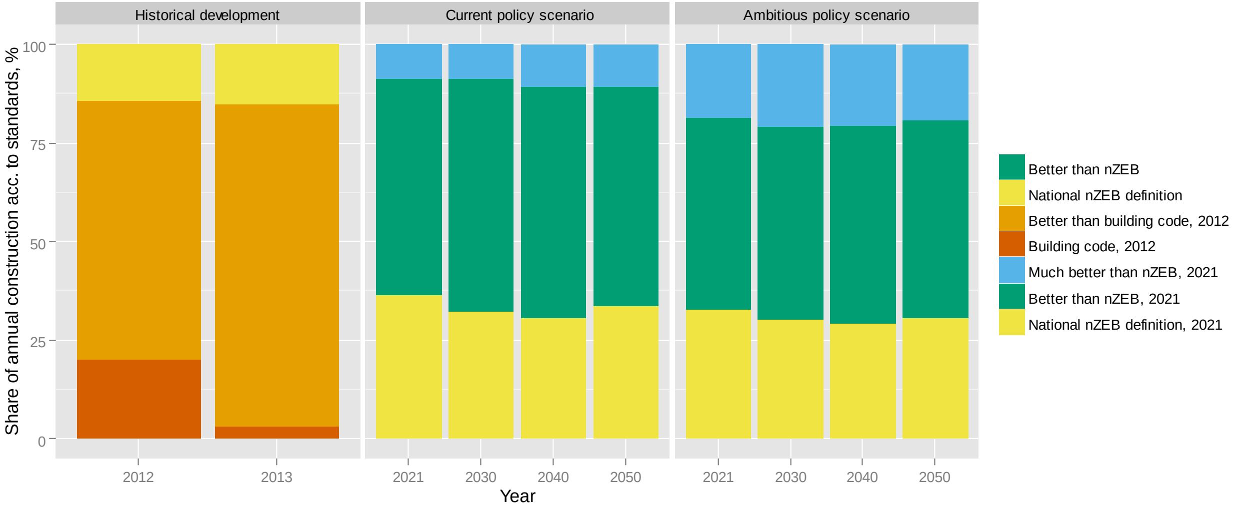


Figure 36 Share of annual construction of conditioned floor area built according to national standards

Building renovation activities

Figure 37 shows the historical and future development in current and ambitious policy scenarios for annual renovation of conditioned floor area by renovation levels.

The following renovation categories were defined in the current policy scenario:

- medium renovation which refers to the building code

- light renovation meaning that in reality not all buildings fulfil the criteria set in the building legislation and
- deep renovation reflecting the assumed nZEB definition

In the ambitious scenario, from 2021 to 2050, all buildings fulfil at least the building standards. There is an additional renovation level "deep plus" which means higher energy performance achievements.

In Germany, in the current policy scenario, the share of the medium and deep renovation makes up a significant share on the total renovated building floor area from 2021 to 2050. In the ambitious policy scenario, which implements stringent measures on existing buildings, the share of the deep and deep plus renovation is increased compared to the current policy scenario. In 2040 around 80% of the renovated building floor area will be renovated with a strong share of deep plus (25%) and deep renovation (55%), resulting in higher energy savings (Figure 41).

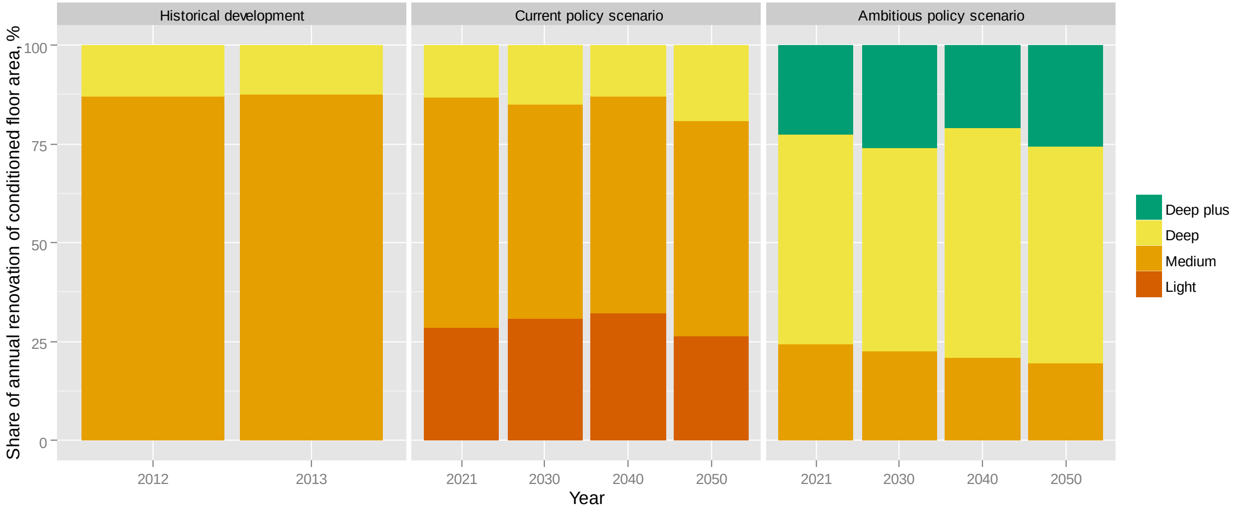


Figure 37Share of annual renovation of conditioned floor areas by renovation levels in current and ambitious policy scenarios

Figure 38 shows the distribution of the specific energy need for space heating (norm energy need calculation according to EN13790) in the total building stock after building renovation by using the following renovation levels, light, medium, deep and deep plus. The specific energy needs are shown in a box-plot diagram. The median (middle quartile) marks the mid-point of the data and is shown by the line that divides the box into two parts while the diamond indicates the mean value. The data is represented for 2012 for not renovated buildings, light, medium and deep renovation. The deep plus renovation shows spec. energy need for buildings being renovated after 2020. The specific energy need for space heating of light renovation is higher compared to the medium renovation, which means that in reality not all buildings fulfil the criteria set in the building legislation. Deep and deep plus renovation include i.e. the installation of mechanical ventilation.

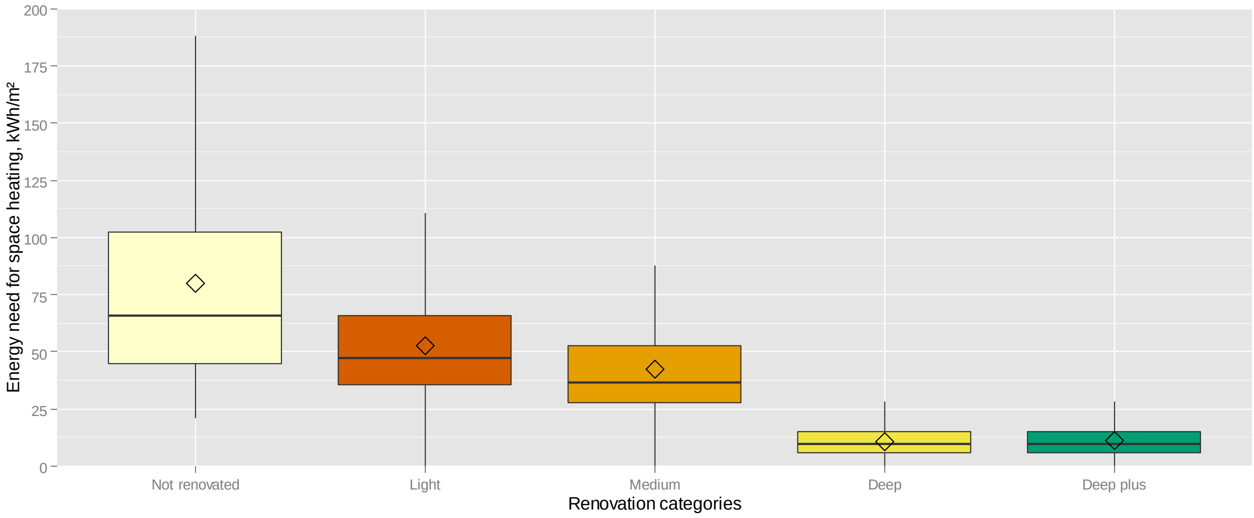


Figure 38 Distribution of the buildings specific energy need for space heating

Economic indicators and national policies supporting the market development for nZEB

Figure 39 shows total yearly investments in the building envelope (thermal renovation) and in renewable heating systems from 2012 to 2050 in the current and ambitious policy scenarios. The investments are slightly higher in the ambitious scenario due to higher number of the renovated buildings, higher quality of the implemented thermal renovation and higher investments in the renewable systems. Figure 40 shows total yearly public budget for financial support of renewable heating systems and renovation of the building envelope. The yearly public budgets are significantly higher in the ambitious policy scenario.

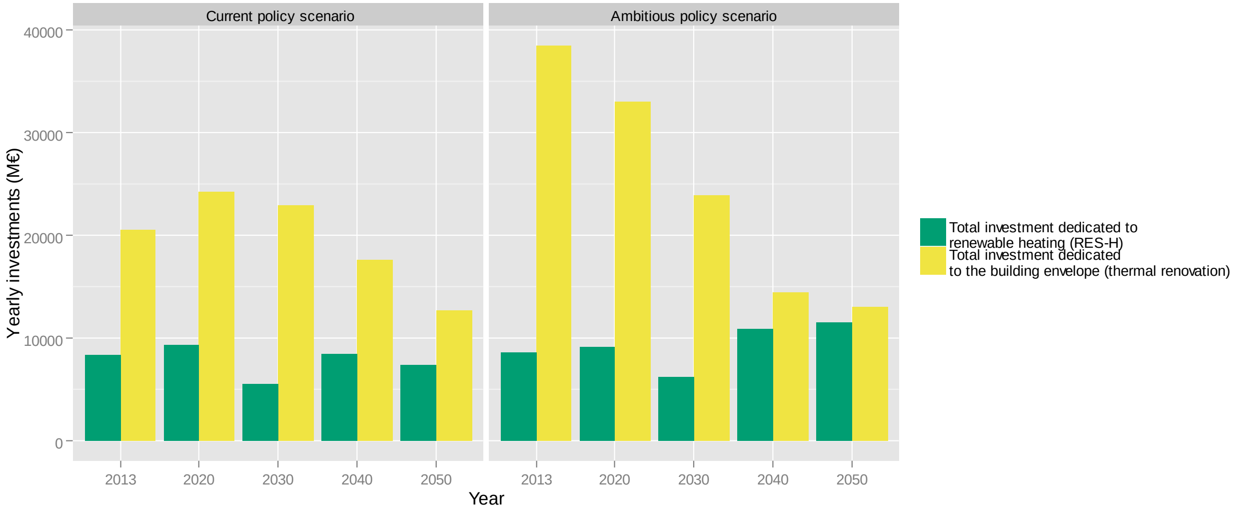


Figure 39Total yearly investments in renewable heating systems (RES-H) and renovation of the building envelope including public budget, 2013 to 2050, current policy and ambitious policy scenario

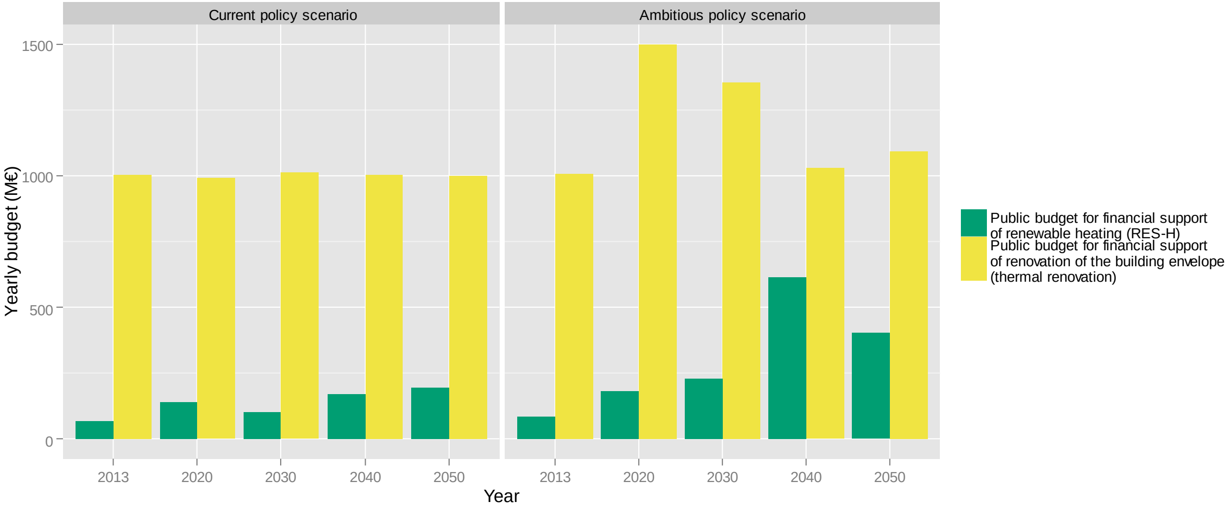


Figure 40Total yearly public budget for financial support of renewable heating systems (RES-H) and renovation of the building envelope, 2013 to 2050, current policy and ambitious policy scenario

Development of the building related energy demand

Figure 41 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Germany´s building stock is 739 TWh in 2012. The scenario shows a slow-down of the energy demand of 15% from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 41% in the current policy scenario in the long term development between 2012 and 2050 and by 52% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Germany, the share of fossil-fuel-based heating systems especially natural gas and oil is significant in 2012. The share of non-delivered energy (i.e. solar and ambient energy) is around 2% of final energy demand in 2012 to around 9% in current policy scenario and in ambitious policy scenario in 2050.

Figure 42 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 49% in current policy scenario and around 60% in ambitious policy scenario. The reduction of the primary energy demand is around 42% and 55% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) The overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

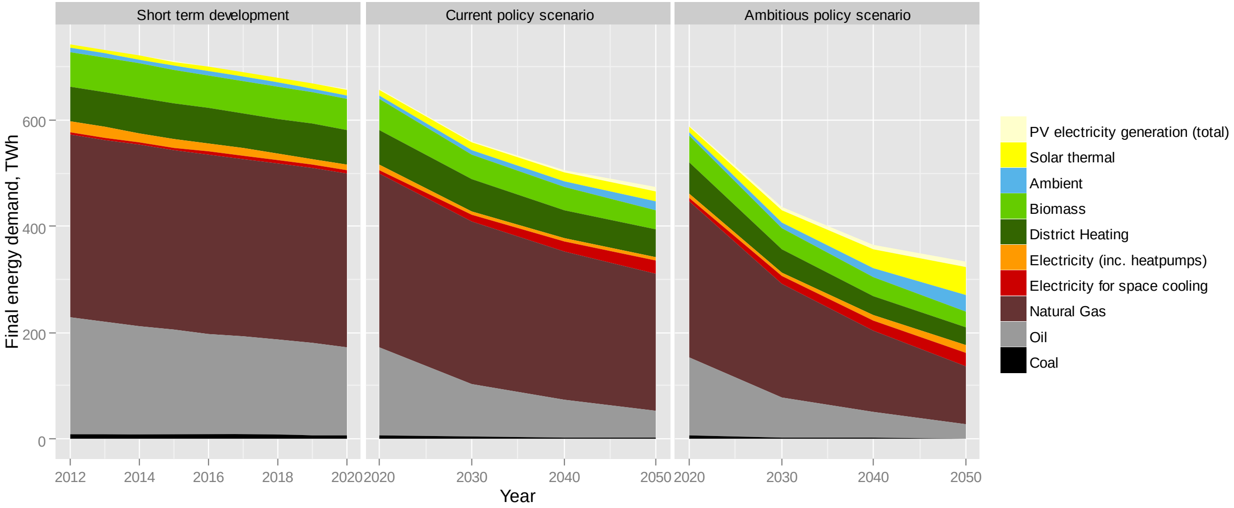


Figure 41Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

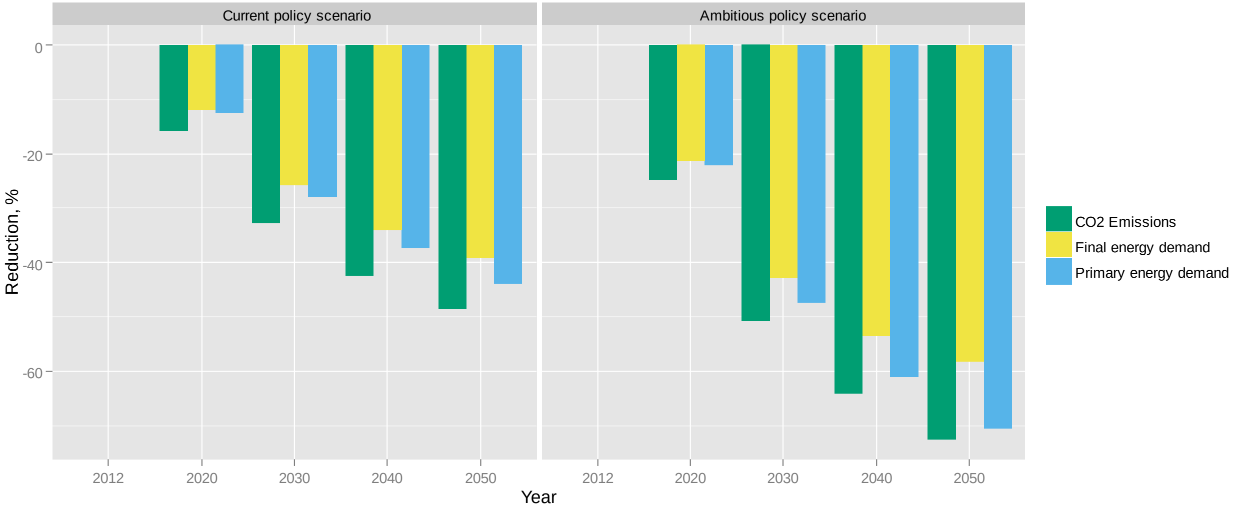


Figure 42Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

4.6 RECOMMENDATIONS

Germany is one of the member states that do not yet have an official definition for nZEB. The definition is under development with scientific support and with regard to economic considerations. It is expected to be part of the amendment of the EnEV in 2017.

So far, the federal government has an approach focusing on "require, support, inform and strengthen market forces" for the building sector. The main financial instruments to improve the energy performance level of buildings in Germany are low-interest loans and repayment bonuses for energy efficient refurbishments. Grants exist for both, new and existing buildings which achieve certain energy performance levels.

So far, two regulations exist in Germany, that specify energy-related requirements for buildings. The EnEV (energy saving ordinance) and the EEWärmeG (renewable energy heat law). Although these regulations are related to nZEB, they are neither harmonized nor directly aiming at nZEB. Harmonizing those regulations can make the development of nZEB easier, support policy processes and reduce barriers for the realization of nZEB.

Regarding financing instruments, the Federal Government has been supporting flexible tools to increase energy efficiency in new and existing buildings. The Federal funding scheme provides funding opportunities on various levels with an increasing amount of funding. This funding scheme is continuously advanced based on the development of the relevant regulatory requirements and technical specifications, with help of transferred results from research and pilot projects. Thus, investors are motivated to construct buildings with a more ambitious energy performance.

The country already started a well-established communication campaign, which aims to inform people on how to increase the energy efficiency not only of houses and appliances but also in behaviour, called "Deutschland Macht's Effizient". The campaign, which is funded by the Ministry of Economic Affairs and Energy and in cooperation with many initiatives in Germany, has a high visibility and provides information for energy efficiency measures with explanatory infographics, as well as support for possible questions. Accordingly, the following recommendations are stated in order to provide more improvement to what has been done so far in Germany.

Germany already provides several best practice examples regarding new business models and innovation. Especially related to the construction industry, there are Max Bögl and PreFair business models that provide good examples. The Max Bögl business model vertically integrates key actors and provides a broad product portfolio. In order to pursue a better communication during project execution, the approach is fostering a partnering approach bringing together all actors from the very beginning24. Similarly, the PreFair business model aims to improve collaborative work between all project partners. The model deploys the innovation potential from all project partners and follows a holistic approach24. Of course quite a number of further business models and innovations are practised in other member states and some of them could also be recommendable for Germany.

For overcoming obstacles related to the implementation of energy efficiency measures and thus reaching nZEB building standards, considering social issues incl. the affordability of deep renovation measures is an important factor. For this purpose, the already well established KfW support schemes could still further be improved to encourage a greater uptake among particular building types and building owner profiles.

Additionally, buildings which have a social function, such as schools and hospitals, should even more be able to receive proper support for deep renovations. In Germany, there is already a national programme that offers grants and lower interest rates for such retrofits and this could be further improved as a best practice.

The following pages will outline recommendations for the further development of policy instruments, based on 6 different categories: (A) Legislative and regulatory instruments, (B) economic instruments, (C) communication, (D) quality of action, (E) new business models and (F) social issues.

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[24] NeZeR, (2016), Report on the successful business models for NZEBR

DE-A1 -Creating a target oriented policy environment with effective set-up and implementation of policy packages

DE-A2 - Creating clear guidelines for the effective design of policy packages

DE-A3 - Developing tailored instruments in order to increase effectiveness, limit market distortions and foster a market uptake

DE-A4 - Mandatory upgrades for non-residential buildings, in case of new lease and tenancy. could be applied in order to achieve higher energy performance levels

DE-A5 - Setting up a building management structure among residents and owners should be mandatory

DE-B1 - Financial support schemes should be easily accessible and understandable

DE-B2 - Development of a programme which focuses on accurate modelling and financing tools in order to increase the effectiveness of subsidy distribution

DE-C1 - Provide detailed information on costs and benefits of an improved energy performance of buildings

DE-C2 - Expanding local energy advice services and demonstration projects

DE-C3 - Raise the awareness of stakeholders about possible measures towards nZEBs

DE-C4 - Install “One-Stop-Shops” for high energy performance buildings to reduce complexity and hassle

DE-D1 - Tailored encouragement tools, information, support and incentives should be provided to investors and building owners in case of nZEB renovations

DE-D2 - Improve the existing dena calculation tool for renovations in order to include co-benefits in the economic appraisal

DE-D3 - Maintain the support for Research and Development

DE-E1 - Foster the uptake of industrialised renovation through increased market confidence

DE-E2 - Encourage new business models to improve management of the overall process

DE-F1 -Allocation of public budgets from income and heating subsidies to effective renovation measures

DE-F2 - Explicitly define energy poverty and set up monitoring mechanisms

#DE-A1 - Legislative and Regulatory Instruments

Creating a target oriented policy environment with effective set-up and implementation of policy packages

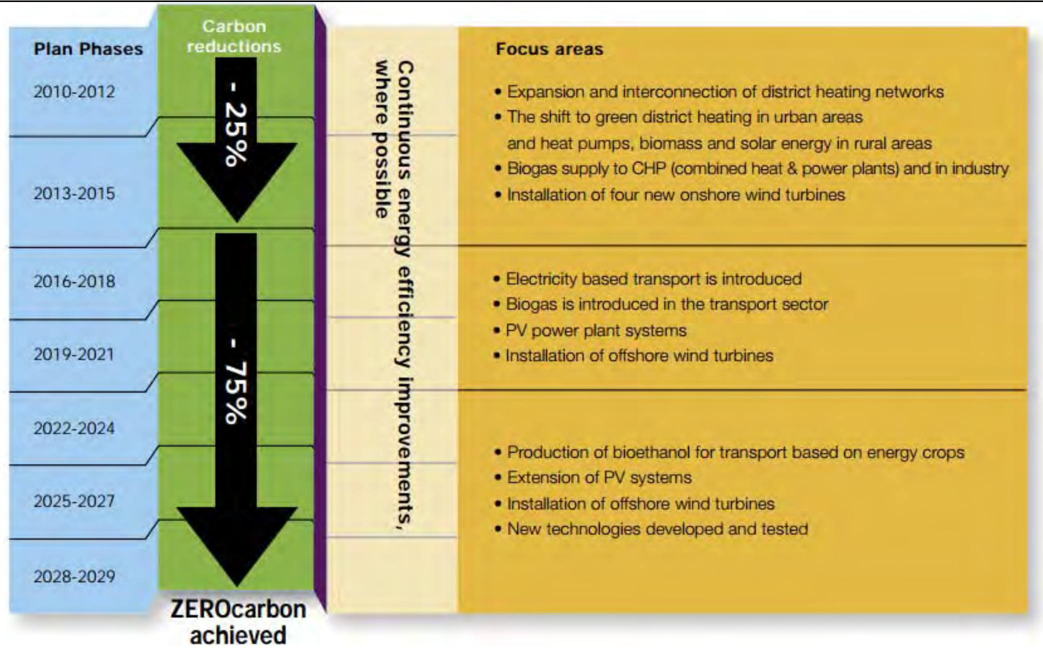
Article 4 of the EED asks the EU Member States to further elaborate long-term plans to support deep renovation of the existing building stock. Therefore, these plans can play a major role in fostering nZEB renovation if they are designed and take into consideration measures tailored towards or aiming at nZEB levels. The weakest section of countries' National Building Renovation Strategies is the "Forward-looking perspective to guide investment decisions". Hence, more attention should be paid to properly implement the long-term renovation plans as required by Art. 4 EED.

Policy packages should be revised according to their ability to achieve the defined targets.

Implement clear targets and set up effective policy packages to reach them

Pilot project – Project Zero

Project Zero is the vision of Sonderborg (a Danish municipality) to become carbon neutral no later than 2029. A Masterplan including "the overall, long-term strategy for achieving the defined development targets" has been developed together with stakeholders and research institutions. While nZEBs play a key role in Sonderborg's vision, their relationship with other elements in the energy system is also emphasised in this comprehensive strategy. The strategy includes clear targets and a realistic timetable, allowing long-term investments in building performance and energy efficiency.



#DE-A2 - Legislative and Regulatory Instruments

Creating clear guidelines for the effective design of policy packages

Creating clear guidelines is vital to properly address the related target groups with these policy packages. Most policies and their effects are interdependent, creating the need for effective governance over the policies in place. It is essential that policies and measures enforce each other, rather than the opposite.

In Germany, the two main regulations addressing energy efficiency in the built environment are the energy saving ordinance (EnEV) and the renewable energy heat law (EEWärmeG /RES-H). Both regulations are not harmonized and in combination with other regulations (e.g. on fire safety) this often leads to uncertainties and confusion among professionals involved in the planning and realization of construction projects.

Set up a clear framework for the development of new policy packages

#DE-A3 *- Legislative and Regulatory Instruments*

Developing tailored instruments in order to increase effectiveness, limit market distortions and foster a market uptake

This way, policies can include building ownership structure, target group specific barriers, climate conditions, societal aspects which will increase the efficiency of the instruments and the level of acceptance. Tailored instruments require more research and longer preparation, but the benefits from the increased effectiveness will be much higher.

Policies need to reflect the national context including the building stock and ownership

structure, target group specific barriers, climate conditions, demographic and migration, energy poverty aspects etc. in order to increase their efficiency and acceptance. Target group specific policies are required. Instruments addressing non-residential buildings should also consider different uses of the buildings.

Tailored instruments must be able to adapt the market conditions, available public budget and cost structure in the country. These instruments need to be also well coordinated depending on the different legislations and funding programmes.

Develop tailored policy instruments, through better research and longer preparation, to increase the efficiency and effectiveness

#DE-A4 *Legislative and Regulatory Instruments*

Mandatory upgrades for non-residential buildings, in case of new lease and tenancy, to be applied in order to achieve higher energy performance levels

Deep renovations of commercial properties are often limited due to tenant laws and split incentives/ benefits, rather than by the low economic viability of the investment. This barrier could be overcome through different means, such as mandatory upgrades on a particular timescale or at certain trigger points (e.g. sale, new lease) to achieve certain performance levels[25].

According to BPIE (2015), 60% of the non-residential buildings could be renovated cost-effectively. Making them mandatory in case of new lease and tenancy could be an effective tool for stimulating this kind of renovations in the market.25

Impose obligatory energy performance improvements, in case of new lease and tenancy

***#DE-A5** - Legislative and Regulatory Instruments*

Setting up a building management structure among residents and owners should be mandatory

Currently, there are no clear regulations on building management structures in Germany. This can create obstacles in case of implementing building energy efficiency measures due to problems in data collection, records and communication. Difficulties in building management structures – for example frequent changes in property management staff – can undermine progress with proposals for improvement measures.

Setting up mandatory building management structures (including standardised data collection and effective communication channels between residents and owners) can streamline the decision making process and provide an infrastructure which can better support installation of low carbon improvements[26].

Set up requirements for the house owners to set up a building management structure

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[25] BPIE, (2015) Renovating Germany's Building Stock-An Economic Appraisal from the Investors' Perspective

[26] LEAF, (2016) National Policy Recommendations for Germany

Demonstration project: Neues Regionenhaus Hannover

One focus of the EnOB demonstration project "Neues Regionenhaus Hannover"[27] was to actively communicate with the occupants of the new buildings. A user manual was developed before the commissioning of the building and special building functions were demonstrated in individual on-site talks. This helped the occupants to quickly adapt to the new technological conditions of the building right from the beginning. A special intranet-website allows to flag building-related problems and preferences. This easy to use portal enables a central gathering of the incidents, quick response and also further analyses of the encountered problems.

#DE-B1 *- Economic measures*

Financial support schemes should be easily accessible and understandable

Uncertainty is one of the biggest barriers to energy efficiency and deep refurbishment. The cost does not only include an unclear forward-looking perspective making long-term investments unwise, but wasted research and development costs.

In Germany, there are currently different schemes across different regions. This can make decision making hard for some customers who invest in certain regions. Therefore, a more comprehensive approach should be followed regarding financial incentives and they should be more informative.

This recommendation is related to the need to have a long-term strategy to provide the market with confidence.

Ensure that the financial support schemes are easy accessible and understandable

Encourage better coordination between schemes in different regions

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[27] BINE Informationsdienst (2010), BINE-Themeninfo I/2010, available at: http://www.bine.info/publikationen/publikation/gebaeude-energieeffizient-betreiben/der-nutzer-als-massstab/

#DE-B2 - Economic measures

Development of a programme which focuses on accurate modelling and financing tools in order to increase the effectiveness of subsidy distribution

A programme for the development of accurate modelling and financing tools to increase the effectiveness of subsidy distribution should be encouraged by the government. The return on investment in such a research programme would be an even more intelligent, streamlined, automated process to make use of public finances and increase the effectiveness of funds in reaching renovation targets and in triggering renovations[28].

Development of a programme which focuses on accurate modelling and financing tools in order to increase the effectiveness of subsidy distribution

Support further research on the effectiveness of different energy efficiency measure

***#DE-C1** - Communication*

Provide detailed information on costs and benefits of an improved energy performance of buildings

The country already started a well-established communication campaign, which aims to inform people on how to increase the energy efficiency not only of houses and appliances but also in behaviour, called "Deutschland Macht's Effizient". The campaign, which is funded by the Ministry of Economy Affairs and Energy and in cooperation with many initiatives in Germany, has a high visibility and provides needed information for energy efficiency measures with explanatory infographics, as well as support for possible questions. Accordingly, the following recommendations are stated in order to provide more improvement to what has been done so far in Germany.

The general awareness is still low, of the cost-effectiveness and benefits an improved energy performance of buildings can offer, making it one of the biggest barriers to deep renovation

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[28] BPIE, (2015) Renovating Germany's Building Stock-An Economic Appraisal from the Investors' Perspective

and new nZEBs. This information needs to be reliable and available for consumers and investors on all levels[29].

Provide accurate and easy-grasping information on the benefits of improved energy performance of buildings

#DE-C2 *– Communication*

Expanding local energy advice services and demonstration projects

Expanding local energy advice services and demonstration projects. Accordingly making these projects more visible in order to share good practice and to motivate users for implementing energy efficiency measures. In the UK this approach is already in practice. The house owners that have increased their building's energy efficiency, share this improvement with people who are interested to get more information about it. Consequently, it helps to increase the motivation of other users and this can trigger further improvements on neighbourhood level. Therefore, improving this sort of communication is recommendable.

Support local energy advice services and demonstration projects

Pilot project – The UK Green Open Homes Programme

The UK Green Open Homes programme was set up with funding from central government in the UK and stimulates renovation through demonstration projects and using the principle of social norming. Householders who have made energy efficiency improvements to their homes open them to visitors to explain what they have done, how it works and what the benefits are. Evaluation data show that visitors are influenced to make improvements to their own homes[30][31].

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[29] [29] Entranze, Laying down the pathways to nearly Zero-Energy Buildings-A toolkit for policy makers

[30] LEAF, (2016) National Policy Recommendations for Germany

[31] Green Open Homes, *Project Summary (2014)*

http://www.greenopenhomes.net/downloads/file/GOH_end_of_project_summary(2).pdf

#DE-C3 - Communication

Raise the awareness of stakeholders about possible measures towards NZEBs

It is possible to see awareness raising campaigns on billboards, publications and social media channels in Germany regarding increasing energy efficiency in general. Thus, Germany represents good examples regarding communication and marketing. Increasing the visibility of nZEBs and raising awareness regarding the implementation of energy efficiency measures is a great part of work that needs to be done in order to reach 2020 targets for Germany.

It is necessary to further improve the knowledge of the different nZEB measures, in order to promote and accelerate the improvements in this direction. This can be done through targeted awareness campaigns, stakeholder forums and other medias.

Increase the effort to raise awareness among stakeholders about possible measures towards NZEBs

Support research on this topic to ensure reliable information sources, in order to build stakeholder confidence

#DE-C4 *– Communication*

Install "One-Stop-Shops" for high energy performance buildings to reduce complexity and hassle

Being widely in practice especially in Nordic countries, One Stop Shop business models aim to provide a comprehensive package of energy efficiency measures and energy performance upgrades for certain building types in order to provide all possible services that might be required from the customers. The model offers easy access to information and expertise for the customers who want to realise energy efficiency measures in their buildings. Additionally, for the service provider, providing a variety of services becomes easier with the collaboration.

Set up, and encourage, one-stop-shop solutions

Example – Habiter Mieux

Habiter Mieux, a French programme assigned to tackle fuel poverty, is directly linked to a one-stop-shop for energy renovation, responsible for assisting all households in France experiencing fuel poverty and wishing to embark on energy efficiency improvements. The national help website directs individuals to ANAH's website. The website provides interested parties with step-by-step guidance and support for projects.[32]

#DE-D1 *– Quality of Action*

Tailored encouragement tools, information, support and incentives should be provided to investors and building owners in case of NZEB renovations

Building owners and investors need the right encouragement, information, support and incentives to choose the deep renovation option, particularly when undertaking other maintenance work on the property, as the additional cost of improving the building's energy performance at this time can be minimised. Such support could come in the form of impartial information centres or one-stop-shops, which guide the owner/investor through the whole process, reducing transaction costs and helping to make the right choice.

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[32] BPIE, 2015 http://bpie.eu/publication/renovation-in-practice/

In certain places in Germany, local or regional energy agencies are already playing that part and should be further supported and strengthened in their endeavour[33].

Develop tailored information kits on NZEB, design for specific target groups

Set up information centres, with the abilities to guide investor with impartial information through the whole process

Example - CO2-Gebäudesanierungsprogramm

In Germany, the large scale national programme supported by the KfW incentivises deep renovations. The programme also provides planning and construction support to the property owners that want to improve their building's energy performance through renovations. The programme provides the largest support in terms of investment per head of population in Europe (BPIE, 2015).

Example - Rheinenergie

As a local example, the energy distribution company Rheinenergie provides information on its website as well as call centre services for their service region. Rheinenergie provides services for home owners and tenants to get support for the examination of the building's energy consumption and the realisation of possible savings with a number of energy efficiency measures.

#DE-D2 – Quality of Action

Improve the existing DENA-calculation tool for renovations in order to include co-benefits in the economic appraisal

For building owners and investors, encouraging the inclusion of co-benefits such as increased comfort and property values in the economic appraisal can have a big impact on the cost-effectiveness of deep renovation. Advice centres and one-stop-shops could offer free software that includes co-benefits in the economic appraisal. The existing Deutsche Energie-

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[33] BPIE, (2015) Renovating Germany's Building Stock-An Economic Appraisal from the Investors' Perspective

Agentur (DENA) calculation-tool for renovation could be modified to take co-benefits into account.[34]

Modify the existing DENA calculation-tool to include wider benefits (social and environmental) of renovation.

Example - Dena Bedburg

25,000 euros in heating costs saved after ten years

In the case of the calculation example in Bedburg, North Rhine-Westphalia, after having bought their one-family home in 2005, the building owners had to decide whether to go for a minimum renovation costing 43,000 euros or for a comprehensive refurbishment to KfW Efficient House 55 standard. The owners came out in favour of energy efficiency and carried out thorough insulation work on the external walls, the cellar and the roof space as well as installing high-quality insulated windows, a modern heating and ventilation system and a solar thermal system. At the time, the building owners received subsidies in the amount of 20,000 euros. Today they would even receive 10,000 euros more. After deduction of the subsidies, the cost of the top-standard refurbishment totalled around 91,000 euros - approx. 48,000 euros more than the necessary minimum renovation would have been.

Ten years later, the family is very positive about their decision: They have already saved close to 25,000 euros in heating costs since their energy consumption declined by more than 80 percent as a consequence of the energy-efficient refurbishment. On top of this, they all agree that their living standard increased right from the beginning. After 20 years, lower energy costs will have paid off the initial outlay made for energy efficiency. By that time, the house with minimum refurbishment would have spent 60,000 euros on heating while the energy-efficient house spends as little as 10,000 euros. A further ten years later, the building owners will have over 30,000 euros on the credit side, and their house will remain low-cost and comfortable.[35]

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[34] BPIE, (2015) Renovating Germany's Building Stock-An Economic Appraisal from the Investors' Perspective

[35] Dena (2015) http://www.dena.de/en/press-releases/pressemitteilungen/dena-practical-example-efficient-house-refurbishment-pays-off-after-20-years.html

#DE-D3 – Quality of Action

Maintain the support for Research and Development

In order to accelerate learning curves and the process of cost reduction, the R&D support should be maintained. NZEB is a developing process, constantly requiring new and better research. Buildings are developing from energy demanding blocks to smart buildings - producing and storing energy, enabling a smarter energy use. This development will require further developments and a growing understanding of buildings new role in smart cities and in relation to the wider energy system.

Continue to support research and development on NZEB and energy efficiency related topics

#DE-E1 – Incentivize the market

Foster the uptake of industrialised renovation through increased market confidence

Build market confidence through different means like branding and quality assurance. Industrialised deep energy retrofits - where one contractor provides a turnkey renovation using mainly prefabricated modules - are still fairly new terrain within the construction sector. Today the majority of renovations happen in a staged approach combining multiple smaller local contractors. In the newly built segment this turnkey approach is more common and integrated.

It is crucial to build consumer trust to allow for a much broader adoption of this approach in renovation as well. This could be done through branding or by developing an independent quality assurance mechanism for products, systems and companies. Actors will be more inclined to work with a company or institution that has an objective quality assessment. Government could play an important role in this mechanism as an objective third party (or as facilitators to set this up).

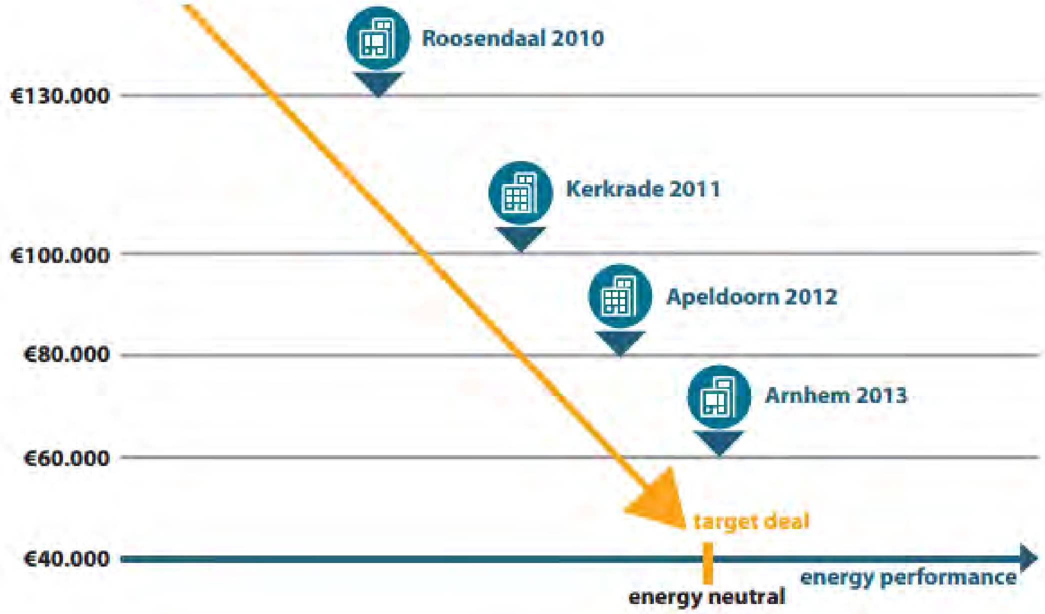
Enable an industrialized renovation through a forward-looking strategy ensuring market confidence

Example – Energiesprong

The Dutch Energiesprong project has demonstrated that the costs for a holistic net zero renovation of a terraced house can decrease from 130.000 euro at the first pilot-project in 2010 to 65.000 euro nowadays thanks to a combination of economy of scale and 3D designed pre-fabricated materials. On top, the on-site execution takes one week, limiting the burden for inhabitants, while at the same time increasing comfort and improving the look of the house. This state-of-the-art renovation programme is embedded in a holistic approach (targeting regulation, sales channels, Net-Zero retrofit, marketing, value uplift and finance), involving all relevant actors and leading to an upscale through an industrialised production process.

The Stroomversnelling project has benefitted from the lessons learned in previous Dutch initiatives to implement holistic renovations which have been undertaken in The Netherlands in recent years. In 2010, 134 houses in Roosendaal were targeted, realising a 72% energy reduction in heating and domestic hot water, at a cost of €130,000 each41. In 2011, 150 houses in Kerkrade were retrofitted to passive house levels at a cost of €100,000 each. Finally, in 2012, 188 zero energy dwellings were renovated in Apeldoorn at a cost of €80,000 per dwelling. These projects show how quickly the price/performance ratio is improving, as illustrated in below:

(Source: Energiesprong, 2014 revised by BPIE)



***#DE-E2** – Incentivize the market*

Encourage new business models to improve management of the overall process

The building renovation for increasing the energy performance requires a competent and innovative service offering based on the exploitation of new technologies suitable for building renovation and business concepts based on example of successful projects. To operate successfully in the renovation market, both contractors and designers need to develop their business models.

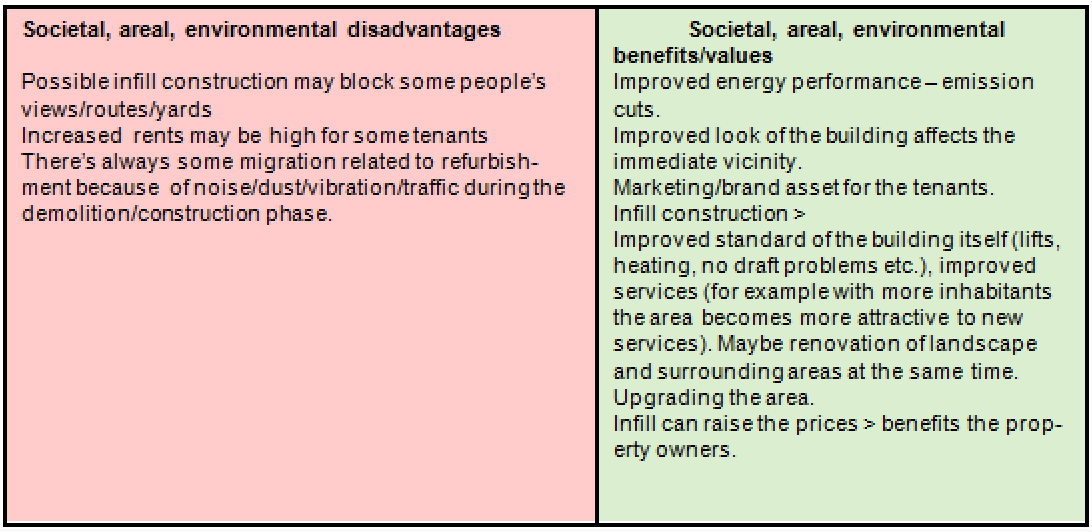
Encourage new business models

Example – TEA business model

Developed by a design Company in Finland, the TEA business model offers a collaboration of project managers and principal designers especially focusing on renovation projects. This collaboration helps to draw a better understanding of the client's profile, condition of the property and for gathering initial data as well as improving the process management. In this model, successfully implemented cases can also be used for marketing purposes.

The main advantage is the possibility to effectively manage the whole process as the principal designer. The improved management of the overall process is based on the preparation of:

- checklists
- communication strategy and process description
- new strategy and process description for the management of all project related materials
- marketing material
- new templates for offering and contracting considering better management and understanding the client needs and building's initial information to support the sales
- clear new way of working, which is also conveyed to the client and is beneficiary for the whole process, where all parties understand what is expected and what their responsibilities are in different phases of the project; it should also in a clear way convey to the client why it is a more cost efficient way of managing the project.



Societal, areal, environmental disadvantages	Societal, areal, environmental benefits/values
Possible infill construction may block some people's views/routes/yards Increased rents may be high for some tenants There's always some migration related to refurbishment because of noise/dust/vibration/traffic during the demolition/construction phase.	Improved energy performance – emission cuts. Improved look of the building affects the immediate vicinity. Marketing/brand asset for the tenants. Infill construction > Improved standard of the building itself (lifts, heating, no draft problems etc.), improved services (for example with more inhabitants the area becomes more attractive to new services). Maybe renovation of landscape and surrounding areas at the same time. Upgrading the area. Infill can raise the prices > benefits the property owners.

(Business model canvas modified by NewBEE –project, 2013.)[36]

#DE-F1 – Social Issues

Allocation of public budgets from income and heating subsidies to effective renovation measures

Fuel poverty can be correlated with low household income, high energy cost and energy inefficient homes and can be tackled by income increase, fuel prices regulation and energy efficiency improvements in buildings. Energy costs are growing faster than household income. Therefore, energy subsidies and direct financial support for household heating cannot provide a sustainable long-term solution to the fuel poverty problem. These measures require continuous public budget allocation without generating added value or economic growth. The continuous expenditure from public budgets only preserves the status quo.

However, vigorous energy renovation measures of fuel poor homes can give a long-term sustainable answer to fuel poverty. These measures address the root of the problem and result in reduced energy costs and/or improved thermal comfort in homes. Moreover, the implementation of energy efficiency measures can create or maintain jobs, reduce illness, rehabilitate poor districts and therefore contribute to social inclusion. Results from

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[36] Newbee – http://www.newbee-wiki.eu/wiki/index.php/Design_company%E2%80%99s_business_concept_for_energy-efficient_retrofitting_based_on_customer_profiling_and_management_of_initial_building_data_(TEA_case)

implemented energy renovation programmes targeting the fuel poor in some EU countries demonstrate these positive effects.[37]

Allocate money from temporary subsidies to long-lasting energy efficiency measures

Example: Ireland - The Warmer Homes Scheme

The Warmer Homes Scheme is "a vital pillar in the Irish Government strategy to tackle energy affordability". This scheme – now known as the Better Energy Warmer Homes scheme – targets vulnerable and fuel poor homes, and provides advice and funds for the adoption of energy efficiency measures. The scheme is administered by the Sustainable Energy Authority of Ireland (SEAI) and involves local community organisations. The energy efficiency interventions are totally funded by the scheme and include measures such as: attic insulation, draught proofing, energy efficient lighting and cavity wall insulation.

From 2000 to 2013 over €82 million were distributed through the Warmer Homes Scheme and more than 95,000 homes were supported. Between 2006 and 2009, the benefited households saved on average €85.83 per year. Additionally, only for 201091, the implemented measures from the Warmer Home Scheme resulted in saving 25 GWh and reducing CO2 emissions by 33,000 tonnes.

The scheme resulted in a substantial percentage of the beneficiaries being lifted out of fuel poverty, as it is implied by the indicators used to measure it. Specifically, the percentage of the beneficiaries who were unable (or who found it difficult) to pay the utility bills on time showed a significant decrease; the rates dropped from 48% (before the interventions) to 28%. Additionally, remarkable improvement was observed in rates regarding the ability of the beneficiaries to keep their home adequately warm. Before the implementation of the energy efficiency measures, only 27% of the families with children were able to keep a comfortable temperature at home, while after the interventions this percentage increased considerably to 71%.

#DE-F2 – Social Issues

Explicitly define energy poverty and set up monitoring mechanisms

Energy poverty is a major problem for Europe, as between 50 and 125 million people are unable to afford a proper indoor thermal comfort. Despite the fact that there is no common European definition, the importance of the problem as well as the severe health impacts

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[37] BPIE. (2014). Alleviating Fuel Poverty. Accessible at: http://bpie.eu/publication/alleviating-fuel-poverty-in-the-eu/

caused by fuel poverty are widely recognised. Energy poverty is still the little sibling to the economic and environmental aspects of new constructions and building renovations.

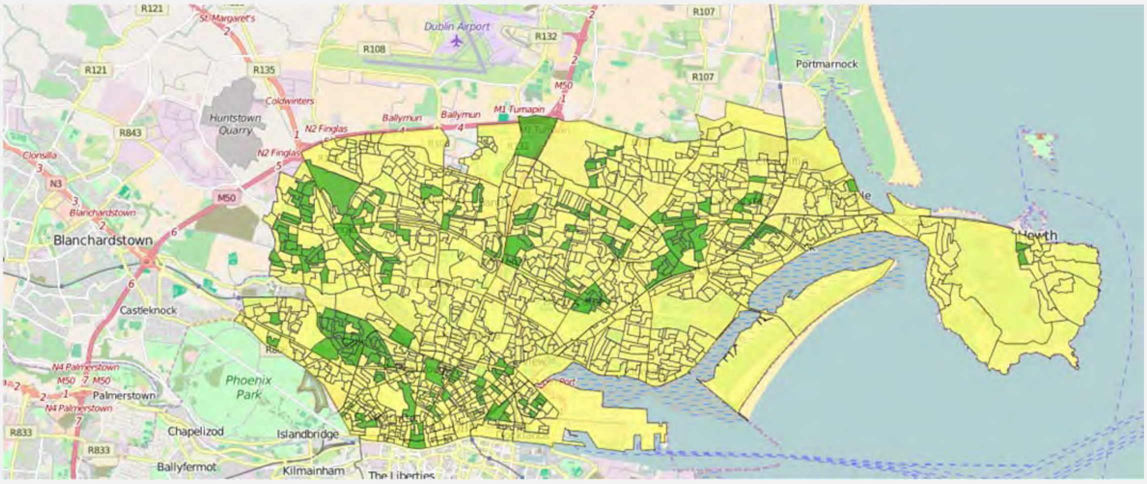
Only four European countries (France, Ireland, Slovakia and UK) have an official definition for energy poverty.

Better data would lead to better understanding of the social challenge. It would also allow to better assess the effectiveness of strategies to tackle energy poverty. This would be to better understand the challenge, and assess effectiveness of strategies to tackle energy poverty. Data for energy poverty must be enhanced and standardized across Europe.

Set up a framework to enable qualitative data of fuel poverty, including a monitoring mechanism

Pilot projects

The Irish Energy Action, in partnership with the EU-project Episcope, have developed an EPC mapping tool. The interactive map over Dublin illustrates different building characteristics (including energy poverty indicators) of different neighbourhoods. The data is aggregated to defined boundaries, namely small areas and electoral divisions. Small areas typically comprise 50-200 dwellings and electoral divisions include clusters of small areas.[38] This mapping allows for local policy making and strategy development alleviating energy poverty from a district approach.



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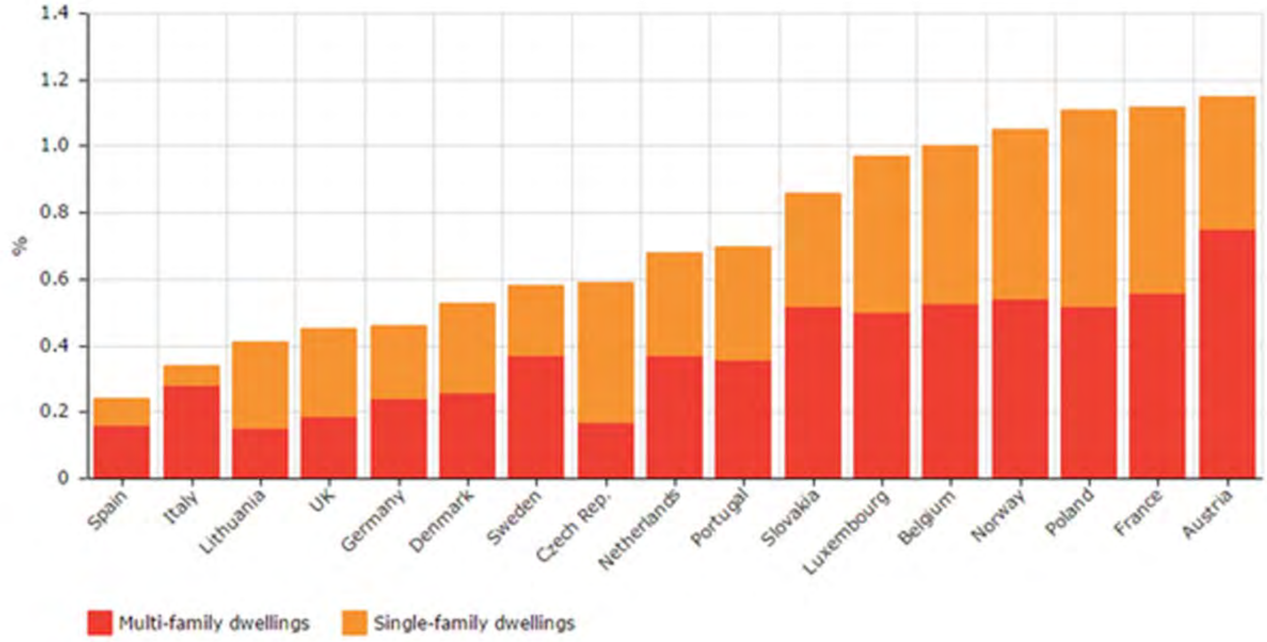
[38] http://energyaction-static.s3-website-eu-west-1.amazonaws.com/index.html

5. ITALY

5.1 BUILDING PERFORMANCE MARKET DATA

5.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES



* Data collected from national sources.

Figure 43 Share of new multi- and single-family dwellings in residential stock in 2012

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (nZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings

2. nZEB buildings according to national definitions

3. Buildings with an energy performance better than the national requirements in 2012

4. Buildings constructed/renovated according to national minimum requirements in 2012

The data of the nZEB Radar graph for Italy have been collected from the annual report of CTI (Comitato Termotecnico Italiano. http://www.cti2000.eu/) for the year 2014. The report shows the EPC (Energy Performance Certificates) status in the Italian regions.

The data available in the CTI report for 2014 are not exhaustively detailed and not all the regions provided the data in the same way. The data for EPC are divided by "Residential" and "Non-Residential", but there is no differentiation between "New buildings" and "Renovation". In some regions, there are no differentiation between "Residential" and "Non-Residential". In these cases, their data have been not considered in the share.

In order to fill the data gaps, it has been done an assumption for whole Italy through the data available for the Lombardy region. In the Lombardy region (the most populated in Italy) there is a detailed and open database (http://www.cened.it/opendata). The database enables to filter the buildings' data by year of construction, type of building, reason of certification (i.e., new building, renovation or other) and energetic class.

The showed data take into account the percentages of EPC available in the CTI report for whole Italy and distinguish between "new building" and "renovation" doing an assumption from the Lombardy region data.

Since there was no national official nZEB definition for Italy until October 2015, the definition of nZEB radar in the case of Italy gives:

1-Better than nZEB (net ZEB or positive house)	Not available
2-National official nZEB definition	EPC Class Gold, Class A+ and Class A.
3-Better than current building code	EPC Class B
4-According to building code	EPC Class C

In 2010, the share of new dwellings at nZEBs level in Italy was about 8,7%, while in 2014 it was about 22,3%. The share of new residential nZEBs has increased gradually in the last years due to several programmes promoting energy efficiency and use of renewable energies, and the staggered increase of the minimum requirements in the building code.

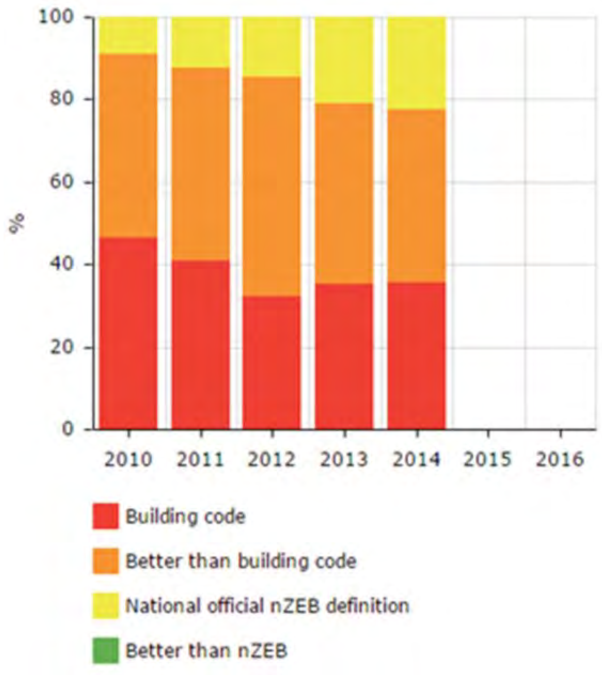


Figure 44 Distribution of new dwellings according to the nZEB radar graph – Italy

Source: ZEBRA

Because of the lack of an official European definition, to ease comparisons the EU ZEBRA2020 project developed the indicator of "major renovation equivalent". In ZEBRA, three renovation levels have been defined: "low", "medium" and "deep". However, these 3 levels definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

In Italy, two levels of energetic renovation level have been considered[39]:

- *Global renovation*, considered as *Major renovation*.
- *One measure*, considered as *Light renovation*.

Based on this differentiation we estimated the following rate of energy savings:

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[39] ENEA Le detrazioni fiscali del 55% per la riqualificazione energetica del patrimonio edilizio esistente 2012 (2014)

	Energy Efficiency Measures	Energy savings estimated
Level 1	This single measure can be the replacement of the boiler or windows, placement of insulation or installation of solar thermal systems. The range of possible measures is huge and so is the resulting number of implemented measures.	6%
Level 2	The source does not define which kind of measures have been applied, but it notes that this kind of renovation is technically complex and it implies an improvement of the energy performance of the whole building-installation.	65%

The equivalent major rate in Italy amounts to around 0,77% and is one of the lowest among the EU countries. The data is only available for 2012 due to the lack of data for Italy.

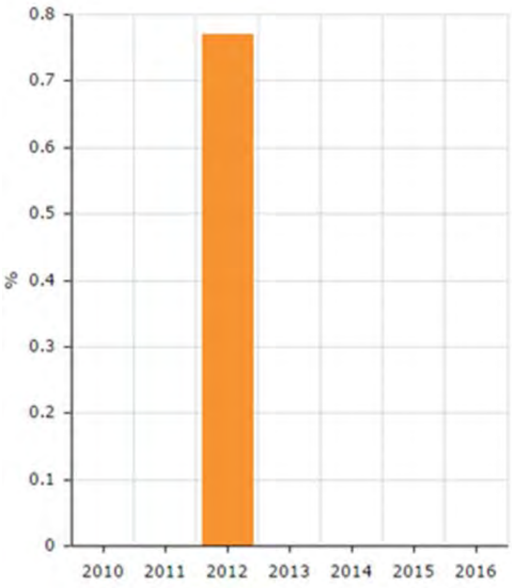


Figure 45 Equivalent major renovation rate – Italy

Source: ZEBRA

5.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Italy, it has been collected data of 100 nZEBs or high energy efficient buildings which were constructed recently. 75 out of the 100 are new buildings and 25 are renovated buildings. 85 have a residential use and 15 are intended for non-residential use.

Climate zones

Table 8 shows, the 35 buildings are located in the climate zone B, which is characterized by cold winters and mild summers, 3 buildings are located in climate zone C with warm winters and warm summers, 11 buildings in climate zone D with temperate winters and mild summers and 51 buildings are located in climate zone E, which has temperate winters and warm summers.

Table 8 Building distribution by climate zones - Italy

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	21	14
C	Warm winters and warm summers	3	
D	Temperate winters and mild summers	10	1
E	Temperate winters and warm summers	41	10

Heating Demand

The average heating demand for new buildings is 16,1 kWh/m² a, while in renovated buildings it is 21,9 kW/m² a.

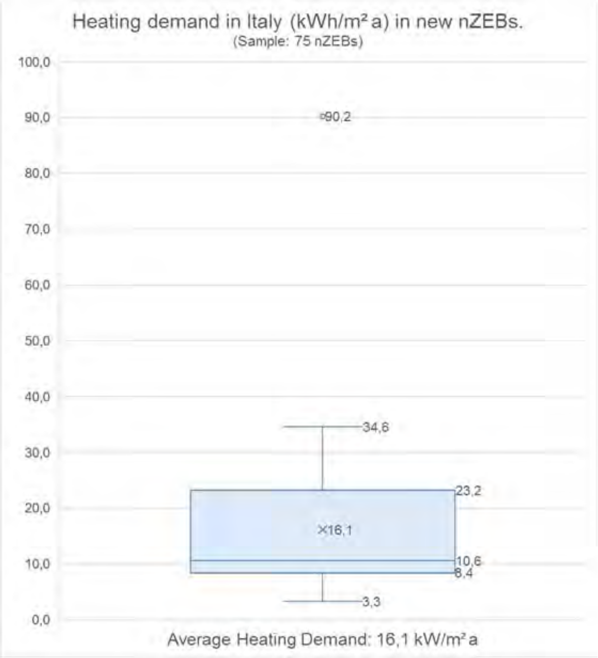


Figure 46. Box plot of heating demand in new nZEBs - Italy

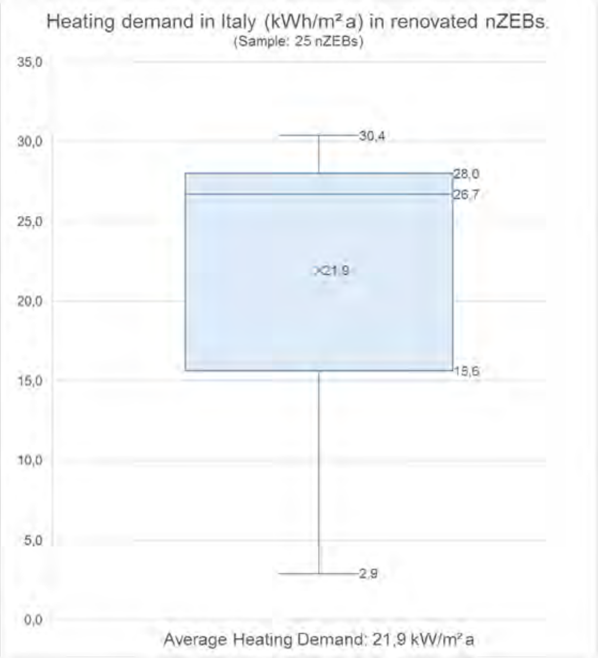


Figure 47. Box plot of heating demand in renovated nZEBs - Italy

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,16 and 0,15 in roofs. In renovated buildings the average U-values are very similar to the new buildings with a value of 0,16 in walls and 0,16 in roofs.

In new buildings, expanded polystyrene is the most used insulating material in walls with a percentage of 33%, while in roofs it is the wood fibre with a share of 47%. In renovated buildings, expanded polystyrene is also the most used insulating material in walls with a share of 36% and in roofs it is the wood fibre with 40% of share.

In windows, the average Uwin-value is 1,02 in new buildings and 0,98 in renovated buildings. Concerning the type of glass, the triple glass is the most common option with a percentage of 67% in new buildings and 76% in renovated buildings.

With respect to passive cooling strategies, in the 80% of the selected buildings it is reported the use of more than one passive cooling strategies.

Active solutions

Mechanical ventilation with heat recovery is the most common option in both new (96%) and renovated (92%) buildings.

With regard to the heating system, heat pump is the most common option in new buildings with a percentage of 55%, whilst in renovated buildings the most used heating system is the condensing boiler with a 36% of share. Electricity is the most used energy carrier in new buildings (53%), while gas is the most used in renovated buildings (32%).

In new buildings, the use of the same system for heating and DHW is the most common option with a percentage of 43%, while in renovated buildings it is the 40%, as well as the use of partially depending on solar thermal collectors together with the heating system.

57% of the new buildings do not use cooling system and 40% use cooling through heat pumps. In renovated buildings, 84% of the buildings do not use cooling systems and the rest (16%) use heat pumps as cooling system.

Renewable energies

In 45 out of the 75 new buildings, it is specified the use of photovoltaic systems and in 34 buildings the use of solar thermal systems.

In 9 out of the 25 renovated buildings, it was mentioned the use of photovoltaic systems and in 11 buildings the use of solar thermal systems.

5.2 EPCS AND REAL ESTATE AGENTS

5.2.1 REAL ESTATE AGENTS SURVEY

1. The dominant form of EPC indicated by all real estate agents in Italy is mandatory certification.

2. In opinion of real estate agents from Italy, the main factors taken into account whilst selecting, purchasing or leasing real estate are mainly the location, price and the size of the real estate various "nuisance" e.g.: a busy road, landing airplanes, landfill, a high-voltage line.

The cost of energy is indicated as very important factor by 19% and as important by 54% of real estate agents in Italy.

3. The EPCs in Italy are very frequently required in concluding the purchase/lease contracts.

4. More real estate agents in Italy are in general satisfied than unsatisfied with reliability of the data provided by the EPC.

5. Usefulness of EPCs in the professional activity of real estate agents in Italy is evaluated by them quite positively. Around 1/3 of the respondents in Italy indicates the usefulness of the certificate in their professional work.

6. The real estate agents in Italy rather don`t observe connection between the EPC and the improvement of the energy performance of buildings.

7. Usually, real estate agents in Italy don`t confirm correlation between the high energy performance and high value of real estate.

8. The real estate agents in Italy rather observe that higher energy performance of buildings cause the growing interest in its purchase / lease in comparison to other buildings.

9. In opinion of real estate agents in Italy, the influence of having the higher EPC class on the exposure time of the real estate is low.

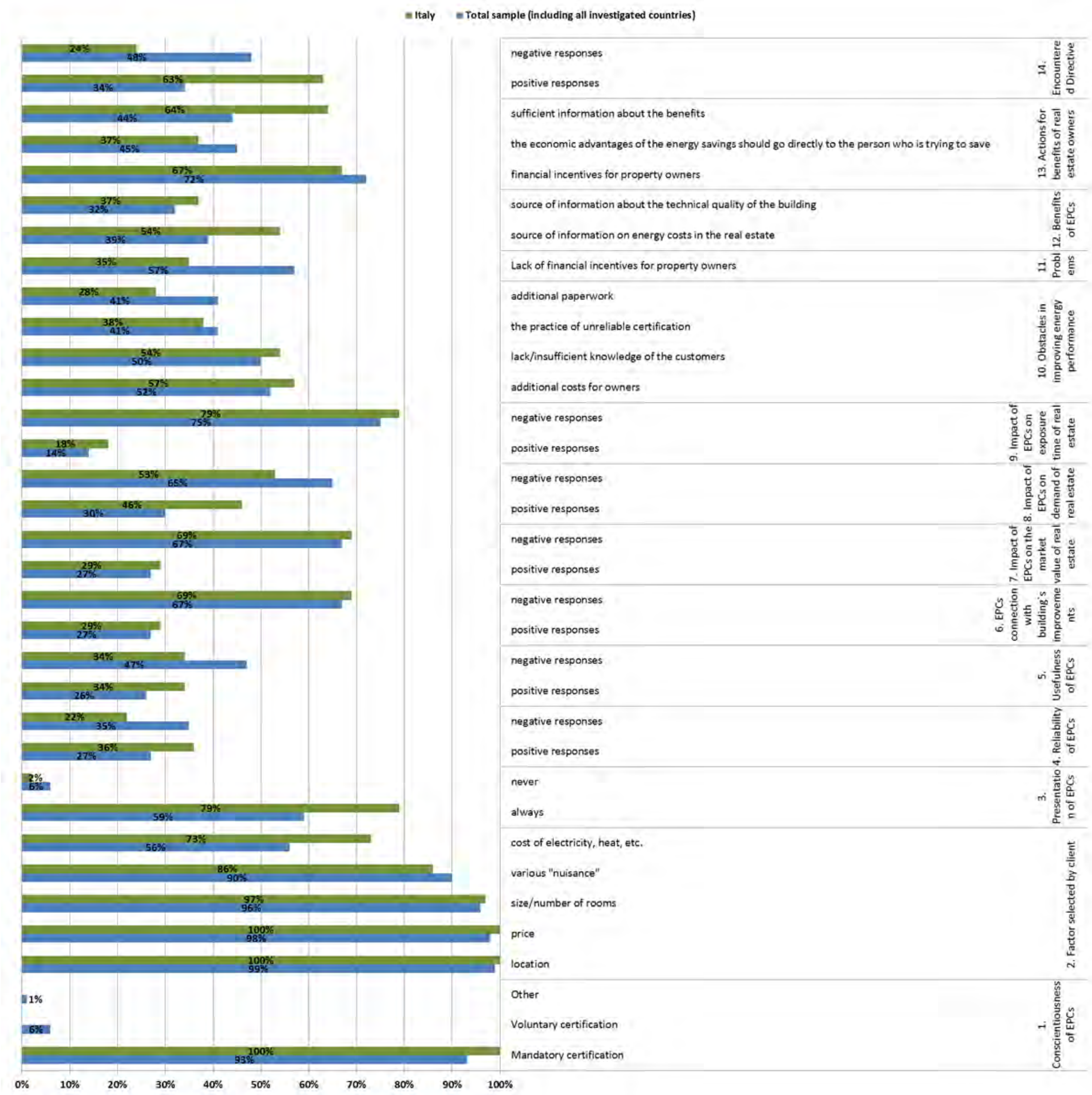
10. The main obstacles in improving the energy performance of buildings were indicated by real estate agents in Italy to be the following: financial matters (additional costs for owners), low social awareness in this subject, the practice of issuing unreliable certificates and additional bureaucracy.

11. Among the problems of implementing the improvement of the energy performance of buildings, the following has been mainly indicated by the real estate agents in Italy: the financial aspect, no incentive for the real estate owners.

12. The EPC as the source of information concerning the energy costs and technical condition of the building is indicated by the real estate agents in Italy as quite important benefit of having EPC.

13. The most expected support that would influence the improvement of the energy performance of buildings, according to the respondents from Italy, is financial activity. Sufficient information about the benefits, economic support directed to real estate owners and economic incentives for those that undertake such actions and.

14. The level of awareness and information about wording, requirements and settlements of the 2002/91/EC or 2010/31/EU Directive among the real estate agents in Italy is very high.



5.3 EXISTING POLICIES

Italy is planning to strengthen the minimum energy standards, improve incentives for renovation of government buildings and the targets of the White Certificates scheme, to increase the overall number of nZEBs and to consolidate tax deductions for renovation of buildings.

It has to be noticed that in Italy energy competences are shared between State and the 21 regions and autonomous provinces. Each regional authority may implement their own transposition of the EPBD, as long as they do not contradict the general principles and requirements of the Italian and European regulations. In Italy the implementation of energy efficiency measures is supported by several incentives for new and existing buildings.

The building sector and energy targets

The National Energy Action Plan 2014 describes the energy efficiency targets established by Italy for 2020, the policy measures for achieving them and the progress made from 2012 onwards. Among others, it foresees:

- To reduce the cost of electricity and gas at €9 million per year
- To reduce GHG emissions by 21% compared with 2005
- To **reduce primary energy consumption by 24%,**
- To achieve 20% share of renewable energy in gross final enrgy consumption
- To reduce dependency on energy imports by about €14 billion per year
- To boost growth and employment by mobilising investments of €170-180 billion by 2020.

For the building sector, a lot of measures are being planned/implemented:

- To strengthen the minimum energy standards for the construction and renovation of buildings
- To increase the number of nZEB (Directive 2010/31/EU, EPBD)
- To consolidate tax deductions, especially for renovations,
- To strengthen the incentives for renovation of government buildings and
- To advance the targets of the White Certificates scheme

National Renovation Strategy

Investing in building renovation is perceived as very important in Italy. The building's contribution to national targets is estimated at 4.9 Mtoe/yr. However, wider benefits are not further estimated or considered.

For the residential sector, the Italian building renovation strategy foresees a complete renovation of 3.5% of single-family buildings and 3% of multi-dwelling buildings built from 1946 to 2005. The plan also foresees a partial renovation of 4% of buildings constructed in the same period. The expected total annual energy savings by 2020 are 48,888 GWh/yr and the estimated investments to achieve the potential savings are €13.6 billion per year for complete renovations and €10.5 billion for partial renovation.

In the non-residential sector, the estimated floor area which can be renovated each year effectively is 5.5 million m² for offices, 6 million m² for schools and 1.5 million m² for hotels. The implementation of renovation measures is expected to achieve 60% of energy savings in the public sector (offices and schools), 45% in the private sector (offices, hotels, schools and banks) and 35% in shopping centres. The estimated investments amount to €17.5 billion per year and should reach potential savings by 2020 of 17.2 TWh/yr.

To support the implementation of energy efficiency measures in the building sector, in addition to the White Certificate scheme, tax deductions, thermal account, Kyoto Fund and the structural funds for the programming period 2014-2020, the following schemes were created:

- National Energy Efficiency Fund
- Financial instruments for school buildings, social housing and hotels
- Fund for home purchase and/or renovation (Plafond casa)
- Development and spread of energy performance model agreements
- Different measures promoted by the Regions

Energy performance requirements

The Legislative Decree 192/2005 and its modification (Legislative Decree 311/2006) set the minimum energy performance requirements for winter performance in new residential and non-residential buildings. The climate zone E is the main climate zone in Italy. About 53% of the Italian municipalities are in this climate zone, according to the table of degree-days for the Italian municipalities of the law 26 of August 1993 (updated on the 5th of July 2002).

Energy requirements in Italy according to the Legislative Decrees 192/2005 and 211/2006.

Primary energy (kWh/m²/yr)		**Residential buildings**		**Non-residential buildings**	
		Min	**Max**	**Min***	**Max**
New stock	**Heating**	34	116	9.6	31
Renovated stock	**Heating**	34	116	9.6	31

*kWh/m^3/yr

Compliance

Municipal authorities perform the compliance check of minimum requirements, which is required for the building permit with be building owners being required to present to the municipal authority the energy performance and thermal transmittance calculations. The local authorities may carry out on-site visits during or after the construction works. It is also compulsory to deliver a final report signed by an engineer confirming compliance with planning rules, construction regulations and energy performance requirements.

The nZEB plan

According to Law 90/2013 a "nearly zero energy building" is a building characterized by a very high energy performance in which the very low energy demand is significantly covered by renewable sources, produced within the building system boundaries.

To improve the energy efficiency of buildings, the current minimum energy parameter values and thermal characteristics (transmittance and conversion performance values) will become more demanding. The minimum transmittance values required for building elements will be lowered by 15% compared to their current value from 1 January 2016 and further 15% from 1 January 2021. A similar improvement will be applied to the minimum performance of heating and conditioning systems. For public buildings, in line with current national legislation, the minimum requirements will be made 10% more demanding. Moreover, verification of the requirements for nearly-zero energy buildings will be applied starting from 2018.

Renewable sources in the building sector

With the Legislative Decree 28/2011 transposing the Renewable Energy Directive, the requirements regarding the share of renewable energy for new buildings and major renovations were increased, establishing a calendar with a progressively larger share of renewable quota for domestic hot water, heating and cooling energy demand. The share of RES in buildings is defined in the Legislative Decree 28/2011, which specifies the following requirements:

- 20% renewable for all buildings between the 31st of May 2012 and the 31st of December 2013
- 35% renewable for all building between the 1st of January 2014 and the 31st of December 2016
- 50% renewable quota for all building from the 1st of January 2017 onwards

For new buildings the following incentives have been implemented: (i) Piano Casa: Regional governments issued provisions under their individual "Piano Casa" (House Plan), which is a complex set of measures intended to re-launch the building sector. (ii) Piano Casa 2: The programme aims at refurbishing social housing. (iii) Thermal Account: It is an incentive scheme intended to promote the use of thermal renewable source and energy efficiency improvement actions in the building sector.

For existing buildings, the following incentives have been implemented: (i)Tax deduction for energy efficiency improvement actions: It supports the energy upgrading of existing buildings by means of deduction on gross tax. (ii) Thermal Account: Above-mentioned. (iii) White certificates: The white certificates are tradable securities certifying the achievement of energy saving in the final uses of energy through energy efficiency and measures and projects. (iv) Guarantee funds and promotion of TPF (third-party financing models): It provided for the use of a guarantee fund to support energy efficiency improvement projects in public buildings, especially schools and hospital.

5.4 NZEB-TRACKER

This section highlights the key findings from the nZEB tracker for Italy in 2014.

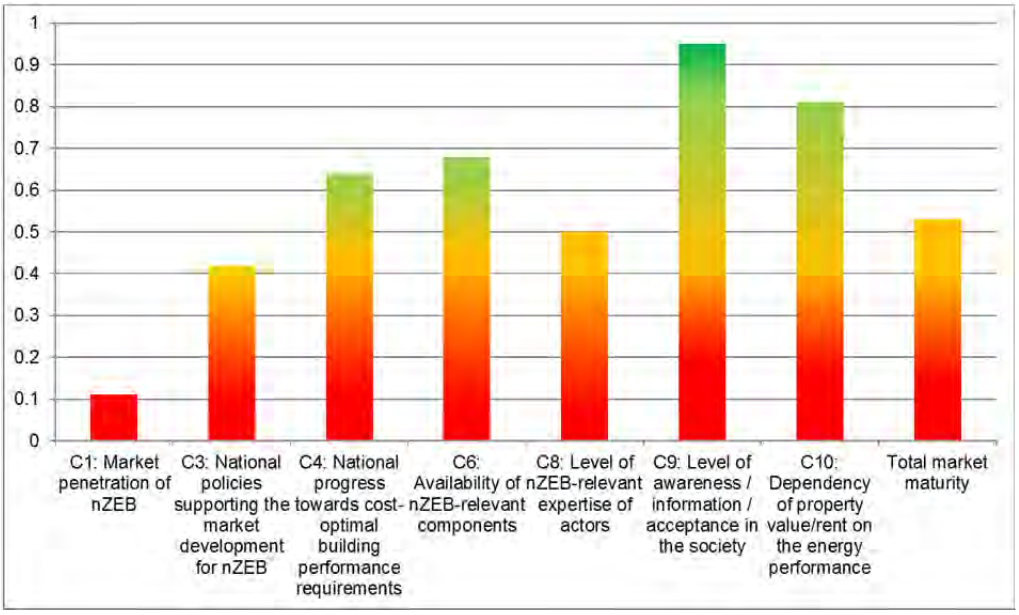


Figure 48 nZEB-tracker score for Italy in 2014

C1: Market penetration of nZEB in 2014

- Italian result: **0.11** ZEBRA average: **0.32**
- nZEB had a share of ~11 % on new constructed floor area in Italy
- The share has been gradually increasing in the past years

C3: National policies supporting the market development for nZEB in 2014

- Italian result: **0.42** ZEBRA average: **0.52**
- Policies in Italy seemed to be slightly insufficient to support the development of the market for residential and non-residential nZEB in 2014.
- The nZEB definition in the Italian Ministerial Decree of October 2015 will support the market development for nZEB.

C4: National progress towards cost-optimal building performance requirements in 2014

- Italian result: **0.64** ZEBRA average: **0.94**

- Italy will increase the national progress towards cost-optimal building performance requirements through the new building performance requirements established in the Italian Ministerial Decree of October 2015.

C6: Availability of nZEB-relevant components in 2014

- Italian result: **0.83** ZEBRA average: **0.83**
- Energy efficient heating systems and other building components for nZEB were well available in Italy.

C8: Level of nZEB-relevant expertise of actors in 2014

- Italian result: **0.50** ZEBRA average: **0.63**
- There were no big different pictures regarding the availability of experts for the three phases.
- The availability of experts for planning and construction was assessed slightly insufficient, but sufficient for examination/certification.

C9: Level of awareness / information / acceptance in the society in 2014

- Italian result: **0.95** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings increased steadily.

C10: Dependency of property value/rent on the energy performance in 2014

- Italian result: **0.81** ZEBRA average: **0.74**
- Compared to site, living quality, aesthetics and financial aspects, the energy performance was the least important aspect for customers' decision on renting/buying a real estate.

Maturity of the Italian nZEB market in 2014

- Italian result: **0.55** ZEBRA average: **0.66**
- The nZEB market seemed to be slightly worse developed than the average of the ZEBRA countries. The political framework appeared insufficient in 2014, nevertheless the official nZEB definition released in October 2015 sets a better Italian framework up.
- High performance building components were relatively available.
- The availability of experts may limit the future development of the nZEB market.
- People became more and more aware of the energy performance of buildings. Still it had a minor priority on buy/rent decisions.

5.5 SCENARIOS

Market penetration of nZEB – new building construction

Figure 49 shows annual construction of conditioned floor area according to different standards. The results are shown for the historical development and in both policy scenarios, current and ambitious for the long term development from 2021 to 2050. For an explanation of the scenario framework of the current policy scenario and the ambitious policy scenario, see part "Introduction". Data on historical development of new building construction according to national standards were collected in the project, see part "Building performance market data" and are available on the project project´s data tool (http://www.zebra-monitoring.enerdata.eu/). The share of the new building construction according to the building code in 2012 was app. 45% of the total new building floor area. According to building code means that buildings are constructed according to national minimum requirements. The share of the new construction according to the nZEB is 10% of the total new building floor area in 2012. From 2030 to 2050, the share of stringent measures is increasing. In the ambitious scenario, the share of stringent measures is much higher due to the policy implication.

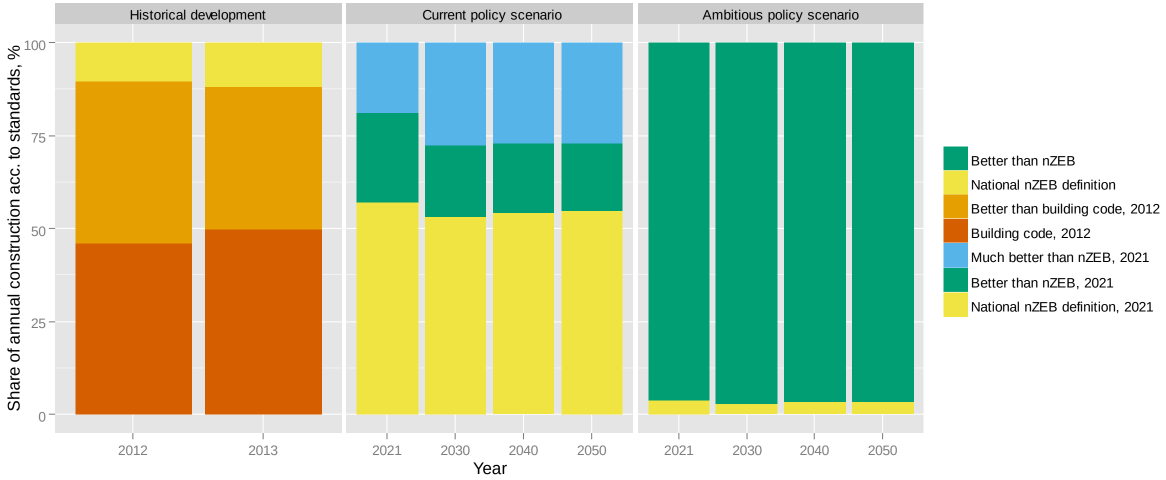


Figure 49 Share of annual construction of conditioned floor area built according to national standards

Building renovation activities

Figure 50 shows historical development and future development in current and ambitious policy scenarios of annual renovation of conditioned floor area by renovation levels.

The following renovation categories were defined in the current policy scenario:

- medium renovation which refers to the building codes

- light renovation meaning that in reality not all buildings fulfil the criteria set in the building legislation and
- deep renovation reflecting the nZEB definition

In the ambitious scenario, from 2021 to 2050, all buildings fulfil at least the building standards. There is an additional renovation level "deep plus" which means higher energy performance achievements.

In Italy, in the current policy scenario, the share of the light and medium renovation makes up a significant share on the total renovated building floor area from 2021 to 2050. In the ambitious policy scenario, which implements stringent measures on existing buildings, the share of the deep and deep plus renovation is increased compared to the current policy scenario. In 2040 around 30% of the renovated building floor area will be renovated with a strong share of deep plus (20%) and deep renovation (10%), resulting in higher energy savings (Figure 54).

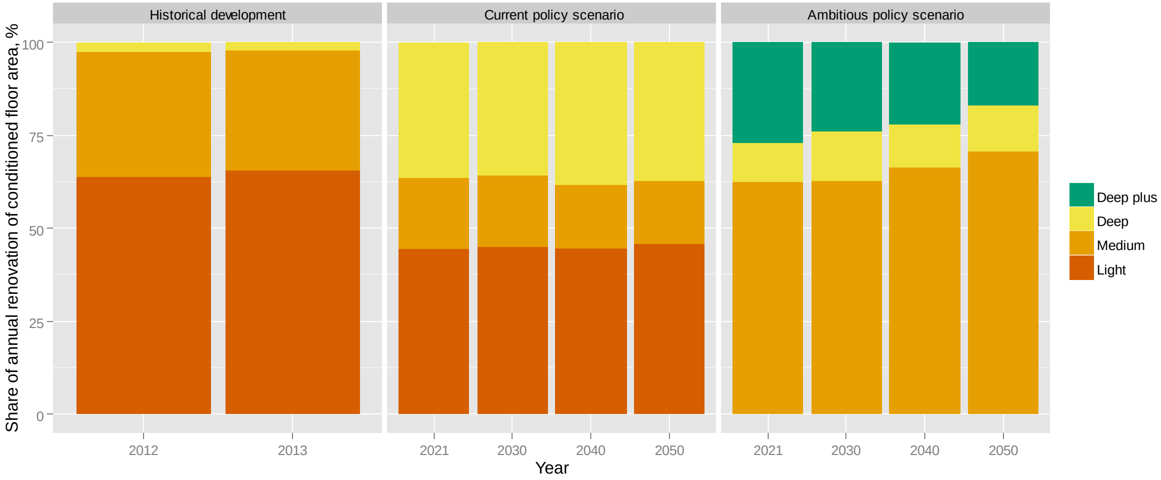


Figure 50 Share of annual renovation of conditioned floor areas by renovation levels in current and ambitious policy scenarios

Figure 51 shows the distribution of the specific energy need for space heating (norm energy need calculation according to EN13790) in the total building stock after building renovation by using the following renovation levels, light, medium, deep and deep plus. The specific energy needs are shown in a box-plot diagram. The median (middle quartile) marks the mid-point of the data and is shown by the line that divides the box into two parts while the diamond indicates the mean value. The data is represented for 2012 for not renovated buildings, light, medium and deep renovation. The deep plus renovation shows spec. energy need for buildings being renovated after 2020. The specific energy need for space heating of light renovation is higher compared to the medium renovation, which means that in reality not all buildings fulfil the criteria set in the building legislation. Deep and deep plus renovation include i.e. the installation of mechanical ventilation.

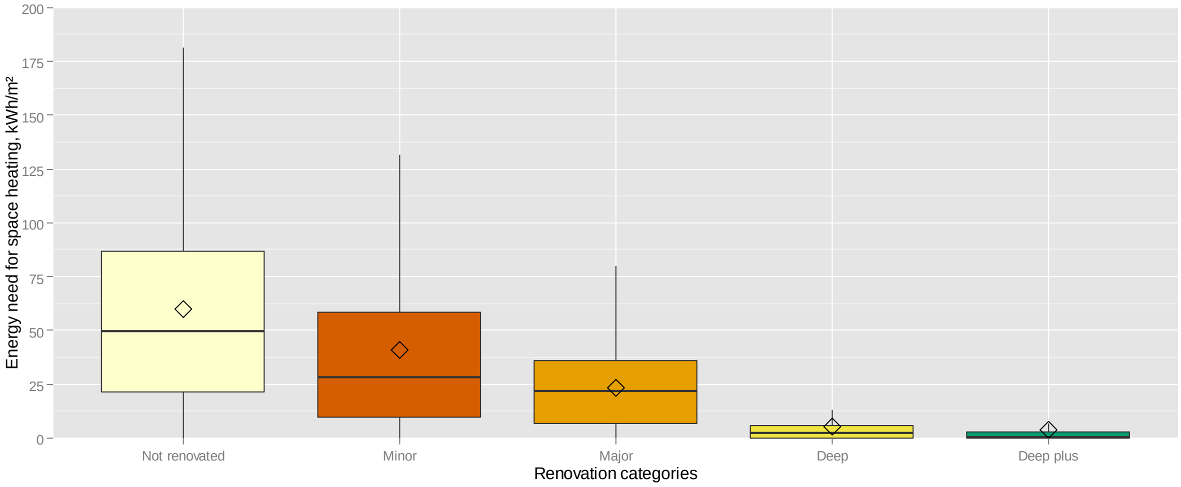


Figure 51 Distribution of the buildings spec. energy need for space heating

Economic indicators and national policies supporting the market development for nZEB

Figure 52 shows total yearly investments in the building envelope (thermal renovation) and in renewable heating systems from 2012 to 2050 in the current and ambitious policy scenarios. The investments are slightly higher in the ambitious scenario due to higher number of the renovated buildings, higher quality of the implemented thermal renovation and higher investments in the renewable systems. Figure 53 shows total yearly public budget for financial support of renewable heating systems and renovation of the building envelope. The yearly public budgets are significantly higher in the ambitious policy scenario.

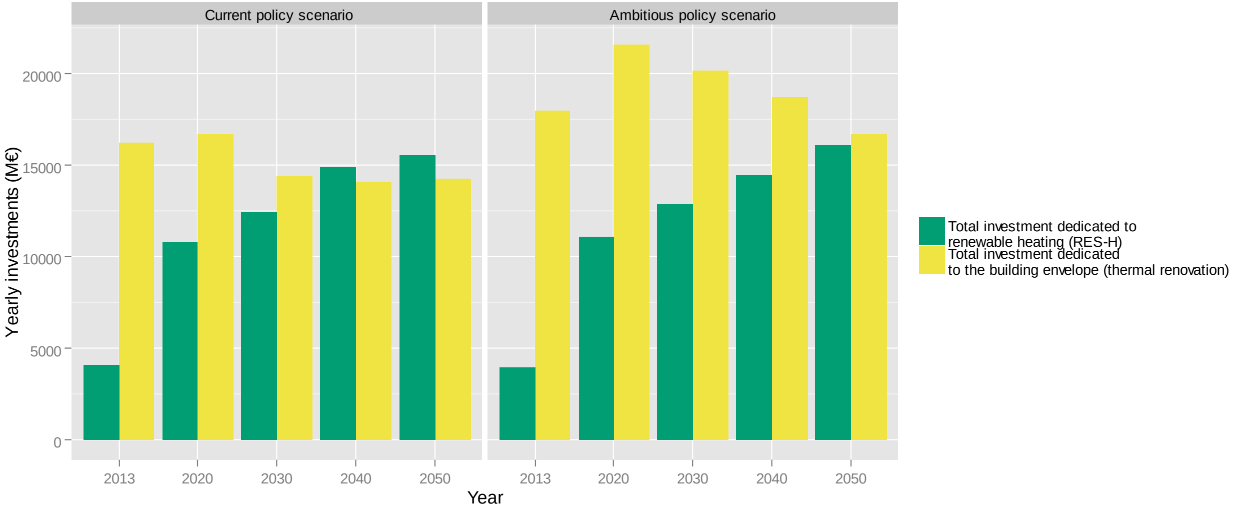


Figure 52 Total yearly investments in renewable heating systems (RES-H) and renovation of the building envelope including public budget, 2013 to 2050, current policy and ambitious policy scenario

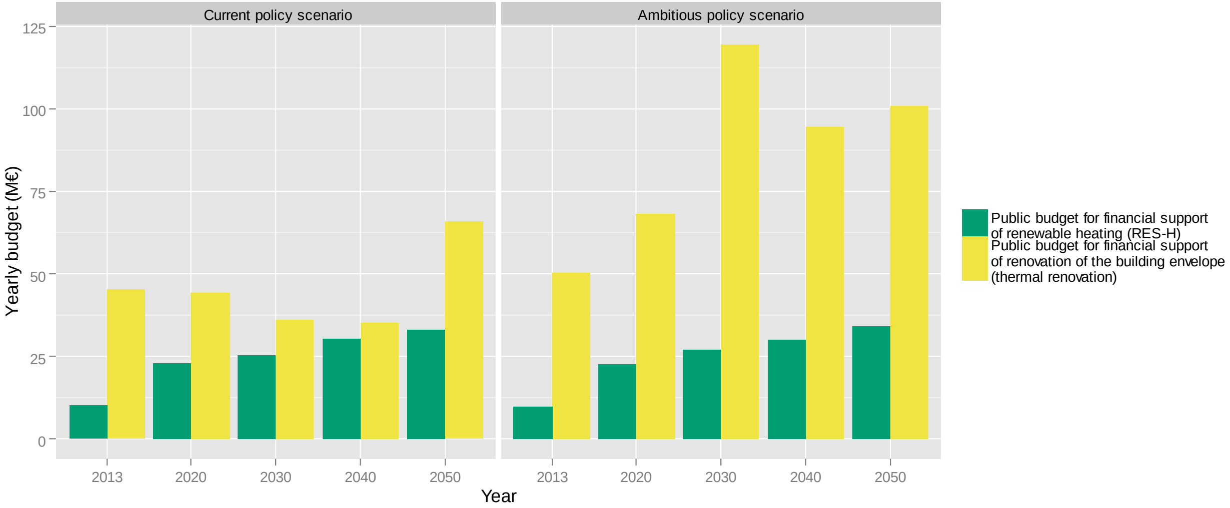


Figure 53 Total yearly public budget for financial support of renewable heating systems (RES-H) and renovation of the building envelope, 2013 to 2050, current policy and ambitious policy scenario

Development of the building related energy demand

Figure 54 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Italy´s building stock is 480 TWh in 2012. The scenario shows a slow-down of the energy demand of 15% from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 42% in the current policy scenario in the long term development between 2012 and 2050 and by 50% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Italy, the share of fossil-fuel-based heating systems especially natural gas and oil is significant in 2012. The share of non-delivered energy (i.e. solar and ambient energy) is around 5.8% of final energy demand in 2012 to around 26% in current policy scenario and around 30% in ambitious policy scenario in 2050.

Figure 55 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 61% in current policy scenario and around 68% in ambitious policy scenario. The reduction of the primary energy demand is around 55% and 62% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) The overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

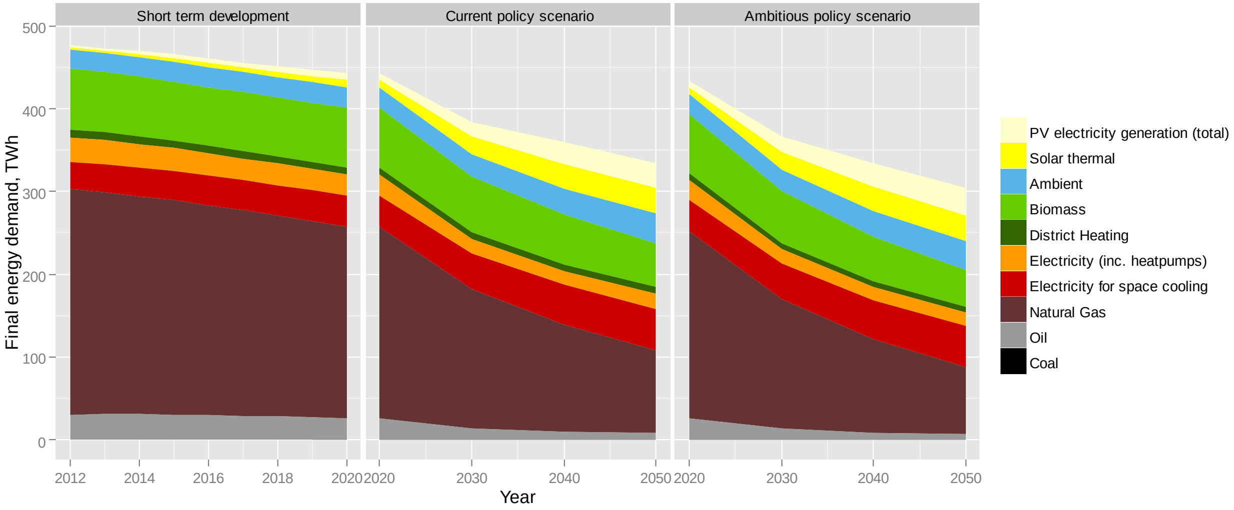


Figure 54 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

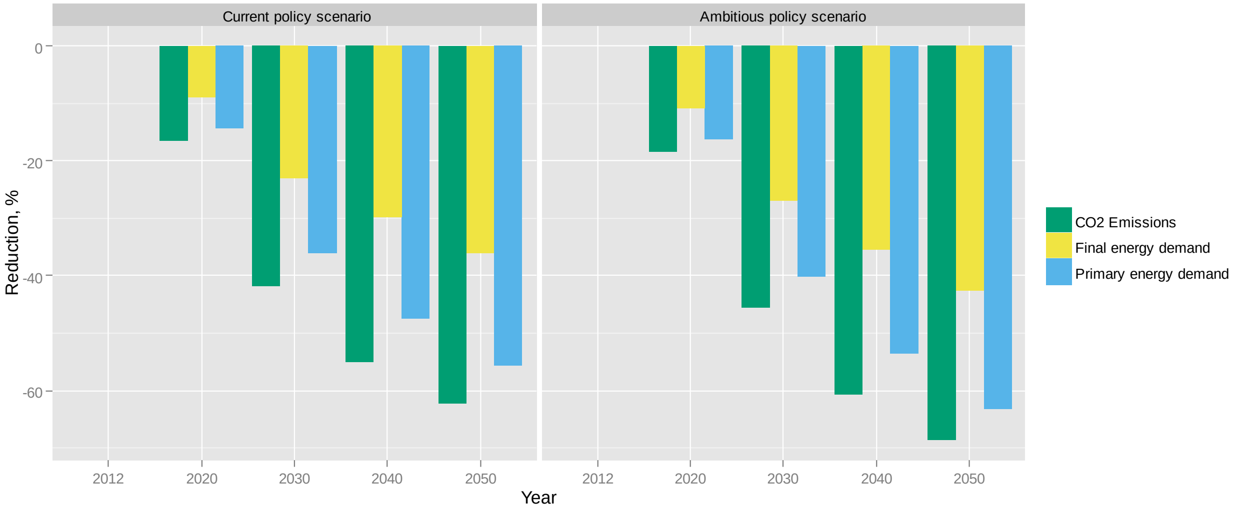


Figure 55 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

5.6 RECOMMENDATIONS

One of the main factors increasing the Italian nZEB ambitions is the common energy law, which came into effect in October 2015 and includes the official nZEB definition for Italy. The Energy Performance of Buildings Directive (EPBD) implementation in Italy includes methods for energy performance calculation using renewable energy sources in buildings and minimum requirements for energy performance of new buildings and refurbishments. Energy-related responsibilities are shared between the Italian state and the 21 regions and Autonomous Provinces. Each regional authority may implement autonomous transpositions of the EPBD, as long as they do not contradict the general principles and requirements of the Italian and European regulations. This fact creates two levels of standards and regulations, a national level and a regional level that may have a higher ambition.

The Italian building renovation strategy foresees a complete renovation of 3,5% of single-family buildings and 3% of multi-dwelling buildings built from 1946 to 2005. Besides, it also foresees a partial renovation of 4% of buildings constructed in the same period. In the non-residential, the estimated floor area which can be renovated each year effectively is 5,5 million m^3 of offices, 6 million m^3 for schools and 1.5 million m^3 for hotels. The Article 5 of Directive 2012/27/EU requires to ensure that as from 1 January 2014, 3% of the total floor area of heating and/or cooled buildings owned and occupied by its central government is renovated each year. However, Italy opted for an alternative approach by implementing other cost-effective measures such as: behaviour change, contracting, envelope and technical systems renovation and energy management inspections. These energy efficiency measures aim at reducing the overall primary energy consumption of about 20Mtoe by 2020.

The Italian energy performance regulation is defined at national level, and each region is responsible of its own implementation. In October 2015, the Ministerial Decree 26/06/2015 entered into effect. It is a new national guideline for energy performance certification of buildings. The Decree defines the application of the methods for calculating the energy performance through reference buildings and definition of minimum requirements for building renovations. These limits change in relation of the climate zone and the ratio S/V. The Ministerial Decree 26/06/2015 establishes limits in the building parameters to be used in a reference building, which is an identical building in terms of geometry, orientation, location, use and boundary conditions. The limits values of global energy performance depend on the results obtained with the calculation of the reference building with the established parameters.

In Italy, there are different financial incentives for new and existing buildings. The most important ones are shortly described here below.

For new buildings:

- Piano Casa: a regional complex set of measures for high energy performance buildings, able to rebate on the building license fees applicable under municipal regulations, or increases in permissible volumes.
- Piano Casa 2: for refurbishing social housings. The labours considered are interventions of energy efficiency, structural assurance, seismic retrofitting, maintenance of common parts, and removal of harmful material and architectural barriers.
- Thermal Account: It is an incentive scheme intended to promote the use of thermal renewable source and energy efficiency improvement actions in the building sector.

For existing building:

- Tax deduction supports the energy upgrading of existing buildings by a deduction on gross tax.
- Thermal Account: Above-mentioned.
- White certificates are tradable securities certifying the achievement of energy saving in the final uses of energy through energy efficiency and measures and projects
- Guarantee funds and promotion of TPF (third-party financing models): It provided for the use of a guarantee fund to support energy efficiency improvement projects in public buildings, especially schools and hospitals.

A detailed overview of the national financial programmes in Annex I of ´D 4.2: Overview of building-related policies´ published by the ZEBRA2020 project in 2016[40].

As already mentioned, in Italy the regions are responsible for energy performance of buildings and for ensuring final quality. Besides, municipal authorities perform the compliance check of minimum requirements, which is required for the building permit. The effectiveness of the energy calculation process developed at regional level and its management is crucial for the building sector. An important obstacle in Italy is the territorial diversity characterized by different climate zones, necessities, energy requirements, construction methods and materials, and different use. Positive example is the Passive House experience, which is also applicable in the South of Italy, where it is necessary to invest in the reduction of the energy consumption during the hot seasons.

The new Italian decrees and policies related with energy efficiency have driven new business models and innovation in the building sector.

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[40] ZEBRA2020 (2016) http://zebra2020.eu/publications/overview-of-building-related-policies/

Innovation and new business possibilities have been created in the following nZEB technologies:

- illumination
- electrical appliances
- efficient thermal energy production
- building automation
- building envelope
- renewable electric energy production
- renewable thermal energy production.

Several Italian programmes (e.g. tax deduction, white certificates, thermal account…) have promoted the energy efficiency for new and renovated buildings. Besides, the programme Guarantee funds and promotion of TPF (third-party financing models) has been focus on facilitate the use of a guarantee fund to support energy efficiency improvements in public building projects.

ESCOs (Energy service company) were recognized in Italy in the Legislative Decree n. 115 of 30 May2008 and these can play an important role as new business models for owners without financial sources. Nevertheless, availability of financial sources seems to be still a big barrier in Italy when constructing or renovating nZEBs.

Social housing buildings were built mainly with prefabricated modules and these are still in use. The threshold of 10% of the tenant's income spent on energy bills is very often exceeded in social housing buildings. The average consumption of residential buildings is estimated in about 160 kWh/m^2 y, while in social housing building stock consumption is in a range between 250 and 300 kWh/m^2 y.

"The National Institute of Statistics (ISTAT) reports an 11.1% (2007) of families (2.6 million families or 7.5 million people, 12.8% of the population) having their residence in Italy being poor.

The incidence of price variations consequently is of considerable relevance. The actual medium energy consumption of social housing buildings has been described as disastrous by managers of the housing associations involved in the investigation. The average consumption of residential buildings is estimated in about 160 kWh/sq.m./year. Social housing building stock consumption is in a range between 250 and 300 kWh/sq.m./year. The consumption is relatively high because of various reasons, not least due to the bad state in which most buildings are. A big part of the residential sector was constructed after the Second World War and therefore does not respond to the actual standards on energy performance of buildings.

8 recommendations have been outlined specifically for the Italian context:

IT1 - Regulate building performance minimum standards through the building code

IT2 - Support nZEB transition with public procurement processes

IT3 - Implement standard methodologies for secure data gathering and assessment

IT4 - Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

IT5 - Develop and consolidate quality frameworks for nZEB techniques and technologies

IT6 - Training building professionals with "NZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

IT7 - Involve and empower local authorities in pilot projects

IT8 - Indoor health and comfort aspects should be included to a greater extent in European building legislation

#IT1 - Legislative and Regulatory Instruments

Regulate building performance minimum standards through the building code

This can be considered as the classical regulatory approach. The building code is a set of rules specifying the minimum standards for new and existing buildings. It can be used effectively to remove inefficient products from the market.

Why this recommendation is a priority for the specific context? A lack of a well-functioning system for compliance and control (e.g. enforcement of penalties for non-compliance) is a major barrier for policy making and makes building regulation lose credibility.

The Italian energy performance regulation is defined at national level, and each region is responsible of its implementation.

The energy performance calculation methodology follows the National Standard UNI TS 11300, which is an application of the European Standard EN ISO 12790:2008. Until now, only Lombardy Region and the Autonomous Province of Bolzano have adopted standards directly from the EN ISO 13790:2008.

In Italy there are six different climates zones (A, B, C, D, E and F), fixed by law n.412 of 26th August 1993, and based on number of degree-days. For each climate zone is established the limits of primary energy for heating, thermal transmittance for the different elements of the buildings, etc.

The new Ministerial Decree 26/06/2015 establishes limits in the parameters to be used in a reference building, which is an identical building in terms of geometry, orientation, location, use and boundary conditions. The limits values of global energy performance depend on the results obtained with the calculation of the reference building with the established parameters.

Example: Alto Adige-Südtirol

In Italy, building performance requirements are managed by the Regions. The energy performance calculation process changes in accord with the regional laws.

Positive results have been achieved in the Alto Adige-Südtirol, where the regional Energy Agency CasaClima/ClimaHouse (www.agenziacasaclima.it) has elaborated a process for the energy balance calculation based on mandatory supervision of an external energy expert. This professional has to check the energy calculation and the building working progress in the construction site. Furthermore, the minimum energy performance requirements are included in the regional building code. Link to website[41].

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[41] Regional Energy Agency of Alto Adige-Südtirol: www.agenziacasaclima.it
Regional building code: Delibera 4 marzo 2013, n. 362 *"Prestazione energetica nell'edilizia - Attuazione della direttiva 2013/31/UE del Parlamento europeo e del Consiglio del 19 maggio 2010 sulla prestazione energetica nell'edilizia e revoca della delibera n. 939 del 25 giugno 2012"* http://lexbrowser.provinz.bz.it/doc/it/198789/delibera_4_marzo_2013_n_362.aspx?view=1

IL PROCESSO DI CERTIFICAZIONE

1. Controllo di Progetto

PRESENTAZIONE PRATICA
Dovrà contenere tutta la documentazione necessaria così come indicato sul sito dell'Agenzia www.agenziacasaclima.it alla sezione Certificato/Come richiedere la certificazione

PRATICA COMPLETA

PRATICA INCOMPLETA

RICHIESTA INTEGRAZIONI
La pratica rimane in sospeso fino alla consegna della documentazione integrativa richiesta

AGGIORNAMENTI: Richiesta di eventuali correzioni o rifiuto della pratica se non sussistono i presupposti per l'ottenimento della certificazione CasaClima

VERIFICA NEGATIVA

VERIFICA POSITIVA

Chiusura del Controllo di Progetto e definizione dei risultati di Calcolo

PASSAGGIO AL CONTROLLO DI PROCESSO

CHECK UP CASACLIMA

Verifica del Calcolo

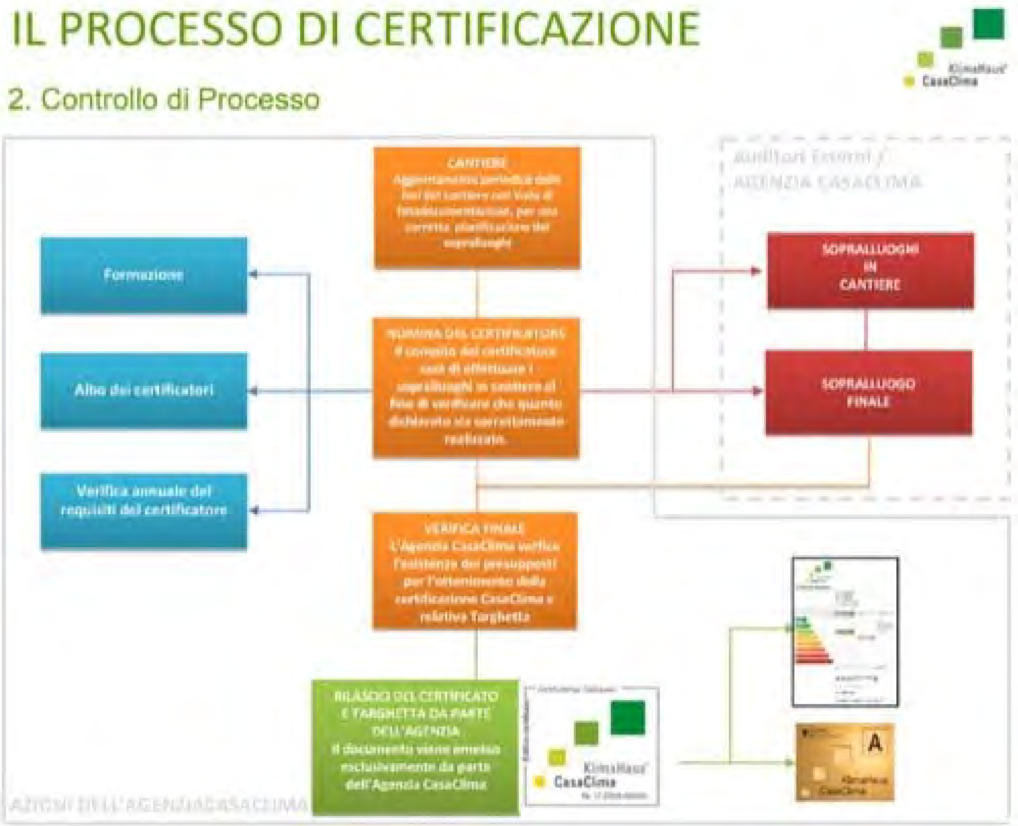
Verifica del Progetto

RISULTATI
"Check up CasaClima"

Invio al richiedente dei risultati della verifica

Per la documentazione necessaria per la richiesta, le tariffe e altre informazioni, consultare il sito web:
www.agenziacasaclima.it

AZIONI DELL'AGENZIACASACLIMA



IL PROCESSO DI CERTIFICAZIONE

2. Controllo di Processo

Formazione

Albo dei certificatori

Verifica annuale dei requisiti del certificatore

CANTIERE

NOMINA DEL CERTIFICATORE

Auditori Esterni / AGENZIA CASACLIMA

SOPRALLUOGHI IN CANTIERE

SOPRALLUOGO FINALE

VERIFICA FINALE
L'Agenzia CasaClima verifica l'esistenza dei presupposti per l'ottenimento della certificazione CasaClima e relativa Targhetta

RILASCIO DEL CERTIFICATO E TARGHETTA DA PARTE DELL'AGENZIA
Il documento viene emesso esclusivamente da parte dell'Agenzia CasaClima

AZIONI DELL'AGENZIACASACLIMA

#IT2 - Legislative and Regulatory Instruments

Support nZEB transition with public procurement processes

Tendering contracts are often integrated contracts, which can comprise construction work in the building envelope, the supply of systems and energy, financing, management and maintenance services, but also energy conservation guarantees. Many of these processes across Europe are mainly focusing on the price/cost of the contract, frequently implying a lower quality.

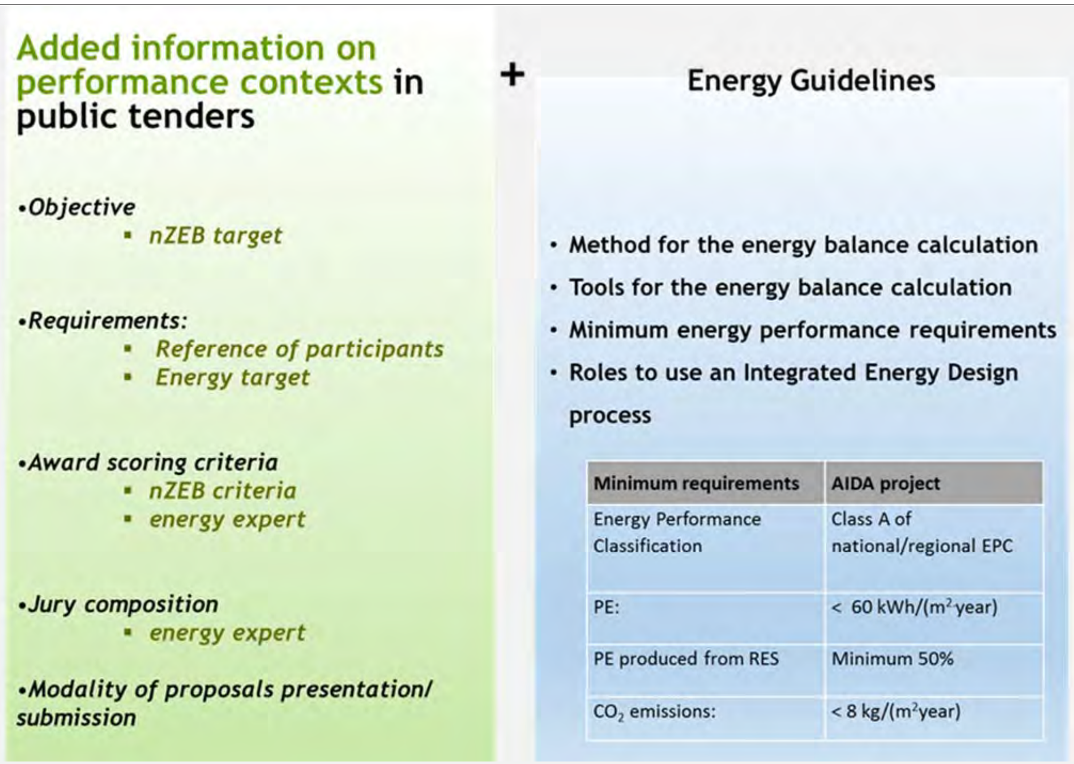
This recommendation supports the building market to increase the number of nZEBs introducing energy performance requirements in public design tenders. This process foresees a high diffusion of the nZEB target in the building sectors, boosting the professional knowledge of building professionals, contractors and public technicians.

This measure depends on energy performance requirements fixed at national/regional level, and the results are strictly influenced by the efficacy of the energy calculation process, i.e. in the design phase.

EU project: IEE-AIDA

In Italy there are some example of GPP criteria and minimum energy performance requirements introduction in public design tenders.

Within the European IEE-AIDA project, design tenders with minimum energy performance requirements were implemented. The goal was to achieve the nZEB target. Two design tenders are developed in Italy.



Added information on performance contexts in public tenders

- *Objective*
  - *nZEB target*
- *Requirements:*
  - *Reference of participants*
  - *Energy target*
- *Award scoring criteria*
  - *nZEB criteria*
  - *energy expert*
- *Jury composition*
  - *energy expert*
- *Modality of proposals presentation/ submission*

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Energy Guidelines

- Method for the energy balance calculation
- Tools for the energy balance calculation
- Minimum energy performance requirements
- Roles to use an Integrated Energy Design process

Minimum requirements	AIDA project
Energy Performance Classification	Class A of national/regional EPC
PE:	< 60 kWh/(m^{2}year)
PE produced from RES	Minimum 50%
CO_2 emissions:	< 8 kg/(m^{2}year)

Image 1: Sketch of added information on performance contexts (highlight on green text) and Energy Guidelines to introduce in public tenders. For additional explanations, see Deliverable 3.1 of IEE-AIDA project (www.aidaproject.eu)

#IT3 – Economic Measures

Implement standard methodologies for secure data gathering and assessment

Energy Performance Contracting (EPC) is a form of 'creative financing' for capital improvement which allows funding energy upgrades from cost reductions. Under an EPC arrangement an external organisation (ESCO) implements a project to deliver energy efficiency, or a renewable energy project, and uses the stream of income from the cost savings, or the renewable energy produced, to repay the costs of the project, including the costs of the investment. Essentially the ESCO will not receive its payment unless the project delivers energy savings as expected.

The approach is based on the transfer of technical risks from the client to the ESCO based on performance guarantees given by the ESCO. In EPC, the ESCO remuneration is based on demonstrated performance; a measure of performance is the level of energy savings or energy service. EPC is a means to deliver infrastructure improvements to facilities that lack energy engineering skills, manpower or management time, capital funding, understanding of risk, or technology information. Cash-poor, yet creditworthy customers are therefore good potential clients for EPC[42].

This recommendation offers the possibility of energy refurbishment to building owners with limited financial resources. Furthermore, the ESCO, which finances the energy refurbishment, guarantees in first person the effectiveness of the energy savings. An important aspect that can be underestimated from the ESCO in the energy refurbishment is the improvement of the indoor quality, though specific measures. Therefore, the owners (or the apartment's administrators) have to address the contract with the ESCO also considering that the building refurbishment measures are able to increase the indoor quality.

State of play: ESCOs in Italy

In Italy the DL 115/2008 identifies the ESCO as a "legal person who delivers energy services or supplies energy efficiency improvement measures to the building plants and to final tenants, and in the meantime accepts the financial risks. The payment of the service supply, in whole or in part, is based on energy efficiency improvements and their achievement."

Link to website[43]

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[42] http://iet.jrc.ec.europa.eu/energyefficiency/european-energy-service-companies/energy-performance-contracting

[43] *ESCO Source: Rastello group (/www.rastellogroup.it)*

#IT4 – Communication

Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

Concerning information and awareness raising nZEB-tools, the nZEB national plan for Italy do not mention any information on this matter. Nevertheless, in Italy there are many initiatives on the nZEB topic like visit tours, workshops and seminars, organized from public and private companies. These events aims to inform both the building professionals and owners, on legislative and financial scheme, and to promote innovative technologies and design strategies.

Concerning information and awareness raising nZEB-tools, the nZEB national plan for Italy do not mention any information on this matter. Nevertheless, in Italy there are many initiatives on the nZEB topic like visit tours, workshops and seminars, organized from public and private companies. These events aims to inform both the building professionals and owners, on legislative and financial scheme, and to promote innovative technologies and design strategies.

This measure boosts and increases the nZEB knowledge of building professionals and private owners. Moreover, a real experience with nZEBs can convince investors and owners to pursue the target in the design, construction and operation life of the building.

Example: nZEB visit tours

During the Passive days (first week of November) several visits at Passive Houses are been organized. During this occasion, also in Italy there are some visit at passive house buildings.

Within IEE-AIDA project, several visit tours to nZEBs are been organized in Italy (see **www.aidaproject.eu**). At national level there are different actions on nZEB visit tours:

Suedtirol - Enertour[44],

Enertour is an initiative that consists of technical visits to CasaClima buildings, installations of renewable energy systems and municipal systems. During an enertour, the planner and managers of the systems and buildings give directly on the location explanations on the technical and economic aspects. The purpose of enertour is to disseminate knowledge and new practical technological solutions to benefit a more sustainable energy.

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[44] IDM Suedtirol - http://www.idm-suedtirol.com/en/home.html, organized by Enertour https://enertour.bz.it/en

Bergamo - EDIFICI A ENERGIA QUASI ZERO VERSO IL 2020[45]

The initiative aims to raise awareness among professionals on the viability and importance of energy efficiency of existing buildings, both public and private type, creating a pathway to a zero carbon buildings by 2020.

#IT5 – Quality of action

Develop and consolidate quality frameworks for nZEB techniques and technologies

The creation of a socially-supported policy framework that declares nZEBs to be an attainable standard constitutes a major social challenge. This will require massive investments on the part of builders, businesses & industry, and the government. It is important that these investments be made correctly in technical construction terms and that they have a long life span. The lack solid quality frameworks would run the risk of providing inadequate support for the large-scale introduction of nZEBs.

Ensuring high-quality workmanship is therefore an essential precondition for conducting a large-scale market launch. This can only happen within integrated quality frameworks which addresses knowledge enhancement (via retraining, specialisation, etc.), the valorisation of knowledge via the certification of individuals and the support of individuals in companies and institutions which themselves have developed an integrated quality framework. Quality frameworks often work well if there are suitable support schemes linked to them. Within this context, a broader framework could also be pursued in which issues such as the environment, safety and product quality are addressed as well.

For the optimal technological development at national level, it is crucial to ensure the quality of the technology and the skills of the professionals. For that the innovation is necessary in the building sector, especially in energy efficiency and sustainable buildings.

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[45] Efidici - http://www.edifici2020.it/temi/

This measure is important in the research field of Energy Efficiency. Furthermore, the improvement of the building components (from thermal plants to building elements) is a continuous natural development imposed by the lifespan of the products.

Example: FACE - Façades Architecture Construction Engineering

It is a work of competences and infrastructures for supporting the change of policies towards performance-based approach in the building sector, organized by EURAC and IBM. Façade engineering faces the challenge to achieve ambitious target from energy, comfort and functional point of view, while keeping a high architectural quality level and optimal costs in the whole life cycle.

EU-projects: **FP7-iNSPiRe Project**

The objective of iNSPiRe is to tackle the problem of high-energy consumption by producing systemic renovation packages that can be applied to residential and tertiary buildings.
In order to realise the implementation of systemic renovation packages in future renovation projects, iNSPiRe aims to develop effective, reliable and cost-efficient technologies that are ready for use by the construction industry[46].

#IT6 – Quality of action

Training building professionals with "NZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

NZEBs demand higher qualifications of building professionals on all levels. Consumers should be able to rely on the skills of the building professional and get value for money, which means state-of-the-art information and advice, achieving the expected (energy) performance, a maximum operational lifetime and a safe and healthy building. This requires higher skills in the nZEB chain – highly energy efficient products require the proper understanding from the installer etc. A high skilled workforce increases the level of trust and confidence in NZEB investments.

To ensure an effective and qualitative construction and installation of nZEBs and installation of related components, all professional involved in the process must receive proper training.

The knowledge of building professionals has to be constantly updated on legislative, innovative technology solutions and products.

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[46] www.inspirefp7.eu

Example: SouthZEB

The SouthZEB project is an Intelligent Energy – Europe funded project (IEE/13/393/SI2.675576) which addresses the IEE priority for 2013 on continuous professional development.

With the objective of fostering the energy efficiency of the building sector through the adoption of nearly Zero-Energy Buildings concepts in new or existing buildings, the SouthZEB project develops training modules targeted towards specific professionals (Engineers, Architects, municipality technicians and decision makers) in Southern European countries (Greece, Cyprus, Southern Italy and Portugal). The training modules will be implemented by the project partners in the target Southern European Countries (less advanced on the progress towards nearly Zero Energy Buildings), leveraging on the experience and know-how from front runner project partners' countries (Austria, UK, Northern Italy).[47]

#IT7 – Incentivize the Market

Involve and empower local authorities in pilot projects

When developing pilot projects anywhere in Europe, it is crucial to involve local authorities from the start. Many of the big cities have already set higher ambitions on climate mitigation and decarbonisation than the EU-level requires and are developing incentive or roll-out programmes to push for the accomplishment of these goals. A strong collaboration between industry actors and local governments can speed up the development of innovative projects, especially when the city takes on the role of a facilitator to align industry actors, the market, end-users and includes them into an ecosystem approach.

Public authorities have to invest in energy efficiencies and energy saving for many reasons:

- Achieve the target of Europe 2020
- Demonstrate that a change in this direction is possible
- Stimulate private owners to invest in energy efficiency.

This measure is strictly connected with the results from energy refurbishment measures that influence on the benefits (costs savings). Furthermore, the positive results from these investments could be study cases of future visit tours.

Example: The RePublic_ZEB project

In Italy there are public nZEBs already used to show the obtained positive results. The

Image source - Request2Action

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[47] http://www.southzeb.eu/training/

RePublic_ZEB project (http://www.republiczeb.org/) is focused on the energy and CO2 emissions associated with existing public buildings and their refurbishment towards nZEB because of the huge potential for energy savings. Republic_ZEB spans across the South-Eastern European region with eleven partners located in target countries and one outside.

Pilot case: Project Zero

Project Zero, in the small Danish municipality of Sonderborg, is based on the belief that education is vital at all levels, from Kindergarten to PhD. Thus, energy consultant courses for municipal service workers were organised and efforts were made to educate the area's tradesmen and unskilled workers in energy renovations. As part of their activities, 1,200 homeowners have received free energy advice.

#IT8 – Social Issues

Indoor health and comfort aspects should be included to a greater extent in building legislation

In EU and national legislation, stricter energy performance requirements should be completed with appropriate requirements and recommendations to secure proper indoor air quality, daylight and thermal comfort. For instance, requirements for stricter insulation and airtightness should be complemented by appropriate minimum requirements for indoor air exchange and ventilation. As there are several ways to obtain significant savings in energy consumption in buildings while at the same time improving the indoor climate, clear legislative provisions for conflicting situations will create certainty for planners and architects.

- In urban areas, 60-90% of people's life is spent in buildings
- In 2012, 99 000 deaths in Europe and 19 000 in non-European high-income countries were attributable to household (indoor) air pollution.

Social housing buildings were built exclusively with prefabricated modules, which are still in use today. In this framework, the threshold of 10% of the tenant's income spent on energy bills (heating + electricity, as defined by English parameter, generally recognised in Europe) is very often exceeded."[48] A positive way to increase the indoor comfort is to fix minimum quality requirements of the air volume changes or daylighting. These indexes should be introduced in the national/local building codes.

State of play

At national level, in Italy the hygiene building code exists: minimum healthy requirements and several roles variably in relation of the building utilization. For example, for the air ventilation it is fixed a minimum number of volume/air changes, as well as criteria that rule the daylighting.

Example: Casa Clima's performance tool

At regional level, the Energy Agency of Alto Adige-Südtirol has introduced in the energy performance tool ProCasaClima the possibility to check the minimum air changes for the airtight buildings. The CasaClima Agency, born in 2002, is an independent public society from South Tyrol (Italy) which operates as a certification body for the energy efficiency of the construction sector. The main goal of the agency is to ensure the quality of the work at every step of the process, and puts a special emphasis on the performance of all actors taking part in the process of construction. [49]

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[48] Source: IEE-FinSH Energy Poverty project. ´ Energy poverty:Impact and Public Recognition in the United Kingdom, France, Germany, Italy and Poland´(www.finsh.eu).

[49] Casa Clima http://www.agenziacasaclima.it/it/service-downloads/downloads/programma-di-calcolo/628-0.html

6. NORWAY

6.1 BUILDING PERFORMANCE MARKET DATA

6.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single- and multi-family dwellings) in the residential stock for EU countries and Norway. Norway is one of the countries with the highest rate of renewal of the building stock: In 2014 more than 1 % of the building stock was renewed, compared to 0.2 %/year in Spain for instance. The annual rate of new buildings increased until 2012 and was then stable over the last years. In 2012 – 2015 there were built around 25 000 – 28 000 new dwelling units per year. Traditionally, there were built more single-family homes, but the last years the annual rate for new multi-family dwellings was higher than for new dwellings in small houses.

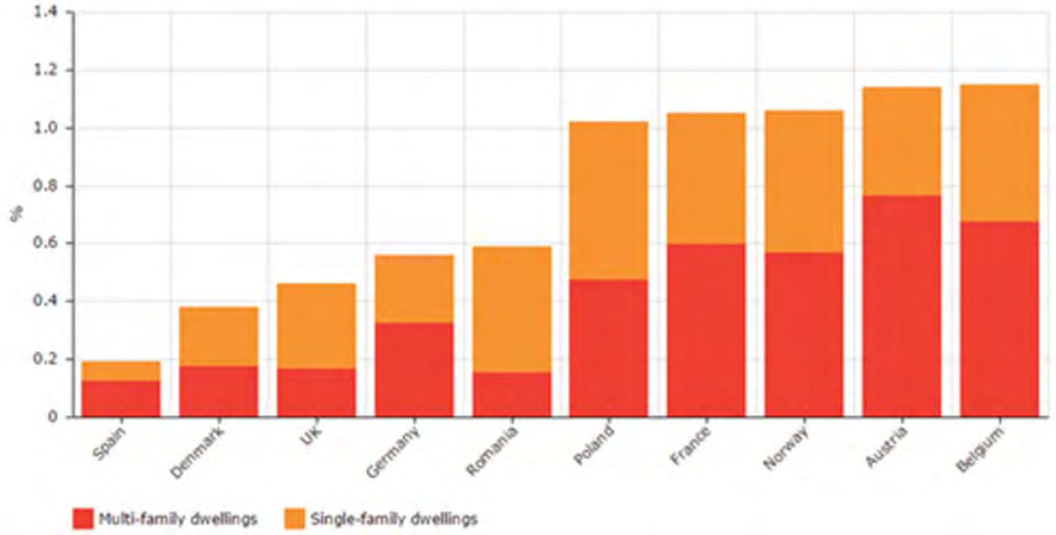

Figure 56 Share of new multi- and single-family dwellings in residential stock in 2014

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar

combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings

2. nZEB buildings according to national definitions

3. Buildings with an energy performance better than the national requirements in 2012

4. Buildings constructed/renovated according to national minimum requirements in 2012

The radar graph levels used for Norway are limited to only no. 3 and 4. In 2012, the Norwegian government stated that all new buildings should be at Passive house level in 2015 and nearly zero-energy buildings by 2020. Nevertheless, there was not provided a more precise definition. Also at present time, an official nZEB definition is missing. According to a proposal, a nearly zero-energy building should be on Passive house level, but in relation to final energy (i.e. not to useful energy) and with a higher share of renewable energy. Neither the proposal includes a clear definition and does not fit the current method within the building regulations, which is related to useful energy demand. The EPC classes in Norway are relating to final energy, but an nZEB according to the proposal would have better performance than the highest EPC class at present.

Due to the above-mentioned reasons, it was not possible to collect data for more than the categories 4 (according to building code) and 3 (better than current building code).

The data for buildings better than the current building code are from the Norwegian EPC database and include all buildings better than EPC class C (i.e. class B or A). By reason of the different reference parameters (building code: useful energy; EPC: final energy), there is no accurate accordance between building code requirements and EPC class C. Furthermore, energy performance certificates may be issued for individual dwellings in apartment buildings, while energy requirements according to the building code always relate to whole buildings. Summing up, we can say that EPC statistics only give an indication of the share "better than current building code".

Despite these limitations, the following graph shows clearly that the share of buildings better than the building code increases year after year. In 2014 there was only a minor portion built according to the building code, while the vast majority had a better energy performance. Within this majority, there are also some non-ambiguous zero- or plus-energy buildings, but these are not visible in statistics.

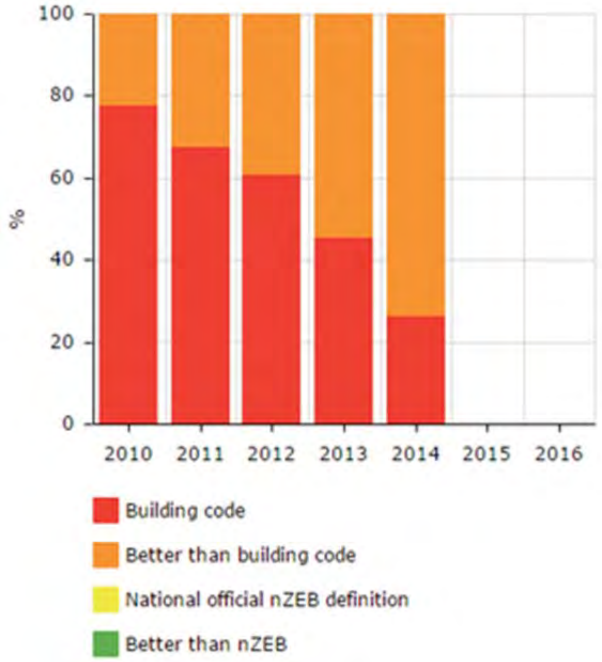

Figure 57 Distribution of new dwellings according to the nZEB radar graph – Norway

Source: ZEBRA

Because of the lack of an official European definition, to ease comparisons the EU ZEBRA2020 project developed the indicator of "major renovation equivalent". In ZEBRA, three renovation levels have been defined: "low", "medium" and "deep". However, these 3 levels definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

In Norway, there are no statistics on renovations available. Therefore, the calculation of the "major renovation equivalent" is solely based on assumptions and estimations. Four levels of renovation are considered: nZEB, deep, major and low (one or only a few single measures). Renovation rate level 1, 2 and 3 taken as a whole represents 1 % on average of the building stock (more in non-residential, less in single-family houses).

- Renovation rate level 2 represents 10 % of the overall rate of renovation for level 1, 2 and 3 (10 % of 1 % = 0.1 % of the building stock).

- Renovation rate level 3 represents 90 % of the overall rate = 0.9 % of the building stock [1 % (level 1, 2 and 3) – 0.1 % (level 2)]
- Renovation rate level 4: 2 % of the building stock

The savings rate by type of renovation is estimated as follows:

- Savings for level 1 – nZEB renovation are not estimated due to very few projects.
- Expected savings for level 2 – deep renovation: 75 % as average for all building categories.
- Expected savings for level 3 – major renovation: 25 %
- Expected savings for level 4 – implementation of single measures: 15 %

Estimations of rates and savings are based on built projects where SINTEF was involved and other reported projects, as well as on SINTEF's work in the Norwegian Zero Emission Buildings project (ZEB), with previous reports as a background. The assumed low total rate of 1 % for level 1-3 has been confirmed by a newer Enova study[50], carried out in 2015. The low estimation for savings according to level 3 is due to the fact that major renovation as defined in the EPBD (25 % of the building's envelope or value), may include only a few measures (e.g. only two external walls + belonging windows) which in itself cannot result in an energy performance like in ambitious renovations including the whole building envelope. The Enova study confirmed also that most major renovation projects do not comprise more than two larger measures.

The following graph shows the estimated "major renovation equivalent" for Norway in 2015, calculated according to the common ZEBRA method. The rate (2.4 %) is the highest of all countries represented in this comparison. However, this result is only caused by the method, not by particularly high renovation activities or ambitions. The underlying cause is the low level of energy savings at ordinary major renovations (25 %). For this reason, the high energy savings level at ambitious renovations (75 %) has an extra-large influence on the equivalent rate and pushes the rate up. On the other hand: With higher energy savings at ordinary major renovations (which is desired), the influence of the most ambitious renovations, and thus the equivalent rate would be substantially lower.

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[50] Enovarapport 2015:10. Enova is a public energy agency owned by the Norwegian State.

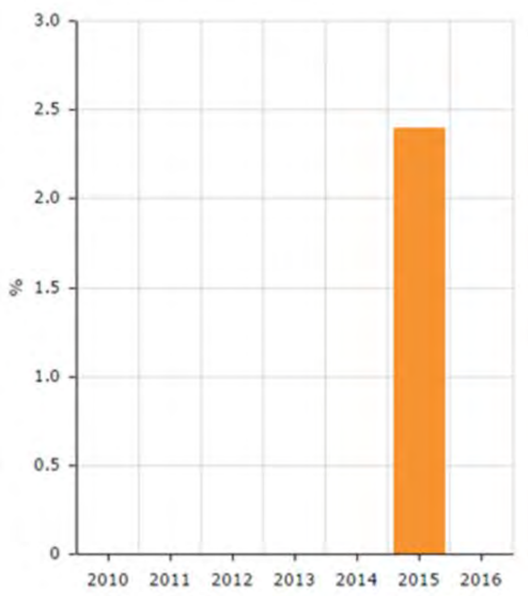


Figure 58 Equivalent major renovation rate – Norway

Source: ZEBRA

6.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Norway, it has been collected data of 31 nZEBs or high energy efficient buildings which were constructed recently. 24 out of the 31 are new buildings and 7 are renovated buildings. 12 have a residential use and 19 are intended for non-residential use.

Climate zones

As Table 9 indicates, the 31 selected buildings are located in the climate zone B, which is characterized by cold winters and mild summers.

Table 9 Building distribution by climate zones - Norway

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	24	7
C	Warm winters and warm summers		
D	Temperate winters and mild summers		
E	Temperate winters and warm summers		

Heating Demand

The average heating demand in new buildings is 15,5 kWh/m² a, while in renovated buildings it is 26,0 kW/m² a.

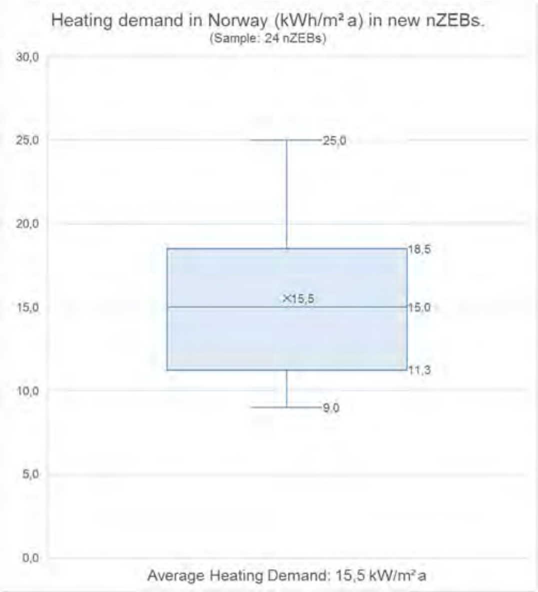


Figure 59Box plot of heating demand in new nZEBs - Norway

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,13 and 0,10 in roofs. In renovated buildings the average U-value in walls is 0,16 and 0,12 in roofs.

In both new and renovated buildings, the insulating material used in walls and roofs is in most of the cases unknown. Nevertheless, stone wool is the most reported option in all the cases with a share of 29% in walls of new buildings, 25% in roofs of new buildings, 43% in walls of renovated buildings and 14% in roofs of renovated buildings.

In windows, the average Uwin-value is 0,79 in new buildings and 0,89 in renovated buildings. Concerning the type of glass, the triple glass is the most common option by far with a percentage of 100% in new buildings and 86% in renovated buildings.

In the 46% of the new buildings, sunshade is the preferred option as passive cooling strategy. While in renovated buildings, 43% of the buildings do not use any passive cooling strategy, followed by the use of sunshade and night cooling strategies with a share of 29% each.

Active solutions

Mechanical ventilation with heat recovery system is used in the 100% of the selected buildings in both new and renovated buildings.

With regard to the heating system, heat pump is the most common option with a percentage of 58% for new buildings and 71% for renovated buildings. Electricity is the most used energy carrier in new and renovated buildings with a percentage about 70% in both cases.

The use of the same system for heating and DHW is the most common system with a share of 75% in new buildings and 57% in renovated buildings.

79% of the new buildings do not use any cooling system and 17% use cooling through heat pumps. While in renovated buildings, 57% of the buildings use heat pump as cooling system and 29% do not use cooling systems.

Renewable energies

In 2 out of the 24 new buildings, it is mentioned the use of photovoltaic systems and in 9 the use of solar thermal systems.

In 1 out of the 7 renovated buildings it is indicated the use of photovoltaic systems and also in 1 is mentioned the use of solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Norwegian reports and realised projects. It is obvious that higher ambition levels do not result in high additional costs. Renovation costs consist mainly of relatively high basic costs for the building renovation itself, regardless if energy savings are intended or not.

Table 10 Costs of different renovation depths and new built according to nZEB standards - Norway Please Note: Costs of minor renovation includes only profitable single measures. If renovation of parts of the building envelope should be the basis for the same minor savings, the costs would be 565 €/m².

Costs (€/m2)	NO
Minor renovation (15% energy savings)	35
Moderate renovation (45% energy savings)	725
Deep renovation (75% energy savings)	750
NZEB renovation (95% energy savings)	830
New built according to nZEB standards	2365
Additional funds for nZEB construction compared to new built	115

6.2 EPCS AND REAL ESTATE AGENTS

6.2.1 REAL ESTATE AGENTS SURVEY

1. The dominant form of EPC indicated by all real estate agents in Norway is mandatory certification.

2. In opinion of real estate agents from Norway, the main factors taken into account whilst selecting, purchasing or leasing real estate are mainly the location, price and the size of the real estate as well as various "nuisance" e.g.: a busy road, landing airplanes, landfill, a high-voltage line.

The cost of energy is indicated as very important factor by 2% and as important by 21% of real estate agents in Norway.

3. The EPCs in Norway are frequently required in concluding the purchase/lease contracts.

4. Majority of real estate agents in Norway are in general unsatisfied than satisfied with reliability of the data provided by the EPC.

5. Usefulness of EPCs in the professional activity of real estate agents in Norway is evaluated by them very low. Only 6% of the respondents in Norway indicates the usefulness of the certificate in their professional work.

6. The real estate agents in Norway rather don`t observe connection between the EPC and the improvement of the energy performance of buildings.

7. Usually, real estate agents in Norway don`t confirm correlation between the high energy performance and high value of real estate.

8. The real estate agents in Norway don`t observe that higher energy performance of buildings cause the growing interest in its purchase / lease in comparison to other buildings.

9. In opinion of real estate agents in Norway, the influence of having the higher EPC class on the exposure time of the real estate is very low.

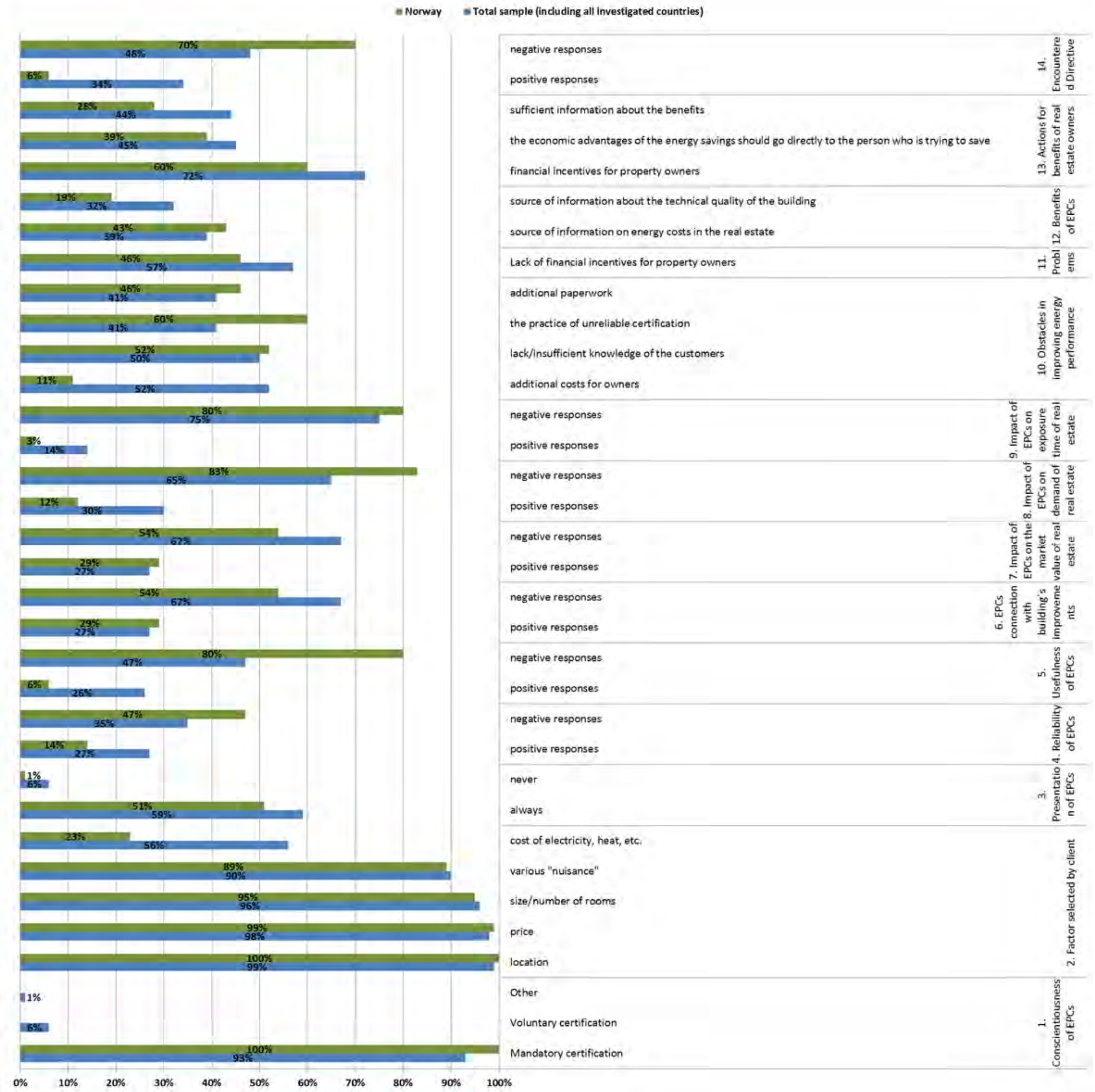
10. The main obstacles in improving the energy performance of buildings were indicated by real estate agents in Norway to be the following: the practice of issuing unreliable certificates, low social awareness in this subject, additional bureaucracy and financial matters (additional costs for owners).

11. Among the problems of implementing the improvement of the energy performance of buildings, the following has been mainly indicated by the real estate agents in Norway: the financial aspect, no incentive for the real estate owners.

12. The EPC as the source of information concerning rather the energy costs than the technical condition of the building is indicated by the real estate agents in Norway as quite important benefit of having EPC.

13. The most expected support that would influence the improvement of the energy performance of buildings, according to the respondents from Norway, is financial activity. Sufficient information about the benefits, economic support directed to real estate owners and economic incentives for those that undertake such actions.

14. The level of awareness and information about wording, requirements and settlements of the 2002/91/EC or 2010/31/EU Directive among the real estate agents in Norway is very low.


Norway
Total sample (including all investigated countries)
14. Encountered Directive
negative responses
70%
46%
positive responses
6%
34%
13. Actions for benefits of real estate owners
sufficient information about the benefits
28%
44%
the economic advantages of the energy savings should go directly to the person who is trying to save
39%
45%
financial incentives for property owners
60%
72%
12. Benefits of EPCs
source of information about the technical quality of the building
19%
32%
source of information on energy costs in the real estate
43%
39%
11. Problems
Lack of financial incentives for property owners
46%
57%
10. Obstacles in improving energy performance
additional paperwork
46%
41%
the practice of unreliable certification
60%
41%
lack/insufficient knowledge of the customers
52%
50%
additional costs for owners
11%
52%
9. Impact of EPCs on exposure time of real estate
negative responses
80%
75%
positive responses
3%
14%
8. Impact of EPCs on demand of real estate
negative responses
83%
65%
positive responses
12%
30%
7. Impact of EPCs on the market value of real estate
negative responses
54%
67%
positive responses
29%
27%
6. EPCs connection with building's improvements
negative responses
54%
67%
positive responses
29%
27%
5. Usefulness of EPCs
negative responses
80%
47%
positive responses
6%
26%
4. Reliability of EPCs
negative responses
47%
35%
positive responses
14%
27%
3. Presentation of EPCs
never
1%
6%
always
51%
59%
2. Factor selected by client
cost of electricity, heat, etc.
23%
56%
various "nuisance"
89%
90%
size/number of rooms
95%
96%
price
99%
98%
location
100%
99%
1. Conscientiousness of EPCs
Other
1%
Voluntary certification
6%
Mandatory certification
100%
93%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

6.2.2 REAL ESTATE PRICES AND EPCS

As a member of the European Economic Area (EEA) but not the EU, Norway is only obliged to transpose and implement the initial 2002 EPBD Directive. This is because the 2010 EPBD recast was not included in the Agreement on the EEA (CA EPBD 2016). The 2002 Directive was fully implemented by 2013 and the 2010 Directive has since been used as a guide for policy formation. Current Norwegian legislation requires EPCs to be displayed at the point of marketing. In addition, the legislation exceeds the requirements of the Directive by stating that all dwellings must acquire an EPC. An energy grade is given on the EPC according to the calculated final energy needs, which ranges from A (lowest energy needs) to G (highest energy needs). New buildings that meet - but do not exceed – requirements, are usually given a C rating (CA EPBD 2016). Given the requirement for all dwellings to be certified, the percentage of the building stock with valid EPCs is relatively high. In 2012, it was estimated to be 75% (CA EPBD 2016b).

Statistically significant results were not obtained for the price contribution due to EPC rating in the Norwegian rental market. As a result, these results have been omitted from the report.

The results for the Norwegian sales market indicate the expected statistically significant surpluses due to EPC ratings for all shifts except for at the lowest end of the scale, between G- and F-rated dwellings. It is possible that the barriers to improving energy efficiency are higher, or perceived to be higher, for the least efficient dwellings. However this effect has not been observed for other countries. Data on the construction year was not available. However, the area variable displays a positive correlation with price. The linear model suggests a significant price surplus of 6.4% for each letter improvement.

6.3 EXISTING POLICIES

The EPBD recast is not yet implemented in Norway. Nonetheless, the content and the ambition of the Directive are actively pursued in agreements, strategies and the planning of future regulations. However, Norway does not necessarily follow all the formal procedures required in the Directive.

A parliamentary agreement states tightened requirements on Norwegian Passive House level from 2015 and nZEB level from 2020. According to a proposal, a nearly zero-energy building should be on Passive House level, but in relation to final energy and with a higher share of renewable energy. As an intermediate step, current regulations are sharpened from 2017.

Existing regulations are among the most stringent in Europe and include already specific requirements on renewable energy. Common U-values are already on a nearly cost-optimal level and most new buildings are equipped with supply and exhaust air ventilation with heat recovery. The gap between current requirements and Passive House or nZEB level is therefore smaller than in Central European countries.

The building sector and energy targets

Norway is not a member of the European Union, but a country within the European Economic Area (EEA). Up to now, the EPBD recast has not been formally included in the Agreement on the EEA. Thus, the recast is not implemented in Norway. The content and the ambition of the Directive are actively pursued in the planning of future regulations, but Norway does not necessarily follow all the formal procedures required in the Directive. Additionally, the EED is not yet implemented in Norway and therefore, a formal NEEAP is not yet prepared. However, elements of a NEEAP are included in certain documents[51,52] and among these present the following targets for energy savings:

- For 2020, **15 TWh energy savings in the building sector**, compared with a base line scenario implying the 1997 building regulations were not tightened.
- For 2040 the energy goal not yet quantified, however, the ambition is that energy use in buildings per square meter will be substantially lower than today.

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[51] Innst. 390 S (2011–2012), Innstilling fra energi- og miljøkomiteen om norsk klimapolitikk ("Klimaforliket 2012")

[52] Innst. 163 S (2012–2013), Innstilling frå energi- og miljøkomiteen om endringar i statsbudsjettet for 2012 under Olje- og energidepartementet, chapter "Mål for energieffektivisering i bygningar"

Energy performance requirements

The intended 2015 requirements were somewhat delayed and have been stated in November. After a transitional period, the modified and sharpened requirements will come into full effect from January 2017. The effective 2010 Technical Building Regulations TEK10 require specific maximum overall net energy demand (total useful energy), which includes space heating, cooling, DHW and all electricity use, also for lighting and appliances.

TEK10 includes two options for how to fulfil the energy performance requirements. The first option (1) contains specific overall net energy limits for 13 different building categories, as shown in the table below. The other option (2) is to use a package of predefined energy measures with component requirements, which in total are considered to meet these overall net energy limits. From 2017 option (2) will apply only to residential buildings. For all non-residential buildings option (1) with overall net energy frame calculation will be mandatory.

Table 11 Energy requirements in Norway

Overall net energy (kWh/m²/yr)		**Residential buildings**				**Non-residential buildings**							
		Single family house (SFH)[1]		**Multi-family house (MFH)**		**Offices**		**Educational buildings[2]**		**Hospitals[3]**		**Others (please specify)[4]**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
New stock	**Total***	125	140	115	115	150	150	120	160	300	335	140	250
Renovated stock **	**Total***	125	140	115	115	150	150	120	160	300	335	140	250
New from 2017	**Total***	105	120	95	95	115	115	110	125	225	265	130	230
Renovated from 2017	**Total***	105	120	95	95	115	115	110	125	225	265	130	230

Note: *Total: Overall net energy demand (total useful energy) includes all energy need within the building envelope, except process energy (such as in workshops or production facilities).

** Applies only in case of general rebuilding, so that the building appears to be new, see body text below.

[1] SFH: To be calculated as: 120 kWh + 1600 kWh/m² heated floor area (2017: 100 + 1600 kWh/m²). The minimum and maximum value was calculated for a 300 and an 80 m² SFH, respectively. For even larger or smaller homes the numbers wood slightly decrease or rise.

[2] Min = School building; Max = University/university college.

[3] Min = Applies to normal floor space; Max = Applies to floor space in which heat recovery of ventilation air poses a risk of spreading pollutants/contagions.

[4] Nursery 140; nursing home 215 (250 if risk of spreading pollutants/contagions); hotel 220; sports facility 170; commercial building 210; culture facility 165; light industry/workshop 175 (190 if risk of spreading pollutants/contagions). 2017: Nursery 135; nursing home 195 (230 if risk of spreading pollutants/contagions); hotel 170; sports facility 145; commercial building 180; culture facility 130; light industry/workshop 140 (160 if risk of spreading pollutants/contagions).

There are no climate adjustments or climate zones. Requirements and calculation method are related to Oslo climate, which approximately corresponds with average climate conditions for the whole country. Nevertheless, only 20 % of the building stock is situated in areas colder than Oslo.

Thermal requirements for building components and thermal requirements

In addition to the energy performance requirements described in the previous paragraph, TEK10 states some absolute minimum requirements on U-values, air tightness and insulation of pipes, equipment and ducting. These minimum requirements have to be met in all cases (i.e. in both options for energy performance described in the previous paragraph, and also in renovations). Except small houses (SFH and row houses), there are also minimum requirements concerning sun exposure.

Regional or local authorities are not allowed to state stronger energy requirements than defined in the building regulations. Nevertheless, some municipalities (as property owners) are selling their own building plots under the precondition of more ambitious energy performance. In such cases, private-law agreements may for example state EPC level A, Norwegian Passive House standard or Norwegian BREEAM excellent as mandatory. National approaches are carried out for Passive Houses as well as for BREEAM assessment.

Compliance

Since 1st January 2013, the Building Application Regulations SAK10 requires supervision by an independent expert company. In this connection, the report of a mandatory air leakage test is to be checked for all new buildings (except leisure homes with only one dwelling unit). Building physics has to be checked for both new buildings and renovations, apart from simpler detached buildings like single family homes.

In addition to the compulsory independent supervision, the public construction authority may carry out inspections on the municipality's own responsibility, which also may include supervision of independent supervisors. However, in most cases public inspections will not be conducted.

The nZEB plan

Norway has until March 2016 neither stated an official nZEB definition nor provided an nZEB plan (see D4.2 “Overview of building-related policies” for background). The 2012 "klimaforliket" agreement confirmed nearly zero-energy level by 2020. So far, there was not provided a more precise definition. According to a former proposal, a nearly zero-energy building should be on Passive House level, but in relation to final energy (i.e. not to useful energy) and with a higher share of renewable energy (current regulations already include requirements on renewable energy sources). The proposal does not include a clear nZEB definition and does not fit the current method within the building regulations, which is related to useful energy demand. Since the EPC classes in Norway are relating to final energy, we can however say an nZEB according to the proposal would have better energy performance than the highest EPC class at present. Common primary energy factors are not stated so far.

Renewable sources in the building sector

According to § 14-7 of the current Technical Building Regulations it is not permitted to install a boiler of fossil oil to accommodate the basic energy load for space and water heating. Buildings with more than 500m² heated floor area must be planned and executed such that at least 60% of the net heat demand (useful energy demand, including DHW) can be covered by other energy supply than direct-acting electricity or fossil fuels. For buildings up to 500m², 40% of net heat demand applies correspondingly.

From 2017, the prohibition of oil boilers is extended to all installations for fossil fuels and in the residential sector for both basic, both for basic and peak load. On the other hand, energy supply by direct-acting electricity is no longer explicitly limited. However, in all buildings with more than 1000m² heated floor area energy-flexible heat systems must be installed. Normally, this implies water-based systems where converting to other energy supply than direct-acting electricity would be possible later

Financial and fiscal support policies/programmes

In Norway, Enova, a government-owned energy agency, offers investment support for energy efficient new buildings and ambitious major renovations as well as grants for single measures or components and also for a state analysis of existing buildings (related to energy efficiency). Legislative document: allocation letter "Oppdragsbrev til Enova SF 2015".

Husbanken, the Norwegian State Housing Bank, offers grants for a state analysis of existing residential buildings (related to need of repair/renovation with a focus on universal design and/or energy efficiency) as well as favourable loan with lower rates of interest than an ordinary bank for both new residential buildings and major renovations. Normally, the prerequisite for favourable loan is energy performance and universal design on a higher level than required in regulations.

6.4 NZEB-TRACKER

This section highlights the key findings from the nZEB tracker for Norway in 2014.

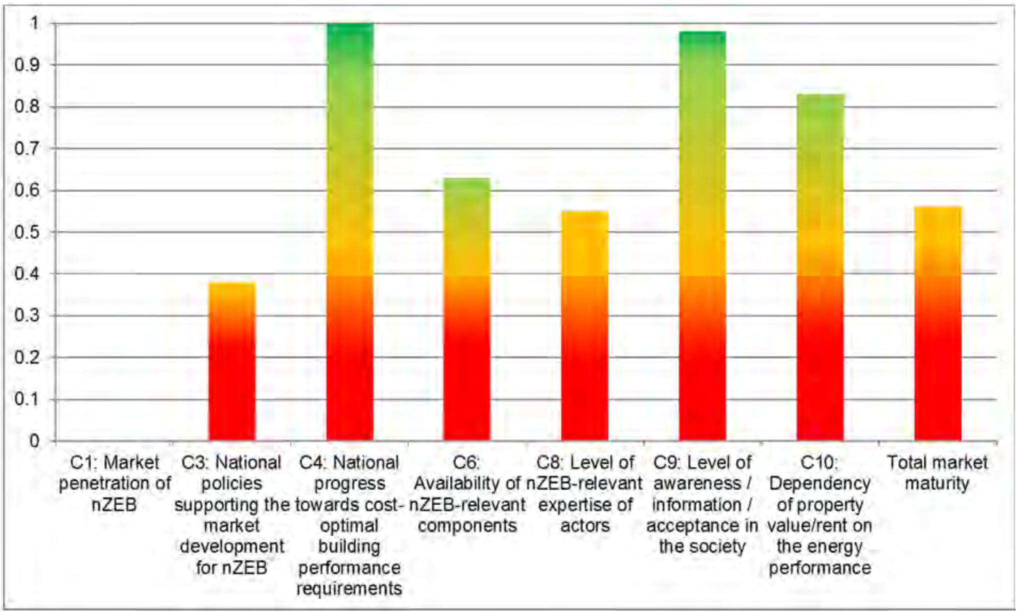

Figure 60 nZEB-tracker score for Norway in 2014

C1: Market penetration of nZEB

- Norwegian result: not stated ZEBRA average: **0.32**
- An nZEB definition is not yet stated, therefore are no data available. There is a high and increasing share of new buildings better than the building code, including some zero- or plus-energy buildings, but there are no precise statistics on these levels in Norway.

C3: National policies supporting the market development for nZEB

- Norwegian result: **0.38** ZEBRA average: **0.52**
- Policies in Norway are evaluated differently, e.g. with better score for current regulations and low score for EPC use and layout in relation to nZEBs. Some policies suite also better for the non-residential sector than for residential buildings.
- There is a need for improvement and adaptation, in particular in connection with the still outstanding final definition of the nZEB standard in Norway.

C4: National progress towards cost-optimal building performance requirements

- Norwegian result: **1.00** ZEBRA average: **0.94**
- According to cost optimality reports, the Norwegian building regulations already matched the cost optimal building energy performance level up to, and including 2014. Current

changes in cost optimality levels will be met by 2017, when stated, sharpened requirements will be in full effect.

C6: Availability of nZEB-relevant components

- Norwegian result: **0.64** ZEBRA average: **0.83**
- Passive components, required or reasonable for nZEBs, were well or very well available in Norway. The same applies most of the relevant active systems.
- Architectural solutions, district heating, PV and solar thermal systems seemed to be available only moderately.

C8: Level of nZEB-relevant expertise of actors

- Norwegian result: **0.55** ZEBRA average: **0.63**
- There were different pictures regarding the availability of experts for the three phases.
- Whereas the availability of experts for planning was assessed moderate sufficient and for examination/certification a bit lower, the interviewees agree that there was a lack of expertise for the construction phase.

C9: Level of awareness / information / acceptance in the society

- Norwegian result: **0.98** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings is high and increased further again slightly from 2014 to 2015.

C10: Dependency of property value/rent on the energy performance

- Norwegian result: **0.83** ZEBRA average: **0.74**
- Compared to site, living quality, aesthetics and financial aspects, the energy performance was the least important aspect for customers' decision on renting/buying a real estate.

Maturity of the Norwegian nZEB market

- Norwegian result: **0.56** ZEBRA average: **0.66**
- The nZEB market seemed to be slightly less well developed than the ZEBRA average. The regulatory framework appeared sufficient in 2014, though the final definition of the nZEB standard is still pending. There is also a need for improvement and adaptation of policies.
- Most of relevant high performance building components were easily available, but the availability of some active components was assessed slightly lower.
- The availability of experts may limit the future development of the nZEB market.
- People became more and more aware of the energy performance of buildings; so far it had a minor priority on buy decisions.

6.5 SCENARIOS

Market penetration of nZEB – new building construction

Figure 61 shows annual construction of conditioned floor area according to different standards. The results are shown for the historical development and in both policy scenarios, current and ambitious for the long term development from 2021 to 2050. For an explanation of the scenario framework of the current policy scenario and the ambitious policy scenario, see part "Introduction". Data on historical development of new building construction according to national standards were collected in the project, see part "Building performance market data"and are available on the project´s data tool (http://www.zebra-monitoring.enerdata.eu/). In 2012, the share of the new building construction according to the building code was app. 60% of the total new building floor area. According to building code means that buildings are constructed according to national minimum requirements. Norway has until now March 2016 neither stated an official nZEB definition nor provided an nZEB plan (see D4.2 "Overview of building-related policies" for background). The 2012 "klimaforliket" agreement confirmed nearly zero-energy level by 2020. From 2030 to 2050, the share of stringent measures is increasing. In the ambitious scenario, the share of stringent measures is much higher due to the policy implication.

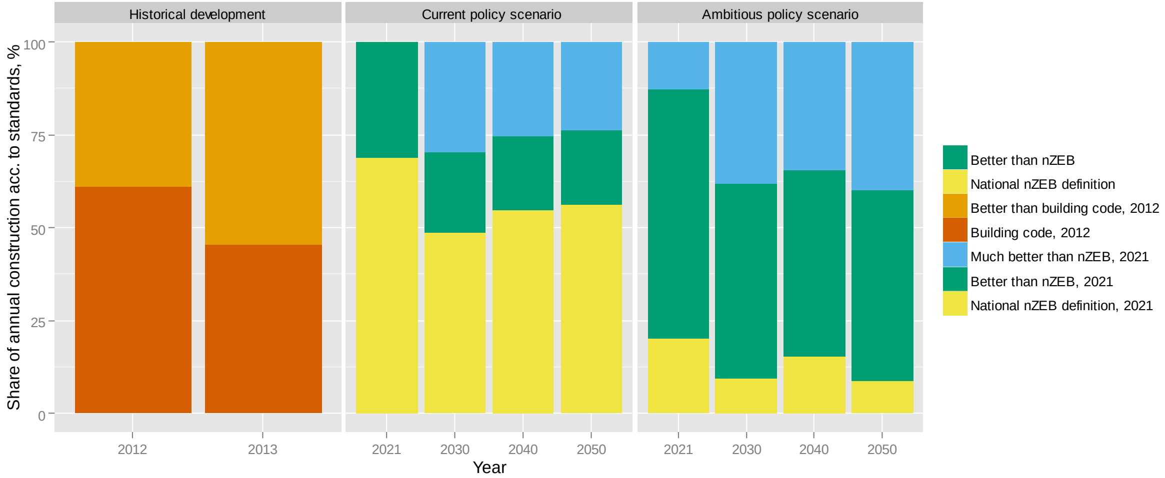

Figure 61 Share of annual construction of conditioned floor area built according to national standards

Building renovation activities

Figure 62 shows historical development and future development in current and ambitious policy scenarios of annual renovation of conditioned floor area by renovation levels.

The following renovation categories were defined in the current policy scenario:

- medium renovation which refers to the building codes

- light renovation meaning that in reality not all buildings fulfil the criteria set in the building legislation and
- deep renovation reflecting the nZEB definition

In the ambitious scenario, from 2021 to 2050, all buildings fulfil at least the building standards. There is an additional renovation level "deep plus" which means higher energy performance achievements.

In Norway, in the current policy scenario, the share of the medium and deep renovation makes up a significant share on the total renovated building floor area from 2021 to 2050. In the ambitious policy scenario, which implements stringent measures on existing buildings, the share of the deep and deep plus renovation is increased compared to the current policy scenario. In 2040 around 73% of the renovated building floor area will be renovated with a strong share of deep plus (23%) and deep renovation (50%), resulting in higher energy savings (Figure 66).

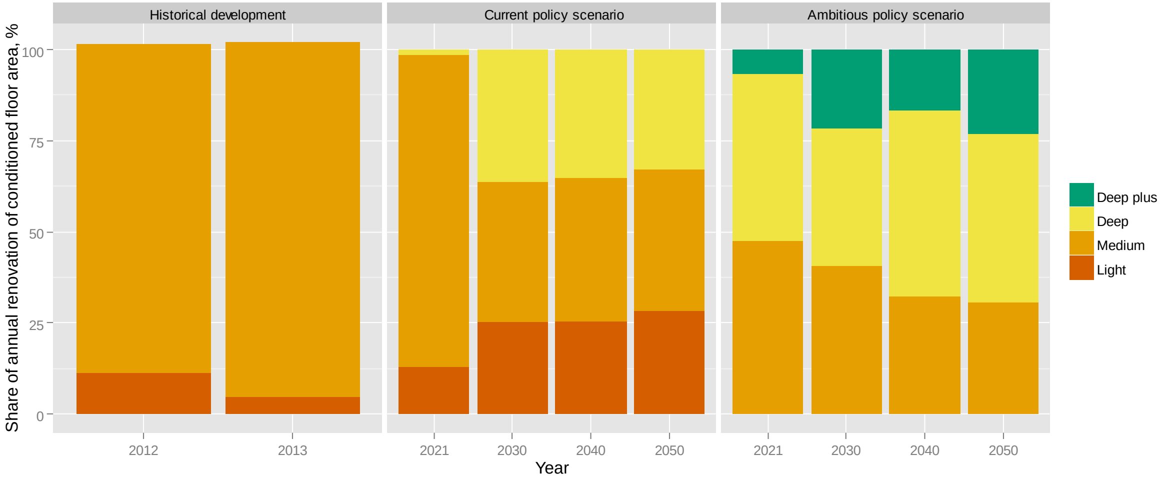

Figure 62 Share of annual renovation of conditioned floor areas by renovation levels in current and ambitious policy scenarios

Figure 63 shows the distribution of the specific energy need for space heating (norm energy need calculation according to EN13790) in the total building stock after building renovation by using the following renovation levels, light, medium, deep and deep plus. The specific energy needs are shown in a box-plot diagram. The median (middle quartile) marks the mid-point of the data and is shown by the line that divides the box into two parts while the diamond indicates the mean value. The data is represented for 2012 for not renovated buildings, light, medium and deep renovation. The deep plus renovation shows specific energy need for buildings being renovated after 2020. In Norway, medium renovation refers to the building code, the effective 2010 Technical Building Regulations TEK10. The specific energy need for space heating of light renovation is higher compared to the medium renovation, which means that in reality not all buildings fulfil the criteria set in the building legislation. Deep and deep plus renovation include i.e. the installation of mechanical ventilation.

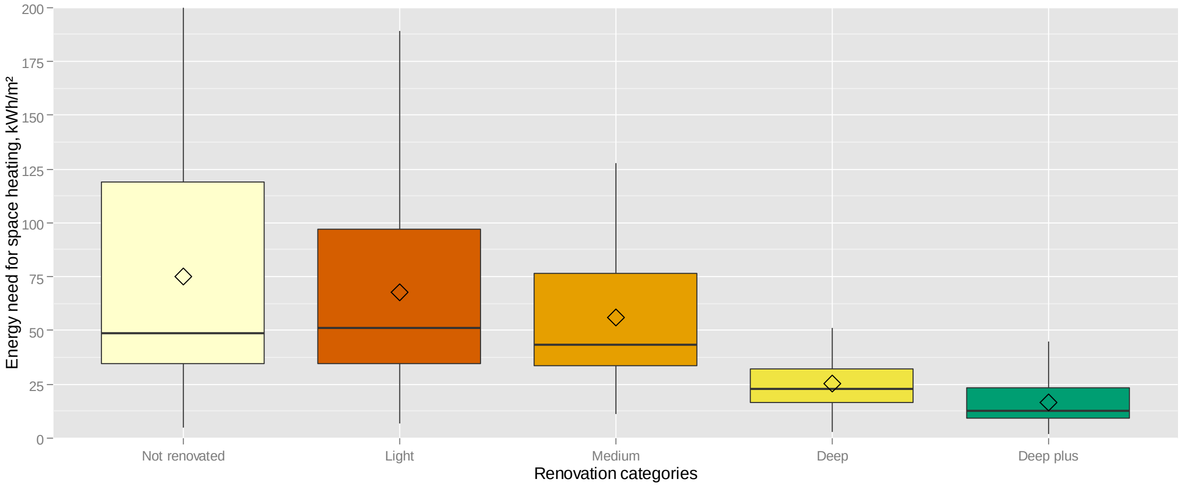

Figure 63 Distribution of the buildings specific energy need for space heating

Economic indicators and national policies supporting the market development for nZEB

Figure 64 shows total yearly investments in the building envelope (thermal renovation) and in renewable heating systems from 2012 to 2050 in the current and ambitious policy scenarios. The investments are slightly higher in the ambitious scenario due to higher number of the renovated buildings, higher quality of the implemented thermal renovation and higher investments in the renewable systems. Figure 65 shows total yearly public budget for financial support of renewable heating systems and renovation of the building envelope. The yearly public budgets are significantly higher in the ambitious policy scenario.

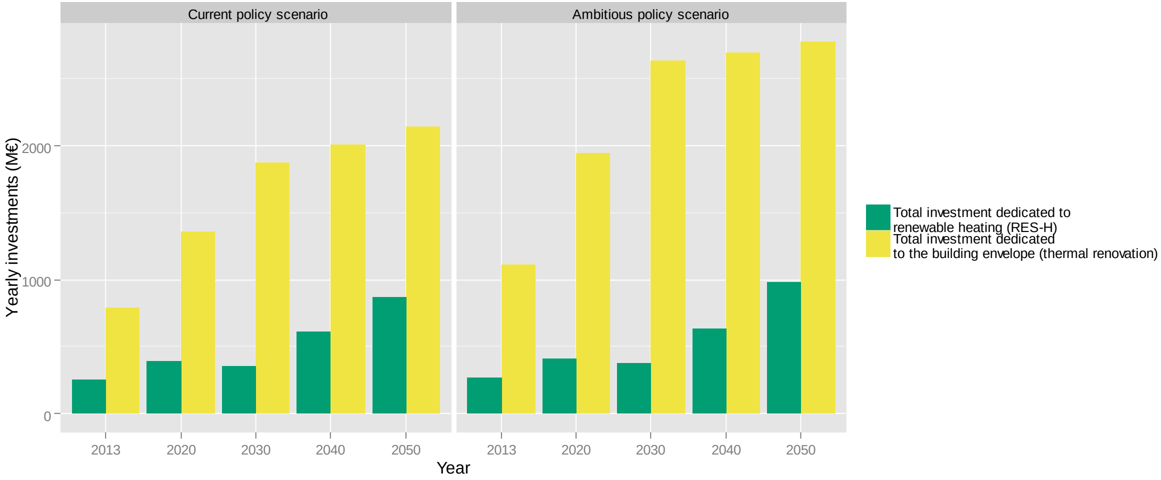

Figure 64 Total yearly investments in renewable heating systems (RES-H) and renovation of the building envelope including public budget, 2013 to 2050, current policy and ambitious policy scenario

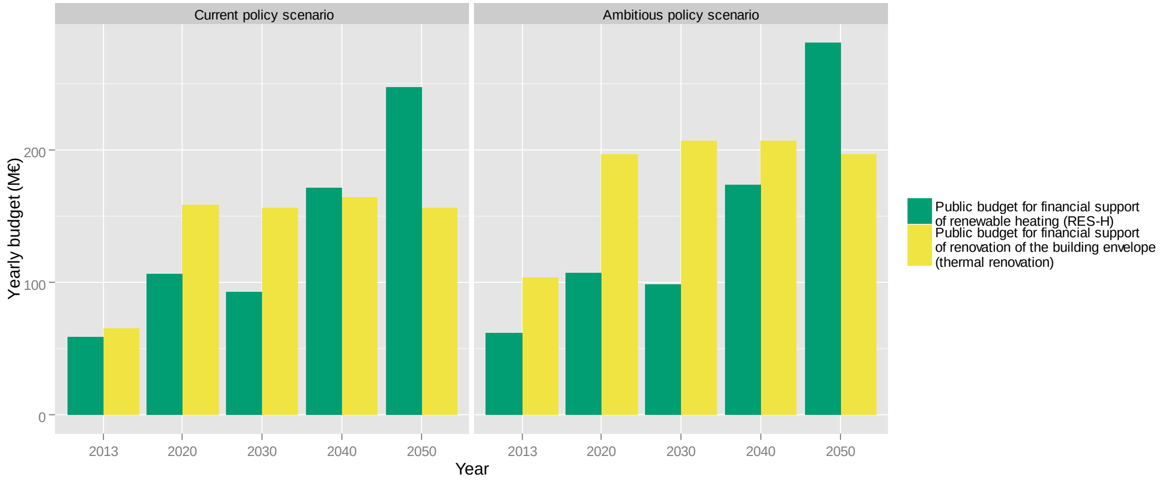

Figure 65Total yearly public budget for financial support of renewable heating systems (RES-H) and renovation of the building envelope, 2013 to 2050, current policy and ambitious policy scenario

Development of the building related energy demand

Figure 66 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Norway´s building stock is 51.7 TWh in 2012. The scenario shows a slow-down of the energy demand of 4% from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 31% in the current policy scenario in the long term development between 2012 and 2050 and by 51% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Norway, according to § 14-7 of the current Technical Building Regulations it is not permitted to install a boiler of fossil oil to accommodate the basic energy load for space and water heating. From 2017, the prohibition of oil boilers is extended to all installations for fossil fuels and in the residential sector for both, basic and peak load. On the other hand, energy supply by direct-acting electricity is no longer explicitly limited. These are the main reasons of the decrease of the fossil-fuel-based heating systems from 2012 to 2050. The share of non-delivered energy (i.e. solar and ambient energy) is around 7% of final energy demand in 2012 and around 25% and 27% in the current policy and ambitious policy scenarios respectively.

Figure 67 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 58% in current policy scenario and around 62% in ambitious policy scenario. The reduction of the primary energy demand is around 42% and 62% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) The overall energy demand and energy performance of buildings and (2) the share of renewable heating.

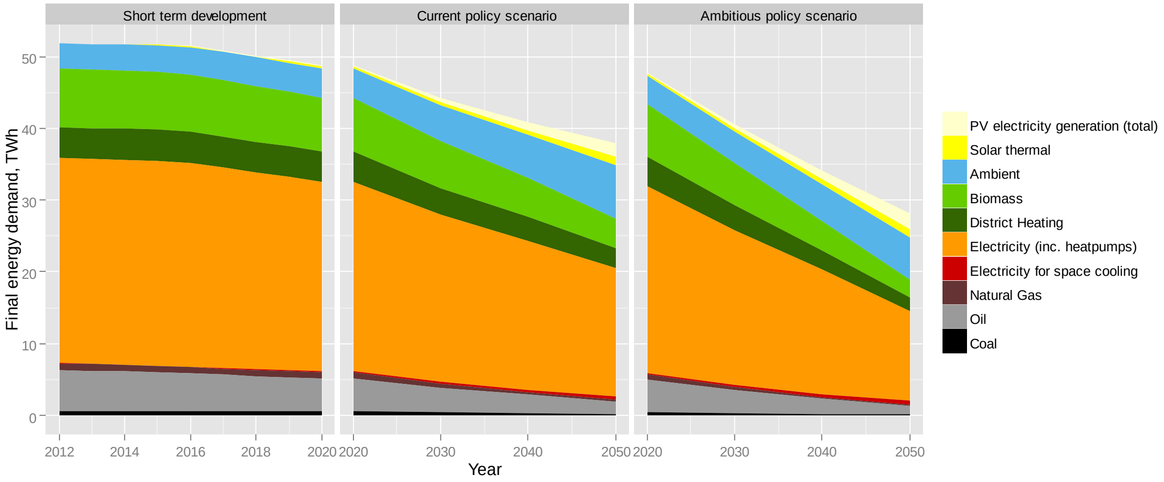

Figure 66 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

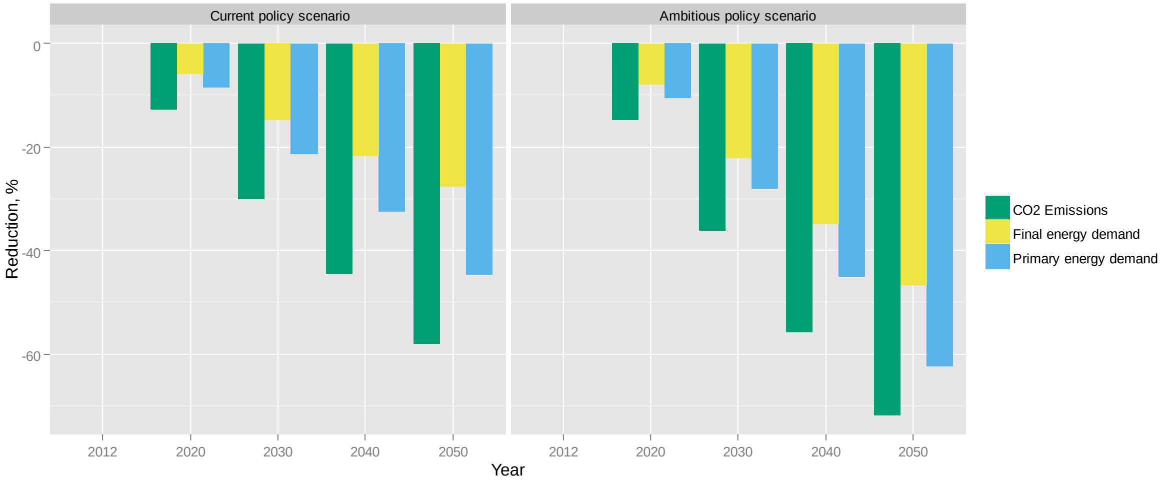

Figure 67 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

6.6 RECOMMENDATIONS

Existing regulations for new buildings in Norway are among the most stringent in Europe and included specific requirements on renewable energy already since 2007. Common U-values are already on a nearly cost-optimal level and most new buildings are equipped with supply and exhaust air ventilation with heat recovery. The gap between current requirements and Passive House or nZEB level is therefore smaller than in Central European countries.

The EPBD recast is not yet implemented in Norway. Nonetheless, the content and the ambition of the Directive are actively pursued in agreements, strategies and the planning of future regulations. However, there are notable barriers also in Norway, mainly connected to the existing building stock, non-professional building owners, unfavourable owner structure, low electricity prices and a lack of incentives for convincing private owners in making costly high energy efficient investments with a comprising high risk and long amortisation terms.

NO1 - Develop clear regulatory requirements for major renovation and renovated building elements

NO2 - Limit basic (fixed) prices for grid connection and electricity supply

NO3 - Improve support programs towards reliable, plain and long-lasting schemes, tailored to specific target groups

NO4 - Improve promotion of demonstration projects by exemplifying comfort benefits and energy performance in practice, after completion

NO5 - Evaluation of EPC system, targeting increased reliability in particular for existing homes

NO6 - Facilitate feed-in of PV surplus electricity into the grid by groups of private households

NO7 - Favourable loan: Require high energy performance also in projects with a share of dwellings for disadvantaged people

#NO1 - Legislative and Regulatory Instruments

Develop clear regulatory requirements for major renovation and renovated building elements

It should be developed clear threshold values, defining when energy performance requirements for comprehensive renovation "kicks in", and distinct component requirements for single renovation measures. Since threshold values could be "bypassed" by renovating in stages, requirements for renovated building elements would be of capital importance.

Current building code is unclear regarding renovation projects. For some projects, the building code can even be counter-productive because less ambitious solutions are chosen to avoid having to build according to the code. There is also a lack of component requirements, related to individual renovated building elements.

Better regulatory requirements for renovation will help trigger the big energy savings potential in the existing building stock. Still, regulatory measures alone cannot contribute substantially to ensure ambitious energy upgrading. Therefore, other instruments like tailored support schemes and improved promotion, including comfort benefits, are important.

Example: Danish Building Requirements

Regulation requirements for renovations are a challenge in all countries, in particular stating requirements for major renovation that cannot be "bypassed". Also for building elements, it is difficult to create strict regulations that are ambitious enough. For example, added insulation on a facade may become unprofitable if the roof overhang needs to be extended. In many other cases, ambitious requirements would be suitable. Trying to meet this challenge, the 2015 Danish building regulations include relatively ambitious requirements in the case of rebuilding or other changes, although these requirements may be adapted if they are not cost-efficient. So, the requirement in effect is realisation on a level which is profitable. In contrast, if a component is to be replaced as a whole, the requirements are obligatory, regardless profitability. For windows, the requirements apply for every single element, but the performance is related to reference dimensions[53].

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[53] http://bygningsreglementet.dk/; www.byggeriogenergi.dk/vaerktoejer/br15/ (guidelines)

#NO2 – Economic Measures

Limit basic (fixed) prices for grid connection and electricity supply

In Norway, every household receives two bills for electricity, eventually one bill divided in two: One for the grid rental and one for electricity consumption itself. Today the bill for grid rental consists mainly of a fixed sum per month or year (big variations through-out the country) and a minor part based on consumed energy (kWh). The bill for electricity consumption itself can also include a fixed som. The grid rental cost with its fixed basic price is often so dominating that the incentive to save energy is lost. To shift the cost away from the fixed part of the grid rental and towards energy consumption (kWh) would give the consumer an economic incentive to use less electricity. Since dwellings in Norway often are heated by electricity, this measure would have greater impact than in many other countries. Strictly limited basic prices for grid rental would also make it more cost-efficient to shift from electricity to other energy carriers for heating and DHW.

In countries like Germany and Austria, electricity bills included traditionally only a small basic price, so they mainly reflect the electricity consumption itself.

#NO3 – Economic Measures

Improve support programs towards reliable, plain and long-lasting schemes, tailored to specific target groups

Government sponsored support programmes have being revised and changed at a high rate in recent years. Schemes should aim to be stable and predictable over time and be customized for specific targets – for instance renovation of owner-occupied multi-family homes built in the 1960s. Also owners of single-family homes and (generally) ambitious step-wise renovation should be addressed in a better way. Clear criteria and simple application are important.

Example: Support programmes in Austria and Germany

Austria has a long tradition of energy ambitious support programs (Wohnbauförderung and Sanierungsscheck) with a high marked share. In recent years, this applies also Germany (KfW programs). Nevertheless, these schemes are less successful when it comes to renovation, in particular renovation of single-family homes and multi-family buildings with owner-occupied dwellings, which are dominating in Norway.

#NO4 – Communication

Improve promotion of demonstration projects by exemplifying comfort benefits and energy performance in practice, after completion

In order to create demand for environmentally ambitious buildings, it is important to demystify green buildings, and to appeal to other client needs or qualities of a building, such as comfort, indoor environment, and a simple and modern everyday/workday. Furthermore, it is crucial to show that these green buildings perform what was promised, in both comfort and energy consumption terms. Therefore, existing databases, web sites and information campaigns should be improved. As a basis, much more projects should be monitored and evaluated during occupancy.

Example: Klimaaktiv

The Austrian Climate Initiative klimaaktiv is an example for a comprehensive program which offers information and consultancy, works on quality standards and helps to build up networks. Buildings and renovation is one of the main topics within the program, including a large project database. Quality and comfort are important issues on the klimaaktiv website[54].

#NO5 – Quality of action

Evaluation of EPC system, targeting increased reliability in particular for existing homes

Frontrunners on sustainability in the building industry has acknowledged the EPC scheme, for example by implementing into the energy chapter in the Norwegian version of BREEAM. But for the rest of the industry the EPC is not considered important and in the housing market it is considered unreliable because of the possibility for home owners and owners of dwellings in existing buildings to do the certification process by themselves. In addition, certification per dwelling instead of the whole residential building may be an issue which is worth an evaluation.

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[54] http://www.klimaaktiv.at/bauen-sanieren.html

Examples: see EU initiative CA EPBD

As far as we know, other country has implemented neither the option of self-certification by the owner, nor certification per dwelling unit. Within the Concerted Action EPBD all 28 EU Member States plus Norway exchange knowledge and experience in implementing the Energy Performance of Buildings Directive (EPBD)[55].

#NO6 – Incentivize the market

Facilitate feed-in of PV surplus electricity into the grid by groups of private households

The existing feed-in regulation does not allow the possibility for multi-family buildings to use electricity generated on the building in the respective dwellings. Self-consumption can only be for common purposes, such as hall lighting etc., and eventual surplus energy must be exported to the grid at a lower price that the individual dwellings then must buy it back for.

#NO7 – Social issues

Favourable loan: Require high energy performance also in projects with a share of dwellings for disadvantaged people

Currently, a precondition of favourable loan, granted by The Norwegian State Housing Bank, is to fulfil ambitious criteria for universal design and energy performance. In the case of projects that include a share of dwellings for disadvantaged people, there is a dispensation from these requirements. This exemption may result in lower energy performance in all dwellings in the whole project, also the dwellings dedicated for the ordinary housing market. Moreover, disadvantaged persons, which often have low income, will have to pay for a higher energy bill than necessary. If energy prices increase in the future, these people must pay still higher bills, or they need further allowances from the municipality or the state. This is not a future-orientated, sustainable rule, for neither the tenant nor the public.

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[55] http://www.epbd-ca.eu/

7. POLAND

7.1 BUILDING PERFORMANCE MARKET DATA

7.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for UE countries. Poland is one of the UE countries with the highest rate of renewal of the building stock: in 2014 more than 1% of the building stock was renewed. The annual rate of new buildings is almost on similar level: it was 135.840 in 2010 and in 2014 it was 143.000. The number of new single and multi-family dwellings is comparable.

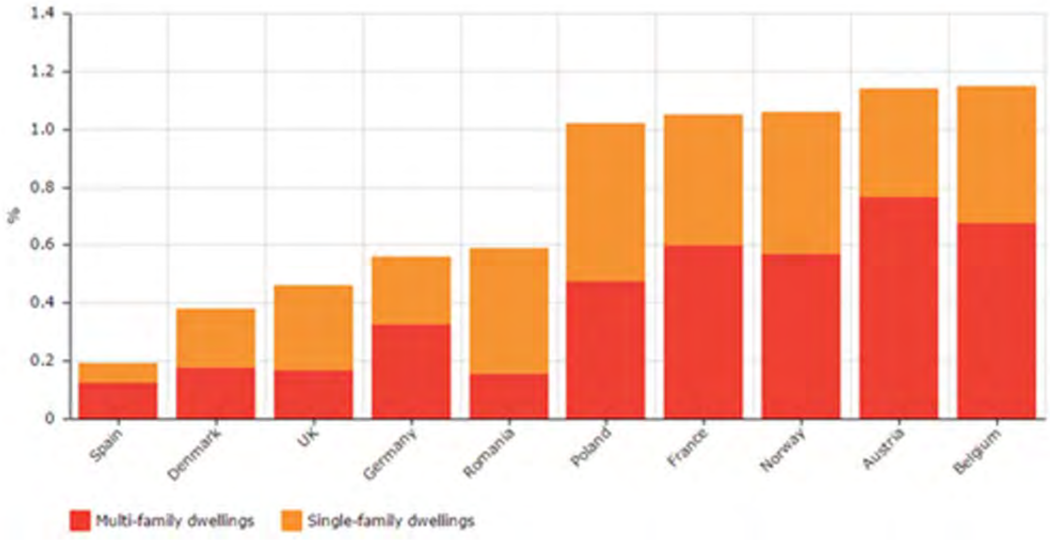


Figure 68 Share of new multi- and single-family dwellings in residential stock in 2014

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 “nearly zero-energy building” means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings

2. nZEB buildings according to national definitions

3. Buildings with an energy performance better than the national requirements in 2012

4. Buildings constructed/renovated according to national minimum requirements in 2012

The data used in nZEB Radar are coming from BuildDesk. BuildDesk offers a suite of software that allows users to make calculations of energy performance of buildings. The company has own database which is covering about one fourth of the market for calculation of energy performance of buildings. This is the largest database available in Poland. The used methodology is based on energy demand for heating.

Translating the definition of nZEB radar in the case of Poland is as follows:

Better than nZEB (net ZEB or positive house)	Energy demand for heating (without DHW, cooling or lightning and without losses in the heating system) ≤ 20 kWh/m^{2}a
2-National official nZEB definition	Energy demand for heating > 20 kWh/m^{2}a and ≤ 40 kWh/m^{2}a
3-Better than current building code	Energy demand for heating > 40 kWh/m^{2}a and ≤ 80 kWh/m^{2}a
4-According to building code	Energy demand for heating > 80 kWh/m^{2}a

The majority of new buildings are constructed according to building code. The share of new buildings better than building code is increasing. Lack of nZEB definition in regulations is a major barrier for the development of the construction market towards energy efficient buildings.

Because of the lack of an official European definition, to ease comparisons the EU ZEBRA2020 project developed the indicator of "major renovation equivalent". In ZEBRA, three renovation levels have been defined: "low", "medium" and "deep". However, these 3 levels definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

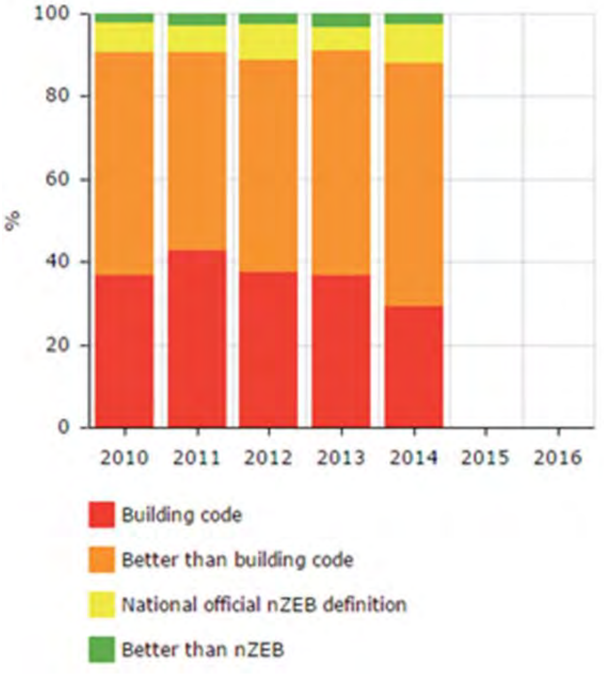


Figure 69 Distribution of new dwellings according to the nZEB radar graph – Poland

Source: ZEBRA

In Poland there is no official definition for deep renovation but some financing programs support investment projects involving deep renovation of multi-family and public buildings. The Operational Programme Infrastructure and Environment 2014-2020 refer to deep renovations increasing energy efficiency by above 60%, that we assume as a reference level (major ranovation) for Poland. This is an official definition from the Programme description: "In terms of deep comprehensive renovation, buildings projects characterized by the best energy efficiency will be preferred, meaning projects that increase energy efficiency above 60%. Projects in the field of deep, comprehensive renovation that increase energy efficiency below 25%, however, will not be eligible for funding." The definition is not enough clear but we can assume that it means reduction of final energy consumption by at least 60%.

According to the Thermo-renovation and repair Act, the investor is eligible to a grant to repay part of the loan if the energy audit shows that the project will reduce the annual energy demand (for heating and domestic hot water):

a) a) in buildings where only the heating system is modernised – at least by 10% - it means that when we are only changing the boiler or modernizing the heating system we have to reduce the final energy consumption by at least 10%, we have assumed that it is light renovation

b) in buildings where after 1984, the heating system was modernised – at least by 15%; - it means that when we are renovating the building envelope (e.g. insulating external walls), without changing the boiler or modernizing the heating system, we have to reduce the final energy consumption by at least 15%

c) in other buildings – at least by 25% - it means that when we are renovating the building envelope and changing the boiler or modernizing the heating system, we have to reduce the final energy consumption by at least 25%, we have assumed that it is medium renovation (at least to elements together e.g. changing of boiler and insulating of external walls.

Data from funded project show that average level of savings in projects which were supported is 35%. Such level of savings is achieved usually for complex renovation, e.g. modernization of heat source, insulation of external walls and insulation of roof.

On this basis: three levels of savings were defined as follows:

Levels of renovation	**Activities to achieve the desired level of renovation**	**Reduction of energy demand**	**Equivalent of deep renovation**
Light renovation	· Modernisation or replacement of heat source/system;	10%	16,7% (10%/60%)
Medium renovation	· Modernisation or replacement of heat source/system together with: · Replacement of window and door joinery; or · Thermal insulation of a façade.	25%	41,7% (25%/60%)
Complex renovation	· Total or partial replacement energy sources, the use of renewables or the use of high-efficiency cogeneration; · Replacement of the central heating and DHW with insulation (in accordance with current technical and construction regulations); · Replacement of external window and door joinery; · Insulation of the whole external envelope (façades, flat roof and the ceiling/ floor); · Repair of balconies.	35%	58,3% (35

The equivalent major rate in Poland it is almost constant and amounts to around 0,12%. It is one of the lowest among the UE countries.

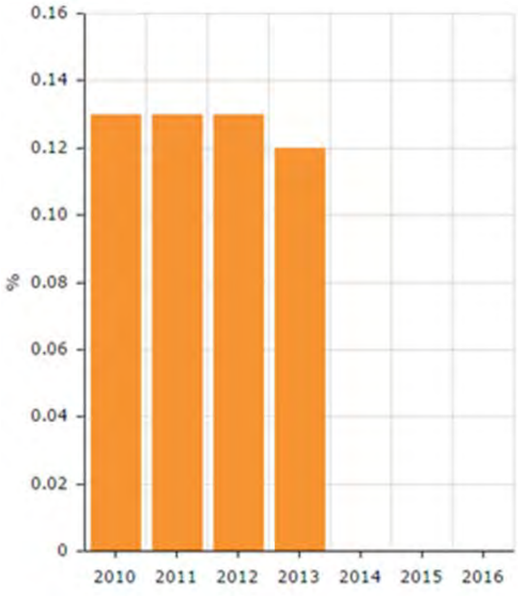


Figure 70 Equivalent major renovation rate – Poland

Source: ZEBRA

7.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Poland, it has been collected data of 23 nZEBs or high energy efficient buildings which were constructed recently. The 23 selected buildings are new buildings. 8 have a residential use and 15 are intended for non-residential use.

Climate zones

As Table 12 shows, the 23 selected buildings are located in the climate zone B, which is characterized by cold winters and mild summers.

Table 12 Building distribution by climate zones - Poland

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	23	
C	Warm winters and warm summers		
D	Temperate winters and mild summers		
E	Temperate winters and warm summers		

Heating Demand

The average heating demand in the selected new buildings is 23,7 kWh/m² a.

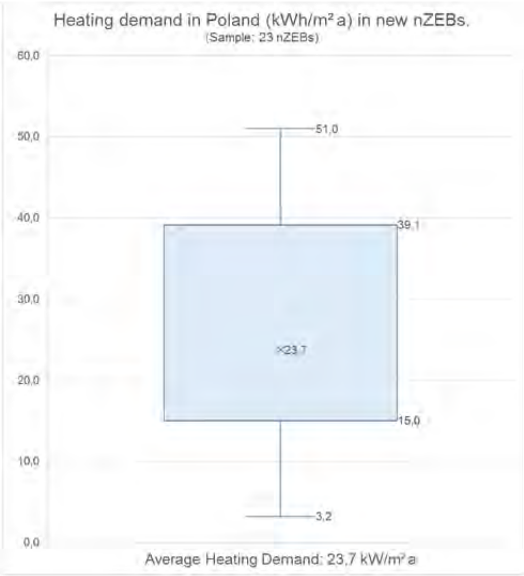


Figure 71. Box plot of heating demand in new nZEBs – Poland

Building envelope and passive solutions

The average U-value in walls is 0,18 and 0,14 in roofs in the selected new buildings.

Stone wool is the most used insulating material in walls (30%) and roofs (35%).

In windows, the average Uwin-value is 0,85 and the most common type of glass is the double glass with a share of 43%.

Concerning passive cooling strategies, 91% of the buildings do not use any strategy.

Active solutions

Mechanical ventilation with heat recovery is the used in the 100% of the selected buildings.

With a percentage about 50%, district heating is the most common heating system type and also energy carrier for heating. Besides, a dedicated generation system with a percentage of 39% is the most used option for DHW.

57% of the buildings do not use cooling system and the rest 43% use heat pump as a cooling system.

Renewable energies

In 3 out of the 23 selected buildings, it is reported the use of photovoltaic systems and in 2 the use of solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Poland reports and realised projects.

Table 13 Costs of different renovation depths and new built according to nZEB standards - Poland

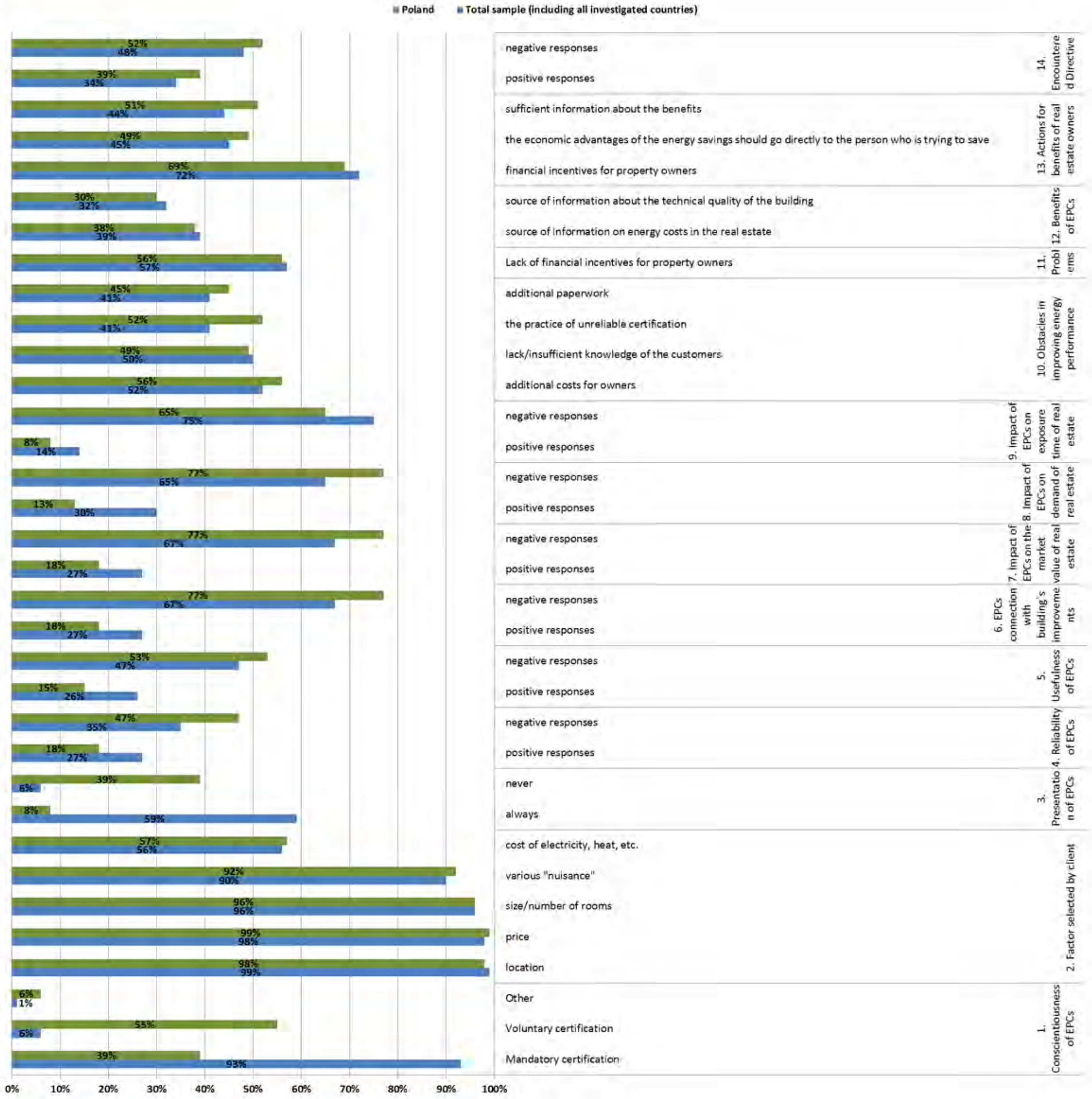
Costs (€/m2)	PL
Minor renovation (15% energy savings)	60
Moderate renovation (45% energy savings)	170
Deep renovation (75% energy savings)	220
NZEB renovation (95% energy savings)	330
New built according to nZEB standards	1037
Additional funds for nZEB construction compared to new built	94

7.2 EPCS AND REAL ESTATE AGENTS

7.2.1 REAL ESTATE AGENTS SURVEY

1. The dominant form of EPC indicated by the real estate agents in Poland indicate that EPCs are rather voluntary than mandatory.
2. In opinion of real estate agents from Poland, the main factors taken into account whilst selecting, purchasing or leasing real estate are mainly the price, location, the size of the real estate, various "nuisance" e.g.: a busy road, landing airplanes, landfill, a high-voltage line.
   The cost of energy is indicated as very important factor by 11% and as important by 46% of real estate agents in Poland.
3. The EPCs in Poland are very rarely required in concluding the purchase/lease contracts.
4. More real estate agents in Poland are in general unsatisfied than satisfied with reliability of the data provided by the EPC.
5. Usefulness of EPCs in the professional activity of real estate agents in Poland is evaluated by them low. Only 15% of the respondents in Poland indicates the usefulness of the certificate in their professional work.
6. The real estate agents in Poland rather don`t observe connection between the EPC and the improvement of the energy performance of buildings.
7. Usually, real estate agents in Poland don`t confirm correlation between the high energy performance and high value of real estate.
8. The real estate agents in Poland don`t observe that higher energy performance of buildings cause the growing interest in its purchase / lease in comparison to other buildings.
9. In opinion of real estate agents in Poland, the influence of having the higher EPC class on the exposure time of the real estate is very low.
10. The main obstacles in improving the energy performance of buildings were indicated by real estate agents in Poland to be the following: financial matters (additional costs for owners), the practice of issuing unreliable certificates, low social awareness in this subject, additional bureaucracy.
11. Among the problems of implementing the improvement of the energy performance of buildings, the following has been mainly indicated by the real estate agents in Poland: the financial aspect, no incentive for the real estate owners.

12. The EPC as the source of information concerning rather the energy costs than the technical condition of the building is indicated by the real estate agents in Poland as quite important benefit of having EPC.
13. The most expected support that would influence the improvement of the energy performance of buildings, according to the respondents from Poland, is financial activity. Sufficient information about the benefits, economic support directed to real estate owners and economic incentives for those that undertake such actions.
14. The level of awareness and information about wording, requirements and settlements of the 2002/91/EC or 2010/31/EU Directive among the real estate agents in Poland is quite high.


Poland
Total sample (including all investigated countries)
52%
48%
negative responses
39%
34%
positive responses
14. Encountered Directive
51%
44%
sufficient information about the benefits
49%
45%
the economic advantages of the energy savings should go directly to the person who is trying to save
69%
72%
financial incentives for property owners
13. Actions for benefits of real estate owners
30%
32%
source of information about the technical quality of the building
38%
39%
source of information on energy costs in the real estate
12. Benefits of EPCs
56%
57%
Lack of financial incentives for property owners
11. Problems
45%
41%
additional paperwork
52%
41%
the practice of unreliable certification
49%
50%
lack/insufficient knowledge of the customers
56%
52%
additional costs for owners
10. Obstacles in improving energy performance
65%
75%
negative responses
8%
14%
positive responses
9. Impact of EPCs on exposure time of real estate
77%
65%
negative responses
13%
30%
positive responses
8. Impact of EPCs on the demand of real estate
77%
67%
negative responses
18%
27%
positive responses
7. Impact of EPCs on the market value of real estate
77%
67%
negative responses
18%
27%
positive responses
6. EPCs connection with building's improvements
53%
47%
negative responses
15%
26%
positive responses
5. Usefulness of EPCs
47%
35%
negative responses
18%
27%
positive responses
4. Reliability of EPCs
39%
6%
never
8%
59%
always
3. Presentation of EPCs
57%
56%
cost of electricity, heat, etc.
92%
90%
various "nuisance"
96%
96%
size/number of rooms
99%
98%
price
98%
99%
location
2. Factor selected by client
6%
1%
Other
55%
6%
Voluntary certification
39%
93%
Mandatory certification
1. Conscientiousness of EPCs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

7.3 EXISTING POLICIES

Poland has implemented the requirements of the EPBD Recast but the effectiveness of this implementation is poor. On paper the coefficients of energy consumption are looking quite reasonable, but in reality buildings will be less energy efficient. The main reasons for that are: (i) Unambitious requirements regarding the thermal insulation of the buildings envelope. (ii) Unintelligible EPCs. (iii) Only theoretical control of EPC quality. (iv) Wrong methodology of energy performance calculation. (v) Lack of real nZEB action plan, in Poland the nZEB means building with low energy consumption. (vi) Lack of programs supporting a real deep renovation (energy saving larger than 60%). (vii) Lack of large education programs.

The building sector and energy targets

According to the National Energy Efficiency Action Plan, the energy efficiency targets set for 2020 devised in accordance with Directive 2012/27/EU include:

- Reduction of primary energy consumption -13.6Mtoe between 2010-2020
- Absolute level of end-use energy consumption - 71.6Mtoe
- Absolute level of primary energy consumption - 96.4Mtoe

To achieve these goals certain measures for improving the energy efficiency were defined:

- Horizontal measures
- Measures related to energy efficiency in public buildings:
    - Thermo-modernisation and Repairs Fund
    - Green Investments Scheme. Part 1 - Energy management in public utility facilities
    - Operational Programme Infrastructure and Environment 2014-2020 (Investment Priority 4.iii.) - Supporting energy efficiency, intelligent energy management and promotion of renewable energy sources for public infrastructure, including public buildings, and in the housing sector
    - Improvement of energy efficiency. Part 3 - Subsidised loans for the construction of energy-efficient houses
    - Operational Programme PL04 – "Energy savings and promotion of renewable energy sources" under the EEA Financial Mechanism in 2009-2014
    - Green Investments Scheme. Part 5 - Energy management in the facilities of selected public finance sector entities
    - Energy efficiency improvement. Part 2 - LEMUR - Energy Efficient Public Utility Facilities;

  - Operational Programme Infrastructure and Environment (OPIE) 2007-2013 (Measure 9.3) – Thermo-modernisation of public utility facilities
  - Efficient energy use. Part 6 - SOWA - Energy-efficient street lighting
  - Regional operational programmes for 2014-2020.
- Energy efficiency measures in industry and SMEs
- Energy efficiency measures in transport
- Efficiency in energy generation and supplies (Article 14 of the Directive)

National Renovation Strategy

According to its renovation strategy Poland is expecting certain energy saving results from building renovation activities:

- Savings in energy consumption:
  - Single-family residential building between 75-95% of non-renewable primary energy
  - Multi-apartment residential building between 72-90% of non-renewable primary energy
  - Public utility building-office building between 77-83% of non-renewable primary energy
- Increased demand for materials for thermal insulation of buildings and for equipment used in modern, energy-efficient systems for heating, ventilating, cooling and lighting buildings and in systems for preparation of hot service water
- Reduction in the use of non-renewable primary energy carriers, such as natural gas, heating oil and coal
- Increased demand for renewable primary energy carriers
- Increased employment in enterprises producing goods for which the demand will increase
- Increased state budget revenues from VAT on the increased sales of thermo-insulation materials, and elements of heating-ventilating-cooling systems using renewable primary energy sources

In order to achieve these results, certain measures will be taken:

- Co-financing of investments supporting the development of an energy efficient construction sector and supporting the use of renewable energy sources (RES) in existing buildings. Sources of co-financing are:
  - Private sector funds
  - State budget (i.a. Thermo-modernisation and Renovation Fund)

  - Environmental Protection Funds (National and Regional ones)
  - Foreign funds (i.a. EEA Financial Mechanism, Norwegian Financial Mechanism)
  - European Union Funds
  - Funds from local self-governments
  - Commercial banks and other sources of financing (agencies, funds)
- Development of energy-efficient technologies in Poland
- Better education, and gathering of competences

Energy performance requirements

Mandatory energy requirements for buildings are published in the Ordinance of the Minister of Transport, Construction and Maritime Economy dated 5 July 2013. The Ordinance provides the required U-values for building elements and the maximum permitted values of the energy performance indicator representing annual demand of non-renewable primary energy per m^2 of heated or conditioned area.

Compliance

The compliance is checked for new or renovated buildings which use sources of co-financing. The energy performance characteristics are included in the architectural and building designs. The compliance is checked at the design phase during the process of obtaining the building permit (issued by the department of architecture at the appropriate prefecture) or the notification of construction. In the case of non-compliance the investment cannot receive public funds.

The nZEB plan

In Poland the nZEB **will be identified and defined** as a building with low energy consumption, referred to in Art. 39 of the Act of 29 August 2014 on the Energy Performance of Buildings, which transposes into national law some of the provisions of Directive 2010/31/EU.

Renewable sources in the building sector

There are no direct requirements in the building codes referring to the required share of RES. However, meeting of the primary energy demand requirements will be only possible in two cases:

- when the energy performance of building is much better than needed e.g. lower U values
- when the most of the energy will be supplied to the building from the RES

The main measures for fostering RES in buildings are:

- National subsidies and loans from The National Fund of Environmental Protection and Water Management (NFEP&WM) e.g. Program Prosumer[56]
- The new RES Act[57]

The share on RES in polish nZEB should be **from 5% to 25%,** according to NAPE estimations.

Financial and fiscal support policies/programmes

The National Fund of Environmental Protection and Water Management (NFEP&WM) is a source of financing numerous activities that improve energy efficiency, also in a scope of building sector. The most important programs referring to new nZEB are:

- Improving energy efficiency. Subsidies for loans to build energy-efficient homes
- Improvement of energy efficiency LEMUR – Energy efficient public utility buildings

The following sources of subsidies are available to support renovation of the building stock:

- The National Fund of Environmental Protection and Water Management (NFEP&WM) - national subsidies and loans, programs like KAWKA
- Thermo – modernization Fund – national loans
- The operational Program Infrastructure and the Environment in 2014- 2020 - in the frame of Union European subsidies.

The leading role of the public sector

Poland follows the alternative approach for fulfilling the requirements of Article 5 of the EED. The measures in this approach include support for energy efficiency and renewables in the public and housing sectors, raising awareness and thermal modernisation projects supported by the National Fund for Environmental Protection and Water Management, use of renewable energy in buildings used by public entities and a Handbook with best practices to improve energy efficiency available on a website. These measures are expected to bring annual savings of 2.12 GWh however, no cumulative target for the period 2014-2020 has been reported to the Commission.

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[56] https://www.nfosigw.gov.pl/oferta-finansowania/srodki-krajowe/programy-priorytetowe/prosument-dofinansowanie-mikroinstalacji-oze/informacje-o-programie/

[57] http://isap.sejm.gov.pl/DetailsServlet?id=WDU20150000478

7.4 NZEB-TRACKER

This section highlights the key findings from the nZEB tracker for Norway in 2014.

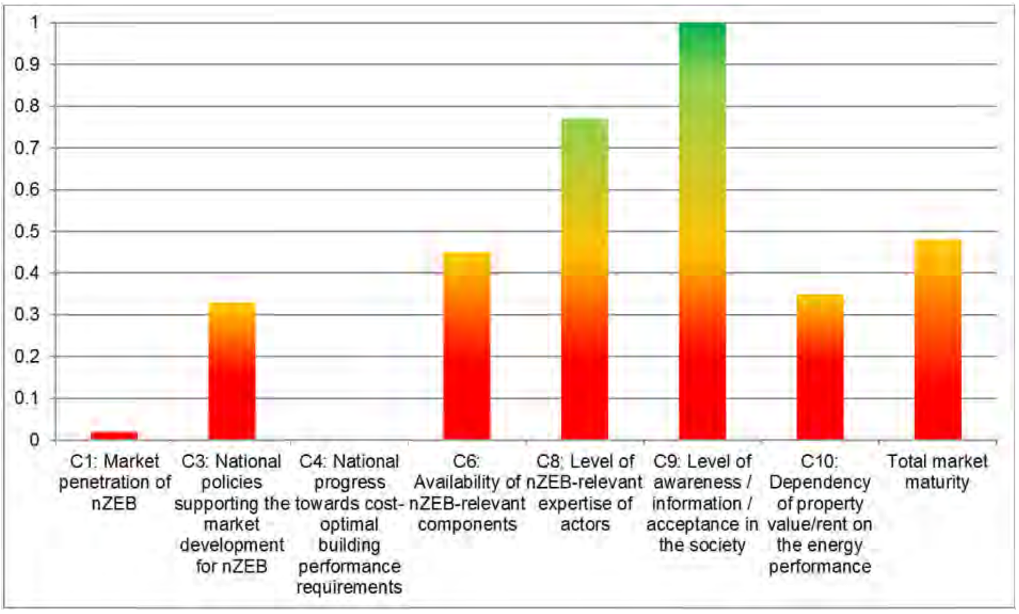


Figure 72 nZEB-tracker score for Poland in 2014

C1: Market penetration of nZEB

- Polish result: **0.02** ZEBRA average: **0.32**
- Buildings with low energy demand had a share of only ~3% of new constructed floor area in Poland
- The share is constant over the past years

C3: National policies supporting the market development for nZEB

- Polish result: **0.33** ZEBRA average: **0.52**
- Policies in Poland are not sufficient to support the development of the market for residential and non-residential nZEB
- Need for adaptations may result from the final definition of the nZEB standard in Poland. It is not known when such a definition will be created.

C4: National progress towards cost-optimal building performance requirements

- Polish result: **0.00** ZEBRA average: **0.94**
- It is not known on what basis are given for example values of heat transfer coefficients.
- The cost-optimal method is not really implemented.

C6: Availability of nZEB-relevant components

- Polish result: **0.68** ZEBRA average: **0.83**
- Energy efficient heating systems and other building components for nZEB were well or very well available in Poland.
- Building automation and control system seemed to be available only moderately.

C8: Level of nZEB-relevant expertise of actors

- Polish result: **0.77** ZEBRA average: **0.63**
- Quite large group of experts is educated and interested in the topic.
- Whereas the availability of experts for planning was assessed sufficient and for examination/certification even good, the interviewees showed that there was a lack of expertise for the construction phase.

C9: Level of awareness / information / acceptance in the society

- Polish result: **1.00** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings increased steadily.

C10: Dependency of property value/rent on the energy performance

- Polish result: **0.35** ZEBRA average: **0.74**
- Compared to site, living quality, aesthetics and financial aspects, the energy performance was not important aspect for customers' decision on renting/buying a real estate.

Maturity of the Polish nZEB market

- Polish result: **0.51** ZEBRA average: **0.66**
- Lack of nZEB definition is a major barrier for the development of the construction market towards energy efficient buildings.
- High performance building components were easily available.
- People became more and more aware of the energy performance of buildings. Still it is not a priority by buy/rent decisions.

7.5 SCENARIOS

Market penetration of nZEB – new building construction

Figure 73 shows annual construction of conditioned floor area according to different standards. The results are shown for the historical development and in both policy scenarios, current and ambitious for the long term development from 2021 to 2050. For an explanation of the scenario framework of the current policy scenario and the ambitious policy scenario, see part "Introduction". Data on historical development of new building construction according to national standards were collected in the project, see part "Building performance market data" and are available on the project project´s data tool (http://www.zebra-monitoring.enerdata.eu/). The share of the new building construction according to the building code in 2012 was app. 35% of the total new building floor area. According to building code means that buildings are constructed according to national minimum requirements. In Poland, mandatory thermal requirements for buildings are published in the Ordinance of the Minister of Transport, Construction and Maritime Economy dated 5 July 2013. In the ambitious scenario, the share of stringent measures is much higher due to the policy implication.

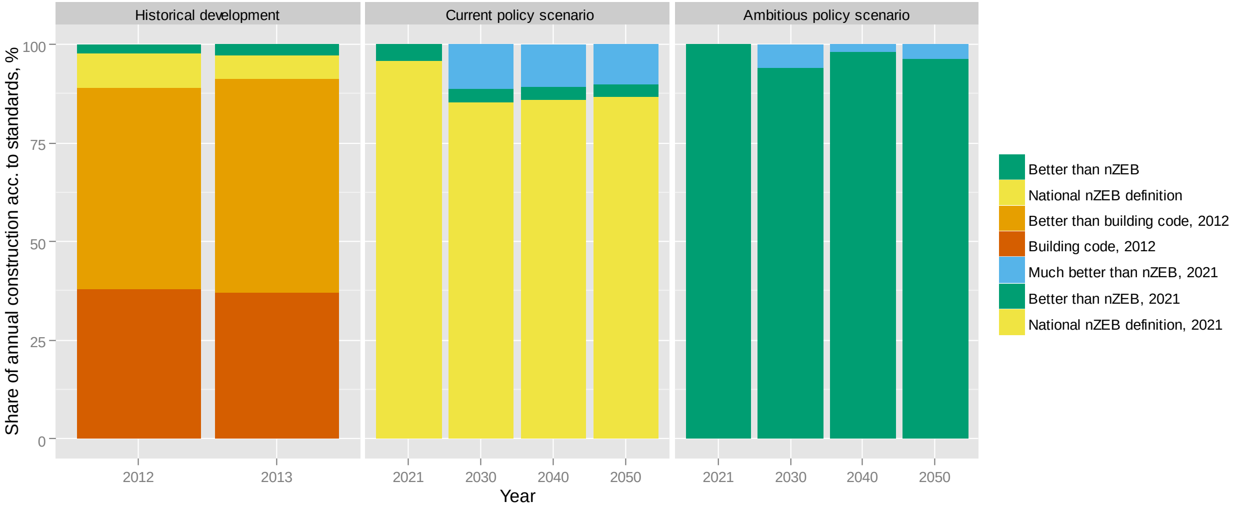


Figure 73 Share of annual construction of conditioned floor area built according to national standards

Building renovation activities

Figure 74 shows historical development and future development in current and ambitious policy scenarios of annual renovation of conditioned floor area by renovation levels. The following renovation categories were defined in the current policy scenario:

- medium renovation which refers to the building codes

- light renovation meaning that in reality not all buildings fulfil the criteria set in the building legislation and
- deep renovation reflecting the nZEB definition

In the ambitious scenario, from 2021 to 2050, all buildings fulfil at least the building standards. There is an additional renovation level "deep plus" which means higher energy performance achievements.

In Poland, in the current policy scenario, the share of the medium and deep renovation makes up a significant share on the total renovated building floor area from 2021 to 2050. In the ambitious policy scenario, which implements stringent measures on existing buildings, the share of the deep and deep plus renovation is increased compared to the current policy scenario. In 2040 around 38% of the renovated building floor area will be renovated with a strong share of deep plus (10%) and deep renovation (28%), resulting in higher energy savings (Figure 78).

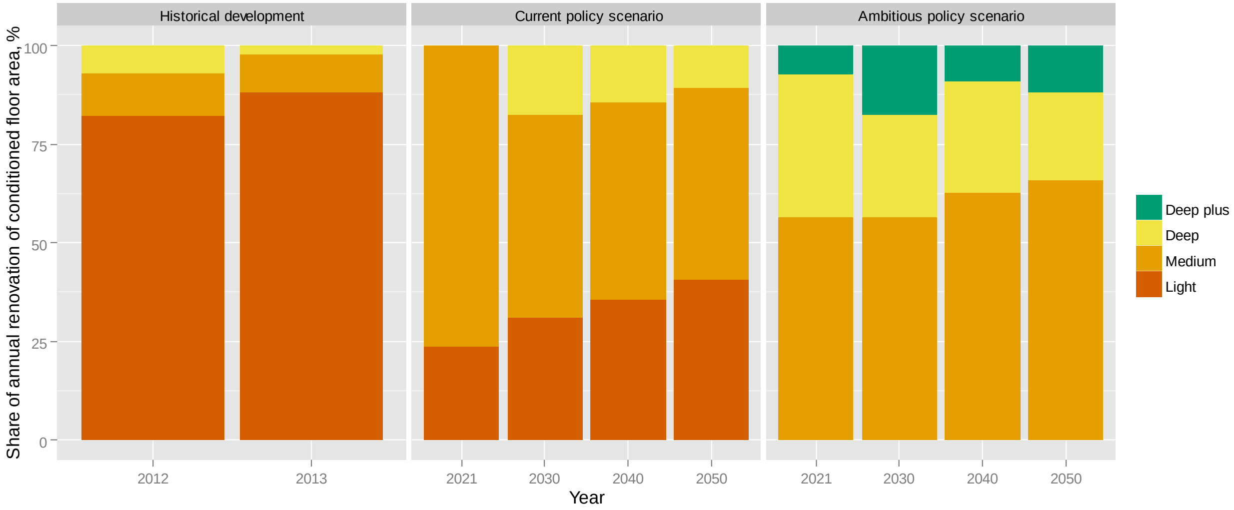


Figure 74Share of annual renovation of conditioned floor areas by renovation levels in current and ambitious policy scenarios

Figure 75 shows the distribution of the spec. energy need for space heating (norm energy need calculation according to EN13790) in the total building stock after building renovation by using the following renovation levels, light, medium, deep and deep plus. The spec. energy needs are shown in a box-plot diagram. The median (middle quartile) marks the mid-point of the data and is shown by the line that divides the box into two parts while the diamond indicates the mean value. The data is represented for 2012 for not renovated buildings, light, medium and deep renovation. The deep plus renovation shows spec. energy need for buildings being renovated after 2020. In Poland, the medium renovation refers to the building code, which is published in the Ordinance of the Minister of Transport, Construction and Maritime Economy dated 5 July 2013. The spec. energy need for space heating of light renovation is higher compared to the medium renovation, which means that in reality not all buildings fulfil the criteria set in the building legislation. Deep and deep plus renovation include i.e. the installation of mechanical ventilation.

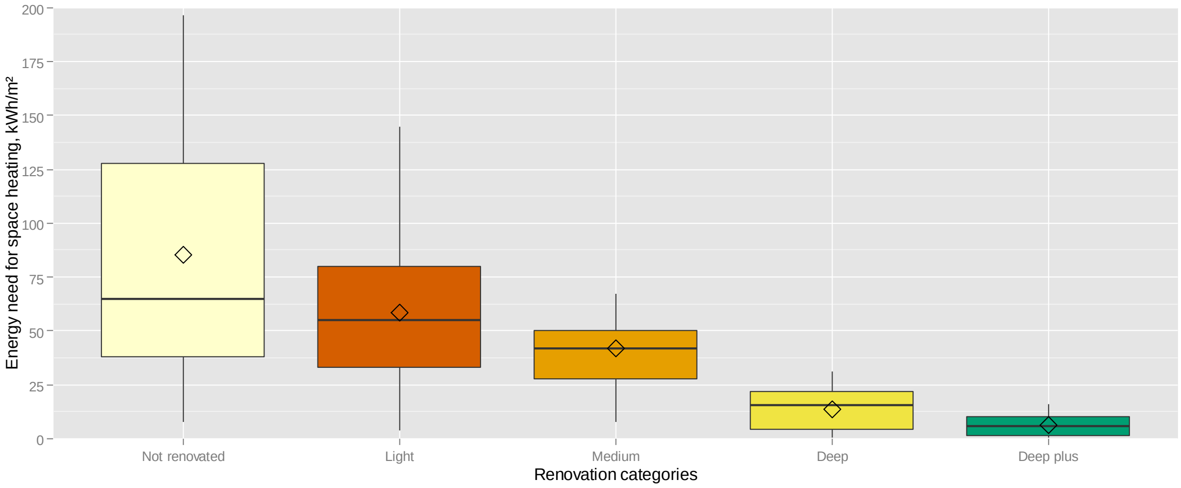


Figure 75 Distribution of the buildings spec. energy need for space heating

Economic indicators and national policies supporting the market development for nZEB

Figure 76 shows total yearly investments in the building envelope (thermal renovation) and in renewable heating systems from 2012 to 2050 in the current and ambitious policy scenarios. The investments are slightly higher in the ambitious scenario due to higher number of the renovated buildings, higher quality of the implemented thermal renovation and higher investments in the renewable systems. Figure 77 shows total yearly public budget for financial support of renewable heating systems and renovation of the building envelope. The yearly public budgets are significantly higher in the ambitious policy scenario.

Development of the building related energy demand

Figure 78 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Poland´s building stock is 247 TWh in 2012. The scenario shows a slow-down of the energy demand of 5% from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 44% in the current policy scenario in the long term development between 2012 and 2050 and by 48% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

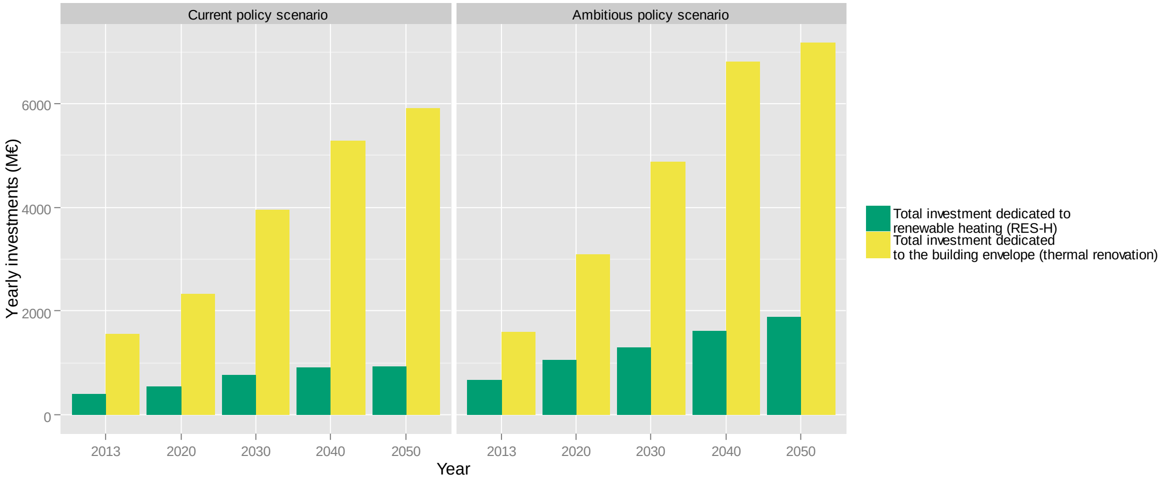


Figure 76Total yearly investments in renewable heating systems (RES-H) and renovation of the building envelope including public budget, 2013 to 2050, current policy and ambitious policy scenario

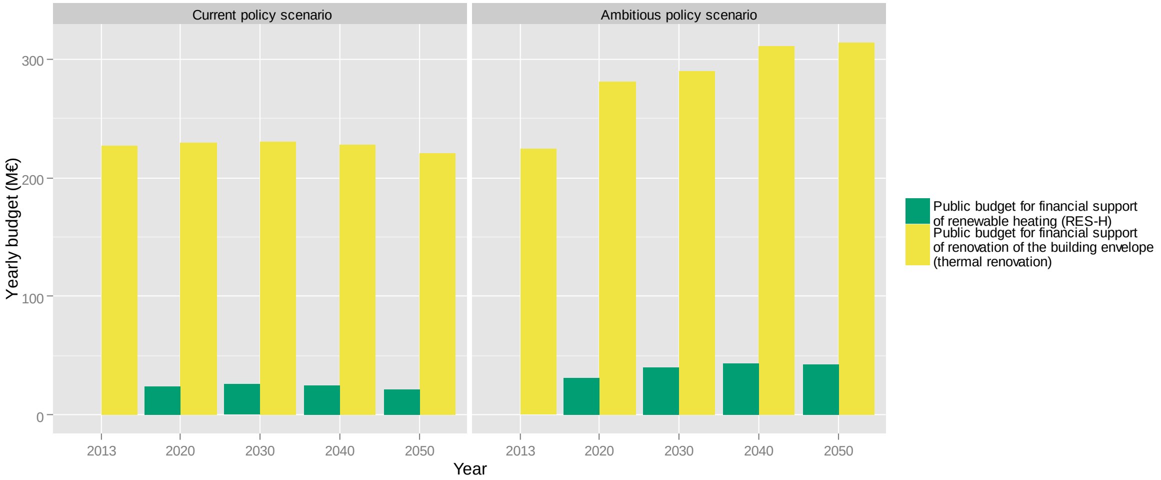


Figure 77Total yearly public budget for financial support of renewable heating systems (RES-H) and renovation of the building envelope, 2013 to 2050, current policy and ambitious policy scenario

In Poland, there are no direct requirements in the building codes referring to the required share of renewable energy systems (RES). Additionally, current politics are supporting coal industry and stopping the RES. According to the national experts, there will be a law defining the quality of the coal supplied heating systems and the coal will not be forbidden in the building sector. These are the main reasons of the slowly decrease of the fossil-fuel-based heating systems from 2012 to 2050 in Poland. The share of non-delivered energy (i.e. solar and ambient energy) is around 1% of final energy demand in 2012 and around 6.7% and 13% in the current policy and ambitious policy scenarios respectively.

Figure 79 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 59% in current policy scenario and around 61% in ambitious policy scenario. The reduction of the primary energy demand is around 52% and 59% in the current and ambitious policy scenarios respectively. The main driver for the CO2-emission and primary energy savings in both scenarios is the overall energy demand reduction and increase of energy performance of new and renovated buildings.

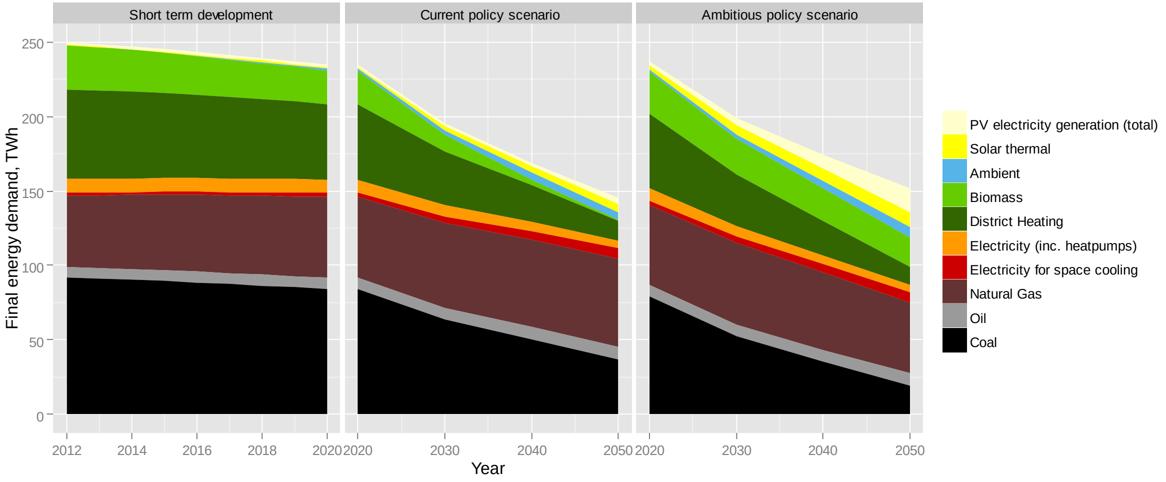


Figure 78 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

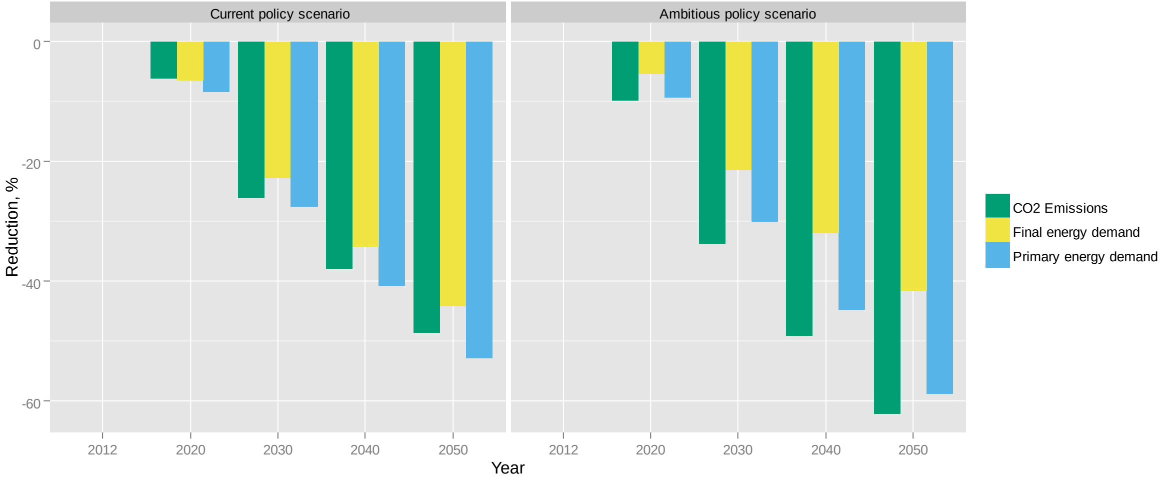


Figure 79 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

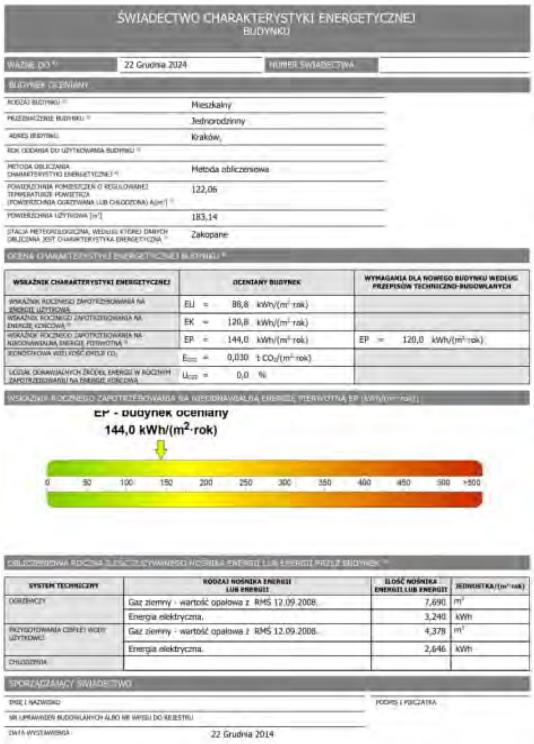
7.6RECOMMENDATIONS

Legislation related to low energy buildings is not functioning properly. There are no specific guidelines for nZEB buildings in Poland. The EPCs are in fact neglected by the property sale or rent parties. Although many awareness raising activities have been undertaken since late 1990-ies, the interest in energy-efficient buildings and technologies in Poland is large and growing, especially on the detached houses market. Developers at the moment rarely construct buildings better than required by law. However, the number of environmentally certified buildings in LEED or BREEAM schemes is growing rapidly. Still, for investors in real estate, buyers/renters of properties the most important features of the building are the location and the price. Customers buying or renting properties rarely get information on the operating cost. The price surplus for energy efficient properties sale or rent is not observed by real estate agents.

The Polish form of EPC does not contain the energy classes, therefore users can't easily interpret data about energy consumption of building.

Polish methodology of calculating the energy performance of buildings was adopted at the national level by the Regulation of the Minister of Infrastructure and Development of 27 February 2015 as simple implementation of.The milieu of professionals (scientists, energy auditors) proposes to modify the regulation by following changes:

- complementary set of data for the reference buildings with the indicators of individual internal heat gains, auxiliary equipment power in heating, domestic hot water and cooling systems including the energy classes of these devices
- due to the fact that the monthly method leads to the erroneous determination of the energy demand for cooling, it is proposed to change the calculation method to hourly.



ŚWIADECTWO CHARAKTERYSTYKI ENERGETYCZNEJ
BUDYNKU

WAŻNE DO *)	22 Grudnia 2024	NUMER ŚWIADECTWA	

BUDYNEK OCENIANY

RODZAJ BUDYNKU *)	Mieszkalny
PRZEZNACZENIE BUDYNKU *)	Jednorodzinny
ADRES BUDYNKU	Kraków,
ROK ODDANIA DO UŻYTKOWANIA BUDYNKU *)	
METODA OBLICZANIA CHARAKTERYSTYKI ENERGETYCZNEJ *)	Metoda obliczeniowa
POWIERZCHNIA POMIESZCZEŃ O REGULOWANEJ TEMPERATURZE POWIETRZA (POWIERZCHNIA OGRZEWANA LUB CHŁODZONA) $A_f[m^2]$ *)	122,06
POWIERZCHNIA UŻYTKOWA $[m^2]$	183,14
STACJA METEOROLOGICZNA, WEDŁUG KTÓREJ DANYCH OBLICZANA JEST CHARAKTERYSTYKA ENERGETYCZNA *)	Zakopane

OCENA CHARAKTERYSTYKI ENERGETYCZNEJ BUDYNKU *)

WSKAŹNIK CHARAKTERYSTYKI ENERGETYCZNEJ	OCENIANY BUDYNEK	WYMAGANIA DLA NOWEGO BUDYNKU WEDŁUG PRZEPISÓW TECHNICZNO-BUDOWLANYCH
WSKAŹNIK ROCZNEGO ZAPOTRZEBOWANIA NA ENERGIĘ UŻYTKOWĄ	EU = 88,8 $kWh/(m^2 \cdot rok)$	
WSKAŹNIK ROCZNEGO ZAPOTRZEBOWANIA NA ENERGIĘ KOŃCOWĄ *)	EK = 120,8 $kWh/(m^2 \cdot rok)$	
WSKAŹNIK ROCZNEGO ZAPOTRZEBOWANIA NA NIEODNAWIALNĄ ENERGIĘ PIERWOTNĄ *)	EP = 144,0 $kWh/(m^2 \cdot rok)$	EP = 120,0 $kWh/(m^2 \cdot rok)$
JEDNOSTKOWA WIELKOŚĆ EMISJI CO_2	E_{CO2} = 0,030 $t\,CO_2/(m^2 \cdot rok)$	
UDZIAŁ ODNAWIALNYCH ŹRÓDEŁ ENERGII W ROCZNYM ZAPOTRZEBOWANIU NA ENERGIĘ KOŃCOWĄ	U_{OZE} = 0,0 %	

WSKAŹNIK ROCZNEGO ZAPOTRZEBOWANIA NA NIEODNAWIALNĄ ENERGIĘ PIERWOTNĄ EP $[kWh/(m^2 \cdot rok)]$

OBLICZENIOWA ROCZNA ILOŚĆ ZUŻYWANEGO NOŚNIKA ENERGII LUB ENERGII PRZEZ BUDYNEK *)

SYSTEM TECHNICZNY	RODZAJ NOŚNIKA ENERGII LUB ENERGII	ILOŚĆ NOŚNIKA ENERGII LUB ENERGII	JEDNOSTKA/$(m^2 \cdot rok)$
OGRZEWCZY	Gaz ziemny - wartość opałowa z RMŚ 12.09.2008.	7,690	m^3
	Energia elektryczna.	3,240	kWh
PRZYGOTOWANIA CIEPŁEJ WODY UŻYTKOWEJ	Gaz ziemny - wartość opałowa z RMŚ 12.09.2008.	4,378	m^3
	Energia elektryczna.	2,646	kWh
CHŁODZENIA			

SPORZĄDZAJĄCY ŚWIADECTWO

IMIĘ I NAZWISKO
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PODPIS I PIECZĄTKA

Strengths with the current policy context for nZEBs

Thanks the initiative of professionals there is in force since 1998 permanent support scheme for thermal-only modernization of buildings, which is used by owners of residential multi-storey buildings in majority. In this scheme are involved state owned and commercial banks and large group of highly qualified independent energy auditors. For public buildings several programs have been launched during 2010-2015 by the National Fund for Environment Protection. The evaluation of the programs confirm their reasonability, advantages for the state budget and positive impact on CO2 reduction.

Weaknesses with the current policy context for nZEBs

- Lack of the definition and requirements for nZEB.
- Elimination 2016 subsidy schemes of the National Fund for Environment Protection for modernization and promotion of energy-efficient buildings and buildings with nearly zero energy consumption.
- Lack in the EPC of obligation to provide recommendations to improve the energy performance.
- Lack in the EPC of energy classes of buildings.
- Lack of legal obligation to prepare energy performance certificates for new buildings built for own use (mostly detached houses).
- No legal repercussions for the lack of an energy performance certificate in the case of selling or renting the property (reluctant role of notaries being witnesses of the transactions)
- Low practise among architect and designers in integrated designing of buildings.

Derived from this background and the requirements of the EPBD, 14 recommendations have been outlined specifically for the Polish context:

PL1 - Introduce a clear nZEB definition, including specific requirements

PL2 - Set long term voluntary targets for existing buildings

PL3 - Improve the usage of Energy Performance Certificates and enable a non-intrusive evaluation from a third party actor to enhance transparency

PL4 - Implement standard methodologies for secure data gathering and assessment

PL5 - Financial support for renovation according long term benchmarks

PL6 - Encourage financial institutions to promote nZEB easing access to finance and lower rates

PL7 - Brand NZEB buildings as part of a positive sustainability narrative

PL8 - Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

PL9 - Visualize existing building information via proper communication tools

PL10 - Develop and consolidate quality frameworks for nZEB techniques and technologies

PL11 - Enhance the proficiency of certifiers in order to increase the reliability of Energy Performance Certifications

PL12 - Involve and empower local authorities in pilot projects

PL13 - Shift from fuel subsidies into energy efficiency measures

PL14 - Improve all social housing to nZEB standards, in order to provide comfortable and affordable housing

#PL1 - Legislative and Regulatory Instruments

Introduce a clear nZEB definition, including specific requirements

Introduction of the definition of the nZEB buildings will give additional incentives for construction market stakeholders. It could be used effectively to remove from the market inefficient construction products, like windows, insulation, HVAC installations.

The lack of nZEB definition is a major barrier for the development of the construction market towards energy efficient buildings. Clarity in definition and requirements for nZEBs is needed to be able to fulfil the requirements of the EPBD.

According to Article 9 of the EPBD Member States shall ensure that[58]*:*

(a) by 31 December 2020, all new buildings are nearly zero- energy buildings; and

(b) after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings.

It also requires Member States to include in their national plans: detailed application in practice of the definition of nearly zero-energy buildings, reflecting their national, regional or local conditions, and including a numerical indicator of primary energy use expressed in kWh/m 2 per year. Primary energy factors used for the determination of the primary energy use may be based on national or regional yearly average values and may take into account relevant European standards[59]*.*

As confirmed by BPIE Surveys (2011, 2013), EPCs are currently among the most important sources of information on the energy performance of the EU's building stock. The improvements in the quality assurance processes and better compliance with the EPBD requirements at national level shall further enhance the EPC credibility and market impact. Additionally, EPCs have the potential to become effective instruments to track buildings' energy performance and the impact of building policies over time as well as to support the implementation of minimum energy requirements within the regulatory process[60].

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[58] EPBD - http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

[59] EPBD - http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

[60] BPIE (2015) http://bpie.eu/wp-content/uploads/2015/10/Energy-Performance-Certificates-EPC-across-the-EU.-A-mapping-of-national-approaches-2014.pdf

#PL2 - Legislative and Regulatory Instruments

Set long term voluntary targets for existing buildings

Voluntary targets (or benchmarks) for existing buildings can steer the market towards deep renovation (i.e. nZEB level) of the building stock. Frontrunners investing in more energy efficiency than necessary ought to be rewarded for their additional effort, but at the same time be given guidance of which performance to aim for. Financial and other support mechanisms can effectively be linked to these benchmarks.

Renovations are often step-wise executed by the building owner with or without involvement of an installer or contractor, mostly without taking into account a final energy performance target. Architects (or energy experts) are mostly only contracted when it is mandatory. Measures like replacing windows or technical installations, changing the roof, adding floor, roof or cavity wall insulation mostly don’t require the involvement of an architect or energy expert.

This makes that decisions on the level of energy performance measures are mostly taken by the (inexperienced) building owner, possibly supported by an installer or contractor, lacking a global perspective. Clear directives on which energy performance level an existing building should fulfil to be future-proof (=nZEB) would decrease building owner’s insecurity at decision making process and help avoid lock-in effect.

Voluntary energy performance targets for existing buildings could serve as benchmark for financial and other support mechanisms and will incentivize the market towards deep renovation (i.e. NZEB level) of the building stock.

Example: Thermal modernization in Poland

The only systematic scheme is the Polish system of support to thermal-only modernization of buildings. The original target of the scheme set-up 1998 was to improve the technical condition of 50 000-100 000 buildings through co-financing of measures leading to energy demand for heating reduction by at least 25%. As of 2016 around 32 000 buildings were subject of this scheme and the average energy demand reduction was (according to evaluation) around 33%. Currently, the scheme is subject of evaluation, which may introduce some changes towards better connection between the level of subsidy and achieved energy demand reduction and towards promotion of deep renovation, which will bring at least 60% energy demand for all purposes in the building[61].

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[61] BPIE (2016) http://bpie.eu/wp-content/uploads/2016/01/BPIE_Financing-building-energy-in-Poland_PL.pdf

#PL3 - Legislative and Regulatory Instruments

Improve the usage of Energy Performance Certificates and enable a non-intrusive evaluation from a third party actor to enhance transparency

The Energy Performance Certificate (EPC) is the most visible aspect of the EPBD and is often part of Member State's building codes. The main aim of the EPCs is to serve as an information tool for building owners, occupiers and real estate actors on the energy performance of the building. Therefore, EPCs have the potential to be a powerful market tool to create demand for energy efficiency in buildings by targeting such improvements as a decision-making criterion in real-estate transactions, and by providing recommendations for the cost-effective or cost-optimal upgrading of the energy performance.

Currently, the EPCs are registered in the central governmental register, however without any verification. The verification may by performed by the Ministry of Construction, but the rules of this have not been set-up so far.

The EPBD requires that all "energy performance certificates are to be included in all advertisements for the sale or rental of buildings". In order for the EPC system to work effectively, it must be qualitative, transparent and reliable. Here, many European Member States have some work to do. Together with reliable databases and qualified certifiers, can an external compliance process generate better rules of conduct and a more efficient system.

In the QUALICHeCK project[62], two important properties of EPC input data have been identified:

- **Compliant input data**: established in line with the procedures in force in the context of the applicable legislation;
- **Easily accessible input data**: can be found, seen and used by taking "reasonable time, effort or money"

With regard to defining penalties with little interference with the court system, proportionate and dissuasive penalties shall be defined according to the EPBD. Nevertheless, social acceptance of extra loads of the court system with non-compliance cases to the energy performance of buildings, which generally do not result in a direct threat to the health and safety, is likely to be difficult. The Belgian experience in the Flemish Region since 2006 shows that fines proportional to the deviation of the input data are workable and appears to be effective. The amounts of the fines were set considering the cost avoided to achieve compliance[63].

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[62] Qualicheck (2016) - http://qualicheck-platform.eu/wp-content/uploads/2016/03/QUALICHeCK-Factsheet-05.pdf

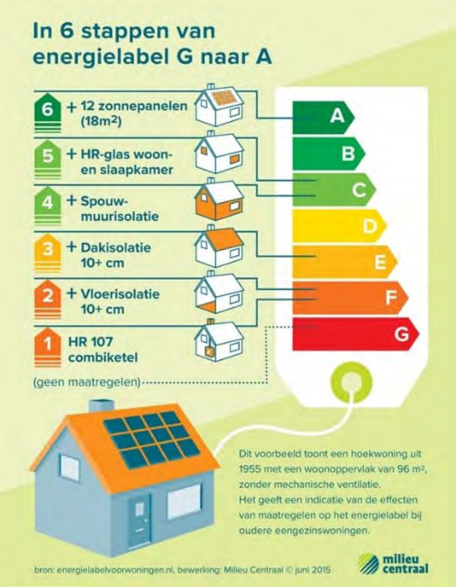
[63] Qualicheck (2016) - http://qualicheck-platform.eu/wp-content/uploads/2016/05/QUALICHeCK-Booklet-1.pdf

Example: EPC in Netherlands

The Dutch EPC system has been incorporated in the national building code. The document assigns an energy performance rating to residential and non-residential buildings. By providing reference values, the consumer can compare and assess energy performance levels.

The Netherlands has also imposed an effective control system, including a check of a certain number of the EPCs issued by qualified assessors (detailed check of documentation, site visit). Check is performed for 2% of EPCs issued for residential and 5% for non-residential buildings per assessor. EPC Data is also publically available, making the building's energy characteristics attainable for the housing market[64][65].

The image from the Dutch 'Milieu Centraal' lays out 6 steps to improve your energy label (i.e. EPC).



#PL4 - Legislative and Regulatory Instruments

Implement standard methodologies for secure data gathering and assessment

Availability and reliability of data on building (performance) vary across Member States. The absence of reliable data hampers policy making at national and local level and makes comparison and benchmarking across borders challenging. Inadequate data is one key barrier to better understanding of the building stock and the effects of measures taken, and thus also to a steeper learning curve.

Standardised methodologies for data gathering and assessment, as well as reporting of high level data are thereby crucial. In addition, a centrally managed register for energy performance of buildings would help to monitor the improvements of energy performance of buildings over time and to design appropriate policies.

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[64] RVO – EPC http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/energieprestatie

[65] Image – Energielabel https://www.energielabel.nl/woningen

- Set up national indicator for renovation rate and depth
- Use EPC databases for data gathering and policy making input
- Standardise and harmonise data gathering to ensure qualitative and comparable data

Example: BuildDesk

Access to reliable data is very necessary. So far, the largest set of data is in possession of commercial company BuildDesk, providing on-line software for issuing the EPCs. However the data collected have not been subject of any verification[66].

#PL5 – Economic Measures

Financial support for renovation according long term benchmarks

EU Member States are obliged to draw-up long-term national building renovation strategies as a part of their National Energy Efficiency Action Plans. One of the purposes of this strategy is to stimulate a higher quality and quantity of renovation through “a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions;”. Stable and long-term subsidies scheme has a positive effect on the construction sector (employment, renovation rate etc.).

Financial support should be linked with the long-term renovation targets and adapted depending on the level of progress. This financial support should reward higher ambition and steer decisions on energy performance renovation towards the nZEB-level, in order to avoid future lock-in effects. Tax payers’ money should stimulate building owners to go further, ensuring cost-optimal investments and bringing societal gains. Furthermore, subsidy mechanisms ought to be aligned with the long-term strategies.

The long-term plan for increase of number of low energy buildings has been adopted by the Polish government 2014, however It doesn`t contain any coherent plan for economic incentivising of investors towards energy efficient construction and renovation of buildings.

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[66] BuildDesk http://www.builddesk.pl/files/BuildDesk/Consultancy/PL%20BD%20Analytics/2009-12-stan-energetyczny-budownictwa-w-polsce.pdf

#PL6 – Economic Measures

Encourage financial institutions to promote nZEB easing access to finance and lower rates

Banks do not yet integrate the advantages of energy efficiency in their financial products/calculations. Governments ought to encourage financial institutions to prepare for the future building stock and thus include the broad set of economic advantages EE investments can generate. Banks should especially consider the following two advantages of nZEB investments:

1. Lower energy costs and therefore higher repayment capacity
2. Higher future property value (because build according the future energy performance and therefore future-proof)

Only example in Poland is minor reduction of the bank charges applied by the state-owned Bank for Environment Protection in case of financing construction of low energy detached houses.

#PL7 – Communication

Brand NZEB buildings as part of a positive sustainability narrative

nZEB and low-energy buildings should get the reputation they deserve. The benefits are many and affect different socio-economic levels. At the macro-level, new nZEB buildings and deep renovation of buildings have multiple positive impacts such as reduction of CO2 emissions, non-transferable job creation, alleviation of energy poverty and improvement of energy security. At the micro-level, as people spend almost 90% of their life in buildings, the benefits of are numerous as well, next to the energy savings, there is the improved indoor climate with clear health benefits and increased productivity and comfort.

The benefits of new nZEB buildings should be highlighted and a new narrative, alleviating the skepticism of renovation still prevailing in many areas of Europe, should be developed for deep renovation.

Example: Szczecin City

In 2016 Szczecin City Council adopted a resolution about the tax exemption for investors constructing buildings with environmental certificate. The newly built building is subject of exempt from property tax in full, if at least 60 percent of its usable area is certified as LEED Gold level or has BREEAM certificate at the level of very good. BREEAM and LEED are the most popular environmental certificates on the Polish market.

#PL8 – Communication

Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

Demonstration of nZEB projects can lead the way in Europe by illustrating the feasibility of a more energy efficient building stock. nZEB is still seen as something ‘outlandish’ by many investors and building owners. Demonstration projects are an effective mechanism to forging partnerships between public, private and community sectors, developing new ways of working together, and learning by doing. Demonstration projects can through its transparency change processes and behaviors. There is a great deal of interest on the part of specific segments of the population as well as the general public for touring demonstration projects.

EU-projects: LEMUR

In Poland 2014-2016 was in force the state support program LEMUR. The aim of the program was to reduce energy consumption and avoid CO2 emissions in public buildings starting from the design of new buildings. An example of positive impact of this program is construction of dozen of low energy public buildings, including the school in Jabłonna (see: picture below)[67]

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[67] http://toiowo.eu/jablonna-nieoczekiwany-zwrot-ws-lemura/

#PL9 – Communication

Visualize existing building information via proper communication tools

Knowledge sharing, best practices and benchmarking processes have a huge time and money saving potential. New technologies, or Internet of Things, and "big data" are enabling us to better monitor and learn from resident's and consumer's behaviour. A better use of building data would enable more efficient process and faster development of building techniques and innovation.

Example: Polish Energy Efficient Building Platform

The entities associated within the Polish Energy Efficient Building Platform of the World Business Council for Sustainable Development have prepared 2016 first review of operational cost of selected office&retail buildings in Poland and presented the initial results during the meeting hold on 22nd June 2016 in Warsaw (supported by NAPE within ZEBRA2020 project). The subject of energy efficiency was an important highlight of the meeting, accompanied by the premiere of "Operating Costs of Office Buildings" project – the first analysis on the Polish market showing operating costs of commercial office buildings, based on actual media consumption. The project is an initiative of: SPIE Poland (project coordinator), BuroHappold Engineering, Colliers International, the Construction Marketing Group, Cushman & Wakefield, Knight Frank, Savills, Skanska Property Poland. Project partners during dedicated discussion panel debated on how to use data showing energy consumption in practice. Analysis of 48 buildings built before 2014, shows that the certification is a useful tool for owners, managers, service facility management, as well as tenants, helping to use a building in a more aware manner, which translates into improving users' comfort and reducing operating costs. A full report showing "Operating Costs" results will be published in autumn[68].

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[68] **http://bluevine.pl/en/konferencja/business-for-climate/**
http://www.wbcsd.org/Pages/eNews/eNewsDetails.aspx?ID=16390&NoSearchContextKey=true

#PL10 – Quality of action

Develop and consolidate quality frameworks for nZEB techniques and technologies

The creation of a socially-supported policy framework that declares nZEBs to be an attainable standard constitutes a major social challenge. This will require massive investments on the part of builders, businesses & industry, and the government. It is important that these investments be made correctly in technical construction terms and that they have a long life span. The lack solid quality frameworks would run the risk of providing inadequate support for the large-scale introduction of nZEBs.

Ensuring high-quality workmanship is therefore an essential precondition for conducting a large-scale market launch. This can only happen within integrated quality frameworks which addresses knowledge enhancement (via retraining, specialisation, etc.), the valorisation of knowledge via the certification of individuals and the support of individuals in companies and institutions which themselves have developed an integrated quality framework. Quality frameworks often work well if there are suitable support schemes linked to them. Within this context, a broader framework could also be pursued in which issues such as the environment, safety and product quality are addressed as well.

Example: Association of Thermal Insulation Systems

Only quality framework is organised by the Association of Thermal Insulation Systems, which promotes the ETICS scheme for improvement of quality of thermal insulation works on buildings[69].

#PL11 – Quality of action

Enhance the proficiency of certifiers in order to increase the reliability of Energy Performance Certifications

Reliable Energy Performance Certificate (EPC) schemes could be part of the key steps towards

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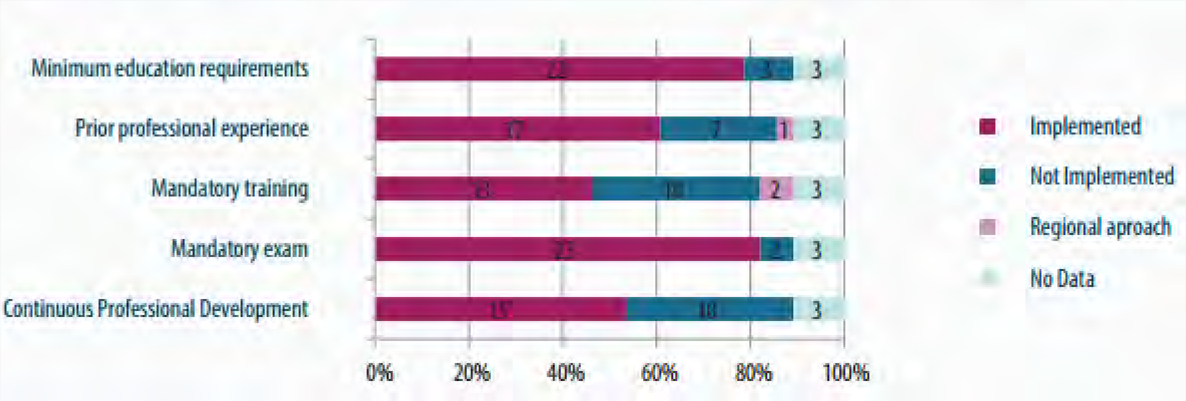
[69] http://www.systemyocieplen.pl/kontakt.php

highly energy-efficient buildings. Building certifiers play an important role in ensuring the credibility of the EPC system, which is why the quality of their skills and performance is essential.

The certifier is responsible for the EPC accuracy, reliability and compliance with the national energy performance calculation method. In case of poor quality, lack of required qualifications or questionable work independency, he/she may be penalised. The EPBD recast obliges MS to set the rules on penalties for non-compliance that are "effective, proportionate and dissuasive" (Art.27).

Building certifiers have a central role to play in ensuring the credibility of the EPC scheme. MS should therefore develop an EPC framework which includes all elements necessary to guarantee an effective and reliable certification process. For this, it is essential to guarantee adequate skills of the certifiers. Minimum standards for training, prior professional experience and independent accreditation procedures should be included in all Member States' legislation in order to ensure a minimum level of quality.

The figure below shows "Minimum qualification for qualified and/or accredited expert"[70]



The next image shows "Path to question relevance of developing specific schemes for training, competence checks, and proper completion checks[71]"

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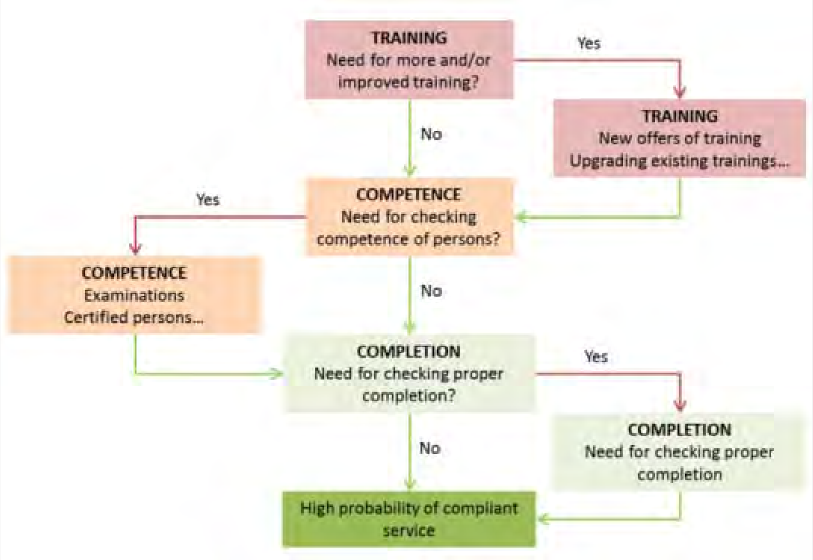
[70] BPIE (2015) http://bpie.eu/wp-content/uploads/2015/09/BPIE-EPCsFactsheet-2015.pdf

[71] Qualicheck (2016) - http://qualicheck-platform.eu/wp-content/uploads/2016/05/QUALICHeCK-Booklet-1.pdf



Example: State of play

There is no registered build-up skills system of certifiers. Most of certifiers are energy auditors associated on facultative way in the Association of Energy Auditors created 2000, which provides internal licencing of members based on verification of their achievements. The Association, supported by the Energy Conservation Foundation and National Energy Conservation Agency (NAPE) is actively offering training on best practices, best available technologies and energy management for its members.

#PL12 – Incentivize the Market

Involve and empower local authorities in pilot projects

When developing pilot projects anywhere in Europe, it is crucial to involve local authorities from the start. Many of the big cities have already set higher ambitions on climate mitigation and decarbonisation than the EU-level requires and are developing incentive or roll-out programmes to push for the accomplishment of these goals. A strong collaboration between industry actors and local governments can speed up the development of innovative projects, especially when the city takes on the role of a facilitator to align industry actors, the market, end-users and includes them into an ecosystem approach.

Currently, the Polish municipalities are focusing more on preparation of low carbon strategies and there are some relatively successful projects of construction of low energy public buildings. The developers usually are not involving the local authorities in new projects.

Example: Project Zero

Project Zero, in the small Danish municipality of Sonderborg, is based on the belief that education is vital at all levels, from Kindergarten to PhD. Thus, energy consultant courses for municipal service workers were organised and efforts were made to educate the area's tradesmen and unskilled workers in energy renovations. As part of their activities, 1,200 homeowners have received free energy advice[72].

Image source - Request2Action

***#PL13** – Social Issues*

Shift from fuel subsidies into energy efficiency measures

Fossil fuel subsidies (FFS) in the form of heating bill support-payments are used by governments as the main instrument to support vulnerable consumers. The social aspect of the payments disguises the fact that the subsidies encourage and prolong the use of fossil fuels. Besides having an adverse impact on the climate, the payments are an ineffective solution for supporting vulnerable households, as they require continuous and increasing funding without generating economic growth and result in wasteful energy consumption. It is striking that in Ireland the budget allocated to the National Fuel Scheme increased by 170% to €228 million from 2004 to 2010 and in Greece, €650 million were committed to oil subsidies for heating from 2010 to 2014 but only €548 million to energy improvements in houses.

Therefore, fossil fuel subsidies play a negative role on energy efficiency in buildings by supporting wasteful energy consumption and by spending every year big part of the public budget, which could have been allocated for energy efficiency measures. Thus, it is high time that policies and financing shifted from supporting inefficient and climate-damaging FFS to promoting energy efficiency measures, leading Europe to smart, sustainable and inclusive growth.

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[72] http://brightgreenbusiness.com/

Example: State of play

As the main fuel for heat&power generation in Poland is hard coal and lignite, the switch to energy efficiency and RES is very hard. However, the existing financing schemes for support of modernization of buildings require complex measures which cover both energy source modernisation and reduction of physical energy demand of buildings. Application of RES in modernised buildings brings additional points by verification of applications submitted to the financing institutions.

#PL14 – Social Issues

Indoor health and comfort aspects should be included to a greater extent in building legislation

In EU and national legislation, stricter energy performance requirements should be completed with appropriate requirements and recommendations to secure proper indoor air quality, daylight and thermal comfort. For instance, requirements for stricter insulation and airtightness should be complemented by appropriate minimum requirements for indoor air exchange and ventilation. As there are several ways to obtain significant savings in energy consumption in buildings while at the same time improving the indoor climate, clear legislative provisions for conflicting situations will create certainty for planners and architects.

- In urban areas, 60-90% of people's life is spent in buildings
- In 2012, 99 000 deaths in Europe and 19 000 in non-European high income countries were attributable to household (indoor) air pollution.

Example: The Małopolska Region

Małopolska Region Centre Energy Certificate. The Małopolska Region Centre for Energy Efficient Building is an innovation unit of Cracow University of Technology whose aim is to establish a network of partner collaboration between research and business in the field of energy efficient building. The Center has created own Energy Performance Certificate, which is in use for public building owners applying for grants from EU Regional Operational Program. The building certification process includes verification of building design, Blower Door Test, thermovision tests, air quality measurements and carbon footprint calculation[73].

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[73] http://www.mcbe.pl/oferta-malopolski-certyfikat-budownictwa-energooszczednego.html

8. ROMANIA

8.1BUILDING PERFORMANCE MARKET DATA

8.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

Figure 80 illustrates the share of new multi – and single- family dwellings in the residential stock. Romania's construction rate is below 0.6 percent, which is very low (although, not lowest in Europe). The construction rate is low because of migration of people on young and medium age and in this way it is affected the request. In the context of the European economic and financial crisis (which has led to significant job losses in Romania's construction industry), consumers prefer to focus on short-term benefits while investments in housing are perceived as long-term despite the immediate impact on comfort/quality of life. The crisis left many dwellings unsold, hampering new constructions. Romania has the highest portion of single-family dwellings. These buildings are built by young people who have relative high income and have intention to build a home.

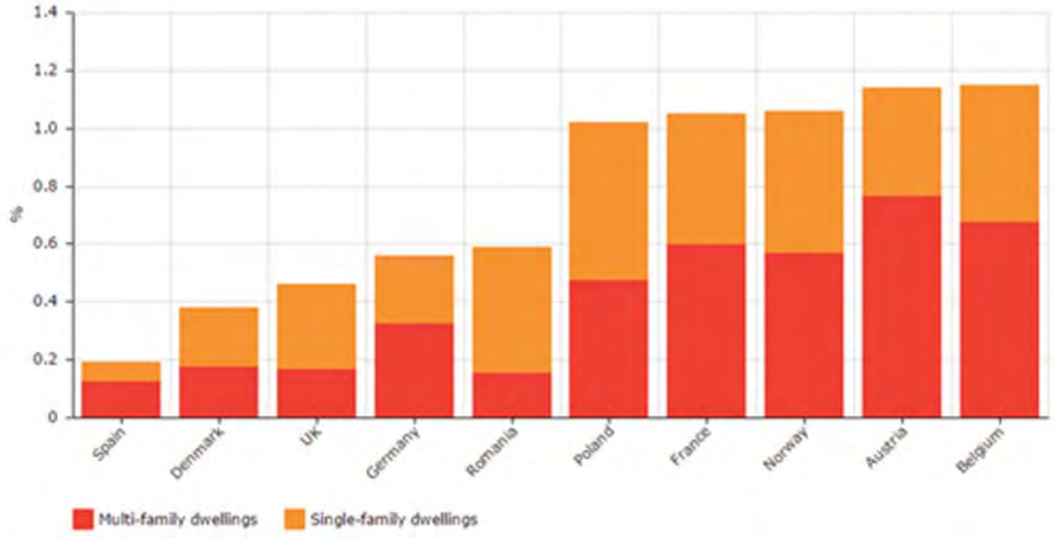

Figure 80 Share of new multi- and single-family dwellings in residential stock in 2014

Source: ZEBRA

Figure 81 shows that all buildings are being built according to the building code. In Romania, more than 42 % of the people have trouble to pay utilities for their homes. Because people are poor,

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http://www.en.mcbe.pl/offer.html

buildings are being built according to the minimum energy performance requirements. The nZEB definition was implemented in February,2016, so there will be improvements in the regard.

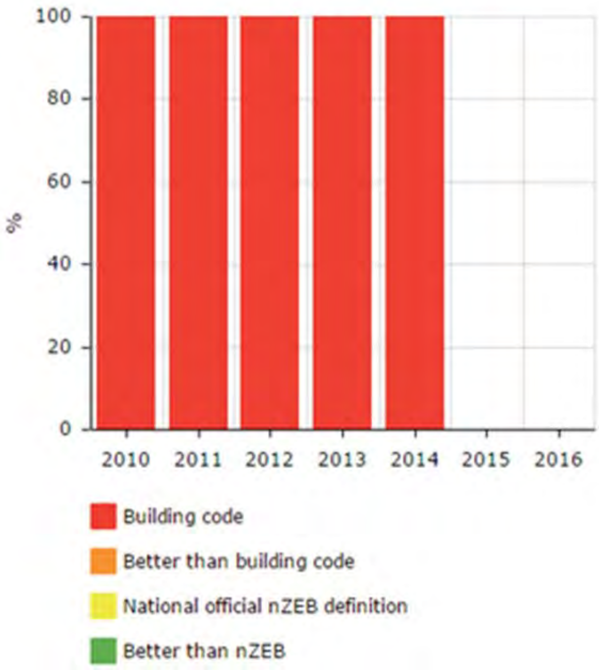


Figure 81 Distribution of new dwellings according to the nZEB radar graph – Romania

Source: ZEBRA

8.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Romania, it has been collected data of 29 nZEBs or high energy efficient buildings which were constructed recently. 26 out of the 29 are new buildings and 3 are renovated buildings. 16 have a residential use and 13 are intended for non-residential use.

Climate zones

As Table 14 Building distribution by climate zones - *Romania* lists, in Romania the selected buildings are located in 4 of the 5 defined climate zones. 12 selected buildings are located in the climate zone A, which is characterized by cold winters and warm summers, 9 are located in climate zone B with cold winters and mild summers, 3 are located in climate zone D with temperate winters and mild summers, and 5 are located in climate zone E that have temperate winters and warm summers.

Table 14 Building distribution by climate zones - Romania

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers	12	
B	Cold winters and mild summers	6	3
C	Warm winters and warm summers		
D	Temperate winters and mild summers	3	
E	Temperate winters and warm summers	5	

Heating Demand

The average heating demand in new buildings is 36,3 kWh/m² a, while in the 3 renovated buildings the average is much higher with a value of 86,3 kW/m² a.

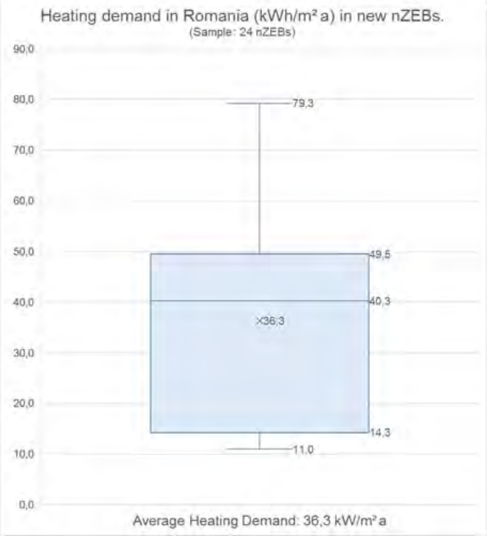


Figure 82Box plot of heating demand in new nZEBs - Romania

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,54 and 0,11 in roofs. In renovated buildings the average U-value in walls is 0,37, whilst it is not available in roofs. In both new and renovated buildings, the insulating material used in walls and roofs is mostly unknown. Aside from that, in new buildings, expanded polystyrene (23%) is the most indicated insulating material in walls, while stool wool together with extruded polystyrene is the most used insulating material in roofs with a share of 8% each. In renovated buildings, one of the buildings uses stone wool as insulating material in walls and in the rest of buildings it is unknown.

In windows, the average U-value is 1,1 in new buildings and 1,33 in renovated buildings. Concerning the type of glass, the double glass with low emissivity is the most common option for new buildings (23%) and the double glass in renovated buildings (67%). 73% of the new buildings do not use any passive cooling strategy and 27% use natural ventilation, while no renovated building uses any passive cooling strategy.

Active solutions

Mechanical ventilation with heat recovery system is the used in the 38% of the new buildings and in 67% of the renovated buildings. With regard to the heating system, boiler is the most common option with a percentage of 38% of new buildings. Non-condensing boiler with low temperature (67%) is the most used option in renovated buildings. In line with the most used heating systems, gas is the most used energy carrier for heating with a percentage of 42% in new buildings and 100% in renovated buildings.

Concerning DHW, the dedicated generation system is the most used system in new buildings with a share of 35%, while 67% of the renovated buildings use the same system for heating and DHW. 46% of the new buildings do not use any cooling system, 23% use heat pumps and 31% an unknown system for cooling. 67% of the renovated buildings use water cooled chiller as cooling system and the rest (33%) do not use any cooling system.

Renewable energies

In 6 out of the 26 new buildings, it is indicated the use of photovoltaic systems and in 7 the use of solar thermal systems. In none of the 3 renovated buildings it is mentioned the use of photovoltaic or solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Romanian reports and realised projects.

Table 15 *Costs of different renovation depths and new built according to nZEB standards - Romania*

Costs (€/m2)	RO
Minor renovation (15% energy savings)	36
Moderate renovation (45% energy savings)	84
Deep renovation (75% energy savings)	197
NZEB renovation (95% energy savings)	376
New built according to nZEB standards	679
Additional funds for nZEB construction compared to new built	200

8.2 EPCS AND REAL ESTATE AGENTS

8.2.1 REAL ESTATE AGENTS SURVEY

1. The dominant form of EPC indicated by almost all the real estate agents in Romania is mandatory certification.

2. In opinion of real estate agents from Romania, the main factors taken into account whilst selecting, purchasing or leasing real estate are mainly the price, location, the size of the real estate, various "nuisance" e.g.: a busy road, landing airplanes, landfill, a high-voltage line.

The cost of energy is indicated as very important factor by 30% and as important by 37% of real estate agents in Romania.

3. The EPCs in Romania are very frequently required in concluding the purchase/lease contracts.

4. More real estate agents in Romania are in general satisfied than unsatisfied with reliability of the data provided by the EPC.

5. Usefulness of EPCs in the professional activity of real estate agents in Romania is evaluated by them very positively. Even 61% of the respondents in Romania indicates the usefulness of the certificate in their professional work.

6. The real estate agents in Romania rather don`t observe connection between the EPC and the improvement of the energy performance of buildings.

7. Usually, real estate agents in Romania don`t confirm correlation between the high energy performance and high value of real estate.

8. The real estate agents in Romania don`t observe that higher energy performance of buildings cause the growing interest in its purchase / lease in comparison to other buildings.

9. In opinion of real estate agents in Romania, the influence of having the higher EPC class on the exposure time of the real estate is very low.

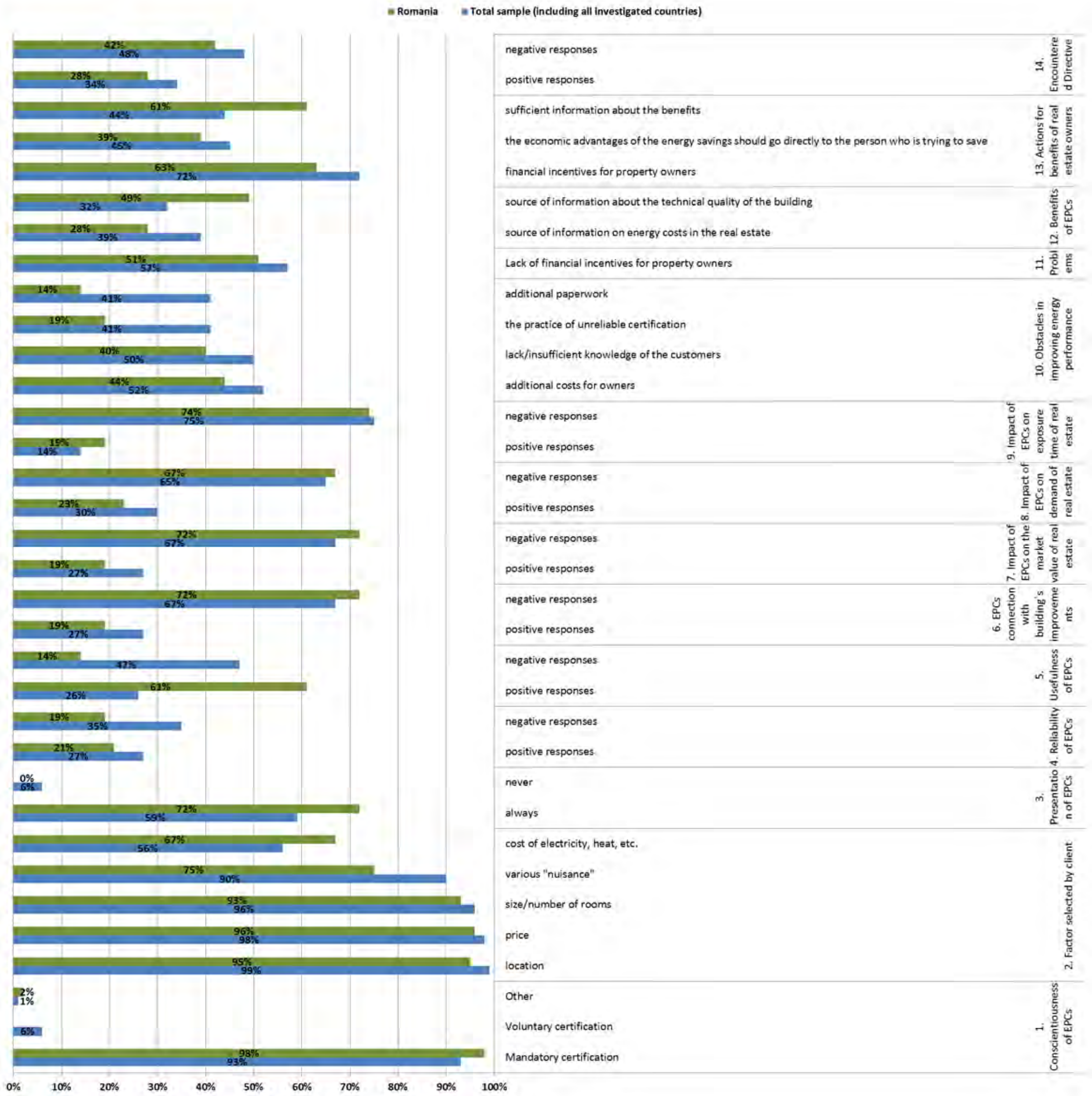
10. The main obstacles in improving the energy performance of buildings were indicated by real estate agents in Romania to be the following: financial matters (additional costs for owners), low social awareness in this subject, the practice of issuing unreliable certificates and additional bureaucracy.

11. Among the problems of implementing the improvement of the energy performance of buildings, the following has been mainly indicated by the real estate agents in Romania: the financial aspect, no incentive for the real estate owners.

12. The EPC as the source of information concerning rather the technical condition of the building than the energy costs is indicated by the real estate agents in Romania as quite important benefit of having EPC.

13. The most expected support that would influence the improvement of the energy performance of buildings, according to the respondents from Romania, is economic support directed to real estate owners, sufficient information about the benefits financial activity and economic incentives for those that undertake such actions.

14. The level of awareness and information about wording, requirements and settlements of the 2002/91/EC or 2010/31/EU Directive among the real estate agents in Romania is below average.


Romania
Total sample (including all investigated countries)
14. Encountered Directive
negative responses 42% 48%
positive responses 28% 34%
13. Actions for benefits of real estate owners
sufficient information about the benefits 61% 44%
the economic advantages of the energy savings should go directly to the person who is trying to save 39% 45%
financial incentives for property owners 63% 72%
12. Benefits of EPCs
source of information about the technical quality of the building 49% 32%
source of information on energy costs in the real estate 28% 39%
11. Problems
Lack of financial incentives for property owners 51% 57%
10. Obstacles in improving energy performance
additional paperwork 14% 41%
the practice of unreliable certification 19% 41%
lack/insufficient knowledge of the customers 40% 50%
additional costs for owners 44% 52%
9. Impact of EPCs on exposure time of real estate
negative responses 74% 75%
positive responses 19% 14%
8. Impact of EPCs on demand of real estate
negative responses 67% 65%
positive responses 23% 30%
7. Impact of EPCs on the market value of real estate
negative responses 72% 67%
positive responses 19% 27%
6. EPCs connection with building's improvements
negative responses 72% 67%
positive responses 19% 27%
5. Usefulness of EPCs
negative responses 14% 47%
positive responses 61% 26%
4. Reliability of EPCs
negative responses 19% 35%
positive responses 21% 27%
3. Presentation of EPCs
never 0% 6%
always 72% 59%
2. Factor selected by client
cost of electricity, heat, etc. 67% 56%
various "nuisance" 75% 90%
size/number of rooms 93% 96%
price 96% 98%
location 95% 99%
1. Conscientiousness of EPCs
Other 2% 1%
Voluntary certification 6%
Mandatory certification 98% 93%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

8.3 EXISTING POLICIES

The most recent Government Ordinance (OG nr. 13/2016) amending and supplementing the Law (no 372/2005) on the energy performance of buildings, sets stricter rules for the implementation of the EPCs schemes (higher fines, size of sampling of EPCs, etc.), clarifies some definitions (e.g. major renovation) and forces the mayors of urban areas with more than 5,000 inhabitants to initiate local multiannual plans for increasing number of nZEBs.

Furthermore, the same Ordinance defines an nZEB as a "building with a very high energy performance, in which energy consumption is nearly zero or very low and is covered in a rate of at least 10% of energy from renewable sources, including renewable energy produced on-site or nearby".

The building sector and energy targets

Romania's national indicative energy efficiency target for 2020 is to save 10 million toe of primary energy, which represents a reduction of 19% in the volume of primary energy consumption (52.99 million toe) forecast in the Primes 2007 model for the realistic scenario. Achieving this target implies that in 2020 primary energy consumption will be 42.99 million toe, while total energy consumption will be 30.32 million toe.

Buildings are a central element of the Romanian Government's policy on energy efficiency, given that the national energy consumption in the residential and tertiary sector (offices, commercial areas and non-residential buildings) together account for 45% of the total energy consumption. Romania has a significant number of buildings, built mainly from 1960 to 1990, with low thermal insulation due to the fact that, before the energy crisis of 1973, there were no regulations on the thermal protection of buildings and enclosure elements, and they are no longer suitable for the purpose for which they were built. The final energy consumption in these buildings varies between 150 and 400 kWh/m2/year.

National Renovation Strategy

In April 2014, Romania published its renovation strategy, which has a unique feature as it has sought to quantify the wider benefits of building renovation. Furthermore, it presents a comprehensive appraisal of policy options that need to work together to address the underlying barriers and recognises the importance of engaging across the political spectrum in support of the strategy for deep renovation of the building stock. The following actions are identified in the Romanian renovation strategy as being of high importance:

Strategic	Legislative/Regulatory	Technical	Communication/Capacity Building
• Establish support across the political spectrum for deep renovation of the building stock • Undertake systematic appraisal of barriers to renovation in each segment of the market and develop policy responses to address each barrier • Establish objective to eradicate fuel poverty through enhancing energy performance of the housing stock	• Identify trigger points and develop respective regulation that could be used to encourage, or require, building energy performance improvement • Address restrictive practices concerning local deployment of low/zero carbon technologies to ensure that a positive environment for buildings integrated renewables is established • Remove restrictive tenancy laws which disincentives or inhibit energy performance improvement	• Analyse potential for district heating systems to provide efficient, low carbon energy • Fiscal/Financial • Secure sources of finance, including those identified in EED Article 20 and EU/international funding sources, together with mechanisms that effectively leverage private capital • Factor in monetary value of co-benefits (e.g. health, employment) in public funding decisions • Develop funding vehicles, tailored to specific market segments that provide a simple ("one-stop-shop") and commercially attractive source of finance for deep renovation • Develop mechanisms to encourage deep renovation via third party financing (TPF) e.g. ESCOs, EPCs	• Gear-up skills and training programmes covering the key professions and disciplines • Encourage development of the local supply chain industry for maximising macro-economic benefits and to minimise embedded CO2 emissions • Develop promotional and dissemination activities that sensitise building owners to opportunities for deep renovation and that provide stepwise support throughout the renovation process • Communicate regularly and publicly on progress with the renovation strategy

Energy performance requirements

In Romania there are no actual energy performance requirements neither for new buildings nor for renovations, expressed in final or primary energy. Instead, there are minimum requirements for the thermal quality of building envelopes. However, for the thermal rehabilitation of block-of-flats in the national rehabilitation program (OUG 18/2009) the implemented measures have to ensure that the specific annual heating consumption has decreased below 100 kWh/m2 of useful area[74]. For residential buildings there is a maximum allowed heating demand from 15 kWh/m3/yr to 37.5 kWh/m3/yr depending on the external area per volume ratio (A/V) (final energy, cooling and domestic hot water not included)[75].

Compliance

The building energy performance is evaluated and presented in the EPC based on the approved calculation methodology (MC 001-2006). The main responsible body for compliance control in construction is the State Inspectorate for Construction (SIC), a public institution as legal entity, to the Ministry of Regional Development and Public Administration (MDRAP). The SIC is responsible for the state control on the uniform application of legal provisions on energy performance of buildings and

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[74] https://ec.europa.eu/energy/sites/ener/files/documents/ro_-_letter.pdf

[75] http://www.epbd-ca.org/Medias/Pdf/CA3-BOOK-2012-ebook-201310.pdf

the inspection of heating / air-conditioning, under procedures approved by the Ministry of Regional Development and Public Administration in order to achieve and maintain the essential requirement on "Energy saving and thermal insulation" and other essential requirements of Law no. 10/1995, as amended.

The nZEB plan

The Government Ordinance nr. 13/2016, defines an nZEB as a "building with a very high energy performance, in which energy consumption is nearly zero or very low and is covered in a rate of at least 10% of energy from renewable sources, including renewable energy produced on-site or nearby". According to the same Ordinance, the level of energy in nZEBs is determined by technical regulations and is updated regularly according to technical progress. In the Romanian national plan to increase the nZEBs (July 2014) there is no official nZEB definition. However, it includes limitations on the primary energy from conventional sources in nZEB.

Renewable sources in the building sector

According to the NREAP (2012) there are no minimum levels for the use of renewable energy in building regulations. The use of renewable energy technologies in buildings is not a usual practice yet but started to grow significantly over the last years. However, the national nZEB plan and the Ordinance 13/2016 mention that 10% of the total primary energy of an nZEB has be covered from RES. The following table presents the estimated share from RES in the building sector that is included in the NREAP.

Estimated share of renewable energy in the building sector

	2005	2010	2015	2020
Residential	93.1%	93.1%	93.1%	93.1%
Services	6.7%	6.7%	6.7%	6.7%
Industrial	0.2%	0.2%	0.2%	0.2%
Total	100%	100%	100%	100%

Financial and fiscal support policies/programmes

There are several financial support schemes already in place by and/or with the support of the Romanian Government. They promote uptake of energy efficiency and renewable energy in buildings and build the capacity of local organisations. The programmes especially target the older building stock with most potential for improvements usually located in low income regions.

8.4 NZEB-TRACKER

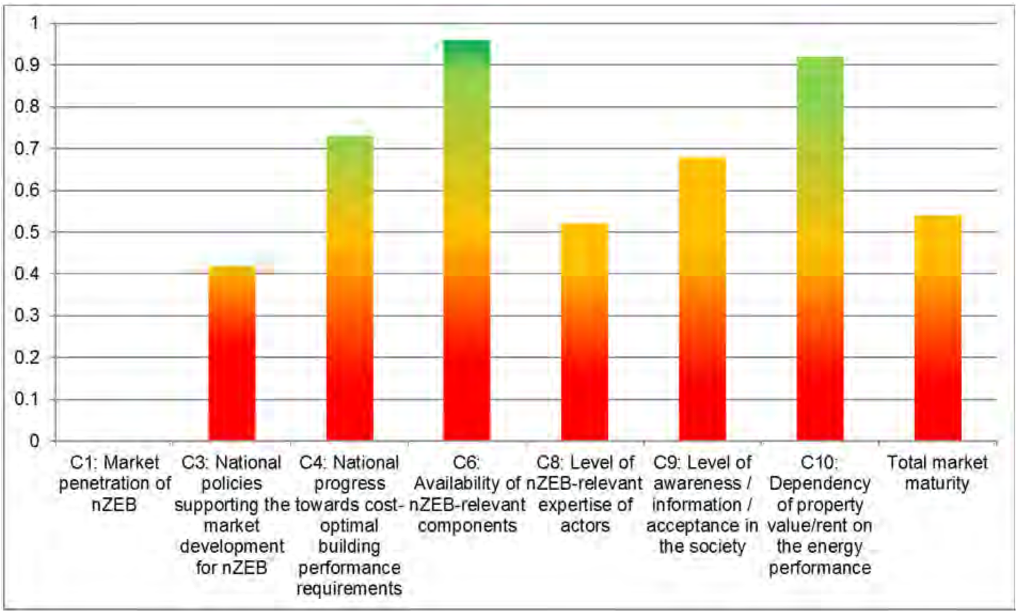

Figure 83 nZEB-tracker score for Romania

C1: Market penetration of nZEB

- Romanian result: >0 ZEBRA average: **0.32**
- Cannot be estimated at this moment. Energy performance requirements for the NZE Buildings were established in April, 2016, by Order no. 386/2016. It is however safe to say that Romania is moving in the right direction.

C3: National policies supporting the market development for nZEB

- Romanian result: **0.42** ZEBRA average: **0.52**
- Romania developed for the first time (in 2016) a scheme to incentivize renovation and construction of new buildings with the best energy class with grants. So Romania is taking some measures to reach nZEB level. The situation has improved since 2014 (start of the ZEBRA2020 project).

C4: National progress towards cost-optimal building performance requirements

- Romanian result: **0.73** ZEBRA average: **0.94**
- Romania established minimum energy performance requirements for buildings in harmony with the estimation of cost-optimality, in January, 2016. Romania is making progress in this regard.

C6: Availability of nZEB-relevant components

- Romanian result: **0.95** ZEBRA average: **0.83**
- Many EU initiatives are increasing the availability of nZEB-relevant products.

C8: Level of nZEB-relevant expertise of actors

- Romanian result: **0.53** ZEBRA average: **0.63**
- The expertise has improved since 2014.

C9: Level of awareness / information / acceptance in the society

- Romanian result: **0.68** ZEBRA average: **0.94**
- Based the survey done for ZEBRA2020 in 2015 by BPIE in Romania[76], the awareness is constantly growing. Although, there are still room for improvement.

C10: Dependency of property value/rent on the energy performance

- Romanian result: **0.92** ZEBRA average: **0.74**
- Based the survey done for ZEBRA2020 in 2015 by BPIE in Romania[77], the awareness of energy performance is constantly growing. Since the energy prices are very low in Romania, the importance of energy performance is fairly low, which is a barrier to energy efficiency measures.

Maturity of the Romanian nZEB market

- Romanian result: **0.54** ZEBRA average: **0.66**
- The nZEB definition was established in Romania, in April ,2016. Romania has come a long way but still has a lot to improve**.**

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[76] The results of the survey regarding the real estate market reaction at the energy efficiency characteristics of buildings from Romania, comparative with countries analyzed by ZEBRA project. Link : http://bpie.eu/wp-content/uploads/2015/10/Laying-down-the-groundwork-for-a-comprehensive-nZEB-market-strategy.pdf

[77] The results of the survey regarding the real estate market reaction at the energy efficiency characteristics of buildings from Romania, comparative with countries analyzed by ZEBRA project. Link : http://bpie.eu/wp-content/uploads/2015/10/Laying-down-the-groundwork-for-a-comprehensive-nZEB-market-strategy.pdf

8.5 SCENARIOS

Market penetration of nZEB – new building construction

Figure 84 shows annual construction of conditioned floor area according to different standards. The results are shown for the historical development and in both policy scenarios, current and ambitious for the long term development from 2021 to 2050. For an explanation of the scenario framework of the current policy scenario and the ambitious policy scenario, see part "Introduction". Data on historical development of new building construction according to national standards were collected in the project, see part "Building performance market data" and are available on the project project´s data tool (http://www.zebra-monitoring.enerdata.eu/). The share of the new building construction according to the building code in 2012 was app. 100% of the total new building floor area. According to building code means that buildings are constructed according to national minimum requirements which are indicated by the Regulation C107/2010. For new residential buildings the requirements refer to minimum thermal resistance R-values and the maximum overall thermal coefficients G-values. In the ambitious scenario, the share of stringent measures is much higher due to the policy implication.

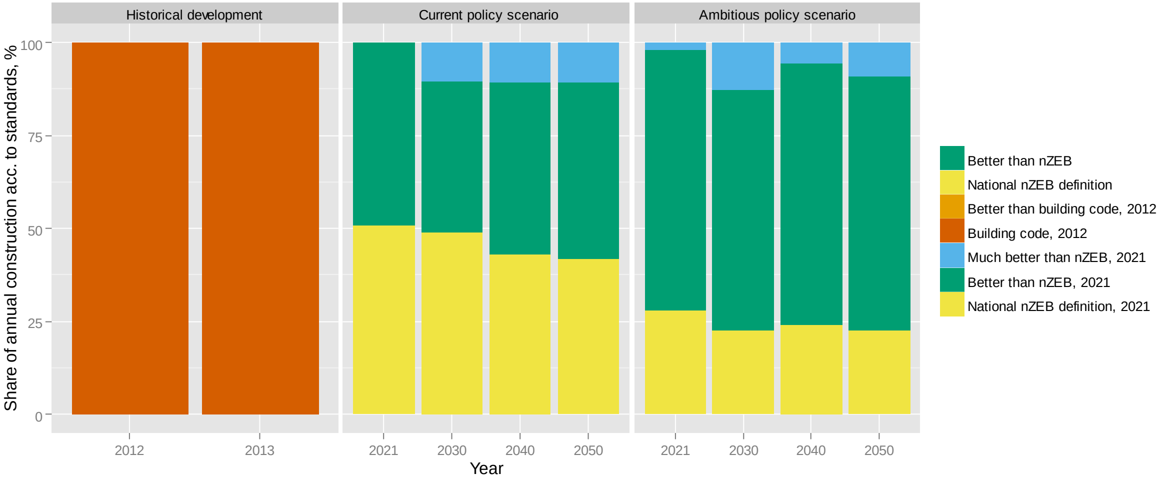

Figure 84 Share of annual construction of conditioned floor area built according to national standards

Building renovation activities

Figure 85 shows historical development and future development in current and ambitious policy scenarios of annual renovation of conditioned floor area by renovation levels.

The following renovation categories were defined in the current policy scenario:

- medium renovation which refers to the building codes

- light renovation meaning that in reality not all buildings fulfil the criteria set in the building legislation and
- deep renovation reflecting the nZEB definition

In the ambitious scenario, from 2021 to 2050, all buildings fulfil at least the building standards. There is an additional renovation level "deep plus" which means higher energy performance achievements.

In Romania, in the current policy scenario, the share of the medium and deep renovation makes up a significant share on the total renovated building floor area from 2021 to 2050. In the ambitious policy scenario, which implements stringent measures on existing buildings, the share of the deep and deep plus renovation is increased compared to the current policy scenario. In 2040 around 60% of the renovated building floor area will be renovated with a strong share of deep plus (20%) and deep renovation (40%), resulting in higher energy savings (Figure 89)

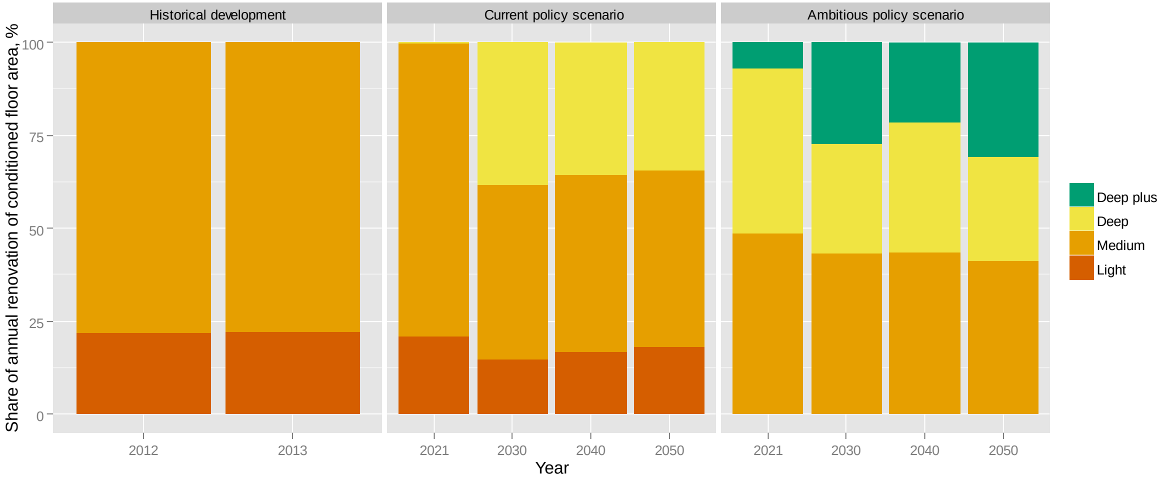

Figure 85 Share of annual renovation of conditioned floor areas by renovation levels in current and ambitious policy scenarios

Figure 86 shows the distribution of the spec. energy need for space heating (norm energy need calculation according to EN13790) in the total building stock after building renovation by using the following renovation levels, light, medium, deep and deep plus. The spec. energy needs are shown in a box-plot diagram. The median (middle quartile) marks the mid-point of the data and is shown by the line that divides the box into two parts while the diamond indicates the mean value. The data is represented for 2012 for not renovated buildings, light, medium and deep renovation. The deep plus renovation shows spec. energy need for buildings being renovated after 2020. In Romania, the medium renovation refers to the building code, which is published in the Regulation C107/2010. The spec. energy need for space heating of light renovation is higher compared to the medium renovation, which means that in reality not all buildings fulfil the criteria set in the building legislation. Deep and deep plus renovation include i.e. the installation of mechanical ventilation.

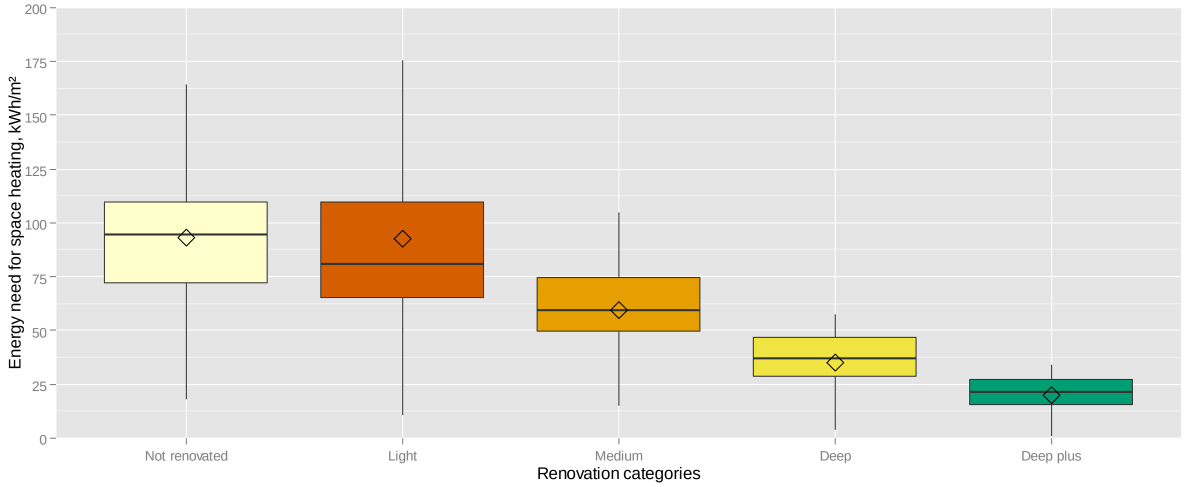

Figure 86 Distribution of the buildings spec. energy need for space heating

Economic indicators and national policies supporting the market development for nZEB

Figure 87 shows total yearly investments in the building envelope (thermal renovation) and in renewable heating systems from 2012 to 2050 in the current and ambitious policy scenarios. The investments are slightly higher in the ambitious scenario due to higher number of the renovated buildings, higher quality of the implemented thermal renovation and higher investments in the renewable systems. Figure 88 shows total yearly public budget for financial support of renewable heating systems and renovation of the building envelope. The yearly public budgets are significantly higher in the ambitious policy scenario.

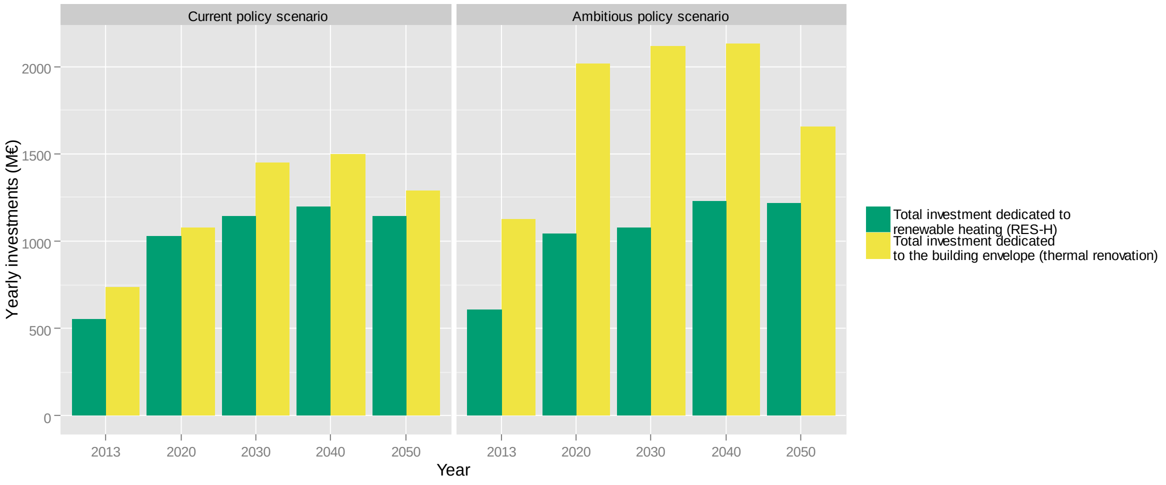

Figure 87Total yearly investments in renewable heating systems (RES-H) and renovation of the building envelope including public budget, 2013 to 2050, current policy and ambitious policy scenario

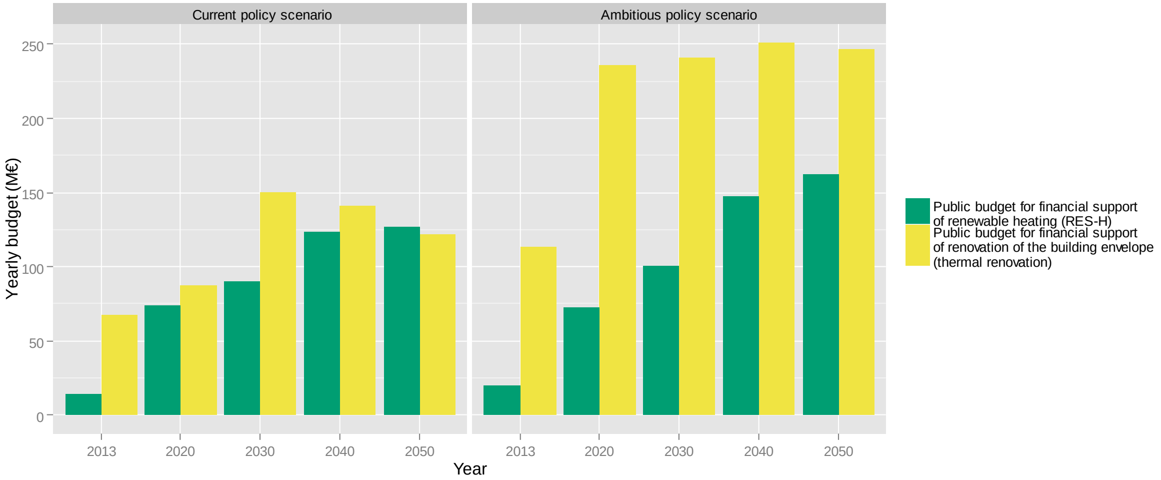

Figure 88Total yearly public budget for financial support of renewable heating systems (RES-H) and renovation of the building envelope, 2013 to 2050, current policy and ambitious policy scenario

Development of the building related energy demand

Figure 89 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Romania´s building stock is 73 TWh in 2012. The scenario shows a slow-down of the energy demand of 3% from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 35% in the current policy scenario in the long term development between 2012 and 2050 and by 42% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Romania, the share of fossil-fuel-based heating systems, natural gas, oil and coal makes up around 35% of the total energy demand for space heating and hot water in 2012. The share of non-delivered energy (i.e. solar and ambient energy) is around 0.5% of final energy demand in 2012 to around 16% in current policy scenario and 20% in ambitious policy scenario in 2050.

Figure 90 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 60% in current policy scenario and around 62% in ambitious policy scenario. The reduction of the primary energy demand is around 50% and 60% in the current and ambitious policy scenarios respectively. The main driver for the CO2-emission and primary energy savings in both scenarios is the overall energy demand reduction and increase of energy performance of new and renovated buildings and the share of renewable heating.

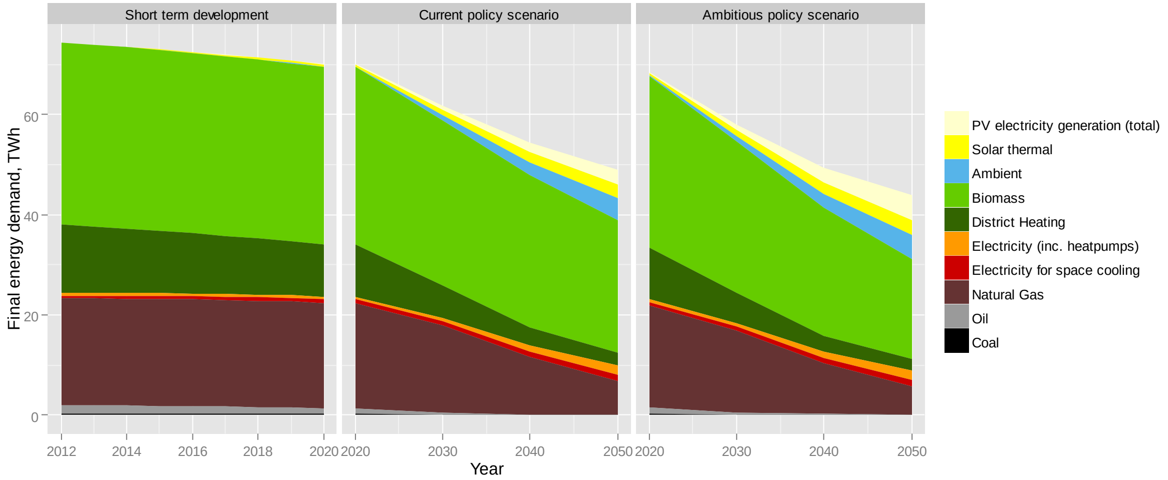

Figure 89 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

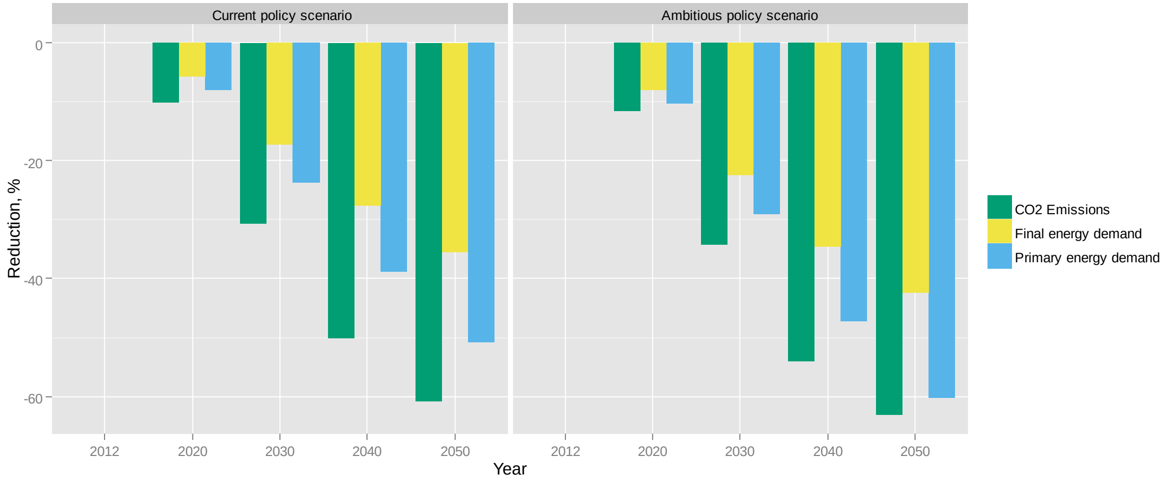

Figure 90Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

8.6 RECOMMENDATIONS

Implementation of nZEBs in Romania will bring multiple benefits for both society and the industry sector. But to ensure a cost-effective and sustainable market transformation, to develop appropriate policies and to increase institutional capacities, more action is needed. It is increasingly important to start mapping out a roadmap towards nZEBs, based on a major public consultation of all relevant stakeholders followed by a comprehensive information campaign. A clear policy roadmap, outlining future measures in a timely way, will provide the business sector and the market with the predictability needed for a fast nZEB market uptake. After a brief description of the Romanian context and challenges, specific recommendations are outlined on how to speed up this development.

There are today 493,000,000 m² of building floor area in Romania, of which 86% are accounted for by residential buildings. Of the 8.1 million dwellings, single family houses dominate, accounting for 61% of the total. In the non-residential stock, the total floor area sums up to 67,200,000 m².

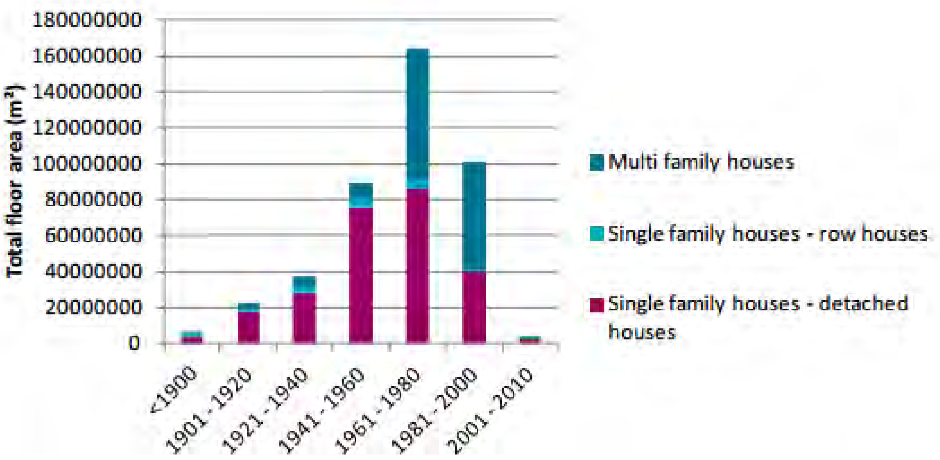

Figure 91 Breakdown of the building stock by age bands, BPIE Data hub[78]

Romania suffers from having a big portion of low performing buildings. 58% of the "block of flats" constructed before 1985 need to be renovated. The need for renovation together with the possibility of replicability, makes this a good opportunity for nZEB renovation projects. Investing in these buildings would also reduce energy poverty and bring environmental gains in better air quality and reduced greenhouse gas emissions.

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[78] BPIE Data hub https://www.buildingsdata.eu/

However, the **low energy prices** in Romania (see figure 2) undercuts the viability of nZEB measures and prolongs fossil fuels dependency and energy poverty. Increased electricity and gas prices in Romania, to be comparable with the rest of the EU, would encourage renovation of existing buildings and the construction of new high performance buildings. In order to ensure that the energy poor don't get punished with higher energy prices, fossil fuel subsidies should be shifted to other subsidies targeting vulnerable groups, for example to energy efficiency measures (see recommendation 10).

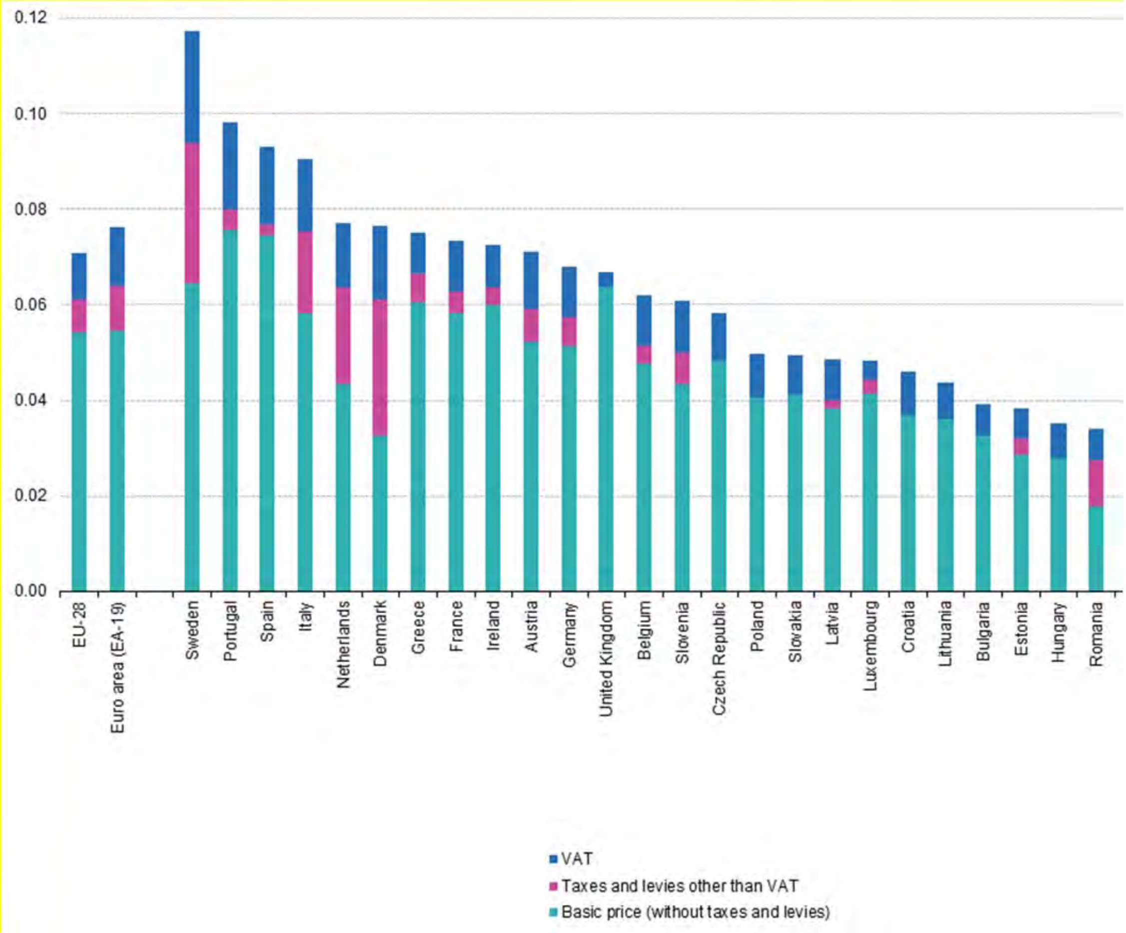

Figure 92 Natural gas prices for household consumers, second half 2015 (EUR per kWh) EUROSTAT[79]

The shortage of **skilled labor** is another challenge for Romania in achieving nZEB level and beyond. The Romanian situation is tinted by low skilled workers and a low level of training for the use of new

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[79] EUROSTAT (2015) http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Natural_gas_prices_for_household_consumers,_second_half_2015_(%C2%B9)_(EUR_per_kWh)_YB16.png

technologies designed for energy efficient and renewables. An important investment for Romania is labor force, in order to harness the benefits of nZEB, more and better skilled workers are required.

Energy poverty is also a big problem in Romania. In 2013, 30,5% of the Romanian population found it difficult to be able to pay housing costs and utility bills (compared to average of 11,7% for the whole Europe). A UNDP/GEF draft assessment report[80] from 2012 concludes: "A large proportion of Romania's population is not able – in general and in normal conditions – to provide itself with sufficient levels of thermal comfort in the home, because of the high cost of heating energy relative to their income."

Following this background, 11 recommendations have been outlined for Romania:

RO1 - Implement long-term coherent (yet dynamic) regulatory framework, in close cooperation with stakeholders

RO2 - The energy performance and thermal requirements of buildings should be stricter and better enforced, creating a path towards nZEB

RO3 - Increase the predictability of financial programmes and steer the building stock towards nZEB level

RO4 - Increase information availability and provide guidance to interested parties

RO5 - Training building professionals with "nZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

RO6 - Develop and consolidate quality frameworks for nZEB techniques and technologies

RO7 - Enhance the proficiency of certifiers in order to increase the reliability of Energy Performance Certifications

RO8 - Stimulate the market uptake of Energy Performance Contracting (ESCOs)

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[80] UNDP/GEF (2012) http://www.undp.ro/libraries/projects/EE/Assesment%20Report%20on%20Fuel%20Poverty%20-%20DRAFT(1).pdf

RO9 - Explicitly define energy poverty and set up monitoring mechanisms

RO10 - Shift from fuel subsidies into energy efficiency measures

RO11 - Improve air quality by better building performance to boost public health and quality of life

#RO1 - Legislative and Regulatory Instruments

Implement a long-term regulatory framework, in close cooperation with stakeholders

Romania needs to further improve the legislative and regulatory framework, in order to ensure its coherence and predictability on medium and longer terms. Equally important is to periodically evaluate the outcomes of the legislative and regulatory framework, including seeking the input from key stakeholders. This would increase the level of transparency, trust and predictability on the market, facilitating more nZEB investments.

Good examples from other countries indicate that a successful policy is always based on longer-term strategies, including wide political agreements between the major political parties. This facilitates a stable and healthy investment framework, reducing the risks of buildings (and nZEB) investments.

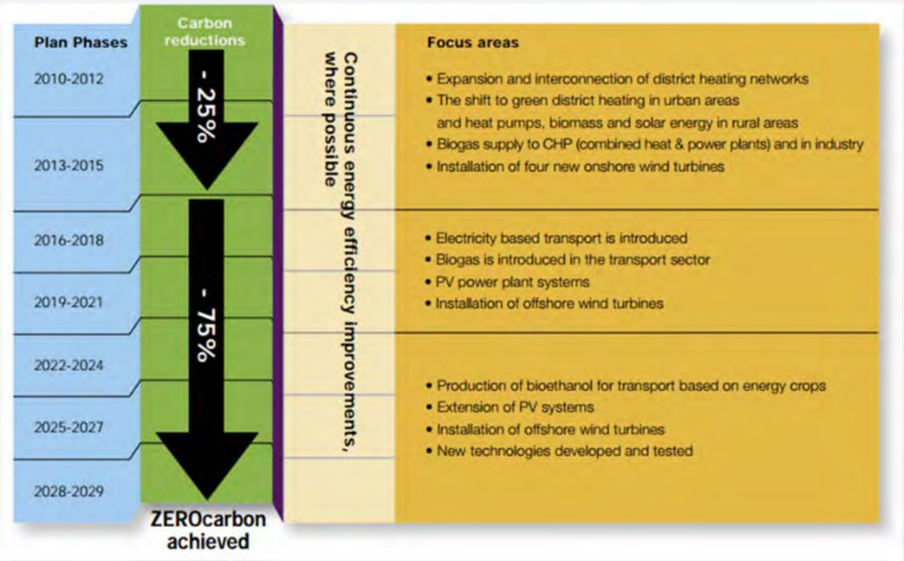
Furthermore, it is also essential to integrate associated social, economic and environmental benefits in the long-term vision, such as:

- security of energy supply by creating conditions for a low energy demand.
- protecting people against energy price fluctuations and securing an affordable energy bill. A cost-effective way to do this is through energy efficiency investments.
- securing a proper living standard and fighting against energy poverty
- increase productivity in offices, schools and hospitals. Better indoor air quality has proven positive effects on productivity and health.
- creating better jobs and higher skills, and thus increases the competitiveness of the construction sector.

On renovation of the existing building stock, there is a good opportunity to elaborate a consistent renovation plan to also boost investment on the longer term as it is requested by the Article 4 of the Energy Efficiency Directive[81]. Renovation of public buildings is another priority and it is also requested by the Article 5 of the same directive.

Pilot projects: Project Zero

Project Zero is the vision of Sonderborg (a Danish municipality) to become carbon neutral no later than 2029. An ambitious, yet reliable, Masterplan including "the overall, long-term strategy for achieving the defined development targets" has been developed, together with stakeholders and research institutions. While nZEBs play a key role in Sonderborg's vision, their relationship with other elements in the energy system is also included in this comprehensive strategy. The strategy comprises clear targets and a realistic timetable, allowing long-term investments in building performance and energy efficiency[82].



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[81] Energy Efficiency Directive - https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficiency-directive

[82] Project Zero - http://www.projectzero.dk/

Project Zero Masterplan - http://www.projectzero.dk/da-DK/Masterplan/Masterplan-og-Roadmaps.aspx

#RO2 - Legislative and Regulatory Instruments

The energy performance and thermal requirements of buildings should be stricter and better enforced, creating a path towards nZEB

The energy and thermal requirements in the building regulation should be stricter and more comprehensively enforced. This is needed to ensure a high level of compliance in the construction sector and to create a path towards nZEB levels.

Buildings regulations are one of the main drivers for a sustainable construction market. The energy related requirements from buildings regulations should be ambitious enough to improve the practices and increase quality of construction and renovation activities.

Stricter requirements should be supported by financial incentives and easy-grasping communication.

Example: Energy performance of single family houses in the Flanders Region

Flanders region in Belgium has implemented a long-term roadmap of minimum standards for new residential buildings, to guide the market towards the nZEB requirement by 2021. The minimum standards are strengthened regularly, allowing building owners and investors to plan ahead.

The Y-line (vertical line) in the chart shows the yearly percentage of building permissions and the X-line (horizontal line) illustrates the energy performance level (NZEB=E30)).

It is very clear that these requirements steer the level of energy performance, but it is also possible to see where the effects of support measures e.g. in 2014 there were subsidies for E50 and E30 (=BEN).

For new residential buildings, the following minimum (called E-level) standards apply.

- *Date building permit application - Maximum E-level*
- *from 2006 until the end of 2009 - E100*
- *from 2010 to end of 2011 - E80*
- *from 2012 until the end of 2013 - E70*
- *From 2014 to end of 2015 - E60*
- *from 2016 until the end of 2017 - E50*
- *from 2018 until the end of 2019 - E40*
- *2020 - E35*
- *2021 - E30 (=NZEB)* [83]

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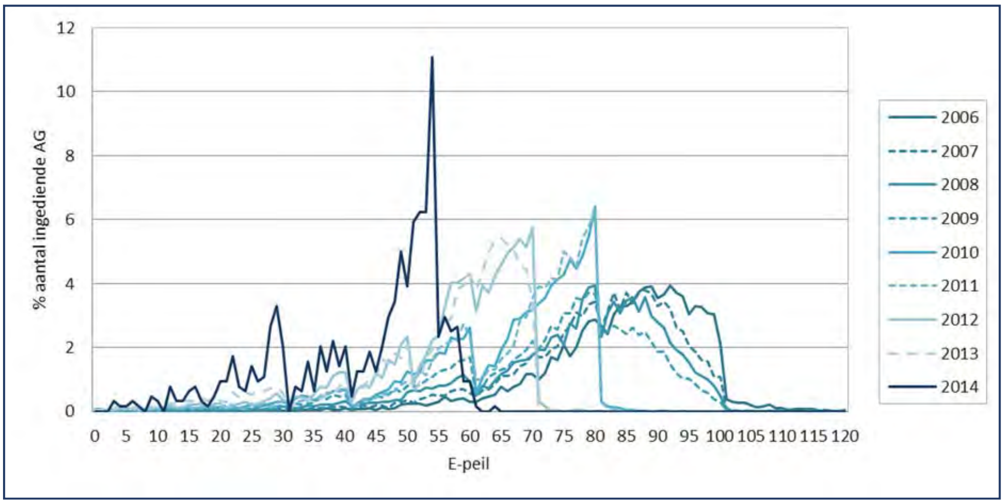
[83] Vlaanderen - http://www.vlaanderen.be/nl/bouwen-wonen-en-energie/bouwen-en-verbouwen/energieprestatieregelgeving-epb-voor-nieuwbouw-en-renovatie



#RO3 – Economic Measure
Increase the predictability of financial programmes and steer the building stock towards nZEB level
New financial programmes should be developed based on existing ones, but with a strong focus to increase predictability. This can be done through interparty support, multi-annual budgets, the transition from highly intensive grants to better business tools. Financial support should be linked with the long-term renovation targets and continuously adapted depending on the level of progress. This financial support should reward higher ambition and steer decisions on energy performance renovation towards the nZEB-level, in order to avoid future lock-in effects. Tax payers' money should stimulate building owners to go further, ensuring cost-optimal investments and bringing societal gains. The Ministry of Environment in Romania has developed a financing scheme (CASA VERDE PLUS) in 2016 that provides premiere financial bonuses for construction of new buildings with the condition to achieve energy class A (the best class energy in Romania)**84**. Such a scheme with an increased condition (nZEB) would be beneficial to carry out at the end of 2020 when nZEB level for new buildings will be mandatory.

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http://www.vlaanderen.be/nl/bouwen-wonen-en-energie/bouwen-en-verbouwen/energieprestatieregelgeving-epb-voor-nieuwbouw-en-renovatie

Example: KfW in Germany

The KfW schemes are designed to promote deep renovation following the motto: "The deeper the renovation, the higher the incentive" and therefore stimulates the frontrunners aiming more tight voluntary energy performance targets than legally obliged. To illustrate this point, a grant of 25% is offered if the refurbishment reaches the most ambitious KfW Efficiency House 55 standard, while the slightly less ambitious level of KfW Efficiency House 70 attracts a lower grant of 20%. While not being a perfect system, it illustrates how benchmarks can incentivize deeper renovation of the building stock.

#RO4 - Communication

Increase information availability and provide guidance to interested parties

A big barrier to a rapid market uptake of nZEBs is the lack of knowledge and accessible information on different levels. Effective information campaigns targeting different actors and stakeholders (e.g. house owners, building professionals, technical staff of public administrations...) are needed. Easy grasping guidelines or how-to manuals can increase the demand and spur the nZEB market transition.

In order for an information or awareness campaign to be effective it must be targeted to a specific group of consumers. Comprehensive preparation for these kinds of campaigns should therefore be conducted beforehand and the effect should be assessed after the campaign has ended.

Database transparency on energy performance of buildings with source data contained in the EPC and the influence on real estate transactions to convince owners of the economic necessity to improve the energy performance of buildings.

Better and more transparent information could increase the investments in energy efficient and building performance and lead the way to market transition towards nZEB level.

Example - Guidelines for future building owners how to build new NZEB in Flanders

The Belgian region of Flanders has produced a "practical guide for building your nZEB house"[85] to support future home owners through the process of prepare, design, execute and use an nZEB dwelling.

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[84] Casa Verde + new program developed by the Ministry of Environment:
http://www.mmediu.ro/app/webroot/uploads/files/2016-07-26_REF_ORDIN_CASA_VERDE_PLUS_FIZICE.pdf
http://www.mmediu.ro/app/webroot/uploads/files/2016-07-26_ORDIN_CASA_VERDE_PLUS_FIZICE%284%29.pdf

[85] http://www.vlaanderen.be/nl/publicaties/detail/praktische-bouwgids-voor-jouw-ben-woning-1-exemplaar

#RO5 – Quality of action

Training building professionals with "nZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

There is an urgent need to introduce more and better training of the labor force to facilitate a proper implementation of nZEB construction. This recommendation derives from struggling workforce situation in Romania (see introduction).

nZEBs demand higher qualifications of building professionals on all levels. Consumers should be able to rely on the skills of the building professional and get value for money, which means state-of-the-art information and advice, achieving the expected (energy) performance, a maximum operational lifetime and a safe and healthy building. This requires higher skills in the nZEB chain – highly energy efficient products require the proper understanding from the installer etc. A high skilled workforce increases the level of trust and confidence in nZEB investments.

To ensure an effective and qualitative construction and installation of nZEBs and related components, all professional involved in the process must receive proper training.

Example: Build Up Skills Romania

One of the major outcomes of the Build Up Skills project is the initiation of Romania qualification platform. This platform brings together all relevant parties interested in training related to the construction sector, in an extensive and comprehensive process. The purpose is to define and implement a strategy/roadmap for integrating coherent training on smart energy solutions for buildings. It will act as a catalyst to establish effective partnerships and provide an interface between national and European policies and programmes.

The main objectives of the Platform are:

1. Defining the overall national vision for the evolution of the short, medium and long term needs of specialists in construction nationwide. The approach will focus on energy efficiency and use of renewable energy in all buildings.

2. Establish nation-wide roadmap including the ways/means/resources/responsibilities for achieving the objectives and priorities of increasing the professional level of specialists involved in the construction sector.

3. Timely implementation of activities included in the roadmap to harmonize the approach of Romania with European objectives set out in documents, plans and directives of the European Union[86].

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[86] http://www.iee-robust.ro/platforma.php

#RO6 – Quality of action

Develop and consolidate quality frameworks for nZEB techniques and technologies

The creation of a socially-supported policy framework that declares nZEBs to be an attainable standard constitutes a major social challenge. This will require massive investments on the part of builders, businesses & industry, and the government. It is important that these investments be made correctly in technical construction terms and that they have a long life span. The lack solid quality frameworks would run the risk of providing inadequate support for the large-scale introduction of nZEBs.

Ensuring high-quality workmanship is therefore an essential precondition for conducting a large-scale market launch. This can only happen within integrated quality frameworks which addresses knowledge enhancement (via retraining, specialisation, etc.), the valorisation of knowledge via the certification of individuals and the support of individuals in companies and institutions which themselves have developed an integrated quality framework. Quality frameworks often work well if there are suitable support schemes linked to them. Within this context, a broader framework could also be pursued in which issues such as the environment, safety and product quality are addressed as well. Progress in this regard as been made recently with a modifications of Law 177/2015 - control + company certification[87]. But Romania still has room for progress.

Example: French quality framework for building airtightness

In the framework of the French RT2012 regulation, it is mandatory to assess the building airtightness. Two possibilities exist:

- a systematic testing of the airtightness of each building; such tests must be done by certified testers and the assessment also includes leakage detection;
- an overall quality framework at the level of the building companies involved; this approach requires the fulfilment of a series of procedures at company level, in combination with testing of about 5% of all buildings. [88]

EU-project: QUALICHeCK

QUALICHeCK, a EU funded project, aims to enhance the reliability of the Energy Performance Certificate and the quality of the building process. They are especially working on three different areas:

- identifying issues in respect to existing procedures;
- highlighting best practices for easy access to reliable EPC input data, delivery of improved

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[87] http://colegiu-diriginti-santier.ro/wp-content/uploads/2016/06/legea-10-modificata.pdf

[88] http://www.epbd-ca.org/Medias/Pdf/CA_EPBD_BUS_interaction_report.pdf

quality of the works, as well as more effective compliance frameworks ("lead people to do what they declare");

- raising awareness and engaging relevant stakeholders.[89]

#RO7 – Quality of action

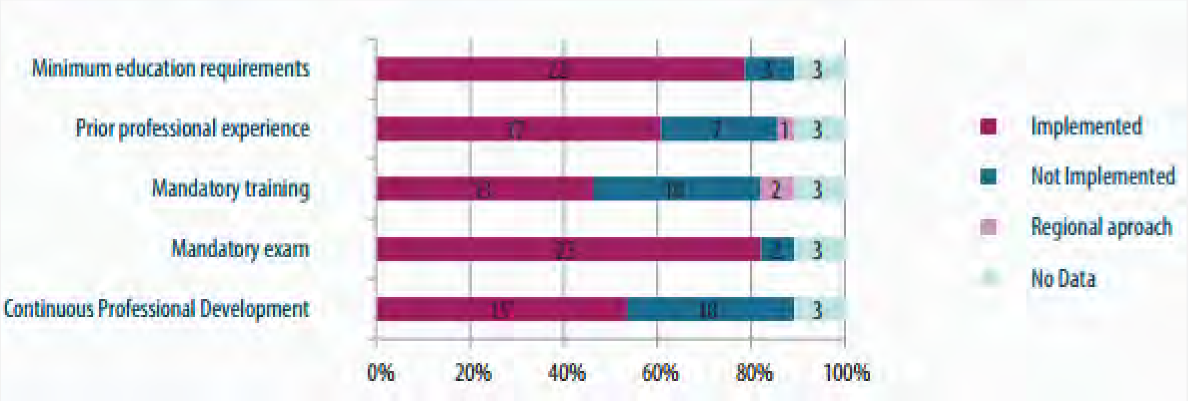
Enhance the proficiency of certifiers in order to increase the reliability of Energy Performance Certifications

Reliable Energy Performance Certificate (EPC) schemes could be part of the key steps towards highly energy-efficient buildings. Building certifiers play an important role in ensuring the credibility of the EPC system, which is why the quality of their skills and performance is essential.

The certifier is responsible for the EPC accuracy, reliability and compliance with the national energy performance calculation method. In case of poor quality, lack of required qualifications or questionable work independency, he/she may be penalised. The EPBD recast obliges MS to set the rules on penalties for non-compliance that are "effective, proportionate and dissuasive" (Art.27).

Building certifiers have a central role to play in ensuring the credibility of the EPC scheme. MS should therefore develop an EPC framework which includes all elements necessary to guarantee an effective and reliable certification process. For this, it is essential to guarantee adequate skills of the certifiers. Minimum standards for training, prior professional experience and independent accreditation procedures should be included in all Member States' legislation in order to ensure a minimum level of quality.

The figure below shows "Minimum qualification for qualified and/or accredited expert"[90]



The next image shows "Path to question relevance of developing specific schemes for training,

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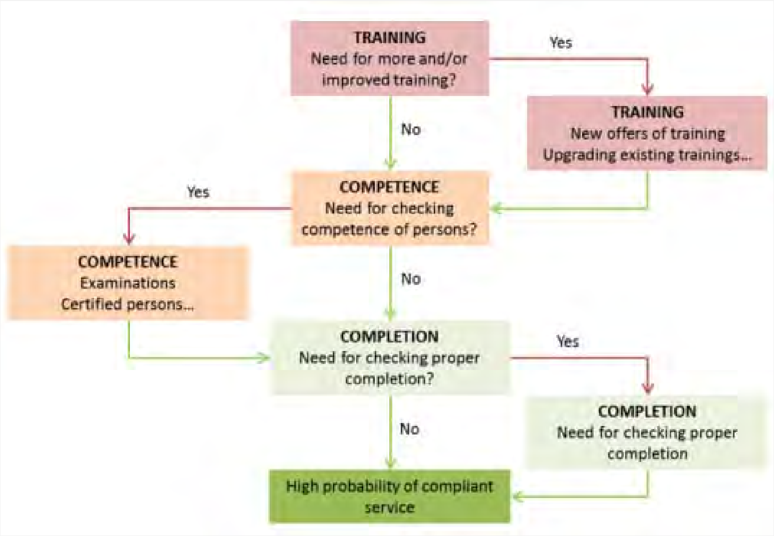
[89] http://qualicheck-platform.eu/about/introduction/

[90] BPIE (2015) http://bpie.eu/wp-content/uploads/2015/09/BPIE-EPCsFactsheet-2015.pdf

competence checks, and proper completion checks**91**"



#RO8 – Incentivize the market

Stimulate the market uptake of Energy Performance Contracting (ESCOs)

The use of fiscal instruments such as taxation, tax breaks or other incentives plays a very important role in sending signals to consumers as well as to market actors. Rules governing treatment of energy service companies (ESCOs) are important in determining whether or not a country has a thriving market for third party financing.

Energy Performance Contracting is a form of 'creative financing' for capital improvement which allows funding energy upgrades from cost reductions. Under these arrangements an external organisation (ESCO) implements a project to deliver energy efficiency, or a renewable energy project, and uses the stream of income from the cost savings, or the renewable energy produced, to repay the costs of the project, including the costs of the investment. Essentially the ESCO will not receive its payment unless the project delivers energy savings as expected. This solution mitigates several of the key barriers to renovation, by alleviating risk for the home-owner and

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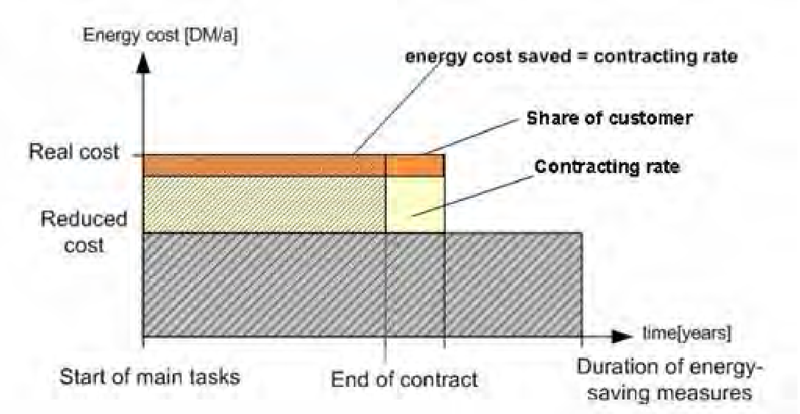
[91] Qualicheck (2016) - http://qualicheck-platform.eu/wp-content/uploads/2016/05/QUALICHeCK-Booklet-1.pdf

The approach is based on the transfer of technical risks from the client to the ESCO based on performance guarantees given by the ESCO. In the Energy Performance Contacting, the ESCO remuneration is based on demonstrated performance; a measure of performance is the level of energy savings or energy service. This is a means to deliver infrastructure improvements to facilities that lack energy engineering skills, manpower or management time, capital funding, understanding of risk, or technology information. Cash-poor, yet creditworthy customers are therefore good potential clients**92**.



Experience shows that Public Buildings are particularly interesting for ESCO-related services since the Return on Investment (ROI) for energy saving measures in public buildings can be much longer than for commercial buildings.

#RO9 – Social Issues

Explicitly define energy poverty and set up monitoring mechanisms

Energy poverty is a major problem for Europe, as between 50 and 125 million people are unable to afford a proper indoor thermal comfort. Despite the fact that there is no common European definition, the importance of the problem as well as the severe health impacts caused by fuel poverty are widely recognised. Energy poverty is still the little sibling to the economic and environmental aspects of new constructions and building renovations.

Only four European countries (France, Ireland, Slovakia and UK) have an official definition for energy poverty.

Better data would lead to better understanding of the social challenge. It would also allow to better assess the effectiveness of strategies to tackle energy poverty. This would be to better understand the challenge, and assess effectiveness of strategies to tackle energy poverty. Data for energy poverty must be enhanced and standardized across Europe.

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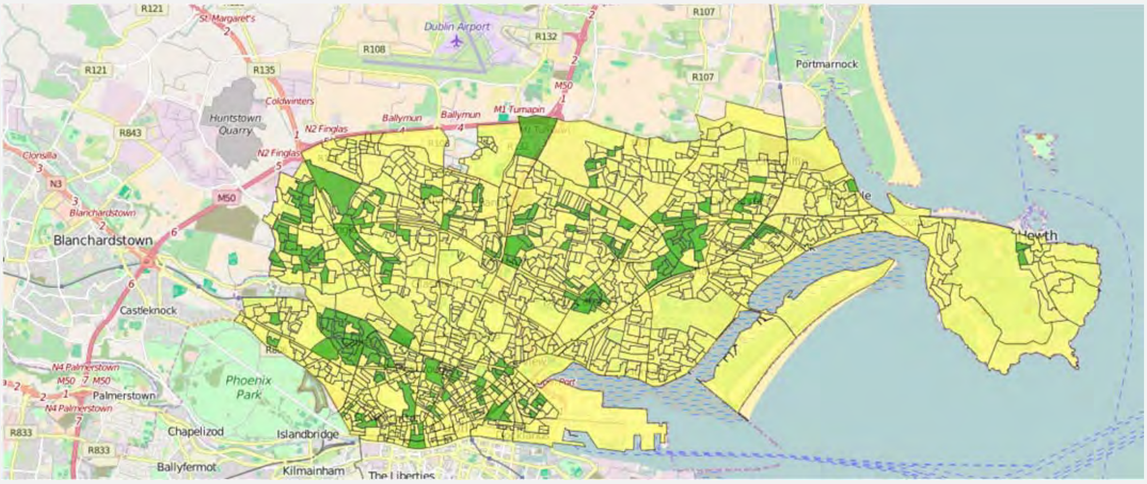
[92] JRC - http://iet.jrc.ec.europa.eu/energyefficiency/european-energy-service-companies/energy-performance-contracting

Pilot projects: The Irish Energy Action

The Irish Energy Action, in partnership with the EU-project Episcope, have developed an EPC mapping tool. The interactive map over Dublin illustrates different building characteristics (including energy poverty indicators) of different neighborhoods. The data is aggregated to defined boundaries, namely small areas and electoral divisions. Small areas typically comprise 50-200 dwellings and electoral divisions include clusters of small areas.[93] This mapping allows for local policy making and strategy development alleviating energy poverty from a district approach.



#RO10 *– Social Issues*

Shift from fuel subsidies into energy efficiency measures

Fossil fuel subsidies (FFS) in the form of heating bill support-payments are used by governments as the main instrument to support vulnerable consumers. The social aspect of the payments disguises the fact that the subsidies encourage and prolong the use of fossil fuels. Besides having an adverse impact on the climate, the payments are an ineffective solution for supporting vulnerable households, as they require continuous and increasing funding without generating economic growth and result in wasteful energy consumption. It is striking that in Ireland the budget allocated to the National Fuel Scheme increased by 170% to €228 million from 2004 to 2010 and in Greece, €650 million were committed to oil subsidies for heating from 2010 to 2014 but only €548 million to energy improvements in

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[93] http://energyaction-static.s3-website-eu-west-1.amazonaws.com/index.html

houses.

Therefore, fossil fuel subsidies play a negative role on energy efficiency in buildings by supporting wasteful energy consumption and by spending every year big part of the public budget, which could have been allocated for energy efficiency measures. Thus, it is high time that policies and financing shifted from supporting inefficient and climate-damaging FFS to promoting energy efficiency measures, leading Europe to smart, sustainable and inclusive growth.

***#RO12** – Social Issues*

Improve air quality by better building performance to boost public health and quality of life

Air quality - be it indoors or outdoors - is one of the major environmental health concerns for Romania. For this reason, and since people spend 60-90% of their life in indoor environments (homes, offices, schools, etc.), indoor air quality plays a very important role in the health of the population, particularly for vulnrable groups such as babies, children and the elderly. According to estimates by the World Health Organization, 583.000 deaths in Europe were attributable to household and ambient air pollution in 2012[94].

There is significant inequality in exposure to air pollution and related health risks: less affluent people living in inadequate buildings/neighbourhoods suffers from a disproportionate disease burden. The level of the health hazardous PM2.5 is for example much lower in newer (especially nZEB) buildings.

Romania ought to ensure a high air quality in public buildings: especially kindergartens and schools since children are more sensitive to air pollution. The most sustainable measure of improving the air quality in inadequate public buildings is through an upgrade of the building.

When planning new nZEBs or nZEB refurbishments, requirements for a healthy indoor environment should be included. While indoor climate is mentioned in the EPBD, the importance of indoor air quality, thermal comfort and daylight has to be strengthened in a future recast. Such requirements should also be reflected in national renovation strategies as developed under Articles 4 and 5 of the Energy Efficiency Directive[95].

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[94] 3 World Health Organization, "Burden of disease from Household Air Pollution for 2012". Available at: http://www.who.int/phe/health_topics/ outdoorair/databases/HAP_BoD_results_March2014.pdf?ua=1

[95] BPIE (2015) http://bpie.eu/wp-content/uploads/2015/10/BPIE__IndoorAirQuality2015.pdf

Example: Implementation of air quality plan for Małopolska Region

Małopolska province in Poland struggles with very poor air quality, particularly during the winter season. The condition of Polish building stock and the quality of fuels used in them is a very important issue which has impact on the air quality and the quality of life in Poland. The problem of low-stack emission (emissions from sources with a height lower than 40m) and bad living conditions make energy efficiency measures indispensable. The region has started an ambitious project to improve air quality in the region, this project has received support from EU's financial instrument - LIFE.

The main LIFE-IP MAŁOPOLSKA project objective is the full implementation of the Małopolska Air Quality Plan (MAQP) adopted by the regional parliament in September 2013. Most LIFE IP activities will focus on the territory of Małopolska province. However, the project approach and results will be directly relevant to all authorities responsible for air quality in the entire air quality hotspot region (southern Poland, northern Czech Republic and Slovakia).

More specifically, The Małopolska Air Quality Plan (MAQP) requires the elimination of obsolete solid fuel boilers in approximately 155 000 homes. There is also significant untapped potential for emission reductions through energy efficiency improvement of buildings (around 70% of houses are insufficiently insulated or not insulated at all).

9. SPAIN

9.1 BUILDING PERFORMANCE MARKET DATA

9.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for UE countries. Spain is the UE country with the lowest rate of renewal of the building stock: in 2014 less than 0.2% of the building stock was renewed, compared to near 1.2%/year in Austria and Belgium for instance. The annual rate of new buildings is slowly declining as the annual building erection is decreasing: from 91.000 in 2010 to 35.000 in 2014. The majority of new buildings in Spain are multi-family dwellings.

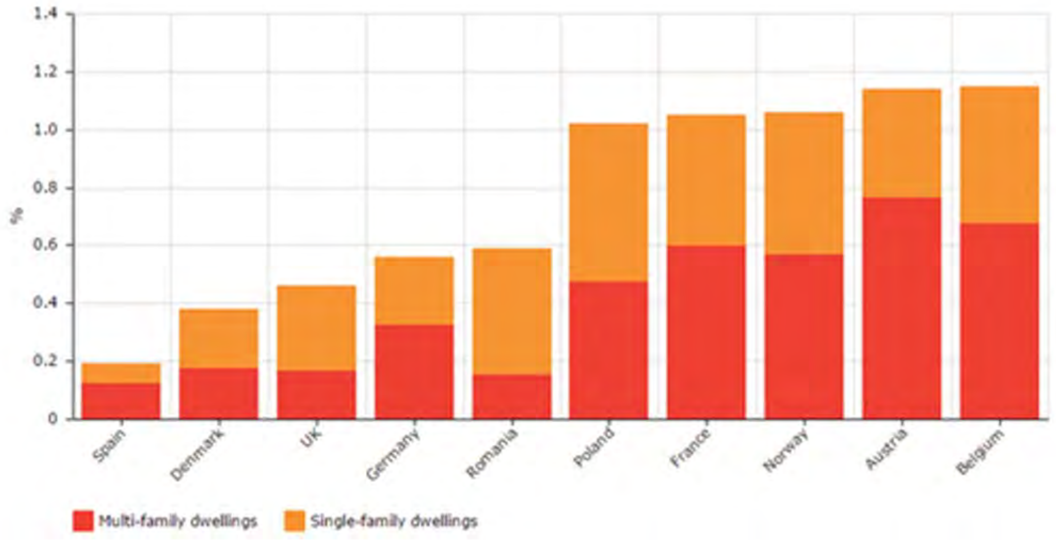

Figure 93 Share of new multi- and single-family dwellings in residential stock in 2014

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings

2. nZEB buildings according to national definitions

3. Buildings with an energy performance better than the national requirements in 2012

4. Buildings constructed/renovated according to national minimum requirements in 2012

As the report COM/2013/0483 "Progress by Member States towards Nearly Zero-Energy Buildings" listed an overview of the national definitions of NZEBs, Spain is still pending on formulating a definition of nZEBs and a planned revision of the technical building code is still far to be achieved until 2018.

For the moment, only the indispensable commitments pointed by the EPBD Directive 2010/31/EU have been implemented in Spain through law regulations like a compulsory energy certification procedure for the whole building stock (Royal Decree 235/2013) and some definition for minimum energy performance requirements (FOM 1635/2013: update of the technical building code concerning energy savings), including cost-optimal calculations made in the cost optimality EU report.

In the case of Spain, due to still pending nZEB standard definition and lack of some other requirements in EPBD, from the proposed 4 energy efficiency categories by experts, only 2 of them can be applied:

1. Net zero energy buildings / Plus energy buildings / nZEB building according to other foreign regulations or private standards

2. Buildings constructed/renovated according to national minimum requirements

Before 2013, the majority of new buildings were built according to Spanish technical building code without updates (CTE 2006). Since 2013, the last update of building code did not improve the minimum energy performance requirements. The share of new buildings better than nZEB (only based on registered cases of Passive House standard) slightly increased from no building in 2010 to 0.3% in 2014.

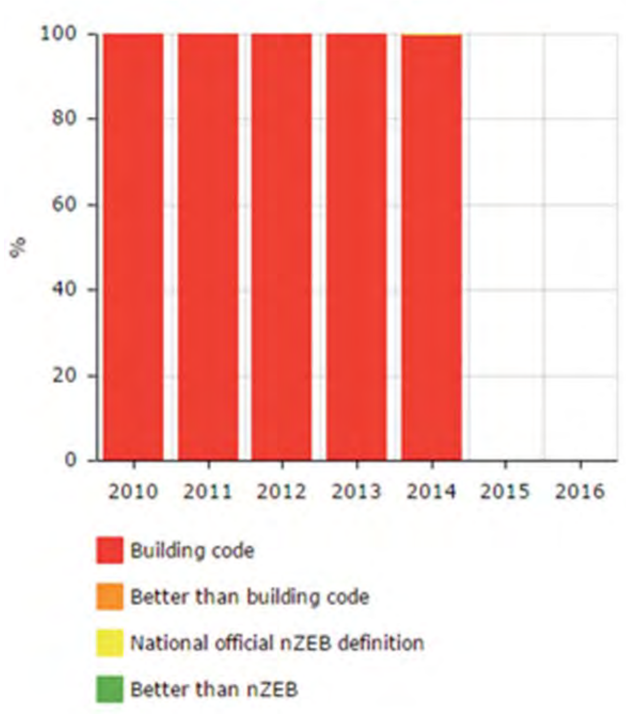

Figure 94 Distribution of new dwellings according to the nZEB radar graph – Spain

Source: ZEBRA

Because of the lack of an official European definition, to ease comparisons the EU ZEBRA2020 project developed the indicator of “major renovation equivalent”. In ZEBRA, three renovation levels have been defined: “low”, "medium" and "deep". However, these 3 levels definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

In Spain, the requirements for undertaking renovations are specified in the Spanish Technical Building Code (CTE). It establishes a limitation on allowed energy demand in case of rehabilitation of existing buildings according three different situations:

1) when there are modifications in indoor or outdoor conditions of one element of the building envelope increases the energy demand of the building: u-values of the element should be limited by the CTE requirements.

2) when renovation work is higher than 25% of the building envelope area and / or the use of the building changes: whole energy demand of the building should be less than the energy demand established for the reference building.
3) when replacements, additions or modifications of several elements of the building envelope are considerable: u-values of the different elements should be limited by the CTE requirements, but it is allowed to increase u-values while energy demand is less or equal than established for the reference building.

This ZEBRA2020 assumption is subjected to data estimated in WWF[96] and GTR[97] reports. In the first report, a total of five improvements for existing dwellings of different nature were considered (E2 Insulation+. E3 Insulation++, E4 Renewables, E5 Renove Plans and E6 Mix) and their effect were compared with respect to a situation in which no intervention was carried out on the building stock (Trend), for different types of buildings and climate zones. In the second report, deep retrofit requirements are estimated to reduce the building energy heating needs up to 80% and hot water by 60% (for a target of 10 million dwellings, i.e. 64% of the building stock until 2001) according to the E6 Mix (85% savings in energy consumption). Therefore, we assume E6 MIX as the reference level for deep renovation by the Spain's building stock and, then, grouping the five improvement actions in 3 levels of renovation:

- Level 1 "light": Average of expected savings in energy consumption is ((12+23)/2) 17,5%, equivalent to MRE. Type of actions:
    - E4 Renewables: The incorporation of facilities for the use of solar thermal energy to produce domestic hot water (coverage 60% - 70%, according to the climate zone) and photovoltaic solar energy for electricity consumption (10%) are considered.
    - E5 Renove Plans: The impact on energy consumption of the existing residential buildings of the implementation of the Renove Plans for boilers and air conditioners are considered, according to the development they are experiencing in the different Autonomous Communities with the implementation of the Savings and Energy Efficiency Plan 2008-2012.
- Level 2 "medium": Average of expected savings in energy consumption is ((57+72)/2) 64,5%, equivalent to MRE. Type of actions:

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[97] Summary Report of Potential Energy Savings And CO2 Emissions Reduction from Spain's existing residential buildings in 2020, WWF, December 2010, http://awsassets.wwf.es/downloads/resumen_rehabilitacionviviendas_vfinal_eng.pdf

  - E2 Insulation+: It considers an improvement of the maximum levels permitted currently referred to under HE1 of the CTE for thermal transmittance parameters of soils, covers and facades as well as measures to improve treatment of cracks and thermal bridges.
  - E3 insulation++: The improvements introduced in the E2 Insulation+ solution are reinforced to incorporate criteria used in the PassivHaus standard: a highly isolated building envelope (maximum U-value of 0.15 W/ m2 K) and heat recovery for the air extracted from the house.
- Level 3 "deep": Average of expected savings in energy consumption is 85%, equivalent to MRE. These actions are the combination of insulation of the building under E3 Insulation ++, E4 Renewables and E5 Renove Plans.

Below are summarized the different levels for the estimated energy savings:

	Thermal improvements implementation	Energy savings estimated
Level 1	Implementation of Renova Plans and/or incorporation of solar thermal/PV	17,5%
Level 2	Insulation improvement for specific building elements (roof, façade, thermal bridges...) and/or whole thermal envelope (including a heat recovery system)	64,5%
Level 3	Sum of level 1 + level 2	85%

The equivalent major rate in Spain amounts to around 0.08% and is the lowest among the UE countries. In Spain, as new constructions as whole building refurbishments/enlargements are subjected to Administration processes and, therefore, they are accessible by the official national database (FOMENTO's website). However, the absence of key data concerning the other minor building renovations makes difficult to collect more data and is probably the reason for having the smallest MRE.

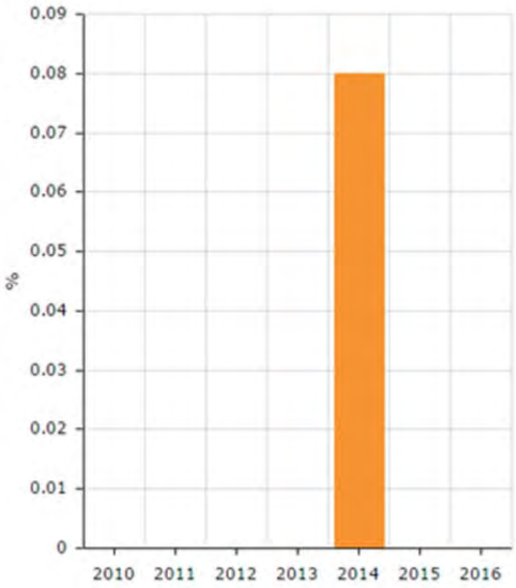


Figure 95 Equivalent major renovation rate – Spain

Source: ZEBRA

9.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Spain, it has been collected data of 32 nZEBs or high energy efficient buildings which were constructed recently. 29 out of the 32 are new buildings and 4 are renovated buildings. 29 have a residential use and 3 are intended for non-residential use.

Climate zones

As Table 16 lists, in Spain the selected buildings are located in 4 of the 5 defined climate zones. 2 selected buildings are located in the climate zone B, which is characterized by cold winters and mild summers, 9 are located in climate zone C with warm winters and warm summers, 11 are located in climate zone D with temperate winters and mild summers, and 10 are located in climate zone E that have temperate winters and warm summers.

Table 16 Building distribution by climate zones - Spain

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	1	1
C	Warm winters and warm summers	8	1
D	Temperate winters and mild summers	10	1
E	Temperate winters and warm summers	10	

Heating Demand

The average heating demand in new buildings is 11,8 kWh/m² a, while in renovated buildings it is 25,0 kW/m² a.

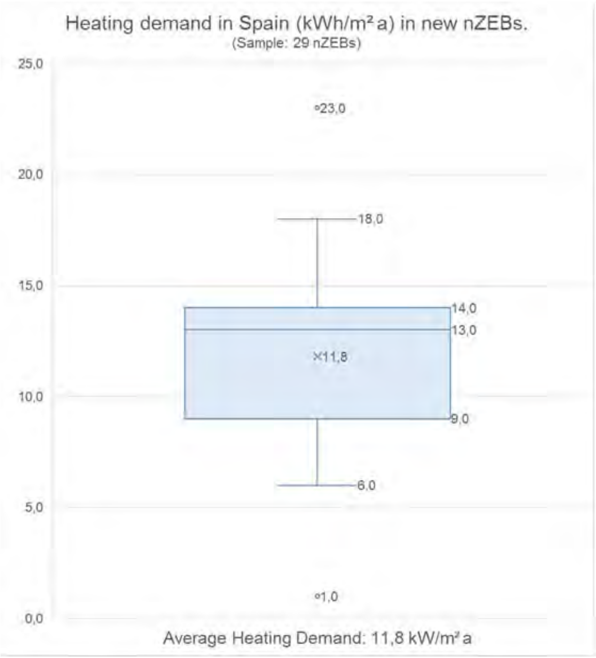


Figure 96 Box plot of heating demand in new nZEBs - Spain

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,18 and 0,16 in roofs, while in renovated buildings the average U-value in walls is 0,18 and 0,14 in roofs.

In new buildings, stone wool is the most used insulating material in walls with a percentage of 28%, while in roofs it is the expanded polystyrene with a percentage of 31%. In renovated buildings, expanded polystyrene is the most used insulating material in walls, whilst in roofs it is used glass wool, stone wool and extruded polystyrene, with equal distribution (33,3%).

In windows, the average Uwin-value is 1,16 in new buildings and 1,0 in renovated. Concerning the type of glass, 55% of the new buildings use triple glass, while in renovated buildings the preferred options are double glass with low emissivity (33%) and triple glass (33%).

With respect to passive cooling strategies, none of the 32 selected buildings mentioned to use any passive cooling strategy.

Active solutions

Mechanical ventilation with heat recovery system is the preferred option in the 32 selected buildings.

With regard to the heating system, heat pump is the most common option in new buildings with a share of 41%. Stove and heat pump with a share of 33,3% each are the preferred options in renovated buildings. Electricity is the most used energy carrier in new buildings, while electricity and biomass, both with a share of 33,3%, are equally the most used energy carrier in renovated buildings.

A system partially depending on solar thermal collectors together with the heating system is the preferred system for DHW (41%) in new buildings. In renovated buildings, a dedicated generation system is used in 67% of the buildings.

72% of the new buildings do not use cooling system, while in the rest 28 % it is used heat pump. None of the 3 renovated buildings use cooling system.

Renewable energies

In 2 out of the 29 new buildings, it is mentioned the use of photovoltaic systems and in 9 the use solar thermal systems.

No renovated building use photovoltaic systems and 2 out of the 3 buildings use solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Spain reports and realised projects.

Table 17 Costs of different renovation depths and new built according to nZEB standards – Spain

Costs (€/m2)	ES
Minor renovation (15% energy savings)	57
Moderate renovation (45% energy savings)	163
Deep renovation (75% energy savings)	288
NZEB renovation (95% energy savings)	695
New built according to nZEB standards	1074
Additional funds for nZEB construction compared to new built	407

9.2 EPCS AND REAL ESTATE AGENTS

9.2.1 REAL ESTATE AGENTS SURVEY

1. The dominant form of EPC indicated by all the real estate agents in Spain is mandatory certification.

2. In opinion of real estate agents from Spain, the main factors taken into account whilst selecting, purchasing or leasing real estate are mainly the price, location, the size of the real estate, various "nuisance" e.g.: a busy road, landing airplanes, landfill, a high-voltage line.

The cost of energy is indicated as very important factor by 7% and as important by 31% of real estate agents in Spain.

3. The EPCs in Spain are quite frequently required in concluding the purchase/lease contracts.

4. More real estate agents in Spain are in general satisfied than unsatisfied with reliability of the data provided by the EPC.

5. Usefulness of EPCs in the professional activity of real estate agents in Spain is evaluated by them not very positively. Only 15% of the respondents in Spain indicates the usefulness of the certificate in their professional work.

6. The real estate agents in Spain rather don`t observe connection between the EPC and the improvement of the energy performance of buildings.

7. Usually, real estate agents in Spain don`t confirm correlation between the high energy performance and high value of real estate.

8. The real estate agents in Spain don`t observe that higher energy performance of buildings cause the growing interest in its purchase / lease in comparison to other buildings.

9. In opinion of real estate agents in Spain, the influence of having the higher EPC class on the exposure time of the real estate is very low.

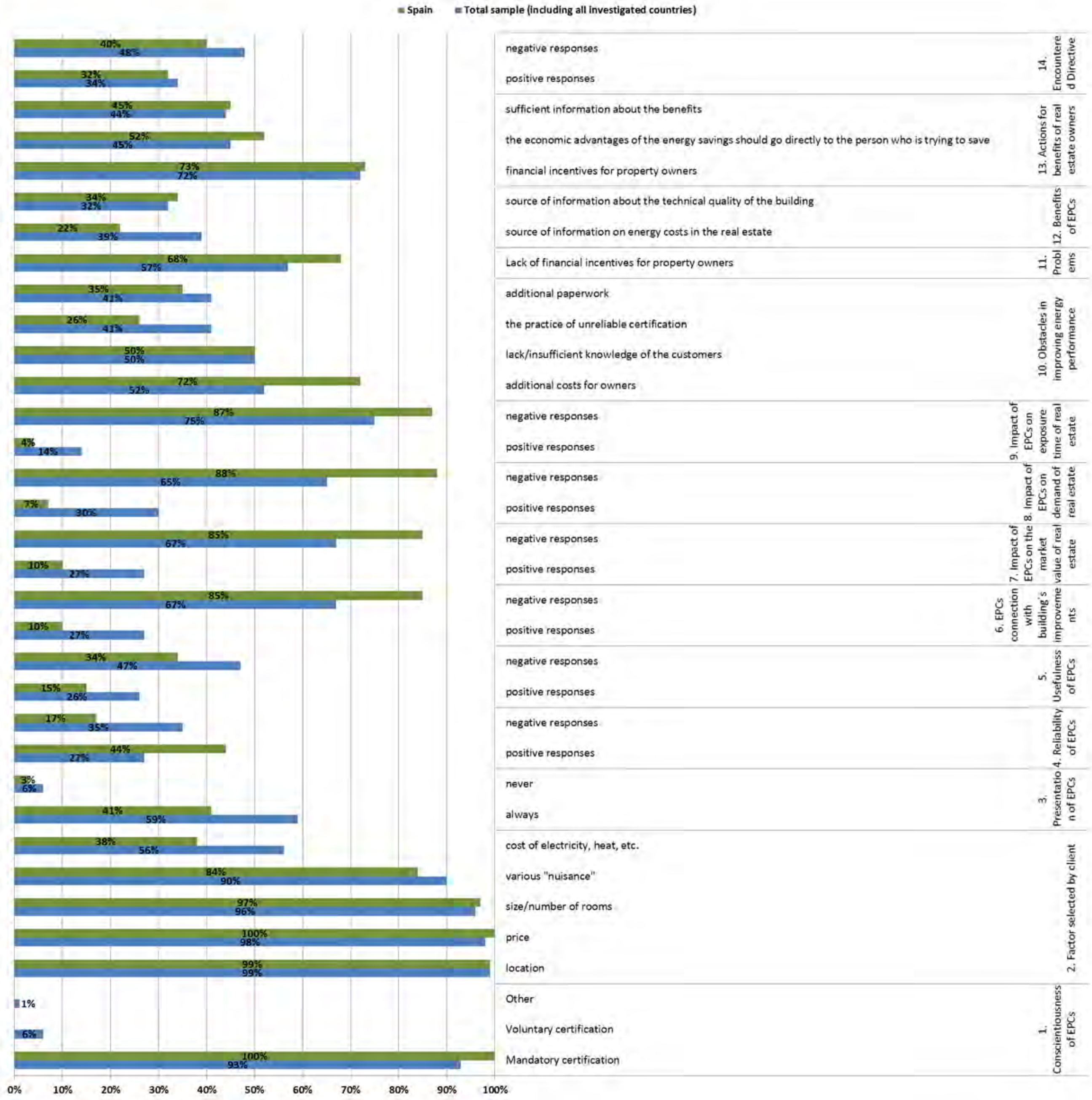
10. The main obstacles in improving the energy performance of buildings were indicated by real estate agents in Spain to be the following: financial matters (additional costs for owners), low social awareness in this subject, additional bureaucracy and the practice of issuing unreliable certificates.

11. Among the problems of implementing the improvement of the energy performance of buildings, the following has been mainly indicated by the real estate agents in Spain: the financial aspect, no incentive for the real estate owners.

12. The EPC as the source of information concerning rather the technical condition of the building than the energy costs is indicated by the real estate agents in Spain as quite important benefit of having EPC.

13. The most expected support that would influence the improvement of the energy performance of buildings, according to the respondents from Spain, is sufficient information about the benefits financial activity, economic support directed to real estate owners and economic incentives for those that undertake such actions.

14. The level of awareness and information about wording, requirements and settlements of the 2002/91/EC or 2010/31/EU Directive among the real estate agents in Spain is quite high.


Spain
Total sample (including all investigated countries)
40%
48%
negative responses
32%
34%
positive responses
14. Encountered Directive
45%
44%
sufficient information about the benefits
52%
45%
the economic advantages of the energy savings should go directly to the person who is trying to save
73%
72%
financial incentives for property owners
13. Actions for benefits of real estate owners
34%
32%
source of information about the technical quality of the building
22%
39%
source of information on energy costs in the real estate
12. Benefits of EPCs
68%
57%
Lack of financial incentives for property owners
11. Problems
35%
41%
additional paperwork
26%
41%
the practice of unreliable certification
50%
50%
lack/insufficient knowledge of the customers
72%
52%
additional costs for owners
10. Obstacles in improving energy performance
87%
75%
negative responses
4%
14%
positive responses
9. Impact of EPCs on exposure time of real estate
88%
65%
negative responses
7%
30%
positive responses
8. Impact of EPCs on demand of real estate
85%
67%
negative responses
10%
27%
positive responses
7. Impact of EPCs on the market value of real estate
85%
67%
negative responses
10%
27%
positive responses
6. EPCs connection with building's improvements
34%
47%
negative responses
15%
26%
positive responses
5. Usefulness of EPCs
17%
35%
negative responses
44%
27%
positive responses
4. Reliability of EPCs
3%
6%
never
41%
59%
always
3. Presentation of EPCs
38%
56%
cost of electricity, heat, etc.
84%
90%
various "nuisance"
97%
96%
size/number of rooms
100%
98%
price
99%
99%
location
2. Factor selected by client
1%
Other
6%
Voluntary certification
100%
93%
Mandatory certification
1. Conscientiousness of EPCs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

9.2.2 REAL ESTATE PRICES AND EPCS

In order to transpose the 2002 EPBD, a national Decree was issued in 2007 that required the use of a newly developed simulation and evaluation tool in the certification process. Until 2013, certification was only required for new buildings. This was updated by a new Decree that fully transposed the 2010 EPBD recast and included the need to certify existing buildings prior to sale or rental transactions. Whilst the EPC policy is formulated on the national level, registration and quality control come under regional jurisdiction (CA EPBD 2016). The energy efficiency index used in Spanish EPCs reports energy consumption in kWh/m2yr and matches this to its corresponding letter on a fixed-value scale that is determined by a reference building. This scale ranges from A (most efficient) to G (least efficient).

A lack of publicly available information has made the analysis of the effect of EPCs on the Spanish housing market difficult in the past. In particular, the most recent and prominent hedonic report uses proxy data to estimate EPCs (de Ayala et al. 2016). The results in the current report therefore represent a significant contribution to this field of research in Spain.

The results for the Spanish sales market confirm the predicted surplus due to EPC rating for the range: C-G. Insufficient data was available to distinguish between A- and B-rated dwellings. A surplus was also observed due to area and a deficit was observed due to construction year. The linear regression model results in a 27% price surplus for each one-letter improvement.

The dummy variable model was used to analyse the Spanish rental market. However, no significant results were found for the EPC-rating coefficients. The linear model was also run and this gave a statistically significant surplus of 22% averaged across the EPC scale. The existence of a surplus in the market can therefore be deduced; however, the pattern of this surplus across the EPC scale cannot be analysed. The results show a positive price relationship and a negative price relationship for area and construction year respectively. The latter is consistent with results in the sales market.

Overall the high surpluses in the Spanish sales and rental markets should be treated with caution and further analysis to proof the magnitude of surplus may be required.

9.3 EXISTING POLICIES

Due to the economic crisis since 2009 the Spanish building sector still faces a debt economy and little investments for private projects, hampering investments in the building sector. Furthermore, the decline of new constructions is even more alarming than in renovations. A sign of that is that there are still no real measures for encouraging new constructions (or nZEBs).

The building sector and energy targets

The Spanish National Energy Efficiency Action Plan includes final energy targets for 2020 and interim targets for 2013 and 2016.

Energy targets in Spain

	2013	2016	2020
Final energy consumption	-12.7% (compared to 2007)	-17.1% (compared to 2007)	80.1 Mtep (-22.5% compared to 2007)
Primary energy consumption	-11,5% (compared to 2007)	-13,9% (compared to 2007)	119.9 Mtep (-18.6% compared to 2007)

With regards to the building stock, it is estimated that in Spain there are 10 million buildings, mostly in residential use. Only around 4% of these buildings are for use in the tertiary sector. Nevertheless, both residential and tertiary sector are relevant to apply energy efficiency targets, as in 2012 the residential sector was responsible for 18.6% of the total energy consumption and the tertiary sector for 12.1%. Therefore, it is obvious that there is an enormous potential in energy saving by renovating the building sector. Despite this fact, there are no updated/new ambitious official plans or strategies for new constructions and only energy efficiency obligations have been adopted by minor updates (the latest revision was in 2013) of the CTE (Spanish Technical Building Code in force since 2006). Furthermore, a **nZEB concept is expected to be implemented in 2018** as a third revision of the same document.

However, certain steps for supporting energy efficiency actions in the building sector have been made. These actions are defined as measures for enforcement of the Energy Efficiency Directive and are part of the NEEAP (Sections 4.2 and 4.3):

- Distribution and evolution of energy consumption in the building sector (residential and non-residential quantifications)
- Spanish Strategy for Energy Renovation in the Building Sector ("Long-Term Strategy for Energy Renovation in the Building Sector in Spain" document for renovation targets to 2020)
- Legislative measures (energy efficiency obligations adopted according to the 2010/31/EU Directive)
- Economic support measures (exclusively focused on building renovation)
- Exemplary role of public bodies' buildings (inventory of public buildings and plans for energy savings and efficiency in a part of these public buildings)

National Renovation Strategy, Art 4 EED

The Spanish building renovation strategy proposes long-term strategic scenarios depending on level of renovation and type of building. A quantification of energy saving targets by 2020 is provided for each case:

- Residential buildings:

Scenario 1	Scenario 2	Scenario 3
Basic residential (7% of the average total final consumption between 2010-2012): 1.044 ktoe of cumulative savings by 2020	Average residential (26% of the average total final consumption between 2010-2012): 4.088 ktoe of cumulative savings by 2020	High residential (32% of the average total final consumption between 2010-2012): 5.077 ktoe of cumulative savings by 2020

- Non-residential buildings

Scenario 1	Scenario 2
High non-residential (20% of the average total final consumption between 2010-2012): 20% of cumulative savings by 2020	Basic non-residential (16% of the average total final consumption between 2010-2012): 16% of cumulative savings by 2020

The step from one strategic scenario to another is linked to the adopted renovation measures. Some of them will be necessary in a short-term, while others will have different horizons. In any case, they may require public funds in line with the country's overall economic policy. They also may be influenced by creating a positive impression to building energy renovation for the key stakeholders (i.e. with awareness campaigns, prompting to pro-renovation culture, etc.). Overall, energy saving target is based on a collection of strategies to increase investments, differentiating between measures with a high renovation (more identified with passive construction elements than other) and basic renovation (usually by replacing active elements).

Energy performance requirements

The main energy performance requirements are regulated by:

1. **CTE DB-HE 2013** (2nd revision): Update of the "energy saving section" (Order FOM/1635/2013) of the Spanish Technical Building Code – CTE (RD314/2006). This update applies to new buildings, enlargements and renovations of buildings.
2. **RITE 2013** (consolidated version): Spanish Thermal Building Regulation – RITE (RD1027/2007) including update of building systems to improve energy efficiency (RD238/2013). It regulates thermal comfort in buildings and requirements for maintenance, metering and control of HVAC, DHW and ventilation systems
3. **RD 235/2013** (new): Spanish Regulation for Energy Certification of Buildings. For new and existing buildings, a compulsory energy efficiency certificate should be available for buyers and tenants from 1st June 2013. Table 18: Energy performance requirements in Spain

Renewable sources in the building sector

There are no specific measures for boosting RES in buildings (like the old incentives established in RD 436/2004 and RD 661/2007 giving an income of 0,44€ by PV kWh injected to grid, but since 2008 they are abolished). Now, they can be only considered as a part of energy efficiency measures in a building renovation.

Financial and fiscal support policies/programmes

The following financial schemes are used to intensify energy savings in building sector:

- PAREER-CRECE: Aid Programme for Energy Rehabilitation in Existing Buildings. Its goal is to encourage and promote the implementation of integral measures in favour of energy saving, energy efficiency improvement and use of renewable energies in existing buildings.
- JESSICA-F.I.D.A.E.: Fund for financing projects in energy efficiency and renewable energy of non-residential buildings. It has a main budget of €123 million (promoted by IDAE).
- PIMA Sol: Environmental Action Plan is an initiative designed to reduce greenhouse gas (GHG) emissions and also to improve efficient use of energy and resources in the Spanish Tourist sector (promoted by MAGRAMA).
- 2013-2016 National Plan for the promotion of rental housing, building refurbishment and urban regeneration (promoted by FOMENTO).
- ICO Companies and Entrepreneurs: Economic financing for refurbishment of dwellings and buildings (funded and promoted by ICO Credit Line).
- FES-CO2: Carbon Fund for a Sustainable Economy to promote Clima Projects (promoted by MAGRAMA). This call intends to support and promote low carbon emission activities.
- Tax and VAT reductions. VAT reduction from 21% to 10% for major renovations in residential buildings.

9.4 NZEB-TRACKER

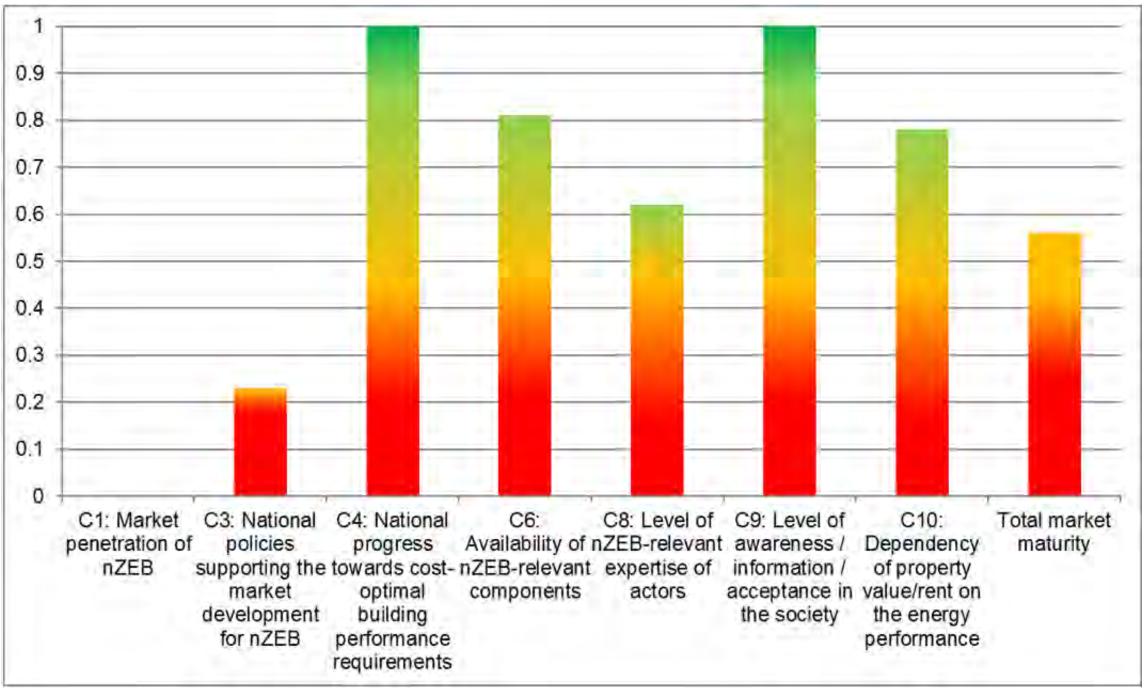


Figure 97 nZEB-tracker score for Spain in 2014

C1: Market penetration of nZEB

- Spanish result: **0** ZEBRA average: **0.32**
- As an nZEB definition has not yet been formulated, therefore it cannot identify buildings that comply with these requirements in the nZEB market. Moreover, despite Passivhaus buildings could be recognized as similar buildings to nZEB, they have a far away share on new constructed floor area in Spain (with only 12 certified buildings in 2014).

C3: National policies supporting the market development for nZEB

- Spanish result: **0.23** ZEBRA average: **0.52**
- Policies in Spain did not seem to be sufficient to support the development of the market for residential and non-residential nZEB in 2014.
- Need for an nZEB standard is necessary, but it is not expected for Spain until 2018. The plan is to set out the nZEB values alongside the revision of the Spanish building code, which will take place in 2016-2017 and will become compulsory in 2018.

C4: National progress towards cost-optimal building performance requirements

- Spanish result: **1.00** ZEBRA average: **0.94**

- The new minimum requirements in the last update of Spanish technical building code (Order FOM/1635/2013) already matched the cost optimal building energy performance level.

C6: Availability of nZEB-relevant components

- Spanish result: **0.81** ZEBRA average: **0.83**
- Despite nZEB concept is not yet defined, energy efficient systems and other building components for were slightly available in Spain.
- It is appreciated that solar thermal and photovoltaic systems were usually used and available. However, other type of renewable systems seemed not to be sufficient available.

C8: Level of nZEB-relevant expertise of actors

- Spanish result: **0.62** ZEBRA average: **0.63**
- There were different pictures regarding the availability of experts for the three phases.
- Whereas the availability of experts for planning was assessed sufficient and for examination/certification even good, the interviewees agree that there was a lack of expertise for the construction phase.

C9: Level of awareness / information / acceptance in the society

- Spanish result: **1.00** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings (overall in passive concept) increased steadily.

C10: Dependency of property value/rent on the energy performance

- Spanish result: **0.78** ZEBRA average: **0.74**
- Compared to site, living quality, aesthetics and financial aspects, the energy performance was the least important aspect for customers' decision on renting/buying a real estate. Otherwise, the site was the most important.

Maturity of the Spanish nZEB market

- Spanish result: **0.56** ZEBRA average: **0.66**
- The nZEB market seemed to be a little less developed than the average of the ZEBRA countries. The political framework did not seem to be sufficient in 2014, though the whole definition of nZEB standard is still pending.
- High performance building components were slightly available, even solar thermal and photovoltaic systems, dismissing other type of renewable systems.
- The availability of experts may limit the future development of the nZEB market.
- People became more and more aware of the energy performance of buildings. Still it had a minor priority on buy/rent decisions.

9.5 SCENARIOS

Market penetration of nZEB – new building construction

Figure 98 shows annual construction of conditioned floor area according to different standards. The results are shown for the historical development and in both policy scenarios, current and ambitious for the long term development from 2021 to 2050. For an explanation of the scenario framework of the current policy scenario and the ambitious policy scenario, see part "Introduction". Data on historical development of new building construction according to national standards were collected in the project, see part "Building performance market data" and are available on the project project´s data tool (http://www.zebra-monitoring.enerdata.eu/). The share of the new building construction according to the building code in 2012 was app. 100% of the total new building floor area. According to building code means that buildings are constructed according to national minimum requirements. In the ambitious scenario, the share of stringent measures is much higher due to the policy implication.

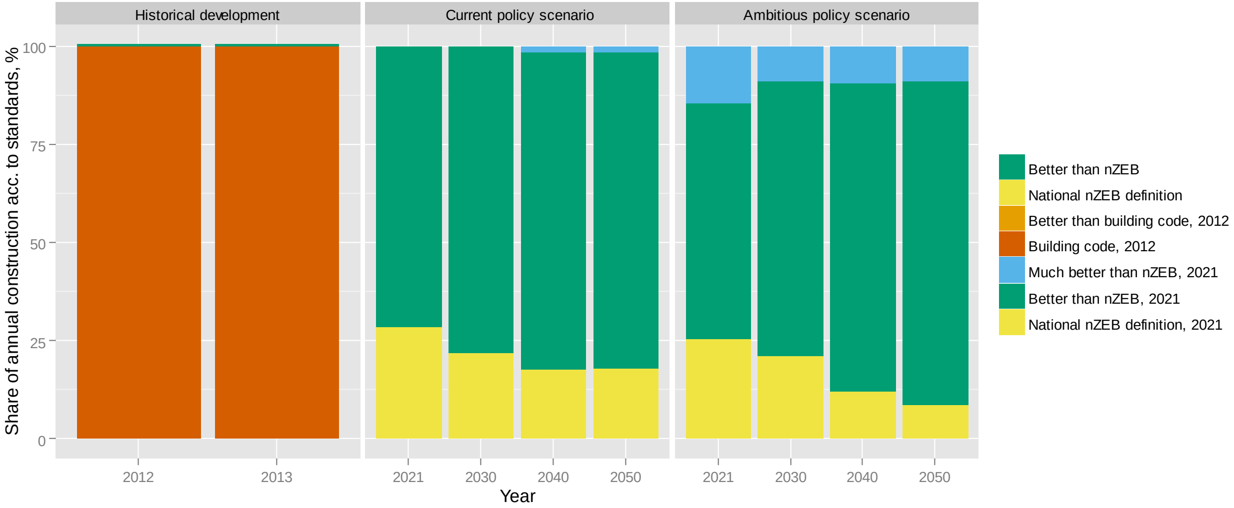


Figure 98 Share of annual construction of conditioned floor area built according to national standards

Building renovation activities

Figure 99 shows historical development and future development in current and ambitious policy scenarios of annual renovation of conditioned floor area by renovation levels.

The following renovation categories were defined in the current policy scenario:

- medium renovation which refers to the building codes

- light renovation meaning that in reality not all buildings fulfil the criteria set in the building legislation and
- deep renovation reflecting the nZEB definition

In the ambitious scenario, from 2021 to 2050, all buildings fulfil at least the building standards. There is an additional renovation level "deep plus" which means higher energy performance achievements.

In Spain, in the current policy scenario, the share of the medium and deep renovation makes up a significant share on the total renovated building floor area from 2021 to 2050. In the ambitious policy scenario, which implements stringent measures on existing buildings, the share of the deep and deep plus renovation is increased compared to the current policy scenario. In 2040 around 25% of the renovated building floor area will be renovated with a strong share of deep plus (5%) and deep renovation (20%), resulting in higher energy savings (Figure 103).

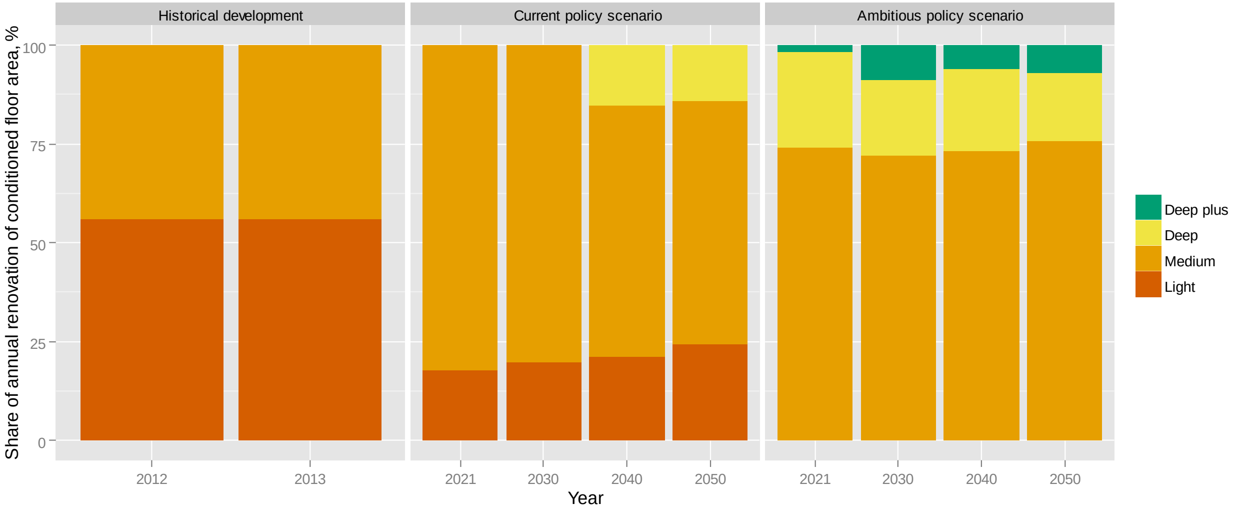


Figure 99 Share of annual renovation of conditioned floor areas by renovation levels in current and ambitious policy scenarios

Figure 100 shows the distribution of the spec. energy need for space heating (norm energy need calculation according to EN13790) in the total building stock after building renovation by using the following renovation levels, light, medium, deep and deep plus. The spec. energy needs are shown in a box-plot diagram. The median (middle quartile) marks the mid-point of the data and is shown by the line that divides the box into two parts while the diamond indicates the mean value. The data is represented for 2012 for not renovated buildings, light, medium and deep renovation. The deep plus renovation shows spec. energy need for buildings being renovated after 2020. The spec. energy need for space heating of light renovation is higher compared to the medium renovation, which means that in reality not all buildings fulfil the criteria set in the building legislation. Deep and deep plus renovation include i.e. the installation of mechanical ventilation.

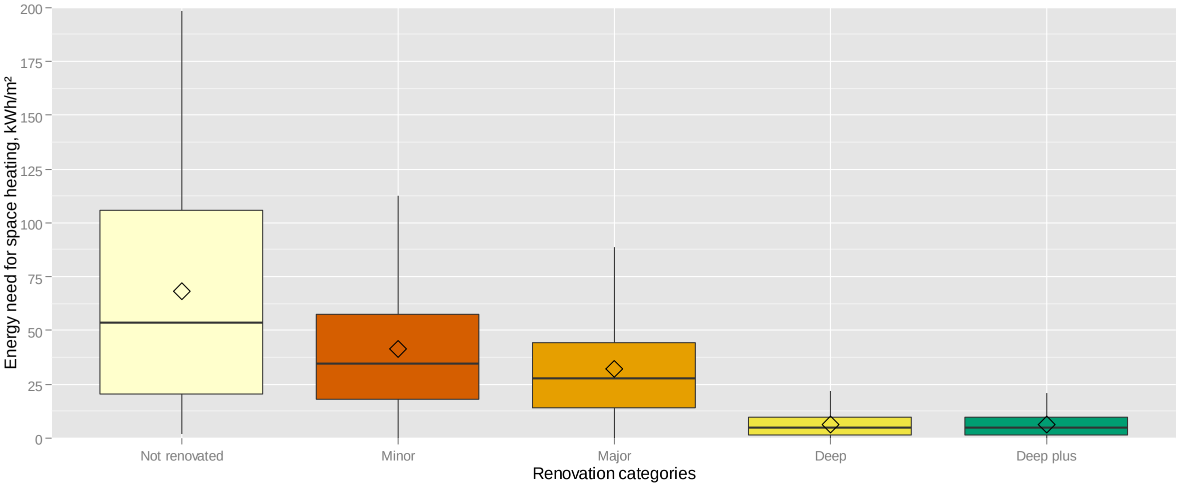


Figure 100 Distribution of the buildings spec. energy need for space heating

Economic indicators and national policies supporting the market development for nZEB

Figure 101 shows total yearly investments in the building envelope (thermal renovation) and in renewable heating systems from 2012 to 2050 in the current and ambitious policy scenarios. The investments are slightly higher in the ambitious scenario due to higher number of the renovated buildings, higher quality of the implemented thermal renovation and higher investments in the renewable systems. Figure 102 shows total yearly public budget for financial support of renewable heating systems and renovation of the building envelope. The yearly public budgets are significantly higher in the ambitious policy scenario.

Development of the building related energy demand

Figure 103 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Spain´s building stock is 143 TWh in 2012. The scenario shows a slow-down of the energy demand of 5% from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 34% in the current policy scenario in the long term development between 2012 and 2050 and by 43% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

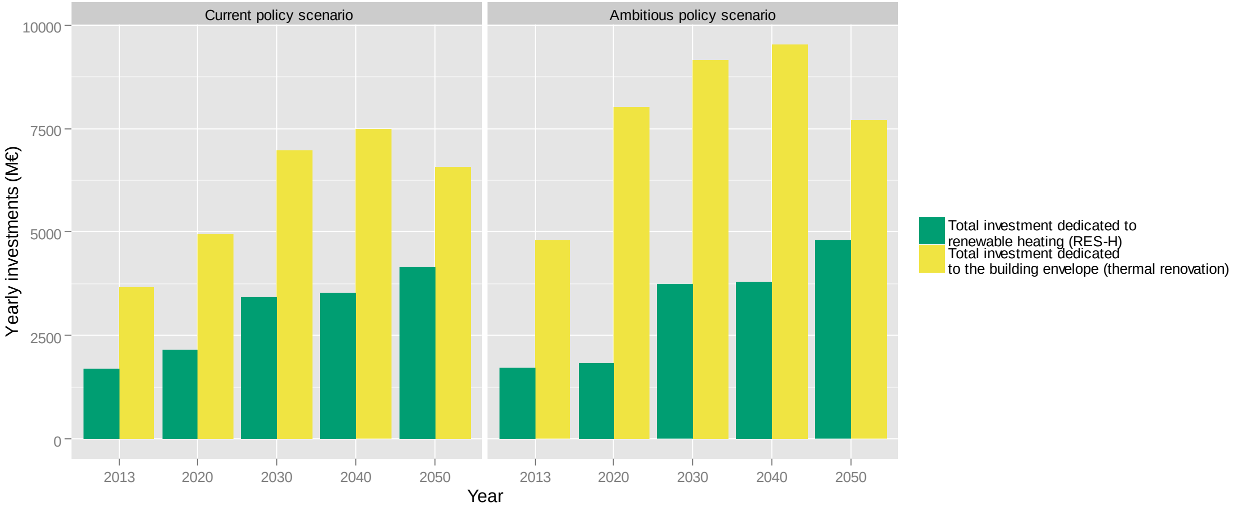


Figure 101 Total yearly investments in renewable heating systems (RES-H) and renovation of the building envelope including public budget, 2013 to 2050, current policy and ambitious policy scenario

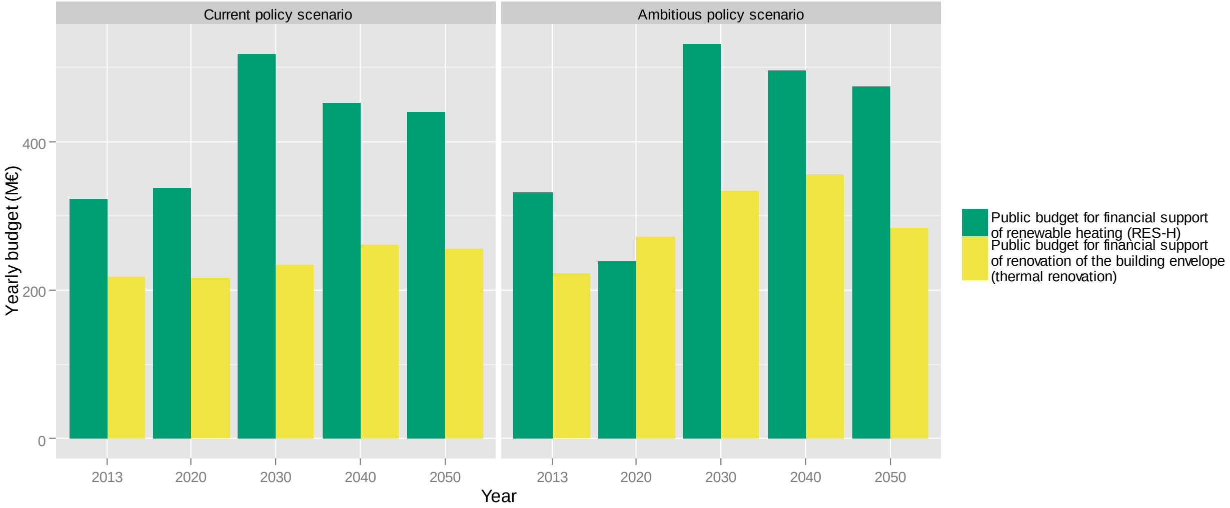


Figure 102 Total yearly public budget for financial support of renewable heating systems (RES-H) and renovation of the building envelope, 2013 to 2050, current policy and ambitious policy scenario

In Spain, the share of fossil-fuel-based heating systems, natural gas, oil and coal makes up around 40% of the total energy demand for space heating and hot water in 2012. The share of non-delivered energy (i.e. solar and ambient energy) is around 2.5% of final energy demand in 2012 to around 40% in current policy scenario and 50% in ambitious policy scenario in 2050.

Figure 104 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 70% in current policy scenario and around 80% in ambitious policy scenario. The reduction of the primary energy demand is around 60% and 71% in the current and ambitious policy scenarios respectively. The main driver for the CO2-emission and primary energy savings in both scenarios is the overall energy demand reduction and increase of energy performance of new and renovated buildings and the share of renewable heating.

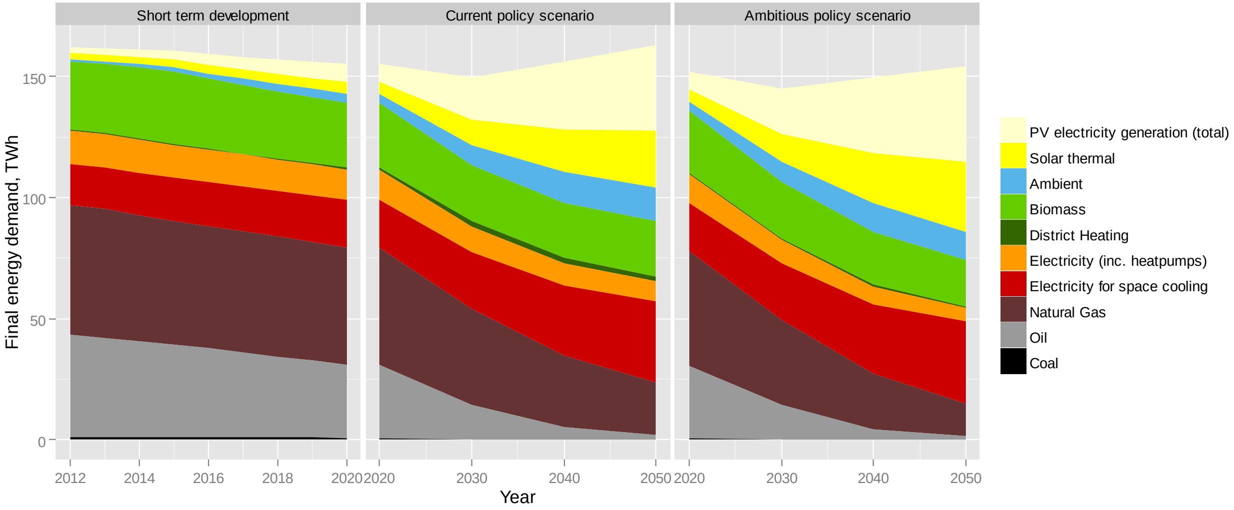


Figure 103 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

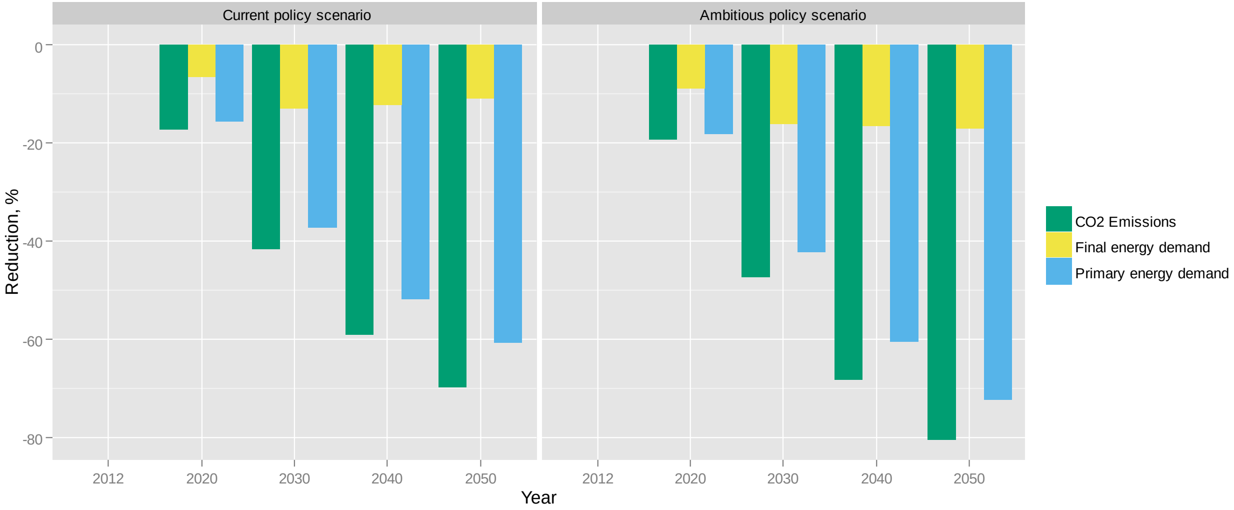
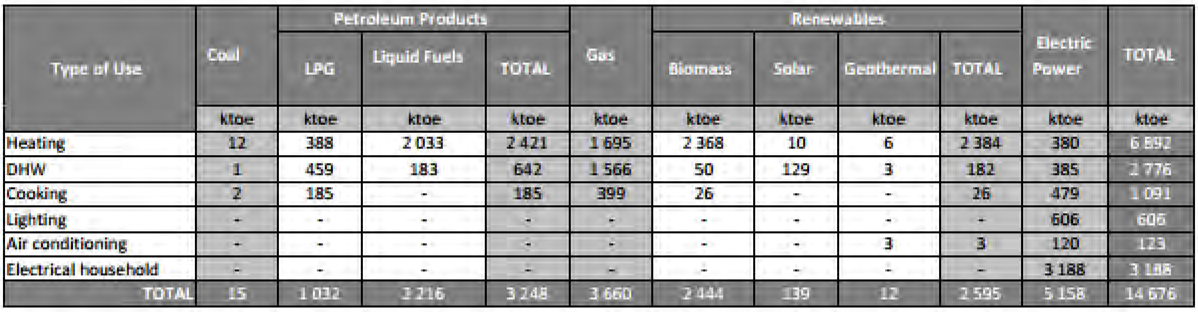


Figure 104 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

9.6 RECOMMENDATIONS

Due to the economic malaise that has prolonged since 2009 in Spain, the building sector struggles with a slow economy and big debts, hampering well-needed investments. The slow rate of building new constructions is even more alarming than the absence of energy renovations. One reason is that there are still no real measures for encouraging new constructions (or nZEBs). The Spanish government and industries should view the investments in buildings as an opportunity rather than a cost. Investing in highly energy efficient buildings and renovations, can boost the lagging economy and generate desirable jobs.

In Spain there are around 10 million existing buildings (96% residential), comprising 25.2 million dwellings, 68.6% of dwellings as multi-family and 31.4% as single-family. Of the more than 18 million Spanish main dwellings, nearly half fall between 61 m2 and 90 m2 in size; 29.6% are between 76 m2 and 90 m2 and 18.6% are between 61 m2 and 75 m2. Almost 75% of existing buildings is constructed before 1980 and around 90% is residential.



Type of Use	Coal	Petroleum Products			Gas	Renewables				Electric Power	TOTAL
		LPG	Liquid Fuels	TOTAL		Biomass	Solar	Geothermal	TOTAL		
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
Heating	12	388	2 033	2 421	1 695	2 368	10	6	2 384	380	6 892
DHW	1	459	183	642	1 566	50	129	3	182	385	2 776
Cooking	2	185	-	185	399	26	-	-	26	479	1 091
Lighting	-	-	-	-	-	-	-	-	-	606	606
Air conditioning	-	-	-	-	-	-	-	3	3	120	123
Electrical household	-	-	-	-	-	-	-	-	-	3 188	3 188
TOTAL	15	1 032	2 216	3 248	3 660	2 444	139	12	2 595	5 158	14 676

Figure 105 Final energy consumption in the residential sector in Spain according to types of use [98]

Some successful results have been already achieved in rehabilitation of buildings in the "PAREER" programme, a grant-financing scheme for building renovation in Spain. The "PAREER programme" has so far funded 465 projects, selected upon the buildings' EPC and application of the energy performance recommendations appearing on the certificate, whose were grouped in four categories: thermal envelope (80%), heating and lighting systems (16%), biomass (3%) and geothermal energy (1%).

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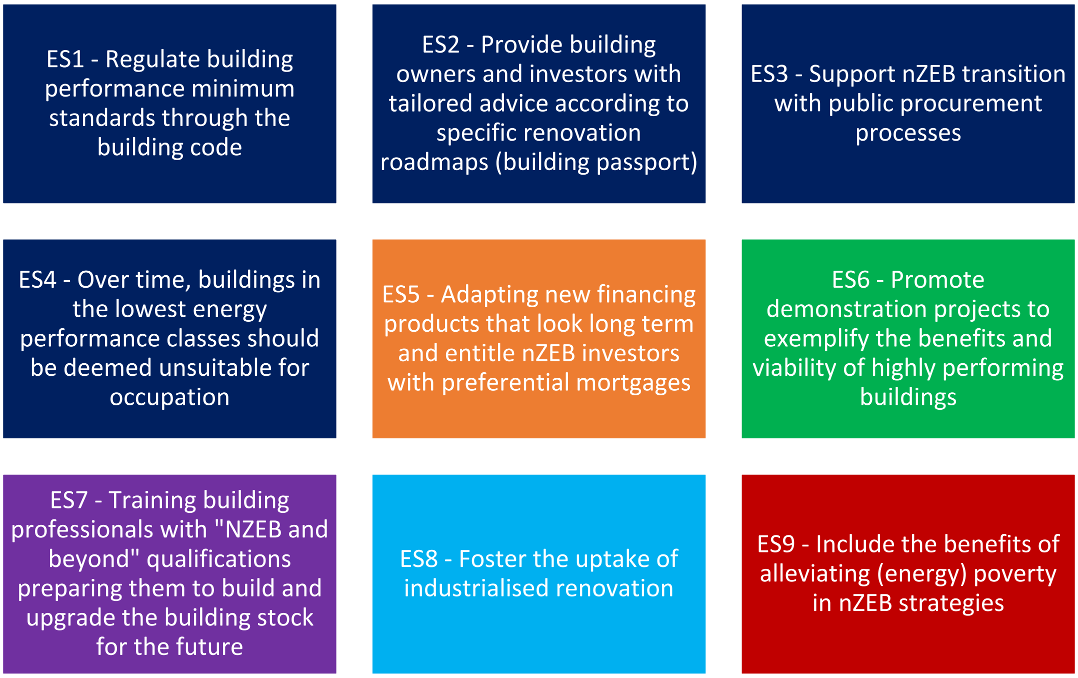
[98] Long-Term Strategy for Energy Renovation in the Building Sector in Spain Pursuant To Article 4 of Directive 2012/27/UE. https://ec.europa.eu/energy/sites/ener/files/documents/ES%20Art%204%20EN%20ENER-2014-01009-00-00-EN-TRA-00.pdf

It is obvious that Spain has an enormous energy saving potential in renovation of the building sector. Despite this fact, there are no updated/new ambitious official plans or strategies for new constructions and only energy efficiency obligations have been adopted by minor updates (the latest revision was in 2013) of the CTE (Spanish Technical Building Code in force since 2006). Furthermore, a nZEB concept is expected to be implemented in 2018.



ES1 - Regulate building performance minimum standards through the building code

ES2 - Provide building owners and investors with tailored advice according to specific renovation roadmaps (building passport)

ES3 - Support nZEB transition with public procurement processes

ES4 - Over time, buildings in the lowest energy performance classes should be deemed unsuitable for occupation

ES5 - Adapting new financing products that look long term and entitle nZEB investors with preferential mortgages

ES6 - Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

ES7 - Training building professionals with "NZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

ES8 - Foster the uptake of industrialised renovation

ES9 - Include the benefits of alleviating (energy) poverty in nZEB strategies

#ES1 - Legislative and Regulatory Instruments

Regulate building performance minimum standards through the building code

As required by the EPBD "EU countries must set minimum energy performance requirements for new buildings, for the major renovation of buildings and for the replacement or retrofit of building elements (heating and cooling systems, roofs, walls, etc.)". Spain ought to use the building code as a key tool to foster the uptake of nZEBs. For the moment, Spain still has no definition or guidelines concerning nZEBs.

An update of Spanish Building code can have a significant impact on the energy performance of buildings by setting minimum requirements for the energy-efficient design and construction/renovation of new and existing buildings.

The minimum values for nZEB standard are very relevant to foster new investments in Spain (such as in tertiary sector) and a good opportunity to allow an initial development of nZEB Spanish market, especially for renovation of the residential stock, which is an almost 75% of existing buildings constructed before 1980.

The future policy plan in Spain is to set out the nZEB standards alongside the revision of the Spanish building code, which will take place in 2016-2017 and will become compulsory in 2018.

Example: Definition of the nZEB standard in Basque Region

The Basque Region has already defined a nZEB standard for public buildings (including social housing) constructed after appliance of their Decree of Energy Sustainability 178/2015 (available since September 2015).

The article 19.2 describes two main and simple features to define a nZEB in Basque Region:

1. To get the Class A as minimum the energy certification level and;
2. Having a 70% of energy consumption from renewable sources.

Read more about the nZEBs regulation in Basque Region**99**.

#ES2 - Legislative and Regulatory Instruments

Provide building owners and investors with tailored advice according to specific renovation roadmaps (building passport)

Step-by-step renovation strategies facilitate the owner's decision to invest in some deeper renovation, in particular if specific elements that need to be taken into account for later renovations are highlighted from the very beginning. For example, if a roof is insulated, roof

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[99] https://www.euskadi.eus/y22-bopv/es/bopv2/datos/2015/10/1504303a.shtml

overhangs, downspout connections, adjustment of the boiler, piping penetrations for future solar systems etc. are also included in the renovation recommendations.

In Spain, the existing long-term renovation strategies established do not encourage individual owners to have a future vision regarding their energy efficiency improvements. They have uncertainty regarding future renovations and this typically leads to retention with respect to renovation decisions or to limited renovations (installation of short-term measures). From this perspective, any instrument that triggers a long-term perspective and allow building owners and potential investors to clearly outline robust long-term renovation plans.

A kind of "building passport", known as IEE – Building Assessment Report, is mandatory in Spain for any residential existing building older than 50 years or any building renovation interested in having access to public economic incentives (regulated by RD 7/2015). But, this IEE is only used to detect some issues for assuring the requirements of building maintenance or solving some deficiency related to technical conservation. Despite the fact of EPC is also required, the "possible" recommended energy improvement measures (if exists, provided by the certificate) are not reliable (due to be a short and simplified methodology for certification compared to a more detailed, i.e. energy audit) and usually are more focused on achieving a better letter (short-term measures) than performing a full and/or scalable energy-efficient renovation (long-term measures).

Taking advantage of the IEE (also known as ITE – Building Technical Inspection, if regulated by autonomic/municipal legislation) and to extend the coverage to all the building market (new and existing buildings for residential and non-residential) could evolve into building-specific renovation roadmaps, providing a "health check" on individual buildings and tailored advice to owners and investors on how to improve them. A building roadmap would allow building owners to have an overview of the full range of renovation options and easily identify each renovation step from begin to end at the same time (step-by-step approach).

Example: Building passport and strategy for building energy renovation in Catalonia

As part of autonomic legislation competences, Catalonia has also regulated (Decrees 67/2015 and 187/2010) and extended its requirement for the "building passport" called ITE (similar to IEE) to new residential constructions (by adding a specific document called "Building Book"). Moreover, new adopted measures have been implemented to encourage the inspections and improve the technical quality of the information. Otherwise, a more oriented vision towards a building-specific renovation roadmap (i.e. "nZEB level") is still missing and energy improvement measures are the same than described in EPC for each building/dwelling.

One of the actions developed by the Catalan strategy for energy renovation in buildings, is a public online tool, which shows technical, economic and environmental features of products and services used to perform energy renovations in different public buildings. This action is taken to provide the user with a reference for real implemented energy efficiency measures and saving values[100]. However, more action like this is needed to increase the level of deep renovation.

#ES3 - Legislative and Regulatory Instruments

Support nZEB transition with public procurement processes

Public procurement is the process where governments is buying goods or services from the external sector, with the purpose is to promote an open and fair competition for public contracts. Tendering contracts are often integrated contracts, which can comprise construction work in the building envelope, the supply of systems and energy, financing, management and maintenance services, but also energy conservation guarantees.

Most of procurement processes in Spain are today too centred on the price of the contract (i.e. the lowest bidder wins), sometimes implying a lower quality. Authorities on different levels should use the public procurement process to ensure an improved energy performance of buildings and steer the sector towards nZEB level.

One key aspect is to provide general guidelines and technical assessment for some common environmental and energy efficiency criteria in public tenders at municipal and regional levels. To have models or examples for procurement processes will improve the influence over smaller municipalities and the encouragement of local market actors to better energy efficiency solutions.

EU-Project: Pro-EE

The EU led project pro-EE aimed to improve energy efficiency through sustainable public procurement. The project brought together producers and consumers, implemented energy-efficient Green Public Procurement (GPP) procedures in local administrations, and organised training for municipalities' procurement staff. At the same time, five pilot cities set up integrated energy efficiency action plans, which included the involvement of stakeholders and awareness-raising campaigns for citizens.

The project concluded "Energy efficient procurement has to be embedded into overarching activities of the public body in the field of sustainable energy and has to be linked to other activities

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[100] Catalan legislation: http://web.gencat.cat/es/tramits/tramits-temes/Inspeccio_tecnica_edificis_ITE_

Catalogue of products and services for energy renovation in buildings: http://cataleg.clustereficiencia.cat/

and projects. To introduce it as an isolated issue diminishes the impact of actions."[101]

Example: Murcia and San Sebastián as pilot cities in the pro-EE project

The city of Murcia, a pro-EE partner situated in the Basque Country, is using the centralised point procurement scheme established by the Spanish national government for the procurement of certain groups of products like vehicles or computers. In this way, local authorities can incorporate the energy efficiency criteria established in the National Action Plan on GPP into their individual purchasing.

The city of San Sebastián, another pro-EE project partner, is one of the pilot administrations participating in the GPP activities coordinated by Ihobe, the Basque Public Agency for the Environment. In 2009, the use of common criteria for green purchasing also used by private companies and the general public was introduced into the programme in order to move the market forward and reduce the impact on the environment. San Sebastián uses the Basque Country criteria, which is based on the EU GPP Toolkit and adapted to the regional situation (supply side).

#ES4 - Legislative and Regulatory Instruments

Over time, buildings in the lowest energy performance classes should be deemed unsuitable for occupation

In the 2010 recast of the EPBD, Member States are required to introduce minimum energy performance standards whenever a building undergoes a major upgrade: defined as one affecting 25% of the building area or where the total cost is 25% or more of the building's value. Two years later, the Energy Efficiency Directive included a requirement for Member States to renovate 3% p.a. of the total floor area of buildings owned and occupied by the central government.

Whilst these are positive developments that begin to address the largest area of energy use in Europe, namely the existing building stock, this legislation affects only a small proportion of Europe's buildings. As a result, there are no requirements to improve the vast majority of the existing building stock, where 40% of the EU's energy is consumed. Member States ought to speed up the transition to nZEB – and specific trigger points for renovation can be an effective way to do so.

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[101] European Commission https://ec.europa.eu/energy/intelligent/projects/en/projects/pro-ee

In Spain almost 75% of existing buildings is constructed before 1980 and around 90% is residential (Eurostat 2012). Therefore, detecting unsuitable technical issues and comfort barriers for occupation in dwellings or family houses becomes relevant.

Spain has regulated a kind of "building passports", known as IEE – Building Assessment Report (RD 7/2015), which are used to detect some issues for assuring the requirements of building maintenance or to solve some deficiency related to technical conservation. As EPCs are also provided in IEEs, some limitations might be taken into account, i.e. the obligation for applying the improvement measures (considered in a specific EPC) in order to improve a bad letter (G). A good understanding of the building stock is a precondition for this recommendation.

Six trigger points for mandatory renovation102:

1. Within a specific timeframe
2. When undertaking maintenance work
3. When renting a property
4. At change of building use
5. When changing a boiler
6. When extending a building

Example: Mandatory upgrades in France

In France, among the provisions in the energy transition law of green growth (approved in August 2015), there is a renovation obligation for private residential buildings whose primary energy consumption exceeds 330 kWh/m2a. This affects all buildings with an energy performance rating in either of the two lowest bands, F or G. These buildings, including rented and owner-occupied, will have to be renovated before 2025. This measure will accelerate the needed transformation of the existing building stock, and help achieve the ambition of bringing the entire building stock to low energy levels (levels "Bâtiment Basse Consommation"(BBC) or equivalent), by 2050, which is also part of the new law.[103]

The law includes a target to renovate 500,000 dwellings per year, starting from 2017, half of them occupied by vulnerable consumers.

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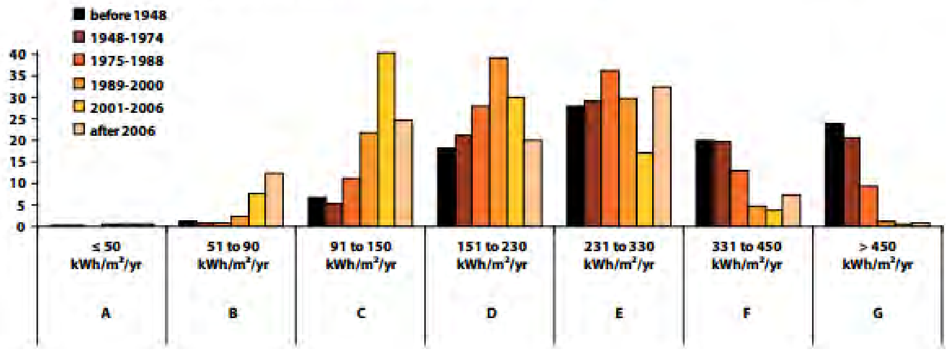
[102] BPIE (2016) http://bpie.eu/wp-content/uploads/2016/02/EASEE-2016-Brux-workshop.pdf

http://bpie.eu/wp-content/uploads/2015/12/Renovation-in-practice_08.pdf

Distribution of residential EPC ratings according to building age and EPC rating (Source: Ministère de l'écologie, du développement durable et de l'énergie)[12]



#ES5 – Economic Measures

Adapting new financing products that look long term and entitle nZEB investors with preferential mortgages

Spanish banks do not yet integrate the advantages of energy efficiency in their financial products/calculations. Governments ought to encourage these banks to prepare for the future building stock and thus include the broad set of economic advantages energy efficiency investments can generate. Banks should especially consider the following two advantages of nZEB investments:

- Lower energy costs and therefore higher repayment capacity
- Higher future property value (because build according the future energy performance and therefore future-proof

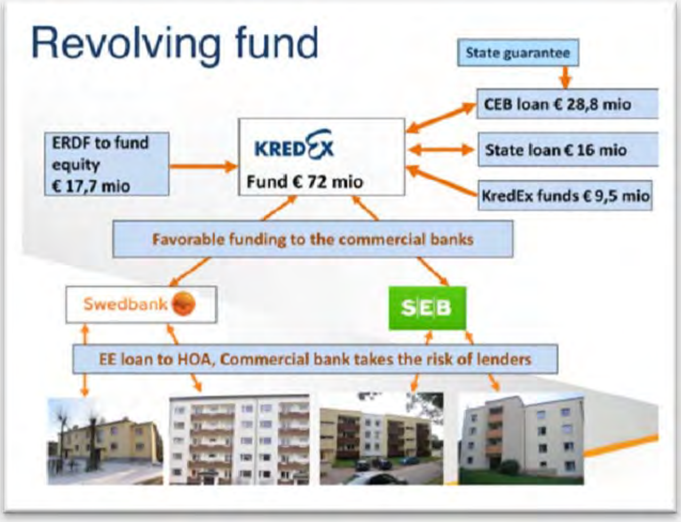
With the current focus on classical mortgages for real estate loans, it is very difficult for a majority of the population to engage in a deep renovation. More flexible financial products adapted to the different financial situations of end-users could speed up the renovation rate and shift the currently staged approach to a fully deep renovation. These could look more like the financing products that the automotive sector provides such as leasing contracts, low interest rate short term loans grouped to aggregate scale, etc. Third party investment under an ESCO (Energy Service Company) format or linking a mortgage to the property and not to the owner are some examples of potential solutions.

National or local strategies for building energy renovation in Spain should consider energy improvement mortgages in order to encourage step-by-step renovations for: those that still have an old mortgage (taking the money saved in the utility bills, like an ESCO company) or those who wants to purchase for renovating an old building (with special economic incentives and/or mitigating the monthly payments)

Example - Revolving loan leveraging EU funds - Estonia

The housing stock in Estonia was mostly built prior to 1980, with little attention given at the time to energy efficiency or energy performance requirements. In fact, before 2008, there were no legal obligations to insulate buildings or to provide efficient technical systems such as heating in buildings. As a result, Estonian buildings are wasteful in terms of energy use, having an average heating energy demand of around 200-400 kWh/m2 per annum.

This poor energy efficiency, combined with the fact that the majority of the population lives in Estonia's cities, with three out of four people residing in apartment blocks, led to the Estonian Government establishing the KredEx Foundation, Estonian Credit and Guarantee Fund in 2001, in order to provide support for improving the energy performance of the housing stock. Originally based on grants, in 2009, KredEx renovation finance changed its structure to a revolving loan fund. KredEx manages the revolving fund, the first of its kind to use EU Structural Funds to provide low-interest loans to housing associations and municipalities.



In order for an apartment block to be renovated under the loan scheme, a mandatory 5-step process must be followed in line with the strategic renovation scheme, and an additional grant is provided. The grant rate depends on the expected energy savings and goes from 15% grant if saving 20 to 30 % and 35% grant if saving 50%.

This funding mechanism provides the housing sector with an opportunity to reuse funds going into the scheme to further renovate the building stock.[104]

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[104] http://bpie.eu/wp-content/uploads/2015/12/Renovation-in-practice_08.pdf

#ES6 – Communication

Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

In Spain "nZEB" is still seen as something 'outlandish' by many investors and building owners. Demonstration projects are an effective mechanism to forging partnerships between public, private and community sectors, developing new ways of working together, and learning by doing. Demonstration projects can through its transparency change processes and behaviours.

Taking into consideration that there is still no nZEB definition for Spain, there are many energy efficiency buildings labelled with other alternative and similar tags like "passive house", "low energy consumption", "zero carbon", etc. It could be a good opportunity to collect all these buildings as references of best cases in order to open the mind of some 'demure' building professional, investor, owner or, even, user.

There is a great deal of interest on the part of specific segments of the population as well as the general public for touring demonstration projects.

Example: Smart Energy Building Strategy of the Basque Region awarded by CLIMA2016

The study presents a review of the Housing Policy and strategies implemented in the Northern Spanish region during the last decade. The analysis was carried out by the Laboratory for the Quality Control of Buildings of the Basque Government and the University of the Basque Country UPV/EHU,

In the same study, the Basque researchers presented the first Zero Energy Social Housing Building (NZEB) in Spain. This project consists of 32 social dwellings built in Portugalete (near Bilbao). The first occupants will move in this summer. This project is included in the European funded project BUILDSMART and is the result of the collaboration between the Basque Government, the University of the Basque Country and TECNALIA[105].

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[105] Poster presentation of CLIMA2016: http://www.buildup.eu/node/49170

BUILDSMART project: http://www.buildsmart-energy.eu/

#ES7 – Quality of action

Training building professionals with "NZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

NZEBs demand higher qualifications of building professionals on all levels. Consumers should be able to rely on the skills of the building professional and get value for money, which means state-of-the-art information and advice, achieving the expected (energy) performance, a maximum operational lifetime and a safe and healthy building. This requires higher skills in the nZEB chain – highly energy efficient products require the proper understanding from the installer etc. A high skilled workforce increases the level of trust and confidence in NZEB investments.

To ensure an effective and qualitative construction and installation of nZEBs and related components, all professional involved in the process must receive proper training.

The proposal of this measure for Spain is to assign some official organism which publicly offers special nZEB training for building professionals in their specific areas of expertise or, otherwise, officially coordinates different training programs for nZEB qualification by professional institutions like professional schools.

EU-Project: SouthZEB

The SouthZEB project is an Intelligent Energy – Europe funded project, which addresses the IEE priority for 2013 on continuous professional development.

"With the objective of fostering the energy efficiency of the building sector through the adoption of near Zero Energy Buildings (buildings that have very high energy performance) concepts in new or existing buildings, the SouthZEB project develops training modules targeted towards specific professionals (Engineers, Architects, municipality technicians and decision makers) in Southern European countries (Greece, Cyprus, Southern Italy and Portugal). The training modules will be implemented by the project partners in the target Southern European Countries (less advanced on the progress towards nearly Zero Energy Buildings), leveraging on the experience and know-how from front runner project partners' countries (Austria, UK, Northern Italy).**106**

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[106] http://www.southzeb.eu/training/

Example: The role of IDAE in Spain

In Spain, the official organism IDAE is focused on training and dissemination of energy efficiency. Much information can be encountered in its website like energy efficiency reports, normative and incentive programs, even, a training platform where different online courses on energy saving measures are available for users[107].

#ES8 – Incentivize the Market

Foster the uptake of industrialised renovation

Industrialisation, in this context, means the aggregation and streamlining of replicable processes, instruments (e.g., financial models) or products (e.g., pre-fabricated materials or modular buildings). The main benefit is a lower price due to economies of scale (i.e. the marginal cost decreases when the production levels up since the fixed costs are the same. The main trigger is market confidence.

Market confidence can be built through different means like branding and quality assurance. Industrialised deep energy retrofits - where one contractor provides a turnkey renovation using mainly prefabricated modules - are still fairly new terrain within the construction sector. Today the majority of renovations happen in a staged approach combining multiple smaller local contractors. In the newly built segment this turnkey approach is more common and integrated.

Passive House market has been extended all around Europe, even, in other continents. This marks a special background for nZEB sue market, at least for Spain, where some replicated components like timber-framed panels, triple-glazing windows or heat-recovery ventilation systems are commonly available in.

Taking advantage of the existing products and methodologies related to the Passive House standard can help to foster the nZEB market in Spain. However, most of these components are focused on new construction and many of them should be adapted to renovations, especially for the different types of existing buildings in Spain.

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[107] IDAE website: http://idae.es/

Energy saving training platform: http://formacion.paee-age.es/

Example – Examples of Spanish building types for housing renovation with the Passive House standard

The aim of the EU project E-RETROFIT-KIT is to develop a web-based tool-kit for passive house retrofitting (PHR) applied to social housing comprising the elements of:

- general guidelines based on best practice;
- examples of passive house retrofittings applied to social housing;
- catalogue of passive house retrofitting building components;
- methodology for making own solutions.

In the case of Spain, the web-tool matches to three different construction periods: before 1960, between 1960 and1979, and post 1979. Also the buildings fit to three different residential building typologies: large residential block (more than 4 floors), small residential block (4 or less floors) and terraced housing. All of them are representative examples of buildings (according to the most common existing building types in Spain) analysed according to PHR measures implemented and the obtained results.

The information provided by the web-tool may enhance professional knowledge and fill the gaps for the nZEB renovation, taking into account the Passive House standard as a similar reference of the nZEB standard. Detailed information like actual state (photo, general information about the building, U-values, building materials, etc., heating system and energy need), energy savings, retrofitting measures, energy costs and energy consumption can be known per each building type[108].

#ES9 – Social Issues
Include the benefits of alleviating (energy) poverty in nZEB strategies
Fuel poverty is a major problem for Europe, as between 50 and 125 million people are unable to afford a proper indoor thermal comfort**109** Energy efficiency improvement is an important long-term mean to combat fuel poverty. However, mobilising the upfront-investments has strong distributional aspects and may impact the poorest part of the population. Energy

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[108] E-RETROFIT-KIT web-tool: http://retrofit.energieinstitut.at/

[109] http://bpie.eu/publication/alleviating-fuel-poverty-in-the-eu/

efficiency policies should be designed to allow the poorest households to undertake the necessary investments and to encourage the participation of stronger investors.

A study commissioned by the European Parliament and carried out by the European Foundation for the Improvement of Living and Working Conditions (Eurofound) showed that European countries spend nearly €194 billion per year in both direct costs, such as healthcare or social services, and indirect costs, like loss of productivity due to inadequate and poor housing. The removal of deficient housing would cost a total €295 billion. However, the totality of money spent would be reimbursed nearly 18 months later according to the study**110**.

Authorities ought to include the indirect costs of inadequate housing in their national building strategies, including nZEB. Investing in energy efficient measures targeting underprivileged neighbourhoods is often a cost-effective investment for the society, bringing social, environmental and economic gains.

It is observed that in several EU countries the (social) housing sector "takes advantage" of energy efficiency schemes to implement energy efficiency measures in fuel poor households. However, in most cases such programs are mostly not integrated in a strategy on national level with the objective to eradicate fuel poverty. The existing fuel poverty schemes are often valuable, but should be integrated in a broader national (nZEB) strategy.

Example: Fuel poverty strategy in Catalonia

As part of autonomic legislation competences, Catalonia is a pioneer region, which has regulated a regional law on urgent measures to address the on-going housing and fuel poverty emergencies (Decree 24/2015). In this case, the regulation is mainly focused on assuring the access to electric, gas and water services for low in-come residents. It describes a methodology and process to avoid outages in the basic supply services where Administration assumes the role of intermediary between companies and residents**111**.

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[110] Euractive, author: Maxim Schuman (2016-08-11) - https://www.euractiv.com/section/social-europe-jobs/news/study-inadequate-and-poor-housing-costs-eu-e194-billion-per-year/

[111] Catalan legislation:
http://consum.gencat.cat/consumidors_i_consumidores/tinformem/pobresaenergetica/index_es.html
Catalan association against fuel poverty: http://pobresaenergetica.es/

10. PART II: OTHER COUNTRIES

10.1 BELGIUM

10.1.1 BUILDING PERFORMANCE MARKET DATA

1.1.1 Construction and renovation activities

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for EU countries. Belgium is one of the EU countries with the highest rate of new buildings: in 2014 more than 1.1% of the total building stock was newly built buildings, with multi-family dwellings a slightly higher share than single-family dwellings.

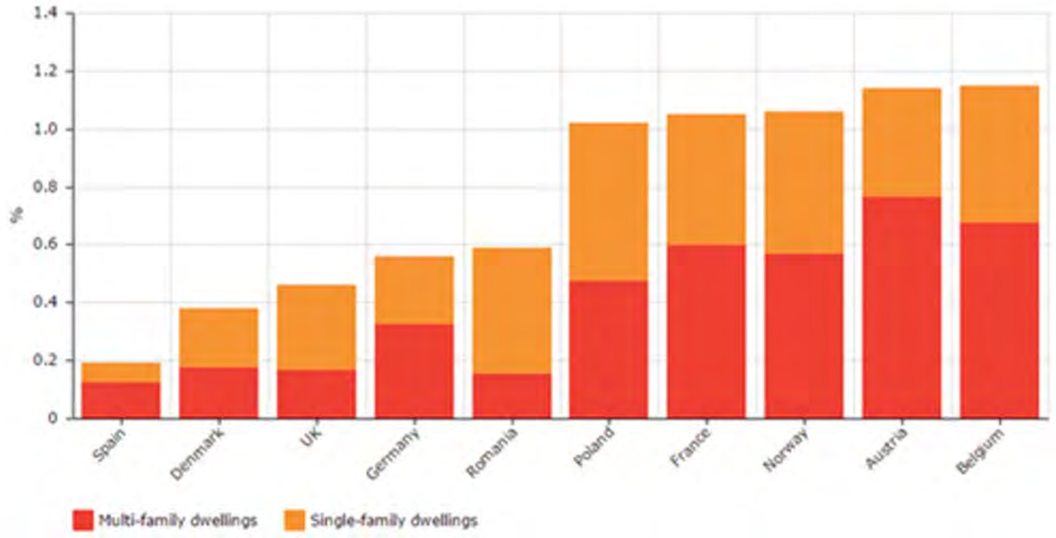

Figure 106: Share of new multi- and single-family dwellings in residential stock in 2014

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar

combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings
2. nZEB buildings according to national definitions
3. Buildings with an energy performance better than the national requirements in 2012
4. Buildings constructed/renovated according to national minimum requirements in 2012

The Belgian nZEB radar is based on the following methodology and assumptions. Given that nZEB regulation is a regional competence and Walloon Region only has an NZEB definition in place since January 2016, and access to data of nZEB market transition is most available for the Flemish Region, makes that the nZEB radar is a reflection of the Flemish market situation.

In Flanders, the dimensionless E-level - calculated by the annual primary energy consumption divided by a reference consumption - is the maximum allowed energy performance level for new residential buildings, offices and schools. From 2006 to 2014 the maximum energy performance level was reduced from E100-level to E60.

In the Flemish Region the nZEB definition for new buildings includes:

- Energy performance: E-level = 30 (residential buildings) or E-level=40 (offices and schools)
- Insulation: K-level = 40
- Net energy demand for heating = 70kWh/m2
- Ventilation and overheating requirements
- Minimum-level of renewable energy

The nZEB radar in Flanders is defined as follows:

Residential buildings	
1-Better than nZEB (net ZEB or positive house)	E = 0
2-National official nZEB definition	0 < E = 30
3-Better than current building code	30 < E = E-level requirement-10
4-According to building code	E-level requirement-10 < E = E-level requirement

Non-residential buildings	
1-Better than nZEB (net ZEB or positive house)	E = 0
2-National official nZEB definition	0 < E = 40
3-Better than current building code	40 < E = E-level requirement-10
4-According to building code	E-level requirement-10 < E = E-level requirement

NZEB definition in Brussels

The regular way to comply with nZEB standards requires:

- Maximum primary energy consumption: 45 kWh/m²/year for residential buildings and about 90 (depending on the building geometry: 95-2.5·(S/V)) for offices, service buildings or schools
- Maximum net energy demand for heating (also cooling for offices, service buildings and schools): 15 kWh/m²/year
- Airtightness: n50=0.6vol/h (starting from 2018)
- Temperature can only exceed 25°C for a maximum of 5% of the time (annually)
- The ventilation system has to comply with a list of specifications and norms
- Specific max U-values per construction element
- The share of renewable energy is taken into account indirectly in the calculation of the energy performance.

NZEB definition in Wallonia

According to the "*Arrêté du Gouvernement wallon du 28 janvier 2016*" the NZEB requirements in Walloon Region are:

Residential buildings

- U values: determined in Annex C1 = Umax and/or Rmin
- Ew-level =45
- Specific consumption (Espec) = 85kWh/m2an
- K-level = K35
- Ventilation: requirements specified in Annex C2
- Overheating indicator: specified in Annex A1 and limited to 6500Kh

Non-residential buildings (offices, hospitals, schools)

- U values: determined in Annex C1 = Umax and/or Rmin
- Ew-level =90/45
- K-level = K35
- Ventilation: requirements specified in Annex C3

The majority of new buildings in Belgium/Flanders are better than the current building code, whereas the share of buildings fulfilling the future nZEB definition or going even beyond is constantly rising as from the introduction of the nZEB concept (better known as BEN in Flanders). This is due to a clear communication on future requirements, a specific dedicated action plan and large involvement from the stakeholders. On the other hand, more than 75% of the new construction in 2014 did not fulfill the nZEB criteria of 2020 yet.

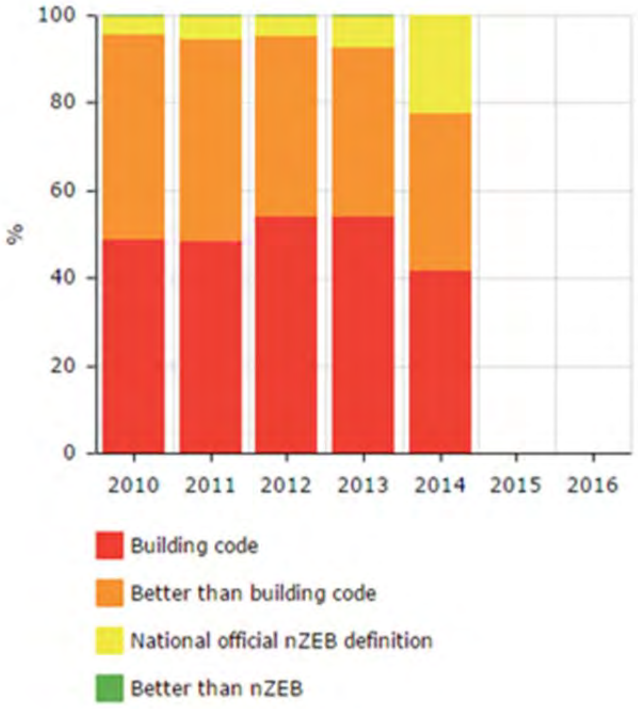

Figure 107: Distribution of new dwellings according to the nZEB radar graph – Belgium

Source: ZEBRA

The equivalent major rate in Belgium/Flanders amounts to be around 0.33% in 2014 which is the third lowest of the Zebra´s countries. Belgium has a large tradition of owners renovating (partially) themselves without needing/requesting a building permission allocated as major renovation.

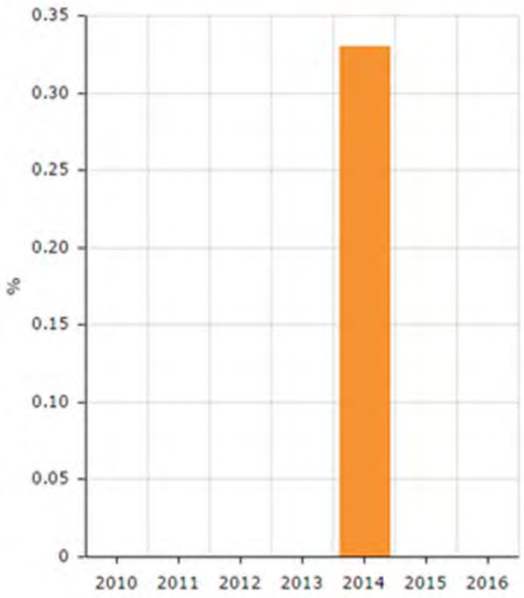

Figure 108: Equivalent major renovation rate – Belgium

Source: ZEBRA

10.1.1.1 SELECTED HIGH PERFORMANCE BUILDINGS

In Belgium, it has been collected data of 15 nZEBs or high energy efficient buildings which were constructed recently. 11 out of the 15 are new buildings and 4 are renovated buildings. 8 have a residential use and 7 are intended for non-residential use.

Climate zones

As Table 19 indicates, the 6 of the 15 buildings are located in the climate zone B, which is characterized by cold winters and mild summers, and 9 buildings are located in zone D, which is distinguished by template winters and mild summers.

Table 19. Building distribution by climate zones - Belgium

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	4	2
C	Warm winters and warm summers		
D	Temperate winters and mild summers	7	2
E	Temperate winters and warm summers		

Heating Demand

The average heating demand in new buildings is 12,3 kWh/m² a, while in renovated buildings it is 17,3 kW/m² a.

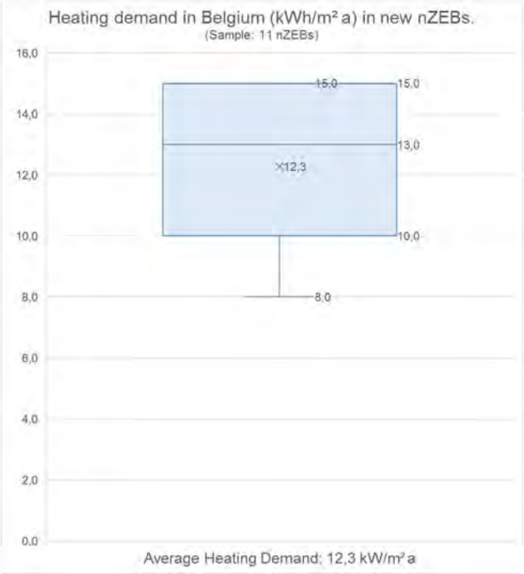

Figure 109Box plot of heating demand in new nZEBs - Belgium

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,12 and 0,10 in roofs, while in renovated buildings the average U-value in walls is 0,14 and 0,13 in roofs.

Cellulose fibre is the most used insulating material. In new buildings, it is used with a share of 45% in walls and 36% in roofs, while in renovated buildings it is used with a percentage of 75% in both walls and roofs.

In windows, the average Uwin-value is 0,8 in new buildings and 0,9 in renovated buildings. The type of glass is mainly triple glass with a percentage close to 75% in both new and renovated buildings.

Concerning passive cooling strategies, most of the buildings did not report any strategy. Nevertheless, sunshade is used in 36% of the new buildings. None specific passive cooling strategy was identified in renovated buildings.

Active solutions

Mechanical ventilation with heat recovery is the preferred option in both new (55%) and renovated (75%) buildings.

In heating systems, the preferred options are boilers, condensing boilers, heat pumps and stoves with the same share of use (18%) in new buildings, whilst in renovated buildings the most used heating system is the condensing boiler with 75% of share. In line with the heating system, gas is the most used energy carrier for heating in new and renovated buildings.

In 55% of new buildings and in 75% of renovated buildings, it is used the same system for DHW as the one used in the heating system.

Only in 1 of the 15 buildings is indicated the use of cooling system.

Renewable energies

In 1 out of the 11 new buildings it is reported the use of photovoltaic systems and in 2 buildings it is mentioned the use of solar thermal systems.

In no renovated building it was stated the use of photovoltaic systems and only in 1 it was declared the use of solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Belgium reports and realised projects.

Table 20 Costs of different renovation depths and new built according to nZEB standards - Belgium

Costs (€/m2)	BE
Minor renovation (15% energy savings)	100
Moderate renovation (45% energy savings)	200
Deep renovation (75% energy savings)	500
NZEB renovation (95% energy savings)	750
New built according to nZEB standards	1600
Additional funds for nZEB construction compared to new built	200

10.1.2 NZEB-TRACKER

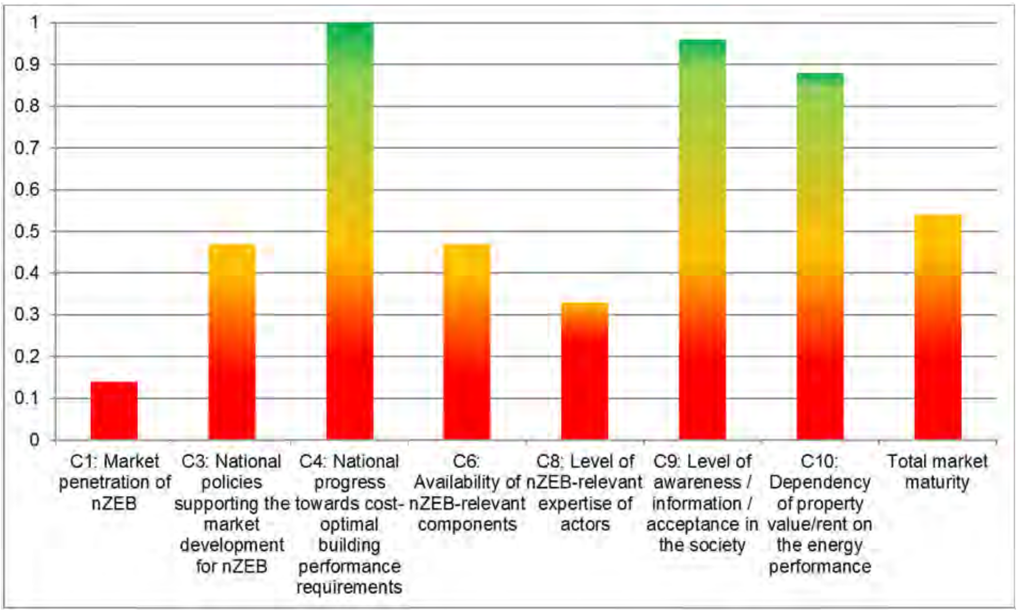

Figure 110: nZEB-tracker score for Belgium

C1: Market penetration of nZEB

- Belgian result: **0.14** ZEBRA average: **0.32**
- nZEB had a share of ~14 % on new constructed floor area in Belgium (Flanders). nZEB is complied with E-level of 30, and a clearly and strongly increasing share for new buildings over the years is observed.

C3: National policies supporting the market development for nZEB

- Belgian result: **0.47** ZEBRA average: **0.52**
- For new buildings the policy framework in Belgium is quite in place, especially for Brussels Capital and Flemish Region. Walloon Region still has to provide an nZEB definition.
- The nZEB concept exists which is defined by respective class of energy performance of the building, although the difference in nZEB definition across the three different regions does not facilitate transformation of the construction sector.
- There are financial incentives for nZEB construction and deep renovation.

C4: National progress towards cost-optimal building performance requirements

- Belgian result: **1** ZEBRA average: **0.94**
- The Belgian building code already matched the cost optimal building energy performance level.

C6: Availability of nZEB-relevant components

- Belgian result: **0.7** ZEBRA average: **0.83**
- Extreme energy efficient building components and technical installations are moderate available, but an overall market acceptance of these products is not yet achieved. This is especially the case for renovations.

C8: Level of nZEB-relevant expertise of actors

- Belgian result: **0.33** ZEBRA average: **0.63**
- Frontrunner companies and building professionals have excellent expertise in constructing nZEB, but is still considered as a niche market, but in general there is a lack of expertise for the construction phase.

C9: Level of awareness / information / acceptance in the society

- Belgian result: **0.96** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings is high and increased further again from 2014 to 2015.

C10: Dependency of property value/rent on the energy performance

- Belgian result: **0.88** ZEBRA average: **0.74**
- In Belgium, as in Ireland and Austria, the rental surplus of a property value was found to be smaller than the sales surplus, which provides empirical confirmation of the well-documented split incentive problem.

Resulting Maturity of the Belgian nZEB market in 2014

- Belgian result: **0.57** ZEBRA average: **0.66**
- The many different approaches over the three Belgian regions, are causing an incoherent nZEB market development. The main challenge for the three Belgian regions however, is to tackle the energy performance of the existing building stock and create nZEB transition into the renovation market.

10.1.3 SCENARIOS

Figure 111 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Belgian building stock is around 122 TWh in 2012. The scenario shows a slow-down of the energy demand of around 10% (around 1.25% yearly) from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 43% in the current policy scenario in the long term development between 2012 and 2050 and by 46% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Belgium, the share of natural gas and oil heating systems with almost 53% make up a significant share on the total energy demand for space heating, cooling and hot water in 2012 whereas the biomass heating systems and district heating makes up app. 6%. The share of non-delivered energy (i.e. solar and ambient energy) is increasing over time from around 0.34% of final energy demand in 2012 to around 17.5% in current policy scenario and 18% in ambitious policy scenario in 2050.

Figure 112 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 69% in current policy scenario and around 72% in ambitious policy scenario. The reduction of the primary energy demand is around 58% and 61% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

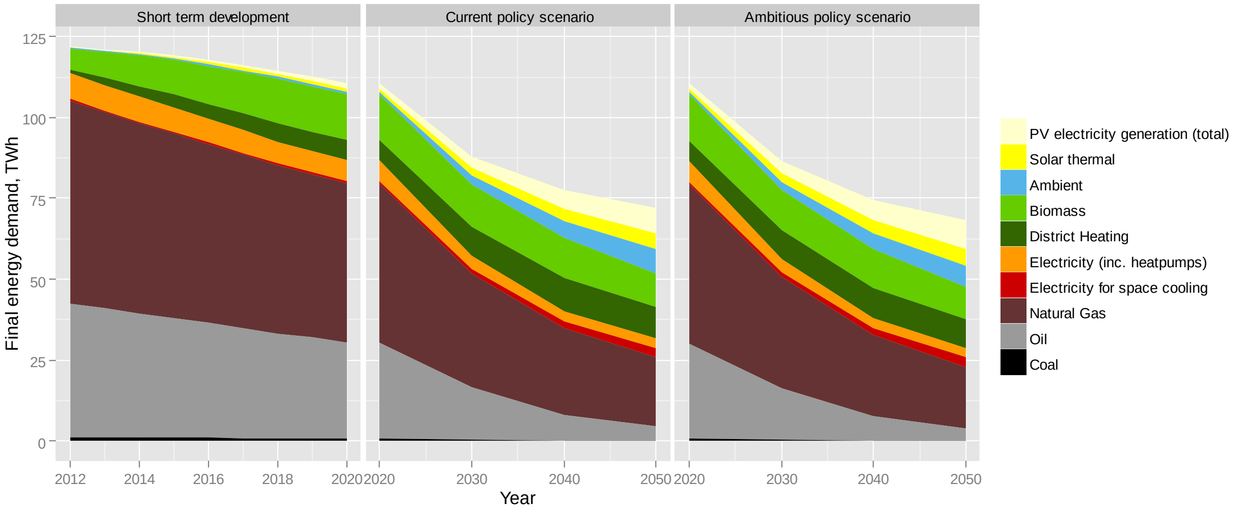

Figure 111 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

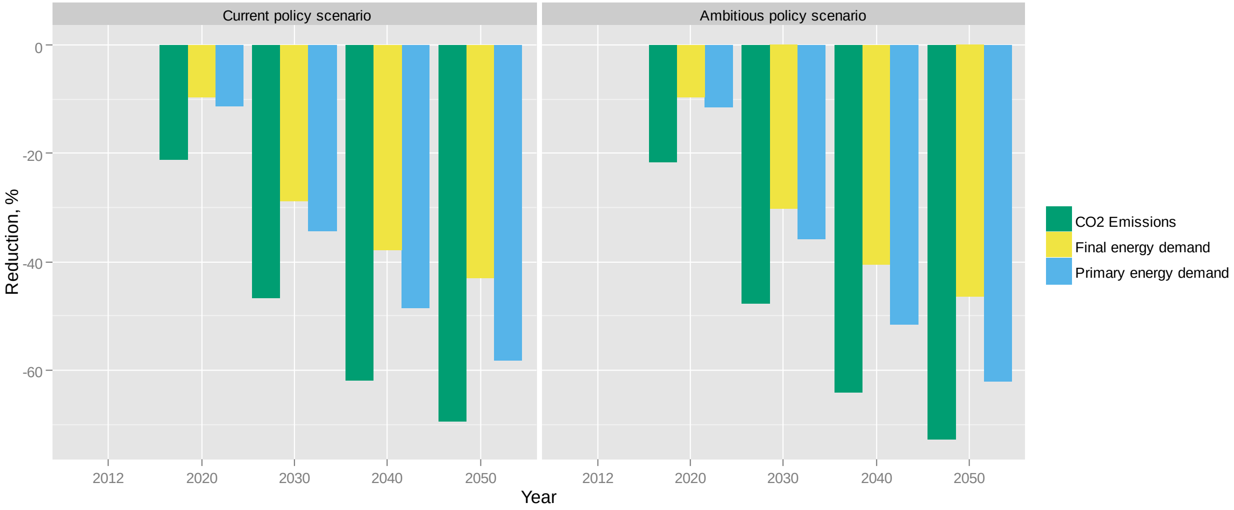

Figure 112 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

10.1.4 RECOMMENDATIONS

In Belgium it is mainly the three regions – Brussels Capital Region, Flemish Region and Walloon Region – who are competent for energy efficiency, building performance and renewable energy related legislation and regulation, which brings policy development for nZEB market uptake on the regional level. Up to a certain degree there is collaboration and cross-exchange of approaches between the three regional and federal governments, e.g. a harmonised energy performance calculation software or for the submission of national energy efficiency plans to the European Commission. However, there are many differences, causing an incoherent nZEB market development. For example, the Walloon Region did not approve yet its nZEB definition, while the definition from the Flemish and Brussels Region differ largely. Also support schemes, quality frameworks, data availability and compliance and control differ across the three Belgian regions.

Depending on size and location, Belgian companies active in the construction sector, often operate in more than one region. Acquiring the necessary information for the concerned region regarding aspects such as building requirements, procedures, financial support schemes etc. is perceived as a large burden.

Belgium is in Europe on nZEB level not often perceived as a frontrunner country, but dedicated actions and strategies have led to interesting results, especially for new buildings in Flanders and Brussels Capital Region. The increase in Flemish Region of 0% new nZEB Single Family Houses (SFH) in 2006 to 10% in 2013 and 22% in 2014 is very significant. This increase was fostered by a combination of stakeholder involvement, a clear path of tighter building performance requirements towards 2021, appropriate marketing campaigns, etc.

The main challenge for the three Belgian regions however, is to tackle the energy performance of the existing building stock and create nZEB transition into the renovation market. Belgian buildings are characterised by an old age, individual ownership, variety of building typologies and general in a bad condition. Mostly, renovations are approached on individual building level and executed in different phases without considering a final building performance target, creating lock-in effect.

The Flemish Government started in 2015 with the Renovation Pact112. This is a coherent action plan with short, medium and long term perspectives (such as a long-term target for existing buildings), aiming for a strong increase in the renovation rate and depth of the Flemish housing stock towards

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[112] http://www.energiesparen.be/renovatiepact

nZEB level. The government facilitates and supports this transformation but all relevant stakeholders are largely involved and take over responsibilities. The Renovation Pact aims therefore to the establishment of a partner organisation in which resources, information, activities and competences are shared for the purpose of achieving the common objective.

Many building professionals in Belgium have experience with building new nZEB, but vigilance on quality is important and therefore supply side should be in constant improvement of competences living up the expected building performances. Surveys show that expertise and knowledge on topics such as airtightness, ventilation, new (renewable energy) technologies and collaboration mechanisms have space to improve.

7 recommendations have been outlined specifically for the Belgian context:

BE1 - Set long term voluntary targets for existing buildings

BE2 - Implement standard methodologies for secure data gathering and assessment

BE3 - Financial support for renovation according long term benchmarks

BE4 - New technologies (IoT) allow us to collect and analyse performance data in a more effective way that was not possible some years ago

BE5 - Encourage new business models to install “One-Stop-Shops” for renovations and aggregate demand to provide sufficient scale and reduce complexity and hassle

BE6 - Enable the market to embrace the new features of buildings as micro-energy hubs (nZEB2.0)

BE7 - Improve all social housing to nZEB standards, in order to provide comfortable and affordable housing

#BE1 - Legislative and Regulatory Instruments

Set long term voluntary targets for existing buildings

Renovations are often step-wise executed by the building owner with or without involvement of an installer or contractor, mostly without taking into account a final energy performance target. Architects (or energy experts) are mostly only contracted when it is mandatory. Measures like replacing windows or technical installations, changing the roof, adding floor, roof or cavity wall insulation mostly don't require the involvement of an architect or energy expert.

This makes that decisions on the level of energy performance measures are mostly taken by the (inexperienced) building owner, possibly supported by an installer or contractor, lacking a global perspective. Clear directives on which energy performance level an existing building should fulfil to be future-proof (=nZEB) would decrease building owner's insecurity at decision making process and help avoid lock-in effect.

Voluntary energy performance targets for existing buildings could serve as benchmark for financial and other support mechanisms and will incentivize the market towards deep renovation (i.e. NZEB level) of the building stock.

State of play: Long term targets for existing building in Flanders

The Flemish Region is already well advanced in developing a long term energy performance target for existing buildings, for which the financial feasibility (cost optimal level) and the building typology are taken into account. It seems like the long-term target for existing buildings will differ than the nZEB-level for new buildings (i.e. E30). The further development, roll-out of this target and communication strategy are essential for the implementation success.**[113]**

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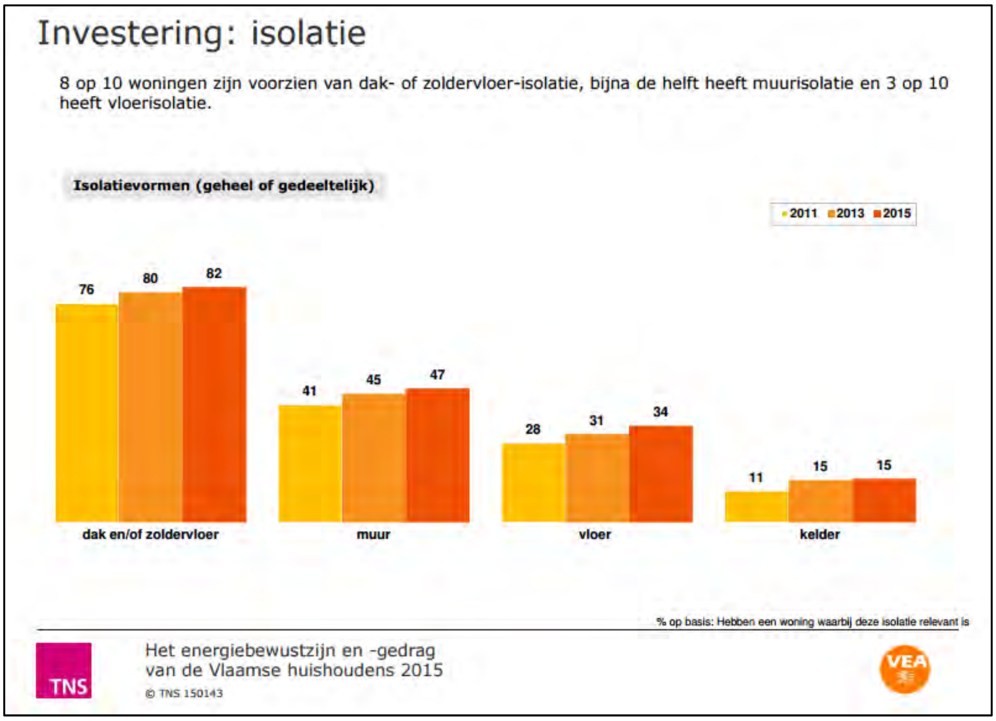
[113] http://www.energiesparen.be/renovatiepact/tweedefase/werf1

#BE2 - Legislative and Regulatory Instruments

Implement standard methodologies for secure data gathering and assessment

The three Belgian regions manage central EPC databases. Although this provides a good static overview of the overall energy performance it is of limited use for monitoring renovation activities. This because the EPC for existing buildings is calculated before a building is sold (or rented), without the need for update afterwards. Furthermore, privacy regulation in Belgium is rather strict compared to countries such as Ireland, Netherlands and Sweden where EPC data is to a certain level public available, allowing third actors the possibility to assess building performance data.

There is already interesting data available on renovation activities, mostly based on the allocated subsidies and household surveys (see the figure below)[114]. Although this data already provides interesting information for policy making, it lacks detail to indicate rate, depth and progress of the renovation transition.



Investering: isolatie

8 op 10 woningen zijn voorzien van dak- of zoldervloer-isolatie, bijna de helft heeft muurisolatie en 3 op 10 heeft vloerisolatie.

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[114] Vlaams Energieagentschap http://www2.vlaanderen.be/economie/energiesparen/beleid/REGenquete2015.pdf

A regional – and if feasible a national - indicator for renovation rate and depth and evolution of the building stock performance would help to monitor the improvements of buildings over time and to design appropriate policies.

#BE3 – Economic Measures

Financial support for renovation according long term benchmarks

For renovations, various financial support schemes exist with qualitative and quantitative requirements (e.g. for 2016, 6 euro subsidy per m² roof insulation of Rd-value > 3.5 m²K/W installed by an official contractor).[115] However, these energy performance levels are not yet aligned with long term building performance targets, and therefore allow and stimulate for the execution of non-cost optimal energy saving measures, leading to lock-in effect for future nZEB renovation.

It is noticed that support schemes often change according legislation, while a long-term and stable support framework is needed to gain market trust and stimulate transition towards nZEB.

For new buildings, the Flemish Region has already aligned its subsidy schemes to the nZEB (or beyond) requirements.

Example: KfW in Germany

The KfW schemes are designed to promote deep renovation following the motto: "The deeper the renovation, the higher the incentive" and therefore stimulates the frontrunners aiming more tight voluntary energy performance targets than legally obliged. To illustrate this point, a grant of 25% is offered if the refurbishment reaches the most ambitious KfW Efficiency House 55 standard, while the slightly less ambitious level of KfW Efficiency House 70 attracts a lower grant of 20%.

While not being a perfect system, it illustrates how benchmarks can incentivise deeper renovation of the building stock.

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[115] http://www.energiesparen.be/subsidies

#BE4– Quality of action

New technologies (IoT) allow us to collect and analyse performance data in a more effective way that was not possible some years ago

With new technologies, a comprehensive and continuous monitoring of the energy consumption, renewable energy production and the technical system performance could provide the building occupant or owner valuable information on the actual performance of the building (e.g. saved, produced and shifted energy and related financial gains) as well as notifying the user on aspects such as unusual consumption patterns, technical defects and needed maintenance. It is very often the case that sub-optimal operation of (new) technologies is not noticed by the building user. Services allowing the building owner or third parties to monitor and detect inappropriate building performance will empower users and increase confidence on nZEB technologies and techniques.

For example, online available monitoring systems on the production of thermal and photovoltaic solar panels exist, but are not yet common practice. In framework of a subsidy scheme (solar thermal) or group purchase mechanisms (PV-systems), those systems could be integrated, allowing for the end-user to follow up on the renewable energy production and indicate flaws.

EU-projects: The iSERVcmb project

The iSERVcmb project[116] is about showing the practical operation and benefits of an automatic monitoring and feedback system, as now allowed for in the recast EPBD, applied to Heating, Ventilation and Air-Conditioning (HVAC) systems in EU Member States (MS). It is an important project as previous work has indicated real savings of up to 60% are achievable in individual HVAC systems through the iSERVcmb project approach. Main objectives of iSERVcmb[117]:

- To provide some reward to HVAC system owners/operators and manufacturers for addressing the energy efficiency of these systems in their operation and design.
- To establish that the continuous monitoring and benchmarking of HVAC processes will provide energy saving benefits equivalent to or better than those achievable by Physical Inspection alone.
- To produce benchmarks of energy consumption by HVAC systems against end use activities derived from measured data around Europe.

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

[117] http://www.rehva.eu/eu-projects/completed-projects/iserv.html

Example: Smappee

Smappee is a private company providing an ingenious energy saving app. After connecting Smappee to the building's fusebox it allows the owner to control all the appliances through the app. The solution also provides a real-time overview of the electricity consumption the building. In the app you can find out all about your total energy use and standby power consumption, including real-time costs. The solution collects data about the owner's energy use, allowing the user to adapt its behaviour.

New business models developing smart technologies like this create the possibility to collect and analyse building performance data in a new and more efficient way than ever before. It can also increase home-owners demand for energy efficiency through available and easy-grasping information.

#BE5 – Quality of action

Encourage new business models to install "One-Stop-Shops" for renovations and aggregate demand to provide sufficient scale and reduce complexity and hassle

The Belgian new build market is typecast by turnkey builders offering a one-stop-shop service to their clients. Within this market segment some bigger players focus on nZEB (or passive) buildings, indicating for new buildings the ongoing market transition towards nZEB.

These larger turnkey players however, hardly offer one-stop-shop services for deep energy renovations, caused by a lack of demand and a larger complexity. Aggregation of demand for deep energy renovations – facilitated by local authorities or other actors – could foster a one-stop-shop market for deep energy renovations, induced by lower costs and higher quality control.

Example: Living Lab Housing Renovation in Flanders, Belgium

The Living Lab Housing Renovation programme is financed by the Flemish Innovation Agency with a total budget of 6 million euro, and was set up as result of a cross-governmental dialogue involving multiple stakeholders. The main objective is to initiate innovative solutions for scalable and reproducible renovation concepts leading to affordable solutions for deep energy renovations.

The Living Lab programme foresees research, development and demonstration activities in eight pilot cases, representing the most common housing typologies in Flanders. Local governments, social housing corporations, research institutes and private actors from the construction value chain are involved in the different pilot cases.

In addition to the pilot cases, a knowledge platform is being developed, responsible for the central coordination and monitoring of projects, quality control and knowledge management[118].

Example: REFURB 2.0

REFURB 2.0 is a consortium of 13 partners in a 3-year project exceeding borders in the EU. The main aim of REFURB is to bridge the gap between the supply side and demand side by developing a methodology or roadmap which will result in dedicated renovation packages (in a one-stop-shop model) for different market segments and regions in Europe, starting with the private residential sector (homeowners). Renovation packages will be customizable in order to ensure that they meet local demands and can be provided by local suppliers. The renovation packages will be defined from the perspective of the demand side through analysis of interests and experience of all relevant stakeholders. Specific focus will be on un-burdening the homeowner and ensuring that the advice is trustworthy, providing an optimal, customised solution for modular, deep renovation towards NZEB standards[119].

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[118] http://www.iwt.be/subsidies/proeftuinbouw - http://www.kennisplatform-renovatie.be/

[119] http://go-refurb.eu/

#BE6 – Incentivize the Market

Enable the market to embrace the new features of buildings as micro-energy hubs (nZEB2.0)

In the Flemish and Brussels Capital region the nZEB transition for new buildings is evolving in positive direction (e.g. in Flanders 0% new nZEB single family houses in 2006 to 10% in 2013 and 22% in 2014), indicating that a mandatory target for nZEBs in 2021 seems feasible.

However, with the 2030 and 2050 climate and energy targets in mind, and the need for Belgium to increase drastically the share of renewable energy, next steps should be considered for new buildings in the coming decade. The nZEB definition and corresponding policy measures should be updated to reflect the new possibilities that a transforming energy market could bring.

Building performance strategies should allow and stimulate buildings to fully take up an active role in the energy system, shaping their role as micro energy-hubs[120] and unlocking opportunities to offer new and tailored services. Technology and services will have to evolve to manage demand in an efficient and responsive manner as well as to integrate energy storage. A strong interaction between different actors in both the energy and construction sectors is needed. New economic ecosystems are expected to appear, crosscutting sectors, integrating innovators and creating disruptors as well as leading to the transformation of buildings into micro energy-hubs.

Legislative instruments should encompass the full scope of micro energy-hubs. The combination of buildings' energy efficiency, renewable energy, storage capacity and demand response ought to be highlighted.

Project Linear

Linear was a Flemish Smart Grid project focusing on solutions to match residential electricity consumption with available wind and solar energy, an approach referred to as demand response. Partners from the research and industrial sectors joined forces in close collaboration with the government to develop, implement and evaluate demand-response technology. In total, 240 families participated, evaluating two different consumer interaction models (variable time of use and automated demand-side management). It seemed that automated demand response with household appliances is technically feasible, but smart-start functionality is needed to avoid user fatigue[121].

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[120] http://bpie.eu/publication/smart-buildings-in-a-decarbonised-energy-system/

[121] www.linear-smartgrid.be

*#**BE7** – Social Issues*

Improve all social housing to nZEB standards, in order to provide comfortable and affordable housing

Social housing companies have an important societal role in providing energy efficient homes. Since their social tenants have limited financial income, a reduction of the energy costs due to energy-efficient social housing, would have a major impact on their daily living conditions. The social housing administrations must reconcile different policy objectives with the (limited) available budget: provide adequate social housing, improve the existing social housing stock and realize energy efficient new buildings.

In some Belgian pilot cases, innovative and energy efficient social housing are constructed and renovated, but nZEB or deep energy renovation are not yet considered as the standard target to implement. This makes that new constructed social houses and renovations are not future-proof in the sense of energy consumption and that lock-in effect is being created. The financing will remain a barrier since tenants pay rent based on their salaries and in case of energy renovation, the rental price can only increase slightly, not sufficient to cover the costs of the energy saving measures. Therefore, more dynamic legislation should be developed allowing for innovative instruments such as third party financing, new property contracting alleviating the split-incentive issue, etc.

Furthermore, policy instruments for (social housing) should include the wider benefits of energy efficient buildings. These benefits are many, both on macro-socio economic level (such as reduced CO2 emissions and contribution to climate change mitigation, employment in the construction sector, increased energy independence, etc.) as on individual building (owner) level:

- Improved indoor climate of renovated buildings with better ventilation systems leads to clear health benefits (such as the relief from symptoms of respiratory and cardiovascular diseases, allergies and rheumatism);
- the lower energy bills from renovated buildings reduce the stress that often arises from the concern of not being able to pay (the so-called "heat or eat" problem);
- days off work and associated productivity impacts can be monetised through a calculation of lost earnings[122]. Including the value of reduced absenteeism of the workforce due to better indoor climate has been shown to increase the NPV of overall benefits (e.g. comfort, energy savings, enhanced cognitive ability) by 11.5%.

To improve living conditions and tackle energy poverty, policies should therefore be set out to build

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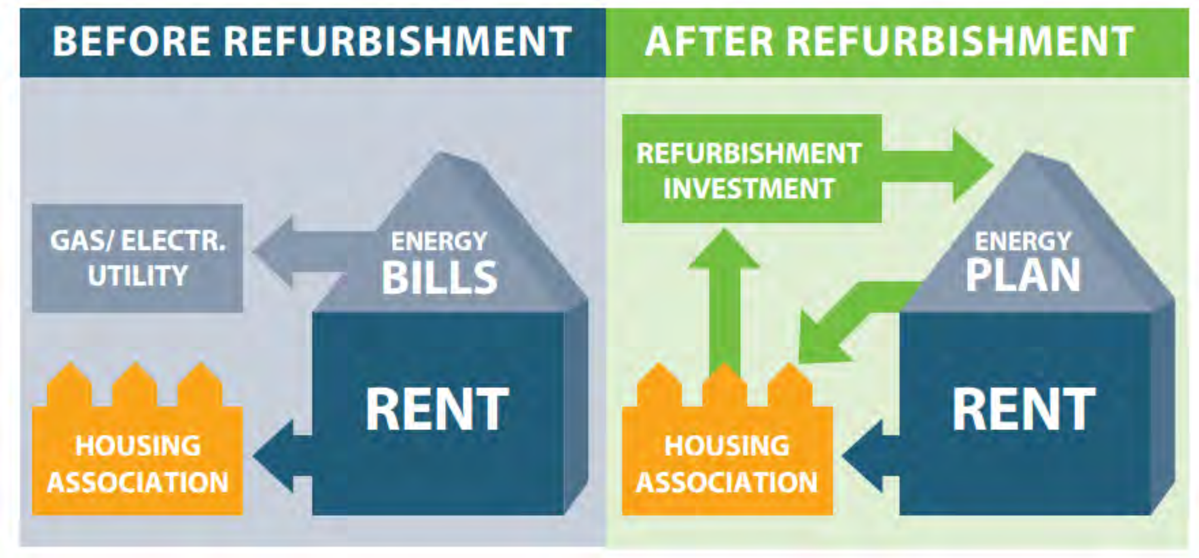
[122] Chapman et al, 2009

or renovate all social houses to nZEB level.

Legislation to allow more flexible financing mechanisms favouring (deep) energy renovations

National legislation has been adapted in some Member States to allow more flexible financing mechanisms favouring (deep) energy renovations, such as in the Netherlands driven by Energiesprong by allowing for social rental prices of homes to increase in case of Net Zero Energy renovations or for the housing associations shifting energy bills into energy plans and the UK driven by the Green Deal by allowing loans to be connected to the property.

Figure – Financing renovation in the social sector[123]



Pilot case 'Drie Hofsteden'

The pilot case 'Drie Hofsteden' has the target to develop and test solutions for the renovation of large social apartment buildings towards nZEB level, suitable within the financial framework of social housing companies. To achieve this, a masterplan will be developed and the construction of prefabricated construction modules is foreseen. The project started in 2014 and will run until 2018[124].

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[123] NeZeR Green Deal for social housing

http://www.nezer-project.eu/newsandupcomingevents/news/greendealforsocialhousingnewapproachesforindustrialscalezeroenergyrenovationconcepts.5.1acdfdc8146d949da6d65ae.html#.V7Wm4aNV3IU

[124] http://www.kennisplatform-renovatie.be/wp-content/uploads/2014/11/proeftuin-Drie-hofsteden.pdf

10.2 CZECH REPUBLIC

10.2.1 BUILDING PERFORMANCE MARKET DATA

10.2.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for EU countries. Czech Republic belongs to the EU countries with relatively low rate of renewal of the building stock: in 2014 about 0.6 % of the building stock was renewed. The annual rate of new dwellings dropped from 30.000 dwellings in 2012 to 25.000 and this number is stagnating since 2013. The majority of new dwellings in the Czech Republic are in family houses.

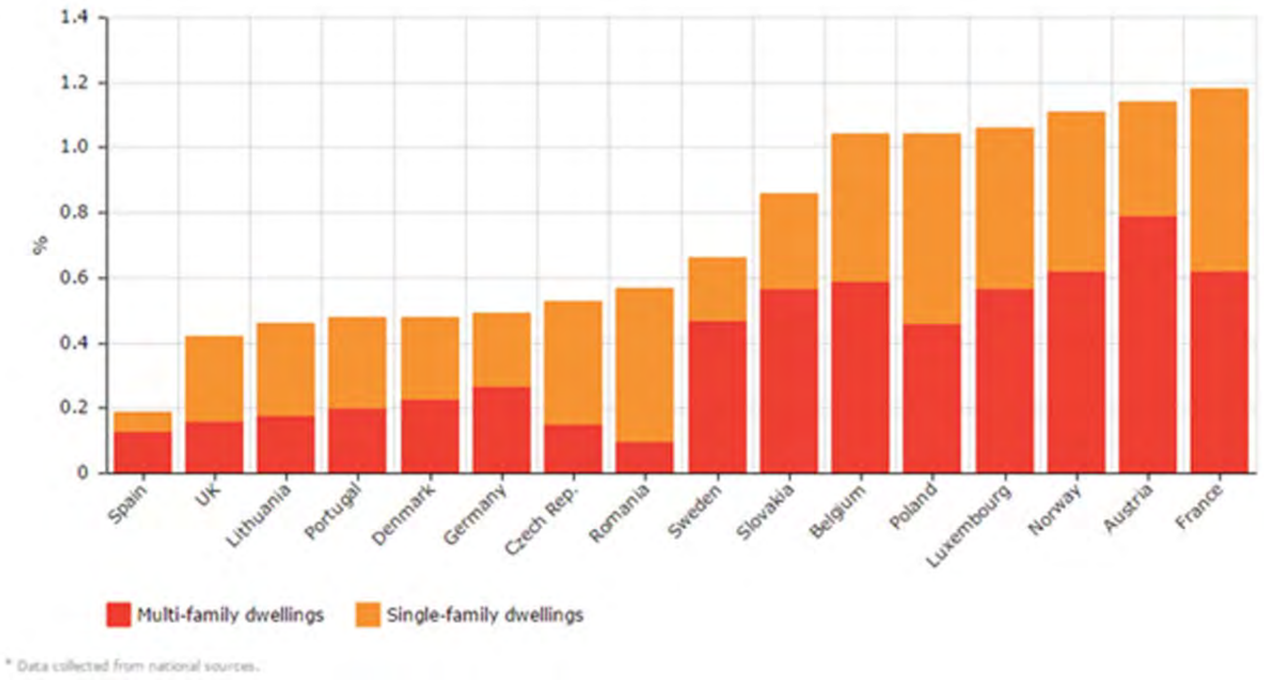

Figure 113: Share of new multi- and single-family dwellings in residential stock in 2013

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (nZEB). According to Article 2 “nearly zero-energy building” means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net-zero energy buildings / Plus energy buildings , passive houses
2. nZEB buildings according to national definitions
3. Buildings with energy performance better than required by the current regulations
4. Buildings constructed/renovated according to national minimum requirements

The radar graph levels used for Czech Republic are shown in the table below and defined as such in the database. CSN means the Czech standard. In the previous regulation that was applied since 2007 the specific energy consumption criterion (annual delivered energy per m2 of conditioned building area) was used to define the energy class. The class C was considered as referential. The class C was 98 -142 kWh/m^2.a for family houses and 83 -120 kWh/m^2.a for multifamily houses. Additional criterions were used for low energy buildings and passive houses. For low energy buildings specific annual heat demand less than 50 kWh/m2.a and for passive houses specific annual heat demand less than 15 kWh/m2.a and total primary energy consumption less than 120 kWh/m2.a were required.

The currently used regulations from 2011-2013 are based on different concept and it is impossible to compare them with previous set of regulations because there are different criterions and different calculation methodologies. In order to evaluate the energy performance of an existing or a planned building a compulsory method of comparison with so called reference building must be applied. The reference building is a building of the same type, size and geometric shape (which includes glass surfaces and shielding from surrounding buildings and natural obstacles), as well as the same internal and climatic data as the assessed building, but with the reference value of the building construction and technical building systems.

It can be however mentionned that the current regulations indicate for passive houses specific annual heat demand less than 15 - 20 kWh/m2.a for family houses and less than 15 kWh/m2.a for multifamily houses. and specific primary energy demand should be less than 60 kWh/m2.a.

Translating the definition of nZEB radar in the case of Czech Republic gives:

1-Better than nZEB (net ZEB or positive house)	Passive houses, net-ZEB or Plus energy buildings: any new buildings designed according to CSN 730540-2011 and other energy related Czech standards with better energy performance than nZEB as defined in the Decree 78/2013 Coll. Usually at least recommended U_{values} for passive house are considered in the design ($U_{pas,20}$)
2-National official nZEB definition	nZEB buildings as defined in the Decree 78/2013 Coll. designed according to CSN 730540-2011 and other energy related Czech standards. Usually recommended U values for passive house or close to these values are considered in the design ($U_{pas,20}$) The nZEB definition is valid and mandatory as follows: public buildings with floor area larger than 1 500 m2 since 01/01/ 2016 public buildings with floor area larger than 350 m2 since 01/01/ 2017 public buildings with floor area smaller than 350 m2 since 01/01/ 2018 other than public buildings with floor area larger than 1500 m2 since 01/01/ 2018 other than public buildings with floor area larger than 350 m2 since 01/01/ 2019 other than public buildings with floor area smaller than 350 m2 since 01/01/ 2020
3-Better than current building code	any new buildings designed according to CSN 730540-2011 and other energy related Czech standards using recommended U_{values} ($U_{rec,20}$)
4-According to building code	Buildings designed according to minimum standard requirements of CSN 730540-2011 and other energy related Czech standards. Required U-values are considered in the design ($U_{n,20}$)

As already mentioned the current regulations have not enforced nZEB so far. Low energy buildings and few passive houses having parameters comparable or better than nZEB were built as a result of voluntary decision. They are labeled as “nZEB” in the chart fig.82. The share of these new buildings in the housing stock is however very low.

“Better than current building code” newly built and especially renovations are more frequent case as these projects were supported by subsidy schemes (e.g. Green Savings and new green savings).

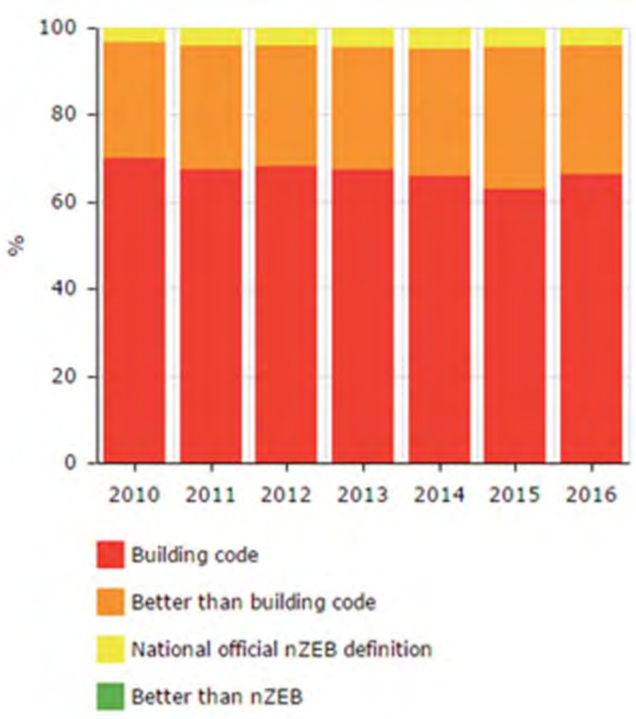

Figure 114: Distribution of new dwellings according to the nZEB radar graph – Czech Republic

Source: ZEBRA

Because of the lack of an official European definition, to ease comparisons the EU ZEBRA2020 project developed the indicator of "major renovation equivalent". In ZEBRA, three renovation levels have been defined: "low", "medium" and "deep". However, these 3 levels definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

In Czech Republic, the major renovation equivalent was estimated according to Building Renovation Strategy125 this equivalent was calculated for 2012 and further assumption of 1,5% of the stock

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[12] Building Renovation Strategy pursuant to Article 4 of the Directive on Energy Efficiency (2012/27/EU), Petr Holub, Jan Antonín, April 2014

refurbished annually was made for the period 2014-2020126. We calculated the expected energy savings for the shallow, medium and deep levels of renovations (levels1, 2 and 3). The estimated current trend is that shallow renovations represent 15%, moderate renovations represent 50% and deep renovations represent 35% of the total renovations in 2014-2020.

Below see the summarized results for the different refurbishment levels and the estimated energy savings:

	Thermal improvements implementation	**Energy savings estimated**
Deep	Complete set of measures (additional insulation of the total building envelope using at least "recommended U_{values}" , replacement of windows with highly efficient windows ($U=0,7$- $0,9W.m^{-2}K^{-1}$) and improved efficiency of heat generation, storage and distribution, e.g. replacement of old gas boiler with condensing boiler)	63%
Medium	Two or three measures, e.g. replacement of windows and additional facade insulation, “required U_{values}”	40%
Shallow	One measure, e.g. replacement of windows or additional facade insulation, “required U_{values}”	25%

Our expert estimation of the expected energy savings from major renovation interpreted as close to “deep renovation” is at the level of 60%. The estimations of expected savings for each renovation level are based on professional experience and on the reference document[12].

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[126] More details available here : http://www.zebra-monitoring.enerdata.eu/overall-building-activities/share-of-new-dwellings-in-residential-stock.html#equivalent-major-renovation-rate.html

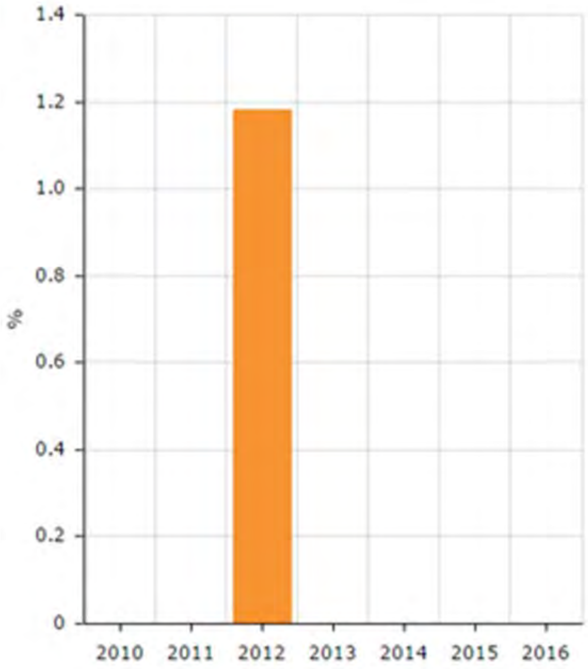


Figure 115: Equivalent major renovation rate – Czech Republic

Source: ZEBRA

Selected high performance buildings

In the Czech Republic, it has been collected data of 9 nZEBs or high energy efficient buildings which were constructed recently. 8 out of the 9 are new buildings and only 1 is a renovated building. 5 have a residential use and 4 are intended for non-residential use.

Climate zones

Table 23 displays that the 9 buildings are located in the climate zone B, which is characterized by cold winters and mild summers.

Table 21. Building distribution by climate zones - Czech Republic

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	8	1
C	Warm winters and warm summers		
D	Temperate winters and mild summers		
E	Temperate winters and warm summers		

Heating Demand

The average heating demand for new buildings is 17,8 kWh/m² a and the only selected renovated building has a heating demand of 16,5 kW/m² a.

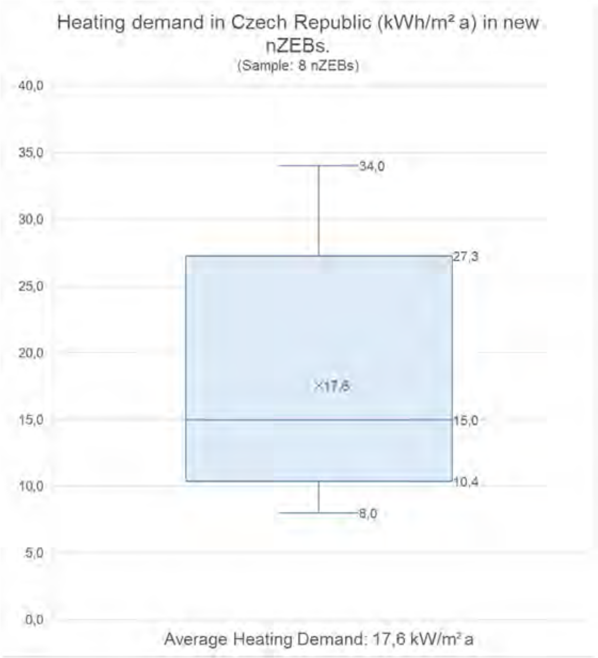


Figure 116. Box plot of heating demand in new nZEBs - Czech Republic

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,13 and 0,09 in roofs. In the only renovated building, the average U-value in walls is 0,15 and 0,12 in roofs.

The most used insulating material in walls and roofs in new buildings with a percentage of 38% is Extruded polystyrene, which is also the used insulating material for walls and roof in the selected renovated building.

In windows, the average Uwin-value is 0,75 in new buildings and 1,0 in the renovated building. Triple glass is the used type of glass in the 9 selected buildings.

Concerning passive cooling strategies, only in 2 buildings it was indicated the use of sunshade and in 1 it was mentioned sunspace as passive cooling strategy.

Active solutions

Mechanical ventilation with heat recovery is the preferred option in new buildings (75%) and in the renovated building.

With regard to the heating system, heat pump is used in 63% of the cases in new buildings, while in the renovated building it is used a stove. Electricity is the most used energy carrier for heating in new buildings and firewood is used in the renovated building.

In 63% of the new buildings and in the selected renovated building, it is used the same system for DHW as the one used in the heating system.

In no building it is reported the use of cooling systems.

Renewable energies

In 3 out of the 8 new nZEBs, it is mentioned the use of photovoltaic systems and also in 3 new buildings it is indicated the use of solar thermal systems.

The only renovated building did not report neither the use of photovoltaic nor the use of solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Czech Republic reports and realised projects.

Table 22 Costs of different renovation depths and new built according to nZEB standards – Czech Republic

Costs (€/m2)	CZ
Minor renovation (15% energy savings)	96
Moderate renovation (45% energy savings)	153
Deep renovation (75% energy savings)	219
NZEB renovation (95% energy savings)	318
New built according to nZEB standards	835
Additional funds for nZEB construction compared to new built	110

10.2.2 REAL ESTATE PRICES AND EPCS

The EPBD has been implemented and transposed in the Czech Republic on the national level. The most recent amendment in April 2013 involved a change to the measurement method of the EPC. As a result, EPCs issued after this date use a reference building approach to classify the energy performance of buildings, instead of the previously used calculated asset rating. The classification system takes the form of a letter scale between A (most efficient) and G (least efficient). By the end of 2014 it was calculated that 3% of the building stock had been certified (CA EPBD 2016).

The observed trend for the sales market in the Czech Republic is consistent with the hypothesis of a price surplus existing across the EPC scale.

In addition, the area variable is observed to have a strongly significant positive correlation with price and a positive correlation is found between construction year and price, which may result from the increased quality of newer dwellings. The price surplus in the sales market is 11% for each improvement by one letter.

The results for the rental market using the dummy variable method yielded unexpected, statistically significant results for the effect of EPC-ratings on house prices. It is possible that missing variables or sample biases have distorted the results. Given the ambiguity in the first set of results, a linear model was run to identify whether a surplus or a deficit dominates when averaged over the full EPC scale. These results give a statistically significant surplus of 4% for a one letter improvement.

10.2.3 EXISTING POLICIES

The Czech Republican nZEB plan sets out the strategy, framework and actions foreseen to increase the number of nZEBs in order to meet the 2018 and 2020 targets. Especially promotion of different economic benefits following nZEB investments are central to the strategy.

The building sector and energy targets

The Czech Republic's national indicative target has been set at 47.78 PJ (13.27 TWh) of new final energy savings by 2020, with a cumulative target of 191.10 PJ. According to the annual report to the Commission (2015), the total benefits achieved by the individual policy measures for 2014 amount to 665.3 TJ of energy savings for final consumption, not meeting the desired savings for the phased compliance with the objectives of Article 7 of the Directive.

National Renovation Strategy

According to a study prepared for the Ministry of the Environment and the Chance for Buildings Alliance, an investment of CZK 1 billion (€36 million) into support programmes can bring CZK 1-1.2 billion (€36-44 million) back into public budgets in the form of taxes, and avoided unemployment benefit payments. At the same time, it will foster GDP growth of CZK 2.1- 3.6 billion (€76-130 million). On the basis of a total investment in building renovation reaching CZK 35-40 billion (€125-145 million) per year as a result of implementing the renovation strategy, 35,000 new jobs would be generated and the GDP increased by 1%.

In addition to the quantified energy, carbon and financial impacts of the different scenarios, the renovation strategy considers wider benefits such as social and environmental benefits.

The potential savings of energy for space heating in residential buildings is calculated as 77 PJ, based on a moderate energy savings approach. This represents 45% reduction compared to current consumption. Further savings of 12 PJ in hot water use and 3.4 PJ in lighting bring the total savings to 92 PJ. The technical potential has also been calculated, assuming the renovation of the entire building stock to a Passive House standard. This would achieve a saving of 140 PJ (a reduction of 81%) on space heating energy use, and of 155 PJ including hot water and lighting.

In the strategy, 17 energy efficiency-related policy initiatives are identified and described, under the following categories:

1. Obligations
2. Inclusion of renovation into national energy policy
3. Incorporating renovation into other aspects of State policy

4. New Green Savings Programme
5. European structural and investment funds
6. Energy Performance Contracting
7. Other financial instruments
8. Public buildings
9. Energy Efficiency social housing
10. Minimum energy standards
11. Energy Performance Certificates (EPCs)
12. Reduce administrative burden of financial support schemes
13. Coherent requirements in construction legislation
14. Introduction of a reporting and evaluation system
15. Strengthen the role of the state-guaranteed consultancy
16. Education at all levels
17. Science and research

Energy performance requirements

The cost-optimal level of energy performance for a new building as required from 2013 and nZEB level that will be required later, differ in two features:

a) required average U-value of envelope (having coefficient of 0.7 for NZEB instead of 0.8 for cost-optimal level when comparing to a reference building)

b) required non-renewable primary energy (deducting 10 to 25% from reference values depending on type of building for NZEB compared to 8 to 10% for cost-optimal one).

Compliance

In the Czech Republic compliance is checked for both new and existing buildings. The State Energy Inspectorate (SEI) is responsible for energy audits and inspections according to the Energy Management Act. At the end of the construction works, the SEI checks whether the constructor or the owner of the building has ensured that the construction complies with the requirements of the Energy Management Act. The SEI conducts a quality control analysis of the EPCs based on random sample. A fine up to €4,000 may be imposed to a QE for issuing a false EPC, violating their duties, not undergoing the obligatory training and/or if they continue conducting certifications after their authorization has been revoked.

The nZEB plan

The nZEB definition is included in the regulation No. 78/2013 Coll. that specifies requirements of the Energy Management Act No. 406/2000 Coll. The definition compares the evaluated building with a reference building of the same type, size, geometry, orientation etc. but with pre-defined construction and technological specifications.

Renewable sources in the building sector

The corresponding percentage for RES share in case of renovation shall be 3%. Measures for fostering RES in buildings:

- Promotion of energy savings, in particular in the area of building heating and cooling as part of EFEKT Programme. This programme started 2000 and for 2016 there are following areas of support in form of subsidy:

- Pilot project and international co-operation: 100%
- Lighting energy efficiency: 50%
- Heating installation and heat source modernisation: 70%
- Energy efficiency consulting: 100%

- Promotion of the use of renewable energy sources in buildings, in particular in the area of building heating and cooling.

Financial and fiscal support policies/programmes

The Ministry of the Environment through the State Environmental Fund of the Czech Republic manages the "New Green Savings Programme" (EU ETS revenues). This programme focuses on energy savings and renewable energy sources in single family houses (later probably also for multi-family buildings). The New Green Savings Programme offers an opportunity to obtain financial means to reach nZEB level of new constructed buildings.

10.2.4 NZEB-TRACKER

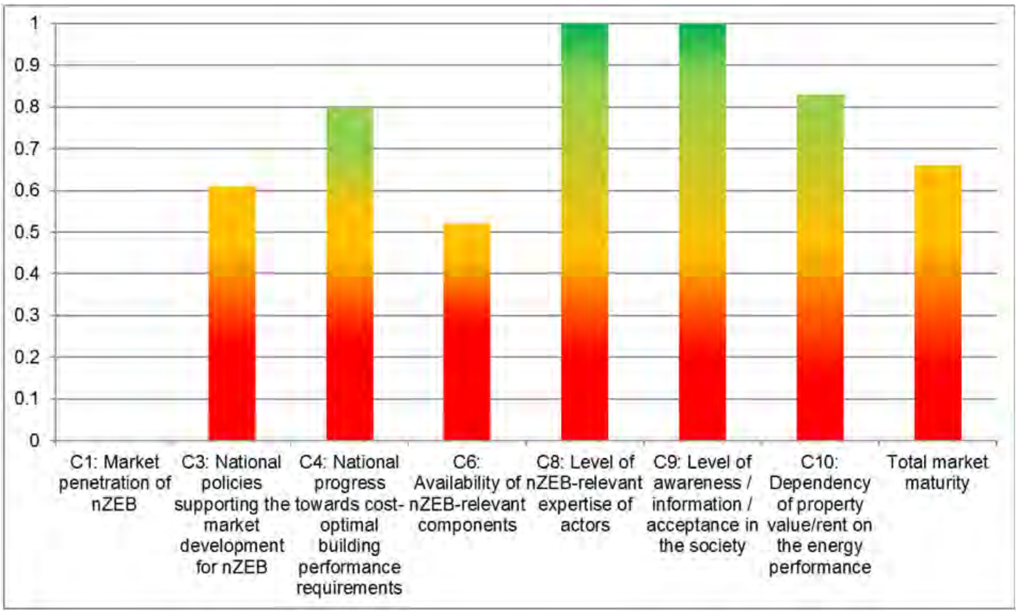


Figure 117: nZEB-tracker score for Czech Republic

C1: Market penetration of nZEB

- Czech result: **0.00** ZEBRA average: **0.32**
- 0% nZEB share has been reported in 2014 because in the Czech Republic the corresponding legislation applies only since January 2016 starting first with newly built public buildings with floor area over 1500 m2

C3: National policies supporting the market development for nZEB

- Czech result: **0.61** ZEBRA average: **0.52**
- Policies in the Czech Republic seemed to be still satisfactory in 2014 to support the development of the market for residential and non-residential nZEB.
- Need for adaptations may result later from the lessons learned in 2016 and from the professionals´ feedback. Updated definition of the nZEB standard in the Czech Republic may be expected in 2018

C4: National progress towards cost-optimal building performance requirements

- Czech result: **0.80** ZEBRA average: **0.94**
- The cost optimal building energy performance level is defined by the Decree 78/2013 Coll.

C6: Availability of nZEB-relevant components

- Czech result: **0.83** ZEBRA average: **0.83**
- Energy efficient heating systems, DHW and ventilation systems as well as other building components for nZEB are nearly fully available on the Czech market.

- Building automation and control systems seem to be available however there is a potential to expand the range.

C8: Level of nZEB-relevant expertise of actors

- Czech result: **1.0** ZEBRA average: **0.63**
- Generally speaking the evaluations of experts´ availability seem to be rather optimistic.
- This is partly due to relatively low number of interviews and partly because the Czech professionals see a lot of opportunities in the projects related to the energy performance, they are motivated and enthusiastic about this hot topic. It should be however noted that the expertise in the design and construction is a long process under permanent development. Not too many highly energy efficient buildings have been constructed so far (passive or close to passive house standard) and only few have been renovated to the above mentioned standard in the Czech Republic. The lessons learned from the past projects and the feedback from the users and the repair and maintenance professionals are essential in the development of performance and professional expertise, as it helps to build knowledge and skills.

C9: Level of awareness / information / acceptance in the society

- Czech result: **1.00** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings increased steadily.

C10: Dependency of property value/rent on the energy performance

- Czech result: **0.83** ZEBRA average: **0.74**
- Compared to location and financial aspects the energy performance is not the most important aspect for customers' decision on renting/buying a real estate. On the other hand the situation changes quite rapidly, this parameter seems to be quite dynamic. The future score is also pretty much dependent on the long-run evolution of energy prices.

Maturity of the Czech nZEB market

- Czech result: **0.7** ZEBRA average: **0.66**
- The nZEB market seemed to be developed on the average level of the ZEBRA countries. The political framework appeared satisfactory in 2014, it is not excluded that the final definition of the nZEB standard will be revised.
- High performance building components were easily available.
- The availability of experts may limit the future development of the nZEB market.
- People became more and more aware of the energy performance of buildings. Still the energy performance had a minor priority on buy/rent decisions.

10.2.5 SCENARIOS

Figure 118 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Czech Republic building stock is around 81.3 TWh in 2012. The scenario shows a steady slow-down of the energy demand of around 2% (around 0.4% yearly) from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 19% in the current policy scenario in the long term development between 2012 and 2050 and by 24% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Czech Republic, the share of biomass-based heating systems and district heating make up 37% on the total energy demand for space heating, cooling and hot water in 2012 whereas the fossil-fuel-based heating systems (natural gas, oil and coal) makes up app. 54%. The share of non-delivered energy (i.e. solar and ambient energy) is rapidly increasing over time from around 1% of final energy demand in 2012 to around 34% in current policy scenario and ambitious policy scenario in 2050.

Figure 119 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 46% in current policy scenario and around 48% in ambitious policy scenario. The reduction of the primary energy demand is around 44% and 52% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

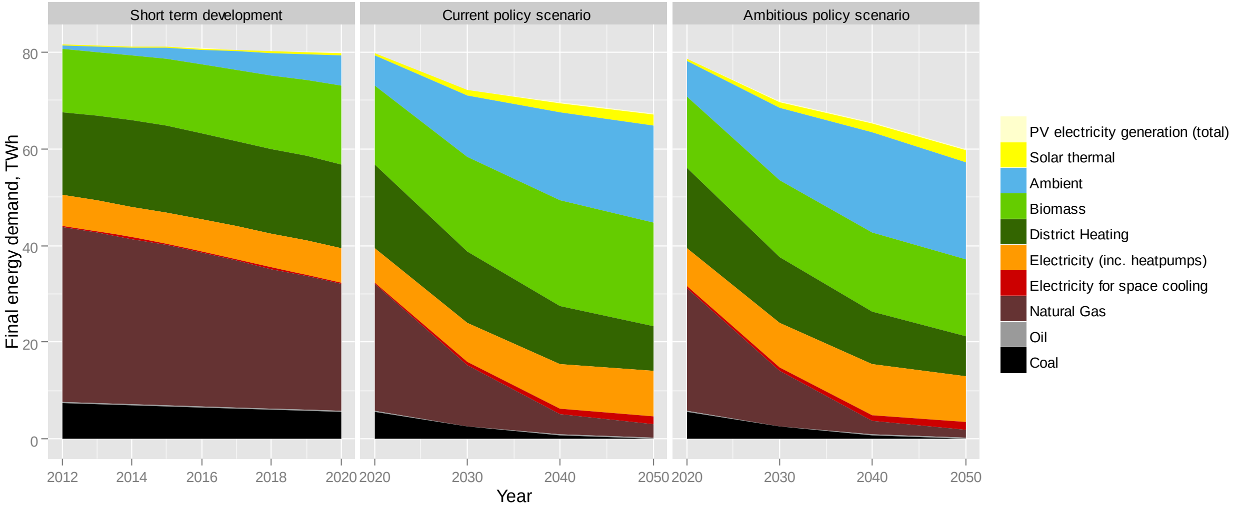


Figure 118 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

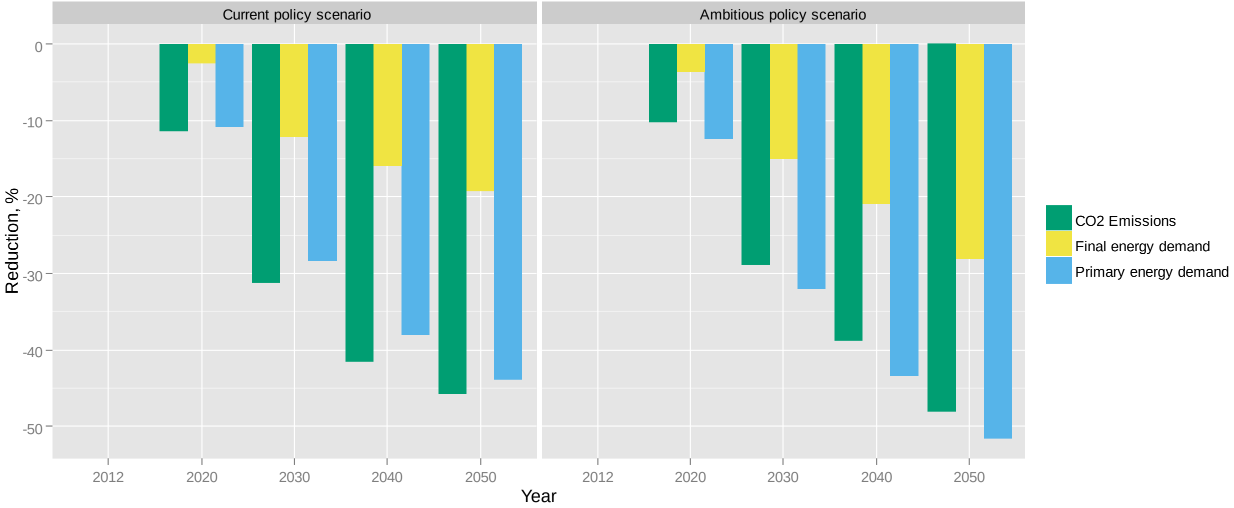


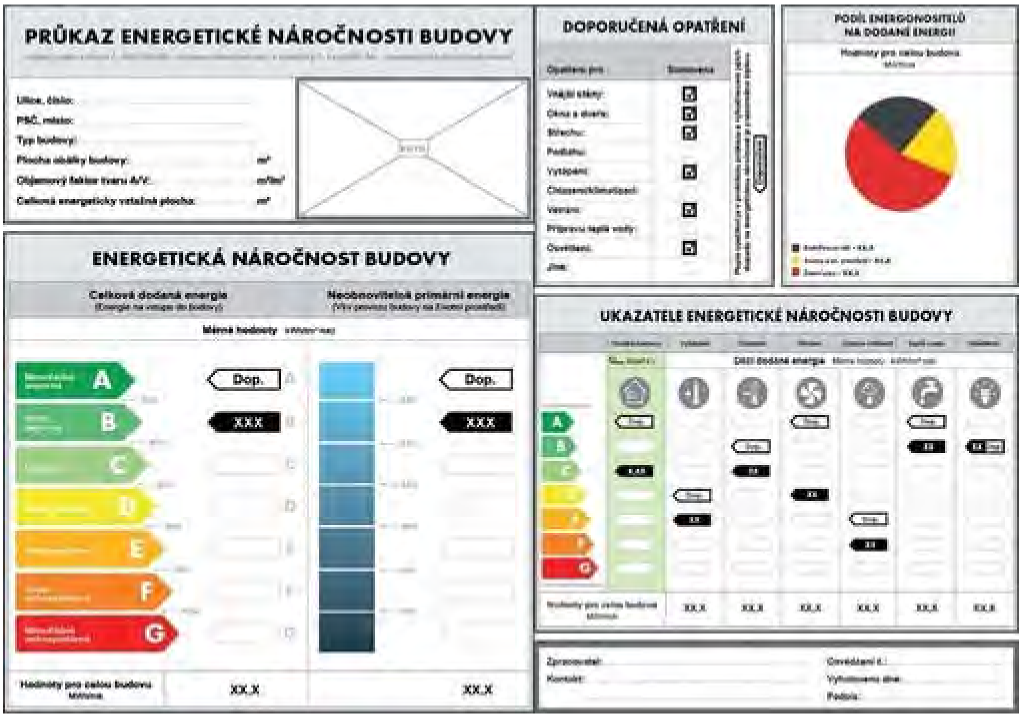
Figure 119 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

10.2.6 RECOMMENDATIONS

In Czech Republic there is currently no special legislation related to low energy buildings. The Energy Performance Building Directive (EPBD) has been transposed to the Czech legislation by the Act No 406/2000 on energy management. More detailed provisions are set out in the Decree No 78/2013 on the energy performance of buildings which includes:

- cost-optimal levels of energy performance requirements for new buildings, major renewals of buildings, other than greater renewals of buildings and for buildings with nearly zero-energy consumption;
- methodology for calculating the energy performance of the building;
- a model assessment of the technical, economic and environmental feasibility of alternative energy supply systems;
- a model of recommended measures to reduce the energy performance of the building;
- the format and content of the Energy Performance Certificate; and
- the method for processing and locating the certificate in the building.

The energy performance certification (EPC), in Czech Republic, is required to prove the compliance with the energy requirements for buildings. The EPC must be updated at least every 10 years (i.e. the EPC is valid for 10 year periods).



PRŮKAZ ENERGETICKÉ NÁROČNOSTI BUDOVY

Ulice, číslo:
PSČ, místo:
Typ budovy:
Plocha obálky budovy: m²
Objemový faktor tvaru A/V: m²/m³
Celková energeticky vztažná plocha: m²

ENERGETICKÁ NÁROČNOST BUDOVY

Celková dodaná energie | Neobnovitelná primární energie

Měrné hodnoty

DOPORUČENÁ OPATŘENÍ

Opatření pro:
Vnější stěny:
Okna a dveře:
Střechu:
Podlahu:
Vytápění:
Chlazení/klimatizaci:
Větrání:
Přípravu teplé vody:
Osvětlení:
Jiné:

PODÍL ENERGONOSITELŮ NA DODANÉ ENERGII

UKAZATELE ENERGETICKÉ NÁROČNOSTI BUDOVY

Dílčí dodaná energie

Hodnoty pro celou budovu

XX.X

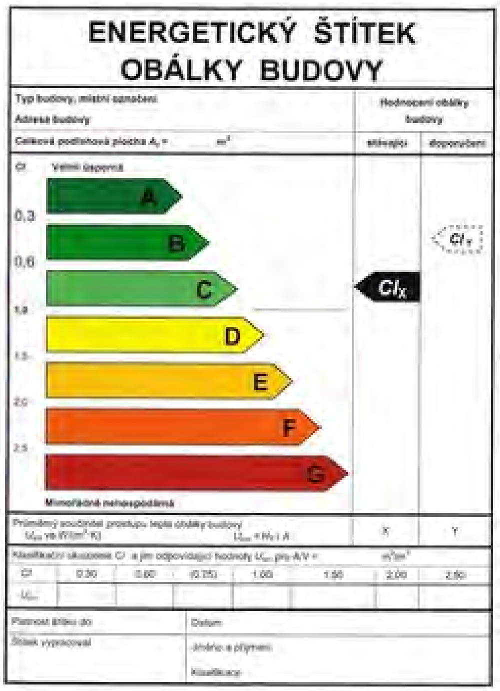
Zpracovatel:
Kontakt:
Osvědčení č.:
Vyhotoveno dne:
Podpis:

Investing in nZEBs will help to reduce energy consumption in the building sector and have a positive impact on CO_2 reduction. This will also accelerate the development and introduction of new efficient products and materials to the Czech market and creating new job opportunities in the construction sector.

Today, nZEB standard is supported by New Green Savings subsidy scheme. The programme provides support for renovations and new residential developments with high energy efficiency and the efficient use of energy sources. The subsidy programme's main objective is to improve the environment by reducing greenhouse gas emissions through the improved energy performance of buildings.

The nZEB market in Czech Republic still faces some challenges:

Figure 120 The energy label (see below) of the building



- The method for calculating energy performance is too much complicated and requires specialized software.
- Absence of simple and user friendly guidelines for design and construction of new nZEB buildings
- Lack of best practice guidelines for renovations to nZEB standards
- Low awareness of nZEB use and maintenance
- Too much focus on primary energy consumption – in some valid project scenarios the energy consumption and heat losses can be still relatively high if the house is heated with biomass.
- Absence of fair life cycle cost data makes rigorous decision-making difficult

Based on this background, 8 recommendations have been outlined for Czech Republic:

CZ1 - Regulate building performance minimum standards through the building code

CZ2 - Improve the usage of Energy Performance Certificates and enable non-intrusive evaluation from a third party actor to enhance transparency

CZ3 - Stimulate the market uptake of Energy Performance Contracting by renovating the public buildings in an ESCO framework

CZ4 - Encourage financial institutions to promote nZEB easing access to finance and lower rates

CZ5 - Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

CZ6 - Training building professionals with "NZEB and beyond "qualifications preparing them to build and upgrade the building stock for the future

CZ7 - Involve and empower local authorities in pilot projects

CZ8 - Indoor health and comfort aspects should be included to a greater extent in building legislations

#CZ1 - Legislative and Regulatory Instruments

Regulate building performance minimum standards through the building code

Regulate building performance minimum standards can be seen as the classical regulatory approach. The building code is a set of rules specifying the minimum standards for new and existing buildings. It can, for example, be an effective measure to foster improved energy efficiency of buildings. By setting minimum standards it can push out inefficient and inadequate components from the market. Member States should also use the building code to ensure a high air quality for the residents.

The energy performance of buildings in the Czech Republic is covered by Act No 406/2000 on energy management. More detailed provisions are set out in the Decree No 78/2013 on the energy performance of buildings which is the implementing legislation, i.e.: The evaluation of energy performance is linked to compliance with a number of energy performance indicators.

The energy performance indicators includes:

a) total primary energy per year;

b) non-renewable primary energy per year;

c) total energy supplied per year;

d) energy supplied for different technical systems (heating, cooling, ventilation, humidity regulation, hot water production and lighting) per year;

e) average thermal transmittance coefficient;

f) thermal transmittance values for individual structures at the system boundary;

g) efficiency of technical systems.

State of play in Czech Republic

The legislation is used extensively to push for energy efficiency of the building stock in Czech Republic. The building performance minimum is regulated by the condition that new buildings must simultaneously comply with three energy performance indicators, namely non-renewable primary energy per year (b), total energy supplied per year (c) and the average thermal transmittance coefficient for the building envelope (e).

For renovation of buildings, or where a major modification is made to a completed building, and where a modification other than a major modification is made to a completed building, it is possible to select a combination of indicators that need to be complied with. In the case of a major modification to a completed building, it is necessary to meet both the requirement relating to non-renewable primary energy per year (b) and that relating to the thermal transmittance coefficient (e), or total energy supplied per year (c) and thermal transmittance coefficient for the building envelope (e). For modified elements of a building envelope or technical systems, it may be possible to comply only with the requirements relating to the modified elements (f) and (g)[127].

Example: Energy performance of single family houses in the Flanders Region

Flanders region in Belgium has implemented a long-term roadmap of minimum standards for new residential buildings, to guide the market towards the nZEB requirement by 2021. The minimum standards are strengthened regularly, allowing building owners and investors to plan ahead.

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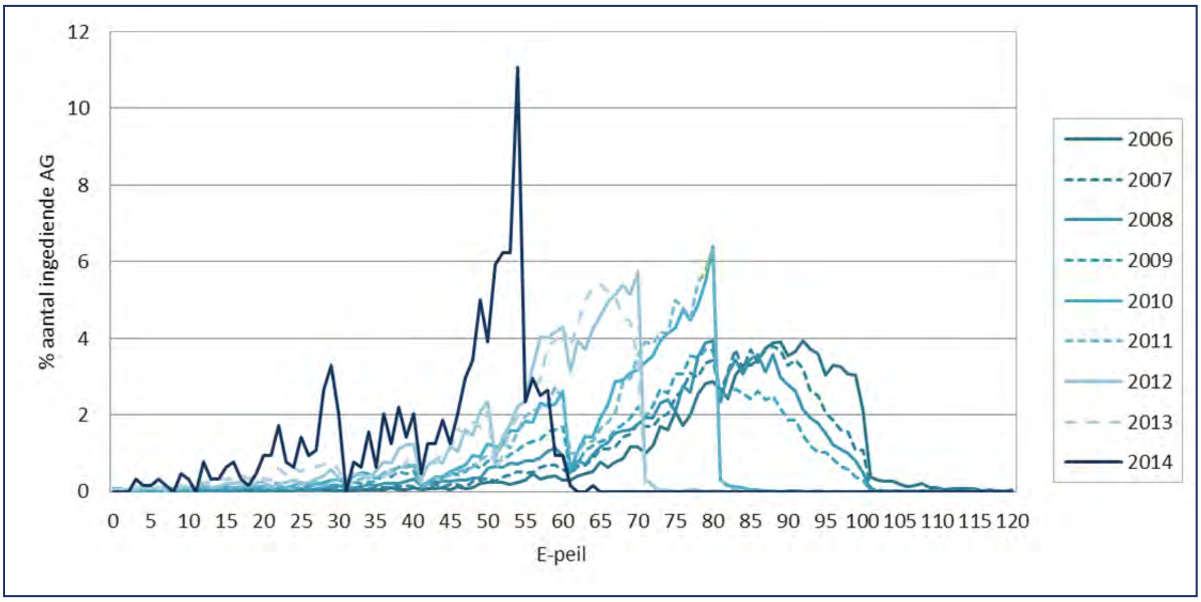
[127] http://aplikace.mvcr.cz/sbirka-zakonu/ViewFile.aspx?type=z&id=25726

The Y-line (vertical line) in the chart shows the yearly percentage of building permissions and the X-line (horizontal line) illustrates the energy performance level (NZEB=E30)).

It is very clear that these requirements steer the level of energy performance, but it is also possible to see where the effects of support measures e.g. in 2014 there were subsidies for E50 and E30 (=BEN).

For new residential buildings, the following minimum (called E-level) standards apply.

- *Date building permit application - Maximum E-level*
- *from 2006 until the end of 2009 - E100*
- *from 2010 to end of 2011 - E80*
- *from 2012 until the end of 2013 - E70*
- *From 2014 to end of 2015 - E60*
- *from 2016 until the end of 2017 - E50*
- *from 2018 until the end of 2019 - E40*
- *2020 - E35*
- *2021 - E30 (=NZEB)* [128]



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[128] Vlaanderen – http://www.vlaanderen.be/nl/bouwen-wonen-en-energie/bouwen-en-verbouwen/energieprestatieregelgeving-epb-voor-nieuwbouw-en-renovatie

#CZ2 - Legislative and Regulatory Instruments

Improve the usage of Energy Performance Certificates and enable non-intrusive evaluation from a third party actor to enhance transparency

The Energy Performance Certificate (EPC) is the most visible aspect of the EPBD and is often part of Member State's building codes. The core aim of the EPCs is to serve as an information tool for building owners, occupiers and real estate actors on the energy performance of the building. Therefore, EPCs have the potential to be a powerful market tool to create demand for energy efficiency in buildings by targeting such improvements as a decision-making criterion in real-estate transactions, and by providing recommendations for the cost-effective or cost-optimal upgrading of the energy performance.

The EPBD requires that all "energy performance certificates are to be included in all advertisements for the sale or rental of buildings". In order for the EPC system to work effectively, it must be qualitative, transparent and reliable. Here, many European Member States have some work to do. Together with reliable databases and qualified certifiers, can an external compliance process generate better rules of conduct and a more efficient system.

Public accessibility of energy performance certification (EPC) data has a positive influence on the market value of energy efficiency measures. The centralised repository of EPCs can be used as a tool to map the national building stock and monitor the development of the stock towards high energy efficiency and low emissions.

The quality of data in the repository is quite a challenging task therefore it is important to develop and apply independent control mechanisms. The transparency shall be enhanced by comprehensive evaluations done by independent third-parties.

State of play: EPC in Czech Republic

Currently the EPC data are collected by the Czech Ministry of Industry and Trade (MPO). Selected data are introduced by energy specialists to one of the modules of system called ENEX. This module with data is not accessible to the public even not to the professionals. If sufficient quality of data in centralised database is achieved through third party verifications these data can be made accessible to the public and may be used for the above mentioned purposes[129].

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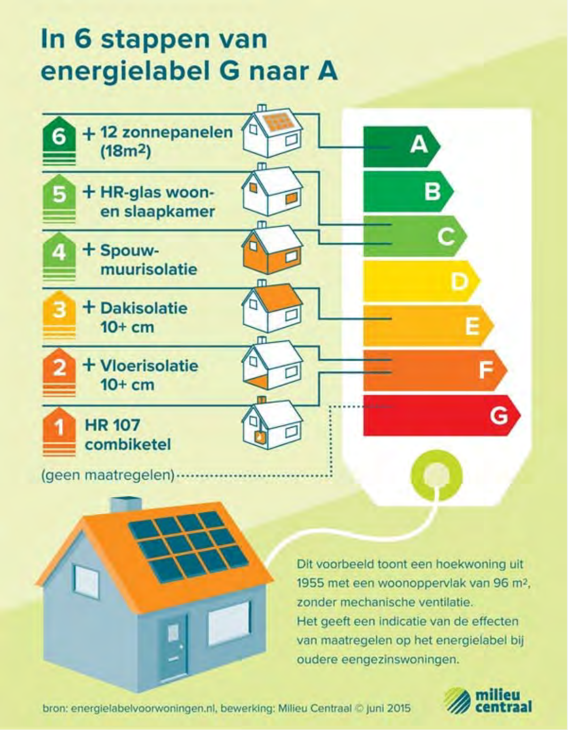
[129] http://www.mpo.cz/dokument179645.html

Example: EPC in Netherlands

The Dutch EPC system has been incorporated in the national building code. The document assigns an energy performance rating to residential and non-residential buildings. By providing reference values, the consumer can compare and assess energy performance levels.

The Netherlands has also imposed an effective control system, including a check of a certain number of the EPCs issued by qualified assessors (detailed check of documentation, site visit). Check is performed for 2% of EPCs issued for residential and 5% for non-residential buildings per assessor. EPC Data is also publically available, making the building's energy characteristics attainable for the housing market[130][131].



bron: energielabelvoorwoningen.nl, bewerking: Milieu Centraal © juni 2015

The image from the Dutch 'Milieu Centraal' lays out 6 steps to imprve your energy label (i.e. EPC).

#CZ3 – Economic Measures

Stimulate the market uptake of Energy Performance Contracting by renovating the public buildings in an ESCO framework

Energy Performance Contracting is a form of 'creative financing' for capital improvement which allows funding energy upgrades from cost reductions. Under these arrangements an external organisation (ESCO) implements a project to deliver energy efficiency, or a renewable energy project, and uses the stream of income from the cost savings, or the renewable energy produced, to repay the costs of the project, including the costs of the investment. Essentially the ESCO will not

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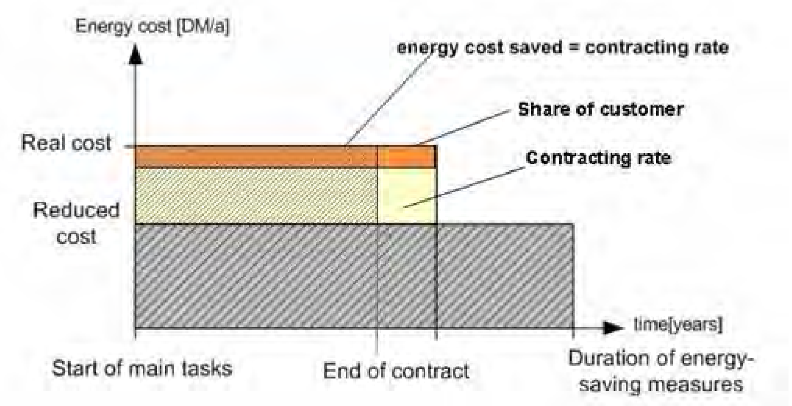
[130] RVO – EPC http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/energieprestatie

[131] Image – Energielabel https://www.energielabel.nl/woningen

receive its payment unless the project delivers energy savings as expected. This solution mitigates several of the key barriers to renovation, by alleviating risk for the home-owner and

According to the ESCO surveys currently, the majority of EPC projects in the Czech republic are being carried out at municipal and regional level, mostly in the buildings hosting kindergartens, primary and secondary schools, where local authorities are the owners of most of the facilities and also in the health care sector, universities and culture facilities. So far, a large EE potential lies in the facilities under direct state control and under the management of regions, which have not been effectively addressed yet due to administrative barriers. The EPC potential in the industry has been estimated at 0.02 TWh while in the tertiary at 0.04 TWh [CombinES project]

The approach is based on the transfer of technical risks from the client to the ESCO based on performance guarantees given by the ESCO. In the Energy Performance Contacting, the ESCO remuneration is based on demonstrated performance; a measure of performance is the level of energy savings or energy service. This is a means to deliver infrastructure improvements to facilities that lack energy engineering skills, manpower or management time, capital funding, understanding of risk, or technology information. Cash-poor, yet creditworthy customers are therefore good potential clients**132**.



Experience shows that Public Buildings are particularly interesting for ESCO-related services since the Return on Investment (ROI) for energy saving measures in public buildings can be much longer than for commercial buildings.

State of play: ESCOs in Czech Republic

The Czech Ministry of Industry and Trade and the Association of ESCOs (APEC) have signed an agreement on voluntary basis to follow the requirements of the Article 7 Directive 2012/27 / EU of the EU Parliament on energy efficiency (EED). The Ministry committed to establish suitable legal conditions and to motivate and guide the public sector entities towards the EPC projects with

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[132] JRC - http://iet.jrc.ec.europa.eu/energyefficiency/european-energy-service-companies/energy-performance-contracting

guaranteed results. The agreement will contribute to the increase in the volume of energy savings achieved under Article 7 of Directive 2012 / 27 / EU on energy efficiency. The objective of the Directive is achieved by means of so called alternative policy measures, which include also the voluntary agreements between public and private entities[133].

#CZ4 – Economic Measures

Encourage financial institutions to promote nZEB easing access to finance and lower rates

Financial institutions do not yet integrate the advantages of energy efficiency in their financial products/calculations. Governments ought to encourage financial institutions to prepare for the future building stock and thus include the broad set of economic advantages energy efficiency investments can generate. Banks should especially consider the following two advantages of nZEB investments:

Lower energy costs and therefore higher repayment capacity
Higher future property value (because build according the future energy performance and therefore future-proof)

The Czech banks have not included the nZEB in their financial policy and products yet. On the other hand there are public institutions like SFZP (Environmental Protection Fund) and SFRB (Housing Development Fund) financially supporting the nZEB, low energy or passive house projects (both newly built and renovations).

The Czech government should motivate the financial institutions to support the energy efficiency investments and activate the market potential.

The financial risk of energy efficiency investments is usually maintained on reasonably low level because the saved energy would generate sources for the repayment of debts and also because

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[133] http://download.mpo.cz/get/55770/63963/656423/priloha001.pdf

of the increased value of the assets due to their energy efficient profile.

Example: The Green Saving scheme

New Green Savings scheme (Nová zelená úsporám) program segmentation and the benchmarking rules for financing of EE projects can be used as a basis to conduct own initiative.

The Green Savings programme focuses on support for heating installations utilising renewable energy sources but also investment in energy savings in reconstructions and new buildings. The programme will support quality insulation of family houses and multiple-dwelling houses, the replacement of environment unfriendly heating for low-emission biomass-fired boilers and efficient heat pumps, installations of these sources in new low-energy buildings, installation of solar-thermal collectors as well as construction of new houses in the passive energy standard.

The methodology for evaluation of financing risks on the retail banking market according to the energy efficiency of the buildings has been elaborated[134].

#CZ5 – Communication

Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

Demonstration projects play important role in the process of market motivation towards high energy efficiency. Showing availability of innovations and giving clients the opportunity to adopt them is crucial for further market development. Some positive ideas and solutions introduced through demonstration projects may be even further developed by qualified persons. Demonstration projects can be also used to develop networks of experienced actors and might contribute to creation of platform for sharing experiences. Awarding and presenting the most successful projects of highly performing buildings to a broad audience is one of possible efficient ways of demonstration.

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[134] http://www.mpo-efekt.cz/uploads/7799f3fd595eeee1fa66875530f33e8a/navrh-metodiky-ocenovani-banky-prosinec-2015.pdf

Example: The Czech Passive House Centre

The Czech Passive House Centre together with Czech Environmental Protection Fund awarded the passive house of the year 2015. This house was partly financed through subsidy scheme New Green Savings (see: picture below)[135].

Picture from (http://www.novazelenausporam.cz/clanek/oceneny-pasivni-dum-byl-postaven-diky-programu-nova-zelena-usporam/) Photo: Jan Medek

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[135] http://www.pasivnidomy.cz/domy/rodinny-dum-vrane-nad-vltavou-408

#CZ6 – Quality of action

Training building professionals with "NZEB and beyond "qualifications preparing them to build and upgrade the building stock for the future

nZEBs use special products and technologies demanding highly qualified and skilled professionals on all levels. Highly energy efficient products require proper understanding from the designer, installer, repair and maintenance specialist, etc. Thus all professionals involved in the process must receive proper training. Presence of skilled workforce increases the level of trust and confidence in nZEB investments and provides guarantee that the consumers will get the expected value for their money. The target of specialised training centres is to introduce efficient new training programmes, business plans and use up-to-date training equipment not only to improve the knowledge but also to provide practical trainings, demonstrations and to offer comprehensive consulting services for design and construction of nZEBs.

EU-Project: Train-to-nZEB

Train-to-nZEB, partner in Czech Republic SEVEn, acts as the umbrella body for support and funding of the training centre. They have established a large network of partners through two related projects (**ingREeS**, **PROF / TRAC**) and they are already stimulated to work together for the launching and operation of the Building Knowledge Hubs (BKH).

The training centre to execute the largest part of Train-to-nZEB activities, using its own trainers with decades of experience, supported by the core team at SEVEn. The trainings follow short-term programmes at acceptable prices, combining different training methods (theory, practical exercises, demonstrations, video content and online training) and providing flexibility in terms of timing of the sessions. The training programmes themselves will follow the pattern set by a selection of EU-financed projects like **QualiBuild** and **IDES-EDU**, as well as contributions by Train-to-nZEB project partners[136].

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[136] http://www.train-to-nzeb.com/

#CZ7– Incentivize the Market

Involve and empower local authorities in pilot projects

When developing pilot projects anywhere in Europe, it is crucial to involve local authorities from the start. Many of the big cities have already set higher ambitions on climate mitigation and decarbonisation than the EU-level requires and are developing incentive or roll-out programmes to push for the accomplishment of these goals. A strong collaboration between industry actors and local governments can speed up the development of innovative projects, especially when the city takes on the role of a facilitator to align industry actors, the market, end-users and includes them into an ecosystem approach.

Example: SMART PRAGUE

The capital city of Prague has put forward its own concept of development called SMART PRAGUE 2014-2020. This pilot project develops a long-term concept of economic, technologically effective and sustainable development supported by the use of sophisticated and integrated data. In order to designate targets in the area of SMART infrastructure there was carried out a case study involving a sample of 20 buildings in the city. Sources of energy were identified and current patterns of energy consumption were worked out and analysed. This enabled the proposal and evaluation of measures leading not only to reduction of energy demand but also to improvement in the quality of the internal environment[137].

#CZ8 – Social Issues

Indoor health and comfort aspects should be included to a greater extent in building legislations

Air quality - be it indoors or outdoors - is one of the major environmental health concerns for Europe. For this reason, and since people spend 60-90% of their life in indoor environments (homes, offices, schools, etc.), indoor air quality plays a very important role in the health of the population, particularly for vulnerable groups such as babies, children and the elderly. According to estimates by the World Health Organization, 583.000 deaths in Europe were attributable to household and ambient air pollution in 2012[138]. There is significant inequality in exposure to air pollution and

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[137] Rohlena, Michael and Frkova, Jana (2014) Smart Cities Smart Prague - http://www.conference-cm.com/podklady/history5/Prispevky/paper_Rohlena.pdf

[138] 3 World Health Organization, "Burden of disease from Household Air Pollution for 2012". Available at: http://www.who.int/phe/health_topics/ outdoorair/databases/HAP_BoD_results_March2014.pdf?ua=1

related health risks: less affluent people living in inadequate buildings/neighbourhoods suffers from a disproportionate disease burden. The level of the health hazardous PM2.5 is for example much lower in newer (especially nZEB) buildings.

Member States ought to ensure a high air quality in public buildings: especially kindergartens and schools since children are more sensitive to air pollution. The most sustainable measure of improving the air quality in inadequate public buildings is through an upgrade of the building. When planning new nZEBs or nZEB refurbishments, requirements for a healthy indoor environment should be included. While indoor climate is mentioned in the EPBD, the importance of indoor air quality, thermal comfort and daylight has to be strengthened in a future recast. Such requirements should also be reflected in national renovation strategies as developed under Articles 4 and 5 of the Energy Efficiency Directive[139].

Example: Implementation of air quality plan for Małopolska Region

Małopolska province in Poland struggles with very poor air quality, particularly during the winter season The condition of Polish building stock and the quality of fuels used in them is a very important issue which has impact on the air quality and the quality of life in Poland. The problem of low-stack emission (emissions from sources with a height lower than 40m) and bad living conditions make energy efficiency measures indispensable. The region has started an ambitious project to improve air quality in the region, this project has received support from EU's financial instrument - LIFE.

The main LIFE-IP MAŁOPOLSKA project objective is the full implementation of the Małopolska Air Quality Plan (MAQP) adopted by the regional parliament in September 2013. Most LIFE IP activities will focus on the territory of Małopolska province. However, the project approach and results will be directly relevant to all authorities responsible for air quality in the entire air quality hotspot region (southern Poland, northern Czech Republic and Slovakia). More specifically, The Małopolska Air Quality Plan (MAQP) requires the elimination of obsolete solid fuel boilers in approximately 155 000 homes. There is also significant untapped potential for emission reductions through energy efficiency improvement of buildings (around 70% of houses are insufficiently insulated or not insulated at all)[140].

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[139] BPIE (2015) http://bpie.eu/wp-content/uploads/2015/10/BPIE__IndoorAirQuality2015.pdf

[140] EU Commission http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5440&docType=pdf

10.3 DENMARK

10.3.1 BUILDING PERFORMANCE MARKET DATA

10.3.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single- and multi-family dwellings) in the residential stock for EU countries and Norway. Denmark is one of the countries with the lowest rate of renewal of the building stock: In 2014 less than 0.40 % of the building stock was renewed, compared to 0.65 %/year in Sweden and more than 1 % in Norway, for instance. In 2010 – 2014 there were built around 10 000 – 14 000 new dwelling units per year. In 2014, there were built slightly more Danish single-family homes than new multi-family dwellings.

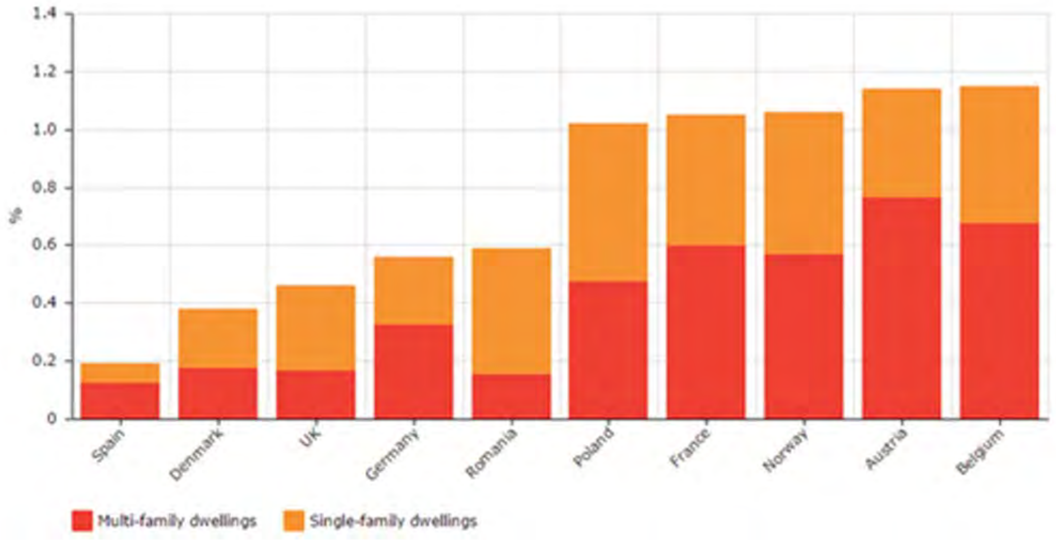

Figure 121: Share of new multi- and single-family dwellings in residential stock in 2014

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings
2. nZEB buildings according to national definitions
3. Buildings with an energy performance better than the national requirements in 2012
4. Buildings constructed/renovated according to national minimum requirements in 2012

The Danish nZEB radar is based on data from the Danish energy certificate scheme. An official nZEB definition has been in force since August 2011.

The BR10 (from 2010) minimum energy frame requirement is:

52.5 + 1,650 / A [kWh/m^2 per year] for residential buildings, and

71.3 + 1,650 / A [kWh/m^2 per year] for non-residential buildings,

where A is the heated gross floor area.

The energy frame for the voluntary Low-energy Class 2015 is:

30 + 1,000 / A [kWh/m^2per year] for residential buildings, and

41 + 1,000 / A [kWh/m^2 per year] for non-residential buildings.

Finally, the energy frame for the voluntary Building Class 2020 (nZEB) is:

20 [kWh/m^2 per year] for residential buildings, and

25 [kWh/m^2 per year] for non-residential buildings.

Below is a description of the different classes in the nZEB radar.

	Translation in case of Denmark	
	Before 2010	Since 2010/2011
1-Better than nZEB (net ZEB or positive house)	n.a.	n.a.
2-National official nZEB definition	n.a.	Building Regulation 2010 (BR10): Voluntary Building Class 2020 (nZEB) since 2011 All building types
3-Better than current building code	Building Regulation 2008 (BR08): Voluntary low energy classes All building types	Building Regulation 2010 (BR10): Voluntary Low-energy Class 2015 All building types
4-According to building code	Building Regulation 2008 (BR08) All building types	Building Regulation 2010 (BR10) All building types

References

[1] Danish Building Regulations 2010, www.bygningsreglementet.dk, Energistyrelsen

[2]Energy performance certificates scheme database, 2014, Energistyrelsen

The following graph shows clearly that the share of buildings better than the building code increased over the last years (exempted 2011). In 2013, almost half of the new dwellings were built better than the building code. Already in 2012 and 2013, around 10 % of all new dwellings met the voluntary nZEB standard.

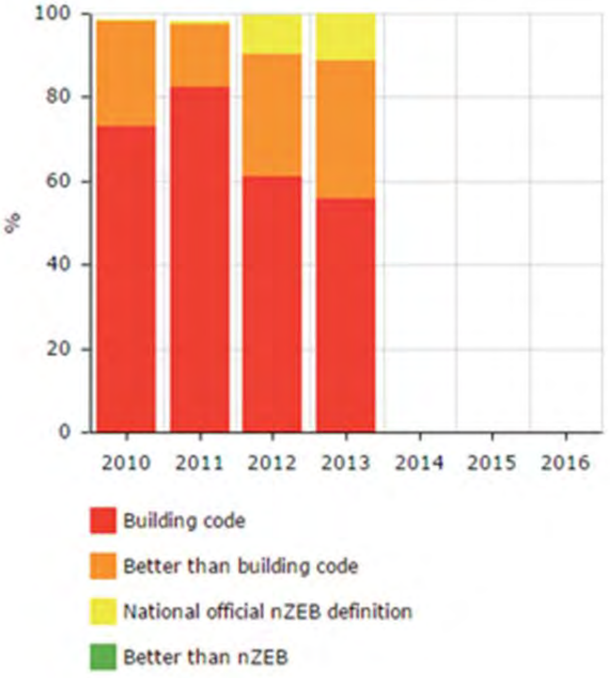

Figure 122: Distribution of new dwellings according to the nZEB radar graph – Denmark

Source: ZEBRA

10.3.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Denmark, it has been collected data of 9 nZEBs or high energy efficient buildings which were constructed recently. 4 out of the 9 are new buildings and 5 are renovated buildings. 3 have a residential use and 6 are intended for non-residential use.

Climate zones

As Table 23 lists, the 9 buildings are located in the climate zone B, which is characterized by cold winters and mild summers.

Table 23. Building distribution by climate zones - Denmark

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	4	5
C	Warm winters and warm summers		
D	Temperate winters and mild summers		
E	Temperate winters and warm summers		

Heating Demand

The average heating demand for new buildings is 12 kWh/m² a, while in renovated buildings it is 20,5 kW/m² a.

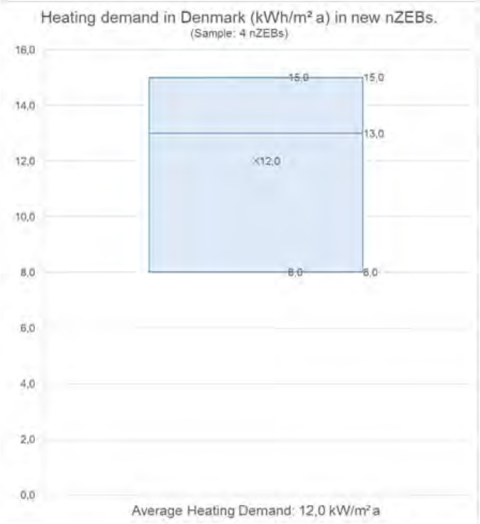

Figure 123Box plot of heating demand in new nZEBs - Denmark

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,13 and 0,08 in roofs, while in renovated buildings the average U-value in walls is 0,12 and 0,10 in roofs.

The type of insulating material is not reported in the 4 new buildings, while in renovated buildings 2 out of the 5 buildings use stone wool in walls as insulating material.

In windows, the average Uwin-value is 0,93 in new buildings and 0,85 in renovated buildings. The triple glass is the only type of glass indicated (8 out of the 9 selected buildings).

Concerning passive cooling strategies, only in 2 renovated buildings it was mentioned to use these strategies (sunshade and night cooling).

Active solutions

Mechanical ventilation with heat recovery is selected in the 100% of buildings as the preferred option in both new and renovated buildings.

Concerning the heating system in new buildings, in 2 cases the type of heating system is unknown, in one case is district heating and in another is heat pump using soil as a heat source. In renovated buildings, district heating is used in 80% of the buildings. In new buildings the most used energy carrier is electricity (50%), while in renovated buildings it is the district heating (80%).

In around 50% of the buildings, it is used the same system for DHW as the one used in the heating system.

Only in 2 renovated buildings it is reported the use of cooling system.

Renewable energies

In no new building it was mentioned the use of photovoltaic or solar thermal systems, while in renovated buildings, in 3 buildings it was indicated the use of photovoltaic systems and in 2 the use of solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Denmark reports and realised projects.

Table 24 Costs of different renovation depths and new built according to nZEB standards – Denmark

Costs (€/m2)	DK
Minor renovation (15% energy savings)	400
Moderate renovation (45% energy savings)	1100
Deep renovation (75% energy savings)	1900
NZEB renovation (95% energy savings)	2500
New built according to nZEB standards	2150
Additional funds for nZEB construction compared to new built	125

10.3.2 REAL ESTATE PRICES AND EPCS

The transposition and implementation of the EPBD takes place on the national level in Denmark. EPCs are calculated using a fixed-value approach, in which different value classes are used for different types of buildings. The energy efficiency factor is given as a letter rating on a scale between A (most efficient) and G (least efficient). The A band is subdivided into three categories: A2020 (most efficient), A2015 and A2010 (least efficient). In 2012, it was calculated that 19% of the building stock was certified (CA EPBD 2016b). More specifically, it has been estimated that 29% of single-family houses have a certificate (CA EPBD 2016). Denmark already had an energy performance certification scheme before the transposition of the first EPBD in 2006. This made implementation relatively simple compared with other countries that did not have existing schemes (BPIE 2010).

The trend for the price contribution due to EPC rating in the Danish sales market is similar to the trend observed in the Austrian sales market. A price surplus is estimated in shifts between all EPC ratings except for at the highest end of the scale, where a deficit is detected. It is possible that a 'tipping point' exists, where the increased benefits of energy efficiency are capitalised at a heightened rate until the point at which energy efficiency ceases to be capitalised in the market. However, the results could also be biased due to the small sample sizes for A2015- and A2020-rated dwelling. The sales market price surplus in the linear model per letter of improvement is 13%.

Statistically significant results are only observed for three of the dummy variable categories in the Danish rental sector. However, each of these results is consistent with the hypothesis of a positive relationship between price and EPC rating. In addition, a positive relationship is observed for area. The linear regression model results in a price surplus of 5.1% for each letter improvement.

10.3.3 NZEB-TRACKER

This section highlights the key findings from the nZEB tracker for Denmark in 2014.

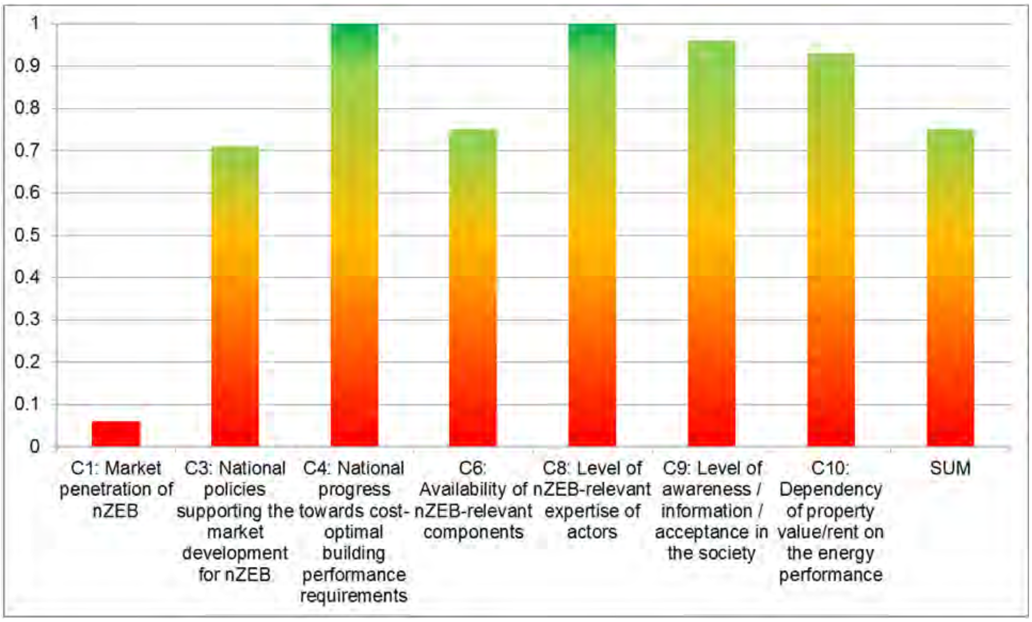

Figure 124: nZEB-tracker score for Denmark in 2014

C1: Market penetration of nZEB

- Danish result: **0.06** ZEBRA average: **0.32**
- nZEB had a share of only ~6 % on new constructed floor area in Denmark
- The share increased over the last three years

C3: National policies supporting the market development for nZEB

- Danish result: **0.71** ZEBRA average: **0.52**
- Policies in Denmark seemed to be sufficient to support the development of the market for residential and non-residential nZEB in 2014.
- In particular the stepwise tightening regulations with voluntary nZEB standard since 2011 scores high.

C4: National progress towards cost-optimal building performance requirements

- Danish result: **1.00** ZEBRA average: **0.94**
- The Danish building code (BR10 in 2014) already matched the cost optimal building energy performance level.

C6: Availability of nZEB-relevant components

- Danish result: **0.75** ZEBRA average: **0.83**
- Passive components, required or reasonable for nZEBs, were well or very well available in Denmark. The same applies most of the relevant active systems.
- Biomass, combined heat and power, building automation and control systems, geothermal systems and wind turbines seemed to be available only moderately or poorly.

C8: Level of nZEB-relevant expertise of actors

- Danish result: **0.96** ZEBRA average: **0.63**
- The availability of experts was assessed as good for all the three phases.

C9: Level of awareness / information / acceptance in the society

- Danish result: **1.00** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings is high and increased further again slightly from 2014 to 2015.

C10: Dependency of property value/rent on the energy performance

- Danish result: **0.93** ZEBRA average: **0.74**
- Energy performance was assessed as just as important for customers' decision on renting/buying a real estate as living quality, aesthetics and financial aspects. Nevertheless, the site was assessed as the most important aspect.

Maturity of the Danish nZEB market

- Danish result: **0.75** ZEBRA average: **0.66**
- The nZEB market seemed to be significantly better developed than the average of the ZEBRA countries. The political framework appeared sufficient in 2014.
- Most of the relevant high performance building components were easily available, although some active systems were assessed as only moderately or poorly available.
- People became more and more aware of the energy performance of buildings.

10.3.4 SCENARIOS

Figure 125 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Denmark´s building stock is around 55 TWh in 2012. The scenario shows a slow-down of the energy demand of around 4% (around 0.5% yearly) from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 15% in the current policy scenario in the long term development between 2012 and 2050 and by 23% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Denmark, the share of biomass-based heating systems and district heating with almost 67% make up a significant share on the total energy demand for space heating, cooling and hot water in 2012 whereas the fossil-fuel-based heating systems makes up app. 26%. The share of non-delivered energy (i.e. solar and ambient energy) is slowly increasing over time from around 2% of final energy demand in 2012 to around 8% in current policy scenario and 11% in ambitious policy scenario in 2050.

Figure 126 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 46% in current policy scenario and around 55% in ambitious policy scenario. The reduction of the primary energy demand is around 25% and 38% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

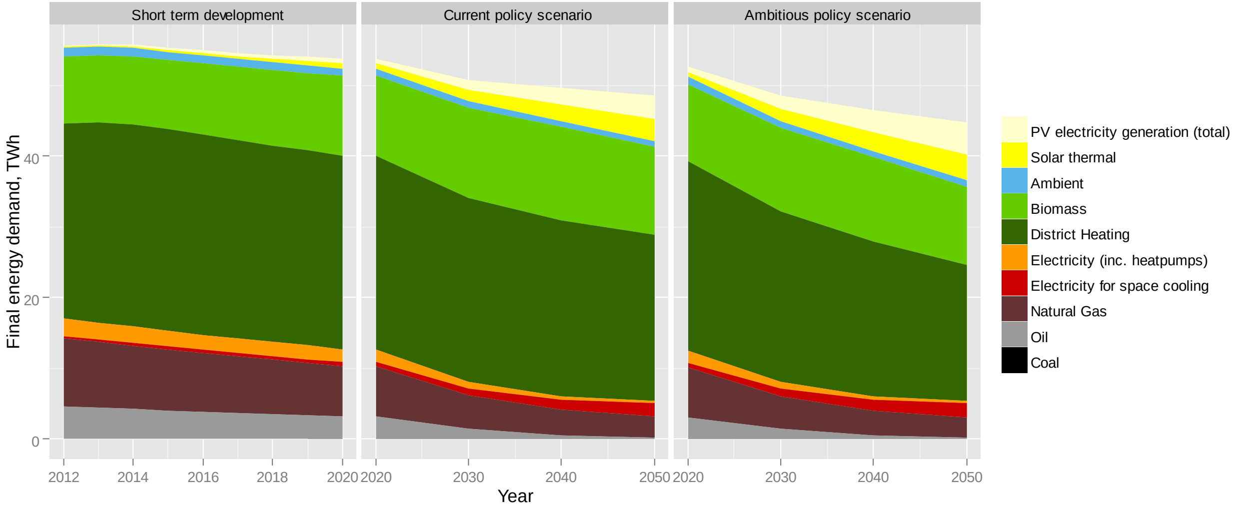

Figure 125 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

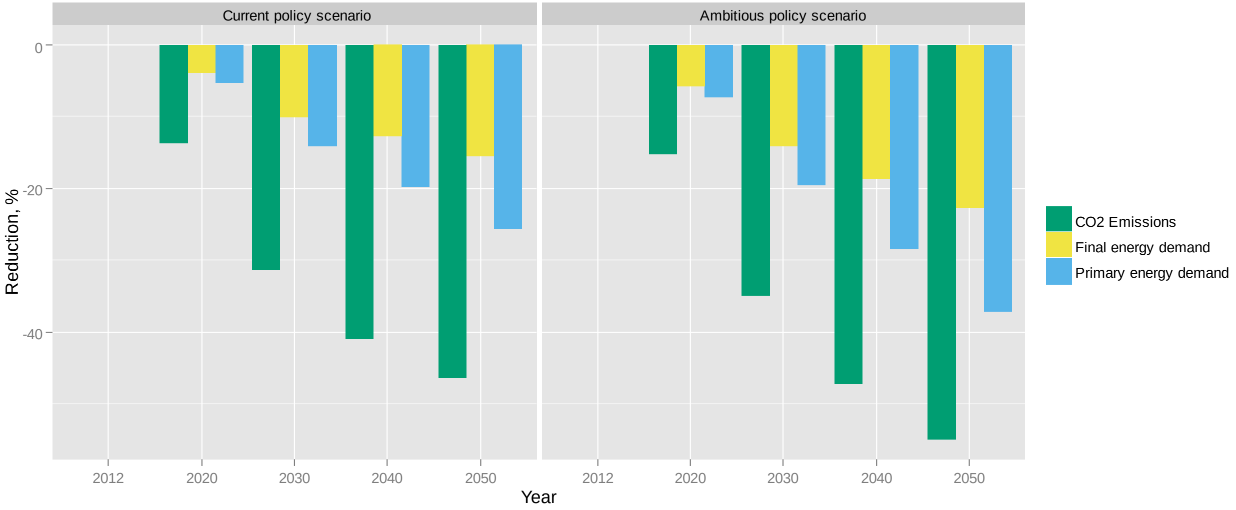

Figure 126 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

10.3.5 RECOMMENDATIONS

Existing regulations for new buildings in Denmark are among the most stringent in Europe. There are also stated relatively ambitious and clear requirements for renovation measures. An nZEB definition is stated and has been introduced as a voluntary standard (Building Class 2020) within the building regulations already since 2010. A lot of policies, measures and instruments are carried out, and these are mainly considered sufficient at current time. Although of course there are opportunities for improvement.

The following recommendations were prepared in collaboration with SBi, the Danish Building Research Institute. Instead of detailed descriptions related to single recommendations, we will give an overview of most relevant issues and present some reflections on improvements in key areas.10 recommendations are considered as most relevant for the Danish context, see the end of this section.

If we look at new constructions, there is a need for both energy controlling and energy management in buildings. Energy control and management of buildings is needed to ensure that the focus on energy-optimization, in use, is maintained.

There is a need for structural flexibility in relation to the energy system. There is also need for more comprehensive energy saving campaigns. There may be a need to focus on both actual energy consumptions in buildings, and how behaviour affects consumption. There are differences in the behaviours that are most appropriate depending on whether it is an older detached house or a new low-energy home. There may be a need for campaigns and guides for private owners of low-energy houses, since studies show that especially newer homes use more energy than expected. This ought to be further explored.

There is a need to spread knowledge about indoor climate conditions are required, so that building owners know what requirements they can and should expect regarding the indoor climate in buildings. Building owners who make specified requirements for the indoor environment in their buildings also need methods to display that their new building actually meets the indoor climate expectations. When the building is transferred to the building owner, it should be assessed whether the building meets the building owners' requirements by looking at the documentation for the building. There may be considerable gains by maintaining a good indoor climate in terms of greater productivity, fewer sick days and good comfort. Therefore, the building's indoor climate performance should be documented, concerning e.g. air quality, which is very dependent on the building's ventilation system, as well as light and sound conditions.

For existing buildings, there is a need for additional drivers for renovation. It is often a building's functionality or lack thereof, that lead to a renovation. If the existing building does not meet requirements, it can lead to a renovation. In these cases, it is important to also focus on energy optimization, as the possibility of achieving savings otherwise are missed in the 30-50 years period before the need for renovated appears again. There is a need to focus on how far it makes sense to go with the renovation of various types of buildings. There are major differences between the level of heating demand that is cost-optimal, depending on whether it is a building from the 1930s or from the 1960s, and there are significantly greater differences between single-family houses or blocks of flats. There is great variation within the existing building stock, and therefore it makes sense to aim for differentiated targets for renovation. There is a need for good examples of successful renovations that can inspire others to renovate.

DK1 - Regulate building performance minimum standards through the building code

DK2 - Define a long term vision to guide the transformation of buildings as integrated parts of the society and the wider energy system

DK3 - Implement standard methodologies for secure data gathering and assessment

DK4 - Set long term voluntary targets for existing buildings

DK5 - Incentivize the market uptake of nZEBs through active price signals

DK6 - Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

DK7 - Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

DK8 -Training building professionals with "NZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

DK9 - New technologies (IoT) allow us to collect and analyse performance data in a more effective way that was not possible some years ago

DK10 - Incentivize the frontrunner entrepreneurs exploring new business models

10.4 LITHUANIA

10.4.1 BUILDING PERFORMANCE MARKET DATA

10.4.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for UE countries. In Lithuania, more than 0.4% of the building stock was renewed in 2013. The majority of the new buildings are single-family dwellings.

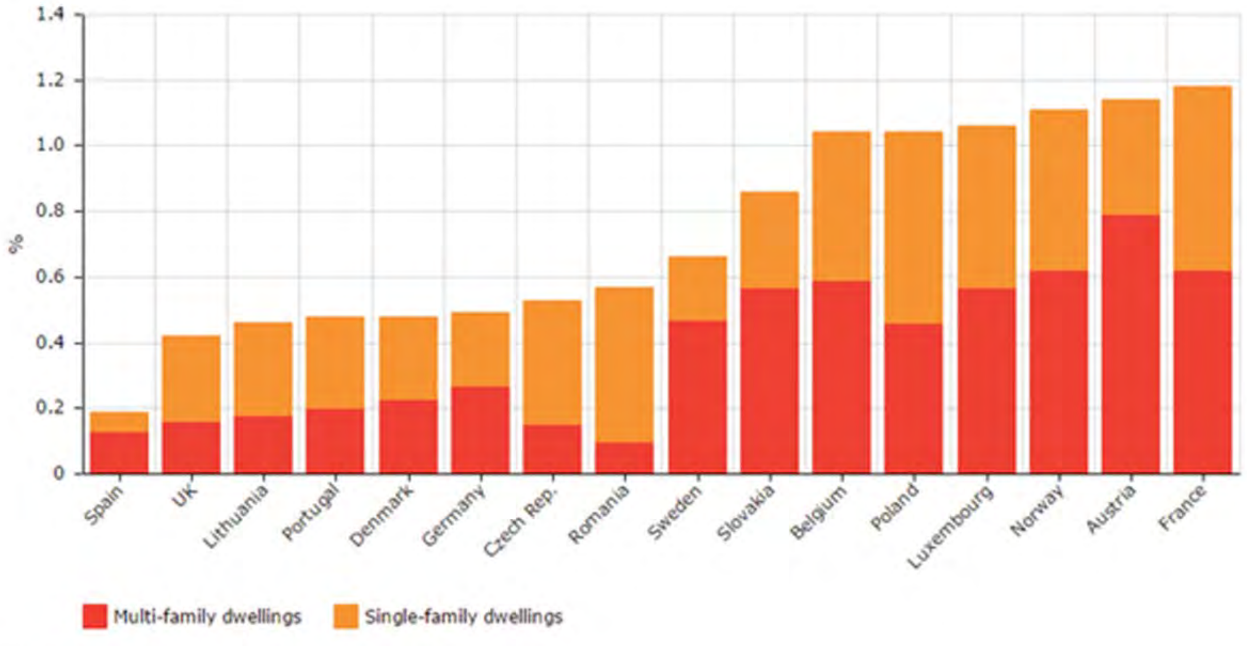

Figure 127 Share of new multi- and single-family dwellings in residential stock in 2013

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar

combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings

2. nZEB buildings according to national definitions

3. Buildings with an energy performance better than the national requirements in 2012

4. Buildings constructed/renovated according to national minimum requirements in 2012

Energy performance is unrelated to particular numerical value of energy consumption and is defined by the respective class of energy performance of the building. According to energy performance, buildings are classified into 9 classes: A++, A+, A, B, C, D, E, F, G. The Lithuanian legislation setting requirements for the energy performance of buildings does not use reference buildings. Each building is assessed individually. The energy performance class of the building is identified on the basis of the following building indicator values (the compliance of all those values with the legislative requirements is assessed):

- calculated specific heat losses of building envelopes;
- building air-tightness;
- technical indicators for mechanical cooling system with recuperation;
- C1 indicator value of energy efficiency of the building, characterising primary non-renewable energy efficiency for heating, ventilation, cooling and lighting;
- C2 indicator value of energy efficiency of the building, characterising primary non-renewable energy efficiency for preparing domestic hot water;
- part of renewable energy used in the building.

Transition of requirements for newly constructed buildings:

- prior to 2014 – new buildings or their parts shall comply with the requirements for class C buildings;
- from 2014 – new buildings or their parts shall comply with the requirements for class B buildings;
- from 2016 – new buildings or their parts shall comply with the requirements for class A buildings;
- from 2018 – new buildings or their parts shall comply with the requirements for class A+ buildings;
- from 2021 – new buildings or their parts shall comply with the requirements for class A++ buildings

Data for the nZEB radar were collected from the EPS database. Translating the definition of nZEB radar in the case of Lithuania gives:

1-Better than nZEB (net ZEB or positive house)	A+ building requirements
2-National official nZEB definition	A building requirements
3-Better than current building code	B building requirements
4-According to building code	C building requirements (prior to 2014 – new buildings or their parts shall comply with the requirements for class C buildings)

In 2012, more than 60% of new buildings were built according to the building code (with the requirements for class C buildings). In 2013, the share of the buildings built according to the building class B, which is defined as better than building code increased compared to 2012. The share of new buildings better than building code is 55% in 2013.

Because of the lack of an official European definition, to ease comparisons the EU ZEBRA2020 project developed the indicator of "major renovation equivalent". In ZEBRA, three renovation levels have been defined: "low", "medium" and "deep". However, these 3 levels definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

In Lithuania, three renovation levels according to available data provided by Lithuanian Statistics were defined[141]: "light" renovation which covers windows replacement, "partial" renovation implementing thermal insulation of wall/ceiling and windows replacement as well as "deep" renovation implementing at least 3 measures.

Estimation of the expected energy savings is based on case studies provided by Ministry of Environment and are summarized in the table below:

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[141] More details available here : http://www.zebra-monitoring.enerdata.eu/overall-building-activities/share-of-new-dwellings-in-residential-stock.html#equivalent-major-renovation-rate.html

Renovation level	Energy savings
Light	15% (equivalent to 21% major renovation)
Partial	50% (equivalent to 71% major renovation)
Deep	68% (equivalent to 97% major renovation)

The equivalent major rate in Lithuania amounts to around 1.13% which is an average of the Zebra´s countries.

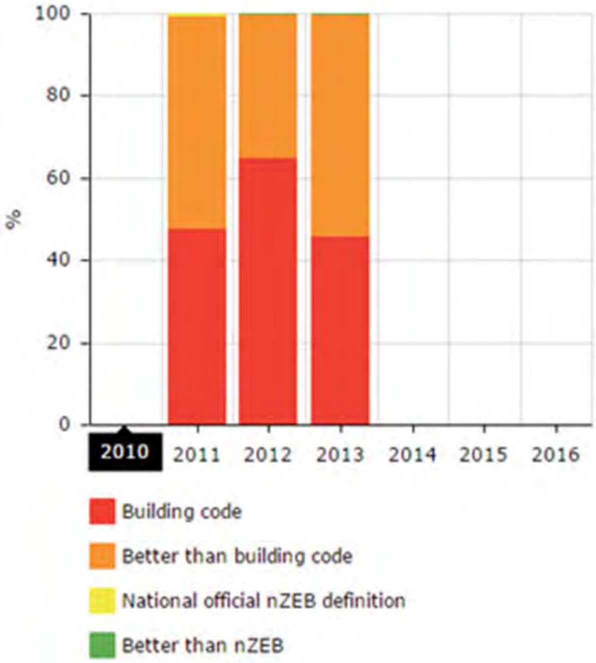

Figure 128 Distribution of new dwellings according to the nZEB radar graph – Lithuania

Source: ZEBRA

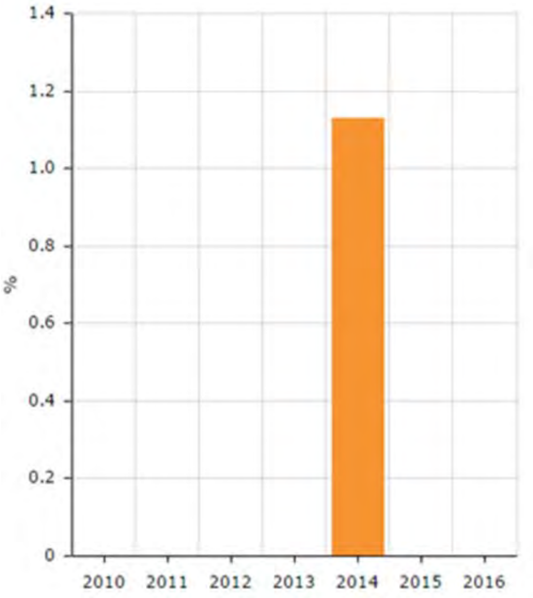

Figure 129 Equivalent major renovation rate – Lithuania

Source: ZEBRA

10.4.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Lithuania, it has been collected data of 8 nZEBs or high energy efficient buildings which were constructed recently. The 8 buildings are new buildings and all of them have a residential use.

Climate zones

As Table 25 indicates, the 8 selected buildings are located in the climate zone B, which is characterized by cold winters and mild summers.

Table 25 Building distribution by climate zones - Lithuania

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	8	
C	Warm winters and warm summers		
D	Temperate winters and mild summers		
E	Temperate winters and warm summers		

Heating Demand

The average heating demand in the collected new buildings is 29,2 kWh/m² a. Nevertheless, there is a building with a dispersed value (89,4 kWh/m²), which increases the average.

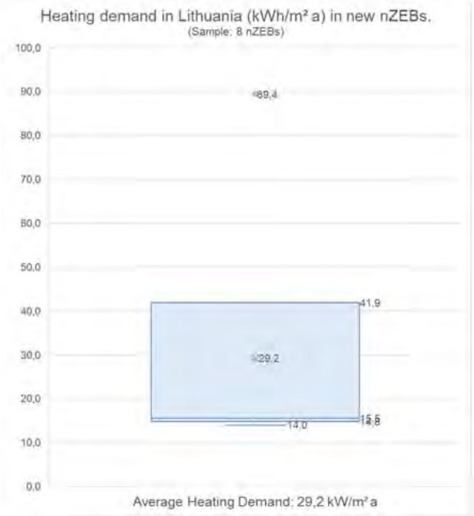

Figure 130. Box plot of heating demand in new nZEBs - Lithuania

Building envelope and passive solutions

In the collected new buildings, the average U-value in walls is 0,11 and 0,07 in roofs.

Expanded polystyrene is the most used insulating material in walls with a share of 38%, while in roofs it is the stone wool with a share of 50%.

In windows, the average Uwin-value is 0,74 and the most used type of glass is the triple glass with a percentage of 50%.

In no buildings it was indicated the use of passive cooling strategies.

Active solutions

The 8 selected buildings use mechanical ventilation with heat recovery.

With regard to the heating system, heat pumps it is used in 50% of the selected buildings, followed by condensing boilers with 38% of the share. Electricity is the most used energy carrier with a percentage of 38%, besides 75% of the buildings use the same system for heating and DHW.

No building indicated the use of cooling system.

Renewable energies

In 1 out of the 8 new buildings, it is noticed the use of photovoltaic systems and in 2 the use of solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Lithuanian reports and realised projects.

Table 26 Costs of different renovation depths and new built according to nZEB standards – Lithuania

Costs (€/m2)	LT
Minor renovation (15% energy savings)	125
Moderate renovation (45% energy savings)	155
Deep renovation (75% energy savings)	238
NZEB renovation (95% energy savings)	286
New built according to nZEB standards	734
Additional funds for nZEB construction compared to new built	125

10.4.2 EXISTING POLICIES

In Lithuania, the nZEB concept is clearly defined. The definition in terms of energy performance is unrelated to particular numeric value of energy consumption and is defined by respective class of energy performance of the building. A nZEB shall be classified as building of class A++ energy performance and most of the energy consumed is renewable energy, including renewable energy produced locally or nearby. All new buildings occupied by public authorities will be nZEBs after 31 December 2018 and all other new buildings after 31 December 2020. Lithuania has set transitional requirements for newly constructed buildings in 2014, 2016, 2018 and 2021.

The building sector and energy targets

In Lithuania the indicative national energy savings target for 2020 is 740 ktoe of the final energy (2011 – 2020). The highest potential is found in buildings and the transport sector: 40% of energy savings should be achieved in buildings and 40% in the transport sector.

The following energy efficiency improvement measures are going to result in significant energy savings:

- Horizontal measures (regulations, norms and public awareness raising activities) are expected to lead to energy savings of 12,147 GWh
- Energy efficiency enhancements in the residential sector (e.g. Programme for renovating multifamily buildings). Expected energy savings: 1,000 GWh by 2020
- Energy efficiency improvements in the non-residential sector (e.g. renovation of heated and/or cooled buildings owned by the state and used by public authorities). Expected energy savings: 50 GWh by 2020
- Metering and invoicing (roll out of smart meters)
- Energy services

National Renovation Strategy

The objective of the Lithuanian renovation strategy is to renovate 2.5 million m2 of public and residential buildings by 2020, with a budget of LTL 1,836 billion (funds from EU support and national budget). The key source of financing for the ongoing renovation of multi-apartment buildings is the funds of low-interest loans and state subsidies with the majority of public buildings being renovated using the EU assistance.

The budget of LTL 1,836 billion is going to be used to renovate buildings in certain priority groups. These groups include multi-apartment buildings, residential buildings for various social groups, public buildings and special-purpose buildings built before 1993. Most of such buildings are buildings of EPC Class E, F, G of energy efficiency that may be subject to mass renovation measures.

Energy performance requirements

According to the Technical Regulation of Construction STR 2.01.09:2005 "Energy Performance of Buildings, Certification of Energy Performance", the energy performance requirements are as follows; transition of requirements for newly constructed buildings:

Prior to 2014 – new buildings or their parts shall comply with the requirements **for class C buildings;**

From 2014 – new buildings or their parts shall comply with the requirements for **class B buildings;**

From 2016 – new buildings or their parts shall comply with the requirements for **class A buildings**

From 2018 – new buildings or their parts shall comply with the requirements for **class A+ buildings**

From 2021 – new buildings or their parts shall comply with the requirements for **class A++ buildings (i.e. nZEB)**

The energy performance requirements set by the Lithuanian legislation do not use reference buildings. Each building is assessed individually. The energy performance class of the building is identified on the basis of the following building indicator values (the compliance of all those values with the legislative requirements is assessed): (a) Calculated specific heat losses of building envelopes. (b) Building air-tightness. (c) Technical indicators for mechanical cooling system with recuperation. (d) C1 indicator value of energy efficiency of the building, characterising primary non-renewable energy efficiency for heating, ventilation, cooling and lighting. (e) C2 indicator value of energy efficiency of the building, characterising primary non-renewable energy efficiency for preparing domestic hot water. (f) Part of renewable energy used in the building.

Compliance

There is energy performance certification requirement for new buildings and refurbished existing buildings. All building certificates are published on the internet. Buildings that do not comply with the energy performance requirements cannot be accepted as serviceable. The experts must inspect the building and the methods of determining the building characteristics are chosen by the expert. The responsibility for the validity of energy performance of a building lies on the expert. The qualifications required from the experts are: engineer diplomas with experience of three years in construction, special training courses and required certification practice of three buildings. The certificate and general information about the building collected by the expert are sent to

Certification Centre database. A representative of the Certification Centre is permitted to carry out a primary evaluation of the certification process and the validity of certification[142].

nZEB Plan

According to the established indicators, a building of class A++ (i.e. nZEB) must comply with the applicable parameters:

1. Values C1 and C2 of energy efficiency indicators of the building must comply with the requirements of the Regulation, i.e. $C1<0.25$ and $C2\leq 0.70$ (C1 indicator value of energy efficiency of the building: characterises primary non - renewable energy efficiency for heating, ventilation, cooling and lighting; C2 indicator value of energy efficiency of the building, characterising primary non - renewable energy efficiency for preparing domestic hot water)
2. Calculated specific heat losses of building envelopes must not exceed the normative heat losses
3. Air - tightness of the building must comply with the requirements of the Regulation, i.e. in case of pressure difference of 50 Pa between the inside and outside of the building, air circulation must not exceed 0.6 times per hour
4. If a building is equipped with a mechanical ventilation system with heat recovery, the performance ratio shall be at least 0.90, and the amount of energy used must not exceed 0.45 Wh/m3

Renewable sources in the building sector

A part of energy from renewable resources consumed in the building shall comply with the requirements of the Regulation, i.e. in buildings of class A++, energy from renewable resources must form the largest part of energy consumed. A part of renewable energy consumed in the building Kers (units) must be higher than 1 and is calculated by using an equation given in "National Plan for Increasing the Number of Nearly-Zero Energy Buildings".

Financial and fiscal support policies/programmes

In order to increase energy performance of buildings and the number of nearly zero-energy buildings under the Cohesion Promotion Action Programme for 2007-2013, the following measures are being implemented in Lithuania:

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[142] http://www.buildup.eu/sites/default/files/content/P184_Lithuania_Impact_compliance_control_ASIEPI_WP3.pdf

- The "Renovation of multi-apartment buildings with the primary aim of increasing their energy efficiency".
- The "JESSICA holding fund" measure will help the reduction of energy consumption in residential houses.
- The "Promotion of renovation of multi-apartment buildings" will help the reduction the energy costs for heating multi-apartment buildings and reducing CO2 emissions, and will improve the living conditions of property owners.
- The "Renovation of public buildings at national level" will help the improvement of the energy production and consumption efficiency and the use of renewable energy resources.
- The "Renovation of public buildings at regional level" will help increasing the energy production and consumption efficiency and the use of renewable energy resources.
- The "Projects for the renovation of public buildings in line with the benefit and quality criteria of measure 1.2 'Ensuring stability of energy supply, accessibility and higher energy efficiency'".

The leading role of the public sector

The aim is to increase the energy efficiency in the public building sector. The criterion of the achievement is as follows: 60 GWh of primary energy savings have to be achieved yearly in the public buildings. Public building is defined as a building used for administrative, culture, education, sport and health care purposes owned by the state or municipalities.

10.4.3 NZEB-TRACKER

This section highlights the key findings from the nZEB tracker for Lithuania in 2014.

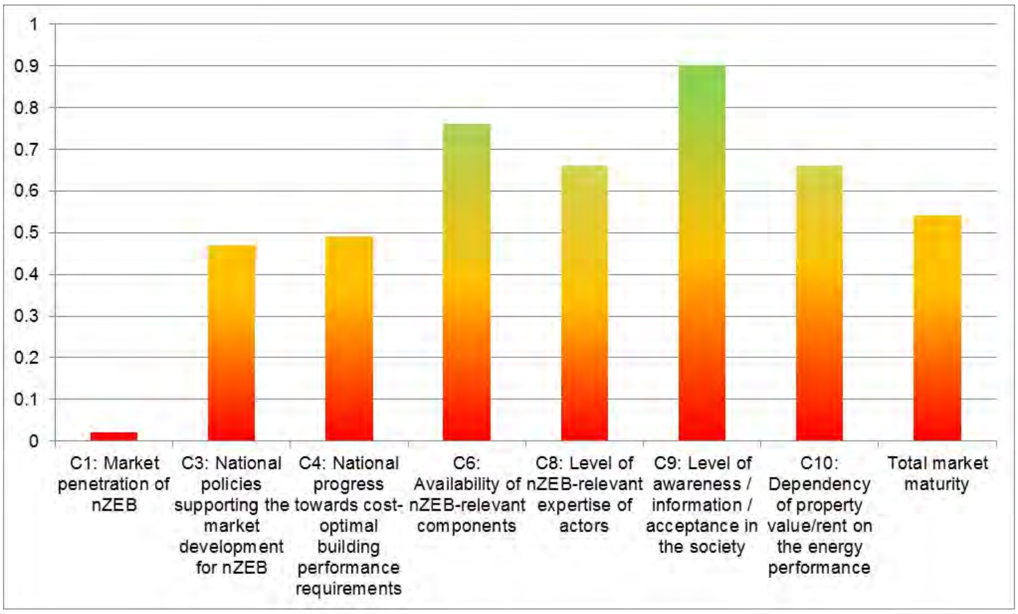

Figure 131 nZEB-tracker score for Lithuania in 2014

C1: Market penetration of nZEB

- Lithuanian result: **0.02** ZEBRA average: **0.32**
- nZEB had a share of only ~0.2 % on new constructed floor area in Lithuania. nZEB is complied with A building requirements (In Lithuania, energy performance is unrelated to particular numerical value of energy consumption and is defined by the respective class of energy performance of the building)

C3: National policies supporting the market development for nZEB

- Lithuanian result: **0.47** ZEBRA average: **0.52**
- Policy framework in Lithuania seemed to be hardly sufficient to support the development of the market for residential and non-residential nZEB in 2014.
- The nZEB concept exists which is defined by respective class of energy performance of the building.
- There is a lack of financial programmes supporting nZEB construction and deep renovation.

C4: National progress towards cost-optimal building performance requirements

- Lithuanian result: **0.49** ZEBRA average: **0.94**

- Cost-optimal levels of minimum energy performance and current minimum energy performance requirements fit quite well for the new building construction hovewer there is a gap for building renovation.

C6: Availability of nZEB-relevant components

- Lithuanian result: **0.76** ZEBRA average: **0.83**
- Energy efficient heating systems and other building components for nZEB are moderately available in Lithuania.

C8: Level of nZEB-relevant expertise of actors

- Lithuanian result: **0.66** ZEBRA average: **0.63**
- Whereas the availability of experts for planning was assessed sufficient and for examination/certification even good, the interviewees agree that there was a lack of expertise for the construction phase.

C9: Level of awareness / information / acceptance in the society

- Lithuanian result: **0.9** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings increased steadily.

C10: Dependency of property value/rent on the energy performance

- Lithuanian result: **0.66** ZEBRA average: **0.74**
- Compared to site, living quality, aesthetics and financial aspects, the energy performance was the least important aspect for customers' decision on renting/buying a real estate.

Resulting Maturity of the Lithuanian nZEB market in 2014

- Lithuanian result: **0.54** ZEBRA average: **0.66**
- The nZEB market seemed to be slightly worse developed than the average of the ZEBRA countries.

10.4.4 SCENARIOS

Figure 132 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Lithuanian building stock is around 17.7 TWh in 2012. The scenario shows a slow-down of the energy demand of around 20% (around 5% yearly) from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 51% in the current policy scenario in the long term development between 2012 and 2050 and by 55% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Lithuania, the share of biomass-based heating systems and district heating with almost 80% make up a significant share on the total energy demand for space heating, cooling and hot water in 2012 whereas the fossil-fuel-based heating systems makes up app. 20%. The share of non-delivered energy (i.e. solar and ambient energy) is slowly increasing over time from around 0.1% of final energy demand in 2012 to around 6.3% in current policy scenario and 7.2% in ambitious policy scenario in 2050.

Figure 133 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 58% in current policy scenario and around 69% in ambitious policy scenario. The reduction of the primary energy demand is around 52% and 58% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

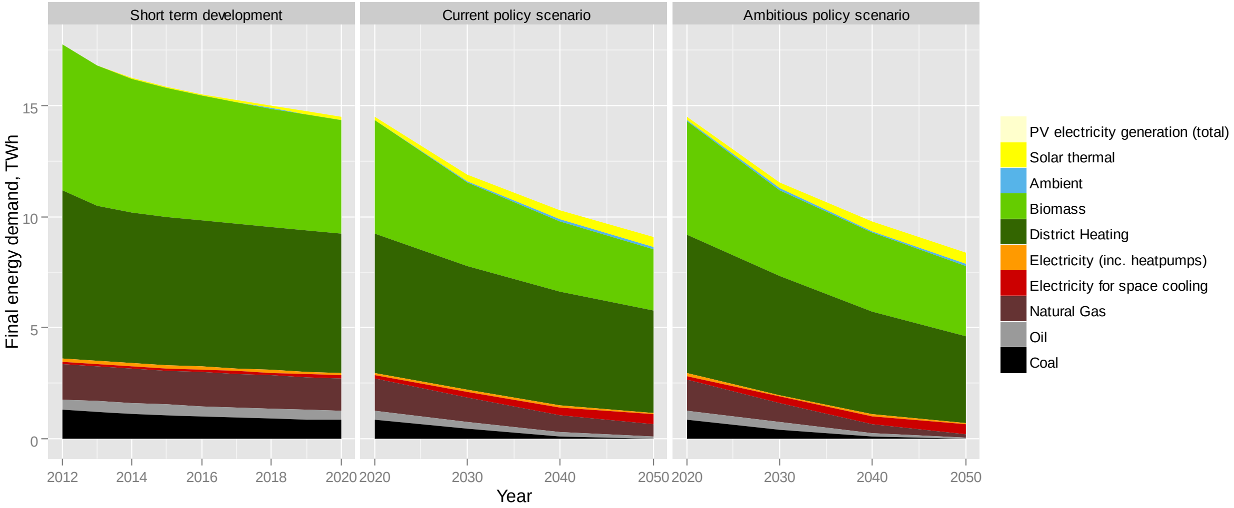

Figure 132 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

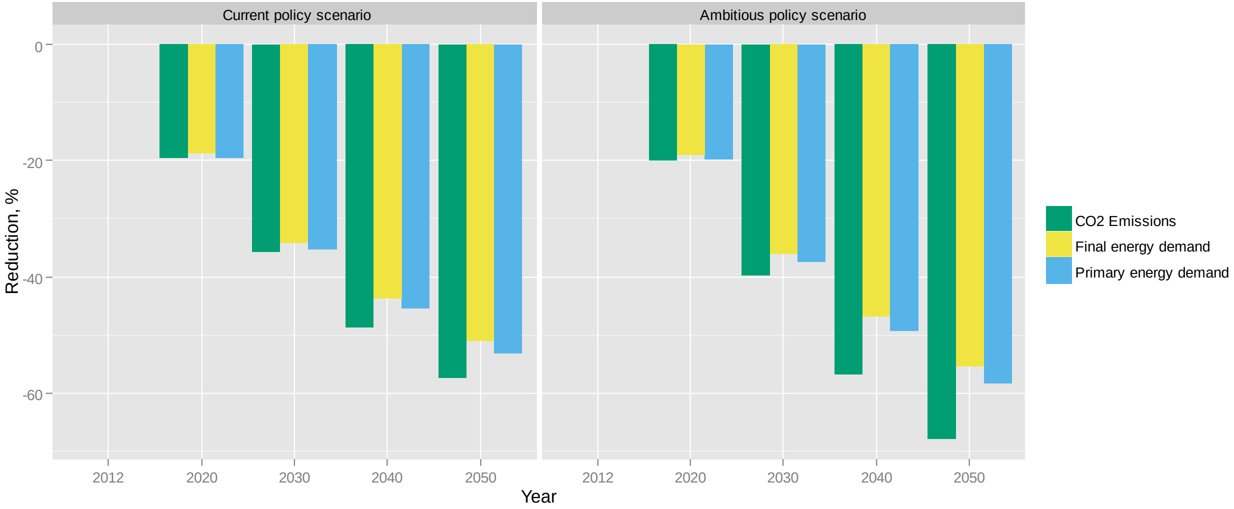

Figure 133 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

10.4.5 RECOMMENDATIONS

In Lithuania, the nZEB concept is already defined. The definition in terms of energy performance is unrelated to particular numeric value of energy consumption and is defined by respective class of energy performance of the building. A nZEB shall be classified as building of class A++ energy performance and most of the energy consumed is renewable energy, including renewable energy produced locally or nearby. All new buildings occupied by public authorities will be nZEBs after 31 December 2018 and all other new buildings after 31 December 2020. Lithuania has set transitional requirements for newly constructed buildings in 2014, 2016, 2018 and 2021.

Between 2015 and 2020 the LTL 1,836 billion are going to be used to renovate buildings falling within priority groups. These groups include multi-apartment buildings, residential buildings for various social groups, public buildings and special-purpose buildings built before 1993. Most of such buildings are buildings of EPC Class E, F, G of energy efficiency that may be subject to mass renovation measures.

Lithuania has implemented an energy performance (EP) certification requirement for new buildings and refurbished existing buildings. All building certificates are published on the internet. Buildings that do not comply with the EP requirements cannot be accepted as serviceable. The experts must inspect the building and the methods of determining the building characteristics are chosen by the expert. The responsibility for the validity of EP of a building lies on the expert.

Lithuania still has a long way to a real market penetration of nZEBs and high energy performance buildings. Although there are several programmes to renovated multifamily buildings, the **renovation rate** is very low. Statistically, 1% of the apartment buildings have been renovated in the last three decades. The low renovation rate depends on **several barriers;** lack of the trust of the building companies, long preparation process of the documents and relatively high share of elderly persons who are not willing to invest. Current market penetration of the nZEB or high energy performance buildings is very low and progress is also hampered by the **lack of the clear and long-term strategy** of the building renovation policy. Another problem is the lack of measures support the uptake of renewables in buildings.

Based on this background, 7 recommendations have been outlined specifically for the Lithuanian context:

LT1 - Refine the Energy Performance Certificates, including a robust compliance system

LT2 - Incentivize the market uptake of nZEBs through price signals

LT3 - Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

LT4 - Training building professionals with "NZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

LT5 - Incentivize the frontrunner entrepreneurs exploring new business models

LT6 - Upgrade all social housing to nZEB standards, in order to provide comfortable and affordable housing

LT7 - Include the benefits of alleviating (energy) poverty in nZEB strategies

#LT1 - Legislative and Regulatory Instruments

Refine the Energy Performance Certificates, including a robust compliance system

The Energy Performance Certificate (EPC) is the most visible aspect of the EPBD and is often part of Member State's building codes. The core aim of the EPCs is to serve as an information tool for building owners, occupiers and real estate actors on the energy performance of the building. Therefore, EPCs have the potential to be a powerful market tool to create demand for energy efficiency in buildings by targeting such improvements as a decision-making criterion in real-estate transactions, and by providing recommendations for the cost-effective or cost-optimal upgrading of the energy performance.

The EPBD requires that all "energy performance certificates are to be included in all advertisements for the sale or rental of buildings". In order for the EPC system to work effectively, it must be qualitative, transparent and reliable. Here, many European Member States have some work to do. Together with reliable databases and qualified certifiers, can an external compliance process generate better rules of conduct and a more efficient system.

In the QUALICHeCK project[143], two important properties of EPC input data have been identified:

Compliant input data: established in line with the procedures in force in the context of the applicable legislation. Easily accessible input data: can be found, seen and used by taking "reasonable time, effort or money"

With regard to defining penalties with little interference with the court system, proportionate and dissuasive penalties shall be defined according to the EPBD. Nevertheless, social acceptance of extra loads of the court system with non-compliance cases to the energy performance of buildings, which generally do not result in a direct threat to the health and safety, is likely to be difficult. The Belgian experience in the Flemish Region since 2006 shows that fines proportional to the deviation of the input data are workable and appears to be effective. The amounts of the fines were set considering the cost avoided to achieve compliance[144].

Example: EPC in Netherlands

The Netherlands has imposed an effective control system, which is performed under the BRL9500 guideline, including a check of a certain number of the EPCs issued by qualified assessors (detailed check of documentation, site visit). Check is performed for 2% of EPCs issued for residential and 5% for non-residential buildings per assessor. EPC Data is also publically available in the Netherlands, making the building's energy characteristics attainable for the housing market.

EU-project: QUALICHeCK

One of the main objectives of the QUALICHeCK-project is to highlight best practices for easy access to reliable EPC input data, delivery of improved quality of the works, as well as more effective compliance frameworks ("lead people to do what they declare").

The project's source book for improved compliance of Energy Performance Certificates of buildings provides guidelines and suggestions for achieving a robust compliance and enforcement framework for energy performance certificates (EPCs) for buildings. A draft version of the QUALICHeCK source book is available, with the final version to be published in 2017[145].

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[143] Qualicheck (2016) - http://qualicheck-platform.eu/wp-content/uploads/2016/03/QUALICHeCK-Factsheet-05.pdf

[144] Qualicheck (2016) - http://qualicheck-platform.eu/wp-content/uploads/2016/05/QUALICHeCK-Booklet-1.pdf

[145] QUALICHeCK - http://qualicheck-platform.eu/wp-content/uploads/2016/03/QUALICHeCK-source-book-Quality-of-Works-DRAFT.pdf

A number of fact sheets produced by the project analyse approaches that have been implemented point out the pros and cons of options that may be considered, and give hints and pitfalls to avoid if replicated in other contexts.[146]

#LT2 – Economic Measures

Incentivize the market uptake of nZEBs through price signals

Presence of stable financial mechanisms supporting market uptake of nZEB is vital. Price signals (e.g. tax remissions on nZEB buildings/components or tax increase on inefficient components) is one of the key instruments at the Member States disposal to steer the market through economic incentives. Price signals can either be positive (i.e. falling prices) or negative (higher prices). Policy-makers can support energy efficient goods through lowering the price on NZEB-level components or increase the price on less efficient substitutes.

Price signals should also be assigned to the energy market. Dynamic pricing would incentivize energy efficiency and the uptake of NZEBs.

Example: Smart Meters in Aarhus

The city of Aarhus (Denmark) is now installing smart heat meters in order to enable a price signal for district heating that differs from the price of the heat to be bought for the district heating system. Just in Aarhus, 6 different sources of heat exist with varying prices. To have a true price signal on heat, consumption will be cheaper in summer, where much heat is available and more expensive in winter, incentivizing people to energy renovations[147].

The Aarhus recommendation illustrates how a city can combine price signals (dynamic pricing of heat) with other support measures (smart meters).

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[146] QUALICHeCK - *http://qualicheck-platform.eu/*

[147] http://www.ecocouncil.dk/documents/horingssvar/1821-150918-uk-energy-performance-of-the-buildings-directive

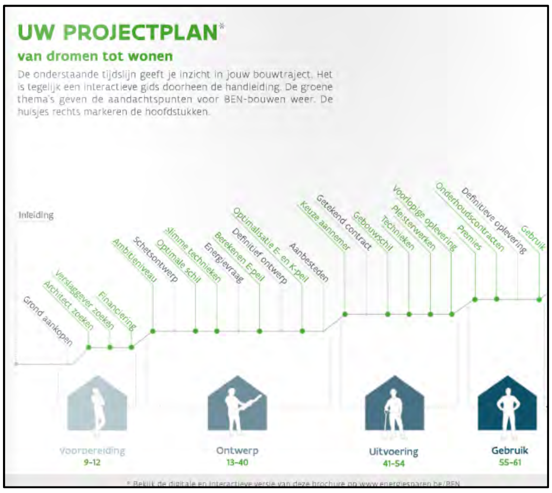
#LT3 – Communication

Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

A big barrier to a rapid market uptake of nZEBs is the lack of knowledge and accessible information on different levels. Effective information campaigns targeting different actors and stakeholders (e.g. house owners, building professionals, technical staff of public administrations...) are needed. Easy grasping guidelines or how-to manuals can increase the demand and spur the nZEB market transition. In order for an information or awareness campaign to be effective it must be targeted to a specific group of consumers. Comprehensive preparation for these kinds of campaigns should therefore be conducted beforehand and the effect should be assessed after the campaign has ended.

Example - Guidelines for future building owners how to build new NZEB in Flanders

The Belgian region of Flanders has produced a "practical guide for building your nZEB house"[148] to support future home owners through the process of prepare, design, execute and use an nZEB dwelling.


UW PROJECTPLAN*
van dromen tot wonen
De onderstaande tijdslijn geeft je inzicht in jouw bouwtraject. Het is tegelijk een interactieve gids doorheen de handleiding. De groene thema's geven de aandachtspunten voor BEN-bouwen weer. De huisjes rechts markeren de hoofdstukken.

* Bekijk de digitale en interactieve versie van deze brochure op www.energiesparen.be/BEN

EU-projects - ConClip for High-quality Passive House Construction

The Passive House is a leading European building technology and constitutes the fastest growing energy performance standard in the world with 30,000 buildings realised to date. Passive houses

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[148] http://www.vlaanderen.be/nl/publicaties/detail/praktische-bouwgids-voor-jouw-ben-woning-1-exemplaar

save energy costs, are environmentally friendly and provide exceptional health benefits for the occupants. Notwithstanding the success of the Passive House as a leading future building technology, the new building technology faces three serious challenges which need to be faced if the Passive House is to succeed longterm[149]:

- Passive House Construction Quality
- Craftsmen and Site Supervisors Training
- One European quality standard

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[149] http://conclip.eu/

#LT4 – Quality of action
Training building professionals with "NZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future
NZEBs demand higher qualifications of building professionals on all levels. Consumers should be able to rely on the skills of the building professional and get value for money, which means state-of-the-art information and advice, achieving the expected (energy) performance, a maximum operational lifetime and a safe and healthy building. This requires higher skills in the nZEB chain – highly energy efficient products require the proper understanding from the installer etc. A high skilled workforce increases the level of trust and confidence in NZEB investments. To ensure an effective and qualitative construction and installation of nZEBs and related components, all professional involved in the process must receive proper training.
EU-Project: SouthZEB The SouthZEB project is an Intelligent Energy – Europe funded project, which addresses the IEE priority for 2013 on continuous professional development. "With the objective of fostering the energy efficiency of the building sector through the adoption of near Zero Energy Buildings (buildings that have very high energy performance) concepts in new or existing buildings, the SouthZEB project develops training modules targeted towards specific professionals (Engineers, Architects, municipality technicians and decision makers) in Southern European countries (Greece, Cyprus, Southern Italy and Portugal). The training modules will be implemented by the project partners in the target Southern European Countries (less advanced on the progress towards nearly Zero Energy Buildings), leveraging on the experience and know-how from front runner project partners' countries (Austria, UK, Northern Italy).[150]

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[150] http://www.southzeb.eu/training/

#LT5– Incentivize the Market

Incentivize the frontrunner entrepreneurs exploring new business models

A more dynamic and legislative framework that incentivizes the frontrunners and allows for entrepreneurs exploring new and better business models would ease the local legislative struggle that many pilots encounter.

The framework should not define one approach to achieve nZEB targets, but rather create flexible legislation that allows for business model innovation (e.g. new aggregated services that improve quality and lower costs) to take place instead of limiting it. It should be adaptable to market evolutions and to successful outcomes of pilot projects. The framework could provide guidance on new financing schemes, how new players – also from other industries – can enter the market and allow for integrators and facilitators to emerge. These are just some examples of the boundary conditions a dynamic framework could create to stimulate innovation in scaling up deep energy retrofits and new nZEBs.

State of Play

EU and its Member States must further stimulate cities, regions or private initiatives to go beyond the set goals. Across Europe, projects that are testing the boundaries of industrialisation and innovation in deep energy renovation (Energiesprong, Project Zero…) are emerging.

Giving pilot cases freedom to colour outside the lines of strict regulations would improve their outcomes and pave the way for more innovation. No matter if they are private, public or PPP initiatives, they would all benefit from a widespread sharing of best practices and a more flexible legislative framework.

EU-projects: COHERENO

The objective of COHERENO is to strengthen collaboration of enterprises in innovative business models for realizing Nearly Zero Energy Building (NZEB) renovations in single family owner occupied houses. The project focuses on eliminating barriers for collaboration, providing enterprises with guidance on how to collaborate and on developing services for the different customer segments.[151]

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[151] http://www.cohereno.eu/

#LT6 – Social Issues

Upgrade all social housing to nZEB standards, in order to provide comfortable and affordable housing

Towards achieving the 2020 targets on sustainable and inclusive goals, the fight against energy and fuel poverty can have a significant impact, as fuel poverty is recognised as one of the serious forms of poverty and social exclusion. While the topic does not have a commonly agreed approach over the EU, there are estimates indicating that at least 50 million people or 10% of Europeans are fuel poor nowadays. Moreover, almost all people at risk of poverty are vulnerable on energy issues struggling to pay their energy bills or to secure a proper thermal comfort in their homes.

Example: France – renovation programme of 800,000 social housing dwellings

In order to support social cohesion and respond to the economic crisis, in 2009 the European Regional and Development Fund (ERDF) regulation was amended to allow for up to 4% of national ERDF resources to be invested in energy efficiency improvements in existing housing in all Member States. France, taking full advantage of this revision, committed €320 million of the ERDF to renovate 800,000 social housing dwellings with low energy performance by 2020 (Grenelle Law). Many regions had already invested all their share of the ERDF in the programme before March 2011 and they provided additional funds to the original ERDF.[152]

#LT7 – Social Issues

Include the benefits of alleviating (energy) poverty in nZEB strategies

Fuel poverty is a major problem for Europe, as between 50 and 125 million people are unable to afford a proper indoor thermal comfort[153] Energy efficiency improvement is an important long-term mean to combat fuel poverty. However, mobilising the upfront-investments has strong distributional aspects and may impact the poorest part of the population. Energy efficiency policies should be designed to allow the poorest households to undertake the necessary investments and to encourage the participation of stronger investors.

A study commissioned by the European Parliament and carried out by the European Foundation

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[152] http://bpie.eu/publication/alleviating-fuel-poverty-in-the-eu/

[153] http://bpie.eu/publication/alleviating-fuel-poverty-in-the-eu/

for the Improvement of Living and Working Conditions (Eurofound) showed that European countries spend nearly €194 billion per year in both direct costs, such as healthcare or social services, and indirect costs, like loss of productivity due to inadequate and poor housing. The removal of deficient housing would cost a total €295 billion. However, the totality of money spent would be reimbursed nearly 18 months later according to the study[154].

Authorities ought to include the indirect costs of inadequate housing in their national building strategies, including nZEB. Investing in energy efficient measures targeting underprivileged neighbourhoods is often a cost-effective investment for the society, bringing social, environmental and economic gains.

It is observed that in several EU countries the (social) housing sector "takes advantage" of energy efficiency schemes to implement energy efficiency measures in fuel poor households. However, in most cases such programs are mostly not integrated in a strategy on national level with the objective to eradicate fuel poverty. The existing fuel poverty schemes are often valuable, but should be integrated in a broader national (nZEB) strategy.

Example: The Home Energy Efficiency Programmes for Scotland (HEEPS)

The Home Energy Efficiency Programmes for Scotland (HEEPS)[155] target "fuel poor" areas in Scotland. The programme attacks fuels poverty through subsidies, interest free loans and easy-accessible information about energy efficiency and other measures on energy performance of buildings. There are many project like this across Europe, alleviating poverty while at the same time improve the environment as well as the economy

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[154] Euractive, author: Maxim Schuman (2016-08-11) - https://www.euractiv.com/section/social-europe-jobs/news/study-inadequate-and-poor-housing-costs-eu-e194-billion-per-year/

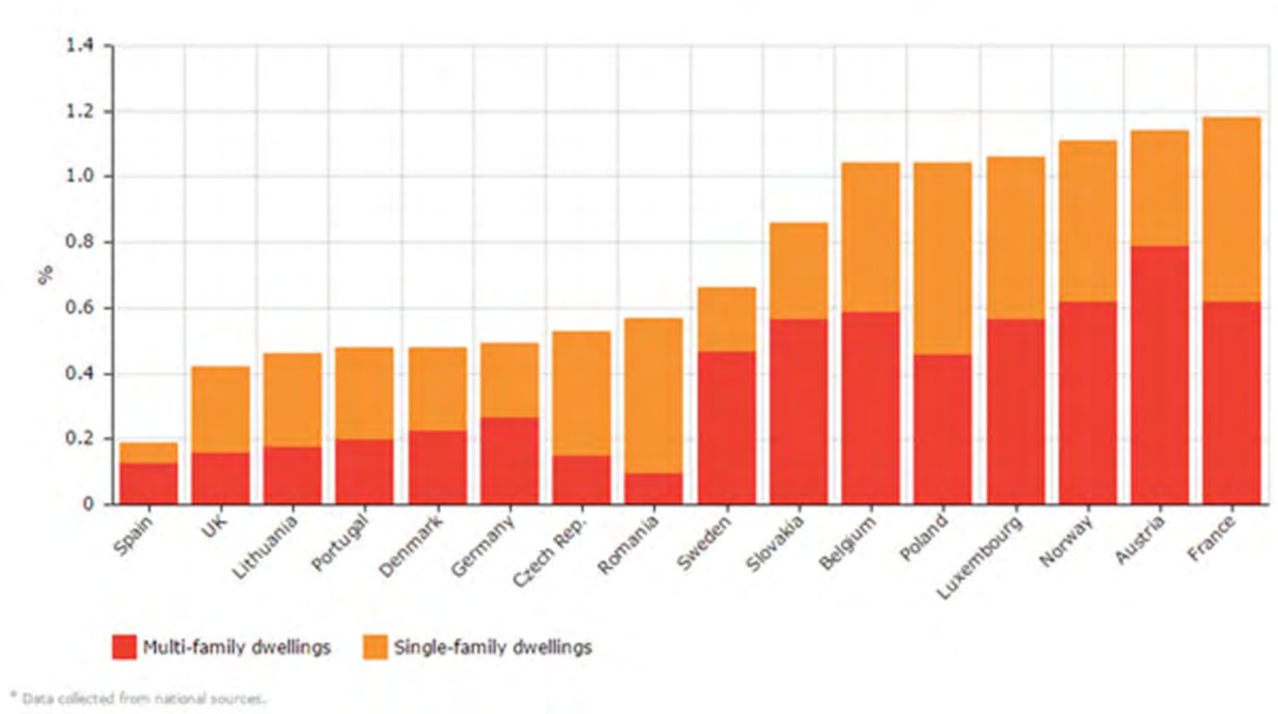
[155] Scottish Government http://www.gov.scot/Topics/Built-Environment/Housing/warmhomes/fuelpoverty Retrieved: 2016/07/07

10.5 LUXEMBOURG

10.5.1 BUILDING PERFORMANCE MARKET DATA

10.5.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for UE countries. Luxembourg is one of the UE countries with the highest rate of renewal of the building stock: in 2013 more than 1% of the building stock was renewed, compared to 0.2%/year in Spain for instance. The annual rate of new buildings is rather steady, i.e. roughly 2,000 erections. The majority of new buildings in Luxembourg are multi-family dwellings.



* Data collected from national sources.

Figure 134 Share of new multi- and single-family dwellings in residential stock in 2013

Source: ZEBRA

10.5.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Luxemburg, it has been collected data of 8 nZEBs or high energy efficient buildings which were constructed recently. The 8 buildings are new buildings and all of them have a residential use.

Climate zones

As Table 27 shows, the 8 selected buildings are located in the climate zone B, which is characterized by cold winters and mild summers.

Table 27Building distribution by climate zones - Luxemburg

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	8	
C	Warm winters and warm summers		
D	Temperate winters and mild summers		
E	Temperate winters and warm summers		

Heating Demand

The average heating demand for the 8 selected new buildings is 13,44 kWh/m² a.

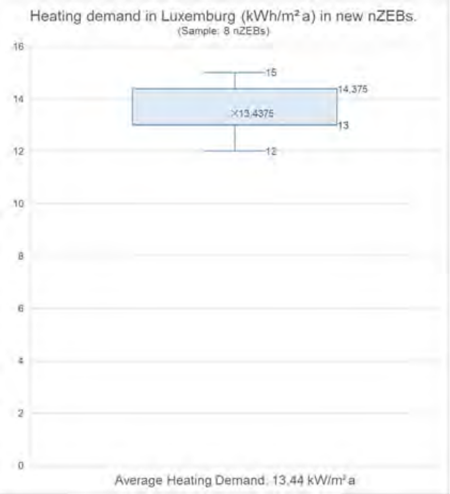


Figure 135. Box plot of heating demand in new nZEBs – Luxemburg

Building envelope and passive solutions

In the selected new buildings, the average U-value is 0,11 in both walls and roofs. Concerning the insulating material in walls and roofs, no information was available.

In windows, the average Uwin-value is 0,78 in selected buildings and no data was available for the type of glass.

With respect to passive cooling strategies, in none building is mentioned the use of any strategy.

Active solutions

Concerning Mechanical ventilation, no data was available for the 8 selected buildings.

75% of the selected buildings use heat pumps as a heating system, the rest (25%) use stoves. With regard to the energy carrier for heating, 2 of the 8 buildings use firewood and no data is available for the other 6 buildings. Besides, 75% of the buildings use the same system for heating and DHW.

None of the 8 selected building use cooling system.

Renewable energies

In 3 out of the 8 new buildings, it is mentioned the use of photovoltaic systems and in 1 the use of solar thermal systems.

10.5.1 REAL ESTATE PRICES AND EPCS

The EPC contains an energy performance letter-indicator, which is calculated using a reference-building approach. The scale ranges from A (most efficient) to I (least efficient). The Luxembourgish EPC rating is given as a number with a corresponding letter-class. However, the dataset used for this report only contains the number class and a conversion to letter classes was not possible, due to the reference-building categorisation method used for EPCs in Luxembourg. As a result, a linear model was used to measure the impact of the number ratings.

The sales market demonstrated a statistically significant price surplus of due to EPC rating across this scale, despite the small sample size. A positive contribution due to area was also observed; however, a significant result was not obtained for the contribution of construction year.

The construction year variable was not included in the rental model, since data was only available for 18 of the useable data entries. Nonetheless, the remaining model displayed a small surplus due to EPC rating. The expected positive area contribution was also observed.

10.5.2 EXISTING POLICIES

Since 2008, Luxembourg has highly prioritized the implementation of energy efficiency requirements in buildings and has increased the energy performance standards in residential (in 2008) and in non-residential buildings (in 2011.) The concept of the nearly zero energy building will become mandatory for all new buildings from January 1st 2019.

The building sector and energy targets

Luxembourg has set certain global targets to be achieved by 2020:

- Final energy consumption: 49,292 GWh or 4,239.2 ktoe
- Primary energy consumption: 52,111 GWh or 4,482 ktoe

Furthermore, the NEEAP includes specific building-related targets for 2020:

- For residential buildings: 474 GWh of final energy savings and 101 ktCO2 of emissions reduction.
- For non-residential buildings: 319 GWh of final energy savings and 40 ktCO2 of emissions reduction.

For the achievement of the abovementioned targets, the action plan presents the following measures for the building sector:

- New buildings and renovation in accordance with the national energy efficiency strategy and targets
- Promotion of the most energy-efficient new buildings
- Promotion of most energy-efficient renovations
- Financial support for solar thermal systems and heat pumps
- Lighting in new buildings in accordance with the national energy efficiency strategy and targets

National Renovation Strategy

The building renovation strategy sets 2020 as the target year but offers further guidance up to 2030. The following actions will be used to support the Luxembourgish renovation strategy:

- Research and development
- Funding - Strengthen the link between EPCs and financial instruments
- Quality assurance and EPCs

- Training, education and training programs
- Implementation in national regulations

Energy performance requirements

The first energy performance-related building code was introduced in 2007 for residential buildings and in 2010 for non-residential buildings. The requirements in energy efficiency are becoming increasingly stringent over time; the regulation is evolving in time. The energy performance requirements for residential buildings have adjustments depending on the ratio between the thermal envelope area (A) and the gross volume (Ve).

Energy performance requirements for residential buildings in Luxembourg

A/V_e	Single-Family houses		Multi-Family houses	
	Heating ($kWh/m^2/yr$)	Total ($kWh/m^2/yr$)	Heating ($kWh/m^2/yr$)	Total ($kWh/m^2/yr$)
$A/V_e \leq 0.2$	$q_{h,max} = 27.4$	$q_{p,max} = 28.4$	$q_{h,max} = 20.4$	$q_{p,max} = 35.8$
$0.2 \leq A/V_e \leq 0.8$	$q_{h,max} = 20+37\cdot(A/V_e)$	$q_{p,max} = 22+32\cdot(A/V_e)$	$q_{h,max} = 11+47\cdot(A/V_e)$	$q_{p,max} = 24+59\cdot(A/V_e)$
$A/V_e \geq 0.8$	$q_{h,max} = 49.6$	$q_{p,max} = 47.6$	$q_{h,max} = 48.4$	$q_{p,max} = 71.2$

For the non-residential building, the minimal energy performance requirements in primary energy are the sum of the each end-uses requirement (heating, DHW, lighting, ventilation, cooling, ventilation, humidifier and auxiliary). For each end-use, the minimal energy performance requirements in primary energy depend on an efficiency factor and the useful energy demand.

Compliance

For new buildings, a control is realized by the control office after the step of structural work and before the finishing work. It is forbidden to complete the work before the validation of the structural work by the legal entity.

The nZEB plan

The definition of a nearly zero-energy building is defined qualitatively as follows:

“Nearly zero-energy building” means a building that has a very high energy performance [...]. The nearly zero or very low energy demand should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

Activities in the area of communication, information and basic advices have been substantially increased in recent years, including a reform of the structures active in this area. These measures are following, it concerns both new buildings and renovations:

The nZEB training programme will concentrate on housing constructions, as the technical requirements of the systems are less complex than for non-residential buildings.

Pilot projects have to be supported for sustain research activities in the fields of construction, technical building equipment, implementation in building practice, monitoring and evaluation, as well as identifying success and risk factors. These pilot projects have to reflect the future law.

Renewable sources in the building sector

The amendment of 11 May 2012 revised the 2008 Energy Savings Regulation for residential buildings aiming to increase the number of energy efficient buildings. One of the revision measures aims to increase the proportion of renewable energy. In order to achieve class B energy performance, assuming that class C thermal insulation is implemented, the use of renewable energy sources (geothermal and solar energy, sustainable energy sources etc.) is required.

10.5.3 SCENARIOS

Figure 136 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Luxembourg´s building stock is around 8.4 TWh in 2012. The scenario shows a slow-down of the energy demand of around 2.4% (around 0.3% yearly) from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 14% in the current policy scenario in the long term development between 2012 and 2050 and by 28% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Luxembourg, the share of natural gas and oil heating systems with almost 82% make up a significant share on the total energy demand for space heating, cooling and hot water in 2012 whereas the biomass heating systems and district heating makes up app. 12%. The share of non-delivered energy (i.e. solar and ambient energy) is increasing over time from around 0.4% of final energy demand in 2012 to around 6.9% in current policy scenario and 7.1% in ambitious policy scenario in 2050.

Figure 137 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 48% in current policy scenario and around 58% in ambitious policy scenario. The reduction of the primary energy demand is around 27% and 39% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

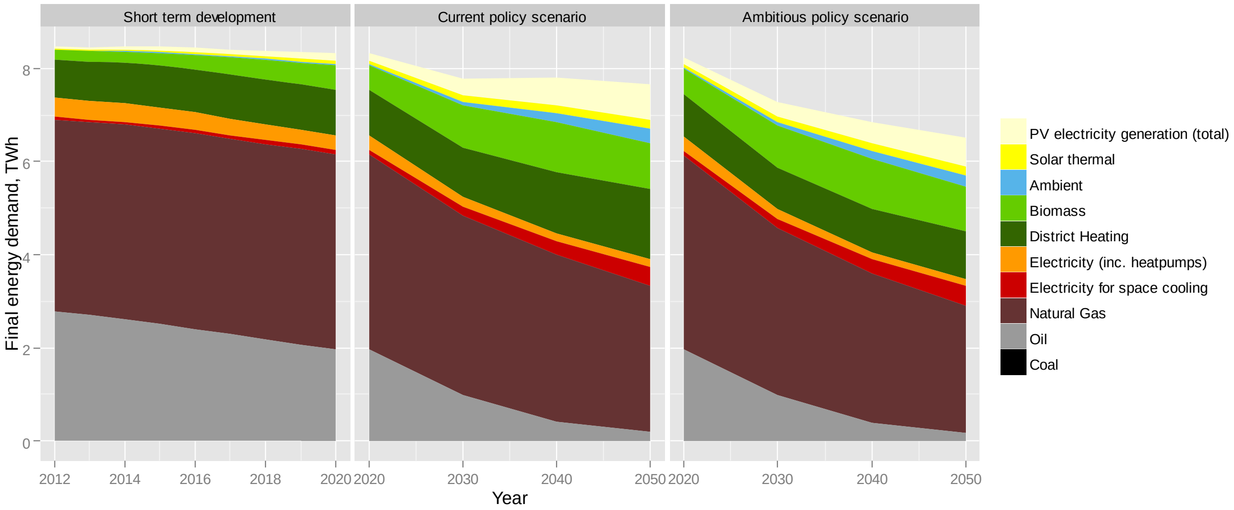


Figure 136 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

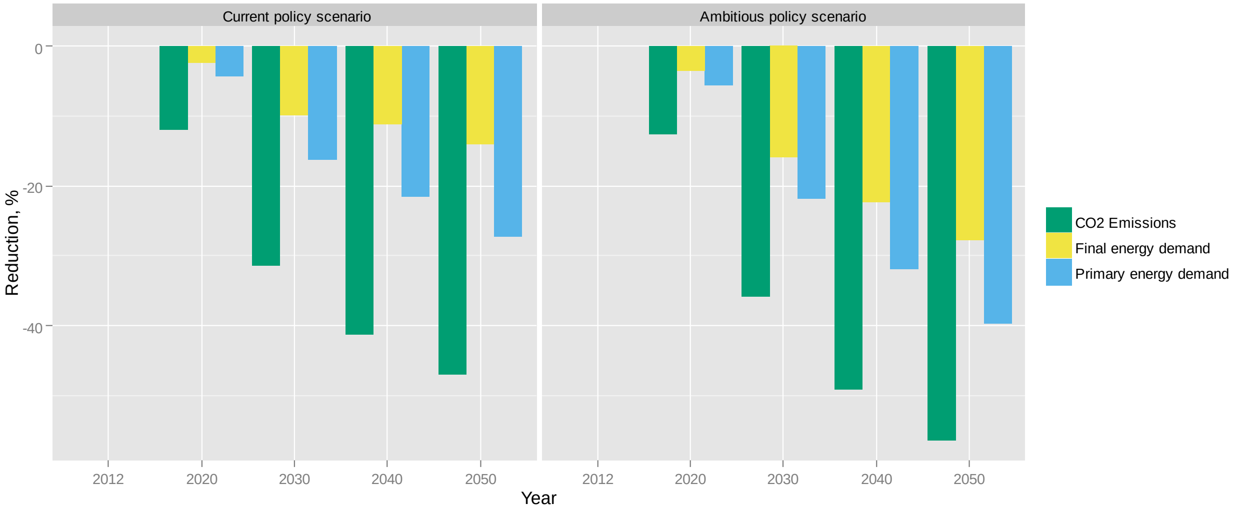


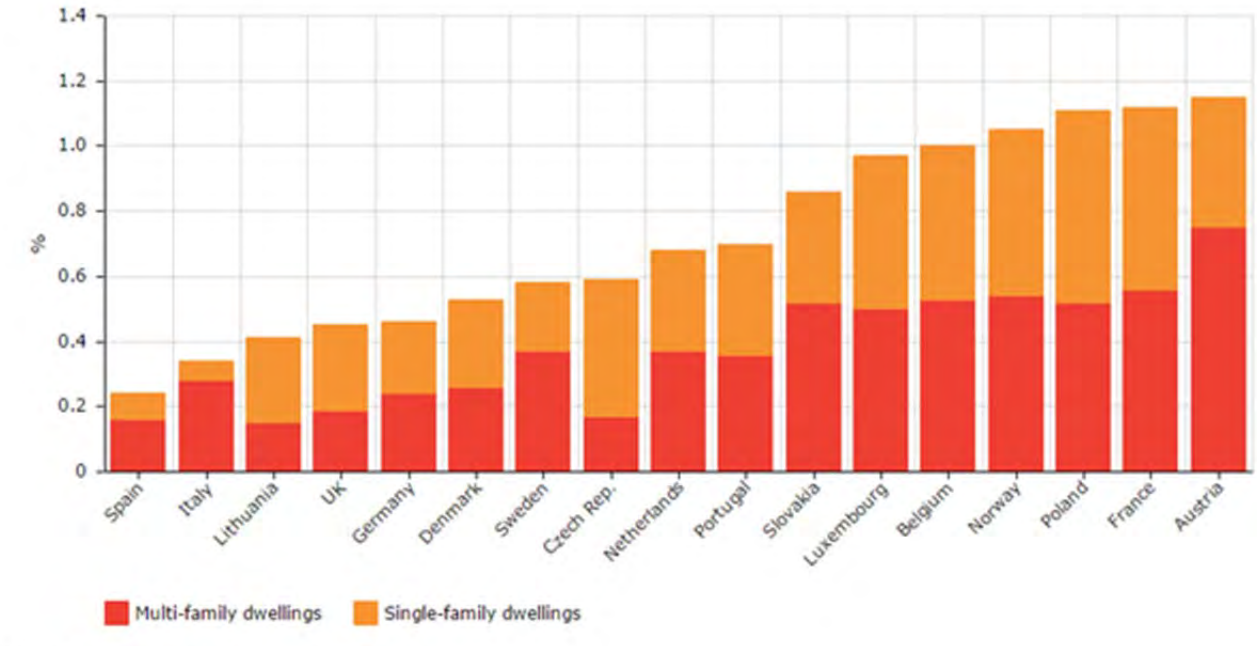
Figure 137 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

10.6 NETHERLANDS

10.6.1 BUILDING PERFORMANCE MARKET DATA

10.6.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for the EU countries. The Netherlands have a share of 0.62% of new dwellings in the residential stock. In 2014, more than 0.5% of the building stock was renewed compared to 0.2% in Italy. The annual rate of new dwellings is slowly declining as the annual building erection is decreasing from 56.000 in 2010 to 48.000 in 2015. The majority of new dwellings in the Netherlands are constructed in multi-family houses.



* Data collected from national sources.

Figure 138 Share of new multi- and single-family dwellings in residential stock in 2012

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 proposes a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings
2. nZEB buildings according to national definitions
3. Buildings with an energy performance better than the national requirements in 2012
4. Buildings constructed/renovated according to national minimum requirements in 2012

The energy performance of new constructed buildings has been estimated based on the qualitative profile of the building permissions in the previous year.

Translating the definition of nZEB radar in the case of the Netherlands gives:

1-Better than nZEB (net ZEB or positive house)	Zero Energy Building or Energy Plus House
2-National official nZEB definition	EPC = 0
3-Better than current building code	EPC < 0,6
4-According to building code	EPC= 0,6

Because of the lack of an official European definition, to ease comparisons the EU ZEBRA2020 project developed the indicator of “major renovation equivalent”. In ZEBRA, three renovation levels have been defined: “low”, "medium" and "deep". However, these 3 levels definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

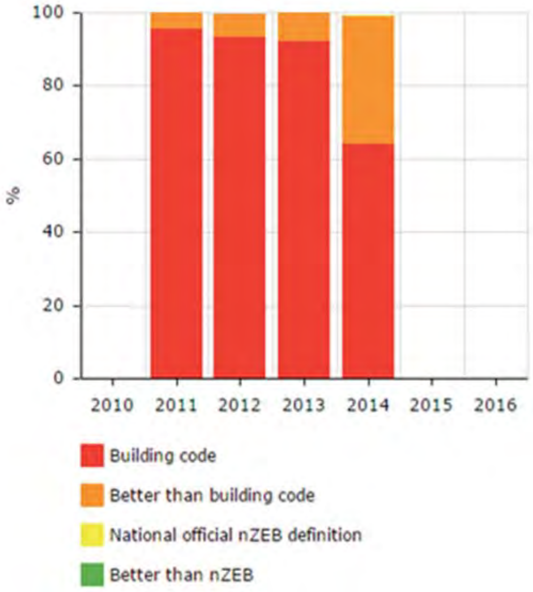


Figure 139 Distribution of new dwellings according to the nZEB radar graph – Netherlands

In the Netherlands, the renovation rate (% of stock) is estimated by considering two energetic renovation levels that are defined by the number of measures. Medium renovations consider at least 1 measure and therefore are assumed to be equivalent to about 6% of a major renovation. The single measure can be the replacement of an old boiler, but also replacing a newer one or just insulating some pipes which yields much lower savings. The range of possible measures is huge and so is the resulting number of implemented measures. From what we know about developments of the Dutch buildings sector, a medium renovation rate of 10% appears very high. We estimate that the average medium renovation would yield less than half the effect of replacing an old boiler, i.e. about 4% total energy savings. Therefore it is equivalent to 6% of a major renovation (4% / 70%)

Deep renovations consider at least 2 measures and therefore are assumed to be equivalent to about 23% savings compared to major renovation level. We assume that the average achievement of this level is comparable to replacing an old gas boiler with a modern condensing boiler (see 1 below) and implementing an additional small measure (see 2 below).

1) old gas boiler with 85% efficiency replaced with a new condensing boiler with 95% efficiency: (leads to 12% energy savings / 70% = 17%) 17% major renovation equivalent (mre)
2) Medium renovation as described before: 6 % mre

The specific major renovation equivalents for medium (6%) and deep renovations (23%) have then been multiplied with the respective renovation rates. Hence, for 2014, we calculated a major renovation equivalent of 1.03 % for the Netherlands.

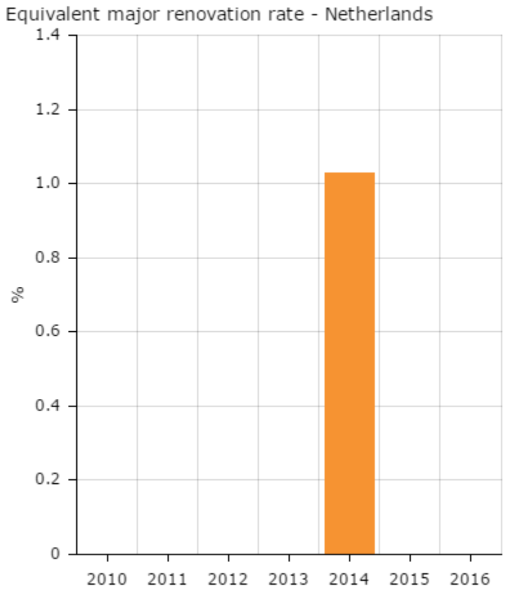


Figure 140 Equivalent major renovation rate – Netherlands

10.6.1 REAL ESTATE PRICES AND EPCS

The transposition and implementation of the EPBD is managed on the national level in the Netherlands. The new EPC system puts a strong emphasis on usability and takes the initial form of an interactive web application. All dwelling owners have been issued with 'temporary' web-based EPCs based on cadastral data. These can then be adjusted by the owners themselves through the input of new data. In order to obtain an official EPC, this adjusted model has to be checked by a qualified professional. The energy performance rating is calculated using this web application, following the input of 20 building characteristics by the owner (CA EPBD 2016).

The Netherlands are the country with the most unexpected results in this report. Deficits, instead of surpluses, were observed for both the sales (-0.8%) and rental markets (-4%). Other studies that have previously been carried out in the Netherlands have reported surpluses due to EPC rating. However, these studies also provide evidence that suggests that the Netherlands struggled to implement the transposition of the 2002 EPBD (Brounen and Kok 2011) (Murphy, 2013). Anyway, omitted variables such as quality and location are more likely to be the cause of the unexpected deficits and clearly demonstrate the importance of having high-quality datasets. Further investigation into the causes would have to expand the scope of the model to include these variables, as shown previously (Brounen and Kok 2011).

10.6.2 NZEB-TRACKER

This section highlights the key findings from the nZEB tracker for the Netherlands in 2014.

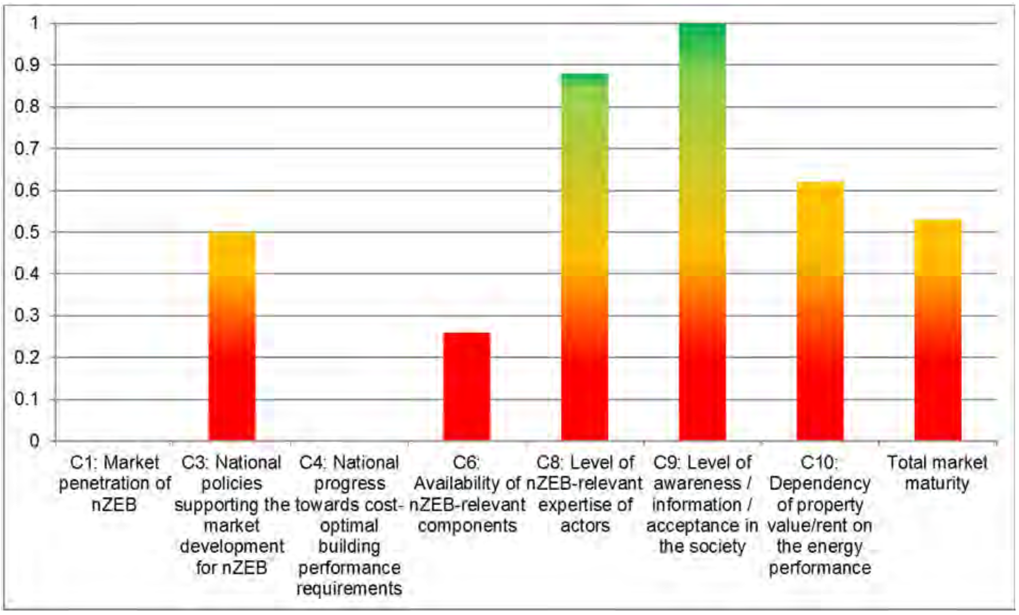


Figure 141 nZEB-tracker score for the Netherlands in 2014

C1: Market penetration of nZEB

- Dutch result: **-** ZEBRA average: **0.32**
- At the time of writing this report, the latest available data for energy performance of new buildings was from WoON 2012. Therefore, assessing this criterion for 2014 was not possible.

C3: National policies supporting the market development for nZEB

- Dutch result: **0.50** ZEBRA average: **0.52**
- Most relevant policies in the Netherlands seemed to be sufficient to support the development of the market for residential and non-residential nZEB in 2014.
- Subsidy programs to promote nZEB existed, but increasing the efforts appeared advisable.
- Programs for educating/training nZEB professionals were rare.

C4: National progress towards cost-optimal building performance requirements

- Dutch result: **-** ZEBRA average: **0.94**
- The Netherlands did not report cost-optimal levels so far.

C6: Availability of nZEB-relevant components

- Dutch result: **0.85** ZEBRA average: **0.83**
- nZEB-relevant building components are available in the Netherlands

C8: Level of nZEB-relevant expertise of actors

- Dutch result: **0.63** ZEBRA average: **0.63**
- The availability of professionals for the realization may restrict the further development of the nZEB market.

C9: Level of awareness / information / acceptance in the society

- Dutch result: **1.00** ZEBRA average: **0.94**
- The awareness for energy performance of buildings is rising in the society.

C10: Dependency of property value/rent on the energy performance

- Dutch result: **0.62** ZEBRA average: **0.74**
- Compared to site, living quality, aesthetics and financial aspects, the energy performance has low importance for customers' decision on buying/renting a real estate.

Maturity of Dutch nZEB market

- Dutch result: **0.56** ZEBRA average: **0.66**
- Data on the Dutch nZEB-market are rare.
- The availability of professionals for the realization may restrict the further development of the nZEB market.

10.6.3 SCENARIOS

Figure 142 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Netherland´s building stock is around 156 TWh in 2012. The scenario shows a slow-down of the energy demand of around 12% (around 1.5% yearly) from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 43% in the current policy scenario in the long term development between 2012 and 2050 and by 46% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Netherlands, the share of natural gas heating systems with almost 87% make up a significant share on the total energy demand for space heating, cooling and hot water in 2012 whereas the biomass heating systems and district heating makes up app. 8%. The share of non-delivered energy (i.e. solar and ambient energy) is increasing over time from around 1% of final energy demand in 2012 to around 9% in current policy scenario and 11% in ambitious policy scenario in 2050.

Figure 143 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 53% in current policy scenario and around 59% in ambitious policy scenario. The reduction of the primary energy demand is around 48% and 52% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating,

(3) the reduction in CO2-intensity of electricity generation.

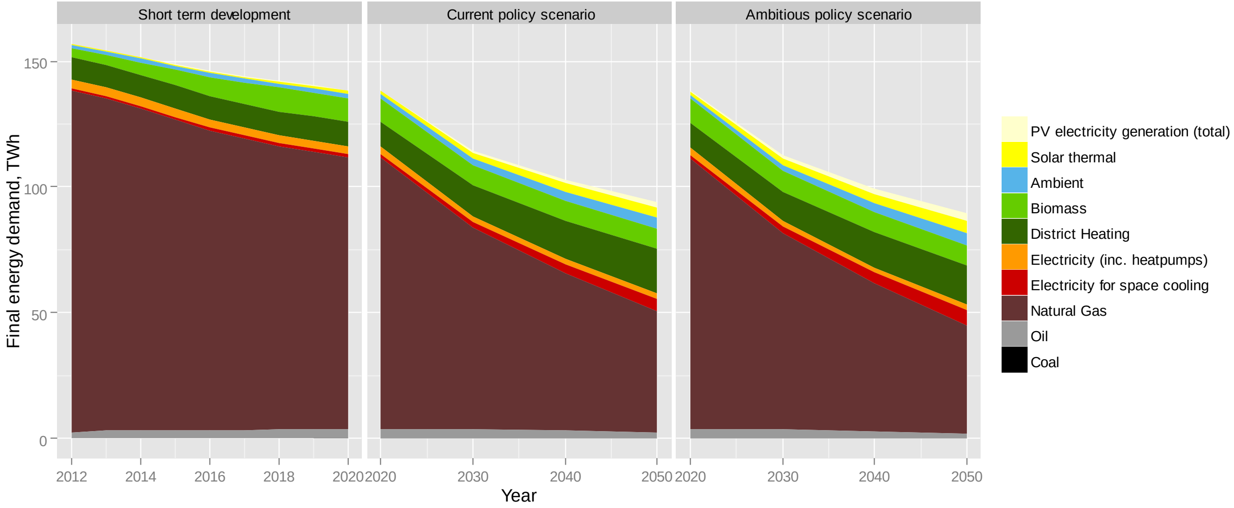


Figure 142 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

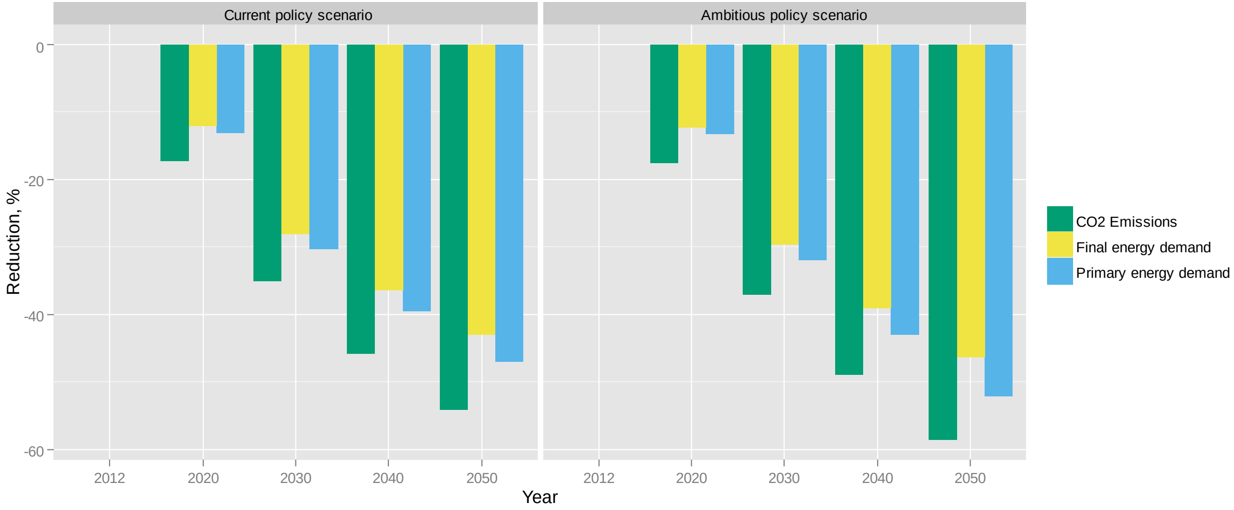


Figure 143 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

10.6.4 RECOMMENDATIONS

The Netherlands introduced energy performance requirements for buildings in 1995 and amend them regularly, considering studies on energy efficiency measures as well as sustainable and renewable heating, cooling and power supply solutions. The current building code “Energy Performance Standard for Buildings” (EPG) requires the calculation of the Energy Performance Coefficient as main indicator for the energy performance of buildings. It is calculated based on the primary energy demand of the building. Compliance with the minimal energy performance requirements is precondition to obtain the building permit for construction or renovation activities. Very energy efficient buildings have been realised in several demonstration projects, yet an official nZEB definition is not in place. Most of these projects are locally implemented by municipalities. The Netherlands have a new Energy Agreement which administers cooperation between, landlords, social housing cooperation, construction and energy companies. They have developed a new social housing project with a budget of 400 million Euros of subsidies to ensure the implementation of efficiency measures and meet the energy savings targets of the country. The country also tightened the energy performance coefficient for the new buildings from 2015 on. Financing for energy efficiency measures has been developed considering several successfully applied mechanisms from over the world. There are also suggested financing tools as a result of studies that have been completed for several Member States. Several platforms work on overcoming split incentives. For social housing, the Housing Valuation System has been developed. It encourages investments in energy efficiency measures with an EPC-based scoring system. Other schemes investigate the distribution between costs and benefits of energy efficiency measures, e.g. sustainable leases of non-residential buildings. It is important to put an emphasis on support for vulnerable groups to ensure the affordability of fuel for heating but also pay attention to the general condition of their homes such as insulation and heating demand. Nationwide actions with support of mainly public budgets are required to raise the awareness for and fight fuel poverty.The following pages will outline recommendations for the further development of policy instruments, based on 6 different categories: (A) Legislative and regulatory instruments, (B) economic instruments, (C) communication, (D) quality of action, (E) new business models and (F) social issues.

NL-A1 - Cost optimal approach to renovation

NL-A2 - Renovations to be steered towards nZEB requirements

NL-B1 - Offering preferential mortgage to energy efficient homes, or an already existing mortgage with extension, in order to finance energy efficiency improvements

NL-B2 - Stimulating the market uptake of Energy Performance Contracting by renovating the public buildings in an ESCO-framework

NL-C1 - Increasing the demand for EPC by the final customers through information and education

NL-C2 - Public buildings to lead by example

NL-C3 - Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

NL-C4 - Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

NL-D1 - Encouraging the demand for energy savings by final customers by making energy performance examinations obligatory

NL-E1 - Full deployment of ESCOs

NL-E2 - Establishing non-profit ESCOs with lower profitability demands

NL-F1 -Allocation of public budgets from income and heating subsidies to effective renovation measures

NL-F2 - Need for a long-term strategy for fuel poverty alleviation on the national level

NL-F3 - Allocating higher percentage of the EU funds in order to implement energy efficiency measures in vulnerable households

NL-F4 - Explicitly define energy poverty and set up monitoring mechanisms

NL-F5 - Providing rehabilitation for poor districts

#NL-A1 - Legislative and Regulatory Instruments

Cost optimal approach to renovation of the building stock

Presentation of the results of cost-optimality analysis should be in accordance with the Commission's guidelines, identifying energy performance levels to be attained in different building types. Note that costs and savings will change over time, as technologies develop, as experience leads to price reductions, and as energy prices change, so cost optimality calculations need to be revisited every 3-5 years.

Cost-optimal renovations must quickly become the norm, and all policies and investment decisions must be geared towards achieving the full economic potential in all building renovation activity going forward. Furthermore, costs can be brought down by scaling up activity levels, both at a local level through targeted initiatives generating larger volumes of renovation activity, and nationally through the policies and support measures that the renovation strategies should put in place[156].

Presentation of the results of cost-optimality analysis should be in accordance with the Commission's guidelines, and revisited every 3-5 years

Example – Brussels Capital Region Cost Effective Approach to Renovation

Brussels Capital Region presents, in their renovation strategy under Article 4 of the EED, a detailed cost-optimality analysis. Furthermore, they outline some general conclusions about the applicability of certain renovation measures, split according to architectural/structural measures, and technical installations. For example, insulation of walls and roof, replacement of single-glazed windows with double glazing, strengthening air-tightness and installation of condensing gas boilers are considered generally cost-effective. For multi-family units with 20 or more apartments, production of heat in a central boiler plant is considered most efficient.

For offices, comfort ventilation with heat recovery is a viable retrofit measure provided a double-flow type network ventilation already exists. Variable speed circulators for both hot and cold are recommended, as are lighting installations comprising T5 luminaires, electronic ballast,

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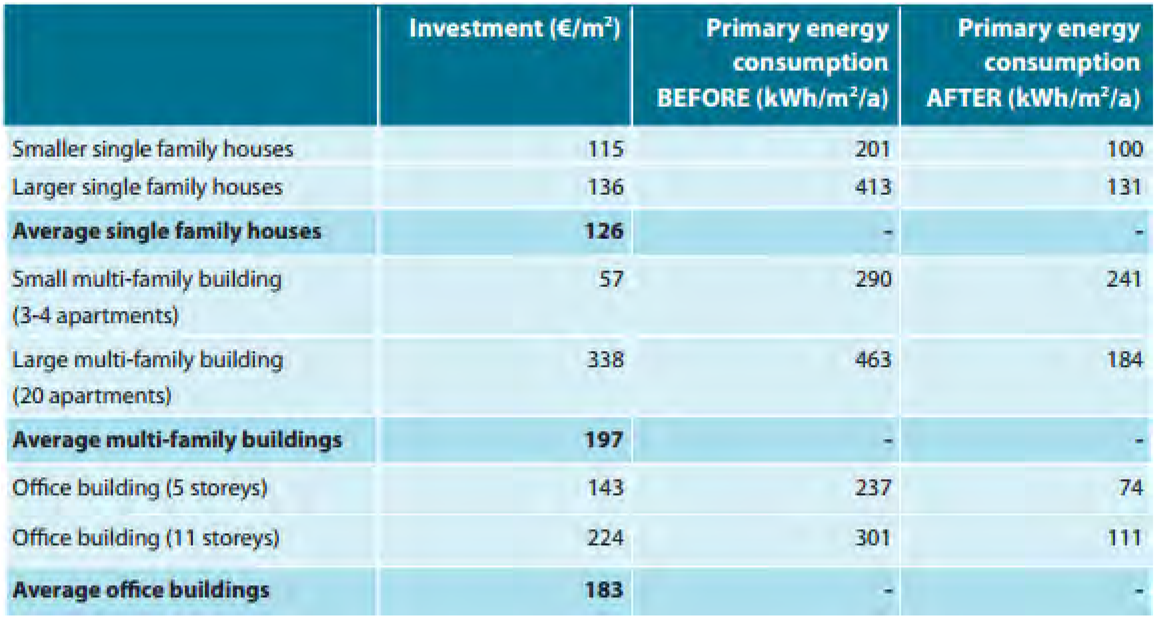
[156] BPIE (2014) *Renovation Strategies of Selected EU Countries*

http://bpie.eu/wp-content/uploads/2015/10/Renovation-Strategies-EU-BPIE-2014.pdf presence detectors and daylight dimming. PV is also considered cost-effective.

The table below summarises the typical investment costs (in €/m2) and resulting impact in terms of primary energy consumption for different building types. [157]



	Investment (€/m²)	Primary energy consumption BEFORE (kWh/m²/a)	Primary energy consumption AFTER (kWh/m²/a)
Smaller single family houses	115	201	100
Larger single family houses	136	413	131
Average single family houses	**126**	-	-
Small multi-family building (3-4 apartments)	57	290	241
Large multi-family building (20 apartments)	338	463	184
Average multi-family buildings	**197**	-	-
Office building (5 storeys)	143	237	74
Office building (11 storeys)	224	301	111
Average office buildings	**183**	-	-

#NL-A2 - Legislative and Regulatory Instruments

Renovations to be steered towards nZEB requirements

In terms of energy efficiency, a comprehensive and extensive renovation is the best option, but this is very often not financially feasible. This is why renovations are often carried out in multiple stages. This frequently causes problems; sometimes individual renovation stages are executed in the wrong order, and other times future decisions are either improperly accounted for or are not taken into account at all. The so-called lock-in effect, which would effectively prevent the attainment of the 2030-2050 targets, must be avoided when carrying out extensive renovations. In order to mitigate lock-in effects, legislative measures need to make the least efficient alternatives (not compliant with nZEB standards) less attractive or forbidden.

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[157] BPIE (2014) *Renovation Strategies of Selected EU Countries*

http://bpie.eu/wp-content/uploads/2015/10/Renovation-Strategies-EU-BPIE-2014.pdf

Provide building owners and investors with tailored advice according to specific renovation roadmaps in order to avoid lock-in-effects.

Example - 2014: "Sanierungsfahrplan Baden-Württemberg"

The German state Baden-Württemberg provides an individual building renovation roadmap that summarises for the property owner coordinated packages of measures to achieve a deep energy renovation. Useful bundles of renovation measures are defined, which should be carried out simultaneously in line with the individual preferences of the building owner. It includes as well the before-and-after comparison of energy costs and CO2 emissions and detailed description of the measures, such as preparatory measures, required U values, further co-benefits, possible funding and additional explanations (Pehnt et al. 2014) to avoid lock-in effect. For instance, if a roof is renovated, the roof overhang shall be designed in such a way that the future expected façade insulation can be smoothly applied.

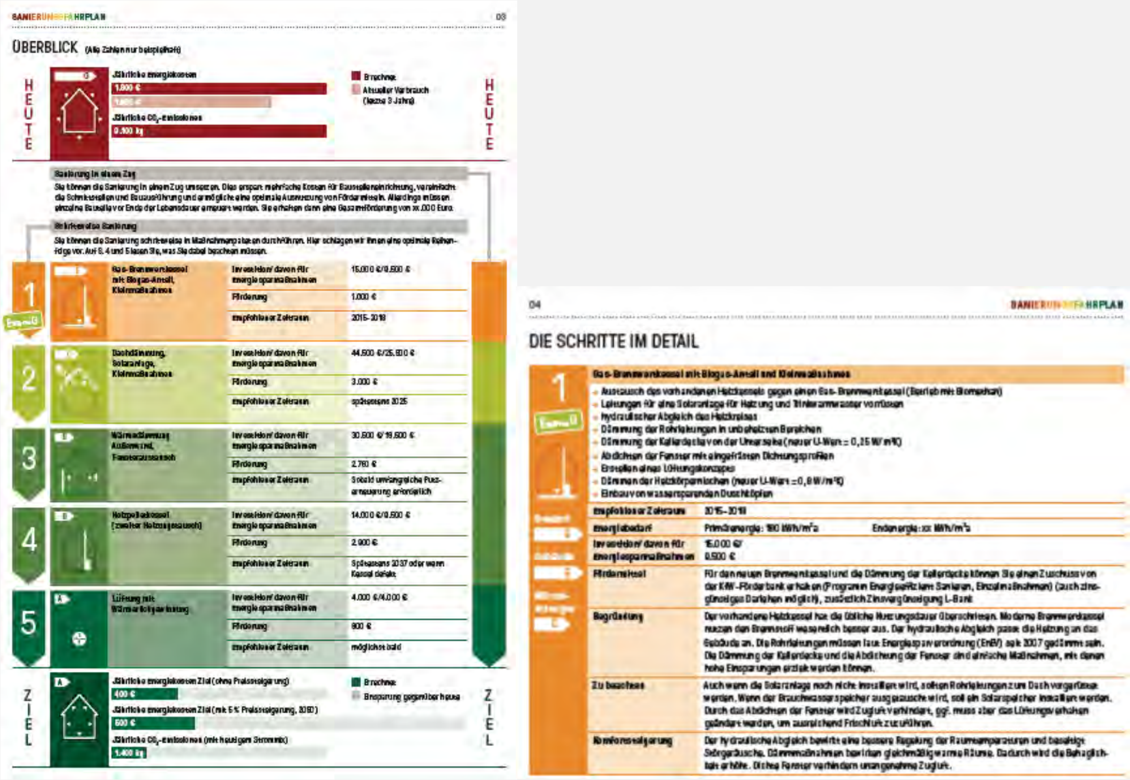

Figure 144: Example pages of the "Sanierungsfahrplan Baden-Württemberg" (Pehnt et al. 2014)[158]

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[158] https://um.baden-wuerttemberg.de/de/energie/beratung-und-foerderung/sanierungsfahrplan-bw/

#NL-B1 - Economic measures

Offering preferential mortgage to energy efficient homes, or an already existing mortgage with extension, in order to finance energy efficiency improvements

Energy mortgages can be offered as a preferential mortgage to energy efficient homes or an already existing mortgage with extension in order to finance energy efficiency improvements. A bank in the Netherlands has already introduced similar sustainability aspects to its home mortgage process. Additionally, interest rate falls by 0.1 percent for each increase in the energy efficiency label The mechanism has a great potential to encourage existing and future mortgage users therefore, can be extended as strategy for more banks in the Netherlands.

Energy mortgages can be differentiated into:

(1) Energy Efficient Mortgage (EEM), which is a mortgage that credits a home's energy efficiency in the mortgage itself and thereby increases the home buying power of consumers and capitalizes the energy savings in the appraisal.

(2) Energy Improvement Mortgages (EIMs), which are used to purchase or re-finance existing homes that will undergo energy efficiency upgrades. They allow borrowers to include the cost of energy-efficiency improvements to an existing home in the mortgage without increasing the down-payment by using the money saved in utility bills.[159]

Encourage banks to support energy efficiency measures, for example through preferential mortgages

Example – Triodos "a sustainable bank"

In the Netherlands, Triodos, a sustainable bank concerned with social and environmental impacts, has introduced sustainability aspects in its home mortgage underwriting process, and partly bases its mortgage interest rates on these criteria. The mortgage interest rate falls 0.1 percent for every increase in the energy efficiency label, while homes with an A++ label are allowed to have €8,000 more financing as compared to regular homes.

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[159] JRC, (2014) Financing Building Energy Renovations, Current experiences & ways forward. Accessible at: http://iet.jrc.ec.europa.eu/energyefficiency/publication/financing-building-energy-renovations-2014

#NL-B2 - Economic measures

Stimulating the market uptake of Energy Performance Contracting by renovating the public buildings in an ESCO-framework

Energy Performance Contracting (EPC) is a form of 'creative financing' for capital improvement which allows funding energy upgrades from cost reductions. Under an EPC arrangement an external organisation (ESCO) implements a project to deliver energy efficiency, or a renewable energy project, and uses the stream of income from the cost savings, or the renewable energy produced, to repay the costs of the project, including the costs of the investment. Essentially the ESCO will not receive its payment unless the project delivers energy savings as expected.

The approach is based on the transfer of technical risks from the client to the ESCO based on performance guarantees given by the ESCO. In EPC, the ESCO remuneration is based on demonstrated performance; a measure of performance is the level of energy savings or energy service. EPC is a means to deliver infrastructure improvements to facilities that lack energy engineering skills, manpower or management time, capital funding, understanding of risk, or technology information. Cash-poor, yet creditworthy customers are therefore good potential clients for EPC.

Ensure stability and consistency of funding directed to energy efficiency in general and NZEB in particular

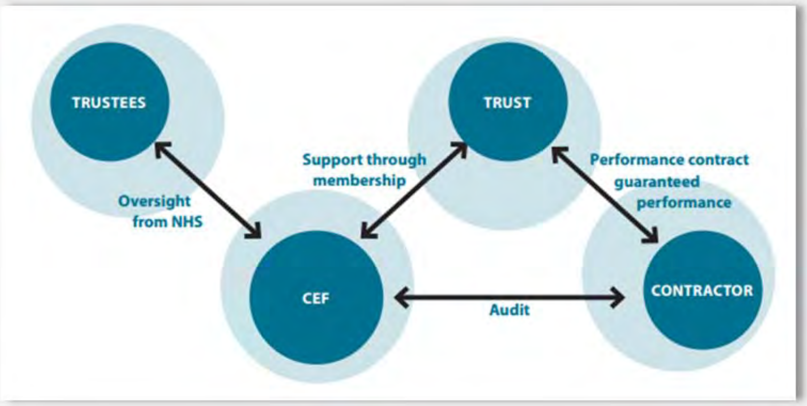
Example: The National Health Service

The National Health Service (NHS) is one of the largest energy consumers in the UK. It has adopted a short-term target to reduce its 2007 carbon footprint by 10% by 2015, on a path to long-term target reductions of 34% in 2020 and 80% in 2050, in line with the UK's emission targets.

The Carbon and Energy Fund (CEF) has been set up as a non-profit making venture and is a NHS initiative available for any qualifying NHS Trust (and other bodies within the UK health sector) wishing to improve the energy performance of their buildings. The CEF is the most widely used framework across the UK83 that assists the NHS in meeting its energy efficiency and carbon targets. A fund of over £300M (€425M) is available for any qualifying NHS body to apply for. Participants do not pay any upfront costs as the investment is repaid through energy saving

The main objective of the Fund is to finance and support projects within the NHS that ensure a certain level of carbon savings for a given level of investment. The idea came from 28 Trusts that had previously undertaken and implemented energy services performance contracts underwritten by guaranteed savings. They saw the opportunity to share their experience with other Trusts, to reduce costs and speed up what can be quite complex procurement processes. A board of trustees from the NHS and the Department of Health procurement hub was established to supervise the CEF.

The CEF provides Trusts with an energy services performance contract that guarantees an agreed level of energy and carbon savings. The contract carries the costs of the design and procurement process and pays the up-front costs of installing energy-efficient improvements. The costs of the improvements are then repaid throughout the life of the contract with guaranteed energy savings endorsed by the contractor in the CEF contract. [160]



#NL-C1 - Communication

Increasing the demand for EPC by the final customers through information and education

In order to build a greater interest by the customer side, the Netherlands need policies which are focusing on encouraging the demand for EPC by the final customers. At this point, replicating similar projects done in other countries and showed a positive result can be taken for implementation. Another important issue is information and education. Because,

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[160] http://carbonandenergyfund.net/The%20Carbon%20and%20Energy%20Fund%20and%20how%20it%20works.pdf

implementing energy measures requires demand from the user side and if users are not provided with enough direct information regarding potentials and technical or business risks, it is possible that they will stay sceptical about implementing measures or investing in energy efficiency.

Increase demand for EPCs through information and education

#NL-C2 – Communication

Public buildings to lead by example

According to Article 5 of the Energy Efficiency Directive (EED), the public sector should lead by example, providing "best practice" cases, testing and developing new building techniques and financing models to be applied. In other words, renovated public buildings should be frontrunners in terms of quality, techniques and ambition.

According to EED's article 5, the Netherlands have chosen the default approach for setting and reporting on the renovation of its public building stock. Accordingly, the renovation of 3% of the total floor area per year, would lead to 2% of energy savings per year. The Netherlands also include historical buildings that are used as public buildings into their energy savings targets. For the buildings owned by the Government Buildings Agency, total energy savings for the period of 2014-2020 is estimates to be 700 TJ. The umbrella organization of municipalities is responsible for these renovations.

Ensure a deep renovation of the public building stock

Example – RE:FIT London

The Dutch government can take an example on this from UK's RE-FIT programme. The programme helps public organizations to retrofit their buildings with an Energy Performance Contract. The programme provides a list of EPC providers and third party financing.

RE:FIT London is a tried and tested programme to help make London's non-domestic public buildings and assets more energy efficient. Established in 2008, the programme not only reduces carbon emissions, but also results in large guaranteed cost savings for the public sector (typically around 28 per cent).

RE:FIT London helps a range of organisations, including as London boroughs, NHS bodies, central government departments, schools and other educational establishments and cultural and heritage organisations to implement retrofit projects. It does this through:

- Information: an expert team providing free of charge, end to end support needed to get projects up, running and successfully implemented
- An easy framework of energy service companies (ESCOs), which saves time and resources for organisations that are procuring retrofit services and works and – because it is an energy performance contracting framework - guarantees energy and cost savings[161].

#NL-C3 - Communication

Promote demonstration projects to exemplify the benefits and viability of highly performing buildings

Increasing the number of demonstration projects. A few municipalities in the Netherlands have been working on demonstration projects and this could create a network among municipalities nationwide in order to learn from each other and share best practices.

Demonstration projects can lead the way in Europe by illustrating the feasibility of a more energy efficient building stock. There is a great deal of interest on the part of specific segments of the population as well as the general public for touring demonstration projects.

Ensure the enhancement of appropriate testing, measuring and assessment techniques

Example: BEN

A Flemish architect's federation (NAV) – effectively demonstrate new nZEB projects through the BEN-architect website [162]. BEN stands for Bijna-EnergieNeutraal = Nearly Zero Energy

Extracted from the website[163]:

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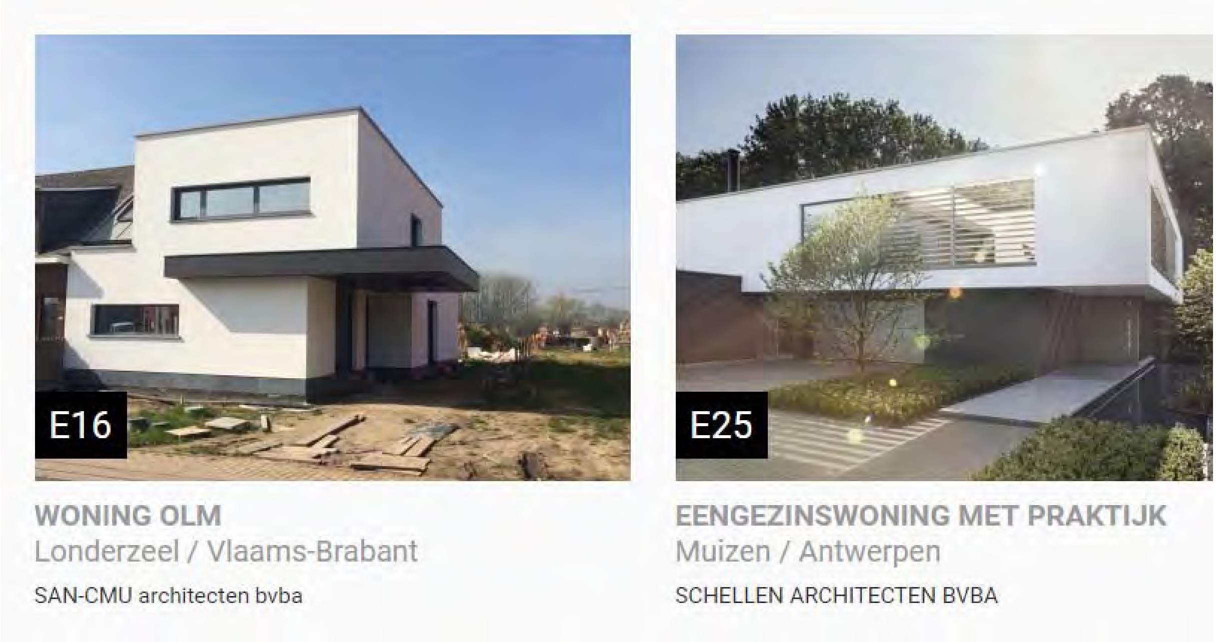
[161] https://www.london.gov.uk/what-we-do/environment/energy/energy-buildings/refit%2520/what-refit-london

[162] http://ben-architect.be/projecten/



WONING OLM
Londerzeel / Vlaams-Brabant
SAN-CMU architecten bvba

EENGEZINSWONING MET PRAKTIJK
Muizen / Antwerpen
SCHELLEN ARCHITECTEN BVBA

#NL-C4 – Communication

Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

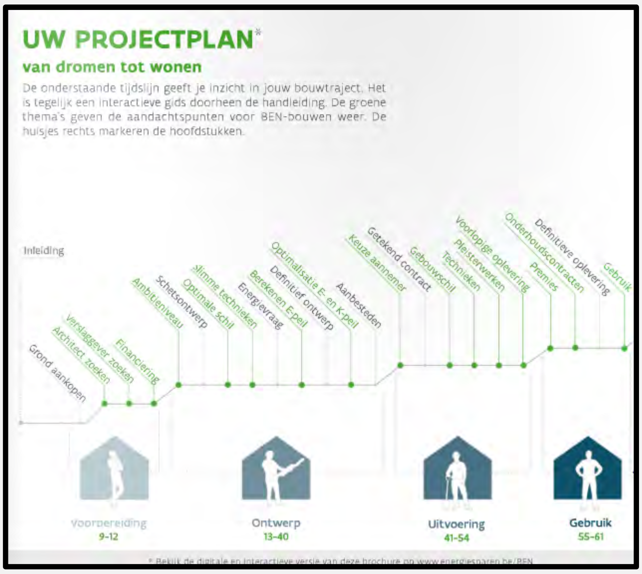
A big barrier to a rapid market uptake of nZEBs is the lack of knowledge and accessible information on different levels. Effective information campaigns targeting different actors and stakeholders (e.g. house owners, building professionals, technical staff of public administrations…) are needed. Easy grasping guidelines or how-to manuals can spur this development.

Encouraging the demand from customer side should also be supported with dissemination of information and education. In this case informative fairs, workshops or public hearing events can be organized with the help of public and private actors related to the topic. For instance, in the UK there is annual Big Energy Saving Week, which is national campaign that delivers information through the media in order to raise awareness of energy and efficiency issues

Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

***Example* - Guidelines for future building owners how to build new NZEB in Flanders**

The Belgian region of Flanders has produced a “practical guide for building your nZEB house”[164] to support future home owners through the process of prepare, design, execute and use an nZEB dwelling.



UW PROJECTPLAN*

van dromen tot wonen

De onderstaande tijdslijn geeft je inzicht in jouw bouwtraject. Het is tegelijk een interactieve gids doorheen de handleiding. De groene thema's geven de aandachtspunten voor BEN-bouwen weer. De huisjes rechts markeren de hoofdstukken.

* Bekijk de digitale en interactieve versie van deze brochure op www.energiesparen.be/BEN

#NL-D1 – Quality of Action

Encouraging the demand from final customers for energy savings by making energy performance examinations obligatory

In the Netherlands, adopting energy saving measures for the building is only obligatory for the users/building owners that are selling, renting or renovating (more than 25% of the property/deep renovation). Therefore, the building owners that are not planning on changing their property, are not encouraged to take energy saving measures for their property[165].

In 2015, around 4.5 million residents, who did not yet have an EPC, received a temporary energy label for their building in form of a letter[165]. This initiative intended to raise awareness

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[164] http://www.vlaanderen.be/nl/publicaties/detail/praktische-bouwgids-voor-jouw-ben-woning-1-exemplaar

[165] Implementing EPBD Featuring Country Reports, 2016

on energy efficiency measures for the buildings and to encourage users to check their options for implementing certain measures for energy saving. These users can start with energy performance examinations for their property to see the possible measures and financial incentives to implement them[166]. Making this process obligatory can be an effective way to encourage more and more users.

#NL-E1 – Incentivize the market

Full deployment of ESCOs

Development of ESCOs can be taken as a recommendation as in the Netherlands the market for ESCO is at a beginner level. According to NEEAP 2014 Netherlands, it is expected that ESCO services will be widely used in near future because the working method of ESCO fits with a trend towards further cooperation. These market actors have received much attention, largely due to their role as a market driver and high impact on energy efficiency sector growth. In most developed markets the ESCO assumes the costs of the equipment, process replacement and building retrofit through an energy performance contract (EPC). Payback is defined as a percentage of energy savings as stipulated in the EPC. Whilst geared towards removing finance barriers faced by the end-user, ESCOs require financing both for themselves as ventures and for the projects they undertake.

Encourage the usage of ESCOs to overcome financial barriers

#NL-E2 – Incentivize the market

Establishing non-profit ESCOs with lower profitability demands

Regarding the feasibility of ESCO business case, it can be complex to implement when there are high profitability demands and commercial incentives. Therefore, non-profit ESCOs can be established which offer lower profitability demands[167].

Support the establishment of non-profit ESCOs

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[166] Transparense, 2015, Towards Transparent Energy Performance Contracting Markets

[167] NeZeR, 2016, Report on Successful Business models for NZEBR

Example - Aberdeen Heat and Power

Aberdeen Heat and Power (AHP), an independent energy services company (ESCo), was developed in 2002.

"In the UK centralized energy market, DH investment is unattractive to commercial investors, and local authorities lack capacity and expertise in energy provision. In Aberdeen, the politics of fuel poverty converged with climate politics, creating an a-typical willingness to innovate through improvisation. The welfare priority resulted in creation of a non-profit locally-owned ESCo, using cost- rather than market-based heat tariffs."[168]

"Aberdeen Heat & Power was set up with the specific aims of alleviating fuel poverty and reducing the carbon footprint in hard to treat properties through installation of efficient heating systems. The aim was to replace the original costly and inefficient electrically heated systems, with affordable and controllable systems. In the multi-storey blocks this has been achieved through installation of a range of piping to all flats."[169]

#NL-F1 – Social Issues

Allocation of public budgets from income and heating subsidies to effective renovation measures

Fuel poverty can be correlated with low household income, high energy cost and energy inefficient homes and can be tackled by income increase, fuel prices regulation and energy efficiency improvements in buildings. Energy costs are growing faster than household income. Therefore, energy subsidies and direct financial support for household heating cannot provide a sustainable long-term solution to the fuel poverty problem. These measures require continuous public budget allocation without generating added value or economic growth. The continuous expenditure from public budgets only preserves the status quo.

However, vigorous energy renovation measures of fuel poor homes can give a long-term sustainable answer to fuel poverty. These measures address the root of the problem and result in reduced energy costs and/or improved thermal comfort in homes. Moreover, the implementation of energy efficiency measures can create or maintain jobs, reduce illness,

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[168] http://www.heatandthecity.org.uk/__data/assets/pdf_file/0008/168245/Abd_En_Pol_Proof.pdf

[169] http://www.vibes.org.uk/winners-stories/2015/aberdeen-heat-and-power/

rehabilitate poor districts and therefore contribute to social inclusion. Results from implemented energy renovation programmes targeting the fuel poor in some EU countries demonstrate these positive effects.[170]

Allocate money from temporary subsidies to long-lasting energy efficiency measures

Example: Ireland - The Warmer Homes Scheme

The Warmer Homes Scheme is "a vital pillar in the Irish Government strategy to tackle energy affordability". This scheme – now known as the Better Energy Warmer Homes scheme – targets vulnerable and fuel poor homes, and provides advice and funds for the adoption of energy efficiency measures. The scheme is administered by the Sustainable Energy Authority of Ireland (SEAI) and involves local community organisations. The energy efficiency interventions are totally funded by the scheme and include measures such as: attic insulation, draught proofing, energy efficient lighting and cavity wall insulation.

From 2000 to 2013 over €82 million were distributed through the Warmer Homes Scheme and more than 95,000 homes were supported. Between 2006 and 2009, the benefited households saved on average €85.83 per year. Additionally, only for 201091, the implemented measures from the Warmer Home Scheme resulted in saving 25 GWh and reducing CO2 emissions by 33,000 tonnes.

The scheme resulted in a substantial percentage of the beneficiaries being lifted out of fuel poverty, as it is implied by the indicators used to measure it. Specifically, the percentage of the beneficiaries who were unable (or who found it difficult) to pay the utility bills on time showed a significant decrease; the rates dropped from 48% (before the interventions) to 28%. Additionally, remarkable improvement was observed in rates regarding the ability of the beneficiaries to keep their home adequately warm. Before the implementation of the energy efficiency measures, only 27% of the families with children were able to keep a comfortable temperature at home, while after the interventions this percentage increased considerably to 71%.

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[170] BPIE. (2014). Alleviating Fuel Poverty. Accessible at: http://bpie.eu/publication/alleviating-fuel-poverty-in-the-eu/

#NL-F2 – Social Issues

Need for a long-term strategy for fuel poverty alleviation on the national level

Long-term policy predictability is needed because of the size of the problem and its importance in reaching the EU socio-economic, energy and climate goals. A comprehensive and systematic approach is needed to handle this complex problem. Investing in fuel poverty alleviation can be a great way to simultaneously reduce poverty, social problems, spur the economy and generate jobs.

Fuel poverty is a general existing problem for most EU Member States. Although the Netherlands have pilot projects to improve the alleviation of fuel poverty in some districts, these actions need to be undertaken nation-wide in order to provide best-practices and follow a bonding approach in the EU as well.

According to the minimum income standard definition, households face fuel poverty if the energy expenditures are higher than 10% of the household's income. Following this definition, approximately 750,000 households are living in fuel poverty, which equals to approximately 10% of the households in the Netherlands[173].

Implement a long-term strategy to eliminate fuel poverty

#NL-F3 – Social Issues

Allocating higher percentage of the EU funds in order to implement energy efficiency measures in vulnerable households

Case studies of EU countries financing measures against fuel poverty indicate that - even though energy efficiency measures have proven to be the most sustainable solution to the fuel poverty problem – they receive lower funding compared to income and fuel price support schemes. The BPIE study analyses the Cohesion Policy funds for the periods 2007-2013 and 2014-2020 and shows that a significant share -higher than the previous period- of the Cohesion Policy budget 2014-2020 can be used for energy efficiency actions. Therefore, all three Cohesion Policy financial instruments may support the energy renovation of buildings and in particular measures targeting fuel poor and vulnerable consumers.

Utilize EU funds to implement energy efficiency measures in vulnerable households

Example - France – Renovation Programme of 800,000 Social Housing Dwellings

In order to support social cohesion and respond to the economic crisis, in 2009 the European Regional and Development Fund (ERDF) regulation was amended to allow for up to 4% of national ERDF resources to be invested in energy efficiency improvements in existing housing in all Member States. France, taking full advantage of this revision, committed €320 million of the ERDF to renovate 800,000 social housing dwellings with low energy performance by 2020 (Grenelle Law). Many regions had already invested all their share of the ERDF in the programme before March 2011 and they provided additional funds to the original ERDF.

#NL-F4 – Social Issues

Explicitly define energy poverty and set up monitoring mechanisms

Energy poverty is a major problem for Europe, as between 50 and 125 million people are unable to afford a proper indoor thermal comfort. Despite the fact that there is no common European definition, the importance of the problem as well as the severe health impacts caused by fuel poverty are widely recognised. Energy poverty is still the little sibling to the economic and environmental aspects of new constructions and building renovations.

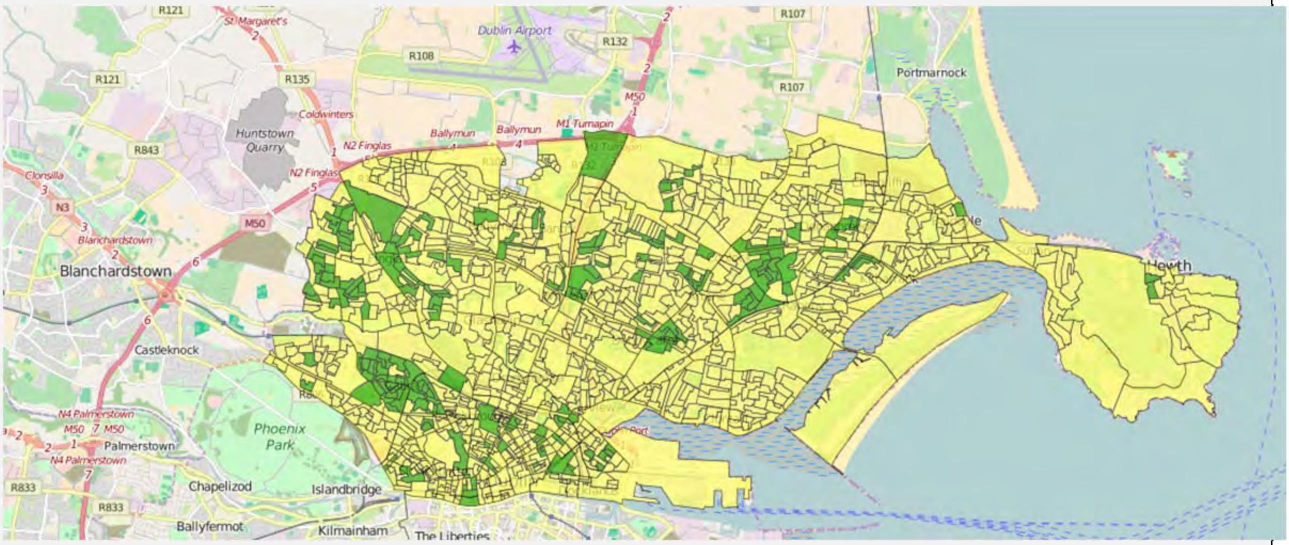
Only four European countries (France, Ireland, Slovakia and UK) have an official definition for energy poverty.

Better data would lead to better understanding of the social challenge. It would also allow to better assess the effectiveness of strategies to tackle energy poverty. This would be to better understand the challenge, and assess effectiveness of strategies to tackle energy poverty. Data for energy poverty must be enhanced and standardized across Europe.

Set up a framework to enable qualitative data of fuel poverty, including a monitoring mechanism

Pilot projects: The Irish Energy Action

The Irish Energy Action, in partnership with the EU-project Episcope, have developed an EPC mapping tool. The interactive map over Dublin illustrates different building characteristics (including energy poverty indicators) of different neighbourhoods. The data is aggregated to defined boundaries, namely small areas and electoral divisions. Small areas typically comprise 50-200 dwellings and electoral divisions include clusters of small areas.[171] This mapping allows for local policy making and strategy development alleviating energy poverty from a district approach.



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[171] http://energyaction-static.s3-website-eu-west-1.amazonaws.com/index.html

#NL-F5 – Social Issues

Providing rehabilitation for poor districts

In fact, the reduction of energy bills is not necessarily the main benefit of renovating poor homes. Even if energy costs are kept at the same level, the inhabitants gain significantly in terms of having a higher indoor thermal comfort and thus avoiding associated illness or premature death due to the impact of low temperatures.

Therefore, the benefits are witnessed at a societal level by reducing the need for medical assistance and, at the same time, by having healthier citizens able to contribute more to the personal and societal welfare. Last but not least, the energy renovation of poor districts may give an important sign of social inclusion to people living at the edge of society.

To a larger extent, it is well-known that renovation activities have a high job creation potential due to a high job intensity required in the construction sector. Therefore, by involving unemployed active people living in poor districts into the renovation processes of their homes, a virtuous circle may be created that can further contribute to their faster social inclusion by simultaneously offering jobs and better homes[172].

Studies in the Netherlands try to reach the fuel poverty target groups and define the actual problems. Additionally, some of the banks are eager to provide monetary or non-monetary incentives to users living in fuel poverty in accordance with information and education on how to use energy in the household more efficiently[173].

The French government implemented a financial supporting scheme for low income households and aims to achieve thermal renovation, improved quality of life and purchasing power for the residents in need. The programme is called Habiter Mieux and it consists of a one-stop energy renovation shop that provides all needed services for the households that want to benefit from it[174].

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[172] BPIE. (2014). Alleviating Fuel Poverty. Accessible at: http://bpie.eu/publication/alleviating-fuel-poverty-in-the-eu/

[173] Fuel Poverty – Instruments and Approaches in the Netherlands

[174] BPIE; 2015, Renovation in Practice

10.7 SLOVAKIA

10.7.1 BUILDING PERFORMANCE MARKET DATA

10.7.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for EU countries. Slovak Republic belongs to the EU countries with average rate of renewal of the building stock: in 2014 about 0.85 % of the building stock was renewed. Since 2011 the annual rate of new dwellings is 15.000 dwellings. Two thirds of newly constructed dwellings in the Slovak Republic are in family houses.

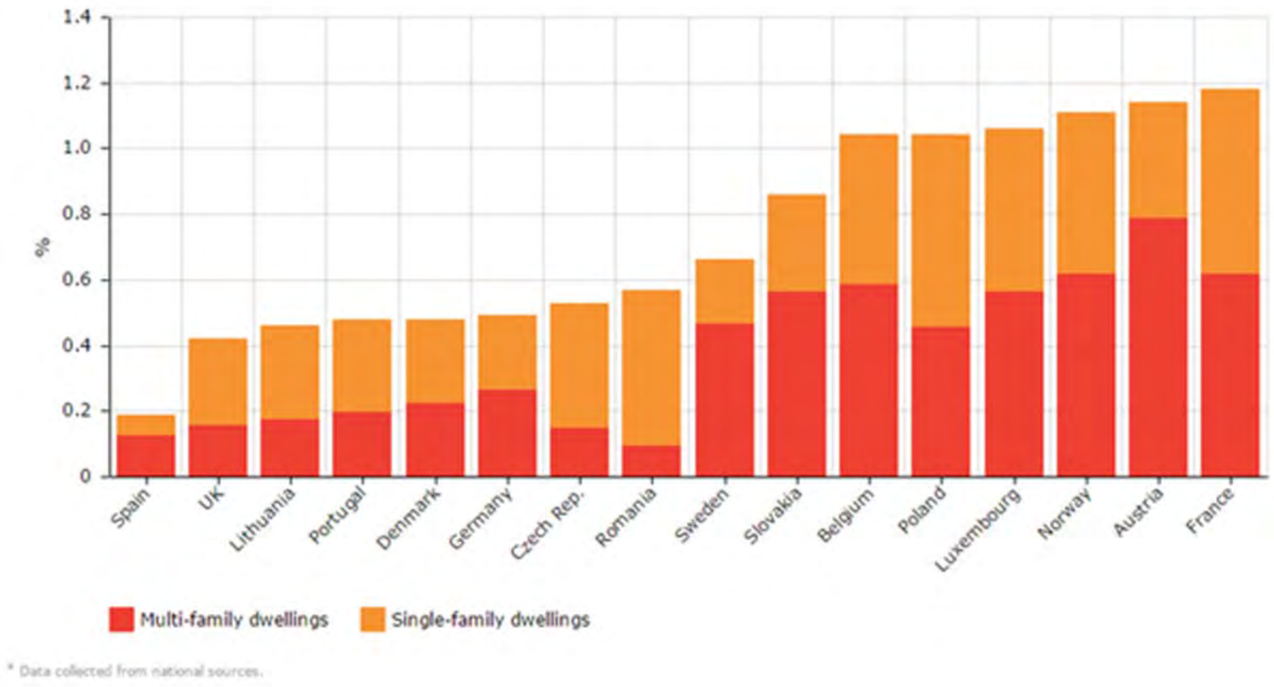

Figure 145 Share of new multi- and single-family dwellings in residential stock in 2013

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (nZEB). According to the Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net-zero energy buildings / Plus energy buildings , passive houses
2. nZEB buildings according to national definitions
3. Buildings with energy performance better than required by the current regulations
4. Buildings constructed/renovated according to national minimum requirements

The radar graph levels used for the Slovak Republic are shown in the table below and defined as such in the database. A new Decree 364/2012 of the MDVRR entered fully into force in January 2013, together with the Act 300/2012 on the Energy Performance of Buildings (EPB Act) which both amended and supplemented Act 555/2005. This brought a change to the definition of major renovations, introduced the definition of Nearly Zero-Energy Buildings (NZEBs), as well as responsibilities related to the preparation of the NZEB national action plan and a global indicator for primary energy use instead of total energy use in buildings. The energy demand for heating is defined by the Slovak standard STN 73 0540-2: 2012. Since 2013 the standard value of energy demand for heating in residential buildings (A/V $\leq$ 0.3) has been $Q_{H,nd,N}$ = 50 kWh/m^2.y, the recommended value $Q_{H,nd,r1}$= 25 kWh/m^2.y has become mandatory since January 2016 and the target value $Q_{H,nd,r2}$ = 12,5 kWh/m^2.y shall become mandatory since January 2021. Similar kind of situation is with the .primary energy global indicator. For residential <u>low energy buildings</u> this indicator was 126 kWh/m^2.y, as of January 2016 due to switching from low energy to <u>ultra low energy</u> the value has dropped to 63 kWh/m^2.y and as of January 2021 the mandatory global indicator of the category of <u>nZEB</u> residential buildings will be 32 kWh/ m^2.y (class A0).

For single family <u>low energy</u> houses the global indicator was 216 kWh/m^2.y , as of January 2016 the global indicator for <u>ultra low energy</u> houses dropped to 113 kWh/m^2.y and as of January 2021 the mandatory global indicator of the category of <u>nZEB</u> single family houses will be 54 kWh/ m^2.y (class A0).

Translating the definition of nZEB radar in the case of the Slovak Republic gives in relation to the standard STN 73 0540-2: 2012:

1-Better than nZEB (net ZEB or positive house)	Any new buildings designed according to STN 73 0540-2: 2012 and other energy related Slovak standards with considerably better energy performance than nZEB as defined by the above mentioned standard (passive house, zero energy or positive house)
2-National official nZEB definition	nZEB buildings as defined by the STN 730540-2: 2012 and other energy related Slovak standards. The nZEB definition is valid and mandatory as follows: all newly constructed public buildings since 01/01/ 2019 all newly constructed buildings since 01/01/ 2021
3-Better than current building code	New buildings designed according to minimum standard requirements of STN 73 0540-2: 2012 and other energy related Slovak standards. Required parameters for Ultra low energy buildings are mandatory as of January 2015.
4-According to building code	New buildings designed according to minimum standard requirements of STN 73 0540-2: 2012 and other energy related Slovak standards. Required parameters for Low energy buildings are mandatory as of January 2013. Other buildings, also renovated buildings .

As already mentioned the current regulations have not enforced nZEB so far. Low energy buildings and few passive houses having parameters comparable or better than nZEB were built as a result of voluntary decision. They are labeled as "nZEB" in the chart fig.110. The share of these new buildings in the housing stock is however very low and the estimation of amount of these buildings is very rough..

"Better than current building code" newly built since 2015 are so called "ultra low energy" buildings.

The parameters are defined in the standard STN 730540-2: 2012.

Better than nZEB however are not defined in the standard. The nZEB class A0 is the highest one and has got only the upper threshold, the lower threshold is not defined.

Passive houses are not defined by the Slovak regulations. The German definition is usually referred to.

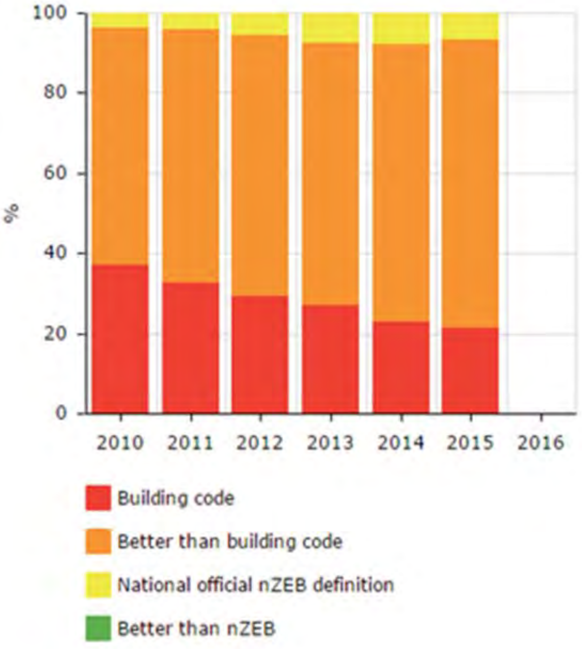

Figure 146 Distribution of new dwellings according to the nZEB radar graph – Slovakia

Source: ZEBRA

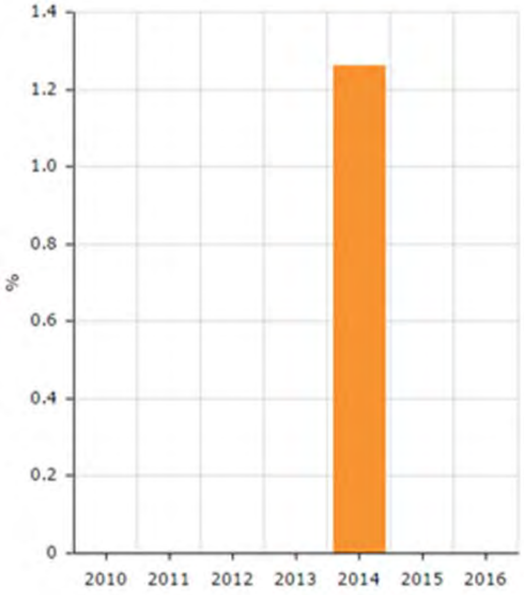

Figure 147 Equivalent major renovation rate – Slovakia

Source: ZEBRA

10.7.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Slovakia, it has been collected data of 9 nZEBs or high energy efficient buildings which were constructed recently. 8 out of the 9 are new buildings and 1 is a renovated building. 5 have a residential use and 4 are intended for non-residential use.

Climate zones

As Table 28 shows, in Slovakia the 9 selected buildings are located climate zone B which characterized by cold winters and warm summers.

Table 28Building distribution by climate zones - Slovakia

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	8	1
C	Warm winters and warm summers		
D	Temperate winters and mild summers		
E	Temperate winters and warm summers		

Heating Demand

The average heating demand for new buildings is 12,6 kWh/m^2 a, while the only renovated building has a heating demand of 59,0 kW/m^2 a.

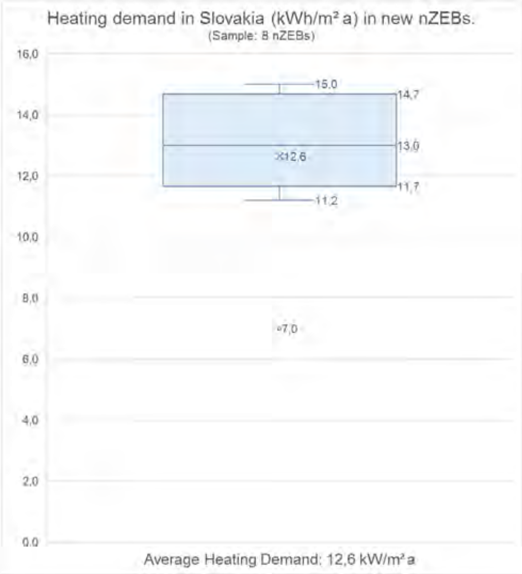

Figure 148. Box plot of heating demand in new nZEBs – Slovakia

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,25 and 0,19 in roofs. In renovated buildings the average U-value in walls is 0,22 and 0,13 in roofs.

In new buildings, glass wool and stone wool with 25% of share each are the most used insulating material in walls, while in roofs it is the stone wool with a share of 25%. In the only renovated building it is used expanded polystyrene in walls and cellulose fibre in roof.

In windows, the average Uwin-value is 0,74 in new buildings, but unknown in the renovated building. Concerning the type of glass, 75% of the new buildings use the triple glass, while the renovated building uses double glass.

In none of the new buildings is mentioned the use of any passive cooling strategy, whilst the renovated building uses natural ventilation.

Active solutions

Mechanical ventilation with heat recovery system is used in the 63% of the selected new buildings and in the renovated building there is mechanical ventilation without heat recovery system.

Devices using electricity for direct heat generation is mention as the most common heating system in new buildings with a percentage of 25%, on the other hand, condensing boiler is the system used in the renovated building. Besides, electricity is the most used energy carrier for heating in new buildings, while in the residential building it is unknown.

The use of the same system for heating and DHW (38%) and a dedicated generation system (38%) are the most common systems for DHW in new buildings. In the renovated building there is a dedicated generation system for DHW.

38% of the new buildings do not use cooling system and 26% use cooling through heat pumps. In the renovated building, air cooled chiller is the system used for cooling.

Renewable energies

2 out of the 8 new buildings reported to use photovoltaic systems and 1 to use solar thermal systems. The renovated building does not use photovoltaic or solar thermal systems.

Cost-assessment

The following table shows estimated renovation costs for different energy performance levels, based on Slovakian reports and realised projects.

Table 29 Costs of different renovation depths and new built according to nZEB standards - Slovakia

Costs (€/m2)	SK
Minor renovation (15% energy savings)	96
Moderate renovation (45% energy savings)	153
Deep renovation (75% energy savings)	219
NZEB renovation (95% energy savings)	318
New built according to nZEB standards	835
Additional funds for nZEB construction compared to new built	110

10.7.2 EXISTING POLICIES

The current constructions of residential and non-residential buildings in the Slovak Republic are mostly achieving energy saving standard. Low-energy buildings as well as passive buildings are well established on the market. However, examples of the design and construction of nZEB with a design different from passive buildings are not known even though satisfactory definition of nZEBs has been introduced in the legislation (Act No 300/2012 amending Act No 555/2005 on the energy performance of buildings and the technical standard STN 73 0540-2: 2012 Thermal protection of buildings).

Energy Performance of Building policy is legally implemented. A key task in the implementation of the renovation strategy is to achieve, in a very short period between 2015 and 2020, the energy efficiency of buildings by gradual tightening the energy performance requirements. This requires amendments of legal and technical regulations, new forms of support and sufficient awareness among all building renovation stakeholders.

Slovakia prepared a National plan to increase of the number of nZEBs. This action plan introduces the starting points and determines the requirements on the energy levels of constructions. The national plan also focuses on the requirements, conditions and methods for increasing the number of NZEBs, in order to meet the legal requirements. The document was approved as a dynamic document, which will be updated annually.

The building sector and energy targets

The 3rd Energy Efficiency Action Plan 2014–2016 has been prepared in accordance with Section 3 of Act No 476/2008 on efficiency in energy use, as amended. It is the third implemented measure in succession under the Energy Efficiency Policy and it builds on the previous two action plans. The 3rd Action Plan encompasses approximately 85% of the overall three-year energy savings target for final energy consumption (10.25 PJ) and more than 100% of the overall three-year energy savings target set for primary energy consumption (16.03 PJ). The biggest contributors to overall savings are buildings.

In the 2014–2016 period (and, prospectively, the period up to 2020), the State Housing Development Fund will continue to channel resources for supporting the improvement of the thermal performance of buildings and the SLOVSEFF III[175] and MUNSEFF[176] projects will come to an end. Between 2014

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[175] http://www.slovseff.eu/index.php/en/#

[176] http://www.munseff.eu/en/

and 2016, savings generated by the State Housing Development Fund – JESSICA financial mechanism, bankrolled by the 2007– 2013 Structural Funds, will become apparent and new State Housing Development Fund projects ("EU-funded residential building insulation") financed by the European Structural and Investment Funds (ESIF 2014–2016) via the Integrated Regional Operational Programme (IROP 2014-2020), will start to be implemented.

National Renovation Strategy

According to Slovakia's Renovation Strategy, in 2020 72.38% of multi-family buildings and 48.81% of single-family buildings should be renovated. As the total floor area of the buildings of central bodies of state administration is 445,791m^2 and every year 3% needs to be renovated, 13,374 m^2 should be renovated annually, saving 52.17GWh/year. The energy-saving potential in the period from 2011 until 2020, if the proposed measures are implemented for residential and non-residential buildings, should result in total energy savings of 15,222.8 TJ.

The most important measures that support the renovation Strategy include:

- Mobilization of investments in public and private building stock renovation (for residential and non-residential buildings)
- Mobilization of key stakeholders
- Long-term plan for the renovation of residential and non-residential public and private buildings as a strategic vision to guide the investment decisions of individuals, the construction industry and financial institutions

Energy performance requirements

The regulatory framework for energy performance of buildings includes a requirement for assessing mandatory energy certificates, which classify the stock according to their global indicator - primary energy use for HVAC and lighting, as well as provide an information on CO_2 emissions. Energy performance requirements have to be implemented for new buildings and major renovations with no adjustments regarding climate, altitude or other conditions.

Energy requirements in Slovakia

Primary energy (kWh/m^2/yr)		Residential buildings		Non-residential buildings					
		Single family houses (SFH)	Multi-family houses (MFH)	Offices	Educational	Hospitals	Hotels & restaurants	Sports halls	Retail
		Max	Max	Max	Max	Max	Max	Max	Max
New stock	Heating	53	83	56	56	70	71	66	65
	Cooling	n/a	n/a	31	n/a	53	28	n/a	66
	Total*	126	216	240	136	384	328	152	340
Renovated stock	Heating	106	172	112	112	140	142	132	130
	Cooling	n/a	n/a	59	n/a	101	56	n/a	132
	Total*	252	432	480	272	769	656	304	680

*Global indicator - total primary energy use, incl. heating, hot water, ventilation and cooling, lighting.

Compliance

Compliance control of the energy performance requirements is conducted through the online database of energy certificates issued. The control body in charge of the compliance check is the Ministry of Transport, Construction and Regional Development of Slovakia, with the process of control focusing mainly of monitoring the data. The compliance is being verified at design stage and the financial penalty for non-compliance ranges up to €5,000.

The nZEB plan

In Slovakia minimum energy performance requirements for buildings are set by Act no. 300/2012 transposing Directive 2010/31/EU. These minimum requirements are based on the upper limit of energy classes determined for the relevant category of building and are also respected by the energy level of construction introduced by national standard STN 73 0540-2: 2012. Standardised requirements for the heat engineering features and heat demand for heating correspond pursuant to national standard correspond to the minimum requirements presented.

The “Major Building Renovation” and the “Living with Energy” information campaigns focusing on owners of single-family and multi-family houses, have been prepared by the Ministry of Transport, Construction and Regional Development in partnership with the Slovak Innovation and Energy Agency as awareness raising tools. Additionally, for schools the “EkoFund for Schools” energy efficiency initiative has been set.

To assist the uptake of the nZEBs, designers should support the efforts of the Slovak Chamber of Architects (SKA) and Slovak Chamber of Construction Engineers (SKSI) for systematic additional training. In addition, the “Energy Auditor” training course provides the legally implemented (Act no. 476/2008) measure of energy efficiency professional knowledge.

Renewable sources in the building sector

For 2020 the National Renewable Energy Action Plan requires a 50% reduction of the global indicator of energy performance values for existing and new buildings provided by the increased use of renewable energy sources. The overall national target for 2020 foresees a slight exceedance of 14% of the RES share in total energy consumption (66 PJ). Possible value of RES transfer to other Member States (6 PJ) is estimated.

The leading role of the public sector

Slovakia is following the alternative approach to comply with Article 5 of the EED. As part of this approach Slovakia has published an inventory that provides clear information about each building covered by the obligation, its area, as well as its energy performance. The targeted savings of final energy consumption is 1,097.65 TJ.

10.7.3 NZEB-TRACKER

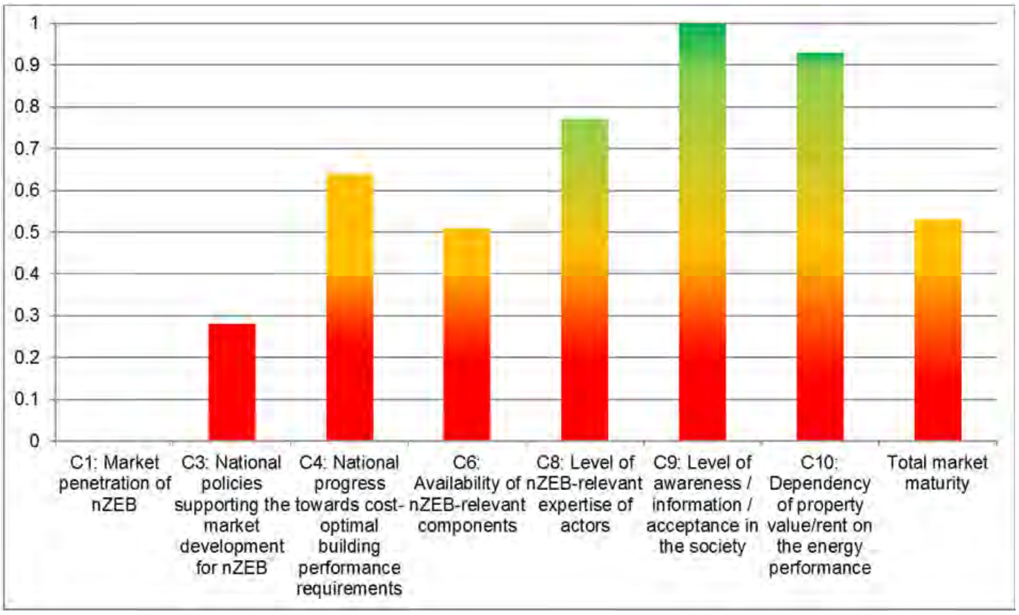


Figure 149 nZEB-tracker score for Slovakia

C1: Market penetration of nZEB

- Slovak result: **0.00** ZEBRA average: **0.32**
- 0% nZEB share has been reported in 2014 because in the Slovak Republic the corresponding legislation applies only since January 2018 starting first with newly built public buildings.

C3: National policies supporting the market development for nZEB

- Slovak result: **0.28** ZEBRA average: **0.52**
- Policies in the Slovak Republic seemed to be lower than average result in other ZEBRA EU countries in 2014. Support schemes for high energy efficiency projects were introduced in the Slovak NEEAP as a part of the nZEB implementation process. Progress in the implementation of the nZEB policy is not obvious. It is difficult to collect up-to date information.
- Need for adaptations may result later from the lessons learned in the upcoming years and from the professionals´ feedback. Updated definition of the nZEB standard in the Slovak Republic may be expected in 2019

C4: National progress towards cost-optimal building performance requirements

- Slovak result: **0.64** ZEBRA average: **0.94**
- The energy performance parameters for nZEB are defined by the standard STN 73 0540-2: 2012 Thermal protection of buildings. Heat engineering features of building structures and buildings. Part 2: Functional requirements. Energy performance classes are defined by the Act No 555/2005 on the energy performance of buildings and amendments to some acts, as amended.
- For the cost optimality the Guidelines accompanying 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 establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements (2012/C 115/01) are used.

C6: Availability of nZEB-relevant components

- Slovak result: **0.83** ZEBRA average: **0.83**
- Energy efficient heating systems, DHW and ventilation systems as well as other building components for nZEB are nearly fully available on the Slovak market.
- Building automation and control systems seem to be available however there is a potential to expand the range.

C8: Level of nZEB-relevant expertise of actors

- Slovak result: **0.77** ZEBRA average: **0.63**
- Generally speaking the evaluations of design experts´ availability seemed to be on a very good level.
- The expertise in construction and building certification as well as the expertise in the repair and maintenance of energy efficient buildings seemed to be on average level.
- Not too many highly energy efficient buildings have been constructed so far (passive or close to passive house standard) and only few have been renovated to the above mentioned standard in the Slovak Republic. The lessons learned from the past projects and the feedback from the users and the repair and maintenance professionals are essential in the development of performance and professional expertise, as it helps to build knowledge and skills.

C9: Level of awareness / information / acceptance in the society

- Slovak result: **1.00** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings increased steadily and is comparable with average value in ZEBRA countries.

C10: Dependency of property value/rent on the energy performance

- Slovak result: **0.93** ZEBRA average: **0.74**
- Compared to location and financial aspects the energy performance and the living quality are less important aspects for customers' decision on renting/buying a real estate. On the other hand the situation changes quite rapidly like in most central European countries The future score of energy performance is much dependent on the long-run evolution of energy prices .

Maturity of the Slovak nZEB market

- Slovak result: **0.57** ZEBRA average: **0.66**
- The Slovak nZEB market seemed to be slightly underdeveloped compared to the average level of the ZEBRA countries in 2014. The political framework appears satisfactory, it is not excluded that the final definition of the nZEB standard will be revised.
- High performance building components were easily available on the market in 2014.
- The availability of experts may limit the future development of the nZEB market, especially in the field of construction, repair and maintenance.
- The Slovak public are more and more aware of the energy performance of buildings. So far it has had a minor priority on buy/rent decisions.

10.7.4 SCENARIOS

Figure 150 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Slovakian building stock is around 20 TWh in 2012. The scenario shows a steady slow-down of the energy demand of around 12% (around 1.5% yearly) from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 55% in the current policy scenario in the long term development between 2012 and 2050 and by 57% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Slovakia, the share of biomass-based heating systems and district heating make up around 30% on the total energy demand for space heating, cooling and hot water in 2012 whereas the fossil-fuel-based heating systems (natural gas, oil and coal) makes up app. 67%. The share of non-delivered energy (i.e. solar and ambient energy) is increasing over time from around 0.3% of final energy demand in 2012 to around 13% in current policy scenario and to around 23% in ambitious policy scenario in 2050.

Figure 151 shows the reduction of the building related final energy demand, primary energy demand and CO_2-emissions. The reduction of the CO_2-emissions from 2012 and 2050 is around 60% in current policy scenario and around 72% in ambitious policy scenario. The reduction of the primary energy demand is around 53% and 67% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

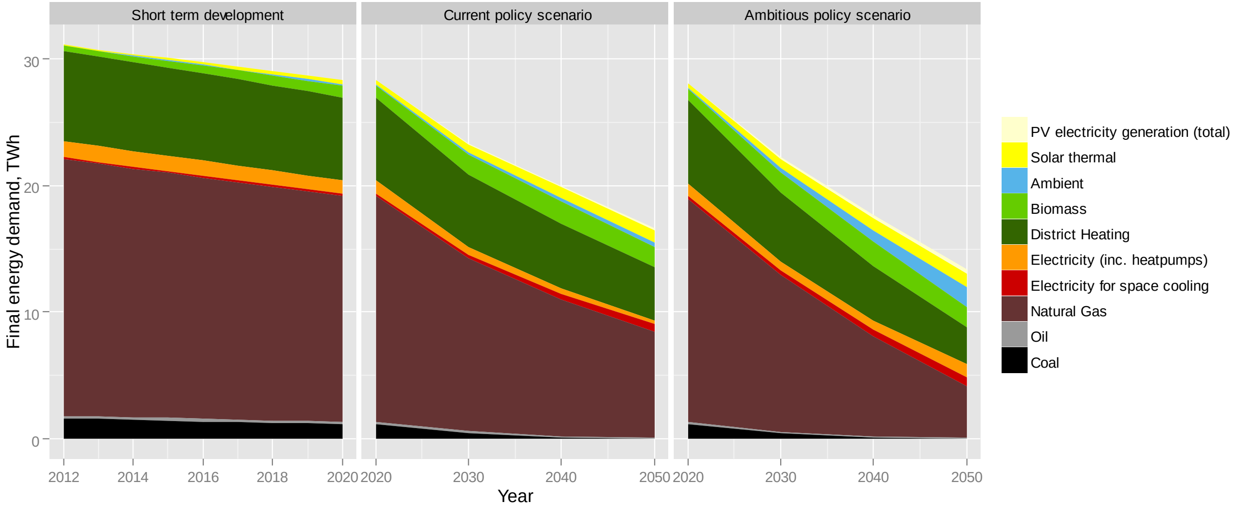


Figure 150 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

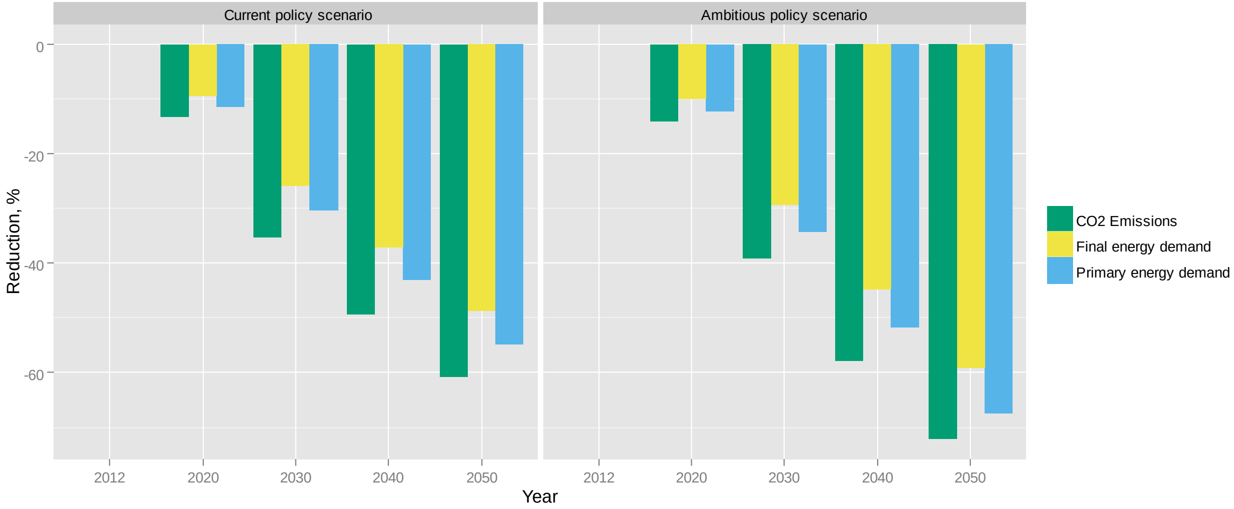


Figure 151 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

10.7.5 RECOMMENDATIONS

The Slovak nZEB national definition has been introduced by the Act No 555/2012. According to the definition, nZEB are buildings with very high energy performance. To achieve the required nZEB parameters, it is necessary to proceed from the acceptance and determination of three interrelated criteria:

- Reduction of specific heat demand for heating to a minimum.
- Reduction of primary energy consumption for heating, cooling,ventilation, domestic hot water and lighting
- Significant coverage of the overall primary energy demands with renewable energy sources

The Slovak methodology separates energy demands into heating, lighting, hot water, ventilation. Total energy demand is a sum of all partial energy demands. Scales of energy classes are given with global indicator for different building types:

- Total building energy demand should have a value betwen 40 and 101 kWh/m2/y
- Primary energy consumption should be in the range of 32 to 96 kWh/m2/y

Intermediate targets for achievement of individual construction energy levels are set in three time phases as following values of energy demand for heating:

Low-energy buildings standard requirements required from 01 Jan 2013: ≤ 100 kW/m2.y (class B)

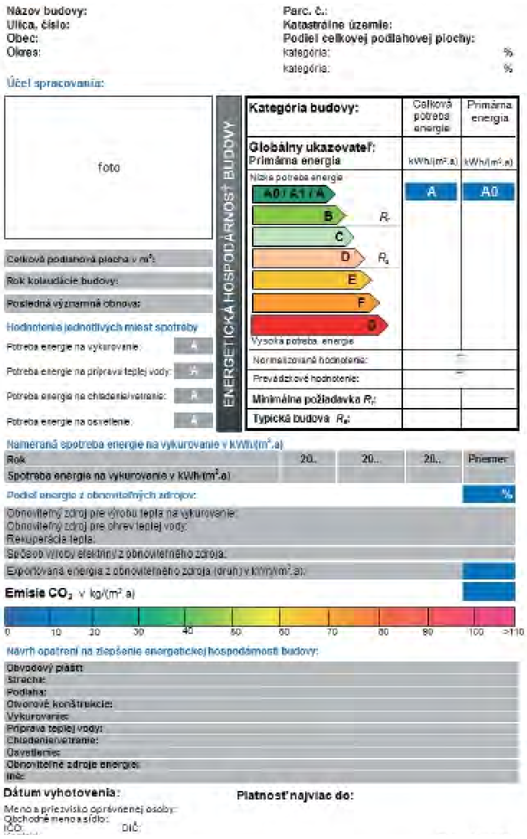
Ultra-low-energy buildings advanced requirements from 31 Dec 2015: ≤ 50 kW/m2.y (class A)

Nearly zero-energy buildings requirements valid from 31 Dec 2018/20 ≤ 25 kW/m2.y (class A0)

Supply of energy from RES found in the building or its proximity should provide at least a 50 % reduction of primary energy (calculated from delivered energy)

nZEB will accelerate the development and introduction of new efficient products and materials to the market, while also create new job opportunities on the Slovakian market.

On the positive note, global energy trend in Slovak Republic consists in permanent reduction of energy



Názov budovy:
Ulica, číslo:
Obec:
Okres:

Parc. č.:
Katastrálne územie:
Podiel celkovej podlahovej plochy:
kategória: %
kategória: %

Účel spracovania:

foto

Celková podlahová plocha v m²:
Rok kolaudácie budovy:
Posledná významná obnova:

Hodnotenia jednotlivých miest spotreby
Potreba energie na vykurovanie: A
Potreba energie na prípravu teplej vody: A
Potreba energie na chladenie/vetranie: A
Potreba energie na osvetlenie: A

ENERGETICKÁ HOSPODÁRNOSŤ BUDOVY

Kategória budovy:	Celková potreba energie	Primárna energia
Globálny ukazovateľ: Primárna energia	kWh/(m².a)	kWh/(m².a)
Nízka potreba energie A0 / A1 / A B R_r C D R_s E F G Vysoká potreba energie	A	A0
Normalizované hodnotenie:	–	
Prevádzkové hodnotenie:	–	
Minimálna požiadavka R_r:		
Typická budova R_s:		

Nameraná spotreba energie na vykurovanie v kWh/(m².a)

Rok	20..	20..	20..	Priemer
Spotreba energie na vykurovanie v kWh/(m².a)				

Podiel energie z obnoviteľných zdrojov: %

Obnoviteľný zdroj pre výrobu tepla na vykurovanie:
Obnoviteľný zdroj pre ohrev teplej vody:
Rekuperácia tepla:
Spôsob výroby elektriny z obnoviteľného zdroja:
Exportovaná energia z obnoviteľného zdroja (druh) v kWh/(m².a):

Emisie CO_2 v kg/(m².a)

Návrh opatrení na zlepšenie energetickej hospodárnosti budovy:

Obvodový plášť:
Strecha:
Podlaha:
Otvorové konštrukcie:
Vykurovanie:
Príprava teplej vody:
Chladenie/vetranie:
Osvetlenie:
Obnoviteľné zdroje energie:
Iné:

Dátum vyhotovenia:
Platnosť najviac do:

Meno a priezvisko oprávnenej osoby:
Obchodné meno a sídlo:
IČO: DIČ:

Figure 152 The template of energy performance cerificate demand as a result of long cost optimisation efforts. Furthermore, nZEB standard is supported by subsidies in Slovakia. The subsidy programme's main objective is to improve the environment by reducing greenhouse gas emissions through the improved energy performance of buildings.

Slovakia faces many hurdles to a wide nZEB market uptake:

- The costs of certain measures are today too high and the possible payback time is uncertain (e.g. heating sources).
- The level of awareness is low and efforts to raise awareness have not been effective so far
- The supporting measures for nZEB (NEEAP measures) do not seem to be fully activated. No real update since 2014 can be found.
- Policies regarding the use of centralised and decentralised heat sources and CHP is unclear.
- The potential of RES has not been sufficiently assessed or activated so far.
- The issues related to the ventilation and elimination of serious health risks related to buildings and indoor air quality have not been sufficiently dealt with.

Based on this background, 6 recommendations have been outlined for Slovakia:

SK1 - Regulate building performance minimum standards through the building code

SK2 - Financial support for renovation according long term benchmarks

SK3 - Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

SK4 - Training building professionals with "nZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

SK5 - Involve and empower local authorities in pilot projects

SK6 - Explicitly define energy poverty and set up monitoring mechanisms

#SK1 - Legislative and Regulatory Instruments

Regulate building performance minimum standards through the building code

Regulate building performance minimum standards can be seen as the classical regulatory approach. The building code is a set of rules specifying the minimum standards for new and existing buildings. It can, for example, be an effective measure to foster improved energy efficiency of buildings. By setting minimum standards it can push out inefficient and inadequate components from the market. Member States should also use the building code to ensure a high air quality for the residents.

As required by the EPBD "EU countries must set minimum energy performance requirements for new buildings, for the major renovation of buildings and for the replacement or retrofit of building elements (heating and cooling systems, roofs, walls, etc.)". Member States ought to use the building code as a key tool to foster the uptake of nZEBs. Building codes can have a significant impact on the energy performance of buildings by setting minimum requirements for the energy-efficient design and construction/renovation of new and existing buildings.

State of play in Slovakia

Following legislative regulations in line with the requirements of the European Parliament, the European Council and the Commission with a significant impact on energy efficiency were amended or prepared in the 2011–2013 period:

- Act No 300/2012 on the energy performance of buildings, 28 which transposes the requirements of Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings (by amending Act No 555/2005 on the energy performance of buildings);
- Act No 310/2012 on the periodic inspection of space heating systems and air conditioning systems29, which supersedes the original Act No 17/2007 on the periodic inspection of boilers, space heating systems and air conditioning systems, and which transposes the requirements of Directive 2010/31/EU on the energy performance of buildings;
- Act No 69/2013 amending Act No 476/2008 on energy efficiency, as amended, based on the results of the previous practical implementation of the law, especially in connection with the obligation to provide heat and hot water distribution systems in buildings with appropriate thermal insulation and the obligation to monitor energy audit reports.
- Act No 100/2014 amending Act No 657/2004 on the thermal energy sector, as amended, which transposes some of the requirements derived from Directive 2012/27/1 on energy efficiency in relation to district heating systems.

- Implementation of the Decree of the Ministry of Transport, Construction and Regional Development No 364/2012 of 12 November 2012 implementing Act No 555/2005 on the energy performance of buildings and amending certain laws, as amended;
- Implementation of the Decree of the Ministry of Economy No 337/2012 of 26 October 2012 establishing the energy efficiency of energy transformation in the operation,
- Implementation of the Decree of the Ministry of Economy No 422/2012 of 13 December 2012 laying down the procedure for periodic inspections of space heating systems, expanded inspections of space heating systems and periodic inspections of air conditioning systems;
- Implementation of the Decree of the Ministry of Economy No 282/2012 of 18 July 2012 laying down technical requirements for the thermal insulation of heat and hot water distribution systems.

The above mentioned changes in the Slovak legislation may be considered as classical regulatory approach. The newly established set of rules specifies the requirements for new and existing buildings.

Furthermore, Act No 300/2012 Coll. on the Energy Performance of Buildings, transposing the requirements of the Directive 2010/31/EU of 19 May 2010 on the energy performance of is a strategic regulatory measure to increase the number of nZEB in Slovakia. The Act No 300/2012 Coll. has formulated the task of elaboration of the National plan for increasing the number of nearly zero-energy buildings in the Slovak Republic[177].

Example: Energy performance of single family houses in the Flanders Region

Flanders region in Belgium has implemented a long-term roadmap of minimum standards for new residential buildings, to guide the market towards the nZEB requirement by 2021. The minimum standards are strengthened regularly, allowing building owners and investors to plan ahead.

The Y-line (vertical line) in the chart shows the yearly percentage of building permissions and the X-line (horizontal line) illustrates the energy performance level (NZEB=E30)). It is very clear that these requirements steer the level of energy performance, but it is also possible to see where the

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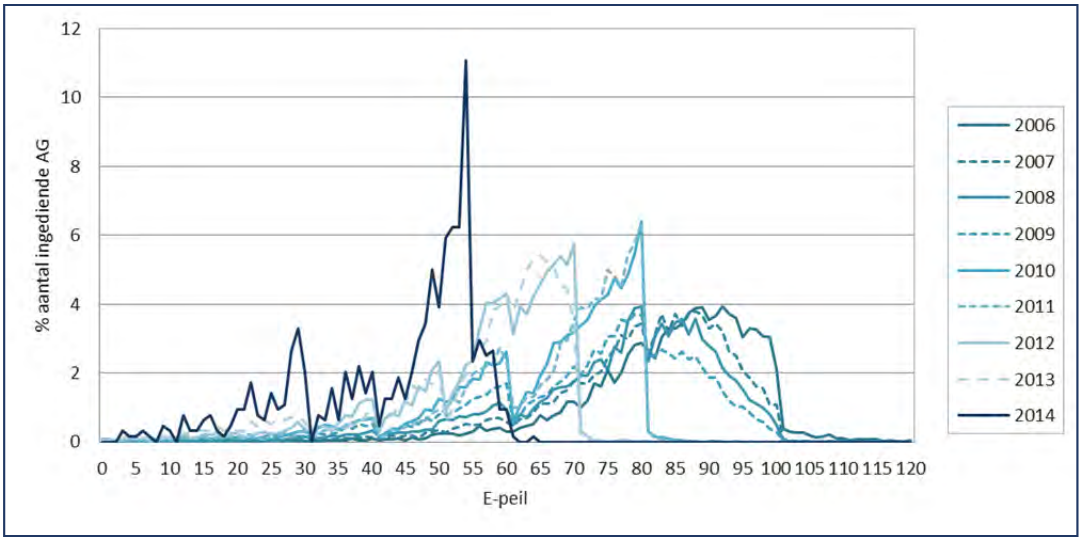
[177] http://www.telecom.gov.sk/index/open_file.php?file=vystavba/StavebnictvoDokumenty/narodny_plan.pdf

effects of support measures e.g. in 2014 there were subsidies for E50 and E30 (=BEN).

For new residential buildings, the following minimum (called E-level) standards apply.

- Date building permit application - Maximum E-level
- from 2006 until the end of 2009 - E100
- from 2010 to end of 2011 - E80
- from 2012 until the end of 2013 - E70
- From 2014 to end of 2015 - E60
- from 2016 until the end of 2017 - E50
- from 2018 until the end of 2019 - E40
- 2020 - E35
- 2021 - E30 (=NZEB)[178]



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[178] Vlaanderen – http://www.vlaanderen.be/nl/bouwen-wonen-en-energie/bouwen-en-verbouwen/energieprestatieregelgeving-epb-voor-nieuwbouw-en-renovatie

#SK2 – Economic Measures

Financial support for renovation according long term benchmarks

EU Member States are obliged to draw-up long-term national building renovation strategies as a part of their National Energy Efficiency Action Plans. One of the purposes of this strategy is to stimulate a higher quality and quantity of renovation through "a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions;". Stable and long-term subsidies scheme has a positive effect on the construction sector (employment, renovation rate etc.).

Existing financial support schemes for the Slovak sector of residential and non-residential buildings are not exclusively focused on the energy efficiency improvement. The current situation can be described as follows:

- Over the past years the Slovak State Housing Development Fund has been supporting a whole range of building renovation measures, the additional insulation of residential buildings has been listed as energy efficiency renovation measure eligible for financial aid.
- The savings banks and commercial banks provided resources mostly for the renovation of residential buildings, but the energy saving criterion did not arise as a specific condition for providing the loan.
- In the area of non-residential buildings such projects like SLOVSEFF II and the pilot project "Energy efficiency in public buildings" financed through the European Bank for Reconstruction and Development (EBRD) or financial aid through the EkoFond could be mentioned.
- The towns and municipalities have several funding options in the area of energy efficiency. The most important are the structural funds, the European Energy Efficiency Fund, initiatives under the Intelligent Energy – Europe Programme – ELENA and MLEI (Mobilising Local Energy Investment), contracts on providing energy services and private banks. The energy efficiency and RES projects could be funded from the Cohesion Fund and European Regional Development Fund. In the years 2007–2013 around 900 projects of improvement of the thermal performance of buildings were accepted under the Regional Operational Programme. Projects of similar nature were also co-funded by the Operational Programme Health.

According to the updated concept for energy efficient buildings the financial support for the nZEB shall distinguish between the renewal of the existing buildings and the new constructions. Financial supporting programmes shall differentiate according to the achieved level of energy savings with focus target on NZEB parameters in new construction and also with focus on achieving more significant energy savings in case of building renovations. An important aspect for the financing of new constructions is to link up with the existing economic instruments from the State as well as with the financial support schemes already available from the public and private financial institutions. Efficient linkage between the private and public sources is important.

The objective of financial aid shall be, above all, the adaptation of existing financial instruments to increase investment into energy efficiency in buildings and to activate the potential for energy savings.

Example: KfW in Germany

The KfW schemes are designed to promote deep renovation following the motto: "The deeper the renovation, the higher the incentive" and therefore stimulates the frontrunners aiming more tight voluntary energy performance targets than legally obliged. To illustrate this point, a grant of 25% is offered if the refurbishment reaches the most ambitious KfW Efficiency House 55 standard, while the slightly less ambitious level of KfW Efficiency House 70 attracts a lower grant of 20%.

While not being a perfect system, it illustrates how benchmarks can incentivise deeper renovation of the building stock.

#SK3 – Communication

Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

A big barrier to a rapid market uptake of nZEBs is the lack of knowledge and accessible information on different levels. Effective information campaigns targeting different actors and stakeholders (e.g. house owners, building professionals, technical staff of public administrations…) are needed. Easy grasping guidelines or how-to manuals can increase the demand and spur the nZEB market transition.

In order for an information or awareness campaign to be effective it must be targeted to a specific group of consumers. Comprehensive preparation for these kinds of campaigns should therefore be conducted beforehand and the effect should be assessed after the campaign has ended.

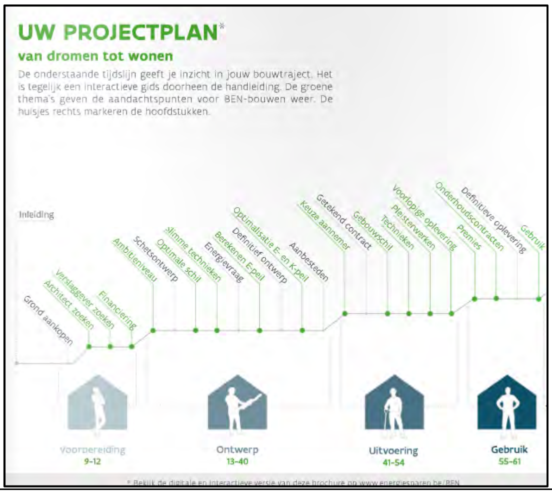
The process must and be continuous and the information campaigns shall take into account the latest developments in the field of construction. The main efforts shall be focused on promotion of eco-friendly technologies and energy efficient systems, the revision of construction processes and use of more energy efficient construction products. These information campaigns shall be supported by public administration.

The promoted products and solutions are:

- progressive construction products and construction systems suitable for the building envelope and glazed windows,
- building technical systems, including high-efficiency alternative energy systems focused on the use of renewable energy sources in the building and its proximity,
- intelligent metering systems,
- automation, control and monitoring systems that aim to save energy

Example - Guidelines for future building owners how to build new NZEB in Flanders

The Belgian region of Flanders has produced a "practical guide for building your nZEB house"[179] to support future home owners through the process of prepare, design, execute and use an nZEB dwelling.



UW PROJECTPLAN*

van dromen tot wonen

De onderstaande tijdslijn geeft je inzicht in jouw bouwtraject. Het is tegelijk een interactieve gids doorheen de handleiding. De groene thema's geven de aandachtspunten voor BEN-bouwen weer. De huisjes rechts markeren de hoofdstukken.

* Bekijk de digitale en interactieve versie van deze brochure op www.energiesparen.be/BEN

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[179] http://www.vlaanderen.be/nl/publicaties/detail/praktische-bouwgids-voor-jouw-ben-woning-1-exemplaar

#SK4 – Quality of action

Training building professionals with "nZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

The process of design and construction of nZEB is more complicated than in case of ordinary buildings. Consumers should be able to rely on the qualified designers and other building professionals. It is important for them to know that they will get value for their money. The professional commitment is to deliver a sustainable, safe and healthy building with high energy efficiency and reasonable operation and maintenance costs (cost optimality approach). Appropriate training possibilities and quality frameworks should be available for all involved professionals.

The designer shall have a detailed knowledge of the principles and must be able to include them in the design, latest in 2016 or 2017. Designers must, however, be already familiar with solutions for the design of low-energy buildings and ultra-low-energy new buildings since 2013 and 2015.

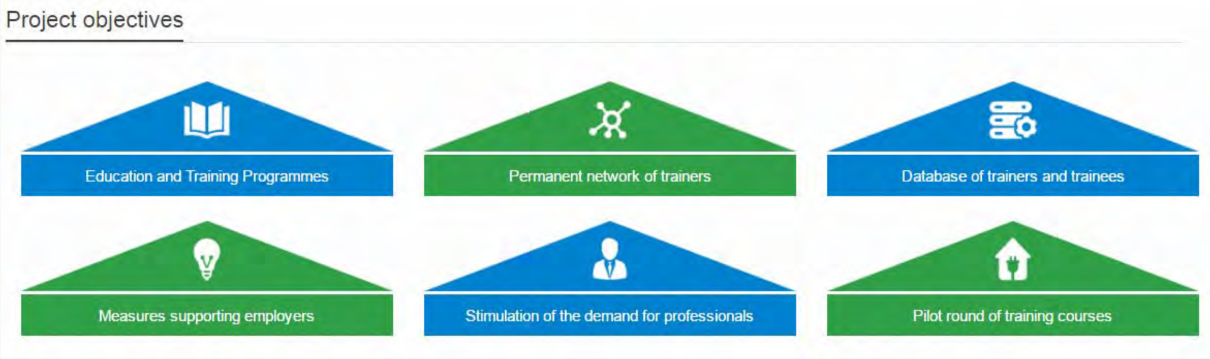
The nZEB design must be based on the fact that the building concept is different from the past concepts. Switching from pure energy consumption approach to energy consumption based on use of RES. The building shape and orientation, quality of thermal insulation and glazed elements the well adapted technical equipment are all part of the new NZEB concept.

EU-Project: The ingREeS project

The ingREeS project, whose participants are the Czech Republic, Slovakia and Austria, was initiated in February 2015 and is a follow-up to the BUILD UP Skills project. Its main goal is to develop five education and training programmes for building professionals establishing a permanent network of trainers providing training programmes developed under the project. It also aims to propose financing for measures that increase the motivation of professionals to participate in education programmes and to invest in further education. In addition, proposals have been discussed that encourage the demand for highly qualified professionals and achieve financial agreements regarding the use of ESF and dissemination of training programmes.

The training of professionals to improve their qualifications and skills is supported by the SKA (Slovak Chamber of Architects) and SKSI (Slovak Chamber of Construction Engineers) actions towards systematic additional training of designers.

A basic premise in this area for meetings targets in 2018 or 2020 is the early inclusion of the necessary information in the study programmes of schools. Universities have a dominant position in this case as independent legal subjects[180].



#SK5– Incentivize the Market

Involve and empower local authorities in pilot projects

When developing pilot projects anywhere in Europe, it is crucial to involve local authorities from the start. Many of the big cities have already set higher ambitions on climate mitigation and decarbonisation than the EU-level requires and are developing incentive or roll-out programmes to push for the accomplishment of these goals. A strong collaboration between industry actors and local governments can speed up the development of innovative projects, especially when the city takes on the role of a facilitator to align industry actors, the market, end-users and includes them into an ecosystem approach.

Demonstration of energy efficiency and utilisation of renewable energy sources through projects of public buildings create a common pool of knowledge for the entire region. During these demonstration projects the professionals acquire new skills and professional experience in the relevant fields and state-of-the-art energy-efficient buildings. These projects visibly prove the feasibility and applicability of RES and EE solutions and help the local authorities to boost NZEB applications.

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[180] http://www.ingrees.eu/en/

Example: CEC5 project

The CEC5 project aimed to evaluate current methods and tools for certification of energy efficiency and environmental quality of buildings in the region of Central Europe as well as at national level of respective project partners. One of the main project targets was to create a common, transnational, certification tool and offer it as an "open source" for professionals and broad public. Making available such tool for mainly public authorities, the project had ambition to include energy efficiency and environmental quality certification into the process of planning and execution of public investments.

Demonstration project in the Slovak town of Senica second key area of the CEC5 was to test and promote the use of renewable energy sources (RES), which utilisation is still relatively low in Slovakia, compared to other EU member states. Thus the project strongly aimed to support and demonstrate RES utilisation at regional level of the project partners through renovation/construction of 7 demonstration buildings. Various devices to use RES and increase energy efficiency were installed in these buildings. A canteen and kitchen of the Secondary technical school in Senica city (western part of Slovakia) were selected as demonstration buildings in Trnava Self-Governing Region. Solar panels, heat pump, pellet station and PV cells were installed during this project.

It is worth mentioning that the School in Senica had been successfully participating in the ENERSOL competition for several years – a competition for secondary schools students in the field of RES innovative approaches. Even before the project start the School in Senica, had installed digitally operated system of regulated heat and warm water consumption. Thus the place for demonstration project seems to be very well selected[181].

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[181] http://www.sossenica.sk/index.php?menu=projekty
http://www.projectcec5.eu/

#SK6 – Social Issues

Explicitly define energy poverty and set up monitoring mechanisms

Energy poverty is a major problem for Europe, as between 50 and 125 million people are unable to afford a proper indoor thermal comfort. Energy policy of the EU devotes a particular attention to disadvantageous groups of consumers (with low income, in rural areas, with low consumption) as they have a weak bargaining power; they are financially or physically weaker in relation to suppliers. The third energy package requests the member states to define the concept of vulnerable consumers and it is expected the number of consumers meeting the conditions of the definition of vulnerable consumer will be low.

Despite the fact that there is no common European definition, the importance of the problem as well as the severe health impacts caused by fuel poverty are widely recognised. Energy poverty is still the little sibling to the economic and environmental aspects of new constructions and building renovations.

Slovak Republic is one of the few European countries having an official definition for energy poverty. However, this definition seems to be rather vague. Better data would lead to better understanding of the social challenge. It would also allow to better assess the effectiveness of strategies to tackle energy poverty. This would be to better understand the challenge, and assess effectiveness of strategies to tackle energy poverty. Data for energy poverty must be enhanced and standardized across Europe.

State of Play

Energy poverty under the law No. 250/2012 Coll. Of Laws is a status when average monthly expenditures of household on consumption of electricity, gas, heating and hot water production represent a substantial share of average monthly income of the household.

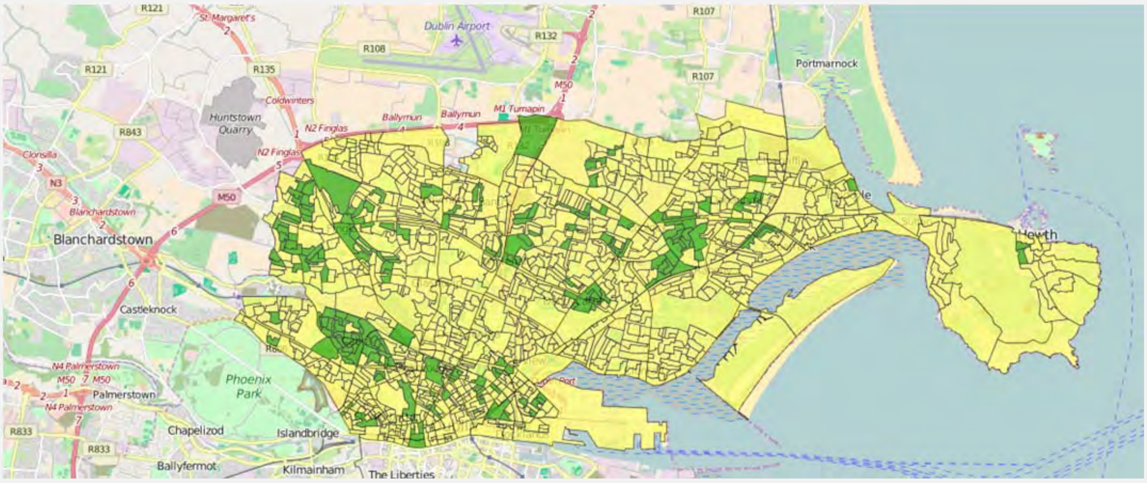
In June 2014, the Slovak government approved the Conception of consumer protection in energy poverty under which a household is in energy poverty if it meets the condition that disposable average income is lower than minimal disposable monthly income. The limit of minimal disposable monthly income is given as a multiple of actual electricity and gas prices and minimal energy costs of household depending on number of its members, the nature and use of energy.

Slovak government is developing a scheme to evaluate energy poverty and to set social benefits for people who cannot pay for energy. The regulatory legislation determines selected households and also small companies to be vulnerable customers. Statistical offices collect data of citizens who cannot maintain sufficient housing heat. According to the Slovak Academy of Sciences in Slovakia it is only six people out of 100 while that problem affects one in every 10 Europeans. The Slovak data, however, appear better because the poorest households in which energy poverty is an almost universal phenomenon live separated and segregated, and are not sufficiently included into the EU Statistics on Income and Living Conditions (EU-SILC).

It is necessary to create a flexible system for monitoring socially-disadvantaged people and offering them social benefits. In addition to the adequate measurement and setting boundaries for energy poverty, it is necessary to consider the continuity of social policy. Given the shift in energy policy towards energy efficiency and lowering energy consumption it is important to support the poorest households with appropriate measures to improve energy efficiency to get poor households out of the vicious circle.

Pilot projects: The Irish Energy Action

The Irish Energy Action, in partnership with the EU-project Episcope, have developed an EPC mapping tool. The interactive map over Dublin illustrates different building characteristics (including energy poverty indicators) of different neighbourhoods. The data is aggregated to defined boundaries, namely small areas and electoral divisions. Small areas typically comprise 50-200 dwellings and electoral divisions include clusters of small areas.[182] This mapping allows for local policy making and strategy development alleviating energy poverty from a district approach.



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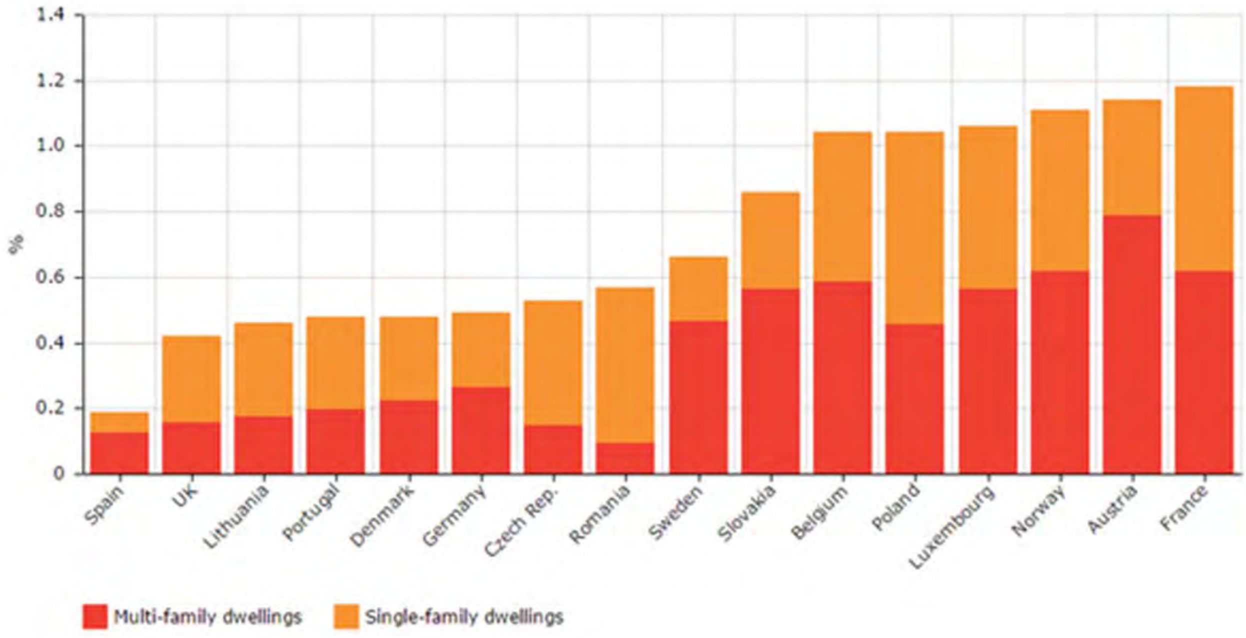
[182] http://energyaction-static.s3-website-eu-west-1.amazonaws.com/index.html

10.8 SWEDEN

10.8.1 BUILDING PERFORMANCE MARKET DATA

10.8.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single- and multi-family dwellings) in the residential stock for EU countries and Norway. Sweden is a country with a "medium-sized" rate of renewal of the building stock: In 2014, 0.65 % of the building stock was renewed, compared to less than 0.40 %/year in Denmark and more than 1 % in Norway, for instance. Since 2013, there were built around 30 000 new dwelling units per year, while the numbers for 2010 and 2011 were only around 20 000. The majority of new dwelling units in Sweden is situated in multi-family buildings.



* Data collected from national sources.

Figure 153 Share of new multi- and single-family dwellings in residential stock in 2013 (data for 2014 is available on the project´s website).

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 defines a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings

2. nZEB buildings according to national definitions

3. Buildings with an energy performance better than the national requirements in 2012

4. Buildings constructed/renovated according to national minimum requirements in 2012

Sweden has not yet stated an official nZEB definition.

In the absence of an official nZEB definition, it was not possible to collect data for the categories 1 (Better than nZEB) and 2 (national official nZEB definition). Although there are several net zero or plus energy buildings, these will not be visible in statistics.

The following graph illustrates that only a small share of new dwellings is built better than the building code, although this share is higher than before 2012.

Because of the lack of an official European definition, to ease comparisons the EU ZEBRA2020 project developed the indicator of "major renovation equivalent". In ZEBRA, three renovation levels have been defined: "low", "medium" and "deep". However, these 3 levels definitions are different across countries and do not correspond to the same level of energy savings. Therefore, the data are hardly comparable. For that reason, the ZEBRA consortium assumes that, with major renovations, a building's final energy demand for heating can be reduced by 50 to 80% (range depending on the country and defined by national experts according to the current efficiency of the building stock). The major renovation equivalent is based on assumptions on the type of measures considered for the different level of renovations and is determined by country.

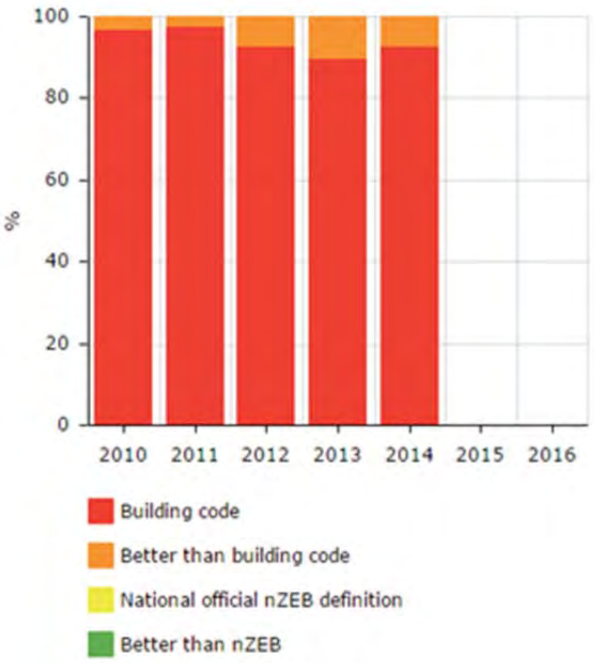


Figure 154 Distribution of new dwellings according to the nZEB radar graph – Sweden

In Sweden data on renovations considers two renovation levels[183]. These levels correspond to 1) less costly measures and 2) more costly measures.

In the more costly measures, change of windows, additional insulation and heat recovery (FTX), are included. Reports analysing renovation measures have examples of these measures which have resulted in an energy saving of around 60 %[184].

In the less costly measures, water-saving nozzles, sealing, adjustments, individually measures of water/household electricity are included. The measures have an expected energy saving ranging from 5-6 % (sealing, water-saving nozzles) to 10% (adjustments/operational optimization and individual measure of hot water). Therefore, the estimated energy saving is set to 7% for the less costly measures.

The following graph shows the estimated "major renovation equivalent" for Norway in 2013, calculated according to the common ZEBRA method. The rate of 0.88 situates Sweden in the lower part of the middle range of the represented countries, slightly below the Netherlands.

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[183] Miljonprogrammet, förutsättningar och möjligheter, Prognoscentret (2013)

[184] Kurkinen et al 2012, Boverket & Energimyndigheten 2013.

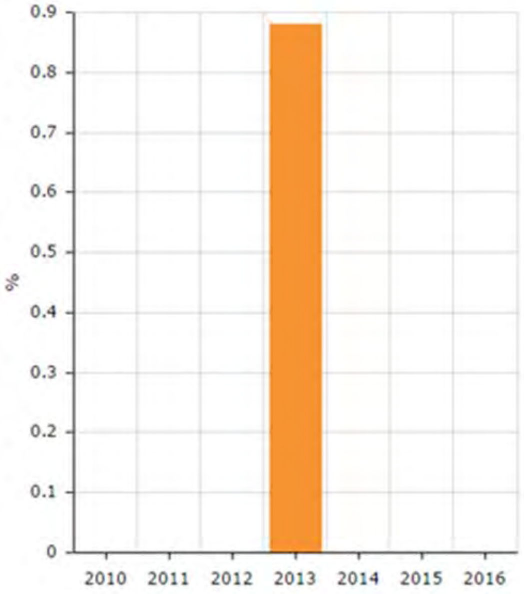

Figure 121: Equivalent major renovation rate – Sweden

Source: ZEBRA

10.8.2 SELECTED HIGH PERFORMANCE BUILDINGS

In Sweden, it has been collected data of 15 nZEBs or high energy efficient buildings which were constructed recently. 13 out of the 15 are new buildings and 2 are renovated buildings. 10 have a residential use and 5 are intended for non-residential use.

Climate zones

As Table 30 indicates, in Sweden the 17 selected buildings are located climate zone B which characterized by cold winters and warm summers.

Table 30Building distribution by climate zones - Sweden

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	15	2
C	Warm winters and warm summers		
D	Temperate winters and mild summers		
E	Temperate winters and warm summers		

Heating Demand

The average heating demand in new buildings is 13,7 kWh/m² a and the average of the 2 renovated buildings is 15,5 kW/m² a.

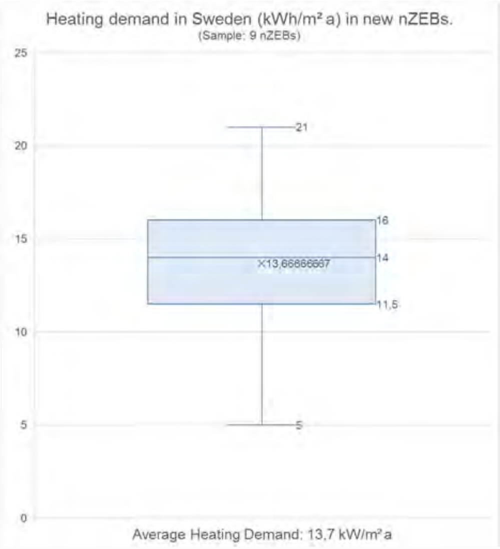

Figure 155 Box plot of heating demand in new nZEBs - Sweden

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,09 and 0,07 in roofs. In renovated buildings the average U-value in walls is 0,12 and 0,13 in roofs.

In new buildings, stone wool with a percentage of 23% is the most indicated insulating material in walls and cellulose fibre with a percentage of 31% in roofs. In renovated buildings, in one of the two selected buildings it is not reported the insulating material and the other one uses stone wool in both walls and roof.

In windows, the average Uwin-value is 0,85 in both new and renovated buildings. Concerning the type of glass, 92% of the new buildings use triple glass, as well as the 2 renovated buildings.

77% of the new buildings do not use any passive cooling strategy, whilst none of the 2 renovated buildings use any passive cooling strategy.

Active solutions

Mechanical ventilation with heat recovery system is the used in the 100% of the 25 selected buildings.

With regard to the heating system, district heating is the most used system with a share of 46% in new buildings and 100% in renovated buildings. In line with the most used heating systems, district heating is also the most used energy carrier for heating in new and renovated buildings.

69% of the new buildings use the same system for heating and DHW, while the 2 renovated buildings use a dedicated generation system for DHW.

In only one of the 32 selected buildings it is mentioned the use of cooling system.

Renewable energies

In 3 out of the 13 new buildings, it is specified the use of photovoltaic systems and in 3 the use of solar thermal systems. In none of the 2 renovated buildings it is indicated the use photovoltaic or solar thermal systems.

10.8.1 REAL ESTATE PRICES AND EPCS

EPC transposition and implementation takes place on a national level in Sweden. The original transposition took the form of an amendment to existing regulations, which were further updated in 2009 and 2012 to account for the requirements in the EPBD recast. The National Board of Housing, Building and Planning is responsible for supervising and controlling the EPC system and the national EPC database, the latter of which includes an online service where all EPC ratings are can be obtained through the address of the dwelling (CA EPBD 2016).

A new rating system using letter-classes entered into force in 2014, with the scale ranging from A (most efficient) to G (least efficient). The top of the C band represents the minimum rating permitted for new buildings. The other classes are then determined by the calculated final energy of a building as a percentage of the minimum requirements for new buildings (CA EPBD 2016). In 2012, it was calculated that 20% of the building stock had obtained an EPC (CA EPBD 2016b).

Rental data was not obtained and therefore results on the rental market are not included in the report.

In the sales market significant surpluses are observed for categories below the ‘hold out’ category, D, in the dummy variable model results. However, the only significant shift above the hold out category relates to a significant deficit. A linear model was therefore run to ascertain whether the surplus or deficit effect dominates when averaged over the scale. The results show that the former effect is dominant with a surplus of 3.2% for each one-letter improvement. Both sets of results show a significant surplus due to area, as expected.

10.8.2 NZEB-TRACKER

This section highlights the key findings from the nZEB tracker for Sweden in 2014.

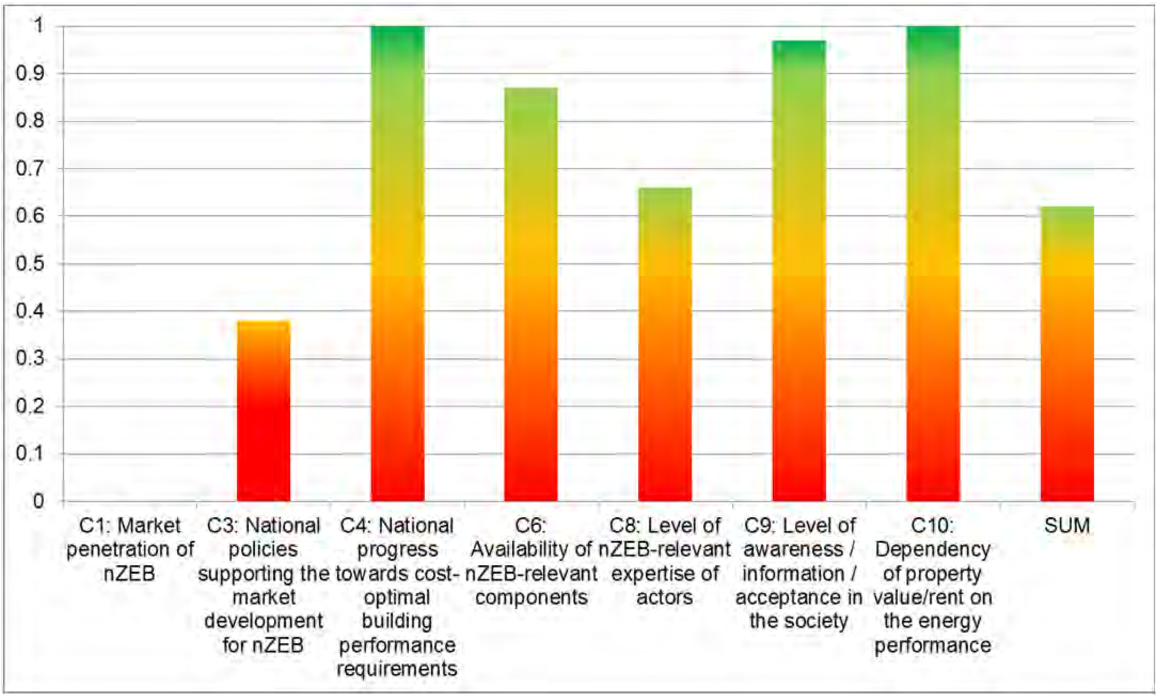

Figure 156 nZEB-tracker score for Sweden in 2014

C1: Market penetration of nZEB

- Swedish result: **not stated** ZEBRA average: **0.32**
- An nZEB definition is not yet stated, therefore are no data available.

C3: National policies supporting the market development for nZEB

- Swedish result: **0.38** ZEBRA average: **0.52**
- Policies in Sweden are evaluated differently, with low score for current regulations, incentives and EPC use and layout in relation to nZEBs. Other policies are assessed as sufficient at current time.
- There is a need for improvement and adaptation, in particular in connection with the still outstanding final definition of the nZEB standard in Sweden.

C4: National progress towards cost-optimal building performance requirements

- Swedish result: **1.00** ZEBRA average: **0.94**
- The Swedish building code already matched the cost optimal building energy performance level.

C6: Availability of nZEB-relevant components

- Swedish result: **0.87** ZEBRA average: **0.83**
- Energy efficient heating systems and other building components for nZEB were well or very well available in Sweden.
- Solar thermal systems seemed to be available only moderately.

C8: Level of nZEB-relevant expertise of actors

- Swedish result: **0.66** ZEBRA average: **0.63**
- The availability of experts were assessed as only moderate good for all the three phases.

C9: Level of awareness / information / acceptance in the society

- Swedish result: **0.97** ZEBRA average: **0.94**
- Awareness for energy efficiency in buildings is high and increased further again slightly from 2014 to 2015.

C10: Dependency of property value/rent on the energy performance

- Swedish result: **1.0** ZEBRA average: **0.74**
- Energy performance, together with financial aspects, was assessed as most important for customers' decision on renting/buying a real estate as living quality, whereas site, living quality and aesthetics scored a little bit lower.

Maturity of the Swedish nZEB market

- Swedish result: **0.62** ZEBRA average: **0.66**
- The nZEB market seemed to be slightly less well developed than the average of the ZEBRA countries. There is a need for improvement and adaptation of policies, in particular in connection with the still outstanding final definition of the nZEB standard.
- High performance building components were easily available.
- The availability of experts may limit the future development of the nZEB market.
- People became more and more aware of the energy performance of buildings.

10.8.3 SCENARIOS

Figure 157 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total Sweden building stock is around 105 TWh in 2012. The scenario shows a slow-down of the energy demand of around 8% (around 1% yearly) from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 27% in the current policy scenario in the long term development between 2012 and 2050 and by 34% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In Sweden, the share of biomass-based heating systems and district heating with almost 71% make up a significant share on the total energy demand for space heating, cooling and hot water in 2012 whereas the fossil-fuel-based heating systems makes up only app. 3%. The share of non-delivered energy (i.e. solar and ambient energy) is 11% on the total energy demand for space heating in 2012.

Figure 158 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 26% in current policy scenario and around 35% in ambitious policy scenario. The reduction of the primary energy demand is around 32% and 44% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

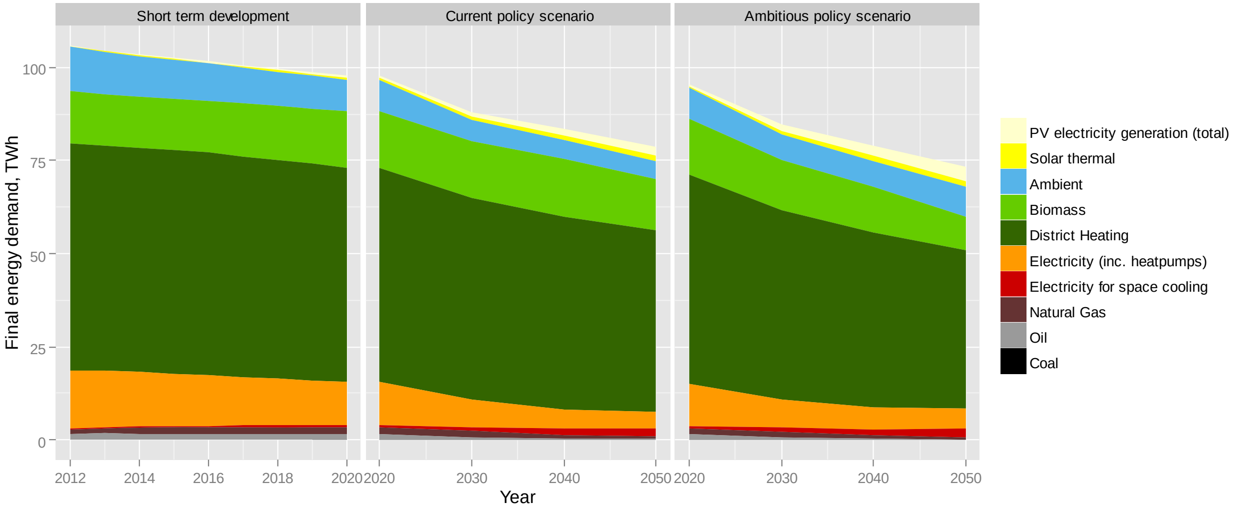

Figure 157 Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

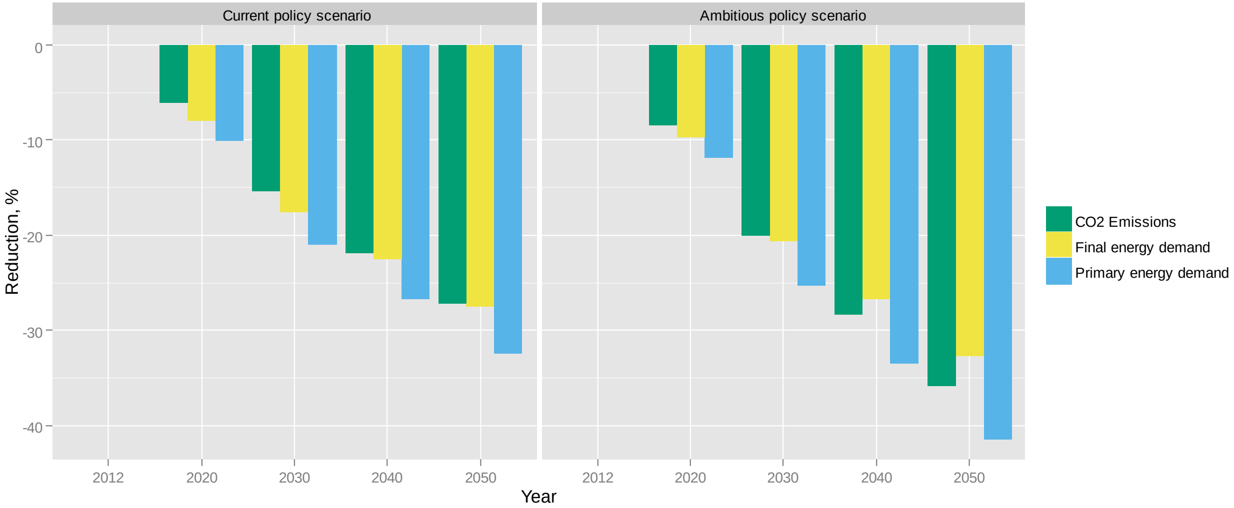

Figure 158 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

10.8.4 RECOMMENDATIONS

Existing regulations for new buildings in Sweden are among the most stringent in Europe. Nevertheless, there are weaknesses connected to verification, heat loss of a building and renovation of existing buildings. A suggestion for definition of nZEB has been developed, but is not yet stated. Several policies, measures and instruments are carried out, although there are opportunities for improvement. The following recommendations for the Swedish context were prepared in collaboration with Passivhuscentrum Västra Götaland:

SE1 - Clarification in the building regulations

SE2 - New outlooks to assessing the value of energy efficiency in the current building stock

SE3 - Information centre for buildings, energy efficiency and renewable energy

SE4 - Improved requirements and verification – from procurement to operating phase

SE5 - Highly efficient building processes

SE6 - Building and renovation with inclusion and without gentrification

#SE1 - Legislative and Regulatory Instruments

Clarification in the building regulations

In order to meet the sharper energy requirements that comes with nZEBs, the calculations need to be standardised, focused on the buildings primarily and the heating system secondarily, as well as not being too complicated. Incorporation of requirements of a maximum heat loss per square meter at dimensional winter temperature (W/m2) has the potential to achieve this, as well as facilitating the supervision of energy requirements.

To make the building code more neutral in relation to heating technology, it should include requirements of a maximum heat loss per square meter at dimensional winter temperature (W/m2)/net energy use.

Using a demand of maximum heat loss (W/m2) at DVUT (dimensioning winter outdoor temperatures) would also make it easier for the municipal building department to assess the energy calculations. It is also easier to calculate for the contractor. The buildings energy use decreases when the energy systems are most congested. Behavioural aspects do not need to be taken into consideration.

The Swedish Board of Housing, Building and Planning have recently suggested clearer demands for verification of a buildings energy performance. The proposition does not require a measurement of the energy use, which is necessary today. In order to prepare for new nZEB requirements, monitoring of energy use in the form of measurement should be essential. The municipalities should also get advice on an action plan for what measures should be taken if the energy use is higher than what was calculated in the design phase185.

Currently the Swedish building code use a system boundary based on how much energy a property needs to buy as opposed to how much energy the building can use. It can pay off to install a heat pump instead of investing in an energy efficient building envelope. The (Swedish) building code should be neutral in relation to the heating system, for example electricity (heat pump) or district heating. A competitive district heating market and less electricity used to heat buildings is necessary to have renewable electricity- and heating supply during cold winter days.

Municipalities have responsibility for supervision of buildings energy requirements. A number of municipalities have difficulties with assessing the energy calculation and ask for guidance from public authorities, increased skills among the municipalities and clarification in the building regulations[186].

Two thirds of the municipalities do not demand that the energy requirements are verified by a measurement of the energy use. Instead, they refer to the act of energy declarations. Meanwhile, 8 out of 262 (3 %) of the municipalities do a verification in the Swedish Board of Housing, Building and Planning's register of performed energy declarations.

Many municipalities have difficulties with the oversight role of energy conservation and energy efficiency.

In order to meet upcoming NZEB standards when renovating, energy requirements focused on the building will steer towards renovation of the climate envelope (# SE-5)

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[185] http://www.bebostad.se/wp-content/uploads/2015/05/BeBo-rapport-Glapp-i-Byggprocessen-final.pdf

[186] http://www.boverket.se/sv/PBL-kunskapsbanken/uppfoljning/uppfoljning-tillsyn/tema-energihushallning-och-energieffektivisering/

#SE2 – Economic Measures

New outlooks to assessing the value of energy efficiency in the current building stock

The essentials of this recommendation is to:

- Investigate how an improved indoor quality, decreased energy costs and less environmental impact is measured when a housing company calculates a renovation project
- Investigate funding of rental income in order to finance energy efficiency refurbishments.

The aspect of funding for deep, energy efficient renovation needs to be addressed. During the 90s, the "renovation funds" were abolished in Sweden. This means that the costs for a deep renovation should be planned for by the housing companies.

However, a common obstacle for deep renovation is funding. In order for a housing company to make the decision to perform a deep renovation with improved energy efficiency, it needs to be profitable. The government have initiated an investigation on "energy saving loan"[187]. Proposals are planned to be presented in September 2017, however the market should now start a process of re-evaluation the costs and benefits of energy efficiency.

The Swedish Board of Housing, Building and Planning have recently developed a proposal on a regulation regarding economic support for renovation and energy efficiency in certain residential areas[188]. However, energy efficiency is not a requirement in order to receive the support, which is why it is not a complete solution for the vital need of energy efficiency in the current building stock.

SE-5 can be a complement to this measure since it shortens the project times and should therefore cut the project costs. An information centre (# SE-3) can contribute with research supporting the benefits of energy efficiency.

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[187] http://www.regeringen.se/pressmeddelanden/2016/07/beslut-om-kommittedirektiv-for-att-utreda-forutsattningarna-for-statliga-energisparlan/

[188] http://www.boverket.se/sv/lag--ratt/pagaende-regelarbete/boverkets-remisser/remiss-ren-1/

#SE3 – Communication

Information centre for buildings, energy efficiency and renewable energy

On behalf of the Swedish government and in accordance with the energy efficiency directive, the Swedish Energy Agency and the Swedish Board of Housing, Building and Planning developed a strategy for energy efficiency renovations[189]. One of the proposals in the strategy is to form an "information centre" in order to increase the rate of energy efficiency in the renovations. The purpose of the centre is to remove the obstacles in the form of a low awareness and high transaction costs amongst building owners. This includes dissemination of information, research projects, demonstration projects as well as quality assurance of information and knowledge.

An information centre for buildings, energy efficiency and renewable energy can play an important role for increasing the market uptake of nZEBs. This may advantageously include new construction. An information centre can also serve as a networking function, bringing essential expertise to projects that need it.

There are some initiatives on education of municipalities (SE-1), although these can be scaled up and/or coordinated by an information centre. Implementation of energy declarations can be supported as well.

#SE4 – Quality of action

Improved requirements and verification – from procurement to operating phase

Procurement documentation needs to be improved, since inadequate documentation gives too much freedom to the contractor to choose solutions that give increased costs for the operational phase. Bids/tenders are based on unclear material[190].

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[189] http://www.boverket.se/globalassets/publikationer/dokument/2015/forslag-till-utvecklad-nationell-strategi-for-energieffektiviserande-renovering.pdf

[190] Bebo, 2014, Glapp i byggprocessen – läckor i energisystemet (http://www.bebostad.se/wp-content/uploads/2015/05/BeBo-rapport-Glapp-i-Byggprocessen-final.pdf)

Earlier investigations have shown:

- In several projects, the components that was planned for was not installed. Functional requirements need to be worked into the procurement documents as well as the correct method for verification[191].
- Research and innovation should focus on developing better components, business models etc[192].
- The municipal housing companies need an expanded decision support regarding evaluation and comparison of bids/tenders and formulation requirements in procurements[193].
- Handover from the construction phase to the operational phase is often problematic, as well as the tuning of technical systems[194].
- Increased system competence for the building, e.g. knowledge about how changes in one subsystem affects the function of other subsystems[195].

Studies have shown that due to lacking in responsibility, requirements and verifications, an over-consumption of energy in buildings can be between 10 and 50 %, mostly around 20-30 % [196].

An information centre (# SE-3) can play a role as a project supporter as well as a platform were actors can share experiences.

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[191] Bebo, 2014, Glapp i byggprocessen – läckor i energisystemet (http://www.bebostad.se/wp-content/uploads/2015/05/BeBo-rapport-Glapp-i-Byggprocessen-final.pdf)

[192] Bebo, 2014, Glapp i byggprocessen – läckor i energisystemet (http://www.bebostad.se/wp-content/uploads/2015/05/BeBo-rapport-Glapp-i-Byggprocessen-final.pdf)

[193] Sundén et al, 2015, Beslutsunderlag för lågenergihus i allmännyttan (http://www.sust.se/wp-content/uploads/2016/04/Slutrapport_Beslutsunderlag_lagnenergihus.pdf)

[194] Sundén et al, 2015, Beslutsunderlag för lågenergihus i allmännyttan (http://www.sust.se/wp-content/uploads/2016/04/Slutrapport_Beslutsunderlag_lagnenergihus.pdf)

[195] Bebo, 2014, Glapp i byggprocessen – läckor i energisystemet (http://www.bebostad.se/wp-content/uploads/2015/05/BeBo-rapport-Glapp-i-Byggprocessen-final.pdf)

[196] Bebo, 2014, Glapp i byggprocessen – läckor i energisystemet (http://www.bebostad.se/wp-content/uploads/2015/05/BeBo-rapport-Glapp-i-Byggprocessen-final.pdf)

#SE6 – Incentivize the Market

Highly efficient building processes

Some research projects which focus on standard facade elements for energy efficient renovation are/have been conducted. This solution has many positive aspects, for example, the residents can stay in the building during the process since it is a shorter project time. These projects need to be put to market in order to speed up the renovation of the so-called "million programme".

Circa 80 % of the current building stock will remain in 2050. There are several challenges tied to the existing buildings from the 1950s, 1960s and 1970s. Firstly, the energy consumption is very high. Second, the indoor climate is often poor. Obstacles that prevent property owners to conduct renovations are amongst others limitations in the investment budget and difficulties to find evacuation for residents during renovation.

Example: NPRFAC

See for example NORFAC, a Nordic open intelligent facade system with high export potential. NORFAC is a Nordic research and development project involving 12 partners collaborating in the development of an innovative Nordic facade system[197].

Example: Brogården

Description Deep renovation of Brogården, Alingsås: Brogården is a residential area constructed in the 1970s. 8 buildings consisting of 144 dwellings were refurbished using passive house techniques. During the refurbishment, prefabricated facade modules were used. The energy use for heating decreased from 115 kWh/m2,year to 19 kWh/m2, year[198].

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[197] http://norfac.eu/

[198] https://www.alingsashem.se/index.php?page=brogarden---ombyggnad

*#**SE6** – Social Issues*

Building and renovation with inclusion and without gentrification

Residents need to be a part of the process before, during and after a renovation. Major renovation projects can be an opportunity for neighbours to get to know each other better and it can create job opportunities. All property owners should know the benefits of including the residents in the process, and the residents need to be aware of their rights when their house is subject to a renovation. Methods for creating dialogue between residents, property owner and contractor as well as co-creation (for example where the residents can decide the level of improvement in their individual apartments and make suggestions for the common areas for example front door and staircase) need to be implemented among municipalities and property owners.

A study conducted by the Board of Housing, Building and Planning show that 25 % of residents move in conjunction with extensive renovations**199**. The residents with the lowest income are moving in the greatest extent. Improved forms for influence from the residents when refurbishment plans start to take place is of great importance.

Some renovations have been conducted with a dialogue with residents and a limited increase of the rent level. Although, there are still many examples of renovations where the rent levels have been increased with circa 60 %. The successful examples of refurbishment where gentrification has been avoided need to be disseminated.

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[199] http://www.boverket.se/sv/om-boverket/publicerat-av-boverket/publikationer/2014/flyttmonster-till-foljd-av-omfattande-renoveringar/

10.9 UNITED KINGDOM

10.9.1 BUILDING PERFORMANCE MARKET DATA

10.9.1.1 CONSTRUCTION AND RENOVATION ACTIVITIES

The following figure represents the share of new dwellings by type (single and multi-family dwellings) in the residential stock for the EU countries. The UK has a share of 0.45% of new dwellings in residential stock. The UK has one of the lowest share in new dwellings among the EU countries. In the UK dynamics of new residential construction shows an increasing trend as the number of new constructions was around 112.000 in 2010 and 149.000 in 2015. The majority of new dwellings in the UK are in single-family houses.

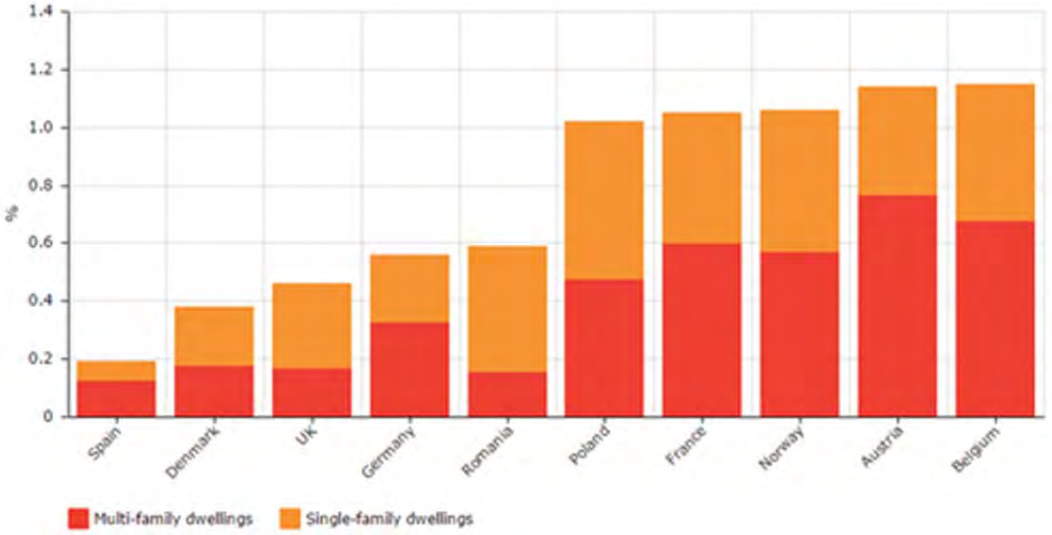

Figure 137: Share of new multi- and single-family dwellings in residential stock in 2014

Source: ZEBRA

The EPBD requires all new buildings from 2021 (public buildings from 2019) to be nearly zero-energy buildings (NZEB). According to Article 2 "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent from renewable sources, including sources produced on-site or nearby. ZEBRA2020 proposes a methodology on how nZEB can be defined for nZEB market tracking, with the nZEB radar graph. This nZEB radar combines a qualitative and quantitative analysis of building standards and clusters new buildings in 4 different energy efficiency categories that have been defined at national level by experts:

1. Net zero energy buildings / Plus energy buildings
2. nZEB buildings according to national definitions
3. Buildings with an energy performance better than the national requirements in 2012
4. Buildings constructed/renovated according to national minimum requirements in 2012

Energy Performance Certificates (EPC) were introduced in the UK in 2007 and became mandatory for new built properties in 2008. They range from A (Very energy efficient) to G (Not energy efficient). Due to the system behind the Standard Assessment Procedure – the scheme for calculating the EPC rating – even recently completed buildings can have an EPC rating of G (least energy efficient). However, since the implementation of the Building Regulations 2010, the Building standard could be associated with EPC rating C and since the 2013 Update with EPC rating B. Nearly Zero Energy Buildings can be associated with the highest class within the EPC rating scheme, class A, which is likely to become building standard in 2016.

In 2007 the Code for sustainable homes (The Code) was implemented, a voluntary rating scheme for dwellings defining 6 levels (one to six stars) more ambitious than the Building Regulations 2006. Meanwhile level 3 of the Code has been incorporated in the Building regulations. Level 6 Certification is granted for zero carbon homes. Since the Code is not mandatory, only about one third of new constructed dwellings are certified by it. Therefore, the shares of new dwellings per level may not be representative for all new dwellings. But at least for an estimation on the amount of total new high performing buildings (level 6), this can be an appropriate basis.

Translating the definition of nZEB radar in the case of the UK gives:

1-Better than nZEB (net ZEB or positive house)	Energy Plus House; Code for sustainable Homes: Level 6
2-National official nZEB definition	EPC class A
3-Better than current building code	EPC class B
4-According to building code	EPC classes C - G

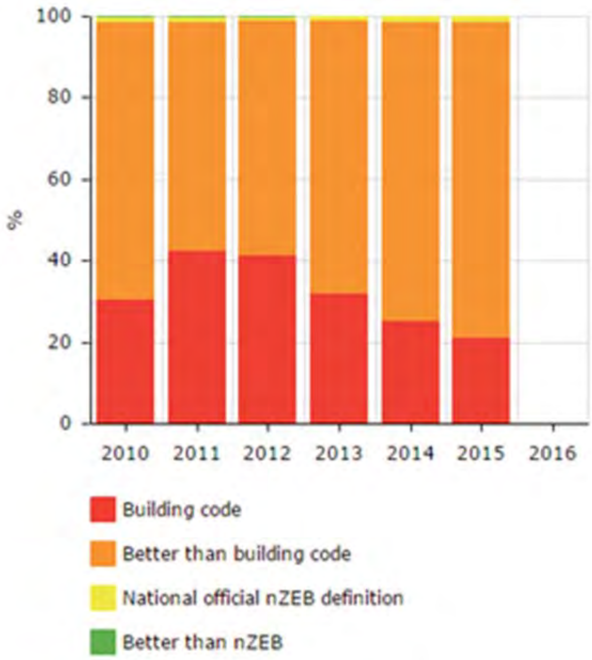

Figure 159 Distribution of new dwellings according to the nZEB radar graph – United Kingdom

Source: ZEBRA

10.9.1.2 SELECTED HIGH PERFORMANCE BUILDINGS

In United Kingdom, it has been collected data of 17 nZEBs or high energy efficient buildings which were constructed recently. 13 out of the 17 are new buildings and 4 are renovated buildings. 10 have a residential use and 7 are intended for non-residential use.

Climate zones

As Table 31 indicates, 7 of the buildings are located in climate zone B which is characterized by cold winters and mild summers and 10 buildings are located in climate zone D with temperate winters and mild summers.

Table 31Building distribution by climate zones - United Kingdom

Climate zones		New Buildings	Renovated Buildings
A	Cold winters and warm summers		
B	Cold winters and mild summers	7	
C	Warm winters and warm summers		
D	Temperate winters and mild summers	6	4
E	Temperate winters and warm summers		

Heating Demand

The average heating demand in new buildings is 25,0 kWh/m² a, while in renovated buildings it is 19,0 kW/m² a.

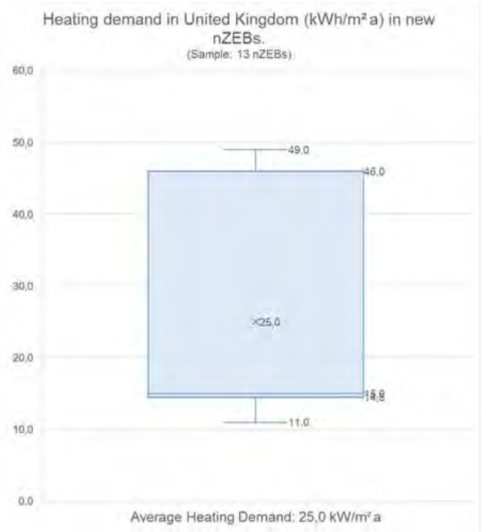

Figure 160Box plot of heating demand in new nZEBs - United Kingdom

Building envelope and passive solutions

In new buildings, the average U-value in walls is 0,12 and 0,10 in roofs, while in renovated buildings the average U-value in walls is 0,10 and 0,13 in roofs.

In new buildings, cellulose fibre is the most used insulating material in walls and roofs with a percentage of 31%. Expanded polystyrene with a percentage of 50% is the most common insulating material in walls of renovated buildings, while the preferred insulating material in roofs of renovated buildings is equally distributed between glass wool, phenolic foam, polyisocyanurate and stone wool, with a share of 25% each.

In windows, the average Uwin-value is 1,04 in new buildings and 0,94 in renovated buildings. Concerning the type of glass, triple glass is the most used glass with a share of 62% in new buildings and 75% in renovated buildings.

With respect to passive cooling strategies, in none of the 17 selected buildings it is indicated the use of any passive cooling strategy.

Active solutions

Mechanical ventilation with heat recovery is the preferred option in the 69% of the new buildings, while the mechanical ventilation without heat recovery is the most used option in renovated buildings with a percentage of 50%.

With regard to the heating system, condensing boiler with a share of 46% is the most common option in new buildings, whilst heat pump with 50% of percentage is the preferred option in renovated buildings. Gas with a percentage of 62% is the most used energy carrier in new buildings, while in renovated buildings the 75% of buildings have an unknown energy carrier for heating.

The same system for heating and DHW are the preferred option with a share of 38% of the new buildings, while a system partially depending on solar thermal collectors and integration with the heating system (50%) is the preferred option for DHW in renovated buildings.

In none of the 17 selected buildings, it is indicated the use of any cooling system.

Renewable energies

In 4 out of the 13 new buildings, it is indicated the use of photovoltaic systems and in 9 the use of solar thermal systems.

One of the renovated buildings uses photovoltaic systems and 2 use solar thermal systems.

10.9.1 REAL ESTATE PRICES AND EPCS

The UK is made up of four jurisdictions: England, Northern Ireland, Scotland and Wales. The transposition and implementation of the EPBD is managed independently in each of the jurisdictions as a result of power devolution. However, before to 31 December 2011 (CA EPBD 2016), the devolution of powers agreement between England and Wales did not include building regulations. As a result, England and Wales were governed by the same EPC regulations before the EPBD recast. However, despite the fact that the EPBD recast has been transposed and implemented separately by each jurisdiction, all of the jurisdictions follow the same UK Standard Assessment Procedure (SAP) to calculate EPC ratings. Furthermore the regulations governing the advertisement and scope of EPCs are broadly consistent (BPIE 2016). As a result, a mixed dataset of dwellings from the UK can be used without the need to treat each of the jurisdictions separately. Nevertheless, as is the case with other countries that formulate EPC legislation on a regional level, the staggered rate of implementation of regulations must be taken into consideration.

The SAP uses a fixed-value measurement approach. The energy efficiency index provided in the EPC displays the level of energy efficiency of a dwelling as a numerical rating between 0 and 100, with 100 representing the highest possible energy efficiency and 0 representing the lowest. These numerical values are then matched to letter-bands, which range from A to G. In addition to the current ratings, potential ratings are displayed to reflect the improvements that would likely arise if renovation recommendations were acted upon (CA EPBD 2016).

The UK sales market demonstrates a price surplus above the 'hold out' category. However, the results for E- and F-rated EPCs are not significant and hence conclusions can only be made for the higher end of the scale. Data was not available for the construction year of the dwellings in the data set; however, the area variable correlates positively with price as expected. The linear regression model results in a price surplus of 4.8% for each one-letter improvement.

The results for the UK rental market are statistically weak, since only one of the EPC coefficients was found to be statistically significant. However, this result, which reflects the presence of a price discount in the shift between D- and E-rated dwellings, is consistent with the hypothesis. In addition, the positive area coefficient confirms expectations. The results for the linear model for the UK market are not statistically significant.

10.9.2 NZEB-TRACKER

This section highlights the key findings from the nZEB tracker for the United Kingdom in 2014.

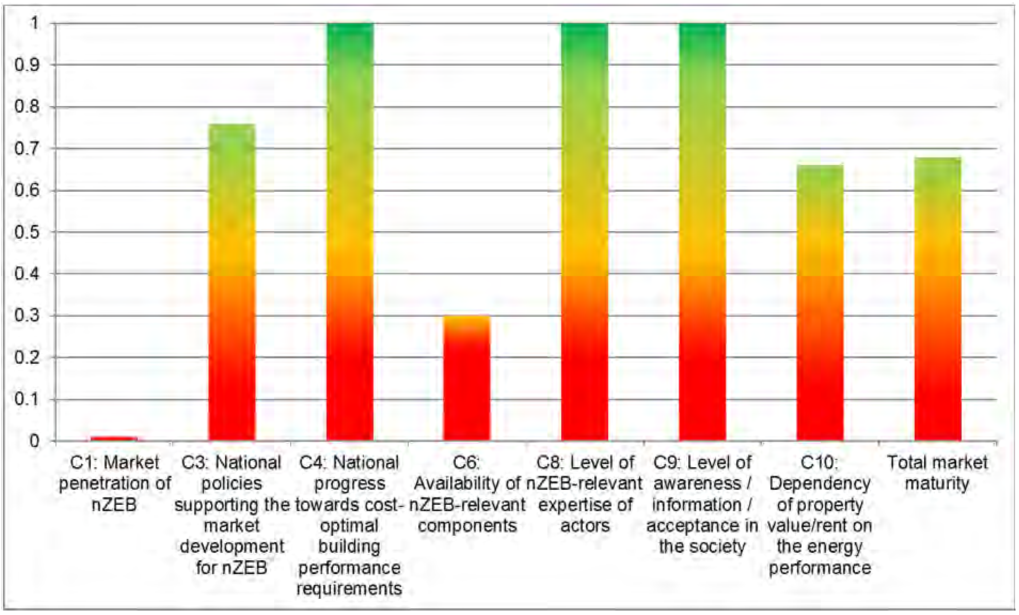

Figure 161 nZEB-tracker score for the United Kingdom in 2014

C1: Market penetration of nZEB

- British result: **0.01** ZEBRA average: **0.32**
- nZEB among new constructions are still rare in the United Kingdom.

C3: National policies supporting the market development for nZEB

- British result: **0.76** ZEBRA average: **0.52**
- In 2014, the amended UK Building Regulation 2010 took effect, strengthening the requirements for energy performance of buildings.
- Relevant economic incentives/financing schemes (e.g. ESOS) seemed convincing.
- Policies for supervision, promotion of nZEB and supporting respective education and trainings appeared sufficient.

C4: National progress towards cost-optimal building performance requirements

- British result: **1.00** ZEBRA average: **0.94**
- The British building code is even more ambitious than the cost optimal value.

C6: Availability of nZEB-relevant components

- British result: **0.91** ZEBRA average: **0.83**
- nZEB-relevant building components are well available in the United Kingdom

C8: Level of nZEB-relevant expertise of actors

- British result: **0.59** ZEBRA average: **0.63**
- The availability of professionals for the realization may restrict the further development of the nZEB market.

C9: Level of awareness / information / acceptance in the society

- British result: **1.00** ZEBRA average: **0.94**
- The awareness for energy performance of buildings is rising in the society.

C10: Dependency of property value/rent on the energy performance

- British result: **0.66** ZEBRA average: **0.74**
- Energy performance plays a minor role in the customers' decision on buying/renting a real estate.

Maturity of British nZEB market

- British result: **0.67** ZEBRA average: **0.66**

Market conditions for nZEB improve in the United Kingdom. However, a lack of professionals may be a risk for the further development.

10.9.3 SCENARIOS

Figure 162 shows the total final energy demand and energy carrier mix for space heating, space cooling and hot water from 2012 until 2020 in the short term perspective and final energy demand development in the long term perspective up to 2050. Final total energy demand of the total UK´s building stock is around 466 TWh in 2012. The scenario shows a slow-down of the energy demand of around 17% (around 2% yearly) from 2012 to 2020. Heating, cooling and hot water energy demand is decreasing over time by 40% in the current policy scenario in the long term development between 2012 and 2050 and by 44% in the ambitious policy scenario. As the ambitious scenario implements more stringent measures and additional financial instruments on existing buildings, the renovation dynamics are significantly higher and accordantly the final energy demand reduction is higher.

In the UK, the share of natural gas heating systems with almost 81% make up a significant share on the total energy demand for space heating, cooling and hot water in 2012 whereas the biomass heating systems and district heating makes up only 2%. The share of non-delivered energy (i.e. solar and ambient energy) is rapidly increasing over time from around 0.1% of final energy demand in 2012 to around 9% in current policy scenario and 25% in ambitious policy scenario in 2050.

Figure 163 shows the reduction of the building related final energy demand, primary energy demand and CO2-emissions. The reduction of the CO2-emissions from 2012 and 2050 is around 52% in current policy scenario and around 68% in ambitious policy scenario. The reduction of the primary energy demand is around 44% and 58% in the current and ambitious policy scenarios respectively. There are several key drivers for the CO2-emission and primary energy savings in the scenarios. (1) the overall energy demand and energy performance of buildings, (2) the share of renewable heating, (3) the reduction in CO2-intensity of electricity generation.

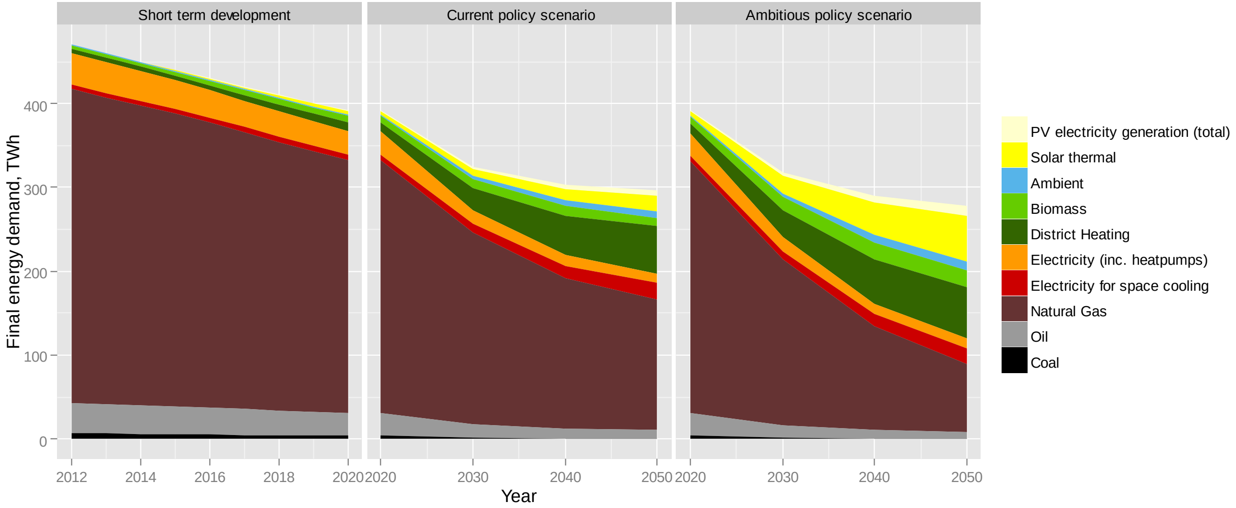

Figure 162Final energy demand for space heating, hot water and cooling, 2012 to 2050, current policy scenario and ambitious policy scenario

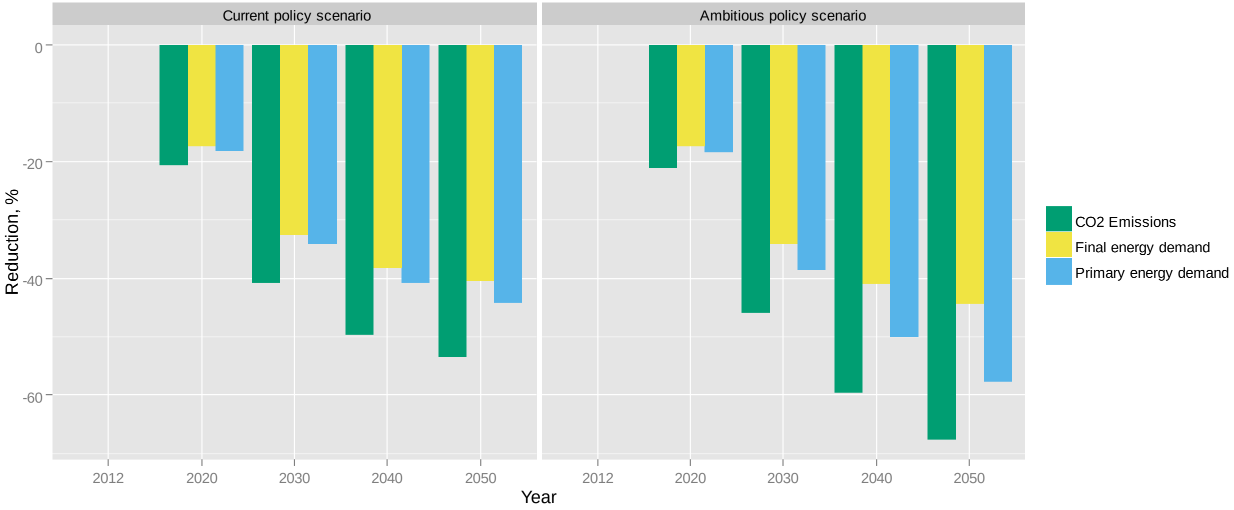

Figure 163 Reduction of CO2 Emissions, final energy demand and primary energy demand for space heating, hot water and space cooling, 2012 to 2050, current policy and ambitious policy scenarios

10.9.4 RECOMMENDATIOS

The UK Government has recently cancelled its ambitious targets to achieve zero carbon buildings in 2020. Together with this cancellation, Zero Carbon Hub was closed and Green Deal was also shut down[200]. The UK had the most ambitious targets and fairly well functioning set of policies. Therefore, when mentioning recommendations, it is important to highlight this update.

In the UK, the Zero Carbon Hub was established in 2008, which took operational responsibility for achieving government's target of delivering zero carbon homes (mainly in England). This public/private body was closed in March 2016 due to government's decision to not pursue zero carbon target at the time being. Zero Carbon Hub provided remarkable recommendations and successful communication between the government and industry. Even with its success so far, it can be considered as a good example for especially raising awareness regarding energy efficiency, encouraging industry to deliver zero carbon homes and achieving collaboration between the government and industry which is a very important step to ensure achieving targets for nZEBs overall.

Following the end of Green Deal and Zero Carbon Hub, there is a possibility and need for new effective measures to steer the market towards nZEB. The following recommendations have been categorized into 6 sections: (i) Legislative and Regulatory Instruments, (ii) Economic measures, (iii) Communication, (iv) Quality of action, (v) Incentivize the market and (vi) Social issues.

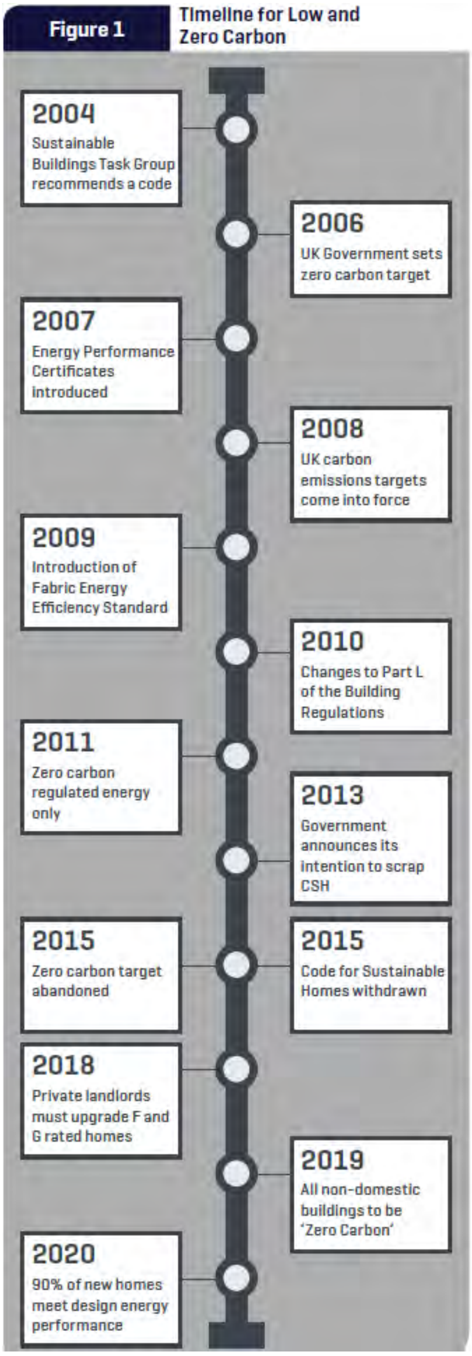

Figure 164 Figure from RICS, 2016

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[200] This update does not affect the applicants before the decision was made or the users who are already paying back on their energy bills as a part of Green Deal.

UK-A1 - Regulate and strengthen building performance minimum standards through the *Building Regulation*

UK-A2 - Integration between regulatory frameworks need to be improved and support NZEB

UK-A3 - Provide building owners and investors with tailored advice according to specific renovation roadmaps

UK-A4 - Evaluation of regulations and standard need to take more account of the cost of uncertainty

UK-B1 - Ensuring the funding will be long term and schemes are easy to understand

UK-B2 - Maintaining subsidies for low carbon improvements

UK-B3 - Support funding schemes that are designed to target multi-occupancy buildings and include funding for engagement

UK-B4 - Developing new funding system for multi-occupancy dwellings

UK-C1 - Develop new commercially viable testing, measurement and assessment techniques to demonstrate the '2020 Ambition'

UK-C2 - Creating new networking and collaboration opportunities

UK-C3 - Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

UK-C4 - Brand NZEBs as part of a positive sustainability narrative

UK-D1 - Training building professionals with "NZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

UK-D2 - Providing construction details scheme in order to assure the implementation of energy performance measurements for the most common fabric junctions as well as new buildings

UK-D3 - Government should accelerate the demand for industry developed qualification schemes by requiring energy certified operatives and professionals

UK-D4 - Support research on how property value changes depending on different energy efficiency measures

UK-D5 - Commissioning processes need to be improved, and be carried out by independent subcontractors

UK-E1 - Foster the uptake of industrialised renovation through increased market confidence

UK-F1 -Allocation of public budgets from income and heating subsidies to effective renovation measures

UK-F2 - Need for a long-term strategy for fuel poverty alleviation on the national level

UK-F3 - Allocating higher percentage of the EU funds in order to implement energy efficiency measures in vulnerable households

UK-F4 - Explicitly define energy poverty and set up monitoring mechanisms

UK-F5 - Providing rehabilitation for poor districts

***#UK-A1 -** Legislative and Regulatory Instruments*

Regulate and strengthen building performance minimum standards through the Building Regulation

The building regulations in England define mandatory standards. Part L of this regulation consists of specifications for the conservation of fuel and power. Public investment should be steered to research for developing the understanding of how these regulations need to be strengthen. This can be made possible by adequate regulatory tools by the government[201].

Strengthen Part L of the Building Regulation and ensure that the minimum requirements are in line with the EU target of "nearly-zero" by 2021

***#UK-A2** - Legislative and Regulatory Instruments*

Integration between regulatory frameworks need to be improved, and must support NZEB

There are national, local policies, regulations, subsidies and support across different sectors such as housing, energy, and environment. These are often overlapping or even contradicting with each other which makes it complicated for householder let even the professionals. Therefore, this needs to be addressed and fixed by policy makers[202]. A better governance framework could increase the value and effectiveness of the policies and measures taken.

The overall regulatory framework across the UK is very complicated, involving national and local policies, regulations, subsidies and support across different sectors (for example building

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[201] RICS, 2016 The future of policy and standard for low and zero carbon homes

[202] LEAF (2016) UK Policy Recommendations Report

control, housing, energy, environment and fuel poverty) which overlap considerably

and often contradict each other. It is hard for professionals, let alone householders, to navigate the system. This needs to be addressed by national and local policy makers, and supported with training for professionals in the different sectors. [203]

There is a growing need for a better understanding of how the different policies and measures interact and stimulates the refurbishment of the existing building stock, and the building of new houses, towards NZEB levels.

Ensure better coordination between different frameworks and institutions

Develop, through supporting of research, a better understanding of how different measures interact

Make clear how these measures specifically target NZEB

#UK-A3 - Legislative and Regulatory Instruments

Provide building owners and investors with tailored advice according to specific renovation roadmaps

In order to become drivers for renovation, the current EPC systems could evolve into building-specific renovation roadmaps, providing a "health check" on individual buildings and tailored advice to owners and investors on how to improve them. A building roadmap will allow building owners to have an overview of the full range of renovation options and easily identify each renovation step from begin to end at the same time (step-by-step approach).

As a result, step-by-step renovation strategies will facilitate the owner's decision to invest in some deeper renovation, in particular if specific elements that need to be taken into account for later renovations are highlighted from the very beginning. For example, if a roof is insulated, roof overhangs, downspout connections, adjustment of the boiler, piping penetrations for future solar systems etc. are also included in the renovation recommendations.

For individual building owners, the uncertainty regarding future renovations typically leads to

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[203] LEAF (2016) UK Policy Recommendations Report

retention with respect to renovation decisions or to limited renovations (installation of short-term measures). From this perspective, any instrument that triggers a long-term perspective and allow building owners and potential investors to clearly outline robust long-term renovation plans. Outlining roadmaps for buildings would avoid possible lock-in-effects and foster better solutions.

Example*: 2014: “Sanierungsfahrplan Baden-Württemberg”*

The German state of Baden-Württemberg provides an individual building renovation roadmap that summarises for the property owner coordinated packages of measures to achieve a deep energy renovation.

Useful bundles of renovation measures are defined, which should be carried out simultaneously in line with the individual preferences of the building owner. It includes as well the before-and-after comparison of energy costs and CO2 emissions and detailed description of the measures, such as preparatory measures, required U values, further co-benefits, possible funding and additional explanations (Pehnt et al. 2014) to avoid lock-in effect. For instance, if a roof is renovated, the roof overhang shall be designed in such a way that the future expected façade insulation can be smoothly applied[204].

This approach has successfully been implemented in Baden-Wuerttemberg, with the German government currently considering it for the rest of the country. France and the region of Flanders (in Belgium) are also developing similar concepts.

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[204] https://um.baden-wuerttemberg.de/de/energie/beratung-und-foerderung/sanierungsfahrplan-bw/

#UK-A4 *- Legislative and Regulatory Instruments*

Evaluation of regulations and standard need to take more account of the cost of uncertainty

Uncertainty is one of the biggest barriers to energy efficiency and deep refurbishment. The cost does not only include an unclear forward-looking perspective making long-term investments unwise, but wasted research and development costs. Furthermore, the cost of "transitional arrangements arising from unexpected changes to policy and standards"[205] should also be considered in these evaluations.

This recommendation is related to the need to have a long-term strategy to provide the market with confidence.

Include "invisible" costs in their evaluations of regulations and standards

#UK-B1 *- Economic measures*

Ensuring the funding will be long term and schemes are easy to understand

The UK implemented stable and consistent founding opportunities to support energy efficient measures for the buildings since years. Therefore, recommendations are mostly consistent of how these funding opportunities could be ensured for more years to come and expanded.

Uncertainty is one of the biggest barriers to energy efficiency and deep refurbishment. The cost does not only include an unclear forward-looking perspective making long-term investments unwise, but wasted research and development costs. Furthermore, the cost of "transitional arrangements arising from unexpected changes to policy and standards"[206] should also be considered in these evaluations.

This recommendation is related to the need to have a long-term strategy to provide the market with confidence.

Foster a stable and long-term financial pathway for nZEB investments

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[205] 205 RICS, 2016 The future of policy and standard for low and zero carbon homes

[206] 206 RICS, 2016 The future of policy and standard for low and zero carbon homes

#UK-B2 *- Economic measures*

Maintaining subsidies for low carbon improvements

Prior to 2013, the UK had relatively stable and consistent funding for energy efficiency measures. As a result, there is a perception that support is and will continue to be available, and indeed is almost expected. In most cases stability and consistency of funding is seen to be more valuable than subsidies which cover the whole cost of improvements.[207]

Ensure stability and consistency of funding directed to energy efficiency in general and nZEB in particular

#UK-B3 *- Economic measures*

Support funding schemes that are designed to target multi-occupancy buildings and include funding for engagement

Directing funding schemes to multi-family houses is often a cost-effective investment, lowering the energy use for many families at ones. It can also be an effective way to reduce fuel poverty and to support local economies.

Direct funding schemes to multi-family buildings, in order to reduce carbon emissions and fuel poverty, and to support local economies

***Good Example:* HEEPS:ABS in Scotland**

In Scotland the Home Energy Efficiency Programmes for Scotland: Area-based Schemes – Programme Structure (HEEPS:ABS) is delivered by local authorities who identify areas and properties to target for funding. Local authorities with areas where multi-occupancy buildings are prevalent have been able to direct funding specifically at these properties: the HEEPS:ABS funding is used to fund measures in private housing whilst social landlords pay for improvements in their own stock. These are otherwise blocks in which social landlords may struggle to improve. Similar devolved powers to local authorities or regional agencies across the whole of the UK would help to target public funding where it is most needed. In addition the HEEPS:ABS funding has provided additional funding to help with engagement work in

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[207] LEAF (2016) UK Policy Recommendations Report

these areas to facilitate the uptake of measures. This is also a recommended feature for funding programmes in other parts of the UK.[208]

The goal with the programme is to:

- reduce fuel poverty;
- reduce carbon emissions;
- encourage ECO activity in Scotland; and
- support the local economy and sustainable local economic development[209]

***#UK-B4** - Economic measures*

Developing new funding system for multi-occupancy dwellings

As multi-occupancy dwellings represent a more complex system than single-family houses, there is a need for agreement and financial contribution from all residents. Therefore, these type of dwellings need structural funding legislation with different improvement targets.

There is additional cost in managing the complexity involved in multi-occupancy buildings (particularly where a package of different improvements is being made or where financial contributions from residents are required). This needs to be built into the funding structure of legislation so that improvements can be targeted where there is greatest need.[210]

Enable new funding structures for multi-occupancy buildings

***#UK-C1** - Communication*

Develop new commercially viable testing, measurement and assessment techniques to demonstrate the '2020 Ambition'

Quality assurance techniques must be improved, in order to demonstrate the '2020 ambition'. There is a clear need to refine existing diagnostic tests to make them more useful, usable and consistent, and to develop new techniques.

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[208] LEAF (2016) UK Policy Recommendations Report

[209] http://www.gov.scot/Topics/Built-Environment/Housing/warmhomes/uhis/heepsguidance

[210] LEAF (2016) UK Policy Recommendations Report

In addition, manufacturers need to develop and adopt testing methods that better reflect the performance of their products as 'systems' within actual buildings. There remain conflicting views on the most commercially viable way to demonstrate a building's as-built performance, however the development of appropriate testing, measuring and assessment techniques is urgently required to enable the '2020 Ambition' to be demonstrated[211].

Ensure the enhancement of appropriate testing, measuring and assessment techniques

#UK-C2 *– Communication*

Creating new networking and collaboration opportunities

Building nZEB is a complicated process, requiring an effective collaboration among a big number of stakeholders. Creating networking and collaboration opportunities can foster better connections and more effective relationships. An example of this, can be encouraging SMEs to work collaboratively to pitch in for sub-contracting.

According to surveys by Transparense (2013), it's shown that customers lack information and trust towards ESCO industry. Therefore, communication between the ESCO and users is highly important and must be present. Target of the marketing need to be right. Especially in case of multi-occupancy buildings in order to see the interest of residents and provide service/consultancy accordingly.

Encourage new collaborations and business structures

Set up new forums to create new connections and more effective partnerships

Example - EU-projects: COHERENO

The objective of COHERENO is to strengthen collaboration of enterprises in innovative business models for realizing Nearly Zero Energy Building (NZEB) renovations in single family owner occupied houses. The project focuses on eliminating barriers for collaboration, providing enterprises with guidance on how to collaborate and on developing services for the different customer segments.[212]

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[211] Zero Carbon Hub. (2014). Design & As-Built Performance End of Term Report. Accessible at: http://www.zerocarbonhub.org/sites/default/files/resources/reports/Design_vs_As_Built_Performance_Gap_End_of_Term_Report_0.pdf

[212] http://www.cohereno.eu/

***#UK-C3** - Communication*

Promote market uptake of nZEB buildings with information campaigns and easy-grasping guidelines

One big barrier to a fast market uptake of NZEBs is the lack of knowledge and accessible information on different levels. Effective information campaigns targeting different actors and stakeholders (e.g. house owners, building professionals, technical staff of public administrations…) are needed. Easy grasping guidelines or how-to manuals can spur this development.

Ensure the enhancement of appropriate testing, measuring and assessment techniques

Example - EU-projects: ConClip for High-quality Passive House Construction

The Passive House is a leading European building technology and constitutes the fastest growing energy performance standard in the world with 30,000 buildings realised to date. Passive houses save energy costs, are environmentally friendly and provide exceptional health benefits for the occupants. Notwithstanding the success of the Passive House as a leading future building technology, the new building technology faces three serious challenges which need to be faced if the Passive House is to succeed longterm[213]:

- Passive House Construction Quality
- Craftsmen and Site Supervisors Training
- One European quality standard

Example: **Guidelines for future building owners how to build new NZEB in Flanders**

The Belgian region of Flanders has produced a "practical guide for building your nZEB house"[214] to support future home owners through the process of prepare, design, execute and use an nZEB dwelling.

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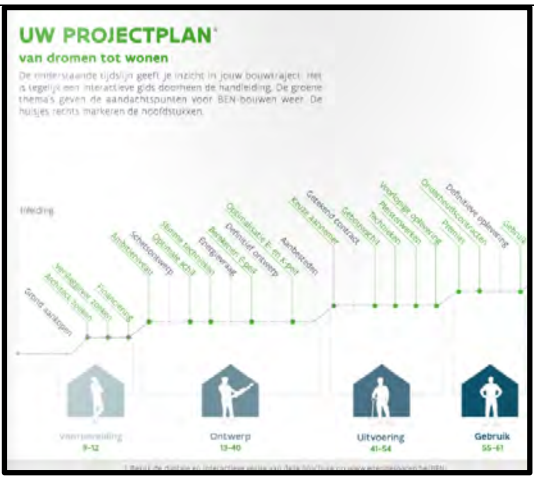
[213] http://conclip.eu/

[214] http://www.vlaanderen.be/nl/publicaties/detail/praktische-bouwgids-voor-jouw-ben-woning-1-exemplaar



UW PROJECTPLAN*

van dromen tot wonen

De onderstaande tijdslijn geeft je inzicht in jouw bouwtraject. Het is tegelijk een interactieve gids doorheen de handleiding. De groene thema's geven de aandachtspunten voor BEN-bouwen weer. De huisjes rechts markeren de hoofdstukken.

#UK-C4 *– Communication*

Brand NZEBs as part of a positive sustainability narrative

NZEB and low-energy buildings should get the reputation they deserve. The benefits are many and affect different socio-economic levels. At the macro-level, new nZEB buildings and deep renovation of buildings have multiple positive impacts such as reduction of CO2 emissions, non-transferable job creation, alleviation of energy poverty and improvement of energy security. At the micro-level, as people spend almost 90% of their life in buildings, the benefits of are numerous as well, next to the energy savings, there is the improved indoor climate with clear health benefits and increased productivity and comfort.

The benefits of new nZEB buildings should be highlighted and a new narrative, alleviating the scepticism of renovation still prevailing in many areas of Europe, should be developed for deep renovation.

Brand NZEBs as investments that will bring social and environmental benefits. NZEBs will fight (fuel) poverty and climate change, while being the cost-optimal choice.

Set up effective awareness campaigns targeting different groups

Example: BEN

nZEBs (BEN), a marketing campaign in the Belgium region of Flanders, providing marketing material and highlighting "BEN frontrunners" such as architects, contractors, installers and banks in contact with the consumer. [215]

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#UK-D1 – Quality of Action

Training building professionals with "NZEB and beyond" qualifications preparing them to build and upgrade the building stock for the future

All stakeholders, including construction managers, designers, planners, building control and engineers, in the housebuilding industry need to improve their knowledge of energy efficient design and energy performance of the buildings[216].

NZEBs demand higher qualifications of building professionals on all levels. Consumers should be able to rely on the skills of the building professional and get value for money, which means state-of-the-art information and advice, achieving the expected (energy) performance, a

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[215] **http://www.energiesparen.be/BEN/voorlopers**

[216] Retrieved from: The Zero Carbon Hub (2014): Closing the Gap between Design and As-Built Performance

maximum operational lifetime and a safe and healthy building. This requires higher skills in the nZEB chain – highly energy efficient products require the proper understanding from the installer etc. A high skilled workforce increases the level of trust and confidence in NZEB investments.

To ensure an effective and qualitative construction and installation of nZEBs and related components, all professional involved in the process must receive proper training. Regarding skills and knowledge development, more departments related to energy, energy efficiency studies can be funded.

Support NZEB-training of building professionals

Fund research on energy efficiency to ensure a continuation of knowledge development

Example: SouthZEB

The SouthZEB project is an Intelligent Energy – Europe funded project (IEE/13/393/SI2.675576) which addresses the IEE priority for 2013 on continuous professional development.

"With the objective of fostering the energy efficiency of the building sector through the adoption of near Zero Energy Buildings (buildings that have very high energy performance) concepts in new or existing buildings, the SouthZEB project develops training modules targeted towards specific professionals (Engineers, Architects, municipality technicians and decision makers) in Southern European countries (Greece, Cyprus, Southern Italy and Portugal). The training modules will be implemented by the project partners in the target Southern European Countries (less advanced on the progress towards nearly Zero Energy Buildings), leveraging on the experience and know-how from front runner project partners' countries (Austria, UK, Northern Italy).[217]

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[217] http://www.southzeb.eu/training/

***#UK-D2** – Quality of Action*

Providing construction details scheme in order to assure the implementation of energy performance measurements for the most common fabric junctions as well as new buildings

The Zero Carbon Hub recommended that an industry-owned and maintained Construction Details Scheme be developed for the most common major fabric junctions and systems. These need to be buildable, flexible, robust, cost effective and capable of being implemented at scale. Clear guidance on thermal bridging should also be provided for housebuilders and industry. [218]

Develop a Construction Details Scheme for the most common major fabric junctions and system

***#UK-D3** – Quality of Action*

Government should accelerate the demand for industry developed qualification schemes by requiring energy certified operatives and professionals

A lot of energy is not only required during the operation of buildings, but already for the production of their components. In order to reduce the energy demand over the complete life cycle of the buildings, it is crucial also to develop more sustainable and efficient production processes. Therefore, qualified employees are required that actively analyse and optimize internal energy flows.

Example: Energy Manager Obligation in Italy

In Italy, an obligatory scheme called the Energy Manager Obligation is applied to industries which have an energy consumption of at least 10,000 tonnes of oil equivalents per year and for organizations such as public administrations with at least 1,000 toe of energy consumption per year. The energy manager is responsible for controlling the energy consumption, establishing an energy balance and reducing the energy demand[219].

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[218] Retrieved from: The Zero Carbon Hub (2014): Closing the Gap between Design and As-Built Performance

[219] Energy Efficiency Watch, 2016, How to Make Europe Number 1 in Energy Efficiency

***#UK-D4** – Quality of Action*

Support research on how property value changes depending on different energy efficiency measures

Research on "how the property or rental values change" should be carried out in order to show there is evidence that implementing energy efficiency measures have positive effect on property value. This could create more confidence in property owners, tenants and investors to invest on implementing energy efficiency measures.

Support research on the effect on property value from energy efficiency measures

***#UK-D5** – Quality of Action*

Commissioning processes need to be improved, and be carried out by independent subcontractors

There is a need for an increased focus on energy-related checks and assessments across all areas of building delivery. Improvements to the role of commissioning are also required. Commissioning is the process to ensure that the building's systems are fully functional at construction completion.

The current process is too simplistic for the complex and dynamic understanding of building performance. It is really important that commissioners should be independent from the sub-contractors whose work they are commissioning, in order to secure a fair and reliable process.

Ensure an effective and reliable commissioning process, to be carried out by independent subcontractors

Examples – BSRIA

BSRIA is a test, instruments, research and consultancy organisation in construction and building services providing specialist support services for design, construction, facilities management, product testing and market intelligence. As a non-profit distributing member-based Association, they publish best practice guides, hold an extensive library and run training and events.

BSRIA has also published a "Commissioning guide set", covering things like ventilations and air-systems, to help commissioners.

***#UK-E1** – Incentivize the market*

Foster the uptake of industrialised renovation through increased market confidence

Build market confidence through different means like branding and quality assurance. Industrialised deep energy retrofits - where one contractor provides a turnkey renovation using mainly prefabricated modules - are still fairly new terrain within the construction sector. Today the majority of renovations happen in a staged approach combining multiple smaller local contractors. In the newly built segment this turnkey approach is more common and integrated.

It is crucial to build consumer trust to allow for a much broader adoption of this approach in renovation as well. This could be done through branding or by developing an independent quality assurance mechanism for products, systems and companies. Actors will be more inclined to work with a company or institution that has an objective quality assessment. Government could play an important role in this mechanism as an objective third party (or as facilitators to set this up).

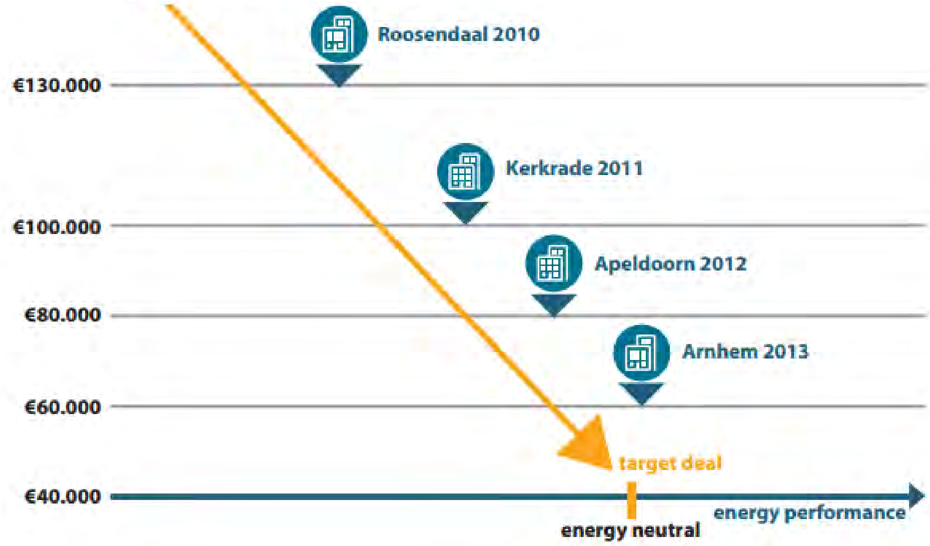
Enable an industrialized renovation through a forward-looking strategy ensuring market confidence

Example – Energiesprong

The Dutch Energiesprong project has demonstrated that the costs for a holistic net zero renovation of a terraced house can decrease from 130.000 euro at the first pilot-project in 2010 to 65.000 euro nowadays thanks to a combination of economy of scale and 3D designed pre-fabricated materials. On top, the on-site execution takes one week, limiting the burden for inhabitants, while at the same time increasing comfort and improving the look of the house. This state-of-the-art renovation programme is embedded in a holistic approach (targeting regulation, sales channels, Net-Zero retrofit, marketing, value uplift and finance), involving all relevant actors and leading to an upscale through an industrialised production process.

The Stroomversnelling project has benefitted from the lessons learned in previous Dutch initiatives to implement holistic renovations which have been undertaken in The Netherlands in recent years. In 2010, 134 houses in Roosendaal were targeted, realising a 72% energy reduction in heating and domestic hot water, at a cost of €130,000 each41. In 2011, 150 houses in Kerkrade were retrofitted to passive house levels at a cost of €100,000 each. Finally, in 2012, 188 zero energy dwellings were renovated in Apeldoorn at a cost of €80,000 per dwelling. These projects show how quickly the price/performance ratio is improving, as illustrated in below:

(Source: Energiesprong, 2014 revised by BPIE)



#UK-F1 *– Social Issues*

Allocation of public budgets from income and heating subsidies to effective renovation measures

Fuel poverty can be correlated with low household income, high energy cost and energy inefficient homes and can be tackled by income increase, fuel prices regulation and energy efficiency improvements in buildings. Energy costs are growing faster than household income. Therefore, energy subsidies and direct financial support for household heating cannot provide a sustainable long-term solution to the fuel poverty problem. These measures require continuous public budget allocation without generating added value or economic growth. The continuous expenditure from public budgets only preserves the status quo.

However, vigorous energy renovation measures of fuel poor homes can give a long-term sustainable answer to fuel poverty. These measures address the root of the problem and result in reduced energy costs and/or improved thermal comfort in homes. Moreover, the implementation of energy efficiency measures can create or maintain jobs, reduce illness, rehabilitate poor districts and therefore contribute to social inclusion. Results from implemented energy renovation programmes targeting the fuel poor in some EU countries demonstrate these positive effects.[220]

Allocate money from temporary subsidies to long-lasting energy efficiency measures

Example: Ireland - The Warmer Homes Scheme

The Warmer Homes Scheme is "a vital pillar in the Irish Government strategy to tackle energy affordability". This scheme – now known as the Better Energy Warmer Homes scheme – targets vulnerable and fuel poor homes, and provides advice and funds for the adoption of energy efficiency measures. The scheme is administered by the Sustainable Energy Authority of Ireland (SEAI) and involves local community organisations. The energy efficiency interventions are totally funded by the scheme and include measures such as: attic insulation, draught proofing, energy efficient lighting and cavity wall insulation.

From 2000 to 2013 over €82 million were distributed through the Warmer Homes Scheme and more than 95,000 homes were supported. Between 2006 and 2009, the benefited households saved on average €85.83 per year. Additionally, only for 201091, the implemented measures from the Warmer Home Scheme resulted in saving 25 GWh and reducing CO2 emissions by 33,000 tonnes.

The scheme resulted in a substantial percentage of the beneficiaries being lifted out of fuel poverty, as it is implied by the indicators used to measure it. Specifically, the percentage of the beneficiaries who were unable (or who found it difficult) to pay the utility bills on time showed a significant decrease; the rates dropped from 48% (before the interventions) to 28%. Additionally, remarkable improvement was observed in rates regarding the ability of the beneficiaries to keep their home adequately warm. Before the implementation of the energy efficiency measures, only 27% of the families with children were able to keep a comfortable temperature at home, while after the interventions this percentage increased considerably to 71%.

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[220] BPIE. (2014). Alleviating Fuel Poverty. Accessible at: http://bpie.eu/publication/alleviating-fuel-poverty-in-the-eu/

***#UK-F2** – Social Issues*

Need for a long-term strategy for fuel poverty alleviation on the national level

Long-term policy predictability is needed because of the size of the problem and its importance in reaching the EU socio-economic, energy and climate goals. A comprehensive and systems approach is needed to handle this complex problem. Investing in fuel poverty alleviation can be a great way to reduce poverty, social problems, spur the economy and generate good jobs.

In the UK, it is estimated that 4,5 million households are living in fuel poverty. This estimation is based on the Low Income High Costs definition. The fuel poverty is caused by low income, high energy prices and low energy performance of the buildings. Thus, buildings with an energy level of E, F and G are considered fuel poor. Fuel poverty is a relevant issue for the UK and it is necessary to provide long term strategies to decrease its relevance.

The UK has introduced a new regulation in England and Wales which obliges the owner of a property to implement the energy efficiency measures suggested by the tenant, in case there is a supporting financial scheme present in order to implement that measure[221].

In 2015, the UK government announced that the Zero Carbon Policy is scrapped, which until then provided valuable support, especially for housing renovation projects. Currently, the National Energy Action provides statistical data on fuel poverty and continues to fund projects for the alleviation of fuel poverty by putting together different funding schemes. However, setting up common policies could provide more efficient results in the UK.

Implement a long-term strategy to eliminate fuel poverty

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[221] National Energy Action http://www.nea.org.uk/projects/

***#UK-F3** – Social Issues*

Allocating higher percentage of the EU funds in order to implement energy efficiency measures in vulnerable households

Case studies of EU countries financing measures against fuel poverty indicate that - even though energy efficiency measures have proven to be the most sustainable solution to the fuel poverty problem – they receive lower funding compared to income and fuel price support schemes. The BPIE study analyses the Cohesion Policy funds for the periods 2007-2013 and 2014-2020 and shows that a significant share -higher than the previous period- of the Cohesion Policy budget 2014-2020 can be used for energy efficiency actions. Therefore, all three Cohesion Policy financial instruments may support the energy renovation of buildings and in particular measures targeting fuel poor and vulnerable consumers.

Utilize EU funds to implement energy efficiency measures in vulnerable households

Example - France – Renovation Programme Of 800,000 Social Housing Dwellings

In order to support social cohesion and respond to the economic crisis, in 2009 the European Regional and Development Fund (ERDF) regulation was amended to allow for up to 4% of national ERDF resources to be invested in energy efficiency improvements in existing housing in all Member States. France, taking full advantage of this revision, committed €320 million of the ERDF to renovate 800,000 social housing dwellings with low energy performance by 2020 (Grenelle Law). Many regions had already invested all their share of the ERDF in the programme before March 2011 and they provided additional funds to the original ERDF.

***#UK-F4** – Social Issues*

Explicitly define energy poverty and set up monitoring mechanisms

Energy poverty is a major problem for Europe, as between 50 and 125 million people are unable to afford a proper indoor thermal comfort. Despite the fact that there is no common European definition, the importance of the problem as well as the severe health impacts caused by fuel poverty are widely recognised. Energy poverty is still the little sibling to the economic and environmental aspects of new constructions and building renovations.

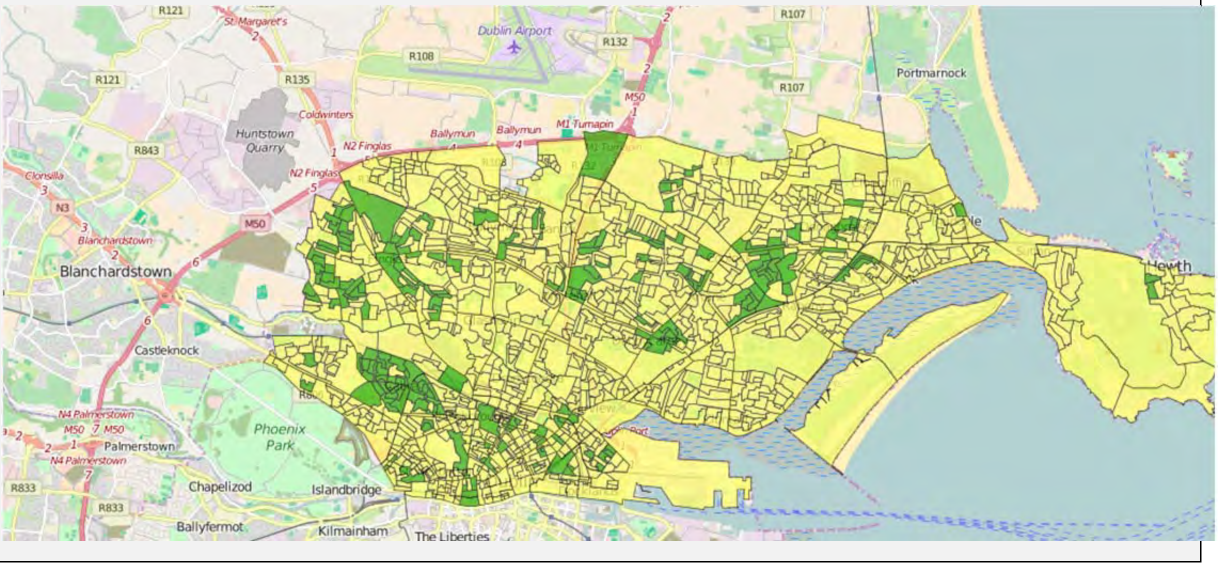
Only four European countries (France, Ireland, Slovakia and UK) have an official definition for energy poverty.

Better data would lead to better understanding of the social challenge. It would also allow to better assess the effectiveness of strategies to tackle energy poverty. This would be to better understand the challenge, and assess effectiveness of strategies to tackle energy poverty. Data for energy poverty must be enhanced and standardized across Europe.

Set up a framework to enable qualitative data of fuel poverty, including a monitoring mechanism

Pilot projects: The Irish Energy Action

The Irish Energy Action, in partnership with the EU-project Episcope, have developed an EPC mapping tool. The interactive map over Dublin illustrates different building characteristics (including energy poverty indicators) of different neighbourhoods. The data is aggregated to defined boundaries, namely small areas and electoral divisions. Small areas typically comprise 50-200 dwellings and electoral divisions include clusters of small areas.[222] This mapping allows for local policy making and strategy development alleviating energy poverty from a district approach.



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[222] http://energyaction-static.s3-website-eu-west-1.amazonaws.com/index.html

***#UK-F5** – Social Issues*

Providing rehabilitation for poor districts

In fact, the reduction of energy bills is not necessarily the main benefit of renovating fuel poor homes. Even if energy costs are kept at the same level, the inhabitants gain significantly in terms of having a higher indoor thermal comfort and thus avoiding associated illness or premature death due to the impact of low temperatures.

Therefore, the benefits are witnessed at a societal level by reducing the need for medical assistance and, at the same time, by having healthier citizens able to contribute more to the personal and societal welfare. Last but not least, the energy renovation of poor districts may give an important sign of social inclusion to people living at the edge of society.

To a larger extent, it is well-known that renovation activities have a high job creation potential due to a high job intensity required in the construction sector. Therefore, by involving unemployed active people living in poor districts into the renovation processes of their homes, a virtuous circle may be created that can further contribute to their faster social inclusion by simultaneously offering jobs and better homes[223].

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[223] BPIE. (2014). Alleviating Fuel Poverty. Accessible at: http://bpie.eu/publication/alleviating-fuel-poverty-in-the-eu/

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Zebra 2016: Zebra data tool, http://www.zebra-monitoring.enerdata.eu/

ANNEX I: METHODOLOGY, KEY INPUT DATA AND ASSUMPTIONS FOR SCENARIO DEVELOPMENT

Invert/EE-Lab

Invert/EE-Lab is a dynamic bottom-up simulation tool that evaluates the effects of different promotion schemes (in particular different settings of economic and regulatory incentives) on the total energy demand, energy carrier mix, CO2 reductions and costs for space heating, cooling, hot water preparation and lighting in buildings. Furthermore, Invert/EE-Lab is designed to simulate different scenarios (energy prices, renovation packages, different consumer behaviors, etc.) and their respective impact on future trends of energy demand and mix of renewable as well as conventional energy sources on a national and regional level. More information is available on www.invert.at or e.g. in (Kranzl et al., 2013) or (Müller, 2012). The model has been extended by an agent specific decision approach documented e.g. in (Steinbach, 2013b), (Steinbach, 2013a).

The key idea of the model is to describe the building stock, heating, cooling and hot water systems on highly disaggregated level, calculate related energy needs and delivered energy, determine reinvestment cycles and new investment of building components and technologies and simulate the decisions of various agents (i.e. owner types) in case that an investment decision is due for a specific building segment. The core of the tool is a multinomial logit approach, which optimizes objectives of “agents” under imperfect information conditions and by that represents the decisions maker concerning building related decisions.

Model structure

The basic structure and concept is described in the following figure

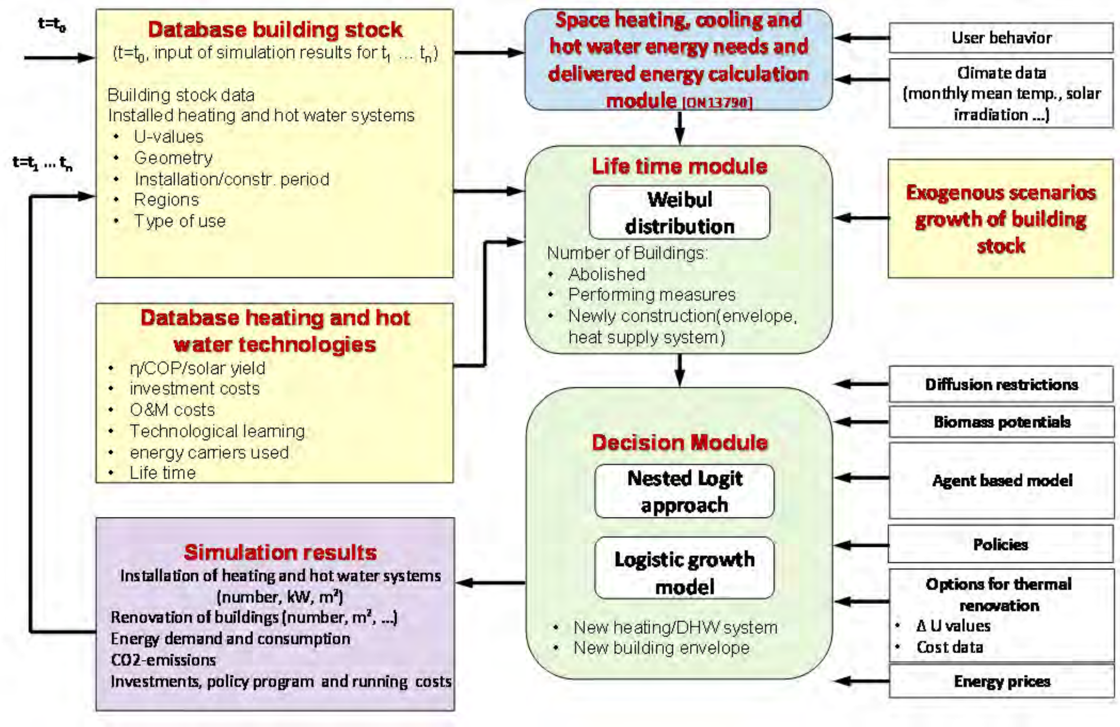

Figure 165 Overview structure of Simulation-Tool Invert/EE-Lab

Coverage and data structure

Invert/EE-Lab covers **residential and non-residential buildings**. Industrial buildings are excluded (as far as they are not included in the official statistics of office or other non-residential buildings).

The following figure shows the disaggregated modeling of the building stock within each country. The level of detail, the number of construction periods etc. depends on the data availability and structure of national statistics. We take into account data from Eurostat, national building statistics, national statistics on various economic sectors for non-residential buildings, BPIE data hub, Odyssee, which are finally summarized in the ENTRANZE database (www.entranze.eu).

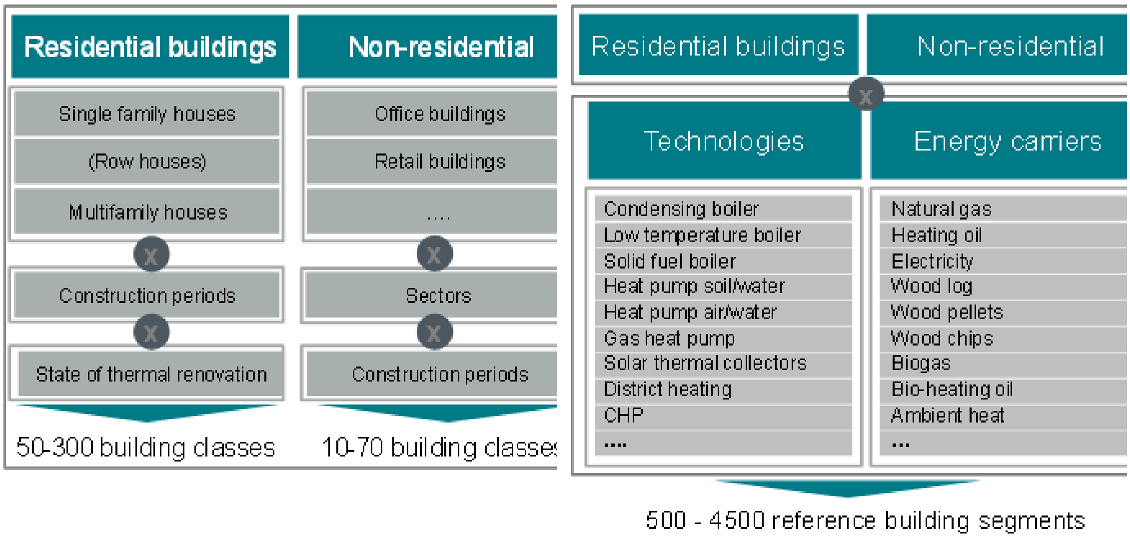

Figure 166 Disaggregated modelling of the building stock within each country. Where relevant, climatic zones are taken into account within a country (ENTRANZE 2014)

As **efficiency technologies** Invert/EE-Lab models the uptake of different levels of renovation measures (country specific) and the diffusion of efficient heating, hot water, cooling and lighting technologies.

General approach of modelling policy instruments in Invert/EE-Lab

Invert/EE-Lab models the decision making of agents (i.e. building owner types) regarding building renovation and heating, hot water and cooling systems. Policy instruments may affect these decisions (in reality and in Invert/EE-Lab) in the following ways:

- Economic incentives change the economic effectiveness of different options and thus lead to other investment decisions. This change leads to higher market share of the supported technology in the Invert/EE-Lab (via the nested logit approach).
- Regulatory instruments (e.g. building codes or renewable heat obligations) restrict the technological options that decision makers have; limited compliance with these measures can be taken into account by limiting the information level of different agents regarding this measure (see next bullet point).
- Information, advice, etc: Agents have different levels of information. Lack of information may lead to neglecting of innovative technologies in the decision making process or to a lack of awareness regarding subsidies or other support policies. Information campaigns and advice can increase this level of information. Thus, the consideration of innovative technologies, knowledge about support programmes and compliance with regulatory standards increases.
- R&D can push technological progress. The progress in terms of efficiency increase or cost reduction of technologies can be implemented in Invert/EE-Lab.