EUROPEAN COMMISSION
RTD - Energy
ENER - Renewables, R&I, Energy Efficiency
JRC – Institute for Energy and Transport
SET Plan Secretariat

SET-Plan ACTION n°5

ISSUES PAPER

Develop new materials and technologies for energy efficiency solutions for buildings

1. Purpose of this document

In September 2015, the European Commission adopted a Communication for an Integrated Strategic Energy Technology Plan (C(2015) 6317 final). The Communication identifies ten priority actions to accelerate the energy system transformation that should facilitate coordinated or joint investments by individual Member States, between Member States and with the EU. These actions have been defined on the basis of the Integrated Roadmap[1] developed with stakeholders and Member States and in line with the new political priorities defined in the Energy Union. Out of the ten priorities of which some are focused on specific technologies, two are related to the development and strengthening of energy-efficient systems, namely Action 5 on the development of new materials and technologies for energy efficiency in buildings, and Action 6 on the continuation of our efforts to make EU industry less energy intensive and more competitive.

For each priority action, the services[2] of the European Commission develop an Issues Paper which will be jointly prepared by and discussed with the representatives of EU Member States and countries forming part of the SET-Plan, working together in the SET-Plan Steering Group, as well as with other stakeholder and Member State forums. These documents will serve as a starting point for discussions with Member States and stakeholders in the development of new research and innovation cooperation at European and national level, not necessarily linked to the on-going H2020 programme. Each Issues paper aims to define (a) the level of ambition (in terms of priorities and targets), (b) the modalities for the implementation and (c) the timing for achieving results and adopting expected deliverables.

This document[3] is intended to progress the implementation of Action 5 on energy efficiency solutions for buildings. It will be used to come to an agreement on targets in a dedicated meeting of the SET-Plan Steering Group with a representation of key stakeholders planned on 15 March 2016.

Stakeholders will be invited to take positions on the proposed targets in accordance with the guidelines set out in the paper "The SET Plan actions: implementation process and expected outcomes" and submit their positions to SET-PLAN-SECRETARIAT@ec.europa.eu by Monday 15 February 2016 at the latest. Relevant documents and material on the SET Plan and Integrated roadmap are available on the SETIS website https://setis.ec.europa.eu/ and other relevant information from the Public-Private Partnership (PPP) on Energy-efficient Buildings is available on the EC website[4].

[1] https://setis.ec.europa.eu/system/files/Towards%20an%20Integrated%20Roadmap_0.pdf
[2] For this Issues Paper: DG ENER, RTD, JRC and EASME
[3] This document is a working document of the European Commission services for consultation and does not prejudge the final form of any future decisions by the Commission.
[4] https://ec.europa.eu/research/industrial_technologies/energy-efficient-buildings_en.html

2. Context

Energy in the building sector

The EU building stock represents a total floor area of around 25 billion m² (2012), around three quarters of which is in residential buildings. Altogether, buildings represent 40% of our final energy demand and they consume more energy than any other sector of the European economy. Their energy consumption is influenced by various factors such as age, size, location (climate, level of urbanisation), number and behaviour of occupants or the presence of appliances.

Residential buildings consume around two third of the total energy of European buildings, and non-residential buildings consume one third[5]. Although, the annual specific energy consumption varies considerably among the heterogeneous building stock, the average annual specific consumption per m² for all types of buildings was around 210 kWh/m² in 2012 (consumption with normalised climate conditions) but non-residential buildings are on average 55% more energy intensive than residential buildings (286 kWh/m² compared to 185 kWh/m²). Space heating remains by far the most important end-use in the residential sector (67%), which is a consistent trend across all building typologies (see Figure 1, in Annex).

According to recent studies[5], household energy efficiency has improved by 1.8% per year[6] at EU level since 2000, thanks to energy efficiency improvements in space heating and the uptake of more efficient new electrical appliances (e.g. labels A+ to A++ in the present labelling system) which counter balance increasing numbers of dwellings and equipment. The improvement in space heating is the result of different factors such as the introduction of more stringent building regulations (new buildings today consume only half as much as typical buildings from the 1980s), the renovation of existing dwellings, or fuel substitution (coal and oil being replaced by electricity). Another important factor is the diffusion of more efficient heating appliances related to the replacement of old boilers with modern boilers and the penetration of more efficient heating systems, such as gas condensing boilers and heat pumps[5]. For instance, 70% of the dwellings in the Netherlands are equipped with a condensing boiler. In the tertiary sector, energy consumption increased rather rapidly before 2008, but it has been decreasing since the economic downturn, by 1.5% per year.

Policy framework and objectives

In order to achieve its targets for 2020 and 2030, the EU has put in place a comprehensive regulatory framework built around the Energy Performance of Buildings Directive (EPBD) (2010/31/EU), the Energy Efficiency Directive (EED) (2012/27/EU) and the Eco-design (2009/125/EC) and Energy-labelling (2010/30/EU) directives. With this legislative framework, the EU has set itself ambitious policy objectives which include, for instance, that all new buildings must be Nearly Zero Energy Buildings (NZEB) by 31st December 2020 (public buildings by 31st December 2018), that minimum energy performance requirements should be set for major renovations and for the replacement or retrofit of building elements, and that at least 3% of the heated and/or cooled floor area of buildings owned and occupied by central governments should be refurbished each year.

In the context of this Issues paper, it is important to underline that as part of the Energy Union Strategy[7] of 25 February 2015, the Commission announced the review of the Energy Efficiency Directive (EED) (2012/27/EU) and the Energy Performance of Buildings Directive (EPBD) (2010/31/EU) as one of the key strategic energy efficiency policy initiatives to contribute to moderation of demand.

[5] Source: Odyssee Mure, http://www.odyssee-mure.eu/publications/br/energy-efficiency-trends-policies-buildings.pdf
[6] Energy efficiency indicator ODEX from Odyssee Mure
[7] COM(2015) 80 final

Looking further into the future, analysis suggests that emissions in the built environment could be reduced by around 90% by 2050[8]. In that scenario, affordable breakthrough technologies, system innovation and holistic solutions will be needed to make our building stock energy neutral and fully integrated into our energy system.

Other benefits

In addition to energy savings, our policy objectives also include taking advantage of the multiple benefits of energy efficiency, including job creation and retention, health improvements, better energy security, industrial competitiveness and fuel poverty alleviation. The building sector (residential and non-residential) represents indeed about 7 % of the EU28 non-financial business economy and provides 11.5 million direct jobs (about 8.8% of total employment in the non-financial business economy).

3. Prioritisation –step 1: where are the energy saving potentials in buildings?

Despite previous progress and the presence of a comprehensive policy framework, there is still great potential for energy savings in buildings. Around 75% of buildings are energy inefficient and it is estimated that 80% of the energy efficiency potential in buildings remains untapped (i.e. in terms of economic gains, energy security improvements and environmental protection). For example, 64% of space heaters are still inefficient, at best low-temperature models, and 44% of windows are still single glazed. Due to the long lifespan of the building stock in Europe, it is estimated that more than **two thirds of the savings potential arise from the refurbishment of existing buildings** (envelope and heating systems), whereas **new buildings accounts for less than a third** (see Fig. 0 in Annex). Therefore, greater exploitation of this untapped potential requires consideration of the specific building stock of each Member States. For instance, on average, in EU28 more than 60% of multi-family houses (MFH) are located in urban areas and more than 70% of single-family houses (SFH) are located in rural and intermediate regions. However, this distribution of building types between urban and rural regions varies significantly across the MSs. It can range from 35% to 93% of MFHs in urban regions and from 16% to 93% of SFHs in rural and intermediate regions. Moreover, an overview of technologies and energy sources used in buildings also reveals differences among MSs. For instance natural gas consumption ranges from 12% of final energy consumption for heating buildings in Poland, to 86% in the UK and up to 96% in the Netherlands. In addition, direct electricity for heating and cooling is practically absent in Germany, while it represents 29% and 39% of final energy use in buildings in France and Spain respectively (Fig.2 in the Annex). Any approach that would seek to exploit the untapped energy efficiency potential would fail unless these differences were adequately considered.

4. Prioritisation –step 2: what are the obstacles to increasing energy efficiency in buildings?

Existing buildings

In many cases, commercially available technologies, materials and products can reduce energy consumption of existing buildings by more than half. However, the current rate of renovation is very low with only 0.4-1.2% of our buildings being renovated each year and, too often, renovations include insufficient energy efficiency measures. Several different obstacles hinder more widespread renovation across Europe:

- Social barriers: building owners do not routinely consider options for improving their home's energy performance, for a number of reasons[9]. Whereas buildings are regularly maintained or improved, energy saving options are often overlooked, ignored, rejected or only partially realised by building owners. When making their decision, consumers are influenced by a number of factors detrimental to

[8] http://eur-lex.europa.eu/resource.html?uri=cellar:5db26ecc-ba4e-4de2-ae08-dba649109d18.0002.03/DOC_1&format=PDF

[9] http://bpie.eu/wp-content/uploads/2015/10/HR_EU_B_under_microscope_study.pdf

the implementation of energy savings, such as competition with more desirable purchases, a lack of trustworthy information or lack of awareness of the possible benefits.

- Financial barriers: the cost of renovation is an important barrier for many building owners. Information from EU-funded research and innovation projects[10] indicate that savings of up to 200kWh/m²/a can be achieved with capital costs of retrofitted measures of less than 200 €/m². However, this cost is increased when reaching Nearly Zero-Energy Buildings levels (NZEB). The cost for renovating an apartment building block to NZEB level is of the order of 360€/m², while the cost for transforming a single family house into a NZEB can reach 540€/m², with insulation cost being the major expense, followed by the heating system (see Table 2 in annex). In addition to the level of investment, the renovation market is also affected by issues of access to capital, high payback expectation, risk related to the volatility of energy prices, and split incentives. According to cost benefit analysis[11], around 20% of the energy saving potential for 2030 in existing buildings is not yet cost-effective on a life cycle basis.
- Technical barriers: Only some innovative energy efficient solutions are optimised for the existing building stock where specific constraints need to be taken into account (e.g. urban planning, orientation, moisture). A major concern is for instance the risk of condensation, mould growth and poor indoor air quality when installing insulation. Moreover buildings, especially residential buildings, are **rarely refurbished using a holistic approach**, which aims at the best integration of different components. This can result in a lock-in of sub-optimal energy performance. Another barrier is the disruption of occupants when major renovation is being undertaken.

New buildings

- The principal barrier to the deployment of Nearly Zero-Energy Buildings (NZEB) is their perceived or actual **additional cost**. It is however difficult to compare the cost of achieving NZEB performance across Europe since the national application of the NZEB definition from the Energy Performance of Buildings Directive varies from country to country. Although many NZEBs have been reported to be built at a similar cost to buildings that comply with standard regulations, in other cases, additional costs as high as 25% have been reported. Taking into account the above constraints, and based on results of demonstration projects, the average additional cost for new buildings is of the order of 10% which are expected to be paid back by the lower operating costs (see Table 3 in Annex). Around half of these extra costs can be attributed to the building envelope (e.g. thicker insulation), and the other half to energy equipment such as small-scale RES systems (see Table 1 in Annex).
- Other barriers include the difficulty of fully integrating renewable energy sources in a building and its grid environment (see SET Plan Action 1 - Initiative for Global Leadership in Photovoltaics – the part related to Building-Integrated PV).

Cross-cutting barriers

The building industry faces serious organisational, institutional and administrative challenges as well as technological inertia. If not addressed thoroughly, these barriers will hamper the large-scale delivery of NZEB and the deployment of in-depth refurbishment solutions.

- Construction processes are currently carried out alongside largely different patterns, involving a large number of players, mainly SMEs, which are **not sufficiently interconnected along the different stages of the construction processes**[12]. There is for instance too little collaboration between the various disciplines involved in design and construction (architects, engineers, craftsmen and builders on and off site).

---

[10] Experiences from CONCERTO
[11] Scientific Support in the Preparation of Proposals for an EU Energy Roadmap, Fraunhofer ISI
[12] EEB roadmap: http://www.ectp.org/cws/params/ectp/download_files/36D2981v1_Eeb_cPPP_Roadmap_under.pdf

- The construction sector suffers from a variety of planning and regulatory obstacles including the difficulty of engaging renovation works in buildings under multiple ownership, for example multi-apartment residential buildings.
- Another cross-cutting barrier is the **performance gap** for both new and refurbished buildings between the predicted building energy use, and the actual measured performance. In some analyses, this gap is reported to be in the order of +/- 30% (See Fig. 4 in Annex). The performance gap is related to limitations in current prediction models but it is also often related to quality and compliance of the built work and linked to the shortage of energy efficiency related design and construction skills.
- Energy losses of around 10-15% can result from sub-optimal operation and use.
- Standardisation can be a barrier for the development of new materials and products.

5. Prioritisation –step 3: How R&I could address the most technological barriers?

Scoping: In line with action 5 of the Strategic Energy Technology Plan Communication, this document is focused on the most technological aspects. While also important, R&I actions on non-technological elements are not the purpose of this paper. In addition, buildings-to-grid integration and interaction are covered under action 3 of the SET Plan related to smart solutions to energy consumers and smart cities and communities. Topics related to renewable energy systems for buildings and their integration are covered under action 1 of the SET Plan (Initiative for Global Leadership in Photovoltaics).

By offering solutions and possibilities that better respond to the market's needs, future technological developments represent an opportunity to further underpin the implementation of EU policies and accelerate the transformation of our building stock. In particular, the market is looking for technologies and solutions which are less costly, easier to install and use, more compatible with existing equipment and systems, more reliable in their performance, more energy efficient or which provide additional benefits to occupants and increase their quality of life (e.g. thermal comfort, acoustic, air quality improvements). However, the development of such solutions should always be driven by a system-based approach where buildings are considered as a system of technologies working together, e.g. building envelope (walls, doors, windows and the roof), heating and cooling systems, and which interacts with building occupants.

The following priorities are directly linked to the SET-Plan integrated roadmap and some parts and aspects of the multi-annual roadmap prepared by the Energy-efficient Buildings (EeB) PPP[13].

Existing buildings

R&I should lead to the deployment of cost-effective and highly replicable **packaged solutions** based on systemic approach, which address the need of representative groups of buildings sharing similar constraints (e.g. construction periods, climatic zones, building types). Although many European projects under the PPP EeB have already developed and demonstrated useful operational solutions[14], technological development should be supported in order to reduce costs, improve reliability and accelerate market deployment .It should also result in solutions for **historic buildings** and cultural heritage which represent 30% of our building stock. In this case the retrofit must respect the integrity, authenticity and compatibility between the old and the new materials and techniques. In addition to improving the efficiency of the building envelope, specific efforts should be devoted to space heating and hot domestic water systems which represent the largest part of energy use in buildings.

New buildings

[13] EEB roadmap: http://www.ectp.org/cws/params/ectp/download_files/36D2981v1_Eeb_cPPP_Roadmap_under.pdf
[14] Examples of EU projects http://cordis.europa.eu/packs/retrofitting-buildings_en.html.

R&I actions together with deployment have to reduce the **cost of NZEB** in order to make them more cost-competitive. In addition, **integral concepts** (e.g. for high-rise buildings), consisting of building and system technologies are needed, ensuring improved indoor environmental quality, high potential for replication and an optimal used of local energy opportunities including RES.

Cross-cutting barriers

Outcomes of R&I activities should lead to more **industrialisation** and mass customisation where tailored solutions can be offered to the market with a lower execution time. They should result in improved collaborative building design and management tools leading to more **reliable prediction of performance**, **best-in-class design tools** and processes, and closer cooperation among the design team and construction teams.
Benefitting to both existing and new buildings, R&I in the field of **material**, should lead to the development of new materials with improved thermal properties, less embodied energy and more multi-functionality (insulation, heat/ cooling supply, electricity generation, energy storage). These material should be sustainable, resilient, more performant and contribute to more comfort.

Research is also necessary in other cross-cutting areas such as building operation where there is a need for more intelligent **automation and control**, energy management systems and continuous commissioning tools that evolve and adapt to the changing operational environment solutions; or on systems and equipment for energy use which fully exploit the RES potential.

6. R&I targets for the SET-Plan action 5

Following the above prioritisation exercise, and building upon the outcomes of the Integrated Roadmap, the following table defines the five key specific research and innovation targets which have been defined for existing buildings, new ones and cross-cutting areas.

Main research and innovation areas	*Target*	*Monitoring approach*
Existing buildings	By 2025, R&I will lead to the development and demonstration of highly replicable and standardised refurbishment packages tailored to the main building typologies in Europe, including historical buildings. These solutions should lead to at least 60% of primary energy-reduction. They should be based on a systemic approach, they should be reliable, easy to install and have a payback time of below 10 years. Based on interoperability among systems, they should combine together existing and emerging technologies and materials to address energy efficiency throughout the building envelope, energy systems (including renewable energy technologies and storage) and improved operation.	*Analysis of future building renovation strategies, building stock observatory and market survey*

New buildings	By 2025, R&I will contribute to reduce the cost of Nearly Zero Energy Buildings (NZEB) by 10% in average.	*Market survey, building stock observatory*
Cross-cutting themes	By 2025, R&I on construction process will contribute to reduce the average construction works duration by at least 20% compared to current practices, with solutions capable of being adapted to the final conditions with a lower execution time. R&I will contribute to reduce the gap between the predicted and the actual energy performance to 10% by 2025. R&I will support the reduction of the % of new and renovated buildings failing on-site commissioning tests by less than 5% by 2025.	*Market survey*

7. Concrete ideas for cooperation based on the Integrated Roadmap

The first stage in the SET plan process is to agree on specific recommendations on the priorities/targets proposed in the Issues paper. Then we will move to the second stage which aims at defining joint implementation plans in order to deliver the priorities/targets set by the Steering Group, including concrete implementation actions, related funding, expected deliverables and timeline for achieving results.
Hereunder is a list of relevant technologies and solutions based from the Integrated Roadmap exercise and the EeB PPP roadmap, which could be considered in the second stage of the process.

Main research and innovation areas	*High potential technologies and solutions*
Envelope & Structure	- Higher performance insulation with e.g. lower lambda values and reduced thickness - Innovative cladding materials and systems (e.g. advanced multi-functional systems) - Highly reflective surfaces for roofing materials - Increased energy storage density using phase change materials (PCM) and thermochemical materials (TCM) - Air-Sealing system technologies for new and existing buildings (e.g. new joining materials, self-healing materials) - High performance glazing systems and windows including active and dynamic systems, and advanced manufacturing methods (low-cost smart window coatings) - Envelope solutions appropriate for historic buildings
Energy Equipment/systems	- Advanced control/ monitoring systems going beyond current Best Available Technologies - Next generation of High performance heat pumps for buildings with COPs >5 - Efficient and smart cogeneration (CHP) for buildings (e.g. micro and small scale CHP) - innovative heating and cooling systems - Highly efficient combined thermal energy transfer and storage, including more compact systems suitable for retrofitting - High efficient lighting systems, e.g. green LEDs, advanced sensors and controls and lower cost retrofit solutions for lighting fixtures - ventilation products tailored to the renovation market
Construction Process	- Mass manufactured, modular, “plug and play” components and systems - Construction materials and processes with reduced embodied energy - Innovative automated/robotised construction processes, tools and mobile factories - Information to support decision making: assessment, simulation and visualisation techniques to support decision making.

	- Improved construction skills and processes both on and off site for higher quality and compliance of construction work, including innovative workmanship training processes.
Design	- Cost-effective and easy to install EE "kits" or packages compatible with various equipment and design for different building typologies based on a systemic approach and adapted to each environment - Accurate simulation tools to evaluate the expected impact of new systems and solutions in buildings in order to bridge the performance gap. - Enhanced Building Information Modelling (BIM) and integration of design, operation and maintenance of buildings - Improved design tools and processes including closer collaboration for Integrated Energy Design (IED) across disciplines - ICT platforms and interoperable tools for integrated energy design, grid integration - Advanced IT tools to support NZEB construction and renovation addressing different building typologies and climatic zones.
Operation	- Optimised automation and control, energy management systems and continuous commissioning ensuring energy performance during service life - Enhanced Building Energy Management tools

Examples of relevant specific actions from the Integrated Roadmap (Annex I):

- Demonstration of integrated approaches for deep energy renovation in EU buildings (Public and private, residential and non-residential, cultural heritage)
- Develop and demonstrate breakthrough solutions and materials for energy retrofitting to improve roof and façade functional characteristics
- Develop and demonstrate the viability and cost-effectiveness of mass manufactured, modular, "plug and play" components and systems for use in deep energy renovation of EU buildings
- Develop and demonstrate innovative, quick and effective insulation solutions for deep energy renovation projects
- Develop energy systems and control, automation and monitoring tools that evolve and adapt to the changing operational environment, including the availability and cost of energy
- New design concepts assisted by tools for new construction and energy retrofit of buildings
- Demonstration and validation of advanced and automated processes that favour the use of prefabricated modular solutions
- Development, demonstration and validation of energy efficient, interoperable, self-diagnostic and scalable storage, HVAC, lighting and energy solutions in line with energy consumption standards

ANNEX

State-of-Play of R&D in the building sector (from the EeB Roadmap)

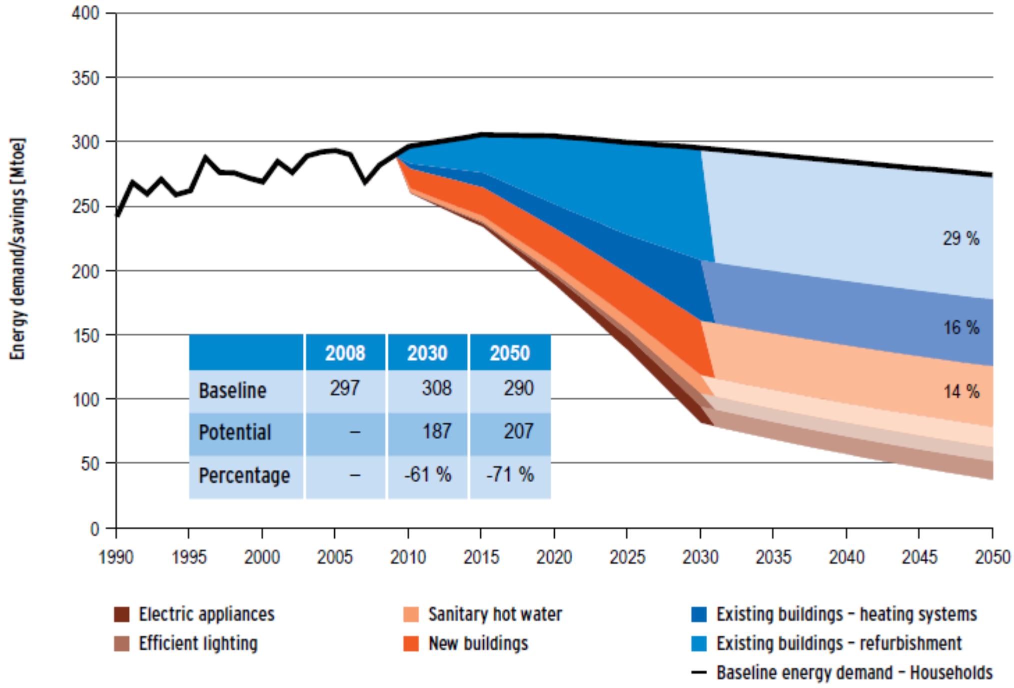
According to the 2011 Industrial R & D Scoreboard, the private R & D investment made by the industry of the building sector has been so far limited in comparison to other industries where a closer collaboration along the value chain is in place and is driving investments in product/ process and service innovation, such as the automobile industry. In buildings and construction in general, the scattered nature of the industry does not allow a precise tracking of all investments along the value chain and during the different steps of the innovation chain. If we consider official figures from the Industrial R & D Scoreboard, we may have the following very conservative estimates[15]:

- The R&D investment in 2010 of the 'Construction and materials' industry amounted to EUR 1 405 million (0.6 % of net sales, figures calculated for 34 companies);
- With regards to the 'Household goods and home construction', R&D investment amounted to EUR 1 377 million (2.1 % of net sales, figures calculated for 19 companies);
- R&D investment was higher for 'Electrical components and equipment' (EUR 5 903, 4.6 % of net sales, figures calculated for 30 companies), however only part of this amount is allocated to the building sector.

Energy efficiency is now becoming a real business opportunity for the construction sector and figures from the European Patent Office show that companies are reacting to this trend with green-construction-related patent having tripled in little over a decade[16]. European companies are in fact developing promising solutions such as e.g. phase-change materials, dynamic glazing and adaptive facade systems to improve buildings' envelopes and are already leading research in the area of heat pumps, condensing boilers and cooling supply technologies.

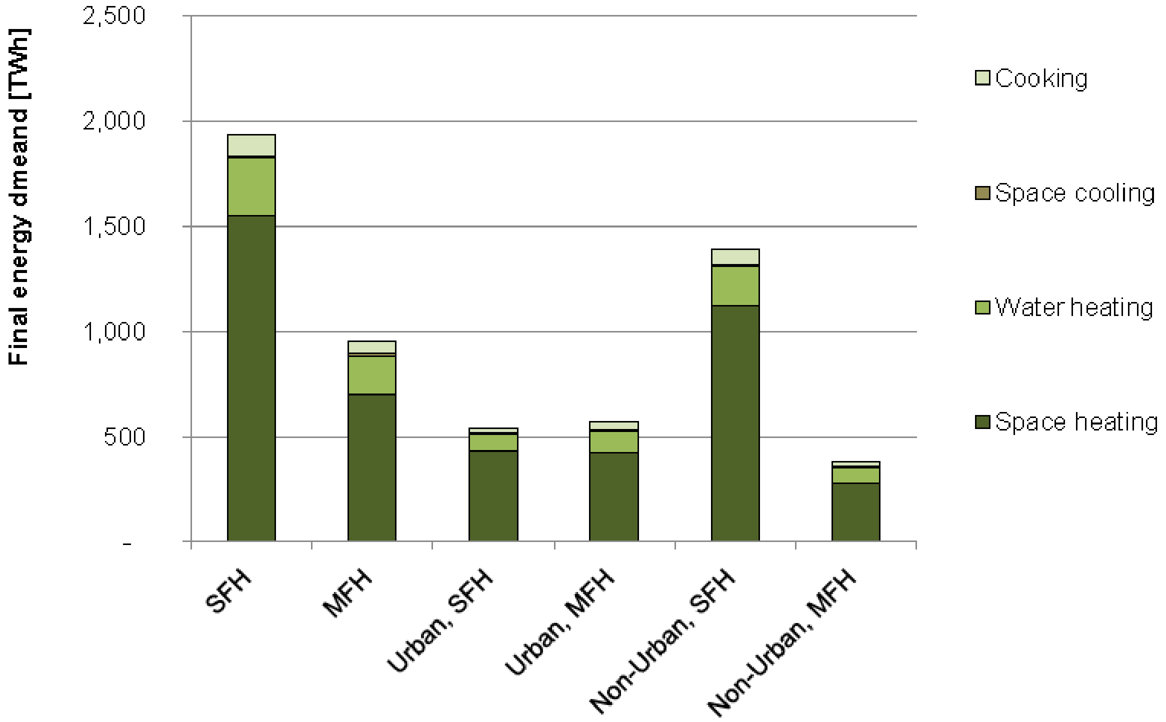
[15] EeB roadmap http://www.ectp.org/cws/params/ectp/download_files/36D2981v1_Eeb_cPPP_Roadmap_under.pdf
[16] http://www.epo.org/news-issues/technology/sustainable-technologies/green-construction.html

Fig 0: Total final energy saving potentials in the household sector



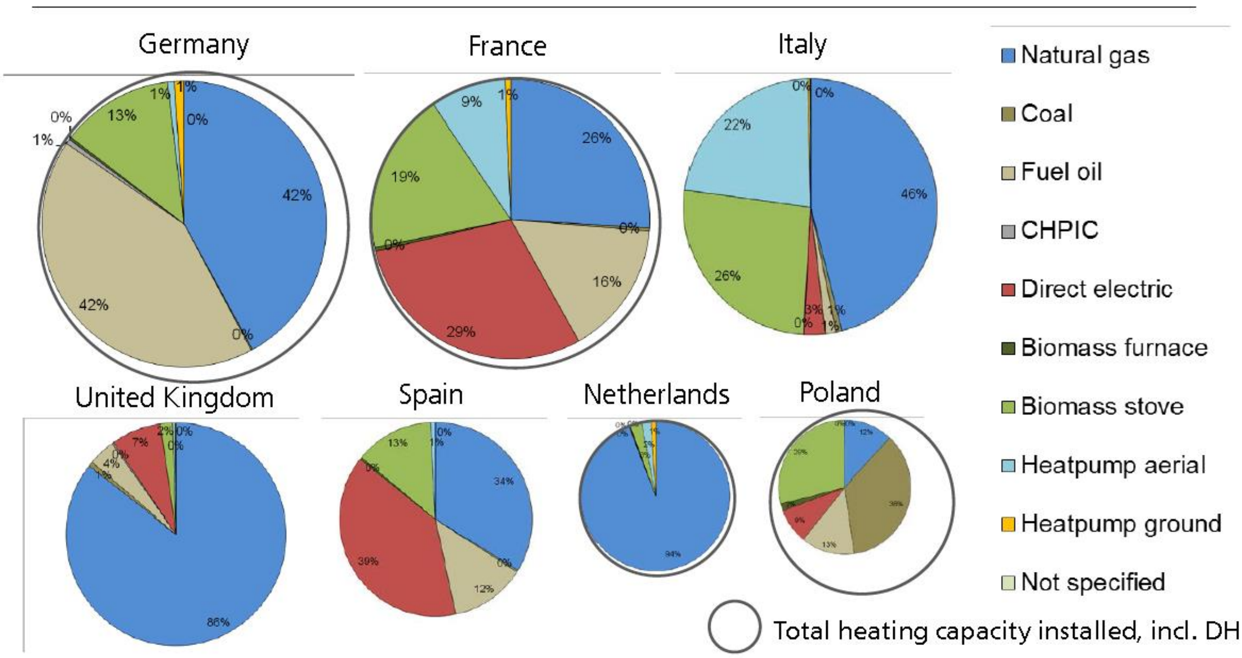
Source: Fraunhofer ISI

Fig 1: Disaggregation per building categories (multi-family houses or MFHs and single-family houses or SFHs) and region types (urban regions, rural regions and intermediate regions) of the final energy consumption in the building sector by end use



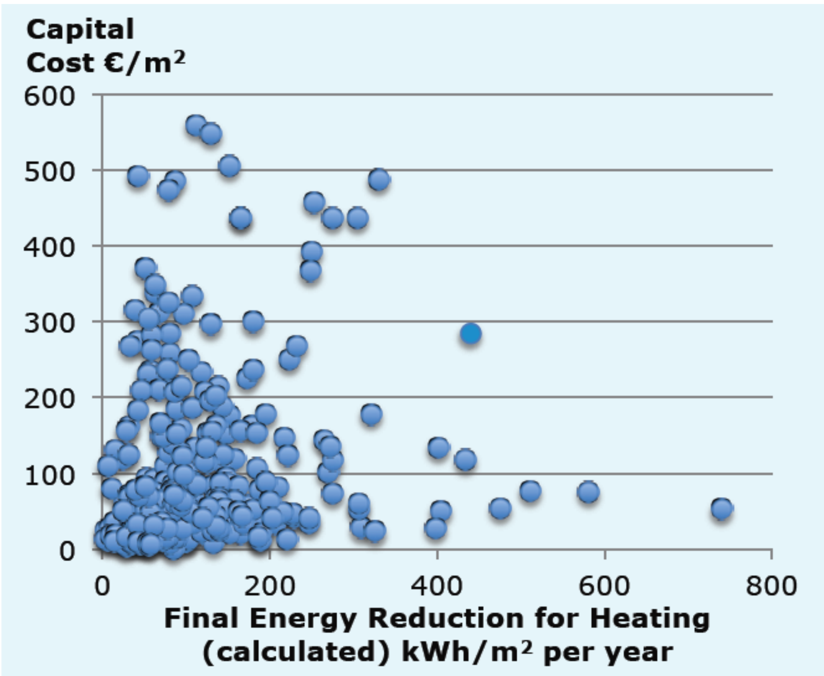
Source: Interim report for tender Study *ENER C2 2014 641* *– (Nov 2015)*

Fig. 2: Overview of technologies and energy sources in buildings for some MSs



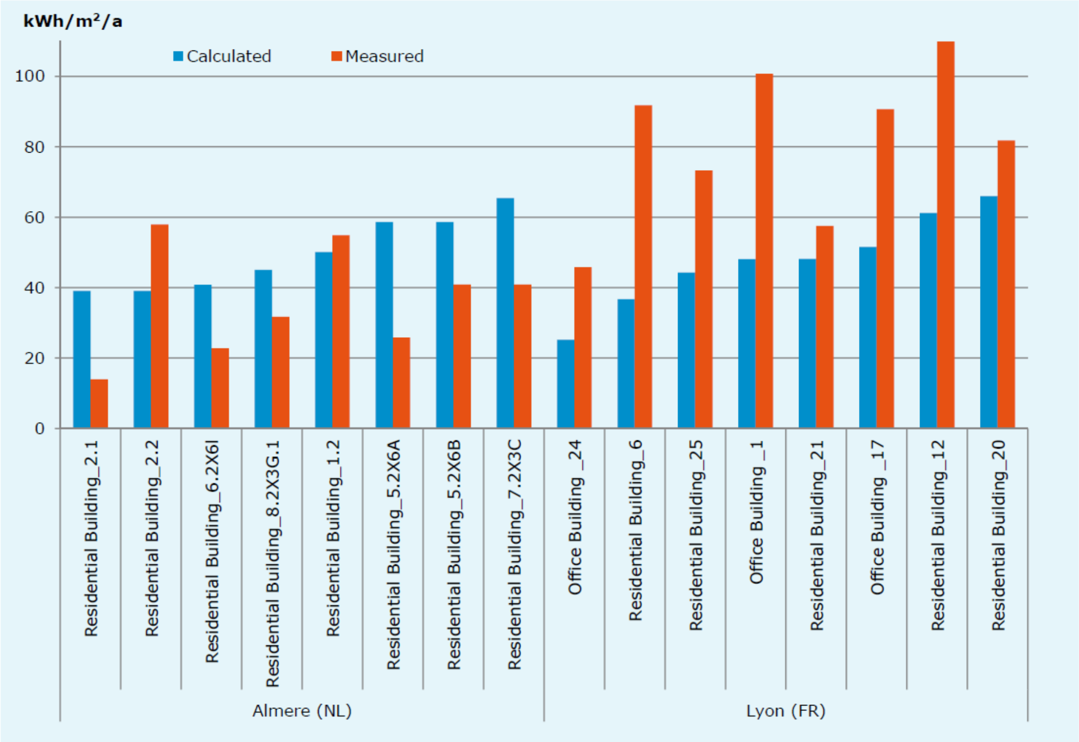
Source: Interim report for tender Study ENER C2 2014 641 – (Nov 2015)

Fig. 3: Cost per m² of refurbished buildings in relation to achieved energy savings (RES contribution not included).



Source: Concerto Technical Monitoring Data base

Fig. 4: Comparison of Calculated and Measured Final Energy Demand for Heating (new buildings)



Source: Concerto Technical Monitoring Data base

Table 1: Additional cost for technologies most often used for NZEB (new building)

Additional cost for technologies most often used for NZEB (new building)	
Insulation walls/roof/floor	5.10%
High energy efficiency windows	1.20%
Energy saving lamps (LED)	0.10%
Ventilation system with heat recovery (up to 70%)	1.70%
Ground heat exchanger (Heat Pumps)	0.60%
Thermal solar	1.40%
PV system	3.70%
High efficiency boilers	2.30%

Source:to be confirmed

Table 2: Distribution of investment cost for NZEB residential buildings refurbishment

DISTRIBUTION OF INVESTMENT COST for NZEB REFURBISHMENT													
Envelope						Systems							
Roof Insul.	Wall insul.	Basement Insul.	Winows change	Night Cooling	Solar shading	Ducts and grilles for heat recovery	Heat recovery equipment	Heat Generati on	Heat emission/ distribution system	Thermostatic Control	DHW-Solar Thermal	PV	**TOTAL**
4%	14%	5%	16%	10%	5%	3%	3%	6%	21%	1%	4%	9%	100%

Source: combination of data from Concerto Technical Monitoring Data base and the IEE ENTRANZE project

Table 3: Additional costs for the NZEB standard compared to the current national minimum energy

	Additional costs of the selected examples of NZEBs compared to the energy level according to the current national requirements		
	Average	Lowest	Highest
% of total costs	11	0	25

Source: EPBD Concerted Action report on" Selected Examples of Nearly Zero-Energy Buildings"

List of Stakeholders to be consulted:

- Energy efficient Buildings association (European construction technology platform)- ECTP AISBL (X-E2BA)
- Buildings Performance Institute Europe (BPIE)
- The European Alliance for Companies for Energy Efficiency in Buildings (EuroAce)
- European Heat Pump Association (EHPA)
- Architects' Council of Europe (ACE)
- Federation of European Heating, Ventilation, and Air Conditioning Association (REHVA)
- The European Association for the Promotion of Cogeneration (COGEN Europe)
- The Energy Materials Industrial Research Initiative (EMIRI)
- Construction Product Europe (CPE)
- Renewable Heating & Cooling Technology Platform (TPRHC)
- European Alliance to Save Energy (EU-ASE)
- European Partnership for Energy and the Environment (EPEE)
- Euroheat & Power
- Association of the European Heating Industry (EHI)
- European Insulation Manufacturers Association (Eurima)
- European Polyurethane Insulation Industry (PU Europe)
- Eurowindoor
- European Committee of Air Handling & Refrigeration Equipment Manufacturers (Eurovent)
- European Solar Thermal Industry Federation (ESTIF)
- EU PV Technology Platform, Working Group Building Integrated Photovoltaics (BIPV)
- European university association (EUA)
- Joint programming initiative on cultural heritage
- European Building Automation and Controls Association (eu.bac)
- European Builders Confederation (EBC)
- Glass for Europe