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ZEBRA 2020 – NEARLY ZERO-ENERGY BUILDING STRATEGY 2020

Deliverable D5.2: Market actors' NZEB uptake - Drivers and barriers in European countries

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Project consortium

Energy Economics Group	EEG	Energy Economics Group Institute of Power Systems and Energy Economics Vienna University of Technology
CIMNE	CIMNE	International Centre for Numerical Methods in Engineering, Building Energy and Environment
ECOFYS	Ecofys	Ecofys Germany GmbH
EURAC research	EURAC	EURAC research Institute for Renewable Energy
NAPE National Energy Conservation Agency	NAPE	National Energy Conservation Agency
SINTEF	SINTEF	The foundation SINTEF
BPIE Buildings Performance Institute Europe	BPIE	Buildings Performance Institute Europe
Enerdata	Enerdata	Enerdata SAS

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About ZEBRA 2020

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.

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Executive summary

In order to meet the targets of the EU energy efficiency plans, measures saving energy related to buildings have received increased attention over the past years. Findings in this study show that there is still a way to go in establishing official national nZEB levels for buildings, although most countries have recently revised existing rules, regulations and guidelines, and facilitated means enabling highly energy conservative buildings in accordance with the EPBD. Determined differences in the structure of national and regional management, attitudes and economic structures are all factors found to have both negative and positive effect on the progress and implementation of nZEBs in the different countries. The study suggests that a number of countries are poorly prepared for implementing nZEBs by 2020 and that there is a great call for increased knowledge on new technology on all levels in the building industry along with economic incentives, building of pilot examples to follow, and in fact utilizing the advantages that nZEBs bring.

It is difficult to draw a clear picture of main, major and minor barriers and drivers among different countries, building categories, stakeholders and so on. There is a lot of former studies – and contributions to the present report – that list up barriers and drivers related to different subjects, often in comprehensive tables. For example, different barriers and drivers apply to different stakeholders and different stages of a building's lifetime. There are other challenges and driving forces in the residential sector than in the non-residential sector, and they differ between new construction and renovation. This is, of course, reflected in the contributions from the consortium partners. However, similar to previous studies, the findings are to a minor degree grouped according to their importance.
In our view, the following issues become more and more clear:

We recognise stronger barriers for energy efficiency renovation versus new buildings, and also stronger barriers in the residential sector than for non-residential buildings. Drivers like green building assessment such as BREEAM are important in office buildings and some other non-residential building categories, but do not play a significant role in the housing sector, especially not in renovations. While tightened regulatory requirements push energy efficiency in new buildings, those measures are unable to contribute substantially to ensure ambitious energy upgrading, in particular in the housing sector. Therefore, other motivation factors, drivers and policy instruments are even more important.

Decision making processes in general and especially in multi-family housing with owner-occupied dwellings are crucial. An owner structure with a high share of private-owned dwellings and single-family houses is a strong challenge in many countries when it comes to energy upgrading. This challenge has to be met by tailor-made policies, also in terms of suitable funding. A high share of co-

financing by the public, like in Austria, is a good basis to require high ambitions. In the case of energy upgrading however, it is a big challenge to address private owners adequately.

1. INTRODUCTION

This study is carried out in the ongoing European project ZEBRA2020 as part of work package 5. The objective of this work package is to monitor current market activities towards nZEBs and identify the gap between nZEB targets and progress up to date. As part of the work package, task 5.4 – led by SINTEF – focuses on investigating the involvement of the market actors in Scandinavian and European countries.

European legislation (Energy Performance of Buildings Directive) sets ambitious goals with objectives to reduce greenhouse gas emissions and increase energy efficiency by 20 % within 2020. In order to realize these targets, the EU has put forward an energy efficiency plan with specific measures to save more energy. As part of these ambitions, regulations and legislation are now being tuned for nearly zero energy use. The technology is already available and proven; however, the large-scale uptake of nZEB construction and renovation will be a big challenge for all market actors and stakeholders involved. A substantial gap in reliable data on current market activities makes it difficult 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. The information gathered from the European construction sector and academia will get structured and analysed to derive recommendations and strategies.

The following report reflects the contributions of collected information on drivers and barriers for nZEB uptake for selected European countries included in this study. Due to the variety of contributions, the chapters differ in characteristics and length and render a narrative of the studies carried out in each participating country or workshop. SINTEF is appointed work package leader and responsible for compiling the results, hence the contribution from Norway is more elaborate.
The study focuses on investigating the involvement of the market actors towards implementing nZEBs. Findings are based on reviews of relevant completed and ongoing studies, interviews and newly conducted workshops. A large part of the collected information uses case study methodology in combination with qualitative interviews. Qualitative methods enable the informants to elaborate on the answers given, which gives a more complete and nuanced information, highlighting important issues which would otherwise not be possible to retrieve.

The first part of the report includes literature studies, interviews and workshops conducted in Scandinavian countries followed by the condensed results from the remaining European contributions covering Poland, Italy, Spain, Lithuania, Austria and Romania. At the end of the report synopses from workshops held in Germany and France are presented.

2. DRIVERS AND BARRIERS FOR THE NZEB UPTAKE IN SCANDINAVIA

2.1. Literature study: Scandinavia

In 2010, the government-appointed "Arnstad committee" provided a comprehensive report on energy efficiency in buildings, barriers, potential and suggestions for improvement towards 2040. According to Arnstad et al. (2010), the main barriers in Norway are the following:

2.1.1. Barriers (Norway)

Structural: The focus should be on retrofitting the existing building stock. Stricter rules and regulations for retrofitting are needed in order to achieve energy efficiency. Around half-part of the floor area in the existing building stock have a private, non-professional owner (single-family and row houses). There is need for more incentives that would convince private persons to invest in energy efficient solutions. The building industry is fragmented: Most of enterprises are small or medium sized. It is difficult to increase their competence and to assure the quality of their competence. Fragmented responsibility between various departments leads to difficulties regarding harmonisation and coordination of policy instruments.

Economic: Energy prices are low, compared with other countries (SINTEF's note: this applies only to electricity, but electricity is the most common energy carrier for heating in Norwegian buildings). Investment costs related to energy efficiency would lead to higher housing prices unless financial support from the state. The owner is given little financial motivation to invest in energy efficiency. It has to be made clear that the investment leads to a higher value of the building.

Cultural: There is a lack of knowledge and competence in the building sector. A tradition to focus on energy efficiency is missing. There are risks, related to both financial aspects and the quality of execution, involved in implementation of new technology. There is little understanding of the extent of necessary changes. There is also a lack of will to handle: The energy used in buildings is mainly produced by hydropower and many building owners do not see the meaning of energy efficiency. Scepticism regarding the climate change and the focus of personal advantages are also barriers to improving energy efficiency in buildings. Energy efficiency is just one of the many qualitative requirements. It is a challenge both financial and technological, to fulfil all the requirements (e.g. a good in-door climate, avoid humidity damages, long life of buildings, universal design, environmental requirements).

2.1.2. Barriers and drivers (Scandinavia)

Arnstad et al. (2010) includes no detailed examination of drivers, but the report proposes a number of measures which will support that the estimated potential can be triggered in praxis. Among them, predictable goals, support schemes and framework conditions with stricter regulations every five years and strong component requirements are the most important. Hauge et al. (2015) evaluated the Arnstad report and some other studies on scenarios, potential and requirements in building regulations in connection with existing residential buildings. According to this evaluation, it is difficult to create regulations for ambitious energy upgrading. "Threshold values when strict requirements for comprehensive renovation 'kicks in', may be bypassed by building in stages. Unless almost the entire building is affected by the work, it is not reasonable to require measures in other parts of the building than in the current part. Component requirements for single measures must often be more moderate because ambitious measures are not always possible, whilst it is not reasonable or possible to claim compensation through measures somewhere else in the building." Therefore, requirements of laws and regulations will not ensure energy ambitious upgrade to a sufficient degree, and other motivations and policy instruments are becoming even more important. "There are different types of motivation (...). For most people, a combination of these may be important: Comfort and indoor environment, general requirements for upgrade (energy efficiency side effect), energy/financial gain, moral, image/group identity." A wide range of instruments is needed (Klinski and Hauge, 2015).

Enova, a state-owned energy agency, carried out its own potential and barrier study in 2012, based on three underlying sub-studies concerning residential and non-residential buildings as well as Passive Houses and nearly zero-energy buildings. Enova (2012) summarises that the real potential primarily depends on whether the owners of buildings and homes consider the measures to be economically profitable. "Another important factor to trigger the real potential is whether the owners are disposed to carry out renovation or making upgrades on their properties. The authorities must primarily address the residential owners or owner of a non-residential building which is receptive to be influenced to implement measures that can reduce energy use. From the society's point of view, the most important barrier concerning all types of homes and buildings is probably a generally low, partly absent awareness of energy use and energy-related measures. A generally low energy price contributes to maintain this barrier. This implies that not all potentially economically viable measures are implemented." At this point it should be clarified that the energy prices in Norway in general are at a similar level as in Central Europe. Actually, only electricity prices are significantly lower than in other countries. Electrical power is approximately as expensive as other energy carriers. The financial advantage results mainly from the fact that direct electric heating does not require a hydronic

pipework system. The investment costs are therefore very low. In addition: Due to high annual fixed costs a kilowatt hour is considerably cheaper in a household with high electricity consumption than in a household with low energy consumption.

Aiming to realize most of the potential, Enova points out that it is important to see the barriers together. Policy instruments should play together in a way that they reinforce each other, and the appropriate parts of the markets should be addressed at the right time. Barriers occur sequentially, i.e. the order in which they appear is essential knowledge for an effective instrument design. In addition, the strength of the barriers is interdependent. For example, lack of expertise and experience affect costs in the industry and thus profitability as economic barrier. If single market participants or entire industry sectors are part of an increasing number of energy efficiency projects, they reiterate decisions and will benefit from reduced barriers every time.

According to this study, cost or lack of profitability emerges as the main barrier to more comprehensive and deep renovation of residential buildings. Nevertheless, a connecting to other planned renovation measures and pointing up such synergies could reduce this barrier. The second strongest barrier is the lack of public recommendations and support. High transaction costs are mentioned as the third barrier, which may cover information gathering, organizing, discomfort and disturbances during the construction work, as well as other disadvantages linked to renovation. Uncertainty for comfort improvement and whether the measures will work illustrates that doubt about the non-economic benefits may become a barrier. Short duration of residence (will soon move), lack of importance, lack of knowledge / information are other barriers. Lack of craftspeople that are able to provide a comprehensive, integrated offer is – according to Enova's experience – also an important barrier, but this barrier pops up only when one has broken through the first line of barriers and established an intention to implement measures.

As general drivers for renovation, rebuilding and extension of owner-occupied residential buildings, the study identifies favourable economic conditions in the country, sales of used dwellings, demographic changes, low quality and comfort (which may imply high energy costs), changes in preferences as well as governmental priorities and regulations. These drivers affect renovation in general, but do not necessarily result in considerable or ambitious energy efficiency measures. Still, there are at all times conducted significant energy efficiency measures in the housing sector, and there are more decision criteria than just profitability.

Concerning non-residential buildings, the Enova study recognises two particular barriers: Split incentives ("landlord-tenant dilemma") as well as insufficient skills and knowledge related to how energy efficient buildings are to be operated, and what the benefits of energy conservation are.

However, a lack of knowledge of operating personnel – just as some other internal barriers within an organisation – can be influenced by the company itself. Overcoming split incentives requires that investment costs and operating gains are distributed in a predictable and accepted way ("green contracts"). The issue is little relevant in the residential sector since nearly 80 % of the households are owner of the dwelling they live in. For public owned buildings it is a particular barrier that the public sector has a more rigid system of rules to deal with. Therefore it can be more challenging both to make visible that measures are profitable, and gain support for their implementation.

The sub-study on Passive Houses and nearly zero-energy buildings describes related economic barriers more specific as economic uncertainty, namely doubts about whether the cost analysis is correct, fear of cost overrun and / or delay in completion, as well as difficult access to capital financing additional costs. Finally, it could be hard to get sold or rented out finished projects at the right price. Regulatory barriers could be conflicts with protection provisions (if renovation). Difficult access to materials and increased need for organising / interdisciplinary collaboration, resource use and time spent in the planning stage are other important barriers.

The Norwegian Status Quo Analysis report within the Intelligent Energy Europe project Build Up Skills based its barrier examination mainly on the above-mentioned Enova study. In addition, the report contains a summary of Norwegian surveys on barriers that prevent competence raising within the building industry. Lack of skills and competence itself may constitute a barrier that "might prevent energy measures from being taken. For example, it might be important that the tradesmen who come into contact with households have the knowledge to sell up to ambitious renovation at low-energy or passive house level instead of simple renovation, since the home is to be renovated anyway. A lack of time and high course costs stand out as the most important barriers to tradesmen's participation in courses. Other factors (...) are a lack of motivation and that the courses are mainly found in cities rather than locally" (Grini et al., 2012).

Persson and Grönkvist (2014) conducted a survey among 11 Swedish construction companies with experience in high performance low-energy buildings. Again a shortage of adequate know-how among the construction companies was identified, in particular among sub-contractors. On the other hand, the interviewees considered environmental awareness and internal pressure as a driver for dealing with Passive Houses within the companies. Personal commitment is observed as "perhaps the strongest driver". It is expressed a request for stricter regulations in Sweden, while some of the companies consider "future building regulations from the European Union" as a regulatory driver and state that it could be "devastating if a firm does not prepare in time for new regulations". Life-cycle thinking is reported to increase among players, but "banks in Sweden are considered to have too short perspectives and a lack of knowledge of what they lend to". Despite of currently low interest for

Passive Houses, the companies consider the market as promising and large enough to become a driver itself. In this regard, it can be observed that the western part of Sweden, where the Passive House Centre is situated, features a higher concentration of Passive Houses than other areas of the country. According to the paper, this confirms the importance of making innovations available at or near the location of potential adopters.

As regards to Denmark, more recent relevant studies could not be observed. For most of the Northern European countries, including Denmark, Sweden and Norway, the issue of overcoming barriers is also explored within the NorthPass project; confer reference in the literature study regarding Poland. Country reports from Sweden and Norway are included in the report D1.1. within the ZenN project; see Karlsson et al. (2013) and a summary in chapter 3 of the present report.

2.2. Qualitative study: Norway

2.2.1. Interview results from Norway

In order to identify motivation drivers and barriers for nZEB buildings in Norway, qualitative interviews with key personnel involved in procurement processes for buildings were conducted in 2014. In addition to workshops with experts (2015), nine individuals in five different organizations were interviewed: two different Norwegian Municipalities (cities), a Norwegian public construction and management company, a section of the Norwegian Student Welfare Organization, and an environmental special interest organization. The main focus was on public building owners; however, the Student Welfare Organization is a private foundation partly supported by governmental founding. Most of the interviews were group interviews, took about one hour, and were done in the informants' work places. The interviews were conducted within the Research Centre on Zero Emission Buildings, ZEB (http://www.zeb.no/index.php/about-zeb/about-the-zeb-centre).

Municipality 1: Project coordinator with responsibility for requirement specifications and environmental considerations in new constructions and total renovations. The position has existed only 1.5 years. In addition, a lawyer and a curriculum manager for procurements were present. The division is responsible for the procurement of all new kindergartens, health- and welfare centres.

Municipality 2: Project leader at a Norwegian Municipality (Division of planning and construction). The division is responsible for the procurement of all new schools, kindergartens, health- and welfare centres, administration and cultural buildings, sport centres, and waste disposals.

Student's Welfare Organization in Norway: Project developer and project leader at the Student's Welfare Organization. In total there are 24 divisions of the Norwegian Student's Welfare Organizations all over the country. They act both as property developers and property managers, responsible for development and maintenance of student housing. The Welfare Organization is, however, not a public owner but a private foundation. They finance their projects about 50 / 50 through loans and governmental grants.

Public construction and management company: Environmental advisor in the Building owner department with responsibility to follow up the environmental certification systems and documentation and follow up on environmental ambitions. Also two project leaders in the Building owner department were present, one of them hired on a project basis, and the other one an architect with experience from different construction projects. The company is a public sector administration that provides appropriate, functional premises to public sector enterprises, preservation of heritage sites and the environment.

Environmental special interest organization: In addition, an expert interview (energy politics) was conducted to get a more holistic picture of the challenges and chances in procurement processes of buildings, especially with focus on policy instruments. An advisor in a special interest organization for environmental issues with a particular responsibility for the building sector was interviewed. This interview was used to discuss findings from the other interviews, to get input to the analysis.

Findings

This section describes how the organizations that were interviewed incorporated environmental goals in the procurement processes. In building projects, procurement covers the whole process of construction, including the design and execution phase. Also, the section identifies different factors that increase or lower nearly zero emission buildings ambitions and market uptake. The findings are divided in three parts: 1) certifications and ambitions, 2) process and 3) competence. What are the drivers and barriers for nearly zero emission buildings in Norway?

Certifications and ambitions

Certification and other tools for control of environmental goals

There are several different rating systems, certifications and standards for obtaining high environmental ambitions in buildings in Norway today. This is in line with Gluch et al. (2014) who found that environmental work today is becoming institutionalized as a strategic part of the companies' business, and integrated within the companies' work practices. The four organizations used different types of tools to keep track of and to verify project ambitions:

Table 1: Licenced certifications and internal practices applied by respondents' organizations

	Certifications / other practices	*Documentation*	*Third-party verification*
Public company	Internal checklist for environmental goals BREEAM Environmental product declaration (EPD) Greenhouse gas calculation	Internal Official, rating Official, rating Internal / official	No Yes No (but through Breeam) No
Municipality 1	BREEAM Environmental product declaration (EPD) Municipality action plan	Official, rating Official, rating Internal / political	Yes No (but through Breeam) No
Municipality 2	ISO 14001 Municipality action plan Greenhouse gas calculation Pilot project program	Internal / Ideal Internal / political Internal / official Official/Application	Yes (of the organization) No No Yes
Student Welfare Org.	LEED (used once) Checklist	Official, rating Internal	Yes No

In the Norwegian construction industry, there was per 2014 no consensus on which types of verification tools or certifications to use or how to document results on green buildings. Internationally used rating systems such as BREEAM and LEED are also in use in Norway. A major characteristic of both BREEAM and LEED is that certification demands third-party verification of an external assessor. For more information and comparison of certification systems of buildings, see e.g. Siew *et al.* (2013) and Ferreira *et al.* (2014).

In the capital Oslo, there might be a tendency towards using BREEAM, but also LEED, The Swan (the official Nordic eco label) and other certifications are used. On some matters these different certifications are overlapping, in other matters not (*Ferreira et al.* 2014). One of the Student's Welfare Organization's projects was certified according to LEED. However, this was the contractors' wish, and they do not plan to use LEED in other projects. Municipality 1 has decided to *"breeam"* all their projects, and the public company is testing BREEAM to see if they want to use it for all their projects.

Environmental management system ISO 14001 is also in use in Norway. According to www.iso.org it is *"applicable to any organization that wishes to establish, implement, maintain and improve an environmental management system, to assure itself of conformity with its stated environmental policy"*. The methodology applying ISO 14001 is described as Plan-Do-Check-Act. ISO 14001 is a third-party certified environmental management system. It does, however, not establish absolute requirements

for environmental performance. Many municipalities and companies apply ISO 14001 to enforce the environmental performance of their organization.

However, since there is little consensus on (and no requirements to use) environmental certifications systems, there exist many different internal documents with adapted environmental aims. For example, Municipality 2 acts in accordance with the Municipality's own action plan on energy and climate. The action plan generally demands to go beyond regulatory requirements (Norwegian Regulations on technical requirements for building works, "TEK10") and requires Norwegian Low Energy Standard for all new buildings procured and planned under the umbrella of the Municipality. In addition, the climate and energy action plan requires 1-2 pilot projects (per year) with even higher ambitions. These projects often get associated with *pilot project programs*, governmental supported programs such as "Cities of the Future" and "Future Built", aiming at pushing ambitions in the building sector. The nature of these programs is idealistic, giving publicity and support, they do not grant economic support.

Another example of verification tool is the Public management company that has its own internal system / checklist for environmental ambitions. The Student Welfare Organization also have developed its own checklist/template which is used in all projects and modified when new demands have to be integrated. The checklist is also used to clarify its goals to other actors involved in the process.

Some organizations also used "Greenhouse gas calculation" in their procurement processes. This is a free web-based tool developed by a public construction and management company. The use of the tool has also become compulsory for documentation of carbon footprint, e.g. in Norwegian pilot project programs (http://www.epa.gov/cleanenergy/energy-resources/calculator.html). The public company uses Greenhouse gas calculation in all their projects, but states that the consequences of these calculations are not always acted upon.

Another measure to obtain green buildings is the use of "EPDs" (The Environmental Product Declaration). These declarations describe the environmental performance of a product or service from a life cycle assessment perspective. This includes the product's use of energy and resources, and shows the potential environmental impact. Norwegian EPDs are documented on the web-site of epd-norge.no. EPDs are verified documents in accordance with ISO 14025. EPDs are also part of the calculation of points when applying e.g. for a BREEAM certificate. Both Norwegian and international EPDs are in use in Norway. Some of the informants in the public company mention the difficulties of following up the use of EPDs. Even if they are told to use EPDs, the EPD-scores seldom matter in

choosing the most environmentally friendly materials and products. The same is found for Municipality 1. The EPDs are collected only because they have to collect EPDs for the ten most used products. This is required for example in Breeam, and incorporated in many internal checklists. Employees find EPDs difficult to trust, since these declarations may change when new environmental information is accessible. Products that had good scores one year may be a bad choice if the EPD is updated with new information. They also state that *"There are too few EPDs, even if we can use English EPDs, however, the amount of EPDs has increased strongly in recent years"*. Because of the increase in the number of EPDs, this practice may be in change.

In addition, in Norway there is an official Energy Labelling system (Energimerkeordningen) that aims at increasing awareness about solutions that can contribute to making a building more energy efficient. All residential and non-residential buildings in Norway being sold or rented out should have an energy certificate/ label. Energy certificates consist of an energy label showing its building's energy standard (www.energimerking.no). Energy labelling was not mentioned as a relevant goal / ambition by the interviewees in this study. The energy labelling may be taken for granted, or may be too little differentiated for ambitious construction projects.

Documentation and verification

The difference between BREEAM, LEED and similar certifications and internal checklists and other tools is that these official certifications demand a third-party verification/control. The internal documents and checklists are only verified inside the organization, carrying the risk of lowering the environmental ambitions. One of the informants in the public management company said about the internal environmental checklist: *"It is easy to get acceptance for deviations"*. Even if deviations are reported in the deviation system, the project leaders are not checked and controlled on environmental aims: *"You are not really pressured on environmental goals."* Internal checklists and documents are not as strict as if a third-party verified it. However, they stated that an internal reporting system on environmental goals is under development in the organization. The project leaders reported that the pressure on economy and building quality is still much higher than on environmental issues.

It therefore seems as if a stronger consensus for certification types requiring third-party verification would be important to keep environmental goals high throughout the procurement and building process. The expert interview revealed that BREEAM probably is the certification most widespread in Norway, because of the national implementation strategy. If this certification (or similar) became more widespread, the use of internal checklists with internal control would probably decrease. A demand for third party verification would increase the pressure to keep the environmental goals high.

Environmental ambitions

The environmental ambitions are high for all the organizations interviewed, and all are aiming at energy standards superseding existing building codes. Either certifications or internal documents and checklists are the common tools to verify ambitions. In that way, the organizations interviewed are pulling the building sector in a more environmentally friendly direction.

The organizations' environmental goals are implemented in the requirement specifications. In Municipality 1, BREEAM is always a starting point for the tender documentation. They state that per 2014, the goal is to take the ambitions further than Passive House level, and to fulfil environmental requirements beyond just energy efficiency.

The project leader at Municipality 2 sums up that ideals and ambitions are high for their common projects, which make up the majority of construction projects, and they even stretch a little longer in their pilot projects. However, Norwegian Passive House standard is not yet the rule for projects in this municipality, only in special pilot projects. The energy standard ambitions seem higher in the capital Oslo. The public company/ Municipality 1 described it as a matter of course to achieve Passive House standard: *"Passive House standard is piece of cake, however, environmental goals beyond that are challenging"*. Environmental impact of materials and solutions is seen as a greater challenge than achieving a certain energy standard, such as Passive House standard. Even if the environmental impact is documented through EPDs, the results of EPDs seldom matters for choice of materials and products.

Other motivating factors for high ambitions

Ideals, idealistic programs, or support schemes are additional motivation factors. One of the Student`s Welfare Organization's goals is to be a good example for their group of clients when it comes to energy and environmental ambitions. They look upon themselves as an organisation with public responsibility. They were also pushed towards being a frontrunner by enterprises / institutions financially supporting their work, e.g. Enova[1], and their lender, the Norwegian State Housing Bank. The Norwegian State Housing Bank and the governmental organization Enova grant financial support and loans for new constructions and renovations which aim at Norwegian Low Energy or Passive House standard[2] and beyond (support criteria may differ). In one project, the Municipality 2 applied for pilot project status once the competition's winner project was elected, and the project was

[1] Enova SF is a Norwegian government enterprise responsible for promotion of environmentally friendly production and consumption of energy. The company is owned by the Norwegian Ministry of Petroleum and Energy.
[2] Norway has developed national standards for *Low Energy Buildings* and *Passive Houses* for residential and non-residential buildings (NS 3700; NS 3701).

connected to one of the governmental programs ("Framtidens bygg": Buildings of the future). Employees in Municipality 2 said that *"through becoming a part of an official program, ambitions became more binding"*. This is in line with Hojem et al. (2014) who concluded that programs aiming at stimulating green ambitions have a positive effect.

Process

Contracts

Competitive tender processes for Design & Build contracts were the most common procedure in Municipality 2. They said they did not have the capacity to follow the processes beyond the procurement and initial design process. However, when choosing Design & Built, the process of handing over the project draft to the contractor is a challenge. They have to make sure that the initial ambitions are understood and followed up.

The Student's Welfare Organization usually invites several contractors for competitive tendering (as private organisation, they do not fall under the Act of Public Procurement). Design & Build is also the contract type the Welfare Organization usually applies in big projects. Only in small projects where follow-up work is less demanding, they sometimes keep the responsibility and use multiple prime contracts. When using Design & Build they also carefully prepare the handover of the project to the contractor in order to agree on ambitions and goals.

The informants in the public company stated that they see a shifting towards a focus on process when it comes to contracts. One project leader talked warmly of collaborative procurement procedures, such as joint specification or concurrent engineering to keep the environmental goals high through the process. The other organizations did not seem to have experience with that type of processes or contracts. The cooperation with all involved contributors right from the start is an advantage of different forms of collaborative processes. It is easier to make changes if something goes wrong, which is important in building processes that lasts for many years. One of the employees in the public company stated that he had a hypothesis that "collaborative processes are positive for high environmental ambitions". This statement is in line with Eriksson & Westberg`s (2011) hypothesis of the positive influence of collaborative procurement procedures for project outcomes, including environmental ambitions. This was also found by Hojem et al. (2014). They stated that the green building process they followed would not have been possible with a standard contract demanding all the main aspects of green building to be put down in a formal manner at the start of the building process. In their investigation, flexibility of the involved, mutual trust, and the continuous revision of the contract during the process were imperative success factors (p.598). Findings from Hojem et al. (2014) indicated that contract and process forms giving room for adaption and learning are useful in ambitious projects transcending current building regulations. They concluded that social learning

with the project team during the procurement process lead to expanding ambitions and broader environmental aims.

The topic is also illustrated by the difficulties of handing over the project to the entrepreneurs. The Student Welfare Organization stated that keeping ambitions high is a general challenge throughout complex processes, but when transferring the project to another phase, from intentions to planning, or from management to use, this is when the ambitions may fall. This relates to different people in different phases and roles. They stated that "if high ambitions are not communicated well enough during transition phases, they are often are washed out more and more during the process." In a collaborative procedure, the ambitions may be communicated from the start to all involved players at all stages. The risks of losing ambitions during transitions are then lowered. The influence of contract type on green building ambitions should be further investigated.

The advantage of ownership with management

The public company and the Student Welfare Organization manage many of the buildings that they build. They have to cope with possible defects, and they also get the profit from the energy savings, which to them is a strong motivation for building energy efficiency.

The municipalities would have the same advantage if the economy in the different departments and sectors were seen more as a total. Municipality 1 stated that "the savings from energy efficient buildings are "invisible" to us, since the savings only show up at the budget of a different department". Cooperation or sharing of profits across different municipality departments, among developers and management in the same sector, would be positive to visualize the advantages of green buildings.

Economy

A possible pitfall is when the economy of the project's design is calculated against the given budget. The economic framework is set in the early planning phase and environmental ambitions have to be realised within. Municipality 2 said that "it is easier to lower ambitions later than to increase ambitions. Increasing ambitions at a later stage during the process is often too expensive". The tenders submitted by the competing firms are generally based on a bill of quantities, a bill of approximate quantities, or other specifications which enable the tenders to attain high levels of accuracy. Municipality 2 experienced that a project with a high level of specification of the draft also leads to a high level of accuracy in pricing by the firms. Due to that accuracy they could avoid later pitfalls that can occur when economic calculations are not good enough. Moreover, a timeframe that allowed changing the plan layout and reducing the area had an important impact on keeping the costs within the economic framework in one of the Municipality's pilot projects.

Cut list

There is always a cut list in a building procurement process, and most of the informants admitted that environmental solutions and products may be on this list. As long as no official certification and third-party verification is demanded, it is easy to cut environmental measures. Cutting costs on products and materials, e.g. energy efficient elevators is easier, while cutting costs on insulations thickness etc. is more difficult, because changing a wall size leads to expensive reprogramming and affects energy standards.

Municipality 2 experienced that once a project was acknowledged as a pilot and the planning continued, the project economy could not live up to all initial ambitions set. They had to lower ambitions, but still had to fulfil minimum requirements for the pilot. The phase of project concretization is according to the project leader at Municipality 2 the most critical phase when it comes to holding on to green ambitions. A possible great "pitfall" is when calculations are made to check if ambitions towards energy standard and greenhouse gas emissions can be achieved with the solutions and materials planned.

Environmental products

Environmental products and solutions are sometime difficult to get hold of. Municipality 1 is involved in an EU-project cooperating to include the same type of environmentally friendly products in their building requirements. The goal is to stimulate the European market to produce these types of products, and to produce them at lower costs. Cooperation with other property developers to stimulate the market to produce environmentally friendly products may be important to keep the environmental ambitious high during the procurement process. They also point to the fact that the description of the products has to be very open, not favouring one producer or making the requirement too difficult to live up to.

Competence

The Municipality 2 engaged a planning team for the early planning phase based on a documentation of formal and practical personal qualification seen in relation to price per hour. A general ambition the project leader pursues in pilot projects is to attract people with high competence in their specific fields. According to her, "this results both in better buildings and lower costs". Also consultants that are chosen later during the process have to document formal and practical experience before they get hired.

Municipality 1 has a focus on giving detailed feedback to entrepreneurs that do not win the competition, so that they can learn what to do better next time. Their experience is that the entrepreneurs that do not reach up in the first competition often win the next. Earlier, around year 2000, they say, it was very hard to find entrepreneurs with high green ambitions or knowledge on how to build e.g. Passive Houses, but this has changed. "The competence in the market is much better today." This is, however, a statement about the entrepreneurs in the capital city. The project leader of Municipality 2 working in a smaller city did not quite agree with that statement.

(Sub-) contractors

The interviewees said that environmental competence was not the most important award criteria for sub-contractors. Many of the informants stated that the environmental aims were under pressure when sub-contractors did their part of the job. The public company employees stated that "the sub-contractors do not necessarily know what an EPD is". Lack of understanding of environmental goals and how to implement them in practice was identified as a main barrier to green building by e.g. Hojem et al. (2014). Mokhlesian (2014) stated that cooperation between all involved stakeholders, including subcontractors in a building process, e.g. through partnering contracts, may lead to learning processes that makes it easier to obtain green buildings.

On the other hand, The Student Welfare Organization had positive experience with working with a contractor that had higher environmental ambitions than the organisation itself, and were pulled forward through this cooperation. The Welfare Organization has generally experienced increasing ambitions throughout processes rather than decreasing ambitions. This was due to being pushed by other involved stakeholders.

Person dependency

Green ambitions are in many ways organization dependent, and also to a high extent person dependent. Hojem et al. (2014) described the process they studied as an enthusiasm-driven process. Also the interviewees in our cases were personally engaged and worked hard to keep the focus on the environment during the whole process. "Have to show that it is possible!" (project leader municipality 2). The willingness to transcend existing building codes also demands for extra engagement. In order to restrain person dependency, green ambitions need to be more binding. Stricter building codes will force less engaged organizations to take a step ahead. Also internal organizational policies, internal learning processes, and in particular building certification with third-party verification, are important tools to set and keep up ambitions throughout procurement processes.

Conclusions from the expert interviews

What factors increase or lower green building ambitions? And at which stages during procurement processes did the key personnel experience challenges and difficulties retaining high ambitions? These were the critical phases and choices for the developers:

- Internal environmental goals and checklists are too little binding. A third-party-verification that international certifications like BREEAM give, keep the ambitions high during the process.
- Governmental supported pilot programs keep up the environmental ambitions.
- The application of environmental product declarations (EPD) and available greenhouse gas calculation tools are challenging. Although the number of EPDs on building products is increasing, it is still challenging to make meaningful comparisons with EPDs. Often, the strategy is limited to a collection of EPDs without further comparisons. Furthermore, when comparisons are carried out, the results do not necessarily have consequences for the choice of materials. System improvement and knowledge among the stakeholders is needed.
- High environmental ambitions from the start avoid expensive changes later in the process. Increasing ambitions at a later stage in the process is often expensive.
- To keep up high environmental goals, a common understanding of ambitions has to be established among all involved parties from the start, and especially in the transition phases. The transition phases are the most vulnerable stages in keeping up the environmental goals. If a common understanding of ambitions and goals is established with the contractors and sub-contractors, it is more difficult for them to cut / lower ambitions even after handover.
- Collaborative contract types, such as partnering, may be better than Design & Build to avoid the vulnerability of lowering the ambitions in the transition phases. The challenge is to avoid the risks of lowering the environmental aims in the strict transition from owner to contractor that is common in Design & Build. Partnering may make the transition phases less vulnerable. Collaborative procurement procedures, contract types where the consultants and the owner cooperate in development of design, may therefore be positive for high environmental goals.
- Consultancy and contractors with high environmental ambitions makes it easier to keep up environmental goals. Feedback to contractors/ sub-contractors that loose the competition may be important for environmental knowledge in the market.

2.2.2. ZEBRA workshop and policy meeting in Norway

In addition to the expert interviews, we have arranged two workshops with policy-makers and industry players in 2015. The aim of these workshops were to identify motivation drivers and barriers for residential and non-residential nZEB buildings, both private and public. Altogether, there were 15

participants representing interest- and governmental organizations, property owners and developers. The workshops lasted for about two hours, and were taped and transcribed.

According to the workshop participants, it is important to establish regulation requirements defining an energy performance level for comprehensive renovation or upgrading. This could have an announcing effect on how ambitious major upgrades are supposed to be. The participants had the opinion that regulatory requirements would be important to set a standard and be educative for the building sector. In comparison, regulatory requirements for new buildings have pulled the environmental ambitions in the building sector forward. Further, they underlined the importance of economic support in order to achieve market uptake of regulation requirements. According to the participants, economic support for energy efficiency measures in housing renovation will motivate both craftsmen and housing owners, and should therefore be more closely connected to regulation requirements.

The workshop discussions showed that instruments such as BREEAM have a positive effect on the Norwegian market uptake of nearly zero emission buildings (non-residential). According to the participants, it is an important factor that these certificates make energy efficiency visible to the players involved. Thus, BREEAM functions as a driver for knowledge sharing and communication in the building industry. All though research and education on energy efficiency and upgrading is important, there is a gap between the research front and the craftsmen and consultants' knowledge. There is a great need for higher expertise in the industry to reach the climate goals, and BREEAM may function as an important instrument for creating energy efficiency competence in the building sector.

The workshop discussions showed great consensus on that it is unlikely that regulatory requirements will lead to ambitious energy upgrading in the housing sector. Regulatory measures will always be possible to "bypass", due to challenges with definition of renovation and strict component requirements. Most residential renovations are not "general rebuilding"[3], and threshold values when strict requirements for comprehensive renovation "kicks in", may be bypassed by building in stages. Unless almost the entire building is affected by the work, it is not reasonable to require measures in other parts of the building than in the current part. Component requirements for single measures must often be more moderate because ambitious measures are not always possible, whilst it is not reasonable or possible to claim compensation through measures somewhere else in the building.

[3] "Hovedombygging" (general rebuilding) is a Norwegian expression which implies that the renovation work is as extensive that the entire building appears to be new, so all regulatory requirements apply as for a new construction.

Since regulatory requirements are unable to contribute substantially to ensure ambitious energy upgrading in the housing sector, other motivations and policy instruments are even more important. Social science research demonstrates that residents will not necessarily be motivated to renovate for energy efficiency through economic incentives (Godbolt 2014). Also, according to the participants of the workshops, there are different types of motivation for energy efficiency and upgrading among the population. For most people, a combination of these may be important (Godbolt, 2014; Thomsen and Hauge, 2014): Comfort and indoor environment, general requirements for upgrade (energy efficiency as a side effect), financial gain, moral considerations, image/group identity and climate change mitigation effects. In addition, the workshop participants emphasized the importance of not only focusing on energy efficiency when trying to engage Norwegian households, but on sustainability in general, including climate change and comfort factors.

Obviously, as the workshop discussions demonstrated, means to achieve ambitious upgrading in the housing sector must answer many different types of motivation factors and user needs. Accordingly, we need to have a wide range of instruments to achieve the ambitious goals of nearly zero emission buildings. For the procurement processes of non-residential buildings, certification systems such as BREEAM are important drivers for obtaining nZEB market uptake (energy efficiency visibility, competence, knowledge sharing tool), in addition to the symbolic value and standard setting of regulation requirements.

3. DRIVERS AND BARRIERS FOR THE NZEB UPTAKE IN EUROPE

Drivers and barriers for energy efficiency in buildings were analysed in several previous European projects. Results from two of these projects are summarised in the first subchapters, followed by ZEBRA results presented country by country.

3.1. Literature study within the project Nearly Zero Energy Neighbourhoods

Karlsson et al (2013) is an outcome of the EU funded project Nearly Zero Energy Neighbourhoods (ZenN). The report "Common barriers and challenges in current nZEB practice in Europe" contains a literature review, an analysis of financial challenges and individual country reports, mainly focusing on barriers and challenges in nearly zero energy building (nZEB) renovations. There are identified a lot of common challenges and barriers in the examined countries (Sweden, Spain, France, Poland and Norway), but it is also pointed up that some barriers and challenges are unique to specific countries. These may, inter alia, concern legislation, ownership structure or energy prices.

The literature review disposes the following barriers and challenges:

- Budgets within the building industry are divided between design/construction and operation. Also there is a challenge in the distribution of savings and costs amongst the different stakeholders.
- Need for more knowledge on energy efficient projects as well as positive examples to feed into decisions for energy efficient projects
- Energy targets are challenging for cultural and historic significant buildings.
- End user awareness of how they are using energy in residential buildings
- Policy, regulation and standards are not established and are still developing across a number of countries
- Need to understand what low energy building means in legislation for the actual building process.
- Need to ensure that information is being used across the building life-cycle.

Financial challenges are summarized as follows:

- There is a long payback period taking between 15-30 years and residents do not stay long enough in a house to benefit from this payback period.
- There are issues where the landlord cannot raise rents.
- There are very little financial instruments available in the EU that are aimed directly and exclusively at supporting nZEB renovations.

Based on workshops and interviews with key stakeholders involved in renovation projects, main common barriers and challenges are identified as below:

Main barriers in the decision making process

• Technical: Existing building structure and technical system limit the choice of technical solutions that can be used but where technical solutions can be found, they are often costly and not financially viable.

• Financial: Investment cost too high

• Social: Lack of knowledge and/or interest for energy efficiency among residents and building owners, often due to lack of awareness combined with challenges with architectural and cultural values

• Environmental/health: No common environmental/health barriers were highlighted

• Organisational: The ownership structure and need for consensus among several homeowners can hinder a nZEB renovations

Main challenges of the retrofitting process

• Technical: Existing building structure and technical systems limit the choice of technical solutions possible for nZEB renovations.

3.2. Barriers and possible policies summarised in the Proficient project

The following table is taken from the report "Energy efficiency Policy in Europe. Review of existing loans, incentives, subsidies" which was prepared within the EU funded project Proficient (MacDonald et al., 2014). The table display the major barriers for accomplishing energy efficiency in the building sector and gives suggestions how to reduce them using policy instruments.

Table 8: Major barriers to EE in the building sector and possible policy instruments to reduce them

Type of barriers	Definition and examples	Possible policies
Financial barriers	Lack of appropriate financing for the long-term benefits, higher-upfront cost for EE improvement, lack of internalisation of environment, health, and other external costs, energy price subsidies.	Financial instruments, tax rebates, subsidized loans, subsidies to energy efficiency improvements, regulations, removal of energy price subsidies, market-based mechanisms.
Cost competitiveness	Lack the ability of energy efficiency technological decision to compete with traditional ones.	Appliances standards, building codes, subsidies, tax rebates to energy efficiency decisions.
Technological barriers	Technological obstacles related to research, development and demonstration energy efficiency measures.	Subsidies, loan for research and development, information instruments, market-based mechanism.
Behavioral barriers	Tendency to ignore small energy saving opportunities, organizational failures, non-payment and electricity theft, tradition, behavioural and lifestyle, corruption.	Support, information and voluntary action, voluntary agreements, information and training programs, market-based mechanism.
Administrative barriers	Lack of support at the regional and local levels to stimulate the energy efficiency improvement.	Creation of local agencies to promote energy efficiency projects, financial incentives, command and control instruments.
Political and structural barriers	Lack of political motivation to support the market initiatives needed for the improvement of energy efficiency, slow process of drafting local legislation, gaps between regions at different economic levels, lack of detailed guidelines, tools and experts, lack of incentive for investment, and lack of equipment testing/certification.	Enhanced implementation of command and control mechanism, policy incentives to encourage energy efficiency building design, enhanced international cooperation and technology transfer, public leadership programs
Information barriers	Lacking awareness of consumer, building managers, construction companies, politicians of the	Awareness raising campaigns, training of building professionals, command and control instruments,
	opportunities and benefits of energy efficiency improvement.	

Adapted from: Ürge-Vorsatz and Koeppel (2007), Belyi (2009)

Koeppel, S., and Ürge-Vorsatz D. (2007) *Assessment of policy instruments for reducing greenhouse gas emissions from buildings. Budapest, Hungary*, CEU,

3.3. Poland

The Polish literature study for identifying drivers and barriers includes four reports based on surveys targeting key players in the Polish building sector. The surveys represent a wide specter of participants spanning from building developers, property owners, building managers, architects, energy consultants, energy auditors, manufacturers, users and certifiers. Other sources in the study include an interview with key experts, a debate and the program for the National Environmental Found for 2015-2020.

Drivers

The most important drivers identified in the Polish study include the recent change of regulations, introduced in 2014 which establishes a strict minimum energy performance requirement for residential and non-residential buildings. Then, an increase in corporate user demands for certified green buildings using assessment methods such as LEED and BREEAM is observed. A national program for financial support was targeting Public Utility Buildings was launche in 2015. High performing indoor environment combined with highly cost efficient solutions using mechanical HVAC systems and the use of passive cooling techniques contribute to ensuring quality indoor environment. In case of residential buildings high energy cost in the future and the aspects of creating an interesting and energy efficient architecture were also found to be important in promoting nZEB buildings in Poland. Another driver is a support program for nZEB operated by National Environmental Found.

Barriers

The barriers found on a policy level reveal a non-coherent and comprehensive pro-energy efficiency policy run by the Polish government. For example, in Polish regulation NZEB is not mentioned, only "buildings with low energy consumption" (which is obviously not the same). There is also a lack of creating energy efficient awareness amongst the public. Instead of energy saving incentives there is still the practice of subsidies for heating cost or coal allowances. Existing energy certification systems were found not to be adequate and unintelligible for users. There are no energy classes on the EPC and there is no relation between energy standard and the cost of the building or apartment. In the design stage there is a notion of additional initial expenses and time consuming operations related to analysis and energy optimization which add to costs. This is a drawback for contractors who wish to meet only minimum requirements and keep cost low. Unawareness amongst investors of the advantages of nZEB buildings, often lead to a late introduction of energy efficient solutions in ongoing projects. Barriers characterizing the market include also banks disinterest in financing nZEB

projects. In addition a low market demand for energy efficient buildings undermines the demand-supply relationship. During the construction phase the low knowledge amongst SME regarding new energy efficient solutions is noticeable. Societal barriers include the low public awareness of energy saving needs and opportunities offered by nZEB. It was found that user behavior often is not consistent with optimal energy-saving system and finally, the number of qualified architects and contractors is still scarce. Negative preconceived notions of simple and non-aesthetic architecture related to nZEB buildings contributes to a negative overall image overshadowing the benefits, such as better indoor environment. There is great access and availability of energy efficient technologies and solutions. The barriers lie rather in the price levels, low knowledge amongst salespeople and consultants, and a miss match between systems making them non compatible. Higher investment cost and long investment return time and lower than expected energy savings are drawbacks.

Summary Poland

The review reveals that Poland is in its early stages of developing a market for nearly zero energy buildings both in terms of highly energy efficient renovation projects as well as new nZEB buildings. The potential of reducing greenhouse gas emissions in Poland is extensive and estimated at 100 million tons CO2 eq. by the year of 2050, representing one quarter of the total emissions nationwide.

A large number of the respondents assess Poland as being poorly prepared of implementing the EPBD and only serve to reach the minimum requirements in order to avoid penalties. They believe that there is not enough focus and action taken by governmental bodies in utilizing the advantage and positive economic benefits that such a change provides. A large number of respondents believe that Poland will not manage to prepare for implementing nZEB buildings by the year of 2020. The majority considers the lack of experience of designers and contractors as an important factor inhibiting the development of energy-efficient projects which is underpinned in a parallel study which present knowledge of energy saving technologies and energy efficient management as some of the most sought after competencies by employers.

A large survey conducted in 2014 representing all sectors of the construction industry shows that a large number of the respondents see economic incentives, such as tax exemptions, as a means to speed up the nZEB implementation on a national level. Many of the participants envision the public authorities to take the lead and responsibility for the building of show cases for private developers to follow. The majority also favors a broad educational campaign. Close to half the respondents believe in stricter rules and regulation will contribute to a self-regulating market. Only a few percentage favors introducing a penalty regime and a majority were against additional taxation of energy

consuming buildings. A majority also believes that changes toward nZEB buildings are beneficial to the Polish building industry providing new perspectives and opportunities.

3.4. Italy

The Italian study of nZEB includes reviews of outputs in six European projects representing interest organizations, owners, and representatives of public nZEB buildings. The study also reflects the views from four interviewees with professionals representing both interest organizations, governmental organizations as well as property owners/developers for nZEB buildings in Italy.

Drivers

One of the main factors increasing an nZEB ambition is the common energy law, which came into effect in October 2015 and includes the official nZEB definition for Italy. The government elaboration to implement the EPBD requirements includes methods for energy performance calculation using renewable energy sources in buildings and minimum requirement for energy performance of new buildings and refurbishments including a 5 years revision cycle of these. Italy has opted for an alternative approach to the requirement posed by the Energy Efficiency Directive to ensure efficient energy retrofitting of 3 % of the total floor area of all public buildings annually. Cost-effective measures such as change of behavior, contracting measures, envelop and technical system renovation, energy management and inspections have been introduced. Representatives of the public administration are somewhat doubtful that the goal of nZEB buildings will be achieved in time but also recognize that there is a possibility of reducing energy consumption considerably and at the same time increasing the indoor environment comfort. These views are underpinned by a national study identifying better working or living conditions as one of the drivers. The study also identifies the following factors of less dependence on energy suppliers, grants, tax deductions, and an Energy Performance Certification database as possible drivers.

Barriers

When the interviews were conducted in the first half of 2015, in Italy there was no national nZEB definition, and this was identified as a relevant barrier. Eleven regions of the 21 regions and autonomous provinces in Italy have their local transposition of the EPBD. The rest follows a national legislation. This situation creates two levels of standards and regulations, a national level, which establishes the national minimum energy performance requirements and a regional level that may have a higher ambition. There is no clear minimum energy performance target. Nor is there a common method for energy balance calculations and use of energy simulation tools. Informants in the study point out a low level of nZEB knowledge amongst professionals as the main factor for decreasing

nZEB ambitions. Other reasons may be the difficulties of finding the right information on technologies, materials and building components. Finally the study identifies a high level of suspiciousness against energy efficient housing amongst a majority of the population.

Summary Italy

Energy labelling, energy certificates and environmental certificates for internal comfort are believed to be a necessity to increase and ensure a higher quality level in buildings. A common national energy law, common calculation methods and clear definitions of nZEB targets area also needed to contribute to increasing the number of nZEB buildings in Italy.

Proposals to ensure nZEB building in Italy include promoting an integrated design processes, support through Energy Service Companies, regulatory measures, tax deductions, favorable loans and information campaigns. Tax deduction for energy efficiency improvements are already in place. Thermal account, white certificates and guarantee and promotion of third-party financing models are also being exercised. Traditional contracting, traditional views of how to build, lack of innovative building design process, and lack of experience amongst professionals and technicians recur as negative contributions to the promotion of nZEB.

Critical aspects identified are, in the case of public tender procedures for public buildings, requirements of innovative energy targets which pose a risk for the design process manager. Other major negative aspects point toward the lack of experience amongst professionals and their work interactions. One informant suggests that planners should benefit from support by craftsmen in the planning process to fully exploit their theoretical knowledge.

3.5. Spain

In Spain it is yet too early to define an nZEB concept since the third revision of the Spanish Technical Building Codes is not expected to be finalized before the year of 2018. Nevertheless, most steps for its implementation have been established at this point although the "National plan for increasing the number of nZEBs" reported in June 2014 is not directly adjusted to the elements required by point 3 in article 9 "Nearly zero-energy buildings" stated in the Directive 2010/31/EU. At this stage the National Plan defines gathered information according to current status of the housing stock. It states intermediate targets for improving the energy performance of buildings and lists strategic legislative and financial measures as well as educational and training measures needed for implementing nZEB renovating of the building stock in Spain. The following chapter illustrates the nZEB market In Spain based on the only national study report reviewing existing building assessments and recommendations for carrying out nZEB renovations. Unfortunately, this study does not include new constructions, but it includes dissemination actions through a National Environment Congress in Madrid, the findings from a project targeting challenges related to nearly zero energy housing in the Mediterranean region (a report from the European Project ZenN – Nearly Zero energy Neighborhoods

published in November 2013) and a literature review of key stakeholders, users and investors (published in 2012).

The existing energy policy in Spain is managed by the national "Ministry of Industry, Energy and Tourism (MINETUR)" which coordinates and channels regulation through the "Energy Diversification and Savings Institute (IDAE). IDAE is in conjunction with the corresponding regional energy agencies in each autonomous region. This organizational structure helps in encouraging new and innovative decision-making processes for each region and their corresponding municipality.

A large percentage of the buildings in Spain are occupied all year around and privately owned which account for approximately 9.5 million out of the 10.3 million existing buildings. 60% were built before 1980, when there were no technical standards or codes to regulate the quality of buildings. There are also a large number of buildings defined as second homes which are mainly empty and unused a large part of the year.

Drivers

Currently there are several ongoing economic support measures targeting mainly renovation of existing buildings, both non-residential and private houses and dwellings in Spain. Environmental Action Plans have been initiated by the Ministry of Agriculture, Food and Environment (MAGRAMA) designed to reduce greenhouse gas and improve efficient use of energy and resources in both the Spanish Tourist sector (diffuse sectors) as well as a part which support and promote low carbon emission activities aiming specific toward the building sector. There is also a possibility for tax reduction ranging from 21 to 10 % for completing energy efficient major renovations in residential buildings. Long-term investment funds, energy service companies (ESCO) and "Green Investment Funds" are new funding mechanisms which can be profitable opportunities in the future. These funding schemes still depend largely on the forming of the new national, regional and local legislation that is being drafted and yet to be approved.

Barriers

The Mediterranean climate in Spain allows for high indoor comfort most of the year with only a few cold weeks occurring mid-winter. Many families live off a low income and already use a minimum of energy on heating and cooling in their houses. The absence of a culture for maintaining buildings, especially in social housing occupied by low-income families, make expensive and high maintenance systems difficult to implement due to owners lack of necessary savings or the lack of economic funding available.

The building industry in Spain is conservative and shows skepticism toward implementing use of new and not yet verified energy saving systems available on the market. They are therefore not being taken in use. Social factors include the reluctance of managing complex, expensive and high maintenance systems. Another barrier is the difficulty to study and define profitability for energy efficiency solutions, due to the heterogeneity of consumers for building types in Spain. What is profitable for one user may be unprofitable for another. There is reluctance in investing in highly energy efficient systems due to initial cost and high maintenance systems especially for social housing. A solution may be to initiate long term studies over a 30 year period to demonstrate the real return on investments for various solutions. Uncertainty tied to what the actual savings are call for automation and monitoring systems which makes it easy for users to view the actual energy use and costs. The lack of a cost-benefit ratio for HVAC or DHW system force most customers to base their investments on the initial price. There is an uncertain perception and lack of confidence toward nZEB and technical feasibility related to these and accounts for users (both high and low-income) as well as professionals. There is a shortage of educational and training offers targeting the market of energy efficient measures and the overall construction labor in Spain still lack qualifications for installing most innovative energy saving solutions and technological devices available.

Summary Spain

Although the nZEB concept first will be adopted as a third revision in 2018, there are expected minor revisions related to the energy saving sections as early as 2016. For new buildings possibilities to include other indicators like CO2 emission and more specific limitations to energy demand and consumption regarding climatic zones are considered. For existing buildings the requirements might depend on type of intervention. A progressive tightening of technical requirements is expected to be in place prior to 2018 for public buildings and in 2020 for all buildings. At the moment most energy requirements from the Directive 2010/31/EU are adopted in the next version of national regulations.

3.6. Lithuania

Along with both Latvia and Estonia, Lithuania is a small country with approximately 3 million inhabitants. A large portion of the population lives in multifamily dwellings which are mostly owner-occupied. A majority of the dwellings date back from the Soviet period and are in great need of renovation. Many studies show that residents and other building owners are highly motivated to adding thermal insulation but like in many other occupied-owner situations the difficulty lie in reaching a common agreement on how to finance the project.

Renovation policy is strongly focused on the apartment building renovation in Lithuania. The renovation policy has started in 2004 with the first apartment building renovation strategy (lit. LRV 2004-01-21 d. nutarimas Nr. 60 „Dėl Lietuvos būsto strategijos patvirtinimo“). However, the finance model has updated and changed several times by now. There are new finance models moving from fragment renovation (increasing energy performance of one particular building) to the complex renovation.

To sum up, the renovation strategy is still developing by changing the finance models; however the most important instrument remains the increase of the energy performance of the apartment buildings.

Barriers

In a summary from the project "Build up skills – Lithuania Status Quo analysis", 2013 the barriers described are related only to education and working skills. Participating stakeholders are ministries, governmental agencies, educational institutions, professional associations and employers. Low demand for high energy performing buildings, an undefined long-term strategy for buildings, lack of nZEB knowledge amongst construction companies and workers, unprepared educational institutions, lack of governmental promotion of nZEB, and the lack of information and understanding for fulfilling and implementing the European directive are some of the identified barriers in this study.

Drivers

Most of the dwellings date from the Soviet period and are badly depreciated. This is made worse by the fact that the climate is very cold, and hence thermal comfort is a major driver for thermal renovations. However, the share of low-income owner-occupiers is relatively high (19-24 %). Several studies show that residents and other buildings owners are very motivated to conduct thermal insulation. The main barriers are similar to those that are generally common among owner-occupied multifamily buildings (see Heiskanen et al. 2012), i.e., organizational difficulties in reaching a decision and financial difficulties in raising funds, which are further aggravated by the low value of the properties.

3.7. Austria

Austria is in a unique position and belongs to the countries in Europe where the Passive House market is furthest developed. The Austrian Federal Ministry of Transport, Innovation and Technology have been promoting innovative solutions and components dating back to 1999. Financial support schemes had a big marked impact due to the fact that traditionally close to 80 % of all new constructed housing units in Austria were co-financed by the public. Today the importance of these

public financing is declining because of low cost of debt, high bureaucratic hurdles and high technical requirements. For renovation of existing buildings the impact is lower, but also here several initiatives are taken.

The number of dwellings in Austria in 2009 amounted to 3.6 million. Close to half of them were single-family housing and the other half were multiple family apartment buildings. 11 % of the apartments are owner-occupied, 40 % are rented and the rest constitutes of other forms of tenure. Potential investments for sustainable refurbishment are estimated to two thirds applicable in the sector of single-family houses older than 30 years. Also a large part of the multi-family structures built in the 60s and 70s are considered easy to refurbish due to their technical composition and their compact characteristics.

Traditional heating systems in Austria have been fossil fuel based heating systems and log wood stoves. Fossil based central heating systems still have a certain degree of importance. Oil boilers are mainly installed in buildings that already had an old boiler, as well as in buildings in non-rural areas without access to natural gas grid. Small-scale use of wood fuel systems are gaining importance and biomass consumption accounts already for approximately 26 % of all fuels and 90 % of renewable energy sources of thermal energy in buildings. The use of biomass in heating and cooling is expected to increase by 4 % by 2020. The number of small-scale pellet boilers has grown by 50 % between 2005 and 2012 and is expected to grow further by 2020.

Barriers

On a legislative level the barriers in Austria include the lack of a holistic view of energy efficient renovation in policy making. Financial programs still need to be designed to support renovations that include all measures towards sustainable energy efficient buildings and supporting deep step by step renovations. Some experts suggest that financial support systems are due for an update. Focus needs to be turned toward increasing knowledge in the renovation market improving project management and selection of cost efficient quality renovation measures and best practice solutions.

Financial barriers are considered of being the largest obstacle for most building owners. Even though financial support is available, initial costs and long payback times remain large obstacles especially for low income owners and owners over 65. Owners often focus on initial investments rather than making a cost analysis over the life cycle of the building. Investment subsidies are found to be most suitable for technology measures based on renewable energy sources. Other barriers are linked to transaction-costs regarding concerns over disruption and failure in renovation projects.

Owners living in multi-family apartment buildings constitute 16 % of the total floor area in Austria and also struggle with challenges related to making a collective decision of investing and carrying through an energy efficient and sustainable renovation. Increased focus from all owner groups on making important decisions at the right time is needed.

The conclusion of the findings suggest that financial barriers are the most critical issues alongside other barriers such as transaction costs, lack of information of building owners and skills of craftsmen.

Drivers

There is a change in awareness and attitudes of people regarding energy saving issues. In Vienna, a competition for increasing the percentage of new Passive Houses from 3 % to 20 % by 2008 was launched, resulting in 1700 housing units in 20 large volume Passive Houses. In the regional state of Lower Austria, all new buildings are required to be similar to Passive House standard. Although the Austrian federal government, as well as regional governments, are taking significant measures to encourage nZEBs, it is a long way to go. An important driving force for Passive House buildings was the Passive House Association. A potential similar driver could be to create a network of educated craftsmen and builders and for energy experts to be involved in all renovation processes starting as early as in the planning stage.

A large financial incentive for energy efficient new residential buildings and thermal renovation is the Wohnbauförderung – support of residential building construction – even if it is to be reformed. The information and assistance offered by regional and local energy agencies may be considered as best practise example. Other examples worth mentioning are the Austrian climate protection initiative Klima:aktiv that promotes thermal renovation and solar-heat initiatives, the research program Haus der Zukunft (building of tomorrow) that help develop technology and concepts and e5, which take action on a local level supporting communities that want to contribute to a sustainable energy policy.

3.8. Romania

The recent 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". The National Plan to increase the number on nZEBs in Romania which proposed a list of the maximum primary energy levels for nZEB was launched in July 2014 and adopted with Order 386/2016. Up to this date there is no available data on the number of low energy buildings and this contributes to the uncertainty of estimating the extent of the low energy buildings carried through.

Barriers

In Romania stakeholders are still concerned about the effectiveness of existing tools. A lack of trust in energy performance certificates (EPC) was particularly mentioned since the minimum 10 % annual verification of energy audit certificates and reports, as well as inspection reports for heating and air conditioning systems has been adopted in early 2016 and therefore not yet been implemented. There are currently no established and widely used procedures for energy performance contracting or invoicing. Nor does procurement regulation facilitate energy performance contracts. Still there are some attempts from the ministries of establishing a clear platform that will allow further development of the situation relating to the ESCO market. An EPC database is yet not available to the market. Financial institutions are very restrictive and reluctant to issue green mortgages. High up front investments, difficulties in accessing existing funds, long payback time, and low income makes nZEB unattractive investments for property owners. A lack of professionalism in procurement procedures where the criteria focus on selecting the lowest bidder and a low level of qualifications in the design phase often lead to projects where low energy performance issues are omitted. The lack of updated technological solutions is still widely spread in Romania and neither international nor national best practice is available. Results from the real estate agents (WP3) show that there is an insufficient engagement of all stakeholders. The result reveals that they are yet not convinced about the benefits and importance of EPC which contributes to it being an off priority. Administrative, financial and behavioral barriers make it difficult for SME to launch innovative products from entering the market.

Drivers

The Romanian contribution advances that financial incentives may act as motivators increasing nZEB ambitions in the procurement process and may be a main instrument in triggering the nZEB market. Further, sufficient information of nZEB benefits and available technologies should be provided to property owners. The need for a clear and simple framework to facilitate nZEB investments by facilitators and a supporting public sector willing to adopt the implementation of new technologies are targeted as important drivers.

4. WORKSHOPS

4.1. Germany

Written by Sven Schimschar, Ecofys

One workshop was carried out on 30.01.2015 with about 30 participants from different Ministries such as the German Federal Ministry of Environment, the German Federal Ministry of Economic Affairs and Energy, the Federal Environment Agency, the Federal Office for Energy efficiency and from several research institutions. The workshop aimed at discussing a mix of policy instruments to increase energy efficiency. Sectoral policies were discussed in several working groups (incl. buildings). In this context, the objectives of the ZEBRA 2020 project were presented and considered while discussing e.g. higher standards of the EnEV or KfW-programs with more ambitious levels to accelerate the market uptake of nearly zero-energy buildings.

Another workshop on 11.02.2015 was organized by NABU (Nature And Biodiversity Conservation Union) with high level participants from research institutes, ministries, industry associations and the industry. The focus of the discussion was on how to bring together nZEB requirements for the energy performance of the building and the share of renewables which both are essential parts of the nZEB definition but which are currently part of two different regulations in Germany:

a) EnEV (energy saving ordinance)
b) EEWärmeG (renewable energy heat law)

Both regulations are not completely harmonized and they are not yet aiming at nZEB; currently it is discussed how they can be brought together in order to achieve the German long-term target of a "nearly" climate neutral building stock. The definition of the nearly climate neutral building stock is almost identical with the EPBD's nZEB definition.

This means several ZEBRA core items which got special attention in the nZEB tracker have been discussed in this meeting:

1. What is a proper definition for an nZEB? How can low performance buildings be avoided that only seem to be "good" because of massive, inadequate share of renewables?
2. What are the market barriers for a broad introduction of nZEB?

3. What policy measures are required to achieve new nZEB till 2020 and an nZEB building stock till 2050?
4. Specifically, how can EnEV and EEWärmeG be brought together in order to match individual nZEB and nZEB building stock?

It got clear that continuous detection of gaps, policy recommendations on how to fill them and monitoring of the progress like done by the ZEBRA nZEB tracker, would be very welcome. A regulation that brings together both energy efficiency requirements and renewable energy share is "badly needed". Therefore, the regulation needs to make a clear distinction between the energy that supply systems have to feed into the building in order to meet heating, cooling and DHW needs on the one hand and on the efficiency and renewable share of those supply systems on the other hand. This is to meet both energy performance and renewable energy targets. For the nZEB tracker, this means that possibly both aspects may be sub-criteria for judging the quality of a MS nZEB definition.

4.2. France

Written by Carine Sebi, Enerdata

This chapter summarizes the discussion that occurred during the first ZEBRA workshop for France that held the 26th of June 2015 in Paris. Several stakeholders participated (15 participants) and represented both public and private bodies. Following to the interview guide sent by SINTEF we dedicated the end of this workshop to ask participants their advice on the main factors that increase or lower the nZEB market uptake.

The following notes are not split according to the point of view of governmental versus private stakeholders. However, the Ministry point of view is clearly mentioned in the following text. This report does not neither enumerate discussion in the chronological order but rather present the main idea by themes that are the following:

1. Financing and investment of renovation/construction;
2. Professional skills and qualification in building industry (training, knowledge, implementation, etc.);
3. Information and communication dedicated to final consumers;
4. Building comfort;
5. The new collective or organizational initiatives implemented at the local or regional level.

1. FINANCING AND INVESTMENT

Lowering factors:

Renovation

- To reach nZEB standard, investment costs are too high and unfordable to end-use consumers;
- It is very high to evaluate the renovation investment payback time.
- The payback time of a deep renovation is estimated at 20 to 30 years while in France property ownership is changing every 7 or 8 years. It is important to define a new dynamic to trigger renovation.
- Decision making processes and financing modes shall be more adapted or designed in relation to the different building types. These latter shall be customized according to their status, i.e. collective or individual dwellings, with an effort made on communication to better inform consumers on existing instruments of each type of dwelling.
- Even if deep renovation shall be prioritized when economically feasible, grants shall also permit renovation sequences with low payback time (3 years).
- Energy Performance Contract or saving guaranties target essentially in France big building projects, such as service buildings or big collective buildings. These initiatives shall be taken to reassure all types of consumers on expected energy savings, and should target as well small types of buildings or individual houses.

New building

- As for renovation, construction costs are too high with the new regulations, and payback time is not at all in the consumer logic.

New and renovation

- Renovation or nZEB construction expenses are higher (ex post) than expected initially. Indeed, installations or equipment's ask for a high maintenance cost that was not initially taken into account (for instance, the new performance ventilation systems have to be inspected every two months). Besides, because of the high fix cost of subscription (of maintenance) the energy bill is not proportional to energy consumption. Because of these two factors, the energy consumption reduction is translated by a lower reduction of energy bill.

Positive factors:

- The Ministry implements tools allowing to model financial instruments in line with the different types of work or thermal equipment to calibrate tax credits (amount, rates, period, etc). Unfortunately, this economic database on which the Ministry model instruments is not public, particularly because of the uncertainty of the reference data.
- To give incentives to renovate or construct nZEB, it may be interesting to propose loan insurance with more attractive rates.

2. PROFESSIONAL COMPETENCE AND SKILLS

Lowering factors:

- Lack of qualification and skills of professionals for renovation. How to ride this level?
- Building enterprises do not have finance/money to contribute to professional trainings for renovation.
- The actual professional building trainings are theoretical and do not present enough the operability of renovation work
- It is urgent to help building professionals to have access to appropriate trainings for renovation.

Positive factors:

- There exists already several training programs and platforms to train professionals (RGE, Plateforme PRIS, etc.)
- For new dwellings, construction processes quasi industrial, the network is well implemented and professional qualification is good for nZEB.
- How could we improve existing tools before implementing new training programmes?

3. SENSIBILISATION AND COMMUNICATION

Positive factors:

- As investment represents a drawback to renovation and that investment amount are not sustainable, the public authority role is to inform and give envy to consumers to renovate their homes thanks to communication campaigns, etc.
- It is important to better communicate to building owners and explain them clearly the cost on the long run of a non-renovation, i.e. what could be the economic losses in terms of energy bill (or in case of future sales) to not renovate their homes.

4. BUILDING COMFORT

Negative factors:

- Because of the complexity of the installation of new equipment or because of bad consumer behaviours (rebound effect), there is often a bad use of buildings, leading to a significant gap between theoretical consumption (ex ante) and real building consumption (ex post). It should be important to associate occupants (renters) during the renovation process to avoid wrong future consumption behaviour.
- Several consumers claim that after an nZEB construction or a deep renovation, the quality of air is lower. This may due again by the bad maintenance of ventilation, or the lack of maintenance contracts. In service buildings it can have a direct macroeconomic impact (salaries sick leaves, etc.)

- Be careful of counter performance of some thermal equipment (as for instance heat pumps in the past) that finally has a lower performance when installed. Hence a lot of architects wait for concrete feedbacks or a long test period before installing these new materials.

Positive factors:

- The Building Social Union (L'Union Sociale pour l'Habitat) has positive feedbacks of renters; the comfort of nZEB building is significantly higher than before.

5. COLLECTIVE ACTION

Positive factors:

- Renovation of collective dwellings or of big projects are easier to implement than small or isolated building projects. Indeed, for each renovation there is a need for a bulk of different professional skills that are more difficult to gather for individual dwelling renovation.
- For renovation in individual dwelling, implement collective action or collective tenders (common dotation).
- Take example on pilot project of some Eco cities (exemplarity but does not represent the bulk of actions)
- nZEB concept should be evaluated at the scale of a territory to favour the development of big renewable heating plant systems or renewable district heating, that at the regional level represents energy savings.
- Cities should take example on the Eco cities pilot programmes that put in relation architects with thermal professionals. These initiatives have a macroeconomic impact (creation of jobs) and evaluate the cost at the local territory level.

6. POLICIES AND MEASURES TARGETING NZEB

Ministry listed the main important policies and measures targeting to promote nZEB.

For new buildings

- 2012 and 2020 French building codes
- Law on Energy transition that enforces public bodies to have an exemplarity role in terms of public building performance.

For renovation

- Regulation tertiary decree that should be published soon
- Law on Energy transition that enforces thermal insulation of collective dwelling in case of maintenance façade.

- **Mandatory renovation in case of transaction expected between 2020 and 2030.**

5. SUMMARY

The following summary reflects on the outcome from national contribution in this study focusing on revealing important barriers and motivations for implementing nZEB. Active and inactive parties, involvement and motivating factors are identified. An attempt of highlighting and analysing some of the common key points found is made. It must be taken into account that the contributions are not fully comprehensive. Results from the workshops carried out in Norway, Germany and France are presented in separate sections.

In Norway, energy efficiency related to buildings has received increased attention over the past years. In 2012 the first White Paper on energy efficiency in buildings was launched including a two-step revision process of existing building regulation with an aim to reach Passive House levels in 2015 and nearly zero energy levels in 2020. Notable barriers in Norway still include the lack of focus on the existing building stock, non-professional private building owners, unfavorable owner structure, low electricity prices, and the absence of incentives for convincing private house owners in making costly high energy efficient investments with a comprising high risk and long amortisation terms.

Poland is still in the early stage of developing a market for nZEB and have great potential of reducing CO2 emission by 2050. The most important drivers identified in the Polish study include the recent change of regulations, introduced in 2014 which establishes a strict minimum energy performance requirement for residential and non-residential buildings. Respondents in the Polish study still assess the country as being poorly prepared in implementing requirements set by the EPBD within the set timeframe. It is believed that the advantages and positive economic benefits which provides new perspectives and opportunity and an increase in energy efficient buildings are not utilized by the governmental bodies nor the Polish building industry.

In Italy, 11 out of the 21 regions and autonomous provinces have their local transposition of the EPBD creating two levels of more or less demanding standards and regulation on both a national and regional level. The Italian study reveal that requirements for energy labelling, energy certificates, integrated design processes, support through Energy Service Companies, regulatory measures, tax deductions, favourable loans and informational campaigns are believed to be necessary means for ensuring a higher quality level of energy conserving buildings in Italy.

In Spain the existing energy policy is managed by the national "Ministry of Industry, Energy and Tourism (MINETUR)" which coordinates and channels regulation through the "Energy Diversification and Savings Institute (IDEA). IDEA is in conjunction with the corresponding regional energy agencies

in each autonomous region. This organizational structure helps in encouraging new and innovative decision-making processes for each region and their corresponding municipality. In Spain, where a formal nZEB standard is planned to be launched in 2018, most steps for its implementation have been established at this point. For new buildings possibilities to include other indicators like CO2 emission and more specific limitations to energy demand and consumption regarding climatic zones are considered. For existing buildings, the requirements might depend on type of intervention. A progressive tightening of technical requirements is expected to be in place prior to 2018 for public buildings and in 2020 for all buildings. At the moment most energy requirements from the Directive 2010/31/EU are adopted in the next version of national regulations. Amongst the draw backs in Spain is the Mediterranean climate, which only display a few cold weeks annually. Families owning older climate adapted housing and living off a low income already use minimum energy for heating and cooling.

The Lithuania study points out thermal comfort as one of the major drivers for dwellings dating back to the Soviet period. Organizational matters, low property value, and a high share of low-income owners, on the other hand, makes it difficult to carry out costly and ambitious large renovations. Governmental promotion of high energy efficient building, and coordination in the construction sector for implementing the EPBD are all needed measures in order for Lithuania to move forward in the effort of implementing nZEB targets. A low demand for buildings with high energy performance, an undefined long-term strategy for buildings, lack of nZEB knowledge, lack of governmental promotion of nZEB, and the lack of information, and an understanding for fulfilling and implementing the European directive are all identified barriers.

Austria belongs to the countries in Europe where the Passive House market is furthest developed. The Austrian Federal Ministry of Transport, Innovation and Technology has been promoting innovative solutions and components dating back to 1999. Currently there are several initiatives that are entitled for financial support. Support schemes have big marked impact since traditionally close to 80 % of all new building projects are co-financed by the public which thus can demand stricter energy efficiency measures. Nevertheless, despite of support, financial barriers are crucial, especially in renovations. There is also a lack of a holistic view of energy efficient renovation policies, also seen in Norway, where financial programs need to be designed to support energy conserving step by step renovations. Financial barriers seems to be the most critical issue alongside other barriers such as transaction costs, lack of information and skills.

Romania have recently passed the Government Ordinance nr. 13/2016, defining 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 National Plan to increase the number on nZEBs in Romania which proposed a list of the maximum primary energy levels for nZEB was launched in July 2014 and adopted with Order 386/2016. Up to this date there is no available data on the number of low energy buildings and this contributes to the uncertainty of estimating the extent of the low energy buildings carried through.

Amongst the identified drivers are the programs acting as a third-party-verification such as BREEAM or LEED which aims at setting the standard for best practice in sustainable building design, construction and operation and keep the ambitions high during the process. However, this is observed mainly for office buildings and some other non-residential building categories, not significantly in the housing sector. Corporate user demands for certified green buildings using assessment methods such as LEED and BREEAM can be seen as a driver in more than one country. In Norway an increase in the use of Environmental Product Declaration (EPD) gives advantages in collecting points toward energy performing certificates such as BREEAM. Governmental supported pilot programs also contribute to keep up the environmental ambitions. At the same time there are examples displaying a lack of focus and action taken by governmental bodies in utilizing advantages that nZEB entails.

A number of respondents view their country as poorly prepared for implementing of the Energy Performance of nZEB buildings required by the Energy Performance Building Directive (EPBD) by 2020. Financing issues is a recurring topic. There is still a need for economic incentives and pilot programs which creating show cases to follow. A lack of professionalism in procurement procedures is mentioned as a barrier. Focus on selecting the lowest bidder results in low level of qualifications in the design phase which lead to projects where low energy performance issues are omitted. A common understanding of the environmental ambitions and partnership contracting including involved parties where high focus on environmental ambitions from the start in building projects helps avoid expensive changes later in process and contribute to successful projects.

For a majority of the examined countries it is pointed out the lack of professional knowledge and experience as a major barrier. Rapid technological development on energy saving solution flourishes the market. Such solutions benefit and promotes the environmental approach of reaching nZEB and at the same time they present a problem relating to the level of keeping the professional skills up to date. The studies show that there is a general lack of updated knowledge relating to energy saving technical solutions amongst designers and craftsmen. In Lithuania the demand for skills amongst craftsmen is high, and in particular building physics knowledge is sought-after. Findings in Norway also display the lack of adequate know-how, which also can be found in the neighbouring country of Sweden, this being especially true for contractors in the building industry. Personal commitment was

observed as one of the stronger drivers in a Swedish study as well as an increased focus on life-cycle thinking.

There are many posing risks, related to both financial aspects and to the quality of execution when implementing new technology. A conservative building industry with great skepticism for non-tested, high maintenance systems, in combination with a shortage of educational training, may be contributing factors which result in a lack of qualification for implementation and installation of new energy saving solutions. Austria considers a possible solution in creating a network of educated craftsmen and builders and for energy experts to be involved in all renovation processes starting as early as in the planning stage. One informant suggest that planners should benefit from supporting craftsmen in order to exploit their theoretical knowledge to the full extent while planning and designing buildings.

The two Norwegian workshops with policy-makers and industry players in 2015 had the aim of identifying motivation drivers and barriers for residential and non-residential nZEB buildings, both private and public. According to the participants, it is important to establish regulation requirements defining an energy performance level for comprehensive renovation or upgrading. This could have an announcing effect on how ambitious major upgrades are supposed to be and could be educative for the building sector. In comparison, regulatory requirements for new buildings have pulled the environmental ambitions in the building sector forward. Further, they underlined the importance of economic support in order to achieve market uptake of regulation requirements. According to the participants, economic support for energy efficiency measures in housing renovation will motivate both craftsmen and housing owners, and should therefore be more closely connected to regulation requirements. A need for higher expertise in the industry and certificates such as BREEAM were both identified as important instrument for creating energy efficiency competence in the building sector.

The workshop discussions showed great consensus on that it is unlikely that regulatory requirements will lead to ambitious energy upgrading in the housing sector. Regulatory measures will always be possible to "bypass", due to challenges with definition of renovation and strict component requirements. Most residential renovations are not complete "general rebuilding", and threshold values when strict requirements for comprehensive renovation "kicks in", may be bypassed by building in stages. Unless almost the entire building is affected by the work, it is not reasonable to require measures in other parts of the building than in the current part. Component requirements for single measures must often be more moderate because ambitious measures are not always possible, whilst it is not reasonable or possible to claim compensation through measures somewhere else in the building.

Since regulatory requirements are unable to contribute substantially to ensure ambitious energy upgrading in the housing sector, other motivations and policy instruments are even more important. Social science research demonstrates that residents will not necessarily be motivated to renovate for energy efficiency through economic incentives. Also, there are different types of motivation for energy efficiency and upgrading among the population. For most people, a combination of these may be important: Comfort and indoor environment, general requirements for upgrade (energy efficiency as a side effect), financial gain, moral considerations, image/group identity and climate change mitigation effects. In addition, the workshop participants emphasized the importance of not only focusing on energy efficiency when trying to engage Norwegian households, but on sustainability in general, including climate change and comfort factors.

Obviously, as the workshop discussions demonstrated, means to achieve ambitious upgrading in the housing sector must answer many different types of motivation factors and user needs. Accordingly, we need to have a wide range of instruments to achieve the ambitious goals of nearly zero emission buildings. For the procurement processes of non-residential buildings, certification systems such as BREEAM are important drivers for obtaining nZEB market uptake (energy efficiency visibility, competence, knowledge sharing tool), in addition to the symbolic value and standard setting of regulation requirements.

The first workshop conducted in Germany had focus on discussing a mix of policy instruments to increase energy efficiency and setting of higher standards for the building energy regulations (EnEV) and support programs (KfW) in order to accelerate nZEB marked uptake. The outcome of the second workshop made it clear that there is a need for one common regulation that brings together both energy efficiency requirements and renewable energy share. A clear distinction between the efficiency requirements for the building (energy need for heating, cooling and DHW), and the efficiency and renewable share of the supplying system, is needed. If this is to be achieved, there is a higher probability for meeting targets regarding both energy performance and renewable measures.

The workshop carried out in France asked the participants to give advice on the main factors that increase or lower the nZEB market uptake within financing and investment, professional competence and skills, sensitisation and communication, collective action and policies and measures targeting nZEB. A large part of the results corresponds with findings in the country-wise studies. High investments cost and long payback time for customers; the lack of decision making processes adapted or designed in relation to different building types; lack of grants promoting low payback time for sequence renovation; the need for Energy Performance Contracts for all types and sizes of buildings were considered drawbacks related to financing and investment. Implementing of tax credits through financial models and incentives through loan insurance with more attractive rates

were seen as positive factors. Lack of qualification and skills and lack of financial means to increase the level of qualifications was a pronounced urgent need. Several ongoing initiatives for raising qualifications related to nZEB performance was seen as positive. Investments often present a drawback to renovation. Public authorities need to continue to carry through information campaigns urging consumers to renovate through explaining the economic benefits of an earlier renovation rather than waiting too long, which increases the costs. The need to involve occupants through the renovation process to avoid bad consumer behaviour and a possible rebound effect amongst consumers was pointed out. A need for collective tenders targeting larger renovation projects as well as individual dwellings using pilot examples was identified as an important collective action. The Ministry listed the main important policies and measures targeting to promote nZEB for new buildings as: 2012 and 2020 French building codes for new buildings; a law on Energy transition that enforces public bodies to have an exemplarity role in terms of public building performance. And for renovations: regulation tertiary decree, soon to be published; law on energy transition that enforces thermal insulation of collective dwellings in case of facade maintenance; mandatory renovation in case of transaction expected between 2020 and 2030.

Concluding remark

Summing up, it can be stated that it is difficult to draw a clear picture of main, major and minor barriers and drivers among different countries, building categories, stakeholders and so on. There is a lot of former studies – and contributions to the present report – that list up barriers and drivers related to different subjects, often in comprehensive tables. For example, different barriers and drivers apply to different stakeholders and different stages of a building's lifetime. There are other challenges and driving forces in the residential sector than in the non-residential sector, and they differ between new construction and renovation. This is, of course, reflected in the contributions from the consortium partners. However, similar to previous studies, the findings are to a minor degree grouped according to their importance.

In our view, the following issues become more and more clear:

We recognise stronger barriers for energy efficiency renovation versus new buildings, and also stronger barriers in the residential sector than for non-residential buildings. Drivers like green building assessment such as BREEAM are important in office buildings and some other non-residential building categories, but do not play a significant role in the housing sector, especially not in renovations. While tightened regulatory requirements push energy efficiency in new buildings, those measures are unable to contribute substantially to ensure ambitious energy upgrading, in

particular in the housing sector. Therefore, other motivation factors, drivers and policy instruments are even more important.

Decision making processes in general and especially in multi-family housing with owner-occupied dwellings are crucial. An owner structure with a high share of private-owned dwellings and single-family houses is a strong challenge in many countries when it comes to energy upgrading. This challenge has to be met by tailor-made policies, also in terms of suitable funding. A high share of co-financing by the public, like in Austria, is a good basis to require high ambitions. In the case of energy upgrading however, it is a big challenge to address private owners adequately.

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