



End-users' opinion on living in multi-family Nearly Zero-Energy Buildings (NZEBs)

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H2020 CONZEBs aims – „focus on end-user“



- MSs prepared **action plans for construction of early NZEBs** before the full implementation of EPBD requirement on NZEBs - after 2020/2018.
In the mean-time, several technical concepts for construction of high energy performance buildings - targeting the anticipated NZEBs performance levels - were tested in practice.

Barriers for better penetration of early NZEBs :

- current gap in life cycle costs (LCC) of a NZEB building and regular buildings,
- higher investment costs of NZEB
- **the lack of trust in NZEBs among end-users, due to complexity of systems and end-users' believes about various constraints regarding living in NZEBs.**
- CoNZEBs project (2017-2019) aims at reduction of the above barriers by studying in detail **the costs reduction opportunities** in new multi-family buildings (MFB) NZEBs and by **addressing most common end-users' myths and fears about living in NZEBs.**



Woman, 45 years, living in a conventional 70-ties building:

»Triple glazing and windows hidden deep in thick walls will reduce the daylight in the house.«

A survey on end-users' attitude to NZEB



CoNZEBs research hypothesis:

Understanding **the doubts and fears** as well as **the opinion of the end-users living and planning to live in NZEBs** >>>

will enable the development of **focused information activities for better acceptance of NZEBs**

among (current and future) tenants and owners

and

thus **improve the market penetration** of NZEB MFBs.

CoNZEBs survey is focused on

- **identification of end-users' attitude to NZEBs** and
- **comparison of the findings** from 4 different countries.



A survey on end-users' attitude to NZEB (2)



Multi-family building sectors in 4 countries strongly differ as per

- building tradition, and state of the art in buildings' energy performance (climate),
- the share of rental and users' owned flats,
- NZEB technical definition (or expected definition),
- penetration of early NZEB,
- end-users experiences, confidence in NZEBs and readiness to live in NZEB.

Differences in MFB-stock per countries

Distribution of population by tenure status, type of household and income group - EU-SILC survey [ilc_lvh02]

2017	Denmark	Germany	Italy	Slovenia
Tenant, rent at reduced price or free	0,1	8,6	9,5	19,0
Tenant, rent at market price	37,7	40,0	18,0	5,4
Owner, with mortgage or loan	47,8	25,7	13,6	12,0
Owner, no outstanding mortgage or loan	14,4	25,7	58,8	63,6

Source: EUROSTAT



Methodology



- A questionnaire – for current and potential future users of NZEBs
 - Common questions used in all participating countries
 - Country specific questions reflecting the national situation of early NZEBs.
- Types of questions:
 - △ questions with multiple choices, △ questions with checkboxes,
 - △ questions with linear scale from 1 to 5, △ questions with paragraph answers.
- The common part addressed the following main questions:
 - Do you know what an NZEB is?
 - Where did you get the information about the NZEB and how good (useful, understandable) this information was for you?
 - **What is important for you as an apartment user?**
 - **What do you think which technologies characterize most NZEBs?**
 - **What would be/were your decision triggers for living in an NZEB?**
 - In which type of building do you currently live?
 - Are you considering moving in a new apartment within the period of the next 5 years?
 - What kind of renewable energy sources do you use?
 - **Do you have any concerns/doubts regarding living in high energy efficient buildings?**



Methodology (2)



- English questionnaire available as online survey tool on the project web site
- Adapted & translated national languages versions.

Data collection approach:

- **Denmark** - online survey tool,
- **Germany, Slovenia and Italy** combined direct mailing (regular mail, e-mails) with printed questionnaire distributed to interested end-users during meetings,
- **Italy** also applied the online survey by using Google Forms and some face-to-face interviews.
- The survey was **conducted by housing organisations** and elaborated along the common template by research partners.
- The participation in the interviews for end-users was **voluntary** and the interview results were **anonymised**.
- Frankfurt, Copenhagen, Ljubljana, South/East Italy

[Link to the questionnaire](#)

The screenshot shows a questionnaire titled "Questionnaire on living in high energy performance buildings". It includes a section for "Part 1" with the question "Do you know what NZEB (Nearly Zero Energy Building) is? *". The response options are "Yes", "Partly", "Very roughly", and "No". Below this is a question about the source of information and its usefulness, with a 5-point Likert scale. The scale is shown for two categories: "Media (magazines, TV, radio)" and "Professional magazines, articles".

	1	2	3	4	5
Media (magazines, TV, radio)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Professional magazines, articles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



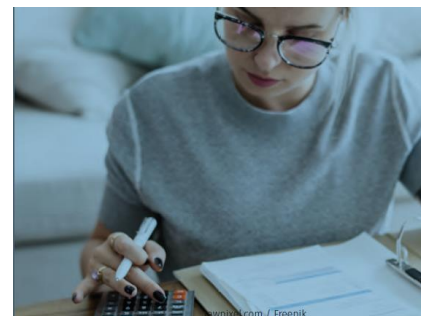
ZEM

- 1558 – End-users' opinion on living in multi-family Nearly Zero-Energy Buildings
- **Šijanec-ZavrI**, Jacimovic, Erhorn-Kluttig, Erhorn, Illner, Engelund Thomsen, Wittchen, Mørck, Sanchez Mayoral Gutierrez, Zinzi, Mattoni, Fasano

Respondents in numbers & structure

- Survey covered **293 end-users** of which
 - **112 are currently** living in an NZEB and
 - **181 are potential future** users of NZEBs.

Country	Current NZEB end-users	Potential future NZEB users	All respondents
Germany	36	10	46
Denmark	19	0	19
Italy	50	81	131
Slovenia	7	90	97
Total	112	181	293
	38%	62%	

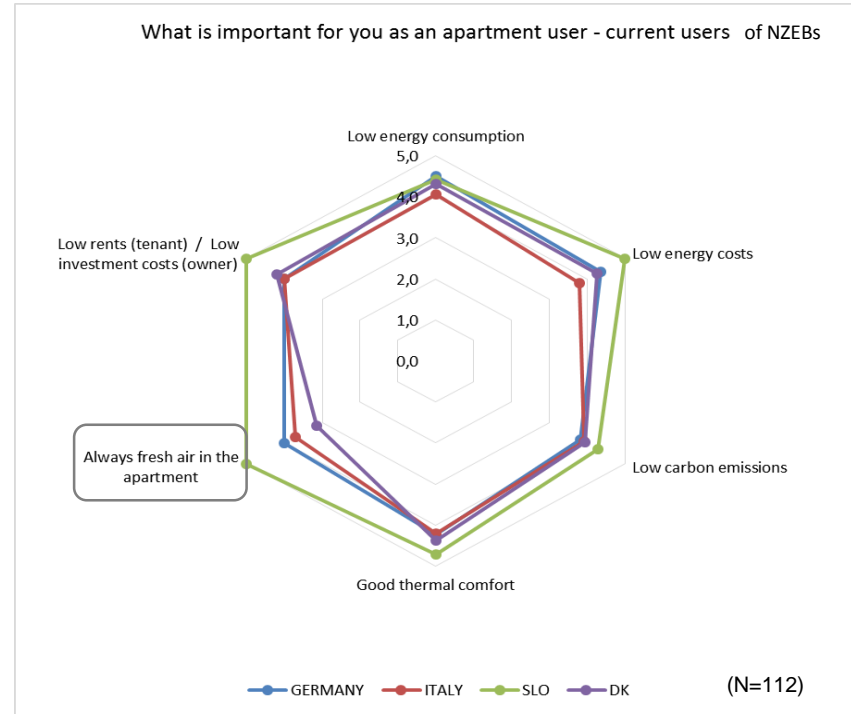


Common findings – end-users' expectations



- **Opinion of current NZEB residents** on the importance of certain **expectations about their flats in NZEBs**
- „**good thermal comfort**“ and „**low energy use/costs**“ (avg_rate 4,4, dev 0.1) are the most important features of the apartment for current NZEN end-users,
- **for Slovenian NZEB users** the most important are low investment costs, low energy costs, fresh indoor air and good thermal comfort,

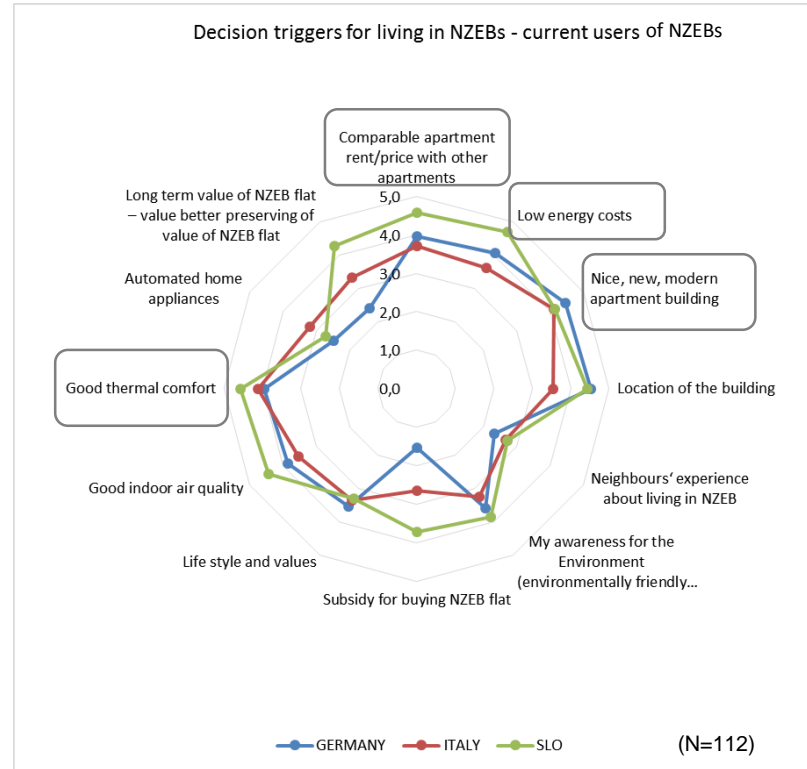
on the other hand
for Danish NZEB users (they have MVHR)
fresh air has a bit lower priority.



Common findings – decision triggers to move into NZEB



- **Why did end-users move into an NZEB?**
- The overall most important triggers: „**nice, new, modern apartment**“ and „**good thermal comfort**“ (avg_rate 4.2)
- followed by „**costs** (rent, energy, maintenance)“ and „**location**“.
- Big deviation per countries in respondents' opinion on decision trigger “better preservation of NZEB flat value in long-term” (0.5).
- In case of owners' used apartments a **value stability of real-estate** is an important trigger for moving into NZEB.



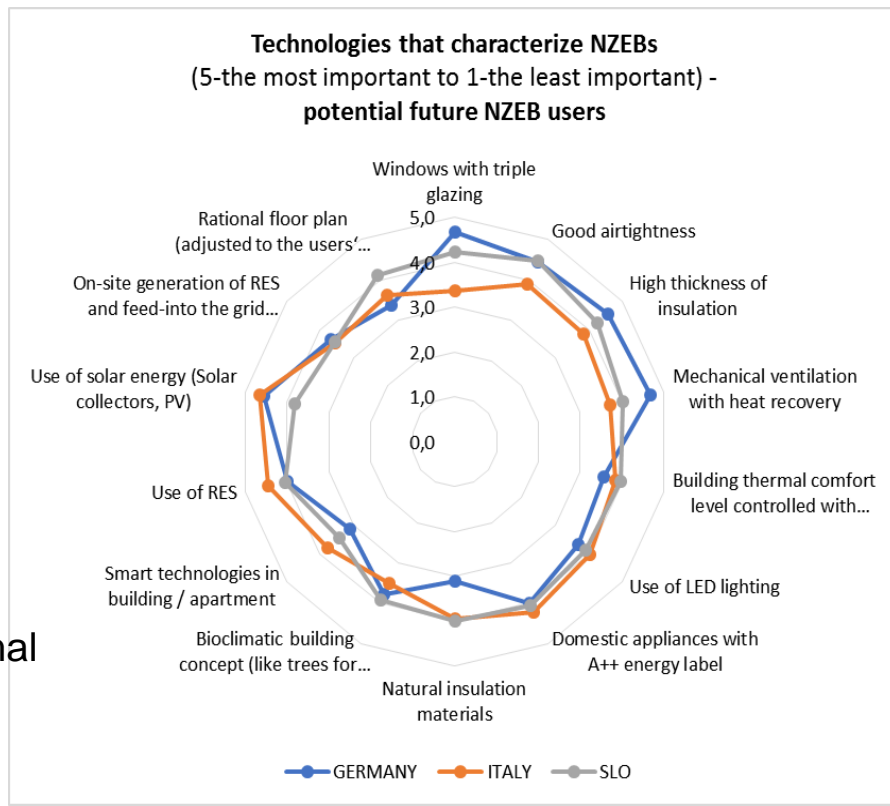
Common findings – NZEB related technologies



- **Perception of technologies that characterize NZEBs – as explained by potential future NZEB users**

- **In Italy** solar collectors, PV panels, use of RES, smart technologies, A++ appliances with LED lighting are of utmost significance if building is to meet NZEB level,

while **in Germany** NZEB is associated mostly with triple glazing, good thermal insulation, envelope airtightness and mechanical ventilation.



Results - Slovenia



- Country specific question - related to **dilemma**: „the more technologies in NZEB – the higher maintenance costs“
- 32% of potential-future NZEB users expect bigger maintenance costs in NZEB,
- while none of current NZEB users experienced bigger costs in NZEB!
- 71% of current NZEB users claim not to have bigger maintenance costs

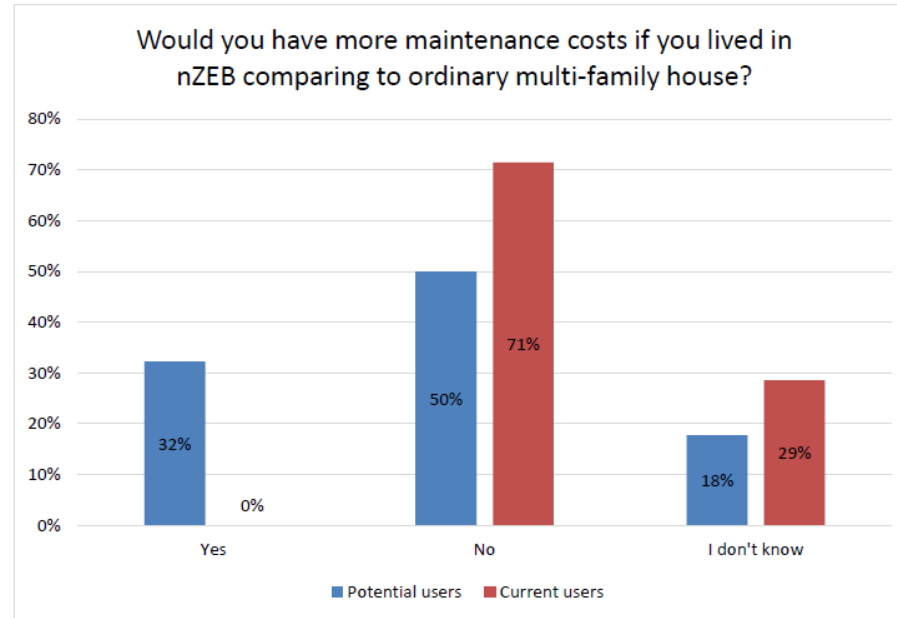


Figure 114: Comparison of the questionnaire for the question "In your opinion, do you have more maintenance costs in NZEBs comparing to ordinary multi-family house buildings?" (Potential NZEB users: N=90, current NZEB users: N=7; Slovenia)

Results - Denmark



- **84% of Danish NZEB residents would choose a NZEB again** if they had to move to another apartment!
- Their **experience with living in NZEBs** (comfort, cost, indoor climate, IAQ) is evaluated as **„good“** (rate 4 on 1-5 scale).

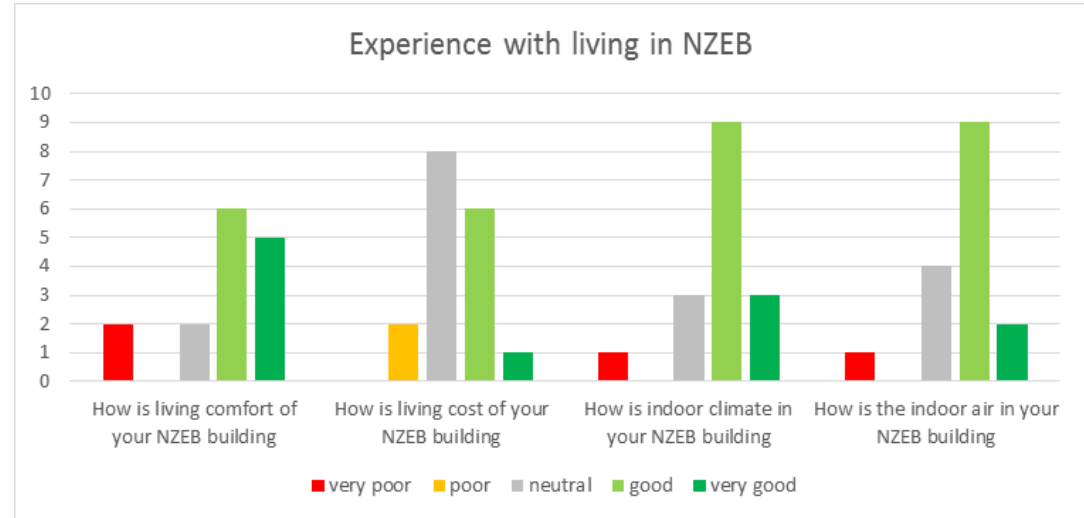


Figure: Knowledge about NZEB solutions among NZEB users in Denmark (N=19)

Results – Italy – the need for technical knowledge



- Respondents living in NZEBs evaluated **technological skills that are necessary to use NZEB buildings.**
- **Most respondents** believe that **technological expertise** for the optimal use of NZEB buildings is **useful, if not necessary.**

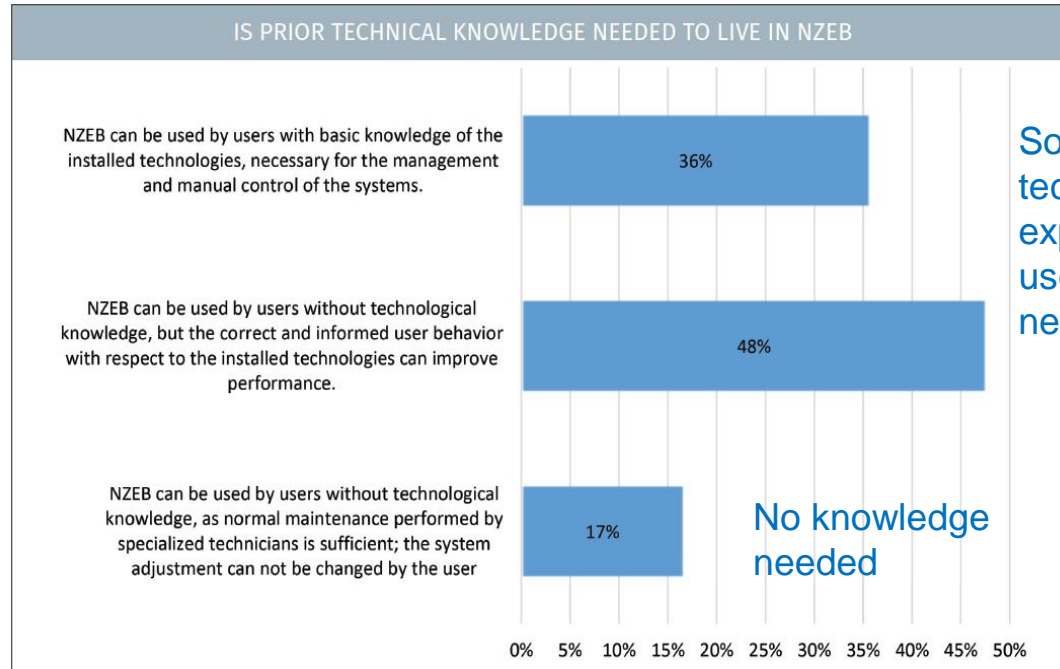


Figure 8: How vital is prior technical knowledge to live in NZEB (Italy)

Summary – concerns and doubts



Survey addressed respondents' **concerns and doubts about living in NZEBs**, which are in general connected to:

- **the indoor air quality** (especially the dry air in connection to ventilation systems with heat recovery during the winter),
- **the longevity** of advanced materials and life-time good performance technical building systems in NZEBs,
- **the user friendliness** of control systems and ICT appliances,
- **the cost benefit** of numerous technologies and **their actual usefulness**.



Man, 47 years old, living in a conventional 70s apartment building:

"I am worried about ageing of advanced materials used in NZEB, how durable the sealants can be?"



Myths about NZEBs

From the end-users opinions about living in NZEBs some typical myths were extracted, like:

- **Myth 1:** “too high building airtightness may cause the lack of fresh air” or
- **Myth 2:** “small windows (to cut energy losses) with low light transmission of advanced glazing systems cause inadequate daylight levels in NZEBs“
-
- In a CONZEBs brochure for tenants and users of owners’ occupied flats in NZEB multi-family buildings **10 myths were explained and dispelled with professional clarification**



NZEBs are too hot in summer

An excessively high level of building airtightness may cause a lack of fresh air

High energy efficient buildings have less daylight

With time, will the airtightness performance of the building be compromised due to a deterioration of materials (like sealants, foils, etc.)

A building needs numerous advanced energy efficiency and RES technologies to meet NZEB requirements

Dry air in NZEBs during winter period

Advanced technologies used in NZEBs may increase the maintenance and operational costs

The PV system is not useful in the event of power outages



Conclusion

Understanding

- **the doubts and fears,**
- **the opinion** of end-users living and planning to live in NZEBs
- **expectations** about dwelling
- **negative and positive** experiences
- **prejudices, myths** about NZEBs
- Information activities for **better acceptance of NZEBs** among (current and future NZEB) tenants and owners.
- The guide „**Why NZEBs are the right choice**“ was developed
- www.conzebs.eu

Why **Nearly Zero Energy Buildings** are the Right Choice

Experiences, expectations, and co-benefits of living in NZEBs

CoNZEBs
Solution sets for the **Cost** reduction of new **Nearly Zero-Energy Buildings**

DISPELLING THE MYTHS about NZEBs



Woman, 60 years, living in a conventional 70-ties apartment building:

"I am worried about these new airtight buildings. Breathing stale air is not what I want."

Too high level of building airtightness may cause the lack of fresh air

There is no such thing as a too high level of building airtightness if a building is designed and constructed in such a way that it enables its users to ventilate it according to actual needs – either naturally or mechanically. This should be one of the essential features of any building, not only of NZEBs. Of course, the user must be adequately acquainted with these elements and aware that a large share of responsibility for comfortable and healthy indoor microclimate lies on him or her. Appropriate airtightness is needed not only to reduce heat losses but also to ensure that systems like mechanical ventilation or air conditioning function with their full efficiency. Technical regulations which prescribe minimum levels of ventilation (air change rate in buildings) – also for NZEB, compliant design and construction, however, are simply not enough if patterns of use are wrong.

A building declared as airtight is not literally fully sealed. No matter how carefully we construct it or how advanced materials and products we use for this purpose there will always be some uncontrolled air exchange between indoors and outdoors. This, of course, is not enough to guarantee fresh air in a room. However, lack of fresh air can occur in any building if we forget about the basic rules of healthy living. The real issue is air quality – excess humidity, odours, VOC, dust particles, even radon. The fact is in a highly airtight NZEB, air quality can be several times better than in a standard building, if the first one is ventilated properly and the second one not. All it takes is remembering that windows have handles to open them, and mechanical ventilation systems have switches and programming buttons to operate them.



NATIONAL EXAMPLES of multi-family NZEBs





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Project website with all reports: www.conzebs.eu

Questions and Comments?

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