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Life-Cycle Assessments Of Near Zero Energy Buildings (NZEBs) and Beyond In Comparison With Regular New Buildings

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Abstract

In one of the work packages of a current EU Horizon 2020 project "Cost reduction of new Nearly Zero-Energy Buildings – CoNZEBs" (https://www.conzebs.eu) life-cycle costs (LCC) and life cycle environmental impact analyses (LCA) of several technical solution sets to reach NZEB and beyond NZEB levels for new multifamily buildings in four European countries (Denmark, Germany, Slovenia and Italy) have been carried out. Some the results obtained are quite remarkable as they indicate that a balance point between energy saving measures and renewable energy (solar) supply has been crossed. In other words, the LCC and LCA results show that both for economic and environmental reasons it pays off to reduce insulation levels and introduce PV-systems and/or solar heating systems for near zero energy buildings. This paper attempts to present the full picture of all the results achieved.

Keywords: cost reduction, life-cycle costs, life-cycle environmental assessments, global warming potential, non-renewable primary energy

1. Introduction

EU Horizon 2020 (https://ec.europa.eu/programmes/horizon2020) research project "Solution sets for the Cost reduction of new Nearly Zero-Energy Buildings – CoNZEBs" started in June 2017. CoNZEBs (www.conzebs.eu) identifies and assesses technology solution sets that lead to significant cost reductions of new Nearly Zero-Energy Buildings in Denmark, Germany, Italy and Slovenia. The focus of the project is on multi-family houses. The project started by setting baseline costs for conventional new buildings, currently available NZEBs and buildings that go beyond the NZEB level (Erhorn-Kluttig H, et al. 2017). The second step was to identify NZEB buildings considered typical for the national building tradition. These typical buildings has been designed to meet national requirements for NZEBs. Thirdly, analyses of possible alternative sets of solutions that show the same calculated energy performance, but have lower investment and potentially lower energy cost were carried out and documented (Wittchen et al. 2018). Some typical buildings are selected real buildings, while others are artificial (figure 1).

Figure 1. Illustration of typical multi-family houses used for the CoNZEBs LCA and LCC analyses in Denmark, Germany, Italy and Slovenia.

The project has used the basic characteristics of NZEBs to first identify technologies that can be made more cost-efficient if applied to NZEBs. Secondly, these technologies was combined into cost-efficient solution sets or concepts for NZEBs, which all reduce the construction costs to reach the NZEB level – keeping the same energy performance as the more traditional NZEB choice of technologies. The technology solution sets includes approaches that can reduce costs for installations or generation systems, pre-fabrication and construction acceleration, local low temperature district heating including renewable energy systems (RES) in the form of solar heating and photovoltaic solar systems (PV). Obviously, the solutions sets differ substantially between the four participating countries due to differences in prevailing construction technology and climates.

All solution sets have been assessed by life cycle costs (LCC) analysis and life cycle environmental impact analyses (LCA) providing a longer-term perspective than the construction costs. The results of the LCC and LCA analyses are to be compared to those obtained for conventional buildings built according to current building regulations, conventionally built NZEBs and to multifamily buildings going beyond NZEB.

The Life Cycle Assessment (LCA) will have primary focus on the Global Warming Potential (GWP) - CO_2 equivalent-emissions (kg CO2eq./m²) and the use of non-renewable primary energy (NRPE).

National tools have been used to assess the energy performance of the solution sets, but a Danish tool, ASCOT_LCA (Mørck et al. 2015), has been further developed to handle the input from the other countries for the developed solutions sets. Thereafter this tool is used for the LCC and LCA analyses of the developed solution sets in all four countries.

ASCOT_LCA was first developed in a Danish R&D project and then further developed within the EU (FP7) project “School of the Future” (http://www.school-of-the-future.eu) and the IEA EBC Annex 56 - Cost Effective Energy and Carbon Emissions Optimization in Building Renovation (http://www.iea-annex56.org).

2. Assumptions and prerequisites

The factors used to calculate global warming potential (GWP) and non-renewable primary energy (NR-PE) factors are quite different for the four countries. These factors primarily reflects the present energy supply mix in each country. They can be seen in Table 1, the sources has been excluded here, but can be found in Gutierrez et al. (2019) (available for download from the project website at www.conzebs.eu).

Tab 1: NR-PE factor and GWP values used for the use phase calculation for each country

Country	Energy source	NR-PEF [kWh/kWh]	GWP, CO_2.Equivalent [kg/kWh]
Denmark	District heating	0.46	0.248
	Electricity	0.86	0.649
Germany	District heating	0.7	0.1517
	Natural gas	1.1	0.24
	Electricity	1.8	0.55
Slovenia	District heating	1.0	0.254
	Natural gas	1.1	0.237
	Electricity	2.5	0.602
Italy	Natural gas	1.05	0.200
	Electricity	1.95	0.445

From table 1 it is seen that the NR-PE factor (NR-PEF) for electricity varies between 0.86 (for Denmark) to 2.5 (for Slovenia) – in between lies 1.8 (for Germany) and 1.95 (for Italy). Likewise, the used GWP factor for district heating varies between 0.15 kg/kWh (Germany) and 0.25 kg/kWh (Slovenia).

3. The identified solution set with lower investment costs

The solution sets for NZEB buildings presenting lower investment costs than the typical NZEB in each location have been presented in detail in the report of the CoNZEBs project presenting this first identification (Wittchen et al. 2018). In this report, they are briefly presented in each national/climate chapter. The solutions constituting the selected solution sets are quite different for each location.

For Denmark, they comprise:

- change of insulation material,
- shift to 4-layer windows,
- reduced insulation in the building envelope,
- energy efficient water taps,
- heat recovery from the grey waste water,
- natural ventilation,
- PV- and
- solar heating systems.

The German solution sets are based on alternative heating and ventilation systems compared to the base system condensing gas boiler with solar thermal support and mechanical exhaust ventilation and include:

- decentral direct electric heating and DHW system,
- central air heating system by air-to-air heat pump,
- district heating and
- a combination of exhaust-air water heat pump and gas condensing boiler
- PV- and
- solar heating systems.

Due to the better efficiency and/or lower primary energy factor of the alternative systems, the insulation level of the building envelope could be reduced while still fulfilling the NZEB requirements.

In Slovenia new technologies taken into consideration are:

- air/water heat pump,
- decentralised hygro-sensible ventilation
- PV
- solar heating systems, and
- additional insulation in the building envelope (in contrast to Denmark and Germany).

In Italy – two climates: Rome and Turin – other new technologies are:

- autoclaved concrete brick with increased insulation in the façade
- mono-block 2-layer windows
- PV- and
- solar heating systems.

This is quite a large variation of technologies combined in different solution sets. It appears that Solar heating and PV are among the technologies used in all countries. The other technologies differ significantly and combined with the different GWP and NR-PE factors it becomes quite clear why no attempt has been made to compare results between the countries.

4. Representative GWP and NR-PE results

To illustrate the main results of this work some of the plots from the different national parts have been selected to be presented here in this paper. These are comparison plots for the LCA and LCC results for the typical NZEB, the range obtained for the NZEB solution sets and for beyond NZEB buildings with the minimum energy performance (EP) as basis.

The first selection of plots shows the comparison of the GWP for Denmark and Rome – figure 1 and figure 2. These two plots are representative for all five plots from the national parts. All improved energy performance level buildings show decreased GWP numbers. The ranges are different, as explained above due to both the different factors used and to the different construction traditions and finally to different energy requirements in the countries.

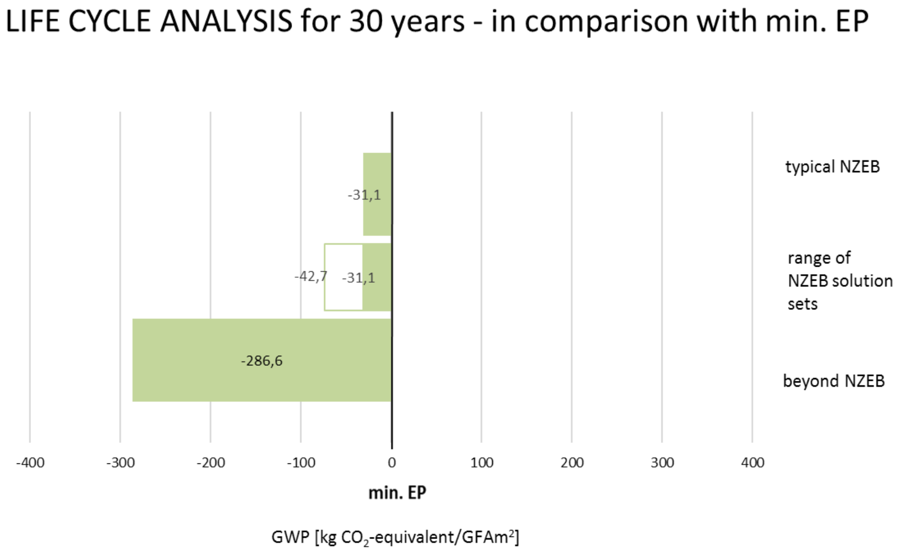

Fig. 1: GWP for the different improved energy performance levels compared to minimum EP – Denmark

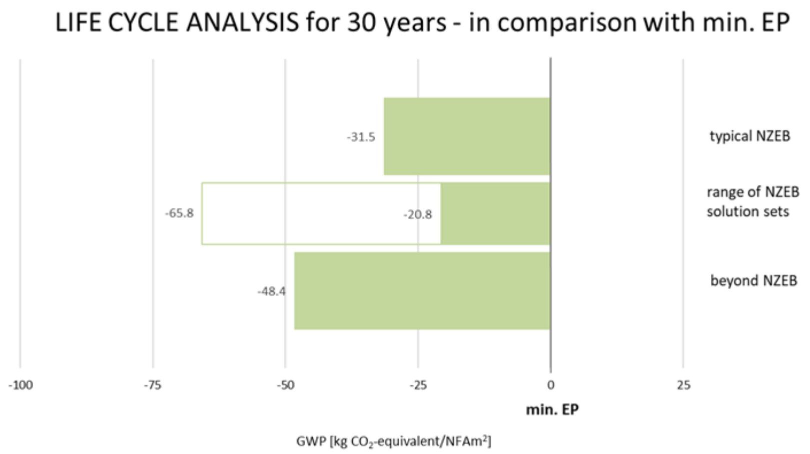

Fig. 2: GWP for the different improved energy performance levels compared to minimum EP – Rome, Italy

Similarly, the next two plots represent the results for non-renewable primary energy (NR-PE) from all the five climates (for Italy, the calculations were made fort two climates: Rome and Turin). Here results have been selected from Germany – figure 3 and Slovenia – figure 4. Again, the plots show that from an environmental point of view all the buildings with improved energy performance exhibit very good results. Same reasons for the differences in the ranges between the countries as mentioned above for the GWP.

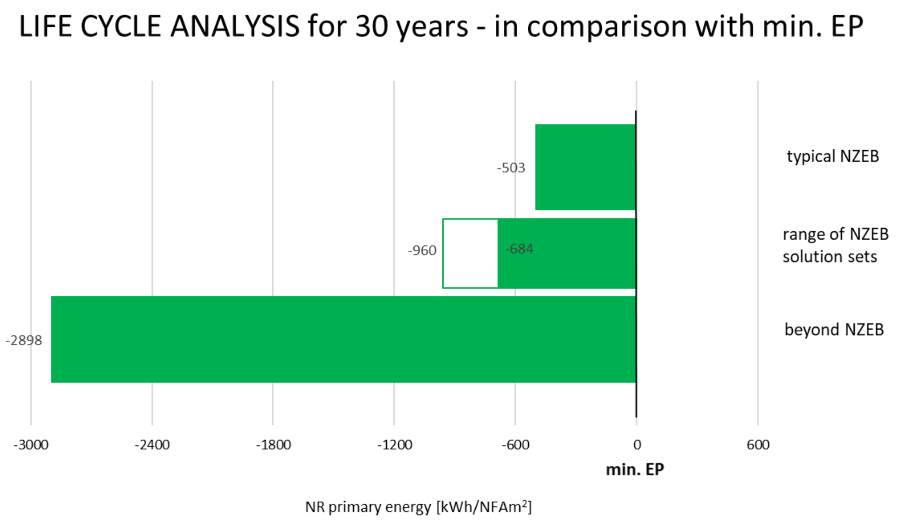

Fig. 3: NR-PE for the different improved energy performance levels compared to minimum EP – Germany

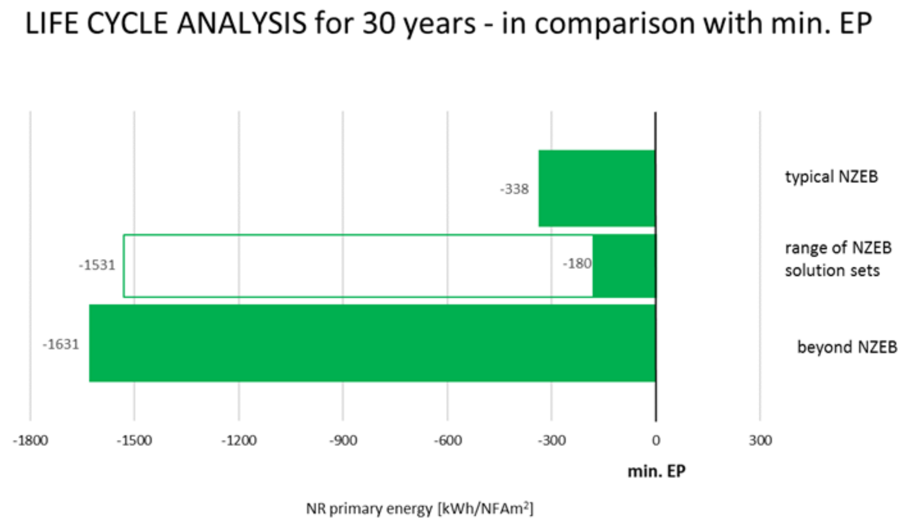

Fig. 4: NR-PE for the different improved energy performance levels compared to minimum EP – Slovenia

It needs to be emphasised at this point that the GWP and NR-EP calculations do take into account the energy use at the production stage of the energy saving and renewable energy producing measures. The plots show that these “investments” are outbalanced by the reduced energy use over the building’s lifetime compared to the minimum EP building levels.

5. GWP and NR-PE results

Looking at the LCC results – expressed in net present value (NPV) - there are larger differences between the five locations. Two countries, Germany (figure 5) and Slovenia, show increased expenses (NPV) for all the improved building levels. As it can be seen on this figure the results for typical NZEB and for the range of the solution sets show that the NZEB level in Germany can be reached at almost the same NPV costs as that of minimum EP buildings. The costs of reaching the beyond NZEB level is however too high to be balanced by the financial value of the energy savings. It should be noted here, though, that for Germany the beyond NZEB level is a plus-energy house including household electricity consumption. For Slovenia, the NPV is significantly above that of the minimum EP for all the improved building types.

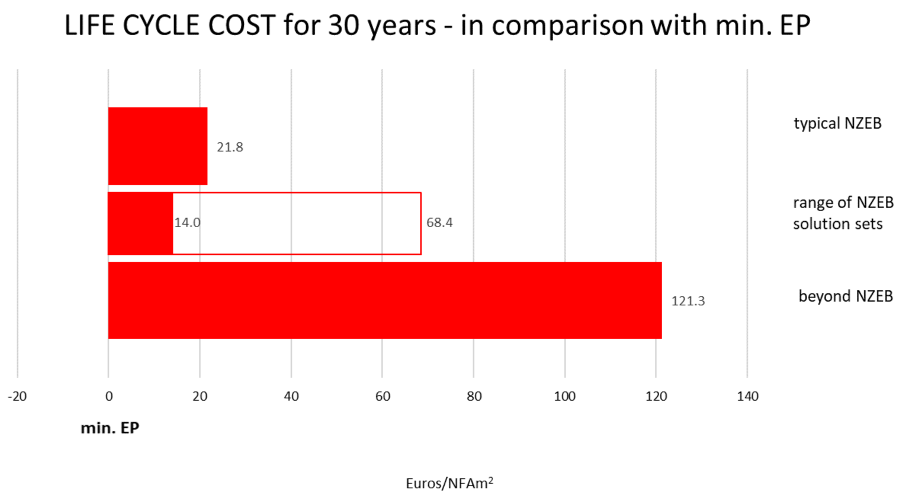

Fig. 5: NPV for the different improved energy performance levels compared to minimum EP – Germany

Denmark represents the picture in between. Here one of the solutions sets and the building built beyond the NZEB level have lower total costs (NPV) than a minimum EP building- see figure 6. However, the typical NZEB and the other solutions sets show higher costs.

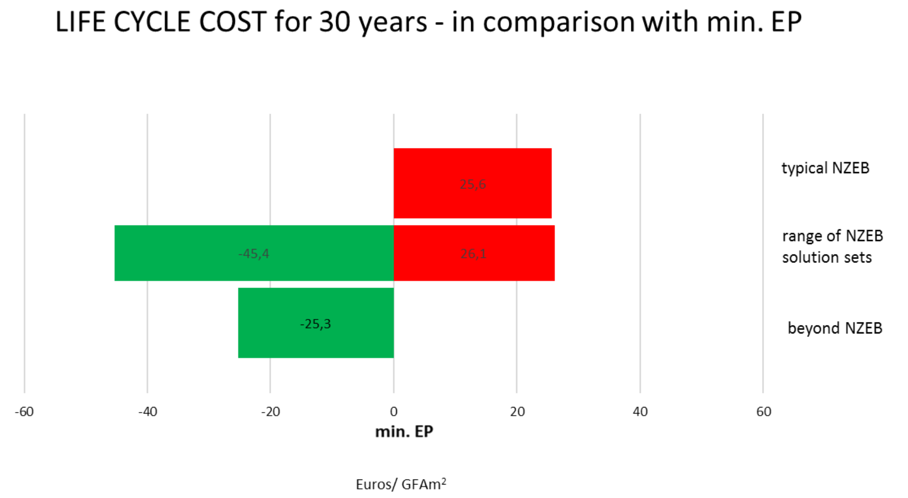

Figure 1: NPV for the different improved energy performance levels compared to minimum EP – Denmark

The two Italian climates show quite different results. In Rome all the solution sets and the beyond NZEB building show reduced total costs (NPV) compared to the minimum EP and the typical NZEB almost the same cost – see figure 7. For the Turin situation, only the solution sets show lower total costs than the minimum EP building. Both the typical NZEB and the beyond NZEB buildings have higher costs – see figure 8.

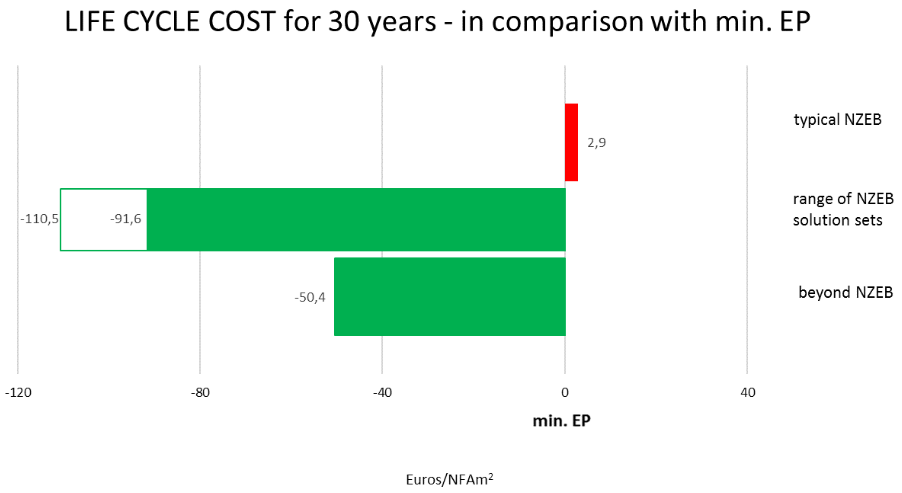

Fig. 7: NPV for the different improved energy performance levels compared to minimum EP – Rome, Italy

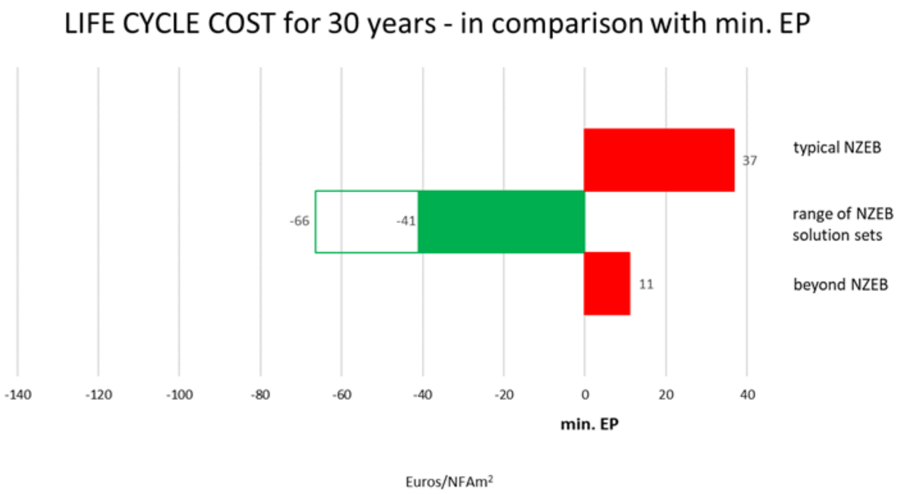

Fig. 8: NPV for the different improved energy performance levels compared to minimum EP – Turin, Italy

To summarise: All improved energy performance levels show clearly improved environmental results compared to the minimum EP building levels in all locations. The picture is more varying when looking at the total costs from the LCC analysis. For Slovenia and Germany, it do not pay off at this moment, whereas in the other three locations some of the solutions also show good financial results.

6. Summary of the results for each climate

Denmark

All solution sets show improved NPV compared to the typical NZEB. However, when comparing them to the minimum EP level only one of the solution sets (SS3 – based on natural ventilation) comes out with a lower NPV. Very interesting is it the buildings designed and built to the beyond NZEB level actually shows better LCC than the minimum EP due to the financial value of the large energy savings of a 0-energy house.

When comparing greenhouse gas emissions in the form of kg CO_2,eq./m² and non-renewable primary energy over the 30 year period of the LCA analyses all solution sets, the typical NZEB and the beyond NZEB houses all show improved environmental results.

The right choice for the future will depend on the local energy infrastructure. If the building is located outside an area with common supply (generally district heating), the best solution may be to design and build beyond the NZEB level, whereas in the situation where a CO_2-neutral supply within relatively few years can be expected a SS3 NZEB would be the right choice, provided special care is taken to assure adequate ventilation rates.

Germany

The detailed calculations for the German situation have shown that there are energy concepts (solution sets) for nearly zero-energy multi-family houses existing that result in lower investment costs, not only in comparison with the typical NZEB configuration but even with the typical building fulfilling the minimum energy performance requirement level. Most of them go in the direction of using electricity for heating, either as direct electrical heating or via heat pumps. Savings are partly based on less cost for distribution and emission (radiators). Alternatively, the change to district heating with a low primary energy factor (here based on CHP) as heat source can be an efficient choice with the focus on investment costs. Both ways the technical building system is more efficient than the standard system used for the minimum EP level and the typical NZEB, the condensing gas boiler with solar thermal support. Therefore, a reduced insulation level at the building envelope leads to further investment cost savings.

Unfortunately no alternative NZEB solution set was able to generate a lower (mind: macro-economic) net present value than the minimum EP level, even though three solution sets only result in a slightly higher net present value of about 20 €/m² (net floor area) or lower in a period of 30 years. This means additional costs of 0.055 €/m² per month or 3.67 €/month per average apartment. These rather low additional costs should be accepted when building a new multi-family house, even more when carbon taxes might be introduced soon in the EU member states. The impact of evolving factors like changing primary energy factors, technology efficiencies, technology costs and possible carbon taxes are studied in another task of the CoNZEBs project and will be documented in another project report.

Slovenia

From the analysis and calculations for Slovenian NZEB, it can be seen that there are different options, described in the solution sets that enable lower investment costs in comparison with the typical NZEB, since all solution sets have lower investment costs. Namely, the typical NZEB has a large area of solar collector implemented, which improves the share of RES, but also significantly increases investment costs. This lead to the idea to use heat pumps, mechanical ventilation with heat recovery and photovoltaics in order to reduce the investment costs and at the same time the greenhouse gas emissions and non-renewable primary energy. Unfortunately, none of the solution sets was cheaper in the 30-years lifetime than the building fulfilling the minimum energy performance requirement level, due to implementation of the technologies with higher energy performance, but also higher investment costs in all solution sets. Besides the investment costs, also the net present value for 30 years of all solution sets is lower in comparison with the typical NZEB.

Looking at the greenhouse gas emissions in the form of kg CO_2eq./m² and non-renewable primary energy over the 30 year period of the LCA analyses, all solution sets, the typical NZEB and the beyond NZEB houses all show improved environmental results in comparison with the minimum EP building. The results of calculations are promising, since the NZEB can be environmentally friendly and at the same time exhibit lower costs over the lifetime than the minimum EP building. Taking in consideration the global warming potential and possible carbon taxes, additional investment costs should be neglected. However, when designing a building and its building services, it is important to consider the building's location and reach the NZEB level with the energy carriers available nearby in appropriate combination of technologies for renewable energy sources.

In Slovenia, alternative solution sets for NZEBs tending to achieve lower investment and life-cycle costs comparing to typical NZEB are related to district heating. Either as a combined space heating and DHW system and air-to-water heat pump for either both, space heating and DHW, or for DHW only. In the latter case in combination with a condensing boiler for heating; combined also with roof PV panels. All solution sets are balanced by reduced or increased insulation levels at the building envelope and windows (2 or 3 layers of glazing) and variations of ventilation systems with different heat recovery rates to meet NZEB or a NZEB-alike threshold.

LCC for alternative NZEB solution sets demonstrated lower costs over 30 years lifetime when comparing to typical NZEB. LCA analysis showed lower GWP in comparison with minimum EP and typical NZEB - for most of alternatives.

Beyond NZEB (with eco-insulation, heat pump, PV panels, and mechanical ventilation with heat recovery) has still higher investment but lower LCC costs and lower GWP than all other NZEB solutions.

Italy – Rome

The Italian calculations in Rome have shown that all the proposed solutions are more environmental friendly and more profitable than the typical NZEB and the minimum EP building. All the solutions are characterized by the same transmittance values as the typical NZEB, but different envelope technologies are chosen to lower the investment costs. From the technical point of view, some solutions go in the direction of using electricity as main driver for heating and DHW supply, either via heat pumps or electric radiators; others, oppositely, use a condensing gas boiler, supplying both heating and DHW. Furthermore, savings are based on lower costs for heating distribution (radiators instead of floor heating).

More in detail, LCA results show that the best performing solution in a long term perspective of 30 years is SS2 with a reduction of non-renewable primary energy up to 335 kWh/m^2 and a reduction of greenhouse gas emissions up to 2 kg CO_2-eq./m^2 compared to a typical NZEB. This is an electricity driven solution where an air-water heat pump is used for both heating and DHW production.

LCC results show that the most profitable solution is SS4, both in terms of investment costs (up to 93 €/m^2 less than the typical NZEB) and net present value over 30 years (up to 113 €/m^2 less than the typical NZEB). In this scenario a condensing gas boiler is used for both heating and DHW services, coupled with aluminium radiators. These savings are even more considerable if compared to the minimum EP building.

Additionally, it has to be noted that the beyond NZEB solution achieved the best environmental results compared to the minimum EP level for non-renewable primary energy (468.6 kWh/m^2) within the 30 years period. These results were predictable, since the beyond, NZEB solution is characterized by the highest energy performance, the lowest envelope transmittance values and the highest number of renewable sources installed. Finally yet importantly, the beyond NZEB is also more profitable than the minimum EP due to the large energy cost reduction over 30 years. Savings in operative costs do indeed compensate for the higher investment costs.

Italy – Turin

The Italian calculations in Turin have shown that all the solutions designed as alternative to the typical NZEB building are more environmental friendly and more profitable than the typical NZEB and the minimum EP building. Some solutions have the same transmittance values as the typical NZEB but are characterized by different envelope technologies. Some other have a super NZEB envelope where transmittances of the walls, roof and ground floor are lower than the values required in the Italian NZEB Standards. As in Rome, from the technical point of view, some of them go in the direction of using electricity as main driver for heating and DHW supply, either via heat pumps or electric radiators; while others use the condensing gas boiler, supplying both heating and DHW. Additionally, the mechanical ventilation with or without heat recovery were alternatively used: the first one is more expensive in the construction phase but allows high savings in the heating costs during the operation phase of the building. Furthermore, radiators are installed instead of floor heating in all the solution sets.

More in detail, LCA results show that the best performing solution in a long-term perspective of 30 years is SS1 with a reduction of non-renewable primary energy up to 302 kWh/m^2 and a reduction of greenhouse gas emissions up to 33.3 kg CO_2-eq./m^2 compared to a typical NZEB. In SS1 the condensing gas boiler is used as main source, supported by solar thermal collectors, providing both heating and DHW. Differently from Rome, where the electricity driven solution showed the best results, a thermal driven solution achieved the highest score in Turin.

LCC results show instead that the most profitable solution is SS2, with a reduction in the NPV up to 103 €/m^2 compared to the typical NZEB. This solution is similar to SS1 apart from the envelope, which is super NZEB and the use of mechanical extract ventilation instead of mechanical ventilation with heat recovery. Regarding the investment costs, all solutions are in the same range with a maximum difference of 15%.

As in Rome, the beyond NZEB configuration showed very good environmental results compared to the minimum EP, namely -98 kg CO_2–eq./m^2 and -663 kWh/m^2 of non-renewable primary energy. Regarding the costs, in Turin both the typical NZEB and the beyond NZEB are more expensive than the minimum EP. Nevertheless, thanks to savings in the energy costs during the operating phase, the beyond NZEB is more profitable than the typical NZEB.

As a conclusion, both in Rome and Turin, the proposed alternative scenarios and the beyond NZEB are more environmental friendly and cheaper on a long term than the typical NZEB. These results pave the way for a wider development of high-efficient buildings in the Italian market; allowing to reach optimal environmental and economic results if optimized design strategies are applied.

7. Conclusions

The overall results of the many analyses carried out in this work indicate that a balance point between energy saving measures and renewable energy (solar) supply has been crossed. In other words, the LCC and LCA results show that both for economic and environmental reasons in most countries and climates it pays off to reduce insulation levels and introduce PV-systems and/or solar heating systems for near zero energy buildings.

Reductions of GWP and NR-PE are difficult to comprehend; here we try to illustrate the importance by comparing to:

- the GWP and NR-PE due to the embedded energy in constructing new NZEB buildings in Denmark,
- the emissions from different transportations means and
- the CO_2-reductions from planting trees.

Two of the new low energy buildings (also used in the first work phases of the CoNZEBs project to establish the references) have been analysed in Denmark as part of a Sustainable Certification according to the Danish DGNB-DK certification scheme (www.dk-gbc.dk/english/). From this, the total GWP emissions and the NR-PE from the construction phase were identified. To serve as a reference here the average for these have been calculated. For the construction itself the GWP was 262.5 kg CO_2eq./m² and the NR-PE: 1,350 kWh/m² (calculated over a 30 year period). As the GWP- and NR-PE factors of the different countries are so varied it is meaningful only to compare the results of the Danish LCA analysis with these numbers. Here we see that the GWP reductions are between 50 and 300 kg CO_2eq./m² and the NR-PE reductions between 50 and 350 kWh/m². In other words the GWP reductions of the beyond NZEB building compared to the minimum EP in Denmark are of the same size as that from the embedded energy in the construction (incl. the technical building systems). This corresponds very well with the general understanding in Denmark today that the energy used for new construction is at the same level as the energy used over a 30-year period. The reduced NR-PE is about one fourth of the used NR-PE under construction of new buildings.

The next comparison is to the GWP of different transportation means. Figure 9 shows the GWP for 1000 person-km using different transportation means.

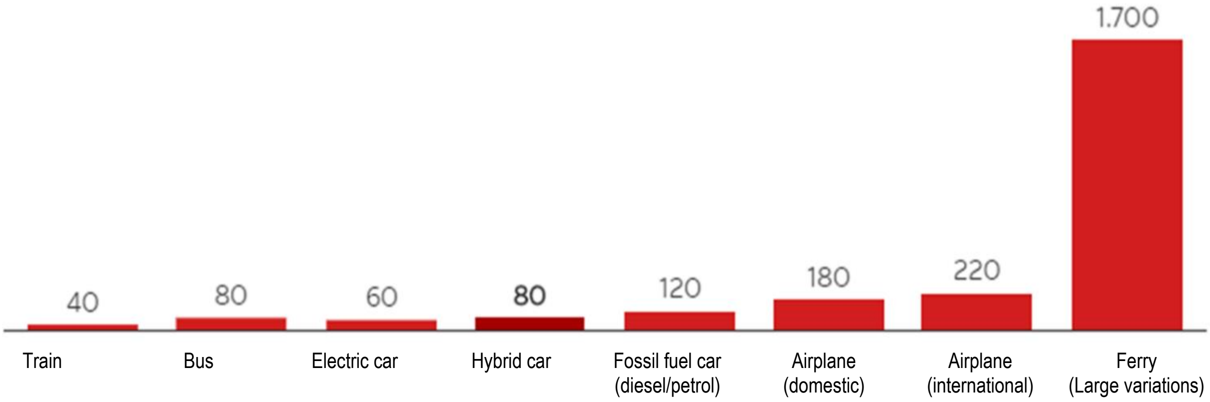

Fig. 9: GWP (kg CO_2eq./1000 person-km) for different transportation means

From figure 9 it can be seen that 1000 person-km in a traditional fossil fuel-car results in the emission of 120 kg CO_2 eq. The annual GWP reductions from the Danish beyond NZEB example thus corresponds to 6369 person-km in a fossil fuel car.

The third comparison is to the growing of trees. 1,000 m² forest results in GWP reductions of approx. 1,000 kg CO_2eq./year or 1 m² ~ 1 kg CO_2eq./year. So, the 286.6 kg CO_2eq./m² reductions of the Danish beyond NZEB houses over

30 years could also have been obtained by increasing the forest area by 286.65/30 = 9.55 m² * 80 (size of the apartment, m²) =764 m² of forest for 30 years..

Looking at the LCC results, they show – as mentioned above – large variations. From 30 year NPV savings of about 100 €/m² no additional costs. Annually, this is around 240 € for an 80 m² apartment (20 €/month) – still a considerable amount. But in some cases the additional cost (NPV) is rather limited and in light of potential new carbon taxes being be introduced soon in the EU member states, these low additional costs should be accepted when building new multi-family houses.

The impact of evolving factors like changing primary energy factors, technology efficiencies, technology costs and possible carbon taxes are studied in another task of the CONZEBs project and will be documented in another project report.

8. Acknowledgements

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9. References

Erhorn-Kluttig H, Erhorn H, Utesch B, Wittchen KB, Thomsen KE, Mørck O, Baslev-Olsen O, Jungshoved M, Zinzi M, Mattoni B, Šijanec-Zavrl M, Varšek D. 2017. Overview of Cost Baselines for three Building Levels. Located at: www.conzebs.eu.

Gutierrez MSM, Mørck O, Thomsen KE, Wittchen KB, Illner M, Erhorn-Kluttig H, Erhorn H, Mattoni B, Zinzi M, Jaćimović M, Šijanec-Zavrl M. 2019. Life cycle assessment of typical multi-family with different energy performance levels. Located at: www.conzebs.eu.

Mørck O, Romeo R. & Zinzi M. 2015. On the implementation of an innovative energy/financial optimization tool and its application for technology screening within the EU-project School of the Future. 6th International Building Physics Conference, IBPC 2015.

Wittchen KB, Thomsen KE, Mørck O, Gutierrez MSM Balslev-Olesen O, Illner M, Erhorn-Kluttig H, Erhorn H, Zinzi M, Mattoni B, Šijanec-Zavrl M, Jačimović M, Gjerkeš H. 2018. Solution sets and technologies for NZEBs. Located at: www.conzebs.eu.