Fraunhofer
IBP

Summary of IBP-Report 025/2020/951

EU Project CoNZEBs -

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

The research report was funded by EU Horizon 2020 and by the research initiative „Zukunft Bau“ of the German Federal Institute for Research on Building, Urban Affairs and Spatial Developments. File reference SWD-10.08.18.7-17.33.

Heike Erhorn-Kluttig
Hans Erhorn
Micha Illner
Johannes Schrade
Linda Lyslow
Astrid Ecker-Brinkmann
Konstantinos Koutsomarkos

Fraunhofer
IBP

Fraunhofer-Institut für Bauphysik IBP

Forschung, Entwicklung,
Demonstration und Beratung auf
den Gebieten der Bauphysik

Zulassung neuer Baustoffe,
Bauteile und Bauarten

Bauaufsichtlich anerkannte Stelle für
Prüfung, Überwachung und Zertifizierung

Institutsleitung

Prof. Dr. Philip Leistner
Prof. Dr. Klaus Peter Sedlbauer

Summary of IBP-Report 025/2020/951

EU Project CoNZEBs -

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

The research report was funded by EU Horizon 2020 and by the research initiative „Zukunft Bau“ of the German Federal Institute for Research on Building, Urban Affairs and Spatial Developments. File reference SWD-10.08.18.7-17.33.

The responsibility for the content lies with the authors.

Authors:
Heike Erhorn-Kluttig
Hans Erhorn
Micha Illner
Johannes Schrade
Linda Lyslow
Astrid Ecker-Brinkmann
Konstantinos Koutsomarkos

Stuttgart, November 25,2020

Institute leader
Philip Leistner
Digital unterschrieben von Philip Leistner Datum: 2020.12.07 13:10:32 +01'00'
Prof. Dr.
Philip Leistner

Department leader
Harald Will
Digital unterschrieben von Harald Will Datum: 2020.12.07 12:23:27 +01'00'
Dr. rer. nat.
Harald Will

Person in charge
Heike Erhorn-Kluttig
Digital unterschrieben von Heike Erhorn-Kluttig Datum: 2020.12.04 18:16:43 +01'00'
Dipl.-Ing.
Heike Erhorn-Kluttig

Fraunhofer-Institut für Bauphysik IBP
Nobelstraße 12 | 70569 Stuttgart
Telefon +49 711 970-00
Telefax +49 711 970-3395
www.ibp.fraunhofer.de

Standort Holzkirchen
Fraunhoferstr. 10 | 83626 Valley
Telefon +49 8024 643-0
Telefax +49 8024 643-366

Content

1 Title

Long version of the project title:

„Solution sets for Cost reduction of new Nearly Zero-Energy Buildings".

2 Motive/initial position

With the EPBD recast of 2010, the EU Commission has defined the energy performance level of new buildings from 2021 onwards to be the nearly zero-energy building (NZEB) level. Pilot projects resulted in not negligible additional costs. E.g. Concerted Action EPBD assessed the average investment cost gap compared to national minimum requirements to be 11 % of the total building costs or 200 €/m² based on a collection of 32 international case studies.

3 Subject of the research project

A project group from four participating countries has analysed how the additional investment costs of NZEBs compared to buildings fulfilling the minimum energy performance requirements of 2017 can be reduced. In the case of Germany the energy performance requirements of the NZEB have not been defined by the time of the project start. Therefore, the German project team has determined the KfW-Efficiency House 55 standard as the "NZEB" level for the studies in the project. The focus was on new built multi-family houses. The following analyses have been performed:

1. Determination of the benchmark: Multiple new-built multi-family houses have been studied regarding their investment costs. The gross investment cost difference (cost groups building components and technical building systems) between the minimum energy performance level and the KfW-Efficiency House 55-level was in average 45 €/m² net floor area.

2. Possible cost savings in the planning and construction processes: Concerning processes, prefabrication and serial construction as well as the use of BIM have been identified as possible cost saving impacts. The gathered measures include large autoclaved concrete blocks, monoblock windows and unheated staircases.

3. Questionnaire for the residents and NZEB brochure: The evaluation of a questionnaire showed that the most important reasons for choosing an apartment are the location, the overall impression, good thermal comfort, high air quality and low energy costs. A 20-page brochure presents the definition of NZEBs, the gathered experiences and expectations of residents and exemplary buildings and gives facts as answers to some existing prejudices against high energy performing buildings.

4. Cost savings because of alternative energy concepts: For this calculated study typical geometries for multi-family houses per country have been de-

termined and the normally used building technologies for meeting the NZEB-level have been applied with correspondent U-values at the building envelope. As typical building technology for the KfW-Efficiency House 55 in Germany a gas condensing boiler in combination with a solar thermal unit and a centralised mechanical exhaust ventilation system has been chosen. The resulting thermal quality of the building envelope is a mean U-value of 0.22 W/m²K. Then different alternative energy concepts have been assessed with the aim of achieving lower investment costs while meeting the same energy performance level. For Germany the following four financially interesting alternative energy concepts have been identified:

1. Direct electrical heating and decentralised electrical DHW generation in combination with decentralised mechanical ventilation with heat recovery and moderate building envelope insulation level.

2. Air heating based on centralised balanced mechanical ventilation in combination with an air-to-air heat pump, decentralised electrical DHW generation, photovoltaics and moderate building envelope insulation level.

3. District heating (based on CHP with fossil fuel) for the heating and DHW, centralised mechanical exhaust ventilation system and moderate building envelope insulation level.

4. Hybrid heating system consisting of an exhaust air-to-water heat pump supported by a gas condensing boiler, DHW heat exchange modules, photovoltaics and moderate building envelope insulation level.

All four energy concepts have in common that the technical building systems are more energy efficient than the typical NZEB solution and therefore allow to lower the thermal building envelope quality. The differences in investment costs are between -44 and -84 €/m^2_{NFA}. However, all alternative energy concepts result in higher energy costs.

5. Life-cycle costs and life-cycle assessment: None of the German NZEB energy concepts resulted in lower life-cycle costs than the energy concept fulfilling the minimum energy performance level. However three alternative solution sets lead to only slightly higher net present values over 30 years with a delta of 20 €/m_{NFA} as maximum. The life-cycle assessment included results concerning greenhouse gas emissions and non-renewable primary energy. Positive values scored the typical NZEB (KfW-Efficiency House 55), the alternative NZEB energy concepts and even more the Efficiency House Plus.

6. Prospects for the future: The foreseeable changes at the impact factors (primary energy factors, energy tariffs, technology costs and efficiency) until 2030 have been evaluated. The calculations for the combination of all changes showed that the direct electrical NZEB energy concept and the hy-

brid heating NZEB energy concept benefit from the foreseeable changes and become economically even more interesting. Also the Efficiency House Plus concept will get economically more interesting.

4 Conclusion

The analyses of the CoNZEBs projects for the German situation have shown that the investment cost difference determined from realised multi-family houses on the two levels of minimum energy performance requirements and NZEBs (KfW-Efficiency House 55) of 45 €/m^2_{NFA} (gross costs) can not only be counterbalanced by an intelligent energy concept, but the project has shown that NZEBs can be even constructed with lower investments costs than standard new buildings. The identified alternative energy concepts have in common that they are more energy efficient on the side of the technical building systems and therefore allow for savings at the thermal quality of the building envelope.

5 Basic Information

Short title:	CoNZEBs
Project management:	Dipl.-Ing. Heike Erhorn-Kluttig (Fraunhofer IBP)
Total cost:	1,561,651.00 €
Proportion of federal subsidy:	245,612.50 €
Project timeline:	30 months

6 Figures

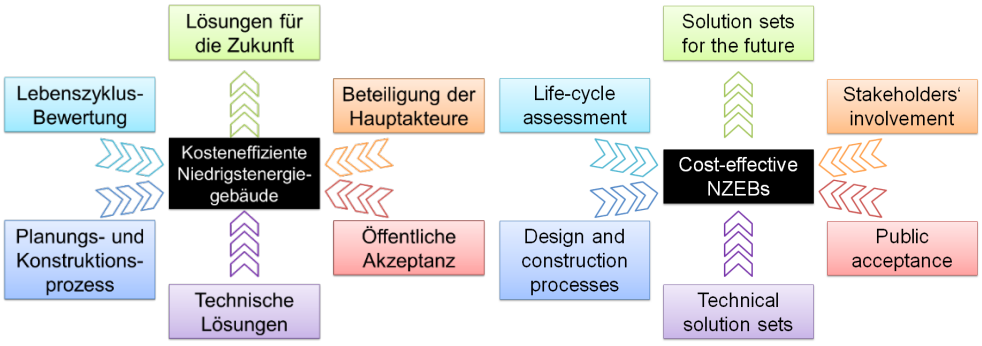

Figure 1: Bild_1_Ansätze_CoNZEBs.png / Fig_1_Approaches_CoNZEBs
Different approaches to towards cost-efficient nearly zero-energy buildings within the EU project CoNZEBs. © CoNZEBs.

Figure 2: Bild_2_Broschüre_CoNZEBs.jpg
Front page of the German brochure „Why nearly zero-energy buildings are the right choice". © CoNZEBs.

Figure 3: Bild_3_Projektwebseite.jpg
Screenshot of the project website www.conzebs.eu at the project end.
© CoNZEBs.

Figure 4: Bild_4_Klimaschutzhaus.jpg
The „Frankfurter Klimaschutzhaus“ of ABG Frankfurt is presented as German case study for cost-saving NZEBs within the CoNZEBs brochure. © Jochen Müller.

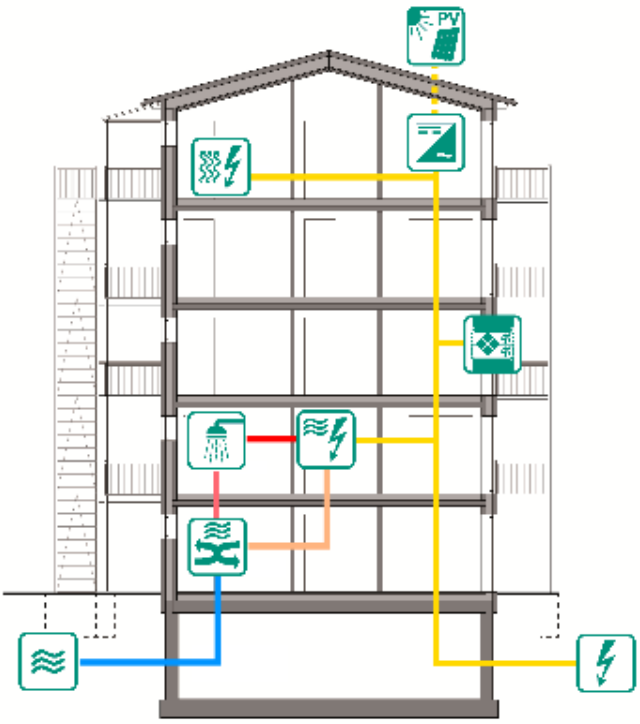

Figure 5: Bild_5_Solution_Set_1.png
Scheme of the technical building system of one of the alternative NZEB energy concepts. © Fraunhofer IBP.