Passive Cooling Approaches in Net-Zero Energy Solar Buildings: Lessons Learned from Demonstration Buildings

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Abstract

Zero Energy performance buildings have gained more attention since the publication in 2010 of the recast of the EPBD [1]. Meanwhile the USA promotes “marketable zero energy homes in 2020 and commercial zero energy buildings in 2025” [2]. Japan proposes “carbon neutralized buildings”, including existing buildings, by 2050 [3]. The UK government aspires to achieve a zero carbon standard by 2016 [4]. With countries well on the way to putting this new standard into effect, worldwide around three hundred buildings are already claiming Zero Energy or similar performance [5]. Successful implementation of such an ambitious target depends on a great variety of factors. For designers and code writers these include: balancing climate driven-demand for space cooling with climate-driven supply for renewable energy resources and/or matching building design to shade from the sun in summer while providing for good daylight. With a literature full of theoretical advice and a building industry rife with myths about the value of technologies, the study of these existing buildings may be decisive in establishing the best strategies for achieving true Net Zero energy performance. The authors of this paper, who are active participants in the IEA Task 40/Annex 52 (“Towards Net Zero Energy Solar Buildings”) [6] intend to present and discuss the strategies used for cooling a number of selected buildings identified in the project database as zero-energy balance, with the aim of defining solution sets and indicators of relative performance. The buildings, which incorporate solutions for passive cooling, have been divided into three functional component sets: overheating prevention, heat rejection, and modulation and control. The IEA NZEB buildings demonstrate a range of passive solutions for both residential and non-residential situations to show that it is possible to reduce cooling loads through passive design. This has contributed to reduction of the size of the active systems with the aim to cover the residual energy demand through Renewable Energy Systems, getting the overall building energy balance to zero. This paper will review the insights that this classification process has revealed.

References

[1] The Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, Official Journal of the European Union, 53 (2010)

[2] DOE, Building Technologies Program (2008); http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/myp08complete.pdf

[3] N. YOKOO, Transition of Technology and Belief for Green Buildings in Japan, International Conference on Sustainable Integrated Design Process for Building and Construction, Hong Kong 2009

[4] Department for Communities and Local Government, Sustainable New Homes – The Road to Zero Carbon: Consultation on the Code for Sustainable Homes and the Energy Efficiency standard for Zero Carbon Homes, London: Department for Communities and Local, 2009

[5] E. Musall, T. Weiss, A. Lenoir, K. Voss, F. Garde, M. Donn, Net Zero energy solar buildings: an overview and analysis on worldwide building projects, EuroSun conference 2010, Graz, Austria, 2010.

[6]The IEA SHC Task 40 / ECBCS Annex 52 'Towards Net Zero Energy Solar Buildings (NZEBs); http://www.iea-shc.org/task40/index.html

Net Zero-Energy Buildings Performance has gained more attention since the publication in 2010 of the EPBD recast [3]. Successful implementation of such an ambitious target depends on a great variety of factors.Â Solar XXI building energy performance is about ten times the energy performance of a standard new office building in Portugal [5]. Looking at the energy balance of the building from a NZEB perspective, it was shown that the wise combination of standard and innovative energy performance measures with renewable systems is able to achieve the zero-energy performance without significant efforts.Â The Road Towards â€œZero Energyâ€ in Buildings: Lessons Learned from SOLARXXI Building in Portugal, Proceedings of EuroSun 2010, Gratz, Austria. Passive solar design takes advantage of a buildingâ€™s site, climate, and materials to minimize energy use. A well-designed passive solar home first reduces heating and cooling loads through energy-efficiency strategies and then meets those reduced loads in whole or part with solar energy. Because of the small heating loads of modern homes it is very important to avoid oversizing south-facing glass and ensure that south-facing glass is properly shaded to prevent overheating and increased cooling loads in the spring and fall. Energy Efficiency First. Before you add solar features to your new home design or existing house, remember that energy efficiency is the most cost-effective strategy for reducing heating and cooling bills. Integrated smart solar building concept and grid integration â€“ need for energy flexibility. Smart Net-Zero Energy Buildings (NZEBs). Solar Optimization and Integration. Optimization of buildings for solar collection.Â Some Research Questions, Barriers, Lessons Learned. Towards smart resilient solar buildings & communities: Challenges. 1. Modelling, Design and Operation of Net-zero Energy Buildings and Lessons Learned. Andreas ATHIENITIS, FCAE, FASHRAE, FIBPSA. NSERC/Hydro Quebec Industrial Chair and Concordia Research Chair Director, Concordia Centre for Zero Energy Building Studies. Professor, Dept. of Building, Civil and Environmental Engineering Concordia University, Montreal, Quebec, Canada www.solarbuildings.ca. Passive Cooling Approaches in Net-Zero Energy Solar Buildings: Lessons Learned from Demonstration Buildings.Â Zero Energy performance buildings have gained more attention since the publication in 2010 of the recast of the EPBD [1]. Meanwhile the USA promotes â€œmarketable zero energy homes in 2020 and commercial zero energy buildings in 2025â€ [2]. Japan proposes â€œcarbon neutralized buildingsâ€, including existing buildings, by 2050 [3]. The UK government aspires to achieve a zero carbon standard by 2016 [4]. With.Â The IEA NZEB buildings demonstrate a range of passive solutions for both residential and non-residential situations to show that it is possible to reduce cooling loads through passive design. â€¢ Passive Cooling Approaches in Net-Zero Energy Solar Buildings: Lessons Learned from Demonstration Buildings more. by Daniel Aelenei. , Michael Donn.Â Synopsis Conceptually, a Net Zero Energy Building (NZEB) is a building with greatly reduced energy needs that are balanced by an equivalent generation of electricity, or other energy carriers, from renewable sources. So far no common agreement exists on a clear and sound definition of NZEB, even though the subject is receiving significant attention in many countries. Journal Name: the Proceedings of EuroSun. Publication Date: 2010. â€¢ Towards net zero energy buildings in hot climates. Part 2: Experimental feedback more. by FranÃ§ois Garde.