EVALUATION TOOL FOR NET ZERO ENERGY BUILDINGS: APPLICATION ON OFFICE BUILDING

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Within the research project "IEA SHC Task 40 – ECBCS Annex 52: Towards Net Zero Energy Solar Buildings" an excel-based tool was developed to assess balance, operating costs and load match index for predefined selected Net ZEB definitions [1]. The tool can be of assistance for different stakeholders, including building designers (evaluation of building design solutions with respect to different Net ZEB definitions), energy managers (assess the balance in monitored buildings) and policy makers (assist in the upcoming implementation process of Net ZEBs within the national normative framework).

Starting from the known general definition of a Zero Energy Building, several definitions can be generated by choosing different options for the main available aspects (e.g., building system boundaries, weighting system, energy balance calculation) and translated into different yearly energy balances as illustrated by Sartori et al. (2012) [2]. The Net ZEB evaluation tool includes four Net ZEB definitions [1] which have been selected by the project participants because they were considered to be the most likely to be applied to both design and monitored building data and to include calculation factors and methodologies already available or close to their finalization [3].

The main worksheet of the workbook is the 'building data' used to collect input data for building monthly/yearly energy demand/supply; subsequently, the desired weighting factors can be specified. Balance calculation can be performed both in static (yearly based) and quasi-static (monthly based) mode by providing static or semi-static weighting factors to convert the final energy into the metrics considered in the selected definitions (primary energy, CO_2 equivalent emissions or a user-defined metric) and calculate the balance [1].

The authors are part of the IEA SHC Task 40 – ECBCS Annex 52 project national experts and are applying the methodology developed to propose a Net ZEB definition at local level (province of Bolzano, Italy). The pilot building of the new Technology Park of Bolzano was selected as demonstrator.

For this application, the target Net ZEB has been fixed by choosing the following definition: '*a building, fulfilling any national and local energy efficiency requirements, which offsets the yearly balance between exported and delivered energy, weighted in terms of primary energy and/or equivalent carbon emissions. Static and symmetric weighting factors are applied to convert the exported/delivered energy carriers in the balance metric (primary energy and/or equivalent carbon emissions). All the energy uses of the building, or the energy uses of the buildings located inside the physical boundaries, are considered as negative balance items (heating, DHW, cooling, indoor lighting, auxiliaries, ventilation and plug loads). As positive balance item, only the on-site generation*

from on- or off-site sources can be considered, as long as the generation systems are architecturally and urban integrated inside the physical boundary, identified as the urban lot.'

In order to achieve the target net zero, the building energy consumption was reduced through passive solutions; additionally, extensive generation from renewable energy sources was planned. The building exchanges electricity (produced on-site from on-site sources), with the grid and is also connected to the gas grid. [4]

As the building is still in the design phase and self-consumption has not be estimated, only building design data about load and generation have been entered in the sheet. The primary energy weighting factors used are those from Italian regulations (UNI TS 11300/4). Spreadsheet outputs are represented in Figure 1 and Figure 2. The Net ZEB limited and the Net ZEB primary balance amount respectively to 64.5 kWh_{pe}/m^2 and 48.8 kWh_{pe}/m^2. The Net ZEB carbon is equal to 17.5 $kgCO_{2eq}/m^2$. The monthly averaged load match index [2] is calculated as well and amounts to 80%.
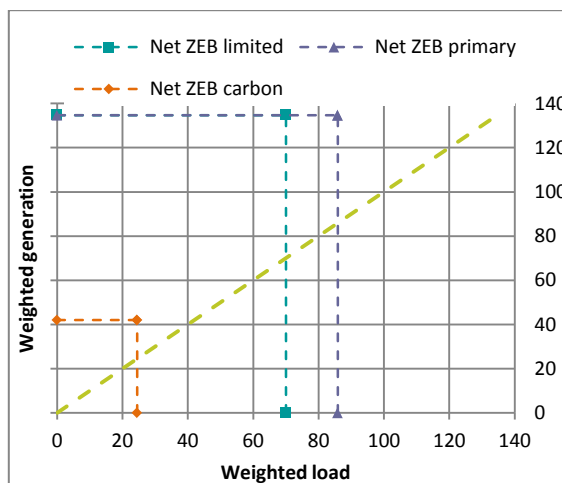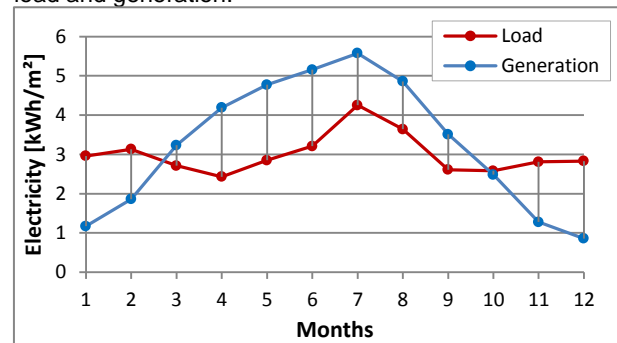

Figure 1. Graph representing balance results for selected Net ZEB definitions.

Figure 2. Graph showing monthly values of electricity load and generation.

References

[1] "IEA SHC - Task 40 - Net ZEB evaluation tool," IEA Solar Heating & Cooling Programme, 28 01 2013. [Online]. Tool and user guide available: http://task40.iea-shc.org/net-zeb.

[2] Sartori I., Napolitano A., Voss K., "Net Zero Energy Buildings: a consistent definition framework.," *Energy and Buildings,* 2012.

[3] Voss K., Sartori I., Lollini R., "Nearly-zero, Net zero and Plus Energy Buildings – How definitions & regulations affect the solutions," REHVA European HVAC Journal, pp. 23 - 27, 06 2012.

[4] "Bolzano," Direction - Demonstration of very low energy buildings, [Online]. Available: http://www.direction-fp7.eu/Case_Studies/Bolzano.kl . [Accessed 30 01 2013].

Acknowledgments