Nearly Zero Energy Community – an affordable and feasible transition concept towards sustainable cities

Ion Visa [a*], Anca Duta [a]

[a] R&D Centre: renewable Energy Systems and Recycling, Transilvania University of Brasov

Abstract: The environmental challanges imposed by the greenhouse gases emissions are currently well recognized. This is why a worldwide committment tends to be reached, on widely replacing the fossile fuels (mainly responsible for the global warming and climatic changes) with renewable based energy systems. Ambitious concepts were formulated, as the *Net Zero Energy Buiding (NZEB)*, although the current building stock mainly consists of about 97% of old buildings. Thus, significant technical and cost-related barriers are faced and transition concepts are formulated, as the *Nearly Zero Energy Buildings (nZEB)*, legally binding for the EU states, starting with 2019/2021, that may ease the transition and can be realistically met, considering the current resources. Following the same pattern this paper proposes the concept of Nearly Zero Energy Coomunities (nZEC), as a transition path towards Net Zero Energy Communities (NZEC), possible to be implemented in various geographical locations, thus answering to rather different prerequisites. As affordability is one important condition to be met, there are discussed diferent scenarios that can be approached, outlining the need for a coherent technical approach, involving large(r) community districts; the public involvement and commitment is necessary along with a clear definition of the short and long-term community gains.

1. Introduction

The role of communities in supporting global heating mittigation is currently well-recognized at conceptual level, however, its implementation is scarce. Most of the examples include models considering the integration of NZEB/nZEB in aggregates, (Lopez et al., 2016) or pilot level applications as the 40 household districts in Ithaca N.Y. or the Kupuni village reported by NREL starting with 2015. The NZEC development is a complex task as there is a broad variety of buildings in the existing building stock, with various energy demands. Obviously, building/community sustainability mostly relies on solar energy convertor systems, alone or part of energy mixes that can be accepted in a village, district or city, as heat pumps, micro-wind turbines, etc. This has however well-known limitations, coming from the variability of the solar energy input (daily, seasonally, etc.) which does not usually match the energy demand and which is even more unpredictable in the built environment due to various factors: atmospheric pollution (particulate matter, gaseous emissions), shadowing, etc. This makes energy storage one of the most challenging issue in the NZEC development, particularly for thermal energy (as grid-connected communities can use the grid as a backup storage system or source). Therefore, changing an existing community currently relying on fossil fuel to a NZEC is highly difficult and with questionable acceptance coming from the inhabitants. More recommended is the gradual change, which starts with common/accepted steps and is extended increasing the solar energy share, by reinvesting the expected profit. This asks for coherent technical planning and management, as already outlined, (Visa and Duta, 2015).

* Corresponding author: Tel +40722929936
E-mail: visaion@unitbv.ro (Ion Visa)

2. Results and Discussions

The concept of *Nearly Zero Energy Communities (nZEC)* is analysed as a transition phase towards *Net Zero Energy Community*. Two scenarios are considered, Fig. 1:
(1) The Transition Scenario A, where renewables implementation is scattered, following the „easy" way, thus avoiding e.g. the city centers (mostly difficult to change as they usually involve historical buildings, narrow spaces, etc.); this scenario limits interconnections and thermal energy storage at district level, thus is more an assembly of nZEB which, although sustainable, is not fully cost-effective.
(2) the Transition Scenario B, where the *nZEC* concepts are involved, through a coherent approach over the entire community, with specific solutions for each neighbourhood. Variable production and consumption is modeled and discussed based on case studies of Romanian communities.
The paper discusses the steps to be followed in reaching the *nZEC* status (thus a community covering at least 50% of its energy demand by using renewables); it is demonstrated that *nZEC* could even represent a more feasible and affordable concept compared to the *nZEB*, and asks for technical solutions and community involvement from the very beginning. It is also outlined that the transition from *nZEC* to *Net Zero Energy Communities* can be more cost-effective and less imposing on the inhabitants if the savings brought by implementing renewables (after the payback time) are invested to increase the sustainability degree.

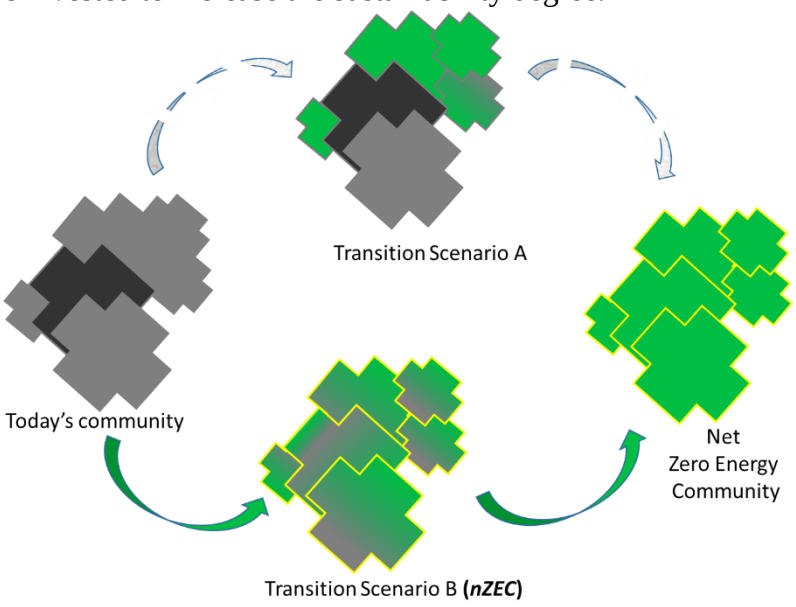

Fig. 1. Transition scenarios from the Today's communities
to the *Net Zero Energy Communities*

3. References

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