Positive Energy Districts - A critical review of definitions and characteristics

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Overview

The concept of Positive Energy Districts, introduced in the Strategic Energy Technology Plan, is a fundamental approach to a successful, clean, and sustainable urbanisation[1]. A Positive Energy District is a set of buildings where the community controls the energy flows and aims at a net positive energy balance over a year by utilising renewable energy sources. However, a plethora of similar concepts, such as Positive Energy Community, Net Zero Energy Neighbourhood, Plus Energy Districts and Renewable Energy Community, create a need to establish a structure that can facilitate the definition, development and precise identification of Positive Energy Districts. Thus, this paper aims to fill this research gap by comparing these and other related concepts based on a thorough critical literature review. Moreover, this paper establishes a chronological order of these concepts' evolution to analyse their development in aims and meanings. This contribution will support the work of researchers and decision-makers in the field of Positive Energy Districts and clarify and structure existing concepts and definitions. The aim is to set the foundation for planning activities such as techno-economic optimisation of the energy and transport systems or urban development on a municipal level.

Methods

This work aims to clarify the topic of Positive Energy Districts (PEDs) by first revising the motivations behind similar concepts and establishing a brief historical timeline. This first part of the study is done through a literature review to trackback the first concepts and their motivations. Secondly, the authors will perform a thorough analysis of the PED concept, highlighting holes in the original definition and the gaps that have already been filled. This study will also identify the connections and similarities with similar concepts to avoid repetition, promote competition and homogenise the use of terms.

The thematic areas identified as essential are spatial resolution, energy balance, environmental aspects, energy efficiency, techno-economic and social aspects. The paper explains the importance of each area based on current available peer-reviewed and grey literature.

Results

The study first establishes the historical timeline regarding the energy efficiency of the building stock. The analysis shows how the initial efforts arose from the oil crisis of the 70s [2], involving mostly passive heating and superinsulation. The focus then moved more towards active management of the energy flow using PV panels, energy storage and smart meters, to mention some. As more integrated and holistic approaches started to become widespread, it became clear that the design phase should include larger areas to involve more end-users and ease matching local production with demand [3]–[5].

Other papers and projects have filled some of the gaps left open by the original definition, from technical solutions to energy efficiency assessment and spatial resolution. The authors identified and presented solutions that other authors have developed thus far. Since its beginning, the +CityxChange has defined geographical and energy boundaries, creating different typologies of Positive Energy Districts (i.e. Plus Autarkic, Dynamic, Virtual and Candidate) [6]. Lindholm et al. identify the role the various typology of PEDs can have to achieve an overall positive balance in an urban scenario[7]. Whereas the Joint Research Committee extrapolates the decision to utilise as an energy form the primary from the Energy Performance of Buildings Directive [8].

Conclusions

With time the urban energy transition has seen a development from passive savings to active management. With time also the geographical scale has changed, moving from a building perspective towards a district level. In this regard, Positive Energy Districts are a natural evolution of all previous concepts. They incorporate efficient buildings, decentralised production, and smart energy management between buildings to achieve a positive energy balance.

The substantial number of similar concepts might confuse those who are just recently approaching the urban energy transition. Due to the number of aspects Positive Energy Districts cover as a concept, municipal urban planners and developers might benefit from clear and established material. Given the diversity of the European climate and cultural composition, a strict definition might be detrimental and hinder the implementation of PEDs. Some aspects still need precise indication. The energy balance needs to be positive, for example, over a year. The energy form accounted for is primary. The end-use of energy must also include municipal services and transport. Some other aspects instead need the construction of a clear framework that local planners can use. The framework might suggest how to quantify and lower energy demand in buildings without imposing strict bounds or select a redevelopment area and not exclude vulnerable groups of people. Hence, bringing all definitions that are now scattered together, with a clear and precise structure, might facilitate the energy transition in urban areas.

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