From smart ground to smart grid:
A method to achieve multi-energy system

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Introduction

During the last two centuries, the urban percentage of the world's population, combined with the overall growth phenomenon, has deeply increased and it is projected to reach 60% by 2030. In this current context linked to environmental issues managing to plan sustainable cities appears a main policy target. The implementation of Net Zero Energy Buildings (**Fig. 1**) as the building target from 2018 onwards represents one of the most important challenges to increase energy savings and minimize greenhouse emissions.

Motivation and Research Question

The aim and motivation of this work is the development of a methodological approach about energy management in a district to the potential of a 'smart ground' towards the development of a 'smart grid' (**Fig. 2**). This work opens and addresses numerous future research perspectives that should be investigated widely to develop districts with an operational, long-term and sustainable context. The paper focuses on districts' 'sustainable transformation' with a long-term and operational context. The study introduces the 'smart ground' as the territorial unit that fulfills the criteria of feasibility to be a NZED.

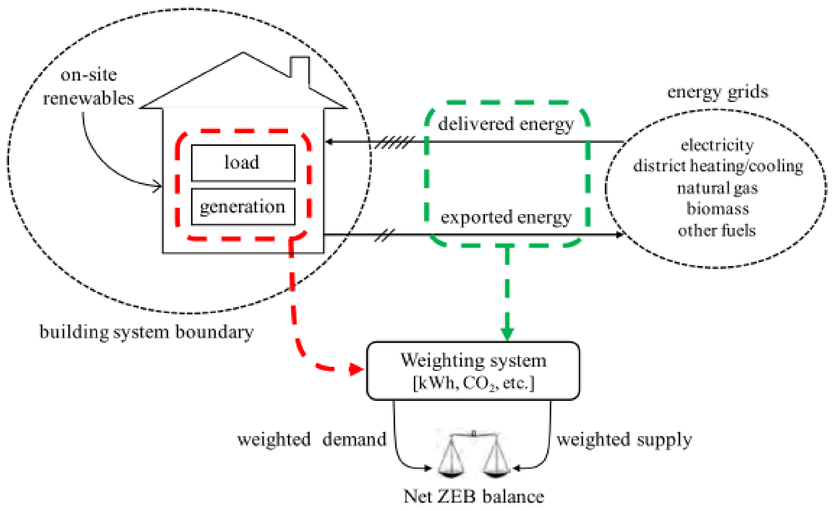

Fig. 1. Presentation of the balance of a NZEB

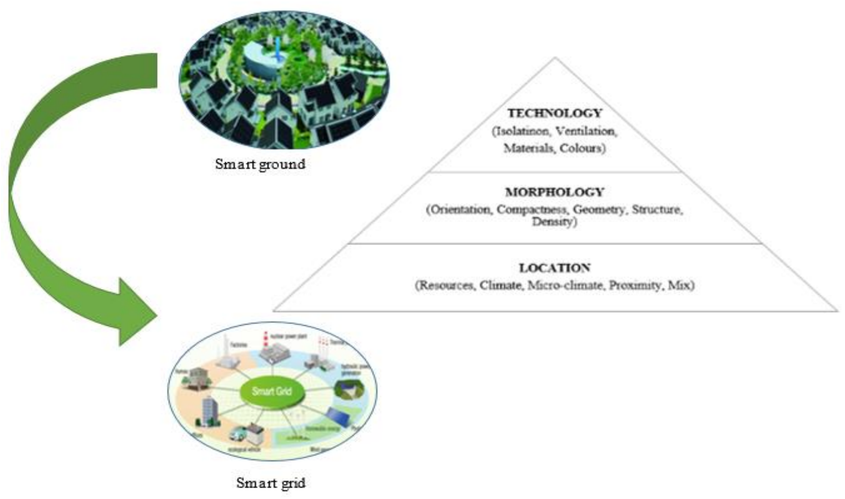

Fig. 2. From the 'smart ground' to the 'smart grid'

Methodology and Scenarios

The 'energy question', the use of renewable energy sources and the energy performance have been calculated in a building scale. For this study, the district is considered to be an 'urban block' and a complex system with diverse parameters that synthesize its profile. The methodological tool developed adapts the NZED in the systemic approach (**Fig. 3)**. **Fig. 4** presents the three levers of the tool in accordance with the criteria (and sub-criteria) that organize its concept: 1) Optimization of occupants' actual needs and requirements in energy, 2) Use of energetic hybridization, 3) Organization of storage.

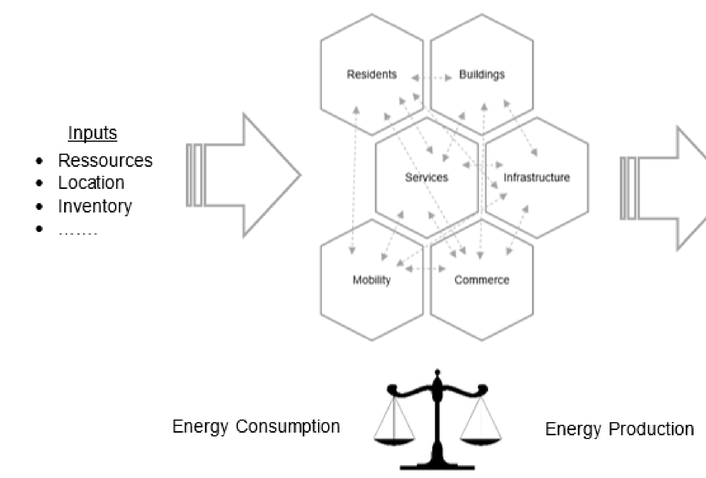

Fig. 3. Components and interconnections of a district with a systemic approach of NZED

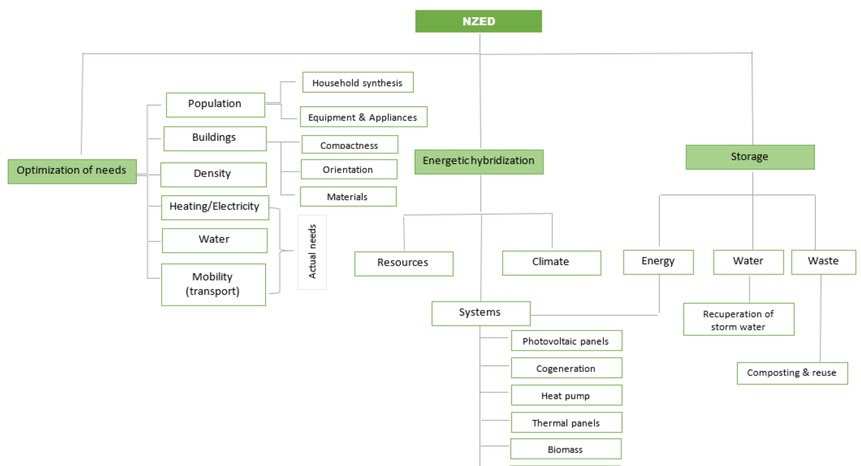

Fig. 4. Analysis of the three pillars of a NZED

Fig. 5. Map of selected 'eco-districts'

Results

Results of ten European case-studies (**Fig. 5)** with sustainable context reviewed in a multi-thematic approach and evaluated within the criteria of the three pillars analysed. Analysis reveals a list of 4 final eco-districts with interesting characteristics to be considered as exemplar in terms of net zero energy concept. This work demonstrates the emergence for integrated policies towards the implementation of zero energy conception in district scale highlighting the interest of a systemic approach. The proposed methodological framework will be extended and validated as a further step of this study within a real case-study.

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