

Positive Energy Districts Methodology and Its Replication Potential [†]

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Abstract: Positive Energy District (PED) strategy aims at speeding up the urban decarbonization, regarding mainly its scalability potential. For MAKING CITY, PED is defined as “an urban area with clear boundaries, consisting on buildings of different typologies that actively manage the energy flow between them and the larger energy system to reach an annual positive energy balance”. Aligned with it, a PED guideline (a standardized concept valid to be the core of specific urban energy transitions planning processes) is being created taking into account the constraints of the fellow cities underlining main needs in terms of energy and land use planning in principle.

Keywords: Positive Energy Districts (PED); PED guidelines; replication; PED boundary; PED solutions; PEDBoard; PED cards; PED SPECS

1. Introduction

Sustainable Development Goal 11 (UN SDG11) of United Nations aims to enhance inclusive and sustainable urbanization, and develop capacity for participatory, integrated and sustainable human settlement planning and management in all countries by the year of 2030 [1].

Positive Energy District (PED) strategy opens the door to lead this aim by speeding up the urban decarbonization, regarding mainly its scalability potential. Positive Energy Districts will raise the quality of life in European cities, contribute to reaching the COP21 targets and enhancing European capacities and knowledge to become a global role model [2]. Nonetheless, definition of PED and PED concept boundary are still under discussion. For MAKING CITY, H2020 project N°824418, the boundary for PED is defined as “an urban area with clear boundaries, consisting on buildings of different typologies that actively manage the energy flow between them and the larger energy system to reach an annual positive energy balance”. Aligned with this definition a procedure and guideline are being generated taking into account the political, economic, social, technical, environmental and legal constraints of the fellow cities underlining their main needs in terms of planning and energy in principle. In the project, the fellow cities are León in Spain, Bassano del Grappa in Italy, Kadiköy in Turkey, Vidin in Bulgaria, Lublin in Poland, and Poprad in Slovakia. Aspects related to the specificities of the cities, regions and even countries, are considered, in order to have a standardized concept that is valid for the core of specific urban energy transitions planning processes.

2. Definition and Objective of the PED Methodology

The objective of the Making City PED Methodology is to empower replicability, scalability, and sustainability of PEDs, taking into account the city needs and priorities, on-site resource availability, Making City PED solutions (demand side solutions as low consumption in buildings, improving energy efficiency by energy management in buildings and districts, supply side solutions as

alternative energy resources and integrated infrastructures as large storage, heat pumps, district heating, etc.) and their business models through a decision-making journey emphasizing citizen engagement.

PED Methodology focuses on the procedure considering the identification process of the PED concept boundary and selection of proper PED solutions peculiar to the cities. It is composed of the phases encompassing a decision-making route that underlines citizen engagement throughout this process. The procedure aims to understand what the city is looking for, described as state of play in cities for figuring out the priorities, objectives and needs of the cities. Therefore, the main goal is the creation of a specific plan/design/guideline for each city that may reach, understand and try to follow the phases of the methodology and find out its needs, vision and objectives.

3. The Phases of Making City PED Methodology

The Making City PED Guideline consists of five main phases shown in Figure 1. The first phase examines the city needs considering a city diagnosis study and organization of main targets defined in city plans in terms of energy and environment. Implementation areas and actions are clarified and main needs and priorities are defined utilizing participatory process. The second phase deals with on-site resource availability in the city. Preliminary study on the identification of PED concept boundary is founded at this stage. The third stage recognizes a PEDBoard consisting of technical and non-technical technologies already tested/being tested in Lighthouse Cities, Oulu & Groningen. Phase four is the analyses of barriers/constraints/supporting factors of already chosen solutions from PEDBoard. If actions on how to overcome the barriers are not possible for the city, the feedback loop mechanism works and a new solution is encouraged to be chosen. The last phase is the outcome of the proper technologies chosen during this process. All the detailed information consisting of technical description, stakeholder analyses, financing data etc. on chosen technologies are listed on solution cards, called SPECS.

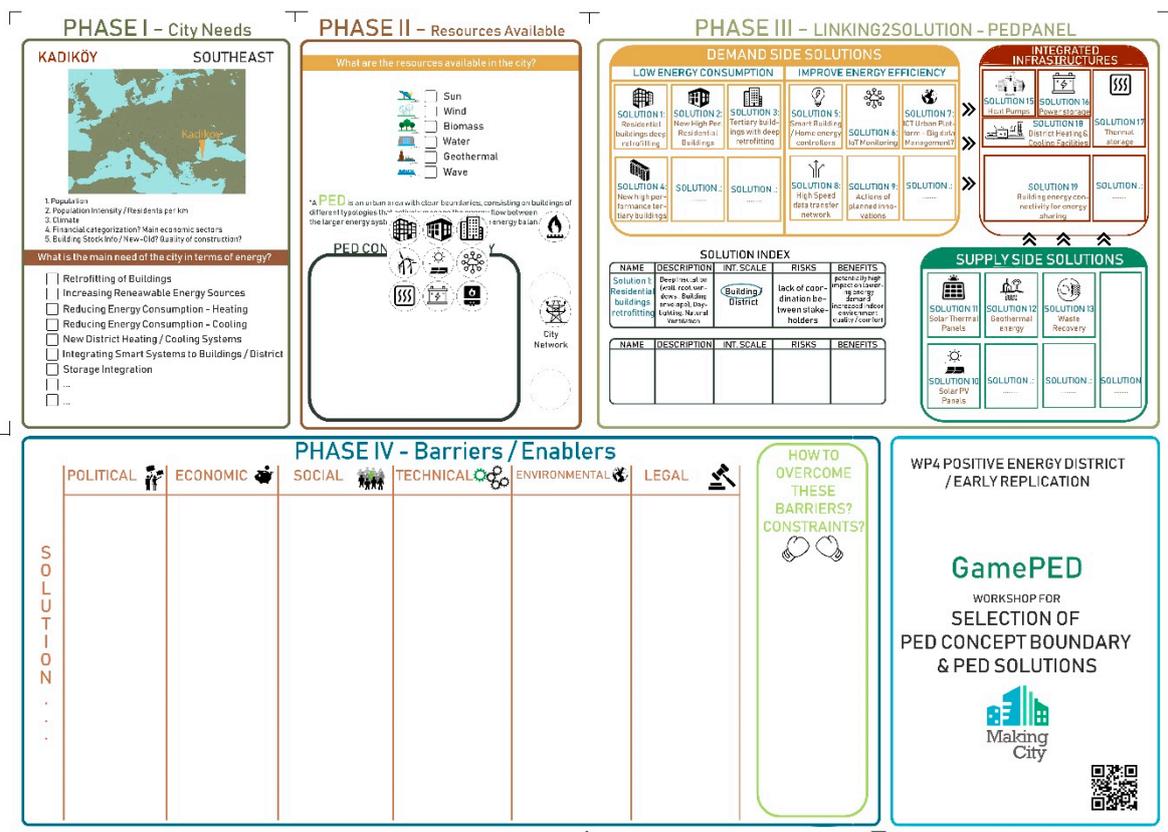


Figure 1. The phases of PED Methodology.

It is important to understand that the methodology combines both district and city scales depending on the phase, pursuing the impact of PED method at both levels with respect to the policy, planning and resource availability. Although the process starts with the diagnosis at city scale, eventually it focuses on the district (identification of the boundary, selection of peculiar solutions for the district etc.). The impact at city level is highly important according to SET Plan, as it supports the planning, deployment and replication of 100 'Positive Energy Districts' by 2025 for sustainable urbanization. Regarding this aspect, citizen engagement is strongly integrated throughout all phases of the guideline. Among other things, a replication workshop, named GamePED (Figure 1) is developed by Demir Energy to help city authorities, citizens, researchers, designers, associated companies to figure out easily the PED concept and PED solutions and encourage the stakeholders to develop PED execution plans.

Phase I: Analyses of City Needs through City Diagnosis Approach

Phase I addresses main city needs in terms of energy aligned with land use planning. This phase includes local authorities, citizens, researchers, planners and designers in the process. In doing so, city needs and priorities are analyzed under four steps:

1. Analysis of the main city characteristics: Calculation of City Level Indicators
2. Analyses of City Plans and definition of Main Targets
3. Energy Demand modelling
4. Identification of main needs and priorities

Step 1: City Diagnosis: City Level Indicators

The city level indicators are used to show to what extent overall policy goals have been reached. In the process to become a smart city, establishing a reliable metric is a key point to support cities to identify strengths and weaknesses and consequently set priorities for action. For this reason, a set of city level indicators are established for the city diagnosis and for the identification of their needs and priorities. These indicators are grouped under energy& environment, mobility, governance and society & citizens domains.

Step 2: Analysis of city plans towards the development of a City Vision 2050

After city diagnosis research for defining the state of play in cities, a comprehensive study on analysis of existing city plans and the targets defined in these plans is carried out. The actions identified to achieve the defined goals are specified and any implementation areas of these actions are introduced. Implementation areas are grouped as New Area Development, Infill Area and Retrofitting area. New development areas are in the context of new urban areas where there are no existing buildings, there are good prerequisites for spatial planning to steer PED replication, because PED can be planned to integrate with the other development interests of the area, prior to the implementation of the buildings and infrastructure. This is especially the case when the local spatial planning system allows public officials to have regulatory powers over private developers' investments. Whereas, infill areas are redevelopment or land recycling that occurs on previously developed land. Infill buildings are constructed on vacant or underused property or between existing buildings. In infill areas, there are certain possibilities for spatial planning to enhance PED replication. As infill projects take place in existing urban environments, there is often a vast number of stakeholders. PED replication depends on the capacity of public officers to cooperate with stakeholders. Lastly, retrofitting areas are development or upgrading of buildings or technology within existing infrastructure. In retrofitting areas, some spatial planning tools are still available to enhance PED replication. PED replication is dependent on citizens and building-owners [3]. Once, the implementation area is determined, financial schemes or innovative business models for the deployment of the actions are analyzed. Step 3: Energy Demand Modelling

Simulation models based on cadastral GIS data of cities are generated to calculate the energy demand. Energy consumption data is also collected to calibrate the models and compare the results of Step 1.

Step 4: City needs and priorities identification

Following the first three steps, Step 4 focuses on results of the analysis. The main city needs and priorities are defined regarding land use context and existing city plans as in policy domain and energy simulations for demand side scenarios.

Phase II: Resource Availability and Identification of PED Concept Boundary

Phase II focuses on the resources available in the city. The natural resources play a significant role for analyzing the PED boundary in terms of managing renewable energy. For instance the supply side is strengthened by renewable energy sources such as sun, wind, biomass, water, deep geothermal, near to surface geothermal and wave. Once the city needs and priorities are identified, land use context of the city is clarified and resources are listed, the boundary for the PED concept may be formed. This phase is connected with city and district scale and accomodates the participation of the local authorities and citizens.

Phase III: Linking to Solution: PEDBoard

Within this phase, the inputs of Phase I and Phase II are evaluated by a decision-making mechanism and the particular technical and non-technical solutions are linked to the according to the data obtained from Phase I and Phase II. The solutions are classified under main solution categories of demand side, supply side and integrated infrastructures. Each PED solution is characterized in a solution index table, including short description, intervention scale, risk factors, benefits and initial budget info. All of the main and subcategories and index of each solution is presented on a panel, named PEDBoard. While selecting the solutions, the stakeholders may go one step back and feed the PED boundary with the new results. This phase is concerned with district scale and includes researches, technical designers and citizens.

Phase IV: Barriers / Enablers of PED Solutions

In this phase, impact-based evaluation is integrated in selection of solutions process and political, economic, social, technical, environmental, legal and spatial barriers, constraints, supporting factors are recognized for each selected solution. A brainstorming on how to overcome the barriers is encouraged and if the results are negative to continue to the next phase, Feedback loop (a system for improving a product, process, etc. by collecting and reacting to users' comments) mechanism starts to find another particular solution for the PED area. The discussion is expected to be developed by an open dialogue and consensus between technical designers, citizens and local authorities.

Phase V: Detailing solutions in Solution Cards: SPECS

This Phase presents the detail cards of each solution categorized in PEDBoard. The solution cards, named SPECS, involve general data, technical and graphical details, implementation time, initial investment and financial models, stakeholder mapping, integration with other smart solutions, potential for replication, expected impacts of all of the solutions.

4. Conclusions

In this research, PED Methodology objectives and phases of implementation and replication are presented. This study is under MAKING CITY project, aiming PED concept boundary identification for cities regarding their geographical, financial and social capabilities and creation of a "PED

Solution Catalogue” consisting of technical and non-technical technologies of cities already experienced PED implementations.

References

1. Sustainable Development Goal 11: Make Cities and Human Settlements Inclusive, Safe, Resilient and Sustainable. Available online: <https://sustainabledevelopment.un.org/sdg11> (accessed on 5 June 2019)
2. European Commission’s Directorates-General for Research and Innovation, Joint Research Centre. *Set-Plan Action N°3.2 Implementation Plan*; European Commission: Brussels, Belgium, 2018.
3. Hirvonen-Kantola, S. (University of Oulu, Oulu, Finland); Kosunen, H. (University of Oulu, Oulu, Finland); Ahokangas, P. (University of Oulu, Oulu, Finland); Xu, Y. (University of Oulu, Oulu, Finland); Rinne, S. (City of Oulu, Oulu, Finland). Personal communication, 2019.



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