

Editorial

# Smart Cities and Positive Energy Districts: Urban Perspectives in 2021

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**Abstract:** This Special Issue of *Energies*, “Smart Cities and Positive Energy Districts: Urban Perspectives in 2021”, introduces contemporary research on Smart Cities and on Positive Energy Districts. The present Special Issue, namely the fourth Special Issue, Smart Cities and Positive Energy Districts: Urban Perspectives in 2021, has been dedicated to tools, technologies, and system integration for Smart Cities and for Positive Energy Districts. The topic highlights the variety of research within this field, including research on: tools facilitating the evaluation of Sustainable Plus Energy neighborhoods, of enabling-technologies and procedures for Positive Energy Districts, and of multicriteria assessment for the identification of Positive Energy Districts; system integration related to optimized energy and air quality management in the COVID-19 scenario; system integration upgrading existing residential areas to the status of Positive Energy Districts; and renovation models for large scale actions.

## 1. Introduction

The Green Deal, Horizon Europe and the EU Urban Agenda focus on fair, green and digital transitions for urban areas, while the New European Bauhaus highlights the role of design and culture within cities; thus, the EU is shaping sustainable and livable futures as we approach a decisive moment for international efforts to tackle the climate crisis, as well as the pandemic crisis, which are the great challenges of our times.

The last few years have been characterized by a major technological boom that has seen the arrival of so-called “disruptive technologies”, innovative technologies which are enabling tools for radical and positive changes to understand, plan, manage and innovate districts and urban areas. The number of countries that have pledged to reach net-zero emissions by the mid-century, or soon after, continues to grow; however, so do global greenhouse gas emissions. Thus, a total transformation of the energy system itself, and its use within urban areas, is needed.

The clean energy transition, as well as the sustainable urban area transition, must be fair, inclusive and leave nobody behind. Both transitions are for and about people. Citizens must be active participants in the entire process, making them feel part of the transition and not simply subject to it.

Technological solutions, especially digital ones, have now changed the approach to manage energy in cities. This will make it possible, in the not-too-distant future, to innovate and administer cities and services to citizens based on an understanding of their real critical issues, needs, particularities, vocations, possibilities and capabilities. The big change will not only be technological but—above all—cultural, as public administrations, citizens, economic operators, governance and business models, and market players will transform their roles within the city.

This means that, to benefit from the opportunities offered by the current technological revolution, a cultural shift must be promoted. Reaching net zero by 2050 requires further rapid deployment of available technologies, as well as a widespread use of technologies that are not on the market yet. Moreover, of particular importance is the development



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of national enabling conditions and conducive policy frameworks that support cities in reaching climate neutrality. Currently, urban governance is fragmented and siloed and support for cities across levels of government is often insufficiently coordinated; moreover, public authorities often lack the right skills, expertise, technical and financial resources, as well as effective intervention portfolios to support cities in their efforts to become climate neutral.

Thus, it is necessary not only to deploy available technologies or the widespread use of technologies that are not on the market yet, but also to support national and regional authorities for a transformative national change processes, by improving their multi-level governance and shaping national ecosystems for urban climate neutrality transitions.

Given this, between 2020–2027, Horizon Europe will support the clean energy transition (CET Partnership), as well as the creation of Positive Energy Districts (DUT Partnerships), which include functions such as energy efficiency (linked with Smart Cities' enabling-technologies), energy flexibility, and energy production (linked with the biggest innovation opportunity deals with advanced batteries, hydrogen electrolyzers, direct air capture and storage).

Since 2018, the EERA Joint Programme on Smart Cities has promoted and published the most promising papers on tools, technologies, and system integration for Smart Cities and Positive Energy Districts, supporting the EERA JPSC Special Issues Series with a dedicated Scientific Board and appointed Scientific Board Coordinator, Paola Clerici Maestosi.

The EERA JPSC Special Issues Series consists of:

2018—First Special Issue: European Pathways for the Smart Cities to come, <https://doi.org/10.13128/Techne-2356>;

2019—Second Special Issue: Tools, technologies and system integration for the Smart and Sustainable Cities to come, <https://doi.org/10.5278/ijsepm.3515>

2020—Third Special Issue: Smart Cities and Positive Energy Districts: Urban Perspectives in 2020, *Energies* 2021, 14, 2351; <https://doi.org/10.3390/en14092351>

The present Special Issue, namely fourth Special Issue, Smart Cities and Positive Energy Districts: Urban Perspectives in 2021, has been dedicated to:

- Tools, technologies and system integration for Smart Cities;
- Tools, technologies and system integration for positive energy districts.

## 2. Published Papers Highlights

This Editorial article provides a summary of the Special Issue of *Energies*, covering the published papers [1–8] which address several of the topics mentioned in the Introduction. Table 1 identifies the most relevant topics in each published paper.

As shown in Table 1, most of the publications focus on Positive Energy Districts (6) while only two focus on Smart Cities.

The eight articles have been selected after a peer review process and we are thankful to all forty-four authors from several countries (in alphabetic order: Austria, Italy, The Netherlands, Poland, Portugal and Spain) for their contribution to the Special Issue.

In work [1] Giuseppe Anastasi et al. I revisit the current energy/environment management strategies of smart buildings and present some experimental activities carried out in the classrooms of the University of Pisa, which are used to support the proposed methodologies with an overview of the sensors used for monitoring actions, as well as the logic of the control system. Moreover, some experimental results obtained in pre-pandemic conditions, in a building of the University of Pisa, are given. The conclusion of the article drives in the direction that new approaches for designing and controlling the operation of HVAC systems are necessary and urgent to make indoor spaces safe and comfortable, without compromising energy efficiency. The installation of instruments for indoor air quality monitoring is paramount, together with the implementation of building management and control systems. Knowledge of the occupancy profile—obtained directly by means of cameras or indirectly by means of measurements of air quality parameters—represents a step forward compared to current design and operation procedures suggested by technical

standards. Interaction with the occupants through active participation is a relevant element of the methodology. The argument specifically developed is that the classic topic of the optimization of a Building Management System (BMS) is becoming even more relevant in a COVID-19 context.

**Table 1.** Topics covered in each publication.

NO	Title	Tools, Technologies and System Integration for Smart Cities	Tools, Technologies and System for Positive Energy Districts
1	Optimized Energy and Air Quality Management of Shared Smart Buildings in the COVID-19 Scenario		
2	PEDRERA. Positive Energy District Renovation Model for Large Scale Actions		
3	Combining Sufficiency, Efficiency and Flexibility to Achieve Positive Energy Districts Targets		
4	Analysis and Evaluation of the Feasibility of Positive Energy Districts in Selected Urban Typologies in Vienna Using a Bottom-Up District Energy Modelling Approach		
5	An Evaluation Framework for Sustainable Plus Energy Neighbourhoods: Moving Beyond the Traditional Building Energy Assessment		
6	Possibilities of Upgrading Warsaw Existing Residential Area to Status of Positive Energy Districts		
7	A GIS-Based Multicriteria Assessment for Identification of Positive Energy Districts Boundary in Cities		
8	Positive Energy Districts and Energy Efficiency in Buildings: An Innovative Technical Communication Sheet to Facilitate Policy Officers' Understanding to Enable Technologies and Procedure		

Article [2] by P. Civiero, J. Pascual, J. Arcas Abella, A. Bilbao Figuero and J. Salom provides a view of the ongoing PEDRERA project, whose main scope is to design a district simulation model able to set and analyze a reliable prediction of potential business scenarios on large scale retrofitting actions, and to evaluate the overall co-benefits resulting from the renovation process of a cluster of buildings. According to this purpose, and to a Positive Energy Districts (PEDs) approach, the model combines systemized data—at both building and district scale—from multiple sources and domains. Once implemented, the PEDRERA tool will facilitate the engagement of multiple stakeholders involved in the building renovation programs to make effective and well-informed decisions from a cluster of georeferenced buildings. Preliminary results obtained by the ongoing PEDRERA project refer to the definition of the conceptual framework of the model, and in regards to: (a) data source aggregation according to the four domains described above; (b) input required for the KPI calculations which can be assumed to assess different “scopes”. Aligned with this vision, the model is powered by the integration of the processed input for the calculation of the most relevant KPI (outputs) algorithms, according to each process phase and stakeholder’s profile.

Contributions [3] proposed by Silvia Erba and Lorenzo Pagliano provide a matrix of interactions between building and district design for use by building designers and city planners; they compare possible scenarios implementing different strategies at the building and urban levels in a case study, in order to evaluate the effect of the proposed integrated

approach on the energy balance at yearly and seasonal time scales, and on land take. The main findings rely on the energy sufficiency enablers.

Analysis and Evaluation of the feasibility of Positive Energy Districts in selected urban typologies in Vienna is presented in article [4] by Hans-Martin Neumann et al., which investigates the potential of selected urban typologies in Vienna to reach the state of Positive Energy Districts (PED) by achieving a positive annual energy balance. Considering relevant urban typologies in different construction periods, the analysis focused on converting the allocated building stocks into PED by employing comprehensive thermal refurbishment and energy efficiency measures, electrification of end-uses and fuel switching, exploitation of local renewable energy potential, and flexible interaction with the regional energy system. The results reveal that a detached housing district can achieve a positive annual energy balance (for heat and power) of 110%, due to the fact that there are sufficient surfaces (roofs, facades, open land) available for the production of local renewable energy; conversely, the remaining typologies fail to achieve the criteria, with an annual balance ranking of between 61% and 97%, showing additional margins for improvement to meet the PED conditions.

Jaume Salom et al. [5] contribute to the on-going debate about the definition of the notion of a Sustainable Plus Energy Neighborhood (SPEN), which highlights the need to consider mutual interaction between the built environment, the inhabitants and nature. Through a multidimensional analysis to address complexity in neighborhoods, this paper outlines an assessment framework for the performance evaluation of SPEN. The selection of the main assessed categories and Key Performance Indicators (KPIs) have been based on a holistic and comprehensive methodology which highlights the multiple dimensions of sustainability in the built environment. The contents of the paper are based on the work developed in the syn.ikia project with extended details on the methodology applied, revised definitions and concise and synthetic presentation of the metrics. As result of the application of the methodology described, five KPI categories were identified, and are defined as: Energy and Environmental, which addresses overall energy and environmental performance, matching factors between load and on-site renewable generation and grid interaction; Economic, addressing capital costs and operational costs; Indoor Environmental Quality (IEQ), addressing thermal and visual comfort, as well as indoor air quality; Social, which addresses the aspects of equity, community and human outcomes; and Smartness and Flexibility, addressing the ability to be smartly managed. This paper presents two main contributions to the existing literature. The first is to put forth a consistent definition of a Sustainable Plus Energy Neighborhood (SPEN), while the second major contribution is to present an evaluation framework for the assessment of SPENs.

In [6], Hanna Jędrzejuk and Dorota Chwieduk analyze the possibilities for the refurbishment of Warsaw's residential buildings towards the standards of a Positive Energy District. The paper refers to the theoretical potential for the use of renewable energies, which appears to be a rational solution only if there is a reduction in energy demand for traditional methods which, in this case, means reducing the energy demand of existing buildings or erecting new ones in accordance with the latest energy and environmental standards. Potential barriers to the implementation of renewable energy technologies and achieving the status of a Smart City with some positive energy districts should be identified and mentioned.

Beril Alpagut et al., paper [7], focuses on a flexible GIS-based Multicriteria assessment method that identifies the most suitable areas to reach an annual positive non-renewable energy balance. For that purpose, a GIS-based tool is developed to indicate the boundary from an energy perspective harmonized with urban design and land-use planning. The method emphasizes evaluation through economic, social, political, legal, environmental, and technical criteria, and the results present the suitability of areas at macro and micro scales. The current study outlines macro-scale analyses in six European cities that represent Follower Cities under the Making-City H2020 project.

Tiziana Ferrante and Teresa Villani [8] refer to an innovative technical communication sheet to facilitate policy officers' understanding about enabling-technologies and

procedure to support the transition to a Positive Energy District. Based on the results of ENEA national research [Sustainable Urban Transition; pp. 240–241; <https://doi.org/10.30448/UNI.916.50733>], which individuated more than 100 key indicators for six areas of investigations to describe PED experiences, T. Ferrante and T. Villani elaborated an innovative technical communication sheet which describes—in a visual, effective and easy way—energy efficiency key indicators and the related implementation process. As key indicators refer both to technological solutions and the execution process, two types of technical communication sheets have been created; the first refers to technological solutions and highlights building system components related to energy efficiency, while the second is about the implementation phase. The article presents two case studies (Milan, Nido in Feltrinelli; Florence, Scuola Materna Capuana) where technical communication sheets have been applied to describe the rehabilitation project supporting the comparison between different technological solutions and implementation procedures. The results presented in this paper seem interesting and in line with ongoing European debate, as there is a need for effective communication on PED case studies highlighting information related to the strategies and solutions implemented by the municipalities. Authors affirm that effective communication on findings related to PED will encourage and facilitate synergies among urban ecosystem stakeholders, by activating a virtuous communication processes and improving the understanding of actions to support the PED transition.

**Conflicts of Interest:** The author declares no conflict of interest.

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