frontiers | Frontiers in Sustainable Cities

EDITORIAL
published: 13 April 2022
doi: 10.3389/frsc.2022.838899

Editorial: Positive Energy Districts: Transforming Urban Areas Into High Efficiency Districts With Local Renewable Generation and Storage

*Ursula Eicker**

Canada Excellence Research Chair in Smart, Sustainable and Resilient Cities, Department of Building, Civil and Environmental Engineering, Concordia University, Montreal, QC, Canada

Keywords: positive energy districts, urban densification, renewables, storage, social inclusion

Editorial on the Research Topic

Positive Energy Districts: Transforming Urban Areas Into High Efficiency Districts With Local Renewable Generation and Storage

Positive energy districts have emerged as a new paradigm of next generation city building, where energy is fully supplied from renewable sources (Brozovsky et al., 2021). Different definitions of the spatial boundaries are still in discussion: an autonomous positive energy district supplies 100% or more of its own energy demand and any excess energy is exported to the grid (Lindholm et al., 2021). This concept works in low density districts with large available surface areas for renewable, mostly solar photovoltaic generation, and low demand. In a dynamic positive energy district, energy can be imported and exported from the grid, but the on-site renewable generation must still be higher than the demand. Again, if the urban density is high and the areas for power generation on roofs and façade limited, this concept has its limits. The most flexible definition is a virtual positive energy district, where renewable energy can be freely imported and exported, but does not have to be produced on site. Here questions of renewable ownership and power purchase agreements arise to make sure that new renewables are built to satisfy the demand of a district (Pan and Pan, 2021). Some further differentiations are available with regards to the metric of the balances: overall carbon neutrality is indicated as a priority in some formulations of the positive energy district definition (i.e., in the EU Setplan) in addition to the focus on surplus renewable energy generation (Derkenbaeva et al., 2022).

Positive energy districts thus have to consider both the demand side and the supply and storage options: only if demand is low by retrofitting existing buildings to high energy standards, can local renewables make significant contributions. In today's urban discussion, densification and a resulting demand increase is very much on the agenda, as only dense urban areas can provide public and active transportation and thus overall low greenhouse gas emissions.

The ongoing transformation of the transportation sector to electric vehicles adds local electrical loads to the low voltage distribution network, which can only be reduced by higher public transportation shares. Together with the electrification of heating systems, urban electricity demand is on the rise and its evolution needs to be carefully analyzed to find supply solutions that can cover changing demand (Yuan et al., 2021).

Different options of renewable supply then need to be studied to determine the best energy mix between solar, wind, or waste to energy and to optimize the required storage volume. Options range from short to seasonal storage and strongly depend on the spatial boundaries discussed above: for an autonomous positive energy district, storage units need to increase in size, as the local demand

Edited and reviewed by:
*Stefan Bouzarovski,
The University of Manchester,
United Kingdom*

****Correspondence:***
*Ursula Eicker
ursula.eicker@concordia.ca*

Specialty section:
This article was submitted to Urban Energy End-Use, a section of the journal Frontiers in Sustainable Cities

Received: *18 December 2021*
Accepted: *11 February 2022*
Published: *13 April 2022*

Citation:
Eicker U (2022) Editorial: Positive Energy Districts: Transforming Urban Areas Into High Efficiency Districts With Local Renewable Generation and Storage. Front. Sustain. Cities 4:838899. doi: 10.3389/frsc.2022.838899

must be supplied at all times. This increases the overall cost of the installation, but also the local resilience in cases of power outages (Petkov et al., 2021).

To support the decision making around demand reduction and renewable supply and storage in a complex district scale setting, new simulation and optimisation tools are needed. Digital twins of the built environment are increasingly used to provide geometry information for building demand modeling, but also to manage data sets of construction and usage. Automated workflows need to be developed to facilitate both demand and supply modeling and the optimisation tasks for planning and operation of such renewable systems (Abolhassani et al., 2022).

But the implementation of positive energy districts does not only encounter technical and financial challenges, but needs new frameworks to also offer a socially inclusive and affordable perspective for the residents, so that gentrification is avoided and the districts are mixed and vibrant (Hearn et al., 2021). Furthermore, all stakeholders' needs should be taken in consideration in an integrated social perspective, in addition to pursuing environmental sustainability and circularity practices and exploring new and innovative business models tailored to the aforementioned issues.

Case studies on a neighborhood scale still play an important role to assess performance, economics and engagement of the community. If the success of such case studies in different regions, climates, and social conditions can be shown across the world, positive energy districts will become a major driver of urban decarbonisation.

Lastly, actions to reduce the carbon, environmental and resource footprints of PEDs are due in several domains and by different actors.

The current Research Topic addresses the multiple perspectives discussed above and contributes to a better understanding of potentials and barriers of positive energy districts, with a specific focus on energy modeling, innovative assessment methodologies, case-studies definitions, and implementation.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

FUNDING

The work was funded by the Canada Excellence Research Chairs Program of the Tri-Agency Institutional Program Secretariat (CERC-2018-00005).

ACKNOWLEDGMENTS

The author would like to acknowledge the work and contributions of my fellow Research Topic editors Francesco Guarino, Genku Kayo, and Matthias Haase who all greatly contribute to make Positive Energy Districts become a reality.

REFERENCES

Abolhassani, S. S., Amayri, M., Bouguila, N., and Eicker, U. (2022). A new workflow for detailed urban scale building energy modeling using spatial joining of attributes for archetype selection. *J. Build. Eng.* 46:103661. doi: 10.1016/j.jobe.2021.103661

Brozovsky, J., Gustavsen, A., and Gaitani, N. (2021). Zero emission neighbourhoods and positive energy districts – a state-of-the-art review. *Sustain. Cit. Soc.* 72:103013. doi: 10.1016/j.scs.2021.103013

Derkenbaeva, E., Vega, S. H., Hofstede, G. J., and van Leeuwen, E. (2022). Positive energy districts: mainstreaming energy transition in urban areas. *Renew. Sustain. Energy Rev*. 153:111782. doi: 10.1016/j.rser.2021.111782

Hearn, A. X., Sohre, A., and Burger, P. (2021). Innovative but unjust? Analysing the opportunities and justice issues within positive energy districts in Europe. *Energy Res. Soc. Sci.* 78:102127. doi: 10.1016/j.erss.2021.102127

Lindholm, O., Rehman, H., and Reda, F. (2021). Positioning positive energy districts in European Cities. *Buildings* 11:19. doi: 10.3390/buildings11010019

Pan, W., and Pan, M. (2021). Drivers, barriers and strategies for zero carbon buildings in high-rise high-density cities. *Energy Build.* 242:110970. doi: 10.1016/j.enbuild.2021.110970

Petkov, I., Gabrielli, P., and Spokaite, M. (2021). The impact of urban district composition on storage technology reliance: trade-offs between thermal storage, batteries, and power-to-hydrogen. *Energy* 224:120102. doi: 10.1016/j.energy.2021.120102

Yuan, M., Thellufsen, J. Z., Lund, H., and Liang, Y. (2021). The electrification of transportation in energy transition. *Energy* 236:121564. doi: 10.1016/j.energy.2021.121564

Conflict of Interest: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.