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EDITED AND REVIEWED BY
Umberto Berardi,
Toronto Metropolitan University, Canada

*CORRESPONDENCE
Gilles Desthieux,
gilles.desthieux@hesge.ch

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Editorial: Solar neighborhood planning: optimize solar energy use in cities through the digitalization of the built environment

Gilles Desthieux[1,2]*, Mattia Manni[3], Gabriele Lobaccaro[3], Caroline Hachem-Vermette[4], Silvia Croce[5], Martin Thebault[6] and Jouri Kanters[7]

[1]High School of Landscape Engineering and Architecture, University of Applied Sciences and Arts Western Switzerland (HES-SO), Geneva, Switzerland, [2]University of Applied Sciences and Arts of Western Switzerland, Delémont, Jura, Switzerland, [3]Norwegian University of Science and Technology (NTNU), Trondheim, Norway, [4]Concordia University, Montreal, QC, Canada, [5]Eurac Research, Bolzano, Italy, [6]Université Savoie Mont Blanc, Chambéry, Auvergne-Rhone-Alpes, France, [7]Lund University, Lund, Skane County, Sweden

KEYWORDS

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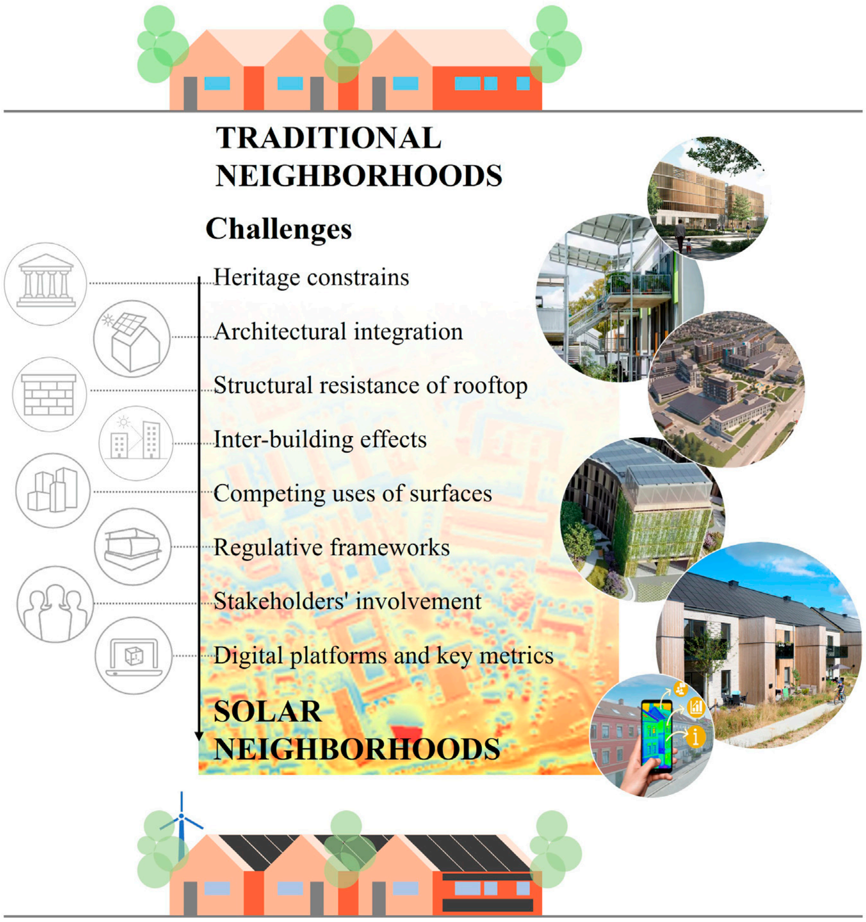
Editorial on the Research Topic
Solar neighborhood planning: optimize solar energy use in cities through the digitalization of the built environment

The urban environment offers a large solar potential that remains untapped due to administrative (heritage constrains) and social barriers (architectural integration), as well as specific challenges like the limited rooftop's structural resistance, the competing uses of surfaces, e.g., and inter-building effects (mutual shading, multiple reflections). The premise of this Research Topic is that the neighborhood is the appropriate scale for overcoming these barriers and facilitating the deployment of solar energy in modern cities (Wall, 2024; Manni et al., 2023).

This Research Topic was proposed in the context of the IEA SHC Task 63 "Solar Neighborhood Planning"[1], which focuses on the design of neighborhoods with high solar accessibility for on-site energy production and daylighting. Also, this Research Topic is in line with the HELIOS project[2], funded by the Research Council of Norway, which aims to develop a digital platform to support to key players in urban energy planning to achieve the solar neighborhood standards, thus boosting the solar energy in the Nordic built environment.

1 https://task63.iea-shc.org/

2 https://www.ntnu.edu/helios



GRAPHICAL ABSTRACT

Wall (2024) presents the key points of IEA SHC Task 63, emphasizing the need to secure the "right to light" for everyone. Indeed, guaranteeing the solar access is the preliminary step for boosting solar energy generation and achieving adequate daylighting in a healthy environment (both indoor and outdoor). In addition, climate change and heat wave events highlight the need for "right to shade", especially in the context of urban heat island. However, there is a lack of specific standards to preserve these rights. Secondly, solar design involves not only active energy production with PV and thermal panels integrated into the building envelope, but also passive strategies that use sunlight to improve indoor and outdoor comfort while reducing energy consumption for heating, cooling, and lighting (Hachem-Vermette et al., 2024). Further Research Topic arise about competing uses of urban surfaces (Croce et al., 2022) as the same surface can have multiple potential usages (e.g., vegetation or solar panels). In this regard, combining two or more solar strategies can be a solution. Additionally, solar neighborhood planning needs to be supported by digital tools and key metrics (Kanters and Thebault, 2022; Kanters et al., 2024) to (i) facilitate stakeholder engagement and citizen participation in the design process (Caballero et al., 2024), (ii) promote social acceptance of solar applications, and (iii) support communities in developing roadmaps for solar energy implementation. Finally, Task 63 explored innovative financing mechanisms and business models for solar neighborhoods to ensure long-term viability and to include and clarify added value (e.g., human health and wellbeing, resilience, energy security, biodiversity) (Wilczynski, 2024).

The Research Topic contains a total of seven papers, three review papers and four original contributions.

The review papers present global approaches and theoretical backgrounds that are central to solar neighborhood planning.

Hachem Vermette et al. review regulatory frameworks in five countries (Canada, Italy, Norway, Sweden, and Switzerland) related to solar access, passive, active, and general building energy regulations. They identify gaps in existing regulations, standards, and codes, and emphasize the need for future regulations to protect solar access and rights. The study reveals that solar energy legislation is generally scarce, lacks comprehensive planning, and is highly dependent on the national policy system - centralized or federal.

Manni et al. reviewed 112 publications focusing on the model chain for horizontal-to-tilted irradiance conversion at high latitudes. The best-performing decomposition and transposition models were identified, considering multiple time resolutions (1-h, 1-min) and specific configurations such as east-west (E-W) vertical bifacial photovoltaics (VBPV). This aspect is central, since the accuracy of the estimated solar potential influences the solar neighborhood planning.

The main challenge in implementing solar energy in the existing built environment is the growing number of buildings classified as cultural heritage in Europe. Akbarinejad et al. review the economic, geographical, technical, conservative, legislative, and social challenges and barriers of adopting solar energy in high-sensitive neighborhoods in Norway. Potential solutions and strategies are identified to help stakeholders, experts, and authorities in successfully integrating solar energy systems in these areas.

The second group of papers in the special issues showcase innovative concepts and applications at three different scales: regional, urban and neighborhood, group of buildings.

Desthieux and Thebault present the project of the solar cadaster of the Greater Geneva (Switzerland and France). A major outcome was the creation of a public web platform that allows the simulation of PV self-consumption for each building in the region, providing key performance indicators for investment decisions. The project demonstrates that the solar cadaster fosters cohesion among local stakeholders, guiding them towards unified solar energy governance.

Hasan et al. examine the relationship between density metrics and the solar potential of building rooftops and facades in Toronto (Canada). The study identifies key metrics affecting roof solar potential, including building height, density, proximity, and roof complexity. Using simulation models, it highlights which neighborhood profiles are best suited for retrofitting active solar technologies. This research offers a valuable framework for solar neighborhood design, particularly in existing urban areas like Toronto.

The study by Viriyaroj et al. evaluates installation sites for VBPVs in low-rise urban neighborhoods at high latitudes. It highlights that E-W VBPVs align with residential electricity consumption, boosting self-consumption in areas with low solar elevation angles. The research compares VBPVs and monofacial PVs in three residential areas of Helsinki with different densities and shading. Simulations using PVSyst® reveal VBPV systems should be prioritized for unshaded areas.

The study by Ranta et al. highlights the need to explore alternative surfaces for solar PV installations, like carports, and proposes reducing the greenhouse gas (GHG) emissions of these structures by substituting steel with wood. Simulations performed for Turku (Finland) and Dijon (France) showed that wood-based systems can halve the GHG emissions.

In conclusion, many of the papers show the importance of digital tools for modeling solar access in the built environment. They also highlight that the implementation of solar solutions in the neighborhoods depends on the successful empowerment of stakeholders, especially when facing constraints and barriers. All these contributions cover large parts of the Research Topic Research Topic focusing mostly on active solar strategies. Finally, four papers highlight the growing interest in solar energy at high latitudes as these regions present a unique solar irradiance pattern that can be particularly convenient for VBPV.

Author contributions

GD: Writing–original draft, Writing–review and editing. MM: Validation, Visualization, Writing–review and editing. GL: Validation, Writing–review and editing. CH-V: Validation, Writing–review and editing. SC: Validation, Writing–review and editing. JK: Validation, Writing–review and editing. MT: Validation, Writing–review and editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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