

Expanding BIPV city deployment against urban and climate change related temperature increases: The BIPV-city project

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Abstract The transition to NZEBs is not an easy process due to its complexity and the associated costs. BIPVs could make a substantial contribution towards this transition due to their passive energy benefits, as well as electricity production. The large available surfaces on the buildings' facades offer unique opportunities to integrate photovoltaics into opaque or transparent areas. Despite the technical maturity and substantial cost reduction of BIPV technologies, there are still challenges to overcome for the expansion of BIPV applications and their wider adaptation at global level. They can be grouped as follows:

- a) Complexity of energy-related properties of BIPV modules and systems
- b) Difficulty in assessing the quality of architectural integration
- c) Outdoor performance and predictive maintenance
- d) Integration dependence on regional climate conditions
- e) Early-stage sustainable BIPV design approach for end-users implementation

Recently, four articles have covered the four challenges considerably by N. Martín-Chivelet et al. [j.enbuild.2022.111998], I. Custódio et al.[j.solener.2022.02.019], D. S. Pillai et al. [j.rser.2021.111946] and N. Skandalos et al. [j.rser.2022.112950] respectively. Since building structure is the interface between humans and their natural environment, the proposed framework with the associated integration criteria prioritizes photovoltaics integration in harmony to local environmental and bioclimatic conditions towards sustainable development. In designing PV building integration in an early-stage approach, detailed building simulations with complex, energy and time-consuming numerical tools is required to be performed by specialists which hinders BIPV deployment. Therefore, the fifth challenge is very weakly addressed in the scientific literature.

Therefore, this work aims to contribute substantially in addressing the fifth challenge by bringing forward three major and important innovations against urban and climate related temperature increases:

-the energy lower boundaries of BIPV deployment at the urban space in Europe was determined. All studies have been confined so far the rooftop PVs potential. We have conservatively estimated the potential of BIPV in Europe towards NZEBs. The estimation will accelerate the BIPV implementation and open the discussion and research for the BIPV-UHI interaction effects.

- the SERAS principle ((Sufficiency, Efficiency, Renewables and Sharing) was applied in a realistic case of a typical Mediterranean city and the feasibility of carbon neutral city until 2030 was validated.
- an innovative and novel BIPV climatic design tool was developed for design, outreach and educational purposes.

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