

Generating building-level heat demand time series by combining occupancy simulations and thermal modeling

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Abstract-

Despite various efforts, decarbonizing the heating sector remains a significant challenge. To tackle it by smart planning, the availability of highly resolved heating demand data is key. Several existing models provide heating demand only for specific applications. Typically, they either offer time series for a larger area or annual demand data on a building level, but not both simultaneously. Additionally, the diversity in heating demand across different buildings is often not considered. To address these limitations, this paper presents a novel method for generating temporally resolved heat demand time series at the building level using publicly available data. The approach integrates a thermal building model with stochastic occupancy simulations that account for variability in user behavior. As a result, the tool serves as a cost-effective resource for cross-sectoral energy system planning and policy development, particularly with a focus on the heating sector. The obtained data can be used to assess the impact of renovation and retrofitting strategies, or to analyze district heating expansion. To illustrate the potential applications of this approach, we conducted a case study in Puertollano (Spain), where we prepared a dataset of heating demand with hourly resolution for each of 9,298 residential buildings. This data was then used to compare two different pathways for the thermal renovation of these buildings. By relying on publicly available data, this method can be adapted and applied to various European regions, offering broad usability in energy system optimization and analysis of decarbonization strategies.

Index Terms- Public data; Thermal building model; Building occupancy; Synthetic heat demand time series; Single building resolution

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