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The dynamic zero energy potential of photovoltaic direct-driven air conditioners based on adaptive thermal comfort using machine learning methods

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ABSTRACT

Usually the energy matching between building load demand and PV generation is rigid for photovoltaic direct-driven air conditioners (PVAC). The utilization of adaptive thermal comfort temperatures can improve the energy flexibility of building loads to increase the dynamic energy matching for PVACs. This study aims to propose a dynamic zero energy evaluation method combined with the adaptive thermal comfort temperatures for PVACs. The interaction between the flexible building load and rigid PV generation are investigated by different machine learning models with 1-minute time resolution. The indoor temperatures conditioned by PVACs are simulated under actual operations. Indicators such as hourly self-consumption (SC), hourly self-sufficiency (SS), hourly zero energy times (ZET) and real-time zero energy probability (RZEP) are used for evaluating the dynamic energy performance of PVACs in different seasons. With fixed indoor setting temperature selected from standard, the RZEP is only 27.87% in summer and 34.88% in winter for hot-summer and cold-winter zone. While taking the adaptive thermal comfort temperature into account, the corresponding RZEP for PVACs reaches 51.31% and 79.55% based on 100% SC of PV generation, respectively. Moreover, the zero energy points always appear at the large cooling demand times which can reduce the burden of the utility grid. An optimization for PV capacity is also conducted, the increasing of PV capacity helps to raise RZEP but brings the excessive energy output. The dynamic zero energy evaluation method with adaptive thermal comfort temperatures is useful to evaluate the zero energy potential and design a more flexible PVACs.

Full paper will be submitted soon

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