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Two million European single-family homes could abandon the grid by 2050

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Rising energy procurement costs and declining capital costs for renewable technologies are provoking interest in self-sufficiency for individual buildings. In this study, we evaluate the potential of self-sufficient energy supply for 41 million freestanding single-family buildings in the European building stock under current and future (2050) conditions. We employ spatial microsimulation to derive a synthetic building stock, identify 4000 representative buildings and calculate weather-robust cost-minimal energy systems using a high-performance computing cluster. Subsequently, we train surrogate models to transfer the optimization results to the entire European building stock. Our analyses show that buildings in regions with low seasonality, high solar radiation and high electricity procurement costs have high potential for self-sufficiency. Under current techno-economic conditions, 53% of the 41 million buildings are technically able to supply themselves independently from external infrastructures by only using local rooftop solar radiation, and this proportion could increase to 75% by 2050. By paying a premium of up to 50% compared to grid-dependent systems with electrified heat supplies, building owners could make over two million buildings fully energy self-sufficient by 2050.