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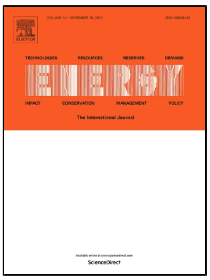

Grid-Independent Residential Buildings with Renewable Energy Sources

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Grid-Independent Residential Buildings with Renewable Energy Sources

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Abstract

The proliferation of grid-dependent, zero-energy buildings in a region will alter the diurnal electric power demand to a U-shaped demand curve that limits the role of base-load power plants and the flexibility of the electric grid to meet the power demand. Zero-energy buildings that are also grid-independent (GIB-ZEBs) ensure that carbon emissions are curtailed and that the electricity grid will retain its flexibility to make appropriate use of large, base-load power production units. Such buildings incorporate a reliable system for energy storage that supplies the needed energy when the renewable energy source does not. This paper offers a detailed analysis of the power needs, the seasonal energy usage, and the seasonal energy storage requirements of two GIB-ZEBs. The first is located in the South-West part of the USA, where the air-conditioning demand is very high and the second in the North, where the heating demand is very high and the irradiance/insolation is less. Hydrogen storage and battery storage systems were considered for the energy storage requirements of the buildings. Calculations for the two buildings include: the hourly electric power and total energy demand of the building throughout the year; the hourly energy production by a system of photovoltaics; the hourly energy storage needed throughout the year; the photovoltaics area requirements; the overall capacity and seasonal use of the energy storage system needed; and the effects of the various components and systems performance on the power production and storage parameters.