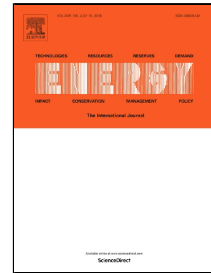


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Optimal renovation of buildings towards the nearly Zero Energy

Building standard

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ABSTRACT

In this paper, a Mixed-Integer Linear Programming model is proposed for the design of the energy renovation of existing buildings, considering both Energy Supply Systems and the adoption of Energy Saving Measures to reduce the demand of buildings in retrofitting towards the nearly Zero Energy Building standard. The method is applied to an existing building located in Bilbao (northern Spain), getting the optimal design, i.e. lower annual net cost, for different limits of non-renewable primary energy consumption. The demand reduction produced by the Energy Saving Measures is included as an input from previously validated dynamic simulations and a simple method is presented for its specific distribution in reference days. This simple method, based on degree-days, allows reference days to be generated that, through an Energy Saving Measure based base temperature, consider the weather, the use and the thermal properties' dependency on the distribution of the demand. The optimization method is used to provide the design selection and operation strategy of the renovation of buildings to meet different non-renewable primary energy consumption limits and to provide designs for different constraints: economic, space availability, etc.

Keywords: Building renovation; *Energy Supply System*; *Energy Saving Measure*; *nZEB*; *optimization*; *MILP*.

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