

Effects of Using Alternative Energy Sources and Technologies to Reduce Energy Consumption and Expenditure of a Single Detached House

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Abstract : In this study, hourly energy consumption model of a single detached house in Ankara, Turkey is developed using ESP-r building energy simulation software. Natural gas is used for space heating, cooking, and domestic water heating in this two story 4500 square feet four-bedroom home. Hourly electricity consumption of the home is monitored by an automated meter reading system, and daily natural gas consumption is recorded by the owners during 2013. Climate data of the region and building envelope data are used to develop the model. The heating energy consumption of the house that is estimated by the ESP-r model is then compared with the actual heating demand to determine the performance of the model. Scenarios are applied to the model to determine the amount of reduction in the total energy consumption of the house. The scenarios are using photovoltaic panels to generate electricity, ground source heat pumps for space heating and solar panels for domestic hot water generation. Alternative scenarios such as improving wall and roof insulations and window glazing are also applied. These scenarios are evaluated based on annual energy, associated CO₂ emissions, and fuel expenditure savings. The pay-back periods for each scenario are also calculated to determine best alternative energy source or technology option for this home to reduce annual energy use and CO₂ emission.

Keywords : ESP-r, building energy simulation, residential energy saving, CO₂ reduction

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