

MODELING AND OPTIMIZATION OF ENERGETIC SYSTEM IN A HYBRID SMART HOUSE

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Introduction. The project objectives are to model the energetic configuration of a Smart House in a numerical platform (e.g., HOMER Energy™ software), to validate the numerical predictions of technical performance with experimental facilities at NU-Technopark and to predict the optimal energetic configuration of the Smart House. This case study will be implemented particularly in Astana, but once the model is validated, configurations can be obtained for other cities with a small extra modeling effort.

Materials and methods. The Smart House is located at the NU-TechnoPark. It is powered by three sets of PV panels (240V, 120V and 48V) and three wind turbines (2x5kW and 3kW) and a set of batteries. The average hourly electricity consumption, hot water demand and heating of a typical house in Astana were determined by conducting a survey (Figs. 1 and 2). Monthly average wind speed and solar radiation were taken from the NASA Surface meteorology and Solar Energy. All these data are the input of our energetic model.

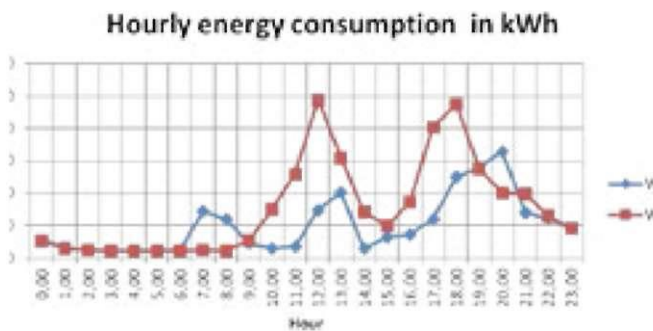


Figure 1. Average hourly energy consumption in kWh

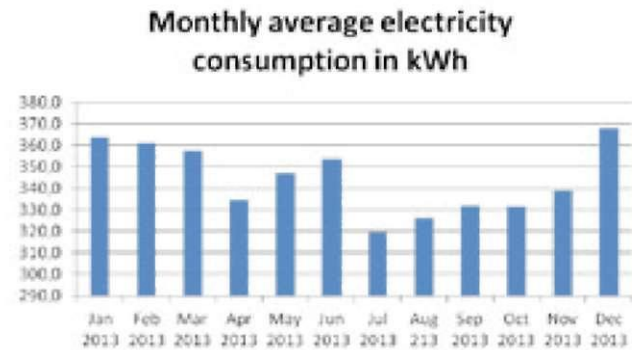


Figure 2. Energy consumption per month in kWh

Simulation. Our model will simulate the operation of the system by making energy balance calculations for each of the 8,760 hours in a year. The model calculates the flows of energy to and from each component of the system, by comparing the electricity demand and electricity supply. Optimization: After simulating all of the possible system configurations, a list of configurations, sorted by net present cost for comparison will be obtained.

HOMER platform allows us to synthesize monthly average data and calculate the baseline hourly data. With synthetic data, it has been proven that virtually the same results as with real hourly data can be obtained. The differences in key performance outputs are typically less than 5%, and differences in costs are less than 2%.

Expected Results. The simulation results will give three outputs: The total Net Present Cost, Levelized Cost and the Operating Cost. In addition to these outputs detailed cash flow and data associated with each input can be obtained.

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References.

1. Lambert T., Gilman P., Lilienthal P., Micropower system modeling with HOMER, Integration of Alternative Sources of Energy, Farret FA, Simdes MG, John Wiley & Sons, December 2005, ISBN 0471712329