

## Integrating Renewable Energy Forecasting Systems with HEMS and Developing It with a Bottom-Up Approach

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**Abstract :** This paper introduces how weather forecasting could help in more efficient energy management for smart homes with the use of Home Energy Management Systems (HEMS). The paper also focuses on educating consumers and helping them make more informed decisions while using the HEMS. A combined approach of technical and user perspective has been selected to develop a novel HEMS-product-service combination in a more comprehensive manner. The current HEMS switches on/off the energy intensive appliances based on the fluctuating electricity tariffs, but with weather forecasting, it is possible to shift the time of use of energy intensive appliances to maximum electricity production from the renewable energy system installed in the house. Also, it is possible to estimate the heating/cooling load of the house for the day ahead demand. Hence, relevant insight is gained in the expected energy production and consumption load for the next day, facilitating better (more efficient, peak shaved, cheaper, etc.) energy management practices for smart homes. In literature, on the user perspective, it has been observed that consumers lose interest in using HEMS after three to four months. Therefore, to further help in better energy management practices, the new system had to be designed in a way that consumers would sustain their interaction with the system on a structural basis. It is hypothesized that, if consumers feel more comfortable with using such system, it would lead to a prolonged usage, including more energy savings and hence financial savings. To test the hypothesis, a survey for the HEMS is conducted, to which 59 valid responses were recorded. Analysis of the survey helped in designing a system which imparts better information about the energy production and consumption to the consumers. It is also found from the survey that, consumers like a variety of options and they do not like a constant reminder of what they should do. Hence, the final system is designed to encourage consumers to make an informed decision about their energy usage with a wide variety of behavioral options available. It is envisaged that the new system will be tested in several pioneering smart energy grid projects in both the Netherlands and India, with a continued 'design thinking' approach, combining the technical and user perspective, as the basis for further improvements.

**Keywords :** weather forecasting, smart grid, renewable energy forecasting, user defined HEMS

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