Microgrids can help maximize efficiency of renewable energy consumption

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A group of Italian researchers has developed a method that enables more efficient use of energy by smart homes that are connected to a microgrid—a web of individualized units that are connected to one

another and one common energy source.

The findings address the need for efficient approaches to residential energy management by presenting a strategy that controls energy distribution. More specifically, the researchers propose a method that enables scheduling of electrical energy activities of smart homes connected in a microgrid to a distributor. This, they demonstrate, enables residents within the microgrid to distribute energy amongst each other in a way that lowers the overall load and demand for renewable energy.

The research was published in the May issue of *IEEE/CAA Journal of Automatica Sinica* (*JAS*), a joint publication of the IEEE and the Chinese Association of Automation.

Providing buildings and homes with a variety of small and grid-connected distributed energy resources is beneficial for several reasons. For one, it reduces energy loss in the process of distributing and transmitting energy from natural sources such as wind and sunlight. Also, wind and sunlight are not constant sources—sun can be blocked by clouds and winds change speed frequently. This means that the energy produced is not always used up completely. One way to address that is to store surplus energy, which can be expensive. Another alternative is connecting smart homes in a proactive way so that supply of electricity is balanced.

In this study, the researchers focused on the scheduling of electrical energy activities of a microgrid made up of smart homes. The overall aim was to reduce the energy supply from the grid by allowing homes to exchange their surplus renewable energy and by optimally planning energy amounts used. Each smart home can both buy/sell energy from/to the grid. Simultaneously, smart homes cooperate and may buy/sell locally harvested renewable energy from/to other smart homes.

"The proposed approach allows maximally exploiting the locally harvested energy, while ensuring that privacy about users' consumption schedules is maintained," adds Raffaele Carli, Ph.D., corresponding author and research fellow at Politecnico di Bari, Italy.

The researchers propose a decentralized optimization algorithm, a system that enables each home within the grid to act as a single electricity load node. They demonstrate that this is the best approach that enables electricity use and use-scheduling so that any excess can be shared with other users within the network.

In the future, the researchers hope to focus on improving estimations of the parameters that revolve around optimization. "The next step is to address a more complex scenario where residential users are eventually equipped with energy storage systems, whose capacities are reallocated among users. In this case the energy management aims at defining a control strategy that additionally ensures an optimal energy storage sharing, while simultaneously planning the consumption profile of the controllable appliances, the exchanged renewable energy among users, and energy to be bought/sold from the distribution network," adds Carli. The ultimate goal is to increase efficiency in addressing the high demand for distribution and storage.

More information: *IEEE/CAA Journal of Automatica Sinica*, www.ieee-jas.org/article/doi/1 … 109/JAS.2019.1911462

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