Microgrids, not always economically efficient in regulated electricity markets

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Credit: Tony Boon/Wikipedia

Installing a microgrid within a regulated electricity market will sometimes, but not always, provide an economic benefit to customers, investors and utilities involved, according to new research led by Chiara Lo Prete, assistant professor of energy economics, Penn State.

A microgrid is a group of power generators and power consumers operating in a coordinated system, and some members of the energy community believe microgrids could smooth out kinks in existing electricity networks.

The researchers examined several scenarios for adding a microgrid to a regulated network served by a vertically integrated utility. In this type of network, the utility company generates, transmits and distributes electricity. This differs from other networks in which these responsibilities are split among different parties. Roughly half of U.S. states today operate in networks served by vertically integrated utilities.

"These types of networks are often viewed as economically inefficient because the price of electricity reflects the average cost of providing power," said Lo Prete. "We wanted to find out how adding a microgrid would affect prices, costs and benefits for everyone involved."

Because this market is regulated, the researchers analyzed the effect of adding a microgrid from the point of view of the energy regulator. The regulator acts to enhance the sum of payoffs, known as economic efficiency, for all market participants—private investors, microgrid customers, utility companies and utility customers. Based on a snapshot of energy and capital costs today, the researchers modeled a variety of scenarios to investigate different contexts for installing a microgrid. They report in a recent issue of Applied Energy that microgrids may increase or decrease a network's economic efficiency depending upon cost assumptions.

For example, when microgrid capital costs were three times today's costs, adding a microgrid to a network reduced regulated electricity rates for both utility and microgrid customers. The economic efficiency would increase, but the private investor is less likely to invest due to the increased startup costs. If this were the case, an energy regulator would

need to provide an incentive to the investor to build the microgrid, as that would enhance the network's economic efficiency.

Another scenario examined the effect of increased utility fixed costs—for example due to higher transmission or distribution costs. Here, installing a microgrid increased utility customers' electricity payments. The private investor would make more money and microgrid customers would have a reduced total energy bill. The researchers calculated that, overall, the microgrid would decrease the economic efficiency of the network when utility fixed costs were higher.

"It's not necessarily that a microgrid always does or doesn't make sense—it really depends on costs and other characteristics of the network, including retail price regulation," said Lo Prete. "There are situations where a regulator should intervene to offer incentives so that all parties can benefit if a microgrid is added. It is also important to note that the benefits of introducing a microgrid don't just apply to microgrid customers and investors who decide to develop a distributed network. Our analysis shows that utility customers who are not served by the microgrid may reap most of these benefits."

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