UC San Diego
UC San Diego News Center

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Microgrid Business Models Analyzed in UC San Diego Study

The UC San Diego campus is home to a world-renowned microgrid.

A multidisciplinary team of researchers from the University of California San Diego have recently published a systematic analysis of microgrids in Southern California in order to better understand the business case for private investment in microgrids. The research appears in the April issue of the journal *Energy Policy.* The work is particularly relevant, in part, because it addresses two parallel trends: increased interest in and implementation of microgrids as a way to decentralize electric power grids; and the growing understanding that electric grids must be decarbonized relatively soon in order to avoid the worst effects of global climate change.

The final sentence of the abstract sums up some of the big-picture issues concerning these trends: “Decentralization [of the electric power grid] could radically reduce customer energy costs, but without the right policy framework it could create large numbers of small decentralized sources of gas-based carbon emissions that will be difficult to control if policy makers want to achieve deep cuts in greenhouse gas emissions.”

Paper: Evaluating business models for microgrids: Interactions of technology and policy

Journal: *Energy Policy*

Q&A with Ryan Hanna, first and corresponding author

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Briefly, what is one of the key questions you looked at?

We did a systematic analysis of microgrid business models. By that I mean we looked at the economics of investment in these systems and the energy sources that comprise them. We were trying to understand which levers—be it technology costs, certain regulatory policies or markets—drive the economics and makeup of the energy sources in the microgrids we studied. We looked in particular at grid-connected microgrids in Southern California. These are systems that can operate independently of the central grid as decentralized sources of power, but by and large operate connected to the larger, traditional electric power grid.

Is there a simple way to describe your big-picture findings?

Essentially, we found that without regulation or government incentives, natural gas is often the least expensive energy source for powering microgrids in Southern California. This is because natural gas is relatively cheap right now compared to other means of generating electricity.

This finding contrasts sharply with the goals of most energy policy, which has focused on deploying grid-scale and distributed renewables. If renewables are indeed our low- or zero-carbon energy future, which I think most people would agree they are—regulators may need to keep a close eye on smaller fossil generators that might proliferate based on economics alone.

Did you get any results, or come to any conclusions, that were surprising to you?

Perhaps the results themselves were not surprising, but their robustness was. Natural gas is the de facto preferred economical option for private entities that want microgrids. Our work suggests that without the right policy framework, microgrids could create a large number of small decentralized sources of gas-based carbon emissions that will be difficult to control if policy makers want to achieve deep cuts in greenhouse gas emissions and decarbonize the electric grid.

What can policy makers do to avoid that?

We found that the four most important levers to influence the makeup of microgrids are the cost of electricity, the cost of natural gas, carbon taxes and the cost of battery storage. Of those, a carbon tax is the most direct tool to control the composition and emissions of microgrids. Taxing grid emissions leads to greater adoption of renewable resources in microgrids.

This work seems to be situated at the intersection of engineering, economics and energy policy. What's the value of working at this intersection? Indeed this was our intent. Ultimately solutions to the climate problem require collaboration among these groups—among those who would devise solutions and those who know which solutions work and can actually be implemented in the real world.

Can you briefly describe the methodology for your study?

We used data from the U.S. Department of Energy to get profiles of an archetypal office building, hospital and so on, as well as databases from U.S. national labs for the costs of various technologies and energy sources. These data served as input to an optimization modeling framework—based on the DER-CAM software tool from Lawrence Berkeley National Laboratory—that gives the least-cost mix of energy sources in microgrids.

We applied the model to three microgrid types in Southern California: a large commercial building, critical infrastructure, such as a hospital, and a campus. We placed the microgrids in San Diego and used electricity and natural gas prices for San Diego Gas & Electric. We also used California's carbon market for carbon tax data.

Who is the audience for this study?

We are interested in reaching policy makers as well as the business and investment communities. The technical modeling community would also find this interesting, we believe.

What are the next steps in the research?

For this study, we looked at what it took for microgrids to provide energy services—essentially to serve as and compete with the local utility. But the framework could also be extended to look at how microgrids provide reliability and resiliency. It is toward this reliability piece that we have now turned.

There is a question of location as well. As we mentioned, we used San Diego. But we want to look at different jurisdictions across the U.S. and indeed perhaps worldwide. These have different rules, regulations and local climate—all of which impact the business case for investing in microgrids.

Author Affiliations

All authors are from the University of California San Diego and are affiliated with the campus' Deep Decarbonization Initiative.

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About the Deep Decarbonization Initiative

The mission of the UC San Diego Deep Decarbonization Initiative is to help guide a transition in the global economy toward net-zero carbon emissions. The aim is to help real societies link the best science and technology with politically realistic economic strategies for putting new energy systems into place on the scale required to make a difference in global carbon emissions while meeting the energy needs of all of humanity. To accomplish this goal, the Deep Decarbonization Initiative pursues research from the combined perspectives of the social sciences, engineering and the physical and biological sciences. The Initiative organizes research across academic disciplines that engage energy industry officials, elected officials and other policy makers.

Ryan Hanna selected for IIASA Young Scientists Summer Program

The first author on the *Energy Policy* paper, Ryan Hanna, has been selected to participate in the International Institute for Applied Systems Analysis (IIASA) Young Scientists Summer Program. He will spend three months over summer 2017 in Vienna, Austria working on independent research alongside other program participants, in collaboration with IIASA researchers with similar expertise and interests.

Hanna's research will build on the work published in the *Energy Policy* paper. In particular, he will be looking at the impact of microgrid adoption on greenhouse gas emissions from the electric power sector.

Since 1977, IIASA's annual Young Scientists Summer Program has offered research opportunities to talented young researchers whose interests correspond with IIASA's ongoing research on issues of global environmental, economic and social change.

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