

Tool created to avert future energy crisis

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(Phys.org) —A University of California, Riverside assistant professor of electrical engineering and several colleagues have created a new measurement tool that could help avoid an energy crisis like the one California endured during the early 2000s and better prepare the electricity market for the era of the smart grid.

The tool also unifies existing measures that assess "market power," which is the ability of power generating companies to alter energy prices. It also incorporates smart grid concepts such as large-scale storage, renewable power generation and demand response, meaning changes in electric usage by customers in response to changes in electricity prices. The smart grid is an automated system that uses real-time data to more efficiently and sustainably produce, deliver, and consume electricity.

As a result, the new tool can figure out what happens to the market power potential for electricity generation firms if, for example, consumers participate in demand response or if more renewable generation capacity is added at different locations.

"In the coming years, as we move towards a smart grid, a tool like this is crucial so that we can quantify the impact of emerging smart grid phenomena, such as demand response and renewable energy, on generation firms' ability to manipulate the prices in a deregulated electricity market," said Hamed Mohsenian-Rad, an assistant professor at UC Riverside's Bourns College of Engineering.

Mohsenian-Rad outlined the work in a paper entitled "[A Unifying Approach to Assessing Market Power in Deregulated Electricity Markets](#)" that he co-authored in collaboration with Professor Adam Wierman of California Institute of Technology and two graduate students: Chenye Wu and Subhonmesh Bose.

The paper received a Best Paper Award at the [IEEE Power and Energy Society General Meeting](#) that was held in July in Vancouver, Canada. It was one of four papers that received this recognition, one in each of the four conference tracks, out of about 1,600 total conference paper submissions.

During the past 10 to 15 years, there has been a growing interest in switching from traditional highly-regulated electricity markets to more competitive, so-called deregulated, electricity markets.

In deregulated markets, prices are decided by the bids that are submitted by power companies, rather than by a state or federal entity. The idea is that competition can encourage innovation to reduce the cost of power generation and, accordingly, reduce the price of electricity to homeowners, businesses and other users.

However, things don't always go as planned. For example, during the California Energy Crisis, people ended up being highly overcharged. The total estimated overcharges were about \$5.5 billion, according to the state power grid operator.

Investigations showed that certain companies would take some of their power plants offline for maintenance in days of peak demand to create an artificial demand supply gap to increase the prices. Generally speaking, they were successful in doing so because they had "market power" due to their dominance either in the overall market or in a particular region in the market where transmission lines had limited

capacities

Given the importance of market power, many people have proposed measures to identify the potential for market power in hopes of coming up with solutions, such as adding transmission lines or increasing generation capacities. However, collectively, these measures are confusing and in some cases may conflict, Mohsenian-Rad said.

Mohsenian-Rad and his colleagues call the measure they created "transmission constrained network flow." It is a combination of three large classes of market power measures: residual supply based, network flow based, and minimal generation based.

Transmission constrained network flow is fundamentally different from the existing methods because it proposes a "function" to assess market power under varying operating conditions, instead of giving a single measure that is designed for a normal operating condition.

"The existing literature on assessing market power is a confusing landscape with no unified view," Mohsenian-Rad said "Our tool unifies this diverse set of measures, and it also takes into account the [smart grid](#)."

Provided by University of California - Riverside

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