Department of Civil and Environmental Engineering

UCI Samueli School of Engineering

CEE@UCI PhD Defense Announcement

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Evaluation of Microgrid Deployment on Resiliency and Air Quality in a Nascent Market

ABSTRACT

California leads the world in the race to decarbonization, with the world's first comprehensive plan to achieve carbon neutrality by 2045. The 2022 Scoping Plan outlines goals such as decreasing greenhouse gas (GHG) emissions by 85% and reducing fossil fuel consumption to less than one-tenth of current levels by 2045. This would yield a 94% reduction in oil demand and an 86% reduction in all fossil fuels. To achieve these ambitious goals, an increase in renewable power generation (e.g., solar and wind) along with large energy storage resources are proposed. While renewable energy resources will assist in achieving carbon neutrality goals, the variability and intermittent behavior of these resources give rise to a more dynamic grid, and extreme weather events lead to an increasing frequency of grid outages. A potential solution to mitigate these challenges is microgrid technology, which allows, in principle, local critical loads to be served should the grid become unstable or suffer an outage.

In the early nascent microgrid market, this dissertation develops a standardized characterization of microgrid types, evaluates a procedure for establishing the minimum distributed energy resources to establish a microgrid, develops a methodology to evaluate a microgrid supporting a critical load external to the microgrid in the event of a prolonged grid outage, and explores the impact of microgrids located within and adjacent to disadvantage communities.

The results are intended to inform essential considerations when defining, designing, developing, and deploying microgrids. The dissertation also addresses the impact of microgrids on urban air quality with a focus on disadvantaged communities that could be adversely impacted by a mass-deployment of microgrids. The deployment of zero-emission microgrids with and adjacent to these communities is found to can not only achieve the energy goals of enhanced reliability and resiliency, but a safer environment as well for low-income families.

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