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Assessment of Air Quality and Emissions Benefits of Microgrids

Additional submitted attachment is included below.

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The Energy Commission is currently soliciting ideas and stakeholder input for the 2018 – 2020 EPIC Triennial Investment Plan. For those that would like to submit an idea for consideration in the 2018-2020 EPIC Triennial Plan, we ask that you complete the form below. Submittals are due by **5:00 p.m. on February 10, 2017.**

Part 1. Initiative Description and Purpose:

1. Please provide a brief description of the proposed initiative:

The development of microgrids is gaining increased interest as a means of increasing the resilience and reliability of the electricity system, reducing greenhouse gas and criteria pollutants of the electricity sector, and increasing the usage of renewable electricity in serving the electric load demand. Microgrids refer to a scaled-down version of the centralized electricity system covering an area ranging from a university campus to a city. These systems meet the electricity needs of the area using local and on-site generation resources to the extent possible, relying only on out-of-area resources when needed and providing power to external load when possible. All of these characteristics have implications for the potential greenhouse gas emissions reductions, air quality benefits, and renewable utilization potential. Determining the impact of serving increased portions of California's load with microgrids (vs. centralized generation) based on these metrics from a statewide perspective, however, has historically been difficult due to the diversity of microgrid energy needs, location, and technology portfolios. Different microgrids in different areas have unique load profiles, load energy compositions, and varying levels of access to different energy resources, especially with regards to renewable resources. The ability for these microgrids to use actually co-generation methods also varies depending on the profiles of their heating and cooling loads, which significantly affects the scale of potential benefits. Microgrid resources will typically dispatch on-site resources to meet internal energy needs, which may limit their flexibility to respond to other microgrids across the state and the needs of the bulk electric grid. Finally, the potential benefits of increasing microgrid utilization must be compared against an equivalently developed centralized electricity system and hybrid microgrid-macrogrid systems must also be explored to determine what role centralized resources may need to fulfill in supporting a microgrid-centric system.

This study aims at addressing these difficulties by performing the following: 1) leveraging currently available tools for modeling microgrid and electric grid system operation in conjunction with developing additional tools as necessary, 2) perform an assessment of the potential benefit of increased microgrid deployment on the state's ability to meet long-term greenhouse gas reduction, renewable utilization, and air quality compliance goals, and 3) compare these benefits against a centralized electricity system.

2. What technical and/or market barriers would the proposed initiative help overcome? For scientific analysis and tools, what knowledge gaps would the proposed initiative help fill?

The proposed effort will address knowledge gaps including determining likely areas for microgrid deployment across California. Characterized microgrids will be assessed for integration with the larger electricity system including best use of waste heat assets and optimal balancing generator types. Additionally, the study will provide insight into the optimal configuration of microgrids across the state from the perspective of minimal criteria pollutant and greenhouse gas emissions. Results can then be used to compare the statewide emissions and renewable utilization performance of optimized microgrid-centric electricity systems vs. optimized centralized electricity to determine if there is an optimal microgrid penetration level from an emissions perspective.

Part 2. Benefits and Impacts

3. If this initiative is successful, either fully or partially, what would be the expected impact? Who are the primary users and/or beneficiaries?

The success of the proposed project will not only benefit the ratepayers of three IOUs, including Pacific Gas and Electric Co., San Diego Gas and Electric Co., and Southern California Edison, but will promote optimal integration approaches of renewable resources, combined cooling, heating and power generation strategies, energy storage technologies, sustainable transportation and industry, and advanced microgrid controls, for greater electricity reliability, renewable energy utilization, lower costs, increased safety. More importantly, the design, integration and evaluation approaches assessed in this project will be highly applicable to the effective and efficient deployment of advanced electricity sector technologies across the State to maximize the environmental benefits of renewable power and fuels while avoiding any unforeseen consequences. Using the results from the analyses in this proposal, more renewable technologies and supporting clean technologies could be built out throughout the State to support modernization of the State electric grid providing additional benefits to ratepayers beyond grid investments alone. This project will develop extensible tools and use them to design and evaluate the optimal integration and control of renewable resource and clean energy technologies.

4. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed initiative:

The proposed project will utilize quantitative metrics associated with emissions and air quality to identify optimal strategies to integrate microgrid entities within the State to support clean energy technologies including renewable generation and fuels. Criteria pollutant and greenhouse gas emissions will be projected and quantified for various microgrid scenarios. Next, simulations of atmospheric chemistry and transport will be conducted to spatially and temporally quantify changes in atmospheric pollution, including ozone and particulate matter. Finally, air quality impacts will be translated to quantified impacts on human health endpoints and valued to provide a measure of the costs and benefits of technology decisions. Results will also be utilized to asses impacts with a particular focus on disadvantaged communities to identify strategies that maximize the benefits of renewable resources and clean energy technologies in such areas.

5. Please provide a list of peer-reviewed references that support the responses for questions 3 and 4. Proposed initiatives that include peer-reviewed references will be given stronger consideration.

Carreras-Sospedra, Marc, et al. "Central power generation versus distributed generation–An air quality assessment in the South Coast Air Basin of California." Atmospheric Environment 44.26 (2010): 3215-3223.

Rodriguez, Marco A., et al. "Air quality impacts of distributed power generation in the South Coast Air Basin of California 1: Scenario development and modeling analysis." Atmospheric Environment 40.28 (2006): 5508-5521.

Razeghi, Ghazal, Jack Brouwer, and Scott Samuelsen. "A spatially and temporally resolved model of the electricity grid–Economic vs environmental dispatch." Applied Energy 178 (2016): 540-556.

Hafez, Omar, and Kankar Bhattacharya. "Optimal planning and design of a renewable energy based supply system for microgrids." Renewable Energy 45 (2012): 7-15.

6. (For technologies only) What competitive advantages does the proposed technology solution have over current benchmark technologies? If the technology is beyond the prototype stage, what strategies do you suggest to bring to scale?

N/A

Part 3. Connection to Energy Commission's EPIC Framework
Energy Commission staff have developed a draft strategic framework to guide the CEC's planning and implementation of EPIC across triennial investment cycles. One of the objectives of the draft strategic framework is to communicate a consistent set of priorities for organizing current and future EPIC investments.

7. Please indicate which of the following strategic framework themes you feel the proposed initiative best fits within:
    - Advance Technology Solutions for Deep Energy Savings in Building and Facilities
    - Accelerate Widespread Customer Adoption of Distributed Energy Resources
    - Increase System Flexibility from Low-Carbon Resources
    - Increase the Cost-Competiveness of Renewable Generation
    - Create a Statewide Ecosystem for Incubating New Energy Innovations
    - Maximize Synergies in the Water-Energy-Food Nexus
    - Develop Tools and Analysis to Inform Energy Policy and Planning Decisions
    - Catalyze Clean Energy Investments in California's Underrepresented and Disadvantaged Communities

If Other, Please Specify