



(This is a Request for Information only - Complete Pages 1 and 2 for each initiative)

Title of Proposed Initiative: Smart Grid and Microgrid Dynamics and Control

Investment Areas (Check one or more) – *For definitions, see First Triennial Investment Plan, page 12:*

- Applied Research and Development
- Technology Demonstration and Deployment
- Market Facilitation

Electricity System Value Chain (Check only one): See CPUC Decision 12-05-037, Ordering Paragraph 12.a. http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF.

- Grid operations/market design
- Generation
- Transmission
- Distribution
- Demand-side management

California Energy Commission

DOCKETED

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Issues and Barriers:

Smart Grid and Microgrid technologies are receiving attention, but, have not been systematically analyzed to develop robust active control strategies for the complex infrastructure systems that they entail.

Initiative Description and Purpose:

Smart Grid and Microgrid dynamics and controls must consider the physics, chemistry and electrochemistry involved in gas turbine, fuel cell, solar and wind power generation dynamics and must develop systems control strategies that are essential for the future electric power grid. The development of smart grid technology is especially important to widespread use of renewable power systems and battery electric vehicles. Research and development should include: (1) realistic “Living Laboratory” microgrids for energy technology testing, (2) interconnection technology development to enable seamless renewable and distributed energy resource integration, (3) dynamic modeling and analysis of smart circuit technology, (4) smart building and smart grid energy management, monitoring, and control systems development, (5) battery electric and plug-in hybrid electric vehicle testing, (6) basin energy management modeling, (7) greenhouse gas life cycle assessment for novel electric, gas and transportation technologies, and (8) air quality modeling and assessment of future energy technologies.

Innovative research and development projects should include, for example: (1) Smart Grid Design Simulation and Modeling, (2) Simulation and analysis of smart circuit technology, (3) Smart Grid Impacts and Performance Assessment, (4) Deep Grid Situational Awareness, and (5) Development of algorithms using digital signal processing techniques to process data from synchronized phasor measurements.

Recommended minimum funding level = \$500,000/project; Recommended maximum funding level = \$3,000,000/project.

Stakeholders:

Southern California Edison; Pacific Gas and Electric; Southern California Gas; San Diego Gas and Electric; Advanced Power and Energy Program; University of California – all campuses; U.S. Department of Energy; Southern California Gas; U.S. Environmental Protection Agency; Air Pollution Control Districts and Air Quality Management Districts;

Background and the State-of-the-Art:

- The Advanced Power and Energy Program is working with Southern California Edison on the Irvine Smart Grid Demonstration project that is testing all levels of Smart Grid technology and garnering international attention.
- Findings for the ISGD research suggest savings of up to 20% in greenhouse gas and criteria pollutant emissions are possible with smart grid technology.
- UC Irvine and UC San Diego both have very active microgrid infrastructure testing and research and development programs.
- Projects to advance Smart Grid and Microgrid technology have been supported previously by the following entities: California Energy Commission; U.S. Department of Energy; California Public Utilities Commission; Southern California Edison; Pacific Gas and Electric; San Diego Gas and Electric, etc.

STATE OF CALIFORNIA

EPIC TRIENNIAL INVESTMENT PLAN 2015-17

Proposed Energy Research Initiative Questionnaire



CALIFORNIA ENERGY COMMISSION

Justification:

Smart Grid and Microgrid technologies will provide California IOU electric ratepayer benefits, including:

- The IOU electric ratepayer will benefit by having additional sustainable sources of electricity that will offset their direct need to pay for more infrastructure (e.g., power plants, transmission and distribution lines)
- The IOU electric ratepayer will benefit by lower cost of electricity due to self-generation support and voltage and ancillary services support of the utility grid network
- The IOU electric ratepayer will benefit by greater electric reliability caused by less stress on the network and better control of the grid dynamics especially as larger and larger amounts of renewable power are being used
- Natural gas utilities, alternative fuel developers, zero emissions vehicle developers all have an interest in better and smart control of grids and microgrids
- Societal benefits include better ability to dispatch power, control power flow according to demand and/or price enabling introduction of clean technology in a cost-effective manner,
- Improvements in air quality and reductions in greenhouse gas emissions will result to the benefit of ratepayers and society.
- This research is appropriate for public funding because it is not currently being accomplished by the private sector and because the market for such technologies is currently restricted due to the recent emergence of tri-generation from the laboratory setting.

Ratepayer Benefits (Check one or more):

- Promote greater reliability
- Potential energy and cost savings

- Increased safety
- Societal benefits
- Environmental benefits – better air quality, less waste disposal
- GHG emissions mitigation/adaptation in the electricity sector at the lowest possible cost
- Low emission vehicles/transportation
- Waste reduction
- Economic development

Describe specific benefits (qualitative and quantitative) of the proposed initiative

Public Utilities Code Sections 740.1 and 8360:

The proposed research initiative is in alignment with section (e) (1) of CPUC Code Section 740.1 by supporting environmental improvement associated with the State's climate change and air quality goals. Additionally, the proposed research meets the criteria of these public utilities code sections by (a) providing benefits to ratepayers and (d) as no similar research is currently being undertaken.