BOARD MEETING DATE: October 6, 2017 AGENDA NO. 4

PROPOSAL: Execute Contract to Assess Air Quality and Greenhouse Gas Impacts of Microgrid-Based Electricity System

SYNOPSIS: California has set a goal of installing 12,000 megawatts of distributed generation in the state by 2020 to reduce criteria pollutant and greenhouse gas emissions from the electricity and transportation sectors. Microgrids allow local management of energy resources and loads, which will more easily allow electrification of transportation. The University of California Irvine (UCI) through its Advanced Power and Energy Program proposes to perform three projects to evaluate air quality and greenhouse gas impacts. These projects will focus on potential fuel cell technology applications for industrial operations and petroleum refineries, assess impacts of renewable hydrogen blending in existing natural gas infrastructure and equipment, and compare economic performance of a fuel cell and battery-electric bus operating in a microgrid. This action is to execute a contract with UCI in an amount not to exceed $660,000 from the Clean Fuels Fund (31).

COMMITTEE: Technology, September 15, 2017; Recommended for Approval

RECOMMENDED ACTION:
Authorize the Chairman to execute a contract with UCI for the assessment of air quality and greenhouse gas impacts of a microgrid-based electricity system in an amount not to exceed $660,000 from the Clean Fuels Fund (31).

Wayne Nastri
Executive Officer

MMM:FM:NB:SH

Background
The development of microgrids is gaining attention as a means of increasing the resilience and reliability of the electricity system, reducing criteria pollutant and greenhouse gas (GHG) emissions from the electricity and transportation sectors, and increasing the deployment of renewable power generation resources in serving electric load demand. The provision of electric service through microgrids has a number of potential advantages, including but not limited to:

- Reducing transmission losses and the need for transmission capacity and additional transmission lines to connect external generation;
- Taking advantage of co-/poly-generation methods such as combined heat and power or distributed heating and cooling;
- Allowing usage of otherwise stranded assets such as biogas and biomass; and
- Maintaining electric service in the event of an external grid outage.

As microgrids become more prevalent, capacity for electricity generation which was previously outside the South Coast Air Basin (Basin) will be retired and replaced with new capacity inside of the Basin. The potential of microgrids to substantially reduce criteria pollutant emissions depends entirely on their design.

The University of California Irvine (UCI) Advanced Power and Energy Program (APEP) has developed expertise in research involving electric grid modeling at the macro- and micro-grid scales and characterizing the technical, economic, and environmental performance sensitivities of these systems. This expertise was developed through several major research projects funded by DOE, California Energy Commission (CEC), and Southern California Gas (SoCalGas). UCI APEP has a Generic Microgrid Controller (GMC) to manage efficient, reliable, and resilient operation of the microgrid. APEP is also applying the GMC to a Southern California Edison state-of-the-art substation in order to explore the applicability of microgrid control to primary circuits of the utility. The proposed project will be linked with those related programs to explore microgrid design features that facilitate zero emissions of both criteria pollutants and GHGs in stationary and mobile uses.

Proposal
This action is to execute a contract with UCI to assess criteria pollutant and GHG impacts of a microgrid-based electricity system by evaluating, respectively: fuel cell technology for industrial applications, emission impacts of renewable fuel blending in the natural gas system, and environmental and economic advantages of a fuel cell and battery-electric bus operating under a microgrid. Matching funding will be provided by UCI, DOE, CEC, SoCalGas, UCI, and National Science Foundation (NSF).

Fuel Cell Technology for Industrial and Petroleum Refinery Microgrids

This project proposes an assessment of emission reductions achievable from fuel cell technology deployment at industrial sites in the Basin, with a focus on petroleum refining activities. Additionally, fuel cells within commercial microgrids will be considered with a focus on the ability of fuel cells to offset emissions from traditional backup generation. This study will address these needs by: 1) thoroughly assessing sources of emissions within the industry to better understand associated needs and constraints; 2) identifying and characterizing optimal pathways for fuel cell deployment in various industrial activities; and 3) quantifying the potential associated emission reductions in the Basin – including consideration of those in underserved communities. Based on the evaluation results, UCI will provide overall assessment of the criteria pollutant and GHG advantages of increased deployment of fuel cells in industrial and commercial applications, including petroleum refineries. This will assist the SCAQMD in developing strategies to transform stationary industrial equipment to zero- and near-zero technologies, e.g., providing insight into how incentive programs should be structured to encourage fuel cell adoption.

Assess the Emission Impacts of Renewable Fuel Blending in the Natural Gas System

Current research on renewable fuel injection into the natural gas system has focused primarily on the feasibility and safety of injection and blending of fuels, and little is known regarding the potential emissions impacts. Therefore, research is needed to support the development of holistic combustion device and burner deployment strategies targeting minimal emissions of criteria pollutants and maximum criteria pollutant, GHG, and human health benefits. This project aims to address these needs by performing the following: 1) leverage existing and currently available tools for modeling combustion burner performance and emissions available at the UCI in conjunction with developing additional tools as necessary; 2) identify and characterize emission impacts for a range of gas-consuming end-use devices to create economy-wide scenarios representative of renewable gaseous fuel blending; and 3) spatially and temporally characterize resulting criteria pollutant, air toxic emissions, and GHG impacts in the Basin. The results will evaluate advantages and disadvantages of increased renewable fuel integration into the natural gas system, as well as guidance for the design of burner-type deployment strategies in different economic sectors to maximize air quality benefits of renewable fuel utilization.

Comparative Study on Environmental-Economic Impacts of Fuel Cell and Battery-Electric Buses within a Microgrid

The improvement of air quality in urban areas requires the reduction of criteria pollutant emissions across several sectors. The public transport sector is of particular interest, in part due to the localized emissions in disadvantaged communities. Transit authorities looking to renew their fleets are faced with decisions between multiple bus technologies, each with different strengths and weaknesses, as well as infrastructure requirements. These decisions are made more difficult by the rapid rate of improvement

and less-well-known costs of advanced technologies such as battery-electric buses (BEBs) and fuel cell buses (FCBs). Both zero-emission bus (ZEB) technologies have been individually tested in several demonstration projects. UCI has been operating one FCB with Anteater Express since November 2015. Anteater Express will acquire 20 plug-in BEBs in the fall of 2017, making UCI's bus fleet the first fully zero-emissions fleet in California; and the first transit agency in the country to have an exclusive mix of BEBs and a FCB in operation. The simultaneous operation of BEB and FCB provides a unique opportunity to develop an evaluation framework under consistent conditions. The project will utilize the unique technology-mix fleet operating at UCI to produce the first comprehensive and consistent analysis of the BEB and FCB in practical operation, by leveraging tools developed by APEP to model the infrastructure requirements for the adoption of ZEBs and comparing the operational and economic performance of BEBs and FCBs in regular service.

Sole Source Justification

Section VIII.B.2 of the Procurement Policy and Procedure identifies four major provisions under which a sole source award may be justified. This request for a sole source award is made under provision B.2.d.(8): Other circumstances exist which in the determination of the Executive Officer require such waiver in the best interest of the SCAQMD. Such circumstances may include but are not limited to projects involving research and development efforts with educational institutions or nonprofit organizations

UCI is an educational institution and the APEP is an umbrella organization that addresses the broad utilization of energy resources and the emerging nexus of electric power generation, infrastructure, transportation, water resources, and the environment. Built on a foundation established in 1970 with the creation of the UCI Combustion Laboratory and the 1998 dedication of the National Fuel Cell Research Center, APEP focuses on education and research on clean and efficient distributed power generation and integration.

Benefits to SCAQMD

The proposed project supports the implementation of advanced technologies that could be used to further reduce NOx emissions from microgrid-based electricity systems. Microgrids offer many opportunities for reducing criteria pollutant emissions from many existing sources within the Basin. Specifically, fuel cell systems can be utilized to reduce emissions from commercial and industrial sources. Fuel cells can replace internal combustion engines in primary, back-up, and emergency generation to achieve emission reductions. Furthermore the injection of gaseous renewable fuels into the existing natural gas system represents a key pathway towards reducing GHG emissions by displacing the corresponding volume of fossil-derived natural gas. For mobile sources, microgrids allow local management of energy resources and loads which will more easily allow electrification of transportation within the Basin.

The proposed project is included in the *Technology Advancement Office Clean Fuels Program 2017 Plan Update* under the categories "Electric/Hybrid Technologies & Infrastructure" and "Hydrogen and Fuel Cell Technologies and Infrastructure."

Resource Impacts
The total cost for the proposed projects is $1,300,000, of which SCAQMD's proposed contribution will not exceed $660,000 from the Clean Fuels Fund (31), as summarized below.

Proposed Projects	SCAQMD Funding Amount	Match Funding Amount	Project cost
Fuel Cell for Industrial Applications	$180,000	$120,000 (SoCalGas, DOE, UCI)	$300,000
Renewable Fuel Blending in Natural Gas System	$230,000	$320,000 (CEC, SoCalGas, UCI)	$550,000
Performance Comparison of Battery-electric and Fuel Cell Bus	$250,000	$200,000 (NSF, SoCalGas, UCI)	$450,000
Total	$660,000	$640,000	$1,300,000

Sufficient funds are available from the Clean Fuels Program Fund, established as a special revenue fund resulting from the state-mandated Clean Fuels Program. The Clean Fuels Program, under Health and Safety Code Sections 40448.5 and 40512 and Vehicle Code Section 9250.11, establishes mechanisms to collect revenues from mobile sources to support projects to increase the utilization of clean fuels, including the development of the necessary advanced enabling technologies. Funds collected from motor vehicles are restricted, by statute, to be used for projects and program activities related to mobile sources that support the objectives of the Clean Fuels Program.