


BOARD MEETING DATE: December 5, 2014

AGENDA NO. 3

**PROPOSAL:** Recognize and Transfer Revenue and Execute Contracts to Develop and Demonstrate Fuel Cell and Plug-In Hybrid Heavy-Duty Trucks 

**SYNOPSIS:** On August 21, 2014, DOE notified SCAQMD of a \$9,725,000 award to develop and demonstrate zero emission drayage trucks under the Zero Emission Cargo Transportation II Program. Other partners are providing additional funds totaling \$4,783,979 to cost-share this project. This action is to recognize revenue upon receipt in the amount of \$14,508,979 into the Advanced Technology Goods Movement Fund (61). This action is to also transfer \$7,183,979 from the Clean Fuels Fund (31), which includes SCAQMD's cost-share of \$2,400,000 and \$4,783,979 as a temporary loan, to the Advanced Technology Goods Movement Fund (61) and to execute contracts for the development and demonstration of zero emission drayage trucks.

**COMMITTEE:** Technology, November 21, 2014; Recommended for Approval

**RECOMMENDED ACTIONS:**

1. Recognize upon receipt up to \$9,725,000 from the DOE into the Advanced Technology Goods Movement Fund (61).
2. Recognize upon receipt up to \$4,783,979 from other project partners, comprised of \$2,400,000 from CEC; \$1,000,000 from LADWP; \$1,133,979 from the Ports' Technology Advancement Program (TAP); and \$250,000 from the Southern California Gas Company (SoCalGas), into the Advanced Technology Goods Movement Fund (61).
3. Transfer \$4,783,979 as a temporary loan and \$2,400,000 for SCAQMD's cost-share from the Clean Fuels Fund (31) into the Advanced Technology Goods Movement Fund (61).
4. Authorize the Chairman to execute contracts, upon DOE approval, with the following entities, from the Advanced Technology Goods Movement Fund (61):
  - A. Center for Transportation and the Environment (CTE) for the development and demonstration of one Class 8 fuel cell range extended electric drayage truck in the amount not to exceed \$7,059,384;

- B. Transportation Power (TransPower) for the development and demonstration of two Class 8 fuel cell range extended electric drayage trucks in the amount not to exceed \$1,634,896;
- C. U.S. Hybrid for the development and demonstration of two Class 8 fuel cell range extended electric drayage trucks in the amount not to exceed \$2,073,034;
- D. Gas Technology Institute (GTI) for the development and demonstration of one Class 8 CNG hybrid electric drayage truck in the amount not to exceed \$5,315,881; and
- E. International Rectifier (IR) for the development and demonstration of one diesel hybrid electric drayage truck in the amount not to exceed \$825,784.

Barry R. Wallerstein, D.Env.  
Executive Officer

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### **Background**

The SCAQMD, CARB and SCAG — the agencies responsible for preparing the State Implementation Plan required under the federal Clean Air Act — have agreed that attainment of federal air quality standards for the region will require a transition to the broad use of zero and near-zero emission energy sources in cars, trucks and other equipment. Accordingly, the 2012 AQMP, the SCAG 2012 Regional Transportation Plan, and the “Vision for Clean Air: A Framework for Air Quality and Climate Control Planning” all identify the need to immediately enact a phasing in of zero and near-zero emission technologies to meet air quality goals.

On June 11, 2014, SCAQMD submitted a proposal under DOE’s Zero Emission Cargo Transport Demonstration Funding Opportunity Announcement. The proposal consisted of two technologies for goods movement operations between the Ports of Los Angeles and Long Beach near dock rail yards and warehouses: 1) development and demonstration of zero-emission fuel cell range extended electric drayage trucks and 2) development and demonstration of hybrid electric drayage trucks. The purpose of these projects is to accelerate deployment of zero emission cargo transport technologies to reduce harmful diesel emissions, petroleum consumption and greenhouse gases in the surrounding communities along the goods movement corridors that are impacted by heavy diesel traffic and the associated air pollution. On August 21, 2014, the DOE notified SCAQMD that the project proposal to develop and demonstrate zero-emission drayage trucks had been selected for an award.

## **Proposal**

This action is to recognize and transfer revenue into the Advanced Technology Goods Movement Fund (61) and to execute contracts from the Advanced Technology Goods Movement Fund (61) for the following projects. The projects described below are based on the applicants' proposals and fuel specifications may change as the designs are finalized, optimized and subject to DOE approval.

### Center for Transportation and the Environment (CTE)

Under project management by CTE, BAE Systems will develop a battery electric truck with hydrogen fuel cell range extender. This project will leverage the expertise of BAE Systems and Ballard Power Systems to test their hybrid electric fuel cell propulsion system, currently used for transit buses, in drayage applications. The power output of the electric drive train is comparable to currently used Class 8 truck engines power output. AC traction motors will be mounted one on each rear drive axle and the electric drive train in the architecture is set up to be fully redundant. The vehicle will operate primarily from the batteries, engaging the fuel cell system only when the batteries reach a specified state of charge. BAE anticipates that the 30 kg of hydrogen (25 kg usable) will provide approximately 112 miles of range between re-fueling.

### Transportation Power (TransPower)

TransPower will develop two battery electric trucks with hydrogen fuel cell range extenders. To extend the operating range of battery-electric trucks operating in the San Pedro Bay Ports while maintaining zero emissions, TransPower proposes to employ a small fuel cell, capable of increasing the amount of onboard energy available between vehicle recharging or refueling events by a factor of 3.25. The preliminary technical concept for the proposed fuel cell range extender project is to use TransPower's proven ElecTruck™ drive system as a foundation and add fuel cells provided by Hydrogenics, one of the world's leading suppliers of hydrogen fuel cells. The proposed project will result in the manufacturing and deployment of two demonstration trucks, one with a 30 kW fuel cell and one with a 60 kW fuel cell, enabling a direct comparison of both variants. The higher power output of the 60 kW systems is expected to be better suited to trucks carrying heavy loads over longer distances that might exceed the average power capacity of the 30 kW systems. The system will store 25-30 kg of hydrogen onboard based on an estimated 7.37 miles per kg fuel economy. TransPower's system also includes a bi-directional J1772-compliant charger that can recharge the vehicle batteries or provide power export.

### U.S. Hybrid

U.S. Hybrid will develop two battery electric trucks with an onboard hydrogen fuel cell generator. U.S. Hybrid has been involved with fuel cell-powered vehicles for several years (including cargo vans, transit/shuttle buses and heavy-duty military vehicles) and believes the technology and product has reached maturity beyond feasibility and is ready for commercial demonstration deployment. The truck is powered by a lithium-ion battery with an 80 kW hydrogen fuel cell generator in charge sustaining mode,

eliminating the need for charging. The fuel cell power plant is sized to sustain continuous operation based on average power demand for drayage applications. As a result, the battery size is significantly reduced, as is the required charging infrastructure. The proposed technology will provide a 150-200 mile range between refueling. Each truck will carry approximately 20 kg of hydrogen storage at 350 bar with an estimated fueling time of less than 10 minutes.

#### Gas Technology Institute (GTI)

Under project management by GTI, contractor BAE Systems will develop one battery electric truck with CNG range extender and optional catenary capability. The proposed technical concept provides a well-balanced blend of all electric and CNG-based operation to provide a system that can operate in a zero emissions (all-electric) mode and in a conventional hybrid electric mode using CNG. The electric drive train will be based on BAE Systems HybriDrive® Series (HDS) propulsion system hardware. The electric drive train will include an Integrated Starter Generator (ISG), mounted on the engine and rated for up to 200 kW continuous output, two dual 200kW propulsion control systems (PCS) and two AC traction motors (ACTM) which can provide a combined propulsion power output of 320 kW (430 hp) continuous. The power output of the electric drive train is comparable to currently used Class 8 truck engines power output.

#### International Rectifier (IR)

IR will develop one plug-in hybrid-electric truck (PHEV) and an ultra-fast charger (UFC) for use in or near the ports. IR's technology will demonstrate a bolt-on architecture that can form the basis of a conversion kit. This kit could be applied to standard Class 8 drayage vehicles, turning them into PHEVs capable of operating in a zero emissions (all-electric) mode for all the required its duty cycles while it is within a predetermined distance from the Ports of Los Angeles and Long Beach. Once outside that predetermined zero emission zone, the Class 8 PHEV would switch from all electric to hybrid-electric mode, whereby the vehicle would operate at higher efficiencies to reduce diesel fuel consumption. Furthermore, the PHEVs are capable of ultra-fast charging (15 to 20 minutes), so that their utilization rates are on par with those of conventional drayage vehicles.

#### **Sole Source Justification**

Section VIII.B.3. of the Procurement Policy and Procedure identifies provisions under which a sole source award may be justified when funded in whole or in part with federal funds. The request for a sole source award for this project is made under the provisions B.3.c: the awarding federal agency authorizes noncompetitive proposals; and B.2.d.: Other circumstances exist which in the determination of the Executive Officer require such waiver in the best interest of the SCAQMD. Specifically, these circumstances are: B.2.d.(1) Projects involving cost-sharing by multiple sponsors. The five truck manufacturers approved by DOE for this zero-emission cargo transport demonstration project: Center for Transportation and the Environment, Gas Technology Institute, International Rectifier, Transportation Power and U.S. Hybrid, each have extensive

knowledge and experience in advanced electric, fuel cell and hybrid vehicle technologies that are needed to successfully complete this project. The manufacturers will utilize their proprietary technologies in the development of prototype drayage trucks to improve system reliability, efficiency and costs over previous generations. This demonstration project will be cost-shared by the five truck manufacturers and SCAQMD, CEC, LADWP, Port of Los Angeles, Port of Long Beach and Southern California Gas Company as discussed in the Resource Impacts section.

**Benefits to SCAQMD**

Projects to support implementation of various clean fuel vehicle incentive programs are included in the *Technology Advancement Office Clean Fuels Program 2014 Plan Update* under the categories of “Electric/Hybrid Technologies & Infrastructure” and “Hydrogen and Fuel Cell Technologies and Infrastructure”. This project is to develop and demonstrate zero-emission drayage trucks with fuel cell range extended and hybrid electric technologies for goods movement operations. Successful demonstration of such projects will contribute to the attainment of clean air standards in the South Coast Air Basin by eliminating PM and NO<sub>x</sub> emissions from replaced diesel drayage trucks.

**Resource Impacts**

The total cost for this proposed project is \$19,984,820, comprised of \$9,725,000 from DOE, \$2,400,000 from SCAQMD and \$4,783,979 from other project partners as well as \$3,075,841 in OEM indirect cost-share, as follows:

<b>Project Partner</b>	<b>Funding Amount</b>	<b>Percent</b>
DOE	\$9,725,000	49%
OEMs	\$3,075,841	15%
CEC	\$2,400,000	12%
SCAQMD ( <i>requested</i> )	\$2,400,000	12%
LADWP	\$1,000,000	5%
Ports’ TAP	\$1,133,979	6%
SoCalGas	\$250,000	1%
<b>Total</b>	<b>\$19,984,820</b>	<b>100%</b>

The \$14,508,979 in revenue from DOE and other project partners will be recognized into the Advanced Technology Goods Movement Fund (61). A transfer of \$4,783,979 as a temporary loan and \$2,400,000 for SCAQMD’s cost share will be made from the Clean Fuels Fund (31) into the Advanced Technology Goods Movement Fund (61), from which contracts will be executed. Any unspent funds will be returned to the Clean Fuels Fund (31) upon project completion.

The proposed contractors and sources of funds are outlined in the table below.

<b>Proposed Contractor</b>	<b>Total Project Cost</b>	<b>DOE Funding</b>	<b>OEM Cost-Share</b>	<b>SCAQMD &amp; Partners</b>
U.S. Hybrid	\$3,220,694	\$1,350,692	\$1,147,660	\$722,342
TransPower	\$2,359,531	\$1,180,196	\$724,635	\$454,700
CTE	\$7,109,384	\$3,554,691	\$50,000	\$3,504,693
GTI	\$5,627,319	\$2,813,637	\$311,438	\$2,502,244
IR	\$1,667,892	\$825,784	\$842,108	
<b>Total</b>	<b>\$19,984,820</b>	<b>\$9,725,000</b>	<b>\$3,075,841</b>	<b>\$7,183,979</b>

Sufficient funds are available from the Clean Fuels Fund (31), 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.