CALIFORNIA AIR RESOURCES BOARD

Low Carbon Transportation Investments

Fiscal Year 2016-17 Off-Road Advanced Technology Demonstration Project Solicitation

List of Applications Received and Project Summaries

Page	Project Applicant	Project Title	Location	Disadvantaged Community Status	Funding Amount Request
1	AgTech Innovation Alliance	Advanced, Modular, and Standardized Power Platform for All Off-Road, Heavy-Duty, or Mobile Freight Vehicles Utilizing a Zero-Idle, Multi-Fuel, and Hyper Efficient Hybrid System	Turlock	Located Within	$2,967,500
2	Bay Area Air Quality Management District (BAAQMD)	Zero-Emission Hydrogen Ferry Demonstration Project	Oakland	Located Within	$3,000,000
3	California State University, Fresno	Series Hybrid Electric Farm Tractor (SHEF Tractor) Demonstration	Fresno	Located Within	$1,542,499
4	CALSTART	Off-Road Electric Drive Wheel Loader Retrofit Project	Sacramento	Located Within	$1,068,457
5	Center for Alternative Fuels	Zero-Emission Airports: All-Electric Ground Power Unit Demonstration	Oakland and Long Beach	Located Within	$1,214,282
6	Center for Transportation and the Environment	Demonstration of Zero-Emission Technologies for Freight Operations at Ports	San Pedro	Located Within	$6,508,544
7	City of Long Beach Harbor Department	C-PORT: The Commercialization of POLB Off-Road Technology Demonstration Project	Long Beach	Provides Benefits to	$6,166,000
8	City of Los Angeles Harbor Department	Port of Los Angeles Zero-Emission Track-Miles Locomotive Demonstration Project	Wilmington	Located Within	$2,793,717

List of Applications Received and Project Summaries (continued)

Page	Project Applicant	Project Title	Location	Disadvantaged Community Status	Funding Amount Request
9	Project Clean Air	San Joaquin Valley Electric Tractor Development and Demonstration	Fresno and Reedley	Located Within	$1,500,000
11	Sacramento Air Quality Management District (SMAQMD)	Hydrogen-Fueled Zero-Emissions Switcher Locomotive	West Sacramento	Provides Benefits to	$4,646,567
13	San Diego Unified Port District	San Diego Unified Port District – Off-Road Advanced Technology Demonstration Project	National City	Located Within	$9,734,239
14	San Joaquin Valley Air Pollution Control District (SJVAPCD)	San Joaquin Valley Off-Road Zero-Emission Agricultural Utility Terrain Vehicle Market Demonstration Project	Several Potential Sites Listed	Provides Benefits to	$3,000,000
15	San Joaquin Valley Air Pollution Control District (SJVAPCD)	San Joaquin Valley Zero-Emission Cargo Handling Demonstration Project	Stockton	Located Within	$772,555
16	San Joaquin Valley Air Pollution Control District (SJVAPCD)	Zero Emission Transport Refrigeration Demonstration in California Foodservice and Grocery Distribution Fleets	Several Potential Sites Listed	Most Locations Located Within	$10,448,137
17	South Coast Air Quality Management District (SCAQMD)	Demonstration of Advanced Battery Switcher Locomotive with Range Extending Technologies	Anaheim	Located Within	$4,512,387

Solicitation materials are available at: www.arb.ca.gov/msprog/aqip/solicitations.htm.

Application scoring criteria are described in the Off-Road Advanced Technology Demonstration Projects Grant Solicitation at https://www.arb.ca.gov/msprog/mailouts/msc1711/msc1711attach1.pdf.

Project Applicant: AgTech Innovation Alliance

Project Title: Advanced, Modular, and Standardized Power Platform for All Off-Road, Heavy-Duty, or Mobile Freight Vehicles Utilizing a Zero-Idle, Multi-Fuel, and Hyper Efficient Hybrid System

Project Summary for Public Posting

Advanced, modular, and standardized power platform for all off-road, heavy-duty, or mobile freight vehicles utilizing a zero-idle, multi-fuel, and hyper efficient hybrid system.

Name of applicant: AgTech Innovation Alliance
Project technology demonstrator: Terzo Power Systems, LLC.
Emissions testing provider: Sensors, Inc.
Project data collection provider: Elevat, Inc.
End User: C R Orchards, Inc.
Total Project Amount: $3,9463,500
Funding Amount Requested: $2,967,500
Match Amount: $996,000

Our advanced technology demonstration and project partners are proposing an applied research and development project under Group E: *Non-Freight Off-Road Equipment Category – Agriculture Equipment*. Our project specifically targets agricultural harvesting equipment currently powered by diesel engines. Powering off-road vehicles with a non-diesel engine presents unique challenges due to torque requirements, vehicle control constraints, highly-varied application specific functions, and hydraulic fluid power integration. Developing an easy to integrate, cost effective solution to these challenges will provide a valuable opportunity for statewide adoption of technology that will not only achieve energy savings and emissions reductions, but will also create safer working environments and a solid transitional platform to zero emission vehicles in the future.

The demonstration portion of this project will be performed within disadvantaged communities throughout the San Juaquin Valley. Operation of both the baseline diesel vehicle and the CNG Hybrid-Electric Vehicle will be undertaken by a commercial harvest company over the course of two fall nut harvest seasons.

Expected estimated reductions of GHG as well as other emission reduction calculations are shown below.

GHG Emissions Reduction		
Baseline Vehicle	86.42	$(Metric\ Tons\ CO2\ e)/Year$
ATV Vehicle	44.26	$(Metric\ Tons\ CO2\ e)/Year$
GHG Reduction (Baseline – ATV)	**42.16**	$\boldsymbol{(Metric\ Tons\ CO2\ e)/Year}$
Criteria Pollutant and PM Emissions Reduction		
Baseline Vehicle (Tier IV Final Diesel)		
Nitrogen Oxide	0.044	$(Tons\ NOx)/Year$
Reactive Organic Gas	0.010	$(Tons\ ROG)/Year$
Particulate Matter (less than 10 microns)	0.0014	$(Tons\ PM10)/Year$
ATV Vehicle (CNG Spark Ignited Engine LSI)		
Nitrogen Oxide	0.016	$(Tons\ NOx)/Year$
Reactive Organic Gas	0.0007	$(Tons\ ROG)/Year$
Particulate Matter (less than 10 microns)	0.0045	$(Tons\ PM10)/Year$
Reductions (Baseline – ATV) (Tier IV Diesel vs CNG LSI)		
Nitrogen Oxide	**0.028**	$\boldsymbol{(Tons\ NOx)/Year}$
Reactive Organic Gas	**0.0093**	$\boldsymbol{(Tons\ ROG)/Year}$
Particulate Matter (less than 10 microns)	**-0.0031**	$\boldsymbol{(Tons\ PM10)/Year}$

Project Applicant: Bay Area Air Quality Management District (BAAQMD)

Project Title: Zero-Emission Hydrogen Ferry Demonstration Project

Zero-Emission Hydrogen Ferry Project

Project Summary for Public Posting

Project Name: Zero-emission Hydrogen Ferry Demonstration Project
Applicant: Bay Area Air Quality Management District (Air District)
Project Partners: Golden Gate Zero Emission Marine, Bay Ship and Yacht, BAE Systems, Hydrogenics, Air Liquide Advanced Technologies U.S. LLC, Red and White Fleet, and the Port of San Francisco
Description of Project: The project will construct and deploy a zero-emission hydrogen fuel ferry providing passenger service, serving the Port of San Francisco, Port of Oakland, Port of Redwood City, and the City of Martinez.
Requested Funding Amount: 3,000,000
Total Project Cost: $5,365,000
Expected Emission Reductions:

Pollutant	Greenhouse Gases (MT)	NOx (tons)	ROG (tons)	PM_{10} (tons)	Weighted Emission Reductions (NOx, ROG, PM_{10})
Annual Reduction	280	2.95	0.37	0.052	4.367

Benefits to Disadvantaged Communities: The zero-emission hydrogen ferry will meet the following Disadvantaged Community criteria:

1. Domiciled within a Disadvantaged Community
2. Provides benefits to Disadvantaged Communities by serving designated Freight Hubs
3. Provides benefits to Disadvantaged Communities by providing increased access to clean transportation for disadvantaged community residents by being accessible by walking within ½ mile of a disadvantaged community.

4

Project Applicant: California State University, Fresno

Project Title: Series Hybrid Electric Farm Tractor (SHEF Tractor) Demonstration

Attachment 1: Project Summary for Public Posting

Project Name: Series Hybrid Electric Farm Tractor (SHEF Tractor) Demonstration
Name of Applicant and Project Partners: California State University, Fresno and Autonomous Tractor Corporation
Brief Description and Location of Proposed Project: Applicant and Technology Demonstrator will convert a typical, diesel-powered mechanical California farm tractor of approximately 100hp to a series hybrid electric drive train that includes a generator coupled to the diesel engine, wheel motors and power electronics (SHEF Tractor). This vehicle will be compared to an identical non-converted diesel farm tractor through typical work cycles including planting, tillage, cultivation, haulage, etc. Comparisons of fuel consumption and emissions will be made during each field activity to assess the comparative benefit of the electric hybrid drive train. Further enhancements to the SHEF tractor could be made, depending on CARB's interest, to include 100% biodiesel use and / or the use of fuel cell technology to provide the electricity needed in place of the diesel engine and generator. The assembly of the SHEF tractor will occur in Technology Demonstrator's facility in Minnesota and all field demonstrations will be conducted in Fresno, California.
Amount of Funding Requested: $1,542,499
Total Cost of Project (Requested and Match): $2, 197,262
Expected Emission Reductions in Criteria, Toxic and GHG: 19% reduction in emissions
Disadvantaged Community Status: Located in a disadvantaged community

Project Applicant: CALSTART

Project Title: Off-Road Electric Drive Wheel Loader Retrofit Project

Project Summary for Public Posting

Project Name: "Off-Road Electric Drive Wheel Loader Retrofit Project"

Name of applicant and project partners: CALSTART, Caterpillar, Inc /Holt of CA/ Teichert Construction

Brief description of project including location: CALSTART and Caterpillar Inc. propose to administer, manage, and coordinate the Off-Road Electric Drive Wheel Loader Retrofit Project, which will develop a 988K XE retrofit kit that will be installed on the 988K Tier 4 model Wheel Loader. The retrofitted equipment will be demonstrated using on a high hour 988 Tier 4 model Wheel Loader at a relevant worksite. The project team will demonstrate that a 988K Tier 4 model, which is currently running at a customer location in California can be retrofitted into a 988K XE and will achieve the same fuel reduction and associated GHG reduction as the new factory machine. The proposed project will allow older models, which still have significant useful life to move "above and beyond Tier 4". The project team will prove the ability to achieve these benefits using both traditional and renewable diesel fuel. The retrofitted 988 Tier 4 model is expected to show significant fuel savings similar to the Caterpillar 988K XE (high technology variant of production Cat 988K) Wheel Loader, a fully developed, operational, advanced vehicle technology prototype for OFF-ROAD applications. This large-sized (~56 ton) electric drive wheel loader utilizes electric generators, motors, and controllers to perform the function of the previous model's transmission and torque converter in order to do the same work with significantly less waste (25%+ fuel burn reduction resulting in a reduction in almost 70 metric tons of CO2 and .048 tons of criteria pollutants per year per machine). It is being developed to be more cost-effective, have higher efficiency, and provide better serviceability than current commercially available systems. The complex control system will be tuned to optimize fuel consumption in all applications and even enhance productivity in certain applications.

Expected reductions in criteria, toxic and GHG emissions: Under the assumption that the entire California population of 988K Tier 4 model Wheel Loader machines were upgraded using the proposed retrofit kit, there is the potential for a statewide impact of almost **21,000 tons of CO2 reductions and 14.4 tons of criteria pollutant** reductions, annually. During the two-year demonstration, the project cost-to-benefit ratio is expected to equal $10,864 per ton in GHG emission reductions and $15,730,331 per ton of combined pollutant & weighted PM emission reductions. After a 10-year equipment useful life, the project cost to benefit is expected to equal $240 per ton in GHG emission reductions and $346,875 per ton of combined pollutant & weighted PM emission reductions.

Whether the project is located within or provides benefits to a disadvantaged community: This project is located with a disadvantaged community (DAC) and will provide benefits to DACs.

CARB Funding Request:	$1,068,457		**Total Project Cost:**	$1,466,128

Project Applicant: Center for Alternative Fuels

Project Title: Zero-Emission Airports: All-Electric Ground Power Unit Demonstration

Summary for Public Posting

Project Name: Zero-Emission Airports: All-Electric Ground Power Unit Demonstration

Name of Applicant: Center for Alternative Fuels

Major Participants: Center for Alternative Fuel (Applicant, Data Collection), FreeWire Technologies (Technology Provider, Commercialization), JetBlue and Kaiser Air (Field Demonstration), Bay Area AQMD (Data Collection and Analysis), Communities for a Better Environment (Community Outreach).

Description of the Project: The Project Team seeks to develop and demonstrate an innovative new product, the Mobi Gen Air, an all-electric ground power unit (GPU). The Mobi Gen Air will displace diesel-powered GPUs. GPUs are critical airport ground support equipment used to supply power to start aircraft engines and turbines; run air conditioning, heating, and lights; and operate control systems while aircraft are serviced on the airfield without access to the electric grid. JetBlue and KaiserAir will each demonstrate two Mobi Gen Air units in commercial settings to validate system performance through a technical and economic lens. The Center for Alternative Fuels and the Bay Area AQMD will provide third-party data collection and analysis services.

Amount of Funding Requested: $1,214,281.74

Total Cost of Project:

Requested Funding: $1,214,281.74

Match Funding Provided: $431,088

Total Cost of Project $1,645,369.74

Expected Criteria and GHG Emissions Reductions:

	GHG	NOx	ROG	PM
Emission Reductions	188.25 $MTCO_2e$/yr.	0.0999 tpy	0.0230 tpy	0.0031 tpy
2-Year Cost Effectiveness	$202.44/$MTCO_2e$	$206,738/ton		
10-Year Cost Effectiveness	$46.63/$MTCO_2e$	$44,559/ton		

Benefits to Disadvantaged Area Communities: The project will be field-demonstrated in two locations: Long Beach Airport and Oakland Airport. The Oakland location is recognized as a freight hub located in a ZIP code that contains a DAC. The demonstration of the all-electric, zero-emission Mobi Gen Air will reduce air pollutants. The demonstration will also reduce noise pollution by displacing diesel-GPUs with all-electric GPUs that are more than five times as quiet.

Project Applicant: Center for Transportation and the Environment

Project Title: Demonstration of Zero-Emission Technologies for Freight Operations at Ports

Project Summary for Public Posting

Project Name:	Demonstration of Zero-Emission Technologies for Freight Operations at Ports
Applicant:	Center for Transportation and the Environment
Project Partners:	Hyster Yale Group, Nuvera, WAVE, StratosFuel, Eagle Marine Services, and the City of Los Angeles, Harbor Department

Project Description: The project team, led by the Center for Transportation and the Environment, will build an electric top loader with wireless charging and fuel cell range extender for demonstration. The top loader will be built in partnership with Hyster Yale Group (HYG) and Nuvera, with wireless charging provided by WAVE and mobile hydrogen fueling provided by StratosFuel. Eagle Marine Services will demonstrate the top loader at their terminal at the Port of Los Angeles which is located within a disadvantaged community.

In the proposed vehicle configuration, the primary energy source is the battery. It delivers peak power demands without having to oversize the fuel cell. The fuel cell functions as a range extender, or an on-board battery charger, allowing greater runtimes by topping off the battery during minimum energy demand. The wireless charger will further enable the vehicle to balance electric utility demand with hydrogen consumption to operate the top loader at a very high level of efficiency. The charger will be utilized during operator break times and shift changes. In addition, this configuration provides the unique opportunity to develop, demonstrate, and compare the efficiency and effectiveness of the two zero-emission range extension technologies.

The vertical integration of zero-emission equipment by a major OEM as proposed in this project provides a clear path towards commercialization and represents the commitment of the OEMs to develop and commercialize advanced technologies that are necessary to meet California's air quality and climate goals. Target markets for commercialized versions of a zero-emission top loaders are primarily ports located in regions where diesel emissions are strictly regulated and where surrounding communities are disproportionately impacted by emissions resulting from operations at the facilities.

Total project cost: $8,874,703 **Requested funding**: $6,508,544 **Proposed match**: $2,366,159

Expected emission reductions: 127.2 tonnes CO2e/year GHG; 0.193 g NOx/gallon; 0.044 g ROG/gallon; 0.006 g PM10/gallon; 0.357 tones CP reduced/year

Project Applicant: City of Long Beach Harbor Department

Project Title: C-PORT: The Commercialization of POLB Off-Road Technology Demonstration Project

Project Summary for Public Posting

Commercialization of the Port of Long Beach Off-Road Technology Project (C-PORT)

The City of Long Beach Harbor Department (Port of Long Beach or "Applicant")—in collaboration with technology vendors BYD Motors, Inc., TransPower, and LOOP Energy; vehicle OEMs Taylor Machine Works International, Kalmar Global, and China National Heavy Duty Truck Group Co.; demonstration partners Long Beach Container Terminal and SSA Marine; data collection and analysis partner Tetra Tech; hydrogen provider Air Products; the International Longshore Warehouse Union; and DAC/outreach partners Green Education Inc., the Center for International Trade at Long Beach State University, the Academy of Global Logistics at Cabrillo High School, Long Beach Unified School District, and Long Beach City College—seek $6,166,000 from the Air Resources Board (ARB) to fund the Commercialization of the Port of Long Beach Off-Road Technology Project (C-PORT).

Figure 1. Battery electric top handler (left), battery electric yard truck (center), and fuel cell electric yard truck (right).

C-PORT will advance the economic viability of three types of pre-commercial, zero-emission cargo handling equipment. Uniquely, the 6+ month demonstration will include a head-to-head comparison of battery electric and fuel cell electric yard trucks at a single site, helping to identify the benefits of each technology as relevant to specific duty cycles and applications. Proposed equipment will include:

- The first-ever demonstration of three battery-electric top handlers, equipment that is critical Port of Long Beach's ongoing operations;
- A battery-electric yard truck featuring TransPower's battery-electric drivetrain, advanced Automated Manual Transmission that uses a rugged manual transmission and advanced shifting controls to outperform conventional automatic transmissions; and
- A fuel cell-electric yard truck using LOOP Energy's advanced, pre-commercial eFlow hydrogen fuel cell system that increases fuel cell power production per unit of fuel cell area by 40 percent, thereby enabling a significant reduction in material usage and a reduction in fuel cell capital costs by 30 to 40 percent in comparison to conventional technologies.

When complete, C-PORT will provide strong commercialization support for zero-emission cargo handling equipment, enabling the future proliferation of a statewide market for these vehicles. C-PORT will also directly reduce 0.690 tons per year (t/y) of NO_x, 0.159 t/y of ROG, 0.0212 t/y of toxic PM_{10} emissions, and 347 t/y of GHG emissions. Project cost effectiveness for GHG emissions will be $6,315 on a 2-year and $836 on a 10-year basis. Cost effectiveness for weighted pollutant emissions reduction will be $1,864,854 on a 2-year and $247,307 on a 10-year basis. The project will be located in a disadvantaged community and will directly benefit that community via targeted education and outreach through local high school and community college programs. These programs will aim to inspire students to pursue careers and leadership in cleantech and give them the initial training, tools, and experience they need to turn that inspiration into reality. To achieve these outcomes, The C-PORT team seeks $6,166,000 to leverage $2,272,408.50 of committed, all-cash match funding to complete a project that will jumpstart commercialization of zero-emission port cargo handling equipment in California.

Project Applicant: City of Los Angeles Harbor Department

Project Title: Port of Los Angeles Zero-Emission Track-Miles Locomotive Demonstration Project

California Environmental Protection Agency
Air Resources Board

Fiscal Year 2016-17
Port of Los Angeles Application
Off-Road Advanced Technology Demonstration Projects

THE PORT OF LOS ANGELES

Project Summary for Public Posting

The Harbor Department, VeRail Technologies and Pacific Harbor Line (PHL) are partnering with the South Coast Air Quality Management District (SCAQMD), the Los Angeles Department of Water and Power (LADWP) and the Coalition for a Safe Environment (CFASE) to propose the demonstration of the first switcher locomotive to operate zero-emission track-miles throughout the Ports of Los Angeles and Long Beach. The Harbor Department requests $2,793,717 in California Climate Investment Program funding to co-fund the *"Port of Los Angeles Zero-Emission Track-Miles Locomotive Demonstration Project"*. For this project, the Harbor Department proposes to demonstrate VeRail's zero-emission battery powered switcher locomotive technology, designed to support the 2,100 horsepower requirements for full operational capability throughout the PHL network of in-harbor track lines. With speeds of 10-15 miles per hour (mph) within the port and 35-40 mph on the Alameda Corridor, the PHL duty cycle for locomotives is the "Mount Everest" of switcher duty cycles, as typical switcher operations rarely exceed 10 mph. The advanced technology 14-pod battery bank is rated at 1,820 kW-hours, and is designed to supply enough energy for a typical working shift (8.5 to 12 hours) without re-charging. Electric charging infrastructure will be installed to support the demonstration unit at the PHL facility in Wilmington, CA. The total project cost is $3,858,037, with project partners providing 27.6%, or $1,064,320 in match funding ($892,371 cash and $171,949 in-kind). PHL headquarters is located at 705 North Henry Ford Avenue, Wilmington, CA and the demonstration unit will operate in revenue service throughout the Ports of Los Angeles and Long Beach. Projected key benefits include:

- Successful implementation of this project will serve as a catalyst for change in the San Pedro Bay Port complex, demonstrating the technical feasibility of zero-emission switcher locomotive service in rigorous goods movement operation.
- Direct localized emission reductions in designated disadvantaged communities, including those in zip codes 90744, 90802, 90731, 90831 and 90813
- Ten-year project cost-effectiveness of $240 per metric ton CO2e and $80,610 per weighted reductions on NOx, ROG and PM10.
- Based on ARB's methodology in Appendix D, annual emission reductions (surplus to a Tier 4 diesel locomotive), for the proposed project are estimated in tons per year (tpy) to be: 0.888 tpy NOx, 0.109 tpy ROG, 0.019 tpy PM10 and 462.31 metric tonnes per year of CO2e (78% GHG reduction). Actual emissions reductions that would result from implementation of the proposed technology across the PHL fleet are much greater than estimated here, since the PHL fleet does not currently consist of Tier 4 locomotive technology.

Port of Los Angeles *3* *September 2017*

Project Applicant: Project Clean Air

Project Title: San Joaquin Valley Electric Tractor Development and Demonstration

Project Summary
SJV Electric Tractor Development & Demonstration

Project Name:	SJV Electric Tractor Development & Demonstration
Applicant:	Project Clean Air
Project Partners:	HummingbirdEV Moonlight Companies Fresno State Ag Farm Ranch Management Fresno State Transportation Institute Kings River Tractor Co. TechTruth Consulting

Project Description: In partnership with Project Clean Air, HummingbirdEV will develop, design and deploy four 50 HP all-electric tractors. HummingbirdEV will deliver the first two eTractors to Moonlight Companies by March 2019 (presuming project start date is March 2018), with the remaining two delivered in October 2019. Before March 2019, HummingbirdEV will build an electric Class 6 truck for Moonlight Companies with the purpose of replacing the current diesel Class 6 truck. The diesel truck is used for operations, maintenance and fueling truck. Moonlight has 35 different site operations that could be used as testing sites. Additionally, two other testing sites have agreed to participate – Fresno State Ag Farm and Ranch Management. All 37 potential test sites are located within a disadvantaged community. Data collection will occur over a twelve month period for the first pair of tractors and six months for the second pair. The Fresno State Transportation Institute will provide the third party data collection and analysis. A key component of this analysis will include the paring of an electric tractor with a diesel tractor – the two will perform identical tasks to show true GHG and emission reductions.

Agriculture pollution has been a hot topic over the past decade for U.S. EPA, ARB, and the San Joaquin Valley Air Pollution Control District (SJVAPCD); so much so that grants have been created to replace or refurbish diesel motors, including locomotives, agriculture pumps, and older tractors. These efforts have had a high level of success, through the Tractor Trade-Up Program provided by the SJVAPCD. More than 6,000 agricultural tractors were replaced with Tier 4 tractors (80 percent cleaner than Tier 2/3) throughout the Valley. While this has allowed SJVAPCD to meet their goal of ten-ton emission reduction per day, the Valley remains the last non-attainment district within the state. In June 2017 the SJVAPCD identified the next key activities to be performed under the Tractor Trade-Up Program and identified agricultural equipment – both on- and off-road, long- and short-haul) as a remaining top priority for SJVAPCD in pursuing strategies to attain the latest federal PM2.5 standards.

The goals of the project include:

- Goal 1: Design, customize, develop, and test the first all-electric agriculture tractors with supporting electric Class 6 truck in California
- Goal 2: Demonstrate the functionality and GHG Emissions Reductions of the electric fleet (including eTractors and eTruck)
- Goal 3: Create a market for electric agriculture and freight equipment

Project Summary
SJV Electric Tractor Development & Demonstration

Amount Requested: $1,500,000

Total Project Cost: $ 2,330,765

Expected Emission Reductions:

- NOx: 0.1344 tons/year (0.0336 per eTractor)
- GHG: 24 Metric Tons/year (6.0 per eTractor)
- NOx: 0.151 tons/year
- GHG: 21.1 Metric Tons/year

Disadvantaged Communities: These tractors and truck will operate within a Disadvantaged Community, as defined by CalEnviroScreen 2.0, 100 percent of the time.* All project demonstration sites are located within a disadvantaged community.

* The truck will travel to various demonstration sites, and may drive through areas that are not within a DAC. The truck's main purpose is to be at the same site as the tractors.

Project Applicant: Sacramento Air Quality Management District (SMAQMD)

Project Title: Hydrogen-Fueled Zero-Emissions Switcher Locomotive

Hydrogen-Fueled Zero Emissions Switcher Locomotive Demonstration Project in West Sacramento

Project Name: Hydrogen-Fueled Zero Emissions Switcher Locomotive Demonstration Project in West Sacramento

Applicant and Partners:

Applicant	Sacramento Air Quality Management District
Technology Demonstrators	Sierra Northern Railway
	RJ Corman Railpower
	Ballard Power Systems
Data Collection & Analysis Providers	UC Davis Institute of Transportation Studies
	Gas Technology Institute
Community Group	Valley Vision

Description:
Sacramento Air Quality Management District (SMAQMD) proposes to use California Air Resources Board (ARB) Air Quality Improvement Program (AQIP) funding to design, build, and demonstrate a hydrogen fueled, zero emissions switcher locomotive. Integration of advanced hydrogen fuel cell, hydrogen storage, advanced battery, and advanced systems control technologies will create a new platform that requires demonstration and validation in order to enable commercialization within the next few years. The locomotive will be demonstrated in Sierra Northern Railway's short-line operations in as close to full-time capacity as possible. Sierra Northern Railway serves the railyard and seaport in West Sacramento, an industrial and residential area and designated disadvantaged community (DAC) census tract. Sierra Northern Railway will retire a Tier 0 diesel locomotive engine, replacing up to 10,000 gallons of conventional diesel fuel per year with hydrogen fuel. The direct benefit to the community in this demonstration will be improvement in local air quality, and reduction in GHG emissions, noise, and odor. Performance and operational data will be analyzed, and product scenarios will be developed for future commercialization of this zero emissions technology for switcher and related applications.

Amount of funding requested: $4,646,567
Total cost of project: $6,498,967
Expected emission reductions:

GHG (m-ton CO_2e/year)	**Weighted Surplus (tons/year)**	NOx (tons/year)	ROG (tons/year)	PM (tons/year)
74	0.309	0.204	0.025	0.004

Benefits to a disadvantaged community:
This project will be based in the City of West Sacramento, and within the City specifically at the Port of West Sacramento and in an industrial railyard in West Sacramento. The communities immediately surrounding the Port of West Sacramento fall within the definition of disadvantaged communities (DACs) per Cal EnviroScreen 2.0. More than 27,000 people live in the four census tracts within which the Port and the railroad operate, and almost 50% of these people are in neighborhoods that fall in the 91%+ Cal EnviroScreen ranking. All told, two-thirds of the total population lives in a neighborhood that falls in the 81%+ Cal EnviroScreen ranking. The project provides direct, meaningful, and assured benefits to these West Sacramento DACs, specifically insofar that the project will entirely remove the existing diesel locomotive engine and replace it with the zero emissions hydrogen-fueled locomotive. This one-for-one engine swap will therefore eliminate 100% of the locomotive-generated emissions currently associated with railroad operations in and around the Port. DACs will benefit from improved air quality, reductions in noise and odor, and reduced GHG emissions. This project, its outcomes, and its community impacts are

5

transferable from the Port of West Sacramento to many of the 250 other switcher locations and operations in the state, including other major ports in California and across the U.S.

Project Applicant: San Diego Unified Port District

Project Title: San Diego Unified Port District – Off-Road Advanced Technology Demonstration Project

Project Summary for Public Posting

San Diego Unified Port District - Off-Road Advanced Technology Demonstration Project

The San Diego Unified Port District—in collaboration with Efficient Drivetrains, Inc. (EDI), TransPower, Kalmar USA, Wiggins Lift Co., ICF, the Environmental Health Coalition, Workshops for Warriors, ChargePoint, and numerous port tenants and terminal operators, including Marine Group Boat Works, Pasha Automotive Services, Pasha Stevedoring and Terminals, and Flagship Cruises and Events—is requesting $9,734,238.97 from the California Air Resources Board to fund the San Diego Unified Port District - Off-Road Advanced Technology Demonstration Project.

This transformative project will demonstrate the operation of a variety of zero-emission, battery-electric technologies, including seven high-capacity forklifts, one 665-ton all-electric boat hoist, and California's, and perhaps the nation's, first battery-electric passenger ferry. During the demonstration, the proposed end user partners will operate the following equipment in revenue service under full-electric power for their entire required duty cycles:

- Marine Group Boat Works: One 665-ton battery-electric Travelift boat hoist and three high-capacity 30,000-pound forklifts to assist with vessel handling, construction, repair, and dry-docking operations at the National City Marine Terminal (NCMT) and in Chula Vista;
- Pasha Automotive Services: One high-capacity 36,000-pound forklift to assist with shoreside roll-on/roll-off (Ro/Ro) vehicle and cargo handling activities at the NCMT;
- Pasha Stevedoring & Terminals: One high-capacity 36,000-pound forklift and one high-capacity 55,000-pound forklift to assist with vehicle and cargo handling at the NCMT;
- Flagship Cruises & Events: One battery-electric, 74-foot ferry to provide hourly passenger service between the Broadway Pier, San Diego Convention Center, and the City of Coronado;
- BAE Systems, Inc.: One high-capacity 30,000-pound battery-electric forklift to assist with material handling during ship repair and reconditioning services for the U.S. Navy and commercial vessels at its facility west of Barrio Logan.

In addition to the above project partners, this project will be supported by ICF and carbonBLU performing emissions testing, validation, and reporting; ChargePoint assisting in the deployment of the charging infrastructure; San Diego Gas & Electric assisting with infrastructure engineering, data collection and monitoring of energy usage at the charging stations, and education and outreach; Workshops for Warriors providing training to operations and maintenance personnel of the end users; and, the Environmental Health Coalition organizing community outreach and engagement.

Importantly, this project will directly benefit the surrounding communities—as well as the people who live and work there—many of which are classified as disadvantaged communities burdened by multiple sources of pollution, high traffic density, and the comingling of industrial buildings and residential housing.

The Project Team seeks $9,734,238.97 to leverage $4,182,744.38 of committed match funding ($2,635,627.38 cash, $1,547,117.00 in-kind) to successfully complete this expansive transportation electrification demonstration project. As a result of this project, the District expects to achieve annual greenhouse gas emissions reductions of 657.72 metric tons (MT) CO_2e, 0.683 tons NOx, 0.179 tons ROG, and 0.0233 tons PM10, or 1.664 tons weighted criteria pollutant emissions reduced. It is anticipated that the demonstrated technologies will become commercially available and replicable within three years of commencing the project, providing multiple avenues to achieve even greater emissions reductions as these technologies gain market and industry acceptance.

Project Applicant: San Joaquin Valley Air Pollution Control District (SJVAPCD)

Project Title: San Joaquin Valley Off-Road Zero-Emission Agricultural Utility Terrain Vehicle Market Demonstration Project

Attachment 1: Project Executive Summary and Project Summary for Public Posting

Project Summary for Public Posting:

San Joaquin Valley Off-Road Zero-Emission Agricultural Utility Terrain Vehicle Market Demonstration Project

The San Joaquin Valley Air Pollution Control District is partnering with local agricultural businesses in the San Joaquin Valley to demonstrate the new application of off-road zero-emission utility terrain vehicles in the agricultural market. The total project cost is $4,000,000 with $3,000,000 being requested form the California Air Resources Board and a cash match of $1,000,000 to be provided by the participating agricultural businesses and the San Joaquin Valley Air Pollution Control District. The expected emissions reductions are as follows: 1,177 MT CO_2e/year, 2.349 tons NOx/year, 1.218 tons ROG/year, and 0.5520 tons PM10/year. All agricultural utility terrain vehicles are expected to be located within or provide benefits to disadvantaged communities.

Project Applicant: San Joaquin Valley Air Pollution Control District (SJVAPCD)

Project Title: San Joaquin Valley Zero-Emission Cargo Handling Demonstration Project

Attachment 1: Project Summary for Public Posting

The *San Joaquin Valley Zero-Emission Cargo Handling Demonstration Project* (Project) will accelerate the commercial deployment of zero-emission off-road technologies by demonstrating state-of-the-art battery-electric heavy-duty forklifts at the Port of Stockton—significantly reducing greenhouse gas (GHG) emissions, criteria pollutants, and toxic diesel emissions to benefit adjacent and surrounding disadvantaged communities.

Ports, airports, warehouses, and logistic centers throughout California today rely primarily on dirty diesel technologies to move, load, and unload higher tonnage loads. Existing diesel heavy-duty cargo handling equipment is currently a major source of GHG emissions, smog-forming oxides of nitrogen (NOx), and toxic diesel particulate pollutants. Emissions from existing higher tonnage cargo handling equipment has a disproportionately adverse impact on disadvantaged communities and hinders attainment of federal health-based air quality standards. Decades old, high lift-capacity diesel forklifts are still extensively used in California ports and distribution centers and have exceptionally high emission rates. The continuous idling of heavy-duty forklifts accounts for a sizable portion of California's GHG emissions and unacceptable toxic exposures to impacted communities.

To help address the immediate need to eliminate these impacts, the Project will demonstrate two heavy-duty, 30,000-pound lift capacity, fully battery-electric forklifts that will provide economic and environmental benefits and demonstrate the scalability, practicality, and economic viability of widespread transformation of zero-emission heavy-duty cargo handling equipment.

The San Joaquin Valley Air Pollution Control District (SJVAPCD) is the project applicant and will be administering the Project for the grant agreement term. The Port of Stockton, located within the top 5% of disadvantaged communities, will demonstrate the zero-emission heavy-duty forklifts with additional cargo handling attachments and charging infrastructure, which will provide direct environmental and economic benefits to the surrounding disadvantaged communities. DANNAR, a leader in zero-emission off-road technologies, will serve as the technology provider for the zero-emission off-road cargo handling equipment. ChargePoint, the world's largest network of electric vehicle charging stations, will install two DC fast-chargers at the Port of Stockton. Bosch, one of the largest engineering companies in the world, will install telematics on the vehicles to collect data and provide analysis for the Project.

The Project will reduce GHG emission by up to 46.781 tons CO2e/year and eliminate .0156 tons/year of weighted criteria pollutants and toxic emissions in disadvantaged communities. The Project will include 34% match funding - $370,000 of cash match and $33,540 of in-kind match from private funding to leverage the proposed $772,555 Air Resources Board investment, for a total project budget of $1,176,095.

The Project will showcase the direct transferability of a multipurpose zero-emission cargo handling platform to other seaports, airports, and logistic centers, and, ultimately, accelerate the transition to zero-emission off-road technologies for freight support facilities to help implement the Sustainable Freight Action Plan, AB 32, SB 32, AB 118, and SB 535.

Project Applicant: San Joaquin Valley Air Pollution Control District (SJVAPCD)

Project Title: Zero Emission Transport Refrigeration Demonstration in California Foodservice and Grocery Distribution Fleets

Attachment 1b: Project Summary for Public Posting

Project Name: Zero Emission Transport Refrigeration Demonstration in California Foodservice and Grocery Distribution Fleets

Applicant: San Joaquin Valley Air Pollution Control District

Project Partners: Advanced Energy Machines, Albertson's, C & S Wholesale Grocers, McLane Company, Ozark Trucking, Performance Food Group (Performance Foodservice, Legacy Roma Distribution, Vistar), Raley's Fine Foods, Safeway, and CleanFuture.

Project Description: This project demonstrates battery-powered all-electric transport refrigeration units (TRUs) with roof-mounted solar panels on insulated trailers in leading foodservice and grocery distribution fleets throughout California. Fleet end-use partners are best-in-class companies representing about 10% of the trailer TRU population based in California. Trailer-mounted transport refrigeration units on grocery and foodservice distribution fleets are ideal to electrify because of their return-to-base operating profile where TRU batteries can be recharged regularly as necessary.

Funding Requested: $10,448,137

Total Cost of Project: $21,829,337, including $11,381,200 in cash and in-kind funding from project partners.

Expected Emission Reduction Benefits: The estimated GHG emissions benefits associated with the 61 TRUs on refrigerated trailers are 1,721.8 MT/year of GHG, 8.14 ton/year of NOx and 0.355 tons/year of reactive organic gases, and 0.0237 tons/year of particulate matter.

Outcomes: This project will develop, deploy, and optimize 61 pre-commercial zero emission transport refrigeration units for refrigerated trailers. The product development and knowledge gained will provide immediate emissions benefits to improve the public health and air quality of Californians living in heavily affected communities and support a pathway for commercialization of next-generation of zero-emission TRUs. This project directly supports the California Sustainable Freight Action Plan with actions to develop requirements for cleaner zero and near-zero technologies for transport refrigeration units. This project supports CARB's control measure "Reducing Residual Risk from Transport Refrigeration Units by Transitioning to Zero-Emission Technologies" which was just introduced on August 16, 2017. By funding the proposed project CARB affirms CARB's commitment to expand and support zero emission TRUs to the refrigerated transport industry as represented by the strong industry coalition assembled for the proposed demonstration project. CARB sends a strong signal to the freight industry on the proposed project.

Whether the project is expected to be within or provide benefits to a disadvantaged community: The project will provide benefits both within and to disadvantaged communities. Project partners operate seven (7) food distribution centers within disadvantaged communities. The delivery routes on which project partners propose to deploy the zero emission refrigerated trailers include stops both within disadvantage communities and within ½ mile of the disadvantaged communities.

Project Applicant: South Coast Air Quality Management District (SCAQMD)

Project Title: Demonstration of Advanced Battery Switcher Locomotive with Range Extending Technologies

Attachment 1: Project Summary for Public Posting

Demonstration of Advanced Battery Switcher Locomotive with Range Extending Technologies

- Low Carbon Transportation and Fuels Investments and the Air Quality Improvement Program Off-Road Advanced Technology Demonstration Projects

Project Name: • Demonstration of Advanced Battery Switcher Locomotive with Range Extending Technologies

Name of Applicant and Project Partners:
Applicant: South Coast Air Quality Management District
Technology Demonstrators: Rail Propulsion Services (RPS)
Technology Partners: Tractive Power, EV Grid, Semikron, Oztek, and Alternative Motive Power
End User: Coast Rail Services
Other Project Partners: Olson Ecologic, Michigan State University, Omnitek Engineering, EF&FF, and Richard Carlson

Amount Requested: $4,512,387

Total Project Cost: $6,506,511 ($1,994,124 match, 31%)

Expected Emission Reductions: 532 MT/year of GHG reductions, 1.022 ton/year of NOX reductions, 0.1257ton/year of ROG reductions, 0.0218 ton/year of PM10 reductions, and 1.58 ton/year of weighted emissions reductions.

Project location and benefits to disadvantaged communities
End user Coast Rail Services is located in a disadvantage community (DAC) and will provide employment and emission benefits to the DAC. The railyard's surrounding communities are between the 61st and 99th percentile for pollution burden in California.

Project description
SCAQMD is proposing a unique project to take much-needed step toward seeing true demonstration of an advanced zero-emission battery electric switcher locomotive with range extending technologies to maximize emissions reduction at a railyard located in a DAC of Anaheim, Ca. The project will convert an existing GE GP9 locomotive to a battery powered locomotive. The Battery system architecture has been developed from an existing 300kW-hr packaging format successfully established by EV Grid for transit buses and scaled up by RPS to 450kW-hr. RPS will collaborate with other partnering specialists to develop the application specific controls, power electronics, charging systems and infrastructure based on existing systems developed and proven in vehicle markets. Additionally, the project will employ extensive independent thermal management, fire propagation and cyclic durability testing of various battery cell construction and chemistries using locomotive specific duty cycles under appropriate environmental conditions. Once the batteries and power electronics are in place, the locomotive will be fitted with a leading edge wireless power transfer system to demonstrate wireless opportunity charging for the locomotive. The project also includes development and incorporation of a small, low NOx CNG generator that will allow the battery locomotive to operate at extended ranges for switching applications outside of the railyard, further reducing metropolitan area exhaust emissions and rail operations reliance on diesel.

Project team includes major OEMs that bring the necessary engineering resources, manufacturing capability, and a distribution/service network to support future commercialization of the locomotive, further helping the advanced locomotive technology achieve cost parity and penetrate the market. Our partnership also includes confirmed end-user who is experienced with the specific challenges and opportunities associated with early technology demonstration efforts. SCAQMD is committing staffing, significant cost share, and demonstration oversight to support this demonstration initiative. These pooled resources validate and drive to market economically viable solutions to the criteria pollutant and GHG emissions challenges associated with goods movement in the South Coast Air Basin.