South Coast
Air Quality Management District
South Coast AQMD 21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 • www.aqmd.gov

# HYBRID TECHNOLOGY COMMITTEE MEETING

**Committee Members**

Councilmember Carlos Rodriguez, Committee Chair
Supervisor Curt Hagman
Mayor Patricia Lock Dawson
Mayor Pro Tem Larry McCallon
Board Member Veronica Padilla-Campos
Supervisor Donald Wagner

**October 18, 2024 ♦ 12:00 p.m.**

## TELECONFERENCE LOCATION

Riverside City Hall
7th Floor Conference Room
3900 Main Street
Riverside, CA 92522

**A meeting of the South Coast Air Quality Management District Technology Committee will be held at 12:00 p.m. on Friday, October 18, 2024 through a hybrid format of in-person attendance in the Dr. William A. Burke Auditorium at the South Coast AQMD Headquarters, 21865 Copley Drive, Diamond Bar, California, and remote attendance via videoconferencing and by telephone. Please follow the instructions below to join the meeting remotely.**

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**http://www.aqmd.gov/home/news-events/meeting-agendas-minutes**

**ELECTRONIC PARTICIPATION INFORMATION**
**(Instructions provided at bottom of the agenda)**

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**Audience will be allowed to provide public comment in person or through Zoom connection or telephone.**

**PUBLIC COMMENT WILL STILL BE TAKEN**

*Cleaning the air we breathe…*

***AGENDA***

*Members of the public may address this body concerning any agenda item before or during consideration of that item (Gov't. Code Section 54954.3(a)). If you wish to speak, raise your hand on Zoom or press Star 9 if participating by telephone. All agendas for regular meetings are posted at South Coast AQMD Headquarters, 21865 Copley Drive, Diamond Bar, California, at least 72 hours in advance of the regular meeting. Speakers may be limited to three (3) minutes total for all items on the agenda.*

**CALL TO ORDER**

**ROLL CALL**

**ACTION ITEMS (1-2):**

**1. Execute Contracts to Develop Data-Based Planning Tool for Medium- and Heavy-Duty Truck Charging Networks, Fleets, and Power Grid Systems and to Investigate Benefits of Electric Vehicle-to-Home Technology on Air Quality *(Motion Requested)***

Fan Xu, Ph.D.
Program Supervisor

In April 2024, the University of California, Riverside's Energy, Economics and Environment Research Center (UCR/E3) proposed to develop a planning tool to assist fleet owners, charging infrastructure developers, and other stakeholders to deploy medium- and heavy-duty (MD/HD) battery electric trucks and charging infrastructure. Also, in August 2024, the University of California, Irvine Advanced Power and Energy Program (UCI APEP) proposed to investigate electric vehicle-to-home (V2H) technology that enables electric vehicles to transfer energy to homes and estimated emission reductions. These actions are to: 1) execute a contract with UCR/E3 to develop a data-based planning tool for the deployment of MD/HD trucks and charging infrastructure in Southern California in an amount not to exceed $300,000 from the Clean Fuels Program Fund (31); and 2) execute a contract with UCI APEP to investigate the emission reduction benefits of V2H technology in an amount not to exceed $220,548 from the Clean Fuels Program Fund (31).

**2. Expand the Purpose of LADWP Settlement Projects Fund, Recognize Funds, Execute Contracts for Electrification Projects at Los Angeles Zoo, and Reimburse General Fund for Project Administrative Costs *(Motion Requested)***

Nicole Silva
Program Supervisor

On October 19, 2023, a Settlement Agreement was entered between the City of Los Angeles, the Los Angeles Department of Water and Power (LADWP), and South Coast AQMD. As a result of the settlement, LADWP paid $450,000 plus a 6.25 percent administrative fee of $28,125, for a total of $478,125, to South Coast AQMD to be used for supplemental environmental project(s) that reduce emissions. These actions are to: 1) Expand the purpose of the LADWP Settlement Projects Fund (38); 2) Recognize $478,125 into the LADWP Settlement Projects Fund (38); 3)

Execute agreements not to exceed a combined total of $450,000 from LADWP Settlement Projects Fund (38) with SSA Group, LLC (SSA) to purchase four electric passenger trams with a five-year maintenance contract, and with American Green Zone Alliance (AGZA) to purchase electric lawn and garden equipment and two electric utility maintenance vehicles; and 4) Reimburse the General Fund up to $28,125 for project administrative costs.

**INFORMATIONAL ITEM:**

**3. Clean Fuels Program Draft 2025 Plan Update** — Vasileios Papapostolou, Sc.D. Planning & Rules Manager

***(Written Report – No Motion Requested)***

The Clean Fuels Plan Update is submitted every year with the Clean Fuels Annual Report as required by legislation. Staff provides the Clean Fuels Program Draft Plan Update to the Technology Committee each fall to solicit input on the proposed priority technology areas and potential projects for the upcoming year before requesting final Board approval for the Plan Update and Clean Fuels Annual Report in early spring. Staff proposes continued support for a wide portfolio of technologies with particular emphasis on zero emission technologies for vehicles, off-road equipment, and supporting infrastructure.

**4. Other Business**

Any member of the Committee, or its staff, on his or her own initiative or in response to questions posed by the public, may ask a question for clarification, may make a brief announcement or report on his or her own activities, provide a reference to staff regarding factual information, request staff to report back at a subsequent meeting concerning any matter, or may take action to direct staff to place a matter of business on a future agenda. (Gov't. Code Section 54954.2)

**5. Public Comment Period**

At the end of the regular meeting agenda, an opportunity is provided for the public to speak on any subject within the Committee's authority that is not on the agenda. Speakers may be limited to three (3) minutes each.

**6. Next Meeting Date**

**Friday, November 15, 2024 at 12:00 p.m.**

**ADJOURNMENT**

**Document Availability**

*All documents (i) constituting non-exempt public records, (ii) relating to an item on an agenda for a regular meeting, and (iii) having been distributed to at least a majority of the Committee after the agenda is posted, are available by contacting Penny Shaw Cedillo at 909.396.3179, or send the request to pcedillo@aqmd.gov.*

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*Disability and language-related accommodations can be requested to allow participation in the Technology Committee meeting. The agenda will be made available, upon request, in appropriate alternative formats to assist persons with a disability (Gov't Code Section 54954.2(a)). In addition, other documents may be requested in alternative formats and languages. Any disability or language-related accommodation must be requested as soon as practicable. Requests will be accommodated unless providing the accommodation would result in a fundamental alteration or undue burden to South Coast AQMD. Please contact Penny Shaw Cedillo at 909.396.3179 from 7:00 a.m. to 5:30 p.m., Tuesday through Friday, or send the request to pcedillo@aqmd.gov.*

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As an attendee, you will have the opportunity to virtually raise your hand and provide public comment.

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**Please note:** During the meeting, all participants will be placed on Mute by the host. You will not be able to mute or unmute your lines manually.

After each agenda item, the Chair will announce public comment.

Speakers may be limited to a total of 3 minutes for the entirety of the consent calendar plus board calendar, and three minutes or less for each of the other agenda items.

A countdown timer will be displayed on the screen for each public comment.

If interpretation is needed, more time will be allotted.

**Once you raise your hand to provide public comment, your name will be added to the speaker list. Your name will be called when it is your turn to comment. The host will then unmute your line.**

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- If you would like to make a public comment, please click on the **"Raise Hand"** button on the bottom of your screen.
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**Directions for TELEPHONE line only:**

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Technology Committee Agenda #1

BOARD MEETING DATE: November 1, 2024 AGENDA NO.

PROPOSAL: Execute Contracts to Develop Data-Based Planning Tool for Medium- and Heavy-Duty Truck Charging Networks, Fleets, and Power Grid Systems and to Investigate Benefits of Electric Vehicle-to-Home Technology on Air Quality

SYNOPSIS: In April 2024, the University of California, Riverside's Energy, Economics and Environment Research Center (UCR/E3) proposed to develop a planning tool to assist fleet owners, charging infrastructure developers, and other stakeholders to deploy medium- and heavy-duty (MD/HD) battery electric trucks and charging infrastructure. Also, in August 2024, the University of California, Irvine Advanced Power and Energy Program (UCI APEP) proposed to investigate electric vehicle-to-home (V2H) technology that enables electric vehicles to transfer energy to homes and estimated emission reductions. These actions are to: 1) execute a contract with UCR/E3 to develop a data-based planning tool for the deployment of MD/HD trucks and charging infrastructure in Southern California in an amount not to exceed $300,000 from the Clean Fuels Program Fund (31); and 2) execute a contract with UCI APEP to investigate the emission reduction benefits of V2H technology in an amount not to exceed $220,548 from the Clean Fuels Program Fund (31).

COMMITTEE: Technology, October 18, 2024; Recommended for Approval

RECOMMENDED ACTIONS:

1. Authorize the Executive Officer to execute a contract with University of California, Riverside's Energy, Economics and Research Center (UCR/E3) to develop a data-based tool for the deployment of medium- and heavy-duty (MD/HD) trucks and charging infrastructure in Southern California in an amount not to exceed $300,000 from the Clean Fuels Program Fund (31); and

2. Authorize the Executive Officer to execute a contract with University of California, Irvine Advanced Power and Energy Program (UCI APEP) to investigate the emission reduction benefits of electric V2H technology in an amount not to exceed $220,548 from the Clean Fuels Program Fund (31).

Wayne Nastri
Executive Officer

AK:MW:VP:FX:NS:BD

**Background**

In April 2024, the UCR/E3 proposed the development of a planning tool designed to assist fleet owners, charging infrastructure developers, utility companies, regulators, and other key stakeholders in deploying MD/HD battery electric trucks and charging infrastructure. UCR/E3 is a multidisciplinary research collaboration focused on addressing the challenges of growing energy demand in an economical and sustainable manner. This study will complement other related research projects funded by South Coast AQMD by providing specific planning guidance to charging infrastructure developers and fleet owners. It is anticipated this tool will help support the implementation of South Coast AQMD charging infrastructure incentive programs.

In addition, in August 2024, UCI APEP proposed to investigate the emission reduction benefits of the electric vehicle-to-home (V2H) technology that enables electric vehicles to transfer energy to homes. UCI APEP is a program that addresses the development and deployment of efficient, environmentally sensitive, sustainable power generation and energy conversion worldwide. The deployment of electric V2H technology has the potential to reduce NOx and PM2.5 emissions by shaving peak usage period generation loads that occur during high electricity usage time periods when renewable power is supplemented by fossil based generating resources. In addition, the V2H capability will demonstrate a clean alternative to supportive residential power during outages instead of using diesel combustion backup generators. This study will investigate and quantify the impact of electric V2H in reducing NOx and PM2.5 emissions in the South Coast Air Basin (Basin) and advancing regional air quality in 2030, 2035, and 2045.

**Proposal**

The proposed UCR project will utilize electricity grid data and truck operation metrics to create a spatio-temporal optimization model. This model will identify optimal locations for charging stations in Southern California and desert areas, assess the capacity of nearby electrical substations to support infrastructure development, and determine whether grid upgrades are needed. Furthermore, the model will calculate the

ideal battery size for trucks and optimize charging schedules to align with time-of-use electricity pricing, enhancing both cost-effectiveness and operational efficiency for truck fleets. The model is built on large-scale, real-world data, including Global Positioning System trajectories of trucks and the hosting capacity of electrical substations. The project team will first complete the development for the module on charging infrastructure in Spring of 2025. The module will allow the potential infrastructure incentive funding participants to evaluate the grid capacity when proposing or selecting the charging sites to minimize the needs for grid upgrade. The project team will complete the development for the other modules, including truck charging schedule, grid upgrade planning, and others as stated above within two years. The tool will bridge the gap between the different entities involved in electrifying MD/HD trucks, providing comprehensive data to support decision making, promoting coordinated development, and reducing misalignment.

The proposed UCI project will leverage a current United States Department of Energy (U.S. DOE) project that is demonstrating the first United States mass market V2H deployment with the Kia EV9 at a new connected microgrid communities' development in the Basin and also quantify the benefits of electric V2H in reducing the emissions of NOx and PM2.5 from the project. The project will: a) analyze energy use reduction for different use cases of V2H and its ability to shave peak energy in 2030, 2035 and 2045; b) identify and assess the associated reductions in NOx and PM2.5 emissions; c) establish the associated air quality and health benefits; d) address V2H as a backup power resource during grid outages as an alternative to combustion backup generators, leveraging a recently completed South Coast AQMD project that evaluated the air quality impact of backup generators in the Basin; and e) address guidelines and recommendations for policy making.

**Sole Source Justification**

Section VIII.B.2. of the Procurement Policy and Procedure identifies provisions under which a sole source award may be justified. The request for sole source award is made under provision B.2.d.(8): Research and development efforts with educational institutions or nonprofit organizations. The University of California, Riverside (UCR) is an educational institution, and the E3 Research Center currently has 37 affiliated UCR faculty from departments or schools of Electrical and Computer Engineering, Computer Science and Engineering, Statistics, and Public Policy. Its research areas include critical infrastructure systems and smart cities, machine learning and optimization, water, energy, climate and food, with some of the research projects on grid analyses funded by U.S. DOE, National Science Foundation, CEC and others. The University of California, Irvine (UCI) is also an educational institution and the APEP currently has 22 affiliated UCI faculty and staff. APEP conducts research in the areas of Energy Systems Integration and Impacts, Renewable Fuels, Energy Storage, Fuel Cell Science and Technology, and Combustion Science and Technology with some of the research projects on the first United States mass market V2H deployment funded by the DOE.

**Benefits to South Coast AQMD**
Projects to support the development and demonstration of MD/HD ZEV technologies and supporting infrastructure are included in the Technology Advancement Office Clean Fuels Program 2024 Plan Update under the categories "Zero Emission Infrastructure" and "Electric / Hybrid Technologies." The proposed tool will help improve the deployment process for the charging infrastructure by providing grid data-insight and also assist the fleet owners in more strategic infrastructure planning when electrifying the fleets and operating the battery electric trucks. The tool will address the common obstacles and challenges faced by infrastructure developers and fleet owners, helping accelerate the transition to battery electric technology in the MD/HD trucking sector. The implementation of this project is consistent with the 2022 AQMP, which relies on MD/HD ZEV technologies to achieve NAAQS for ozone and PM2.5 in the Basin.

Projects that support the development and demonstration of electric vehicle technologies like electric V2H are included in the Technology Advancement Office Clean Fuels 2024 Plan Update under the categories "Stationary Clean Fuel Technologies" and "Fuel and Emission Studies" and "Electric / Hybrid Technologies." The proposed investigation will provide a better understanding of the emission benefits that electric V2H technology can have on regional air quality, how much of an impact it can have on peak power shaving at power plants, and how effective it will be in advancing regional air quality in 2030, 2035 and 2045.

**Resource Impacts**
South Coast AQMD's support of the development of the data-based planning tool for MD/HD Charging Networks, Fleets, and Power Grid Systems shall not exceed $300,000 from the Clean Fuels Program Fund (31). UCR and AmpTrans, Inc. will each contribute $150,000 of in-kind support to this project.

South Coast AQMD's support to investigate the impact of V2H technology on the regional air quality of the Basin shall not exceed $220,548 from the Clean Fuels Program Fund (31). The DOE will contribute $120,000 and the UCI APEP will contribute $30,000 as in-kind support to this project.

Sufficient funds are available from the Clean Fuels Program Fund (31). The Clean Fuels Program Fund (31) is established as a special revenue fund resulting from the state mandated Cleans 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.

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# Agenda Item #1

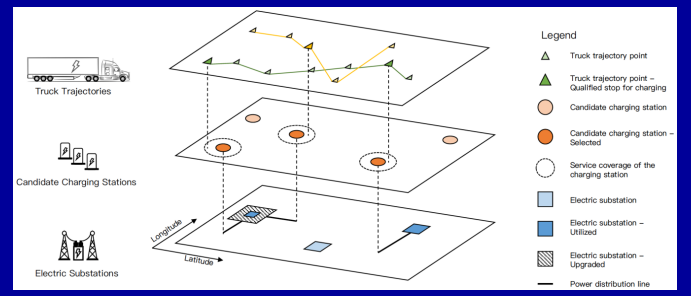
Execute Contracts to

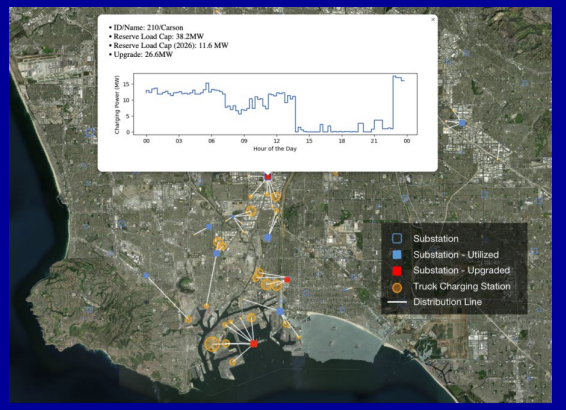
Develop Data-Based Planning Tool for Medium- and Heavy-Duty Truck Charging Networks, Fleets, and Power Grid Systems and Investigate Benefits of Electric Vehicle-to-Home Technology on Air Quality

Fan Xu

# Proposal - UCR Project

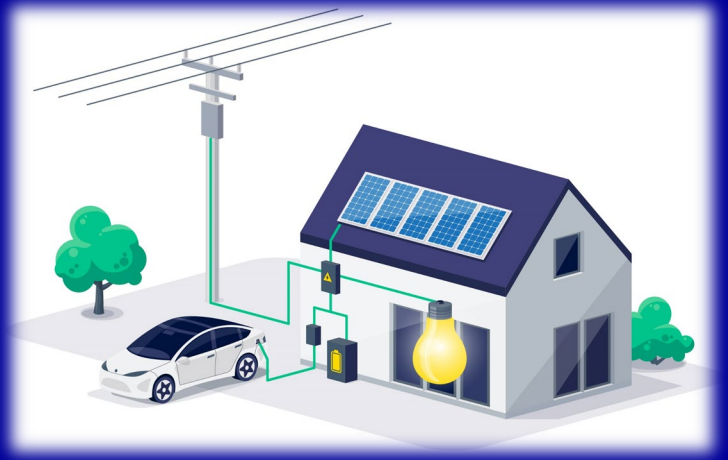
- Medium/heavy-duty truck fleets and charging infrastructure developers face challenges in siting charging stations
- The proposed UCR project will develop an online planning tool (CHARGE)
  - Consolidate electricity grid data, truck operation metrics, truck traffic data, maps, etc.
  - Identify optimal locations for charging stations
  - Assess capacities of electrical substations and upgrade needs
  - Calculate ideal truck battery sizes and optimize charging schedules
- The charging infrastructure planning module will assist with upcoming South Coast AQMD infrastructure solicitations



# Proposal - UCI Project

- Vehicle-to-Home (V2H) technology:
  - Enables electric vehicles to transfer energy to homes
  - Potential emissions benefits from reducing electricity from fossil fuel generators during peak loads
  - Provides clean backup power to homes without generator



- The proposed UCI project will:
  - Quantify the benefits of V2H in reducing NOx and PM2.5 emissions in the Basin from this study and leveraging existing projects
  - Model the use cases of V2H and its ability to reduce electricity peak loads along with providing power during outages
  - Evaluate associated health benefits

# Resource Impacts

| | Source | Funding Amount $ | Project Cost % |
|---|---|---|---|
| UCR Project | UCR | $150,000 | 25% |
| | AmpTrans, Inc | $150,000 | 25% |
| | South Coast AQMD (proposed) | $300,000 | 50% |
| | **Total Project Cost** | **$600,000** | **100%** |
| UCI Project | UCI | $30,000 | 8.1% |
| | DOE | $120,000 | 32.4% |
| | South Coast AQMD (proposed) | $220,548 | 59.5% |
| | **Total Project Cost** | **$370,548** | **100%** |

# Summary of Recommended Actions

- Authorize the Executive Officer to execute a contract with the University of California, Riverside to develop data-based planning tool for MD/HD truck charging networks, fleets, and power grid systems in an amount not to exceed $300,000 from the Clean Fuels Program Fund (31)
- Authorize the Executive Officer to execute a contract with the University of California, Irvine to investigate the air quality benefits of electric vehicle-to-home technology in an amount not to exceed $220,548 from the Clean Fuels Program Fund (31)

BOARD MEETING DATE: November 1, 2024 AGENDA NO. XX

PROPOSAL: Expand the Purpose of LADWP Settlement Projects Fund, Recognize Funds, Execute Contracts for Electrification Projects at Los Angeles Zoo, and Reimburse General Fund for Project Administrative Costs

SYNOPSIS: On October 19, 2023, a Settlement Agreement was entered between the City of Los Angeles, the Los Angeles Department of Water and Power (LADWP), and South Coast AQMD. As a result of the settlement, LADWP paid $450,000 plus a 6.25 percent administrative fee of $28,125, for a total of $478,125, to South Coast AQMD to be used for supplemental environmental project(s) that reduce emissions. These actions are to: 1) Expand the purpose of the LADWP Settlement Projects Fund (38); 2) Recognize $478,125 into the LADWP Settlement Projects Fund (38); 3) Execute agreements not to exceed a combined total of $450,000 from LADWP Settlement Projects Fund (38) with SSA Group, LLC (SSA) to purchase four electric passenger trams with a five-year maintenance contract, and with American Green Zone Alliance (AGZA) to purchase electric lawn and garden equipment and two electric utility maintenance vehicles; and 4) Reimburse the General Fund up to $28,125 for project administrative costs.

COMMITTEE: Technology, October 18, 2024; Recommended for Approval

RECOMMENDED ACTIONS:

1. Expand the purpose of LADWP Settlement Projects Fund (38) to include electrification projects; and
2. Recognize $478,125 into the LADWP Settlement Projects Fund (38);
3. Authorize the Executive Officer to execute agreements not to exceed a combined total of $450,000 from LADWP Settlement Projects Fund (38) with:
   a. SSA to purchase four electric passenger trams with a maintenance contract for a total of $342,910, and
   b. AGZA to administer and purchase two electric utility maintenance vehicles and electric lawn and garden equipment for a total of $107,090; and

4. Reimburse the General Fund up to $28,125 for project administrative costs.

Wayne Nastri
Executive Officer

AK:MW:VP:FX:NS:MG

**Background**
On October 19, 2023, a Settlement Agreement was entered between LADWP and South Coast AQMD. As a result of the settlement, LADWP paid $450,000 plus a 6.25 percent administrative fee of $28,125, for a total of $478,125, to be used for supplemental environmental projects(s) for alleged violations of failing to properly maintain compressors for natural gas fueled turbines, among other allegations. The funds will be recognized in LADWP Settlement Projects Fund (38). South Coast AQMD determined that the settlement funds would pay for electrification projects at Los Angeles Zoo, owned by the City of Los Angeles.

In June 2001, the Board approved the establishment of the LADWP Settlement Project Fund (38) to fund microturbine supplemental environmental projects. The purpose of the Fund will need to be expanded to include the proposed electrification projects so that greater emission reductions can be achieved through zero-emission battery electric technology.

Los Angeles Zoo currently has contracts with SSA Group, LLC (SSA) for its operation of their diesel-powered passenger trams. Los Angeles Zoo and SSA will replace their diesel-powered passenger trams with new electric passenger trams and will purchase electric utility maintenance vehicles and electric lawn and garden equipment through American Green Zone Alliance (AGZA). The replacement of diesel passenger trams with electric trams and the use of new electric utility maintenance vehicles and electric lawn and garden equipment will improve air quality and benefit the zoo staff, visitors, and inhabitants, and the surrounding recreational and residential communities.

**Proposal**
Staff proposes to expand the purpose of LADWP Settlement Projects Fund (38) to include electrification projects; and recognize $478,125 into the LADWP Settlement Projects Fund (38). The funds will purchase up to four electric passenger trams with a maintenance contract, up to two electric utility maintenance vehicles, and electric lawn and garden equipment. Staff proposes a contract with SSA to purchase four electric passenger trams with a supporting five-year maintenance and repair plan.

Staff also proposes a contract with AGZA to purchase two electric utility maintenance vehicles and administer and purchase electric lawn and garden equipment to be used at the Los Angeles Zoo.

| Projects | Costs |
|---|---|
| Four electric trams | $282,910 |
| Five-year maintenance and repair plan | $60,000 |
| Two battery electric utility vehicles and electric lawn and garden equipment | $92,090 |
| Administration for lawn and garden equipment | $15,000 |
| **Total:** | **$450,000** |

**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 to SSA and AGZA is made under the following justifications: B.2.c. (1) the unique experience and capabilities of the proposed contractor or contractor team and B.2.d. (1) projects involving cost sharing by multiple sponsors.

SSA has unique experience as the existing company that is contracted with Los Angeles Zoo for its operation of their diesel-powered passenger trams. SSA will purchase new electric passenger trams that meet the needs of the zoo's daily operations to replace their diesel-powered passenger trams. Los Angeles Zoo will continue to cover the cost of daily tram operation after the diesel-powered passenger trams are replaced.

Also, AGZA has unique experience and capabilities to educate, train, and certify operators in the deployment of zero-emission lawn and garden equipment as an existing contractor for South Coast AQMD through its Commercial Electric Lawn and Garden Equipment Incentive Program. AGZA will help identify the equipment that best fits Los Angeles Zoo's operational needs, purchase the equipment Los Angeles Zoo selects, and train the staff to use the utility maintenance vehicles and the lawn and garden equipment. AGZA will also monitor the Los Angeles Zoo's maintenance and use of the equipment for two years, providing periodic reporting to South Coast AQMD on the project's progress.

**Benefits to South Coast AQMD**
The project supports the Technology Advancement Office Clean Fuel Program 2024 Plan Update under the category of "Electric/Hybrid Technologies." Los Angeles Zoo is a public zoo owned and operated by the City of Los Angeles with nearly 1.5 million visitors each year and hosts several special events, including events for youth and students. The Los Angeles Zoo is located near other public spaces including a museum and a large outdoor recreational area. The electrification project will benefit the millions

of visitors by improving the air quality, reducing noise, and reducing exposure to exhaust emissions in and around the zoo. Additionally, the implementation of off-road zero-emission technologies in public areas will showcase these new zero-emission technologies. This project will implement zero-emission technology and reduce emissions from four diesel-powered passenger trams. The project will reduce NOx, VOC, PM2.5, and DPM emissions by approximately 0.16, 0.15, 0.005, and 0.005 tons per year, respectively and reduce exposure to toxic diesel exhaust.

**Resource Impacts**

The contracts with SSA for the purchase of electric passenger trams and with AGZA for the purchase of electric utility maintenance vehicles and electric lawn and garden equipment under the recommended actions will not exceed $450,000. A total 6.25 percent administrative fee of $28,125 will be used to reimburse the General Fund for project administrative costs. Sufficient funds will be available in the LADWP Settlement Projects Fund (38).

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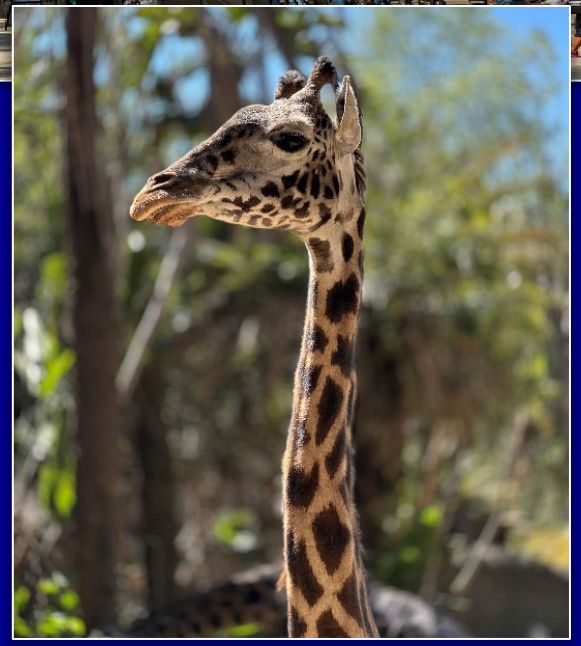
# Agenda Item #2

Expand the Purpose of LADWP Settlement Projects Fund, Recognize Funds, Execute Contracts for Electrification Projects at Los Angeles Zoo, and Reimburse the General Fund for Project Administrative Costs

Nicole Silva

# Background

- LADWP paid South Coast AQMD $450,000 for supplemental environmental projects for a settlement agreement with City of Los Angeles
- Fund's current purpose is for microturbine projects
- LA Zoo selected for several reasons:
  - Proximity to LADWP's site that resulted in the SEP agreement
  - Air quality, noise, and exposure reduction benefits for visitors annually at the zoo
  - Implementation of off-road zero-emission technologies in public areas will showcase these new zero-emission technologies

# Proposal

- Staff is recommending to expand purpose of LADWP Settlement Projects Fund to include electrification projects
- South Coast AQMD to fund 100% of proposal:
  - 4 electric trams w/ maintenance contract
  - 2 electric utility maintenance vehicles
  - Electric lawn and garden equipment

# Summary of Recommended Actions

- Recognize $478,125 into the LADWP Settlement Projects Fund
- Execute contracts for a combined total up to $450,000
  - With SSA Group, LLC to purchase 4 electric trams with a 5-year maintenance contract
  - With American Green Zone Alliance (AGZA) to purchase 2 electric utility maintenance vehicles and electric lawn and garden equipment

PROPOSAL: Clean Fuels Program Draft 2025 Plan Update
[Written Report Only]

SYNOPSIS: The Clean Fuels Plan Update is submitted every year with the Clean Fuels Annual Report as required by legislation. As part of that process, staff provides the Clean Fuels Program Draft Plan Update to the Technology Committee to solicit input on the proposed priority technology areas and potential projects for the upcoming year before requesting final Board approval for the Plan Update in early spring. Staff proposes continued support for a wide portfolio of technologies emphasizing zero emission technologies for vehicles, off-road equipment, and supporting infrastructure.

AK:MW:VP:mw

**Background**

Each calendar year, as required by legislation, the Clean Fuels Program Plan Update is revised to reflect technical priorities and proposed project areas for the upcoming year. As part of this process, staff provides the Clean Fuels Program Draft Plan Update (Draft Plan Update) to the Technology Committee as a separate item to solicit input on the proposed allocation of Clean Fuels funds before requesting final approval in early spring. This has provided an opportunity for the Committee to provide input before Board approval of the final Plan Update (concurrent with approval of the Clean Fuels Annual Report).

For Calendar Year 2025, staff has prepared a 2025 Draft Plan Update which proposes continued support for a wide portfolio of technologies with emphasis on zero emission technologies for vehicles, off-road equipment, and supporting infrastructure to create a pathway towards attainment of National Ambient Air Quality Standards for ozone. This aligns well with South Coast AQMD's FY 2024-25 Goals and Priority Objectives and assists in achieving goals outlined in the 2022 AQMP, which calls for a significant reduction in NOx emissions by 2037 through the transition to zero emissions technologies wherever feasible. The portfolio is also designed to leverage funds from

other state and federal programs such as the CARB Greenhouse Gas Reduction Fund Program, CEC Clean Transportation Program, U.S. EPA grants such as the Diesel Emissions Reduction Act, the Targeted Airshed, and the Clean Air Technology Initiative Grants, and recent federal grants from U.S. EPA, DOE, and DOT established by the Infrastructure Investment and Jobs Act and the Inflation Reduction Act.

**Proposal**

The attached Draft Plan Update identifies potential projects to be considered for funding during 2025. The proposed projects reflect promising near-zero and zero emission technologies and applications that are emerging for different emission categories. This update includes several proposed projects. The actual projects to be funded in the current fiscal year will depend on the available budget and the awards received from other funding sources. Some of the proposed projects for 2025 include but are not limited to: 1) Large deployment projects of medium-duty (MD) and heavy-duty (HD) zero emission trucks and charging/fueling infrastructure, 2) Innovative micro-grid solutions to support HD truck charging and hydrogen fueling, 3) Development and deployment of advanced charging technologies, including high-power charging at the megawatt levels to increase range of battery electric trucks, 4) Development and demonstration of long range Class 8 fuel cell electric trucks and equipment, and 5) Development and demonstration of green hydrogen production pathways. Projects that will not be funded in 2025, may be considered for funding in subsequent years.

In addition to identifying proposed projects to be considered for funding, this Draft Plan Update confirms ten key technical areas of highest priority to the South Coast AQMD. These high priority areas are listed below based on the proposed funding distribution shown in Figure 1:

- Zero Emission Infrastructure
- Battery Electric Technologies
- Health Impacts Studies
- Stationary Clean Fuel Technologies (including renewables) Fuel and Emissions Studies
- Hydrogen/Mobile Fuel Cell Technologies
- Fuel/Emissions Studies
- Renewable Fuel Infrastructure
- Technology Assessment and Transfer/Outreach
- Engine Systems/Technologies (particularly in the HD vehicle sector)
- Emission Control Technologies

It should be noted that these priorities represent the areas where South Coast AQMD funding is thought to have the greatest impact. In keeping with the diverse and flexible "technology portfolio" approach, these priorities may shift during the year to: capture

opportunities such as cost-sharing by state government, federal government, or other entities, or address specific technology issues which affect residents within the South Coast AQMD's jurisdiction.

Figure 1 graphically depicts potential distribution of South Coast AQMD's Clean Fuels funds, based on projected program costs of $31 million for the ten project areas discussed previously. The expected actual project expenditures for 2025 are expected to be less than the total projected program cost since not all projects will materialize. Target allocations are based on balancing technology priorities, addressing technical challenges and opportunities, and achieving near-term versus long-term benefits with the constraints on available South Coast AQMD funding. Specific contract awards throughout 2025 will be based on this proposed allocation, quality of proposals received and evaluation of projects against standardized criteria, and ultimately, Governing Board approval. At that time, additional details will be provided about the technology, its application, specific scope of work, project team capabilities, and project cost-sharing.

These technical priorities will necessarily be balanced by funding availability and availability of qualified projects. Established under H&SC Section 40448.5 and Vehicle Code Section 9250.11, the Clean Fuels Program collects revenues from mobile and stationary sources to support the program's objectives, albeit with constraints on the use of funds. Grants and cost-sharing revenue contracts from various government agencies, such as CARB, CEC, NREL, U.S. EPA, DOT, and DOE, also support technology advancement efforts and may be utilized for cost-sharing.

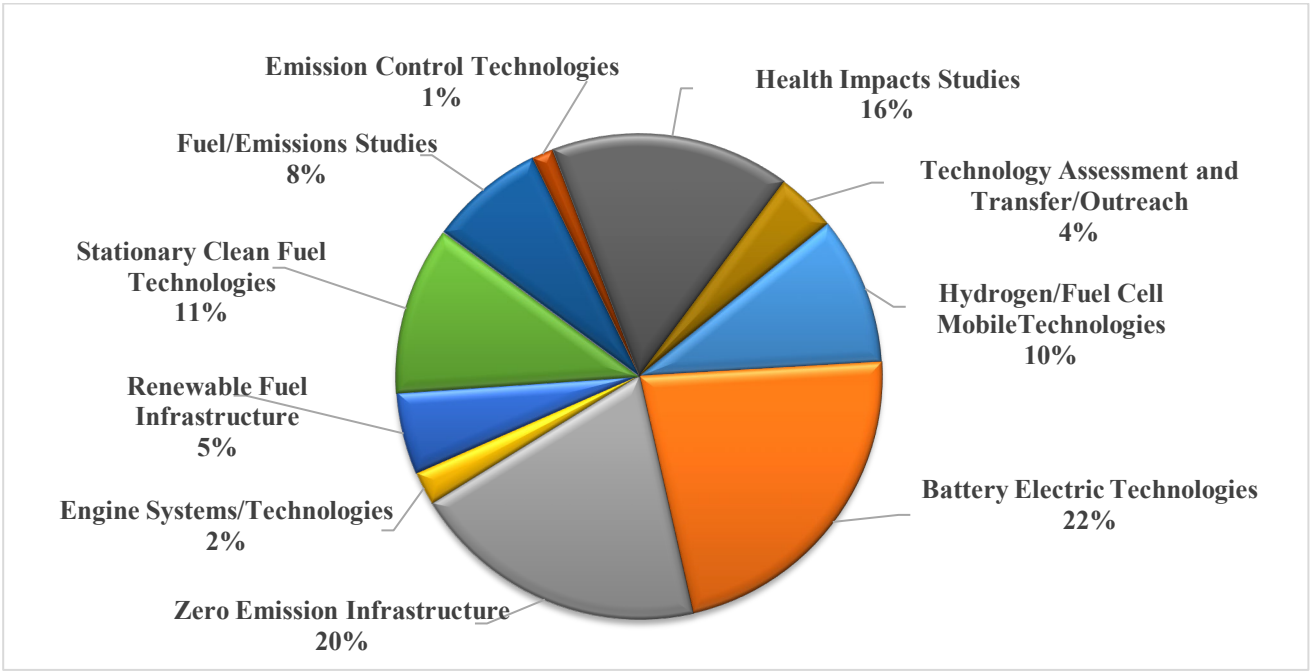



**Figure 1: Projected Funding Distribution for Potential Projects in 2025 ($31M)**

The proposed update is the result of historical as well as current comprehensive planning and review process, which will continue over the next few months as the 2025 Draft Plan Update is further refined before the Governing Board considers adoption in early spring. This process includes consideration of the 2022 AQMP, San Pedro Bay Ports' Clean Air Action Plan, California Sustainable Freight Action Plan, CARB's 2023 - 2024 Funding Plan, CARB 2020 Mobile Source Strategy and new mobile source regulations, such as the Advanced Clean Trucks and Fleets regulations, as well as our Indirect Source Rules. The proposed update also incorporates coordination activities involving outside organizations on federal, state and local activities, and proposed integrated solutions ranging from the Governor's Executive Orders and goals for MD and HD vehicles to U.S. EPA and CARB climate pollution reduction strategies. The Governor's Executive Order issued in January 2018 setting a target of 200 hydrogen stations by 2025 (double the original 2023 target) and 5 million ZEVs by 2030 is a good example of state and local alignment. As part of the Clean Fuels Program, staff hosted two advisory group meetings in January and September 2024 to solicit input from the Clean Fuels Advisory Group, Technology Advancement Advisory Group, and other technical experts. During these advisory meetings, participants reviewed current and proposed Technology Advancement projects as well as the proposed funding distribution for the 2025 Draft Plan Update and discussed near-term and long-term technologies as potential projects.

Discussions from the review process and advisory meetings, where appropriate, have been and will continue to be fashioned into project areas and included in this year's Plan Update as it is finalized. Additionally, staff regularly interacts with CARB, CEC, DOE, DOT, U.S. EPA, Hydrogen Fuel Cell Partnership, Veloz, and other entities to solicit and incorporate technical areas for potential leveraged funding. Overall, the Draft Plan Update attempts to maintain flexibility to address dynamically evolving technologies and incorporate new research and data.

The major areas of focus are proposed in the following areas:

- Continued development and deployments of MD and HD zero emission trucks;
- HD zero emission infrastructure development, demonstration, deployment, and planning, including Innovative solutions to support zero emission infrastructure;
- Fleet planning tools and grid studies;
- Microgrids, and low- and zero emission power generation demonstrations to support zero emission infrastructure;
- Other Microgrid demonstrations to support vehicle to grid/home concepts;
- Battery and fuel cell electric transit and school bus fleet charging/fueling infrastructure;

- HD diesel truck replacements with zero emission trucks through incentive programs; and
- Fuel and emissions studies, such as airborne measurement, emissions from new ICE fuel sources and conducting non-tailpipe PM studies and support of the MATES VI study.

**Maintain other areas of emphasis**

The funding allocation remains largely the same as in the previous year. The fluctuations among the categories are within 5 percent in relative to the total funds. While some categories, such as hydrogen fuel cell or electric/hybrid technologies, have lower percentages in 2025, the Clean Fuels fund allocations and total project cost will be higher. As shown in Figure 2, the 2025 Draft Plan Update has a particular focus on zero emission infrastructure for large-scale charging and fueling stations necessary to support medium- and heavy-duty battery electric and fuel cell vehicles. There remains an urgent need to develop, demonstrate, and deploy zero emission technologies for HD vehicles and equipment, especially for goods movement applications, including supporting infrastructure. The emphasis on zero emission technologies continues to pave a technological pathway towards achieving the 2037 federal ozone National Ambient Air Quality Standard.

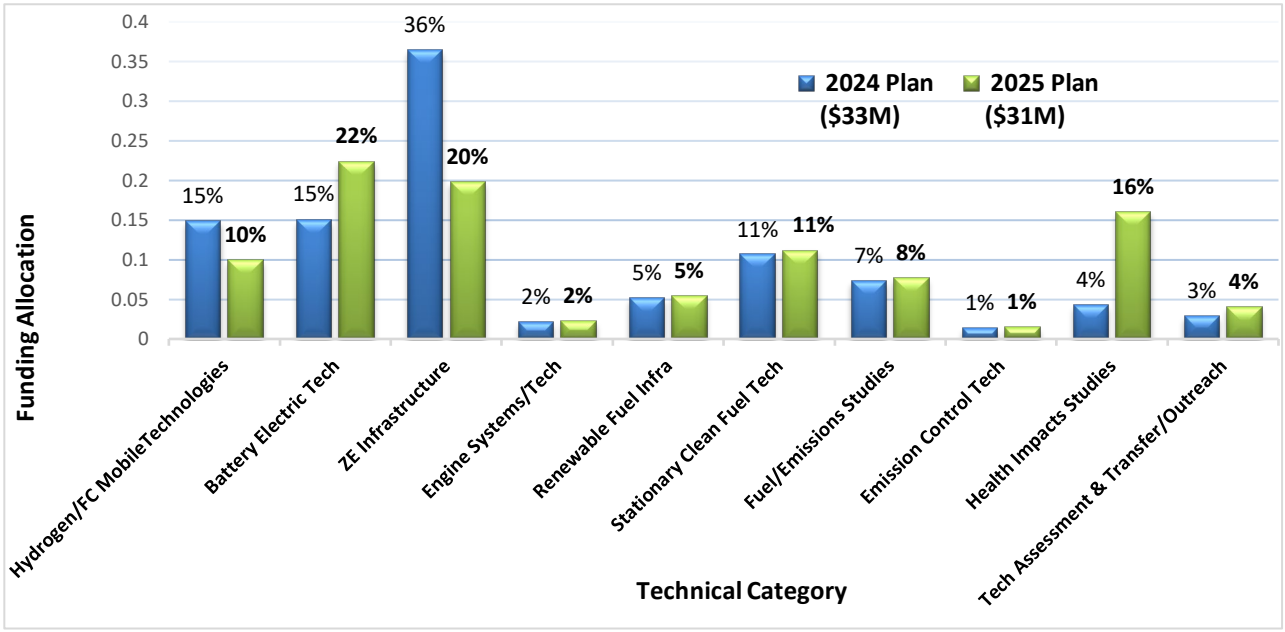



**Figure 2: Plan Update Comparison**

Based on communications with organizations specified in H&SC Section 40448.5.1 and review of their programs, the projects proposed in this update do not appear to duplicate any past or present projects. As each individual project is recommended to the

Governing Board for funding, staff will continue to coordinate with these organizations to ensure that duplication is avoided and optimal expenditure of Clean Fuels Program funds.

**Attachment**
Clean Fuels Program 2025 Draft Plan Update

# TECHNOLOGY ADVANCEMENT OFFICE
# DRAFT 2025 PLAN UPDATE

**South Coast Air Quality Management District**
**October 2024**

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# EXECUTIVE SUMMARY

## Introduction

South Coast Air Quality Management District (South Coast AQMD) is the air pollution control agency for Orange County and the urban portions of Los Angeles, Riverside, and San Bernardino counties. This region, which encompasses the South Coast Air Basin (Basin) as well as small portions of the Mojave Desert and Salton Sea Air Basins, historically experiences the worst air quality in the nation due to its natural geographic and atmospheric conditions, coupled with its high population density and associated mobile and stationary source emissions.

In 1988, Senate Bill (SB) 2297 (Rosenthal) was signed into law (Chapter 1546). It initially established a five-year program to increase the use of clean fuels, but subsequent legislation extended and removed the sunset clause for the Program. That legislation also reaffirmed the existence of the Technology Advancement Office (TAO) to administer the Clean Fuels Program. The Clean Fuels Program is an integral part of South Coast AQMD's effort to achieve the significant nitrogen oxide (NOx) emission reductions called for in the 2022 Air Quality Management Plan (AQMP) because it affords South Coast AQMD the ability to fund research, development, demonstration and accelerated deployment of clean fuels and transformative transportation technologies.

Using funding from a $1 motor vehicle registration fee, the Clean Fuels Program encourages, fosters, and supports clean fuels and transportation technologies, such as hydrogen fuel cells, advanced natural gas (NG) technologies, alternative fuel engines, battery electric vehicles, plug-in hybrid electric vehicles and related fueling infrastructure including renewable fuels. A key strategy of the Program is its public-private partnerships with private industry, technology developers, academic institutions, research institutions, and government agencies. Since 1988, the Clean Fuels Program leveraged nearly $267.9 million into $1.7 billion in clean technology projects. Leveraging of the Clean Fuels Fund is based on executed contracts and total project costs from the prior year's Clean Fuels Annual Report and Plan Update. The Mobile Source Air Pollution Reduction Review Committee (MSRC) discretionary fund, established under Assembly Bill 2766, is another funding source for mobile source emission reduction projects. The MSRC develops an annual Work Program to define the categories of projects for funding. Each year, approximately $15 million, collected from motor vehicle registration fees, is allocated to the discretionary fund and is an important source of funding to supplement the Clean Fuels Program.

As technologies are commercialized (battery electric trucks or BETs) or move towards commercialization (fuel cell trucks or FCTs), the Clean Fuels Program partners with large original equipment manufacturers (OEMs), such as Daimler, Volvo, Hyundai, and Peterbilt to deploy these vehicles at scale. These OEM partnerships allow the Program to leverage their research, product development, customer relationships, and financial resources needed to move advanced technologies from the laboratories to the field and into customers' hands. The OEMs have the resources and capabilities to design, engineer, test, manufacture, market, distribute, and service quality products under trusted brand names. This scale is needed to reduce emissions and attain national ambient air quality standards (NAAQS).

South Coast AQMD and its partners play a leadership role in technology development and commercialization to accelerate criteria for reductions in pollutant and greenhouse gas (GHG) emissions. The Clean Fuels Program has traditionally supported a portfolio of technologies at different technology

readiness levels. This helps develop new technologies across many mobile sectors needing new technologies that provide emission and GHG reductions and health benefits. This approach enhances the region's chances of achieving the NAAQS.

California Health and Safety Code (H&SC) 40448.5(e) calls for the Clean Fuels Program to consider factors such as current and projected economic costs and availability of fuels, cost-effectiveness of emission reductions associated with clean fuels compared with other pollution control alternatives, use of new pollution control technologies in conjunction with traditional fuels as an alternative means of reducing emissions; potential effects on public health, ambient air quality, visibility within the region; and other factors. The Legislature recognized the need for flexibility, allowing focus on a broad range of technology areas, including cleaner fuels, vehicles, equipment, emission control technologies, and supporting infrastructure, which helps South Coast AQMD make progress toward achieving its clean air goals.

California H&SC 40448.5.1 requires South Coast AQMD to prepare and submit a Clean Fuels Annual Report and Plan Update annually to the Legislative Analyst by March 31. The Clean Fuels Annual Report looks at Program accomplishments in the prior calendar year (CY), and the Clean Fuels Plan Update looks ahead at proposed projects for the next CY, re-calibrating the program's technical emphasis.

# Setting the Stage

The overall strategy of the Clean Fuels Program is largely based on emission reduction technologies identified in the 2022 AQMP and South Coast AQMD Board directives to protect the health of almost 18 million residents (nearly half the population of California) in the Basin. The 2022 AQMP is the long-term regional blueprint that identifies the fair-share emission reductions from all jurisdictional levels (e.g., federal, state, and local). The 2022 AQMP is composed of stationary and mobile source emission reductions from traditional regulatory control measures, incentive-based programs, projected co-benefits from climate change programs, mobile source strategies, and other innovative approaches, including indirect source measures and incentive programs, to reduce emissions from federally regulated sources (e.g., aircraft, locomotives, and ocean-going vessels). California Air Resources Board's (CARB) 2022 State Implementation Plan (SIP) Strategy included a revised mobile source strategy required for the Basin to meet the 2015 8-hour ozone standard of 70 ppb by 2037. The CARB 2022 SIP Strategy for mobile and stationary sources requires rapid deployment of zero emission technologies to achieve air quality targets.

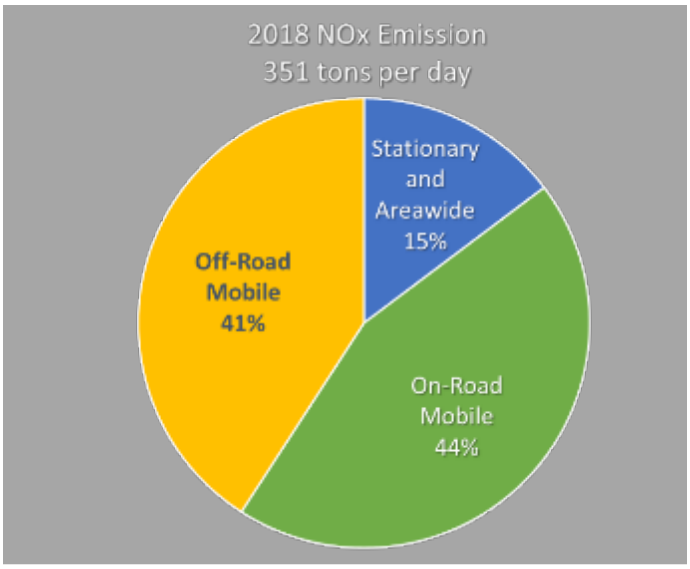


**Figure 1: NOx Emissions by Source Category in South Coast Air Basin for 2018**

Ground-level ozone (a key component of photochemical smog) is formed by a chemical reaction between NOx and volatile organic compound (VOC) emissions in the presence of sunlight. NOx emission reduction is the key to improving ozone air quality and attaining the ozone NAAQS in the Basin. Approximately 85 percent of NOx emissions were from mobile sources in 2018, as shown in Figure 1[1]. Furthermore, NOx and VOC emissions also lead to the secondary formation of PM2.5 in the atmosphere (particulate matter measuring 2.5 micrometers or less in size).

The emission reductions and control measures in the 2022 AQMP rely on the commercial adoption of a mix of currently available technologies and the expedited development and commercialization of clean fuel mobile and stationary advanced technologies in the Basin to achieve air quality standards. The 2022 AQMP identifies that 83 percent NOx emission reductions from the 2018 level and 67 percent additional reductions in 2037 beyond already adopted regulations and programs are necessary to meet the 2015 8-hour ozone standard by 2037. Figure 2 illustrates the needed NOx reductions in the Basin by source category. Most NOx reductions must come from mobile sources, both on- and off-road categories. Notably, South Coast AQMD is one of only two regions in the nation designated as an extreme nonattainment area of the 2015 8-hour ozone NAAQS (the other region is California's San Joaquin Valley).

[1] 2022 South Coast AQMD Air Quality Management Plan, http://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan

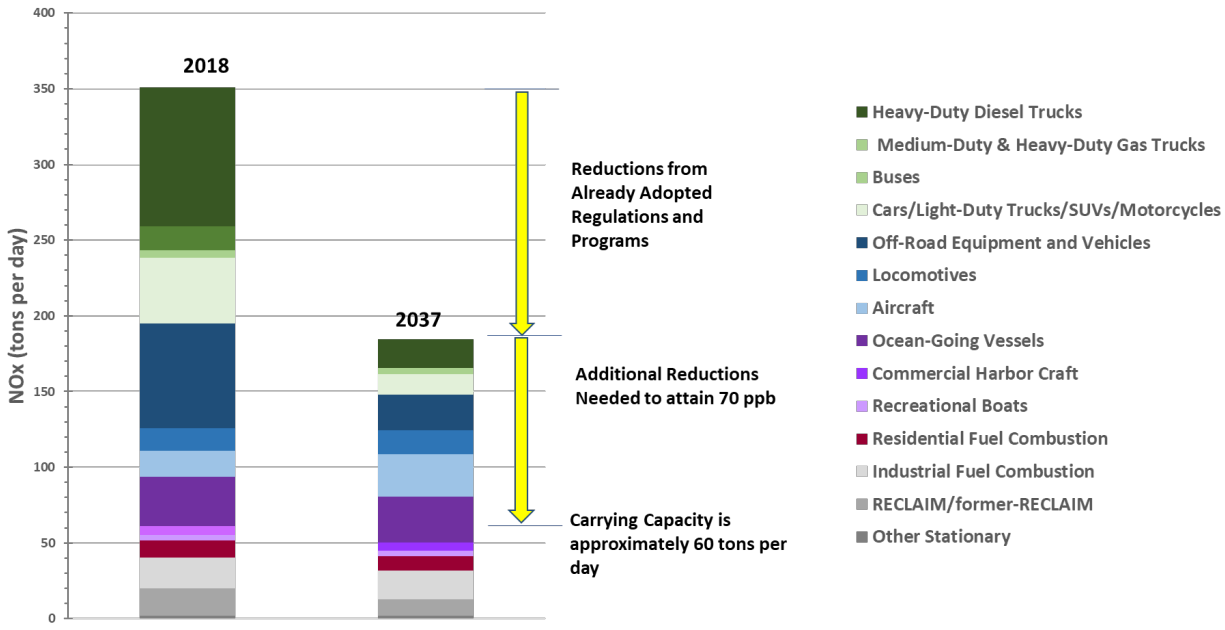


**Figure 2: NOx Emissions and Reductions Required to Attain 2015 Ozone Standard in 2037[2]**

The 2022 AQMP shows the need for an economy-wide transition to zero emission technologies where feasible, along with the CARB 2020 Mobile Source Strategy and low NOx technologies in other applications. New mobile source technologies must be developed, commercialized, and implemented widely to achieve these targets.

# Clean Fuels Program

The Clean Fuels Program, established in California H&SC 40448.5, is an important mechanism to encourage and accelerate the advancement and commercialization of clean fuels in stationary and mobile source technologies.

Figure 3 provides a conceptual design of the wide scope of the Clean Fuels Program and its relationship with incentive programs. Various stages of technology projects are funded to provide a portfolio of technologies and achieve near-term and long-term emission and GHG reductions. The Clean Fuels Program typically funds projects in the Technology Readiness Level (TRL) ranging between 3-9 but does support research projects and early stage of commercial products as needed.

[2] South Coast AQMD 2022 AQMP. Chapter 4, p. 4-2, Figure 4-1. https://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/07-ch4.pdf?sfvrsn=6

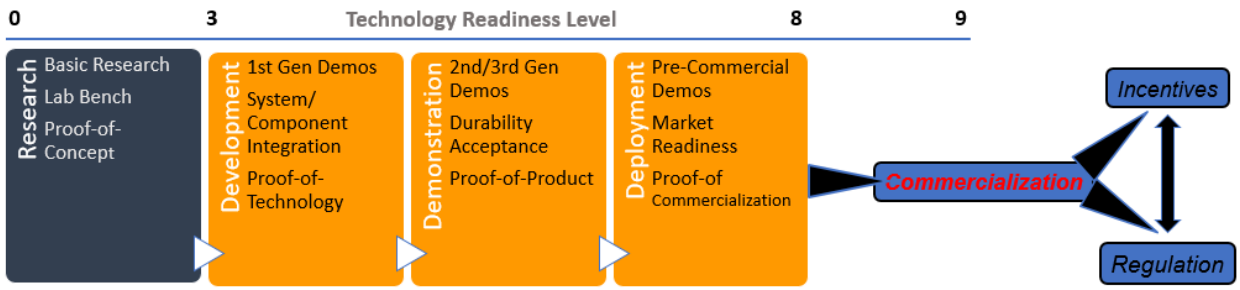


**Figure 3: Stages of Clean Fuels Program Funding**

Below is a summary of the 2025 Plan Update. Every Plan Update is reviewed by two advisory groups–the Clean Fuels Advisory Group, legislatively mandated by SB 98 (chaptered, 1999), and the Technology Advancement Advisory Group, created by the South Coast AQMD Board in 1990. These stakeholder groups review and assess the overall direction of the Program. The two groups meet approximately every six months to provide expert analysis and feedback on potential projects and areas of focus. Key technical experts in the Program's core technologies field also attend and provide feedback. South Coast AQMD's Board and other interested parties and stakeholders also offer preliminary reviews and comments. In 2024, the advisory groups met on January 23 and September 12.

## 2025 Plan Update

The Clean Fuels Program is re-evaluated annually to develop the annual Plan Update based on a reassessment of technology progress and direction for the agency. The program continually seeks to support developing and deploying cost-effective clean fuel technologies with increased collaboration with OEMs to achieve large-scale deployment. The design and implementation of the Clean Fuels Program Plan must balance the needs in the various technology sectors with technology readiness on the path to commercialization, emission and GHG reduction potential, and co-funding opportunities. South Coast AQMD is committed to developing, demonstrating, and commercializing technologies that reduce criteria pollutants, specifically NOx and toxic air contaminants (TACs). Most of these technologies address the Basin's need for NOx and TAC reductions and garner GHG reductions and petroleum use. Due to these co-benefits, South Coast AQMD has successfully partnered with the state and public/private partnerships to leverage its Clean Fuels funding.

South Coast AQMD engages in outreach and networking efforts to identify technology and project opportunities where funding can make a significant difference in deploying cleaner technologies in the Basin. These activities include close involvement with state and federal collaboratives, partnerships and industrial coalitions, and discussions with OEMs and technology providers on the current state of technologies and development and commercialization challenges. Additionally, unsolicited proposals from OEMs and other clean fuel technology developers are regularly received and reviewed. Potential development, demonstration, and certification projects resulting from these outreach and networking efforts are included in the 2025 Clean Fuels Plan Update.

Assembly Bill (AB) 617[3] requires reduced exposure to communities most impacted by air pollution; TAO conducts additional outreach to AB 617 communities regarding available zero and near-zero emission

[3] https://ww2.arb.ca.gov/capp

technologies and incentives to accelerate the deployment of cleaner technologies. Replacement of HD diesel trucks with zero emission trucks was in the Community Emission Reduction Plans (CERPs) for these AB 617 communities, and a zero emission HD truck loaner program was launched in 2023. The Program funded by the Community Air Protection Program (CAPP) provided smaller fleets and independent owner operators the opportunity to try and learn about zero emission trucks for their business operations. The Clean Fuels Program played an important role in developing the ZE technologies.

Today, diesel truck emissions are still one of the largest NOx emission categories in the Basin. While CARB has the Advanced Clean Trucks (ACT), Advanced Clean Fleets (ACF), and Heavy-Duty (HD) Omnibus regulations in place, there is still a need to tackle interstate truck emissions that travel to and from the Basin. CARB estimates that 60 percent of total on-road HD vehicle miles traveled in the Basin are from vehicles purchased outside of California. This indicates the need for a more stringent federal and state standard for on-road HD vehicles. U.S. EPA has acknowledged the need for additional NOx reductions through a harmonized and comprehensive national NOx reduction program for HD on-highway engines and vehicles. U.S. EPA adopted the final rule "Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards" in December 2022 in similar stringency as the CARB Omnibus Standard. Two additional U.S. EPA rules were adopted in March 2024, including the Phase 3 HD GHG and light-duty (LD) and medium-duty (MD) vehicle multi-pollutant standards for model year 2027. These rules emphasized the large adoption of zero-emission LD, MD, and HD vehicles.

The South Coast AQMD Warehouse Actions and Investments to Reduce Emissions (WAIRE) program established as a part of Warehouse Indirect Source Rule (ISR) adoption reduces NOx and diesel particulate matter (DPM) emissions from mobile sources that are attracted to the Warehouses. The San Pedro Bay Ports implemented the Clean Truck Fund (CTF) to generate funds to achieve zero emission drayage trucks by 2035. Despite all these major efforts, per the 2022 AQMP, additional NOx emission reductions in the Basin are needed to meet ozone attainment target deadlines.

In the past year, significant federal and state funding has been made available to support the deployment of zero emission vehicles and installing infrastructures. Between 2023 and 2024, South Coast AQMD released several rounds of Carl Moyer and Community Air Protection Program (CAPP) funding announcements to solicit near- and zero- emission vehicles and equipment projects and the zero emission supporting infrastructures totaling over $300M, and the programs were heavily oversubscribed. In July 2024, the U.S. EPA awarded South Coast AQMD $500M under the Climate Pollution Reduction Grants (CPRG) to implement the INVEST CLEAN (Infrastructure, Vehicles, and Equipment Strategy for Climate, Equity, Air Quality, and National Competitiveness) to prioritize the emission reductions in the goods movement sectors for their potentially substantial reductions of criteria and hazardous air pollutants, impacts on low-income disadvantaged communities, and the opportunity to drive economic growth, including job creation. This incentive funding will ensure the demonstration and deployment by the Clean Fuels Program to continue to advance to full commercialization.

The Plan Update includes projects to develop, demonstrate and commercialize technologies, from near-term to long-term commercialization, that are intended to provide significant emission reductions over the next five to ten years. Areas of focus include:

- developing and demonstrating technologies to reduce emissions from goods movement and port-related activities, including zero emission drayage trucks, cargo handling equipment and supporting infrastructure;
- understanding particulate emissions from tire and brake wear;

- demonstrating ultra-low NOx, gaseous and liquid alternative/renewable fueled, large displacement/high efficiency engines and HD zero emission technologies;
- mitigating criteria pollutant emissions from the production of renewable fuels, such as renewable natural gas, diesel, hydrogen, and electricity as well as other renewable, low/zero carbon fuels and waste streams;
- producing transportation fuels and energy from renewable and waste stream sources;
- developing and demonstrating electric-drive (fuel cell, battery, plug-in hybrid, and non-plug-in hybrid) technologies across LD, MD, and HD platforms;
- establishing large-scale hydrogen fueling and electric vehicle (EV) charging infrastructure to support MD and HD zero emission vehicles;
- ultra-fast, higher power charging (1 megawatt (MW)) for HD battery electric vehicles and similar charger rate for MD battery electric vehicles;
- developing and demonstrating high flow fueling protocols and standards to address hydrogen refueling station network health and reliability and expand HD hydrogen refueling stations;
- developing and demonstrating portable hydrogen refueling equipment to address the short-term need for hydrogen refueling and advance these technologies;
- developing and demonstrating green hydrogen production pathways and hydrogen ecosystems to reduce the cost of hydrogen and improve state-wide hydrogen station reliability and availability;
- developing and demonstrating low and zero emission alternative charging solutions (ACS) that support the deployment of permanent EV charging infrastructure and provide temporary backup power generation; and
- developing and demonstrating zero emission microgrids that utilize battery energy storage systems and onsite clean power generation to support transportation electrification demands associated with goods movement and freight handling activities; and workforce training.

Table 1 (page 25) lists potential projects across ten core technologies by funding priority:

- Battery Electric Technologies (battery electric and hybrid electric trucks and container transport technologies with capability of zero emission operations);
- Zero Emission Infrastructure - both hydrogen and battery electric as well as studies that aid the readiness and management of ZE infrastructure;
- Health Impact Studies;
- Stationary Clean Fuel Technologies (microgrids and stationary clean fuel technology projects, but not in combination with EV and Hydrogen infrastructure);
- Hydrogen / Fuel Cell Mobile Technologies;
- Fuel and Emission Studies;
- Renewable Fuel Infrastructure;
- Technology Assessment and Transfer/Outreach
- Engine Systems / Technologies (alternative and renewable fuels for truck and rail applications); and
- Emission Control Technologies.

These potential projects, planned for 2025, total $31 million of the Clean Fuels funds, with the anticipated total project costs of $182.9 million, leveraging almost $6 for every $1 of Clean Fuels funds spent. Some proposed projects may also be funded by state and federal grants and incentive programs, including AB 617 CAPP funds, Volkswagen Mitigation, Carl Moyer Program, and others.

# CLEAN FUELS PROGRAM

# 2025 Plan Update

In 1988, SB 2297 (Rosenthal) was signed into law (Chapter 1546) establishing South Coast AQMD's Clean Fuels Program and reaffirming the existence of the TAO to administer the Clean Fuels Program. The funding source for the Clean Fuels Program is a $1 motor vehicle registration surcharge that was originally approved for a limited five-year period, but legislation eventually extended both the Program and surcharge indefinitely. The Clean Fuels Program has evolved over the years but continues to fund a broad array of technologies spanning near- and long-term implementation. Similarly, planning will remain an ongoing activity for the Clean Fuels Program, which must remain flexible to address evolving technologies as well as capitalize on the latest progress in technologies, research areas and data.

Every year, South Coast AQMD re-evaluates the Clean Fuels Program to develop a Plan Update based on reassessment of clean fuel technologies and direction of the South Coast AQMD Board. This Plan Update for CY 2025 targets several projects to achieve near-term emission reductions needed for the South Coast to meet health-based NAAQS.

## Overall Strategy

The overall strategy of TAO's Clean Fuels Program is based on emission reduction technology needs identified through the AQMP process and South Coast AQMD Board directives to protect the health of the approximately 18 million residents (nearly half the population of California) in the Basin. The 2022 AQMP is the long-term regional blueprint that relies on fair-share emission reductions from all jurisdictional levels (e.g., federal, state and local). The 2022 AQMP is composed of stationary and mobile source emission reductions from traditional regulatory control measures, incentive-based programs, projected co-benefits from climate change programs, mobile source strategies and reductions from federally regulated sources (e.g., aircraft, locomotives and ocean-going vessels). CARB's adopted 2022 SIP Strategy included a revised mobile source strategy required for the Basin to meet the 2015 8-hour ozone standard of 70 ppb by 2037. The adopted 2022 SIP Strategy for both mobile and stationary sources require rapid deployment of zero emission technologies to achieve air quality targets.

The emission reductions and control measures in the 2022 AQMP rely on commercial adoption of a mix of currently available zero emission technologies as well as the expedited development and commercialization of clean fuel mobile and stationary advanced technologies in the Basin to achieve air quality standards. The 2022 AQMP identifies that 83 percent NOx emission reductions from the 2018 level and 67 percent additional reductions in 2037 beyond already adopted regulations and programs are necessary to meet the 2015 8-hour ozone standard by 2037. The majority of NOx reductions must come from mobile sources, including both on- and off-road sources. Notably, South Coast AQMD is currently one of only two regions in the nation designated as an extreme nonattainment area of the 2015 8-hour ozone NAAQS (the other region is California's San Joaquin Valley). As a result, the 2022 AQMP shows the need for economy-wide transition to zero emission technologies where feasible, and low NOx emission technologies in other applications.

Current federal and state efforts in developing regulations for on- and off-road vehicles and stationary equipment are expected to significantly reduce NOx emissions, but additional measures are needed to achieve 2031 and 2037 ozone attainment deadlines. To support fleet turnover, the Clean Fuels Program will

emphasize on commercialization and deployment of zero emission HD trucks, supporting zero emission infrastructure, as well as studies that plan and prioritize the needs to support the development of zero emission trucks and infrastructure.

While zero emission technologies have been demonstrated in greater numbers in the last few years, many more battery electric trucks (BETs) and fuel cell trucks (FCTs) are needed to meet the 2031 and 2037 ozone standards. Several challenges must be overcome to enable widespread deployments of BETs and price reductions on these trucks from at-scale production. These challenges can be addressed by providing an easier process for fleets and independent owner operators to purchase BETs, installing public charging infrastructure, increasing grid capacity at the sites that the trucks are being delivered, and determining adequate charging system to accommodate the duty cycles needed for drayage, short, regional haul, and last mile freight truck applications. Also, education, work force training, planning and studies are needed tool to improve the ZE adoption. In July 2024, the U.S. EPA awarded South Coast AQMD $500 million under the Climate Pollution Reduction Grants (CPRG) to implement the INVEST CLEAN (Infrastructure, Vehicles, and Equipment Strategy for Climate, Equity, Air Quality, and National Competitiveness). INVEST CLEAN prioritizes emission reductions in the goods movement sectors for their potential of substantial reductions of criteria and hazardous air pollutants, impacts on low-income overburdened communities, and the opportunity to drive economic growth, including job creation and workforce training.

The lack of charging infrastructure for the BETs is often a hindrance that many fleets chose to delay their electrification plans. Even for large fleets who are interested in deploying BETs, the lack of grid capacity and challenges in deploying solar, energy storage, or other technologies to offset grid demand and long lead time to obtain the power needs are some of many barriers in ZE deployment. Between 2023 and 2024, South Coast AQMD released several rounds of Carl Moyer, Community Air Protection Program (CAPP) funding opportunity totaling over $300M. The infrastructure proposals submitted under the RFP has been overwhelming. The most recent solicitation receiving over $300M funding requests, almost double the funds available. Meanwhile, public accessible truck charging is needed for small fleets and owner operators transiting to ZE fleets.[4,5] To mitigate the grid capacity issue, additional technology solutions that provide energy generation from non-grid tied microgrids can bypass the utility complex interconnection requirements are needed to mitigate the frustrations with deploying BETs. South Coast AQMD has been strongly engaged in development and demonstration of low and zero emission alternative charging solutions (ACS) to support the deployment of zero emission vehicles. The availability of reliable ACS will help fill the void of infrastructure delays as well as provide a backup generation option during grid outages and public safety power shutoff events. In May of 2024, Prologis opened a first of its kind 9MW EV charging depot that's powered by a non-grid connected microgrid with linear generators and batteries capable of charging 96 heavy-duty electric trucks simultaneously.[6]

Today, diesel truck emissions are still one of the largest NOx emission categories in the Basin. While CARB has the Advanced Clean Trucks (ACT), Advanced Clean Fleets (ACF), and Heavy-Duty (HD) Omnibus regulations in place, there is still a need to tackle interstate truck emissions that travel to and from

[4] https://www.wattev.com/post/wattev-opens-electric-commercial-truck-charging-depot-in-san-bernardino-second-in-socal-in-the-last

[5] https://www.businesswire.com/news/home/20240327434127/en/Greenlane-Announces-280-mile-Corridor-of-Commercial-EV-Charging-Stations-from-Los-Angeles-to-Las-Vegas

[6] https://www.prologis.com/about/news-press-releases/performance-team-maersk-company-prologis-launch-new-ev-truck-charging

the basin. CARB estimates that 60 percent of total on-road HD vehicle miles traveled in the Basin are from vehicles purchased outside of California, which points to the need for a more stringent federal and state standard for on-road HD vehicles. U.S. EPA has acknowledged the need for additional NOx reductions through a harmonized and comprehensive national NOx reduction program for HD on-highway engines and vehicles. U.S. EPA adopted the final rule "Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards" in December 2022 in similar stringency as the CARB Omnibus Standard. Two additional U.S. EPA rules were adopted in March 2024, including the Phase 3 HD GHG and light-duty (LD) and medium-duty (MD) vehicle multi-pollutant standards for model year 2027. Both these rules emphasized large adoption of zero-emission LD, MD, and HD vehicles.

Evaluation of health impacts of exposure to air pollution helps to assess source-specific impacts, guides potential policy and control strategies, and provides essential information to the public. Thus, health impact studies form a key component of the Clean Fuel Program strategy. South Coast AQMD has conducted five Multiple Air Toxics Exposure Study (MATES) campaigns since the 1980s, with MATES V completed in August 2021 and MATES VI currently in preparation phases. MATES uses comprehensive measurements, modeling, and health risk assessment methods to estimate cancer and non-cancer chronic health risks due to exposure to air toxins throughout the South Coast AQMD jurisdiction. A summary of MATES program findings is included in the Core Technologies section. Updating MATES is a key Clean Fuels Program Strategy. MATES VI is in the preparation stages, with monitoring scheduled to start in early 2025 and final data and dissemination of findings expected in late 2027 and early 2028. This update will extend the measurements, emission inventory, modeling, health risk analysis, and trends analysis. Two near-road monitoring sites will be added, and one additional site at Mecca will provide data to determine air toxics risk from measurements in the Coachella Valley for the first time in MATES.

MATES VI includes a study that will quantify whether an increased cancer potency factor may result in total cancer risk being dominated by EtO rather than diesel particulate matter, which has driven cancer risk since at least 1998 when MATES II first conducted measurements required to track it. Uncertainties on the importance of the following factors in determining EtO concentrations have been identified: local emission sources, including vehicles and their emission rates, transport of background EtO into the Basin, and secondary formation of EtO in the atmosphere. South Coast AQMD is consulting subject matter experts on these topics and is planning a study to address some of these uncertainties. A source apportionment study using measurements for MATES VI may also identify sources contributing to the observed concentrations.

A key strategy of the Clean Fuels Program, which allows significant leveraging of Clean Fuels funding (historically $4 to every $1 of Clean Fuels funds), is its public-private partnerships with private industry, technology developers, academic institutions, research institutions, and government agencies. Since 1988, the Clean Fuels Program provided more than $268.7 million toward projects with a total project value of over $1.7 billion. Leveraging of the Clean Fuels Fund is based on actual executed contracts and total project costs from the prior year's Clean Fuels Annual Report and Plan Update. In 1998, South Coast AQMD's Carl Moyer Program was launched. The two programs produce a unique synergy, with the Carl Moyer Program (and other subsequent incentive programs) providing the necessary funding to push market penetration of commercial technologies partially developed and demonstrated by the Clean Fuels Program. This synergy enables South Coast AQMD to act as a leader in technology development and commercialization efforts targeting the reduction of criteria pollutants. Since the Carl Moyer Program began, South Coast AQMD has already started implementing other incentive programs (i.e., Volkswagen Mitigation, Proposition 1B-Goods Movement, and Community Air Protection Program), with cumulative funding of over $200 million in 2022. Since 2017, there has been cumulative funding of $370 million in

AB 617 Community Air Protection Program (CAPP) incentives, of which $16.6 million will be used for zero emission trucks and charging infrastructure in the East Los Angeles/Boyle Heights/West Commerce, Southeast Los Angeles, San Bernardino/Muscoy, and Wilmington/Carson/West Long Beach[7]. The 2022 AQMP also included control measures to develop an indirect source regulation for the San Pedro Ports and strengthen fleet rules to take advantage of incentives to accelerate emission reductions further.

Despite several current California incentive programs to deploy commercially available cleaner technologies and offset the higher procurement costs of commercially available cleaner technologies, significant additional resources and technology development are needed to achieve the NAAQS for this region. Several key emerging technologies are discussed in detail later that will provide NOx and GHG co-benefits while requiring fewer vehicle purchase incentives.

The Clean Fuels Program has partnered with large OEMs, such as Daimler, Volvo, and Hyundai, to deploy HD BETs and FCTs. These OEM partnerships allow the Clean Fuels Program to leverage their research, design, engineering, manufacturing, sales and service, and financial resources to move advanced technologies from the laboratories to the field and into customers' hands. The OEMs have the resources to develop advanced technology vehicles such as battery electric and fuel cell powertrains, manufacture large quantities, and utilize their distribution networks to support sales across the state.

Figure 4 outlines a developmental progression for technology demonstration and deployment projects funded by the Clean Fuels Program and the relationship incentive programs administered by TAO play in that progression. The Clean Fuels Program funds various stages of technology projects, typically ranging from Technology Readiness Levels 3-8, to provide a portfolio of technology choices and achieve near-term and long-term emission reduction benefits.

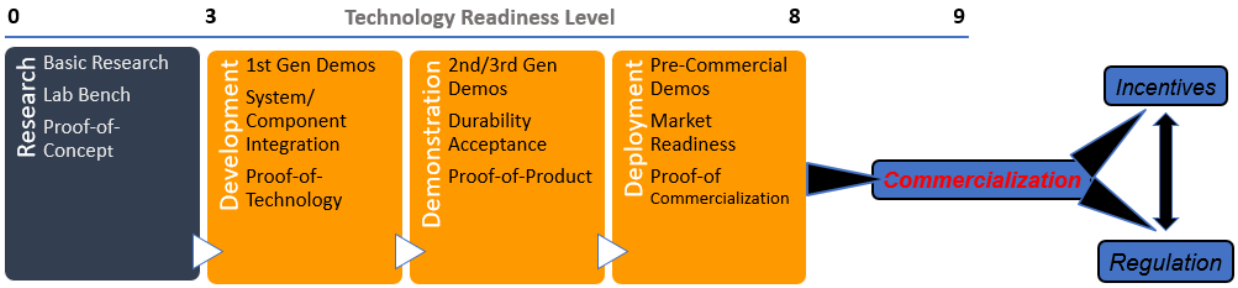


**Figure 4: Stages of Clean Fuels Program Funding**

Many technologies that address the Basin's needed NOx reductions align with the state's GHG reduction efforts. U.S. EPA (2023)[8] noted that the transportation sector contributed 28 percent of GHG emissions. Due to these co-benefits, South Coast AQMD has successfully partnered with the state and public/private partnerships to leverage its Clean Fuels funding extensively.

[7] Wilmington/Carson/West Long Beach will also provide incentive funding for near-zero emission trucks.

[8] U.S. Greenhouse Gas Emissions and Sinks 1990-2021. 2023. https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

## Program and Funding Scope

This Draft 2025 Plan Update includes projects to research, develop, demonstrate, and deploy a variety of advanced technologies, from near-term to long-term, that are intended to address the following challenges:

1) implementation of federal requirements, such as the more stringent federal 8-hour ozone standard of 70 ppb promulgated by the U.S. EPA in late 2015;
2) implementation of new technology measures, including accelerated development of technologies nearing commercialization and deployment of commercially ready technologies;
3) development of electric vehicle charging infrastructure and assess the readiness of the existing power grid; and development of alternative charging solutions to support the deployment of electric vehicles;
4) necessity to improve hydrogen refueling station network reliability and availability, support alternative hydrogen production, and the application of mobile hydrogen refueling where needed; and
5) continued development of near-term cost-effective approaches.

The overall scope of projects in the Draft 2025 Plan Update remains sufficiently flexible to address new technologies and control measures identified in the 2022 AQMP, dynamically evolving technologies, and new research and data. The latter includes findings from MATES V and emission inventories periodically updated by CARB.

Project objectives range from near-term to long-term within the core technology areas defined later in this section. The Clean Fuels Program concentrates on supporting development, demonstration, and technology commercialization and deployment efforts rather than fundamental research. The nature and typical time-to-product for Clean Fuels Program projects are described below, from near-term to long-term.

- Deployment or technology commercialization efforts focus on increasing the utilization of clean technologies in conventional applications, promising immediate and growing emission reduction benefits. It is often difficult to transition users to non-traditional technologies or fuels due to higher upfront costs, limited refueling infrastructure, or required changes to user behavior, even if these technologies or fuels offer significant emission reduction benefits. In addition to the government's role in reducing risk by funding technology development and testing, it is also necessary to offset upfront purchase costs through incentives to accelerate the use of cleaner technologies. The increased use of these clean fuel technologies also depends on efforts to increase stakeholder confidence that these technologies are viable and cost-effective in the long term.
- Field demonstrations provide a controlled environment for manufacturers to gain real-world experience and address end-user issues that arise before the commercial introduction of technologies. They also provide real-world evidence of performance to allay early adopters' concerns and provide preliminary emissions reduction potential.
- Technology development projects are typically more advanced and require two or more years. Additionally, field demonstrations to gain long-term performance verification may also be needed before commercialization. Certification and commercialization would be expected to follow. Projects may involve the development of emerging technologies that are considered long-term and higher risk but with significant emission reduction potential. Additionally, field demonstrations to gain long-term performance verification may also be needed prior to commercialization. In addition

to field demonstrations, large-scale pilot deployments are key to full certification and commercialization.

- Clean fuel vehicle technologies might be more mature but unable to deploy further due to higher costs and the need to support infrastructure. This is true for all clean fuel technologies but especially true for fuels with higher production costs.

## Core Technologies

The following technologies have been identified as having the greatest potential to enable the emission reductions needed to achieve the NAAQS, thus forming the core of the Clean Fuels Program.

The goal is to fund viable projects in all categories. However, due to funding limitations, not all project categories will be funded in 2025. The focus will remain on control measures identified in the 2022 AQMP, with consideration for the availability of suitable projects. The project categories identified below are appropriate within the context of the current air quality challenges and opportunities for technological advancement.

Within these areas, there are significant opportunities for South Coast AQMD to leverage its funds with other funding partners to expedite the demonstration and deployment of clean technologies in the Basin. A concerted effort is continually made to form public-private partnerships to maximize leveraging of Clean Fuels funds.

Several of the core technologies discussed below are synergistic. For example, an HD vehicle, such as a transit bus or drayage truck, may utilize a hybrid electric drive train with a fuel cell operating on hydrogen fuel or an internal combustion engine (ICE) operating on an alternative fuel as a range extender. Components of the core hybrid electric system may overlap. Similarly, a hydrogen powered engine may utilize an NG HD vehicle that combusts gaseous fuel and requires a compressed tank storage system; similar combustion and fuel storage components may overlap.

Priorities may shift during the year in keeping with the diverse and flexible technology portfolio approach or to leverage opportunities such as cost-sharing by the state or federal government or other entities. Priorities may also shift to address specific technology issues that affect residents within the South Coast AQMD's jurisdiction. For example, the AB 617 CAPP, signed by the Governor in 2017, implements emission reduction actions and provides incentive funding for designated AB 617 communities. The six AB 617 communities within the South Coast region designate funding priorities in their Community Emission Reduction Plans (CERPs). Additional flexibility will be needed to develop new strategies and technologies for those disadvantaged communities.

The following ten core technology areas are listed by current South Coast AQMD priorities based on the goals for 2025.

### *Zero Emission Infrastructure*

Significant demonstration and commercialization efforts for zero emission infrastructure are funded by the Clean Fuels Program as well as other local, state and federal programs. Zero emission infrastructure has become an increasing focus of the Clean Fuels Program to support large-scale demonstration and deployment of hydrogen fuel cell and battery electric vehicles and equipment. This stand-alone category was created in the 2023 Plan Update, separate from Hydrogen/Fuel Cell and Electric/Hybrid Technologies.

### *Hydrogen Infrastructure*

With lead times on retail-level hydrogen fueling stations requiring 18-36 months for permitting, construction, and commissioning, plans for future stations must be implemented. While coordination with the California Division of Measurement Standards (DMS) to establish standardized measurements for hydrogen fueling started in 2014, additional efforts to offer hydrogen for sale in higher volumes are still needed specifically with upcoming ZE vehicle and infrastructure policy deadlines on a national and state level. Moreover, CARB's Low Carbon Fuel Standard (LCFS) regulation provides incentives for producing and dispensing the low carbon intensity (CI) hydrogen for FCEVs, enabling station operators to remain solvent and cover part of their operational cost and consequently reducing the dollar per kilogram cost of hydrogen for consumers. Lastly, a deliberate and coordinated effort is necessary to ensure that hydrogen stations are developed with design flexibility to address specific location limitations, robust hydrogen supply, and fueling reliability matching those of existing gasoline and diesel fueling stations. The current network of hydrogen fueling stations to support the current number of LD FCEVs on the road and future MHD FCVs is insufficient, and the supply of hydrogen and additional hydrogen production, specifically carbon-neutral hydrogen, continue to be challenges that need to be addressed.

In 2019, the Clean Fuels Program awarded $1.2 million to Equilon (Shell) as part of the H2Freight project for a new 1,000 kg/day HD hydrogen fueling station using hydrogen produced by a new tri-generation fuel cell on Port of Long Beach property leased by Toyota. The station was commissioned in July 2021, and Shell continues to operate and maintain this station to consumers, including Toyota and other fleet operators that commit to use FCEVs. As part of the $83 million Shore-to-Store project led by the Port of Los Angeles, for which the Clean Fuels Program committed $1 million, Toyota and Kenworth deployed 10 Class 8 fuel cell trucks and Equilon (Shell) built two large capacity hydrogen fueling stations in Wilmington and Ontario. Kenworth leveraged the development of the fuel cell truck demonstrated in South Coast AQMD's ZECT 2 project and integrated Toyota's fuel cells into the Kenworth trucks. These fuel cell trucks are deployed at fleets, including UPS, Total Transportation Services, Southern Counties Express, and Toyota Logistics Services at the Ports of Los Angeles and Port Hueneme, as well as other fleets in Riverside County. Most of the fuel cell trucks completed the demonstration phase. Also, the Ontario and Wilmington stations were commissioned, and site acceptance testing was completed in November 2022, moving to 24-hour unstaffed operations. However, in early 2024, Shell announced the closure of all its light-duty hydrogen stations in California, including pausing operations of the three publicly accessible heavy-duty stations.[9] As of this report, all three stations remain offline on H2FCP's availability dashboard. This essentially creates a pause in all FCT operations in Southern California. In contrast, when sufficient fueling is available, the FCTs are running well, like the NorCAL ZERO project that operates a fleet of 30 FCTs out of the port of Oakland.[10] South Coast AQMD continues to work with H2FCP to achieve a reliable hydrogen refueling network in California through demonstrating and developing standards, protocols, and green hydrogen production pathways. South Coast AQMD is also participating in the Angeles Link project, which seeks to build a dedicated hydrogen pipeline to bring clean, renewable hydrogen to South Coast Air Basin, as well as the DOE-funded Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) efforted for California's initiative to accelerate renewable hydrogen projects and the necessary infrastructure. TAO is also discussing with technology providers about looking at new ways to expand the production of clean, renewable hydrogen through different sources.

[9] https://www.autoweek.com/news/a46791348/shell-closes-hydrogen-stations-california/

[10] https://www.portofoakland.com/port-of-oakland-celebrates-hydrogen-powered-trucks-project/

New, ongoing, and recently completed hydrogen infrastructure projects include: 1) Port of Los Angeles Shore-to-Store project with the deployment of two 400 kg/day hydrogen fueling stations in Wilmington and Ontario for HD fuel cell trucks and 2) retrofit of existing hydrogen infrastructure stations to accommodate HD fuel cell trucks by First Element to demonstration Hyundai Class 8 fuel cell trucks, 3) Equilon (Shell) project to develop a new 1000 kg/day HD hydrogen fueling station in Port of Long Beach, 4) Toyota Tsusho America, Inc. (TAI) project to demonstrate zero-emission port equipment and mobile hydrogen refueler, 5) Zero Emission Industries, Inc, (ZEI) project to demonstrate a portable liquid hydrogen fueling system for marine and locomotive applications, and 6) replace and expand the existing LD hydrogen refueling station at South Coast AQMD headquarters with FirstElement Fuel, Inc.

There are numerous fuel cell applications for off-road equipment; however, one of the primary challenges is the need for more access to hydrogen fueling stations in these settings. Installing on-site hydrogen refueling infrastructure would be costly and impractical, particularly in land-constrained areas like port complexes. The Clean Fuels Program awarded TAI $900,000 to develop and demonstrate a fuel cell-powered mobile hydrogen refueler to address this issue. This mobile refueler currently provides the hydrogen for fuel cell-powered cargo handling equipment (CHE) at the Port of Los Angeles. This demonstration will give valuable insights into the technical requirements of mobile hydrogen fueling and the economic viability of this approach within a port complex.

### *Electric Charging Infrastructure*

The challenges of installing charging infrastructure include costs, permitting, Underwriters Laboratories (UL) certification of equipment, utility interconnection requirements and extended timeline and requirements for grid upgrades, all of which need to be better understood and streamlined. In addition, CPUC modeling and forecasting need to be updated to reflect increased regulatory requirements from ACT, ACF, and ISR regulations, which require fleets to begin transitioning to BETs. Under existing CPUC regulations, investor-owned utilities can only build just in time grid upgrades and need to have the ability to upgrade the grid in advance of these deployments in high priority corridors such as the I-710 where there is significant truck traffic between the San Pedro Bay Ports and the warehouse facilities in the Inland Empire.

Continued technology advancements in LD infrastructure have facilitated the development of corresponding codes and standards for MD and HD infrastructure including the adoption of a Megawatt Charging Standard (MCS) for high power megawatt charging. Additionally, SCE's Charge Ready Transport Program and the Los Angeles Department of Water and Power's (LADWP) Commercial EV Charging Station Rebate Program include funding for charging infrastructure.

LD EV charging infrastructure is commercially available, and the market aligns with the North American Combined Charging Standard (CCS1). MD and HD charging infrastructure using CCS1 connectors are commercially available in an early deployment stage. The CCS1 connector continues to be the standard for MD and HD charging up to 350 kW direct current (DC) in the United States. Charging Interface Initiative (CharIN) released a Megawatt Charging System (MCS) connector in June 2022 for Class 6 -8 EVs designed for a maximum current of 3,000 A at up to 1,250V for charging up to 3.75 MW DC, which has not yet been adopted. Currently there are no commercially available MD or HD EVs capable of accepting charging above 350 kW DC. There is also an agreed upon SAE J3068 connector standard for single-phase and three-phase AC charging as well as Tesla's semi charging connector. The challenges and costs of installing MD and HD charging infrastructure increase exponentially compared to LD infrastructure due to higher power requirements.

South Coast AQMD seeks state and federal funding to lead local and regional collaboratives to create MD/HD charging infrastructure networks. SCAG is developing a six-county regional MD/HD charging and hydrogen fueling infrastructure plan as part of the CEC eTRUC project to develop and demonstrate high power DC fast charging for HD BETs. A detailed plan for the San Pedro Bay Ports and the I-710 corridor will be created using advanced modeling and additional data sources. Metro has committed $50 million of its funding in a related effort to deploy charging for HD BETs between the San Pedro Bay Ports and along the I-710 corridor. South Coast AQMD also partnered with private entities to build and expand the MD/HD charging network and submitted proposals to the federal government to support the BETs and equipment at the Ports and facilitate electrifying long-haul transportation. Additional state and federal funding opportunities exist under CARB, CEC, and U.S. EPA for HD electrification and climate pollution reduction. In July 2024, South Coast AQMD received an award of $500M from the U.S. EPA under the Climate Pollution Reduction Grants (CPRG) for the project Infrastructure, Vehicles, and Equipment Strategy for Climate, Equity, Air Quality, and National Competitiveness (INVEST CLEAN). Focusing on the electrification of the goods movement sector, INVEST CLEAN will allocate significant funding to support the installation of heavy-duty truck charging infrastructure in Southern California. More than 1,000 heavy-duty truck chargers are expected to be developed in the following few years to help accelerate the deployment of battery-electric heavy-duty trucks alongside the currently available state-funded infrastructure programs.

Meanwhile, private fleets seek alternatives to build faster infrastructure, such as non-grid-connected microgrids. In May 2024, Prologis and Performance Team launched Southern California's largest HD electric vehicle microgrid charging depot. The charging depot is located in Torrance, near the Ports of Los Angeles and Long Beach, and can charge up to 96 electric trucks simultaneously. This microgrid uses 2.75 megawatts of Mainspring Energy's linear generators, along with 18 MWh of batteries to provide up to 9 MW of charging capacity. The flexible fuel linear generators run on natural gas and can be grid-connected but currently operate independently.

Another example of Microgrid is GenCell, a hydrogen fuel cell energy solution provider, is launching a backup power solution at University of California Los Angeles (UCLA) campus. The solution incorporates battery storage and hydrogen fuel cell technology to provide power to electric vehicle chargers when grid power is insufficient. The GenCell unit can store energy from the grid or the fuel cell to power multiple vehicle chargers. This project is planned to be completed in October 2026.

Aside from grid supporting technologies, with the upcoming funding for infrastructure development. There is an increasing need for planning tools and grid analysis tools for fleet owners, regulatory agencies, and infrastructure developers to better understand the grid capacity and plan efficiently. South Coast AQMD executed a $150,000 contract with UCR for technical planning Medium-Duty and Heavy-Duty ZEV infrastructure deployment and perform criteria and benefits analysis for Southern California as part of CEC MD/HD blueprint project. There are ongoing discussions with various research entities to expand the scope of fleet tools and grid analysis to support the upcoming ISRs and infrastructure grant solicitations.

New, ongoing, and recently completed electric charging infrastructure projects include: 1) JETSI Pilot Project with installation of 350 kW DC fast chargers to support 100 Daimler and Volvo Class 8 BETs at NFI and Schneider; and 2) Switch-On Project with installation of multiple DC fast chargers to support 70 Volvo Class 8 battery electric drayage/freight trucks at eight fleets, 3) GenCell UCLA Mircogrid demonstration at UCLA; and 4) EPRI eTRUC project to develop and demonstrate MCS chargers at Travel Centers of American Ontario.

The Draft 2025 Plan Update identifies key opportunities while clearly leading the way for demonstration and deployment of hydrogen fueling and charging infrastructure. Future projects may include the following:

- continued development and demonstration of distributed hydrogen production and fueling stations from multiple providers, including energy stations with electricity and renewable hydrogen co-production and higher pressure (10,000 psi) hydrogen dispensing and scalable/higher throughput;
- development of additional sources of hydrogen production and local generation of hydrogen for fueling stations far from local production sources to better meet demand of FCVs;
- development of carbon-natural (or low carbon intensity) hydrogen production, distribution, and infrastructure network through a partnership with regional hydrogen hub projects;
- large scale deployments of commercial large fleet and public charging infrastructure to meet needs for owner operators/small fleets/large fleets for various segments (drayage, last mile delivery, short regional haul, and corridor charging for long-haul applications);
- development of fleet tools and grid assessment studies to assist in successful operation for drayage, last mile delivery, short regional haul and long-haul applications;
- development of low and zero emission alternative charging solution (ACS) technologies to accommodate delays in deploying permanent EV charging infrastructure due to lead times for grid upgrades or provide temporary power and/or backup power generation;
- development and demonstration of micro-grid systems to support non-grid connected EV charging, load-shifting, energy resilience, and lower operating energy costs;
- demonstration, installation, and expansion of infrastructure to support battery electric and fuel cell electric LD, MD and HD fleets, and ways to reduce cost and incentivize incremental costs over conventionally fueled vehicles, meet fleet operational needs, improve reliability, and integrate with battery energy storage, renewable energy and energy management strategies (e.g., vehicle-to-grid or vehicle-to-building functionality, demand response, load management);
- creation of MD/HD charging and hydrogen fueling regional infrastructure planning efforts; and
- deployment of infrastructure corresponding to codes and standards specific to LD, MD and HD vehicles, including standardized connectors, fuel quality, communication protocols, and open standards and demand response protocols for EV chargers to communicate across charging networks, fleet telematics, and vehicle platforms.

## *Hydrogen / Fuel Cell Mobile Technologies*

South Coast AQMD supports hydrogen fuel cell technologies as one option in the technology portfolio; the agency is dedicated to assisting federal and state government programs to deploy LD, MD, and HD fuel cell electric vehicles (FCEVs).

Calendar Years 2015-2019 were a critical timeframe for the introduction of LD hydrogen FCEVs. In 2014, Hyundai introduced the Tucson FCEV for lease. In 2015, Toyota commercialized the Mirai, the first FCEV available to consumers for purchase. In December 2016, Honda started commercial lease of its 2017 Clarity FCEV. The 2019 Hyundai Nexo was the second FCEV offered for sale and lease in California. In the past, Clean Fuels funding has gone towards leases for LD FCEVs as part of its technology outreach efforts for conferences and events in overburdened communities. Although in recently years, the availability of LD FCEV model has decreased, major OEMs still committed in supporting FCEVs in California.

Fuel cells can play a role in MD and HD applications where battery recharge time and vehicle range, although improving, need to be enhanced to meet fleet operational requirements. The Hydrogen Fuel Cell Partnership's (H2FCP, previously known as California Fuel Cell Partnership or CaFCP) 2030 Vision[11], released in July 2018, provides a broader framework for the earlier MD and HD Fuel Cell Electric Truck Action Plan completed in October 2016, which focused on Class 4 parcel delivery trucks and Class 8 drayage trucks with infrastructure development and established metrics for measuring progress. The CaFCP's HD Vision, released in July 2021, sets an interim milestone of 70,000 Class 8 fuel cell electric trucks supported by 200 HD hydrogen stations operating in California and beyond by 2035.

South Coast AQMD has created many alliances with large OEMs and will continue to fund projects over the next year to develop HD fuel cell trucks. One player in the HD fuel cell truck space is Cummins, who acquired Hydrogenics and Efficient Drivetrains, Inc. (EDI) to develop fuel cell powertrains. Cummins is working on a CEC/South Coast AQMD project to develop and demonstrate fuel cell drayage trucks with next generation fuel cell modules – easy to package system design and other innovative integration strategies. Another is Hyundai; in June 2021, South Coast AQMD recognized $500k from the U.S. EPA to demonstrate two Hyundai Class 8 fuel cell trucks with a range of up to 500 miles for regional and long-haul operations and another $3,500,000 to expand the demonstration with another five fuel cell trucks. In 2022, Volvo and Daimler also announced a joint venture to develop fuel cell powered trucks. Though the Southern California fuel cell fleet has been impacted by the closure of the three HD H2 fueling stations, when fuel was available, the MD and HD fuel cell trucks have demonstrated viability.

The CaFCP Fuel Cell Electric Bus Road Map released in September 2019 supports implementing CARB's Innovative Clean Transit and Zero Emission Airport Shuttle regulations. SunLine Transit Agency (SunLine) received a U.S. EPA Targeted Airshed grant in June 2020 to deploy six fuel cell transit buses, in addition to their existing fleet of 26 fuel cell and four battery electric transit buses as well as a recently upgraded 900 kg/day hydrogen station capable of supporting up to 30 fuel cell transit buses. SunLine has accepted and commissioned five of the buses into its fleet. In August 2021, the Clean Fuels Program committed $531,166 to a $2 million project to develop and demonstrate two MD fuel cell transit buses at SunLine. Additional outlets for hydrogen fueling infrastructure for these buses will also be developed.

In March 2021, Frontier Energy was awarded $25,000 to perform a high-flow bus fueling protocol development project as a part of the DOE H2@Scale program with partners including SoCalGas, Shell, and NREL. NREL was also awarded $25,000 for California HD Infrastructure Research, and UC Davis was awarded $50,000 for California Hydrogen Systems Analysis. Projects aim to fill in the gaps between LD and HD hydrogen fueling infrastructure to encourage expanding hydrogen fueling infrastructure as more state and federal policies are developed or passed. In addition, as more fuel cell MD/HDVs are commercialized, this research becomes more pivotal to ensuring sufficient hydrogen fueling stations are available.

Fuel cells are also being considered for power generation applications. Stationary fuel cells operating in prime or backup power applications are becoming more available. RockeTruck is developing and demonstrating a mobile fuel cell trailer capable of continuously producing 35 KW of power for 48 hours. The trailer uses the Honda Clarity fuel cell. The project is designed to supply charging capability in emergencies and remote locations. The trailer can also charge vehicles when stranded from loss of charge.

[11] CaFCP's The California Fuel Cell Revolution, A Vision For Advancing Economic, Social, and Environmental Priorities (Vision 2030), September 4, 2018.

The Draft 2025 Plan Update identifies key opportunities while leading the way for pre-commercial demonstrations of OEM FCEVs. Future projects may include the following:

- development and demonstration of cross-cutting fuel cell applications (e.g. scalable and cost-effective fuel cell powertrain components);
- development and demonstration of fuel cells in off-road, locomotive, and commercial harbor craft applications such as port cargo handling equipment, switcher locomotives, and tugs;
- demonstration of FCEVs in controlled fleet applications in the Basin;
- coordination with FCEV OEMs to establish a roadmap to commercialization by overcoming barriers to economically competitive FCEVs and developing realistic scenarios for large scale deployment;
- development and implementation of strategies with government and industry to build increasing scale and renewable content in the hydrogen market including certification and testing of hydrogen as a commercial fuel to create a business case for investments as well as critical assessments of market risks to guide and protect these investments;
- repurposing fuel cells and hydrogen tanks for other secondary energy production and storage uses, as well as reusing fuel cells and hydrogen tanks, and approaches to recycle catalysts and other metals; and
- fuel cell standby power generators.

## *Battery Electric Technologies*

To meet the NAAQS, a primary focus continues to be on zero and near-zero emission technologies. A key strategy to achieve these goals is through wide-scale transportation electrification. South Coast AQMD supports projects to address concerns regarding cost, battery life, all-electric range, and OEM commitment. Integrated transportation systems can encourage further emission reductions by matching EVs to typical consumer and fleet duty cycles and demands including drayage, short regional haul, and last mile delivery. There are Class 8 BETs CARB and U.S. EPA certified, commercially available, and eligible for incentives from Hybrid and Zero Emission Truck and Bus Voucher Incentive Project (HVIP), Carl Moyer, Volkswagen Mitigation Trust, Voucher Incentive Program, and CAPP funding.

Developing and deploying zero emission goods movement and freight handling technologies remains one of the top priorities for the South Coast AQMD to support balanced and sustainable growth at the San Pedro Bay Ports and freight/logistics facilities throughout the Basin. South Coast AQMD continues to work with our regional partners, including the San Pedro Bay Ports, Southern California Association of Governments (SCAG) and Los Angeles County Metropolitan Transportation Authority (Metro) to demonstrate and deploy technologies that are technically feasible, cost-effective with the assistance of incentives and/or grant funding, and beneficial to all stakeholders. Specific technologies include zero emission trucks/freight handling equipment (battery and/or fuel cell), plug-in hybrid powertrains, and linear synchronous truck motors. The California Sustainable Freight Action Plan also outlines a blueprint to transition the state's freight system to an environmentally cleaner, more efficient, and economical system, including a call for a zero and near-zero emission vehicle pilot project in Southern California. The Zero Emission 2028 Roadmap 2.0 for the Los Angeles 2028 Olympics corroborates this effort, calling for an additional 25% each in GHG and criteria pollutant reductions. The San Pedro Bay Ports Clean Air Action Plan Update (2017) calls for zero emissions cargo handling equipment by 2030 and zero emission drayage trucks by 2035, respectively.

South Coast AQMD will fund battery electric vehicles and equipment under the INVEST CLEAN program. They include heavy-duty Class 8 trucks and Class 4 and 5 trucks in SCAG's Last Mile Freight Program. Additionally, INVEST CLEAN will support the deployment of cargo handling equipment (CHE) to accelerate the commercialization of battery electric CHE at goods movement facilities such as warehouses, intermodal railyards, airports, ports, and freight facility centers. Examples of CHE are rubber-tired gantry (RTG) cranes, yard trucks, forklifts, side handlers, top picks and reach stackers. INVEST CLEAN also has a significant portion of funding for battery electric locomotives to encourage the development and deployment of zero-emission switcher locomotive technologies.

HD hybrid vehicles have historically been optimized for fuel economy; under the adopted CARB and U.S. EPA regulation, new hybrid powertrains must co-optimize for both criteria emissions and fuel economy by either meeting the criteria standard by the engine itself or as a combined system. Furthermore, CARB's Advanced Clean Trucks (adopted 2020) and Advanced Clean Fleets (adopted 2022) regulations allow sales of plug-in hybrid vehicles capable of zero-emission operation as an alternative compliance pathway for meeting the manufacturer and fleet zero emission vehicle mandate. New, ongoing, and recently completed zero emission battery electric technology projects include: 1) JETSI Pilot Project with the deployment of 100 Daimler and Volvo Class 8 BETs for drayage and regional haul at NFI and Schneider; 2) Switch-On Project with the deployment of 70 Volvo Class 8 battery electric drayage/freight trucks at eight fleets; 3) Daimler Zero Emission Electric Delivery Truck project, commercial deployment of 35 Daimler Class 6 and Class 8 BETs, 4) development and demonstration of two Cummins/Meritor battery electric Class 8 refuse trucks, and 5) development and demonstration of battery powered electric trailer technology with Range Energy for both zero emission and conventional trucks.

A new emerging technology is a battery-powered trailer that can assist and recover energy with onboard energy storage and electric motors. It is expected to increase the range when used with zero emission trucks or increase the range and reduce emissions with conventional trucks. SCAQMD has partnered with Range Energy to demonstrate a "dry van" version with a fleet in SCAB and perform emissions testing on a diesel tractor. The "dry van" project is expected to be completed in early 2025. The electrified trailer can also be used to power TRU, which currently requires onboard diesel generated; the discussion for a refrigerated trailer project is in progress.

Other emerging technology developments are faster charging and electrification for the medium-duty work truck segment. In 2023, U.S. EPA awarded $500,000 to develop and demonstrate an electrified power-take-off (PTO) system for job site power for class 4 medium-duty electric trucks. There is also an ongoing project discussion looking at faster charging electrified work trucks for class 3/4/5 platforms via different battery chemistry and anode material. A faster-charging work truck can meet the increased duty-cycle demand from different fleet users and allow for a higher payload. Some examples include higher voltage batteries, newer battery chemistry, and vehicle-to-grid capabilities. Another new technology is battery-swap trucks; these trucks have the advantage of faster recharging (swap) compared to traditional or even megawatt-level charging. Moreover, the battery swap station can have lower grid demand and a smaller footprint than traditional chargers. The battery-swap trucks are growing rapidly in overseas markets; their fast swapping ability and easier infrastructure deployment can be an alternative solution to certain applications in the U.S.

As South Coast AQMD continues its commitment to EVs and as they become more cost-competitive and attractive to consumers, an increasing flow of EVs reaching end-of-life is expected. In a period of approximately five to ten years, a large amount of EVs are expected to retire from service. As EVs are retired from service, their batteries can be sold as-is, remanufactured, repurposed, recycled, or discarded as hazardous waste. These EV batteries contain valuable minerals, such as lithium, crucial to our low carbon

future. Lithium is becoming an increasingly critical resource as the state moves toward a clean energy future. Proper management of battery materials presents an opportunity to drive sustainability by planning when these EV batteries reach their end of life. At the same time, we expect new battery materials/chemistry to emerge and reduce dependence on lithium.

Voltu Motor Inc.'s OnBoard Fast Charger is a fast-charging powertrain solution that uses a bidirectional inverter paired with purpose-built motors to manage the power to the wheels and enable 200 kWh charging on AC from a standard three-phase outlet. The technology uses motor inverter power switches in conjunction with the motor coils to fast-charge the battery pack. Ten Voltu electrified Ford F350 work trucks will be used alongside ICE equivalent trucks and tested for performance. This project is planned to be completed in March 2025.

Enevate will demonstrate a fast charging solution and the capability of Class 4/5 trucks to charge in 15 minutes from zero to eighty percent. It will also test the performance and ability to charge quickly upgraded Class 4/5 trucks with a newly developed battery pack. The project is planned to be completed in mid-2026.

Range Energy will test a battery-powered TRU. Chargers will be installed at the fleet site, and the trailer and trailer-installed equipment will be charged. The following equipment will be tested: 1) modified hybrid-electric TRU with power from an onboard battery; 2) electric powered trailer system, including an onboard battery and e-axle; and 3) electric vehicle supply equipment operated with 480V 3-phase AC circuits. This project aims to measure range extension from regenerative braking, track energy usage and generation from the e-axle and TRU, and demonstrate the benefits of 3-phase AC charging hardware. This project is planned to be completed in late 2024.

RockeTruck is developing and demonstrating a mobile fuel cell trailer capable of producing 35 KW of power continuously for 48 hours. The trailer uses the Honda Clarity fuel cell. The project is designed to supply charging capability in emergency situations and remote locations. The trailer can also charge vehicles when stranded due to a loss of charge.

New, ongoing, and recently completed zero emission battery electric technology projects include: 1) JETSI Pilot Project with deployment of 100 Daimler and Volvo Class 8 BETs for drayage and regional haul at NFI and Schneider funded by $16 million from CARB, $11 million from CEC, $8 million from MSRC, $5.5 million from the Clean Fuels Fund, $5 million from SCE, and $3 million from the San Pedro Bay Ports; 2) Switch-On Project with deployment of 70 Volvo Class 8 battery electric drayage/freight trucks at eight fleets funded with $20 million from the U.S EPA Targeted Airshed grant; 3) Daimler Customer Experience project to demonstrate eight Class 6 and 8 BETs and fast charging infrastructure funded with $1 million by the Clean Fuels Fund; 4) Daimler Innovation Fleet project to demonstrate five Class 6 and 15 Class 8 BETs with $13 million from the Clean Fuels Fund , $1 million from the U.S. EPA Clean Air Technology Initiative grant, and $2 million from the San Pedro Bay Ports; 5) Daimler Zero Emission Electric Delivery Truck project, a commercial deployment of 35 Daimler Class 6 and Class 8 BETs funded by $4 million from the U.S. EPA Targeted Airshed grant, and 6) development and demonstration of two Cummins/Meritor battery electric Class 8 refuse trucks with South Coast AQMD Special Revenue Funds.

Opportunities to develop and demonstrate technologies that could enable expedited widespread use of pre-commercial and commercial battery electric and hybrid-electric vehicles in the Basin include the following:

- demonstration of battery electric technologies for cargo handling and container transport operations, e.g., HD battery electric drayage trucks;

- large scale deployments of commercial battery electric vehicles (i.e. 50 or more vehicles) to prove feasibility and develop fleet tools to assist in successful operation for drayage and short regional haul operations;
- demonstration of MD battery electric vehicles in package delivery or last mile operations, e.g., battery electric delivery vans;
- development and demonstration of battery electric off-road equipment, e.g. battery electric off-road construction equipment, yard tractors, forklifts, or top handlers with wireless charging;
- demonstration of niche application battery electric MD and HD vehicles, including school and transit buses, shuttle buses, MD vocational trucks, and refuse trucks with short-distance fixed service routes;
- demonstration of integrated programs that make the best use of electric drive vehicles through interconnectivity between fleets of shared electric vehicles and mass transit, and rideshare services that cater to multiple users and residents in disadvantaged communities;
- development of eco-friendly intelligent transportation system (ITS), geofencing, and Eco-Drive strategies to maximize emission reductions and energy consumption when driving in disadvantaged communities; demonstrations that encourage electric drive vehicle deployment in autonomous applications; optimized load-balancing strategies and improved characterization of in-duty drayage cycles and modeling/simulations for cargo freight and market analysis for zero emission HD trucks;
- development of higher density, faster charging battery technologies for use in MD and HD vehicles;
- repurposing EV batteries for other or second life energy storage uses, as well as reusing battery packs and approaches to recycle lithium, cobalt and other critical materials in EV manufacture;
- development of electrified trailer technology, to support the efficiency and emissions of zero emission and conventional trucks and support electrified TRU operation; and
- development of a methodology to increase capability to accept fast-charging and resultant life cycle and demonstration of effects of fast-charging on battery life and vehicle performance.

## *Stationary Clean Fuel Technologies*

Although stationary source NOx emissions are small compared to mobile sources in the Basin, there are applications where clean fuel technologies or processes can be applied to reduce NOx, VOC and PM emissions. As discussed in engine systems, low and zero carbon fuels could also be used in stationary applications; it is easier to develop optimized engine systems and stationary sources typically operate in steady-state modes.

Additionally, with the rapid development of battery electric vehicles, alternative energy storage could be achieved through vehicle-to-grid or vehicle-to-building technologies, as well as power-to-gas that could allow curtailed renewable electricity to be stored as hydrogen fuel. Microgrid demonstration and deployment projects to support large scale deployment of zero emission vehicles and equipment could also be incorporated into new or existing deployment projects to facilitate the installation of infrastructure. A few ongoing projects such as the UCR's Sustainable Integrated Grid Initiative and UCI's Advanced Energy and Power Program, funded partly by the South Coast AQMD, for example, could assist in evaluating these technologies.

In 2019, linear generators were introduced as a new and alternative technology for power generation applications. Unlike traditional internal combustion engines (ICEs), linear generators produce electricity by driving magnets through copper coils in a linear motion. A unique feature of linear generators is that the thermochemical reaction occurs at lower temperatures than ICE, resulting in lower emissions without add-on control devices (e.g., selective catalytic reduction). Linear generators are also fuel agnostic and can run on fuels such as hydrogen, ammonia, and biogas. Currently, linear generators are being used for stationary prime power applications, but it is anticipated that they can also be used for emergency backup power applications.

Projects conducted under this category may include:

- development and demonstration of reliable, low emission stationary technologies and fuels (e.g., new innovative low NOx burners and fuel cells);
- exploration of renewables, waste gas and produced gas sources for cleaner stationary technologies;
- evaluation, development and demonstration of advanced control technologies for stationary sources;
- vehicle-to-grid, vehicle-to-building, or other stationary energy demonstration projects to develop sustainable, low emission energy storage alternatives and reduce total cost of ownership (TCO); and
- development and demonstration of microgrids with linear generators/photovoltaic/fuel cell/battery storage/EV chargers and energy management to support large scale deployment of zero emission vehicles and equipment.

The development, demonstration, deployment and commercialization of advanced stationary clean fuel technologies will support control measures in the 2022 AQMP that reduce emissions of NOx and VOCs from traditional combustion sources by replacement or retrofits with zero and near-zero emission technologies. In 2023, UCI was awarded $150,000 to study regional air quality and health impacts of utilizing Hydrogen Blends in commercial buildings and industrial applications as a part of a CEC award that focuses on the decarbonization of California.

## *Fuel and Emissions Studies*

Monitoring of pollutants in the Basin is extremely important, especially when linked to a particular sector of the emissions inventory. This information highlights the need for further emission studies to identify emissions from high polluting sectors resulting from these technologies.

Over the past decade, the South Coast AQMD has funded emission studies to evaluate the impact of tailpipe emissions of biodiesel, renewable diesel, and ethanol fueled vehicles mainly focusing on criteria pollutants and GHG emissions. These studies showed that biofuels, especially biodiesel in some applications and duty cycles, can contribute to higher NOx emissions while reducing other criteria pollutant emissions. South Coast AQMD expects additional fuel and emission studies needed on non-carbon containing fuel such as hydrogen.

In addition, as the market share for gasoline direct injection (GDI) vehicles has rapidly increased from 4 percent of all vehicle sales in the U.S. to an estimated 60 percent between 2009 and 2016, it is important to understand the air quality impacts of these vehicles. South Coast AQMD has funded studies to investigate both the physical and chemical composition of tailpipe emissions, focusing on PM from GDI vehicles as

well as secondary organic aerosol formation formed by the reaction of gaseous and particulate emissions from NG and diesel HD vehicles. The results of these studies suggest adding a particulate filter to control particulate emissions from GDI vehicles. In 2024, the U.S. Environmental Protection Agency (U.S. EPA) adopted the new multi-pollutant standard for LD and MD vehicles starting with the model year 2027, which further lowered the PM standard that will require a particulate filter.

In recent years, non-exhaust PM emissions have been gaining attention. Vehicles emit inhalable particles from the exhaust system but also from non-exhaust sources including brake wear, tire and road wear, clutch wear and road dust resuspension. The non-exhaust sources are not regulated because they are difficult to measure and control. Model predictions suggest that non-exhaust sources will eventually dominate traffic-related emissions of both PM2.5 and PM10. The Clean Fuels program has been engaged in research efforts to support MATE VI efforts, including awarding an RFP in August 2024 to study ambient exposure from non-exhaust PM sources. At the same time, CARB and others are conducting ongoing research to assess the emission factor directly from non-exhaust PM sources. The clean fuels program must join forces with other agencies to better understand the contribution to the overall emissions inventory.

Based on higher average summer temperatures over the past few years, there is interest in how higher temperatures impact ozone formation. A project was launched in 2019 to evaluate meteorological factors and trends contributing to recent poor air quality in the Basin. These types of studies may be beneficial in supporting the CERPs developed under AB 617, as well as other programs targeting benefits to residents in disadvantaged communities. With the phase in of various CARB regulations such as the Omnibus regulation HD inspection and maintenance (HD I/M) program as well as the upcoming MATES VI study in 2025, there will be a continued need for the Clean Fuels Program to focus on additional fuels and emissions studies, some areas of focus include:

- demonstration of remote sensing technologies to target different high emission applications and sources;
- studies to identify health risks associated with ultrafine and ambient particulate matter to characterize toxicity and determine specific combustion sources, and support MATES VI;
- in-use emission studies using biofuels, including renewable diesel and other alternative fuels such as hydrogen;
- in-depth emission studies of non-ICE sources, such as linear generators;
- in-use emission studies to determine the impact of new technologies, in particular new near-zero emission engine technologies and hybrids on local air quality as well as the benefit of telematics on emission reduction strategies;
- emissions studies of non-exhaust PM from vehicular sources;
- on-board sensing and reporting system to identify low exposure truck routes;
- particulate matter emission study for brake- and tire-wear for LD, MD, and HD vehicles and locomotives;
- lifecycle energy and emissions analyses to evaluate conventional and alternative fuels;
- analysis of fleet composition and its associated impacts on criteria pollutants;
- evaluation of emissions impact of low- and zero-carbon fuels/blends on the latest technology engines; and

- evaluation of the impact of higher ambient temperatures on primary and secondary air pollutants emissions.

## *Renewable Fuel Infrastructure*

The Clean Fuels Program in the past has provided funding for renewable natural gas (RNG) infrastructure including: 1) upgrade and buildup of public and private RNG infrastructure projects, 2) expansion of the network of public access and fleet fueling RNG stations based on the population of existing and anticipated vehicles, 3) infrastructure to accommodate transportation fuels with very low gaseous and GHG emissions, and 4) local production of clean, low carbon intensity, renewable transportation fuels. There are commercial public access RNG refueling stations throughout Southern California, and a certain percentage of renewable gas is in the pipeline. Additionally, incentive funds have been made available for RNG infrastructure. The Clean Fuels Program expects minimum funding to be allocated for RNG infrastructure but maintains this category to provide continued support for past efforts.

## *Health Impacts Studies*

Assessment of potential health risks linked to exposure to pollution is extremely important. South Coast AQMD has conducted five Multiple Air Toxics Exposure Study (MATES) campaigns since the 1980s, with MATES V completed in August 2021 and MATES VI currently in preparation phases. MATES V used comprehensive measurements and modeling and health risk assessment methods to estimate cancer and non-cancer chronic health risks due to exposure to air toxics throughout the South Coast AQMD jurisdiction, where cancer risk is the expected number of additional cancers over a 70-year lifetime in a population of one million individuals if they are exposed to the measured or modeled air toxics levels for 30 years. MATES V found that model population-weighted average air toxics cancer risk decreased from 997 per million in 2012 (MATES IV) to 455 per million in 2018 in the Basin and 357 to 250 per million in Coachella Valley. The highest risk locations in 2018 were at Los Angeles Airport (LAX), the San Pedro Bay Ports, and along major goods movement and transportation corridors. At the ten MATES V monitoring sites, located in areas that are disproportionately impacted by pollution and disadvantaged based on socioeconomic indicators, the cancer risk ranged from 585 to 842 per million, 40 percent lower than in 2012. Since at least 1998, when MATES II first conducted measurements required to track it, diesel PM has been the largest contributor to air toxics cancer risk, accounting for approximately 50 percent of the risk in 2018 (MATES V). MATES V estimated chronic non-cancer risk for the first time in a MATES campaign, with chronic hazard indices of 5 to 9 at the 10 stations, where a hazard index greater than 1 indicates that no chronic health risks are expected. MATES V also included advanced air monitoring to characterize the impacts of VOC emissions from major refineries in the Basin to surrounding communities.

Furthermore, despite recent advancements in toxicological research related to air pollution, the relationship between particle chemical composition and health effects is still not completely understood, especially for biofuels, CNG and other alternative fuels. In 2015, South Coast AQMD funded chamber studies as part of the 200-vehicle study to further investigate the toxicological potential of emissions from MD and HD vehicles, such as ultrafine particles and vapor phase substances, and to determine whether substances such as volatile or semi-volatile organic compounds are being emitted in lower mass emissions that could pose harmful health effects. The results indicated higher SOA emissions from CNG vehicles compared to baseline, due to excess lube oil consumption, ammonia emissions and lack of particulate filters.

Therefore, the MATES VI program includes studies to estimate exposure to break wear particles (BWP) and tire and road wear particles (TRWP) to provide information about the chemical composition of tires

and brakes used in commercial LD and HD vehicles, which will be instrumental to determine which measurements should be conducted to attribute PM mass and gas phase markers to these sources. MATES VI will also include a special study to characterize emissions of ethylene oxide (EtO) in ambient air and at the near-road sites to assess the contribution of vehicular emissions to background EtO concentration levels. These proposed studies will require specialized instrumentation and expertise. Although South Coast AQMD already possesses some of the monitoring and laboratory equipment needed for MATES VI, the Clean Fuels Program will provide $5 million to purchase additional equipment and supplies and retain temporary staff necessary to complete all the proposed measurements.

## *Technology Assessment and Transfer/Outreach*

Since the Clean Fuels Program depends on the deployment and adoption of demonstrated technologies, technology transfer and outreach efforts are essential to its success. This core area encompasses assessment of advanced technologies, including retaining outside technical assistance to expedite implementation of low emission and clean fuel technologies, coordinating activities with other organizations and educating end users of these technologies. Technology transfer efforts include supporting various incentive programs that encourage the purchase of cleaner technologies, cosponsoring technology-related conferences, workshops, and other events, and disseminating information on advanced technologies to various audiences (i.e., residents in AB 617 or disadvantaged communities, local governments, funding agencies, technical audiences). South Coast AQMD's AB 617[12] program is designed to reduce emissions in communities disproportionately impacted by air pollution. TAO conducted additional outreach to AB 617 communities regarding available zero and near-zero emission technologies and incentives to accelerate the adoption of cleaner technologies. Incentivizing deployment of zero emission HD trucks has been included in the CERPs and an RFP for zero emission HD truck incentive funding was released in September 2023 for four out of the six AB 617 communities.

South Coast AQMD is in the process of executing a contract with California State University, Los Angeles (Cal State LA), to support workforce training and professional development of EV battery engineers. Cal State LA is one of 12 selected universities nationwide to participate in the Battery Workforce Challenge (BWC), an initiative aimed at advancing EV technology. This competition challenges universities and their partners to design, build, test, and integrate advanced EV battery packs into a vehicle. The design and development of advanced batteries are a key component to electrify the transportation sector. This program will prepare and train the next generation of engineers and technicians to handle the increased demand for EVs. In 2018, South Coast AQMD supported a similar competition that resulted in participating students from disadvantaged backgrounds of East Los Angeles securing high-pay engineering jobs.

INVEST CLEAN will also implement a comprehensive workforce training program in partnership with the NECA and IBEW and supported by more than three (3) universities, seven (7) colleges, one (1) community college, and seven (7) educational related institutions. Through INVEST CLEAN, South Coast AQMD and partners will support a world-class apprenticeship pipeline that opens pathways into high-quality union careers performing CPRG related work. This approach is centered around joint-labor-management apprenticeship programs, which are designed to foster a diverse, highly skilled, and sustainable workforce equipped to meet the challenges of today and tomorrow. Workforce training will ensure enough drivers and technicians will operate and maintain the battery-electric equipment implemented with INVEST CLEAN. In addition to the NECA – IBEW partnership, the GHG Reduction Measure for the ZE locomotive deployment will include onsite and classroom training. Each locomotive deployed will be supported by at

[12] http://www.aqmd.gov/nav/about/initiatives/environmental-justice/ab617-134

least one dedicated expert from the manufacturer in locomotive and battery technology. This technician will be on the ground to support the safe and efficient operation of the locomotive and charging process, as well as provide "on the job" training to the operators and maintainers of the locomotive. This hands-on "train the trainer" methodology will provide the rail operators with best practices for locomotive operations and maintenance practices to prepare the operator on transitioning to ZE equipment.

## *Engine Systems/Technologies*

To achieve the emission reductions required for the Basin, ICEs used in the HD sector will require widespread implementation of zero emission technologies as outlined in CARB's 2022 Mobile Source Strategy and 2022 AQMP. However, the path to 100 percent zero emission trucking sector will take time Meanwhile, with the recent CARB announcement, ICE engines will slowly transition to ultra-low NOx level starting MY 2024.

The effort with low emission ICE engines started back in 2016, with Cummins natural gas achieved a new ultra-low NOx threshold by commercializing the first on-road HD engine to be certified to CARB's optional low NOx standard of 0.02g NOx/bhp-hr, 90 percent cleaner than the existing federal standard. Powering these vehicles with low Carbon Intensity renewable fuels or biomethane to help address GHG objectives became a popular alternative for the HD transportation sector. Later, Cummins also certified the different displacement version of the engine for more market sectors including a more powerful 15L NG engine available starting MY 2024.

Although no 0.02g NOx diesel technology is commercially available today, development and demonstration efforts have proven low NOx diesel technology is viable. Both CARB and U.S. EPA has adopted lower NOx regulations stating MY 2027. Low NOx diesel technology is expected to operate alongside with battery electric, fuel cell, natural gas and others. We do expect next generation lower NOx diesel engines to be commercially available in the MY 2027 timeframe, in time for the phase in of the U.S. EPA and CARB regulations.

More recently, Cummins announced a hydrogen powered ICE with near-zero NOx capabilities ready for implementation also in the 2027 timeframe. While using hydrogen in fuel cells is a core strategy to achieve the air quality goals in this region, in the near term, it is possible to use hydrogen in ICE for on- and off-road vehicles as a bridge technology to fuel cells. Hydrogen ICE has the benefit of using existing engine platforms, insensitivity to hydrogen quality, and use of existing hydrogen production and distribution systems that can deploy hydrogen refueling infrastructure which could later complement fuel cell vehicles. Recognizing the importance of hydrogen fuel, there is a need for research and development that can achieve significant efficiency and emissions improvements in hydrogen combustion engines. As a result, the Draft 2025 Plan Update includes on-road truck demonstrations and real-world emissions benefit analysis using hydrogen as a fuel for internal combustion.

The Draft 2025 Plan Update continues to Incorporate pursuit of cleaner engines and hybrid powertrains for the HD sector but is starting to transition to zero emission technologies. Future engine projects will continue to support the development, demonstration and emissions verification/certification of engines and powertrains that can achieve needed near-term emission reductions. At the same time, aggressive GHG emission reduction targets set forth by both CARB and U.S. EPA have invigorated interest in revisiting low- and zero carbon alternative fuels for those high power/torque applications such as hydrogen ICE. While the GHG benefit is relatively easy to assess by fuel source, it is also important to understand the

criteria emissions impact under real-world conditions and over its useful lifetime to ensure reduction of criteria pollutants and GHGs are fully realized.

The Draft 2025 Plan Update includes potential projects that the South Coast AQMD might participate with federal, state, and other private entities towards these efforts. Specifically, these projects are expected to target the following:

- demonstration of ultra-low emissions and improved higher efficiency gaseous and liquid fuel powered engines for HD vehicles and high horsepower application projects;
- demonstration of gaseous and liquid fuel powered engines to support hybrid and plug-in hybrid vehicle technology;
- demonstration of alternative fuel engines for on- and off-road applications;
- vehicle level demonstration of engine systems that employ advanced engine design features, cylinder deactivation, improved exhaust or recirculation systems, and aftertreatment devices; and
- further development of robust aftertreatment systems which can maintain certified emissions levels under a wide variety of duty cycles and throughout the vehicle's useful life.

U.S. EPA's recent adoption of a national low NOx standard for on-highway HD engines starting in 2027 will further motivate manufacturers to develop lower-NOx emitting technologies expected to result in greater NOx emission reductions. Low- and zero carbon alternative fuels for new low emitting engines will continue to emerge as timelines for GHG reductions approach.

## *Emission Control Technologies*

Over the last several decades, diesel emissions have been greatly reduced with introduction of RNG, hydrogen, biofuels, synthetic and low carbon fuels into the engine but also via aftertreatment controls such as close coupled catalysts, advanced SCR and DPF catalysts coupled with electrically heated diesel exhaust fluid (DEF) dosers as well as advanced control strategies using cylinder deactivation, which have proven to lower emissions to near-zero and increase efficiency. Recently, particulate matter (PM and PN) emissions from GDI fueled LD vehicles, gaseous and gasoline fueled MD and HD vehicles have gathered attention due to the lack of particulate filters. While relative PM levels are low and below the applicable standard, concerns on ultra-fine emissions needs to be assessed especially with the recent adoption of the U.S. EPA LD/MD regulation requiring particulate filter. South Coast AQMD will continue to fund studies to help mitigate emissions concerns all internal combustion engines as new as new emerging technology such as the linear generator. On another hand, onboard emissions sensors have been identified by CARB and other agencies as a reliable method for assessing in-use emissions compliance. Researchers have proposed to use sensors, coupled with GPS, cellular connection, weather, traffic, and other online air quality models together to enable advanced concepts like Geofencing, Eco-routing, and more. Similar strategies have been presented in CARB's latest 2022 SIP Strategy. The most promising of these technologies will be considered for funding, specifically:

- demonstration of particulate filter technology for LD, MD and HD gasoline and gaseous fueled vehicles;
- develop, evaluate, and demonstrate onboard sensor-based emissions monitoring methodology; and
- develop emissions control technology for new emerging technologies such as linear generators and hydrogen ICEs.

# Target Allocations to Core Technology Areas

Figure 5 presents the potential allocation of available Clean Fuels Program funding, based on South Coast AQMD projected program costs of $31 million for all potential projects. The actual project expenditures for 2025 will be less than the total South Coast AQMD projected program costs since not all projects will materialize. Target allocations are based on balancing technology priorities, technical challenges and opportunities discussed previously, and near term versus long term benefits with the constraints on available South Coast AQMD funding. Although the Clean Fuels Program must consider the cost-effectiveness of emission reductions as one of several factors in determining which technologies to fund, the Legislature allows for flexibility in prioritizing technologies with higher cost-effectiveness if it is deemed necessary for South Coast AQMD to meet its NAAQS. The 2022 AQMP specifically calls for accelerated deployment of zero emission technologies wherever feasible to achieve the 2015 8-hour ozone standard. The associated CARB 2020 Mobile Source Strategy shows the need for rapid implementation of zero-emission transportation. Specific contract awards throughout 2025 will be based on this proposed allocation, the quality of proposals received, the evaluation of projects against standardized criteria, and, ultimately, South Coast AQMD Governing Board approval. Some of the Clean Fuels Program projects may utilize the MSRC discretionary fund depending on the project types and the MSRC's annual Work Program.

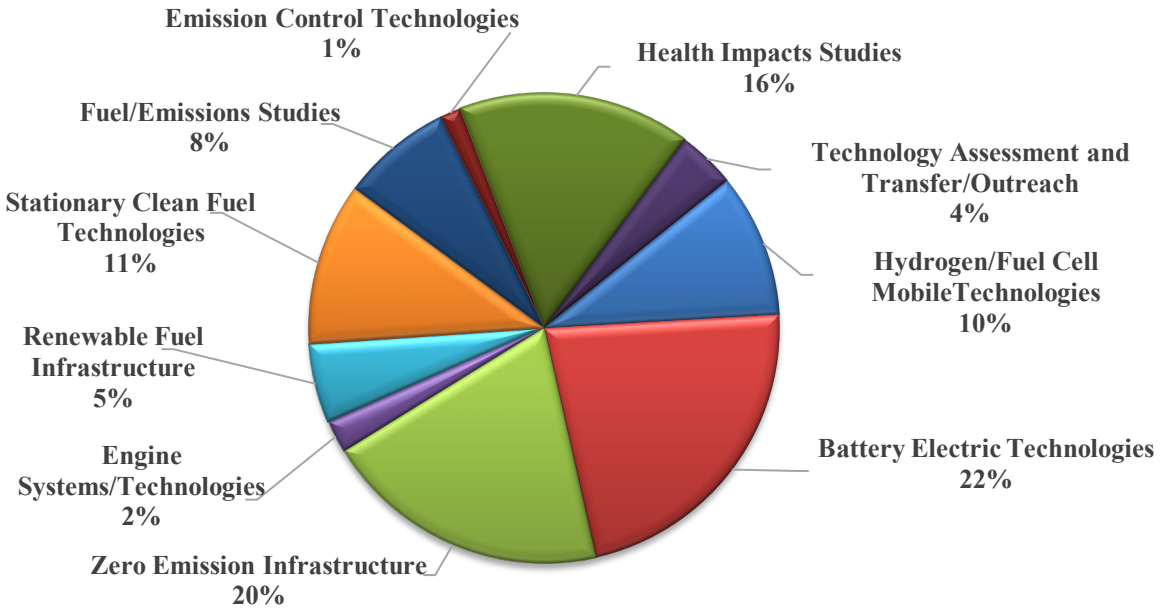


**Figure 5: Projected Cost Distribution for Potential South Coast AQMD Projects in 2025 ($31M)**

# CLEAN FUELS PROGRAM

## Program Plan Update for 2025

This section presents the Clean Fuels Program Plan Update for 2025. The proposed projects are organized by program areas and described in further detail, consistent with the South Coast AQMD budget, priorities and the best available information on the state-of-the-technology. Although not required, this Plan also includes proposed projects that may also be funded by revenue sources other than the Clean Fuels Program, through state and federal grants for clean fuel technologies, incentive programs such as AB 617 Community Air Protection Program (CAPP) funding, Volkswagen Mitigation and Carl Moyer, and VOC and NOx mitigation.

Table 1 summarizes potential projects for 2025 and the distribution of South Coast AQMD costs in some areas compared to 2024. The funding allocation continues the focus on development and demonstration of zero and near-zero emission technologies including infrastructure to support vehicles and off-road equipment. For the 2025 Draft Plan Update, there is a continuing focus on zero emission technologies including funding for hydrogen/fuel cell technologies, electric/hybrid technologies, and zero emission infrastructure. Zero emission infrastructure was formerly included within hydrogen/fuel cell and electric/hybrid technologies, but given its increasing importance it is now being presented as a separate category. There are significant decreases in funding for RNG infrastructure and engine systems/ technologies as near-zero engine development has been significantly reduced as funding is increasingly shifted to zero emission technologies and infrastructure for future planned projects in 2025, including:

- HD zero emission battery electric and fuel cell trucks;
- HD zero emission infrastructure development, demonstration, deployment and planning, including ACS solutions:
- Fleet planning tools and grid studies to aid the upcoming zero emission truck and infrastructure programs;
- Microgrids, and low- and zero emission power generation demonstrations to support zero emission infrastructure;
- Other Microgrid demonstrations to support vehicle to grid/home concepts;
- Battery and fuel cell electric transit and school bus fleet charging/fueling infrastructure;
- HD diesel truck replacements with zero emission trucks; and
- Fuel and emissions studies, such as airborne measurements and analysis of NOx emissions and assessing emission impacts of hydrogen-fueled ICE, and testing for particulate matter emissions from brake- and tire-wear.

As in prior years, funding allocations again align well with the South Coast AQMD's FY 2024-25 Goals and Priority Objectives, which include supporting the development of cleaner advanced technologies. Overall, the Clean Fuels Program is designed to ensure a broad portfolio of technologies, complement state and federal efforts, and maximize opportunities to leverage technologies synergistically.

Once fully developed, each of the proposed projects described in this Plan will be presented to the South Coast AQMD Governing Board for approval before contract initiation. This Plan Update reflects the maturity of the proposed technology and identifies contractors to implement projects, participating host sites and fleets, and securing sufficient cost-sharing to complete projects, and other necessary factors. Recommendations to the South Coast AQMD Governing Board will include descriptions of technologies to be demonstrated or deployed, their applications, the proposed scope of work, and capabilities of the selected contractor(s) and project teams, in addition to the expected costs and project benefits as required by H&SC 40448.5.1.(a)(1). Based on communications with all organizations specified in H&SC 40448.5.1.(a)(2) and a review of their programs, projects proposed in this Plan do not appear to duplicate any past or present projects.

## Funding Summary of Potential Projects

The remainder of this section contains the following information for each of the potential projects summarized in Table 1.

**Proposed Project:** Descriptive title and a designation for future reference.

**Expected South Coast AQMD Cost:** Estimated proposed South Coast AQMD cost-share as required by H&SC 40448.5.1.(a)(1).

**Expected Total Cost:** The estimated total project cost, including South Coast AQMD's cost-share and the cost-share of outside organizations, is expected to be required to complete the proposed project. This indicates how much South Coast AQMD public funds are leveraged through its cooperative efforts.

**Description of Technology and Application:** Brief summary of the proposed technology to be developed and demonstrated, including expected vehicles, equipment, fuels, or processes that could benefit.

**Potential Air Quality Benefits:** Brief discussion of expected benefits of the proposed project, including anticipated contribution towards meeting the goals of the 2022 AQMP, as required by H&SC 40448.5.1.(a)(1). In general, the most important benefits of any technology research, development and demonstration program are not necessarily realized in the near-term. Demonstration projects are generally intended to be proof-of-concept for an advanced technology in a real-world application. While emission benefits, for example, will be achieved from the demonstration, true benefits will be seen over a longer term, as a successfully demonstrated technology is eventually commercialized and implemented on a wide scale.

**Table 1: Summary of Potential Projects for 2025**

| Proposed Project | Expected SCAQMD Cost $ | Expected Total Cost $ |
|---|---|---|
| **Hydrogen/Fuel Cell Mobile Technologies** | | |
| Develop and Demonstrate Hydrogen Research to Support Innovative Technology Solutions for Fueling Fuel Cell Vehicles | 100,000 | 900,000 |
| Develop and Demonstrate MD and HD Fuel Cell Vehicles | 3,000,000 | 14,850,000 |
| Subtotal | $3,100,000 | $15,750,000 |
| **Battery Electric Technologies** | | |
| Develop and Demonstrate MD and HD On-Road Battery Electric Vehicles and Equipment | 6,850,000 | 102,800,000 |
| Demonstrate Light-Duty Battery Electric Vehicles and Plug-In Hybrid Vehicles | 160,000 | 160,000 |
| Subtotal | $7,010,000 | $102,960,000 |
| **Zero Emission Infrastructure** | | |
| Develop and Demonstrate Hydrogen Production and Fueling Stations | 2,000,000 | 15,000,000 |
| Develop and Demonstrate Permanent Electric Charging Infrastructure | 1,700,000 | 4,700,000 |
| Develop and Demonstrate Innovative Charging Solutions for Grid Support | 2,200,000 | 5,000,000 |
| Charging and Grid Optimization Platform for Transportation (CHARGE-OPT) | 300,000 | 600,000 |
| Subtotal | $6,200,000 | $25,300,000 |
| **Stationary Clean Fuel Technologies** | | |
| Develop and Demonstrate Microgrids with Photovoltaic/Fuel Cell/Battery Storage/Energy Management | 1,000,000 | 4,000,000 |
| Develop and Demonstrate Zero or Near-Zero Emission Energy Generation Alternatives | 2,500,000 | 7,000,000 |
| Subtotal | $3,500,000 | $11,000,000 |
| **Fuel and Emissions Studies** | | |
| Conduct In-Use Emission Studies including MATES VI for Advanced Technology Vehicle Demonstrations | 1,000,000 | 4,000,000 |
| Conduct Emission Studies including MATES VI on Biofuels, Alternative Fuels and Other Related Environmental Impacts | 1,000,000 | 4,000,000 |
| Identify and Demonstrate In-Use Fleet Emission Reduction Technologies and Opportunities | 400,000 | 1,500,000 |
| Subtotal | $2,400,000 | $9,500,000 |
| **Renewable Fuel Infrastructure** | | |
| Demonstrate Low-Emission Engine/Generation Technology | 1,000,000 | 2,000,000 |
| Develop, Maintain and Expand Renewable Fuel Infrastructure | 300,000 | 1,000,000 |
| Demonstrate Renewable Transportation Fuel Production and Distribution Technologies | 400,000 | 1,500,000 |
| Subtotal | $1,700,000 | $4,500,000 |

**Table 1: Summary of Potential Projects for 2025 (cont'd)**

| Proposed Project | Expected SCAQMD Cost $ | Expected Total Cost $ |
|---|---|---|
| **Health Impacts Studies** | | |
| Conduct Monitoring and Support MATES VI Program Implementation | 5,000,000 | 5,000,000 |
| Subtotal | 5,000,000 | 5,000,000 |
| **Technology Assessment and Transfer/Outreach** | | |
| Assess and Support Advanced Technologies and Disseminate Information | 750,000 | 2,000,000 |
| Support Implementation of Clean Fuels Incentives and Demonstration Projects | 350,000 | 400,000 |
| Subtotal | $1,100,000 | $2,400,000 |
| **Engine Systems/Technologies** | | |
| Develop and Demonstrate Advanced Gaseous- and Liquid-Fueled MD and HD Engines and Vehicle Technologies to Achieve Ultra-Low Emissions | 500,000 | 2,000,000 |
| Develop and Demonstrate Low Emission Locomotive Technologies and After Treatment Systems | 200,000 | 1,500,000 |
| Subtotal | $700,000 | $3,500,000 |
| **Emission Control Technologies** | | |
| Onboard Sensors for On-Road/Off-Road Vehicles | 250,000 | 1,000,000 |
| Integration of On-Road Technologies in Off-Road Applications | 200,000 | 1,000,000 |
| Subtotal | $450,000 | $2,000,000 |
| **TOTALS FOR POTENTIAL PROJECTS** | $31,310,000 | $182,910,000 |

## Technical Summaries of Potential Projects

### *Zero Emission Infrastructure*

**Proposed Project:** Develop and Demonstrate Hydrogen Production and Fueling Stations

**Expected South Coast AQMD Cost:** $2,000,000

**Expected Total Cost:** $15,000,000

**Description of Technology and Application:**

Alternative fuels, such as hydrogen and the use of advanced technologies, such as FCEVs, are necessary to meet future clean air standards. A key element in the widespread acceptance and increased use of alternative fuel vehicles is the development of a reliable and robust infrastructure to support the fueling of vehicles, cost-effective production and distribution and clean utilization of these new fuels.

A challenge to the entry and acceptance of direct-hydrogen FCVs is the limited number and scale of hydrogen fueling and production sites. This project would support developing and demonstrating hydrogen fueling technologies with a focus on MD/HD fueling infrastructure. Proposed projects would address:

Fleet and Commercial Fueling Stations: Further expansion of the hydrogen fueling network to both on- and off-road equipment, based on retail models, providing renewable generation, adoption of standardized measurements for hydrogen fueling, other strategic fueling locations, dispensing pressures that support zero emission vehicle deployment.

Energy Stations: Multiple-use energy stations that can produce hydrogen for FCVs or stationary power generation are considered an enabling technology and potentially cost-competitive with large-scale reforming. System efficiency, emissions, hydrogen throughput, hydrogen purity, and system economics will be monitored to optimize strategies for hydrogen fueling infrastructure deployment, producing power and hydrogen from renewable feedstocks (e.g., biomass, digester gas), and storing hydrogen on a larger scale.

Innovative Fueling Appliances: Home or small scale fueling/charging or portable refueling solutions are an attractive advancement for alternative clean fuels for potential applications. This project would evaluate an innovative hydrogen refueler for cost, compactness, performance, durability, emission characteristics, ease of assembly and disassembly, maintenance and operations. Other issues such as setbacks, building permits, building code compliance and UL ratings for safety would also be evaluated.

Innovative Hydrogen Production: new and innovation pathways to provide local production of renewable hydrogen. This could either align or supplement California hydrogen hub effort. The production could also include efforts such as a dedicated hydrogen pipeline similar to CNG.

CARB projections for on-road FCEVs counts are now 30,800 in 2024 and 61,000 in 2027 in California[13] and the majority of these do not include MD and HD vehicles deployed in the Basin. To meet demand, the number of hydrogen fueling infrastructures needs to be significantly increased and become more reliable in terms of uptime and supply. South Coast AQMD will seek additional funding from CEC and CARB to construct and

[13] California Air Resources Board. *2021 Annual Evaluation of Fuel Cell Vehicle Deployment & Hydrogen Fuel Station Network Development* (AB 8 Report). September 2021.

operate hydrogen fueling stations and take advantage of funding opportunities that may arise soon with the California hydrogen hub application and others, such as the anticipated adoption of the Advanced Clean Fleets Regulation.

**Potential Air Quality Benefits:**

The 2022 AQMP identifies using alternative clean fuels in mobile sources as a key attainment strategy. Under AQMP goals, the South Coast AQMD has several fleet rules in effect that require public and certain private fleets to purchase clean-burning alternative-fueled vehicles when adding or replacing vehicles to their vehicle fleets. The Warehouse Indirect Source Rule (ISR) also requires certain warehouse owners and operators to comply with the rule through preapproved actions, such as by operating clean fuel vehicle technologies. FCEVs constitute some of the cleanest alternative-fuel vehicles today. Since hydrogen is a key fuel for FCEVs, this project would address some of the barriers faced by hydrogen as a fuel with a focus on MD/HD infrastructure and thus assist in accelerating its acceptance and ultimate commercialization. In addition to supporting the immediate deployment of the demonstration fleet, expanding the hydrogen fuel infrastructure should contribute to the market acceptance of fuel cell technologies in the long run, leading to substantial reductions in NOx, VOC, CO, PM and toxic compound emissions from vehicles.

**Proposed Project:** Develop and Demonstrate Permanent Electric Charging Infrastructure

**Expected South Coast AQMD Cost:** $1,700,000

**Expected Total Cost:** $4,700,000

**Description of Technology and Application:**

There is a critical need to address gaps in EV charging infrastructure availability. Forty-one percent of the 3,916,106[14] EVs sold in the U.S. since 2010 were in California, and of those sales in California, almost half (44 percent) of CVRP[15] rebates issued as of July 2023 were for vehicles in the South Coast AQMD jurisdiction. In addition, the California ZEV Action Plan, which was updated in 2018, calls for 5 million ZEVs and supporting infrastructure by 2030.

There are separate challenges associated with infrastructure for LD EVs versus MD and HD EVs, which are on opposite ends of the commercialization spectrum. LD EVs and charging infrastructure have long been commercially available with an SAE J1772 connector standard for Level 1 and Level 2 charging. In recent months, multiple LD OEMs and EVSE providers have adopted the CCS1 connector moving towards more reliable, harmonized LD charging network availability of public fast charging and workplace charging continues to increase and is needed particularly for residents in multi-unit dwellings without easy access to home charging. The availability and costs of infrastructure deployment remain the main challenges for LD EVs.

MD and HD EVs are becoming more commercially available, with multiple OEMs supplying Class 4 through Class 8 battery electric vehicles. Standards for charging infrastructure to support MD and HD EVs have generally been with the CCS1 connector in North America, although Tesla has adopted a different connector for their semi-trucks. A separate Megawatt Charging System (MCS) connector is under development by the Charging Interface Initiative (CharIN) for Class 6 -8 EVs for charging up to 4.5 MW DC. There is also an agreed upon SAE J3068 connector standard for single-phase and three-phase AC charging. The challenges and costs of installing MD and HD charging infrastructure have exponentially increased compared to LD infrastructure. Further, innovative solutions must be explored and demonstrated for off-road mobile applications where a fixed charging solution is not feasible. For urbanized public charging hub and fleet depot charging, significant funding has already been provided by the Bipartisan Infrastructure Law and the Inflation Reduction Act, as well as various state funding programs that can support widespread EVSE projects to be funded within the next few years. For corridor charging, South Coast AQMD has partnered with private entities to submit proposals to the DOT to support battery electric vehicles and equipment at the Ports and facilitate electrifying long-haul transportation. Another emerging technology is the popularity of battery-swap trucks and its swap stations in other markets, but those are still in very early stages in the U.S.

Alongside various deferral and state incentive funds for charging infrastructure, the clean fuels program will continue to support:

- deployment of a network of DC fast charging infrastructure (350Kw or more) and rapidly expand the existing network of public EV charging stations including energy storage systems;

[14] https://www.veloz.org/ev-market-report/. Q2 2023 data uploaded on 8/2/23.

[15] https://cleanvehiclerebate.org/eng/rebate-statistics

- deployment of DC fast charging infrastructure (500 Kw or more) in conjunction with energy storage and/or solar to support large scale deployments of 50 or more battery electric trucks (BETs) at a single fleet location;
- charging infrastructure and innovative systems (i.e. solar or battery swap) to support MD and HD vehicle and off-road equipment demonstration and deployment projects;
- regional planning for MD/HD charging;
- development of MD/HD charging infrastructure solutions that provide easier installation through reduced grid reliance and increased resiliency;
- development of ACS solutions that provide prime power for temporary solutions charging and or mobile backup power;
- investigation of fast charging impacts on battery life;
- development of intelligent transportation system strategies for cargo containers; and
- development of freight load-balancing strategies as well as to conduct market analysis for zero emission HD trucks in goods movement.

**Potential Air Quality Benefits:**

The 2022 AQMP identifies zero emission vehicles as a key attainment strategy. MD/HD infrastructure is currently a limiting factor to deploying BETs for many fleets. This proposed project category will reduce PM pollution along major roadways through the expansion of the public EV charging infrastructure network by allowing drivers to shift away from conventional-fueled vehicles to battery and fuel cell EVs. In addition, this project will assist in achieving improved fuel economy and lower tailpipe emissions, further helping the region to achieve NAAQS and protect public health. Expected benefits include the establishment of criteria for emission evaluations, performance requirements and customer acceptability of the technology. This will help both regulatory agencies and OEMs to expedite introduction of ZEVs in the Basin, which is a high priority of the 2022 AQMP.

**Proposed Project:** Develop and Demonstrate Innovative Charging Solutions for Grid Support

**Expected South Coast AQMD Cost:** $2,200,000

**Expected Total Cost:** $5,000,000

**Description of Technology and Application:**

The South Coast AQMD has been involved in the development and demonstration of battery electric vehicles and has transitions to pre-commercial deployment phase. Over the past few years, several OEMs have commercialized battery electric medium and heavy-duty (HD) models. As the number of battery electric vehicles increase, the site peak demand increases and often faces long delays in getting sufficient grid capacity. Development and demonstration of innovative charging solutions for providing prime power while the grid capacity is added and backup power is now in high demand. Traditional off-grid power generation using ICE generators are often not preferred and does not fit within the funding guidelines. Innovative charging solutions that combine with the advantages of renewable fuel sources could yield major benefits, including low and zero emissions.

This project category is to apply advanced and innovative power generation technologies to identify best fit low and zero emission electric generation solution for battery electric vehicle charging, and to demonstrate their viability, reliability, and durability, gauge market preparedness, evaluate costs relative to traditional grid power and ICE-based generators. The use of alternative charging solutions and generation (i.e. solar, linear generators) could support a large-scale deployment of battery electric trucks (BETs) and charging infrastructure at a single fleet location where energy storage is optimized for grid reliability and to offset electricity demand charges.

South Coast AQMD is actively pursuing development of alternative charging solutions (ACS) to support temporary power charging as well as providing power during grid outage events. These innovative charging solutions ranging from mobile battery packs, hydrogen fuel cell generators, combustion of renewable fuels, as well as temporary installations of chargers via existing electrical systems, different than permanent infrastructure, which requires long term planning as well as permitting of the site and equipment, ACS systems are mobile and can often deployed quickly and falls under backup generator category for permitting, or local building department for electrical permitting. ACS technologies can also provide power for off-road equipment which also requires mobile charging.

Linear generators were introduced in 2010s and provide an alternative technology for power generation applications. Unlike traditional internal combustion engines (ICEs), linear generators produce electricity by driving magnets through copper coils in a linear motion. A unique feature of linear generators is that the thermochemical reaction takes place at lower temperatures than ICE, which results in lower emissions without add-on control devices (e.g., selective catalytic reduction). Linear generators are modular in their design, rapidly dispatchable, and have the ability to run on fuels such as hydrogen, ammonia, natural gas, and biogas, making them a viable alternative charging solution for microgrid applications.

Similar category also includes sections of the Stationary Clean Fuel Technologies.

**Potential Air Quality Benefits:**

Certification of battery electric and hybrid electric vehicles and engines and their integration into the Basin's transportation sector is a high priority under the 2022 AQMP. This project is expected to further efforts to

develop innovative charging technologies that could aid in the deployment of MD and HD trucks, buses, off-road equipment, and other applications. Benefits will include proof of concept for new technologies, diversification of transportation fuels and lower emissions of criteria, toxic pollutants and greenhouse gases.

**Proposed Project:** CHARGE-OPT: Accelerating Electrification of Medium- and Heavy-duty Trucks in Southern California with Data-Driven Planning Platforms for Charging Networks, Truck Fleets, and Power Systems

**Expected South Coast AQMD Cost:** $300,000

**Expected Total Cost:** $600,000

**Description of Technology and Application:**

The proposed project will develop a holistic software platform based on the foundational optimization model to facilitate the coordinated development of an electrified ecosystem for medium duty and heavy duty (MDHD) vehicles. Named CHARGE-OPT (Charging and Grid Optimization Platform for Transportation), or simply CHARGE, this platform will enable stakeholders to share common background data across transportation, policy, charging networks, and power systems sectors. The foundation model and corresponding software functionalities will be customized for the specific needs of each stakeholder, including fleet owners, regulators, charging station developers, and electric utilities. CHARGE aims to fill a significant market gap by providing essential services required by these stakeholders, moving beyond the narrow focus of other initiatives, which primarily cater to charging station developers. The model will integrate real-world data—including truck trajectory data, existing charging station data, and power system capacity data—into a cohesive framework. The incorporation of large-scale, real-world truck trajectory data offers a higher fidelity of traffic information compared to agent-based models. Additionally, the integration of extensive power system capacity data into the model represents a novel approach not previously reported in the literature. The detailed scope of the solution in addressing each stakeholder's problems is listed in the table below. The CHARGE platform will bridge the gap between stakeholders, ensuring that all parties make decisions based on common data and the same foundation model, thereby promoting coordinated development and reducing misalignment.

| No. | Stakeholder | Primary Interest | Scope of Our Solution in Addressing Challenging Problems |
|---|---|---|---|
| 1 | Fleet Owners | Maintain uninterrupted business with ZEVs at comparable or reduced costs. | ● Assess the benefits and pace of ZEV conversion and select appropriate models.<br>● Decide whether to build depot chargers and onsite distributed energy resources (e.g. solar and battery storage).<br>● Establish reliable day-to-day joint routing and charging schedules. |
| 2 | Regulators | Achieve the ZEV policy goals. | ● Provide holistic analyses considering the dynamics of all downstream parties – electric utilities, charging station developers, and fleet owners – to identify the most cost-effective strategies for achieving ZEV goals.<br>● Evaluate and refine policy based on the insights gained from the above analysis and the real-world trends. |

| No. | Stakeholder | Primary Interest | Scope of Our Solution in Addressing Challenging Problems |
|---|---|---|---|
| 3 | Charging Station Developers | Ensure profitable utilization rates of charging stations. | ● Identify optimal locations & scales for new stations.<br>● Engage the right customers for conversion to electric and use the charging stations.<br>● Anticipate when the grid will be ready to support newly-sited charging stations while considering solar and battery storage integration. |
| 4 | Electric Utilities | Align grid capacity with state ZEV regulation goals. | ● Identify the most cost-effective extent of necessary upgrades to the existing infrastructure.<br>● Justify the necessity of grid investment and the potential electricity price increase to regulators.<br>● Remain developer-agnostic while supporting long-term transportation demands. |

**Potential Air Quality Benefits:**

Projects to support the development and demonstration of MD/HD ZEV technologies and supporting infrastructure are included in the Technology Advancement Office Clean Fuels Program 2024 Plan Update under the categories "Zero Emission Infrastructure" and "Electric / Hybrid Technologies." The proposed tool will help improve the deployment process for the charging infrastructure by providing grid data-insight and also assist the fleet owners in more strategic infrastructure planning to when electrifying the fleets and operating the battery electric trucks. The tool will address the common obstacles and challenges faced by infrastructure developers and fleet owners, helping accelerate the transition to battery electric technology in the MD/HD trucking sector. The implementation of this project is consistent with the 2022 AQMP, which relies on MD/HD ZEV technologies to achieve NAAQS for ozone and PM2.5 in the Basin.

## *Hydrogen / Fuel Cell Mobile Technologies*

**Proposed Project:** Develop and Demonstrate Hydrogen Research to Support Innovative Technology Solutions for Fueling Fuel Cell Vehicles

**Expected South Coast AQMD Cost:** $100,000

**Expected Total Cost:** $900,000

**Description of Technology and Application:**

California regulations require automakers to place increasing numbers of ZEVs into service every year. By 2050, CARB projects that 87 percent of LD vehicles on the road will be zero emission battery and FCVs.

Many stakeholders are working on hydrogen and fuel cell products, markets, requirements, mandates and policies. California has been leading the way for hydrogen infrastructure and FCV deployment. This leadership has advanced a hydrogen network that is not duplicated anywhere in the U.S. and is unique worldwide for its focus on providing a retail fueling experience. In addition, the advancements have identified many lessons learned for hydrogen infrastructure development, deployment and operation. Other interested states and countries are using California's experience as a model case, making success in California paramount to enabling market acceleration and uptake in the U.S. U.S. leadership for hydrogen technologies is rooted in California, a location for implementing many DOE H2@Scale pathways, such as reducing curtailment and stranded resources, reducing petroleum use and emissions, and developing and creating jobs. The technical research capability of the national laboratories can be used to assist California in decisions and evaluations, as well as to verify solutions to problems impacting the industry. Because these challenges cannot be addressed by one agency or one laboratory, in 2018, a hydrogen research consortium was organized to combine and collaborate. Moreover, in 2022, California announced its intention to develop a renewable hydrogen hub as a part of the DOE announcement for an $8B funding opportunity to establish up to ten regional hydrogen hubs to build self-sustaining hydrogen economies of producers and infrastructure in the nation. The Governor's Office of Business and Economic Development (GO-Biz) established the Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) to unite critical public and private stakeholders to build the framework for a California renewable, clean hydrogen hub.

The California Hydrogen Infrastructure Research Consortium focuses on top research needs and priorities to address near-term problems and support California's continued leadership in innovative hydrogen technology solutions needed for fueling FCEVs. These tasks also contribute significantly to the DOE H2@Scale Initiative. For instance, advances in fueling methods and components can support the development of supply chains and deployments. Tasks completed include data collection from operational stations, component failure fix verification (i.e., nozzle freeze lock), reporting about new fueling methods for MD and HD applications and HD tasks to develop HD reference station design, model HD station capacity with high flowrates and provide near-real-time verification of fuel quality with on-site hydrogen contaminant detectors (HCDs) for use at both LD and HD stations. The tasks are supported by leading researchers at NREL and coordinating national labs and managed in detail (e.g., schedule, budget, roles, milestones, tasks, reporting requirements) in a hydrogen research consortium project management plan. The UC Davis Institute of Transportation study on hydrogen systems analysis in 2021 is intended to evaluate the current hydrogen policies and their impact on carbon-neutral transportation by 2050 with data analysis and modeling support of the current hydrogen resources.

These efforts are complemented by projects undertaken and supported by the H2FCP and its members over the last few years such as the H2 Fuel Cell Electric Trucks, A Vision for Freight Movement in California – and Beyond document released in July 2021 establishing a vision for 70,000 Class 8 FC trucks supported by 200 hydrogen fueling stations by 2035, including barriers that need to be overcome, CARB's Advanced Clean Truck Regulation adopted in June 2020, and anticipated adoption of the Advanced Clean Fleets Regulation in 2022.

This project area would enable co-funding support for additional or follow on mutually agreed technical tasks with the California Hydrogen Infrastructure Research Consortium members, the H2FCP, UC Davis as well as other collaborative efforts that may be undertaken to advance hydrogen infrastructure technologies including the upcoming hydrogen hubs efforts.

**Potential Air Quality Benefits:**

The 2022 AQMP identifies the use of alternative fuels and zero emission transportation technologies as necessary to lower NOx and VOC emissions to meet federal air quality standards. One of the major advantages of FCEVs is the fact that they use hydrogen, a fuel that can be domestically produced from a variety of resources such as NG (including biogas), electricity (stationary turbine technology, solar or wind), and biomass. The technology and means to produce hydrogen fuel to support FCEVs are available but require optimization to achieve a broad market scale. The deployment of large numbers of FCEVs, which is one strategy to attain air quality goals, requires a well-planned and robust hydrogen fueling infrastructure network. These South Coast AQMD projects, with significant additional funding from other governmental and private entities, will work towards providing the necessary hydrogen production and fueling infrastructure network for our region.

**Proposed Project:** Develop and Demonstrate MD and HD Fuel Cell Vehicles

**Expected South Coast AQMD Cost:** $3,000,000

**Expected Total Cost:** $14,850,000

**Description of Technology and Application:**

This proposed project would support evaluation, including demonstrating promising fuel cell technologies for applications using direct hydrogen with proton exchange membrane (PEM) fuel cell technology. Battery dominant fuel cell hybrids are another potential technology that can reduce costs and enhance the performance of FCEVs.

The California ZEV Action Plan specifies actions to help deploy an increasing number of ZEVs, including MD and HD ZEVs. CARB's Advanced Clean Truck and Fleet and Innovative Clean Transit Bus Regulations will also increase the deployment of MD and HD FCVs. Fleets are useful demonstration sites because economies of scale exist in central fueling, training skilled personnel to operate and maintain FCVs, monitoring and collecting data on vehicle performance, and OEM technical and customer support. In some cases, MD and HD FCVs could leverage the growing network of hydrogen stations and provide an early base load of fuel consumption until the number of LD FCVs grows. These vehicles could include hybrid-electric vehicles powered by fuel cells and equipped with batteries capable of charging from the grid and even supplying power to the grid.

In 2012, the DOE awarded South Coast AQMD funds to demonstrate Zero Emission Container Transport (ZECT) technologies. In 2015, the DOE awarded South Coast AQMD additional funds to develop and demonstrate additional fuel cell truck platforms and vehicles under ZECT II. Both ZECT I and ZECT II enabled the largest strides in the Technology Readiness Level (TRL) of hybrid, battery electric, and fuel cell HD trucks on the overall vehicle design and architecture. The fuel cell drayage truck's TRL before this project was at a strong Level 4 with several proof-of-concept vehicles constructed, and it has advanced the TRL to Level 7 with ZECT II. The Clean Fuels Program cost-shared the demonstration of transit buses at OCTA which was completed in September 2021. In 2020, the U.S. EPA Targeted Airshed Grant Program awarded South Coast AQMD six fuel cell transit buses to be deployed at SunLine Transit which were also cost-shared by the Clean Fuels Program, Subsequently, in 2022 and 2023, the U.S. EPA awarded South Coast AQMD two additional grants for development and demonstration fuel cell trucks that will also be cost-shared by Clean Fuels Program.

This category may include projects in the following applications:

| **On-Road:** | **Off-Road:** |
|---|---|
| • Transit Buses | • Vehicle Auxiliary Power Units |
| • Shuttle Buses | • Construction Equipment |
| • MD & HD Trucks | • Lawn and Garden Equipment |
| • Specificality trucks such as refuse | • Cargo Handling Equipment |

**Potential Air Quality Benefits:**

The 2022 AQMP identifies the need to implement ZEVs. South Coast AQMD adopted fleet regulations that require public and some private fleets within the Basin to acquire alternatively fueled vehicles when making new purchases. CARB is revising the Advanced Clean Fleets for adoption in 2022 to impose 100 percent

zero emission vehicle fleet targets for last mile delivery, drayage and public fleets in 2035. In the future, such vehicles could be powered by zero emission fuel cells operating on hydrogen fuel. The proposed projects have the potential to accelerate the commercial viability of FCEVs. Expected immediate benefits include the establishment of zero and near-zero emission proof-of-concept vehicles in numerous applications. Over the longer term, the proposed projects could help foster wide-scale implementation of FCEVs in the Basin. The proposed projects could also lead to significant fuel economy improvements, manufacturing innovations and the creation of high-tech jobs in Southern California, besides realizing the air quality benefits projected in the AQMP as well as GHG reductions. Currently, the trucks in the ZECT II project have a targeted range of 150 miles. Future projects would include extending the range of the FCVs up to 400 miles and demonstrating improvements in the reliability and durability of powertrain and hydrogen storage systems. For fuel cell transit buses, projects are being proposed that reduce the cost of the fuel cell bus to less than $1 million through advanced technologies for the fuel cell stack, higher density and lower cost batteries, and increased production volumes.

## *Battery Electric Technologies*

**Proposed Project:** Develop and Demonstrate MD and HD On-Road Battery Electric Vehicles and Equipment

**Expected South Coast AQMD Cost:** $6,850,000

**Expected Total Cost:** $102,800,000

**Description of Technology and Application:**

The South Coast AQMD has long promoted early demonstrations of next-generation LD vehicle propulsion technologies (and fuels). However, given the commercial availability of LD EVs and relatively low LDV emissions inventory, priorities have shifted. South Coast AQMD will continue to evaluate market offerings and proposed technologies in LD vehicles to determine if any future support is required.

Meanwhile, MD and HD vehicles only make up 5[16] percent of vehicles in the U.S. and drive 11[17] percent of all vehicle miles traveled each year and yet are responsible for more than 30[18] percent of all the fuel burned annually. Moreover, the 2022 AQMP identified MD and HD vehicles as the largest source of NOx emissions in the Basin. Electric and hybrid technologies have gained momentum in the LD sector with commercial offerings by most of the automobile manufacturers. Unfortunately, given the advances in LD sector, significant emission reductions are still needed for MD and HD vehicles and off-road equipment, exacerbated by low turnover of these vehicles by fleets and high incremental costs for battery and hybrid electric vehicles and equipment compared to conventional-fueled vehicles and equipment.

Vehicle categories to be considered for potential or future demonstration and deployment projects include drayage/freight/regional haul trucks, utility trucks, last mile delivery vans, shuttle buses, transit buses, waste haulers, construction equipment, cranes and other off-road equipment such as yard tractors, forklifts, top handlers, and RTG cranes. Innovations that may be considered for demonstration and deployment include advancements in the auxiliary power unit, either ICE or other heat engine; and battery-dominant plug-in hybrid systems utilizing off-peak charging, with advanced battery technologies including alternative chemistries, design, and management systems. Alternative fuels are preferred in these projects, e.g., natural gas, especially from renewable sources, LPG, hydrogen, gas-to-liquid (GTL) and hydrogen-natural gas blends, but conventional fuels such as gasoline, renewable diesel, or even modified biodiesel may be considered if emission benefits can be demonstrated as equivalent or superior to alternative fuels. Both new designs and retrofit technologies and related charging infrastructure will be considered.

Electric vehicle technology has seen rapid early successes as both on-road vehicles and off-road equipment are transitioning increasingly towards zero emission technologies. Off-road equipment includes cargo handling equipment as well as construction equipment. The JETSI Pilot Project included deployment of 100 Daimler and Volvo Class 8 BETs and the Volvo LIGHTS project included deployment of 30 Volvo Class 8 BETs and 29 battery electric yard tractors and forklifts. Volvo Construction Equipment recently finished demonstrating a small battery electric compact excavator and wheel loader in California that was commercially released in late 2021. Several other manufacturers have released battery electric and hybrid

[16] https://www.bts.gov/content/number-us-aircraft-vehicles-vessels-and-other-conveyances

[17] https://www.bts.gov/content/us-vehicle-miles

[18] https://www.bts.gov/content/fuel-consumption-mode-transportation

equipment, and more are becoming commercially available. CARB has introduced the Clean Off-Road Equipment Voucher Incentive Project (CORE), successfully deploying zero-emission cargo handling equipment and switcher locomotives. The most recent round of funding in 2022 also included off-road construction equipment. Since the applications are more diverse in this sector, continued development and incentives are needed to accelerate progress in this sector, especially for large mobile off-road equipment where infrastructure solutions are more difficult and will require alternative charging solutions (ACS).

New and emerging technologies including higher power charging as well as different battery chemistry and technology. This category also includes battery swap technologies and well as electrified trailer technologies.

This project category will develop and demonstrate the following:

- various electric vehicles and equipment;
- studies for anticipated costs for electric vehicles and equipment;
- customer interest and preferences for these alternatives;
- new innovative technology such as higher power charging, new battery technology/chemistry, and battery-swap technologies;
- battery electric and hybrid-electric MD and HD vehicles (e.g., drayage/freight/regional haul trucks, utility trucks, delivery vans, shuttle buses, transit buses, waste haulers); and
- development and demonstration of battery electric off-road equipment, (e.g., battery electric off-road cargo handling such as yard tractors, forklifts and top-handlers, and construction equipment.

**Potential Air Quality Benefits:**

The 2022 AQMP identifies zero or near-zero emission vehicles as a key attainment strategy. Plug-in hybrid electric technologies have the potential to achieve near-zero emissions while retaining the range capabilities of conventional-fueled vehicles, a key factor expected to enhance broader consumer acceptance. Given the variety of EV systems under development, it is critical to determine actual emission reductions and performance metrics compared to conventional-fueled vehicles. Successful demonstration of optimized prototypes would promise to enhance the deployment of zero and near-zero emission technologies.

Expected benefits include establishing criteria for emission evaluations, performance requirements, and customer acceptability of the technology. This will help both regulatory agencies and OEMs to expedite introduction of zero and near-zero emission vehicles in the Basin, which is a high priority of the 2022 AQMP.

**Proposed Project:** Demonstrate Light-Duty Battery Electric Vehicles and Plug-In Hybrid Vehicles

**Expected South Coast AQMD Cost:** $160,000

**Expected Total Cost:** $160,000

**Description of Technology and Application:**

South Coast AQMD has included BEVs and PHEVs in its demonstration fleet since developing early conversion vehicles. At the headquarters, South Coast AQMD installed 94 Level 2 EV charging ports in 2017 and a DC fast charger with CHAdeMO and CCS1 connectors in 2018 to support public and workplace charging as a means of educational outreach regarding BEV and PHEV technology. Additionally, 30 networked Level 2 fleet chargers were added through the Southern California Edison Charge Ready Fleet program in 2020. In 2024, South Coast AQMD is in the process of updating these chargers to the latest standards.

LD BEVs and PHEVs are now widely available and continuously improving with the latest technology, safety, features, and reliability. Some OEMs have proposed vehicle-to-home concepts using BEVs as backup power solutions. As a result, the Clean Fuels Program will continue to evaluate commercially available LD PHEVs and BEVs.

**Potential Air Quality Benefits:**

The 2022 AQMP identifies the need to implement LD EVs. South Coast AQMD's adopted fleet regulations require public and some private fleets within the Basin to acquire alternatively fueled vehicles when making new purchases. In the future, such vehicles could be powered by BEVs. The proposed projects can potentially accelerate the commercial viability of BEVs and PHEVs. Expected immediate benefits include the deployment of ZEVs in South Coast AQMD's demonstration fleet. Over the longer term, the proposed projects could help foster wide-scale implementation of ZEVs in the Basin. The proposed projects could also lead to significant fuel economy improvements, manufacturing innovations and the creation of high-tech jobs in Southern California, besides realizing the air quality benefits projected in the 2022 AQMP.

## *Stationary Clean Fuel Technologies*

**Proposed Project:** Develop and Demonstrate Microgrids with Photovoltaic/Fuel Cell/Battery Storage Energy Management

**Expected South Coast AQMD Cost:** $1,000,000

**Expected Total Cost:** $4,000,000

**Description of Technology and Application:**

CARB has proposed the Advanced Clean Truck Regulation which is part of a holistic approach to accelerate a large-scale transition of zero emission MD and HD vehicles from Class 2B to Class 8. Manufacturers who certify Class 2B-8 chassis or complete vehicles with combustion engines would be required to sell zero emission trucks as an increasing percentage of their annual California sales from 2024 to 2030. By 2030, zero emission truck/chassis sales would need to be 50 percent of Class 4–8 straight trucks sales and 15 percent of all other truck sales.

The commercialization of zero emission HD trucks is currently under way with two of the largest manufacturers offering commercial products in California. South Coast AQMD is deploying 100 Daimler and Volvo Class 8 BETs, solar, and energy storage for the JETSI Pilot Project for drayage and regional haul applications. Ever larger deployments of zero emission trucks will be needed for the technology to impact air quality. Large deployments of zero emission Class 8 BETs each carrying 300+ kWh of battery-stored energy or fuel cell trucks (FCTs) carrying 30-50 kg of hydrogen will require costly infrastructure that creates a barrier for some fleets to adopt zero emission technologies. Many fleet operators lease their facilities, making it impossible to recoup the capital expenditure of EV or hydrogen infrastructure in a short period. To comply with existing and upcoming regulatory requirements, fleets must navigate challenges installing and maintaining charging and/or fueling infrastructure. Microgrids can be instrumental in meeting the challenge of cost-effectively providing large amounts of energy for EV charging or hydrogen generation to support zero emission vehicle charging and fueling. Additionally, suppose the microgrid equipment is owned by a third party and energy is sold to the fleet through a power purchase agreement. In that case, the financial challenge of large capital investment can be avoided by the fleets.

A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity concerning the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected and island-mode. Microgrids can work synergistically with the utility grid to provide power for zero emission vehicle fueling by managing when energy from the grid is used during off-peak hours when it is the least expensive. Then during peak demand periods, the microgrid would use energy from battery storage or onsite generation. Most technologies that make up microgrids include photovoltaic, fuel cells, battery storage, along with hardware and software for the energy management system (EMS). When grid service is interrupted, the microgrid can disconnect from and continue to operate as an energy island independent from the grid. Ensuring an uninterrupted power source is an important consideration for fleets. If the microgrid is connected to the fleet's logistics and telematics systems, additional benefits in infrastructure cost and battery life for BETs can be realized. If the EMS is fed information on the route a truck is planning to travel, it can charge the vehicle with enough energy for the trip so the truck will operate within the desired 20-80 percent state of charge (SOC) of the battery having the least amount of impact to battery life. Additionally, if the EMS is connected to the logistics system, it can plan charging schedules with 150 Kw or lower power chargers which will have less impact on battery life than 350+ Kw chargers and lower charging costs.

Electricity demand for electric and fuel cell HD trucks is substantial. For a 100-vehicle fleet of BETs with 300 kWh batteries, 30 MW hours/day of electricity would be required to charge these BETs. The hydrogen requirement for a 100-vehicle fleet of FCTs is 2,000 kg/day. Microgrids can provide energy for EV and hydrogen infrastructure to enable large zero emission vehicle deployments and make charging and fueling economical and reliable. The staff has demonstrated several microgrid projects with the University of California Irvine and has toured a microgrid at the Prologis Charging Depot in Torrance. In May 2024, Prologis and Performance Team launched a microgrid near the ports of Los Angeles and Long Beach that is capable of charging up to 96 electric trucks simultaneously. This microgrid uses 2.75 megawatts of Mainspring Energy's linear generators, along with 18 MWh of batteries to provide up to 9MW of charging capacity. The linear generators are fueled by natural gas and can operate independently from the grid or grid-connected.

Several pilot projects are being discussed with microgrid developers and fleets that involve various configurations of microgrid technologies and different business models. Proposed projects would include development and demonstration of microgrids utilizing various types of renewable and zero and or low emitting onsite generation (fuel cell tri-generation, power to gas, photovoltaic, wind), energy storage, connectivity to logistics systems, vehicle-to-grid and vehicle-to-building technologies. Projects demonstrating different business models will be considered, such as projects involving a separate entity owning some or all the microgrid equipment and engaging in a power purchase agreement to provide energy to fleets transitioning to zero emission trucks. Proposed projects would partner with truck OEMs and their major customers, such as large- and medium-sized fleets looking at microgrid solutions for their operations in the Basin.

**Potential Air Quality Benefits:**

Microgrids can provide grid resilience and potentially support large deployments of zero emission MD and HD trucks that are necessary to meet the AQMP target of 83 percent NOx emission reductions from the 2018 level and 67 percent additional reductions in 2037 beyond already adopted regulations and programs by 2037. Both renewable and zero emitting power generation technologies that make up a microgrid can provide a well-to-wheel zero emission pathway for transporting goods. Projects could potentially reduce a significant class of NOx and CO emissions over the assumptions in the 2022 AQMP and further enhance South Coast AQMD's ability to enforce full-time compliance.

**Proposed Project:** Develop and Demonstrate Zero or Near-Zero Emission Energy Generation Alternatives

**Expected South Coast AQMD Cost:** $2,500,000

**Expected Total Cost:** $7,000,000

**Description of Technology and Application:**

This project aims to support the development and demonstration of clean energy and renewable alternatives in stationary applications. The technologies to be considered include thermal, photovoltaic and other solar energy technologies; wind energy systems; energy storage potentially including vehicle to grid or vehicle to building functionalities for alternative energy storage; biomass conversion; and other renewable energy and recycling technologies. Innovative solar technologies, such as solar thermal air conditioning and photovoltaic-integrated roof shingles, are particularly interesting. Also, in the agricultural sections of the Basin, wind technologies could potentially be applied to drive large electric motor-driven pumps to replace highly polluting diesel pumps. Besides renewable technologies, electrolyzer technology could be used to generate hydrogen as a clean fuel. Hydrogen, when used in ICEs, can potentially reduce tail-pipe emissions of NOx, while emissions in fuel cells are reduced to zero.

This project is expected to result in pilot-scale zero or near-zero emission energy production demonstrations, scale-up process design and cost analysis, overall environmental impact analysis and projections for ultimate clean fuel costs and availability. This project is expected to result in several projects addressing technological advancements in these technologies that may improve performance and efficiency, potentially reduce capital and operating costs, enhance the quality of RNG generated from renewable sources for injection into NG pipelines, improve reliability and identify markets that could expedite implementation of successful technologies. One example of a near-zero technology is the linear generator. This technology was introduced in 2019 and unlike traditional internal combustion engines, linear generators produce electricity by driving magnets through copper coils in a linear motion. This reaction takes place at much lower temperatures than ICEs, which result in lower emissions without the need for add-on emission control devices such as catalysts. In addition, linear generators are fuel agnostic and can switch between fuels like hydrogen, natural gas, ammonia, and biogas.

**Potential Air Quality Benefits:**

The 2022 AQMP identifies that the development and implementation of non-polluting power generation could gain maximum air quality benefits. Polluting fossil fuel-fired electric power generation needs to be replaced with clean, renewable energy resources or other advanced zero emission technologies, such as hydrogen fuel cells, particularly in a distributed generation context to help provide grid resiliency as the transportation sector becomes more reliant on electricity.

This project is expected to accelerate implementation of advanced zero and near-zero emission energy sources. Expected benefits include directly reducing emissions by displacement of fossil generation; proof-of-concept and potential viability for zero emission power generation systems; increased exposure and user acceptance of the new technology; reduced fossil fuel usage; and potential for increased use, once successfully demonstrated, with resulting emission benefits, through expedited implementation. These technologies would also have a substantial influence in reducing GHG emissions.

## *Fuel and Emissions Studies*

**Proposed Project:** Conduct In-Use Emission Studies including MATES VI for Advanced Technology Vehicle Demonstrations

**Expected South Coast AQMD Cost:** $1,000,000

**Expected Total Cost:** $4,000,000

**Description of Technology and Application:**

Hybrid electric, plug-in electric hybrid and battery-electric and fuel cell electric vehicles will all play a role in the future of transportation. Each of these transportation technologies has attributes that could provide unique benefits to different transportation sectors. Identifying optimal placement of each transportation technology will provide the co-benefits of maximizing environmental benefit and return on investment.

As the new CARB and U.S. EPA low-NOx regulations focus on addressing the gap of in-use and certification values, staff expects the in-use emissions from new engines to perform closer to certification values, but there are still a significant population of the diesel legacy fleet expected to remain in service well into the 2030s. There is always a need to better assess real world truck emissions, fuel economy, and activity from engines, hybrid powertrain and zero carbon combustion technologies for continued technology improvements and verification of emission reductions.

This project would review and potentially coordinate application specific drive cycles for specific applications. Potential emission reductions and fossil fuel displacement for each technology in a specific application would be quantified on a full-cycle basis. This information could be used to develop a theoretical database of potential environmental benefits of different transportation technologies when deployed in specific applications. This duty-cycle requirement, often based on traditional vehicles, is used for planning purposes for building MD and HD public zero emission vehicle fueling stations, similar to the approaches provided for NREL's fleet DNA database. Furthermore, the creation and standardization of test cycles, like the chassis dyno-based cycle, can be used to evaluate efficiency of zero-emissions vehicles and direct comparisons with baseline ICE vehicles.

Another project would be characterization of intermediate volatility organic compound (IVOC) emissions, which is critical in assessing ozone and secondary organic aerosol (SOA) precursor production rates. Diesel vehicle exhaust and unburned diesel fuel are major sources and contribute to formation of urban ozone and SOA, which is an important component of PM2.5. NGVs are also a concern due to lack of particulate filters, however the actual impact based on current and projected vehicle populations needs to be further studied. Another emerging PM emissions of interest non-tailpipe emissions from brake and tire wear. CARB estimates PM from non-tailpipe sources already exceeded traditional sources and increase with VMT. CARB has introduced a series of projects to assess the emission factor for brake- and tire-wear emissions. South Coast AQMD also expects new fuels and emission studies projects to support the research needed for MATES VI study.

**Potential Air Quality Benefits:**

Development of an emissions reduction database for various application specific transportation technologies would assist in targeted deployment of new transportation technologies. This database coupled with application specific vehicle miles traveled and population data would assist in intelligently deploying

advanced technology vehicles to attain the maximum environmental benefit. These two data streams would allow vehicle technologies to be matched to an application that is best suited to the specific technology, as well as selecting applications that are substantial enough to provide significant environmental benefits. Demonstration of a quantifiable reduction in operating cost through intelligent deployment of vehicles will also accelerate commercial adoption of various technologies. Accelerated adoption of lower emitting vehicles will further assist goals in the 2022 AQMP.

**Proposed Project:** Conduct Emission Studies including MATES VI on Biofuels, Alternative Fuels and Other Related Environmental Impacts

**Expected South Coast AQMD Cost:** $1,000,000

**Expected Total Cost:** $4,000,000

**Description of Technology and Application:**

The use of renewable fuels such as biofuels can be an important strategy to reduce petroleum dependency, air pollution and greenhouse gas (GHG) emissions and help with California's aggressive GHG reduction goals. Biofuels are receiving increased attention due to national support and state activities resulting from SB 32, AB 1007 and the Low-Carbon Fuel Standard. With an anticipated increase in renewable fuel use, it is the objective of this project to further analyze these fuels to better understand their benefits and impacts not only on GHGs but also air pollution and associated health effects.

In various diesel engine studies, replacement of petroleum diesel fuel with renewable fuel has demonstrated reduced PM, CO and air toxics emissions. Renewable fuel also has the potential to reduce GHG emissions if made from renewable feedstocks such as soy and canola. However, certain blends of biodiesel can increase NOx emissions for some engines and duty cycles, which exacerbates ozone and PM2.5 challenges faced in the Basin. In addition, despite recent advancements in toxicological research in the air pollution field, the relationship between biodiesel particle composition and associated health effects is still not completely understood.

Ethanol is another biofuel that is gaining increased national media and state regulatory attention. CARB's reformulated gasoline regulation increases ethanol content to 10 percent as a means to increase the amount of renewable fuels in the state. As in the case of biodiesel, ethanol has demonstrated in various emission studies to reduce PM, CO and toxic emissions. South Coast AQMD also has been monitoring efforts in using ethanol as a primary fuel for MD and HD applications in optimized engine systems that allows both criteria and GHG reductions which could be another pathway for reducing emissions due to abundance of ethanol from the light duty sector.

CARB recently proposed a regulation on commercialization of alternative diesel fuels, including biodiesel and renewable diesel, while noting that biodiesel in older HD vehicles can increase NOx. The need for emerging alternative diesel fuels for HD trucks and transit buses is also being studied. Researchers have proposed evaluating the emissions impact of RNG and other NG blends such as renewable hydrogen or pure hydrogen.

To address these concerns on potential health effects associated with alternative fuels and fuel blends, this project will investigate physical and chemical composition and associated health effects of tailpipe PM emissions from LD to HD vehicles burning biofuels to ensure public health is not adversely impacted by broader use of these fuels. This project also supports future studies to identify mitigation measures to reduce NOx emissions from biofuels. Additionally, a study of well-to-wheel emissions from for the extraction and use of shale gas might be considered.

The Power-to-Gas concept as well as demand for additional green hydrogen supply has renewed interest in hydrogen-fossil fuel blends as well as pure hydrogen for use in both ICE and other combustion sources. Hydrogen fueled ICEs were studied heavily in the early 2000s and results have shown significant possible

criteria emission reductions with optimized engine calibration though any new hydrogen ICE will need to comply to the latest standard for MY 2024 and MY 2027

To evaluate contribution of meteorological factors to high ozone and PM2.5 episodes occurring in the Basin, mainly as a result of higher summer temperatures and increased air stagnation following droughts, a comprehensive study is necessary to evaluate trends of meteorological factors that may adversely impact air quality in the Basin to support efforts such as the MATES VI. The study will assist in better understanding potential impact of recent weather trends on criteria pollutant emissions and developing more effective strategies for improving air quality in the future.

**Potential Air Quality Benefits:**

If renewable diesel, biodiesel and biodiesel blends can be demonstrated to reduce air pollutant emissions with the ability to mitigate NOx impacts, this technology will become a viable strategy in meeting air pollutant standards as well as the goals of SB 32 and the Low-Carbon Fuel Standard. The use of biodiesel is an important effort for a sustainable energy future. Emission studies are critical to understanding emission benefits and any tradeoffs (NOx impacts) that may result from using this alternative fuel. With reliable information on the emissions from using biodiesel and biodiesel blends, this can ensure the use of biodiesel without creating additional NOx emissions. Additionally, understanding meteorological factors on criteria pollutant emissions may help identify mitigation strategies, possibly through targeted advanced transportation deployment.

**Proposed Project:** Identify and Demonstrate In-Use Fleet Emission Reduction Technologies and Opportunities

**Expected South Coast AQMD Cost:** $400,000

**Expected Total Cost:** $1,500,000

**Description of Technology and Application:**

New technologies, such as alternative fueled HD engines, are extremely effective at reducing emissions because they are designed to meet the most stringent emissions standards while maintaining vehicle performance. In addition, many new vehicles are now equipped with telematics enabling motorists to obtain transportation information such as road conditions to avoid excessive idling and track information about vehicle maintenance needs, repair history, tire pressure and fuel economy. Telematics have been shown to reduce emissions from new vehicles through various vehicle usage optimization strategies. Unfortunately, many in-use fleets lack telematic systems, particularly HD engines in trucks, buses, construction equipment, locomotives, commercial harbor craft and cargo handling equipment, and have fairly long working lifetimes (up to 20 years due to remanufacturing in some cases). Even LD vehicles routinely have lifetimes exceeding 200,000 miles and 10 years. The in-use fleet, especially the oldest vehicles, are responsible for the majority of emissions. In the last few years, real-time emissions and fuel economy data reporting along with telematics has been demonstrated with large fleets as fleet management tools to identify high emitters and increase operational efficiency. Similar efforts have already been proposed by CARB as part of the HD I/M regulation. Moreover, the same telematic systems are being installed on zero emission trucks where fleet and charging management are important. Cloud based fleet management concepts are being proposed by researchers to maximize range and air quality benefits of zero emission trucks.

This project category is to investigate near-term emission control technologies that can be cost-effectively applied to reduce emissions from the in-use fleet. The first part of the project is to identify and conduct proof-of-concept demonstrations of feasible candidate technologies, such as:

- remote sensing for HD vehicles including license plate recognition systems;
- annual testing or for high mileage vehicles (>100,000 miles);
- replace or upgrade emission control systems at 100,000-mile intervals;
- on-board emission diagnostics with remote notification;
- low-cost test equipment for monitoring and identifying high emitters;
- intelligent transportation system such as fleet management tools, dashboards and localized traffic policies;
- electrical auxiliary power unit replacements;
- development, deployment and demonstration of smart vehicle telematic systems;
- fleet and charger management concepts; and
- low-cost emissions sensor development.

**Potential Air Quality Benefits:**

Many of the technologies identified can be applied to LD and HD vehicles to identify and subsequently remedy high-emitting vehicles in the current fleet inventory. Estimates suggest that 5 percent of existing fleets account for up to 80 percent of the emissions. Identification of higher emitting vehicles would assist

with demand-side strategies, where higher emitting vehicles have correspondingly higher registration charges. Identification and replacement of high-emitting vehicles has been identified in the Community Emission Reduction Plans (CERPs) from multiple AB 617 communities as a high priority for residents living in these communities, particularly as HD trucks frequently travel on residential streets to bypass traffic on freeways surrounding these disadvantaged communities.

## *Renewable Fuel Infrastructure*

**Proposed Project:** Demonstrate Low-Emission Engine/Generation Technology

**Expected South Coast AQMD Cost:** $1,000,000

**Expected Total Cost:** $2,000,000

**Description of Technology and Application:**

Natural gas vehicles (NGVs) have been very successful in reducing emissions in the Basin due to the deployment by fleet owners and operators of HD vehicles utilizing this fuel. This technology category seeks to support the expansion of OEMs producing engines or systems certified to the lowest optional NOx standard or near-zero emission and useable in a wide variety of MD and HD applications, including Class 6 vehicles such as school buses and in passenger and goods delivery vans, Class 7 vehicles such as transit buses, waste haulers, street sweepers, sewer-vector trucks, dump trucks, concrete mixers, commercial box trucks, Class 8 tractors used in goods movement and drayage operations, and off-road equipment such as construction vehicles and yard hostlers. This category can also include advancing engine technologies to improve engine efficiencies that will help attract HD vehicle consumers to near-zero emission powertrains.

Hydrogen fueled internal combustion engines starts to gain more attentions as a few major advantages exist with this technology. Comparing with the fuel cell electric technology, hydrogen ICE can work at a lower level of fuel purity and costs significantly less upfront. It is also expected to be more reliable as it largely based on today's engine technology. The increase in hydrogen ICE can also be a drive force for the fuel cell application by increasing the consumption of hydrogen fuel in the transportation sector. Efforts have been put on to optimize tailpipe NOx and PM emissions, while greenhouse gas (GHG) emissions are nearly zero.

**Potential Air Quality Benefits:**

Gaseous fueled vehicles have inherently lower engine criteria pollutant emissions relative to conventionally fueled vehicles, especially older diesel-powered vehicles. The deployment of near-zero emission vehicles would significantly further emission reductions relative to the state's current regulatory requirements. Incentivizing the development and demonstration of near-zero emission vehicles in private and public fleets, goods movement applications, and transit buses will help reduce local emissions and emissions exposure to nearby residents. NG and hydrogen vehicles can also have lower GHG emissions, help address national energy security objectives and reduce biomass waste produced from such feedstocks. Deployment of additional near-zero emission vehicles is consistent with the 2022 AQMP goal to reduce criteria pollutants. When fueled by RNG and renewable hydrogen, it supports California's objectives of reducing GHGs and carbon intensity of the state's transportation fuel supply, as well as the federal government's objective of increasing domestically produced alternative transportation fuels.

**Proposed Project:** Develop, Maintain and Expand Renewable Fuel Infrastructurde

**Expected South Coast AQMD Cost:** $300,000

**Expected Total Cost:** $1,000,000

**Description of Technology and Application:**

This project supports the development, maintenance and expansion of renewable fuel fueling infrastructure in strategic locations throughout the Basin, including the Ports, and advancing technologies and station design to improve fueling and fueling efficiencies of HDVs. This category supports broader deployment of near-zero emission HD vehicles and implementation of South Coast AQMD's fleet rules. In addition, as existing NG and hydrogen fueling infrastructure begins to age or has been placed in demanding usage, components will deteriorate. This project offers facilities the opportunity to replace worn-out equipment or to upgrade existing fueling and/or garage and maintenance equipment to provide increased fueling capacity to public agencies, private fleets and school districts.

**Potential Air Quality Benefits:**

The 2022 AQMP identifies the use of alternative clean fuels in mobile sources as a key attainment strategy. HD NGVs have significantly lower emissions than their diesel counterparts and represent one of the cleanest ICE-powered vehicles available today. The project has the potential to significantly reduce the installation and operating costs of NGV fueling infrastructure and improve vehicle fueling times through improved fueling system designs and high-flow nozzles. New or improved NGV infrastructure helps facilitate hydrogen refueling infrastructure. Increased exposure and fleet and consumer acceptance of renewable fuel vehicles will lead to significant and direct reductions in NOx, VOC, CO, PM and toxic compound mobile source emissions. Such increased penetration of NGVs and other renewable fuel vehicles will provide direct emission reductions of NOx, VOC, CO, PM and air toxic compounds throughout the Basin.

**Proposed Project:** Demonstrate Renewable Transportation Fuel Production and Distribution Technologies

**Expected South Coast AQMD Cost:** $400,000

**Expected Total Cost:** $1,500,000

**Description of Technology and Application:**

The transportation sector represents a significant source of criteria pollution in the Basin. Clean, alternative fuel-powered transportation is a necessary component for this region to meet NAAQS. Alternative fuels produced from renewable sources such as waste biomass help further efforts associated with landfill and waste diversion, GHG reduction, energy diversity and petroleum dependency. Locally produced renewable fuels further reduce concerns associated with out-of-state production and transmission of fuel and help support the local economy. Renewable fuels recognized as a transportation fuel under the state's LCFS program and the federal government's Renewable Fuel Standard program can provide financial incentives, including reduced fuel price and operational costs, which act as incentives to purchase and deploy alternative or renewable energy powered vehicles.

This project category will consider development and demonstration of technologies for the production and use of renewable transportation fuels such as RNG, renewable diesel (RD), and renewable hydrogen (RH). These renewable fuels can be converted from various waste biomass feed stocks, including municipal solid wastes, green waste, and biosolids produced at wastewater treatment facilities generated from anaerobic digestion, gasification, and pyrolysis. Transport of fuels can include mobile refueling but also dedicated pipeline for long distance and high-volume transport. For example, at the Port of Los Angeles, a mobile hydrogen refueler is currently being demonstrated. This mobile refueler is powered by a hydrogen fueled fuel-cell truck and has the capability of hauling 247 kg of hydrogen. The purpose of this mobile hydrogen refueler is to provide hydrogen fuel to support zero emissions equipment operating at the port.

The main objectives of this project are to Investigate, develop and demonstrate:

- commercially viable methods for converting renewable feed stocks into CNG, LNG, hydrogen or diesel (e.g., production from biomass);
- economic small-scale NG and hydrogen liquefaction technologies;
- utilization of various feed stocks locally available;
- commercialize incentives for fleets to site, install and use renewable refueling facilities; and
- pipeline interconnection in the local gas grid to supply users.

**Potential Air Quality Benefits:**

The 2022 AQMP relies on a significant increase in the penetration of zero and near-zero emission vehicles in the Basin to attain the NAAQS by 2037. This project would help develop renewable transportation fuel production and distribution facilities to improve local production and use of renewable fuels to help reduce transportation costs and losses as well as reduce total operating costs of zero and near-zero emission vehicles to be competitive with comparable diesel fueled vehicles. Such advances in production and use are expected to lead to greater infrastructure development. Additionally, this project could support the state's goal of redirecting biomass waste for local fuel production and reduce GHGs associated with these waste biomass feedstocks.

## *Health Impacts Studies*

**Proposed Project:** Conduct Monitoring and Support MATES VI Program Implementation

**Expected South Coast AQMD Cost:** $5,000,000

**Expected Total Cost:** $5,000,000

**Description of Technology and Application:**

MATES is a Governing Board environmental justice initiative that started back in 1987 with MATES I. South Coast AQMD previously conducted five MATES campaigns to characterize the concentration of airborne toxic compounds within the South Coast AQMD jurisdiction and to determine the region-wide cancer risks associated with major airborne carcinogens. However, as each successive MATES campaign builds on the previous work, each iteration added additional goals and objectives and employed more sophisticated measurement and modeling techniques. Results of MATES are used to provide public information about air toxics and associated health risks throughout the region, evaluate progress in reducing air toxics exposure, and provide direction to future toxics control programs. Previous MATES campaigns have also identified unknown air toxics sources and have been critical in the interpretation of data from special air toxics monitoring studies in communities throughout the region. MATES continues to be the most sophisticated regional air toxics analysis conducted in the nation, taking advantage of the extensive air quality monitoring, modeling, and analysis expertise and resources at the agency.

South Coast AQMD has initiated MATES VI and will begin measurements beginning in 2025. Similar to previous MATES campaigns, South Coast AQMD staff has convened a Technical Advisory Group (TAG) to provide technical guidance in the design of the study. The group includes experts from academia, health agencies, and government. MATES VI field measurements will be conducted over a one-year period at ten fixed sites to evaluate air toxics levels. MATES VI monitoring is being extended to the Coachella Valley for the first time. In addition, two of the ten monitoring locations will be sited adjacent to freeways to capture near-road air toxics impacts. MATES VI will also include measurements of ultrafine particle (UFP) and black carbon (BC) concentrations, which can be compared to the UFP and BC levels measured in MATES IV and MATES V, continuous measurement of metals, some of which are chemical tracers for non-exhaust vehicular emissions, and measurement of ammonia, a key precursor to PM2.5 formation in the region. Currently South Coast AQMD operates only one ammonia monitor in Coachella Valley and more measurements as part of MATES VI can help better understand the sources of ammonia across South Coast AQMD's jurisdiction. While MATES VI is focused on air toxic impacts, these ammonia measurements and particle speciation measurements will provide additional information about the sources and composition of PM2.5, which will assist in the design of control strategies to attain federal PM2.5 standards.

In addition to the fixed site monitoring, MATES VI will include a special study to characterize emissions of ethylene oxide (EtO) in ambient air and at the near-road sites to assess the contribution of vehicular emissions to background EtO concentration levels. The TAG will assist with the overall design of this study, and a scope and project plan for this part of the MATES VI campaign will be developed through the TAG meetings.

South Coast AQMD already possesses some of the monitoring and laboratory equipment needed for MATES VI. However, additional instrumentation and replacement, repair, and calibration of some older equipment is required to complete all the proposed measurements and can be used after MATES VI for additional studies, special investigations, or community monitoring. Laboratory and field supplies are also needed to conduct MATES VI. In addition to equipment and supply needs, temporary staffing is necessary to meet the additional

workload associated with MATES VI, as well as contractor support services for conducting tire-wear marker study, and to support study design, data analysis, and review.

The total program cost for MATE VI is around $5M to over FY 2023-24 through FY 2027-28 to purchase the necessary equipment and supplies and retain temporary staff for the MATES VI program. That include Solicitation for Tire and Brake Wear Study, Purchase Orders for Condensation Particle Counters, Aethalometers, Xact 625i Multi-Metal Monitor, Xact 625i Switching Inlet Systems, Continuous Monitors for Ethylene Oxide , Continuous Monitors for Ammonia, Gas Chromatograph Mass Spectrometer Instruments, GC-MS Canister Autosamplers, Monitoring Shelters, Vehicles, Zero Air Generators , GC-MS Thermal Desorption System, Air Toxics Samplers, Gas Dilution Systems and Linux Computational Server System and so-on.

**Potential Air Quality Benefits:**

The MATES studies conducted by South Coast AQMD provide essential information on air toxics levels in the South Coast AQMD's jurisdiction and present a unique opportunity to evaluate long-term trends in air toxics and their health impacts. South Coast AQMD continues to work toward reducing air toxics emissions through supporting cleaner technologies (including cleaner diesel technologies), rulemaking to address toxic emissions from mobile and stationary sources, and implementing air toxics monitoring and enforcement initiatives. The MATES VI program complements these efforts and provides information to track progress on reducing air toxics in the region along with the identification of sources contributing to the air pollution health risk.

## *Technology Assessment and Transfer/Outreach*

**Proposed Project:** Assess and Support Advanced Technologies and Disseminate Information

**Expected South Coast AQMD Cost:** $750,000

**Expected Total Cost:** $2,000,000

**Description of Project:**

This project supports assessment of clean fuels and advanced technologies, progress towards commercialization and dissemination of information on demonstrated technologies. The objective of this project is to expedite transfer of technology developed from Technology Advancement Office projects to the public domain, industry, regulatory agencies and the scientific community. This project is a fundamental element in South Coast AQMD's outreach efforts by coordinating activities with other organizations to expedite implementation of advanced engines and clean fuels technologies.

This project may include the following:

- technical review and assessment of technologies, projects and proposals;
- support for alternative charging solutions and zero emission charging and fueling infrastructure;
- advanced technology curriculum development, mentoring and outreach to local schools;
- emission studies and assessments of near-zero and zero emission alternatives;
- preparation of reports, presentations at conferences for technical and non-technical audiences, meet funding agency/grant requirements and improve public relations by conducting public outreach on successful clean technology demonstration and deployment projects;
- participation in and coordination of workshops and various meetings;
- support for training programs related to fleet operation, maintenance and fueling of alternative fuel vehicles and equipment;
- publication of technical papers as well as reports and bulletins; and
- dissemination of information, including websites development and updates.

These objectives will be achieved by consulting with industry, scientific, health, medical and regulatory experts and co-sponsoring related conferences and organizations, resulting in multiple contracts. In addition, an ongoing outreach campaign will be conducted to encourage decision-makers to voluntarily switch to alternatively fueled vehicles and train operators to purchase, operate and maintain these vehicles/equipment and associated infrastructure.

**Potential Air Quality Benefits:**

As the Clean Fuels Program transitions increasingly to zero emission vehicle, equipment and infrastructure technologies, there will continue to be challenges in assisting fleets and others to successfully make this transition. The benefits of highlighting challenges, lessons learned, and success stories in the use of zero emission and near-zero emission vehicles, equipment and infrastructure can expedite acceptance and commercialization of these technologies. In addition, projects that support workforce training and professional development will prepare and train the next generation of engineers and technicians to handle the increased demand of EVs. The emission reduction benefits will contribute to the goals of the 2022 AQMP.

**Proposed Project:** Support Implementation of Clean Fuels Incentives and Demonstration Projects

**Expected South Coast AQMD Cost:** $350,000

**Expected Total Cost:** $400,000

**Description of Project:**

This project supports implementation of incentive programs, including state and federal grant programs, Carl Moyer, Prop 1B, VW, VIP, CAPP, lower emission school bus, Replace Your Ride, and South Coast AQMD residential EV charger rebate program. Implementation support includes application review, funds allocation, equipment owner reports collection, documentation to CARB, verification of vehicle operation, and other support as needed. Information dissemination is critical to successfully implementing coordinated and comprehensive incentive programs. Outreach will be directed to vehicle OEMs, dealers, individuals and fleets.

**Potential Air Quality Benefits:**

South Coast AQMD will provide matching funds to implement several key incentive programs to reduce emissions in the Basin. The benefit of highlighting zero emission vehicle, equipment and infrastructure incentives is to expedite acceptance and commercialization of advanced technologies. Future emission reduction benefits will contribute to the goals of the 2022 AQMP. Carl Moyer, Prop 1B, VW, VIP, CAPP, and lower emission school bus incentive programs can reduce large amounts of NOx and PM emissions, and toxic air contaminants in the Basin.

## *Engine Systems / Technologies*

**Proposed Project:** Develop and Demonstrate Advanced Gaseous- and Liquid-Fueled MD and HD Engines and Vehicle Technologies to Achieve Ultra-Low Emissions

**Expected South Coast AQMD Cost:** $200,000

**Expected Total Cost:** $1,500,000

**Description of Technology and Application:**

The objective of this proposed project would be to support development and certification of near-commercial prototype low emission MD and HD gaseous- and liquid-fueled engine technologies, as well as integration and demonstration of these technologies in on-road vehicles. The NOx emissions target for this project area is 0.02 g/bhp-hr or lower and the PM emissions target is below 0.01 g/bhp-hr. The recent adoption of U.S. EPA and CARB low NOx regulation commenced the transformation to near-zero NOx engines starting MY 2027 but there will be no availability of MY 2024 CARB compliant engines until at least MY 2026. Moreover, the adoption of U.S. EPA HD GHG Phase 3 National Proposed Rulemaking further promoted development of internal combustion engines using non-carbon containing fuels such as hydrogen. This effort is expected to result in several projects, including:

- demonstration of advanced engines in MD and HD vehicles and high horsepower and long haul (HP) applications;
- field demonstrations of advanced technologies in various fleets operating with different classes of vehicles;
- development and demonstration of ultra-low emission renewable fueled hybrid powertrain technology; and
- development and demonstration of optimized engine systems for use with low- and zero carbon alternative fuels such as hydrogen.

Anticipated fuels for these projects include but are not limited to alternative fuels (fossil fuel-based and renewable natural gas, propane, hydrogen blends, ethanol, electric and hybrid), conventional and alternative diesel fuels, ultra-low sulfur diesel, renewable diesel, dimethyl ether and gas-to-liquid fuels. There has been significantly more interest as well as a mandate requiring the use of renewable fuels across all sectors due to CARB's Low Carbon Fuel Standard (LCFS). Projects listed under Fuel/Emissions Studies will assess the emissions impact of renewable fuels on past and future optimized combustion technologies. Several key diesel engine development projects that have demonstrated the ability to achieve 0.02 g/bhp-hr NOx under all conditions are near the on-road truck demonstration stage. Truck integration and packaging are another critical step towards commercialization. Prototype trucks are typically placed in revenue service to collect real-world performance data as well as end user feedback for production engines. Furthermore, with the new in-use and low-load emissions requirements within the CARB Omnibus and the U.S. EPA Clean Trucks Plan regulations, we expect these new generation of ultra-low emission engines to comply with the low emissions standard for their full useful life.

Moreover, as incentive funding shifts away as clean combustion technologies reach full commercial readiness, development of cost-effective technologies that do not rely on incentives are key to drive additional market penetration and emissions reduction. In August 2023, CARB adopted amendments to the already passed Omnibus Regulation, proposing alignment with the adopted U.S. EPA Clean Truck Plan NOx rule in

MY 2027 and provisions for allowing sale of legacy engines starting MY 2024. South Coast AQMD is closely monitoring low emission ICE availability and ensuring the lowest possible emissions ICEs are being deployed in our region. Due to the slow fleet turn over, the legacy 2010+ diesel fleet will remain in service well into the 2030s and beyond, especially for the high powered applications. Thus, continued development of cost-effective low emission engine technologies is key to reduce the impact of legacy fleets in our region.

**Potential Air Quality Benefits:**

This project is intended to expedite the commercialization of near-zero emission gaseous- and liquid-fueled MD and HD engine technology both in the Basin and in intrastate operation. The emissions reduction benefits of replacing one 4.0 g/bhp-hr HD engine with a 0.02 g/bhp-hr engine in a vehicle that consumes 10,000 gallons of fuel per year is about 1,400 lb/yr of NOx. MD and HD engines between 6L to 12L using NG and propane achieving NOx emissions of 0.02 g/bhp-hr have been certified and commercialized, with larger displacement and advanced technology (e.g., opposed piston) engines still undergoing development. Further, renewable or blended alternative fuels can also reduce HD engine particulate emissions by over 90 percent compared to current diesel technology. The key to future engine system project success are emissions, cost-effectiveness and availability of future incentives. This project is expected to lead to increased availability of low emission alternative fuel HD engines. Fleets can use the engines and vehicles emerging from this project to comply with South Coast AQMD fleet regulations and towards compliance of the 2022 AQMP control measures as well as future CARB and U.S. EPA low NOx regulations.

**Proposed Project:** Develop and Demonstrate Low Emission Locomotive Technologies and After Treatment Systems

**Expected South Coast AQMD Cost:** $500,000

**Expected Total Cost:** $2,000,000

**Description of Technology and Application:**

This project aims to support the development and demonstration of gaseous and liquid-fueled locomotive engines. With the upcoming revision of locomotive regulations and the plan to establish Tier 5 or cleaner locomotive emission standards and the adoption of the rail ISR in 2024, railroads are exploring the possibility of transitioning from diesel to cleaner fuels or installing aftertreatments to the existing locomotives. The railroad is also considering alternative fuels for its potential economic benefit as compared with diesel fuel. The requirements of locomotive engines as primary generators of electricity to power the locomotive poses serious challenges. From an operational standpoint, there is a significant difference between NG and diesel energy density, a fuel tender would need to provide sufficient fuel for an acceptable range. Locomotives operate at a specific duty cycle different than conventional on-road engines. The engines often run at low speed and have extended periods of idle time. The durability requirements also surpass other forms of transportation.

Large displacement gaseous fueled engines are still in early stages of commercialization in the U.S., especially in the locomotive sector. Engine emissions are expected to be below the current 0.2g/bhp-hr NOx standard. Adaptation of alternative fueled locomotives in coordination with required infrastructure improvements by leading manufacturers in the industry, shows great potential for further research and cost savings with fewer maintenance costs and better reliability. Depending on the type of combustion strategy, aftertreatments are likely needed to achieve Tier 4 or cleaner emission standards. Urea-based selective catalytic reduction (SCR) or exhaust gas recirculation (EGR) can be used to reduce NOx emissions and methane slip. Similar low and zero carbon fueled engines could migrate as a retrofit option.

**Potential Air Quality Benefits:**

The 2022 AQMP identifies the use of low emissions technologies for locomotives where zero emission technologies are not yet commercially available. This project is expected to reduce emissions of around 97 tons per year of NOx per locomotive. The reduction of PM and GHG emissions also show great potential mitigation in environmental justice communities.

## *Emission Control Technologies*

**Proposed Project:** Onboard Sensors for On-Road/Off-Road Vehicles

**Expected South Coast AQMD Cost:** $250,000

**Expected Total Cost:** $1,000,000

**Description of Technology and Application:**

New HD on-road vehicles represent one of the largest categories in the NOx emissions inventory in the Basin. The 2022 AQMP identifies that 83 percent NOx emission reductions from the 2018 level and 67 percent additional reductions beyond already adopted regulations and programs are necessary to meet the 2015 8-hour ozone standard by 2037. Previous in-use emission studies, including studies funded by the South Coast AQMD, have shown significantly higher NOx emissions from on-road HD vehicles than the certification limit under certain in-use operations, such as low power duty cycles. In CARB's adopted HD On-Road "Omnibus" Low NOx regulation, in addition to the lower certification values, there is a low load test cycle and revisions to the not-to-exceed compliance tests. NOx sensor data reporting is also introduced where the vehicle computer is required to store a past period of emissions data to ensure real-world emission reductions are realized over various duty cycles, especially those low power duty cycles in urban areas. An alternative proposed new methodology is to continuously measure real-time emissions from trucks with onboard sensors. Both industry, government and regulators are looking to use sensors to better monitor emissions compliance and leverage the real-time data from sensors to enable advances concepts such as geofencing. CARB's newly adopted HD I/M rules addresses in-use emissions from the older legacy fleets and also has onboard sensors as one of the emission testing methods.

This project category is to investigate near term and long-term benefits from onboard sensors to understand in-use emissions better and reduce emissions from the advanced management concept. The first part of the project is to identify and conduct proof-of-concept demonstrations of feasible candidate technologies, such as:

- laboratory evaluation/verification of new and baseline sensors;
- development and evaluation of next generation sensors;
- development of algorithms to extract sensor information into mass-based metric;
- demonstrate feasibility to monitor emissions compliance using sensors;
- identify low-cost option for cost and benefit analysis;
- demonstrate sensors on NG and other mobile sources such as LD, off-highway and commercial harbor craft; and
- development, deployment and demonstration of smart energy/emissions management systems.

**Potential Air Quality Benefits:**

The proposed research projects will assist the trucking industry to monitor emissions, using sensors as one of the design platform options and identify freight routes which result in lower emissions. Reduction of NOx and PM emissions from mobile sources is imperative for the Basin to achieve NAAQS and protect public health.

**Proposed Project:** Integration of On-Road Technologies in Off-Road Applications

**Expected South Coast AQMD Cost:** $200,000

**Expected Total Cost:** $1,000,000

**Description of Technology and Application:**

On-road HD engines have demonstrated progress in meeting increasingly stringent federal and state requirements. New HD engines have progressed from 2 g/bhp-hr NOx in 2004 to 0.2 g/bhp-hr NOx in 2010, which is an order of magnitude decrease in just six years. Off-road engines, however, have considerably higher emissions limits depending on engine size. For example, Tier 3 standards for HD engines require only 3 g/bhp-hr NOx. There are apparent opportunities to implement cleaner on-road technologies in off-road applications. There is also an opportunity to replace existing engines in both on-road and off-road applications with the cleanest available technology. Current regulations don't usually require repowering (engine replacement) or remanufacturing to meet cleaner emission standards as engines are retired. Unfortunately, this does not take advantage of recently developed clean technologies.

Exhaust gas cleanup strategies, such as EGR, SCR, DPF, electrostatic precipitators, baghouses and scrubbers, have been used successfully for many years on stationary sources. The exhaust from the combustion source is routed to the cleaning technology, which typically requires a large footprint for implementation. This large footprint has made installation of such technologies on some mobile sources prohibitive. However, in cases where the mobile source is required to idle for long periods of time, it may be more effective to route emissions from the mobile source to a stationary device to clean the exhaust stream.

Projects in this category will include utilizing proven clean technologies in novel applications, such as:

- demonstrating certified LNG and CNG on-road engines as well as other clean alternative fuels such as hydrogen in off-road applications including yard hostlers, locomotives, commercial harbor craft, gantry cranes, waste haulers and construction equipment;
- implementing lower emission engines requirement in repower applications for both on-road and off-road applications; and
- applying stationary best available control technologies, such as EGR, SCR, scrubbers, DPF, baghouses and electrostatic precipitators, to appropriate on- and off-road applications, such as idling locomotives, commercial harbor craft at dock and HD line-haul trucks at weigh stations.

**Potential Air Quality Benefits:**

Transfer of mature emission control technologies, such as certified engines and SCR, to the off-road and retrofit sectors offers high potential for immediate emission reductions. Further development and demonstration of these technologies will assist in regulatory efforts which could require such technologies and retrofits.

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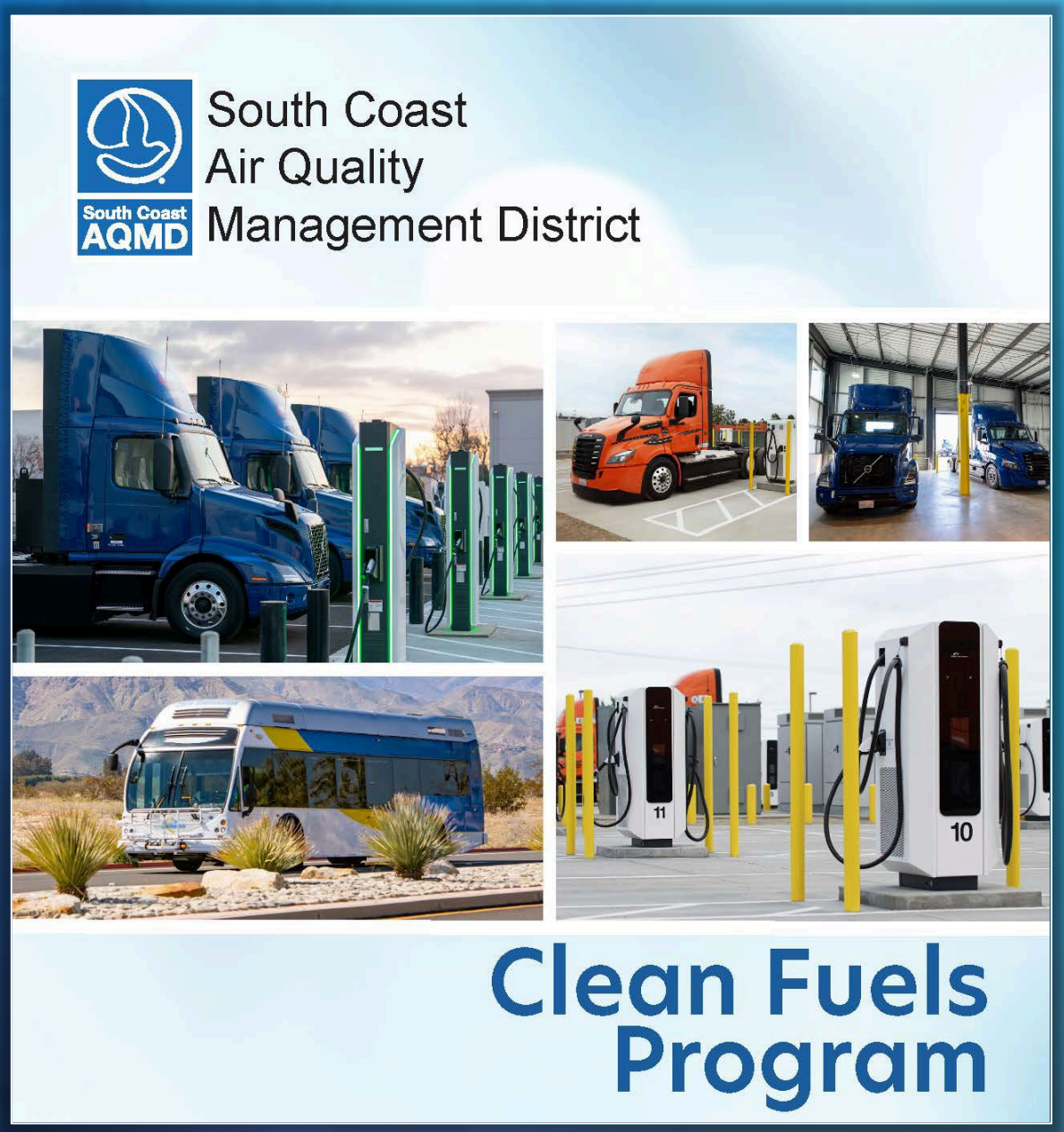



# Clean Fuels 2025 Plan Update

Agenda Item #4

Vasileios Papapostolou, Sc.D.
Technology Demonstration Manager

# Clean Fuels Fund Program

- Established in 1988
- $1 fee on DMV registrations ($~13.5M/year)
- Stationary source fee (~$293k for CY2023)
- Since inception, $269M for 1,542 Clean Technology Research, Development, Demonstration & Deployment projects (total project cost: $1.7B)
- Revised annually to reflect technical priorities and proposed project areas

**Research**

Basic Research
Lab Bench
Proof-of-Concept

**Development**

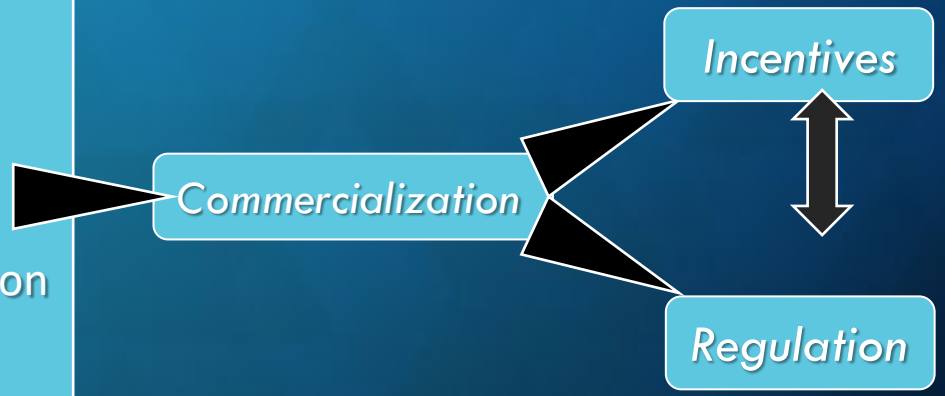
1st Gen Demos
System/Component Integration
Proof-of-Technology

**Demonstration**

2nd/3rd Gen Demos
Durability Acceptance
Proof-of-Product

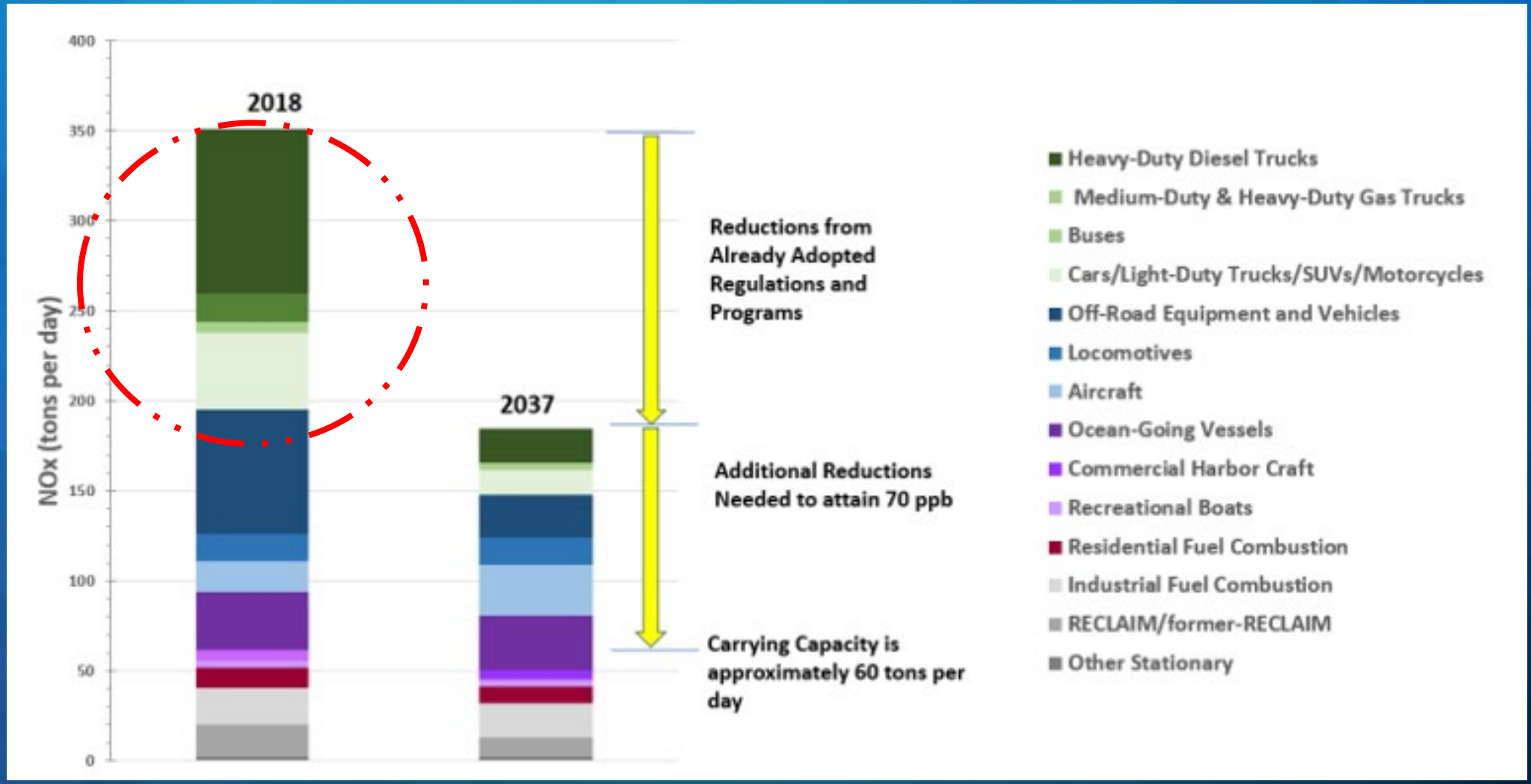
**Deployment**

Pre-Commercial Demos Market Readiness
Proof-of-Commercialization



# NOx Emission Reductions Needed

**83%**



# Draft 2025 Clean Fuels Plan Update
# Key Technical Areas

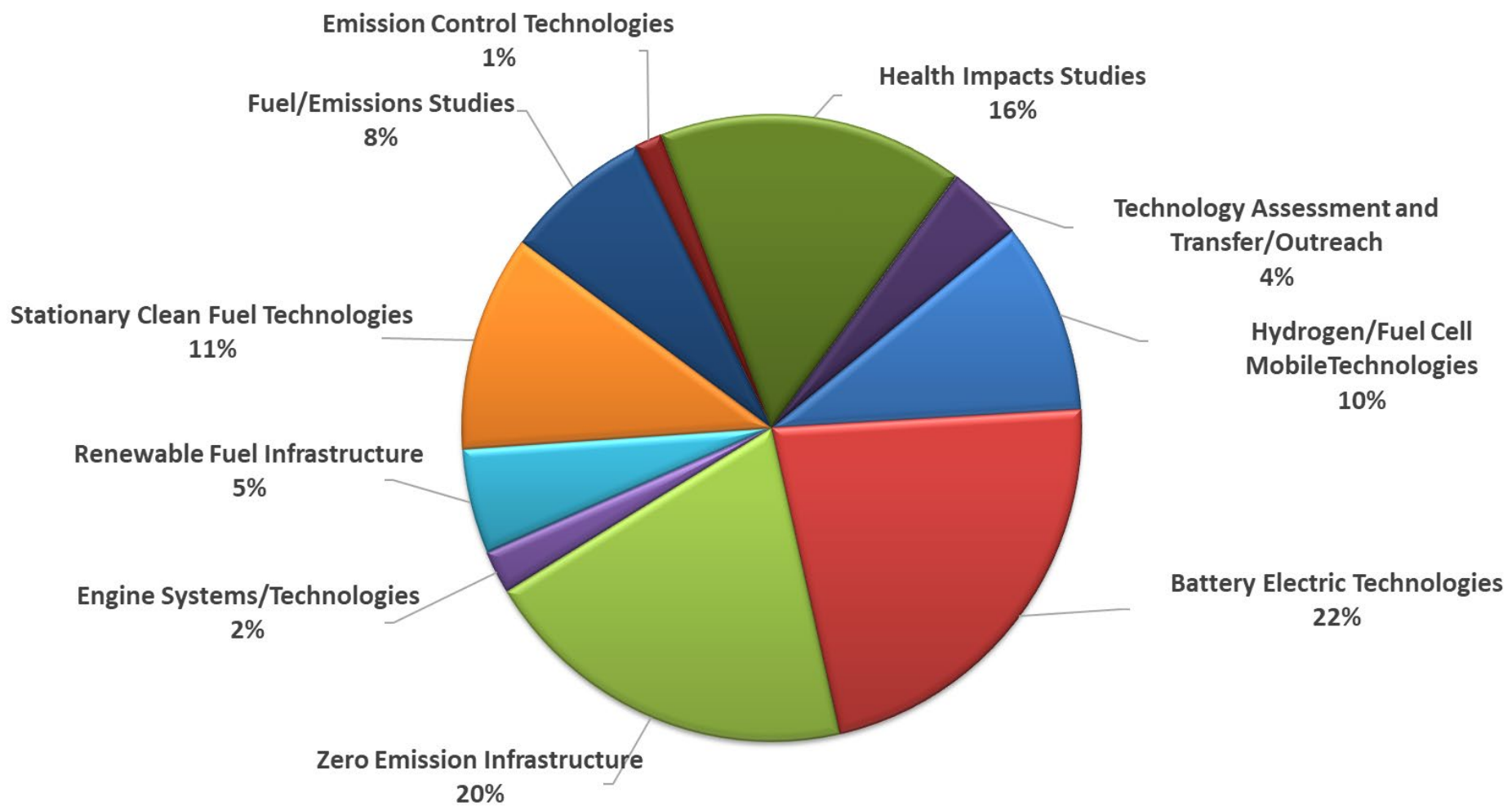
- Zero emission Medium Heavy Duty (MHD) trucks and equipment, including innovative electrified trailer, battery-swap technologies and vocational applications
- Alternative charging solutions to deploy ZE infrastructure
- Microgrid technologies including vehicle-to-grid and vehicle-to-home
- Grid capacity and fleet electrification assessment studies
- Fuel and emission studies from H2 fueled ICE, linear generators, brake and tire wear
- Workforce training & development

# Draft 2025 Clean Fuels Plan Update
# Key Proposed Projects

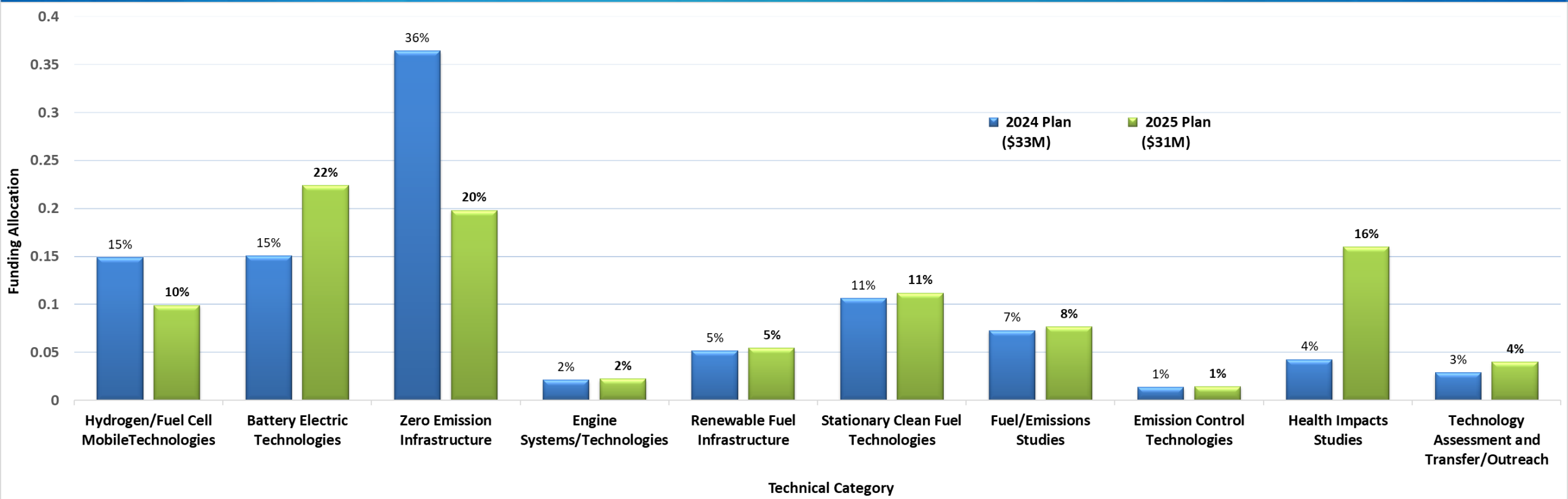
- Deployment of zero emission (ZE) MHD trucks and infrastructure
- Development of data-based energy & planning management tools for ZE MHD truck charging infrastructure
- Super/Fast charging infrastructure installations to increase BE MHD truck utilization
- Innovative solutions to support ZE MHD truck charging and hydrogen fueling
- Power grid readiness, energy and planning management studies
- Development and demonstration of ZE vocational trucks and equipment
- Deployments of localized hydrogen production, storage and distribution pathways

# Proposed 2025 Clean Fuels Plan Distribution

**$31M**



# Plan Update Comparison



# Increased AQMD Funding Support

- **Electric/Hybrid Technologies:**
  - MHD On-Road BEV and Equipment
- **Stationary Clean Fuel Technologies:**
  - Microgrids with Photovoltaic/Fuel Cell/Battery Storage/Energy Management
  - Energy Generation Alternatives
- **Health Impacts Studies:**
  - Conduct Monitoring and Support MATES VI Program Implementation
- **Technology Assessment and Transfer/Outreach:**
  - Assess/Support Advanced Technologies and Disseminate Information
  - Support Implementation of Clean Fuels Incentives and Demonstration Projects

***Zero Emission Infrastructure ->** Grid Readiness and Energy Management **(New category!)**

# Next Steps

- Finalize the 2025 Plan Update
- Continue to pursue off-road mobile technology and equipment solutions
- Pursue solutions to support deployment of ZEV charging and fueling infrastructure
- Focus on Workforce Training & Development