CALIFORNIA AIR RESOURCES BOARD

Proposed Fiscal Year 2018-19 Funding Plan for Clean Transportation Incentives

For

Low Carbon Transportation Investments and the Air Quality Improvement Program

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Acronym List

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EXECUTIVE SUMMARY

The proposed Fiscal Year 2018-19 Funding Plan for Clean Transportation Incentives (FY 2018-19 Funding Plan or Funding Plan) represents a total of $483 million in clean transportation investments from two related funding sources appropriated to the California Air Resources Board (CARB, State Board, or Board) in budget bills passed by the Legislature and signed by the Governor in 2018.

Each fiscal year, CARB must submit a proposed Funding Plan to the Board for approval. The Funding Plan serves as the blueprint for expending the Low Carbon Transportation and Air Quality Improvement Program (AQIP) funds appropriated to CARB in the State budget. The plan establishes CARB's priorities for the funding cycle, describes the projects CARB intends to fund, and sets funding targets for each project.

CARB uses incentives to accelerate development and early commercial deployment of the cleanest mobile source technologies and to improve access to clean transportation. These incentives are important in helping California achieve its goals to reduce GHG emissions, improve air quality, deploy zero-emission vehicles (ZEVs), and reduce petroleum dependency.

This Funding Plan continues to support the emission reduction goals identified in the *Climate Change Scoping Plan*, *State Implementation Plan*, SB 350 (De León, Chapter 547, Statutes of 2015) study on *Overcoming Barriers to Clean Transportation Access for Low-Income Residents, California Sustainable Freight Action Plan, and the ZEV Action Plan*. These incentives provide important early steps to transform the transportation sector to zero-emission and near zero-emission technologies. These goals also support our overall air quality and climate goals in reducing emissions in impacted communities throughout the State.

The Low Carbon Transportation and AQIP investments covered in the proposed FY 2018-19 Funding Plan represent just one part of California's portfolio of clean transportation incentives. These are complemented by other CARB programs, other State agency programs, and local air district programs. Each program has its own statutory and policy direction, but collectively they fit together to support California's multiple near-term and long-term public heath, air quality, and climate change goals.

The two funding sources covered in this Funding Plan are:

- $455 million for Low Carbon Transportation investments funded with Cap-and-Trade Auction Proceeds, which are deposited in the Greenhouse Gas Reduction Fund (GGRF), and have been appropriated to CARB through the Budget Act of 2018 as amended by Senate Bill (SB) 856 (Committee on Budget and Fiscal Review, Chapter 30, Statutes of 2018).

- $28.64 million for the Air Quality Improvement Program (AQIP) appropriated to CARB in SB 840 (Mitchell, Chapter 29, Statutes of 2018), the Budget Act of 2018.

The proposed Funding Plan describes CARB's policy drivers and vision for these advanced technology mobile source investments, eligible project categories and criteria, project funding allocations, program implementation details, and the justification for these investments. Background on these two funding sources is provided below, followed by a summary of the proposed investments.

Low Carbon Transportation: The Low Carbon Transportation Program is part of California Climate Investments, a statewide program that puts billions of Cap-and-Trade dollars to work reducing GHG emissions, strengthening the economy, and improving public health and the environment—particularly in disadvantaged communities. CARB's Low Carbon Transportation Program is designed to accelerate the transition to advanced technology low carbon freight and passenger transportation with a priority on providing health and economic benefits to California's most disadvantaged communities. These investments support the state's climate change, air quality, ZEV deployment, and petroleum reduction goals.

For FY 2018-19, the Legislature appropriated $455 million for the Low Carbon Transportation Program to continue and build on investments from previous years. The budget appropriation explicitly specifies the funding be invested in the following categories:

- $200 million for CVRP, with the requirement that $25 million fund increased rebates for low-income recipients.

- $75 million for the Enhanced Fleet Modernization Program (EFMP) and EFMP Plus-up Pilot Project / Clean Cars 4 All, Financing Assistance, Clean Mobility Options, replacement of school buses, and light-duty equity pilot projects authorized pursuant to SB 1275 (De León, Chapter 530, Statutes of 2014).

- $55 million for the Freight Equipment Advanced Demonstration and Pilot Commercial Deployment Project, including projects for ships at berth.

- $125 million for clean truck and bus vouchers through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP).

AQIP: AQIP is a mobile source incentive program that focuses on reducing criteria pollutant and diesel particulate emissions with concurrent GHG reductions. CARB investments started under AQIP provide the foundation for the Low Carbon Transportation investments that now make up the vast majority of the proposed Funding Plan. AQIP has provided funding for CVRP, HVIP, and advanced technology demonstrations since 2009. In recent years, these projects have been primarily funded with Low Carbon Transportation appropriations, and the majority of AQIP funds have been directed to the Truck Loan Assistance Program and other diesel emission reduction projects. For FY 2018-19, the Legislature appropriated $28.64 million to CARB for AQIP.

Staff's Proposal

Staff proposes using these incentives to accelerate development and deployment of the cleanest feasible mobile source technologies and to improve access to clean transportation. This continues the primary focus of these investments since these programs started, supporting the emission reduction goals identified in the Climate Change Scoping Plan, State Implementation Plan, and California Sustainable Freight Action Plan. These projects are designed to both achieve immediate emission reductions and, equally important, support the transformation of the fleet to one that is largely zero-emitting where feasible and as clean as possible where zero-emissions are not feasible. In designing these investments, CARB strives to maximize the benefits for disadvantaged communities, low-income communities, and low-income households.

In most cases, these projects continue and build on investments from previous budget cycles that were envisioned as multi-year investments. Staff developed the proposed project allocations as part of a thorough public process by evaluating anticipated demand and technology readiness, reviewing the long-term planning elements of previous Funding Plans.

The Three-Year Investment Strategy for Heavy-Duty Vehicles and Off-Road Equipment and the Long-Term Plan for CVRP and Light-Duty Vehicle Incentives played a key role in this assessment. Staff also considered other available funding sources and stakeholder input. Staff's proposed funding allocations are shown in Table 1.

Table 1: Proposed Project Allocations for FY 2018-19 Funding Plan

Project Category	**Allocation*** (millions)
LIGHT-DUTY VEHICLE AND TRANSPORTATION EQUITY INVESTMENTS	
CVRP (including increased Rebates for Lower Income Applicants)	$200
Transportation Equity Projects	$75
Light-Duty Vehicle and Transportation Equity Investment Total	**$275**
HEAVY-DUTY VEHICLE AND OFF-ROAD EQUIPMENT INVESTMENTS	
Clean Truck and Bus Vouchers (HVIP + Low NOx Engine Incentives)	$125
Freight Equipment Advanced Demonstration and Pilot Commercial Deployment Project	$55
AQIP-FUNDED HEAVY-DUTY INVESTMENTS	
Truck Loan Assistance Program	$25.6
Diesel Particulate Filter Retrofit Replacements	$3
Heavy-Duty Vehicle and Off-Road Equipment Investment Total	**$208.6**
TOTAL	**$483.6**

*Does not include any adjustments for project administration.

Light-Duty Vehicle and Transportation Equity Investments:

As directed by the Legislature, staff proposes a total of $275 million for light-duty vehicle and transportation equity projects. This continues CARB's dual focus on investments in CVRP to support broad deployment of ZEVs coupled with equity-focused investments to increase access to clean transportation and mobility options for low-income households,

disadvantaged communities, and low-income communities as called for in SB 1275. These investments are designed to make progress towards the ZEV deployment goals established in statute and by the Governor and implement the recommendations of CARB's SB 350 (De León, Chapter 547, Statutes of 2015) study on overcoming the barriers for low-income Californians to access clean transportation and mobility options.

The transportation equity funding would expand ongoing projects as directed in the budget appropriations and as envisioned in the long-term plan for light-duty vehicle incentives included in the FY 2016-17 Funding Plan. These include: car scrap and replacement; financing assistance; car sharing, ride sharing, vanpools, and other clean mobility options; and rural school bus replacement. Staff also proposes a new project, the Clean Mobility in Schools project. This project would introduce advanced clean transportation to disadvantaged community students, teachers, staff, and greater community residents by funding zero-emission vehicles, charging equipment, clean mobility options, zero-emission lawn and garden equipment, and education and outreach efforts for a K-12 public school district located in a disadvantaged community.

Heavy-Duty Vehicle and Off-Road Equipment Investments:
Staff proposes a total of $180 million for heavy-duty vehicle and equipment projects as shown in Table 1. The proposed projects include advanced technology demonstrations, early commercial pilots, and voucher incentives for commercially available technologies consistent with the direction of SB 1204 (Lara, Chapter 524, Statutes of 2014), which guides CARB's heavy-duty vehicle investments funded with Cap-and-Trade auction proceeds. These investments support a broad range of clean and efficient vehicle technologies, with funding opportunities for battery electric, fuel cell, hybrid, natural gas, and clean diesel engine technologies as well as engine and system efficiency improvements and low carbon renewable fuel use.

As directed by the Legislature, $125 million of this proposal would be used to continue CARB's ongoing effort to fund the incremental costs of clean trucks and buses using zero-emission, hybrid, and low nitrogen oxides (NOx) technologies through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP). Another key focus is advanced technology freight equipment deployment and transformational freight projects, supporting the actions called for in the California Sustainable Freight Action Plan. For FY 2018-19, staff is proposing to use the $55 million allocation as additional funding for last year's Zero- and Near Zero-Emission Freight Facilities project, which was over-subscribed by almost $70 million. Staff proposes continued funding for the Truck Loan Assistance Program, which is anticipating an increase in demand a result of a new law that will only allow clean trucks to be registered by the Department of Motor Vehicles (DMV). Staff is also proposing a new project that would fund new diesel particulate matter filters for existing heavy-duty vehicles that do not meet duty cycle requirements to simply replace the filter substrate.

The proposed projects are based on staff's assessment of the state of each technology and its role in the long-term transformation of the heavy-duty fleet to zero-emission where feasible and hybrid and low NOx engines powered by clean, low-carbon renewable fuels

everywhere else. They support the beachhead technologies identified in last year's Three-Year Investment Strategy for Heavy-Duty Vehicles and Off-Road Equipment.

Disadvantaged Community, Low-Income Community, Low-Income Household Investment Targets: A key component of these programs is providing health and economic benefits to California's most disadvantaged communities, low-income communities, and low-income households, collectively referred to as "priority populations[1]." AB 1550 establishes disadvantaged community, low-income community, and low-income household targets for the State's Cap-and-Trade auction proceeds investments. With the majority of the FY 2018-19 allocation focused on first-come, first-served project categories, it may be difficult to predict or know with certainty if the projects in this year's Funding Plan will meet the targets set in prior years. Staff has designed program projects with additional incentives to benefit priority populations. In addition, staff will focus outreach in low-income and disadvantaged communities in order to help increase these targets. With this in mind, staff recommends that at least 45 percent of the Low Carbon Transportation appropriation be invested in projects that meet the criteria for providing direct, meaningful, and assured benefits to priority populations with the following targets:[2]

- At least 35 percent of funds for projects located within, and benefiting individuals living in, disadvantaged communities.

- At least 10 percent of funds for projects within and benefiting low-income communities or benefiting low-income households, or within and benefiting low-income communities within a half-mile of a disadvantaged community.

Staff considers the targets to be a floor and strives to exceed them. In designing project solicitations and implementation requirements, staff will consider whether there are provisions that can be incorporated to help ensure that CARB exceeds these minimum targets. CARB is not limiting the disadvantaged community and low-income community/household focus to Low Carbon Transportation investments. Staff designs investments from the other funding sources to benefit underserved populations as well.

Summary of Investments

Table 2 provides an illustrative example of how the suite of proposed investments in this Funding Plan is part of CARB's coordinated strategy to make progress toward California's multiple air quality and climate change goals. Most of this funding comes from Cap-and-Trade auction proceeds, and as such, there is a primary focus on investments that reduce GHG and benefit disadvantaged and low-income communities. However, CARB has also designed these investments to provide co-benefits to support the Governor's climate pillars of reducing short-lived climate pollutants and petroleum use,

[1] Priority populations include residents of: (1) census tracts identified as disadvantaged by California Environmental Protection Agency per SB 535; (2) census tracts identified as low-income per AB 1550; or (3) a low-income household per AB 1550. See Section VII.B of CARB Funding Guidelines for more information on the definitions of priority populations.

[2] Benefit Criteria Tables for determining benefits to priority populations: www.arb.ca.gov/cci-resources

provide emission reductions for the State Implementation Plan and 2016 *Sustainable Freight Action Plan*, and to reduce diesel toxics emissions.

Table 2: Multiple Policy Goals Met by Proposed Funding Plan Investments

Proposed Projects	Climate Change Scoping Plan	Short-Lived Climate Pollutants	Ozone and PM State Implementation Plan	Sustainable Freight	Air Toxics	Petroleum Reduction	Disadvantaged / Low Income Communities
CVRP	✓	✓	✓		✓	✓	✓
Transportation Equity Projects	✓	✓	✓		✓	✓	✓
HVIP – Clean Truck and Bus Vouchers	✓	✓	✓	✓	✓	✓	✓
Freight Equipment Demonstrations & Pilots	✓	✓	✓	✓	✓	✓	✓
Truck Loan Assistance		✓	✓	✓	✓		✓
Diesel Particulate Filter Retrofit Replacements		✓	✓	✓	✓		✓

California Environmental Quality Act (CEQA) Requirements

CARB has determined that the proposed FY 2018-19 Funding Plan is exempt from the requirements of CEQA. CARB's certified regulatory program, which applies to the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State's ambient air quality, has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 of CEQA (14 California Code of Regulations (CCR) 15251(d)). Public agencies with certified regulatory programs are exempt from certain CEQA requirements, including but not limited to, preparing environmental impact reports, negative declarations, and initial studies. For activities that constitute project approvals, as those terms are used in CEQA, CARB, as a lead agency, prepares a substitute environmental document (referred to as an "Environmental Analysis" or "EA") as part of the Staff Report prepared for a proposed action to comply with CEQA (17 CCR 60000-60008).

The proposed FY 2018-19 Funding Plan is a governmental funding mechanism which does not involve any commitment to any specific projects which may result in potentially significant impacts on the environment. Therefore, CARB has determined that the proposed FY 2018-2019 Funding Plan is not a project under CEQA (14 CCR 15378 (b)(4)) and is exempt from CEQA. If the FY 2018-19 Funding Plan is finalized, a Notice of Exemption will be filed with the State Clearinghouse for public inspection.

CHAPTER 1: INTRODUCTION AND BACKGROUND

The proposed FY 2018-19 Funding Plan includes $455 million for Low Carbon Transportation Investments funded with Cap-and-Trade Auction Proceeds (deposited in the GGRF), and $28.64 million for the Air Quality Improvement Program (AQIP).

- $200 million for CVRP, with the requirement that $25 million fund increased rebates for low-income recipients.

- $75 million for the Enhanced Fleet Modernization Program (EFMP) and EFMP Plus-up Pilot Project, replacement of school buses, and light-duty equity pilot projects authorized pursuant to SB 1275.

- $55 million for the Freight Equipment Advanced Demonstration and Pilot Commercial Deployment Project, including projects for ships at berth.

- $125 million for clean truck and bus vouchers through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP).

The proposed Funding Plan describes CARB's policy drivers and vision for these advanced technology mobile source investments, eligible project categories and criteria, project funding allocations, program implementation details, and the justification for these investments. CARB staff has developed a joint plan for these funding sources to ensure investments are coordinated while also ensuring that the statutory requirements applicable to each are met. The Low Carbon Transportation investments build upon and greatly expand the technology advancing projects CARB has funded through AQIP since 2009.

CARB's 2014 and 2017 *Climate Change Scoping Plans* and 2016 *Mobile Source Strategy* conclude that many of the same actions are needed to meet greenhouse gas (GHG), smog forming, and toxic pollutant emission reduction goals – specifically, a transition to zero-emission and near zero-emission technologies and use of the cleanest, lowest carbon fuels and energy across all vehicle and equipment categories. The 2016 *California Sustainable Freight Action Plan* reiterates the need for this transition as it relates to the freight sector. In addition, Assembly Bill (AB) 617 established new goals for reducing emissions of toxic air contaminants and criteria air pollutants in communities affected by a high cumulative exposure burden.

CARB is using these incentives to accelerate development and deployment of the cleanest feasible vehicle technologies for all vehicle and equipment sectors, from light-duty passenger cars to heavy-duty trucks and off-road equipment to meet California's air quality, climate change, and petroleum reduction goals. These goals include:

- Reducing GHG emissions to 1990 levels by 2020 as required by AB 32 (Núñez, Chapter 488, Statutes of 2006) and to 40 percent below 1990 levels by 2030 as required by Senate Bill (SB) 32 (Pavley, Chapter 249, Statutes of 2016).

- Reducing petroleum use in vehicles by 50 percent by 2030, one of the pillars of the State's climate change strategies for reducing GHG emissions, and reducing GHG emissions from the transportation sector to 80 percent below 1990 levels by 2050 as directed in the Governor's Executive Order B-16-2012, and achieving carbon neutrality as soon as possible, but no later than 2045, and achieving and maintaining net negative emissions thereafter as directed in the Governor's Executive Order B-55-2018.

- Meeting the federal health-based ambient air quality standards for ozone by 2023 and 2031 as well as the fine particulate matter (PM2.5) air quality standards.

- Reducing emissions of toxic air contaminants and criteria air pollutants in communities affected by a high cumulative exposure burden as required by AB 617.

- Support the State's overall auction proceeds program in meeting the investment minimums for disadvantaged communities, low-income communities, and low-income households established in AB 1550 (Gomez, Chapter 369, Statutes of 2016) and maximizing the benefits to these communities and households as required by the 2018 *Cap-and-Trade Auction Proceeds Funding Guidelines for Agencies that Administer California Climate Investments*.

- Following and incorporating goals and priorities from relevant legislation. Some of the key bills guiding the Funding Plan include SB 1275 (De León, Chapter 530, Statutes of 2014), SB 1204 (Lara, Chapter 524, Statutes of 2014), and SB 350 (De León, Chapter 547, Statutes of 2015).

- Incorporating the findings and recommendations from CARB's SB 350 Low-Income Barriers Study, Part B: *Overcoming Barriers to Clean Transportation Access to Low-Income Residents*.

- Deploying 1.5 million ZEVs by 2025 as directed in Executive Order B-16-2012, and deploying at least 5 million ZEVs by 2030 as directed in Executive Order B-48-18.

- Deploying over 100,000 freight vehicles and equipment capable of zero-emission operation and maximizing near zero-emission freight vehicles and equipment powered by renewable energy by 2030 as called for in the 2016 *California Sustainable Freight Action Plan*.

- Reducing emissions of methane and black carbon to 40 percent and 50 percent, respectively, below 2013 levels by 2030 as called for in the Short-Lived Climate Pollutant Reduction Strategy.

A Balanced Portfolio: CARB is developing this investment strategy in a coordinated manner as part of a larger balanced portfolio of available investments. Where possible, CARB tries to identify investments that support several of these air quality and climate change goals while meeting the statutory requirements governing each program. The investments proposed in this Funding Plan build on previous years' Low Carbon Transportation and AQIP investments incorporating lessons learned.

CARB has developed a portfolio of incentive programs that complement our regulatory program to reduce emissions and increase access to clean transportation. Each incentive program comes with its own statutory requirements, emission reduction goals, and eligible projects making the portfolio diverse and far reaching. Together, these projects address multiple goals, including:

- Turning over the legacy fleet to achieve cost-effective, near-term emission reductions in support of SIP, air toxics, and community air protection goals.
- Accelerating the introduction and deployment of zero-emitting technologies to meet California's longer-term air quality and climate change goals.
- Improving access to clean transportation for low-income households and investing in the disadvantaged and low-income communities most impacted by pollution.
- Supporting a green economy.

One of our challenges is finding the right balance between investing in technologies that provide cost-effective, near-term emission benefits and investing in transformative zero-emission technologies that cost more in the near-term but are needed to meet our longer-term 2030 and 2050 goals. If we focus exclusively on the projects that are most cost-effective today, we miss the opportunity to accelerate deployment of zero-emission technologies thereby jeopardizing our ability to meet 2030 and 2050 goals. We need both. While many of the investments here are more focused on longer-term emission reductions, these investments complement the more near-term efforts of some of our other funding programs.

The large-scale statewide investments CARB can make through the Low Carbon Transportation Program can send a market signal and move the needle in terms of advancing technologies in a way that smaller, locally-focused investments simply cannot match. The State's $500 million investment in consumer rebates for ZEV passenger vehicles, for example, has resulted in California leading the nation in ZEV deployment by a considerable margin even compared to the other states that have opted into our ZEV regulation. We are doing the same with large scale investments to electrify the heavy-duty sector and are already starting to see success of our investments in zero-emission transit buses, a natural beachhead for transforming the heavy-duty sector. These investments also set California up to benefit from the green

economy with companies setting up zero-emission vehicle manufacturing operations in the state.

Achieving these goals requires programs that provide near-term reductions with cleaner combustion and some advanced technologies as well as programs that will provide long-term reductions using mostly advanced technologies. While CARB's overall investment strategy is balanced across all its programs, this Funding Plan is weighted toward more zero-emission technologies. Typically funding for cleaner congestion projects is more readily available at the local level, while funding for longer-term advanced technology projects tends to come at the State level. Nevertheless, we include funding for low NOx combustion freight categories to ensure the near-term NOx reductions coupled with investments in ZEV technologies. A larger share of investments are directed to the zero-emission categories because of their relatively higher cost at this stage of development compared to combustion technologies. This is necessary and appropriate to fund enough vehicles and equipment to move the market and have a real impact in accelerating zero-emission technologies towards broader commercialization.

The remainder of this introductory chapter provides background on the two funding sources covered in this Funding Plan including a summary of Low Carbon Transportation and AQIP projects funded to date. This is followed by chapters covering proposed funding allocations, light-duty vehicle and transportation equity investments, heavy-duty vehicle and equipment investments, approaches to maximize disadvantaged community benefits for the Low Carbon Transportation Program, contingency provisions, and grant administration.

LOW CARBON TRANSPORTATION: Cap-and-Trade auction proceeds provide funding for CARB's advanced technology, clean transportation incentive programs that reduce GHG emissions, expanding the types of projects previously funded through AQIP. These investments accelerate the transition to low carbon freight and passenger transportation, supporting the Governor's climate change strategy pillar of a 50 percent reduction in petroleum use in vehicles by 2030 and the Administration's goal to deploy five million zero-emission vehicles by 2030. Low Carbon Transportation and Fuels investments account for about 93 percent of the funds that will be covered in the FY 2018-19 Funding Plan.

Low Carbon Transportation Funding to Date: The Legislature has appropriated nearly $1.2 billion to CARB for Low Carbon Transportation projects over the past five budget cycles (FY 2013-14 through FY 2017-18). These appropriations are being used to fund: zero-emission and plug-in hybrid passenger vehicles through CVRP; light-duty vehicle equity projects to increase access to the cleanest vehicles benefiting low-income and disadvantaged communities and for lower-income Californians; deployment incentives for clean trucks and buses utilizing zero-emission, hybrid, and low NOx technologies; and advanced technology demonstration and pilot projects for freight trucks and equipment. More information regarding the current status of previously funded projects can be found in the chapters that follow.

Over 33 percent of CARB's Low Carbon Transportation funding has been allocated to projects located in disadvantaged communities, including low-income residents of these communities as shown in Table 3. The 33 percent spent in disadvantaged communities greatly exceeds the commitments made in past Funding Plans. Much of the disadvantaged community focused funding is for light-duty equity projects, Zero-Emission Truck and Bus Pilot Projects, and Advanced Freight Technology Demonstration Projects. While not limited to disadvantaged communities, over 50 percent of HVIP funding has been awarded for trucks and buses operating in disadvantaged communities.

Table 3: Low Carbon Transportation Project Allocations to Date

(FY 2013-14, 2014-15, 2015-16, 2016-17, and 2017-18)

Project	Funding (millions)	In DC	Project Outcomes[1]
Light-Duty Vehicle and Transportation Equity Investments			
CVRP	$502	8%[2]	• Statewide 1st come, 1st served rebates for 218,000 ZEVs.
Public Fleet Incentives for CVRP Eligible Vehicles	$6	47%[2]	• ~750 ZEV rebates for public fleets in or near disadvantaged communities.
EFMP Plus-up / Clean Cars 4 All	$96	58%[2]	• ~2,900 vehicles scrapped and replaced.
Car Sharing and Mobility Options	$31.6	100%[3]	• Sacramento and Los Angeles car share projects launched. • Four additional projects in the Bay Area, San Joaquin Valley (2), and Watsonville.
Financing Assistance for Lower-Income Consumers	$25.9	39%[2]	• Loan assistance project launched in Bay Area. • Statewide pilot launched in June 2018
Agricultural Worker Vanpools	$6	100%[3]	• Grant executed summer 2018; project launching fall 2018.
Heavy-Duty Vehicle and Off-Road Equipment Investments			
Advanced Technology Freight Demonstrations	$183	>30%[3]	• ~40 zero emission drayage truck projects at multiple ports/facilities. • Multi-source projects: ~40 pieces of zero-emission freight equipment at Port of Los Angeles and 3 facilities in San Bernardino County. • Solicitation for Zero- and Near Zero-Emission Freight Facilities Project closed: 13 application for $219 million received.
Zero-Emission Off-Road Freight Vouchers	$40	tbd[4]	• Project solicitation expected this year.
Zero-Emission Truck/Bus Pilots	$85	97%[3]	• ~150 zero-emission buses and trucks + supporting infrastructure and training.
Rural School Bus Pilot	$40	21%[2]	• ~100 zero-emission or renewable-fueled school buses.
Low NOx Engine Incentives with Renewable Fuel	$13	tbd[4]	• ~1,000 low NOx engine vouchers.
HVIP	$228	51%[2]	• Statewide 1st come, 1st served vouchers for ~3,800 hybrid and zero-emission trucks or buses.
Total[5]	**$1,256.5**[5]	**33%**	

[1]Projected outcomes are estimated based on full expenditure of funds.
[2]Estimate based on rebates/vouchers issued to date as reported in the March 2018 *Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds* projected forward to full expenditure of funds. Will be updated after all funds expended. For EFMP Plus-up, used a conservative estimate because data not yet available for the new air districts launching EFMP programs.
[3]Based on terms of project solicitation and/or grant agreement.
[4]To Be Determined. Insufficient data yet to estimate; will be reported in future Reports to the Legislature.
[5]Total does not include $13 million for State operations.

AQIP: AQIP is a mobile source incentive program that focuses on reducing criteria pollutant and diesel particulate emissions with concurrent reductions in GHG emissions. AQIP has an annual budget of about $28 million. AQIP has provided funding for CVRP, the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), and demonstrations for advanced emission reduction vehicle technologies since 2009. In recent years, these projects have been primarily funded from the Low Carbon Transportation appropriations, because demand has exceeded AQIP's budget, and the majority of AQIP funds have been directed to the Truck Loan Assistance Program, which helps small business truckers to secure financing for newer trucks and diesel exhaust retrofits to meet compliance deadlines for CARB's in-use truck and bus regulation. AQIP accounts for about six percent of the funds that will be covered in the FY 2018-19 Funding Plan.

AQIP Funding to Date: Table 4 provides a summary of AQIP investments to date including one-time funding provided in various years to help meet demand. In some years, CVRP and HVIP received funding from both AQIP and Low Carbon Transportation.

Table 4: AQIP Project Allocations to Date[1]

AQIP Project	Cumulative Project Allocations (millions)
Truck Loan Assistance	**$126**
CVRP[2]	**$146**[2]
HVIP[2]	**$64**[2]
Low NOx Engine Incentives	**$10**
Agricultural Equipment Trade Up in San Joaquin Valley	**$4***
Advanced Technology Demonstration/Vehicle Testing	**$6***
Lawn and Garden Equipment Replacement	**$3***
Off-Road Hybrid Equipment Pilot	**$2**
Zero-Emission Agricultural Utility Equipment	**$0.1**
TOTAL	**$362***
Air Quality Improvement Fund	$269
Other funding sources[1]	$93.3

[1]Includes a total of $93 million from other funding sources: $53 million from the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program or Fund to support CVRP and HVIP in various fiscal years, $10 million appropriated to Truck Loan Assistance Program in FY 2013-14 as a loan from the Vehicle Inspection and Repair Fund (VIRF) per SB 359 (Corbett, Chapter 415, Statutes of 2013), and $30 million transferred by the Legislature from VIRF to meet CVRP demand in 2014 per SB 852 (Leno, Chapter 25, Statutes of 2014) and SB 862 (Committee on Budget and Fiscal Review, Chapter 36, Statutes of 2014).

[2]CVRP and HVIP also received Low Carbon Transportation funds in FY 2013-14 through 2017-18.

Additional Legislation Guiding Funding Plan Development and Implementation

Several laws passed by the Legislature in recent years provide further guidance to CARB on these programs and specify requirements for the Funding Plan.

SB 1275 (De León, Chapter 530, Statutes of 2014) guides CARB's light-duty vehicle investments. SB 1275 establishes the Charge Ahead California Initiative to increase the number of zero-emission and near zero-emission vehicles on California's roads and to increase access to these vehicles for lower-income Californians and disadvantaged communities. It also identifies the Cap-and-Trade auction proceeds as a funding source that could be utilized to meet the provisions established in the Charge Ahead California Initiative. SB 1275 establishes requirements for how CARB implements CVRP and also requires that CARB establish programs such as car sharing, financing assistance, and enhancements to the EFMP scrap and replace program to increase access to clean vehicles for lower-income consumers and disadvantaged communities. Finally, SB 1275 requires CARB to include a long-term plan for CVRP and related light-duty vehicle incentives. CARB included the long-term plan of the FY 2016-17 Funding Plan.

SB 1204 (Lara, Chapter 524, Statutes of 2014) guides CARB's heavy-duty vehicle investments funded with Cap-and-Trade auction proceeds. SB 1204 creates the California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program intended to help accelerate the introduction of the next generation of cleaner heavy-duty vehicles and engines with a priority on projects that benefit disadvantaged communities. Among other requirements, SB 1204 directs CARB to develop an annual framework and plan to guide these investments. The Three-Year Investment Strategy for Heavy-Duty Vehicles and Off-Road Equipment included in last year's Funding Plan was designed to help address this requirement.

SB 350 (De León, Chapter 547, Statutes of 2015) directs CARB to conduct a study on the barriers for low-income Californians to access clean transportation options, including those in disadvantaged communities, as well as recommendations on how to increase access. In February 2018, CARB released the Final Guidance Document - Low Income Barriers Study, Part B: Overcoming Barriers to Clean Transportation Access for Low-Income Residents (Guidance Document). CARB's Guidance Document is an initial step in identifying the main barriers low income residents, including those in disadvantaged communities, face in accessing clean transportation and mobility options. Recommendations to overcome these barriers include both short-term and longer-term implementable actions that the Legislature, communities, State and local planning, transportation, public health, and air quality agencies can take to formulate innovative, meaningful solutions.

Many of the investments staff proposes for continued funding in the FY 2018-19 Funding Plan are already working to address the barriers to accessing clean transportation. For example, the recommendations include increasing investments in used and new vehicle ownership projects, such as EFMP Plus-up, point-of-sale incentives, and low-cost loans. Additional funds should also be available to increase access for other clean mobility options such as car sharing, ride sharing and bike sharing as well as clean transit and school buses. CARB is evaluating the best mechanisms to make further progress, incorporating lessons learned from existing projects and evolving them over time to ensure the accessibility needs of low-income residents are being met. The investments in this Funding Plan are just one part of the State's efforts to address the barriers to clean transportation for low-income Californians. The availability of new community focused incentives to implement AB 617 provides an additional funding that can help overcome these barriers. Other State and local air quality, transportation, energy, and planning agencies all have programs that can help address these barriers.

CHAPTER 2: PROPOSED FUNDING ALLOCATIONS FOR FY 2018-19

Investment Priorities for 2018-19

CARB uses incentives to accelerate deployment of the cleanest feasible mobile source technologies and to improve access to clean transportation. When allocating these funds to projects, staff strives to maximize benefits for disadvantaged communities, low-income communities, and low-income households. Staff also prioritizes investments that support multiple clean air goals described in the Introduction. These projects are designed to both achieve immediate emission reductions and support the transformation necessary to meet long-term air quality and climate change goals.

The proposed projects for the FY 2018-19 funding cycle in most cases continue and build on investments from previous budget cycles that were envisioned as multi-year investments. These investments also continue to support CARB's portfolio approach of investing in both technologies that provide a balance of cost-effective near-term benefits, as well as more costly zero-emission technologies with longer term benefits. This includes building on successful beachhead technologies, funding promising next markets, and maintaining the innovation pipeline with targeted demonstration projects.

The Legislature specified the amounts to be allocated to the four largest project categories. The other project allocations were developed after staff assessed anticipated demand, reviewed the long-term plans from previous Funding Plans, considered other available funding sources, and took into account stakeholder input. Staff also evaluated the state of technology in order to determine what projects are ready for investment. Staff's proposed funding allocations are shown in Tables 5 and 6.

Draft Project Allocations

Low Carbon Transportation: For the $455 million Low Carbon Transportation and Fuels appropriation, CARB staff proposes the project level allocations and disadvantaged community investment targets shown in Table 5. The details of each of these projects and rationale for these recommendations are described more fully in the remaining sections of this discussion document. These investments would:

- Meet expected consumer demand for existing first-come, first served projects such as CVRP and HVIP and provide incentives for new vehicles and equipment just coming to market.

- Provide funding for Transportation Equity Pilot projects to benefit low-income residents and low-income and disadvantaged communities including a new Clean Mobility in Schools project.

- Continue to fund additional projects from last year's Zero- and Near Zero-Emission Freight Facilities project solicitation.

Table 5: Draft Staff Proposed Project Allocations for $455 Million Low Carbon Transportation Appropriation

Project Category	Allocation* (millions)	Minimum AB 1550 Investment
Light-Duty Vehicle and Transportation Equity Investments		
CVRP (standard rebates and increased rebates for lower income consumers)	$200	22%
Transportation Equity Projects EFMP Plus-up / Clean Cars 4 All - $16M Financing Assistance for Lower-Income Consumers - $10M Clean Mobility Options - $15M Agricultural Worker Vanpools - $3M Rural School Bus Pilot - $15M Clean Mobility in Schools - $10M Funding Reserve - $6M	$75	82%
Heavy-Duty Vehicles and Off-Road Equipment Investments		
Clean Truck and Bus Vouchers Hybrid Zero-Emission Low NOx with Renewable Fuel	$125	75%
Freight Equipment Demonstration and Pilot Commercial Deployment	$55	≥50%
TOTAL	**$455**	**≥45%**

*Does not include any adjustments for project administration.

Light-Duty Vehicle and Transportation Equity Investments: Staff proposes a total of $275 million for light-duty vehicles and transportation equity investments funded from Low Carbon Transportation. This includes $175 million for Standard CVRP rebates plus an additional $25 million for lower income applicants to ensure the equity element of CVRP continues to grow and that rebates are prioritized for lower income applicants even if funding for standard rebates runs short.

Staff proposes a total of $75 million for transportation equity projects to increase access to clean transportation and mobility options in low-income and disadvantaged communities and for low-income households as directed by SB 1275 and supported by SB 350. The transportation equity funding would continue to fund ongoing projects and one new project as envisioned in the long-term plan for light-duty vehicle incentives included in the FY 2016-17 Funding Plan.

Heavy-Duty Vehicle and Off-Road Equipment Investments: Staff proposes a total of $180 million for heavy-duty vehicle and off-road equipment projects in this discussion

document. This includes $125 million to continue funding Clean Truck and Bus Vouchers, including Low NOx engines, as well as $55 million to fund freight equipment advanced demonstration and pilot commercial deployment projects, including ships at berth.

Project Administration: Staff anticipates that one percent of each category may be used for project administration by CARB. CARB's allocation for State Operations has been about $5 million per year; however, this amount has not increased, even as the total Low Carbon Transportation allocation has grown.

AQIP: CARB staff proposes directing AQIP funding to projects that primarily provide criteria pollutant and toxics benefits and, thus, are not the best fit for GHG-focused auction proceeds funding. Table 6 shows proposed AQIP project allocations.

Table 6: Draft Staff Recommended Project Allocations for $28.6 Million AQIP Appropriation

Project Category	**Allocation** (millions)
Truck Loan Assistance Program	$25.6
Diesel Emission Retrofit Replacement Filters	$3
TOTAL	**$28.6**

- The majority of the AQIP funds would be directed to the Truck Loan Assistance Program. Staff also proposes $3 million in funding be used to help pay for replacement filters for diesel emission control device retrofits in on-road trucks.

- AQIP funding is directed to continue the criteria pollutant and air toxics-focused Truck Loan Assistance Program that is not the best fit for the GHG-focused Low Carbon Transportation funds. The truck loan program is expected to the see an increase in demand as a result of a new law, SB 1 that will only allow clean trucks to be registered by the DMV.

Tracking Project Performance and Reporting on Outcomes: Through its grant agreements for each project, CARB will require grantees to collect all data necessary to document the emission reductions achieved, benefits to AB 1550 populations, project effectiveness, and any other data specified in the California Climate Investments Guidelines. This will include requirements for project administrators to maintain records and submit regular status reports for CARB. Staff will use this information to report to the public, the Board, and the Legislature on program implementation in future Funding Plans and each Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds.

Disadvantaged Community, Low-Income Community, Low-Income Household Investment Targets: A key component of these programs is providing health and economic benefits to California's most disadvantaged communities and low-income households. AB 1550 establishes disadvantaged community, low-income community, and low-income household targets for the State's Cap-and-Trade auction proceeds investments. Staff proposes that at least 45 percent of the Low Carbon Transportation appropriation be invested in projects meeting one of the AB 1550 criteria with the following targets:

- At least 35 percent of funds for projects located within, and benefiting individuals living in, disadvantaged communities.

- At least 10 percent of funds for projects within and benefiting low-income communities or benefiting low-income households, or within and benefiting low-income communities within a half-mile of a disadvantaged community.

Staff considers these targets to be a good and appropriate minimum and strives to exceed them. In designing project solicitations and implementation requirements, staff will consider whether there are provisions that can be incorporated to help ensure that CARB exceeds these minimum targets. Staff will also focus outreach in low-income and disadvantaged communities in order to help increase these targets. CARB is not limiting the disadvantaged community and low-income community/household focus to Low Carbon Transportation investments. Staff designed investments from the other funding sources to benefit underserved populations as well.

Appendix A provides additional details on how CARB staff developed these minimum AB 1550 investment targets. There are a few projects where staff took a very conservative approach of projecting no AB 1550 benefits up front where there is little or no prior data, leaving the benefits for those projects "to be determined." Even with this conservative approach, staff is able to demonstrate that at least 45 percent of the Low Carbon Transportation funds meet at least one of the AB 1550 criteria. Staff will design each project to prioritize disadvantaged community, low-income community, or low-income household benefits. Thus, staff expects an appreciable amount of the funding will meet one of the AB 1550 criteria, even in cases where no benefits are estimated up front.

The guidance for implementing AB 1550 has been incorporated into the latest guidelines approved by the Board in July 2018. Staff will follow these requirements for determining AB 1550 benefits of Low Carbon Transportation investments.

While the AB 1550 requirements formally only apply to programs funded from the GGRF, CARB develops and implements all these incentives with an eye toward providing benefits to disadvantaged communities, low-income communities, and low-income households wherever possible. For example, the AQIP-funded Truck Loan Assistance Program helps underserved populations by providing financing for small business truckers who have trouble getting conventional truck loans, thereby supporting

the goals of AB 1550. Many of these cleaner trucks operate in and near disadvantaged communities.

Funding Plan Development Process

Staff held 2 public workshops, 9 public work group meetings, and numerous individual meetings with interested stakeholders to develop the FY 2018-19 Funding Plan. Table 7 summarizes these public meetings.

Table 7: Public Meetings on Development of FY 2018-19 Funding Plan

Date	Meeting
3/15/2018	Workshop on Development of the FY 2018-19 Funding Plan
4/4/2018	Work Group Meeting: CVRP
4/4/2018	Work Group Meeting: Transportation Equity Projects
4/9/2018	Work Group Meeting: CVRP and Labor
4/12/2018	Work Group Meeting: Heavy-Duty Vehicle and Equipment Investments
4/16/2018	Work Group Meeting: HVIP
4/25/2018	Work Group Meeting: CVRP
4/26/2018	Work Group Meeting: Transportation Equity Projects
6/11/2018	Work Group Meeting: HVIP
6/15/2018	Workshop on Development of the FY 2018-19 Funding Plan
7/19/2018	Work Group Meeting: Three-Year Heavy-Duty Investment Strategy

In addition to the public meetings on developing this Funding Plan, CARB does public outreach to inform stakeholders on incentive opportunities for funding appropriated in past budget years. There's been an increasing focus over the past year on tailoring outreach to disadvantaged communities. CARB has been in the process of conducting extensive community-based outreach as part of the development of the Community Air Protection Program (AB 617) and Accessible Clean Transportation Options as directed by the Clean Energy and Pollution Reduction Act of 2015 (SB 350). Input received as part of these processes is reflected in this Funding Plan. A summary of all of these outreach activities is provided later in the document, in Chapter 6: Addressing California Climate Investment Guidelines Requirements.

CHAPTER 3: LIGHT-DUTY VEHICLE AND TRANSPORTATION EQUITY INVESTMENTS

This section of the Funding Plan describes staff's draft proposals for light-duty vehicle and transportation equity investments.

CARB's light-duty vehicle investments are aimed at supporting the long-term transformation of the fleet and meeting policy, statutory, and regulatory goals and requirements. There are two distinct, but complementary elements to CARB's advanced technology light-duty investments: CVRP and Transportation Equity Projects. In recent budgets, the Legislature has explicitly appropriated funding for these elements.

> CVRP supports increasing the number of ZEVs on California's roadways to meet these deployment goals and achieve the large scale transformation of the fleet. In addition CVRP supports the Governor's goal to put at least 5 million ZEVs on California roads by 2030.
>
> Transportation Equity Projects are designed to increase access and awareness to clean transportation and mobility options in disadvantaged and low-income communities and for lower-income households. These projects provide opportunities for residents of these communities to participate in a range of clean transportation and mobility options including (1) vehicle ownership projects such as vehicle retirement and purchase incentives and financing assistance, and (2) projects increasing consumer awareness and access to clean vehicles in disadvantaged communities through car sharing and other mobility improvement programs.

CARB's light-duty vehicle deployment investments are complemented by parallel California Energy Commission (Energy Commission) investments in ZEV charging and fueling infrastructure. To date, the Energy Commission has invested nearly $80 million in electric vehicle charging infrastructure for over 7,500 charging stations and over $132 million for over 60 hydrogen fueling stations through the Alternative and Renewable Fuel and Vehicle Technology Program. The Energy Commission also provides funding to support the development of regional readiness plans, helping regions to prepare for and expedite the deployment of ZEVs.

CARB's long-term plan for CVRP and light-duty vehicle incentives included an assessment of the state of the ZEV market and technology development (as required by SB 1275). The assessment found that ZEV technology costs are declining, in most cases, more quickly than originally expected. The assessment also showed growth in vehicle diversity, number of manufacturers selling vehicles, and consumer demand.

Staff found that ZEV sales have accounted for about 5 percent of total light-duty

vehicle sales in 2017. While these are all positive signs, the ZEV market is still in its infancy, and the assessment notes that it will take at least another 5 to 10 years before the market reaches sustainability. Thus, the long-term plan notes the continued need for the types of projects recommended in this Funding Plan. In the fall of 2018, staff will begin the process to update the long-term plan to cover the next three fiscal years (2019-20, 2020-21, and 2021-22) which will be included in the FY 2019-20 Funding Plan.

CVRP

Low Carbon Transportation Appropriation –
$200 million for CVRP of which at least $25 million is to be used to support increased CVRP rebates for Low-Income Applicants

PROJECT GOALS

CVRP is a grant project designed to offer vehicle rebates on a first-come, first-served basis for light-duty ZEVs, plug-in hybrid electric vehicles, and zero-emission motorcycles. CVRP helps get the cleanest vehicles on the road in California by providing consumer rebates to partially offset the higher initial cost of these advanced technologies. Current per-vehicle rebate amounts are based on consumers' income and vehicle technology as shown in Table 8. Increased rebates for low-income applicants were introduced in 2016. As discussed later in the chapter, staff does not propose any major changes to the rebate amounts at this time.

Table 8: CVRP Rebate Amounts and Income Limits

	Filing Status	**Gross Annual Income**	**Fuel Cell**	**Battery Electric**	**Plug-in Hybrid[1]**	**Zero-Emission Motorcycles**
Increased Rebate for Low-Income Applicants	≤ 300 percent of the federal poverty level (FPL)		$7,000	$4,500	$3,500	$900
Standard Rebate	Individual	300% FPL to $150,000	$5,000	$2,500	$1,500	
	Head of Household	300% FPL to $204,000				
	Joint	300% FPL to $300,000				
Income Cap	Individual	> $150,000	$5,000	Not Eligible		
	Head of Household	> $204,000				
	Joint	> $300,000				

[1]With an all-electric range of at least 20 miles

In 2016, the Legislature passed SB 859, which mandated a number of changes to CVRP, including:

- Increasing rebate amounts for low-income applicants with household incomes less than or equal to 300 percent of the federal poverty level to those shown in Table 8.

- Reducing the income cap to the levels shown in Table 8.
- Limiting plug-in hybrid electric vehicle eligibility to vehicles with at least 20 miles of electric range.
- Requiring outreach to low-income consumers.
- Requiring prioritized rebate payments for low-income consumers.

CARB incorporated all of these changes to CVRP as part of the FY 2016-17 Funding Plan. Senate Bill 615 (Cooper, Chapter 631, Statutes of 2017) extends these provisions through December 31, 2018. While the statutory requirement for these provisions sunsets at the end of 2018, staff proposes keeping these provisions in place for FY 2018-19. In addition, Assembly Bill 2885 (Rodriguez, Chapter 366, Statutes of 2018) extends the requirements for CARB to continue providing outreach to low-income households and low income communities and prioritize rebate payments to low-income applicants until January 1, 2022. While the statutory requirement for some of the above mentioned provisions sunsets at the end of 2018, staff proposes to keep the following provisions in place for FY 2018-19: (1) provide rebates for applicants who report gross annual income on Internal Revenue Service (IRS) Form 1040, IRS Form 1040A, or IRS Form 1040EZ, that does not exceed the limits as shown in Table 8; (2) provide increased rebates to eligible low-income applicants as shown in Table 8; and (3) limit plug-in hybrid electric vehicle eligibility to vehicles with at least 20 miles of electric range.

CURRENT PROJECT STATUS

Through June 2018, CVRP has provided rebates for over 256,000 vehicles at a cost of over $570 million since the project's launch in 2010. About 60 percent of rebates went to battery electric vehicles and nearly 40 percent for plug-in hybrid electric vehicles, with only a small number of rebates issued for fuel cell electric vehicles and zero-emission motorcycles. There are now 40 eligible vehicle models available and more vehicle introductions are planned for 2018 and 2019. As noted in the introduction to this chapter, ZEV sales in California have grown to over 5 percent of the total light-duty vehicle sales. Additional project statistics are available on the CVRP website: https://cleanvehiclerebate.org/eng/rebate-statistics.

Staff monitors CVRP participation rates by comparing rebate application data to California vehicle registration data to evaluate program trends. Historically, about 74 percent of ZEVs purchased or leased in California received a rebate prior to the introduction of income-based consumer eligibility. Since the introduction of the CVRP income cap, roughly 50 percent of ZEVs purchased or leased in California have been rebated. This suggests that the income cap is having its intended effect. Staff will continue to monitor these trends.

Rebate Now: Staff developed a pre-qualification mechanism to bring the CVRP rebate closer to the point of sale, which was approved as a part of the FY 2016-17

Funding Plan. The pre-qualification mechanism, called Rebate Now, launched on January 30, 2018 and is currently being piloted in San Diego County. Eligible residents in the county will have the opportunity to be preapproved for a CVRP rebate prior to purchasing or leasing an eligible vehicle. Rebate Now is expected to increase CVRP participation, and the initial pilot is allowing CARB and the CVRP administrator to test and refine implementation on a small scale, provide one-on-one dealer training and support, and gauge the effectiveness of the pilot before launching statewide.

In the first few months of the pilot's launch, staff has learned that a significant amount of adjustment and outreach is needed to ensure its success. Staff is closely monitoring the pilot project and reviewing data from the first six months of implementation to determine where to adjust and tackle any implementation hurdles before expanding outside of San Diego County. Some implementation challenges include: increasing dealer participation in the pilot, limiting consumer confusion during the application process, and coordinating with other incentive programs, such as EFMP Plus-Up/Clean Cars 4 All and financing assistance. We are continuing to work through these challenges and believe that the launch of the One Stop Shop Pilot Project will help with the overall coordination of incentives. Staff will keep stakeholders updated on expansion efforts through the work group process.

Low-Carbon Fuel Standard (LCFS) Point of Purchase ZEV Rebates: Board Resolution 18-17 directed CARB staff to work with stakeholders to explore opportunities to offer point of sale ZEV rebates funded by the sale of LCFS credits. Electric utilities, who receive LCFS credits associated with residential charging of EVs, have considered using their LCFS value to set up a statewide point of purchase clean fuel rebate which may launch as early as late-2019. CARB is working internally and with the utilities and auto dealers to make sure that this effort will be closely coordinated with CVRP and other CARB light-duty incentive programs in a way that is easy for the consumer to understand and utilize.

Outreach and Education in Disadvantaged and Low-Income Communities: Staff continues to implement expanded outreach and public education efforts. The CVRP administrator is currently working with Central Valley Asthma Collaborative, Legacy LA, and GRID Alternatives who help support on-the-ground outreach efforts, including ride and drive events. These community-based organizations also canvas for information, promote events, and provide assistance at these events. There are plans to expand these efforts in 2019 to include partnerships with additional community-based organizations.

There has also been an increase in the number of outreach events held in disadvantaged communities and low-income communities. Since the introduction of increased rebates for low-income consumers, over 230 outreach events have occurred in disadvantaged communities and low-income communities. These events include ride and drives, presentations, and community events. The CVRP administrator is also creating a newsletter targeted at consumers in disadvantaged

communities and low-income communities which is expected to be distributed by the end of 2018.

Additionally, the CVRP administrator has increased outreach to dealerships in disadvantaged and low-income communities. Outreach efforts include phone calls, conference calls, and in-person outreach with dealerships. In the past six months, the CVRP administrator has provided outreach to over 250 dealerships located in areas designated as benefitting disadvantaged communities.

Lastly, the CVRP Community Incentive Assistance webpage offers tools such as a cost savings calculator to give low-income consumers a better understanding of available incentives. More information on cost savings and other tools are available on the CVRP website, https://cleanvehiclerebate.org/eng/community.

Prioritized Rebates: In the FY 2016-17 Funding Plan, CARB introduced prioritized rebate payments to low-income applicants as directed by SB 859. Staff expects last year's allocation of $25 million for low-income applicant rebates to last through at least December 2018. This will keep CVRP's increased rebates up and running for low-income rebate applicants until the FY 2018-19 funding becomes available. Staff will continue to evaluate funding needs to ensure that low-income rebates are processed as soon as applications are reviewed and approved even though the project may be in a waiting list mode for other applicants.

DMV Mailer: Staff developed a DMV mailer to provide consumers information on the benefits of ZEV ownership and available incentives. In this preliminary mailing, inserts were included in 700,000 DMV title notices for vehicle owners who either paid off their vehicle or purchased a vehicle outright. Staff will analyze the impact of these mailers on CVRP participation and determine if and when additional DMV mailers should be sent. This concept directly supports one of the tasks outlined in the 2016 Governor's ZEV Action Plan. The increased outreach with low-income consumer and disadvantaged community focus is also consistent with recommendations from the SB 350 Guidance Document.

Choose Your Incentive: AB 544, enacted in October 2017, limits incentives for consumers with an income greater than the thresholds outlined in Table 8 who purchase or lease an eligible FCEV on or after January 1, 2018. These consumers must choose between obtaining a CVRP rebate or receiving a decal under the Clean Air Decal Program administered by the DMV. Staff is working with the DMV to compare CVRP and Clean Air Decal applicant information to verify that affected participants are only utilizing one incentive. Consumers with an income below the thresholds outlined in Table 8 who purchase or lease a qualifying vehicle remain eligible for both the Clean Air Decal and CVRP rebate.

Public Fleet Incentives: Staff incorporated several provisions unique to the Public Fleet Pilot into CVRP. These included: the option for public fleets to reserve funds by submitting a pre-acquisition plan; a streamlined application process (e.g. one

application for all vehicles); required annual vehicle usage reports; flexibility for assigning rebates and retaining ownership; and tribal government participation. Staff also included provisions that allow fleets up to 6 months to apply for pre-acquisition applications and up to 18 months to apply for regular applications (i.e. after the purchase is complete or vehicles are delivered). These changes apply to public fleets anywhere in California, not just those operating in disadvantaged communities. These are intended to make participation easier for public fleets by accommodating their typical procurement process.

Similar to the Public Fleet Pilot Project, CVRP Public Fleet funding maintains an increased incentive for fleets operating in disadvantaged communities. Staff aligned the increased incentives for fleets to match the incentives for low-income consumers of up to $7,000 as shown in Table 8. Eligibility for the extra incentive is limited to those vehicles domiciled in a disadvantaged community census tract consistent with the direction in AB 1550, rather than allowing vehicles in ZIP Codes containing disadvantaged community census tracts to qualify.

Staff also set aside $1 million of CVRP's FY 2017-18 allocation so that fleets can acquire CVRP-eligible vehicles through DGS's procurement process. Staff is finalizing an interagency agreement with DGS to administer rebates during the procurement process, allowing fleets to utilize the incentive at the point of sale. Fleets that do not use the DGS procurement process are allowed to use the normal CVRP process to obtain funding for vehicles. CARB is working with DGS on implementation details and staff expects this to launch in late-2018.

Additionally, rebates are provided to rental and car share fleets as they provide a unique opportunity for introducing eligible vehicles to a large consumer base. Public, rental, and car share fleets are capped at a maximum number of rebates per entity per calendar year. Rental car fleets and car share fleets are capped at 20 rebates per calendar year and public fleets are limited to 30 rebates per calendar year.

Staff Proposal FOR FY 2018-19

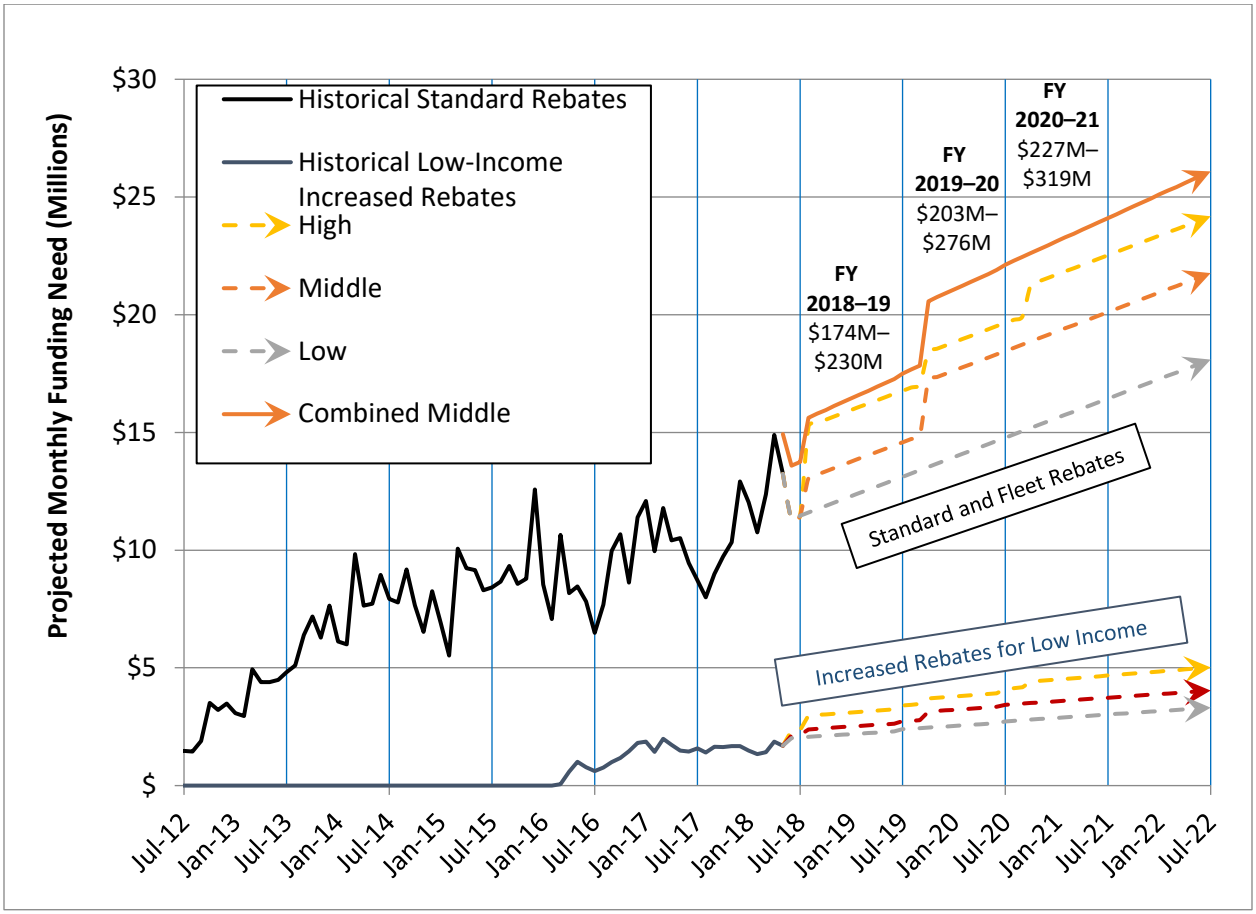
In SB 856, the Legislature appropriated $200 million for CVRP of which at least $25 million is to be used to support low-income increased rebates. The allocation for FY 2018-19 is expected to meet rebate demand through at least the end of the fiscal year based on the CVRP projections presented below.

At this time, staff is not proposing to adjust rebate amounts as a result of the phased-out federal tax credit for affected manufacturers as the program does not have funding to support this change. Additionally, no changes were made to rebate amounts for FCEVs when the federal tax credit sunset for those vehicles at the end of 2017.

CVRP Demand Projections: Estimated CVRP demand over the next three years is shown in Figure 1. This updates the projections included in last year's Funding Plan

using a similar methodology but factoring in the most recent CVRP and registration data, the income caps and low-income increased rebate levels data.

Figure 1: Projected Three-Year CVRP Demand



The projections shown in Figure 1 differ slightly from the projections shared previously because they are based upon updated rebate data through July 2018, which yield increased demand relative to previous projections.

Further discussion on how CVRP projections are developed is included in Appendix C.

Table 9 shows estimated rebate demand for the FY 2018-19 funding cycle and the corresponding funding need, with projections for both standard (including fleet) rebates and low-income increased rebates. The FY 2018-19 budget appropriation meets demand through at least the end of the fiscal year. Given a recent uptick in rebate applications with record months in April-August 2018, projections have been updated to reflect the increasing demand.

Table 9: Projected Rebate Demand for FY 2018-19 Funding Cycle

Time Period	Projected CVRP Demand		
	All Rebates	Standard Rebates	Low-Income Rebates Only
Sep 2018-Aug 2019[1]	$174 to $230 million 68,251-87,400 rebates	$159 to $204 million[2] 61,690-78,358 rebates	$12 to $24 million 5,952-8,394 rebates

[1] Accounts for balance from FY 2017-18 when determining projected demand.
[2] Standard Rebates does not include rebates for Public Fleet

Since FY 2018-19 funds started becoming available in August 2018 and disbursed in September 2018, the time period covered by the projection has been adjusted accordingly. According to projections, the allocation for FY 2018-19 should be sufficient to meet demand through at least the end of the fiscal year. Ideally we would like the funding to last through the first three months of the following year to allow for a seamless transition without the need for a waitlist that would erode dealer and consumer confidence and reduce program effectiveness. As indicated by the high end of the range shown in Table 9, this depends on various assumptions. Further, all scenarios assume no expansion of the Rebate Now pilot in the upcoming fiscal year.

Based on these projections, the Legislature's $200 million appropriation should meet demand through July and much of August 2019. Moreover, the appropriation of $25 million for low-income rebates would meet at least 15-16 months of demand. This would keep the low-income applicant element of CVRP funded through at least fall 2019 to keep it running through the transition between funding years.

The Legislature’s appropriation for low-income applicants would keep increased rebates funded longer than standard rebates. Staff believes this is consistent with the Legislature’s direction to prioritize rebates for low-income applicants. Staff will reassess these projections at the start of the fourth quarter of the fiscal year. In the event that staff finds the low-income applicant demand is higher than projected, it would consider reallocating funding from standard rebates to low-income rebates. However, staff would not consider reallocating funding from low-income rebates to standard rebates. It would instead consider managing a standard rebate funding shortfall with a waiting list.

Because the Legislature’s appropriation aligns with projected demand through the fiscal year, staff believes no major changes to CVRP rebate amounts or eligibility requirements are needed. This is consistent with staff’s findings from the long-term plan for CVRP and light-duty vehicle incentives that the ZEV market has not progressed to the point where changes, such as reduced rebates, are warranted.

CVRP Eligibility Requirements: Staff is recommending no major changes to CVRP eligibility requirements. However, staff did evaluate several refinements, including:

- Reducing fuel cell vehicle rebate amounts and bringing fuel cell vehicles under the income cap requirements
    - Staff determined that it is premature to reduce fuel cell vehicle rebate amounts or to bring them under income cap requirements because these vehicles and their infrastructure are still in the earliest stage of commercialization.

- Limiting consumers to one rebate per person
    - It was also determined that it was too early to implement a one-rebate limit on consumers (down from the existing two-rebate limit). However, staff will explore how to implement a limit in future years and will outline those strategies in the next three-year plan.

- Increasing minimum all-electric range requirements for PHEVs
    - Staff determined that further analysis is needed before any changes can be made to the minimum all electric range requirements for PHEVs. Staff will look into this proposal further and address any need for changes in the upcoming three-year plan.

- Bundling funding for home charging infrastructure with low-income rebates
    - Staff determined that providing an additional incentive to low-income rebate applicants for charging infrastructure may lead to other program changes. In addition, CARB and other State agencies and public utilities already offer incentives for home charging. Staff determined not to include rebates for charging infrastructure for low-income applicants and instead recommend focusing on the coordination of various transportation equity project efforts for low-income consumers through the One Stop Shop Pilot Project.

Federal Tax Credit Phase-Out: Internal Revenue Code Section 30D provides a credit of up to $7,500 for Qualified Plug-in Electric Drive Motor Vehicles, including passenger vehicles and light trucks, purchased after December 31, 2009. The credit begins a phase-out period for a manufacturer's vehicles when at least 200,000 electric vehicles have been sold for use in the United States. Staff continues to monitor monthly electric vehicle sales as Tesla has reached the 200,000 mark in quarter 3 of 2018[3] and GM is projected to reach the threshold by the end of 2018 or early 2019[4]. These vehicles will still be eligible for the full credit the quarter the manufacturer reaches the threshold as well as the quarter after. A reduced federal tax credit will be available to consumers during the year-long phase-out period which begins the second quarter after the threshold is reached.

[3] Felton, R. (2018, July 12). Tesla Buyers Will Soon Lose The $7,500 EV Tax Credit. Retrieved August 20, 2018, from https://jalopnik.com/tesla-has-hit-the-federal-ev-tax-credit-threshold-and-1827537854.
[4] Kane, M. (2018, August 6). JULY UPDATE – 5 Automakers Closest To Losing The Federal Tax Credit. Retrieved August 20, 2018, from https://insideevs.com/top-6-automakers-200000-federal-tax-credit-limit/.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits: CVRP will continue to be implemented on a first-come, first-served, statewide basis, so it is not possible to estimate in advance exactly how much funding will be spent in and benefit disadvantaged communities, low-income communities, and low-income households. About 8 percent of Low Carbon Transportation funding for CVRP to date has been applied for and received by applicants in disadvantaged communities as reported in the March 2018 Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds. Staff has also reviewed recent CVRP data and found that an additional 11 percent of funds were applied for and received by applicants in low-income communities that don't overlap with disadvantaged communities.

Staff expects that the AB 1550 benefits for the FY 2018-19 funding should increase with the changes to increase the equity-focused components of CVRP. These include the higher rebates for low-income consumers, a dedicated funding allocation for low-income rebates, launch of the Rebate Now prequalification pilot, and increased outreach for disadvantaged communities and low-income households, all of which should help low-income consumers make these purchases.

Terms and Conditions: When CVRP was established, CARB and the project administrator developed Terms and Conditions to highlight the policies set forth by the Board in more detail for consumers, and ensure a fair, equitable, and responsible project. More specifically, the Terms and Conditions are intended to notify consumers of the core requirements of the program prior to submitting an application. Additionally, CARB and the project administrator developed an Implementation Manual to further define these rules and define roles and responsibilities. The current Terms and Conditions and Implementation Manual are available at:

CVRP Terms and Conditions: https://cleanvehiclerebate.org/eng/terms-and-conditions
CVRP Implementation Manual: https://cleanvehiclerebate.org/sites/default/files/docs/nav/transportation/cvrp/documents/CVRP-Implementation-Manual.pdf

These documents are incorporated into the proposed Funding Plan by reference and updated periodically throughout the year to reflect project changes after the Board adopts each funding plan and as other changes are necessary to provide further clarity.

Solicitation Process: CARB selected a grantee to administer FY 2016-17 CVRP funds via a three-year competitive solicitation with the option of adding the FY 2017-18 and FY 2018-19 funds with an updated grant agreement. CARB used this option for FY 2017-18 and the agreement was executed with the Center for Sustainable Energy (CSE) in January 2018. Again, staff proposes to utilize this option; and therefore, CARB would not issue a new solicitation for FY 2018-19 CVRP funds. The next competitive solicitation is planned for FY 2019-20 and staff plans to incorporate sufficient funding from the FY 2019-20 appropriation into the FY 2018-19 grant to ensure CVRP continues without interruption during the

solicitation period.

Outcomes

Staff expects the $175 million CVRP allocation for standard rebates would fund approximately 72,500 rebates and provide 431,600 metric tons of carbon dioxide (CO2) equivalent GHG emission reductions. The allocation would also provide 54 tons of NOx, 24 tons of PM 2.5, and 11 tons of reactive organic gas (ROG) emission reductions. The additional $25 million allocation for low-income consumer rebates would fund approximately 6,000 rebates and provide 34,600 metric tons of CO2 equivalent GHG emission reductions, 4.3 tons of NOx, 2.0 tons of PM 2.5, and 0.9 tons of ROG emission reductions. After the funding is expended, CARB will report on the number of rebates issued, emission reductions achieved, and disadvantaged community benefits as part of future Annual Reports to the Legislature on California Climate Investments.

The ZEV market is continuing to grow dynamically. Although it is still early in the ZEV market's development, there is a clear need to evaluate the effectiveness of investments toward CVRP and other light-duty vehicle incentives. Staff provided an update to its long-term plan for CVRP and light-duty vehicle incentives in the introduction to this chapter, including an update on the metrics CARB is tracking to evaluate ZEV market growth. In the fall of 2018, staff will begin the process to update the long-term plan to cover the next three fiscal years (2019-20, 2020-21, and 2021-22). This will include a review of market and technology indicators and a determination of if and when changes need to be made to CVRP. These indicators include, but are not limited to: ZEV sales as a fraction of the new car market; technology advancement such as vehicle range; battery cost and vehicle price; vehicle diversity and number of manufacturers producing ZEVs; growth of the used ZEV market; and consumer awareness about ZEVs.

As part of the Budget Act of 2018-19, CARB is required to submit an annual supplemental report, until January 1, 2030, that includes a forecast of the total state rebate investment necessary to reach the goal of placing at least 5 million ZEVs in service on California's roads. Development of the first report will be occur alongside the development of the update to the long-term plan for CVRP and light-duty incentives that will kick-off this December. The first report will be provided in the FY 2019-20 funding plan and annually thereafter until January 1, 2030.

TRANSPORTATION EQUITY INVESTMENTS OVERVIEW

This section describes CARB's transportation equity investments, including core legislative drivers, and provides proposed funding recommendations for the FY 2018-19 budget cycle. Since FY 2014-15, CARB has allocated Low Carbon Transportation funding grants to a suite of pilot projects in disadvantaged and low-income communities and for lower-income households, as directed by SB 1275. This includes clean vehicle ownership, clean mobility, streamlining access to funding and financing opportunities, and increasing community outreach, education and exposure to clean technologies. Equity pilot projects exemplify the importance of understanding the unique needs across communities and provide lessons for how we most directly address barriers to collectively achieve our equity, air quality, and climate goals. Equity projects previously funded include:

- EFMP Plus-up / Clean Cars 4 All
- Financing Assistance for Lower Income Consumers
- Clean Mobility Options for Disadvantaged Communities
- Agricultural Worker Vanpools
- Rural School Bus Pilot
- One-Stop-Shop for CARB's Equity ZEV Replacement Incentives
- Increased CVRP Rebates for Public Fleets (discussed in the CVRP section above)
- CVRP Rebates for Low-Income Households (discussed in the CVRP section above)

These transportation equity projects are a result of multiple key legislative drivers, including SB 535, AB 1550, and SB 350, but also recognize that increasing access and awareness must be an ongoing process. Projects follow SB 535's direction that investments must benefit California's disadvantaged communities, as defined by CalEPA based on geographic, socio-economic, public health, and environmental hazard criteria. These projects provide direct benefits to targeted communities, such as reduced GHG, criteria pollutant, and toxics emissions. These projects also result in critical co-benefits such as improving public health from reduced pollution exposure, transportation-cost savings, increased household economic stability, increased connectivity to destinations, reduced traffic congestion, and increased environmental sustainability. CARB continues to explore other potential co-benefits such as accessibility to job and workforce training opportunities, which are vital to the broader understanding of how we address clean transportation and mobility challenges, with the goal of allowing for a balanced mix of environmental, social, and economic benefits.

One of the core priorities and objectives for these equity projects is to incorporate the findings of CARB's SB 350 Guidance Document and implement the lessons learned from this work in communities. The Guidance Document identifies barriers that low-income residents and disadvantaged communities face in accessing clean transportation and mobility options, and makes specific recommendations to address

them. The equity projects are already addressing many of these barriers and support the implementation of recommendations by increasing awareness and exposure to clean transportation and mobility options, helping low-income consumers and disadvantaged community residents afford to purchase clean vehicles, install home chargers, or participate in clean vehicle ride sharing, car sharing, vanpooling, ride-hailing, bike sharing, and other clean transportation and mobility options across the State. In addition, equity projects provide unique and exciting opportunities to collaboratively and creatively address complex challenges to clean transportation access, fostering low-income resident and disadvantaged community engagement and solution building that go beyond the State's traditional approaches.

It is also important to consider CARB's AB 617 Community Air Protection Program, given the shared air quality and equity goals with our pilot projects, ties to SB 350, and AB 617 funding and outreach to targeted communities. CARB staff continue to work closely with the AB 617 team to understand how lessons learned can be shared across these critical programs to maximize benefits for low-income residents and disadvantaged communities.

CARB continues to see the importance of pilot projects in the most disadvantaged and low-income communities and are committed to furthering our goals in increasing access to clean transportation and mobility options across the State. Table 10 below shows that CARB has allocated $204.5 million to date for the current group of transportation equity projects, including $179.5 million of Low Carbon Transportation funding since FY 2014-15 and $25 million of FY 2017-18 Volkswagen Settlement funding. The table does not display two CVRP-related components that began as transportation equity projects in earlier cycles (the Increased CVRP Rebates for Public Fleets project and the CVRP Rebates for Low-Income Households project, discussed in the CVRP section of this document.

Table 10: Transportation Equity Project Allocation and Award History

Projects	Funds Allocated to Date (millions)	Funds Awarded To Date* (millions)	Funds Remaining to Award (millions)
EFMP Plus-up / Clean Cars 4 All	$96	$82	$14
Financing Assistance for Lower-Income Consumers	$25.9	$7.9	$18
Clean Mobility Options for Disadvantaged Communities	$31.6	$14.6	$17
Agricultural Worker Vanpools	$6	$6	$0
Rural School Bus Pilot	$40	$40	$0
Clean Mobility in Schools (New)	$0	$0	$0
One-Stop-Shop for CARB's Equity ZEV Replacement Incentives	$5	$5	$0
General Equity Project Funding Reserve	**	**	$0
Total	**$204.5**	**$155.5**	**$49**

*Grants are in place or grant agreements are under development.
**FY 2017-18 Funding Reserve of $20 million was reallocated in spring 2018 (see below).

Equity Project Implementation Challenges and Lessons Learned

Overall, these projects have begun to demonstrate and show success in increasing access to clean transportation and mobility options for low-income residents and low-income and disadvantaged communities. They have also allowed for an unprecedented level of coordination across state, local, and regional agencies, air districts, and engagement with local community partners. Nonetheless, these are first of their kind, multifaceted projects and implementing organizations must accomplish multiple goals to be successful. As such the equity projects have faced a variety of implementation challenges along the way and have learned some valuable lessons.

Primary among each project's multiple goals is providing the necessary assistance and safeguards to the intended consumers. For example, implementing organizations must provide training and education to each applicant, as well as targeted outreach to low-income residents and disadvantaged communities. This requires building an understanding of the target audiences, including addressing issues such as language barriers, social, economic, and environmental constraints, as well as the community specific barriers related to accessing clean transportation.

One of the most common objectives for each project has been establishing working relationships with a variety of partners, such as community-based organizations, financial institutions, and car dealerships to name just a few. These partnerships are essential to the outreach, safeguards, and assistance each project must provide to overcome the barriers to clean transportation faced by low-income and disadvantaged communities. It has taken a lot time for implementing organizations to create their partnership networks, causing some projects to get off to a slower than expected start.

Once launched, certain key aspects of the implementation process are also proving to be challenging. For some of the more complex projects, such as Financing Assistance and EFMP Plus-Up, helping applicants navigate the car-buying process – which includes educating applicants about advanced vehicle technologies, ensuring they pay a fair price for their vehicle, and helping them secure affordable financing – is time consuming and resource intensive for the program administrators. This means it is taking longer than expected for some projects to scale-up to meet the growing demand from consumers and to meet the significant increase in funding provided by the Legislature beginning in FY 2016-17.

As a result of these issues, the overall cost of developing and operating some projects is higher than expected. Likewise, some grantees are finding it difficult to meet the funding expenditure deadlines. Although these projects have faced unforeseen challenges, implementing organizations are now building on the lessons learned and making adjustments. These lessons will provide long-term benefits across CARB's pilot projects as they are shared more broadly and best practices are developed.

CARB has learned through SB 350 and other related efforts that barriers lead to opportunities. Equity project implementation challenges provide CARB with valuable information on how to adapt our clean transportation policies and programs as well as other related efforts across the agency. Having the flexibility to pilot program approaches and implementation provides increased benefits over time, especially to allow program administrators the ability to create and modify implementation for those communities that are learning what solutions best meet their accessibility needs.

Staff will continue to closely monitor each project and work with implementing organizations to ensure they have the necessary support and flexibility to overcome the unique challenges they face. Central to this effort is the One-Stop-Shop pilot project, which is described in greater detail below.

Streamlining Access to Programs, Funding Opportunities, and Outreach

The One-Stop-Shop pilot project, which was funded with $5 million in Volkswagen settlement funding in the FY 2017-18 Funding Plan, will address a core recommendation from CARB's Low-Income Barriers Study to increase awareness for low-income residents by expanding education and outreach on clean transportation and mobility options. CARB selected GRID Alternatives as the project administrator via a competitive grant solicitation earlier this year, and staff expects to launch the project by

mid-2019. The goal of the One-Stop-Shop pilot is to streamline access for low-income consumers to clean energy, transportation, energy efficiency and water-efficient upgrades for housing serving low-income residents, and other related consumer-based incentives and augment existing outreach and education on clean transportation and mobility options. The initial pilot, however, focuses on the development and maintenance of a single application for low-income consumers to apply and qualify for CARB's Equity ZEV Replacement Incentives (e.g., CVRP, EFMP Plus-Up / Clean Cars 4 All, Financing Assistance, and Clean Mobility Options). Staff will report back on the project in future funding plans and present opportunities for expansion or adjustments as necessary.

Table 10 shows CARB has awarded $155.5 million and $49 million remains to be awarded. The large amount of funding not yet awarded is due, in part, to the time needed to carefully design and implement projects to fit the needs of lower-income consumers and disadvantaged communities. CARB requires grantees to seek and receive community feedback about the community's unique transportation barriers to help shape the project solutions offered. Outreach and education efforts must not only be multilingual but also culturally appropriate and respectful. Installation of charging in public areas must garner the support of local officials, businesses, and planning agencies. As projects roll out, grantees must continue to process feedback and adjust to meet challenges. Staff acknowledges that this approach takes time to design and implement projects, but believes this level of care and consideration is essential to deliver positive project outcomes over the long term.

Table 11 below shows staff's proposed allocations for the FY 2018-19 budget of $75 million for Transportation Equity Projects. Staff's proposal is based on the understanding that each project has unique goals and requires additional funding in order to overcome multiple barriers that low-income residents face in accessing clean transportation and mobility options.

Note that staff recommends holding $6 million in reserve to award to any transportation equity projects that have higher demand than can be met with initial allocations. This reserve funding provides CARB the flexibility to direct funds to projects that are oversubscribed, and follows a similar provision in the FY 2017-18 allocation table that held $20 million of funding in reserve that was allocated in Spring 2018 to EFMP Plus-up ($4 million), Rural School Bus Pilot ($15 million), and State Operations ($1 million).

In addition, staff recommends that the Executive Officer once again be allowed to reallocate funds between transportation equity projects based on demand. If any reallocations are made between these projects, the reallocation of funds will stay within the Transportation Equity Projects.

Table 11: Recommended Transportation Equity Project Allocations for FY 2018-19

Projects	Staff's Proposed FY 18-19 Allocations (Governor's Proposed Budget includes $75M)	Total Project Allocations To Date Including This Proposal
EFMP Plus-up / Clean Cars 4 All	$16	$112
Financing Assistance for Lower-Income Consumers	$10	$35.9
Clean Mobility Options	$15	$46.6
Agricultural Worker Vanpools	$3	$9
Rural School Bus Pilot	$15	$55
Clean Mobility in Schools (New)	$10	$10
One-Stop-Shop for CARB's Equity ZEV Replacement Incentives	$0	$5
General Equity Project Funding Reserve	$6	$6
TOTAL	**$75**	**$279.5**

*The zero allocation for One-Stop-Shop reflects that the FY 2017-18 allocation of $5 million from the Volkswagen settlement is intended to cover two funding cycles.

A new transportation equity funding opportunity that goes into effect in 2019 came about as part of Assembly Bill 193 (Cervantes, Chapter 363, Statutes of 2018), which creates the Zero-Emission Assurance Project. This project will provide rebates for battery replacement or a vehicle service contract for battery, fuel cell, or related components for an eligible used vehicle. This new project complements CVRP and equity projects, such as EFMP Plus-Up/Clean Cars 4 All and Financing Assistance, by helping to alleviate low-income residents' concerns about premature battery degradation resulting in reduced vehicle performance, vehicle depreciation, and costly repairs. Staff will be incorporating this project into next year's Funding Plan.

The remainder of this chapter provides additional details for each of the proposed Transportation Equity Projects.

EFMP PLUS-UP / CLEAN CARS 4 ALL

Recommended Low Carbon Transportation Allocation – $16 million

Project Overview

EFMP Plus-up is a district-administered grant project that provides incentives for lower-income consumers living in and near disadvantaged communities who scrap their old vehicles and purchase new or used hybrid, plug-in hybrid, or ZEV replacement vehicles. Participants must have a household income of less than 400 percent of the Federal Poverty Level and live in a ZIP Code containing a disadvantaged community census tract. Measures of success include participation rates by lower-income consumers and disadvantaged communities, number of vehicles funded in total and by technology type, GHG benefits and the increased fuel economy achieved by vehicle replacements, and the age and mileage of retired and replaced vehicles.

Recently enacted legislation, AB 630 (Cooper, Chapter 636, Statutes of 2017), requires CARB to create guidelines for a new vehicle replacement program called the Clean Cars 4 All Program. In establishing this new program, AB 630 is codifying the existing EFMP Plus-up pilot project into a formal, stand-alone program. In July 2016, the Board approved regulatory guidelines for Clean Cars 4 All. Staff expects these new guidelines to be finalized in early 2019, at which point Clean Cars 4 All will formally replace the EFMP Plus-Up pilot project. Detailed requirements for the Clean Cars 4 All Program will be proposed and approved via the Low Carbon Transportation Funding Plan process, beginning in FY 2019-20.

Current EFMP Plus-up Project Status

Since FY 2014-15, CARB has allocated $96 million for EFMP Plus-up, including $86 million of Low Carbon Transportation funding and $10 of FY 2017-18 Volkswagen funding. Of that total, CARB has allocated $72 million ($36 million each) to South Coast Air Quality Management District (AQMD) and San Joaquin Valley Air Pollution Control District (APCD), and $10 million ($5 million each) to the Bay Area AQMD and Sacramento Metropolitan AQMD to launch new programs. The remaining $14 million is in reserve and will be allocated based on demand at a future date.

EFMP Plus-Up launched in July 2015. Through June 30, 2018, San Joaquin Valley APCD has expended about $7 million to replace 1,186 vehicles (about 15 percent battery electric, 30 percent plug-in hybrid, 55 percent hybrids). South Coast AQMD has expended about $15 million to replace 2,541 vehicles (about 20 percent battery electric, 40 percent plug-in hybrid, 40 percent hybrids). 93 percent of participants across both air districts have annual incomes below 225 percent of the federal poverty level.

Implementation Challenges and Lessons Learned

Despite a better-than-expected start in both the South Coast and San Joaquin Valley air districts and focused efforts from all parties, the growth in overall participation hasn't been able to keep pace with the increase in funding levels in recent years. The districts are working to increase participation through increased outreach and scaling up capacity to support processing applications to meet the demand of each project.

However, implementing districts must commit significant time and resources to process each application, making it challenging to build capacity and scale-up quickly enough to meet the project's increasing popularity without taking any short cuts. EFMP Plus-Up is an intricate project for air districts to implement. Each air district's program by necessity consists of a unique multi-step process – including community outreach, consumer protections, education about the pros and cons of the replacement options, and partnering with vehicle dismantlers and dealerships. In addition, case managers provide each applicant – whether or not he or she successfully completes the process – one-on-one assistance throughout a multi-step process, with the ultimate goal of ensuring the applicant is able to find a vehicle that meets their needs and is making a sustainable financial decision.

As such, it has taken longer than expected for the air districts to expend their allocated funding, which has increased significantly since the projects first launched three years ago. The air districts have expended $22 million of the $96 million allocated to date. Due to concerns that the $60 million appropriation from FY 2016-17 would not be expended in time to meet the statutory encumbrance deadlines, the Legislature re-appropriated $25 million of this funding to increase the amount of time allowed for funds to be awarded to appropriate air districts and grants to be executed. CARB staff are working closely with each air district to ensure their programs continue their progress, steadily increase participation, and have the necessary funding to ensure air districts are able to make the required investments for the projects to be successful.

The Bay Area AQMD project is receiving $5 million and is expected to launch in early 2019 and Sacramento AQMD project is receiving $5 million and is expected to launch later in 2019. Staff anticipates that the One-Stop-Shop and Financing Assistance programs will further assist air districts to build capacity, increase participation, and help each district expend the available funding in a timely manner. Staff continues to reach out to other interested air districts.

Staff Proposal for FY 2018-19

Staff recommends a $16 million allocation, split as follows:

- $10 million ($5 million each) to South Coast AQMD and San Joaquin Valley APCD.
- $6 million held in reserve to be allocated to any EFMP Plus-up project, based on demand.

To ensure consistency among CARB's various lower-income consumer vehicle incentives projects, staff recommends that the grantees work with CARB's

One-Stop-Shop project to analyze aligning the incentive amounts offered by EFMP Plus-up/Clean Cars 4 All with the vehicle price buy-down amounts available in the Financing Assistance for Lower-Income Consumers and CVRP for Low Income Consumers. Staff also recommends changes to the EVSE installation incentives: expand eligibility to include participants who choose a plug-in hybrid vehicle, expand the equipment eligible for funding (i.e., electrical panels, etc.), and provide opportunities to help residents who are unable to have EVSE installed at their residence.

The Low Carbon Transportation funding would continue to be limited to lower-income consumers living in a ZIP code containing a disadvantaged community census tract. To date, this requirement has resulted in 57 percent of project funds be spent within a DAC census tract while staff estimates that about 90 percent of funds have gone to low-income households as defined by AB 1550.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits: EFMP Plus-up requires that recipients must reside in ZIP codes containing a disadvantaged community census tract. For FY 2017-18 and later, AB 1550 imposed new investment criteria and goals for projects funded by GGRF. Staff considered whether it should change the geographic eligibility requirements in response to AB 1550, such as limiting participation to disadvantaged community census tracts rather than ZIP codes containing disadvantaged community census tracts. However, feedback from stakeholders indicated such a change would create unnecessary implementation barriers. As such, rather than downsizing the program to meet AB 1550 requirements, staff proposes continuing the existing ZIP code eligibility and low-income eligibility requirements for the Low Carbon Transportation funding.

Using historic project data, staff estimated at least 75 percent of these FY 2018-19 funds would meet one of the AB 1550 criteria (see Table A-61 in Appendix A), but staff expects to exceed this minimum estimate.

Finally, staff considered expanding geographic eligibility to also include low-income communities, as defined by AB 1550. Such a change could help facilitate expansion of the program to new air districts that have a limited number of zip codes containing disadvantaged communities. Before making this change, however, staff prefers to first monitor the progress of the pilot programs in new air districts once they launch to further assess whether expanding the geographic eligibility requirements is necessary.

Grant Award Process: Consistent with previous years' allocations, CARB would award EFMP Plus-up/Clean Cars 4 All funding non-competitively through grant agreements with the San Joaquin Valley APCD, South Coast AQMD, Bay Area AQMD and other air districts that choose to start an EFMP Plus-up program. This project will continue to require outreach, education, and consumer protections for lower-income consumer recipients living in or near disadvantaged communities. The small set aside to cover the cost of developing a data reporting system would be awarded via a competitive grant solicitation.

Outcomes

CARB's air quality and climate change plans show that the vast majority of the on-road fleet must be zero- and near zero-emission vehicles by 2050 to meet the State's GHG targets. CARB's *Mobile Source Strategy* indicates that incentive programs such as EFMP and EFMP Plus-up will be essential in facilitating the light-duty fleet transition to zero-emission and near zero-emission technologies. It also calls for further deployment of cleaner light-duty vehicle technology through the expansion and enhancement of retire-and-replace incentive projects to accelerate the turnover of the fleet to meet an overall LEV III or better emissions level. Further, the draft SB 350 Guidance Document identifies barriers that low-income consumers experience, such as affordability and lack of infrastructure, and recommends increased funding and outreach for clean transportation incentives projects. The increased funding proposed above will play an important part in meeting these demands.

Staff estimates the proposed $16 million in new FY 2018-19 funding would pay for 1,800 vehicle replacements and reduce 8,049 metric tons of CO2 equivalent GHG emissions, 16 tons of NOx, 0.4 tons of PM 2.5, and 3.8 tons of ROG emission reductions over the lifetime of the project. In addition to these clean air and climate change benefits, the program is helping low-income participants reduce the cost of owning and operating a vehicle by replacing older and less reliable cars with newer and significantly more fuel efficient cars. So far, the average replacement vehicle is 18 years newer, and twice as fuel-efficient as the average scrapped vehicle. Reducing the cost of ownership provides an economic benefit to participants and their local communities.

Participating air districts must report project information on a quarterly basis based on project administration and consumer surveys. With this information, and through continued interaction with stakeholders and analysis of the state of the light-duty vehicle market, CARB will be able to determine the participation rate and advancement of clean vehicles for disadvantaged communities and lower-income consumers, assess future funding needs, and evaluate other opportunities for making program enhancements.

CARB will report in Annual Reports and future Funding Plans the outcomes of this project including GHG reductions achieved or anticipated using the appropriate CARB quantification methodology; progress in meeting or exceeding SB 535 and AB 1550 targets for investment in and benefits to disadvantaged communities; updates on economic, environmental, and public health co-benefits achieved or anticipated; and transaction locations. Metrics to measure progress for this project includes information on the types of vehicles utilized, the number of participants, and clean mobility improvements experienced by participants.

FINANCING ASSISTANCE FOR LOWER-INCOME CONSUMERS

Recommended Low Carbon Transportation Allocation – $10 million

Project Overview

The Financing Assistance for Lower-Income Consumers pilot project is a grant project that helps lower-income Californians overcome the barrier of obtaining vehicle financing by providing low interest loans and vehicle price buy-downs to consumers. One method to encourage lenders to participate is by offering funds for a loan loss reserve to mitigate risk. In addition, buyers of plug-in hybrid and battery electric vehicles are also eligible for a home charger incentives. This pilot is meant to complement CVRP and EFMP Plus-up by providing low-interest loans. Administrators provide financial literacy, advanced vehicle technology training to ensure that vehicles meet participant needs and loans are successful, and other consumer protections. Measures of success include the number of consumers who participate, their income level and residency location, costs and types of vehicles purchased, and loan repayment status.

Current Project Status

Fiscal Year 2014-15

- Community Housing Development Corporation (CHDC), a community-based organization, received a $932,457 grant to begin a financing assistance project to low-income residents living in the Bay Area. To date, CHDC has helped more than 65 participants purchase clean vehicles with low-interest rate loans and vehicle price buy-downs and is currently out of funds for additional loans. In addition to greater transportation security, participants have experienced co-benefits such as improved credit scores, more and better housing options, and better job opportunities.

Fiscal Year 2016-17 (funds were not available in FY 2015-16)

CARB allocated $6 million for the Financing Assistance of Lower-Income Consumers projects, split into $5 million for a statewide project and $1 million for a local project(s). A competitive solicitation resulted in a grant award for a statewide administrator (see below), and the $1 million for local projects was moved to Clean Mobility Options for Disadvantaged Communities due to the fact that no applications were submitted for this part of the solicitation.

- Clean Vehicle Assistance Program: Beneficial State Foundation received a $5 million grant to provide financing assistance for eligible participants statewide. The project seeks to help about 800 participants purchase clean vehicles using low-interest rate loans. Project partners include Beneficial State Bank, the Center for Sustainable Energy, and GRID Alternatives. The project launched in

June 2018 and is providing financing assistance to low-income residents statewide.

- No applications were submitted for the allocation of local funds. CARB reallocated the $1 million of expansion funding first to the FY 2016-17 Clean Mobility Options for Disadvantaged Communities program to support additional projects, and, when not needed due to a withdrawn project, to CVRP Rebates for Low-Income Households.

Fiscal Year 2017-18

CARB allocated $20 million split into $18 million for a competitive solicitation for a statewide administrator to be released in late 2018 and $2 million to expand the existing CHDC pilot project. The expansion funding process is underway and an application for the expansion funding is due in September 2018.

Implementation Challenges and Lessons Learned
Similar to EFMP Plus-Up, helping applicants through the loan processing and car-buying experience is proving to be more time intensive than originally anticipated. Because of this, case managers have to spend more time with each applicant before a loan or buy-down can be issued. In addition, some participants who live in multi-unit dwellings are also finding it difficult to install EVSE for their plug-in vehicles and have requested that alternatives be available to help overcome barriers to charging infrastructure.

Staff Proposal for FY 2018-19

Staff recommends a $10 million allocation to increase the funds for the statewide administrator pilot project via a competitive solicitation or expand the existing statewide administrator pilot project. If funding is not fully awarded, staff proposes flexibility to shift the funding to other transportation equity projects that are showing demand.

To ensure consistency among CARB's various lower-income consumer vehicle incentives projects, the grantees will work with CARB's One-Stop-Shop project to analyze aligning the vehicle price buy-down amounts available in the Financing Assistance projects with the incentive amounts offered by EFMP Plus-up and CVRP. Staff also recommends changes to the EVSE installation incentives: expand eligibility to include participants who choose a plug-in hybrid vehicle, expand the equipment eligible for funding (i.e., electrical panels, etc.), and provide opportunities to help residents who are unable to have EVSE installed at their residence.

Terms and Conditions: As with CVRP, when this project was established, CARB and both of the project administrators developed terms and conditions to highlight the policies set forth by the Board in more detail for consumers, and ensure a fair, equitable, and responsible project. More specifically, the terms and conditions are intended to notify consumers of the core requirements of the program prior to submitting

an application. Additionally, CARB and the project administrators developed an Implementation Manual, which includes the terms and conditions, to further define these rules and define roles and responsibilities. The Implementation Manuals are available at:

Clean Vehicle Assistance Program Implementation Manual:
https://cleanvehiclegrants.org/

CHDC: https://drivingcleandotchdcnrdotcom.wordpress.com/

These documents are incorporated into the proposed Funding Plan by reference and updated periodically throughout the year to reflect project changes after the Board adopts each funding plan and as other changes are necessary to provide further clarity.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits: This proposed funding would be available statewide, so it is not possible to estimate in advance exactly how much funding will be spent in and benefit disadvantaged communities, low-income communities, and low-income households. Based on program design, however, staff expects that much of this funding will be spent in and will benefit these communities and households because the project would be closely coordinated with EFMP Plus-up, which will continue to focus on benefiting consumers living in and near disadvantaged communities. As part of the Cap-and-Trade auction proceeds reporting requirements, CARB will track where funds are spent and report the portion that meets AB 1550 investment criteria.

Outcomes

CARB will continue to use data from the current CHDC project and Clean Vehicle Assistance Program as it becomes available to better understand the costs, types, and issues associated with vehicle purchased or leased, how well participant needs are met, how well the financing mechanisms work, and opportunities to continue or expand this project.

For FY 2018-19, the goal is to provide $10 million to expand the statewide project. For the statewide project, staff proposes a program that may include a loan loss reserve model that is designed to minimize the lender risk for loans made to lower-income consumers, in combination with a low cost loan and vehicle price buy-down to assist consumers by making a clean vehicle purchase more affordable. Together, both projects address barriers that disadvantaged communities' experience, such as the ability to finance a clean vehicle, affordability, and lack of infrastructure, and incorporates recommendations for increased funding and outreach, as identified in the draft SB 350 Guidance Document.

Because implementation of this project is in its early stages, staff has limited data upon which to estimate emission benefits. Based on the assumptions described in Appendix A, the proposed allocation of $10 million is estimated to 3,607 metric tons of

CO2 equivalent GHG emission reductions, 0.61 tons of NOx, 0.23 tons of PM 2.5, and 0.12 tons of ROG reductions. Staff will refine these estimates as more data become available.

CARB will report in Annual Reports and future Funding Plans the outcomes of this project, including GHG reductions achieved or anticipated using the appropriate CARB quantification methodology; progress in meeting or exceeding SB 535 and AB 1550 targets for investment in and benefits to disadvantaged communities; updates on economic, environmental, and public health co-benefits achieved or anticipated; and project locations. Metrics to measure progress for this project may include information on the loans made, types of vehicles utilized, the number of participants, and changes in access to mobility experienced by participants.

CLEAN MOBILITY OPTIONS FOR DISADVANTAGED COMMUNITIES

Recommended Low Carbon Transportation Allocation – $15 million

Project Overview

The Clean Mobility Options for Disadvantaged Communities pilot project consists of grant projects designed to address the barriers and transportation needs of low-income residents and those living in disadvantaged communities. In talking with low-income residents and those living in disadvantaged communities through the SB 350 Low-Income Barriers Study efforts, mobility needs are not the same in all disadvantaged communities and it is important to provide various options in order to be flexible and responsive to the transportation needs of specific communities. The project provides funding for various clean mobility options (other than vehicle ownership) in order to overcome those barriers and increase access to clean mobility options. The project provides funding for various clean mobility options that increase access to zero-emission and plug-in hybrid car sharing, vanpools, electric and regular bicycle sharing, ride-hailing, and other clean mobility options.

CARB will encourage these projects to link with current or future innovative mobility hub concepts, including co-located passenger rail, bus/shuttle, ride-hailing, public charging, and first mile/last mile transit solutions. In addition, the Energy Commission and the Strategic Growth Council (SGC) have invested in six clean mobility options projects, including car sharing, within the last year throughout California. CARB staff will continue to work in close coordination with the Energy Commission and SGC and use the lessons learned from each to help guide future investment decisions.

Current Project Status

Fiscal Year 2014-15

- BlueLA – The City of Los Angeles received $1.7 million for a zero-emission car share pilot project in four Los Angeles disadvantaged communities. Project partners include the Shared Use Mobility Center, several City of Los Angeles departments, and community-based organizations including the Coalition for Clean Air, Communities for a Better Environment, East LA Community Corporation, LA Mas, Korean Immigrant Workers Alliance, Move LA, PATH Ventures, and T.R.U.S.T. South LA. The project launched to the public in April 2018 with 25 electric vehicles and 35 chargers in 7 locations, and will grow to 100 vehicles and 200 chargers in 40 locations by the end of 2018.

- Our Community Car Share - Sacramento Metropolitan AQMD received $1.4 million for electric car sharing services for Sacramento subsidized multi-unit dwellings. Project partners include the City of Sacramento, Sacramento Housing Redevelopment Authority, Mutual Housing California, Sacramento Metropolitan

Utility District, and Zipcar. The original project launched in April 2018 with 8 vehicles supported by 8 level 2 chargers and one DC fast charger in four locations. An award of $1 million of expansion funding will allow the project to expand by adding 6 electric vehicles and chargers for 3 more subsidized multi-unit housing communities, and will add subsidized ride-hailing to increase access to more mobility options.

Fiscal Year 2016-17 (funds were not available in FY 2015-16)

CARB allocated $8 million for Clean Mobility Options Pilot Projects, split into a $6 million solicitation and $2 million for expansion of existing projects. A $6 million competitive solicitation resulted in offers of awards to five applicants. Due to the number of worthy project applications received, CARB moved $1 million of expansion funding and $1 million of Financing Assistance funding to support additional projects. When one project subsequently withdrew, CARB ended up awarding four new projects, expanded one existing project, and reallocated the remaining funds, as follows:

- Lift Line Paratransit Dial-a-Ride Electric Vehicle Transition Program – Community Bridges received a $268,219 grant for two electric ADA-equipped shuttle vans replacing internal combustion engine vans for Lift Line service in the Watsonville community. The community-based partner for this project is Ecology Action. The project includes two DC fast chargers and will serve about 700 disadvantaged community residents.

- Car Sharing and Mobility Hubs in Affordable Housing Pilot Project – Metropolitan Transportation Commission was awarded $2.25 million for an electric vehicle and ebike sharing pilot project. The project will serve about 2,800 disadvantaged community residents of low-income housing in San Jose, Oakland, and Richmond. The project includes 24 electric vehicles, 24 chargers, 18 ebikes, and subsidized ride-hail and public transit. Partners include Bay Area AQMD, Transform, GIG Car Share, Shared Use Mobility Center, AC Transit, Santa Clara Valley Transportation Authority, and the Greenlining Institute.

- Valley Air Zero-Emission Vehicle Pilot – San Joaquin Valley APCD was awarded $749,800 for an electric vehicle car sharing, vanpool, and ebike sharing project for about 1,000 disadvantaged community residents of Merced, Bakersfield, and West Fresno County. The project includes 12 electric vehicles, 30 chargers, and 16 ebikes. Partners include Green Commuter, Swiftmile, and CalSTART.

- Ecosystem of Shared Mobility – San Joaquin Valley APCD was awarded $2.25 million for an electric vehicle car sharing project and unique ride-matching application serving 7 disadvantaged community affordable housing complexes in rural Tulare and Kern. The project includes 25 electric vehicles, one electric van, and 19 chargers. Partners include the Shared Use Mobility Center, UC Davis Institute of Transportation Studies, Sigala Inc., Self Help Enterprises, and MOVE.

These four projects are expected to launch in late 2018 and early 2019.

- An additional $1 million of expansion funding was awarded to expand the FY 2014-15 Sacramento car sharing pilot project.

- $2.25 million that remained after an awarded project withdrew was reallocated to CVRP for Low-Income Households.

Fiscal Year 2017-18

CARB allocated $17 million in FY 2017-18 for a competitive solicitation for a statewide administrator to award funding on a first-come, first-served basis for small, car sharing and ridesharing projects serving disadvantaged communities. A competitive solicitation will be released in late 2018 and staff will be working to award a grant for the statewide administrator.

In addition, staff are working with the existing car sharing pilot project administrators on the $5 million reserved for expansion to assess current progress and the need for expansion.

Implementation Challenges and Lessons Learned

The two initial car sharing projects have had challenges in both project development and implementation. For example, both projects had unforeseen challenges arise on the on the installation of charging infrastructure. For charging sites located on public streets required additional review and approval from multiple local agencies that substantially extended the amount of time needed for installation. These challenges are still occurring and are being addressed by the program administrators.

In addition, initial outreach and education to potential users did not prove to be as successful as planned. These challenges required changes to program outreach and changes in the way community members were engaged and enrolled into the programs. By allowing flexibilities within these pilot projects, CARB staff worked with the program administrators in coming up with solutions that allowed for the projects to continue moving forward and making adjustments to help ensure they were successfully launched and implemented. We will continue to work with all program administrators, especially as the new projects come on board, to ensure that lessons learned will be shared and project models can be flexible to the needs to of their targeted community members.

Staff Proposal for FY 2018-19

Staff recommends a $15 million allocation for FY 2018-19 to the Clean Mobility Options statewide administrator pilot project who will continue to award funding for vehicles and equipment on a first-come, first served basis to small car sharing and ridesharing projects serving low-income residents and disadvantaged communities. Staff believes

that the demand for these types of projects will be met by this additional allocation as a result of the analysis done as part of the three year projections in the FY 2016-17 Funding Plan. For this pilot project, shared mobility and ridesharing is the shared use of zero-emission or near zero-emission mobility options including, but not limited to, zero-emission vehicles, fuel cell vehicles, plug-in hybrid electric vehicles, bicycles, electric bicycles (e-bike), electric scooters, vanpools, microtransit, or other modes that enables users to have short term access to transportation modes on an "as needed" basis. Rideshare strategies for this pilot project can also be combined with one or more other transportation modes, such as public transportation and walking.

Project Solicitation: Staff proposes that this grant funding be awarded by issuing a competitive solicitation for another statewide administrator(s), providing expansion funding to successful pilots including the statewide administrator funded with FY 2017-18 funds without a competitive solicitation, or a combination of these options. Staff will analyze the status of the statewide administrator in 2019 to determine the best option to ensure funds are provided to the communities successfully.

In addition, staff proposes the flexibility to direct any funding that is not awarded for Clean Mobility Options for Disadvantaged Communities projects to fund other transportation equity projects that show demand as described in Chapter 6.

The light-duty transportation sector is a quickly changing landscape. Staff proposes that a Clean Mobility Options administrator be given flexibility to work with CARB to evaluate and implement innovative approaches to increasing access to clean transportation in disadvantaged communities and lower-income consumers. Other approaches that increase access to clean transportation and mobility options, continue to increase the involvement of local community organizations, and provide co-benefits such as workforce training and job creation in these communities may also be considered.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits: These projects provide direct benefits to residents in disadvantaged communities. After analyzing barriers administrators faced in the current projects and in talking with stakeholders in the SB 350 barriers study and the Funding Plan process, staff proposes that Clean Mobility Options be expanded to projects that may be outside but will benefit disadvantaged communities thereby providing better access to the residents of these communities. Because AB 1550 prohibits "double counting" investments for determining compliance with minimum disadvantaged community and low-income household/community targets, staff will not count any of the Clean Mobility Options funding as being within and benefiting low-income communities or benefiting low-income households even though staff expects some of the funds will meet those criteria as well.

Outcomes

The grant for the statewide Clean Mobility Pilot project is designed to meet the pressing needs to assist low-income residents and those living in and near disadvantaged communities. This project is responding to the quickly changing transportation landscape by providing a testbed for new ideas that combine strategies and technologies into urban transportation hub locations. CARB will continue to use data from the current projects as it becomes available to better understand the costs, strategies, and issues associated with introducing car sharing and other clean mobility options to low-income residents and disadvantaged communities. In addition, CARB will continue to collaborate with Energy Commission and SGC along with local governments to better understand these projects, review lessons learned, and look for opportunities for expanding and/or duplicating existing successful clean mobility projects. Finally, these projects will be coordinated with the efforts of the One-Stop-Shop pilot project described later in this document.

Staff cannot estimate the exact emission benefits until projects are selected and implemented. Measures of success include the numbers and types of clean vehicles, chargers, and clean mobility options introduced into disadvantaged communities, number of disadvantaged community residents participating as drivers or riders, vehicle miles traveled and number of trips taken, and improvements in access to mobility experienced by participants. Staff provides an example of the magnitude of anticipated benefits by quantifying the emission reductions associated with a “sample” project based on assumptions described in Appendix A. The proposed allocation of $15 million is estimated to provide 1,849 metrics tons of CO2 equivalent GHG emission reductions, 0.23 tons of NOx, 0.10 tons of PM 2.5, and 0.05 tons of ROG reductions.

CARB will report in Annual Reports and future Funding Plans the outcomes of this project including GHG reductions achieved or anticipated using the appropriate CARB quantification methodology; progress in meeting or exceeding SB 535 and AB 1550 targets for investment in and benefits to disadvantaged communities; update on economic, environmental, and public health co-benefits achieved or anticipated; and project locations. Metrics to measure progress for this project may include information on the types of vehicles utilized, the number of participants, numbers of trips and vehicle miles traveled, and changes in access to mobility experienced by participants.

AGRICULTURAL WORKER VANPOOLS

Recommended Low Carbon Transportation Allocation – $3 million

Project Overview

The grant for the Agricultural Worker Vanpools Pilot Project expands access to clean transportation vanpools for agricultural workers, and achieves emission reduction benefits by providing incentives for advanced technology vehicles instead of conventional vehicles. This project meets a basic transportation need of agricultural workers, while also resulting in immediate emission reductions benefits within low-income and disadvantaged communities, and promotes increased acceptance and understanding of clean, advanced technology vehicles.

Current Project Status

The FY 2016-17 and FY 2017-18 project funds were combined into one solicitation focused on serving disadvantaged communities in the San Joaquin Valley, while allowing for expansion to other disadvantaged communities. The California Vanpool Authority (CalVans) was competitively selected to implement this $6 million grant. CARB's grant funds, combined with CalVans $1.5 million cash match, provide up to 154, 15-passenger hybrid vans serving eight San Joaquin Counties, ranging from San Joaquin in the north to Kern in the south, with expansion to other disadvantaged communities outside of the San Joaquin Valley. Vehicles are expected to be on the road in late 2018. The project includes a strong community outreach and education component, and includes ridership surveys and opportunities for participant feedback.

Staff Proposal for FY 2018-19

Staff proposes $3 million for FY 2018-19, with an emphasis on projects benefiting disadvantaged communities, while also allowing expansion into low-income communities. Stakeholder feedback and current project data suggests that this level of funding will largely meet current demand, but future funding is needed to meet the transportation demands of agricultural workers in disadvantaged and low-income communities statewide. Staff also proposes the flexibility to expand funding for the existing grant if it meets project milestones and the Grantee provides an acceptable plan for expansion, or to include this type of project as an option in the Clean Mobility Options pilot project.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits:
Consistent with FY 2016-17 Agricultural Worker Vanpools in the San Joaquin Valley pilot project requirements, staff proposes that funding be prioritized to increase access for agricultural workers working in disadvantaged communities and then low-income communities. AB 1550 prohibits "double counting" investments for determining compliance with minimum disadvantaged community and low-income

household/community targets. Staff will count any of the Agricultural Worker Vanpools pilot project funding as benefiting low-income and disadvantaged communities. Staff's approach is already consistent with recently enacted legislation, AB 2006 (Eggman, Chapter 364, Statutes of 2018), which requires the project to serve disadvantaged communities, as defined, and low-income communities, as defined, and to allocate a minimum of 25% of the moneys appropriated for agricultural vanpool programs to those programs servicing low-income communities.

Project Solicitation: Staff proposes that this grant funding be awarded to expand the existing CalVans project if that project is substantially meeting project milestones and shows additional demand or via a competitive solicitation for a new administrator.

Outcomes

The proposed allocation is expected to fund about 70 vans, meeting demand and providing an estimated 2,300 metric tons of CO2 equivalent GHG emission reductions. The project would also provide about 0.14 tons of NOx, 0.21 tons of PM 2.5, and 0.02 tons of ROG emission reductions from advanced technology vehicles replacing conventional gasoline vehicles. Appendix A provides additional details on the emission estimates. The project may achieve more significant emission benefits through VMT reductions and the displacement of single owner vehicles, however, there is not project data yet to quantify these potential emission reductions.

Metrics to measure progress for this project include information on the types of vehicles purchased, the number of disadvantaged community residents signed up for services, the vehicle miles traveled and number of trips taken, and changes in access to mobility experienced by participants. These metrics will be used to guide future shared mobility investments and adaptively manage funded projects.

CARB will report in Annual Reports and future Funding Plans the outcomes of this project, including GHG reductions achieved or anticipated using the appropriate CARB quantification methodology; progress in meeting or exceeding SB 535 and AB 1550 targets for investment in and benefits to disadvantaged communities; updates on economic, environmental, and public health co-benefits achieved or anticipated; and project locations. Metrics to measure progress for this project may include information on the types of vehicles purchased, the number of workers signed up for services, the vehicle miles traveled and number of trips taken, and changes in access to mobility experienced by participants.

RURAL SCHOOL BUS PILOT

Recommended Low Carbon Transportation Allocation – $15 Million

Project Overview

The objective of the Rural School Bus Pilot Project is a grant project designed to enhance the turnover of the California school bus fleets to lower-carbon transportation choices. The project provides funding for zero-emission and new conventionally-fueled school buses that use renewable fuels. The project prioritizes older school buses with higher mileage in small and medium sized air districts (as defined by CAPCOA). The project provides immediate GHG emission reductions and reduces schoolchildren's exposure to cancer-causing and smog-forming pollution.

Current Project Status

Fiscal Year 2016-17

- CARB awarded a $15 million grant to the North Coast Unified AQMD to administer the project. A competitive solicitation for school districts to apply for funding statewide in March 2017 resulted in 422 applications requesting $127 million. Approximately 30 zero-emission and 10 internal-combustion renewable-fueled buses have been funded. A handful are already in service transporting schoolchildren. Approximately one-fifth of buses funded to date are located in disadvantaged or low-income communities.

Fiscal Year 2017-18:

- A $10 million FY 2017-18 grant agreement with North Coast Unified AQMD was executed in May 2018. A new solicitation was held in summer 2018.
- CARB reallocated $15 million of FY 2017-18 reserve funding for a total of $25 million to meet the strong demand for cleaner school buses.
- The grant will continue to fund school buses using the same priorities. FY 2017-18 allocation will fund approximately 60 new school buses.

Staff Proposal for FY 2018-19

Several state and local programs fund school bus replacements, including the Carl Moyer Program, local air district funds, early-action funding for communities identified under the Community Air Protection Program, and the Energy Commission's one-time school bus replacement project funded by SB 110 (Committee on Budget and Fiscal Review, Chapter 55, Statutes of 2017). However, a wide variety of important, cost-effective projects place demand on several of these funding sources, and no one source can fully modernize the California school bus fleet. Given that schoolchildren are more sensitive to air pollution because their lungs are still developing, the Board has repeatedly stated the importance of cleaning up the California school bus fleet. Based

on the large remaining need for cleaner school buses, and demand for this project in particular, staff recommend allocating $15 million for FY 2018-19.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits
Rural school bus funding is prioritized first to applicants in small air districts, medium air districts, and then large air districts. Staff is not proposing a minimum disadvantaged community investment target for these funds because rural areas in small air districts infrequently meet the definition of disadvantaged communities, despite their lack of access to school bus replacement funds. The priority air districts do contain a large number of low-income communities, so staff expects a significant portion of this funding may be spent in low-income communities. As part of the Cap-and-Trade auction proceeds reporting requirements, CARB will track where funds are spent, in order to calculate and report the portion that meet AB 1550 investment criteria.

Project Solicitation
Staff proposes to continue implementing this project for the FY 2018-19 allocation with the North Coast Unified AQMD as the project administrator. The air district may continue to fund projects from the waiting list generated from the FY 17-18 application period, or hold a new solicitation.

Outcomes

This project continues to encourage turnover of California school bus fleets to lower carbon transportation choices. The proposed $15 million allocation for FY 2018-19 could fund approximately 30 to 60 additional new school buses. Depending on the technology and school bus size purchased, nearly 12,000 metric tons of CO_2 equivalent GHG emission reductions could result from this project. Criteria pollutant and toxic air contaminant emission reductions are also expected as the advanced-technology school buses replace conventionally-fueled engines. Appendix A provides additional details on the emission estimates.

With approximately 21,000 diesel-fueled or gasoline-fueled school buses operating throughout California, this project provides opportunities to transform California's school bus fleet and meet zero-emission vehicle deployment goals along with near-term and long-term air quality goals. Additional funding will be needed to continue this work as staff expects demand for advanced technology school buses to continue for years as the existing fleet continues to age.

CLEAN MOBILITY IN SCHOOLS

Proposed Low Carbon Transportation Allocation – $10 Million

Project Overview

The Clean Mobility in Schools Pilot Project is a multi-faceted mobility grant related to schools that will provide funding to reduce GHG emissions in kindergarten through twelfth grade (K-12) schools located in a disadvantaged community. The project resulted from the SB 350 Guidance Document and is designed to provide a showcase for a broad range of clean mobility options through deploying and demonstrating GHG emission reduction techniques, helping to facilitate 'greening' one or more schools located in disadvantaged communities, and eventually leading to a larger statewide project. Clean mobility options in schools protect the environment, keep teachers and students healthy, and promote environmental literacy.

The goal of this new grant is to deploy synergistic GHG emission reduction techniques that can be emulated on school campuses statewide. This funding provides for the electrification of the transportation fleets, including vehicles, infrastructure, and education and awareness, and other efforts to encourage clean mobility in and around schools. Partnerships with other state and local agencies are encouraged to implement and fund other green technologies and practices along with additional outreach about these efforts.

This project supports the statutory goals of SB 1275 and SB 350 recommendations by prioritizing funds for clean light-duty and heavy-duty transportation, transforming transportation by: encouraging car sharing and bike sharing; increasing access in disadvantaged communities; increasing awareness of clean transportation and mobility options by educating the K-12 students, parents, school employees, and others in the surrounding community. Outreach to other schools may include sharing or loaning the newly acquired advanced technology vehicles and equipment.

Staff Proposal for FY 2018-19

CARB staff proposes an allocation of $10 million in grant funds for FY 2018-19. CARB staff will use a public work group process to develop project parameters, including development of criteria for projects that are eligible for funding.

Clean mobility projects could include both light-duty and heavy-duty zero-emission vehicles, charging infrastructure, and other mobility options. Examples include, but are not limited to:

- Zero-emission school buses,
- Zero-emission white fleet vehicles,
- Light-duty and heavy-duty vehicle charging infrastructure, and

- Zero-emission passenger cars for staff to share on a rotating basis thereby familiarizing staff and students with the technology and getting emission reductions by parking the conventional vehicle that would otherwise be driven.
- Active transportation projects (such as bicycle sharing), at the suggestion of stakeholders during the workshop and working group process,
- Additional synergistic GHG emission reductions could come from zero-emission lawn and garden equipment; installation of solar and battery back-up; and other technologies or techniques.

All projects could include classroom instruction and community outreach about the vehicle technologies and other GHG emission reduction ideas.

Project Solicitation: These funds will be allocated through a competitive solicitation process, directed to assist in deployment and demonstration of complementary GHG emission reduction techniques in one or more K-12 schools primarily located in or near disadvantaged communities.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits: Staff proposes that all funds allocated for the Clean Mobility in Schools Pilot Project benefit disadvantaged communities. Because AB 1550 prohibits "double counting" investments for determining compliance with minimum disadvantaged community and low-income household/community targets, staff will not count any of the Clean Mobility in Schools Pilot Project funding as being within and benefiting low-income communities or benefiting low-income households where they overlap even though staff expects some of the funds will meet those criteria as well.

Outcomes

This project encourages the turnover of the California school bus fleet and white fleet vehicles to lower carbon transportation choices as well as encourages holistically reducing greenhouse gas emissions on school campuses. The proposed $10 million allocation is estimated to provide 6,400 metric tons of CO_2 equivalent GHG emission reductions. Appendix A provides additional details on the emission estimates. Criteria pollutant and toxic air contaminant emission reduction are also expected as the advanced technology vehicles and equipment replace conventional-fueled engines. Metrics such as data on zero-emission miles will be used to assess the success of these incentives.

This pilot project provides the opportunity to reduce GHG and other air pollution emissions, meet zero-emission vehicle deployment goals, and provide familiarity to zero-emission vehicle technology and other advanced mobility options to the next generation. There are over 10,000 schools throughout California that could adopt similar green technologies and practices. Additional funding will be needed to continue financially supporting schools to make this transformation.

FUNDING RESERVE

Recommended Low Carbon Transportation Allocation – $6 million

Staff recommends reserving up to $6 million to be allocated in early to mid-2019 to a transportation equity project (or projects) showing demand. Possible project recipients include one or more of the projects listed above or the equity-related CVRP Rebates for Low-Income Households project.

CHAPTER 4: HEAVY-DUTY VEHICLE AND OFF-ROAD EQUIPMENT INVESTMENTS

Achieving California's air quality and climate change goals requires a transformation of the on-road and off-road fleet to one that utilizes zero-emission and low NOx technologies operating with the cleanest, lowest carbon fuels. CARB staff's proposed investments for heavy-duty vehicles and off-road equipment are intended to support this transformation by demonstrating emerging technologies, advancing commercial viability through pilot and other deployment projects, and catalyzing further technological development by the private sector. CARB's investment in this transformation also supports progress towards creating the jobs of the future and achieving and maintaining healthy and sustainable communities for all Californians.

This section of the Funding Plan summarizes progress on current projects, then presents staff's proposed allocations and recommendations for heavy-duty vehicle and off-road equipment investments. This includes investments for the following projects:

- Clean Truck and Bus Vouchers (HVIP + Low NOx Engine Incentives)
- Zero- and Near Zero-Emission Freight Facilities Project
- Truck Loan Assistance Program
- Diesel Particulate Filter Retrofit Replacements

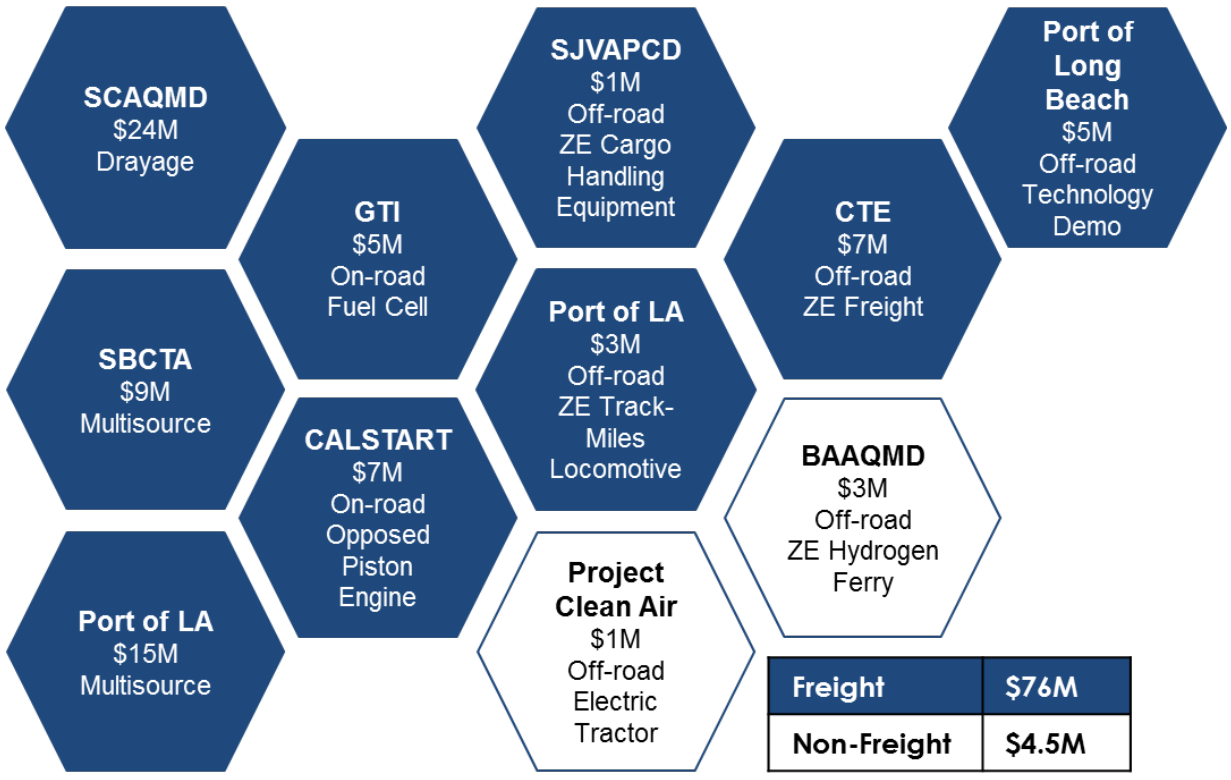
As was discussed in the introduction, the Low Carbon Transportation Program and AQIP are part of a much larger clean transportation funding portfolio, and the intent of this program is to move the needle in terms of advancing technologies and to improve near- and long-term air quality in California.

Portfolio of Incentives

Development and commercialization of advanced heavy-duty technologies requires a portfolio of incentives that provide funding for the range of technologies needed to achieve both near-term and long-term emission reductions. Programs such as the Carl Moyer Program, the Proposition 1B Goods Movement Emission Reduction Program, and the AQIP-funded Truck Loan Assistance Program achieve near-term emission reductions through incentivizing fleet turnover. These programs complement Low Carbon Transportation and other AQIP projects that support the transition to advanced technologies for long-term emission reductions. Low Carbon Transportation and AQIP investments have traditionally funded multiple technologies at different points on their commercialization arcs in order to support technologies that are providing emission reductions today, as well as the technologies that need to mature to meet future goals. These longer-term program benefits accrue primarily from overcoming deployment barriers, reducing production costs, promoting consumer acceptance, and accelerating technology transfer to other sectors.

The transition toward cleaner, more efficient heavy-duty vehicles and off-road equipment will require a substantial financial commitment from the public and private sectors. The relatively low price of diesel fuel, current lack of high volume advanced technology manufacturing, and resulting large price differential are all obstacles to making this happen. The Low Carbon Transportation investments made thus far have had a positive impact, moving towards achieving lifecycle cost parity between conventional and advanced technology. For example, the costs associated with zero-emission transit buses, both battery electric and fuel cell electric, have dropped in recent years due to early commercial deployment projects such as the Zero-Emission Truck and Bus Pilot Commercial Deployment Projects and HVIP. Additionally, as technologies continue to advance, technology transfer to new applications, such as drayage trucks and off-road equipment, will be supported by projects such as Advanced Technology Demonstration Projects and Zero-Emission Off-Road Freight Voucher Incentive Project. CARB's investments in Advanced Technology Demonstrations and Truck and Bus Pilot Commercial Deployment Projects are paving the way for this transition. Figure 2 and Figure 3 summarize CARB's investments in the demonstration and early commercial deployment of important technologies and applications critical in helping California meet its long-term air quality and GHG goals.

Figure 2: Summary of Advanced Technology Projects



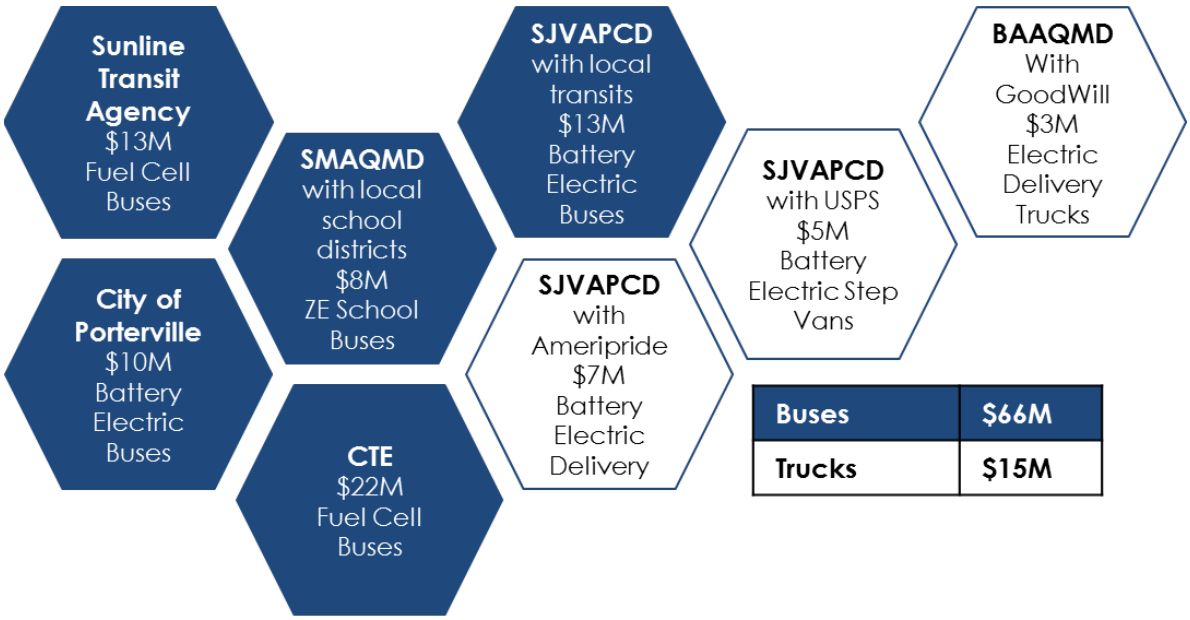
Note: Funding amount rounded to the millions

- **South Coast Air Quality Management District (SCAQMD) -** $24M – Demonstrate 44 battery-electric, plug-in hybrid electric, and range-extending Low NOx Trucks at the ports of LA, Long Beach, San Diego, and Oakland. Nine battery-electric trucks and one plug-in hybrid electric truck have been deployed along with supporting EVSE infrastructure with five different trucking fleets serving the different ports.
- **San Bernardino County Transportation Agency (SBCTA)** - $9M – Demonstrate 23 Class 8 battery-electric yard trucks and four Class 5 battery-electric service trucks at 2 rail yards and a freight distribution center. As of June 2018, nine Class 8 battery yard trucks, and three Class 5 battery service trucks have been deployed.
- **Los Angeles Harbor Department (Port of LA) -** $15M - Multiple zero- and near zero-emission technologies; microgrid; battery storage; energy management system. Two drayage trucks and two yard tractors have been delivered with three forklifts to be delivered by the end of the year. Microgrid system has been installed and additional infrastructure components, such as new transformer and the ShoreKat system, have been commissioned.
- **Gas Technology Institute (GTI) –** $5M - Demonstration of fuel cell class-8 on-road trucks in two phases with Hydrogenics and Loop. Grant was executed in June 2018 and the project is in progress.
- **CALSTART –** $7M - Demonstration of an opposed-piston engine on two Class-8 On-Road Trucks. Achates is developing engines and Walmart and Tyson foods will demonstrate. Grant was executed end of January. Project is in progress.
- **San Joaquin Valley Air Pollution Control District (SJVAPCD) –** $1M – Deploy two new battery-electric 30,000 pound capacity forklifts with additional cargo handling attachments (off-road cargo truck bed and scissor lift), which will be demonstrated at the Port of Stockton. Grant was executed in June 2018 and expected deployment in Q4 of 2018.
- **Project Clean Air –** $1M - Develop and deploy four 50-hp all-electric agriculture tractors and an electric Class 6 truck, which will be outfitted with the ability to charge the tractors at remote locations, essentially becoming a mobile charger for the tractors. The technology will developed by HummingbirdEV and demonstrated at various sites in the San Joaquin area. Grant was executed in May 2018 and expected phased deployment of two electric tractors in Q3 of 2019 and two more electric tractors in Q4 of 2019.
- **Los Angeles Harbor Department (Port of LA) –** $3M - Demonstrate a battery-electric switcher locomotive in freight service. The project will involve integrating battery and electric components developed by VeRail to the currently ongoing “Near-Zero Emissions Locomotive Demonstration Project” under the Port Technology Advancement Program (funded in collaboration with SCAQMD, United States Environmental Protection Agency, and Port of Long Beach). Grant was executed in May 2018 and expected deployment in Q2 of 2019.
- **Bay Area Air Quality Management District (BAAQMD) –** $3M - Develop and deploy a hydrogen fuel cell ferry providing passenger service between the Port of San Francisco, Port of Oakland, Port of Redwood City, and the City of

Martinez. Grant was executed in May 2018 and expected deployment in Q3 of 2019.

- **Center for Transportation and the Environment (CTE) –** $7M - Develop and deploy a fuel cell range extended electric top loader with wireless inductive charging. Nuvera, WAVE, and Hyster-Yale Group are all working together to develop this advanced piece of equipment, and it will be operated at the Port of Los Angeles by Eagle Marine Services. Grant was executed in May 2018 and expected deployment in Q3 of 2019.
- **City of Long Beach Harbor Department (Port of Long Beach) -** $5M - Two main elements: First, demonstrate three battery-electric top handlers with collaboration between BYD and Taylor Machine Works. Second, perform a head-to-head comparison of a battery electric yard truck and a fuel cell yard truck. The battery electric yard truck will be developed by TransPower and Kalmar, and the fuel cell yard truck will be developed by LOOP Energy and China National Heavy-Duty Truck Group. All of the equipment will be demonstrated at the Port of Long Beach at two different terminals. Grant was executed in May 2018 and expected deployment in Q3 of 2019.

Figure 3: Summary of Truck and Bus Pilot Commercial Deployment Projects



Note: Funding amount rounded to the millions

- **San Joaquin Valley Air Pollution Control District (SJVAPCD) –** $13M – 15 Proterra battery transit buses deployed in 5 transit agencies; depot and in-route chargers. Fresno County Rural Transit Agency received 5 buses, Visalia Transit Agency received 3 buses, and San Joaquin Regional Transit District received 2 buses. Modesto Transit Agency will get their 3 buses in October 2018. Charging infrastructure is being installed prior to vehicle deployment in fall 2018.

- **Center for Transportation and the Environment (CTE) –** $22M - 20 New Flyer Fuel cell bus project, 10 to be deployed by OCTA and 10 to be deployed by ACTransit; new Trillium/Air Products H2 station at OCTA and upgraded H2 station at ACTransit. OCTA will receive the first bus in September 2018, with the remaining 9 buses delivered before the end of 2018. The new OCTA hydrogen station will be operational at the end of 2018. AC Transit will receive their first bus in October 2018, with the remaining buses delivered by March 2019.
- **Sunline Transit Agency–** $13M - 5 New Flyer Fuel Cell buses operated out of 1000 Palms and new H2 station by NelH2/Proton OnSite. Buses will be delivered to SunLine by the end of 2018, and the hydrogen station will be operational by March 2019. New buses will fuel at SunLine's existing hydrogen station.
- **City of Porterville–** $10M –10 GreenPower battery transit buses deployed throughout Porterville; depot chargers and five buses have been delivered for limited deployment, with full deployment pending installation of charging infrastructure, which is anticipated to be complete by the end of 2018. The remaining 5 buses will be delivered by the end of 2018.
- **Sacramento Metropolitan Air Quality Management District (SMAQMD) –** $8M – deploy 29 state-of-the-art zero-emission school buses with 29 Electrical Vehicle Supply Equipment charging ports in disadvantage communities in the Greater Sacramento Region, including Elk Grove, Sacramento City, and Twin Rivers Unified School Districts.
- **San Joaquin Valley Air Pollution Control District (SJVAPCD) –** $7M – 20 battery linen delivery trucks (with Motiv powerdrive) operating out of 4 CV hubs; depot chargers. AmeriPride facility in Stockton received 4 trucks, Fresno facility received 2 trucks, and Merced facility received 4 trucks for a total of 10 trucks that are waiting for infrastructure to be installed before deployment. The second batch of 10 trucks will be delivered this fall along with infrastructure.
- **San Joaquin Valley Air Pollution Control District (SJVAPCD) –** $5M – 15 battery-electric class 4 mail step vans (Motiv and EDI powertrains) operating out of 2 USPS hubs; depot chargers
- **Bay Area Air Quality Management District (BAAQMD) – $**3M - 10 BYD Class 6 delivery trucks and 1 BYD Class 8 debris hauler deployed by Goodwill Industries in SF area; depot chargers. Project is in progress with chargers will be installed in September 2018.

In addition to the projects listed above, CARB also issued a solicitation for the Zero- and Near Zero-Emission Freight Facilities Project (Freight Facilities Project) under the Fiscal Year 2017-18 Funding Plan. CARB's goal under the Freight Facility Project solicitation is to support bold, transformative emission reduction strategies that can be emulated throughout freight facilities statewide. Total funding included up to $100 million from the FY 2017-18 Low Carbon Transportation Allocation and $50 million from the Trade Corridor Enhancement Account (TCEA). It is anticipated that up to $150 million will be available under this Solicitation for the Freight Facilities Project and at least $50 million of the total funding will be spent directly on zero- and near zero-emission warehouses, as required under SB 132. The solicitation closed on July 19, 2018 and CARB received

13 applications totaling approximately $220 million. Addition information on selected projects will be provided in the next Funding Plan.

Three-Year Investment Strategy for Heavy-Duty Vehicles and Off-Road Equipment from Low Carbon Transportation and the Air Quality Improvement Program

In the FY 2017-18 Funding Plan, staff developed the first "Three-Year Investment Strategy for Heavy-Duty Vehicles and Off-Road Equipment from Low Carbon Transportation and the Air Quality Improvement Program" (Three-Year Heavy-Duty Strategy). Staff provided a three-year strategy for heavy-duty vehicle and off-road equipment incentives to ensure that CARB continues to meet its goal of advancing technology and establishing sustainable markets for technologies. The plan also laid the framework for the effective investment of Low Carbon Transportation and AQIP funds. Three-Year Heavy-Duty Strategy is built upon three connected principles: maintaining momentum of previous investments across the commercialization arc, prioritizing investments in three technology groupings, and overlaying the organizational concept of beachheads.

The Three-Year Heavy-Duty Strategy developed last year has helped signal CARB's focus for Low Carbon Transportation and AQIP investments and sparked dialogue with other agencies to stretch public funding further with equal or greater impact. Augmenting the efficacy of these investments has been bolstered by identifying beachheads that can be built upon, much like a foundation, to enable further expansion of a given technology into follow-on applications later. The development of a sequenced roadmap, one that recognizes the different stages of the commercialization process for each technology, sector, and application, while leveraging private sector investments, is essential.

Updates being made for FY 2018-19 are intended to reflect current technology statuses and make recommendations based on the best available information. The foundations of the document (such as the cornerstone concept of beachheads and the principles of technology advancement) remain integral in this update and CARB intends to continue funding along beachheads. The following areas have been updated:

- Technology Status Snap-Shots
- Recommendations for Investment Priorities to Advance Long-Term Pathways table

More information on how CARB funds technologies at different levels of development to stock the innovation pipeline and why these three strategies are integral to CARB's

investment strategy can be found in last year's Three-Year Heavy-Duty Investment Strategy.

Proposed Project Allocations for Heavy-Duty Vehicle and Off-Road Equipment Investments

In 2014, SB 1204 created the California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program, which utilizes cap and trade revenues for the development, demonstration, pre-commercial pilot, and early commercial deployment of zero- and near zero-emission truck, bus, and off-road vehicle and equipment technologies. SB 1204 also prioritizes certain types of heavy-duty projects, including those that provide a benefit to disadvantaged communities.

For FY 2018-19, the Legislature directed a total of $180 million from the Greenhouse Gas Reduction Fund, through Low Carbon Transportation Program for heavy-duty vehicle and off-road equipment projects. This includes $125 million to continue funding Clean Truck and Bus Vouchers, which supports zero-emission and hybrid heavy-duty on-road vehicles and low NOx engines. The allocation also includes $55 million to fund freight equipment advanced demonstration and pilot commercial deployment projects, including ships at berth. The Zero- and Near Zero-Emission Freight Facilities Project, described above, was approved in the FY 2017-18 Funding Plan with a total allocation of $150 million. The solicitation for the project was over-subscribed by almost $70 million. Staff is proposing to use the FY 2018-19 $55 million allocation to split funds across funding cycles to increase the expenditure timelines for projects selected, to fund additional well-qualified projects from the solicitation, or, if insufficient well-qualified projects remain, to fund projects identified as priority in the three year investment strategy. The proposed heavy-duty vehicle and off-road equipment projects support SB 1204's overarching vision, described in Appendix B, for the phases of technology development and deployment, with a focus on moving technologies through the commercialization process. Additionally, staff will continue the development and implementation of the Zero-Emission Off-Road Freight Voucher Incentive project, which is funded with FY 2017-18 Low Carbon Transportation investments.

AQIP funding is directed to continue the criteria pollutant and air toxics-focused Truck Loan Assistance Program to support small fleet turnover. The truck loan program is expected to the see an increase in demand for compliance as a result of a new law, SB 1, which will only allow cleaner compliant trucks to be registered by the DMV. In response, the majority of the AQIP funds would be directed to the Truck Loan Assistance Program to meet the expected increase in fleet demand. Staff also proposes $3 million in AQIP funding be used on a first-come, first-served basis to support filter substrate replacements for existing heavy-duty vehicles equipped with recalled filters. The proposed AQIP funds for truck filter replacements reduce uncontrolled criteria and toxic air contaminant emissions by helping replace affected filters.

Further details of the projects are included in this chapter. The update to the Three-Year Heavy-Duty Strategy is included in Chapter 5 of this Funding Plan. A summary of the projects and their respective proposed funding allocations from Low Carbon Transportation and AQIP is shown in Table 12.

Table 12: Summary of Proposed Heavy-Duty Vehicle and Off-Road Equipment Project Allocations

Project Category	**Project Allocation by Funding Source** (millions)
HEAVY-DUTY VEHICLE AND OFF-ROAD EQUIPMENT INVESTMENTS (SB 1204)	
Clean Truck and Bus Vouchers (HVIP + Low NOx Engine Incentives)	$125
Zero- and Near Zero-Emission Freight Facilities Project	$55
AQIP-FUNDED HEAVY-DUTY INVESTMENTS	
Truck Loan Assistance Program	$25.6
Diesel Particulate Filter Retrofit Replacements	$3
Total	**$208.6**

Clean Truck and Bus Vouchers (HVIP and Low NOx Engine Incentives)

Low Carbon Transportation Appropriation – $125 million

Project Overview

Clean truck and bus voucher incentives are successfully bringing zero-emission and other clean heavy-duty vehicle technology to California. The Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) and Low NOx Engine Incentives are the cornerstone of advanced technology heavy-duty incentives, providing funding since 2010 to support the long-term transition to zero-emission vehicles in the heavy-duty market, as well as supporting investments in near-term technology to help meet health-based ambient air quality standards. Incentives for low NOx engines began in 2016, corresponding with the introduction of the first engine certified to an optional low NOx standard – with up to 90 percent fewer NOx emissions than an engine meeting today's mandatory standards. Voucher incentives complement other programs in CARB's heavy-duty funding portfolio and provides a streamlined application process without requiring scrapping an existing vehicle.

Incentives provide vouchers of up to $300,000 for California purchasers and lessees of zero-emission trucks and buses, up to $30,000 for eligible hybrid trucks and buses, and up to $40,000 for low NOx engines on a first-come, first-served basis. In addition, HVIP provides increased incentives up to $15,000 for fleets purchasing zero-emission vehicles located in disadvantaged communities.

Through SB 856, the Legislature directed $125 million for clean truck and bus vouchers, and provides an opportunity for California to continue to invest in the deployment of clean heavy-duty technologies in new vehicle applications and fully meet market demand. Building on the success of past HVIP investments, we are now seeing new manufacturers enter the market with technologies transferring to heavier weight classes, such as 60-foot transit buses and Class 8 trucks. For low NOx engines, the release of the 11.9-Liter Low NOx Cummins Westport Engine has begun expanding low NOx technology availability to Class 8 trucks. Recommended changes to funding amounts and other criteria are proposed later in this section.

Staff anticipates that the $125 million Low Carbon Transportation appropriation coupled with the approximately $80 million in carry over funds (includes $8 million AQIP for low NOx only) will fully meet demand for all eligible technologies through and beyond the FY 2018-19 budget cycle. However, staff will re-evaluate the funding status at the start of the fourth quarter of the fiscal year.

HVIP and Low NOx Engine Incentives will continue to support the statutory goals of SB 1204 by prioritizing funds for early commercial clean heavy-duty vehicles and engines. The proposed HVIP and Low NOx Engine Incentive funding will ensure that at least 20 percent of Low Carbon Transportation truck funding supports early commercial

deployment of existing zero- and near zero-emission heavy-duty truck technology. These projects are intended to help accelerate the introduction of the next generation of cleaner heavy-duty vehicles and engines with priority given to projects that benefit disadvantaged communities. We expect to significantly exceed the 20 percent requirement in SB 1204 through the investments made in this project.

To date, about two thirds of the HVIP and Low NOx Engine Incentives funding awarded has benefited disadvantaged communities, as reported in the *Annual Report to the Legislature on California Climate Investments*, March 2018.[5] HVIP and Low NOx Engine Incentives will continue to be implemented on a first-come, first-served, statewide basis. CARB staff uses historical data to estimate in advance how much of this funding is expected to go to vehicles domiciled in disadvantaged communities. As part of the reporting requirements associated with Low Carbon Transportation funding, CARB will track where these funds are spent so the portion that is spent in disadvantaged and low-income communities can be calculated and reported in annual reports to the Legislature.

CURRENT PROJECT STATUS

HVIP and Low NOx Engine Incentives have supported the purchase of 1,264 zero-emission trucks and buses, 2,392 hybrid trucks, 1,015 low NOx engines, and 159 trucks with electric power take off systems (ePTOs) by California fleets through June 30, 2018. There are now over 25 manufacturers producing 90 eligible trucks and buses models. Market demand for battery-electric buses has been especially strong, and battery-electric trucks are starting to gain traction in this early market. Demand for hybrid trucks has lowered due to reduced inventory. Demand for trucks (mostly refuse) with low NOx engines has remained steady. Voucher requests for trucks with ePTOs has slowed down compared to last year. Overall, HVIP and Low NOx Engine Incentives continues to experience high demand, with overall funding demand averaging about $7 million in voucher requests per month.

Over the next three years, existing commercial applications need to be bolstered and expanded to grow supply chains further adding to demand for HVIP. Interest from many transit agencies continues to contribute to the strong demand for zero-emission transit buses. Additionally, commercially available zero-emission trucks in the heaviest weight classes, up to 80,000-pounds, are entering the market. At least four additional manufacturers are expected to introduce zero-emission Class 8 commercial trucks in the next one to three years, and manufacturers representing the majority of the California truck market have publicly announced plans to launch zero-emission trucks in the next five years. Fleets are recognizing the benefits of zero-emission terminal trucks, resulting in increasing voucher demand for these trucks. Furthermore, despite the reduced demand for vouchers in the past fiscal year, there has been interest from public utilities regarding purchasing work trucks with ePTOs. Utilities are beginning to realize the benefits of operating in zero-emission mode, and virtually eliminating work-site idling. The Three-Year Heavy-Duty Strategy expands on factors contributing to

[5] www.arb.ca.gov/cci-annualreport

increased demand and addresses barriers to successfully bring innovative technologies to commercialization.

Tables 13 and 14 summarize the types of vehicle vocations and weight classes receiving HVIP funding thus far. Table 15 summarizes vehicle vocations receiving Low NOx Engine Incentives.

Staff Proposal for FY 2018-19[6]

The advanced clean heavy-duty vehicle sector is growing but still is in the early stages of commercialization. As a result, staff continues to refine HVIP and Low NOx Engine Incentives, making adjustments to build on the momentum HVIP and Low NOx Engine Incentives has generated in bringing these vehicles to market. After receiving input from stakeholders during public work group meetings, and working with CARB's HVIP administrator, staff recommends the following changes to the project criteria:

HVIP

- *Revised funding structure for hydrogen fuel cell trucks and buses:* The current funding structure provides funding for Class 8 (more than 33,000 lbs. GVWR) hydrogen fuel cell trucks, and hydrogen fuel cell buses 40 feet in length and longer. In an effort to broaden the range of funding to support smaller weight classes and bus lengths, staff recommends developing a tiered allocation for hydrogen fuel cell trucks based on GVWR, and for hydrogen fuel cell buses based on length. Funding will be less for fuel cell vehicles using combustion or plug-in range extenders compared to vehicles that are 100 percent fueled by hydrogen. Since hydrogen fuel cell trucks, and buses under 40 feet are not yet commercially available, price data is currently unavailable. Once these vehicles are commercially available, staff will determine interim voucher amounts on a case by case basis, not to exceed existing voucher amounts for the larger fuel cell vehicles.

- *Revise funding for ePTOs:* Currently, funding for ePTOs is based on gross vehicle weight rating (GVWR). Staff recommends that ePTO funding be based on battery system sizes, and work site performance, rather than chassis GVWR to ensure that ePTO systems optimize engine-off time to maximize emission reductions. Additionally, staff recommends funding levels to cover up to half of the incremental cost of the ePTO.

[6] For all current voucher amounts and HVIP and Low NOx Engine Incentives requirements, please view the most current Implementation Manual at https://www.californiahvip.org/wp-content/uploads/2018/01/Final-IM-01172018.pdf

- *Incentives amounts for new hybrid vehicles*: Manufacturers of new hybrid vehicles have not significantly advanced commercial hybrid technology, such as incorporating all-electric range into their vehicles. As advanced technology becomes more commercialized, costs are expected to decline. Hybrids have been commercially available for many years with no improvements or cost reductions. Currently, the voucher amount covers nearly 100 percent of incremental cost. Staff proposes to prioritize funding by reducing the voucher amount of new hybrid vehicles that do not achieve 35-miles of all-electric range or better to half of incremental cost, not to exceed funding amounts as stated in Table 16.

  To support technology improvements and innovation, staff proposes a new voucher enhancement that will encourage manufacturers to develop new hybrid vehicles that will achieve at least 35 miles of all-electric range. The voucher enhancement will offer the same funding as the current hybrid conversion vehicle voucher enhancement (up to $45,000). The 35-mile all-electric range requirement is consistent with the Board approved Innovative Technology Regulation (ITR). The total voucher will not exceed 50 percent of incremental cost, including the 35-mile all-electric range voucher enhancement if applicable.

  Note: Voucher amounts that remain unchanged is available in the HVIP Implementaiton Manual.[7]

- *Remove "first three" voucher enhancements*: Last year the Board approved staff's proposal of removing the "first three" voucher enhancement for new hybrid vehicles. Staff recommends the removal of the "first three" voucher enhancement for the remaining two technologies in HVIP (ePTOs and zero-emission vehicles) that currently receive the enhancement. The enhancement has not been an effective tool in encouraging new fleets to participate.

- *Remove reduced voucher amount for more than 100 vehicles per fleet*: Current HVIP requires any fleet wishing to purchase more than 100 vehicles during the current project year receive a voucher reduction by almost half the original voucher amount. Instead of incentivizing fleets to make large purchases, and promoting the goal of achieving economies of scale, this condition penalizes fleets willing to commit to purchasing many vehicles, and stifles the goal of increasing the population of advanced technology vehicles. Staff proposes removing this penalty, and allowing full funding of vouchers regardless of quantity requested.

- *Eliminate funding for lead acid battery technology:* Lead acid batteries do not support the advancement of battery technology, nor help contribute to achieving economies of scale for advanced battery technology used in zero-emission

[7] https://www.californiahvip.org/wp-content/uploads/2018/01/Final-IM-01172018.pdf

vehicles. Staff recommends that lead acid batteries no longer be supported for ePTO operation or traction power. However, lead acid batteries may be used to power accessories or other justified uses. No vehicles currently in HVIP will be impacted by this change.

- *Transition funding support for terminal, and yard trucks to the Zero-Emission Off-Road Freight Voucher Incentive Project:* Staff recommends that once the Off-Road Zero-Emission Freight Voucher Project is operational, all terminal, and yard trucks will be transferred into this project. These trucks are predominantly not used on roadways, and will be well suited for the Off-Road Zero-Emission Freight Voucher Project.

- *Optional warranty*: Eligibility for clean-truck and bus vouchers requires that the vehicle warranty must provide protection for a minimum of 3 years or 50,000 miles, whichever comes first, and provide full warranty coverage of the engine (if applicable), motor, drive train, battery, parts and labor. Recently, some bus manufacturers have requested HVIP allow for a 2-year/100,000-mile warranty in lieu of the current 3-year/50,000-mile warranty. Staff is proposing to allow for a second warranty option of 2-year/100,000-miles. The manufacturer does not have to choose one warranty option for their whole product line. Instead, the manufacturer will have the option to offer either of the two HVIP warranty options. This option will not apply to Low NOx engines. Low NOx engines have a separate warranty requirement that differs slightly from HVIP.

- *Extended warranty voucher enhancement revision*: Revisions to the extended warranty 3-tiered voucher enhancement are needed in order to reflect the new allowance of the 2-year/100,000-mile standard warranty option. HVIP's existing extended warranty option is as follows: $2,000 for warranty coverage of 6 years or 120,000 miles; $4,000 for 7 years or 140,000 miles; or $6,000 for 8 years or 160,000 miles. Staff recommends increasing the mileage requirement in the first tier from 120,000 miles to 300,000 miles, for the second tier 140,000 miles to 350,000 miles, and the last tier 160,000 miles to 400,000 miles. Staff does not recommend changing the warranty time periods or funding amounts.

  Currently, the vehicle manufacturer may not offer the extended warranty enhancement on just a subset of each HVIP-eligible make and model vehicle. The voucher enhancement must apply to every vehicle of the same make, year and model. To improve flexibility of the extended warranty voucher enhancement, staff proposes that manufacturers have the flexibility to offer the voucher enhancement based on fleet preference. The manufacturer would not be required to cover all vehicles under the extended warranty voucher enhancement. Instead, the manufacturer would have the flexibility to offer the extended warranty option to fleets when requested.

Low NOx Engine Incentives

- *Revisions to the 8.9-liter low NOx engine incentives*: The current voucher amount for the Cummins Westport 8.9-liter low NOx engine is $10,000 for a new purchase and repower. Staff is proposing to discontinue offering a voucher for the purchase of new refuse trucks and transit buses equipped with the Cummins Westport 8.9-liter low NOx engine since Cummins Westport no longer produces the conventional 8.9-liter natural gas engine, and only offers the 8.9-liter low NOx engine.

  Currently, the voucher amount is too low to entice a fleet to repower a truck or bus equipped with a conventional low NOx engine. Instead they rebuild the existing engine. Staff is recommending to increase funding for repowers of all vocations, including refuse and transit, and offer funding for purchases of new trucks only for non-refuse vocations. Specifically, staff is proposing a $45,000 voucher for repowers of all vocations using the Cummins Westport 8.9-liter low NOx engine. Additionally, staff recommends a $45,000 voucher for the purchase of new trucks that are not considered refuse trucks using the Cummins Westport 8.9-liter low NOx engine. These are trucks that are not typically fueled by natural gas. New purchases of transit buses and refuse trucks with the 8.9 liter Cummins Westport low NOx engine will no longer be eligible for funding under HVIP. Renewable fuel requirements apply as stated in the FY 2017-18 Funding Plan.

- *Revisions to 11.9-liter low NOx engine incentives*: Staff proposes funding for the 11.9-liter Cummins Westport engine continue to be based on the incremental cost relative to the equivalent diesel baseline, and proposes to set the voucher amount at $45,000, a $5,000 increase over last year, for new truck and bus purchases. Additionally, like with the Cummins Westport 8.9-liter low NOx engine, staff recommends allowing repowers. For repowers, the voucher would also be $45,000. Both conventional natural gas, and diesel engine will be eligible for repowers. Allowing more flexibility, and adjusting the voucher amount is intended to encourage existing diesel truck fleets to switch to the low NOx option in a vehicle sector where zero-emission options are not widely available. Renewable fuel requirements apply as stated in the FY 2017-18 Funding Plan.

- *FY 2017-18 AQIP allocation for Low NOx Engine Incentives*: In the FY 2017-18 Funding Plan, the Board approved $8 million of AQIP funding to provide small fleets, with three or fewer vehicles, the option to utilize conventional, non-renewable fuel and receive Low NOx engine vouchers funded by AQIP. This flexibility was introduced using AQIP funding to help reduce the barriers small fleets have in adopting low NOx engines as AQIP funding is focused on criteria pollutant reduction and not GHG. As of August 1, 2018, there has not been any voucher requests from fleets of three or fewer vehicles. Staff proposes to increase the minimum fleet size to 10 or fewer. Furthermore, staff recommends this apply to both the Cummins Westport 8.9-liter and 11.9-liter low

NOx engine proposals as stated above. However, to reiterate, no renewable fuel requirement would apply to fleets of 10 or fewer using the AQIP allocation, which parallels the small fleet provision for the Truck Loan Program. Once AQIP funding is fully allocated, this option will no longer be available, and fleets of 10 or fewer vehicles will no longer have the option to forgo the low NOx engine renewable fuel requirements as stated in the FY 2017-18 Funding Plan.

- *FY 2016-17 GGRF Low NOx Engine Incentives allocation*: The FY 2016-17 Funding Plan allocated $23 million in GGRF funding to be used only to fund Low NOx engines. In February 2017, the Executive Officer reallocated $10 million from Low NOx Engine Incentives and made that funding available on a first-come first-served basis to any eligible technology to help fund the HVIP waiting list. Following the reallocation, $13 million was available to Low NOx Engine Incentives. Now, there is approximately $3 million remaining. Staff proposes to transfer this funding into the HVIP allocation, which is available to all technology including low NOx engines. The timeline between truck orders and deliveries is approximately 12-18 months and staff is concerned that the expenditure deadline may occur before funding is fully expended before the expenditure deadline of June 2020. Staff anticipates that the combined HVIP allocation will continue to support the demand for low NOx engines.

- *Other Low NOx Engines*: Other potential low NOx engines may become commercially available and eligible for Low NOx Engine Incentives. Staff proposes to continue the same process outlined in the FY 2017-18 Funding Plan.

General Staff Proposals:

The following items apply to both HVIP and Low NOx Engine Incentives:

Voucher enhancements for electric vehicle supply equipment (EVSE) and hydrogen fueling infrastructure: In the FY 2017-18 Funding Plan, funding was approved to help offset infrastructure costs for battery-electric and fuel cell heavy-duty vehicles. This voucher enhancement was structured as a short-term solution to help fleets overcome non-vehicle cost barriers until other more suitable funding sources became available. HVIP was designed to offer a streamlined approach to funding advanced technology vehicle purchases through a simple first-come, first-served program. However, infrastructure installation is a complex issue with long lead times, which is incongruous with HVIP's simplified approach, and statutory expenditure deadlines. Looking to the future, and to capitalize on HVIP's core competencies, staff recommends funding infrastructure voucher enhancements through FY 2018-19, and reevaluate its continuation into FY 2019-20.

EVSE, and hydrogen fueling infrastructure will continue to be evaluated on a case by case basis or until a more established procedure is in place. Mobile charging and fueling stations are not eligible for EVSE or hydrogen fueling infrastructure voucher enhancements.

Effective Date: Upon approval, all proposed changes to HVIP and Low NOx Engine Incentives will become effective the day after the Board meeting.

Flexibility to adjust voucher amounts: Due to economic uncertainty tariffs pose on the production of advanced technology vehicles, staff proposes that the Executive Officer have the authority to increase voucher amounts no more than 25 percent to help offset costs that would be passed on to fleet purchasers.

Flexibility to Meet Market Demand: To balance uncertainty in the market for clean heavy-duty vehicle technologies with the growing demand to support the turnover of the older fleet, staff proposes that the Executive Officer have the authority to reallocate remaining FY 2017-18 and FY 2018-19 AQIP funding between Low NOx Engine Incentives and the Truck Loan Assistance Program. Staff will re-evaluate demand for these projects at the start of the fourth quarter of the fiscal year. If demand for the Truck Loan Assistance Program is higher than projected, staff will consider recommending to the Executive Officer reallocating funding from Low NOx Engine Incentives to the Truck Loan Assistance Program.

Terms and Conditions for HVIP and Low NOx Engine Incentives: HVIP Terms and Conditions are intended to notify potential participants of the requirements of the program prior to submitting an application. Additionally, CARB and the project administrator developed an Implementation Manual to further define these rules and explain roles and responsibilities. The current Terms and Conditions and Implementation Manual for HVIP are available at https://www.californiahvip.org/wp-content/uploads/2018/01/Final-IM-01172018.pdf.

Project Solicitation for HVIP and Low NOx Engine Incentives: CARB held a competitive solicitation for the selection of a HVIP and Low NOx Engine Incentives Grantee in November 2016. CALSTART was selected as the Grantee to administer the project in January 2017. CALSTART was selected to administer FY 2016-17 HVIP and Low NOx Engine Incentives funding via a three-year competitive solicitation with the option of adding the FY 2017-18 and FY 2018-19 funds with an updated grant agreement. CARB used this option for FY 2017-18 and the agreement was executed with CALSTART in January 2018. Again, staff proposes to utilize this option; and therefore, CARB will not issue a new solicitation for FY 2018-19 HVIP and Low NOx Engine Incentives. The next competitive solicitation is planned for FY 2019-20.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits: HVIP and Low NOx Engine Incentives will continue to be implemented on a first-come, first-served, statewide basis, so it is not possible to estimate in advance exactly how much funding will be spent in disadvantaged communities. As of June 30, 2018, about 50 percent of Low Carbon Transportation funding for HVIP and low NOx Incentives has been spent in disadvantaged communities.

Currently, a higher HVIP incentive is offered for zero-emission vehicles domiciled and

operating in disadvantaged communities as a way to encourage HVIP participation from fleets operating in these communities. As part of the Cap-and-Trade auction proceeds reporting requirements, CARB will track where HVIP and Low NOx Engine Incentive funds are spent, so it can calculate and report AB 1550 investment criteria.

Outcomes

The proposed allocation is expected to fund about 2,420 zero-emission, hybrid, and low NOx vehicle vouchers, meeting expected demand and providing an estimated 650,000 metric tons of CO2 equivalent GHG emission reductions. Staff also estimates about 1,100 tons of NOx, 29 tons of PM 2.5, and 10 tons of ROG emissions would be reduced as the advanced technology vehicles replace conventional diesel trucks and buses. Appendix A provides additional details on the emission estimates.

Over the next several years increasing annual investments will be needed to continue encouraging technology advancements and early deployment of advanced clean heavy-duty technology vehicles, such as zero-emission delivery trucks and transit buses and low NOx engines in heavier truck sectors. These investments will be structured to encourage increasing participation among smaller California fleets, and with benefits in disadvantaged communities. The hybrid, zero-emission, and low NOx heavy-duty truck and bus markets are still at the early stages of commercialization.

Production capacity has substantial growth potential and CARB expects production costs to decline as production volumes increase. CARB staff continuously monitors vehicle production costs to correspond with voucher amounts and make adjustments.

There continues to be a need to evaluate the effectiveness of investments. Staff believes metrics can help identify when specific heavy-duty vehicle technologies become self-sustaining. Potential metrics could include:

- Number of hybrid (or battery electric and low NOx) trucks sold per vehicle vocation.
- Number and types of battery electric buses (or low NOx) sold per vocation (e.g., transit, school bus, airport shuttle, etc.).
- Vehicles sold per manufacturer.
- Manufacturer diversity.
- Declining vehicle incremental cost.
- Number of offerings in different vocational applications.
- Number of vehicles sold in states without public incentives.

These metrics are unlikely to drive a decision to sunset funding in the near term. Instead, such a decision will be driven more by desire to promote purchase of a new, even cleaner available technology. This could take the form of phasing out eligible technologies in favor of new commercially available technologies. Possible metrics of

market health will continue to be developed as more technologies enter the market and will be discussed in depth with stakeholders in future work group meetings.

HVIP AND LOW NOX ENGINE INCENTIVES TABLES

Table 13: HVIP Vouchers Issued by Vocation

Vehicle Type	Vouchers Issued	Total Voucher Funds	Average Voucher	% of Total Vouchers
Parcel Delivery	1,348	$36,506,000	$27,082	36%
Beverage Delivery	456	$15,048,000	$33,000	12%
Other Truck	552	$21,703,485	$39,318	14%
Food Distribution	231	$5,731,000	$24,810	6%
Uniform/Linen Delivery	112	$2,800,000	$25,000	3%
Tow Truck	76	$2,396,000	$31,526	2%
LP Pick-up & Delivery	47	$942,000	$20,043	1%
Refuse Hauler	35	$1,212,000	$34,629	1%
School Bus	41	$3,962,350	$96,643	1%
Shuttle Bus	153	$13,106,776	$85,665	4%
Utility Truck	144	$3,373,000	$23,424	4%
Urban Bus	127	$15,804,000	$124,441	3%
Dump Truck	4	$103,000	$25,750	<1%
Not Yet Defined	489	$58,073,000	$118,758	13%
Total	**3,815**	**$180,760,611**	**$47,382**	**100%**

Through June 30, 2018.

Table 14: HVIP Vouchers Issued by Gross Vehicle Weight Range

Gross Vehicle Weight Range	Vouchers Issued	Total Voucher Funds	% of Total Vouchers
5,001 – 6,000	51	$653,000	1%
10,001 – 14,000	92	$4,190,000	2%
14,001 – 19,500	2,158	$76,456,351	57%
19,501 – 26,000	374	$9,326,548	10%
26,001 – 33,000	326	$31,479,776	9%
≥33,001	814	$58,654,936	21%
Total	**$3,815**	**$180,760,611**	**100%**

Through June 30, 2018.

Table 15: Low NOx Engine Incentives Vouchers Issued by Vocation

Vehicle Type	Vouchers Issued	Total Voucher Funds	Average Voucher	% of Total Vouchers
Refuse	615	$5,546,463	$9,019	61%
Transit	10	$145,000	$14,500	1%
Other Truck	49	$1,900,000	$38,776	5%
Not Yet Defined	341	$3,673,470	$10,773	33%
Total	**1,015**	**$11,264,933**	**$11,098**	**100%**

Through June 30, 2018.

Table 16: New Hybrid Truck and Bus Voucher Amounts

GVWR (lbs.)	Base Vehicle Incentive[1, 2]
6,001 – 8,500	$ 8,000
8,501 – 10,000	$10,000
10,001 – 19,500	$15,000
19,501 – 26,000	$20,000
26,001 – 33,000	$25,000
> 33,000	$30,000

[1] A vehicle that achieves 35 miles or more of AER is eligible for the following additional funding amounts: $5,000/vehicle if below 8,501 lbs.; $10,000/vehicle if 8,501 to 19,500 lbs.; and $45,000/vehicle if over 19,500 lbs.

[2] Funding up to half of incremental cost. Not to exceed listed voucher amounts.

Zero- and Near Zero-Emission Freight Facilities Project

Proposed Low Carbon Transportation Allocation – $55 million

Project Overview

The Zero- and Near Zero-Emission Freight Facilities Project (Freight Facilities Project) was approved as part of the FY 2017-18 Funding Plan. The project received a total of up to $100 million from Low Carbon Transportation and a $50 million allocation from the Trade Corridor Enhancement Account. The solicitation for the project closed on July 19, 2018 and was over-subscribed by almost $70 million. Given the value of these Freight Facilities projects to support a wide array of State goals and the signal that was sent in last year's funding plan on supporting oversubscription to this solicitation, CARB proposes to use $55 million from the legislature's FY 2018-19 appropriation to supplement existing funding. Funding may be used to fund additional projects, to split funding cycles to extend the expenditure timelines for projects, or if insufficient well-qualified projects remain, to fund projects identified as priority in the three year investment strategy. Including last year's allocation, this brings the total available Freight Facilities Project funds to $205 million.

The Freight Facilities Project is a multi-faceted project that is designed to holistically reduce GHG and criteria pollutant emissions in freight facilities and to help achieve additional benefits, such as providing economic, environmental, and public health benefits to disadvantaged communities and/or low-income communities.

The project applications received during the open solicitation propose a variety of technologies and strategies designed to:

- Provide direct GHG, criteria, and toxic pollutant emission reductions from freight facilities.

- Demonstrate the practicality and build the business case for zero- and near zero-emission technologies at freight facilities along with multiple zero- and near zero-emission vehicles and equipment including necessary infrastructure.

- Showcase the potential for widespread commercial acceptance of the various types of zero- and near zero-emission vehicles and equipment, including transport refrigeration units (TRUs), used in freight facilities and associated on-road freight applications.

- Accelerate commercialization of zero- and near zero-emission goods movement technologies.

Under the same terms as last year's appropriation, the bill amending the Budget Act of 2018 (SB 856), appropriated $55 million from the Greenhouse Gas Reduction Fund to

be used for the "Freight Equipment Advanced Demonstration and Pilot Commercial Deployment Project."

The project applications support the continued implementation of the *California Sustainable Freight Action Plan's* Vision for a Sustainable Freight Transport System — one that is characterized by transporting freight reliably and efficiently by zero-emission equipment everywhere feasible, and near zero-emission equipment powered by clean, low-carbon renewable fuels everywhere else. It also supports the Plan's goal of deploying over 100,000 freight vehicles and equipment capable of zero-emission operation and maximize near zero-emission freight vehicles and equipment powered by renewable energy by 2030.

Staff Proposal for FY 2018-19

The intent of the overall project is to facilitate the transition of freight facilities to zero- or near zero-emission, which can then be emulated by other facilities. Augmenting the FY 2017-18 funds to continue funding eligible, well-designed applications provides a unique opportunity to support and showcase freight facilities that are committed to a zero-emission future to take the steps necessary to achieve their goals.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits: The Board directed that at least 90 percent of the funding be reserved for projects located in or providing benefits to priority populations.

In order to identify areas that are designated as disadvantaged communities that meet the AB 1550 requirements, staff will utilize CalEnviroScreen 3.0.[8] Information on the model and the map[9] identifying designated disadvantaged community areas can be found on the Cal/EPA's website. Based on CalEnviroScreen 3.0, many major warehouse districts and ports are located in disadvantaged communities.

Project Solicitation: CARB developed a competitive process that clearly identified eligible types of projects, vehicles and equipment, along with funding caps determined through the work group process. Eligible grantees were public agencies, such as air districts, cities and counties, and non-profit organizations with relevant experience. The competitive process identified important required elements of any project application. Final determination of the project structure and mechanism were developed through a public work group process after Board approval of the Proposed FY 2017-18 Funding Plan. The solicitation for the project was released on March 21, 2018 and closed on July 19, 2018.

[8] https://oehha.ca.gov/calenviroscreen
[9] www.calepa.ca.gov/EnvJustice/GHGInvest
www.arb.ca.gov/cci-communityinvestments

Outcomes

The funding allocation for zero- and near-zero emission freight facilities could fund a large number of vehicles and materials handling equipment, supporting fueling infrastructure, and facility improvements. CARB received a total of 13 applications totaling $220 million when the solicitation closed on July 19, 2018. Based on the anticipated benefits by quantifying the emission reductions of on one of many possible scenarios, staff estimates that $55 million for this project could provide an additional estimated 62,800 metric tons of CO2e emission reductions and 110 tons of NOx, 3.5 tons of PM 2.5, and 66 tons of ROG emission reductions, based on the assumptions provided in Appendix A.

Staff envision the large flagship projects funded through this category to act as models for other freight facilities interested in reaching zero- and near zero-emissions. This type of model — combining vehicles and equipment across the entire commercialization arc and pairing those with infrastructure, system, and energy efficiency upgrades — can be applied to a much wider array of facilities, including schools, passenger transportation hubs, industrial facilities, and others. This project helps support the concepts discussed in Three-Year Heavy-Duty Investment Strategy (an updated version appears in this year's document), including: building on successful beachheads by supporting early commercial technologies; seeding promising next markets by including technologies in the pilot phase, and maintaining the innovation pipeline by including technologies that are in the demonstration phase. As staff develop this concept, lessons learned from this project category can be used to build similar project categories for other types of facilities.

Truck Loan Assistance Program

Recommended AQIP Allocation – $25.6 million

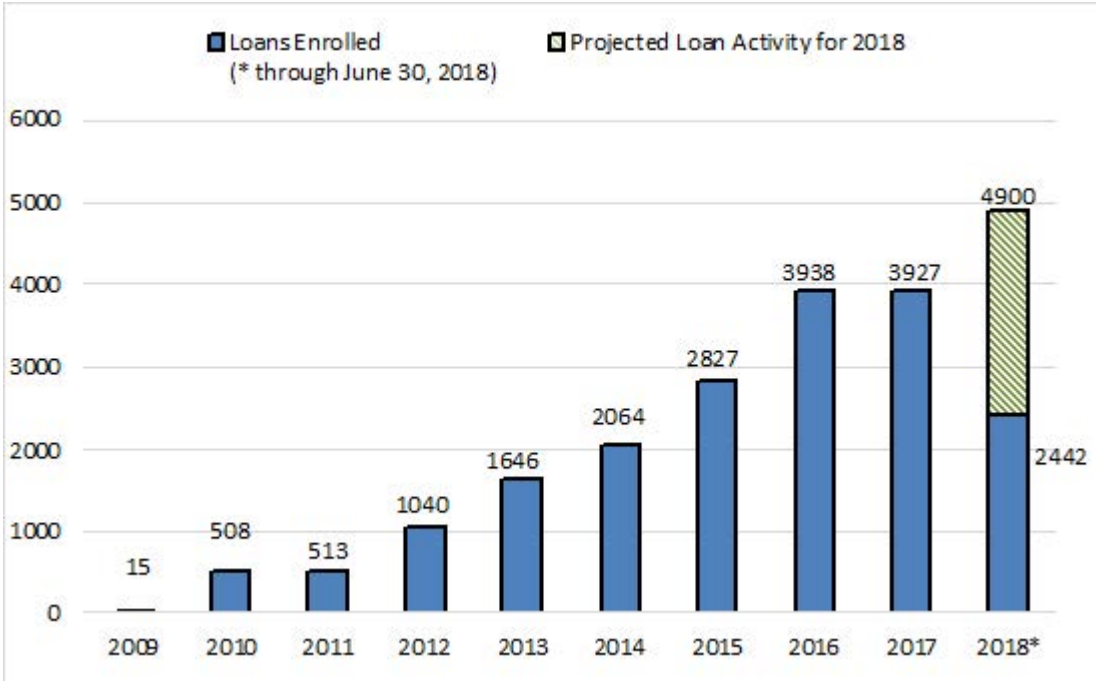
Project Goals

Launched in 2009, the Truck Loan Assistance Program utilizes AQIP funds to help small-business fleet owners affected by CARB's In-Use Truck and Bus Regulation to secure financing for upgrading their fleets with newer trucks or with diesel exhaust retrofits. The program, implemented in partnership with the California Pollution Control Financing Authority (CPCFA) through its California Capital Access Program (CalCAP), leverages public funding with private funding from participating lending institutions. The program is available for small fleets with 10 or fewer trucks at the time of application. Lenders use their traditional underwriting standards to establish loan terms; however, the program currently includes an interest rate cap of 20 percent. AQIP is the only source of CARB funding available to fund the Truck Loan Assistance Program.

Current Project Status

As of June 30, 2018, approximately $99.8 million in Truck Loan Assistance Program funding has been expended to provide $1.2 billion in financing to small-business truckers for the purchase of approximately 20,400 cleaner trucks, exhaust retrofits, and trailers. Demand by truck owners has generally increased as shown in Figure 4. Program growth is driven by increased lender and borrower awareness and utilization of the program, increased cost of new diesel trucks, and increased enforcement of the Statewide In-Use Truck and Bus Regulation.

Figure 4: Loan Activity by Calendar Year



CARB allocated $25 million during FY 2016-17, and allocated $20 million for the program for FY 2017-18. Due to concerns from forecasted funding shortfalls, at the end of FY 2017-18, CARB allocated an additional $15 million of its own funds to the Truck Loan Assistance Program.

In 2017, CARB staff successfully worked with CPCFA to establish incremental recapture procedures. This mechanism redirects older contributions back to the Truck Loan Assistance Program to support future enrollments and makes the program more self-sustaining by reinvesting funds from matured loans. Active lenders enrolled in the program on or after August 15, 2017 are subject to recapture. Based on loan activity from program inception in 2009 through June 30, 2017, approximately $6 million in recaptured funds have been collected and reinvested into the program. The quantity of recaptured funds from matured loans will be determined after the conclusion of each fiscal year.

Table 17 provides a summary of financing provided to date. About 35 percent of enrolled loans have been issued to owner operators with one truck, and about 96 percent of enrolled loans have been issued to fleet owners with 10 or fewer employees.

Table 17: Truck Loan Assistance Program Status –Vehicles/Equipment Financed

Number of Loans Issued[1]	Number of Projects Financed	Project Type	State Funding (millions)	Total Amount Financed (billions)
18,917	19,344	Truck Purchases	$99.8	$1.2
	608	Exhaust Retrofits		
	417	Trailers		

Based on data through June 30, 2018.

[1]Total number of loans issued does not equal the number of projects financed because some loans included multiple projects.

Staff Proposal for FY 2018-19

CARB staff recommends an allocation of $25.6 million for the Truck Loan Assistance Program to help meet expected demand for the FY 2018-19 cycle. CARB remains committed to meeting demand, as having loan assistance unavailable for even a short period erodes the confidence lenders have in providing the necessary financing to purchase trucks to meet the compliance requirements of the In-Use Truck and Bus Regulation. Program need and popularity is expected to grow because the Road Repair and Accountability Act of 2017 (SB 1), beginning in 2020, will only allow clean trucks in compliance with CARB's Truck and Bus Regulation to be registered by the Department of Motor Vehicles (DMV). The Truck and Bus Regulation requires most heavy-duty vehicles to be equipped with 2010 or newer model year engines between 2020 and 2023. Additionally, CARB has begun an aggressive enforcement pilot in preparation for upcoming replacement deadlines and SB 1. The Enforcement Pilot is a

streamlined enforcement process that will substantially increase the number of Notices of Violation and vehicle registration holds received by non-compliant fleets. For many small fleets, this loan program may offer the only viable option to achieve compliance.

To ensure the sustainability of the program and continuous availability of funding to participating lenders, staff is working with CPCFA to address both short and long-term cash flow and meet demand.

- *Short-term cash flow:* Because the AQIP revenues accrue throughout the fiscal year, the demand for funding for the Truck Loan Assistance Program may, from time-to-time, precede the availability of funds to advance to CPCFA. The current interagency agreement includes a provision of a $5 million bridge loan from CPCFA to cover temporary funding needs if necessary.

- *Project continuity between funding cycles*: Staff proposes the following contingency provision to allow for uninterrupted implementation of the Truck Loan Assistance Program in the event that consideration of the FY 2019-20 Funding Plan is delayed beyond July 2019. If CARB is appropriated AQIP funding in the FY 2019-20 State budget, and the Executive Officer determines that the Truck Loan Assistance Program would run out of funding prior to Board consideration of the FY 2019-20 Funding Plan, the Executive Officer would have the authority to allocate up to 25 percent of FY 2019-20 AQIP funds to the Truck Loan Assistance Program.

- *Long-term cash flow:* Projections of the potential funding needed for loan applicants purchasing compliant vehicles through the loan program due to the DMV registration requirements and engine upgrade requirements in the Truck and Bus Regulation greatly exceed forecasted funding allocations starting in FY 2019-20 or earlier. CARB staff is continuing to search for future sources of funding to meet anticipated increases in demand.

CARB staff will continue to closely monitor program demand and work with CPCFA staff, participating lenders, and other stakeholders to evaluate whether to implement program changes to balance available funding with meeting the needs of the fleets. One strategy to improve program leverage is to assess borrower and lender fees. If this or similar changes are warranted, they would be developed and implemented through a public process resulting in an amended interagency agreement between CARB and CPCFA.

Though nearly all AQIP funds are directed to the Truck Loan Assistance Program, and staff continues to pursue actions to further leverage funds, forecasted demand is expected to exceed available AQIP funds before 2020.

AB 1550 Disadvantaged Community and Low-Income Household/Community Benefits:
The AB 1550 disadvantaged community, low-income community, and low-income household investment targets apply only to projects funded with Cap-and-Trade auction

proceeds. They are not a requirement of AQIP funding, the sole funding source for the Truck Loan Assistance Program. However, it is worth noting much of the Truck Loan Assistance Program funding has been spent within and benefiting individuals living in disadvantaged and low-income communities.

Outcomes

The proposed FY 2018-19 allocation for the Truck Loan Assistance Program is expected to fund about 8,200 new truck purchases. This will help small business truckers comply with the In-Use Truck and Bus Regulation and result in an estimated 3,438 tons of NOx and 54 tons of ROG emission reductions. Appendix A provides additional details on the emission estimates.

This program has experienced growing demand since its creation. Staff expects the Truck Loan Assistance Program will likely face unprecedented demand in future fiscal years as truck owners take action to meet truck replacement requirements and come into compliance due to CARB's aggressive Enforcement Pilot in preparation for truck replacement deadlines and SB 1 in 2020. Staff will continue to closely monitor program demand and work with CPCFA staff, participating lenders, and other stakeholders to balance available funding with meeting the needs of fleets.

Truck Filter Replacements

Recommended AQIP Allocation – $3 million

Project Overview

In 2012, Cleaire Advanced Emission Controls, Incorporated (Cleaire) voluntarily recalled its LongMile diesel PM filter system. During the recall, Cleaire replaced the LongMile with either a certified silicon carbide core, a Cleaire Muffler Module (CMM™), or removed the entire system. However, several months later Cleaire ceased operation and their assets were acquired by ESW CleanTech Incorporated (ESW CleanTech), a manufacturer of verified on-road and off-road diesel emissions control strategies. ESW CleanTech has provided product support of the Cleaire product line since the closure.

Between May 2015 and March 2017, the Sacramento Metropolitan Air Quality Management District (SMAQMD) and ESW CleanTech entered into a Grant Agreement to provide reimbursement for up to $6.3 million in filter substrate replacements through the Proposition 1B Goods Movement Emission Reduction Program. These replacements ensured reductions of particulate matter consistent with the original system operations prior to the recall. However, some fleets could not qualify for Proposition 1B funding or could not meet required temperature or engine family criteria.

The purpose of this project is to provide funds on a first-come, first-served basis to support filter substrate replacements for existing heavy-duty vehicles equipped with a certified CMM. The proposed AQIP funds for truck filter replacements reduce uncontrolled criteria and toxic air contaminant emissions by helping replace recalled filters.

Staff Proposal for FY 2018-19

Staff proposes to fund filter substrate replacements on remaining trucks equipped with certified CMMs. The funds will also cover new diesel PM filters for vehicles that do not meet the assessment and duty cycle requirements for the LongMile-S. Based on results from the Proposition 1B project, the proposed $3 million will cover 270 to 500 substrate replacements or about 150 new diesel particulate filter systems (DPFs).

Substrate replacement costs vary according to the horsepower of the engine with higher costs for higher horsepower engines. For new diesel particulate systems staff used an average of $20,000 per system. Staff estimate that 1,061 CMMs need replacement and based on duty cycle requirements from the Proposition 1B project, approximately 38 percent of the CMMs will need new DPFs instead of a substrate replacement. This project will cover the costs of the substrate, new systems where needed, parts, and installation labor.

- Staff expects to award these funds based on a competitive solicitation to a third party administrator.

- Staff will work closely with the administrator and stakeholders to determine final eligibility criteria and identify potential funding recipients.

- Eligibility criteria may include, but would not be limited to: age of the vehicle, whether the vehicle is subject to any upcoming replacement requirements, whether the vehicles needs only substrate replacement or full DPF replacement, and location or operation in disadvantaged or low income communities

- Regardless of final eligibility criteria, CARB will track where funds are spent, in order to calculate and report the portion that meet AB 1550 investment criteria for disadvantaged and low income communities.

Outcomes

This project for truck filter replacements would reduce uncontrolled criteria and toxic air contaminant emissions by helping replace remaining CMMs on 150 to 500 heavy-duty vehicles. The proposed allocation would fund an estimated 5.33 tons of PM2.5 emissions reductions, based on statistics from the similar, recent Proposition 1B program. The calculations for this example are outlined in detail in Appendix A. Because PM filters only control PM, no other criteria or GHG emissions reductions are expected.

CHAPTER 5: SUMMARY OF THE UPDATE TO THE THREE-YEAR INVESTMENT STRATEGY FOR HEAVY-DUTY VEHICLES AND OFF-ROAD EQUIPMENT FROM LOW CARBON TRANSPORTATION INVESTMENTS AND AQIP

In the previous year's investment document, CARB articulated its refined strategy framework for accelerating the development and market introduction of technologies critical to achieving the State's near term and longer-term climate and air quality goals. This includes supporting zero-emission freight technologies and advanced technologies that are transferrable to the freight sector. This strategy is organized around a new approach for accelerating targeted technology improvement in three ways:

1. Focusing on continuing to invest Low Carbon Transportation and AQIP dollars across the commercialization arc for various technologies, building on our previous investments. This includes supporting technologies through the demonstration, pilot, commercial phases.

2. Focusing on critical technology pathways necessary to meet the state's 2030 climate and criteria emission goals. The three critical technology pathways identified are Zero Emission (organized around battery electric, fuel cell electric and zero-emission-enabling hybrid electric technologies[10]); Low NOx (engines and powertrains); and Efficiencies (engine and powertrain, full vehicle and system operations); and

3. Targeting investments on the expansion of beachhead markets – early successful vehicle applications where the pathway technologies can best establish initial market acceptance, and then from there seed additional adjacent market applications.

This year, CARB, in collaboration with its partners at CALSTART, is proposing updates to the Three-Year Investment Strategy to account for changes observed over the last year, refine investment needs over the three-year horizon, and forecast funding priorities for a new third year: FY 2021-22. In this section, staff provides a high-level overview of the proposed updates — formulated with stakeholder and industry input. A more detailed description of the updates and reasoning can be found in Appendix D. Starting next year, with the 2019-20 fiscal year, SB 1403 (Lara, Chapter 370, Statutes of 2018) requires CARB to include a 3-year investment strategy for zero- and near zero-emission heavy-duty vehicles and equipment commensurate with meeting certain goals. The bill also requires the Funding Plan to include information related to

[10] Hybrid electric technologies enable ZE operations, build near term volume for common components (such as energy storage and power electronics) and help build the broader supply chain for components needed to reach scale in all ZE applications.

milestones achieved by the state's school bus incentive programs and the projected need for funding.

Technology Status Updates

To maintain the effectiveness of the investment strategy and to track progress against goals, it is important to monitor the status of the key pathway technologies. Therefore, for each of the three critical technology pathways listed above, staff have prepared an updated high-level overview of the market and readiness assessment of the technology as it pertains to heavy-duty vehicles and off-road equipment. Building on the baseline approach established in FY 2017-18, applications of the technology are characterized in terms of general stages on the path to commercialization — demonstration, pilot, and commercial deployment — and the potential market penetration of the application. These updates have helped inform CARB's investment strategy and refine priorities for future years.

Overall, CARB has observed significant progress in a number of applications in each of the technology pathways. In particular, battery electric vehicle (BEV) technologies have advanced rapidly in the heavy-duty (HD) delivery segment, moving that application and BEV drayage into pilot-ready status. BEV medium-duty (MD) delivery, yard hostlers, and BE transport refrigeration units (TRU) have moved into early market commercialization, with school buses on the cusp of commercial status. Fuel cell electric vehicles made progress on HD delivery and drayage (demonstration), and transit bus (now nearly commercial). While hybrid systems saw movement on pilot-stage extended range regional delivery and drayage, the biggest change was the advancement of stop-start systems to commercial availability. For Low-NOx, the 12L Low-NOx natural gas engine is now fully commercial and advanced engine architectures have made progress. Finally, in the efficiencies pathway, numerous technologies have advanced to pilot and early commercial status, including connected-automated vehicles, stop-start systems, and towbar-less tugs. Truck platooning technologies, advanced HD engine architectures, and extended range drayage are ready for pilots.

For more detail on the updates made to technology statuses, including charts showing technology status, descriptions of changes over the last year, and information on information collection, see Appendix D at the end of this document.

Investment Funding Priorities and Recommendations

The Three Year Heavy-Duty Investment Strategy is a living document that encompasses a rolling three-year horizon. Therefore, the funding levels recommended in this updated strategy expand upon the levels identified in the FY 2017-18 report by adding a new third year, FY 2021-22. Staff and consultant also re-evaluated the required level of activity to move pathway technologies forward toward 2030 goals over the updated three-year funding period.

Based on the technology status updates and the progress being made against the beachhead strategy to date, staff has developed updated priorities and projects that could benefit from targeted funding investments. These priorities were assembled based on:

1) Evaluating the updated technology status and progress outlined above;
2) Identifying areas of accelerated progress where funding could support or speed technologies in reaching the market;
3) Identifying areas of slower progress where barriers could be targeted to aid development; and
4) Additional sector research as well as industry conversations and feedback during the assembly of this update.

The aggregated results of this planning activity are summarized in Table 18 at the end of this section, presented by fiscal year and by stage of technology (demonstration, pilot, and commercial). It highlights the key priority areas and frames the range of investments ideally needed each year over the three years of the plan. Low and high funding levels are portrayed to suggest the minimum levels needed to maintain progress. At lower funding levels not all of the priorities can be achieved. The higher levels represent adequate funding to drive all of the identified priorities and potentially allows additional pathway applications to be advanced. The listed technologies represent top priorities, not an exhaustive list of all technologies or platforms that could be funded.

At top level, the organizing goals of Three Year Investment Strategy are:

- **Keep Expanding Successful Beachheads and Pathways.** The beachhead markets are showing success and establishing footholds, but the market remains in flux. Using commercial stage funding investments, it is crucial that the first beachhead market successes noted in this update be consolidated and further expanded
- **Target Promising Next Pathway Markets.** As technologies mature to satisfy next stage markets, they need to be deployed at higher volumes in pilot projects to validate their ability to scale and be supported by infrastructure. Well timed, large scale pilots are crucial to maintaining the pace of beachhead expansion.
- **Focus on and Expand the Innovation Pipeline.** The success of the beachhead strategy relies on steady improvement of pathway technologies, supported via demonstration stage projects. California companies are among the world leaders in responding to and developing advanced, innovative solutions, bringing economic and job benefits.

CARB is aware that there are numerous barriers to the commercialization of new advanced technologies (e.g. infrastructure). See Appendix D for an assessment of these barriers and the progress being made to resolve them.

Potential Future Projects

It should be noted that there are six key areas of interest that were identified this year that align with the proposed areas of focus over the next three years. If ample funding is available in the forthcoming fiscal years, staff will continue to work with stakeholders to explore these potential projects.

Zero-Emission Drayage Pilot - Zero-emission drayage trucks, while relatively new, have been advancing quickly. CARB is conducting a focused zero-emission drayage truck demonstration from FY 2014-15 and zero-emission drayage trucks are included in Freight Facilities projects. By next year zero-emission drayage trucks will be ready for larger pilot-scale deployment to maintain momentum and continue to push the technology toward commercialization.

Fuel Cell Electric Transit Bus Pilot Projects - Fuel cell and battery electric transit buses can receive funding through HVIP, but battery electric transit buses dominate today's HVIP transit requests. Even though fuel cell bus technology has made significant advances in terms of performance, durability, and potential for one-to-one diesel bus replacement, the high initial cost of installing hydrogen infrastructure creates a significant adoption hurdle. Funding for fuel cell transit bus pilot projects is needed to lower bus production costs and learn from and alleviate infrastructure challenges.

Innovative Solutions Pilot for Zero-Emission Vehicle Adoption - CARB funding programs have aggressively targeted the most formidable barrier to ZEV adoption: cost. ZEVs cost more upfront than their conventional counterparts and also require new fueling infrastructure. However, there are a number of other barriers to ZEV adoption beyond vehicle cost, such as perceived risk associated with owning and maintaining new technologies, training of maintenance staff and drivers, adaptation of operations, and others. This year CARB began working with stakeholders to develop a new pilot intended to remove these barriers and increase ZEV access. This pilot would increase affordability and access to ZEVs for small fleets and fleets or vocations not ideally served by existing funding projects, possibly through an all-inclusive lease or other financing mechanism. CARB intends to continue refining this idea for potential inclusion in the FY 2019-20 Funding Plan.

Expanding Technology Options for Class 8 Low-NOx Trucks - Over the next year, staff will seek stakeholder input to consider expanding support for emerging low-NOx technologies. Currently, CARB supports the two available CNG options, the 8.9L and 11.9L CNG engines. CARB is interested in expanding this support to other early market low-NOx technologies such as the opposed piston engine. This kind of support is needed to bridge the gap to full commercialization. Potential implementation options may be proposed in future funding plans.

Small Ports Pilot - California's emission reduction goals at ports and upcoming regulations for ships at berth necessitate continued investment, especially at the state's small ports. The pressing need at small ports and their more limited resources in

applying for funding highlights the need for a streamlined project providing funding focused on small ports. Next year, CARB would like to explore options for funding holistic projects at small ports that include shore power or bonnet systems in addition to zero- and near- zero-emission port equipment.

Zero-Emission Facilities – As numerous technologies and applications advance into pilot and commercial stages, it is becoming increasingly important to facilitate the broader transition of large facilities to zero-emission. Transit bus depots and freight facilities that are beginning to accommodate large numbers of zero-emission vehicles have new lessons to learn about fueling infrastructure and facility operations with pilot- and commercial-sized deployments of vehicles. Data gathered from these new zero-emission ecosystems will help other large facilities deploy more zero-emission vehicles faster.

Table 18: Draft Recommendations for Investment Priorities

THREE-YEAR HEAVY-DUTY STRATEGY INVESTMENT PLAN UPDATE*			
	FY 2019-20	**FY 2020-21**	**FY 2021-22**
Demos	*$65-$100 Million* Focus: ZE/PHEV M/HD Delivery, Advanced Powertrains, ZE/Hybrid Heavier Cargo Handling Equipment	*$60-$85 Million* Focus: ZE/PHEV HD Regional Delivery, ZE/Hybrid Construction Equipment, ZE/Hybrid Heavier Cargo Handling Equipment	*$50-$90 Million* Focus: ZE/PHEV Longer Range HD Goods Movement, ZE/PHEV Construction Equipment, ZE/Hybrid Heavier Cargo Handling Equipment
Pilots	*$170-$310 Million* Focus: ZE/PHEV On-Road Drayage and M/HD Trucks, Fuel Cell Transit, ZE/Hybrid heavier Cargo Handling Equipment, ZE Facilities	*$185-$310 Million* Focus: ZE/PHEV Drayage and Regional Delivery, Advanced Powertrains, ZE/Hybrid Heavier Cargo Handling Equipment, ZE Facilities	*$200-$325 Million* Focus: ZE/PHEV Drayage and Regional Delivery, Advanced Powertrains, ZE/Hybrid Heavier Cargo Handling Equipment, ZE Facilities
Commercial	*$215-$325 Million* Focus: ZE Transit, ZE Delivery, Low NOx Regional Trucks, Yard Tractors, Ground Support Equipment, ZE/Hybrid Heavier Cargo Handling Equipment	*$365-$545 Million* Focus: ZE Delivery, ZE Transit, Low NOx Linehaul Trucks, Ground Support Equipment, ZE/Hybrid Heavier Cargo Handling Equipment	*$420-$580 Million* Focus: ZE/PHEV Drayage and Regional Delivery, ZE Delivery, ZE Transit, Low NOx Linehaul Trucks, ZE/Hybrid Heavier Cargo Handling Equipment
Total Funding	***$450-$735 Million****	***$610-$940 Million****	***$670-$995 Million****

Three-year funding plan investment priorities define yearly focus areas and propose funding that aligns with progress required for each key pathway.
** The draft funding amounts listed here represent a critical down payment towards meeting the funding need outlined at the beginning of this section, but do not meet the entire need.*

CHAPTER 6: ADDRESSING CALIFORNIA CLIMATE INVESTMENT GUIDELINES REQUIREMENTS

CARB's August 2018 Funding Guidelines for Agencies that Administer California Climate Investments provide direction for implementing agencies.[11] This chapter summarizes the steps CARB is taking to meet some of the key Guidelines requirements, primarily those relating to priority populations (disadvantaged communities, low-income communities, and low-income households), but also addresses some of the new requirements from the August 2018 Guidelines for the Low Carbon Transportation Program.

The California Climate Investments Guidelines requirements related to evaluating investments for priority populations and maximizing benefits for disadvantaged communities can be found in Section V of the Guidelines and are summarized below, along with the actions CARB is taking to address them.

Guideline Requirement: Assess overall program structure for opportunities to target investments to benefit priority populations and evaluate projects for potential benefits to priority populations, using the criteria available at: www.arb.ca.gov/cci-resources.

> CARB Action: Staff expects that every project funded with the FY 2018-19 Low Carbon Transportation appropriation will provide some benefit for AB 1550 populations. The project category descriptions included in Chapters 3 and 4 of this Funding Plan describe the anticipated AB 1550 benefits for each project, and Appendix A shows how staff developed its minimum AB 1550 investment target that at least 45 percent of funds meet one of the AB 1550 criteria.
>
> For each project, staff will use the criteria from www.arb.ca.gov/cci-resources to evaluate the AB 1550 benefits and to develop project solicitation and grant requirements. As project funds are expended, CARB will report the AB 1550 benefits in future *Annual Reports to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds*.

Guideline Requirement: Target funding, to the extent feasible, for projects that benefit priority populations.

> CARB Action: The FY 2018-19 Funding Plan includes a mix of projects that are available statewide on a first-come, first-served basis and those that are limited to disadvantaged communities or to low-income households. These are clearly specified in the Funding Plan. In cases where projects are not limited to disadvantaged communities, many grant agreements that include a requirement to focus outreach on disadvantaged communities to increase participation in those communities.

[11] See Funding Guidelines for Agencies that Administer California Climate Investments, 2018. https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/2018-funding-guidelines.pdf

For the statewide first-come, first-served projects (CVRP and HVIP), staff has incorporated project criteria intended to increase benefits to disadvantaged communities and low-income households. For HVIP, zero-emission truck and bus voucher amounts are higher for vehicles that operate in disadvantaged communities. For CVRP, rebate amounts are higher for low-income vehicle purchasers with household incomes less than 300 percent of the federal poverty level. Outreach is being increasingly focused on disadvantaged communities and low-income households.

Guideline Requirement: Create or modify program guidelines or procedures to meet or exceed AB 1550 program targets.

CARB Action: This Funding Plan outlines the procedures CARB is taking to meet or exceed AB 1550 targets.

Guideline Requirement: Design programs and select projects that avoid substantial burdens to residents of disadvantaged and low-income communities, such as physical displacement of low-income or disadvantaged community residents or businesses, including small-, women-, and/or minority-owned businesses; or increased exposure to toxics or other health risks.

CARB Action: In designing the projects in the Funding Plan, staff is careful to avoid or minimize potential substantial economic, environmental, and public health burdens. Any potential substantial burdens are identified early in the project development process and are discussed with stakeholders through the public work group process.

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Guideline Requirement: Provide direct outreach to disadvantaged communities and identify an agency point or contact to provide the information on funding opportunities and to coordinate with other State agencies on California Climate Investments.

CARB Action: CARB has taken multiple actions to outreach to disadvantaged communities.

Hire dedicated staff: CARB has hired dedicated staff to assist with disadvantaged community and low-income household outreach on Low Carbon Transportation investments and help ensure these communities are aware of funding opportunities. As part of this, CARB is working with liaisons from State agencies administering California Climate Investments to better share information at community events, so citizens can have access to all relevant California Climate Investments opportunities. This includes participating in the inter-agency California Climate Investments Outreach Work Group and the coordinating with the Strategic Growth Council on the California Climate Investments Outreach & Technical Assistance Program.

Conduct outreach to help potential applicants access funding, particularly for priority populations: CARB's multi-faceted outreach effort to support its Low Carbon Transportation Program and help ensure priority populations are aware of funding opportunities is summarized earlier in this chapter. These outreach efforts include the following elements:

- *Outreach events:* CARB has started an enhanced outreach/education program on the Low Carbon Transportation Program with a disadvantaged community focus. An important part of the effort is dedicated to assessing the needs of the communities. CARB is partnering with stakeholders, such as community based organizations, community advocates, and environmental justice groups to conduct community meetings aimed at explaining available incentives and increasing the community's awareness of these programs. A list of outreach events since July 2017 where CARB provided information on its Low Carbon Transportation Program is shown in Table 20.

- *Website*: CARB has developed a new, user-friendly Moving California website to promote Low Carbon Transportation projects and increase awareness about funding opportunities: https://arb.ca.gov/msprog/lct/movingca.htm.

- *Outreach by grantees*: As a part of project solicitations, CARB requires that applicants provide information on how they will outreach to disadvantaged communities, and their applications are scored in part on the quality of the outreach proposal.

- *One-Stop-Shop*: The FY 2017-18 Funding Plan funded the One-Stop-Shop Pilot Project to address a core recommendation identified in the SB 350 Low-Income Barriers Study to increase awareness for low-income residents by expanding education and outreach on clean transportation and mobility options. One of the primary objectives of this pilot is to provide coordinated community-based outreach and education to maximize Low Carbon Transportation program participation and promote advanced technology vehicle adoption in disadvantaged communities, low-income communities, and low-income households.

- *Outreach Plan:* One of CARB's priority recommendations in the SB 350 Guidance Document is to develop an outreach plan to streamline engagement with low-income residents and disadvantaged communities. CARB is leading outreach plan development with the goal of improving state and local coordination and content development, tailoring and delivery of information, as well as strategies that will increase awareness of clean transportation and mobility options through improved education and information access for low-income residents across the State. The roadmap will include actions intended to strengthen collaboration and partnerships, outreach to low-income residents in urban, rural, and tribal communities

based on community-identified needs and increase the ability to participate in CARB or related incentive programs. In April 2018, CARB convened working groups consisting of both internal and external stakeholders to solicit ongoing feedback, identify outreach and community engagement best practices, and develop the outreach roadmap. CARB anticipates releasing the draft roadmap in the fall for public feedback and finalizing later this year.

Guideline Requirement: Maximize economic, environmental, and public health co-benefits to the State.

CARB Action: To the extent feasible, staff seeks to ensure that the investments in the Funding Plan maximize co-benefits, such as fostering job creation, improving air quality, providing opportunities for business, public agencies, nonprofits, and other community institutions to participate in and benefit from investments, and lessening the impacts and effects of climate change.

Guideline Requirement: Foster job creation and job training, wherever possible.

CARB Action: The investments in the Funding Plan help to foster job creation by providing employment opportunities or job training tied to employment. To the extent feasible, jobs and job training are targeted to priority populations. This can take place at either the program or the project level.

Guideline Requirement: Ensure transparency and accountability and provide public access to program information.

CARB Action: All CARB grant agreements with funding recipients require grantees to collect and report to CARB all data necessary regarding AB 1550 benefits. This includes all information described in Section VI (Reporting Requirements) of the 2018 Funding Guidelines. CARB uses this information to provide input for the *Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Proceeds* including the AB 1550 benefits of Low Carbon Transportation investments.

Guideline Requirement: When evaluating projects for benefiting priority populations, assess how projects meet a community or household need. The California Climate Investments Guidelines provides a list of common needs identified by community advocates during the development of the guidelines. Letters of community support can also be used to document that investments address a community need.

CARB Action: Staff reviewed the commonly identified needs of priority populations in the California Climate Investments Guidelines. The needs being met by proposed FY 2018-19 Low Carbon Transportation investments are shown in Table 19 below.

Table 19: Common Needs of Priority Populations Addressed by Proposed FY 2018-19 Low Carbon Transportation Investments

Public Health, Need 1	Reduce health harms suffered disproportionately by priority populations due to air pollutants. *All Low Carbon Transportation projects meet this need. All projects reduce criteria air pollutants and/or toxic air contaminants as co-benefits thereby reducing health harms due to air pollutants, and a portion of funding from all projects is expected to benefit priority populations.*
Economic, Need 5	Reduce transportation costs and improve access to public transportation. *The Low Carbon Transportation projects that provide consumer incentives for more fuel efficient vehicles meet this need. These include CVRP, EFMP Plus-Up, Financing Assistance for Lower-Income Consumers, and Clean Mobility Options projects.*
Economic, Need 10	Provide educational and community capacity building opportunities through community engagement and leadership. *Public outreach in an element of many Low Carbon Transportation projects. For the light-duty equity projects in particular, CARB will continue to require that grant awardees have strong community-based experience and commit to conduct extensive outreach and education tailored to the communities' projects will serve.*
Environmental, Need 1	Reduce exposure to local environmental contaminants, such as toxic air contaminants, criteria air pollutants, and drinking water contaminants. *All Low Carbon Transportation projects meet this need because they reduce criteria air pollutants and/or toxic air contaminants as co-benefits*.
Environmental, Need 2	Prioritize zero-emission vehicle projects for areas with high diesel air pollution, especially around schools or sensitive populations with near-roadway exposure. *The Low Carbon Transportation projects that provide incentives for zero-emission vehicles to replace diesel vehicles meet this need. These include Rural School Bus Pilot, Zero- and Near Zero-Emission Freight Facilities, and HVIP.*

Guideline Requirement: Facilitate GHG emission reductions and further the purposes of AB 32 and related statutes.

CARB Action: All of the Low Carbon Transportation projects in the Funding Plan help to facilitate the achievement of GHG emission reductions and further the purposes of AB 32. Facilitating these reductions is a priority as the programs or projects are designed, guidelines are developed, and final projects are selected. In selecting projects, staff has focused on funding those projects that: achieve near-term quantifiable GHG emissions reductions; achieve long-term quantifiable GHG emission reductions and provide co-benefits; promote early adoption of advanced technologies and practices that facilitate near-term GHG emission reductions; and/or support strategies and development of accelerated technologies needed to achieve the State's long-term GHG emission reduction goals.

CARB staff also reports on the outcomes of expenditures, including the cost-effectiveness of investments in achieving GHG emission reductions. In considering cost-effectiveness, staff has also noted where there may be tradeoffs when selecting projects with high GHG cost-effectiveness compared to projects that facilitate GHG emission reductions but primarily provide other co-benefits.

Guideline Recommendations: In addition to the requirements summarized above, the California Climate Investments Guidelines list a number of recommended program design strategies for targeting investments to priority populations.

CARB Action: In developing the FY 2018-19 Funding Plan, staff utilized a number of these strategies, including:

Encourage projects that contribute to other State climate goals: Many of the projects in this Funding Plan contribute to a variety of the State's climate goals. Table 2 in the Executive Summary lists many of the multiple goals that these projects address. A more detailed list of the State's climate goals that are addressed by the Funding Plan is included in Chapter 1.

Coordinate investments and leverage funds where possible to provide multiple benefits and to maximize benefits: CARB staff coordinates with other agencies and meets with stakeholders both in individual meetings and in public work group meetings and workshops to discuss ways to maximize project benefits. A number of the projects leverage private investments and other government investments where possible.

Set aside a portion of funding for projects benefiting priority populations: Funding for the Clean Mobility Options, Agricultural Worker Vanpools, and Zero-Emission Freight Facilities projects are all limited to disadvantaged communities. In addition, the Low Carbon Transportation funding for EFMP Plus-up is limited to ZIP Codes benefiting disadvantaged communities. EFMP Plus-up and Financing Assistance funding is limited to lower-income consumers, and staff included an allocation of reserved CVRP rebates for low-income consumers earning less than 300 percent of the federal poverty level as a new refinement in the FY 2017-18 Funding Plan.

Offer higher incentive amounts for projects benefiting priority populations: HVIP provides higher voucher amounts for zero-emission trucks and buses that operate in disadvantaged communities. CVRP provides higher rebate amounts to lower-income consumers. EFMP Plus-up provides tiered incentive amount based on income, with the lowest-income participant receiving the highest incentive amounts.

Table 20: Low Carbon Transportation Program Outreach Events

Outreach Event	Date	Location
OneStop Diesel Truck Events(LCTI outreach material table)	08/30/2017	Santa Rosa
California Trucking Show	10/14/2017 10/15/2017	Ontario
Oakland Yard Party in Partnership with WOEIP* (Resource Fair)	10/24/2017	Oakland
OneStop Diesel Truck Events (LCTI outreach material table)	11/01/2017	Moreno Valley
Ritchie Bros. Auction	11/06/2017	Tipton
CCI Programs Housing and Transportation (Assembly member Jim Copper Event)	11/14/2017	Elk Grove
OneStop Diesel Truck Events (LCTI outreach material table)	11/30/2017	Simi Valley
South Coast Air Quality Management District Annual EJ Conference	12/01/2017	Los Angeles
Ritchie Bros. Auction	12/4/2017	Dunnigan
Cap and Trade Funding Workshop	12/15/2017	Del Paso Heights
OneStop Diesel Truck Events (LCTI outreach material table)	12/21/2017	Fortuna, Eureka
OneStop Diesel Truck Events (LCTI outreach material table)	1/22/2018	Sacramento
OneStop Diesel Truck Events (LCTI outreach material table)	01/23/2018	Sacramento
LCTI Outreach, Education and Awareness	02/27/2018	Pomona
LCTI Outreach, Education and Awareness at California Climate Investment Summit	03/12/2018	Riverside
Outreach and Education of LCTI to Spanish Community at La Familia Family Awareness Event	03/16/2018	South Sacramento
Outreach and Education of LCTI at CLEPA EJ Initiative Report Back Meeting (LCTI Table)	03/20/2018	Pomona
Coming Home: Post Fire Rebuilding Expo	03/24/2018	Ukiah
OneStop Diesel Truck Events (LCTI outreach material table)	04/17/2018	Bakersfield
LCTI outreach, Education and Awareness Session with Breath LA	04/19/2018	Los Angeles
LCTI Outreach at Blue LA Car Share Launch Event	04/20/2018	Los Angeles
Asparagus Festival	04/20-22/2018	Stockton
LCTI Programs outreach, awareness and Education	04/26/2018	South Los Angeles

Outreach Event	Date	Location
CCI Guidelines Community Meeting	04/27/2018	South East Los Angeles
CCI Guidelines Community Meeting	05/02/2018	Colton
CCI Guidelines Community Meeting	05/03/2018	Modesto
CCI Guidelines Meeting	05/07/2018	Brawley
Pomona Beautification Day	05/12/2018	Pomona
Asians In Energy & Hispanics in Energy first Energy Summit	05/17/2018	San Francisco
CALETC Prove It! Campaign	05/23/2018	Los Angeles
Greenlining Economic Summit	05/24/2018	Oakland
Prove it! Campaign Mid-Year Gathering	06/20/2018	Los Angeles
OneStop Diesel Truck Events (LCTI outreach material table)	06/21/2018	Imperial
Capitalizing on Climate Investments in Southern San Joaquin Valley: Finding Common Ground	07/18/2018	Tulare
CALEP EJ Task Force Meeting with CBOs and Community Residents	07/25/2018	Stockton
Meeting with Vietnamese American Community of Sacramento	08/02/2018	South Sacramento
Assembly Member Chris Holden Block Party and Resource Fair	08/04/2018	Pasadena
OneStop Diesel Truck Events (LCTI outreach material table)	08/21/2018	Seaside
Capitalizing on Climate Investments: Finding Common Ground in Northern San Joaquin Valley	08/22/2018	Stockton
SCAQMD EJ Community Conversation	08/30/2018	Los Angeles
California Climate Investments Guidelines Community Meeting	08/31/2018	Sacramento

**West Oakland Environmental Indicators Project*

CHAPTER 7: CONTINGENCY PROVISIONS

The proposed FY 2018-19 Funding Plan is based on the latest available information. However, circumstances may change between the time the proposed Funding Plan is released for public comment and when the Board approves the Funding Plan, project solicitations are issued, project funds awarded, or as projects are implemented. This section describes staff's proposed contingency plans should mid-course corrections be needed to ensure that funds are spent expeditiously, efficiently, and where the need is the greatest. Under these provisions, the Board would grant the Executive Officer authority to make adjustments as necessary.

Low Carbon Transportation Appropriation: CARB was appropriated $455 million from GGRF for its Low Carbon Transportation Program. Section 15.14 of the Budget Act of 2018 specifies that "no department shall encumber or commit more than 75 percent of any appropriation prior to the fourth cap and trade auction in the 2018-19 fiscal year. Upon determination of the final amount of auction proceeds after the fourth cap and trade auction, the Department of Finance shall make a final determination for the expenditure of the remaining auction proceeds."

AQIP Funding Levels: Over past funding cycles, AQIP revenues were sometimes lower than the levels included in the State Budget, and project solicitations had to be scaled back. AQIP appropriation levels have been adjusted in the State Budget in recent years to more closely track anticipated revenues, so staff does not expect needing to scale back AQIP funding in the FY 2018-19 funding cycle.

Additional Funding Sources: If funding from other sources is provided for any of the project categories authorized in the Funding Plan, these outside funds will be allocated as needed for projects or as specifically required by the authorizing entity. Additionally, projects receiving additional funding may be altered to accommodate any conditions placed upon the use of alternative sources of funding as long as these conditions are consistent with the statutory provisions for Low Carbon Transportation and AQIP. Staff will consult with project work groups prior to making any changes to projects.

Project Demand: Staff plans to issue initial solicitations and funding agreements based on the allocations listed in Table 5 (Chapter 2). However, these solicitations and grant agreements will be written with provisions to allow an increase in awarded funding if there are sufficient revenues and project demand. Some solicitations may be written to allow for the potential use of funding from the FY 2019-20 budget year to meet excess demand subject to approval by the Board as part of the FY 2019-20 Funding Plan. Conversely, staff proposes that the Executive Officer have the ability to reallocate funding from any project in the event that demand does not materialize or if it is determined that the project is not viable as envisioned in the Funding Plan (e.g. a technology considered for pilot deployment is not ready to be funded). In this case, funds would be reallocated within the same project category or sector prior. For example, if demand falls short for one of the transportation equity projects, CARB would shift that funding to another transportation equity project. Any changes in funding for a

particular project category would be publicly vetted through a public project work group process.

When CARB is evaluating solicitations, there may be cases where funding has been awarded to the highest scoring applications and the remaining available funds are less than the amount requested in the next highest scoring application. In these cases, staff proposes that the Executive Officer have the authority to offer funding to the next highest scoring project(s) at a scaled down scope, carry the remaining funds forward to the next fiscal year, or shift the funds to another project category at his discretion.

Project Continuity Between Funding Cycles: To avoid disruptions to ongoing projects, staff proposes the Executive Officer have the authority to establish applicant waiting lists for CVRP (including the public fleet element), Financing Assistance for Lower-Income Consumers, HVIP, or Truck Loans in the event funding is exhausted prior to the end of the funding cycle. If any of these projects end up with waiting lists, the Executive Officer would have the authority to amend the FY 2018-19 grant agreements to add FY 2019-20 funding upon the enactment of the 2019-20 State budget if funding is appropriated to these projects in the budget.

Staff also proposes a contingency provision to allow for uninterrupted implementation of the Truck Loan Assistance Program in the event that consideration of the FY 2019-20 Funding Plan is delayed beyond July 2019. If CARB is appropriated AQIP funding in the FY 2019-20 State budget and the Executive Officer determines that the Truck Loan Assistance Program would run out of funding prior to Board consideration of the FY 2019-20 Funding Plan, the Executive Officer would have the authority to allocate up to 25 percent of FY 2019-20 AQIP funds to the Truck Loan Assistance Program.

Technical or Administrative Changes: The proposed Funding Plan specifies all policy-related details regarding the projects to be funded. However, technical or administrative changes in implementation procedures may be needed from time to time to ensure these projects are successful. Staff proposes a transparent process in which changes to a project category would be publicly vetted through the project work group process that has been established to discuss the implementation details of each project. For several project categories, staff is already planning to use the public work group process to finalize technical details prior to issuing solicitations. These changes would be within the Funding Plan parameters approved by the Board.

CHAPTER 8: GRANT ADMINISTRATION

This chapter describes staff's proposed approach for addressing project implementation costs and provisions for advanced payments in grant agreements.

Project Implementation Costs: Grants include indirect costs and direct project costs that support implementation and technology associated with the project. Staff reviewed grants from various project types to identify the common definitions associated with costs within grants. Indirect costs and direct project costs are identified within each grant agreement, and sometimes vary depending upon the needs of that particular project. Project costs should be detailed such that they include all necessary staff, tasks, and materials needed to implement the project. If appropriate, this includes activities such as outreach and education, research, data management, and reporting. Below is an overview of project implementation costs and how these costs are typically divided among various project types.

Indirect Project Costs: Indirect costs are costs which are not tied directly or solely to the project such as, distributed administration and general administrative services; non-project related contracts or subscriptions; rent and office space, phones and telephone services, printing, or mailing services not associated with staff working on the project; or any other costs that are not directly and fully incurred to support the grant project.

Direct Project Costs: SB 856 does not address non-administrative direct project costs. To present a complete picture, direct project costs are outlined below.

- *Direct Project Costs for First-come, First Serve Projects:* Includes project implementation costs and technology costs. Although the statute does not specify a threshold for implementation costs, grant administrators should focus on limiting costs to ensure that the majority of grant funds reach their ultimate recipients. Examples below.

    - Project Implementation Costs: Direct project labor and expenses associated with the project, including all components of project implementation, outreach and education, research and data analysis, program evaluation, required reporting, external consultants, third-party contracts for direct support, travel, and information technology related to project implementation.

    - Technology Costs: Costs associated with vehicles, equipment, and infrastructure that is either used to demonstrate the ability of the technology to achieve emission reductions or to deploy technology to an end user (i.e. business, consumer, etc.) for the purpose of achieving emission reductions. This includes the direct maintenance of these components, if required by the project.

- *Direct Project Costs for Transportation Equity Projects, Pilots, and Demonstrations:* Includes project implementation costs and technology costs as described above, but limitations are typically based on milestones or deliverables, in addition to some amounts for general direct project expenses, if necessary.

Advance Payments to Grantees: Consistent with the Legislature's direction to expeditiously disburse grants, CARB provides advance payments of grant awards in a timely manner to support project initiation and implementation with a focus on mitigating the constraints of modest reserves and potential cash flow problems. SB 854 (Section 39603.1 of the Health and Safety Code) allows this as described below:

"a) Notwithstanding any other law, the state board may provide advance payments to grantees of a grant program or project if the state board determines all of the following:

(1) The advance payments are necessary to meet the purposes of the grant program or project.
(2) The use of the advance funds is adequately regulated by grant or budgetary controls.
(3) The request for application or the request for proposals contains the terms and conditions under which an advance payment may be received consistent with this section.
(4) The grantee is either a small district or the grantee meets all of the following criteria:
    (A) Has no outstanding financial audit findings related to any of the moneys eligible for advance payment and is in good standing with the Franchise Tax Board and Internal Revenue Service.
    (B) Agrees to revert all unused moneys to the state if they are not liquidated within the timeline specified in the grant agreement.
    (C) (i) Submits a spending plan to the state board for review prior to receiving the advance payment.
        (ii) The spending plan shall include project schedules, timelines, milestones, and the grantee's fund balance for all state grant programs.
        (iii) The state board shall consider the available fund balance when determining the amount of the advance payment.
    (D) Reports to the state board any material changes to the spending plan within 30 days.
    (E) Agrees to not provide advance payment to any other entity.
(5) In the event of the nonperformance of a grantee, the state board shall require the full recovery of the unspent moneys. A grantee shall provide a money transfer confirmation within 45 days upon the receipt of a notice from the state board.

(b) The state board, in consultation with the Department of Finance, shall adopt a regulation implementing this section to ensure the moneys are used properly.
(Added by Stats. 2018, Ch. 51, and Sec. 11. (SB 854) Effective June 27, 2018.)"

ACRONYM LIST

1. AB – Assembly Bill
2. AGV – automated guided vehicle
3. AMT – automated manual transmission
4. ARFVTP – Alternative and Renewable Fuel and Vehicle Technology Program
5. APCD – Air Pollution Control District
6. AQIP – Air Quality Improvement Program
7. AQMD – Air Quality Management District
8. BEV – battery-electric vehicle
9. CalCAP – California Capital Access Program
10. Cal/EPA – California Environmental Protection Agency
11. CAPCOA – California Air Pollution Control Officers Association
12. CARB – California Air Resources Board
13. CEC – California Energy Commission
14. CHDC – Community Housing Development Corporation
15. CHE – cargo handling equipment
16. CO_2 – carbon dioxide
17. CPCFA – California Pollution Control Financing Authority
18. CPUC – California Public Utilities Commission
19. CSE – Center for Sustainable Energy
20. CVRP – Clean Vehicle Rebate Project
21. DGS – Department of General Services
22. DOE – Department of Energy
23. DMV – Department of Motor Vehicles
24. EERE – Office of Energy Efficiency and Renewable Energy
25. EFMP – Enhanced Fleet Modernization Program
26. ePTO – electric power take-off
27. EV – electric vehicle
28. FC – fuel cell
29. FCEV – fuel cell electric vehicle
30. FPL – federal poverty level
31. FTA – Federal Transit Administration
32. FY – fiscal year
33. g/bhp-hr – grams per brake horsepower-hour
34. GHG – greenhouse gas
35. GPS – global positioning system
36. GSE – ground support equipment
37. GVWR – gross vehicle weight rating
38. HD – heavy-duty
39. HEV – hybrid-electric vehicle
40. HHD – heavy heavy duty
41. HV – hybrid vehicle
42. HVAC – heating, ventilation, and air conditioning
43. HVIP – Hybrid and Zero-Emission Voucher Incentive Program

44. ITR – Innovative Technology Regulation
45. ITS – intelligent transportation systems
46. LCFS – Low Carbon Fuel Standard
47. LHD – light heavy duty
48. LoNo – Low or No Emission Vehicle Program
49. MD – medium-duty
50. MHD – medium heavy duty
51. MOU – memorandum of understanding
52. MSRC – Mobile Source Air Pollution Reduction Review Committee
53. NG – natural gas
54. NOx –nitrogen oxides
55. N/ZE – near zero- and zero-emission
56. OEM – original engine manufacturer
57. PHEV – plug-in hybrid-electric vehicle
58. PM – particulate matter
59. ROG – reactive organic gas
60. RTG – rubber tired gantry crane
61. SB – Senate Bill
62. SECAT – Sacramento Emergency Clean Air and Transportation Program
63. SGC – Strategic Growth Council
64. SLCP – short lived climate pollutant
65. SOx – sulfur oxides
66. TIRCP – Transit and Intercity Rail Capital Program
67. TRL – technology readiness level
68. TRU – Transport Refrigeration Unit
69. VTO – Vehicle Technologies Office
70. WHR – waste heat recovery
71. XO – extended operations
72. XR – extended range
73. ZE – zero-emission
74. ZERO – Zero Emission Research Opportunity
75. ZEV – zero-emission vehicle

Appendix A:

Emission Reductions Quantification Methodology

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Table of Contents

Overview

In the Governor's budget for the 2018-19 fiscal year (FY), the California Air Resources Board (CARB) was appropriated $28.6 million for Air Quality Improvement Program (AQIP) projects and $455 million for Low Carbon Transportation Investments from Cap-and-Trade auction proceeds. This appendix conservatively estimates the emission reductions of the project categories presented in the Funding Plan and provides additional details on the methodology developed and assumptions used. This analysis was guided by Assembly Bill (AB) 8 (Perea, Chapter 401, Statutes of 2013) and published Greenhouse Gas Reduction Fund (GGRF) quantification methodologies.[1]

It is important to note that these emission reduction estimates are illustrative examples of potential emission reductions that can be achieved with the funding allocated to these projects. Refined emission reduction estimates will be quantified as projects are implemented and data becomes available.

Table A-1 summarizes the funding allocations for the projects proposed in the Funding Plan and the potential emission reductions over the project life.

[1] Cap-and-Trade auction proceeds quantification materials are available at: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm.

Table A-1: Summary of Proposed Projects in the FY 2018-19 Funding Plan and Total Potential Emission Reductions

Category	Project	Proposed FY 2018-19 Allocation (millions)	# of Vehicles or Equipment Funded	Total Potential Lifetime Emission Reductions (tons)			
				GHG	NOx	PM 2.5	ROG
Light-Duty & Transportation Equity	CVRP	$175	72,000	431,600	54	24	11
	CVRP Increased Rebates for Lower-Income Consumer	$25	6,000	34,600	4.3	2.0	0.9
	EFMP Plus-Up	$16	1,800	8,108	16.2	0.40	3.81
	Financing Assistance for Lower-Income Consumers	$10	800	3,607	0.61	0.23	0.12
	Clean Mobility Options for Disadvantaged Communities	$15	400	1,849	0.23	0.10	0.05
	Agricultural Worker Vanpools	$3	77	2,300	0.14	0.21	0.02
	Rural School Bus Pilot	$15	40	11,600	130	1.7	1.9
	Clean Mobility in Schools	$10	108	6,400	5.0	0.40	0.22
Heavy-Duty & Off-Road	Clean Truck and Bus Vouchers	$125	2,420	650,000	1,100	29	10.4
	Zero- and Near-Zero Emission Freight Facilities	$55	170	62,500	110	3.5	66
	Truck Loan Assistance Program	$25.6	8,200	--	3,387	--	54
	Diesel Truck Replacement Filters	$3	150	--	0	5	0

Note: the emissions reductions listed in this table do not include the $6 million reserve for equity projects based on demand.

Emission Factor Development

To support the analysis of emission reductions from the proposed projects, staff developed a set of emission factors for a variety of different vehicle classes. The emission factors and assumptions used in the analysis were derived from a number of sources such as CARB's California-modified Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (CA-GREET 2.0) Model,[2] CARB's Emission Factor (EMFAC2014) Model,[3] information from CARB regulation staff reports and emissions inventories, publically available technical reports, and staff assumptions. Greenhouse gas (GHG) emission factors were developed on a well-to-wheel (WTW) basis since greenhouse gases are global pollutants. Criteria pollutant and toxic emission factors are calculated based solely on tailpipe emissions because of their localized impact.

Staff developed emission factors for the following vehicle classes:

- Light-duty vehicles (LDV)
- Light heavy-duty vehicles (LHD)
- Medium heavy-duty vehicles (MHD)
- Heavy heavy-duty vehicles (HHD)
- Urban buses
- School buses
- Cargo-handling equipment (CHE)
- Transport refrigeration units (TRU)
- Off-road mobile agricultural equipment (tractors)
- Locomotives

GHG Emission Factors

Fuel economy is an important component of the emission reduction analysis, as the value determines the emissions generated based on the consumption of each unit of fuel for the miles traveled or for off-road applications, unit of fuel consumed per hour of use. Fuel economy values were derived from EMFAC 2014[4] and CARB's off-road mobile source emissions inventories[5], specifically the 2011 Cargo Handling Equipment Inventory and the 2011 TRU Emissions Inventory models. Table A-2 provides a summary of the fuel economy values for baseline gasoline or diesel on-road vehicles, while Table A-3 provides a summary of fuel economy values for baseline diesel off-road vehicles. These values were used in the analysis for conventional vehicles.

[2] http://www.arb.ca.gov/fuels/lcfs/ca-greet/ca-greet.htm
[3] https://www.arb.ca.gov/emfac/2014/
[4] https://www.arb.ca.gov/emfac/2014/
[5] https://www.arb.ca.gov/msei/msei.htm

Table A-2: On-Road Fuel Economy Values of Baseline Conventional Vehicles

Vehicle Class	Fuel Type	Fuel Economy Values (mpg)			
		1996	1998	2014	2018
LDV	Gasoline	23.1	-	27.3	32.8
LHD	Gasoline	-	-	-	11.5
MHD	Diesel	-	-	-	8.9
HHD	Diesel	-	-	-	6.2
Urban Bus	Diesel	-	-	-	5.4
School Bus	Diesel	-	7.3	-	7.7

Table A-3: Off-Road Fuel Economy Values of Baseline Diesel Vehicles

Vehicle Class	Horsepower Range	Fuel Economy Values (gal/hr)
		Tier 4 Final
Forklift	100-174	1.4
Yard Truck	175-299	3.5
TRU	23-25	0.7

The fuel economy was paired with carbon intensity (CI) values from the Low Carbon Fuel Standard (LCFS)[6] and the lower heating value (LHV) of applicable fuels to calculate the WTW GHG emission factor for each project type, as shown in Formula 1. This was done so that the upstream (well-to-tank) emissions of the fuel were representative of the fuel used, paired with an illustrative potential technology. For on-road vehicles, the GHG emission factor is in units of grams of carbon dioxide (CO2) equivalent per mile (gCO2e/mi), and for off-road vehicles, the GHG emission factor is in units of grams of CO2e per hour (gCO2e/hr).

Formula 1: GHG Emission Factors

$$GHG\ Emission\ Factor\ \left(\frac{gCO2e}{mi}\ or\ \frac{gCO2e}{hr}\right) = \frac{LCFS\ carbon\ intensity * LHV\ of\ fuel}{fuel\ economy\ of\ vehicle}$$

For alternative-fueled vehicles, the baseline fuel economy values were converted for a given alternative fuel, using LHVs of the baseline and alternative fuels and the energy economy ratio (EER) value, as shown in Formula 2. EER values were derived from the LCFS Regulation[7] or based on a study on the energy efficiency of battery-electric vehicles compared to conventional diesel vehicles operating on the same duty cycle.[8]

[6] https://www.arb.ca.gov/fuels/lcfs/lcfs.htm
[7] https://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf
[8] https://www.arb.ca.gov/msprog/actruck/mtg/170425eerdraftdocument.pdf

Formula 2: Alternative Fuel Vehicle Economy

$$Alt.Fuel\ Vehicle\ Economy\left(\frac{miles}{fuel\ unit}\ or\ \frac{hours}{fuel\ unit}\right) = fuel\ economy_{baseline} * \frac{LHV_{alt.\ fuel}}{LHV_{baseline\ fuel}} * EER$$

Lifecycle emission factors were adopted from the LCFS Program's carbon intensities, representing average or typical production processes for each fuel used in California. Staff assumed the following pathways for the fuels analyzed:

- Gasoline: California reformulated gasoline (CaRFG) from the LCFS Lookup Table[9];
- Diesel: ultra-low sulfur diesel (ULSD), also from the LCFS Lookup Table;
- Compressed Natural Gas (CNG): volume-weighted average CI of CNG from North American natural gas consumed in California in 2016 from LCFS Reporting Tool (LRT)[10] data;
- Electricity: California grid average mix, which meets the Renewable Portfolio Standard (RPS) requirements, from the LCFS Lookup Table;
- Hydrogen: SB 1505 compliant gaseous hydrogen reformed on-site at the refueling station from a mix of North American natural gas and 33 percent biomethane from landfill gas, from the LCFS Lookup Table;
- Renewable Diesel (RD): volume-weighted average CI of RD consumed in California in 2016 from LRT data; and
- Renewable Natural Gas (RNG): biomethane to CNG (off-site refueling), based on the average CI of RNG consumed in California in 2016 from LRT data.

It should be noted that as more renewables are introduced into the transportation fuel mix, lowering the average CI of the fuel, additional GHG benefits may be achieved, which may lower the emission factors. As the fuel mix changes, staff will reflect those changes in future analyses.

[9] https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm
[10] https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm

Criteria Pollutant and Toxics Emission Factors

For the determination of tailpipe criteria pollutant emission factors for on-road vehicles, staff used CARB's EMFAC 2014 model to calculate the tailpipe emissions and emissions associated with the usage of the supported vehicles or equipment, such as idling emissions and PM 2.5 emissions from brake and tire wear, when applicable. For off-road equipment, staff used CARB's 2011 Cargo Handling Equipment Inventory and 2011 TRU Emissions Inventory to develop emission factors associated with the usage of the supported vehicles or equipment.

As discussed in previous funding plans, preliminary data show that attaching a hybrid driveline to a vehicle without careful integration with the engine and after-treatment system can have the unintended consequence of increasing criteria pollutant emissions. Subsequently, the emission factors for hybrids are based on a certified vertically integrated hybrid vehicle. Moreover, improved fuel economy from the use of a hybrid system[11] provides improvements in the emission factors as less fuel is used and the well-to-tank GHG emissions are reduced.

Staff incorporated deterioration, when available, for both on-road and off-road vehicles. Staff also applied a 50 percent reduction in brake wear emissions for on-road vehicles that implement regenerative braking capability.[12] Emission factors were developed for advanced technology vehicles supported by the proposed projects when appropriate, along with emission factors for baseline conventional vehicles.

[11] Hybrid vehicle fuel economy improvement based on Climate Change Scoping Plan Appendices, Volume I: Supporting Documents and Measure Detail. http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf

[12] NREL, BAE/Orion Hybrid Electric Buses at New York City Transit, http://www.afdc.energy.gov/pdfs/42217.pdf, March 2008

Quantification Methodology for Projects

To quantify the potential emission reductions for each project, staff must first determine the annual per-vehicle emission reductions for each technology weighted by the amount of each technology funded in the project. Once the annual per-vehicle emission reductions are determined, staff estimate the average project costs to determine the number of vehicles or equipment that may be funded by the allotted funding amounts. Finally, to determine the total potential emission reductions for each project, the average annual per-vehicle emission reductions is multiplied by the number of vehicles or equipment funded and the project life. As noted in the individual project write-ups, staff have quantified emission reductions based on an illustrative example due to the uncertainty in the vehicle and equipment types that will be funded.

Annual Per-Vehicle Emission Reductions

Annual emission reductions are first calculated for each eligible or representative technology in the project using the emission factors that have been developed for each project. Annual emission reductions are in units of tons per year (tpy) for the emissions reduced and are calculated by taking the difference in emission rates between the baseline vehicle and advanced technology vehicle and then multiplying by usage. This value is then converted from grams per year to metric tons per year for GHG emissions and tons per year for criteria pollutants and toxic air contaminants.

For on-road projects, annual emission reductions are calculated using Formula 3, where emission factors are in terms of grams per mile (g/mi) and usage is based on annual vehicle miles traveled (VMT) or miles per year (mi/yr). For off-road projects, annual emission reductions are also calculated using Formula 3, however, emission factors are in terms of grams per hour (g/hr) and usage is in terms of hours per year. Additionally, the vehicle or equipment's load factor, which is an indicator of the nominal amount of work done by the engine for a particular application, and the horsepower rating of the engine are included when developing emission factors for off-road projects.

Formula 3: Annual Per-Vehicle Emission Reductions

$$Annual\ Per\ Vehicle\ Emission\ Reductions\ (tpy) = (EF_{baseline} - EF_{ATV}) * Usage$$

Once the annual per-vehicle emission reductions are calculated for the eligible technologies in each project, technology splits are factored in so that the emission reductions on a per-vehicle basis are representative of an average vehicle or equipment replaced under the project, as shown in Formula 4. The technology splits or mix for each project are determined based on historical project data or projected demand.

Formula 4: Average Annual Per-Vehicle Emission Reductions

$$Average\ Annual\ Per\ Vehicle\ Emission\ Reductions\ (tpy) = \sum (annual\ emission\ reductions\ per\ vehicle\ type * fraction\ of\ vehicles\ funded)$$

Project Costs

Once staff have identified the incentive cost for each technology and potential technology split for a given project, staff can calculate the average incentive amount for each project, using Formula 5.

Formula 5: Average Incentive Cost

$$Average\ Incentive\ Cost\ (\$) = \sum (cost\ per\ vehicle\ type * fraction\ of\ vehicles\ funded)$$

Once the average incentive amount is determined, the allotted funding for the project minus the administrative cost can be divided by the average incentive amount to estimate the number of vehicles or equipment likely to be funded, as shown in Formula 6. Staff evaluated the appropriate administrative cost for each project, which vary depending on the amount of oversight necessary to implement the project.

Formula 6: Number of Vehicles Funded

$$Number\ of\ Vehicles\ Funded = \frac{(Proposed\ Funding\ Allocation - Administrative\ Cost)}{Average\ Incentive\ Cost}$$

Total Lifetime Emission Reductions

Once the average per-vehicle emission reductions are determined, it is multiplied by the potential number of vehicles funded and the project life to determine the total potential lifetime emission reductions for a project, as shown in Formula 7.

Formula 7: Lifetime Emission Reductions

$$Lifetime\ Emission\ Reductions\ (tons) = average\ per\ vehicle\ emission\ reductions * number\ of\ vehicles * project\ life$$

Light-Duty Vehicle and Transportation Equity Investments

CARB's LDV and transportation equity investments are grouped into two broad project categories: the Clean Vehicle Rebate Project (CVRP) and transportation equity projects. CVRP supports increasing the number of zero-emission vehicles (ZEV) on California's roadways to meet the State's ZEV deployment goals and achieve the large scale transformation of the light-duty fleet. The transportation equity projects are designed to increase access to clean vehicles in disadvantaged communities and lower-income households. The transportation equity projects proposed in this year's Funding Plan include: the Enhanced Fleet Modernization Program (EFMP) Plus-Up, Financing Assistance for Lower-Income Consumers, Clean Mobility Options for Disadvantaged Communities, Agricultural Worker Vanpools, Rural School Bus Pilot Project, and Clean Mobility in Schools.

All light-duty vehicle and transportation equity investment projects use the light-duty automobile classification in EMFAC 2014 for the development of emission factors, with the exception of the Agricultural Worker Vanpools Project, which uses the LHD vehicle classification.

In addition to the light-duty vehicle and transportation equity investment projects mentioned above, CARB set aside $6 million to be allocated to transportation equity projects based on demand. The additional $6 million in funding is not quantified in the project sections below, but the funds may be used to increase the number of vehicles deployed in the transportation equity projects, which would result in additional emission reduction benefits.

Quantification of the LDV and transportation equity investment projects proposed in this year's Funding Plan are described in more detail below.

CVRP

CVRP achieves emission benefits by providing incentives for plug-in hybrid electric vehicles (PHEV), battery-electric vehicles (BEV), and fuel cell vehicles (FCV) to help motivate consumer purchasing decisions and support widespread adoption. When estimating emission benefits for CVRP, staff assumed that the consumer was purchasing or leasing a new vehicle. As a result, emission reductions for CVRP are calculated as the difference between an average 2018 model year conventional LDV and an average 2018 model year advanced technology LDV that was purchased or leased.

Project data from November 2017 through May 2018 shows that approximately 60 percent of standard CVRP rebates went to BEVs and 40 percent went to PHEVs. Project data for low-income applicants for the same period shows that 45 percent of rebates went to BEVs and 55 percent went to PHEVs. For this analysis, staff assumed that rebates for FY 2018-19 would continue to fund those same technologies at similar rates. Just over five percent of the rebates between November 2017 and May 2018

were claimed for FCVs, therefore, FCVs are not included in the emission reduction estimates for FY 2018-19.

Table A-4 shows the emission factors for the selected baseline vehicle and PHEV and BEV replacements. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-4: CVRP Emission Factors

Pollutant	2018 Gasoline (g/mi)	2018 Plug-in Hybrid Electric Vehicle (g/mi)	2018 Battery Electric Vehicle (g/mi)
NOx	0.0281	0.0135	0
PM 2.5	0.0199	0.0109	0.0099
ROG	0.0056	0.0027	0
GHG	348	211	109

Staff generated vehicle usage assumptions for CVRP through literature review for each of the vehicle types evaluated. The annual usage assumptions for CVRP are shown in the table below.

Table A-5: CVRP Annual Usage Assumptions

Technology	Usage (mi/yr)
PHEV	14,855[13]
BEV	11,059[14]

Using the emission factors, technology mix, and the annual usage assumptions above, staff calculated the potential annual per-vehicle emission reductions for CVRP, as shown in Table A-6.

[13] Based on 40.7 miles per day. Smart, J., Powell, W., and Schey, S., "Extended Range Electric Vehicle Driving and Charging Behavior Observed Early in the EV Project," SAE Technical Paper 2013-01-1441, 2013, doi:10.4271/2013-01-1441. (http://papers.sae.org/2013-01-1441/)

[14] Based on 30.3 miles per day. Smart, J. and Schey, S., "Battery Electric Vehicle Driving and Charging Behavior Observed Early in The EV Project," *SAE Int. J. Alt. Power.* 1(1):27-33, 2012, doi:10.4271/2012-01-0199. (http://papers.sae.org/2012-01-0199/)

Table A-6: CVRP Annual Emission Benefits on a Per-Vehicle Basis

Type of Rebates	Pollutant	Supported Technologies	Per Vehicle Annual Emission Reductions (tpy)	
			Per Technology	Average
Standard Rebates	GHG	PHEV	2.04	2.40
		BEV	2.64	
	NOx	PHEV	0.00024	0.0003
		BEV	0.00034	
	PM 2.5	PHEV	0.00015	0.0001
		BEV	0.00012	
	ROG	PHEV	0.00005	0.0001
		BEV	0.00007	
Rebates for Low-Income Applicants	GHG	PHEV	2.04	2.31
		BEV	2.64	
	NOx	PHEV	0.00024	0.0003
		BEV	0.00034	
	PM 2.5	PHEV	0.00015	0.0001
		BEV	0.00012	
	ROG	PHEV	0.00005	0.0001
		BEV	0.00007	

As directed in the 2018-19 State Budget, staff is allocating at least $25 million to CVRP rebates for low-income applicants for FY 2018-19. Based on project data, staff anticipate the average rebate cost to be $3,900 for low-income applicants and $2,250 for standard rebates.

With the $175 million allocation for CVRP outlined in the 2018-19 State Budget and the average cost discussed above, staff estimate that approximately 72,500 vehicles can be funded, in addition to the 6,000 vehicles that can be funded with the $25 million allocation for CVRP rebates for low-income applicants. CVRP has a 30 month (2.5 years) ownership requirement; therefore, total potential emission reductions for the project are quantified over the course of 30 months and shown in Table A-7.

Table A-7: Total Potential Emission Reductions for CVRP

Type of Rebates	Pollutant	Per Vehicle Average Annual Emission Reductions	Number of Vehicles	Average Annual Emissions	Project Life (years)	Lifetime Annual Emission Reductions
Standard Rebates	GHG	2.40	72,500	172,656	2.5	431,600
	NOx	0.0003		21.71		54
	PM 2.5	0.0001		9.49		24
	ROG	0.0001		4.30		11
Rebates for Low-Income Applicants	GHG	2.31	6,000	13,847	2.5	34,600
	NOx	0.0003		1.72		4.3
	PM 2.5	0.0001		0.81		2.0
	ROG	0.0001		0.34		0.9

EFMP Plus-up

EFMP Plus-up achieves emission reductions by incentivizing the scrap and replacement of old, high-emitting vehicles with cleaner advanced technology vehicles. To calculate the emission reductions for this project, staff used past project data to determine the model year of the baseline vehicle and the replacement vehicle. Based on project data through the 2018 calendar year, on average, a 1996 model year vehicle was being scrapped and replaced by an average 2014 model year advanced technology vehicle.

Project data for the 2018 calendar year shows that 16 percent of the funding went to BEV purchases, 40 percent went to PHEV purchases, and the remaining 44 percent went to conventional hybrid vehicle purchases. For the purposes of this analysis, staff assumed that FY 2018-19 funding would continue to incentivize those technologies at similar rates. Table A-8 reflects the emission factors for the selected baseline conventional hybrid, PHEV and BEVs. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-8: EFMP Plus-up Emission Factors

Pollutant	1996 Gasoline (g/mi)	2014 Conventional Hybrid (g/mi)	2014 PHEV (g/mi)	2014 BEV (g/mi)
NOx	0.3860	0.0402	0.0241	0
PM 2.5	0.0208	0.0109	0.0105	0.0099
ROG	0.0797	0.0081	0.0048	0
GHG	493	334	253	131

Staff generated conservative usage assumptions for EFMP Plus-up based on data in EMFAC 2014 for the baseline vehicle. According to EMFAC 2014, a 1996 model year vehicle operates approximately 7,500 miles per year in calendar year 2019.

Using the emission factors and technology mix mentioned above and the annual usage of 7,500 miles per year, staff calculated the potential annual per-vehicle emission reductions for EFMP Plus-up, as shown in Table A-9.

Table A-9: EFMP Plus-up Annual Emission Reductions on a Per-Vehicle Basis

Pollutant	Supported Technologies	Per-Vehicle Annual Emission Reductions (tpy)	
		Per Technology	Average
GHG	Conventional Hybrid	1.19	1.49
	PHEV	1.80	
	BEV	2.71	
NOx	Conventional Hybrid	0.0033	0.0030
	PHEV	0.0034	
	BEV	0.0036	
PM 2.5	Conventional Hybrid	0.0001	0.0001
	PHEV	0.0001	
	BEV	0.0001	
ROG	Conventional Hybrid	0.0008	0.0007
	PHEV	0.0008	
	BEV	0.0008	

Based on proposed funding amounts and past project data, staff anticipates the average incentive amount to be $7,500 per vehicle. With proposed $16 million allocation for EFMP Plus-up, staff estimates that approximately 1,800 vehicles can be funded. For the purpose of this analysis, staff estimates that the remaining useful life of the baseline 1996 model year vehicle is 3 years, therefore, emission reductions are quantified over the course of 3 years, (the ownership requirement for EFMP Plus-up is 2.5 years). The total potential emission reductions for EFMP Plus-up are shown in Table A-10 below.

Table A-10: Total Potential Emission Reductions for EFMP Plus-up

Pollutant	Per-Vehicle Average Annual Emission Reductions (tpy)	Number of Vehicles	Average Annual Emission Reductions (tpy)	Project Life (years)	Lifetime Annual Emission Reductions (tons)
GHG	1.49	1,800	2,683	3	8,049
NOx	0.0030		5.35		16.04
PM 2.5	0.0001		0.13		0.40
ROG	0.0007		1.26		3.79

Financing Assistance for Lower-Income Consumers

The Financing Assistance for Lower-Income Consumers project (Financing Assistance) achieves emission reduction benefits by assisting lower-income consumers in purchasing clean vehicles by improving access to more affordable financing options. Because this project is designed to assist the same consumer base as EFMP Plus-up, staff used EFMP Plus-up project data to determine the average replacement vehicle. According to these data, the average replacement vehicle is a 2014 model year, so staff used a 2014 model year, conventional gasoline vehicle as the baseline.

Because this project is designed to help facilitate the purchase of advanced technology vehicles, staff assumed the same vehicle technologies would be funded as in EFMP Plus-up (16 percent BEVs, 40 percent PHEVs, and 44 percent conventional hybrids). Emission factors for Financing Assistance are shown in Table A-11. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-11: Financing Assistance Emission Factors

Pollutant	2014 Gasoline (g/mi)	2014 Conventional Hybrid (g/mi)	2014 PHEV (g/mi)	2014 BEV (g/mi)
NOx	0.0503	0.0402	0.0241	0
PM 2.5	0.0013	0.0109	0.0105	0.0099
ROG	0.0101	0.0081	0.0048	0
GHG	418	334	253	131

Staff generated vehicle usage assumptions for Financing Assistance through literature review for each of the vehicle types evaluated, similar to CVRP. The annual usage assumptions for Financing Assistance are shown in Table A-12.

Table A-12: Financing Assistance Annual Usage Assumptions

Technology	Usage (mi/yr)
Conventional Hybrid/PHEV	14,855[15]
BEV	11,059[16]

Using the above assumptions and emission factors, staff calculated the potential annual per-vehicle emission reductions for Financing Assistance, as shown in Table A-13.

Table A-13: Financing Assistance Annual Emission Reductions on a Per-Vehicle Basis

Pollutant	Supported Technologies	Per-Vehicle Annual Emission Reductions (tpy)	
		Per Technology	Average
GHG	Conventional Hybrid	1.24	1.80
	PHEV	2.45	
	BEV	3.17	
NOx	Conventional Hybrid	0.00016	0.0003
	PHEV	0.00043	
	BEV	0.00061	
PM 2.5	Conventional Hybrid	0.00013	0.0001
	PHEV	0.00014	
	BEV	0.00011	
ROG	Conventional Hybrid	0.00003	0.0001
	PHEV	0.00009	
	BEV	0.00012	

Staff anticipate the average cost per loan, including the vehicle price buy down and loan loss reserve, will range from $9,000 to $12,000 and thus, estimated the average incentive cost per loan would be $10,500.

Based on the proposed $10 million allocation for Financing Assistance and the average cost shown above, staff estimate that approximately 800 vehicles can be funded. Financing Assistance has a 30-month ownership requirement; therefore, total potential emission reductions for the project are quantified over the course of two and a half years, as shown in Table A-14.

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[15] Based on 40.7 miles per day. Smart, J., Powell, W., and Schey, S., "Extended Range Electric Vehicle Driving and Charging Behavior Observed Early in the EV Project," SAE Technical Paper 2013-01-1441, 2013, doi:10.4271/2013-01-1441. (http://papers.sae.org/2013-01-1441/)

[16] Based on 30.3 miles per day. Smart, J. and Schey, S., "Battery Electric Vehicle Driving and Charging Behavior Observed Early in The EV Project," *SAE Int. J. Alt. Power.* 1(1):27-33, 2012, doi:10.4271/2012-01-0199. (http://papers.sae.org/2012-01-0199/)

Table A-14: Total Potential Emission Reductions for Financing Assistance

Pollutant	Per-Vehicle Average Annual Emission Reductions (tpy)	Number of Vehicles	Average Annual Emissions (tpy)	Project Life (years)	Lifetime Annual Emission Reductions (tons)
GHG	1.80	800	1,443	2.5	3,607
NOx	0.0003		0.243		0.61
PM 2.5	0.0001		0.093		0.23
ROG	0.0001		0.049		0.12

Clean Mobility Options for Disadvantaged Communities

Clean Mobility Options for Disadvantaged Communities (Clean Mobility Options) projects achieve emission reduction benefits by implementing car share programs that use advanced technology vehicles instead of conventional light-duty vehicles in disadvantaged communities. Clean Mobility Options projects also offer alternate modes of transportation that encourage the use of zero-emission and plug-in hybrid vehicles, vanpools, and other mobility options. While a number of strategies can be employed, the use of advanced technology vehicles instead of conventional light-duty vehicles in a car sharing component provides the primary GHG reductions resulting from a project. For this analysis, staff estimates reductions from the emissions offset between a brand new, conventional light-duty vehicle and an advanced technology vehicle. As project data becomes available, staff anticipate updating this analysis to also reflect alternate modes of transportation.

Two Clean Mobility Options pilot projects launched in April 2018 and May 2017, with more projects on the way. Because future projects are unknown and each project is different, for this analysis, staff assumes that vehicles funded are an equal split of BEVs and PHEVs. Table A-15 shows the emission factors for the selected baseline vehicle and PHEV and BEV replacements. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-15: Clean Mobility Options Emission Factors

Pollutant	2018 Gasoline (g/mi)	2018 Plug-in Hybrid Electric Vehicle (g/mi)	2018 Battery Electric Vehicle (g/mi)
NOx	0.0281	0.0135	0
PM 2.5	0.0199	0.0109	0.0099
ROG	0.0056	0.0027	0
GHG	348	211	109

Staff generated an annual usage assumption of 8,200 miles per year for Clean Mobility Options based on data from other car sharing programs in the United States.[17]

Using the above assumptions and emission factors, staff calculated the potential annual per-vehicle emission reductions for Clean Mobility Options, as shown in Table A-16.

Table A-16: Clean Mobility Options Annual Emission Reductions on a Per-Vehicle Basis

Pollutant	Supported Technologies	Per-Vehicle Annual Emission Reductions (tpy)	
		Per Technology	Average
GHG	PHEV	1.12	1.54
	BEV	1.96	
NOx	PHEV	0.00013	0.00019
	BEV	0.00025	
PM 2.5	PHEV	0.00008	0.00009
	BEV	0.00009	
ROG	PHEV	0.00003	0.00004
	BEV	0.00006	

Based on costs to lease or purchase new or used project eligible vehicles that range from below $10,000 to more than $100,000, staff believes that a reasonable estimate for the average incentive amount for is $35,000. Based on the proposed $15 million allocation for Clean Mobility Options and the average cost of $35,000, staff estimates that up to 400 vehicles can be funded.

The required project life for Clean Mobility Options vehicles is one to two and a half years. However, light-duty vehicles can last about 15 years. For the purpose of this analysis, staff conservatively assumed that emission reductions will occur over the course of three years. The total potential emission reductions for Clean Mobility Options are shown in Table A-17.

[17] Martin, E., Shaheen, S., and Lidicker, J. "Impact of Carsharing on Household Vehicle Holdings," *Transportation Research Record: Journal of the Transportation Research Board, No. 2143,* Transportation Research Board of the National Academies, Washington, D.C., 2010, pp. 150–158. DOI: 10.3141/2143-19. http://sfpark.org/wp-content/uploads/carshare/Impact_of_Carsharing_on_Household_Vehicle_Holdings.pdf

Table A-17: Total Potential Emission Reductions for Clean Mobility Options

Pollutant	Per-Vehicle Average Annual Emission Reductions (tpy)	Number of Vehicles	Average Annual Emission Reductions (tpy)	Project Life (years)	Lifetime Annual Emission Reductions (tons)
GHG	1.54	400	616	3	1,849
NOx	0.00019		0.077		0.23
PM 2.5	0.00009		0.034		0.10
ROG	0.00004		0.015		0.05

Agricultural Worker Vanpools

The Agricultural Worker Vanpools Pilot Project (Agricultural Worker Vanpools) achieves emission reduction benefits by providing incentives for advanced technology vehicles instead of conventional vehicles to be used for agricultural worker vanpools in disadvantaged communities. While Agricultural Worker Vanpools may achieve more significant emission benefits through VMT reductions and the displacement of single owner vehicles, there is not enough project data yet to quantify the potential emission reductions from VMT reductions or vehicle displacements. For the purposes of this analysis, staff estimated reductions from the emissions offset between a new 2017 model year conventional LHD van and a conventional hybrid van.

Emission factors for Agricultural Worker Vanpools are shown in Table A-18. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-18: Agricultural Worker Vanpools Emission Factors

Pollutant	2018 Gasoline (g/mi)	2018 Conventional Hybrid (g/mi)
NOx	0.0565	0.0452
PM 2.5	0.0363	0.0196
ROG	0.0085	0.0068
GHG	994	795

Staff also generated an annual usage assumption of 25,000 miles per year based on the average use of a 2018 model year, LHD van in EMFAC 2014.

Using the above assumptions and emission factors, staff calculated the potential annual per-vehicle emission reductions for Agricultural Worker Vanpools, as shown in Table A-19.

Table A-19: Agricultural Worker Vanpools Annual Emission Reductions on a Per-Vehicle Basis

Pollutant	Per-Vehicle Annual Emission Reductions (tpy)
GHG	4.97
NOx	0.00031
PM 2.5	0.00046
ROG	0.00005

Estimating the cost for all components for a van conversion to a hybrid system van equipped to carry agricultural workers, staff anticipates the average incentive amount per van would be approximately $42,000. Based on the proposed $3 million allocation for Agricultural Worker Vanpools and the average cost of $42,000 per van, staff estimate that approximately 60 vans can be funded. Using data from a similar program through CalVans, staff anticipate the funded vans would have a project life of 6 years. Using the estimated number of vehicles and project life as stated previously, staff calculated the total potential emission reductions for Agricultural Worker Vanpools, as shown in Table A-20.

Table A-20: Total Potential Emission Reductions for Agricultural Worker Vanpools

Pollutant	Per-Vehicle Average Annual Emission Reductions (tpy)	Number of Vehicles	Average Annual Emissions (tpy)	Project Life (years)	Lifetime Annual Emission Reductions (tons)
GHG	4.97	77	383	6	2,300
NOx	0.00031		0.024		0.144
PM 2.5	0.00046		0.035		0.213
ROG	0.00005		0.004		0.022

Rural School Bus Pilot Project

The Rural School Bus Pilot Project provides emission reduction benefits by providing incentives for school districts to purchase advanced technology school buses, giving priority to districts in rural areas and small air districts in the state. The Rural School Bus Pilot Project provides funding for battery-electric school buses and school buses that operate on renewable fuels.

The Rural School Bus Pilot Project requires school buses to be at least 20 years old to be eligible for replacement, this is a 1998 or older chassis. Based on projects funded for the 2016-17 fiscal year project staff expect that 75 percent of the buses funded will be battery-electric and the remaining 25 percent will operate on renewable diesel. Because limited data is available on vehicles utilizing renewable fuels, staff assumes that the renewable diesel vehicles will have similar emission rates as conventional diesel-fueled vehicles. Emission factors for the Rural School Bus Pilot Project are shown in Table A-21. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-21: Rural School Bus Pilot Project Emission Factors

Pollutant	1998 Diesel (g/mi)	2018 Battery Electric (g/mi)	2018 Renewable Diesel (g/mi)
NOx	15.2954	0	1.4080
PM 2.5	0.4058	0.1626	0.3249
ROG	0.2366	0	0.0549
GHG	1,896	334	622

Staff generated an annual usage assumption of 13,000 miles per year, based on the average use of 1998 model year school buses in EMFAC 2014. Applying the emission factors, technology mix, and annual usage assumptions mentioned above, staff calculated the potential per-vehicle emission reductions for the Rural School Bus Pilot Project, as shown in Table A-22.

Table A-22: Rural School Bus Pilot Project Annual Emission Reduction Benefits On a Per-Vehicle Basis

Pollutant	Supported Technologies	Per Vehicle Annual Emission Reductions (tpy)	
		Per Technology	Average
GHG	BEV	20.31	19.37
	Renewable Diesel	16.56	
NOx	BEV	0.2192	0.2141
	Renewable Diesel	0.1990	
PM 2.5	BEV	0.0035	0.0029
	Renewable Diesel	0.0012	
ROG	BEV	0.0034	0.0032
	Renewable Diesel	0.0026	

Applying the assumed technology mix from FY 2016-17 project applications, staff calculated the average incentive cost for the Rural School Bus Pilot Project, as shown in *Table A-23*.

Table A-23: Rural School Bus Pilot Project Average Incentive Cost

Supported Technologies	Cost Per Technology	Average
BEV	$400,000	$341,250
Renewable Diesel	$165,000	

Based on the proposed $15 million allocation for the Rural School Bus Pilot Project, staff anticipate that approximately 40 school buses to be funded. The average school bus has a useful life of 15 years.[18] Thus, for this analysis, staff assumed a conservative project life of 15 years and quantified the Rural School Bus Pilot Project's potential emission reduction benefits over the course of 15 years, as shown in Table A-24.

[18] https://www.afdc.energy.gov/uploads/publication/case-study-propane-school-bus-fleets.pdf

Table A-24: Total Potential Emission Reductions for the Rural School Bus Pilot Project

Pollutant	Per-Vehicle Average Annual Emission Reductions (tpy)	Number of Vehicles	Average Annual Emissions (tpy)	Project Life (years)	Lifetime Annual Emission Reductions (tons)
GHG	19.37	40	775	15	11,600
NOx	0.2141		8.566		130
PM 2.5	0.0029		0.116		1.7
ROG	0.0032		0.128		1.9

Clean Mobility in Schools Pilot Project

The Clean Mobility in Schools Pilot Project (Clean Mobility in Schools) achieves emission reduction benefits by funding deployment of synergistic GHG emission reduction technologies at schools located in disadvantaged communities. Project components could include electrification of transportation fleets (both light-duty and heavy-duty vehicles used at schools); installation of necessary infrastructure to support advanced technology vehicles and equipment; advanced technology car sharing; using GHG emission reduction curriculum in the classroom; using GHG emission reduction outreach efforts to the community; and other green technologies and practices.

Because this project can fund a variety of components, staff chose three vehicle classes likely to be funded to illustrate the potential emission reductions from this project including LDV, MHD and School Bus. Emission factors for these vehicles are shown in Table A-25. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-25: Clean Mobility in Schools Emission Factors

Vehicle Class	Pollutant	2018 Baseline (g/mi)	2018 Battery Electric (g/mi)
LDV	NOx	0.0281	0
	PM 2.5	0.0199	0.0099
	ROG	0.0056	0
	GHG	348	109
MHD	NOx	0.8536	0
	PM 2.5	0.0616	0.0309
	ROG	0.0368	0
	GHG	1,581	296
School Bus	NOx	1.4080	0
	PM 2.5	0.3249	0.1626
	ROG	0.0549	0
	GHG	1,786	334

Staff used the same annual usage assumption for LDVs as is used in CVRP, the same annual usage assumptions for MHD as is used in HVIP, and the same annual usage assumptions for school bus as Rural School Bus Pilot Project. The annual usage assumptions for Clean Mobility in Schools are shown in Table A-26.

Table A-26: Clean Mobility in Schools Annual Usage Assumptions

Vehicle Class	Usage (mi/yr)
LDV	11,059
MHD	12,000
School Bus	13,000

Using the above assumptions and emission factors, staff calculated the potential annual per-vehicle emission reductions for the Clean Mobility in Schools, as shown in Table A-27.

Table A-27: Clean Mobility in Schools Annual Emission Reductions on a Per-Vehicle Basis

Pollutant	Vehicle Class	Supported Technologies	Per-Vehicle Annual Emission Reductions (tpy)
GHG	LDV	Battery Electric	2.64
	MHD		15.42
	School Bus		18.87
NOx	LDV		0.0003
	MHD		0.0113
	School Bus		0.0202
PM 2.5	LDV		0.0001
	MHD		0.0004
	School Bus		0.0023
ROG	LDV		0.0001
	MHD		0.0005
	School Bus		0.0008

This is a new project type and staff assumed that one third of the funding will be spent on each of the vehicle classes. The expected cost per technology for the three vehicle classes is shown in Table A-28. Staff anticipates funding the full cost of the vehicles and used vehicle costs consistent with Clean Mobility Options for light-duty vehicles, the average new vehicle cost in HVIP for MHD vehicles, and the Rural School Bus Pilot Project for school buses.

Table A-28: Clean Mobility in Schools Average Incentive Costs

Vehicle Class	Supported Technologies	Cost Per Technology
LDV	Battery Electric	$35,000
MHD		$200,000
School Bus		$400,000

Using one third of the proposed project allocation for each vehicle class, staff calculated the potential number of vehicles that could be funded with the above incentive amounts. Based on the proposed $10 million allocation for Clean Mobility in Schools and the costs shown above, staff anticipates that approximately 108 vehicles can be funded – 85 LDVs, 15 MHDs (delivery vehicles), and 8 school buses. Please note that this is an illustrative example of the types of vehicles that can be funded in Clean Mobility in Schools.

For calculating the potential emission reductions, light-duty vehicles were given a conservative project life of 3 years, consistent with Clean Mobility Options for light-duty vehicles, and medium heavy-duty vehicles and school buses were given a project life of

15 years, consistent with HVIP. Staff quantified Clean Mobility in Schools' total potential emission reductions, as shown in Table A-29 below.

Table A-29: Total Potential Emission Reductions for Clean Mobility in Schools

Pollutant	Vehicle Class	Per Vehicle Annual Emission Reductions (tpy)	Number of Vehicles	Annual Emission Reductions (tpy)	Project Life (years)	Lifetime Emission Reductions Per Vehicle Class (tons)	Project Total Lifetime Emission Reductions (tons)
GHG	LDA	2.64	85	224	3	673	6,400
	MHD	15.42	15	231	15	3,469	
	School Bus	18.87	8	151	15	2,265	
NOx	LDA	0.0003	85	0.029	3	0.087	5.0
	MHD	0.0113	15	0.169	15	2.540	
	School Bus	0.0202	8	0.161	15	2.421	
PM 2.5	LDA	0.0001	85	0.010	3	0.031	0.40
	MHD	0.0004	15	0.006	15	0.091	
	School Bus	0.0023	8	0.019	15	0.279	
ROG	LDA	0.0001	85	0.006	3	0.017	0.22
	MHD	0.0005	15	0.007	15	0.110	
	School Bus	0.0008	8	0.006	15	0.094	

Heavy-Duty Vehicle and Off-Road Equipment Investments

CARB continues to support a diverse portfolio of investments in heavy-duty and off-road technologies. This year's Funding Plan proposes investments in pre-commercial demonstration and early commercial pilots through a new funding allocation to the Zero- and Near Zero-Emission Freight Facilities Project; the deployment of commercialized on-road advanced technologies through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP); and legacy vehicle improvements, including assistance for cleaner trucks through the Truck Loan Assistance Program and Diesel Particulate Filter Retrofit Replacements Project.

Quantification of the emission reduction benefits for each of the heavy-duty vehicle and off-road equipment investment projects is described in more detail below.

Zero- and Near Zero-Emission Freight Facilities

The Zero- and Near Zero-Emission Freight Facilities Project achieves emission reduction benefits by deploying zero- and near zero-emission technology associated with freight facilities. Eligible types of vehicles, equipment, and technologies in this project include forklifts, yard trucks or tractors, delivery and drayage trucks, TRUs, and supporting fueling infrastructure. Because this project includes a variety of eligible types of vehicles, equipment, and technologies, it is important to note that this analysis is an illustrative example of the potential emission reductions that may be achieved through this project.

This project can support a wide variety of vehicles and equipment that are commercially available, near commercial, or in the demonstration phase. Staff is proposing to use FY 2018-19 funds to address any over-subscription to the FY 2017-18 solicitation. Therefore, the emission reductions estimated here are based on the same assumptions as last year, but reflect this year's available funds. For this analysis, staff estimated the potential emission reductions for four vehicle and equipment types that are likely to be funded under this project: Class 1 and 2 forklifts, off-road yard trucks, drayage trucks, and TRUs. Unless project data supports an alternate baseline, staff typically quantifies emission reductions using the cleanest available technology as the baseline. Emission factors for the remaining three categories (off-road yard trucks, drayage trucks, and TRUs) are shown in Table A-30. For off-road vehicles, such as yard trucks and TRUs, emission factors are in units of grams per hour and for on-road vehicles, such as drayage trucks, emission factors are in units of grams per mile. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-30: Zero- and Near Zero-Emission Freight Facilities Emission Factors

Vehicle Class	Pollutant	2017/Tier 4 Final Baseline	2017 Battery Electric Vehicle	2017 Fuel Cell Vehicle
Yard Truck (g/hr)	NOx	8.238	0	
	PM 2.5	0.484	0	
	ROG	4.271	0	
	GHG	47,885	8,974	
Drayage Truck (g/mi)	NOx	1.905	0	0
	PM 2.5	0.040	0.022	0.022
	ROG	0.089	0	0
	GHG	2,096	393	955
TRU (g/hr)	NOx	47.26	0	
	PM 2.5	1.699	0	
	ROG	36.85	0	
	GHG	9,001	1,687	

Note: As noted in the Emission Factor Development section, PM 2.5 emissions associated with brake and tire wear for off-road vehicles are not identified separately; therefore, PM 2.5 emissions associated with brake and tire wear are currently included for on-road vehicles only.

Staff generated annual usage assumptions using CARB's cargo handling equipment (CHE) inventory model for yard trucks, EMFAC 2014 for drayage trucks, and TRU inventory model for TRUs, as shown in Table A-31. For off-road vehicles, such as yard trucks and TRUs, annual usage is in terms of hours per year, and for on-road vehicles, such as drayage trucks, annual usage is in terms of miles per year.

Table A-31: Zero- and Near Zero-Emission Freight Facilities Annual Usage Assumptions

Vehicle Class	Technology	Usage (mi/yr or hrs/yr)
Yard Truck (hrs/yr)	BEV	2,400
Drayage Truck (mi/yr)	BEV and FCV	60,000
TRU (hrs/yr)	Battery Electric	1,300

Applying the emission factors and usage assumptions above, staff calculated the potential annual per-vehicle emission reductions for Zero- and Near Zero-Emission Freight Facilities, as shown in Table A-32.

Table A-32: Zero- and Near Zero-Emission Freight Facilities Annual Emission Reduction Benefits on a Per-Vehicle Basis

Pollutant	Vehicle Class	Supported Technologies	Per-Vehicle Annual Emission Reductions (tpy)
GHG	Yard Truck	BEV	93.4
	Drayage Truck	BEV	102
		FCV	68.4
	TRU	BEV	9.51
NOx	Yard Truck	BEV	0.0218
	Drayage Truck	BEV	0.1260
		FCV	0.1260
	TRU	BEV	0.0677
PM 2.5	Yard Truck	BEV	0.0013
	Drayage Truck	BEV	0.0012
		FCV	0.0012
	TRU	BEV	0.0024
ROG	Yard Truck	BEV	0.0113
	Drayage Truck	BEV	0.0059
		FCV	0.0059
	TRU	BEV	0.0528

Staff is evaluating applications from the FY 2018-18 solicitation so for this analysis, staff maintained assumptions used for the FY 2017-18 analysis: $11 million of the project funding will be used to support infrastructure (the match requirement will cover energy efficiencies and infrastructure costs), $11 million for Class 1 and Class 2 forklifts, $11 million for off-road yard trucks, $11 million for drayage trucks with $3.1 million for fuel cell drayage trucks and $7.9 million for battery electric drayage trucks, and $11 million for TRUs. Based on applications from past demonstration and pilot projects and discussions with manufacturers, staff generated estimated incentive costs as shown in Table A-33.

Table A-33: Zero- and Near Zero-Emission Freight Facilities Average Incentive Cost

Vehicle Class	Supported Technologies	Cost Per Technology
Yard Truck	BEV	$300,000
Drayage Truck	BEV	$440,000
	FCV	$1,500,000
TRU	BEV	$90,000

Based on the proposed $55 million allocation for Zero- and Near Zero-Emission Freight Facilities and the estimated costs shown above, staff anticipates that approximately 35 battery-electric yard trucks, 17 battery-electric drayage trucks, 2 fuel cell drayage trucks, and 116 battery-electric TRUs may be funded. Note that this is just illustrative and actual funding amounts for each technology will vary based on the applications received. Considering the expected life of heavy-duty diesel trucks and equipment, staff conservatively quantified the emission reductions over the course of 10 years, as shown in Table A-34.

Table A-34: Total Potential Emission Reductions for Zero- and Near Zero-Emission Freight Facilities

Pollutant	Vehicle Class & Technology	Per-Vehicle Annual Emission Reductions (tpy)	Number of Vehicles	Annual Emission Reductions (tpy)	Project Life (years)	Lifetime Emission Reductions Per Vehicle Class (tons)	Project Total Lifetime Emission Reductions (tons)
GHG	Yard Truck BEV	93.4	35	3,270	10	32,700	62,500
	Drayage Truck BEV	102	17	1,740		17,400	
	Drayage Truck FCV	68.4	2	137		1,370	
	TRU BEV	9.51	116	1,100		11,000	
NOx	Yard Truck BEV	0.0218	35	0.763		7.63	110
	Drayage Truck BEV	0.1260	17	2.14		21.4	
	Drayage Truck FCV	0.1260	2	0.252		2.52	
	TRU BEV	0.0677	116	7.86		78.6	
PM 2.5	Yard Truck BEV	0.0013	35	0.045		0.450	3.5
	Drayage Truck BEV	0.0012	17	0.020		0.200	
	Drayage Truck FCV	0.0012	2	0.002		0.020	
	TRU BEV	0.0024	116	0.282		2.82	
ROG	Yard Truck BEV	0.0113	35	0.395		3.95	66
	Drayage Truck BEV	0.0059	17	0.100		1.00	
	Drayage Truck FCV	0.0059	2	0.012		0.120	
	TRU BEV	0.0528	116	6.13		61.3	

Clean Truck and Bus Vouchers

Clean Truck and Bus Vouchers are intended to encourage and accelerate the deployment of zero-emission trucks and buses, vehicles using engines that meet the optional low NOx standard, and hybrid trucks and buses in California. There is a total of $125 million available for Clean Truck and Bus Vouchers projects, which include HVIP and Low NOx Engine Incentives. To illustrate the potential magnitude of emission reductions in this Funding Plan, staff assumed $100 million would be used for HVIP and $25 million for Low NOx Engine Incentives, based on staff assumptions. However, funding for HVIP and Low NOx Engine Incentives may change based on demand. Note the Per-Vehicle Average Annual Emission Reductions for Low NOx Engine Incentives appears to be greater than HVIP eligible vehicles due to the greater usage values used in staff's assumptions.

HVIP

HVIP achieves emission reduction benefits by reducing the up-front cost of hybrid or zero-emission trucks and buses, allowing fleet owners to secure a voucher through their local dealer as part of their vehicle purchase. For the purposes of this analysis, staff estimated reductions from the emissions offset between a new, 2018 model year conventional truck or bus, and an advanced technology vehicle.

Based on HVIP data from the last two fiscal years as of June 2018, approximately 48 percent of vouchers will go towards the purchase of MHD conventional hybrids, 13 percent for MHD battery-electric trucks, 2 percent for HHD battery-electric trucks, 10 percent battery-electric urban buses, 2 percent for battery-electric school buses, and approximately 25 percent for electric power takeoff (ePTO) systems. The technology splits applied in this analysis differ from last year's due to the inclusion of ePTO systems and updated HVIP data.

For baseline urban bus emission factors, staff used an average of diesel and CNG urban bus emission rates since the current California fleet utilizes a mix of the two fuel types. Only limited data is available for heavy-duty CNG-fueled vehicles, therefore, staff assumed CNG vehicles have similar emission rates as diesel-fueled vehicles because they are certified to the same emission standard.

Based on discussions with manufacturers, ePTO systems automatically prevents engine idle by shutting the engine off while in park or neutral, preventing unnecessary engine usage during PTO operation. For emission factors associated with ePTOs, staff utilized the emission factors found in EMFAC to quantify the emissions reduction associated with ePTO systems that are currently eligible in HVIP. The emission factor used is associated with the excess emissions due to the usage of PTOs powered by a diesel engine. Emission factors for HVIP are shown in Table A-35 and emission factors used to quantify PTOs are shown in Table A-36. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-35: HVIP Emission Factors

HVIP Emission Factors (WTW for GHG, TTW for CP/Toxics)					
Vehicle Class	**Pollutant**	**2018Diesel (g/mi)**	**2018 CNG (g/mi)**	**2018 Conv. Hybrid (g/mi)**	**2018 BEV (g/mi)**
MHD	NOx	0.8536		0.6829	0
	PM 2.5	0.0616		0.0331	0.0309
	ROG	0.0368		0.0295	0
	GHG	1,540		1,232	289
HHD	NOx	1.4041			0
	PM 2.5	0.0404			0.0222
	ROG	0.0766			0
	GHG	2,223			417
Urban Bus	NOx	0.8140	0.8140		0
	PM 2.5	0.3669	0.3669		0.1834
	ROG	0.0228	0.0228		0
	GHG	2,539	2,451		476
School Bus	NOx	1.4076			0
	PM 2.5	0.3249			0.1626
	ROG	0.0549			0
	GHG	1,786			335

Note: MHD and HHD emission factors are based on population-weighted averages of the T6 and T7 diesel vehicle classes in EMFAC 2014, respectively, excluding out-of-state vehicles.

Table A-36: ePTO Emission Factors

Vehicle Class	Pollutant	2018 Diesel (g/hr)	2018 Battery Electric (g/hr)
ePTO	NOx	72.84	0
	PM 2.5	0.0724	0
	ROG	0.4171	0
	GHG	44,144	8,273

Staff generated an annual usage assumption for MHD conventional hybrid vehicles, based on the average use of a conventional MHD diesel vehicle in EMFAC 2014. For urban buses, staff used data provided by previous HVIP voucher recipients to determine the average annual usage. Data for ePTO systems were obtained from NREL's Fleet Test and Evaluation Team.[19] Based on the information, staff assumed that a vehicle typically operates in PTO mode for 4 hours a day and 250 workdays a year. Additionally, staff assumed the fuel consumption rate of 3.218 gallons per hour for ePTO systems based on data from EMFAC. For all other battery-electric vehicle classifications, the annual usage assumption was based on the California Hybrid,

[19] https://www.nrel.gov/transportation/assets/pdfs/67116.pdf (accessed June 26, 2018)

Efficient and Advanced Truck Research Center (CalHEAT) Research Center's report on "Battery Electric Parcel Delivery Truck Testing and Demonstration."[20] The annual usage assumptions for HVIP are shown in Table A-37.

Table A-37: HVIP Annual Usage Assumptions

HVIP Annual Usage Assumptions		
Vehicle Class	**Technology**	**Usage (mi/yr)**
MHD	Conv. Hybrid	20,000
	BEV	12,000
HHD	BEV	12,000
	ePTO	1,000 hours/yr
Urban Bus	BEV	30,000
School Bus	BEV	12,000

Using the emission factors, technology mix, and the annual usage assumptions above, staff calculated the potential annual per-vehicle emission reductions for HVIP, as shown in Table A-38.

[20] Gallo, Jean-Baptiste, Jasna Tomić. (CalHEAT). 2013. Battery Electric Parcel Delivery Truck Testing and Demonstration. California Energy Commission.

Table A-38: HVIP Annual Emission Benefits on a Per-Vehicle Basis

HVIP Annual Emission Benefits				
Pollutant	**EMFAC Vehicle Class**	**Supported Technologies**	**Per Vehicle Annual Emission Reductions (tpy)**	
			Per Technology	**Average**
GHG (metric tons CO2e per year)	MHD	Conv. Hybrid	6.16	20.72
		BEV	15.02	
	HHD	BEV	21.68	
		ePTO	35.87	
	Urban Bus	BEV	60.57	
	School Bus	BEV	17.41	
NOx (tpy)	MHD	Conv. Hybrid	0.0038	0.0268
		BEV	0.0113	
	HHD	BEV	0.0186	
		ePTO	0.0803	
	Urban Bus	BEV	0.0269	
	School Bus	BEV	0.0186	
PM 2.5 (tpy)	MHD	Conv. Hybrid	0.0006	0.0010
		BEV	0.0004	
	HHD	BEV	0.0002	
		ePTO	0.0001	
	Urban Bus	BEV	0.0061	
	School Bus	BEV	0.0021	
ROG (tpy)	MHD	Conv. Hybrid	0.0002	0.0004
		BEV	0.0005	
	HHD	BEV	0.0010	
		ePTO	0.0005	
	Urban Bus	BEV	0.0008	
	School Bus	BEV	0.0007	

Applying the proposed voucher amounts for the 2017-18 fiscal year and the technology mix from the current HVIP waitlist data, staff calculated the average voucher cost for HVIP as shown in Table A-39.

Table A-39: HVIP Average Incentive Cost

HVIP Average Incentive Cost			
EMFAC Vehicle Class	**Supported Technologies**	**Cost Per Technology**	**Average**
MHD	Conv. Hybrid	$20,000	$50,675
	BEV	$90,000	
HHD	BEV	$150,000	
	ePTO	$30,000	
Urban Bus	BEV	$143,750	
School Bus	BEV	$225,000	

The budget includes $125 million for Clean Truck and Bus Vouchers. To illustrate the potential magnitude of emission reductions in this Funding Plan, staff assumed that $100 million would be used for HVIP eligible vehicles with $25 million for low NOx vehicles, which will be discussed in the next section. Of the $100 million, staff assumed $2 million will be used for infrastructure. With the remaining $98 million for HVIP vehicles and the average cost shown above, staff estimate that approximately 1,900 vehicles can be funded.

Heavy-duty trucks can have a useful life of over 20 years[21] and the average school bus has a useful life of 15 years.[22] Therefore, staff assumed a conservative project life of 15 years and quantified HVIP's total potential emission reductions over the course of 15 years, as shown in Table A-40 below.

Table A-40: Total Potential Emission Reductions for HVIP

HVIP Potential Lifetime Emission Reductions					
Pollutant	**Per Vehicle Average Annual Emission Reductions**	**Number of Vehicles**	**Average Annual Emissions**	**Project Life (years)**	**Lifetime Annual Emission Reductions**
GHG	20.72	1,900	39,360	15	590,401
NOx	0.0268		50.89		763
PM 2.5	0.0010		1.95		29
ROG	0.0004		0.696		10.4

Low NOx Engine Incentives

Low NOx Engine Incentives achieve emission reduction benefits by supporting the deployment of engines that meet optional low NOx standards. The optional low NOx standards provide manufacturers the ability to certify engines to NOx emission levels

[21] http://www.calstart.org/Libraries/CalHEAT_Documents/Baseline_and_Preliminary_Pathways_Whitepaper.sflb.ashx

[22] https://www.afdc.energy.gov/uploads/publication/case-study-propane-school-bus-fleets.pdf

that are 50 percent, 75 percent, or 90 percent lower than today's mandatory heavy-duty engine emission standards. Currently, the only available low NOx engines are natural gas engines, so staff used 2018 model year, CNG-fueled vehicles and the associated fuel economy values as the primary baseline for this analysis. Based on currently available technology, staff assumed that approximately 80 percent of the incentives would go to HHD vehicles, which includes most refuse haulers and trucks, and 20 percent for urban buses.

Because data available for heavy-duty CNG-fueled vehicles is limited, staff assume CNG-fueled vehicles have similar emission rates as diesel-fueled vehicles since they are certified to the same emission standard. At this time, the only optionally certified low NOx engine meets the standard that is 90 percent lower than the diesel baseline, so staff assumed a 90 percent tailpipe NOx reduction for the low NOx engines.

In order to maximize the GHG emission reduction benefits for low NOx engines, staff proposes to require the use of 100 percent renewable fuels for the first three years for vehicles funded by GGRF. Currently, low NOx engines are only available for natural gas, therefore, staff developed emission factors for low NOx engines fueled with RNG. Emission factors for Low NOx Engine Incentives are shown in Table A-41. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

Table A-41: Low NOx Engine Incentives Emission Factors

Low NOx Emission Factors (WTW for GHG, TTW for CP/Toxics)					
Vehicle Class	**Pollutant**	**2017 CNG (g/mi)**	**2017 Diesel (g/mi)**	**2017 Low NOx RNG (g/mi)**	**2017 Low NOx Diesel (g/mi)**
MHD	NOx	0.8536		0.0854	
	PM 2.5	0.0616		0.0616	
	ROG	0.0368		0.0368	
	GHG	1,487		735	
HHD	NOx	1.4041	1.4041	0.1404	0.1404
	PM 2.5	0.0404	0.0404	0.0404	0.0404
	ROG	0.0766	0.0766	0.0766	0.0766
	GHG	2,146	2,223	1,061	2,223
Urban Bus	NOx	0.8140		0.0814	
	PM 2.5	0.3669		0.3669	
	ROG	0.0228		0.0228	
	GHG	2,451		1,211	

Note: MHD and HHD emission factors are based on population-weighted averages of the T6 and T7 diesel vehicle classes in EMFAC 2014, respectively, excluding out-of-state vehicles.

Staff generated annual usage assumptions for Low NOx Engine Incentives, based on the average use of a conventional diesel vehicle in EMFAC 2014 for the corresponding vehicle class and reports from the U.S. Department of Energy's Alternative Fuels Data

Center.[23] The annual usage assumptions for Low NOx Engine Incentives are shown in Table A-42.

Table A-42: Low NOx Engine Incentives Annual Usage Assumptions

Low NOx Annual Usage Assumptions	
Vehicle Classification	**Usage (mi/yr)**
MHD CNG	20,000
HHD Diesel	58,000
HHD CNG	25,000
Urban Bus CNG	47,000

Using the emission factors, technology mix, and the annual usage assumptions above, staff calculated the potential annual per-vehicle emission reductions for Low NOx Engine Incentives, as shown in Table A-43. Engines certified to the optional low NOx standard are held to the same standards for PM 2.5 and ROG as currently certified heavy-duty engines, therefore, the only criteria pollutant emission benefit for Low NOx Engine Incentives is a reduction in NOx.

Table A-43: Low NOx Engine Incentives Annual Emission Reduction Benefits on a Per-Vehicle Basis

Pollutant	Baseline Vehicle	Supported Technologies	Per-Vehicle Annual Emission Reductions (tpy)	
			Per Technology	Average
GHG	MHD CNG	Low NOx with RNG	14.09	38.66
	HHD CNG	Low NOx with RNG	25.43	
	HHD Diesel	Low NOx	0	
	HHD Diesel	Low NOx with RNG	82.34	
	Urban Bus CNG	Low NOx with RNG	54.58	
NOx	MHD CNG	Low NOx with RNG	0.0170	0.0450
	HHD CNG	Low NOx with RNG	0.0355	
	HHD Diesel	Low NOx	0.0823	
	HHD Diesel	Low NOx with RNG	0.0823	
	Urban Bus CNG	Low NOx with RNG	0.0380	

For Low NOx Engine Incentives, staff is modifying the funding amounts to reflect staff's proposals for the upcoming fiscal year. Staff proposes to remove vouchers for new low NOx vehicle purchases for the 8.9L engine and fund only repowers at a voucher amount of $45,000. Staff is also proposing to increase the voucher amounts of the 11.9L engine to $45,000 for new purchases and repowers. Staff's proposed

[23] https://www.afdc.energy.gov/data/10309

modification brings the average inventive cost for Low NOx Engine Incentives to $45,000.

Staff assumed that $25 million would be used for Low NOx Engine Incentives. Using the average cost of $45,000 per engine, staff estimate that approximately 520 engines can be funded, thus meeting the expected demand. For this analysis, staff used a project life of three years when estimating the potential GHG emission reduction benefits because GHG emission reductions are tied to the use of renewable fuel, which is required for three years. However, heavy-duty trucks can have a useful life of over 20 years,[24] therefore, staff used a project life of 15 years to calculate the emission benefits for criteria pollutant and toxic air contaminants. The total potential emission reductions for Low NOx Engine Incentives are shown in Table A-44.

Table A-44: Total Potential Emission Reductions for Low NOx Engine Incentives

Pollutant	Per Vehicle Average Annual Emission Reductions (tpy)	Number of Vehicles	Average Annual Emission Reductions (tpy)	Project Life (years)	Lifetime Annual Emission Reductions (tons)
GHG	39.82	520	20,708	3	62,124
NOx	0.0445		23.16	15	347.35

Truck Loan Assistance Program

The Truck Loan Assistance Program aids small business truckers affected by CARB's In-Use Truck and Bus Regulation[25] by providing financing assistance for fleet owners to upgrade their fleets with newer trucks or with diesel exhaust retrofits. Program data from the 2017 calendar year through June 2018 shows that, on average, funds were directed toward the replacement of 2003 model year diesel trucks in both the MHD and HHD vehicle classifications.

While analyzing the annual loan trends, staff have seen an increasing number of trucks with 2010 model year or newer engines purchased through the Truck Loan Assistance Program. From the 2017 calendar year through June 2018, ten percent of loans went towards the purchase of MHD vehicles with 2010 model year or newer engines, six percent towards the purchase of HHD vehicles with a 2007 to 2009 model year engine, and 84 percent towards the purchase of HHD vehicles with 2010 model year or newer engines. On average, fleet owners that purchased trucks with 2010 model year or newer engines purchased 2012 model year trucks.

Staff used this engine model year information to develop the emission factors as shown in Table A-45. For more information on how these emission factors were developed, please see the Emission Factor Development section at the beginning of this appendix.

[24] http://www.calstart.org/Libraries/CalHEAT_Documents/Baseline_and_Preliminary_Pathways_Whitepaper.sflb.ashx
[25] https://www.arb.ca.gov/msprog/onrdiesel/onrdiesel.htm

Table A-45: Truck Loan Assistance Program Emission Factors

Vehicle Class	Pollutant	2003 Diesel (g/mi)	2008 Diesel (g/mi)	2012 Diesel (g/mi)
MHD	NOx	7.5401		1.4109
	PM 2.5	0.4665		0.0620
	ROG	0.5929		0.0423
HHD	NOx	13.5691	10.6516	2.4624
	PM 2.5	0.1372	0.0911	0.0414
	ROG	0.2397	0.3170	0.0842

Note: MHD and HHD emission factors are based on population-weighted averages of the T6 and T7 vehicle classes in EMFAC 2014, respectively, excluding out-of-state vehicles.

Staff generated annual usage assumptions based on the average use of a 2003 model year, conventional MHD and HHD diesel truck in EMFAC 2014. The annual usage assumptions for the Truck Loan Assistance Program are shown in Table A-46.

Table A-46: Truck Loan Assistance Program Annual Usage Assumptions

Vehicle Class	VMT (mi/yr)
MHD	11,000
HHD	19,000

Using the emission factors and annual usage assumptions above, staff calculated the potential annual per-vehicle emission reductions for the Truck Loan Assistance Program, as shown in Table A-47. Please note that PM reductions for the Truck Loan Assistance Program are not quantified because PM reductions are required by the Truck and Bus Regulation through the use of diesel particulate filters. Additionally, GHG emission reductions are not quantified because this program is funded through AQIP, which focuses on criteria pollutant and toxics emission reductions, and the trucks do not achieve a significant fuel economy improvement.

Table A-47: Truck Loan Assistance Program Annual Emission Reduction Benefits on a Per-Vehicle Basis

Pollutant	Vehicle Class	Supported Technologies	Per Vehicle Annual Emission Reductions (tpy)	
			Per Technology	Average
NOx	MHD	2012 MY	0.0743	0.2097
	HHD	2008 MY	0.0611	
		2012 MY	0.2326	
ROG	MHD	2012 MY	0.0067	0.0033
	HHD	2008 MY	-0.0009	
		2012 MY	0.0033	

In the Truck Loan Assistance Program, the average loan contribution amount has gone down over time and based on program data from 2017 and 2018, staff found that the average cost per loan is approximately $3,100. With the proposed $25.6 million allocation for the Truck Loan Assistance Program, staff estimate that approximately 8,200 vehicles can be funded. To achieve NOx reductions, the Truck and Bus Regulation requires the replacement of 2003 engine model year trucks with 2010 or newer engines by January 1, 2021. Therefore, when calculating the emission reduction benefits for this program, staff used a project life of two years to estimate emission reductions that have occurred prior to what is required by the Truck and Bus Regulation.

The total potential emission reductions for the Truck Loan Assistance Program are shown in Table A-48.

Table A-48: Total Potential Emission Reductions for the Truck Loan Assistance Program

Pollutant	Per Vehicle Average Annual Emission Reductions (tpy)	Number of Vehicles	Average Annual Emission Reductions (tpy)	Project Life (years)	Lifetime Annual Emission Reductions (tons)
NOx	0.2065	8,200	1,693	2	3,387
ROG	0.0033		27.4		55

Truck Filter Replacements

Funds for Truck Filter Replacements serve to support filter substrate or particulate matter (PM) filter replacements for existing heavy duty vehicles equipped with a certified Cleaire Muffler Module (CMM). These are empty can mufflers that offer little or no PM control. The proposed funds for truck filter replacements reduce uncontrolled criteria and toxic air contaminant emissions by helping replace remaining CMMs.

Cleaire voluntarily recalled its LongMile diesel PM filter system. During the recall Cleaire replaced the LongMile with either a certified silicon carbide core, a CMM, or

removed the system. Cleaire ceased operation and their assets were subsequently acquired by ESW Cleantech and has provided product support since the closure.

From May 2015 to March 2017 the Sacramento Metropolitan Air Quality Management District (SMAQMD) and ESW Cleantech entered into a Grant Agreement to provide reimbursement for up to $6.3 million in filter substrate replacements through the Proposition 1B Goods Movement Emission Reduction Program. However, some fleets could not qualify for Proposition 1B funding or could not meet required temperature or engine family criteria. Staff used emission factors from the Proposition 1B project to help quantify the emission reductions.

The emission factors are shown in Table A-49 based on the average vehicle that applied for the Proposition 1B project.

Table A-49: Truck Filter Replacements Emission Factors

Vehicle Class	Average Year	Pollutant	Old Equipment (g/mi)	New Equipment (g/mi)
HHD	1997	NOx	--	--
		PM 2.5	0.74	0.11
		ROG	--	--

Note: Filter replacements have no NOx or ROG reduction.

Staff generated annual usage assumptions based on the average use of a 1997 model year public and solid waste collection HHD diesel trucks in EMFAC 2014. The annual usage assumptions are shown in Table A-50.

Table A-50: Truck Filter Replacements Annual Usage Assumptions

Vehicle Class	VMT (mi/yr)
HHD	10,000

Using the emission factors and annual usage assumptions above, staff calculated the potential annual per-vehicle emission reductions for Truck Filter Replacements as shown in Table A-51. Though PM emission reductions are required by the Truck and Bus Regulation through the use of diesel particulate filters, PM emissions are quantified since these emission reductions were actually not being obtained due to the recall. Additionally, GHG emission reductions are not quantified because this program is funded through AQIP, which focuses on criteria pollutant and toxics emission reductions, and the filter replacements in the trucks do not achieve any fuel economy improvement.

Table A-51: Truck Filter Replacements Annual Emission Reduction Benefits on a Per-Vehicle Basis

Pollutant	Vehicle Class	Supported Technologies	Per Vehicle Average Annual Emission Reductions (tpy)
PM 2.5	HHD	1997 MY	0.007113

Based on results from the Proposition 1B project, the proposed $3 million will cover 270 to 500 substrate replacements or about 150 new diesel particulate filter systems (DPFs). Substrate replacement costs vary according to the horsepower of the engine with higher costs for higher horsepower engines. For new diesel particulate systems staff used an average of $20,000 per system. Staff used a project life of five years since this is the number of years covered by the warranty.

The total potential emission reductions for the Truck Filter Replacements are shown in Table A-52.

Table A-52: Total Potential Emission Reductions for the Truck Filter Replacements

Pollutant	Per Vehicle Average Annual Emission Reductions (tpy)	Minimum Number of Vehicles	Average Annual Emission Reductions (tpy)	Project Life (years)	Lifetime Annual Emission Reductions (tons)
PM 2.5	0.007113	150	1.067	5	5.33

AB 8

AB 8 extended the funding for AQIP through 2023, refined the evaluation criteria for projects supported by AQIP, and introduced the following requirements that staff followed to develop the project scoring criteria:

- The state board shall provide preference in awarding funding to those projects with higher benefit-cost scores that maximize the purposes and goals of the Air Quality Improvement Program.[26]
- "Benefit-cost score" means the reasonably expected or potential criteria pollutant emission reductions achieved per dollar awarded by the Board for the project.[27]
- The state board also may give additional preference based on the following criteria, as applicable, in funding awards to projects:[28]

    1. Proposed or potential reduction of criteria or toxic air pollutants.
    2. Contribution to regional air quality improvement.

[26] Health & Safety Code Section 44274(b)
[27] Health & Safety Code Section 44270.3(e)(1)
[28] Health & Safety Code Section 44274(b)

3. Ability to promote the use of clean alternative fuels and vehicle technologies as determined by the state board, in coordination with the Energy Commission.
4. Ability to achieve climate change benefits in addition to criteria pollutant or air toxic emission reductions.
5. Ability to support market transformation of California's vehicle or equipment fleet to utilize low carbon or zero-emission technologies.
6. Ability to leverage private capital investments.

Statute directs CARB to annually evaluate potential project categories to assign preference for AQIP funding, based upon the specific criteria identified above. The analysis and methodology in this section of the appendix describes the implementation of the provisions that require CARB to assign preference to projects with a higher benefit-cost score. The AB 8 analysis is fully executed for the two projects that will be funded through AQIP: the Truck Loan Assistance Program and Truck Filter Replacements.

Overview

Conservative estimates for criteria pollutant and toxic air contaminants were developed using guidance provided in AB 8. Because criteria pollutant and toxic air contaminant emissions are geographically localized, criteria pollutant and toxic air contaminant emissions reductions reported in this appendix are estimated at the tailpipe. The two AQIP projects do not have Greenhouse gas emission reductions so these were not tabulated. Building upon the emission reductions and cost information from the Project Quantification section, this section of the appendix provides information on the following:

- Benefit-Cost Score Analysis;
- Additional Preference Criteria Scores; and
- Total Benefit Index Scores.

Benefit-Cost Score Analysis

Staff analyzed the expected costs and developed cost-effectiveness values for each AQIP-funded project using well-established cost-effectiveness calculation methodology for incentives, consistent with that used in the Carl Moyer Memorial Air Quality Standards Attainment Program (Carl Moyer Program). In addition, to calculate cost-effectiveness, staff also applied an appropriate discount rate and utilized a capital recovery factor (CRF) in the analysis based on 2017 Carl Moyer Program Guidelines.[29] The one percent discount rate was used and the corresponding CRF was determined based on the assumed usage life of the vehicles or equipment supported by a given project.

For each of the proposed projects funded by AQIP, a cost-effectiveness value was calculated. The cost-effectiveness of a project is determined using Formula 8 below.

[29] https://www.arb.ca.gov/msprog/moyer/guidelines/2017gl/2017_cmp_gl_volume_1.pdf

Formula 8: Cost-Effectiveness

$$Cost\ Effectiveness\ \left(\frac{\$}{ton}\right) = \frac{Incentive\ Amount\ per\ Vehicle\ or\ Equipment * CRF}{Annual\ Per\ Vehicle\ Weighted\ Emission\ Reductions}$$

Weighted emission reductions are calculated using Formula 9, consistent with Carl Moyer Program Guidelines:

Formula 9: Annual Weighted Emission Reductions

$$Annual\ Weighted\ Emission\ Reductions\left(\frac{weighted\ tons}{year}\right) = NOx\ reductions + ROG\ reductions + (20 * PM\ reductions)$$

Table A-53 provides the inputs and the resulting weighted criteria pollutant and toxic air contaminant cost-effectiveness, in terms of dollars per ton of weighted emission reductions, for projects funded by AQIP. For Truck Filter Replacements, PM 2.5 emissions are the pollutant that is reduced so staff utilized the PM 2.5 emission reduction benefits for the AB 8 analysis.

Table A-53: AB 8 Analysis – Weighted Criteria Pollutant and Toxic Air Contaminant Cost-Effectiveness

Proposed Project	Project Life	CRF	Average Annual Per-Vehicle Weighted Emission Reductions (tpy)	Average Incentive Cost	Cost-Effectiveness ($/ton)
Truck Loan Assistance	2	0.508	0.210	$3,100	$7,505
Truck Filter Replacements	5	0.212	0.007113	$20,000	$613,900

The cost-effectiveness values for each project were given points based on a scale of one to five points. The bins were determined by taking the high and low resulting benefits and scaled to develop an equal distribution of scores. Those projects with a cost-effectiveness of less than $5,000 per ton of weighted emission reductions received a high of five points. The remaining bins were increased by $5,000 increments with the least cost-effective projects, those projects that cost over $20,000 per weighted ton of emissions reduced, receiving the lowest points possible. The cost-effectiveness of each proposed project was scored based on the following scale:

5: Less than $5,000 per ton
4: $5,000 to $9,999 per ton
3: $10,000 to $14,999 per ton
2: $15,000 to $19,999 per ton
1: $20,000 per ton or more

The resulting scores from the scale shown above were then used in the "Total Benefit Index" for AB 8 project selection. Finally, per AB 8, the cost-effectiveness values were converted to benefit-cost values based on pound of weighted emission reductions per dollar spent. The cost-effectiveness, benefit-cost value, and resulting score of each of the proposed projects are shown in Table A-54.

Table A-54: AB 8 Analysis – Benefit-Cost Value and Score for Total Benefit Index

Proposed Project	Cost-Effectiveness ($/ton)	Benefit-Cost Value (lbs/$)	Benefit-Cost Score
Truck Loan Assistance	$7,505	0.267	4
Truck Filter Replacements	$613,900	0.003	1

Additional Preference Criteria

Per AB 8, additional preference criteria may be used to provide additional funding preference in conjunction with the benefit-cost scores summarized in Table A-11. The additional preference criteria includes:

- Proposed or potential reduction of criteria and toxic air pollutants;
- Contribution to regional air quality improvement;
- Ability to promote the use of clean alternative fuels and vehicle technologies;
- Ability to achieve GHG reductions;
- Ability to support market transformation of California's vehicle or equipment fleet to utilize low carbon or zero-emission technologies; and
- Ability to leverage private capital investments.

Recognizing the range of potential benefits and to ensure a robust mix of proposed projects to be funded, staff analyzed the associated data and equally divided the results into scores between 0 and 5 for quantitative preference criteria. The quantitative preference criteria for each project includes the proposed or potential reduction of criteria and toxic air pollutants, contribution to regional air quality, and the ability to achieve GHG reductions. Staff used the following steps to develop scoring scales and final scores for the quantitative preference criteria:

1. Quantify the results for each additional preference criteria for the proposed projects;
2. Establish scoring scale increments to generate an equal distribution in points for the proposed projects; and
3. Rank the proposed projects based on the established scoring scale, which is then used in the "Total Benefit Index."

Staff anticipate that the scales for the quantitative additional preference criteria may change each year depending on the mix of projects proposed, due to differences in the range of expected benefits or when additional information becomes available to refine

the evaluation. The data and rationale used to establish each of the criteria weighting factors for the associated scores are described below.

Proposed or Potential Reduction of Criteria or Toxic Air Pollutants

This analysis considered the magnitude of emission reductions by quantifying the direct criteria pollutant and toxic air contaminant emission reductions expected per average vehicle or equipment supported under each project. With the benefit-cost score analysis primarily driven by overall project incentive amounts, this additional criteria allowed staff to make direct comparisons of the emission reductions expected by the different proposed projects, independent of the associated incentive amounts.

For this additional preference criterion, staff analyzed the emission benefits on a per-vehicle basis to account for the differences in vehicle sales volumes and statewide populations of the various vehicles supported by AQIP. Resulting total lifetime emission reductions ranged from less than one ton to almost three tons of lifetime criteria pollutant and toxic air contaminant emission reductions per-vehicle. The scoring scale for this criterion was established by evaluating the range of lifetime tons of emission reductions between the highest and lowest value to try to have an equal distribution of scores. As a result, the bins were scaled in half ton increments. Projects with less than or equal to one ton of criteria pollutant and toxic air contaminant emission reductions received one point, while those projects with greater than two and a half tons of criteria pollutant and toxic air contaminant emission reductions received a score of five points. The resulting scale for criteria pollutant and toxic air contaminant emission reductions on a per-vehicle basis is shown below.

5: Greater than 2.5 tons of criteria and toxic emission reductions per vehicle
4: 2 to 2.49 tons of criteria and toxic emission reductions per vehicle
3: 1.5 to 1.99 tons of criteria and toxic emission reductions per vehicle
2: 1 to 1.49 tons of criteria and toxic emission reductions per vehicle
1: Less than 1 ton of criteria and toxic emission reductions per vehicle

Based on the information described above, Table A-55 summarizes the results and the corresponding score for this additional preference criterion.

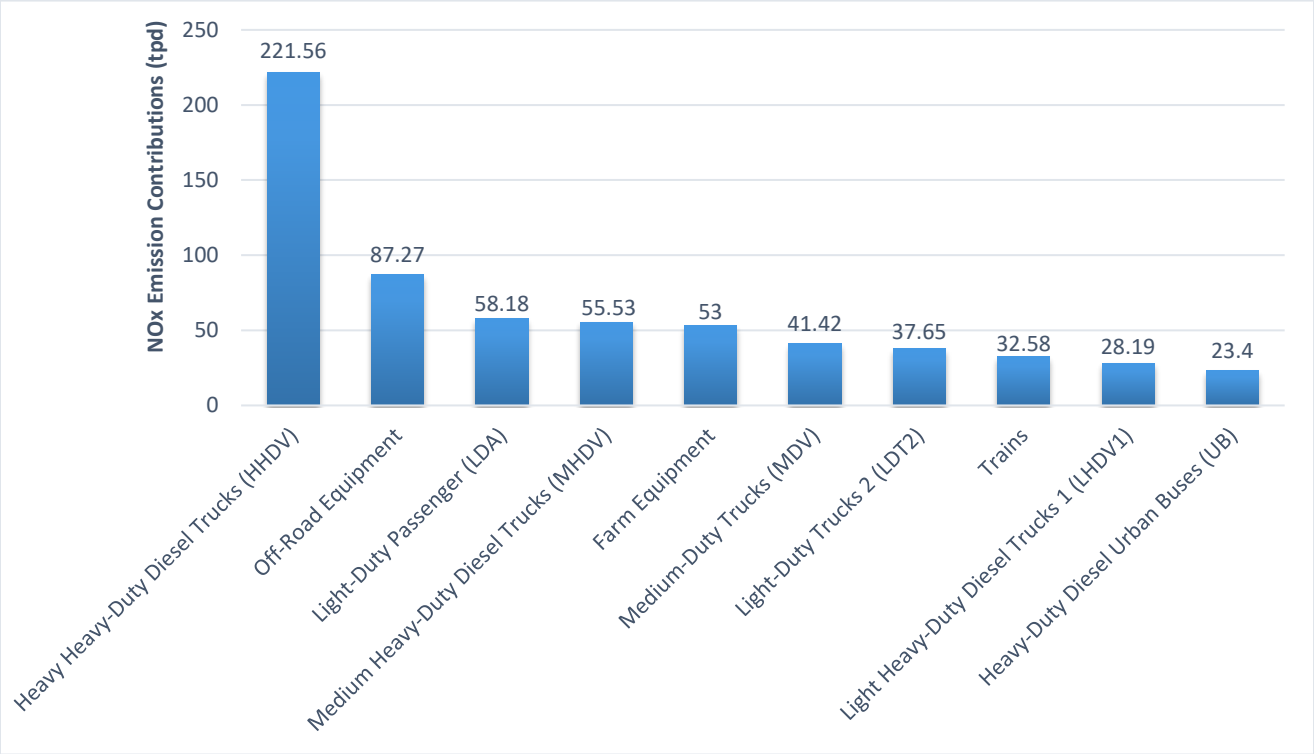
Table A-55: AB 8 Analysis – Potential Reduction of Criteria or Toxic Air Pollutants

Proposed Project	Annual Per-Vehicle Emission Reductions (tpy)	Project Life (years)	Per-Vehicle Lifetime Emission Reductions (tons)	Score
Truck Loan Assistance	0.210	2	0.42	1
Truck Filter Replacements	0.007	5	0.03	1

Contribution to Regional Air Quality Improvement

Staff developed a scoring scale based on CARB's emissions inventory for the South Coast and San Joaquin Valley air basins, two of the state's extreme nonattainment regions, and ranked projects based on their corresponding emissions contributions from highest to lowest. Specifically, staff used the NOx emissions inventory in tons per day from the 2016 State Implementation Plan (SIP) emission projection data for the South Coast and San Joaquin Valley air basins.[30] The ranking scale is based on the emissions inventory shown in Figure A-1.

Figure A-1: Largest NOx Emission Sources in the South Coast & San Joaquin Valley Air Basins



The top ten NOx emission sources were ranked in tons per day for various vehicle and equipment types, ranging from heavy heavy-duty diesel trucks, at 222 tons per day, to heavy-duty diesel urban buses, at 23 tons per day. Because the HHD diesel truck category is the largest emission source by far, the scoring scale for this criterion was established for the range of NOx emissions between the second highest and lowest value. As a result, the bins were rounded and scaled in 25-ton per day increments. Projects corresponding to inventory sources with less than or equal to 25 tons of NOx per day receive one point, while those projects with greater than 100 tons of NOx per day receive five points. Each project's potential contribution to regional air quality improvement was ranked based on the scale below.

[30] https://www.arb.ca.gov/ei/maps/2017statemap/abmap.htm

5: Category contributes more than 100 tons of NOx per day
4: Category contributes 75 to 99 tons of NOx per day
3: Category contributes 50 to 74 tons of NOx per day
2: Category contributes 25 to 49 tons of NOx per day
1: Category contributes less than 25 tons of NOx per day

Based on the information described above, Table A-56 summarizes the results and the corresponding score for this additional preference criterion.

Table A-56: AB 8 Analysis – Contribution to Regional Air Quality Improvement

Proposed Project	Annual Per-Vehicle Emission Reductions (tpy)	Project Life (years)	Per-Vehicle Lifetime Emission Reductions (tons)	Score
Truck Loan Assistance	0.210	2	0.42	5
Truck Filter Replacements	0.007	5	0.03	5

Ability to Promote the Use of Clean Alternative Fuels and Vehicle Technologies

Clean alternative fuels are fuels that have lower well-to-wheel emissions compared to conventional fuels, such as electricity, hydrogen, and renewable fuels. Clean vehicle technologies are technologies that emit zero tailpipe emissions, such as battery-electric and fuel cell vehicles, or enabling technologies, such as vehicles that utilize conventional hybrid or plug-in hybrid systems. This qualitative analysis ranked projects by whether or not they used a clean low carbon alternative or renewable fuel or utilized clean vehicle technologies. Staff scored this additional preference criterion on the scale below.

5: Projects that use low carbon alternative fuels and clean vehicle technologies
3: Projects that use low carbon alternative fuels or clean vehicle technologies
1: Projects that do not use low carbon alternative fuels nor clean vehicle technologies

Based on the information described above, Table A-57 summarizes the results and the corresponding score for this additional preference criterion.

Table A-57: AB 8 Analysis – Ability to Promote the Use of Cleaner Alternative Fuels and Vehicle Technologies

Proposed Project	Annual Per-Vehicle Emission Reductions (tpy)	Project Life (years)	Per-Vehicle Lifetime Emission Reductions (tons)	Score
Truck Loan Assistance	0.210	2	0.42	3
Truck Filter Replacements	0.007	5	0.03	1

Ability to Achieve GHG Reductions

Similar to the methodology established in the first preference criterion for criteria pollutant and toxic air contaminant emission reductions, staff conducted a full well-to-wheel GHG emissions analysis for the vehicles and equipment supported by the proposed projects. Staff determined expected lifetime GHG emission reductions achieved for each vehicle or equipment funded by the proposed projects and found that there were no GHG emission reductions. Because staff are proposing to use AQIP funding for Truck Filter replacements without reduction in fuel usage, staff found that there were no GHG emission reductions funded by AQIP. The scoring scale for GHG emission reductions is shown below.

5: Greater than 200 metric tons of CO2e per vehicle
4: 150 to 199 metric tons of CO2e per vehicle
3: 100 to 149 metric tons of CO2e per vehicle
2: 50 to 99 metric tons of CO2e per vehicle
1: Less than 50 metric tons of CO2e per vehicle

Based on the information described above, Table A-58 summarizes the results and the corresponding score for this additional preference criterion.

Table A-58: AB 8 Analysis – Ability to Achieve GHG Emission Reductions

Proposed Project	Annual Per-Vehicle GHG Emission Reductions (tpy)	Project Life (years)	Per-Vehicle Lifetime GHG Emission Reductions (tons)	Score
Truck Loan Assistance	N/A	2	N/A	1
Truck Filter Replacements	N/A	5	N/A	1

Ability to Support Market Transformation of California's Vehicle or Equipment Fleet to Utilize Low Carbon or Zero-Emission Technologies

This qualitative analysis ranked projects by whether or not technologies with the potential for market transformation are supported by the proposed projects. Staff used CARB's Three-Year Investment Strategy for Heavy-Duty Vehicles and Off-Road Equipment from Low Carbon Transportation and Air Quality Improvement Program Investments as a key reference in scoring technologies used for this evaluation. Low NOx engines, battery-electric, and fuel cell electric vehicle technologies, for example, are considered transformative technologies that will help the State meet its air quality goals. Staff scored this preference criterion based on the scale below.

5: Technologies that support market transformation
0: Technologies that do not support market transformation

Based on the information described above, Table A-59 summarizes the results and the corresponding score for this additional preference criterion.

Table A-59: AB 8 Analysis – Ability to Support Market Transformation of California's Vehicle or Equipment Fleet to Utilize Low Carbon or Zero-Emission Technologies

Proposed Project	Annual Per-Vehicle Emission Reductions (tpy)	Project Life (years)	Per-Vehicle Lifetime Emission Reductions (tons)	Score
Truck Loan Assistance	0.210	2	0.42	0
Truck Filter Replacements	0.007	5	0.03	0

Ability to Leverage Private Capital Investments

Staff is proposing not to include this criterion for FY 2018-19 as staff works on developing methodologies to analyze the private capital investments leveraged by projects. Staff intends to identify information sources and may include this preference criterion in future years.

Total Benefit Index

Staff utilized the benefit-cost/cost-effectiveness scores of the proposed projects and the additional preference criteria in the consideration of the projects to be given funding preference under AB 8. Staff developed the Total Benefit Index (TBI) score that preferentially weights the benefit-cost score (at 75 percent of the total score) with additional preference scores (at 25 percent of the total score). Staff weighted the benefit-cost/cost-effectiveness scores in this manner because AB 8 identified the benefit-cost score as the primary metric to assign funding preference for proposed projects.

Table A-60 summarizes the individual scores and the TBI scores for all of the AQIP projects currently proposed in the FY 2018-19 Funding Plan.

Table A-60: AB 8 Analysis – Project Scores and Total Benefit Index Score of Proposed Projects

Proposed Project	Additional Preference Criteria					25% of TBI	75% of TBI	Total Benefit Index Score
	Potential Reduction of Criteria or Toxic Air Pollutants	Contribution to Regional Air Quality Improvement	Ability to Promote Use of Clean Fuels and Technologies	Ability to Achieve GHG Emission Reductions	Ability to Support Market Transformation	Average of Additional Preference Criteria Score	Benefit-Cost Score	
Truck Loan Assistance	1	5	3	1	0	2	4	3.5
Truck Filter Replacements	1	5	1	1	0	1.6	1	1.15

AB 1550: Disadvantaged Community, Low-Income Community, Low-Income Household Investment Targets

In the proposed Funding Plan, staff proposes that at least 45 percent of CARB's Low Carbon Transportation appropriation be invested in projects meeting one of the AB 1550 criteria with the following targets:

- At least 35 percent of funds for projects located within and benefiting disadvantaged communities.

- At least 10 percent of funds for projects within and benefiting low-income communities or benefiting low-income households. The subset of these funds meeting the additional AB 1550 requirement for low-income community/ household investments that are within ½ mile of a disadvantaged community would be determined based on program implementation and reported in future Annual Reports to the Legislature on California Climate Investments.

Staff considers the investment targets to be a floor and expects to exceed them. This section provides additional detail showing how CARB will meet, and very likely exceed these targets, based on a historical performance of Low Carbon Transportation funded projects and the project criteria established in this Funding Plan.

This minimum CARB commitment of at least 45 percent would exceed the overall target set in AB 1550 for the State's collective California Climate Investments in disadvantaged communities, low-income communities, and low-income households. AB 1550 does not set targets for individual agencies, but requires that the State overall invest at least 25 percent in project located in and benefiting disadvantaged communities, at least 5 percent in and benefiting low-income communities or benefiting low-income households, and at least 5 percent low-income communities located within one half mile of a disadvantaged community for a total AB 1550 investment of at least 35 percent of California Climate investment funds.

Table A-61 shows staff estimates of the minimum percent of funds for each project expected to be spent within and benefiting disadvantaged community census tracts as well as the non-overlapping minimum percent of funds expected to be spent within and benefiting low-income communities. Staff only counted an investment as being in a low-income community if it had not already been counted as being spent in disadvantaged communities because AB 1550 does not allow funds to be counted twice for reporting purposes. Staff used several different methods for these estimates.

For ongoing projects with several years of implementation data such as CVRP, HVIP, and EFMP Plus-Up, staff used the historical percent of funds spent in disadvantaged communities as reported in the *2017 Annual Report on California Climate Investments* to project future performance. In the case of HVIP, staff updated these estimates based on vouchers issued through February 2017. In the case of EFMP Plus-Up, staff

adjusted the future projection to be more conservative because of the lack of historical data for the potential new air districts expected to start programs. Staff estimated the percent of funds within low-income communities by comparing the most recent project data with the low-income communities identified by CARB and Cal/EPA in April 2017 and the development of guidelines for implementing AB 1550. For EFMP Plus-Up, there are historical data on participants' incomes, so staff estimated the expected percent of funds that would be invested in low-income households.

As shown in Table A-61, several project categories are limited to disadvantaged communities, so staff can say with certainty 100 percent of these funds will be spent in these communities. These include Clean Mobility Options for Disadvantaged Communities, Agricultural Worker Vanpools, and Zero- and Near Zero-Emission Freight Facilities.

There are also a number of proposed projects that lack sufficient historical data upon which to make an informed estimate of the percent of funds that will be spent in disadvantaged and low-income communities. In these cases, staff took the most conservative approach and left the estimates as "to be determined" even though staff expects an appreciable amount of this funding will meet one of the AB 1550 criteria. For example, the Financing Assistance of Lower-Income Consumers pilot project will be limited to consumers with household incomes of less than 400 percent of the federal poverty limit and outreach will be targeted in disadvantaged communities. Thus, staff expects much of this funding will be spent in disadvantaged communities, in low-income communities, or for consumers meeting the AB 1550 low-income household definition.

Even with these conservative estimates, staff estimates that 35 percent of the proposed Low Carbon Transportation funds would be spent in disadvantaged communities and over 10 percent in non-overlapping low-income communities for a total of over 45 percent meeting one of the AB 1550 criteria as shown in Table A-61. When data are included for all the projects based on actual performance including those for which no AB 1550 is estimated at this time, staff expects CARB will exceed its AB 1550 targets by a considerable margin. CARB will report on these projects' performance in future Annual Reports to the Legislature on California Climate Investments as funds are awarded and spent.

Table A-61: Estimate of the Minimum Proposed FY 2018-19 Low Carbon Transportation Investments in Disadvantaged Communities, Low-Income Communities, and Low-Income Households

Project	Allocation (millions)	% in DC	$ in DC (millions)	% in LIC (non-overlapping)	$ in LIC (millions)	% in LIC Half Mile (non-overlapping)	$ in LIC Half Mile (millions)	% DC/LIC Combined	$ DC/LIC Combined (millions)	Assumptions and Data Sources
Light-Duty Vehicle and Transportation Equity Projects										
CVRP	$175	8%	$14	12%	$21	0%	$0	20%	$35	Assumes that the % of DC and LIC (based on rebates from 11/1/2016 to 4/23/2018) remain constant
CVRP Rebates for Lower Income Consumers	$25	17%	$4.3	21%	$5.3	0%	$0	38%	$9.5	Assumes that the % of DC and LIC (based on rebates from 11/1/2016 to 4/23/2018) remain constant
EFMP Plus-up / Clean Cars 4 All	$16	50%	$8	25%	$4	0%	$0	75%	$12	Estimates a more conservative 50% based on assumption that new districts will have a less dense concentration of DCs.
Financing Assistance for Lower Income Consumers	$10	39%	$3.9	37%	$3.7	0%	$0	76%	$7.6	From Table 1, 2018 Annual Report, Cap and Trade Auction Proceeds
Clean Mobility Options	$15	90%	$14	10%	$1.5	0%	$0	100%	$15	Staff proposal is for 90% of funds in a DC and 10% in a LIC

Project	Allocation (millions)	% in DC	$ in DC (millions)	% in LIC (non-overlapping)	$ in LIC (millions)	% in LIC Half Mile (non-overlapping)	$ in LIC Half Mile (millions)	% DC/LIC Combined	$ DC/LIC Combined (millions)	Assumptions and Data Sources
Ag Worker Vanpools	$3	90%	$2.7	10%	$0.3	0%	$0	100%	$3	Staff proposal is for 90% of funds in a DC and 10% in a LIC
Rural School Bus Pilot	$15	21%	$3.2	38%	$5.7	2%	$0.1	61%	$9.2	From Table 1, 2018 Annual Report, Cap and Trade Auction Proceeds
Clean Mobility in Schools	$10	100%	$10	0%	$0	0%	$0	100%	$10	Staff proposal is for 100% of funds in a DC
Funding Reserve	$6	tbd		tbd		tbd		tbd		TBD
Heavy-Duty Vehicles and Off-Road Projects										
Clean Truck and Bus Vouchers (HVIP + Low NOx Engine Incentives)	$125	51%	$63.8	22%	$27.5	2%	$1.3	75%	$93.8	From Table 1, 2018 Annual Report, Cap and Trade Auction Proceeds
Zero- and Near Zero-Emission Freight Facilities	$55	50%	$27.5	0%	$0	0%	$0	50%	$27.5	Staff proposal is for 50% of funding in a DC
Total	**$455**	**33.1%**	**$151**	**15.2%**	**$69**	**0.9%**	**$1**	**48.9%**	**$223**	

DC *means disadvantaged community as described in Health and Safety Code Section 39711.*
LIC *means low-income community (or low-income household in the case of EFMP Plus-up) as defined in Health and Safety Code Section 39713. "% in LIC" shown in this table means the percent of funds spent in low-income communities that have not already been counted as being spent in disadvantaged communities because AB 1550 does not allow funds to be counted twice for reporting purposes.*
LIC Half Mile *means low-income community within one-half mile of a disadvantaged community as defined in Health and Safety Code Section 39713.*
tbd *means "to be determined" and reported in future Annuals Report on California Climate Investments based on project implementation.*

Appendix B

SB 1204 Requirements and Performance Criteria Evaluation for Heavy-Duty Projects

(Health & Safety Code Section 39719.2(c) and (d))

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Overview

SB 1204 (Lara, Chapter 452, Statutes of 2014) created the California Clean Truck, Bus, and Off-road Vehicle and Equipment Technology Program funded with Low Carbon Transportation Investments, to support the development, demonstration, pre-commercial pilot, and early commercial deployment of zero- and near zero-emission technologies with priority given to projects that benefit disadvantaged communities. This appendix describes the ten requirements of SB 1204 and how CARB is addressing each of these requirements, followed by an evaluation of how each applicable heavy-duty or off-road project proposed in the FY 2017-18 Funding Plan satisfies the proposed performance criteria.

CARB's proposed heavy-duty vehicle and off-road equipment projects were evaluated based on a range of criteria that address emission reductions, technology viability and advancement, and market acceptance. Both SB 1204 and AB 8 (Perea, Chapter 401, Statutes of 2013) provide important policy drivers behind CARB's process of evaluating heavy-duty and off-road projects for funding consideration. Projects funded by AQIP must be evaluated based on the benefit-cost of criteria pollutant reductions and five additional preference criteria consistent with the requirements of AB 8, as detailed in Appendix A – Emission Reductions: Quantification Methodology. While some of the heavy-duty and off-road projects receive funding from AQIP, most are funded from CARB's Low Carbon Transportation appropriation and must satisfy the requirements of SB 1204, discussed in this appendix. Therefore, to ensure compliance with the requirements from both bills, CARB evaluated all proposed heavy-duty projects consistent with the benefit-cost and additional preference criteria requirements of AB 8 and the requirements of SB 1204, regardless of the project funding source. The complete AB 8 and GHG emission analysis is detailed in Appendix A.

1. Addressing SB 1204 Requirements

SB 1204 establishes specific program planning and project eligibility requirements and directs CARB to use the existing AQIP Funding Plan process to develop the guidance necessary to implement the program (Health and Safety Code section 39719.2(c)). The Funding Plan coordinates AQIP and Low Carbon Transportation investments in the heavy-duty sector, while implementing the specific statutory requirements that apply to each program.

SB 1204 establishes ten goals for California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program in Health and Safety Code section 39719.2(d) that should be addressed in CARB's guidance. The following describes how CARB will address each of these requirements, either by continuing procedures and processes that have been in place for previous AQIP or Low Carbon Transportation funding cycles or through new requirements proposed in this Funding Plan, followed by CARB's overarching vision for heavy-duty vehicle investments.

SB 1204 Requirement 1: Outline performance criteria and metrics for deployment incentives. The goal shall be to design a simple and predictable structure that provides incentives for truck, bus, and off-road vehicle and equipment technologies that provide significant greenhouse gas reduction and air quality benefits.

As Low Carbon Transportation and AQIP evolve, there is a clear need to evaluate the effectiveness of program investments. Staff has and will continue to work with stakeholders to identify appropriate metrics of success for each project funded under AQIP and the California Clean Truck, Bus, and Off-Road Vehicle and Equipment Program.

To achieve the pace of technology advancement needed to meet long-term air quality and climate goals, this funding should spur increasingly low-emission and low-carbon technologies as they are introduced and achieve market acceptance. The availability of significant Low Carbon Transportation funding will enable the progression of advanced heavy-duty technologies toward commercialization at a faster pace. Similar to how light-duty vehicles transitioned from basic hybrids to plug-in and fuel cell electric vehicles, basic hybrid trucks are a precedent to advanced hybrids, and finally to the ultimate goal of zero-emission trucks (or trucks that achieve zero-emission miles in specific duty cycles).

California Clean Truck, Bus, and Off-Road Vehicle and Equipment Program funding will expedite widespread deployment of zero-emission urban buses, freight and line-haul trucks, and off-road equipment, which are responsible for the bulk of emissions from the heavy-duty sector. Investments in Clean Truck and Bus Vouchers (HVIP and Low NOx Engine Incentives) and Zero- and Near Zero-Emission Freight Facilities Projects play a critical role in transitioning the entire freight and passenger transportation sector to zero-emission technologies, while at the same time providing immediate benefits to disadvantaged communities.

Proposed Performance Criteria for Evaluating Heavy-Duty Projects: Staff proposes the following performance criteria for evaluating heavy-duty projects funded through AQIP, California Clean Truck, Bus, and Off-Road Vehicle and Equipment Program, or both. These performance criteria are also intended to fulfill SB 1204 requirements:

- Potential for statewide and local emission reductions and health benefits.
    - Near-term reductions in both GHG and criteria emissions.
    - Long-term reductions in GHG and criteria emissions.
    - Emission reductions in non-attainment areas.
    - Emission reductions in and benefiting disadvantaged communities.

- Potential for technology viability.
    - Cost parity compared to conventional technology.
    - Reliability and durability in chosen application.
    - Ability to transfer technology to other vehicle or equipment types.

- Fueling infrastructure support.
- Ability to integrate renewable fuels.

- Broad market acceptance.
  - Ability to leverage additional public and private funding.
  - Collaboration between multiple entities.
  - Ability to address market barriers.

SB 1204 Requirement 2: Ensure that program investments are coordinated with funding programs developed pursuant to the California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007 (Chapter 8.9 (commencing with Section 44270) of Part 5).

Developing a joint Funding Plan that covers both AQIP and Low Carbon Transportation funding sources ensures coordinated investments between these two programs. The California Clean Truck, Bus, and Off-Road Vehicle and Equipment Program complements and enhances the existing CARB/Energy Commission coordination in the AQIP planning process by directing additional funding for the development, demonstration, pre-commercial pilot, and early commercial deployment of zero- and near zero-emission truck, bus, and off-road vehicle and equipment technologies.

In developing the joint Funding Plan, CARB and the Energy Commission staff meet routinely during the development of each agency's funding/investment plans for these respective programs to ensure that investments are coordinated. CARB has a representative on the Advisory Committee that assists with the development of the Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program. Similarly, Energy Commission staff participate in the public workshops and work groups that are part of CARB's annual funding plan development.

SB 1204 Requirement 3: Promote projects that assist the state in reaching its climate goals beyond 2020, consistent with Sections 38550 and 38551.

In all funding plans since FY 2014-15, heavy-duty projects focused on vehicles and industry sectors that, when transitioned to zero-emission, will have a significant impact on reducing climate change emissions. All of these Funding Plans included significant Low Carbon Transportation funding allocations for demonstrations, pilot commercial deployments, and ongoing deployments of commercially available vehicles that will achieve both near-term and long-term GHG emission reductions.

By continuing to develop promising near zero- and zero-emission technologies for use in industry sectors that: (1) are significant GHG emitters; and (2) hold promise for technology expansion and transfer to other sectors, these investments will help the State reach its long-term climate goals. Some of the key performance criteria listed above are "potential for long-term GHG reductions" and "ability to transfer technology to other vehicle or equipment types." These criteria help to promote projects that will contribute to meeting post-2020 climate goals.

SB 1204 Requirement 4: Promote investments in medium- and heavy-duty trucking, including, but not limited to, vocational trucks, short-haul and long-haul trucks, buses, and off-road vehicles and equipment, including, but not limited to, port equipment, agricultural equipment, marine equipment, and rail equipment.

Since the launch of AQIP with the first annual Funding Plan in 2009, CARB has funded the types of projects identified by SB 1204, and staff proposes to continue and to expand these investments. As shown in Table 5 in Chapter 2 of this Funding Plan, staff proposes $180 million for pilots and deployment projects in the truck, bus, and off-road vehicle and equipment sectors.

SB 1204 Requirement 5: Implement purchase incentives for eligible technologies to increase use of the cleanest vehicles in disadvantaged communities.

To date, approximately 55 percent of CARB's Low Carbon Transportation funding has been spent in disadvantaged communities. Since the implementation of AB 1550 in 2016, an additional 19 percent has been spent in non-overlapping low-income communities[31]. For FY 2018-19, staff anticipates exceeding the current requirement that at least 25 percent of auction proceeds be invested for projects within and benefiting disadvantaged communities; 5 percent for projects within and benefiting low-income communities or benefiting low-income households statewide; and 5 percent for projects within and benefiting low-income communities, or low-income households, that are within ½ mile of a disadvantaged community. This will ensure that CARB's heavy-duty vehicle incentives increase the use of the cleanest vehicles in these communities.

Over past funding cycles, CARB has provided AQIP and Low Carbon Transportation funding for purchase incentives for clean technologies, reducing emissions from the heavy-duty sector and providing benefits to disadvantaged communities. HVIP has supported the purchase of 1,264 zero- emission trucks and buses, 2,392 hybrid trucks, 1,015 low NOx engines, and 159 trucks outfitted with electric power take off systems (ePTOs) by California fleets through June 30, 2018. About two-thirds of HVIP funding is providing benefits to disadvantaged communities, and about 60 percent spent in disadvantaged and low income communities.

SB 1204 Requirement 6: Allow for remanufactured and retrofitted vehicles to qualify for purchase incentives if those vehicles meet warranty and emissions requirements, as determined by the state board.

The Hybrid and zero-emission conversions of original equipment manufacturer (OEM) vehicles were added to HVIP in FY 2015-16 and will continue for this project in FY 2018-19. Conversions of existing in-use vehicles to zero-emission are also already

[31] *Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds,* March 2018.
https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/2018_cci_annual_report.pdf

an eligible vehicle category, as are repowers of existing heavy-duty vehicles with engines certified to an optional low NOx standard.

SB 1204 Requirement 7: Establish a competitive process for the allocation of moneys for projects funded pursuant to this section.

CARB has used an established process for awarding AQIP funding through competitive solicitations since 2009. While there are no new solicitations this year, FY 2018-19 dollars are being used on projects that were competitively solicited using this process and staff proposes using the same process moving forward to solicit and award California Clean Truck, Bus, and Off-Road Vehicle and Equipment Program funding. Staff also proposes to allow funding allocations to be directed to a local air district or other agency to administer first-come first-served funding projects that more effectively address local needs.

SB 1204 Requirement 8: Leverage, to the maximum extent feasible, federal or private funding.

Currently, most grant solicitations require a minimum level of match funding, and projects that offer more match funding have the potential to be scored higher than projects with less match funding. Proponents are encouraged to seek additional funding from federal, state, and local public sources, as well as private sources. Staff proposes continuing the solicitation scoring criteria to encourage leveraging and is working with other funding providers to maximize federal and private funding.

SB 1204 Requirement 9: Ensure that the results of emissions reductions or benefits can be measured or quantified.

Since the inception of AQIP, all grant solicitations require that the project proponent report various metrics associated with vehicle operation and fuel consumption. Emissions from vehicles certified to a cleaner standard (i.e., low NOx) will be compared to a diesel baseline to determine emission reductions. Fuel consumption and carbon intensity will be used to quantify GHG emission benefits from hybrids, battery electric and fuel cell electric vehicles, as well as from vehicles using renewable fuels, compared to their conventional counterparts. All program-level emission reduction benefits will be quantified by comparing to conventional technologies on a well-to-wheel basis. In addition, telematic devices will be used when possible to monitor in-use data and provide information on usage in disadvantaged communities and other designated areas.

SB 1204 Requirement 10: Ensure that activities undertaken pursuant to this section complement, and do not interfere with, efforts to achieve and maintain federal and state ambient air quality standards and to reduce toxic air contaminants.

The zero- and near zero-emission technologies funded in California Clean Truck, Bus, and Off-Road Vehicle and Equipment Program provide GHG reductions as well as criteria pollutant and toxic air contaminant reductions, consistent with the existing AQIP program. These technologies operating in and near disadvantaged communities will reduce NOx and diesel particulate matter, contribute to criteria pollutant emission reductions, and reduce GHG emissions in the heavy-duty sector.

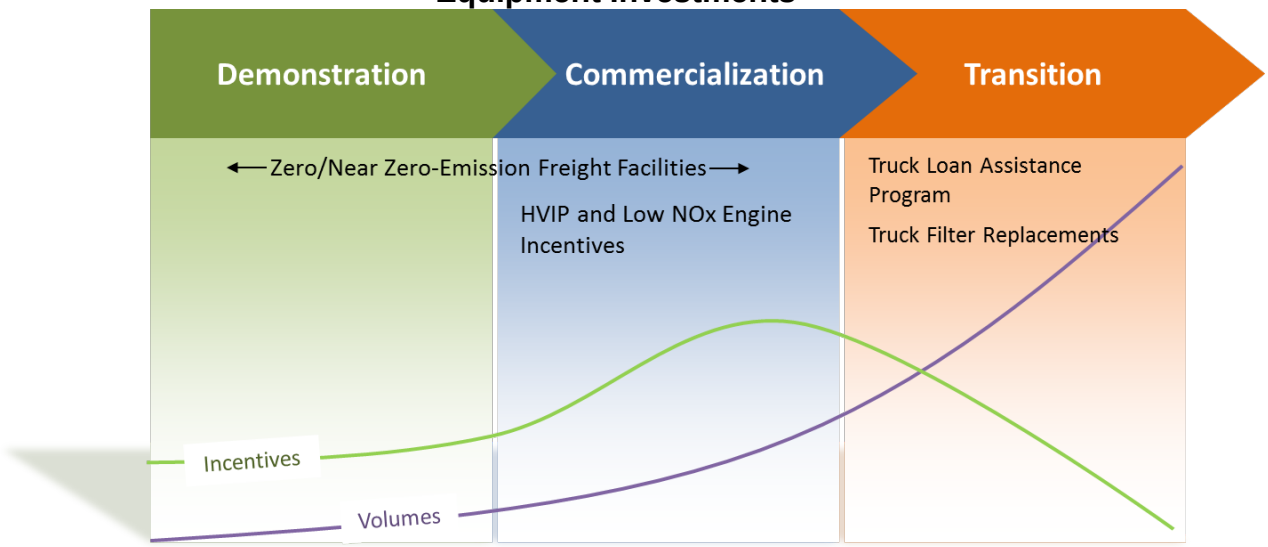
Overarching Vision for Heavy-duty Vehicle Investments

SB 1204 directs that the annual framework and plan required under Health and Safety Code Section 39719.2(f):

> Articulate an overarching vision for technology development, demonstration, pre-commercial pilot, and early commercial deployments, with a focus on moving technologies through the commercialization process.

The recommended heavy-duty vehicle and off-road equipment projects support SB 1204's overarching vision for technology development, demonstration, pre-commercial pilot, and early commercial deployments, with a focus on moving technologies through the commercialization process. This evolutionary role of incentives – is illustrated in Figure B-1 and described below.

Figure B-1: Recommended FY 2018-19 Heavy-Duty Vehicle and Off-Road Equipment Investments



In the *demonstration phase*, manufacturers are placing pre-commercial vehicles and equipment in service under real-world operating conditions. In this phase, per-vehicle incentives are high because manufacturing is not standardized and is focused on smaller batches of vehicles.

Funding is also provided for *pilot projects* to help the technology evolve in the early commercialization phase by deploying a larger volume of vehicles and equipment. Pilot projects can include both pre-commercial pilots and commercial pilots depending on the stage of technology advancement. *Pre-commercial pilots* are focused on first-time demonstrations of advanced technologies in new applications. *Commercial pilots*, on the other hand, involve deployments of vehicles and equipment that have been demonstrated, are certified by CARB, come with a warranty, and are purchased or leased by the end user. Vehicles in commercial pilots are ready to be sold commercially, but in such small numbers that they would not be able to compete without incentive support.

Table B-1: Pilot Project Categories

Milestone	Demonstration or Pre-commercial Pilot	Early Commercial Deployment or Commercial Pilot
CARB Certification/Approval	Experimental permit	Vehicle/engine certification or zero-emission approval letter
Vehicle Ownership	Retained by manufacturer	Purchase or lease transaction
Manufacturer Warranty	No	Yes

In addition, many projects would not advance to commercialization without the appropriate fueling infrastructure. For this reason, CARB provides funding for fueling infrastructure that directly supports pilot-funded vehicles and equipment.

In the *commercialization phase*, incentives are provided to encourage consumer adoption of advanced technologies. The commercialization phase can be broadly separated into lower volume and higher volume production phases. In the lower volume commercialization phase, per vehicle incentives are high. As sales grow and economies of scale are achieved, incentive funding levels and vehicle eligibility requirements can be adjusted to reduce per vehicle funding to ensure maximum incentive efficiency. In this higher volume commercialization phase, while per vehicle incentives are decreasing, total sales are increasing and total incentive funding commitments increase as a result. As a technology moves from lower volume commercialization to a fuller more mature higher volume, the incentive funding goals shift from a focus on technology development to a more specific focus on moving the technology from early adopters to mainstream consumers, disadvantaged communities, and the secondary market.

As a technology moves from commercialization into the transition phase, incentives can be adjusted to focus specifically on moving the technology into new consumer

demographic segments and on building upon earlier benefits in disadvantaged communities.

2. Project-Specific SB 1204 Performance Criteria Evaluation

The following sections include an evaluation of each proposed heavy-duty and off-road equipment project in terms of how they satisfy the proposed performance criteria detailed earlier in this appendix.

Zero- and Near Zero-Emission Freight Facilities Project

Following is an assessment of the proposed Zero/Near Zero-Emission Freight Facilities Project in terms of how it meets the proposed SB 1204 evaluation and performance criteria.

Potential for Statewide and Local Emission Reductions and Health Benefits: The proposed project is expected to achieve near-term greenhouse gas reductions along with co-benefit reductions in toxic and criteria pollutant emissions. Longer term reductions in GHG, criteria and toxic pollutant emissions will be realized as the zero/near zero-emission freight facilities projects increase in scale over time, and as more end-users take advantage of the incentive funding for these technologies. Staff expects 100% of the equipment funded will benefit disadvantaged communities, which will have the added benefit of improving air quality in areas non-attainment.

Potential for Technology Viability: Funding to incentivize the purchase of zero and near zero-emission advanced technology freight vehicles and equipment has significant potential for technology viability by helping to support their penetration into the broader market, which in turn will positively impact cost differentials and consumer acceptability. The availability of funds for current commercialized freight technology will also help transition zero and near zero-emission technologies to similar freight related applications that require even higher horsepower and longer duty cycles.

Broad Market Acceptance: Collaboration and commitment on the part of early users and beneficiaries of clean technology is essential to market acceptance. Fortunately, the need for air quality improvements is the impetus behind federal, state, and local funding for technologies that will result in lower emissions and increased use freight technology. The project will increase public and industry acceptance of the technology through education, outreach, and positive exposure to new technologies. Zero and near zero-emission freight technologies that successfully perform the same functions as their conventional counterparts will send a strong signal to those considering adopting similar zero and near zero-emission technologies.

Where the project can successfully demonstrate pre-commercial zero-emission on- and off-road vehicles and equipment, it will support broad market utilization of these technologies and future cost-reductions due to economy-of-scale production. Since many of these projects will also require the installation of fueling infrastructure, they

provide the opportunity to demonstrate hydrogen and charging fueling infrastructure in heavy duty on-and off-road applications, as well as provide increased opportunities to integrate renewable fuels. Staff proposes that 100% of the funding in this category go to projects located in disadvantaged communities.

Clean Truck and Bus Vouchers (HVIP)

Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project

Following is an assessment of the proposed Zero-Emission Truck and Bus Pilot Commercial Deployment Projects relative to the proposed SB 1204 evaluation and performance criteria.

Potential for statewide and local emission reductions and health benefits: Zero emission trucks and buses, along with hybrid trucks, are designed to achieve near-term and long-term emission reductions, while Low NOx engine incentives project achieve near-term reductions of GHG and criteria pollutant emissions. Vouchers issued to date indicate that about two thirds of HVIP funding has provided benefits to disadvantaged communities. Staff expects that for FY 2018-19 allocations, about one-third of HVIP and Low NOx Engine Incentives would be located in disadvantaged communities and an additional 15 percent located in low-income communities, with a combined total of about 50 percent. HVIP is designed to encourage and accelerate the deployment of low NOx engines and new hybrid and zero-emission trucks and buses in California, ultimately leading to long-term reductions in criteria and greenhouse gas emissions, and aiding California in attaining federal ozone and particulate matter standard within non-attainment areas.

Potential for technology viability: The incremental cost for zero-emission trucks and buses is substantial when compared to their conventional counterpart. For hybrid and low NOx trucks, the incremental cost is not as significant. Providing incentive funding towards the purchase of zero-emission trucks and buses, along with hybrid trucks accelerates the penetration of these technologies into the heavy-duty market. Increased production volumes will lead to cost reductions in vehicle components and assembly, energy storage systems, and fueling infrastructure. Making this funding available to medium heavy-duty vehicles (14,001 to 26,000 pounds GVWR) will help transition the technology to heavy heavy-duty vehicles (greater than 26,000 pounds GVWR), since advanced technologies are often implemented in lighter weight classes before evolving to heavier weight classes with longer duty cycles. Increasing the numbers of advanced technology vehicles and miles traveled will also result in increased demand for electricity and hydrogen fuels, which will help the state meet goals for transitioning from petroleum to fuels produced from renewable resources. The requirement for low NOx trucks to use renewable fuels encourages the development of those fuels.

Broad Market Acceptance: HVIP is structured to encourage leveraging of local, State, federal funding and private funding. The collaboration between public agencies and

their commitment to invest resources toward improving local air quality motivates advanced technology providers to invest in developing near zero-, and zero-emission technologies. Incentive funding, along with public and private partnerships, encourages the deployment of advanced technology, reduces production costs, and increases commercial viability within the truck and bus market.

Truck Loan Assistance Program

The proposed allocation for this ongoing AQIP-funded program is not required to meet SB 1204 requirements, and much of SB 1204's performance criteria does not apply since no advanced technologies would be used. However, the project would continue to help small business truckers comply with the In-Use Truck and Bus Regulation, which would result in criteria pollutant and toxic air contaminant emission reductions as older diesel trucks are replaced with cleaner vehicles or retrofitted with diesel emission control devices. Because newer trucks are more fuel-efficient, fleet turnover resulting from the proposed allocation will also achieve GHG emission reductions. Additionally, much of the Truck Loan Assistance Program funding has been spent in and benefits disadvantaged communities.

Truck Filter Replacement Project

The proposed allocation for this AQIP-funded program is not required to meet SB 1204 requirements, and much of SB 1204's performance criteria does not apply since no advanced technologies would be used. However, the project would help small business truckers replace faulty diesel particulate matter filters, which would result in criteria pollutant and toxic air contaminant emission reductions. The project is expected to provide benefits to disadvantaged communities by reducing diesel particulate emissions from trucks operating in disadvantaged communities.

provide benefits to disadvantaged communities by reducing diesel particulate emissions from trucks operating in disadvantaged communities.

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Appendix C

Clean Vehicle Rebate Project: Projected Funding Need for the Next Three Grant Years

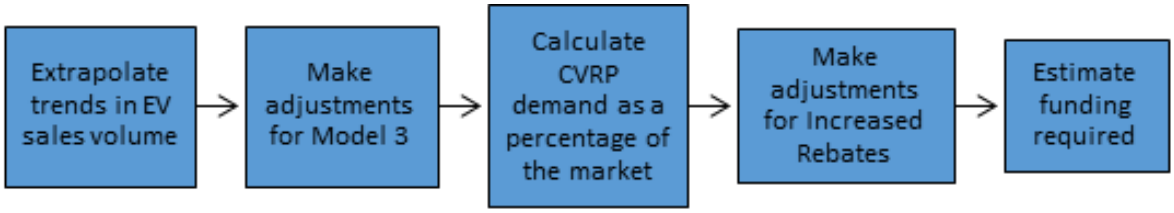
August 2018

Prepared by the Center for Sustainable Energy in collaboration with CARB staff

Overview

As shown in Table C-5 of this appendix, the proposed allocation for FY 2018-19 meets the demand estimate through at least the end of the fiscal year. The average program demand for the Clean Vehicle Rebate Project (CVRP) is currently estimated to be **$201 million–$275 million per grant year** during the next three cycles. Such funding would rebate a total of **231,000–307,000 clean vehicles**. These estimates include rebate data through August 2018, which yield increased demand relative to previous projections.

The estimates were produced by extrapolating trends in past light-duty clean-vehicle sales data to generate market projections. A minor group of "Other" eligible vehicles—primarily zero-emission motorcycles, for which no registration data was available—was incorporated using rebate extrapolations. Secondary adjustments were made to reflect the expansion of the Tesla Model 3 and Increased Rebates for lower-income consumers. Rebate demand was estimated using an assumed percentage of the projected market that would receive a rebate for each technology type.



It is important to note that these projections do not capture the unknown effects of new program features, such as Rebate Now (which is designed to increase access by making the rebate available as a discount at the time of sale), nor its expansion outside the current San Diego test region. The extrapolations also do not capture the net effect of new model releases over time. Finally, the projections do not address the federal tax credit phase out.

Approach

Data

Projections for plug-in hybrid electric vehicles (PHEVs), range-extended BEVx vehicles,[32] battery electric vehicles (BEVs), and fuel-cell electric vehicles (FCEVs) are based on monthly new-vehicle registration data from March 2010 through December 2017.[33] This was supplemented with sales estimates based on rebate data from January 2018 through August 2018.

Registration data was unavailable for the vehicle category "Other," which since April 2016 has been composed of a small number of zero-emission motorcycles. Projections for this minor vehicle category are based entirely upon extrapolated CVRP rebate data

[32] A regulatory category of vehicle that receives a BEV rebate but has a range-extending combustion engine. See cleanvehiclerebate.org for more detail. To date, the only eligible model in this category is the BMW i3 REx.

[33] Contains content supplied by R.L. Polk & Co; Copyright R.L. Polk & Co, 2017. All rights reserved.

(rather than registration data).[34] When projecting the full market for Other vehicles, the number of Other rebates is divided by the BEV percent of market rebated.[35]

Method

A. Extrapolate trends in EV sales volume

After evaluating a variety of curve-fitting and autoregressive integrated moving average-based approaches, linear extrapolations were used to forecast monthly sales volume for each of the five vehicle categories. Linear trends were calculated using data going back to the beginning of the "life" of each vehicle category. This approach reduces the relative weight of outliers and mitigates the impact of recent—often temporary—supply trends, which distorted comparison estimates made using shorter timeframes (e.g., the most recent 12 months). This linear extrapolation of past trends in vehicle sales serves as the foundation of this assessment of rebate funding requirements.

B. Make adjustments for Model 3

Early indications in rebate data support the assumption that the introduction of the Tesla Model 3 will increase rebate demand significantly beyond what might be expected from historical growth trends. Starting in April 2018, Model 3 applications exceeded 1,000 applications per month, reaching 3,000 applications in July and August (out of approximately 8,000 total). However, registration data is currently only available through December 2017. To account for this recent and dramatic increase in Model 3 rebates, sales estimates based upon rebate data through July were used to supplement available registration data—thereby updating the linear extrapolations to those illustrated by Figure C-1.

The extrapolations now explicitly capture the most recent months of Model 3 sales. However, further market expansion is expected for at least three reasons, in order of increasing uncertainty: 1) Tesla continues to increase Model 3 production capacity, 2) other models may succeed beyond past trends, and 3) new model introductions may substantially add to existing growth trends. No attempt is made to explicitly model future vehicle introductions (reason #3). However, to conservatively capture *part* of the expected but uncertain expansion of existing models (#1 and #2), an adjustment is made to BEV sales volumes based upon expectations for the Model 3. Specifically, additional BEVs are added to the monthly sales forecasts in the middle and high scenarios starting in the first funding cycle projected here, which begins September 1st, 2018. In the low scenario, no additional vehicles are added. This scenario implies that purchases of the Model 3 (or other similarly impactful new vehicles) will simply replace sales of other models that would have been purchased instead.

In the middle scenario, the number of vehicles added to the first funding cycle is based on the Tesla goal to increase Model 3 production from 5,000 vehicles per week to 6,000

[34] For publicly available data and visualizations, see http://cleanvehiclerebate.org/rebate-statistics.
[35] The BEV percent of market rebated was used because ZEM drivetrains are all-electric, and barriers to adoption are assumed to be more similar to BEV than other drivetrain technologies.

vehicles per week.[36] Using the share of Model 3 vehicles rebated to date, that additional 4,000 vehicles per month equates to roughly 600 *rebates* per month, which are added through the first program-funding cycle (September 30th 2019). At the start of the second funding cycle, the rebated share of 6,000 vehicles per week is increased to match the rebated share of national Chevrolet Bolt sales (31%).[37] Note that 31% represents the share of national sales rebated, which is significantly lower than the overall percent of California vehicles rebated.

In the high scenario, we assume the production goal is met and the rate at which additional Model 3 vehicles are rebated is 31% by the start of the first funding cycle. Further Model 3 expansion is assumed to increase rebate volume by 500 vehicles per month starting at the beginning of each funding cycle. Table C-1 summarizes the number of BEVs added in each scenario.

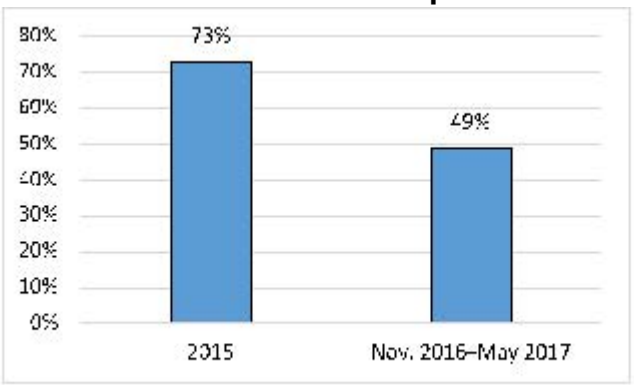
Table C-1. Additional BEVs rebated monthly due to Tesla Model 3 expansion

	Low	Middle	High
Added monthly in cycle 1	0	600	1,500
Added monthly in cycle 2	0	1,500	2,000
Added monthly in cycle 3	0	1,500	2,500

C. Calculate CVRP rebate demand as a percentage of the market

Monthly rebate demand was calculated by multiplying each vehicle category's monthly sales forecast by a vehicle-category-specific percentage of past rebated sales (i.e., one each for PHEVs, BEVx vehicles, BEVs, and FCEVs). These percentages changed substantially after March 2016, when an income cap and rebate increase for low-/moderate-income consumers were implemented. Figure C-1 illustrates the change in the overall percentage before and after the implementation of income-based eligibility.

Figure C-1. Percent of the EV market rebated before and after implementation of the income cap



[36] Sumagaysay, L. and Baron, E. (2018). Tesla finally hits Model 3 production target, sets the next one. The Mercury News. Retrieved 2 August 2018 from https://www.mercurynews.com/2018/07/02/tesla-hits-model-3-production-target-sets-the-next-one/

[37] Calculated using data from: Inside EVs. (2018). Monthly Plug-In Sales Scorecard. Retrieved on 3 August 2018 from https://insideevs.com/monthly-plug-in-sales-scorecard/

For the projections, the percentage of past rebated sales was calculated using rebate and sales data from November 2016 (when the existing income cap and rebate increase for low-/moderate-income consumers began) through June 2017, the start of a program waitlist.[38]
The Other category, lacking registration data with which to calculate a percent of market rebated, uses the BEV participation rate, as described in footnote 4. The percentages for each category are displayed in Table C-2.

Table C-2. Percent of market rebated by vehicle category

PHEV	48%
BEVx	44%
BEV	58%
FCEV	92%
Other	58%

D. Make adjustments for Increased Rebates and estimate funding required

From the estimated rebate totals, the monthly funding need was calculated by multiplying monthly projected rebates by the current rebate amount for each category, then summing the monthly funding needs for each category. These calculations assume no changes in CVRP program design.
CVRP allows lower-income consumers to claim an additional $2,000 per rebate. The percentage of the program projected to receive this increased rebate was based on the percent of the program that previously received an increased rebate by vehicle category (Table C-3).

Table C-3. Percent of projected rebates to receive an increased rebate for lower-income consumers

Vehicle category	Lower-income increased rebate
PHEV	8.8%
BEVx	6.1%
BEV	9.3%
Additional (Model 3) BEV	7.2%
FCEV	3.6%
Other	Not eligible for increased rebates

Growing awareness of the increased rebate for lower-income consumers is expected to increase uptake and may induce new consumers to participate in the EV market and

[38] For more information see cleanvehiclerebate.org.

subsequently in CVRP. To account for this, we assumed a growth percentage in the number of lower-income increased rebates in excess of the growth of the market and program in general (Table C-4). These scenarios demonstrate the possible effect of little-to-no increase (low scenario), a minor increase (middle), and a major increase (high) in application volume.

Table C-4. Additional growth added to lower-income increased rebate applications

	Low	Middle	High
Year 1	0%	5%	15%
Year 2	3%	8%	20%
Year 3	5%	10%	25%

Public fleets are also eligible to receive increased rebates if the vehicle will be operated in or near a disadvantaged community. Over the course of the Public Fleet Pilot Project (PFPP)[39] an average of 377 vehicles per year were rebated. Though PFPP has since been incorporated into CVRP and the increased rebate amount changed to match the increased rebate amount for lower-income individuals, the past average annual application volume has been added to the program at the new amount.
Finally, the projected funding need was increased by 7% to account for the rebate processing fee used to fund public outreach and education, applicant support, dealer training and support, data transparency, and program administration. This percentage assumes no program changes.

Factors not addressed

Several new aspects of the clean-vehicle market with potentially significant (but insufficiently understood) impacts were not included in the projections.
A pilot program feature called Rebate Now, which has been deployed in San Diego County, allows applicants to be preapproved to receive a rebate. These projections do not attempt to account for consumers induced into the market by the existence of Rebate Now nor its expansion, and do not reflect the pilot's cashflow requirements.
Tesla has reached—and General Motors is quickly approaching—the 200,000-vehicle threshold that triggers the ramp down of the federal tax credit for the purchase of a new electric vehicle.[40] The incentive, up to $7,500, has a major, but unquantified, impact on adoption. The sunset of the federal tax credit can be expected to significantly affect

[39] Center for Sustainable Energy (2017). Public Fleet Pilot Project Final Report Fiscal Year 2014–15. October. https://energycenter.org/sites/default/files/docs/nav/transportation/pfp/PFP%20Final%20Report_FY14-15_1-5-17.pdf.

[40] Isidore, Chris (2018). Tesla, GM buyers to lose $7,500 tax credit within a year. CNN Money. Retrieved 6 July 2018 from http://money.cnn.com/2018/02/23/news/companies/tesla-tax-credit/index.html.

demand for those makes and, by extension, rebate demand. Some of this effect may be moderated for the Tesla Model 3 as the shorter-range trim becomes available, which is expected to be priced at least $7,500 less than rebated Model 3 vehicles to date.

The California Vehicle Code (CVC § 5205.5 & 21655.9) was amended on August 17, 2016 to require certain EV buyers (those with household income above $150,000 for single filers, $204,000 for head-of-household filers and $300,000 for joint filers) to choose between receiving a rebate from CVRP or an HOV lane access decal. Implications of this law or future changes to its income thresholds have not been studied, and the possible effect on rebate demand is not included.

As described above, PFPP was reintegrated with CVRP in FY 2017–18. This reintegration made streamlined and flexible fleet application processes, developed for public fleets participating in the PFPP, available to all fleets applying to CVRP. Additionally, a portion of allocated CVRP funds has been provided to California Department of General Services (DGS) with the intention of streamlining the vehicle acquisition process for state agencies utilizing DGS to acquire vehicles. The effect of these changes has not been quantified and is thus not included in these projections.

Results

Average rebate demand calculated from these market projections is estimated to be $201 million–$275 million per grant year during the next three cycles. Such funding would rebate a total of 231,000–307,000 clean vehicles.

Results are presented in Table C-5, and as monthly totals in Figure C-2. In Figure C-2, the solid red line represents the total funding need projected for the middle scenario (i.e., the sum of the two dotted red lines). The cycle timeframe begins in September to reflect when funds are expected to be available to the program. This reduces the risk of artificially underfunding the program by not accounting for the gaps between the end of the state fiscal year and funding availability (which has been as much as six months).

Table C-5. Projected funding requirements and rebated vehicle totals by rebate subtype and fiscal year

FY 2018-19 (Sep 2018–Aug 2019) + FY 2017-18 bal.	**Total**	**$174 M**	**$196 M**	**$230 M**	**68,251**	**75,808**	**87,400**
Standard Individual & Non-Public Fleet Rebates		*$159 M*	*$177 M*	*$204 M*	*61,690*	*68,350*	*78,358*
Lower-income Increased Rebates		*$12 M*	*$16 M*	*$24 M*	*5,952*	*6,827*	*8,394*
Standard Public Fleet Rebates		*$0.6 M*	*$0.6 M*	*$0.7 M*	*231*	*255*	*271*
DAC Increased Public Fleet Rebates		*$2 M*	*$2 M*	*$2 M*	*377*	*377*	*377*
FY 2019-20 (Sep 2019–Aug 2020)	**Total**	**$203 M**	**$253 M**	**$276 M**	**76,843**	**94,603**	**102,089**
Standard Individual & Non-Public Fleet Rebates		*$170 M*	*$212 M*	*$227 M*	*69,522*	*85,368*	*91,290*
Lower-income Increased Rebates		*$31 M*	*$39 M*	*$46 M*	*6,683*	*8,572*	*10,118*
Standard Public Fleet Rebates		*$1 M*	*$1 M*	*$1 M*	*261*	*287*	*305*
DAC Increased Public Fleet Rebates		*$2 M*	*$2 M*	*$2 M*	*377*	*377*	*377*
FY 2020-21 (Sep 2020–Aug 2021)	**Total**	**$227 M**	**$280 M**	**$319 M**	**85,435**	**104,306**	**117,318**
Standard Individual & Non-Public Fleet Rebates		*$190 M*	*$234 M*	*$262 M*	*77,354*	*94,032*	*104,686*
Lower-income Increased Rebates		*$35 M*	*$43 M*	*$54 M*	*7,414*	*9,578*	*11,916*
Standard Public Fleet Rebates		*$1 M*	*$1 M*	*$1 M*	*290*	*319*	*340*
DAC Increased Public Fleet Rebates		*$2 M*	*$2 M*	*$2 M*	*377*	*377*	*377*

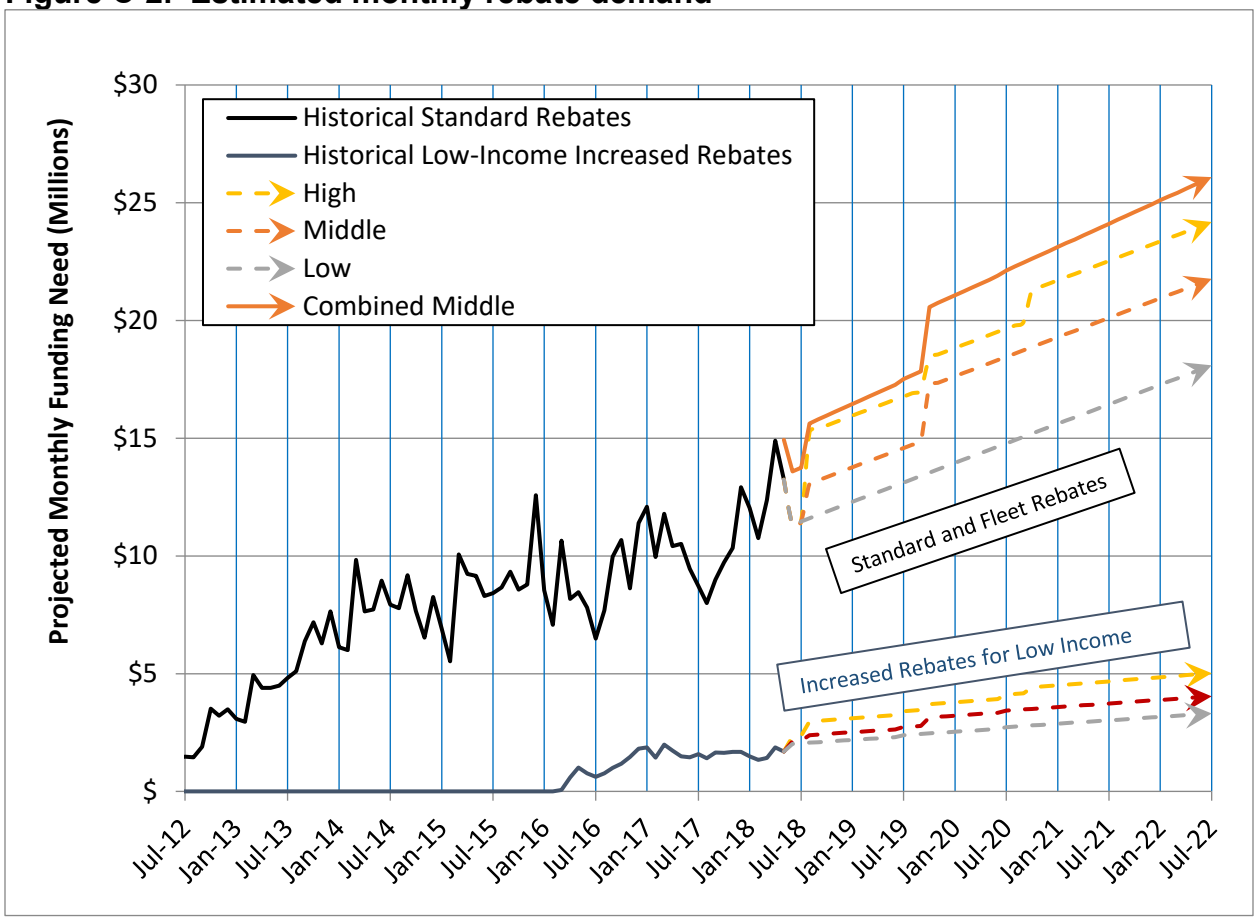
**Note: New FY 2018–19 funding became available in August 2018 as 2017–18* standard rebate funding was depleted, so there was no interruption in rebate reservation.

It is reasonable to assume that gaps in program funding lead to declines in rebate demand—both temporarily and overall—due to increased confusion, decreased trust, and other sources of consumer and dealer disengagement. For illustration, during the 2017 waitlist, the middle scenario projection overestimated standard and fleet rebate demand by 15%, compared to 9% overestimation in the five months immediately following the waitlist. Seasonality likely has a confounding effect on these error terms.

Trajectory towards state goals

The projections described above are regularly used to *predict* end-of-funding dates within a given fiscal year with reasonable accuracy. They are reasonably appropriate to help *set expectations* for funding requirements over a three-year timeframe, assuming no market disruptions. Nevertheless, the farther into the future past trends are extrapolated, the more *illustrative* they become. Unforeseen, market-altering events become increasingly likely over time. Even within a three-year planning horizon, they represent a trend that averages out peaks and valleys in demand. And any adjustments represent a careful balancing act between accounting for the accelerated expansion that would represent market and policy success without underestimating the barriers to widespread commercialization.

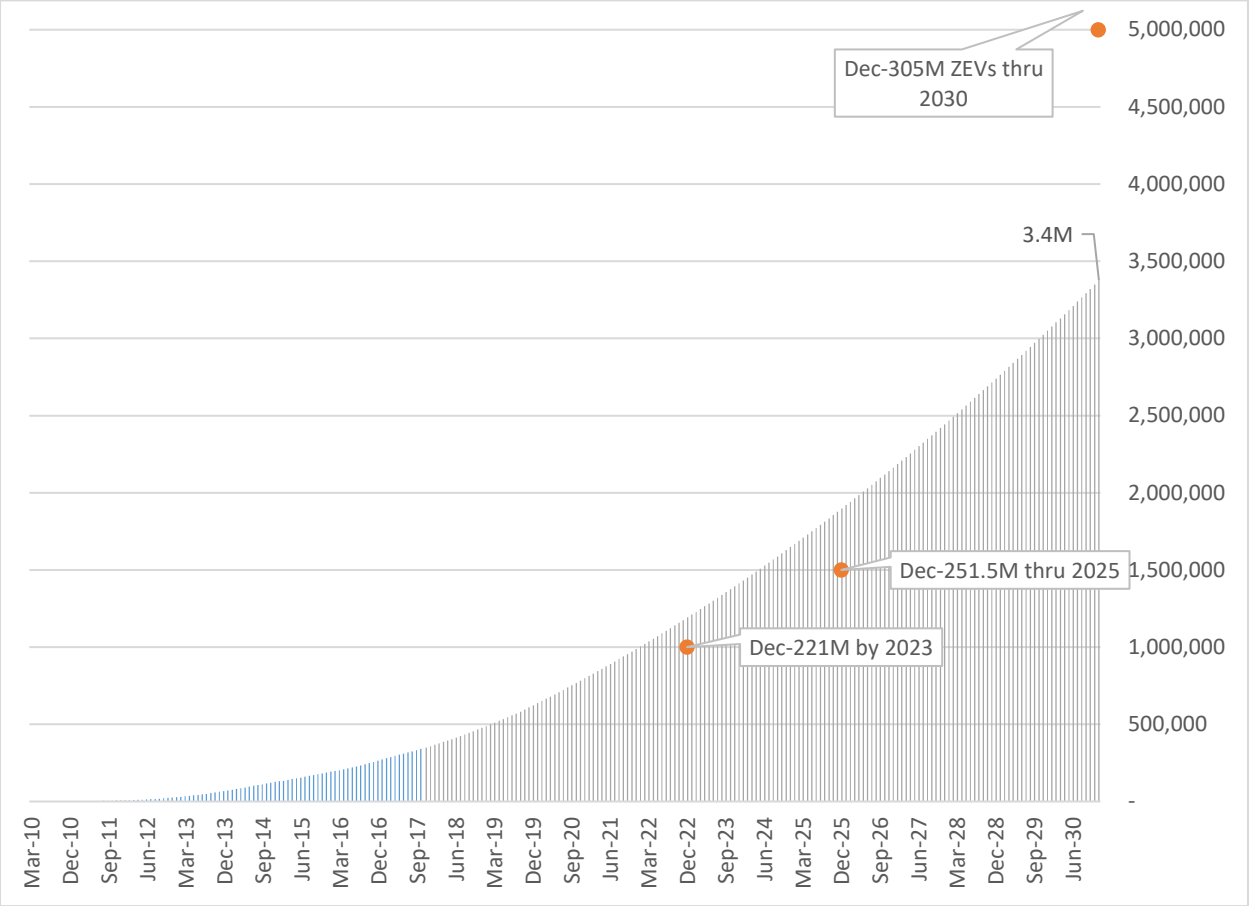
Figure C-2. Estimated monthly rebate demand



As such, the use of such projections to assess the state's progress towards its long-term goals must be cognizant of these limitations. Nevertheless, when taken as illustrative rather than predictive, extrapolating past and current trends can be informative. For example, if the current trajectory points towards a goal, it does not predict its attainment. But it gives a no-guarantees indication of being "on course" under current conditions (unless an expected future factor will slow progress, such as any of the challenges related to making inroads with more mainstream consumer segments). If the trajectory falls short of a goal, it does not necessarily predict failure. But it gives an indication that measures greater than or in addition to those already in place might be needed (unless an expected future factor, such as ZEV regulations, will sufficiently accelerate progress beyond the growth trend to attain the goal).

In this spirit, Figure C-3 compares the market projections discussed here with state EV deployment goals. It should be noted that this approach is different than analyzing expected compliance with ZEV regulations, but provides an additional, trend-based perspective on the market's *trajectory* toward state goals. That said, these past-demand-based trends produce a trajectory reasonably consistent with state goals through 2025, but they are not on pace to reach Governor Brown's goal of 5 million vehicles by 2030.

Figure C-3. Cumulative actual and projected EV sales trends relative to state goals



Appendix D

UPDATE TO THE THREE-YEAR INVESTMENT STRATEGY FOR HEAVY DUTY VEHICLES AND OFF-ROAD EQUIPMENT FROM LOW CARBON TRANSPORTATION INVESTMENTS AND AQIP

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UPDATE TO THE THREE-YEAR INVESTMENT STRATEGY FOR HEAVY-DUTY VEHICLES AND OFF-ROAD EQUIPMENT FROM LOW CARBON TRANSPORTATION INVESTMENTS AND AQIP

In the previous year's investment document, CARB, in collaboration with its partners at CALSTART, outlined its refined strategy framework for accelerating the development and market introduction of technologies critical to achieving the State's near term and longer-term climate and air quality goals.

This strategy is organized around a new approach for accelerating targeted technology improvement in three ways:

1. Focusing on continuing to invest Low Carbon Transportation and AQIP dollars across the commercialization arc for various technologies, building on our previous investments. This includes supporting technologies through the demonstration, pilot, commercial phases.

2. Focusing on critical technology pathways necessary to meet the state's 2030 climate and criteria emission goals. The three critical technology pathways identified are Zero Emission (organized around battery electric, fuel cell electric and hybrid electric technologies); Low NOx (engines and powertrains); and Efficiencies (engine and powertrain, full vehicle and system operations); and

3. Targeting investments on the expansion of beachhead markets – early successful vehicle applications where the pathway technologies can best establish initial market acceptance, and then from there seed additional adjacent market applications.

Beachhead Strategy Review

Three main beachheads and their resulting progress stages have been developed and adopted and are now being followed to define CARB investments. They are organized around the three technology pathways identified earlier: Zero-Emission; Low NOx; and Efficiencies. These beachheads and pathways are not mutually exclusive as some of the efficiency technologies can be overlaid on any one of these beachheads to maximize reductions (i.e. connected-automated vehicles, automated guided vehicles, stop-start systems, etc.).

Progress is already being made in building out technology capability against these beachheads as identified in the tech status updates provided later in this document. Some of the progress noted is remarkably fast year-over-year and signals the early success of the strategy. For those desiring a more detailed description of the beachheads and their pathways, please reference the 2017 document: Three Year Investment Strategy for Heavy-Duty Vehicles and Off-Road Equipment from Low Carbon Transportation Investments and AQIP.[41] It can be found at: https://www.arb.ca.gov/msprog/aqip/fundplan/proposed_1718_funding_plan_final.pdf

Given a dynamic market, timing and stages can change and evolve differently. Additional opportunistic applications can develop. **Therefore, these beachhead sequences are not intended to be absolute or guaranteed, but to guide the investment focus. They represent a reasonable potential to progressively scale and transfer components and capabilities to additional applications and platforms.**

These beachheads define and guide CARB's investment strategy and are adopted policy. However, in recognition of the dynamic nature of markets and technology they remain "works in progress" and will be updated and modified as needed to adapt to changing conditions. CARB staff welcomes comments and feedback on these beachheads.

Using the beachhead strategy, staff has prioritized most funding around applications that have strong potential to transfer and spread to broader applications. This involves identifying key places in the market where technology can be successful and then serve as a launch pad for additional market segment deployments. Important considerations are the ability of the technology or its core components to transfer to other applications, or scale to other weight classes in an application. An additional consideration is the ability of the beachhead and its follow-on applications to build the expansion of a common supply chain that can provide similar components for powertrains and systems that can reduce cost over time. This in turn helps to build greater production volumes, leading to continued affordability.

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[41] *Three Year Investment Strategy for Heavy-Duty Vehicles and Off-Road Equipment from Low Carbon Transportation Investments and AQIP*, Fiscal Year 2017-18 AQIP Funding Plan for Clean Transportation Incentives, CARB 2017,

Technology Status Updates

To maintain the effectiveness of the investment strategy and to track progress against goals, it is important to monitor the status of the key pathway technologies. This approach allows staff to adjust investment recommendations to help further expand market and technology success or to further assist technologies moving more slowly or facing additional barriers.

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Therefore, for each of the critical pathways and technology categories identified above staff and its partners at CALSTART have prepared an updated high-level overview of the market and readiness assessment of the technology as it pertains to heavy-duty vehicles and off-road equipment. Building on the baseline approach established in FY 2017-18, applications of the technology are characterized in terms of general stages on the path to commercialization and the potential market penetration of the application.

For ease of tracking, these updated assessments expand on the assessments presented in the first Three Year Heavy-Duty Investment Strategy and adjust them for changes in the intervening year. The assessments originally started from technology assessments conducted by CARB staff (in conjunction with staff from other agencies and industry) over previous years[42] and included additional or updated data and information from literature and technology providers where available.

These status "snap-shots" are broadly guided by the framework of Technology Readiness Levels, or TRLs[43], but are not intended to be absolute. Rather, these status assessments are meant to provide directional information on where pathway technologies generally reside, and what supporting tools or funding could then benefit them. In the technology status charts that follow, the x-axis represents how far the technology has advanced toward production, with those in the early demonstration stages shown on the left. Those that are closer to being commercially

In the technology status charts that follow, the x-axis represents how far the technology has advanced toward production, with those in the early demonstration stages shown on the left. Those that are closer to being commercially available are shown on the right.

[42] CARB, Technology and Fuels Assessment Reports, June 2015 to December 2016. https://www.arb.ca.gov/msprog/tech/report.htm

[43] NASA, Technology Readiness Levels, October 28, 2012. https://www.nasa.gov/directorates/heo/scan/engineering/technology/txt_accordion1.html

available are shown on the right. The y-axis shows the potential market penetration for that technology, with those technologies having a very small potential market near the bottom, and those with a larger potential market near the top. An arrow next to a technology platform will show directional changes in commercialization status since the last update.

For example, In Figure 3, battery electric heavy-duty delivery trucks are near the top left quadrant on the graph because the technology is in the early stages of demonstration, but the potential for fleets that can be converted is high. Conversely, transit buses are commercially available, so they are in the right quadrant, but the potential fleet size is smaller than that for trucks.

For simplification, and for purposes of this document, this investment strategy refers throughout to heavy-duty vehicles. However, that designation is meant in the broader sense of commercial vehicle ranges and applications. Indeed, CARB incentives for commercial vehicles can be used from weight classes starting above 8,500 pounds Gross Vehicle Weight Rating (GVWR). This document will refer to medium-duty and heavy-duty applications but will attempt as often as possible to refer back to the CARB weight designation system where they are applicable. This consists of Light Heavy-Duty - LHD (>14,000 pounds - 19,500 pounds GVWR); Medium Heavy-Duty - MHD (>19,500 pounds – 33,000 pounds GVWR) and Heavy Heavy-Duty - HHD (>33,000 pounds GVWR). These weight class initials will be listed next to platforms being tracked to aid in understanding

Note:

- *Applications listed are meant as reasonable examples to illustrate tech status points, but do not specifically represent investment targets.*
- *Where a meaningful change in technology status has occurred since the previous year's assessment, an arrow is used to show the directional scale of the change.*
- *Since vehicle application platforms can be at various levels of readiness depending on manufacturer, the positions shown display a representational average for the application as a whole, but not any one manufacturer's position.*

Technology Status Snap-Shot UPDATE: Battery Electric Vehicles

Battery-electric vehicle (BEV) technologies and key platforms have seen continuing and rapid progress over the last year, particularly in applications identified in the ZEV beachhead pathway. As indicated previously, the core beachhead application in the on-road market for BEVs has been full size transit buses (HHD weight classes). This segment, now in the commercial phase, continues its growth. Every major North American bus maker, and several new or emerging manufacturers, have BEV buses in production. There are now at least ten manufacturers and up-fitters producing BEV buses across more than 23 different models. More than 1,400 ZEV buses have been deployed or ordered as of this writing, and most of these are BEVs. California is home to nearly 700 of these deployments and orders. There are several benefits resulting

from this growth, including the expansion of a supply chain capable of supporting other vehicle types and applications and the early identification of infrastructure needs in advance of the larger truck market.

Notably, other important BEV applications also made significant commercialization progress over the past year. One of the key secondary beachhead markets, medium-duty delivery (MHD weight classes) has also moved noticeably forward in this assessment. This includes parcel and package delivery and other urban truck delivery applications. There are several manufacturers and up-fitters of various models in early production in Classes 4-6 weight categories as well as strong market announcements of product development coming from large national and global manufacturers. Overall this category ranges from later pilot stage to full commercial stage, with the weighted placement of this application being late pilot stage. Additional commercial product introductions are expected over the coming year.

Additional next stage beachhead markets such as shuttle buses (MHD) made some progress; but the expanded activity in school buses (MHD) was a significant step forward. All North American school bus original equipment manufacturers (OEMs) have announced or introduced an electric school bus, and other emerging manufacturers have expanded their offerings. At least eight school bus products are either commercially available or coming to market. The application can make full use of the

TECH EXAMPLE

Accelerated BEV Investments Show Tech Scalability

The past year saw significant battery electric truck announcements from global truck makers, engine makers and technology innovators. Tesla unveiled a Class 8 BEV tractor which it says could achieve ranges of 300 to 500 miles and a total cost of $180,000, with first versions in 2019. Diesel engine maker Cummins, Inc. unveiled its series electric powertrain plans to combine an engine with battery electric drive or be fully electric. Global truck and bus leader Daimler and its family of companies have made several product announcements, including the start of field trials for battery electric versions of its flagship Cascadia Class 8 tractor (eCascadia, range up to 250 miles) and M2 medium-duty truck (eM2), signaling 2021 production. Global truck and bus giant Volvo is expanding electric bus production and launching Class 7 and 8 tractor and straight trucks off its FL platforms with 2019 product in Europe and potentially North America. Global truck and bus conglomerate VW combined VW, Scania and Man capabilities to announce a suite of electric truck and bus offerings including a Class 6 truck to be produced by partner Navistar in North America by 2019.

same supply chain and many of the same components supporting transit buses and medium-duty delivery vehicles, partly accounting for the rapid progress. Public agencies have signaled a strong interest in funding this application.

In the heavier weight classes, the broader category of heavy regional delivery (HHD: Class 7/8 tractors operating mostly in urban or regional operations) and its subset of drayage (HHD: Class 7/8 tractors carrying port and warehouse cargo) both have progressed from the demonstration phase to the pilot stage. At least one product in this category is in commercial production now, but the majority of the platforms assessed for this update range from early- to mid-pilot stage. All major global truck manufacturers have announced product development. This is strong progress toward a vital BEV beachhead pathway market. 2021 is emerging as a common early market production timeline for these products and they are ripe for pilot stage deployment and validation.

One additional category added to the tech status chart this year is refuse trucks (HHD). While many refuse trucks in California have transitioned to alternative fuels there is emerging interest in BEV versions in some duty cycles. Two large manufacturers and

TECH EXAMPLE

Electric School Bus Expansion – Rapid Tech Transfer

Every major manufacturer of conventional school buses has now developed an electric product or has announced plans to do so. Why such fast progress? The duty cycle matches electric drive capabilities and benefits well: high idle times in front of schools, operating approximately 60-75 miles per day, ability to charge overnight, and a ridership highly sensitive to diesel emissions. Most importantly, electric school bus powertrains transfer directly from transit and truck components. Blue Bird has partnered with electric powertrain supplier, Efficient Drivetrains, Inc. (EDI) – recently acquired by Cummins, Inc. – to use EDI's PowerDrive™ 7000 drivetrain, developed for transit buses, for Type C and Type D school buses. Thomas Built Buses, Inc., a subsidiary of Daimler, recently announced plans to incorporate the EDI drivetrain into their Saf-T-Liner C2 electric school bus, leveraging Daimler's expertise from the FUSO eCanter and Freightliner eCascadia and eM2 products. IC Bus, a Navistar subsidiary, unveiled its ChargE Type C electric school bus, available for sale in late 2019 or early 2020, using components validated by partner Volkswagen. This powertrain is also being considered for medium duty trucks. Multiple other manufacturers are active, including Lion Electric Company; GreenPower Motor Company, a transit bus maker; Motiv Power Systems, which provides its modular powertrain system in partnership with Trans Tech for their eSeries Type A school bus and with Starcraft for their eQuest XL Type C electric school bus; and Transpower has converted both Type C and Type D school buses by leveraging their ElecTruck™ 5-speed AMT solution developed for medium and heavy-duty

other technology providers are developing product and the application on average is in the demonstration phase.

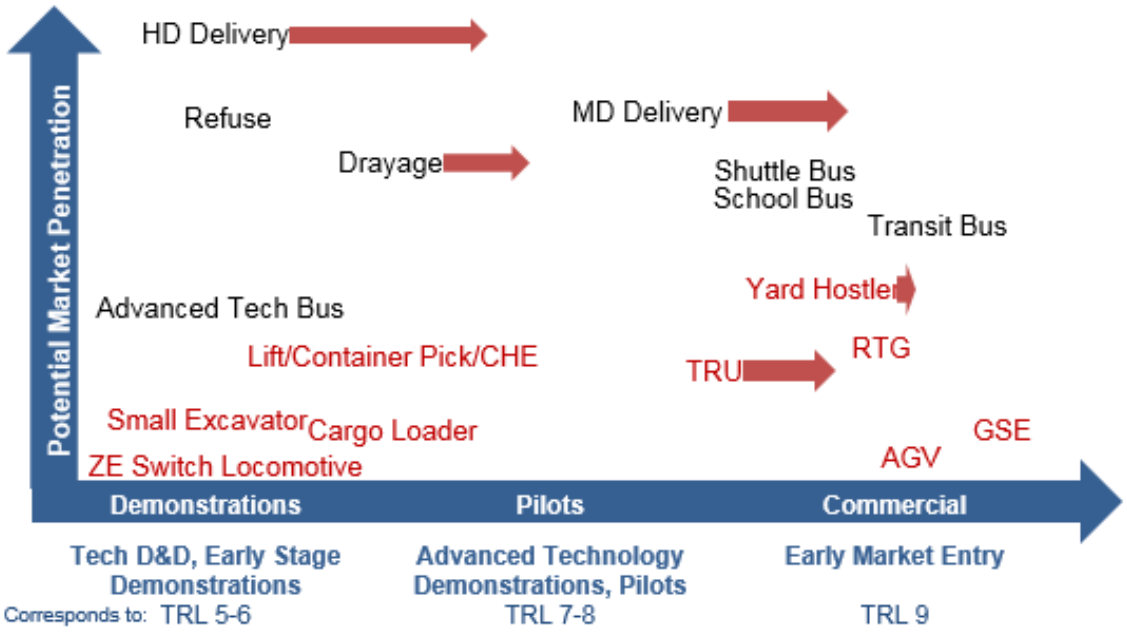
On the off-road side, the status report from the previous year holds for most applications. Class I and II electric forklifts are ubiquitous. BEV ground support equipment at airports is available today as a commercially available option, as are some select heavier equipment categories at ports such as rubber-tired gantries and cranes.

Yard hostlers/terminal tractors (HHD), designed to move trailers within a warehouse facility, intermodal facility, port terminal, or cargo yard, remains a category on the cusp of pilot and early commercial market deployments. The largest manufacturer of terminal tractors has developed a BEV solution and one other major global manufacturer is actively selling vehicles, along with two up-fitters. (See Figure 3).

BEV cargo handling equipment such as top picks, which are used to lift or pick up containers usually at port or multi-modal facilities, are making progress at the demonstration phase. Even more dramatic progress and innovation is being made in zero emission transport refrigeration units (TRUs), perhaps because of impending regulation and emission concerns. Battery-electric TRUs are being developed and fielded for pilot evaluations, including some designs with solar panels. There are also additional technologies emerging to allow zero emission operation without batteries, but instead using cryogenic gases and pneumatic power generation. Zero emission switch locomotives remain promising, but progress has been slow.

These platforms can benefit from future year funding assistance to help them transition to upgraded system designs and early market stage deployments.

Figure 3: Technology Status Update – Battery Electric



Key: Off-road shown in red
AGV = automated guided vehicle
GSE = ground support equipment
RTG = rubber tired gantry crane
CHE = cargo handling equipment
TRU = transport refrigeration unit

Source: Based on CARB technology assessments, interviews with manufacturers, and other studies and publications. These may be adjusted before being finalized based on further conversations and gathering additional information.

Key Barriers to BEV Adoption

Low Carbon Transportation and AQIP funding can assist in overcoming key barriers to current adoption of battery electric heavy-duty vehicles and off-road equipment. These barriers include (with updated observations noted in italics):

- High incremental cost of the vehicles due to low production volume, energy storage, and electric powertrain costs. *Energy storage costs remain on a step reduction path. Beachhead markets are starting to expand core component supplies.*
- Potential payload impacts from the size and weight of the battery electric components. *Legislation is being pursued to provide a 2,000-pound weight exemption to zero and near zero emission commercial vehicles.*
- Limited, though steadily improving, range or time of operations before refueling. *Energy storage capacity continues to expand as price drops. Class 8 ranges of 150-250 miles are being announced, with some as high as 300-plus miles.*

- Infrastructure costs for facility upgrades and fueling demand charges. *The recent California Public Utility Commission SB 350 rate case outcomes for the state's major investor owned utilities will be assisting with infrastructure costs by mid-2019*.
- Lack of understanding of the business case and best deployment applications. *The beachhead strategy has assisted in defining where technology will provide capability and business case. Increasing demonstration, pilot, and commercial deployments are providing data to validate the fuel and maintenance savings associated with BEVs and the associated total cost of ownership. Early transit bus deployments are yielding payback periods as short as 3-5 years relative to conventional technologies.*
- Limited vendor and product selection and the accompanying service and support network. *Product selection is expanding in the primary and secondary beachhead markets. Major OEMs and their dealer networks are entering the market. Established service providers are providing support to smaller company products.*

BEV Opportunities over the Next Three Years

In on-road applications, BEV technology is steadily expanding in the early beachhead market of transit buses, and emerging in medium delivery vehicles, shuttle buses and school buses. Heavier vehicle applications such as drayage and regional delivery trucks are moving into pilot stage and refuse is entering demonstration phase. In the off-road sectors BEV technology is in the commercial stage for industrial lifts and GSE. Port equipment is in the late pilot to early commercial stage for yard hostlers/terminal tractors and in the demonstration stage or heavy-duty cargo handling equipment such as top picks and high tonnage forklifts. TRUs are in pilot to early commercial stages. All these applications are promising areas for investment funding to advance.

Technology Status Snap-Shot UPDATE: Fuel Cell Electric Vehicles and Equipment

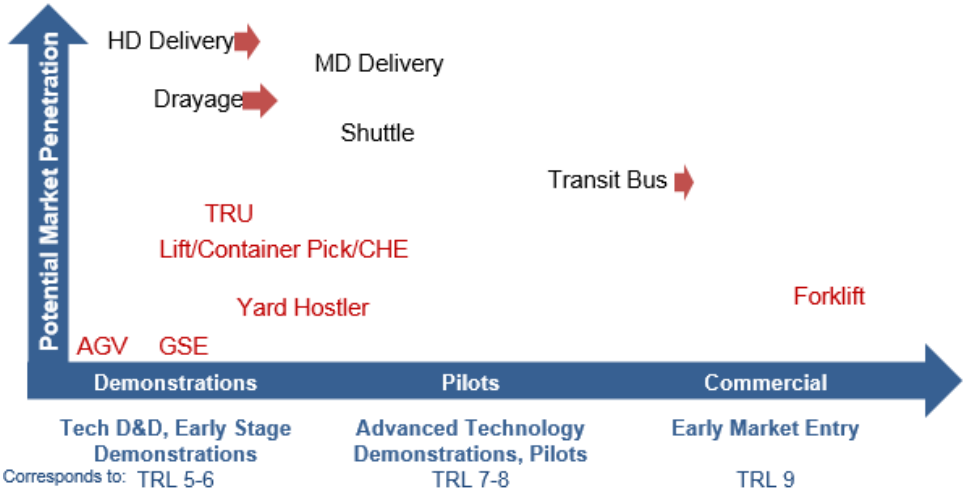
Fuel cell electric vehicle (FCEV) technology continues to expand as a commercially available product in forklifts and to seed demonstration activity in heavier lift and cargo handling equipment (CHE). This has spurred interest in FCEV ground support equipment (GSE). Interestingly, these industrial lift-scale fuel cells (hydrogen fuel cell forklifts are commercially available in Class I, II, and III lift capacities) are under consideration as range extender power plants for on-road vehicles, as well, as they can tap an established supply chain and early volumes (See Figure 4). Similarly, fuel cell power plants developed for the passenger car market are being demonstrated as full propulsion units in on-road drayage truck applications

In the on-road market, fuel cell transit buses remain the focus and continue to make progress. They are in the late pilot to early commercial stage. There are now three fully certified commercial FCEV bus products offered in North America, and nationwide there

are at least 74 fuel cell buses deployed or on order[44]. This segment, still on the cusp of commercialization, would benefit from a focused pilot to help with hydrogen infrastructure scaling and to further increase fuel cell component volumes.

The development of fuel cell electric trucks, specialty equipment and shuttle buses is underway at the demonstration phase. Multiple medium- and heavy-duty demonstration projects are underway in the United States, including in drayage applications that need longer range performance. Due to their many powertrain similarities, advancements in the commercialization of both battery electric trucks and fuel cell electric buses have the potential to expedite the commercialization of fuel cell electric trucks. As the cost and timing of electric vehicle infrastructure, permitting and installation become better understood, there will be opportunities for FCEV technology to provide an alternative particularly for longer range, extreme duty cycle and high utilization vehicles that may need faster refueling and lower vehicle weight.

Figure 4: Technology Status Update – Fuel Cell Electric



Key: Off-road shown in red
AGV = automated guided vehicle
GSE = ground support equipment
CHE = cargo handling equipment
TRU = transport refrigeration unit

Source: Based on CARB technology assessments, interviews with manufacturers, and other studies and publications. These may be adjusted before being finalized based on further conversations and gathering additional information.

[44] NREL, Fuel Cell Electric Bus Evaluations, December 2017. https://www.nrel.gov/hydrogen/fuel-cell-bus-evaluation.html

Key Barriers to FCEV Adoption

Low Carbon Transportation and AQIP funding can assist in overcoming key barriers to current adoption of fuel cell electric heavy-duty vehicles and off-road equipment. These barriers include:

- High incremental cost of the vehicles due to fuel cell stack, balance of plant and hydrogen tank costs. *Costs are slowly dropping with improved engineering and product integration.*
- Unknowns about the life cycle of the fuel cell and time before replacement. *Recent fuel cell transit bus performance data shows that fuel cell vehicles can attain long service lives that match service intervals of a standard transit bus.*
- Significant infrastructure costs and a lack of easily accessible infrastructure. *California continues to invest in hydrogen infrastructure, but these sites are focused on light duty passenger cars and generally do not support medium- and heavy-duty vehicle access.*
- Cost of hydrogen fuel is high relative to current diesel prices. *Projects are underway to explore multi-benefit hydrogen production facilities that could help reduce hydrogen cost. The use of renewable feedstocks in California incented by Low Carbon Fuel Standard (LCFS) credits could reduce hydrogen cost.*
- Lack of understanding of the business case outside forklifts, and best deployment applications. *The fuel cell transit bus business case is just starting to emerge from demonstration projects.*
- Limited vendor and product selection and the accompanying service and support network. *The fuel cell manufacturer market is expanding and starting to grow outside a solid base in forklifts.*

FCEV Opportunities over the Next Three Years

In on-road applications, FCEV technology is still straddling pilot and commercial stages for transit buses and could benefit from additional pilot stage funding, particularly to assist with building out facility infrastructure. The ability to transfer and scale fuel cell electric systems, perhaps from smaller applications, such as forklifts and passenger cars, to serve as range extenders for such applications as ZEV delivery and distribution vehicles looks promising and deserves attention. Similarly, fuel cell technology is ready to demonstrate in other on- and off-road applications, including cargo handling equipment where infrastructure can be developed and supported. Fuel cost remains a barrier to scaling.

Technology Status Snap-Shot UPDATE: Hybrid Electric Vehicles

There have been some significant announcements over the past year with at least one major engine manufacturer signaling new capabilities to bring BEV and hybrid electric vehicle (HEV) technologies to market in heavy weight class applications including delivery trucks (MHD), transit buses (HHD) and regional heavy haul trucks (HHD). HEV capability is commercially available and successful in transit buses, though mostly

through a single system supplier. Notably, these HEV buses have added the capability for limited zero emission operation via full electrification of components and expanded energy storage. Hybrid systems are also available commercially from qualified vehicle modifiers (QVMs), sometimes referred to as up-fitters, in medium duty delivery and service applications (MHD).

HEV systems continue to also progress in so-called “milder” versions of the technology, such as start-stop operations that allow an engine to turn off at stop lights, traffic delays or during idle operation. Start-stop systems have been validated or are being offered in transit, yard hostler/terminal tractors and refuse trucks (HHD) and some medium duty truck applications (MHD). In the light truck and sport utility platforms, which often presage technology that will become available in trucks, these segments have seen a rapid growth of start-stop to as high as 20 percent of new vehicle sales. The importance of this development is in building out a high-volume supply chain for key components.

Some HEV drayage and heavy regional delivery truck applications (HHD), including plug-in hybrid electric (PHEV) and extended range series-electric designs, are in demonstration phase and moving to pilot stage. With the rapid emergence of BEV technology some HEV development has slowed (See Figure 5).

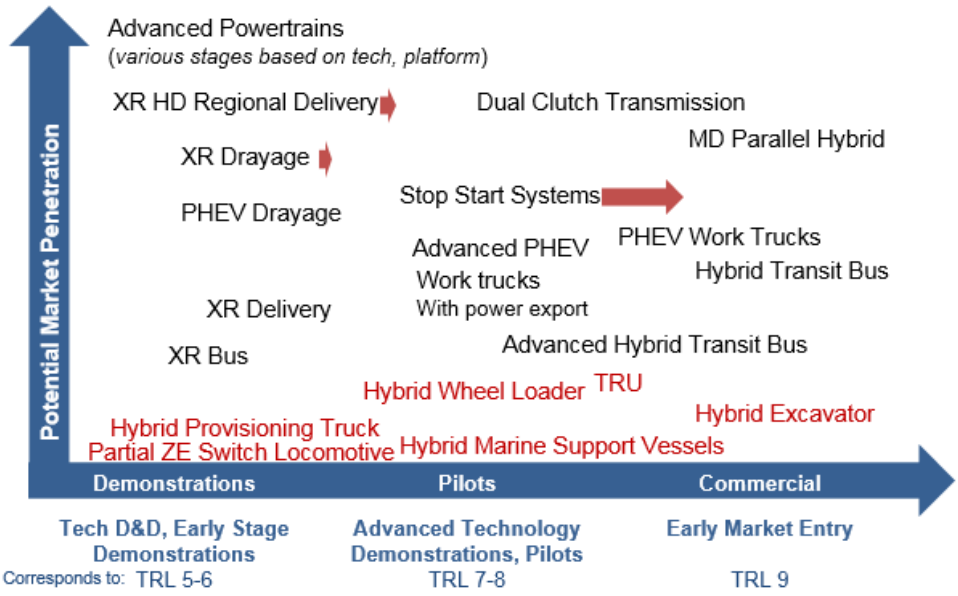
In the off-road segment, hybrid excavators range from the pilot stage to early commercial stage. Hybrid wheel loaders are in the demonstration or advanced demonstration stage. Both products are commonly used for construction purposes. Wheel loaders also have goods movement/freight uses. Both wheel loaders and excavators, as well as other hybrid construction and agricultural equipment, should be considered freight-enabling applications because of the common supply chain for components. Hybrid cargo handling equipment has been developed, mostly in Europe, and some is entering the very early market.

A promising emerging application for hybrid systems are marine vessels. Hybrid electric systems for harbor and support vessels have been developed using components taken directly from transit hybrid systems and should be considered in the pilot stage. These applications include tugs, tenders, ferries and other similar vessels.

Hybrid systems already enable idle reduction at worksites (electric power take-off) and potentially could be used to power TRUs as well as provide ambulance and first responder power.

Hybrid technologies provide synergistic benefits for battery electric and fuel cell heavy-duty vehicle technologies because they share several core components with battery electric and fuel cell electric vehicles. While hybrids are not zero-emission, they provide a pathway for zero-emission technologies. Hybrid electric heavy-duty vehicles help increase the production volume for components like battery packs, electric motors, and control systems by bringing down manufacturing costs, and supporting the supply chain to benefit other zero-emission technologies.

Figure 5: Technology Status Update – Hybrid Electric



Key: Off-road shown in red
Hybrid = electric hybrid
HEV = hybrid electric vehicle
PHEV = Plug In Hybrid Electric Vehicle; can allow for some zero emission range
XR = Extended Range; series electric drive with power generator to allow longer range driving
Marine Support Vessels = tugs, tenders, ferries
TRU = transport refrigeration unit

Source: Based on CARB technology assessments, interviews with manufacturers, and other studies and publications. These may be adjusted before being finalized based on further conversations and gathering additional information.

Barriers to HEV Adoption

Low Carbon Transportation and AQIP funding can assist in overcoming key barriers to current adoption of hybrid electric heavy-duty vehicles and off-road equipment. These barriers include:

- The incremental cost of the vehicles, due to energy storage and control system integration, though this has dropped substantially for some platforms.
- Infrastructure is a barrier for plug-in hybrids but not conventional designs.
- Lengthy and expensive certification process for hybrid vehicles and equipment sometimes result in missing incentive funding opportunities. *The Innovative Technology Regulation was partially designed to assist hybrid technologies. However, some manufacturers remain concerned about the complexity of meeting emission regulations in systems combining engines and hybrid components.*
- OBD integration, and the optimization of hybrid operations with emissions control systems. *See note above.*

- Lack of understanding of the business case and best deployment applications.
- Limited vendor and product selection.

HEV Opportunities over the Next Three Years

While BEV technology is drawing more of the near-term focus, existing commercial HEV applications should be bolstered and expanded to help grow supply chains, while extended range architectures for medium- and heavy-duty transit and delivery applications could benefit from demonstration and pilot focus to ensure options are developed to cover needs across the entire market. The ability to power TRUs and provide worksite engine-off operation, as well as some drive cycle engine-off operations, needs expansion as they can bring NOx reduction benefits as well. In the off-road sector, hybrid heavy cargo handling equipment and construction equipment share many common architectures and components; construction should be considered a freight-enabling application for purposes of commercialization. Demonstration projects can expand these capabilities for goods movement.

Technology Status Snap-Shot UPDATE: Low NOx

The most significant status change from the previous year is the beginning of commercial production for the natural gas low NOx (certified to 0.02 g/bhp-hr NOx) Cummins Westport 11.9-liter engine. The emergence of this engine as a commercial product brings low NOx technology to drayage, regional delivery and some line haul applications (HHD).

Several other low NOx gaseous fuel engines (natural gas and propane) certified to one of the optional low NOx levels are now in commercial production for transit buses (HHD) and medium-duty on-road trucks and school buses (MHD). These include 6.8- and 8-liter propane, and 8.9-liter and 6.7-liter natural gas engines (See Figure 6).

13-liter natural gas engines employing combustion ignition technology are available in Europe but are not currently being built for the U.S. market. Notably, however, an

TECH EXAMPLE
DIESEL LOW NOX PROGRESS

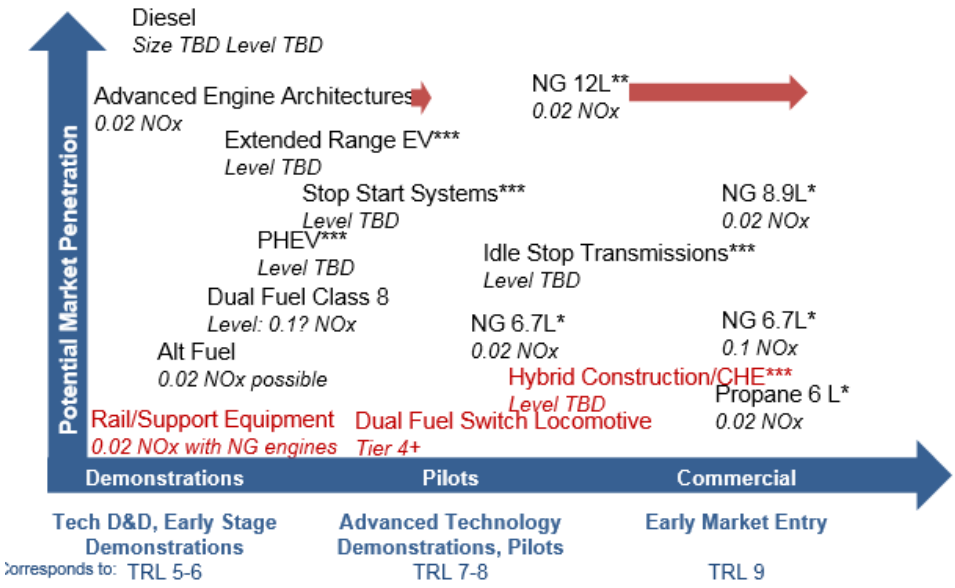
San Diego, CA based Achates Power has achieved an important milestone in its development of a high-efficiency, low NOx diesel engine based on its opposed piston (OP) architecture. Engine design and operation modeling shows that using innovative but available aftertreatment systems and new strategies to reduce start-up emissions, its new Class 8 linehaul engine can meet and exceed the stringent CARB optional low NOx engine certification level of 0.02 grams/bhp-hr. This is 90 percent lower than the EPA 2010 engine standard, achieved while exceeding 2027 engine fuel economy goals. The engine features higher power density than conventional diesel engines and can replace 13 to 15-liter engines in a 10.6-liter size. The engine enters the build and validation stage in 2019.

advanced heavy-duty line haul diesel engine that could achieve both higher efficiency and meet the low NOx standard is now in demonstration phase. As of this writing the Achates Power opposed piston engine has been validated in modeling to meet or exceed the 0.02 g/bhp-hr NOx standard. It could be ready for pilot stage deployments in two years. Larger displacement engines for switch locomotives and some marine vessels may also show the potential to exceed Tier 4 emissions.

Expanding low NOx engine deployment into diesel-fueled vehicles and the heaviest on-road engine weight classes is important for technology transfer to off-road equipment. New low NOx engine technologies should be paired with renewable fuel use to maximize criteria and climate emission reduction benefits

There is a potential overlap between the hybrid space and low NOx, assuming engines and after treatment systems are sufficiently integrated with the hybrid components and operation. There is value in assessing the potential for NOx reductions over a duty cycle from these full powertrain efficiency improvements.

Figure 6: Technology Status Update – Low NOx



*Applicable applications include: transit vehicles, refuse haulers, and school buses.
**Adds drayage, Class 8 regional haul, some line haul
***Could use Innovative Technology Regulation to validate duty cycle NOx reduction

Key: Off-road shown in red
NG = natural gas engine, either compressed or liquefied
Alt fuel = a recognized alternative, low carbon fuel other than NG
PHEV = plug in electric vehicle
Dual fuel = engine capable of operating on diesel and NG/alt fuel
CHE = cargo handling equipment

Source: Based on CARB technology assessments, interviews with manufacturers, and other studies and publications. These may be adjusted before being finalized based on further conversations and gathering additional information.

Barriers to Low NOx Adoption

Low Carbon Transportation and AQIP funding can assist in overcoming key barriers to the adoption of low NOx heavy-duty vehicles and off-road equipment. These barriers include:

- The additional cost added to the vehicles from engines and fuel systems. *Advanced engine systems could eliminate additional fuel systems.*
- Reliability and maintenance concerns with the new systems. *Current generation engine production should provide highly reliable solutions; case studies need to be shared with fleet decision makers.*
- Lack of payback for emission reductions systems (unless there is an efficiency or reduced fuel cost benefit). *Low Carbon Fuel Standard credits could provide a significant price differential if more readily available to the user.*
- Limited vendor and product selection.

Low NOx Opportunities over the Next Three Years

It remains important to accelerate the turnover of conventional natural gas engines to low NOx versions as fleets either repower or buy new vehicles, to expand the market as additional engines become available, and to transition to expanded use of renewable fuels. More low NOx heavy-duty engine classes and renewable fuel types are needed. Expanded demonstration and pilot activities for low NOx diesel, alternative fuel and advanced engines would assist this growth. Validating other innovative NOx reduction strategies involving duty cycle improvements, powertrain efficiencies, and engine-off operations would also help drive innovation. This work should be focused on areas where zero-emission technologies are significantly further behind on the commercialization arc.

Technology Status Snap-Shot UPDATE: Efficiencies

In the heavy-duty and off-road sectors, efficiency strategies can be grouped roughly into three categories: engine/powerplant and drivetrain optimization; vehicle efficiency improvements; and operational/worksite efficiency improvements. See the previous year's snap-shot for background details.

There have been several areas of tech status advancement in the efficiency category over the past year. As noted in the HEV technology update, start-stop systems are starting to emerge from pilot stage to commercial stage. Driven partly by federal Phase 2 heavy-duty fuel economy standards, these systems will partly support some supply chain components needed for BEV, FCEV and HEV expansion.

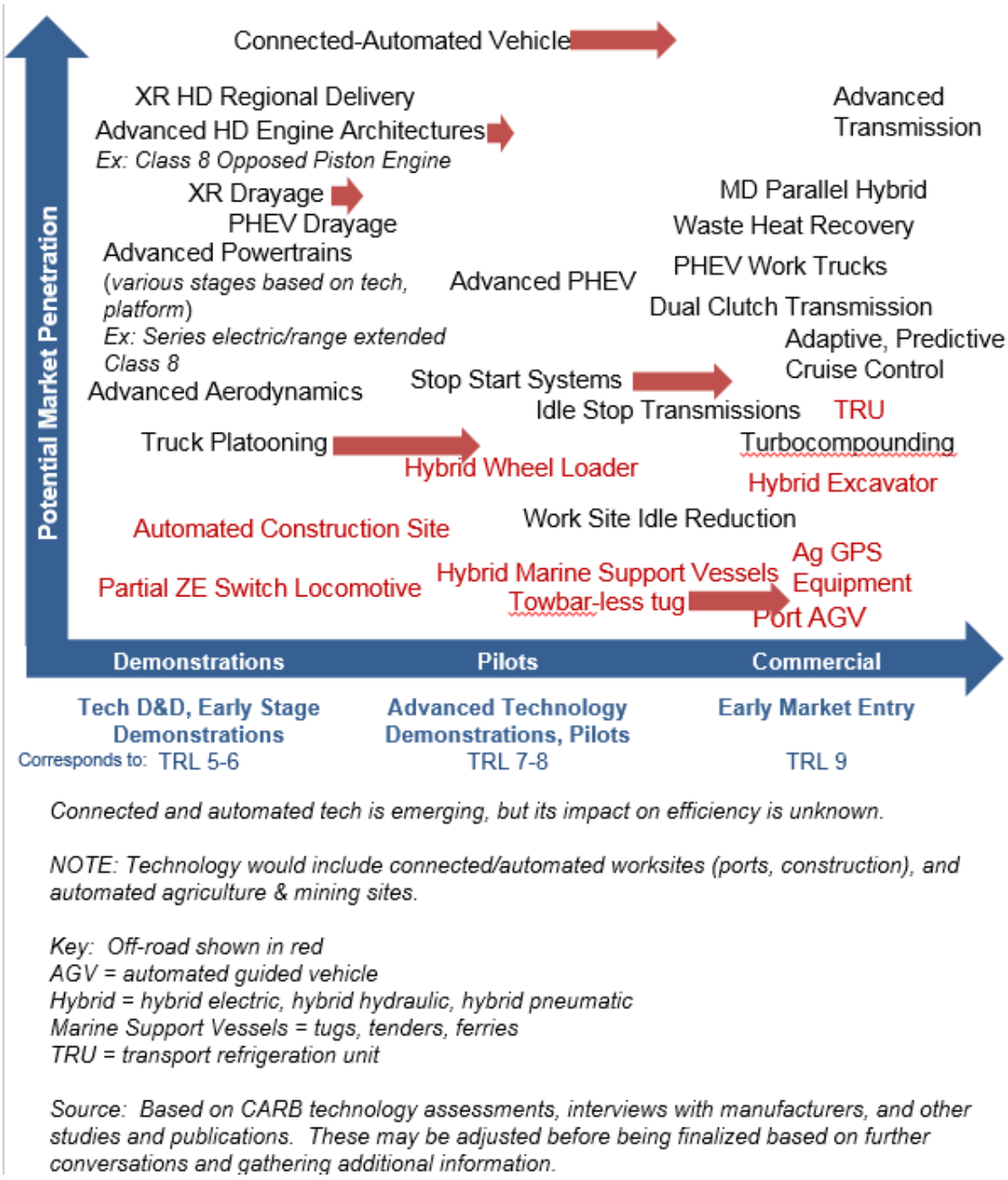
More efficient plug-in hybrid and range extended electric heavy-duty vehicles made progress in demonstration phase and should during the next three years enter pilot stage. Similarly, advanced engine architectures are making progress in demonstration phase and should enter pilot phase in two to three years (see Figure 7).

Areas of significant advancement this year came in the connected and automated technology arena. Platooning of trucks – the ability of two or more trucks using sensor and control technologies to follow closely to save fuel from better aerodynamics – has emerged from demonstration phases and is moving into pilot stages. Indeed, the first commercial product for platooning may become available in the coming year. Similarly, connected and autonomy-pathway technologies are becoming increasingly commonplace as they prove their worth for safety. This includes adaptive cruise control, collision avoidance and lane departure warning systems. While these systems are enablers of automation, they are not yet ready for integration into a fully autonomous system for commercial applications. Nonetheless they can today contribute to greater fuel efficiency.

In the off-road sector, several of the technologies have been described in other sections of this assessment. However, in the GSE category, continued progress is being made in towbar-less tugs for aircraft push back. They could enable aircraft to not start their engines until towed all the way to the runway, saving fuel and emissions. Zero emission versions of these tractors are in the demonstration phase.

For CARB investment purposes, connected vehicle technologies are viewed as having a “multiplier” effect. While they may not be a large investment category on their own, their inclusion in projects paired with advanced low NOx, near and zero-emission powertrains can extend the effectiveness of these systems and should be encouraged.

Figure 7: Technology Status Update – Efficiencies



Connected and automated tech is emerging, but its impact on efficiency is unknown.

NOTE: Technology would include connected/automated worksites (ports, construction), and automated agriculture & mining sites.

Key: Off-road shown in red
AGV = automated guided vehicle
Hybrid = hybrid electric, hybrid hydraulic, hybrid pneumatic
Marine Support Vessels = tugs, tenders, ferries
TRU = transport refrigeration unit

Source: Based on CARB technology assessments, interviews with manufacturers, and other studies and publications. These may be adjusted before being finalized based on further conversations and gathering additional information.

Barriers to Adoption of Efficiency Opportunities

Low Carbon Transportation and AQIP funding can assist in overcoming key barriers to the continuing adoption of more efficient heavy-duty vehicles and off-road equipment. These barriers include:

- The additional cost added to the vehicles, due to cost of components and relatively expensive integration varies greatly by technology.

- The low cost of diesel fuel makes for longer payback times for efficiency technology.
- Infrastructure may be a potential barrier for connected and automated technologies – the question is how much off-vehicle infrastructure is required.
- Lack of understanding of the business case and best deployment applications are a challenge with most new capabilities.
- There is not much familiarity yet with some of the advanced technologies. *This issue is steadily being addressed as trucking fleets see the value of specific technologies and add additional connected and semi-autonomous technology to their standard truck fleets.*

Efficiency Opportunities over the Next Three Years

Advanced engine development is a technology gap California funding could fill because of its potential to leap-frog current designs in efficiency. Extended range electric drive architectures for regional vehicles and hybridized systems for off-road equipment are at key demonstration and pilot stages. Worksite and powertrain engine off technologies can be accelerated to the market via focused pilots or commercial incentives. Combining connected technology with the above strategies, such as geo-fenced powertrain management, provides a highly-leveraged strategy to move multiple technologies forward. Off-road connected and automated worksite demonstrations are good controlled applications to expand the technology and are ready for pilot stage projects. Construction and agricultural sites are promising candidates and should be considered to be freight-enabling applications because of the similar components and supply chain.

Other Emerging Technologies

There are additional applications that represent opportunities, including locomotives and ocean-going vessels. Early demonstration projects utilizing zero-emission or near zero-emission technologies are underway and should be expanded in the rail sector. For the marine sector, there are potential retrofit technologies as well as emission capture and control systems for reducing NOx, PM, and SOx emissions. In these areas, there is limited opportunity for technology transfer to other applications, but advances in these technologies do help in meeting State climate and air quality goals.

Staff anticipates working with other CARB divisions, other State agencies and stakeholders to coordinate on funding developments in these areas.

Investment Funding Priorities

Based on the technology status updates and the progress being made against the beachhead strategy to date staff has developed updated priorities for the prime categories of technologies and projects that could benefit from targeted funding investments. These priorities were assembled based on:

1) Evaluating the updated technology status and progress outlined above;
2) Identifying areas of accelerated progress where funding could support or speed technologies in reaching the market;
3) Identifying areas of slower progress where barriers could be targeted to aid development; and
4) Additional sector research as well as industry conversations and feedback during the assembly of this update.

It is important to note that the recommended funding levels resulting from these priorities do not represent the total funding need. These amounts are guided in part on assessments of OEM and supplier capabilities for producing a meaningful number of demonstration and pilot projects during the three-year investment strategy timeframe. The funding strategy and amounts are designed to ensure State funds are going to the best projects. These investments focus on a targeted and vital portion of what needs to move forward over the next three years to impact 2030 and 2050 outcomes, while still also mindful of providing crucial near-term benefits. If significant additional resources were to become available, the transformation of the heavy-duty and off-road sectors could be expedited and, if that funding were sufficient, it could also spur manufacturers to increase production capacity and provide additional fleet support, training and infrastructure.

These investments focus on a targeted and vital portion of what needs to move forward over the next three years to impact 2030 and 2050 outcomes, while still also mindful of providing crucial near-term benefits.

Keep Expanding Successful Beachheads and Pathways. The beachhead markets are showing success and establishing footholds, but the market remains in flux. Using commercial stage funding investments, it is crucial that the first beachhead market successes noted in this update be consolidated and further expanded. This means:

- Building out market success in the zero-emission bus and low NOx engine beachhead markets and supporting the growth of the secondary and other follow-on markets now emerging.
- Adequate funding for HVIP vouchers and off-road commercial vouchers is a high priority.
- The secondary markets now showing expanded products includes urban and suburban delivery, school bus, shuttle bus and some specialized service applications for technologies in the zero-emission pathway. Regional haul and tractor applications have been added to the low NOx pathway.

Several off-road freight-enabling and zero-emission enabling technologies are also ready for commercial purchase incentives.

- BEV yard hostlers/terminal tractors are available and can expand the off-road beachhead pathway that helps enable drayage as well as other port and terminal equipment.
- Selected port, goods movement, ground support equipment (GSE) as well as some construction and agricultural equipment meets this commercial market threshold and overall can be freight-enabling and supporting markets because of similar components and supply chains.

It is important to note that while commercial stage funding, including HVIP and other programs, have been meeting recommended levels and market demand, State funding for critical next markets and innovation is decreasing. Left unaddressed, this gap could slow the pace of beachhead expansion.

Target Promising Next Pathway Markets. Combined with the commercial stage priorities outlined above, the Three Year Investment Strategy must also prioritize investments at the pilot and demonstration stages. It is important to note that while commercial stage funding, including HVIP and other programs, have been meeting recommended levels and market demand, State funding for critical next markets and innovation is decreasing. Left unaddressed, this gap could slow the pace of beachhead expansion. The result would be that technologies needed for next beachhead market growth will not have been demonstrated, validated and brought through product develop quickly enough. Such gaps could stall or slow transformation momentum. Pilot stage priorities include:

- FCEV transit buses to help develop larger scale infrastructure, service and component volumes and move these products closer to full commercial readiness.
- Zero- and near zero-emission drayage trucks; this sector has been receiving significant focus and now shows promise to move even faster than originally projected in the beachhead strategy. Ensuring pilot stage funding for multiple projects over the next two to three years will maintain this pace and ensure supply chain growth and competition.
- School buses in rural areas to assist smaller and more distributed districts to assess use profiles, develop infrastructure and explore additional benefits such as grid integration.
- BEV or FCEV yard hostlers and other off-road equipment could use both commercial incentives and additional pilot deployments. Funded in parallel with market incentives this will encourage those ready to purchase to move forward, while supporting additional higher volume fleet assessments.
- Near zero- and zero-emission port, construction and agricultural equipment, including wheel loaders, lifts, and heavier cargo handling equipment. Pilots can help build component volumes, validate performance in a system of vehicles and provide improved business case data.
- FCEV medium- and heavy-duty delivery vehicles, particularly in the higher weight classes (MHD and HHD, Classes 6-8).

- Advanced PHEV with extended range in the higher weight classes (MHD and HHD, Classes 5-8).
- Advanced engine architectures for efficiency and low NOx, including technologies such as opposed piston designs and compression ignition alternative fuels, which will be ready for pilot stage expansion during the timeline of this investment strategy.

An additional priority will be the inclusion of emerging connected and automated technologies with the pilot project priorities noted above. These technologies can provide additive benefits that should be encouraged, particularly in off-road worksites and in on-road sequencing and separating of vehicles. Encouraging their inclusion in pilots can support continual progress.

Focus on and Expand the Innovation Pipeline. CARB funding alone cannot drive the continual innovation required for the state to meet 2030 climate, criteria and fuel reduction goals. However, this "innovation pipeline" is of critical importance to meeting state goals and for the success of the beachhead strategy, which relies on steady improvement of pathway technologies. California companies are among the world leaders in responding to and developing advanced, innovative solutions, bringing economic and job benefits. CARB demonstration funding is a powerful lever when coordinated with the work and funding of private companies and other state and federal agencies. CARB's funding focus is on demonstrations just past or at the prototype phase. CARB staff must work

TECH EXAMPLE
TECH INNOVATORS BECOMING NEW SUPPLY CHAIN

Early technology leaders in advanced vehicle components are becoming critical assets to the growing electric drive supply chain. California companies have been some of the first beneficiaries. Efficient Drivetrain, Inc. (EDI), the Milpitas, CA developer of advanced electric and plug-in electric powertrains and generators, using technology spun out of U.C. Davis, has recently been acquired by Cummins, Inc. to augment the manufacturer's powertrain capabilities. The agreement gives EDI the ability to manufacture its systems at scale. Transportation Power, Inc. (Transpower), the Poway, CA developer of electric drive systems and components for trucks and buses, is in a partnership with Meritor, Inc., a global Tier 1 supplier of axles and other components to the truck and bus market. The agreement will help expand Meritor's electrified axle products and provide a market path for Transpower components. Foster City, CA-based Motiv Power Systems (Motiv) has qualified to be an electric qualified vehicle modifier (eQVM) for Ford trucks, allowing it to install Motiv powertrains while retaining Ford warranties. Brighton, MA based XL and Loveland, CO based Lightning Systems are also eQVM certified. Livonia, MI-based Roush Clean Tech, with long QVM experience bringing alternative fuels to major manufacturer platforms, has now added an electric truck to its portfolio and will be adding other platforms.

in partnership with other agencies that also provide demonstration stage funding to target technologies and projects driving beachhead success. These include:

- Longer range (>250-miles) zero emission and PHEV electric drive medium- and heavy-duty goods movement vehicles. Range extender designs should focus on using fuel cell or low NOx engines.
- Heavier duty on-road applications like refuse trucks and off-road equipment such as heavy cargo handling equipment, rail and marine applications and construction and agricultural equipment.
- Further improvement of near zero- and zero-emission heavy-duty sector technologies, from advanced engines to advanced near- and zero emissions powertrains. Demonstration platforms could include transit and regional medium- and heavy-duty delivery vehicles.
- Advanced low NOx high-efficiency engine and low carbon alternative fuel engine demonstrations have longer-term benefits both on their own and as components of a near zero-emission powertrain design.
- The off-road sector is also poised for demonstrating breakthrough technologies in high fuel use applications. These technologies include near zero-, zero-emission, and low NOx technologies as well as efficiency technologies. The construction and agricultural sectors can be important demonstration applications because of the ability to transfer and scale many of the technologies to goods movement applications. They are in this way freight-enabling categories that strengthen overall commercialization potential.

The construction and agricultural sectors can be important demonstration applications because of the ability to transfer and scale many of the technologies to goods movement applications. They are in this way freight-enabling categories that strengthen overall commercialization potential.

Recommendations

The Three Year Heavy-Duty Investment Strategy is a living document that encompasses a rolling three-year horizon. Therefore, the funding levels recommended in this updated strategy expands upon the levels identified in the FY 2017-18 report by adding a new third year, FY 2021-22. Staff also re-evaluated the required level of activity to move pathway technologies forward toward 2030 goals over the updated three-year funding period.

The assessment of funding needs recommended is based on the updated priorities and strategies and the segment opportunities identified in the beachhead pathways and the technology status snap shot updates.

The assessment of funding needs recommended is based on the updated priorities and strategies and the segment opportunities identified in the beachhead pathways and the technology status snap shot updates. From these inputs, a portfolio of high value and

critical path project funding was assembled and compiled into the recommended funding levels. These levels are presented by fiscal year and by stage of technology:

- Demonstration;
- Pilot; and
- Commercial.

The representative projects used to compile the recommendations for Demonstration and Pilot were sized based on expected funding needed from the Low Carbon Transportation and AQIP funds in each application category, considering historical investments, possible number, type, and size of vehicles or equipment, project duration, the need to encourage competition, and a desire for multi-regional participation. Manufacturer feedback from private conversations as well as past examples of comparable demonstration and pilot projects managed by CARB and other state and regional agencies were a factor. Infrastructure support for projects is included in the recommended funding levels for demonstration and pilot activities.

For the commercial project recommendations, market research, OEM and supplier interviews, and confidential sales projections from manufacturers were used to develop an aggregated expected market demand projection for HVIP and Low NOx engines. Industry production capacity and fleet acceptance were factored in. This process has been discussed with industry at separate HVIP work group meetings. Infrastructure funding is included for commercial incentives for the first two years of the three-year plan presented here. *However, it is not included in the third year as staff believes adequate infrastructure funding from utilities or other agencies should be available for commercial products at that point.*

Low and high funding levels are portrayed to suggest the minimum levels needed to maintain progress. At lower funding levels not all of the priorities can be achieved. The higher levels represent adequate funding to drive all of the identified priorities and potentially allows additional pathway applications to be advanced.

The aggregated results of this planning activity are summarized in Table 17 below. It highlights the key priority areas and frames the range of investments ideally needed each year over the three years of the funding plan. Low and high funding levels are portrayed to suggest the minimum levels needed to maintain progress. At lower funding levels not all of the priorities can be achieved. The higher levels represent adequate funding to drive all of the identified priorities and potentially allows additional pathway applications to be advanced.

This strategy and the funding it recommends is specific to continuing the technology transfer demonstrated through targeted Low Carbon Transportation and AQIP investments. However, it is just a subset of the larger work required and does not represent the overall funding need for fully transforming the heavy-duty and off-road sectors. The funding recommended here is meant to be a critical part of driving

technology transformation. But as has been highlighted in many public meetings, the need for incentives geared towards meeting California's near- and long-term GHG and air quality goals far exceeds the resources available from these two incentive programs alone.

Table 17: Draft Recommendations for Investment Priorities

THREE-YEAR HEAVY-DUTY STRATEGY INVESTMENT PLAN UPDATE*			
	FY 2019-20	**FY 2020-21**	**FY 2021-22**
Demos	*$65-$100 Million* Focus: PHEV/ Extended Range M/HD Delivery, Advanced Powertrains, ZE/Hybrid Heavier Cargo Handling Equipment	*$60-$85 Million* Focus: ZE/PHEV HD Regional Delivery, ZE/Hybrid Construction Equipment, ZE/Hybrid Heavier Cargo Handling Equipment	*$50-$90 Million* Focus: ZE/PHEV Longer Range HD Goods Movement, ZE/PHEV Construction Equipment, ZE/Hybrid Heavier Cargo Handling Equipment
Pilots	*$170-$310 Million* Focus: ZE/PHEV On-Road Drayage and M/HD Trucks, Fuel Cell Transit, ZE/Hybrid heavier Cargo Handling Equipment, ZE Facilities	*$185-$310 Million* Focus: ZE/PHEV Drayage and Regional Delivery, Advanced Powertrains, ZE/Hybrid Heavier Cargo Handling Equipment, ZE Facilities	*$200-$325 Million* Focus: ZE/PHEV Drayage and Regional Delivery, Advanced Powertrains, ZE/Hybrid Heavier Cargo Handling Equipment, ZE Facilities
Commercial	*$215-$325 Million* Focus: ZE Transit, ZE Delivery, Low NOx Regional Trucks, Yard Tractors, Ground Support Equipment, ZE/Hybrid Heavier Cargo Handling Equipment	*$365-$545 Million* Focus: ZE Delivery, ZE Transit, Low NOx Linehaul Trucks, Ground Support Equipment, ZE/Hybrid Heavier Cargo Handling Equipment	*$420-$580 Million* Focus: ZE/PHEV Drayage and Regional Delivery, ZE Delivery, ZE Transit, Low NOx Linehaul Trucks, ZE/Hybrid Heavier Cargo Handling Equipment
Total Funding	***$450-$735 Million****	***$610-$940 Million****	***$670-$995 Million****

Three-year funding plan investment priorities define yearly focus areas and propose funding that aligns with progress required for each key pathway.
** The draft funding amounts listed here represent a critical down payment towards meeting the funding need outlined at the beginning of this section, but do not meet the entire need.*

On-Going Issues Impacting Commercialization

In assessing technology status progress and success in growing beachhead pathways, staff have also compiled observations on a number of on-going issues that are or can impact successful commercialization. Many of these issues have been raised in stakeholder and industry discussions in work group sessions and privately. However, because of their importance to beachhead success and meeting state 2030 goals, this document captures several critical issues below. This list builds on the observations compiled in the previous year's strategy plan, adds additional issues noted since, and highlights steps taken or changes to the issues in the intervening time. While Low Carbon Transportation investments and AQIP funds cannot address of these observations, they are critical to reaching full commercialization. These issues are highlighted below, with updates provided as appropriate.

Fueling infrastructure. CARB demonstration and pilot incentives reduce the purchase price of vehicles and often do allow for infrastructure costs, but fleets purchasing vehicles that use emerging alternative fuels (e.g. electricity, hydrogen) face potentially expensive fueling infrastructure costs. Fleets purchasing commercialized technologies currently have fewer options for infrastructure funding. Further, the impacts of charging increasing numbers of heavy-duty vehicles to the electrical grid need to be considered. In the early years of deployment assistance with infrastructure costs will be crucial.

MAKING PROGRESS
FUNDING FOR FUELING INFRASTRUCTURE

A major development was the California Public Utility Commission's (CPUC) authorization of California's large investor-owned utilities (IOUs) to implement new, five-year programs to invest in electric vehicle charging infrastructure, including for medium- and heavy-duty vehicles, and new rate structures for commercial EV charging. These programs represent a significant opportunity to provide both behind-the-meter and customer-side infrastructure at no cost to the customer. However, it's important to note that these programs will only be available to customers of participating utilities. Further, with current CPUC policy, utilities are only allowed to invest in electric vehicle charging infrastructure, not hydrogen fueling. While other incentive programs will remain necessary to allow widespread and equitable deployment of alternative fuel vehicles, this is an important first-step for California fleets.

UPDATE: Over the last year, there have been a number of developments to reduce the cost burden of siting alternative fuel infrastructure. The HVIP program began issuing voucher enhancements on an ad-hoc basis to provide additional incentive funding to support electric and hydrogen fueling. These enhancements provide critical aid but are only designed to cover the cost of physical infrastructure and do not assist with the costs to upgrade utility service, install equipment, or make site improvements. Other program funding is needed to cover those additional costs.

California's major utilities are becoming more active in funding infrastructure. See the separate break-out box with information on this development. However, it's important to note that these programs will likely not be available until at least early to mid-2019.

Until more funding sources for infrastructure are identified, it will be important to increase the efficacy of those available. The State will see the greatest return on its investments by coordinating investment programs and streamlining participation. Over the coming years, a number of actions can be taken to maximize State resources:

- Align vehicle and infrastructure solicitations for demonstration or pilot projects
- Work to make utilities partners for infrastructure in demonstration and pilot projects
- Interconnect utilities and voucher projects to connect fleets to one after applying to the other
- Establish protocol for utilities, state agencies, air districts and other first-contact entities to direct interested fleets to the appropriate funding
- Develop a one-stop-shop portal that allows fleets to access information, apply for funding, and contact program staff. The portal would interconnect programs allowing for simplified coordination and real-time communication.

There exist, however, a number of hurdles in aligning different programs, especially those held by separate agencies. Many programs — and the funding sources they use — come with different goals, requirements, timelines, and restrictions. Some of these are statutorily imposed while others are agency policies.

As infrastructure is a critical barrier to broader fuel-switching, CARB will work to develop available resources and build effective connections with other incentive programs to make infrastructure funding more accessible.

Service centers. Many advanced technology vehicle suppliers do not yet have an adequate network of service centers in California. Access to local service and warranty support is an important commercialization component for prospective fleets. Likewise a shared network of service centers around California could reduce the cost of support for each supplier. Additionally, building and supporting vocational training programs with California's community colleges will continue to be important.

UPDATE: Some national feet support and maintenance providers have been exploring and developing partnerships to provide the service and support network to new manufacturers or importers of vehicles. This structure may signal a new and innovative strategy to address service gap and distance issues as these providers often have national networks of service and maintenance centers.

Policy signal. There is a need for a stable multi-year signal on policy and incentives that includes clear metrics of success.

Secondary market. It is important to the commercialization cycle for Advanced Technology Heavy-Duty vehicles to retain their use after the initial purchase. Second and third owner incentives can help in this regard.

California as a first adopter. California's state fleets should be first adopters of these technologies.

UPDATE: Assembly Bill 739 (AB 739) requires state of California fleets to reach a significant penetration of clean technologies for its commercial class vehicles. It mandates that 15% of specified medium- and heavy-duty vehicle purchases by state agencies must be zero-emission vehicles (ZEVs) by 2025 and increasing to 30% beginning in 2030. Public safety vehicles are exempt.

Certification process. Even with CARB's new Innovative Technology Regulation, the certification process can be very expensive and time consuming, and it can be a barrier to the timely introduction of new technologies. This appears to be particularly true for hybrid technologies.

Better align funding timeline with approval/certification process. The timeline for certification does not align well with the timeline for seeking incentive funding: available incentive funds have in the past already been spent by the time a technology makes it through the yearly certification process.

Coordinated Funding
A number of hurdles exist in aligning different programs, especially those held by separate agencies. Many programs — and the funding pots they use — come with different goals, requirements, timelines, and restrictions. Some of these are statutorily imposed while others are agency policies.

Across programs funded by the state, a common challenge is implementing flexible and compatible programs. Most legislature-appropriated funds come with strict encumbrance and expenditure deadlines that can make it difficult to align programs across agencies. These restrictions are also not well aligned with the manufacturing time needed for new commercial vehicles, especially those with advanced technologies. Adopters of advanced technologies need assurances that funding will be available when they take delivery of a new vehicle. However, vouchers are reserved at the time of order and vehicle build times can stretch out to nearly two years, bringing funds close to their deadlines. This can create even bigger obstacles for demonstration projects which have less predictable and often protracted timelines to build, fully demonstrate, and analyze data from pre-commercial vehicles.

Codes and Standards. There is still no agreed upon charging connector nor charging power range for commercial vehicle charging. Several approaches are currently used in early deployments and markets. While some medium-duty trucks and buses, including most school buses, can likely use the standardized Level 2 charging interface (J1772) the needed charging rates vary by vehicle and manufacturer, making establishing a

standard template for planning infrastructure installation more difficult. For the higher rate charging needed for full size transit buses and heavy-duty vehicles, the connector interface has yet to be standardized in the U.S. At least five approaches can be found in the field. In Europe there is growing backing behind the Combined Charging Standard (CCS) which could provide inter-operability for light duty passenger cars and trucks, and for standard and high rate charging levels. Three other competing approaches exist. While setting such codes and standards is not a CARB or State function, California funding could be used to encourage inter-operability and commonality.

Summary

Clearly signaled, adequately funded, and multiple-year incentives remain a critical factor for driving the rapid transformation of the transportation sector, through the full commercialization arc, to zero-emission technologies wherever feasible and near zero-emission technologies with the cleanest, lowest carbon fuels everywhere else. CARB's Low Carbon Transportation and AQIP funding for vehicles represent a key component of this important approach when applied against the targeted Three Year Heavy-Duty Investment Strategy and priorities outlined in this document.

The three-year roadmap updated here builds on CARB's Low Carbon Transportation and AQIP Investments portfolio approach by applying the framework of strategic beachheads to help prioritize funding around those technologies and applications that have strong potential to transfer and spread to broader applications. This approach is proving successful based on the assessment update outlined here. It will continue to provide strategic focus to drive actions needed over the next three years to both support the transformation required for the long-term, as well as needed near-term benefits.

Clearly signaled, adequately funded and multiple-year incentives remain a critical factor for driving the rapid transformation of the transportation sector to zero-emission technologies wherever feasible and near zero-emission technologies with the cleanest, lowest carbon fuels everywhere else.

Nonetheless, it must again be noted that the funds recommended here are not the full amount required for transformation. Rather they are focused on jump-starting the transformation process by moving crucial technologies and applications through the commercialization process and into early beachhead success markets. While more funding is becoming available for commercial vehicle purchases, there is a growing gap emerging for critical demonstration and pilot stage technology investments that could stall rapid commercialization. As additional sources of funding for heavy-duty on- and off-road

technologies become available they will ideally be applied against the strategy outlined here.

CARB Low Carbon Transportation and AQIP funds are a down payment on the overall funding need. The incentives needed to drive complete transformation is quite large; it will require the investments of multiple agencies at the federal, state, and local level contributing funding to this 'down payment' to achieve the changeover of technologies in transportation needed to meet the climate and criteria emissions and petroleum reduction goals the State has set.

While more funding is becoming available for commercial vehicle purchase, a growing gap is emerging for critical demonstration and pilot stage technology investments that could stall rapid commercialization.