Appendix A:
Emission Reduction Quantification Methodology

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Overview

In Fiscal Year (FY) 2023-24, the California Air Resources Board (CARB) received $170 million from the Greenhouse Gas Reduction Fund (GGRF), $50 million from the General Fund, $375 million from the Proposition 98 General Fund, and $28.6 million from the Air Quality Improvement Fund for incentive projects described in the Funding Plan for Clean Transportation Incentives (Funding Plan). This appendix describes the applied methodology and the assumptions used to generate conservative estimates of emission reductions for the Funding Plan's proposed projects. Assembly Bill (AB) 8 (Perea, Chapter 401, Statutes of 2013) and published GGRF quantification methodologies guided this analysis.

It is important to note that these estimates are illustrative examples of potential emission reductions that can be achieved with the allocated funding to these projects. Refined emission reduction estimates will be quantified as projects are implemented and data becomes available. There are also instances where emission reductions cannot be estimated, because the projects are too new and not enough is known about the project yet to quantify the benefits; in those cases, those projects will report their emission reductions during project implementation and will provide potential emission reductions in future funding plans. There are also projects that facilitate benefits and provide technical assistance or support for other programs; therefore, benefits will not be quantified for those programs.

Table A-1 through Table A-3 summarize the funding allocations for the projects in the Funding Plan and the total potential greenhouse gas (GHG), oxides of nitrogen (NOx), fine particulate matter (PM2.5), and reactive organic gas (ROG) emission reductions over the project life.

Table A-1: Summary of Proposed Light-Duty Vehicle Purchase Incentive Projects in the FY 2023-24 Funding Plan and Total Potential Lifetime Emission Reductions

Project Category	Proposed FY 2023-24 Allocation (millions)	Number of Vehicles, Equipment, or Projects Funded	GHG Emission Reductions (metric tons CO_2e)	NOx Emission Reductions (tons)	PM2.5 Emission Reductions (tons)	ROG Emission Reductions (tons)
Financing Assistance for Lower-Income Consumers	$28	2,360	15,700	1.39	0.165	0.264
Clean Cars 4 All	$28	2,020	16,700	27.5	0.277	3.73
California E-Bike Incentive Project	$18	TBD	TBD	TBD	TBD	TBD
Access Clean California	$5	-	-	-	-	-
California Integrated Travel Project	$1	-	-	-	-	-

Table A-2: Summary of Proposed Sustainable Community-Based Transportation Equity Projects in the FY 2023-24 Funding Plan and Total Potential Lifetime Emission Reductions

Project Category	Proposed FY 2023-24 Allocation (millions)	GHG Emission Reductions (metric tons CO_2e)	NOx Emission Reductions (tons)	PM2.5 Emission Reductions (tons)	ROG Emission Reductions (tons)
Mobility Projects	$50	29,500	131	0.824	58.4
Planning and Capacity Building	$10	-	-	-	-

Table A-3: Summary of Proposed Heavy-Duty Incentive Projects in the FY 2023-24 Funding Plan and Total Potential Lifetime Emission Reductions

Project Category	Proposed FY 2023-24 Allocation (millions)	Number of Vehicles, Equipment, or Projects Funded	GHG Emission Reductions (metric tons CO2e)	NOx Emission Reductions (tons)	PM2.5 Emission Reductions (tons)	ROG Emission Reductions (tons)
Drayage Trucks - Heavy-Duty Vehicle Incentive Project	$80	360	45,900	47.5	0.976	1.33
Public School Buses	$375	950	51,300	346	1.93	3.63
Innovative Small e-Fleets Pilot	$14.3	70	2,850	2.11	0.0475	0.0618
Clean Off-Road Equipment	$14.3	110	12,000	12.1	0.287	7.53

Emission Factor Development

To support the emission reduction analysis from the proposed projects, staff developed emission factors for the following vehicle classes and equipment sectors:

- Light-duty vehicles;
- Class 2b vehicles;
- Class 3 vehicles;
- Class 4-5 vehicles;
- Class 6-7 vehicles;
- Class 8 vehicles;
- Drayage trucks;
- School buses;
- Agricultural equipment;
- Construction equipment;
- Cargo-handling equipment;
- Portable equipment; and
- Transport refrigeration units (TRU).

GHG emission factors were developed on a well-to-wheel (WTW) basis because GHG emissions are global pollutants whereas criteria pollutant and toxic air contaminant emission factors were calculated based solely on the vehicle emissions because of their localized impact.

The emission factors and assumptions used in the analysis were derived from several sources. These sources include CARB's California-specific version of Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model[1] (known as the CA-GREET 3.0 model); CARB's EMission FACtors (EMFAC2021) model[2]; information from CARB's regulatory staff reports and off-road emission inventories, including OFFROAD2021[3]; publicly available technical reports; implemented incentive project data; and staff assumptions.

One major update with this year's quantification methodology and assumptions is the use of CARB's EMFAC2021 model, which was approved by the United States Environmental Protection Agency in November 2022 for use in state implementation plan development and transportation conformity in California. The updated EMFAC2021 model now includes the addition of energy consumption and emissions data for plug-in hybrid electric vehicles (PHEV) and battery-electric vehicles (BEV) as well as updated PM2.5 emissions from brake wear for internal combustion engine (ICE), PHEV, and electric vehicles.

Greenhouse Gas Emission Factors

The fuel or energy economy of a vehicle is an important component of the GHG emission reduction analysis, as this value is used to determine the GHG emissions generated per unit of fuel consumed per mile traveled or in the case of off-road applications, per hour of use. Fuel economy values were derived from EMFAC2021 and CARB's off-road mobile source emission inventories[4] for the vehicle classes and model years (MY) or engine Tiers associated with each project in the proposed Funding Plan. Table A-4 provides a summary of the fuel economy values for baseline gasoline or diesel-fueled on-road vehicles in units of miles per gallon (mpg).

Table A-4: On-Road Fuel Economy Values in Miles Per Gallon for Baseline Vehicles

Vehicle Class	Fuel Type	2001 MY	2007 MY	2020 MY	2023 MY	2024 MY
Light-Duty Vehicle	Gasoline	23.9	-	30.7	34.0	-
Class 2B Vehicle	Gasoline	-	-	-	-	14.0
Class 2B Vehicle	Diesel	-	-	-	-	19.4
Class 3 Vehicle	Diesel	-	-	-	-	16.7
Class 4-5 Vehicle	Diesel	-	-	-	-	9.49
Class 6-7 Vehicle	Diesel	-	-	-	-	9.78

[1] *https://ww2.arb.ca.gov/resources/documents/lcfs-life-cycle-analysis-models-and-documentation*

[2] *https://arb.ca.gov/emfac/*

[3] *https://arb.ca.gov/emfac/emissions-inventory/*

[4] *https://arb.ca.gov/emfac/emissions-inventory*

Vehicle Class	Fuel Type	2001 MY	2007 MY	2020 MY	2023 MY	2024 MY
Class 8 Vehicle	Diesel	-	-	-	-	6.99
Drayage Truck	Diesel	-	-	-	-	6.84
School Bus	Diesel	-	7.42	-	-	9.19

Table A-5 provides a summary of fuel economy values for baseline diesel-fueled off-road vehicles or equipment in units of gallons per hour (gal/hr).

Table A-5: Off-Road Fuel Economy Values in Gallons Per Hour for Baseline Equipment

Equipment Category	Equipment Type	Maximum Horsepower Range (HP)	2024 MY Tier 4 Final Diesel Fuel Economy Values
Agriculture	Agricultural Tractor	25-50 HP	1.35
Construction	Skid Steer Loader	50-75 HP	1.57
Forklift	Port Forklift	100-175 HP	1.78
Mobile Power Unit (MPU)	Portable Generator	25-50 HP	0.87
Terminal Tractor	Port Yard Truck	175-300 HP	5.04
TRU	In-State Trailer TRU	25-50 HP	0.76

As shown in Formula 1, the first step is to calculate the carbon content of a given fuel type by multiplying the carbon intensity (CI) of the fuel, in units of grams of carbon dioxide equivalent (gCO2e) per megajoule (MJ), by the lower heating value (LHV) or energy density of the fuel, in units of MJ per unit of fuel.

Formula 1: Carbon Content of Fuel

$$Carbon\ Content\ of\ Fuel\ \left(\frac{gCO2e}{unit\ of\ fuel}\right) = LCFS\ CI\ \left(\frac{gCO2e}{MJ}\right) * LHV\ of\ fuel\ \left(\frac{MJ}{unit\ of\ fuel}\right)$$

The GHG emission factor for a vehicle is then calculated by taking the carbon content of the fuel and dividing by the fuel or energy economy of the vehicle, as shown in Formula 2. For on-road vehicles, the GHG emission factor is in units of gCO2e per mile (gCO2e/mi), and for off-road vehicles, in units of gCO2e per hour (gCO2e/hr).

Formula 2: GHG Emission Factor

$$GHG\ Emission\ Factor\ \left(\frac{gCO2e}{mi}\ or\ \frac{gCO2e}{hr}\right) = \frac{Carbon\ Content\ of\ Fuel}{Fuel\ or\ Energy\ Economy\ of\ Vehicle}$$

The GHG emission factors for electric on-road vehicles were calculated using the vehicle miles traveled (VMT) and energy consumption estimates from EMFAC2021 and converted to units of mile per kilowatt-hour (mi/kWh) or, for fuel cell electric vehicles (FCEV), mile per kilogram (mi/kg) of hydrogen. The fuel economy values for the replacement, alternative-fueled on-road (e.g., renewable diesel) and off-road electric vehicles were calculated based on a comparable ICE vehicle's fuel economy and paired with the LHVs of the respective fuels and the energy economy ratio (EER), as shown in Formula 3. EER values were derived from the Low Carbon Fuel Standard (LCFS) Regulation.[5]

Formula 3: Replacement Vehicle Fuel Economy

$$Replacement\ Vehicle\ Fuel\ Economy\ \left(\frac{miles\ or\ hours}{unit\ of\ fuel}\right) = fuel\ economy_{ICE} * \frac{LHV_{replacement\ fuel}}{LHV_{ICE\ fuel}} * EER$$

Lifecycle emission factors adopted from the LCFS Program's CI values represent the average or typical production processes for each fuel used in California. Staff assumed the following pathways for the fuels analyzed:

- Gasoline: California reformulated gasoline from the LCFS Lookup Table;
- Diesel: ultra-low sulfur diesel, also from the LCFS Lookup Table;
- Renewable Diesel: volume-weighted average CI of renewable diesel consumed in California in 2022 from the LCFS Program;
- Electricity: California grid average mix, which meets the Renewable Portfolio Standard (RPS) requirements, from the LCFS Lookup Table; and
- Hydrogen: Senate Bill (SB) 1505 compliant gaseous hydrogen reformed on-site at the refueling station from a mix of North American natural gas and 33% biomethane from landfill gas, from the LCFS Lookup Table.

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

[5] *https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/lcfs-regulation*

lower the emission factors. As the fuel mix changes, staff will reflect those changes in future analyses.

Criteria Pollutant and Toxic Air Contaminant Emission Factors

For the criteria pollutant and toxic air contaminant emission factors for on-road vehicles, staff used EMFAC2021 to develop the emission factors for the baseline and replacement vehicles and included exhaust emissions, idling emissions, and PM2.5 emissions from brake and tire wear. For off-road equipment, staff used CARB's off-road emissions inventories to develop emission factors associated with the use of the baseline and replacement vehicles. These emission factors incorporate deterioration for on-road and off-road vehicles, reflecting the increased emissions from combustion engines as they age. Staff also applied a 50% reduction in brake wear emissions[6] for conventional hybrid, light-duty on-road vehicles that implement regenerative braking. On-road vehicle emission factors are in units of grams per mile (g/mi) and off-road emission factors are in units of grams per hour (g/hr). The emission factors for the baseline and replacement vehicles are listed by the proposed projects.

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 or vehicle classification. The average annual per-vehicle emission reductions are then calculated by weighting the annual per-vehicle emission reductions by the amount of each technology or vehicles funded in the project. Staff then use the average cost per project or vehicle to determine the number of vehicles that may be funded by the allotted funding amounts. Finally, to determine the potential emission reductions for each project, the average annual per-vehicle emission reductions are multiplied by the number of vehicles funded and the project life. As noted in the individual project write-ups, staff have quantified emission reductions based on projections or assumptions, since the actual vehicle and equipment types that will be funded may not yet be known.

Annual Per-Vehicle Emission Reductions

Annual emission reductions are calculated for each eligible or representative technology in the project using the emission factors appropriate for each project. Annual emission reductions are in units of tons per year (tpy) and are calculated by taking the difference in emission rates between the baseline and replacement, or funded, vehicle and then multiplying by usage, as shown in Formula 4. This value is then converted from grams per

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[6] *https://ww2.arb.ca.gov/sites/default/files/2021-08/emfac2021_technical_documentation_april2021.pdf*

year to metric tons per year for GHG emissions and U.S. tons per year for criteria pollutants and toxic air contaminants.

Formula 4: Annual Per-Vehicle Emission Reductions

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

For on-road projects, the emission factors are in units of g/mi and usage is based on annual VMT or miles per year (mi/yr). For off-road projects, the emission factors are in units of g/hr and usage is based on annual hours of operation. Additionally, the vehicle'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 the emission factors for off-road projects.

Once the annual per-vehicle emission reductions are calculated for the eligible technologies in each project, the technology or vehicle classification splits are factored in so that the emission reductions on a per-vehicle basis are representative of an average vehicle replaced under the project, as shown in Formula 5. The technology splits or mix of vehicle classifications for each project are determined based on historical project data or projected demand.

Formula 5: Average Annual Per-Vehicle Emission Reductions

$$Average\ Annual\ Per\ Vehicle\ Emission\ Reductions\ (tpy) = \sum (Annual\ Emission\ Reductions\ Per\ Vehicle * Fraction\ of\ Vehicles\ Funded)$$

Project Costs

Once staff have identified the incentive cost for each technology and potential technology split for a given project, staff calculate the average incentive amount for each project using Formula 6.

Formula 6: Average Incentive Amount

$$Average\ Incentive\ Amount\ (\$/vehicle) = \sum (Cost\ per\ Vehicle * Fraction\ of\ Vehicles\ Funded)$$

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 likely to be funded, as shown in Formula 7.

Formula 7: Number of Vehicles Funded

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

Total Lifetime Emission Reductions

Once the average per-vehicle emission reductions are determined, this value 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 8.

Formula 8: Lifetime Emission Reductions

$$Lifetime\ Emission\ Reductions\ (tons) = Average\ Annual\ Per\ Vehicle\ Emission\ Reductions\ (tpy) * Number\ of\ Vehicles * Project\ Life\ (years)$$

Light-Duty Vehicle Purchase Incentives

Vehicle purchase incentives support increasing the number of clean vehicles on California's roadways to meet the State's zero-emission vehicle (ZEV) deployment goals and achieve the large-scale transformation of the light-duty fleet. The vehicle purchase incentives proposed in this year's Funding Plan include Financing Assistance for Lower-Income Consumers, Clean Cars 4 All, Electric Bicycle Incentives Project, Access Clean California, and the California Integrated Transit Project. Quantification of the light-duty vehicle purchase incentive projects proposed in this year's Funding Plan are described in more detail below.

Financing Assistance for Lower-Income Consumers

The Financing Assistance for Lower-Income Consumers (Financing Assistance) project achieves emission reductions by assisting lower-income consumers with purchasing clean vehicles (BEVs, PHEVs, and FCEVs) by improving access to more affordable financing options and providing down-payment assistance. Based on past project data, the average MY of the purchased vehicle is a year old. Therefore, for Financing Assistance projects implemented in 2024, the baseline vehicle is assumed to be a 2023 MY, gasoline light-duty vehicle. Emission factors for Financing Assistance are shown in Table A-6.

Table A-6: Financing Assistance Emission Factors

Vehicle	GHG Emission Factor (g/mi)	NOx Emission Factor (g/mi)	PM2.5 Emission Factor (g/mi)	ROG Emission Factor (g/mi)
2023 MY Gasoline	338	0.0164	0.00546	0.00331
2023 MY PHEV	224	0.00291	0.00377	0.00134
2023 MY BEV	113	0	0.00353	0
2023 MY FCEV	211	0	0.00353	0

Staff generated an average annual usage estimate of 13,600 miles per year for light-duty vehicle purchase incentives based on the average VMT of all light-duty, gasoline vehicles operating in California. Using the emission factors above and the annual usage estimate, staff calculated the potential annual per-vehicle emission reductions for Financing Assistance, as shown in Table A-7.

Table A-7: Financing Assistance Potential Annual Per-Vehicle Emission Reductions

Supported Technology	Annual Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Per-Vehicle NOx Emission Reductions (tpy)	Annual Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Per-Vehicle ROG Emission Reductions (tpy)
PHEV	1.55	0.000202	0.0000253	0.0000296
BEV	3.07	0.000246	0.0000289	0.0000496
FCEV	1.73	0.000246	0.0000289	0.0000496

Financing Assistance project data from December 2022 through May 2023 shows that approximately 24% of projects were for PHEVs, 73% for BEVs, and 3% for FCEVs. For this analysis, staff assumed that Financing Assistance would continue to support the same vehicle technologies at a similar rate. Pairing this with the annual per-vehicle emission reductions for each technology, staff calculated the weighted average annual per-vehicle emission reductions, as shown in Table A-8.

Table A-8: Financing Assistance Annual Weighted Average Per-Vehicle Emission Reductions

Annual Average Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Average Per-Vehicle NOx Emission Reductions (tpy)	Annual Average Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Average Per-Vehicle ROG Emission Reductions (tpy)
2.66	0.000235	0.0000281	0.0000448

Financing Assistance provides $7,500 for PHEVs, BEVs, and FCEVs. Participants may also be eligible for either an electric vehicle charge card or at home charging, thus receiving an additional $2,000 per project. Applying the technology mix noted above, along with the conservative assumption that each applicant would receive the additional $2,000 incentive, staff calculated the weighted average incentive amount per project to be $9,500.

Based on the proposed $28 million allocation for Financing Assistance, an estimated 20% administrative fee (based on historic implementation costs), and the weighted average cost shown above, staff estimate that approximately 2,360 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 2.5 years. Table A-9 summarizes the estimated number of vehicles funded and total potential lifetime emission reductions for Financing Assistance.

Table A-9: Summary of Estimated Total Vehicles Funded and Lifetime Potential Emission Reductions for Financing Assistance

Number of Vehicles Funded	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
2,360	15,700	1.39	0.165	0.264

Clean Cars 4 All

Clean Cars 4 All (CC4A) 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 MY of the baseline and replacement vehicles. Based on project data through the 2022 calendar year, on average, a 2001 MY conventional gasoline vehicle was scrapped and replaced with a 2020 MY conventional hybrid, PHEV, BEV, or FCEV. Emission factors for CC4A are shown in Table A-10 below.

Table A-10: CC4A Emission Factors

Vehicle	GHG Emission Factor (g/mi)	NOx Emission Factor (g/mi)	PM2.5 Emission Factor (g/mi)	ROG Emission Factor (g/mi)
2001 MY Gasoline	481	0.3722	0.00775	0.05146
2020 MY Conv. Hybrid	300	0.0167	0.00443	0.00377
2020 MY PHEV	249	0.0034	0.00409	0.00157
2020 MY BEV	113	0	0.00353	0
2020 MY FCEV	211	0	0.00353	0

Staff generated an average annual usage estimate of 13,600 miles per year for light-duty vehicle purchase incentives based on the average VMT of all light-duty, gasoline vehicles operating in California. Using the emission factors above and the annual usage estimate, staff calculated the potential annual per-vehicle emission reductions for CC4A, as shown in Table A-11.

Table A-11: CC4A Potential Annual Per-Vehicle Emission Reductions

Supported Technology	Annual Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Per-Vehicle NOx Emission Reductions (tpy)	Annual Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Per-Vehicle ROG Emission Reductions (tpy)
Conv. Hybrid	2.47	0.00533	0.0000498	0.000715
PHEV	3.16	0.00553	0.0000549	0.000748
BEV	5.02	0.00558	0.0000632	0.000771
FCEV	3.68	0.00558	0.0000632	0.000771

Project data for the 2022 calendar year shows that 38% of projects went to the purchase of conventional hybrids, 38% for PHEVs, 22% for BEVs, and 2% for FCEVs. For this analysis, staff assumed that CC4A would continue to support the same vehicle technologies at a similar rate. Pairing this with the annual per-vehicle emission reductions for each technology, staff calculated the average annual per-vehicle emission reductions, as shown in Table A-12.

Table A-12: CC4A Annual Weighted Average Per-Vehicle Emission Reductions

Annual Average Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Average Per-Vehicle NOx Emission Reductions (tpy)	Annual Average Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Average Per-Vehicle ROG Emission Reductions (tpy)
3.32	0.00547	0.0000550	0.000741

CC4A provides maximum vehicle incentives of up to $7,000 for conventional hybrids, $11,500 for PHEVs, $12,000 for BEVs, and $12,000 for FCEVs. This includes an additional $2,000 for participants who are located in disadvantaged communities. Participants who purchase a PHEV or BEV may also be eligible for up to $2,000 for charging equipment or an electric vehicle charge card. For this analysis, staff conservatively assumes that all participants will receive the maximum vehicle and charging incentives. Applying the technology mix noted above, along with the conservative assumption that each applicant would receive the maximum incentive amount, staff calculated the weighted average incentive amount per project to be $11,100.

Based on the proposed $28 million allocation for CC4A, an estimated 20% administrative fee (based on historic implementation costs), and the weighted average cost shown above, staff estimate that approximately 2,020 vehicles can be funded. CC4A has a 30-month ownership requirement; therefore, total potential emission reductions for the project are quantified over the course of 2.5 years. Table A-13 summarizes the estimated number of vehicles funded and total potential lifetime emission reductions for CC4A.

Table A-13: Summary of Estimated Total Vehicles Funded and Lifetime Potential Emission Reductions for CC4A

Number of Vehicles Funded	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
2,020	16,700	27.5	0.277	3.73

California E-Bike Incentive Project

CARB is proposing to allocate $18 million to support the California E-Bike Incentive Project for FY 2023-24. The California E-Bike Incentive Project will achieve GHG emission reductions by providing low- to moderate-income individuals incentives for e-bikes to help motivate consumer purchasing decisions, support active transportation, and displace VMT with bike trips.

At this time, there is not enough specific data on the California E-Bike Incentive Project to make the assumptions needed to quantify benefits. CARB and the program administrator are in the process of developing criteria for a third-party administrator to assess telematic data through California E-Bike Incentive Project applicant participation. CARB staff have also contracted with the University of California, Davis to develop a quantification methodology for the program, which will be further refined as detailed implemented project data becomes available.

Access Clean California

CARB is proposing to allocate $5 million to scale-up implementation of the Access Clean California program. Access Clean California is designed to increase awareness of and streamline access to CARB's equity ZEV incentives, while expanding participation by low-income households. Because this project enables ZEV adoption through other incentive projects, such as Financing Assistance and CC4A, staff is not quantifying any direct emission reductions for this project. Instead, this project is expected to help achieve the emission reductions projected for CARB's light-duty vehicle purchase incentives.

California Integrated Travel Project

CARB is proposing to allocate $1 million to the California Integrated Travel Project. The California Integrated Travel Project supports various equity and light-duty vehicle purchase incentive projects by ensuring that any transit customer, and specifically underbanked and unbanked customers, can easily pay for transit by accepting EuroPay, MasterCard, and Visa open-loop payments. This project supports consumer transit and micro-mobility options offered in CARB's other incentive projects, such as CC4A; therefore, staff is not quantifying any direct emission reductions for this project. Instead, like with Access Clean California, this project is expected to help achieve the emission reductions projected for CARB's light-duty vehicle purchase incentives.

Sustainable Community-Based Transportation Equity Investments

This year's Sustainable Community-Based Transportation Equity Investments are grouped into two broad project categories: Mobility Projects and Planning and Capacity Building Projects. Sustainable Community-Based Transportation Equity Investments support the transportation needs (other than vehicle ownership) of low-income residents and those living in low-income, disadvantaged, and tribal communities.

Previously, CARB funded three separate mobility projects – the Sustainable Transportation Equity Project, Clean Mobility in Schools, and the Clean Mobility Options Project. CARB is considering a statewide Mobility Project Administrator(s) that would oversee FY 2023-24 mobility projects. For FY 2023-24, staff is proposing that the $50 million in funding will be split equally among the three mobility projects, at $16.67 million each. For this year's quantification, the three mobility projects will be quantified separately and then combined. Quantification of these mobility projects are described below.

Sustainable Transportation Equity Project

The Sustainable Transportation Equity Project (STEP) achieves GHG emission reductions through implementing a wide variety of capital, infrastructure, operations, planning, policy, and outreach projects. For this year's quantification, staff scaled a sample project's $8.9 million budget to $16.67 million. Based on program data, staff then removed 25% of this $16.67 million for implementation/administration costs and non-quantifiable costs, leaving the scaled project's budget at $12.5 million for quantifiable project costs.

The quantifiable components of STEP projects include, but are not limited to, new bike lanes, transit subsidies, new bus routes, and shuttle services. With this round of funding scaled to the sample project's budget, staff estimates to fund 3.4 miles of bike lanes, 1,411 transit subsidies, three zero-emission transit bus routes, and six ZEV shuttles. Staff also made several assumptions based on the sample project to include as inputs for STEP's quantification and then used the Clean Mobility Projects benefit calculator to quantify potential emission reductions. The tool and more information on quantification can be found on CARB's website.[7]

Table A-14 through Table A-17 provide the assumptions staff used to build the components for the sample project. The first of these tables, Table A-14, provides the assumptions for the new bike lanes.

Table A-14: Assumptions for New Bike Lanes Component

Field in Tool	Assumptions
Year 1	2023
Existing Bikeway Class	None
New Bikeway Class	Class IV Cycle Track
One-Way Facility Length	3.4 miles
Average Daily Traffic	3,000
Number of Key Destinations within ¼ Mile & ½ Mile	10 & 10 Destinations

The second table, Table A-15, provides the assumptions used for the transit subsides component of the sample project.

Table A-15: Assumptions for Transit Subsidies Component

Field in Tool	Assumptions
Year 1	2023
Final Year	2025
Are Input Values for One-way Trips or Roundtrips?	One-way Trips
Increase in Fixed-route Transit Ridership Associated with Project in Year 1 & Final Year	130,000 and 155,000 passengers (respectively)
Length of Average Passenger Trip on Fixed-route Transit	4.03 miles
Annual Number of Subsidies Associated with Project	1,000

The third table, Table A-16, provides the assumptions used for the new bus route component of the sample project.

[7] *https://ww2.arb.ca.gov/resources/documents/cci-quantification-benefits-and-reporting-materials*

Table A-16: Assumptions for New BEV Bus Route Component

Field in Tool	Assumptions
Year 1	2023
Final Year	2029
Primary Use of Service	Local Passenger Trips
Are Input Values for One-way Trips or Roundtrips?	One-Way Trips
Number of Vehicles in Year 1 & Final Year	3 & 3
Increase in Fixed-route Transit Ridership Associated with the Project in Year 1 & Final Year	90,000 and 170,000 passengers (respectively)
Length of Average Vehicle Trip	4.03
Average Expected VMT in Year 1 & Final Year	31,200 and 31,200
Annual Number of Fares Associated with Project	300,000

The fourth table, Table A-17, provides the assumptions used for the shuttle services component of the sample project.

Table A-17: Assumptions for BEV Shuttle Services Component

Field in Tool	Assumptions
Year 1	2023
Final Year	2026
Primary Use of Service	Local Passenger Trips
Are Input Values for One-way Trips or Roundtrips?	One-Way Trips
Number of Vehicles in Year 1 & Final Year	6 & 6
Average Occupancy per Vehicle in Year 1 & Final Year	4 & 6 occupants (respectively)
Average Number of Vehicle Trips per Vehicle Expected in Year 1 & Final Year	2,800 and 5,600 trips (respectively)
Length of Average Vehicle Trip	12 miles
Annual Number of Fares Associated with Project	30,000

It is important to note that the project presented in this appendix is a sample. This sample is staff's best estimate of some of the types of components that might be funded with this allocation and is not an exhaustive list. Table A-18 provides the emissions reduction estimates for the sample scaled project that may be funded through STEP.

Table A-18: Estimated Benefits of an Average Sample Project from STEP Quantifiable Funds

Mobility Option	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
New Bike Lanes	104	0.0130	0.0017	0.0026
Transit Subsidies	253	0.0382	0.0042	0.0080
New BEV Bus Route	529	0.0850	-0.0051	0.0176
BEV Shuttle Services	631	0.1157	-0.0041	0.0241
Total	1,520	0.252	-0.0033	0.0524

Clean Mobility in Schools

Clean Mobility in Schools (CMIS) achieves emission reduction benefits by funding deployment of synergistic GHG emission reduction technologies at schools located in disadvantaged communities. Similar to STEP's quantification, staff scaled a sample CMIS project's $7.1 million budget to $16.67 million. Based on program data, staff then removed 15% of this $16.67 million for implementation/administration costs and non-quantifiable costs, leaving the scaled project's budget at $14.2 million for quantifiable project costs. Staff estimates that $14.2 million will be used to fund 20 electric school buses, 16 ZEV carshare, eight off-road electric utility vehicles, eight electric vanpool vans, 59 zero-emission pieces of lawn and garden equipment, 24 solar photovoltaic (PV) installations, and eight medium heavy-duty (MHD) delivery vans. To quantify these reductions, staff used the Clean Mobility Project quantification tool.[8]

For calculating the potential emission reductions, light-duty vehicles (LDV) were given a project life of three years, consistent with applicant assumptions for the LDVs, and MHD vehicles were given a project life of six years. School buses were given a project life of 12 years. Table A-19 through Table A-25 provide the assumptions based on the sample project used in the quantification tools for each CMIS project component. The first of these tables, Table A-19, provides the assumptions for the new electric school bus (Type A) portion.

[8] *https://ww2.arb.ca.gov/resources/documents/cci-quantification-benefits-and-reporting-materials*

Table A-19: CMIS Assumptions New Electric School Buses (Type A)

Field in Tool	Assumptions
Quantification Period (years)	12
Baseline Vehicle MY	2001
Baseline Vehicle Fuel Type	Diesel
New/Replacement Vehicle MY	2023
New/Replacement Vehicle Fuel Type	Electric (kWh)
Number of Vehicles in Year 1 and Final Year (respectively)	20 and 20
Average Number of Annual Trips per Vehicle Expected in Year 1 and Final Year (respectively)	360 and 360
Length of Average Trip (miles)	50

The second table, Table A-20, provides assumptions for solar PV deployment portion.

Table A-20: CMIS Assumptions for Solar PV Deployment

Field in Tool	Assumptions
Vehicle/Equipment/Facility Type	Solar Photovoltaic
Project Type	Solar PV Generation
Annual Solar PV Production (kW/yr)	642,530
Electricity Pricing (Residential or Commercial)	Commercial

The third table, Table A-21, provides the assumptions for ZEV lawn and garden equipment.

Table A-21: CMIS Assumptions for ZEV Lawn & Garden Equipment

Field in Tool	Assumptions
Vehicle/Equipment/Facility Type	Lawn & Garden
Project Type	Equipment Replacement
Type of Commercial Lawn & Garden	Standing Ride Mowers (Commercial)
Number of Pieces of Lawn & Garden Equipment	63

The fourth table, Table A-22, provides the assumptions for an all-electric car share service for district employees.

Table A-22: CMIS BEV Carshare Assumptions

Field in Tool	Assumptions
Year 1	2023
Final Year	2026
Primary Use of Service	Local Passenger Trip
Are Input Values for One-way Trips or Roundtrips?	One-way Trips
Average Number of Vehicle Trips in Year 1 & Final Year (per vehicle)	100
Number of Vehicles in Year 1 & Final Year	16
Length of Average Trip (miles)	10
Annual Average Number of Fares (quantity per year)	1,700

The fifth table, Table A-23, provides the assumptions for a zero-emission vanpool program.

Table A-23: CMIS ZEV Vanpool Component Assumptions

Field in Tool	Assumptions
Year 1	2023
Final Year	2029
Primary Use of Service	Local Passenger Trip
Are Input Values for One-way Trips or Roundtrips?	Roundtrips
Number of Vehicles in Year 1 and Final Year	8 and 8
Average Occupancy in Year 1 and Final Year	8 and 8
Average Number of Vehicle Trips in Year 1 and Final Year	370 and 370
Length of Average Trip (miles)	30

The sixth table, Table A-24, provides the assumptions for the ZEV utility vehicle deployment component.

Table A-24: CMIS ZEV Utility Vehicle Component Assumptions

Field in Tool	Assumptions
Quantification Period (years)	3
Year 1	2023
Baseline Vehicle MY	2023
Baseline Vehicle Fuel Type	Gasoline (gal)
Number of Vehicles in Year 1 and Final Year	8 and 8
New/Replacement Vehicle MY	2023
New/Replacement Vehicle Fuel Type	Electric (kWh)
Baseline Horsepower	48
Average Annual Hours of Operation	9,360

The seventh table, Table A-25, provides the assumptions for medium duty zero-emission van deployment.

Table A-25: CMIS ZEV Medium Duty Van Assumptions

Field in Tool	Assumptions
Quantification Period (years)	6
Year 1	2023
Baseline Vehicle MY	2007
Baseline Vehicle Fuel Type	Gasoline (gal)
Number of Vehicles in Year 1 and Final Year	4 and 4
New/Replacement Vehicle MY	2023
New/Replacement Vehicle Fuel Type	Electric (kWh)
Expected VMT in Year 1 & Final Year	10,000 and 10,000

It is important to note that the project presented in this appendix is a sample. This sample is staff's best estimate of some of the types of components that might be funded with this allocation and is not an exhaustive list. Table A-26 provides the emissions reduction estimates for a scaled sample project that may be funded through CMIS.

Table A-26: Total Potential Emission Reductions for CMIS

Project Component	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
New Electric School Buses (Type A)	6,712	34.33	0.1772	1.07
ZEV Lawn & Garden Equipment	1.61	0.0024	0.0022	0.0158
ZEV Utility Vehicle Deployment	7,619	79.92	0.5372	56.64
ZEV Medium Duty Van Deployment	3,166	14.99	0.0652	0.3561
ZEV Carshare	1.38	0.0010	-0.0001	0.0002
ZEV Vanpool	1,141	0.1662	0.0173	0.0347
Solar PC Deployment	4,261	0	0	0
Total	22,900	129	0.799	58.1

Clean Mobility Options

Clean Mobility Options (CMO) achieves emission reduction benefits by implementing carshare programs that use advanced technology vehicles instead of conventional LDV in disadvantaged communities. CMO projects also offer alternate modes of transportation that encourage the use of zero-emission and plug-in hybrid vehicles, shuttle service, and micro-mobility options that include e-scooters, e-bikes, and e-mopeds. While a number of strategies can be employed, the use of advanced technology vehicles or micro-mobility options instead of conventional LDV 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 carshare vehicle, an advanced technology vehicle, micro-mobility projects, and shuttle service.

Again, like STEP and CMIS, CMO's quantification is based on a funding amount of $16.67 million. Based on program data, staff then removed 25% of this $16.67 million for implementation/administration costs, leaving the scaled project's budget at $12.5 million for project costs. Based on the most recent year's project statistics, staff assumes that 30% of the funding will go towards micro-mobility projects, 30% towards light-duty vehicles and 40% towards ZEV shuttles. Of the LDV funded, 90% are expected to be BEVs and 10% PHEVs. With this funding split, staff estimates to fund 469 e-bikes for micro-mobility, 52 carsharing EVs, 9 PHEVs for carsharing, and 50 ZEV shuttles. Table A-27 through Table A-30 show the assumptions based on program data for each project type for Clean Mobility Project benefits tool.[9] The first of these tables, Table A-27, provides the assumptions for the micro-mobility portion of CMO.

Table A-27: CMO Micro-Mobility Assumptions

Field in Tool	Assumptions
Year 1	2023
Final Year	2027
Vehicle Type	Electric Bicycle
Primary Use of Service	Local Passenger Trip
Are Input Values for One-way Trips or Roundtrips?	One-way Trips
Number of Vehicles in Year 1 & Final Year	469
Average Number of Vehicle Trips in Year 1 & Final Year (per vehicle)	1,095
Length of Average Trip (miles)	1.5
Annual Average Number of Fares (quantity per year)	513,555

The second table, Table A-28, provides the assumptions for the BEV carshare component.

Table A-28: CMO BEV Carshare Assumptions

Field in Tool	Assumptions
Year 1	2023
Final Year	2027
Primary Use of Service	Local Passenger Trip
Are Input Values for One-way Trips or Roundtrips?	One-way Trips
Average Occupancy in Year 1 & Final Year	2
Number of Vehicles in Year 1 & Final Year	52
Average Number of Vehicle Trips in Year 1 & Final Year (per vehicle)	5,595
Length of Average Trip (miles)	5
Annual Average Number of Fares (quantity per year)	290,940

[9] *https://ww2.arb.ca.gov/resources/documents/cci-quantification-benefits-and-reporting-materials*

The third table, Table A-29, provides the assumptions for the PHEV carshare component.

Table A-29 CMO PHEV Carshare Assumptions

Field in Tool	Assumptions
Year 1	2023
Final Year	2027
Primary Use of Service	Local Passenger Trip
Are Input Values for One-way Trips or Roundtrips?	One-way Trips
Average Occupancy in Year 1 & Final Year	2
Number of Vehicles in Year 1 & Final Year	9
Average Number of Vehicle Trips in Year 1 & Final Year (per vehicle)	5,595
Length of Average Trip (miles)	5
Annual Average Number of Fares (quantity per year)	50,355

The fourth table, Table A-30, provides the assumptions for the ZEV shuttle component.

Table A-30: CMO ZEV Shuttle Assumptions

Field in Tool	Assumptions
Year 1	2023
Final Year	2027
Primary Use of Service	Local Passenger Trip
Are Input Values for One-way Trips or Roundtrips?	One-way Trips
Average Occupancy in Year 1 & Final Year	2
Number of Vehicles in Year 1 & Final Year	8
Average Number of Vehicle Trips in Year 1 & Final Year (per vehicle)	370
Length of Average Trip (miles)	30
Annual Average Number of Fares (quantity per year)	18,500

For this analysis, staff conservatively assumed that emission reductions will occur over the course of four years for LDV, shuttles, and micro-mobility projects. The total potential emission reductions for CMO are shown in Table A-31.

Table A-31: Total Potential Emission Reductions for CMO

Mobility Option	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
Micro-Mobility	377	0.0870	-0.0018	0.0182
BEVs	1,853	0.3608	0.0203	0.0755
PHEVs	213	0.0593	0.0030	0.0116
Shuttles	2,686	0.4422	0.0069	0.0926
Total	5,130	0.949	0.0285	0.198

Statewide Mobility Project

As stated earlier, CARB is considering combining the STEP, CMIS, CMO programs into a statewide mobility project for FY 2023-24 funds to simplify access for disadvantaged and low-income communities. Staff is proposing that the funding will be split equally among the previous three mobility project types. Staff then combined these different project quantifications below in Table A-32. These combined benefits would then constitute the Sustainable Community-Based Transportation Equity Mobility Project's $50 million in funding for FY 2023-24.

Table A-32: Total Potential Emission Reductions for Sustainable Community-Based Transportation Equity Mobility Projects

Mobility Project Type	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
STEP	1,520	0.252	-0.00330	0.0524
CMIS	22,900	129	0.799	58.1
CMO	5,130	0.949	0.0285	0.198
Total	29,500	131	0.824	58.4

Planning and Capacity Building Projects

CARB is proposing to allocate $10 million toward Planning and Capacity Building projects that would support two separate efforts administered by a single statewide administrator. The two efforts include: 1) community planning and capacity building grants, which consists of funding provided through the statewide administrator to project awardees to implement their project(s), and 2) project assistance and support provided by the statewide administrator to the project awardees in the form of technical assistance, guidance, and other non-monetary support for project implementation.

This funding category incorporates dedicated technical assistance that is focused on strengthening community capacity so that priority populations are prepared to access, apply for, and receive funding that advances their transportation and equity goals. In addition, this supports existing clean vehicle ownership investments by increasing community awareness and outreach and capacity building of CARB programs. Therefore, staff is not quantifying any direct emission reductions for this project. Instead, this project is expected to help achieve the emission reductions projected for CARB's clean vehicle ownership and clean mobility investments.

Heavy-Duty Investments

CARB continues to support investments in heavy-duty on-road and off-road technologies. This year's Funding Plan proposes investments in the deployment of commercialized advanced technology drayage trucks, public school buses, zero-emission on-road vehicles owned by small fleets and individual owner/operators, and commercialized off-road advanced technology equipment. Quantification of the emission reduction benefits for each of the heavy-duty on-road and off-road incentive projects is described in more detail below.

Drayage Trucks in the Clean Truck and Bus Voucher Incentive Project

The Clean Truck and Bus Voucher Incentive Project (HVIP) achieves emission reduction benefits by reducing the up-front cost of zero-emission trucks and buses, allowing fleet owners to secure a voucher through their local dealer as part of their vehicle purchase. This year's budget appropriation included $80 million specifically for zero-emission drayage trucks in HVIP. For this analysis, staff estimated emission reductions from the emissions offset between a new 2024 model year (MY) diesel-fueled drayage truck and a 2024 MY zero-emission drayage truck. Emission factors for HVIP are shown in Table A-33 below.

Table A-33: HVIP Emission Factors

Vehicle	GHG Emission Factor (g/mi)	NOx Emission Factor (g/mi)	PM2.5 Emission Factor (g/mi)	ROG Emission Factor (g/mi)
2024 MY Diesel Class 8 Drayage Truck	1,975	1.298	0.0500	0.0364
2024 MY BEV Class 8 Drayage Truck	524	0	0.0233	0
2024 MY FCEV Class 8 Drayage Truck	1,901	0	0.0233	0

Staff generated an average annual usage estimate of 31,000 miles per year for Class 8 drayage trucks based on the average vehicle miles traveled (VMT) of all Class 8 electric trucks operating at ports in California. Using the emission factors above and the annual usage estimate, staff calculated the potential annual per-vehicle emission reductions for HVIP, as shown in Table A-34.

Table A-34: HVIP Potential Annual Per-Vehicle Emission Reductions

Supported Technology	Annual Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Per-Vehicle NOx Emission Reductions (tpy)	Annual Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Per-Vehicle ROG Emission Reductions (tpy)
BEV	44.96	0.0444	0.00091	0.00124
FCEV	2.28	0.0444	0.00091	0.00124

Based on past project data, staff estimate that this year's vouchers will be split 95% battery-electric Class 8 trucks and 5% fuel cell electric Class 8 trucks. Pairing this with the annual per-vehicle emission reductions for each technology, staff calculated the average annual per-vehicle emission reductions, as shown in Table A-35.

Table A-35: HVIP Annual Weighted Average Per-Vehicle Emission Reductions

Annual Average Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Average Per-Vehicle NOx Emission Reductions (tpy)	Annual Average Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Average Per-Vehicle ROG Emission Reductions (tpy)
42.83	0.0444	0.00091	0.00124

HVIP provides $120,000 as the base voucher amount for Class 8 trucks, with additional base voucher modifiers and voucher enhancements for fuel cell electric technologies, projects located in disadvantaged communities, and small business recipients. Using past project data for Class 8 trucks, staff calculated the average incentive amount to be $211,000.

Based on the $80 million allocation for drayage trucks in HVIP, an estimated 6% administrative cost (1% for CARB and 5% for the program administrator), and the average incentive amount mentioned above, staff estimate that approximately 360 trucks can be funded. HVIP has a 3-year ownership requirement; therefore, total potential emission reductions for the project are quantified over the course of three years. Table A-36 summarizes the estimated number of vehicles funded and total potential lifetime emission reductions for HVIP.

Table A-36: Summary of Estimated Total Vehicles Funded and Lifetime Potential Emission Reductions for HVIP

Number of Vehicles Funded	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
360	45,900	47.5	0.976	1.33

Public School Buses

In FY 2022-23, $1.125 billion from the Proposition 98 General Fund was appropriated to CARB for public school buses and approved in the FY 2022-23 Funding Plan. As part of the Legislature's prudent approach to the 2023 budget, the $1.125 billion was reduced to $375 million with the intent to provide an additional $375 million in FY 2024-25 and FY 2025-26. While the $375 million in public school bus funding is not new this year, CARB staff updated the emission reduction calculations for this project category to reflect the latest data available, particularly with the introduction of heavy-duty electric vehicle data in EMFAC2021.

For this first round of funding, CARB is proposing to focus on zero-emission replacements, such as battery-electric school buses. Using the same baseline vehicle assumption as last year, staff generated updated emission factors for public school buses as shown in Table A-37 below.

Table A-37: Public School Bus Emission Factors

Vehicle	GHG Emission Factor (g/mi)	NOx Emission Factor (g/mi)	PM2.5 Emission Factor (g/mi)	ROG Emission Factor (g/mi)
2007 MY Diesel	1,820	9.194	0.0619	0.0964
2024 MY BEV	319	0	0.0107	0

Using the same average annual usage assumption as last year of 12,000 miles per year along with the emission factors above, staff calculated the potential annual per-vehicle emission reductions for public school buses, as shown in Table A-38.

Table A-38: Public School Bus Potential Annual Per-Vehicle Emission Reductions

Supported Technology	Annual Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Per-Vehicle NOx Emission Reductions (tpy)	Annual Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Per-Vehicle ROG Emission Reductions (tpy)
BEV	18.0	0.122	0.000677	0.00128

CARB provides up to $395,000 for each zero-emission school bus. For this analysis, staff conservatively estimate that each school bus would be funded at the maximum amount.

Based on the $375 million allocated to public school buses in HVIP, staff estimate that approximately 950 school buses can be funded. HVIP has a 3-year ownership requirement; therefore, total potential emission reductions for public school buses are quantified over the course of three years. Table A-39 summarizes the estimated number of vehicles funded and total potential lifetime emission reductions for public school buses.

Table A-39: Summary of Estimated Total Vehicles Funded and Lifetime Potential Emission Reductions for Public School Buses

Number of Vehicles Funded	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
950	51,300	346	1.93	3.63

Innovative Small e-Fleets

Innovative Small e-Fleets (ISEF) achieves emission reductions by helping small fleets and individual owner/operators make the transition to zero-emission by reducing the up-front cost of the vehicle. For this analysis, staff estimates the emission reductions as the emissions offset between a new, 2024 MY conventional fuel vehicle and a ZEV. For most vehicle classes, the baseline vehicle's fuel is diesel, except for Class 2B vehicles. Class 2B vehicles operating in California are a mix of diesel and gasoline vehicles; therefore, staff developed emission factors for both gasoline and diesel Class 2B vehicles. Emission factors for ISEF are shown in Table A-40 below.

Table A-40: ISEF Emission Factors

Vehicle	GHG Emission Factor (g/mi)	NOx Emission Factor (g/mi)	PM2.5 Emission Factor (g/mi)	ROG Emission Factor (g/mi)
2024 MY Gasoline Class 2B	821	0.0148	0.0304	0.00711
2024 MY Diesel Class 2B	697	0.118	0.0363	0.0522
2024 MY Diesel Class 3	811	0.136	0.0418	0.0604
2024 MY Diesel Class 4-5	1,424	0.431	0.0212	0.00752
2024 MY Diesel Class 6-7	1,381	0.406	0.0212	0.00719
2024 MY Diesel Class 8	1,933	1.345	0.0516	0.0445
2024 MY Class 2B BEV	176	0	0.0157	0
2024 MY Class 3 BEV	175	0	0.0179	0
2024 MY Class 4-5 BEV	308	0	0.0108	0
2024 MY Class 6-7 BEV	308	0	0.0107	0
2024 MY Class 8 BEV	527	0	0.0244	0
2024 MY Class 8 FCEV	1,912	0	0.0244	0

For ISEF, staff conservatively estimate an average annual usage estimate of 12,000 miles per year for small fleets and single owner/operators across all vehicle classes. Paired with the emission factors above, staff calculated the potential annual per-vehicle emission reductions for ISEF, as shown in Table A-41.

Table A-41: ISEF Potential Annual Per-Vehicle Emission Reductions

Supported Technology	Annual Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Per-Vehicle NOx Emission Reductions (tpy)	Annual Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Per-Vehicle ROG Emission Reductions (tpy)
Class 2B BEV	7.17	0.000723	0.000225	0.000325
Class 3 BEV	7.63	0.00179	0.000315	0.000799
Class 4-5 BEV	13.4	0.00570	0.000138	0.000100
Class 6-7 BEV	12.9	0.00537	0.000138	0.0000951
Class 8 BEV	16.9	0.0178	0.000359	0.000588
Class 8 FCEV	0.253	0.0178	0.000359	0.000588

ISEF included Class 2B vehicles for the first time last year; although no vouchers have been requested for Class 2B vehicles at this time. For this year's analysis, staff estimate that 1% of the vouchers will be requested for Class 2B vehicles. Factoring that into the past ISEF vouchers requests, staff estimate that this year's ISEF vouchers would be split 1% Class 2B BEVs, 2% Class 3 BEVs, 46% Class 4-5 BEVs, 16% Class 6-7 BEVs, 28% Class 8 BEVs, and 7% Class 8 FCEVs. For this analysis, staff assume that this year's vouchers will be split the same way. Pairing this with the annual per-vehicle emission reductions for each technology, staff calculated the average annual per-vehicle emission reductions, as shown in Table A-42.

Table A-42: ISEF Annual Weighted Average Per-Vehicle Emission Reductions

Annual Average Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Average Per-Vehicle NOx Emission Reductions (tpy)	Annual Average Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Average Per-Vehicle ROG Emission Reductions (tpy)
13.18	0.00975	0.000220	0.000245

ISEF provides a set voucher amount for each vehicle class, but additional base voucher modifiers and voucher enhancements are available for fleet owners and single owner/operators that purchase fuel cell electric vehicles or are in disadvantaged communities. Using past voucher data, staff calculated the average incentive amounts to be $14,000 for Class 2B vehicles, $90,000 for Class 3 vehicles, $122,000 for Class 4-5 vehicles, $171,000 for Class 5-6 vehicles, and $295,000 for Class 8 vehicles. Applying the vehicle classification split to the average incentive amounts, staff calculated $189,000 as the average incentive amount for ISEF.

Based on the proposed $14.3 million allocation for ISEF, an estimated 6% administrative cost (1% for CARB and 5% for the program administrator), and the average incentive amount mentioned above, staff estimate that approximately 70 trucks can be funded. ISEF has a 3-year ownership requirement; therefore, total potential emission reductions for the project are quantified over the course of three years. Table A-43 summarizes the estimated number of vehicles funded and total potential lifetime emission reductions for HVIP.

Table A-43: Summary of Estimated Total Vehicles Funded and Lifetime Potential Emission Reductions for ISEF

Number of Vehicles Funded	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
70	2,850	2.11	0.0475	0.0529

Clean Off-Road Equipment

Clean Off-Road Equipment (CORE) achieves emission reductions by accelerating the deployment of zero-emission off-road technologies by reducing the up-front cost of the equipment. Eligible project types include agricultural equipment, airport ground support equipment, cargo handling equipment, commercial harbor craft, construction equipment, heavier lift forklifts, mobile power units (MPU), railcar movers and freight locomotives, terminal tractors (yard trucks), and transport refrigeration units (TRU). Because CORE can fund a variety of categories, it is important to note that the analysis in this appendix is an illustrative example of the potential emission reductions that may be achieved through this project.

For this analysis, staff analyzed past voucher request data and estimated potential emission reductions for the project categories that comprised the majority of vouchers under this project: agricultural equipment, construction equipment, forklifts, MPUs, yard trucks, and TRUs. These categories were further analyzed to determine representative equipment, in terms of the equipment type and maximum rated horsepower (HP) bin, for each category as follows:

- Agricultural equipment: a 25-50 HP agricultural tractor
- Construction equipment: a 50-75 HP skid steer loader
- Forklifts: a 100-175 HP port forklift
- MPUs: a 25-50 HP portable generator
- Yard trucks: a 175-300 HP port yard truck
- TRUs: a 25-50 HP in-state trailer TRU

For this analysis, staff estimates the emission reductions as the exhaust emissions offset between a new, 2024 MY, Tier 4 Final diesel engine and a zero-emission motor. Emission factors for CORE are shown in Table A-44 below.

Table A-44: CORE Emission Factors

Representative Equipment	GHG Emission Factor (g/hr)	NOx Emission Factor (g/hr)	PM2.5 Emission Factor (g/hr)	ROG Emission Factor (g/hr)
2024 MY Tier 4 Final Diesel Agricultural Tractor (25-50 hp)	18,300	46.4	0.184	2.61
2024 MY Tier 4 Final Diesel Skid Steer Loader (50-75 hp)	21,300	68.9	0.331	3.93
2024 MY Tier 4 Final Diesel Port Forklift (100-175 hp)	24,100	6.07	0.430	5.28
2024 MY Tier 4 Final Diesel Portable Generator (25-50 hp)	11,800	5.58	0.397	4.76
2024 MY Tier 4 Final Diesel Off-Road Yard Truck (175-300 hp)	68,100	11.5	0.971	18.0
2024 MY Tier 4 Final Diesel Trailer TRU (25-50 hp)	10,300	30.2	0.197	19.1
2024 MY BEV Agricultural Equipment	5,450	0	0	0
2024 MY BEV Construction Equipment	6,350	0	0	0
2024 MY BEV Forklift	5,110	0	0	0
2024 MY BEV MPU	3,520	0	0	0
2024 MY BEV Yard Truck	20,300	0	0	0
2024 MY BEV TRU	2,450	0	0	0

Staff developed annual usage estimates for CORE based on the average annual usage for the given equipment type operating in California, according to the associated off-road emissions inventories, as shown in Table A-45.

Table A-45: CORE Annual Usage Assumptions

Representative Equipment	Annual Usage (hr/yr)
25-50 HP Agricultural Tractor	1,000
50-75 HP Skid Steer Loader	450
100-175 HP Port Forklift	860
25-50 HP Portable Generator	1,400
175-300 HP Port Yard Truck	1,800
25-50 HP In-State Trailer TRU	1,800

Paired with the emission factors above, staff calculated the potential annual per-vehicle emission reductions for CORE, as shown in Table A-46.

Table A-46: CORE Potential Annual Per-Vehicle Emission Reductions

Supported Technology	Annual Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Per-Vehicle NOx Emission Reductions (tpy)	Annual Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Per-Vehicle ROG Emission Reductions (tpy)
BEV Agricultural Equipment	12.8	0.0512	0.000202	0.00288
BEV Construction Equipment	6.71	0.0342	0.000164	0.00195
BEV Forklift	16.3	0.00575	0.000408	0.00500
BEV MPU	11.6	0.00861	0.000613	0.00735
BEV Yard Truck	85.9	0.0229	0.00193	0.0358
BEV TRU	14.2	0.0599	0.000391	0.0379

Past CORE vouchers were split among the above equipment types as follows: 18% agricultural equipment, 10% construction equipment, 5% forklifts, 12% MPUs, 31% yard trucks, and 24% TRUs. For this analysis, staff assumes that this year's vouchers will be split the same way. Pairing this with the annual per-vehicle emission reductions for each technology, staff calculated the average annual per-vehicle emission reductions, as shown in Table A-47.

Table A-47: CORE Annual Weighted Average Per-Vehicle Emission Reductions

Annual Average Per-Vehicle GHG Emission Reductions (metric tons CO2e/year)	Annual Average Per-Vehicle NOx Emission Reductions (tpy)	Annual Average Per-Vehicle PM2.5 Emission Reductions (tpy)	Annual Average Per-Vehicle ROG Emission Reductions (tpy)
35.2	0.0354	0.000838	0.0220

CORE provides a set voucher amount for each eligible equipment model within the various equipment categories, but additional base voucher modifiers and voucher enhancements are available for fleet owners. Using past voucher data, staff calculated the average incentive amounts to be $50,500 for agricultural equipment, $167,000 for construction equipment, $128,000 for forklifts, $157,000 for MPUs, $152,000 for yard trucks, and $76,600 for TRUs. Applying the equipment category split to the average incentive amounts, staff calculated $117,000 as the average incentive amount for CORE.

Based on the proposed $14.3 million allocation for CORE, an estimated 7% administrative cost, and the average incentive amount mentioned above, staff estimate that approximately 110 pieces of equipment can be funded. CORE has a 3-year ownership requirement; therefore, total potential emission reductions for the project are quantified over the course of three years. Table A-48 summarizes the estimated number of vehicles funded and total potential lifetime emission reductions for CORE.

Table A-48: Summary of Estimated Total Vehicles Funded and Lifetime Potential Emission Reductions for CORE

Number of Vehicles Funded	Total Potential Lifetime GHG Emission Reductions (metric tons CO2e)	Total Potential Lifetime NOx Emission Reductions (tons)	Total Potential Lifetime PM2.5 Emission Reductions (tons)	Total Potential Lifetime ROG Emission Reductions (tons)
110	12,000	12.1	0.287	7.53

Assembly Bill 8 Analysis

Assembly Bill (AB) 8 extended funding for the Air Quality Improvement Program (AQIP) through 2023, and subsequently AB 126 (Reyes, pending Governor's Action, Statutes of 2023) further extended AQIP funding through 2035. AB 8 also refined the evaluation criteria for projects supported by AQIP, and introduced the following requirements that staff following 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.[10]
- “Benefit-cost score” means the reasonably expected or potential criteria pollutant emission reductions achieved per dollar awarded by the board for the project.[11]
- The state board also may give additional preference based on the following criteria, as applicable, in funding awards to projects:
    - Proposed or potential reduction of criteria or toxic air pollutants.
    - Contribution to regional air quality improvement.
    - Ability to promote the use of clean alternative fuels and vehicle technologies as determined by the state board, in coordination with the California Energy Commission.
    - Ability to achieve climate change benefits in addition to criteria pollutant or air toxic emission reductions.
    - Ability to support market transformation of California’s vehicle or equipment fleet to utilize low carbon or zero-emission technologies.
    - Ability to leverage private capital investments.[12]

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 conducted for the project categories proposed for funding with AQIP funds: ISEF and CORE.

Overview

Conservative estimates for criteria pollutant, toxic air contaminants, and GHG emission reductions 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 reported in this appendix are estimated at the tailpipe. GHG emission reductions are calculated on a well-to-wheel (WTW) basis, as GHGs are a global pollutant. Building upon the emission reductions and cost information from the previous sections, this section of the appendix provides information on the following:

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[10] Health and Safety Code (HSC) § 44274(b)

[11] HSC § 44270.3(e)(1)

[12] HSC § 44274(b)

- Benefit-Cost Score Analysis.
- Additional Preference Criteria Scores.
- 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). To calculate cost effectiveness, staff applied an appropriate discount rate and utilized a capital recovery factor (CRF) in the analysis based on 2017 Carl Moyer Program Guidelines.[13] The 1% 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. Since both ISEF and CORE use a 3-year project life, the CRF for both projects is 0.340.

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 9 below.

Formula 9: Cost-Effectiveness

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

Weighted emission reductions are calculated using Formula 10 below, consistent with Carl Moyer Program Guidelines.

Formula 10: Annual Weighted Emission Reductions

$$Annual\ Weighted\ Emission\ Reductions = NOx\ Reductions\ (tpy) + ROG\ Reductions\ (tpy) + (20 * PM\ Reductions\ (tpy))$$

Table A-49 provides the inputs and the resulting weighted criteria pollutant and toxic air contaminant cost-effectiveness, in units of dollars per ton of weighted emission reductions, for projects funded by AQIP. For ISEF and CORE, staff utilized the oxides of nitrogen (NOx), particulate matter (PM) 2.5, and reactive organic gases (ROG) emission reductions calculated previously for the AB 8 analysis.

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[13] *https://ww2.arb.ca.gov/sites/default/files/classic/msprog/moyer/guidelines/2017/2017_cmpgl.pdf*

Table A-49: AB 8 Analysis – Cost-Effectiveness

Proposed Project	CRF	Average Annual Per-Vehicle Weighted Emission Reductions ($/weighted ton)	Average Incentive Amount	Cost-Effectiveness ($/weighted ton)
ISEF	0.340	0.0144	$188,500	$4,440,000
CORE	0.340	0.0742	$116,500	$534,000

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 $500,000 per ton of weighted emission reductions received a high of five points. The remaining bins were increased by $1,500,000 increments with the least cost-effective projects, those projects that cost over $5,000,000 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 $500,000 per ton

4: $500,000 to $1,999,999 per ton

3: $2,000,000 to $3,499,999 per ton

2: $3,500,000 to $4,999,999 per ton

1: $5,000,000 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 (lb) 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-50.

Table A-50: AB 8 Analysis – Benefit-Cost Value and Score for Total Benefit Index

Proposed Project	Cost-Effectiveness ($/weighted ton)	Benefit-Cost Value (lb/$)	Benefit-Cost Score
ISEF	$4,440,000	0.00045	2
CORE	$534,000	0.00375	5

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-50. The additional preference criteria are listed below.

- 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.
- 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 zero and five 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.
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 criterion 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 and resulting total lifetime emission reductions ranged from 0.0308 tons to 0.175 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 0.035-ton increments. Projects with less than or equal to 0.035 tons of criteria pollutant and toxic air contaminant emission reductions received one point, while those projects with greater than 0.140 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 0.140 tons of criteria and toxic emission reductions per vehicle

4: 0.105 to 0.139 tons of criteria and toxic emission reductions per vehicle

3: 0.070 to 0.104 tons of criteria and toxic emission reductions per vehicle

2: 0.035 to 0.069 tons of criteria and toxic emission reductions per vehicle

1: Less than 0.035 tons of criteria and toxic emission reductions per vehicle

Based on the information described above, Table A-51 summarizes the results and the corresponding score for this additional preference criterion.

Table A-51: AB 8 Analysis – Potential Reduction of Criteria or Toxic Air Pollutants

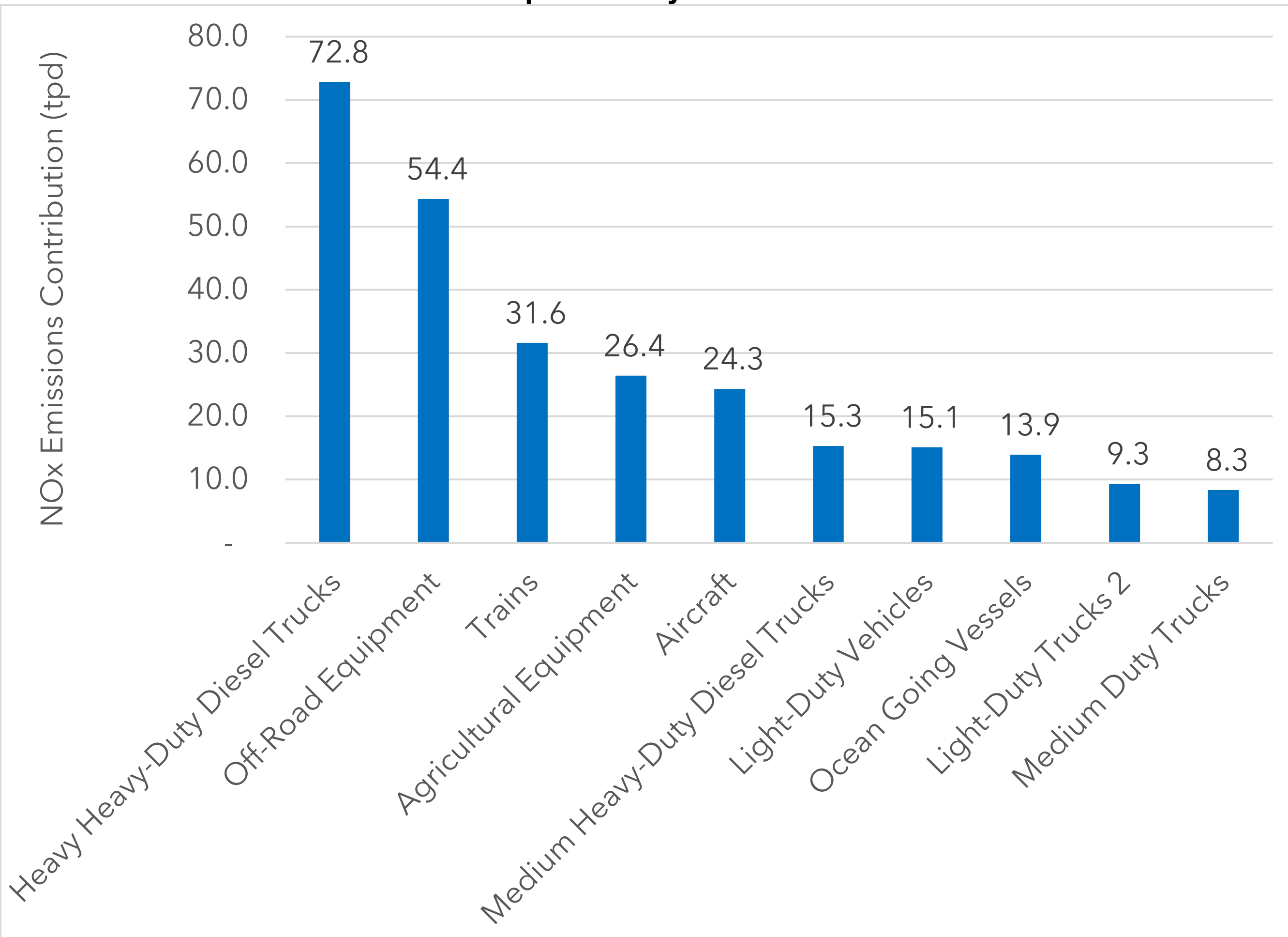
Proposed Project	Average Annual Per-Vehicle Emission Reductions (tpy)	Project Life	Per-Vehicle Lifetime Emission Reductions (tons)	Score
ISEF	0.0103	3	0.0308	1
CORE	0.0583	3	0.1750	5

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 ability to reduce emissions from the corresponding sources of emissions from highest to lowest. To develop the scale, staff used the NOx emissions in tons per day (tpd) from the California Emissions Projection Analysis Model (CEPAM)[14], version CEPAM2019v1.03, which is used in State Implementation Plan development and air quality modeling efforts. The ranking scale is based on the emissions inventory shown in Figure A-1.

[14] *https://ww2.arb.ca.gov/criteria-pollutant-emission-inventory-data*

Figure A-1: Largest Mobile NOx Emission Sources in the South Coast and San Joaquin Valley Air Basins



The top 10 NOx emission sources were ranked for various vehicle and equipment types, ranging from heavy heavy-duty diesel trucks, at 72.8 tpd, to medium duty trucks, at 8.3 tpd. The scoring scale for this criterion was established for the range of NOx emissions between the highest and lowest value, and as a result, the bins were rounded and scaled in 20-tpd increments. Projects corresponding to inventory sources with less than 10 tpd of NOx receive one point, while those projects with greater than 70 tpd of NOx receive five points. Each project's potential contribution to regional air quality improvement was ranked based on the scale below.

5: Category contributes more than 70 tons of NOx per day

4: Category contributes 50 to 69.9 tons of NOx per day

3: Category contributes 30 to 49.9 tons of NOx per day

2: Category contributes 10 to 29.9 tons of NOx per day

1: Category contributes less than 10 tons of NOx per day

This year's proposed projects have the ability to fund multiple vehicle and/or equipment categories, therefore, the ranking of each project is based on the vehicle or equipment category that accounts for the highest contribution of NOx emissions. Based on the information described above, Table A-52 summarizes the results and the corresponding score for this additional preference criterion.

Table A-52: AB 8 Analysis – Contribution to Regional Air Quality Improvement

Proposed Project	Types of Vehicles or Equipment Funded from Top 10 NOx Sources	Score
ISEF	Heavy Heavy-Duty Diesel Trucks and Medium Heavy-Duty Diesel Trucks	5
CORE	Off-Road Equipment and Agricultural Equipment	4

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 both low carbon alternative fuels and clean vehicle technologies.
- 3: Projects that use either low carbon alternative fuels or clean vehicle technologies.
- 1: Projects that do not use low carbon alternative fuels nor clean vehicle technologies.

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 WTW 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. The resulting total potential lifetime per-vehicle GHG emission reductions ranged from just under 40 metric tons of CO2e to over 100 metric tons of CO2e. 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 25-metric ton increments. Projects with less than 30 metric tons of CO2e GHG emission reductions received one point, while those projects with greater than 120 metric tons received a score of five points. The resulting scale for GHG emission reductions on a per-vehicle basis is shown below.

- 5: Greater than 105 metric tons of CO_2e per vehicle
- 4: 80 to 104.9 metric tons of CO_2e per vehicle
- 3: 55 to 79.9 metric tons of CO_2e per vehicle
- 2: 30 to 54.9 metric tons of CO_2e per vehicle
- 1: Less than 30 metric tons of CO_2e per vehicle

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

Table A-53: AB 8 Analysis – Potential GHG Emission Reductions

Proposed Project	Average Annual Per-Vehicle GHG Emission Reductions (metric tons/yr)	Project Life	Per-Vehicle Lifetime Emission Reductions (metric tons CO_2e)	Score
ISEF	13.2	3	39.5	2
CORE	35.2	3	105.7	5

Ability to Support Market Transformation of California's Fleet

This qualitative analysis ranked projects by their ability to fund technologies with the potential for market transformation. 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. 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

Ability to Leverage Private Capital Investments

Staff is proposing not to include this criterion for FY 2023-24 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 score that preferentially weights the benefit-cost score at 75% of the total score with additional preference scoring criteria accounting for 25% 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-54 summarizes the individual scores and the Total Benefit Index scores for the AQIP projects currently proposed in the FY 2023-24 Funding Plan.

Table A-54: Total Benefit Index for AB 8 Analysis

Proposed Project	Potential for Criteria Pollutant or Toxics Reductions	Regional Air Quality	Promotes Clean Fuels or Vehicles	Potential for GHG Reductions	Ability to Support Market Transformation	Average Additional Preference Score	Benefit Cost Score	TBI Score
ISEF	1	5	5	2	5	3.6	2	2.40
CORE	5	4	5	5	5	4.8	5	4.95

Jobs Co-Benefits

CARB's Low Carbon Transportation Investments yield a whole host of co-benefits including an impact on jobs – directly and indirectly. Quantifying direct, indirect, and induced jobs at the start and during a project allows stakeholders to take a much more holistic and robust approach while assessing the positive impacts from these projects. Furthermore, job quantification could help shape programmatic changes. Job co-benefits refer to California jobs supported. A job is defined as one full-time equivalent employee position over one year, equal to approximately 2,080 hours of work. Jobs supported include direct, indirect, and induced employment:

- Directly supported jobs refer to labor to complete projects, through direct employment or contracted work paid with Low Carbon Transportation investment dollars (e.g., housing construction, ecosystem restoration, or technical assistance) and labor to produce equipment or materials purchased with Low Carbon Transportation investment dollars (e.g., manufacturing ZEVs or anaerobic digesters).
- Indirectly supported jobs exist in the supply chains supporting Low Carbon Transportation investment projects. Funding a project generates demand for intermediate inputs of materials and equipment needed to complete the project, leading to expanded production and employment in the relevant industries (e.g., manufacturing construction equipment, ZEV parts, or solar panel components).
- Induced jobs are linked to the spending of income from directly and indirectly supported jobs. The personal consumption expenditures of workers in jobs directly and indirectly supported by Low Carbon Transportation investment projects (i.e., increased household spending) stimulate demand for goods and services in the wider California economy.

The methodology for assessing the number of jobs supported was developed by CARB in consultation with the Center for Resource Efficient Communities at the University of California, Berkeley (UC Berkeley). CARB first released the Job Co-benefit Assessment Methodology and Modeling Tool in January 2019 and has since updated the tool. A detailed documentation of the methodology itself and the comprehensive steps that went into its development can be found on CARB's California Climate Investments (CCI) Co-benefit Assessment Methodologies page[15].

Based on inputs such as proposed funding allocation, the percentage of funds going to the actual vehicle and/or equipment procurement, the percentage of funds going to implementation and administrative expenses, among other inputs, staff determined the number of jobs supported for each of the Low Carbon Transportation project categories using the jobs assessment methodology. For projects where there was not a methodology to quantify emissions reductions, the number of supported jobs was not assessed. The job estimate results for FY 2023-24 Low Carbon Transportation/Greenhouse Gas Reduction

[15] *https://www.arb.ca.gov/resources/documents/cci-methodologies*

Fund (GGRF) Investments are shown in Table A-55 and the total jobs from all funding sources are shown in Table A-56.

Table A-55: Estimate of Jobs Supported by FY 2023-24 GGRF Low Carbon Transportation Investments

Project Category	Directly Supported Jobs	Indirectly Supported Jobs	Induced Jobs	Total Supported Jobs
Financing Assistance	11.6	7.1	39.8	58.5
CC4A	10.8	6.6	30.5	47.9
Mobility Projects	329.8	71.7	116.6	518.1
Planning and Capacity Building	72.8	18.5	56.0	147.3
Drayage Trucks (HVIP)	171.8	93.1	158.2	423.1

Table A-56: Estimate of Jobs Supported by FY 2023-24 General Fund, AQIP, and Proposition 98 General Fund Investments

Project Category	Directly Supported Jobs	Indirectly Supported Jobs	Induced Jobs	Total Supported Jobs
Financing Assistance	8.7	5.3	29.9	43.9
Clean Cars 4 All	10.8	6.6	30.5	47.9
California e-Bike Incentive Project	59.6	25.3	69.3	154.2
Access Clean California	34.1	8.7	28.5	71.3
California Integrated Travel Project	7.3	1.9	5.6	14.8
Public School Buses (HVIP)	847.8	459.2	640.6	1947.6
ISEF	30.7	16.6	28.3	75.6
CORE	37.4	21.9	28.5	87.8

Californians have begun to see the economic benefits of these Clean Transportation Incentives by the thousands number of jobs created as California has become a hub for the manufacture and deployment of clean technologies and associated green jobs. CARB staff shall continue to keep a cumulative job creation total moving forward and direct job data will continue to be collected through the project reports.

AB 1550: Disadvantaged Community, Low-Income Community, and Low-Income Household Investment Targets

In the proposed Funding Plan, staff proposes that at least 60-70% of CARB's Low Carbon Transportation appropriation from GGRF will be invested in projects meeting one of the AB 1550 criteria with the following targets:

- At least 45-50% of funds for projects located within, and that benefit individuals who live in, disadvantaged communities (DAC).
- At least 15-20% of funds for projects located within, and that benefit low-income communities (LIC), or that benefit low-income households (LIH). The subset of these funds meeting the additional AB 1550 requirement for LIC or LIH investments that are within 1/2 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 analysis is conducted for GGRF-funded projects since AB 1550 only statutorily applies to projects funded by GGRF; however, CARB is committed to investing in projects located in and benefiting AB 1550 priority populations, regardless of funding source.

This minimum CARB commitment of at least 60-70% would exceed the overall target set in AB 1550 for the State's collective California Climate Investments in DACs, LICs, and LIHs. AB 1550 does not set targets for individual agencies, but requires that the State, overall, invest at least 25% in projects located in and benefiting DACs, at least 5% in projects in and benefiting LICs or benefiting LIHs, and at least 5% in projects in LICs located within 1/2 mile of a DAC for a total AB 1550 investment of at least 35% of California Climate investment funds.

Table A-57 displays estimates of the minimum percentage of funds for each project expected to be spent within and benefiting DAC census tracts as well as the nonoverlapping minimum percent of funds expected to be spent within and benefiting LICs. Staff only counted an investment as being in a LIC if it had not already been counted as being spent in DACs 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 Financing Assistance and Clean Cars 4 All, staff used the historical percent of funds spent in DACs as reported in the *2023 Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds*[16] to project future performance.

As shown in Table A-57, there are some project categories that are limited to DACs and LICs, so staff can say with certainty 100% of these funds will be spent in these communities. These include CARB's Sustainable Community-Based Transportation Equity Projects, such as Clean Mobility in Schools (CMIS), Clean Mobility Options (CMO), and the Sustainable Transportation Equity Project (STEP).

Even with these conservative estimates, staff estimates that approximately 51.6% of the proposed Low Carbon Transportation funds would be spent in DACs and approximately 23.6% in nonoverlapping LICs for a total of 75.2% of funds meeting one of the AB 1550 criteria as shown in Table A-57. 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.

[16] *https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/cci_annual_report_2023.pdf*

Table A-57: Estimate of the Minimum Proposed FY 2023-24 Low Carbon Transportation Investments Funded with GGRF Dollars in AB 1550 Priority Populations

Project Category	Allocation (millions)	% in DACs	$ in DACs (millions)	% in LICs	$ in LICs (millions)	% in DACs/LICs Combined	$ in DACs/LICs Combined (millions)	Data Source for AB 1550 Priority Population Estimates
Financing Assistance	$15	15%	$2.25	65%	$9.75	80%	$12.0	California Climate Investments program webpage based on data from Dec 1, 2021- Nov 30, 2022.[17]
Clean Cars 4 All	$15	41%	$6.15	57%	$8.55	98%	$14.7	California Climate Investments program webpage based on data from Dec 1, 2021- Nov 30, 2022.[18]
STEP	$16.7	90%	$15	10%	$1.67	100%	$16.7	This project is designed to support DACs and LICs.
CMIS	$16.7	90%	$15	10%	$1.67	100%	$16.7	This project is designed to support DACs and LICs.
CMO	$16.7	90%	$15	10%	$1.67	100%	$16.7	This project is designed to support DACs and LICs.
Planning and Capacity Building	$10	TBD	TBD	TBD	TBD	TBD	TBD	No supporting program data
Drayage Trucks (HVIP)	$80	43%	$34.4	21%	$16.8	64%	$51.2	California Climate Investments program webpage based on data from Dec 1, 2021- Nov 30, 2022.[19]
Total	**$170**	**51.6%**	**$87.8**	**23.6%**	**$40.1**	**75.2%**	**$128**	

[17] *https://www.caclimateinvestments.ca.gov/financing-assistance-for-lowerincome-consumers*
[18] *https://www.caclimateinvestments.ca.gov/clean-cars-4-all*
[19] *https://www.caclimateinvestments.ca.gov/clean-truck-and-bus-vouchers*