California Air Resources Board

Greenhouse Gas Quantification Methodology for the

Air Resources Board

Low Carbon Transportation Program:

Classic Clean Vehicle Rebate Project (CVRP)

Public Fleets in Disadvantaged Communities

Vehicle Retirement and Replacement Plus-up

Financing Assistance Programs

Greenhouse Gas Reduction Fund
Fiscal Year 2014-15

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A. Introduction

The California Air Resources Board (ARB) is responsible for providing the quantification methodology to estimate greenhouse gas (GHG) emission reductions from projects receiving monies from the Greenhouse Gas Reduction Fund (GGRF). ARB staff developed this GHG emission reductions quantification methodology for the Low Carbon Transportation light-duty vehicle projects listed in Table 1 to estimate proposed project GHG emission reductions for Fiscal Year (FY) 2014-15 funds. The emission reduction estimates detailed in this quantification methodology are based on the methods described in the document titled "AB 8 Project Scoring Criteria: Methodology" (AB 8 Methodology) to estimate GHG emission reductions. The AB 8 Methodology is detailed in Appendix A of the Fiscal Year 2014-15 Funding Plan for the Air Quality Improvement Program and Low Carbon Transportation (LCT) Greenhouse Gas Reduction Fund Investments.[1]

Methodology Development

For FY 2014-15, ARB staff followed a set of principles to guide the development of the quantification methodology. These principles ensure that the methodology would:
- Apply at the project-level;
- Provide uniform methods among similar project types to be applied statewide;
- Use existing and proven methodologies where available; and
- Support the analysis of GHG emission reductions from the proposed projects.

ARB will continue to evaluate and update the GHG emission reductions quantification methodologies as necessary for future FY GGRF appropriations.

Light-Duty Vehicle Projects

LCT investments expand existing ARB clean transportation programs that provide incentives for advanced clean vehicles, such as battery-electric and plug-in hybrid passenger vehicles, to achieve GHG emission reductions along with criteria pollutant and air toxics co-benefits. LCT investments place an emphasis on projects that benefit disadvantaged communities. For the LCT projects listed in Table 1 and described below, GHG emission reductions estimates were performed by comparing advanced clean vehicles to conventional new vehicle baselines using GHG emission factors generated for each of the vehicle technology types. Staff analyzed the following projects with the corresponding supported advanced vehicle technologies:

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[1] http://www.arb.ca.gov/msprog/aqip/fundplan/final_fy1415_aqip_ggrf_fundingplan.pdf

Table 1. FY 2014-15 LCT Light-Duty Vehicle Projects and Advanced Vehicle Technology Types

LCT Projects	Supported Advanced Vehicle Technology Types[2]	Estimated Percentage Split of Each Advanced Vehicle Technology Type[3]
Classic Clean Vehicle Rebate Project		
Classic Clean Vehicle Rebate Project	Plug-in hybrid and battery-electric	50% plug-in hybrid and 50% battery-electric vehicle technology types based on historical CVRP rebate data
Light-duty Pilot Projects in Disadvantaged Communities		
Public Fleets in Disadvantaged Communities	Plug-in hybrid and battery-electric	50% plug-in hybrid and 50% battery-electric vehicle technology types assumed
Vehicle Retirement and Replacement Plus-up	Plug-in hybrid and battery-electric	50% plug-in hybrid and 50% battery-electric vehicle technology types assumed
Financing Assistance Programs	Plug-in hybrid and battery-electric	50% plug-in hybrid and 50% battery-electric vehicle technology types assumed

Classic Clean Vehicle Rebate Project (Classic CVRP)
Classic CVRP provides rebates to California residents, businesses, non-profit organizations and government entities that purchase or lease a battery, fuel cell, or a plug-in hybrid electric vehicle. Since its inception, the objective of classic CVRP has been to seed the market for widespread commercialization of the cleanest vehicles available today by helping to drive consumer purchasing decisions.

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[2] While fuel cell technologies may be included in some light duty vehicle projects, for FY 2014-15 fuel cells vehicles are not included in GHG estimates since vehicle volumes are low.
[3] This is the estimated percentage split of each technology type for the LCT project. See AB 8 Methodology Table A-7, available at: http://www.arb.ca.gov/msprog/aqip/fundplan/final_fy1415_aqip_ggrf_fundingplan.pdf.

<u>Public Fleets in Disadvantaged Communities</u>
Incentives for Public Fleets in Disadvantaged Communities offers rebates to public fleets located in or serving disadvantaged communities for plug-in hybrid electric vehicles, battery-electric vehicles, and fuel cell vehicles.

<u>Vehicle Retirement and Replacement Plus-up</u>
As an augmentation to ARB's Enhanced Fleet Modernization Program, the EFMP Plus-up Pilot Project focuses on promoting advanced technology vehicle replacements (new or used) for lower income consumers. This pilot project provides an additional incentive amount above the base incentive under district-run EFMP scrap and replacement programs for lower-income consumers in and near disadvantaged communities who retire older, higher-emitting vehicles and replace them with used or new hybrids, plug-in hybrids, or ZEVs. In addition, this pilot project provides an additional incentive for the purchase and installation of electric vehicle supply equipment at single-family residences or multiunit dwellings.

<u>Financing Assistance Programs</u>
The Light-Duty Financing Assistance Program offers financing options to low-income or disadvantaged individuals in disadvantaged communities in order to improve financing options for low-income individuals interested in moving into a cleaner vehicle. Further, as more hybrids and advanced clean cars enter the used car market, financing assistance for used vehicles may help to increase the number of cleaner vehicles in disadvantaged communities.

GHG Emission Reductions

This methodology estimates the GHG emission reductions by comparing each supported advanced technology vehicle type against a conventional new vehicle baseline for each project. For the LCT projects listed in Table 1, the difference in the GHG emissions from the baseline conventional gasoline vehicle and the advanced technology vehicle is the quantified GHG emission reductions for one advanced technology vehicle.

The following sections describe the calculations needed to estimate the GHG emission reductions for FY 2014-15 LCT light-duty projects.

B.   Quantification Methodology

Estimated GHG emission reductions are based on the specific GHG emission factor for each vehicle type and default annual mileage assumptions (i.e., vehicle miles travelled or VMT).

Emission Factors

This quantification methodology uses a well-to-wheel (WTW) GHG emissions analysis to estimate the GHG emission reductions from the projects. WTW emission analysis

allows staff to analyze the emissions resulting from the production, distribution and usage, including exhaust emissions, of the different fuel types such as gasoline, electricity and hydrogen. The methodology provides a uniform approach to estimate GHG emission reductions in metric tons (MT) of carbon dioxide equivalent (CO2e) for the projects.

Staff developed WTW emissions factors, as shown in Table 2, for light-duty vehicles (LDV) utilizing carbon intensity data from ARB's Low Carbon Fuel Standard (LCFS) Program; fuel energy density values from the California-modified Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation model (CA GREET 2.0); and vehicle fuel economy values to estimate GHG emission factors in grams per mile.

Table 2. Vehicle Categories and WTW GHG Emission Factors for Light-Duty Vehicles[4]

Light Duty Vehicle Type GHG Emission Factor	Conventional Gasoline (2015)	Battery-Electric	Plug-in Hybrid (PHEV)	Fuel Cell
GHG (g/mi)	498	76	234	127

As described in the AB 8 Methodology, staff developed vehicle usage assumptions (annual miles traveled) through a literature review for each of the vehicle technology types evaluated, or actual usage data when available. Table 3 summarizes the annual mileage assumptions used for emission reductions analysis.

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[4] See AB 8 Methodology, Table A-2, available at:
http://www.arb.ca.gov/msprog/aqip/fundplan/final_fy1415_aqip_ggrf_fundingplan.pdf

Table 3. Annual Usage Assumptions[5]

Supported Advanced Vehicle Technology Type	Annual VMT Assumptions (miles per year)
Classic Clean Vehicle Rebate Project, Vehicle Retirement and Replacement Plus Up, and Financing Assistance Programs	
Battery-Electric	11,059
Plug-in Hybrid	14,855
Fuel Cell	14,855
Public Fleets in Disadvantaged Communities	
All Vehicle Types	10,647

Use Steps 1, 2 and 3 to estimate the GHG emissions reductions for each project.

Step 1: Calculate annual GHG emission reductions: Use the GHG emission factors from Table 2, in conjunction with annual VMT assumptions from Table 3, to calculate the annual GHG emission reductions from the use of one advanced technology vehicle in place of a conventional new gasoline vehicle.

$$(Eq. 1) \qquad \textbf{GHG\_AR}_{\textbf{Advanced Vehicle Type}} = \frac{[(\textbf{C\_EF} - \textbf{AV\_EF}) * (\textbf{VMT\_AV})]}{1,000,000}$$

Repeat Eq. 1 for each advanced vehicle type included in the project.
Where:
- C_EF = conventional new vehicle baseline (conventional gasoline, 2015) GHG emission factor from Table 2 (grams/mile)
- AV_EF = advanced vehicle technology type GHG emission factor from Table 2 (grams/mile)
- VMT_AV = annual VMT for the advanced vehicle type from Table 3 (miles per year)
- GHG_AR $_{Advanced\ Vehicle\ Type}$ = annual GHG reductions from the use of one advanced technology vehicle in place of a conventional new gasoline vehicle (MTCO$_2$e)

Step 2: Calculate the average (or weighted) annual GHG emission reductions:
Sum the product of GHG emission reductions for each vehicle type (e.g., battery-electric or plug-in hybrid) by the percentage of that vehicle type.

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[5] See AB 8 Methodology, Table A-9, available at:
http://www.arb.ca.gov/msprog/aqip/fundplan/final_fy1415_aqip_ggrf_fundingplan.pdf

$$(\text{Eq. 2}) \qquad \textbf{W\_GHG\_AR} = \sum \left[\% \textbf{ VT} * \textbf{GHG\_AR}_{\textbf{Advanced Vehicle Type}} \right]$$

Where:
- %VT=percentage split (in decimal format) of vehicle type from Table 1
- W_GHG_AR = weighted annual GHG emission reductions for one advanced vehicle (MTCO2e/year)

Step 3: Calculate the GHG emission reductions over the project life: Calculate the GHG emission reductions for all advanced vehicles for one year and over the project life[6] (i.e., 15 years).

$$(\text{Eq. 3}) \qquad \textbf{GHG\_A} = \text{\# of vehicles replaced} * \textbf{W\_GHG\_AR}$$

$$(\text{Eq. 4}) \qquad \textbf{MT CO2e over the project life} = \textbf{GHG\_A} * \textbf{15}$$

Where:
- GHG_A=annual GHG emission reductions total for all advanced vehicles

The estimated total lifetime GHG emission reductions per dollar of GGRF funds requested is reported as:

$$(\text{Eq. 5}) \qquad \frac{\underline{\textbf{MT CO2e over the project life}}}{\textbf{GGRF Funds Requested (\$)}}$$

C.   Reporting and Documentation

ARB is required to capture and retain documentation that is complete, and sufficient enough to allow the quantification calculations to be reviewed and replicated.

Documentation will include:
- Contact information for the person who can answer project specific questions; from staff reviewers on the quantification calculations;
- Project specific equipment specifications and certifications;
- Summary page with, at a minimum, the following information;
  - Number of advanced vehicles by vehicle type;
  - GHG emission reduction estimates for year 1 and project life total;
  - GGRF funds requested for the project;
  - Total Project GHG emission reductions per GGRF dollar; and
- Each project may have specific reporting requirements that can be found at the following: http://www.arb.ca.gov/msprog/aqip/solicitations.htm

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[6] The project life for all project types included in this methodology is based on a 15 year vehicle life as listed in the AB 8 Methodology, Table A-24, available at:
http://www.arb.ca.gov/msprog/aqip/fundplan/final_fy1415_aqip_ggrf_fundingplan.pdf