

California Air Resources Board

Greenhouse Gas Quantification Methodology for California Air Resources Board Low Carbon Transportation Program Car Sharing and Mobility Options in Disadvantaged Communities Pilot Project

Greenhouse Gas Reduction Fund Fiscal Year 2016-17



Note:

Applicants must use the Fiscal Year 2016-2017 Low Carbon Transportation Investments Application for Targeted Car Sharing and Mobility Options in Disadvantaged Communities Pilot Project to calculate greenhouse gas reductions for application purposes. Solicitation materials can be found at:

<https://www.arb.ca.gov/msprog/aqip/solicitations.htm>

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Section A. Introduction

The goal of California Climate Investments (CCI) is to reduce greenhouse gas (GHG) emissions and further the purposes of the Global Warming Solutions Act of 2006, known as Assembly Bill (AB) 32. The California Air Resources Board (CARB) is responsible for providing the quantification methodology to estimate the GHG emission reductions from projects receiving monies from the Greenhouse Gas Reduction Fund (GGRF). CARB develops these methodologies based on the project types eligible for funding by each administering agency, as reflected in the program Expenditure Records available at:

<https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/expenditurerecords.htm>.

For the Fiscal Year (FY) 2016-17 CARB Low Carbon Transportation (LCT) Car Sharing and Mobility Options in Disadvantaged Communities Pilot Project (Car Sharing Pilot Project), CARB staff developed this quantification methodology to estimate GHG emission reductions in metric tons (MT) of carbon dioxide equivalent (CO₂e) from supported advanced technology vehicle types (Sections B), provide instructions for documenting and supporting the estimate (Section C), and outline the process for tracking and reporting GHG emission reductions once a project is funded (Section D).

LCT Car Sharing Pilot Project

The LCT Car Sharing Pilot Project reduces GHG emissions by providing incentives for advanced vehicle technology types (e.g., plug-in hybrid electric vehicles (PHEV), battery electric vehicles (BEV), fuel cell electric vehicles (FCEV), or a combination of advanced technology vehicles) to be used for car sharing, vanpooling, ride-sharing and other mobility options in disadvantaged communities. This quantification methodology provides an initial estimate for two primary project models: traditional car sharing and vanpools. This quantification methodology does not account for all possible project models, such as a model that includes electric bike sharing, nor does it account for the reductions in vehicle miles travelled associated with the mode shift from low-occupancy vehicles.

Methodology Development

CARB developed this quantification methodology consistent with the guiding implementation principles of CCI, including ensuring transparency and accountability.ⁱ The implementing principles ensure that the methodology will:

- Apply at the project-level;
- Provide uniform methods to be applied statewide;
- Use existing and proven methods;
- Use project-level data, where available and appropriate; and

- Result in GHG emissions reduction estimates that are conservative and supported by empirical literature.

Program Assistance

CARB staff will ensure that the quantification methods described in this document are properly applied to estimate the GHG emission reductions for the project types. Applicants should use the following resources for additional questions and comments:

- Questions on this quantification document should be sent to:
GGRFProgram@arb.ca.gov
- For more information on CARB's efforts to support implementation of GGRF investments, see: www.arb.ca.gov/auctionproceeds
- Questions not related to this quantification document, but pertaining to the LCT Car Sharing Pilot Project should be sent to:
Tim Hartigan
Tim.Hartigan@arb.ca.gov
(916) 323-1284

Note: Questions will not be answered by CARB during the solicitation period. Please refer to the Fiscal Year 2016-17 Low Carbon Transportation Investments Application for Targeted Car Sharing and Mobility Options in Disadvantaged Communities Pilot Project for more information on how to submit questions during the solicitation period. Solicitation materials can be found at:
<https://www.arb.ca.gov/msprog/aqip/solicitations.htm>

Section B. Greenhouse Gas Quantification Methodology

The purpose of this quantification methodology is to document the process used by CARB to estimate GHG emission reductions from the FY 2016-17 LCT Car Sharing Pilot Project. Applicants for funding must use the FY 2016-17 LCT Application for Car Sharing Pilot Project for application purposes as it includes methods for quantifying reductions in criteria pollutant emissions in addition to reductions in GHG emissions. Project solicitation materials, including emission factors to be used in calculations, can be found at: www.arb.ca.gov/msprog/aqip/solicitations.htm.

In general, the GHG emission reductions are calculated using the following approach:

$$\text{Annual GHG Emission Reductions} = \text{GHG Emissions}_{\text{Conventional Vehicle}} - \text{GHG Emissions}_{\text{Advanced Technology Vehicle}}$$

Step 1. Calculate the total combined vehicle miles traveled (VMT) of the fleet

The total combined VMT of the fleet is calculated using Equation 1.

$$VMT_{\text{Fleet}} = \text{Vehicles} * \frac{\text{Trips}}{\text{Day}} * \frac{\text{Miles}}{\text{Trip}} * \frac{\text{Days}}{\text{Year}} \quad (\text{Eq. 1})$$

Where,

VMT _{Fleet}	is the annual VMT for the fleet (vehicle-miles/year);
Vehicles	is the number of eligible advanced technology vehicles;
Trips/Day	is the average number of one-way trips driven per day per vehicle;
Miles/Trip	is the average number of miles traveled per trip; and
Days/Year	is the number of days per year that vehicles would be available for use.

Step 2. Calculate the GHG emissions produced by conventional vehicles

The GHG emissions produced by conventional vehicles are the GHG emissions that would have been produced if conventional vehicles were used in lieu of advanced technology vehicles for trips. The GHG emissions from the conventional vehicle are calculated using Equation 2.

$$GHG_{CV} = VMT_{Fleet} * EF_{CV} \quad (\text{Eq. 2})$$

Where,

GHG_{CV} is the GHG emissions from conventional vehicles (grams (g) CO₂e/year);
 VMT_{Fleet} is the result from Equation 1; and
 EF_{CV} is the emission factor for a conventional vehicle (gCO₂e/mile).

Step 3. Calculate the GHG emissions produced by advanced technology vehicles

The GHG emissions for PHEVs and BEVs are calculated using Equation 3 and Equation 4, respectively. If FCEVs are included in the proposed project, group the number of FCEVs with the number of BEVs. The separate GHG emissions for the advanced vehicle types are then combined using Equation 5.

Step 3a. Calculate the GHG emissions of PHEVs

$$GHG_{PHEV} = VMT_{Fleet} * EF_{PHEV} * P_{PHEV} \quad (\text{Eq. 3})$$

Where,

GHG_{PHEV} is the GHG emissions from PHEVs (gCO₂e/year);
 VMT_{Fleet} is the result from Equation 1;
 EF_{PHEV} is the emission factor for a PHEV (gCO₂e/mile); and
 P_{PHEV} is the percentage of the project vehicles that are PHEVs.

Step 3b. Calculate the GHG emissions of BEVs

$$GHG_{BEV} = VMT_{Fleet} * EF_{BEV} * P_{BEV} \quad (\text{Eq. 4})$$

Where,

GHG_{BEV} is the GHG emissions from BEVs (gCO₂e/year);
 VMT_{Fleet} is the result from Equation 1;
 EF_{BEV} is the emission factor for a BEV (gCO₂e/mile); and
 P_{BEV} is the percentage of the project vehicles that are BEVs or FCEVs.

Step 3c. Calculate the combined GHG emissions of the advanced technology vehicles

$$GHG_{AV} = GHG_{PHEV} + GHG_{BEV} \quad (\text{Eq. 5})$$

Where,

GHG_{AV} is the GHG emissions of the advance technology vehicles (gCO₂e/year);
 GHG_{PHEV} is the result from Equation 3; and
 GHG_{BEV} is the result from Equation 4.

Step 4. Calculate the Total GHG emissions reductions for the useful life

The total GHG emission reductions for the useful life of the project is calculated using Equation 6.

$$ER_{Fleet} = \frac{GHG_{CV} - GHG_{AV}}{1,000,000} * UL \quad (\text{Eq. 6})$$

Where,

ER_{Fleet} is the annual emission reductions form (MTCO₂e/year);
 GHG_{CV} is the result from Equation 2;
 GHG_{AV} is the result from Equation 5; and
 UL is the useful project life (3 years).

Note: The useful project life for the FY 2016-17 LCT Car Sharing Pilot Project solicitation is 3 years, but may change for future solicitations.

Section C. Documentation

CARB reports total project GHG emission reductions by project type. Total Project GHG Emission Reductions per dollar of GGRF funds can be calculated using Equation 7.

$$\frac{\text{Total Project GHG Emission Reduction (MTCO}_2\text{e)}}{\text{Total GGRF Funds (\$)}} \quad (\text{Eq. 7})$$

Supporting Documentation

CARB is required to retain documentation that is sufficient to allow all quantification calculations to be reviewed and replicated. Refer to the FY 2016-2017 LCT Application for Car Sharing Pilot Project for information on the required supporting documentation. Solicitation materials can be found at:

<https://www.arb.ca.gov/msprog/aqip/solicitations.htm>

Section D. Reporting after Funding Award

Accountability and transparency are essential elements for all GGRF CCI projects. As described in CARB's Funding Guidelines, each administering agency is required to track and report on the benefits of the CCI funded under their program(s). Each project funded by the GGRF is expected to provide real and quantifiable GHG emission reductions. The previous sections of this document provide the methods to estimate the GHG emission reductions of a proposed project based on project characteristics and assumptions of expected conditions and activity levels. This section explains the minimum reporting requirements for administering agencies and funding recipients. Table 1 below shows the project phases and when reporting is required.

Funding recipients have the obligation to provide, or provide access to, data and information on project outcomes to CARB.

It is the responsibility of CARB to collect and compile project data from funding recipients, including the GHG emission reduction and information on benefits to disadvantaged communities.

Table 1. Quantification and Reporting By Project Phase

	Timeframe	Quantification Methods
Project Selection	Period from solicitation to funding awards. Applicant submits application to CARB by due date in solicitation materials.	All applicants use methods in CARB's quantification methodology to estimate the GHG emission reductions of the project.
Phase 1	Period from project award date through project completion date.	All funded projects use methods in CARB's quantification methodology to update initial estimates of GHG emission reductions, as needed, based on project changes.

Phase 1 reporting is required for all Car Sharing Pilot Projects. CARB will collect and submit data to satisfy Phase 1 reporting requirements. Funding recipients must report any changes that impact GHG emission reduction estimates (i.e., assumptions or quantities) to CARB prior to project completion.

ⁱ California Air Resources Board. Funding Guidelines for Agencies Administering California Climate Investments. December 21, 2015. <http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/arb-funding-guidelines-for-ca-climate-investments.pdf>.

Appendix A. Example Projects

The following example is a hypothetical project to demonstrate how the FY 2016-17 LCT Car Sharing Pilot Project Quantification Methodology would be applied. The hypothetical projects have not undergone verification of any LCT Program requirements; all assumptions about project features are for quantification methodology demonstration purposes only. This example does not provide examples of the supporting documentation that is required of actual project applicants.

Overview of the Proposed Project

The proposed pilot project includes the purchase of one PHEV and the lease of one BEV, both 2016 model year. Each vehicle is estimated to be used for 5 trips a day for approximately 300 days a year. The expected average trip length is 5.5 miles. The PHEV will be purchased for a cost of \$30,000 and the BEV will be leased for three years for \$4,800 per year. The total grant amount being requested by the project is \$60,000.

Example Calculations using the Method in Section B

Emission factors in the example calculations were taken from Appendix A of the FY 2016-17 LCT Application for Car Sharing Pilot Project.

Step 1. Calculate the total combined VMT of the fleet

$$\begin{aligned}
 VMT_{Fleet} &= Vehicles * \frac{Trips}{Day} * \frac{Miles}{Trip} * \frac{Days}{Year} \\
 &= 2 \text{ vehicles} * 5 \frac{\text{trips}}{\text{day}} * 5.5 \frac{\text{miles}}{\text{trip}} * 300 \frac{\text{days}}{\text{year}} = 16,500 \frac{\text{vehicle} - \text{miles}}{\text{year}}
 \end{aligned}$$

Step 2. Calculate the GHG emissions produced by conventional vehicles

$$GHG_{CV} = VMT_{Fleet} * EF_{CV} = 16,500 \frac{\text{miles}}{\text{year}} * 382 \frac{\text{gCO}_2\text{e}}{\text{mile}} = 6,303,000 \frac{\text{gCO}_2\text{e}}{\text{year}}$$

Step 3. Calculate the GHG emissions produced by advanced technology vehicles

Step 3a. Calculate the GHG emissions of PHEVs

$$GHG_{PHEV} = VMT_{Fleet} * EF_{PHEV} * P_{PHEV} = 16,500 \frac{miles}{year} * 243 \frac{gCO_2e}{mile} * 0.5$$

$$= 2,004,750 \frac{gCO_2e}{year}$$

Step 3b. Calculate the GHG emissions of BEVs

$$GHG_{BEV} = VMT_{Fleet} * EF_{BEV} * P_{BEV} = 16,500 \frac{miles}{year} * 120 \frac{gCO_2e}{mile} * 0.5 = 990,000 \frac{gCO_2e}{year}$$

Step 3c. Calculate the combined GHG emissions of the advanced technology vehicles

$$GHG_{AV} = GHG_{PHEV} + GHG_{BEV} = 2,004,750 \frac{gCO_2e}{year} + 990,000 \frac{gCO_2e}{year} = 2,994,750 \frac{gCO_2e}{year}$$

Step 4. Calculate the Total GHG emissions reductions

$$ER_{Fleet} = \frac{GHG_{CV} - GHG_{AV}}{1,000,000} = \frac{6,303,000 \frac{gCO_2e}{year} - 2,994,750 \frac{gCO_2e}{year}}{1,000,000 \frac{gCO_2e}{MTCO_2e}} * 3 \text{ years}$$

$$= 9.9 \text{ MTCO}_2e$$

Finally, Total Project GHG Emission Reductions per dollar of GGRF funds can be calculated using Equation 7.

$$\frac{\text{Total Project GHG Emission Reduction (MTCO}_2e\text{)}}{\text{Total GGRF Funds (\$)}} = \frac{9.9 \text{ MTCO}_2e}{\$60,000}$$

$$= 0.00017 \frac{\text{MTCO}_2e}{\text{GGRF Dollar}}$$