

California Air Resources Board

Greenhouse Gas Quantification Methodology for the California Department of Resources Recycling and Recovery Waste Diversion Grant and Loan Program

Greenhouse Gas Reduction Fund Fiscal Year 2015-16



Note:

ARB is accepting public comments on the draft FY 2015-16 greenhouse gas (GHG) quantification methodology and draft calculator tool until April 22, 2016 via GGRFProgram@arb.ca.gov. This draft GHG quantification methodology and draft calculator tool are subject to change pending stakeholder comments and final Waste Diversion Program Guidelines for FY 2015-16.

DRAFT
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Section 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) for California Climate Investments. For the California Department of Resources Recycling and Recovery's (CalRecycle) Waste Diversion Program, ARB staff developed this GHG quantification methodology and the accompanying calculator tool for applicants to use to estimate the GHG emission reductions from each proposed project. ARB staff will periodically review each quantification methodology to evaluate its effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified.

This methodology uses calculations to estimate the reduction in GHG emissions associated with the diversion of waste from landfills. These calculations are based on estimates of tonnage of diverted material, composition of feedstock, tonnage of residual material, co-products produced, and emission reduction factors from published sources. This GHG quantification methodology applies to additional material only (i.e., material that would otherwise be sent to a landfill).

Methodology Development

ARB staff followed a set of principles to guide the development of the GHG quantification methodology. These principles ensure that the methodology for Waste Diversion Program projects would:

- Apply at the project-level;
- Align with the project types proposed for funding;
- Provide uniform methods to be applied statewide, and be accessible by all applicants;
- Support the analysis of GHG emission reductions from the proposed projects;
- Use existing and proven tools and methods; and
- Use project-level data for estimated tonnage diverted from landfills.

The methodology fits these objectives, and provides a uniform approach to quantify GHG emission reductions in metric tons of carbon dioxide equivalent (MTCO₂e).

Tools

This GHG quantification methodology and the accompanying calculator use emission factors derived from ARB tools and published studies that are publicly available, applicable statewide, and subject to regular updates to incorporate new information. The documents are free of charge, available to anyone with internet access, and provide California specific methods for quantifying the impacts of waste diversion projects.

Recycling Emission Reduction Factors (RERFs)

The material-specific RERFs were determined using a life-cycle approach to calculate the net avoided emissions from manufacturing using recycled material in place of raw virgin materials. The methods used, results, and discussion of the RERFs are detailed in reports titled *Method for Estimating Greenhouse Gas Emission Reductions from Recycling* (2011),¹ *Draft Estimating Greenhouse Gas Emission Reductions from Recycling Residential and Commercial Carpets* (2016),² and *Mattress and Box Spring Case Study* (2012).³ The RERFs are consistent with GHG accounting practices used in California and can be used to accurately and uniformly quantify GHG emission reductions attributable to the diversion of recycled materials (i.e., fiber, plastic, and glass) for the purpose of manufacturing recycled-content products.

Compost Emission Reduction Factors (CERFs)

The CERFs were determined using a life-cycle approach to calculate the net avoided emissions from diverting organic wastes to composting facilities. The methods used, results, and discussion of the CERFs are detailed in a draft ARB report titled *Draft Method for Estimating Greenhouse Gas Emission Reductions from Diversion of Organic Waste from Landfills to Compost Facilities* (2016).⁴ The CERFs are consistent with GHG accounting practices used in California and can be used to accurately and uniformly quantify GHG emission reductions attributable to the diversion of organic waste (i.e., food scraps, yard trimmings, branches, leaves, grass, and organic municipal waste) for the purpose of composting.

Low Carbon Fuel Standard (LCFS) Regulation and Pathways

The LCFS pathways use a well-to-wheels (WTW) life-cycle approach to determine the emissions associated with 27 different transportation fuels taking into consideration the fuel production, transportation, distribution and use. This GHG quantification methodology uses the fuel production rates and GHG emissions from the *Low Carbon Fuel Standard (LCFS) Pathway for the Production of Biomethane from High Solids Anaerobic Digestion (HSAD) of Organic (Food and Green) Wastes* (2014)⁵ and *Low Carbon Fuel Standard (LCFS) Pathway for the Production of Biomethane from the Mesophilic Anaerobic Digestion of Wastewater Sludge at Publicly-Owned Treatment Works (POTW)* (2014)⁶ to accurately and uniformly quantify GHG emission reductions attributable to the diversion of organic waste (i.e., food scraps, yard trimmings, branches, leaves, grass, and organic municipal waste) for the purpose of anaerobic digestion.

¹ http://www.arb.ca.gov/cc/protocols/localgov/pubs/recycling_method.pdf

² <https://www.arb.ca.gov/cc/waste/carpetrerf.pdf>

³ <http://www.calrecycle.ca.gov/publications/Documents/1430/20121430.pdf>

⁴ <http://www.arb.ca.gov/cc/waste/cerffinal.pdf>

⁵ <http://www.arb.ca.gov/fuels/lcfs/121514hsad.pdf>

⁶ <http://www.arb.ca.gov/fuels/lcfs/121514wastewater.pdf>

Food Rescue Emission Reduction Factor

The GHG emission reduction factor for food rescue was calculated based on GHG emissions from avoidable U.S. food waste as reported in *The Climate Change and Economic Impacts of Food Waste in the United States (2012)*⁷ published in the International Journal on Food System Dynamics also used by institutions such as the U.S. Department of Agriculture (USDA) and Organisation for Economic Co-operation and Development (OECD) to estimate food losses.

Transportation Emissions

Transportation related emissions in this GHG quantification methodology are calculated based on a WTW emission factor utilizing carbon intensity data, fuel energy density values, and fuel efficiency values. The emission factor was developed using ARB's Low Carbon Fuel Standard,⁸ ARB's Mobile Source Emission Factor Model (EMFAC 2014),⁹ and California-modified Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (CA-GREET 2.0).¹⁰ The WTW method accounts for the emissions produced from the production and distribution of the different fuel types as well as any associated exhaust emissions.

GHG Emission Reduction Calculator Tool

Applicants must use this GHG quantification methodology, in conjunction with the accompanying calculator tool, to estimate the GHG emission reductions from their proposed waste diversion projects. The calculator tool can be downloaded here: <http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm>. Additional documentation on how the emission reduction factors used in the calculator were developed is available from the same website. Applicants that propose eligible projects that cannot be calculated using the calculator tool (e.g., manufacturing projects from a recycled material not included in the calculator), may propose the use of alternative GHG quantification methods. Applicants who intend to use alternative quantification methods must contact CalRecycle prior to submitting an application. CalRecycle, in consultation with ARB, will evaluate the proposed alternative method to ensure that 1) the proposed project is substantially outside of the scope of the calculator tool and warrants project-specific calculations; and 2) the proposed alternative method is appropriate and of sufficient quality.

⁷ <http://www.cleanmetrics.com/pages/ClimateChangeImpactofUSFoodWaste.pdf>

⁸ Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Re-Adoption of the Low Carbon Fuel Standard, December 2014 available at:

<http://www.arb.ca.gov/regact/2015/lcfs2015/lcfs15isor.pdf>

⁹ <http://www.arb.ca.gov/emfac/2014/>

¹⁰ Direct values (without energy efficiency ratio adjustments). Source: California Air Resources Board, CA-GREET 1.8b versus 2.0 CI Comparison Table, April 1, 2015 available at:

http://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/040115_pathway_ci_comparison.pdf

Major Updates

ARB updated the prior interim quantification methodology to enhance the analysis and provide additional clarity. The major changes include:

- Use of updated LCFS pathways, revised draft CERF, draft carpet RERF and mattress and box spring study;
- Application of standardized emission reduction factors to estimate GHG emission reductions from high solid anaerobic digestion projects;
- Removal of GHG benefits associated with the application of compost to agricultural and working lands from the GHG accounting boundary;
- Use of consistent assumptions pertaining to avoided landfill emissions across project types;
- Exclusion of biogenic CO₂ emissions from the combustion of biomethane to produce electricity;
- Addition of calculation for food waste prevention source reduction projects;
- Application of a standardized emission reduction factor to estimate GHG emissions associated with the transportation of diverted material;
- Details on requirements for reporting after funding award consistent with Funding Guidelines for Agencies that Administer California Climate Investments;¹¹ and
- Additional definitions and clarity in the calculator tool.

Waste Diversion Project Types

CalRecycle developed the GGRF Waste Diversion Grant and Loan Program to reduce GHG emissions by supporting the expansion of the waste management infrastructure such as composting and anaerobic digestion facilities as well as facilities that manufacture recycled materials into beneficial products. Projects will result in reduced methane emissions from landfills and further GHG reductions in upstream resource management and manufacturing processes. Funded projects will increase the quantity of newly diverted materials from the following categories:

- 1) California-generated green waste, food materials, or alternative daily cover (ADC) to be composted or digested; and
- 2) California-generated fiber (paper, textiles, carpet, or wood), plastic, or glass materials to be used to manufacture products.

This GHG quantification methodology and accompanying calculator tool must be used to estimate the net GHG emission reduction associated with the following measures:

- Manufacturing Value-Added Finished Products using Recycled Fiber, Plastic, and Glass (FPG);
- Composting of Organics;

¹¹ California Air Resources Board. Funding Guidelines for Agencies Administering California Climate Investments. December 21, 2015. <http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/arb-fundingguidelines-for-ca-climate-investments.pdf>

- High Solid Anaerobic Digestion (HSAD) of Organics Producing Biofuels or Bioenergy;
- Low Solid Anaerobic Digestion (LSAD) of Organics Producing Biofuels or Bioenergy; and
- Food Waste Prevention.

Applicants must use the project type-specific quantification method provided in this GHG quantification methodology and the accompanying calculator. If the applicant is proposing an eligible project that cannot be calculated using the calculator tool, they must contact CalRecycle as described on the previous page.

GHG Emission Reductions Quantification Approach

The following metric will be used for ARB reporting purposes to assess the effectiveness of the project to reduce GHG emissions per dollar of GGRF funds:

$$\frac{\text{Total Project GHG Emission Reductions in Metric Tons of CO}_2\text{e}}{\text{GGRF Funds Requested (\$)}}$$

GGRF Funds Requested is the dollar amount requested through the Waste Diversion Program and any other GGRF programs to which the applicant has or may apply. Section B of this quantification methodology describes the process for estimating the GHG emission reductions for proposed waste diversion projects in FY 2015-16. Additional documentation and reporting requirements are provided in sections C and D.

Program Assistance

CalRecycle staff will review the quantification portions of the waste diversion project applications to ensure that the methods described in this document were properly applied to estimate the GHG emission reductions for the proposed project. Applicants should use the following resources for additional questions and comments:

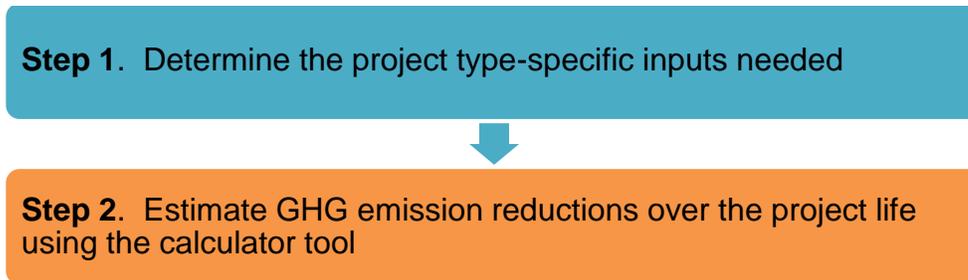
- Questions on this quantification document should be sent to GGRFProgram@arb.ca.gov.
- For more information on ARB's efforts to support implementation of GGRF investments, see: www.arb.ca.gov/auctionproceeds.
- Questions not related to this quantification document but pertaining to the Waste Diversion Program should be sent to GHGReductions@CalRecycle.ca.gov.
- Applicants with project proposals outside of the scope of the calculator tool that warrant project-specific calculations must contact CalRecycle at GHGReductions@CalRecycle.ca.gov.

Section B. Quantification Methodology

Overview

Applicants will follow the steps outlined in Figure 1 to estimate the total GHG emission reductions from the proposed project over a project life of 10 years. Detailed instructions for each step are provided on subsequent pages.

Figure 1. Steps to Estimating GHG Emission Reductions



Step 1: Determine the Project Type-Specific Inputs Needed

The following section describes the data inputs needed to estimate the GHG emission reductions for proposed projects with the calculator tool per project type.

Table 1. Required Calculator Inputs for Eligible Project Type(s)

Manufacturing Value-Added Finished Products using Recycled Fiber, Plastic, and Glass (FPG)
<p>General Information (Read Me worksheet)</p> <ul style="list-style-type: none"> • Project Name; • Grant ID, if applicable; • Contact Name; • Contact Email; and • Date Completed. <p>Greenhouse Gas Quantification Inputs (FPG worksheet)</p> <ul style="list-style-type: none"> • Net tonnage of newly diverted material of each feedstock that will be used in manufacturing of recycled products each year of the project life; and • Feedstock categories: Glass, HDPE, PET, Mixed Plastics, Corrugated Cardboard, Magazines/3rd Class Mail, Newspaper, Office Paper, Phone Books, Dimensional Lumber, Mattress and Box Spring Sets, Nylon 6 Carpet Engineered Resin, Nylon 6 Carpet Cushion, Nylon 6 Tile Backing, Nylon 6.6 Carpet Engineered Resin, Nylon 6.6 Carpet Cushion, Nylon 6.6 Tile Backing, PET Carpet Cushion, Polypropylene Carpet Engineered Resin, Polypropylene Carpet Cushion, and Polypropylene Extruded Yarn. <p>GHG Emission Reduction/GGRF \$ Requested (GHG Summary worksheet)</p> <ul style="list-style-type: none"> • Total amount of GGRF funds requested to implement the project.
Composting of Organics
<p>General Information (Read Me worksheet)</p> <ul style="list-style-type: none"> • Project Name; • Grant ID, if applicable; • Contact Name; • Contact Email; and • Date Completed. <p>Greenhouse Gas Quantification Inputs (Compost worksheet)</p> <ul style="list-style-type: none"> • Tonnage of organic material that will be diverted from a landfill for windrow composting each year of the project life; and/or • Tonnage of organic material that will be diverted from a landfill for aerated static pile (ASP) composting each year of the project life; • Composition of feedstock (i.e., % food waste and % green waste; default values available if unknown, see accompanying calculator); and • Tonnage of residual material that will be landfilled or used as alternative daily cover (ADC) each year of the project life. <p>GHG Emission Reduction/GGRF \$ Requested (GHG Summary worksheet)</p> <ul style="list-style-type: none"> • Total amount of GGRF funds requested to implement the project.

High Solid Anaerobic Digestion (HSAD) of Organics Producing Biofuels or Bioenergy

General Information (Read Me worksheet)

- Project Name;
- Grant ID, if applicable;
- Contact Name;
- Contact Email; and
- Date Completed.

Greenhouse Gas Quantification Inputs (HSAD worksheet)

- Tonnage of newly diverted organic material that will be sent to an anaerobic digester to produce compressed natural gas (CNG) and digestate that is landfilled or used as alternative daily cover (ADC) each year of the project life;
- Tonnage of newly diverted organic material that will be sent to an anaerobic digester to produce CNG and digestate that is composted each year of the project life;
- Tonnage of newly diverted organic material that will be sent to an anaerobic digester to produce electricity and digestate that is landfilled or used as alternative daily cover (ADC) each year of the project life; and/or
- Tonnage of newly diverted organic material that will be sent to an anaerobic digester to produce electricity and digestate that is composted each year of the project life.
- Tonnage of residual material that will be landfilled or used as alternative daily cover (ADC) each year of the project life.

GHG Emission Reduction/GGRF \$ Requested (GHG Summary worksheet)

- Total amount of GGRF funds requested to implement the project.

Low Solid Anaerobic Digestion (LSAD) of Organics Producing Biofuels or Bioenergy

General Information (Read Me worksheet)

- Project Name;
- Grant ID, if applicable;
- Contact Name;
- Contact Email; and
- Date Completed.

Greenhouse Gas Quantification Inputs (LSAD worksheet)

- Tonnage of newly diverted organic material that will be sent to an anaerobic digester to produce biofuel or bioenergy and digestate that is landfilled or used as alternative daily cover (ADC) each year of the project life;
- Tonnage of newly diverted organic material that will be sent to an anaerobic digester to produce biofuel or bioenergy and digestate that is composted each year of the project life;
- Composition of Feedstock (% food waste, % green waste, and % mixed paper waste; default values available if unknown, see accompanying calculator);
- Tonnage of material that will be sent for pre-processing prior to sending organic material to an anaerobic digester each year of the project life;
- Tonnage of residual material that will be composted each year of the project life;

- Tonnage of residual material that will be landfilled or used as alternative daily cover (ADC) each year of the project life;
- Power requirement of equipment used for pre-processing, if applicable (default value is available if unknown, see accompanying calculator);
- Efficiency of pre-processing equipment, if applicable (default value is available if unknown, see accompanying calculator); and
- Hours that the pre-processing equipment will operate each year of the project life, if applicable.

GHG Emission Reduction/GGRF \$ Requested (GHG Summary worksheet)

- Total amount of GGRF funds requested to implement the project.

Food Waste Prevention

General Information (Read Me worksheet)

- Project Name;
- Grant ID, if applicable;
- Contact Name;
- Contact Email; and
- Date Completed.

Greenhouse Gas Quantification Inputs (Food Waste worksheet)

- Tonnage of edible food that will be rescued and used to feed people each year of the project life.
- Tonnage of food waste that will be prevented from being landfilled as a result of source reduction.

GHG Emission Reduction/GGRF \$ Requested (GHG Summary worksheet)

- Total amount of GGRF funds requested to implement the project.

Step 2: Estimate GHG Emission Reductions Over the Project Life Using the Calculator Tool

Once the applicant has compiled all of the required inputs from Step 1, the applicant should download the calculator tool and enter project specific data to estimate GHG emission reductions. The calculator tool can be accessed here:

<http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm>.

The calculator allows users to estimate the net GHG benefit from a variety of specific waste diversion activities using a life-cycle approach. Each eligible activity has a worksheet within the calculator. Applicants must input data from Step 1 into the worksheets that apply to the proposed project. The calculator provides fields for users to input project specific information. User input fields are shaded yellow and calculator outputs of GHG emission reduction estimates are shaded grey. After the user inputs are entered for each proposed activity, the GHG summary worksheet displays the annual and lifetime project GHG emission reductions as well as the estimated GHG emission reduction per GGRF dollar requested.

Section C. Documentation

The final step to complete this quantification methodology is to record the estimated avoided GHG emissions and provide documentation of the inputs and calculations.

Applicants are required to provide electronic documentation that is complete and sufficient enough to allow the quantification calculations to be reviewed and replicated. Paper copies of any materials must be available upon request by CalRecycle or ARB staff.

Documentation must include, at a minimum:

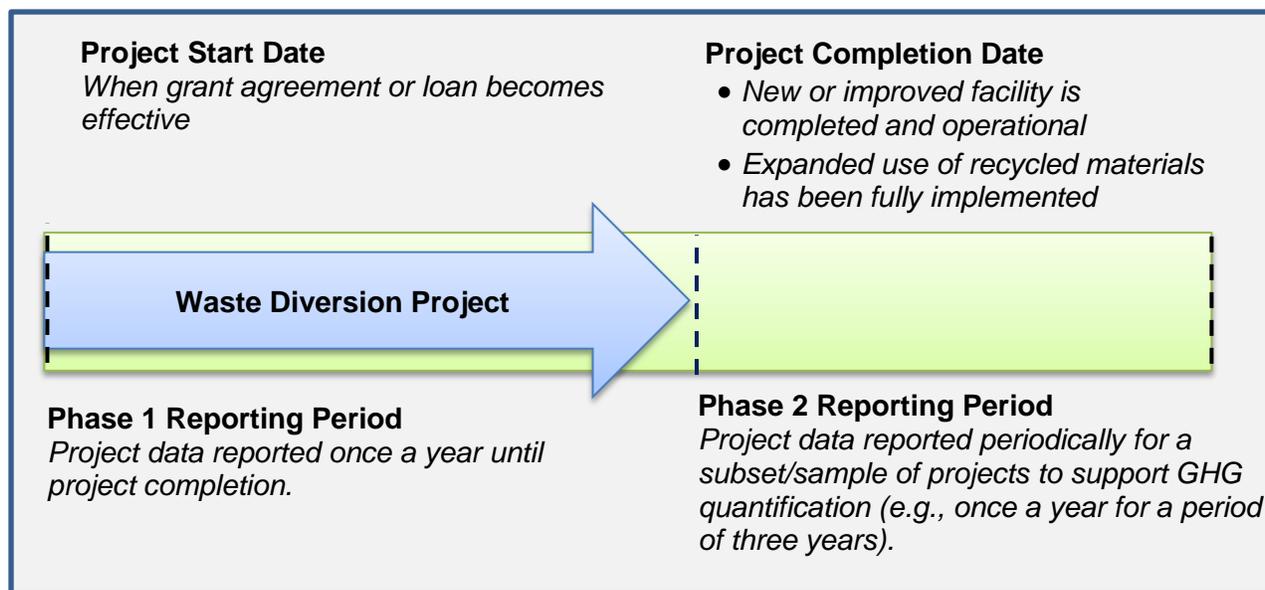
- Project application;
- Project description, including excerpts or specific references to the location in the main waste diversion application of the project information necessary to complete the applicable portions of the GHG quantification methodology;
- Populated calculator tool file;
- Project data support, including:
 - Documentation of the project data used as inputs in the calculator;
 - References to public documents that are the source of the project data;
 - Explanation of GHG calculation methods including appropriate citations and calculation worksheets if using an alternative quantification method (only applicable to applicants proposing eligible projects outside of the scope of the calculator tool with approval from CalRecycle);
- Summary page with, at minimum, the following information from the GHG summary worksheet of the calculator:
 - Avoided GHG emission estimates for each year of the project life;
 - Estimate of total avoided GHG emissions over the project life;
 - GGRF funds requested for the project; and
 - Estimated total avoided GHG emissions per GGRF funds requested.

Section D. Reporting After Funding Award

Accountability and transparency are essential elements for all projects funded by the GGRF. Each administering agency is required to track and report on the benefits of the California Climate Investments funded under their program(s) and each funding recipient has the obligation to provide the necessary data or access to data for their project to support reporting on project outcomes.

In 2015, ARB developed Funding Guidelines for Agencies Administering California Climate Investments (Funding Guidelines).¹² These Funding Guidelines describe the reporting requirements and set the minimum project-level reporting requirements for projects funded by CalRecycle. Volume III of the Funding Guidelines summarizes the major reporting components that Caltrans must report to ARB. Because much of this data comes directly from waste diversion projects, waste diversion funding recipients will need to provide project data to CalRecycle to support these reporting requirements. Figure 2 and Table 2 below show the project phases and when reporting is required.

Figure 2. Project Reporting Timeline



¹² California Air Resources Board. Funding Guidelines for Agencies Administering California Climate Investments. December 21, 2015. <https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/arb-funding-guidelines-for-ca-climate-investments.pdf>

Table 2. Quantification and Reporting By Project Phase

	Timeframe	Quantification Methodology Section
Project Selection	Covers the period from solicitation to selection of projects and funding awards	All applicants use methods in this QM to estimate GHG reductions based on application data.
Phase 1	Covers the period from the beginning of the project until it becomes operational or the initial implementation is completed	Funded projects use methods in this QM, as needed, to update GHG estimates based on project changes.
Phase 2	Starts after Phase 1 is complete and a project becomes operational	GHG reductions achieved are quantified and reported for a subset of funded projects.

Phase 1 reporting is required for all waste diversion funding recipients during project implementation (e.g., initial construction). This quantification methodology provides guidance on how to estimate project benefits to satisfy Phase 1 reporting requirements. At a minimum, ARB expects that waste diversion funding recipients will report to CalRecycle once a year during project construction (for projects with a capital component) or during implementation (for projects without a capital component) and once at the end of the project.

Phase 2 reporting is required for only a subset of waste diversion projects and is intended to document actual project benefits achieved after the project becomes operational. Phase 2 data collection and reporting will not be required for every project. CalRecycle will be responsible for identifying the subset of individual projects that must complete Phase 2 reporting, identifying who will be responsible for collecting Phase 2 data, and for reporting the required information to ARB. ARB will work with CalRecycle to address “Phase 2” procedures, including but not limited to:

- The **timelines** for Phase 2 reporting, i.e., when does Phase 2 reporting begin, how long will Phase 2 reporting be needed.
- As applicable, **approaches for determining the subset of projects** that need Phase 2 reporting (i.e., how many **X** projects out of **Y** total projects are required to have Phase 2 reporting).
- **Methods for monitoring or measuring** the necessary data to quantify and document achieved GHG reductions and other select project benefits.
- **Data to be collected**, including data field needed to support quantification of GHG emission benefits.
- Reporting requirements for transmitting the data to ARB or CalRecycle for program transparency and use in reports.

Once the Phase 2 quantification method and data needs are determined, ARB will develop and post the final ARB approved Phase 2 methodology for use in Phase 2 reporting.