

**California Air Resources Board**

## **Quantification Methodology**

**California Department of Resources Recycling and Recovery  
Recycled Fiber, Plastic, and Glass Grant Program**

**California Climate Investments**



**FINAL  
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## Table of Contents

Section A. Introduction.....	1
Methodology Development.....	2
Tools .....	2
Updates .....	4
Section B. Methods.....	5
Project Types .....	5
General Approach .....	5
Section C. References .....	7
Table 1. General Approach to Quantification by Project Type.....	5

## Section A. Introduction

California Climate Investments is a statewide initiative that puts billions of Cap-and-Trade dollars to work facilitating greenhouse gas (GHG) emission reductions; strengthening the economy; improving public health and the environment; and providing benefits to residents of disadvantaged communities, low-income communities, and low-income households, collectively referred to as “priority populations.” Where applicable and to the extent feasible, California Climate Investments must maximize economic, environmental, and public health co-benefits to the State.

The California Air Resources Board (CARB) is responsible for providing guidance on estimating the GHG emission reductions and co-benefits from projects receiving monies from the Greenhouse Gas Reduction Fund (GGRF). This guidance includes quantification methodologies, co-benefit assessment methodologies, and benefits calculator tools. CARB develops these methodologies and tools based on the project types eligible for funding by each administering agency, as reflected in the program expenditure records available at: [www.arb.ca.gov/cci-expenditurerecords](http://www.arb.ca.gov/cci-expenditurerecords).

For the California Department of Resources Recycling and Recovery (CalRecycle) Recycled Fiber, Plastic, and Glass Grant Program (FPG), CARB staff developed this FPG Quantification Methodology to provide guidance for estimating the GHG emission reductions and selected co-benefits of each proposed project type. This methodology uses calculations to estimate reductions in GHG emissions associated with the diversion of recyclable materials from landfills. These calculations are based on estimates of tonnage of diverted material 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). Projects will report the total project GHG emission reductions and select co-benefits estimated using this methodology as well as the total project GHG emission reductions per dollar of GGRF funds requested.

The FPG Benefits Calculator Tool automates methods described in this document, provides a link to a step-by-step user guide with a project example, and outlines documentation requirements. Projects will report the total project GHG emission reductions and co-benefits estimated using the FPG Benefits Calculator Tool as well as the total project GHG emission reductions per dollar of GGRF funds requested. The FPG Benefits Calculator Tool is available for download at: <http://www.arb.ca.gov/cci-resources>.

Using many of the same inputs required to estimate GHG emission reductions, the FPG Benefits Calculator Tool estimates the following co-benefits and key variables from FPG projects: select criteria and toxic air pollutants (in pounds (lbs))—including nitrogen oxide (NO<sub>x</sub>), reactive organic gases (ROG), and fine particulate matter less than 2.5 micrometers (PM<sub>2.5</sub>); and material diverted from landfill (in tons). Additional co-benefits for which CARB assessment methodologies were not incorporated into the FPG Benefits Calculator Tool may also be applicable to the project. Applicants should

consult the FPG guidelines, solicitation materials, and agreements to ensure they are meeting FPG requirements. All CARB co-benefit assessment methodologies are available at: [www.arb.ca.gov/cci-cobenefits](http://www.arb.ca.gov/cci-cobenefits).

## Methodology Development

CARB and CalRecycle developed this FPG Quantification Methodology consistent with the guiding principles of California Climate Investments, including ensuring transparency and accountability.<sup>1</sup> CARB and CalRecycle developed this FPG Quantification Methodology to be used to estimate the outcomes of proposed projects, inform project selection, and track results of funded projects. The implementing principles ensure that the methodology would:

- Apply at the project-level;
- Provide uniform methods to be applied statewide, and be accessible by all applicants;
- Use existing and proven methods;
- Use project-level data, where available and appropriate; and
- Result in GHG emission reduction estimates that are conservative and supported by empirical literature.

CARB assessed peer-reviewed literature and tools and consulted with experts, as needed, to determine methods appropriate for the FPG project types. CARB also consulted with CalRecycle to determine project-level inputs available. The methods were developed to provide estimates that are as accurate as possible with data readily available at the project level.

CARB released the Draft FPG Quantification Methodology and Draft FPG Benefits Calculator Tool for public comment in January 2019. This Final FPG Quantification Methodology and accompanying FPG Benefits Calculator Tool have been updated to address public comments, where appropriate, and for consistency with updates to the FPG Guidelines.

In addition, the University of California, Berkeley, in collaboration with CARB, developed assessment methodologies for a variety of co-benefits such as providing cost savings, lessening the impacts and effects of climate change, and strengthening community engagement. Co-benefit assessment methodologies are posted at: [www.arb.ca.gov/cci-cobenefits](http://www.arb.ca.gov/cci-cobenefits).

## Tools

Applicants must use the FPG Quantification Methodology, in conjunction with the accompanying Benefits Calculator Tool, to estimate the GHG emission reductions and co-benefits. These tools can be downloaded from: <http://www.arb.ca.gov/cci-resources>.

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<sup>1</sup> California Air Resources Board. [www.arb.ca.gov/cci-fundingguidelines](http://www.arb.ca.gov/cci-fundingguidelines)

Applicants that propose eligible projects that cannot be calculated using the Benefits Calculator Tool, such as projects that recycle a material not included in the Tool, may propose the use of alternative GHG quantification methods. Applicants who intend to use alternative quantification methods must contact CalRecycle via [email](#) to describe how the proposed project is outside the scope of the Tool and indicate that they would like to use an alternative GHG methodology. CalRecycle will confer with CARB, and the applicant will be notified whether they have permission to use an alternative method.

#### 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),<sup>2</sup> U.S. EPA's Waste Reduction Model (Version 14)<sup>3</sup>, and *Advancing Sustainable Materials Management: Facts and Figures 2013: Assessing Trends in Material Generation, Recycling and Disposal in the United States*.<sup>4</sup> 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 fiber, plastic, and glass for the purpose of manufacturing recycled-content products.

In addition to the tools above, the FPG Benefits Calculator Tool relies on CARB-developed emission factors. CARB has established a single repository for emission factors used in CARB benefits calculator tools, referred to as the California Climate Investments Quantification Methodology Emission Factor Database (Database), available at: <http://www.arb.ca.gov/cci-resources>. The Database Documentation explains how emission factors used in CARB benefits calculator tools are developed and updated.

Applicants must use the FPG Benefits Calculator Tool to estimate the GHG emission reductions and co-benefits of the proposed project. The FPG Benefits Calculator Tool can be downloaded from: <http://www.arb.ca.gov/cci-resources>.

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<sup>2</sup> [http://www.arb.ca.gov/cc/protocols/localgov/pubs/recycling\\_method.pdf](http://www.arb.ca.gov/cc/protocols/localgov/pubs/recycling_method.pdf)

<sup>3</sup> <https://www.epa.gov/warm>

<sup>4</sup> [https://www.epa.gov/sites/production/files/2015-09/documents/2013\\_advncng\\_smm\\_rpt.pdf](https://www.epa.gov/sites/production/files/2015-09/documents/2013_advncng_smm_rpt.pdf)

## Updates

CARB staff periodically review each quantification methodology and benefits calculator tool to evaluate their effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified. CARB updated the FPG Quantification Methodology from the previous version<sup>5</sup> to enhance the analysis and provide additional clarity. The changes include:

- Creation of a standalone FPG Benefits Calculator Tool;
- Addition of a link to a step-by-step User Guide with a project example; and
- Addition of a new Co-benefits Summary tab in the Benefits Calculator Tool that summarizes co-benefits and key variables using many of the same inputs used to estimate GHG emission reductions.

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<sup>5</sup> [Greenhouse Gas Quantification Methodology for the California Department of Resources Recycling and Recovery Waste Diversion Grant and Loan Program \(FY15-16 & 16-17\)](#)

## Section B. Methods

The following section provides details on the methods supporting emission reductions in the FPG Benefits Calculator Tool.

### Project Types

CalRecycle developed ten recycling project types that meet the objectives of the FPG and for which there are methods to quantify GHG emission reductions.<sup>6</sup> Other project features may be eligible for funding under the FPG; however, each project requesting GGRF funding must include at least one of the following:

- California-generated fiber (paper, textiles, or wood), plastic, or glass materials to be used to manufacture products.

### General Approach

Methods used in the FPG Benefits Calculator Tool for estimating the GHG emission reductions and air pollutant emission co-benefits by activity type are provided in this section. The Database Documentation explains how emission factors used in CARB benefits calculator tools are developed and updated.

These methods account for the construction or expansion of waste management facilities that manufacture recycled materials into beneficial products. Projects result in GHG reductions in upstream resource management and manufacturing processes. In general, the GHG emission reductions are estimated in the FPG Benefits Calculator Tool using the approaches in Table 1. The FPG Benefits Calculator Tool also estimates air pollutant emission co-benefits and key variables using many of the same inputs used to estimate GHG emission reductions.

**Table 1. General Approach to Quantification by Project Type**

Recycling Fiber, Plastic, and Glass Project Type
$\text{GHG emission reductions} =$ $\text{Emissions from manufacturing goods from raw materials}$ $- \text{Emissions from manufacturing goods from recycled materials}$

<sup>6</sup> <https://www.calrecycle.ca.gov/Climate/GrantsLoans/>

## A. GHG Emission Reductions from Recycling of Fiber, Plastic, and Glass

The GHG emission reductions from recycling fiber, plastic, or glass materials is estimated based on lifecycle emission reduction factors developed by CARB using Equation 1.

### Equation 1: GHG Emission Reductions from Recycling Fiber, Plastic, and Glass Materials

$ER_{FPG,GHG} = ERF \times MD$		
<i>Where,</i>		<u>Units</u>
$ER_{FPG,GHG}$	= GHG emission reductions associated with recycling of fiber, plastic or glass material	MTCO <sub>2e</sub>
$ERF$	= Emission reduction factor for recycled fiber, plastic, or glass material	MTCO <sub>2e</sub> /short ton of material
$MD$	= Net tonnage of material diverted	short ton of material

## B. Criteria and Toxic Emission Reductions from Recycling of Fiber, Plastic, and Glass

The criteria and toxic emission reductions are based on energy savings from recycling fiber, plastic, and glass materials. Emission reduction factors for criteria and toxic emissions are based on EPA's WARM Model energy savings for each material type and California grid emission factors.

### Equation 2: Criteria and Toxic Emission Reductions from Recycling Fiber, Plastic, and Glass Materials

$ER_{FPG,CT} = ES \times EF_{Grid} \times MD$		
<i>Where,</i>		<u>Units</u>
$ER_{FPG,CT}$	= Criteria and toxic emission reductions associated with recycling of fiber, plastic, or glass material	lbs
$ES$	= Energy savings from recycling of fiber, plastic, or glass material	kWh/short ton of material
$EF_{Grid}$	= Criteria and toxic emission factor based on the California electrical grid	kWh/lbs
$MD$	= Net tonnage of material diverted	short ton of material

## Section C. References

The following references were used in the development of this Quantification Methodology and the FPG Benefits Calculator Tool.

CARB Method for Estimating Greenhouse Gas Emission Reductions from Recycling (2011). [http://www.arb.ca.gov/cc/protocols/localgov/pubs/recycling\\_method.pdf](http://www.arb.ca.gov/cc/protocols/localgov/pubs/recycling_method.pdf)

U.S. EPA Advancing Sustainable Materials Management: Facts and Figures 2013 Assessing Trends in Material Generation, Recycling, and Disposal in the United States (June 2015) [https://www.epa.gov/sites/production/files/2015-09/documents/2013\\_advncng\\_smm\\_rpt.pdf](https://www.epa.gov/sites/production/files/2015-09/documents/2013_advncng_smm_rpt.pdf)

U.S. EPA Waste Reduction Model. Version 14. Accessed 1/14/2019. <https://www.epa.gov/warm>