California Air Resources Board

Quantification Methodology for the California Department of Resources Recycling and Recovery Food Waste Prevention and Rescue Program

California Climate Investments Greenhouse Gas Reduction Fund

FINAL
July 20, 2018

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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 benefit 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: https://ww2.arb.ca.gov/resources/documents/cci-attestation-memorandums-and-expenditure-records.

For the California Department of Resources Recycling and Recovery (CalRecycle) Food Waste Prevention and Rescue Program, CARB staff developed this Food Waste Prevention and Rescue Program Quantification Methodology and Food Waste Prevention and Rescue Program Benefits Calculator Tool to provide guidance for estimating the GHG emission reductions and select co-benefits of each proposed project type (Section B), provide instructions for documenting and supporting the estimate (Section C), and outline the process for tracking and reporting GHG and other benefits once a project is funded (Section D).

This methodology uses calculations to estimate reductions in GHG emissions associated with the diversion or prevention of food waste 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.

In an effort to enhance the analysis, provide greater transparency, and assist in project-level reporting, CARB has included an additional output tab for select co-benefits and key variables. Key variables are project characteristics that contribute to a project's GHG emission reductions and signal an additional benefit (e.g., renewable energy generated, trees planted).

Using largely the same inputs required to estimate GHG emission reductions, the Food Waste Prevention and Rescue Program Benefits Calculator Tool estimates the following co-benefits and key variables from Food Waste Prevention and Rescue Program projects: select criteria and toxic air pollutants (in pounds (lbs))—including nitrogen oxide (NO_x), reactive organic gases (ROG), diesel particulate matter (diesel PM), and fine particulate matter less than 2.5 micrometers ($PM_{2.5}$); edible food rescued and donated (in tons); material diverted from landfill (in tons); reduction of vehicle miles traveled (in miles); and energy and fuel cost savings (in dollars). Additional co-benefits for which CARB assessment methodologies were not incorporated into the Benefits Calculator Tool may also be applicable to the project. Applicants should consult the Food Waste Prevention and Rescue Program guidelines, solicitation

materials, and agreements to ensure they are meeting Food Waste Prevention and Rescue Program requirements.

Food Waste Prevention and Rescue Project Types

CalRecycle Food Waste Prevention and Rescue Program reduces GHG emissions by diverting edible food from the landfill or prevents the generation of food waste. Projects result in reduced methane emissions from landfills and GHG reductions in upstream resource management and manufacturing processes.

CalRecycle developed project types that meet the objectives of the Food Waste Prevention and Rescue Program and for which there are methods to quantify GHG emission reductions.[i] Each project requesting GGRF funding must include at least one of the following project types:

- Food Waste Prevention
- Edible Food Waste Rescue.

Food waste prevention, also known as source reduction of food waste, is the elimination of food waste before it is created. Food waste prevention activities include but are not limited to: use of food waste prevention technology/software, conducting food waste assessments to identify where and why food waste is occurring and then purchasing less or preparing less food based on waste assessment results, implementing trayless dining, creating food waste prevention training programs, and food waste prevention education and outreach. All prevention activities must be quantifiable. If multiple food waste prevention strategies will be used, the applicant must provide clear calculations to quantify the impact of each strategy. Food waste prevention does not include food rescue, diverting food waste to compost or anaerobic digestion, or any activity that manages food waste once the waste has already been created.

Edible food rescue is the act of collecting edible food that would otherwise be landfilled for distribution to feed people.

Section B of this Quantification Methodology details the methods to use based on the project type(s) proposed.

Methodology Development

CARB and CalRecycle developed this Quantification Methodology consistent with the guiding implementation principles of California Climate Investments, including ensuring transparency and accountability.[ii] CARB and CalRecycle developed this 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 tools and methods;
- Use project-level data, where available and appropriate (e.g. estimated tonnage diverted from a landfill); 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 Food Waste Prevention and Rescue Program project types. CARB also consulted with CalRecycle to available determine project-level inputs. The methods were developed to provide estimates that are as accurate as possible with data readily available at the project level.

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 reducing the incidence of asthma/respiratory disease. As they become available, co-benefit assessment methodologies are posted at: www.arb.ca.gov/cci-cobenefits.

Tools

This Food Waste Prevention and Rescue Program Quantification Methodology and accompanying Food Waste Prevention and Rescue Program Benefits Calculator Tool adopted methods and emission factors from existing quantification methodologies 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 online, and provide California specific methods for quantifying the impacts of waste diversion projects. These source materials are described below.

CARB has established a single repository for emission factors used in quantification methodologies, referred to as the California Climate Investments Quantification Methodology Emission Factor Database (Database).[iii] The Database Documentation explains how emission factors used in CARB quantification methodologies are developed and updated.

Compost Emission Reduction Factor (CERF)
The 2017 draft *Method for Estimating Greenhouse Gas Emission Reductions from Diversion of Organic Waste from Landfills to Compost Facilities*[iv] document (CERF) calculates the net avoided emissions from diverting organic waste from landfills to composting facilities. It includes California-specific emission factors for avoided landfill emissions attributable to the diversion of organic waste (i.e., food scraps, yard trimmings, branches, leaves, grass, and organic municipal waste). These emission reduction factors are used consistently across all organic waste diversion projects included in the Quantification Methodology and Benefits Calculator Tool. The methods used, assumptions, and results are detailed in the draft CERF.

Food Rescue Emission Reduction Factor
The GHG emission reduction factor for food rescue is calculated based on lifecycle 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)[v] and published in the International Journal on Food System Dynamics. These factors are also used by institutions such as the U.S. Department of Agriculture (USDA) and Organisation for Economic Co-operation and Development (OECD) to estimate emissions from food waste.

Refrigeration and Freezer Equipment Emissions
The emissions associated with refrigerant leakage from equipment used for food rescue was developed using the inventory from CARB's Refrigerant Management Program as described in *California's High Global Warming Potential Gases Emission Inventory (2015)* [vi]. The emissions associated with energy consumption of the refrigeration equipment is calculated based on the energy use requirements set by the California Energy Commission in *2015 Appliance Efficiency*

Regulations[vii] and the Department of Energy in the *Code of Federal Regulations: 10 CFR 431.66 - Energy conservation standards and their effective dates.*[viii]

Transportation Emissions

Transportation related emissions in this GHG quantification methodology are calculated based on a well-to-wheel (WTW) emission factor derived from carbon intensity data, fuel energy density values, and fuel efficiency values. The emission factor was developed using CARB's Low Carbon Fuel Standard,[ix] ARB's Mobile Source Emission Factor Model (EMFAC 2014),[x] California-modified Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (CA-GREET 2.0),[xi] and U.S. Department of Transportation mileage assumptions.[xii] The WTW method accounts for the emissions associated with the production and distribution of different fuel types as well as any associated exhaust emissions.

Applicants must use this Quantification Methodology, in conjunction with the accompanying Food Waste Prevention and Rescue Program Benefits Calculator Tool, to estimate the GHG emission reductions and air pollutant emission co-benefits of the proposed project. The Food Waste Prevention and Rescue Program Benefits Calculator Tool is available at: www.arb.ca.gov/cci-quantification.

Major Updates

CARB staff 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. CARB updated the Food Waste Prevention and Rescue Program Quantification Methodology from the previous version[xiii] to enhance the analysis and provide additional clarity. The major changes include:

- Creation of a standalone Food Waste Prevention and Rescue Benefits Calculator Tool;
- The addition of new vehicle types and the option to select multiple vehicles;
- The option to select multiple refrigeration systems;
- Additional definitions and clarity in the Benefits Calculator Tool; and
- Addition of new output tab in the Benefits Calculator Tool that summarizes select co-benefits and key variables using largely the same inputs used to estimate GHG emission reductions.

Program Assistance

CARB and CalRecycle staff will review the quantification portions of the Food Waste Prevention and Rescue Program project applications to ensure that the methods described in this document were properly applied to estimate the GHG emission reductions and co-benefits for the proposed project. Applicants should use the following resources for additional questions and comments:

- Questions on this document should be sent to: GGRFProgram@arb.ca.gov.
- For more information on CARB's efforts to support implementation of GGRF investments, see: https://www.arb.ca.gov/auctionproceeds.
- Questions pertaining to the Food Waste Prevention and Rescue Program should be sent to GHGReductions@CalRecycle.ca.gov.

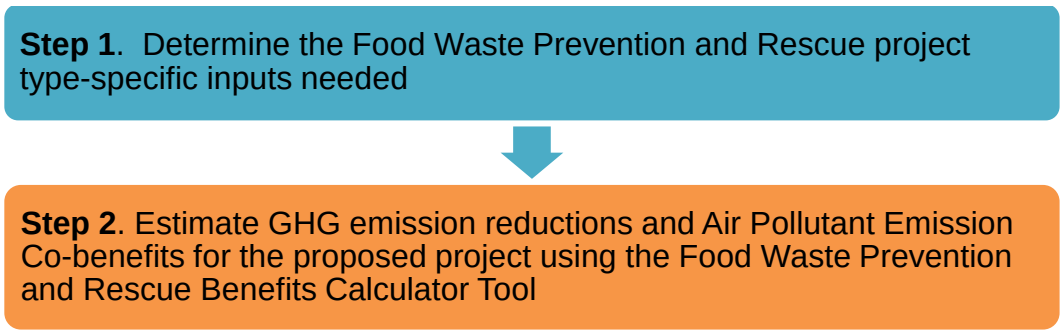
Section B. Quantification Methodology

Overview

Applicants will follow the steps outlined in Figure 1 to estimate the GHG emission reductions and air pollutant emission co-benefits from the proposed project. Detailed instructions for each step are provided on subsequent pages. An example project showing how to estimate the GHG emission reductions and air pollutant emission co-benefits from a food waste rescue and food waste prevention project is provided in Appendix A.

Methods and equations used in the Food Waste Prevention and Rescue Program Benefits Calculator Tool for estimating GHG emission reductions and air pollutant emission co-benefits are provided in Appendix B. Methods and equations used in the Food Waste Prevention and Rescue Program Benefits Calculator Tool for estimating other co-benefits and key variables not included in this Quantification Methodology are available at: www.arb.ca.gov/cci-cobenefits. Emission factors used in calculations are contained in the Database available at: www.arb.ca.gov/cci-quantification. Documentation on the sources and methods used to develop the emission factors are also provided.

Figure 1. Steps to Estimating GHG emission reductions and Air Pollutant Emission Co-benefits



Step 1: Determine the Food Waste Prevention and Rescue Program Benefits Calculator Tool Inputs Needed

Table 1 identifies the required data inputs needed to estimate the GHG emission reductions and air pollutant emission co-benefits for the proposed project with the Food Waste Prevention and Rescue Program Benefits Calculator Tool by project type.

Table 1. Required Food Waste Prevention and Rescue Program Benefits Calculator Tool Inputs for Eligible Project Type(s)

ALL PROJECTS
General Information (Read Me worksheet) • Project Name; • Grant ID, if applicable; • Contact Name; • Contact Phone Number; • Contact Email; • Date Completed; • Total amount of Food Waste Prevention and Rescue Program GGRF funds requested from this solicitation to implement the project; • Total amount of additional GGRF funds to implement the project (include GGRF funds previously awarded to the project by CalRecycle's Food Waste Prevention and Rescue Program or another California Climate Investments program, GGRF funds currently being requested from another California Climate Investments program, and GGRF funds the project plans to request in the future from CalRecycle's Food Waste Prevention and Rescue Program or another California Climate Investments program). • Total amount of leveraged funds that do not come from GGRF. • Identify California Climate Investments program(s) from which the project has been awarded GGRF funds (include award date), is currently requesting GGRF funds, or plans to request GGRF funds. For a list of GGRF funded programs, go to: www.arb.ca.gov/cci-events.

Food Waste Prevention and Rescue

Quantification Inputs (Inputs worksheet)
• Pounds of edible food that will be rescued and used to feed people each year of the proposed project.
• Pounds of food waste that will be prevented from being landfilled as a result of source reduction each year of the proposed project.
• If refrigeration or freezer equipment will be purchased as part of the project, the following inputs are required:
  o Type of refrigeration equipment;
  o Number of identical units;
  o Compartment volume of the refrigeration equipment;
  o Refrigerant charge size (default values are available if unknown, leave the cell blank to use defaults. See definitions worksheet in accompanying calculator for additional details); and
  o Refrigerant type used in equipment
• If a new vehicle will be purchased as part of the project, the following inputs are required:
  o Vehicle type (for additional details, see the definitions worksheet in the accompanying calculator tool.)
  o Number of identical vehicles.

Step 2: Estimate GHG Emission Reductions and Air Pollutant Emission Co-benefits for the Proposed Project Using the Food Waste Prevention and Rescue Program Benefits Calculator Tool

Applicants must use the Food Waste Prevention and Rescue Program Benefits Calculator Tool to complete this step. The Food Waste Prevention and Rescue Program Benefits Calculator Tool can be downloaded from: www.arb.ca.gov/cci-quantification.

Users should begin with the **Read Me** tab, which contains instructions and prompts users to enter project information.

Key terms are defined in the **Definitions** tab.

The **Inputs** tabs identify inputs required by the user, generally requiring project-specific data or assumptions. Input and output fields are color coded:

- Yellow fields indicate a direct user input is required.
- Green fields indicate a drop down menu for applicants to select.
- Orange fields indicate a user input is optional.[1]
- Gray fields indicate output or calculation fields that are automatically populated based on user entries and the calculation methods.

Details of calculation methods are provided in Appendix [B].

The **GHG Summary** tab displays the estimated:

- GHG emission reductions over the 10 year quantification period (metric tons of carbon dioxide equivalent ($MTCO_2e$));
- Total GHG emission reductions per total GGRF dollars requested ($MTCO_2e$/$);
- GHG emission reductions per Food Waste Prevention and Rescue Program funds requested ($MTCO_2e$/$);[2]
- Food Waste Prevention and Rescue Program funds requested per Food Waste Prevention and Rescue Program GHG emission reductions ($/$MTCO_2e$); and
- Portion of the GHG emission reductions attributable to the GGRF funding from another California Climate Investments program, as applicable.

[1] If an optional field is used, the applicant must submit additional supporting documentation (see Section C. Documentation).

[2] This is the portion of GHG emission reductions attributable to funding from Food Waste Prevention and Rescue Program; GHG emission reductions are prorated according to the level of program funding contributed from Food Waste Prevention and Rescue Program and other California Climate Investments programs, as applicable. The results in the Co-benefits Summary tab are prorated using the same approach, as applicable.

The **Co-benefits Summary** tab displays the estimated:

- ROG emission reduction estimates (lbs);
- NO_x emission reduction estimates (lbs);
- $PM_{2.5}$ emission reduction estimates (lbs);
- Diesel PM emission reduction estimates (lbs);
- Edible food rescued and donated (short tons);
- Food waste prevention (short tons)
- Material diverted from a landfill (short tons);
- Vehicle miles travelled reduction (miles); and
- Energy and fuel cost savings ($).

Section C. Documentation

In addition to Food Waste Prevention and Rescue Program application requirements, applicants for GGRF funding are required to document results from the use of this Quantification Methodology, including supporting materials to verify the accuracy of project-specific inputs.

Applicants are required to provide electronic documentation that is complete and sufficient to allow the calculations to be reviewed and replicated. Paper copies of supporting materials must be available upon request by agency staff.

The following checklist is provided as a guide to applicants; additional data and/or information may be necessary to support project-specific input assumptions.

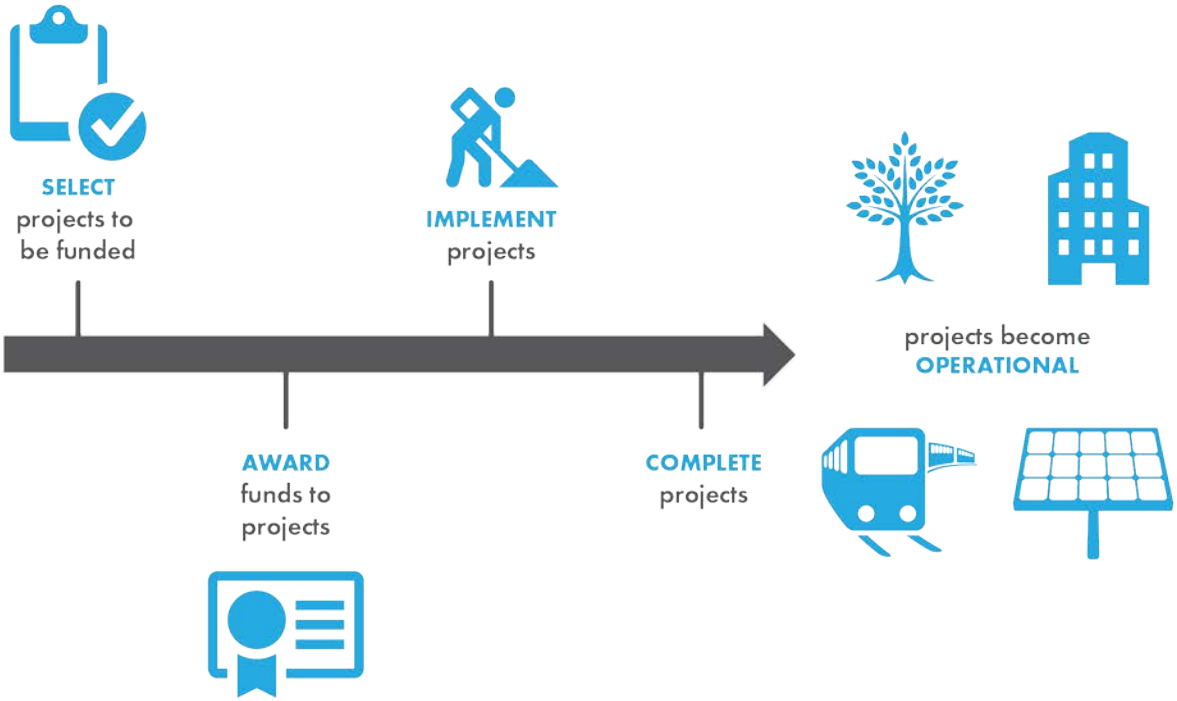
	Documentation Checklist	Completed
1.	Contact information for the person who can answer project specific questions from staff reviewers on the quantification calculations	
2.	Project description, including excerpts or specific references to the location in the main Food Waste Prevention and Rescue Program application of the project information necessary to complete the applicable portions of the Quantification Methodology	
3.	Populated Food Waste Prevention and Rescue Program Benefits Calculator Tool file (in .xlsx) with worksheets applicable to the project populated	
4.	Documentation of the project data used as inputs in the calculator	
5.	Any other information as necessary and appropriate to substantiate Food Waste Prevention and Rescue Program Benefits Calculator Tool inputs (e.g., vehicle purchase information, refrigeration unit information, contracts for food rescue sources, etc.)	

Section D. Reporting after Funding Award

Accountability and transparency are essential elements for all California Climate Investments. All administering agencies are required to track project implementation and report on the benefits of those investments. CARB develops tracking and reporting guidance for California Climate Investments. The reporting process and requirements are found in CARB's Funding Guidelines for Agencies that Administer California Climate Investments (Funding Guidelines).[3]

Food Waste Prevention and Rescue Program uses a one-step approach to quantification and reporting. In the one-step approach, GHG emission reductions and select co-benefits are estimated once for reporting purposes based on project-specific inputs.

CalRecycle will submit periodic reports to CARB. The specific data that need to be reported depend on the project type and the stage of project implementation at the time of reporting. Initially, administering agencies must report basic project information and expected benefits. As projects are implemented, administering agencies provide additional information on project status, benefits, and results. When projects are completed, administering agencies submit project closeout reports. A subset of projects, selected by CalRecycle, will report on project outcomes upon reaching a specified milestone and being considered "operational." Reporting templates which contain detailed reporting requirements that are specific to each project type and cover all stages of reporting are available at: www.arb.ca.gov/cci-quantification.



[3] CARB released Proposed Funding Guidelines in July 2018. These Proposed Funding Guidelines are subject to change based on public input and Board direction. Administering agencies must incorporate all provisions reflected in the Proposed Revised Funding Guidelines and subsequent Board approved Funding Guidelines.

CalRecycle is required to collect and compile project data from funding recipients, including the GHG emission reductions estimated using this Quantification Methodology, co-benefits, and information on benefits to priority populations.[4] Reported information will be used to demonstrate how the Administration is achieving or exceeding the statutory objectives for California Climate Investments. Select co-benefit and key variable estimates are highlighted in the Co-benefits Summary tab of the Food Waste Prevention and Rescue Program Benefits Calculator Tool. Funding recipients have the obligation to provide, or provide access to, data and information on project outcomes to CalRecycle. Applicants should familiarize themselves with the requirements within the Food Waste Prevention and Rescue Program Guidelines, solicitation materials, and grant agreement, as well as the CARB Funding Guidelines.

[4] Priority populations include residents of: (1) census tracts identified as disadvantaged by the California Environmental Protection Agency per Senate Bill (SB) 535; (2) census tracts identified as low-income per Assembly Bill (AB) 1550; or (3) a low-income household per AB 1550. Detailed information is provided in CARB's Funding Guidelines.

Section E. References

The following references were used in the development of this Quantification Methodology and the accompanying Food Waste Prevention and Rescue Program Benefits Calculator Tool.

10 CFR 431.66 - Energy conservation standards and their effective dates
http://www.ecfr.gov/cgi-bin/text-idx?SID=ea9937006535237ca30dfd3e03ebaff2&mc=true&node=se10.3.431_166&rgn=div8

CARB's California's High Global Warming Potential Gases Emission Inventory Emission Inventory Methodology and Technical Support Document (2016)
http://www.arb.ca.gov/cc/inventory/slcp/doc/hfc_inventory_tsd_20160411.pdf

CARB Method for Estimating Greenhouse Gas Emission Reductions from Diversion of Organic Waste from Landfills to Compost Facilities (2017)
http://www.arb.ca.gov/cc/waste/cerffinal.pdf

CARB Refrigerant Management Program
http://www.arb.ca.gov/cc/rmp/rmprefrigerants.htm

CARB EMFAC 2014 Web Database
http://www.arb.ca.gov/emfac/2014/

The Climate Change and Economic Impacts of Food Waste in the United States (2012)
http://www.cleanmetrics.com/pages/ClimateChangeImpactofUSFoodWaste.pdf

San Joaquin Valley Air Pollution Control District, Greenwaste Compost Site Emissions Reductions from Solar-powered Aeration and Biofilter Layer (2013)
http://www.valleyair.org/Grant_Programs/TAP/documents/C-15636-ACP/C-15636_ACP_FinalReport.pdf

U.S. EPA Emission Factors for Greenhouse Gas Inventories (2015)
https://www.epa.gov/sites/production/files/2015-12/documents/emission-factors_nov_2015.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

U.S EPA AP-42, Compilation of Air Emission Factors, 2.4, Municipal Solid Waste Landfills,
https://www3.epa.gov/ttnchie1/ap42/ch02/final/c02s04.pdf

US Department of Transportation: Table VM-1 Annual Vehicle Distance Traveled in Miles and Related Data - 2014 by Highway Category and Vehicle Type
http://www.fhwa.dot.gov/policyinformation/statistics/2014/vm1.cfm

Section F. Endnotes

[i] http://www.calrecycle.ca.gov/climate/grantsloans/

[ii] California Air Resources Board. www.arb.ca.gov/cci-fundingguidelines

[iii] California Air Resources Board. www.arb.ca.gov/cci-quantification

[iv] http://www.arb.ca.gov/cc/waste/cerffinal.pdf

[v] http://www.cleanmetrics.com/pages/ClimateChangeImpactofUSFoodWaste.pdf

[vi] http://www.arb.ca.gov/cc/inventory/slcp/doc/hfc_inventory_tsd_20160411.pdf

[vii] http://www.energy.ca.gov/2015publications/CEC-400-2015-021/CEC-400-2015-021.pdf

[viii] http://www.ecfr.gov/cgi-bin/text-idx?SID=ea9937006535237ca30dfd3e03ebaff2&mc=true&node=se10.3.431_166&rgn=div8

[ix] 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

[x] http://www.arb.ca.gov/emfac/2014/

[xi] 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

[xii] http://www.fhwa.dot.gov/policyinformation/statistics/2014/vm1.cfm

[xiii] https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/calrecycle_finalgm_15-16_16-17.pdf?_ga=2.82600214.1804767872.1528124959-1010765147.1456955011

Appendix A. Example Project

Introduction

The following is a hypothetical project[5] to demonstrate how the Food Waste Prevention and Rescue Program Quantification Methodology would be applied. This hypothetical project does not provide examples of the supporting documentation that is required of actual project applicants.

Overview of the proposed project

A Sacramento based food bank proposes to rescue 200,000 lbs of food each year for three years to provide food to the local community. As a part of the application, they plan to purchase one commercial refrigerator/freezer with solid doors that has a volume of 50 ft^3. The refrigerant charge size and refrigerant type are unknown. The food bank also proposes to buy a refrigerated hybrid van for pickups and deliveries of the rescued food. The proposed project is asking for $100,000 and proposes to leverage $20,000 from other local sources for a total proposed cost of $120,000.

Methods to apply

Step 1: Determine the Food Waste Prevention and Rescue Program Benefits Calculator Tool Inputs Needed

General Information	
Total Food Waste Prevention and Rescue Funds Requested	$100,000
Non-GGRF Leveraged Funds	$20,000
Quantification Inputs	
Refrigeration Equipment Type	Commercial Refrigerator/freezer with solid doors
Number of Identical Units	1
Volume of System	50
Refrigerant Charge Size	Unknown
Refrigerant Type	Unknown
New Vehicle Type	Refrigerated Hybrid Van
Number of Identical Vehicles	1
Edible Food Rescued	200,000

[5] The hypothetical project has not undergone verification of any Waste Diversion Grant and Loan Program requirements; all assumptions about location type and project features are for quantification methodology demonstration purposes only.

Step 2: Estimate GHG emission reductions and Air Pollutant Emission Co-benefits for the Proposed Project Using the Food Waste Prevention and Rescue Program Benefits Calculator Tool

Once the Food Waste Prevention and Rescue Program Benefits Calculator Tool is accessed the applicant must complete the project identifier information on the "Read Me" tab.

Read Me Tab (This Page)

Project Name:	Sacramento Food Bank
Grant ID, if applicable:	1234-5678
Contact Name:	John Smith
Contact Phone Number:	916-555-1234
Contact Email:	John.Smith@sacfoodbank.com
Date Completed:	6/5/2018
Total Food Waste Prevention and Rescue GGRF Funds Requested ($):	$ 100,000
Other GGRF Leveraged Funds ($):	$ -
Other GGRF Funding Source (Program Name[s])	
Non-GGRF Leveraged Funds ($):	$ 20,000
Total Funds ($):	$ 120,000

Food Waste Prevention and Rescue Inputs Tab

Applicants must enter data into the yellow and green cells within the "Inputs" tab. Orange cells are optional. The required data in the "Inputs" tab reflect project specific information. See the following figures for how the data should be entered for this example project.

Inputs Worksheet

New Refrigeration Equipment for Project (if necessary)

Refrigeration Equipment Type (select from options)	Number of Identical Units	Volume of System (ft^3)	Refrigerant Charge Size - *Optional Input* (lbs)	Refrigerant Type (select from options)	Annual GHG Emissions from Refrigeration Equipment (MTCO2e/Year)
Commercial Refrigerator/freezer with solid doors	1	50		Default Value	3
				Default Value	0
				Default Value	0
				Default Value	0
				Default Value	0
				Default Value	0
				Default Value	0
				Default Value	0
				Default Value	0
				Default Value	0

New Vehicles for Project (if necessary)

New Vehicle Type (select from options)	Number of Identical Vehicles	Annual GHG Emissions from New Vehicle (MTCO2e/Year)
Refrigerated Hybrid Van	1	12
		0
		0
		0
		0
		0

Year	Edible Food Rescued (lbs)	Food Waste Reduction (lbs)	Net Tons of Material Diverted (Short Tons)	Net GHG Benefit ($MTCO_2e$)
2018	200,000		100	164
2019	200,000		100	164
2020	200,000		100	164
2021			0	0
2022			0	0
2023			0	0
2024			0	0
2025			0	0
2026			0	0
2027			0	0
SUBTOTAL	600,000	0	300	**491**

Project reporting metrics and a summary of the overall project GHG emission reductions, air pollutant emission co-benefits, and key variables are provided on the "GHG Summary" and "Co-benefits Summary" tabs.

Project Information		
Project Name	Sacramento Food Bank	
Total Food Waste Prevention and Rescue GGRF Funds Requested ($)	$	100,000
Other GGRF Leveraged Funds ($)	$	-
Non-GGRF Leveraged Funds ($)	$	20,000
Total GGRF Funds ($)	$	100,000
Total Funds ($)	$	120,000

GHG Summary	
Total GHG Emission Reductions (MTCO2e)	491
Total GHG Emission Reductions per Total Funds Leveraged (MTCO2e/$)	0.00409
Total GHG Emission Reductions per Total GGRF Funds Leveraged (MTCO2e/$)	0.00491
Total GHG Emission Reductions per Food Waste Prevention and Rescue GGRF Funds Requested (MTCO2e/$)	0.00491
Food Waste Prevention and Rescue GGRF funds requested per Food Waste Prevention and Rescue Program GHG emission reductions ($/$MTCO_2e$)	$203.81
Portion of the Net GHG Benefit attributable to the GGRF funding from another CCI program	0
Other GGRF Leveraged Funding Source	0

Co-benefits and Key Variables Summary	
Total NOx emission reductions (lbs)	96
Total ROG emission reductions (lbs)	32
Total PM2.5 emission reductions (lbs)	5
Total Diesel PM emission reductions (lbs)	0
Edible Food Rescued & Donated (short tons)	300
Food Waste Prevention (short tons)	0
Material Diverted from Landfill (short tons)	300
Vehicle Miles Traveled Reduction (miles)	-39,369
Energy and Fuel Cost Savings ($)	-$8,623

Submit Documentation

To complete the quantification process, the applicant must submit an electronic copy of the calculator (in .xlsx) and all of the required documentation as noted in Section C of this Quantification Methodology.

Appendix B. Equations Supporting Emission Estimates in the Food Waste Prevention and Rescue Program Benefits Calculator Tool

Methods used in the Food Waste Prevention and Rescue Program Benefits Calculator Tool for estimating the GHG emission reductions and air pollutant emission co-benefits by activity type are provided in this appendix. The Database Documentation explain how emission factors used in CARB quantification methodologies are developed and updated.

These methods account for the avoidance of GHG and co-pollutant emissions associated with food production due to the rescue of edible food for people or the source reduction of food. This method takes into account the avoided emissions associated with food production, transportation, and disposal of food waste. This method also accounts for new sources that may be needed to implement the distribution of the collected food including new refrigeration units and delivery vehicles. In general, the GHG emission reductions are estimated in the Food Waste Prevention and Rescue Program Benefits Calculator Tool using the following approaches in Table B-1. The Food Waste Prevention and Rescue Program Benefits Calculator Tool also estimates air pollutant emission co-benefits and key variables using largely the same inputs used to estimate GHG emission reductions.

Table B-1. General Approach to Quantification by Project Type

Edible Food Rescue and Food Waste Prevention
GHG emission reductions = Avoided Food Production due to Food Waste Rescue or Prevention – Increased vehicle miles traveled (if applicable) – New Refrigeration Electricity Use and Refrigerant Leakage (if applicable)

A. Emission Reduction Estimates from Food Waste Rescue and Prevention

Both the GHG emission reductions and air pollutant emission estimates from food waste rescue and prevention are estimated as the difference between the baseline and project scenarios using Equations 1-8. Equations 1 and 2 estimate the annual emissions of new transportation vehicles associated with the pickup and delivery of rescued food.

Equation 1: GHG Emissions from Transportation Vehicles

$$GHG_{TR} = \sum_{i} \left[\left(\frac{VEF_{GHG} \times M}{1{,}000{,}000} \right) + \frac{(R_{Leak} \times R_{charge} \times R_{GWP})}{2{,}204.62} \right]$$

Where,			Units
GHG_{TR}	=	GHG emissions from transportation vehicle	$MTCO_2e$/ year
i	=	Number of identical vehicles	
VEF_{GHG}	=	Vehicle GHG Emission Factor	g/mile
M	=	Average Miles per Year for a Delivery Truck	miles/year
1,000,000	=	Conversion from g to MT	g/MT
R_{Leak}	=	The leak rate of the TRU, if necessary	%
R_{charge}	=	TRU refrigerant charge size, if necessary	lbs
R_{GWP}	=	GWP of the refrigerant. All TRUs are assumed to use R-134A	CO_2e
2,204.62	=	Conversion from lbs to MT	lbs/MT

Equation 2: Criteria and Toxics Emissions from Transportation Vehicles

$$CT_{TR} = \sum_{i} \left(\frac{VEF_{CT} \times M}{454} \right)$$

Where,			Units
CT_{TR}	=	Criteria and Toxics emissions from transportation vehicle	lbs/year
i	=	Number of identical vehicles	
VEF_{CT}	=	Vehicle ROG, NOx, PM2.5, Diesel PM Emission Factors	g/mile
M	=	Average Miles per Year for a Delivery Truck	miles/year
454	=	Conversion from g to lbs	g/MT

Equations 3 and 4 estimate the annual emissions of new refrigeration equipment that is necessary to store the rescued food until it can be consumed or delivered to people. These equations take into account electricity consumption of the equipment and also refrigerant leakage which has a climate impact due to the high Global Warming Potential of many refrigerants.

Equation 3: GHG Emissions from Refrigeration Equipment

$$GHG_{RF} = \sum_{i} \left[((V \times EC + E_{Constant}) \times EF_{E,GHG}) + \frac{(R_{Leak} \times R_{charge} \times R_{GWP})}{2{,}204.62} \right]$$

Where,			Units
GHG_{RF}	=	GHG emissions from refrigeration equipment	$MTCO_2e$/ year
i	=	Number of identical units	
V	=	Volume of refrigeration compartment	ft^3
EC	=	Electricity consumption of refrigeration unit	kWh/year-ft^3
$E_{Constant}$	=	Electricity consumption of refrigeration unit constant factor	kWh/year
$EF_{E,GHG}$	=	Grid GHG electricity emission factor	$MTCO_2e$/ kWh
R_{Leak}	=	The leak rate of the refrigeration unit	%
R_{charge}	=	Refrigerant charge size	lbs
R_{GWP}	=	GWP of the refrigerant	CO_2e
2,204.62	=	Conversion from lbs to MT	lbs/MT

Equation 4: Criteria and Toxic Emissions from Refrigeration Equipment

$$CT_{RF} = \sum_{i} ((V \times EC + E_{Constant}) \times EF_{E,CT})$$

Where,			Units
CT_{RF}	=	Criteria and toxic emissions from refrigeration equipment	lbs/year
i	=	Number of identical units	
V	=	Volume of refrigeration compartment	ft^3
EC	=	Electricity consumption of refrigeration unit	kwh/year-ft^3
$E_{Constant}$	=	Electricity consumption of refrigeration unit constant factor	kWh/year
$EF_{E,CT}$	=	Grid criteria and toxic electricity emission factor	lbs/kWh

Equations 5 and 6 estimate the annual emissions reductions associated with the rescue of food waste for human consumption and food waste prevention. These equations are based on factors that take into account both upstream avoided food production emissions, avoided transportation emissions, and avoided emissions from disposal of food waste.

Equation 5: GHG Emission Reductions from Diversion of Food Waste or Source Reduction

$$GHG_{FW} = \frac{(FR + FW)}{2{,}000} \times EF_{FW}$$

Where,			Units
GHG_{FW}	=	GHG emissions reductions from diversion of food waste or source reduction	$MTCO_2e$
FR	=	Amount of food rescued	lbs
FW	=	Amount of food waste reduction	lbs
2,000	=	Conversion from lbs to short tons	lbs/short tons
EF_{FW}	=	Food Waste Prevention and Rescue Emission Reduction Factor	$MTCO_2e$/ short ton of food waste

Equation 6: Criteria and Toxics Emission Reductions from Diversion of Food Waste or Source Reduction

$$CT_{FW} = \left(\frac{(FR + FW)}{2{,}000} \times EF_{AFT}\right) + \left(\frac{(FR + FW)}{2{,}000} \times EF_{LF}\right)$$

Where,			Units
CT_{FW}	=	Criteria and toxic emissions from refrigeration equipment	lbs
FR	=	Amount of food rescued	lbs
FW	=	Amount of food waste reduction	lbs
2,000	=	Conversion from lbs to short tons	lbs/short tons
EF_{AFT}	=	Avoided transportation for food waste emission reduction factor	lbs/short ton of food waste
EF_{LF}	=	Avoided landfill flare emission reduction factor	lbs/short ton of food waste

Equations 7 and 8 estimate the net benefits for GHG and co-pollutants associated with a food rescue or food waste prevention project.

Equation 7: Net GHG Benefit

$$GHG = GHG_{FW} - (GHG_{TR} + GHG_{RF})$$

Where,			Units
GHG	=	Net GHG benefit from the project	MT CO_2e
GHG_{FW}	=	GHG benefit of food waste diversion and source reduction (from Equation 5)	MT CO_2e
GHG_{TR}	=	GHG emissions from delivery vehicles (from Equation 1)	MT CO_2e
GHG_{RF}	=	GHG emissions from refrigeration unit (from Equation 3)	MT CO_2e

Equation 8: Net Criteria and Toxics Benefit

$$CT = CT_{FW} - (CT_{TR} + CT_{RF})$$

Where,			Units
CT	=	Net criteria and toxics benefit from the project	lbs
CT_{FW}	=	Criteria and toxics benefit of food waste diversion and source reduction (from Equation 6)	lbs
CT_{TR}	=	Criteria and toxics emissions from delivery vehicles (from Equation 2)	lbs
CT_{RF}	=	Criteria and toxics emissions from refrigeration unit (from Equation 4)	lbs