California Air Resources Board

Job Co-benefit Assessment Methodology

California Climate Investments

May 13, 2021

Table of Contents

Section A. Introduction

The goal of California Climate Investments is to reduce greenhouse gas (GHG) emissions and further the objectives of the California Global Warming Solutions Act of 2006, Assembly Bill (AB) 32. The California Air Resources Board (CARB) is responsible for providing guidance on reporting and quantification methods for all State agencies that receive appropriations from the Greenhouse Gas Reduction Fund (GGRF). Guidance includes developing methodologies for estimating GHG emission reductions and other economic, environmental, and public health benefits of projects, referred to as "co-benefits."

Co-benefit Assessment Methodologies are intended for use by administering agencies, project applicants, and/or funding recipients to estimate the outcomes of California Climate Investments. Co-benefit estimates can be used to inform project selection and track results of funded projects. In addition to this methodology, general guidance on assessing California Climate Investments co-benefits is available in CARB's Funding Guidelines for Agencies Administering California Climate Investments (Funding Guidelines), found at: www.arb.ca.gov/cci-fundingguidelines.

CARB staff developed this Co-benefit Assessment Methodology and an accompanying tool to estimate jobs supported by California Climate Investments projects.

Job Co-benefit Description

Job co-benefits refer to California jobs supported, not created, by California Climate Investments. A job is defined as one full-time equivalent (FTE) employee position over one year, equal to approximately 2,000 hours of work. Jobs supported by California Climate Investments include direct, indirect, and induced employment:

- *Directly supported jobs* refer to labor to complete California Climate Investments projects, through direct employment or contracted work paid with GGRF dollars (e.g., housing construction, ecosystem restoration, or technical assistance) and labor to produce equipment or materials purchased with GGRF dollars (e.g., manufacturing zero-emission vehicles or anaerobic digesters).
- *Indirectly supported jobs* exist in the supply chains supporting California Climate Investments projects. Funding a project generates demand for intermediate inputs of materials and equipment needed to complete the project, leading to expanded production and employment in the relevant upstream industries (e.g., manufacturing construction equipment, zero-emission vehicle parts, or solar panel components).
- *Induced jobs* are linked to the spending of income from directly and indirectly supported jobs. The personal consumption expenditures of workers in jobs directly and indirectly supported by California Climate Investments projects (i.e., increased household spending) stimulate demand for goods and services in the wider California economy.

All California Climate Investments can provide positive job co-benefits. A positive job co-benefit results when a California Climate Investments project supports employment in California. These co-benefits may accrue directly (as a central objective of the project) or indirectly (as a consequence of project activities).

The accompanying Job Co-benefit Modeling Tool automates the methods described in this document and provides a link to a step-by-step user guide, including a list of required inputs and a project example.

Job Co-benefit Projects

This Co-benefit Assessment Methodology is applicable to all California Climate Investments projects.

Methodology Development

CARB developed this Co-benefit Assessment Methodology in consultation with the Center for Resource Efficient Communities at the University of California, Berkeley (UC Berkeley). Consistent with the guiding principles of California Climate Investments, the methodology is developed to:

- Support calculating the applicable co-benefits for individual projects;
- Apply to the project types proposed for funding;
- Provide uniform methods that can be applied statewide and are accessible by all applicants and funding recipients;
- Use existing and proven tools or methods, where available; and
- Identify the appropriate data needed to calculate co-benefits.

UC Berkeley assessed peer-reviewed literature and consulted with experts, as needed, to identify:

- The direction and magnitude of the co-benefit;
- Project types to which the co-benefit is relevant;
- The limitations of existing empirical literature;
- Existing assessment methods and tools; and
- Knowledge gaps and other issues to consider in developing co-benefit assessment methods.

This work is summarized in a literature review on this co-benefit, which can be found at: www.arb.ca.gov/cci-cobenefits. UC Berkeley also considered ease of use, specifically the availability of project-level inputs and the development of an accompanying modeling tool for users of this methodology.

UC Berkeley recommended using an input-output model to develop a tool to estimate employment co-benefits of California Climate Investments. Specifically, UC Berkeley suggested the use of information from IMPLAN, a proprietary input-output model that prohibits the publication of underlying data. To ensure consistency with the guiding principles of transparency and accountability, CARB instead used data from a different input-output model, the Regional Input-Output Modeling System (RIMS II)[1], to develop the accompanying Job Co-benefit Modeling Tool for California Climate Investments. The RIMS II data used in this tool are non-proprietary and available for public use.

CARB first released the Job Co-benefit Assessment Methodology and Modeling Tool in January 2019. CARB staff periodically review each co-benefit assessment methodology to evaluate its effectiveness and update methodologies to make them more robust, user friendly, and appropriate to the projects being quantified. CARB released the Draft Updated Job Co-benefit Modeling Tool for public comment in April 2021. This Final Job Co-benefit Assessment Methodology and Modeling Tool been updated to include:

- 2021 RIMS II employment multipliers;
- Job modeling for the Community Fire Planning and Preparedness Program and Fire Engine Procurement and Maintenance Program;
- Revised program names for the Safe and Affordable Drinking Water Fund and Climate Change Adaptation and Coastal Resilience Planning Program; and
- Updated job modeling activities for the Affordable Housing and Sustainable Communities Program, Alternative Manure Management and Dairy Digester Research and Development Programs, Climate Adaptation and Resiliency Program, Community Air Grants Program, Community Air Protection Funds, Healthy Soils Program, Fire Prevention and Fire Prevention Grants Programs, Forest Health Program, Low Carbon Transportation Program, Prescribed Fire Program, Regional Forest and Fire Capacity Program, Training and Workforce Development Program, Urban and Community Forestry Program, Urban Greening Program, and Waste Diversion Program.

Program Assistance

For assistance with this Co-benefit Assessment Methodology, send questions to: GGRFProgram@arb.ca.gov.

For more information on CARB's efforts to support implementation of California Climate Investments, see: www.arb.ca.gov/auctionproceeds.

[1] https://apps.bea.gov/regional/rims/rimsii/home.aspx

Section B. Co-benefit Assessment Methods

This section describes the methods used in the Job Co-benefit Modeling Tool to estimate employment supported by California Climate Investments. Overall, the methods for assessing job co-benefits are quantitative, based on a regional input-output model. Appendices A, B, C, and D provide additional information about the data sources and supporting calculations. Further information about the specific data inputs and a project example are provided in the user guide, accessible from the Job Co-benefit Modeling Tool and at: www.arb.ca.gov/cci-cobenefits.

General Approach

Regional input-output models characterize the relationships between all industries in an economy, with the foundational assumption that an initial change in economic activity prompts additional spending. For instance, increased demand for the outputs of one industry generates demand for intermediate inputs from supporting industries. Greater employment and earnings in the affected industries lead to higher household spending, resulting in additional demand for goods and services throughout the region.

The Job Co-benefit Modeling Tool uses industry-specific multipliers for California derived from RIMS II to estimate total direct, indirect, and induced jobs supported by California Climate Investments, following Equation 1.

Equation 1: Jobs Supported by California Climate Investments Projects

$$Jobs = \sum_{i=1}^{3}\left(\frac{Project\ Budget}{1{,}000{,}000} \times Cost\ Percentage_i \times Retail\ Adjustment\ Factor \times Employment\ Multiplier_i\right) + \left[\frac{Project\ Budget}{1{,}000{,}000} \times \left(1 - \sum_{i=1}^{3} Cost\ Percentage_i\right) \times Employment\ Multiplier_{Average}\right]$$

Where,			Units
Jobs	=	Total number of direct, indirect, or induced FTE jobs supported by project	Direct, indirect, or induced FTE jobs
i	=	Top three funded project activities by cost	Unitless
Project Budget	=	Total project budget, including funding from all California Climate Investments programs and match funding sources, if applicable	Dollars
Cost Percentage	=	Percentage of total project budget associated with activity *i*	Percent
Retail Adjustment Factor	=	If applicable, adjustment factor to account for retail purchases, calculated as explained in Appendix D	Unitless
Employment Multiplier	=	RIMS II FTE-adjusted direct, indirect, or induced employment multiplier for industry associated with activity *i* or average across all industries, derived as explained in Appendix B	Direct, indirect, or induced FTE jobs per million dollars demand

To estimate the number of direct, indirect, and induced jobs supported by GGRF dollars, the results of Equation 1 are prorated according to the GGRF dollars requested or awarded from the program, following Equation 2. If the project requests or receives funding from more than one California Climate Investments program or from the same program in multiple solicitations, the Job Co-benefit Modeling Tool must be completed once for each application.

Equation 2: Jobs Supported by GGRF Project Dollars

$$GGRF\ Jobs = Jobs \times \left(\frac{GGRF\ Dollars}{Project\ Budget}\right)$$

Where,			Units
GGRF Jobs	=	Total number of direct, indirect, or induced FTE jobs supported by GGRF project dollars	Direct, indirect, or induced FTE jobs
Jobs	=	Total number of direct, indirect, or induced FTE jobs supported by project, from Equation 1	Direct, indirect, or induced FTE jobs
GGRF Dollars	=	Total GGRF dollars requested or awarded from California Climate Investments program	Dollars
Project Budget	=	Total project budget, including funding from all California Climate Investments programs and match funding sources, if applicable	Dollars

Limitations

This Co-benefit Assessment Methodology and the accompanying Job Co-benefit Modeling Tool develop prospective estimates of likely job co-benefits of California Climate Investments projects, subject to the following limitations:

- The Job Co-benefit Modeling Tool outputs are estimates of jobs supported by GGRF dollars, not created by these investments. Since GGRF investments are transfers of existing funds within California, it would be necessary to assess an alternative scenario without GGRF investments in order to establish a causal link between California Climate Investments and job creation.
- This Co-benefit Assessment Methodology is based on state-level RIMS II employment multipliers. As such, estimated jobs cannot be linked to specific locations within California.
- Input-output models include only general information about employment per industry, so job quality is beyond the scope of the Job Co-benefit Modeling Tool.
- The start date and duration of job co-benefits are uncertain since RIMS II does not have a time dimension.
- For industries in which employers do not need to hire many additional workers to increase production, RIMS II may overestimate employment outcomes.
- RIMS II may overestimate employment outcomes for industries with products that are both imports to and exports from California. For example, concrete is produced both in California and in other states, but the local purchasing assumptions in RIMS II mean that projects with inputs of concrete are represented as buying that concrete in-state. If a project actually sources concrete from outside California, employment outcomes will be overestimated.
- RIMS II industry classifications do not yet fully describe newer industries, such as those producing advanced technologies.
- Direct and indirect employment in government cannot be modeled using RIMS II. Appendix B describes how induced employment related to investments in government is estimated.

Section C. References

Bureau of Economic Analysis (2021). *Regional Input-Output Modeling System* [RIMS II 2012/2019 Multipliers]. Retrieved from: https://apps.bea.gov/regional/rims/rimsii/.

Bureau of Economic Analysis (2020). *National Income and Product Accounts* [Table 6.4D. Full-Time and Part-Time Employees by Industry]. Retrieved from: https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&nipa_table_list=193.

Bureau of Economic Analysis (2020). *National Income and Product Accounts* [Table 6.5D. Full-Time Equivalent Employees by Industry]. Retrieved from: https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&nipa_table_list=197.

Bureau of Economic Analysis (2021). *National Income and Product Accounts* [Table 3.9.4. Price Indexes for Government Consumption Expenditures and Gross Investment]. Retrieved from: https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&select_all_years=0&nipa_table_list=97&series=a&first_year=2013&last_year=2020&scale=-99&thetable.

Bureau of Economic Analysis (2019). *2012 US Benchmark Input-Output Data* [Table C – Composition of NIPA Final Demand – I-O Commodity Composition of NIPA Final Use by Personal Consumption Expenditures]. Retrieved from: https://apps.bea.gov/regional/rims/rimsii/viewerdistribution.aspx?selectedOrderDetailKey=17808&Sample=Yes.

Appendix A. RIMS II

The Bureau of Economic Analysis (BEA) developed RIMS II as a tool for economic impact studies. The California Department of Finance and other federal, State, and local government agencies use multipliers from RIMS II to evaluate how various types of projects may affect regional economies.[2]

BEA regularly updates RIMS II using national input-output accounts and regional economic information. The RIMS II multipliers released in 2019 are based on 2017 regional data and 2012 national data.[3] These multipliers include California-specific values for 372 industries.

This Job Co-benefit Assessment Methodology uses RIMS II Type I and Type II final-demand and direct-effect employment multipliers.

Type I employment multipliers are used to estimate total direct and indirect jobs. Type II employment multipliers also account for induced jobs.

Final-demand employment multipliers measure the increase or decrease in jobs when the demand for an industry's outputs changes. Direct-effect employment multipliers measure the increase or decrease in jobs when employment in an industry changes.

[2] BEA does not endorse the results of this co-benefit assessment methodology or any study conducted using RIMS II multipliers.

[3] The RIMS II multipliers released in 2021 must be applied to investments in 2019 dollars because the underlying regional data are from 2019. Consequently, the Job Co-benefit Modeling Tool is designed to adjust user inputs to 2019 dollars using an implicit price deflator for government gross investment. https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&select_all_years=0&nipa_table_list=97&series=a&first_year=2013&last_year=2020&scale=-99&thetable

Appendix B. Industry Assignments for Project Activities

RIMS II contains multipliers for 372 industries, which are defined based on the North American Industry Classification System (NAICS). In order to match California Climate Investments projects to the appropriate RIMS II multipliers, CARB staff took the following steps:

- Examined expenditure records and program descriptions from administering agencies to identify activities conducted with GGRF dollars;
- In consultation with administering agencies, created program-specific lists of possible project activities;
- Matched each program activity to the NAICS 2017 code representing the most closely related industry; and
- Converted NAICS codes to the associated RIMS II 372 codes.

Some project activities, such as establishing conservation easements and leasing right-of-ways, do not involve paying worker salaries. These activities were assumed not to support employment and were assigned null multipliers.

For project activities which are best represented by a combination of industries (e.g., real estate and legal services supporting the implementation of conservation easements), this methodology uses a weighted average multiplier derived based on past project budgets and consultation with administering agency staff.

RIMS II does not include direct and indirect employment multipliers for most government agencies, since government is treated as a purchaser rather than a producer in the national input-output accounts. Therefore, direct and indirect employment in government cannot be modeled using RIMS II multipliers. Induced employment from California Climate Investments in government activities can still be captured. When government employees paid with GGRF dollars spend their earnings, their personal consumption expenditures support induced jobs throughout the state. This Co-benefit Assessment Methodology applies a RIMS II multiplier for induced employment from household spending to the earnings of government employees in order to estimate induced jobs supported by California Climate Investments in government activities.

Appendix C. Derivation of Employment Multipliers

RIMS II employment multipliers produce combined estimates of direct, indirect, and induced full-time and part-time jobs. CARB staff adjusted the RIMS II employment multipliers to convert total full-time and part-time jobs to FTE and separately estimate direct, indirect, and induced jobs.

BEA's National Income and Product Account (NIPA) tables include total full-time and part-time employees per industry and FTE per industry for 95 industry groupings.[4] Using these data, CARB staff calculated FTE conversion factors to apply to RIMS II multipliers, following Equation 3.

Equation 3: FTE Conversion Factors

$$FTE\ Conversion\ Factor = \frac{FTE\ Employees}{Full\text{-}time\ and\ Part\text{-}time\ Employees}$$

Where,			Units
FTE Conversion Factor	=	FTE per total employees for NIPA industry aggregation	FTE per total full-time and part-time employees
FTE Employees	=	Number of FTE employees per NIPA industry aggregation	FTE employees
Full-time and Part-time Employees	=	Number of full-time and part-time employees per NIPA industry aggregation	Total full-time and part-time employees

[4] https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&nipa_table_list=193; https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&nipa_table_list=197

To adjust the RIMS II Type I and Type II final-demand multipliers to estimate FTE per industry, CARB staff applied the FTE conversion factors from Equation 3 to each industry component of the disaggregated Type I and Type II final-demand employment multipliers, per Equation 4.

Equation 4: FTE-adjusted Final-demand Employment Multipliers

$$FTE\text{-}adjusted\ Final\text{-}demand\ Employment\ Multiplier = \sum(Industry\ Component \times FTE\ Conversion\ Factor)$$

Where,			Units
FTE-adjusted Final-demand Employment Multiplier	=	Adjusted industry-specific RIMS II Type I or Type II multiplier for FTE jobs associated with initial increase in demand	FTE jobs per million dollars final demand in industry
Industry Component	=	Industry component of disaggregated RIMS II Type I or Type II final-demand employment multiplier	Jobs per million dollars final demand in industry
FTE Conversion Factor	=	FTE per total employees in NIPA industry aggregation corresponding to RIMS II industry component, from Equation 3	FTE per total full-time and part-time employees

CARB staff derived separate industry-specific direct employment multipliers and adjusted them to estimate FTE according to Equation 5.

Equation 5: FTE-adjusted Direct Employment Multipliers

$$FTE\text{-}adjusted\ Direct\ Employment\ Multiplier = \frac{Final\text{-}demand\ Employment\ Multiplier}{Direct\text{-}effect\ Employment\ Multiplier} \times FTE\ Conversion\ Factor$$

Where,			Units
FTE-adjusted Direct Employment Multiplier	=	Adjusted industry-specific RIMS II multiplier for direct FTE jobs	Direct FTE jobs per million dollars output in industry
Final-demand Employment Multiplier	=	RIMS II multiplier for total jobs associated with initial increase in industry demand	Jobs per additional million dollars demand in industry
Direct-effect Employment Multiplier	=	RIMS II multiplier for total jobs per industry associated with initial increase in industry employment	Jobs per additional job in industry
FTE Conversion Factor	=	FTE per total jobs in NIPA industry aggregation corresponding to RIMS II industry, from Equation 3	FTE per total full-time and part-time employees

CARB staff derived separate industry-specific FTE indirect employment multipliers according to Equation 6.

Equation 6: FTE-adjusted Indirect Employment Multipliers

$$\textit{FTE-adjusted Indirect Employment Multiplier} = \textit{FTE-adjusted Type I Final-demand Employment Multiplier} - \textit{FTE-adjusted Direct Employment Multiplier}$$

Where,			Units
FTE-adjusted Indirect Employment Multiplier	=	Adjusted industry-specific RIMS II multiplier for indirect FTE jobs	Indirect FTE jobs per million dollars demand in industry
FTE-adjusted Type I Final-demand Employment Multiplier	=	Adjusted RIMS II multiplier for total direct and indirect FTE jobs per industry associated with initial increase in industry demand, from Equation 4	Direct and indirect FTE jobs per additional million dollars demand in industry
FTE-adjusted Direct Employment Multiplier	=	Adjusted industry-specific RIMS II multiplier for direct FTE jobs, from Equation 5	Direct FTE jobs per million dollars output in industry

CARB staff derived separate industry-specific FTE induced employment multipliers according to Equation 7.

Equation 7: FTE-adjusted Induced Employment Multipliers

$$\textit{FTE-adjusted Induced Employment Multiplier} = \textit{FTE-adjusted Type II Final-demand Employment Multiplier} - \textit{FTE-adjusted Type I Final-demand Employment Multiplier}$$

Where,			Units
FTE-adjusted Induced Employment Multiplier	=	Adjusted industry-specific RIMS II multiplier for induced FTE jobs	Induced FTE jobs per million dollars demand in industry
FTE-adjusted Type II Final-demand Employment Multiplier	=	Adjusted RIMS II multiplier for total direct, indirect, and induced FTE jobs associated with initial increase in industry demand, from Equation 4	Direct, indirect, and induced FTE jobs per additional million dollars demand in industry
FTE-adjusted Type I Final-demand Employment Multiplier	=	Adjusted RIMS II multiplier for total direct and indirect FTE jobs per industry associated with initial increase in industry demand, from Equation 4	Direct and indirect FTE jobs per additional million dollars demand in industry

Appendix D. Retail Purchases

RIMS II multipliers must be applied to producers' values (i.e., production costs of goods or services, not including retail or wholesale markups or transportation costs). Some California Climate Investments projects provide consumers with vouchers or reimbursements for retail purchases. For these rebate-based projects, and for other project activities primarily involving retail purchases, CARB staff accounted for the difference between producers' and purchasers' values.

Increased production in retail industries does not always track closely to additional hiring. To avoid overestimating employment in either retail or manufacturing industries, CARB staff calculated the producer share of project retail purchases and used this value to estimate job co-benefits.

Following Equation 8, CARB staff used BEA's national distribution cost tables for personal consumption expenditures[5] to calculate an adjustment factor to apply to retail-based project costs as shown in Equation 1.

Equation 8: Adjustment Factor for Retail-based Projects

$$Retail\ Adjustment\ Factor = \frac{Producers'\ Value}{Purchasers'\ Value}$$

Where,			Units
Retail Adjustment Factor	=	Ratio of production cost of good or service to price paid by consumer for good or service	Unitless
Producers' Value	=	Production cost of good or service, excluding retail or wholesale markups and transportation costs	Dollars
Purchasers' Value	=	Price paid by consumer for good or service	Dollars

5 https://apps.bea.gov/regional/rims/rimsii/viewerdistribution.aspx?selectedOrderDetailKey=17808&Sample=Yes