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Methods to Assess Co-Benefits of California Climate Investments

Air Pollutant Emissions

Natural Resources and Waste Diversion Sectors

California Air Resources Board

I. Background

Under California's Cap-and-Trade Program, the State's portion of the proceeds from Cap-and-Trade auctions is deposited in the Greenhouse Gas Reduction Fund (GGRF). The Legislature and Governor enact budget appropriations from the GGRF for State agencies to invest in projects that help achieve the State's climate goals. These investments are collectively called California Climate Investments (CCI).

Senate Bill 862[1] requires the California Air Resources Board (CARB) to develop guidance on reporting and quantification methods for all State agencies that receive appropriations from the GGRF. Guidance includes developing quantification methodologies for greenhouse gas (GHG) emission reductions and other social, economic, and environmental benefits of projects, referred to as "co-benefits."

This document is one of a series that reviews the available methodologies for assessing selected co-benefits for CCI projects at two phases: estimating potential project-level co-benefits prior to project implementation (i.e., forecasting of co-benefits) and estimating actual co-benefits after projects have been implemented (i.e., tracking of co-benefits). The assessment method at each of these phases may be either quantitative or qualitative. As with CARB's existing GHG emission reduction methodologies, these co-benefit assessment methods will be developed to meet the following standards:

- Apply at the project level,
- Align with the project types proposed for funding for each program,
- Provide uniform methods to be applied statewide, and be accessible by all applicants,
- Use existing and proven tools or methods where available,
- Use project level data, where available and appropriate, and
- Reflect empirical literature.

[1] SB 862, Chapter 36, Statutes of 2014, Health and Safety Code Section 39715.

CARB, in consultation with administering agencies, has selected ten co-benefits to undergo methodology assessment and development under a contract with University of California, Berkeley. CARB is also evaluating two additional co-benefits, air pollutant emissions and vehicle miles traveled (VMT). This document reviews available data and methods to assess the ***air pollutant emissions*** co-benefit for the Natural Resources and Waste Diversion sectors. It identifies:

- the direction and magnitude of the co-benefit,
- the limitations of existing empirical literature and data,
- the existing assessment methods and tools,
- other issues to consider in developing co-benefit assessment methods, and
- a proposed assessment method for further development.

II. Co-Benefit Description

Air pollution is a general term used to describe undesirable amounts of particulate or gaseous matter in the atmosphere. Some air pollutants are visible such as the reddish-brown haze in smog; however, other air pollutants, including some of the most dangerous, are invisible. Very small amounts of these pollutants can cause serious health and environmental problems. Very fine particulate pollution is particularly dangerous since it burrows deep into the lungs where it can enter the bloodstream and harm the heart and other organs. Fine particulate pollution poses an especially critical health danger for children, the elderly, and people with existing health problems. Air pollution is also harmful to crops and property values. In California, our cities are among the smoggiest urban areas in the country (CARB, 2010). Smog, or ground-level ozone, result from emissions of reactive organic gases (ROG) and nitrogen oxides (NO_X). Other air pollutants, such as toxic air contaminants (toxics), may cause serious adverse health effects with short- or long-term exposure. Despite significant success in reducing overall pollution levels, air pollution continues to be an important public health problem (CARB, 2015b). Criteria and toxic air pollutants are of particular concern to public health. Recent legislation, Assembly Bill (AB) 617[2] and AB 398[3], underscore the importance of reducing air pollution and prioritize GGRF funding for investments that reduce criteria and toxic air pollutant emissions from stationary and mobile sources.

While there are many air pollutants that may be relevant to CCI projects, CARB staff recommends evaluating the following criteria and toxic air pollutants in the initial co-benefit assessment method:

- Criteria Pollutants
    - Particulate Matter ($PM_{2.5}$)
    - Nitrogen Oxides (NO_X)
    - Reactive Organic Gases (ROG)
- Toxic Air Pollutants
    - Diesel Particulate Matter (diesel PM)

[2] AB 617, C. Garcia, Chapter 136, Statutes of 2017.
[3] AB 398, E. Garcia, Chapter 135, Statutes of 2017.

These air pollutants are prioritized for assessment based on their prominence in State Implementation Plans (SIPs), which describe how an area will attain national ambient air quality standards established by federal clean air laws (CARB, 2017). They were also selected due to their high concentration levels and the associated health risks. Concentrations of $PM_{2.5}$, NO_X, and ROG are high relative to the other criteria pollutants displayed in the EMFAC 2014 model (short for EMission FACtor) (CARB, 2014). Diesel PM is the most common airborne toxic that Californians breathe and it is estimated that about 70 percent of the total known cancer risk related to air toxics in California is attributable to diesel PM (CARB 2017). CCI projects that reduce emissions of the selected criteria and toxic air pollutant emissions can improve both air quality and related public health outcomes. Additional air pollutants may be added for future iterations of the assessment method.

III. Directionality of the Co-Benefit

CCI projects in the Natural Resources and Waste Diversion sectors can help support air pollutant emission reductions and removal through measures including:

- planting and/or protecting the health of trees, vegetation, and soils;
- reducing wildfire severity;
- producing biomass-based fuels and energy that displaces higher-polluting fossil fuels;
- installing biogas control systems on uncontrolled open manure lagoons;
- diverting organic waste from landfills and manure lagoons;
- avoiding the use of virgin materials by reducing food waste or using recycled fibers, plastics, and glass in the production of manufactured goods; and
- reducing VMT through protection of natural and working lands at risk of expansive, vehicle-dependent development.

Some CCI projects may also contribute to criteria and toxic air pollution due to emissions that result from equipment operation or, in the case of forest fuels reduction projects, emissions from prescribed burning. Due to these competing factors, the direction of the co-benefit will depend on individual project characteristics for most programs in these sectors. Table 1 illustrates the CCI programs for which air pollutant emission benefits (or dis-benefits) are most likely to accrue once a project is operational.

Table 1: CCI Programs Affected by Co-Benefit

Administering Agency	Program	Likely direction of co-benefit (+ = beneficial change)
Natural Resources and Waste Diversion		
CDFW	*Wetlands and Watershed Restoration*	**+**
CDFA	*Alternative Manure Management*	**+ / -**
	Dairy Digester Research and Development Program	**+ / -**
	Healthy Soils	**+ / -**
CAL FIRE	*Forest Health*	**+**
	Urban and Community Forestry	**+**
CalRecycle	*Waste Diversion*	**+ / -**
CNRA	*Urban Greening Program*	**+**
SGC	*Sustainable Agricultural Lands Conservation Program*	**+**

IV. Magnitude of the Co-Benefit

Overall, investments in the Natural Resources and Waste Diversion sectors are expected to result in air pollutant emission reductions but some individual projects may increase air pollutant emissions. At the project level, the magnitude of the co-benefit will depend on individual project characteristics. Overall, air pollutant emission co-benefits are likely to be significant when considered across the entire CCI portfolio.

V. Limitations of Current Studies

Criteria and toxic air pollutant emissions associated with the Natural Resources and Waste Diversion sector project types are not always well understood or well documented in peer-reviewed literature. There is also a wide variety of project types, multiple activities within project types, and numerous potential emission sources for any given activity. As a result, it may not be possible for CARB to provide a quantitative assessment of the air pollutant emissions co-benefit for each CCI project type within these sectors, or do so without requiring more specific inputs from project applicants. In some cases, data gathered from previously funded CCI projects may be used to inform assumptions contained in future assessment methodologies.

VI. Existing Quantification Methods and Tools

CARB staff evaluated existing quantification methodologies and data sources to estimate criteria and toxic air pollutant emissions from CCI projects. The sections below discuss the materials reviewed and their applicability.

Existing quantification methodologies and data sources reviewed for CCI projects within the Natural Resources and Waste Diversion sectors are summarized in Table 2.

Table 2: Applicability of Evaluated Criteria and Toxic Air Pollutant Emission Quantification Methods and Data Sources

Data Source	Applicability
United States Environmental Protection Agency (US EPA) Compilation of Air Pollutant Emission Factors (AP-42)	• $PM_{2.5}$ and NO_X emissions from wood residue combustion boilers • $PM_{2.5}$ and VOC emissions from wildfire and prescribed burning • $PM_{2.5}$ and NO_X emissions for select wood product industry processes • • Emissions of ammonia for select livestock • $PM_{2.5}$ emissions from landfills • Criteria and toxic air pollutant emissions from food processing • Criteria and toxic air pollutant emissions for production of fibers, plastics, and glass
US EPA Emissions Inventory Improvement Program	• Criteria air pollutant emissions for slash and prescribed burning • $PM_{2.5}$ from wildfire • $PM_{2.5}$ from agricultural soil tilling • Ammonia emissions from landfills
United States Forest Service (USFS) and the Davey Institute	• $PM_{2.5}$ removal by trees and forests
USFS i-Tree	• $PM_{2.5}$ or PM_{10} removed by urban trees (size of particles estimated vary within the i-Tree suite of tools)
USFS Missoula Fire Sciences Laboratory, Rocky Mountain Research Station	• Criteria air pollutant emissions from wildfire and prescribed burning
CARB Wildland Fire Use Methodology	• Criteria air pollutant emissions from a naturally ignited lightning fire that is managed for resources benefit
CARB Wildfire Emissions Methodology	• Criteria air pollutant emissions from wildfire
CARB Low Carbon Fuel Standard Fuel Pathways	• Carbon intensities of biofuels

UC Davis Biomass Collaborative, US EPA Region 9, and National Risk Management Research Lab Office of Research and Development Research for US EPA	• Criteria air pollutant emissions from biogas management technologies
UC Davis Research for CARB	• NO_X emissions from dairy manure management
South Coast Air Quality Management District Rule 1127 – Emission Reductions from Livestock Waste Staff Report	• Ammonia and ROG emissions from livestock waste
CSU Fullerton for the California Energy Commission	• Criteria and toxic air pollutant emissions from anaerobic digestion of food waste
CARB Emissions Inventory Methodology for Composting Facilities	• Ammonia and VOC emissions from composting
San Joaquin Valley Air Pollution Control District	• Ammonia and ROG emission from composting
Hanandeh and El-Zein	• Criteria air pollutant emissions from recycling, anaerobic digestion, and landfills
CARB Mobile Source Emissions Inventory for Off-Road Vehicles	• $PM_{2.5}$ and NO_X emissions from off-road diesel equipment

In addition to the sources above, CARB staff will use sources and emission factors consistent with those used in the Sustainable Communities and Clean Transportation sector and Energy Efficiency and Clean Energy sector when estimating air pollutant emissions associated with VMT reductions and fossil fuel-based energy and fuel displacement.

VII. Other Issues to Consider in Developing Co-Benefit Quantification Methods for Air Pollutant Emissions

For Natural Resources and Waste Diversion sector projects that produce biomass-based fuels or energy, there is a possibility that a project could result in air pollutant emission reductions statewide but increases in emissions within the air basin that the project is located. This may occur when the production and/or combustion of biomass-based fuels or energy causes air pollutant emissions locally, while the air pollutant emission reductions associated with the displacement of fossil fuels occur outside of the air basin. Under this scenario, both the directionality and magnitude of the project-level air pollutant emissions co-benefit would be impacted, depending on the geographic level of assessment (i.e., air basin or statewide).

VIII. Proposed Method/Tool for Use in Further Development

To the extent feasible, CARB staff recommends developing emission factors for criteria and toxic air pollutant emissions appropriate for CCI projects. For the Natural Resources and Waste Diversion sectors, this would involve using the most appropriate data sources to develop air pollutant emission factors that apply to: absorption of air

pollutants by trees, vegetation, and soil; production and combustion of biofuels and bioenergy; landfills and compost production; manure management practices; wildfire and prescribed burning; reductions in VMT; and equipment operation.

Air pollutant emission factors for the Natural Resources and Waste Diversion sectors will have the added benefit of being integrated into CARB's existing quantification methodologies for CCI projects and utilizing generally the same methods already used to estimate GHG emission reductions. The same emission factors could be used to estimate air pollutant emission co-benefits prior to and after CCI funds are awarded.

As criteria and toxic air pollutant emission factors are developed, CARB staff recommends:

- Including draft criteria and toxic air pollutant emission factors in the CCI Quantification Methodology Emission Factor Database;
- Documenting how the criteria and toxic air pollutant emission factors were developed in the CCI Quantification Methodology Emission Factor Database Documentation; and
- Adding air pollutant emission calculations and a new output tab to CARB calculator tools that accompany quantification methodologies to estimate a project's air pollutant emission co-benefits in addition to GHG emission reductions.

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