

STATE OF CALIFORNIA
Budget Change Proposal - Cover Sheet
 DF-46 (REV 10/20)

Fiscal Year 2022-23	Business Unit 3900	Department California Air Resources Board	Priority No.
Budget Request Name 3900-113-BCP-2022-MR, 3900-114-BCP-2022-MR		Program 3510 – Climate Change & 3530 - Community Air Protection	Subprogram

Budget Request Description

2022 Cap and Trade Expenditure Plan: Methane Monitoring and Accountability Project; and Community Air Protection Program

Budget Request Summary

The California Air Resources Board (CARB) requests \$100 million in one-time funding and 7.0 permanent positions from the Greenhouse Gas Reduction Fund to expand the use of satellite remote-sensing technology to make methane observations. These resources are necessary to increase the frequency of observations and expand the area that can be monitored for methane emissions in California using satellite remote-sensing technology to enforce and further inform the state's methane regulations. Additionally, CARB requests \$20 million in one-time funding from the Greenhouse Gas Reduction Fund for the Community Air Protection Program.

Requires Legislation <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Code Section(s) to be Added/Amended/Repealed	
Does this BCP contain information technology (IT) components? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>If yes, departmental Chief Information Officer must sign.</i>	Department CIO	Date 1/10/2022

For IT requests, specify the project number, the most recent project approval document (FSR, SPR, S1BA, S2AA, S3SD, S4PRA), and the approval date.

Project No. N/A **Project Approval Document:** N/A

Approval Date: N/A

If proposal affects another department, does other department concur with proposal? Yes No
Attach comments of affected department, signed and dated by the department director or designee.

Prepared By Jorn Herner	Date 5/12/2022	Reviewed By Hafida Habek	Date 5/12/2022
Department Director Rajinder Sahota	Date 5/12/2022	Agency Secretary Jared Blumenfeld	Date

Department of Finance Use Only

Additional Review: Capital Outlay ITCU FSCU OSAE Dept. of Technology

PPBA Christian Beltran	Date submitted to the Legislature 5/13/2022
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Analysis of Problem

A. Budget Request Summary

The California Air Resources Board (CARB) requests \$100 million in one-time funding and 7.0 permanent positions from the Greenhouse Gas Reduction Fund to expand the use of satellite remote-sensing technology to make methane observations. These resources are necessary to increase the frequency of observations and expand the area that can be monitored for methane emissions in California using satellite remote-sensing technology to enforce and further inform the state's methane regulations. Additionally, CARB requests \$20 million in one-time funding from the Greenhouse Gas Reduction Fund for the Community Air Protection Program.

B. Background/History

Recent reports from the Intergovernmental Panel on Climate Change identify that the planet is out of time and the best chance the planet collectively has is to slow warming in the near term and keep 1.5 degrees C in reach is to drastically reduce emissions of short-lived climate pollutants such as methane. In its Global Methane Assessment Report, the United Nations (UN) stated that a 40-45% reduction in methane emissions by 2030 is necessary to avoid unacceptable climate change. Inger Andersen, Under-Secretary-General of the UN and Executive Director of the UN Environment Programme said that "Fast and ambitious methane mitigation is one of the best strategies available today to deliver immediate and long-lasting multiple benefits for climate, agriculture, human and ecosystem health." However, you cannot manage what you cannot measure, and a robust observational system to identify where emissions is occurring, at a detailed scale, does not currently exist.

Since 2015 California has demonstrated that remote sensing can be an important tool to identify methane beyond any existing routine manual monitoring requirements. This was accomplished by using remote sensing from planes to identify individual plumes of methane in major sources in California. This method does not measure total methane from a large area, but it does identify the specific location where highly concentrated emissions are occurring, and where you can send inspectors to enforce methane regulations, fix leaks, and achieve mitigation quickly. From aerial surveys in 2016, 2017, 2018, 2020 and 2021 we now know that approximately 40% of total emissions may be occurring in this manner, and that 50-60% of those emissions are unintentional and fixable. We also know that the sources are intermittent and frequent measurements are necessary. However, the frequency and areal coverage needed to identify these emissions cannot be accomplished with boots on the ground, or even airplanes. Satellites are also a potential tool to identify these sources, evaluate any regulatory non-conformances, and direct quick action to mitigate the leak.

The national and international will to address methane is growing. In late 2021, the Biden Administration and the European Union launched the Global Methane Pledge, focused on collectively reducing methane emissions at least 30 percent below 2020 levels in 2030. Already, over 100 countries representing half the world's anthropogenic methane emissions have signed the pledge. Around the same time, leading philanthropies committed over \$300 million, through the newly stood up Methane Hub, to support implementation of the pledge and, more broadly, drive methane reductions globally. How countries will implement the pledge is still to be determined.

California has an opportunity to escalate to address a major community concern as well as demonstrate global leadership in the fight against methane by investing in remote sensing technologies and hyper-local monitoring that would identify methane leaks here in California and around the globe at a detailed scale. Information paired with regulatory programs, similar to those here, could result in significant reductions in methane.

California cannot reach its greenhouse gas (GHG) reduction targets without significant reductions in emissions of the most potent greenhouse gases, such as methane. The key sources of methane are livestock, oil and gas, landfills, and wastewater treatment facilities. These sectors and the various co-pollutant emissions associated with their operations create significant environmental justice concerns for low-income communities of color across the state. While methane is a greenhouse gas without direct health implications it is typically emitted with co-pollutants that have been identified as malodorous or toxic air contaminants. This is particularly true of methane emissions from landfills and oil and gas operations. For this reason, methane is often measured as a tracer for the presence of

these other compounds. For example, methane was extensively monitored during the Aliso Canyon incident near Los Angeles in 2015 to understand where residents were being exposed to these co-pollutants.

While we know, generally, the sources of methane, a very significant portion of methane emissions – perhaps as much as half of large emission sources – comes from leaks from oil and gas operations, landfills, and livestock operations. These sources can be monitored effectively only with remote sensing technologies given the number of sources throughout the state, large area over which the sources operate, and inability to regularly inspect sources with historical tools (e.g., currently, most sources receive an annual or perhaps quarterly inspection). For several years, California has been involved in remote sensing projects to detect and repair leaks. These pilot efforts to use remote sensing data on leaks, while limited, enabled California to reduce methane emissions by sharing these data with industry. It is clear this technology is a game-changer when it comes to addressing methane leaks.

C. State Level Consideration

Methane is a very potent greenhouse gas that not only absorbs 86 times more heat than CO₂ over twenty years but is also a short-lived climate pollutant. California has an aggressive set of regulations, goals and programs to reduce methane including CARB's climate change programs under AB32, SB 32, SB 1383, and the Short-Lived Climate Pollutant reduction strategy. Reaching carbon neutrality will require addressing all emissions as quickly as possible and a constellation of satellite will enable the largest emissions and more sources to be detected and available for regulatory follow-up much sooner. Additionally, scientific research has shown that an important fraction of current methane emissions occurs as individual, large, concentrated plumes, which these satellites will detect.

The Administration is also proposing additional resources for the AB 617 Community Air Protection Program, which reduces emissions in communities with disproportionate exposure to air pollution through targeted air monitoring and community emissions reduction programs.

D. Justification

The requested resources will provide approximately eight additional satellites, quadrupling the information available within California and globally, and staff to develop the data management tools needed and work with partners in and beyond California. As a state that has already demonstrated the utility of the data and has started to develop the tools to integrate these data into our regulatory programs, California is in a position to better protect its communities while concurrently elevating its worldwide leadership role on addressing climate change. California would lead the way on the first in world comprehensive high resolution satellite network focused on detecting/addressing methane leaks. In doing so, California international standing for ambitious targets backed up by action will be further solidified thus attracting additional partners consistent with the requirement in AB32 that CARB shall consult with other states, the federal government, and other nations to facilitate the development of integrated and cost-effective regional, national, and international greenhouse gas reduction programs (§38564). The data from the satellites will provide a unique opportunity for jurisdictions to take significant action on methane, provide critical information on potential excess co-pollutant emissions in communities, and provide a unique set of land use data (collected in addition to methane by the remote sensing technology that will be used).

Eight additional satellites are enough to achieve unmatched coverage, sensitivity, and measurement frequency that can be supplemented to develop a full constellation of 20 or more satellites in the coming years to be funded by partnerships the effort is expected to catalyze. The satellite network called for in this proposal focuses on identifying highly concentrated leaks. Those leaks represent a significant portion of all emissions and have been found to usually be unintentional and mitigatable with the appropriate policies and regulations. As such they are anticipated to be the best hope for achieving significant emission reductions in the short term, if coupled with concerted efforts in California and elsewhere. Extrapolating information from California on the potential to the world, an estimated 40-80 million tons of methane could be reduced worldwide annually, or somewhere between a quarter to half of what the UN Global Methane Assessment says is needed by 2030. Using

all market and non-market costs of methane as outlined in the UN Global Methane Assessment, the monetized benefit of the reduction is \$172-344 billion.

The satellites will be able to monitor oil and gas infrastructure as well as the waste industry. These emissions sources can be adjacent to disadvantaged communities and methane emissions from them tend to be coupled with excess emissions of smog forming, toxic and odor-causing chemicals. While there isn't a consistent relationship between methane and co-pollutants, mapping methane plumes with satellites can be an indirect way of mapping excess emissions of these harmful air pollutants. Disadvantaged community members across the State have expressed concern that they experience excess emissions of harmful air pollutants. Detecting 'excess emissions events' such as leaks, which are often transient and short-lived is incredibly difficult with conventional technology (you cannot measure everywhere all the time). Satellites enable measurement over broad spatial areas with high frequency, giving us a powerful new tool for detecting excess emissions events that can be brought to the attention of communities through the open data portal that is being developed for the satellite data, and by working with local partners. From the flight campaigns discussed previously CARB has demonstrated a pathway for producing rapid emissions mitigation after a leak has been detected. Satellites will not only enable us to follow-up and better understand community members' potential exposure to hazardous air pollution from excess emissions events, but through rapid follow-up by regulatory agencies, will afford us the opportunity to reduce community exposure. And if an emergency level plume is detected by the satellite (meets certain criteria for emissions rate, source type, harmful co-pollutant levels, etc), it will trigger a rapid response from CARB and other state agencies and immediate publication of the data. This will help address community members' concerns that they are not informed when an emergency is occurring.

The technology used to measure methane for the satellites envisioned (and for the two already slated for launch in 2023) is a hyperspectral imager that has been developed at NASA's Jet Propulsion Laboratory in Pasadena over the past three decades. It represents the absolute best in class, and no instrument in the world has its capabilities. Through the unique Carbon Mapper partnership, JPL is transferring much of this technology to Planet lab's so new instruments can be built at lower cost and faster. This technology transfer is being accomplished during the construction of the two instruments that will be in the first two satellites slated for launch in 2023 and is now far enough along to where additional cheaper instruments can be constructed for a future launch. The funding requested here is critical to start that process now, so instruments can be ready to be launched in satellites in 2024 or 2025 and be operational for long enough to achieve the mitigation goals laid out by California, the Methane Pledge, and stated as necessary by 2030 by the United Nations.

Additionally, the instrument has over 400 data acquisition channels, of which methane is just one. Other channels can make observations that assist in managing our natural and working lands. While not the purpose of this request, the additional observational capacity enabled by the additional satellites will allow for the observations to target forests, wetlands, and other natural areas to gather these indicators of our environment. The data could help other state and federal agencies manage their environment. The specific capabilities of the additional channels of the instrument are as follows:

- *Geology and Soils*
Mineral mapping, Dust source mapping, Soil type and nutrient mapping
Hazards: Landslide hazard area mapping
- *Agriculture*
Species mapping (crop type), Phenology, Disease, Canopy Water Content
Application/End users: Precision Farming, Natural Resource Agencies
- *Forests and Natural Vegetation (Biophysical and Structural Information)*
Species mapping, Forest Classification, Change Detection, Invasive Species Distribution
Biophysical and biochemical properties, Phenology, carbon content
Disturbance: Fire (fuel moisture, fire extent and severity, fuel levels), Logging and Disease
- *Water Remote Sensing*
Water Quality, Rivers and Lakes; Coastal margins and Oceans, Coral Reefs
Chlorophyll, Turbidity, Suspended Sediments, Invasive Species Mapping, Oil Spill Monitoring
- *Urban Land Cover/Man-made Surfaces*
Surface Classification, Land-use Change, Urban Canopy Assessment and Monitoring

- *Snow and Glaciers*
Snow type, albedo, grain size, snow density and snowpack

Applications: Climate Change, Hydrological and Environmental Monitoring and Modelling

CARB will require the following resources and staff for this proposal:

Methane Satellites: \$100 million GGRF that will be used for a competitive solicitation of bids and subsequent award for satellite methane sensing technologies. The satellites will have capabilities similar to those being launched by Carbon Mapper in 2023. The data from these new satellites will be available within a few days of observation in California and other jurisdictions that are committed to action on methane, or as California should decide. It is expected that these funds will act as an initial down payment on these data, and that other jurisdictions would add to it in the future.

This proposal also includes 7 new permanent positions for a new section to develop, manage and analyze the new data, will be responsible for some operational aspects of the new satellites, and to coordinate with and help jurisdiction beyond California that will use the data and copy our programs, as follows:

1 Air Pollution Specialist (APS) – Satellite targeting (tell satellites where to look). With the additional data from the new satellites more work will have to go in to identifying the right places to for the satellites to monitor as they pass overhead; to respond to observational needs from communities and partner jurisdictions; and to make sure follow up observations are made when plumes have been identified, or operators have informed CARB that they have fixed a leak (i.e., confirm the fix with observations where the emissions should now be gone).

1 APS – Ensure data quality and data assurance. With the additional data there will be a greater need for resources to ensure data is accurate and reliable before action steps are initiated. This APS will also provide feedback and work with existing staff (asked for in companion BCP) to automate processes and improve the machine learning algorithms that generate the methane data products quickly and accurately and with a little staff intervention as possible.

2 APS – For management and analysis of the incoming data to understand the sources and causes of emissions. Combine with other data sets, discuss with regulatory groups, and look at feedback to inform our regulatory and program staff. Determine trends, identify best practices, and work with program staff to minimize emissions and avoid unintended leaks. Work with the SAPS and APS to incorporate other remote methane data streams, such as from TROPOMI and MethaneSat to inform targeting (where the satellites are tasked to look) and gain a better understanding of methane emissions in California. Ensure that the right data management practices are being used and that the right databases and tools are available.

1 Staff Air Pollution Specialist (SAPS) – Take the lead on strategy and coordination with jurisdictions in California who are motivated to work with us to use the data for mitigation. This will include hosting coordination meetings, understanding other jurisdictions' unique needs, communicating CARB's approach, and writing an annual summary report on methane emissions observed from the satellites and California's and the worlds progress on mitigation. Work with other outside partners who operate satellites or make methane observations (TROPOMI, MethaneSat, etc) that provide complimentary information that may be able to improve the operation of the constellation or provide additional insights on emissions.

1 APS – Gather data to understand co-pollutants of methane plumes that are occurring in communities and understand the exposure and health effects of those co-pollutants. Work through existing CARB programs that are engaged with communities to let them know the satellite and co-pollutant data is available. Analyze the occurrence of these types of emissions in communities and work with internal partners on developing potential mitigation strategies.

1 Air Resources Supervisor I (ARS I) – One manager to oversee the work of these six staff and provide guidance to the work. The manager will be the main conduit of information from the staff to upper management, and internal and external stakeholders.

Community Air Protection Program: \$20 million of additional GGRF would greatly benefit this program by allowing CARB to expand their efforts to reduce both stationary and mobile source emissions in communities identified as heavily impacted by air pollution. Under the Program CARB will continue to identify at-risk communities and key measures to reduce neighborhood pollution.

E. Outcomes and Accountability

[Click or tap here to enter text.](#)The outcome includes developing robust, scientifically defensible data on global methane emissions at a detailed scale, informing regulations and policies, improving the enforcement of existing methane regulations in California, and advancing the exportation of similar mitigation and enforcement programs to partner jurisdictions around the world. The constellation and the staff that will work on this program will facilitate a paradigm shift in our understanding of methane emissions at a detailed scale and give the world the tools needed to achieve a significant portion of the methane mitigation so urgently needed.

F. Analysis of All Feasible Alternatives

Alternative 1: Approve as requested. Provide \$100 million GGRF and 7.0 permanent positions in 2022-23, and ongoing to solicit and award competitive bids for satellite methane sensing technologies. Additionally, provide \$20 million GGRF one-time funding for the Community Air Protection Program.

Pro(s): Provides necessary staff and methane data to inform programs in California to achieve significant reductions in methane with near term climate benefits to lessen the worst impacts of climate change. Also provides additional one-time funding for the AB 617 Community Air Protection Program.

Con(s): Requires ongoing staff and one-time funding.

Alternative 2: Provide staff positions but no funding for additional satellites or the Community Air Protection Program.

Pro(s): GGRF money will be available for other purposes.

Con(s): With only staff California will be able to develop the tools and programs to use the satellite data to achieve additional methane mitigation, but CARB would not have the data to use these tools and inform the programs. Also, left to purchase their own data, other jurisdictions could abandon or delay plans to implement programs like California. In addition, while there isn't a consistent relationship between methane and co-pollutants, mapping methane plumes with satellites can be an indirect way of mapping excess emissions of harmful air pollutants and take follow-up actions to understand and address emissions and related health impacts. This alternative would also miss the opportunity to get significant additional reductions in California by 2030 more efficiently through regulatory actions.

Alternative 3: Take no action.

Pro(s): No additional positions or costs.

Con(s): Missed opportunity to make significant progress on limiting the most important short lived climate pollutant and to take a leadership role on methane worldwide. Reductions of this potent short lived climate pollutant could have near term impacts on climate change.

G. Implementation Plan

FY 2022-23	FY 2023-24	FY 2024-25 & on-going
<ul style="list-style-type: none"> • Recruit, hire, and train new technical staff • Solicit competitive bids for data purchase and satellites • Initiate data analysis on first two satellites • Collaborate with enforcement and regulatory program staff • Evaluate data management needs and tools to fulfill them • Analyze how best to use additional observational capacity and develop strategy for optimal constellation operation 	<ul style="list-style-type: none"> • Support methane survey planning • Develop Global Methane Report on first two satellites • Present results at workshops and conferences • Investigate potential co-pollutant emissions • Initiate data analysis on first two satellites • Collaborate with enforcement and regulatory program staff • Finalize development of metrics for costs, emissions reductions, and other factors 	<ul style="list-style-type: none"> • Support methane survey planning • Initiate data analysis on additional satellites • Publish Global Methane report and incorporate additional satellite data as available • Use metrics to inform programs and for Annual Report • Collaborate with other jurisdictions and provide technical expertise and data management tools • Collaborate with enforcement and regulatory program staff

H. Supplemental Information

N/A

I. Recommendation

Approve Alternative 1 to provide \$100 million and 7.0 permanent positions in 2022-23, and ongoing from the Greenhouse Gas Reduction Fund to solicit and award competitive bids for remote methane sensing technologies. Additionally, provide \$20 million GGRF one-time funding for the Community Air Protection Program.

BCP Fiscal Detail Sheet

BCP Title: 2022 Cap and Trade Expenditure Plan: Community Air Protection Program

BR Name: 3900-113-BCP-2022-MR

Budget Request Summary

Operating Expenses and Equipment

Operating Expenses and Equipment	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
54XX - Special Items of Expense	0	20,000	0	0	0	0
Total Operating Expenses and Equipment	\$0	\$20,000	\$0	\$0	\$0	\$0

Total Budget Request

Total Budget Request	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
Total Budget Request	\$0	\$20,000	\$0	\$0	\$0	\$0

Fund Summary

Fund Source

Fund Source	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
Local Assistance - 3228 - Greenhouse Gas Reduction Fund	0	20,000	0	0	0	0
Total Local Assistance Expenditures	\$0	\$20,000	\$0	\$0	\$0	\$0
Total All Funds	\$0	\$20,000	\$0	\$0	\$0	\$0

Program Summary

Program Funding

Program Funding	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
3530 - Community Air Protection	0	20,000	0	0	0	0
Total All Programs	\$0	\$20,000	\$0	\$0	\$0	\$0

BCP Fiscal Detail Sheet

BCP Title: 2022 Cap and Trade Expenditure Plan: Methane Monitoring and Accountability Project

BR Name: 3900-114-BCP-2022-MR

Budget Request Summary

Personal Services

Personal Services	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
Positions - Permanent	0.0	7.0	7.0	7.0	7.0	7.0
Total Positions	0.0	7.0	7.0	7.0	7.0	7.0

Operating Expenses and Equipment

Operating Expenses and Equipment	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
5340 - Consulting and Professional Services - External	0	100,000	0	0	0	0
Total Operating Expenses and Equipment	\$0	\$100,000	\$0	\$0	\$0	\$0

Total Budget Request

Total Budget Request	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
Total Budget Request	\$0	\$100,000	\$0	\$0	\$0	\$0

Fund Summary

Fund Source

Fund Source	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
State Operations - 3228 - Greenhouse Gas Reduction Fund	0	100,000	0	0	0	0
Total State Operations Expenditures	\$0	\$100,000	\$0	\$0	\$0	\$0
Total All Funds	\$0	\$100,000	\$0	\$0	\$0	\$0

Program Summary

Program Funding

Program Funding	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
3510 - Climate Change	0	100,000	0	0	0	0
Total All Programs	\$0	\$100,000	\$0	\$0	\$0	\$0

Personal Services Details

Positions

Positions	FY22 Current Year	FY22 Budget Year	FY22 BY+1	FY22 BY+2	FY22 BY+3	FY22 BY+4
3762 - Air Resources Supvr I (Eff. 07-01-2022)	0.0	1.0	1.0	1.0	1.0	1.0
3875 - Staff Air Pollution Spec (Eff. 07-01-2022)	0.0	1.0	1.0	1.0	1.0	1.0
3887 - Air Pollution Spec (Eff. 07-01-2022)	0.0	5.0	5.0	5.0	5.0	5.0
Total Positions	0.0	7.0	7.0	7.0	7.0	7.0