

STATE OF CALIFORNIA  
**Budget Change Proposal - Cover Sheet**  
 DF-46 (REV 08/15)

Fiscal Year 2016-17	Business Unit 3900	Department Air Resources Board	Priority No. 4
Budget Request Name 3900-L04-BCP-BR-2016-GB		Program <b>3510- CLIMATE CHANGE</b>	Subprogram N/A

Budget Request Description  
 Implementation of Methane Measurements (AB 1496)

Budget Request Summary

The Air Resources Board requests \$580,000 for 4.0 new permanent full-time positions, \$790,000 in annual contract funding, and \$60,000 for a one time equipment funding from the Cost of Implementation Account to meet the legislative requirements of AB 1496 (Chapter 604, Statutes of 2015) to carry out measurements of high-emission methane "hot spots" and conduct life-cycle greenhouse gas emission analysis in the natural gas sector.

Requires Legislation <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Code Section(s) to be Added/Amended/Repealed
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Does this BCP contain information technology (IT) components? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <i>If yes, departmental Chief Information Officer must sign.</i>	Department CIO	Date
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For IT requests, specify the date a Special Project Report (SPR) or Feasibility Study Report (FSR) was approved by the Department of Technology, or previously by the Department of Finance.

FSR  SPR Project No. Date:

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 Bart Croes <i>Bart E. Croes</i>	Date <i>1-7-16</i>	Reviewed By Alice Stebbins <i>Alice Stebbins</i>	Date <i>1-7-16</i>
Department Director Richard W. Corey <i>[Signature]</i>	Date <i>1/7/2016</i>	Agency Secretary Matthew Rodriguez <i>[Signature]</i>	Date <i>1/7/16</i>

**Department of Finance Use Only**

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

BCP Type:  Policy  Workload Budget per Government Code 13308.05

PPBA	Original Signed By: Ellen Moratti	Date submitted to the Legislature <i>1/8/17</i>
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## Analysis of Problem

### A. Budget Request Summary

The budget proposal includes \$580,000 for 4.0 new permanent full-time positions, \$790,000 in annual contract funding, and \$60,000 in one-time equipment funding to: 1) perform aerial and ground-based monitoring and measurements of high-emission methane "hot spots"; and 2) carry out a life-cycle greenhouse gas emission analysis of natural gas produced and imported into the State. These positions, funded through the Cost of Implementation Account (COIA), include 2.0 Air Resources Engineers (ARE) and 2.0 Staff Air Pollution Specialists (SAPS).

Methane is a major short-lived climate pollutant (SLCP) that is emitted from natural and anthropogenic sources. SLCPs are especially potent climate forcers that remain in the atmosphere for much shorter time periods than carbon dioxide (CO<sub>2</sub>), but are responsible for roughly 40 percent of current global warming. Strong immediate actions to cut emissions of SLCPs such as methane are seen to have the potential to reduce global warming by 0.6 degrees Celsius in the near future. Currently, efforts are underway by the Air Resources Board (ARB) to develop a comprehensive strategy by early 2016 to reduce emissions of SLCPs in California pursuant to Senate Bill 605 (Lara, Chapter 523, Statutes of 2014). Recent studies of satellite data have shown broad regions of high methane concentrations (methane "hot spots") in the Central Valley and throughout California, while other studies have shown the presence of "super emitters" in several source sectors which emit disproportionately higher emissions than their counterparts. There is also evidence in the scientific literature that suggests ARB's emission estimates of methane are underestimated and that there are higher-than-expected levels of emissions from the principal sources of anthropogenic methane (including dairies, landfills, and the oil and gas sector) in California. There is an urgent need to conduct monitoring and measurements of methane emissions from such "hot spots" in California to improve the understanding of emission source distribution and strength, as well as better estimates of the overall magnitude of anthropogenic methane emissions in California, and to make our programs and policies more effective at reducing (or mitigating) methane.

With current resources, ARB does not have the capacity to achieve the intent of Assembly Bill (AB) 1496 to carry out measurements of high-emission methane "hot spots" and conduct life-cycle greenhouse gas emission analysis in the natural gas sector.

The work to be performed under AB 1496 includes the following:

- Monitor and measure high emission methane "hot spots" in California, using aerial surveys and ground-based measurements in consultation with local air districts that monitor methane.
- Consult with federal and State agencies, independent scientific experts, and other appropriate entities to gather and acquire the necessary information to carry out a life-cycle greenhouse gas emissions analysis of natural gas produced and imported into California.
- Update relevant policies and programs to incorporate the information gathered and acquired from the monitoring and measuring of methane "hot spots" and carrying out the life-cycle greenhouse gas analysis of natural gas. This task will be conducted by current staff in consultation with the new staff.
- Review, in consultation with independent scientific experts, the most recent available scientific data and reports on the atmospheric reactivity of methane as a precursor to the formation of photochemical oxidant. This task will be conducted by current staff.

### B. Background/History

#### California's Climate Goals

The California Global Warming Solutions Act of 2006 (AB 32) directed ARB to design measures that achieve real, quantifiable, cost-effective reductions of greenhouse gas (GHG) emissions and return California to 1990 emission levels by 2020. Since then, the State of California has implemented a steady set of actions aimed at reducing GHG emissions while providing for cleaner air, diversification of

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the energy and fuel sectors, and experiencing a wide range of technological innovations in these sectors. These efforts to reduce GHG emissions have put California on a trajectory to achieve the 2020 emissions target required by AB 32, as well as the goals to reduce greenhouse gas emissions by 40 percent below 1990 levels by 2030 and by 80 percent below 1990 levels by 2050 as directed by Executive Orders B-30-15 and S-3-05, respectively.

### Methane's Role as a Short-Lived Climate Pollutant

SLCPs are climate pollutants that have a relatively short lifetime in the atmosphere compared to CO<sub>2</sub> – ranging from a few days to a few decades – with a large warming influence on the global climate. SLCPs are the most important contributors to anthropogenic enhancements of the global greenhouse effect after CO<sub>2</sub> itself (40 percent of total global warming to date is attributable to SLCPs). Recent research has identified global action on the reduction of SLCP emissions as the best mechanism for slowing global warming in the near future and to keep warming to below 2 degrees Celsius through 2050. SLCP emission reductions alone can contribute to this goal by lowering “business as usual” global warming by up to 0.6 degrees Celsius.

Methane, a key SLCP, is the principal component of natural gas, and its emissions also contribute to background ground-level ozone, which itself is a powerful GHG and contributes to ground-level air pollution. Methane is roughly 25 times more potent than CO<sub>2</sub> over a 100-year time horizon and has an atmospheric lifetime of about 12 years. Thus, the impacts of methane as a GHG are especially strong in the near-term. Reducing methane emissions can make an immediate beneficial impact on climate change, and deep reductions in methane emissions are required for California to meet its future GHG emission targets and air quality goals.

California has taken several steps to reduce emissions from the agricultural, waste treatment, and oil and gas sectors. California has existing or proposed offset protocols under our Cap-and-Trade program to reduce methane emissions from dairies, coal mines, and rice cultivation, rules under development and being implemented that should create a comprehensive approach to limit methane leaks from the oil and gas sectors, and the nation's strongest standards for limiting methane emissions from landfills.

However further action is required. Methane is responsible for roughly 25 percent of current global warming, and its emissions continue to increase in California and globally. Important areas for potential reductions are methane emissions from the oil and gas sector, waste management, and dairies. Regulatory processes are already moving forward for the oil and gas sector. For other sectors, ARB needs to implement better source identification and monitoring strategies, followed by immediate actions and the development of robust long-term strategies of detection and validation.

Additionally, several research efforts have suggested that the ARB's estimates for statewide methane emissions are underestimated by 30 to 50 percent. These underestimates are especially pronounced in California's Central Valley, but also exist in Southern California and the San Francisco Bay Area. In order to achieve real and effective emission mitigation targets, there is an urgent need to improve the inventory estimates of methane emissions in California, and monitoring and measurement can provide a valuable tool for evaluating and informing the inventory estimates.

In his 2015 Inaugural Address, Governor Brown renewed his commitment to reduce SLCP emissions in California, recognizing that reducing SLCPs plays a crucial role in the State's climate efforts and calling on California to show the world the path to limiting global warming below 2 degrees Celsius through 2015. In keynote remarks at an event hosted by the United Nations Environment Programme and the Climate and Clean Air Coalition on SLCPs, Governor Brown outlined goals for cutting methane emissions in California by 40 percent below current levels by 2030. The Legislature has previously passed SB 605, which directs ARB to develop a comprehensive strategy to reduce SLCP emissions by the end of 2015. Failure to adequately address methane emissions would be inconsistent with

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legislative intent and the Governor's directives and jeopardize our ability to meet California's climate change goals.

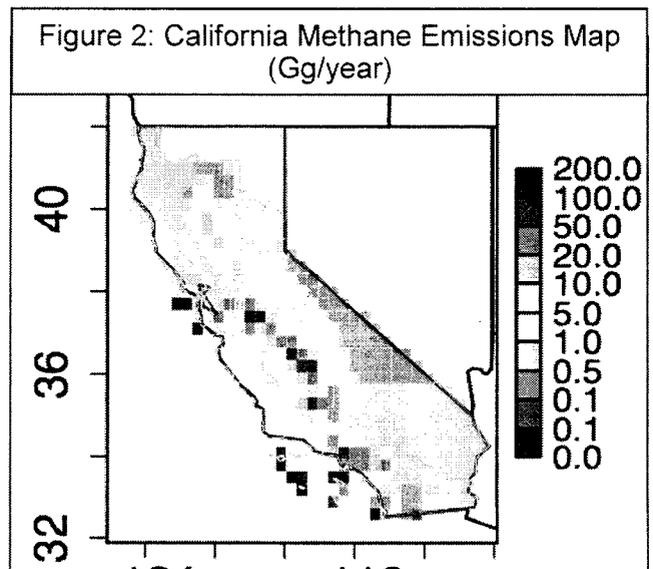
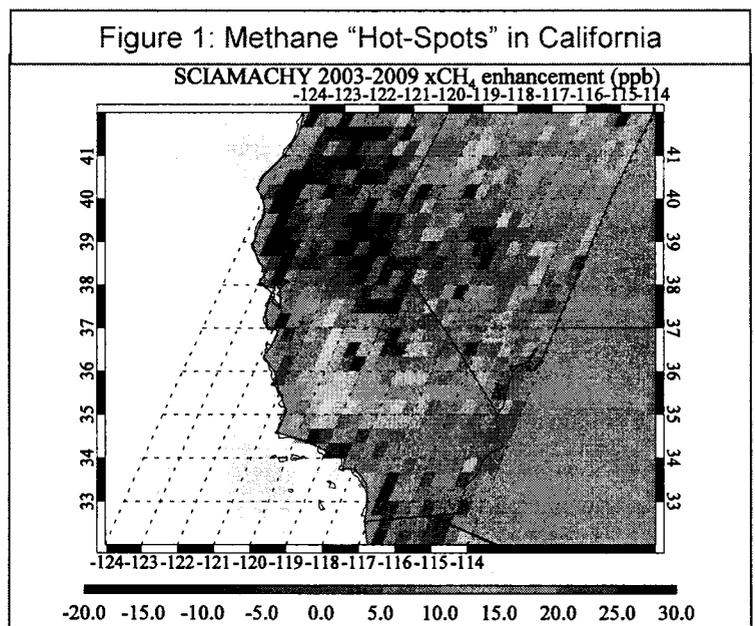
### Methane "hot spots" in California

Methane is emitted from a variety of emission sources, including dairies, landfills, oil and gas activities, rice cultivation, industrial activities, and transportation sources, as well as naturally occurring oil and gas seeps.

- The California Department of Food and Agriculture (CDFA) estimates there are over 76,400 farms and ranches and over 1,470 dairies in California.
- CDFA estimates that California has over 1.79 million milk-producing cows, and the average milk production per cow in 2014 was estimated at 23,702 pounds.
- The California Division of Oil, Gas, and Geothermal Resources (DOGGR) estimates that about 210,000 oil, gas, and geothermal wells have been drilled in California since the petroleum industry began in the 1860s, and about 88,500 of the wells are still in use.
- The California Department of Resources Recycling and Recovery (CalRecycle) and ARB estimate that there are currently over 372 landfills in the State that contain and/or receive biodegradable, carbon-bearing waste.

Knowledge of the sources and distributions of fugitive methane emissions is critical, given the importance of this high global warming potential greenhouse gas and ozone precursor. A recent analysis of satellite data conducted by scientists from National Aeronautics and Space Administration (NASA) and the University of Michigan found a large methane "hot spot" over the Central Valley in California, and this was likely the second largest "hot spot" over the entire United States (Figure 1). Other areas of the State also have enhanced methane concentrations. These atmospheric methane enhancements were persistent over the 2003-2009 periods and emphasize the need to identify the many contributing sources throughout the State for an effective emission mitigation program.

ARB has operated a GHG Research Monitoring Network since 2010 to study the regional GHG emissions trends throughout the State, and evaluate the regional and statewide inventories to support the AB 32 program. The network currently has seven ARB-operated monitoring stations located throughout California and uses high precision analyzers to study methane, carbon dioxide, and nitrous oxide emissions. These efforts rely on highly accurate and precise ambient measurement of GHGs, which are analyzed using complex analytical tools. Figure 2 shows the regional estimation of statewide methane emissions from atmospheric inverse modeling efforts. The ARB GHG network



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helps identify larger regions with high methane emissions. ARB staff is currently undertaking efforts to expand the monitoring network and refine the statewide emissions maps, however, additional efforts as described in this document are needed to make measurements in the methane “hot spots” themselves and identify the high-emitting methane sources that cause the “hot spot”.

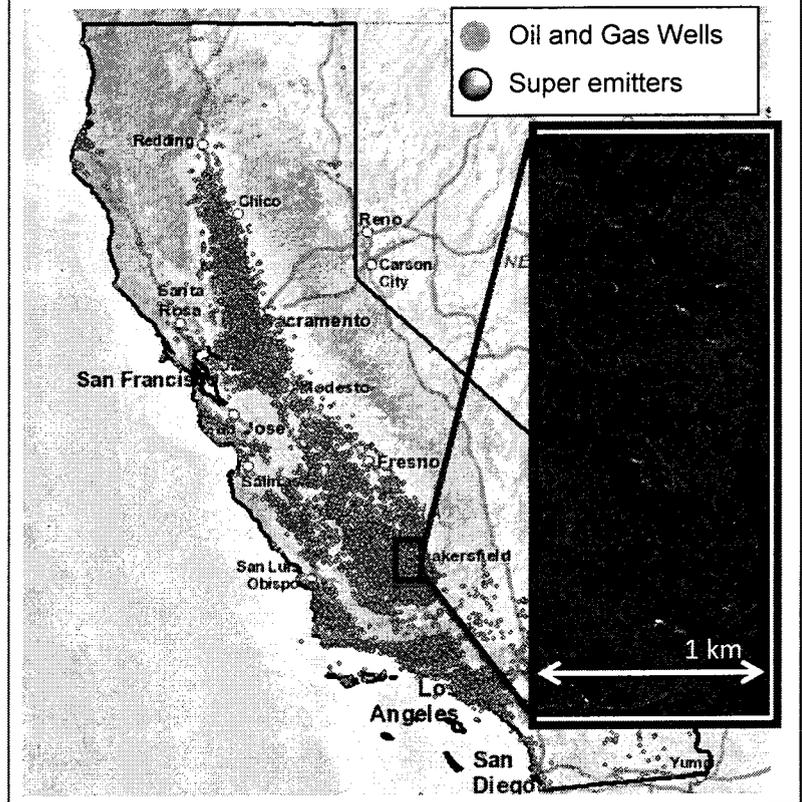
There is also growing evidence in the recent scientific literature suggesting that a small fraction of methane sources within a category are responsible for the majority of the emissions, usually referred to as “super emitters” (Figure 3). However, since these “super emitter” sources are generally not concentrated in a small region, but instead are distributed across the State, there is a critical need to utilize aircraft monitoring and other remote sensing approaches to consistently and comprehensively survey methane emission sources throughout California.

Several exploratory, short-duration aircraft field campaigns by leading researchers at the Jet Propulsion Laboratory (JPL) of NASA (using internal NASA funds available for developing and demonstrating new instrument technologies) have demonstrated the efficacy of remote sensing for detecting methane “super emitters” within a methane “hot spot” area. An aerial survey of the Kern River Oil Field (Figure 3), with tens of thousands of active and abandoned wells, other production equipment, storage tanks, natural gas pipelines, natural seeps, etc., successfully identified a relatively small number of “super emitters” that were disproportionately high contributors to overall methane emissions. Because many individual pieces of equipment from multiple operators are co-located, ground observations were necessary to identify the specific piece of equipment (and facility operator) responsible for the methane leakage. Since the number, geographical location, persistence, emission behavior, and responsible party for these sources is currently unknown, a comprehensive aerial survey with ground-based confirmation is needed to successfully identify and quantify the emissions from these sources, identify best management practices in the different sectors for managing methane emissions, and develop an effective emission mitigation plan to control their emissions. Moreover, understanding and mitigating these “super emitters” in the oil industry and natural gas transmission and distribution sector will also be crucial from a public health and safety perspective.

### Methane life-cycle in the natural gas sector in California

Methane is the principal component of natural gas, and as noted in the recent SLCP Strategy, controlling methane leaks would play an important role in mitigating methane emissions, thereby having an immediate effect on slowing and reducing the impacts of climate change. California’s natural gas consumption has been increasing since 2011, and a large portion of the natural gas consumed in-State is transported from other states and Canada. Leaks in the natural gas infrastructure that deliver fuel to California’s vehicles, homes, and other end-uses impact the potential GHG benefits of using natural gas. As such, it is important to characterize and quantify leaks and losses of methane within California’s natural gas system and evaluate mitigation strategies both within California and nationally.

Figure 3: Methane “Super Emitters” in the Oil and Gas Sector (small fraction of the total wells in the region)



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Currently available tools to model fuel life-cycle emissions cannot accommodate the complexity of the widespread and multi-jurisdictional natural gas system because they assume a national average factor. Adding factors by region, production field, and other characteristics based on the fuel delivered to California would either require significant detail added to an existing model or a new model. The need for a more exact and detailed modeling tool to quantify life-cycle emissions of the natural gas delivered to California is necessary, as the impact of these emissions on climate change is significant. Understanding these emissions will not only help shape California strategies but will enable ARB to work with other states and the federal government to minimize emissions related to natural gas used within California.

### The atmospheric life-cycle of methane and its role as a precursor in ozone formation

Methane is an ozone precursor with low ozone forming potential and a lifetime of approximately 12 years. Modeling studies have clearly identified the role of methane in rising global background ozone formation, and this contribution is expected to increase by the year 2030 due to rising anthropogenic methane emissions. However, when compared to the primary ozone precursor species, oxides of nitrogen and non-methane volatile organic compounds (VOCs), methane emissions are not considered a contributor to regional ozone formation due to its long decadal lifetime (compared to lifetimes of minutes and hours for many anthropogenic and biogenic VOCs). AB 1496 requires a thorough review of the latest science to improve our understanding of processes and contributions of methane to ozone formation, and review the most recent available scientific data and reports on the atmospheric reactivity of methane as a precursor to the formation of photochemical oxidant. This work can be completed by ARB with existing staff resources.

### Update relevant policies and programs

The monitoring effort will play a significant role in improving ARB's Methane Emissions Inventory. Currently, many of the emission factors used for estimating methane emissions come from studies done by the United States Environmental Protection Agency (U.S. EPA) and industry more than a decade ago; furthermore, these emission factors may not be specific to California sources. Additional monitoring and measurement in California can provide information to update existing emission factors to reflect the emission rates representative of California sources, derive emission factors for sources without existing estimation methods, as well as locate previously unknown sources of methane. Several sources that could benefit from additional data include dairies, landfills, abandoned oil wells, petroleum seeps, and leaks from refueling and residential gas use. Consequently, this work will also help in improving the regional emissions estimates and reconciling the methane emissions underestimates in the State.

The life-cycle natural gas analysis is important to characterize and quantify leaks and losses of methane within California's natural gas system and evaluate mitigation strategies both within California and nationally. This will enable ARB to work with other states to implement reduction strategies in the most effective manner. In addition, this analysis will inform several ARB programs and policies. The results of the life-cycle analysis could be used in the LCFS program, in technology and fuels assessments, to evaluate incentive programs, and to inform policy decisions.

The findings will also aid in identifying local "super emitters", which can aid in controlling local emissions through enforcement actions. Additionally, this effort will help in better understanding methane emission sources, identifying important components responsible for "super emitter" behavior, identifying best management practices to reduce source emissions, and ultimately aid in developing effective mitigation programs. Moreover, understanding and mitigating these "super emitters" in the oil industry and natural gas transmission and distribution sector will also be crucial for public health and safety as these leaks are not just methane but may also contain toxic air contaminants or criteria pollutants. Additionally, a large enough leak could be an explosive risk.

This work will be conducted by current staff in consultation with the new staff.

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### Workload Metrics

This proposal would implement new programs; however, experience with developing, implementing and enforcing ARB's early action measures and operating and maintaining monitoring instrumentation for existing air quality programs provides a basis for determining potential work metrics for this proposal. For the methane "hot spot" measurement and monitoring strategy development, ARB requests one lead staff, and one technical staff, as well as contract funds. For the life-cycle greenhouse gas emissions analysis of natural gas, ARB requests one lead staff, and one technical staff, as well as contract funds. Experience with developing, implementing, and enforcing other focused technical strategies suggests this level of effort is appropriate for the scope of the analysis for this particular sector.

### **C. State Level Considerations**

This proposal will enable ARB to meet the legislative requirements of AB 1496 of identifying, measuring, and monitoring methane "hot spots" in California, as well as conducting a life-cycle greenhouse gas emissions analysis of natural gas. Capabilities, expertise, and results gained through the resources allocated in this proposal will in turn support a wide range of California's GHG and air quality goals such as the State's near term, mid-term, and long-term GHG reduction goals and ozone reduction goals. These goals include the "five pillars" objectives announced by the Governor (reduction of SLCPs, doubling energy efficiency savings in existing buildings and developing cleaner heating fuels by 2030, 50 percent renewables in electricity generation, 50 percent reduction in petroleum-based fuel use and improved carbon storage in soils and agricultural lands by improved management techniques); State Implementation Plans for achieving air quality goals; and Executive Order B-30-15 (40 percent reduction of GHG emission goal by 2030). The proposal would also build upon recommendations in the draft AB 1257 Report to improve the understanding of greenhouse gas emissions from the natural gas system.

### **D. Justification**

As mentioned above, SLCPs (especially methane) are potent GHGs that are collectively responsible for roughly 40 percent of climate change to date. Prior legislation such as SB 605 recognized the critical role that SLCPs must play in the State's climate efforts by requiring ARB to develop a comprehensive strategy to reduce emissions of SLCPs. In September 2015, ARB released the Draft Short-Lived Climate Pollutant Reduction Strategy proposing additional measures to reduce methane emissions by 40 percent, which is significantly beyond existing 2020 goals. The resources identified in this proposal will assist in these goals by providing tools for verification of actual emission sources, emissions, and emission factors. In order to meet the legislative intent of AB 1496, ARB will develop a comprehensive program that will include the following elements:

#### Task 1: Aerial and ground-based monitoring and measurements of high emission methane "hot spots" and update programs and policies

AB 1496 includes a mandate that ARB undertake monitoring and measurements of high-emission methane "hot spots" in the State using the best available scientific and technical methods. A detailed program to study methane "hot spots" will require a comprehensive monitoring and measurement program. ARB currently uses a ground-based monitoring network to study regional methane emissions in California. Although this approach has been invaluable in evaluating statewide and regional emissions and tracking statewide emission trends, it does not have the capability to identify and study local methane "hot spots" and identify specific local sources responsible for the emissions. Furthermore, ARB does not have the capability to conduct aerial or satellite measurements.

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In order to achieve a complete understanding of local “hot spots” and their contributing sources, ARB will develop a Tiered Monitoring and Measurement Program, which will include the following:

- Satellite measurements and results from the GHG Research Monitoring Network to identify regional “hot spots” across California and to track the annual and seasonal regional emission behavior to understand the source sector contributions.
- Airborne measurements to conduct sub-regional and local surveys of methane emission sources using remote sensing techniques in “hot spot” areas identified by satellite and GHG Research Monitoring Network measurements.
- Ground-based measurements to identify specific pieces of equipment and the operator responsible for the high emissions, as well as measurements of source-level emission rates.

Satellite data, GHG Research Monitoring Network data, and facility maps will be used to identify broad regions that need to be surveyed. Aerial measurements will also be used to inform the ground-based measurements to verify and pinpoint “super emitters.” Currently, NASA-JPL is the only known entity with the demonstrated technological capability and expertise needed to make aerial surveys of methane “hot spots”. These capabilities include end-to-end competency in methane remote sensing including instrument deployment, aircraft field campaign planning and execution, data processing, analysis, and project management.

In the past, ARB’s research partners (including NASA-JPL) have used their internal research funds for proof of concept measurements. However, even exploratory measurement studies are expensive, and NASA-JPL’s limited methane remote sensing missions funded by their internal NASA funds cost around \$500,000 to study a small representative sample of the State near Bakersfield (Figure 3). A future comprehensive program with high quality measurements relevant to ARB programs will require extramural funding from ARB to conduct statewide aerial surveys in California and will require sustained annual support and funding for a systematic multi-year survey of all the high methane regions in California. Moreover, measurement campaigns will only cover about 10 percent of the statewide methane sources of the State each year (with multiple seasonal measurements), and sustained measurements will offer both a complete statewide coverage, as well as the opportunity to re-visit areas to look at persistence of oil and gas leaks and seasonal differences for landfills and dairies. Researchers from NASA-JPL have estimated that a representative survey covering 10 percent of the statewide methane sources will cost \$1.4 million over a one year period which includes \$790,000 for consulting and other professional services. ARB anticipates doing a series of 3-year extramural research contracts to systematically study regional methane “hot spots”, survey methane sources, identify the regional “super emitters”, and study their emission behavior.

The data generated by the aerial measurements through these contracts will be further analyzed by ARB staff to identify regional characteristics of the various source sectors, emission attributes related to specific activities within a sector, and the potential for methane mitigation. The results from these analyses will also form the basis of future research, methane mitigation programs and policy, and enforcement actions, and will therefore require rigorous and comprehensive evaluation. As such, these tasks are both outside the scope of responsibilities and beyond the capabilities of current ARB staff. In order to meet these needs, this assignment will require hiring a Staff Air Pollution Specialist (SAPS) and an Air Resources Engineer (ARE), with detailed understanding of the science, measurement techniques, as well as program application related to methane source sectors. A SAPS-level staff will be needed for program coordination, high-level technical analyses, technical modeling, contract management, and synthesizing the results. An ARE-level staff will be needed for ground-based measurements, technical analyses, and day-to-day coordination with the project and contract teams. Both staff will also have the responsibility to identify and recommend areas for research and policy actions, identify sources for enforcement review, and provide input to update relevant policies and programs.

Task 2: Life-cycle greenhouse gas emissions analysis of natural gas produced in and imported to California and update programs and policies

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Understanding methane emissions from the life-cycle (production, processing, storage, transmission, distribution, compression, and use) of natural gas that is consumed in California is an important component of an overall strategy to reduce those emissions. Although the Low Carbon Fuel Standard includes a life-cycle assessment for natural gas, it is limited and includes, in general, national level data and does not enable differentiation between sources of natural gas. These limitations hinder staff's development of the most representative and appropriate methane emissions estimates from the natural gas system and also limit the ability to provide appropriate regulatory incentives. Additionally, many studies are ongoing in this area, and future work is expected. As such, methane leakage science is rapidly developing and will likely impact emissions estimates. Developing a California specific model would make analysis of natural gas life-cycle emissions more consistent with the analysis for petroleum, which is analyzed with a similar life-cycle model, the Oil Production Greenhouse Gas Emissions Estimation (OPGEE) Model. Finally, in its recent draft AB 1257 report on natural gas use in California, the California Energy Commission concurs with the need for more detailed study on this issue. The results of the life-cycle model will be evaluated for use in the LCFS program, technology and fuels assessments, to evaluate incentive programs, and to inform policy decisions.

An in-depth analysis of the emissions associated with natural gas delivered to the State is beyond the capability of the current life-cycle model and would require a dedicated model and additional staff resources to complete. A model designed to analyze the complexities of natural gas delivered to California could provide the best representation of natural gas life-cycle emissions. The analysis of natural gas emissions is complicated and multi-layered: natural gas is produced, processed, and stored outside of California and transported by pipeline via multiple routes to the State. Regulations at the federal level and in other states and jurisdictions impact the magnitude of emissions from these processes, and as a result, impact life-cycle emissions of natural gas delivered to California. In addition, regulations are evolving as more emphasis is put on understanding and quantifying methane emissions nationwide. To maintain the most accurate estimates possible, staff would monitor changing regulations and policies in jurisdictions supplying natural gas to California and ensure the impacts and most current information are reflected in the model. To maintain a rigorous model, staff would also monitor, review, and analyze current and future methane emissions research studies and results and apply information to the model as appropriate.

Tools that are currently available for modeling fuel life-cycle emissions cannot accommodate the complexity of the widespread and multi-jurisdictional natural gas system. The need for a more exact and detailed modeling tool to quantify life-cycle emissions of the natural gas delivered to California is necessary, as the impact of these emissions on climate change is significant. Understanding the emissions in a more detailed manner would ensure the proper incentives are in place to mitigate methane emissions. The geographic detail would allow ARB to work with U.S. EPA and other states to ensure the most effective and cost-effective regulations are implemented both within and outside of California.

The evaluation of data and policies to provide as input to the life-cycle model is both outside the scope of responsibilities and beyond the capabilities of current ARB staff. In order to meet these needs, this assignment will require hiring a Staff Air Pollution Specialist (SAPS) and an Air Resources Engineer (ARE). The SAPS-level staff would coordinate the program, interact with federal and State agencies, independent scientific experts, and any other appropriate entities and would have detailed understanding of the sector with particular emphasis on prior modeling and contract management experience. The ARE-level staff would evaluate the technical data from existing studies on California, national, regional, and external state levels. The ARE-level staff will be needed to evaluate programs and policies and determine emissions or emission factors by oil and gas basin for all natural gas supplied to California and be able to interpret results of scientific and technical studies to determine the best emission estimates and incorporation into an overall modeling framework. As studies are ongoing and knowledge is quickly evolving, the ARE-level staff will be needed to continually evaluate studies and work with the SAPS to integrate new knowledge into the life-cycle model.

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### Summary:

Based on past experience, ARB anticipates that four technical positions will be filled by professional staff including two AREs and two SAPS. These new positions will be absorbed into existing sections within ARB.

More details on the resource needs are described in the table:

Resource Need/Task	FY 2015-2016	FY 2016-2017	FY 2017-2018 and beyond
<p><u>Task 1:</u> Undertake aerial and ground-based monitoring and measurements of high-emission methane "hot spots" as a contributor to greenhouse gas emissions in California, using the best available scientific and technical methods and in consultation with local air districts that monitor methane. Specific tasks include:</p> <ul style="list-style-type: none"> <li>• Initiate and manage extramural research contracts to conduct aerial measurements to identify regional hot spots.</li> <li>• Analysis of satellite and GHG Research Monitoring Network data to identify areas for aerial surveys.</li> <li>• Conduct aerial measurements to inform the ground-based measurements to verify and pinpoint "super emitters".</li> <li>• Ground-based measurements to verify and pinpoint "super emitters", and measure source-level emissions using existing and new equipment.</li> <li>• Conduct and compile research, and write reports.</li> <li>• Develop and conduct technical modeling, as needed.</li> <li>• Identify and recommend areas for research and policy actions.</li> <li>• Identify sources for enforcement review.</li> <li>• Provide input to update relevant policies and programs.</li> </ul>	<p>2 Positions (1 SAPS, 1 ARE) plus \$640,000 contract and \$60,000 equipment funding</p>	<p>2 Positions (1 SAPS, 1 ARE) plus \$640,000 contract funding</p>	<p>2 Positions (1 SAPS, 1 ARE) plus \$640,000 contract funding</p>

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<p><b>Task 2:</b> Consult with outside experts and carry out life-cycle greenhouse gas emissions analysis of natural gas produced in and imported to California, using the best available scientific and technical methods. Specific tasks include:</p> <ul style="list-style-type: none"> <li>• Develop a natural gas model to quantify life-cycle emissions of the natural gas delivered to California.</li> <li>• Evaluate state and national emissions and relevant policies and programs.</li> <li>• Assess scientific and technical literature and data to determine appropriate data incorporation and conduct necessary data analysis.</li> <li>• Identify research needs and implement contracts – identify data sources, potential data collection methods, and options for model development; coordinate with contractor to achieve research goals.</li> <li>• Manage extramural research contracts, including technical review – understand research goals and implementation of results into existing and future ARB programs.</li> <li>• Consult with federal and state agencies, independent scientific experts, and any other appropriate entities.</li> <li>• Provide input to update relevant policies and programs such as LCFS, fuel assessments and incentive programs.</li> </ul>	<p>2 Positions (1 SAPS, 1 ARE) plus \$150,000 contract</p>	<p>2 Positions (1 SAPS, 1 ARE) plus \$150,000 contract</p>	<p>2 Positions (1 SAPS, 1 ARE) plus \$150,000 contract</p>
<p><b>Total</b></p>	<p><b>4 Positions (\$580,000) plus \$790,000 annual contracts and \$60,000 one-time equipment</b></p>	<p><b>4 Positions (\$576,000) plus \$790,000 annual contracts</b></p>	<p><b>4 Positions (\$576,000) plus \$790,000 annual contracts</b></p>

In Task 1, staff will develop concepts and coordinate research plans for methane “hot spot” measurements in collaboration with outside experts and contractors. In Task 2, staff will conduct and coordinate detailed life-cycle analysis in collaboration with outside experts. As such, a total of 4.0 staff positions are needed to complete both Tasks 1 and 2, which will include conducting literature reviews, compiling research and technical information, performing technical analyses, and coordinating with external stakeholders, including other agencies. Staff will develop and conduct technical modeling, manage contracts, and develop interagency agreements or working groups on an as needed basis. In addition, the staff will use information gathered through those avenues to write internal reports and academic, peer-reviewed papers. Based on all the information, staff will identify and make policy recommendations, and help develop strategy documents and regulatory concepts.

### E. Outcomes and Accountability

Under this proposal, ARB will hire four additional staff to assist in research, analysis, and program development and implementation of methane “hot spot” measurements and natural gas life-cycle

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greenhouse gas emission analysis in accordance with AB 1496. ARB will also receive \$790,000 in annual contract funding, and a \$60,000 one-time equipment funding for extramural research, which will be invested to conduct routine aerial surveys and research to identify methane “hot spots” across California and for developing and applying a natural gas model to quantify life-cycle emissions of the natural gas delivered to California. Staff will also conduct analyses of satellite data and aerial measurements to inform the ground-based measurements to verify and pinpoint “super emitters” and measure source-level emissions, develop and conduct technical modeling, conduct and compile research, and write reports to identify areas for research, policy, and enforcement actions.

### Projected Outcomes

Workload Measure	CY	BY	BY+1	BY+2	BY+3	BY+4
Development of Research Plan	X					
Annual Aerial Methane Surveys		X	X	X	X	X
Identification of Contractor for Developing the Natural Gas Model	X					
Establish Model Data Sources and Framework		X	X			
Development and Technical Updates of the Natural Gas Model		X	X	X	X	X
Identification and Analysis of Methane “Super Emitters”		X	X	X	X	X
Research, Policy, and Enforcement Recommendations		X	X	X	X	X

## F. Analysis of All Feasible Alternatives

1. Approve proposal: Under this alternative, ARB will receive the requested \$580,000 for 4.0 full-time positions, \$790,000 in annual contract funding, and a \$60,000 one-time equipment funding. This alternative will allow ARB to fully investigate high emission methane “hot spots,” and provide a life-cycle GHG analysis of the natural gas sector to support and enforce SLCP emission reduction measures. These resources are needed to meet the tasks set for ARB in AB 1496. The evaluation of the current atmospheric science in regard to methane and its role as an ozone precursor will rely on existing staff resources. This proposal develops a comprehensive program for methane “hot spot” measurements and monitoring using a tiered approach of satellite, airborne, and ground-based measurements. This approach will also utilize the best available scientific techniques in-house in collaboration with external contractors utilizing their unique technology and expertise in remote sensing to conduct high-resolution aerial surveys. This approach will also result in the completion of an in-depth analysis of the emissions associated with natural gas delivered to the State.
2. Redirecting existing ARB resources: This alternative would redirect existing staff resources to work on the tasks identified in this proposal. However, current staff resources are working full-time on implementing and enforcing existing regulations, conducting outreach and compliance assistance, developing/updating the emissions inventory, evaluating the effectiveness of existing rules, and identifying gaps to ensure California meets the 2020 emissions reduction goals required by AB 32. Current resources are at full capacity and cannot be diverted from the important task of implementing existing regulations that enable ARB to meet the legislatively mandated 2020 goals. Diverting existing staff resources to work on the tasks identified in this proposal would result in the State backsliding from meeting important existing goals. Moreover, several of the tasks outlined above (including conducting aerial measurements and developing the natural gas model consistent

## Analysis of Problem

with existing models) are both outside the scope of responsibilities and beyond the capabilities of current ARB programs and staff. Therefore, under this alternative, it will not be possible to complete critical data collection and model development tasks required by AB 1496.

3. Fewer staff, additional contract and equipment funds: Under this alternative, ARB will receive lower staff resources and increased contract fund resources. Although ARB will be able to collect critical aerial and satellite remote sensing data for analysis and develop the natural gas model required by AB 1496, staff would not be able to direct and review the analysis fully and would be limited in the ability to confer with all appropriate stakeholders and integrate the input into the strategy development. Therefore, ARB would not be able to fully achieve the objectives required by AB 1496. Lowering staff resources and including additional contract funds would result in the inability to develop robust strategies and regulations and affect collection of robust, enforceable data for future enforcement support, thus not achieving the intended goals of AB 1496.
4. Additional staff, less contract funds: This alternative will provide additional staff, but less contract funds to ARB to achieve the goals of AB 1496. As such, ARB needs the requested annual extramural research and equipment funds (\$790,000 in annual contract funding, \$60,000 one-time equipment funding) to fully investigate high emission methane “hot spots,” and provide a life-cycle GHG analysis of the natural gas sector to support and enforce SLCP emission reduction measures. The current state-of-the-science technology requires aerial surveys for the detection and mapping of methane hot spots. Only one known entity in the world possesses the demonstrated technology and expertise needed to make aerial surveys of methane “hot spots.” While NASA-JPL has funded the technology development and demonstration, ARB will need funding to conduct statewide surveys in California using external contractor. Without the proposed level of contract funds, ARB would not be able to fund the necessary statewide survey to identify and monitor methane “hot spots”. ARB does not have the expertise to develop the natural gas model and ensure it is consistent with existing models. A contractor would be able to fulfill this role. Without those funds, either the model would not be completed or additional staffing would be necessary to develop the modeling expertise.
5. No action: Under this alternative, ARB will not receive any additional staff or contract funds. Under this alternative, ARB would not have the adequate resources to meet the legislative requirements of AB 1496. ARB would not be able to investigate high-emission methane “hot spots” in the State using the best available scientific and technical methods, provide a state-of-the-art life-cycle GHG emissions analysis of the natural gas sector in California, and update relevant policies and programs.

## Analysis of Problem

### G. Implementation Plan

FY 2016/17	FY 2017/18	FY 2018/19 & ongoing
<ul style="list-style-type: none"> <li>• Recruit, hire, and train new technical staff (6 months)</li> <li>• Identify research needs and implement contracts</li> <li>• Develop concept for statewide methane “hot spot” survey methodology</li> <li>• Specify, procure, and configure additional mobile monitoring equipment</li> <li>• Develop and document necessary laboratory and data analysis methods</li> <li>• Conduct literature review</li> <li>• Consult with experts and air districts</li> <li>• Initiate methane life-cycle related stakeholder outreach</li> <li>• Support aerial methane survey planning</li> </ul>	<ul style="list-style-type: none"> <li>• Support and train air districts on monitoring activities</li> <li>• Support aerial methane survey planning</li> <li>• Initiate data analysis (results from “hot spot” survey and methane monitoring)</li> <li>• Validate and report measurement data</li> <li>• Conduct public workshops, where necessary</li> <li>• Develop interagency agreements or workgroups</li> <li>• Identify research needs and implement contracts</li> <li>• Manage extramural research contracts, including technical review</li> <li>• Increase stakeholder outreach</li> </ul>	<ul style="list-style-type: none"> <li>• Support aerial methane survey planning</li> <li>• Improve data analysis (results from “hot spot” survey and methane monitoring)</li> <li>• Validate and report measurement data</li> <li>• Data analysis</li> <li>• Prioritize possible control strategies</li> <li>• Develop new SLCP measures for methane and initiate regulatory proceedings</li> <li>• Conduct public workshops, where necessary</li> <li>• Participate in interagency coordination (workgroups, MOUs, etc.)</li> <li>• Identify research needs and implement contracts</li> <li>• Update current programs with life-cycle results as appropriate</li> <li>• Manage extramural research contracts, including technical review</li> <li>• Assess the efficacy of control strategies</li> <li>• Identify and make policy recommendations</li> </ul>

### H. Supplemental Information

Item #	Element	Unit Cost	Qty	Sub-total	Ongoing Costs/Year	Comments
1	Methane EC Flux System	\$55,000	1	\$55,000	\$2,750	Maintenance @ 5 percent of capital assets per year
2	Thermal Plume Camera	\$2,500	2	\$5,000	\$250	
				<b>Capital \$60,000</b>	<b>Annual \$3,000</b>	

## Analysis of Problem

### I. Recommendation

ARB recommends approving the proposed alternative (Alternative 1) requesting \$580,000 for 4.0 full-time permanent positions, \$790,000 annually in contract funding, and a \$60,000 one-time equipment funding to fulfill the legislative requirements of AB 1496. Furthermore, this alternative supports California's efforts to achieve the State's near-term (under AB 32), mid-term, and long-term GHG and air quality goals; all of the Governor's "five pillars" objectives; State Implementation Plan strategies for achieving air quality goals; and the 40 percent GHG mid-term reduction goal by 2030 in Executive Order B-30-15.

Air Resources Board				Attachment A Workload Justification			
Fund:		Cost of Implementation					
Position Title:		Staff Air Pollution Specialist					
Workload Measure		FY 2016-17			FY 2017-18		
Description of task	Number of Times the task was performed	Number of hours needed to complete task	Total number of annual hours	Number of times the task was performed	Number of hours needed to complete task	Total number of annual hours	
Manage research contracts to conduct aerial measurements to identify regional hot spots	12	10	120	12	10	120	
Analyze satellite and GHG tower network data to identify areas for aerial surveys	12	40	480	12	40	480	
Analyze aerial measurements to inform the ground-based measurements to verify and pinpoint "super-emitters"	2	80	160	2	80	160	
Conduct ground-based measurements to verify and pinpoint "super-emitters", and measure source-level emissions using existing and new equipment			-			-	
Conduct and compile research, and write reports	4	100	400	4	100	400	
Develop and conduct technical modeling, as needed.	4	110	440	4	110	440	
Identify and recommend areas for research, policy, and enforcement actions	4	40	160	4	40	160	
Manage contracts to develop and maintain a Natural gas model to quantify life cycle emissions of the natural gas delivered to California	12	20	240	12	20	240	
Evaluate state and national emissions and relevant policies and programs			-			-	
Assess scientific and technical literature and data to determine appropriate data incorporation and conduct necessary data analysis			-			-	
Identify research needs and implement contracts – identify data sources, potential data collection methods, and options for model development; coordinate with contractor to achieve research goals	4	80	320	4	80	320	
Manage research contracts, including technical review – understand research goals and implementation of results into existing and future ARB programs	12	40	480	12	40	480	
Consult with federal and state agencies, independent scientific experts, and any other appropriate entities	12	40	480	12	40	480	
Update relevant policies and programs such as LCFS, fuel assessments and incentive programs	4	80	320	4	80	320	
<b>Total Hours (2 SAPS)</b>			3,600			3,600	

1.0 Position Equivalent = 1,800 hours

Numbers are based on previous workload experience

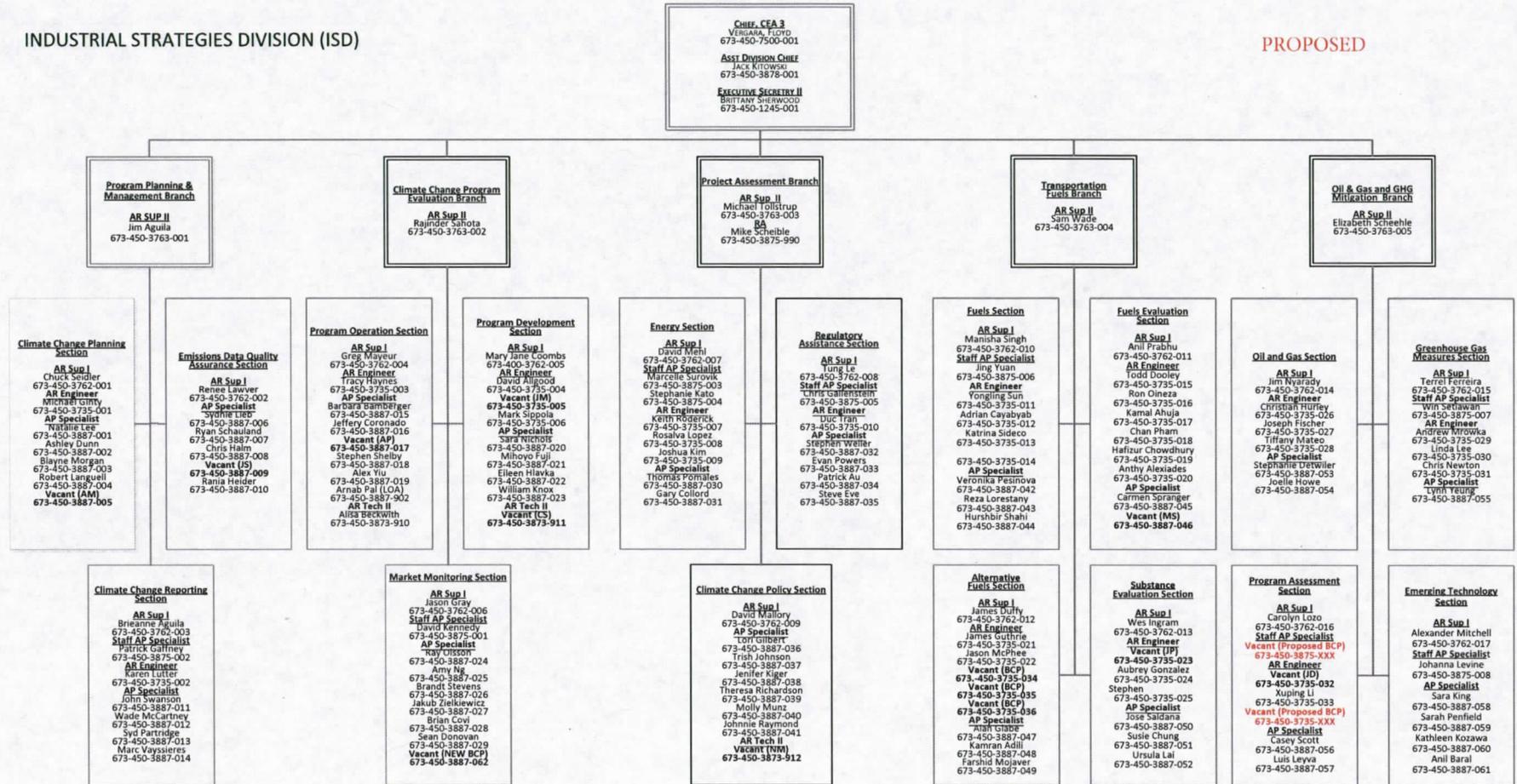
Air Resources Board				Attachment A Workload Justification		
Fund:		Cost of Implementation				
Position Title:		Air Resources Engineer				
Workload Measure	FY 2016-17			FY 2017-18		
Description of task	Number of Times the task was performed	Number of hours needed to complete task	Total number of annual hours	Number of times the task was performed	Number of hours needed to complete task	Total number of annual hours
Manage research contracts to conduct aerial measurements to identify regional hot spots			-			-
Analyze satellite and GHG tower network data to identify areas for aerial surveys	12	40	480	12	40	480
Analyze aerial measurements to inform the ground-based measurements to verify and pinpoint "super-emitters"	2	80	160	2	80	160
Conduct ground-based measurements to verify and pinpoint "super-emitters", and measure source-level emissions using existing and new equipment	4	150	600	4	150	600
Conduct and compile research, and write reports	2	100	200	2	100	200
Develop and conduct technical modeling, as needed.	2	80	160	2	80	160
Identify and recommend areas for research, policy, and enforcement actions	4	40	160	4	40	160
Manage contracts to develop and maintain a Natural gas model to quantify life cycle emissions of the natural gas delivered to California			-			-
Evaluate state and national emissions and relevant policies and programs	6	120	720	6	120	720
Assess scientific and technical literature and data to determine appropriate data incorporation and conduct necessary data analysis	6	120	720	6	120	720
Identify research needs and implement contracts – identify data sources, potential data collection methods, and options for model development; coordinate with contractor to achieve research goals			-			-
Manage research contracts, including technical review – understand research goals and implementation of results into existing and future ARB programs	4	40	160	4	40	160
Consult with federal and state agencies, independent scientific experts, and any other appropriate entities	4	20	80	4	20	80
Update relevant policies and programs such as LCFS, fuel assessments and incentive programs	4	40	160	4	40	160
<b>Total Hours (2 ARE)</b>			3,600			3,600

1.0 Position Equivalent = 1,800 hours

Numbers are based on previous workload experience

INDUSTRIAL STRATEGIES DIVISION (ISD)

PROPOSED



The Administrative Analysis Unit in TTD will provide administrative and clerical support to both TTD and ISD.

Updated 10/9/15

**AIR RESOURCES BOARD  
INDUSTRIAL STRATEGIES DIVISION  
OCTOBER 5, 2015**

131.55 Authorized Positions  
1 Blanket Position

**ASST DIVISION CHIEF**  
Jack Kitowski  
673-450-3878-001

**CHIEF, CEA 3**  
Floyd Vergara  
673-450-7500-001

**EXEC SEC II**  
Brittany Sherwood  
673-450-1245-001

**PROGRAM PLANNING & MANAGEMENT BRANCH**

**AR SUP II**  
Jim Aquila  
673-450-3763-001

**CLIMATE CHANGE  
PLANNING SECTION**

**AR SUP I**  
Chuck Seidler  
673-450-3762-001

**AR ENG**  
Michael Ginty  
673-450-3735-001

**AP SPEC**  
Natalie Lee  
673-450-3887-001  
Ashley Dunn  
673-450-3887-002  
Blayne Morgan  
673-450-3887-003  
Robert Lanquell  
673-450-3887-004  
Vacant (Mebust)  
673-450-3887-005

**EMISSIONS DATA  
QUALITY  
ASSURANCE  
SECTION**

**AR SUP I**  
Renee Lawver  
673-450-3762-002

**AP SPEC**  
Sydnie Lieb  
673-450-3887-006  
Ryan Schauland  
673-450-3887-007  
Chris Halm  
673-450-3887-008  
Vacant (Swanson)  
673-450-3887-009  
Rania Heider  
673-450-3887-010

**CLIMATE CHANGE PROGRAM EVALUATION BRANCH**

**AR SUP II**  
Rajinder Sahota  
673-450-3763-002

**PROGRAM OPERATION  
SECTION**

**AR SUP I**  
Greg Mayeur  
673-450-3762-004

**AR ENG**  
Tracy Haynes  
673-450-3735-003

**AP SPEC**  
Barbara Bamberger  
673-450-3887-015  
Jeffery Coronado  
673-450-3887-016  
Vacant (Pal)  
673-450-3887-017  
Stephen Shelby  
673-450-3887-018  
Alex Yiu  
673-450-3887-019  
Amab Pal  
673-450-3887-020

**PROGRAM  
DEVELOPMENT  
SECTION**

**AR SUP I**  
Mary Jane Coombs  
673-450-3762-005

**AR ENG**  
David Allgood  
673-450-3735-004  
Vacant (McPhee)  
673-450-3735-005  
Mark Sippola  
673-450-3735-006

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Sara Nichols  
673-450-3887-020  
Mihoyo Fuji  
673-450-3887-021  
Eileen Hlavka  
673-450-3887-022  
William Knox  
673-450-3887-023

**PROJECT ASSESSMENT BRANCH**

**AR SUP II**  
Michael Tollstrup  
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**ENERGY SECTION**

**AR SUP I**  
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**STAFF APS**  
Marcelle Surovik  
673-450-3875-003  
Stephanie Kato  
673-450-3875-004

**AR ENG**  
Keith Roderick  
673-450-3735-007  
Rosalba Lopez  
673-450-3735-008  
Joshua Kim  
673-450-3735-009

**AP SPEC**  
Thomas Pomaes  
673-450-3887-030  
Gary Collord  
673-450-3887-031

**REGULATORY  
ASSISTANCE SECTION**

**AR SUP I**  
Tung Le  
673-450-3762-008

**STAFF APS**  
Chris Gallenstein  
673-450-3875-005

**AR ENG**  
Duc Tran  
673-450-3735-010

**AP SPEC**  
Stephen Weller  
673-450-3887-032  
Evan Powers  
673-450-3887-033  
Patrick Au  
673-450-3887-034  
Steve Eve  
673-450-3887-035

**TRANSPORTATION FUELS BRANCH**

**AR SUP II**  
Sam Wade  
673-450-3763-004

**FUELS SECTION**

**AR SUP I**  
Manisha Singh  
673-450-3762-010

**STAFF APS**  
Jing Yuan  
673-450-3875-006

**AR ENG**  
Yongling Sun  
673-450-3735-011  
Adrian Cayabyab  
673-450-3735-012  
Katrina Sideco  
673-450-3735-013  
Greg O'Brien  
673-450-3735-014

**AP SPEC**  
Veronika Pesinova  
673-450-3887-042  
Reza Lorestanty  
673-450-3887-043  
Hushbir Shahi  
673-450-3887-044

**FUELS EVALUATION  
SECTION**

**AR SUP I**  
Anil Prabu  
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**AR ENG**  
Todd Dooley  
673-450-3735-015  
Ron Cineza  
673-450-3735-016  
Kamal Ahuja  
673-450-3735-017  
Chan Pham  
673-450-3735-018  
Hatizur Chowdhury  
673-450-3735-019  
Anthy Alexiades  
673-450-3735-020

**AP SPEC**  
Carmen Spranger  
673-450-3887-045  
Vacant (Surovik)  
673-450-3887-046

**OIL & GAS AND GHG MITIGATION BRANCH**

**AR SUP II**  
Elizabeth Scheehle  
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**OIL AND GAS  
SECTION**

**AR SUP I**  
Jim Nyarady  
673-450-3762-014

**AR ENG**  
Christian Hurley  
673-450-3735-026  
Joseph Fischer  
673-450-3735-027  
Tiffany Mateo  
673-450-3735-028

**AP SPEC**  
Stephanie Detwiler  
673-450-3887-053  
Joelle Howe  
673-450-3887-054

**GREENHOUSE GAS  
MEASURES SECTION**

**AR SUP I**  
Terrel Ferreira  
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**STAFF APS**  
Win Setiawan  
673-450-3875-007

**AR ENG**  
Andrew Mrowka  
673-450-3735-029  
Linda Lee  
673-450-3735-030  
Chris Newton  
673-450-3735-031

**AP SPEC**  
Lynn Yeung  
673-450-3887-055

**CLIMATE CHANGE  
REPORTING SECTION**

**AR SUP I**  
Brienne Aquila  
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**STAFF APS**  
Patrick Gaffney  
673-450-3875-002

**AR ENG**  
Karen Lutter (95)  
673-450-3735-002(95)

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673-450-3887-011  
Wade McCartney  
673-450-3887-012  
Syd Partridge  
673-450-3887-013  
Marc Vayssieres  
673-450-3887-014

**MARKET MONITORING  
SECTION**

**AR SUP I**  
Jason Gray  
673-450-3762-006

**STAFF APS**  
David Kennedy  
673-450-3875-001

**AP SPEC**  
Ray Olsson  
673-450-3887-024  
Amy Ng  
673-450-3887-025  
Brandt Stevens  
673-450-3887-026  
Jakub Zielkiewicz  
673-450-3887-027  
Brian Covi  
673-450-3887-028  
Sean Donovan  
673-450-3887-029  
Vacant (BCP)  
673-450-3887-062

**CLIMATE CHANGE POLICY  
SECTION**

**AR SUP I**  
David Mallory  
673-450-3762-009

**AP SPEC**  
Lon Gilbert  
673-450-3887-036  
Trish Johnson  
673-450-3887-037  
Jennifer Kiger (8)  
673-450-3887-038 (8)  
Theresa Richardson  
673-450-3887-039  
Molly Munz (8)  
673-450-3887-040 (8)  
Johnnie Raymond  
673-450-3887-041

**ALTERNATIVE FUELS  
SECTION**

**AR SUP I**  
James Duffy  
673-450-3762-012

**AR ENG**  
James Guthrie  
673-450-3735-021  
Jason McPhee  
673-450-3735-022  
Vacant (BCP)  
673-450-3735-034  
Vacant (BCP)  
673-450-3735-035  
Vacant (BCP)  
673-450-3735-036

**AP SPEC**  
Alan Glabe  
673-450-3887-047  
Kamran Adili  
673-450-3887-048  
Farshid Mojaver  
673-450-3887-049

**SUBSTANCE  
EVALUATION  
SECTION**

**AR SUP I**  
Wes Ingram  
673-450-3762-013

**AR ENG**  
Vacant (Peterson)  
673-450-3735-023  
Aubrey Gonzalez  
673-450-3735-024  
Stephen d'Esterhazy  
673-450-3735-025

**AP SPEC**  
Jose Saldana  
673-450-3887-050  
Susie Chung  
673-450-3887-051  
Ursula E. Lai  
673-450-3887-052

**PROGRAM  
ASSESSMENT  
SECTION**

**AR SUP I**  
Carolyn Lozo  
673-450-3762-016

**AR ENG**  
Vacant (Duffy)  
673-450-3735-032  
Xuping Li  
673-450-3735-033

**AP SPEC**  
Casey Scott  
673-450-3887-056  
Luis Leyva  
673-450-3887-057

**EMERGING  
TECHNOLOGY  
SECTION**

**AR SUP I**  
Alexander Mitchell  
673-450-3762-017

**STAFF APS**  
Johanna Levine  
673-450-3875-008

**AP SPEC**  
Sara King  
673-450-3887-058  
Sarah Penfield  
673-450-3887-059  
Kathleen Kozawa  
673-450-3887-060  
Anil Baral  
673-450-3887-061

# Research Division

## Management & Admin (310)

**Chief**  
**Bart Croes (CEA 3)**  
673-310-7500-001

PROPOSED

### Research Planning, Administration, and Emission Mitigation Branch

**Jorn Herner (AR Sup II)**  
673-310-3763-001

### Health & Exposure Assessment Branch

**Linda Smith (AR Sup II)**  
673-310-3763-002

### Climate, Atmospheric Science, and Economic Studies Branch

**Michael FitzGibbon (AR Sup II)**  
673-310-3763-003

#### Emission and Exposure Research Section (310)

**Abhilash Vijayan (AR Sup I)**  
673-310-3762-001  
SAPS  
**Vacant (Proposed BCP)**  
673-310-3875-XXX  
ARE  
Toshihiro Kuyawama  
673-310-3735-001  
**Vacant (Proposed BCP)**  
673-310-3735-XXX  
APS  
Yanju Chen  
673-310-3887-001  
Matthias Falk  
673-310-3887-003  
Steve Mara  
673-310-3887-004  
Walter Ham  
673-310-3887-005

#### Climate Change Mitigation & Emissions Research Section (310)

**John Collins (AR Sup I)**  
673-310-3762-002  
SAPS  
Hector Maldonado  
673-310-3875-001  
ARE  
Seungju Yoon  
673-310-3735-002  
Chris Ruehl  
673-310-3735-003  
Tao Zhan  
673-310-3735-004  
Chandan Misra  
673-310-3735-005

#### Populations Studies Section (310)

**Barbara Weller (AR Sup I)**  
673-310-3762-004  
APS  
Cynthia Garcia  
673-310-3887-011  
Brian Moore  
673-310-3887-012  
Hye-Youn Park  
673-310-3887-013  
Nargis Jareen  
673-310-3887-014  
ART I/II/P/INT  
William Chen  
673-310-3873-910

#### Indoor Exposure Assessment Section (310)

**Peggy Jenkins (AR Sup I)**  
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APS  
Susan Lum  
673-310-3887-015  
Stephanie Parent  
673-310-3887-016  
Hyung Joo Lee  
673-310-3887-017  
Jeff Williams  
673-310-3887-018  
Zoe (Qunfang) Zhang  
673-310-3887-902  
ART I/II/P/INT  
Victor Mendiola  
673-310-3873-911

#### Atmospheric Processes Research Section (310)

**Eileen McCauley (AR Sup I)**  
673-310-3762-008  
SAPS  
Ash Lashgari  
673-310-3875-004  
ARE  
Jin Xu  
673-310-3735-006  
APS  
William Vance  
673-310-3887-023  
Longwen Gong  
673-310-3887-024

#### Air Quality and Climate Science Section (310)

**Dongmin Luo (AR Sup I)**  
673-310-3762-009  
SAPS  
Nehzat Motallebi  
673-310-3875-005  
Ralph Propper  
673-310-3875-006  
ARE  
Winston Potts  
673-310-3735-007  
APS  
Lei Guo  
673-310-3887-025  
ART II  
Maxwell Montrose  
673-310-3873-913  
Tristan Pulido  
673-310-3873-914

#### Climate Action and Research Planning Section (310)

**Annalisa Schilla (AR Sup I)**  
673-310-3762-003  
SAPS  
Sarah Pittiglio  
673-310-3875-002  
APS  
Heather Choi  
673-310-3887-006  
Tabetha Willmon  
673-310-3887-007  
Dana Waters (.5)  
673-310-3887-008  
Melanie Zauscher  
673-310-3887-009  
Maggie Witt  
673-310-3887-010  
STUDENT ASSISTANT T/INT  
Jill Bilodeaux  
673-310-4870-960

#### Administrative Section (310)

**Emma Plasencia (SSM I)**  
673-310-4800-001  
AGPA  
Sarah Szepesi  
673-310-5393-701  
Trish Chancey  
673-310-5393-702  
SSA  
Monica Vejar  
673-310-5157-703  
Vacant  
673-310-5157-704  
QT(T)  
Vince Vicari  
673-310-1139-801  
Saffron Jaune  
673-310-1139-802  
QA (T) P/INT  
Maureen Alexis  
673-310-1379-901

#### Health & Ecosystems Assessment Section (310)

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# Research Division

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### Health & Exposure Assessment Branch

**Linda Smith (AR Sup II)**  
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### Climate, Atmospheric Science, and Economic Studies Branch

**Michael FitzGibbon (AR Sup II)**  
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#### Climate Change Mitigation & Emissions Research Section (310)

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#### Air Quality and Climate Science Section (310)

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#### Climate Action and Research Planning Section (310)

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#### Administrative Section (310)

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# BCP Fiscal Detail Sheet

BCP Title: Implementation of Methane Measurements (AB 1496)

DP Name: 3900-011-BCP-DP-2016-GB

## Budget Request Summary

	FY16					
	CY	BY	BY+1	BY+2	BY+3	BY+4
Positions - Permanent	0.0	4.0	4.0	4.0	4.0	4.0
<b>Total Positions</b>	<b>0.0</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>
Salaries and Wages						
Earnings - Permanent	0	332	332	332	332	332
<b>Total Salaries and Wages</b>	<b>\$0</b>	<b>\$332</b>	<b>\$332</b>	<b>\$332</b>	<b>\$332</b>	<b>\$332</b>
Total Staff Benefits	0	152	152	152	152	152
<b>Total Personal Services</b>	<b>\$0</b>	<b>\$484</b>	<b>\$484</b>	<b>\$484</b>	<b>\$484</b>	<b>\$484</b>
Operating Expenses and Equipment						
5301 - General Expense	0	8	8	8	8	8
5302 - Printing	0	4	4	4	4	4
5304 - Communications	0	8	8	8	8	8
5320 - Travel: In-State	0	16	16	16	16	16
5322 - Training	0	4	4	4	4	4
5324 - Facilities Operation	0	40	40	40	40	40
5340 - Consulting and Professional Services -	0	790	790	790	790	790
5346 - Information Technology	0	16	12	12	12	12
5368 - Non-Capital Asset Purchases - Equipment	0	60	0	0	0	0
<b>Total Operating Expenses and Equipment</b>	<b>\$0</b>	<b>\$946</b>	<b>\$882</b>	<b>\$882</b>	<b>\$882</b>	<b>\$882</b>
<b>Total Budget Request</b>	<b>\$0</b>	<b>\$1,430</b>	<b>\$1,366</b>	<b>\$1,366</b>	<b>\$1,366</b>	<b>\$1,366</b>

## Fund Summary

Fund Source - State Operations						
3237 - Cost of Implementation Account, Air	0	1,430	1,366	1,366	1,366	1,366
<b>Total State Operations Expenditures</b>	<b>\$0</b>	<b>\$1,430</b>	<b>\$1,366</b>	<b>\$1,366</b>	<b>\$1,366</b>	<b>\$1,366</b>
<b>Total All Funds</b>	<b>\$0</b>	<b>\$1,430</b>	<b>\$1,366</b>	<b>\$1,366</b>	<b>\$1,366</b>	<b>\$1,366</b>

## Program Summary

Program Funding						
3510 - Climate Change	0	1,430	1,366	1,366	1,366	1,366
<b>Total All Programs</b>	<b>\$0</b>	<b>\$1,430</b>	<b>\$1,366</b>	<b>\$1,366</b>	<b>\$1,366</b>	<b>\$1,366</b>