STi | Sonoma Technology

November 3, 2023 STI-9723106

Dr. David Ridley
California Air Resources Board
david.ridley@arb.ca.gov

Re: 2023CARB_SMMI-RFI001, Statewide Mobile Monitoring Initiative (SMMI)

Dear Dr. Ridley,

Sonoma Technology is pleased to respond to CARB's Request for Information (RFI) regarding the Statewide Mobile Monitoring Initiative (SMMI).

We are submitting a joint response from Sonoma Technology, FluxSense, Inc., and the University of California, Berkeley, which presents a statewide mobile monitoring project approach using regulatory and research-grade analyzers for community-scale air quality monitoring and mapping.

Sonoma Technology is a world-renowned expert in air quality monitoring, measurements, modeling, and analyses. We were founded in 1982 and are headquartered in Petaluma, California. We work with federal, state, and local government agencies, private industry clients, universities, and non-governmental organizations on diverse projects, including multiple types of air quality and meteorological monitoring and measurements, emissions inventory development, meteorological and air quality modeling, human health and exposure studies, data analysis, and software development. Our measurements partners from FluxSense, Inc. are world-renowned experts in design, development, and deployment of mobile platforms for air quality research. Our analysis partner, Dr. Joshua Apte from the University of California, Berkeley, is a leading authority on the engineering and statistical aspects of mobile monitoring design and is world-renowned in the analysis of community scale air monitoring data. Collectively, our team has the expertise, experience, and skills to complete this project successfully.

I certify the information in this response is true and accurate to the best of my knowledge at the time of submittal. Please don't hesitate to contact me at 707.665.9900 or avijayan@sonomatech.com.

Sincerely,

Abhilash Vijayan, Ph.D., PE
Director of Climate, Community Air Quality Programs/
Senior Scientist

Approved:

Hilary R. Hafner
Chief Operating Officer

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2023

Statewide Mobile Monitoring Initiative: Request for Information Response

Joint Submission From:
Sonoma Technology, Inc., FluxSense, Inc., and the University of California, Berkeley
Event Number: 2023CARB_SMMI-RFI001

Attachment – A: Vendor Profile

1. Identify the Company Name, address, city, state, and zip code, telephone.

Sonoma Technology
1450 N. McDowell Blvd., Suite 200
Petaluma, CA 94954
Ph 707.665.9900 | F 707.665.9800
sonomatech.com

2. Identify the name, title, address, phone number, and email address of the primary contact person for this RFI.

Abhilash Vijayan, Ph.D., PE
Director of Transportation, Climate, and Community Air Quality Programs / Senior Scientist
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avijayan@sonomatech.com

3. Provide a brief overview of your company including number of years in business, number of employees, nature of business, and description of clients.

Sonoma Technology is partnering with **FluxSense, Inc.** and **University of California, Berkeley** to submit a joint response to the Request for Information. We have also received support from a number of leading air quality monitoring equipment manufacturers, who have committed support for our project concept.

Sonoma Technology is a world-renowned expert in air quality monitoring, measurements, modeling, and analyses. Our objective is to provide our clients with high-quality, innovative, science-based solutions for air quality, meteorological, and other environmental needs worldwide in an ethical and objective manner to facilitate effective environmental management. Sonoma Technology was founded in 1982 and is headquartered in Petaluma, California. We are a Sonoma County Certified Green Business with over 40 years in business, and have worked with federal, state, and local government agencies, private industry clients, universities, and non-governmental organizations on diverse projects, including multiple types of air quality and meteorological monitoring and measurements, emissions inventory development,

meteorological and air quality modeling, human health and exposure studies, data analysis, and software development. Sonoma Technology has a wide variety of experience in stationary air monitoring networks and mobile monitoring projects, and has deployed regulatory, facility-level, and community-focused air quality monitoring resources. Sonoma Technology has a diverse workforce of nearly 100 highly trained and experienced staff members, which includes 17 scientists who hold PhDs. We have an interdisciplinary team of scientists, modeling experts, software developers and engineers, field technicians, and publications and support staff who work together to cover the full life cycle of a project.

FluxSense, Inc, was started in 2013 in San Diego, CA, to fill a need for reliable diffuse emissions measurements on the U.S. market, and consists of about 15 employees. FluxSense designs and develops sophisticated mobile measurement platforms, and has deployed these platforms to conduct measurements throughout the United States, Europe, South Korea, China, and other parts of the world on request. FluxSense clients include local authorities, state and federal agencies, universities, and research institutes, in addition to private companies including, but not limited to petrochemical industries, oil and gas production, refineries, ports, landfills and waste management, agriculture and animal feed lots, water treatment facilities, power plants, product storage facilities, and environmental consultant firms.

Dr. Joshua Apte (University of California, Berkeley) is a leading authority on the engineering and statistical aspects of mobile monitoring design, including in developing algorithms for accurately representing time-averaged spatial patterns from periodic mobile monitoring data, for assessing the validity and reliability of the mobile monitoring products, and in assessing the sampling requirements to adequately represent spatial patterns of different air pollutants. He and his team world-renowned in the analysis of community scale air monitoring data, and have made seminal contributions to the development of hyperlocal block-by-block mapping using Google Street View cars and other mobile laboratories, and to identifying the air pollution disparities that emerge at fine spatial scales.

4. Identify any parent corporation and/or subsidiaries, if applicable.

N/A

5. Give a brief description of your company's product(s), platform(s), service(s), etc. that may be relevant to this RFI.

Experience in Mobile Monitoring: Some recent mobile-oriented projects for the team include:

- Sonoma Technology has a long history in conducting complex air quality measurements using state-of-the-art stationary and mobile measurement platforms. Our founders designed and ran ground-breaking projects to study ozone transport into and throughout California using data analysis and photochemical modeling of measurements conducted with Sonoma Technology's instrumented aircraft.
- Sonoma Technology designed, implemented, and maintained two Google Street View cars for the Environmental Defense Fund (EDF); these cars were outfitted with instruments to collect mobile air pollution data in Houston, TX. The team designed, installed, calibrated, and operated mobile air quality instruments and data systems to collect measurements of community-scale $PM_{2.5}$, BC, PM_{10}, NO, NO_2, and CO_2.
- Sonoma Technology conducted an air quality research study in collaboration with the UC Davis Air Quality Research Center and Entanglement Technologies to measure and map air pollution in disproportionately impacted Sacramento communities. We deployed a mobile monitoring platform, equipped with research-grade instrumentation, to measure the levels of criteria air pollutants ($PM_{2.5}$, NO_2, ozone, and CO), greenhouse gases (methane, CO_2, and black carbon), and air toxics (aromatics, dienes, alkanes, and chlorinated VOCs).
- Sonoma Technology is leading the design of an integrated methane monitoring platform design plan for the U.S. Department of Energy (USDOE). The project will evaluate all available methane monitoring technologies; survey oil and gas sector stakeholders and practitioners to document operational requirements and best practices in methane monitoring; and deploy bottom-up, top-down, and bridge technologies in a real-world application to inform the design of a comprehensive integrated methane monitoring platform plan for USDOE. Sonoma Technology will collect data and develop data fusion techniques using data from satellites (TROPOMI, GHGSat), aircraft (Scientific Aviation), near-surface drones (SeekOps), fenceline stationary networks (Sonoma Technology and Kern Energy), and ground-level mobile platforms (FluxSense) for regional and facility-level emissions monitoring to evaluate the real-world strengths, limitations, and complementarity of the various measurement techniques for leak detection and emission quantification.
- Sonoma Technology is also conducting a comprehensive assessment of annual methane emissions from the oil and gas basins of the San Joaquin Valley, California, and Denver, Colorado, using a multi-tiered measurement and analysis system for the USDOE. This includes bottom-up inventory analysis using the VISTA methane inventory and extensive inverse modeling applied on measurement from TROPOMI satellite data, GHGSat satellite methane measurements. ground-based stationary networks, and ground-level mobile flux measurements using the FluxSense mobile platform. We will conduct

integrated data analysis and data fusion to study the regional emissions, as well as the spatial and temporal trends in each region.

- FluxSense, Inc., is a world-renowned expert in design, development, and deployment of mobile platforms for air quality research. In the last eight years, FluxSense has built ten mobile laboratories using state-of-the-art optical remote sensing instrumentation for environmental authorities in California, Colorado, South Korea, and China as well as the platforms for their own fleet of mobile laboratories based in California and Sweden. These design and development efforts include the entire process chain, from sampling inlets, electrical HVAC system, battery pool for self-sustained sampling, seamless swap between grid-, engine- and battery power, vibration dampening for delicate instrumentation, cooling, pilot screen environment for instrument control and data display, etc. The laboratories have been built on a variety of platforms, including Mercedes Benz Sprinter, Mercedes Vito, Ford Transit, and Hyundai vehicles.
- FluxSense is typically contracted for quantification of gaseous emissions from industrial and agricultural sites, concentrations monitoring and leak search using their mobile laboratory, building and supporting monitoring stations for stationary long-term monitoring in polluted community areas, and building mobile laboratories for other clients with attached training and support. FluxSense has conducted projects with California Air Resources Board (CARB), South Coast Air Quality Management District (SCAQMD), Bay Area Air Quality Management District (BAAQMD), Department of Energy (DOE, subcontractor), Texas Commission on Environmental Quality (TCEQ, subcontracting with University of Houston), Colorado Department of Health and Environment (CDHPE), and has also been hired for consent decree type of contracts with private businesses.
- The University of California, Berkeley, team, led by Dr. Joshua Apte, focuses on hyperlocal air pollution measurement and modeling methods for characterizing community air pollution exposures and disparities. His research group has made seminal contributions to the development of hyperlocal block-by-block mapping using Google Street View cars and other mobile laboratories,[1] and to identifying the air pollution disparities[2] that emerge at fine spatial scales.[3]

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[1] Apte JS, Messier KP, Gani S, Brauer M, Kirchstetter TW, Lunden MM, Marshall JD, Portier CJ, Vermeulen RCH, Hamburg SP. 2017. High resolution air pollution mapping with Google Street View cars: exploiting big data. Environmental Science & Technology 51, 6999-7008

[2] Tessum CW, Paolella DA, Chambliss SE, Apte JS, Hill JD, Marshall JD. 2021. $PM_{2.5}$ polluters disproportionately and systemically affect people of color in the United States. Science Advances 18, eabf4491

[3] Chambliss SE, Pinon CP, Messier KP, LaFranchi B, Upperman CR, Lunden MM, Robinson AL, Marshall JD, Apte JS. 2021. Local and regional-scale racial and ethnic disparities in air pollution determined by long-term mobile monitoring. Proceedings of the National Academy of Sciences 118 e2109249118

Experience in Operating Advanced Air Quality Monitoring Equipment: The project team has extensive experience deploying and operating a wide range of air quality instruments:

- Sonoma Technology has over four decades of experience in operating air quality measurement systems and has applied these systems in a range of regulatory, industrial, research, and community monitoring projects. Many of these projects include continuous monitoring for particulate matter (PM_{10}, $PM_{2.5}$), black carbon (BC), nitrogen oxides (NO, NO_2), carbon dioxide (CO_2), carbon monoxide (CO), hydrogen sulfide (H_2S), benzene/toluene/ethylbenzene/xylenes (BTEX), hydrogen cyanide (HCN), methane, total volatile organic compounds (tVOCs), 1,3-butadiene, acetylene, alkenes, other VOCs, and numerous other compounds (e.g., speciated metals, hexavalent chromium), and associated meteorological measurements.
- Many Sonoma Technology experts have also gained decades of prior experience in air quality monitoring and operating complex measurement systems at regulatory agencies, leading universities, national research laboratories, and other research leaders like NASA. With the addition of FluxSense, Inc., and UC Berkeley, the project team has wide-ranging and complementary expertise in the use of advanced systems for air quality, greenhouse gas (GHG), and toxic air contaminant monitoring.

Experience in Measuring Complex Air Toxics: The project team has extensive experience in air quality measurements for traditional air pollutants, GHG, and complex air toxics. Representative projects include:

- Sonoma Technology is managing several ongoing fenceline monitoring projects at refineries to quantify multiple air toxics using both spectroscopic and gas chromatography methods.
- Other Sonoma Technology projects include the (1) measurement of methanol at a wastewater treatment process, (2) measurement of air toxic emissions from interstates and city highways at schools, (3) exposure assessment of school children to re-entrained diesel particulate exhaust and benzene, (4) continuous onsite assessment of community exposure to air toxics from a remediation site, and (5) community assessment of fumigant exposure.

Experience in Setting Up and Operating Fast Data Collection Systems: In our combined decades-long experience of designing and operating instrumental measurement systems, the Sonoma Technology team has cultivated a rich knowledge base and expertise in fast data collection systems:

- Currently, Sonoma Technology operates the data collection and management systems for (1) fenceline monitoring at several oil refineries, (2) a wastewater treatment center, (3) a rare earth mine, (4) a landfill, (5) industrial sites, and (6) several ambient air monitoring stations. Many of these projects include public websites to disseminate air quality data on a 5-minute basis. Across the 150 measurement systems that Sonoma Technology operates and manages, over 1.7 million data points are collected on a daily basis.
- As part of the EDF study described above, Sonoma Technology developed and operated a fast- response data management system (DMS) to handle the large volume of data collected in real time from the two Google Street View cars mobile platforms.
- Similar to the EDF study, data were collected with our DMS for the Sacramento mobile monitoring study.

Experience in Community and Regional Air Quality Monitoring Projects: The project team has extensive experience in air quality measurements for traditional air pollutants, GHG, and complex air toxics. Representative projects include:

- For over two decades, Sonoma Technology worked with the U.S. EPA in the development, operation, and enhancement of the AirNow program, the United States' national source of real- time air quality data and forecasts.
- Sonoma Technology is managing an ongoing fenceline project using continuous gas chromatographs to collect multiple air toxic species in a community adjacent to an industrial facility.
- Sonoma Technology is also operating several air toxics monitoring sites for the Sacramento Metropolitan AQMD to quantify local-scale benzene and mobile source air toxics in environmental justice communities in Sacramento, CA.

Data Management: Sonoma Technology has extensive experience in managing data to achieve high data quality and maintain chain of custody and transparency. In our operational projects, raw data management occurs on a real-time, daily, monthly, quarterly, and annual basis. In near-real time, data are transferred from infield instruments through a data acquisition system (DAS) to a DMS. The DMS automatically quality-controls data upon data ingest, detects outliers and problems, generates reports, and creates alerts. Automated screening checks of data feeds are used to screen out invalid data for public display (if applicable) and are helpful to focus the data reviewer's efforts on the data that needs the most attention. The DMS provides data to a (non-public) operations website that is used for daily graphical review of the data by experienced analysts. Data flags identified through auto-screening are graphically reviewed during data validation (i.e., not in real time), and QC flags are updated with daily and quarterly actions. The DMS keeps track of data changes in its chain-of-custody feature—i.e., raw data are preserved as

well as all changes and quality flags. Data storage and backups can be made using a cloud solution or an on-premises solution.

Data Analysis and Visualization Systems: In the last 20 years, air pollution data have expanded in volume, source, and complexity, as air monitoring has expanded from criteria pollutants to chemical speciation, high time-resolution, and space-based measurements on satellites. Sonoma Technology routinely conducts analyses of air pollution data, and develops tools or applications to visualize, assess, and communicate such data including EPA's AirNow platform and app. Our team has been using machine learning to fuse observations and model output to create improved, real-time visualization.

The FluxSense team has decades of experience in air quality monitoring and emissions analysis using mobile platforms. Their systems are able to measure and report complex geo-tagged vertical column and concentration data of criteria air pollutants, GHG, and volatile organic compounds (VOC), and couple the data with vertical wind profiles of wind speed and wind directions in the 10-300 m range to quantify source emission fluxes. Their data systems are able to provide real-time graphical representations of measured entities, and aggregate the statistics over the entire project seamlessly.

Dr. Joshua Apte's team at UC Berkeley are world-renowned in the analysis of community scale air monitoring data, and have made seminal contributions to the development of hyperlocal block-by-block mapping using Google Street View cars and other mobile laboratories, and to identifying the air pollution disparities that emerge at fine spatial scales.

Education Outreach: Sonoma Technology has a long and successful history of developing and delivering environmental education and training courses to a variety of audiences, including air agencies, professionals, and the public. We have developed and delivered training materials on air quality measurement methods (research, regulatory, and low-cost sensors), data validation, and data analysis. In addition to training on specific topics, we developed and deploy a program called Kids Making Sense® (KMS) which uses low-cost sensors to educate and empower students and community members about air quality issues and how to take action.

Partnerships: Sonoma Technology also has long standing partnerships with several leading manufacturers of regulatory and research grade monitoring equipment, who all have potential to support the statewide mobile monitoring project by providing equipment and support for community-scale air monitoring. Our partnerships also allow us to have trained staff with knowledge about the operations and maintenance of the systems, which will minimize project downtime. Support letters from some of our partners are enclosed as attachments.

6. List and briefly describe the projects and/or activities your company was engaged within the last ten (10) years that are similar to the project identified in the RFI.

The table below lists some recent examples of relevant projects conducted by Sonoma Technology, FluxSense, Inc., and UC Berkeley.

Project	Description	Client	Mobile (M) Stationary (S)	Advanced Monitoring	Complex Data Acquisitions	Complex Air Toxics	Community/Regional Monitoring
Sonoma Technology							
Air quality instrumentation, maintenance, and data management for Google Street View cars	Designed, installed, calibrated, and operated mobile AQ instruments for $PM_{2.5}$, BC, ultrafine particles, NO, NO_2, and CO_2	Environmental Defense Fund	M	√	√	√	√
Community-scale air quality monitoring in Sacramento communities	Designed, installed, calibrated, and operated mobile research grade AQ instruments for $PM_{2.5}$, BC, NO, NO_2, CO_2, NO_2, CO, methane, and air toxics	Sacramento Metropolitan Air Quality Management District	M	√	√	√	√
Integrated Methane Monitoring Platform	Designing an integrated methane monitoring platform comprising satellites, aircraft, near-surface drones, ground-level mobile platforms, and fenceline stationary networks for regional and facility-level emissions monitoring	U.S. Department of Energy	M S	√	√	√	√

Project	Description	Client	Mobile (M) Stationary (S)	Advanced Monitoring	Complex Data Acquisitions	Complex Air Toxics	Community/Regional Monitoring
Regional methane emissions study from oil and gas basins	Comprehensive top-down and bottom-up estimation of annual basin-wide methane emissions from the San Joaquin Valley (California) and Denver (Colorado) oil and gas basins using a multi-tiered measurement and analysis framework	U.S. Department of Energy	M S	√	√	√	√
Sacramento Mobile Air Toxics Study	Deployed micro Aethalometers and BTX monitors at six environmental justice community locations	Sacramento Metropolitan Air Quality Management District	S	√	√	√	√
West Oakland Air Monitoring Project	Design, install, calibrate, and operate research grade instruments for BC, BTX compounds, toxic metals, $PM_{2.5}$, and NO_2	West Oakland Environmental Indicators Project	S	√	√	√	√
Comparing Air Toxics and Wood Smoke Pollution Levels Across Sacramento Environmental Justice and Non- Environmental Justice Communities	Designed, installed, operated research grade instruments (including canisters, filters) and low-cost sensors to measure air toxics, particulate wood smoke markers, PM, and BC	Sacramento Metropolitan Air Quality Management District	S	√		√	√

Project	Description	Client	Mobile (M) Stationary (S)	Advanced Monitoring	Complex Data Acquisitions	Complex Air Toxics	Community/Regional Monitoring
Baldwin Hills Oil Field Air Quality Monitoring Study	Quantifying air toxics emissions and estimating health risks	Los Angeles County Dept. of Reg. Planning	S	√	√	√	√
Nevada Mobile Source Air Toxics Study	Mobile source air toxics study next to U.S. 95 freeway	Nevada Dept. of Transp.	S	√	√	√	√
Santa Rosa, California Wood Smoke Study	Fixed and mobile monitoring to identify fine PM hotspots	Bay Area Air Quality Management District (BAAQMD)	M S	√	√	√	√
Forest Service Smoke Monitoring System	Prototype smoke monitoring system for measuring smoke via vehicles	U.S. Forest Service	M S	√	√	√	√
FluxSense, Inc.							
Design and development of mobile platforms for air quality research	In the last eight years, FluxSense has built ten mobile laboratories using state-of-the-art optical remote sensing instruments. These design and development efforts include the entire process chain, from sampling inlets, electrical HVAC system, battery pool and power systems, to instrumentation and data management.	Environmental authorities in California, Colorado, South Korea, and China; FluxSense California; FluxSense Sweden	M	√	√	√	√

Project	Description	Client	Mobile (M) Stationary (S)	Advanced Monitoring	Complex Data Acquisitions	Complex Air Toxics	Community/Regional Monitoring
CARB Air Toxics and GHG Emissions and Community Air Quality Study	Characterization of Air Toxics and GHG Emission Sources and their Impacts on Community Scale Air Quality Levels in Disadvantaged Communities	California Air Resources Board (2021)	M	√	√	√	√
CARB Air Toxics and GHG Emissions from Oil and Gas Operations Study	Toxic Air Contaminant and Greenhouse Gas Measurements near Oil and Gas Operations and Proximate Communities	California Air Resources Board (2022)	M	√	√	√	√
SCAQMD and BAAQMD VOC Emissions and Community Air Quality from Refineries Studies	Application of Next Generation Air Monitoring Methods to Provide Baseline (1 year) VOC Emissions and Fenceline Concentration Estimates from Refineries in the Wilmington/Carson/West Long Beach AB 617 Community.	South Coast Air Quality Management District (2013, 2015, 2016-18, 2022-23) Bay Area Air Quality Management District (2013)	M	√	√	√	√

Project	Description	Client	Mobile (M) Stationary (S)	Advanced Monitoring	Complex Data Acquisitions	Complex Air Toxics	Community/Regional Monitoring
City of Houston Air Toxics Studies	Near-Source Characterization of Formaldehyde, including community air testing to find high levels of formaldehyde and obtain information regarding elevated ambient toxins. Highly reactive VOC, HCHO, NO_2, SO_2, and BTEX measurements of the Houston Ship Channel.	City of Houston (2013, 2015, 2017, 2020)	M	√	√	√	√
University of California, Berkeley							
Various Research Studies	Hyperlocal air pollution measurement and modeling methods for characterizing community air pollution exposures and disparities	California Air Resources Board, California Office of Environmental Health Hazards Assessment, Health Effects Institute, Environmental Defense Fund, National Oceanic and Atmospheric Administration, Google	M	√	√	√	√

7. Are there any of the requirements described in the Proposed Environment section not technologically feasible with your existing service(s), product(s), platform(s)?

N/A

Attachment – B: Vendor Questions

I. General Questions

1. What scale of operation would be required to bid on a future RFP of the concept described here? Are there any minimum requirements necessary at which below you would not be interested in bidding on a proposal of this nature?

Response:

Although there are no minimum requirements necessary to bid on a proposal of this nature, certain scales of operations may be beneficial to provide cost effective solutions. This will include the following:

- Project Scale for General Mobile Mapping in Communities:
    - The lowest costs calculated herein were optimized for a project that will use five platforms deployed across the state for a 2-year monitoring period (which may result in a combined total community survey of 216,000 miles across the state). This will allow the deployment of multiple platforms in multiple regions for contemporaneous measurements and allow economies of scale to optimize the measurement and analysis costs, which will maximize project advantages and cost-effective solutions for the project. As the miles decrease, the unit mile costs would increase.
    - At a minimum, the project scale may need to cover at least 100,000 miles of mobile monitoring using these systems to achieve a cost-effective campaign (however, the unit mile costs will be higher than the listed cost).
- Multiple repeats
    - As discussed in papers published by the proposal team members,[4, 5] projects will need a minimum 15-30 repeated measurements.
    - However, in order to adequately understand the spatial patterns representatively over the course of the whole year, it may be advisable to have multiple repeated measurements on each selected community road link (50-100 repeats),

[4]Chen, Y, Gu, P, Schulte, N, Zhou, X, Mara, S, Croes, BE, Herner, JD, Vijayan, A, "A new mobile monitoring approach to characterize community-scale air pollution patterns and identify local high pollution zones", Atmospheric Environment, Vol 272, 2022, 118936, ISSN 1352-2310, https://doi.org/10.1016/j.atmosenv.2022.118936.
[5] Apte, JS, Messier, KP, Gani, S, Brauer, M, Kirchstetter, TW, Lunden, MM, Marshall, JD, Portier, CJ, Vermeulen, RCH, Hamburg, SP, High-Resolution Air Pollution Mapping with Google Street View Cars: Exploiting Big Data, Environmental Science & Technology 2017 51 (12), 6999-7008, DOI: 10.1021/acs.est.7b00891

strategically staggered throughout the year, and preferably over two years to account for month to month and year to year variability.

- A statewide program with simultaneous measurements in multiple regions.
    - This will allow better program synergies, as well as more cost-effective data analysis. This will also eliminate seasonal discrepancies by helping collect more consistent temporal coverage in all regions.
- Project Scale for Localized Intensive:
    - Our team will also be able to provide specialized monitoring with fewer platforms for advanced follow up measurements at observed air pollution hotspots (such as emissions monitoring, speciation analysis). These follow up measurements can be scheduled by surveying one region at a time (will not require contemporaneous measurements across the state).

2. What types of monitoring objectives have you explored using your company's mobile monitoring approaches?

Response:

Our team has deployed our mobile platforms for a variety of community-scale air quality monitoring and source characterization applications:

- Community scale air quality mapping:
    - Similar to the SMMI Initiative applications, our previous mobile monitoring projects have measured criteria air pollutants, GHG, and air toxics in a number of communities and neighborhoods using similar regulatory and research grade equipment.
    - All projects have used instruments with fast response (1-5 seconds response rate), which allowed air quality mapping at hyperlocal scale (gridded analysis at 10-30 meters).
    - Due to challenges with mobile monitoring snapshot effects, and routine variability in meteorological conditions and regional background levels of air pollutants, our approach focuses on studying the contribution from local sources (local enhancements).
    - In these projects, we have conducted extensive spatial analysis to explore community-scale patterns of local air pollution, and additional statistical analysis to identify air pollution hotspots for subsequent stationary measurements.
- Longer-term stationary deployment for temporal trends and speciation analysis:
    - We have also used our platforms for longer-term stationary monitoring at selected air pollution hotspots in communities.

  - The instrumentation setup is identical, whereas the systems are operated in long term or speciation mode to collect measurements every 15-60 minutes.
  - These stationary measurements allow for characterizing the constituents, distribution, and toxicity implications of air toxics in each community.
  - It should also be noted that each hotspot location does not correspond to high concentrations for all pollutants. However, this approach to measure all pollutants with the same platform at each location will provide a detailed understanding of pollutant-to-pollutant variability, and the data may be used in the future for optional analyses – such as source apportionment, developing speciation profiles, etc.
- Leak detection and source localization:
  - The project team has also deployed mobile platforms for source localization using a variety of integrated modeling and data fusion tools.
  - As part of our USDOE Integrated Design project, Sonoma Technology is applying sophisticated transport models on fenceline stationary network data, and ground-level mobile platform measurements to triangulate sources.
  - Sonoma Technology has developed a commercial tool, called AQ360©, which is a modeling-based decision support tool that enhances situational awareness and enables rapid assessment of emissions-related scenarios on air quality in the surrounding areas. The tool combines trajectory modeling and Gaussian plume principles to assess potential upwind emission sources that may be impacting an air quality monitor or community location based on time-varying local meteorological conditions. The AQ360© modeling tool has been customized to support facility operators that are tasked with directing resources to identify and remedy potential leaks in response to anomalous monitored air quality concentrations or community inquiries.
- Emission flux estimation:
  - In addition to source localization, the USDOE project is also exploring emissions estimations from facilities using Sonoma Technology's AQ360© model, the SOOFIE Atmospheric Smarts (SAS) data analysis module, and U.S. EPA's Other Test Method (OTM) 33A methodology.
  - Our project partner, FluxSense, has decades of experience in air quality monitoring and emissions flux analysis using mobile platforms. Their systems are able to measure and report geo-tagged vertical column and concentration data of criteria air pollutants, GHG, and VOCs, and couple the data with vertical wind profiles of wind speed and wind direction in the 10-300 m range to quantify source emission fluxes.

    - Screening for air toxics and GHG in communities adjacent to pollution areas, for instance near oil and gas production, refineries, CAFOs, landfills, water treatment plants, petrochemical facilities.
    - Plume tracing and concentration decay with distance from source and into adjacent communities.
    - Refineries – BTEX, VOCs, NO_2, SO_2, HCHO, methane (fenceline and internal measurements)
    - Oil and Gas – BTEX, VOCs, methane (small- and large-scale measurements of oil fields)
    - Petrochemical Industries – Formaldehyde and ozone precursor emissions monitoring
    - Emissions and concentrations of ammonia, methane, phenol, CO, CO_2, and other compounds from/near CAFOs
    - Long term baseline studies - BTEX, VOCs, SO_2, NO_2, HCHO, methane (refinery fenceline)
    - Consent decree related to benzene and SO_2 emissions at Metallurgical Coke production - BTEX, VOCs, SO_2
    - Volcanic emissions
    - Drone-based measurements - methane and ethane
  - Sonoma Technology is also conducting a comprehensive assessment of annual methane emissions from the oil and gas basins of the San Joaquin Valley, California, and Denver, Colorado, using ground-level mobile flux measurement on the FluxSense mobile platform.

3. What are the advantages and limitations of your company's mobile monitoring services?

Response:

Mobile monitoring can be a cost effective, efficient, and complementary solution for air quality monitoring in communities. A mobile platform allows the use of a single set of air monitoring systems to be driven around a large area to collect a large amount of spatially resolved data in a short time window. Moreover, a mobile platform offers a hyper-localized view of air pollution at neighborhood scale and allows the differentiation of air pollution levels from one street to another. Mobile measurements also reduce the initial cost (i.e., a single platform instead of multiple sensors at multiple sites), and eliminate sensor to sensor variability, which is a key advantage over distributed low-cost sensors.

However, unlike stationary monitors, the mobile platforms are always in motion, and don't measure the air quality levels at any location for more than a few seconds per survey. Therefore, they don't offer data equivalent to continuous monitoring at any location. Also, air pollution levels change throughout the day (due to a variety of factors such as source behavior changes, meteorological changes, as well as control and mitigation events), so it is challenging to generalize any difference in two locations as permanent. Such differences are best explored using continuous monitoring and achieving that through multiple mobile platforms is often cost prohibitive.

Given the snapshot nature of mobile monitoring, our project team believes that data collected from such studies are most appropriate for understanding the spatial distribution of local pollution enhancements. This is accomplished by collecting data over a minimum number of repeats, subtracting dynamic backgrounds to arrive at local enhancements, and implementing advanced statistical analyses to study the typical air pollution patterns and identify air pollution hotspots in the communities.

Our team has experience in developing and implementing mobile monitoring platforms for a variety of applications:

The Tier 1 systems use low-cost sensors on individual vehicles, or even in a fleet of vehicles, that offer contemporaneous surveys. Due to the lower upfront costs (lower instrument costs), these may be deployed in individual vehicles or a fleet of vehicles. Fleets may be deployed in multiple regions for contemporaneous measurements, or survey a larger area every single day (more spatial coverage); or multiple platforms may also be deployed in the same community during each day to obtain multiple scans of the same community (more temporal coverage).

Tier 2 and Tier 3 applications use high quality analyzers, the former in which the platforms are driven around for mobile mapping, and the latter in which the same high-quality platforms may be used for stationary measurements at selected sites.

Tier 4 systems are very new and are mostly being designed for research applications and program support for various program objectives such as source identification, source triangulation, and emission rate estimation. These use advanced air pollutant and meteorological measurement systems (including remote sensing systems), which are combined with advanced modeling algorithms to estimate source locations and quantify emission fluxes.

Each type of system offers some advantages and limitations. Overall, Tier 1 systems have lower system costs because of the use of low-cost sensors; however, data analysis costs are typically similar to all higher tiered systems. These systems are also not equipped to measure all pollutants (e.g., speciated VOCs, metals, etc.) due to technological limitations and unavailability of low-cost sensors for those pollutants. Moreover, while it may be possible to use low-cost sensors on fleets for ubiquitous deployment (Tier 1), the use of low-cost sensors itself poses inherent challenges for these applications including sensor-to-sensor variability, data quality, need for data massaging. Furthermore, given the challenges with mobile monitoring (temporally limited snapshots), it is important to offset/eliminate additional confounding issues (such as data quality issues). Therefore, higher quality systems using regulatory and research grade instruments for community air quality mapping and monitoring are preferable.

Given the scale and scope of the project, the recommended list of pollutants, the desired objectives, and the accuracy and precision required for the project, our team is proposing that a regulatory and research grade system for ground-level air quality measurement and emission source identification (Tiers 2, 3, and 4) will be the best fit for this project. The project team will use a series of state-of-the-science mobile platforms, with the best-in-class regulatory and research grade equipment for ground-level air quality monitoring in the communities for all the listed pollutants. The platforms will be available for deployment for mobile mapping (Tier 2) and stationary monitoring at selected hotspot locations (Tier 3).

In addition, each platform will also be equipped with Solar Occultation Flux instrument for emissions screening and monitoring (Tier 4). This technology is based on a mid-infrared spectrometer which allows fast mobile measurement through the plume cross section for efficient source screening, source identification, and emissions monitoring results.

The project team also includes Dr. Joshua Apte from the University of California, Berkeley. He will be contributing his expertise in multiple areas, including the design of air pollution sampling platforms and mobile air pollution monitoring sampling protocols, processing and analysis of

mobile air pollution measurements, and assessment of community air pollution disparities. They will also provide access to their mobile air pollution lab and other instrumentation and facilities in their group at the University of California, Berkeley.

Collectively, this system will meet all the desired objectives of the program, and provide the following features:

- **Measurement Quality**: This approach will allow collection of high-quality data by using advanced systems.
- **Data Quality and Transparency**: This approach is enhanced by performing daily data quality checks and weekly calibrations, which are reported with data transmittals.
- **Expertise and Partnerships**: A team approach provides a high level of experience, expertise, knowledge, and efficiency.
    - Design: Research experts from Sonoma Technology, FluxSense, and all our instrumentation partners will configure and provide a comprehensive system with state-of-the-science instrumentation and technical approach for community monitoring.
    - Deployment: The deployment will be led by Sonoma Technology, FluxSense, Inc., and various other local project partners and research experts who have extensive experience in operating mobile platforms for community monitoring. This approach will ensure measurements and analyses of the highest quality.
    - Analysis: The project team is comprised of research experts who have extensive publication in the use of mobile monitoring for community applications. The collective team expertise will allow the highest quality analysis to meet program objectives.
- Our project team will aim to survey the entire community during the daily measurement survey in order to capture day-to-day variability.
- We also stagger the survey schedules in each community, so that each zone within a community is surveyed at different times of the day, and the data are equally distributed (to avoid inadequate temporal coverage and balance).
- The project will also recommend contemporaneous local-scale stationary monitoring networks for local anchoring, and comprehensive trend analysis to study total air pollution (regional background and local enhancements). Our team has the requisite systems and partnerships to deploy such systems for comprehensive solutions.

Key advantages:

- State-of-the-science regulatory and research monitoring solutions for community monitoring.

- Additional state-of-the-science remote sensing emissions monitoring system to identify and track large sources and their impacts in the community.
- Ability to measure all feasible pollutants of interest through advanced, real-time, air quality monitoring systems (pollutants like Hexavalent Chromium can only be measured with passive sampling and lab analysis).
- Project team with extensive experience with air quality monitoring using research and regulatory analyzers.
- Deployment led by local partners and research experts in each region.
- Project team with decades of experience in mobile monitoring platform design, development, and deployment for air quality and emissions measurement.
- Complete data transparency with data sharing protocols.
- Leaders in developing real-time data dissemination and visualization systems to facilitate public access to the data.
- Project team experience in community engagement, training, and local capacity building.
- Additional optional solutions to complement the mobile monitoring, including:
    - Zero emissions platform to eliminate any confounding source of pollution, while also eliminating additional pollution in the communities while surveying
    - Data dissemination systems for hyperlocal air quality information
    - Additional education and outreach tools for communities

II. Engagement and Coordination

1. Describe your interpretation of what community engagement should look like throughout the process of conducting mobile air monitoring in communities.

Response:

We believe that all community air monitoring projects should be fundamentally designed with the communities in mind. This initiative must also be foundationally developed with community participation and engagement in all facets of decision-making, from planning, to implementation, to outreach. Some of the key elements of a comprehensive engagement strategy are described below:

- **Community Advisory Committee**: The Statewide Mobile Monitoring Initiative will also benefit from instituting a Community Advisory Committee, with stakeholders from all regions where monitoring will be conducted. It is vital to engage with all parties in the selected communities including community groups, researchers, industry, university, and government.
- **Project Selection**: The project review and selection should also include members from the Community Advisory Committee. This will allow the public to see the different types of systems available, and evaluate the strength, limitations, and applications of each system for the program initiative.
- **Blueprint**: Once a project team is selected, CARB (in consultation with the selected project team), should consider the development of a project blueprint, which describes the community selection process, measurement approach, technical approach, pollutants measured, and other complementary systems. For a comprehensive community engagement process, CARB should consider sharing the blueprint document with the community groups and the Community Advisory Committee and have thorough engagement to get their feedback.
- **Designing the community surveys**: The communities and community members should have an opportunity to participate in community and route selection. This could include inputs on public roadways, schools and daycares, healthcare centers, sensitive receptors, parks and play areas, and other public spaces that should be included in the surveys. These conversations could be organized by CARB and the Districts and could also be attended by the project team. The feedback from these meetings should be incorporated in the survey plans.
    - The process should also include gathering input from the community members on sources and areas of concern, which should be incorporated in survey routing.

    - If additional, optional stationary monitoring is desired as part of the project, these community inputs and insights will help in site selection for stationary monitoring sites.
- **Participation and Education**: Community members should also have an opportunity to participate in various community education events such as instrumentation demonstrations.
- **Engagement workshops**: All the measurement results from the community should be presented in each community during the course of the study. For example, for a 2-year measurement period, the first set of reporting workshops (one per region) could be done at the project midway point (after 1 year), and another workshop could be conducted at the end of the project (after year 2).
- **Data accessibility**: It will be crucial to develop accessible and engaging data systems which can provide accurate and consistent information to communities and the public. It will also be important to use effective tools (such as ArcGIS StoryMaps) and language that describes the correct context to use the data. Additional education and outreach tools, such as school education toolkits, outreach videos, and mobile applications, can also make the data more accessible and engaging.
- **Language accessibility**: All the above engagement efforts should be appropriately and adequately translated so that the information is accessible for all the public.

2. What experience do you have with community and public engagement? Is any of this experience directly related to air monitoring activity and data dissemination?

3. What is your experience coordinating with community members, CBOs, regulated industry, academia, and governmental agencies when planning monitoring objectives and data analysis and communication?

<u>Combined Response to 2 and 3:</u>

Sonoma Technology has extensive background and experience in community and public engagement. We have worked with a number of community groups, schools, faith-based organizations, non-profit NGOs, and tribal organizations across that nation in assisting them for air quality monitoring support, data dissemination, and engagement. We also routinely develop and deliver training and education to air quality professionals, students, and the general public.

In response to recent state mandates such as AB 617, we have worked closely with community-based organizations to build air quality management capacity in EJ communities. Importantly, we have partnered with leading professionals in training, education, community capacity-building, and stakeholder involvement. For example, Sonoma Technology successfully partnered

with several community groups in EJ areas to support their efforts to develop and implement projects from USEPA, Supplemental Environmental Projects (SEPs) and CARB AB 617 Community Air Grants including Central California Environmental Justice Network, Tree Fresno, Comité Pro Uno and the Coalition for Clean Air, Community Focus, Youth Learning as Citizen Environmental Scientists, The Climate Initiative, Institute for Tribal Environmental Professionals, and many other community organizations. These community engagement projects have included community monitoring, near-road vegetative planting and air monitoring, school-based monitoring, and education and outreach for school students and community members.

We also have expertise in building robust, clear, and accessible data communication systems. We currently operate the largest number of continuous, real-time monitoring and data dissemination systems in the state, with over 150 analyzers reporting air quality measurements from regional and fenceline monitoring systems. For example, we have supported fenceline and community air quality monitoring around the Torrance Refinery through a SCAQMD SEP. The Torrance Air project included a large community outreach and engagement effort - including KMS events, public meetings, and a website for real-time data dissemination. These systems allow dissemination of highly technical information in a public-friendly manner through public meetings, technical advisory committee meetings, and the website.

For EPA, we authored and conducted training on How to Conduct a Successful Air Toxics Monitoring Project, geared to community groups. Of note, technical advisory committees, with all interested parties involved from the beginning, are an important foundation for a successful project. It is vital to establish cooperation, clear objectives, and channels of communication right at the start.

4. Please provide the number and size ($) of technical projects previously managed for coordination and communication with both community and technical contractors.

Response:

Sonoma Technology and team have conducted hundreds of projects that include coordination and communication with both community and technical leads. We have provided a few representative examples in the table below.

Project	Description	Client	Contract Period	Contract Value
Sonoma Technology				
Community-scale air quality monitoring in Sacramento communities	Designed, installed, calibrated, and operated mobile research grade AQ instruments for $PM_{2.5}$, BC, NO, NO_2, CO_2, NO_2, CO, methane, and air toxics	Sacramento Metropolitan Air Quality Management District	2022-2023	$150,000
Sacramento Mobile Air Toxics Study	Deployed micro Aethalometers and BTX monitors at 6 EJ community locations	Sacramento Metropolitan Air Quality Management District	2021-ongoing	$347,700
West Oakland Air Monitoring Project	Design, install, calibrate, and operate research grade instruments for BC, BTX compounds, toxic metals, $PM_{2.5}$, and NO_2	West Oakland Environmental Indicators Project	2023-ongoing	$1,140,835
Comparing Air Toxics and Wood Smoke Pollution Levels Across Sacramento EJ and Non-EJ Communities	Designed, installed, operated research grade instruments (including canisters, filters) and low-cost sensors to measure air toxics, particulate wood smoke markers, PM, and BC	Sacramento Metropolitan Air Quality Management District	2016-2018	$307,844
Baldwin Hills Oil Field Air Quality Monitoring Study	Quantifying air toxics emissions and estimating health risks	Los Angeles County Dept. of Reg. Planning	2012-2015	$269,891
Nevada Mobile Source Air Toxics Study	Mobile source air toxics study next to U.S. 95 freeway	Nevada Dept. of Transp.	2007-2014	$1,658,401

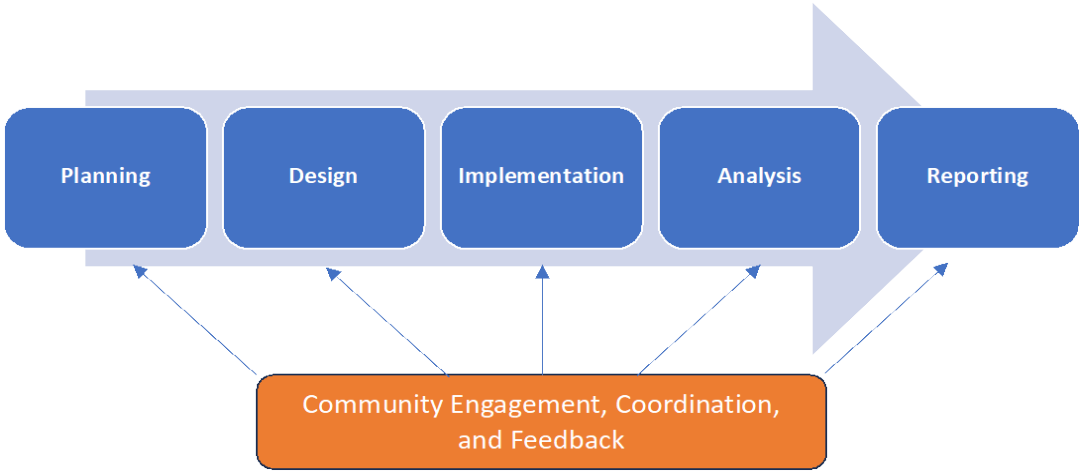
Project	Description	Client	Contract Period	Contract Value
Santa Rosa, California Wood Smoke Study	Fixed and mobile monitoring to identify fine PM hotspots	Bay Area Air Quality Management District (BAAQMD)	2013-2014	$83,765
Maywood, CA Community and School Monitoring	Deployed continuous PM, metals, and BC, and hexavalent chromium (24-hr filters). Community engagement.	Coalition for Clean Air Comité Pro Uno	2018-2021	$259,153
New River Pollutant Monitoring in Calexico, CA	Install, maintain H_2S, ammonia, BTX, VOC, PCB, and pesticide samplers	Imperial County Air Pollution Control District	2021-2023	$474,740
FluxSense, Inc.				
CARB Air Toxics and GHG Emissions and Community Air Quality Study	Characterization of Air Toxics and GHG Emission Sources and their Impacts on Community Scale Air Quality Levels in Disadvantaged Communities	California Air Resources Board	2021	$224,500
CARB Air Toxics and GHG Emissions from O&G Operations Study	Toxic Air Contaminant and Greenhouse Gas Measurements near Oil and Gas Operations and Proximate Communities	California Air Resources Board	2022	$280,000

Project	Description	Client	Contract Period	Contract Value
SCAQMD and BAAQMD VOC Emissions and Community Air Quality from Refineries Studies	Application of Next Generation Air Monitoring Methods to Provide Baseline (1 year) VOC Emissions and Fenceline Concentration Estimates from Refineries in the Wilmington/Carson/West Long Beach AB 617 Community.	South Coast Air Quality Management District Bay Area Air Quality Management District	2013, 2015, 2016-18, 2022-23 2013	Over $3.5 Million
City of Houston Air Toxics Studies	Near-Source Characterization of Formaldehyde, including community air testing to find high levels of formaldehyde and obtain information regarding elevated ambient toxins. Highly reactive VOC, HCHO, NO2, SO2 and BTEX measurements of the Houston Ship Channel.	City of Houston	2013, 2015, 2017, 2020	Over $400,000
University of California, Berkeley				
Various Research Studies	Hyperlocal air pollution measurement and modeling methods for characterizing community air pollution exposures and disparities	California Air Resources Board, California Office of Environmental Health Hazards Assessment, Health Effects Institute, Environmental Defense Fund, National Oceanic and Atmospheric Administration, Google	2013-Ongoing	Over $2 Million

5. How would you apply your engagement and coordination model on a statewide scale?

Response:

The Project team will seek community engagement and feedback throughout the project lifespan. Key facets of the project are outlined below.



- Project Planning:
  - The project team will recommend to CARB to institute a Community Advisory Committee for the project, with stakeholders from all regions where monitoring will be conducted. It is vital to engage with all parties in the selected communities including industry, university, government, and community groups.
  - The project team will develop a Statewide Mobile Monitoring Planning / Blueprint document to present our approach (technical as well as outreach protocols), and request feedback from the Community Advisory Committee. In addition to the technical aspects in the plan, it will be vital to provide a communication and outreach plan.
  - It is crucial to develop, and follow, a robust quality management plan.

- Design:
  - During the design of the study, the project team will request input from the agency and community on priority pollutants for different regions. Although the project team will aim to use the same set of instruments in all platforms for surveys across the state, consolidating the information may be useful for instrument selection and instrument operation modes.
  - The project team will seek feedback from the Community Advisory Committee for the design and implementation of the data presentation and visualization tools.

- Implementation:
    - The typical schedules in all regions will focus on typical weekdays and daytime hours for surveys. However, the project team will seek community inputs and feedback about additional times of day and days of week when air pollution hazards and nuisances are routinely noticed by the local public. This will inform the design and optimize survey schedules for each community.
    - The project team will seek input from the community members on sources and areas of concern, which will be incorporated in survey routing.
    - If additional optional stationary monitoring is approved as part of the project, these community inputs and insights will help in siting selection for stationary monitoring sites.
    - The project team will host annual community engagement events, which will provide opportunities for community members to participate in "drive along sessions", where they will be able to participate in data collection and ask questions. We have used a similar collaborative deployment in the past, and the approach was highly rewarding allowing for engagement and conversations with the public about air pollution.

- Analysis:
    - For the Tier 3 stationary deployment of mobile platform at identified hotspot locations, the statistical hotspot analysis will provide a list of all observed hotspot locations in each community for each pollutant. However, site prioritization will include input from the communities.

- Reporting:
    - The project team will host community workshops to present the results. For example, if the measurement surveys occur over a 2-year project, the first set of reporting workshops (at least one per region) could be done at the project midway point (after 1 year), and another workshop could be conducted at the end of the project (after year 2).
    - It is important to use appropriate engagement best practices such as conducting community meetings at various times of day, engaging with local community groups who understand local air quality issues, providing incentives for community participants (e.g., pay participants for housing an instrument), and providing translation services.

Our project team, along with local research partners will be responsible for deploying the mobile platforms in each community. Each of our partners have extensive experience in the deployment of mobile platforms for community monitoring, and will have knowledge of the local air

pollution issues. The local teams will also participate in student engagement in communities and schools annually, including showcasing the platform, and educating the school-grade students on the use of these systems to understand and identify air pollution issues.

III. Mobile Monitoring Technologies and Capabilities

1. How many mobile monitoring platforms do you currently own and operate? How long have these platforms been in operation?

a. What areas/sources/locations do you have experience conducting mobile monitoring?
b. Has collected data been used to support community emission reduction, enforcement, or other actions? Please provide examples.

Response:

Our team and project partners have a total of three mobile systems that could be made available, modified, and or expanded for this project. Some of these systems are brand new, and some have been in operation for up to 10 years:

- **FluxSense, Inc.** currently has one fully equipped mobile laboratory (SOF, SKyDOAS, MeFTIR, MeDOAS, 8 years in operation) and a second for wind LIDAR monitoring (in operation for 3 years). The second laboratory is prepared to be fully equipped with SOF, SkyDOAS, MeFTIR, and MeDOAS as well, and this will be accomplished in 2024. These platforms have been deployed in a number of states, including California, Texas, and Colorado. Within the FluxSense concern, there are two additional fully equipped mobile platforms operating on the European market or deployed globally as individual instrumentations on a contract-to-contract basis (10+ years in operation, with renewed and updated instrumentations). FluxSense also operates a few stand-alone SOF systems (SOF Sentinel) for easy field deployment in specific contracts.
- **Dr. Apte's lab at the University of California, Berkeley** team is also developing a state-of-the-art mobile platform with fast-response particle instruments for ultrafine particles and size-resolved $PM_{2.5}$, as well as measurement capability for CO_2, CH_4, NO, NO_2, and O_3. It will also have the capability of installing an Aerodyne VOCUS for fast-response VOC measurements.

Our team also has extensive experience in the design, development, and deployment of stationary and mobile deployments of complex air quality equipment for air quality and emissions research and monitoring. Our primary services directly related to this RFI are in the enhancement and deployment of air monitoring systems and mobile monitoring platforms for project-specific needs. We have built and deployed mobile platforms with custom features of design, instrumentation, power, telemetry, and calibration for a variety of end users and stakeholders to address the specific needs of their projects. Therefore, we will be able to

customize specific systems which will address all the objectives for this initiative. In addition, our team has several experts with decades of experience in managing mobile monitoring programs for federal government, state agencies, as well as academic institutions prior to joining Sonoma Technology (including EPA, NASA, CARB, as well as research universities). These experiences include building, managing, and operating fleet of mobile monitoring platforms for regional and community-scale exposure monitoring, air pollutant emissions measurements, and GHG emissions research.

For example, **Sonoma Technology** designed, implemented, and maintained two Google Street View cars for the Environmental Defense Fund (EDF); these cars were outfitted with instruments to collect mobile air pollution data in the San Francisco Bay Area and Houston, TX. The team designed, installed, calibrated, and operated mobile air quality instruments and data systems to collect measurements of community-scale $PM_{2.5}$, BC, PM_{10}, NO, NO_2, and carbon dioxide (CO_2). These vehicles were prototypes for other deployments.

In addition, we will also be able to access available mobile platforms from a number of our project collaborators, including Entanglement Technologies and Syft Technologies, and leverage the experience and participation from various other collaborators in the configuration of additional advanced air quality monitors and mobile platforms, as desired by the project (letters of support are provided in Attachment D). These platforms have been deployed in various states across the country, including California, New Mexico, Utah, Colorado, Texas, Georgia, North Carolina, and Kentucky for emissions measurements and air quality monitoring. For example, **Entanglement Technologies'** mobile analysis systems have also been deployed and operated in California, New Mexico, Utah, Colorado, Texas, Georgia, North Carolina, Kentucky, the Netherlands, and other locations. These deployments have been in collaboration with federal, state, and municipal government agencies, oil and gas companies, and universities, and include performance validations against gold-standard regulatory analyzers in collaboration with BAAQMD, the U.S. Department of Defense's (DoD) Environmental Security Technology Certification Program, and U.S. EPA Region 9. Similarly, we also have support from **Syft Technologies**, a world leader in real-time, direct injection mass spectrometry with more than 20 years of SIFT-MS expertise and offices worldwide. Syft instruments support a broad range of industries worldwide including environmental monitoring and protection, pharma and CDMOs, food, flavor and fragrance, and many more. Syft has deployed many of its real-time mass spectrometers for VOC measurements in mobile laboratories around the world, including mobile monitoring labs in the United Kingdom, supporting the South Korean government with a fleet of approximately 40 mobile instruments, and multiple instruments with the EPA and several state agencies in the U.S., including CARB and TCEQ.

Applications:

Sonoma Technology has a long history in conducting complex air quality measurements using state-of-the-art stationary and mobile measurement platforms. Our founders designed and ran ground-breaking projects to study O3 transport into and throughout California using data analysis and photochemical modeling of measurements conducted using Sonoma Technology's instrumented aircraft. These studies led to improved State Implementation Plans to reduce emissions.

Sonoma Technology conducted an air quality research study in collaboration with the UC Davis Air Quality Research Center and Entanglement Technologies to measure and map air pollution in Sacramento EJ communities. We developed a mobile monitoring platform with research and regulatory grade analyzers and instrumentation, and deployed the platform to measure levels of criteria air pollutants ($PM_{2.5}$, NO_2, ozone, and CO), greenhouse gases (methane, CO_2, and black carbon), and air toxics (aromatics, dienes, alkanes, and chlorinated VOCs) in Sacramento communities. We collected over 20 repeated measurements on each selected roadway, and applied advanced statistical analysis to identify air pollution hotspots. We also applied stationary measurements with the mobile platform at the priority hotspots identified by the mobile monitoring campaign.

Sonoma Technology designed and conducted a study for BAAQMD and the community- based organization Families for Clean Air that characterized the spatial and temporal variability of $PM_{2.5}$ concentrations during winter in Santa Rosa, California, using fixed and mobile measurement approaches. Sonoma Technology developed a mobile platform with PM instruments to conduct a field study to characterize the spatial and temporal variability of $PM_{2.5}$ concentrations. The sensors were also driven around EPA FEM Beta Attenuation Monitors at five community sites added for the study to better understand how representative the FEMs were of local concentrations.

The **FluxSense, Inc.,** mobile laboratories are specially equipped optical remote sensing measurement techniques suitable for real-time emission and concentration measurements. The unique mix of instrumentation in FluxSense platforms allow quantification of emissions, concentration enhancements above background, identify leaks and incomplete combustion (flares) with ppb level detection and fast time response (2-15 second scans, typically). In addition, these mobile laboratories can be deployed within 48 hours with as quick a response as 1-2 hours depending on the proximity of the target measurement area. This makes it well-suited for conducting measurements anywhere in the state of California. All instrumentation operates without the need for calibration as it uses published cross-sections and spectral data for evaluations. Furthermore, these platforms can measure sources of virtually any scale, from

individual oil wells to entire oil fields. The flux calculations are accomplished using the wind speed and direction thus we require wind speeds between 1.5 – 12 m/s and orthogonal wind direction (±45°) relative to the driving path.

FluxSense platforms have been used to study emissions and air quality impacts from refineries and tank storage facilities, landfills, petrochemical industries, ports, oil and gas fields, volcanic sources, concentrated animal feeding operations (CAFOs), metallurgical coke producers, water treatment facilities, and adjacent communities. Monitoring has been conducted on site, at fenceline, and in adjacent communities dependent on contract scope.

FluxSense has participated in a yearlong emissions study of five refineries in the greater Los Angeles area. The goal of the campaign was to establish the emissions baseline line for air pollutants including BTEX, alkanes, formaldehyde, SO_2 and NO_2 with the aim that these facilities must reduce their overall emissions by 25% by the year 2026. In addition, FluxSense has been involved in multiple field campaigns in the Houston ship channel area investigating the emissions of formaldehyde and HRVOC ozone precursors (ethylene, propylene, 1,3-butadiene, butene). These large-scale measurements were aimed at quantifying direct and indirect formaldehyde production from petrochemical industries such that reduction efforts can be put into motion. FluxSense mobile laboratory has also been contracted for consent decree projects regarding benzene, VOC and SO_2 emissions.

Collectively, our range of expertise, and our access to these resources from the project team will allow us to meet the objectives of the program.

2. Please provide operational information on your company's current mobile monitoring capabilities. This should answer the following questions:

a. **What frequency can platforms be deployed?**
b. **What days/hours are the platforms generally in use?**
c. **What pollutants can be monitored and with what frequency?**
d. **What types of instrumentation do you use? Describe all relevant methodologies.**
e. **What level of coverage or scale of monitoring can be accomplished within a community? (For example, how would you approach characterizing emissions from a source or identifying a leak? How long would that take?)**
f. **How do you determine that you've adequately characterized a given area?**
g. **What workflow processes or software do you have for managing mobile monitoring?**

Response:

Below, we describe our deployment and operational approach used for similar projects.

Measurement Strategy

Each platform can theoretically be deployed daily, depending on driver availability. Typically, since the focus is on local enhancements from local sources (which are generally active during workdays), we conduct a majority of the measurements during weekdays and daytime hours (8 am to 6 pm). Additional weekends and evening measurements may be added to meet monitoring objectives, e.g., to study time of day and day of week patterns (typically up to 10% of survey hours are dedicated for such studies). Night-time measurements are generally not warranted given the lower source activity during those hours.

Each survey day is typically 8 hours per day, with a minimum of 6 hours of community surveys per day. Within the 8-hour workdays, we include the following:

- Pre-checks of instrumentation: 1 hour/day
- Community monitoring: 6 hours/day
- Post-checks of instrumentation: 1 hour/day

Instrumentation:

All the instruments selected for criteria air pollutants and greenhouse gas measurements are advanced research-grade analyzers, and their capability has been proven through a variety of field studies by regulatory and research organizations. In addition to their robust measurement capabilities, these also represent some of the fastest instruments available in the market for each pollutant, which is a key requirement to conduct high spatial resolution mobile monitoring.

Pollutant	Instrumentation Options	Detection Limit	Measurement Frequency
Particulate Matter ($PM_{2.5}$ & PM_{10})	Teledyne T640X	0.1 µg m^{-3}	10-sec
Black Carbon (BC) as a surrogate for Diesel PM	Aerosol Magee Scientific AE36s	0.1 µg m^{-3}	1-sec
Ozone (O_3)	Teledyne T400 Thermo 49i	< 0.4 ppb	< 5-sec
Carbon Monoxide (CO)	Teledyne T300 Thermo 48i	< 0.04 ppm	< 5-sec

Pollutant	Instrumentation Options	Detection Limit	Measurement Frequency
Carbon Dioxide (CO_2)	Picarro G2301	< 70 ppb	< 5-sec
Nitrogen Oxides (NO & NO_2)	Teledyne T200 Thermo 42i	< 0.2 ppb	< 10-sec
Methane (CH_4)	Picarro G2204 / Picarro G2301	1 ppb	5-sec
Hydrogen Sulfide (H_2S)	Picarro G2204 Entanglement Technologies AROMA-VOC	3 ppb 1ppbv	5-sec
Benzene, Toluene, Ethyl Benzene, Xylenes (BTEX)	Tofwerk Vocus Elf Entanglement Technologies AROMA-VOC Syft Voice200 Ultra	Variable	1-sec to 10-min, depending on instrument and operating format
Formaldehyde			
Acrolein			
Arsenic			
Ethylene Oxide			
1,3-Butadiene			
Sulfur containing compounds	Tofwerk Vocus Elf Teledyne T102	< 0.4 ppb	1-sec to 10-sec
Carbonyls	ATEC 2200	Variable	8-hour
Polycyclic Aromatic Hydrocarbons (PAHs)	Tisch PUF Sampler	Variable	Daily
Metals	Sailbri Cooper Xact 625i	Variable	5-min
Hexavalent Chromium	Cr6 is not possible to measure continuously, Total Chromium with Salibri Cooper Xact 625i		5-min total Cr 24-hr Cr6
Ammonia	Picarro G2103	0.03 ppb	< 5-sec
Methyl bromide	Tofwerk Vocus Elf		1-sec

The SOF Sentinel instrumentation

Each platform will also be equipped with an ultralight and compact FluxSense Sentinel instrument for emissions monitoring using the SOF method. SOF is patented by FluxSense and is

a Best Available Technology in Europe for refineries and the chemical industry. The method is included in the European standard EN 17628 (April 2022. It is based on a mid-infrared spectrometer equipped with a (multi-stage) thermoelectrically cooled MCT detector, operating with 1-8 cm-1 resolution dependent on configuration. A custom rapid, sensitive and controllable solar tracker automatically directs the sunbeam into the spectrometer during mobile measurements, allowing for fast mobile measurement through the plume cross section from an industrial or agricultural site.

Figure - The SOF Sentinel instrument for emissions monitoring and source screening.

The instrument can be easily deployed on the roof of a vehicle within minutes and operated either remotely or by an operator aboard. Geo-tagged measurement results (vertical columns) are displayed in real-time on satellite or map imagery to allow for efficient source screening, emissions monitoring and immediate strategy adaptation in the field based on results. By combining the data with measured or modeled wind speed and direction, the vertical column data will be converted to gas fluxes in g/s.

The SOF Sentinel comes in two editions, one tailored for optimal alkane detection in the 3 μm wavelength region, and another broadband version for ammonia and alkene detection at 10 μm and comparably less sensitive detection of alkanes at 3 μm.

Table - SOF Sentinel specifications.

SOF Sentinel Specifications	
Dimensions (W x H x L)	7″ x 6″ x 13″
Weight	8.4 lbs
Power	< 20 W
Time resolution	1-4 s dependent on resolution
Wavelength range	a) 2-6 μm (alkanes) b) 2-12 μm (alkanes, alkenes, ammonia)
Resolution	1-8 cm^{-1} dependent on configuration
Detector type	Thermoelectrically cooled MCT
Sensitivity	a) ~2.5 mg/m^2 alkanes b) ~5 mg/m^2 alkanes, ~5 mg/m^2 ammonia

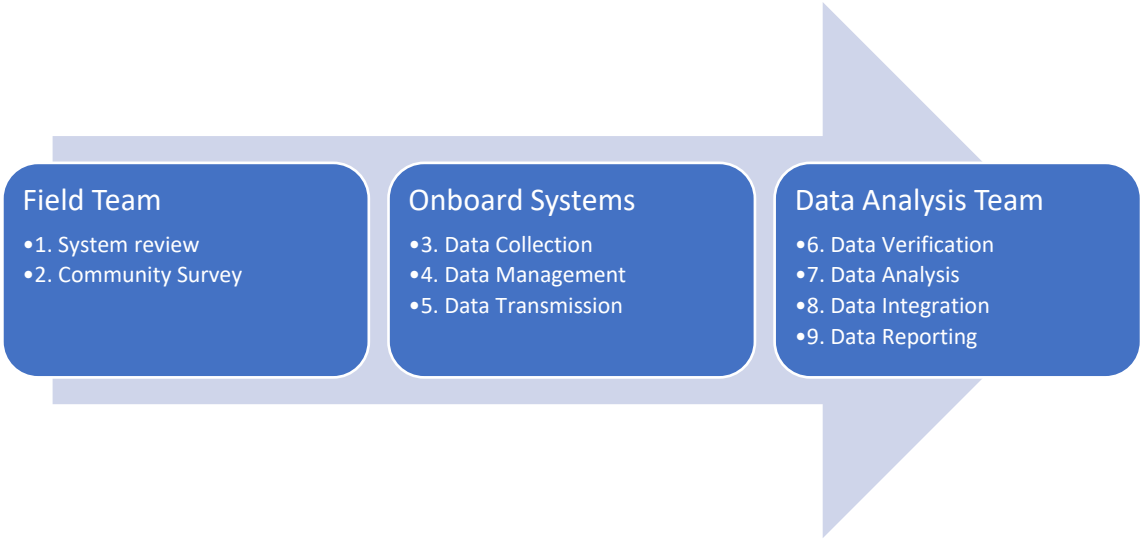
Survey Frequency and Measurement Adequacy:

Recent literature suggests that mobile mapping of air pollution would require 15–30 repeated measurements to map the general air pollution patterns within the community (Chen et al., 20224). In order to study the representative air pollution levels in communities, the project will require adequate mobile monitoring data collection to draw reasonable inferences and complement the mobile measurement data with additional actionable information. Similarly, in order to document the temporal patterns of air pollution in communities would require extensive continuous measurements over an extended period (months, years) in order to capture the diurnal, seasonal, and annual patterns, given the variable operations and emission characteristics of regional and local sources and complex meteorological impacts. We recommend that in order to understand temporal patterns, it will be advisable to have strategically staggered measurements throughout the year, and preferably over two years. Overall, this may necessitate multiple repeated measurements on each community route (between 50-100), spread out and staggered during different hours of day, days of week, and months of year.

For emissions measurements, given the inherent variabilities in emissions and air pollution behavior, the FluxSense measurement techniques require a certain level of statistical certainty. FluxSense's measurement techniques follow the European standard EN 17628, which requires a minimum of four valid transects, acceptable wind speed and direction (relative to transect path), and solar angle (SOF) for an area measurement to be considered valid.

Workflow processes:

Once the platform is designed, developed, and configured, and the ground crews are sufficiently trained in the operations of the platform and the instruments, our approach follows the following process.



The **Field Team** will be trained in the safe operations of the platform and the systems through a comprehensive Standard Operating Protocol. This will also detail safety instructions, as well as the step-by-step process for vehicle and instrument checks to be performed at the beginning and end of each day. The daily schedule will account for these startup and post-survey protocols (1 hour each). After the completion of the system review, the field team will be responsible for conducting the community survey. The field team will have access to an onboard computer system which will provide the drive schedule for the day, and routing instructions. The field manual will also include process for uploading the check reports to the server. Each mobile platform requires two operators: one driver, and one instrument operator. The instrument operator reviews the measurements in real time which gives insight about measurements and system operations. This team communicates throughout this process to ensure the adequate number of high-quality measurements are being collected at each site. All of the staff are trained to operate the mobile platform and the instruments, which adds redundancy and allows for rotations, and thus longer measurement periods and campaigns. Additional staff are utilized (off-site) to analyze the real-time and previously collected data to ensure measurements pass the QA/QC protocols, and that the goals of the monitoring campaign are achieved.

The **Onboard System** will have all the state-of-the-science instrumentation and an integrated GPS system for geo-coordinated data collection, as well as a DMS for data integration and data archiving. The onboard system will also have cellular modem capabilities to transmit the data to the project data server at short intervals throughout the day.

The **Data Analysis Team** will obtain the data from the data server and will be responsible for running the scripts for data verification. All the daily verified data will be analyzed for daily enhancement maps, and the daily maps will be integrated for multiple days to apply statistical models to identify hotspots. The consolidated analysis results (such as the hotspots maps) will

be reported at regular intervals to the agency and the public through the data visualization system (typically quarterly or annually). The preliminary daily results may also be made available on the data visualization system (as desired by the agency).

3. Describe your usual approach or strategy to mobile monitoring. Include, if possible:

a. **Drive plan and operational logistics**
b. **Staffing**
c. **Power requirements (e.g., battery powered, requires generator, etc.)**
d. **Consumables**
e. **Quality control procedures**
f. **Performance and acceptance criteria (e.g., precision, bias, limit of detection)**
g. **Data logging and storage**
h. **Notifications and communication**

Response:

Drive plans: Typical drive plans require that each day of the survey will rotate the driving order of the neighborhoods to monitor each location at different times of the day. The rotation pattern for a recent sample project in the table below. The driver follows the designated driving path through each neighborhood every day, beginning at the designated starting point for each route, unless there is an extenuating circumstance.

Given the different sizes of community polygons, such a schedule allows a similar amount of data in each community polygon in each temporal bin (i.e., no bias from more time in any period): (1) Early AM, (2) Late AM, (3) Early PM, and (4) Late PM.

For an example 21 days of monitoring, such a plan provides 20 days of data with equal distribution, with the 21st day of data collected as a backup. Any missed/skipped routes on weekdays or weekends will be followed up at the succeeding weekday or weekend after the completion of the campaign.

Sample mobile monitoring driving schedule for a past project (routes are designated by letter)

	Day	AM				PM			
Weekday 1	Thu.	A		B		C	D	E	F
Weekday 2	Fri.	C	D	E	F	A		B	
Weekday 3	Mon.	B		A		E	F	C	D
Weekday 4	Tue.	E	F	C	D	B		A	
Weekday 5	Wed.	A		B		C	D	E	F
Weekday 6	Fri.	C	D	E	F	A		B	
Weekday 7	Mon.	B		A		E	F	C	D
Weekday 8	Tue.	E	F	C	D	B		A	

Staffing: Platform design and configuration will be led by Sonoma Technology and FluxSense team. This will be aided by consultation support from our technology partners from Entanglement Technologies, Syft Technologies, Tofwerks, and other partner organizations.

All community deployments will be led by the project team and local research partners. The project will be divided into three to five zones, and a team will be assigned for driving and operations in a region in each zone. The local teams will not only have extensive monitoring experience, but also have knowledge of local air pollution issues.

- Los Angeles
- San Diego/Border
- San Francisco Bay Area
- Sacramento/NorCal
- San Joaquin Valley

Data analysis will be managed by staff at Sonoma Technology, FluxSense, and UC Berkeley. The data analysis approach will build upon previously published research on community-scale air quality mapping[4, 5] and emissions data analysis papers published by the project team. Sonoma Technology and UC Berkeley team will lead the community-scale air quality mapping and analysis tasks, while FluxSense will lead the emission data analysis.

Power: All our platforms derive power from onboard extended battery systems installed within the platform. This includes built in battery banks, an additional lead acid and lithium-ion battery to run devices on a separate circuit, and a vehicle alternator (with 100A excess capacity). Additionally, the mobile platform will be installed with dual high-output alternators that are integrated with the mobile battery bank. This will enable the vehicle to charge and maintain the

battery level, ensuring uninterrupted measurements indefinitely. Collectively, these power sources provide 8 hours of continuous operations for all instruments installed in the platform. Additionally, our systems will be designed to plug in to shore power for stationary measurements, where the instruments can operate continuously for multiple days, as needed.

Consumables: The project team will be responsible for acquiring and deploying all consumables for the project, including calibration gases, carrier gases, replacement filters, tape, cleaning supplies, etc. Additionally, Liquid Nitrogen is used to cool detectors in each of the SOF spectrometers, and 20 oz lasts up to 8 hours for each instrument. The project team will also be responsible for vehicle charging and fuel.

Data Quality Management: Our team has significant experience in developing Standard Operating Procedures (SOPs) for a range of monitoring and instrumentation projects; the development and use of SOPs is a key aspect of projects we have conducted to meet regulatory requirements for refinery fenceline monitoring programs in California, and for other monitoring efforts across the country. The project team will develop SOPs for all instruments and functions, with clear operational and quality assurance protocols.

Our project team conducts system testing and validation before field deployment and documents the system's performance on a routine weekly basis including pre-calibration, weekly calibrations, and post-calibration of instruments. The mobile platform is also checked every morning before field deployment including flow checks, match strike tests to document response time and lag, zero air checks, etc. All these calibration steps and daily checks will be conducted by research experts with extensive experience in mobile monitoring.

For emissions measurements, prior to campaign deployment, the mobile platform and instruments are rigorously tested in field to ensure they are performing properly. During campaigns, at the start of every day, the instruments each undergo a QC checklist to ensure they are running within parameters. Any potential issues are noted and addressed before measurements are collected. Measurements of sites/regions/communities are repeated to build statistics. Standard practice is 10 measurement days for each target, with a minimum of 4 measurements (often 8+) that pass QC for each measurement day.

Data Logging and Data Acquisition Systems: We design our platforms to have inbuilt data loggers which will record the measured concentrations and GPS data at a minimum 1 Hz frequency. In addition, we include a secondary data logging system, which uses a commercially available Campbell Scientific Data Logger, and records data at the fastest native data rate through the serial connection. Additionally, we use cellular modems to transfer data to a cloud data management system.

Additionally, FluxSense uses fully integrated in-house software for instrument control, real-time measurements, visualization, analysis, and reporting for all the systems. Raw spectral, GPS, and wind data are saved onto the mobile platform computers during measurements. The data are also copied onto external devices for backup redundancies and to begin data analysis.

Notifications and Communication:

The team is in constant communication with one another and with the client before, during, and after a measurement campaign to ensure project targets are met, findings reported, and any issues notified. Typically, the project managers and the on-site measurement team discuss campaign objectives and expectations with the client throughout the process. During campaigns, the client is given routine updates on the project status (i.e., notable measurements, issues, etc.). Afterwards, results and analysis updates are provided to the client frequently to ensure the reporting and/or data delivery is on schedule.

Additional Optional Services:

We are also able to leverage other complementary solutions, such as optional stationary measurements for anchoring the measurements in the community and the use of advanced data visualization and modeling tools.

For example, Clarity has developed sensor-based air quality management solutions to provide real-time, high-resolution air monitoring measurement data (e.g., $PM_{2.5}$, NO_2, O_3 – with many additional forthcoming pollutants like BC) to cities in over 75 countries, across 6 continents – including extensively with CARB / AB617-funded community projects. Clarity's air monitoring solutions can supplement the limited spatial and temporal data available from the existing regulatory monitoring infrastructures thereby enabling further community/neighborhood-specific insights necessary to advance and promote environmental justice. Given the temporal limitations of mobile monitoring, the co-deployment of stationary sensor networks can complement the data collection activities under the SMMI. Specifically, the addition of stationary sensor networks will provide for consistent temporal anchoring of the mobile monitoring data and enable further data fusion opportunities that will greatly enhance the actionability of the collected data and community benefits resulting from the Initiative.

4. Please provide an estimated cost to operate all applicable mobile monitoring platforms as a function of time (e.g., 1 week of monitoring) deployed and/or measurements taken.

a. **These cost estimates should include all costs associated with mobile monitoring operation. This includes but is not limited to:**

i. Direct costs – instrumentation consumables and repairs, vehicle operation costs, staff cost to operate platforms, recharging requirements.

ii. Indirect costs – support staff costs, associated insurance for operation, administrative overhead, any required permits.

iii. Data Management – costs to move data from raw data collected by instrumentation to the final data products requested by CARB.

b. How often are invoices and payments typically required?

Response:

Typical Mobile Monitoring Costs: Costs for mobile monitoring include the use of the mobile platform and instrumentation, consumables, and labor cost for project management, surveying, analysis, reporting, data collection, data management, and reporting.

- For a project with **5 mobile platforms** covering **over 200,000 miles**, the typical mobile monitoring project cost will range from **$120-$130/unit mile**.
- For a project with **1 to 3 mobile platforms** covering **100,000 miles**, the typical mobile monitoring project cost will range from **$130-$150/unit mile**.

These estimates correspond to a one-time survey. The project would ideally require multiple repeats over the year, which should be accounted for to estimate the unique miles surveyed over the course of the project.

We invoice our clients on a monthly basis and payment periods are negotiated with the contract.

Optional Services:

Stationary Network: Deployment of a stationary network in up to 25 communities can provide temporal anchoring and additional data fusion opportunities. The systems will be self-contained, and operate on solar power. The data systems will be all integrated, and will have onboard cellular modem to push the data to the DMS.

- To operate 25 new community networks for 2 years, each with up to 10 sites of PM and NO_2 monitors, three of which will also include BC and tVOC monitors, the total cost will be roughly $3 million.

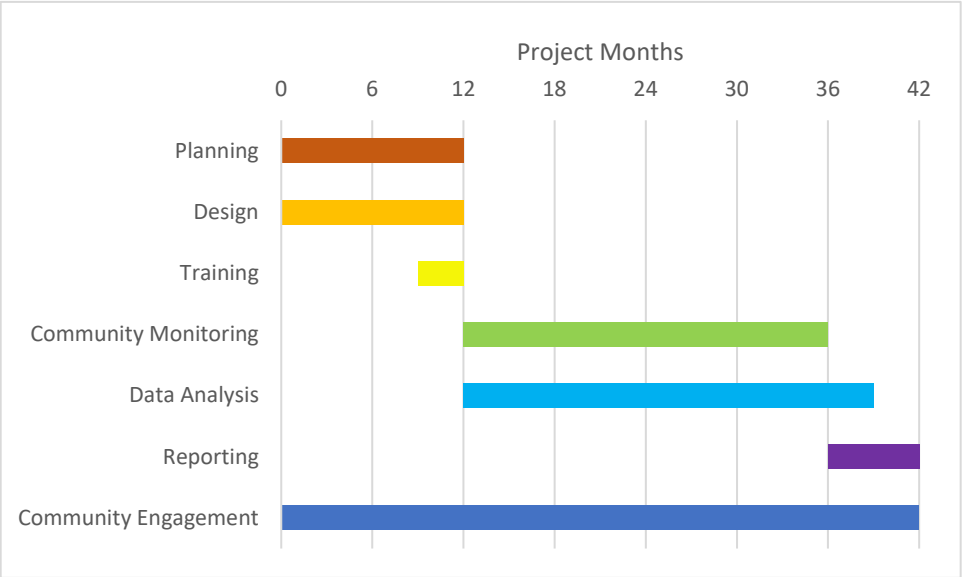
5. If an RFP is developed based on the information provided here, how much preparation time is required to deploy the platforms and begin monitoring?

a. **Do you have recommendations for a minimum timeline to achieve potential monitoring objectives described here?**
b. **What is the maximum number of platforms that you could deploy by early 2025?**

Response:

Schedule:

Sonoma Technology and our partners will be able to configure and deploy platforms for community scale monitoring within 12 months including project planning and design. A proposed schedule is shown below with discussion following. For this example, we have assumed a total project duration of 42 months.



- Design Phase: This phase will include the design, configuration, customization, and testing of the mobile platform. Given the scale and scope of the project, our team may leverage existing platforms, or may configure new platforms to the fleet with desired features (such as the use of zero emissions vehicle platform). The platforms will also be configured with new state-of-the-science instruments to minimize breakdown and performance issues and have the platforms available for a 2-year measurement period. [12 months]
- Planning Phase: This phase will include the development of planning and protocol documents (including the QAPP, SOP), community route selection, and agency and

community feedback. This phase will occur simultaneously during the Design Phase. [12 months]

- Training Phase: This phase will occur simultaneously during the Planning phase. [3 months]
- Community Monitoring. [24 months]
- Analysis Phase: Data analysis will occur simultaneous with the Monitoring Phase, and extends 3 months after the completion of the Monitoring Phase.
- Reporting Phase: Final Data Products and Final Report [6 months]
- Community Engagement: Throughout the course of the project following the communication and engagement plan. [42 months]

<u>Deployment Strategy:</u>

- The Project Team will deploy up to five identical platforms for contemporaneous measurements in up to five major regions in the state by early 2025 depending on CARB's desires:

    - San Diego and Border communities
    - Los Angeles / South Coast Air Basin
    - San Joaquin Valley Air Basin
    - San Francisco Bay Area
    - Sacramento and Northern California

<u>Maximum number of platforms deployable by early 2025:</u>

If existing platforms are desired, the project team has three fully equipped mobile laboratories in California, and access to several other mobile platforms from our partner organizations, which could be available for direct application or ancillary support. Given the scope and scale of the project, the project team may also configure and customize additional mobile platforms to our fleets with the appropriate instrumentation for measuring all the desired pollutants, and the additional features desired in the RFP (e.g., zero emissions vehicle platform). Such a design and configuration phase will require 12 months of upfront time. By early 2025, the project team will be able to deploy up to five (5) standalone mobile platforms with state of the science air quality and emissions monitoring systems.

6. Do you have experience developing Community Air Monitoring Plans (CAMPs) as defined by the CARB Community Air Protection Program Blueprint5 or similar? Please provide examples of community-focused monitoring plans or similar.

Response:

Yes, the project team has extensive experience in supporting federal, state, and local agencies, as well as community and tribal groups in community air monitoring planning and implementation. Some recent examples include:

- We have created a community-focused air monitoring plan for the CARB grant to Blue Lake Rancheria. The goal of the measurement effort is to establish a regulatory grade PM instrument at a central site to provide robust data. Low-cost measurements are used to assess the spatial variability of PM and to engage and educate the community members. An EPA grant will continue measurements at the site and add a year's worth of BC and toxic metals (collected by filter) to better understand current conditions.
- We developed air monitoring plans for several refineries in response to BAAQMD and SCAQMD regulations. These monitoring plans include community measurements of air toxics and criteria pollutants with high temporal frequency.
- FluxSense has also worked with CARB in conducting measurements in SNAPS (Study of Neighborhood Air near Petroleum Sources) communities in Los Angeles and the San Joaquin Valley and with SCAQMD for monitoring related to AB 617 in the Carson Wilmington area.

7. Do you have existing standard operating procedures (SOPs) or quality assurance project plans (QAPPs) for your mobile monitoring approach?

Response:

Yes. We have developed a number of QAPPs and SOPs for several government projects for operations of complex air quality monitors for stationary measurements. The project teams have also implemented other community-scale mobile monitoring projects, which required the development of a SOP and QAPP document. We will leverage these protocols as a starting point, and further develop the protocols for the additional monitoring and analysis deemed necessary for the statewide project.

IV. Data Collection, Storage, Reporting

1. In what format do you generally provide data to your clients? What is your final data product?

Response:

We provide several different types of data formats to clients for mobile air monitoring and other air monitoring data. This includes, but is not limited to, geographic information systems (GIS) layers (e.g., shapefiles, rasters), tabular data, Esri products (interactive maps, StoryMaps, Survey123), interactive dashboards, and static reports. We have built several interactive dashboards for displaying and communicating data to the public in an easily understood manner, including information on health-based risk exposure levels.

2. Do you have off-the-shelf, or modifiable-off-the-shelf, data management products compatible with mobile monitoring data?

Response:

We currently have a Cloud-based DMS that is used for monitoring applications which is flexible enough to consume multiple types of data at multiple collection frequency. The DMS has built-in automated quality control features that allow for Level 0 data validation in real-time.

3. What is your experience in mobile monitoring data analysis and visualization? Specifically, do you have any experience using ESRI products to manage and visualize data?

Response:

Sonoma Technology has experience collecting, processing, quality assuring, and visualizing mobile air monitoring data in a number of different manners. We have built ESRI web applications for public consumption of mobile air monitoring data in communities. Additionally, we use a process to evaluate concentration enhancements in addition to the concentration data.

4. What is your experience in public dissemination of complex information? To what extent have you generated data visualization for the public?

Response:

We currently collect, process, and display real-time air monitoring data around refinery fencelines in California on a number of websites that were developed by Sonoma Technology. These websites display complex air monitoring data in a publicly consumable manner which effectively describes risk exposure levels and the air pollutants of concern. These websites visualize a large number of pollutants over the previous 48 hours and, in some cases, have notification systems that community members can subscribe to on the website. A representative example is the SEP Torrance Air Project in which fenceline and community-based air quality measurements were made with reporting to a public website in near-real-time. We worked with the technical advisory committee to design the "look and feel" of the project website which presents:

- the monitoring data in a science-based, balanced manner
- the data in a manner that the public can understand
- the data in the context of health thresholds or health guidance values
- information about the potential effects of exposure to the measured compounds
- an overview of the project
- a guide for understanding the concentration display
- a Monitors page that showed a map and time series for each pollutant monitored
- a set of Resources pages (Air Quality Education, Compound Information, Definitions, and Frequently Asked Questions, or FAQs)

5. What suggestions do you have for handling large amounts of data from a variety of sources (e.g., multiple mobile monitoring platforms) into cohesive data visualizations?

Response:

We have a number of suggestions regarding this data handling and visualization process:

- Datalogging systems should be comprehensive and should log different data streams using one software to remove potential errors in joining data. These types of datalogging systems can also be enhanced to include necessary field information such as quality control check data, GPS data, etc.
- A robust DMS is crucial to ensuring data is of high quality and is processed in a consistent and standardized format. The use of a Cloud-based DMS ensures that storage

is flexible as these datasets can grow quite large very quickly depending on the types of instruments used.

- Real-time data reporting is discouraged for mobile monitoring. Several quality control measures need to be considered before data are reported to the public. One suggestion is that data be reported by the following day after bracketing quality control checks are performed.

V. Feedback

1. Provide input on the requirements or areas listed in this RFI. Specifically, CARB is looking for:

1. **Availability of existing systems that perform all or a portion of the requirements in Section II – C. New systems cannot be built using funds in a potential RFP.**
2. **Questions, suggested modifications, or additions to the proposed environment that would allow or encourage potential bidders. Please include justifications for any suggested changes and concept modifications.**

Response:

The RFI has identified a wide range of desired pollutants, and other important desired features, such as the use of zero-emission vehicle platforms. Given the expertise and partnerships available to the project team, we will be able to meet all the technical and desired requirements of the project (including platform characteristics, pollutants, measurement quality). However, these updates and additional configurations to the platforms will require additional funding to reach and sustain maximum planned capacity. Given the large financial risks associated with these purchases for universities and small to mid-size businesses, CARB may want to provide budget advances to provide upfront capital support for the purchase of new instruments and related equipment, Likewise, the labor costs for implementation of the upgraded platforms during the first year should be reimbursed on a monthly basis.

Additionally, all in-use mobile platforms currently in use are all built on non-zero emission vehicle platforms. As preferred in the RFI, use of a zero-emission platform would necessitate additional design and development of new platforms. However, given that new sprinter vans with such configurations are now available (e.g., 2024 Mercedes Benz eSprinter with 250 mile range), it is certainly possible to develop such platforms for this project, and configure them with all the desired measurement systems for measuring criteria air pollutants, greenhouse gas, and air toxics (including VOCs and metals). The availability of emission monitoring systems, such

as those presented in this proposal (FluxSense Sentinel SOF system) can also be integrated into such a platform for community air quality and emissions tracking applications with ease.

Attachment – C

Rough Order of Magnitude Cost Estimate

Rough Order of Magnitude	
Estimated range of cost per month of full-time monitoring. *This may be costs associated with conducting monitoring, engagement activities to support monitoring, or both. If this is not applicable, please specify a different time range or more appropriate metric to quantify your capabilities. Please describe what "full-time monitoring" looks like for you and itemize costs with as much specificity as possible.*	**See below**
Estimated range of cost to complete a full year of monitoring. $	**See below**
Answers and Assumptions Used in Cost Estimate	
Please answer, in as much detail as possible, the State's questions (1-4) below. *Also, please provide details pertaining to the assumptions, expectations, and/or performance parameters used as the basis of the cost estimate.*	

Cost Estimation: The table below shows the project costs for mobile monitoring, additional optional services, and total project for two options:

- Five platforms, which will provide contemporaneous operations in five regions in the state (e.g., San Diego/Border communities, Los Angeles, San Joaquin Valley, San Francisco Bay Area, and Sacramento/Northern California)
- Three platforms, which will provide contemporaneous operations in three regions in the state (e.g., Northern California, Central Valley, Southern California)

<u>Cost assumptions:</u>

- Project duration: **42 months**
- Measurement duration: **24 months**
- Minimum miles driven were calculated by assuming 24 months of measurement, with 15 days of measurement/month X 6 hours of community surveys/day (daily survey hours) X number of platforms (3 or 5 platforms).
- Cost includes:
    - Project Management
    - Mobile platform modifications and use
    - Consumables, including calibration gases, filters, fuel/charging, etc.

- Labor (Platform operations, Data analysis, Reporting)
- Data dissemination using customized data visualization tools
- Participation in CARB-organized Community workshops (quarterly)
- Quarterly progress reports
- Final project report

Category	3 Platforms	5 Platforms
Project Management, Data Analysis, Reporting, and Community Engagement	$ 5,600,000	$ 8,000,000
Mobile Platform Modifications and Use	$ 8,000,000	$ 13,000,000
Charging, Maintenance, Parking	$ 600,000	$ 1,000,000
Labor (Mobile Surveys)	$ 2,400,000	$ 4,000,000
Data Processing and Storage	$ 600,000	$ 1,000,000
Total Mobile Monitoring Project Costs	**$ 17,200,000**	**$ 27,000,000**
Minimum Miles Surveyed	129,600	216,000
Unit Mile Costs	**$130 - $150**	**$120 - $130**
Additional Optional Services	*$ 2,800,000*	*$ 3,000,000*
Total Project Costs	**$ 20,000,000**	**$ 30,000,000**

<u>Additional Optional Services</u> includes deployment of Stationary Monitoring Networks in all surveyed communities (assuming 25 communities) for the 2-year mobile measurement period for temporal anchoring of the mobile monitoring data.

- Cost includes:
  - Deployment of stationary air monitoring networks in 25 communities.
  - Each community will receive a network of up to ten (10) sites for measuring PM and NO_2, and up to three (3) sites for measuring BC and tVOC for 2 years.

THE STATE's QUESTIONS and VENDOR'S RESPONSE/ANSWERS:

1. What is the timeline for your mobile platform(s) (that is, how many platforms do you have operational right now, and what is your timeline for launching more)? Will your platform(s) depend on additional funding to reach and sustain maximum planned capacity?

Response:

As discussed, the project team currently has three operational mobile platforms, and will have access to several additional mobile platforms from our various partner organizations. However, given the scale and scope of the project, the various additional pollutants of interest (including speciated VOCs and metals), and the desire for zero-emission vehicle platforms, it may require at least 6-12 months after the contract award date to complete the design, configuration, customization, and field testing (and training) for community deployment.

These updates and additional configurations to the platforms will require additional funding to reach and sustain maximum planned capacity. Upfront capital will be required for the purchase of new instruments and related equipment, Likewise, the labor costs for implementation of the upgraded platforms during the first year will need to be reimbursed on a monthly basis.

2. Approximately how much monitoring can be accomplished in the period of a month? A year?

Response:

Monitoring coverage is dependent on hours of operation, days of operation, and vehicle speed. Given our monitoring window, we aim to conduct 6 hours of community surveys every day, where the platform is driven at or below speed limit for operator and traffic safety. Assuming 20 mph of average speed for in community measurements (including traffic lights, stop signs, and traffic flow), and 15 days of measurement per platform, each platform is able to survey between 100-120 miles per day. This translates to roughly 1,500-1,800 community miles every month, and roughly 18,000-21,600 community miles every year per platform (assuming some downtime for weather, instrument servicing, and training/outreach events).

Assuming 5 platforms operating in tandem (one in each region), we should be able to survey a minimum of 216,000 community miles over a 24-month community monitoring period. If 3 platforms are deployed across the state, the project will survey a minimum of 129,600 community miles over a 24-month monitoring period. These estimates are for a one-time

survey. The project would ideally require multiple repeats over the year (e.g., up to 30 repeated measurements for each selected community road over 2 years for identification of local hotspots), which should be accounted for to estimate the unique miles surveyed over the course of the project.

3. Are there any requirements that would preclude you from competing should an RFP be released? If yes, what suggested changes would allow you to compete?

Response:

The solutions described in this response will be able to meet all the technical and desired requirements of the project (including platform characteristics, pollutants, measurement quality). As such, there are no specific technical requirements that would preclude our team from competing in the RFP. However, we would require contract terms and conditions that accommodate unanticipated challenges that will inevitability arise.

Moreover, given the scope of procurement and system configuration that will be required for the project, the ideal scale of the project will require a total project duration to include design, training, deployment, analysis, reporting, and engagement phases. This concept is presenting a project plan for a 42 months project, which will include 12 months for platform design, modifications, and project planning, 24 months for community surveys and data analysis, and 6 months for reporting. The costs listed here were optimized for a multi-platform deployment over this recommended project period.

4. Are any of the goods, products, or services you've identified in your RFI response available on a Federal GSA or State of CA LPA? If yes, please identify the contract type, name, and number.

Response:

Yes. Our services are available under Federal GSA Multiple Award Schedule (MAS) Contract: #47QRAA18D00D1; with the following Special Item Numbers (SINs):

- 541620 Environmental Consulting Services;
- 611430 Professional and Management Development Training;
- 541370 GIS Geographic Information Systems (GIS) Services; OLM Order Level Materials

VENDOR'S ASSUMPTIONS:

What assumptions have you made in preparing a response to this RFI?

Response:

Given the scale and scope of the project, the recommended list of pollutants, and the accuracy and precision desired for the project, our assumption is that the project will require state-of-the-art regulatory and research grade equipment for mobile mapping and stationary monitoring. This will allow collection of high-quality data by using advanced systems. This will also need to be supported by performing daily data quality checks and weekly calibrations, and will require a team with high level of experience, expertise, knowledge, and efficiency.

Although there are no minimum requirements necessary to bid on a proposal of this nature, certain scales of operations may be beneficial to provide cost effective solutions, including:

- Project Scale:
    - The lowest costs calculated herein assume that the project will use 5 platforms that will cover a combined minimum community survey miles of 216,000 across the state. This will allow the deployment of multiple platforms in multiple regions for contemporaneous measurements and allow economies of scale to optimize the measurement and analysis costs, which will maximize project advantages and cost-effective solutions for the project. As the total miles decrease, the unit mile costs would increase.
- Multiple repeats
    - As discussed in papers published by the proposal team members, projects will need a minimum 15-30 repeated measurements.
    - However, it may be advisable to have roughly 100 repeated measurements on each selected community road link, strategically staggered throughout the year, and preferably over two years.
- Statewide program with simultaneous measurements in multiple regions would be ideal.
    - This will allow better program synergies, as well as more cost-effective data analysis. This will also eliminate seasonal discrepancies by helping collect more consistent temporal coverage in all regions.
    - However, our team will also be able to provide one platform, and deploy it in one region at a time, if needed.

FluxSense Inc
113 W G Street, #757
San Diego, CA 92101

FluxSense

11/01/2023

Letter of commitment

To: **Dr. Abhilash Vijayan**
Director of Transportation, Climate, and Community Air Quality Programs
Sonoma Technology, Inc.
1450 N. McDowell Blvd., Suite 200, Petaluma, CA 94954

We hereby acknowledge FluxSense Inc's support for the RFI response governed by Sonoma Technology Inc for the CARB Statewide Mobile Monitoring Initiative (2023CARB_SMMI-RFI001): "Using regulatory and research grade analyzers for community-scale mobile air quality monitoring and mapping".

FluxSense Inc was started 2013 in San Diego to fill a need for reliable diffuse emissions measurements on the US market. The company is a subsidiary to FluxSense AB, started 2001 in Sweden as a self-sustained spin-off company from research conducted by the optical remote sensing group at Chalmers University of Technology in Gothenburg. Currently, the FluxSense business concern consists of about 15 employees with one third active in the US branch.

FluxSense measurement platform is highly mobile and uses research grade analyzers (FTIR and DOAS spectrometers) for high quality monitoring of a broad range of compounds. Our Solar Occultation Flux (SOF) instrumentation is a unique product considered Best Available Technology (BAT) and now standardized in the European Union standard (EN17628) for VOC emissions monitoring. We conduct mobile monitoring and emissions measurements throughout the United States, Europe, South Korea, China and other parts of the world. FluxSense clients encompass local authorities, state and federal agencies, universities, research institutes and private companies. Our qualified team has experience from multi-tier research campaigns, multi-year monitoring contracts (for instance with CARB and SCAQMD), consent decree contracts as well as shorth term consultant case studies.

The FluxSense mobile platform and personnel have been deployed in studies at petrochemical industries, oil and gas production, refineries, ports, landfills and waste management, agriculture and concentrated animal feeding operations (CAFO), water treatment facilities, power plants, product storage facilities, volcanic sources and adjacent communities to select sources.

For the present RFI, FluxSense will bring a qualified and skilled team with many years of experience in mobile monitoring, design and buildout of mobile platforms for research grade analyzers, mobile monitoring data analysis and management. Specifically, our team brings instrumentation and capability for vertical column mapping and emissions monitoring using SOF to the project platform. Our analysis team will take on data analysis of all SOF measurements in the project, which will streamline the data treatment and monitoring implementation for all included monitoring regions. Furthermore, the FluxSense team will operate one of the platforms in the project where our experienced field operators will secure an efficient and quality assured mobile monitoring service.

FluxSense commit to provide the appropriate services and qualified personnel as necessary to the Sonoma Technology team and to fulfilling our obligations for the proposed scope. FluxSense agrees to ensure compliance with all pertinent federal, state, and funding agency regulations and policies.

For reference, the FluxSense mobile monitoring and emissions approach has been employed in two recent CARB studies: Contract 18ISD023 "*Toxic Air Contaminant and Greenhouse Gas Measurements near Oil and Gas Operations and Proximate Communities*" and contract 17ISD023 "*Characterization of Air Toxics and GHG Emission Sources and their Impacts on Community Scale Air Quality Levels in Disadvantaged Communities*".

Sincerely,

Jerker Samuelsson, CEO
FluxSense Inc, (EIN46-3988250)
113 W G Street, #757
San Diego, CA 92101

UNIVERSITY OF CALIFORNIA, BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

Joshua S. Apte
Department Civil and Environmental Engineering & School of Public Health
661 Davis Hall, Berkeley, California 94720-1710
apte@berkeley.edu

Dr. Abhilash Vijayan
Sonoma Technology, Inc.

2 November 2023

Dear Dr. Vijayan,

I am writing to provide this letter of support and commitment to your proposal "Statewide Mobile Monitoring using Regulatory and Research-grade Analyzers for Community-Scale Air Quality Monitoring and Mapping". I am excited to partner with Sonoma Technology (STI) for this impactful vision of providing detailed, high resolution mobile air pollution measurements across the State of California.

By way of introduction, my research group focuses on hyperlocal air pollution measurement and modeling methods for characterizing community air pollution exposures and disparities. My research group has made seminal contributions to the development of hyperlocal block-by-block mapping using Google Street View cars and other mobile laboratories[1], and to identifying the air pollution disparities[2] that emerge at fine spatial scales[3].

For this project, I would be pleased contribute my expertise in the multiple areas, including: design of air pollution sampling platforms and mobile air pollution monitoring sampling protocols, processing and analysis of mobile air pollution measurements, and assessment of community air pollution disparities. We can also provide access to our mobile air pollution lab and other instrumentation and facilities in my group at UC Berkeley.

Sincerely,

Joshua Apte
Associate Professor of Environmental Engineering and Environmental Health Sciences
University of California, Berkeley

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[1] Apte JS, Messier KP, Gani S, Brauer M, Kirchstetter TW, Lunden MM, Marshall JD, Portier CJ, Vermeulen RCH, Hamburg SP. 2017. High resolution air pollution mapping with Google Street View cars: exploiting big data. *Environmental Science & Technology* 51, 6999-7008. [link]

[2] Tessum CW, Paolella DA, Chambliss SE, Apte JS, Hill JD, Marshall JD. 2021. $PM_{2.5}$ polluters disproportionately and systemically affect people of color in the United States. *Science Advances* 18, eabf4491. [link]

[3] Chambliss SE, Pinon CP, Messier KP, LaFranchi B, Upperman CR, Lunden MM, Robinson AL, Marshall JD, Apte JS. 2021. Local and regional-scale racial and ethnic disparities in air pollution determined by long-term mobile monitoring. *Proceedings of the National Academy of Sciences* 118 e2109249118. [link]

entanglement
TECHNOLOGIES, INC.

October 25th, 2023

Abhilash Vijayan, PhD, PE
Director, Transportation, Climate, and Community Air Quality
Sonoma Technology, Inc.
1450 N McDowell Blvd #200
Petaluma, CA 94954

Dear Dr. Vijayan,

I'm writing on behalf of Entanglement Technologies, Inc. in support of your proposal for the California Air Resources Board Request for Information (2023CARB_SMMI-RFI001) for the Statewide Mobile Monitoring Initiative. Entanglement Technologies intends to support this work using regulatory and research grade analyzers for community-scale mobile air quality monitoring and mapping through the use of our AROMA analyzer and software package as well as providing our air quality monitoring expertise in project planning and platform design, technical support during deployments, and assistance with data interpretation and reporting.

Entanglement Technologies has been developing, manufacturing, and subsequently deploying our flagship sensor platform, AROMA, for over 14 years. AROMA analyzers are thermal desorption, broadband cavity ring-down spectroscopy (TD-CRDS) systems providing sensitive, laboratory-grade analysis of air toxics, greenhouse gases, and other volatile organic compounds (VOCs) in the field and from vehicles at the touch of a button. AROMA analyzers have two main modes of operation: RapidScan and LabScan. RapidScan is a direct spectroscopy mode, where an air sample is directly analyzed by the CRDS core providing real-time measurement of small molecules (methane, H2S, HCN, etc.) and large molecule compound classes (alkanes, aromatics, etc.). The LabScan operating mode utilizes the thermal separation front-end before CRDS detection. This provides near real-time measurements of ethylene oxide, BTEX, and other VOCs at detection limits as low as 2 pptv. These modes can be used together for mobile monitoring; RapidScan for hyper-local mobile hotspot detection and LabScan for broad area surveys and stationary monitoring for more complex chemical profiling. AROMA can be connected with GPS and an anemometer and data from the analyzer can be output as a simple excel file or as a .kml file to be imported into Google Earth to generate mobile monitoring maps.

Our team offers a broad range of experience in atmospheric chemistry and air quality monitoring, instrument and application development for ambient chemical analysis, precision manufacturing, and open-source software development for laboratory equipment control. The Entanglement team has expertise in a variety of ambient air monitoring applications including emergency response and triage monitoring campaigns and mobile monitoring in communities. Our mobile analysis systems have been used in more than a dozen specific projects for mobile monitoring at locations across the country. Some key projects include:

- San Antonio, TX – large area ozone precursor study
- Houston, TX – leak identification and source fingerprinting after Hurricane Harvey
- Carlsbad Caverns, NM – ozone precursor study by Colorado State University (Collett group) in collaboration with EPA Office of Research and Development (ORD) and National Park Service
- Atlanta, GA – monitoring ethylene oxide around sterilization facilities
- Longmont/Denver, CO – surveying various VOC sources around oil and gas activities
- Baton Rouge/New Orleans, LA – surveying ethylene oxide emitters by Louisiana Department of Environmental Quality (DEQ)
- Rotterdam, Netherlands – surveying the Port of Rotterdam by Rotterdam/Netherlands DCMR
- North Carolina – leak identification and surveys after Hurricane Florence
- Sacramento Metro Air Quality Monitoring District – hyper local community monitoring in collaborator with Sonoma Technology and the University of California – Davis.

Entanglement Technologies' AROMA analyzers have been deployed by Harris County (Texas) Pollution Control Services and the City of Houston in city vehicles to measure hydrogen sulfide (H2S), hydrogen cyanide (HCN), benzene, toluene, ethylbenzene, xylene(s) (BTEX), 1,3-butadiene, acrolein, and other air toxics species. Entanglement Technologies' team has also conducted mobile monitoring with AROMA analyzers in Houston after Hurricane Harvey in 2017, and after the Intercontinental Terminals Corporation fire in 2019. In 2022, California Air Resources Board acquired two AROMAs for community air toxics monitoring. Several universities including Colorado State University and Baylor University use AROMA to conduct mobile monitoring around oil and gas and industrial activities.

AROMA analyzers have been deployed in Nissan LEAF, minivans, SUVs, and Colorado Department of Public Health and Environment (CDPHE) vehicles (Figure 1). The system can be mounted in a rack or contained in a custom Pelican Case, so that the system can be easily anchored into any vehicle. We also own a Ford Sprinter van that has been used for several mobile monitoring deployments in Texas and most recently used for the hyper-local mobile monitoring project in Sacramento with Sonoma Technology.

We look forward to working with you to provide rapid and sensitive toxic air contaminant measurements to support community-focused programs and inform future monitoring programs and actions to improve the health of community members in California. Please let me know if you have any specific questions at amarcotte@entanglementtech.com.

Sincerely,

Aurelie Marcotte, Ph.D.
Director of Sales and Business Development
Entanglement Technologies, Inc.

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Boulder, CO, USA 80301
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Abhilash Vijayan, PhD, PE
Director, Transportation, Climate, and Community Air Quality
Director of Business Strategy
Sonoma Technology, Inc.
1450 N. McDowell Blvd., Suite 200
Petaluma, CA 94954

Dear Dr. Vijayan,

Tofwerk is pleased to offer this letter of support for Sonoma Technology's submittal to the California Air Resources Board Request for Information (RFI) 2023CARB_SMMI-RFI001. Tofwerk currently offers 7 models of Vocus CI-TOF-MS instrumentation platforms that operate in mobile laboratory environments.

Trace chemical composition of air is complex and compounds of interest might undergo rapid changes in concentration due to interactions with ozone, NOx, SOx, UV light, humidity, as well as chemical species from other sources. These dynamic processes might require real-time monitoring of target and non-target species at trace concentration levels and at fast analytical speeds.

Please include us in your list of technical partners for this future effort, and we look forward to working with you.

Kind Regards,

Wade Bontempo | Head of Sales - Americas

+1 832 606 0071 | Wade.Bontempo@tofwerk.com

Boulder, Colorado, USA

TOFWERK

COOPER ENVIRONMENTAL

A DIVISION OF SCI

November 1, 2023

Abhilash Vijayan, PhD, PE
Sonoma Technology, Inc.
Petaluma, CA

Dear Dr. Vijayan,

Cooper Environmental, A Division of SailBri Cooper, Inc. is pleased to offer this letter of support for Sonoma Technology's submittal to the California Air Resources Board (CARB) Request for Information (RFI) titled 2023CARB_SMMI-RFI001 for community-scale mobile air quality monitoring and mapping.

We are the global leader in near real-time metals measurement through Xact® monitoring products for ambient air, stack emissions, and water. Xact 625i can simultaneously measure multiple metals at high time resolution and generate data in near real-time for fence-line monitoring, source apportionment studies, and pollution event characterization. During 2019, we also collaborated with South Coast Air Quality Management District (AQMD) to perform optimizations and modifications to Xact 625i for conducting high-time resolution metals measurements in a mobile setting. This mobile monitoring approach enabled identification of persistently elevated levels of certain metals and Xact 625i was incorporated into South Coast AQMD's own mobile platform for community-scale multi-metals monitoring.

We will be glad to offer technical support to Sonoma Technology's efforts as a potential partner for CARB's community-scale mobile air quality monitoring program.

Sincerely,

Varun Yadav, PhD
Vice President,
SailBri Cooper Inc.

10300 SW Nimbus Ave Suite P-B
Tigard, Oregon 97223

SailBri Cooper Inc.
www.sci-monitoring.com

Phone 503-670-8127
Fax 503-624-2120

October 30th, 2023

California Air Resources Board (CARB)
1001 I St #2828
Sacramento, CA

To Chair Liane Randolph or whom it may concern,

On behalf of Clarity Movement Co. ("Clarity"), I would like to express our support of Sonoma Technology, Inc.'s response, being submitted in response to the California Air Resources Board (CARB)'s Request for Information (RFI) for the *Statewide Mobile Monitoring Initiative*.

Since 2014, Clarity has developed sensor-based air quality management solutions to provide real-time, high-resolution air monitoring measurement data *(e.g. $PM_{2.5}$, NO_2, O_3 – with many additional forthcoming pollutants)* to cities around the world. To date, Clarity's Sensing-as-a-Service air monitoring solutions have been deployed with government and community partners in over 75 countries, across 6 continents – including extensively with CARB / AB617-funded community projects, and various collaborations with many of California's AQMDs and APCDs.

Throughout California, Clarity's air monitoring solutions are deployed by communities and governments to supplement the limited spatial and temporal data available from the existing regulatory monitoring infrastructures thereby enabling further community/neighborhood-specific insights necessary to advance and promote environmental justice. We recognize that the future of air quality management relies not upon a singular technology approach, but rather the integration of complementary measurement and modeling tools with robust study designs and equitably structured community engagement activities.

The deployment of regulatory and research grade analyzers for mobile monitoring applications is a powerful tool for providing communities with hyperlocal spatial insights. However, due to the temporal limitations of mobile monitoring, the co-deployment of stationary sensor networks is a valuable complement to the data collection activities proposed to be funded under the Statewide Mobile Monitoring Initiative. Specifically, the addition of stationary sensor networks will provide for consistent temporal anchoring *(of the mobile monitoring data)* and enable further data fusion opportunities that will greatly enhance the actionability of the collected data and community benefits resulting from the Initiative.

Together, Clarity and Sonoma Tech are already actively collaborating with numerous California communities. We welcome this opportunity to provide further technical support in the form of planning and deployment of such complementary and additional networks to ensure this Initiative results in the greatest possible benefits to California's communities.

Thank you,

Sean Wihera
VP, Business Development & Partnerships
Clarity Movement Co.
E: sean@clarity.io
M: (925)876-3381

November 2, 2023

Abhilash Vijayan, PhD, PE
Sonoma Technology, Inc.
Petaluma, CA

Dear Dr. Vijayan,

Syft Technologies, Inc is pleased to offer this letter of support for Sonoma Technology's submittal to the California Air Resources Board Request for Information (RFI) 2023CARB_SMMI-RFI001.

Syft is considered the world leader in real-time, direct injection mass spectrometry with more than 20 years of SIFT-MS expertise and offices worldwide. Syft instruments support a broad range of industries worldwide including environmental monitoring and protection, pharma and CDMOs, food, flavor and fragrance, and many more. Continually developed and proven in high stakes commercial environments, you can be assured of operational robustness, speed and support.

As a potential partner in the eventual mobile monitoring program (dependent on the scope of work), we believe we can offer significant technical value to the effort, as we have substantial experience in this application. Syft has deployed many of its real-time mass spectrometers for VOC measurements in mobile laboratories around the world, including mobile monitoring labs in the United Kingdom, and multiple instruments with the EPA and several state agencies in the USA, including CARB and TCEQ. Syfts SIFT-MS instruments are the trusted platform for air monitoring by the South Korean government, with a fleet of approximately 40 mobile instruments monitoring both toxic and nuisance odor VOCs around the country. VOCs can be measured quickly, robustly and with high sensitivity and selectivity thanks to the rapidly switchable reagent ions available with SIFT-MS.

Please include us in your list of technical partners for this future effort, and we look forward to working with you.

Sincerely,

Leslie Silva, PhD
Applications Scientist, Syft Technologies Inc.