UNIVERSITY OF CALIFORNIA, DAVIS

AIR QUALITY RESEARCH CENTER

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October 4, 2023

David Ridley
California Air Resources Board

Dear David,

I certify that the information contained in this response is true and accurate to the best of my knowledge at the time of this submittal.

Thank you.

Sincerely,

Anthony S. Wexler
Distinguished Professor
Mechanical and Aerospace Engineering
Civil and Environmental Engineering
Land, Air and Water Resources
Director
Air Quality Research Center

Email to

Contact: David Ridley
Agency: California Air Resources Board
Email: david.ridley@arb.ca.gov
Subject line: 2023CARB_SMMI-RFI001

Contact Information:

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Attachment A: Vendor Profile

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

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

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

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

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

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.

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)?

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?

We would need to hire post-docs and/or graduate students to help carry out this work so would require at least $200,000 per year in funding for at least two years.

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

We have developed a new portable instrument, under CARB funding, for measuring toxic metals in the atmosphere. We are also developing a new portable instrument for measuring toxic VOCs in the atmosphere. Both of these are real time instruments. We also have two electric vehicles for emission free mobile monitoring and have wired them for 120VAC to be able to power instruments that need this voltage. The toxic metal instrument and toxic VOC instrument are battery powered so do not require power from the EVs, but the 120 VAC is available for other instruments that may be needed for a given mobile monitoring project. We have not yet used these EVs and instruments for mobile monitoring.

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

The advantages are totally electric vehicles and portable low power instruments that rapidly assess the two major categories of hazardous air pollutants – metals and VOCs. In addition, we have experience associating air pollutants with wind direction to triangulate on the emission source. Our limitation is that we have not done this before with this set of instruments.

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.

We have grants from the US EPA and University of California Office of the President to work with underserved communities on their air monitoring. Social scientist professors and students on the team from UC Davis, UC Irvine and UC San Diego engage with communities, include paying them for their time to work with us, to learn about their air quality concerns. These social scientists and community members work with chemical scientists at UC Davis and San Diego State University to develop a monitoring program. The whole team conducts the measurements. The chemical scientists work with the social scientists to present the measurement results in a format that is accessible to community members who may not be versed in air pollution fundaments.

To help communities understand air pollution and its health effects, we have a contract with CARB to develop educational videos that explain air pollution and what CARB is doing to improve air quality. These videos will be used to educate community members about what we are doing, why, and what the results mean. The first three videos can be viewed here.

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?

We have contracts with the US EPA and University of California Office of the President to deploy new instruments that we have developed and are developing in underserved communities. We have just begun these projects so have not used these instruments in communities yet, but the social scientists that we work with on all three campuses have extensive experience working with communities on their environmental exposures.

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?

Community members: Social scientists on the team have extensive experience working with communities on environmental exposures.

Regulated Industry: Dr. Wexler (PI) has worked with the Electric Power Research Institute and auto manufacturers on various projects over his career.

Academia: As Director of the Air Quality Research Center at UC Davis, Dr. Wexler (PI) has extensive experience working with faculty in California, nationally and internationally.

Government: Dr. Wexler (PI) has obtained substantial funding from the US EPA, CARB, EPRI, National Parks Service, Department of Energy, National Oceanic and Atmospheric Administration, National Science Foundation, National Institute of Health, and more. And he along with other scientists at UC Davis have made multiple presentations to these government agencies.

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

Currently, the Air Quality Research Center manages about $60M in state and federal funding spanning at least 10 different projects.

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

We have colleagues at many UC and CSU campuses across the state. We would work with them to engage with communities locally then work with them to supply the EVs and instruments needed for each project.

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?

We have not done mobile monitoring yet with these instruments, but Air Quality Research Center staff have performed mobile monitoring in prior studies with other instruments locally in Sacramento.

b. Has collected data been used to support community emission reduction, enforcement, or other actions? Please provide examples.

We were involved in one project with STI doing mobile monitoring in Sacramento with Sac AQMD. Not clear if SacAQMD used the information for such actions.

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?

We have two EVs, a trailer to transport them to communities and a truck to haul the trailer. We have two metals instruments and will soon have two VOC instruments to use in these EVs. They can be deployed as long as we can keep everything charged.

b. What days/hours are the platforms generally in use?

We prefer daytime to not overburden staff, but we could run at night if there were compelling reasons.

c. What pollutants can be monitored and with what frequency?

Almost all the HAPs: metals and VOCs. Current metals time resolution is 15 – 30 minutes. For this project we would increase the flow rate to get the time resolution down to a few minutes. The VOC time resolution is about 10 minutes. Using sorption tubes and higher flow rates, we can reduce the time resolution to a few minutes.

d. What types of instrumentation do you use? Describe all relevant methodologies.

For metals, we will use TARTA (Toxic-metals Aerosol Real Time Analysis) documented in the following papers.

> Li, H, L. Mazzei, C.D. Wallis, and A.S. Wexler, Improving Quantitative Analysis of Spark-Induced Breakdown Spectroscopy: Multivariate Calibration of Metal Particles Using Machine Learning. J. Aerosol Sci. J. Aerosol Sci. 159:105874, 2022.
>
> Li, H, L. Mazzei , C.D. Wallis, S.A. Davari, and A.S. Wexler, The performance of an inexpensive spark-induced breakdown spectroscopy instrument for near real-time analysis of toxic metal particles. *Atmos. Environ.* 264:118666, 2021

For the VOCs, we will use Inficon HAPSite portable GC-MS (gas chromatography mass spectrometry) instruments. We have already ordered one and have the funds to purchase more for this project and others that we are working on. Here are papers describing studies that used the HAPSite:

> Quintin, A.R., Murphy, M.J., Moore, D. and Cain, L., TRICHLOROETHYLENE IN INDOOR AIR: TO-15 SUMMA DATA VS HAPSITE DATA. In ANNUAL INTERNATIONAL CONFERENCES Volume 22 (p. 96).
>
> Smith, M.E., Westbrook, E., Stastny, A.L., Streicher, R.P. and Elliott, M.G., 2022. Method development for on-site monitoring of volatile organic compounds via portable TD-GC-MS: evaluation of the analytical performances of HAPSITE® ER instrumentation and thermal desorption sampling media. International Journal of Environmental Analytical Chemistry, pp.1-18.

We can also accommodate other instruments in/on our EVs as needed for a given study.

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?)

If community engagement is needed, that would add weeks to any timeframe since community member meetings would have to be scheduled. If the location of the source is known, we would truck our EVs to the location and circle it, keeping wind direction in mind, to characterize emissions. If the source location is not known, we would use a combination of mobile monitoring to track down the source in combination with stationary monitoring with an anemometer to record wind direction. Wind rose based on composition would indicate the direction of the source, as we have done before:

> Phares, D.J., Rhoads, K.P., Johnston, M.V. and Wexler, A.S., 2003. Size-resolved ultrafine particle composition analysis 2. Houston. Journal of Geophysical Research: Atmospheres, 108(D7).

Two of these would triangulate the source location.

f. How do you determine that you've adequately characterized a given area?

This is a tough question because a source may only emit intermittently. If the mobile strategies do not work, stationary sites may be needed for longer periods of time. If nothing is found after weeks of monitoring, the conclusion may be that the source is not emitting detectable HAPs.

g. What workflow processes or software do you have for managing mobile monitoring?

We do not have software available now but can easily develop it using components that we have developed for other projects. For example, our custom-built databases hold all the PM2.5 composition data for the US EPA Chemical Speciation Network and the NPS IMPROVE network.

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

a. Drive plan and operational logistics

This depends on engagement with communities to identify their concerns and their on-the-ground knowledge of the neighborhood and where likely emissions sources might be. Consultation with the National Emissions Inventory (NEI) can also be helpful for identifying potential sources. Then a scoping drive targeted to community knowledge and the NEI would be undertaken, followed by more localized routes as the source(s) are identified.

b. Staffing

The UC Davis Air Quality Research Center has about 40 employees plus many additional faculty and research staff from departments across campus. If the program had substantial and long-term funding, we would hire staff specifically for mobile monitoring.

c. Power requirements (e.g. battery powered, requires generator, etc.)

Our current instruments are battery powered. The EVs have already been wired to supply 120 VAC and they already supply 12 VDC from the battery that runs the vehicle lights and ancillaries. Any additional 120 VAC or 12 VDC instruments can run off the EV without needing a generator or other power source.

d. Consumables

Replacement electrodes for TARTA. Replacement nitrogen cylinders for HAPSite.

e. Quality control procedures

Monthly re-calibration of instruments:

TARTA: We use metal nitrate solutions of known concentration to calibrate.

HAPSite: We use diffusion tubes of a variety of toxic VOCs to calibrate.

f. Performance and acceptance criteria (e.g. precision, bias, limit of detection)

These are all part of the calibration process. We vary concentration of the range that is relevant to the atmosphere. We have published limit of detection for TARTA.
Paper

Inficon claims limit of detection down to PPT for HAPSite but we will test this ourselves and reconfirm during the calibration procedure.

g. Data logging and storage

Both instruments collect data on board. These data will be downloaded to a laptop and stored in their native form on a shared drive such as Dropbox.

h. Notifications and communication

When community engagement is part of the project, members will be informed of what we find. We will also engage with CARB and local air districts, as appropriate, once source(s) are identified so that appropriate regulatory action can be taken.

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.

$20,000 per week for deployment of the EV and both instruments, plus travel costs at the federal mileage rate to transport the EVs to the community.

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

State negotiated indirect rate for the UC system.

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

This is difficult to estimate because we do not know what CARB requires. If CARB requirements can be set and remain the same for all deployments, the software development charges would be one-time only.

b. How often are invoices and payments typically required?

Quarterly.

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?

The TARTA instruments are ready. We have a contract with CARB research division to improve them, but we have enough instruments for this project. The EVs are ready. We have one HAPsite on order that is supposed to arrive this week and we will purchase more with existing funds over the next few months. The greatest time constraint is personnel, and this depends on how many communities will be monitored in a given year and how much commitment CARB can give ahead of time.

b. What is the maximum number of platforms that you could deploy by early 2025?

We have instruments and funding in hand for two platforms. For modest additional funds, we could deploy more. The greatest constraint is appropriately trained personnel which will depend on CARB's commitment to stable funding for this effort.

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.

Dr. Wexler (PI) has helped the Sacramento Air Quality Management District with a couple of CAMPs but is not an expert in their development. We prefer partnering with CARB, Air Districts and communities to develop such plans.

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

No

IV. Data Collection, Storage, Reporting

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

This depends on the client. For community members who do not have an engineering or science background, simple oral communication is appropriate. For air district and CARB staff, communication will be routes driven, concentrations found for each pollutant per location, wind roses for each compound (as appropriate from stationary monitoring), and source location identification.

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

Possibly. This depends on the exact requirements for such products.

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?

None

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

Social scientists on our team have expertise in this area, but still struggle with how best to present such information to the public. The videos referenced above are one successful attempt. We are going to have to work with communities to understand what level of detail is appropriate and what they can digest.

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?

For each compound, 2D maps of the community with the drive track highlighted and the concentration superimposed on the drive track color coded to represent concentration. Multiple maps may be needed for different time periods. Wind direction arrows will be superimposed on the drive tracks so that concentration can be associated with the location of the source. Suspect source locations will be identified on these maps for each HAP compound.

This communication process needs to be iterative, especially when communicating to communities, so that it is toned up or down to communicate findings appropriately.

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.*	Successful community monitoring of air toxics is best accomplished with substantial community engagement, which means multiple meetings with community members, and compensating them for their time during these meetings and for related activities that they engage in outside the meetings. We prefer to present our cost on a per community basis, which includes working with communities to understand their concerns, identifying possible local sources of air toxics, perform the mobile measurements, analyze the data, present the results to the community, and present the results to the local air district. Cost estimate per community to use mobile monitoring to identify metal and VOC air toxics is $100,000. This effort would take much more than a month considering all the logistics and community engagement activities.
Estimated range of cost to complete a full year of monitoring	Our preferred unit of measure is not time but number of communities. As discussed above, we would need a commitment of at least $200,000 per year for at least two years to develop the appropriate personnel and infrastructure for these mobile monitoring efforts, which would encompass a minimum of 2 communities per year for 2 year.
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.*	
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? We have two EVs and two metal instruments ready for mobile monitoring. We will have two VOC instruments within a few months. If funding is assured, we can increase the number of such platforms at low cost within a year. The more important constraints are (a) appropriately trained personnel to interact respectfully with community groups, (b) appropriately trained personnel to deploy the EVs and analyze the data, and (c) appropriately trained personnel to work with air districts on source	

mitigation. UC Davis has a large cohort of faculty and students in these areas and we have colleagues at other campuses and in the CSU system who we can work with so that the whole state is covered locally.

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

Considering the community engagement activities that are crucial to a successful project, the time scale for any effort is more than a month. But multiple projects can run in parallel. As a result, we hesitate to present our results on a per month or per year basis. Roughly, we can run 6 projects per EV per year, so with our 2 current platforms we could perform 12 campaigns per year. With assured funding, we can build more platforms to scale up.

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?

As discussed already, bidding on a per month or per year basis would be difficult. We prefer to bid on a per community or per neighborhood basis.

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.

Not that we know of.

VENDOR'S ASSUMPTI ONS:
What assumptions have you made in preparing a response to this RFI?

Assumptions have been enumerated above.