Attachment - A
Vendor Profile

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

   University of California Riverside (UCR)
   College of Engineering - Center for Environmental Research and Technology (CE-CERT)
   1084 Columbia Ave
   Riverside, CA 92507
   (951) 827-8509

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

   Don Collins
   Professor of Chemical and Environmental Engineering and Director of CE-CERT
   (951) 827-8536

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

   UCR: Established about 65 years ago; 4,800 employees; university

   CE-CERT: Established 31 years ago; 100 employees; university research center

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

   NA

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

   UCR professor Dr. Don Collins has partnered with a research team from the University of Houston (UH; Drs. James Flynn and Subin Yoon) and Baylor University (BU; Drs. Rebecca Sheesley and Sascha Usenko) on multiple air quality monitoring studies. The partnership began while Dr. Collins was a professor at Texas A&M University, and has continued since his move to UCR in 2018. Most recently, UCR, UH, and BU deployed an instrumented trailer to five locations in the Houston, TX area during a DOE-supported field study. That instrumented trailer is one of three mobile sampling platforms maintained by the UH and BU research team.

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.
   - DISCOVER-AQ – 2013: The first use of the original Mobile Air Quality Laboratory (MAQL-1) was in the Houston area during the NASA-supported project aimed at improving retrieval of near-surface air pollutant concentrations using satellites.
   - Galveston, TX – 2016: The MAQL-1 was operated at a fixed site in Galveston, TX to examine the role of precursor gases from the Gulf of Mexico on ozone downwind in the Houston area. The project was supported by the Texas Commission on Environmental Quality (TCEQ).
   - University of Michigan Biological Station – 2016: The MAQL-1 was deployed to Michigan during an NSF-sponsored project to contrast secondary aerosol formation at a remote location with that at a site downwind of Houston where there is a similar biogenic emissions profile, but also significant anthropogenic influence.
   - San Antonio Field Study (SAFS) – 2017: The MAQL-1 was deployed in and around San Antonio, TX during a study funded by the TCEQ to better understand the causes of elevated ozone concentration in the region.
   - Corpus Christi and San Antonio (CCSA) study – 2021: To accommodate a wider range of sampling equipment, the MAQL-2 was developed and first used in this study. It is an instrumented trailer that can be used in either in-motion or short-term mobile mode.
   - TRACER-AQ – 2021: The TCEQ and NASA funded campaign utilized both the MAQL-1 for in-motion sampling and the MAQL-2 for short-term/portable sampling in the Houston area to leverage NASA's deployment of ground and airborne remote sensing instrumentation to gain additional insights into ozone formation in the Houston area.
   - TRACER-MAP – 2022: As part of the larger DOE TRACER campaign, the UCR, UH, and BU researchers measured an array of traces gases and the size distribution, composition, and properties of particulates. The MAQL-2 moved between five locations in and around Houston.
   - SARP, Southern California – 2022: MAQL-1 was deployed to southern California to participate in NASA's Student Airborne Research Program (SARP) to provide undergraduates additional opportunities to participate in research and add a surface component to support the DC-8 research flights. Sampling objectives included in-motion sampling of the LA Basin residential and industrial areas, Central Valley agriculture and livestock operations, Bakersfield oil & gas, and the Salton Sea.
   - SARP, Virginia – 2023: In-motion measurements of mobile, point, and area sources in in the Hopewell, Virginia area for the NASA Student Airborne Research Project (SARP-East) where MAQL-3 was deployed for three weeks with NASA student interns in close coordination with airborne measurements to provide simultaneous observations at ground level and aloft.

- Houston, TX – 2023: In-motion measurements of mobile, point, and area sources supported by TCEQ. MAQL-3 was deployed for four weeks to help the TCEQ expand their understanding of point source VOC and inorganic emissions in industrial areas and their potential impact on Houston air quality. These measurements included sampling between the network of monitoring sites as well as in unmonitored areas within and beyond the network spatial range.
- Austin, San Antonio, and Corpus Christi, TX – 2023: In-motion measurements of mobile, point, and area sources in the three cities using MAQL-3. The project is supported by the Council of Governments to provide additional information on known and formerly unknown emission sources within their regions to aid in proactively maintaining compliance with the O_3 NAAQS and avoiding future non-attainment designations.

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)?

   No, though we do not currently have instrumentation to measure the full set of pollutants identified at the bottom of page 9.

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?

   The mobile sampling facilities are kept in Texas. The logistical challenges of bringing them to California would make deployment of less than a month or so difficult to justify.

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

   Many of the studies have been designed to develop an improved understanding of the emissions sources and meteorological processes responsible for ozone formation. Measurements of particulate composition, size distribution, and properties were core elements of the deployment to Michigan and the TRACER-MAP study.

   Emissions sources that have been targeted include oil and gas extraction, production, and distribution (including refineries and retail gas stations), chemical manufacturing, animal feed lots, rendering facilities, ports, airports, cement plants, and agricultural (VOCs from industrial farming, soil NOx).

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

   We have considerable experience making these sorts of measurements and expertise in analyzing the resulting data. Having three mobile platforms allows us to deploy the optimal one(s) for the selected measurement payload and observational strategy. The team has a strong record of data completeness during field campaigns. We possess a wide variety of instrumentation with previous experience in mobile deployments under diverse conditions.

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.

   Among the approaches UCR has used are giving presentations at community meetings or informal gatherings and distributing information through multi-lingual flyers. The goal for this program will be to inform community members of what is being done and to solicit input on when and where measurements would be most valuable.

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?

   Dr. Collins and others at CE-CERT at UCR participate in many community and public engagement activities. CE-CERT hosts several high school tours each year and participates in programs at its facility (e.g., STEPCon) and those in Riverside and nearby communities. Dr. Collins and CE-CERT are beginning a new program with SCAQMD in which community members will be able to check-out low-cost sensors from CE-CERT and will receive assistance from UCR undergraduates when analyzing and understanding the data.

   Baylor PIs have participated in a number of outreach and community engagement opportunities including 1). community lectures to the City of Waco on the fundamentals of climate change as well as intersection of air quality pollutants and climate change, 2) Mobile Air Quality Laboratory - show and tell for local rural school districts, 3) National STEM Day – air quality lectures with hands-on experiments for middle school students attending a local urban school district, 4) the development of an advanced informal STEM outreach exhibit at the Smithsonian Institute Natural History Museum Exhibition and the California Academy of Science Steinhart Aquarium Whale Earwax Exhibition (combined total visitors over 7 million per year), and 5) NASA Student Airborne Research Program (NASA's premier outreach program) – focusing on community-level air quality assessments.

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?

   We have worked successfully with federal, state and local agencies to provide QAQC-validated air quality data. Our mobile campaigns with TCEQ are often well coordinated, with designated calls prior, during, and post sampling campaigns to confirm objectives and receive input on known areas of interest. Meteorology often dictates the short-term planning, so a scorecard of targeted emission sources, impact areas under different wind directions and e.g. expected high ozone days is discussed prior to the campaign.

4. Please provide the number and size ($) of technical projects previously managed for coordination and communication with both community and technical contractors.
5. How would you apply your engagement and coordination model on a statewide scale?

   Possibly assisted by CARB, we would identify community groups active in those regions where sampling will be conducted and reach out to them for suggestions on how best to engage with community members.

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?

MAQL-1 Built and first operated in 2013, the first Mobile Air Quality Lab (MAQL-1) is a 2013 Chevy Silverado 3500 HD Crew Cab with 325 cu ft air-conditioned equipment space and an air suspension system to reduce vibration and bumps to the shock mounted instrumentation during in-motion sampling. The science team is able to remotely access all of the instrumentation systems from the front seats through the onboard network, allowing them to be protected by the vehicle's seat belts and air bags while in use. Remote access is provided through an industrial high speed cellular modem. Power is drawn from an alternator/battery/inverter system but can tow a generator when instrument power demand is high. A boom mounted inlet system samples from in front of the truck while driving and can be quickly raised when stationary to reduce self-sampling under variable wind conditions or to increase the spatial representation of the measurement. The system is also equipped with a 50A 120/240V shore power connection which allows the system to remain sampling overnight, providing added benefits of a short-term sampling site and maintaining instrument readiness for the following day(s). This laboratory has been used in multiple campaigns as described in Attachment A, Section 6.

MAQL-2: In 2021, the MAQL-2 underwent a conversion to become an in-motion sampling platform. It is a cargo trailer converted for in-motion measurements with a full air suspension and air hitch. The cargo space houses several racks as well as space for larger floor or table mounted instrumentation. Although it is not self-powered, it is integrated with the tow vehicle and is used as a combined unit for in-motion measurements. The inlet system is on a flexible umbilical which allows it to be mounted to a forward support on the tow vehicle to ensure the sample is undisturbed by the vehicle or generator in the bed of the truck or can be attached to a 30' telescoping tower welded to the tongue of the trailer for sampling at elevated heights while stationary. Like MAQL-1, the science team is stationed in the crew cab tow vehicle for safety, and access the instrumentation remotely through the onboard network. Remote access is provided through an industrial high speed cellular modem. The system is also equipped with a 50A 120/240V shore power connection, which allows the system to remain sampling overnight, providing added benefits of a short-term

sampling site and maintaining instrument readiness for the following day(s). This laboratory has been used in multiple campaigns as described in Attachment A, Section 6.

MAQL-3: – First deployed in 2023 for the NASA SARP-East program, MAQL-3 is a 2018 Freightliner M2 Crew Cab with a 24' cargo box that has been converted into flexible laboratory space and can house numerous racks and larger floor or table mounted instrumentation. Instrument loading is facilitated either through a curb-side pedestrian door or the rear doors via the liftgate or loading docks. The inlets are attached to a roof-mounted hydraulic tilting tower, which allows the inlets to be in front of the vehicle to sample undisturbed air during in-motion sampling or can quickly be raised to 33' when stationary. During in-motion sampling, the science team operates the instrumentation remotely via the onboard network from the seats in the cab, which is also connected through to the lab space similar to an RV. Remote access is provided through an industrial high speed cellular modem. Power is provided by a 20kW generator mounted under the body, which draws fuel from the main tanks, simplifying operations. The system is also equipped with two 50A 120/240V shore power connection, which allows the system to remain sampling overnight providing added benefits of a short-term sampling site and maintaining instrument readiness for the following day(s). Depending on instrument payload configuration, the MAQL-3 can be operated from a single shore power connection. This laboratory has been used in multiple campaigns for five different sponsors in 2023 as described in Attachment A, Section 6.

In addition to the sampling instruments described below, BU and UH maintain an array of meteorological sensors, including a ceilometer that provides boundary layer height, which is important for characterizing contributors to day-to-day variability in measurements.

a. What areas/sources/locations do you have experience conducting mobile monitoring?

- **Texas** – Coastal, oil and gas, refinery, petrochemical facilities, urban centers and tracking urban plumes into suburbs and exurbs, on- and off-road mobile sources, shipping emissions, power plants, cement kilns, rendering plants, biogenics, biomass burning plumes
- **Michigan** – Biogenics and transported urban plumes
- **Virginia** – Refineries and petrochemical plants, urban plumes, 2023 Canadian wild fire plume, on-road mobile sources
- **California** – Los Angeles Basin urban plume, Torrance refineries and petrochemical plants, Salton Sea, Central Valley industrial agriculture, feed lots, Bakersfield oil and gas fields

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

Data from many of the Texas studies have been used to help test and validate models for developing State Implementation Plans for the State of Texas.

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?

The platforms have been operated continuously for up to three months during previous short-term mobile operation, though this was possible only because there were secure locations where they could remain unsupervised at night. For this potential program, deployment 5 or 6 days a week would be appropriate for lengthy operational periods (>month), while 7 days a week would be possible for shorter, more-focused periods.

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

Most measurements can be made 24/7. In-motion operation has typically been restricted to daytime, though that is at least in part due to the greater relevance of daytime observations for understanding ozone chemistry. In-motion operation at night is possible, but may add to staffing requirements.

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

Our capabilities are added next to the list of pollutants below, which is copied from the bottom of page 9 of the RFI. The raw data output rate is provided for most measurements; averaging over longer time intervals will obviously increase the signal to noise ratio. Depending on which platform is used, there would likely be space for hosting other instruments to fill in any gaps.

- Particulate Matter (PM2.5 & PM10) – YES: Size distributions and concentration (1 Hz through 2 min); composition (PM1; 1 Hz)
- Black Carbon (BC) – YES: 1 min with possibility of adding capability to reduce to 1 Hz
- Diesel PM – Same as for BC
- Ozone (O_3) – YES: 1 Hz
- Carbon Monoxide (CO) – YES: 1 Hz
- Carbon Dioxide (CO_2) – YES: 1 Hz
- Nitrogen Oxides (NO & NO_2) – YES: 1 Hz
- Methane (CH_4) – YES: 1 Hz
- Hydrogen Sulfide (H_2S) – NO, though may be possible to do so with SO_2 analyzer
- Benzene, Toluene, Ethyl Benzene, Xylenes (BTEX) – YES: 1 min or less
- Formaldehyde – YES: 1 Hz
- Acrolein – YES: 1 min or less
- Arsenic – NO
- Ethylene Oxide – YES: 10 min
- 1,3-Butadiene – YES: 1 min or less
- Sulfur containing compounds – YES (SO_2 and any compounds detected by PTR-MS anyway)
- Carbonyls – YES (those detected by PTR-MS) – 1 min or less
- Polycyclic Aromatic Hydrocarbons (PAHs) – MAYBE: UH has an instrument, but need to confirm operation.
- Metals – NO
- Hexavalent Chromium - NO
- Ammonia – NO
- Methyl bromide - NO

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

- Particulate Matter (PM2.5 & PM10) –
  - Size distribution: Scanning mobility particle sizer (fabricated) and Aerodynamic Particle Sizer (TSI, Inc. Model 3321), Optical particle spectrometer (Handix, Inc. POPS)
  - Light scattering: 3-wavelength nephelometer (TSI, Inc. Model 3563)
  - Composition: Aerosol Mass Spectrometer (Aerodyne HR-TOF-AMS)
- Black Carbon (BC) – Tricolor absorption photometer (Brechtel, Inc., Model 2901-UV) and (possibly) DMT, Inc. Single Particle Soot Photometer (SP2)
- Ozone (O_3) – 2B Technologies, Inc., Model 205 (UV absorption) and Thermo Environmental, Inc. Model 42C (chemiluminescence) modified to measure O_3
- Carbon Monoxide (CO) – Los Gatos Research, Inc., Model CO-23R
- Carbon Dioxide (CO_2) – LiCor, Inc., Model Li-7000
- Nitrogen Oxides (NO & NO_2) – Air Quality Designs, Inc., high sensitivity NOx analyzer
- Methane (CH_4) – Picarro, Inc., Model G2307
- Benzene, Toluene, Ethyl Benzene, Xylenes (BTEX) – Ionicon, Inc., Model Q300 PTR-MS and Entanglement Technologies, Inc. AROMA-VOC
- Formaldehyde – Picarro, Inc., Model G2307
- Ethylene Oxide – Entanglement Technologies, Inc. AROMA-VOC
- 1,3-Butadiene – Ionicon, Inc., Model Q300 PTR-MS and Hills Scientific Reactive Alkene Detector
- Sulfur containing compounds – Thermo Environmental, Inc., Model 43i-TL (SO_2) and Ionicon, Inc., Model Q300 PTR-MS (DMS)
- Carbonyls – Ionicon Q300 PTR-MS
- Boundary layer height – Vaisala, Model CL-31 or CL-51
- GPS location – Garmin, Model 19hvs and Airmar, Model 220WX
- Meteorology – Airmar, Model 220WX with RH module
- Surrounding area – Forward, aft, left, right cameras plus an upward looking hemispheric camera to document surrounding and sky conditions

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?)

As noted above, many of the instruments used in the MAQL platforms are fast-response, with data acquisition rate as high as 1 Hz. As has been done during prior in-motion deployments of the MAQL platforms, a driving pattern with repeated passes downwind of known or suspected sources would be used. The time required would depend on the emitted pollutant and, consequently, the time resolution of the measurement. Passes on the upwind side of the source is also used to assess possible transport from sources further upwind that would complicate interpretation of downwind measurements.

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

Though there is no simple and universal answer to this question, the UCR/UH/BU team can rely on the decades of experience for such decisions.

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

Data from the various instrumentation are handled differently according to file type and size, however whenever possible data are transmitted to off-vehicle servers via rsync or Synology CloudStation software. For larger amounts of data batch files using robocopy commands are used to quickly backup files to multiple external hard drives on a daily basis. These hard drives are then connected to a computer in an office, hotel, etc. where they are automatically uploaded to a storage server at UH. This server can then be used to access mobile lab data without using cellular data in the truck. The storage server is then backed up to a second "cold storage" system located at BU and/or UCR, providing multiple layers of redundancy.

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

a. Drive plan and operational logistics

As noted above, the MAQL platforms have been used for both in-motion and short-term mobile sampling. Most in-motion deployments have been limited to daytime driving. Measurements during prior short-term mobile deployments have been uninterrupted during or outside of repositioning.

b. Staffing

Prior deployments have relied on involvement of the faculty identified above and a team of post-docs, field technicians, and graduate students. It is anticipated that the same would be true for this program.

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

Each of the mobile platforms provide their own electricity either from engine driven alternators or onboard generators (in the bed of the tow vehicle in the case of MAQL-2). All three systems can accept shore power service for stationary or overnight operation. Care is taken with short-term stationary measurements to orient the vehicles in such a way as to avoid self-contamination.

d. Consumables

The primary consumables are compressed gases used as reagents, carriers, or calibrants.

e. Quality control procedures

Many of the instruments go through 2-point calibrations every day, while others undergo more extensive calibration at a lower frequency. For the black carbon sensors, BU does an instrument intercomparison study each year with the 14 TAPS they use to run the BC2 aerosol optical network in Texas.

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

Limits of detection vary with instrument and averaging times but are generally calculated to be three times the standard deviation of the calculated measurement precision.

g. Data logging and storage

h. Notifications and communication

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.

The cost to prepare the MAQL, integrate and calibrate all instruments, and transport it to California is estimated to be $100k. This cost would be the same regardless of the duration or scope of the deployment. Additional costs of approximately $20k per week for activities directly associated with data collection, $20k per week for data processing, quality assurance, analysis, and $15k per week for indirect costs.

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?

UCR typically requests quarterly invoices.

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?

The MAQL platforms and instrumentation are available as early as May, 2024.

a. Do you have recommendations for a minimum timeline to achieve potential monitoring objectives described here?

Prior studies using a MAQL platform have lasted between approximately one and three months. The appropriate duration for this program would obviously depend on the number of communities to be studied.

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

It would be possible to deploy more than one of the MAQL platforms, but duplicates are not available for all of the instruments identified above.

6. Do you have experience developing Community Air Monitoring Plans (CAMPs) as defined by the CARB Community Air Protection Program Blueprint[5] or similar? Please provide examples of community-focused monitoring plans or similar.

No.

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

Yes, we have both.

IV. Data Collection, Storage, Reporting

1. In what format do you generally provide data to your clients? What is your final data product?
2. Do you have off-the-shelf, or modifiable-off-the-shelf, data management products compatible with mobile monitoring data?
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?
4. What is your experience in public dissemination of complex information? To what extent have you generated data visualization for the public?
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?

V. Feedback

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

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.*	$100k - $250k
Estimated range of cost to complete a full year of monitoring.	$400k - $800k

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?

   As described above, there are three MAQL platforms and a wide range of instruments operational right now. More than one of the MAQL platforms could be deployed, though one would have only a subset of the measurement capabilities outline above. The responses we have provided do not assume any additional funding to reach and sustain maximum planned capacity.

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

   Based on past experience, we estimate that monitoring could be conducted on 20 days per month and 200 days per year.

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?

   No

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.

   No

VENDOR'S ASSUMPTIONS:

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