South Coast
Air Quality Management District
21865 Copley Drive, Diamond Bar, CA 91765
(909) 396-2000, www.aqmd.gov

TECHNOLOGY COMMITTEE MEETING

Committee Members
Council Member Joe Buscaino, Chair
Mayor Larry McCallon
Mayor Pro Tem Judith Mitchell
Supervisor V. Manuel Perez
Council Member Dwight Robinson
Supervisor Hilda L. Solis

November 16, 2018 ♦ 12:00 p.m. ♦ Conference Room CC8
21865 Copley Drive, Diamond Bar, CA 91765

TELECONFERENCE LOCATIONS

73710 Fred Waring Drive
Suite 222
Palm Desert, CA 92260

Hall of Administration
500 W. Temple Street
Room 493A
Los Angeles, CA 90012

11461 West Sunset Boulevard
The Brentwood Room 1
Los Angeles, CA 90049

(The public may participate at any location listed above.)

Call-in for listening purposes only is available by dialing:
Toll Free: 866-244-8528
Listen Only Passcode: 5821432
In addition, a webcast is available for viewing and listening at:
http://www.aqmd.gov/home/library/webcasts

AGENDA

Members of the public may address this body concerning any agenda item before or during consideration of that item (Gov't. Code Section 54854.3(a)). Please provide a Request to Address the Committee card to the Committee Secretary if you wish to address the Committee on an agenda item. If no cards are available, please notify SCAQMD staff or a Board Member of your desire to speak. All agendas for regular meetings are posted at District Headquarters, 21865 Copley Drive, Diamond Bar, California, at least 72 hours in advance of the regular meeting. Speakers may be limited to three (3) minutes each.

CALL TO ORDER

ACTION ITEMS – Items 1 through 2

DECEMBER BOARD AGENDA ITEMS

1. Conduct Emissions Study on Use of Alternative Diesel Blends in Off-Road Heavy-Duty Engines and Amend SOON Provision Awards ***(Motion Requested)***

Joseph Lopat
AQ Specialist

CARB has committed to adopting a low emission diesel measure in the State Implementation Plan to reduce NOx and particulate matter (PM) emissions from on-road and off-road vehicles. Renewable diesel and biodiesel with NOx-mitigating additives show a potential for reductions up to 13 percent in NOx and 30 percent in PM. CARB is currently contributing $932,499 in a $1,353,499 study by the University of California Riverside UCR CE-CERT testing on- and off-road diesel engines on a wide matrix of test fuels. Additional cost-share is proposed for this comprehensive study as follows: SCAQMD, $261,000; U.S. EPA, $150,000; and San Joaquin Valley Air Pollution Control District, $10,000. This action is to execute a contract with UCR CE-CERT in an amount not to exceed $261,000 from the Clean Fuels Program Fund (31). In addition, in November 2017 and September 2018, the Board approved SOON Provision awards. This action is to also amend awards under the SOON Provision.

2. Develop and Demonstrate Near-Zero and Zero Emissions Vehicles and Equipment at Ports ***(Motion Requested)***

Naveen Berry
Assistant Deputy Executive Officer

The Port of Long Beach and its project partners have received $50,000,000 in funding and the Port of Los Angeles and its project partners have received $41,122,260 under CARB's Low Carbon Transportation Investments grant solicitation to demonstrate near-zero and zero emissions on-road, off-road and marine vehicles and equipment, including battery electric and hydrogen fuel cell trucks and supporting infrastructure. Total anticipated projects costs are $102,998,742 and $82,547,024 for the Ports of Long Beach and Los Angeles, respectively. This action is to execute contracts from the Clean Fuels Program Fund (31) with the Port of Long Beach in an amount not to exceed $500,000 and the Port of Los Angeles in an amount not to exceed $1,000,000 for SCAQMD's project cost-share.

INFORMATION ONLY ITEM

3. Using Unmanned Aerial Vehicles for Air Monitoring Applications ***(presentation only)***

Andrea Polidori
Atmospheric Measurements Manager

In recent years, there have been significant advances in the technology, performance, and affordability of commercially available Unmanned Aerial Vehicles (UAVs). Although safety and privacy issues have still not been fully addressed by policy makers, the civilian and commercial UAV market in the United States is rapidly expanding. These systems

provide a versatile platform for a wide variety of environmental applications including air pollution monitoring. Currently, the commercial use of UAVs is limited by their relatively short flight time, their low carrying capacity, and other technical and FAA restriction issues. However, the use of UAVs could soon become viable tools to monitor air quality over large areas. This presentation will discuss the current status of UAVs, important regulations limiting the wide deployment of this technology, and the possibility of using drones to augment SCAQMD's monitoring and emergency response capabilities.

OTHER MATTERS

4. **Other Business** – *Any member of the Committee, or its staff, on his or her own initiative or in response to questions posed by the public, may ask a question for clarification, may make a brief announcement or report on his or her own activities, provide a reference to staff regarding factual information, request staff to report back at a subsequent meeting concerning any matter, or may take action to direct staff to place a matter of business on a future agenda. (Gov't. Code Section 54954.*2)

5. **Public Comment Period**
At the end of the regular meeting agenda, an opportunity is provided for the public to speak on any subject within the Committee's authority that is not on the agenda. Speakers may be limited to three (3) minutes each.

6. **Next Meeting Date –** Friday, January 18, 2019 at 12:00 pm

ADJOURNMENT

Americans with Disabilities Act
The agenda and documents in the agenda packet will be made available, upon request, in appropriate alternative formats to assist persons with a disability (Gov't. Code Section 54954.2(a)). Disability-related accommodations will also be made available to allow participation in the Technology Committee meeting. Any accommodations must be requested as soon as practicable. Requests will be accommodated to the extent feasible. Please contact Pat Krayser at 909.396.3248 from 7:30 a.m. to 6:00 p.m., Tuesday through Friday, or send the request to pkrayser@aqmd.gov.

Document Availability
All documents (i) constituting non-exempt public records, (ii) relating to an item on an agenda for a regular meeting, and (iii) having been distributed to at least a majority of the Committee after the agenda is posted, are available prior to the meeting for public review at the South Coast Air Quality Management District, Public Information Center, 21865 Copley Drive, Diamond Bar, CA 91765.

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DRAFT
Technology Committee Agenda #1

BOARD MEETING DATE: December 7, 2018 AGENDA NO.

TITLE: Conduct Emissions Study on Use of Alternative Diesel Blends in Off-Road Heavy-Duty Engines and Amend SOON Provision Awards

SYNOPSIS: CARB has committed to adopting a low emission diesel measure in the State Implementation Plan to reduce NOx and particulate matter (PM) emissions from on-road and off-road vehicles. Renewable diesel and biodiesel with NOx-mitigating additives show a potential for reductions up to 13 percent in NOx and 30 percent in PM. CARB is currently contributing $932,499 in a $1,353,499 study by the University of California Riverside (UCR) CE-CERT testing on- and off-road diesel engines on a wide matrix of test fuels. Additional cost-share is proposed for this comprehensive study as follows: SCAQMD, $261,000; U.S. EPA, $150,000; and San Joaquin Valley Air Pollution Control District, $10,000. This action is to execute a contract with UCR CE-CERT in an amount not to exceed $261,000 from the Clean Fuels Program Fund (31). In addition, in November 2017 and September 2018, the Board approved SOON Provision awards. This action is to also amend awards under the SOON Provision.

COMMITTEE: Technology, November 16, 2018; Recommended for Approval

RECOMMENDED ACTIONS:

1. Authorize the Chairman to execute a contract with UCR CE-CERT to conduct an emissions and performance study to characterize tailpipe emissions using renewable diesel and biodiesel in off-road engines in an amount not to exceed $261,000 from the Clean Fuels Program Fund (31).
2. Amend SOON Provision awards approved by the Board in November 2017 and September 2018 with C5 Equipment Rental and Peed Equipment to change the project types from engine replacements to repowers.

Wayne Nastri
Executive Officer

MMM:FM:NB:JL

Background

CARB has committed to adopting a low emission diesel (LED) measure in the State Strategy for the 2016 State Implementation Plan to reduce NOx and particulate matter (PM) emissions from on-road and off-road vehicles. This measure, which is anticipated for implementation in the South Coast Air Basin first, would require diesel fuel providers to steadily decrease criteria pollutant emissions from diesel products. This includes achieving emissions reductions from currently available renewable diesel and NOx-mitigated biodiesel fuels that can reduce both NOx and PM. CARB, in conjunction with researchers from the University of California Riverside (UCR), University of California Davis and others, conducted a study to characterize the emissions impacts of biodiesel and renewable diesel relative to ultra-low sulfur diesel (ULSD) fuel in several on-road and off-road engines under a variety of test conditions. However, this study did not investigate the emissions impacts of these fuels on performance or in engines without emissions controls. Since off-road engines, including those for stationary uses, represent a large NOx and PM source in the South Coast Air Basin, it is essential to support the development and implementation of clean fuels that will help reduce mobile source emissions. It is also equally important to assess the new technologies to prevent or mitigate any negative impact on air quality and public health.

In November 2017, the Board approved FY 2016-17 "Year 19" Carl Moyer Program and SOON Provision awards, and subsequently amended these awards augmenting funds in September 2018. These Board letters included awards for engine replacements to C5 Equipment Rental and Peed Equipment. Staff realized these two project awards should have been listed in the Board letter as engine repowers (not replacements); they were evaluated as repower projects and the emissions reductions, cost-effectiveness and ranking remain unchanged.

Proposal

The purpose of this study is to better understand emissions and performance effects from renewable diesel and NOx-mitigated biodiesel relative to ULSD fuel. This study proposes to conduct detailed emissions testing on various renewable diesel blends and biodiesel blends on heavy-duty off-road engines, with and without selective catalytic reduction (SCR) exhaust treatments and diesel particulate filters (DPF) using an engine dynamometer. The study will focus on the physical and chemical characterization of particulate emissions and gaseous toxic pollutants from two off-road engines, one equipped with SCR and DPF aftertreatment systems and one Tier 2 engine without an

aftertreatment system. This action is to execute a contract with UCR CE-CERT to conduct an emissions and performance study to characterize tailpipe emissions using renewable diesel and biodiesel in off-road engines.

This action is to also amend SOON Provision awards with C5 Equipment Rental and Peed Equipment to change the project types from engine replacements to repowers. The funding awards and project parameters remain the same.

Sole Source Justification
Section VIII.B.2 of the Procurement Policy and Procedure identifies provisions under which a sole source award may be justified. This request for a sole source award to UCR CE-CERT is made under provisions B.2.d.(1) and (8): Other circumstances exist which in the determination of the Executive Officer require such waiver in the best interest of the SCAQMD. Specifically, such circumstances may include but are not limited to projects involving cost-sharing by multiple sponsors and research and development efforts with educational institutions or nonprofit organizations. The project is being funded by CARB and may also be funded by the U.S. EPA and the San Joaquin Valley APCD. UCR is an educational institution and CE-CERT is their research center with multidisciplinary resources to engage in diverse environmental and transportation research programs.

Benefits to SCAQMD
To achieve national ambient air quality standards and protect public health, one of SCAQMD's primary priorities is to reduce NOx and PM emissions from mobile sources while realizing GHG co-benefits, where possible. The proposed alternative diesel fuel study will help to better understand the air quality and public health impact of older equipment that exists in large numbers in the off-road sector. It will also support the need and benefit for cleaner fuels in the Basin. Large-scale use of renewable diesel and NOx-mitigated biodiesel in California can lead to the expanded availability of these alternatives as a transportation fuel, as well as a clean alternative energy source. This will further accelerate the deployment of near-zero heavy-duty transportation technologies, helping to lower NOx and PM emissions in the Basin.

Resource Impacts
The total estimated cost for the proposed project is $1,353,499, of which SCAQMD's proposed cost-share will not exceed $261,000 from the Clean Fuels Program Fund (31), as summarized below:

Proposed Project Cost-Share

Project Partner	UCR Study
CARB	$932,499
U.S. EPA*	$150,000
SJVAPCD*	$10,000
SCAQMD *(requested)*	$261,000
Total Project Cost	**$1,353,499**

*anticipated

Sufficient funds are available in the Clean Fuels Program Fund (31) for this proposed project. The Clean Fuels Program Fund (31) is established as a special revenue fund resulting from the state-mandated Cleans Fuels Program. The Clean Fuels Program, under Health and Safety Code Sections 40448.5 and 40512 and Vehicle Code Section 9250.11, establishes mechanisms to collect revenues from mobile sources to support projects to increase the utilization of clean fuels, including the development of the necessary advanced enabling technologies. Funds collected from motor vehicles are restricted, by statute, to be used for projects and program activities related to mobile sources that support the objectives of the Clean Fuels Program.

There is no fiscal impact for the two SOON Provision awards, which simply change the project type from engine replacements to repowers.

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Agenda Item #1

Joseph Lopat

Conduct Emissions Study on Use of Alternative Diesel Blends in Off-Road Heavy-Duty Engines and Amend SOON Provision Awards

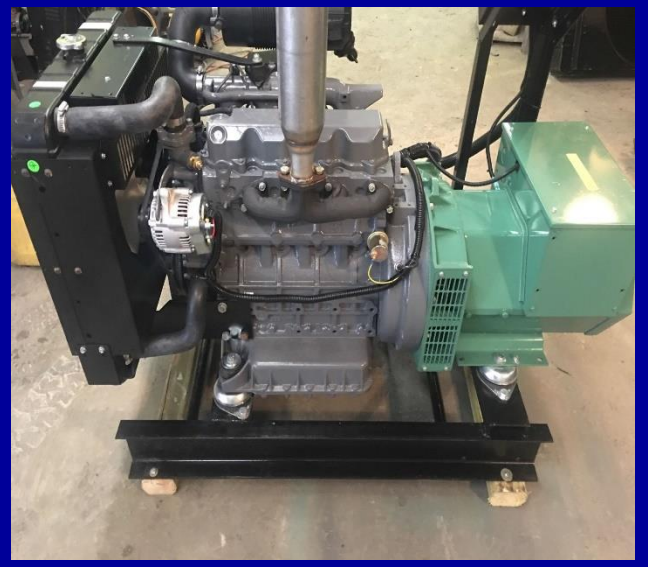
Background

- AB 32 requires a return to 1990 GHG emissions levels by 2020
- Growing interest in renewable fuels
- Reduce greenhouse gas emissions and criteria pollutants
- Renewable diesel
  - similar molecular structure as fossil diesel
  - stable and cleaner
  - SCAQMD/BAAQMD sponsored study
- NOx mitigated biodiesel
  - antioxidant mixed fuels

Proposal

UCR CE-CERT study

- Equipment
  - older off-road engines
  - stationary generators
  - construction equipment
- Emissions analyses
  - criteria pollutants such as NOx and PM
  - Physical and chemical characterization of ultrafine particles



Proposed Funding

Agency	Funding	Percent of Project
CARB	$ 932,499	69
U.S. EPA	$ 150,000	11
SJVAPCD	$ 10,000	1
SCAQMD (*requested)*	$ 261,000	19
TOTAL	$1,353,499	100

Amend SOON Provision Awards

- In November 2017 and September 2018, the Board approved FY 2016-17 “Year 19” Carl Moyer Program and SOON provision awards
- Included awards for engine replacements to C5 Equipment Rental and Peed Equipment
- Need to change project type from engine replacements to engine repowers for both awardees
- No change to award amounts

Recommended Actions

- Execute agreement with UCR CE-CERT to conduct an emissions and performance study to characterize tailpipe emissions using renewable diesel and NOx mitigated biodiesel in older off-road engines - $261,000 from Clean Fuels Fund
- Amend two SOON Provision awards to change project types from engine replacements to repowers
  - C5 Equipment Rental
  - Peed Equipment

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DRAFT
Technology Committee Agenda #2

BOARD MEETING DATE: December 7, 2018 AGENDA NO.

PROPOSAL: Develop and Demonstrate Near-Zero and Zero Emissions Vehicles and Equipment at Ports

SYNOPSIS: The Port of Long Beach and its project partners have received $50,000,000 in funding and the Port of Los Angeles and its project partners have received $41,122,260 under CARB's Low Carbon Transportation Investments grant solicitation to demonstrate near-zero and zero emissions on-road, off-road and marine vehicles and equipment, including battery electric and hydrogen fuel cell trucks and supporting infrastructure. Total anticipated projects costs are $102,998,742 and $82,547,024 for the Ports of Long Beach and Los Angeles, respectively. This action is to execute contracts from the Clean Fuels Program Fund (31) with the Port of Long Beach in an amount not to exceed $500,000 and the Port of Los Angeles in an amount not to exceed $1,000,000 for SCAQMD's project cost-share.

COMMITTEE: Technology, November 16, 2018; Recommended for Approval

RECOMMENDED ACTION:
Authorize the Chairman to execute a contract with the Port of Long Beach in an amount not to exceed $500,000 and a contract with Port of Los Angeles in an amount not to exceed $1,000,000 from the Clean Fuels Program Fund (31) to develop and demonstrate near-zero and zero emissions vehicles and equipment at the Ports.

Wayne Nastri
Executive Officer

MMM:FM:NB

Background
In July, the Port of Long Beach (POLB) and its project partners submitted an application to CARB under their Low Carbon Transportation Investments grant solicitation for a project entitled Sustainable Terminals Accelerating Regional Transformation (START). The Port of Los Angeles (POLA) and its project partners also submitted an application to CARB under their Low Carbon Transportation Investments grant solicitation for a project

entitled Zero Emissions Freight "Shore to Store" (S2S). CARB recently awarded the POLB $50,000,000 towards their START Project, which has an anticipated total project cost of $102,998,742, and POLA $41,122,260 towards their S2S Project, which has an anticipated total project cost of $82,547,024.

Proposal

The POLB's START Project is to develop and demonstrate 102 near-zero and zero emissions vehicles, vessels and cargo handling equipment, including charging infrastructure, across an intermodal freight network spanning three California seaports and three California air districts. All deployments will be located in disadvantaged communities, improving air quality in areas heavily burdened by freight related emissions. At the POLB, the demonstration will include 33 zero emissions yard tractors, one top handler, 9 rubber tire gantry cranes, five Class 8 trucks and one tug. Additionally, two Tier 3 ocean going vessels will service the POLB and Port of Oakland. Several vehicle and original equipment manufacturers as well as multiple port terminals and fleets will be involved in this project. The remainder of equipment will operate in the Ports of Oakland and Stockton.

The POLA's S2S Project is to develop and demonstrate ten Kenworth zero emissions Class 8 hydrogen fuel cell electric trucks, integrated with Toyota's fuel cell drive technology, along with the two hydrogen fueling stations that will be built in Ontario and Wilmington. Like the POLB project, all deployments will be located in disadvantaged communities. The hydrogen fuel cell electric trucks will be operated by UPS, Total Transportation Services, Inc., Southern Counties Express and Toyota Logistics Services (TLS) throughout the Los Angeles basin ports, inland locations such as Riverside County and the Port of Hueneme (POH). Additionally, POH will demonstrate two electric yard tractors, and TLS will demonstrate two zero emissions forklifts at their facility. Fleet operators participating in this demonstration project are subject to change, contingent upon CARB's approval if required.

Sole Source Justification

Section VIII.B.2. of the Procurement Policy and Procedure identifies provisions under which a sole source award may be justified. The request for a sole source award for this project is made under the provision B.2.d.(1): Projects involving cost-sharing by multiple sponsors. The development and demonstration project with the POLB will be cost-shared by CARB, POLB, SCE and other project partners; the project with the POLA, by CARB, CEC, Toyota and other project partners. Further details are in the Resource Impacts section.

Benefits to SCAQMD

This demonstration project provides a unique opportunity to directly compare the performance of battery electric trucks to hydrogen fuel cell trucks, as well as provide a pathway for implementation of the recently adopted Clean Air Action Plan by the

Gateway Ports. Projects to support development and demonstration of battery electric and hydrogen fuel cell transportation technologies are included in the *Technology Advancement Office Clean Fuels Program 2018 Plan Update* under "Electric/Hybrid Technologies & Infrastructure" and "Hydrogen and Mobile Fuel Cell Technologies & Infrastructure." This project will also provide additional NOx reductions towards attainment of upcoming 1-hour and 8-hour ozone air quality standards, as well as the 24-hour and annual PM2.5 air quality standards.

Resource Impacts

SCAQMD's cost-share will not exceed $500,000 and $1,000,000 from the Clean Fuels Program Fund (31) for these two projects. Anticipated cost-share and partners are shown below.

POLA START Project

Proposed Partners	Cost-Share	Percent of Project
CARB	$50,000,000	48.5
POLB	$7,891,157	7.7
Southern California Edison	$3,000,000	2.9
Port of Stockton	$2,000,000	2.0
Port of Oakland	$1,250,000	1.2
Other Project Partners (cash & in-kind)* --Harley Marine Services --Matson --SSA Marine --Shippers Transport Express --Tetra Tech	$38,357,585	37.2
SCAQMD *(requested)*	$500,000	0.5
Total	**$102,998,742**	**100.0**

*subject to change

POLB S2S Project

Proposed Partners	Cost-Share	Percent of Project
CARB	$41,122,260	49.8
CEC	$25,999,331	31.5
Toyota	$9,740,000	11.8
Other Project Partners* --Kenworth Truck Company --Port of Hueneme --Shell Oil Products USA --Southern Counties Express --Total Transportation Services --UPS	$4,685,433	5.7
SCAQMD *(requested)*	$1,000,000	1.2
Total	**$82,547,024**	**100.0**

*subject to change

Sufficient funds are available from the Clean Fuels Program Fund (31), established as a special revenue fund resulting from the state-mandated Clean Fuels Program. The Clean Fuels Program, under Health and Safety Code Sections 40448.5 and 40512 and Vehicle Code Section 9250.11, establishes mechanisms to collect revenues from mobile sources to support projects to increase the utilization of clean fuels, including the development of the necessary advanced enabling technologies. Funds collected from motor vehicles are restricted, by statute, to be used for projects and program activities related to mobile sources that support the objectives of the Clean Fuels Program.

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Agenda Item #2

Naveen Berry

Develop and Demonstrate Near-Zero and Zero Emissions Vehicles and Equipment at Ports

Background

- In July, POLA and POLB submitted separate applications to CARB's solicitation
- Both projects seek to achieve emissions reductions and deploy both pre-commercial and commercial near-zero and zero emission technologies
- Gateway Ports - partnered with other CA ports and OEMs to develop and demonstrate on-road and off-road vehicles and equipment with supporting electric and hydrogen infrastructure

Proposal

POLB – Sustainable Terminals Accelerating Regional Transformation (START) Project

- Preliminary award of $50 million
- Ports of Oakland & Stockton
- Develop and demonstrate102 total near-zero and zero emissions vehicles
  - Cargo handling equipment – yard hostlers, top handlers, rubber tire gantry cranes, Class 8 battery electric trucks
  - Marine vessels – tug and ocean going vessels
  - Supporting electrical infrastructure (EVSE)

Proposal (cont'd)

POLA – Zero Emissions Freight "Shore to Store" (S2S) Project

- Preliminary award of $41.1 million
- Port of Hueneme
- Develop and demonstrate ten fuel cell trucks
- H2 stations in Wilmington and Ontario

Proposed Project Costs - POLB

START Project

Partner	Cost-Share	Percent of Project
CARB	$50,000,000	48.5
POLB	$7,891,157	7.7
Southern California Edison	$3,000,000	2.9
Port of Stockton	$2,000,000	2.0
Port of Oakland	$1,250,000	1.2
Other Project Partners	$38,357,585	37.2
SCAQMD (requested)	$500,000	0.5
Total	**$102,998,742**	**100.0**

Proposed Project Costs - POLA

S2S Project

Partner	Cost-Share	Percent of Project
CARB	$41,122,260	49.8
CEC	$25,999,331	31.5
Toyota	$9,740,000	11.8
Other Project Partners	$4,685,433	5.7
SCAQMD *(requested)*	$1,000,000	1.2
Total	**$82,547,024**	**100.0**

Recommended Action

Execute contracts from Clean Fuels Program Fund (31):

- Port of Long Beach: $500,000
- Port of Los Angeles: $1,000,000

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INFORMATION ONLY ITEM
Technology Committee Agenda #3

Using Unmanned Aerial Vehicles For Air Monitoring Applications

Andrea Polidori

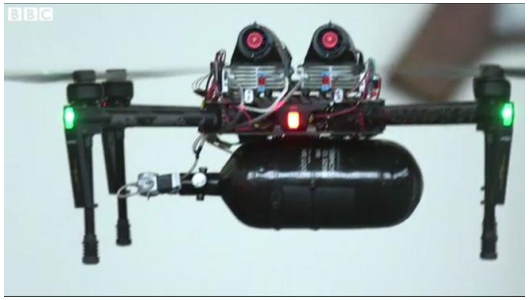
Background

- Unmanned Aerial Vehicles (UAVs or drones)
  - Cheaper and safer than manned aircraft
  - Recreational, commercial and governmental uses
  - FAA restrictions being slowly lifted
- Continued use and expansion
  - Used and developed since 1916!
  - Market expansion: 40 million (2012) to 5 billion (2018)
  - Used for land surveillance, search and rescue, air quality monitoring and many other applications
- Integration with available sensors and optical sensing methods
  - Potential to augment monitoring capabilities of air quality agencies
  - Optical tent method to be used at BP, Chevron and other refineries

Background (cont'd)

Commercial UAV characteristics

- Type
  - *Rotary-wing*: Vertical take off and landing
  - *Fixed wing:* require a runway to take-off/land
  - *Hybrid*
- Flight range
  - *Electric:* 15-45 min
  - *Hybrid hydrogen:* 6 hrs
  - Gasoline: 10+ hrs
- Flight altitude
  - Less than 400 ft
  - Restricted around controlled air space
- Cost
  - A few hundred dollars to 10k+
  - Depends on payload and range
  - Use of remote sensing can substantially increase cost



Background (cont'd)

Why should SCAQMD be interested in UAVs?

- Viable and affordable tools to monitor air quality over large areas
- Technology has matured for ease of use and safety
- Guidance for use available from federal authorities
- Can improve the effectiveness of air monitoring programs
- Synergy between UAV technology and the objectives of air monitoring initiatives
  - AQ-SPEC
  - Fence-line optical remote sensing program
  - Special monitoring
  - Odor complaint response
  - Other

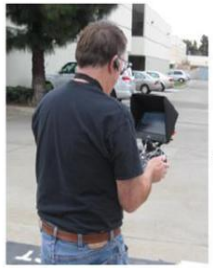


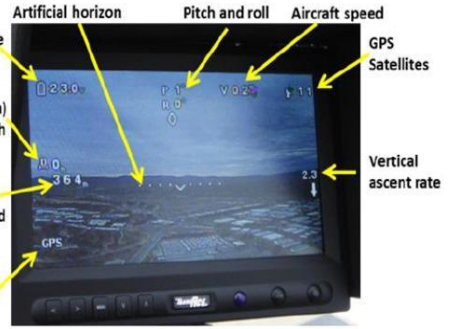





Air Monitoring Applications

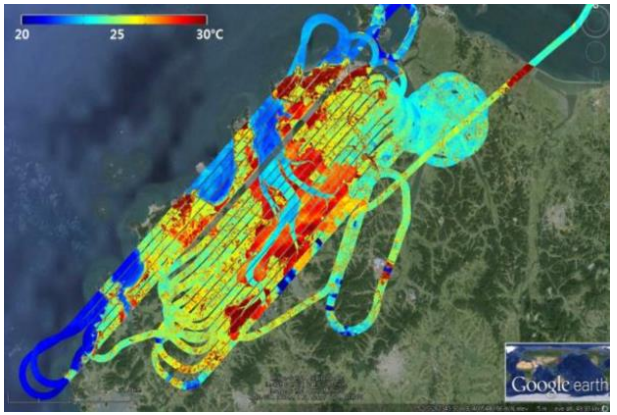
- Meteorological measurements
  - Temperature, relative humidity, pressure and winds
- Continuous gas monitoring
  - Ozone, nitrogen oxides, carbon monoxide, others
- Integrated gaseous sampling
  - Sorbent tubes and small canisters for VOC collection
- Particulate matter measurements
  - Real-time and integrated sampling
- Horizontal/vertical gradient studies
  - Real-time measurements at different distances from emissions source
  - Measurement and characterization of air pollution plumes





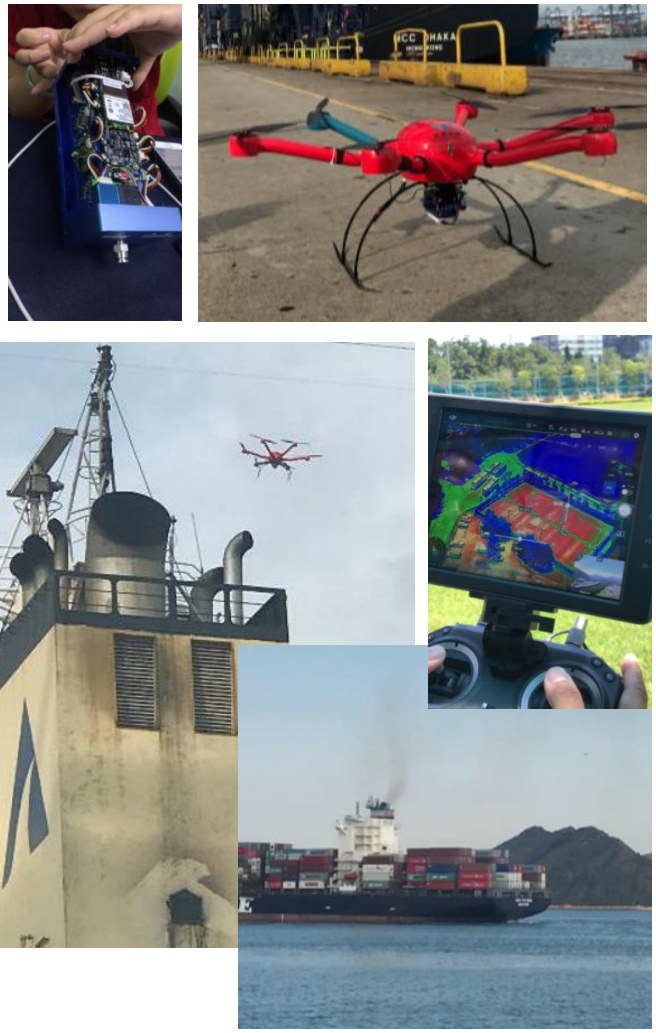
Air Monitoring Applications (cont'd)

- Leak identification
  - Refineries, oil and gas, marine vessels and other sources
- Incident response
  - Refinery accidents and other hazardous situations
- Odor identification and monitoring
  - Locate odor source(s) in remote or inaccessible locations (e.g. off-shore)
  - Collect samples and/or provide real-time measurements during odor events
- Perimeter/fence-line monitoring and video surveillance
- Remote sensing
  - Monitor gaseous pollutants over large areas



Example: Marine Vessel Emissions Measurements

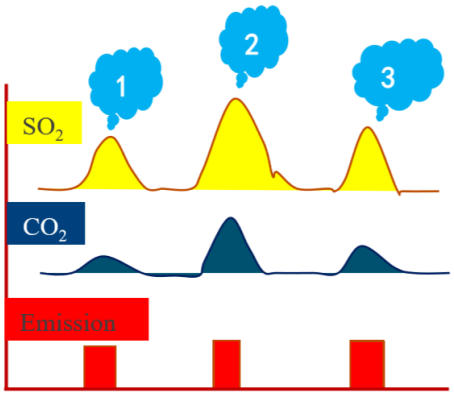
- Ship emissions
  - Important sources of particle and gaseous pollutants
  - Major contributors to overall port emissions
  - Ship and port-related emissions are difficult to measure with stationary monitors
- UAV based “sniffer” system
  - Sensor array (SO2, NOx, CO, CO2, VOC and PM)
  - Visible and infrared camera for plume detection and tracking



Courtesy of Dr. Zhi Ning (The Hong Kong University of Science and Technology)

Ex: Marine Vessel Emissions Measurements (cont'd)

- "Sniffer methodology"
  - Identify and track ship plume
  - Cross-sectional scanning of plume
  - Sensors measurements
  - Determine pollutants / CO2 ratios
  - Emissions factors
- Limitations
  - T, RH and P can impact sensor performance
  - Steel structures can limit visual control and interfere with data transmission
  - Limited time (minutes) to conduct plume measurements
  - Liability due to potential accidents
  - Obtaining necessary permits from port, FAA and other authorities



Courtesy of Dr. Zhi Ning (The Hong Kong University of Science and Technology)

UAVs - FAA Regulations (14 CFR)

- Fly under the Special Rule for Model Aircraft (Section 336; hobby or recreation only)
- Fly under the FAA's Small UAV Rule (Part 107; recreational OR commercial use)
  - Register your drone
  - Get a Remote Pilot Certificate
  - Fly a drone under 55 lbs.
  - Fly within visual-line-of-sight*
  - Don't fly near other aircraft or over people*
  - Don't fly in controlled airspace near airports*
  - Fly only during daylight at or below 400 feet*

  ** These rules are subject to waiver (apply for a Certificate of Waiver or Authorization or COA)*
- https://www.faa.gov/uas/

Potential Path Forward

- Explore feasibility of deployment
- Continue reaching out to agencies with existing UAV programs or third-party contractors
  - ➢May have existing authorization to fly in areas of interest to SCAQMD
  - ➢May not have ambient air monitoring experience
- RFP for technology demonstration
  - ➢Landfill emissions
  - ➢Leak detection
  - ➢Refinery monitoring
  - ➢Other