CLEAN FUELS PROGRAM ADVISORY GROUP AGENDA
SEPTEMBER 12, 2018, 9:00 AM – 3:30 PM
Conference Room GB
21865 Copley Drive
Diamond Bar, CA 91765

	Welcome & Overview - 9:00 – 10:00 AM	
(a)	Welcome & Introductions	Matt Miyasato, Deputy Executive Officer
(b)	Goals for the day	Naveen Berry, Assistant Deputy Executive Officer
(c)	Incentive Programs Update	Vicki White, Technology Implementation Manager
(d)	AB 617 Implementation	Jo Kay Ghosh, Health Effects Officer
(e)	Feedback and Discussion	All
	Areas of SCAQMD Focus	
1.	**Heavy-Duty Technologies - 10:00 AM – 12:00 PM**	
(a)	In-Use Emissions Testing/PAMs update	Adewale Oshinuga, Program Supervisor
(b)	Heavy-Duty Near Zero Emission Engines	Joseph Lopat, Air Quality Specialist
(c)	Zero Emission Container Truck (ZECT) Update	Phil Barroca, Program Supervisor
(d)	Class 8 Electric Trucks	Joe Impullitti, Program Supervisor
(e)	Medium-Duty Zero-Emission Vehicles	Seungbum Ha, Air Quality Specialist
(f)	Feedback and Discussion	All
	Lunch 12:00 - 1:00 PM	
2.	**Light-Duty Technologies/Infrastructure 1:00 – 2:30 PM**	
(a)	Hydrogen Station – Heavy Duty	Lisa Mirisola, Program Supervisor
(b)	Hydrogen and Electric Vehicle Charging – Light-Duty	Patricia Kwon, Air Quality Specialist
(c)	Enhanced Fleet Modernization Program (EFMP)	Mei Wang, Program Supervisor
(d)	Feedback and Discussion	All
	Break 2:30 – 2:45	
3.	**Wrap-up – 2:45 – 3:30 PM**	
(a)	Discussion & Wrap-up	Naveen Berry
(b)	Advisor and Expert Comments	All

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. (Government Code Section 54954.2)

Public Comment *Members of the public may address this body concerning any agenda item before or during consideration of that item (Govt. Code Section 54954.3). All agendas for regular meetings are posted at District Headquarters, 21865 Copley Drive, Diamond Bar, California, at least 72 hours in advance of a regular meeting. At the end of the regular meeting agenda, an opportunity is also provided for the public to speak on any subject within this body's authority. Speakers may be limited to three (3) minutes each.*

Document Availability
All documents (1) constituting non-exempt public records; (ii) relating to an item on the agenda for a regular meeting; and (iii) having been distributed to at least a majority of the Advisory Group 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.

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. Disability-related accommodations will also be made available to allow participation in the meeting. Any accommodations must be requested as soon as practicable. Requests will be accommodated to the extent feasible. Please contact Donna Vernon at 909-396-3097 from 7:00 a.m. to 5:30 p.m., Tuesday through Friday, or send the request to dvernon@aqmd.gov.

SCAQMD's Incentive Programs Update

Vicki White
Technology Implementation Manager
Technology Advancement Office

Main Incentive Programs

Carl Moyer Program

- Trucks
- Transit buses
- Refuse trucks
- Public agency/utility vehicles
- Emergency vehicles
- Construction/Ag
- Marine Vessels
- Shore Power
- Locomotives
- Cargo Handling

- 1998 – Present
- $467 Million
- 6,708 vehicles

Prop 1B

- Trucks
- Shore Power
- Locomotives
- Cargo Handling
- TRUs

- 2009 - Present
- $485 Million
- >7,300 vehicles

EFMP – Replace Your Ride

- Light-Duty Vehicles
- Alternative Mobility Options (transit passes, Uber, Lyft)
- Electric vehicle chargers

- 2015 - Present
- $24 Million
- 3,100 vehicles

Lower Emission School Bus Program

- School buses
- Infrastructure
- CNG tank replacements

- 2001 - Present
- $280 Million
- 5,000 vehicles

New Funding in FY 2017/18

Program Title	Description	Funding Amount
AB 134 – Community Air Protection	Funds early action mobile source projects in disadvantaged and low-income communities	$107.5 million
CEC Grant for Near Zero Emission, Natural Gas Drayage Trucks	Accelerate deployment of near zero emission, natural gas trucks that service the Ports	$8 million (+ $6 million in cost share funds from SCAQMD, POLB and POLA)
Enhanced Fleet Modernization Program (Replace Your Ride)	CARB granted additional funding for EFMP to continue vouchers for low and moderate income motorists for cleaner vehicles	$16.4 million
Voluntary NOx Remediation Measure Funding	Funds mobile source projects that will reduce NOx emissions to mitigate the NOx emissions increase from biodiesel use in CA	~$2.67 million

New Funding in FY 2017/18

Program Title	Description	Funding Amount
EPA Targeted Air Shed Program Grant – Lawn and Garden Equipment	Funds zero emission, electric lawn and garden equipment for commercial use in environmental justice areas	~$2.47 million
EPA Diesel Emission Reduction Act (DERA)	Funds to replace older diesel trucks with new optional low NOx, natural gas trucks	$1.6 million
Lower Emission School Bus Program	Fund the replacement of older, high-polluting school buses with near-zero emission school buses	~$35.6 million total (incl. $32.5 million from SCAQMD and $3.1 million from EPA)
Funding Agricultural Replacement Measures for Emissions Reductions (FARMER)	Fund the replacement of agricultural equipment using the Carl Moyer Program Guidelines	~$1.88 million
	Total New Funding:	$182.1 million

Community Air Protection Program (AB 134)

- Signed by Governor in September 2017
- $250M from GGRF for Carl Moyer and Prop 1B type projects:

$107.5M	SCAQMD
$80M	SJVAPCD
$50M	BAAQMD
$12.5M	Others

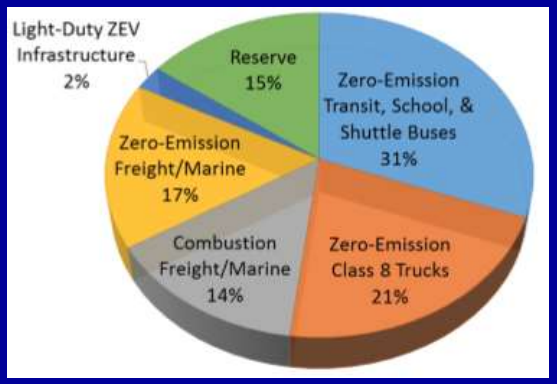
- At least 80% of projects must be implemented in disadvantaged and low-income communities

AB 134 Update

- In November 2017, SCAQMD approved $51.7M in Carl Moyer projects
  - 88% are located in disadvantaged and low-income communities
- Public workshops in Feb-Apr 2018
- Community input used to target outreach efforts and identify projects for this year's Carl Moyer Program
- About $19M recommended for clean truck projects (October Board meeting)
- Remaining AB 134 funds for 2018 Carl Moyer Program (November Board meeting)

Volkswagen Settlement (2019)

- Environmental Mitigation Trust (Appendix D)
  - $423 million for California
  - CARB will serve as lead agency
- Beneficiary Mitigation Plan
  - Approved on April 25, 2018
  - 5 eligible mitigation actions
  - Mostly scrap and replace for heavy-duty sector
  - 10,000 tons of NOx reductions over 10-yr period
  - Funds available starting in 2019

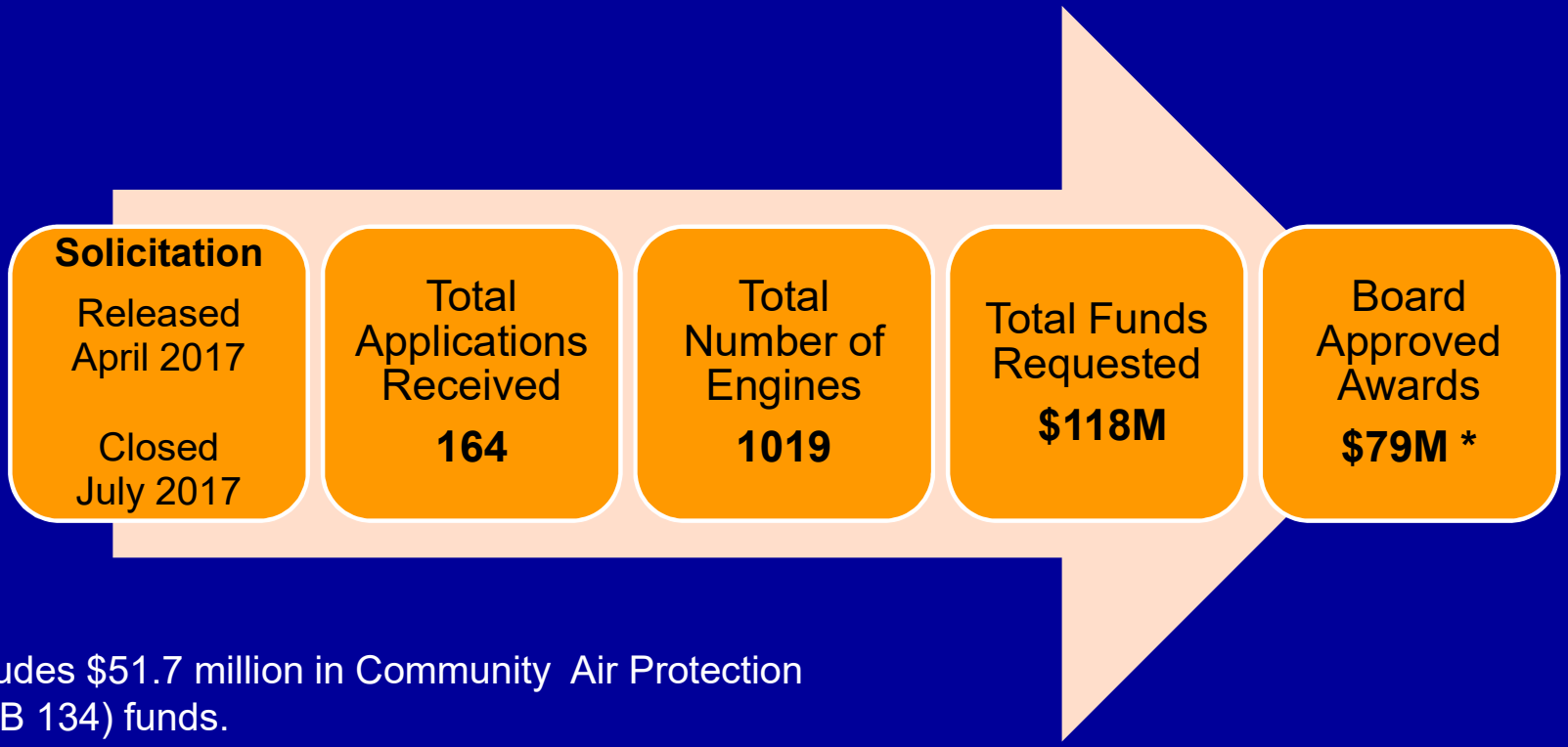


CARB's Beneficiary Mitigation Plan

VW Mitigation Program

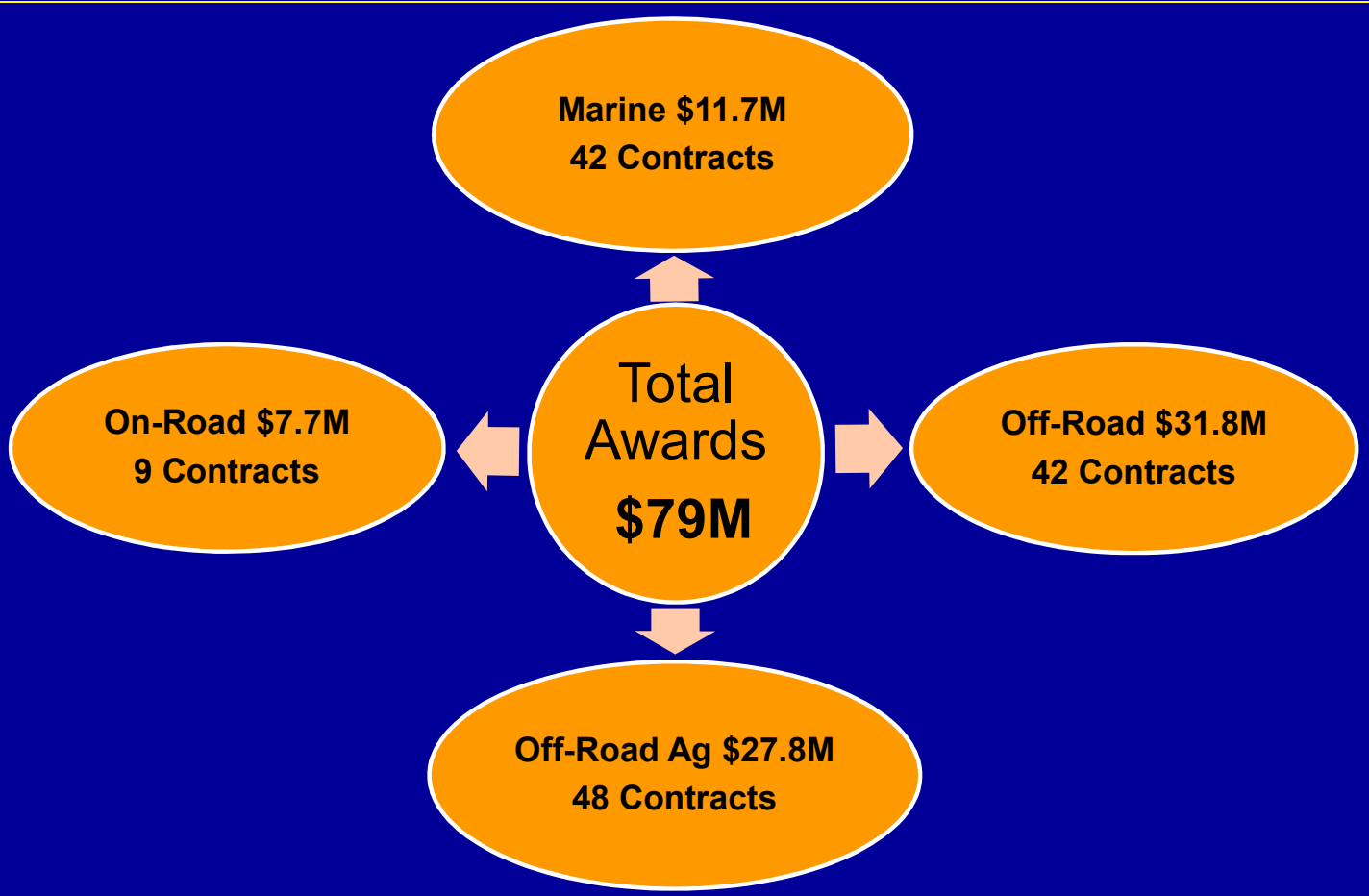
Project Category	Technology	Allocation (millions)	Air District
Zero-Emission Transit, School and Shuttle Buses	Battery electric or fuel cell	$130	SJVAPCD
Zero-Emission Class 8 Freight and Port Drayage Trucks	Battery electric or fuel cell	$90	**SCAQMD**
Zero-Emission Freight and Marine Projects (airport GSE, forklifts, port cargo handling equipment, shore power at port terminals)	Battery electric or fuel cell	$70	BAAQMD
Combustion Freight and Marine Projects (waste haulers, dump trucks, concrete mixers, switcher locomotives, ferries, tug boats)	Low NOx engine, Tier 4, or Tier 4 equivalent	$60	**SCAQMD**
Light-Duty Zero-Emission Vehicle Infrastructure	Electric charger or hydrogen fueling station	$10	BAAQMD
CARB Reserve		*$63*	
Total		**$423**	

Carl Moyer Program (Year 19)



- Includes $51.7 million in Community Air Protection (AB 134) funds.

Contract Awards (Year 19)



Year 20 Proposed Funding

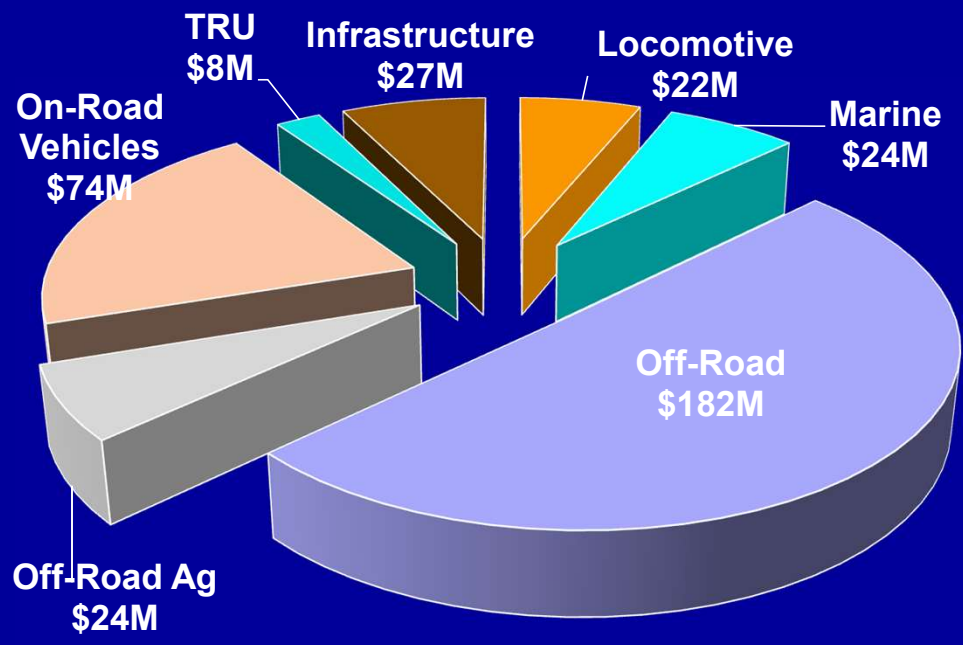
Funding Source	Est. Available Funds (million)
Carl Moyer (SB 1107)	$28.4
State Reserve	$2.8
FARMER	$1.8
NOx Remediation Measure	$2.5
Community Air Protection (AB 134)	$26
Total (approx.)	**$61.5**

Carl Moyer Program (Year 20)

Solicitation
Released
March 2018
Closed
June 2018

Total Applications Received
291

Total Funds Requested
$361M



Proposition 1B Status

Program	Project	No. of Equip.	NOx tons/yr	PM tons/yr	Funding (million)
Years 1-4	Trucks	6,297	6,712	216	$351
	Shore Power	25			
	Locomotives	10			
Year 5 *	Trucks	1,069	*In progress*		$111
	Cargo Handling Equipment	14 CHE 6 Chargers			$2
	Locomotives	10			$19.2
	Transportation Refrigeration Units (TRUs)	21 TRUs 446 Chargers			$1.8
				Total:	$485

* All Year 5 funds committed as of March 1, 2018.

Questions/Contact Info

- Questions:

  Vicki White (909) 396-3436
  vwhite@aqmd.gov

South Coast AQMD

Update on AB 617 implementation

Dr. Jo Kay Ghosh
Health Effects Officer
Planning, Rule Development & Area Sources
Clean Fuels Advisory Group Meeting
September 12, 2018

South Coast AQMD

Key elements of AB 617

Community Air Monitoring

Community Emission Reduction Plans

Easier Access to Emissions Data

Community centered

Best Emission Controls

Clean Technology Investments

South Coast AQMD

Key milestones in statute

2018 **Oct** – October 1– Deadline for CARB to set statewide strategy (select Year 1 communities, guidelines, benchmarks)

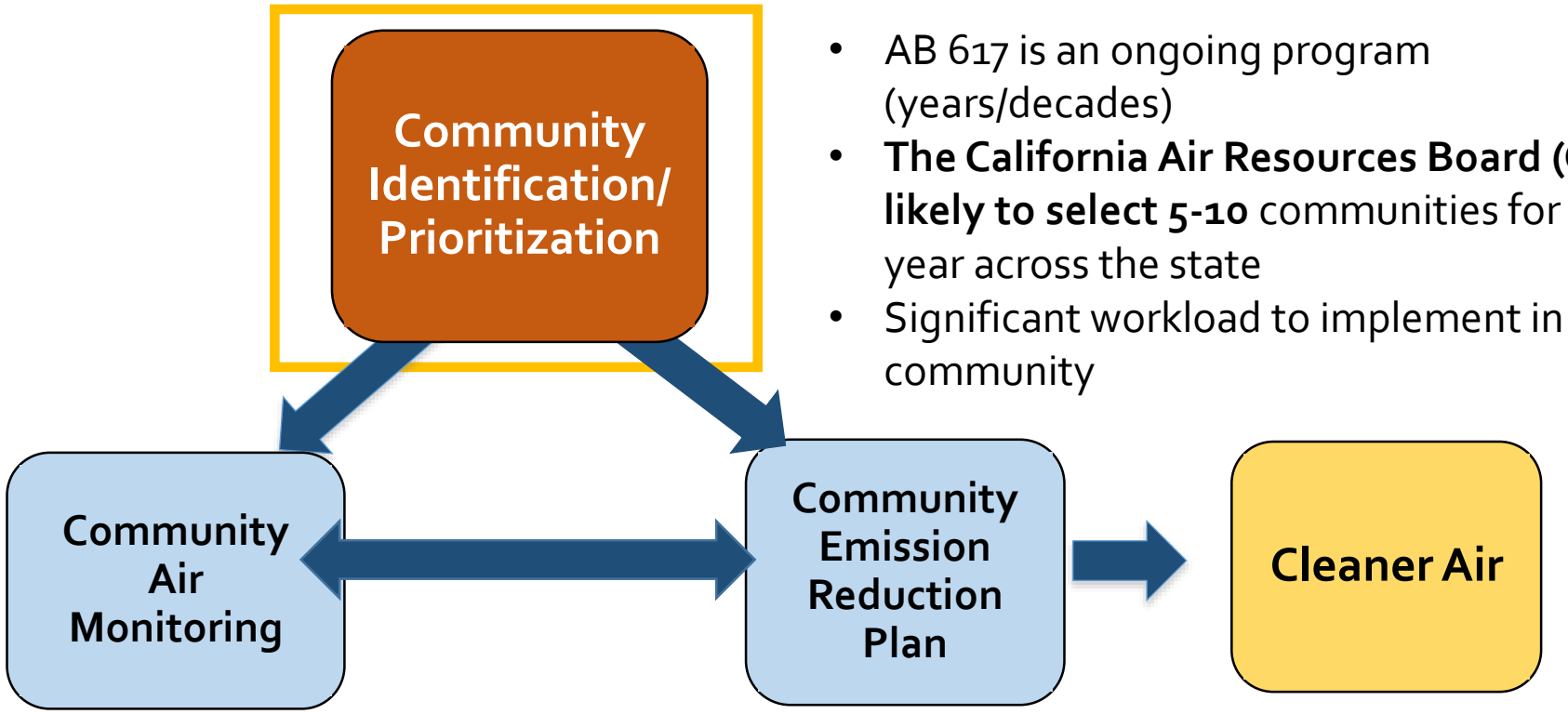
2019 **Jul** – July 1 – Deadline for SCAQMD to deploy **air monitoring for YEAR 1 communities**

2019 **Sep** – Sept 27 – Deadline for SCAQMD to adopt **emissions reduction plans for YEAR 1 communities**

2023 **Dec** – December 31 – Deadline for SCAQMD to fully implement **Best Available Retrofit Control Technology (BARCT)**

South Coast AQMD

Community Identification & Prioritization for AB 617

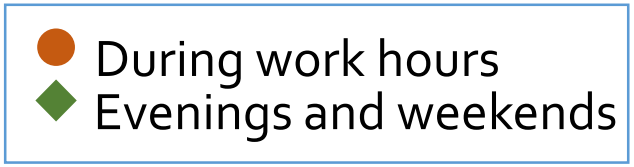


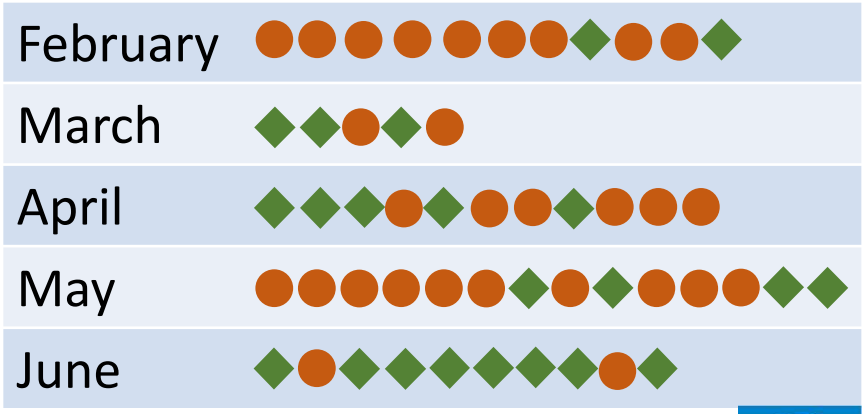
- AB 617 is an ongoing program (years/decades)
- **The California Air Resources Board (CARB) likely to select 5-10** communities for 1st year across the state
- Significant workload to implement in each community

South Coast AQMD

Outreach – Meetings & presentations

- **10** SCAQMD Community Meetings
  - Commerce, Wilmington, Riverside, San Bernardino, Anaheim, Santa Ana, Jurupa Valley, South Gate, Colton, San Fernando
- **1** Technical Workshop
- **2** SCAQMD EJCP meetings (Indio, Irvine)
- **9** Community Meetings hosted by other organizations and elected officials
- **25** Government agency meetings, workshops, advisory groups, staff briefings
- **1** Media interview
- **3** Academic presentations





South Coast AQMD

Key input received to date

Air pollution sources

- Diesel sources (freeways, trucks, warehouses, railyards)
- Oil production & processing (wells, refineries)
- Landfills, scrap yards, hazardous waste sites

Proximity/land use factors

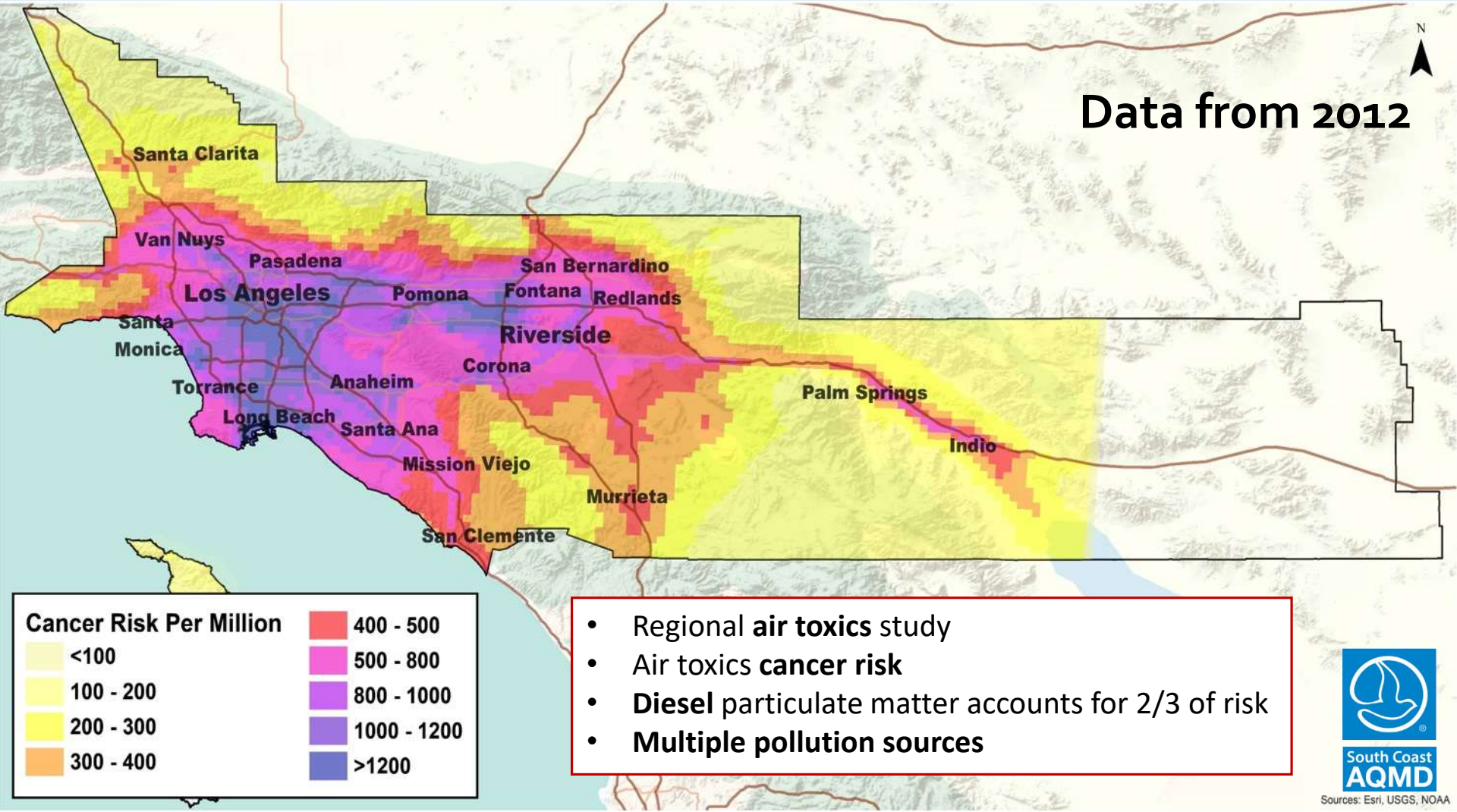
- Schools near air pollution sources/ industrial areas
- Concentration of industries
- Green spaces

Population factors

- Population density
- Low income
- Communities of color
- Access to healthcare
- Asthma, cancer rates
- Education levels
- Children & elderly

South Coast AQMD

Multiple Air Toxics Exposure Study (MATES IV)



- Regional **air toxics** study
- Air toxics **cancer risk**
- **Diesel** particulate matter accounts for 2/3 of risk
- **Multiple pollution sources**

South Coast AQMD

CalEnviroScreen 3.0 (OEHHA)

Pollution Burden

Exposures


Ozone


PM2.5


Diesel PM


Pesticide Use


Traffic


Drinking Water Contaminants


Toxic Releases from Facilities

Environmental Effects


Solid Waste Sites and Facilities


Cleanup Sites


Groundwater Threats


Impaired Water Bodies


Hazardous Waste Generators and Facilities

Population Characteristics

Sensitive Populations


Asthma


Cardiovascular Disease


Low Birth-Weight Infants

Social and Economic Factors


Poverty

Unemployment


Educational Attainment

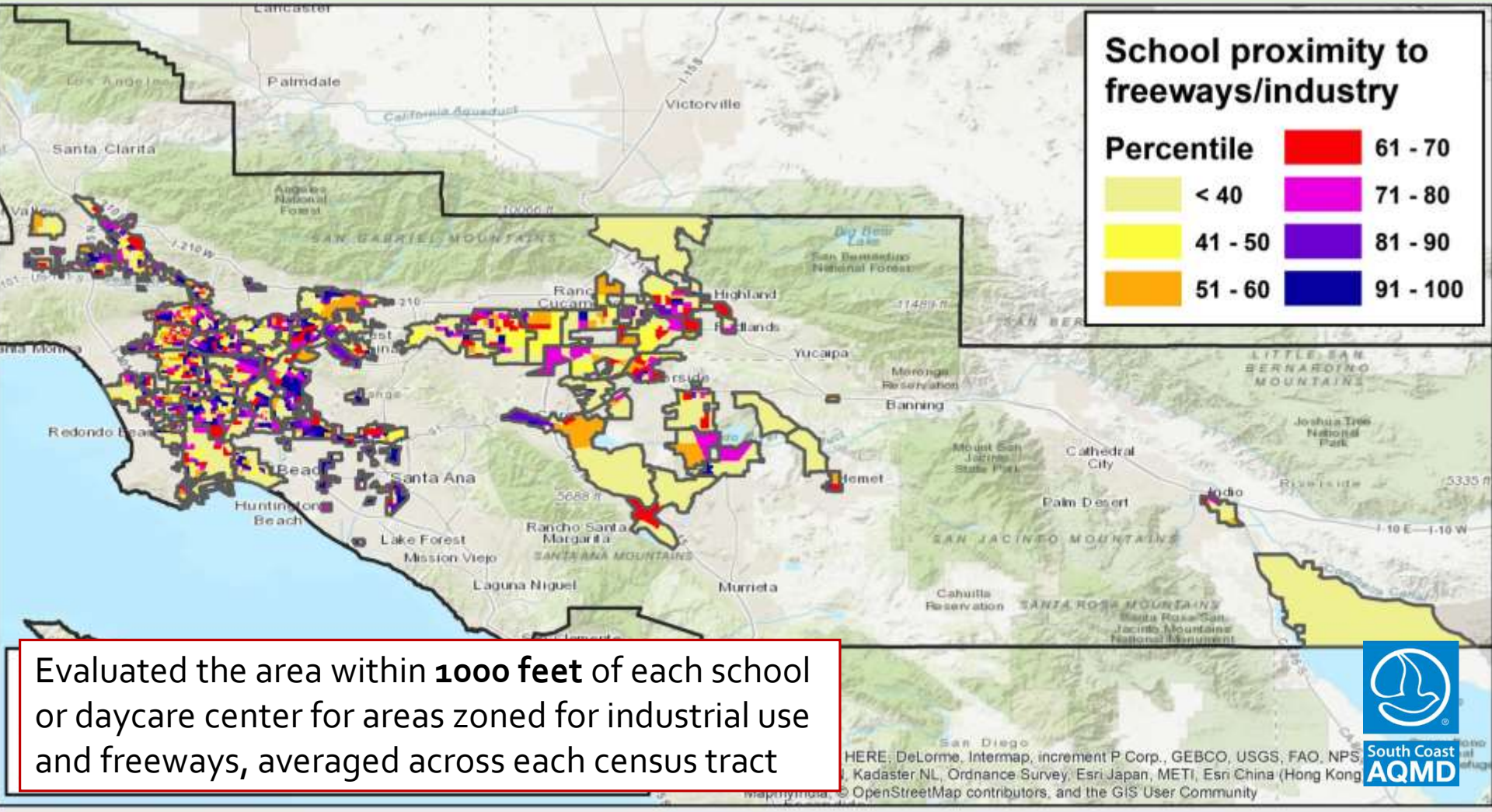

Linguistic Isolation


Housing Burdened Low Income Households

OEHHA:
Office of Environmental Health Hazard Assessment (State agency)

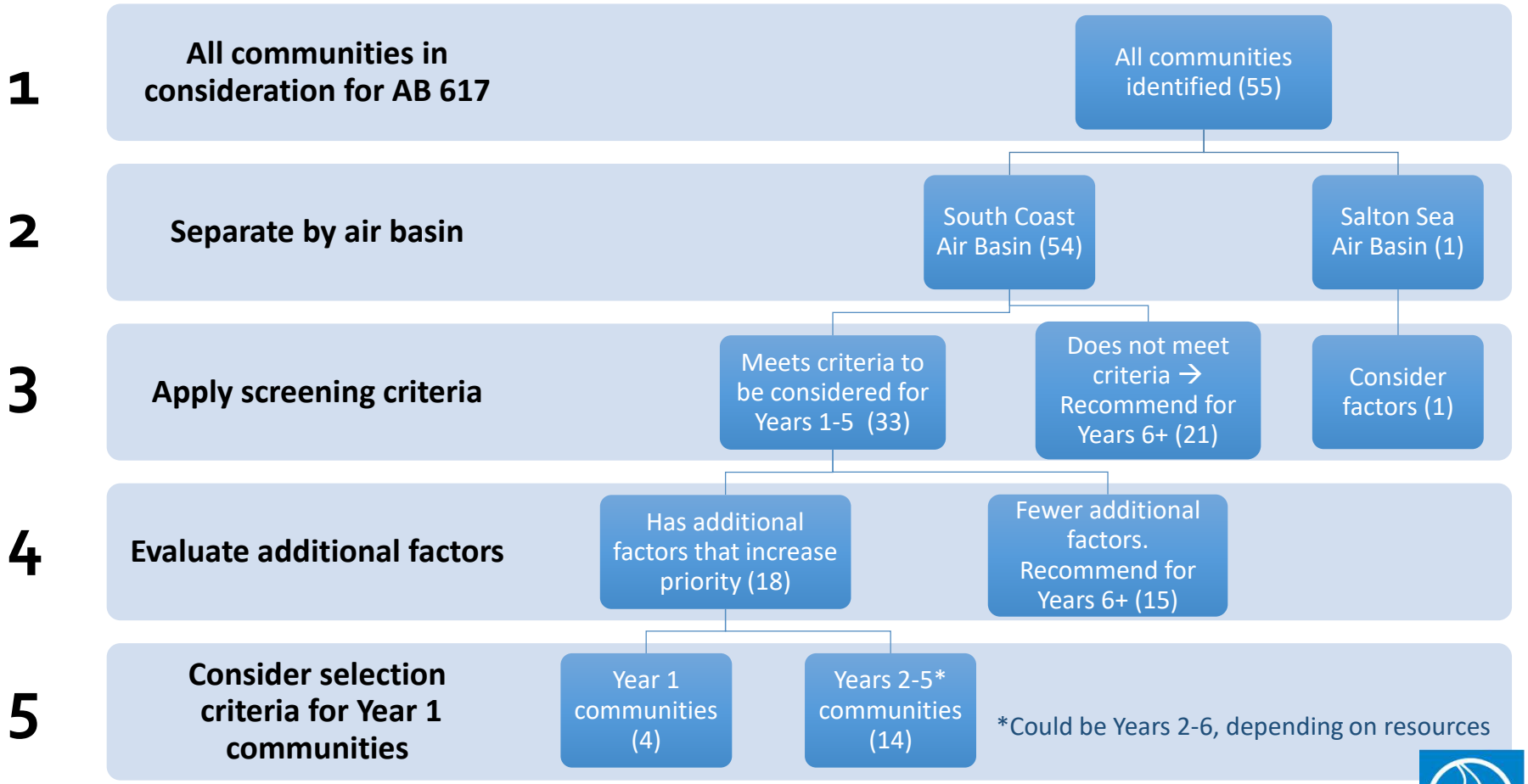
South Coast AQMD

Schools near industrial areas and freeways



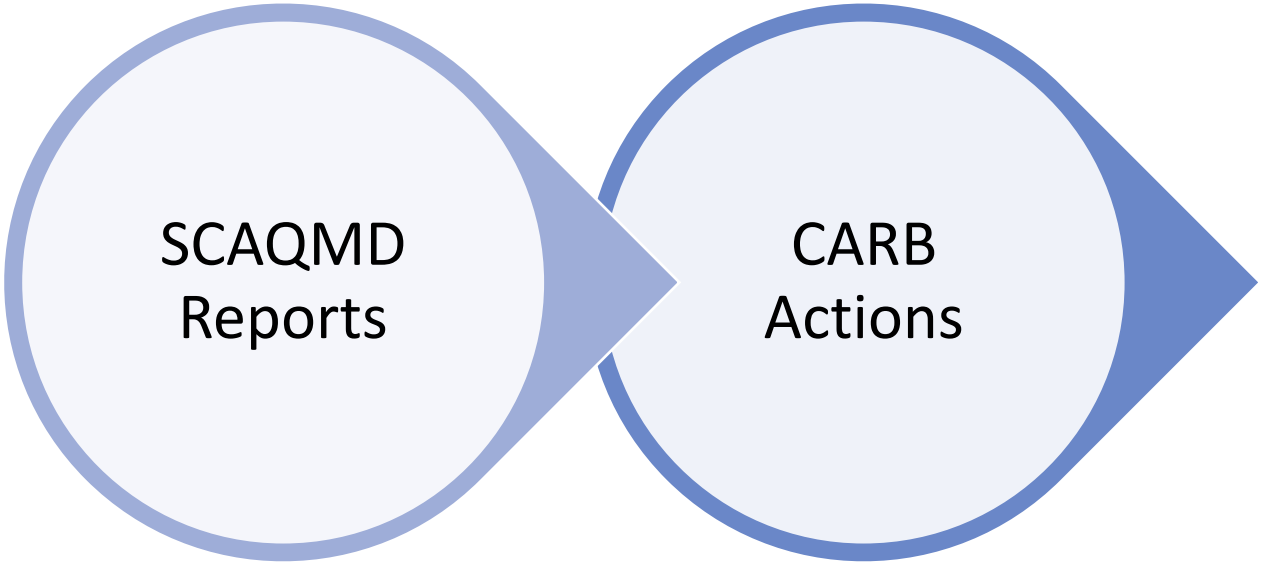
Evaluated the area within **1000 feet** of each school or daycare center for areas zoned for industrial use and freeways, averaged across each census tract

Summary Methods and Criteria for Community Prioritization



South Coast AQMD

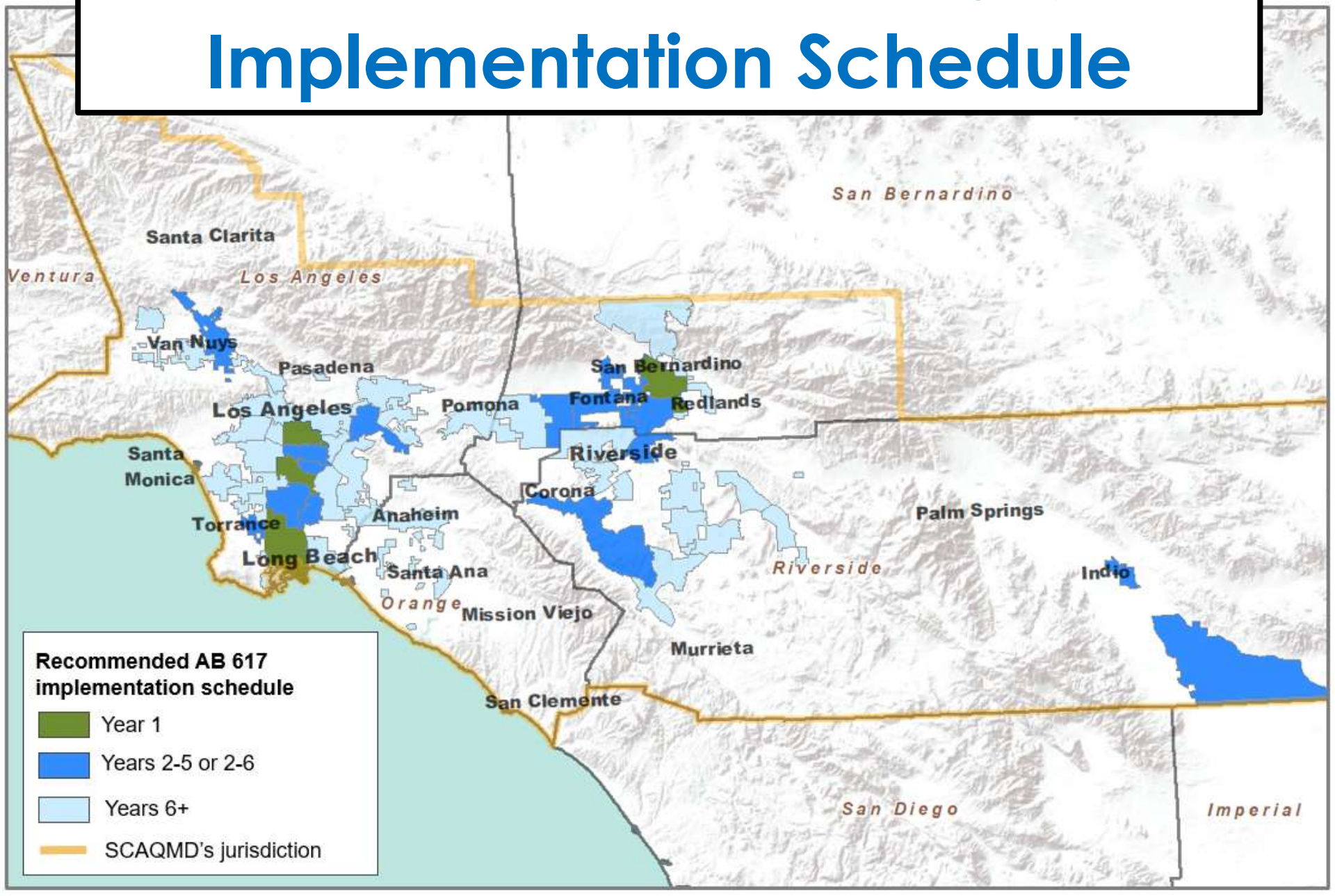
2018 Milestones: Recommendations for Year 1 implementation of AB 617



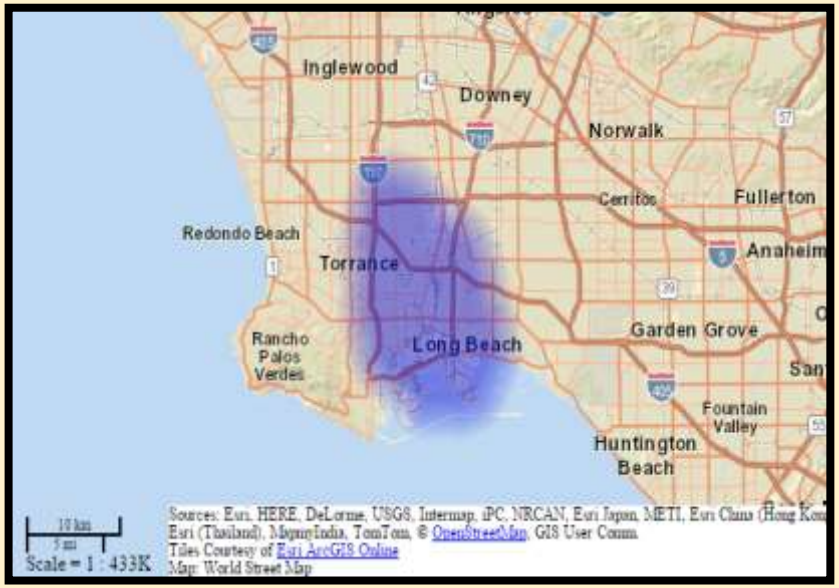
- **April-June:** Preliminary Report submitted to CARB
- **July:** Final Report submitted to CARB

- **August**: Staff recommendations released
- **September**: CARB considers statewide strategy

Recommended AB 617 Implementation Schedule



Wilmington, West Long Beach, Carson



- Port area communities, with several major refineries
- Socioeconomic burdens
- Previous and future air monitoring: Fluxsense pilot study, 710 study, MATES V Advanced Monitoring, Rule 1180 monitoring
- **MATES IV**: 100th percentile
- **CalEnviroScreen 3.0**: 98.8th percentile
- Nominations received from Cities of Carson and Los Angeles, and Communities for a Better Environment

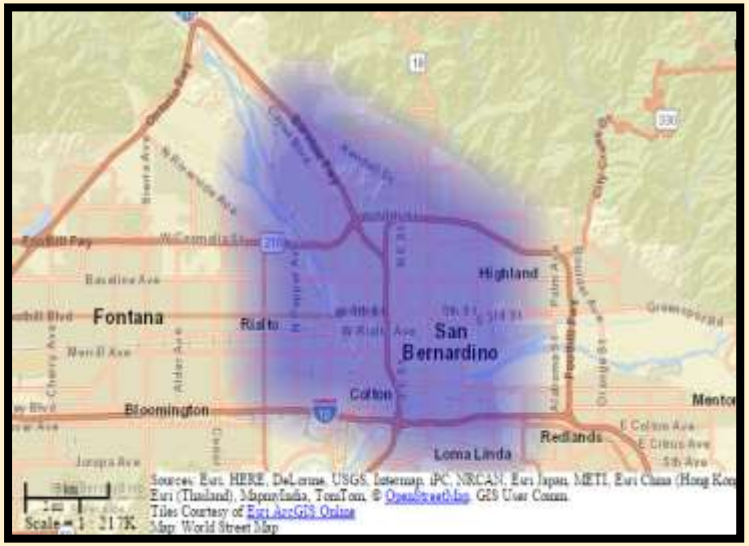
South Coast AQMD

East Los Angeles, Boyle Heights

- East LA communities, near freeways, rail yards, and major industrial areas
- Socioeconomic burdens
- Clean Communities Plan
- Previous air toxics monitoring
- **MATES IV**: 99.4th percentile
- **CalEnviroScreen 3.0**: 99.9th percentile
- Nominations received from community members

South Coast AQMD

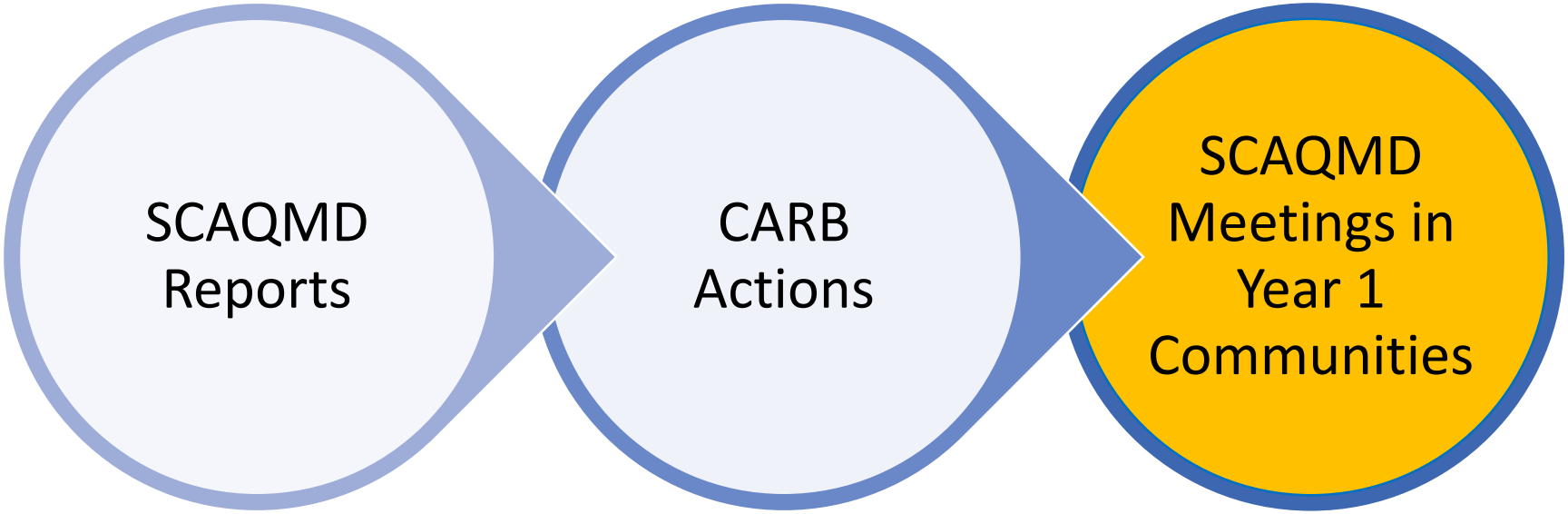
San Bernardino, Muscoy



- Inland Empire community, with a major rail yard, and other industrial sources
- Socioeconomic burdens
- Clean Communities Plan
- MATES IV local-scale monitoring
- Geographical diversity, and diversity of sources
- **MATES IV**: 51.3th percentile
- **CalEnviroScreen 3.0**: 99.7th percentile
- Nominations received from elected official and Center for Community Action and Environmental Justice

South Coast AQMD

2018 Next Steps



- **April-June:** Preliminary Report submitted to CARB
- **July:** Final Report submitted to CARB

- **August**: Staff recommendations released
- **September**: CARB considers statewide strategy

- **Sept-Oct:** Community meetings
- **Oct-Nov:** Convene Community Steering Committees

In-Use Emissions Testing Program Update

Clean Fuels Advisory Group
September 12, 2018

Adewale Oshinuga, Program Supervisor

Cleaning the Air That We Breathe…

In-Use Emissions Testing Scope of Work

- Collect and analyze vehicle activity and emission data
- Assess effectiveness of current heavy-duty drive cycles
- Conduct in-use emissions testing of 200 heavy-duty vehicles
- Test Matrix

Vehicles	Number	Fuel
Goods Movement Trucks	90	**Natural gas, Renewable natural gas, diesel, renewable diesel, and alternative fuels (hybrid and fully electric)**
Delivery trucks	45	
Refuse trucks	25	
School and transit buses	40	

- Assess technology and fuels on fuel consumption and emissions
- Match technology to vocation

In Use Emission Vehicle Test

- Testing laboratory
  - University of California Riverside/CE-CERT
  - West Virginia University
- Testing phase

Testing Phase	Test Vehicles	
	Number	Vocation
Portable Activity Monitoring System (PAMS)	200	**All**
Portable Emission Monitoring System (PEMS)	100	All
Dynamometer	60	All
Real World In-Use Emission	10	Goods Movement

- Non-testing phase
  - Technology impact, issues, improvements, and benefit
  - In-use emissions versus EMFAC

Status of In-Use Emission Testing

- Testing phase

Vocation	Assigned	Recruited	Completed	Reason
PAMS	200	176	146	Near-zero CNG, Diesel, diesel-electric, electric, and fuel cell
PEMS	100	84	35	
Dynamometer	60	0	0	Pending Completion of PAMS/PEMS
Real-World In-Use	10	0	0	Pending Completion of Dynamometer Testing

- PEMS emissions results are pending
- Project schedule
  - Study ends in February 2019
  - Draft final reports in May 2019

Funding Partners

- SCAQMD
- CEC
- CARB
- Southern California Gas Company

Near-Zero Emission Heavy-Duty Engine Technology: Gaseous and Liquid Fuels Update

Joseph Lopat

Key Projects

Significant progress in emissions reductions from Heavy-duty engines 0.02 g/bhp-hr

- Currently in production 8.9 and 12 liter CNG engines.
- Development of diesel engines and aftertreatment.

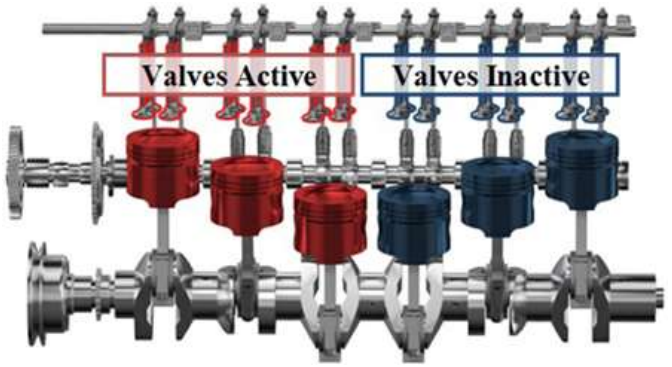
  - 15–liter diesel engine
  - Achates Power Opposed Piston Diesel Engine
  - Cylinder deactivation

Engines in Production certified at 0.02 g/bhp-hr NOx

- Cummins Westport 8.9-liter and 12-liter CNG engines
- Roush 6.8-liter propane engine
    - CNG engine orders at highest level since 2006
    - US Postal and other Fleets giving financial incentives
    - Carl Moyer and other incentive programs funding buses and heavy-duty trucks
    - Used in hybrid electric heavy-duty truck demonstrations

Heavy-Duty Diesel update

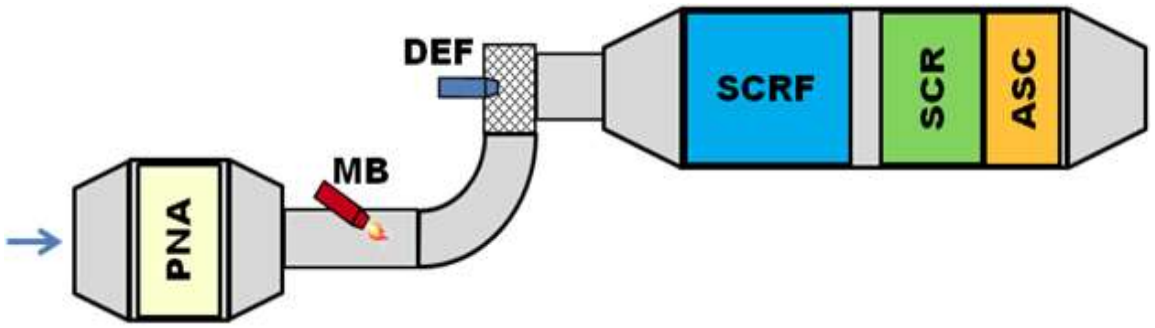
- Southwest Research to develop and optimize diesel performance to reach 0.02 g/bhp-hr NOx levels

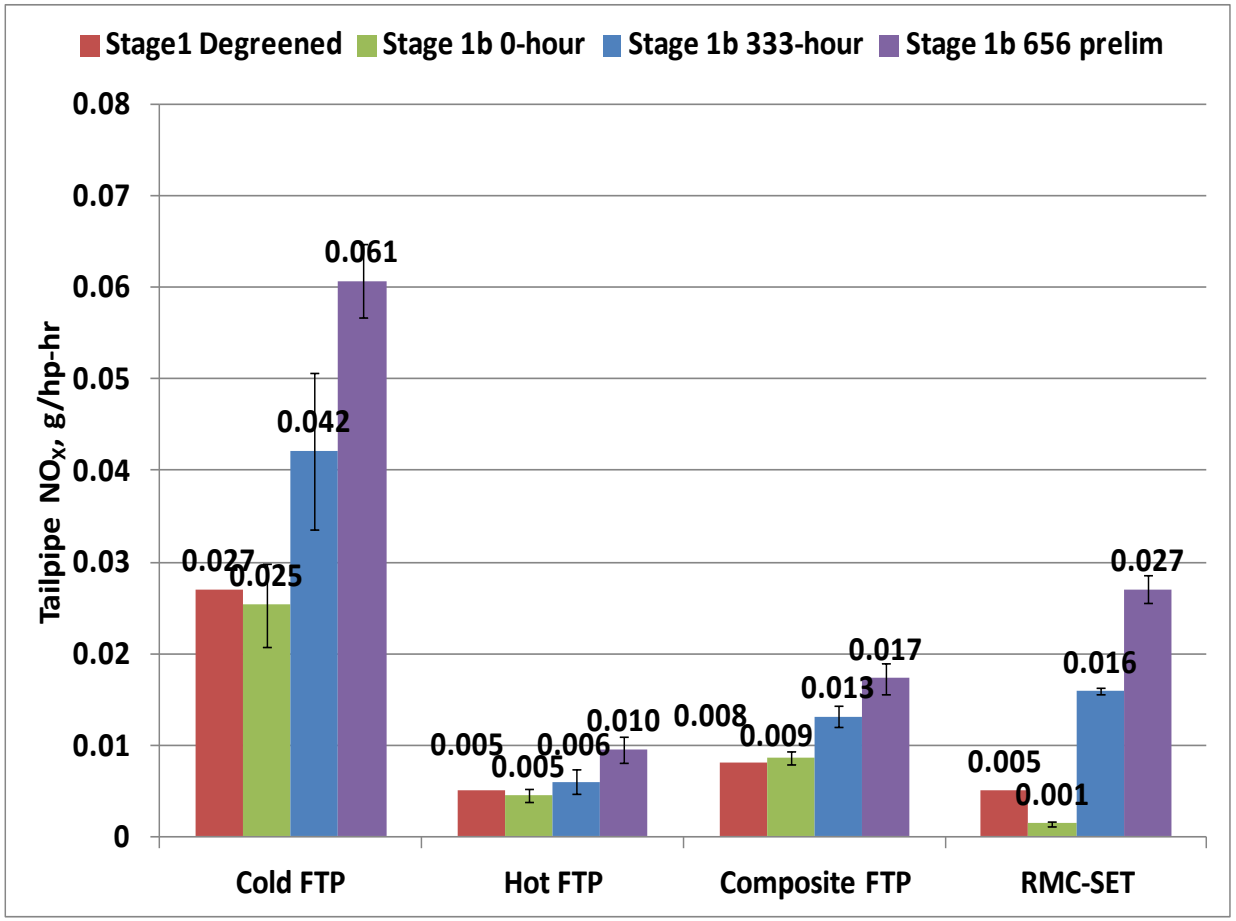


  - Developing low-load and low-temperature cycles
  - Optimization of engine controls to achieve near-zero NOx throughout the duty cycle
  - Cylinder Deactivation West Virginia University and SwRI
  - Minimal impact on efficiency
  - Exhaust gas recirculation and Turbo Bypass
  - Aging and testing of the aftertreatment during useful life

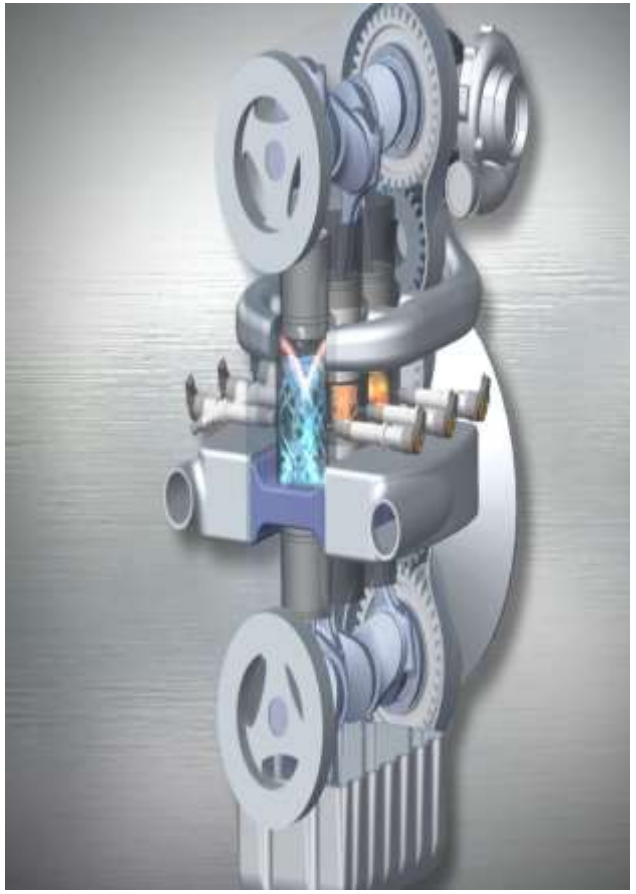
SwRI current Ultra-low NOx Diesel results

- Low load and cold start control
- Significant After-treatment development and aged testing
- NOx results in lab promising
- Early Light off Catalyst option considered





Achates Power Opposed Piston Engine Project



- Greater efficiency 9.8 liter 3 cylinder 450 HP and 0.02 g/bhp-hr NOx
  - $ 7,000,000 CARB GGRF Grant
  - Complete engine assembled
  - SwRI after-treatment design
  - Peterbilt truck integration
  - Walmart and Tyson Foods fleet demonstration
  - Total project cost $17 million, SCAQMD cost share $1 million

Heavy-duty Engine Summary

- Lessons learned
  - Technology pathway to Near-Zero NOx diesel engine showing promise
  - Pathways to keeping the Catalyst hot are achievable without fuel penalty in diesels
- Future Goals
  - Demonstration in the basin of a class 8 diesel truck capable of 0.02 g/bhp-hr Nox throughout the engine duty cycle and useful life of the engine
  - Development and demonstration leading to certification 0.02 g/bhp-hr NOx of smaller (5L-7L) and larger > 13-liter gaseous and liquid fueled engines

Zero Emission Cargo Transportation

Projects I and II

Clean Fuels Advisory Meeting

South Coast Air Quality Management District
September 12, 2018

Phil Barroca
Air Quality Specialist, Technology Demonstration
Technology Advancement Office

South Coast AQMD

ZECT Projects - Overview

- **Objective -** Develop and demonstrate zero and near-zero emission technologies for Class 8 goods movement trucks operating in the South Coast Air Basin, primarily between the Ports and near-dock rail yards
- **ZECT 1 – Awarded: 2012; Kickoff: 2012**
  - Two technologies: Battery Electric and Plug-in Hybrid Electric Trucks
  - Two technology integrators: TransPower and U.S. Hybrid
  - Data Analysis: NREL
  - Fleet participation: drayage fleets
  - Funding: DOE: $4,169,000; Match Share: $5,205,641; Total Cost: $9,374,641
- **ZECT 2 – Awarded: 2014; Kickoff: 2015**
  - Three Technologies: Fuel Cell, Battery Electric with Fuel Cell, Battery Electric with CNG
  - Four technology integrators: TransPower, U.S. Hybrid, Hydrogenics, BAE
  - Data Analysis: NREL
  - Fleet Participation: Drayage fleets, Kenworth Trucks
  - Funding: DOE: $10,000,000; Match Share: $5,205,641; Total Cost: $9,374,641

South Coast AQMD

ZECT 1

- Two Integrators: TransPower (TP) and U.S. Hybrid (USH)
- Three Technologies / Eleven Trucks:
  - Battery Electric: 4 TP ; 2 USH
  - Series Plug-In Hybrid: 2 TP
  - Parallel Plug-in Hybrid: 3 USH


South Coast AQMD

ZECT 1 - Truck Specifications

	BET		PHET	
Developer	TransPower	US Hybrid	TransPower	US Hybrid
No. of Trucks	4	2	2 Series Hybrid	3 Parallel Hybrid
Chassis	International Prostar	International Prostar	International Prostar	Peterbilt 384
Traction	Dual IPM Motors	Induction Motor	Dual IPM Motors	IPM Motor
Motor	300 kW	320 kW	300 kW	222 kW (402 kW total)
Transmission	Automated Manual	Direct Drive	Automated Manual	Automatic
APU Displ./Fuel	N/A	N/A	3.7L / CNG	8.9L / LNG
APU Power	N/A	N/A	65-110 kW	180 kW
Battery/Fuel Storage Capacity	215 kWh - 311 KWh	240 kWh	138 kWh/ 60 DGE	80 kWh/ 72 DGE
Charger On-Board	70 kW	60 kW	70 kW	20 kW
Recharge/Refuel Time	2.5-4 hrs	3-4 hrs	2 hrs/ 10-15 min	3-4 hrs/ 10-15 min
Drayage Range (miles)	75-100 (@215 kWh) 110-150 (@ 315 kWh)	70-100	250+ / 35-50 AER	250+ / 30 AER

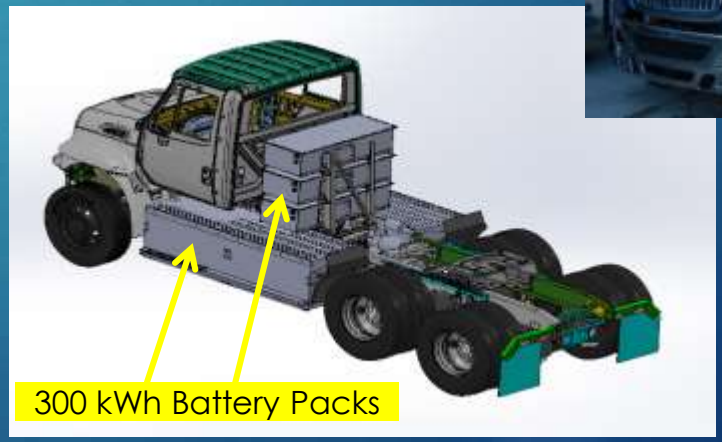
South Coast AQMD

TransPower BET

- Project completed September 2017
- Four Electric Drayage Demonstration (EDD) trucks built, EDDs 1 – 4
- EDDs 2,3,4 maintained demonstration efforts
- Matched performance of baseline diesel in power, torque, load handling
- Achieved higher reliability than previous generation of Class 8 BETs
- Zero emissions and higher energy efficiency
- Drivers responses:
  - performance and quietness favorable
  - range and recharge time less favorable
- Cumulative Vehicle Performance Data (NREL)
  - 579 days; 2660 hrs; 25,786 miles; 44.6 miles/day (avg.)
  - 60-70 mile range full load, single charge
  - 2.13 kWh/mi average efficiency; 17.7 mi/DGE (calc.)
- After Project Life
  - Three EDD's to be upgraded with fuel cell range extender and NMC batteries

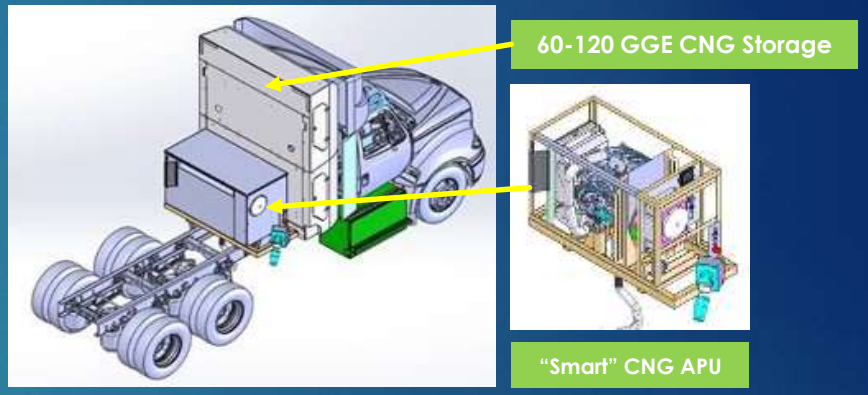
US Hybrid BET

- Two BETs in Project
- First BET delivered to TTSI in Q2 2016
  - LFP battery; 300 kWh ; 11 packs in parallel
- Performed pre deployment chassis dyno testing at UCR Q1 2017
- 48 days & 412 hrs. of operation
- 1,479 miles of usage
- 2.2 kWh/mi average efficiency
- Second BET to TTSI in Q3 2018
  - A123 Li – NMC
  - 30% higher energy density
  - 6 battery packs in parallel
  - 600V operation



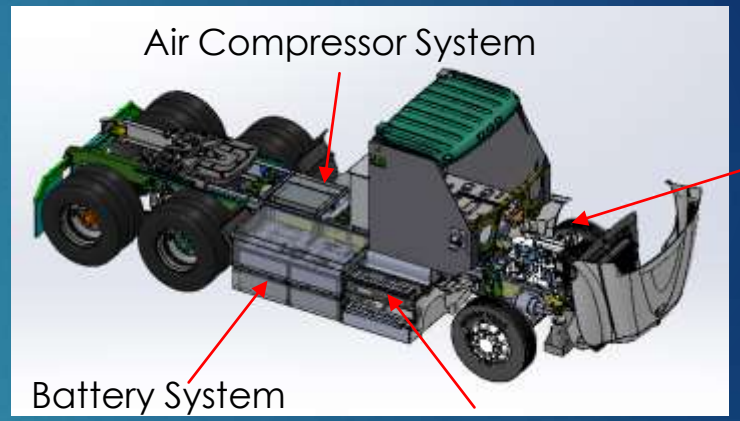
TransPower Series PHET

- Two PHETs Series Hybrid architecture based on EDD drive train
- APU: 3.7L Ford SI; CNG; 62 – 110 kW
- Hybrid system optimized with APU dynamometer
- Design/Performance Criteria:
  - 2.6kWh/mi for 8 hr. drayage shift
  - 100 mile range extension (~150 miles total)
  - min 32.5kW over 8hrs or 62kW ~50% duty cycle
  - 3.5kWh/mi highway (40% more than typical drayage)
  - Bridge climb (6% grade)
- Lessons Learned
  - Smaller battery design requires 80-120kW from APU
  - Stationary Trim engine output is capped in firmware to 62kW
  - Automotive Trim engine output 110-120kW peak
- First PHET testing in Q2 2018; deployment Q3 2018 – Q2 2019
- Second PHET, upgraded NMC batteries; deployment Q3 2018 – Q2 2019



US Hybrid PHET

- Three PHETs in Project
- Three Trucks completed; Two in demonstration
- Parallel hybrid architecture
- APU: 8.9L Cummins ISLG SI; LNG; 180 kW
- PHET tested at UC Riverside chassis dynamometer
- Design/Performance
  - Power and Torque comparable to ISX12 or ISX15
  - 30 miles AER (250 miles total)
  - Positive Driver Feedback
- Hybrid Control Unit (HCH)
  - Seamless transition from All Electric to Hybrid
  - Senses load and battery charge level to engage ICE for motive electrical power
  - Electric only during queuing and traffic
- 185 days; 7,167 miles of usage
- 3.87 kWh/mi average efficiency



Data Analysis through August 2018

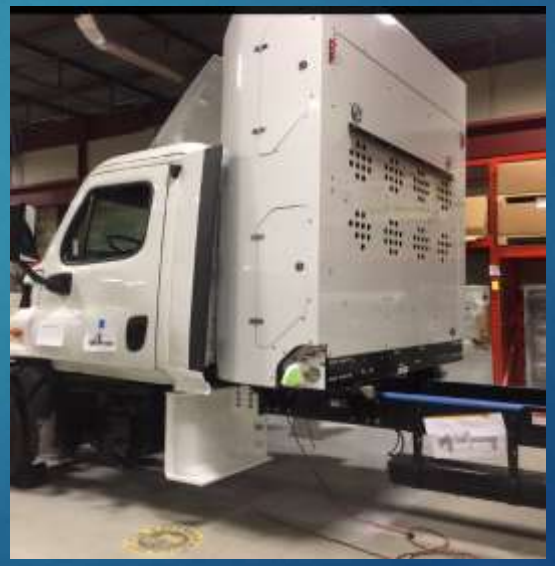
Median Daily Values	Conventional	EDD2-4	USH BET	USH LNG	Units
Operating Time	7.85	5.09	7.32	3.83	hr
Distance	124.15	43.77	21.65	40.43	mi
Average Energy Efficiency	6.12	2.13	2.17	3.82	kWh/mi (or equivalent)
Average Regeneration Energy	N/A	17.24	No Info	38.04	kWh
Average Speed		9.55	3.36	11.54	mph
Average Driving Speed	16.5	19.77	17.79	22.39	mph
Average Idle Time	2.6	2.87	6.14	1.62	hr
Average Idle Time > 5 min	1.1	1.59	4.14	0.72	hr
Average Start SOC	N/A	91.25	82.00	56.50	%
Average End SOC	N/A	54.68	75.50	51.50	%
Average Median Motor Temp	N/A	40.32	39.00	59.00	C
Average Median Electronics Temp	N/A	38.60	35.00	45.00	C
Time on Charge	N/A	9.60	2.65	0.42	hr
Average kWh per Charge	N/A	101.47	53.72	0.16	kWh
Average Air Cond Energy	N/A	3.08	No Info	0.42	kWh

South Coast AQMD

ZECT 2 Trucks

BAE SYSTEMS
INSPIRED WORK
KENWORTH
A PACCAR COMPANY

TransPower



HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

US Hybrid

South Coast AQMD

ZECT 2

- Four Integrators: TP, USH, Hydrogenics, BAE/Kenworth
- Three Technologies: Battery and Fuel Cell dominant Fuel Cell Trucks (FCT), Plug-in Series Hybrid Electric Near Zero Emission CNG
- Seven Trucks: 2 TP FCTs; 2 USH FCTs ; 1 BAE/Kenworth FCT; 1 Hydrogenics FCT; 1 BAE/Kenworth Series Hybrid with Near Zero-Emission CNG engine



South Coast AQMD

ZECT 2 - Truck Specifications

	FUEL CELL TRUCKS				PHET/CNG
Fuel Cell Configuration	**BATTERY DOMINANT**		**FUEL CELL DOMINANT**		
	TransPower	**Hydrogenics**	**US Hybrid**	**BAE/Kenworth**	
# of Vehicles	2	1	2	1	1
Platform	International	Freightliner	Kenworth T800	Kenworth T370	Kenworth T680
Mfg: Fuel Cell / APU	Hydrogenics	Hydrogenics	PureMotion	Ballard	CWI L9N NZE
Fuel Cell Power	**60 kW**	**60 kW**	**80 kW**	**100 kW**	n/a
Battery Capacity	125 kWh	100 kWh	26 kWh	100 kWh	100 kWh
Battery Chemistry	Li-ion	Li-ion	Li-ion	Li-ion	Li-ion
Traction Motors	2x 150 kW	1x 320 kW	1x 320 kW	2x 180 kW	1x 320 kW
Range (per fueling)	200 miles	150 miles	150-200 miles	100 miles	150 miles
Fuel Cap.: H2 (kg) / CNG (DGE)	27 kg @350 bar	30 kg @350 bar	20 kg @350 bar	30 kg @350 bar	30 DGE (assumed)
Plug-in Charging	Yes/bi-directional	Yes	Yes	Yes	Yes

South Coast AQMD

Hydrogen Infrastructure

- Hydrogen supplier: Air Products delivered and commissioned fueling stations at Kenworth test sites in Renton and Mt. Vernon, WA and demonstration site at Port of LA, San Pedro, CA
- Trailer mounted Hydrogen Station at Ports
  - Capacity - 300 kg
  - Fill Pressure - 350 bar

South Coast AQMD

Questions

From Catenary to Battery Electric Trucks

Clean Fuels Advisory Committee Presentation

Joseph Impullitti
Program Supervisor
Technology Advancement Office

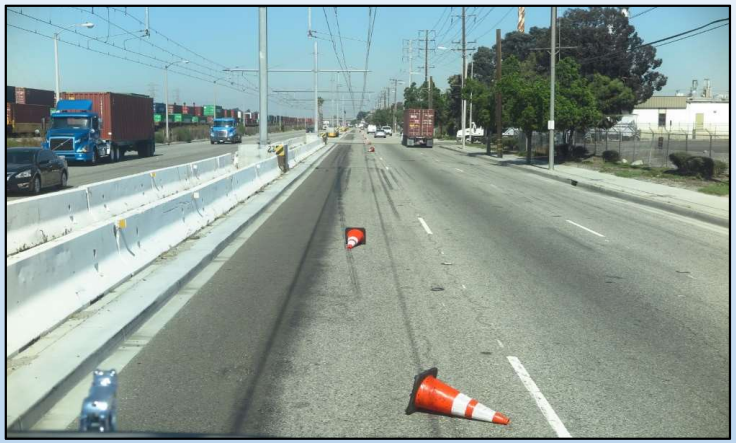
Agenda

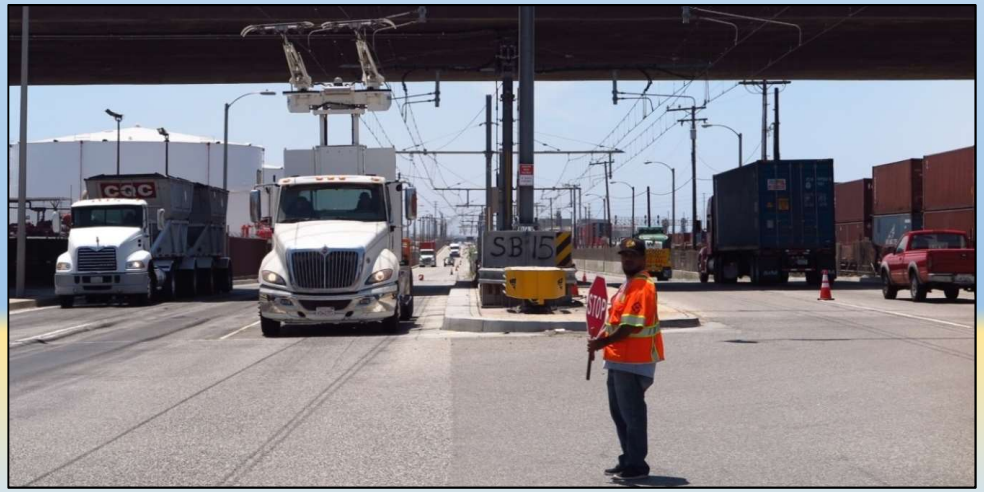
- Closeout of Siemens OCS Technology Demonstration Project
- Daimler Battery Electric Truck and EV Infrastructure Project (Recent Award)
- Volvo Battery Electric Truck Project (Proposal to ARB's Zero – and Near Zero-Emission Freight Facilities Solicitation)

Proprietary picture of Volvo truck removed for the web

Siemens OCS Project

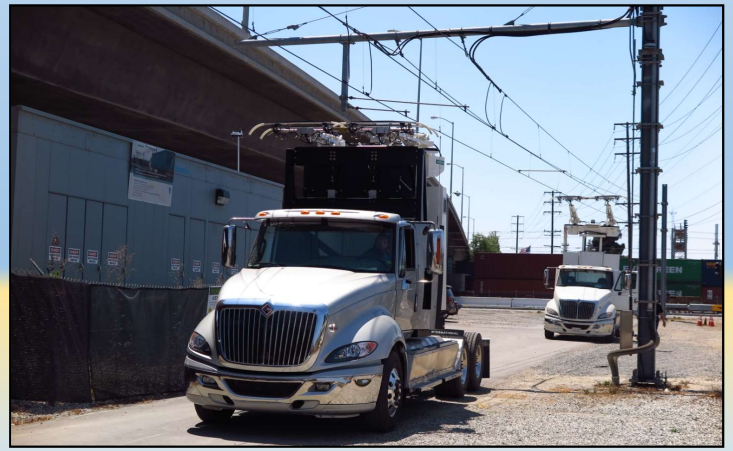
- Constructed and demonstrated eHighway infrastructure
  - Significant construction challenges
  - Undocumented utilities were uncovered in the median of Alameda Street. A new foundation type had to be designed for above ground
- Concept is still in a R&D phase and has not reached product maturity
- Alameda Street is a successful proof of concept in a representative application environment





Siemens OCS Project

- Demonstrated 3 trucks: Battery electric, CNG Hybrid, Diesel Hybrid
- The prototyped hybrid trucks used in the demonstration had limitations - extended wheelbase reduced payloads, not ready to be commercialized
- Siemens' Recommendation: Need intensified cooperation with truck OEMs to allow for truck and pantograph commercialization.



Studies and Reports

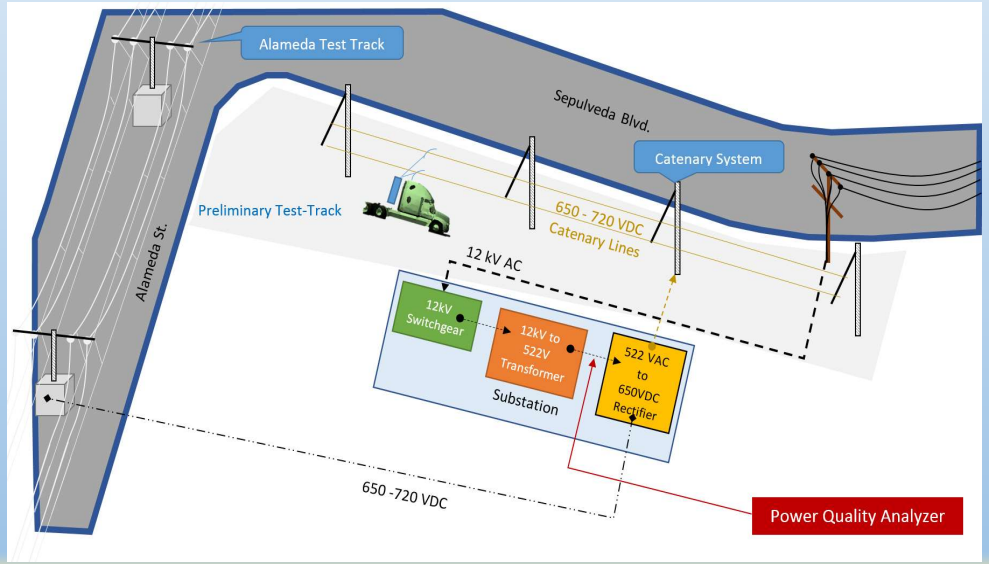
Owner Operator Survey

- Survey of three entities to assess interest in management of a potential OCS system: SCE, LA Metro, and Cofiroute USA
  - Issues: adoption of the OCS by private operators, competition with other technologies, truck costs too high for fleets
  - SCE could potentially construct the system but would require approval from the CPUC
  - LA Metro discussed the possibility of linking incentive funds for catenary-enabled trucks to commitments to use the system
  - Cofiroute's services are currently limited to operation and maintenance of tolling system

Studies and Reports

Grid Impact Report

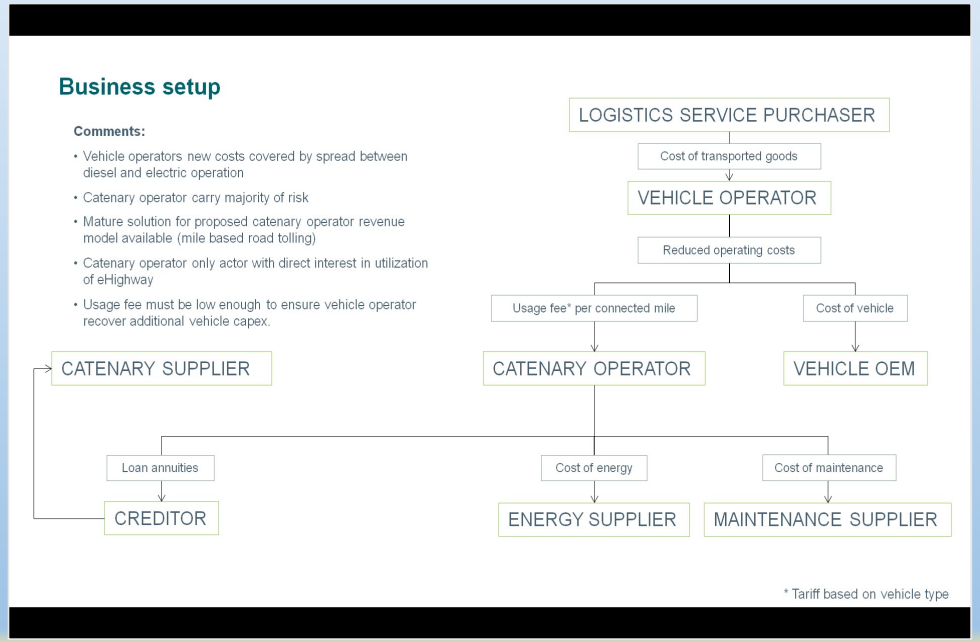
- SCE performed a grid impact study to understand potential electrification and expansion of the OCS technology
  - The eHighway system was compliant with IEEE 519 standards based on the data, and operated safely. There were no indications of adverse impact to grid voltage



Studies and Reports

Siemens Business Case Study

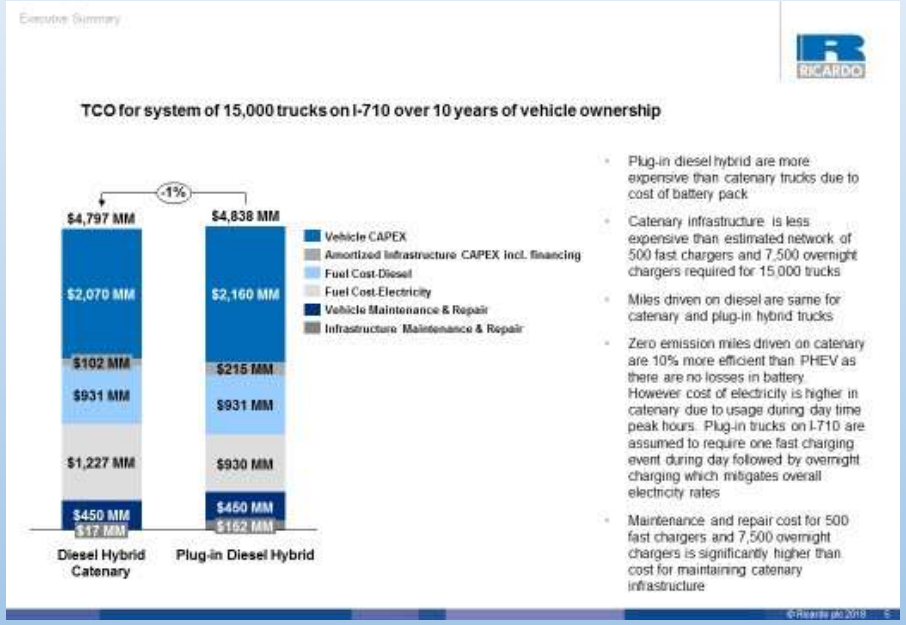
- Optimistic economic feasibility and technical implementation
- Risks are identified:
  - Uncertainty for installation of catenary infrastructure
  - Uncertainty that vehicle operators will adopt technology (Fleets were not included in demonstration)
  - Construction of infrastructure impacts and mitigation not discussed



Studies and Reports

Total Cost of Ownership Analysis

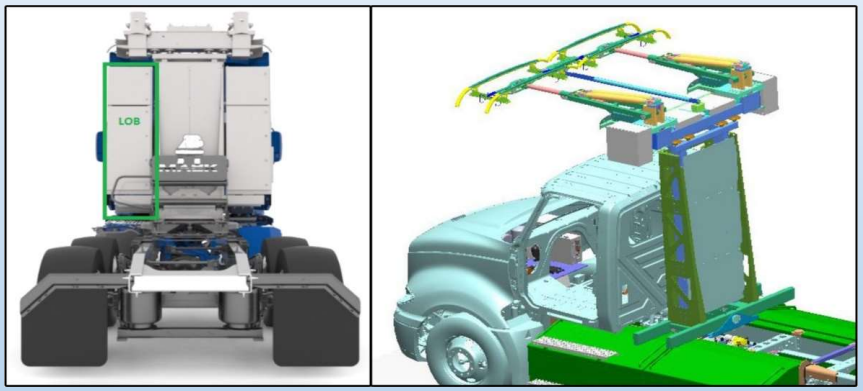
- A total cost of ownership (TCO) study (by Ricardo) analyzed OCS systems for 500 drayage trucks on Alameda Street and 15,000 drayage trucks on I-710
  - Catenary truck TCO is 8-20% higher than PHEV on Alameda St
  - Catenary truck TCO is comparable to PHEV on I-710



Siemens OCS Project

Siemens' Recommendations:

- Further R&D works and steps towards higher TRL must be taken
  - Most important - commercialization and robustness of the pantographs is needed and optimized electric hybrid drivetrains
- Technology improvements and lower costs are needed for vehicles and infrastructure to impact economic feasibility



Siemens OCS Project

SCAQMD & Funding Partners

Recommendations:

- SCAQMD does not champion one technology over another; we determine our funding for development based on the technologies merits and potential emission benefits
- Catenary systems may work in specific duty cycles with high concentrations of traffic on specific routes
- Drawback is vehicles are tied to Catenary technology and route
- Having dual propulsion technologies on a vehicle is complex and expensive for limited utilization
- Technologies not tied to wayside power are more versatile and flexible in their application for multiple duty cycles

DAIMLER

South Coast AQMD

Battery Electric Trucks and EV Infrastructure Project

Project Summary & Overview

- Daimler Trucks North America (DTNA) is the largest truck OEM in North America
- DTNA will develop 20 battery-electric heavy-duty Freightliner trucks
- DTNA will demonstrate the electric trucks in real-world commercial fleet operations in the South Coast Air Basin. The project will include:
- Ten (10) Class 6 eM2 trucks (GVWR 26,000 lbs)
- Ten (10) Class 8 eCascadia trucks (GVWR 80,000 lbs)
- The project will include appropriate charging infrastructure for heavy-duty trucks

Freightliner eM2

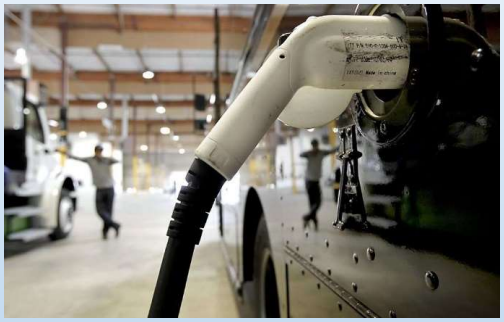
- Class 6 straight truck
- 220 horsepower
- 4x2 axle configuration
- 106-inch wheelbase
- Day cab configuration
- 26,000 lbs GVWR
- 150-200 miles of service range
- 225-300 kWh battery packs
- Charging via CCA T1
- Applications: municipal, utility, pick up & delivery, food & beverage, etc.

Freightliner eCascadia

- Class 8 tractor
- 455 horsepower
- 6x4 axle configuration
- 116-inch wheelbase
- Day cab configuration
- 80,000 lbs GVWR
- 150-200 miles of service range
- 400-600 kWh battery packs
- Applications: regional hauling, port drayage, distribution, etc.

EV Infrastructure

- DTNA will install DC fast charger stalls at four fleet locations to support their fleet of 20 trucks
- Each DC fast charger will be paired with multiple battery energy storage systems (ESS) to optimize utility costs
- Utilizing grid-aware scheduling algorithms allows the ESS to recharge from the grid at a much lower peak power demand, reducing utility and facility demand charges



Project Funding

Source	Amount	Percent
Daimler Trucks North America	$15,670,072	50%
San Pedro Bay Ports (POLA/POLB)	$2,000,000	6%
US EPA FY18 Section 105 Clean Air Technology Initiative	$500,000	2%
California State Emissions Mitigation Fund	$4,400,000	14%
SCAQMD Clean Fuels Program	$8,730,072*	28%
TOTAL	**$31,340,144**	**100%**

*Currently working to get additional funding partners

Air Quality Benefits in South Coast Air Basin

Number of Trucks	NOx Reductions (TPY)	DPM Reductions (TPY)	GHG Reductions (MT/year)
20 (this project)	3.55	0.079	2,741
500 (potential deployments by 2030)	80.1	1.85	63,000


VOLVO
Volvo LIGHTS Project

Preliminary Award

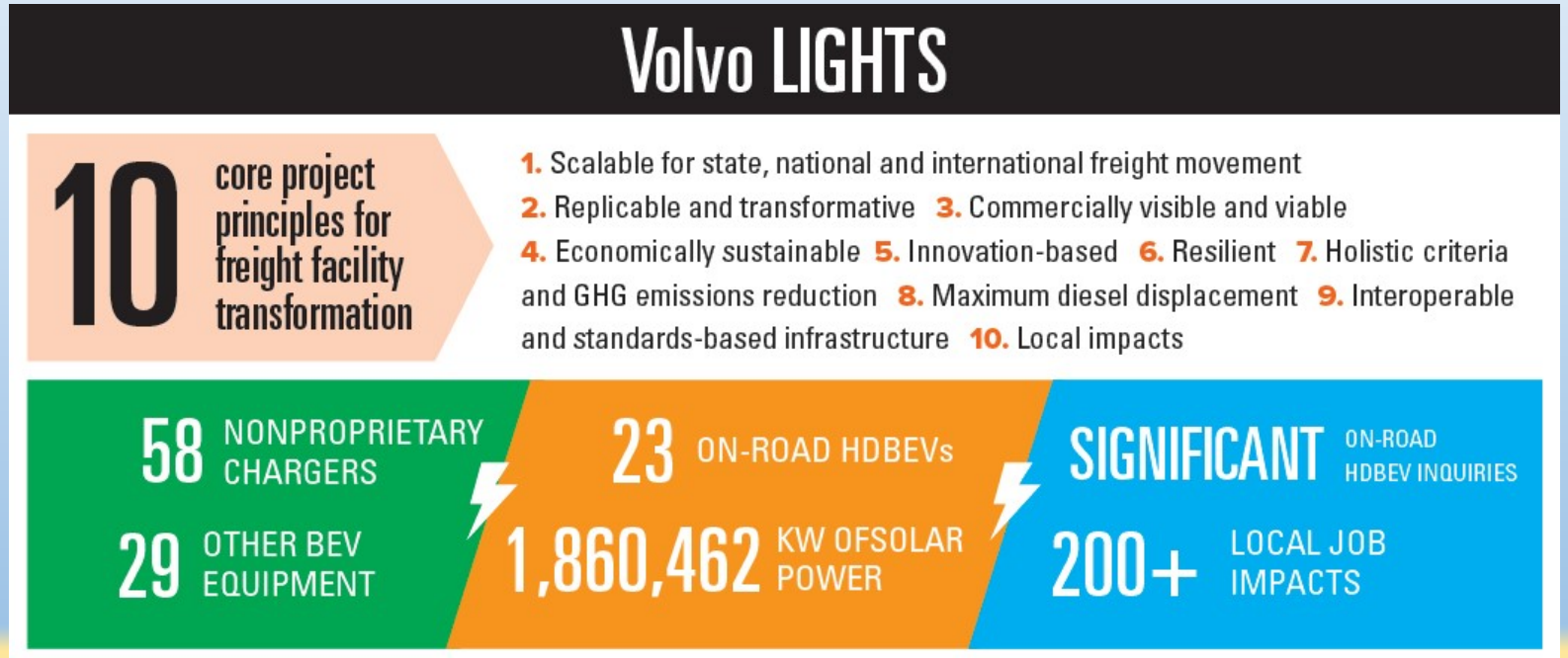
The California Air Resources Board (CARB) has preliminarily awarded $44.8 million dollars to SCAQMD for Low Impact Green Heavy Transport Solutions (LIGHTS) project. The LIGHTS project is part of California Climate Investments, a statewide initiative that puts billions of Cap-and-Trade dollars to work reducing greenhouse gas emissions, strengthening the economy and improving public health and the environment — particularly in disadvantaged communities.

Volvo LIGHTS – Zero Emission

- Volvo LIGHTS (Low Impact Green Heavy Transport Solution)
- Showcases zero-emission freight movement in support of CA's clean air goals
- The scope of Volvo LIGHTS encompasses the development of Class 8 demonstration units, production of Class 8 commercial units, facility improvements, installation of the charging infrastructure, public outreach, and data collection and reporting.

Proprietary picture of Volvo truck removed for the web

Volvo LIGHTS – Goals & Objectives

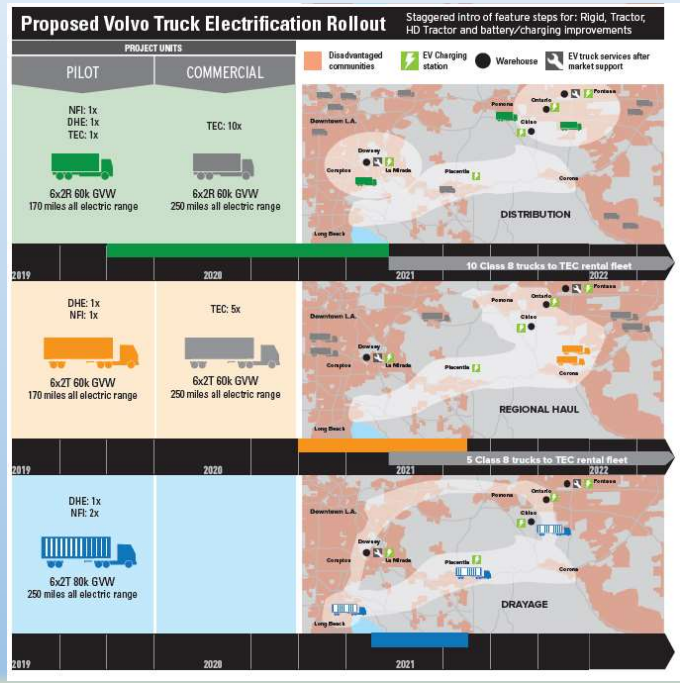


Volvo LIGHTS – Freight Transport

- Demonstrate zero-emission freight movement solutions within communities severely impacted by air quality
- Roll out an entire support system to enable zero-emission operations in at least 3 freight distribution facilities
- Reduce environmental footprint by integrating zero-emission equipment, renewable solar energy, and battery storage technologies into the freight mobility network

Volvo LIGHTS - Vehicles

- Truck Rollout Plan:
- Three chassis configurations for 8 demo and 15 commercial & pre-commercial trucks
- Freight Haul Demonstration:
  - Distribution
  - Short Regional Haul
  - Drayage
  - From Ports to Inland Empire warehouse locations



Volvo LIGHTS - Facilities

Unique Aspects of Innovation and Market Initiatives:

- The commercial Introduction of class 8 HDBEV for trucks
- Performance based testing and data collection from CE-CERT will aid Volvo in the development of battery requirements
- Networked chargers use vehicles telematics to prioritize charging and energy use based on vehicle needs, pricing, facility needs, time of day and utility status

Volvo LIGHTS – Potential Emission Reductions

- During the project period, it is estimated that the trucks and equipment will directly facilitate weighted emission reductions of NOx, ROG, and PM by 3.57 tons per year
- The project will produce an estimated 1.86 million kWh of renewable electricity, the majority of which will be used to charge the proposed EVs and displace 207,000 diesel gallons equivalent
  - This will produce estimated reductions of 3,020 metric tons of GHG emissions annually

Volvo LIGHTS – Proposed Funding

Funding Source	Amount
CARB	$44,839,686
Volvo & Partners	$41,855,308
SCAQMD	$4,000,000*
Total	$90,694,994

*SCE Make Ready Program if approved may offset this amount.

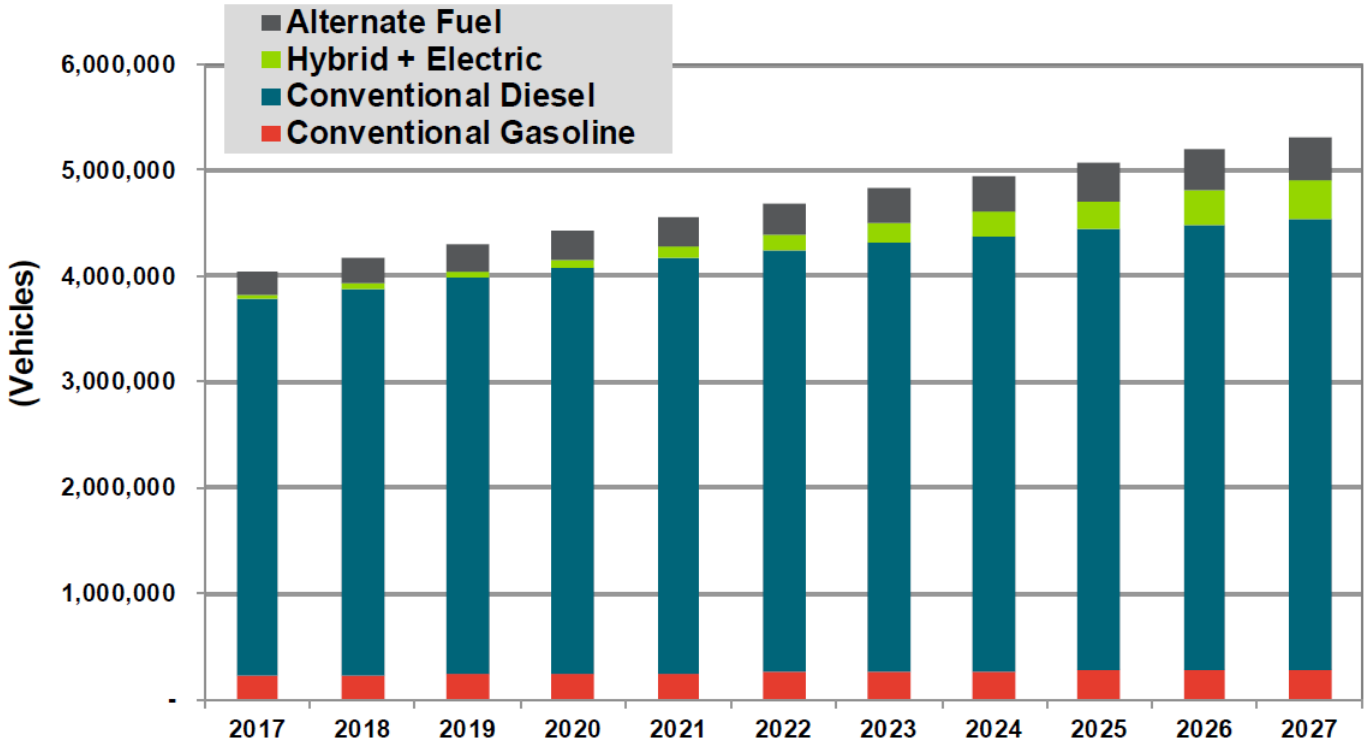
Medium and Heavy Duty Zero and Near-zero Emission Vehicle

Technology Advancement Office
Air Quality Specialist

Seungbum Ha

Clean Fuels Fund Advisory Retreat
Sep. 12, 2018

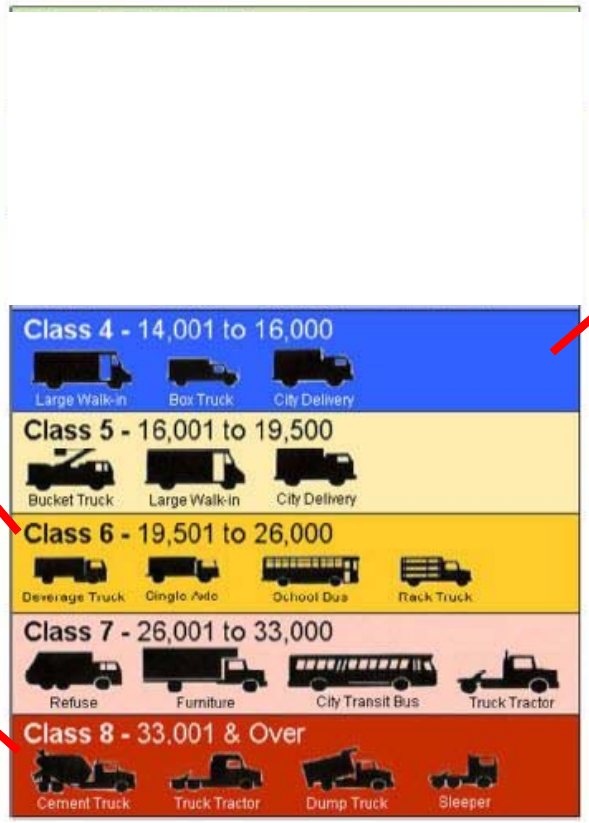
Annual Truck Sales Forecast



Annual Truck Sales by Fuel Type, World Markets: 2017-2027

(Source: Navigant Research)

Demonstration for MHD Trucks



Fuel cell UPS Package Van

Electric Airport Shuttle by EPA Airshed grant

NG Hybrid & Fuel cell Drayage Truck by ARB GGRF

Plug-in Hybrid MHD Work Truck by DOE

South Coast AQMD

1. **Southern California - Zero Emission Shuttle Transportation**
2. **Develop and Demonstrate Medium-Heavy Duty Plug-in Hybrid Work Truck**
3. **Fuel Cell Extended-Range Powertrain for Parcel Delivery Trucks**
4. **California Collaborative Advanced Technology Drayage Truck Demonstration**

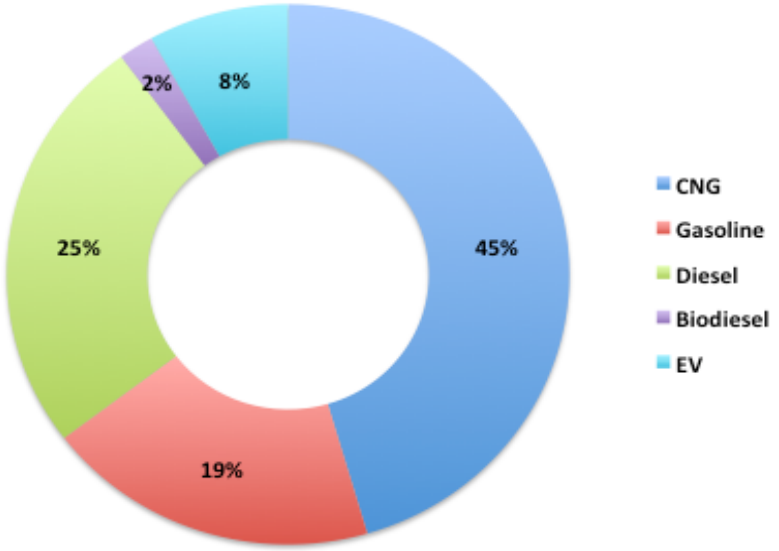
South Coast AQMD

Growing Market – Electric Class 4 Shuttle

Airport Shuttles – Estimated Population in California

Vehicle Weight Class	Vehicle Type	Annual Mileage	Number of Vehicles		
			Part I: On-Airport	Part II: Off-Airport	Part I + Part II
Class 2b-3	Van/Cutaway	10,000-68,000	3	277	280
Class 4-5	Cutaway	10,000-54,000	82	409	491
Class 7-8	32'-40' Low-Floor Bus	17,500-65,000	156	0	156
Class 8	60' Articulated Bus	4,700	21	0	21
Total			**262**	**686**	**948**

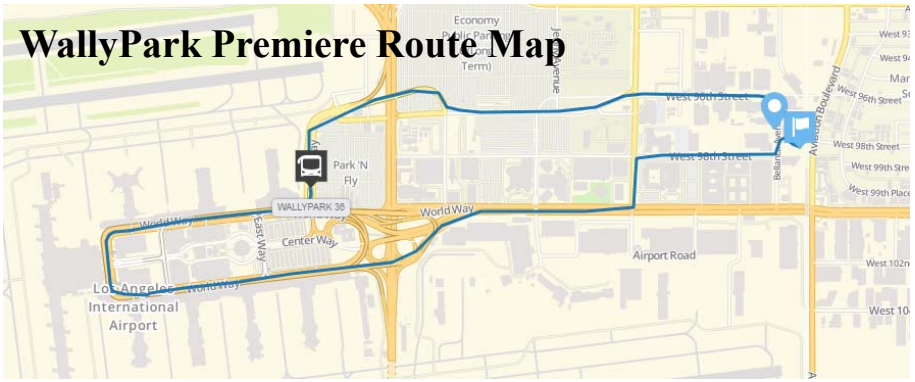
Share of Airport Shuttles by Fuel Type



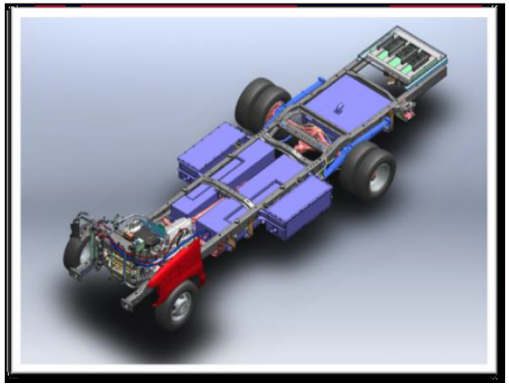
Source: CARB – Zero Emission Airport Shuttle Bus Workgroup Public Workshop Presentation

Sample Route Data for Airport Shuttle

Operator	WallyPark	Joe's Parking
Date	2018-07-26	2018-07-26
Loop Start Time	06:53	06:58
Loop End Time	07:17	07:17
Duration	24 minutes	19 minutes
Distance	4 miles	2.50 miles
Average Speed	14.5 mph	10.6 mph
Energy Used	3.3 kWh	2.72 kWh
Consumption in Service	0.84 kWh/mile	1.09 kWh/mile



Performance Specifications



Parameter	Specification
Chassis & Body	Ford E450 Superduty Chassis
GVWR	14,500 lbs.
Seating Configuration	14 passenger, perimeter seating
Motor	Permanent magnet motor, High-Power Inverter
Battery	105 kWh Nickel, Manganese, Cobalt (NMC) battery
Range	Up to 110 Miles All Electric Range
Charger Type	Dual Charging Capability: Level III: CHAdeMO compliant – 50 kW Level II: J1772 - 13 kW
Charge Time	Level II: 8 hrs / Level III: 3 – 4 hrs
Max Speed	65 mph (limited)
Acceleration	0-50 mph under 16 seconds
Gradeability	16% at 30 mph
Telematics	Phoenix Connect Telematics System

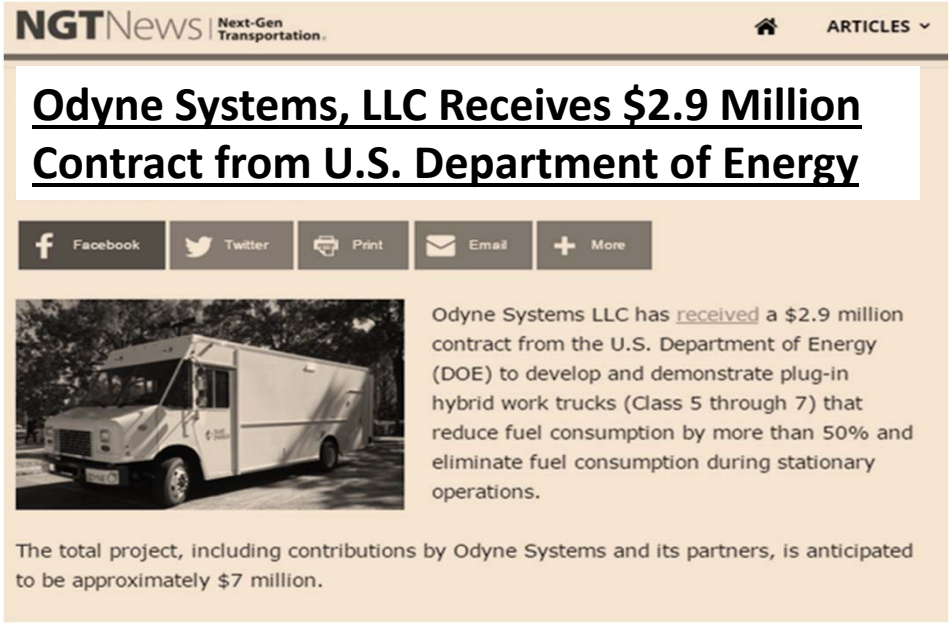
1. Southern California - Zero Emission Shuttle Transportation

2. **Develop and Demonstrate Medium-Heavy Duty Plug-in Hybrid Work Truck**

3. Fuel Cell Extended-Range Powertrain for Parcel Delivery Trucks

4. California Collaborative Advanced Technology Drayage Truck Demonstration

Develop and Demonstrate Medium-Heavy Duty Plug-in Hybrid Work Truck



NGTNews | Next-Gen Transportation. ARTICLES

Odyne Systems, LLC Receives $2.9 Million Contract from U.S. Department of Energy

Facebook Twitter Print Email More

Odyne Systems LLC has received a $2.9 million contract from the U.S. Department of Energy (DOE) to develop and demonstrate plug-in hybrid work trucks (Class 5 through 7) that reduce fuel consumption by more than 50% and eliminate fuel consumption during stationary operations.

The total project, including contributions by Odyne Systems and its partners, is anticipated to be approximately $7 million.

- Develop M/HD PHEV work trucks
  - Simulation Model for Powertrain Development and Optimization
  - Battery System Development
  - Vehicle Integration
    - PHEV powertrain and control system
    - Battery system
    - Electrified job site equipment
- 12 Month Field Demonstration
  - 5 in South Coast – Sempra Energy and Others
  - 5 in Southeast US – Duke Energy

South Coast AQMD

Technical Progress - Optimization

Dyno Baseline Results

- 2017 Freightliner-Odyne Hybrid Work truck Chassis tested by NREL
  - 3 NREL-Odyne Drive Cycles
  - 2 Standard Drive Cycles
  - Transient PTO Stationary cycle
  - PTO Stationary Fuel Mapping
  - Stationary Battery Recharge Cycle

- Data transferred to Odyne and Oak Ridge National Lab for model correlation and drive optimization

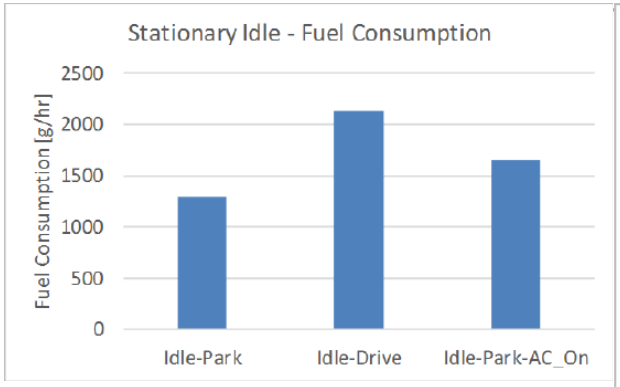
South Coast AQMD

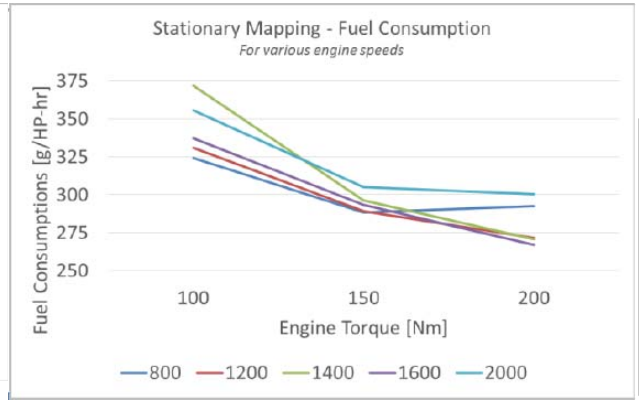
Technical Progress - Optimization

Dyno Baseline Results

- Dyno testing provided input for Simulation and further development
  - Idle Testing
  - Drive Fuel Mapping
  - Stationary Fuel Mapping
  - NOx and GHG Emissions analysis

Odyne-NREL Baseline Drive Cycle Testing		Fuel economy MPG	Hybrid Improvement %	Battery Use kWh/mi
UDDS	Conventional	6.19		
	Hybrid	6.31	1.99%	0.02
ODYNE High	Conventional	7.53		
	Hybrid	7.53	0.05%	-0.02
ODYNE Medium	Conventional	6.04		
	Hybrid	6.30	4.26%	0.16
ODYNE Low	Conventional	4.22		
	Hybrid	4.58	8.47%	0.47
HHDDT Transient	Conventional	5.86		
	Hybrid	6.24	6.57%	0.21



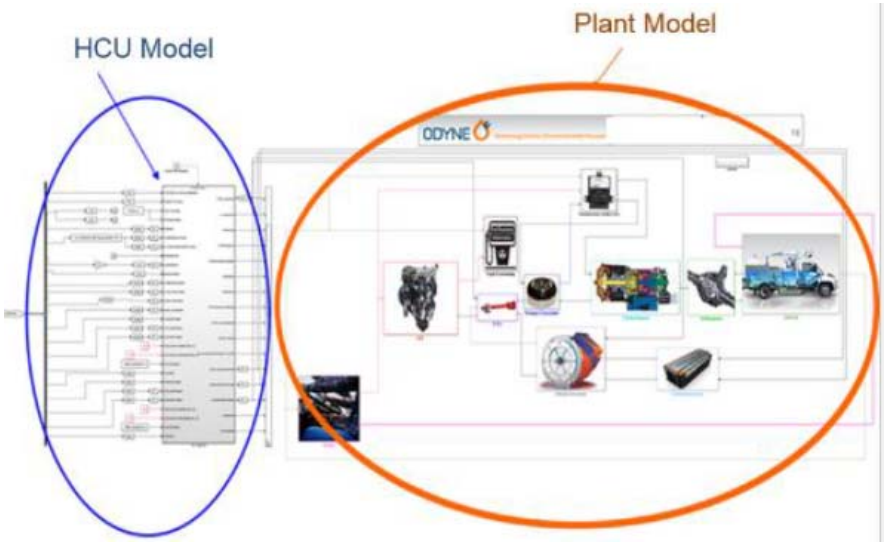


PTO shaft work specific results comparison			
	NOx	CO2	Fuel Use
	g/kW-hr	g/kW-hr	g/kW-hr
Calculated equivalent electrical PTO	**3.34**	**1815.21**	**549.59**
Tested conventional PTO	**32.61**	**8483.42**	**2827.03**

Technical Progress - Optimization

PHEV Model Development

- Oak Ridge National Lab, and Odyne prepared a Simulink Model incorporating the vehicle and hybrid system model
- After many iterations and refinements of the plant model, >90% correlation was achieved across all drive duty cycles in April, 2018



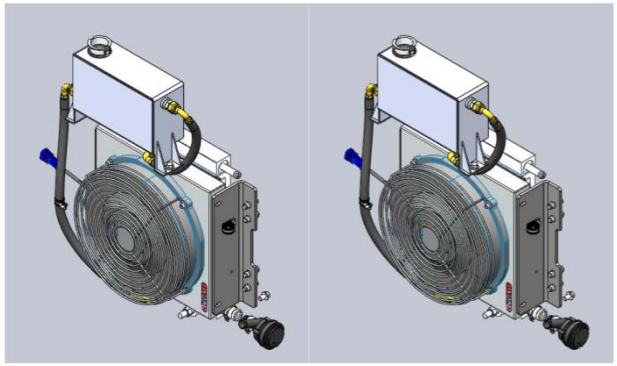
Odyne M2 ISB Correlation Results		UDDS			$HHDDT_{trans}$			NREL Low			NREL Med			NREL High		
Metric	Units	Dyno	Model	% Corr	Dyno	Model	% Corr	Dyno	Model	% Corr	Dyno	Model	% Corr	Dyno	Model	% Corr
Avg. Speed	MPH	18.55	18.59	100%	15.16	14.94	101%	7.55	7.45	101%	13.76	13.61	101%	25.98	25.94	100%
Fuel Use - Conventional	Gal	0.92	0.99	91%	0.49	0.50	98%	0.91	0.92	99%	1.52	1.60	95%	1.35	1.47	91%
Fuel Use - Hybrid Mild	Gal	0.89	0.93	95%	0.46	0.47	98%	0.83	0.80	103%	1.53	1.45	105%	1.35	1.43	94%

Technical Progress - Optimization

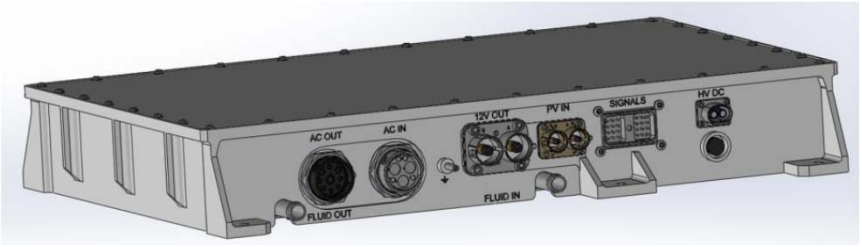
Chassis Development and Integration

- Drivetrain
  - Parker motor and Chelsea extended PTO

- Cooling System



- Power Electronics improvements



1. Southern California - Zero Emission Shuttle Transportation

2. Develop and Demonstrate Medium-Heavy Duty Plug-in Hybrid Work Truck

3. **Fuel Cell Extended-Range Powertrain for Parcel Delivery Trucks**

4. California Collaborative Advanced Technology Drayage Truck Demonstration

Fuel Cell Extended-Range Powertrain for Parcel Delivery Trucks

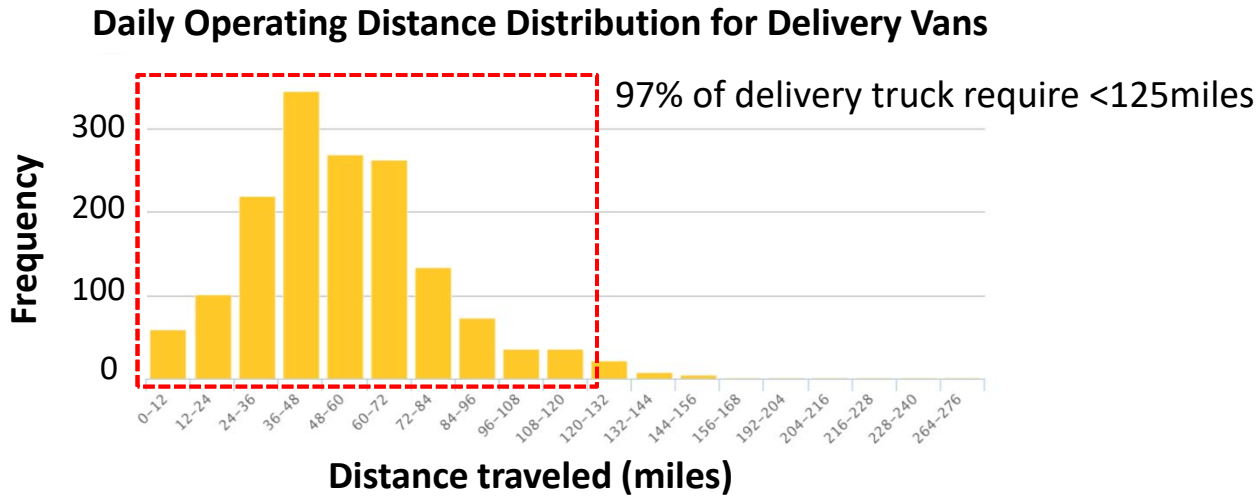
- Local operations with frequent stops
- Return-to-base fleets for centralized recharging/refueling

- Fuel cell extended-range powertrain expected to support performance and operational needs, all with zero emissions
- AQMD cost share: $589,750

South Coast AQMD

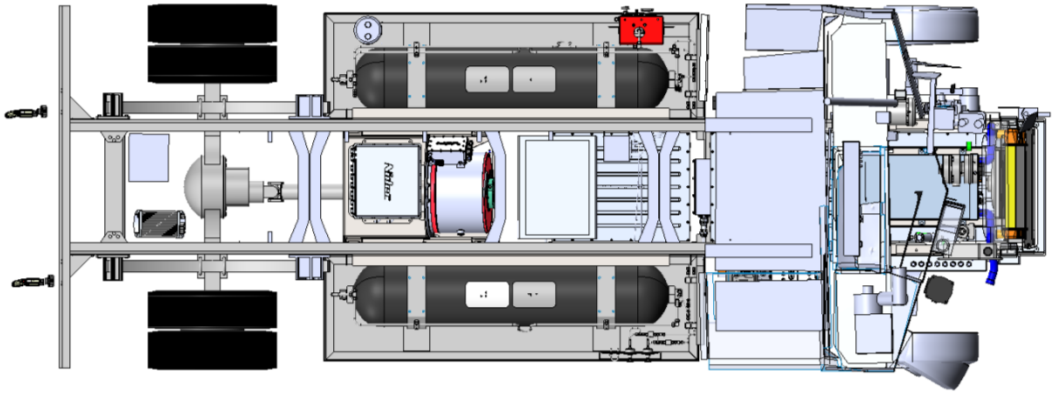
Fuel Cell Extended-Range Powertrain for Parcel Delivery Trucks

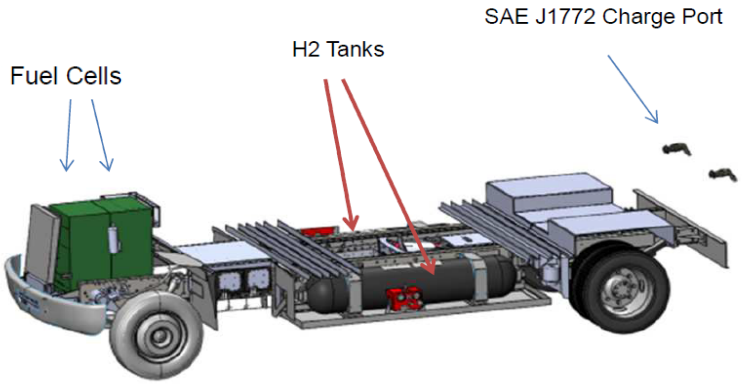
- Goal: Meet vehicle performance specifications
  - – Meet performance of existing delivery vans (diesel, CNG, electric)
  - – Increase existing route length capability of zero-emission delivery van from 70 miles to 125 miles
  - – Modeling for driving simulation

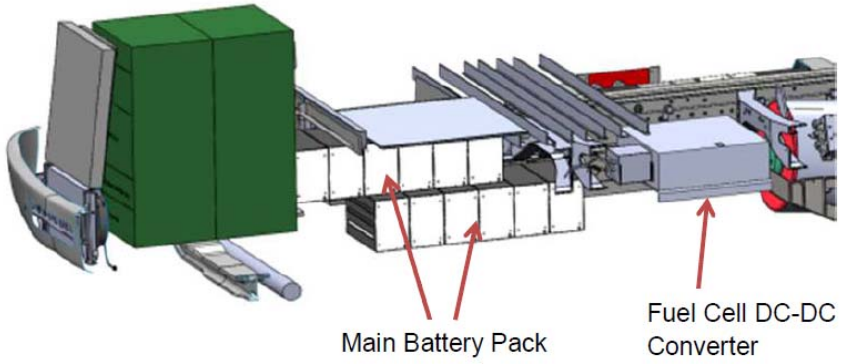


Source: Walkowicz, K.; Kelly, K.; Duran, A.; Burton, E. (2014). Fleet DNA Project Data. National Renewable Energy Laboratory.]

Vehicle design & simulation







South Coast AQMD

1. Southern California - Zero Emission Shuttle Transportation

2. Develop and Demonstrate Medium-Heavy Duty Plug-in Hybrid Work Truck

3. Fuel Cell Extended-Range Powertrain for Parcel Delivery Trucks

4. **California Collaborative Advanced Technology Drayage Truck Demonstration**

Advanced Technology Drayage Truck Demonstration

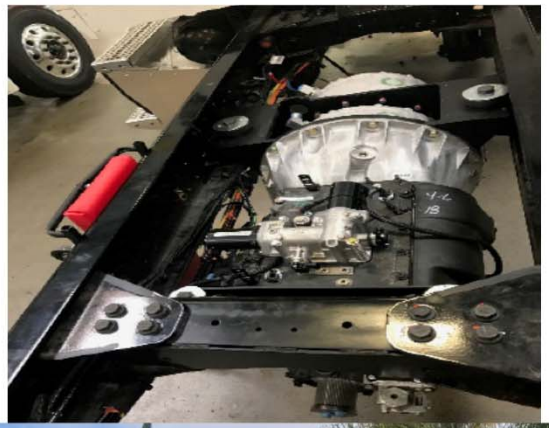
- Disproportionate impact on communities near Ports and along goods movement corridors

- Demonstration in real world drayage operation with fleet partners
  - –Assess technical and commercial viability
  - –Promote market acceptance

Architecture	Manufacturer	GGRF
BEV	BYD	25
	TransPower/Peterbilt	12
	US Hybrid	
PHEV	Kenworth	4
	TransPower	
	US Hybrid	
	Volvo	2

Technical Progress

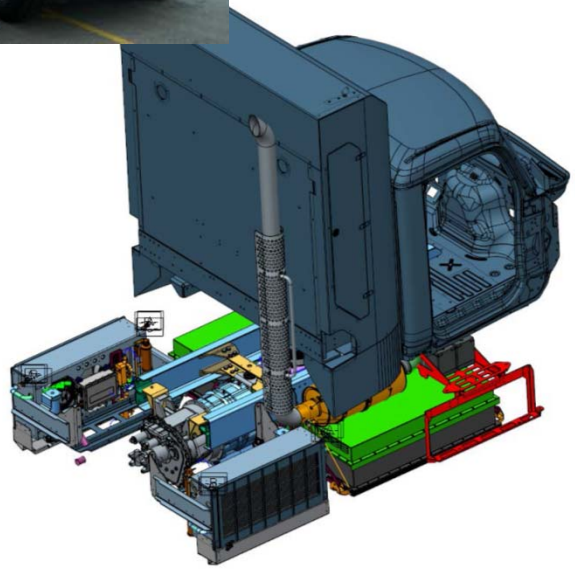
Peterbilt – Battery Electric Drayage Truck



Technical Progress

Kenworth– NG PHEV Drayage Truck

Test Data



Summary

❑ Battery Electric Airport Shuttle

Objective: To replace 29 conventional airport shuttles with battery electric shuttles

Accomplishments: Progress on executing contract and preparation for manufacturing

❑ Plug-in hybrid work truck

Objective: To develop and demonstrate medium-heavy duty Plug-In Hybrid Work Trucks

Relevance:

- Advanced work truck with a ≥50% reduction in fuel consumption and greenhouse gases when compared to a conventional diesel vehicle baseline,
- comprised of bucket trucks, digger derricks and underground utility trucks
- Improvement of the overall return on investment (ROI) of the vehicle system

Accomplishments: Progress on simulation work, dyno test and system optimization

Summary

❑ Fuel cell range extended delivery truck

Objective: To substantially increase the zero emission driving range and commercial viability of electric drive medium-duty delivery trucks.

Relevance: Fuel cell hybrid electric delivery van design, build, validation, deployment, and data collection project in the UPS fleet environment. Performance objectives includes 125 mile range and over 95% of UPS routes

Accomplishments: Completed vehicle design and dynamic simulation
Progress on assembly to be completed by Oct, 2018

❑ Advanced Technology Drayage Truck Demonstration

Objective: To demonstrate zero and near-zero emission drayage trucks

Relevance: Deploy battery electric and NG PHEV drayage truck, and data collection project

Accomplishments: 1st battery electric truck in under testing.
NG hybrid truck is to be completed by Apr, 2019.

Clean Fuels Advisory Group Meeting
September 12, 2018

Large Scale Hydrogen Refueling

Lisa Mirisola
Program Supervisor
Science and Technology Advancement
South Coast Air Quality Management District

SCAQMD's Clean Air Choices Program

- Features the cleanest new retail passenger vehicles
- Part of the AQMD website http://www.cleanairchoices.org.
- Out of 35 models listed for 2018
  - 18 Zero Emission (2 hydrogen fuel cell & 16 battery electric)
  - 17 Advanced Technology Partial (or new Transitional) Zero Emission plug-in hybrid gasoline-electric
- Outreach Efforts with clean and efficient vehicles, and highlight new electric and hydrogen fueling infrastructure

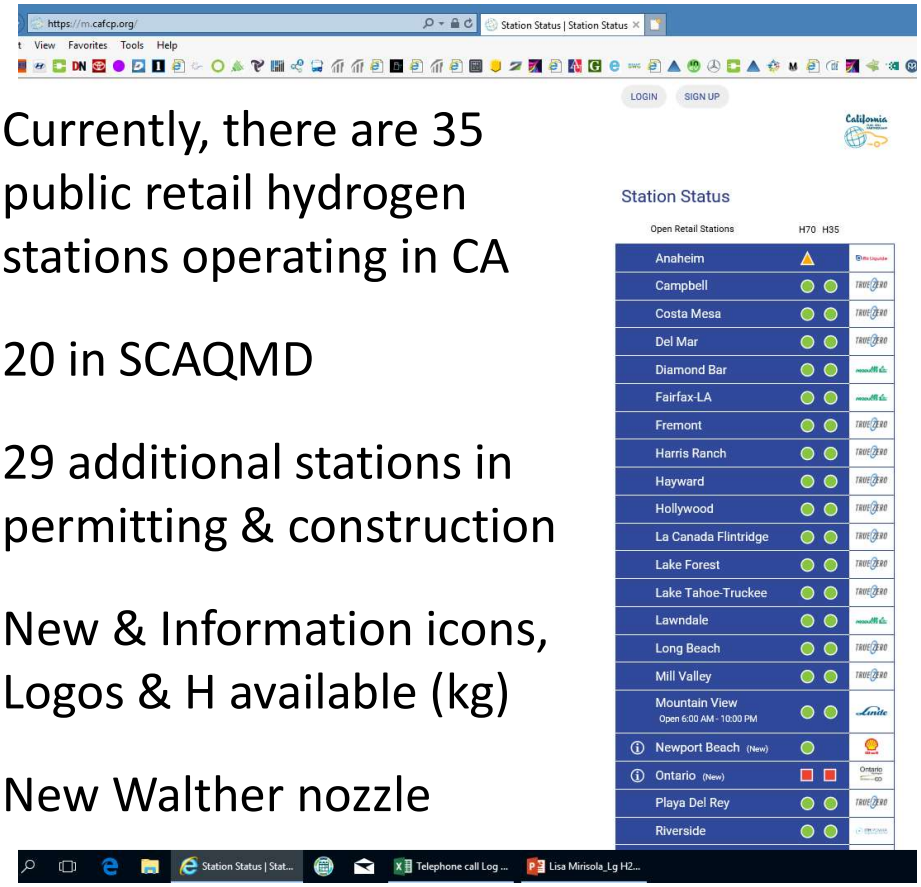
Federal & CA Current Incentives

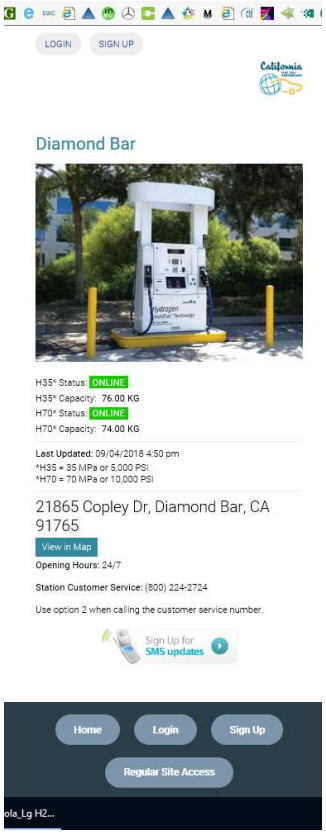
- $2,500 – $7,500 PEV federal tax credit for PEVs
- Up to $7,000 CA Clean Vehicle Rebate Project
  https://cleanvehiclerebate.org/eng
  Up to $9,500 if low-income www.replaceyourride.com
- Revised CA HOV lane incentive for new
  CARB certified FCV, BEV, & PHEVs (No cap, MY 2017+)
- Governor Brown executive order B-48-18
  - 1.5 million ZEVs in CA by 2025
  - 5 million ZEVs in CA by 2030
  - Proposes additional 200 hydrogen fueling stations and 250,000 EV chargers
- CA (2016) & Multi-State ZEV Action Plan (2018-2021)
- CEC & CARB infrastructure support
- Electric Utility - Off-peak (TOU) electric rates & Incentives

CLEAN VEHICLE REBATE PROJECT℠

CA Hydrogen Stations

- Currently, there are 35 public retail hydrogen stations operating in CA
- 20 in SCAQMD
- 29 additional stations in permitting & construction
- New & Information icons, Logos & H available (kg)
- New Walther nozzle





http://m.cafcp.org

California Fuel Cell Partnership

2018 CaFCP 2030 Vision

- Reduce costs and increase renewable hydrogen production
- Accelerate the pace of adoption
- Enable 1,000,000 fcvs and 1,000 hydrogen stations
- Diversify the portfolio of fuel cell products
- Deploy heavy-duty hydrogen fueling infrastructure along CA freight corridors
- Connect hydrogen and electricity as energy carriers

https://cafcp.org/sites/default/files/CAFCR.pdf

CaFCP Truck & Bus Fueling Codes & Standards Coordination

To facilitate the foundational work required for the growth of medium- and heavy-duty fuel cell truck and bus deployments, tasks include:

- Sponsor SAE J2600 Compressed Hydrogen Surface Vehicle Fueling Connection Devices revision to include high flow interface geometries and align with ISO 17268
- Sponsor SAE J2601-2 Fueling Protocol for Gaseous Hydrogen Powered Heavy Duty Vehicles from TIR 2014 to Surface Vehicle Standard & align with J2600 & ISO
- General MD/HD vehicle and infrastructure safety, codes, and standards & update first responder training
- Facilitate task forces (truck & bus) and outreach; coordinate 2018 Fuel Cell Electric Truck (FCET) Action Plan with stakeholders

California Hydrogen Infrastructure Research Consortium

- U.S. DOE H2@Scale program with national labs, CA GO-Biz, CEC, SCAQMD, and CARB
- Joint agreement led by NREL to continue hydrogen infrastructure research efforts, focused on California near-term priorities
- Project Management Plan with schedule, budget, roles, milestones, tasks and reporting

Heavy-Duty Hydrogen Vehicle Activities

- Toyota 700 bar fuel cell truck demonstration at POLB

- Renewable hydrogen (biogas) produced by FuelCell Energy trigeneration at POLB

H2Freight Project

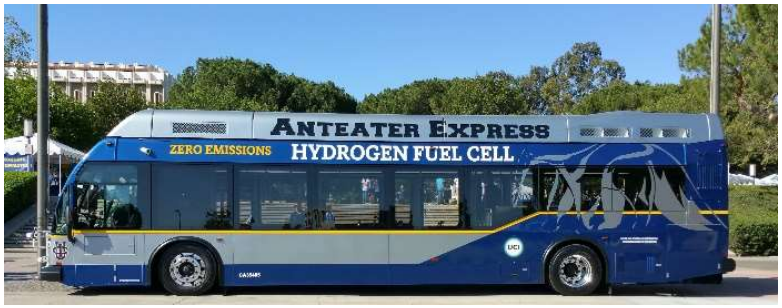
- CEC GFO-17-603 - Advanced Freight Vehicle and Infrastructure Deployment:
  Award to Equilon (dba Shell) for 1,000 kg/day truck refueling to demonstrate zero emission goods movement at ports (H2Freight Project),
  with multiple fueling positions at 700 bar
- SCAQMD cost-share to refuel heavy-duty vehicles at 350 bar, supporting fuel cell demonstrations by multiple operators at local ports
- Evaluate fueling protocols, dispenser design, station throughput/reliability, etc.

UC Irvine Hydrogen Station Expansion

- UCI station has been operating at design capacity and is in urgent need of additional capacity to fuel cars and buses.

- Proposed expansion to 800 kg/day with liquid delivery, increased storage, and four fueling positions
- Public use will continue 24/7, with buses scheduled to refuel at night

- MSRC PON 2018-02 for up to $1M
  MSRC-TAC recommended to MSRC (Sept. 20)
- Requested $400k CEC ARFVTP
  October Business meeting
- Proposed for $400k Clean Fuels Funding for October Technology Committee & November Governing Board



Potential Projects & Funding

Potential Clean Fuels Projects

- Continue to evaluate large capacity H2 production and refueling infrastructure opportunities
- Coordinate with CaFCP – Vision 2030 Implementation
- POLA-ZANZEFF Application – 10 FCTs & 2 H2 stations (Ontario & POLA)

Potential Truck & Station Cofunding

- MSRC PON2018-02
- Moyer
- VW Settlement
- Other State & Federal Solicitations

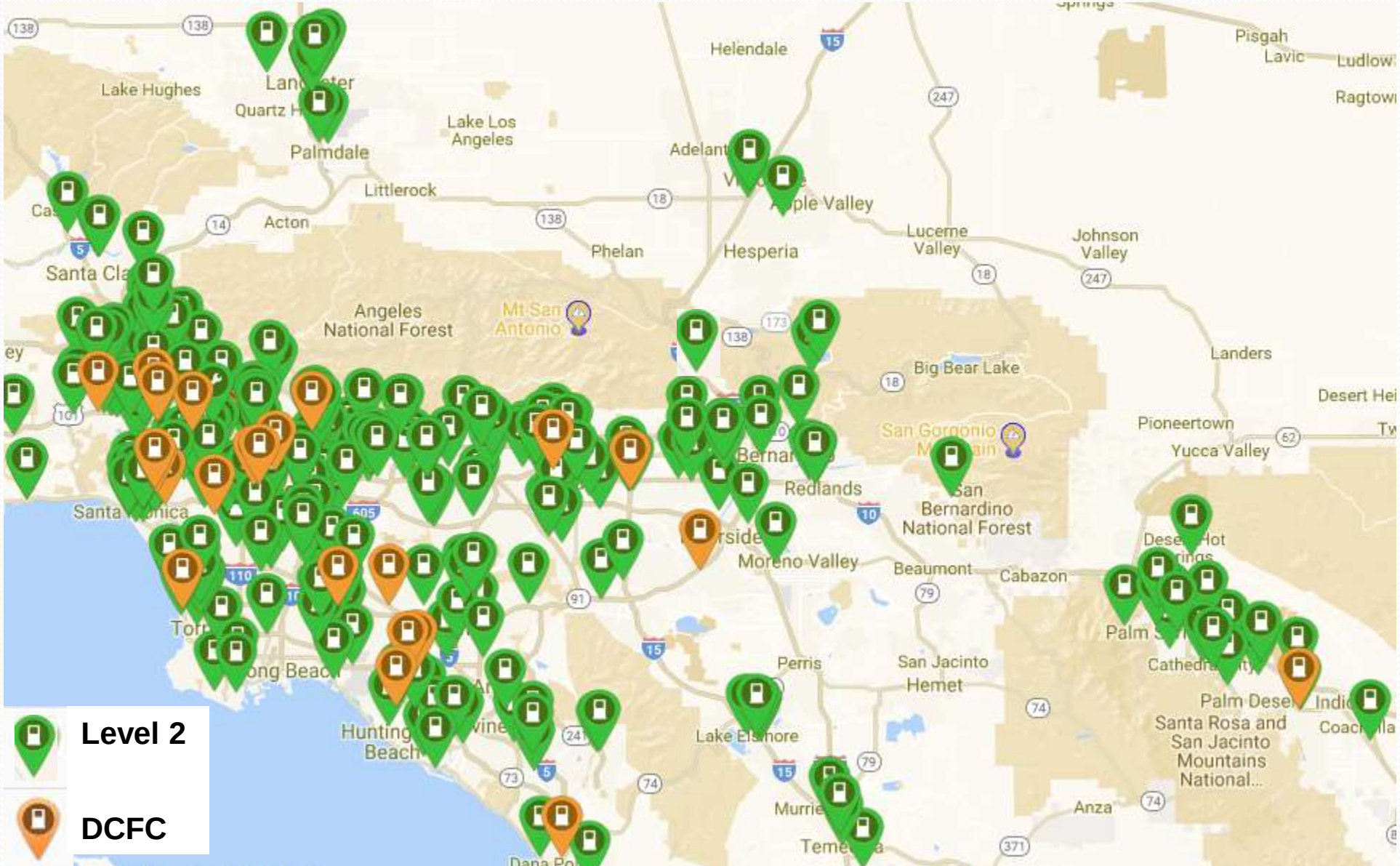
Residential EV Charger Rebate Program Update
Clean Fuels Retreat
September 12, 2018

Patricia Kwon
Technology Advancement Office

EVSE Deployment Efforts

- DC Fast Charging – 17 site network
  CEC $1.22M
- SoCalEV – 321 Level 2 for workplace
  and destination charging
  CEC $840k
- SCAQMD Workplace Charging – 92 Level 2 chargers
- Residential EV Charger Rebate Program
  $500k SCAQMD, $500k MSRC
- Disbursing Chargers to Utilities, Municipalities

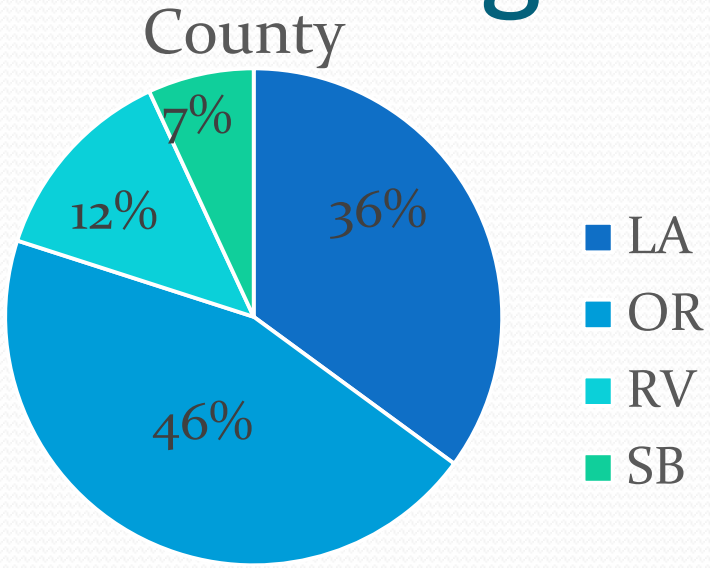
Level 2 and DC Fast Charging Map

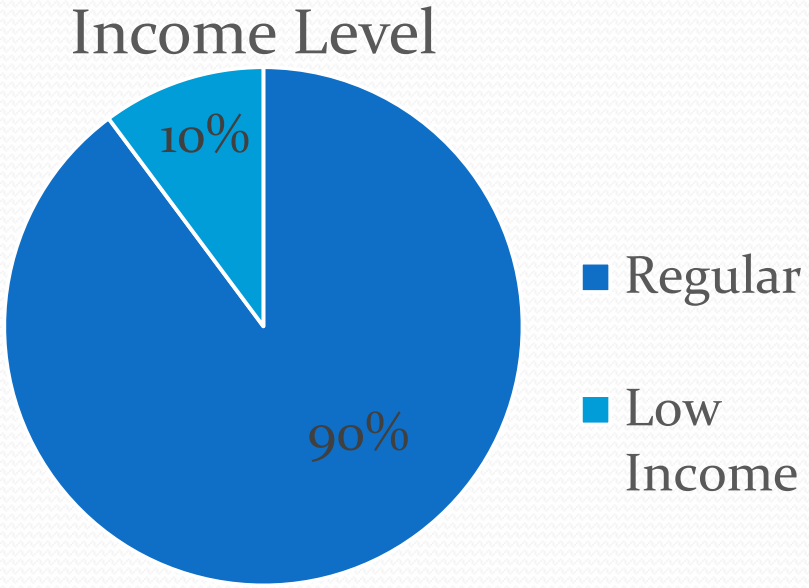


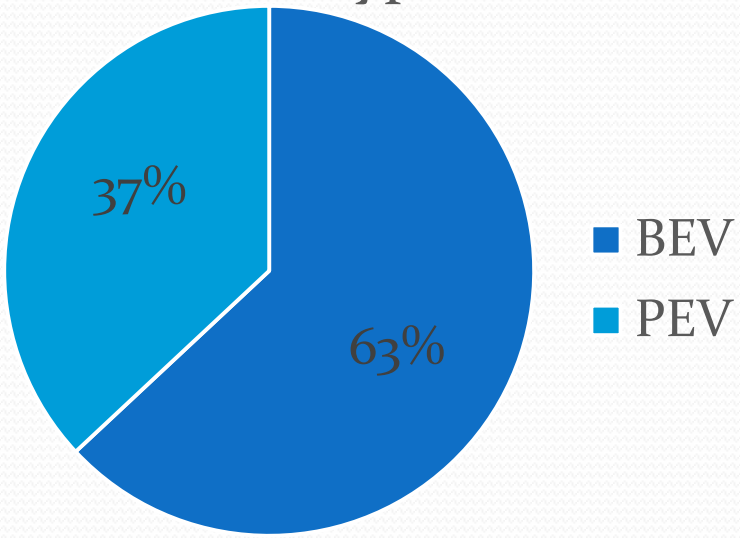
Residential EV Charger Rebate

- $250 or $500 (low income) rebate towards hardware
- 579 rebates awarded
- Residential chargers cost $400 - $800
- BEV rebates continue to be more popular
- Popular charger models: ChargePoint, Clipper Creek, Juicebox

EV Charger Rebate Statistics

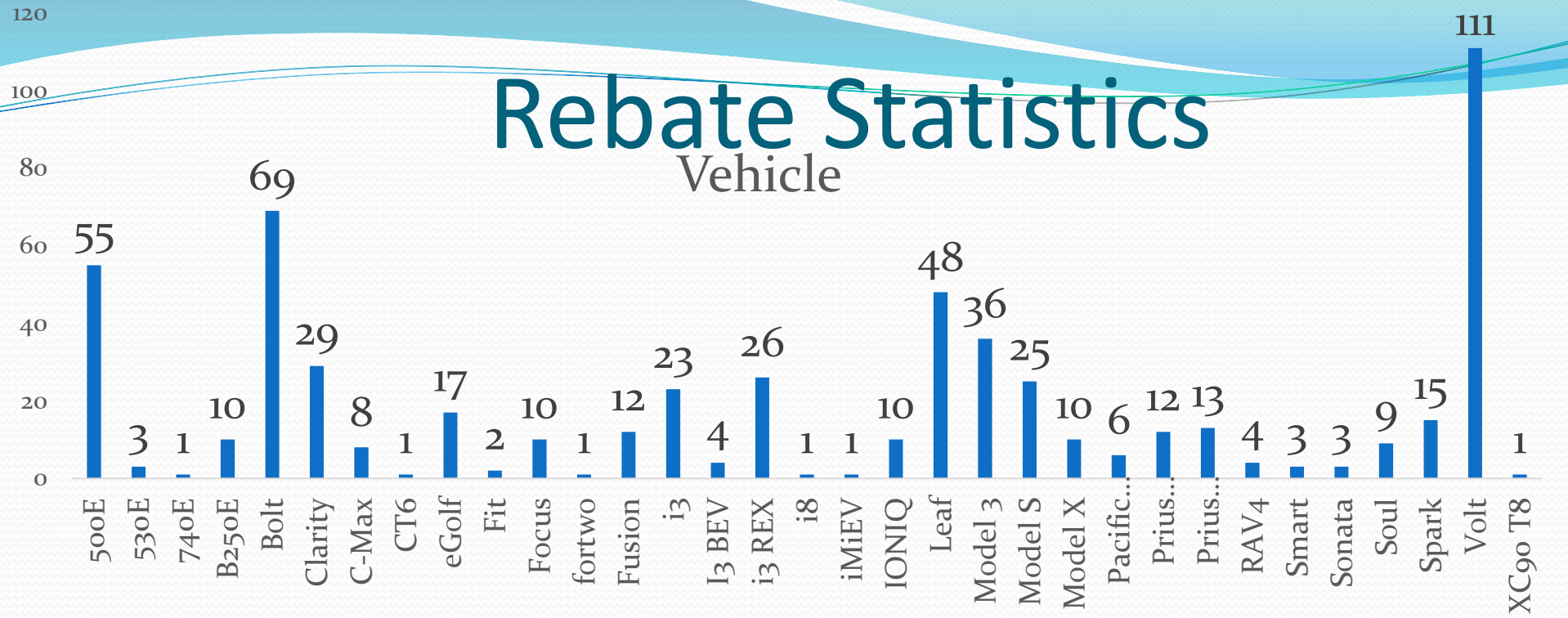


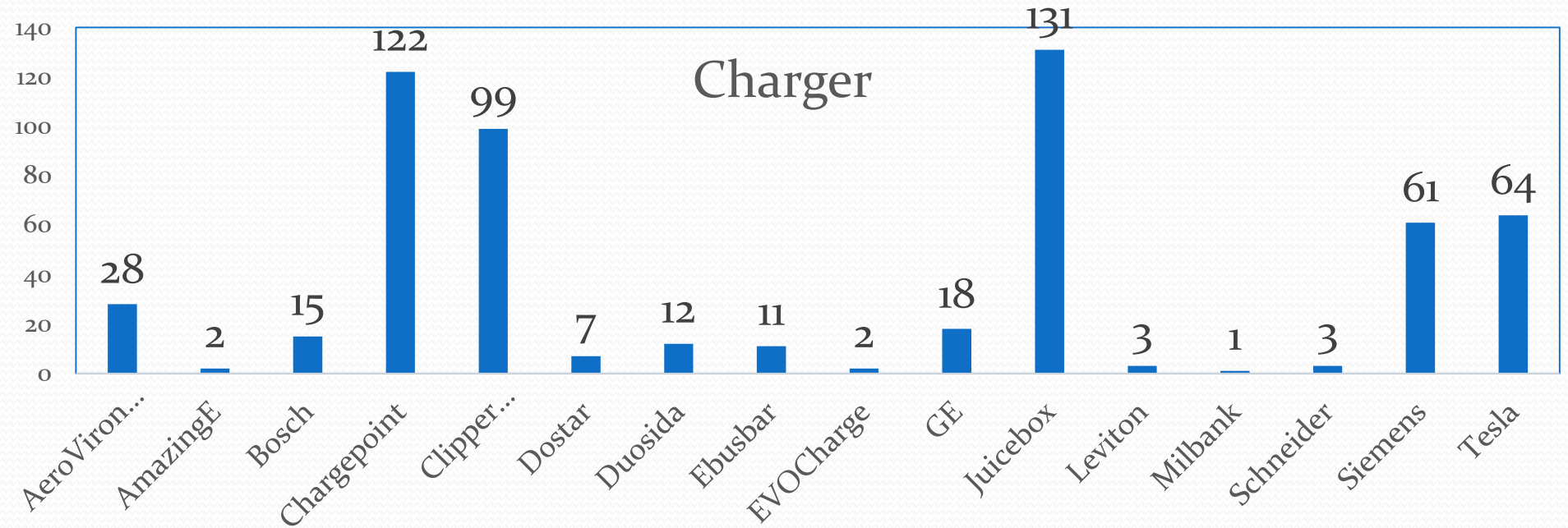




579 EV Rebates Processed 8/31/18

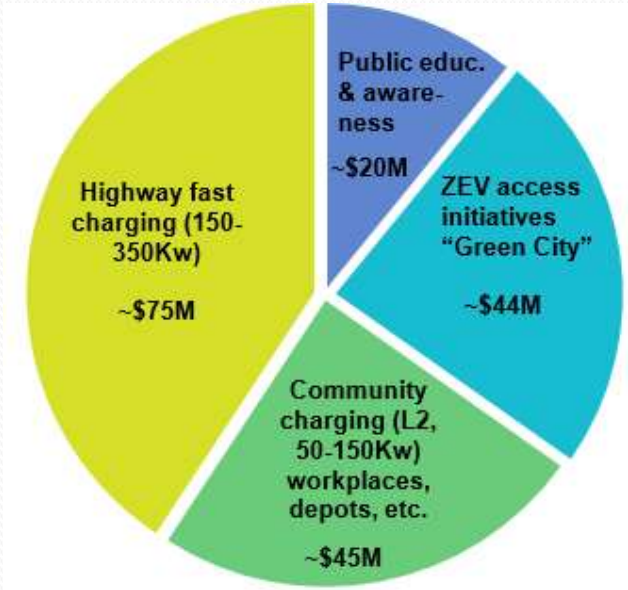
Rebate Statistics



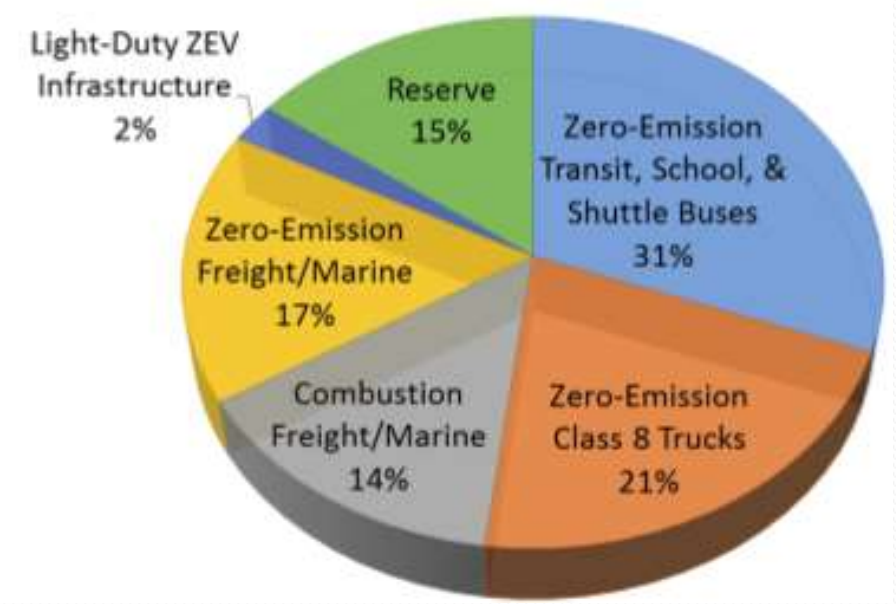


Incentive Opportunities

- VW Settlement, Appendix C (CA)—first round of $200M
  - $75M DC fast charging (150 kW)
  - $45M community charging in six communities including LA
- VW Settlement, Appendix D—$10M light duty infrastructure



Cycle 1 California Plan



Environmental Mitigation Trust

Incentive Opportunities

- CEC ARFVTP 2018-2019 Investment Plan
  - Adopted May 2018
  - $94.2M for EV infrastructure
- Southern CA Incentive Project (SCIP)
  - $29M for DC fast charging
  - $70,000/$80,000 DCFC or 75%/80% total cost for new installations (higher for DACs)
  - $40,000/DCFC or 75% total cost for swapouts
  - $600,000/application in LA, OR counties
  - $300,000/application in RV, SB counties

Utility or City Programs

- SCE ChargeReady Home Installation ($500 or $1500/charger)
- LADWP Charge Up LA! ($500/charger)
- Power Up Pasadena ($200 or $600/charger)
- Burbank Charger Rebate ($500/charger)
- Colton Electric Utility Rebate ($500/charger)
- Anaheim EV Charger Rebate ($500/charger)
- Azusa EV Charger Rebate ($150/charger)
- Long Beach EV Charger giveaway

ANAHEIM
PUBLIC UTILITIES

LONG BEACH

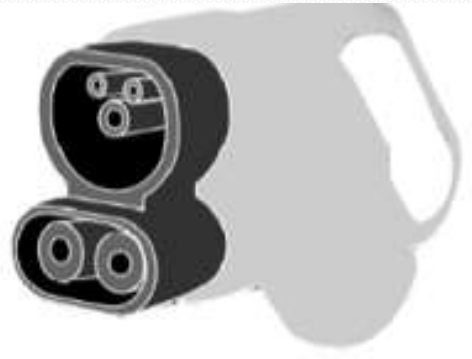
CITY OF BURBANK
Water and Power
Since 1913

CITY OF AZUSA
INCORPORATED
DEC. 29, 1898
CALIFORNIA

City of Colton
ELECTRIC UTILITY

Medium/Heavy Duty Infrastructure

- EPA Targeted Air Shed
  - Demonstrate 16 battery electric yard tractors
  - POLA (WBCT), POLB (TTI)
  - Install 150/200 kW fast chargers
- CARB CPORT
  - Demonstrate 3 battery electric top handlers, battery and fuel cell yard trucks
  - POLB (LBCT and SSA)
  - Install 200 kW fast chargers
- SAE J3068 or CCS connectors, J3105 overhead charging



Clean Fuels Program Advisory Group
September 12, 2018

Enhanced Fleet Modernization Program

Mei Wang
Program Supervisor
Science and Technology Advancement
South Coast Air Quality Management District

Background

- Branded as Replace Your Ride
- Voluntary vehicle retirement & replacement program
  - Light and Medium duty vehicles
  - Old vehicle must be scraped
- Vouchers can be used to obtain:
  - Replacement vehicle (8 years old & newer)
  - Alternative transportation card
    - Transit passes, taxicab, Uber, Lyft

Program Overview

- Up to $9,500 for qualified applicants
  - Higher funding amount in disadvantaged communities
  - Additional $2000 to install EV charger for a battery electric vehicle
  - Tiered funding based on household income
- 48 participating dealerships
- Consumer protections provided
- Multilingual assistance is available
- Funds remaining: $4 million
  - Additional 16.4 M was allocated for FY17-18

Program Incentive Amounts[1]

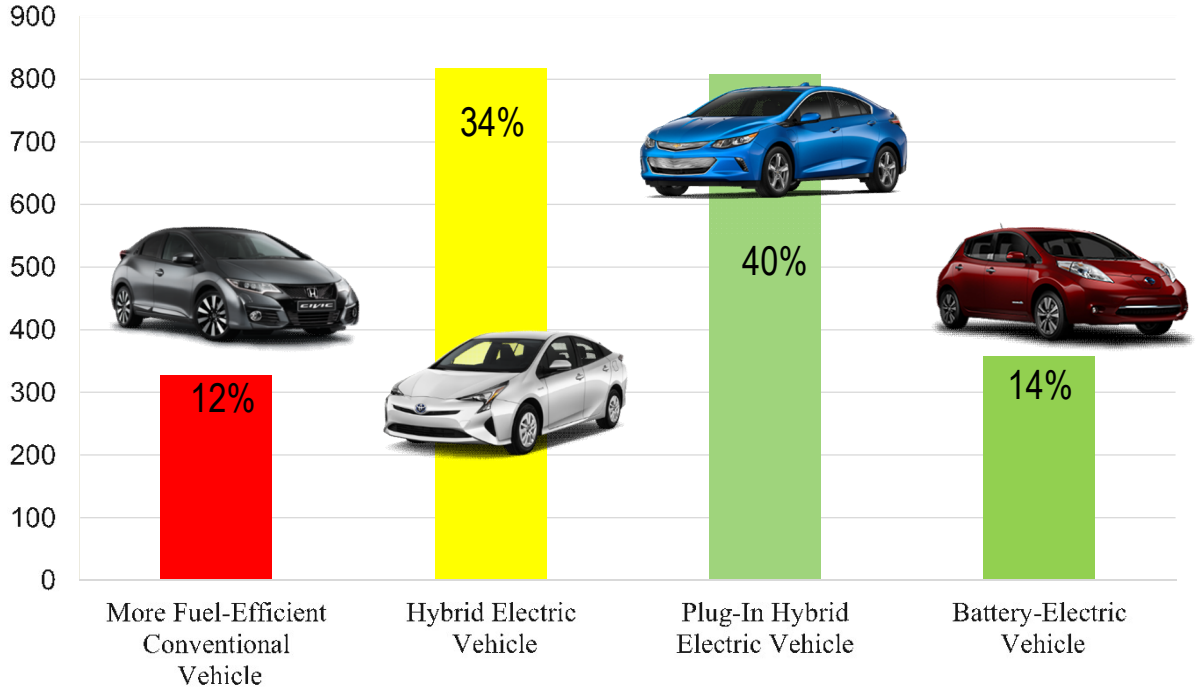
Income Eligibility	Conventional		Hybrid		Plug-In Hybrid & Zero-Emission[3,4]
	20+ MPG[2]	35+ MPG	20+ MPG	35+ MPG	
Low	$4,000	$4,500	$4,000 or $6,500	$4,500 or $7,000	$4,500 or $9,500
Moderate	-----	$3,500	-----	$3,500 or $5,000	$3,500 or $7,500
Above Moderate	-----	-----	-----	-----	$2,500 or $5,500

1 Option to receive a transportation voucher valued at $2,500 to $4,500 in lieu of obtaining a replacement vehicle.
2 MPG threshold varies by vehicle model year.
3 Zero-emission vehicles include battery electric vehicles (BEVs) and fuel cell vehicles.
4 BEVs are eligible for an additional incentive up to $2,000 for the installation of electric vehicle charging equipment.

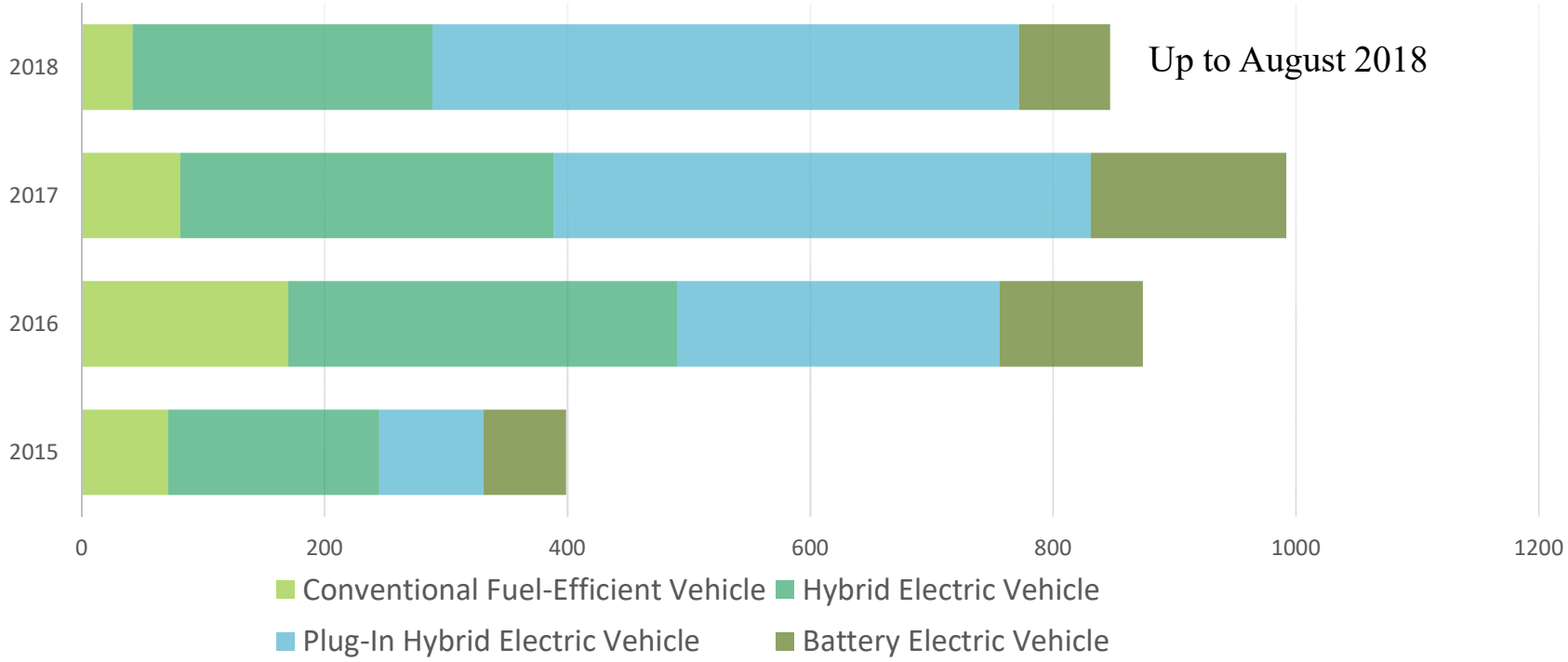
Program Statistics (as of August)

- Implementation started in 2015
- Over 3,100 vouchers issued and over $24M spent
  - 94% - Disadvantaged communities
  - Income level participation
    - 88% - ≤ 225% federal poverty level (low)
    - 9% - ≤300% federal poverty level (moderate)
    - 3% - ≤ 400% federal poverty level (above moderate)
- Average replacement vehicle MY 2014, fuel economy: 40 mpg
- Average retirement vehicles MY1999, fuel economy: 22 mpg

Program Funded Replacement Vehicle Summary



Replacement Vehicle Technologies

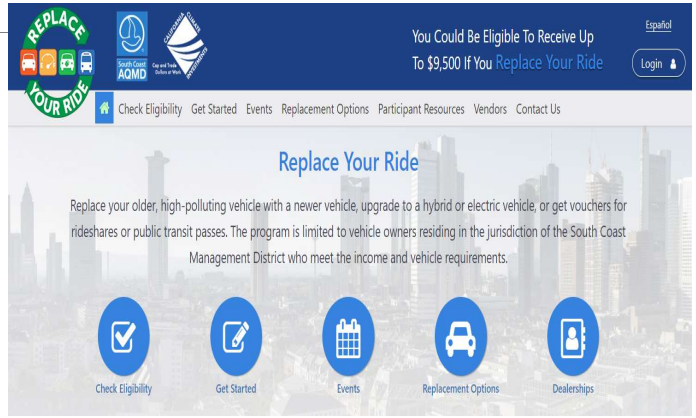


Challenges and Improvements

- Vouchers processing timeline
- Website improvements
  - Automation
  - Finance module
- Bi-monthly application assistance workshops
- Case managers and dealerships training
- Video - application processing procedure

Additional Program Information

Website: www.replaceyourride.com



Call Center: (844) 797-2223

email: info@replaceyourride.com

Questions?

South Coast Air Quality Management District

Clean Fuels Program

November 2018

2019 Draft Plan Update

Technology Advancement Office

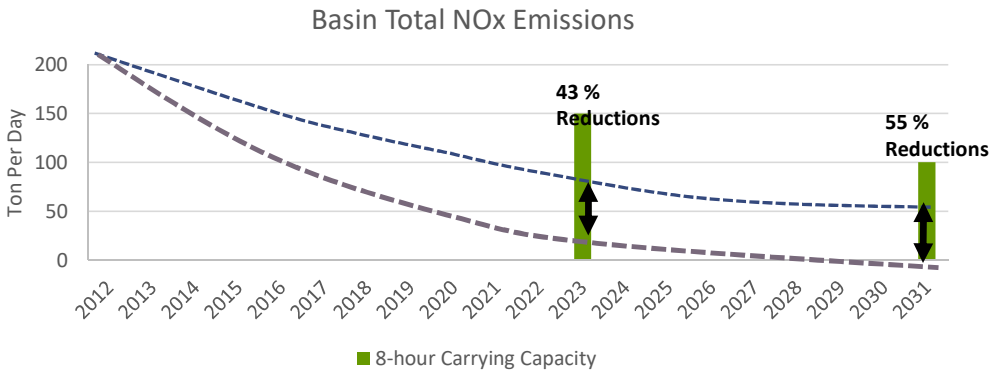
Leading the way to zero and near-zero emission technologies

Federal/State Actions

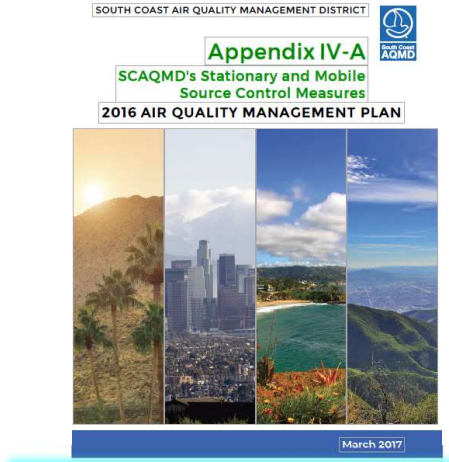
- USEPA – Pending NG Engine FOA
- CARB – Mobile Source Strategy
  - Innovative Clean Transit – Proposed
  - Zero and Near Zero Freight Facilities
- LACI/Other Stakeholders – Zero Emissions 2028 RoadMap
- CPUC – IOU (SCE) MHD Infrastructure
- The 100 Percent Clean Energy Act of 2019
  - SB 100-California Renewables Portfolio Standard
  - Carbon Free by 2045

South Coast Plans & Policies

- 2016 AQMP – NAAQS
  - 2008 8-hr Ozone – 75 ppb



  - Facility Based Mobile Source Measures
    - MOB-01 – Commercial Marine Ports
    - MOB-02 – Railyard and Intermodal Yards
    - MOB-03 – Warehouse Distribution Centers
    - MOB-04 – Commercial Airports
    - EGM01 – New/Redevelopment Projects



2019 Plan
Key Proposed Projects

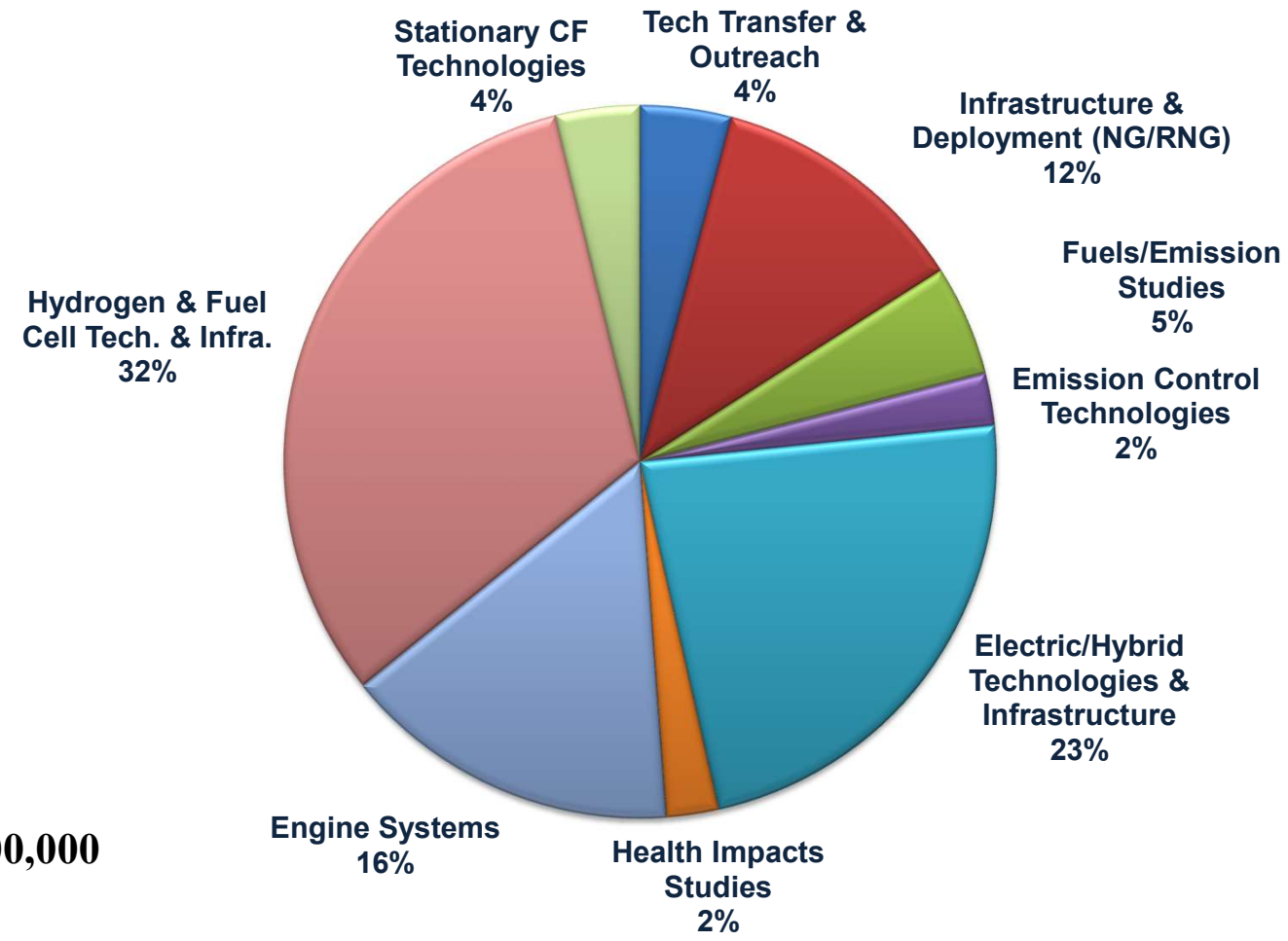
- Zero Emission Container Truck Development
- Medium and Heavy-Duty Fuel Cell Vehicles
- Infrastructure – Medium- & Heavy-Duty
  - Hydrogen Refueling Stations
  - Electric Vehicle Charging Infrastructure
- Development & demonstration of advanced engines
- Renewable Fuels
- Freight Efficiency Studies

Projects not funded in 2019 may be considered for funding in future years

Draft 2019 Plan Update
(Key Technical Areas)

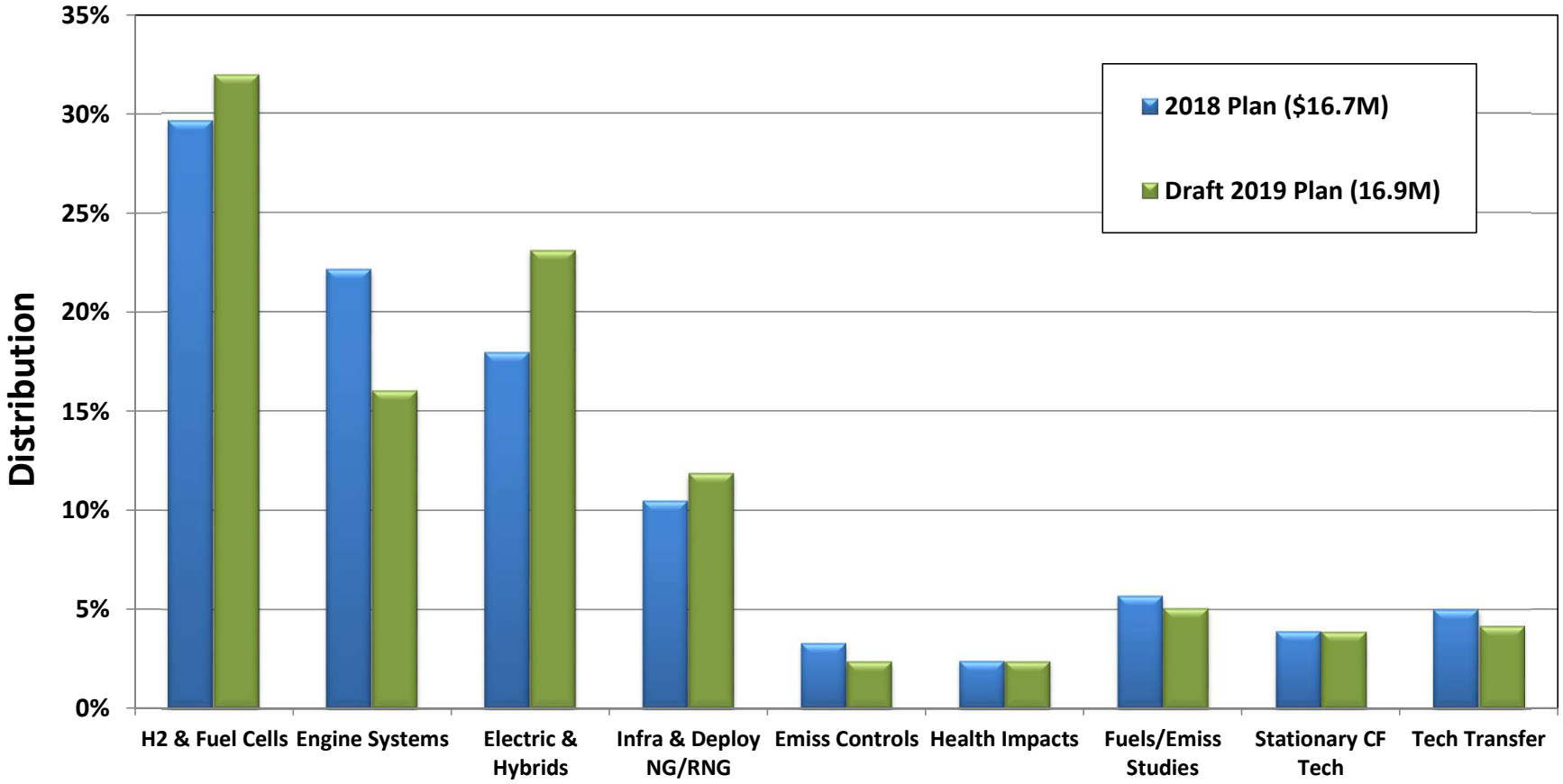
- Maintain focus priorities on zero and near-zero emissions goods movement technologies
- Near-zero emission (gaseous and liquid fuel) engine systems, especially high HP uses
- Expand focus on local biogas production and use
- Maintain focus on hybrid, plug-in, electric-drive technologies and infrastructure
- Onsite hydrogen production and dispensing
- Maintain other areas of emphasis

Proposed 2019 Plan Distribution



$16,700,000

Plan Update Comparison



Proposed Distribution

	2018 Plan	Draft 2019 Plan
H2 & Fuel Cells & Infra	30%	32%
Electric & Hybrids & Infra	18%	23%
Engine Systems/Technologies	22%	16%
Infrastructure & Deployment (NG)	10%	12%
Fuels & Emissions Studies	6%	5%
Stationary CF Tech	4%	4%
Emissions Control Technologies	3%	2%
Health Impacts Studies	2%	2%
Tech Transfer/Assessment & Outreach	5%	4%
	100%	100%

Feedback

Email Naveen Berry
nberry@aqmd.gov