CLEAN FUELS PROGRAM ADVISORY GROUP AGENDA
JANUARY 29, 2026, 8:00 AM – 4:00 PM

University of California, Riverside
College of Engineering - Center for Environmental Research & Technology
1084 Columbia Ave
Riverside, CA 92507

TELECONFERENCE LOCATIONS

LADWP 111 N. Hope St., Los Angeles, CA 92324	University of Nevada, Reno 1667 N. Virginia St, Reno NV 89557

A meeting of the South Coast Air Quality Management District Clean Fuels Program Advisory Committee will be held at 9:00 a.m. on Thursday, January 29, 2026, through a hybrid format of in-person attendance in the University of California, Riverside College of Engineering - Center for Environmental Research & Technology (UCR/CE-CERT), 1084 Columbia Ave, Riverside, CA 92507, and remote attendance via videoconferencing and by telephone. Please follow the instructions below to join the meeting remotely. Please refer to South Coast AQMD's website for information regarding the format of the meeting, updates if the meeting is changed to a full remote via webcast format, and details on how to participate:

INSTRUCTIONS FOR ELECTRONIC PARTICIPATION

Join Zoom Webinar Meeting - from PC or Laptop
https://aqmd.zoomgov.com/j/1601382674
Zoom Webinar ID: 160 138 2674
Teleconference Dial In: +1 669 254 5252
One tap mobile: +16692545252,1601382674#

Audience will be allowed to provide public comment through telephone or Zoom connection.

INSTRUCTIONS FOR ELECTRONIC PARTICIPATION AT BOTTOM OF AGENDA

AGENDA

Members of the public may address this body concerning any agenda item before or during consideration of that item (Gov't. Code Section 54954.3(a)). If you wish to speak, raise your hand on Zoom or press Star 9 if participating by telephone. All agendas for regular meetings are posted at South Coast AQMD Headquarters, 21865 Copley Drive, Diamond Bar, California, at least 72 hours in advance of the regular meeting. Speakers may be limited to two (2) minutes each.

Please note that under the California Public Records Act (Gov't. Code § 7920.000 et seq.) your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email) become part of the public record and can be released to the public on request or posted on the South Coast AQMD website.

Breakfast (UCR/CE-CERT Foyer Area)
8:00 AM – 9:00 AM

Welcome & Overview
9:00 AM – 10:15 AM

(a)	Welcome and Opening Remarks	Aaron Katzenstein, Ph.D., Deputy Executive Officer* & Don Collins, Ph.D., Professor of Chemical and Environmental Engineering & Director of UCR/CE-CERT
(b)	Goals for the Day	Vasileios Papapostolou, Sc.D., Technology Demonstration Manager*
(c)	Updates on Grants and Incentives	Mei Wang, Assistant Deputy Executive Officer*
(d)	Feedback and Discussion	Advisors and Experts
(e)	Public Comment (2 minutes/person)	

1.	**Hydrogen/Mobile Fuel-Cell Electric Technologies: Refueling Infrastructure and Vehicles** **Moderator – Maryam Hajbabaei, Ph.D., Program Supervisor*** **10:15 AM – 12:00 PM**	
(a)	California Fuel-Cell Electric Vehicle and Hydrogen Market Outlook and 2026 Activities	David Park, Director of Industry Affairs, Hydrogen Fuel Cell Partnership
(b)	Current Hydrogen Related Activities and Policies	Leslie Goodbody, Staff Zero Emission Vehicle Infrastructure Specialist, California Air Resources Board
(c)	Accelerating Clean Hydrogen Deployment with Cost-Effective Production: A Differentiated, Scalable Hydrogen Production Platform Designed for Local Deployment	Timothy Fogarty, Chief Executive Officer, PCC Hydrogen
(d)	Infrastructure Considerations for Hydrogen Fuel-Cell Powered On- and Off-Road Applications	Benjamin Happek, Ph.D., General Manager, Energy & Hydrogen, Hyundai Motor America
(e)	Hydrogen Fuel-Cell Electric Vehicle Modular Architecture: Current Projects and Future Applications	Juan Andres Garza, Engineering Site Director, Symbio, Inc.
(f)	Feedback and Discussion	Advisors and Experts
(g)	Public Comment (2 minutes/person)	

Lunch (UCR/CE-CERT Foyer Area)
12:00 PM – 1:00 PM

2.	**Emissions Characterization Studies: UCR/CE-CERT Research** **Moderator – Sam Cao, Ph.D., Program Supervisor*** **1:00 PM – 2:30 PM**	
(a)	Secondary Particulate Matter from Tire Emissions	Don Collins, Ph.D.
(b)	Assessing Community Air Quality and Health Benefits of Freight Emission Mitigation Strategies in South Coast Air Basin	Kanok Boriboonsomsin, Ph.D., Research Engineer
(c)	Real-World Measurements and Evaluation of Brake- and Tire-Wear Emissions from Light-Duty Vehicles	Georgios Karavalakis, Ph.D., Professor of Chemical and Environmental Engineering
(d)	Ammonia Observations in the Los Angeles Basin	Heaven Denham, Doctoral Candidate in Climate Change and Sustainability
(e)	Feedback and Discussion	Advisors and Experts
(f)	Public Comment (2 minutes/person)	

3.	**Wrap-up** **2:30 PM – 3:15 PM**	
(a)	2026 Clean Fuels Plan Update & Wrap-up	Vasileios Papapostolou, Sc.D.
(b)	Advisor and Expert Comments	All
(c)	Public Comment (2 minutes/person)	

4.	Tour of UCR/CE-CERT Laboratories 3:15 PM – 4:00 PM

(a) Vehicle Testing Laboratories (25 minutes):
- Heavy-Duty Chassis Dynamometer — Tom Durbin, Ph.D.
- Heavy-Duty Engine Dynamometer — Kent Johnson, Ph.D.
- Light-Duty Chassis Dynamometer — Georgios Karavalakis, Ph.D.

(b) Atmospheric Processes Laboratory (20 minutes): — David Cocker, Ph.D.
- World's Largest Indoor Climate-Controlled Chamber
- Incremental Reactivity Dual Chambers

* South Coast AQMD Technology Advancement Office

Other Business
Any member of the Advisory Group, 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)

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 Advisory Group's authority that is not on the agenda. Speakers may be limited to two (2) 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 by contacting 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.

Americans with Disabilities Act
Disability and language-related accommodations can be requested to allow participation in the Clean Fuels Program Advisory Group meeting. The agenda will be made available, upon request, in appropriate alternative formats to assist persons with a disability (Gov't Code Section 54954.2(a)). In addition, other documents may be requested in alternative formats and languages. Any disability or language-related accommodation must be requested as soon as practicable. Requests will be accommodated unless providing the accommodation would result in a fundamental alteration or undue burden to South Coast AQMD. 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.

INSTRUCTIONS FOR ELECTRONIC PARTICIPATION

Instructions for Participating in a Virtual Meeting as an Attendee
As an attendee, you will have the opportunity to virtually raise your hand and provide public comment.

Before joining the call, please silence your other communication devices such as your cell or desk phone. This will prevent any feedback or interruptions during the meeting.

Please note: During the meeting, all participants will be placed on Mute by the host. You will not be able to mute or unmute your lines manually.

After each agenda item, the Chairman will announce public comment.

Speakers will be limited to a total of three (3) minutes for the Consent Calendar and Board Calendar, and three (3) minutes or less for other agenda items.
A countdown timer will be displayed on the screen for each public comment.

If interpretation is needed, more time will be allotted.

Once you raise your hand to provide public comment, your name will be added to the speaker list. Your name will be called when it is your turn to comment. The host will then unmute your line.

Directions for Video ZOOM on a DESKTOP/LAPTOP:

- If you would like to make a public comment, please click on the **"Raise Hand"** button on the bottom of the screen.
- This will signal to the host that you would like to provide a public comment and you will be added to the list.

Directions for Video Zoom on a SMARTPHONE:

- If you would like to make a public comment, please click on the **"Raise Hand"** button on the bottom of your screen.
- This will signal to the host that you would like to provide a public comment and you will be added to the list.

Directions for TELEPHONE line only:

- If you would like to make public comment, please **dial *9** on your keypad to signal that you would like to comment.

January 2026 Incentive & Grant Updates
Mei Wang

South Coast AQMD

Main Incentive Programs

Carl Moyer Program

- HD trucks
- Off-Roa/Construction/Ag
- Marine vessels
- Locomotives
- Cargo handling equipment
- Infrastructure

- 1998 to Present

Proposition 1B Goods Movement

- HD trucks
- Cargo handling equipment
- Transport Refrigeration Units (TRU)
- Locomotives
- Shore power
- 2009 to Present

Lower-Emission School Bus Program

- School buses replacement,
- infrastructure
- CNG tank replacements

- 2001 to Present

Replace Your Ride

- Light-duty vehicles
- EV chargers
- E-Bikes
- Alternative options (transit passes, car sharing, fuel cards)

- 2015 to Present

Other Incentive Programs

Voucher Incentive Program

(for small fleets with 20 or fewer vehicles)

Funding Agricultural Replacement Measures for Emission Reductions (FARMER) Program

Volkswagen Environmental Mitigation Trust Program

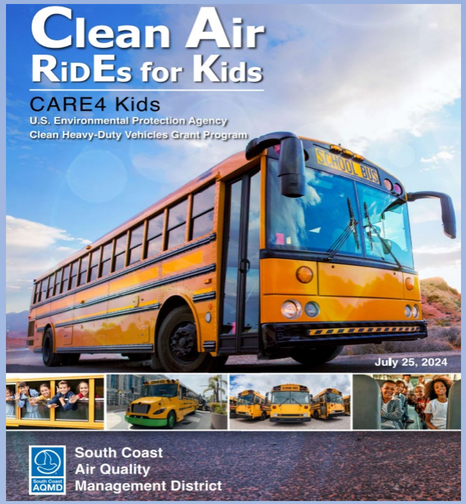
Commercial Electric Lawn and Garden Equipment Program

Community Air Protection Program (supports AB 617)

Other Incentive Programs

EPA CPRG
INVEST CLEAN Implements
Four Incentive Measures

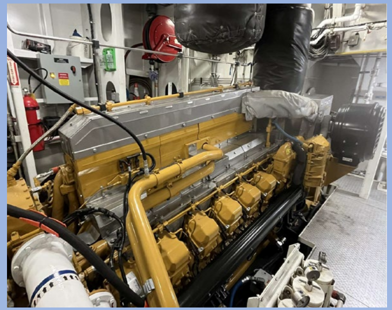
Electric
Replace Class 6
and 7 Vehicles,
including Box
Trucks, TRU, Step
Vans

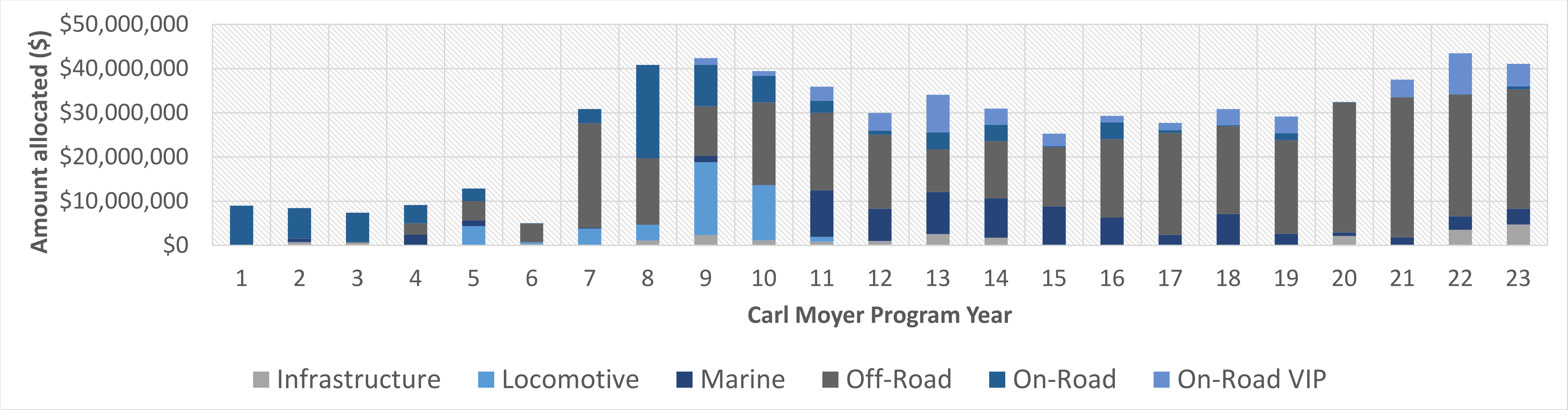


Care4Kids
Replace Class 6
and 7 School
buses with ZE

Carl Moyer Program Updates

- Completed 23 years of the program implementation
- Emissions Reduced (TPY): NOx: 9,242, PM: 263
- Liquidated $652 million and upgraded over 9,100 engines
- Years 24 through 26 are in various stages of implementation, totaling $180M





Carl Moyer Program Updates

- ❖Carl Moyer Year 27 Solicitation closed in July 2025
- ❖Carl Moyer Year 27 allocation: $48 million included the required district match
- ❖Total requests: $588 million, eligible projects totaling $414 million
- ❖Additional funding sources ($216 million):
  - ❖Carl Moyer Year 28 allocation: $48 million included the required district match
  - ❖At Berth Funds: $51 million
  - ❖CAPP funds: $65 million
  - ❖SB 129: $19 million
  - ❖Interests: $33 million

VW Mitigation Program

- Inception in 2019
- Over 1,300 equipment/vehicle projects received, requesting $271 million
- To date, 510 eligible equipment/vehicles have been approved, totaling $106 million
- PA 2024-03 opened in March 2024
  - project categories include:
    - Combustion Freight and Marine Projects
      - Approximately $7M still available for Class 7/8 CNG and Marine
      - Switcher category is oversubscribed and new applications are waitlisted
    - Zero-Emission Class 8 Freight and Port Drayage Trucks (oversubscribed; new applications are waitlisted)

Proposition 1B - Goods Movement Emission Reduction Program

- Inception in 2009
- $485 Million in Funding
- Replacing Diesel Equipment
- More than 7,300 vehicles/equipment replaced
- Emissions Reduced (TPY) NOx: 7,086, PM: 220
- Approximately $50 million remains from withdrawn projects
- Solicitation released on October 28, 2025, for cargo handling equipment and TRUs (close on January 28, 2026)*

*Likely extended

Lower Emission School Bus Program

Since 2001, South Coast AQMD has funded over $372M to:

- Replaced over 1,900 diesel school buses with lower-emission CNG/Propane or zero-emission buses
- Retrofitted 3,400 diesel school buses with PM traps

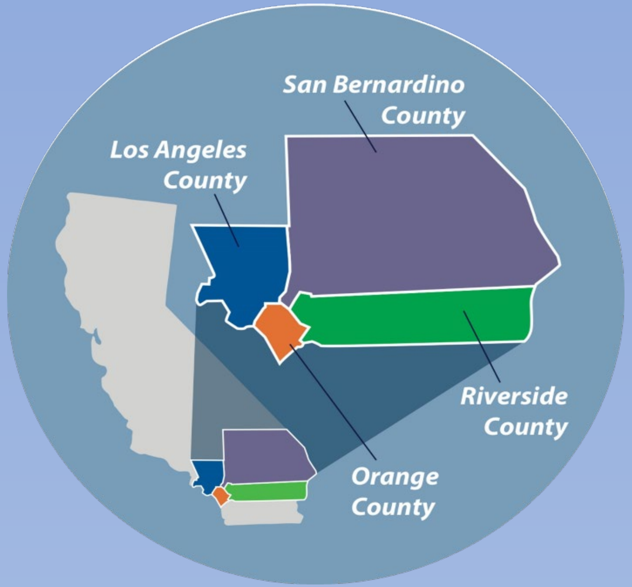
2025 joint solicitation for LESBP, CARE4Kids, Carl Moyer Program and Special Revenue funds

- Awarded over 230 Zero Emission school buses and infrastructure totaling $78 million
- Over 33 public school districts applied and over 220 ZE buses

Replace Your Ride

- Program Inception in 2015
- Light Duty Vehicle Scrap & Replace Program
- Over 14,000 vehicles replaced and $120 million spent
- Alternative Mobility and E-Bike Options
- Average retired vehicle – 23 years old
- 88% of participants at lowest poverty level
- Up to $12,000 incentive for Zero-Emission Vehicles
- 41 tons NOx & 2.1 tons PM Reduced Annually

South Coast AQMD INVEST CLEAN



- Climate Pollution Reduction Grants of $500 million
  - Partnered with two Metropolitan Statistical Areas (MSAs): Los Angeles-Long Beach-Anaheim and Riverside-San Bernardino-Ontario
- Workforce training-IBEW contract executed in December 2025
- Data collection and Validation- UCI contract executed in December 2025
- Community benefits – Third-party facilitators were selected and awarded contracts in October 2025
- Website: https://investclean.org

INVEST CLEAN

- All solicitations for the four incentive measures were opened between June and August 2025
  - Three solicitations were closed in December 2025
  - Heavy-Duty Charging Infrastructure and last-mile freight solicitations are open till the end of January 2026

Heavy-Duty Charging Infrastructure

$191 million

Class 8 Heavy-Duty Trucks and Last Mile Freight for Class 4 and 5 Vehicles

$84 million

Battery Electric Locomotives

$199 million

Cargo Handling Equipment

$26 million

Summary of applications received by December 16, 2025:

Measures	Number of Units	Funding Requested
Class 8 Trucks	303	$112 million
Cargo Handling Equipment	145	$44 million
Switchers	54	$371 million
Total	**502**	**$527 million**

Funding Opportunities

Incentive Program Funds:

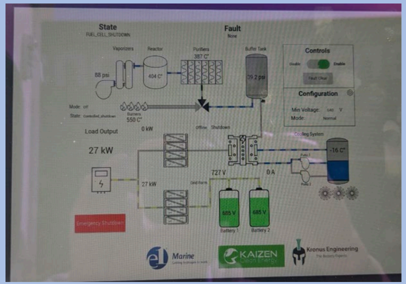
- ➢South Coast AQMD WAIRE Program: ~$50 million
- ➢South Coast AQMD AB 617 Clean Community School Initiative: $30 million
- ➢Prop1B Program: $50 million
- ➢INVEST CLEAN Charging Infrastructure: $191 million
- ➢INVEST CLEAN Last-Mile Freight (SCAG): $50 million
- ➢CARB Climate Heat Impact Response Program (CHRIP): $6 million

Potential Demonstration Funds for 2026:

- ➢CARB award: large-scale deployment and demonstration of municipality medium and heavy-duty vehicles: $32 million
- ➢US EPA Targeted Airshed Grant: $270 million

Capture and Control System for Oil Tankers

- Barge-Base emissions capture and control system
- Capture and treat ship exhaust to reduce NOx, PM, and ROG emissions by 90%
- CARB EO for container, RoRo, and Tanker vessels
- A methanol fuel cell system was installed in December 2025, providing partial power to the barge



Questions

HYDROGEN FUEL CELL PARTNERSHIP®

California's Hydrogen and FCEV Market: 2026 Direction, Risks and Priorities

South Coast AQMD
Clean Fuels Advisory Group

David Park, Director of Industry Affairs

29January2026

2026 is a Pivotal Year

1. Mixed policy signals- state v. federal
2. ZEV market momentum slowdown
3. Fleet and infrastructure investment -Cautious but Active-
4. Opportunity for Regional Actors to shape outcomes

What we often hear in the market

Illustrative market narratives- presented for discussion, not conclusions

- *“Fuel cell-electric vehicles struggle because the technology isn’t ready.”**
- *“Station challenges indicate hydrogen infrastructure doesn’t work.”**
- *“Heavy-duty FCET will repeat light-duty FCEV outcomes.”**
- *“Without mandates, hydrogen markets stall”**

*Illustrative market perceptions; not H2FCP positions or conclusions

What if the Constraint is Alignment, not Capability?

- Vehicles performed; Systems were mis-sequenced
- Infrastructure stability requires throughput and scale
- Heavy-duty markets are structurally different- and advantaged
- Markets can be shaped before mandates- especially by Air Districts

Questions worth investigating

- What sequencing would have changed early hydrogen outcomes?
- What scale stabilizes hydrogen infrastructure economics?
- Where can Air Districts de-risk heavy-duty FCET deployment?

2026 Direction, Risks and Priorities

2026 Market Direction

- Sequenced market development
- Application of light-duty learning to heavy-duty scaling
- From mandate-driven action to market-shaping leadership

Key Risks to Manage

- Fragmented investments without sufficient throughput
- Misdiagnosing deployment challenges as technology failure
- Loss of continuity during policy and regulatory reset

2026 Focus Areas

- Alignment across vehicles, infrastructure, and finance
- Early de-risking of fleet-centered hydrogen infrastructure deployment
- Clear pathways from hundreds to thousands of vehicles

California Hydrogen Mobility Vision & Roadmap

Hydrogen Market Development Phases & Targets

California Draft Planning Targets for 100% ZEV Success

	Market %	# FCVs	# HRS
HDV	40-80%	128,000	900
MDV	15-50%	714,000	1600
LDV	10-35%	5,157,000	

Develop a California Hydrogen Mobility Vision and Strategy

… to align and enable coordinated stakeholder investments and actions

… that leads to a sustainable California hydrogen ZEV market

… and enables North American hydrogen ZEV market expansion

Success

- *Commercial self-sustainability, market-driven conditions*
- Parity or better with traditional systems
- **100% ZEV transition**

Commercial Scaling (Run)

- Fuel, vehicle, and infrastructure *reach scale and cost tipping points*
- Significant growth of robust, reliable station network (in & beyond CA)
- Critical mass: ***50,000 HD FCETs + 200 HRS*** / ***500,000 LMD FCEVs + 1,000 HRS***

Pre-Commercial Launch (Walk)

- Initial *deployments and market launch*
- Market preparation phase, minimal viable networks
- Launch: ***5,000 HD FCETs + 50 HRS*** / ***50,000 LMD FCEVs + 200 HRS***

Demonstrations (Crawl)

- *A common vision & purpose* for market development
- Demonstrations, prototypes, R&D learning phase
- *Stakeholder commitment to market success* and *to each other*

Hydrogen Truck Market Logic: Economics + Air Quality Alignment

COMMERCIAL VIABILITY

- Duty cycle fit
- $/mile TCO
- Infrastructure utilization
- Fleet uptime & productivity

AIR QUALITY VALUE

- NOx tons reduced
- Extreme & Severe nonattainment
- Ozone sensitivity
- $/ton NOx effectiveness
- Health Benefits

↓

PRIORITY USE CASES

Port Drayage & I-5 / SR-99 Freight Corridors

↓

TARGETED POLICY & INFRASTRUCTURE SUPPORT

Fleet Adoption → NOx Reduction → Ozone Attainment

What This Enables for 2026?

Offered to support continued dialogue and program design

- *A shared understanding of where hydrogen and FCEVs are essential—not optional*
- *A basis for regional market shaping during policy transition*
- *Clear alignment between air quality priorities and fleet economics*
- *The ability to move deliberately from pilots to durable scale*

Thank You!

HYDROGEN FUEL CELL PARTNERSHIP®

dpark@h2fcp.org

H2FCP Vision, Mission, and Objectives

From Partnership Bylaws

Vision	Hydrogen and fuel cells play a crucial role in enabling communities to transition to a robust, 100% decarbonized transportation and energy systems.	
Mission	To establish a thriving hydrogen and fuel cell electric vehicle market	
Objectives:		
Drive Market Success	**Win Hearts and Minds**	**Be the Trusted Expert Resource**
Establish the market conditions to build an expanding and robust hydrogen fuel cell transportation market	Demonstrate, build support and win over Customers and Decision Makers to the value and benefit of hydrogen and fuel cells	Bring together thought leaders and experts to share all aspects of transforming our transportation systems. Produce and distribute high-quality data and tools to help inform policy and stakeholder investment decisions.

Win Hearts and Minds

Engage the public as potential hydrogen stakeholders to raise awareness, demonstrate the value and benefit of hydrogen fuel cell mobility, and build support for hydrogen technology and market development activities.

A. Develop a multi-year outreach & education strategy
   - Align on Key Audiences & Messaging
   - Develop Hydrogen 101 Educational Materials
   - Implement Outreach, Education & Engagement Strategy

Be the Trusted Resource

Build stakeholder awareness, trust, and confidence around market needs, progress, and challenges through responsible engagement and credible resources. Facilitate stakeholder engagement and collaboration to accelerate market commercialization through reliable data tracking and analysis tools and resources.

A. Convene regular Partnership meetings to build transparency and understanding among stakeholders and to advance market progress and commitments.

B. Engage and facilitate external market stakeholders to provide increased connectivity, thought leadership, and expanded market opportunities in parallel with formal projects and programs.

C. Expand data collection, analysis, and sharing capabilities to increase stakeholder understanding of leading technology and market challenges, progress, and needs.

   - *Expand SOSS* to become a more robust data collection and analysis tool
   - *Update the Partnership website*, station map, and other online resources to include a Dashboard of the latest hydrogen market data, progress, and educational resources.
   - *Develop Best Practices and Lessons Learned* documentation based on decades of organizational and stakeholder experience, knowledge, and need.

Drive Market Success

Actively advance technology and market development through collaborative analysis, thought leadership, and coordinated activities to develop effectual rollout and implementation actions.

A. Identify leading technology & market development challenges, develop necessary metrics, KPIs, & tracking mechanisms, develop tools to provide market condition feedback loops, and collectively engage and prioritize actions to address these challenges.

   – Develop a *State-of-the-Industry dashboard*, tracking system, and related tools for enhanced understanding and review of leading market development challenges. Leverage member meetings and other stakeholder engagements to develop internal and external feedback loops and to prioritize and develop resolutions to technology and market development challenges.

B. Be active thought leaders on market development needs and priorities.

   – Engage members and leading stakeholders on market development opportunities and strategies *developing common visions and strategies* for success. Use these discussions and outputs to build alignment and clarity, and to catalyze more rapid and coordinated action.
   – Identify additional stakeholders necessary to achieve the Partnership's Mission of a sustainable hydrogen mobility market and actively secure their committed participation.

C. Conduct iterative consensus building through regular Partnership engagement processes

   – Leverage member engagement to identify and create new work projects to address critical issues, workshopping concepts through a collaborative stakeholder process to reach a consensus of action.

CALIFORNIA
AIR RESOURCES BOARD

Current Hydrogen Related Activities and Policies

South Coast AQMD Clean Fuels Advisory Group Meeting, January 29, 2026

Leslie Goodbody, CARB Staff ZEV Infrastructure Specialist

California Continues Forward

Executive Order N-27-25

- Reaffirms California's commitment to deploy ZEVs and improve air quality

ZEV Forward

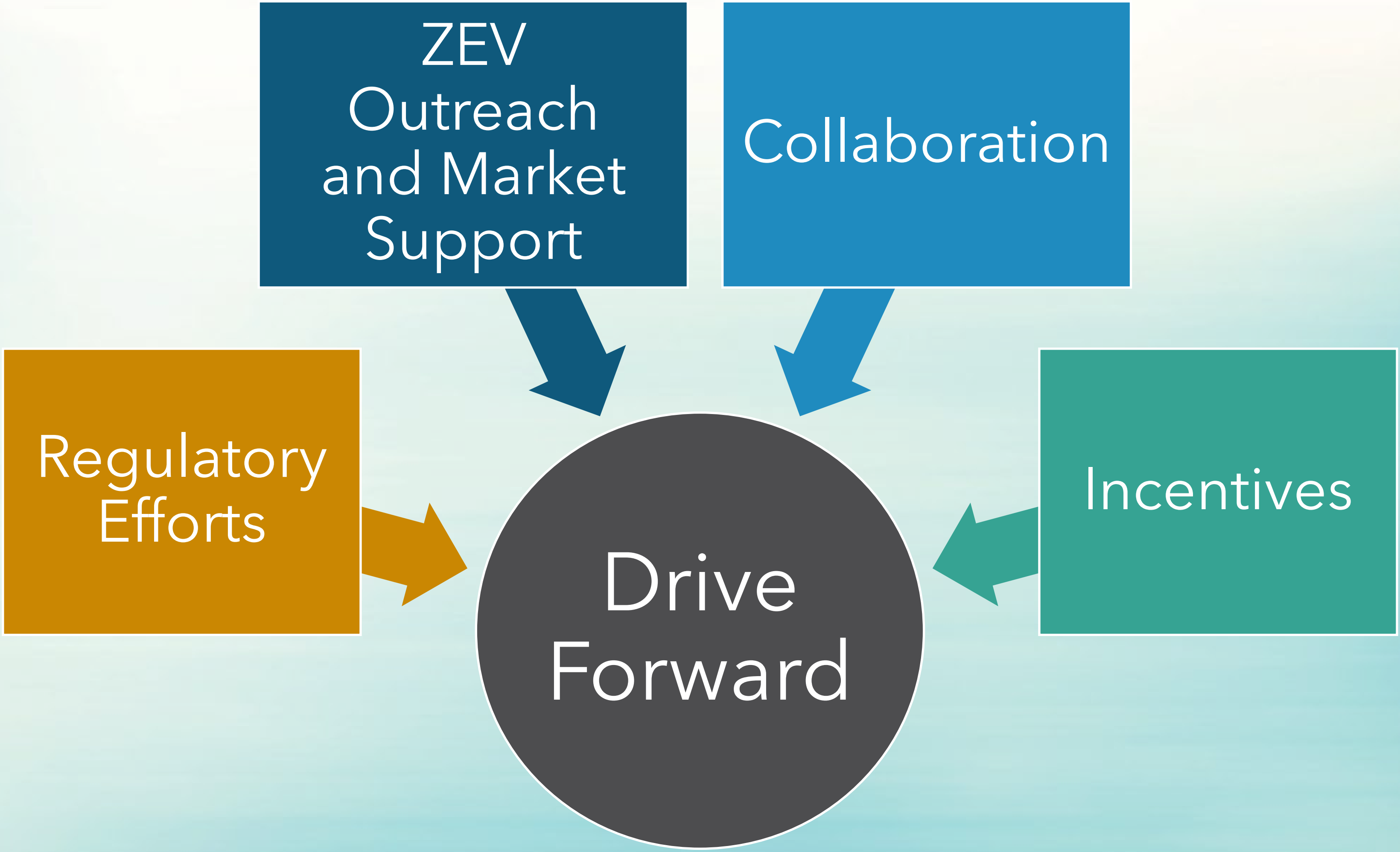
- Assessed additional actions needed to advance ZEV adoption

Report to Governor

- Recommended actions to further light-, medium-, and heavy-duty ZEV adoption in the state

Drive Forward

Drive Forward



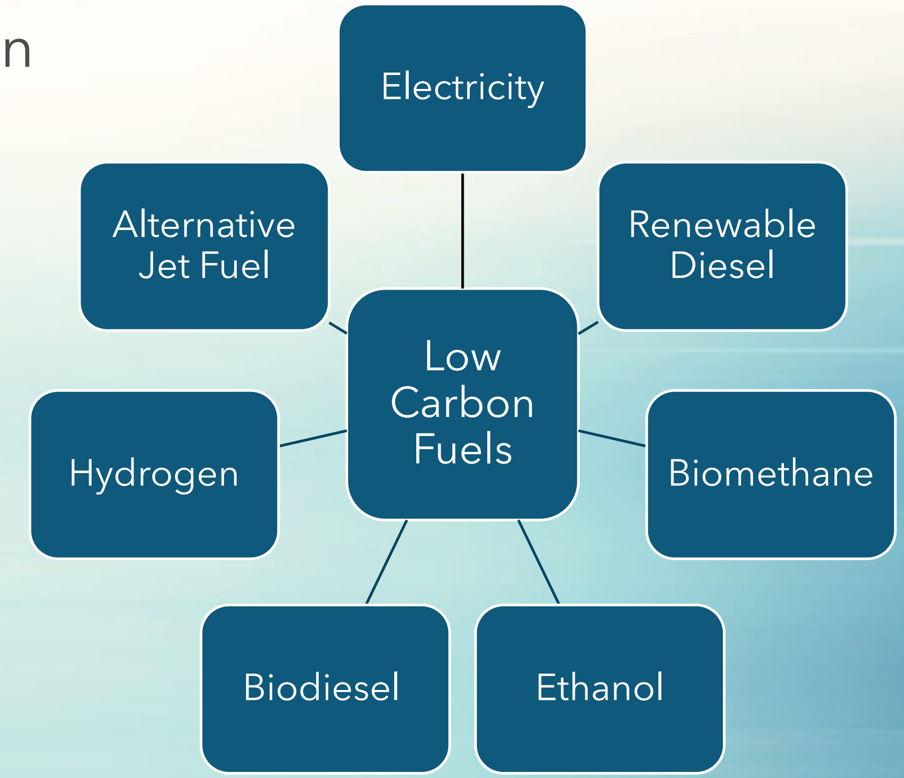
CARB

Drive Forward Websites

- Drive Forward website activities, engagement opportunities and workshops
  - https://ww2.arb.ca.gov/drive-forward

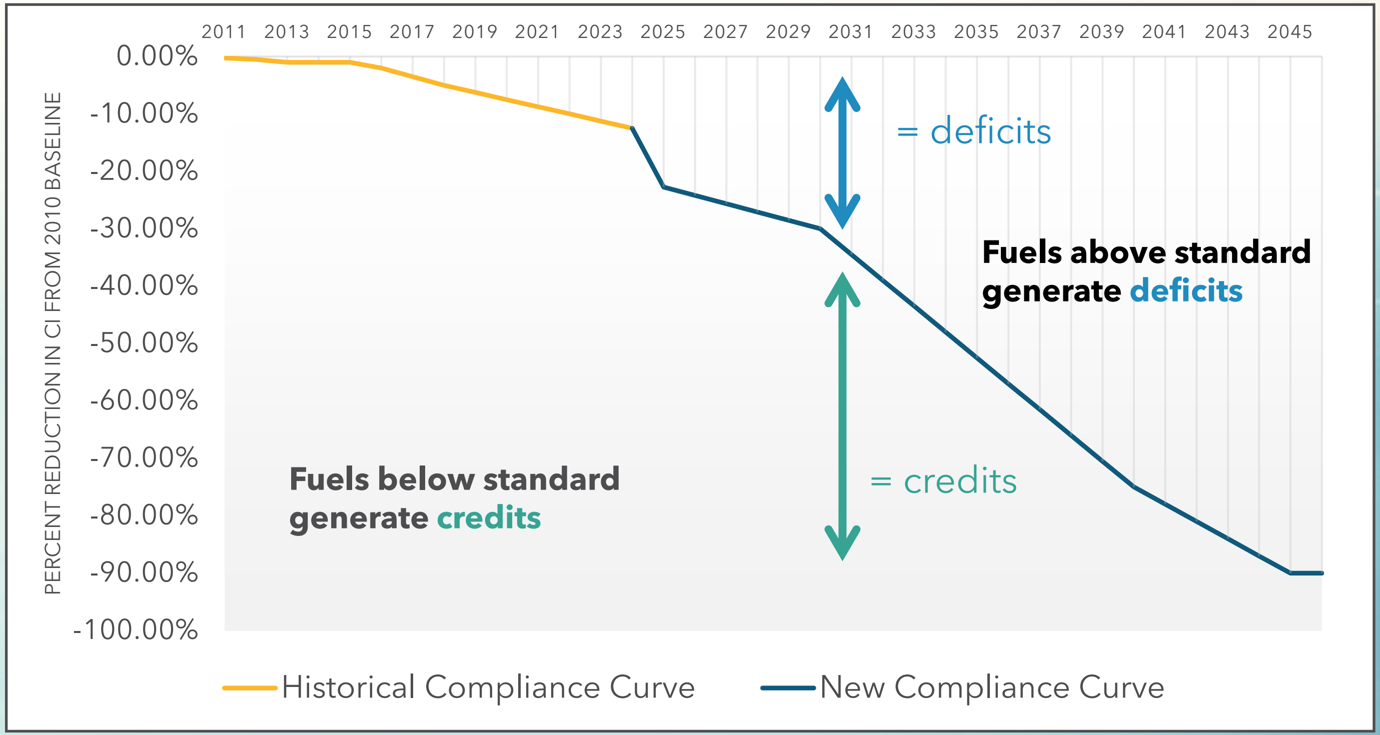
Low Carbon Fuel Standard (LCFS)

- Goal: reduce carbon intensity (CI) of transportation fuel pool by at least **30% by 2030** and **90% by 2045** (from 2010 baseline)
- Expected benefits:
  - Complement other Scoping Plan measures
  - Transform and diversify fuel pool
  - Reduce petroleum dependency
  - Reduce emissions of other air pollutants



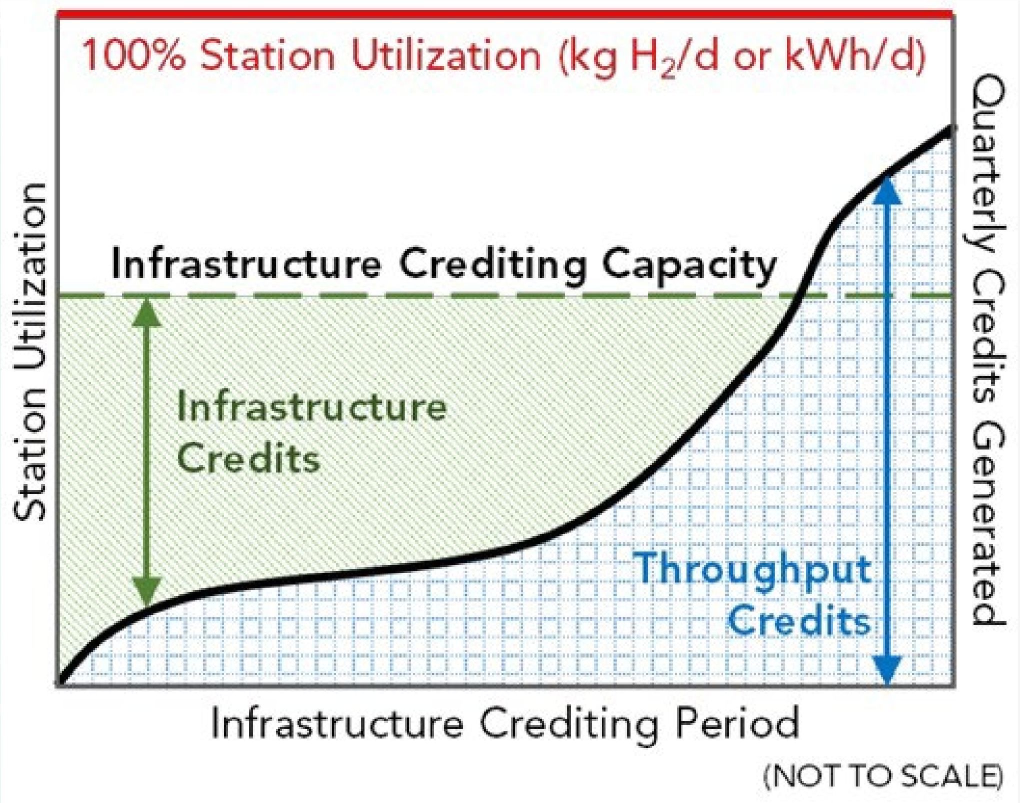
Basic LCFS Framework

- Sets annual CI benchmarks for gasoline, diesel, jet fuel, and the fuels that replace them
- CI is the measure of greenhouse gas emissions associated with producing, distributing, and consuming a fuel
  - Based on complete life cycle analysis
  - Measured in grams of carbon dioxide equivalent per megajoule (gCO_2e/MJ)



CARB

ZEV Infrastructure Crediting



- Infrastructure crediting provides LCFS credits based on unused fueling capacity (credited capacity – dispensed fuel) of fuel supply equipment (FSE)
- Four categories of infrastructure crediting are available beginning July 1, 2025:
  - Heavy-Duty Hydrogen Refueling Infrastructure (HD-HRI)
  - Heavy-Duty DC Fast Charging Infrastructure (HD-FCI)
  - Light- and Medium-Duty Hydrogen Refueling Infrastructure (LMD-HRI)
  - Light- and Medium-Duty DC Fast Charging Infrastructure (LMD-FCI)
- As station utilization increases, the site will generate more LCFS credits for dispensed fuel and fewer infrastructure credits
- Total capacity for each program category is capped at 2.5% of LCFS deficits, calculated quarterly

Criteria for New Heavy-Duty HRI Sites

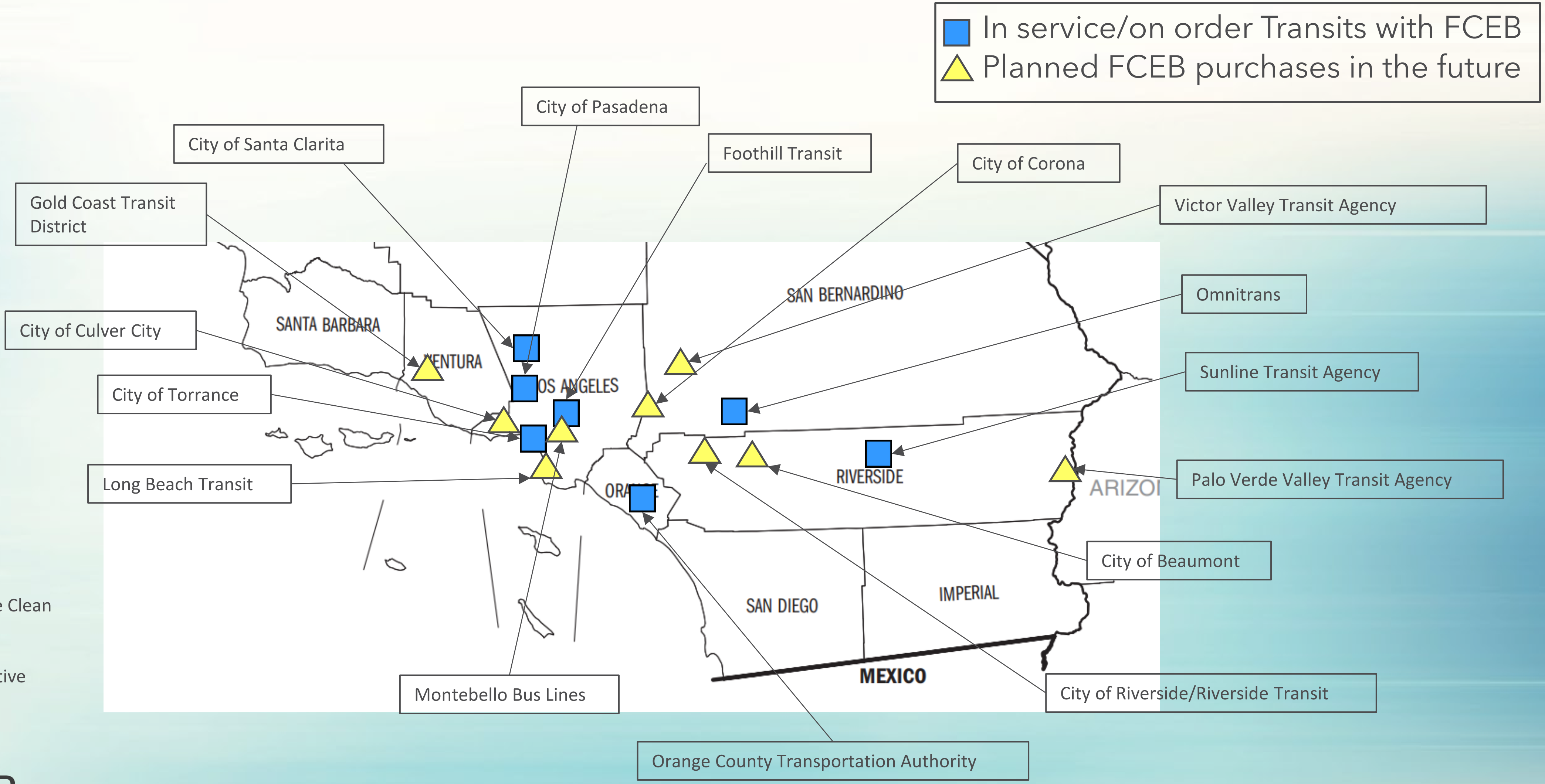
	HRI
All Stations	• Must be connected to the Station Operational Status System (SOSS) • Must accept major credit/debit cards at POS terminal • Must not have been permitted to operate on/before 01/01/2022 • Dispensed hydrogen must be ≥ 40% renewable content until 2030 and ≥ 80% thereafter • Other program eligibility requirements also apply
Heavy-Duty	• Application must be received on/before 12/31/2035 • Must accommodate Class 8 HDVs • Up to 6,000 kg/day refueling capacity • Shared site: 62.5% crediting factor (subject to location and access conditions) • Private site: 31.5% crediting factor

Innovative Clean Transit (ICT) Regulation

- Adopted in 2018 as the first heavy-duty zero-emission vehicle regulation in the United States
  - Zero-emission bus (ZEB) Rollout Plan to ensure adequate planning
  - Phase-in schedule to allow preparation time
  - Compliance flexibility and safeguards for a smooth transition
  - Early action for additional benefits
- ZEBs act as beachhead in heavy-duty vehicle sectors
- Does not require a waiver from US EPA
- Approved by US EPA as a control measure in the State Implementation Plan (88 FR 10049, 2/16/2023)

Year	ZEB Percentage of Total New Bus Purchases	
	Large Transit	Small Transit
2023-2025	25%	-
2026-2028	50%	25%
2029 & on	100%	100%

ICT Regulation is Spurring FCEB Adoption in SoCal



Data Sources: 2024 Innovative Clean Transit reporting data, federal discretionary funding programs, various state incentive programs, and Rollout Plans

Map last updated 1/20/2026

CARB

Transit Agency Data on FCEB Deployments

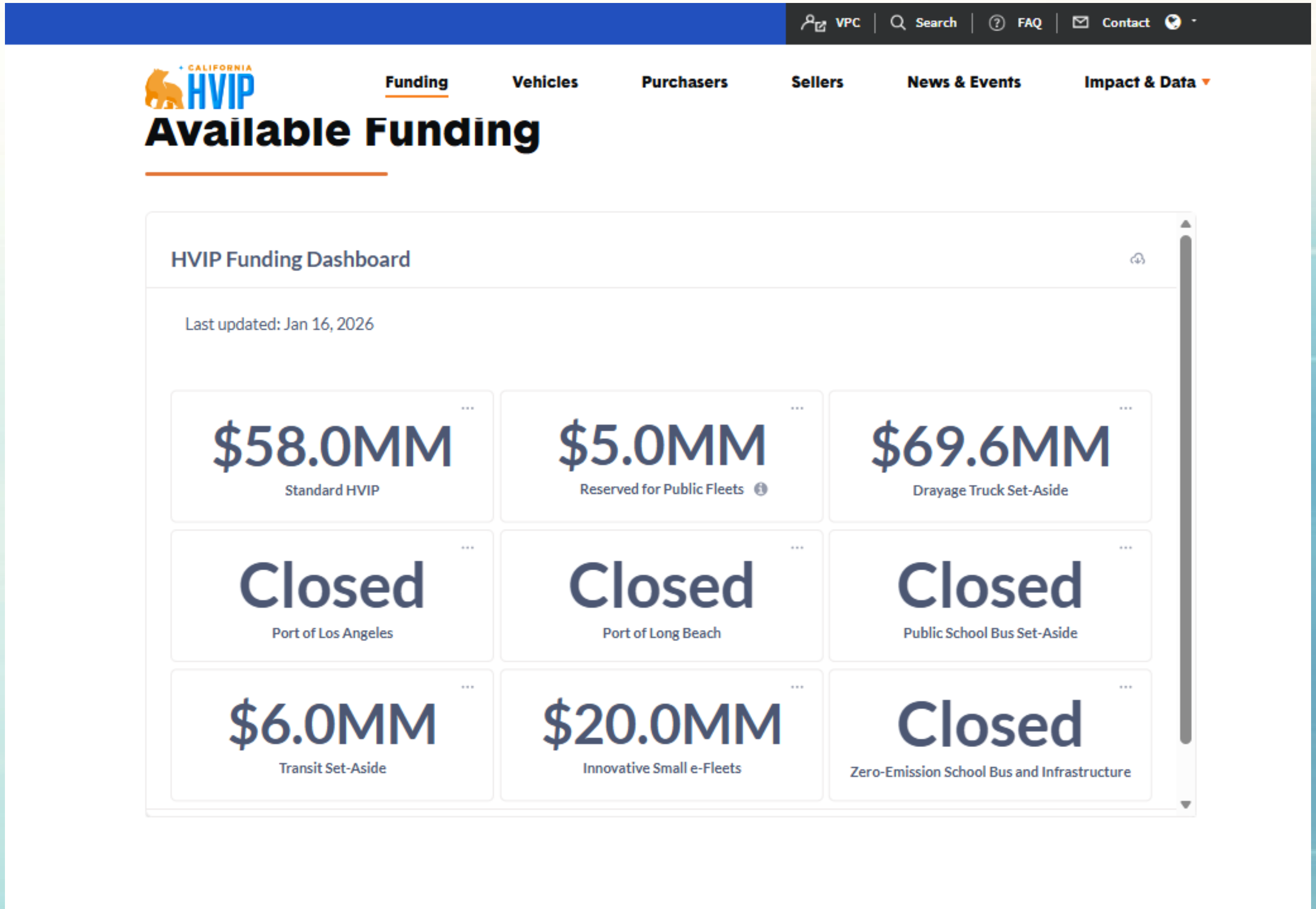
Transit	Location	Size of Transit	Deployed by 12/31/2024*	On-Order by 12/31/2024*	Ordered after 12/31/2024**	Total FCEBs in fleet on full deployment	Fleet Size†
City of Culver City	Culver City	Small	0	0	1	1	57
City of Corona	Corona	Small	0	0	0	0	20
City of Pasadena	Pasadena	Small	0	0	17	17	52
City of Torrance	Torrance	Small	0	0	-	0	-
Foothill Transit	West Covina and Pomona	Large	33	0	19	52	355
Long Beach Transit	Long Beach	Large	0	0	-	0	231
Montebello Bus Lines	Montebello	Large	0	3	-	3	53
Orange County Transportation Authority	Santa Ana	Large	10	40	-	50	587
City of Beaumont	Beaumont	Small	0	0	-	0	23
City of Riverside	Riverside	Small	0	0	-	0	32
City of Santa Clarita	Santa Clarita	Small	0	7	3	10	107
Omnitrans	San Bernardino	Large	4	0	0	4	228
Riverside Transit Agency	Riverside	Large	0	5	6	11	224
Sunline Transit Agency	Thousand Palms	Small	32	0	-	32	67
Gold Coast Transit District	Oxnard	Small	0	0	-	0	69
Palo Verde Valley Transit Agency	Blythe	Small	0	0	0	0	7
Victor Valley Transit Agency	Hesperia	Small	0	13	-	13	99
Total			**79**	**68**	**46**	**193**	**2211**

* 2024 Innovative Clean Transit reporting data
** 2025 purchases based on transit agency responses to a CARB survey. 2025 data is not yet available in the ICT Reporting Tool (ICTRT).
- Transit agency has not provided data.
† Fleet size reflects the number of buses GVWR>14,000 lbs, of all fuel types, and with "active" and "inactive" status as of 12/31/2024 based on ICTRT.
Table last updated 1/21/2026

CARB

HVIP & EnergIIZE
Demand for transit funding remains strong

- HVIP Transit Set-Aside
  - Opened 12/16/25 - $23.8M
  - $6M remaining as of 1/16
  - Transits can apply for HVIP standard ($58M available)
- EnergIIZE Transit Set-Aside
  - Closed 10/2/25
  - $26.7M requested
  - 5 H2 and 7 charging station applications
  - Applications under review
  - https://energiize.org/

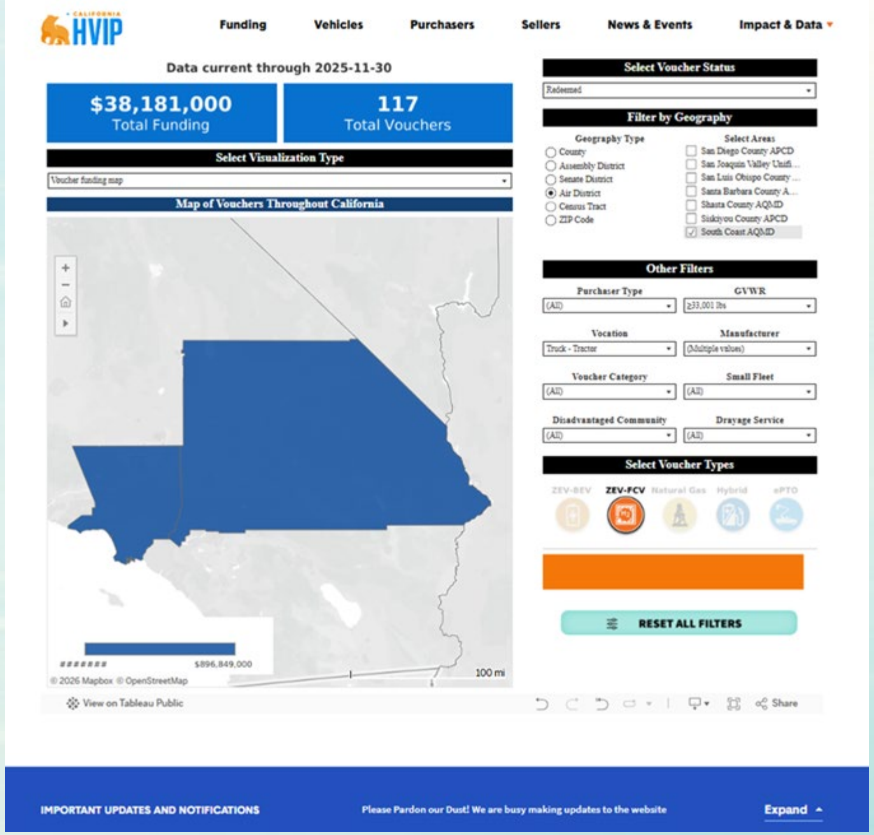


https://californiahvip.org/funding/

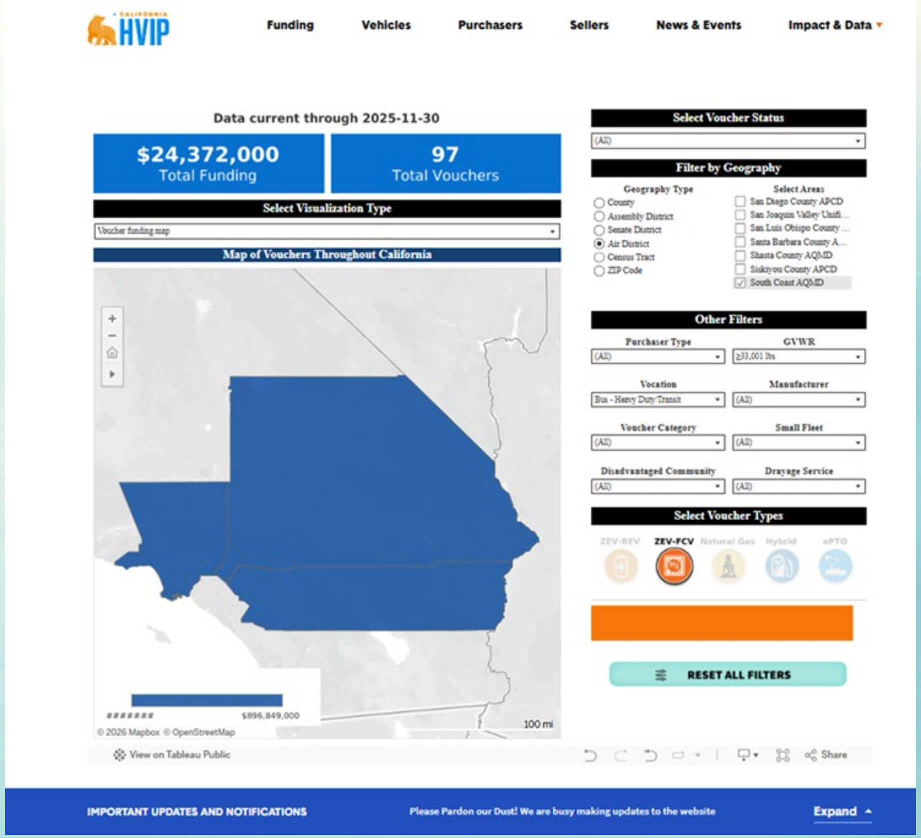
CARB

HVIP Fuel Cell Electric Truck and Bus Voucher data within South Coast AQMD

Fuel cell trucks delivered



Fuel cell buses on order and delivered



CARB

https://californiahvip.org/impact/

South Coast Hydrogen Infrastructure Updates

- **Others learn from transit agencies' infrastructure experience**
  - Foothill, Orange County and SunLine share learnings
  - Smaller initial deployments start with mobile fuelers
  - Permanent LH2 stations: 15,000-25,000 gallons (4045-6757 kg), could increase throughput by supporting LDVs, SLG fleets and possibly freight
- **In the news**
  - Victor Valley Transit (Jan 26): ribbon cutting on first 13 buses and mobile fueler, permanent stations in Hesperia (in progress) and Barstow (CFI funded)
  - Riverside Transit (Dec 25): Clean Energy and Nikkiso contracted to build station
  - HyRoad Energy and Pacific Clean Fuels (Nov 25) – striving to keep the Nikola TreFCV fleet on the road
- **Funding for hydrogen**
  - CEC funding (deadline March 20, 2026): GFO-24-612 – up to $20 million for depot charging and hydrogen fueling infrastructure for medium- and heavy-Duty On-Road ZEVs
  - Port of Long Beach hydrogen fuel grant program (Dec 25) $10 million for fuel rebates for fuel cell trucks operating in the San Pedro Bay ports complex

Thank you!

Leslie Goodbody

Staff ZEV Infrastructure Specialist

Mobile Source Control Division

Leslie.Goodbody@arb.ca.gov

VoiP: 279.208.7839

CARB

PCC Hydrogen

Jan 29th, 2026

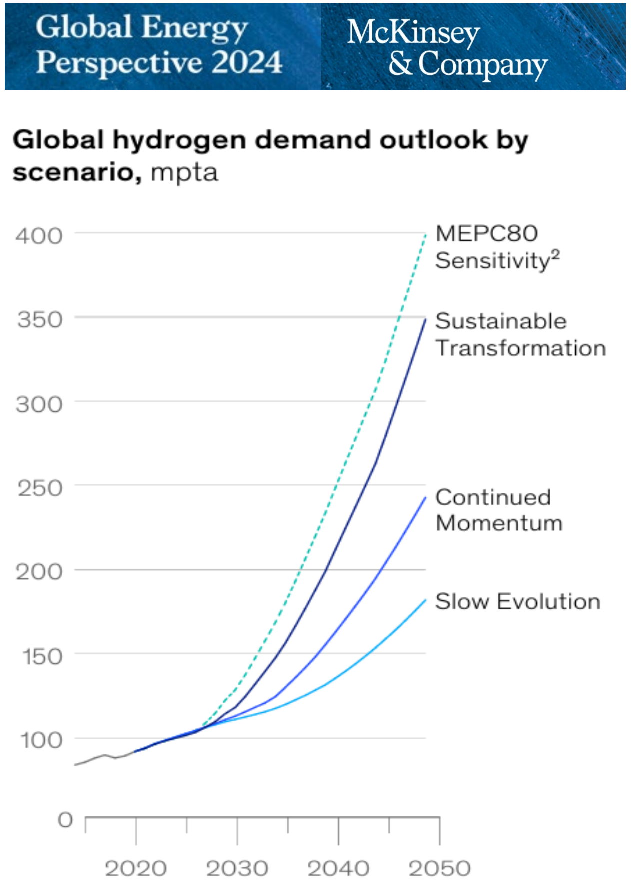
Accelerating Clean Hydrogen Deployment with Cost-Effective Production

A Differentiated, Scalable Hydrogen Production Platform Designed for Local Deployment

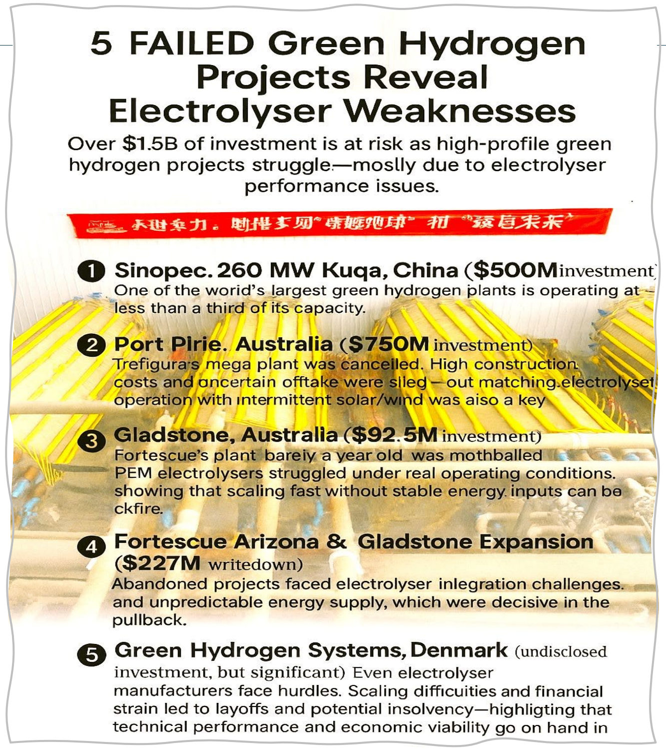
Hydrogen Market Review

PCC Hydrogen

Rosy market projections



Green H_2 is struggling



5 FAILED Green Hydrogen Projects Reveal Electrolyser Weaknesses

Over $1.5B of investment is at risk as high-profile green hydrogen projects struggle—moslly due to electrolyser performance issues.

1. Sinopec. 260 MW Kuqa, China ($500M investment) One of the world's largest green hydrogen plants is operating at less than a third of its capacity.
2. Port Pirie. Australia ($750M investment) Trefigura's mega plant was cancelled. High construction costs and oncertain offtake were sileg—out matching electrolyset operation with intermittent solar/wind was aiso a key
3. Gladstone, Australia ($92.5M investment) Fortescue's plant barely a year old was mothballed PEM electrolysers struggled under real operating conditions. showing that scaling fast without stable energy inputs can be ckfire.
4. Fortescue Arizona & Gladstone Expansion ($227M writedown) Abandoned projects faced electrolyser inlegration challenges. and unpredictable energy supply, which were decisive in the pullback.
5. Green Hydrogen Systems, Denmark (undisclosed investment, but significant) Even electrolyser manufacturers face hurdles. Scaling difficulties and financial strain led to layoffs and potential insolvency—highligting that technical performance and economic viability go on hand in

Shell Closes H_2 Refueling Stations in CA

2025 Annual Eval. of FCEV Deployment...

- Fuel cell electric vehicles expansion is hampered by high prices and low demand.
- Potential regions identified in this year's analysis still lack convenient access to hydrogen infrastructure.

Critical Vulnerabilities of “Legacy” Distributed H_2

PCC Hydrogen

PRICE

California pump price of over $30/kg H_2 equivalent to paying over $12/gal gasoline.[1]

AVAILABILITY

Liquefying 1 ton of H_2 for transportation uses 30% of the energy in H_2 (the energy equivalent to ~300 gal of diesel).[2]

CARBON INDEX

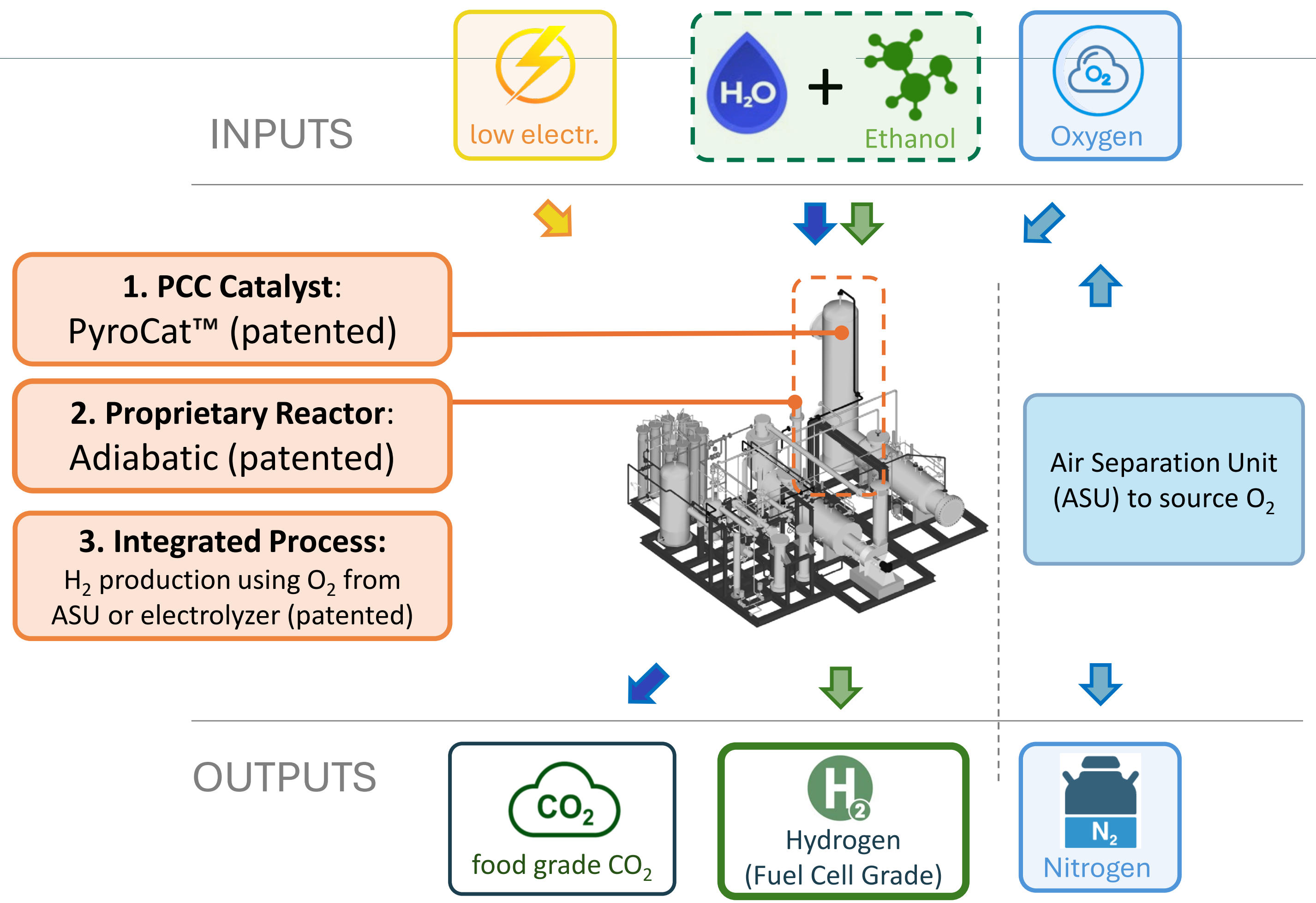
Today in the U.S., ~95% of H_2 is produced from natural gas.[3]

[1] Electrolysis requires grid electricity which is in high demand and/or renewable electricity that is costly, has capacity factor issues, and is difficult to permit and access.

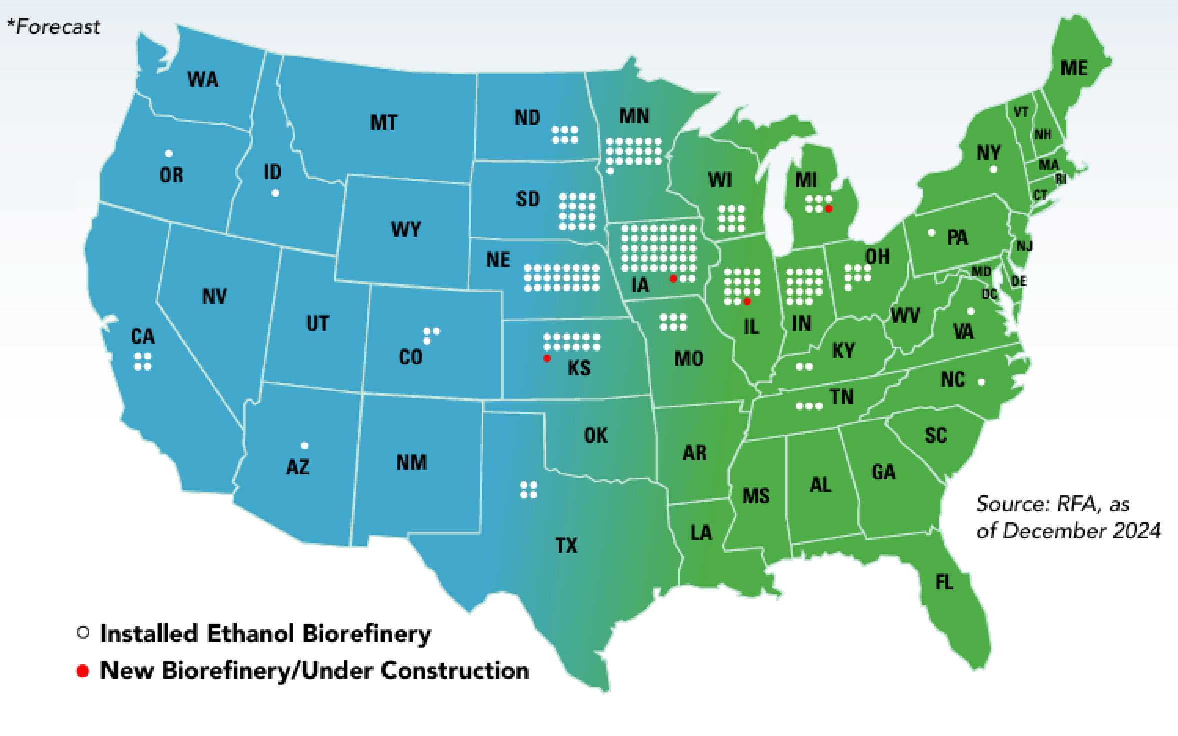
[2] Centralized H_2 production is high CapEx and requires expensive liquefaction and cryogenic transportation to reach distributed customers. Storing large quantities of hydrogen is not practical or economical as Liquid H_2 has to be maintained at -253C.

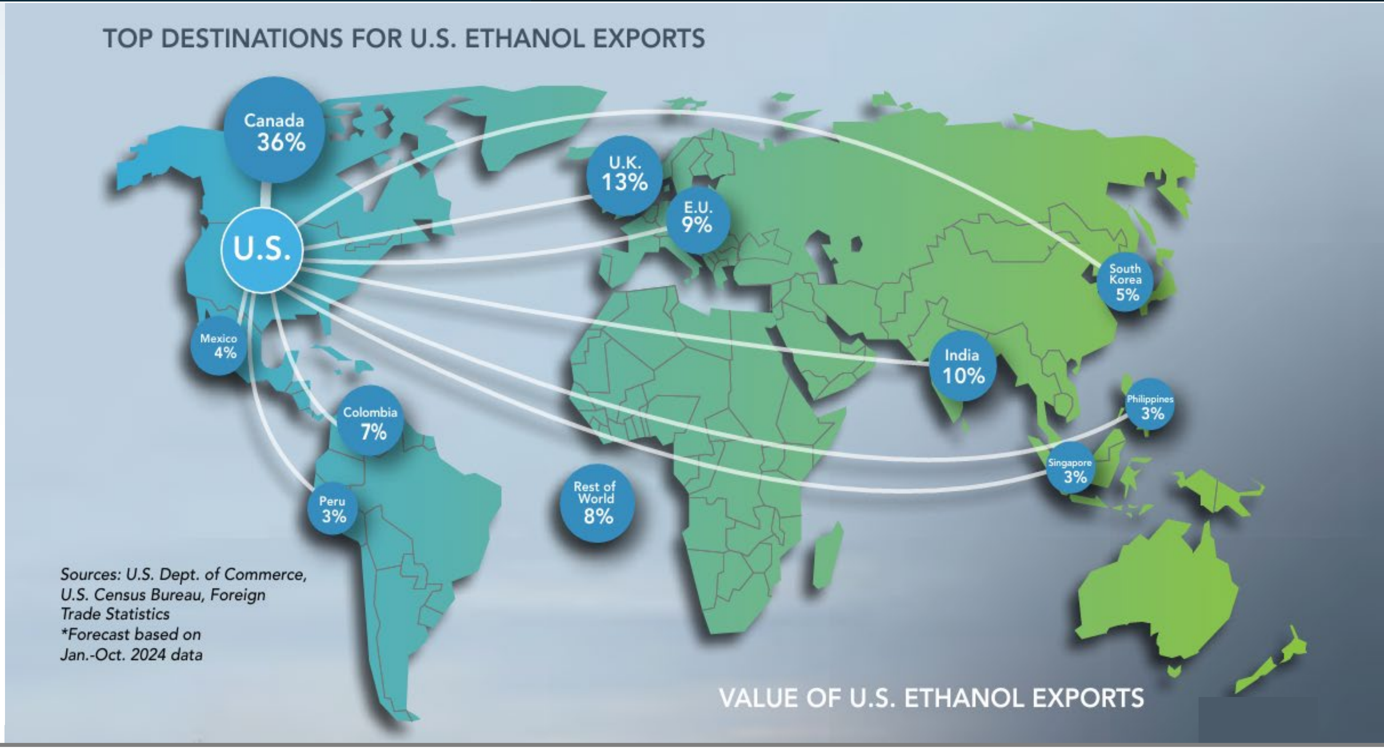
[3] 95% of H_2 is from produced from Steam Methane Reforming (SMR) of natural gas, offering no environmental benefit to using H2. CO_2 capture solutions are expensive & energy intensive.

Plant scalable from 300kg to 20-ton H_2/Day



Why Start with Ethanol?

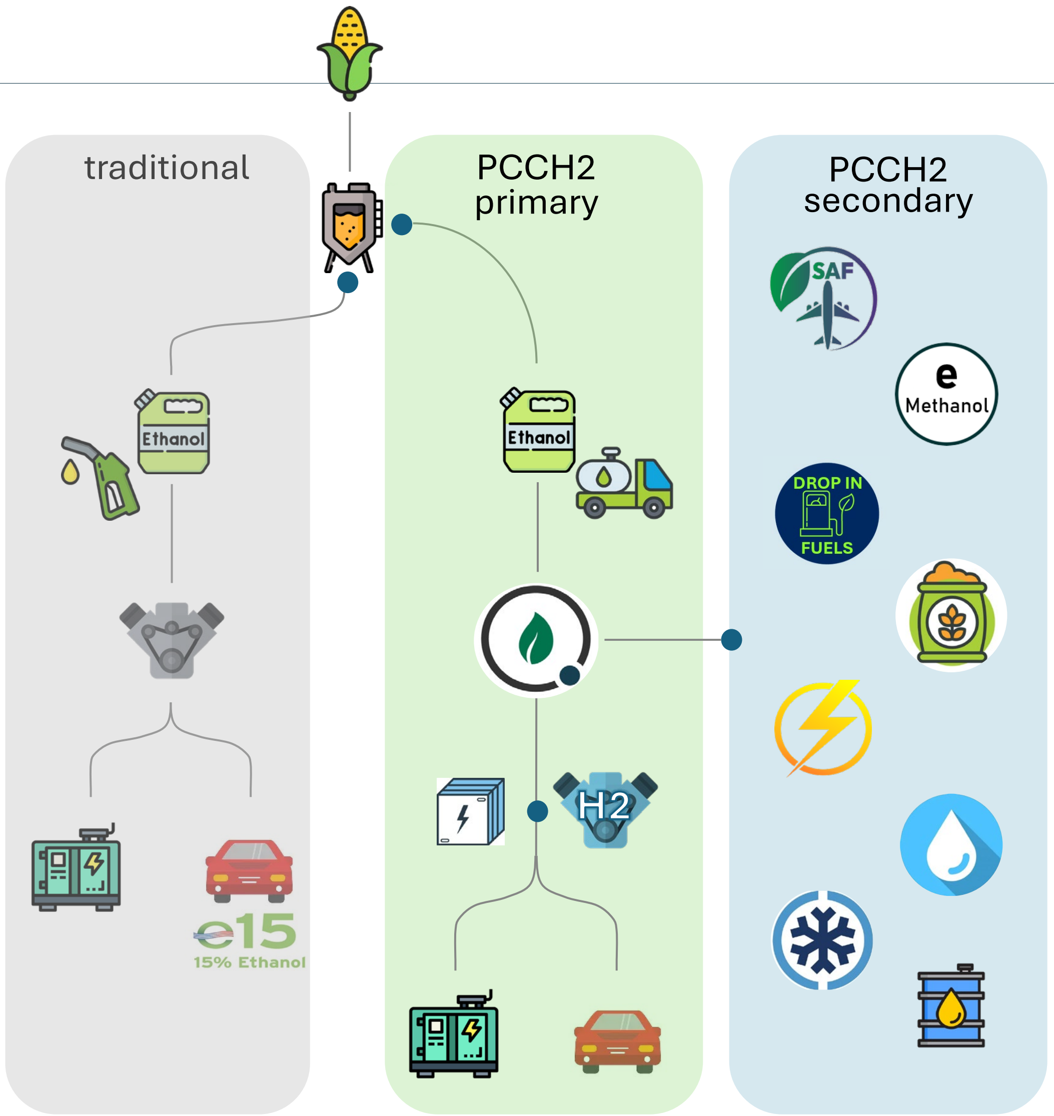




- Biogenic fuel
- 16.1B gallon annual U.S. production
- Support farmers (~45% of corn goes to ethanol)
- Logistically friendly fuel
- 2.5x more H_2 in ethanol than in liquid H_2

- Energy security
- Existing regulated and well understood fuel (CA E15)
- Some reservation about “real” CI
- CARB Review: Impact of higher ethanol blends—Multimedia evaluation (December 2025)

Ethanol – a better use case



Advantages – Ethanol to Hydrogen

More efficient: Automotive use case

Fuel Type	Energy Source	Effective Usable Energy	Range (Miles)
Ethanol (2.3 gal E100)	60 kWh	~5.6-7.7 kWh usable	~32-40 miles (18 MPG flex-fuel)
Hydrogen (1.8 kg)	60 kWh LHV	~30-36 kWh usable	~126 miles (Toyota Mirai)
Ethanol (2.3 gal E100)	60 kWh	~19-23 kWh usable*	~80 miles (Toyota Mirai)

*Including losses from converting ethanol to H_2 in the PCCH2 system

Less emissions

- CO_2 beneficially used and not vented out the tailpipe
- No NOx
- No PM
- Lower CI ethanol feedstock (99.5% purity not required)

Enabling secondary markets

- SAF/eSAF, e-Methanol, and drop-in fuels
- Ammonia
- Electricity (backup or base load)
- Water
- Cold-chain logistics and food processing (biogenic CO_2)
- Safe, cheap onsite energy storage

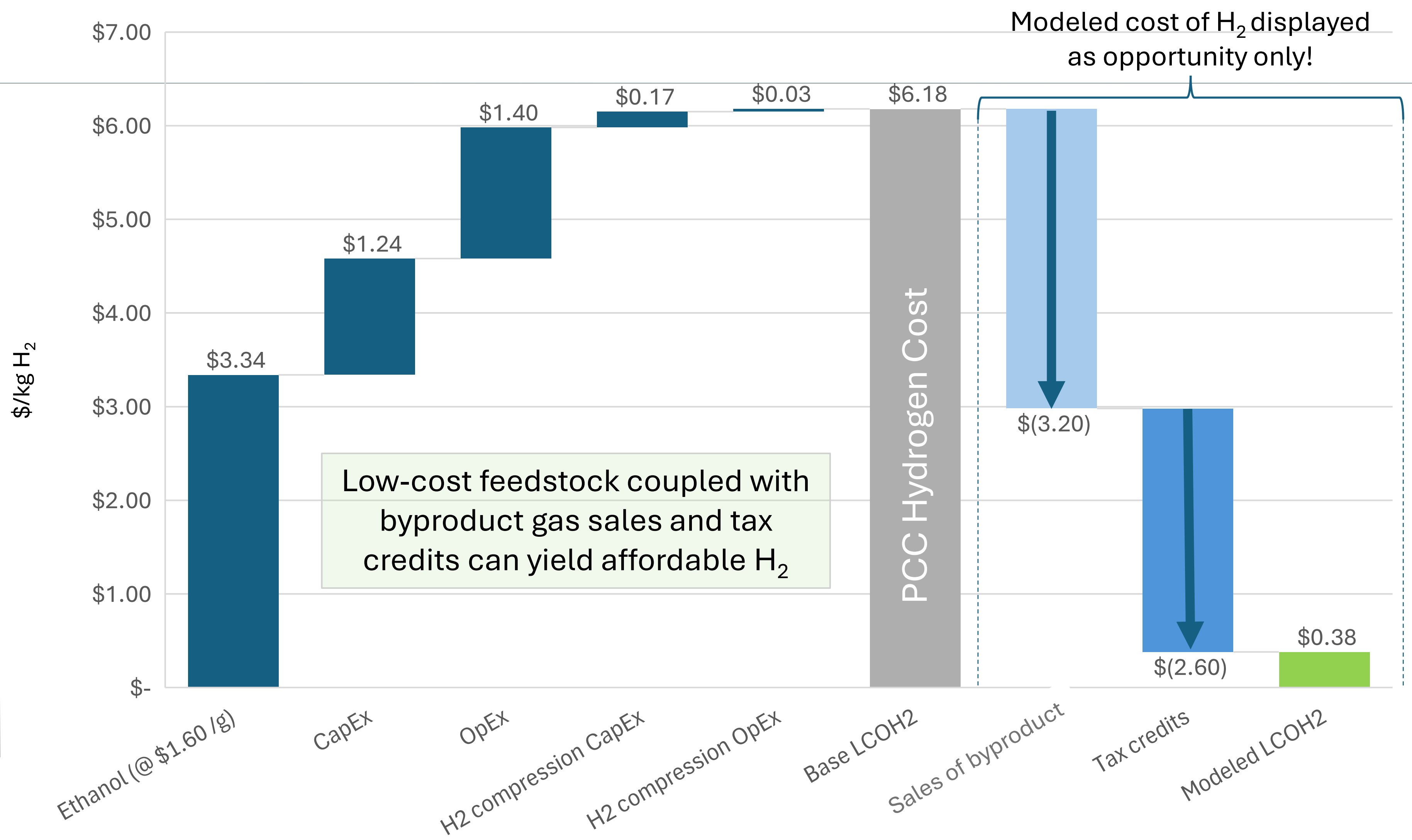
Competitive Advantage - Lower Cost for Distributed H_2

PCC Hydrogen

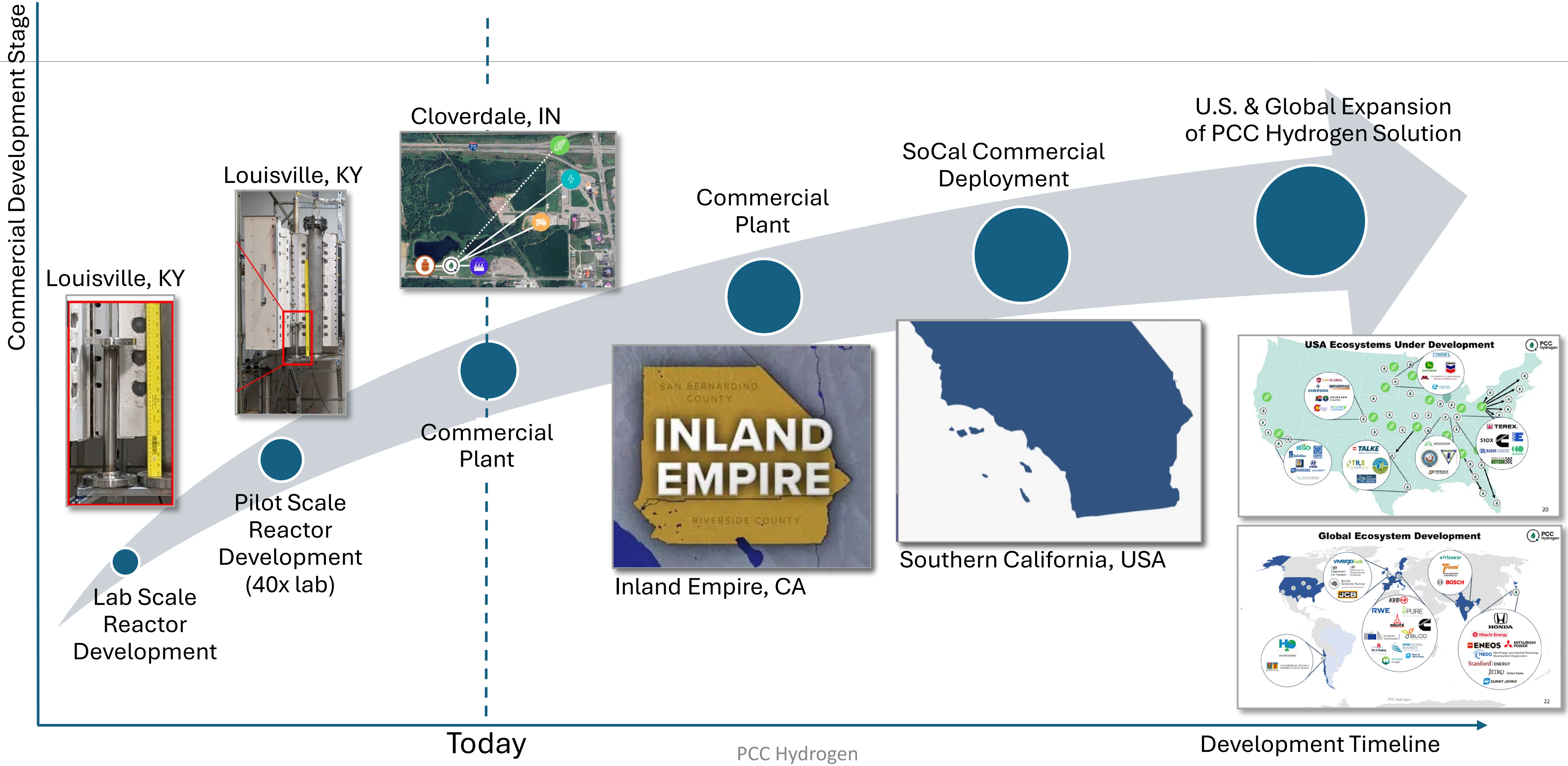
PCCH2 Cost $0.40-$6.2/kg vs. **CA Retail $30-36/kg**

Assumptions:

- 3-ton per day plant (CA pricing structure)
- Other gas sales based on actual wholesale prices
- Tax credits can include RFS, LCFS, 45V and 45Q.
- Modeled price will vary with fluctuations in byproduct gas sales and available tax credits



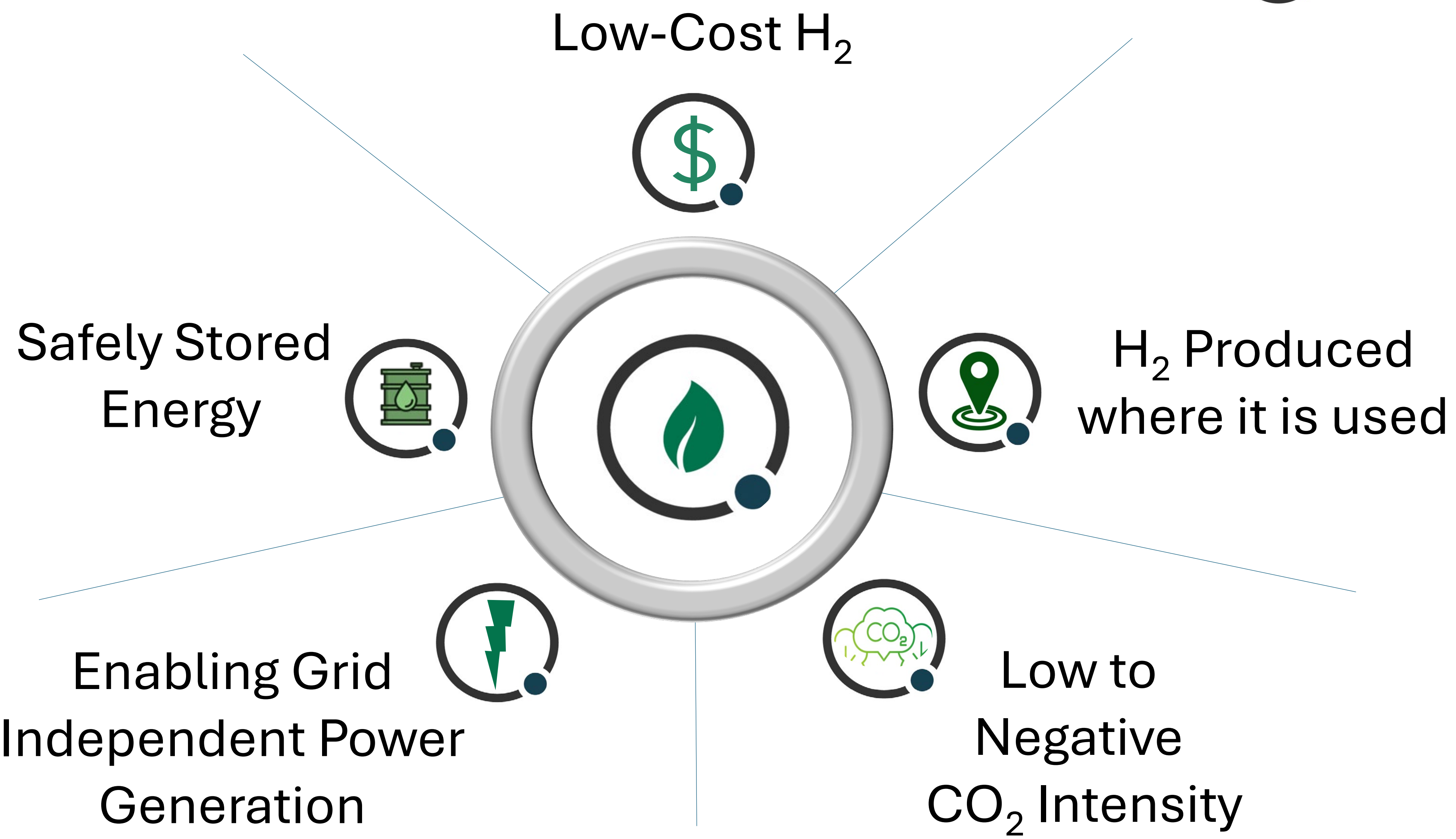
Growth - Pathway to Ecosystem Development



ABOUT US

Our Hydrogen Solution:

Ethanol To Hydrogen



Deployable Infrastructure

Not a Concept

"If you want clean hydrogen and/or resilient, grid independent power, we have a novel and deployable solution. Pick a site and let's build a plant together now."

Thank you

HMG Energy Vision

Pioneering Hydrogen in Mobility and Beyond

Dr.-Ing. Benjamin Happek
General Manager
Hyundai Motor North America Energy & Hydrogen Business Development

HTWO
HYUNDAI MOTOR GROUP

Hyundai Motor Group

Together for a Better Future

The vision of "Together for a better future", goes hand in hand with respect for humanity and consideration for the environment.

HYUNDAI MOTOR GROUP

Global Network
286 Offices
42 Countries

Employees Worldwide
307,000

Affiliates
59
Companies

AUTOMOBILE

CONSTRUCTION

PARTS

STEEL

FINANCE

OTHERS

Hyundai Motor Company

Financial Overview 2024

Annual revenue (USD)
133b

Global Sales
4.14m

Employees worldwide
120k+

Sales for eco-friendly cars
757k (Cumulative: EV, HEV, PHEV, FCEV)

Manufacturing plants
12 (Korea/USA/Singapore/Brazil China/Czech/Turkey/India)

1967
Founding Year

193
Represented Countries

Hydrogen Mobility Heritage

1998

Fuel Cell System Development

2000

FCEV Prototype Developed

2013

ix35 Launched
World's 1st
Commercialized FCEV

2018

NEXO Launched
World's 1st
Dedicated Fuel Cell Model

2020

XCIENT Fuel Cell (Europe) Commercialized
World's 1st
Commercialized FCEV Truck

ELEC CITY Fuel Cell Commercialized
World's 1st
FCEV Public Bus

Numerous 'World's 1st' in 30 years of Commitment to Hydrogen

2022

High-Performance FCEV Concept

2023

XCIENT Fuel Cell
(Tractor for North America)
Commercialized

UNIVERSE Fuel Cell Commercialized
World's 1st
FCEV Coach Bus

2024

INITIUM FCEV concept

2025

The all-new NEXO Launched

Enhanced XCIENT Fuel Cell
(Tractor for North America)
Launched

HMG Energy Vision

Previous FCEV & Lesson Learned

HMC gathered 1.4B mi of field data, which has been utilized to improve the quality and durability of our next-gen FC system.

Passenger Vehicle, NEXO ('18 ~)

Total 40,822 ('18~'25.5)

- In-house development of core tech. "Cell & System"
- In-house manufacturing from MEA to System

	NEXO (2018)
Output (FC / Battery / Motor)	***85*** / 40 / 120 kW
Hydrogen storage	6.33 kg (Tank 3ea)
Range	381 mi

Mass Production Capacity @ Chungju Factory 17,000 ea/year

1.4B mi of real-world driving data assets

Commercial Vehicle ('20 ~)

Total 2,443 ('19~'25.5)

- High durability cell for CV (Commonized system components)
- Sales volume for buses : 1,438 (City) / 722 (Coach)

	City Bus	Coach Bus
FC Power	***160 kW** (80kW x 2ea)*	
Motor Power	180 kW	350 kW
Hydrogen storage	34.3 kg (Tank 5ea)	34.3 kg (Tank 5ea)
Range	470 mi	600 mi

Current status of HMC FC & FCEVs

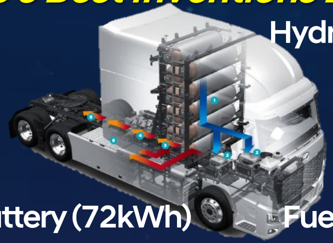
New FCEV platforms have been launched with latest FC systems, featuring a significantly extend mileage by increasing hydrogen storage capacity and boost output with an improved FC system

The All New NEXO (2025)

	NEXO (2018)	The All New NEXO
Output (FC / Battery / Motor)	85 / 40 / 120 kW	**94** / 80 / 150 kW
Max speed	111 mph	112 mph
0→100kph	9.2 sec	7.8 sec (1.4 sec ↓)
Hydrogen storage	6.33 kg (Tank 3ea)	6.69 kg (Tank 3ea)
Mileage	381 mi	450 mi (69 mi↑)

The New XCIENT (NA Tractor 2025)

Awarded Time Magazine's Best Inventions 2025



	XCIENT (EU)	The New XCIENT (North America)
FC Power	160 kW (80kW x 2ea)	160 kW (80kW x 2ea)
Motor Power	350 kW	350 kW
Hydrogen storage	31.08 kg @350bar (Tank 7ea)	68.6 kg @700bar (Tank 10ea)
Mileage	250 mi	500 mi

Enhanced Fuel Cell System

27+ Years of Development – Built on the foundations of reliable automotive grade stack technology, the advanced fuel cell system bring commercial vehicle specific design improvements, ready to operate in the most demanding applications.

In-house applications

| 45,000+ NEXOs

| 250+ XCIENT Fuel Cell Heavy Duty Trucks

| 1,700+ ELEC CITY Fuel Cell Public City Buses

| 1,000+ Universe Fuel Cell (Intercity) Coach Buses

Partner applications

| Bus, Truck, Container Handling Equipment, Maritime, Trams, AAM, Power Generators, etc.

Output (net)
94 kW

System Efficiency (max.)
61.7%

Operating Temperature
-30 ~ 85℃

Dimensions (mm)
651 x 888 x 718

Weight:
180kg

IP Rating:
IP67/IP69K

Hydrogen Specification
ISO 14687-2 / SAE J2719

Certification
UN R-134, ECE R100, ISO26262, Cybersecurity ready

Fuel Cell System Manufacturing Capability

Hyundai's manufacturing footprint combines serial production at scale, regional diversification, and forward-looking investment.

Throughput
12,000 units

Employees
447 staff

Total Capacity
17,000 units

Fuel Cell Gen 2.5 Manufacturing
Chungju, South Korea

Primary Fuel Cell manufacturing, supplying current generation systems to global mobility programs. Optimized for automotive-grade quality, repeatability, and volume flexibility, providing customers with confidence in delivery reliability and the ability to moderate surge demand without disruption.

China Market Manufacturing
Guangzhou, China

Anchoring Hyundai’s Fuel Cell manufacturing in China, supporting regional localization, supply-chain resilience, and cost optimization. It provides geographical diversification of production and reinforces ability to scale Fuel Cell manufacturing across multiple regions as the global demand accelerates.

Investment
$1.1 billion

Total Capacity
6,000 units

Investment
$630 million

Employees
276 staff

Planning Capacity
30,000 units

Next Generation Fuel Cell and Electrolysis Manufacturing
Ulsan, South Korea

Hyundai’s next-generation Fuel Cell manufacturing hub, integrated within the worlds largest automotive manufacturing complex. The site is designed to support future platforms, higher automation and long-term cost reduction, ensuring continuity of supply and technology leadership as Fuel Cell systems gain legitimacy in global markets.

HMG Energy Vision

Fuel Cell Applications

Fuel Cell System

94kW

Flat-type Fuel Cell System

94kW

Fuel Cell Powerpack*

30kW

*System + H2 Tank + Battery + Etc

Fuel Cell Power Generator

100kW

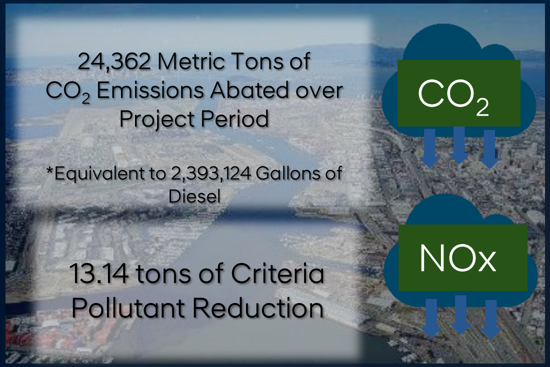
Fuel Cell Systems Application

NorCal Zero Project

H_2 Refueling Station

- Largest HD HRS in the World Capable of Filling 200 Class 8 Trucks per Day with Hydrogen
- 20-minute Fill Time to Enable 450+ Miles of Range

Community Impact



West Oakland Environmental Indicators Project

- Improving Air Quality of Disadvantaged Communities Around the Port of Oakland
- Strong Community Engagement via the West Oakland Environmental Indicators Project (WOEIP)

H_2 Truck Deployment

CARB Chairwoman Liane M. Randolph with WOEIP Executive Director Brian Beveridge

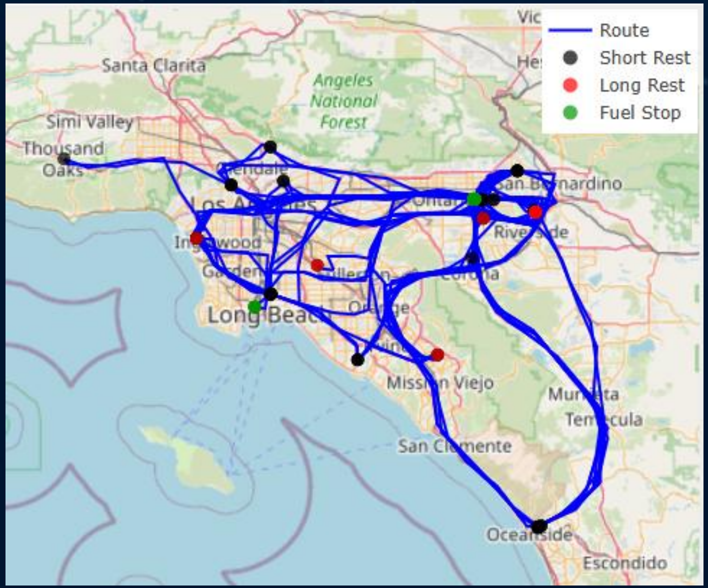
- Largest Single Deployment of HD Trucks in the World: 30 Hyundai XCIENT Fuel Cell Tractors at the Port of Oakland
- 10 service technicians and 30+ operators trained
- Fleet Operator GET Freight is Serving 7 Customers Within a 150 mi Radius

ALAMEDA County Transportation Commission

EPA TAG – Targeted Airshed Grant with SCAQMD

Hyundai XCIENT Fuel Cell, operated by Pilot Company, took part in the 2025 NACFE Run on Less, delivering hydrogen fuel to HRS in SoCal

Metric	Value
Driving distance	4,076 mi
No. of deliveries	66
Average temperature	69 F
Average Fuel Economy	7.8 mi/kg
GCW	~70,000 lbs.



Operating routes during Run on Less

NACFE
NORTH AMERICAN COUNCIL FOR FREIGHT EFFICIENCY

XCIENT Fuel Cell hauling gaseous hydrogen fuel

South Coast AQMD

In proud collaboration with SCAQMD and Pilot Company, Hyundai was able to deploy 5 trucks in Southern California; their exceptional performance has been showcased in the 2025 NACFE Run on Less, “Messy Middle”: https://www.youtube.com/watch?v=b5WKJbUYbbM

HMG Energy Vision

Clean Logistics Business

HTWO Logistics
Joint Venture

21 XCIENT Class 8 Fuel Cell trucks deployment supporting HMGMA logistics

HYUNDAI HYUNDAI GLOVIS

HTWO Energy
Savannah

Hydrogen production and refueling station for Class 8 Fuel Cell trucks in the Savannah region

*Current hydrogen production: 1,200 kg/day (with plans to scale up to 4,200 kg/day to meet future demand)

HMG Energy Vision

Global Energy Transition Leader

Mobility ›› **Hydrogen** ›› **Energy**

Fuel Cell in Application: Stationary Power 100kW

Korea's H_2 Cities and broader Hydrogen Economy programs were launched to accelerate real-world deployment of hydrogen technologies across residential, industrial, and utility energy systems.

Project overview

Developed under Korea's national H_2 Cities Program, the 100 kW fuel cell power generator is a grid-connected stationary system designed to deliver clean, reliable electricity in residential and community environments. Optimized for on-site urban installation, the system enables decentralized power generation with zero local emissions, low noise, and high efficiency while operating seamlessly with the existing grid.

System Performance & Scale

- Rated output: 100 kW (≈70 kW net AC)
- Continuous operation at ~92% capacity factor
- Generates approximately 66 MWh per month, equivalent to the electricity demand of 200+ households
- Electrical efficiency: ~50% (LHV basis)
- Startup time: < 5 minutes

Technology Differentiation

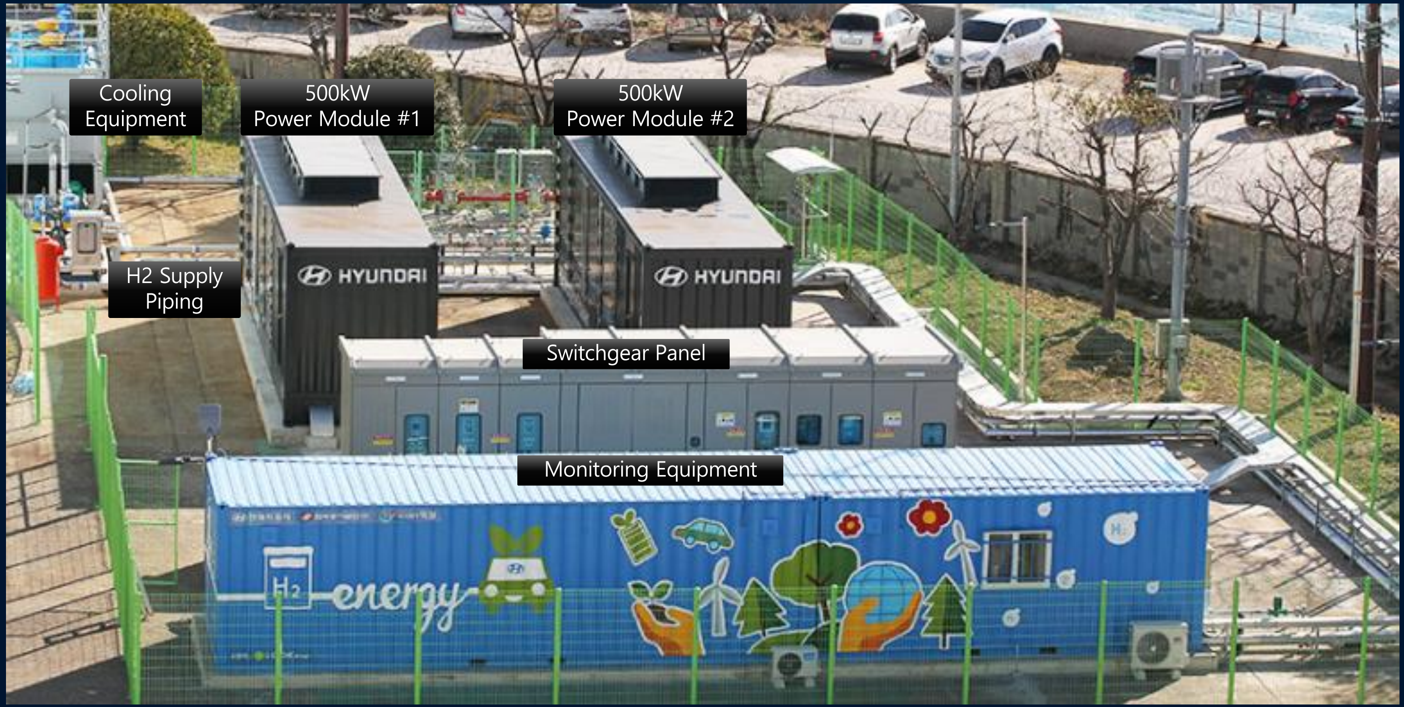
- Built using automotive-derived fuel cell system modules, transferring:
  - Proven durability and lifetime validation
  - High-volume manufacturing quality processes
  - Robust control and safety architecture
- Modular building-block approach enables scalability and serviceability

Fuel Cell in Application: Stationary Power 500kW

This demonstration validates the scalability of a single fuel cell technology platform from residential to utility-scale power. Using modular, automotive-proven building blocks, the system delivers high availability, redundancy, and ease of maintenance, providing utilities and industrial customers with a credible reference for on-grid hydrogen power at the hundreds-of-kilowatts scale and beyond.

Project overview

The 500 kW fuel cell power system was developed for the Ulsan Hydrogen City initiative and deployed at the Ulsan East–West Power and Thermal HQ site. Designed for continuous, on-grid operation, the system demonstrates large-scale hydrogen fuel cell power generation integrated with urban utility infrastructure, targeting industrial, commercial, and utility power applications.



System Performance & Scale

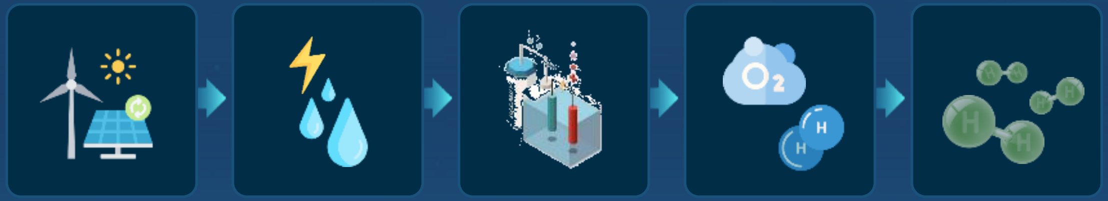
- Total output: 500 kW
- Electrical efficiency: ~50%
- System weight ≈ 25 metric tons, reflecting industrial-grade construction

System Architecture

- Multi-module layout including:
  - Multiple 500 kW-class power modules
  - Centralized switchgear and monitoring systems
  - Integrated hydrogen supply piping and cooling equipment
- Designed for continuous grid-connected operation with external monitoring via LAN

Hydrogen Production Business

PEM Electrolysis

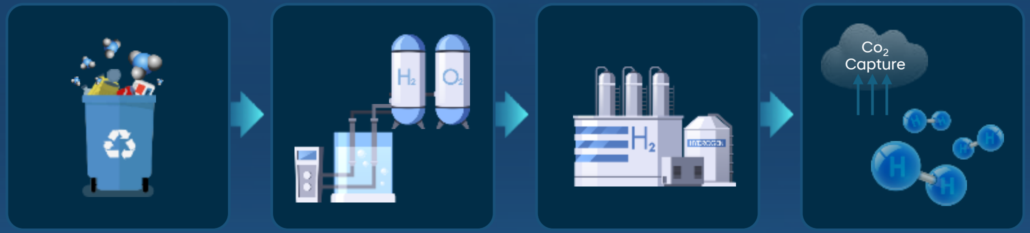


Renewable Energy → PEM Electrolysis → Green Hydrogen

South Korea

- Boryeong (1MW) / '26
  Buan (1MW) / '26
- Jeju (5MW) / '25
  (Start of Construction)
- Southwest Region (1GW) / '27
  (Start of Construction)

Waste to Hydrogen (W2H)



Biowaste → Biogas Extraction → Biomethane → Steam Methane Reforming (SMR)

South Korea

- Chungju W2H / '23
- Cheongju W2H / '26
- Paju W2H / '27

Indonesia

- West Java W2H / '29

(as of Construction Completion)

HTWO

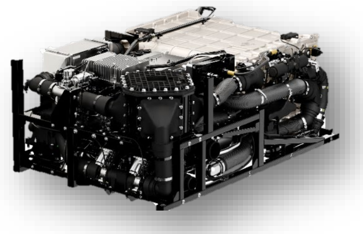
HYUNDAI MOTOR GROUP

Fuel Cell Electric Vehicle Modular Architecture

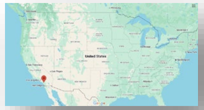
January 29, 2026

Agenda

- Symbio North America Timeline
- FCEV Modular Architecture - Flexible, Industry Friendly Solutions
- Demo Project
- Class 8 Projects
- Upcoming Projects
  - Transit Bus
  - Refuse
- Questions



Symbio North America Timeline



Start of Operations
POWAY

Start of Operations
TEMECULA

Re-defining Strategy

Ramp up

Temecula Inauguration

2010
- Creation

2019
- Forvia and Michelin 50/50 shareholders

2021
- Explore business opportunities

2023
- Forvia, Michelin, Stellantis each 1/3 shareholding

2024
- Manufacturing capability expansion

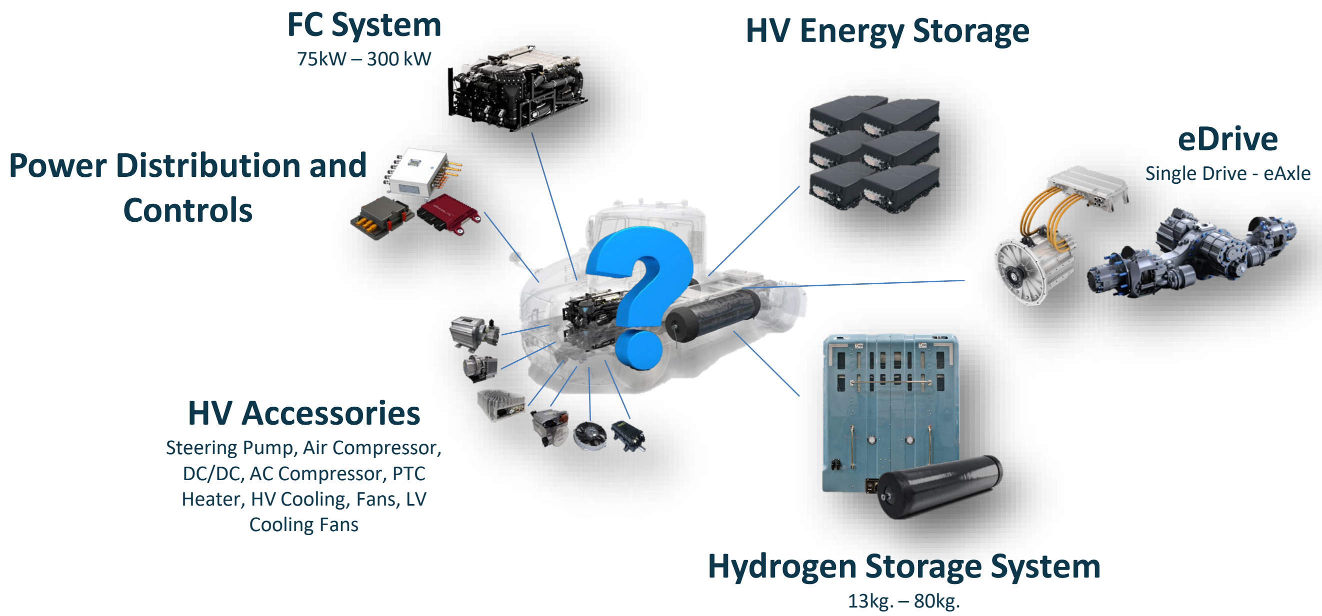
2025
- Focus on key segments and application

2026

2025 - Modular Architecture Focus on key applications

8+ million Km
on-road vehicle experience

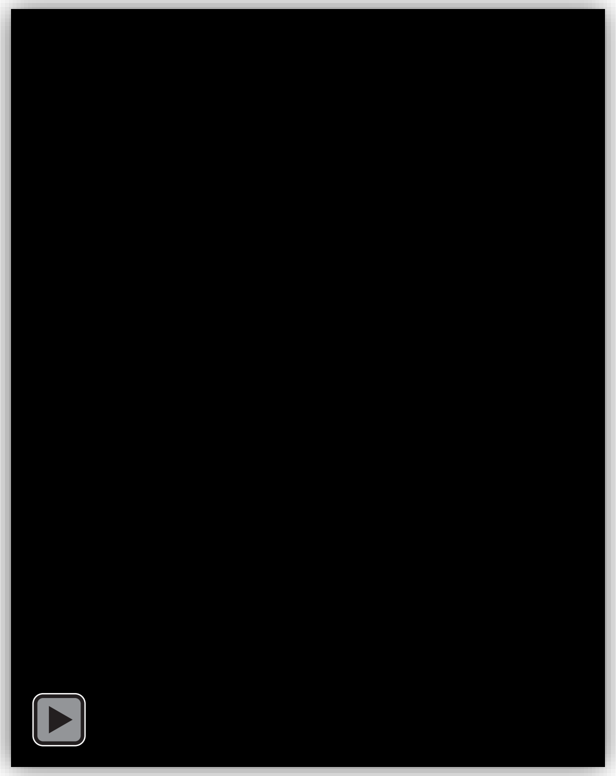
Modular Architecture, Flexible, Industry Friendly Solutions



Notes

- Engineered for streamlined integration to different vehicle platforms
- Maximizes “off the shelf” components to reduce weight and cost
- Chassis, eDrive, and HSS agnostic

Demo Projects

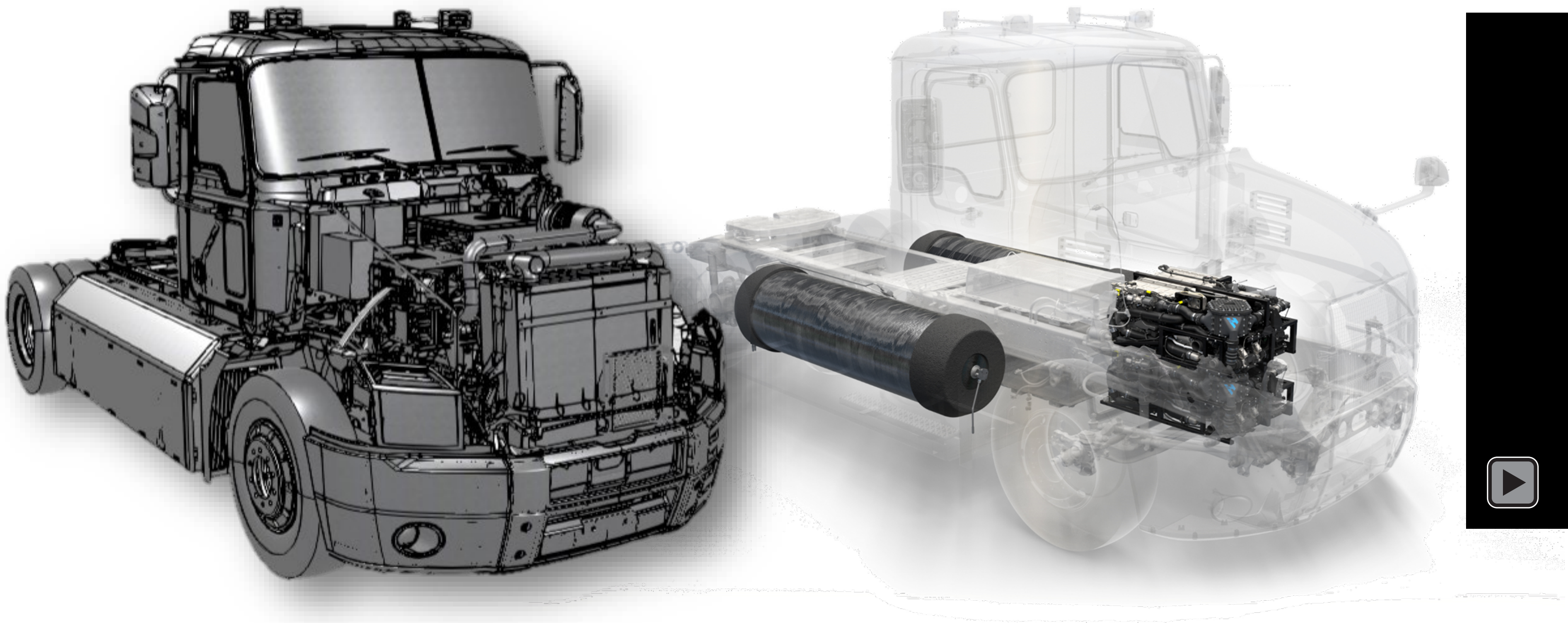


Notes

- FCEV CL8 Truck – Long Hauling
- Project funded by the **California Energy Commission**
- Performance under evaluation

Class 8 Projects

SAVAGE



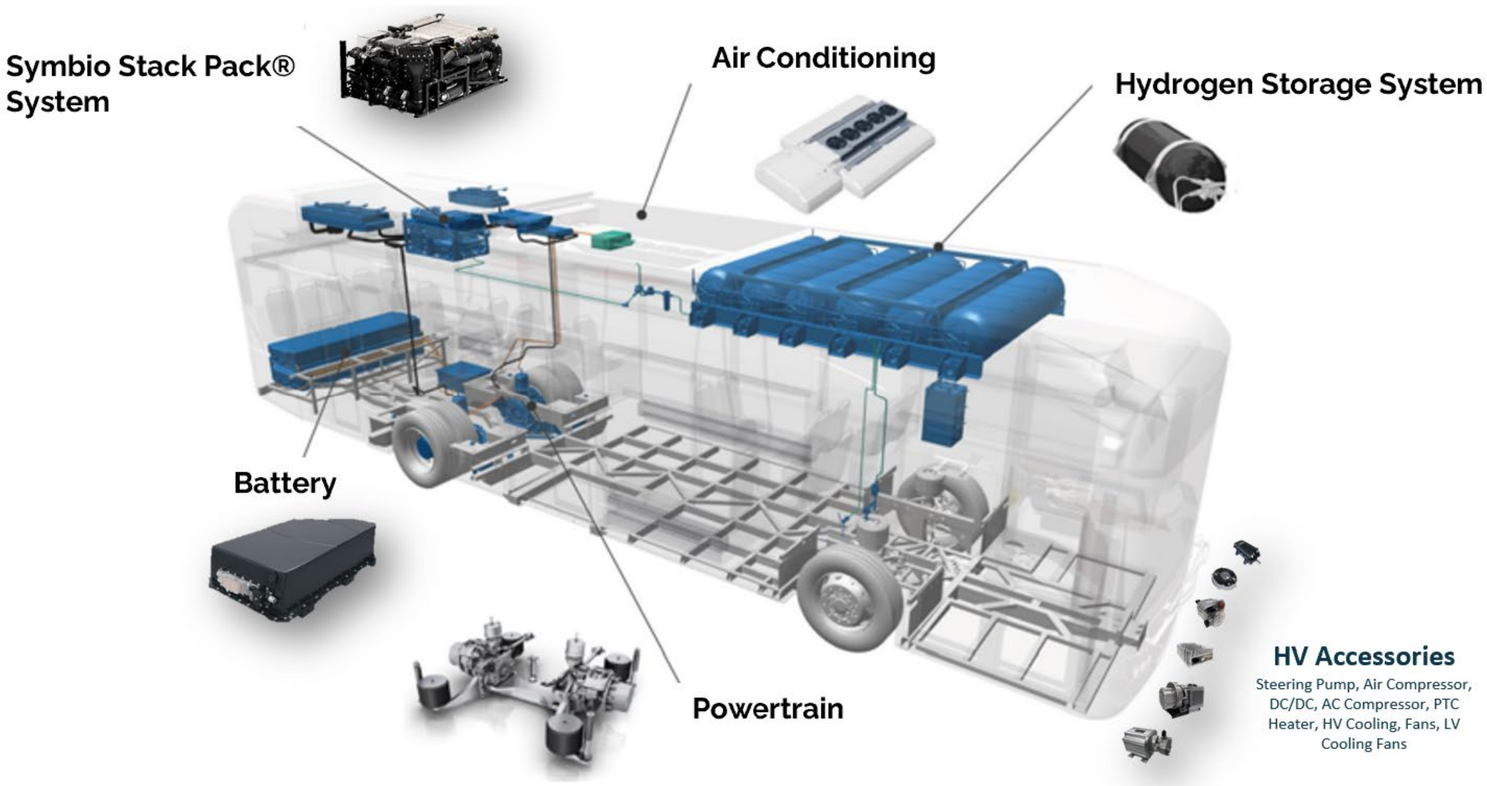
Notes

- FCEV CL8 Truck – Bulk/Drayage
- **Symbio – SAVAGE collaboration,** 2x4 Diesel Chassis re-power
- Optimized for Drayage, **estimated weight <17,000 lbs.**

- FCEV CL8 Truck – Bulk/Drayage
- 4x6 Diesel Chassis re-power
- Optimized for Drayage, **estimated weight <18,500 lbs.**

Upcoming Projects – Transit Bus

- **Re-power fully refurbished bus**
- **Symbio**: Fuel Cell Electric conversion kit
- **Local partner** to re-furbish and build FCEV Bus
- Scalable



Why is this important?

- Demonstrate FC Transit Buses are commercially viable (Total estimated cost: ~45% less than current market offering)
- Develop a modular, chassis agnostic conversion kit to accelerate adoption of FCEVs
- Regional economic development, creating skilled jobs, and strengthening local supply chains

Upcoming Projects - Refuse

- Design and development a zero-emission HFCE refuse truck
- **Utility Global** to provide fueling
- **Demonstrate operation for one year** in partnership with CR&R, WM and local municipalities in the South Coast Air Basin.
- **University of California, Irvine** (UCI) will be carrying out the data collection, analysis, and third-party performance validation.

Why is this important?

- Major step forward in the commercialization of HFCE refuse trucks
- Cost-effective and reliable HFCE refuse trucks enabled by SCAQMD funding
- Regional economic development, advancing clean mobility expertise, and strengthening local supply chains

South Coast AQMD

UTILITY

Questions

?

Thank You !

Secondary Particulate Matter from Tire Emissions

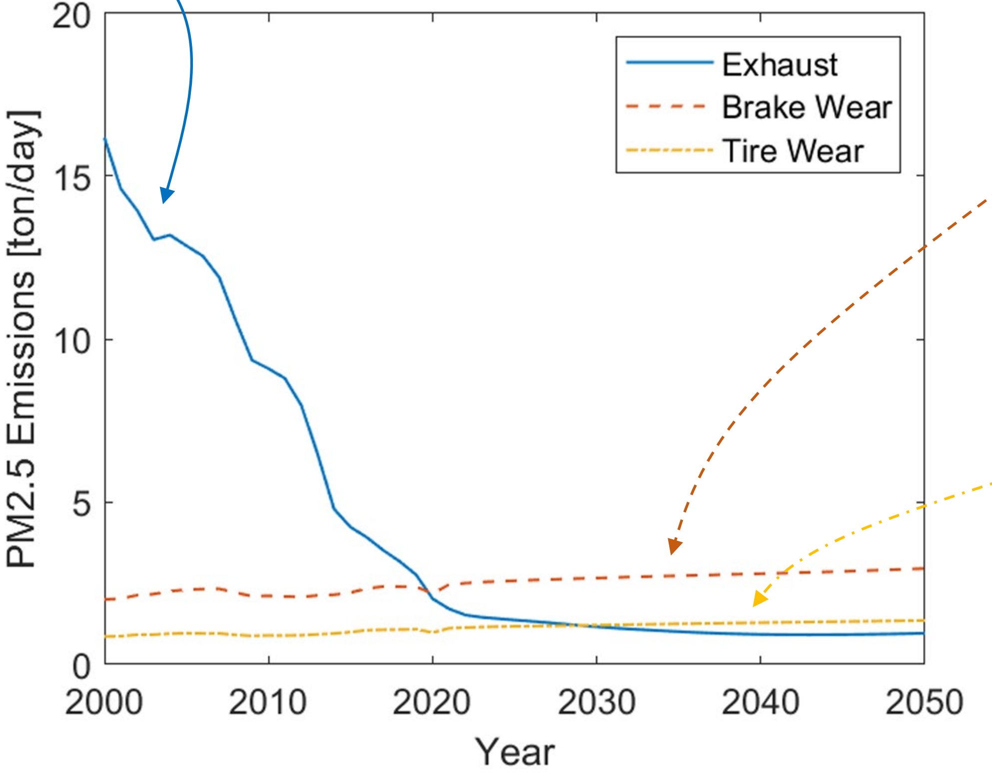
Don Collins – UCR Professor and Director of CE-CERT

Minghao Han – Ph.D. student

Hannah Velazquez and Matisse Rios – Current undergraduate researchers

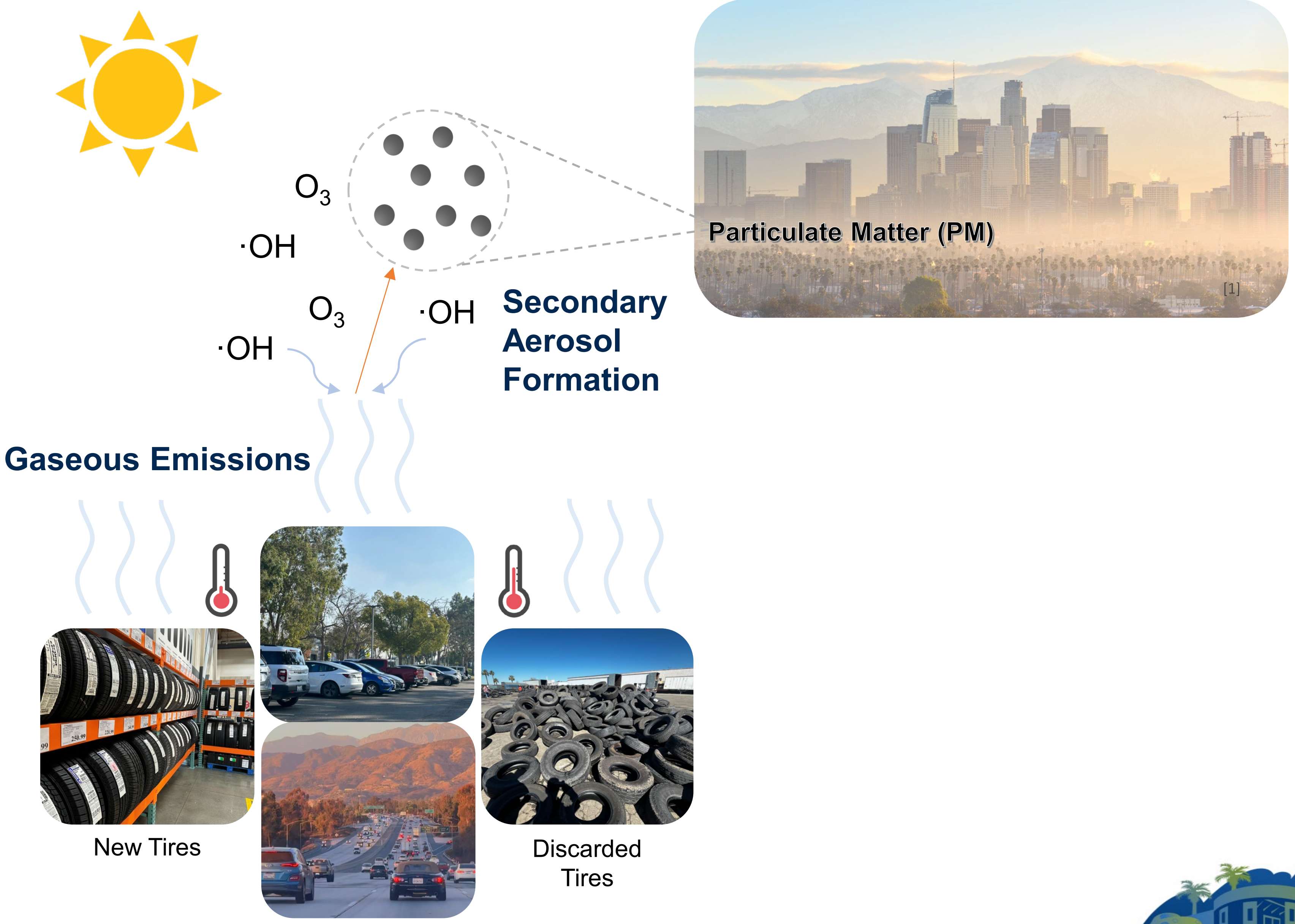
Evan Hoffman-Jastermsky and Alyssa Gomez – Former undergraduate researchers

Importance of non-exhaust emissions



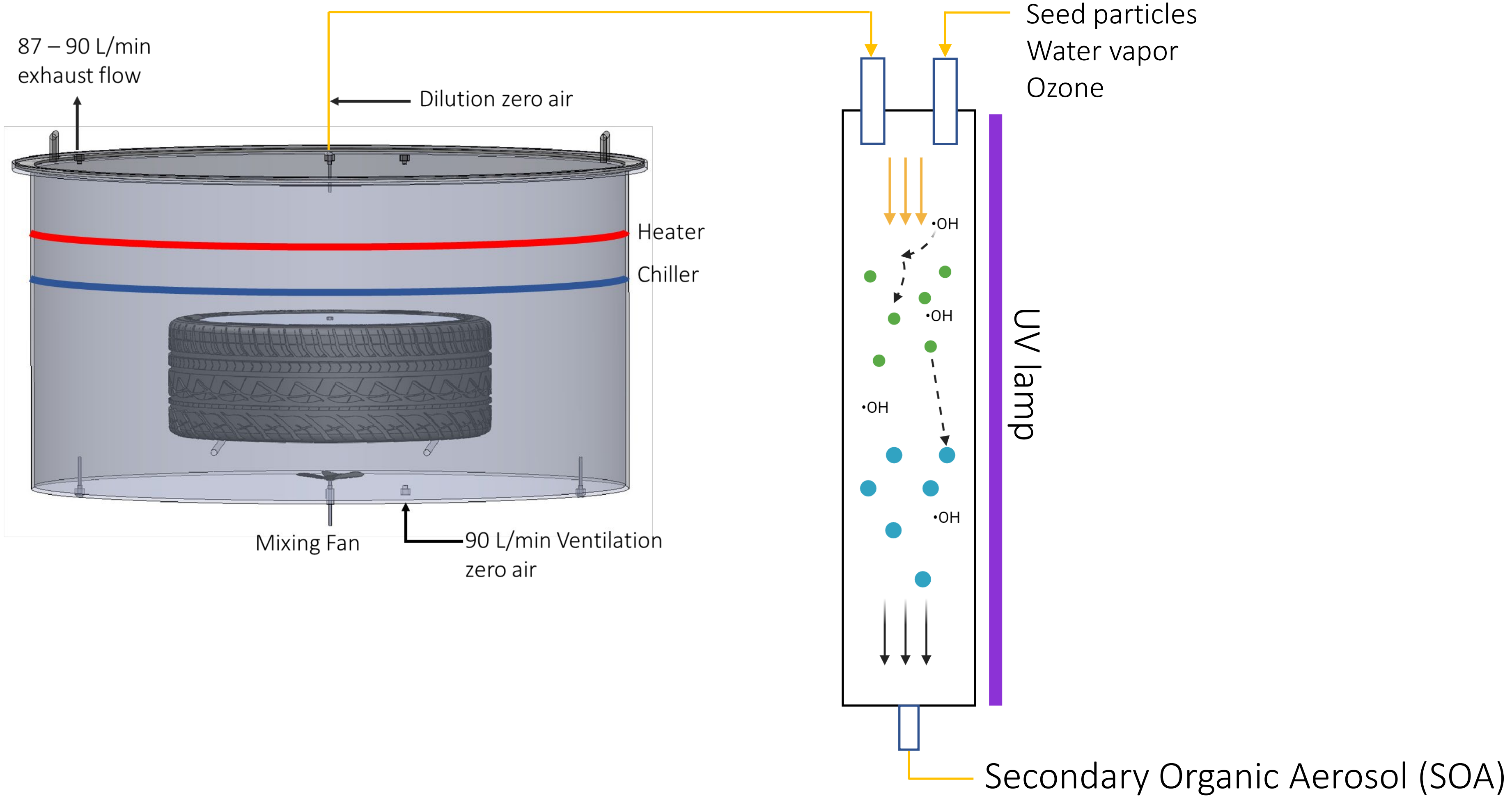
Graph copied from SCAQMD Brake, Tire Wear, and Road Dust Emission Health Risk Study RFP

Secondary PM from tire off-gassing



Our tire emissions testing system

Temperature controlled tire enclosure + Oxidation flow reactor



Questions we have addressed or hope to address using our laboratory system

- Do tires emit gaseous precursors that form significant amounts of secondary organic aerosol?

  Referred to as effective SOA emissions or E_{SOA}

- How does E_{SOA} vary with tire temperature?
- How does E_{SOA} vary with extent of photochemical processing?
- How does E_{SOA} vary with tire brand?
- How does E_{SOA} vary with tire age and wear?
- How does E_{SOA} vary with NO_x concentration?
- What is the SOA yield of the emitted gases?
- How much SOA is formed from the gases emitted from a tire over its lifetime?
- How does E_{SOA} from MDHD tires compare with that from passenger vehicle tires?
- Does SOA from tires have characteristics that make it detectable in ambient samples?
- How toxic is the SOA from tires?

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Questions about how the data from our laboratory system can be used

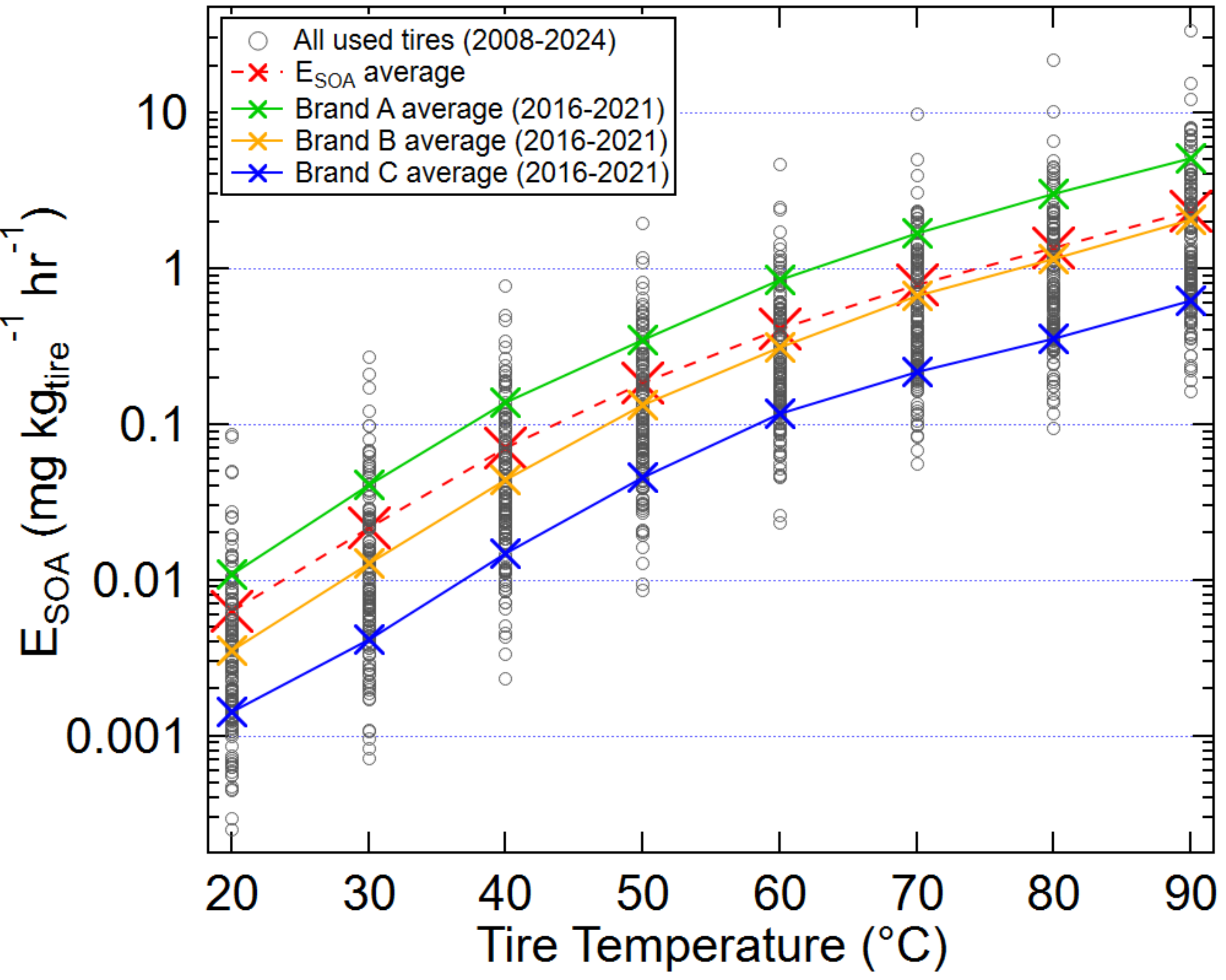
- What steps could be taken to reduce SOA-forming emissions?
- How will SOA from tire emissions change in the future?
- Under what conditions will tire SOA contribute most to total PM?
- How can our results be used to determine regional emissions?
- How can our results be used to determine air quality impacts?

  No spatial resolution: Back of the envelope calculations

  Coarse spatial resolution: Source apportionment (maybe)

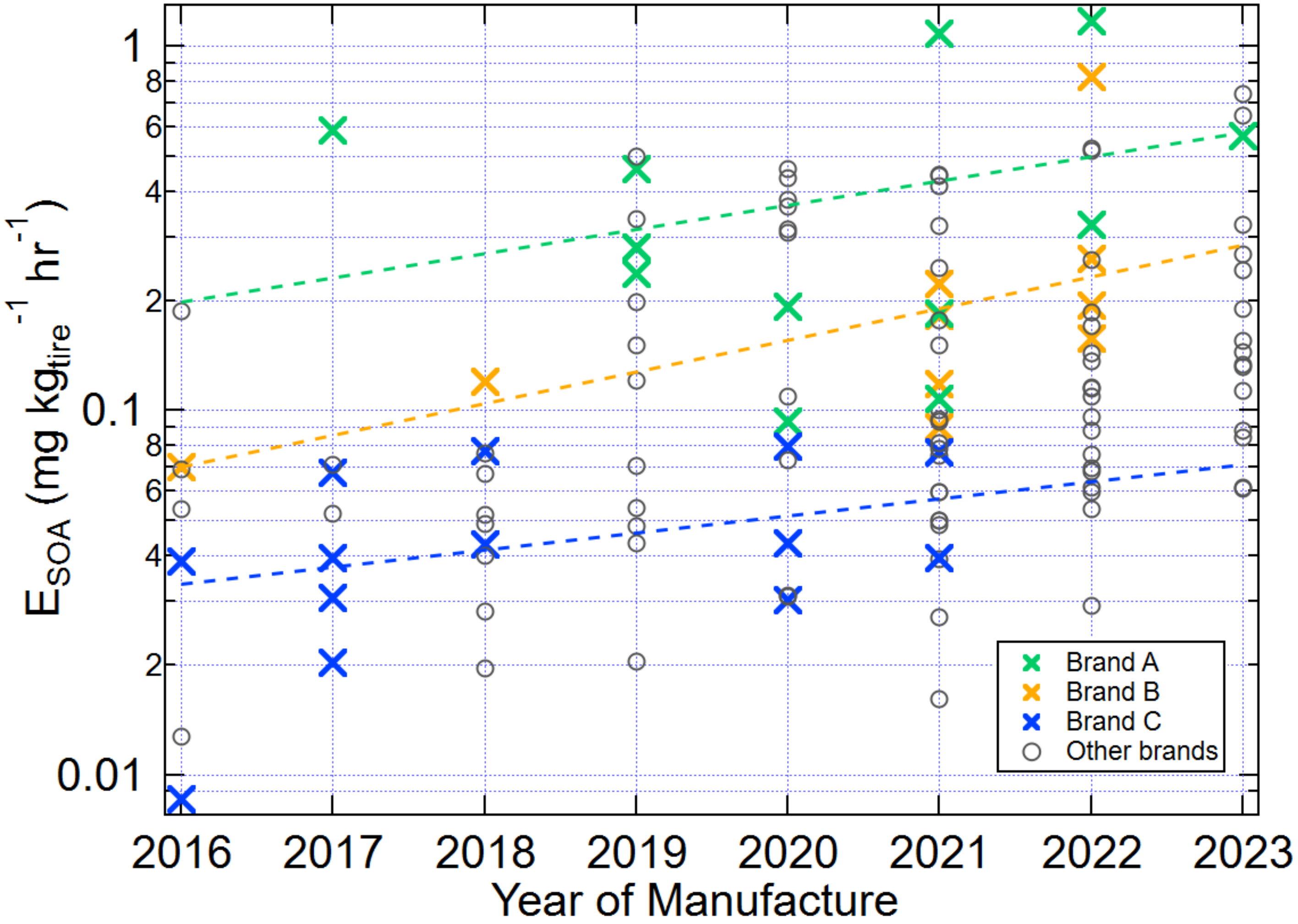
  Fine spatial resolution: Photochemical modeling

- How does E_{SOA} vary with tire temperature?
- How does E_{SOA} vary with tire brand?

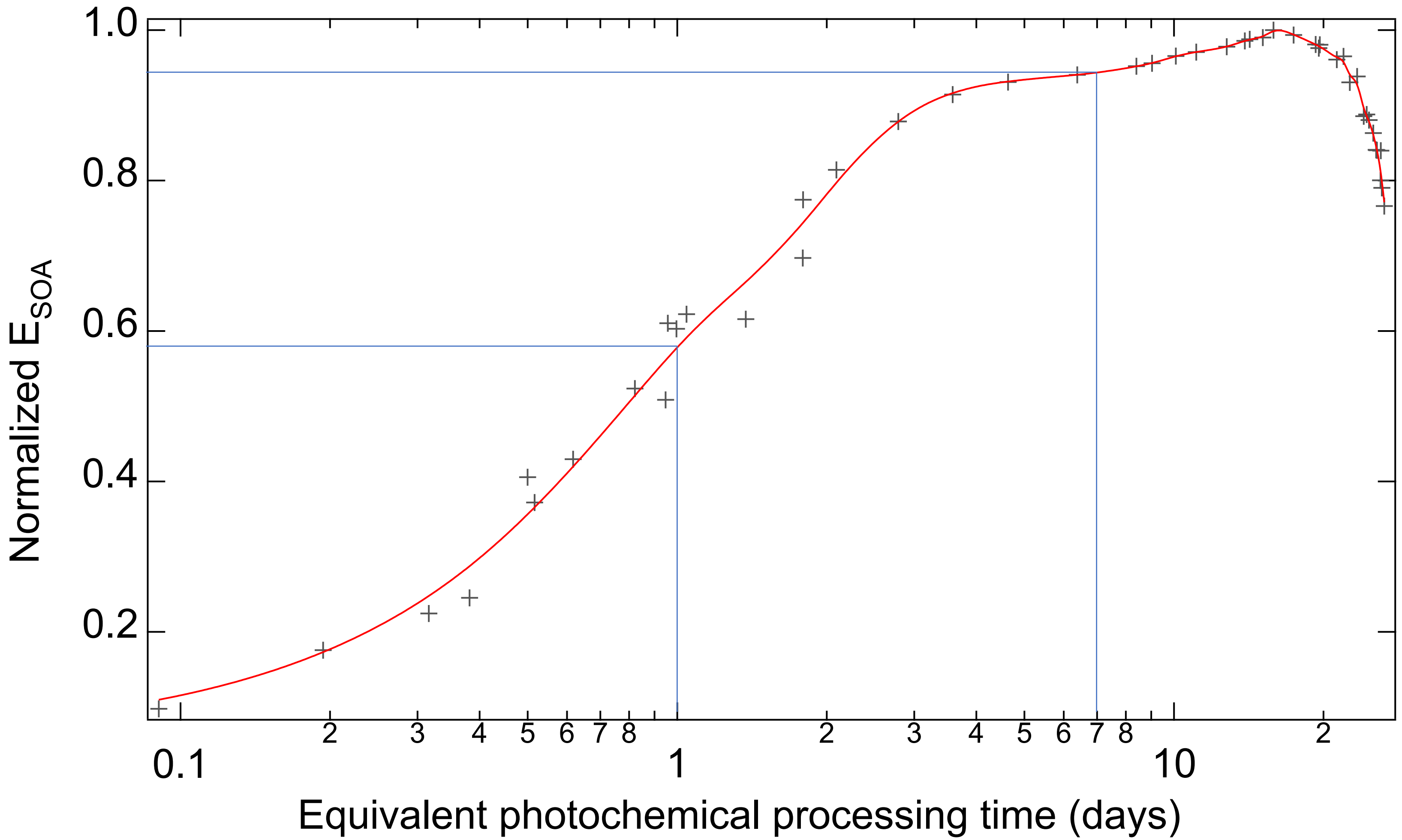


Effective SOA emission rate (E_{SOA}) of **143 used tires**.

- How does E_{SOA} vary with tire brand?
- How does E_{SOA} vary with tire age and wear?

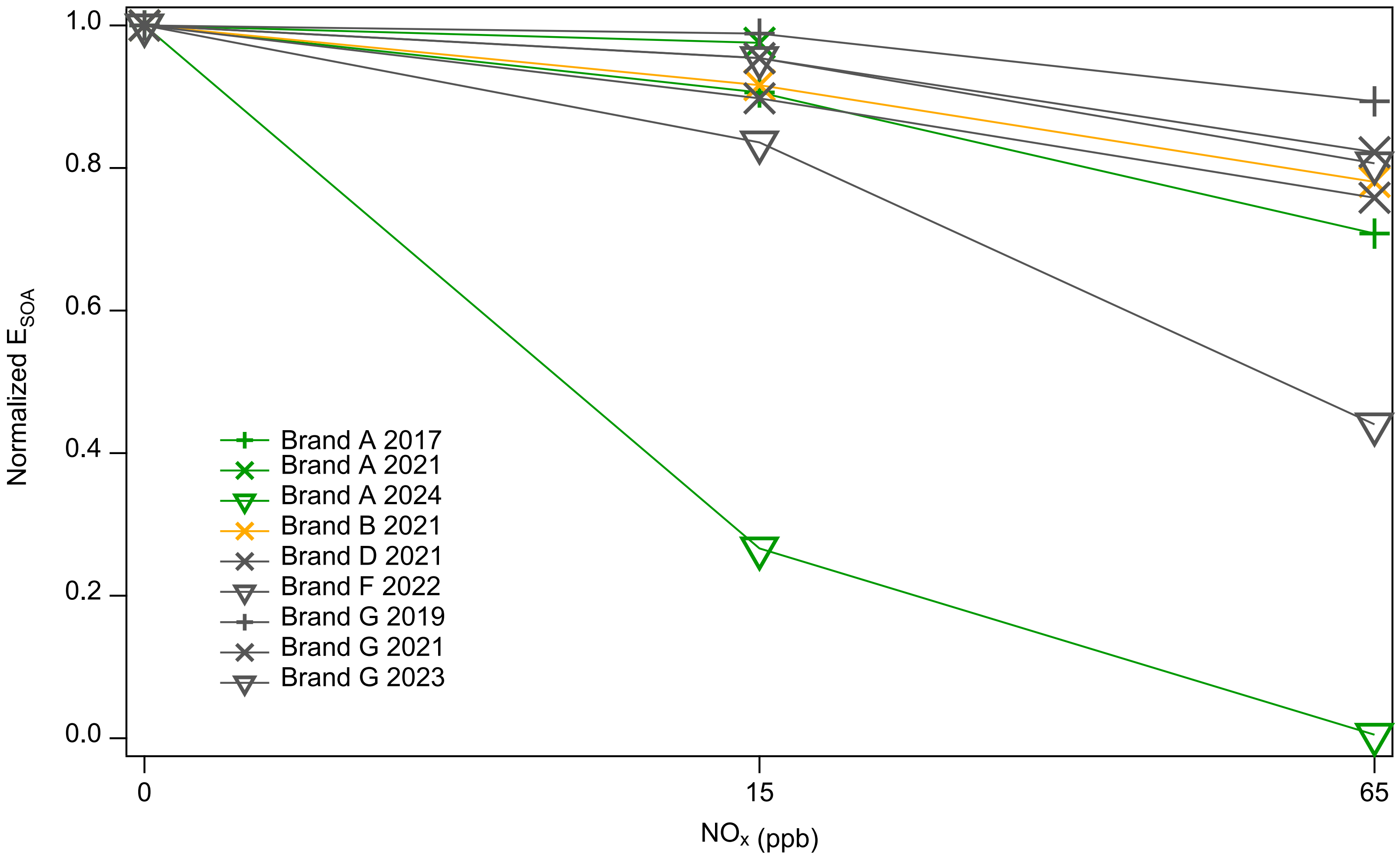


- How does E_{SOA} vary with extent of photochemical processing?



- Based on assumed atmospheric average [OH] = 1.5 x 10^6 cm^{-3}

- How does E_{SOA} vary with NO_x concentration?



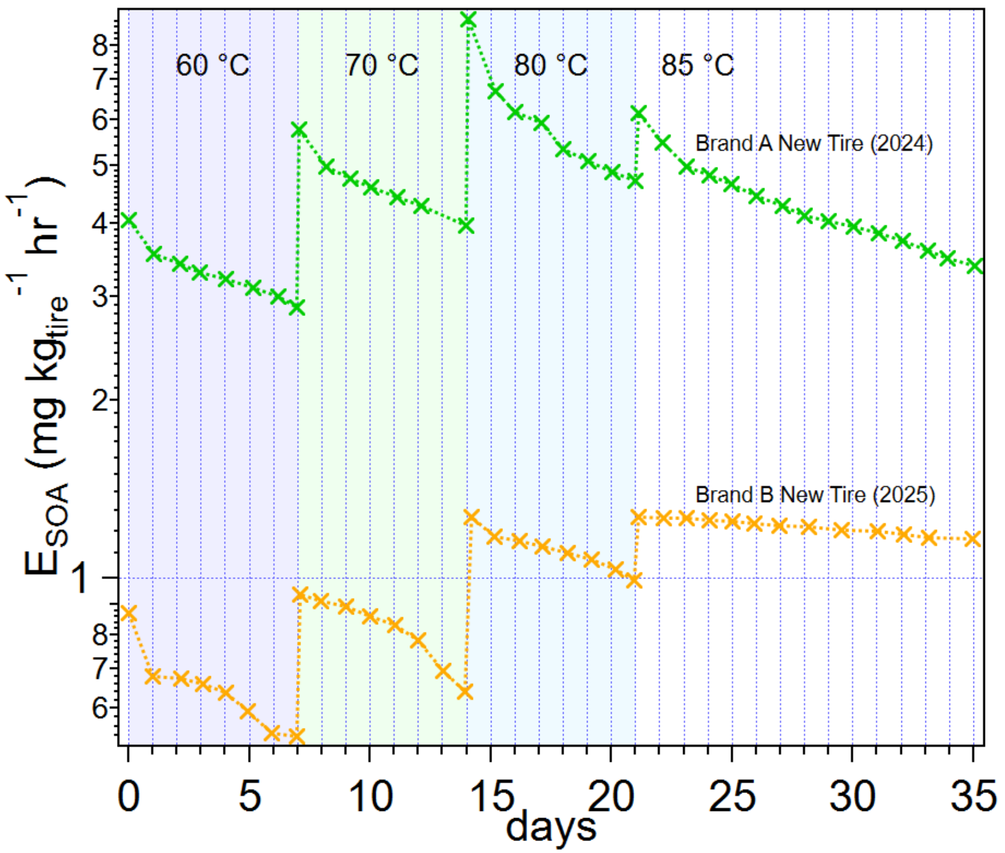
- What is the SOA yield of the emitted gases?
- How much SOA is formed from the gases emitted from a tire over its lifetime?

Testing procedure

1. Weigh prior to test
2. Keep in heated enclosure for 5 weeks
   - Measure E_{SOA}
   - Adjust tire temp over the weeks
3. Weigh after test
4. Calculate the yield

Results

Brand A: $Y_{SOA} \approx 38\%$
Brand B: $Y_{SOA} \approx 18\%$



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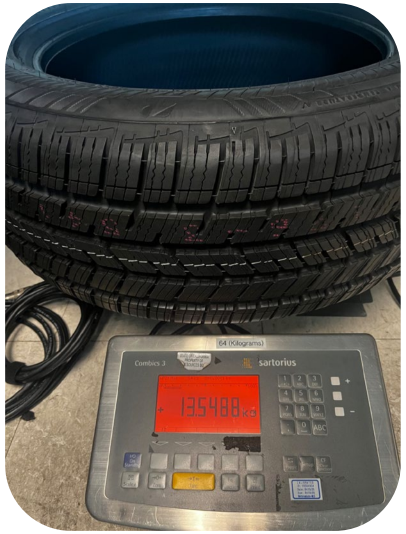
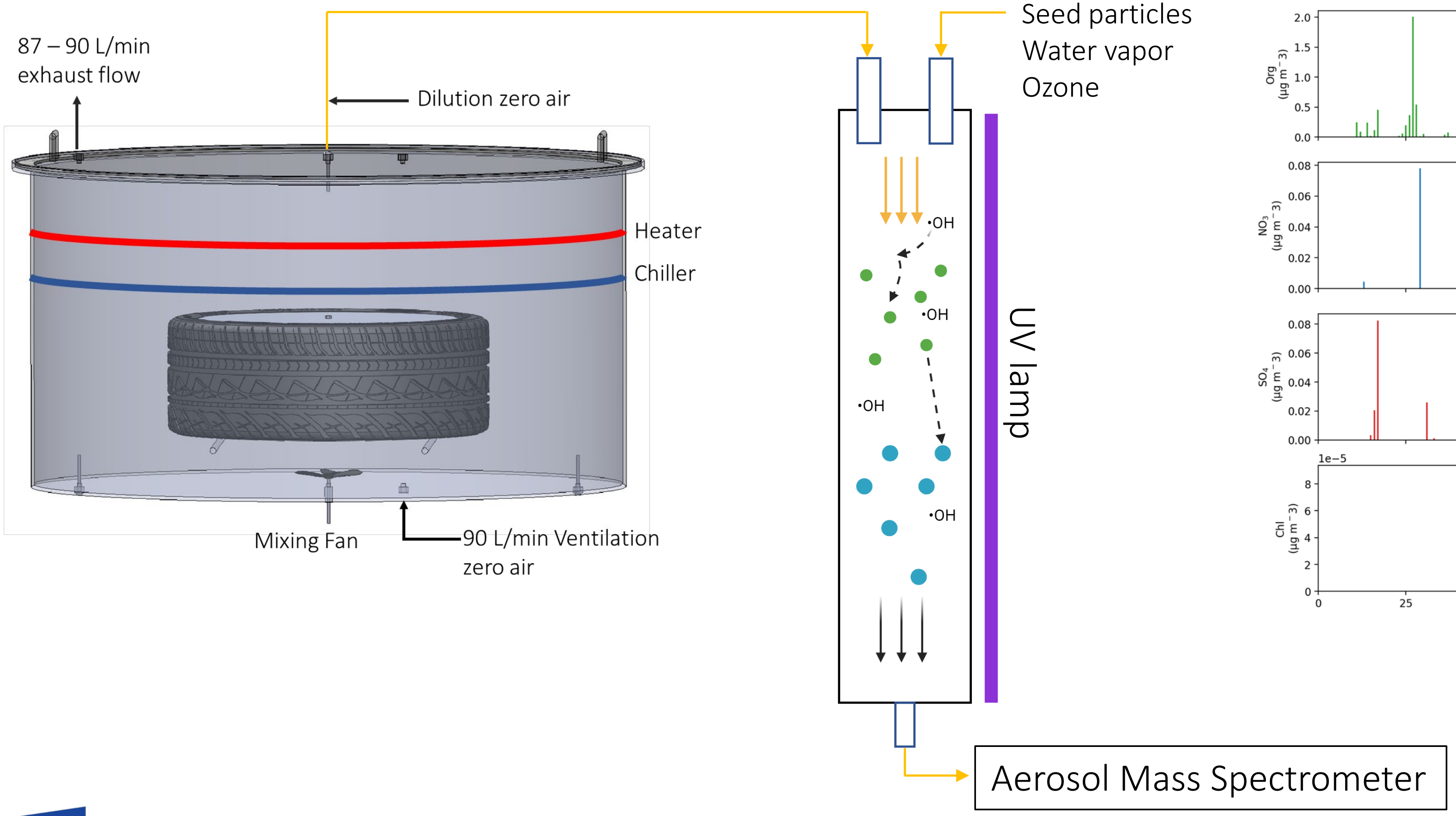
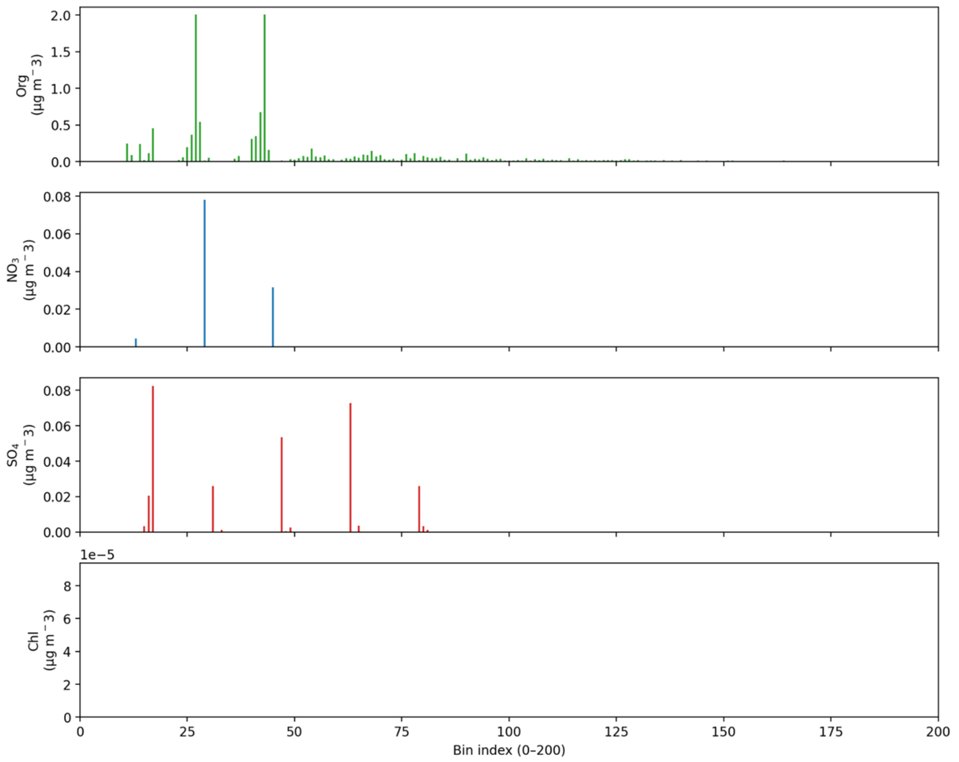
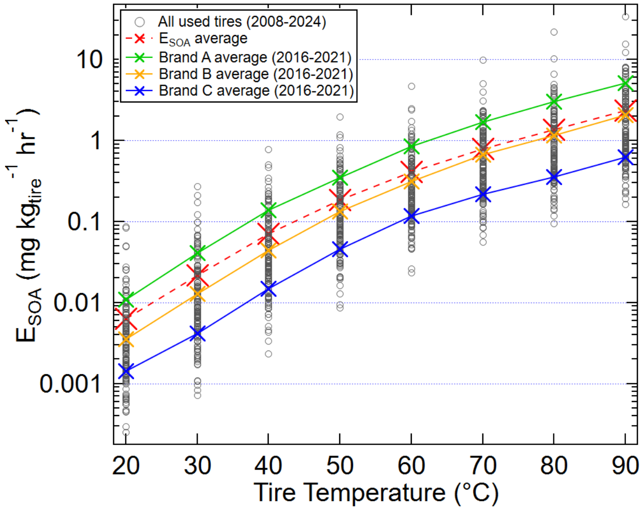


- Does SOA from tires have characteristics that make it detectable in ambient samples?





- What steps could be taken to reduce SOA-forming emissions?



- Identify causes of substantial brand-to-brand differences and work with manufacturers to adjust composition

- Minimize long-term storage in populated areas

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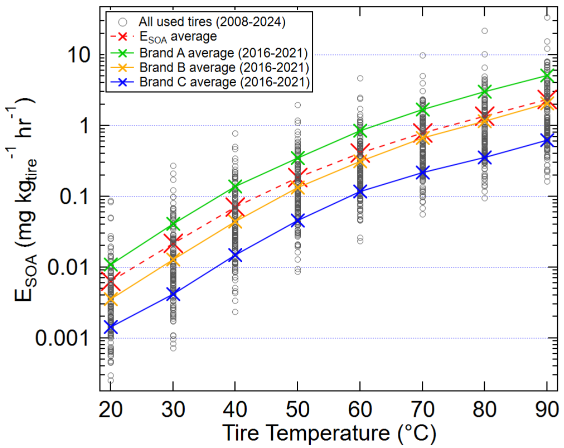
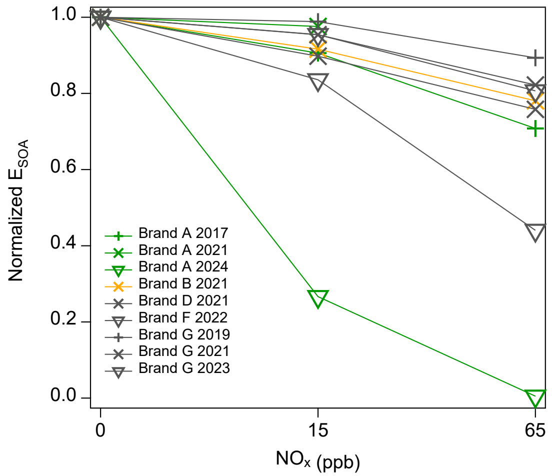
- How will SOA from tire emissions change in the future?





- Higher temperature → Higher emissions
- Lower NO_x → Higher SOA yield
- Heavier EVs → Higher tire temperatures

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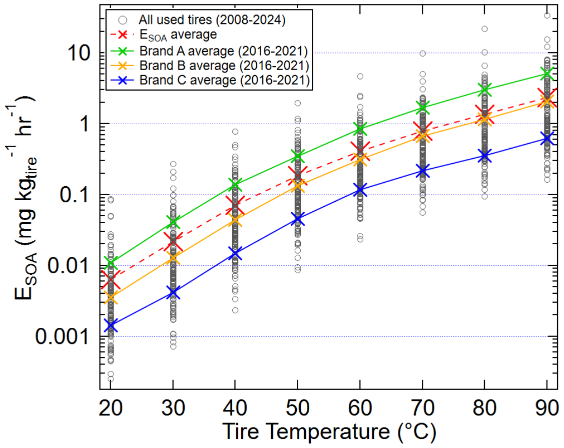
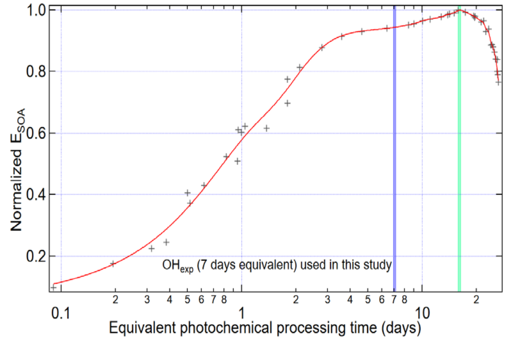
- Under what conditions will tire SOA contribute most to total PM?



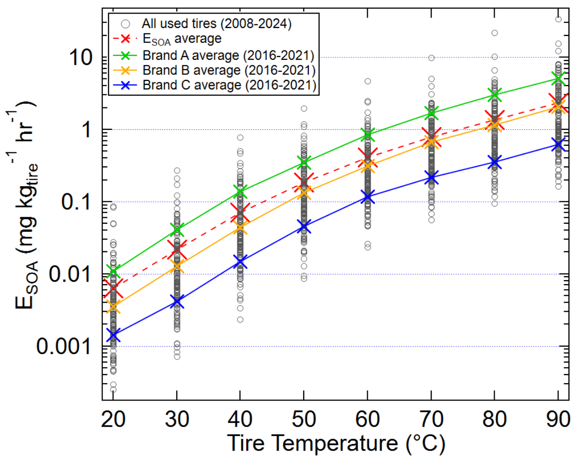
- Higher summertime temperature → Higher emissions

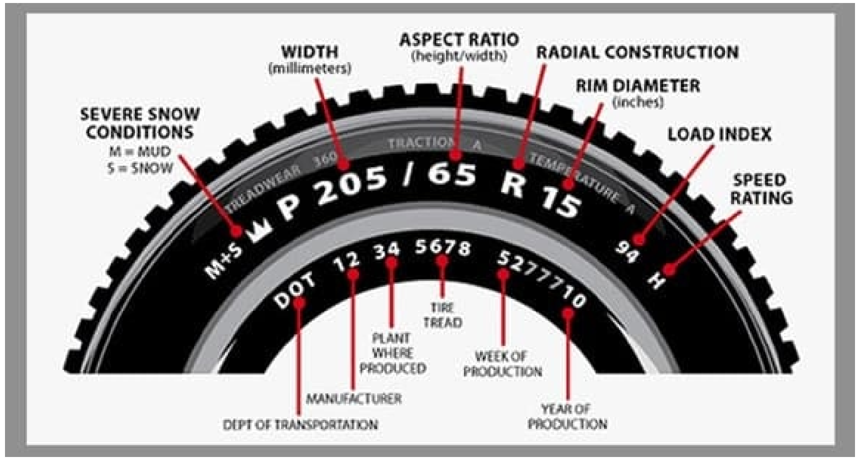


- Higher summertime oxidant concentration → Faster production

- Higher summertime solar insolation → Higher tire temperature

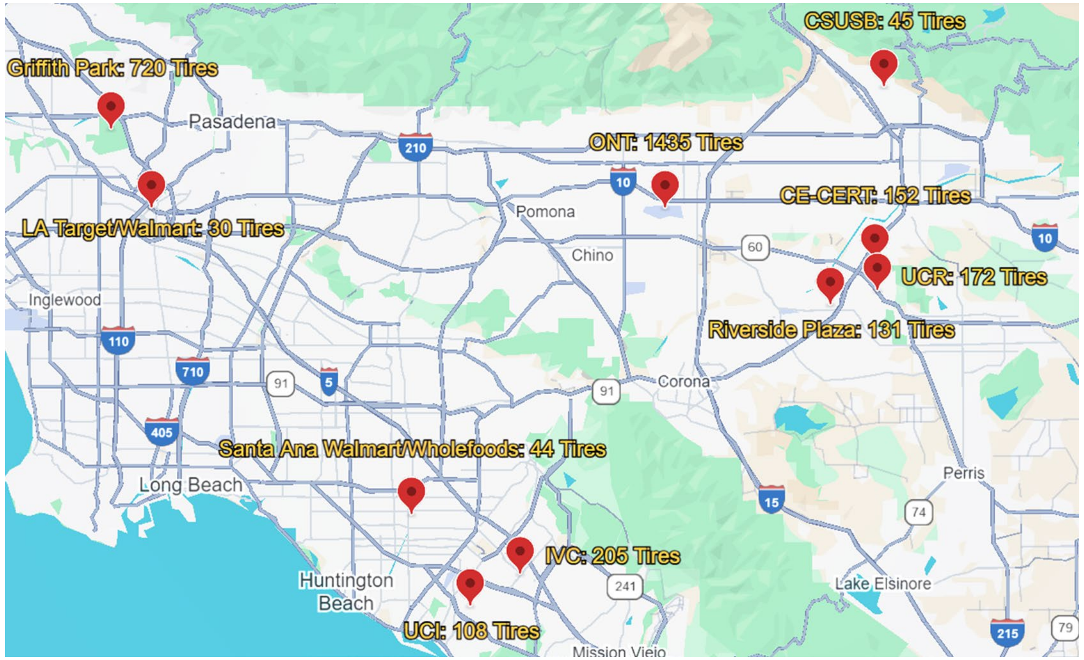
- How can our results be used to determine regional emissions?





+ Distribution of tire brands and ages

+ Distribution of tire temperature relative to ambient



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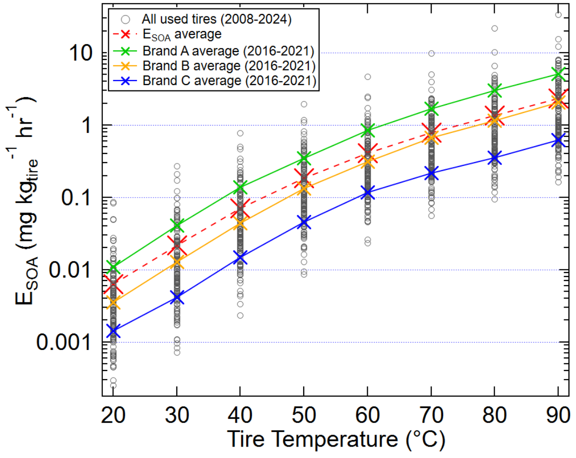

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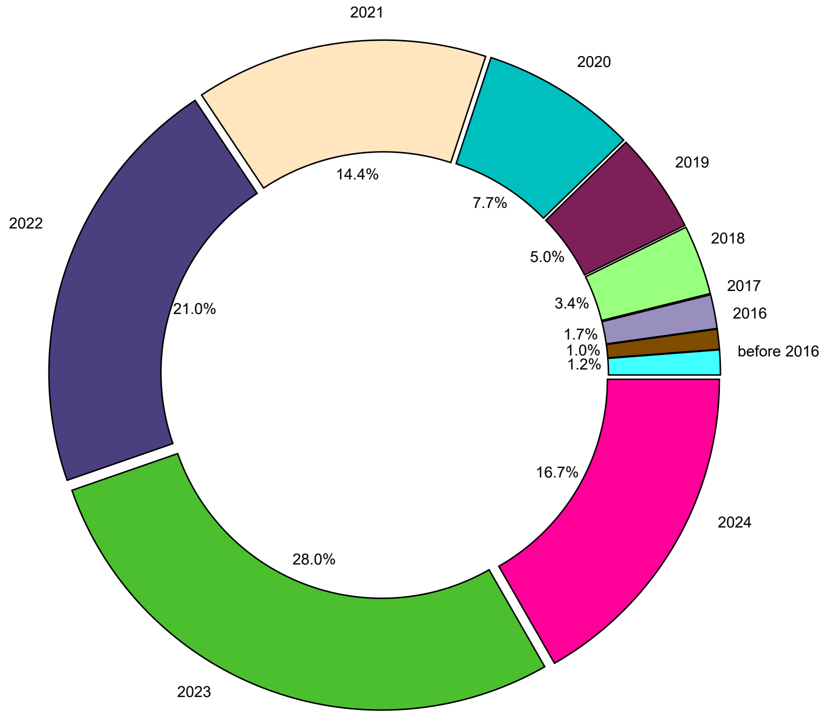

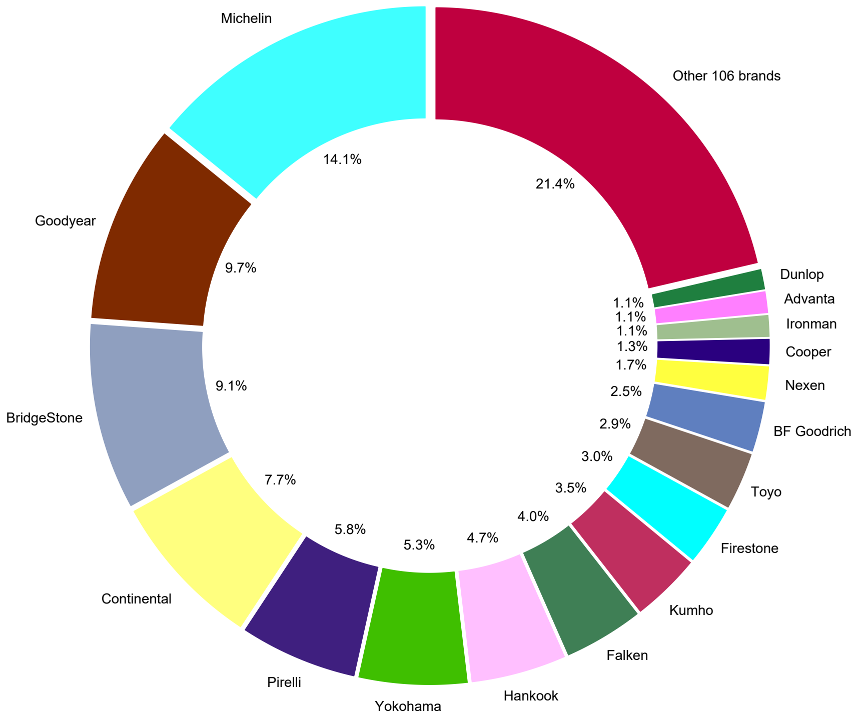

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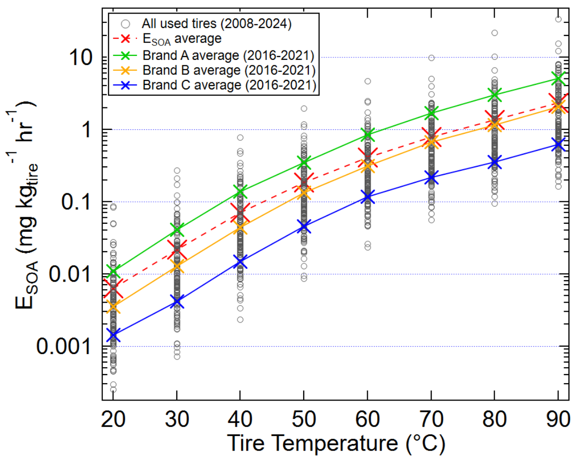
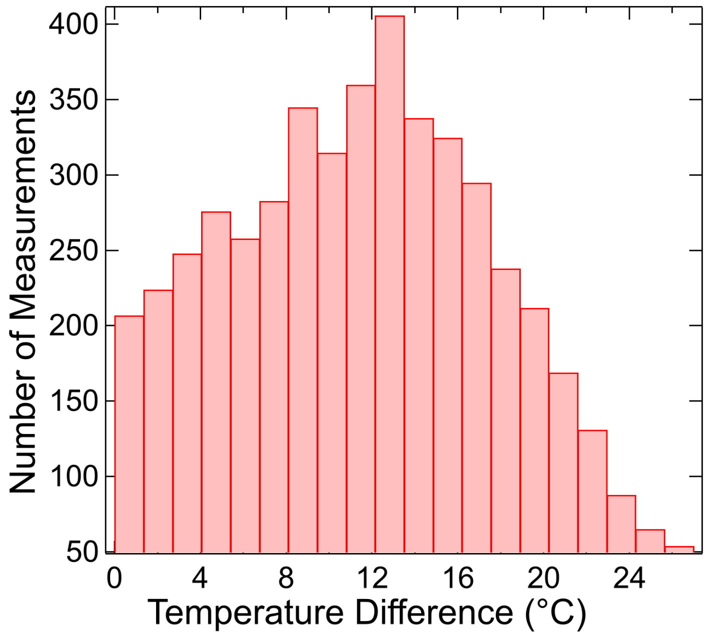


+ Distribution of tire brands and ages

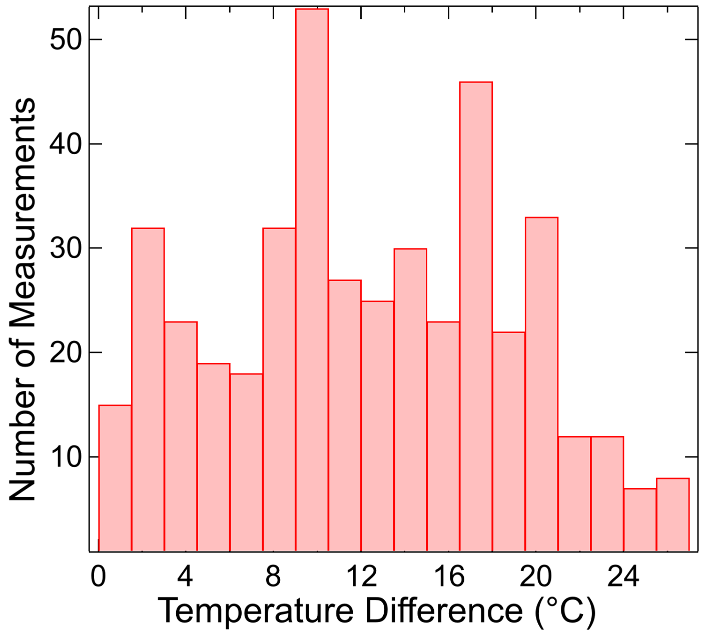
+ Distribution of tire temperature relative to ambient

Driving cars



Average ΔT ≈ 11.8 °C
Internal temperature
July–September 2025

Parked cars



Average ΔT ≈ 14.5 °C
Surface temperature
July–September 2025)

- How can our results be used to determine air quality impacts?

No spatial resolution: Back of the envelope calculations

Coarse spatial resolution: Source apportionment (maybe)

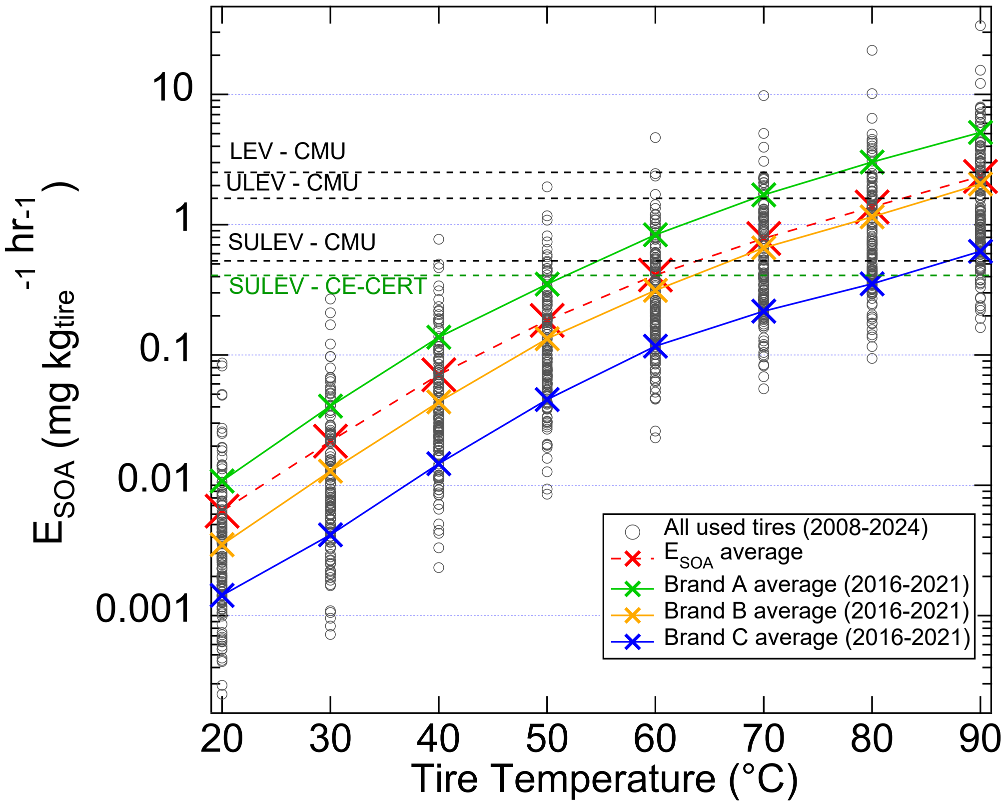
Fine spatial resolution: Photochemical modeling

- How can our results be used to determine air quality impacts?

No spatial resolution: Back of the envelope calculations

Zhao, Y., A. T. Lambe, R. Saleh, G. Saliba, and A. L. Robinson, 2018, Secondary organic aerosol production from gasoline vehicle exhaust: effects of engine technology, cold start, and emission certification standard, *Environmental Science & Technology* 52, 1253-1261.

Kuittinen, N., C. McCaffery, W. Peng, S. Zimmerman, P. Roth, P. Simonen, P. Karjalainen, J. Keskinen, D. R. Cocker, T. D. Durbin, Rönkko, T., Bahreini, R., and Karavalakis, G., 2021, Effects of driving conditions on secondary aerosol formation from a GDI vehicle using an oxidation flow reactor, *Environmental Pollution* 282, 117069.



Assuming:

- All vehicles get 25 mpg
- Average speed of 35 mph
- Each tire weighs 10 kg
- Each vehicle has 4 tires

Questions we have addressed using our laboratory system

- Do tires emit gaseous precursors that form significant amounts of secondary organic aerosol?
  - Yes
- How does E_{SOA} vary with tire temperature?
  - Significantly. Average emissions @ 50 ^{o}C is ~30x that at 20 ^{o}C.
- How does E_{SOA} vary with extent of photochemical processing?
  - About 60% forms within a day; about 95% within a week.
- How does E_{SOA} vary with tire brand?
  - Significantly. Emissions vary by ~7 x between two major brands.
- How does E_{SOA} vary with tire age and wear?
  - On average, emissions decrease by ~15% per year.
- How does E_{SOA} vary with NO_x concentration?
  - A lot for some tires, little for others.
- What is the SOA yield of the emitted gases?
  - For the two tested so far, 18% and 38%.
- How much SOA is formed from the gases emitted from a tire over its lifetime?
  - For the two tested so far, 0.15% to 0.3% of the weight of the tire.

Questions about how the data from our laboratory system can be used

- What steps could be taken to reduce SOA-forming emissions?
  - Determine cause of high emissions from some brands and store old tires outside of basin.
- How will SOA from tire emissions change in the future?
  - Higher temperatures, less NO_x, and heavier EVs will lead to increasing SOA.
- Under what conditions will tire SOA contribute most to total PM?
  - During summertime photochemical episodes.
- How can our results be used to determine regional emissions?
  - Through connection with our tire database and actual tire temperature data.
- How can our results be used to determine air quality impacts?
  - No spatial resolution: Back of the envelope calculations.
  - Coarse spatial resolution: Source apportionment (maybe).
  - Fine spatial resolution: Photochemical modeling.

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Assessing Community Air Quality and Health Benefits of Freight Emission Mitigation Strategies in the South Coast Air Basin

Kanok Boriboonsomsin, Peng Hao, and Matthew Barth
College of Engineering – Center for Environmental Research and Technology
University of California at Riverside

Clean Fuels Program Advisory Group Meeting

CE-CERT, University of California at Riverside

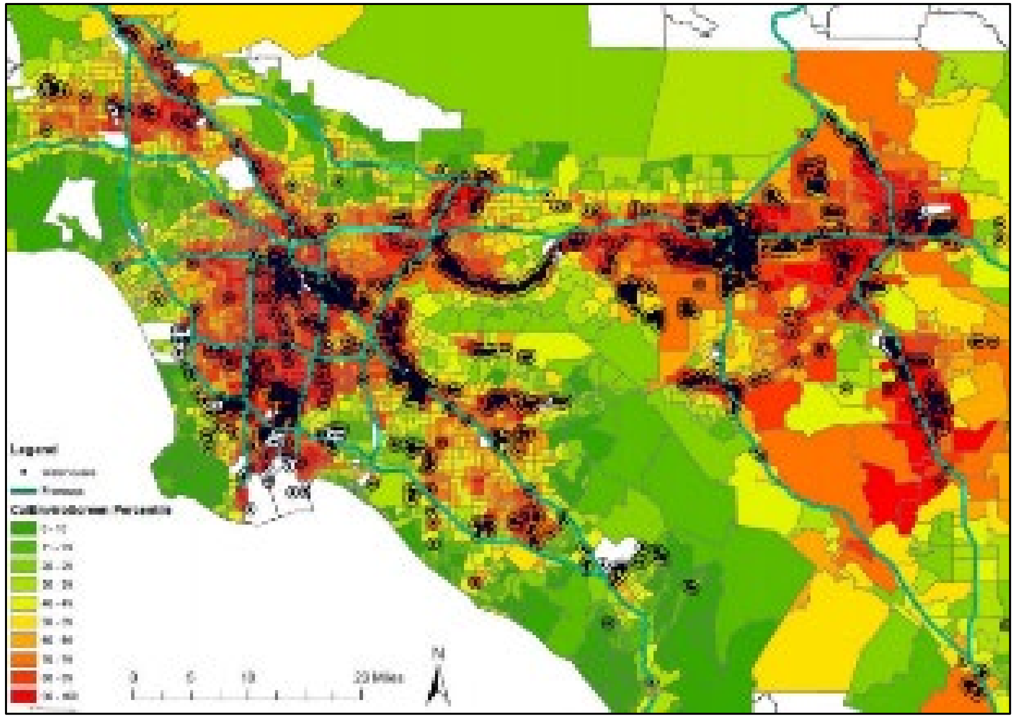
January 29, 2026

UCR College of Engineering – Center for Environmental Research and Technology

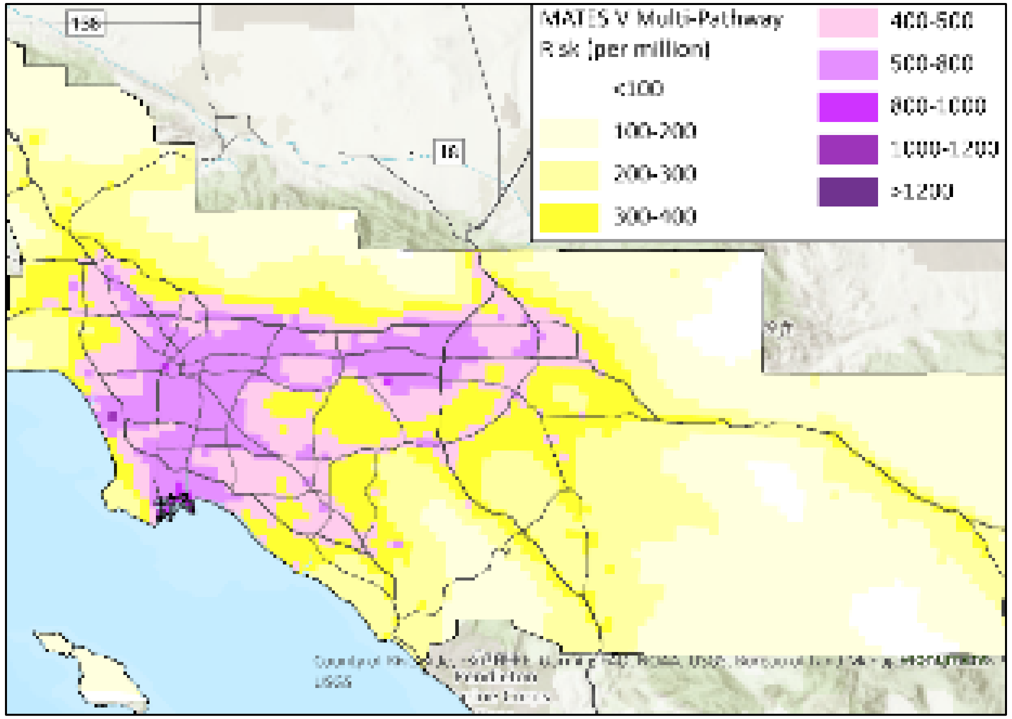
The OMEGA Initiative

***O**bjective **M**easurement/Monitoring/Mitigation of **E**missions from **G**oods Movement and Impacts on **A**ir Quality*

Goal: Address emissions and air quality impacts of goods movement in communities most impacted by air pollution



Large warehouses are often located in disadvantaged communities

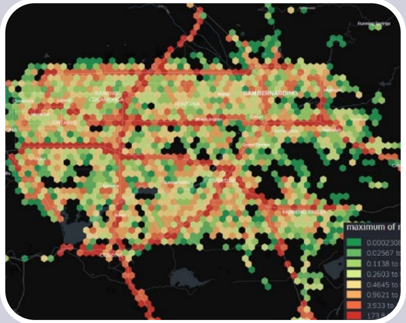


Estimated cancer risk from MATE V study

OMEGA – Inland Southern California

Measuring heavy-duty truck activities and emissions

Monitoring air quality in selected disadvan-taged communities



Modeling emission and air quality impacts of goods movement

Developing and assessing impact mitigation strategies

Community outreach and engagement

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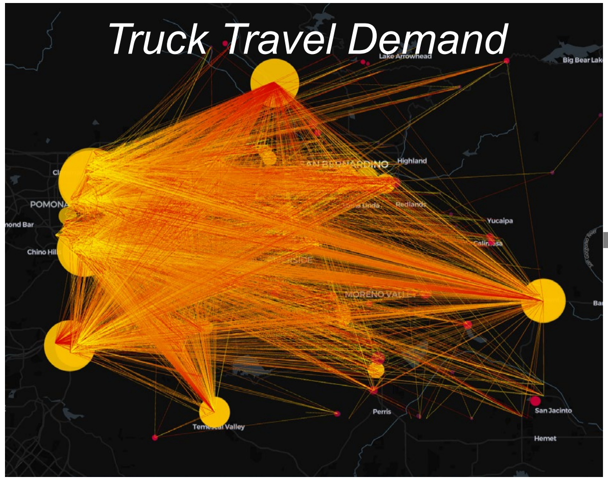
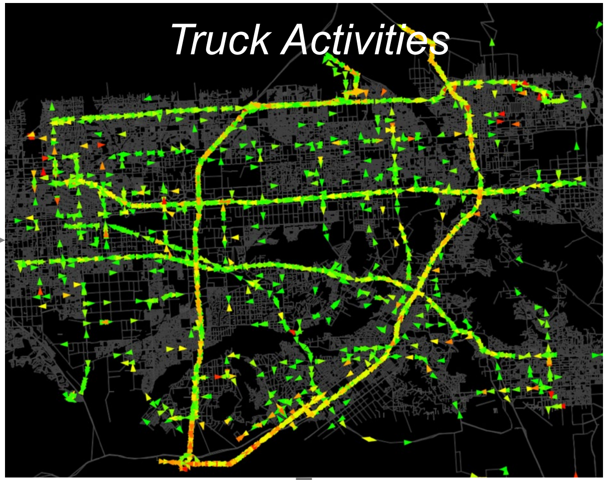
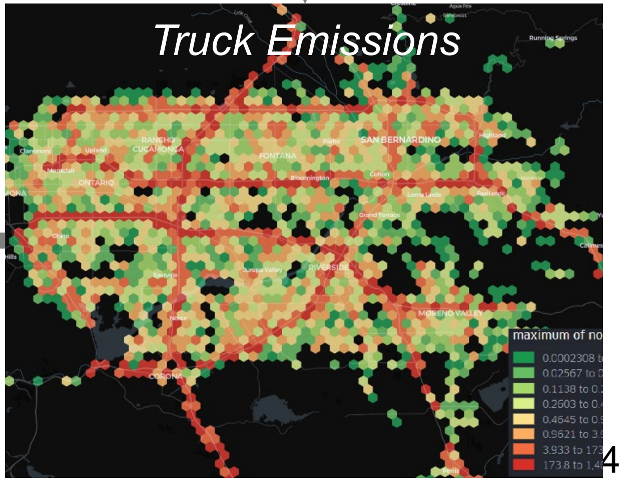
Truck Activities, Emissions, and Impact Modeling

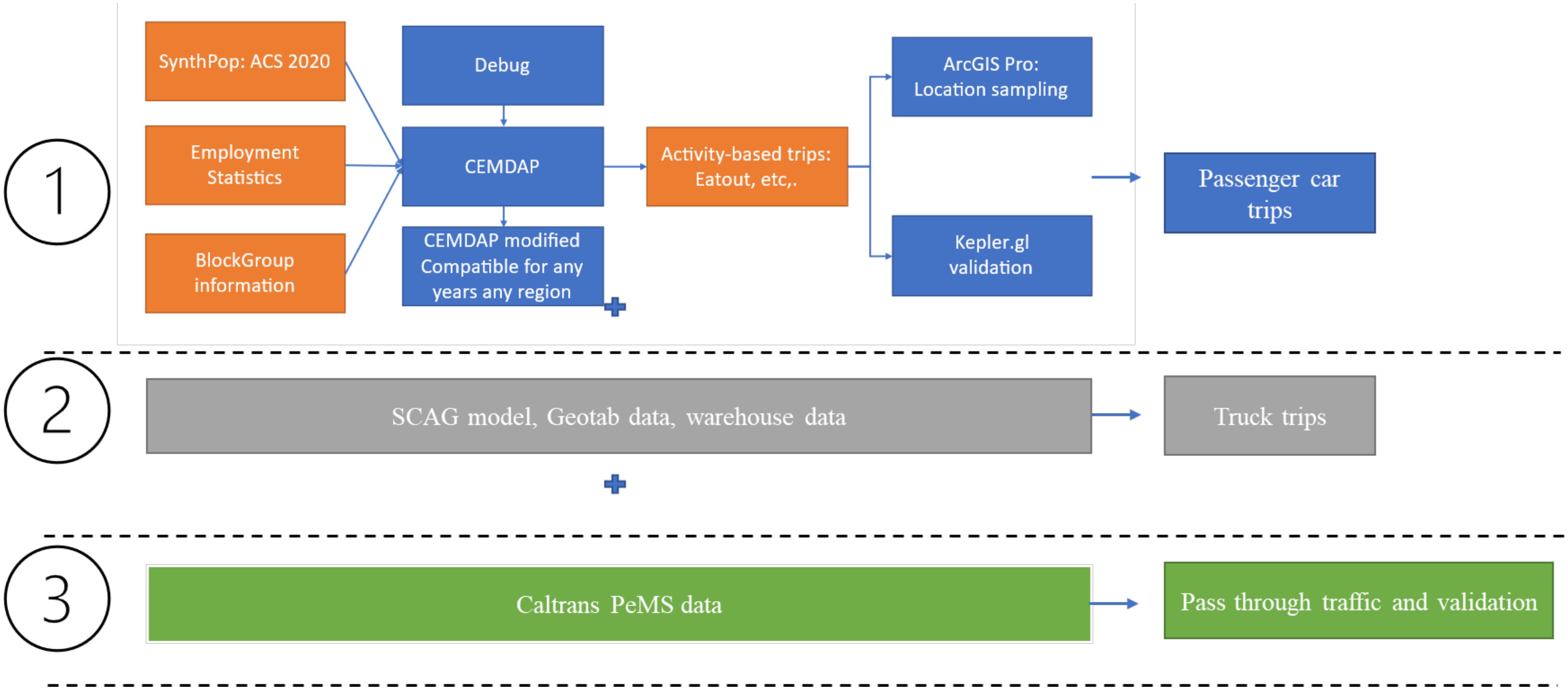
High-fidelity modeling of truck activities, emissions, and the associated air quality and human exposure impacts







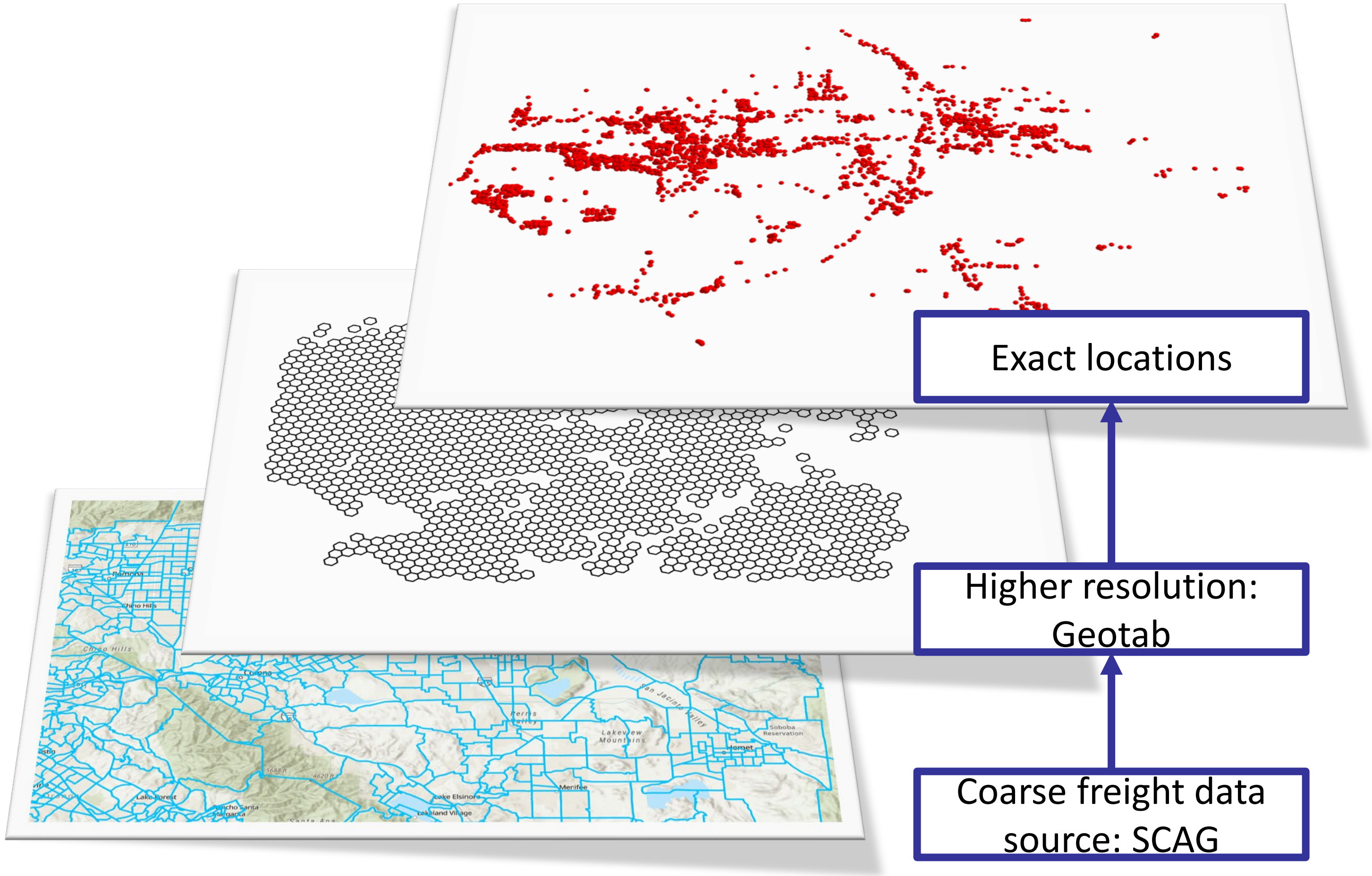
Agent-based Modeling of Freight/Passenger Activities



Refined Truck Trip Generation

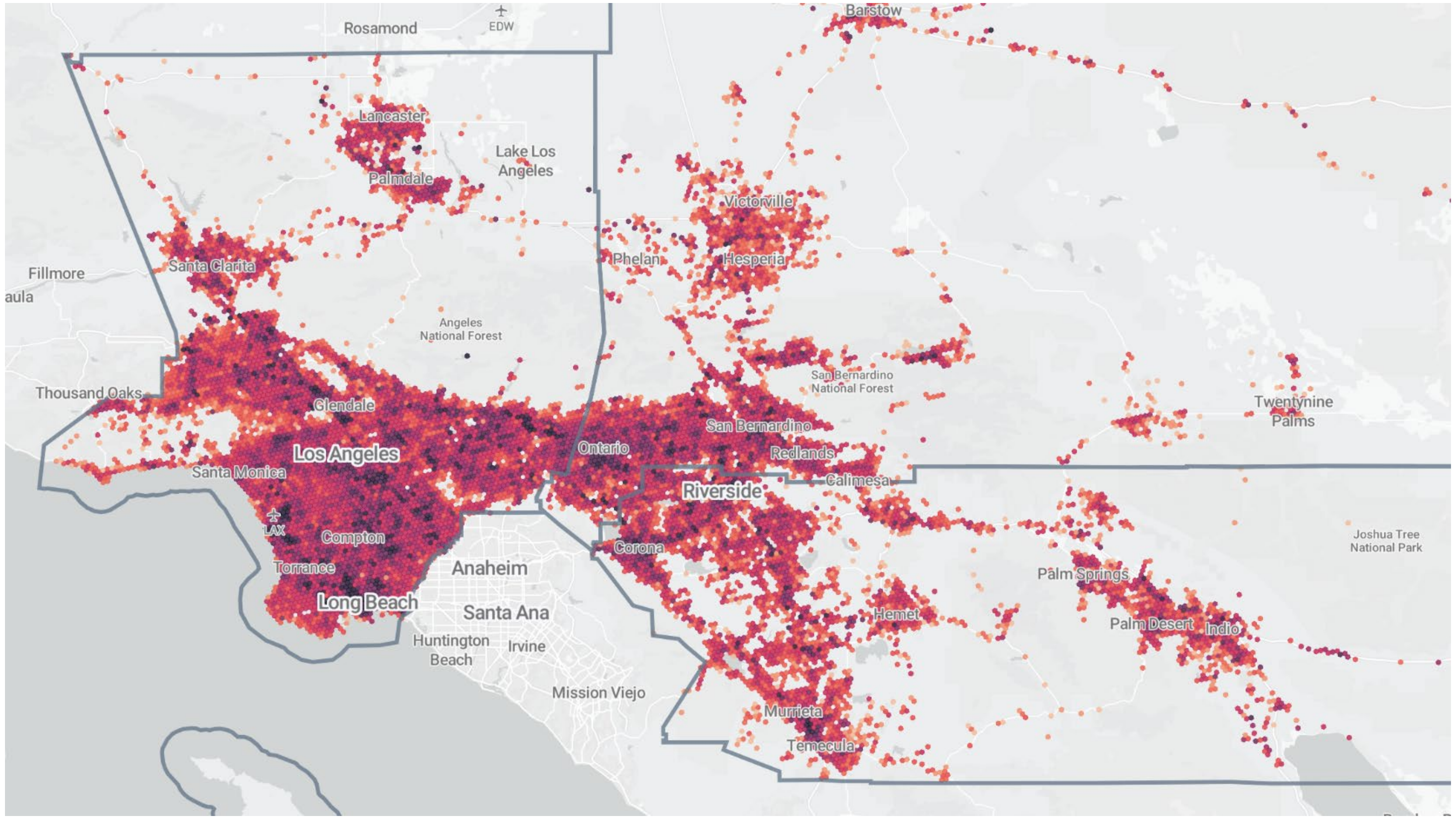
- Utilize multi-layer framework that integrates:
  - SCAG's truck origin–destination trip tables
  - High-resolution (0.7 km²) fleet telematics data
  - Real-world freight facilities

- Traffic model (BEAM) simulates journey of individual trucks from one freight facility to another.

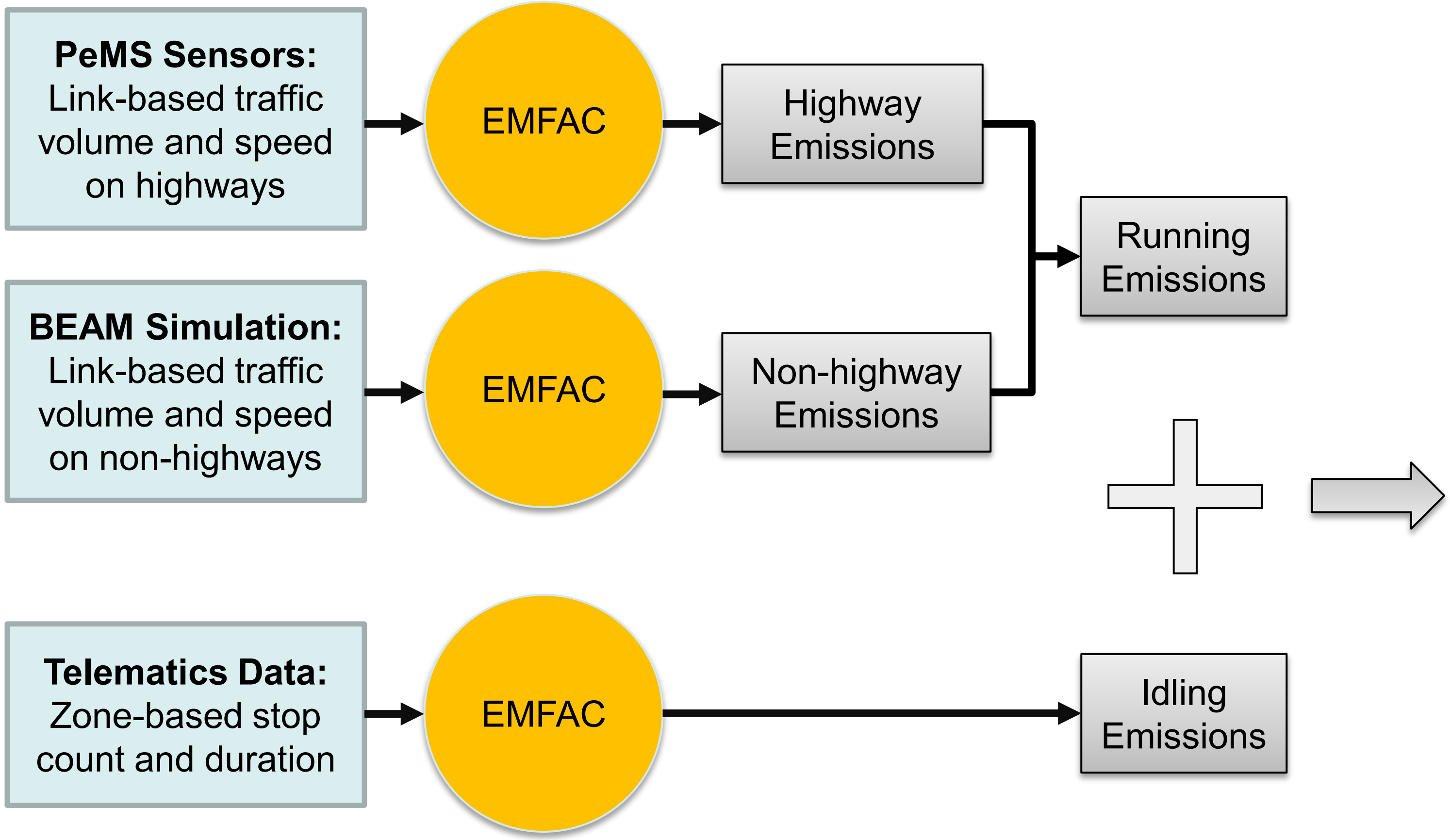


Large-Scale Fleet Telematics Data (Geotab)

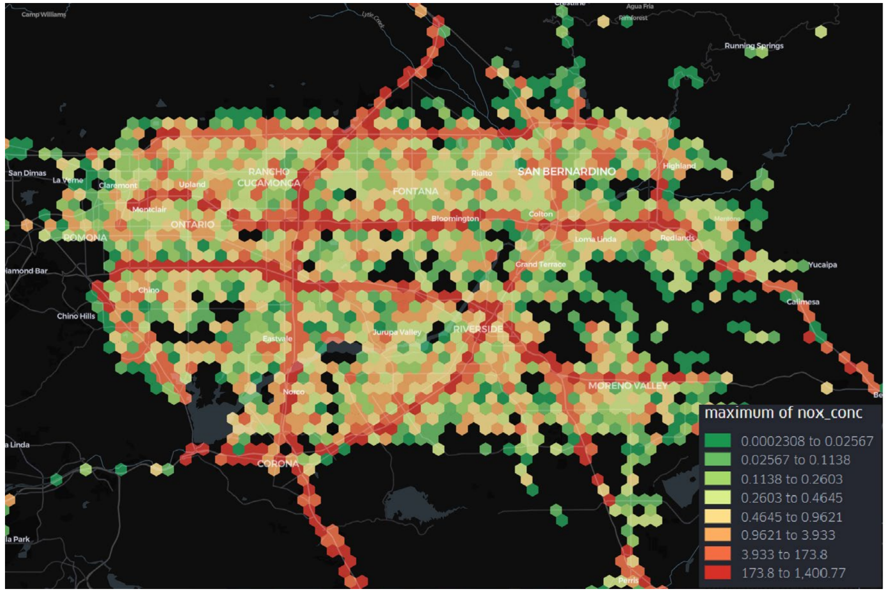
- Spatial coverage
  - Los Angeles, Riverside, San Bernardino Counties
- Temporal coverage
  - September 2023
- Stop Analysis feature
  - Provides data on number of stops and stop duration in each hexagon
  - One hexagon ~ a circle with 0.3 miles radius



Enhanced Regional Traffic Emission Inventory

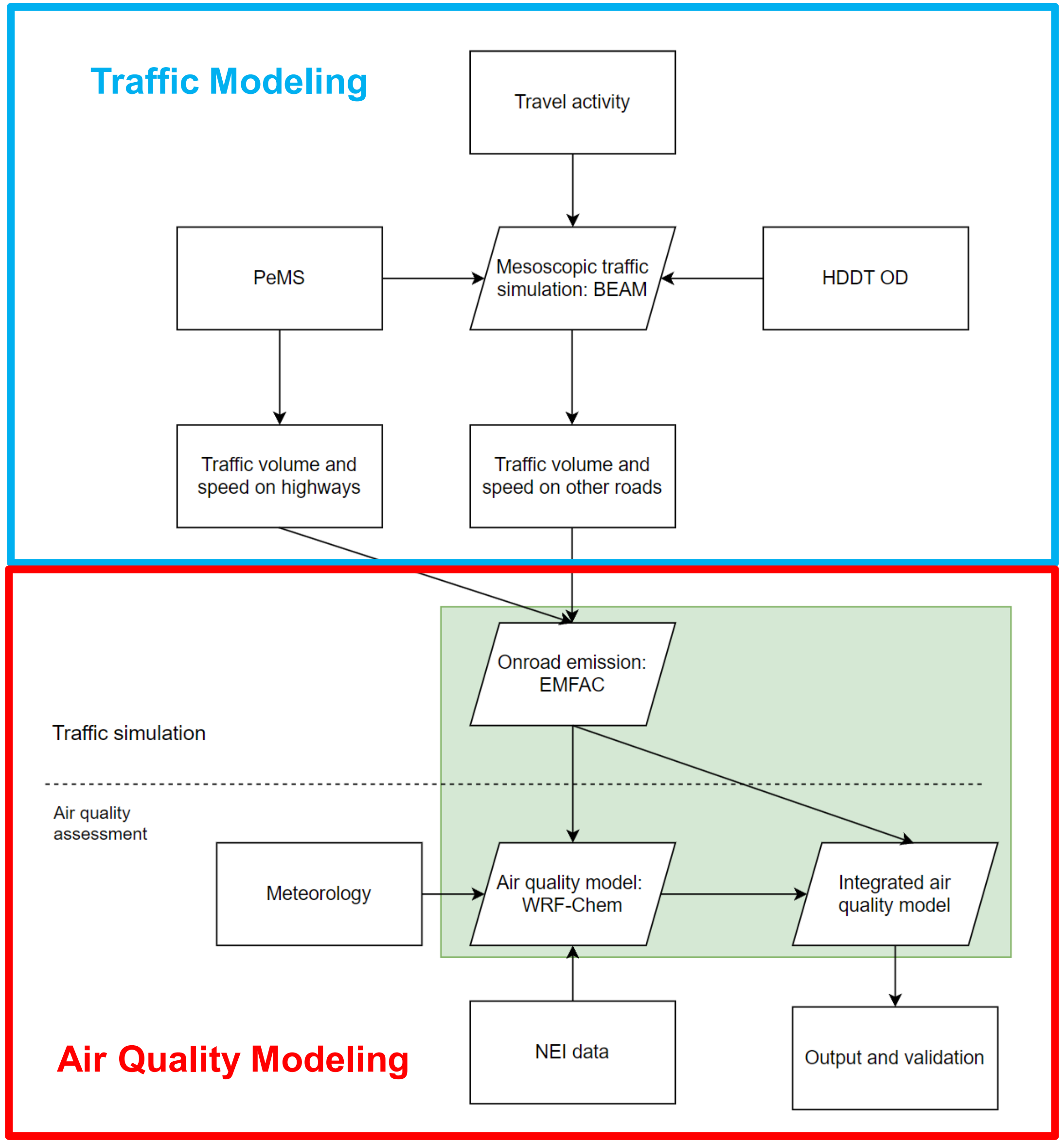


Regional Traffic Emission Inventory



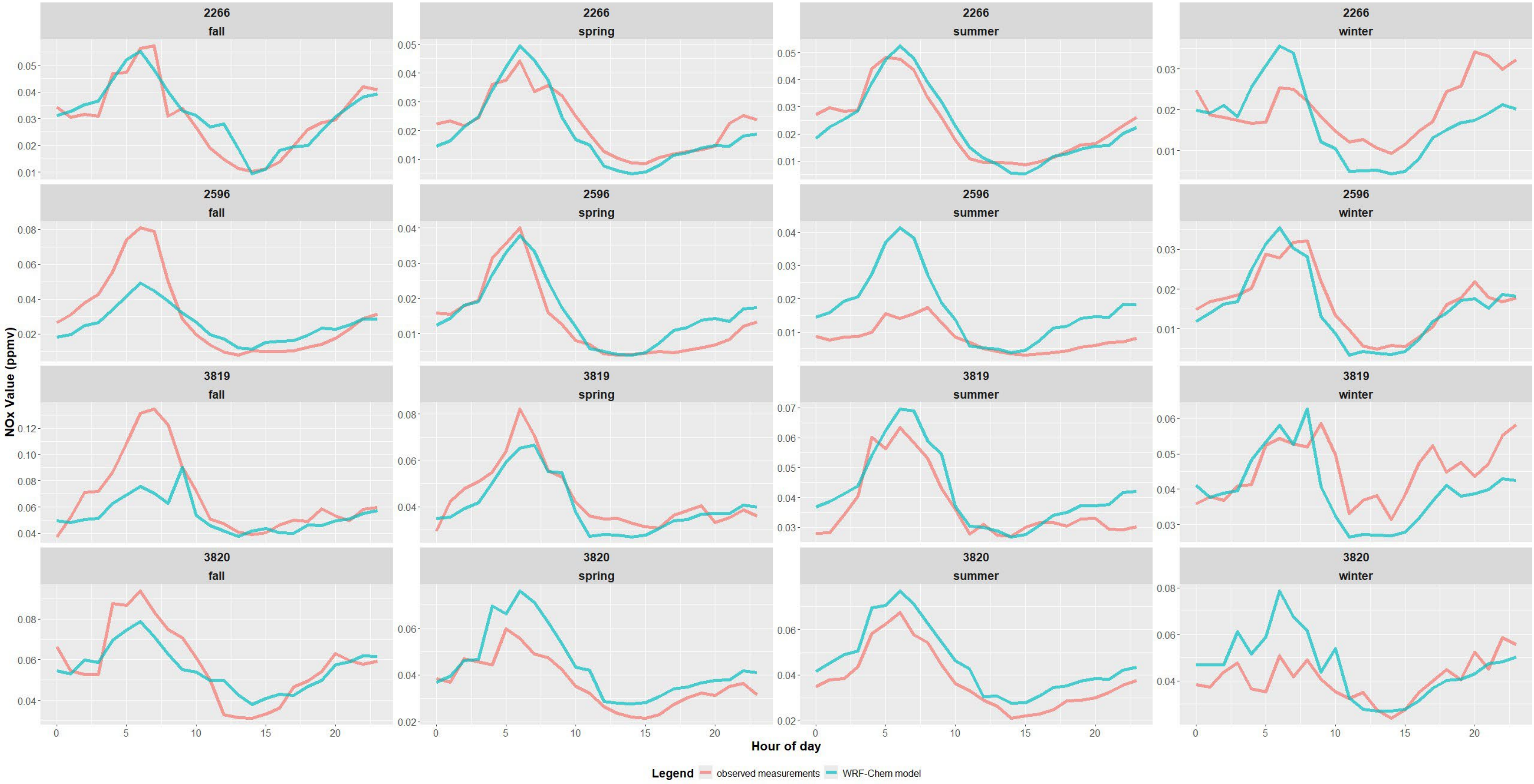
Air Quality Modeling

- WRF-Chem v4.5.1 with 1km x 1km x 0.55km grid resolution
  - *Inputs*: Traffic emissions, other anthropogenic emissions (EPA NEI2017), biogenic emissions (MEGAN), meteorology (NCEP FNL)
  - Calibrated with data from 4 local AQ monitoring stations
  - *Outputs*: Grid-averaged pollutant concentrations



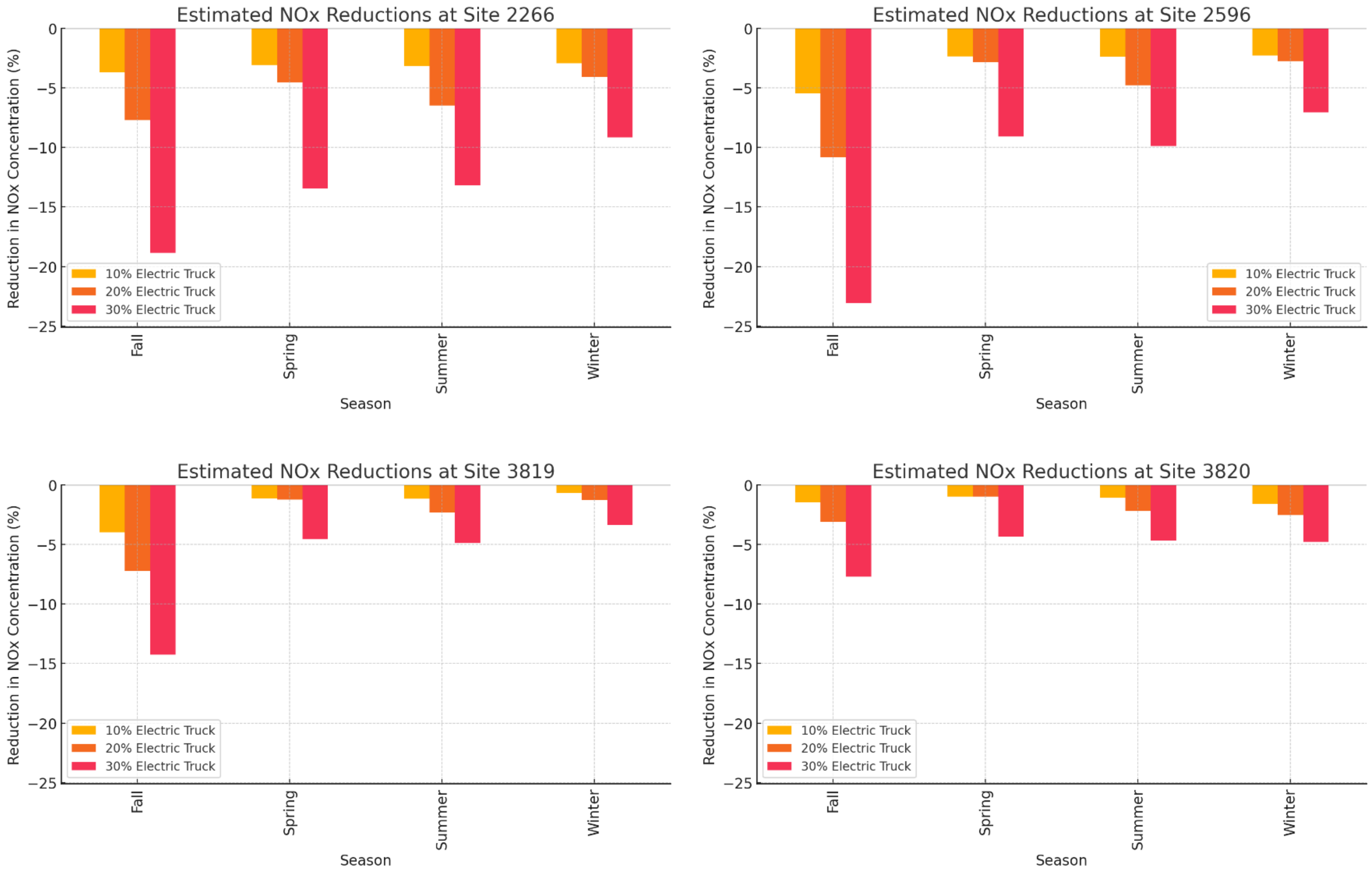
Enhanced Air Quality Prediction

- Adjust modeled pollutant concentration based on traffic emissions around receptors and time of day
- Reduce RMSE from 0.02 ppmv to 0.006 ppmv



Lower NOx Concentrations from Truck Electrification

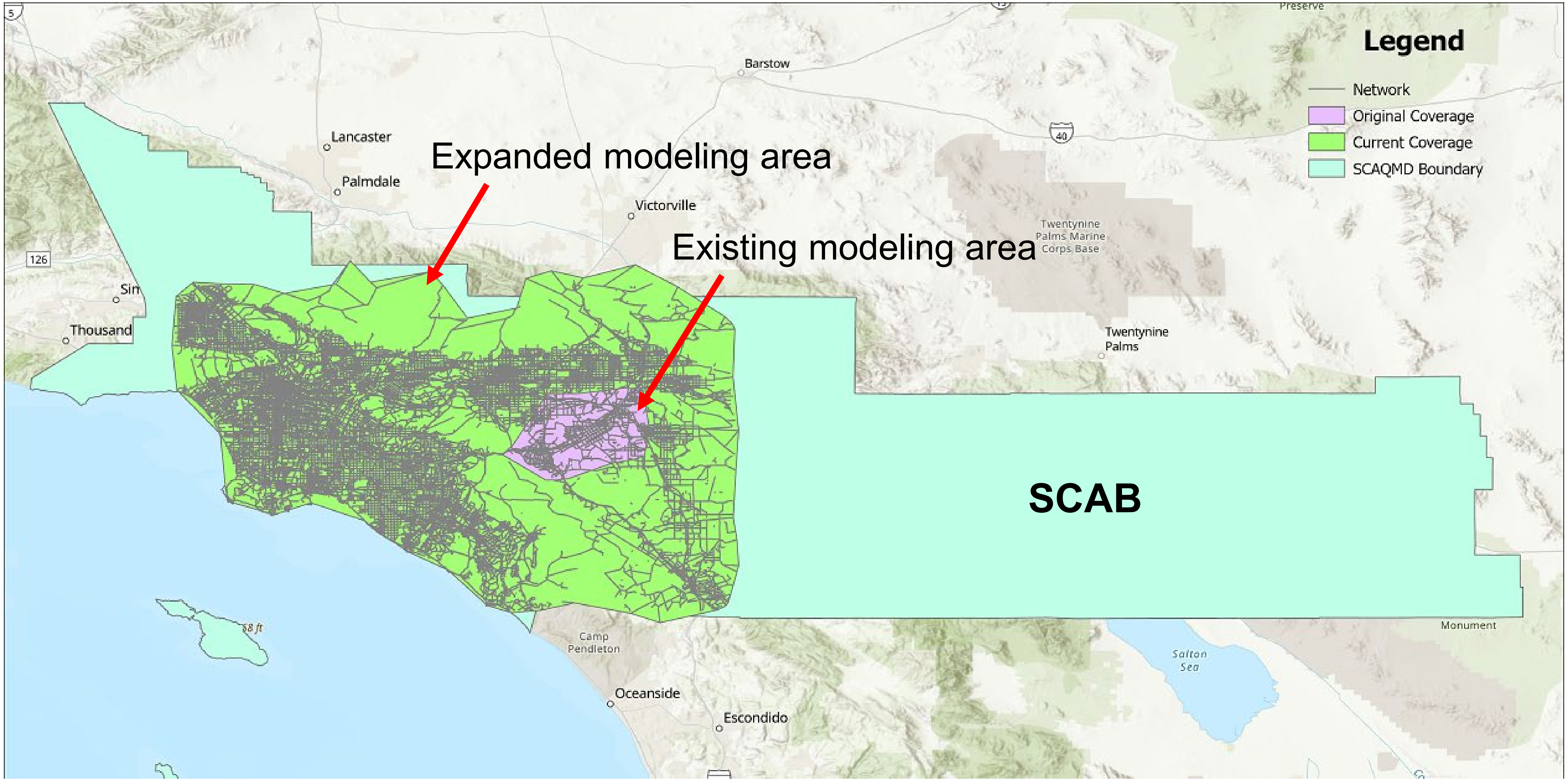
- Non-near-road sites (2266, 2596):
  - Larger reductions due to decreases in both running and idling emissions
- Near-road sites (3819, 3820):
  - Smaller reductions, driven mainly by running emission decreases



Proposed Expansion and Enhancement

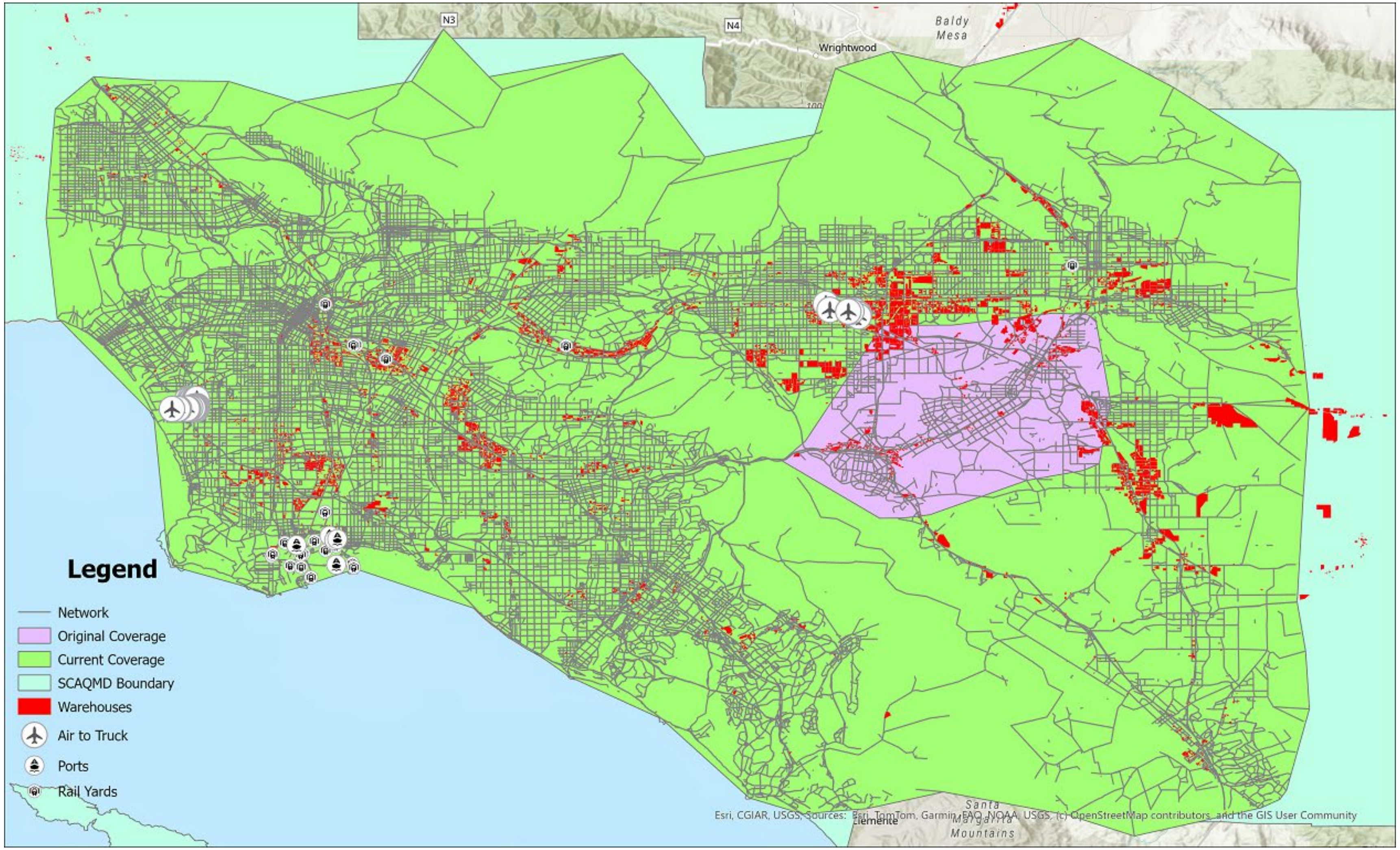
	Completed OMEGA-ISC	Proposed OMEGA-SCAB
Modeling Area	Inland Southern California	South Coast Air Basin
Modeling Scope	Activities, emissions, air quality	Activities, emissions, air quality, human exposure, health effects
Real-World Truck Activity Data	One month (September 2023)	One year
Temporal Scenarios	• Activities & emissions – one season • Air quality – four seasons	• Activities & emissions – four seasons • Air quality & exposure – four seasons
Mitigation Strategies	• Truck electrification (10% - 30%)	• Truck electrification (50% - 100%) • Other clean fuel / fleet transition scenarios • Selected charging / refueling infrastructure scenarios

Modeling Areas



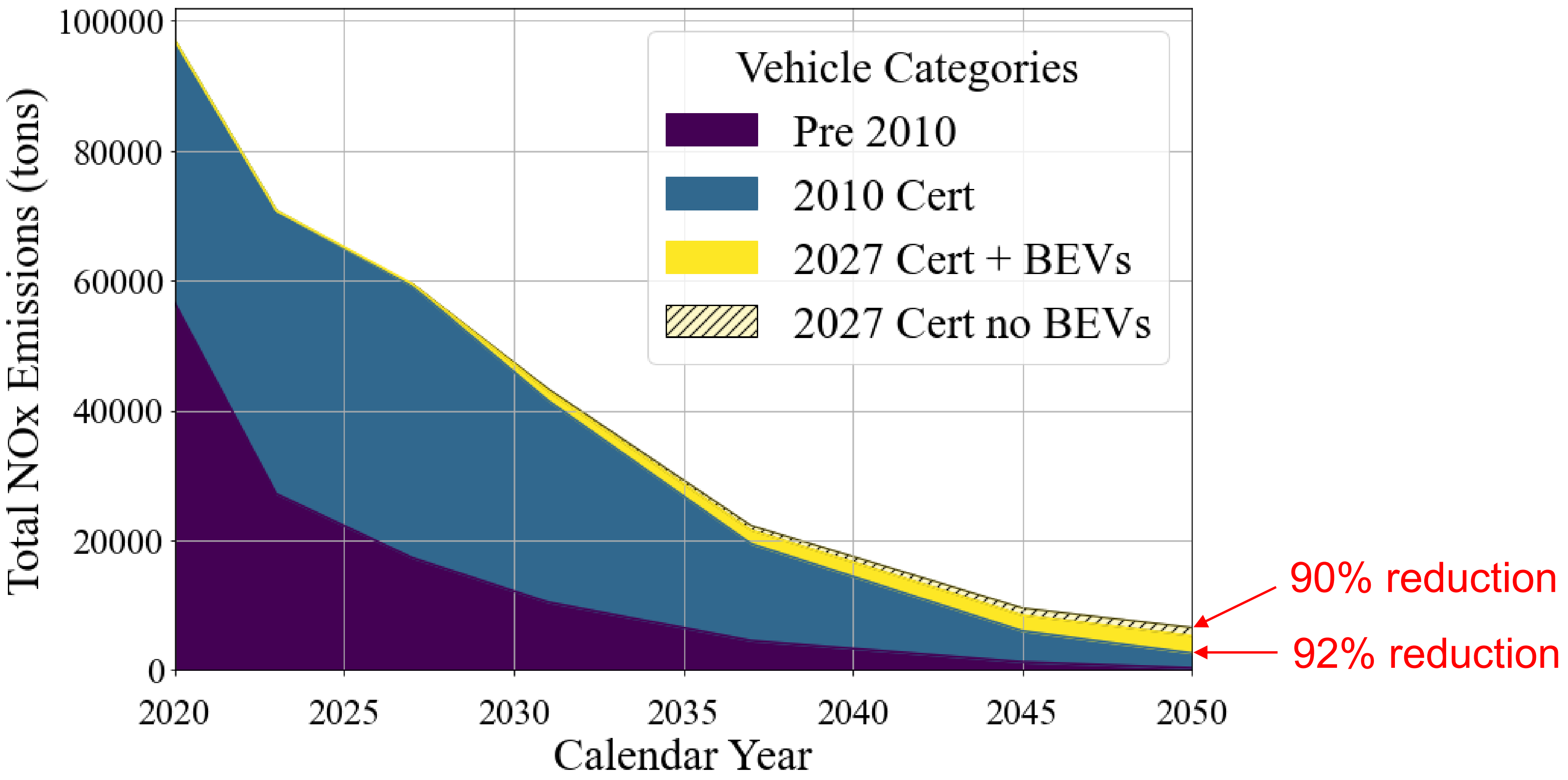
Major Freight Facilities in Expanded Modeling Area

Capturing not only ***regional*** but also ***localized*** benefits of impact mitigation and clean fuels investment scenarios



College of Engineering – Center for Environmental Research and Technology

Example Fleet Transition Scenarios



Source: Troy Hurren; Thomas D. Durbin; Kent C. Johnson, Georgios Karavalakis, 2025. The Impacts of improving heavy-duty internal combustion engine technology on reducing NOx emissions inventories going into the future. *Science of the Total Environment*, 986, 179781

Real-World Measurements and Evaluation of Brake- and Tire-Wear Emissions from Light-Duty Vehicles

South Coast AQMD Clean Fuels Advisory Group Retreat

Georgios Karavalakis
Professor of Chemical and Environmental Engineering
Center for Environmental Research and Technology
University of California, Riverside

Email: georgios@ucr.edu

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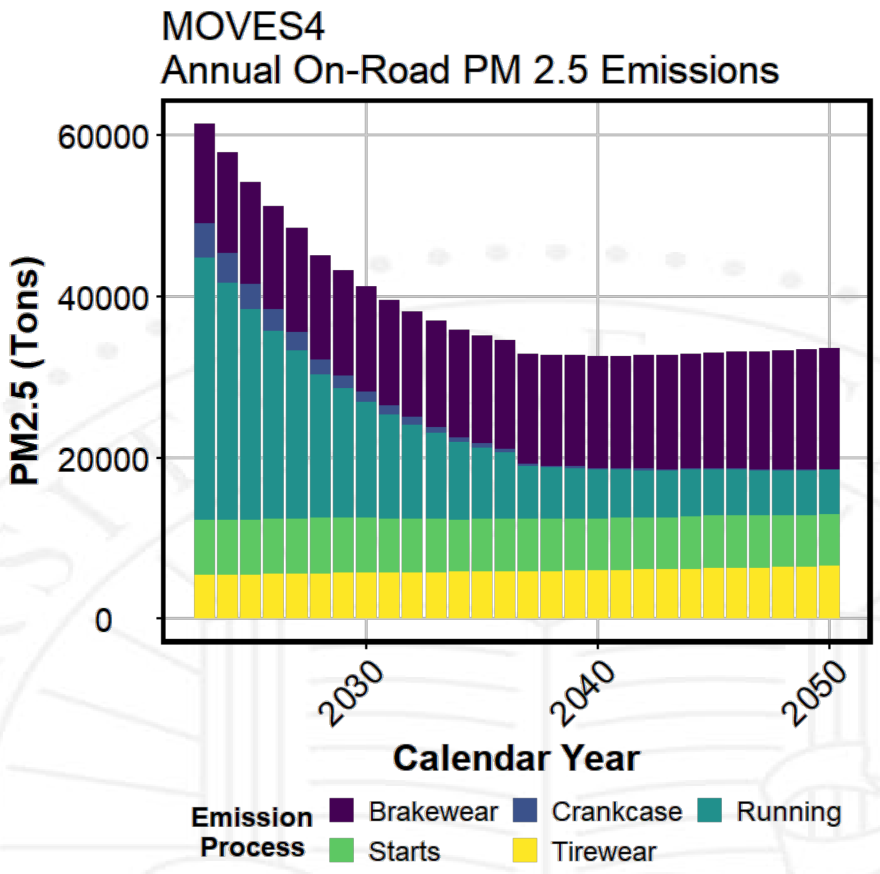
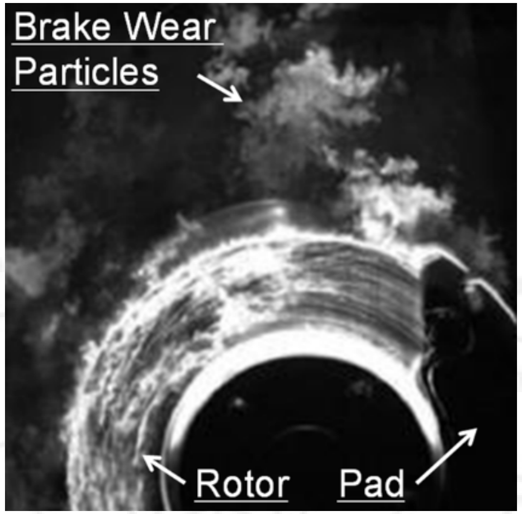
Non-Exhaust Emissions: The Next Hot Environmental Issue

- As tailpipe emissions continue to decrease, non-exhaust emissions (brake- and tire-wear) are anticipated to dominate the direct PM from mobile sources
- Vehicle electrification is expected to reduce brake-wear PM emissions due to regenerative braking, but produce more tire-wear PM emissions than conventional vehicles due to their inherently higher weight



Non-Exhaust Emissions: What are they?

- Brake-wear: Originate from the frictional contact between the disc and the pad



- Tire-wear: Originate from the tire abrasion due to the contact with the road surface

- Road surface: A source of both primary and secondary PM in urban areas that originate from the fragmentation of the road pavement surface due to the interaction with vehicle tires

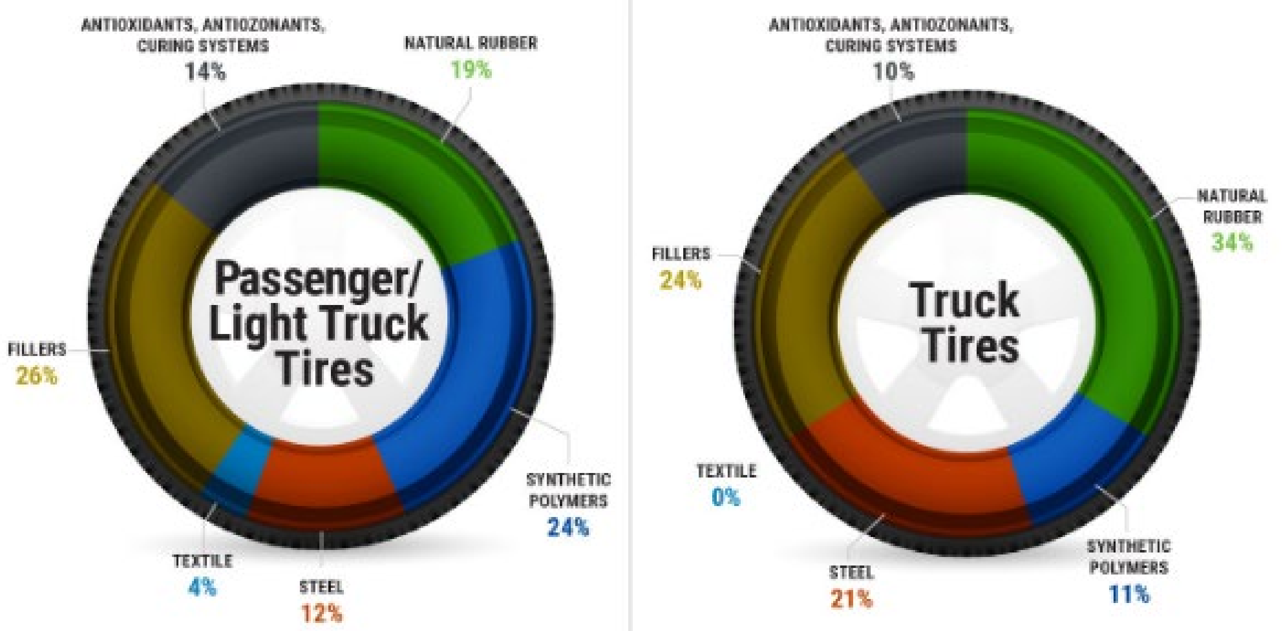
- Resuspended road dust: Originate from the resuspension if material already deposited on the road surface

The Role of Brake Wear Emissions and their Composition

- Complex composition – brake wear consists of particles with a wide range of sizes
- Brakes account for up to 21% of total PM10 from road transport (Niemann et al., 2020)
- Brakes are responsible for more than 55% of all non-exhaust PM10 in urban (populated) areas (Grigoratos & Martini, 2015)
- Brake PM emissions are dominated by metals and trace elements
- Carbonaceous materials such as coke, graphitic carbon, etc.
- Organic compounds such as phenolic resins (binders), rubbers used in friction modifiers, aramid fibers, etc.

Tire Wear Emissions Composition

- Tires are identified as the biggest contributor of microplastics, which are persistent solid particulates composed of synthetic or semi-synthetic polymers
- 2.3 billion tires produced annually around the world, equivalent to 21 million tons of tire material consisting of steel, fabric plies, and vulcanized rubber
- Approximately 10-20% of tire mass is lost as tire wear during its lifetime



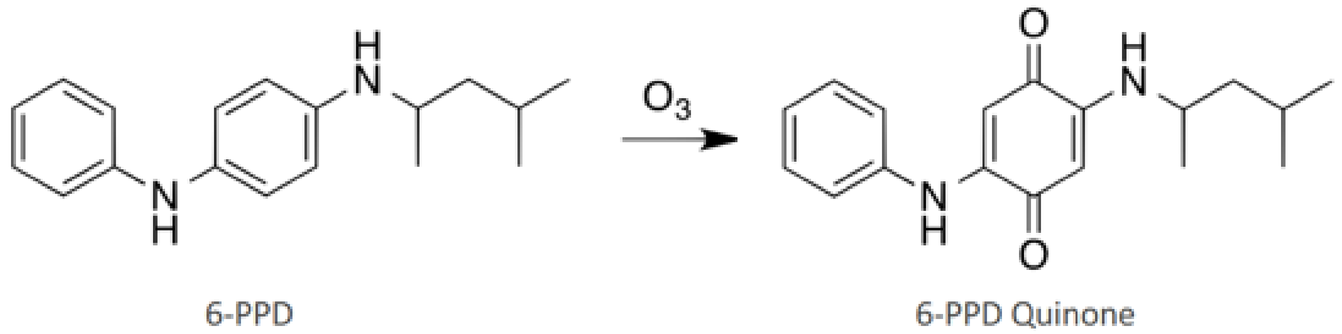
Cont.

Tire-wear is not just ‘rubber’:

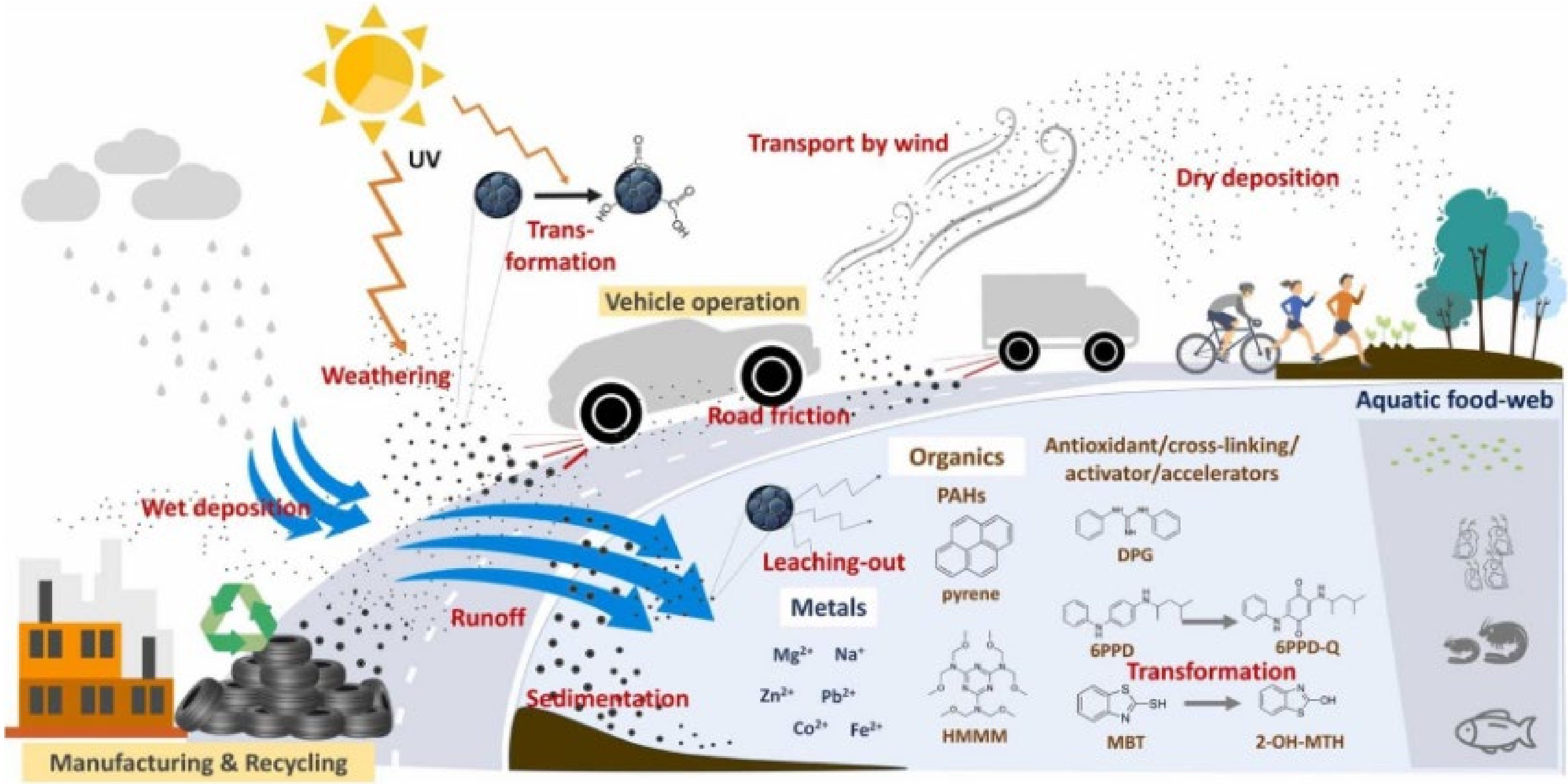
- Heavy metals (Zn, Fe, Co…) – can lead to respiratory and cardiovascular effects
- Polycyclic aromatic hydrocarbons (toxic and carcinogens)
- Phthalates
- Microplastics – can potentially impact human health including neurotoxicity ad reproductive and developmental toxicity
- Plasticizers – have been identified as endocrine disruptors
- Volatile organic compounds (VOCs) – released from the off-gassing of tires at high temperatures and can lead to acute and chronic health effects, as well as form secondary PM

More toxic chemicals

- PPD derivatives are among the most widely used classes of antioxidants/antiozonants in rubber products, with 6PPD being the most widely used in tires
- 6PPD-quinone is toxic and responsible for the acute mortality of coho salmon



Non-Exhaust Emissions in the Environment: A Focus on Air Quality

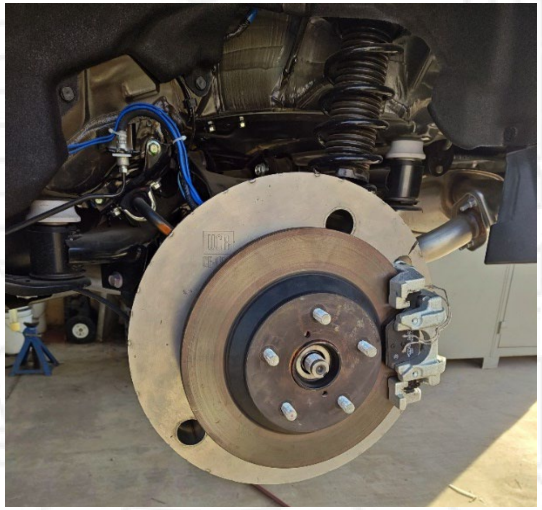


Innovative Sampling Systems to Measure Non-Exhaust Emissions

Direct brake PM measurements during real-world vehicle testing. The system is composed of two different elements:

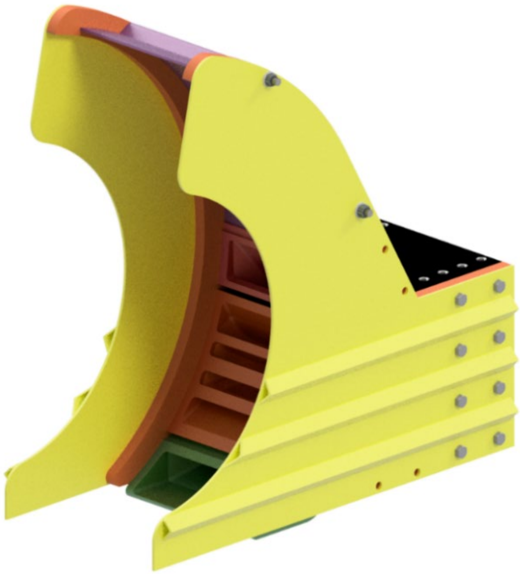
- Front plate enclosure: This is a rotating part following the motion of the wheel and is designed to cover the surface between brake and inner wheel rim
- Back plate: This is a non-moving part with respect to the chassis and is designed to isolate the area between brake system and axle mount area



Cont.

Direct tire PM measurements during real-world vehicle testing. The system in semi-open and cannot be closed



Robust Measurement Capabilities

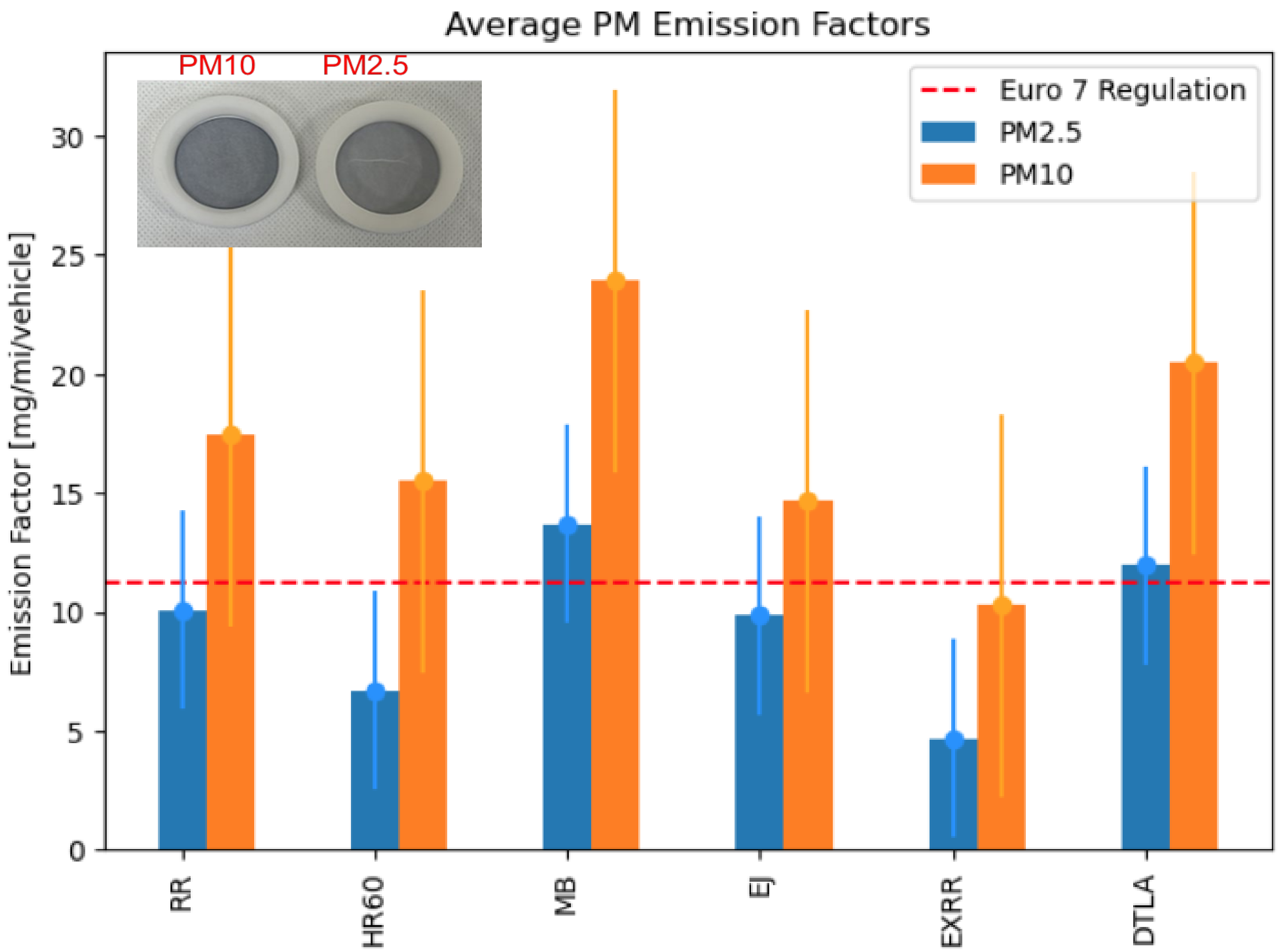
Online instrumentation:

- Particle counters → Particle number and particle sizing

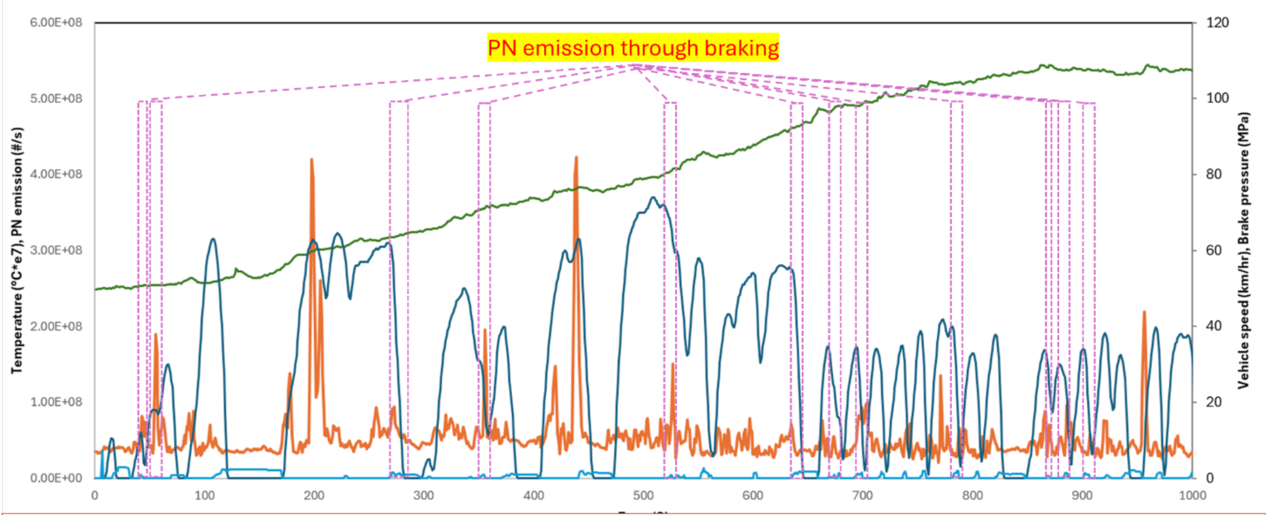
Offline instrumentation:

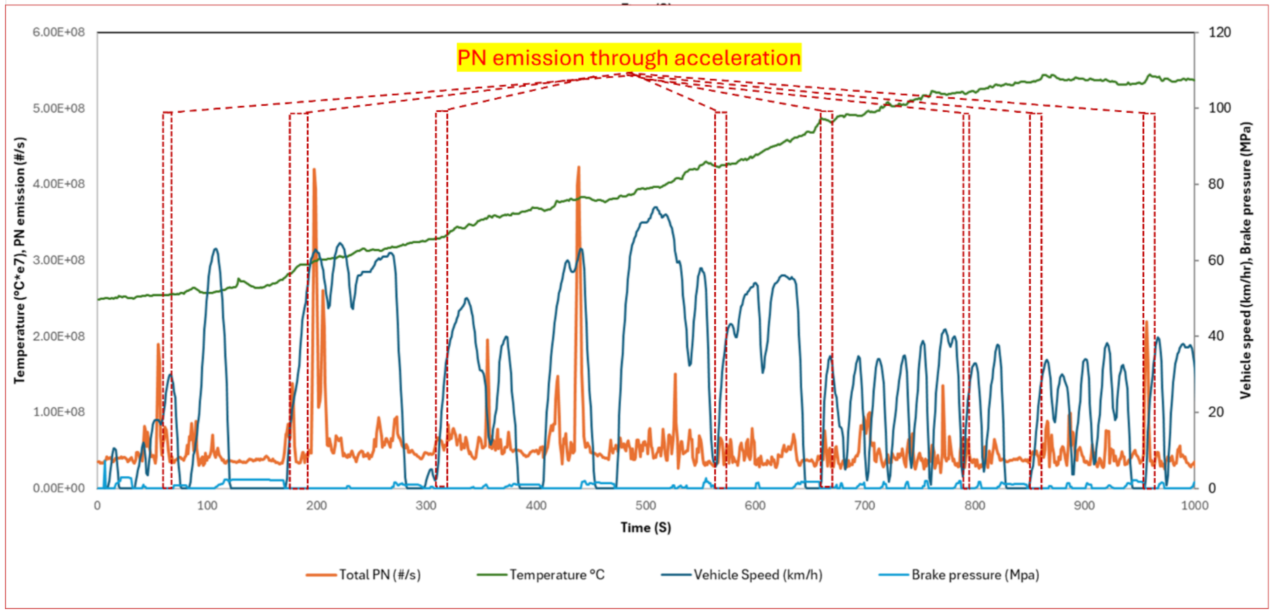
- ICP-MS/XRF → Metals content
- SEM/EDX → Morphology and single particle elemental spectra
- LC-MS → >20 organic rubber compounds (6PPD, 6PPD-quinone, etc.)
- Gravimetric PM mass → PM2.5 and PM10

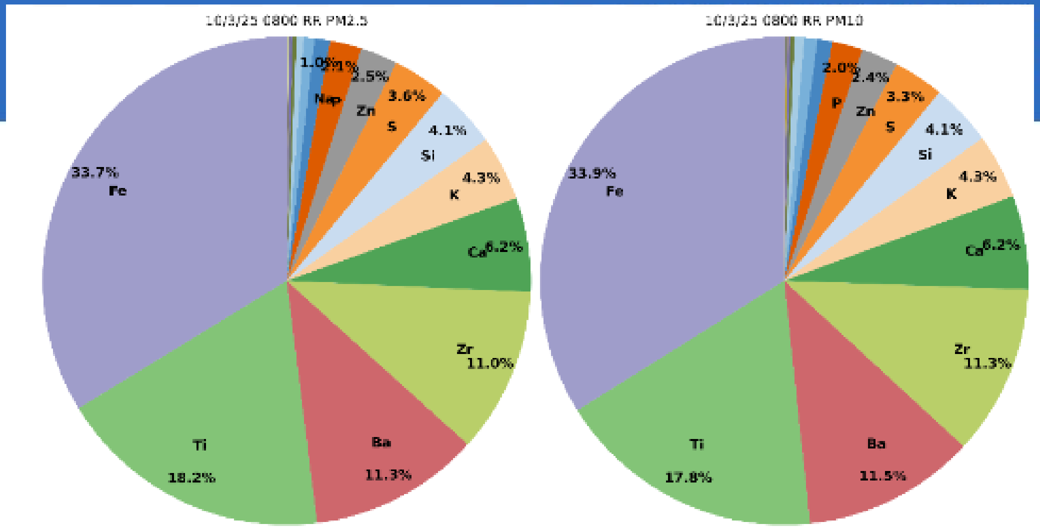
Brake-Wear PM Emissions

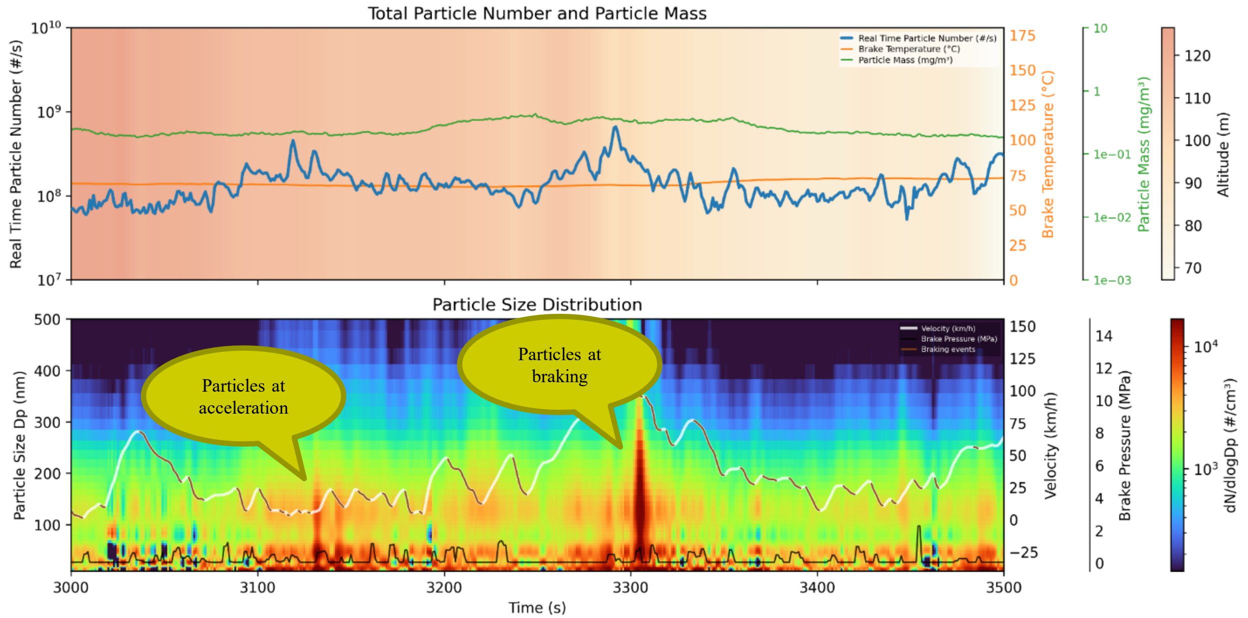


Brake-wear PM Emissions



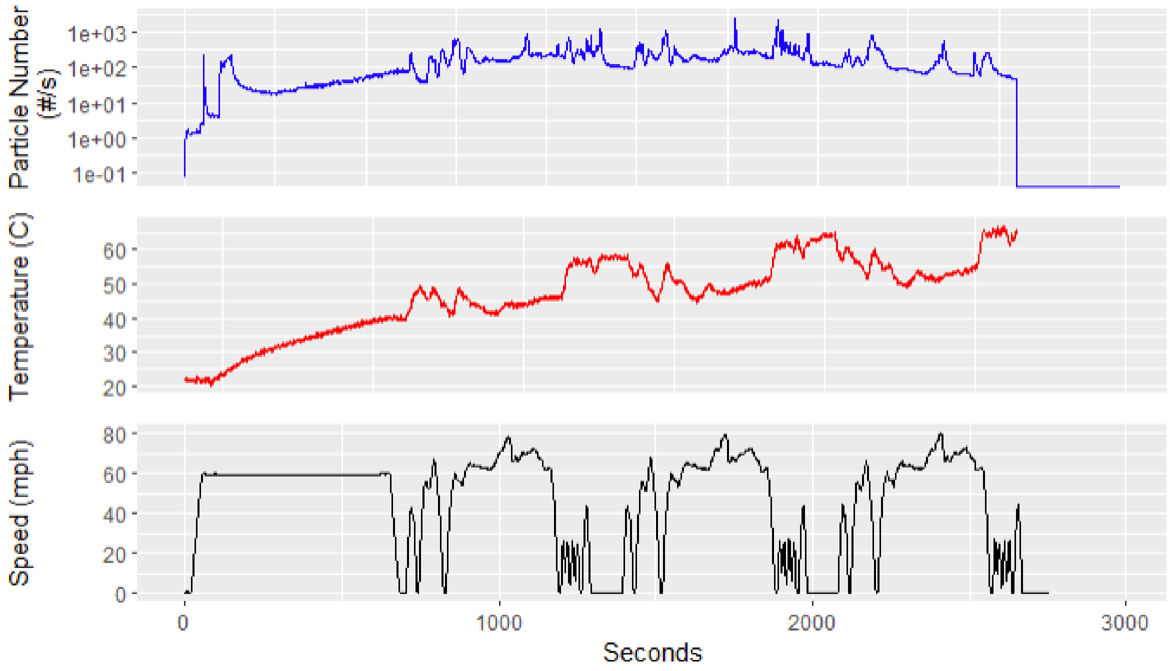


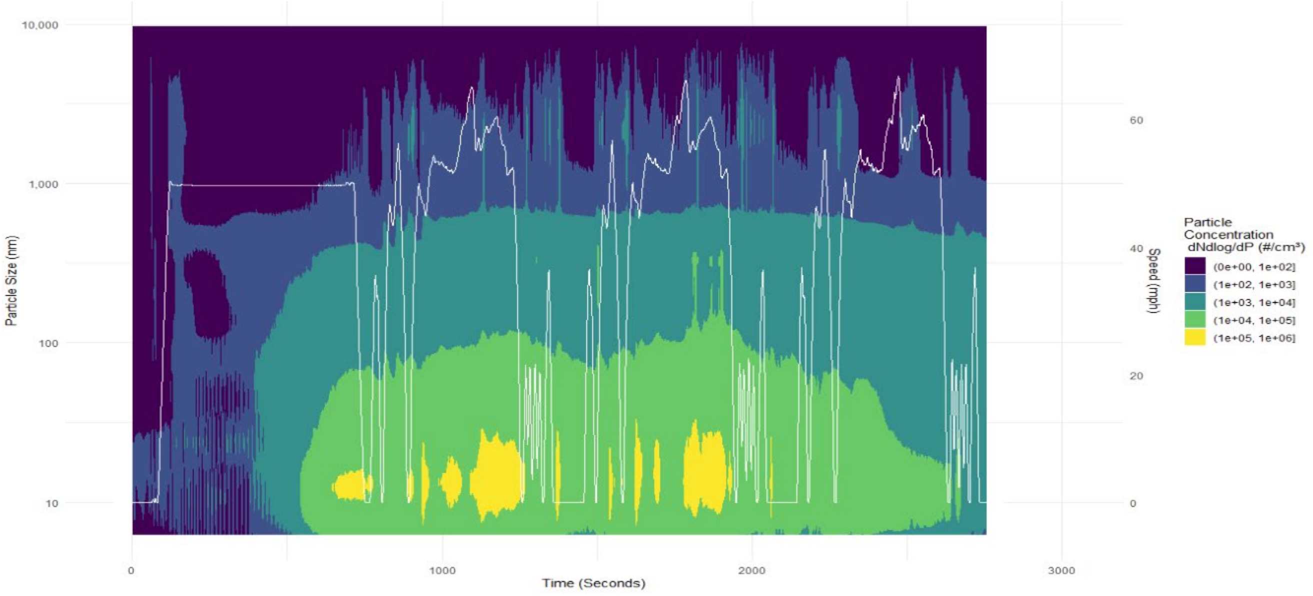




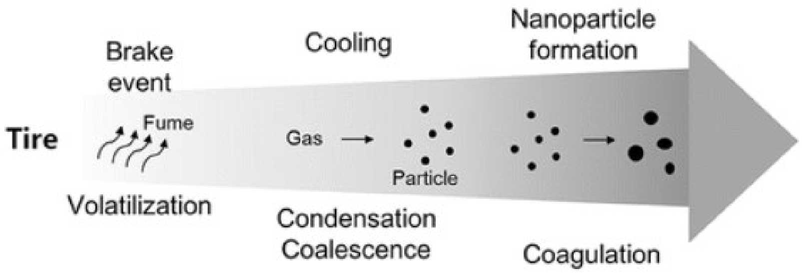
- Significant ultrafine particle populations originated from condensation of vapors and through coagulation or agglomeration
- Formed at microscopic parts of the brake disc, which reach very high temperatures during high energy braking

Tire-wear PM Emissions: Ultrafine Particles



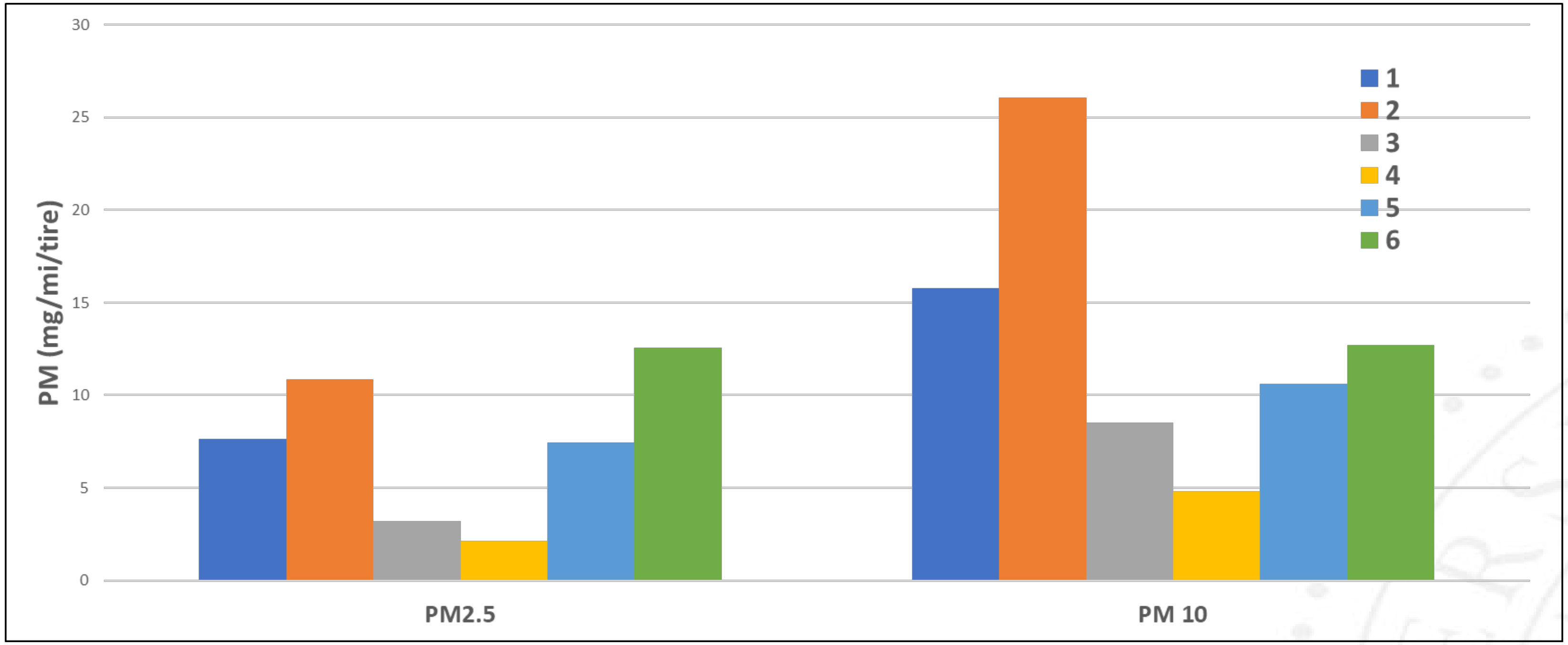


- Strong nucleation mode particle formation at ~10-15 nm in diameter during accelerations and decelerations
- The majority of these particles are semi-volatile



- Particle number peaks associated with acceleration and deceleration events
- Tire temperature increased with time, up to 65℃

Tire-wear PM Mass Emissions



- Differences in PM emissions between tire manufacturers
- Tire 1 (old) versus Tire 2 (new): higher PM for the new tire
- PM2.5 mass ranged from 2.14 mg/mi/tire to 12.58 mg/mi/tire
- PM10 mass consistently higher than PM2.5 mass and ranged from 4.82 mg/mi/tire to 26.07 mg/mi/tire

How relevant is the lab data compared to on-road vehicle testing?

- PM2.5: 1.7-32.1 mg/mi/tire (City Route)/0.32-16.5 mg/mi/tire (Highway Route)
- PM10: 5.95-110 mg/mi/tire (City Route)/1.7-17 mg/mi/tire (Highway Route)

Future Work

- Expand brake- and tire-wear testing on BEVs, delivery trucks, and goods movement trucks
- Design and develop sampling systems suitable for larger vehicles
- Detailed chemical characterization of brake and tire-wear PM emissions, including toxicological properties
- Expand gaseous emissions testing for brakes and different types of tires
- Include air dispersion modeling to better assess the air quality impacts and non-exhaust emission exposures to disadvantaged communities

Thank you!

Questions?

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Ammonia Observations in the LA Basin

Heaven Denham
Dr. Francesca Hopkins

Greenhouse Gas Emissions Lab

UCR

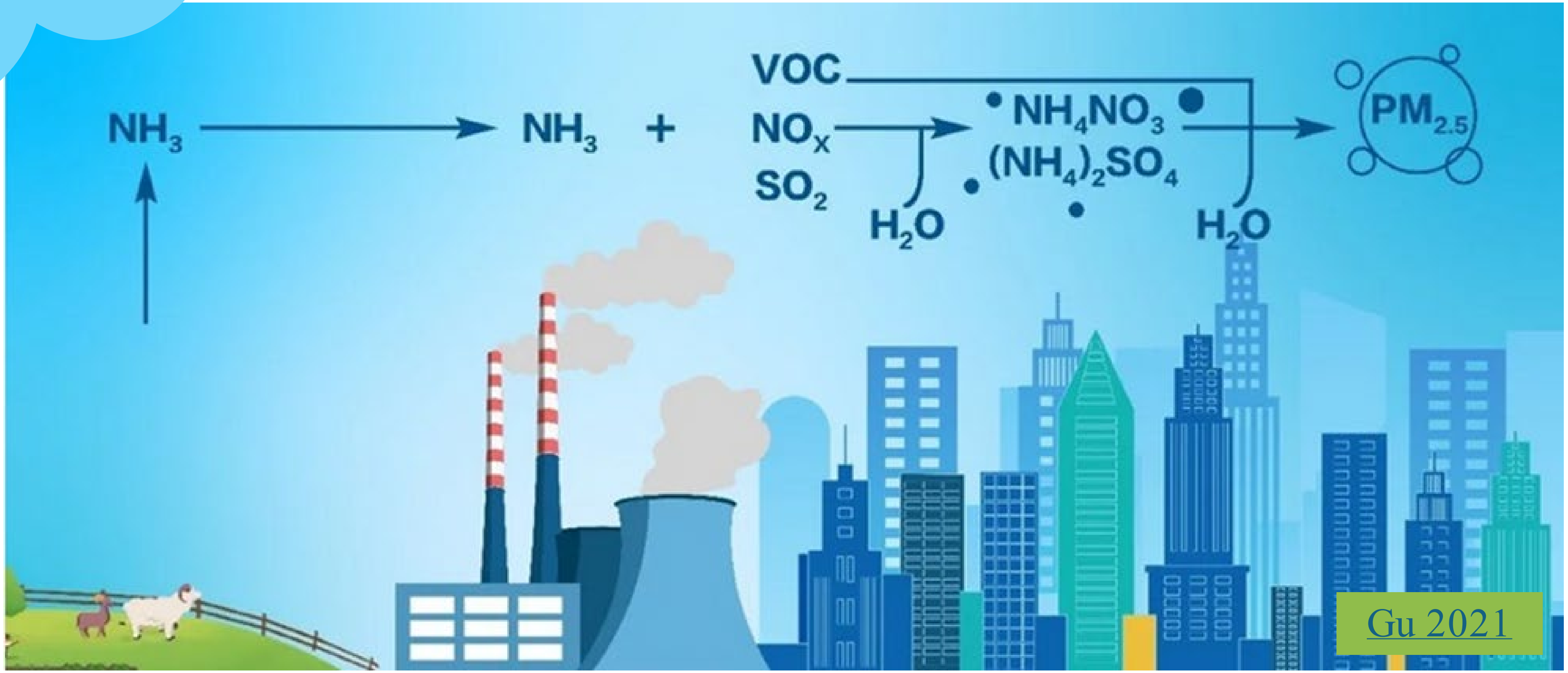
Is ammonia important?

Air quality

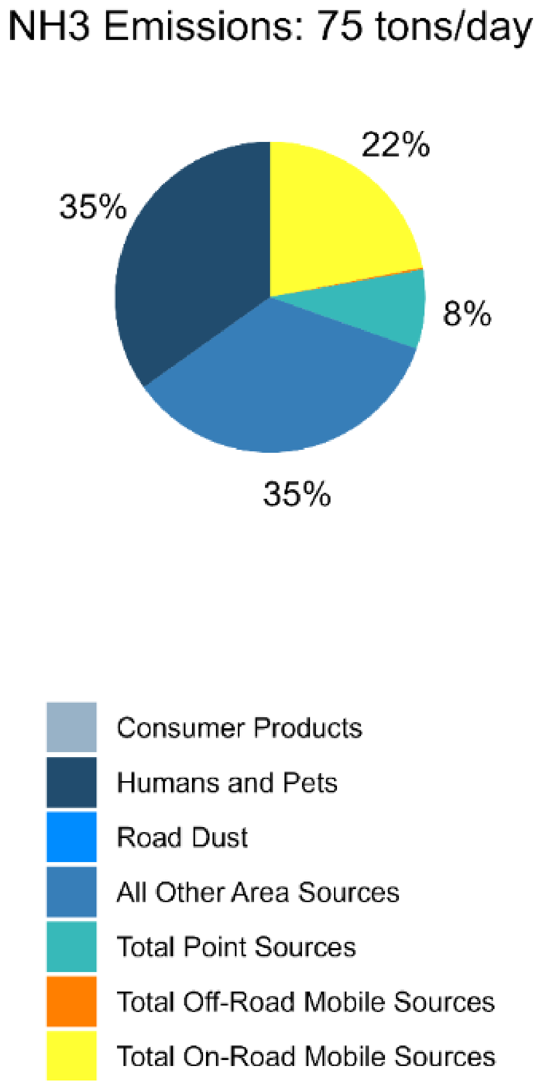
Atmospheric chemistry

Health

Safety



AQMD 2024 PM2.5 Attainment Plan



From 2018 data, AQMD estimates 22% of NH_3 emissions are on-road sources

Estimates say NH3 from vehicles will increase to 27% by 2030

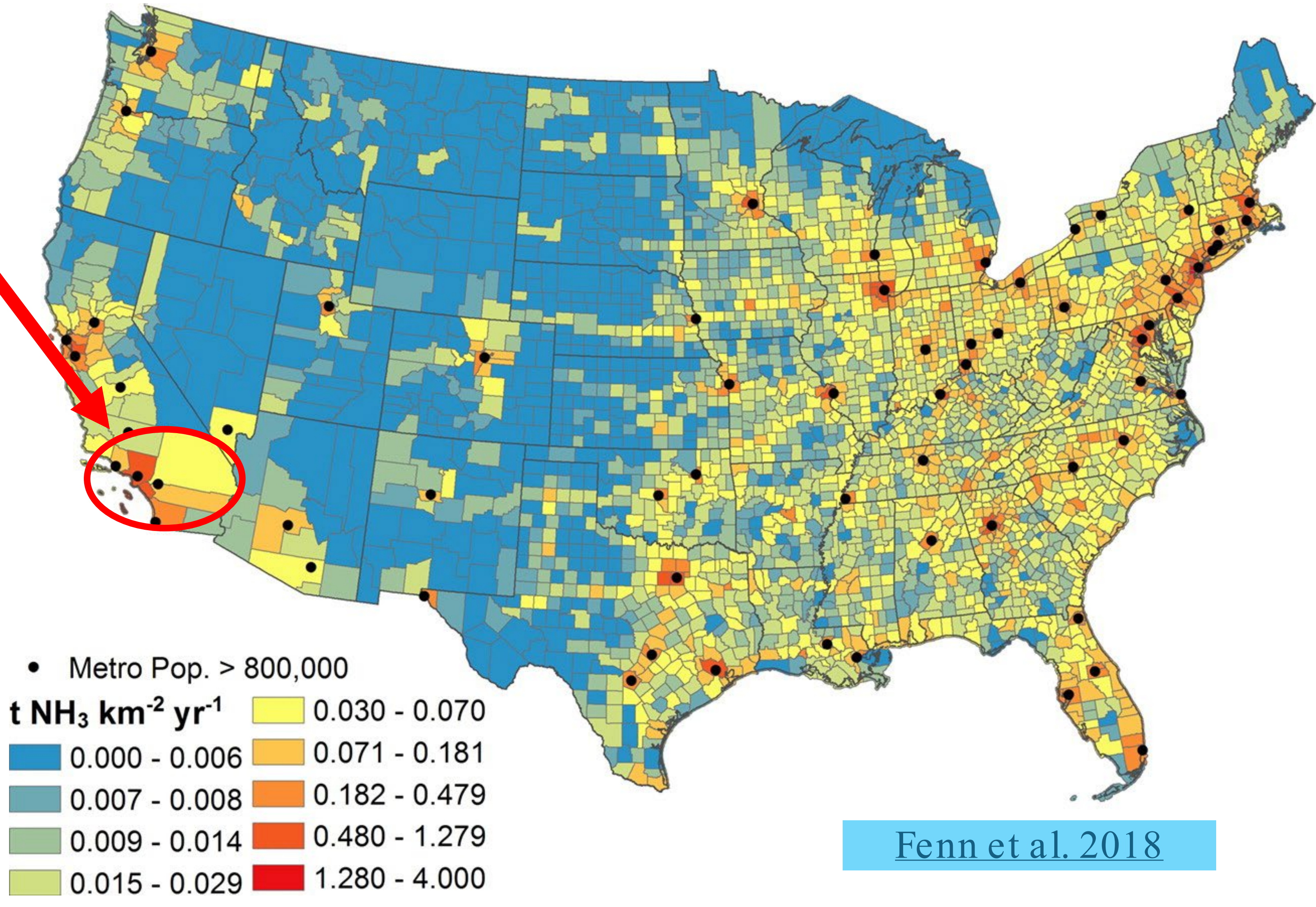
→In a 2001 article, researchers estimated, in the SoCAB, vehicles contributed to 20 to 27% of daily NH_3 emissions (Baum et al. 2001)

Underestimates of Urban Ammonia

- NH_4-N to NO_3-N ratios indicate elevated NH_3 emissions in urban deposition (Fenn et al. 2018)

- Sun et al. used a mobile platform with an open path sensor
    - Mean on-road NH_3:CO (0.029±0.005) showed emissions inventories were underestimating NH_3 emissions (2014).

- NH_3 from vehicles changes based on speed, road grade, and fuel/catalyst

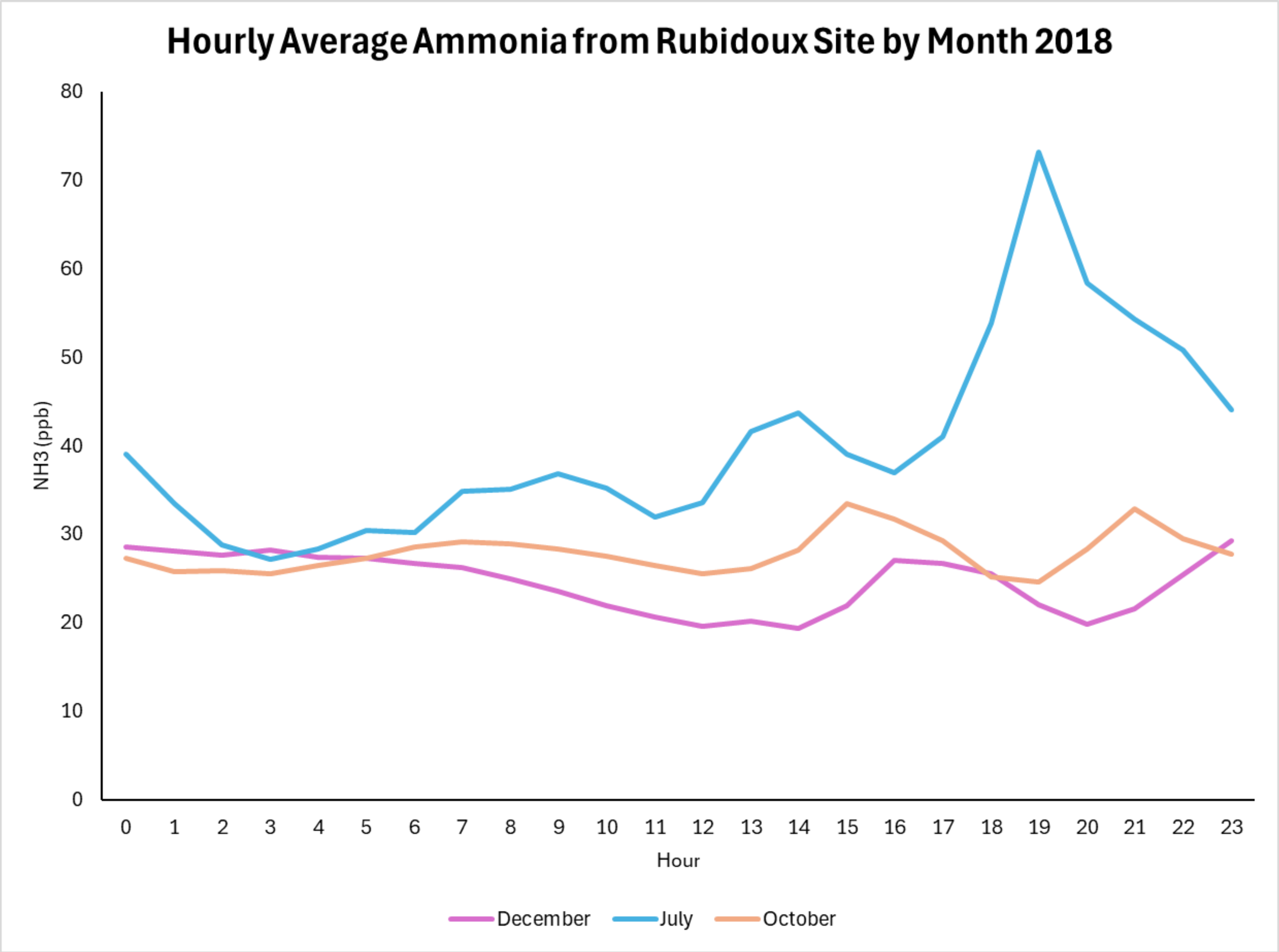


Fenn et al. 2018

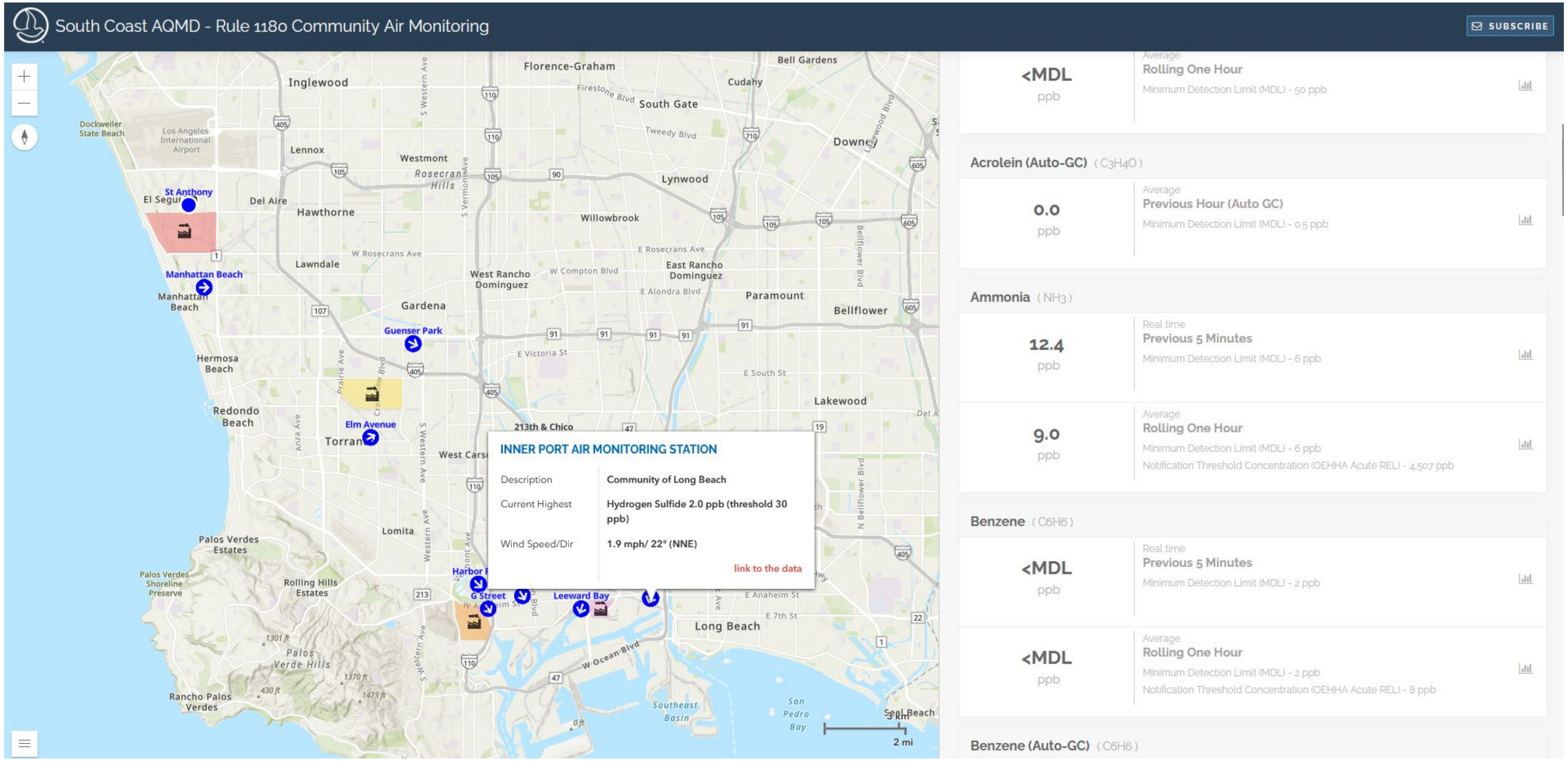
NH_3 at Rubidoux site 2018

→Monitored: July, October, December, and January

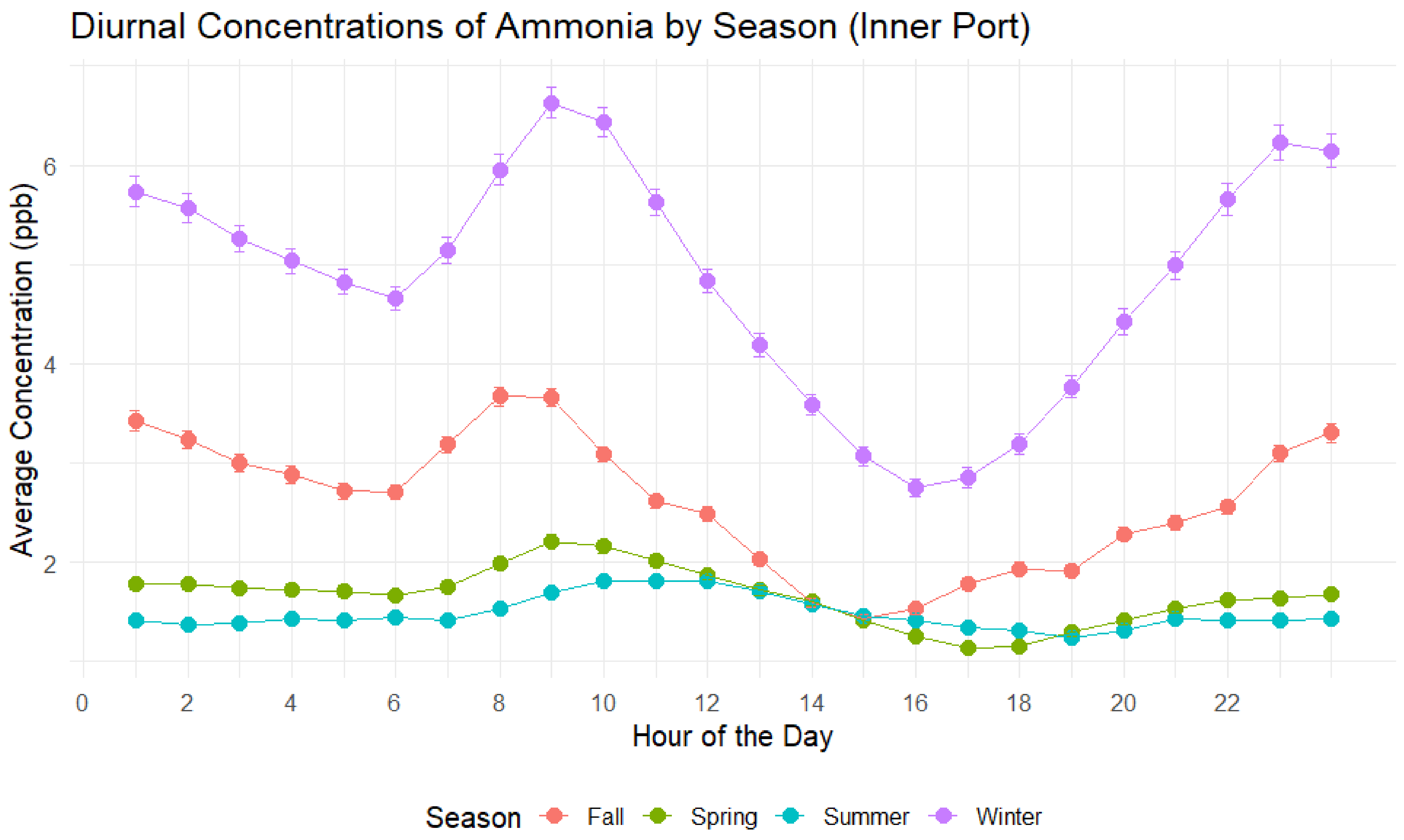
→CO_2 would help understand sources and atmospheric conditions



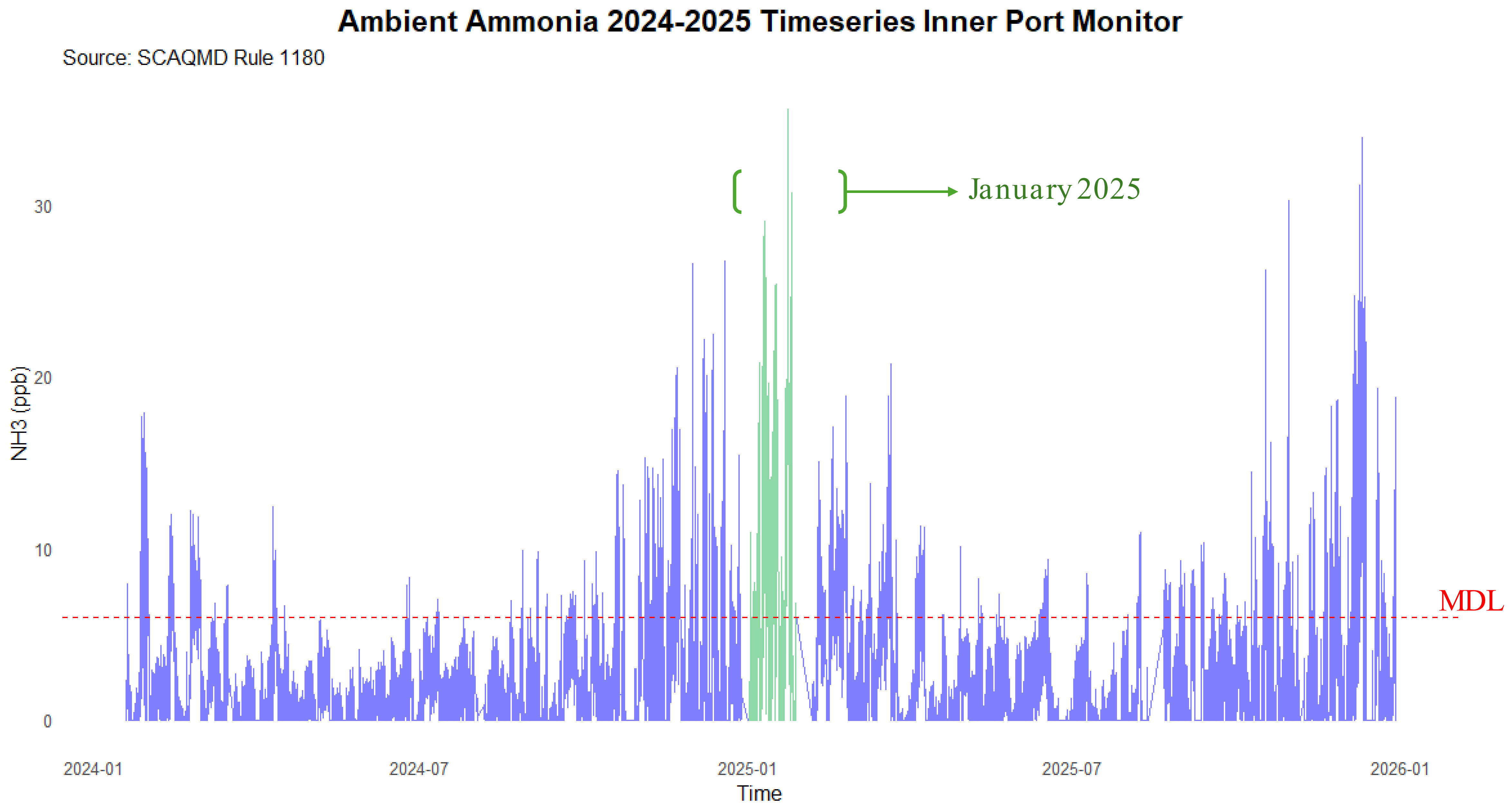
NH_3 near the port



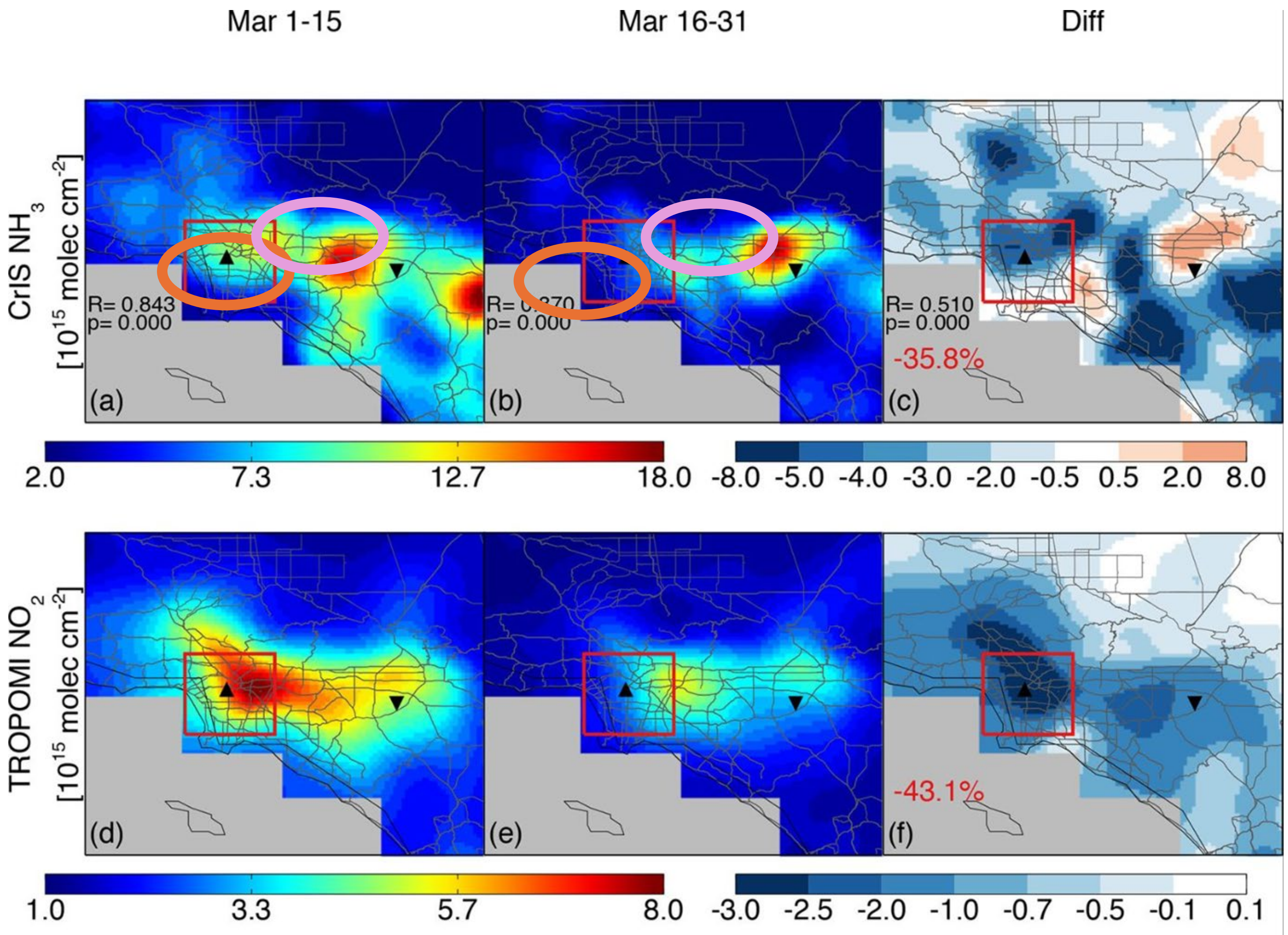
- Rule 1180 fenceline monitoring includes NH_3 (FTIR)
- MDL: 6 ppb



Diurnal Concentrations of Ammonia by Season (Inner Port)
Average Concentration (ppb)
2
4
6
0
2
4
6
8
10
12
14
16
18
20
22
Hour of the Day
Season
Fall
Spring
Summer
Winter


Ambient Ammonia 2024-2025 Timeseries Inner Port Monitor
Source: SCAQMD Rule 1180
NH3 (ppb)
30
20
10
0
January 2025
MDL
2024-01
2024-07
2025-01
2025-07
2026-01
Time

NH_3 near the port



NOAA's CrIS Satellite

- LA vs. San Bernardino
- NO_2 vs NH_3

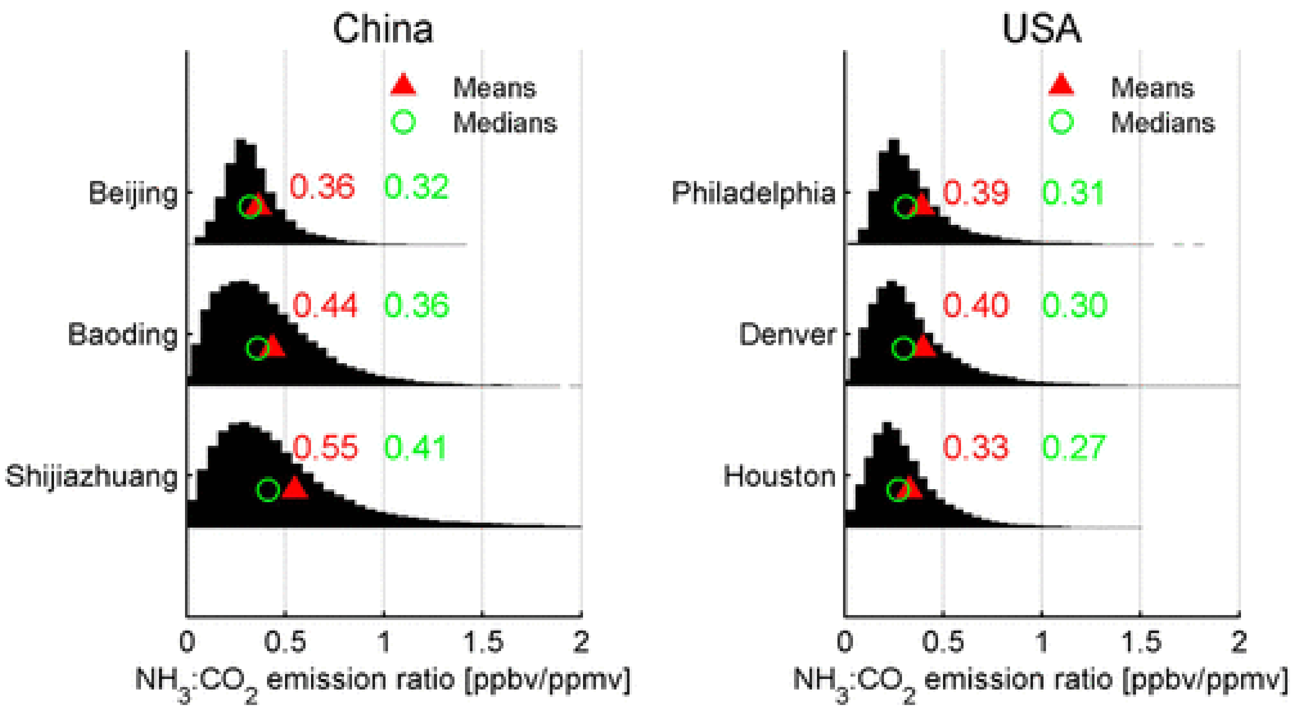
Cao et al. 2020

Proposed On-Road NH_3 Observation

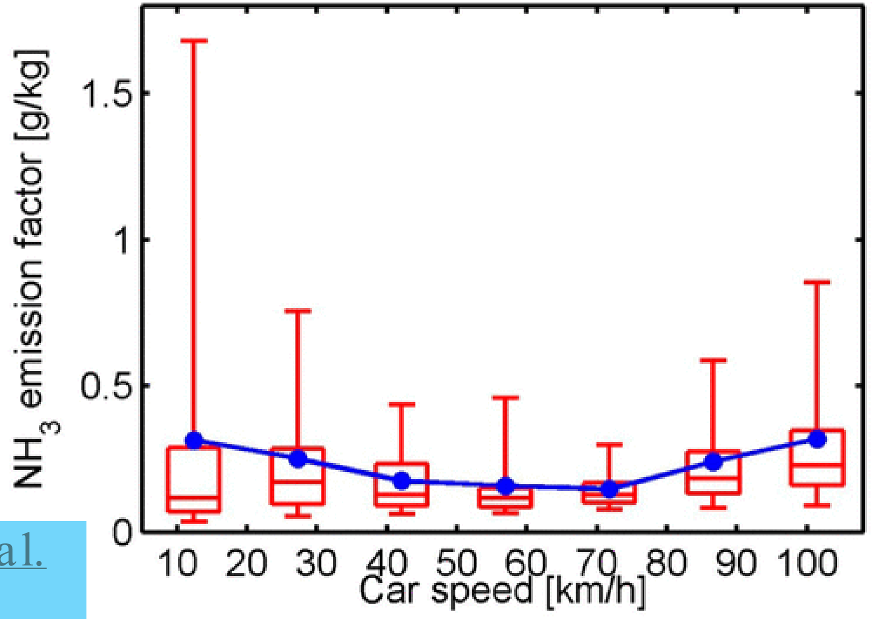
→ Using our mobile platform equipped with Picarro G2123 (NH_3), Picarro G2401 (CO/CO_2), and 2B Technologies NO_x analyzer

→ Collaboration with Dr. Karavalakis for trace metals, ultrafine particles, and secondary aerosol measurements on road

→ Outcome: comprehensive on-road monitoring of NH_3 across the entire basin. Validation of recent EMFAC changes



Sun et al. 2017



Sun et al. 2014

Proposed NH3 On-Road Observation Route

Based on CalTrans traffic data.

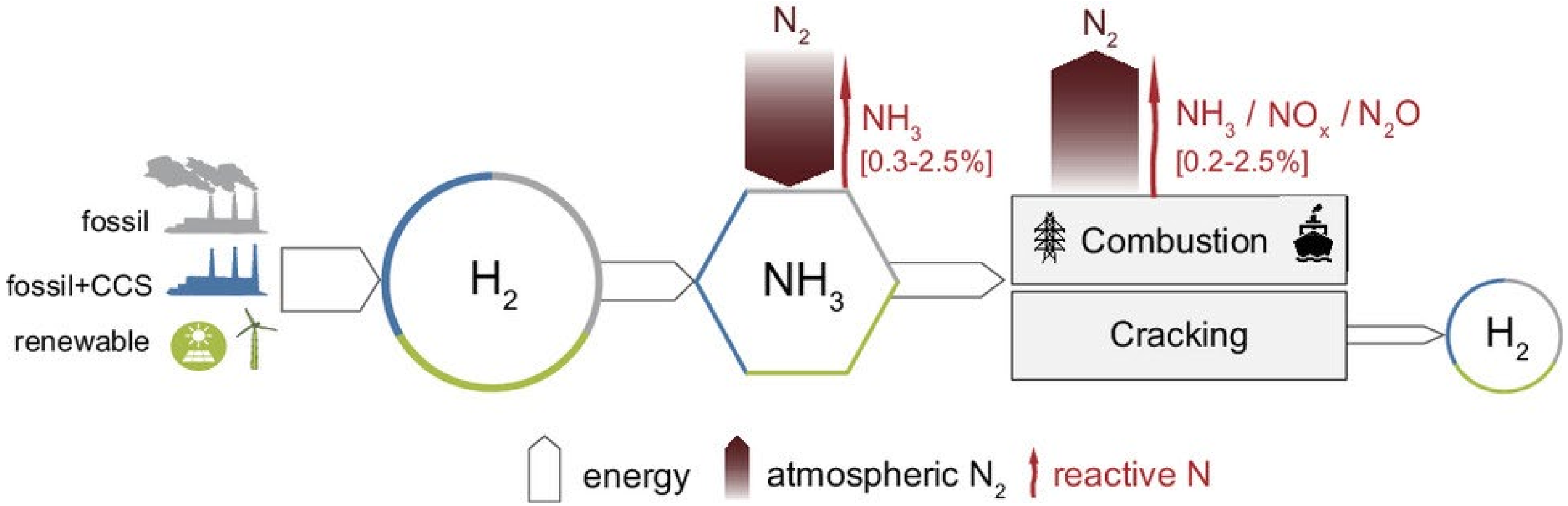
Additional monitoring routes in Ontario due to presence of heavy duty trucks.

Time: Morning & evening rush hour

Frequency: minimum 4 repeats per county

Conclusion

- NH_3 budget remains a question of reliability
- Under-monitoring in the regions that need it most
- Potential increases on-road, how do we monitor it?
- Future of NH_3 emissions uncertain



Bertagni et al. 2023

Ammonia is now an attractive "zero carbon" energy source for the future

Clean Fuels Program
2024 Annual Report
& 2025 Plan Update
Technology Advancement Office
Leading the way to cleaner air

Clean Fuels Program Advisory Group Meeting

The 2026 Plan Update

Vasileios Papapostolou, Sc.D.
Technology Demonstration Manager

South Coast AQMD
South Coast Air Quality Management District

January 29, 2026


Background
State law requirements:
• 2025 Annual Report on Clean Fuels Program and 2026 Technology Advancement Plan Update (H&SC 40448.5.1)
• Submit to Legislature by March 31 every year
*Draft 2026 Plan Update submitted to Technology Committee October 17, 2025

Public & Industry Outreach and Input

- Clean Fuels Advisory Group meetings
- Meetings: agencies, technology providers, national labs and other stakeholders
- Symposiums and conferences:
  - Transportation and energy sector conferences discussing vehicle emissions data, tire studies, ZE infrastructure, grid integration, hydrogen fuel cells, emissions reduction, and sustainable mobility systems
- Clean technology partnerships:
  - Renewed 4 memberships, including:
    - California Hydrogen Business Council (CHBC)
    - CALSTART
    - Clean Energy Institute (UC Irvine)
    - Hydrogen Fuel Cell Partnership (H2FCP)

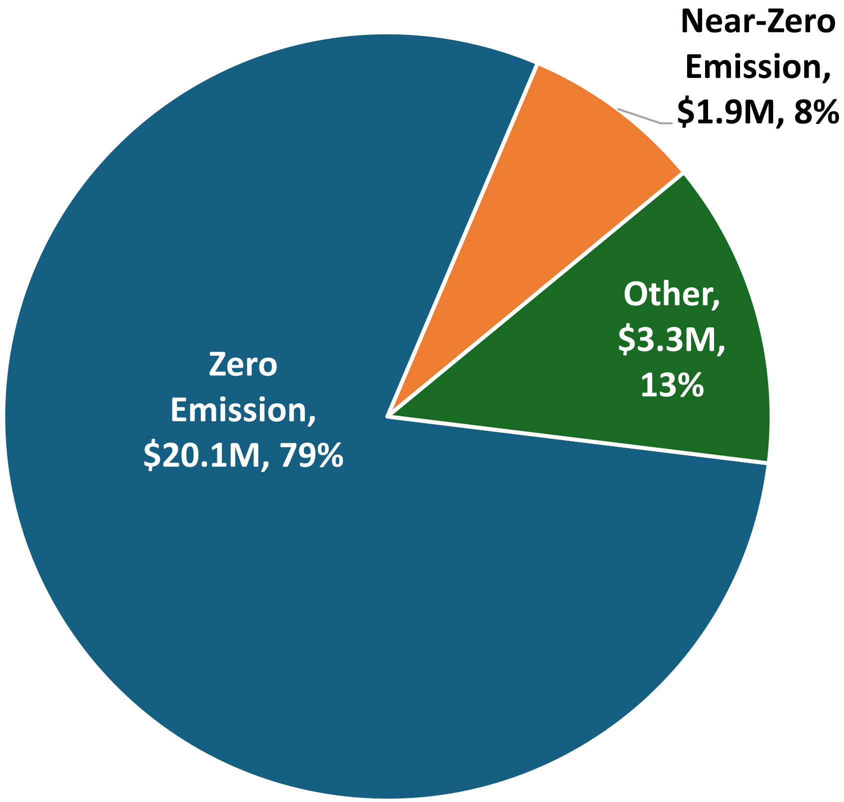
Clean Fuels Zero and Near-Zero Emission Projects between 2021-2025

Volvo LIGHTS:
Deployment of 30 Battery Electric Trucks to 11 fleets in Southern California

JETSI:
Deployment of 100 Battery Electric Trucks and Supporting Charging Infrastructure in Southern California

Hyundai: Demonstration of 5 Long-Range Class 8 Fuel Cell Trucks

Clean Fuels Funding, $25.4M*
(Total Project Cost $390M)



*Includes projected totals from 2025 approved projects

Funding Partners for Executed Contracts in 2025

CALSTART

voltu

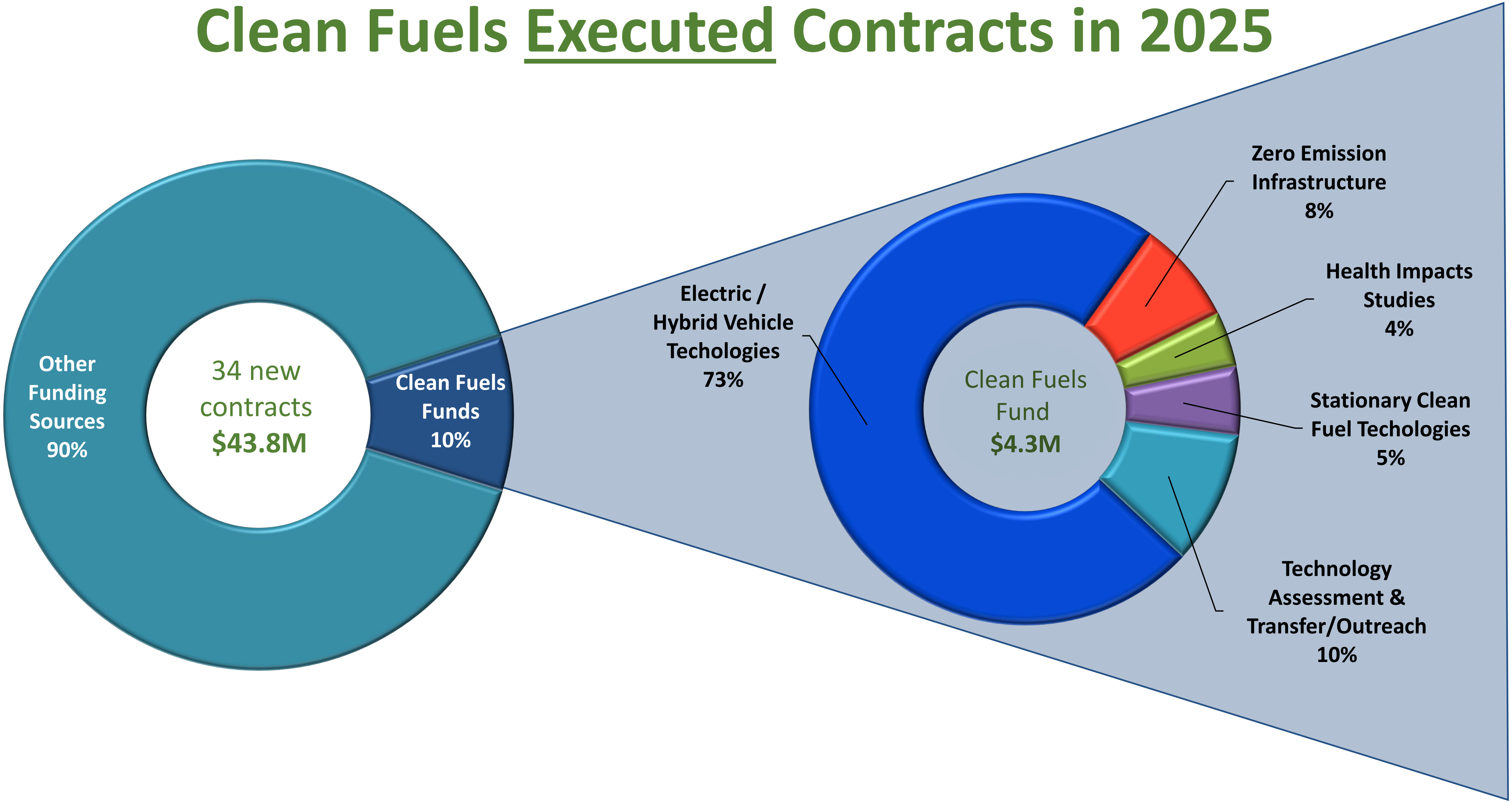
ADVANCED POWER & ENERGY PROGRAM
UNIVERSITY of CALIFORNIA · IRVINE

EPRI
ELECTRIC POWER RESEARCH INSTITUTE

VOLVO

UC RIVERSIDE | CE-CERT
UNIVERSITY OF CALIFORNIA

Clean Fuels Executed Contracts in 2025



Highlighted Executed Contracts in 2025

- Develop and Demonstrate Megawatt Fast Charging for Battery Electric Trucks (Electric Power Research Institute)

- Develop, Demonstrate and Deploy 10 Ford F350 Class 2B/3 Medium-Duty Work Trucks (Voltu Motor, Inc.)

- Investigate the Impact of Vehicle-to-Home Technology on Regional Air Quality (UC Irvine)

- Electrification of Ferries and Installation of Supporting Charging Infrastructure (Balboa Island Ferry)

- Battery Workforce Challenge Competition (Cal State University, Los Angeles

- Ethylene Oxide Formation Study (UC Riverside)

Highlighted Completed Contracts in 2025

- Deployment of 6 Zero-Emission Fuel Cell Transit Buses (Sunline Transit Agency)

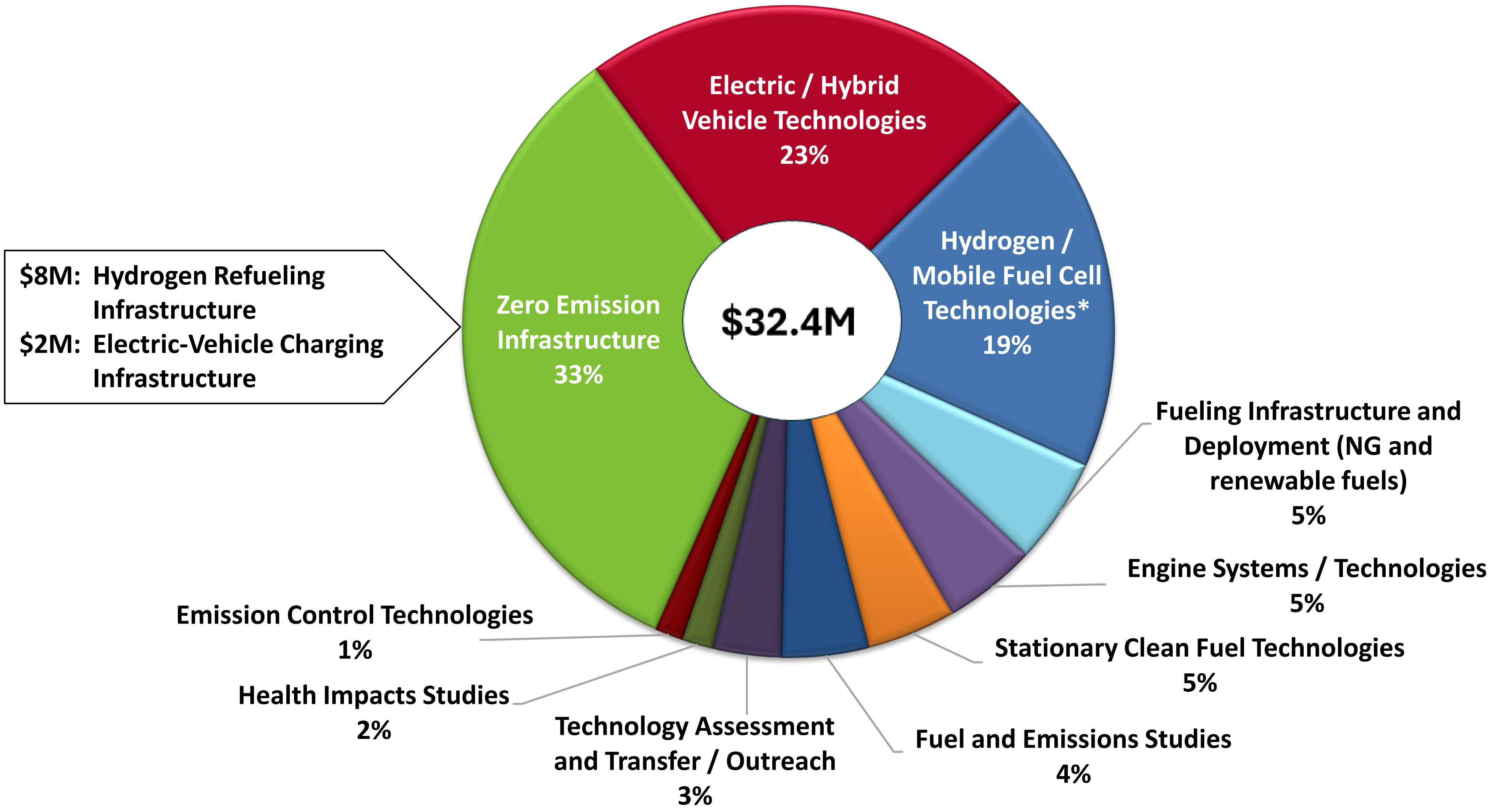
- Switch-On: Develop and Deploy 70 Heavy-Duty Battery Electric Vehicles (Volvo Group North America, LLC)

- Development and Demonstration of Electric Powered Trailer for Heavy-Duty Vehicles (Range Energy, Inc.)

- Replacement of 18 Battery Electric Shuttle Buses (Phoenix Cars, LLC)

- Replacement of 10 Battery Electric Yard Tractors (West Basin Container Terminal, LLC)

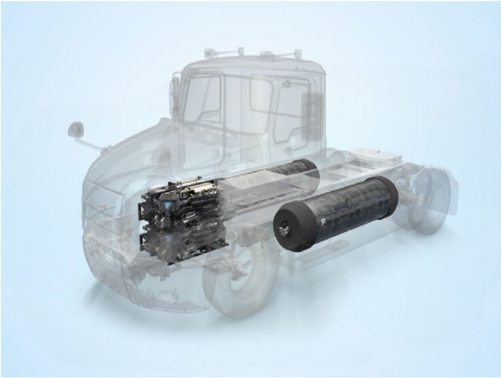
Potential Clean Fuels Funding for 2026



*** Additional Hydrogen FCE Technology projects through other grant funding sources**

Hydrogen Projects for 2026

- Class 6-8 Drayage Truck(s)
- Hybrid Powertrain
- Refuse Truck
- Cargo Handling Equipment
- Mobile/Portable Hydrogen Refueler for Off-Road Technologies

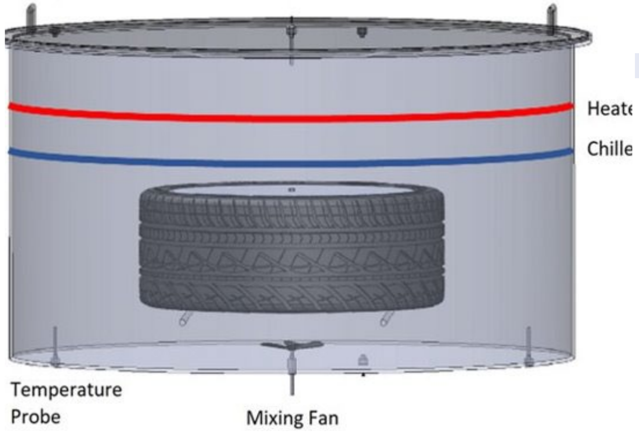


Battery Electric Projects for 2026

- All-Electric Transport Refrigeration Unit (TRU) Trailers
- Battery-Electric Class 8 Cement Truck
- Linear Generators for Prime Power Use and Microgrid Application(s)
- Charging Microgrid Application(s) Using Methanol Reforming to Produce Electricity from Hydrogen

Academic Research Projects for 2026

- Secondary PM Formation in Tire Emissions
- Mobile Battery-Integrated EV Chargers To Accelerate Medium- and Heavy-Duty On-Road BE Vehicle Deployment
- On-Road Brake and Tire Wear Emissions from Light-, Medium-Heavy-Duty Vehicles
- Monitor Urban NH3 and NOx For Potential Emission Sources (e.g., target freeways, near warehouses)



Proposed New Advisory Group Members

Technology Advancement Advisory Group

Julie Burbridge

- California Energy Commission

Jessie Denver

- Governor's Office of Business and Economic Development

Paul Lin

- Southern California Gas Company

2025 Annual Report & 2026 Plan Update Development Schedule

Technology Committee

October 17, 2025
(Draft Plan Update)

Advisory Group Review

November 2025
(Draft Plan Update)

Advisory Group Review

January 29, 2026
(Draft Annual Report & Final Plan Update)

Technology Committee

February 20, 2026
(Draft Annual Report & Final Plan Update)

Governing Board Approval

March 6, 2026

Due to State Legislature

March 31, 2026

Feedback

Email

Vasileios Papapostolou, Sc.D.
vpapapostolou@aqmd.gov

or

Aaron Katzenstein, Ph.D.
akatzenstein@aqmd.gov