

Why Hydrogen and Fuel Cells Make Sense for Commercial Transportation

Today's webinar will start at:

1 p.m. PT / 4 p.m. ET

In Partnership With



CALIFORNIA HYDROGEN
BUSINESS COUNCIL



Why Hydrogen and Fuel Cells Make Sense for Commercial Transportation



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**Total Transportation
Services, Inc.**



Before we get started:

Q&A

Submit your questions to the host using the Q&A box in the upper right-hand corner.

Survey

A 30-second survey will pop-up at the end. We appreciate your feedback!

Presentations

A recording of today's webinar will be posted on the ACT News website and you will be emailed a link by the end of this week.

Technical Issues

Contact Celeste Griffy at:
celeste.griffy@gladstein.org
or **424-744-4489** for assistance.





Purpose and Activities

■ CHBC Overview

- The California Hydrogen Business Council (CHBC) is comprised of over 100 companies, agencies and individuals involved in the business of hydrogen. Our mission is to advance the commercialization of hydrogen in the energy sector, including transportation, goods movement, and stationary power systems to reduce emissions and dependence on oil in California.

■ CHBC Activities

- Advocacy
 - Light Duty Infrastructure Buildout; Renewable Hydrogen, Pipeline Injection, Heavy Duty Infrastructure Deployment, and Advocacy Outreach
- Communications & Business Expansion
- Goods Movement, Heavy-Duty Transportation, and Clean Ports
- Hydrogen Energy Storage and Renewable Hydrogen
- Public Transport
- Infrastructure & Vehicle Deployment

MEMBER ORGANIZATIONS

Platinum



Gold



Silver



Innovators



Affiliates



Our Members include:

- Hydrogen producers and distributors
- Automotive companies
- Public transit systems and suppliers
- Fuel cell, electrolyzer, compressor and storage manufacturers
- Fueling station developers
- Engineers and consultants
- Municipal, state and federal agencies
- Component suppliers



CALIFORNIA HYDROGEN
BUSINESS COUNCIL

Hydrogen & Fuel Cells for Freight Workshop Report Overview



Cory Shumaker

Development Specialist

California Hydrogen Business Council



Workshop Context

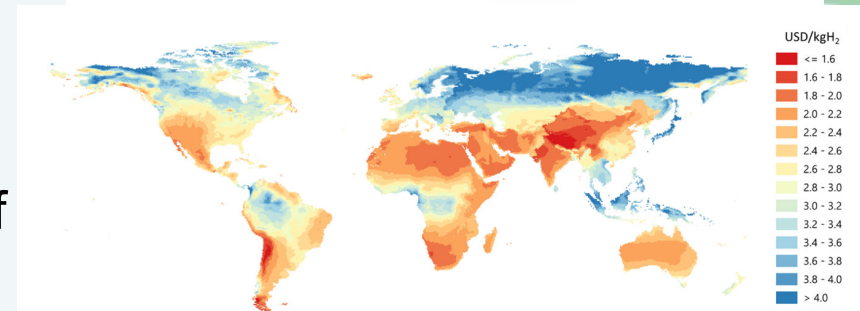
- 3rd CHBC Workshop Focused on Freight
- Transportation accounts for 41% of California's total greenhouse gas (GHG) emissions; global freight emissions are expected to double by 2050.
- The Clean Air Action Plan by Ports of Los Angeles and Long Beach has a goal of zero emission trucks in all port terminals by 2035.





IEA Report: The Future of Hydrogen

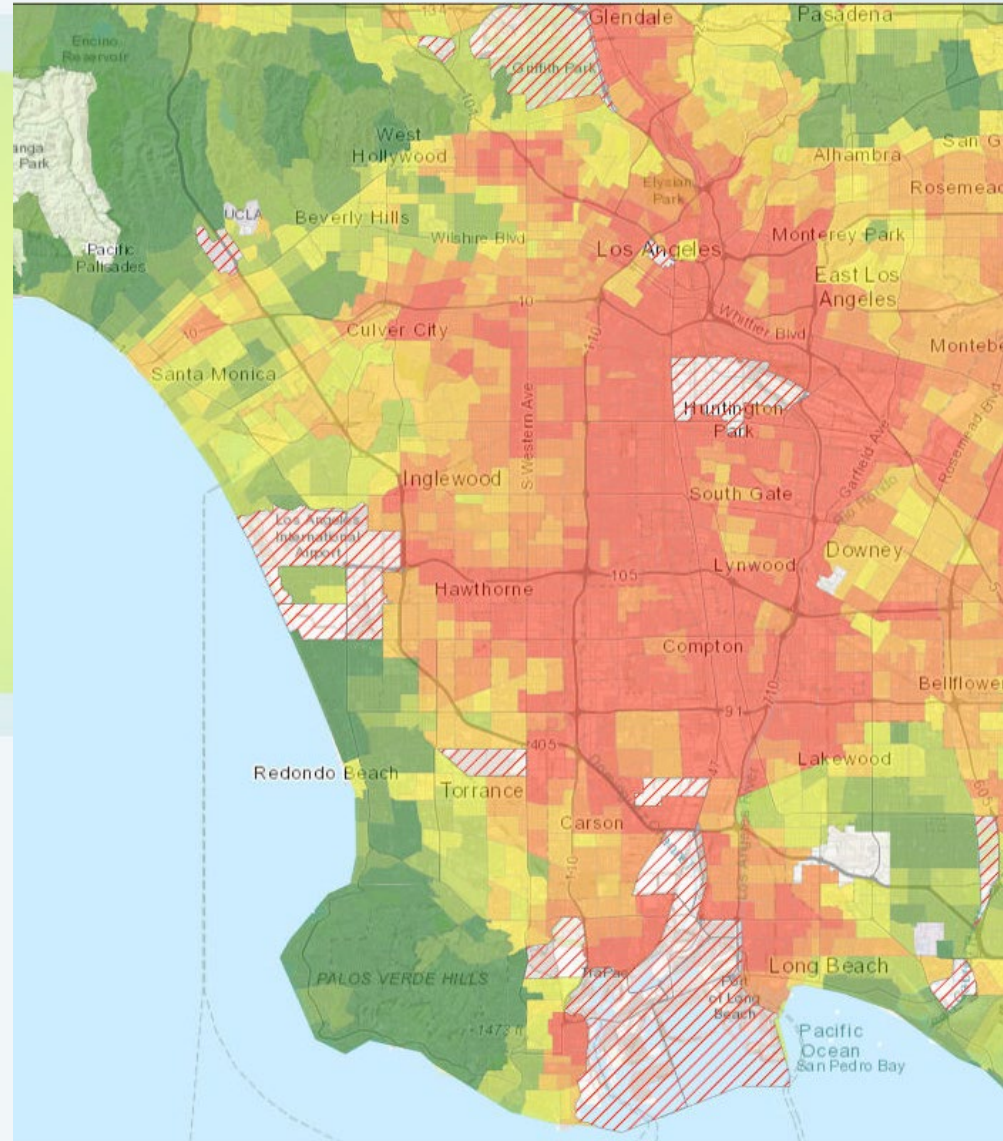
- Released June 2019 for G20, Japan
- The report finds that clean hydrogen is currently enjoying unprecedented political and business momentum, with the number of policies and projects around the world expanding rapidly.
- IEA identified the following opportunities:
 - Expand hydrogen in transport through fleets, freight and corridors.
 - Make industrial ports the nerve centres for scaling up the use of clean hydrogen.





Societal Need for Hydrogen and Fuel Cells

- The Environmental Justice community in California focuses on improving air quality within disadvantaged communities subjected to disproportionate impacts from one or more environmental hazards, socio-economic burdens, or both. The EJ Community holds significant influence in California, acting as a gatekeeper to climate and air quality policy.
- Southern California is currently non-compliant with the federal EPA NO_x standards and has the worst ozone and fifth worst particulate matter pollution in the United States.





One for One: Technology Platform Comparison for Goods Movement

- Hydrogen and fuel cells for material handling is commercially viable.
- 77% of operational costs come from labor and 11% from equipment.
- Capital costs of hydrogen infrastructure are lower than outfitting a warehouse with fast chargers for forklifts (minimum 200 vehicles).
- Valuable warehouse space required for charging is not needed.
- Unlike battery, a fuel cell forklift maintains constant voltage throughout the duration of a shift.
- Fuel cell forklifts vs. battery savings:
 - 4-6% battery labor savings
 - 6-15% productivity increase
 - 10-30% added enterprise value





- In the 2020's the California Air Resources Board will begin to require an increasing percentage of Class 2-8 trucks to be zero emission.
- Toyota has accelerated its advancement of zero emission vehicles, including fuel cell electric trucks.
 - Toyota launched its first Class 8 fuel cell electric truck (FCET) in 2017, which has since moved 10,000 miles of freight. Latest model has a range of over 200 miles in port drayage operations.





OEM Perspective

- Hyundai plans to produce 700,000 fuel cell systems by 2030, including Class 2-8 trucks and buses.
- 1,600 Xcient 35-ton trucks in Switzerland by 2025 with 250 mile range and refueling in 15 minutes.
- Nikola has received 13,000 orders for their Nikola Two.
- Nikola and Nel partnered to build a network of 700 stations across the USA by 2028.
- Developed Hydrogen Station Testing Apparatus to test and validate hydrogen stations.





Report from the Field: Operator Experience

- Total Transportation Services, Inc. (TTSI) is testing a variety of FCETs in their trucking operations within Los Angeles county.
 - Deploying 10 FCETs by end of 2019; 225 total trucks in TTSI fleet.
- TTSI uses two mobile refuelers with 300kg capacity to fuel the FCETs from a facility near the Port of Long Beach.
- Exploring the possibility of a hydrogen station in the inland empire to operate the trucks between the ports and interior LA County basin.





Fast Refueling: Heavy-Duty Hydrogen Infrastructure

- Hydrogenics and Air Liquide partnered to build a large scale renewable hydrogen production facility.
 - 5MW electrolysis producing 4,000kg/day; enough for 100 FCETs.
 - Design scalable to 40MW electrolysis to produce 17,000kg/day.
- Air Liquide uses “hub-and-spoke model” for hydrogen production and distribution: Hydrogen production -> liquefaction -> trucked to distribution hub -> liquid hydrogen is vaporized into gaseous hydrogen at 450 bar and delivered to stations.
 - Liquid hydrogen tanker can move up to 3,500kg of hydrogen.
- Standards development for high flow nozzles for heavy-duty is underway.
- Shell will use Nel electrolyzers to produce hydrogen onsite to test FCETs in the Los Angeles area for Nikola.
- Lessons learned from hydrogen at bus depots can be applied to heavy-duty FCETs.



Conclusions/Takeaways

- The hydrogen and fuel cell industry should continue to engage with Environmental Justice groups.
- Hydrogen and fuel cell technology has proven its potential through demonstration projects; now is the time to scale up and enable mass deployment.
- Policy funding needs to be designed for medium/heavy-duty vehicle roll out, including infrastructure.
- Need to incentivize fleet operators to transition away from carbon intensive fuels to zero emission technologies.
- A comprehensive, multi-stakeholder state action plan for the medium and heavy duty sector is needed to enable deployment.
- The Workshop was missing the energy/utility company perspective.



CALIFORNIA HYDROGEN
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Thank You!

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Join us!

www.californiahydrogen.org



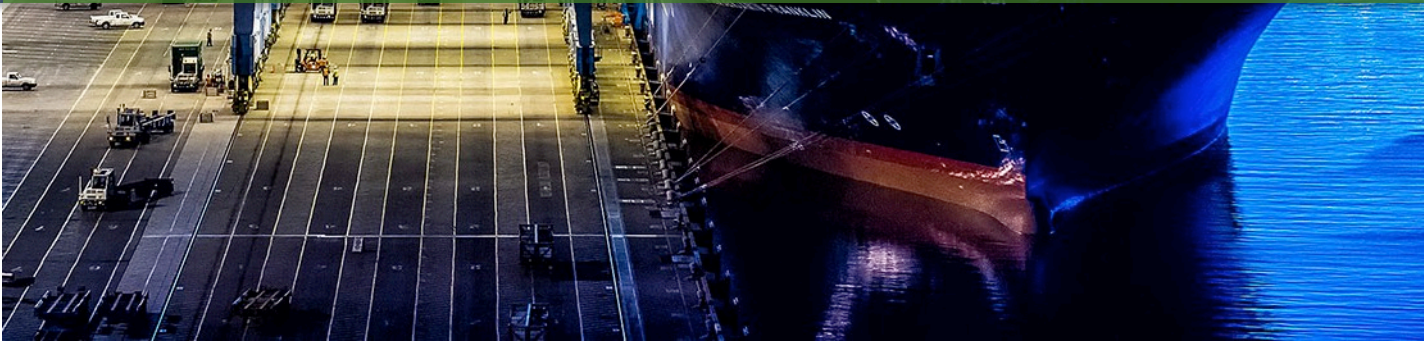
Moving Towards Zero Emissions

Opportunities and Challenges for Hydrogen Fuel



THE PORT
OF LOS ANGELES 

August 14, 2019





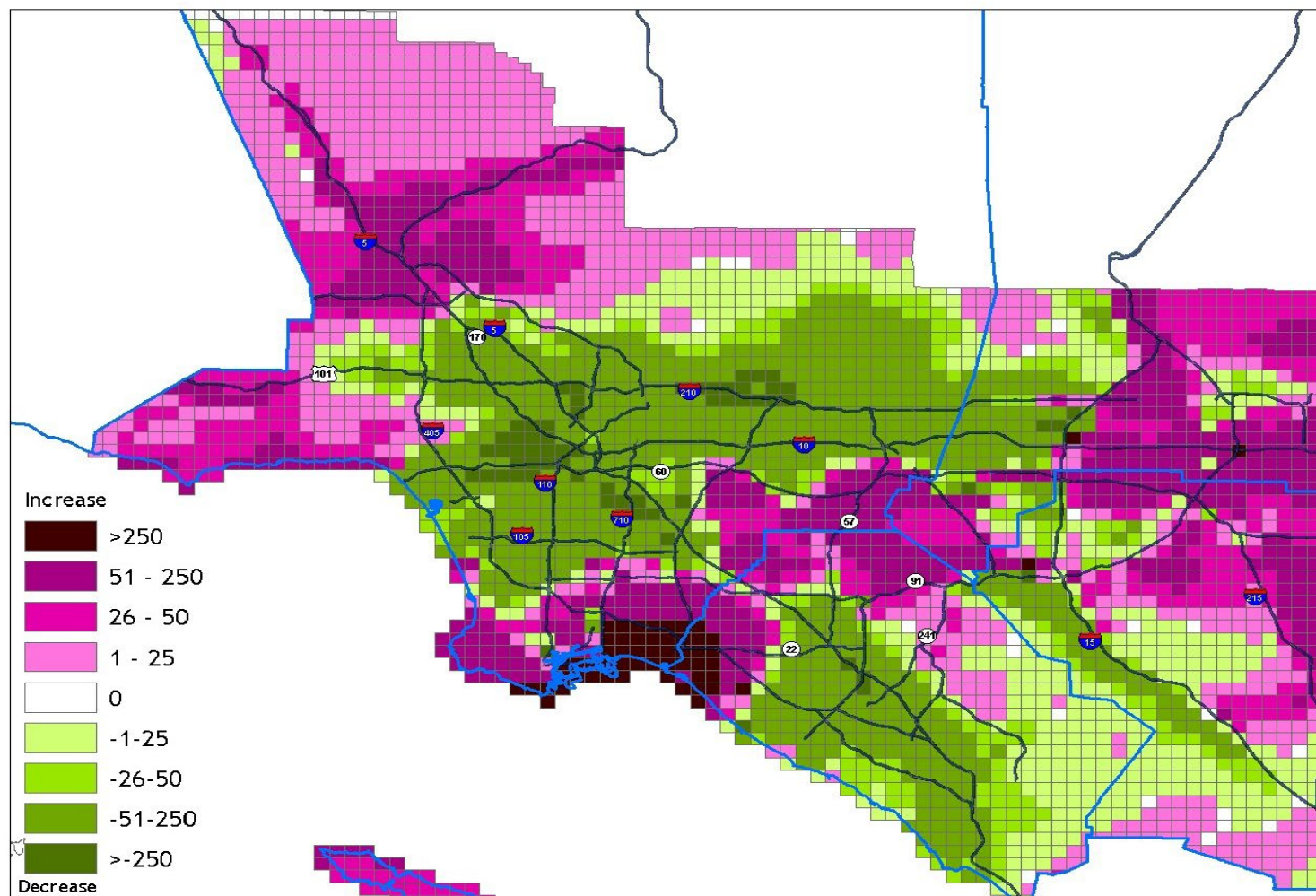
Port of Los Angeles at a Glance

- Founded in 1907, Landlord business model
- 7,500 acres of land and water
- 43 miles of waterfront
- 270 berths and 27 cargo terminals





Modern Impacts: Southern California



Pollution,
traffic are
linked
to illness

ENVIRONMENT: German study finds heart attacks are three times more likely in congestion. Bad air is blamed.

Latino areas
are hit hard by
environmental
health threats

REPORT: Group suffers more from pollution than the rest of the population, study finds.

Figure 4-8

Change in CAMx RTRAC Simulated Air Toxics Risk (per million) from the 1998-99 to 2005
(using back-cast 1998 emissions and 1998-99 MM5 generated meteorological data fields)



Clean Air Action Plan

- Planning document that outlines a series of strategies and goals for reducing air emissions from Port operations
- Primary goals:
 - All terminal equipment to be zero emissions by 2030
 - All on-road trucks to be zero emissions by 2035
- Current technologies not feasible for widespread implementation



Benefits of Hydrogen Technology

- Potential capability for Long Haul freight movement (potentially up to 400 miles)
- Hydrogen offers a comparable driver experience compared to diesel (fueling time and range)
- Expandable fueling infrastructure
- Vehicle weight comparable to standard options, and significantly lighter than battery



Challenges of Hydrogen Technology

- Both equipment and fuel is expensive
- Unproven technology in heavy-duty sector
- Infrastructure permitting can be challenging
- Renewable generation is necessary



ZANZEFF Grant Program

- “Zero and Near Zero Emissions Freight Facilities” (ZANZEFF)
- \$205 Million awarded to various projects in California
- Supports bold, transformative emission reduction strategies that could be emulated throughout freight facilities statewide.
- Harbor Department received preliminary notice of award for \$41,122,260
- Project focuses on connecting freight hubs throughout Southern California





Hydrogen Elements

- 10 Hydrogen Fuel Cell Class 8 Trucks
- 2 Heavy Duty Hydrogen Fueling Stations
 - 1 near-port station in Wilmington
 - 1 Inland Empire station in Ontario

- Key Partners:



- \$42 million in cost share across public and private partners



Looking Forward

- Future demonstrations provide opportunity to prove the technology's viability in the heavy-duty sector
- Need to bring overall costs down
- Future public funding opportunities can be leveraged to generate the necessary infrastructure network
- Expanding renewable hydrogen generation

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Hydrogen and Fuel Cells for Heavy Duty Commercial Transportation

August 14, 2019



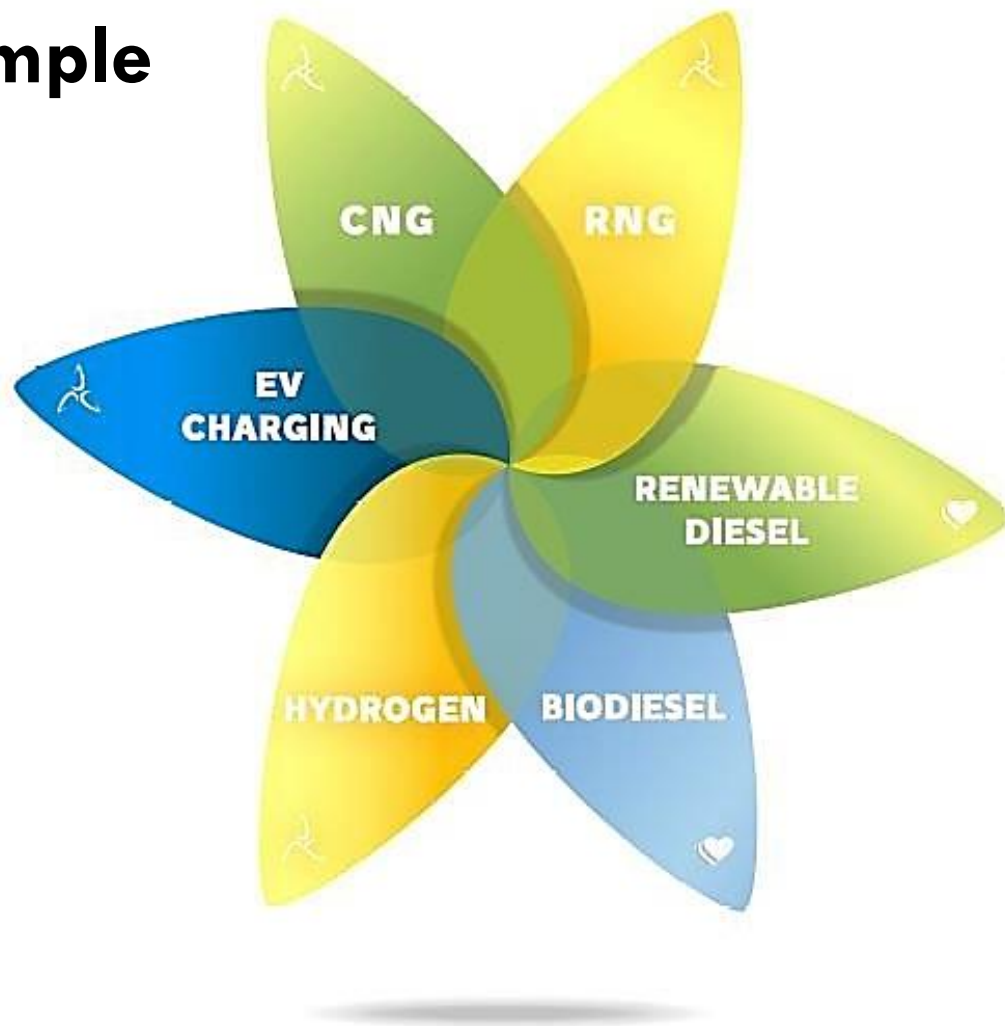
A  Love's Company

One Partner, Any Fuel



It really can be that simple

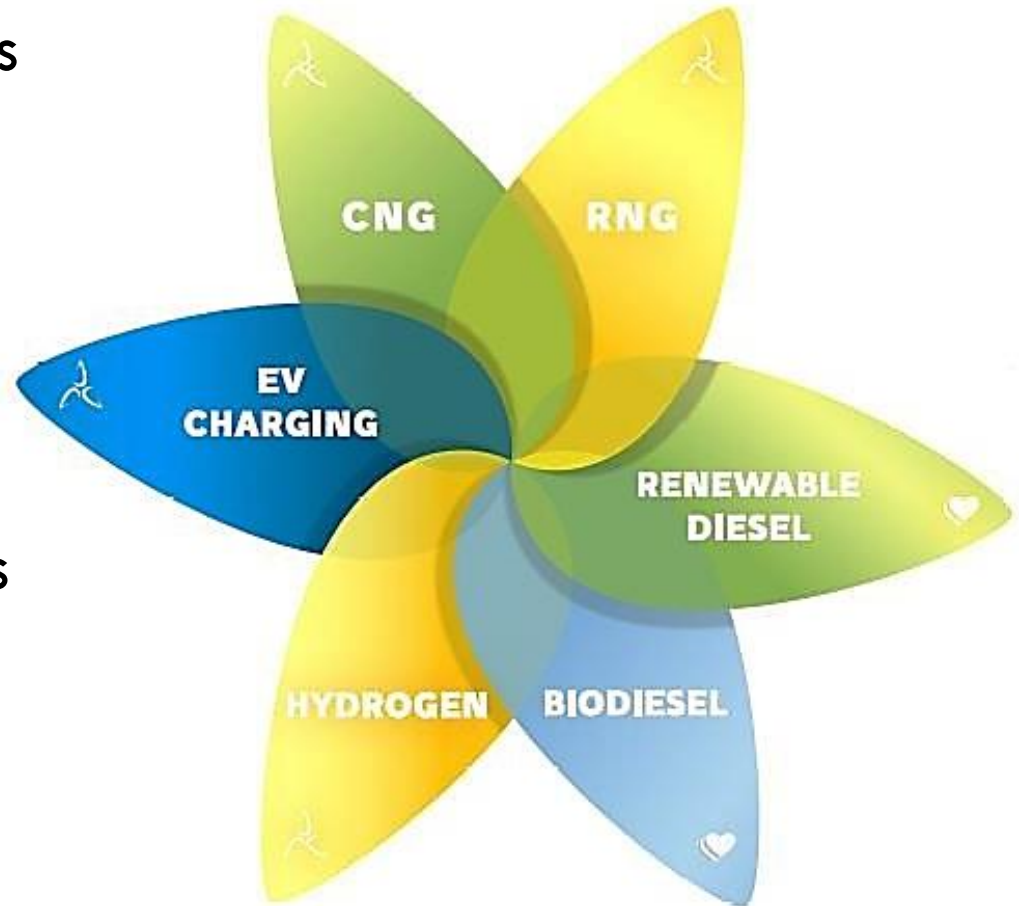
Through our Love's Family of Companies, Trillium can supply fueling stations with any clean fuel as fleet's needs evolve and grow



One Partner, Any Fuel

Trillium works with customers to identify the unique clean fuel and power supply opportunities based on:

- Cost
- Reliability
- Deployment timelines
- Sustainability goals
- Location
- Scale



Customer-Centered Approach to Fueling

Trillium can partner with fleets at any stage of station development to help maximize efficiency, cost savings, and operating performance.



Customer-Centered Approach to Fueling

Our 24/7 service model has helped us achieve the highest customer satisfaction in the industry and 99.9% uptime for our stations.



Recent Hydrogen Project



Key Project Elements



- Largest HD commercial Hydrogen refueling facility in the US
- Designed for up to 50 buses
- 30 kg of hydrogen fuel per vehicle
- 6 minute refueling time with 2 simultaneous dispensers
- Up to 1,500 kg/day
- Small footprint of ~3,400 sq. ft.
- Operational in Q3 2019



Capitalizing on Benefits, Overcoming Barriers



Benefits:

- Zero Tailpipe Emissions
- Cost-effective at Scale
- HD Truck Technology
Improving
- Duty Cycle
- Vehicle Range
- Refueling Speed

Barriers:

- New Market
- OEM Products
- Infrastructure
- Hydrogen Deployments
Require Scale
- Incentives
- Commercialization

Making H2 Work in Commercial Trucking



Commercial Focus:

- Building a Market
- Dedicated Lanes
- Return-to-Base Operations
- Fuel Production & Logistics

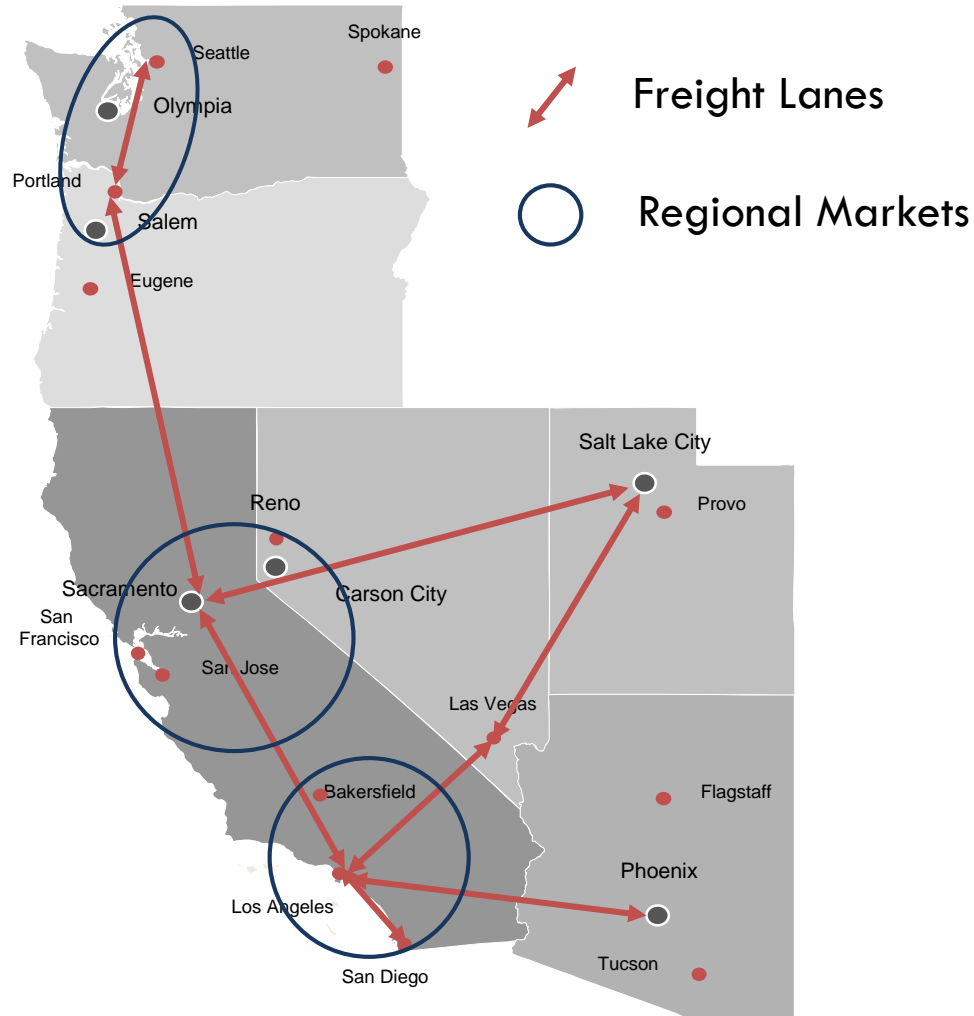
Policy Focus:

- Level Playing Field
- Commercial Economics
- Regulatory Certainty
- Multi-state Approach

Making H2 Work in Commercial Trucking



Making H2 Work in Commercial Trucking



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Hydrogen Fuel Cell Program



We are



- 3rd Party Logistics Company, managing import and exports of ocean containers
- Headquartered in Rancho Dominguez, CA
- Started in 1989 as air freight company, incorporated in 1997
- Operated in all major ports in the United States, either directly or indirectly with partner companies
- Services consists of Drayage, Warehousing, Over-The-Road Transportation, and Brokerage
- Power - Assets owned and contracted
- Equipment – Chassis and Van Trailers



Sustainability

At TTSI, we are committed to leaving as small a footprint as possible on our precious environment. That's why we are committed to several ecological goals designed to drastically reduce our operational emissions and subsequent environmental pollution.

Our goal is to operate a zero emission fleet that services our customers while being a steward to the environment.





Environmental Steward



- 1st company to convert it's fleet to 100% clean (accomplished in less than 12 months)
- 2009 San Pedro Bay Ports Clean Air Action Plan Air Quality Award
- 2009 Alternative Fuel Vehicle Institute Industry Excellence Award
- 2011, 1st company to place a Class 8, Hydrogen Fuel Cell Truck, into drayage operation
- Special Recognition Award from the Congress of the United States House of Representatives and many other awards
- 2019 California Air Quality Award





2007 CAAP Announcement

LB News | 08.03.07 | publishers@lbpost.com

Coalition Funds Green Trucks

Long Beach Mayor Bob Foster and LA Mayor Antonio Villaraigosa were on hand to support the Clean Trucks Program to address the impact of diesel-related emissions on the surrounding communities by 2012.

The program places truck drivers into environmentally friendly vehicles by providing them with financial support which allows them to remain as independent owner operators.

The program will fund 100 "clean" trucks into service over the next 12 months.

The retail store, Target, has partnered with Total Transportation Services, Inc (TTSI) and NYK Logistics and identified an innovative solution which meets both industry and independent owner/operator needs.

This group, along with other beneficial cargo owners and trucking companies, has also formed a coalition for the sole purpose of developing and implementing solutions to address the issues of truck emissions. The Coalition for Responsible Transportation will use the framework from TTSI, NYK and Target as a starting point for encouraging discussions and partnership as companies identify possible solutions.



TTSI announced during the press conference that it would convert its entire fleet to comply with the provisions of the CAAP



TTSI's CAAP

July 11, 2011, TTSI takes possession of the 1st Class 8 Hydrogen Fuel Cell Truck



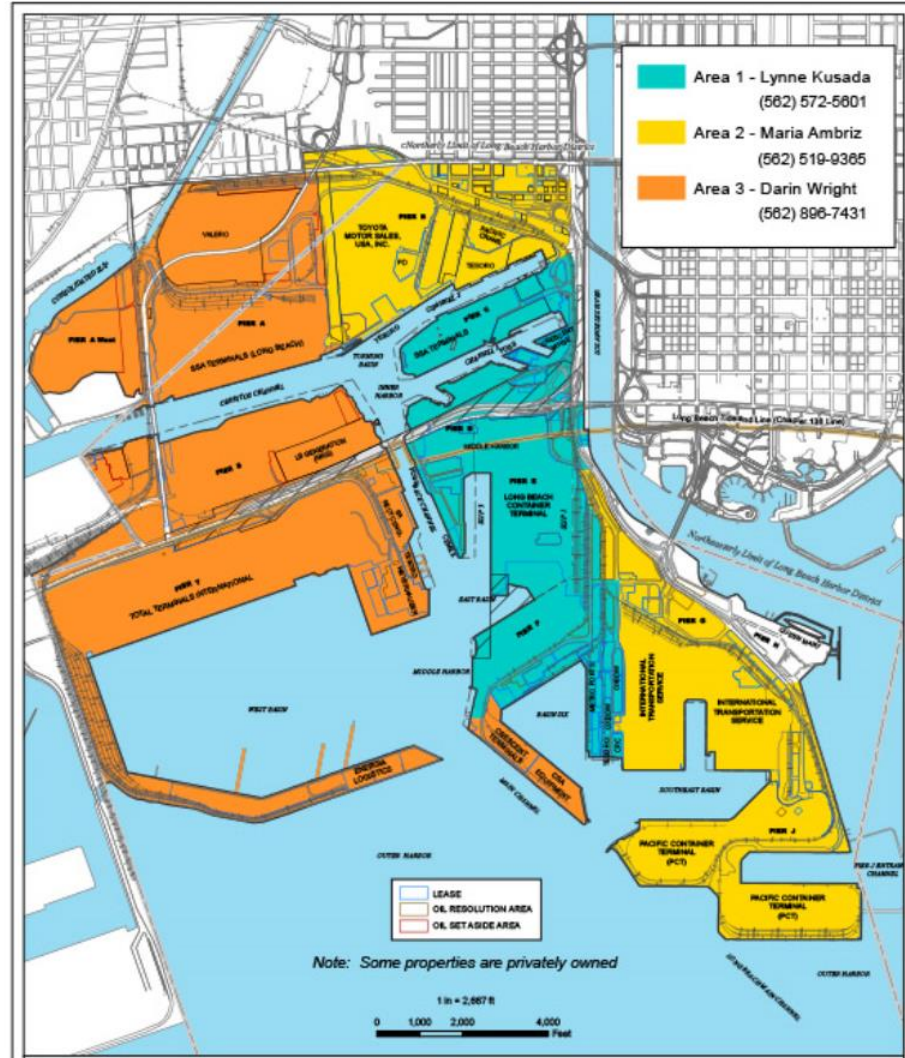


Duty Cycle

- **Weekly Operation Ports of LA & LB:**
 - 6 Days per week
 - 4 – Days of two, 10 Hour Shifts
 - 2 - Days of one, 10 Hours Shift
- **Operational Needs:**
 - Class 8 Zero Emission Trucks
 - Power to transport 36 to 39K Loads
 - Reliability/Dependable
 - Able to travel 6% Grade at minimal 30 to 35 MPH
 - Minimal fueling time (Same time as diesel)
 - Available fueling (Infrastructure)

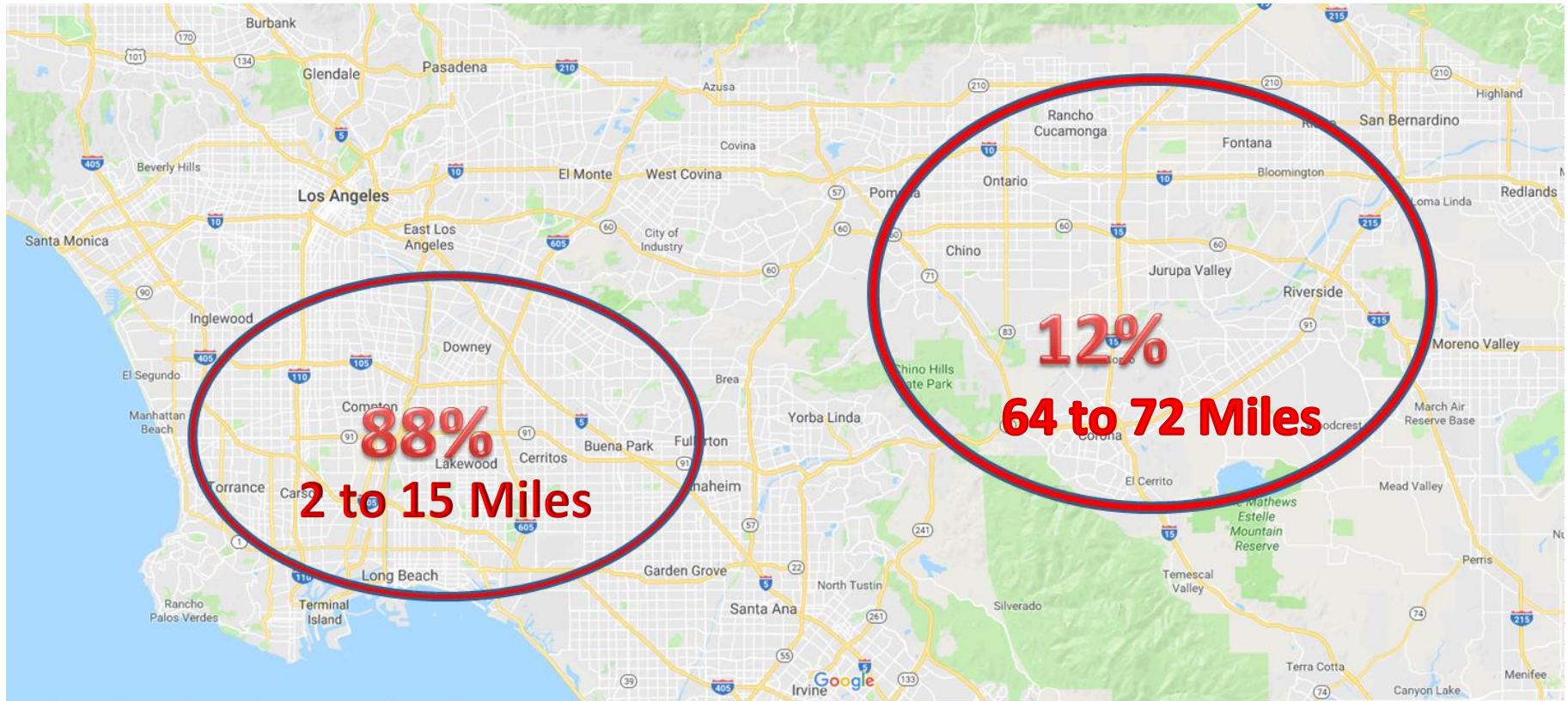


Southern CA Port Complex





Drayage Operations



Southern CA Basin



Hydrogen Fuel Cell Trucks



Range: 200 Miles
Fuel Capacity: 25kg
Horsepower: 429



Range: 150 Miles
Fuel Capacity: 20kg
Horsepower: 442



Range: 130 Miles
Fuel Capacity: 25kg
Horsepower: 560





Hydrogen Fuel Cell Trucks

Operations Experience

■ Positives

□ Regulatory

- ✓ Zero Greenhouse Gases
- ✓ No idling
- ✓ Low noise pollution

□ Operations

- ✓ Substantial torque
- ✓ Driver Acceptance
- ✓ Duty Cycle

■ Concerns

□ Costs

- ✓ Purchase Cost
- ✓ Insurance Costs
- ✓ Fuel Costs
- ✓ Service/Repair Costs

□ Operations

- ✓ Tractor Tare Weight
- ✓ Fuel Infrastructure
- ✓ Battery Life



Future Hydrogen Fuel Trucks

Alternative Fuel Vehicle Demonstrations

Alternative Fuel Vehicle Type	Manufacturer	Projected Demonstration	Number of Trucks
Fuel Cell Battery Truck (Hydrogen)	CTE/Kenworth	In Progress	1
Fuel Cell Battery Truck (Hydrogen)	Hydrogenics	August 2019	1
Fuel Cell Battery Truck (Hydrogen)	Toyota/Paccar	March 2020	2
Fuel Cell Battery Truck (Hydrogen) - Gen 2	TransPower	In Progress	2
Fuel Cell Battery Truck (Hydrogen)	TransPower/GTI	August 2019	3
Fuel Cell Battery Truck (Hydrogen)	US Hybrid Corporation	In Progress	2
Total			11

CTE - Center for Transportation and Environment



Hydrogen Fueling Station

Hydrogen Fueling Equipment

- Permitted on-site capacity – 500kgs
- 2 HF-150 Hydrogen Fueler, self contained
- Each at 150 kg (63,450 SCF) of compressed, gaseous hydrogen
- 5,076 psig (350 bar)
- Fill time ~ 20 to 25 minutes
- Air Products Facility <5 miles from site
- Requires no utilities/Footprint – 45' X 82'



Partners

- Center for Transportation and Environment (CTE)
- S CA Air Quality Management District (SCAQMD)
- Air Products
- Port of Los Angeles & Port of Long Beach





Take Away from Experience

☐ Fuel Cell Technology

- ❖ Moving in the right direction with heavy duty technology
- ❖ New Players in the HD “Game” (OEMs and Integrators)
- ❖ Downtime is reduced/Issues quickly resolved

☐ Drivers/Operators

- ❖ Accepting technology
- ❖ Beginning to understand the operation of FCs in Heavy-Duty Trucks



For more information on TTSI, please
visit our website at: www.tts-i.com

Thank You



Questions and Answers:

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