

Funding Mechanisms to Assist and Accelerate ZEB Deployment (Co-Hosted by California Hydrogen Business Council)

July 11, 2019

How to Ask Questions

- Submit your questions anytime during the program using the Questions module in your webinar control panel at the right of your screen.
- We will collect all questions and get to as many as time permits during the Q&A portion of the program.









Emanuel Wagner Deputy Director California Hydrogen Business Council



Mission & Sector Action Groups:

The California Hydrogen Business Council (CHBC) is comprised of over 100 companies and agencies 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 & Initiatives
 - Renewable Hydrogen, Renewable Energy and Climate
 - Hydrogen Blending and Gas System Integration
 - Hydrogen Fueling Station Build-out
 - Stakeholder Advocacy Campaign
- Communications & Business Expansion
- Goods Movement, Heavy-Duty Transportation, and Clean Ports
- Hydrogen Energy Storage and Renewable Hydrogen
- Public Transport



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 and state agencies
- Component suppliers

Get the Facts!



CALIFORNIA HYDROGEN BUEINESS COUNCIL Harger Vern Burein C California California Rissillian

FUEL CELL ELECTRIC BUSES for Zero-Emission Public Transit



California has made great strides in improving its air quality over many decades, but transportation remains the state's dominant source of air pollution. If California is to meet its air quality improvement and emissions reduction goals, the continued growth of zero emission electric bus deployment is essential.

Among the different electric bus options available today, fuel cell electric buses (FCEBs) offer a number of advantages.

Emissions and GHG Reductions

FCEBs have zero tailpipe emissions and produce no nitrogen oxides, sulfur dioxides or particulate matter. Hydrogen from renewable sources like solar, wind and biogas ensures full carbon neutrality from a well-to-wheels perspective and significantly reduces carbon dioxide (CO2) emissions. As a result, FCEBs can make the biggest impact on the health-related impacts of poor air quality in disadvantaged communities.

Performance

Zero-emission FCEBs offer conventional full vehicle performance (e.g. gradeability, highway speeds, fueling times and range) over all types of transit routes. Expected efficiency improvements will continue to increase the fuel economy of FCEBs, which is already 1.7 to 1.9 times higher than conventional buses. In addition, ElDorado National and New Flyer FCEBs have successfully completed testing at the FTA's Altoona Bus Research and Testing Center.

With more than 10 million miles in revenue service and more than 15 years on the road in different environments and transit bus duty cycles, FCEBs have proven to meet operational requirements of transit agency operators. FCEBs offer a 1:1 replacement to CNG & diesel buses without compromises. For example, an AC Transit progress report on zero-emission bus expansion found that "95% of all routes can be served by FCEBs on a 1:1 replacement basis."

Scalability

The use of a compressed gas like hydrogen fuel for transit buses is a scalable solution for up to hundreds of buses per depot without stressing electrical infrastructures.



Fueling

Rapid fueling, like CNG & diesel fueling, can take place at any bus fueling depot designed with the addition of delivered hydrogen or onsite hydrogen production. There are no route constraints due to limited range and fueling.

Cost

FCEB capital costs have decreased considerably as early volumes have grown. 2010 Winter Olympics fuel cell buses cost \$2m per bus for a fleet of 20. For the 25 New Flyer FCEBs currently being built for 3 California transit agencies, the cost per bus is \$1.235m. New Flyer estimates that a production run of 100 buses will reduce the cost to \$850,000 per bus.

Fuel Cell Electric Bus (FCEB) Fact Sheet from CHBC and California Fuel Cell Partnership:

https://www.californiahydrogen.org/wpcontent/uploads/2017/10/CHBC-CaFCP-Fuel-Cell-Electric-Bus-Fact-Sheet.pdf



Fuel Cell Electric Bus Technology: Technical Capabilities and Experience



Takeaways

- Hydrogen fueling infrastructure is versatile and easily scaled-up as more FCEBs are integrated in the fleet.
- Station developers work with transit agencies to find the best solution for the existing depot footprint.
- Hydrogen can be produced onsite through steam methane reformation or electrolysis. Fuel can also be delivered from a central production facility.
- One hydrogen station can fuel 1 to 100s of buses, offering similar operations and logistics to current diesel and CNG buses.
- If you missed the first three webinars, the recordings are available here: <u>https://caltransit.org/events/webinars/fuel-cell-technology-a-four-part-series/</u>

Events



- Fuel Cell Freight Webinar (July 31)
- Policy Summit Sacramento (August)

 Enabling Deep Decarbonization with Utility-Scale
 Hydrogen Energy Storage Workshop - San Francisco (Sept./Oct 2019)

 The Other Electric Bus: Meeting California's Innovative Clean Transit Regulation with Fuel Cell Technology Workshop (November 2019)

 Hydrogen & Fuel Cell Ports Briefing -POLB & POLA (November 2019)

Stay Informed: <u>https://www.californiahydrogen.org/chbc-events/</u>







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California Fuel Cell Electric Bus Tour 2019

A city-to-city tour across Northern and Southern California, showcasing fuel cell electric buses and their advantages to transit agencies.

- Bus test drives
- Static displays of buses
- Fueling demonstrations
- Preventative maintenance workshops

CaFCP

Fuel Cell

Bus Tour

2019

Reserve a spot for your agency on the tour! Contact Juan Contreras <u>icontreras@cafcp.org</u>, 916-371-2792





Thank You!

Emanuel Wagner

+1 (310) 455-6095 x360

ewagner@californiahydrogen.org

Join us!

www.californiahydrogen.org

Fund the Fleet: Funding Mechanisms to Assist and Accelerate ZEB Deployment

California Hydrogen Business Council July 11, 2019

Erik Bigelow Sr. Engineering Consultant

Center for Transportation and the Environment



About CTE



- **Mission:** To advance clean, sustainable, innovative transportation and energy technologies
- **501(3)(c) non-profit** engineering and planning firm
- Portfolio >\$500 million
 - Research, demonstration, deployment
 - 86 Active Projects Totaling over \$300 million
- Focused on Zero-Emission Technologies
- National Presence

Atlanta, Berkeley, Los Angeles, St. Paul

Zero-Emission Projects





ZEB Planning Projects
ZEB Deployment Projects

FCEBCC Program

TRANSIT



- Fuel Cell Electric Bus Commercialization Consortium (FCEBCC)
 - AC Transit and OCTA 0
 - \$45 million 0
 - 20 Buses \cap
 - **Two Stations** \cap
 - Facility Upgrades 0

• Next Step **100-Bus Initiative**









OCTA Fuel Cell Bus Deployment

- Orange County Transportation Authority
 - 10 Buses 40' Fuel Cell Electric \bigcirc
 - 40' Buses delivered under \$1.2M each Ο
 - Station Installation \$4.7M station ; \$0.4M utility work 0
 - Facility Upgrade for hydrogen \$1M for 250 bus facility 0



















MTD Fuel Cell Bus Deployment

- Champaign Urbana MTD Fuel Cell Bus Deployment
 - o 2x 60' Fuel Cell Electric Buses
 - About \$1.5M each
 - \circ $\;$ Hydrogen station with Electrolysis production on site
 - o RFP currently out for bid
 - Facility Upgrades
 - Estimate complete, but to be bid soon





100-Bus Initiative





NEED

Transit agencies will need **both** Battery-Electric and Fuel Cell Electric Buses (FCEBs) to meet the California Air Resources Board goal of 100% zero emission buses by 2040.

OBJECTIVE

Drive down the capital cost of North American FCEBs to the point where they are commercially viable for transit properties seeking zero-emission solutions — \$850,000/bus.

ACTION

Four or more transit agencies in northern and southern California, **purchasing up to 25 FCEBs** each, and installing hydrogen fueling stations and facility upgrades where needed.

Driving Price Down



Fuel Cell Bus Costs are Declining with Technology Advancements and Manufacturing Volume

Source: New Flyer Industries



Low or No Emission Grant Program July 11, 2019

Tara Clark Program Manager





U.S. Department of Transportation Federal Transit Administration

Program Description

The Low-No Program (5339(c)) provides funding for the purchase or lease of zero-emission and low-emission transit buses as well as for the acquisition, construction or leasing of supporting facilities and equipment. To date, approximately \$194 million has been awarded for 123 projects across the country.

The Low-No Program is unique in its support of the deployment of advanced technology vehicles.





Lextran FY 2016 Low-No Recipient

Eligibility Information

Eligible Applicants

 Designated Recipients, States, local governmental authorities or federally recognized Indian Tribes are eligible to submit proposals for this program.

Cost Sharing or Matching

- Vehicles are eligible for a maximum 85% Federal/15% non-Federal match.
- Low or no emission bus related equipment or facilities are eligible for a 90% Federal/10% non-Federal match.



Eligibility Information

Eligible Projects

- Purchase or lease of low or no emission buses
- Acquiring low or no emission buses with a leased power source
- Constructing or leasing facilities and related equipment for low or no emission buses
- Rehabilitating or improving existing facilities to accommodate low or no emission buses
- Workforce development



Low-No Competitions

	2016	2017	2018	2019
Amount Available	\$55 million	\$55 million	\$84.49 million*	\$85 million*
Proposals Received	101 from 32 states	131 from 40 states	151 from 42 states	157 from 38 states and DC
Total Requested	\$446 million	\$515 million	\$558 million	\$500 million
Funded Projects	20	51	52	TBD

*Congress added additional funds in the appropriations bills for FY 18 and FY 19



Other FTA Programs

- Urbanized Area Formula Program (Section 5307)
- Rural Formula Program (Section 5311)
- Buses and Bus Facilities Formula Program (Section 5339(a))
- Buses and Bus Facilities Competitive Program (Section 5339(b))



Questions?

Tara Clark

Federal Transit Administration

Phone: 202-366-2623

Email: tara.clark@dot.gov

https://www.transit.dot.gov/funding/grants/lowno







CALIFORNIA HUP

FC11

SunBus

Hydrogen Bus Voucher Incentives

HYDROGEN FUEL CELL Powering A Clean Tomorrow - Today



What is HVIP?

Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project

- First-come, first-served vouchers Immediate discount at sale
- **Dealers learn voucher system** Fewer complications for fleets
- Set aside funding for each voucher Price certainty. No scrappage.
- New and retrofits; electric, hybrid, fuel cell, EPTO, Low-NOx natural gas
- 7,000 + vouchers, 1,000 fleets, 9 years



Zero-Emission Truck Voucher Amounts

	Base Vehicle Incentive		
	1 to 100 v		
GVWR (lbs)	Outside Disadvantaged Community	In Disadvantaged Community	>100 vehicles
5,001 - 8,500	\$20,000	\$25,000	\$12,000
8,501 - 10,000	\$25,000	\$30,000	\$18,000
10,001 - 14,000	\$50,000	\$55,000	\$30,000
14,001 – 19,500	\$80,000	\$90,000	\$35,000
19,501 – 26,000	\$90,000	\$100,000	\$40,000
26,001 - 33,000	\$95,000	\$110,000	\$45,000
>33,000	\$150,000	\$165,000	\$70,000
Hydrogen Fuel Cell Electric Truck	\$300,000	\$315,000	\$142,000

1 - The first three vouchers received by a fleet, inclusive of previous funding years, are eligible for the following additional funding amount: \$2,000/vehicle if below 8,501 lbs; \$5,000/vehicle if 8,501 to 10,000 lbs; and \$10,000/vehicle if over 10,000 lbs.

Can combine incentives, to cover up to 100% of vehicle cost for public fleets, 90% for private fleets

Zero-Emission Transit Bus Voucher Amounts

	Base Vehicle Incentive			
	1 to 100			
Bus Length and Bus Type	Outside Disadvantaged Community	In Disadvantaged Community	>100 vehicles	
20 ft – 24 ft	\$80,000	\$90,000	\$35,000	
25 ft – 29 ft	\$90,000	\$100,000	\$40,000	
30 ft – 39 ft	\$120,000	\$135,000	\$55,000	
40 ft – 59 ft	\$150,000	\$165,000	\$70,500	
≥ 40 ft. Double Decker Bus	\$175,000	\$190,000	\$82,250	
≥ 60 ft. Zero-Emission Battery- Electric Articulating Transit Bus	\$175,000	\$190,000	\$82,250	
≥ 40 ft. Hydrogen Fuel Cell Electric Bus	\$300,000	\$315,000	\$142,500	

1 - The first three vouchers received by a fleet for transit buses, inclusive of previous funding years, are eligible for the \$10,000/vehicle in additional funding amounts.

Case-by-Case Consideration for Smaller Vehicles

- Effective October 2018, CARB will consider **additional funding categories for smaller vehicles** as they become commercially available.
- The approach would create a tiered allocation based on length and GVWR, with an interim system for case-by-case approval of voucher amounts until price data is available for commercial vehicles using hydrogen fuel cell technologies.
- Voucher amounts would be lower for vehicles that supplement fuel cell power with either combustion or plug-in range extenders.

Eligible Hydrogen Vehicles

NEW FLYER FUEL CELL ELECTGRIC XHE40/XH60 TRANSIT BUS (not pictured) OEM: New Flyer VEHICLE INCENTIVES: \$300,000 MODEL YEAR: 2019 LENGTH: 40 / 60 foot DEALER: New Flyer of America



AXCESS 40 FT FUEL CELL HYBRID TRANSIT BUS OEM: El Dorado National VEHICLE INCENTIVES: \$300,000 MODEL YEARS: 2018-19 DEALERS: Creative Bus Sales, El Dorado National CA



AXESS 35 FOOT FUEL CELL HYBRID TRANSIT BUS

OEM: El Dorado National VEHICLE INCENTIVES: \$120,000 MODEL YEARS: 2018-19 DEALERS: Creative Bus Sales, El Dorado National CA

First H2 Order in HVIP

SunLine Transit Agency deployed the first HVIP-funded hydrogen fuel cell buses this year.

HVIP vouchers reduced the price of the 5 buses by **\$300,000 per vehicle.**

SunLine's clean fleet now numbers over **75 alternative-fuel buses.**



Infrastructure Voucher Enhancements

H2 infrastructure: Up to **\$100,000** available in equipment costs for each fuel cell vehicle voucher; covers real costs of equipment

- Must have at least 5 vehicle vouchers
- Infrastructure cost can't be already covered by other public funding
- Approved on a case-by-case basis by CARB/CALSTART (info@californiahvip.org)



Tarah Campi, HVIP Program Manager

HVIP's Toll-Free Hotline Available Mondays to Fridays, 9 a.m. – 5 p.m. 1-888-HVIP or 1-888-457-4847 or Email us at: **info@californiahvip.org** Visit: **CaliforniaHVIP.org**



Low Carbon Fuel Standard and Hydrogen Fuel Cell Electric Buses July 11, 2019

CARB's Mission

- Leads California's fight against air pollution and climate change
- Protects public health
- Promotes clean, energy-efficient fuels and technology



Low Carbon Fuel Standard (LCFS) History

- State's primary program to promote alternative fuel use
- Original adoption in 2009, amended in 2018 to strengthen targets through 2030
- Goal: Reduce carbon intensity (CI) of transportation fuels
- Expected benefits:
 - Reduce greenhouse gases
 - Transform and diversify fuel pool
 - Reduce petroleum dependency
 - Reduce emissions of criteria pollutants and toxics





How Does LCFS Work?



* Negative CIs have been achieved for some fuel pathways but are not shown. ** The average percent carbon intensity (CI) reduction for electricity shown represents Light-Duty Electric Vehicle charging.

Opportunities for Hydrogen in LCFS

- Who is eligible to generate LCFS credits?
 - Owner of fueling supply equipment (FSE) used for dispensing hydrogen are default credit generator
 - Including FCEV bus fleet operator if they also own the FSE

The default credit generator can designate a third-party to act on its behalf



Key Steps for Participating in the LCFS



Step 4 Complete quarterly reporting for credit issuance

* https://ssl.arb.ca.gov/lcfsrt/Login.aspx

** See FSE registration guidance on website: <u>https://ww3.arb.ca.gov/fuels/lcfs/guidance/lcfsguidance_19-04.pdf</u>



Step 3: Obtain a Fuel Pathway Carbon Intensity through AFP*

or

Lookup Table Application (Default Pathways)

- Pre-defined representative life-cycle assumptions**
- Streamlined application process with additional requirements for renewable hydrogen***
- Limited verification requirements

Tier 2 Application (Customized Pathways)

- User-defined inputs throughout
- Detailed application
 process
- Verification required for user-defined inputs

* <u>https://ssl.arb.ca.gov/lcfsrt/Login.aspx</u>

- ** Documentation for Lookup Table pathway assumptions available on LCFS website: <u>https://www.arb.ca.gov/fuels/lcfs/ca-greet/lut-doc.pdf</u>
- *** See Hydrogen Lookup Table Checklist on LCFS website: https://www.arb.ca.gov/fuels/lcfs/fuelpathways/h2lut.xlsx

Tier 2 Hydrogen Pathways



Key:

Applicant

CARB Staff

CARB Staff (2019) or Third-Party Verifier (2020)

ACARB

Applications must include, at a minimum (not limited to):

- Completed CA-GREET3.0 model
- Life cycle analysis report
- Supporting documentation for all user-defined inputs
- Attestation letter

Step 4: Reporting and Credit Generation

- Credits are generated based on fuel pathway carbon intensity, quantity of fuel dispensed and vehicle type
- Owner of hydrogen dispensing equipment reports fuel transactions in the LRT and generates credits on a quarterly basis
 - Can designate another party to report fuel transactions and generate the credits
- Credits can then be banked or sold to other parties participating in the program



Potential LCFS Credit Revenue for Hydrogen

Fuel Production Technology	Feedstock	Example Carbon Intensity	Fuel Displacement Multiplier	Potential LCFS Credit Revenue
	Fossil natural gas	117.67 gCO2e/MJ	1.9	\$1.57/DGE
Steam Methane	Biomethane from landfills	99.48 gC02e/MJ	1.9	\$2.03/DGE
Reformation	Biomethane from dairy/swine manure	-300 gCO2e/MJ	1.9	\$12.24/DGE
Flootrobusio	CA grid electricity	164.46 gC02e/MJ	1.9	\$0.37/DGE
Electrolysis	Zero-CI electricity	10.51 gCO2e/MJ	1.9	\$4.30/DGE



Note: assumes \$190/credit, the average for June, 2019



THANK YOU

Contacts:

Application questions: Jordan Ramalingam, <u>Jordan.Ramalingam@arb.ca.gov</u> Reporting/crediting questions: Arpit Soni, <u>Arpit.Soni@arb.ca.gov</u>



California Mitigation Trust

Administered statewide by:

South Coast Air Quality Management District Bay Area Air Quality Management District San Joaquin Valley Air Pollution Control District

VW Mitigation Trust Funding for California



\$130M Total \$65M in 2019

Zero-Emission Transit, School, and Shuttle Bus





Zero-Emission Transit, School, and Shuttle Buses

TEMISSIONS ELECTRIC BUS

8200



San Joaquin Valley



Zero-Emission Transit, School, and Shuttle Buses Key Points





Zero-Emission Transit, School, and Shuttle Buses Eligible Projects and Funding Amounts

\$65M to Replace Class 4-8 School, Transit and Shuttle Buses

School Buses

Transit Buses

Up to \$400,000

To replace an eligible school bus with new, commerciallyavailable, zero-emission technology

Up to \$180,000

For a new, commercially-available, battery-electric bus

Up to \$400,000

For a new, commercially-available, fuel-cell bus

Shuttle Buses

Up to \$160,000

To replace an eligible shuttle bus with new, commerciallyavailable, zero-emission technology

- ✓ Total funding for this category is \$130 million, with the initial \$65 million increment available in 2019
- ✓ No more than 50% of available funds in each increment will be allocated to a single bus category
- ✓ Total cost per vehicle must not exceed 75% for non-government owned and 100% for government owned vehicles
- ✓ Stacking of VW funds with HVIP and other CARB funds not allowed



Grantee Reporting and Operational Requirements

	Inspections	Make old and new engine / vehicle available for inspection
0	Operations	Operate the "grant-funded" engine / vehicle in accordance with the contract
	Payment	Submit request for grant funds AFTER receiving award and completing project
	Reporting	Submit annual reports for the term of the contract (expected 3 years)
3	Scrapping	Scrap an older engine / vehicle and replace it with the "grant-funded" engine / vehicle



Zero-Emission Transit, School, and Shuttle Buses Tentative Schedule





Contact Us



vwbusmoney.valleyair.org/

https://ww2.arb.ca.gov/ourwork/programs/volkswagen -environmental-mitigationtrust-california



Alameda-Contra Costa Transit District Fuel Cell Bus Program

Funding Mechanisms for ZEB Deployment at AC Transit

July 11, 2019



actransit.org

Our major hydrogen production and fueling facilities

- D2 Emeryville 2010 to present
 - Solar Powered Electrolyzer (65kh/day)
 - Currently undergoing major upgrade to increase fueling capacity and efficiency
- D4 Oakland 2014 to present
 - Solar Powered Electrolyzer (65kg/day)





Hydrogen Bus Fleet

- 2003-2006
 - 1 x 30ft Thor
- 2006-2010
 - 3 x 40ft VanHool A330
- 2010-present
 - 13 x 40ft VanHool A300
- 2019-future
 - 10 x 40ft New Flyer
 - 1 x 60ft New Flyer











How we funded past projects 2005-2015

- Construction of two hydrogen fueling stations
- Current 13 Fuel Cell buses in service

Agency Level	Agencies	Amount/Value
Federal	FTA, DOE	\$20 million
State	Caltrans, CARB, CEC	\$19 million
Regional	BAAQMD, VTA, SamTrans, Golden Gate Transit	\$13 million
Local	PG&E, MTC	\$11 million
	TOTAL	\$63 million











California Environmental Protection Agency





How we're funding current projects 2016-2019

MANAGEMENT

DISTRICT

- Emeryville station upgrade
- Next 10 Fuel Cell buses
- Consortium with OCTA (add'l 10 buses)

Agency Level	Agencies	Amount/Value
State	CARB (AQIP program)	\$7.4 million
Regional	BAAQMD, MTC	\$6 million
Local	District funds	\$2.6 million
	TOTAL	\$16 million
		BAY AREA AIR QUALITY





How we're funding our future projects 2019 - 2021

- 45 Zero Emission Buses (mix of fuel cell and battery electric)
 - Currently in planning phase
 - Full design and construction for fueling/charging facilities

Agency Level	Agencies	Amount/Value
Federal	Formula Funds	\$17.5 million
State	CARB (TIRCP program), SB1 LPP, HVIP	\$37 million
Regional	MTC (RM3)	\$6 million
Local	AC Transit Match (TBD)	\$7.5 million
	TOTAL	\$68 million

California Environmental Protection Agency





Fitting them all together

- Bus purchase
 - What is the "incremental" need above base cost of the diesel or hybrid bus you would have purchased?
 - What can fund that increment?
 - HVIP
 - LCTOP, Air Districts, VW Mitigation Trust
- Funding the fueling station



Funding challenges

- Funding for
 - Planning and design phases
 - Maintenance training for new technologies
 - Battery and/or fuel cell replacement at half life?
- Grant management
- Educating the grantors and auditors all learning from one another as we go along
- Operational costs





Thank You!

For further Information:

Chris Andrichak

Director of Budget and Management AC Transit

candrichak@actransit.org

Eve Ng Capital Planning and Grants Manager AC Transit eng@actransit.org



actransit.org

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Michael Pimentel Legislative & Regulatory Advocate 916-446-4656 x1034 michael@caltransit.org



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