

# The Growing Market for Fuel Cell Buses – Commercialization Status



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# About CTE



- **Who We Are: 501(3)(c) non-profit** engineering and planning firm
- **Our Focus: Zero-Emission** Transportation Technologies
- **Our Mission:** Improve the **health of our communities and the planet**
- **Portfolio - >\$1.2 billion; 115 Active Projects** totaling over **\$365 million**
- **National Presence**  
Atlanta, Berkeley, Los Angeles, Minneapolis/St. Paul

# 101 CTE Members



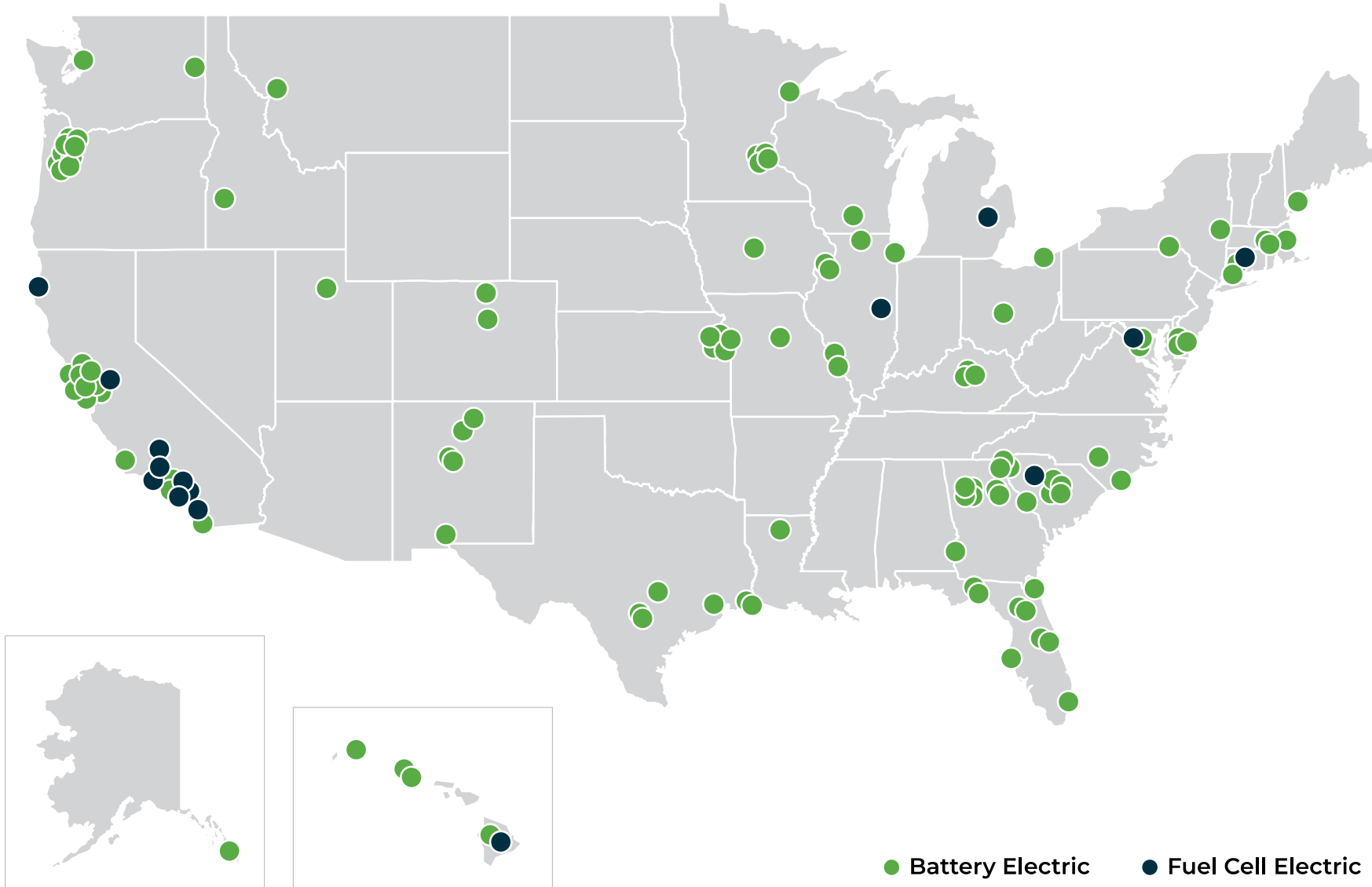
## Leadership Circle Members



## Members



# CTE Projects



# Hydrogen Fuel Cell Projects

## CTE has supported 40+ hydrogen based projects over the past 30 years

- **AC Transit** FCEB Support (13 FCEBs)
- **AC Transit** and **OCTA** FCEB (\$45 million – 20 buses)
- **Champaign-Urbana** FCEB deployment, electrolysis hydrogen refueling station and full facility modifications for indoor parking and maintenance
- **SamTrans** FCEB Deployment (10 FCEBs)
- **Winnipeg** Hydrogen Fueling Station – Electrolyzer
- **Foothill Transit** Fueling Station
- **North County Transit District Fueling Station**
- Fuel Cell Electric **Class 8 Drayage** Truck (Kenworth)
- Fuel Cell **UPS Class 6** Delivery Van (2 deployments)
- Transit Fuel Cell Electric **Top Loader** – POLA (Hyster-Yale)
- **NorCal Zero Class 8 Trucks** and Infrastructure (Hyundai)

2023



2018



2018



2019



2023

# NorCAL ZERO – 30 Class 8 Fuel Cell



- Range – 400 to 500 mi
- GVWR – 82,000 lbs.
- Payload – 39,000 lbs.



# California FCEB Deployments



## Innovative Clean Transit Regulation

2018 – 3 Transit Agencies

2022 – 23 Transit Agencies

**2023 – 41 Transit Agencies with FCEBs**

- 2021: 56 Buses
- 2022: > 100
- **2030: > 1,000**
- 2035 : > 3,000
- 2040 : >5,000 (50% FCEB)

# ARCHES – 1,000-Bus Initiative





# FCEB Advantages

**300-350  
miles**

Proven  
range



Significant  
reduction in  
vehicle weight

(carry more  
passengers)



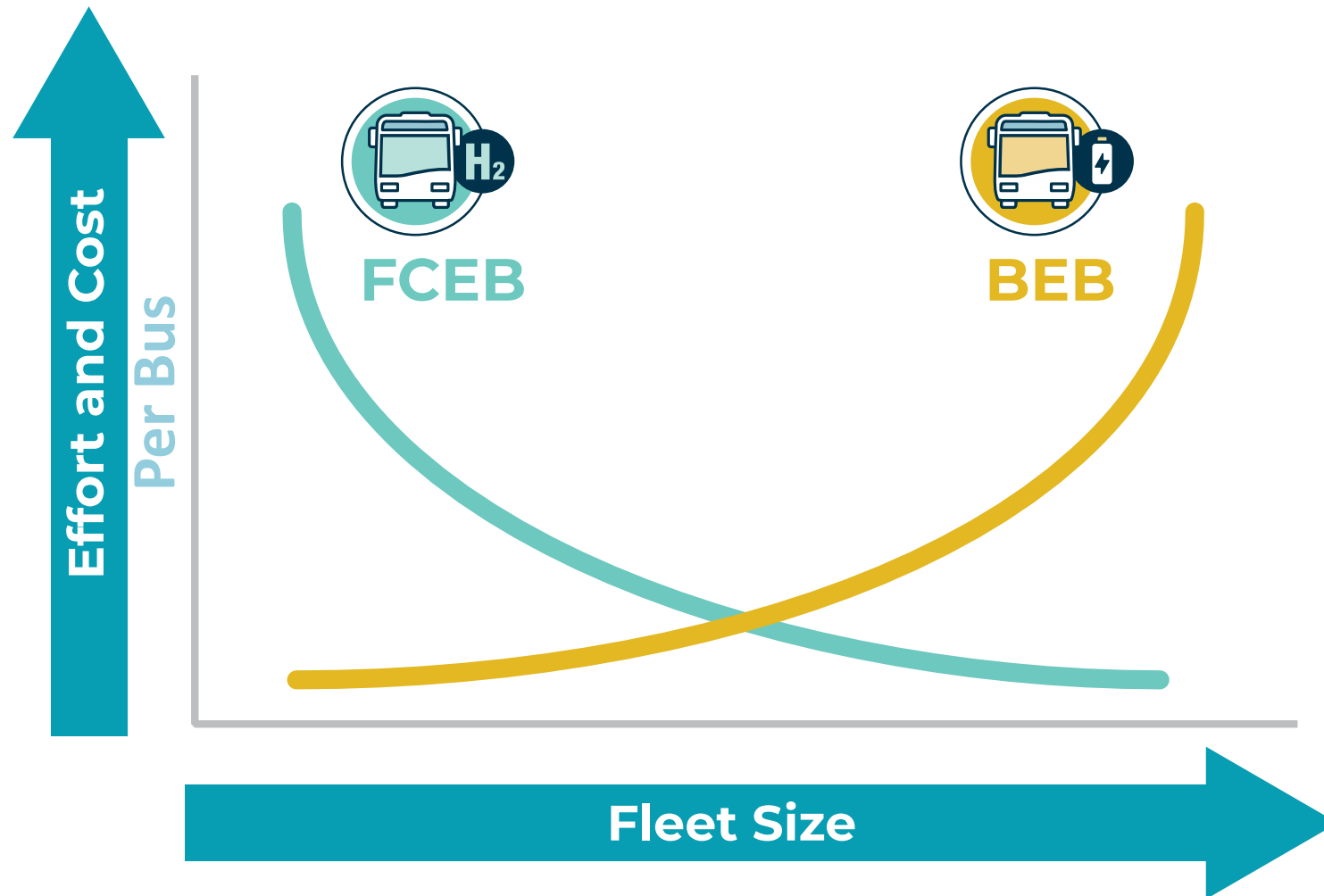
Rapid refueling  
speeds

(6 to 10 minutes)



**1:1**  
replacement of  
conventional  
vehicles

# ZEB Infrastructure Costs



- FCEB: High initial cost for H2 fueling stations can be leveraged over many buses in larger fleets
- BEB: More equipment and infrastructure is needed to support larger fleets

# 3+ H2 Fuel Challenges

1. **SUPPLY** (Reliability)
  2. **ACCESS** (Location, Reliability, Speed)
  3. **PRICE**
- + **GREEN SOURCING**  
(Renewable Feedstock and CI of Zero)



NorCAL ZERO



Foothill Transit



OCTA



AC Transit

# Fuel Suppliers & Station Providers

## Fuel Suppliers

1. Air Liquide (Las Vegas)
2. Air Products (Sacramento/Los Angeles)
3. Linde (Ontario, CA)
4. Plug Power (Fresno)
5. **ARCHES Fuel Supply**

## Station Providers

1. Air Products
2. Air Liquide
3. Chevron
4. Clean Energy
5. FirstElement Fuel
6. HTEC
7. Linde
8. Messer
9. Nikkiso
10. Plug Power
11. Trillium

# California ZEV Regulations



- ❖ 2018 Innovative Clean Transit
- ❖ 2020 Advanced Clean Truck (Sales)
- ❖ 2023 Advanced Clean Fleet (Purchases)



# Revenue Incentives – \$25B



Auction Quarter or Fiscal Year	Proceeds to Investor-Owned Utilities	Proceeds to Publicly Owned Utilities	Proceeds to California
<b>TOTAL</b>	<b>\$13,311,082,055.50</b>	<b>\$2,012,762,183.55</b>	<b>\$25,552,539,984.77</b>

Transit Programs	Source	FY 2024 Allocation	Application	Allocation Formula
<b>Formula</b>	Federal	\$633 million	Buses	Population Based
<b>Buses and Facilities</b>	Federal	\$394 million	Buses and <u>Facilities</u>	Competitive
<b>LowNo Emissions</b>	Federal	\$1.124 billion	Buses and <u>Facilities</u>	Competitive
<b>H2 Production Tax Credits</b>	Federal	Up to \$3/kg	Fueling Stations	TBD
<b>Heavy-Duty Vouchers</b>	California	\$240,000/Bus	Buses	1st Come, 1st Served
<b>VW Mitigation Funding</b>	California	\$380,000/Bus	Buses	1st Come, 1st Served
<b>EnergIIZE</b>	California	\$3 million/Project	Stations	Competitive
<b>LCFS Credits</b>	California	\$75/MT	Stations	Depends on Pathway

Truck Programs	Source	FY 2024 Allocation	Application	Allocation Formula
<b>CARB Pilot Demonstrations</b>	California	Variable	Class 8 Trucks	Competitive Grants
<b>CEC HRS Demonstrations</b>	California	Variable	HD H2 Refueling	Competitive Grants
<b>Air Districts and Counties</b>	California	Variable	Trucks	Competitive Grants
<b>H2 Production Tax Credits</b>	Federal	Up to \$3/kg	Fueling Stations	TBD
<b>Heavy-Duty Vouchers</b>	California	\$240,000/Truck	Class 8 Trucks	First Come, First Served
<b>VW Mitigation Funding</b>	California	\$90 Million	Class 8 and Drayage	First Come, First Served
<b>EnergIIZE</b>	California	\$3 million/Project	Stations	Competitive
<b>Clean Vehicle Tax Credit</b>	Federal	Up to \$40k/Truck	Trucks	TBD
<b>Federal Highway Admin</b>	Federal	Variable	Trucks and Stations	TBD
<b>EPA</b>	Federal	Variable	Trucks and Stations	TBD

# Fuel Cell Fire Trucks?

