



# **Electrifying State Light-Duty Fleets & Transit**

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**Amanda Graor, Chief Innovation Officer,  
Mid-America Regional Council**

**#WeTheStates**



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**Ryan Daley, CEO, Sawatch Labs**

**#WeTheStates**



# Data Driven Fleet Electrification & Optimization

NGA North Central Transportation Electrification Workshop  
April 29, 2019





# Sawatch Labs Approach

## Telematics



## Analytics



## Compliance

## Management



# EV Suitability Assessment

myGEOTAB

Getting Started & Help

Dashboard

Map

Vehicles

Activity

ezEV - Sawatch Grp

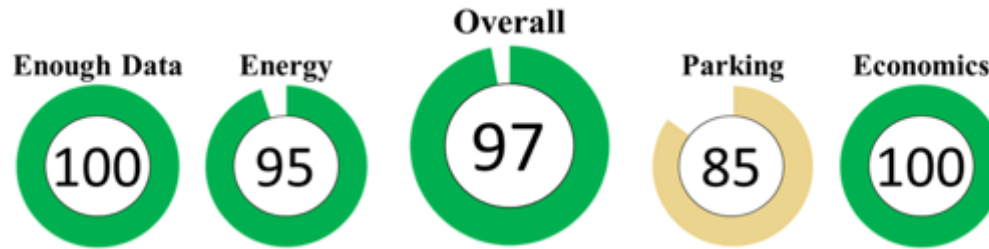
Engine & Maintenance

Zones & Messages

Rules & Groups

Administration

Marketplace



## Estimated Operational Metrics in a 2018 Nissan Leaf

These metrics estimate what the usage numbers would be if the miles driven by your 2008 FORD Fusion had been driven in an EV

VMT	GHG Reduction	CPM Reduction in an EV <sup>1</sup>	Operational Savings <sup>2</sup>	TCO Change <sup>2</sup>
5,350	80%	15%	\$12,000-15,000	\$6,000-9,000





# EV Management

## Are they actually...

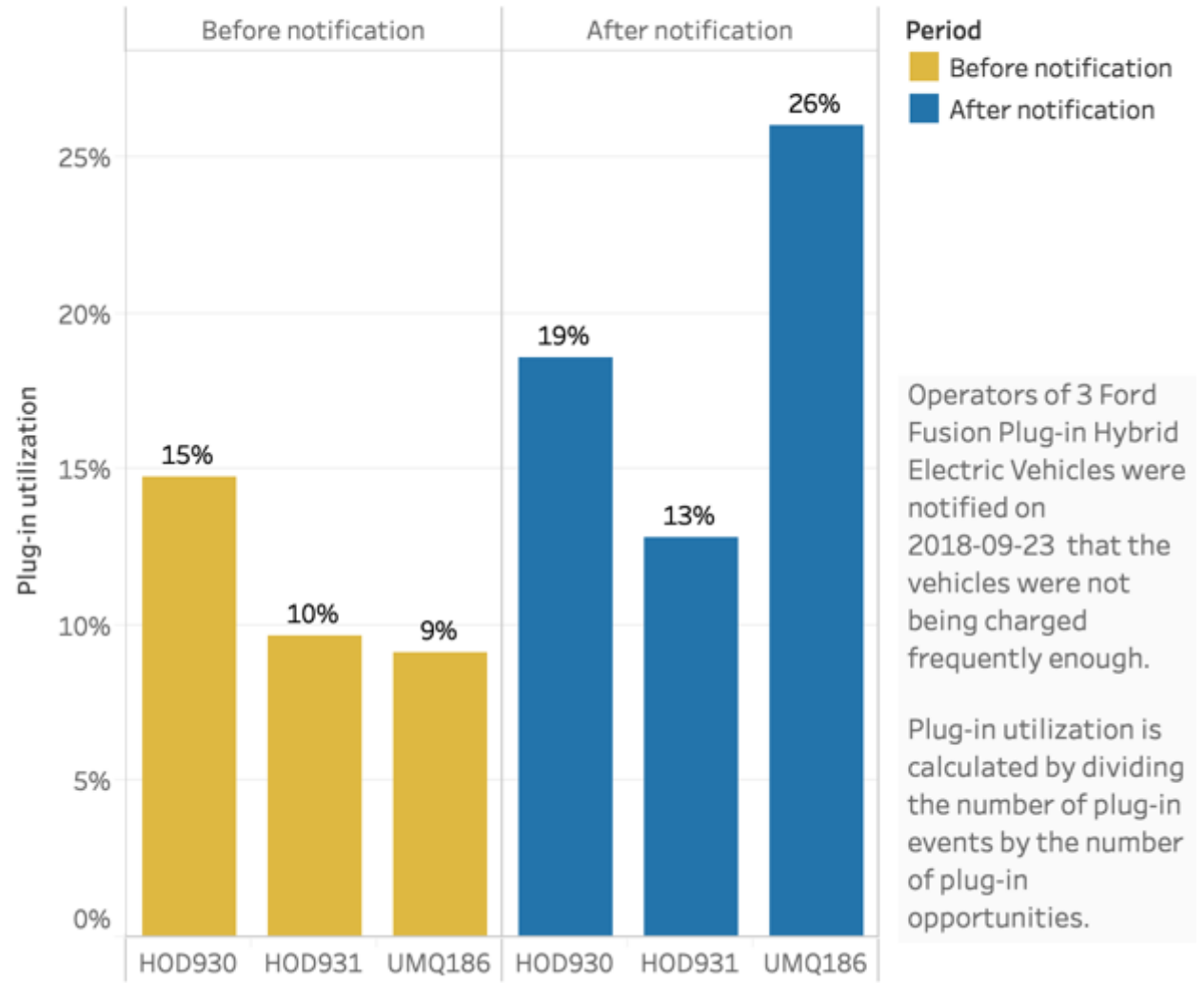
- Approaching an ROI?
- Plugging in?
- Fully charged?

## Missed Opportunities

- e-vmt > g-vmt



## PHEV charging behavior by vehicle

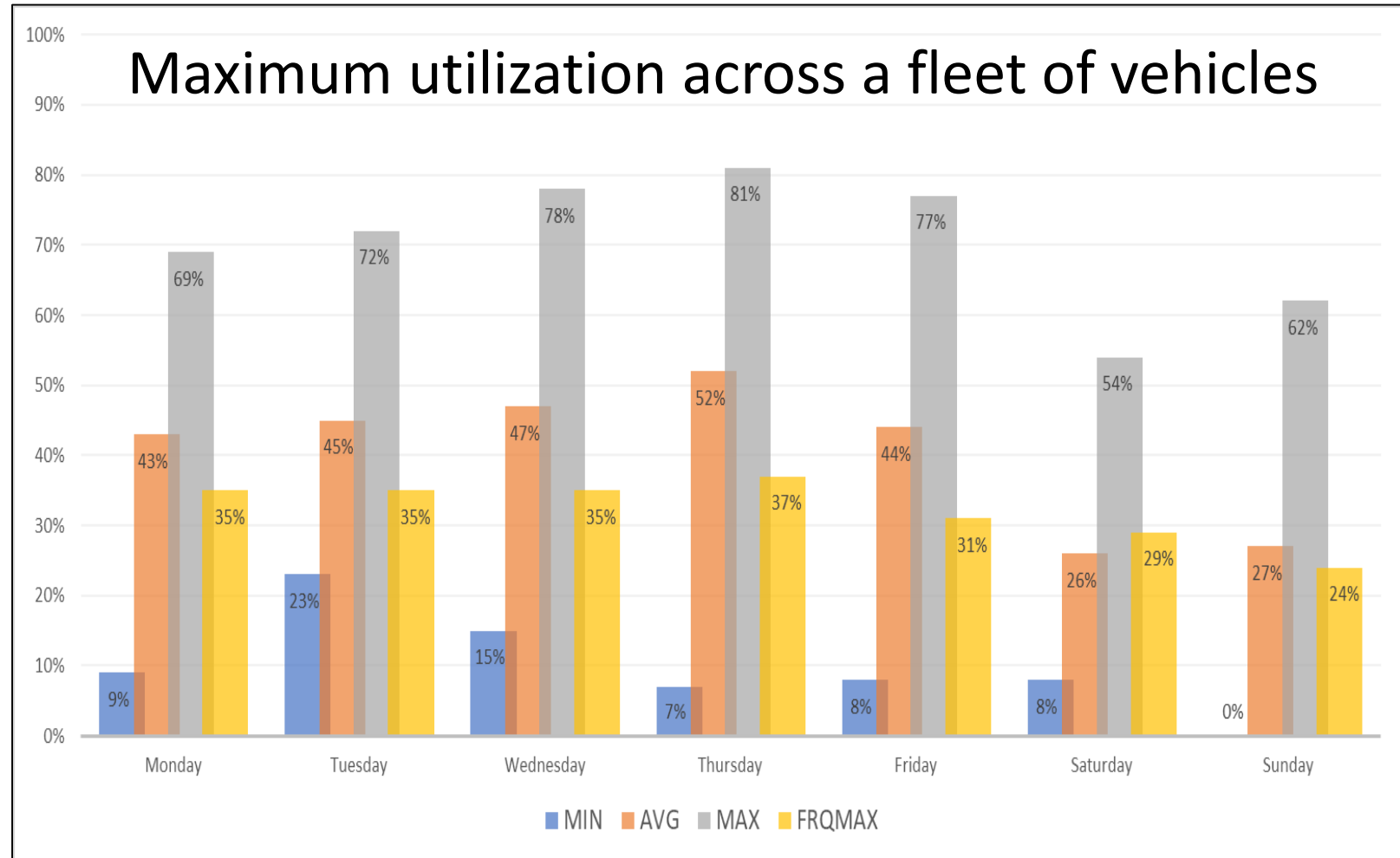




# Transportation & Mobility Management

## Employee Mobility

- Fleet Share
- Right miles on the right tech
- Right-sizing
- Multimodal
- Cost, time, sustainability





# EV Suitability Assessments with States



## Colorado Fleet Details Path to 200 EVs by 2020

February 27, 2019 • by Thi Dao



<https://www.government-fleet.com/325300/colorado-fleet-details-path-to-200-evs-by-2020>



## Utah

- 1,300 Vehicles across all state departments
- EVSE needs statewide
- Initiated 3/20/19

## Ohio

- Pilot with ODRC at correctional facilities
- 10 Vehicles
- Initiated 2/1/19





Thank You!

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# **Electrifying State Light-Duty Fleets & Transit**

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**John Walsh, Senior Vice President of  
Sales, Proterra**

**#WeTheStates**

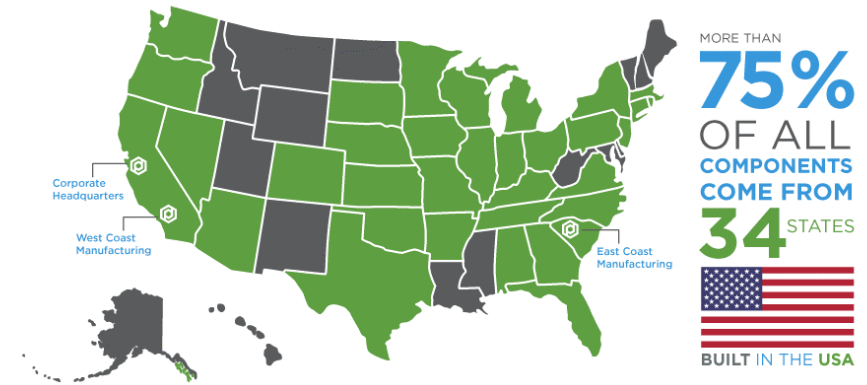
# PROTERRA: REVOLUTIONIZING TRANSIT



## Proterra's Mission

Advancing electric vehicle technology to deliver the world's best-performing heavy-duty vehicles

- Offices and manufacturing in CA and SC
- 500+ employees, with strong transportation expertise
- >90 customers; >700 vehicles sold
- >265 vehicles delivered; >7,000,000 service miles
- >39,000,000 pounds of CO2 emissions avoided



## Strong Transportation Expertise



## World-Class Financial Partners



# HIGH-QUALITY, ADVANCED MANUFACTURING FOR RAPID EV ADOPTION AT SCALE



## Burlingame, California

*Battery Manufacturing  
Company HQ*



## Los Angeles, California

*Bus Manufacturing  
West Coast Operation*

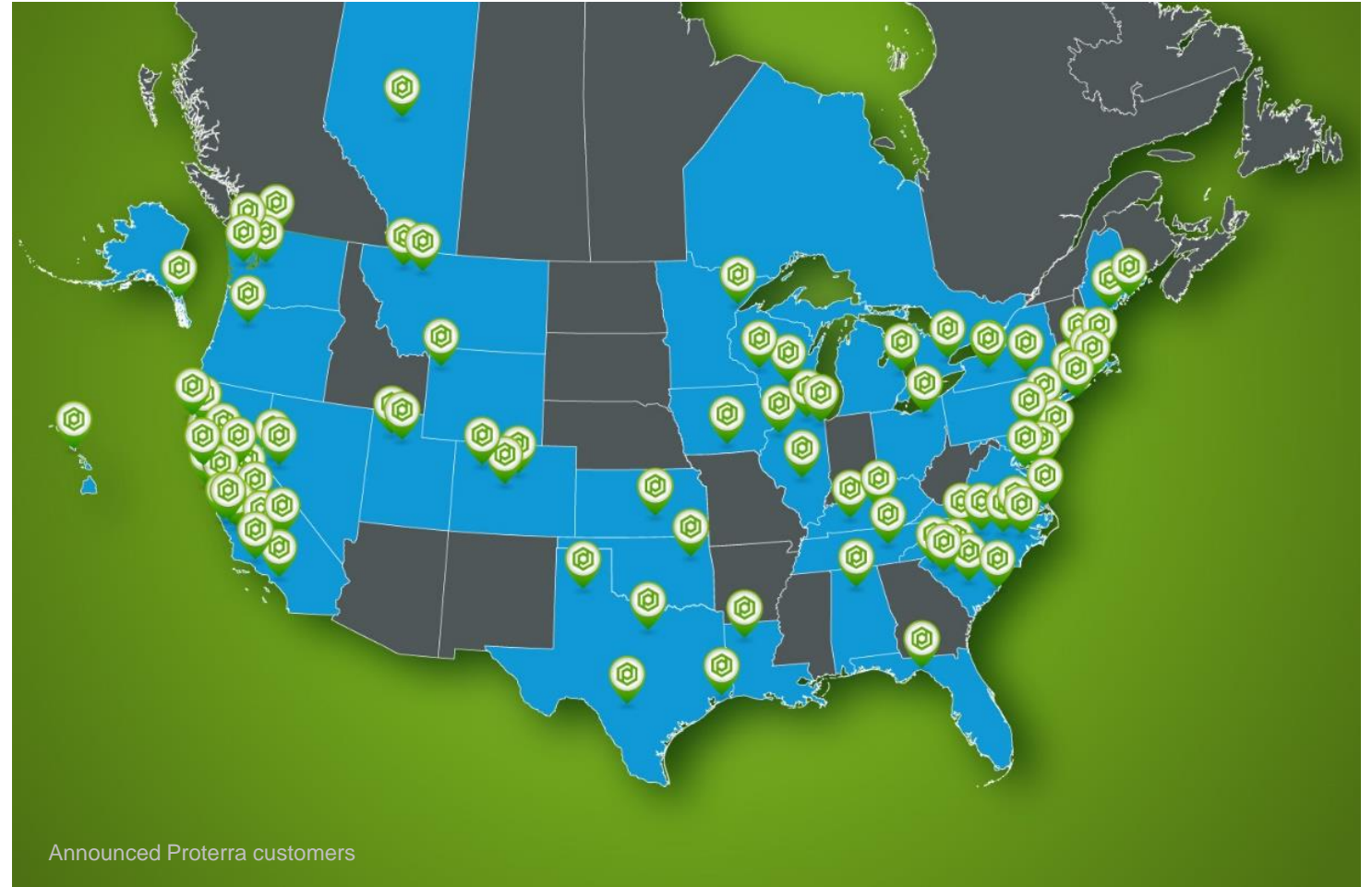


## Greenville, South Carolina

*Bus Manufacturing  
East Coast Operation*

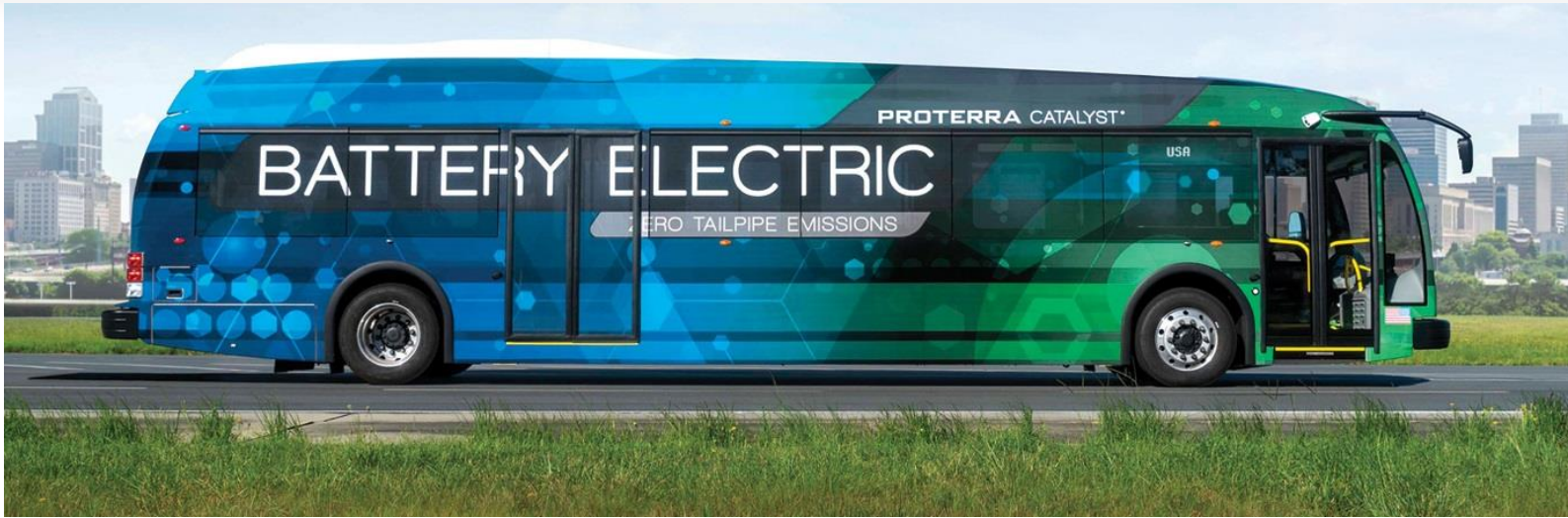
# PROTERRA CUSTOMERS IN THE CENTRAL US

- **Illinois**
  - Chicago Transit Authority (CTA)
  - Bloomington-Normal Public Transit System (Connect Transit)
  - Quad Cities METROLink
  - Jones Lang LaSalle
- **Iowa**
  - DART Des Moines
- **Kansas**
  - Wichita Transit
- **Michigan**
  - Blue Water Area Transit
- **Minnesota**
  - Duluth Transit Authority
- **Ohio**
  - Laketrans County
- **Wisconsin**
  - La Crosse MTU



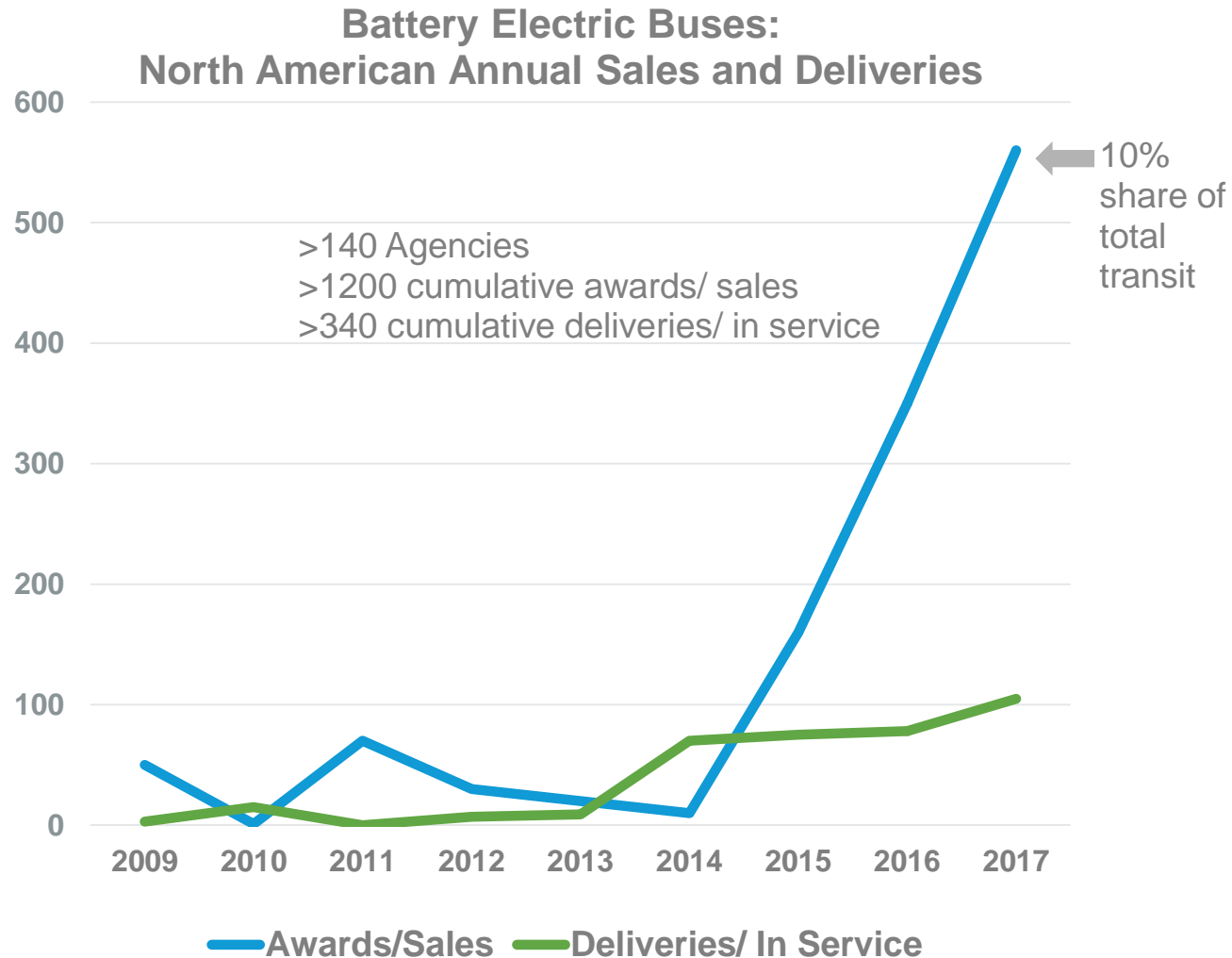
**>700 buses sold to >90 customers across 41 states/provinces**

# THE SOLUTION: REVOLUTIONARY APPROACH TO TRANSPORT



THE ONLY TRANSIT PLATFORM DESIGNED SPECIFICALLY FOR EV PERFORMANCE

- ✓ **Clean**  
100+%  
Less Tailpipe emission
- ✓ **Reliable**
- ✓ **Quiet**  
25+%  
Quieter
- ✓ **Efficient**
- ✓ **Demonstrable ROI**  
400+%  
More fuel efficient
- ✓ **Flexible and scalable**  
78+%  
Lower lifetime fuel cost



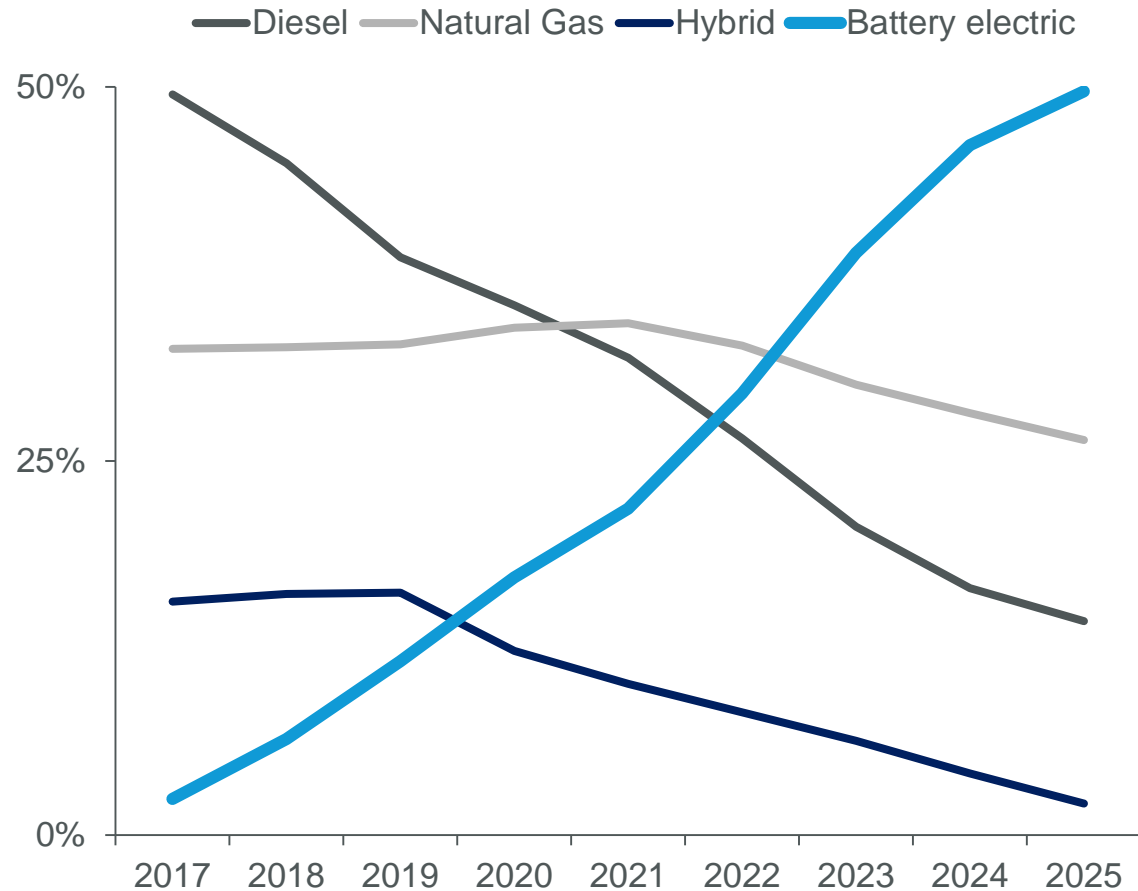
Source: CTE Center for Transportation and the Environment

- Moving toward **widespread industry adoption**
- **Purchase barriers eliminated** due to:
  - Improved range
  - Charging standardization
  - Sharp decline in battery costs
  - Service-proven performance
  - Increased total cost of ownership
  - Environmental stewardship
  - Rising health costs associated with fossil fuels
  - Government programs (e.g., grants)
  - Urbanization



## EV Transit Bus adoption continues to increase

## Major cities adopting EV technology for transit buses



Source: Frost & Sullivan Heavy Duty Transit Bus North America Powertrain Adoption Forecast

 New York <b>100% EV by 2040</b> 4,700 buses	 Chicago <b>Piloting since 2014</b> 2,100 buses	 Washington D.C. <b>100% EV by 2045</b> 1,900 buses
 Seattle <b>100% EV by 2034</b> 1,500 buses	 Philadelphia <b>Piloting since 2017</b> 1,500 buses	 Miami <b>50% EV by 2035</b> 800 buses

## California mandates 100% electric transit buses by 2040

New purchase mandates

**25%** → **50%** → **100%**

**by 2023**      **by 2026**      **by 2029**

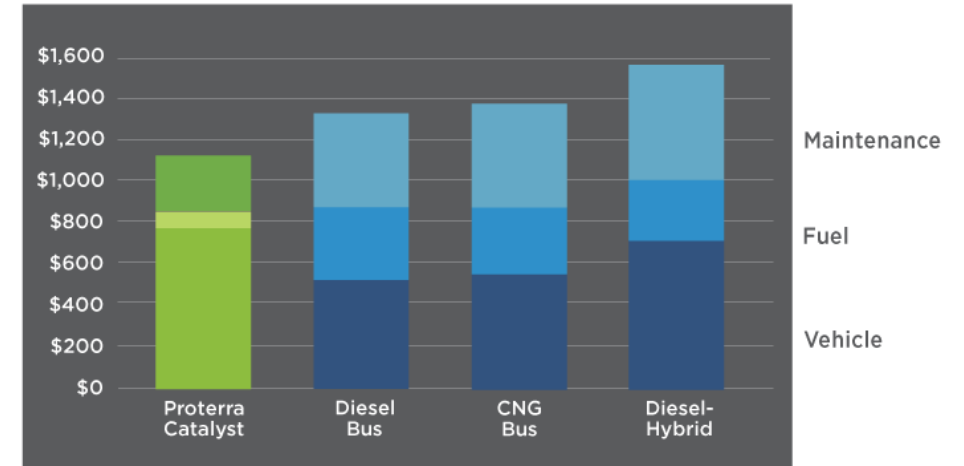
**12,000 buses across California**  
*(17% of nationwide fleet)*

Source: National Transit Database; agency websites; 2017 American Public Transportation Association Fact Book

# CATALYST 40 FT. TOTAL COST OF OWNERSHIP ADVANTAGE



	Proterra EV	Diesel Bus	CNG Bus	Diesel Hybrid
Vehicle	\$749	\$493	\$531	\$712
Energy/Fuel	\$94	\$381	\$336	\$297
Maintenance	\$275	\$450	\$500	\$550
TCO	\$1,118	\$1,324	\$1,367	\$1,559
TCO \$'s/Mile	\$2.24	\$2.65	\$2.73	\$3.12



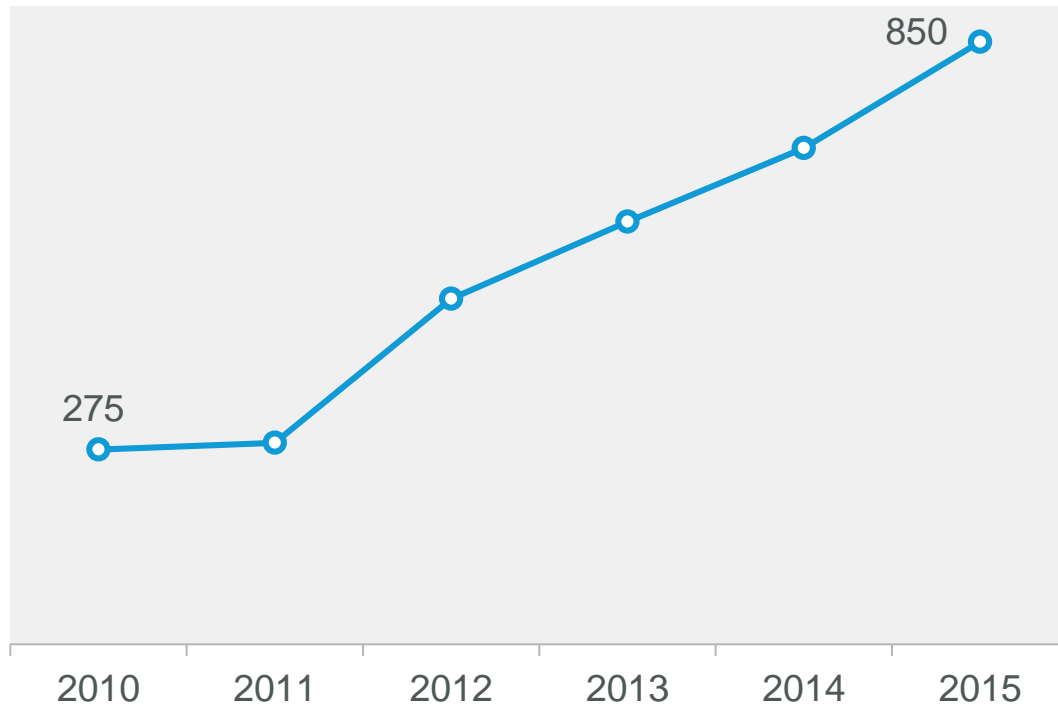
est. over 12 year lifetime / \$ in thousands, except TCO \$'s/mile

- **Battery-electric vehicles** have the **lowest operational lifecycle** cost:
  - High EV energy efficiency, low electricity rates, and high annual vehicle mileage combine to create significant fuel savings
  - **30% fewer parts** dramatically reduce maintenance and operating costs
  - Electricity prices far **more stable** and predictable than volatile fossil fuel prices

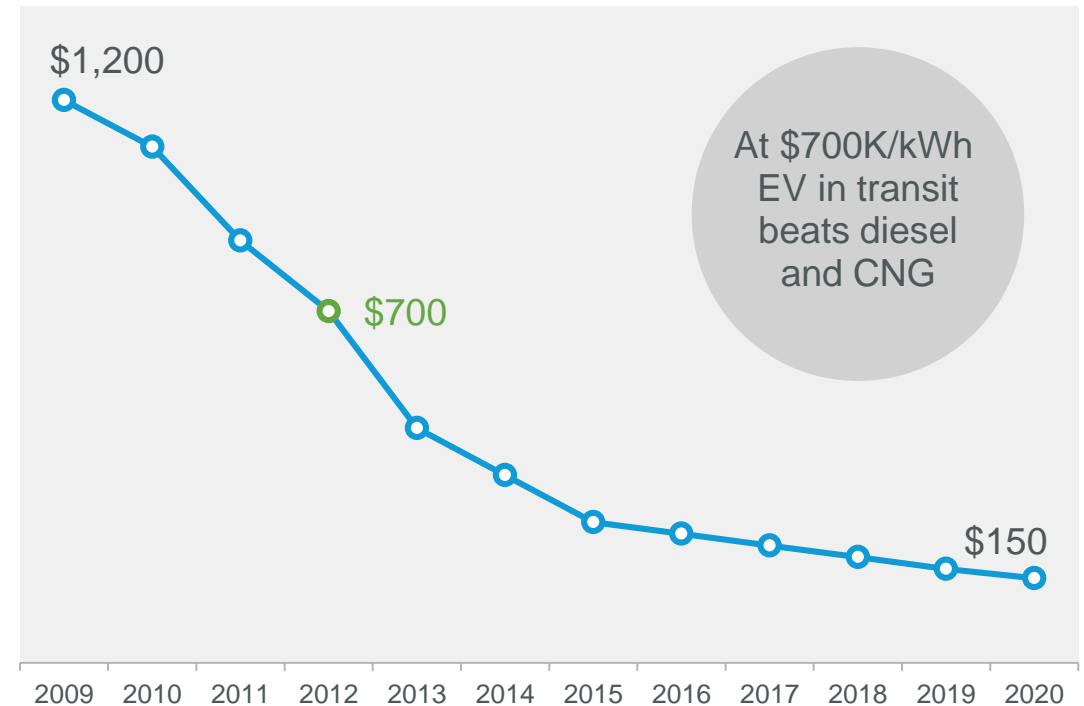
**12-yr Operational Savings per Bus**

**\$462k vs. Diesel**  
**\$467k vs. CNG**  
**\$479k vs. Hybrid**

## U.S. Electric Vehicle Sales (000s Units)



## Proterra Battery Cost (\$/kWh)



Advanced battery technology cost has declined to the point of replacing fossil fuels in the transit market.

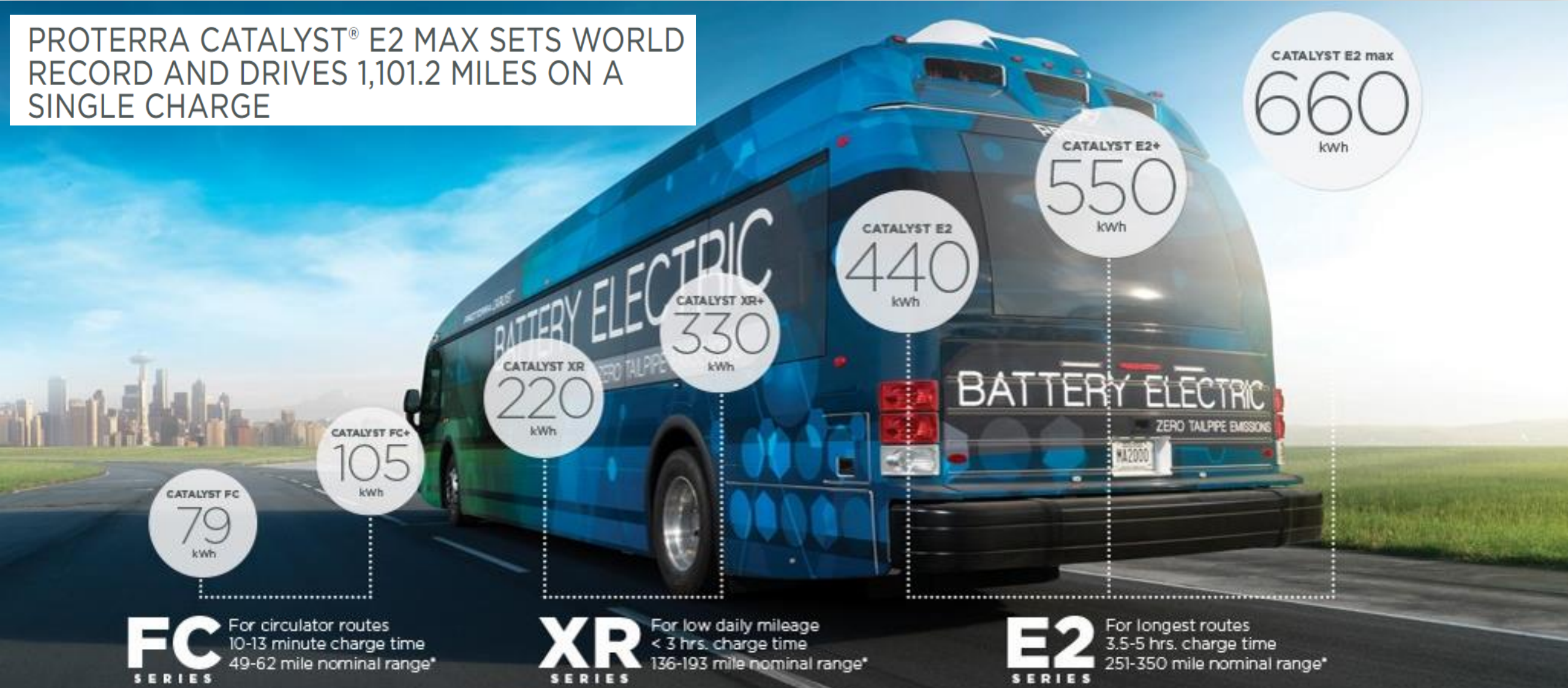
Sources: Navigant Research, green.autoblog.com, Electric Drive Transportation Association. xEV = PHEV, HEV, EREV and BEV.

# THE PROTERRA CATALYST'S RANGE



PROTERRA

PROTERRA CATALYST® E2 MAX SETS WORLD RECORD AND DRIVES 1,101.2 MILES ON A SINGLE CHARGE



**FC**  
SERIES For circulator routes  
10-13 minute charge time  
49-62 mile nominal range\*

**XR**  
SERIES For low daily mileage  
< 3 hrs. charge time  
136-193 mile nominal range\*

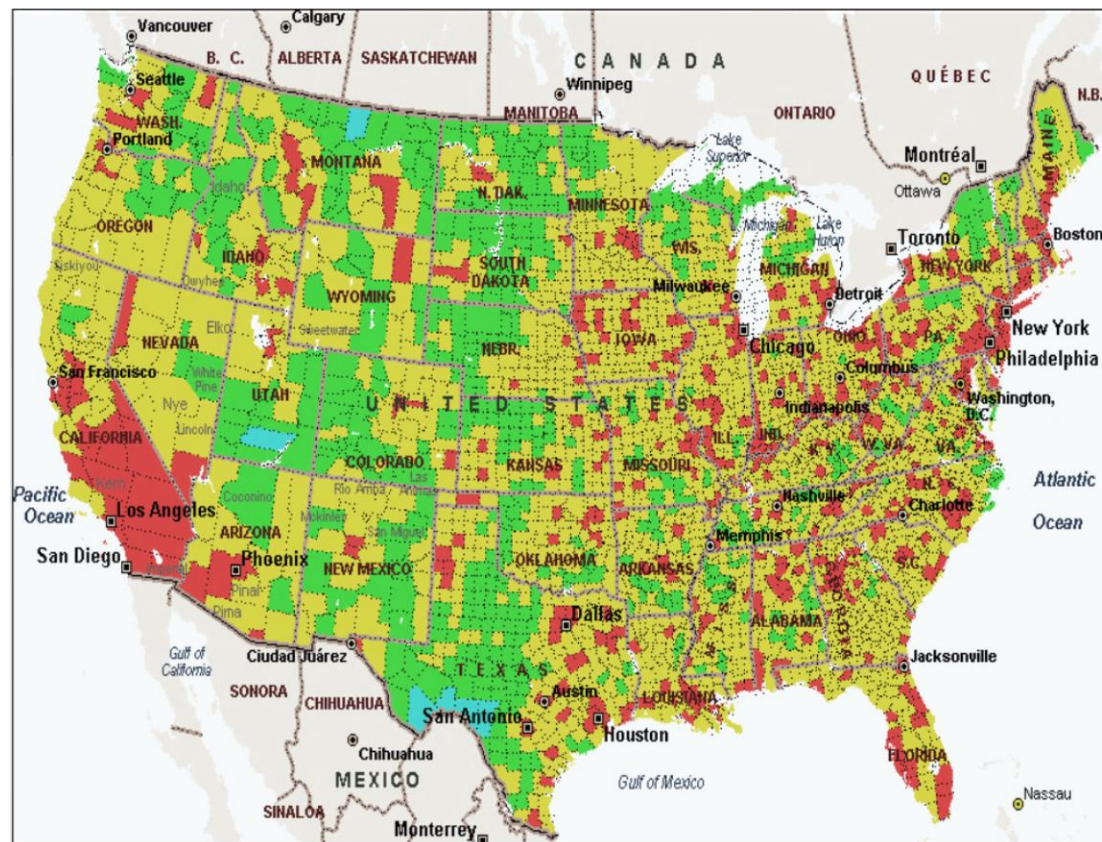
**E2**  
SERIES For longest routes  
3.5-5 hrs. charge time  
251-350 mile nominal range\*

\*Depending on model. Nominal range = total energy/ projected Altoona efficiency. Actual range will vary with route conditions, battery configuration and driver behavior.

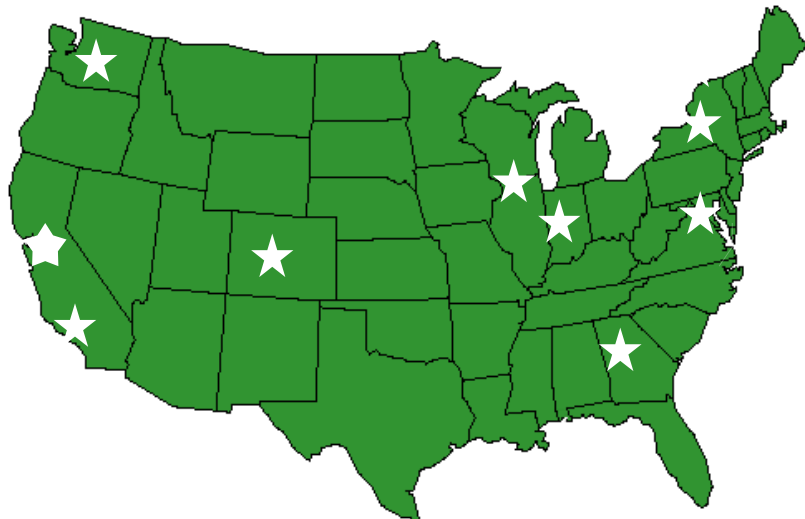
# THE HEALTH COSTS OF FOSSIL FUELS

## Annual Diesel Health Impacts in the US (Number of cases in 2010)

Premature Deaths	21,000
Lung Cancer Deaths	3,000
Hospital Admissions	15,000
Emergency Room Visits for Asthma	15,000
Non-fatal Heart Attacks	27,000
Asthma Attacks	410,000
Chronic Bronchitis	12,000
Work Loss Days	2,400,000
Restricted Activity Days	14,000,000



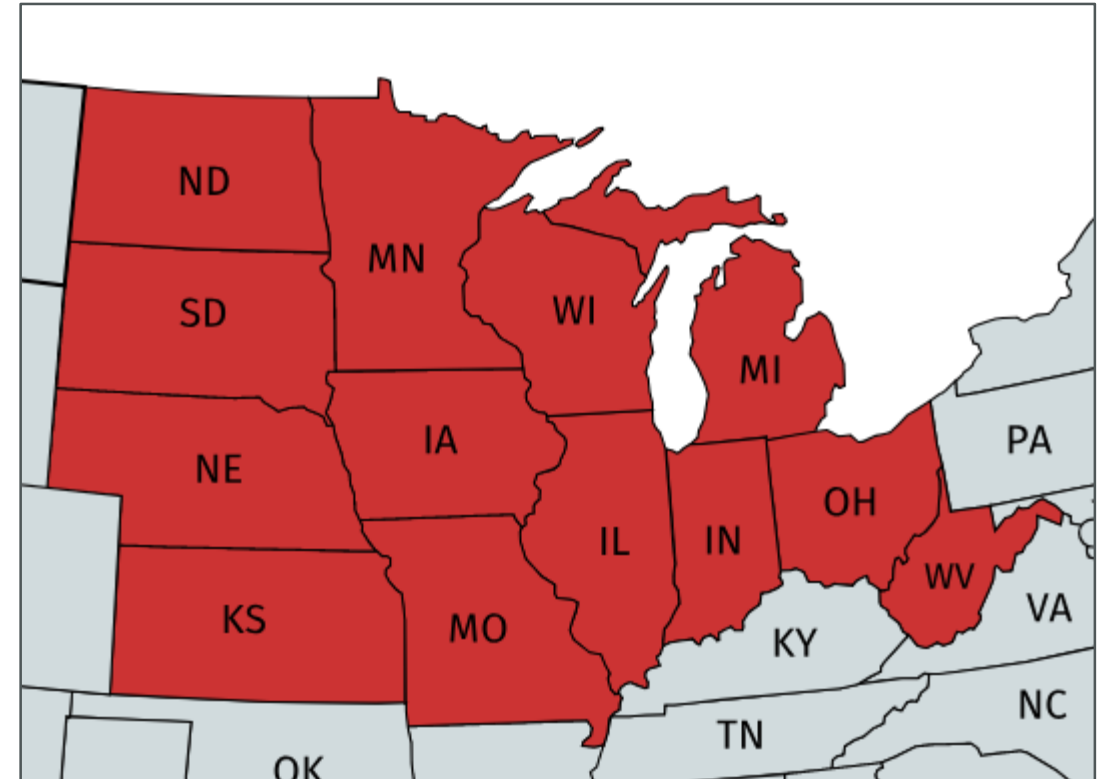
- New York's Truck Voucher Incentive Program offers \$150k per Proterra bus
- FAST Act: LowNo grants increased >100% to \$55M annually; introduction of innovative procurement methods and leasing options
- Maryland Freedom Fleet Voucher program offers \$20k per heavy duty vehicle; BG&E used to purchase 2 Proterra buses



- LA Metro Board passed resolution to convert its entire bus fleet to all-electric by 2030; LA DOT also moving to 100% zero emission by 2030
- Colorado now funds up to \$35k per vehicle for Class 8 vehicles
- Stockton, CA announced the nation's first all-electric bus rapid transit (BRT) route
- Georgia now offers EV public transit buses on master state contract; CA will soon follow
- Chicago's Drive Clean Truck Voucher Program offers \$150k per Proterra bus
- King County announced the purchase of 120 electric buses by 2020; 100% EV by 2034



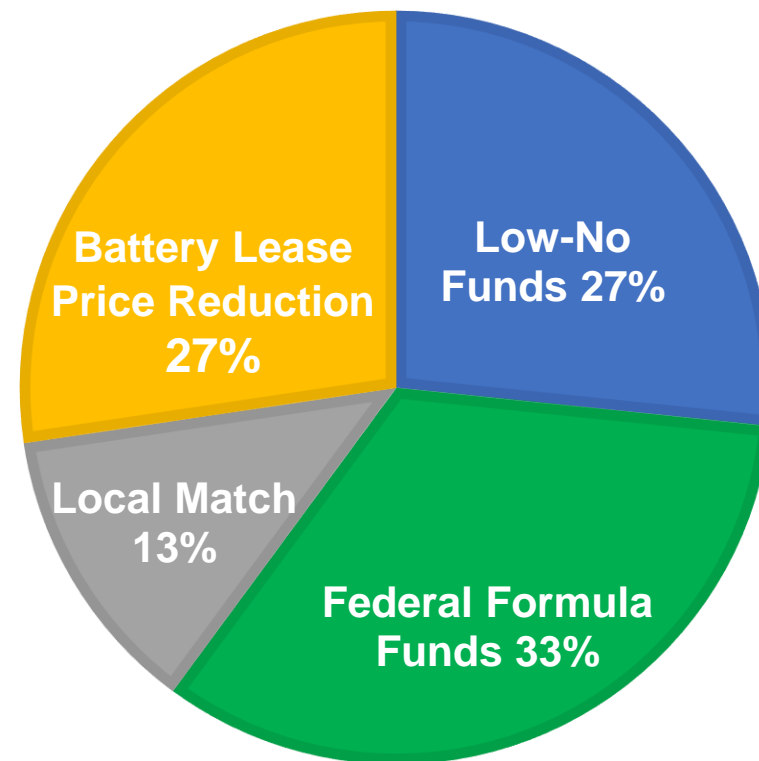
- Through the Volkswagen Settlement, VW agreed to invest \$2.925 billion nationwide under Appendix D - the Environmental Mitigation Trust, to reduce NOx emissions.
- Of this, \$513 million is allocated to the states in the Central Region (highlighted in map). Through the development of Beneficiary Mitigation Plans, these states have allocated approximately \$141 million to replace transit and school buses to date, including electrification.
- States investing heavily in electric buses include:
  - **Wisconsin:** \$32 million for transit bus replacement
  - **Illinois:** \$32 million for transit bus and passenger line projects
  - **Ohio:** \$15 million for transit bus replacement, \$15 million for school bus replacement
  - **Indiana:** \$21 million for heavy-duty vehicle replacement, including \$8.5 million for school buses
  - **Iowa:** \$9.5 million for transit and school bus replacement
  - **Missouri:** \$4 million for transit and \$12 million for school bus replacement
  - **Minnesota:** \$4.1 for transit bus replacement.
  - **Michigan:** \$3 million for school bus electrification





## Case Study: Jackson, Wyoming

- 8 buses with 2018 Low-No Award of \$2,290,000



JACKSON, WY 2018 LOW-NO SOURCES OF FUNDS

Grant “applicants may choose to combine formula and Low-No funding” – [FTA Low-No FAQ](#)

1. Use formula funds budgeted for replacement fossil fuel bus for electric bus
2. Reduce up-front capital cost by leasing battery
3. Leverage small Low-No Award to purchase many electric buses

\*\* VW settlement dollars are also now available to use



## What Can Utilities Do?

- Customers are confused and unsure about large scale charging solutions; easing the customer experience through utility support can facilitate vehicle adoption
- Establish a transportation electrification group
- Support electrification efforts with lower TOU rates for charging and addressing demand charges
- Rate basing infrastructure build-out
- E.g. PECO developed model legislation that facilitates rate based long-term clean transportation infrastructure & time of use rates for the state of PA (HB 1446)
- Utilities can identify steps in interconnection and local permitting processes that can be streamlined and made more uniform

## Why Beneficial?

- Potential to drive down average rates through infrastructure investment in high utilization projects
- Opportunity to strengthen utility service through a smarter grid
- Optimize the load profile on the grid through smart charging and using vehicles as distributed storage devices
- More load on the grid will potentially lead to lower electricity rates or the stabilization of such rates. EVs lead to increased throughput on utility distribution assets and more balanced loads in the generation market.
- Utilities can demonstrate their support for improving air quality and local health benefits, particularly in disadvantaged communities

# SMARTER CHARGING

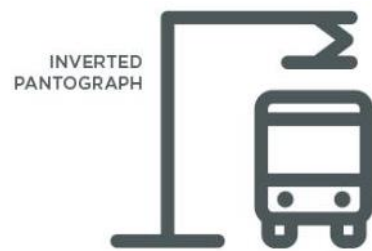
## COMPATIBLE WITH INDUSTRY-STANDARD CHARGING SYSTEMS



### OVERHEAD CHARGING

Keep your Catalyst buses rolling with easy depot or on-the-road charging, made simple by industry-standard SAE J3105 overhead systems.

- Charge on the road for longer routes or enable 24/7 circulator operations
- Low maintenance costs and high availability
- Compatible with roof-mounted pantographs as well as inverted pantograph systems, offered by Schunk and other suppliers



ADOPTED BY MAJOR OEMS



### PLUG IN CHARGING

Regardless of your fleet size, powering up your Proterra buses at the depot is as easy as plugging in a standard J1772-CCS Type 1 charger.

- Universal chargers are offered by Proterra and other suppliers
- Catalyst vehicles can be configured with two charge ports for flexibility at the depot
- Electric buses, utility vehicles and cars can share the same standardized chargers



ADOPTED BY MAJOR OEMS



# SMARTER CHARGING PROTERRA POWER CONTROL SYSTEMS



## 60KW

For fleets with longer available charge times.

Catalyst E2 charge time:  
~6 hours, w/ J1772-CCS plug-in



## 125KW

For fleets with high uptime requirements

Catalyst E2 charge time:  
~3 hours, w/ J1772-CCS plug-in



## 500KW

For fleets with extended operating hours and high mileage requirements

Catalyst FC+ charge time:  
~38 miles per 10 minutes, w/ J3105 overhead



## INTELLIGENT

Automated and rules-based vehicle charging

## UNIVERSAL

Standards-based, OCPP 1.6 open communications protocol-compatible

## REMOTE

Can be located up to 492 feet from dispenser

## SCALABLE

Can be installed side-to-side and back-to-back for high-density charger banks



Open source communications protocol



Bi-directional V2G capability



Smart grid ready



Telematics-enabled

## COMPATIBLE CONNECTIONS



PANTOGRAPH



INVERTED PANTOGRAPH



UNIVERSAL PLUG IN



Proterra works closely with customer to recommend the [appropriate charging solution](#) for fleets and facilities planning for scale as the demand for charging increases.

Proterra technologies enable:

- Efficient charge speed
- Dynamic power sharing
- Driver-friendly stations
- Cost-effective operations
- Universal compatibility
- Serviceability
- Low maintenance costs
- High availability

Our experts provide counsel on:

- Site layout
- Energy management
- Real-time energy monitoring
- Site configurations



## ZERO EMISSIONS

- 100% battery-electric with no tailpipe emissions

## FAST CHARGING

- DC charging enables a full charge in ~ 3 hours using Proterra's 60 kW PCS

## HIGH PERFORMANCE

- Efficient, smart, safe drivetrain technology for optimal performance in any climate

## PROVEN TECHNOLOGY

- Proterra batteries and drivetrains proven in more than 7,000,000 service miles on transit buses

Proterra Introduces the DuoPower™ Drivetrain for its Catalyst® Zero-Emission Buses at APTA



New drivetrain delivers nearly twice the horsepower and acceleration of a standard combustion engine and 500 percent improvement in efficiency

Proterra Gives Fleet Operators More Reasons To Go Electric With New Line Of Charging Stations



Global Double Deck Bus Market Leader, Alexander Dennis, Selects Proterra to Power North America's First Electric Double Deck Transit Bus



Emphasizing Connectivity at Scale, Proterra Introduces the APEX™ Vehicle Intelligence System for Heavy-Duty Transit Fleets



Proterra, Van Hool Venture to Build Electric Motor Coaches **TRUCKS.COM**

Daimler invests in electric bus company Proterra; exploring electrification of Daimler's Thomas Built school buses **Green Car Congress**  
*Energy, technologies, issues and policies for sustainable mobility*

Proterra and Mitsui & Co., Ltd. Create \$200 million Credit Facility to Scale Proterra Battery Leasing Program **MASS TRANSIT**