

CaliforniaTransit
Association



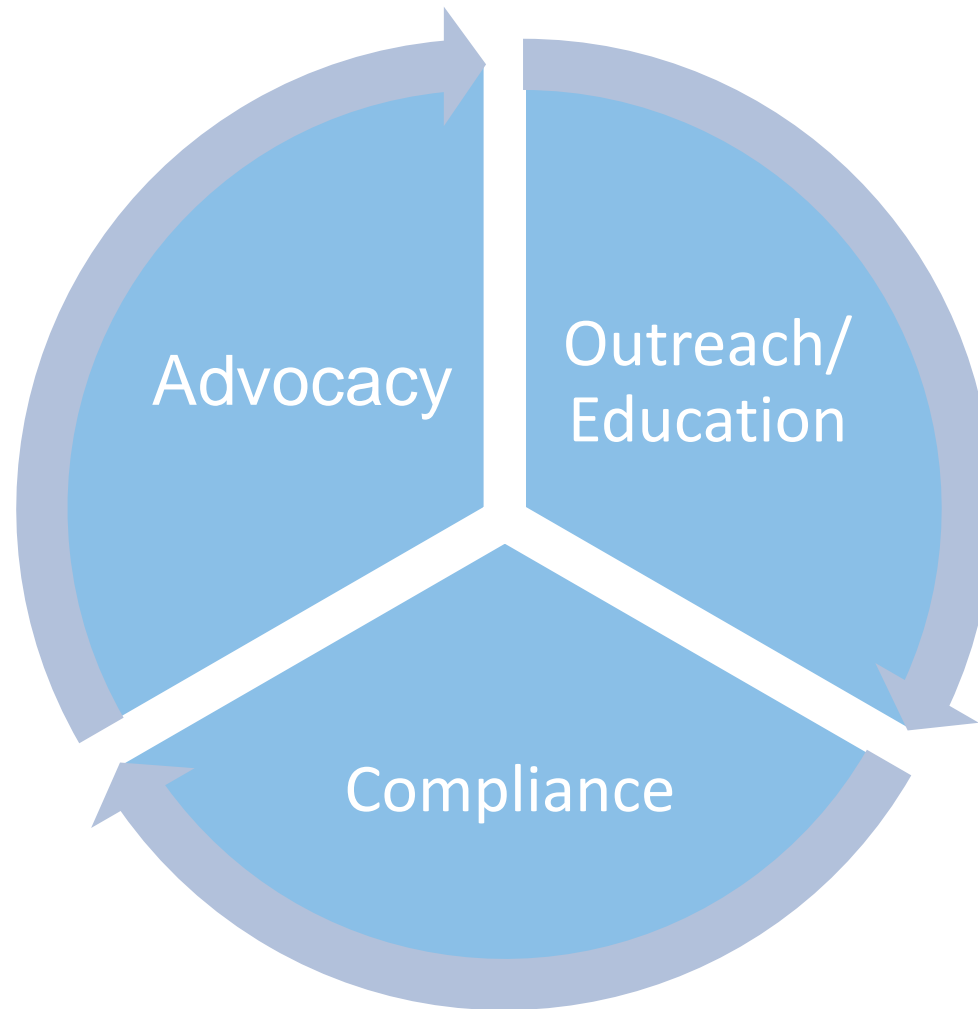
Zoom to Zero: Battery-Electric Buses on the Road

(Co-Hosted by CALSTART)

September 19, 2019



Support for ICT Regulation Implementation



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.

A screenshot of the webinar control panel. The 'Questions' module is highlighted with a red border. It shows a table with columns for 'X', 'Question', and 'Asker'. Below the table are buttons for 'Send Privately' and 'Send to All'. The panel also shows 'Polls (0/0)', 'Handouts: 0 of 5', and 'Chat' sections. At the bottom, the webinar title 'State Transit Assistance Program Allocation Methodology' and ID '125-149-947' are displayed, along with the 'GoToWebinar' logo.

X	Question	Asker

Send Privately Send to All

State Transit Assistance Program Allocation
Methodology
Webinar ID: 125-149-947

GoToWebinar



Bus Compendium - CALSTART

9-19-2019

Jared Schnader

National Program Manager, Small Urban and Rural
Transit Agencies

CALSTART

- Non-profit, member driven company that helps to advance, advocated and deploy alternative fuels. We focus on 4 Pathways:
 - Transit
 - Trucking
 - Infrastructure
 - Fuels





CALSTART's 220+ Member Companies and Organizations

(PARTIAL LISTING)

CALSTART – A National Organization 9 Offices Six Regional Offices + Four Field Offices

- California
- 3 offices
 - 2 field offices





PROTERRA





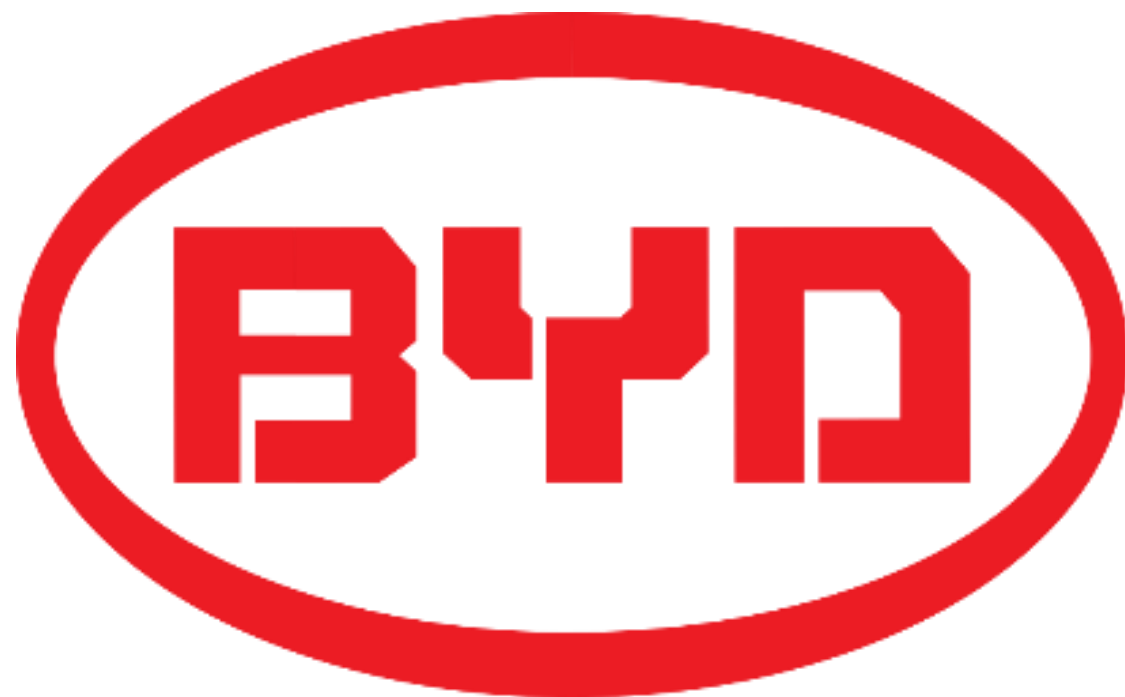
PROTERRA

35' -28 Pax

40' – 40 Pax

Model	XR	E2
Operating Range	98-121	163-234
Energy Level (kWh)	220	440
Overhead Charging (10 Min Charge)	+16 miles	+28 miles
Overhead Charging from E to F	2.7 hrs	2.7 hrs
Plug In Charging from E to F	2.8 Hours	3.2 Hours

Model	XR	E2	E2 Max
Operating Range	97-118	161-230	232-328
Energy Level (kWh)	220	440	660
Overhead Charging (10 Min Charge)	+16 miles	+27 miles	+31 miles
Overhead Charging from E to F	2.7 hrs	2.7 hrs	2.8 hrs
Plug In Charging from E to F	2.8 Hours	3.2 Hours	4.5 hours





30' -23 Pax

Model	K7
Operating Range	<150 Miles
Energy Level (kWh)	215kWh
Plug In Charging from E to F	2.5-3 Hours

40' – 38 Pax

Model	40' Electric Bus
Operating Range	<157 miles
Energy Level (kWh)	352 kWh
Plug In Charging from E to F	4.5 – 5 hours Hours





NEW FLYER





35' & 40' -28 Pax

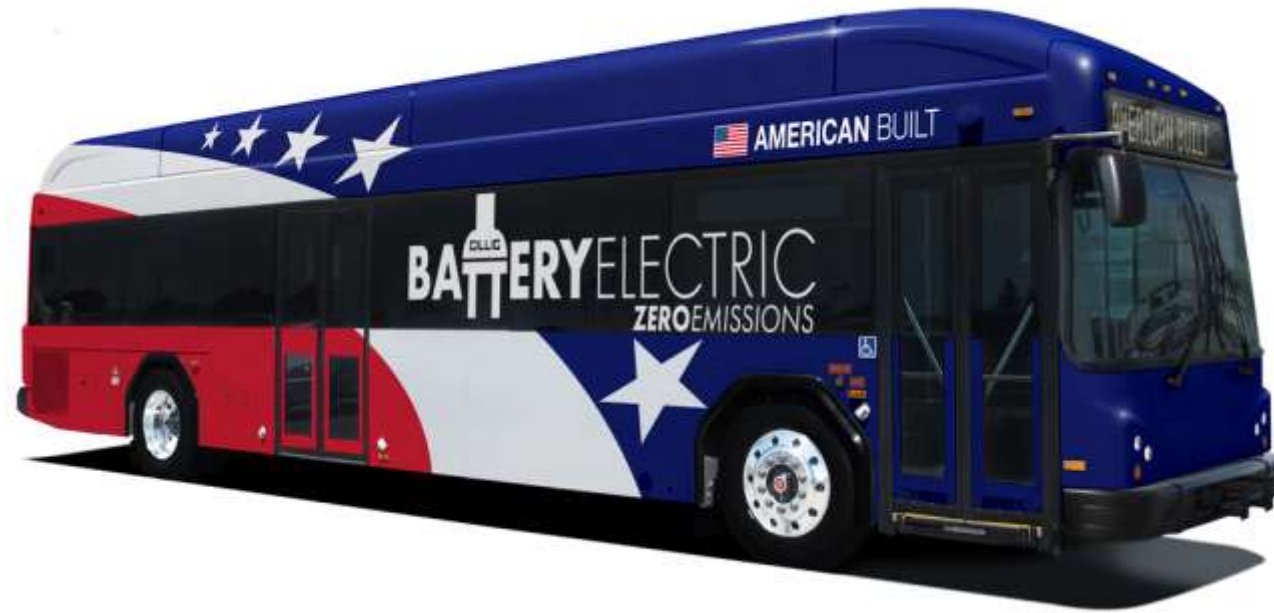
Model	35'	40'
Operating Range	<75 to <195 miles	<75 to <225 miles
Energy Level (kWh)	160-388	160-466

60' – 51 Pax

Model	60'
Operating Range	<55 to <135
Energy Level (kWh)	213-466



GILLIG



GILLIG

40'

Model	40'
Operating Range	TBD
Energy Level (kWh)	444kWh (per Cummins?)



CEW

COMPLETE COACH WORKS





Model	30'/35'/40'
Operating Range	<150 miles
Energy Level (kWh)	311
Plug In Charging from E to F	4 Hours







25' – 14 + 2 pax

Model	EV Star ADA
Operating Range	<150 miles
Energy Level (kWh)	118

Altoona Testing starts at the end of September 2019







25' – 14 + 2 pax

Model	ZEUS
Operating Range	<110 miles
Energy Level (kWh)	105

**Altoona Testing Completed.
Test Report expected Q1 2020**





UMS

Urban Mobility Systems





Model	Mission
Operating Range	<185 miles
Energy Level (kWh)	110

Altoona Testing starts January 2020



CALSTART Agency Assistance Toolkit

- Electric Bus Corridor Modeling
- Total Cost of Ownership Estimator
- Transit Fleet Infrastructure Planning Toolkit



Electric Bus Corridor Modeling Tool

Through a series of inputs, the system will allow an agency to predict energy usage with each changing season to better plan routes, as well as model the charging infrastructure and battery size needed to achieve the desired operational results.



200 kW charger

vs.



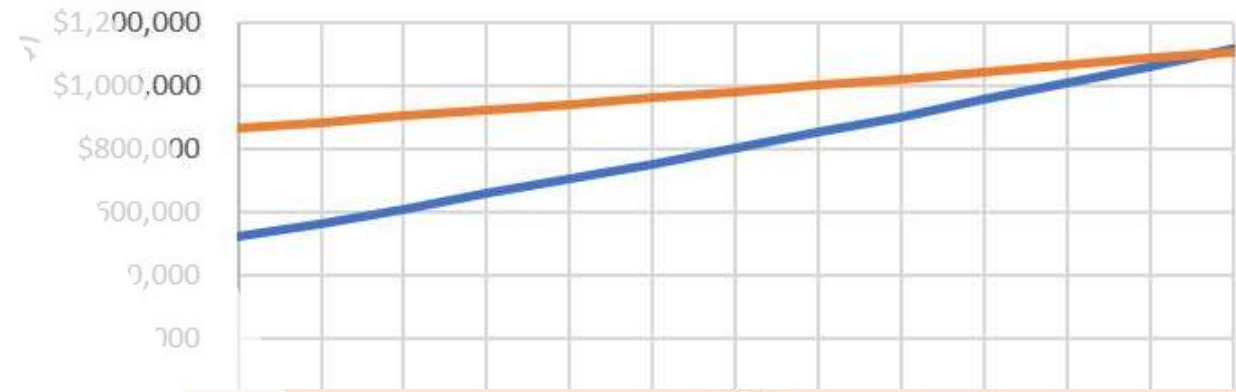
400 kW charger



Total Cost of Ownership Estimator

Through inputs from vehicle pricing, incentives, energy costs, etc., the industry vetted estimator will create a projected payback period and overall lifetime savings.

Payback Period Clean vs Baseline



Inputs		
Use National Average?	Use National Average Values	select from dropdown
Fuel	Diesel	select from dropdown
Vehicle Type	Battery	select from dropdown
Vehicle Model	Transit Bus 30-39'	select from dropdown
Number of Vehicles	1 #	
Program	None	select from dropdown
California LCFS Program?	No	select from dropdown
and LCFS, how will H2 be generated?	N/A	select from dropdown
	80 miles	
	325 days	
	12 years	
Fleet Type	Public	select from dropdown
Override		
	10%	
	\$0 per year per vehicle	
	2019	date of purchase
	3%	
Payback Period (years)	12 years	
	35%	
	2%	

Cost Breakdown



Transit Fleet Infrastructure Planning Tool

Step 1: Consideration of Electric Bus Deployment

- Engage your utility, identify needed technical support, and obtain a new service request form.
- Confirm charging requirements, needs and costs from vehicle manufacturer and EVSE supplier.
- Determine fleet scaling potential.

Step 2: Bus Fleet Electrification

- Plan for phasing and timeline for deployment.
- Perform system modeling and understand bus duty cycles and projected energy needs (daily kWh, charging times and speed).

Step 3: Depot Yard Analysis

- Evaluate site infrastructure and utility grid infrastructure needs.
- Identify space availability.
- Evaluate charging/renewable energy options.

Step 4: Development of Charging Schedule

- Identify charging hardware.
- Develop charging schedule (best window for charging).

Step 5: Development of Electric Service Plan

- Detail requested service voltage and load schedule.
- Identify service drop and transformer locations.
- Develop conceptual electric single line diagram.
- Determine costs for design, site works and installation

Through CALSTART's extensive experience with infrastructure planning for transit agencies, a planning tool was developed to assist with this incredibly important task.



Thank you!





Battery Electric Buses on the Road – In San Joaquin County

September 2019

Donna DeMartino



San Joaquin RTD's Service Area and Services

Where is
San Joaquin RTD?

Services

- Commuter
- BRT
- Fixed Route
- Paratransit
- Deviated Fixed Route
 - HOPPER
- Mobility on Demand
 - VanGO!



A Diverse Fleet to Serve a Diverse Community



Rightsizing the Services and Fleet to Meet the Needs



Commuter



BRT



Electric BRT



Hoppers



RTD Go!
UBER



Van Go!

Battery Electric Bus Fleet

Early Adopter

Started in 2013, through a California Energy Commission grant and its partnership with Proterra, RTD introduced northern California's first 100% battery-electric buses into service.

RTD implemented the **nation's first all-electric BRT corridor in South Stockton**

Current BEB Fleet

# of Busses	Year built	Battery Size	Manufacturer
2	2012	74 kWh	Proterra
10	2016	105 kWh	Proterra
5	2018	440 kWh	Proterra

Current Charging Infrastructure

- 3 in-route overhead chargers (500 kW each)
- 5 depot chargers (60 kW each)



Battery Electric Bus Funding

Electric Buses												
Bus #	Total Cost	Funding Program (Grantor)										
		California Hybrid and Zero-Emission Truck and Bus Voucher Program (HVIP) (California Air Resources Board)	Section 5312 Low and No Emissions Bus Deployment Program (Federal Transit Administration)	Congestion Mitigation and Air Quality Improvement Program (CMAQ) (Federal Highway Administration)	Heavy Duty Truck and Bus Program (California Air Resources Board)	State Transit Assistance Program (CA State Transit Development Act: Diesel Fuel Tax)	Transit and Intercity Rail Capital Program (CA State Greenhouse Gas Reduction Fund)	Enhanced Transportation Strategies-Public Benefit Grant (San Joaquin Valley Air Pollution Control District)	Measure K Local Sales Tax (San Joaquin Council of Governments)	Alternative and Renewable Fuel and Vehicle Technology Program (California Energy Commission)	In-Kind Match (Proterra)	
RTD 1	\$ 1,100,000										770,000	330,000
RTD 2	\$ 1,100,000										770,000	330,000
RTD 3	\$ 874,438				\$ 871,358	\$ 3,080						
RTD 4	\$ 874,438				\$ 873,022	\$ 1,415						
RTD 5	\$ 1,084,487	\$ 140,000	\$ 787,032			\$ 157,455						
RTD 6	\$ 1,084,487	\$ 140,000	\$ 787,032			\$ 157,455						
RTD 7	\$ 1,084,487	\$ 140,000	\$ 787,032			\$ 157,455						
RTD 8	\$ 1,084,487	\$ 130,000	\$ 787,032			\$ 167,455						
RTD 9	\$ 1,084,487	\$ 130,000	\$ 787,032			\$ 167,455						
RTD 10	\$ 981,769	\$ 130,000				\$ 151,839		\$ 699,930				
RTD 11	\$ 981,769	\$ 130,000		\$ 425,885					\$ 425,885			
RTD 12	\$ 927,362	\$ 130,000				\$ 525	\$ 796,837					
RTD 13	\$ 926,837	\$ 165,000		\$ 299,879			\$ 7,399		\$ 454,559			
RTD 14	\$ 926,837	\$ 165,000		\$ 699,035			\$ 7,399		\$ 55,403			
RTD 15	\$ 926,837	\$ 165,000		\$ 699,035			\$ 7,399		\$ 55,403			
RTD 16	\$ 926,837	\$ 165,000		\$ 699,035			\$ 7,399		\$ 55,403			
RTD 17	\$ 926,837	\$ 165,000		\$ 699,035			\$ 7,399		\$ 55,403			
	\$ 16,896,400	\$ 1,895,000	\$ 3,935,162	\$ 3,521,903	\$ 1,744,380	\$ 964,134	\$ 833,833	\$ 699,930	\$ 1,102,058	\$ 1,540,000	\$ 660,000	



DRIVEN BY PRIDE

Battery Electric Bus Funding

Electric Bus Chargers												
Charger Type	Total Cost	Funding Program (Grantor)										
		California Hybrid and Zero-Emission Truck and Bus Voucher Program (HVIP) (California Air Resources Board)	Section 5312 Low and No Emissions Bus Deployment Program (Federal Transit Administration)	Congestion Mitigation and Air Quality Improvement Program (CMAQ) Program (Federal Highway Administration)	Heavy Duty Truck and Bus Program (California Air Resources Board)	State Transit Assistance Program (CA State Transit Development Act: Diesel Fuel Tax)	Transit and Intercity Rail Capital Program (CA State Greenhouse Gas Reduction Fund)	Enhanced Transportation Strategies-Public Benefit Grant (San Joaquin Valley Air Pollution Control District)	Measure K Local Sales Tax (San Joaquin Council of Governments)	Alternative and Renewable Fuel and Vehicle Technology Program (California Energy Commission)	In-Kind Match (Proterra)	PG&E Fleet Ready Pilot Program
Fast-Charger #1	\$ 850,000										\$ 850,000	
Fast-Charger #2	\$ 605,467				\$ 605,467							
Fast-Charger #3	\$ 856,300		\$ 740,886				\$ 27,588		\$ 87,826			
Fast-Charger #4	\$ 540,875				\$ 500,875	\$ 40,000						
5 Depot-Chargers*	\$ 285,280											\$ 285,280
	\$ 3,137,922	\$ -	\$ 740,886	\$ -	\$ 1,106,342	\$ 40,000	\$ 27,588	\$ -	\$ 87,826	\$ -	\$ 850,000	\$ 285,280

*Excludes construction costs covered by PG&E



DRIVEN BY PRIDE

Challenges

The State implemented the Innovative Clean Transit (ICT) and **RTD plans to scale from pilot to fully-electric operations by 2025**, but challenges must be addressed:

Charging Technology

- Vehicle chargers are not standardized
- Differences in depot & on-route charging
- Intercity services will require standardized power sources statewide

Infrastructure

- Power requirement is massive
- Long-term site and budget planning for infrastructure needed
- Grid upgrades needed to support new loads

Electricity costs

- Demand charges increase charging costs for electric buses
- Utility providers are working on “fleet ready” programs and have applied to the PUC for a transit rate plan

Charging Technology

Early-stage bus and charging technologies lack standardization

Overhead Charging

- First generation of RTD electric buses have a short range (~30 miles) and require frequent, on-route charging at high power levels
- Demand Management software did not exist until a custom implementation was created for RTD



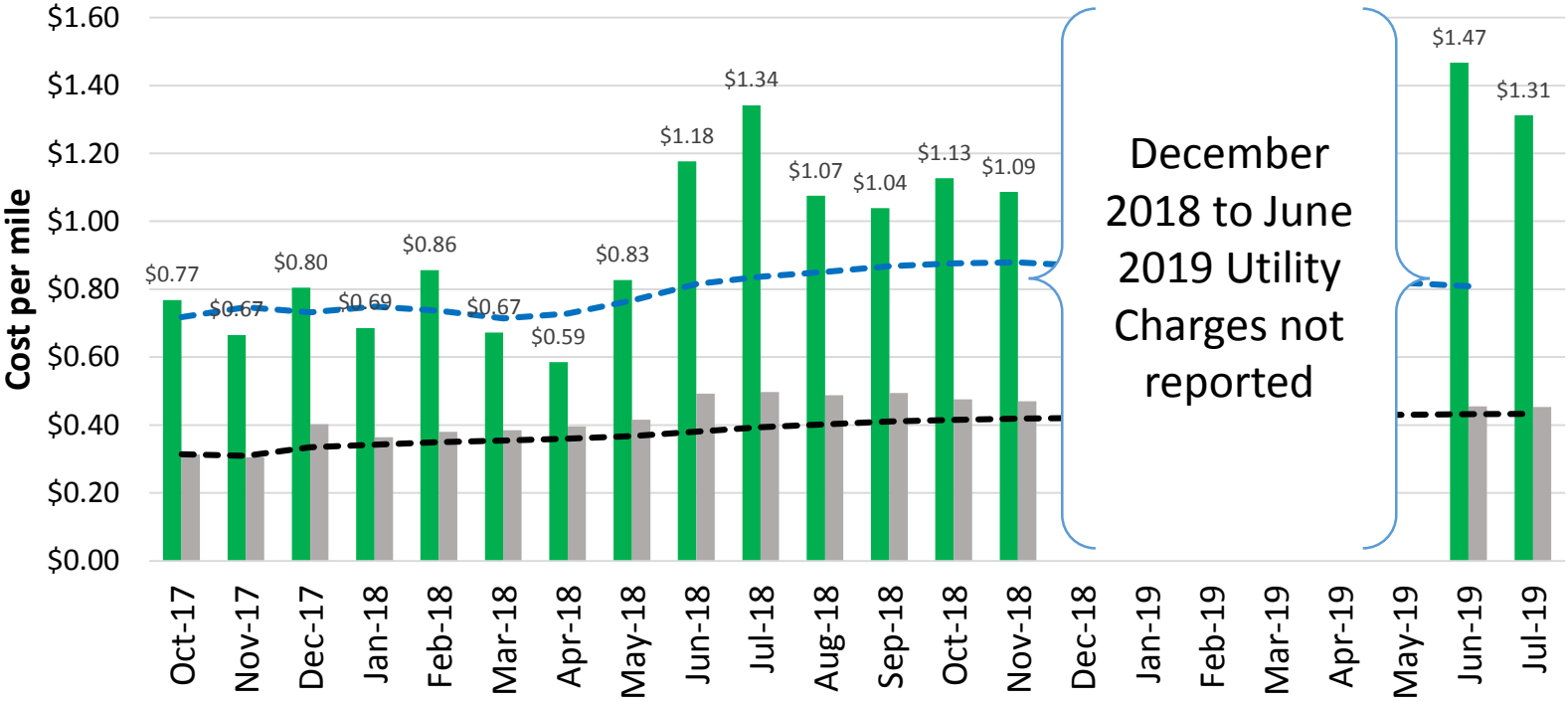
Depot Charger

- Second generation RTD buses have longer range (~130 miles) using overnight charging at lower power levels
- Newly installed depot chargers only have 1 port
- Planning for full fleet electrification will require significant planning and space for charging stations using current designs



Diesel vs. Electric Fuel Cost

Existing commercial electric rate structure makes operating battery electric buses more expensive than operating diesel hybrid buses in Stockton



RTD and PG&E Partnership

RTD and PG&E are partnering on a pilot to better understand these challenges and develop innovative solutions to aid future agencies in electrifying

PG&E Collaborates with San Joaquin Regional Transit District on Electric Vehicle Pilot

Release Date: June 21, 2018

Contact: PG&E External Communications (415) 973-5930

SAN FRANCISCO, Calif. — Pacific Gas and Electric Company (PG&E) today announced it will conduct an electric vehicle (EV) pilot with [San Joaquin Regional Transit District](#) (RTD) to help prepare the agency for its long-term electric transportation needs.

With San Joaquin RTD, PG&E will test how smart charging and battery storage can lower operating costs and maximize efficiencies for the agency. PG&E will test, analyze and compare the economics for charging at various times of the day using different models with and without battery storage. As part of the pilot, PG&E will fund up to five new electric bus chargers and a battery energy storage system, and will fund and build the infrastructure from the electric grid to the chargers and storage system.

San Joaquin RTD has taken a lead in electric transportation and already has electric buses in its fleet. This pilot aligns with San Joaquin RTD's goal of being powered by 100 percent EVs by 2025.

San Joaquin Regional Transit District (RTD)

PRESS RELEASE

Contact: Terry Williams
Public Information Officer
(209) 467-6695

[FOR IMMEDIATE RELEASE](#)

June 21, 2018

RTD Selected for New PG&E Electric Vehicle Pilot Program

Stockton, CA — In another first for San Joaquin Regional Transit District (RTD) and Stockton, Pacific Gas and Electric Company (PG&E) today announced it will conduct an electric vehicle (EV) pilot to support RTD's long-term electric transportation needs with chargers and infrastructure improvements.

Recently approved by the California Public Utilities Commission, this pilot will be a test case for PG&E's new FleetReady program, which supports electric charging for customers with medium-duty, heavy-duty, and off-road fleets such as transit agencies, school districts, and delivery fleets. For this new pilot with San Joaquin RTD, PG&E will test how smart charging and battery storage can lower operating costs and maximize efficiencies for the agency.

Seeking to partner with a transit agency located in a disadvantaged community who already had electric buses and plans for more in the future in order to meet the timelines of the project proposal, PG&E chose RTD.

"Because we already had a plan for adding more electric buses to our fleet and have a long-term goal around electrification, PG&E approached us with this pilot opportunity," said CEO Donna DeMartino. "Due to our focus on electric transportation, PG&E can jump right into creating the specifics of the pilot, which aligns with our goal of being powered by 100% electric vehicles by 2025."



DRIVEN BY PRIDE

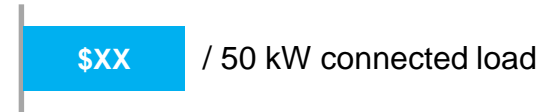


Reimagining Electric Rate Design

PG&E is proposing a new EV rate for commercial charging applications:

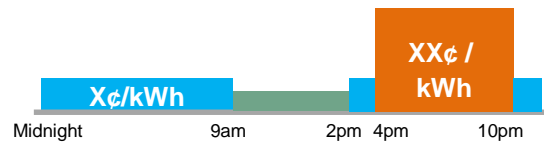
Proposed EV rate structure

Subscription
Charge
(monthly)



Monthly subscription charge is much lower than current demand charges, and enables more predictable budgeting

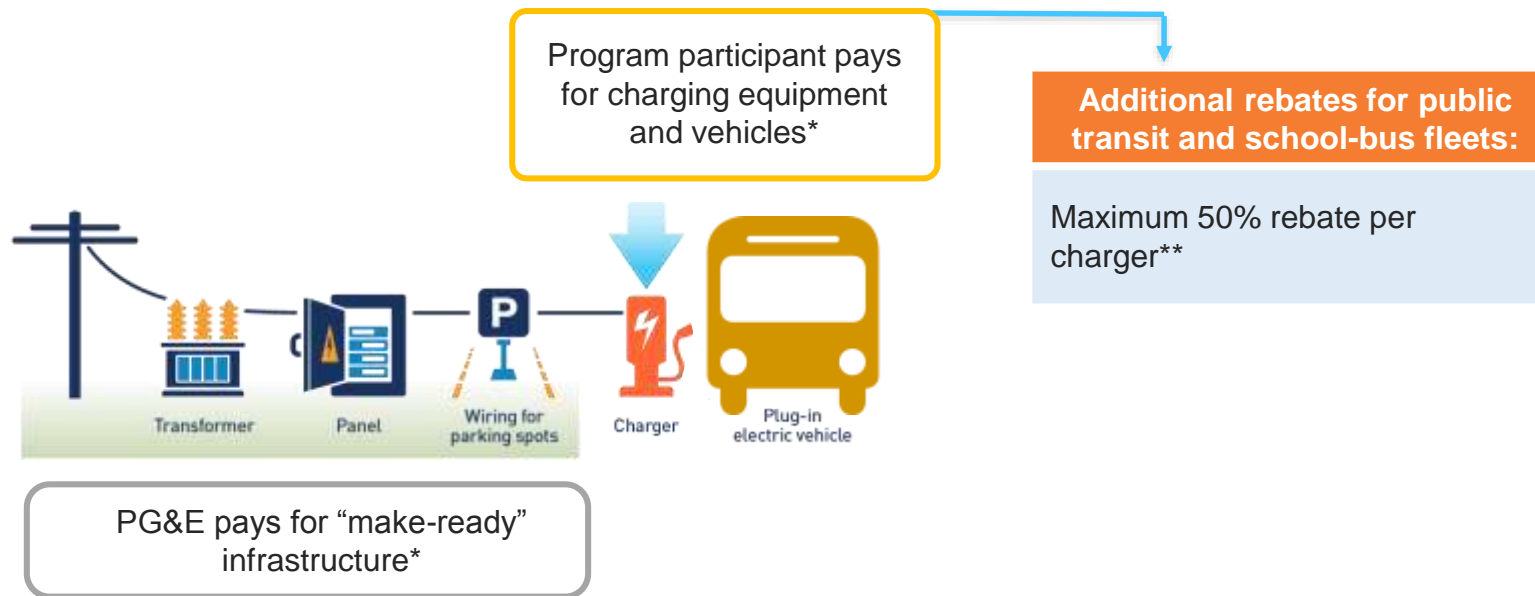
+
Energy
Charge
(per kWh)



Time-of-use energy rates encourage charging overnight and mid-day, when renewable, solar energy is generated

Utility Support for Charging Infrastructure

PG&E launched the FleetReady program to reduce the infrastructure hurdles for medium/heavy duty electric vehicles. This program pays for a significant portion of the total site costs, including civil design, utility upgrades, and electrical construction costs:

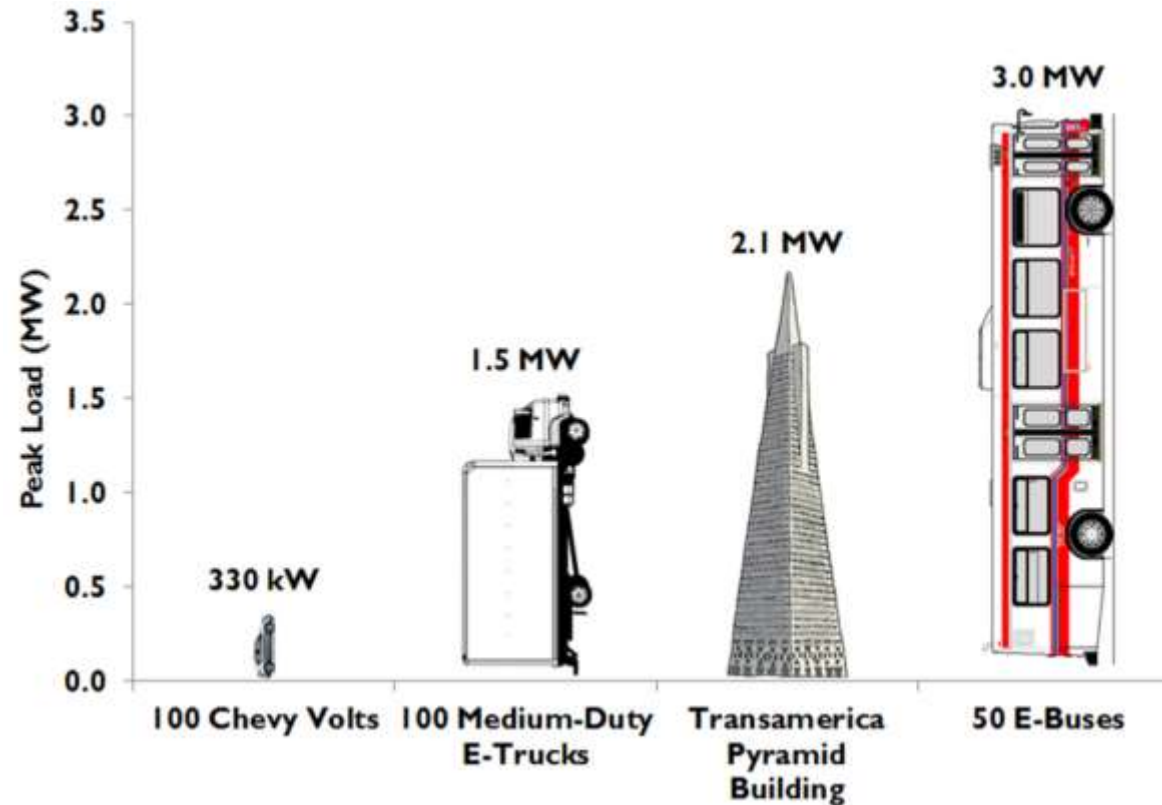


* Some exceptions may apply to customers who hold Primary Service with PG&E

** Rebate amount not to exceed 50% of charger equipment and installation costs

What Will it Take to Power Our Fleets?

Fully electrified fleets will have large energy needs, but utilities believe they can meet capacity requests with adequate planning and active collaboration with transit agencies



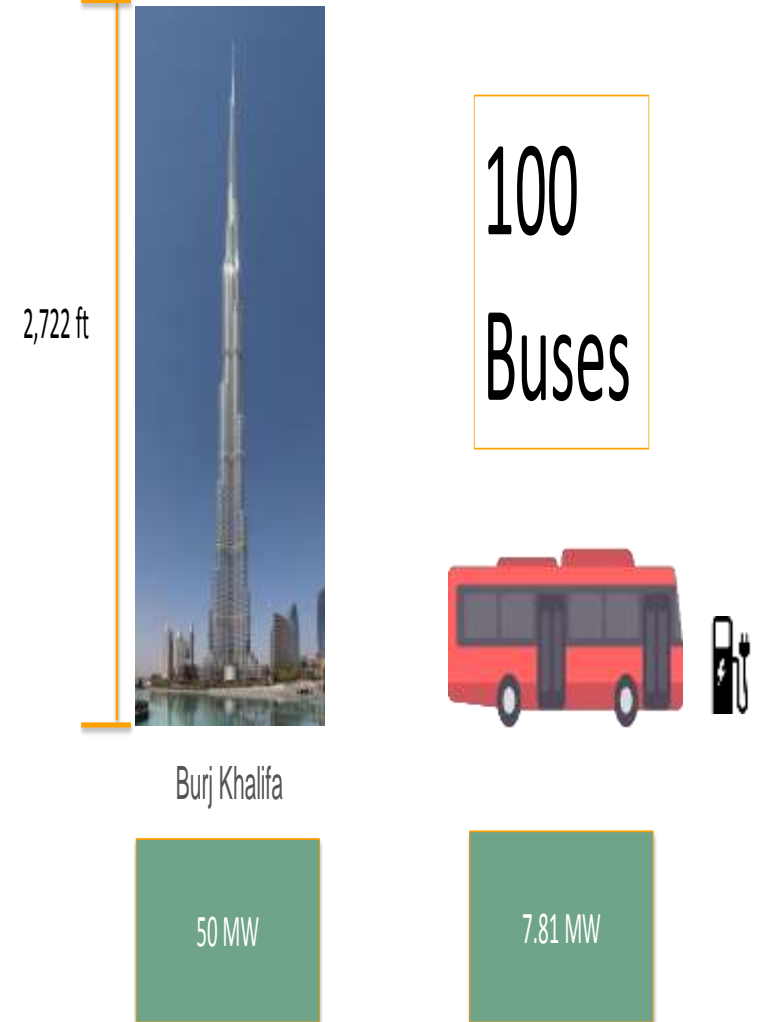
What Will it Take to Power our Fleets??

100 buses @ ~8 MW = 16%
250 buses @ ~20 MW = 40%
10,000 buses statewide @ ~800 MW = power equivalent
of 16 Burf Khalifa-sized skyscrapers



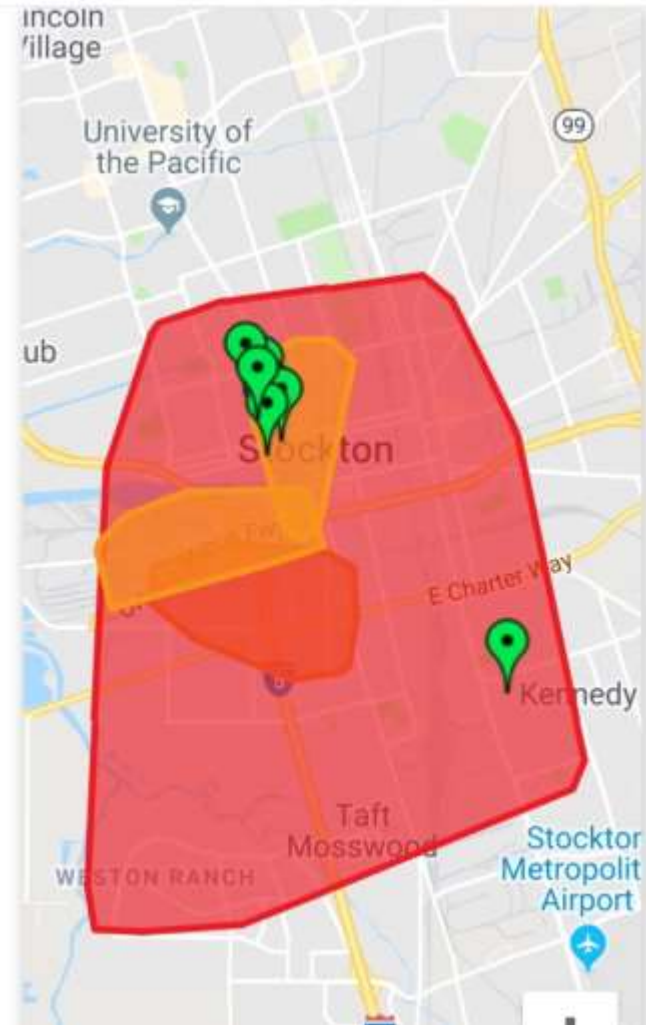
Power Requirements of a Skyscraper in Dubai vs. 100 Buses at RTD

Takeaway: The tallest skyscraper in the world Burj Khalifa located in Dubai requires 50 MW of power to support it. In comparison, a 100 buses would require approximately 7.81 MW, which is about 16% (7.81/50) of the power required to power Burj Khalifa.



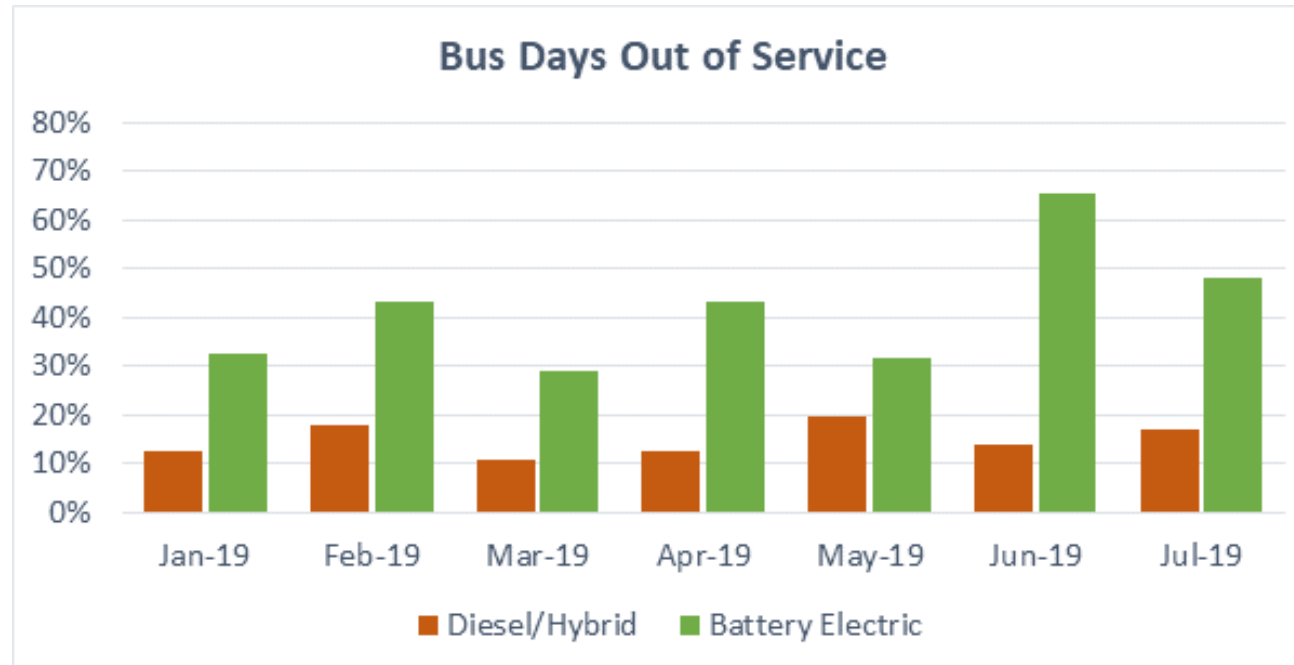
What Happens When the Power Goes Out?

One day in April in Stockton



Challenges

- One more thing:



This represents buses out of service only. The chargers regularly fail as well.

Questions?



ELECTRIC BUS

Program History, Lessons Learned and Future Plans

Doran Barnes | Executive Director



Foothill Transit

ABOUT Foothill TRANSIT

- Pomona and San Gabriel Valleys of eastern Los Angeles County
- 327 sq. mi service area, 1.5 million residents
- 12 Million boarding's per year
- 36 local and express routes.
- 343 CNG buses, 33 electric buses.



THE Foothill Transit MISSION

To be the premier public transit provider
committed to:

SAFETY
COURTESY
QUALITY
RESPONSIVENESS
EFFICIENCY
INNOVATION





LOS ANGELES BASIN AIR QUALITY

- Poor air quality
- Large population base
- On-shore breeze pushes air inland





Foothill Transit is proud to introduce the world's first heavy duty, fast charge, zero emissions electric bus.

Launching in
Pomona, California
September 3, 2010.



ecoliner
Zero Emissions Electric Vehicle



Foothill Transit



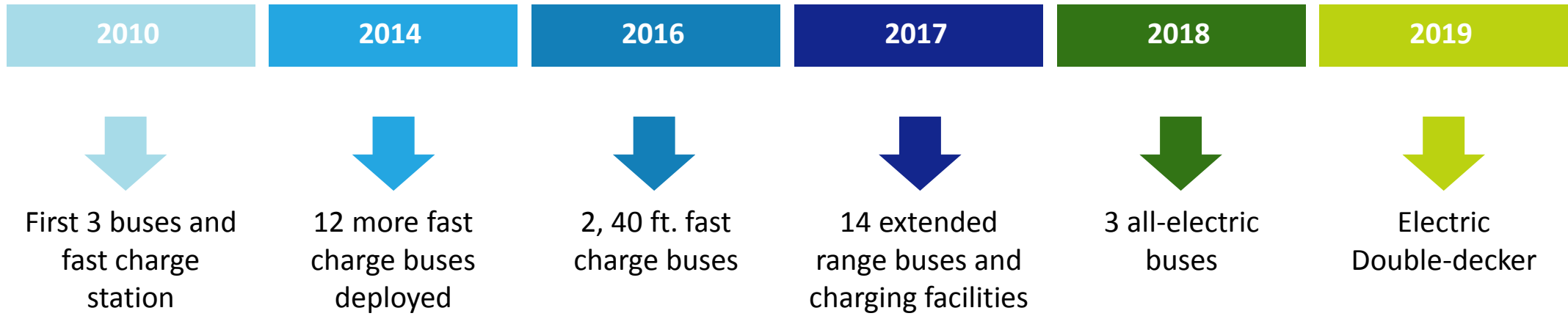
Foothill Transit

FOOTHILL TRANSIT ECOLINER 2010



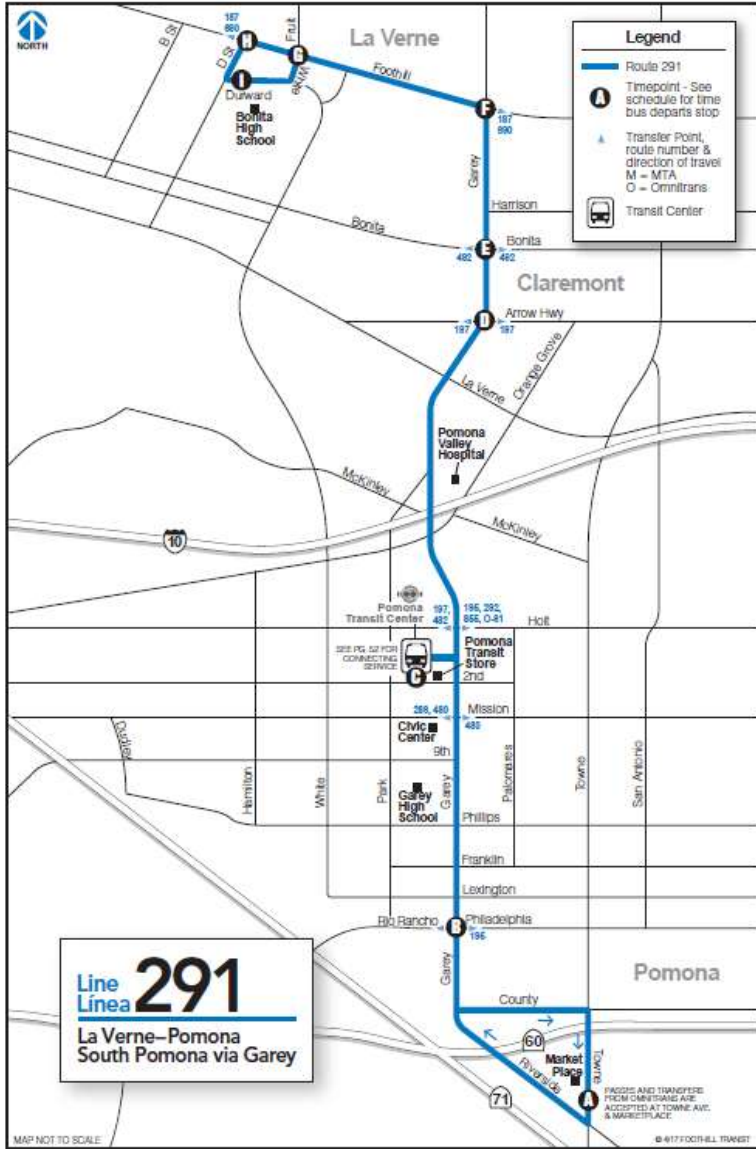
Foothill Transit

ELECTRIC BUS MILESTONES



CURRENT SERVICE

- 16 FAST CHARGE electric buses
- Line 291 – La Verne – Claremont – Pomona
- 7-min charge at Pomona Transit Center
- 8 buses at peak service
- In operation since 2010





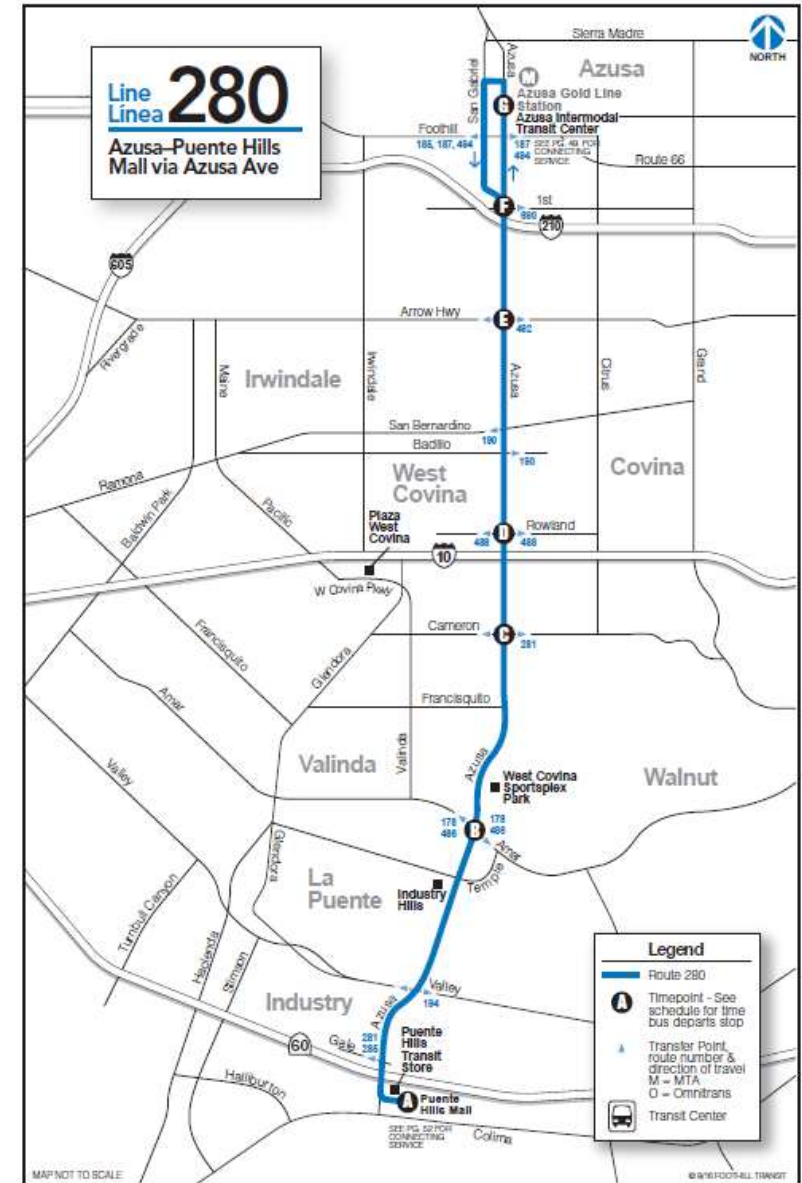
ABOUT OUR CHARGING STATIONS

- One high power fast-charge station with two overhead chargers, sufficient to serve all buses
- Over 150,000 charge cycles to-date, and 1.8 million electric bus miles
- Located at Pomona Transit Center, a central hub with off-street flexibility, safety and security



CURRENT SERVICE

- 14 EXTENDED RANGE electric buses
- Line 280: Azusa – Covina – West Covina
La Puente – Industry – Puente Hills Mall
- Overnight charging at Arcadia
Maintenance and Operations Facility
- On-route charging available at Azusa
Intermodal Transit Center (near Gold Line
Station)



INITIAL CHARGING INFRASTRUCTURE



NEXT GENERATION CHARGING INFRASTRUCTURE



CURRENT CHALLENGE: INSTALLING DEPOT CHARGERS



MAINTENANCE FACILITY CHARGING



SCE TIME OF USE EV8 RATES

TOU Period	Weekdays	Weekdays	Weekends/Holidays	Weekends/Holidays
	Summer	Winter	Summer	Winter
On-Peak	4 p.m. – 9 p.m.	N/A	N/A	N/A
Mid-Peak	N/A	4 p.m. – 9 p.m.	4 p.m. – 9 p.m.	4 p.m. – 9 p.m.
Off-Peak	All other hours	9 p.m. – 8 a.m.	All other hours	9 p.m. – 8 a.m.
Super Off-Peak	N/A	8 a.m. – 4 p.m.	N/A	8 a.m. – 4 p.m.



SCE TIME OF USE EV8 RATES

Summer season starts 12 a.m.
June 1 to 12 a.m. October 1

Timeframe	Rates
Summer Season On-Peak	\$0.483
Mid-Peak	\$0.245
Off-Peak	\$0.119
Winter Season Mid-Peak	\$0.284
Off-Peak	\$0.133
Super Off-Peak	\$0.0764

Winter season starts 12 a.m.
October 1 to 12 a.m. June 1



NEXT: ELECTRIC DOUBLE DECK BUS



Foothill Transit

RECOMMENDATIONS

Start small

Expect the unexpected

Electric power infrastructure is the
key to success



THANK YOU

Doran J. Barnes | Executive Director
dbarnes@foothilltransit.org



Foothill Transit

How to Ask Questions

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- We will collect all questions and get to as many as time permits during the Q&A portion of the program.



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X	Question	Asker

Remember to Register!

- Session 3: Zoom to Zero: Best Practices for EV Infrastructure (9/25)
- Session 4: Zoom to Zero: Fund the Electric Fleet (10/3)

Register at caltransit.org/events/webinars

Contact Us



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CaliforniaTransit
Association



Zoom to Zero: Battery-Electric Buses on the Road

(Co-Hosted by CALSTART)

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