# Real Life Experiences with Battery Electric Buses

## CTA 54th Annual Fall Conference

**November 2019**

**Donna DeMartino**

# San Joaquin RTD's Service Area and Services

SERVICE AREA San Joaquin County:
**1,426 square miles**

SERVICES
**33** Stockton Metro routes,
including, **5** Bus Rapid Transit (BRT)

**9** Metro Hopper routes
(deviated fixed routes)

**7** Intercity and Countywide routes

**3** Commuter routes

RTD Go! And RTD Van Go!

# 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!

# 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 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Funding Program (Grantor) | | | | | | | | | | |
| Bus # | Total Cost | 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 (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 Transportation 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** |

# Battery Electric Bus Funding

| Electric Bus Chargers | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Funding Program (Grantor) | | | | | | | | | | |
| Charger Type | Total Cost | 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 (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 Transportation 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

# Some Basic 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

RTD is engaged on all fronts to address the statewide challenges.

# Charging Technology

## Early-stage bus and charging technologies lack standardization

### Overhead Charging

- First generation of RTD electric buses have a short range and require frequent, on-route charging at high power levels
- Demand Management software designed for RTD regulates the chargers to reduce cost

### Depot Charging

- Second generation RTD buses have longer range allowing for overnight charging at lower power levels
- Currently depot chargers available on the market only have 1port
- Planning for full fleet electrification will require significant planning and space for charging stations using current designs

# RTD Charging Technologies

## Downtown Transit Center

Two opportunity chargers - both on one separately metered PG&E invoice


## Union Transfer Station

One current and one future opportunity charger - both will be on one separately metered PG&E invoice. Currently the site lighting and FVM are on this invoice, which will be separated in the future

# RTD Charging Technologies

Regional Transportation Center

Five depot chargers, all are on one separately metered PG&E invoice


Regional Transportation Center

One shop charger currently tied to the building meter to be separated in the future

# Addressing Infrastructure - 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."

# Addressing Infrastructure - RTD and PG&E Partnership

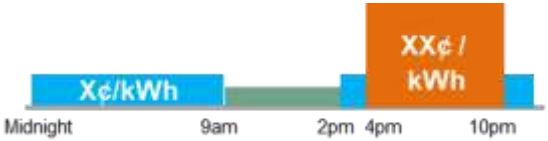
## RTD and PG&E Partnership

- RTD and PG&E are partnering on a pilot to better understand these challenges and develop innovative solutions to aid future agencies in electrifying
- Existing commercial rate structures can cost more than diesel per mile. PG&E has proposed a new EV rate for commercial charging applications:

**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

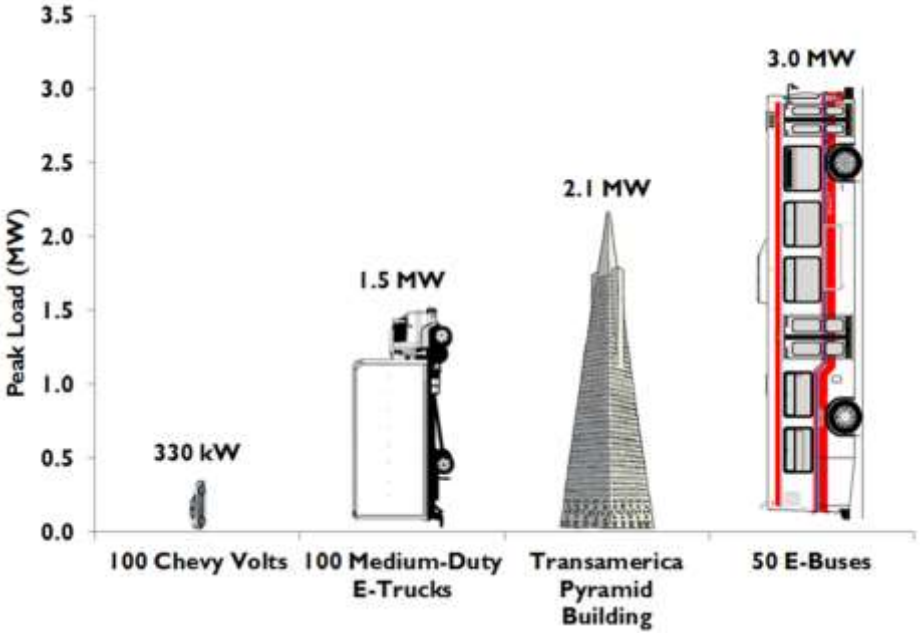
PG&E launched the FleetReady program to reduce the infrastructure hurdles for medium/heavy duty electric vehicles. This program pays for a significant portion of the total site costs, including civil design, utility upgrades, and electrical construction costs:

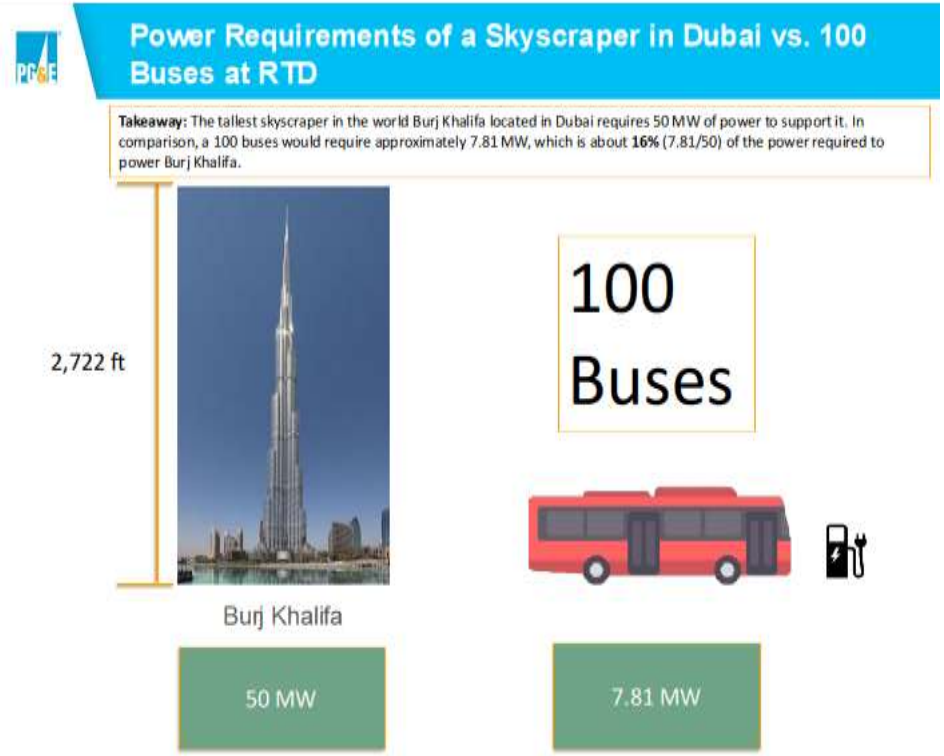

* Some exceptions may apply to customers who hold Primary Service with PG&E

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

# Infrastructure
# What will it take to power our fleets?

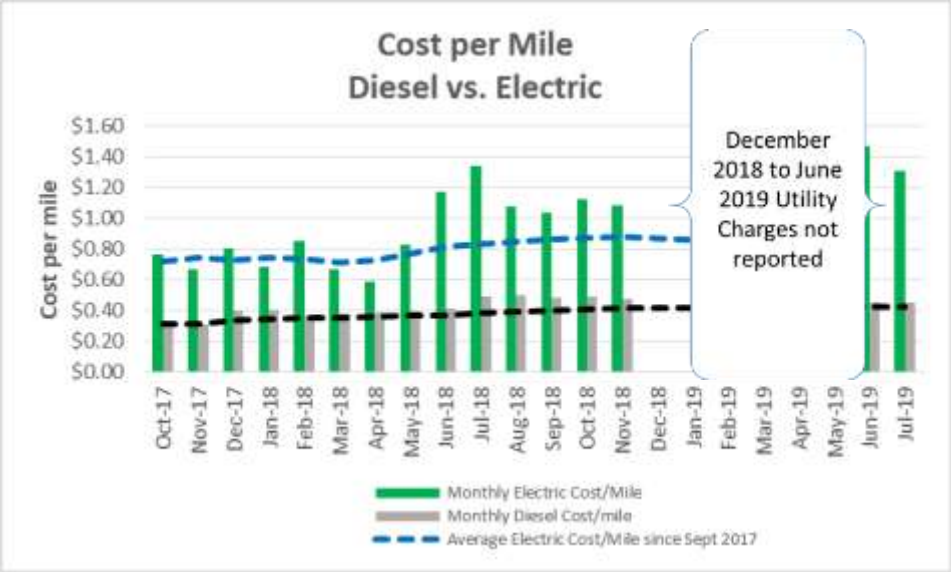
Fully electrified fleets will have large energy needs, but utilities believe they can meet capacity requests with adequate planning and active collaboration with transit agencies



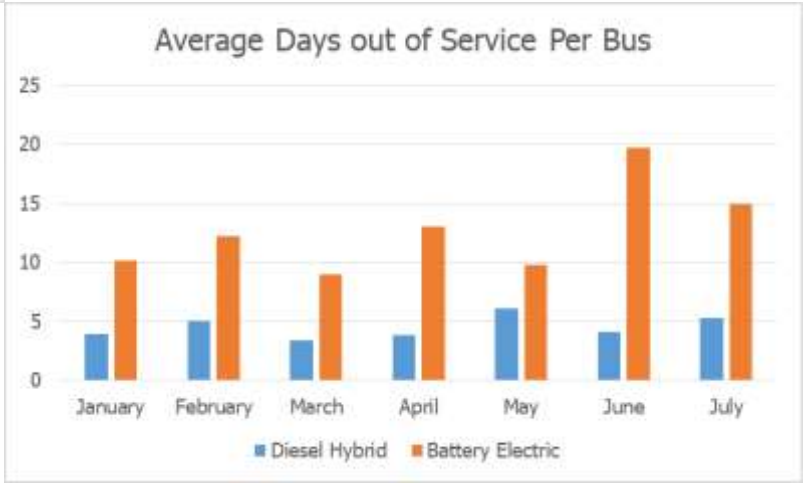

100 buses @ ~8 MW= 16%
250 buses @ ~20 MW = 40%
500 buses @ ~40 MW = 80%
10,000 buses @ ~800 MW = equivalent of 16 skyscrapers

# Additional Challenges -Hybrid vs. Electric Cost & Reliability



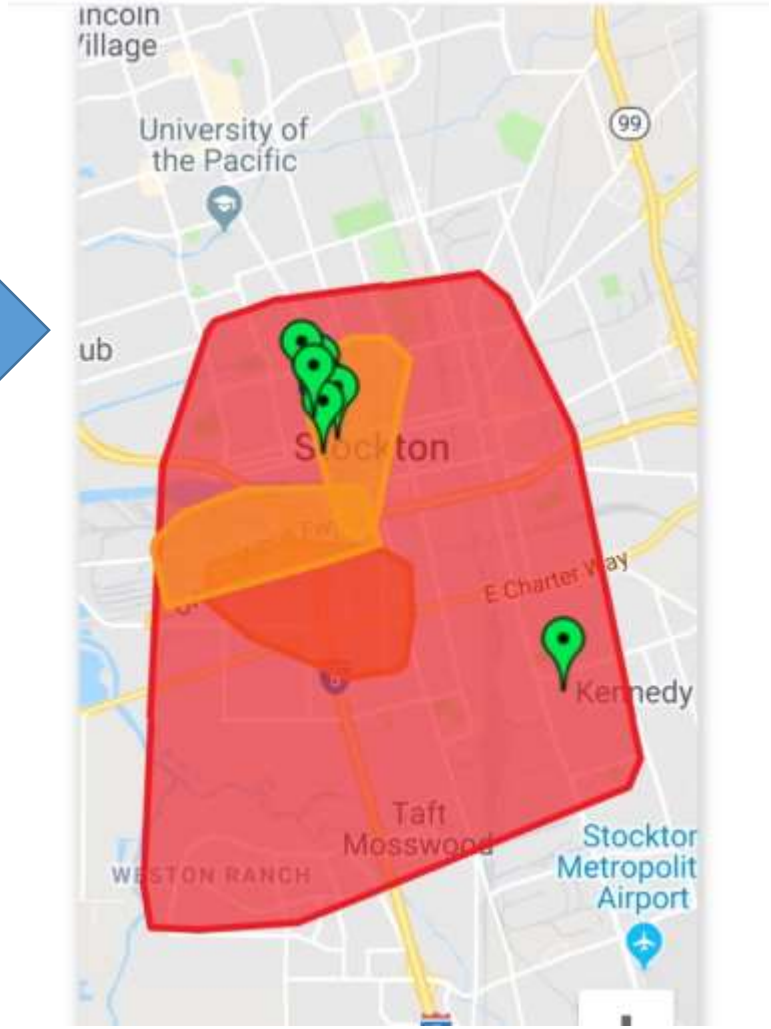

Diesel Hybrid vs. Electric Fuel Cost

Chargers and buses out of service



# Additional Challenges - What Happens When the Power Goes Out?

One day last April in Stockton



# Questions?


For more information please contact RTD Darla Smith at drsmith@sjrtd.com