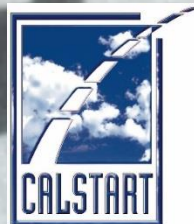


Best Practices: Deploying Low or No Emission Buses

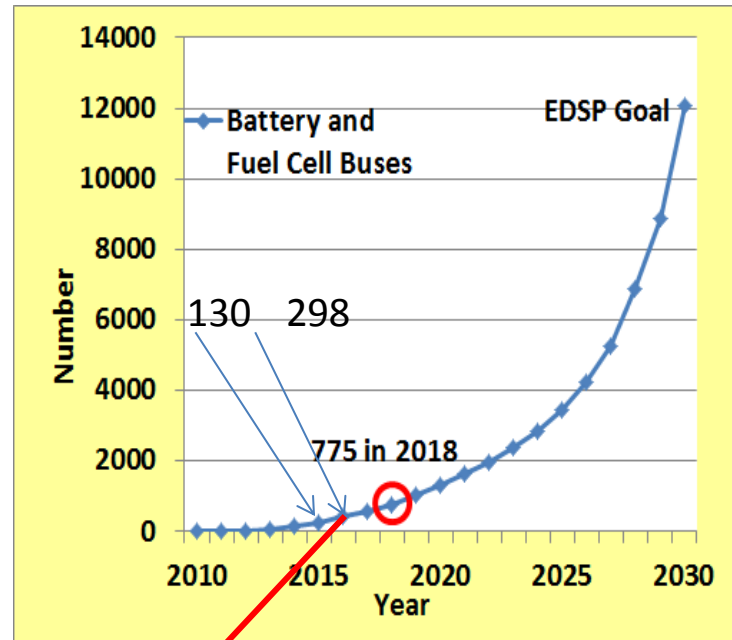
- Getting ready for the FTA Low or No Emission Vehicle Deployment Program

Fred Silver- Vice President and Bus Initiative Team Leader 1/24/17

fsilver@calstart.org 626-744-5687



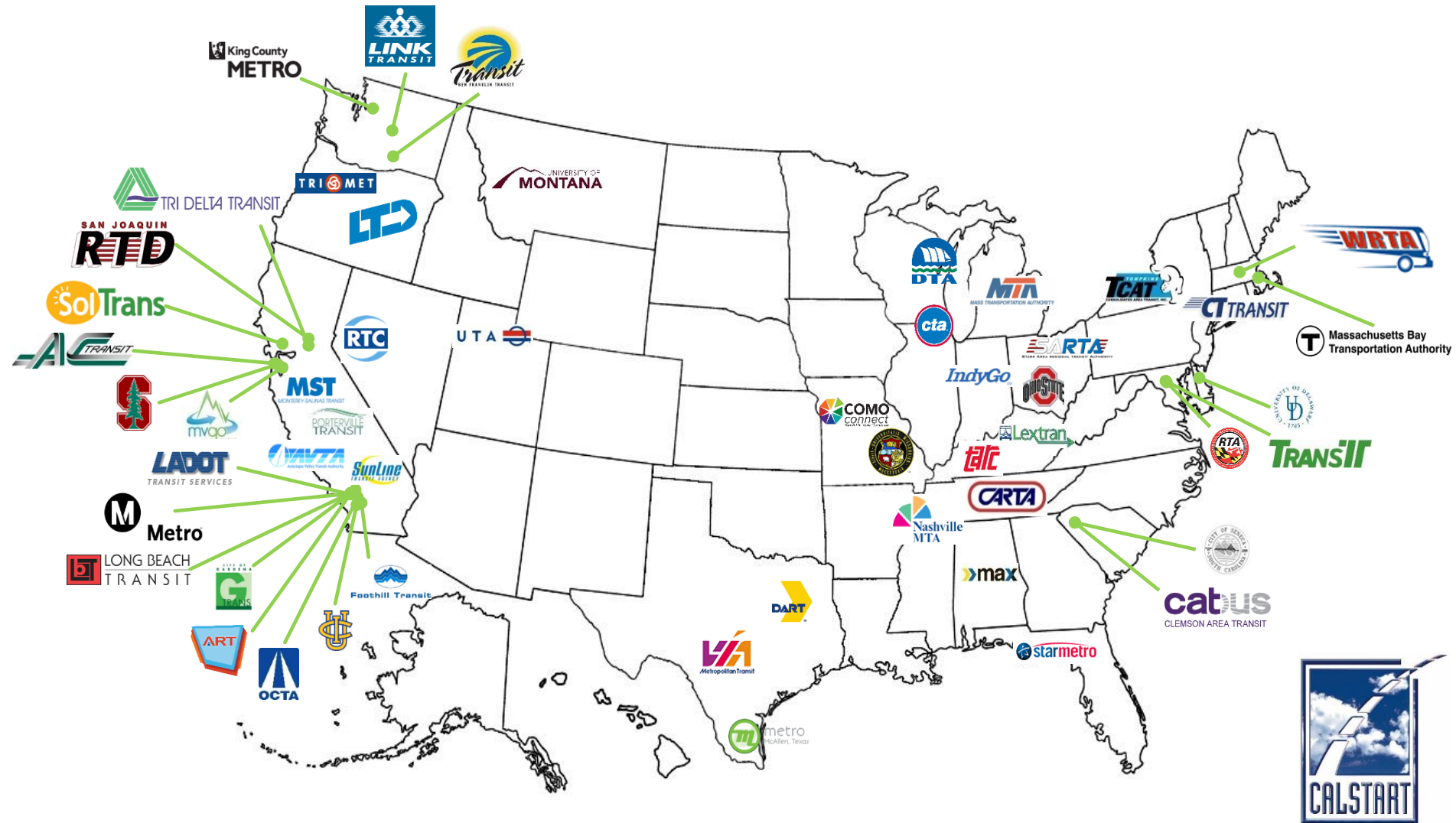
2016 ZEB Order and Deployment Status



Approaching 600 Cumulative On Order or Deployed Buses as of CY 2016
Approx. 10% Fuel Cell

- Some ZEBs are Approaching Initial Capital Cost Parity with Hybrid Electric buses
- California, New York and Chicago offer Excellent \$ Incentives
 - up to an additional \$150,00 per ZEB
 - Please contact fsilver@calstart.org for assistance in tapping these incentive \$

Updated April 11, 2016

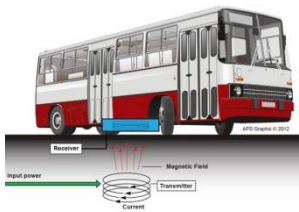


Zero Emission Bus Operational Schemes

- Fuel Cell Buses offers extended daily operating range (up to 300 miles) as well as centralized refueling similar to natural gas
- Battery Electric Buses delivered today typically provide approx. 150 miles operating range and have two operational schemes
 - Opportunity or On Route Charging
 - Allows bus to operate extended hours , even 24 hours per day
 - Overhead Coupler- 50-500kw
 - Wireless Charging-50-200kw Systems
 - Depot Charging
 - Provides centralized refueling back at the maintenance facility
 - Depot chargers ranging from 50 to 500 kw



More than Twenty ZEB Products Across Ten Bus Makers



Do Not Go it Alone

- A significant amount of assistance is available to help you succeed in
 - capturing FTA Low and No Emission Bus Funding
 - as well as successfully deploying the buses
- CALSTART, established was as a consortium to support the FTA in 1992 and has managed more that 700 Million in medium and heavy duty vehicle technology
 - We have 161 members including 21 Transit Fleets and nearly every Zero Emission Bus Maker
- **CALTART Vehicle and Technology Evaluation Services** can be a valuable resource
 - Check out reports available online at <http://www.calstart.org/Projects/Low-Carbon-Buses/high-efficiency-low-carbon-buses.aspx>
- CALSTART also administers three regional Zero Emission Bus Voucher \$ Programs <http://www.calstart.org/Projects/Incentive-Projects.aspx>
 - New York, Chicago and California
 - Provides up to \$ 150,000 in buy down funding per bus

Take Advantage of FTA LoNo Key Partnering

- FTA Lo No rules in the past have allowed for you to include key partnerships within your grant- (even the bus supplier)
- Do some diligence (but no need to do a full competition) on your bus key partnership and look ask for significant assistance to
 - Determine appropriate Zero Emission Bus Size and Product preference-
 - Preliminary Corridor analysis (top speed requirements, hours of operation)
 - Centralized Hydrogen Refueling strategies and/or Grid Issues –On route or depot charging
 - Other operational issues i.e. maintenance and training
- Key partners may include: List is not complete



List of Potential Key Partners in Alphabetical Order

- BAE Systems- Robert Devine robert.w.devine@baesystems.com
- Ballard Power Systems- Christopher Johnson christopher.johnson@ballard.com
- BYD Motors- Macy Neshati macy.neshati@byd.com
- CALSTART- Fred Silver fsilver@calstart.org
- Complete Coach Works-Ryne Shetterly rshetterly@completecoach.com
- Eldorado National California, Inc. Tony Wayne Tony.Wayne@eldorado-ca.com
- GreenPower Bus Brendon Riley brendan@greenpowerbus.com
- Hydrogenics- Robert DelCore rdelcore@hydrogenics.com
- New Flyer Bus-David Warren David_Warren@newflyer.com
- Nova Bus- Contact Judy Dennis judy.dennis@volvo.com
- Proterra Bus- Contact Mathew Horton mhorton@proterra.com
- Zenith Motors- Christine.Smith@zenith-motors.com
- Wave Technologies –Mark Masquelier michael@waveipt.com

SARTA FUEL CELL BUS AND FUELING PROJECT





SARTA Key Facts

- Transport 2.8 million passengers in 2014
- 210 employees
- \$18 million budget
- Operates express routes to Akron and Cleveland (the longest route in Ohio)
- 30 routes and countywide paratransit
- Extensive use of technology



SARTA Vehicle Types

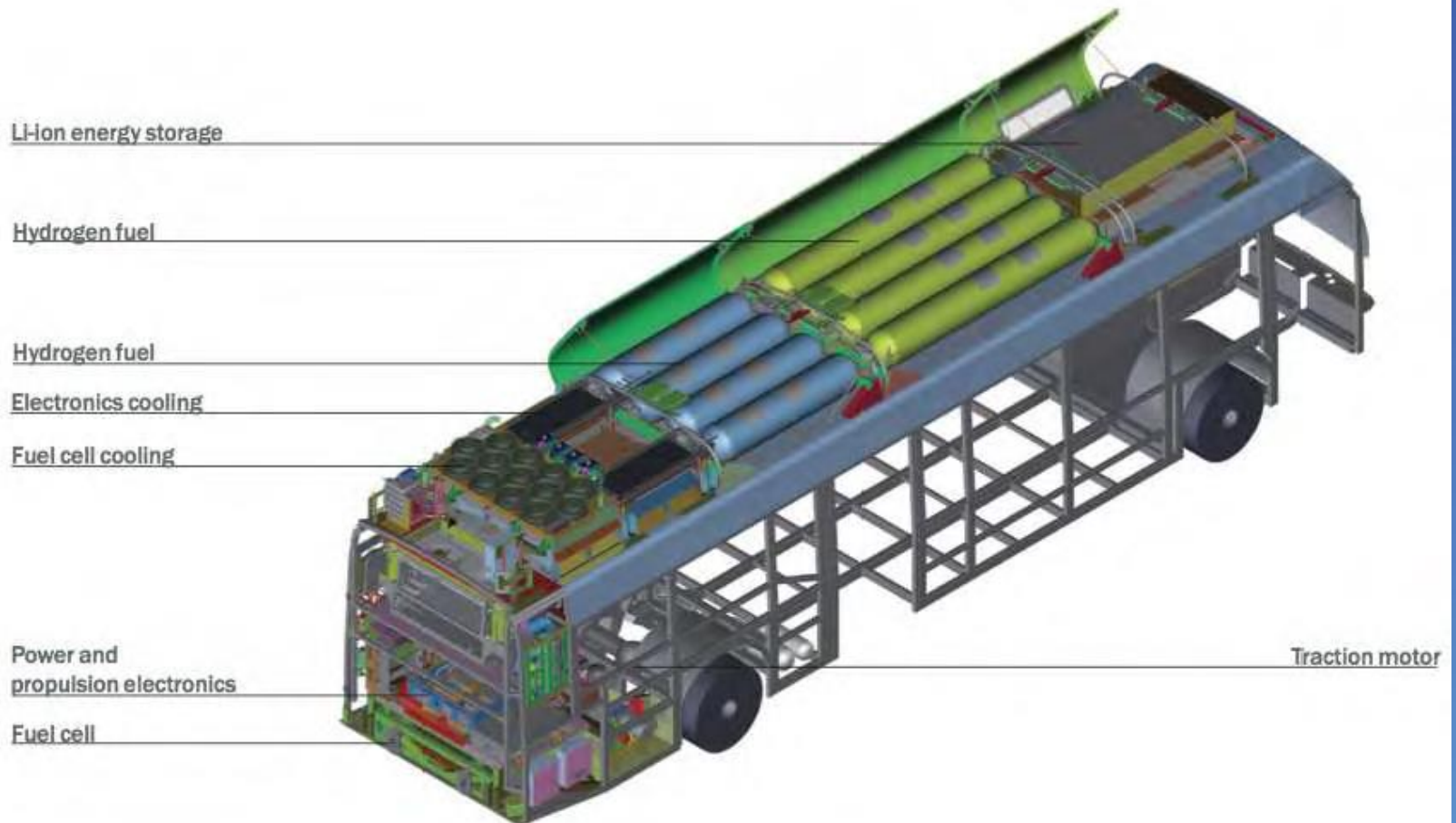
- 11 CNG Paratransit
- 11 CNG MV1
- 8 GNG transit buses
- 3 CNG Honda Civics
- 3 CNG Chrysler Town & County
- 4 Diesel Electric Hybrids
- 1 Diesel/CNG Duel Fuel
- 40 buses use B5 bio diesel

A vertical strip on the left side of the slide shows a close-up of a fuel cell bus component, featuring a series of circular vents or lights arranged vertically on a metallic surface.

National Fuel Cell Bus Program

- Part of a \$90 million Federal Transit Administration program
- Goal is to demonstrate fuel cell buses
- Set goals for performance and demonstration of vehicles
- Deployed vehicles IN NY, CA, MA, and SC
- 2 fuel cell buses will be in Canton
- Total federal funding is \$5.54 million

Bus Schematic



SARTA Fuel Cell Bus



Fuel cell and converter



Inside Fuel Cell Bus



Compressors



Compressor Pad



Hydrogen compressors



Hydrogen Storage



Station Controls





Why Fuel Cells:

- Why did We get involved with fuel cells?
- What are our motivations? Expectations?
- Supply Chain
- Why should others support fuel cells?



San Joaquin Regional Transit District

Best Practices: Deploying Low or No Emission Buses

Donna DeMartino
Chief Executive Officer

San Joaquin Regional Transit District

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

OPERATING BUDGET \$34.2 Million (FY 2016)

SERVICES

33 Stockton Metro routes, including:

3 Bus Rapid Transit routes

7 Intercity and Countywide routes

9 Metro Hopper routes

11 Commuter routes

ADA and General Public Dial-A-Ride

TRANSFER STATIONS

Downtown Transit Center

Mall Transfer Station

Hammer Triangle Station

EMPLOYEES 199 (RTD) + 77 (MV)

REVENUE VEHICLES

MCI Diesel Commuter

Gillig Hybrid Electric

Proterra Electric

**RIDERSHIP 4,047,559 (FY 2016)**

Electric Bus Fleet

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.

Current Fleet: Two (2) 35-foot Proterra buses
(2013)

Two (2) 40-foot Proterra buses
(2016)

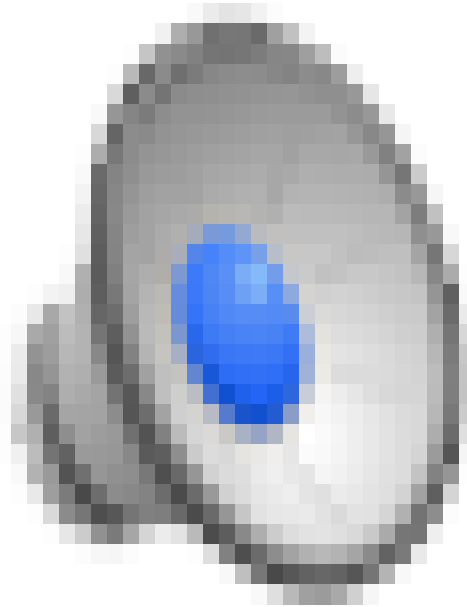
Projected Additions: Thirteen (13) 40-foot Proterra buses

- Average equivalent consumption is 20.1 miles per gallon
- RTD saves an average of over 500 gallons of diesel fuel monthly
- That reduce greenhouse gas emissions by over 15,000 pounds monthly
- That is the equivalent of planting over 300 trees monthly

RTD is working to develop the nation's first all-electric BRT corridor along Martin Luther King, Jr. Boulevard in South Stockton. The agency is committed to investing in new technologies, not just as a matter of innovation, but as a matter of mobility, public health, and environmental justice.



How Does It Work?



Metro Express 2007



Metro Express Facts:

- Provides 50% of RTD's annual systemwide ridership
- Three major corridors in the Stockton Metropolitan Area
- Uniquely-branded buses and shelters, use of pre-paid fares, and 10-, 15-, and 20-minute peak frequencies
- Operates 60-foot articulated buses to accommodate its ever-increasing ridership
- In June 2015, RTD received a \$6.8 million grant to fund two new Bus Rapid Transit corridors

Project Total: \$27,769,556

Funding Sources

Federal: \$21,788,230

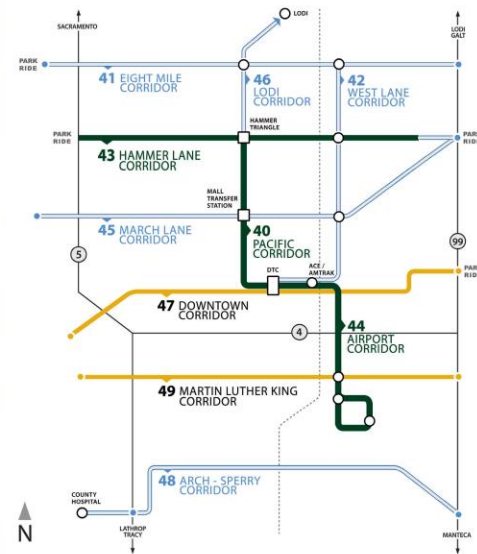
State: \$3,761,932

Local: \$2,219,394

Proposed BRT SYSTEM MAP

- Transfer Station
- Transfer Point
- PARK RIDE Park-N-Ride Location

- Proposed BRT Corridors
- Existing BRT Corridors
- Future BRT Corridor





CHICAGO TRANSIT AUTHORITY

CTA All Electric Bus Program

<http://www.transitchicago.com/electricbus/>

Marc Manning

01/24/2017





Overview

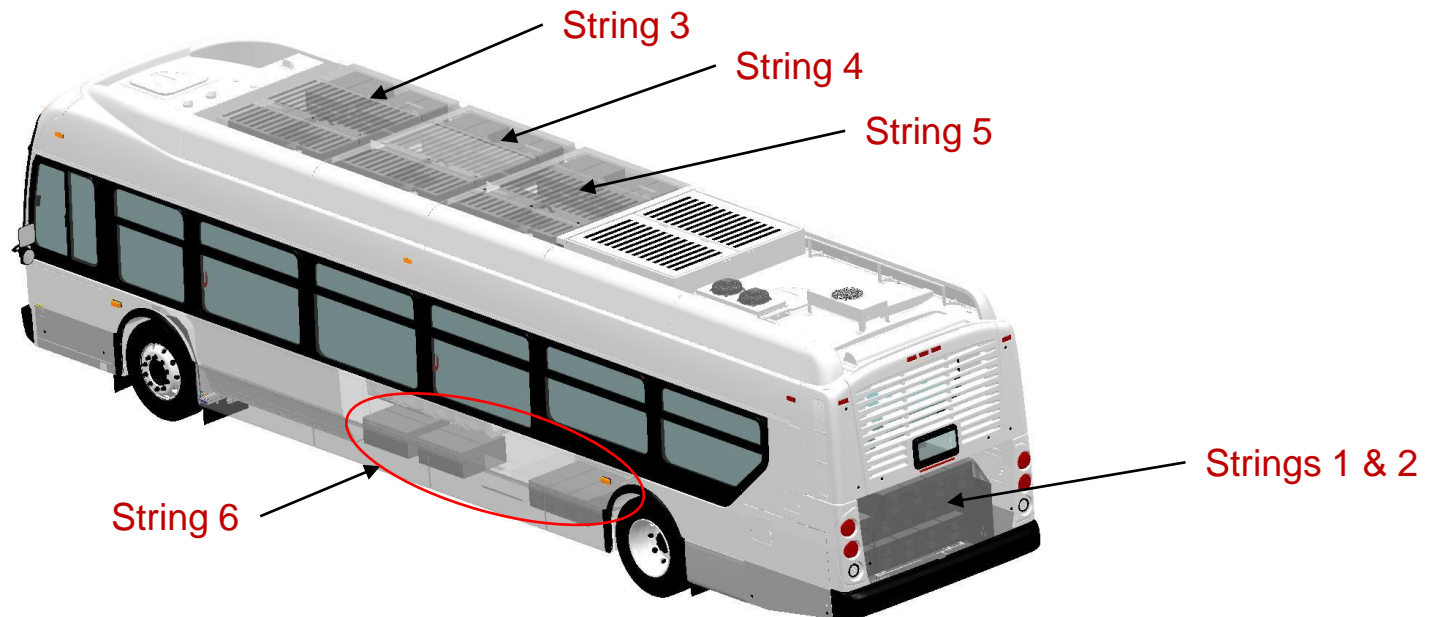
- Electric Bus
- Charging Infrastructure
- Electric Bus Daily Revenue Schedule
- Bus Livery
- Promotional Interior Ads
- Questions

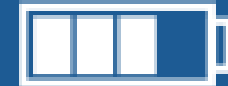




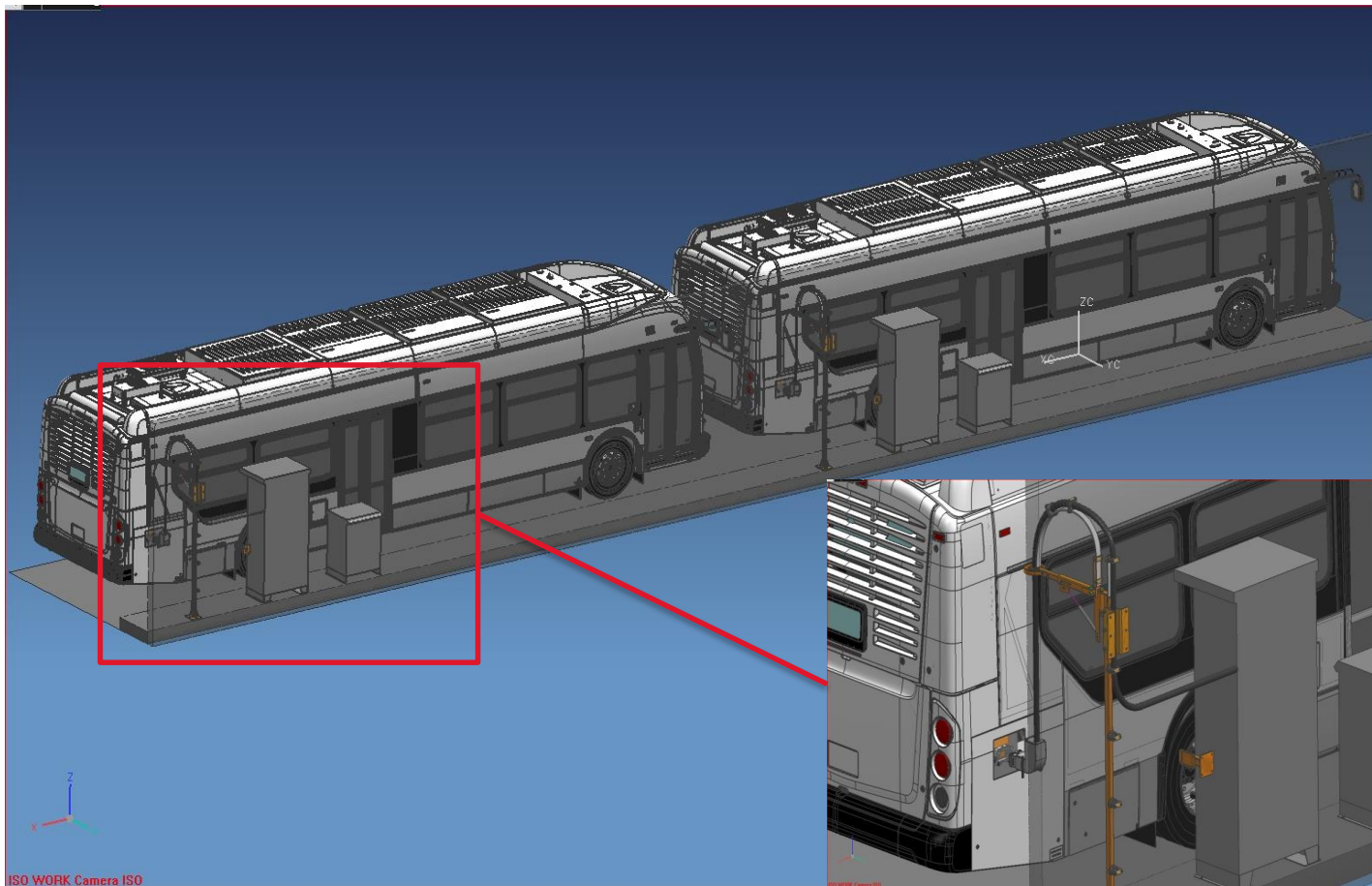
Electric Bus

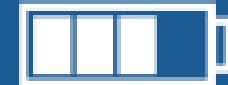
- New Flyer XE40 with 300 kW-hr Battery Capacity





Charging Infrastructure





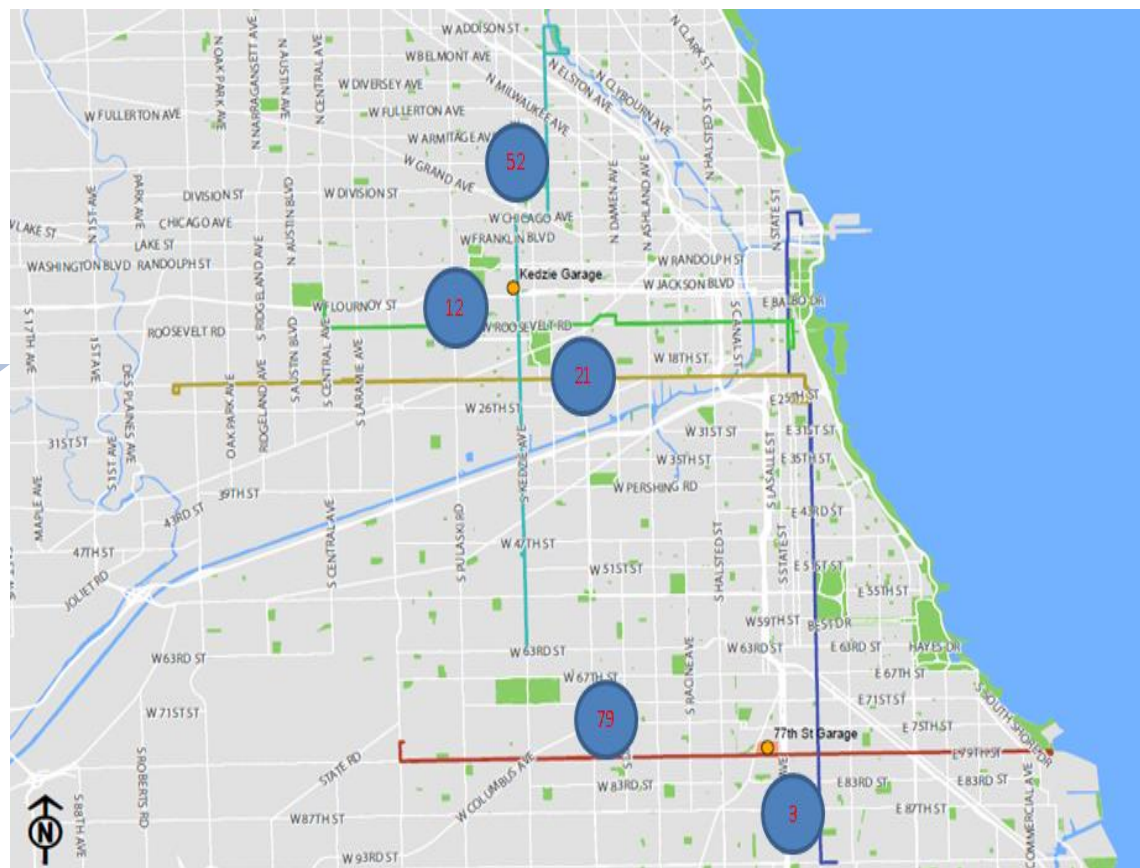
Electric Bus Daily Revenue Schedule

Overnight Charge
@ Garage (~3-5
hours)

Morning Revenue
Service 50-60
miles (~6 hours)

Afternoon
Revenue Service
70-80 Miles (~8
hours)

Mid-Day Charge
@ Garage (~3-5
hours)

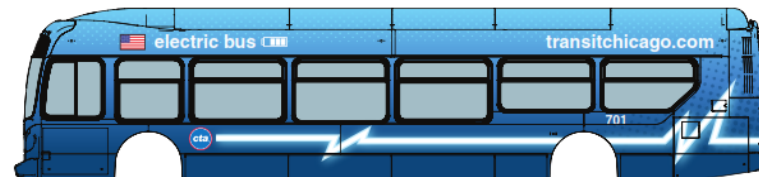
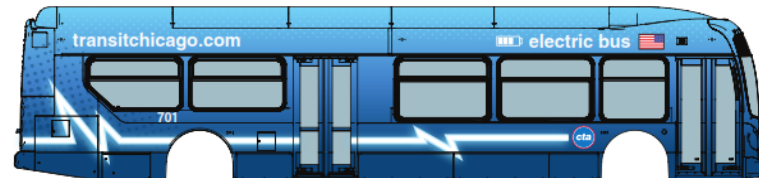
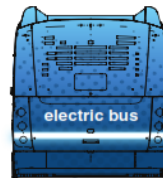
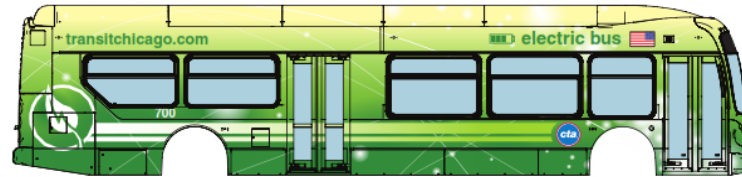
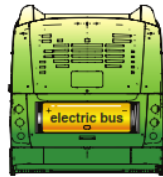


Note: Ridership for routes is published here → <http://www.transitchicago.com/ridership/>



CHICAGO TRANSIT AUTHORITY

Bus Livery





CHICAGO TRANSIT AUTHORITY

Promotional Interior Ads



\$25,000

CTA's annual net savings in fuel costs for each electric bus, or \$300,000 over the expected 12-year life span of each bus.*

*When compared to the Nova 6400-series buses they replace.

transitchicago.com/electricbus



80 to 120 miles

The estimated distance this bus can travel on a single charge. Charging a bus takes about 3-5 hours, less than the amount of time needed to charge some tablet devices.

transitchicago.com/electricbus



Breathe easier

With lower harmful emissions, operating one electric bus is the equivalent of removing 23 cars from the road each year! Reduction in harmful emissions also reduces incidents of illnesses and respiratory diseases, which is valued at \$55,000 annually per bus, or \$660,000 over the expected 12-year bus lifespan.*

*Based on the EPA's Diesel Emissions Quantifier Health Benefits Methodology

transitchicago.com/electricbus



You're helping shape the future of public transit

What we learn from using electric buses will not only help shape the future of CTA, but also the overall public transit industry in its ongoing efforts to become more environmentally friendly.

transitchicago.com/electricbus



Did you hear?

The noise produced by this electric bus is the equivalent to a human conversation. Enjoy the smooth, *quiet* ride!

transitchicago.com/electricbus





CHICAGO TRANSIT AUTHORITY

Questions



Kirt Conrad
CEO

Stark Area Rapid Transit District

Kirt Conrad has been the Executive Director/CEO of the Stark Area Regional Transit Authority (SARTA) in Canton, Ohio since 2009. SARTA operates 100 buses with 200 employees. Last year nearly 2.8 million passenger trips were transported by 30 fixed routes or demand response service throughout Stark County. SARTA opened Northern Ohio's first public-private Compressed Natural Gas (CNG) fueling facility. Currently, 40 vehicles are powered by CNG. Over 70,000 gasoline gallon equivalent is dispensed from the CNG station per month. SARTA's also operates diesel electric hybrids, biodiesel, and dual fuel GNC/DIESIL vehicles. They are also working with FTA, Ballard, BAE, and El Dorado to deploy 11 fuel cell buses, which will be the largest fleet in the country outside of CA. Together with Ohio State University's Center for Automotive Research, SARTA has launched the Midwest Fuel Cell Center of Excellence funded by the Federal Transit Administration. From 1996, Kirt worked for the METRO Regional Transit Authority in Akron as planner, grants manager, and planning director.

Kirt is also president of the Transit Health Pool of Ohio, the president of the Ohio Public Transit Association and treasurer of the Ohio Transit Risk Pool. Kirt is also on the board of directors for Clean Fuels Ohio and the Ohio Fuel Cell Coalition. He serves on Calstart's fuel cell infrastructure advisory board for public transit. Kirt, also served on the Center for Transportation and the Environment/Federal Transit Administration Procurement Risk Reduction for Zero Emission Vehicles committee. He is also a member of American Public Transportation Association's Zero Emission Bus Specification committee updating the Bus Specification White Book.

He received a Bachelor in Political Science from Kent State and a Master of Public Administration from the University of Akron. He recently completed graduate certificate in finance from the Grenoble Graduate School of Business in Grenoble France and is currently pursuing a Doctorate of Business Administration at Grenoble Ecole de Management focusing the development of hydrogen fueling infrastructure.

Donna DeMartino
General Manager/CEO
San Joaquin Regional Transit District

Donna DeMartino has worked in the transit industry for 30 years, having started as a part-time coach operator at Sacramento Regional Transit (RT). She joined RTD in 2001 after 14 years at RT and has served as RTD's CEO since 2001. Ms. DeMartino holds a Bachelor's Degree in Education, a Master's Degree in Transportation Management, and a certificate in Construction Management from UC Davis. She is a past chair of APTA's CEO Committee, the immediate past chair of the California Transit Association's Executive Committee, and serves on several

boards, including the National Transit Institute, Mineta Transportation Institute, and CALSTART.

Marc Manning

Asst Chief Bus Equipment Engineer

Chicago Transit Authority

Marc Manning graduated with a BSME from Georgia Institute of Technology in 2004 and a MSME from North Carolina State University in 2008. From 2005 – 2014, he worked in product development of diesel engines at Cummins Inc. He joined CTA in February 2014. Marc is now the Assistant Chief Bus Equipment Engineer for CTA.