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*Implementing Electric
& Alternative Fuel
Bus & Motorcoach
Operations Session*

Presentation Outline

- **DART Overview**
- **Bus Fleet Summary**
- **AFV Deployment & Capital Investment
[CNG Fuel / Electricity]**
- **CNG & BEB Charging Infrastructure(s)**
- **Electric Bus Program – Performance Experience**
- **Implementation – Bus Operations / Training**
- **Future Fleet Outlook**



Presented By:
Darryl E. Spencer, P.E.
Sr. Assistant Vice President,
Engineering
Dallas Area Rapid Transit (DART)

Mon., Jan. 13, 2020



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684 buses



Fleet

163 LRVs



4 streetcars



**Assets
(\$5.5B)**

256 Miles & 64 Stations



Infrastructure

**64 Million passenger
trips/year**



Operating Profile



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DART Bus Fleet Overview

26' Innovative / On-Call
(17%)



31' Urban Transit (9%)



35' Battery Electric (1%)



40' Urban Transit (60%)



40' Suburban Express (7%)



40' -- 2019 Urban Transit (6%)



DART let's go.

684

4

DART Bus Fleet Summary

<u>Fuel Type</u>	<u>Total Qty</u>	<u>Total %</u>
26' CNG	115	17%
30'-40'CNG	475	69%
40' Transit CNG (2019 Delivery)	41	6%
40' Suburban CNG	46	7%
35' <i>Electric</i>	7	1%
Total (ALL) (<i>Clean Fleet</i>)	684	100%



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DART Vehicles

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AFV Service Deployment & Capital Investment [CNG Bus Fleet]



**In-Service CNG Fleet
Deployment:** *Oct. 2012*



**CNG Bus Fleet Miles
Logged:** *153,892,445 Miles*



**CNG Bus Fleet Capital
Investment:** *\$315 Million*



Added: *Forty-One (41) 2019
CNG Urban Transit Buses*

Supply Cost of CNG...

☐ Contract Term:

- *Apr., 2010 to Sept., 2020*

☐ Awardee:

- *Texas General Land Office (GLO)*

☐ Contract Value: *\$86.3M*

☐ Fuel Cost: *\$7.36/MMBtu*

☐ Fuel Cost(2): *\$0.97/DGE*

- CNG National Average: *\$2.17*
- Texas CNG Average: *\$2.02*



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Electrical Grid / Distribution System for Fuels



GLO manages an Oil and Natural Gas program and a state Electric Power Program.

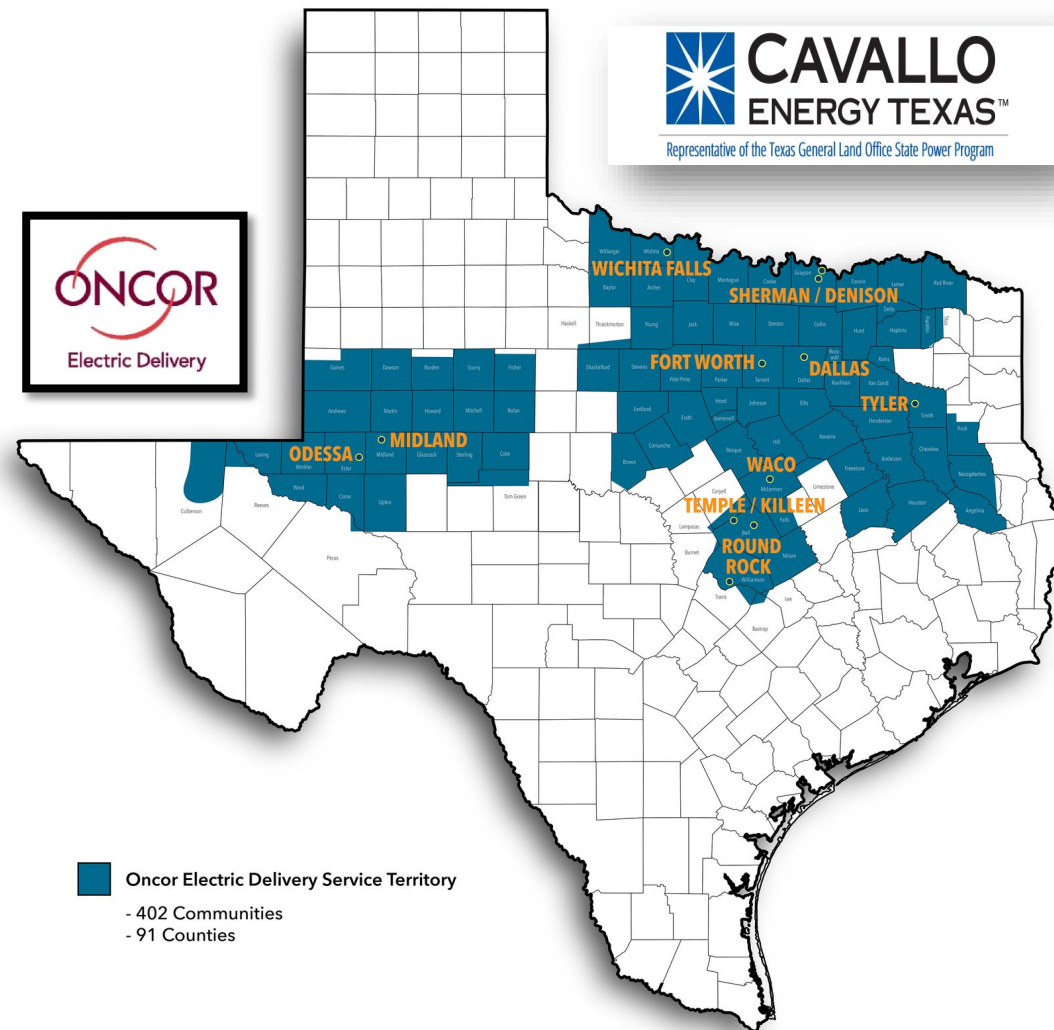
The Texas General Land Office

\$86,389,758 / 10-year CNG Fuel Contract

Electricity rates per kWh are budgeted at \$0.06740.

- \$11.34 kWh/car mile consumption rate for light rail vehicles (LRV).
- \$2.20 kWh/bus mile for the Battery Electric Bus average.

Electricity Contract extension from 2019 through 2023



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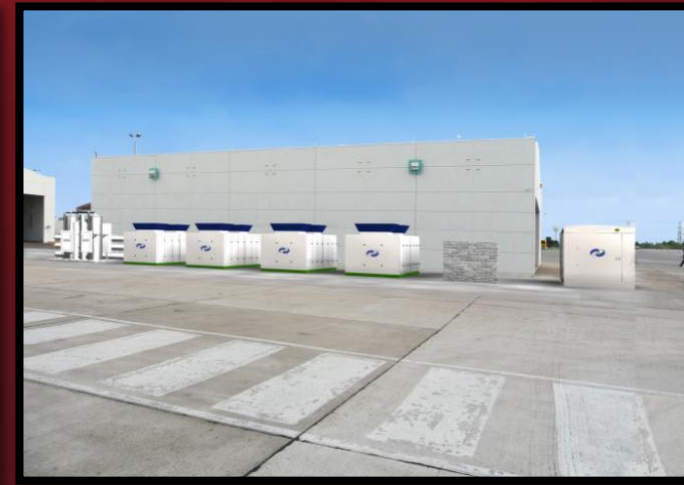
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DART CNG Infrastructure

Infrastructure Design/Build

- **4 facilities**
 - Compressors/Dispensers
 - Methane Detection/Alarms
- **Transtar Energy Company, LP**
[~\$40.4M]
- **Design & Construction of CNG fuel stations & facility modifications**
- **Startup – 10/2012**



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Overhead
On-Route Chargers
[primary charger]
(2 ea.)

Charging Infrastructure



Description	Budget
Bus Manufacturer's Contract	
7 - Proterra EcoRide™ V2 35ft Transit Buses	\$6,995,047
4 – Chargers:	\$810,000
(2) In-Route/Overhead & (2) Facility/Shop	
Training & Spare Components	\$191,051
Total Proterra Contract	\$7,996,098
Project Support Contracts	
Engineering Support (Design)	\$148,396
4 - Charger Installs (Construction)	\$1,013,000
Total Project Budget	\$9,157,494



Shop / Depot
Chargers
(3 ea.)

DART Electric Bus Program – Performance Experience

☛ **Customer Experience**: Passengers think the vehicles are Great! Enjoy the Roominess of the Interior layout and the A/C system.

☛ **Vehicle Reliability**:

❑ 70% (5 of 7) Average Availability → 143K Fleet Miles

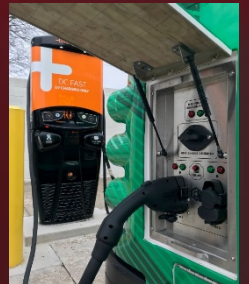
❑ Refresher Training Planned

❑ HVAC, PMI, Doors, and Electrical Systems Training

❑ Issues Experienced: CAN Cables || Windows Leaks || Controller || Overhead Fast Charger Blade Spacer || Claim Shell Shock Bracket Rework || Roof-mounted Battery Pack Overheating (Improved coolant loop)

☛ **Overhead Fast Chargers Exp.**: Various Chargers (A/B) Intermittent Faults.
(A = 56/28 Average per Month || B = 42/10 Average per Month)

☛ **Plug-In Depot Chargers**: OEM Upgrade Completed.





Implementation ➔ Bus Operations / Training

☑ TRAINING, OPERATORS [BUS OPS]

- ☐ TRAIN-THE-TRAINERS [8]
- ☐ OPERATORS TRAINED [110]
- ☐ FIELD SUPERVISORS [5]

☑ TRAINING, MECHANICS

- ☐ SOC BUS MECHANICS [43]
 - ❖ CENTRAL SUPPORT [10]
- ☐ ON-ROUTE CHARGER
 - ❖ TES (*Traction Electrification Systems*) MECHANICS [37]

☑ Special Tools

- ❖ Tow adapters / Laptops

☑ PPE (Personal Protection Equipment)

- ❖ Insulated tool sets for work on the E-Bus.

☑ SPARE PARTS / INVENTORY [115 LINE ITEMS]

☑ CONTRACT SPARE PARTS [22 LINE ITEMS]

☑ Manuals [Technical Publications]

- ❖ Operators ▲ Parts ▲ Maintenance

☑ CHARGING STATION COMMISSIONING

☑ Maintenance Templates [PMI]

☑ BUS MAKE-READY / MARKETING & COMMUNICATION

☑ Bus Deliveries / In-Service Deployment



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Readiness Review [Electric Bus Program]

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DART Bus Fleet Replacement Plan

Year	OEM	Length (ft.)/ Passenger Seats	Bus Qty	Fuel Type	Unit Cost (Yr. Purchased)	Replacement Year [Programmed]
2015-2016	ARBOC	26/17	28	CNG	\$220K	2021
2017	ARBOC	26/17	73	CNG	\$220K	2022
2018	ARBOC	26/14 26/17	14	CNG	\$172K / \$220K	2023
2013	NABI	31/26 40/37	186	CNG	\$435K / \$460K	2025
2014	NABI	31/26 40/37	183	CNG	\$435K / \$460K	2026
2015	NABI	40/37	106	CNG	\$467K	2027
2016	New Flyer (Express)	40/39	46	CNG	\$513K	2028
2018	Proterra	35/27	7	Electric	\$971K	2030
2019	New Flyer	40/37	41	CNG	\$527K	2031
Total			684			



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Future Fleet Outlook Comparison

Small MD Shuttle Bus

- **Battery Electric**
 - Cost Est: \$150-300K
 - Range: 80 – 150 miles
- **Hydrogen Fuel Cell Electric**
 - Cost Est: N/A
 - Range: N/A
- **CNG**
 - Cost Est: \$190-250K
 - Range: 250 miles

Heavy Duty 40' Bus

- **Battery Electric**
 - Cost Est: \$750-850K
 - Range: 175 – 250 miles
- **Hydrogen Fuel Cell Electric**
 - Cost Est: \$1.25M
 - Range: 225 – 300 miles
- **CNG**
 - Cost Est: \$625-650K
 - Range: 400 miles



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DART Principles

DARTing to the Future...

➔ Board Governance

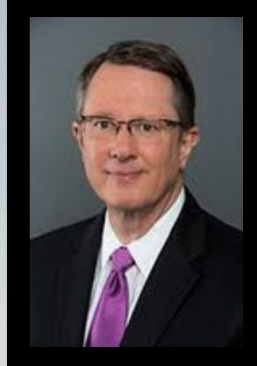
DART Board Strategic Goals serves as our cornerstone commitment to operating a **Clean Vehicle Fleet within the DFW Area and North Texas Region.** DART has made a commitment to the Environment.

➔ Technology Optimization

We continue to push the envelope for optimizing vehicle reliability and leveraging **OEM continuous improvements** within CNG fuel systems and BEBs technology. We have one of the most modern fleets in the industry.

➔ Maintenance & Operators National Recognitions

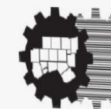
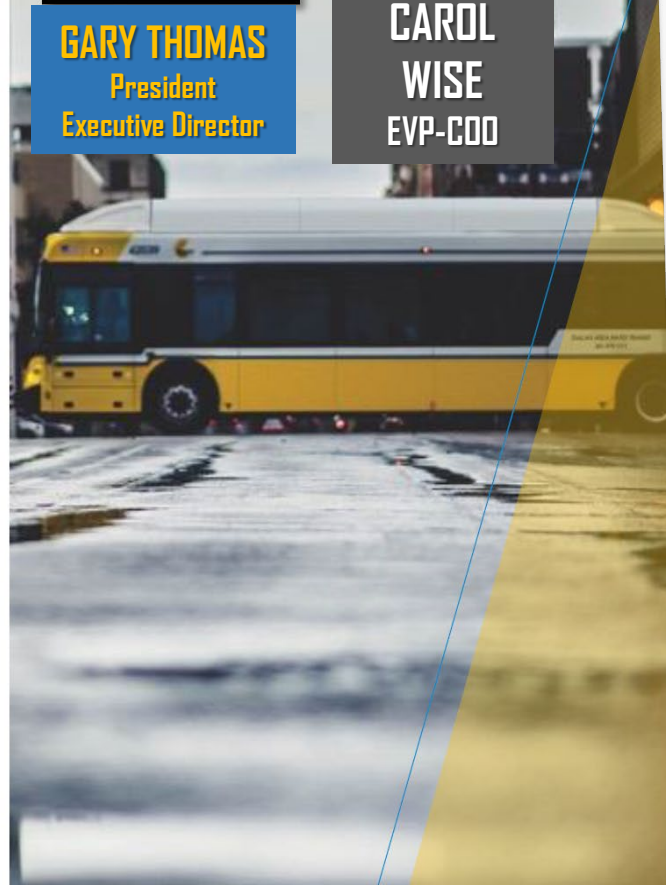
National & International skills performance competition achievements.



GARY THOMAS
President
Executive Director



CAROL WISE
EVP-COO



North Central Texas
Council of Governments



Dallas-Fort Worth
CLEAN CITIES



PRESS RELEASE

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DFW Fleets Recognized for Actions to Improve Air Quality

Recipients contributed to regional savings of over 23 million gallons in 2018

Dec. 17, 2019 (Arlington, Texas) — The Dallas-Fort Worth Clean Cities Coalition on Dec. 17 announced the winners of its Fleet Recognition Awards. For the first time in the awards' five-year history, there were entities that brought home the Gold. The cities of Euless and Southlake and Dallas Area Rapid Transit earned the top award for their efforts to reduce emissions and improve the fuel efficiency of their fleets.



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Transit 2.0: Innovative Mobility Solutions in Dallas



DART hired Uber to drive around riders. Now, it's considering driverless buses

DART has joined a national consortium that will study the safety of driverless buses and how they could reduce congestion.

DART Sets Its Sights on Automated Buses

The Dallas-area transit agency is partnering with other agencies to study driverless buses and their role in the future of transit systems.
June 10, 2019, 2pm PDT | [Camille Fink](#)
[SHARE](#) [TWEET](#) [LINKEDIN](#) [EMAIL](#) [COMMENTS](#)



Dallas Area Rapid Transit is part of the [Automated Bus Consortium](#), a group of transit agencies exploring the future of automated driverless buses, reports Melissa Repko.

"For the first 12 months, the consortium plans to study the feasibility of autonomous buses. It plans to buy an initial fleet of 75 to 100 full-sized, automated buses, which it will test in 2021 or 2022 on routes chosen by the transportation agencies," writes Repko.

DART, along with transit agencies across the country, is contending with ridership decreases. With much of the agency's costs related to labor, DART officials see autonomous buses as a way to lower operations costs. The consortium approach will allow the agencies to work together to test the vehicles and lower purchase costs.

Government Technology
(govtech.com)
June 4, 2019

Autonomous Buses Could Follow DART's Uber Program

By working together, the transit agencies aim to lower the cost of testing and share best practices, the news release said.

BY MELISSA REPKO



A DART light rail train in Dallas, Texas. SHUTTERSTOCK/STOCK_PHOTO_WORLD

(TNS) — Dallas Area Rapid Transit has joined a national association of transit and transportation agencies to explore how autonomous buses could shuttle people around cities in the future.



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DART's fleet of electric buses roll out in downtown Dallas

The seven new buses started running on DART's free downtown service, the D-Link route, early this month.

Filed under [TRANSPORTATION](#) at <https://www.dallasnews.com/news/transportation/2018/07/10/darts-fleet-electric-buses-roll-downtown-dallas>

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