

Rhett Crowninshield
Transit Administrator

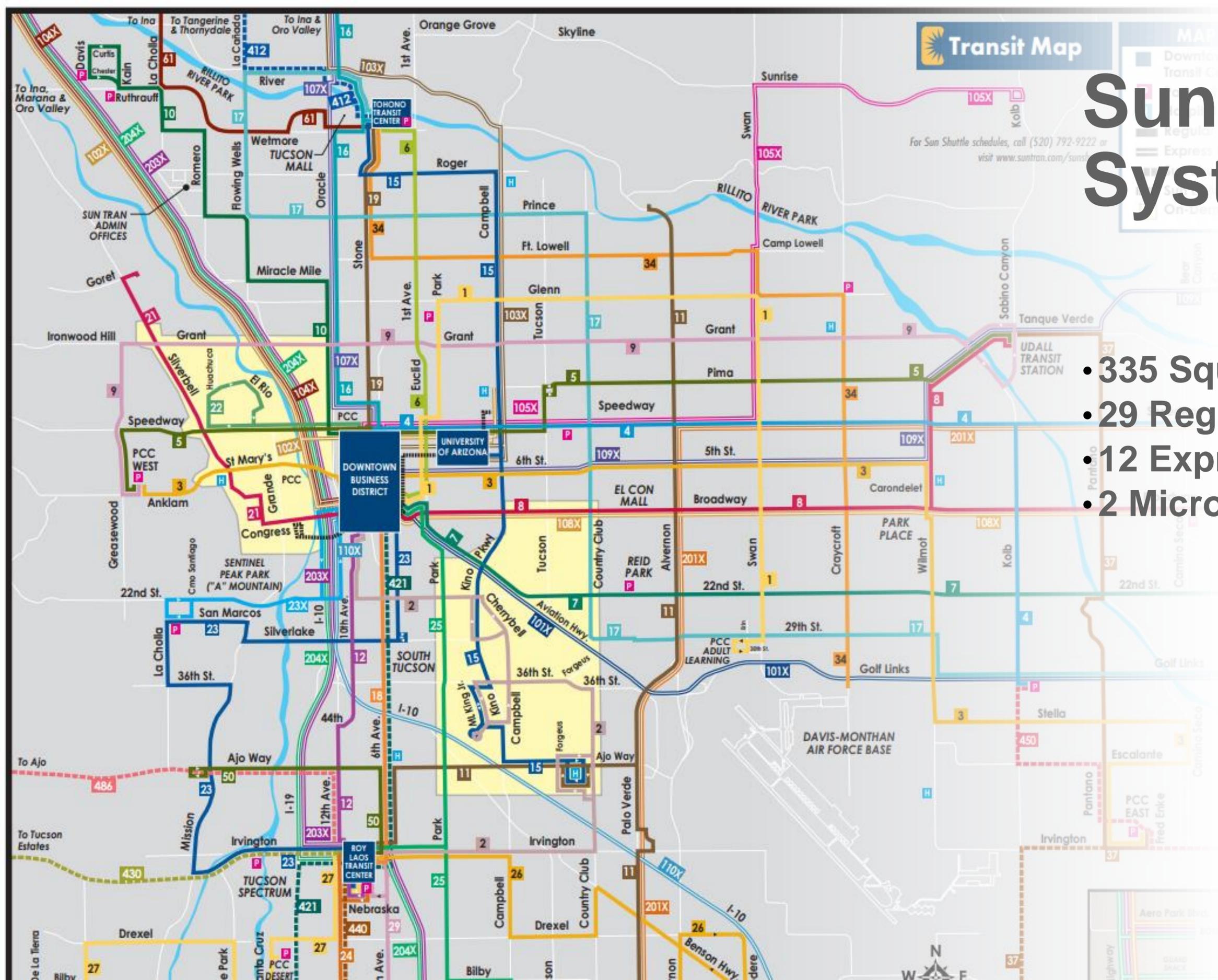
City of Tucson – Department of Transportation and Mobility

Background

- Well-traveled Tucson Native
- University of Arizona BSBA, Vanderbilt University MBA
- Began oversight of Transit Division in 2019
- 20 years combined experience in transit related projects with a focus on energy and economic development

Sun Tran System

- 335 Square Miles
- 29 Regular Fixed Routes
- 12 Express Routes
- 2 Micro Transit



Fast Facts About Sun Tran's Fleet

- **Current**

- 185 Total 40-foot Buses in Fleet Serving 30+ Routes
- 126 CNG Buses
- 10 Battery Electric Buses
- 49 Diesel Buses

- **Future**

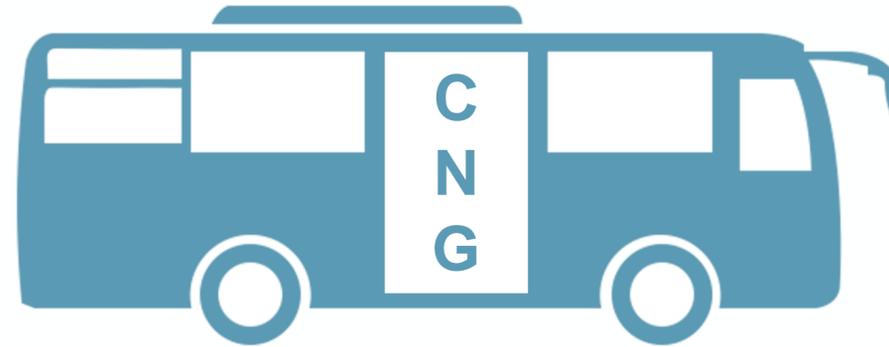
- 165 CNG Buses (New CNG Station to be completed in 2025)
- 20 Battery Electric Buses (New Electric Charging to be completed in Q4 2025)
- Potential Bus Rapid Transit Line for 2026 (Electric or CNG)



Bus Comparison

Cost & Emissions Info for Bus Fleet
Life Cycle Analysis

Emissions data is in Metric Tons of Carbon Dioxide Equivalent (MTCO2e)
Information on emissions data taken from Atlas Public Policy Data



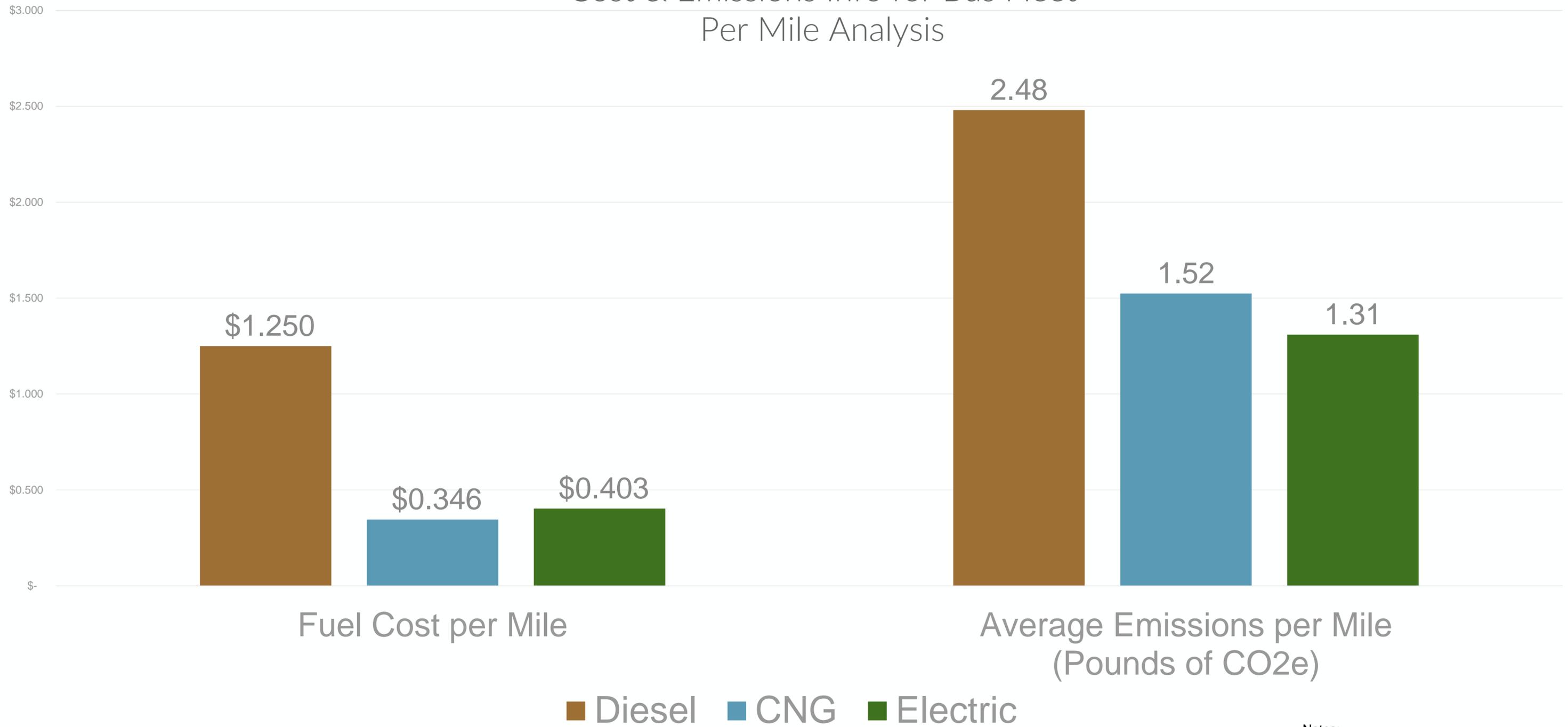
Diesel	
Total Cost of ownership (fuel & purchase price)	\$ 830,227
Fuel Cost per Gallon	\$2.50
Lifetime Emissions (MTCO2e)	893 MTCO2e
Emissions Reduction vs. Diesel	N/A
Emissions Reduction vs. Electric	N/A
Cost per MTCO2e Reduced	
Diesel	N/A
CNG	N/A

CNG	
Total Cost of ownership (fuel & purchase price)	\$ 635,427
Fuel Cost per GGE (Gallon of Gas Equivalent)	\$.35
Lifetime Emissions	548 MTCO2e
Emissions Reduction vs. Diesel	(344 MTCO2e)
Emissions vs. Electric	77 MTCO2e
Cost per MTCO2e Reduced	
Diesel (savings per MTCO2e avoided)	(\$566)
CNG	N/A

Electric	
Total Cost of ownership (fuel & purchase price) Not including charger installation	\$1,776,178
Fuel Cost per Gallon of Gas Equivalent (2.5 kWh per mile)	\$.40
Lifetime Emissions	471 MTCO2e
Emissions Reduction vs. Diesel	(421 MTCO2e)
Emissions Reduction vs. CNG	(77 MTCO2e)
Cost per MTCO2e Reduced	
Diesel (additional \$ per MTCO2e avoided)	\$ 445
CNG (additional \$ per MTCO2e avoided)	\$ 5,073
With Govt grants (no cost busses, savings in parentheses)	(\$5,785)

Bus Comparison

Cost & Emissions Info for Bus Fleet
Per Mile Analysis



Notes:
Diesel price based on \$5 per gallon (4 miles per gallon)
CNG price based on \$9 delivered per MMBTU
Electric price based on \$.16 delivered per kWh- Electric emissions per mile based on TEP's Integrated Resource Plan that they are not legally obligated to follow.

Range

- **CNG Buses**

- 300-mile range
- 18-36 hours of service life
- Can operate two consecutive days without needing to refuel

- **BEB Buses**

- 120-170 Miles (depends on weather, driver habits, and topography)
- 8-12 hours of service life between charges
- Need to be recharged daily





Environmental Impacts

- **CNG Buses**

- Byproduct of fracking
- New sources for renewable natural gas (RNG)
- Los Reales landfill gas project (trash to tank)

- **BEB Buses**

- Where are the electrons created (is it from coal or something cleaner)?
- Rare Earth mining, copper mining
- Zero tailpipe emissions



Day to Day Operations

- **CNG Buses**

- Fast fill fueling (five minutes to fuel to capacity)
- Buy natural gas on contracts, able to budget
- Buses can go two days on one fill

- **BEB Buses**

- Time of use fueling window
- Charge once daily (5-7 hours to charge)
- On route charging is prohibitive

Lessons Learned



FUELING INFRASTRUCTURE IS EVERYTHING (TRANSFORMERS, SWITCHGEAR, PIPELINES, ETC)



TRANSMISSION AND DISTRIBUTION IS KEY, GRID WILL NEED SIGNIFICANT INVESTMENT TO ALLOW FOR FULLY ELECTRIC TRANSITION



PLANNING TAKES YEARS



ABILITY TO BE NIMBLE IS KEY



AT FULL BUILD OUT, 2.2 MILLION GALLONS OF DIESEL REMOVED FROM USER PER YEAR

Questions/Contact Information



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