Feasibility Study of Alternative Fueled Buses

May 25, 2023
OVERVIEW

• Purpose
• Project Goals
• Technology Options and Evaluation
• Recommendations
PURPOSE OF A FEASIBILITY STUDY OF ALTERNATIVE FUELS

- Evaluate the technical and economic feasibility of alternative fuel vehicles based on commercially-available technology.

- Focus for Jaunt: vans and cutaway style buses, possible conversion of demand-response and ADA fleets
PROJECT GOALS

- Achieve 45% GHG reduction by 2030
  - Net zero GHG by 2050

- Determine a preferred cleaner fuel type for Jaunt
  - Consider trade-offs including operating and capital cost, emissions impact, and operational viability
  - Balance the current level of service with practicality of low or no emissions vehicles (minimize impact to operations)
  - Consider well-to-wheel impact of propulsion technology on emissions

- Determine high level implementation strategy and timeline of the preferred fuel type
TECHNOLOGY EVALUATION

- ‘Traditional’ Diesel or Gasoline Fossil Fuel
- Compressed Natural Gas (CNG) - Natural or Renewable
- Battery Electric - Depot and fast charging
- Hydrogen Fuel Cell Electric
- Other types:
  - Hybrid Electric
  - Propane
  - Biodiesel
TECHNOLOGY EVALUATION:
COST OF FUEL PER GASOLINE GALLON EQUIVALENT (GGE)

Average Retail Fuel Prices in the United States

Source: Clean Cities Alternative Fuel Price Reports | Electricity prices are from EIA's Real Prices Viewer.
Notes: Fuel volumes are measured in gasoline gallon equivalents (GGEs).
TECHNOLOGY EVALUATION:
CURRENT SHARE OF TRANSIT BUS FUEL TYPES

Source: Derived from Tables 21 and 34 in Appendix A of the 2020 Public Transportation Fact Book from the American Public Transportation Association

Notes: “Natural Gas” includes compressed and liquefied forms. “Other” up to 2007 included propane, bio/soy fuel, and biodiesel. After 2007, “Other” included battery-electric, hydrogen, and propane.
TECHNOLOGY EVALUATION: COMPRESSED NATURAL GAS AND PROPANE AUTOGAS

- Combustion-based fuel
- Like conventional gasoline or diesel vehicles
- Similar vehicle range
- Emissions are dependent on fuel sourcing
TECHNOLOGY EVALUATION: CNG AND RENEWABLE NATURAL GAS PROS AND CONS

Opportunities

- Fixed-route and demand-response services can be accommodated
- CNG technology is widely adopted
- Some renewable sources may have negative carbon emissions

Barriers

- CNG is not net zero emissions
- Most renewable natural gas is mixed into the distribution network
TECHNOLOGY EVALUATION: BATTERY ELECTRIC

- Non-combustion propulsion
- Range can vary based on equipment and weather largely
- Most vehicles will perform 100-200 miles
- Larger vehicles can be supplemented with fossil fuel heating units in cold weather
- Emissions dependent on electric grid generation source
TECHNOLOGY EVALUATION: BATTERY ELECTRIC PROS AND CONS

Opportunities

- Most fixed route service could be accommodated with commercially ready EV’s
- Technology is scalable to number of vehicles deployed

Barriers

- Range
- Charging operations would require additional space and staff oversight
TECHNOLOGY EVALUATION:
EXISTING VS. POTENTIAL BATTERY ELECTRIC CHARGING STATIONS

Existing Charging Stations

Potential Charging Stations
TECHNOLOGY EVALUATION: HYDROGEN FUEL CELL

- Non-combustion propulsion
- Fuel is either gaseous or liquified hydrogen
- Range varies based on operating conditions
- Emissions are highly dependent on hydrogen generation
TECHNOLOGY EVALUATION:
HYDROGEN FUEL CELL PROS AND CONS

Opportunities

► All fixed-route and demand response service could be accommodated with FCEVs

► Hydrogen deployment is more cost-effective for systems with more vehicles

Barriers

► Sourcing
► Cost
► Upstream Emissions
TECHNOLOGY EVALUATION

Battery Electric
- Deployable at Small Scale
- Fast Charging
  - Diffused Charger Network
  - Requires Extensive Partnership

CNG/RNG
- Cost Effective
- Produces Emissions
- Hydrogen Fuel Cell
  - Resilient Operations
  - High Cost to Deploy

Kimley-Horn
TECHNOLOGY EVALUATION

Greenhouse Gas Emissions Comparison

- Gasoline
- CNG
- RNG
- Battery
- Hydrogen

GHG Emissions in Tons
## Technology Comparison Analysis

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<th>Scenario</th>
<th>Number of Vehicles</th>
<th>Emissions Reduction</th>
<th>Vehicle Costs</th>
<th>Facility Costs</th>
<th>Operational Costs (Fuel+Maintenance)</th>
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*Assumes carbon-neutral electric grid or pure RNG

**Long-term**

**Near-term**

*Text in Image:* 
- TECHNOLGY COMPARISON ANALYSIS
RECOMMENDATIONS

- Implement battery electric vehicles as the initial deployment technology on select run classes.
- Pursue a small-scale, initial deployment of zero emissions vehicles in fixed-route services.
- Conduct future evaluation of initial deployment performance.
- Conduct partnership conversations with government entities, businesses, and utilities.
- Jaunt is recommended to receive an implementation planning grant.
QUESTIONS