

Multi-Modal, what about Multi-Fuel?

Energy Diversification and Operational Impacts

APTA Sustainability Workshop



July 31, 2018

LEXTRAN AT A GLANCE • • • • •

Public transportation provider
in Fayette County since

1973



4.5 MILLION
PASSENGER TRIPS (FY17)

14,000
TRIPS PER DAY

22

**FIXED
ROUTES**



**COUNTY
WIDE
PARATRANSIT
SERVICE**

**65% OF TRIPS
ARE FOR WORK
OR SCHOOL**

OUR FLEET



65 VEHICLES



**55 WHEELS
PARATRANSIT
VEHICLES**



Lextran

To present:

- Lextran's experience with 'multi-fueling'
 - Operations and maintenance
 - Pre-development costs
 - Contracting and back up fueling options
 - Emissions reductions
 - Facility renovations
 - Route planning and scheduling
 - Data on impacts



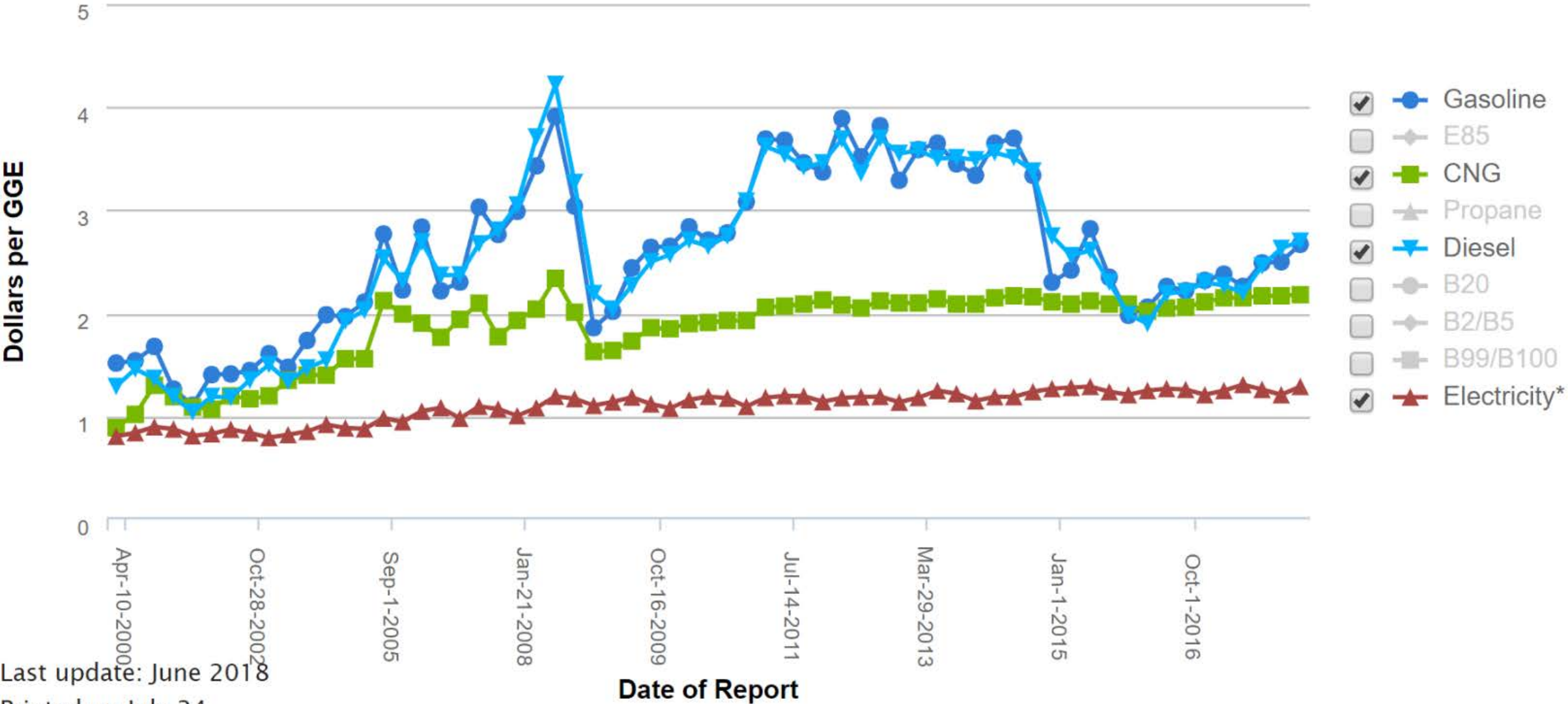
Considerations for multi-fuel / alt-“FUEL”

- Decreasing carbon emissions from the tailpipe = cleaner air
- Stability in energy prices = more balanced budgets
- “Greener” Brand = increased ridership
- Different engine type = lowered maintenance costs
- ‘Station’ Infrastructure = increased initial capital costs



Average Retail Fuel Prices in the U.S.

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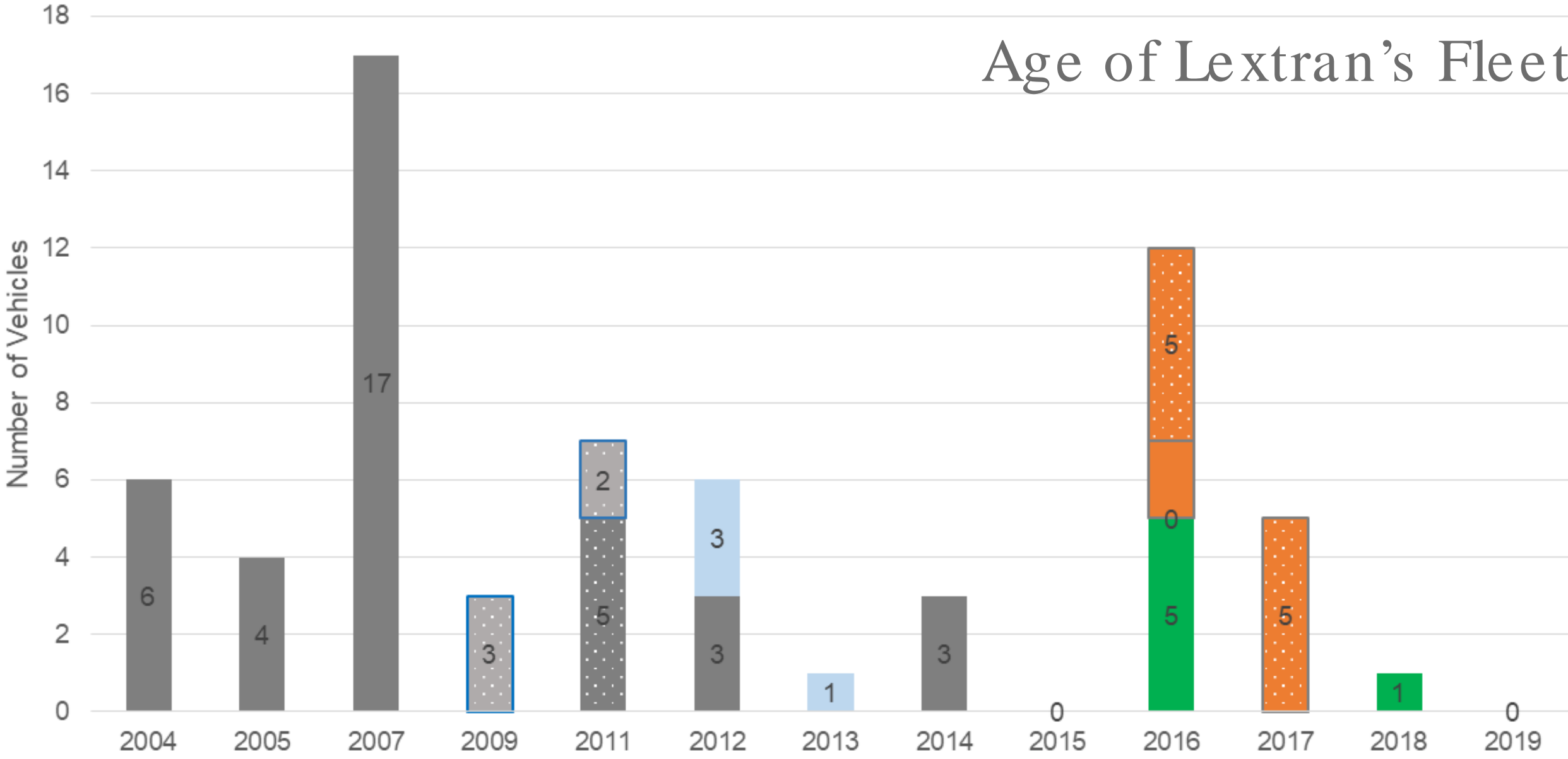


Last update: June 2018

Printed on July 24

Source: US Department of Energy <https://www.afdc.energy.gov/fuels/prices.html>

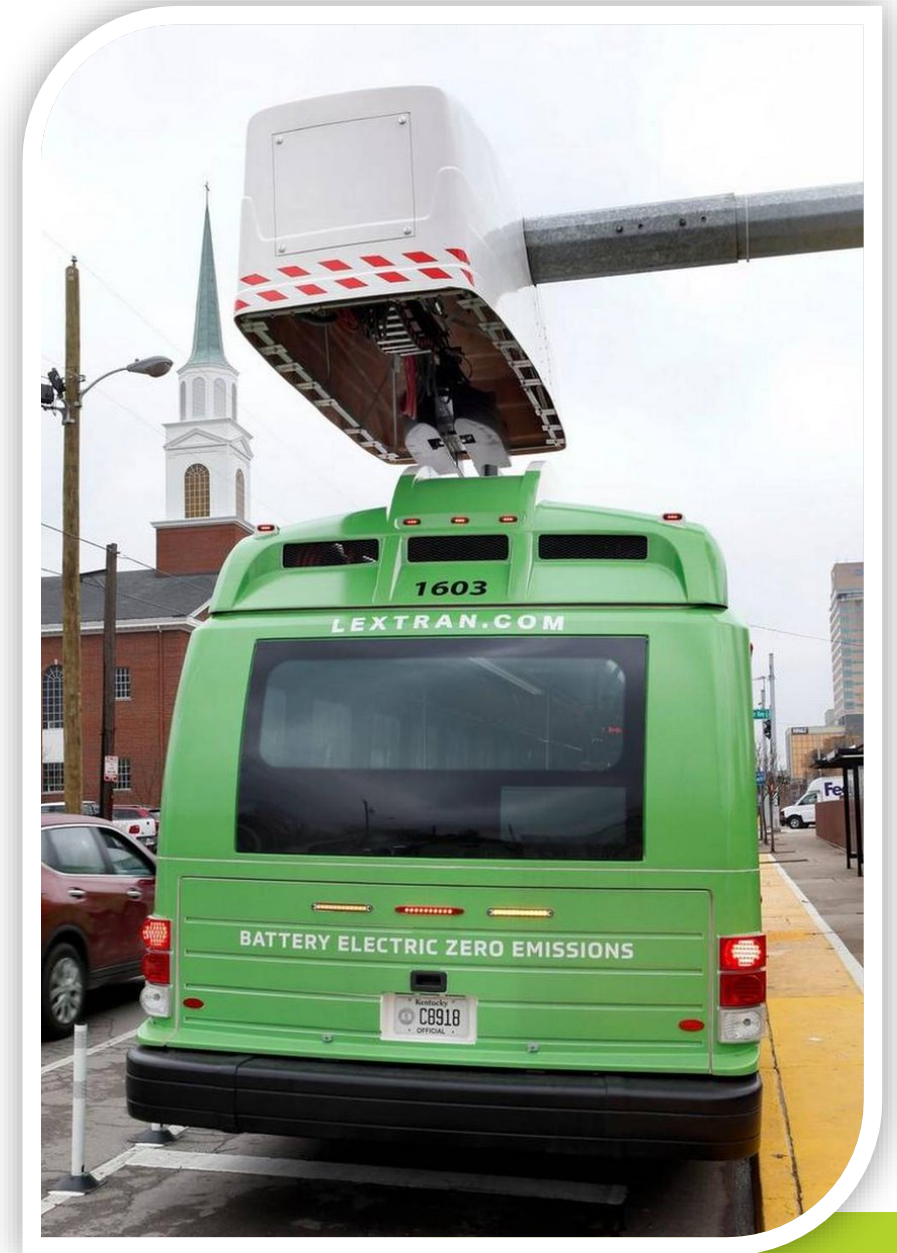
Age of Lextran's Fleet



- Gillig-29 ft
- Proterra-40+'
- Gillig-40 ft
- Gillig-40' CNG
- Gillig-35 ft
- Gillig-35' CNG
- Gillig-Trolley
- Cutaway

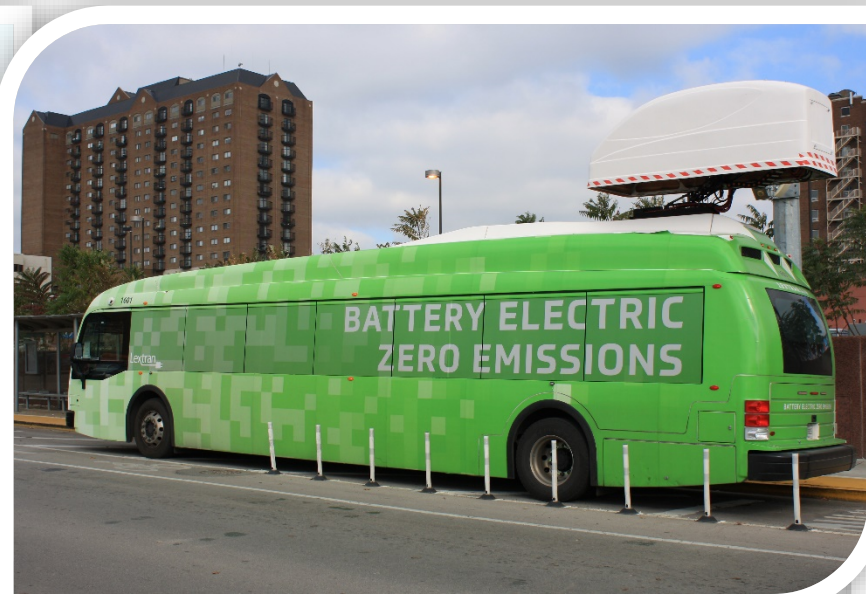
What we did

- Awarded 'LoNo' Low or No Emissions Section 5339 to purchase
 - Proterra on-route, fast charge battery electric zero emission buses
 - Partnered with Center for Transportation and the Environment (CTE)
- Awarded Kentucky 'CMAQ' Congestion Mitigation Air Quality grants to purchase
 - Gillig Compressed Natural Gas



So Now...Lextran's Fleet and Fuel Profile (UPDATE)

Type of Bus	In Fleet	On order	Fuel Type / Cost	Contract Rate	Fiscal Year average
Diesel Bus	45	0	Diesel Fuel / Hybrid	OPIS - \$ 0.0252	\$ 1.53 per gallon
CNG Bus	12	3	CNG Bus	Actual gas + \$ 0.35 DGE	\$ 1.39 per DGE
Electric Bus	6	1	Electric Bus	KU Rates	Not enough data
Hybrid Electric	6	0	Hybrid Electric	Uses diesel	---
Gasoline	4	0	Gasoline	OPIS - \$ 0.0201	\$ 1.69 per gallon



CNG Considerations

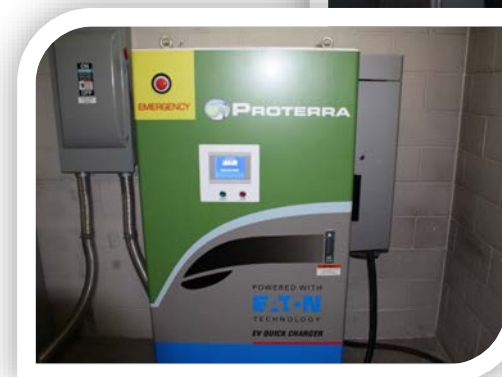
- Similar to diesel
- In the garage, for major engine work:
 - Airflow
 - Explosion proof lighting
 - Local / state safety, code
- Explore options for capital work:
 - i.e. bid, RFP, lease, own, construct
 - ‘wild west’ and many players in the market



Electric* Considerations

- Not at all like diesel or CNG
- Conductive charging system
- Electrical components installed curbside, underground or in a building
- Charge head installed overhead on-route bus stop or layover point
- Lextran Cost = \$349,000++ construction and labor, any ROW acquisition, and other utilities costs

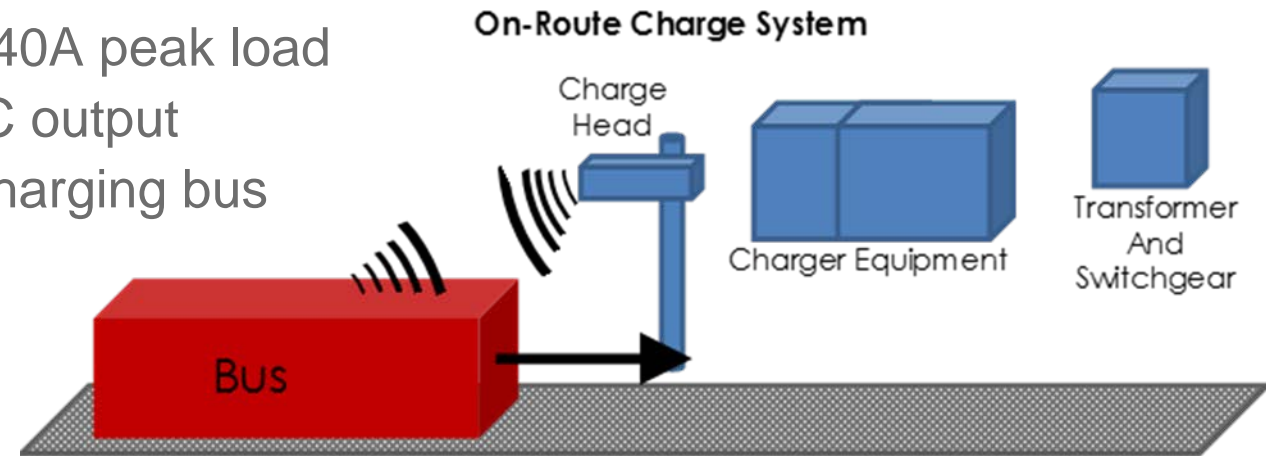
*fast charge, on-route system



Electric * Considerations

(the fine print)

- Input voltage:
 - 3 Phase 480 VAC, Split Phase 120 VAC
- Input current:
 - 500kW Charger
 - 480VAC: 800A Breaker to support 640A peak load
 - Capability to charge up to 500kW DC output
 - Actual peak power is 360kW while charging bus
 - 120VAC: 2 x 20A
- Input frequency: 60 Hz
- Power factor: 0.95
- Site provisions:
 - Energy source safety disconnect with a built-in LOTO hasp
 - Internet access



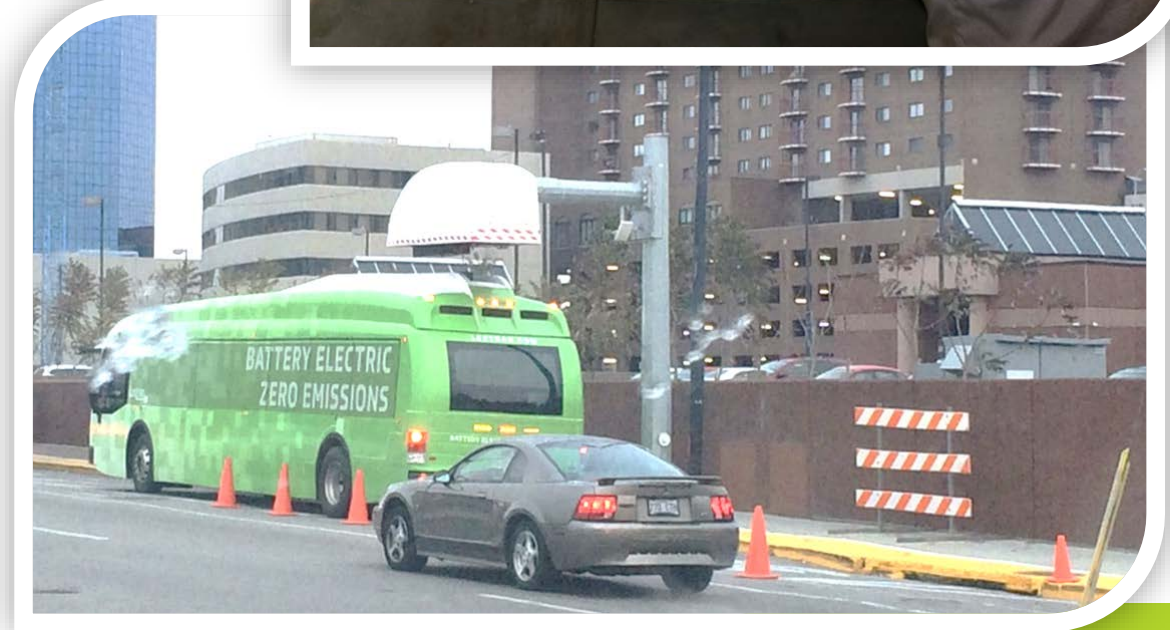
Electric Considerations

- Design AND location of charge head is critical
 - Visual impact
 - Traffic impact
 - Operations impact
-
- Fast charge, on-route bus is well suited for circulator route
 - Operations and Scheduling WILL be impacted



Electric Considerations

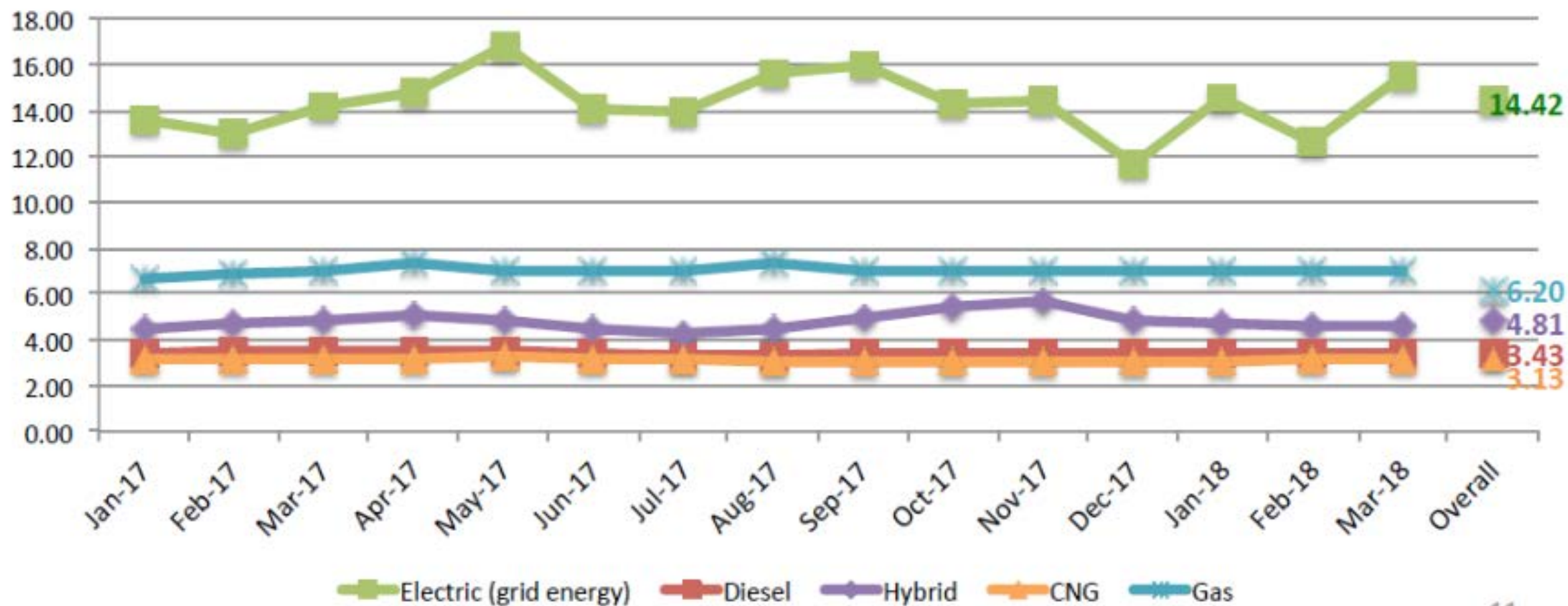
- Training maintenance techs
- Construction costs:
 - Underground utilities
 - Conduit
 - Cabling
 - Transformers
- What about a power outage?



KPI: Efficiency



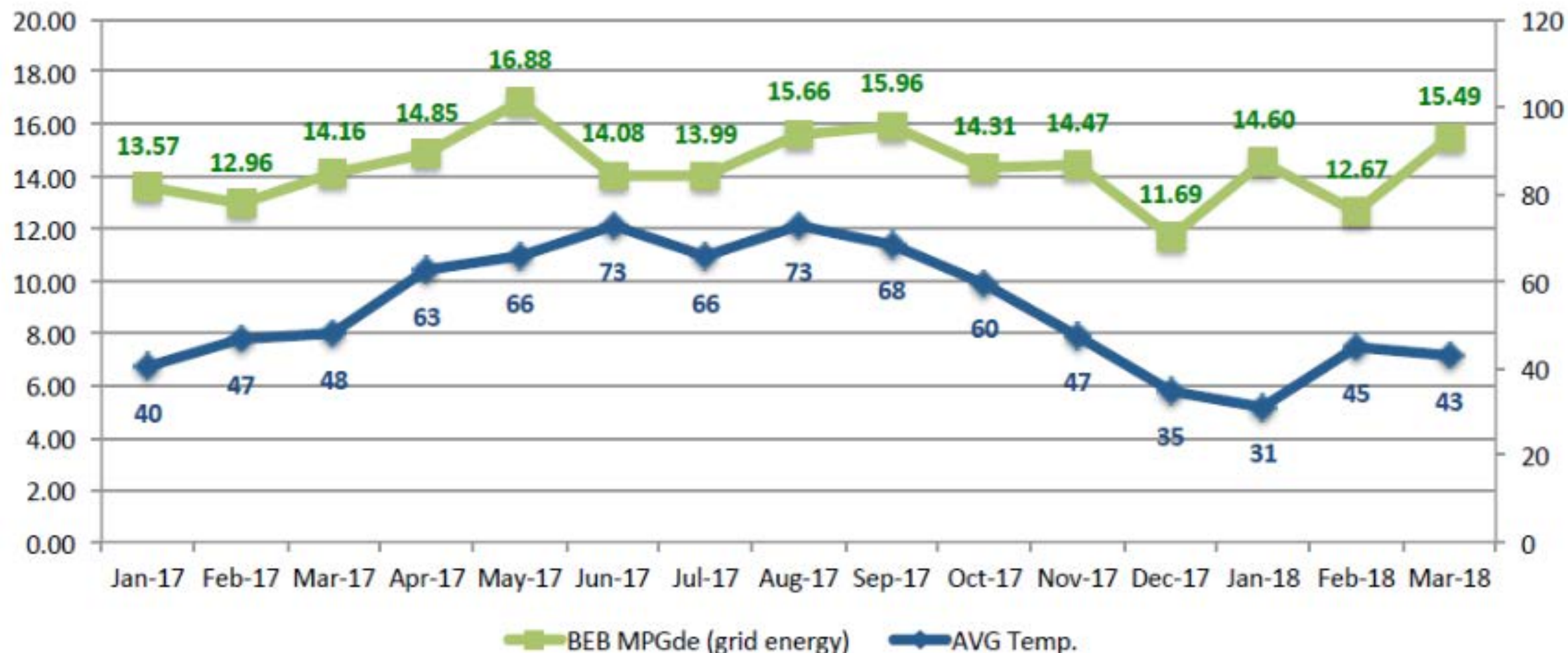
Monthly MPG Diesel Equivalent EV Fleet vs. Conventional Fleet



KPI: Efficiency



AVG MPGde vs. AVG Temperature



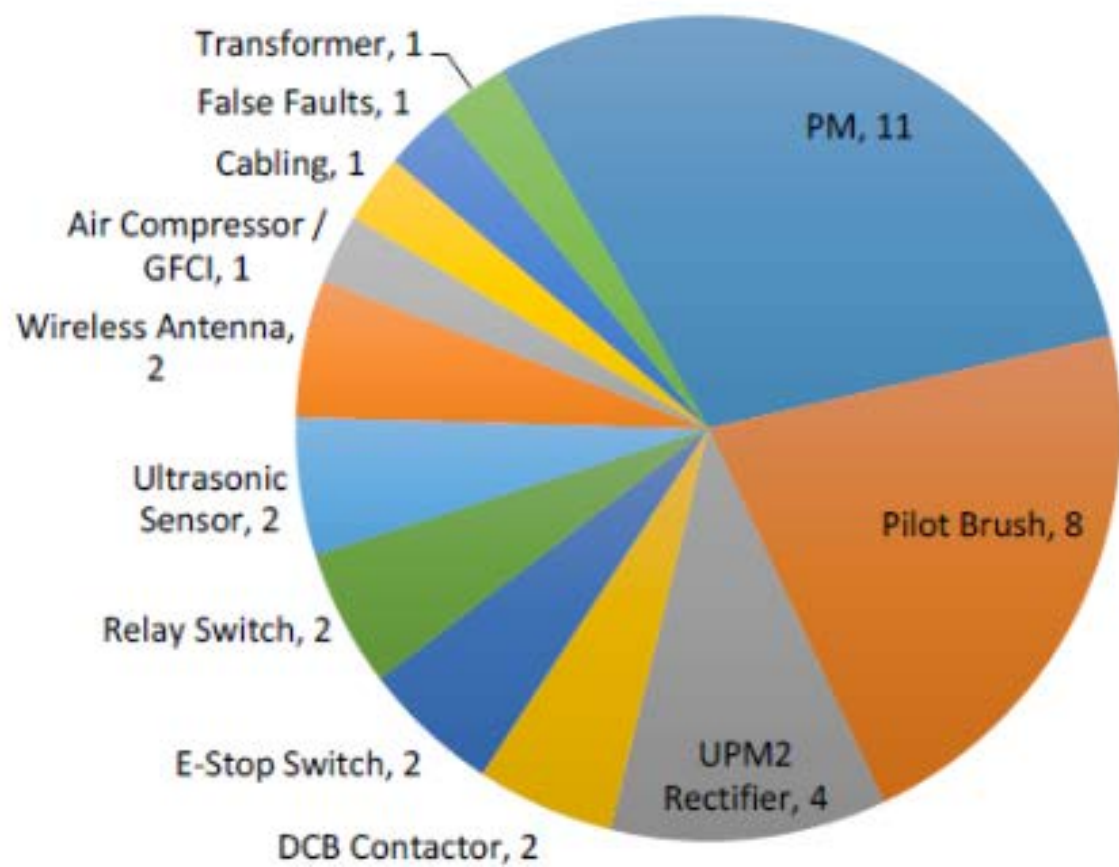
KPI: Charger Maintenance



Total Maintenance Events by Category

January - December 2017

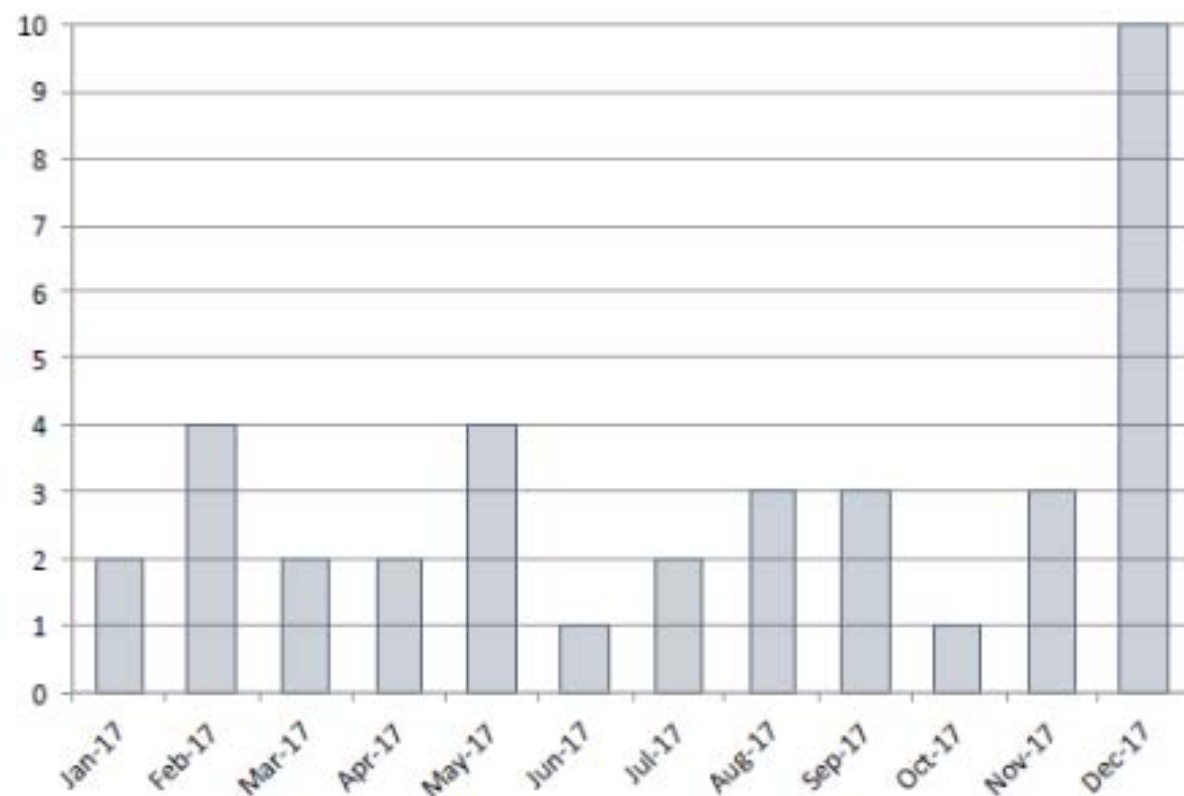
Total Events = 37



Total Maintenance Events by Month

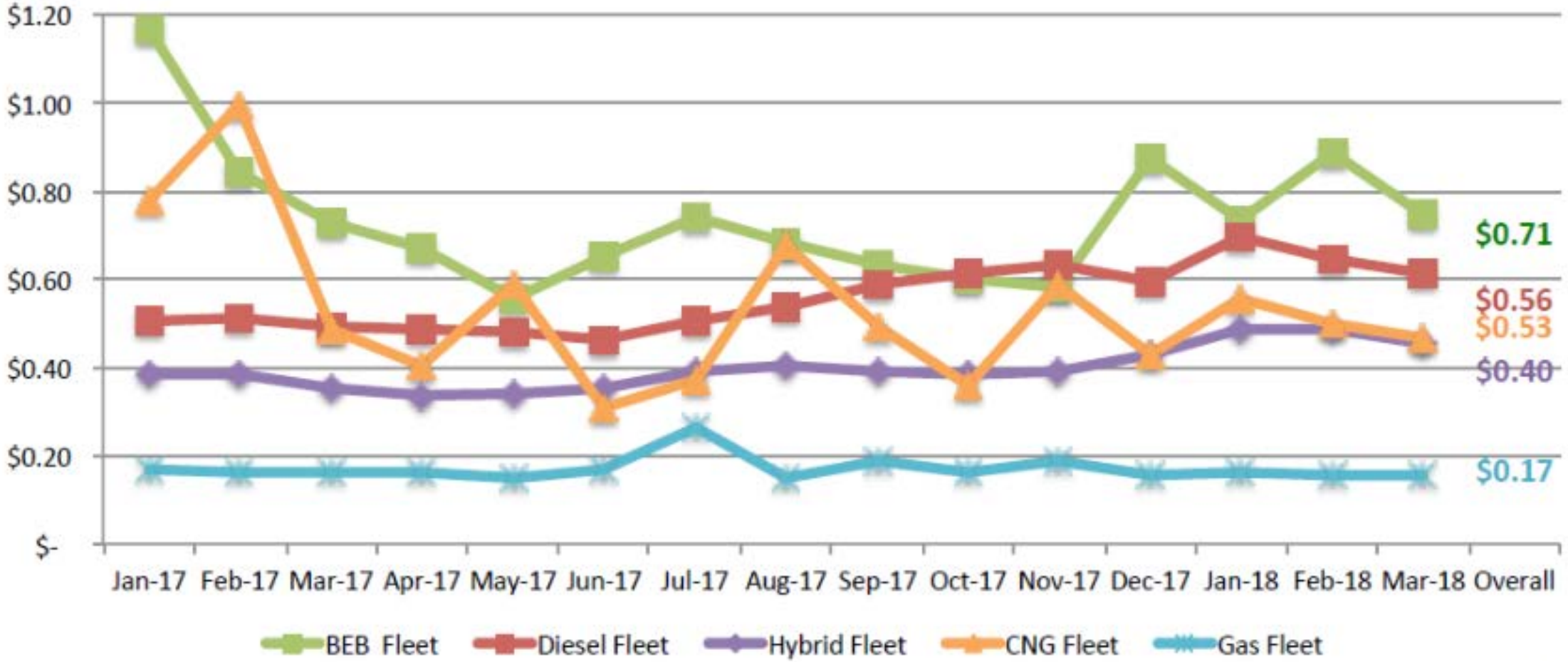
January - December 2017

Total Events = 37



KPI: Fuel Cost Comparison

Monthly Fuel Cost/Mile by Fleet Type

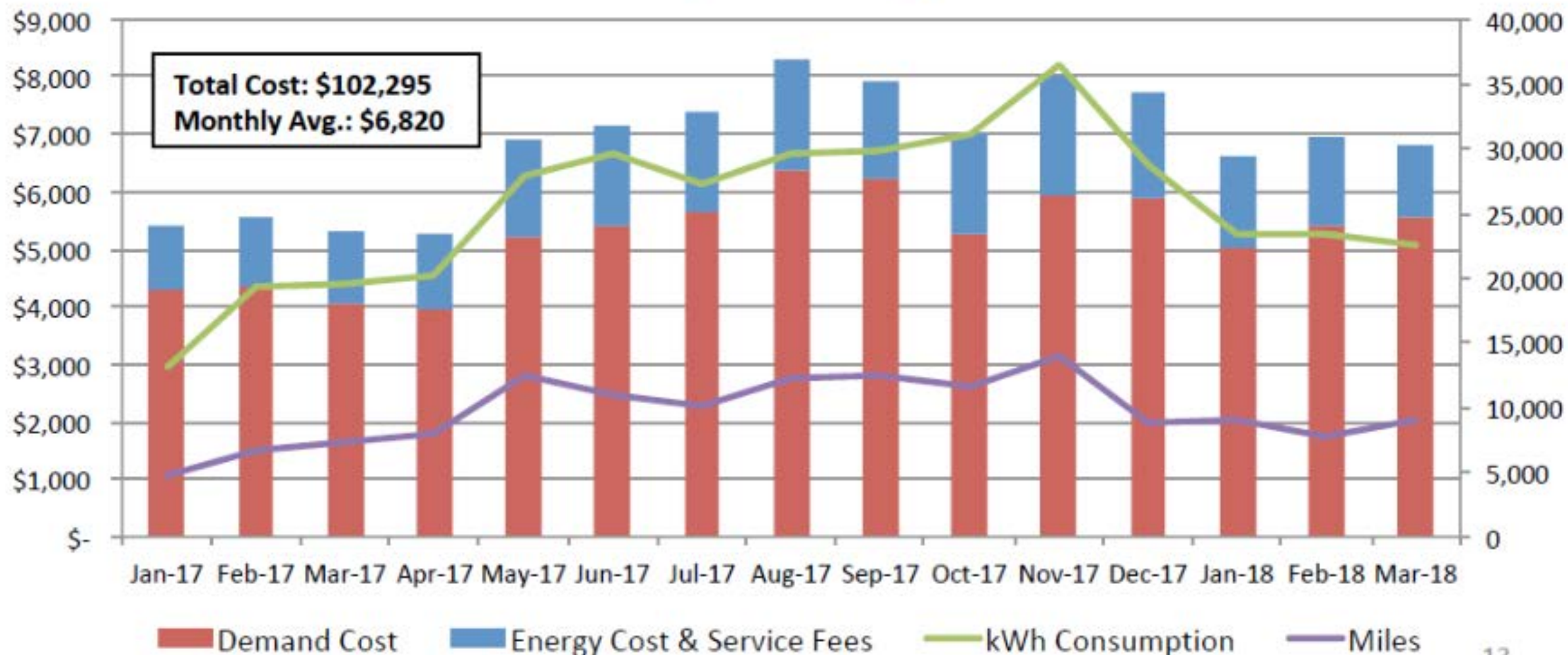


*January BEB cost/mile was \$1.87 due to limited operation during initial rollout.

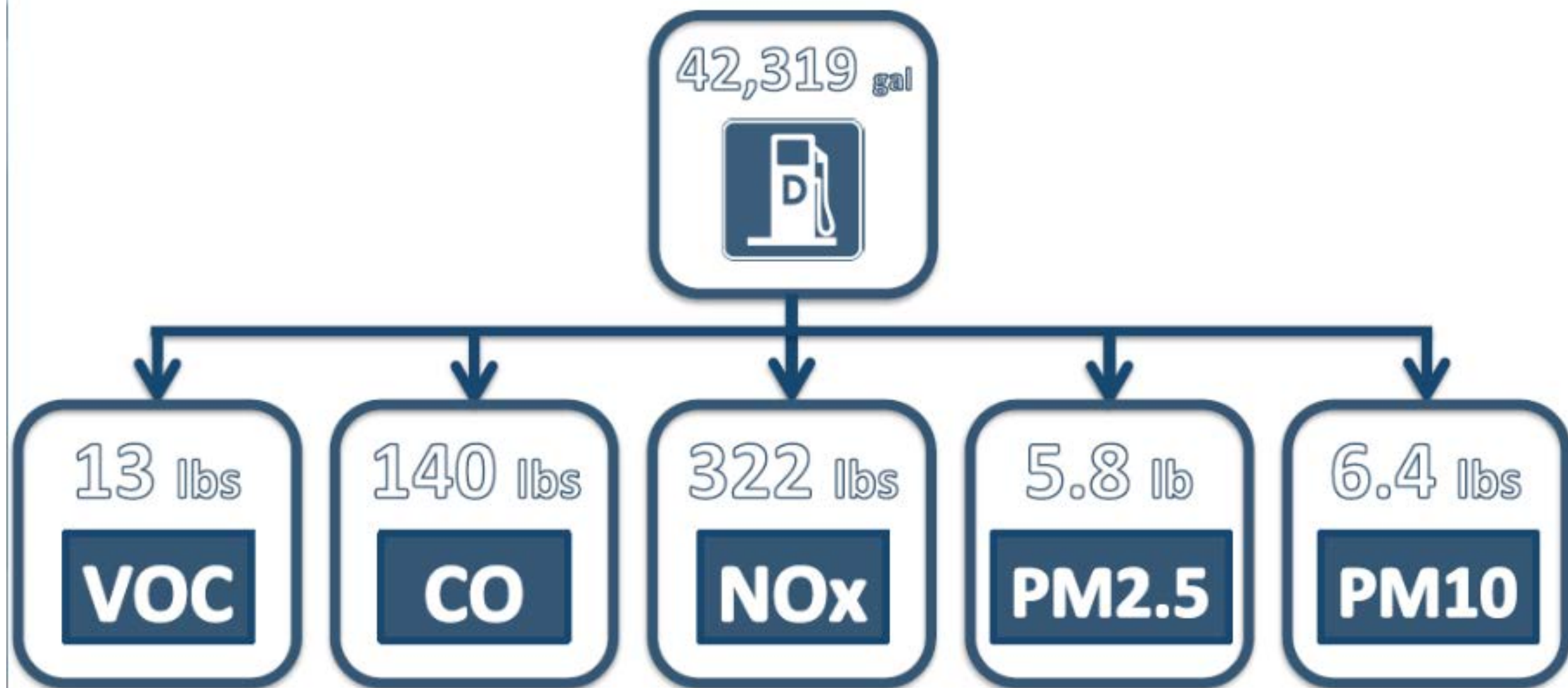
KPI: Energy Consumption and Cost



Monthly BEB Energy Cost



KPI: Fuel and Tailpipe Emissions Reductions



Diesel

CNG

Electric- Fast Charge

Electric – Extended Range

45 in fleet

12 in fleet, 1 ordered

6 in fleet, 1 on order

Pending Grant

\$ 2.31 per gallon

\$ 1.42 per gallon

High \$ per DGE
Efficient MPG

Unknown \$ per DGE

Sufficient infrastructure

Need another compressor \$400K plus generator \$ 500K

2 to 3 more charge locations

Capital Cost to yard, canopy, transformer, step down switch

\$ 450K per vehicle

\$ 500K per vehicle

\$763K per vehicle

Estimated \$763K per vehicle

No grant funds available

Possible CMAQ grants

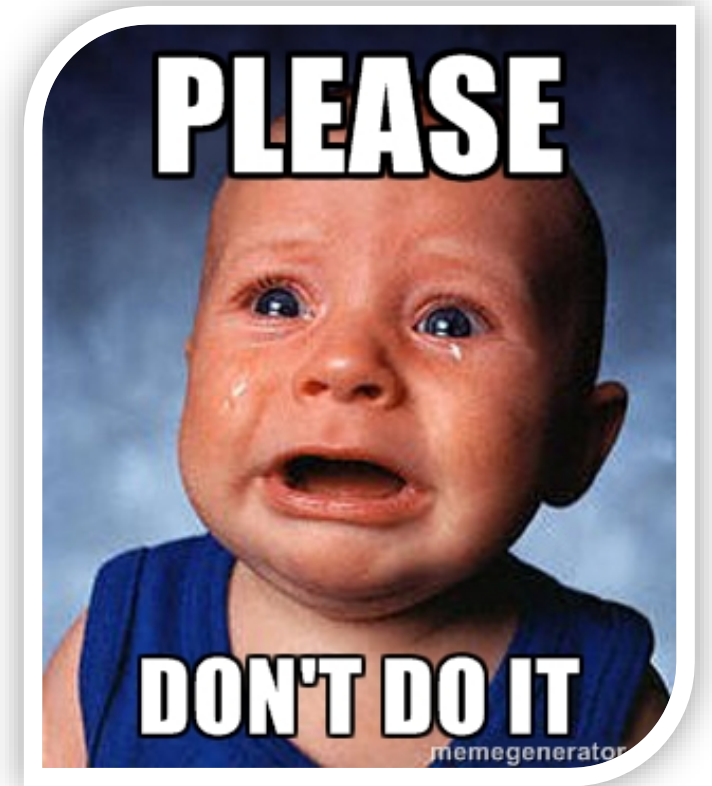
Applied for LoNo, competitive 4x in a row???

LoNo, VW,



Conclusions

- No one should do this – and definitely don't apply for any of the competitive grant programs, like LoNo 😊



Conclusions

- With support, it is a worthy endeavor
- Start early with stakeholders, decision makers, and regulatory/utility agencies
- Cutting edge v. bleeding edge v. energy cost fluctuations
- “Station” costs for fueling infrastructure vary considerably, land cost and site selection critical
- Too early to determine changes to Maintenance cost, especially over the life of the bus (12 years)
- Mix of fleet and energy sources can smooth budget, but changes operating procedures

