Houston Zero Emission Delivery Vehicle Deployment

Houston-Galveston Clean Cites
April 11, 2018

Houston-Galveston Area Council

Project Goals

- Accelerate the penetration of electric vehicle technologies into the cargo transportation sector, through the funding of all-electric delivery trucks in the Houston region
- Help offset the high cost of low-volume orders for all-electric vehicles
- Provide assistance to freight partners to match trucks to correct applications and routes

Project Milestones

Activity	Timeline	Status
Call for Projects *(for fleet partners with all-electric delivery vehicle OEM)*	5/2014 – 5/2016	Complete
Select Partners & Issue Notice to Proceed	6/2014 – 9/2016	Complete
Purchase & Manufacture of Vehicles	9/2014 – 7/2016	Complete
Delivery of Vehicles	10/2015 – 8/2016	Complete
Full Demonstration of All Vehicles	11/2016 – 11/2018	Ongoing
Project End Date	1/30/2019	

E-100 Electric Delivery Van

- Chassis: 88 feet
- Wheelbase: 178 feet
- Batteries: 145 kWh
- Motor: 180 kW
  1,106 ft-lbs torque
- Range: 80 to 90 miles

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Equipment Issues

- These are experimental vehicles
- Has resulted in unanticipated and ongoing issues with certain components
- Two categories of issues:

Equipment Defects	Other Mechanical Issues
DC/DC Converters	12V Batteries
Chargers	Parking Pawl
High Voltage Interlock	

Equipment Issues

- The originally installed DC/DC converters had an improper heat sink leading to overheating and part failure.
- Chargers are having similar issues and have had high failure rates.
- Workhorse is working to procure new equipment in both cases, but there are difficulties.

Retrofitting

- It isn’t just swapping out parts.
- Since this is still an early stage commercial product, the vehicles were designed with very a specific part in mind
- The replacement part can be significantly different resulting in the need to significantly re-engineer the existing vehicle to accept the improved equipment
- This issue caused significant delays in replacing the DC/DC converter and is effecting charger replacement similarly.

Other Equipment Issues

- High Voltage Interlock
  - Manufacturer notified Workhorse of a defect in cables that can result in an intermittent signal which can trigger the HVIL unnecessarily.
  - Workhorse is exploring options.
- 12V Batteries
  - Batteries can drain when a vehicle sits for an extended period
  - There were instances where vehicles were tagged with problems when only a new battery was needed.
- Parking Pawl
  - This sometimes needs adjustment in all vehicles. UPS has been reluctant to adjust in these vehicles.

Results

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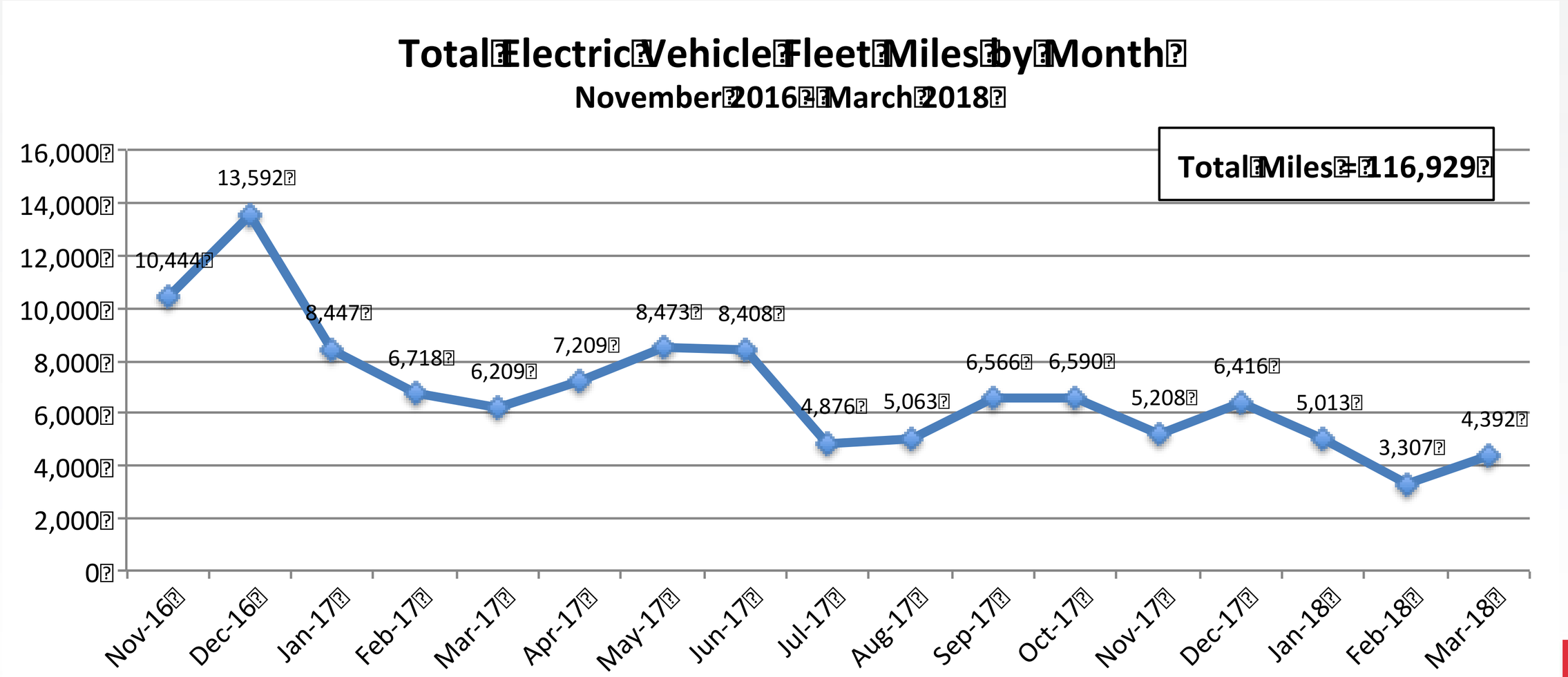
Maintenance Events & Availability

- All of these issues have contributed to low vehicle utilization.
- These have resulted in concerns about vehicle reliability from some facility managers. Leading to less utilization, even in completely operable vehicles.

Utilization



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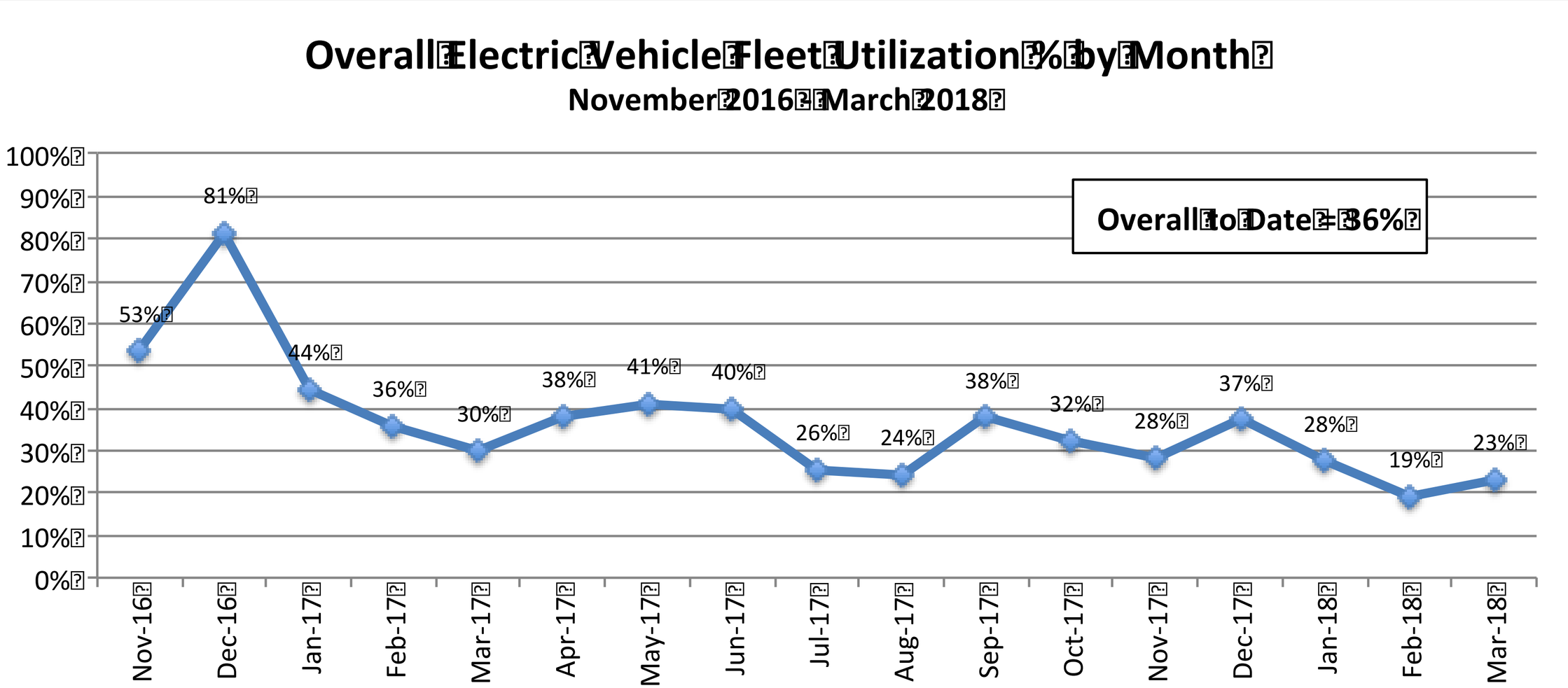
Utilization



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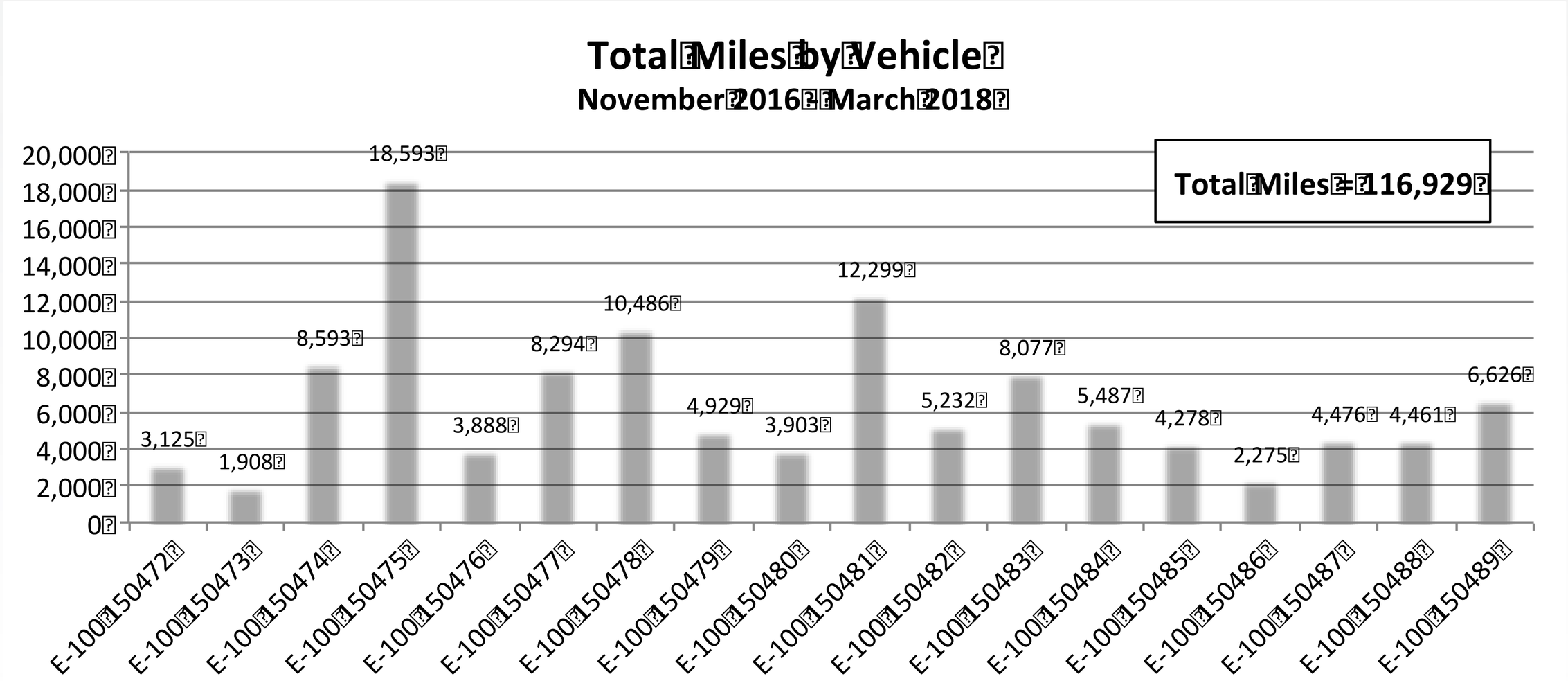
Utilization



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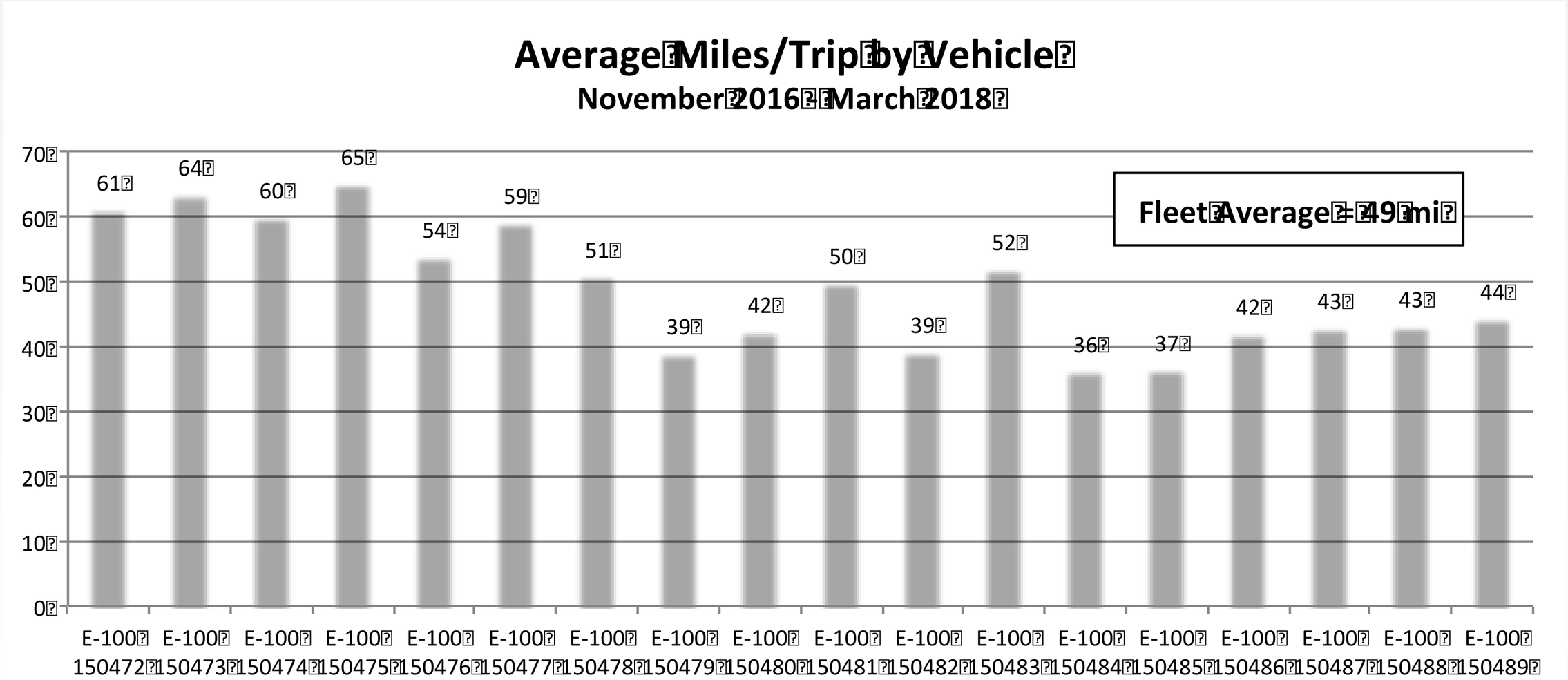
Utilization



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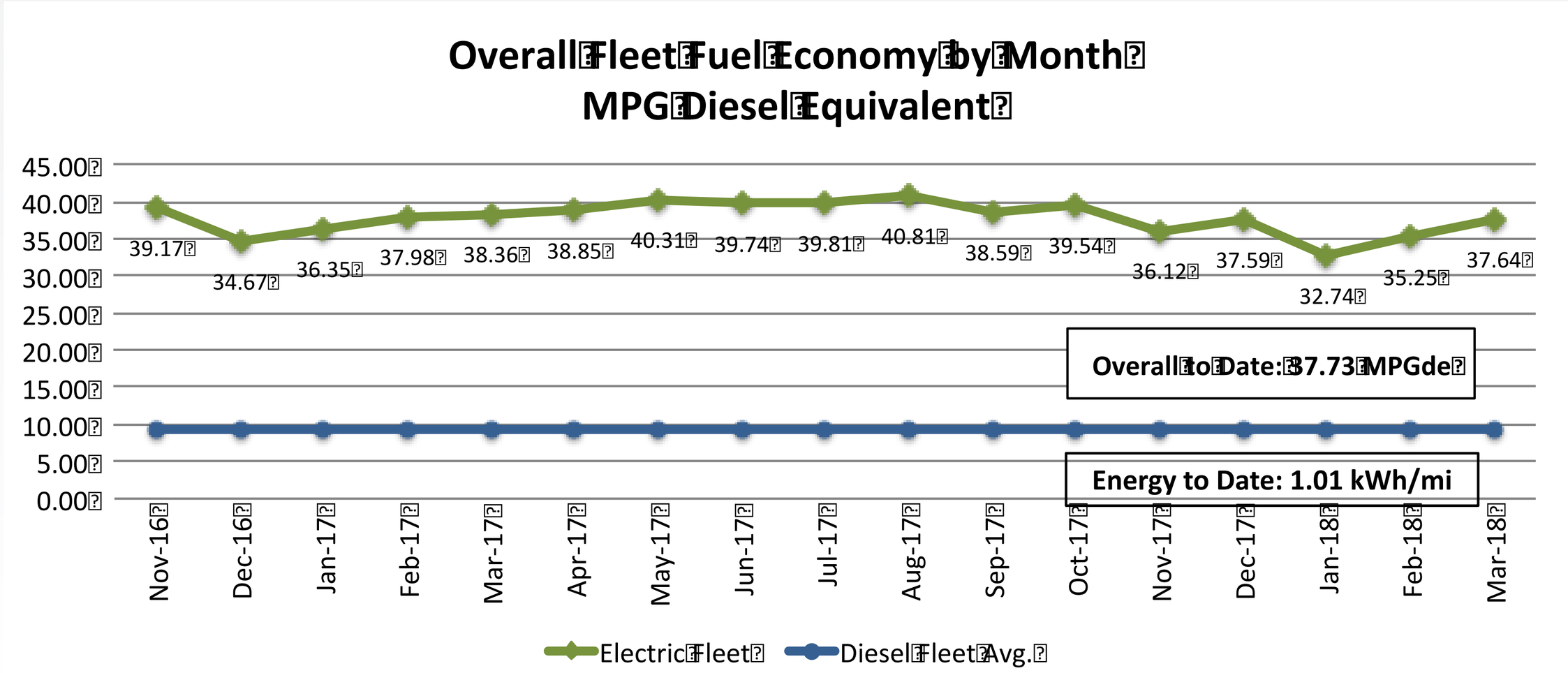
Efficiency



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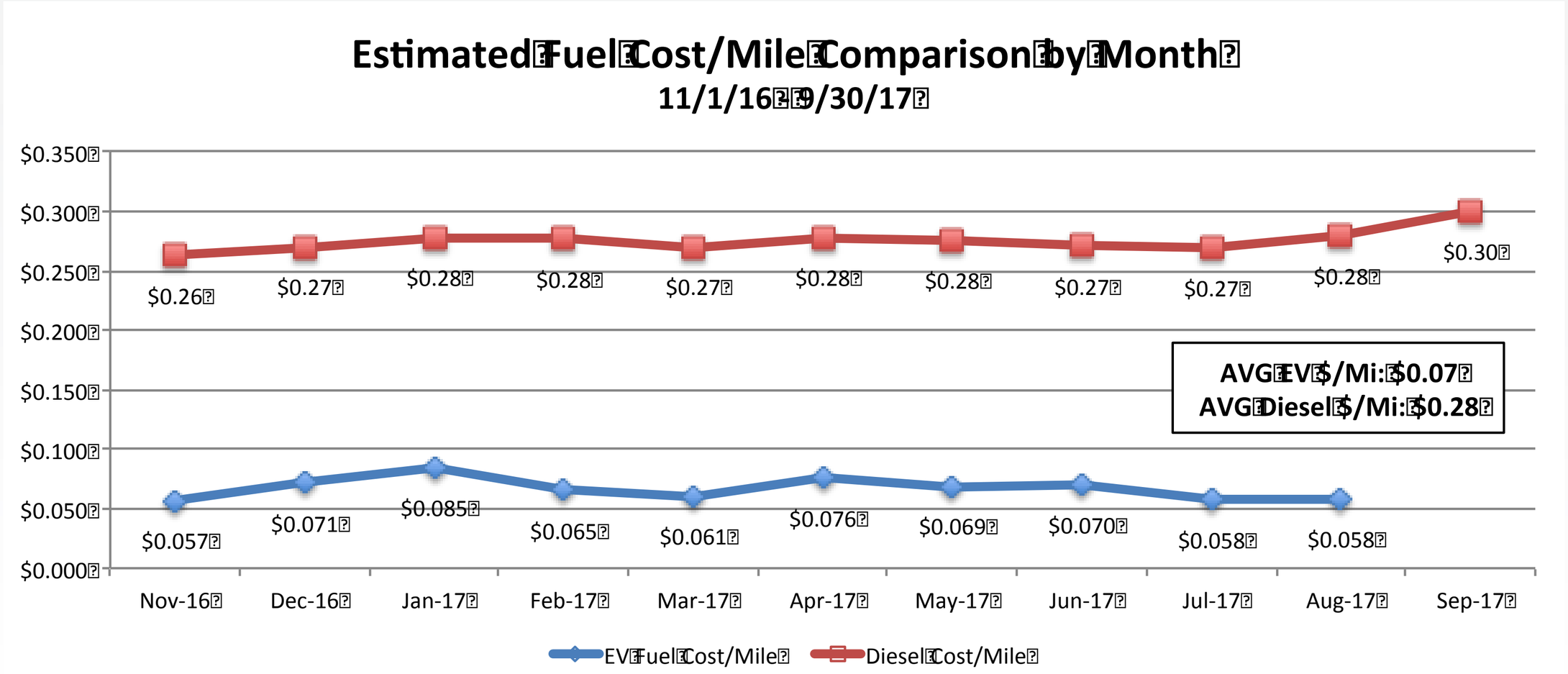
Energy Consumption and Cost



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Fuel and Tailpipe Emissions Reductions

162,683 mi*

17,530 gal

404,465 lbs

Sources

https://nnsa.energy.gov/sites/default/files/nnsa/08-14-multiplefiles/DOE%202012.pdf, https://greet.es.anl.gov/afleet, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Fuel and Tailpipe Emissions Reductions

404,465 lbs

=

~1,900 ft²

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Fuel and Tailpipe Emissions Reductions

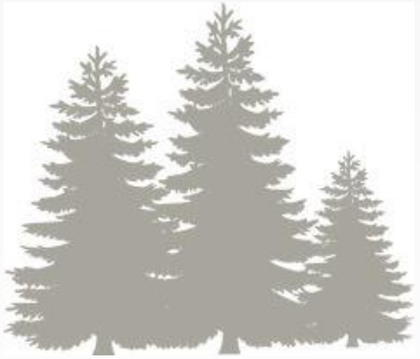
404,465 lbs

=

CARBON REMOVED FROM THE AIR BY

4,260 trees*

147 acres**



*Seedlings planted and grown for 10 years.

**Acres of US forests in 1 year

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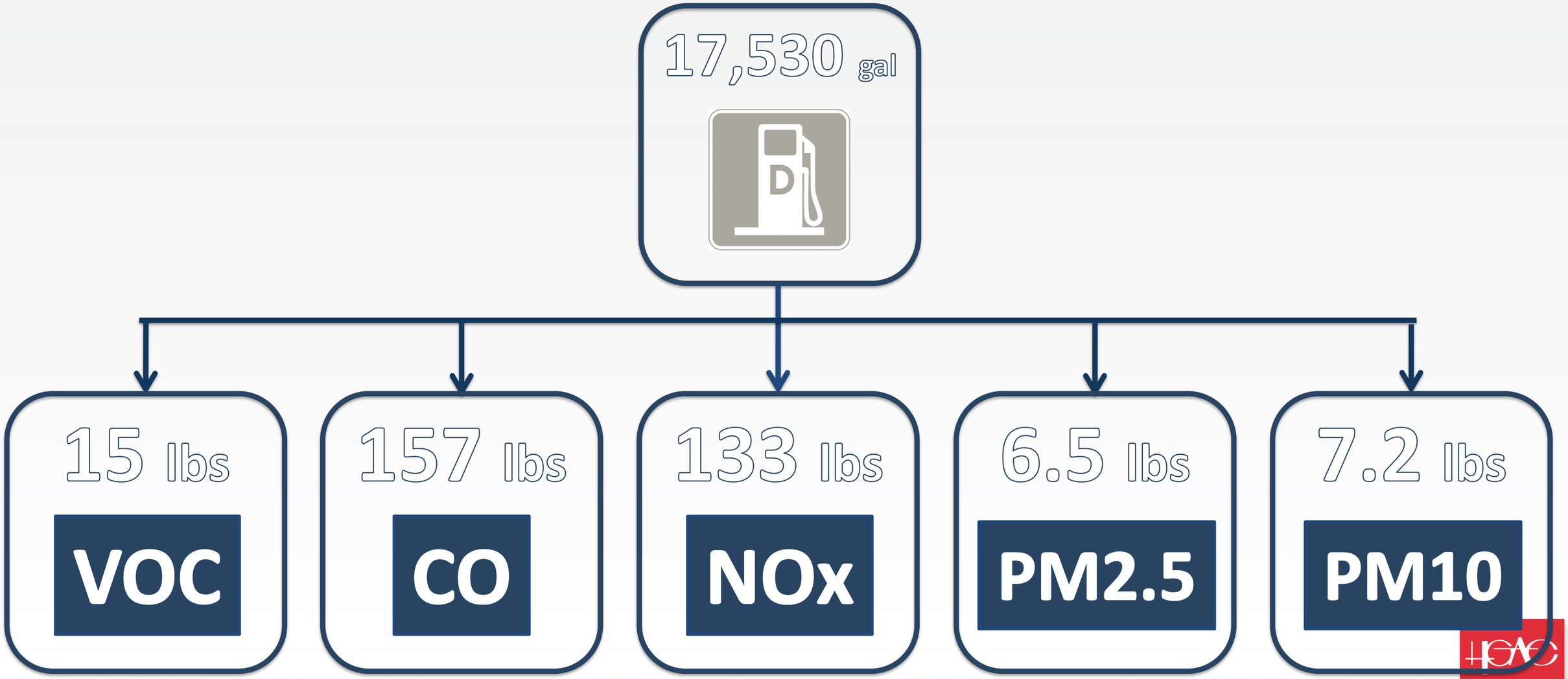
Fuel and Tailpipe Emissions Reductions



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Fuel and Tailpipe Emissions Reductions

404,465 lbs

GHG

=

121

Cars Off The Road*

*During demonstration period.

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What about emissions at the power plant?

Tailpipe Emissions Reduction		Grid Emissions from Generation*		Overall Emissions Reduction
392,331 lbs CO_2	−	146,997 lbs CO_2	=	245,334 lbs CO_2

n EIA's 2016 Texas AVG = 1,146 lbs CO2/MWh generate