

NGV U.P.-T.I.M.E. Analysis:

Updated Performance Tracking Integrating Maintenance Expenses

Led by Clean Fuels Ohio, this project will provide fleets, natural gas vehicle (NGV) industry stakeholders, and other end-users relevant, real-world information through a proven, **multi-data set analysis** approach detailing NGV maintenance costs to improve total cost of ownership calculations and to determine the maintenance cost differences between NGV technology generations (current state-of-the-art) and current advanced clean diesel engines (post-2010 and post-2017) for relevant **medium-/ heavy-duty freight and good movement applications**. There is little publicly available data that clearly compares the relative maintenance costs of NGVs and diesel trucks using modern exhaust after-treatment systems to validate claims of NGVs' lower TCO and their potential to improve energy security and cost-effectiveness nationwide. Our team will conduct a comprehensive study quantifying the difference in maintenance costs between diesel and CNG vehicles resulting in individualized fleet reports.

Delivering Real Results from Real Data

The project will implement a proven, multi-data set analysis approach to clearly determine the maintenance cost differences between compressed natural gas (CNG) generations (current state-of-the-art and previous) and current advanced clean diesel engines (post-2010 and post-2017).

The study will strive to capture the impacts of different technology solutions and/or best practices used by project partner fleets capable of impacting/reducing maintenance costs. The results will also showcase the analysis findings by end-use application, engine/fuel system manufacturer, vehicle chassis manufacturer, among others to determine specific research and development and/or outreach needs by application.

What The Project Needs from Fleet Data Partners

- Signed Data Sharing Agreement** guaranteeing that the fleet will that the fleet receives data protection and anonymity by providing data to project team and US DOE.
- Preliminary fleet data:** Total # of NGVs, Total # of Diesel Vehicles, Vehicle Class(es), Duty Type(s)/Application(s), and if fleet uses VMRS
- Natural Gas Vehicle (NGV) and Diesel Vehicle Maintenance Data**
 - Via a one-time data upload, spanning data from Jan 2007 and later

Type of Data	Vehicle Maintenance Data Specifics	
Vehicle Data	<ul style="list-style-type: none"> Number Year/Make/Model Vehicle Type 	<ul style="list-style-type: none"> Current Mileage Fueling Data Vehicle End-Use Application
Repair Data	<ul style="list-style-type: none"> Repair Order Number Open Date/Time Close Date/Time Days in Service 	<ul style="list-style-type: none"> Length of Repair Order System/subsystem/ parts repaired
Repair Costs	<ul style="list-style-type: none"> Parts Labor 	<ul style="list-style-type: none"> Vendor Repair Total Warranty Costs



Why Fleet Data Partners Should Join (Benefits of Project)

- Individual Fleet Maintenance Analysis Data Report**
 - Graphical assessment of major parameters by vehicle powertrain, year and model: repair cost per mile, repair frequency, and vehicle utilization
 - Data to help fleets answer operational questions comparing natural gas and diesel vehicles
 - Data to help fleets assess cost reduction strategies
- Secured Fleet Partnership Agreement**
 - Agreement will guarantee fleet receives data protection, anonymity, and a fleet specific analysis report of their NGV vs. Diesel maintenance costs.
- Access to Full Report with Key Recommendations on Best Practices & Technology Solutions to Reduce NGV Maintenance Costs**
 - Highlighting cost differences between CNG (both old & new) and current advanced clean diesel engines
 - Capturing the impacts of different technology solutions and/or best practices used by project partner fleets capable of reducing maintenance costs

Project Timeline (Oct 1, 2019 – Sep 31, 2022)

- Year 1 (Oct 2019 – Sep 2020):**
- Gather signed Data Sharing Agreements, collect data
- Year 2 (Oct 2020 – Sep 2021):**
- Collect data, conduct initial data quality review, develop maintenance & repair code decoder, ensure dataset consistency
- Year 3 (Oct 2021 – Sep 2022):**
- Combine and finalize datasets, perform combined dataset analysis, generate and distribute fleet-specific reports and final project report

Join us and other committed fleet partners to work together to improve the NGV industry!

Fleet Data Partners Must Fit Project Requirements:

- Operates natural gas and diesel vehicles/trucks
- Medium-/Heavy-Duty Trucks (Class 6-8)
- Freight and Goods Movement (includes parcel/package, food/beverage, raw materials, finished consumer products)
- Maintenance cost records for natural gas and diesel vehicles

Individualized Fleet Maintenance Analysis Data Report

As a result of this project, project facilitators will provide a report to each committed fleet stakeholder who provides data to this NGV maintenance study. The individualized fleet maintenance analysis data report will include real-world, relevant information and data with the following (see below):



From the report, fleet data partners will receive:

1. Complete cleaned dataset including all vehicle and repair order records

2. Graphical assessment of major parameters by vehicle powertrain, year, and model

- Repair cost per mile, both total and by sub-system
- Repair frequency (e.g., repairs per 100 miles, days in shop per 1,000 miles)
- Vehicle utilization (e.g., miles per day, percent uptime)

3. Answers to important operational questions from the assessment such as:

- Has NGV technology improved operational costs? Are older models more expensive to maintain?
- Are NGV's in the shop more or less expensive to repair than conventional diesel/gasoline vehicles?
- Are the models that have the least cost to operate per mile being driven the most to minimize fleet maintenance costs?
- Where are most of the maintenance costs coming from? (e.g. engine repair, tires, wear-and-tear, unscheduled component failure, etc.) Is this different for conventional diesel vehicles versus NGV's?
- Which vehicles spend the most time in the shop? What portions of these repairs are covered by warranty?

**Fleets should be aware that the level of detail in the individual fleet maintenance analysis report strongly depends on the fleet data inputs and the quality and type of data provided by the fleet.*

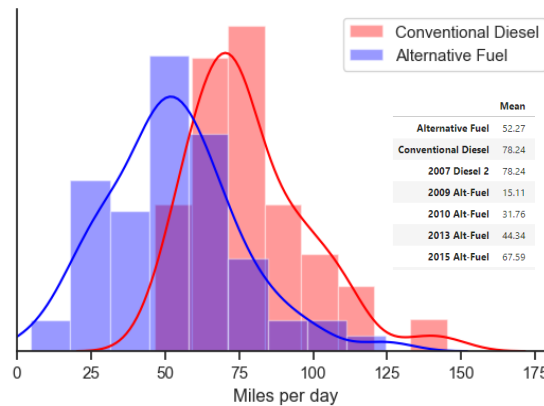
Final outputs may include tables and graphics similar to those below:

**The sample tables and graphics below were produced as examples and do not represent conclusions for any given fleet or technology.*

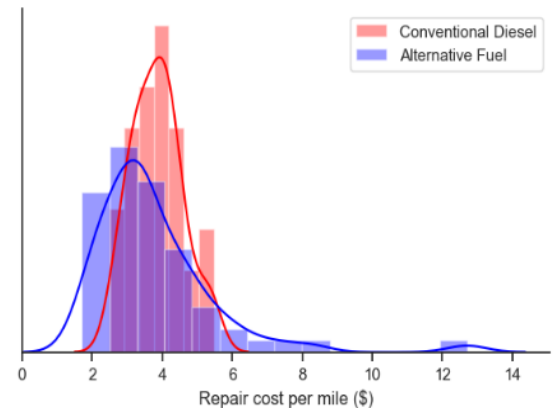
Vehicle Component & Conventional	Pre-2015 Alt-Fuel	2015 Alt-Fuel
Fuel	1.32	0.89
Tires	1.07	1.55
Brakes	0.3	0.04
Engine	0.13	0.07
Cooling	0.06	0.01
Other	0	0.01
PM	0.14	0.25
Body	1.21	1.21
HVAC	0.03	0.01
Suspension	0.02	0.01
Instruments	0.02	0.01
DEF	0	0.04
Overall	5.18	3.68

- Miles driven per day by vehicle type
- Repair cost per mile (\$) by vehicle type
- Repair orders per 100 mi by vehicle type
- Average repair order length (days) by vehicle type

Miles per day by vehicle type (< 30k mi.)



Repair cost per mile (\$) by vehicle type (< 30k mi.)



Miles per day per vehicle by vehicle type (< 30k mi.)

