

# CALSTART

## Volvo HighLIGHTS: Heavy-Duty Trucks

CALSTART evaluated the cost and performance of zero-emission trucks (ZETs), including Class 7 box trucks and Class 8 tractors, as part of the Volvo LIGHTS project conducted at the Dependable Highway Express (DHE) and the NFI Industries (NFI) freight facilities. Data on these vehicles, including metrics on charging, discharging, idling, and start and end state of charge, were collected from Geotab and Accuenergy dataloggers, analyzed by CALSTART, and validated by the fleets.

### Class 7 and 8 Vehicles

DHE deployed four trucks, including one electric box truck, one electric tractor, and two diesel tractors. NFI deployed two trucks, including one electric tractor and one diesel tractor. Specifications for the baseline trucks and the ZETs are listed in the tables below.

	DHE Electric Box Truck	DHE Electric Tractor	DHE Diesel Tractor
Type	Lithium-ion	Lithium-ion	Diesel
Model Year	2020	2021	2016
Manufacturer	Volvo	Volvo	Volvo
Model Name	VNR Box Truck	VNR Tractor	-
Battery Capacity (kWh)	264	264 or 396	-
Gross Vehicle Weight Rating (lbs.)	33,200	82,000	80,000

	NFI Electric Tractor	NFI Diesel Tractor
Type	Lithium-ion	Diesel
Model Year	2021	2014-2019
Manufacturer	Volvo	Detroit
Model Name	VNR Tractor	-
Battery Capacity (kWh)	264	-
Gross Vehicle Weight Rating (lbs.)	82,000	80,000



DHE's Volvo VNR tractors charging



NFI's Volvo VNR tractor

### Duty Cycle

Results on the ZETs' duty cycle were averaged over both fleets in the table below.

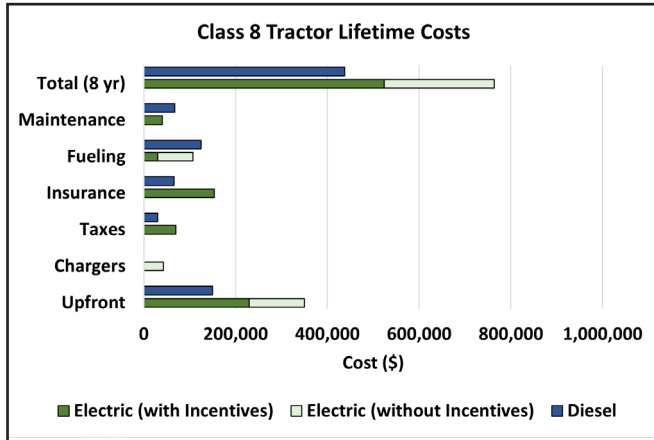
	DHE Electric Box Truck	DHE Electric Tractor	DHE Diesel Tractor	NFI Electric Tractor	NFI Diesel Tractor
Daily Distance Driven (miles)	60	82	150	108	152
Daily Energy Charged (kWh)	111	189	-	144	-

DHE's electric box trucks were able to meet the required duty cycle. However, the electric tractors could perform only about half of DHE's short haul duty cycle, completing one shift per day to allow for charging overnight and traveling a maximum of 179 miles in a single day. During the first week of deployment at DHE, a tractor ran out of energy enroute once. Volvo increased the tractor's battery capacity from 70% to 80%, resolving the issue and increasing DHE's confidence in the ZET's range. NFI's tractors were also range limited to one shift per day and a maximum of 202 miles driven in a single day. Despite these limitations, operators at both fleets were satisfied with the ZETs' performance, and both fleets intend to integrate more ZETs into their future operations.

## Total Lifetime Costs

DHE and NFI charged their electric box trucks and electric tractors on Southern California Edison's Time of Use EV-8 rate structure.

- DHE's electric box truck did not reach cost parity with their diesel box truck because of its short duty cycle. The more a fleet operates their ZETs, the quicker they will achieve a lower total cost of ownership.



- Neither fleet's tractors reached cost parity with conventional diesel equipment due to high upfront costs, infrastructure costs, and taxes. However, DHE and NFI achieved greater savings in fueling costs for their heavy-duty ZETs after applying Low Carbon Fuel Standard credits.
- Though heavy-duty ZETs are not yet commercially viable, fleets should consider additional factors in the total cost of ownership. For example, truck chargers begin decreasing in cost per truck as more ZETs are deployed.



DHE employee and Volvo VNR tractor

## Annual Emissions Offsets

- Diesel box trucks release the same amount of tailpipe emissions as ~5.2 gas-powered cars.
- Diesel tractors release the same amount of tailpipe emissions as ~36 gas-powered cars.
- Offsets were estimated based on tailpipe emissions measured by UC Riverside's Portable Emissions Measurement Systems testing.

1 electric Class 7 box truck offsets... 5.2 cars



1 electric Class 8 tractor offsets... 36 cars



## Best Practices for ZET Deployment

- Smart charging multiple ZETs all at once at differing power levels can offer fleets more operational flexibility and cost-saving potential.
- Fleets should consider ZET vehicle specifications that will impact operations, such as load capacity, battery capacity, and range, before procuring ZETs.
- Piloting multiple ZETs and utilizing real-world data captured from the deployments can help fleets optimize ZET performance and develop a more robust electrification roll-out plan.
- Fleets should partner with service manufacturer shops in proximity to their base of operations should ZETs break down and require maintenance or a quick, temporary replacement.