

## Navistar eStar Vehicle Performance Evaluation – 1st Quarter 2014

The Fleet Test and Evaluation Team at the U.S. Department of Energy's National Renewable Energy Laboratory is evaluating and documenting the performance of electric and plug-in hybrid electric drive systems in medium-duty trucks across the nation. U.S. companies participating in this evaluation project received funding from the American Recovery and Reinvestment Act to cover part of the cost of purchasing these vehicles. Through this project, Navistar will build and deploy all-electric medium-duty trucks. The trucks will be deployed in diverse climates across the country.

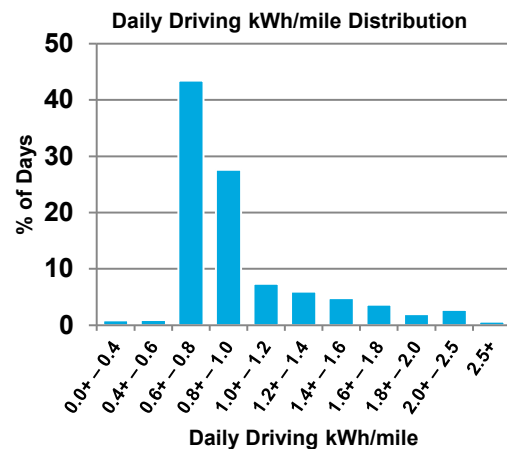
Number of vehicles reporting:	58	Number of vehicle days driven:	2,246
Reporting period:	(1/1/2014 to 3/31/2014)	Number of operating cities:	23

### Project Vehicle Specifications<sup>1</sup>

Curb Weight	7,022 pounds	Electric Top Speed	50 mph
Overall Length	255 inches	Battery Capacity	80 kWh
Overall Width	78.75 inches	Battery Voltage	300+ V
Overall Height	106 inches	Charging	SAE J1772
Peak Motor Power	70 kW	Transmission	Single speed reduction gear
Motor Location	Rear, in front of rear axle	Drive	Rear wheel drive
Advertised Range <sup>2</sup>	Up to 100 miles	Drag Coefficient	~0.5
Seating	2	Wheelbase	141.7 inches
Payload (Max)	5,100 pounds		

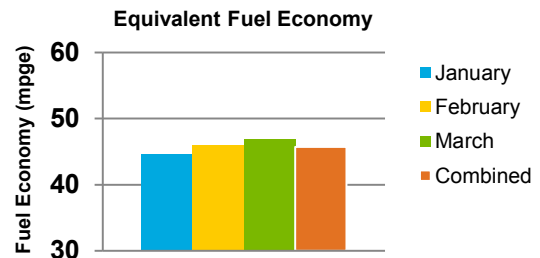
### Trip Data

Overall Diesel Equivalent Fuel Economy <sup>3</sup>	45.7 mpge
Overall AC Electrical Energy Charged <sup>++</sup>	890.3 Wh/mi
Overall DC Electrical Energy Charged	849.7 Wh/mi
Overall DC Electrical Energy Discharged	822.6 Wh/mi
Driving DC Electrical Energy Consumption <sup>4</sup>	751.6 Wh/mi
Total Number of Charge Events	2,238
Total Charge Energy Delivered	45,554.3 kWh
Total Distance Traveled	53,610.2 miles
City   Highway Distance <sup>5</sup>	40,189   13,422 miles
City   Highway Distance <sup>5</sup>	75.0   25.0 %

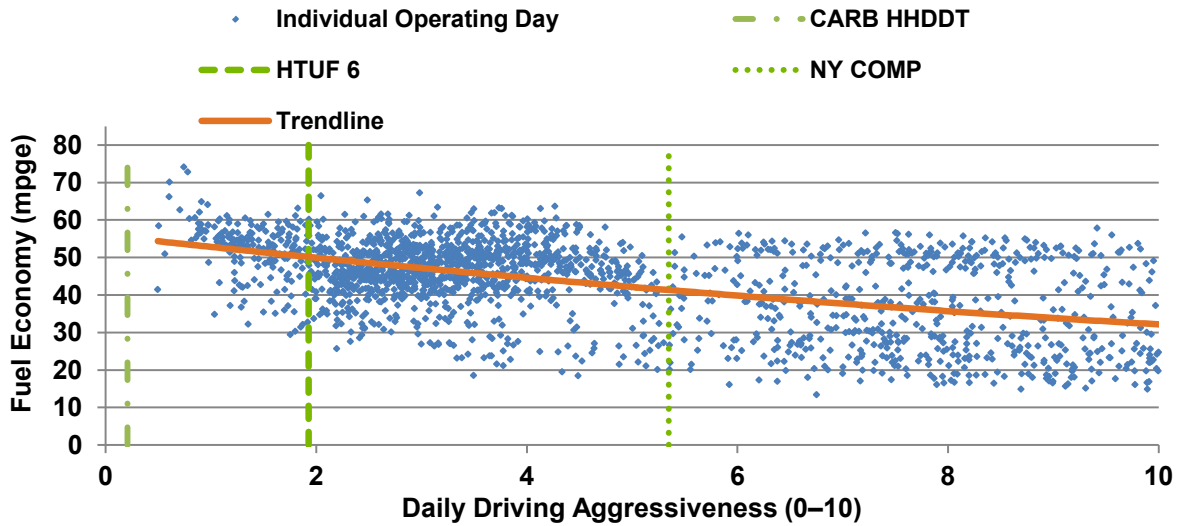


### Route Information

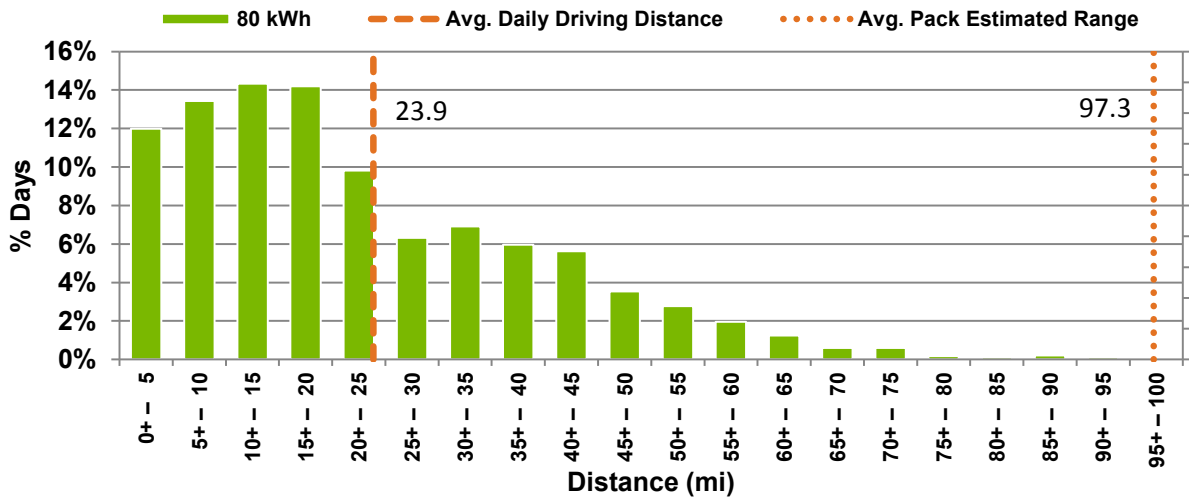
Average Distance Traveled per Day	23.9 miles
Median Daily Driving Aggressiveness <sup>6</sup>	3.7 [0-10]
Average Number of Stops per Day   per Mile	131.2   5.5
Average Brake (Regen) Events	14.7 per mile
Average Maximum Acceleration	0.31 g
Average Daily Maximum Driving Speed	49.0 mph
Average Daily Driving Speed	15.1 mph



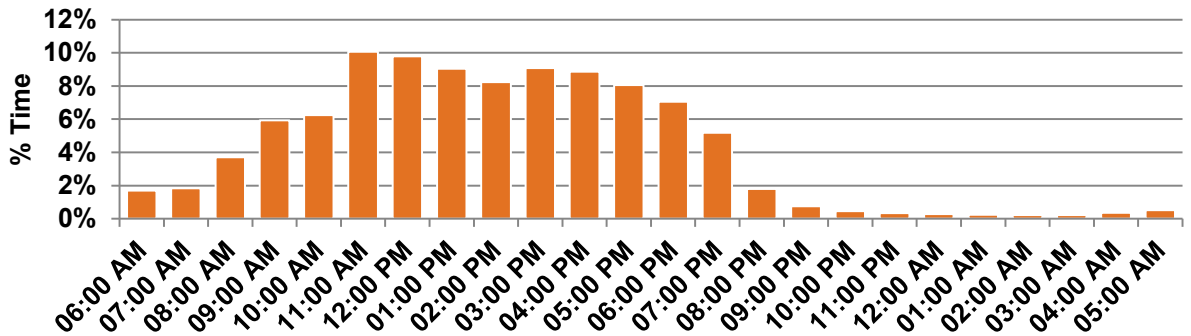
### Effect of Daily Driving Aggressiveness on Fuel Economy<sup>7</sup>



### Daily Driving Distance<sup>8</sup>

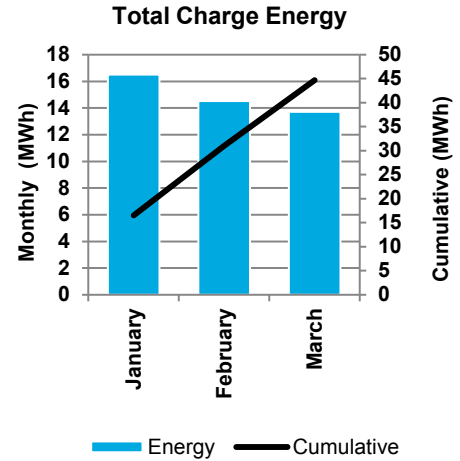


### Time of Day When Driving

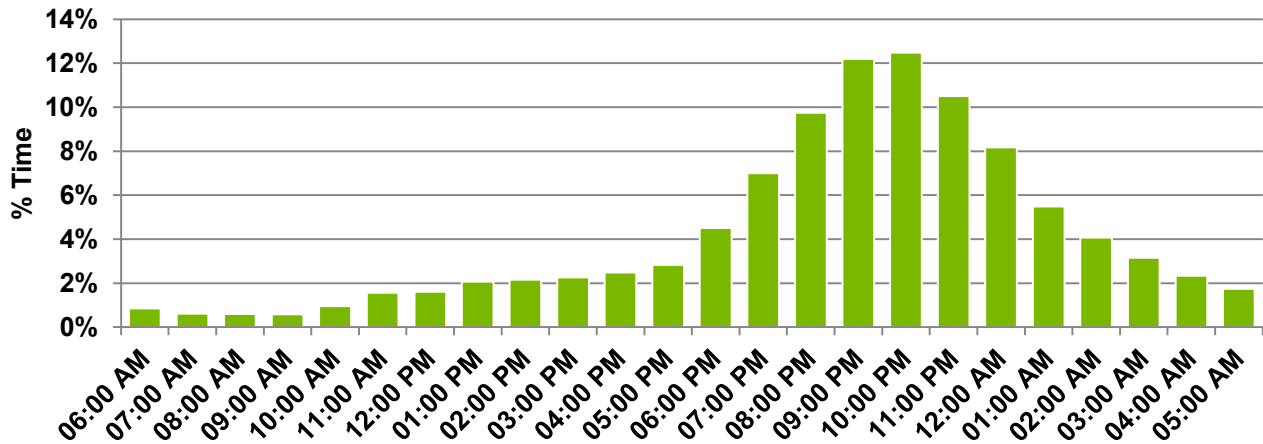


### Plug-In Charging

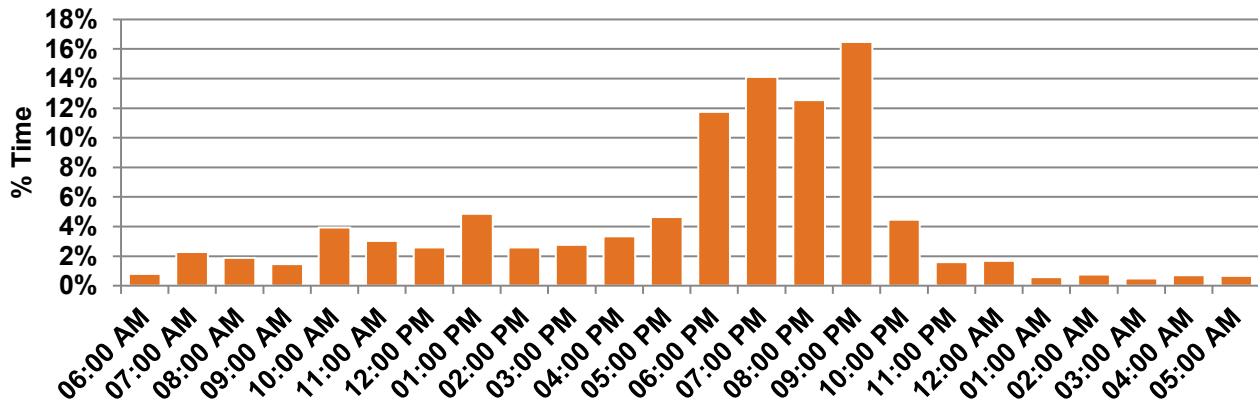
Average Fleet Charging Frequency	746.0 charge events per month
Average Fleet Charge Energy per Month	15,184.8 kWh/month
Average Vehicle Charging Frequency	1.00 per day driven
Average Vehicle Charge Energy per Day	20.3 kWh/day driven
Average Energy Delivered per Charge	20.4 kWh
Average Duration of Charge Event	3.6 hours
Average Distance between Charges	24.0 miles



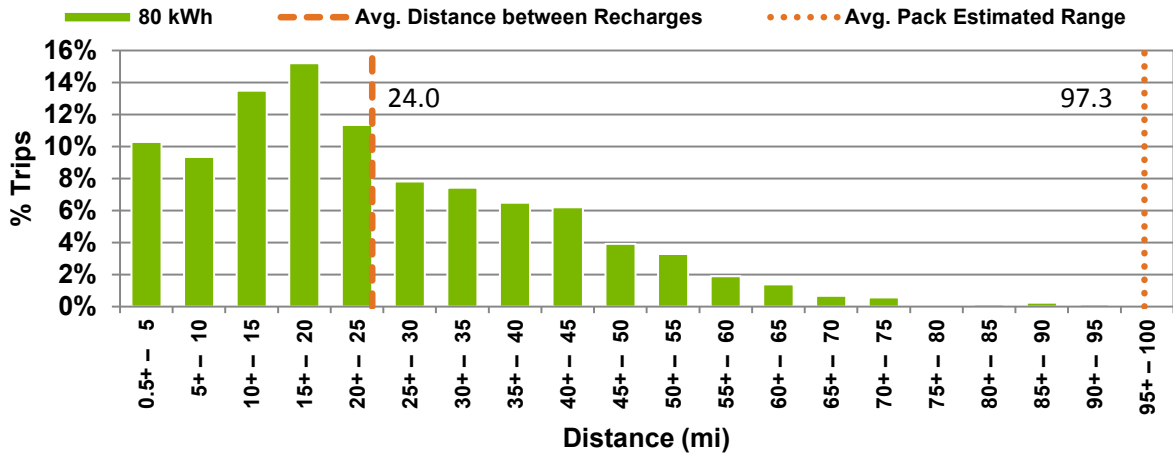
### Time of Day When Charging



### Time of Day When Plugging In



## Distance between Recharges<sup>8,9</sup>



1. Vehicle specifications provided by Navistar Inc.
  2. Actual electric range will vary based on drive cycle and vehicle configuration.
  3. Miles per gallon diesel equivalent (mpge) is calculated assuming U.S. Environmental Protection Agency standard energy density of 37.6 kWh per gallon of diesel.
  4. Total in-motion energy consumption averaged per mile.
  5. City and highway distance classifications are distinguished by a 35-mph trip speed limit. Trips classified as "highway" achieved a maximum driving speed in excess of 35 mph, while trips classified as "city" do not.
  6. Daily driving aggressiveness is kinetic intensity scaled by a factor of two. Kinetic intensity measures hybrid advantage. For more information on kinetic intensity, please refer to O'Keefe, M., Simpson, A., Kelly, K., and Pedersen, D., "Duty Cycle Characterization and Evaluation Towards Heavy Hybrid Vehicle Applications," SAE Technical Paper 2007-01-0302, 2007, doi:10.4271/2007-01-0302.
  7. Selected test cycles for comparison: Hybrid Truck Users Forum class 6 (HTUF 6), California Air Resources Board Heavy Heavy-Duty Diesel Truck (CARB HHDDT), and New York Composite (NY COMP). For more information please visit: <http://www.dieselnet.com/standards/cycles/>
  8. Average pack estimated range calculated based on battery energy storage capacity (80 kWh or 120 kWh) and average overall DC electrical energy consumption. Data are being collected for both 80 kWh and 120 kWh battery capacity vehicle configurations.
  9. All recharges occurring with less than 0.5 miles traveled were excluded from the chart for visual clarity.
- ++ Not all vehicles are reporting AC charge information.



Energy Efficiency & Renewable Energy

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