EESI • 1020 19th Street, NW, Suite 400 • Washington, DC 20036 • (202) 628-1400 • www.eesi.org

Environmental and Energy Study Institute

Fact Sheet

The Future of the Trucking Industry: Electric Semi-Trucks

April 2023

The trucking industry is a critical part of the economy, transporting 71.6 percent of U.S. goods totaling $10.4 trillion.[1] But trucks are also a significant source of pollution, having emitted seven percent of U.S. greenhouse gas (GHG) emissions in 2020.[2] Electric trucks can reduce GHG emissions while also providing other benefits, including better safety and improved public health. Major fleets have committed to transitioning at least 30% of their new heavy-duty truck purchases to be zero-emission vehicles, including electric models, by 2030.[3] But many companies are daunted by the extra upfront cost of electric trucks, as well as challenges like the limited availability of chargers. The *Inflation Reduction Act* (IRA) and *Infrastructure Investment and Jobs Act* (IIJA) will help address these challenges, and bring forward the cost parity of electric and diesel trucks. The benefits of electric trucks, increased availability of more makes and models, investments in charging infrastructure, the rapid improvement of the upfront and long-term economics, and policy incentives all point to a near-term boom in their adoption. This fact sheet will focus on electric semi-trucks, although many of its findings apply to electric trucks in general.

BENEFITS OF ELECTRIC SEMI-TRUCKS

Improved Health and Prosperity: Diesel-fueled semi-trucks produce 18% of U.S. vehicle emissions and emit pollutants that increase the risk of asthma attacks, heart attacks and strokes, lung cancer, and premature death.[4] These risks are heightened in communities of color that are disproportionately affected by vehicle pollutants.[5] Implementing zero-emission trucking could prevent 66,800 premature deaths, 1.75 million asthma attacks, and 8.5 million lost work days between 2020 and 2050—providing $735 billion in cumulative U.S. public health benefits.[5]

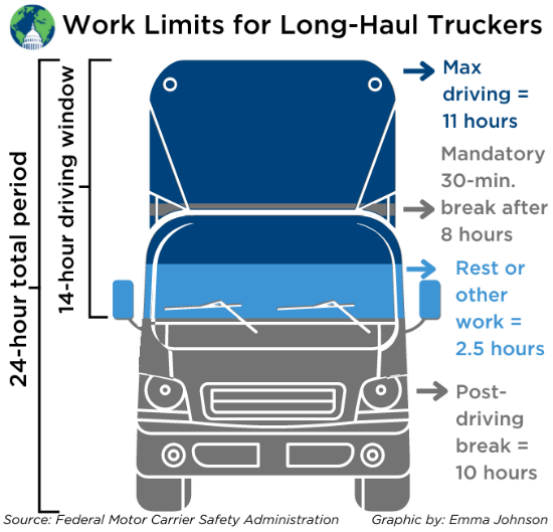
Lower Total Cost of Ownership: Electricity is less expensive than diesel fuel, producing large savings over long distances, and electricity rates are relatively stable, providing predictability for fleet operators. A simpler electric drivetrain also reduces maintenance costs.[6] Regenerative braking extends brake life and increases range.[7] A 2021 study from the Lawrence Berkeley National Lab estimated that an electric semi-truck with a 375-mile range would have a 13% lower total cost of ownership ($1.51 per mile) than a diesel model ($1.73 per mile).[8] This leads to a net savings of $200,000 over the semi-truck's 15-year lifetime.[8]

Increased Safety: Electric vehicles have a lower center of gravity because their motors and batteries are located at the bottom of the vehicles, making them less likely to roll over.[9]

CHALLENGES CURRENTLY FACING ELECTRIC SEMI-TRUCKS

Upfront Costs: Absent incentives, electric semi-trucks currently cost up to 2.8 times more to purchase than their diesel counterparts.[10] Falling battery costs and growing manufacturing scale will reduce this upfront cost differential over time.

Range: At first glance, conventional trucks have a substantial advantage when it comes to range. They can travel up to 2,000 miles without refueling, compared to up to 500 miles for current electric semi-trucks.[11] But because long-haul truck *drivers* are required to take breaks, these rest periods could be used to recharge electric truck batteries. Within a 24-hour period, truckers are allowed to drive a maximum of 11 hours, with a mandatory 30-minute break after eight consecutive hours of driving.[12] That translates to an average range of 500 to 715 miles a day.[13] Charging during mandatory breaks and during loading times allows electric semi-trucks to maintain efficient schedules.

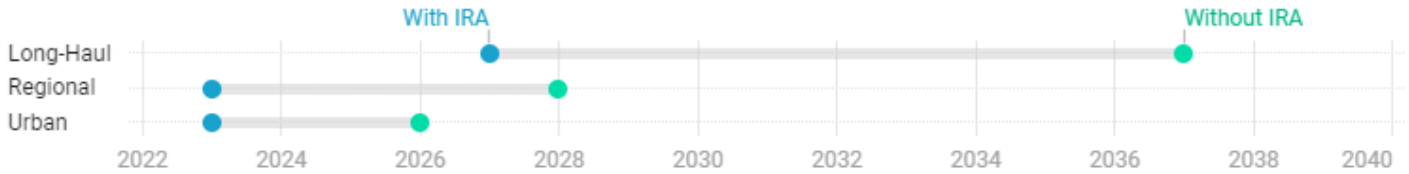


Charging Network: There are 6,700 public DC (direct current) fast-charging stations in the United States, but most only serve passenger vehicles.[14] The absence of a widespread heavy-duty truck charging network limits electric trucks primarily to regional hub-and-spoke routes with centralized private chargers at warehouses and other trucking depots.[15]

FEDERAL AND STATE INCENTIVES

***Inflation Reduction Act*:** Under the IRA, fleet operators can qualify for up to $40,000 in tax credits for each electric truck heavier than 14,000 pounds placed into service. The law also includes a $1 billion Clean Heavy Duty Vehicle Program to provide funding to states, municipalities, tribes, and nonprofit school transportation associations to electrify heavy-duty fleets. An RMI analysis found that the IRA will bring forward cost-parity between electric and diesel semi-trucks for short- and long-haul applications.[16] The IRA also extended the 30 percent tax credit for electric vehicle supply equipment and increased the commercial cap to $100,000 per charger.[17]

Electric Truck Parity Dates with Diesel by Duty Cycle *(Graphic Credit: RMI)*



***Infrastructure Investment and Jobs Act*:** The National Electric Vehicle Infrastructure Formula Program requires states to make plans to build public charging stations every 50 miles along alternative fuel corridors. The bill also funds research, demonstration, and deployment for low- and zero-emission transportation options, as well as expanded electric vehicle charging infrastructure (including for heavy-duty vehicles).[18]

State Initiatives: Five states have adopted California's *Advanced Clean Truck Act*, requiring manufacturers to increase zero-emission semi-truck sales by 75%, and at least five others are considering it.[19,20] Fifteen governors and the mayor of the District of Columbia have set a goal to have all new medium- and heavy-duty vehicle sales be electric by 2050.[21]

ELECTRIC SEMI-TRUCK MODELS AVAILABLE IN THE UNITED STATES

Several Class 8 heavy-duty electric semi-trucks (weighing more than 33,000 pounds when fully loaded with cargo) are already available in the United States. Some of these semi-trucks are better suited to regional routes rather than long-haul routes that exceed 250 miles. Thanks to improvements in technology, models with larger battery capacities (and more range) do not necessarily take longer to recharge. Manufacturers recommend fast-charging a battery to between 70 and 90% capacity, because charging rates slow down drastically past that point.[22]

Model	Range miles (mi)	Charging Time minutes (mn)	Battery Capacity kilowatt hour (kWh)
Kenworth T680E	150 mi	125mn (80%)	396 kWh
Peterbilt 579EV	150 mi	120mn (90%)	400 kWh
Freightliner eCascadia	150-230 mi	90mn (80%)	291 - 438 kWh
Volvo VNR Electric	275 mi	90mn (80%)	565 kWh
Nikola Tre BEV	330 mi	160mn (80%)	733 kWh
Tesla Semi	500 mi	30mn (70%)	500 - 1,000 kWh

All figures are courtesy of the manufacturers

Author: Shreya Agrawal
Editors: John-Michael Cross, Jon Jantz, Emma Johnson, Amaury Laporte
This fact sheet is available electronically (with hyperlinks and endnotes) at www.eesi.org/papers.

ENDNOTES

[1] "What's in That Truck I Just Passed on the Highway?" (February 24, 2021). United States Census Bureau, www.census.gov/library/stories/2021/02/what-is-in-that-truck-i-just-passed-on-the-highway.html

[2] " Fast Facts on Transportation Greenhouse Gas Emissions." Environmental Protection Agency, www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions (accessed March 16, 2023).

[3] "Trucking." World Economic Forum, www3.weforum.org/docs/WEF_First_Movers_Coalition_Trucking_Commitment_2022.pdf (accessed November 14, 2022).

[4] "Semi | The Future of Trucking." Tesla, www.tesla.com/semi (accessed November 14, 2022).

[5] "Delivering Clean Air: Health Benefits of Zero-Emission Trucks and Electricity." American Lung Association, www.lung.org/getmedia/e1ff935b-a935-4f49-91e5-151f1e643124/zero-emission-truck-report (accessed November 10, 2022).

[6] "Why Regional and Long-Haul Trucks are Primed for Electrification Now" Envase, www.envasetechnologies.com/comparing-total-cost-of-ownership-electric-vs-diesel-trucks (accessed on November 29, 2022).

[7] "Electric Truck Regenerative Braking, Explained" (May 27, 2021). Fleet Equipment, www.fleetequipmentmag.com/electric-truck-regenerative-braking-explained

[8] "Why Regional and Long-Haul Trucks are Primed for Electrification Now" (March 2021). Amol A Phadke, Aditya Khandekar, Nikit Abhyankar, David Wooley, Deepak Rajagopal. Lawrence Berkeley National Laboratory, https://eta-publications.lbl.gov/publications/why-regional-and-long-haul-trucks-are

[9] "Maintenance and Safety of Electric Vehicles" U.S. Department of Energy, Energy Efficiency and Renewable Energy Office, Alternative Fuels Data Center, https://afdc.energy.gov/vehicles/electric_maintenance.html (accessed November 10, 2022).

[10] "How Much Does an Electric Semi Really Cost" (February 24, 2022). The International Council on Clean Transportation, https://theicct.org/cost-electric-semi-feb22

[11] "All Electric Semi Truck Models in One Graphic" (September 6, 2022). Visual Capitalist, www.visualcapitalist.com/every-electric-semi-truck-model-in-one-graphic

[12] "Interstate Truck Driver's Guide to Hours of Service." Federal Motor Carrier Safety Administration, www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/Drivers%20Guide%20to%20HOS%202015_508.pdf (accessed January 8, 2022).

[13] "How Many Miles Do Truck Drivers Drive a Day?" (June 2, 2022). FrieghtWaves Ratings, https://ratings.freightwaves.com/miles-driven-per-day-by-truck-drivers

[14] "Alternative Fueling Station Locator" U.S. Department of Energy, Energy Efficiency and Renewable Energy Office, Alternative Fuels Data Center, https://afdc.energy.gov/stations/#/find/nearest?fuel=ELEC&ev_levels=dc_fast&country=US (accessed on November 11, 2022).

[15] "What's sparking electric-vehicle adoption in the truck industry?" (September 2017). McKinsey & Company, www.mckinsey.com/industries/automotive-and-assembly/our-insights/whats-sparking-electric-vehicle-adoption-in-the-truck-industry

[16] "The Inflation Reduction Act Will Help Electrify Heavy-Duty Trucking" (August 25, 2022). Rocky Mountain Institute, https://rmi.org/inflation-reduction-act-will-help-electrify-heavy-duty-trucking

[17] "Breaking it Down: What does the IRA Mean for Fleet Electrification?" (August 18, 2022). Edison Energy, www.edisonenergy.com/blog/breaking-it-down-what-does-the-ira-mean-for-fleet-electrification

[18] "Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act of 2021)." U.S. Department of Energy, Energy Efficiency and Renewable Energy Office, Alternative Fuels Data Center, https://afdc.energy.gov/laws/infrastructure-investment-jobs-act (accessed November 7, 2022).

[19] "Advanced Clean Trucks." California Air Resources Board, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks (accessed November 14, 2022).

[20] "How Six States Could Transform the Trucking Industry" (January 6, 2022). Bloomberg, www.bloomberg.com/news/articles/2022-01-06/how-zero-emission-laws-will-reshape-u-s-trucking

[21] "Memorandum of Understanding: Multi-State Medium- and Heavy-Duty Zero Emission Vehicle" (July 2020). California et al, www.nescaum.org/documents/mhdv-zev-mou-20220329.pdf

[22] "Electric Vehicle Charging Speeds." U.S. Department of Transportation, www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds (accessed March 16, 2023)