Electric Buses and Trucks

An Electrifying Transformation in Transportation
This report was written by Stephanie Thomas, Ph.D., organizer and researcher for Public Citizen based in Houston, TX. The author would like to thank Mike Stankiewicz, Adrian Shelley, Tom “Smitty” Smith, Kaiba White and Rhoda Feng for their contributions and revisions. The author would also like to thank Air Alliance Houston for their sponsorship of the Electric Vehicle Tour to California.

About Public Citizen

Public Citizen is a national non-profit organization with more than 500,000 members and supporters. We represent consumer interests through lobbying, litigation, administrative advocacy, research, and public education on a broad range of issues including consumer rights in the marketplace, product safety, financial regulation, worker safety, safe and affordable health care, campaign finance reform and government ethics, fair trade, climate change, and corporate and government accountability.
Introduction

Over the next 15 years Texas can expect to have 3 million electric cars, 200,000 electric heavy-duty trucks and 80,000 electric buses and delivery vehicles on its roads. The electric vehicle (EV) market is rapidly expanding, with EV purchases reaching 1.1 million in 2017 and was projected to reach 1.6 million in 2018. The growth of EVs is occurring across vehicle markets, with not only passenger vehicles but also heavy-duty vehicles like trucks and buses. Public health and climate change necessitates a transition away from antiquated internal combustion engines, and now is the time to act.

Cities around the world are facing public health challenges from emissions of nitrogen oxides and volatile organic compounds (precursors to harmful ground level ozone), carbon dioxide and other greenhouse gases, and particulate matter, including black carbon. Because electric vehicles have zero tailpipe emissions, they can help reduce the public’s exposure to these compounds and their secondary impacts in the atmosphere.

Funding from the Volkswagen emissions scandal settlement, which is providing over $200 million to Texas (Figure 1), alongside other sources, will help spur the transition to zero emission vehicles.

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1 See ERCOT, 2018 LTSA Update, Regional Planning Group Meeting (May 22, 2018).
A report released by University of Houston, funded by the Healthy Port Communities Coalition (of which Public Citizen is a member), modeled several projected air quality and health scenarios in the greater Houston area in the year 2040. The researchers found that electrifying 70% of the area’s heavy-duty vehicles would result in a 75% reduction in nitrogen oxides and particulate matter in the Greater Houston Area. Ozone across the region would be reduced up to 3 parts per billion. These pollution reductions would prevent 188 deaths in 2040, with a cost benefit of over $1.5 billion in just the Greater Houston Area.4

The Intergovernmental Panel on Climate Change also released a report stating that the world has only 12 years to limit global warming below the 1.5°C threshold, above which scientists predict catastrophic outcomes.5 A recent report released by 13 U.S. federal agencies has predicted drastic declines in the U.S. economy due to global warming, and that report,6 alongside another report from the Lancet,7 indicate severe threats to human health due to global warming.

According to the U.S. Environmental Protection Agency (EPA),8 greenhouse gas (GHG) emissions from the transportation sector account for 28 percent of total GHG emissions in the US. Of all of the GHG emissions from the transportation sector, light duty vehicles account for 60 percent and medium- and heavy-duty vehicles account for 23 percent. In Texas, 35 percent of GHGs came from power plants, 26 percent from refineries, petrochemical facilities and other industrial sources and 34.5 percent from transportation, including heavy-duty vehicles like buses and trucks.9

The transportation sector represents a key opportunity for governments, transit agencies, businesses and the general public to reduce GHG emissions.

In October 2018, Public Citizen’s Stephanie Thomas joined Houston-based nonprofit Air Alliance Houston in leading a delegation of nonprofit and public sector representatives on an excursion to California to visit a heavy-duty EV manufacturing facility as well as sites where such vehicles are currently in operation. We spoke with manufacturers, end-users, regulatory officials, and utility representatives. The group learned about the transition of heavy-duty diesel trucks and buses away from diesel and other fossil fuel-based combustion and towards zero-emissions.

This report highlights the current state of heavy-duty electric buses and trucks and outlines some of the benefits that EVs bring: zero tailpipe emissions, improved air quality, improved fuel economy, and lower maintenance costs. It also details strategies for moving EVs forward in our communities, including opportunities to finance EVs. Lastly, this report discusses policy recommendations to promote heavy-duty EVs.

Electric vehicles are available today

EV sales were expected to reach 1.6 million in 2018, and are becoming more commonplace. Heavy-duty EVs are no exception. The 2018 Bloomberg New Energy Finance report predicts a surge in electric bus sales over the next 12 years such that in the year 2030, EV buses will make up 84 percent of all buses sold.\(^\text{10}\) In its 2018 Long-Term System Assessment, the Electric Reliability Council of Texas predicted that by 2033 Texas will have 3 million EV passenger cars, 200,000 long haul trucks, and 80,000 short haul trucks/buses.\(^\text{11}\) While heavy-duty EV truck sales currently lag behind EV buses, many American manufacturers have been developing technology for Class 3 to Class 8 EV trucks, and battery EV trucks can be found currently in operation.\(^\text{12}\)

\(^{10}\) [https://about.bnef.com/electric-vehicle-outlook/](https://about.bnef.com/electric-vehicle-outlook/) (Accessed Dec. 9, 2018)

\(^{11}\) See ERCOT, 2018 LTSA Update, Regional Planning Group Meeting (May 22, 2018).

One of the limiting factors for purchasing heavy-duty electric vehicles is the cost. Today many EVs have a higher upfront cost than traditional diesel vehicles, though this may change as soon as 2025. The United Parcel Service (UPS) recently placed an order for 950 electric delivery trucks which matched the cost of trucks powered by conventional fuels, no government subsidies needed.

EVs also have much better fuel efficiency than their diesel counterparts. Furthermore, EVs have lower operating costs, with both fuel and maintenance costs lower than for internal combustion engine vehicles. EVs lack components which cause failure in diesel trucks: engines, cooling systems and transmissions.

The most costly item in an electric vehicle is the battery. Current battery costs reach up to $325 per kilowatt hour (kWh), depending on battery chemistry. Class 8 vehicle battery

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packs can be in excess of 200 kWh per truck or bus, adding heavily to the cost. The price of batteries has been declining, and is predicted to continue to decline.\textsuperscript{17}

Most buses made in the U.S. meet the Federal Transit Authority’s Buy America requirement which states that “the steel, iron, and manufactured goods used in the project are produced in the United States.”\textsuperscript{18}

While there are several EV transit buses currently on the market, only a few EV school buses are on the market due to the large cost differential between diesel and electric (e.g. $75k - 110k vs. $350k, respectively).\textsuperscript{19} EV buses, however, are cheaper over the lifetime because of the reduced costs of fuel and maintenance.\textsuperscript{20} EVs also help reduce costs for families because diesel pollution can be particularly detrimental to the health of young people. Transitioning school buses from diesel to electric both supports the health of students and fits into a larger strategy of decarbonization. And when the lifetime costs of maintenance and fuel are included into the cost of an EV, they are cheaper than vehicles powered by diesel.

Several truck models are currently in use at businesses and ports around the country. Yard trucks, also known as terminal tractors, move cargo around cargo yards and warehouse facilities. Yard truck batteries can last 15-25 hours depending on battery size. Because yard trucks are not on-road vehicles, they typically move at slower speeds and have more frequent starts and stops. This type of driving behavior supports battery range through regenerative braking. Drayage trucks haul cargo over short distances, and other heavy-duty trucks haul cargo on road for longer distances. Currently EV trucks work best over short distances. Manufacturers are developing technology to increase the range of EV trucks to

\textsuperscript{17} https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF-Lithium-ion-battery-costs-and-market.pdf (Accessed Dec 11, 2018)
\textsuperscript{18} https://www.transit.dot.gov/buyamerica (Accessed Dec. 9, 2018)
\textsuperscript{19} Personal Communication, Jack Symington, BYD Motors (Oct. 25, 2018)
500 miles per charge. Because trucks with refrigeration units must often idle their engines in order to maintain cooling, some manufacturers are creating Class 6 box trucks/delivery trucks with solar power to support refrigeration.

**Charging infrastructure considerations must be developed to meet EV Demand**

Heavy-duty EVs require charging infrastructure, and in some cases, this might require a build out of electric grid infrastructure to bring capacity to a new area. There is no universal standard for electric vehicle plugs. CHAdEMO is a fast charging technology originating in Japan that is used by several manufacturers. CharIN is another charging technology that allows for normal and fast charging through the Combined Charging System.

Heavy-duty EVs can also be charged in ways other than directly plugging in. Pantograph charging attaches to the roof of a vehicle stopped at the charging station. Induction coil charging requires no direct connection between charger and bus. Induction coil charging can wirelessly charge EV batteries, providing an efficient and effective way to charge vehicles. This technology is currently being used in Long Beach, Calif., Salt Lake City, Tampa-St. Petersburg, and McAllen, Texas, among other locations.

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22 [https://www.charinev.org/about-us/why-were-different/](https://www.charinev.org/about-us/why-were-different/) (Accessed Dec. 9, 2018)
Strategies for transition to zero emission fleets

Never before has the imperative to go zero emissions been clearer. Air pollution kills, and the climate crisis presents an overwhelming need to reduce GHG emissions. The long-term cost-savings of transitioning to EVs provides additional motivation. While price volatility of fossil fuels is all but certain over the next 10-20 years, electricity prices are predicted to be stable.\(^{25}\) Working with utilities can provide a mechanism to lock in affordable electricity rates.

Buses are already making the switch, with over 300,000 electric buses on the road globally.\(^{26}\) While there are fewer EV trucks on the road, the current state of technology provides a logical path to transition to EV trucks. At this point, EV adoption makes sense for nonroad applications, including cargo yards, drayage (short-distance movement of cargo), and fixed routes.\(^{27}\) Hybrid EVs can make longer journeys, and can fill the gap for longer hauls until vehicle range is extended for battery EVs. As battery costs drop and energy density improves, heavy-duty EV trucks are expected to have a longer range that will increase their application over longer distances. Cities are also beginning to adopt EV refuse trucks.

Funding opportunities

Because of the high capital cost of heavy-duty electric vehicles currently, direct purchases are a challenge. Several grants and incentive programs can help ease the financial burden of purchasing electric vehicles for transit agencies, government fleets, and businesses. Programs like the Volkswagen (VW) Mitigation Plan can provide funding for heavy-duty electric vehicles. State governments have information about how VW funds are being allocated.\(^{28}\) The public health benefit of electrifying transport is significant: models show that in 2040, electrification of heavy-duty vehicles could prevent 188 deaths and save over $1.5 billion for just the greater Houston area in that year alone.\(^{29}\)

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\(^{26}\) [https://about.bnef.com/electric-vehicle-outlook/](https://about.bnef.com/electric-vehicle-outlook/) (Accessed Dec. 9, 2018)


In Texas, the Texas Emissions Reduction Plan (TERP)\textsuperscript{30} provides funding for heavy-duty electric vehicle purchase. Currently, the TERP fund contains over $1.7 billion, much of which the state can put to use to support heavy-duty vehicle electrification.

The Federal Transit Authority provides funding for electric buses through its Low-No program, which supports low- or no-emission transportation projects.\textsuperscript{31} Several states also offer their own incentive programs, such as TERP in Texas and programs through the California Energy Commission.\textsuperscript{32}

Leasing is another attractive option for heavy-duty EVs. It is possible to lease the entire vehicle. However, given that the battery is the most expensive part of the vehicle, some purchasers are making agreements to lease only the battery.

Repowering, in which a vehicle with a combustion engine is retrofitted with electric technology, is another option. Boulder, CO, for instance, is repowering diesel buses to make them electric, saving nearly $500,000 per bus.\textsuperscript{33}

The Center for Climate and Energy Solutions 2017 report “Transitioning to Electrification: Funding Resources”\textsuperscript{34} and Environment America’s 2018 report “Paying for Electric Buses: Financing Tools for Cities and Agencies to Ditch Diesel”\textsuperscript{35} both contain more information on financing of heavy-duty EVs like buses and trucks.

\textbf{Next Steps}

Electric vehicle technology adoption is growing quickly and can help cities, transit authorities, ports, and businesses improve air quality, reduce greenhouse gas emissions, and save over the long-term through reduced fuel and maintenance costs. In addition to these benefits listed, EV manufacturing supports the economy and provides jobs. Transitioning from heavy-duty diesel vehicles to EVs will provide many benefits to fleets and communities alike.

\textsuperscript{30} \url{https://www.tceq.texas.gov/airquality/terp} (Accessed Dec. 9, 2018)
\textsuperscript{31} \url{https://www.transit.dot.gov/funding/grants/fiscal-year-2018-low-or-no-emission-low-no-bus-program-proje} \textsuperscript{32} \url{https://www.energy.ca.gov/contracts/transportation.html} (Accessed Dec. 9, 2018)
\textsuperscript{35} \url{https://environmentamerica.org/reports/ame/paying-electric-buses} (Accessed Dec. 10, 2018)
Policies can support the adoption and proliferation of EVs for the benefit of our communities. At this moment, however, electric vehicles are under attack. The Trump Administration has been trying to roll back fuel efficiency standards and recently announced a proposal to eliminate the federal tax credit for light-duty and some medium-duty EVs. The tax credit currently provides a $7,500 incentive for EV purchasers.

The federal government should adopt policies that promote, not stifle, the adoption of new technologies, particularly if the United States wants to continue its role as leader in energy and transportation.

The Low and Zero Emission Public Transportation Research, Demonstration, and Deployment Funding, which currently supports electric bus deployment, is funded through 2020, but will require additional appropriations to extend funding beyond 2020. In addition to extending funding for zero emissions vehicles at the federal level, states can continue to support the electric vehicle revolution through programs aimed to reduce pollution from the transportation sector.

Transitioning to electric vehicles will benefit public health and save money while mitigating pollution and climate impact. Now is the time to act.

38 ibid.