IEEE-USA

POSITION STATEMENT

Electrified Transportation

Adopted by the IEEE-USA
Board of Directors (November 2024)

Recommendations

Most of the world is steadily moving toward broad electrification of vehicles, trucks, buses, rail, and all other forms of transportation. The IEEE-USA recommends that the local and federal administrations and the private sector of the United States accelerate the pace of transportation electrification through strategies that reduce the costs of Electric Vehicle (EV) ownership, strengthen the domestic industry, establish a domestic supply chain of chips and components, and expand the electrical grid and the national energy portfolio that support this transition.

More specifically, the IEEE-USA recommends:

- **Domestic supply chains of EV Power Electronics, Chips and Components**:
    - Enable the domestic industry with incentives and financing tools that establish a domestic EV supply chain.
- **Battery Charging Infrastructure**:
    - Promote the development of battery charging infrastructure, both stationary and drive-by means.
    - Develop funding programs for deploying charging infrastructure for cities, states, and private companies for all types of vehicles.
    - Local regulatory agencies should acknowledge the need for grid infrastructure upgrades.
- **Battery Charging Infrastructure R&D**:
    - Encourage research on fast charging and mass transit charging.
    - Encourage on-road and inductive charging studies, primarily focusing on heavy-duty vehicle needs.

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- **Grid Integration of EV charging**:
    - Expand federal and industry research of charging infrastructure integration on the electric grid.
    - Develop and implement standards and policies with broad industry consensus on integrating growing charging infrastructure and expanding grids.
    - Promote policies and standards that support electrical grid operation with EV battery energy (vehicle-to-grid functionalities).
- **Electrification of Fleets of Vehicles, Trucks and Freight Trucks**:
    - Replicate via incentives the examples of the United States Postal Service and Amazon in the electrification of their last-mile fleets for other public and private sector services.
    - Support R&D in the range extension and loading capacity increase for electrified trucks (freight and others).
- **Battery R&D and Procurement of Materials**:
    - Increase federal and private sector R&D aimed at improving automobile battery technology and battery disposal, recycling and reusing through improved energy storage density, increasing battery life, using recyclable materials, implementing rapid battery recharge or change-out strategies, and sourcing battery materials with respect to native and international ethnic groups.
    - Continue and expand funding for improved battery technologies.

Background

Introduction

Compared to about 290 million cars with internal combustion engines (ICE), there are a little over 3 million EVs registered in the US – mostly passenger cars[1]. About 1.6 million of these EVs were sold in 2023 alone. The rapid growth in EV sales continues.

Simply put, US transportation is overwhelmingly reliant on fossil fuels. As with other sectors of the US economy, reducing greenhouse gas (GHG) emissions has become a high priority in our efforts to combat climate change.

Also, historically, high dependence of any sector to one energy source raises concerns of national security.

With more than half of all petroleum consumed in the US used in transportation, local and federal policies and incentives have attempted to shift the demand for vehicles to a demand for more EVs. The incentives benefitted several manufacturers that

[1] https://www.edmunds.com/electric-car/articles/how-many-electric-cars-in-us.html

scaled up their production and accommodated most of the market demand. Tesla, Chevrolet, Toyota, Volvo, Mercedes, BMW, Hyundai, and others in the US and beyond have established broad offerings of EV and hybrid electric vehicles. Moreover, communities, cities and states have made pledges to drastically reduce their greenhouse gas emissions by 2030-2050, which will further favor broader and faster proliferation of EVs.

At the international level, China has set bold transportation decarbonization goals, has developed a strong EV industry, has been the major global supplier of batteries and chips, and the EV sector is empowered by strong government subsidies and benefits significantly from lower material and labor costs. This allows China's EV sector to target the European and US markets, despite the protective policies of the latter for the sake of domestic manufacturers.

Technology

While the Internal combustion engine (ICE) efficiency is around 25% to 30%, an electric motor is almost 100% efficient with only minor losses at part load. The entire electric drive is close to 80% efficient. In addition, electric motors do not incur idling losses. An electric motor is energy consumption depends on its instantaneous power output rather than its rated power. As a result of these factors, electric vehicles convert 87% to 91% of the supplied electrical energy (from the electrical grid) to power at the wheels compared to conventional gasoline-powered vehicles, which convert only about 16% to 25% of the energy stored in gasoline to power at the wheels. These energy conversion efficiencies at the vehicular level translate to a well-to-wheels efficiencies of about 35–37 percent for electric and about 15–19 percent for conventional cars.

Even more dramatic results are obtained when GHG emissions are weighed in.

In the same vein, passenger EVs boast an average range of 250 miles on a single full charge, with the upper quartile of the most efficient EVs reaching ranges of 310 miles. Even hybrid EVs equipped with electric motors improve fuel efficiency at up to 50 miles per gallon of gas.

In the broader space of electrified transportation, bus, ship, train, and truck vehicle manufacturers have been developing and commercializing more efficient electric drivetrain technologies. Also, a few EV companies have attempted to enhance their offers with self-driving features and have targeted the ride-sharing market to afford increased profits to riders.

Infrastructure

Undoubtedly, the technological leaps enabling electrified transportation have sparked an unprecedented transformation of the transportation sector. This transformation now propagates to the electrical power sector, such as the electrical grid necessary for EV charging across the continent. Thousands of public charging stations are deployed throughout the US, and end customers upgrade their service entrances accordingly to allow charging at home. Demand management has emerged as a means for utilities to defer the required infrastructure improvements.

The current electrical energy mix and the proliferation of distributed energy resources increase transportation primary energy efficiency and reduce greenhouse gas and critical air pollutants.

The most critical concerns about charging infrastructure are its availability, convenient siting, and good working order.

However, the overall electrical power generation capacity, the aging grid components, and the lengthy permitting processes for system expansions and reinforcements are trailing the projections of load growth and, thus, the imminent rise in EV energy demands – particularly for fast charging. Moreover, distribution system bottlenecks are already apparent, with several states suffering from service disruptions of several hours per household per year[2], indicating that hosting EV charging demand will only exacerbate existing problems. For the same reasons, mass transit electrification might face severe obstacles unless load hosting capacity can be significantly improved across the country.

At the experimental stage, highway infrastructure is also important to the issue because inductive (wireless) charging may serve as an alternative or complement plug-in charging. Electrified roadways, providing on-road charging while the vehicle is moving, have been demonstrated and tested with positive results. In the next stages, assessing the interdependencies with the power grid infrastructure and conducting more expansive highway testing of the available technologies is necessary. Such technologies will be significant for heavy-duty vehicles.

This statement was developed by the IEEE-USA Energy Policy Committee and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public policy interests of the nearly 150,000 engineering, computing, and allied professionals who are U.S. members of the IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of IEEE or its other organizational units.

[2] https://www.eia.gov/electricity/annual/html/epa_11_05.html