Electrification of Transportation

In the European Union

An IEEE European Public Policy Initiative
Position Statement

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Introduction

Today, the public is generally more concerned with the environmental impact of technology than in any period of the modern industrial economy.

The use of electricity to provide the energy to drive transportation is not a new idea: railways around the world have used electricity to drive trains and trams for many years. This was due to the nature of the railway, with defined routes allowing power to be routed effectively along the railway lines.

The internal combustion engine gave transportation a degree of flexibility that the railways could not. The ability to travel in an ad-hoc manner, without having access to an energy infrastructure, gave motorised vehicles a freedom to access places where the railway could not. However, this came at the expense of the increased usage of fossil fuels to drive the transportation growth during the 20th century. The IEEE Transportation Electrification Community has grown to address these issues.

This position paper is related to the IEEE-USA "Transforming Transportation by diversifying Energy sources" position paper[1], looking at this topic from an EU perspective following publications by the EU on Electrification of Transport[2,3].

IEEE EPPI Recommendations:

- Investment in an integrated transportation strategy covering more efficient and coordinated transportation of people and goods to minimise the need for energy.
- Charging infrastructure investment for passenger and goods vehicles; Policy makers should focus on enhancing the rollout of a smart-charging infrastructure, including via private sector participation.

[1] IEEE USA Transportation Position Paper
[2] European Roadmap – Electrification of Road Transport, 2nd Edition June 2012
[3] Electrification of the Transport System, Studies and Report (2017), European Commission Directorate General for Research and Innovation. Directorate H – Transport, Unit H.2 – Surface Transport

- A thorough assessment of the interaction between electric vehicles and the grid with a high proportion of renewables; Public policies to encourage e-mobility and smart charging of electric vehicles so that ubiquitous grid-friendly charging can be provided.
- Research and development of higher capacity and longer life battery technology and alternative energy storage systems, to increase the range capability of electrified transportation.
- Energy harvesting, regenerative braking and other recycling techniques should be encouraged to increase the working range of electrified transportation.
- Standardization in these areas to address interoperability, manufacturing economies, and distributed sourcing of key components and systems.

The Current Situation with Electrified Transportation

Along with the drive towards zero carbon economies, removing coal and gas-fired generation from the supply chain, the use of electricity as the energy source for transportation has grown.

- Many railways globally use electrical power systems to drive trams, as well as local, regional and international rail services.
- Electric cars, vans, trucks and buses are reaching technological maturity for reliable use in urban environments.
- For passenger vehicles, ranges of 400 km are already available, with high-power and the ability to quickly recharge, that allows for long distance traveling; Longer ranges still can be achieved by hybrid vehicles.
- Heavy-duty, long-range vehicles present much more of a challenge due to their high-energy requirements.
- Urban public transport has experienced a clear shift towards electric buses due to their substantial increase in energy efficiency and environmental benefits.
- The primary drive for most large, marine vessels is now an electrical propulsion system, although they may still require fossil fuels for generating on-board electricity.
- Aviation is a developing area for electrification. While there are few viable alternatives for the main propulsion unit, most other systems in the aircraft are being electrified. The prospect of an all-electric aircraft is being explored by prototype aircraft, such as the recent flight by a solar powered craft around the globe.

A significant challenge for these technologies is the cost of energy from a modern battery is more than the equivalent cost of energy from petroleum fuels[4]. Therefore, there needs to be a strategic approach to incentivise the integration of transportation into the overall energy system to reduce carbon emissions.

The rapid development of battery technology has been due largely to progress in lithium-ion batteries. These are predicted to play a leading role in improving battery storage capability. Moreover, the technology is expected to benefit further from considerable cost reductions as the market develops batteries. However, other technologies also exist which could play a role in the overall scheme, such as fuel cells. Another example of alternative solutions is a recent development in the realm of super

[4] Lithium Ion Batteries And Beyond

capacitors that have the potential to compete with petroleum-based energy sources, both in terms of cost and performance, with very fast recharging capabilities. Refer to the IEEE EU position paper on Energy Storage for more detail. In the meantime, new technologies such as wireless power charging are evolving rapidly to minimise the impact of the limitation of longer battery charging times, among others.

Investment in more efficient and coordinated transportation of people and goods is necessary to minimise the need for energy. There is a move towards less personal ownership of transportation and vehicle sharing schemes, particularly in urban environments, so an integrated transportation strategy is needed that allows these to be incorporated alongside public transport systems. Soon there will be autonomous vehicles, which will need their own charging infrastructure.

Charging infrastructure for passenger vehicles is a key issue and a typical chicken-and-egg problem. Case studies show that having a good network of charging infrastructure in place results in a sense of ease for the drivers, and therefore a willingness to invest in electric vehicles. In this respect, policy makers should focus on enhancing the rollout of a smart-charging infrastructure, including via private sector participation.

The interaction between electric vehicles and the grid should be assessed to fully understand the impact of electric transportation. Public policies to encourage e-mobility and smart charging of electric vehicles should be initiated quickly, to ensure ubiquitous grid-friendly charging can be provided.

Research and development of higher capacity and longer life battery technology should continue to be funded. This will increase the range capability of electrified transportation. Energy harvesting, regenerative braking and other recycling techniques should be encouraged to increase the working range of electrified transportation. Energy harvesting technology collects energy from the environment, such as heat or vibration. Regenerative braking systems are already in use on rail systems, using the machine drives in reverse mode to generate electricity, while slowing the vehicle by taking kinetic energy out of the system.

Finally, standardization in these areas is critically needed to address interoperability, manufacturing economies, and distributed sourcing of key components and systems.

Conclusion

The global energy mix is changing, with a focus on renewable sources with low or zero carbon emissions. In this environment, there is a need to change the way transportation systems are powered.

The trend to move towards electric vehicles is growing in pace, with the need to reduce carbon emissions in line with international agreements and the forecast of future scarcity of fossil fuels driving this demand.

Public policy makers need to act, encourage and cultivate the support of these technologies, as well as create a framework for their integration into the overall energy strategy.

This statement was developed by the IEEE European Public Policy Initiative and represents the considered judgment of a broad group of European IEEE members with expertise in the subject field. IEEE has nearly 60,000 members in Europe. The positions taken in this statement do not necessarily reflect the views of IEEE or its other organizational units.

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