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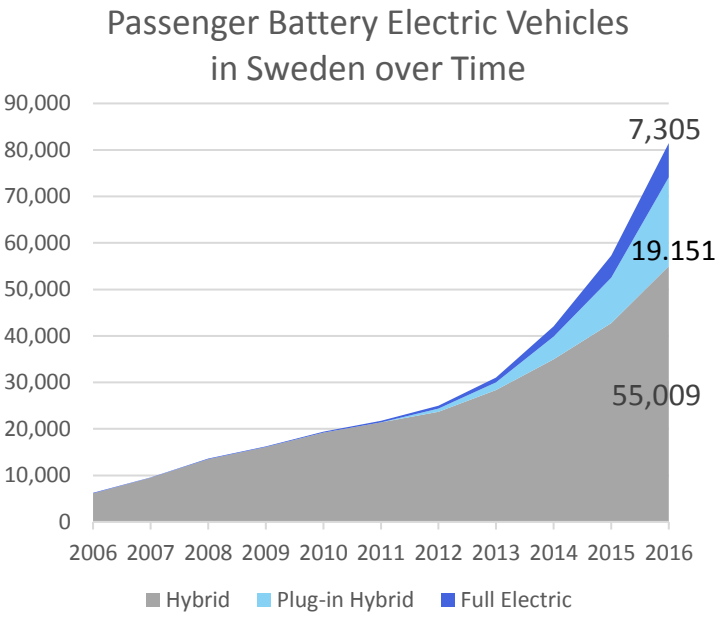
DEPARTMENT OF BUSINESS DEVELOPMENT AND TECHNOLOGY

THE STATUS AND CHALLENGES OF ELECTRIC VEHICLES IN SWEDEN - 2016

Summary

Given its low-carbon electricity power system and strong commitments to further decarbonization, Sweden is ideally situated to transition to electric vehicles. The country currently faces challenges to its electricity power system, as nuclear power plants are phased out and renewable electricity develops, as well as its transport sector, with the continuous push to meet its ambitious carbon reduction goals and urbanization challenges.

Electric vehicles are consistently seen as essential to transport decarbonization, but they face three central barriers: 1) capital cost, 2) charging infrastructure, and 3) lack of knowledge and experience. While many were intrigued by the idea of vehicle-to-grid (V2G), skepticism was expressed towards its necessity within a Swedish context. The interviewees agreed on the central policy recommendations that Sweden should implement include the bonus-malus system, continue support for charging infrastructure, and develop sector-wide programs to increase consumer knowledge of EVs.



Source: Transport Analysis (link) *through Nov 2016*

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About this project:
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Transport challenges

Based on our interviews, the main challenge facing the transportation system is the target of 70% carbon reductions by 2030 (as compared to 1990 levels). In the context of this goal, Sweden faces two problems; incentivizing the shift away from fossil fuels to electric vehicles and biofuels, as well as encouraging a stronger development of public transportation systems. Public transportation, especially within urban areas, is seen as the solution to decarbonization, with many interviewees seeing the future of cities as one with drastic decreases in the personal vehicle ownership rates. This is said to be replaced by more attractive forms of public transportation, as well as car-sharing schemes. Many of the interviewees agree that the future of personal vehicles, outside of urban areas where public transit is not an alternative, will largely become either partially or entirely electrified, though some called for higher investment in the train system.

Electrification in general was seen often in the context of certain market segments; that is, certain modes of transportation would be electrified, such as passenger vehicles and buses. Other modes of transport were seen as essential for the role of biofuels, such as long-distance trucks and aviation. But, the interviewees were split whether biofuels and electric vehicles were competitive or complementary, while agreeing on the need for both fuel types in the near future and dispelling a geographical urban/rural benefit for either of them.

Noteworthy, a distinctive characteristic of Sweden is the legacy of its own automotive manufacturing industry, with interviewees mentioning the close relationship between its manufacturing brand (Volvo) and the government at a local, municipal and federal level. This steers to different degrees' transportation and mobility strategies, particularly on the bus and passenger vehicle segments; which brings research and economic benefits (i.e. job creation) but developmental challenges in transitioning to electrified transport fleets.

Nonetheless, these barriers to both electrification and the conversion to biofuels made many skeptical that transportation decarbonization goals would be met, under current incentive schemes and decarbonization pace.

THE CENTRAL TRANSPORTATION CHALLENGE IS MEETING THE 70% REDUCTION IN CARBON EMISSIONS BY 2030; MANY SEE THIS GOAL AS UNREALISTIC

Energy challenges

Sweden is said to have a strong and well-developed grid, on both the transmission and distribution scale, benefits from robust production sources and decreasing electricity prices. In general, the distribution networks are said to have an overcapacity due to the built-in capacity for electric heating (that has since switched to district heating or geothermal) as well as increasing energy efficiency. In turn, the transmission networks are seen as sufficient for now. However, as wind capacity increases there may be further need to increase alternate transmission routes.

The central barrier facing the Swedish electricity system was seen as the phasing out of their four (near-term) and remaining six (long-term) nuclear reactors. The first phase-out of nuclear is not considered a serious problem, given the existing surplus of electricity production of around 10-22 terawatt-hours, and the large amounts of existing, flexible hydropower production.

However, multiple persons viewed the future of the electricity system as very uncertain. As the final six nuclear plants are expected to be phased out starting in the 2030's, depending market developments, the grid at this time

period is expected to become much more reliant on intermittent sources, namely wind and solar electricity. While overall electricity surplus was not expected to decrease significantly, interviewees were concerned with the increasing volatility of the grid and the need for more balancing capacity.

Still there seems to be a general belief that the current hydro capacity will be sufficient to withstand this increase in volatility, others also suggested further regional interconnection, as Sweden's hydro capacity would be valuable for the Nordic and Northern European region as well, especially as the transition to intermittent renewable electricity sources continues.

Electric Vehicles & V2G Benefits, Barriers

Electric vehicles are seen as playing a central role to the future of Swedish sustainable transport, with some viewing them as inevitable. Most of the benefits recognized by the interviewees were primarily environmental, focusing on reducing greenhouse gases and health impacts. Other impacts, such as noise reduction, and the better performance of electric vehicles were also discussed frequently. Oil independency was hardly mentioned at all.

The two central barriers to electric vehicles typically mentioned were price and charging infrastructure. The capital cost of electric vehicles was by far the most commonly discussed as the largest barrier to electric vehicle deployment. Many of the interviewees believed that the current incentive scheme for electric vehicles was sufficient, often citing the success of company cars, and few argued for significant increases in the subsidy for electric vehicles (currently 40,000 SEK for BEVs, and 20,000 SEK for PHEVs). Instead of matching most of the other Nordic country's subsidies to the capital cost of vehicles, participants argued that a better route to take would be make the petrol and diesel car a less attractive option, with most supporting the proposed bonus-malus system.

A number of interviewees noted that vehicle incentive schemes had traditionally benefited petrol and diesel cars because of Sweden's legacy of its own manufacturing brand (Volvo); for example, considering that the manufacturer will have fully electric vehicles commercially available only until 2018-19. This can be further characterized as an industry barrier to electric vehicles in Sweden; which is coupled with the fact that, in a parallel study we undertook visiting car dealerships, ICEs are still offered as the first option for consumer purchase, even when a suitable EV option is available.

In terms of charging infrastructure, interviewees argued that "daily" charging was the biggest barrier, that is, installing chargers in homes, work places, and at apartments. After "daily" charging, they discussed the need for the further development of public charging infrastructure. However, the opinions of these barriers were split; while some thought the role of public charging infrastructure was a technical barrier to EV adoption, others believed public charging played more of a symbolic role.

In that thread, nearly all of the interviews explored social barriers, though in most interviews, they were discussed as secondary to the technical and the economic barriers above. However, in almost all the interviews experience (or lack thereof) and perception were mentioned as central barriers to consumer's decision to purchase EVs. Several experts believed that word of mouth and actual experience trying out EVs as the central drivers to actual EV purchases. This experience would decrease commonly-held myths of EVs, especially regarding range, charging infrastructure, total cost of ownership, among others. They called for the normalization and increased visibility of EVs, and suggested programs such as government agencies requiring all their vehicles to be electric.

On the other hand, the benefits of V2G were less well defined. Interviewees believed it to be an interesting technology but some struggled to see its benefits for Sweden, especially

compared to second-hand purpose-built (stationary) battery storage. Furthermore, several experts recognized that the central benefit of V2G would be to "save" hydro capacity for services it was better suited for, given battery's suitability for short-term balancing.

They also brought up the barriers facing V2G. Besides the general concerns regarding its need, these focused on battery lifespan, both on the warranty as well as social acceptability of allowing others to use their battery. Other barriers discussed were consumer ignorance, indifference, and skepticism of the revenue potential to attract consumers to participate.

Key suggested recommendations

- Implement the bonus-malus system
- Stabilize government policy
- Allow municipalities to implement environmental zones, restricting certain vehicle use within cities
- Develop initiatives to increase EV knowledge and experience

Offered suggestions

Based on the interviews, the initial observations suggests that Sweden is an ideal platform for electrification of transport and can accelerate EV deployment by working on the following things.

First, the most common barrier to electric vehicles, outside of company cars, was the price. Though the prices of EVs are decreasing on an annual basis, there continues to be a significant price disparity between EVs and conventional petrol and diesel cars. The implementation of the bonus-malus system was discussed as the central mechanism government is and should undertake to encourage EV deployment, but its set-up must provide clear incentives that reduce the price gap between petrol and diesel cars and EVs. Some experts hinted that something similar should be applied to the used car market as well, to encourage a swifter transition to electrification.

Next, many interviews discussed the necessity for government incentives to develop charging infrastructure, both for daily and public charging. Without government subsidies it was stated that charging infrastructure would not be developed, especially given concerns over the lack of established business models, particularly in respect to public charging. In addition, government support was still seen as necessary for daily charging infrastructure, especially as an independent information provider and as a facilitator allowing for collaboration between charger companies, homeowner associations, and building developers.

Third, multiple interviewees saw the main way for government to encourage the development of electric vehicles is to allow municipalities to employ stricter environmental zones within the cities. The experts suggested that these environmental zones allow only electric vehicles or other zero-emission vehicles within these sections of the city, which would subsequently drive demand for electric vehicles drastically. These experts saw vast co-benefits of such a rule, by decreasing noise and local air pollution within certain neighborhoods, improving local property prices.

Finally, the knowledge and competence of the average Swedish consumer needs to be considered in order to have a successful transition to EVs. Knowledge and experience were seen as key drivers of EV adoption, and thus policies that give consumers access to independent information and real-life experience of EVs would be beneficial. Among others, experts suggested increasing the visibility of EVs and charging infrastructure.