Regulatory Considerations for Cost Effective Integration of Electric Vehicle Charging Infrastructure

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Introduction

Sales of electric vehicles (EVs) in the US were 330,000 in 2019[1] and represented 1.9% of the new light-duty vehicles sold in 2019. Globally, sales of electric cars topped 2.1 million and while the Covid-19 pandemic will affect sales, it is expected that EV adoption will grow as costs decline and automakers shift production toward EVs.[2] Alongside expected growth in EV ownership, US state legislators and regulators are actively formulating policies, and evaluating programs as regulated utilities are expected to play an increasing role in supporting EV infrastructure development.

Depending on state legislative requirements, utility regulatory authorities and the level of involvement of the different stakeholders, the role of the utility can be expected to vary considerably as EV ownership grows. Early experience in a number of countries and some US states shows that EV infrastructure deployment, learning-by-doing and experimentation will be important factors for legislators, regulators and utilities to consider.

In this article, we examine how Electric Vehicle Supply Equipment (EVSE) and charging stations have developed in some non-US countries and contrast it with the current state of EVSE and charging infrastructure in the US. Based on this experience to date, we identify some key factors that utilities and regulators can consider for effective and efficient EV infrastructure development.

Incentivizing Increased EV Ownership

Experience from other regions and countries reveals that ownership incentives are a key factor for EV adoption, and when EV ownership reaches a high enough level, charging station economics improve considerably. However, while charging station availability is an important consideration for EV owners, early studies show it is not a limiting factor as many early EV adopters are able to use home charging stations.

A study conducted by Energeia reviewed the policy and regulatory framework of leading countries by Plug-In Electric Vehicles (PEV) market share identified several key factors for encouraging the development of PEV models and PEV sales: purchase incentives, government purchase targets, third-party PEV import regulations and fuel efficiency standards.[3] Moreover, in New York, analysis has shown that tax incentives are a key for consumers to replace gasoline-fueled vehicles with EVs.[4]

Similarly in Norway, consumers reported that up-front incentives reducing EV purchase costs are the largest factor when deciding to own an EV (Figure 1). Further, consumers in Norway bought EVs in response to significant vehicle taxes even before much of the charging network was built, where tax exemptions can be worth over half of the retail car price.[5] In particular, Norway's new car purchase taxes, which include the costs of environmental externalities (CO2 and NOx emissions) and Value Added Tax (VAT), increase the cost of gasoline and diesel fuel vehicles such that they exceed EV up-front costs (Table 1). These up-front incentives are an important driver of EV sales. To contrast, in Denmark, even the presence of a much more robust charging network was not sufficient to incentivize EV adoption, as there were fewer up-front

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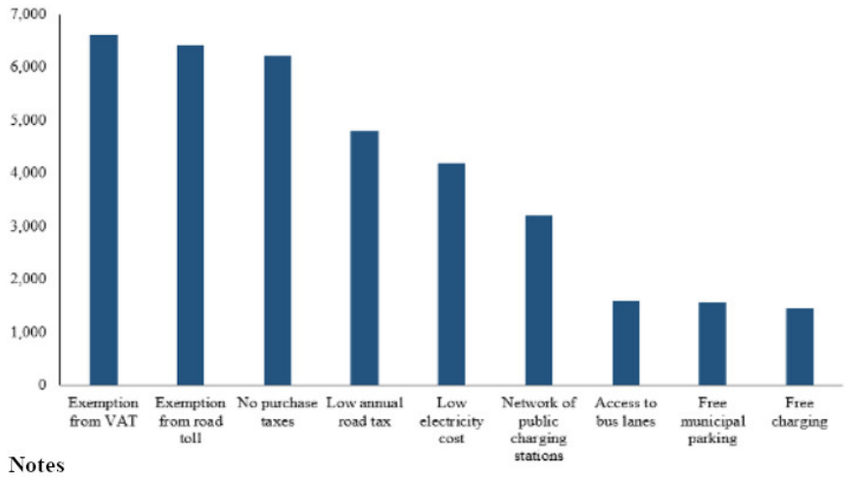
See footnotes at end of text

Most Important EV Incentives to Norwegian EV Owners



Notes

Put a price on carbon to fund EV incentives - Norwegian EV policy success (2017)

Source

[1] 12,500 Norwegian electric vehicle responded to the 2017 survey

[2] Survey Respondents were asked to select their three most valued electric vehicle incentives

Price Comparison of Electric and Gas Vehicles in Norway

	Audi A7[1]	Tesla Model S[2]	Volkswagen Golf[1]	Volkswagen E-Golf[2]	Volkswagen Up![1]	Volkswagen e-Up![2]
Import Price	319,464	636,000	180,624	259,900	103,621	188,100
CO_2 Tax	125,253	-	31,827	-	19,209	-
NOx Tax	1,525	-	2,263	-	1,276	-
Weight Tax	109,198	-	21,526	-	13,494	-
Scrapping Fee	2,400	2,400	2,400	2,400	2,400	2,400
25% VAT	139,460	-	59,660	-	35,000	-
Retail Price	**697,300 NOK**	**638,400 NOK**	**298,300 NOK**	**262,300 NOK**	**175,000 NOK**	**190,500 NOK**

Notes:
[1] Indicates a gas vehicle
[2] Indicates an electric vehicle
Source:
http://www.ofvas.no/

incentives.6

Further, there is evidence that charging stations can become economically self-sustaining once there is enough EV adoption. In Norway, EV charging stations became self-sufficient when EVs grew to 3% of all vehicles, suggesting "a limited need for public support after a relatively short introduction phase."7 However, data assessing charging station network costs are very sensitive to specific geographic regions and generalized estimates can be misleading.

These factors suggest that EV charging infrastructure should be planned in conjunction with EV purchase incentives; if there are up-front incentives, more consumers are likely to buy EVs, the EV share of all vehicles will increase, and the need to subsidize EV charging stations will be reduced. Thus, a principled economic analysis for the development of EVSE and charging stations can be expected to be an important tool to guide future investment as utilities seek regulatory approval for EV infrastructure investment.

Considerations for EVSE and Charging Station Development

In order to support EV adoption, it is important for EV owners to be able to cost-effectively charge their EVs. Evidence compiled to date, learnings from non-US countries, and pilot projects across US states shows that there are a number of key factors to consider that can help ensure EV owners can access cost-effective charging stations. Some of the factors that utilities/regulators should consider are:

- Sequencing the investment in, and construction of, different types of EV charging sites to ensure complementary growth of EV charging stations. It has been observed that most EV owners use EV for daily commuting and short trips.[8] Ensuring that EV owners can charge at home/workplace can meet charging demand and encourage EV adoption. By prioritizing charging at home (overnight), then at work during the day (if necessary, albeit less so as EV travel ranges are now reaching 300 miles), and then public fast charging (including corridors for longer trips) EV charging infrastructure can develop organically; the development of charging stations meets the expected demand for each type of charging site.[9] Legislators and regulators can evaluate bottlenecks and determine where publicly supported financing may be necessary. For example, not all multi-unit dwellings allow for cost-effective EV charging. Further, potential EV owners that lack off-street parking face a barrier to home charging.[10]
- Planned and thoughtful siting of EV charging stations: by analyzing demographic data and the experience gained from various pilot projects regulators can evaluate policies and programs that allow utilities to identify potential sites for EV charging stations. Demographic data at zip-code level can be used to estimate charging demand and merging it with insights from utility data on customer willingness to host a DCFC or Level 2 charger can help identify potential sites for home/workplace charging. For example, a pilot study conducted for the city of San Diego developed a mathematical model to calculate the demand of public Level 2 chargers using data on zip code, charging behavior, EV range and factors like duration/power consumed in charging an EV. The study concluded that although San Diego had enough chargers to meet the existing demand, the public charging distribution network was neither well designed nor effective in its usage therefore it was recommended to implement charging location priority.[11] Such initiatives can help lead the way in meeting the demand for EV charging adequately and effectively.
- Evaluate utilizing existing gas station networks to increase EV charging connectivity: the adoption of EVs will lead to greater demand for public chargers specifically for non-city travel. The existing gas station infrastructure may be utilized by installing EV chargers at these existing sites. Countries like Germany have taken this initiative, and as part of a broader Covid-19 stimulus plan, Germany now requires all gas stations to offer electric car charging.[12] The move comes as "range anxiety" was identified as one of the main reason for consumers not buying EVs.[13] Within the US, the state of California has budgeted more than $3 billion to electrify transportation with the funding coming from a mix of sources: utilities (San Diego Gas & Electric, Southern California Edison and Pacific Gas & Electric), California Energy Commission, California Air Resources board, and more than $800 million from the Volkswagen settlement.[14] Private players are also getting involved; for example, Chevron is collaborating with EVgo

to provide EV charging stations at Chevron's gas stations.[15]

Also, in the U.S., companies like ChargePoint, which focus on charging station development, also offer "turnkey" solutions for site hosts, removing an additional hurdle from the charging infrastructure deployment process.[16] In Europe, New Motion provides back office services such as billing and payments in addition to building charging stations; EV owners pay a subscription fee for access to the charging network.[17]

While the most common pricing is time-of-use, demand response pricing can manage impact on the grid. In the US, states such as CA and VT have more mature demand response charging tariffs. Lastly, a central database can provide up-to-date information on the whole charging network. China has advanced data collection,[18] and Norway's NOBIL gathers information and distributes it to third parties.[19]

Thus, evaluation of expansions to EV charging infrastructure can include sequencing the types of chargers to accommodate EV owners, relying on data analysis to inform charging site locations, and building on the existing gas station network if economically viable. Moreover, charging station business models that generate additional revenue can be used to improve the economics for charging station investments, and demand response tariffs can provide attractive prices to customers while simultaneously reducing EV charging stations' impact on the power system.

Role of Government/Utilities in EV Charging Station Development

The role of public financial support for EVSE and EV charging stations is evolving and there are a number of considerations that arise when policymakers and regulators evaluate the various approaches that may be adopted to support EV charger accessibility. Three key concerns that emerge are: 1) Ensuring that investment is in the public interest; 2) Minimizing potential public policy interference with market-driven, private investment that is not borne by the public; and, 3) Guarding against electricity consumer cross-subsidization that can result if a subset of customers benefits at the expense of other customers that do not realize the same benefits (i.e., EV owners being subsidized by non-EV owners). Moreover, establishing policies and programs that do not fundamentally change is critical to provide the certainty necessary for investors to be able to access capital at attractive interest rates.

Adherence to a consistent and long-term policy framework supported by government can facilitate charging network development. Predictability of plans and policies over time encourage consumers and industry to invest. For example, consistent support from the parliament helped drive EV adoption and charging station development in Norway.[20] Moreover, governments are using public funds to support the creation of pilot cities/regions and EV corridors.

Although not expected to turn a profit, the goal of early stage investment is to encourage competition among charging providers leading to the growth of early infrastructure and help in identifying the leading business models over time.[21] For example, Germany has eight pilot regions for testing new charging programs.[22] To address the issue of range anxiety, the concern of not finding chargers over long-distance trips, EV charging corridors used in Europe include fast charging, and often target a set distance between chargers. [23] Europe has FastNed in the Netherlands, as well as a network of fast-charging stations between Munich and Leipzig.[24]

However, some experts believe that the US is more episodic and short-term, which creates a more difficult environment to invest in and can impede EVSE and charging station investment.[25] In the US, strong and consistent support at the state and local level is key. For example, in the state of Massachusetts, the Governor signed Senate Bill 2505, An Act Promoting Zero Emission Vehicle Adoption to encourage the purchase and use of Zero emission vehicles. The legislation works to increase access to ZEV charging stations for the general public by prohibiting owners of public charging stations from charging users a subscription or membership fee and requiring the use of payment options available to the general public. Further, the legislation allows municipalities and private businesses to restrict parking spaces specifically for ZEV use. These measures serve to provide convenient and predictable access to EV charging.[26]

In addition, in the US, state regulators often collaborate with different stakeholders to set policy and define standards for EV infrastructure implementation. For example, New York's "Reforming the Energy Vision" includes an economic framework for evaluating the costs and benefits of publicly financed investments that ultimately informed detailed economic analyses of EVSE and EV charging stations in New York.[27]

For example, in New York the state designed a program to incentivize development of EVSE for Level 2 chargers and DCFC.[28] The state of NY commissioned a study to understand and assess the cost-effectiveness of potential utility transportation electrification programs to guide its potential recommendation, in order to publicly back investment of $750 million in EVSE and charging station infrastructure.[29] Importantly, the economic cost-benefit analysis revealed that societal, program participant, and ratepayer benefits will vary widely and depending on the monetization of benefits (for example, environmental externalities) and the inclusion of tax incentives, benefits may or may not exceed costs.[30] Similarly, in Massachusetts the Department of Public Utilities (DPU) put in place a regulatory policy that identified principles it would consider when evaluating utility proposals to develop, and in some instances own, EVSE and charging stations. The DPU noted that: "For Department approval and allowance of cost recovery, any proposal must: be

in the public interest; meet a need regarding the advancement of EVs in the Commonwealth that is not likely to be met by the competitive EV charging market; and not hinder the development of the competitive EV charging market."[31] The DPU has applied its principles and in doing so turned down a proposal by National Grid to spend $140 million on a large proposed program.[32] In addition, in California, the California Public Utilities Commission (CPUC) has instituted a "balancing test" that weighs the benefits of utilities owning and operating EVSE against the potential anticompetitive nature of utility ownership on a case by case basis.[33] Such intervention by policymakers can ensure that private market participants are not crowded out by public investment.

Policymakers and regulators should carefully evaluate the various approaches available to support EV charging system development. Guiding investment based on careful analysis is a viable public policy solution, as the large number of charging options and significant variation in costs across these options allows for a mix of public and private investment. This requires flexible regulatory frameworks that can be used to assess private and utility proposals to build and own EVSE and charging station hardware. While government support and policies that may support utility investments appears required for the development of EV charging infrastructure in the near-term, it is important to ensure that government intervention does not adversely affect the development of a competitive market for EV charging infrastructure.

Footnotes

[1] https://insideevs.com/news/393629/us-plugin-sales-charted-2019.

[2] https://www.iea.org/reports/global-ev-outlook-2020.

[3] Australian Electric Vehicle Market Study, May 2018, Energeia, at 20.

[4] Benefit-Cost Analysis of Electric Vehicle Deployment in New York State, Feb 2019 at 29.

[5] Example: Audi A7 has 375,436NOK in taxes for 697,300NOK retail price, while Tesla Model S has no taxes for 638,400NOK retail price (2,400NOK scrapping fee is included in retail price for both). See Put a price on carbon to fund EV incentives -- Norwegian EV policy success, October 2017, EVS30 Symposium, at 4.

[6] Charging infrastructure experiences in Norway -- the worlds most advanced EV market, October 2017, EVS30 Symposium, at 9.

[7] Charging infrastructure experiences in Norway -- the worlds most advanced EV market, October 2017, EVS30 Symposium, at 10.

[8] Australian Electric Vehicle Market Study, May 2018, Energeia, at 35.

[9] Australian Electric Vehicle Market Study, May 2018, Energeia, at 5.

[10] In response to this issue, the UK took steps to promote curbside residential charging. See Emerging Best Practices for Electric Vehicle Charging Infrastructure, October 2017, ICCT, at 11.

[11] Development of an assessment model for predicting public electric vehicle charging stations, 2018, European Transport Review, at 8.

[12] Germany will require all petrol stations to provide electric car charging, Reuters, June 2020 at https://www.reuters.com/article/us-health-coronavirus-germany-autos/germany-forces-all-petrol-stations-to-provide-electric-car-charging-idUSKBN23B1WU.

[13] Germany to Require EV Chargers at Gas Stations, June 2020, at https://www.convenience.org/Media/Daily/2020/Jun/8/6-Germany-Require-EV-Charger-Station_International.

[14] Here's how much California is spending to put electric cars on the road, The North Bay Business Journal, at https://legacy.northbaybusinessjournal.com/industrynews/technology/9254147-181/california-electric-vehicle-transportation.

[15] Chevron starts deploying EV charging stations at its gas stations, Electrek, May 2019, at https://electrek.co/2019/05/20/chevron-ev-charging-gas-stations.

[16] ChargePoint also provides additional services to customers as well as advertising to generate revenue beyond electricity provided for charging. See https://www.chargepoint.com/about.

[17] See https://newmotion.com/en.

[18] Electric Vehicle Charging in China and the United States, February 2019, Columbia Center on Global Energy Policy, at 57.

[19] https://info.nobil.no/eng.

[20] Policies include removing purchase taxes on EVs in 1990, exemptions from road tolls in 1997, 50% reduced company car tax in 2000, and exemptions from VAT in 2003. See Put a price on carbon to fund EV incentives -- Norwegian EV policy success, October 2017, EVS30 Symposium, at 2.

[21] Emerging Best Practices for Electric Vehicle Charging Infrastructure, October 2017, ICCT, at 28.

[22] Emerging Best Practices for Electric Vehicle Charging Infrastructure, October 2017, ICCT, at 11.

[23] Evolution Electric vehicles in Europe: gearing up for a new phase, Amsterdam Roundtable Foundation, 2014, at 33.

[24] See Evolution Electric vehicles in Europe: gearing up for a new phase, Amsterdam Roundtable Foundation, 2014 at 33.

[25] Electric Vehicle Charging in China and the United States, February 2019, Columbia Center on Global Energy Policy, at 56.

[26] See https://www.mass.gov/news/governor-baker-signs-electric-vehicle-promotion-legislation.

[27] See http://www3.dps.ny.gov/W/PSCWeb.nsf/All/8C1741CD17739013852582F30056EEE8?OpenDocument#ElectricVehicles and Benefit-Cost Analysis of Electric Vehicle Deployment in New York State, Feb 2019.

[28] Proceeding on Motion of the Commission Regarding Electric Vehicle Supply Equipment and Infrastructure, New York State Department of Public Service, 2020.

[29] Proceeding on Motion of the Commission Regarding Electric Vehicle Supply Equipment and Infrastructure, New York State Department of Public Service, 2020.

[30] Benefit-Cost Analysis of Electric Vehicle Deployment in New York State, February 2019 at 79.

[31] Order on Department jurisdiction over electric vehicles, the role of distribution companies in electric vehicle charging and other matters, DPU 13-182-A, Department of Public Utilities, August 2014 at 14.

[32] See Petition of Massachusetts Electric Company and Nantucket Electric Company, each doing business as National Grid, pursuant to G.L. c. 164, § 94 and 220 CMR 5.00, for Approval of General Increases in Base Distribution Rates for Electric Service, Department of Public Utilities.

[33] See Phase 2 Decision Establishing Policies to Overcome Barriers to Electric Vehicle Deployment and Complying with Public Utilities Code Section 740.2, Rulemaking 09-08-009. Note that more recently, the CPUC released a proposal for a new transportation electrification framework (TEF), but it appears to still be cautious about publicly supported utility investment crowding out private competitors. See also, Phase 1 Decision Establishing Policy to Expand the Utilities Role in Development of Electric Vehicle Infrastructure, Application 14-04-014.