How electric do you want the future to be? Electric vehicles in urban transport policies

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Overview

The transport sector is among the world's biggest polluters. It accounts for approximately one quarter of global energy-related greenhouse gas emissions (International Energy Agency, 2017). Road transport alone accounts for about 20 percent of the European Union's (EU's) overall greenhouse gas emissions. According to the European Environmental Agency (2017), European greenhouse gas (GHG) emissions increased by 0.5 percent between 2014 and 2015, thereby breaking the trend of declining emissions since 2010. Emissions from road transport increased for the second year in a row in 2015, and were consequently among the key drivers of the growth in emissions.

Enforced in 2016, the Paris agreement responds to the pressing threat of climate change, aiming to limit the global temperature increase this century to well below 2°C above pre-industrial levels and pursues efforts to limit the temperature rise even further to well below 1.5°C above pre-industrial levels. Being one of the top polluters, the transport sector is required to deliver major emission reductions to achieve these targets. The electrification of transport is considered to play an important role in reducing greenhouse gas emissions (International Energy Agency, 2017). In June 2017, the Clean Energy Ministerial launched its EV30@30 campaign that targets a 30 percent sales share for Electric Vehicles (EVs) by 2030. The UK and France have both announced plans to end sales of new conventional petrol and diesel cars by 2040.

Norway has the highest penetration of EVs worldwide, making it much like a social experiment to examine the results of EV-friendly policies. Currently, there are about 120 000 battery electric vehicles (BEVs) and 50 000 plug-in hybrids (PHEVs) in Norway, a small country with only 5.3 million inhabitants. In 2016, BEVs accounted for 16 percent of all new vehicles, while PHEVs accounted for 11 percent of new vehicles. Close to 30 percent of new vehicles registered this year in the counties of Oslo and Hordaland– home to Norway's two largest cities – were EVs.

Which policies will be the most welfare enhancing in the urban transport system with multiple market failures: congestion, accidents, local air pollution and GHG emissions, and what role do EVs play in achieving these policies? What characterizes the potential conflicts between welfare maximization and targets for reducing GHGs – where the promotion of EVs is a key instrument – and car transport in cities? Furthermore, what trade-offs do we see between efficiency and acceptability? These are the key research questions addressed by our paper.

Methods

To respond to the research questions, we develop a stylized transport model for passenger transport in the Oslo metropolitan area, an urban area with approximately 1.2 million inhabitants. While the modeling approach draws on Börjesson, Fung, and Proost (2017), our paper provides several novel extensions to the framework.

Our modelling framework allows the agents to choose their equilibrium car from a range of car types, including long and short range EVs. The framework also includes multiple representative agents that are heterogeneous with regards to employment, income, and their demand for short and long trips. This allows us to analyze how different types of agents respond to different policies, and how costs and benefits of polices are distributed among agents. This distribution is key to understand political feasibility.

As in Börjesson et al. (2017), the modelling framework permits to assess the effects of policies on the multiple market failures that characterize an urban transport system, e.g., congestion, emissions, crowding on public transport etc. It allows us to analyze how the availability of EVs introduce benefits to the system, like lower user costs for energy and reduced GHG emissions, but also new challenges, such as induced congestion. Furthermore, we can analyze costs and benefits of current transport policies, including those for promoting EVs. We touch upon the potential goal conflict in the transport sector; reducing GHG emissions, where promoting EVs is currently a favored policy, and promoting walking, cycling, and public transportation in cities, which loses attractiveness relative to EVs.

Results

Preliminary results: We find that "uncritical" promotion of EVs for the sake of GHG reductions comes in conflict with the goal of curbing growth in passenger car transport and limiting congestion. We also find that there is a specific combination of cars to match with the different agent groups that bring about the optimal equilibrium. The model finds that the plug-in hybrid car is the technology for agents who take occasional long trips (100 km +), given the assumption that they drive hybrids in electric mode on short trips, and fossil fuel mode on long trips. For the agents who only take short trips, the short-range EVs is the best available technology, as it keeps both energy and other user costs and external costs low. In this optimal equilibrium, with the optimal car combination, transport externalities are priced efficiently, giving the right incentives for transport-consuming agents.

Conclusions

Preliminary conclusions: There are many market failures and policy parameters to adjust in an urban transport market. There are reasons to believe that none of the current polices in Norway are optimally assigned. Although the exact numbers from the reported results must be interpreted with caution, they provide some policy lessons.

First, efficiency can be gained through differentiating tolls in peak and off-peak periods. Oslo launched a peak toll system in October 2017 to their cordon ring, but it would probably be more efficient if the difference between peak and off-peak tolls were larger. Currently there are no tolls for EVs, even in peak-hours, although this is expected from 2019. The differentiation is an important step, but widening the gap between peak and off-peak would probably be beneficial.

Second, widening the gap between peak and off-peak fares would also probably produce efficiency gains. In particular, finding ways to reduce the consumer price for riding off-peak seems like a promising first step.

Third, there are good reasons to maintain the low tax levels for EVs, at least for the short-range ones. Providing agents that only use the car for short trips with the incentive to own a low-cost and short-range EV, along with incentives to internalize external costs seems to be very welfare enhancing.

Promising extensions of the model includes issues of EV-charging. Higher EV density could impose costs on other electricity users, as it would require enhancements of the distribution grid. On the other hand, strengthening the EV charging infrastructure could work as a network externality, as it would reduce user costs (e.g., searching and waiting) for all EV-users. More knowledge on these issues of charging could improve policy-making for a transport sector with a sizable and growing share of EVs, and makes thus a promising venue for further research.

References

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