Incentive schemes

Electric vehicles are a good choice for *reducing exhaust-pipe emissions* and *improving local-air quality,* however, their total emissions depend on the way the electricity needed for charging is produced. Moreover, electric vehicles have other advantages: they reduce noise, their maintenance costs are lower and they are cheaper to operate. In spite of all that advantages, electric vehicle adoption has been relatively slow. Research points out that there are *three major barriers* in their adoption: The high purchase prices of electric vehicles, limited driving distance range and inconvenience in charging.

Purchase costs

When designing incentive schemes it is good to keep these major hurdles in mind. In these lecture notes we will mainly focus on the *financial barrier*, the high purchase cost. Electric vehicles currently are more expensive to buy, mainly because of the high costs for batteries. The purchase price of the vehicle can be substantially higher than their gasoline or diesel equivalents, often in the range of $15.000. Electric vehicles are however cheaper to own due to lower fuel and maintenance costs. In some cases over the lifetime of a vehicle, the so-called Total Cost of Ownership (TCO) for electric vehicles is actually lower. Yet, the adoption of electric vehicles remains rather slow. Many surveys point out that the high purchase cost is a barrier. During the purchase decision, future savings are valued up to three times as low as their actual monetary value would predict.

Pre or post purchase rebates?

When designing purchase incentives it's therefore important that they have an impact on the *direct purchase price.* There are three main options that can be used by policy makers. First offering a direct or point-of-sale grant. Secondly, reduce the value added-tax and thirdly, exempt electric vehicles from vehicle purchase taxes. Which option can be used in your country is often dependent on local rules and regulations. Purchase grants are mostly seen in the range of $2.500 to $7.500, although there are some exceptional cases in which the incentives reach up to $15.000. Electric vehicles can then be cheaper when looking at the upfront purchase costs.

Other options that are less efficient are so-called *post-purchase rebates*. These include cash back options or income tax reductions. These are widely used in the United States. Just as future savings in maintenance and fuel costs, these post-purchase subsidies are valued less than point-of-sale grants.

Disincentives

Besides lowering the purchase price of electric vehicles, it is good to *combine such an incentive with higher taxes* or *disincentives* for electric vehicles. Purchase taxes for vehicles can be linked to their CO2 emission levels. This provides direct disincentives to purchase gasoline driven vehicles. A key example is Norway. In Norway electric vehicles don't have to pay value-added-tax nor purchase taxes. For heavier gasoline vehicles this purchase tax can be an additional 100% of the original

purchase price. This combination has made electric vehicles very popular, with nearly 50% of all new vehicles being electric in 2018.

Designing the policy

Other things that should be considered are that incentives should be dependent on income or on the purchase price of the vehicle. As this image shows, the majority of persons that bought a more expensive *Tesla Model S* would still buy the vehicle without the tax incentive. However for the *Nissan Leaf* a substantial portion would shy away from the purchase. A rebate on the Nissan Leaf would lead to a relatively higher reduction in purchase price than for the Tesla Model S. To promote more electric vehicles for the lower end of the price segment policy makers can decide to *cap the incentive at a certain price point*. In Germany cars priced over €50.000 are not eligible for the incentive.

Plug-in electric vehicles are not always fully electric. The plug-in hybrid electric vehicle can also offer a substantial reduction in emissions. The plug-in hybrid can be a solution for those that have range anxiety or in countries in which the charging infrastructure is not yet sufficient for longer trips. Research shows that plug-in hybrids with sufficient range can travel an equal number of electric kilometers compared to short range full electric vehicles. The example on the table below from a study in the United States shows that plug-in hybrids drive more on a monthly basis but their electric miles are equivalent to the full electric alternative.

Electric miles travelled on average per month

Vehicle	Miles travelled	Electric miles travelled	Gasoline miles travelled
Nissan Leaf (Full electric)	808.1	808.1	0
Chevrolet Volt (Plug-in hybrid)	1019.8	759.3	260.5

Table: Idaho National laboratory (2015) 'Plug-in Electric Vehicle and Infrastructure Analysis'. Idaho Falls, Idaho

They should therefore be eligible for a similar incentive as full electric vehicles. However, plug-in hybrids with lower electric ranges, below 40 to 50 kilometers, should receive a lower incentive as their emission reduction is limited.

If we look into the future eventually the electric vehicle should become a product that does not need financial support. Phasing out incentives should however not happen instantly. This image shows the reduction in sales in Denmark after the EV incentive was removed.

Danish EV Sales

Figure: Danish EV sales, Source: Cleantechnica (2017) 'Denmark Goes Backward, Lowers Tax On Dirty Cars — Wha??'. Retrieved from: https://cleantechnica.com/2017/10/01/denmark-goes-backward-lowers-tax-dirty-cars-wha/

Too early removal could mean a market collapse. A gradual phase out is considered more efficient and could be combined with higher taxes for gasoline vehicles to on the one hand provide a revenue source for the incentive for electric vehicles and to allow the markets to come to par.

Electric cars: Policy

Lecture notes: Lecture 3.1

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