Travel behaviour of potential Electric Vehicle drivers. The need for changing: A contribution to the Edison project

The decarbonisation of road transport is one of the top priorities of policy makers in Europe. Battery powered electric vehicles are seen as one of the most promising long term sustainable options. They offer advantages in terms of energy efficiency as well as in a number of environmental aspects such as their potential contribution to reducing CO2 and local emissions and other negative external effects of mobility.

The extent to which Electric Vehicles (EVs) will contribute to reducing Green House Gas emissions depends on the energy mix used to recharge the battery. Theoretically, where there is a deregulated energy market the driver can choose whether to run his EV off conventional electrical energy sources or strictly from renewable electrical energy source. But EVs also have the potential to contribute to the integration of renewable energy sources into the electricity grid as they provide storage options.

The user of the electric vehicles is the link between the energy supply on one hand and use of batteries as storage of excess supply of sustainable energy production on the other. The attractiveness of EVs for the grid depends on how charging is regulated.

The paper will address three main questions:

1) The relation between transport behaviour and the need for electricity either as normal battery recharging or as fast charging. Knowledge of this is necessary since the accessibility to charging and the battery capacity are central factors for the users' willingness to purchase an electric vehicle.

2) Assessment of the possibility to regulate the charging periods and to use the EVs as storage.

3) Analyses of optimisation of the localisation of the infrastructure based on the travel patterns of the EV.

At the moment when very few EVs are in the market it is necessary to assess the potential behaviour from analyses of travel patterns of conventional cars. Two datasets are used for this purpose. A GPS based driving dataset obtained in a road pricing experiment in the Copenhagen area is covering the driving of 365 cars in between 13 and 150 days each is used to illustrate the need for charging over a fortnight period. The GPS data set is complemented by the Danish National Travel Survey from which the respondent’s daily travel by car can be utilised for a geographical representative picture of when and where connection to the grid can take place.

The analyses show that if the car only has a driving range of 80 km, only 3 % of the owners in families with several driving licences and 11 % of the people living alone can avoid charging outside home in a two weeks period. Even with a capacity of 160 km, it is only one third of the families with two driving licences who can avoid charging during the day in a 2 weeks’ period.

Approximately 15 % of the cars must perform fast charging in a couple of days and approximately 20 % once a week if they only have a driving range of 80 km. In case of a driving range of 150 km, a maximum of 8 % will have to perform fast charging once a week.

On the other hand, the analyses show that it is not necessary to charge very much in periods when other costumers use the electricity but it depends on how charging is regulated. If the charging is not regulated 56 % of the normal charging of cars with 80 km driving range will take place in the day time concentrated in two peaks when other kind of electricity demand is also at maximum. If the charging is fully regulated only 19 % need to take place during the day as normal charging and further 19 % as fast charging. For cars with a driving range of 160 km only 4 % need to take place in daytime as normal charging and 10 % as fast charging.

To be able to regulate the grid when big amounts of wind power is introduced to the system it is attractive to use the batteries of the EVs as storage for the grid. The analyses will show at which places it will be most relevant to establish normal charging facilities to serve both needs for charging and for the possibilities to get the drivers to connect even when they do not need to charge.

Furthermore the needed density of fast charging stations will be analysed.

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