Electric mobility case study for Finland

Electric vehicles in Finland

In Finland the first electric vehicle was a train. Then electric busses took places in local public transportation. Pure e-cars are a slowly rising trend of decade 2010. Hybrid cars based on petrol and electric have been much more popular in private use in Finland than pure e-cars. These days combined use of diesel and electric in hybrid cars are getting popular in general and also among heavy duty vehicles.

According statistics in Finland have been registered 614pure electric cars until the end of 2015. Year before the number was 461 so raise over 60 percent. Among vans corresponding numbers were 129 and 96 so raise almost 35 percent. The number of hybrid cars raised more than e-cars from 492 to 937 so raise up to 90 percent during 2015.

In Finland winter season is cold and distances are long what makes difference between Nordic countries and especially southern Europe. Also charging points have been located mostly nearby growth centers because of greater population thus it's still inconvenient to commit road trips from city to city. This headache is reliefing due to gas stations which have started to involve e-car charging also and have charging points in addition of fuel pumps. A coverage of charging points is improved slowly.

Also e-motorbikes can be found in Finland and number of those has raised from 12 to 22 so over 80 percent up. But amount of E-scooters and e-mopeds have been decreased from 853 to 753 so down almost 12 percent.

Electric assisted e-bicycles have been used in Finland for several years but specific number of e-bikes isn't known because e-bikes aren't required to register. But offering of e-bikes is better now than few years ago and e-bikes can be seen in daily traffic. It's obvious that the number of e-bikes have raised recent years.

Regulations

Pure e-cars and hybrid cars are regulated similar way like ordinary cars are. Taxation class is the lowest one 5 percent of a price of a brand new hybrid or e-car. Also, electric and hybrid vehicles will have to pay tax on energy just like diesel or gas-powered vehicles. Electric cars, the amount of the tax is 1,5cnt / day / 100 kg when it is in diesel powered 5,5cnt / day / 100kg. Instead, the emission of the basic you don´t have to pay fees as

because deferred emission of carbon dioxide / 100 km is 0g, and thus the basic tax to the electric cars are only 43.07 € / year.
Only motorcycles and mopeds, as well as other light electric vehicles are outside these taxes.
The beginning of 2016, the Finnish State to amend its legislation so that the light electric vehicles were allowed among public transport, under certain conditions.
The beginning of 2016, the Finnish State to amend the legislation so that the light electric vehicles were allowed among public transport, under certain conditions. These preconditions include, obligation to use the helmet and traffic insuring when a certain power threshold is exceeded.

The geographical conditions and its effects

Finland is a large and sparsely populated country, and thus the distances are very long. Finland is also a climatic region where the weather and temperature variations are very large. Long distances, together with the cold winter, causing all-electric car a very unfavorable conditions for part of the year.
Cold air and adverse factors together will bring the electric car operating range will be halved at worst, in winter. When to this combined with the time being sparse charging point network, cause this that to the electric motoring will focus more on growth centers than to sparsely populated areas.
On the other hand, on electric vehicles the greatest benefit is achieved just in city traffic, where the braking energy can be utilized to the maximum. In addition, when the car is stationary eg. in traffic lights, the electric motor does not spin and energy is saved.

Charging Point Network

Earlier, the charging stations have been private and mostly owned by operators who charging their own vehicles. When the electronic traffic have increased also in private transport, also the public charging points have increased. Most of the Finnish charging points are just in the major cities and their centers. Beside the main road network, charging points have less, and the distances between these points are long.
Finnish traffic offices (TRAFI) statistic were dated 31.12.2015 According we have 383 public charging points. These points are located at 193 different addresses. The

southernmost of these points in Hanko, and the northernmost village of Inari. The westernmost point in Vaasa and the easternmost in Joensuu. While charging point network appears to Finland to coverage the whole land, have to remember that the points are located mainly in growth centers and the distances are long, especially in northern Finland.

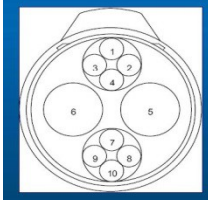
Finnish public charging points by far the most common type of charging is Mennekes (type 2). Mennekes type of charging the maximum load capacity is up to 43kW, the most of 22kW. This type is a standard agreed in Finland. Mennekes name comes from the German manufacturer. The plug is seven-pole and the image shows the meaning of the connectors. As you can see from the image, charging on alternating current.

Charging by the Mennekes- type the electric vehicle battery pack charging approx. 1-2 hours. Charging by the Mennekes- type the charging electric vehicle battery pack charging approx. 1-2 hours. Restrictions to the charging current can cause the car's own control system and the different situations in the power system.

Another to Finnish standard approved type is CHAdeMO. This type of charging is a high-power quick charger. Output can reach up to 62,5kW. In practice, the charging efficiency is slightly lower, normally approx. 50 kW. In this way, when charging the battery, charger supply the current through a rectifier. A battery pack is charged directly to the direct current, and the car's own charging system is not used. When charging this charger type the charger and the vehicle are connected to the charging time via the CAN bus.

In Finland, to the standard is approved for use in the third type which is Combo2 style charging. In this type DC and AC is connected to the same outlet. In this case, need only one plug, depending from the charger can be fed either by a slower charging by via terminals AC or fast charging via DC terminals.

Connector pin-layout and assignment



Connector surface

Pin No.	function / assignment	Pin diameter (mm)	Wire size (mm²)
1	Reference GND for insulation monitor	1.6	0.75
2	Control EV relay (1 of 2)	1.6	0.75
3	(not assigned)	1.6	–
4	Ready to charge control	1.6	0.75
5	Power (supply) line-negative	9.0	150A : 42.4 200A : 53.5
6	Power (supply) line-positive	9.0	150A : 42.4 200A : 53.5
7	Proximity detection	1.6	0.75
8	Communication +	1.6	0.75
9	Communication -	1.6	0.75
10	Control EV relay (2 of 2)	1.6	0.75

Schuko charging can be carried out everywhere, where you can find a normal outlet. Schuko download is intended only for temporary use and thereby obtain electric power is also so small that charging electric car battery takes 8-12 hours. This type charging cables has usually in own control unit, which limits the charging current of 6-10 amps. This is not recommended for continuous use.

Electric Vehicles

Electric vehicles can be classified according to size easily. All vehicles regardless of the size, the basic technical implementation is still similar, just the size of components is changed.

In machinery, heavy equipment and passenger cars, it is possible to choose from including the so-called hybrid drive. This means that to diesel engine was added to the electric motor / generator to collect energy and to reduce the actual load on the motor and to reduce emissions and consumption. The hybrid powered vehicles still can be found in the very same electronic structure as pure electric vehicles.

Vehicles below are sorted according to their size:

- Heavy equipment, which includes all machinery and trucks and buses.
- Lightweight construction equipment, which includes vans
- Cars
- Motorcycles
- Mopeds

- Electrically assisted bicycles
- Light electric vehicles

Heavy equipment and in non-road sector development has gone hybrid direction of full power. Hybrid use is achieved very good results, as well as the usability and consumption. At the moment there are also a lot of research in the use of hybrid use of non-road sector.

Fully electric light transportation vehicles has increased during the past year, from 96 to 129. The majority of the full electric vans located in growth centers and these cars using in delivery transport. Electronic vans operating range in a city moves between 100 and 150 km.

Passenger cars side TESLA's entry into the market of large audience by significant electric cars (Tesla S) was refreshing. The operating range is also different from the traditional 400 kilometers. Tesla's entry to market is certainly a positive impact on other brands electric car sales.
Nissan brand is still the number one of the sales in statistics and TESLA in a good second. As has already been processed, the Finnish conditions and long distances causes that electric vehicles cannot be the family's only car, because the most of electric cars operating range moves between 120 - 190 km and in optimal circumstances.
However, Toyota's pioneer working in hybrid technology will certainly appear in the future increasingly also in Finland. Even now, several brands has brought to the worldwide market of hybrid or plug-in hybrids, and it has been clearly seems also in Finnish statistics. Hybrid can be divided into two categories PHEV and HEV. Rechargeable hybrid called PHEV is a hybrid, which can be used in very small operating range like the electric vehicle. HEV is a traditional hybrid without a separate battery charging possibilities and the electric motor mainly work with a combustion engine.

Moped and motorcycle market has come some interesting names. The largest manufacturers like Peugeot and KTM has brought to market their own models. Growth in the motorcycle market has still been limited and mopeds growth is even smaller.

Electrically-assisted bicycles have been in the market for a long time and they have their own well-established user base. Because the bicycles do not need to register their statistics is too hard to say the exact number and direction of development is difficult to

specify. Into the market has come new models, and sales of these can be said that these are more popularity day by day. Electrically-assisted bikes have been to the present day made from basic bikes, and they have not offered any extra features. Lately, the market has been really stylish and versatile useful in the electrically-assisted bikes that anyone could possess.

These electrically assisted bikes engine powers are moving typically 250W- 500W and the operating range of 30 to 80 kilometers.

This year the beginning of 2016 the Finnish government eased its light electric vehicles law and to allow them access to the traffic. Remains to be seen how much this will affect the general level of awareness coming of e-mobility and the growth of electronic passing popularity.

Technology

Electric or hybrid vehicles contain the same basic components, although on a different scale. Roughly speaking vehicles can be found in three basic components.

- Battery
- Electric motor
- Engine Controller

Each of these basic components requires to function perfectly lot of other drivers, components, and often also for communication data bus.

The battery or battery bank is most often LiFePO4 or LiIon cells, which are connected in series with each other to achieve a sufficient voltage level. In order to obtain sufficient battery capacity are those of series-connected cells are also connected to sufficiently parallel. TESLA mm S: approx. 85kWh battery pack contains more than 7,000 individual battery cells.

Lithium-based batteries are the accurate level of charge and discharge, as well as the charging currents. This is why batteries are equipped with BMS (Battery Management System) control, which makes sure that all the cells are discharged and recharged as much from the battery and is always available for the maximum amount of energy safely use.

Since the batteries perform direct current cars has its own charging system for those situations when using the Mennekes or Combo2 AC charging. Charging system rectifies the voltage and adjusts the charge current.

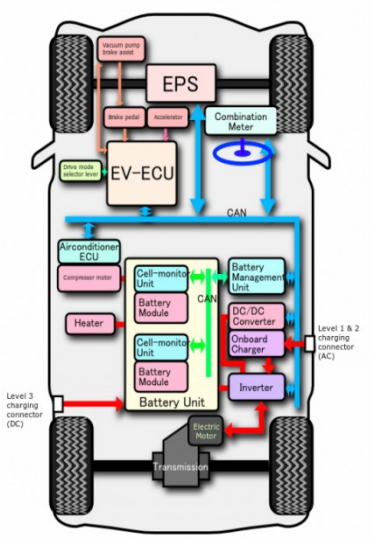
The electric motor is often a three-phase AC induction motor. The engine has advantages of high efficiency motor operation, as well as the collection of the braking energy is recovered from the generator. Good engine feature is its maximum torque at the right from the 0- rounds, as well as a wide speed range of the engine. Also, structurally engines are optimal for use in vehicles.

The engine requires a controller for controlling the

motor speed and power. This driver is called an inverter. The inverter converts the DC voltage obtained from the battery to AC. The inverter requires external control devices, which are given control signals like motor speed, direction of rotation etc. These control devices as one example of an electronic accelerator pedal. Below is an outline diagram Mitsubishi's electric vehicle based components.

Costs

The purchase price is currently the largest single electric vehicle cost items. Purchase price include car tax of 5%, on top of this will become an annual tax on "fuel/energy", which is 1,5cnt / day / 100kg. In addition to these contributions, will also be paid an annual tax based on a vehicle, which is the smallest possible and amounts to 43.07 € / year.



Currently, the electricity price of energy is an average of approx. 4cnt / kWh, when we add to this energy transfer price, which is approx. 3cnt / kWh, and electricity tax which is equal to n. 3cnt / kWh provides a simple charging energy price without any other charges of 10cnt / kWh. Electric vehicle consumption is typically approx. 10 - 15 kWh / 100 km so this calculation is obtained for one hundred kilometers energy costs € 1-1.5.

Other fixed expenses accounted / 100 km will change, of course, in relation to the kilometers driven. One of the most significant operating costs by lowering electric cars is that their need for maintenance is significantly less than comparable diesel or petrol driven into.

The future

The future of electric vehicles in Finland will depend very largely on energy policy orientations, as well as government attitudes towards taxation and the use of electric vehicles. Developing a network of charging also plays a key role in the development of

electronic mobility. Own chapter is intelligent tools that are not yet in Finland not managed to fully take advantage of.