Vattenfall AB is the fifth largest electricity generator and the largest district-heating company in Europe. The vision is to become one hundred percent climate-neutral and the strategic focus is to make electricity clean.

“E-Mobility” is a Vattenfall Group R&D programme to support and stimulate the introduction of electricity to vehicles. Electric vehicles make a good example of where high ambitions in the electricity sector can have positive impact on energy use and emissions in the whole of society.

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The E-Mobility programme is responsible for the monthly newsletter “Business Intelligence for E-Mobility”. The newsletter is distributed mostly internally within Vattenfall, but also externally. The newsletter highlights topics of interest in the E-mobility field and describes the latest news in short.

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Having a plug-in hybrid as your family car -what is it actually like?

Ever since 2007, Vattenfall and car manufacturer Volvo co-operate around plug-in hybrid electric vehicles (PHEVs). The first result of this co-operation is two demo vehicles, that have been real-life tested in Göteborg, Sweden since December last year. The test drivers are employees at Volvo and Vattenfall, who use the car to replace their ordinary family car. As far as we know, this is the first ever demo test of PHEVs in the role as a family car, and the results from the user evaluations from the first phase have recently been presented.

HOW WAS THE DEMO CARRIED OUT?
In total, 16 families used the cars in the first phase, which ended in June this year. Some families had the car for 1.5 weeks; some had it for a month. Ten of the test drivers were interviewed before and after their test period, to evaluate how they used the car, what their impressions were, and what it is like to live with an electric vehicle. Logging equipment in the vehicles has also collected data that has been analyzed quantitatively.

POSITIVE IMPRESSIONS
Generally, the test drivers are very positive towards the experience of driving and using a PHEV. All of them say they are willing to buy a PHEV if the total cost of owning and using it is not higher than for a standard car. Several of the test drivers say they were surprised by how easy the car is to use, and that the difference compared to their ordinary car is smaller than they expected. The biggest difference is, quite naturally, the electric drive, which the drivers much appreciate in city traffic. Many of the test drivers comment on how well suited the electric drive is to the city traffic rhythm, with smooth and quick starts and stops at traffic lights or in congestion, and no engine sound at all when standing still.

THE USE OF ELECTRICITY VERSUS DIESEL
In this prototype, transition between electric and diesel driving mode is done manually, by pressing a button. The majority of the test drivers have chosen to use electricity in city traffic and at lower speeds, and switch to diesel on larger roads and in higher speeds. The reasons to do so vary, but most commonly the drivers have wanted to use the electricity where they feel it has the largest environmental impact. Using electricity in the city improves local air quality and reduces noise where people are. Another reason is that the test drivers feel they optimize the driving characteristics of the car in this way – electricity is comfortable in city traffic, but the diesel mode works better at higher speeds.

WHAT ABOUT THE ELECTRIC RANGE?
The all electric range – the distance possible to drive on only electricity – varies quite substantially between the test drivers. Some report around 20 km as the longest electric range, some have managed over 30 km. However, all of the test drivers think that the electric range of this PHEV is too short. When asked about how long all electric range they would like to have, some answer 50 km, and some want 80 km or up to 150-200 km. Combining this with the test drivers’ common wish to not pay more for a PHEV than for a standard vehicle, is going to be a substantial challenge for auto manufacturers.

Another interesting aspect of the all electric range, is that from data logged in the vehicles, it can be seen that often not all of the electricity available is used. This is likely due to the driving pattern of shifting to diesel mode in higher speeds, but will need to be investigated more thoroughly in the on-going second phase of the test (July – December 2010).
DRIVING BEHAVIOR
All of the test drivers report that they have changed their normal style of driving in the PHEV, to be more calm and careful. Here too the reasons vary, but most test drivers say it was either to save electricity and make the all electric range longer, or because the performance of the car did not support their normal style of driving. The test cars have been limited in speed and acceleration due to their prototype state, which affects the test drivers’ experiences of the performance. Notably, a number of the test drivers report quite severe sacrifices in order to save electricity, such as not using the heating during winter (and instead wearing warm hats and gloves in the car), or leaving the radio off.

CHARGING
Regarding charging, most test drivers say this has been easy. Many of them normally use or have used electric engine heaters, so the procedure of plugging in and plugging out the cable is already a daily routine. None of the test drivers report to have neglected to plug in because they were stressed, concerned about getting soiled by the cable or worried about damage on the cable. One test driver avoided to charge at home during a period, because it was difficult to reach the socket during a refurbishment. None of the test drivers report any problems with the electricity supply to the rest of their homes in connection to charging (blown fuses etc). There have, however, been some incidents where the car has not charged properly.
In this test, all test drivers have had access to charging at home and at their work places. One public charging station was installed in connection to the test, but none of the test drivers have ever used it. Many of the test drivers say the charging possibilities they have had have been sufficient, whereas others have missed being able to charge at other places where the car remains parked for some hours at the time, such as large shopping centers or central parking houses. Most of the test drivers believe that public charging will be widespread in the future.

HEVMS - AN INVESTMENT FOR THE ENVIRONMENT
Many of the test drivers talk a lot about the environmental feeling of driving on electricity. Before their test periods, they also talk about PHEVs as a good environmental investment, and most of them then refer to lower carbon emissions and the climate issue. After their test periods, most of the test drivers report that improved local air quality and less noise are the environmental gains of PHEVs. The test drivers in this project were not offered any special electricity contract with electricity from renewable sources. Some of them say they would have been interested in having that, whereas others feel that the Swedish electricity mix is low-emitting enough as it is.

SAFETY ASPECTS REGARDING PEDESTRIANS AND CYCLISTS
The fact that electric vehicles are less noisy than standard vehicles is often debated in terms of pedestrian safety – it can be dangerous if people do not hear cars coming. Several of the test drivers talk about this before their test periods, and feel concerned about being a danger to pedestrians and cyclists. After the test, several of them have changed their opinion on this, and say that this issue is less of a problem than they expected it to be. However, some test drivers have experienced incidents of not being noticed, and some say they have taken extra care in their driving with respect to this.
The tests now continue with Vattenfall employees in Göteborg and Stockholm until the end of this year, after which a thorough analysis of both qualitative and quantitative data will be done. However, the results from this first phase of the tests are generally positive, and have strengthened Vattenfall in its view that electricity is the future for the transport sector.
To learn more about the demo with Volvo V70 PHEV, you can download the entire report here: vattenfall.se
Why Buy a PHEV?

To this date, the UC Davis PHEV Research Center has published six reports on consumer behaviour. These publications include qualitative analyses of PHEV driving patterns and customers’ expectations on battery technology. One of the most important questions asked by UC Davis is “Why would consumers buy PHEVs?” In one of their publications from 2009, UC Davis researchers have converted Toyota Priuses into PHEVs and asked several Californian households to use them for a period of time. One of the questions asked was “Will people recharge a vehicle that does not have to be recharged?” The results from the first 34 households, all selected partly because they can recharge at home, indicate that the PHEV is charged on average once a day. Most charging is done at home during night-time. As with the Swedish Volvo test drivers, the Californian drivers feel that plugging in is easy and quickly becomes a daily routine.

California and Swedish Drivers

An interesting difference between the Californian and Swedish test drivers is the desired all-electric range. Where the Swedish drivers would like an electric range from 50 and up to 200 kilometres, Californian drivers feel that 30-60 kilometres is sufficient for most of their needs. This could partly be because, for the Californian drivers, the overall fuel economy is more important than all-electric range. This means that the Californian drivers in the study see PHEVs as a way of improving fuel economy, rather than driving all-electric. Other conclusions from the Californian demonstration is that the idea of saving money is more important than how much money you actually save driving a PHEV. Calculating payback periods or similar evaluation is therefore not of great importance. Consumers believe that automakers have poor understanding of their needs regarding environmentally friendly vehicles and should also not produce “hype” if the technology is not ready.

Values Communicated by Driving a PHEV

The UC Davis researchers have also investigated the values consumers think owning and/or driving a PHEV communicates. These values can also be viewed as driving forces to own and drive a PHEV:

- Advanced technology
- Low fuel consumption
- Reduced emissions
- Freedom from petroleum fuels
- Economic sensibility/smart consumer
- Pioneer/progressive
- Involved community member

All of the reasons above to drive a PHEV would be true even in European countries, except for “Freedom from petroleum fuels”, which is something that is more widely discussed in the US. All in all, the driving forces and advantages of driving electric seem to be more or less the same, regardless of where you live.
Warning sounds for electric vehicles

As a result of a growing number of electric and hybrids electric vehicles in several countries, there have been increased concerns about pedestrian safety due to reduced noise levels when those vehicles operate in all-electric mode. Automakers handle these kinds of issues, by developing different kinds of warning sounds for their electric vehicles. Pedestrian safety was also a concern discussed among Vattenfall’s and Volvo’s test drivers before the tests started. However, after the real life tests, it is interesting to notice that several of the test drivers changed their opinion on this -the noise reduction was a minor problem than they expected it to be.

HOW CAN PHEVS BE A SAFETY HAZARD?
The concerns raised have a background in previous tests results showing that vehicles operating in electric mode can be particularly hard to hear at lower speeds, below 32 km/h (20 mph). This could mean that there is an added danger with hybrid and electric vehicles, particularly at pedestrian crossings and in parking places. Those findings have implications for pedestrians who are blind, small children, the elderly, runners, and cyclists. The distance at pedestrian crossings and parking areas are however a small percentage of the car’s total mileage per day. And actually, at speeds above 32 to 40 km/h per hour hybrid and electric vehicles likely generate enough tire and aerodynamic noise to make them sufficiently audible. But this does not exclude that the issue of pedestrian safety must be addressed and taken seriously.

RESEARCH PROJECT ON THE TOPIC
In a research project in the U.S. funded by the National Federation of the Blind, Lawrence Rosenblum, professor of psychology, further investigated noise levels from electric vehicles. The researchers made audio recordings of hybrid and combustion-engine cars approaching from two directions at 8 km/h to assure that the hybrid car operated only with its electric motor. Test persons in a lab listened to the recordings and indicated when they could hear from which direction the cars approached. In one study, the background sounds of two quietly idling combustion-engine cars were added to simulate the noise of a parking place. The test result indicated that the electric vehicle needed to be 74 percent closer than the combustion-engine car before the test persons could hear from which direction the cars approached. This conclusion indicates that the driver of a plug-in hybrid or electric vehicle must pay extra attention to pedestrians and others at areas like parking places or pedestrian crossings.

EXPLORING LEGISLATION WITHIN THE AREA OF PEDESTRIAN SAFETY
The U.S. Congress and the European Commission are exploring legislation to establish a minimum level of sound for electric and hybrid electric vehicles when operating in electric mode, so that blind people and other pedestrians and cyclists can hear them coming. Beginning in July 2009, the Japanese government began assessing possible countermeasures through the Committee for the Consideration of Countermeasures Regarding Quiet Hybrid and Other Vehicles, and in January 2010 the Japanese Ministry of Land, Infrastructure, Transport and Tourism issued guidelines for hybrid and other near-silent vehicles.

ELECTRIC VEHICLE WARNING SOUNDS
Installing electric vehicle warning sounds is a solution to the perceived problem with electric vehicles not being heard by pedestrians and cyclists. Electric vehicle warning sounds are a series of sounds designed to alert pedestrians to the presence of electric drive vehicles travelling at low speeds. General Motors has for instance been working with the U.S. National Federation of the Blind on solutions to develop a safe level of sound to alert pedestrians. GM’s system is called Pedestrian-Friendly Alert System and it will be manually activated by the driver, but future generations will probably include an active system. Another example of automakers working with sounds for their electric vehicles is Fisker Automotive, who is developing a sound-generator to be incorporated in its Fisker Karma. According to the automaker,
the sound is designed to both alert pedestrians and enhance the driver attention. The sound is a mix between a “Formula One car and a starship”, which probably is supposed to fit the vehicle’s sporty image. On of the advantages of electric vehicles, is that the urban environment becomes quieter than it is today. And even if electric vehicles will be equipped with a warning sound, the traffic environment would not be as noisy and disturbing as today.

VATTENFALL’S AND VOLVO’S TEST DRIVERS
The issue of pedestrian safety was discussed among Vattenfall’s test drivers beforehand and it appeared that many were worried of being a danger to pedestrians and cyclists. However, after the test, several of the test drivers changed their opinion on this, and say that this issue is a minor problem than they expected it to be.

One of the test drivers, Erik Skoglund said: “I was a little bit concerned that the vehicle would be dangerous for pedestrians, since it was so quiet, but it did not feel as if people noticed that it was an electric vehicle. Neither at parking places nor pedestrian crossings have I seen that someone has turned his head and thought ‘what is that?’ I have certainly not felt as if the car was dangerous.” However, some test drivers have experienced incidents of not being noticed, and some say they have taken extra care in their driving with respect to this.