7.2.2 Big Data : Electric... and Connected Vehicles (2/2)

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For this last part, we focus on two elements : preventive maintenance and smart charging.

Preventive maintenance

Preventive maintenance, and we will go into more technical details, can be tackled through three separate methods.
The first one is based on a known physical model. In this situation, we will be trying to take into account the physical model, and to add part damage models to it. Then, by adding them to the data collected in real-time on the vehicle, we will be able to instantaneously determine the health of the car. This is the most handy and precise method.
There are two other methods, in case we do not yet know the physical model. The first one is called supervised learning and the second one unsupervised learning. The difference is that the first one has examples of breakdowns. Based on these examples, it is easier to add the known data, to mix both of these, and to try and deduce damage models or rules which may be reproduced on existing vehicles. And thus, based on the rules which were established, we will be able, once again, to determine the health or wear and tear of the vehicle and inform the customer.
In the last method of unsupervised learning, we have to search differently. We will try and isolate homogeneous data domains to deduce rules without a specific goal in mind. This method is more complicated but it can lead to non-standard results for the profession. We can have very rich and varied results.
Preventive maintenance is still finding its feet and there is a lot of research in the field.

Smart charging

The last focus is on smart charging. As I said previously, charging is an important issue for electric vehicle users. Making charging more fluid and simple is an important favor that can be done for them. We can distinguish three aspects of smart charging.
The first one is contactless payment. Today, customers must swipe their cards on the station to identify themselves and pay the fee. Tomorrow, with the 1518 standard and the PLC technology I mentioned, the station will be able to immediately recognize the car, to establish a certificate and to receive contactless payments.
Secondly, it will be possible to book a station before reaching it. Users will then be certain, before arriving, that the station is available and if it is not, they will be rerouted to another available station. The challenge here is still optimizing electric mobility while guaranteeing an optimal navigation time.
The third issue is reducing charging costs. To do so, we try and only recharge when energy is cheap. In France, usually, energy is cheap during off-peak hours. Once we have been able to figure out the charge level and the expectations of tens of customers, it is possible to negotiate rates adapted to our customers to make recharging

cheaper. This service is also facilitated by the PLC standard based on PLC technology and the 1518 standard. Let us illustrate this by the graph of Figure 7.1, which represents the energy consumption in the United States.

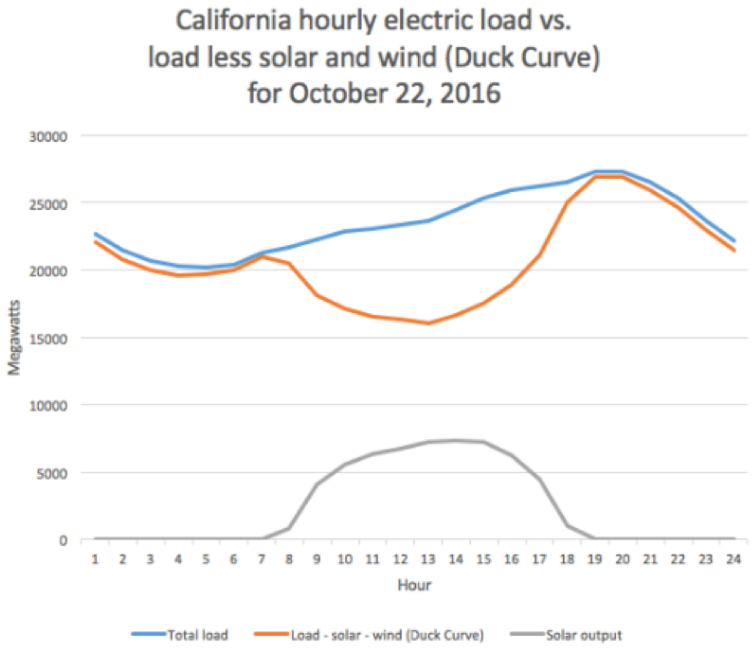

FIGURE 7.1 – California hourly electric load vs. load less solar and wind (Duck Curve) for October 22, 2016

The energy consumed in the United States usually peaks around 7 or 8 pm. It is the blue curve on the screen. As you can see, the first thing we could do would be to not charge at that time and to postpone charging to when electricity is cheaper and when the network is not being overtaxed, especially in winter, due to electric heating. A second issue is added to the first one : the apparition of renewable energies. The power of renewable energies is at its peak during the day, when there is less power consumed. At the end of the day, when the consumption increases, the power supplied by renewable energies decreases, so the other energy sources are being overtaxed. Electric vehicles face a major challenge : to limit the electric consumption of the network in two ways. The first one is by fading out and not charging between 7 and 8 pm. But tomorrow, thanks to reversible charging, it will be possible to offset the decrease in the power supplied by renewable energies by having the car supply extra power. The car will start "recharging" the network. Thus, we can maximize and optimize the use of renewable energies by charging batteries using renewable energies during the day and by temporarily discharging them during peak hours to avoid having to start very polluting thermal power plants.

Conclusion

In these sections on data, we discuss the three challenges faced by electric vehicle services. First, making charging easier. Then, improving vehicles and services continuously to benefit the customers. And finally, an environmental issue, evening out the energy consumption of the electric network.