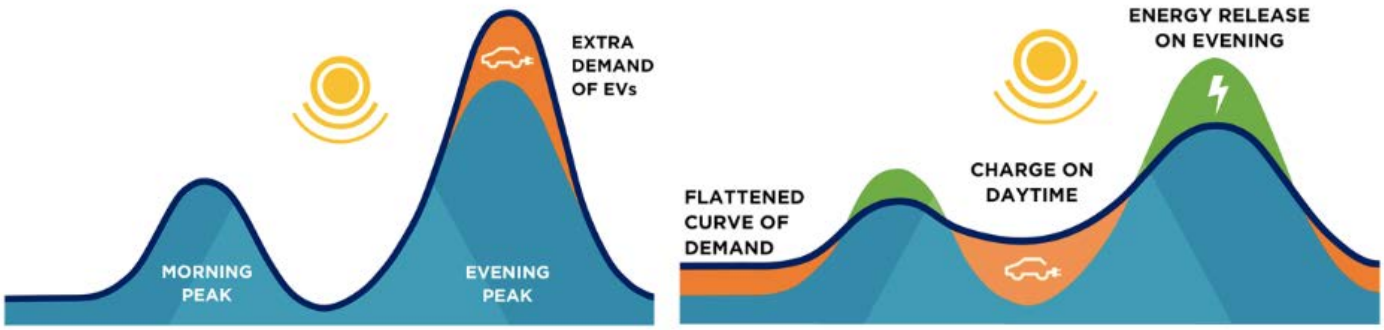
Why V2X?

A vehicle is parked at home or at the office 22 hours per day on average. Most vehicles remain idle for most of the day. But what if we come up with a smart solution? Let's say you could charge your car battery during the afternoon, when electricity is cheap and plentiful, and during the evening, when demand and prices are high, you could supply this stored electricity to the grid or use it to run appliances at home. What we need to achieve this, is the ability to extract power from the car battery. This is exactly what Vehicle-to-X (V2X) does. This means it's earning money for you while you work or sleep.

"But what happens when cars are shared? Or when they become autonomous? They would not be standing still as often." Well, this is true. Car sharing and autonomous driving will certainly ensure that vehicles are utilized better. However,



a study by McKinsey shows that even by 2030 only one in 10 cars sold will potentially be a shared vehicle. A similar thing is true for autonomous cars. So in next decades there will still be lots of cars, electric cars, that will be standing still. This means there is an opportunity to use them in a smart way and earn money with your connected car.

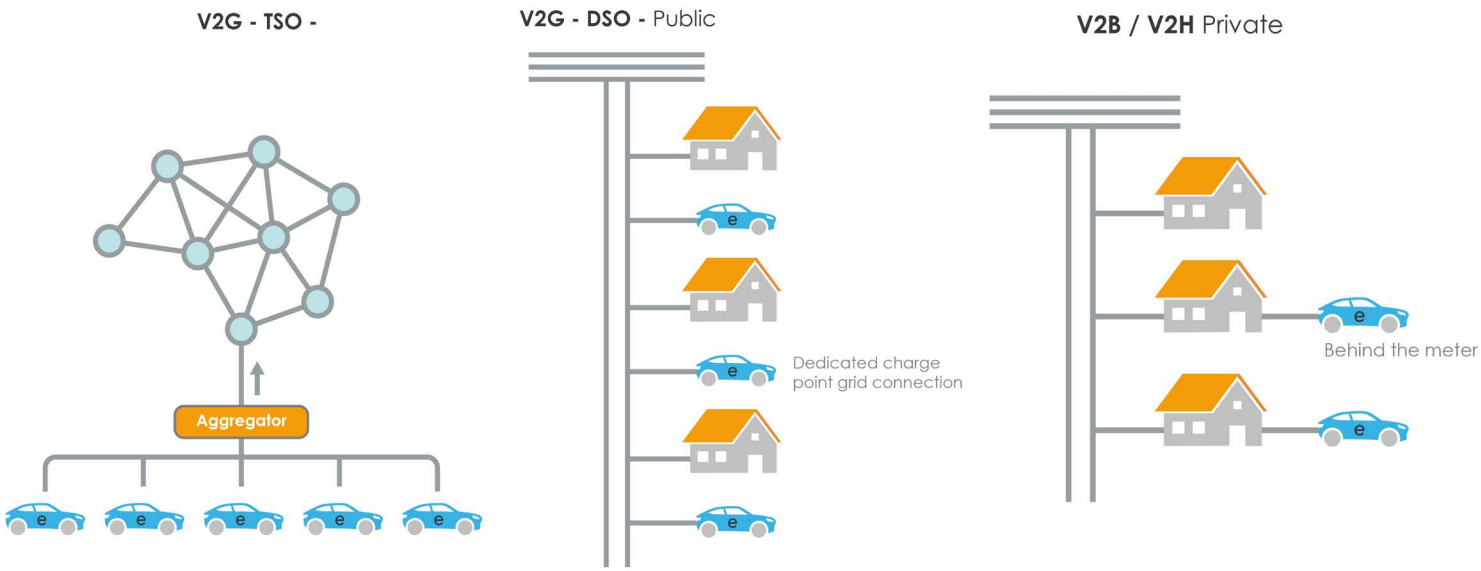
Vehicle-to-grid may change EVs from a problem to the grid, into a possible provider of grid solutions as a flexible asset. They could be a solution to many issues the grid will face during the energy transition.

Within an energy system powered by renewable, storage solutions such as batteries will become an essential piece of the puzzle. So what if we can use the electric cars for this? In fact they are just big batteries on wheel.

This way we do not need to invest in extra and expensive stationary batteries for your home or office, thus saving you money.

V2X aggregation levels

What you below is a simple diagram that shows how the car can be interconnected and provide power and value to the grid. There are three levels that we distinguish. Vehicle-2-grid for balancing services to the Transmission System Operator, Vehicle-2-Grid to Distributed System Operator and Vehicle-2-Builing/Home.



However, to understand this we need to first understand the function of an aggregator, the central player in the V2X framework. The aggregator is responsible for acquiring flexibility from customers who not only consume electricity but may also produce it. An aggregator can pay customers a fee for reducing their electricity consumption during peak hours. Once the aggregator has a sufficient number of customers it can sell this flexibility to a transmission system operator (TSO) as shown in the figure.

V2G can also manifest itself on a local level to balance loads on the DSO low voltage grid, or at a building level where EVs are connected “behind the meter” of a building.

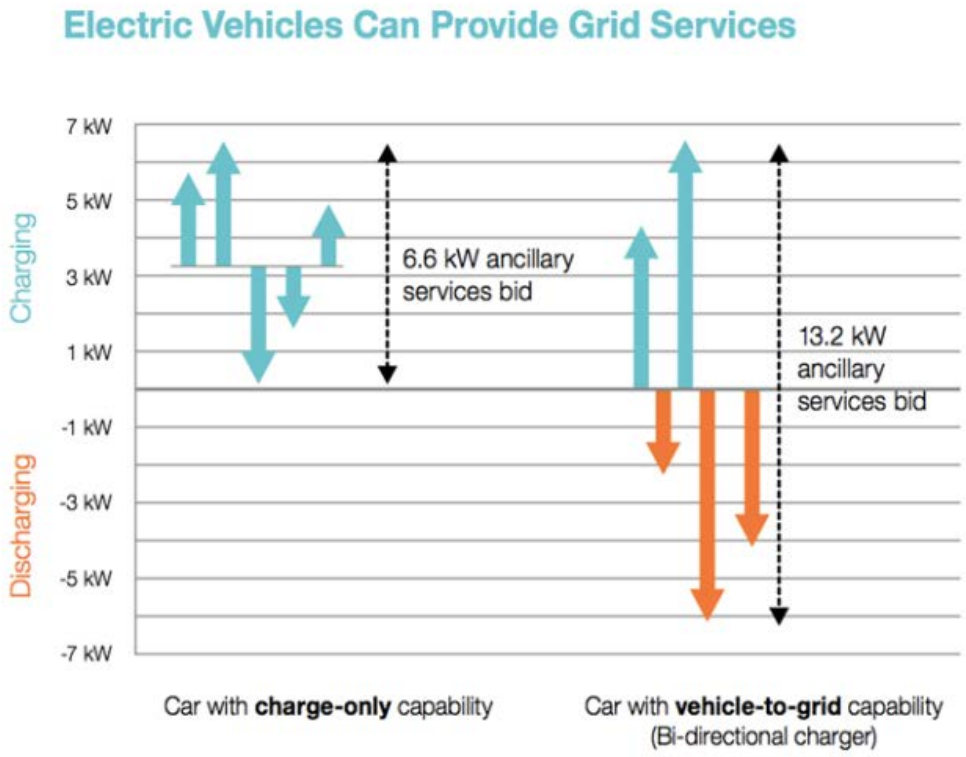
V2X capabilities

The additional capabilities of V2X compared to smart charging are the following: Because the car can now discharge energy into the grid, it can serve as a back-up power source for a building in case of a blackout or grid failure. And it can be used a storage of locally produced solar energy, to be used later that same day. On a DSO level, the electric car can – by discharging electricity to the grid - reduce peak loads on the low voltage grid caused by other loads, such as for example heat pumps. And it can be used to mitigate power quality issues.

And lastly, the case of vehicle-to-grid for the TSO. In the case of V2G, because the car can now also discharge, the maximum flexible power capacity of the car is doubled.

The other important difference is the duration that the car can supply the service. With V2G, the vehicle can constantly provide a service to the grid when it is plugged in. In the case of smart charging, or V1G, the EV can only provide a service when

it is actively charging. Because when the car's battery is fully charged, it might still be connected, but it cannot be used as a flexible load anymore. So this means that with V2G we can earn a lot more money with our electric car than with regular smart charging. But there is another possibility to even further increase the value per car.



Source : Newmotion.com

V2X market models

What we can do is supply a number of different services to multiple different actors. This is called stacking of services. It allows us to create value by trading on the energy markets and buying electricity for the cheapest price. And by supplying services to the DSO, the TSO and to for example the office building.

So, by enabling V2G, the possible revenues are much higher than the benefits in case of smart charger. These can go as high as, and possibly even over, a thousand euros per EV per year. However, it should be noted that these are revenues and do not equal the profits. This is because there are additional costs to enable vehicle-to-grid to work. This can be quite complex and therefore costly. Extra costs include the costs of a special bi-directional charger, additional energy losses and extra aggregation, communication and back-end costs.

Barriers to V2X

And as with any new technology, many barriers are encountered in the implementation of V2G as a business. On the technical side, the cost of the hardware for implementing V2X is high. It is expected that as technology evolves with time and demand volumes grow, the prices will come down. Yet, it remains to be seen if this will make the V2X business profitable. Also it is still not completely clear to what extent V2X may degrade batteries due to extra charge and discharge cycles.

These extra cycles mean, with the current tax system, that both outgoing and incoming energy streams are taxed. Obviously this affects the business case in a negative way, but governments may be willing to exempt V2G charging from this double taxation.

And in the previous section we've seen that net metering and feed-in tariffs lower the value of local storage and thus V2G. And lastly an important part of implementing V2G is to understand, predict and control the behaviour of consumers. Because you need to know when the car is available to supply the service to the grid. This also remains a challenge.

V2X pilots

Below are a few projects in which currently V2X is implemented. Click on the links for more information or this V2G repository for all European Projects.

- The Parker project in Denmark is an extension of earlier smart charging projects and will look to evaluate the various EV capabilities and their usefulness to the grid.
- The FCR project in Netherlands looks to commercialize V2G by applying it to decentralized frequency control of the grid.
- The Toyota city project aims to balance the load by supplying power on a large scale from EVs.
- The Lombox V2G pilot in the Netherlands which is being implemented by a consortium of Renault, Utrecht City Council, ElaadNL and LomboXnet. Their aim is to develop a framework for smart solar charging and show the potential of vehicle-to-grid in real-life.