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Electric cars join forces to shake up the power system

Discussions regarding the future design of our power system are fierce and conflicting these days when it comes to topics such as local storage vs. long-distance transmission or the future role of nuclear power and natural gas. But consensus shows up when it comes to individual transport: most voices seem to agree that the market share of electric vehicles (EVs) will see tremendous growth in the years to come. While the timescale of this development remains to be seen, it has become clear that the combined load of potentially thousands of cars charging at the same time will pose both an opportunity and a challenge to utilities. This becomes apparent by looking at two numbers: the average household today rarely exceeds a peak demand of 5 kW, while a nominal power of 11 kW will become the gold standard for residential charging stations. Even considering the fact that not all cars will be plugged in at once, both the peak load and the net consumption in distribution grids will certainly increase.

For energy-related roles in the system, like utilities, this is an opportunity: the net electricity consumption of the average household will almost double, as the average car in central Europe will require about 3000-4000 kWh for charging per year.

In addition, these cars will be usually plugged in for a much longer time than needed by the actual charging process, as, for example, at home during the night or at work during the day.

At full power on a residential charging station, the daily charging process for the average user requires no more than two to three hours, while the car may often be plugged in for at least ten hours. At current spot-market prices and spreads, this flexibility represents a monetary value for dayahead/intraday optimization that easily falls in the range of hundred or more Euro per year. Spot market spreads might even increase with the further growth of renewables, fostering the attractiveness of demand-side management even further. In places like Scandinavia where there is already a high penetration of EVs, business models around this mechanism are employed to provide the user the energy for charging at no cost.

The challenge – too many at the same time and same place

But opportunities for some market players might become a threat for others like grid operators: some parts of distribution grids will face capacity challenges and voltage drops caused by the

simultaneous charging processes. In addition to the challenges created by the charging profile, system security could be impacted. Having most of the charging stations connected to the public internet creates an easy game for manipulation. Taking control of a pool of charging stations means being able to quickly and unforeseeably add or remove huge loads from specific grid sections. In other words: shutting down the power supply of an entire neighborhood at the push of a button. Therefore, secure connectivity and control will play an increasingly important role.grid sections. In other words: shutting down the power supply of an entire neighborhood at the push of a button. Therefore, secure connectivity and control will play an increasingly important role.

Although the race among car manufacturers to produce the most appealing electric car with the longest range and the fiercest acceleration is already up to speed, the solution development for a fully sustainable form of aggregated charging-management has just begun. Here the biggest challenge lies in a sustainable business model for all involved parties. Considering the numbers given above, the key is low connection cost to provide sufficient financial benefits to both end-customer and pool operator, but without any drawback on security. Modern IOT technology allows the development of these solutions for distributed devices at the right cost level. The key distinguishing feature will be matching the regulatory and security requirements of different countries in order to scale solutions.

Charging stations – one more valuable piece to the puzzle

Considering the growth rate, power needs and flexibility opportunities of the charging process, we firmly believe that charging stations for electric vehicles will become a group of residential assets in the power system, where demand-side management gives considerable value for Virtual Power Plants for energy and grid services as well as the end-consumer. A combination with assets providing other usage profiles will be key to stack up value streams in the Virtual Power Plant and deliver the highest value to all involved parties. But such a system not only needs to fit the bill in terms of cost, but also needs to be built around an architecture consisting of both hard- and software that is inherently safe from external manipulation. A virtual power plant is a power plant no less, so the same standards regarding security and stability should be applied. It brings a huge potential and supports the way into a better energy future.