ELITE POWER GROUP

EV Charging on a Constrained Grid

The key words in this article's title are "constrained grid" What does this mean?

It means that the power delivery capability from the grid is limited to whatever it is currently capable of transmitting and in order to carry increased levels of power, modifications to the grid need to be done by way of what is called a "grid upgrade." These upgrades are always expensive, if at all technically possible, so alternatives need to be found to supply the energy required at the power levels necessary.

Enter electric vehicle chargers. The drive is on to recharge EVs quickly so that they can emulate the rapid refueling capability of internal combustion vehicles. The batteries in the vehicles are large, around 75 to 100 kWh. If the chemistry would allow it to charge the 100kWh battery in our Tesla Model S in 1 hour we would need to supply it with 100,000Watts (100kW).
The Tesla would allow such a high rate but what about the local grid connection? What if we wanted to provide capacity for two Tesla's to charge simultaneously? We are starting to get some very big numbers for required power flow from the grid and we are surely going to need a grid upgrade; or something else. Here we are going to investigate that something else and we are going to do so by using analogies.

Imagine this Scenario.

An administrative office block has existing car parking within the building; possibly underground.
There's a need to provide EV charging for a changing vehicle fleet. Say the mix might be 10 cars needing slow charging over 9 hours and 10 fast charging in 4.5 hour. Defining slow, let's assign 11kW and fast 22kW.

We need, if all 20 bays are occupied, a total of **111kW + 220kW = 331kW** clearly beyond the building's wiring present capability and even if it were possible to run thicker cables from the street in an existing building the grid connection would probably need upgrading: all expensive.

Think of the building's wiring in terms of water pipes, a good, easily understood analogy. The pipes in the building and the main street water main are conveying "fuel" to the vehicles and they are clearly not going to be able to fill the vehicles quickly unless they are made larger in diameter.

What to do? Let's locate a water tank inside the garage, adjacent to the vehicles with short large pipes supplying the cars. If it's a large water tank, then all the cars requirements will be met. The volume of water required is proportional to the amount of energy in kWhs. If all the cars have 100kWh batteries then the total energy required to fill them once is **20 x 100kWatts =2000kWh =2MWh**, a large amount of energy equivalent to a large but manageable water tank.

Now the cars will be out on the road most of the day returning at day's end. This is an opportunity to refill the water tank from the building's small water pipe but big enough to refill the tank before the cars return. And while the cars are filling some water, within the capability of the pipe to the street, can make up for some of the water going to the cars.

Replace a battery for the water tank and we have an easily understood picture of the situation in our office block charging scenario. The battery isn't cheap, but the building and grid upgrades are expensive as well. Plus batteries have one ace up their sleeve: They can be used at all times during the day and night to earn money by arbitrage in the electricity spot market with short burst of small amounts of energy to help stabilise the grid in this world of fluctuating renewable energy on the grid.