On the road to grid stability

- Using batteries in heavy vehicles and charging infrastructure as frequency reserves

Climate change is one of the most pressing issues of today, and decreased emissions of greenhouse gases from various industries is of utmost importance. Electrification of the transport sector is a challenge, but electric heavy vehicles have started to traffic Swedish roads. These are equipped with big batteries that have the potential to act as a frequency reserve and help stabilise the power grid.

As a result of global warming and the climate threat, emissions of greenhouse gases must be limited. A vital part of decreasing emissions is to electrify the transport industry. With electrification comes an increasing need for the power grid to function as intended. In addition, more intermittent energy in the energy mix, as well as a heavier load on the grid, makes for more instability. One of the three main factors that need to be in balance for the power grid to function as desired is the frequency, which is to be kept at 50 Hz in the Nordic power system. To maintain the balance and stability of the power grid, various balancing services can be used. In the case of maintaining the proper frequency, the services are called frequency regulation.

Frequency regulation can be delivered by many kinds of energy sources and the supply has historically been dominated by water power. However, new kinds of frequency reserves and potentially sharpened requirements on delivery time of the service makes room for new actors on the market. One example of such, is the increasing use of large batteries as energy reserves to support the power grid.

Electrification of heavy vehicles results in potential for aggregations of energy storage capacity at sites. In other words, with increased electrification, bus operators and haulage contractors will, at certain times during the day, have a large number of heavy electric vehicles gathered at their sites. This happens, for example, during the night when many vehicles are at the home depot, charging. If the vehicle batteries have capacity available during certain hours of the day, that makes for room to use the battery for other purposes, such as frequency regulation.

The concept of letting the battery in a vehicle connect to the power grid to either charge or discharge to help maintain the frequency of the grid is called vehicle-to-grid (V2G). This technology is not available in heavy vehicles at present, but with an increased demand and level of electrification in the future, this might change. Moreover, there are other more pressing technological challenges regarding electric heavy vehicles to be dealt with at present, which has placed the topic of V2G several steps down on vehicle manufacturers' to-do list.

If V2G were to be made possible in the future, then there are many transport companies that would have good potential to become suppliers of frequency regulation. This is due to their predictable schedules, the accumulated capacity at their sites and availability during several hours per day. However, as of now, electrification of heavy vehicles is expensive and an electric truck costs around 2 to 2,5 times more than a regular fossil driven truck does. This has led to a shift in driving patterns towards 24/7 operation. This leaves no room for frequency regulation. If instead, providing frequency regulation is included in the business model as a part of the actor's value creation, then additional revenue can be obtained.

There are also other sites that have a potential in delivering frequency regulation, and when focusing on heavy vehicles, logistics hubs could be of interest as well. However, the trucks that transport cargo to and from the logistics hubs generally do not stay at the site long enough to provide V2G. Therefore, the potential mainly lies in working vehicles at the sites.

To a given site, energy storage and solar panels can be added. This could supply the site with green energy, as well as enable storage of intermittent energy for later usage. In addition to storing intermittent energy, a battery can be placed at a site to provide extra electric capacity when there is a shortage from the power grid. In both cases, such a battery could be used for frequency regulation, and thus providing additional income. Regarding the case of heavy vehicles, a site could combine all mentioned elements: solar panels, batteries, and vehicle charging, to create a holistic energy system that also can help stabilise the power grid.

As of now, there is money to make as a provider of frequency regulation, but with the shift in the energy system, and more actors being able to act as a frequency reserve, this might change in the future. With an increased supply, and, as of now, fixed demand for several kinds of frequency reserves, prices might decrease with an increase in suppliers and competition. This could imply that an actor that wants to ensure a lucrative business case should enter the market fast, before the current earnings might decrease. As a result of including frequency regulation in one's business, actors can obtain additional income that could shorten pay-back times and improve the investment case for electrification, which hopefully could help speed up electrification and therefore also help the shift towards a sustainable energy system.

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