BELLONA EUROPA *brief*

THE DISRUPTIVE WORLD OF LARGE SCALE ENERGY STORAGE:

THE OUTSIZED INFLUENCE ELECTRIC VEHICLES WILL HAVE ON ELECTRICITY MARKETS

Electricity storage has often seemed to be at the periphery of the energy transition debate, with conversations generally fixated on renewable deployment. This is changing rapidly; in Europe many countries use or are considering the use of capacity mechanisms to prop-up faltering fossil generation plant.[1] This is seen as necessary to guarantee electricity supply when the wind or sun are not performing sufficiently. But it raises the question of why consumers should pay for little used fossil plants when energy storage could provide a more attractive solution.

Many in the electricity supply sector regard the deployment of electricity storage technologies as too expensive and therefore not a significant competitor in comparison to fossil generation. But actions in the automobile industry may directly result in the deployment of large amounts of battery electricity storage, regardless of the investment preference of electricity generators.

Energy Storage good fit for environment, renewables and consumers

The benefits of large scale electricity storage technologies such as pumped hydro, compressed air storage and batteries are many. Such technologies can store low-cost renewable energy when the system experiences oversupply, then releasing this electricity to the grid when it is more needed, such as at night in the case of solar or when the output of wind falls below demand. This has benefits for the climate as low carbon electricity can be used as needed. It also directly benefits renewable deployment as issues surrounding grid and security of supply are addressed. Last but not least, it is potentially positive for consumers as the wholesale price advantage of renewables can be passed on, while the need for excess backup capacity provided from fossil plants is reduced.

Energy Storage will be disruptive to the core of the electricity market

Due to the low marginal cost of releasing energy from a storage site, the commercial characteristics of electricity storage share some similarities to those of renewables. Once deployed, electricity storage will have the potential to take any opportunity to generate revenue. In reality this means that as with renewables, a relatively small amount of electricity storage deployment will have a large effect on incumbent generators. This may have long-term and far-reaching implications for the operation of the electricity market.

Taking Europe as an example, electricity storage will further squeeze the already embattled fossil generation sector by outcompeting such plants for the most valuable peak market prices, which generally occur at times of low renewable generation. In fact such plants will be forced to source revenue in-between times of renewable generation and dispatchable electricity storage.

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The used battery packs from the stock of 4 million electric cars from 2010 to 2015 have electricity storage capacity sufficient to store and release nearly all of Germany's peak summer solar capacity on a daily basis.

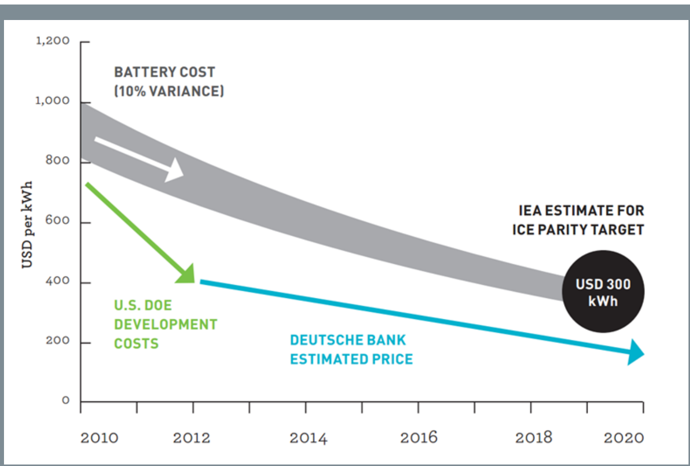

Figure 1 Estimated Costs of EV Batteries through 2020

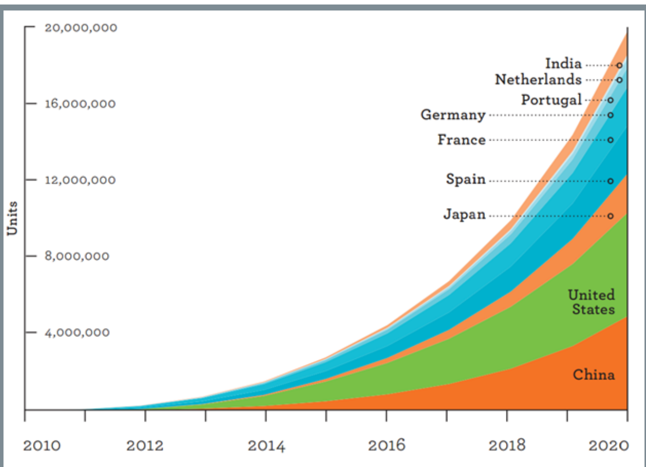

Figure 2 EV Stock Targets IEA Global EV Outlook: Understanding the Electric Vehicle Landscape to 2020

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Commercial industries prompt electricity storage revolution

The technologies leading to the electricity storage revolution have been developed and deployed in a wide variety of commercial activities. For example automotive industry development has led to advances in both batteries and flywheels. Similarly technology and expertise developed for the hydrocarbon and gas storage sectors are critical to the advancement of compressed air electricity storage.
Such external development may create unexpected and disruptive market linkages, where the activities in one sector have a profound knock-on effect in the electricity sector. That is to say that the commercialisation and sale of a technology in one sector may greatly affect the economics of electricity storage deployment in the electricity sector.

A second life for electric vehicles

The development of electric vehicles (EVs) is decreasing the price of battery electricity storage while simultaneously increasing supply. The large scale investment into lithium-ion and lithium-polymer batteries for transport is resulting in tumbling production costs, higher capacity, and increased efficiency. The price of lithium-ion batteries has already fallen by 40% since 2010. These trends are expected to continue (Figure 1).

The lowering cost of batteries for electricity storage is one effect of the arrival of EVs. More importantly the sale and eventual retirement of EVs will provide the electricity storage sector with a readily available and growing stock of high capacity batteries.

Every EV contains a large integrated battery unit. However, these batteries will not be able to perform indefinitely. At present most manufactures provide a ten year guarantees for the battery unit. The battery pack of cars is expected to retain 70% to 80% of its capacity after 5 to 10 years of operation; at this point the loss in capacity will decrease the driving range of the car.[2]

These battery packs are still fit for use in other sectors, and will be well suited to having a second life as system scale electricity storage. Used vehicle batteries will migrate to where they have the largest potential to generate income, and it is highly unlikely that they will simply be disposed of.[3] The liberalised electricity market offers low capital and operational cost automotive battery packs ample opportunity to have a profitable second life. In this way the disruptive deployment of large scale electricity storage is to a large extent inevitable. The growing size of the electric car market and the subsequent reuse of battery packs in the electricity supply sector offer huge potential to revolutionise electricity storage deployment.

The scale could be substantial

The potential scale of electricity storage from used automotive battery packs is staggering and growing exponentially. The IEA anticipates 4 million electric cars to be in use by 2015, rising to 20 million in 2020 (Figure 2). As an example the Nissan LEAF, a popular electric car, has a relatively modest battery with a capacity of 24 kWh, while Tesla Model S, a luxury car has a much larger capacity of 85kWh. For simplicity we can assume the average electric car sold has a capacity of 40 kWh, with a loss of 20% capacity before replacement. If the used battery packs from the stock of 4 million electric cars from 2010 to 2015 are used in the electricity sector, electricity storage deployment of 128 GWh would result.

To put that in perspective **128GWh** would be sufficient to store and release nearly all of Germany's peak summer solar capacity on a daily basis.[4] A fraction of that electricity storage capacity deployed in Germany would greatly increase the efficiency of renewables, shaving the price peaks and thus removing much of the need for backup plants from the system. Including cars expected sold by 2020, the number rises to **640 GWh** of potential electricity storage. It appears evident that the electric car revolution will be followed by an electricity supply revolution, which is advantageous for renewable deployment and damaging to fossil incumbents.

The fundamental shift that electric vehicles will bring to the electricity supply sector is already materialising. In February this year, Nissan along with other partners opened the World's first large-scale power storage system which utilises used batteries collected from EVs.[5] This prototype storage system will measure the smoothing effect of energy output fluctuation from the nearby solar farm and will aim to establish a large-scale power storage technology by safely and effectively utilising the huge quantities of discarded used EV batteries which will become available in the future (Sumitomo Corporation 2014).

Referances

[1] Could capacity markets derail EU climate progress? http://bellona.org/publication/capacity-markets-derail-eu-climate-progress

[2] The life expectancy of traction batteries is not only modeled in a generic manner but also rather arbitrarily defined based on industry conventions: a battery is considered "dead" for mobility purposes when it has lost 20% of its initial charge capacity (Besselink & Oorschot 2010).

[3] In this way, the production impact would be attributed to two or more applications, rather than only the EV. In addition, reuse will generate value for the society.

[4] German solar electricity generation record is from July 2013, with an average production of 164 GWh per day.

[5] Nissan Harvests Solar Power With World's First Large-Scale Energy Storage System http://ecowatch.com/2014/05/13/nissan-solar-energy-storage-system/

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