CEPS COMMENTARY
Thinking ahead for Europe

Low-cost batteries will not disrupt (all) energy utilities

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On April 30th, Tesla announced the launch of an affordable lithium-ion home battery, the Powerwall. The company's new product has prompted analysts to postulate some rather apocalyptic scenarios for the future of traditional energy utilities. Because batteries can be used to store energy from rooftop solar panels, some are expecting an off-grid revolution: The premise is that consumers would become increasingly self-sufficient, thus further undermining the business model of energy utilities, which rely on selling electricity from large, centralised power stations.

Given its limited storage volume, however, Tesla's Powerwall will not pave the way for such a revolution. Certainly, the trend towards more decentralised generation has already begun – initially instigated by the political choice to subsidise renewables, but nowadays increasingly driven by the low cost of solar. Low-cost storage will enable solar to capture a larger market share than anticipated, which may be bad news for those who want to build large transmission lines and deploy wind turbines – but not for energy utilities in general.

Self-consumption of solar energy pays for the consumer already

In many EU member states, electricity generated from solar panels is cost-competitive with electricity purchased from the grid, a phenomenon commonly referred to as 'grid parity'. An illustrative example is Germany, where the average retail price of residential grid electricity amounts to €0.30 per kilowatt-hour.[1] This is well-above the cost of self-generated solar electricity, which is between €0.12 and €0.15 per kilowatt-hour.[2] Therefore, self-consumption pays for the consumer without *direct*[3] subsidies. However, there is a natural cap to the benefit

[1] This is the full retail price, which includes grid fees, policy costs, taxes and levies. In Germany, these are charged volumetrically to a large extent, i.e. based on the amount of electricity purchased from the grid. Policy costs, taxes and levies make up for almost 50% of end-consumers' electricity price.
[2] On top of that, the recent amendment of the Renewable Sources Act (August 2014) foresees a tax on self-generation for installations above 30 kW_p. It is between 30 and 40% of the surcharge for supporting renewables, currently corresponding to roughly €0.02 per kilowatt-hour.
[3] Avoiding grid fees, taxes and levies is considered an *indirect* support (see section below, on role for policy-makers).

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of self-generation, because household consumption peaks in the early evening and therefore does not coincide with the peak of solar production, which is at noon. Batteries allow solar panel owners to consume self-generated electricity at a later stage. Based on Tesla's recent announcement, one can estimate storage costs of roughly €0.20 per kilowatt-hour.[4] This makes stored, self-generated solar electricity cost around €0.32 to €0.37 per kilowatt-hour and therefore more expensive than grid electricity. Still, one has to consider that there will be further cost reductions. There is empirical evidence that technology costs decrease by 20-30% for each doubling of cumulative production volume. As a result, storage costs could be halved by the end of this decade,[5] making stored, self-generated solar power less expensive than grid electricity in Germany. With further cost reductions in solar,[6] one can expect that stored, self-generated solar power could cost €0.20 to €0.22 per kilowatt-hour by 2020.

Not a revolution but not good news either for utilities

While this cost reduction is indeed significant, it still does not represent the starting point of an off-grid revolution. Tesla's Powerwall has a rather limited storage volume making it impossible to reach 100% self-sufficiency. Therefore, people will not want to disconnect from the grid unless they are prepared to sit in the dark after two successive cloudy winter days. A minority of consumers might aim for 100% self-sufficiency by installing multiple batteries and oversizing the solar array, but this is not economically feasible and therefore unlikely to attract a mass-market. Low-cost batteries therefore do not represent the next nail in the coffin of a centralised grid, but rather they will change the usage pattern of grid electricity.

Existing solar panel owners installing a battery will consume less grid-electricity in the evening and inject less electricity into the grid at noon. Demand for power from centralised stations will therefore increase at noon but decrease in the evening. The net effect is close to zero given the high conversion efficiency of lithium-ion batteries – certainly not a frightening scenario for power-plant owners.[7]

The situation is different when it comes to new installations and replacements of existing solar panels. Home owners will likely opt to install more or larger solar panels, if low-cost storage is available. This reduces the demand for grid electricity and for conventional power compared to a scenario where batteries are expensive. Conventional power plants would still be needed – but *different* ones due to a declining trend in operating hours. They would mainly be needed when there is not enough sun but not any longer to ensure a continuous level of electricity demand.

This trend, however, is not new. Even without batteries, the power industry faces significant structural change. In 2030, 50% of conventional capacity could be idle at least 80% of the time, assuming that the EU reaches its renewables target by deploying wind turbines and solar

[4] Based on the following main underlying assumptions: i) daily usage over 10 years, ii) investment costs of €4,000 (incl. power inverter and mounting) and iii) financing at 1.75% interest (standard rate of German government-owned development bank KfW for rooftop solar panels).
[5] The cumulative production volume would have to double three times, i.e. increase by a factor of eight.
[6] Doubling the cumulative production volume of solar by the end of the decade would decrease technology costs by 20%.
[7] The exact impact depends on the power-plant portfolio, i.e. the share of base-load, mid-merit and peak-load power plants.

panels. Today, less than one-third of the EU's power station fleet operates on this basis. Conventional power will in any event be relegated to back-up status with an increasing share of renewables. Low-cost storage will simply accelerate this trend.

New opportunities for energy utilities

Competitive decentralised generation combined with affordable storage allows for an entry of new players, because there is an opportunity to gain market share. These could be non-energy companies or second-tier players challenging their respective national incumbent. For energy utilities, this calls for business models with a stronger focus on downstream activities and ultimately on consumers. Batteries will have to be installed, maintained and operated in such a way that the use of self-generated solar power is maximised. Will consumers be interested in running apps to know when to charge and discharge their battery? Probably not a majority of them. Most will expect that this is done automatically or that a service provider takes over this task. This player could be either a traditional utility or a non-energy company, for example from the ICT sector. In any case, complementary products such as heat pumps (which turn electricity into heat) could be offered, and the service provider could take over the task of selling excess electricity and flexible demand on the market – acting as an aggregator for potentially millions of households.

Role for policy-makers

Although self-consumption pays for the consumer already, this is not necessarily the case for the system as a whole. Retail prices include cost components unrelated to electricity supply, e.g. surcharges to finance renewables. As a result, self-consumption leads to potential consumer savings that do not necessarily correspond to actual system savings, because those costs unrelated to electricity supply will simply be incurred by the remaining end-consumers. This situation will need to be addressed by policy. It is not only a matter of social equity but also of sending efficient price signals. A framework in which policy costs, taxes and levies are allocated on the basis of electricity consumed from the grid encourages households to install relatively small batteries 'behind the meter'. But this would discriminate against the installation of medium-scale batteries in city districts – despite potential cost savings (due to their scale) and the fact that they could offer flexibility to the whole system.

Conclusions

Tesla's CEO Elon Musk is betting that batteries are going to become a mass market. This may very well become reality. But one should not jump to the conclusion that this is the end of energy utilities. Similar to solar panels, batteries have high upfront costs. The massive deployment of solar was driven by dedicated policy support, in many cases without any kind of cost or volume control. There is no such thing for batteries. In the absence of financing programmes, high upfront costs provide an unfavourable starting point for a disruptive development. But the fact that self-consumption of *stored* solar energy will soon pay for consumers represents a paradigm shift in the power industry. This should be seen as an opportunity, at least for first-movers.