Technology: Batteries (for grid tied storage)

Definition and description

Batteries are devices used to transform electrical energy into chemical energy, store the chemical energy and transform it back to electricity when needed. The first battery was invented by the Italian physicist Alessandro Volta in 1800. Ever since, a large number of different types using various materials have been developed. Over time energy density and cycle stability has improved significantly making it possible to even power electric sports cars today.

Some modern battery technologies require rare earth metals that are scarce, expensive and sometimes release toxins during mining. Additionally, mining some of those materials is quite energy intensive. These facts have brought increased scrutiny on the sector. However, there are several technologies available and in development that solve most of those problems.

This fact sheets focusses on batteries for grid tied energy storage ranging from residential storage systems with capacities of several kWh to utility scale systems with more than 1 MWh of storage capacity.

With an increasing number of variable Renewable Energy (vRE) systems connected to the grid, storage of some kind, becomes inevitable. Due to their good scalability and fast response, batteries are suitable to close the gap between demand and supply in a system with a high amount of vRE.

In addition, batteries in combination with distributed vREs have the potential to make Grenada's electricity system more reliable and resilient to natural disasters. In a centralized system, like it is today, one failure can lead to a whole system shut down while in a distributed system parts of the grid would remain operational.

Potential in Grenada[9]

Quantifying the potential for batteries to support the grid is difficult as they would only be required in combination with variable Renewable Energy technologies like solar photovoltaics and wind power. Consequently, the future energy mix is essential to quantify the demand/potential for batteries. Provided Grenada wants to transform its electricity sector to 100 % Renewable Energies the following scenario could be used to do an estimation:

Assuming a total demand (including system losses) of 300 GWh/a with 200 GWh/a of supply coming from Geothermal power plants would require another 100 GWh/a of supply from wind (10 MW and 30 GWh/a) and solar (45 MW and 70 GWh/a). Further assuming that geothermal covers baseload this would require vREs and batteries to cover all peaks and periods of low sun and wind. In theory this means that storage systems would have to be able store the complete production of vREs during days of low demand. This could lead to extremely high storage capacities. Studies for Germany indicated that the demand for short term storage would be in the range of 0.07 % of total demand in order to achieve 100 % Renewables. In Grenada's case this would mean approx. 200 MWh of storage capacity. However, if longer term storage would be

[9] Due to the lack of detailed analyses the demand /potential has been estimated based on assumptions.

included, which in Germany is envisioned to be covered by other technologies, the storage demand would increase to 5 %. This would mean 1,500 MWh for Grenada.

Mitigation to climate

Batteries by them self don't mitigate greenhouse gases. However they enable other technologies like solar photovoltaics and wind power to achieve their full mitigation potential.

Advantage(s)

- Very good scalability making it perfect for distributed generation
- Job opportunities for technically skilled (tertiary education) people in the field of operation and maintenance
- Low environmental risks at the place of use
- Essential for a major deployment of variable renewable energies

Disadvantage(s)

- Limited capacity and expertise in Grenada increasing the risk of malfunctioning systems
- High upfront costs
- Fire and explosion potential with some technologies
- Environmental issues at the place of material's origin with some technologies
- Most promising technologies are rather new
- If deployed as none utility or IPP owned it could increases the risk of social inequality[10]

Costs and other financial requirements

Currently, costs for batteries are still quite high making it difficult to realize economic cases for islands the size of Grenada. However, most experts expect prices to fall below 100 US$/kWh of storage capacity (0.02 US$/kWh stored at 5,000 cycles) within the next five years. This would make PV plus storage and wind plus storage economic.

Furthermore, new technologies like new solid state batteries could further decrease costs in the future. Consequently, batteries may play a vital role in electricity systems around the world and especially in island systems.

Status of the technology in Grenada

Mature battery technologies (lead) are used in off-grid PV systems in Grenada. Grid tied systems are new to the country.

[10] Compare Technology fact sheet on grid tied photovoltaics