QUESTIONS & ANSWERS

ON GRID-SCALE BATTERY ENERGY STORAGE SYSTEMS

1. Why are BESS or grid-scale battery systems necessary in the UK?

Battery energy storage systems are used to store excess electricity that is generated by renewable energy sources such as solar panels or wind turbines. This excess electricity can then be used to meet demand when renewable energy sources are not available, such as at night or on cloudy days. In the UK, battery energy storage systems are becoming increasingly necessary as the country moves towards a low-carbon economy and aims to reduce its reliance on fossil fuels. Battery storage can help to smooth out fluctuations in renewable energy generation and make the power grid more stable and reliable. It can also help to reduce greenhouse gas emissions by allowing more renewable energy to be used instead of fossil fuels.

2. How do battery energy storage systems stabilise the electricity grid

Battery energy storage systems can help to stabilise the electricity grid by smoothing out fluctuations in renewable energy generation and balancing supply and demand.

When there is excess electricity available on the grid, the battery can be charged. This excess electricity might be generated by renewable energy sources such as solar panels or wind turbines, or it might be surplus electricity that is being produced by traditional power plants. When demand for electricity increases, the battery can then discharge this stored electricity back onto the grid to meet the additional demand.

By providing a source of stored electricity, battery energy storage systems can help to stabilise the grid and reduce the need for fossil fuel-based power plants to ramp up production in response to fluctuations in demand. This can help to reduce greenhouse gas emissions and make the power grid more reliable and efficient.

3. How does the balancing mechanism work in the UK electricity grid

The UK electricity grid is designed to balance supply and demand in real time, in order to ensure that the power system remains stable and reliable. This is known as the balancing mechanism.

There are several different ways that the balancing mechanism works in the UK:

- Automatic Generation Control (AGC): This system uses computer algorithms to automatically adjust the output of power plants in response to changes in demand.
- Frequency Response: This system uses fast-acting energy storage systems, such as flywheels or battery storage, to help stabilise the grid by absorbing excess electricity or injecting additional electricity as needed.
- Demand Side Response (DSR): This system pays businesses and consumers to reduce their electricity usage at times of high demand, in order to help balance the grid.
- Reserve and Regulation Services: These are provided by power plants and energy storage systems that are able to quickly increase or decrease their output in response to changes in demand.

Overall, the balancing mechanism in the UK electricity grid is designed to ensure that supply and demand are constantly matched, in order to keep the power system stable and reliable.

4. What are the risks of battery energy storage systems?

There are a few risks associated with battery energy storage systems that should be considered:

- Safety: Like any type of battery, there is a risk of fire or explosion if the battery is damaged or handled improperly.
- Durability: Battery energy storage systems can degrade over time, reducing their capacity to store energy. This can be a concern if the battery is expected to last for a long period of time.
- Cost: Battery energy storage systems can be expensive, especially if they are large enough to store a significant amount of energy.
- Environmental impact: The production of batteries can have negative environmental impacts, including the use of hazardous materials and the generation of greenhouse gases.
- Intermittency: Renewable energy sources like solar and wind are intermittent, meaning they may not always be available to generate electricity. This can be a challenge for battery energy storage systems, as they need a constant supply of electricity to charge the batteries.

Overall, the risks of battery energy storage systems can be managed by following proper installation and maintenance procedures, as well as careful planning and design to ensure that the system is appropriate for the needs of the user.

5. Are vanadium redox flow batteries safer than lithium-ion grid-scale batteries?

Vanadium redox flow batteries (VRFBs) and lithium-ion batteries are both commonly used for grid-scale energy storage. Both types of batteries have their own benefits and drawbacks, and the choice of which one to use will depend on the specific application and the requirements of the user.

In terms of safety, VRFBs generally have a number of advantages over lithium-ion batteries. VRFBs use a liquid electrolyte, which is stored in tanks outside of the battery cell. This means that the risk of thermal runaway (a potentially hazardous condition that can occur in lithium-ion batteries if the temperature gets too high) is much lower in VRFBs. VRFBs also have a longer lifespan than lithium-ion batteries, which can make them more cost-effective in the long run.

However, VRFBs have some drawbacks as well. They are generally larger and heavier than lithium-ion batteries, which can make them more difficult to transport and install. They also tend to be more expensive to manufacture, which can make them less cost-effective upfront.

6. What are the advantages of lithium iron phosphate grid-scale batteries?

Lithium iron phosphate batteries (LiFePO4 batteries) are a type of lithium-ion battery that has a number of advantages compared to other types of lithium-ion batteries:

- Safety: LiFePO4 batteries are generally considered to be safer than other types of lithium-ion batteries, as they are less prone to thermal runaway (a potentially hazardous condition that can occur if the temperature gets too high).
- Durability: LiFePO4 batteries have a longer lifespan than many other types of lithium-ion batteries, as they are less susceptible to degradation over time. This can make them more cost-effective in the long run.
- High energy density: LiFePO4 batteries have a high energy density, which means that they can store a lot of energy in a relatively small space.
- Low cost: LiFePO4 batteries are generally less expensive to manufacture than other types of lithium-ion batteries, which can make them more cost-effective upfront.
- Environmental impact: LiFePO4 batteries are made with iron, which is a more abundant and less toxic material than some of the other materials used in lithium-ion batteries. This can make them more environmentally friendly.

Overall, LiFePO4 batteries have a number of advantages that make them a popular choice for a wide range of applications, including electric vehicles, solar energy storage, and portable electronics.

7. What are the advantages of vanadium redox flow grid-scale batteries?

Vanadium redox flow batteries (VRFBs) are a type of flow battery that has a number of advantages for grid-scale energy storage:

- Long lifespan: VRFBs have a long lifespan compared to other types of batteries, as they are not subject to the same level of degradation over time. This can make them more cost-effective in the long run.
- High energy density: VRFBs have a high energy density, which means that they can store a large amount of energy in a relatively small space.
- Flexibility: VRFBs can be scaled up or down in size to meet the needs of the user, making them more flexible than some other types of batteries.
- Safety: VRFBs use a liquid electrolyte, which is stored in tanks outside of the battery cell. This means that the risk of thermal runaway (a potentially hazardous condition that can occur in lithium-ion batteries if the temperature gets too high) is much lower in VRFBs.
- Environmental impact: VRFBs use vanadium as the active material, which is abundant, non-toxic, and environmentally friendly.

Overall, VRFBs have a number of advantages that make them a promising technology for grid-scale energy storage. They are particularly well-suited for applications that require long-duration energy storage, such as balancing the electricity grid or providing backup power for critical infrastructure.

8. How much grid-scale battery capacity is necessary in the UK?

It is difficult to determine exactly how much grid-scale battery capacity is necessary in the UK, as this will depend on a number of factors, including the amount of renewable energy being generated, the level of electricity demand, and the availability of other types of energy storage.

The UK government has set a target of achieving net zero greenhouse gas emissions by 2050, which will require a significant increase in the use of renewable energy. As the share of renewable energy on the grid increases, the need for energy storage will also increase, in order to smooth out fluctuations in generation and balance supply and demand.

Overall, it is likely that the UK will need to significantly increase its grid-scale energy storage capacity in order to support the transition to a low-carbon economy and meet its ambitious climate goals.

The United Kingdom might need as much as 50 GW of storage capacity by 2050, in order to achieve its target of net-zero carbon emissions, according to the National Grid.

In a new study for storage and other players in the UK's energy sector, the Oxford-based consultancy Aurora Energy Research finds that up to 46 GW of energy storage will be required to manage renewable intermittency to achieve the net zero emission target for the power sector by 2035.

9. How much grid-scale battery capacity exists in the UK today?

As of 2021, the total grid-scale battery capacity in the UK was approximately 1.4 GW. This represents a significant increase from previous years, as the country has been actively investing in grid-scale energy storage as part of its efforts to transition to a low-carbon economy.

There are several different technologies that can be used for grid-scale energy storage, including batteries, pumped hydro storage, and compressed air energy storage. The majority of grid-scale battery capacity in the UK is currently provided by lithium-ion batteries, although there are also some vanadium redox flow batteries and other technologies in use.

10. Where should grid-scale batteries be installed ideally?

Grid-scale batteries can be installed at a variety of locations, depending on the specific needs and resources of the power system. Some potential locations for grid-scale batteries include:

- Near renewable energy generation sources: Batteries can be installed near renewable energy generation sources, such as solar panels or wind turbines, in order to store excess electricity that is generated when demand is low.
- At substations: Batteries can be installed at substations, which are key points in the electricity grid where electricity is transmitted and distributed. This can help to stabilise the grid and improve reliability.
- At critical infrastructure: Batteries can be installed at critical infrastructure, such as hospitals, water treatment plants, and other facilities that need a reliable source of power.
- In urban areas: Batteries can be installed in urban areas to help meet the electricity needs of the local community.

Ultimately, the ideal location for grid-scale batteries will depend on the specific needs and resources of the power system, as well as the characteristics of the battery technology being used.

11. Are grid-scale batteries dangerous?

Like any type of battery, grid-scale batteries can pose some risks if they are not used or maintained properly. However, with proper handling and maintenance, grid-scale batteries can be safe and reliable.

One potential risk associated with grid-scale batteries is the risk of fire or explosion if the battery is damaged or handled improperly. This risk can be minimised by following proper installation and maintenance procedures, and by ensuring that the battery is used in a way that does not exceed its design limits.

Another potential risk is the risk of chemical spills or leaks if the battery is damaged or not properly maintained. This risk can be minimised by properly storing and handling the battery, and by regularly inspecting and maintaining the battery to ensure that it is in good working condition.

Overall, grid-scale batteries can be safe and reliable if they are used and maintained properly. It is important to carefully assess the risks and follow proper safety procedures in order to ensure the safety of the battery and the people who work with it.

12. What is the difference between battery power and capacity?

Battery power and battery capacity are related but distinct concepts.

Grid-scale battery power refers to the amount of electricity that a battery system is capable of producing and delivering to the grid, while battery capacity refers to the amount of energy that a battery is able to store.

Grid-scale battery systems are typically used to store excess electricity generated by renewable energy sources, such as solar or wind, and to release that electricity back onto the grid as needed. These systems are typically much larger than batteries used in consumer devices and are intended to provide power to a wide area, rather than just a single device.

Battery capacity, on the other hand, refers to the amount of energy that a battery is able to store. It is usually measured in watt-hours (Wh) or kilowatt-hours (kWh). A battery with a higher capacity will be able to store more energy and power a device for a longer period of time before needing to be recharged.

Battery power refers to the rate at which energy is being used or generated by a battery. It is typically measured in watts (W, or kW, MW, GW). For example, a battery that is able to deliver a power of 100 W can power a device that requires 100 W of power to operate. For the avoidance of doubt, the addition ‘p’ is often used to denote peak-power, i.e. Wp, kWp, MWp, GWp etc.

In summary, grid-scale battery power is the amount of electricity a battery system can produce and deliver to the grid, while battery capacity is the amount of energy a battery can store.

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