Super-Electric Utility-Employees

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1. Introduction

The U.S. Electric Production Industry has been hiring these great new employees lately. They all have the same last name: BESS. They have this ability to extend the production of the least expensive electric-source (photovoltaics, although these like to be called "PV") to cover the typical peak demand period (early-evening) even though the sun has pretty-much gone away.

Although the above talent is extremely valuable, we have discovered they have other talents that may be even more valuable, for instance:

- Storing the output of wind generation, and using it when there is little or no wind.
- Allowing highly-efficient fueled generation (cogeneration units) to run at full output (for maximum efficiency) and storing any over-generation for later use.
- Responding to sudden loss of capacity from generation- and/or transmission-loss with their full output within seconds to minutes (even when they are shut down).

2. Battery Energy Storage Systems (BESS)

Now that I've finished my silliness in the Intro, I can return to my normal writing-mode.

2.1. Tesla Megapack 3

Tesla Energy dominates in North America, but its lead is narrowing globally.[1]

Tesla Energy retained its leadership in the North American market with a commanding 39% share in 2024. Sungrow, though still ranked second in the region, saw its share drop from 17% to 10%. Powin took third place, even if the company itself filed for bankruptcy earlier this year, as noted in a Solar Power World report.

[1] Simon Alvarez, TESLARATI, "Tesla Energy is the world's top global battery storage system provider again," August 7, 2025, https://www.teslarati.com/tesla-energy-tops-global-battery-storage-rankings-again/

On the global stage, Tesla Energy's lead over Sungrow shrank from four points in 2023 to just one in 2024, indicating intensifying competition. Chinese firm CRRC came in third worldwide with an 8% share.

Wood Mackenzie ranked vendors based on MWh shipments with recognized revenue in 2024. According to analyst Kevin Shang, "Competition among established BESS integrators remains incredibly intense. Seven of the top 10 vendors last year struggled to expand their market share, remaining either unchanged or declining."

3. General Considerations for BESS

Like all electro-mechanical systems BESS are not perfect. We will look at some of their compromises below.

3.1. Loses

All BESS experience efficiency-losses of various types. They largely fall into two categories: Charge/Discharge Losses and Aging Losses. Starting with the first type:

3.1.1. Charge/Discharge Losses

Even when it's brand-new, a BESS will experience losses when it charges and then discharges, that is, when the user fully charges the BESS and then fully discharges it, that user doesn't get as much power out discharging as when supplied in charging it. These are quantities are converted to a percentage that is commonly called Round-Trip Efficiency (RTE) losses. BESS typically have an RTE of around 80-85%, meaning 15-20% of the energy input is lost during cycling due to charging and discharging inefficiencies.[2]

3.1.2. Time-Related Losses

Over time, either with periodic cycling, or with inconsistent or limited cycling (like when used for emergency power, a.k.a. as an Uninterruptable Power System (UPS)) electro-chemical batteries lose capacity. The following short-term or long-term factors impact a given battery-bank's capacity include:

Self-discharge: occurs when the stored charge (or energy) of the battery is reduced through internal chemical reactions, or without being discharged to perform work for the grid or a customer. Self-discharge, expressed as a percentage of charge lost over a certain period, reduces the amount of energy available for discharge and is an important parameter to consider in batteries intended for longer-duration applications.[3]

Author's comment: The above is why battery banks are frequently operated in a "float" or "trickle-charge" mode to keep them fully charged, but for most battery types, this has a downside in that total battery capacity degrades over time. Also, there is the cost of the trickle-charge energy, which can be considerable over weeks and months.

[2] NEN Power, "What are the typical losses associated with BESS systems over time," November 4, 2024, https://nenpower.com/blog/what-are-the-typical-losses-associated-with-bess-systems-over-time/

[3] Jennifer E. Leisch and Ilya Chernyakhovskiy, NREL and USAID, Grid-Scale Battery Storage, Frequently Asked Questions. https://docs.nrel.gov/docs/fy19osti/74426.pdf

Cycling: *Repeated charging and discharging cycles lead to chemical and physical changes, reducing battery capacity (kWh) and peak discharge rate (kW).*[4]

Temperature Extremes: *High temperatures accelerate chemical reactions, while low temperatures can hinder charging and discharging efficiency.*

Author's comment: High internal battery temperature can be caused by high ambient temperature or an excessive charge or discharge rate over time.

Depth of Discharge: *Deep discharges stress the battery, while frequent shallow discharges can also accelerate degradation.*

Aging: *Over time, batteries naturally lose capacity due to chemical reactions within the battery.*

Usage Patterns: *Poor usage such as overcharging or frequent deep discharges, can significantly shorten battery life.*

3.2. Other BESS Losses

The charging system should be designed for a specific battery-bank using a specific type of battery (like Li-Ion), chemistry (like Lithium Ferro-Phosphate, a.k.a. LFP), and battery bank size. This is best determined by recommendations by the battery manufacturer for a specific cell part-number and the number/ arrangement of cells in the bank and/or the charger manufacturer using similar parameters. However, even the-best matched charging system and battery bank complying with the above constraints has some inefficiencies.

4. Future Rechargeable Batteries

About a year ago I covered the best candidate replacement for Lithium-Ion Batteries in the post summarized and linked below.

Sodium-Ion Battery Energy Storage Systems: *This paper is about a leading technology in the manufacture of electric vehicles (EVs), and the title technology, a rapidly developing competitor. If you know anything about EVs, you've immediately guessed that the above "…leading technology…" is lithium-ion batteries, and you are correct. However, electric vehicles are not the only market that that uses these batteries, and one of them offers the first step up a ladder that may lead the new-comer to an entry-point into the EV market. Furthermore lithium-ion battery technology has some vulnerabilities, one of them very recent, very large, particularly with respect to sodium-ion batteries.*

https://www.energycentral.com/energy-management/post/sodium-ion-battery-energy-storage-systems-kCu0mhhQZcpvDRq

[4] Exro Technologies Inc., "Battery Degradation," 2025, https://www.exro.com/industry-insights/battery-degradation-explained

About two months ago I posted a paper on a new class of batteries (solid-state batteries) that include Lithium-Ion Batteries, potentially Sodium-Ion Batteries and other types of batteries. The post summarized below just focused on the Lithium-Ion variant of this architecture, because that technology is currently developing more rapidly than any other technology. Furthermore, this paper mainly focused on electric vehicles (EVs), because that is where the largest market solid state batteries will be initially. Furthermore, it will revolutionize EVs through lighter weight, lower-cost and a better safety profile, significantly improving their competitiveness vs. internal-combustion powered vehicles.

However, it is likely solid-state batteries will eventually migrate into stationary applications over time. Combining components from both markets (EVs and BESS) will result in economies of scale and thus lower total battery/charging system prices.

The Future of EVs Are Solid: *Further to the title of this paper, the "solid" I'm referring to is solid-state batteries. An EV battery has three electro-active components: anode, cathode and electrolyte. All batteries used in EVs (mostly lithium-ion batteries) use a liquid or perhaps gel electrolyte. These are definitely not solid-state. Solid-state batteries have been considered the wave of the future for several years now. Perhaps the future is closer than we think.*

https://www.energycentral.com/energy-management/post/the-future-of-evs-are-solid-x9AsbsknMblTkEi

One other comment on future batteries. Lithium-Ion Batteries still have a long developmental-road ahead of them by using different materials for anode, cathode, electrolyte and other battery components. I found many variants of these described on-line, but at this point of development, none really stood out.

It is reasonable to assume that some of the Lithium-Ion or Sodium-Ion batteries under development today will make major breakthrough in capital-cost (lithium is vulnerable here because of a shaky supply-chain, sodium is not, being one of the most common elements in many minerals), lifetime, weight, charge-time, or other attributes.

In addition to EVs and BESS, there are many applications out there for a better rechargeable battery – Just about anything that uses electricity and is potentially portable can benefit from smaller or more powerful rechargeable batteries.