

Market Dynamics and Financing Grid Scale Energy Storage Projects

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Why Storage?

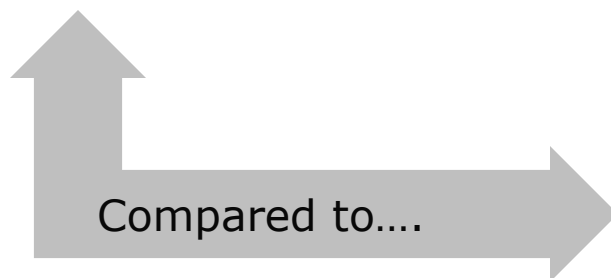
Complete decarbonization is not possible without storage

- ❑ 100% renewables scenario – mismatch with load
- ❑ Grid instability – Europe, California
- ❑ MWs \neq MWs.....Ramp speed matters
- ❑ Aging peakers
- ❑ ESG focus and fossil generation economics
- ❑ Offshore wind integration and curtailment

Forecasts

More than \$400B globally and more than \$100B in the US are estimated to be invested in greenfield storage by 2030

- BNEF forecasts by 2030 cumulative storage installations will be –
 - More than 400 GWs globally and
 - **More than 100 GWs** in the US



- CAISO is about **84 GW**
- SPP is about **65 GW**
- NJ+NY+CT+RI+MA+NH+ME +VT is about **100 GW**

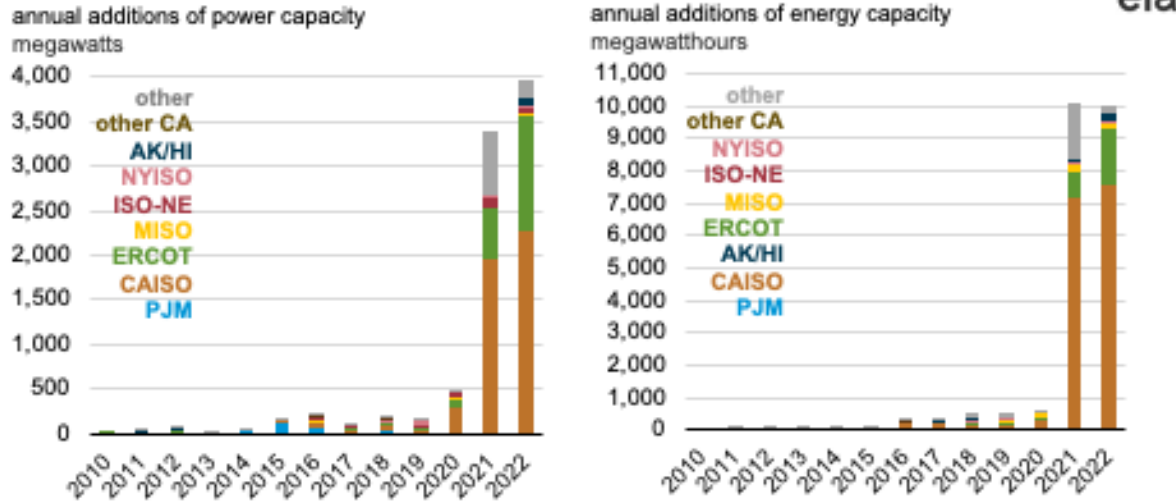
Storage build will be a monumental effort...requiring all stakeholders to work together

Forecasts

Are the forecasts realistic?

- 2022 has seen a rapid increase in the installed base of battery storage in the US – led by CAISO and ERCOT

Figure 1a. Large-scale battery storage capacity additions by region (2010–2022)



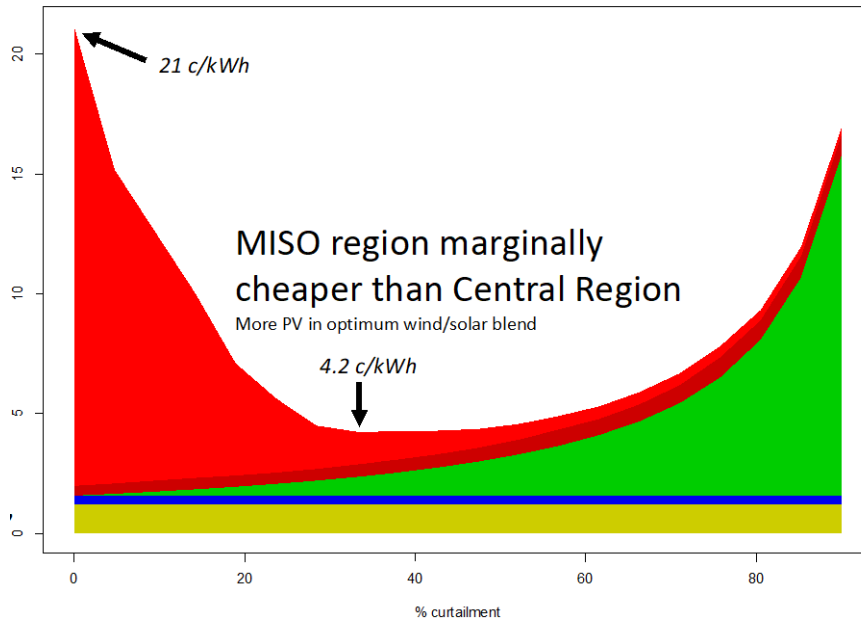
Data source: U.S. Energy Information Administration, 2022 Form EIA-860 Early Release, Annual Electric Generator Report

In the first half of 2023, about 5 GW of storage capacity has come online

Planning Considerations

Paths to Decarbonization with the lowest “Levelized Cost of Electricity” (LCOE)

- Clean Energy States Alliance studied the impact on LCOE for several scenarios across different mixes of technology to achieve 100% clean electricity in MISO



**Overbuilding renewables
(and transmission)
combined with curtailment
is most cost-effective!**

■ Storage energy component ■ Storage power component ■ PV ■ Wind ■ Implicit Storage

Planning Considerations

Long Vs. Short Duration Energy Storage

- Effective load carrying capability (“ELCC”) measures a resource’s contribution to the system’s needs relative to perfect capacity

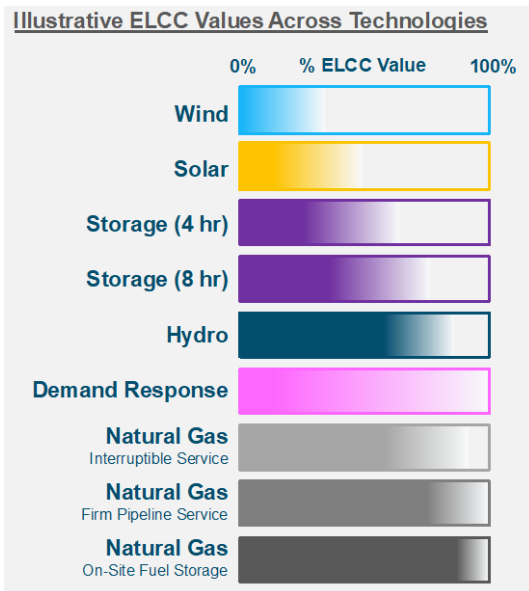
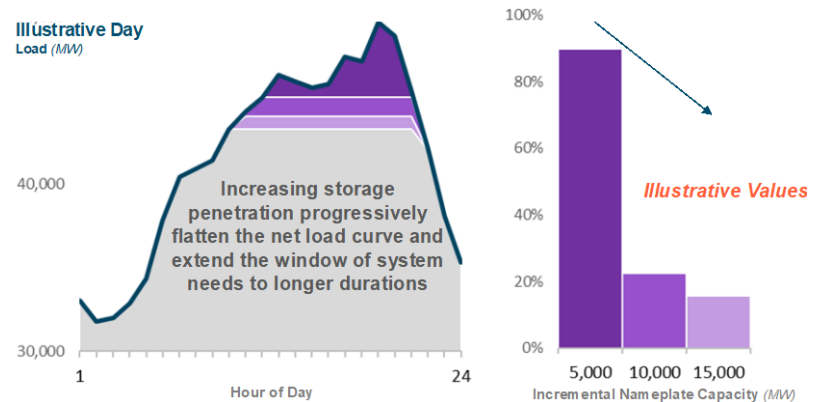


Illustration of Declining ELCC for 8-hour Energy Storage as a function of Penetration



Source: Charging Forward: Energy Storage Toward A Net Zero Commonwealth Study, August 2023; Massachusetts Clean Energy Center and Massachusetts Department of Energy Resources

Short Duration Energy Storage reaches a saturation point beyond which its ELCC drops and Long Duration Energy Storage is needed

Economics

Grid connected Battery Storage has 3 main categories of revenue –

- ❑ Capacity
- ❑ Energy Arbitrage
- ❑ Ancillary Services
 - Reserve
 - Frequency Regulation
 - Reactive Power
 - Voltage Support
 - Black Start

- ❑ Batteries can and do offer further value through –
 - Deferral of investments in transmission and distribution
 - Congestion relief
 - Enhancing transmission utilization

Current Financing Considerations

Grid connected Battery Storage has limited “contracted” revenue sources

- ✓ Capacity
- Energy Arbitrage
- Ancillary Services

- Merchant and/or hybrid projects starting to get financed
- Alternatively – there are contracts with Investor-Owned utilities
- Storage as Transmission Asset (SATA) is another business model being promoted by Utilities

Current Financing Considerations

Market design and regulation haven't caught up, but there are few bright spots worth highlighting –

- ❑ Interconnection study reform
- ❑ ITC for standalone battery storage installations
- ❑ FERC Order 841 – RTOs/ISOs were asked to craft new rules to allow storage resources to bid their services into the markets
- ❑ State Incentives/Mandates includes – California, Oregon, Nevada, Illinois, Virginia, New Jersey, New York, Connecticut, Massachusetts, New Mexico, Maine
- ❑ Federal support/grants – IIJA, OCE

Take Aways

- ❑ Battery storage will grow rapidly and fundamentally restructure the US grid
- ❑ Market participants and government entities need to work collaboratively to transition from the current market structure
- ❑ Both – Short Duration and Long Duration battery storage are needed for grid stability and reliability
- ❑ Battery storage offers a compelling value proposition for investors at a large scale for years to come – need to know and manage risks