INVESTMENT PERSPECTIVES

Capital Dynamics
TRULY INVESTED.

SEPTEMBER 2020

BATTERY STORAGE: THE NEXT DISRUPTIVE TECHNOLOGY IN THE POWER SECTOR

THE BRIGHT FUTURE

Cost competitive energy storage has arrived and is expected to transform the power landscape. The implications are profound, especially as they will accelerate the grid's transition to renewable energy.

Renewable energy projects now dominate new power generation capacity additions throughout the U.S. The limit to the replacement of thermal generation with renewable energy is the intermittent nature of wind and solar assets. Stationary battery storage is emerging as the best solution to solve this issue.

Energy storage benefits from significant global investments in electric vehicles. Large scale battery factories are being built around the world to supply the transportation sector. At the beginning of September 2020, the market capitalization of the new dominant companies in the supply chain reflected this seismic shift:

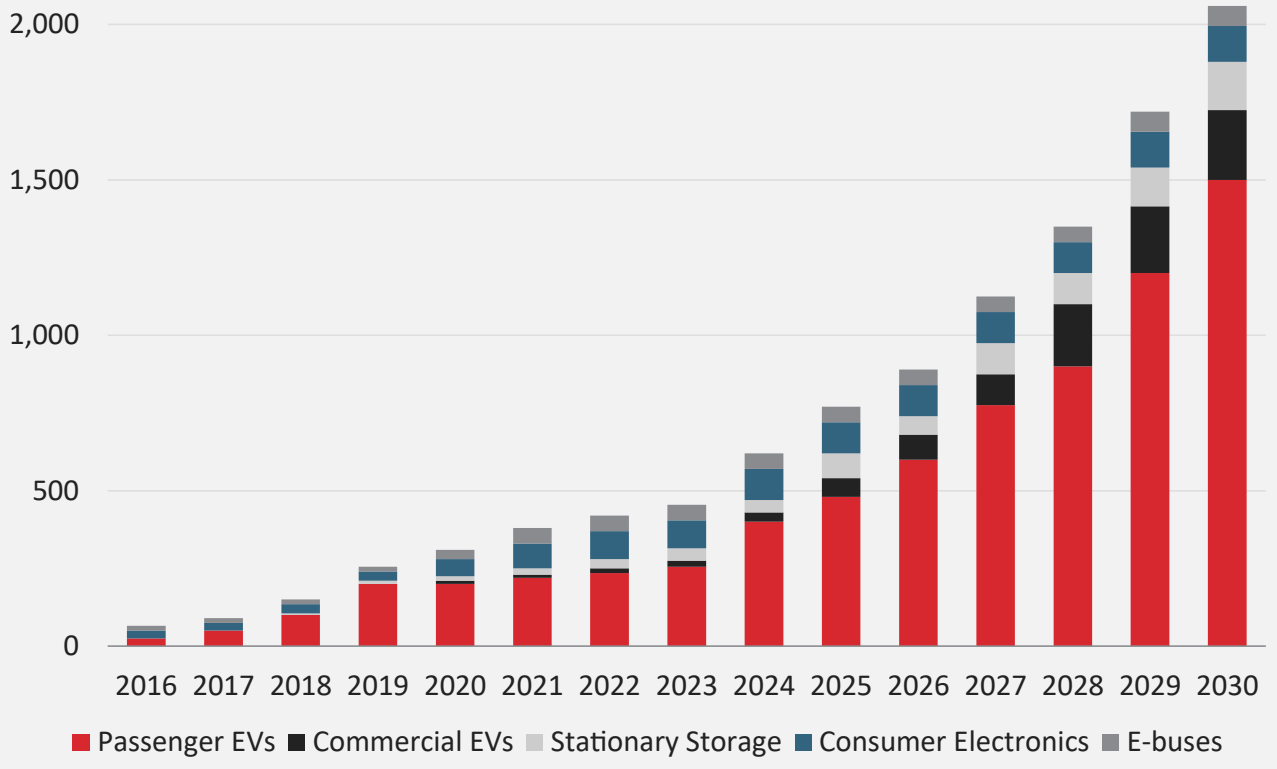
USD 35 BILLION BYD

USD 71 BILLION CATL

USD 387 BILLION TESLA

As shown in **Figure 1,** demand for stationary storage is projected to increase ten-fold between 2020 and 2030 to 155GWh and will still only represent 7% of total demand.

FIGURE 1: GLOBAL ANNUAL LITHIUM-ION BATTERY PROJECTED DEMAND (GWH)



Source: BloombergNEF, Avicenne Note: The demand outlook for consumer electronics comes from Avicenne. Commercial EVs refer to electric trucks.

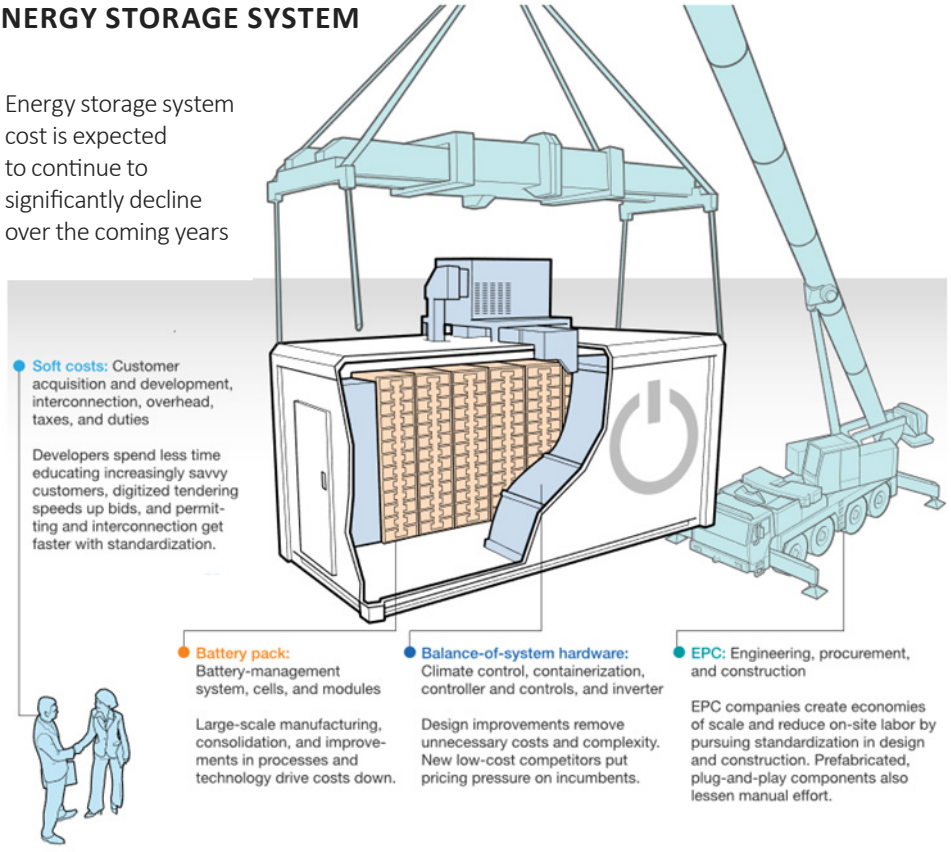
The dominant technology of choice is currently lithium-ion. While significant R&D is ongoing into evaluating alternatives (zinc hybrid, flow batteries, etc.), lithium-ion is expected to be the main solution for the foreseeable future. Within the lithium-ion family there are numerous chemistry combinations available based on the desired application. The most common chemistry has been Lithium-Nickel-Manganese-Cobalt Oxide (NMC), but most batteries are shifting to Lithium-Iron-Phosphate (LFP) due to better safety and a longer life span.

Lithium-ion batteries have experienced a tremendous drop in prices. Bain & Company notes that the cost of battery storage has plummeted by about 80% since 2010, and expects storage system costs to fall another 60% by 2030. Energy storage could put one-third of U.S. gas peaker capacity at risk from four-hour storage by the mid-2020s.

> **"According to Bain & Co, the cost of battery storage has plummeted by about 80% since 2010, and expects storage system costs to fall another 60% by 2030."**

The cost of a full system, as illustrated in **Figure 2**, was approximately $1,000/kW or $250/kWh in 2020. The industry continues to reduce costs for not only the batteries but also EPC, balance of system and soft costs.

FIGURE 2: ENERGY STORAGE SYSTEM



Source: McKinsey & Company, April 2018.

According to consultancy Wood MacKenzie, the U.S. added 430MW of large-scale and behind-the-meter energy storage in 2019, up from 311MW in 2018. A recent S&P Global Market Intelligence analysis identified over **1,500MW of large-scale energy storage planned for completion in 2020 and over 3,000MW in 2021.**

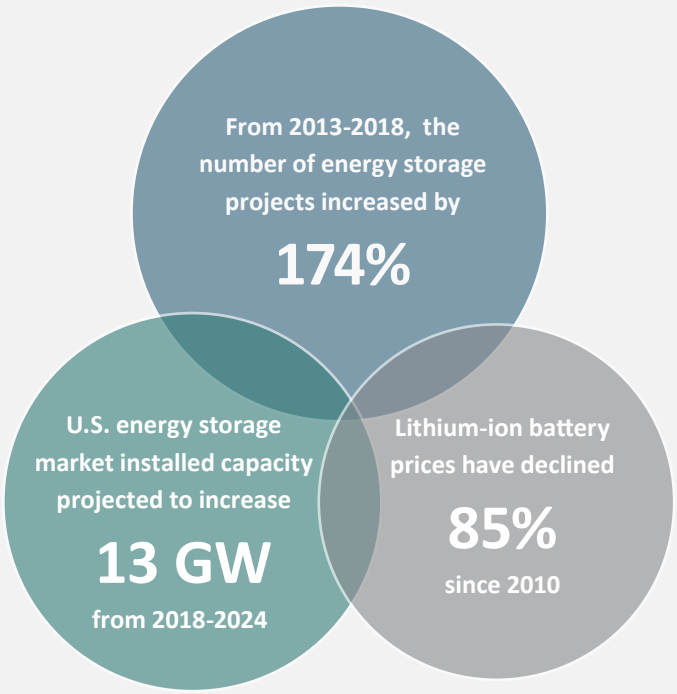
The commercial and distribution sector is quickly adopting storage for cost savings and resiliency reasons. Capital Dynamics installed its first solar + battery project at Colorado State University - Pueblo.

In the utility-scale market, investors have quickly adopted storage with numerous PPAs for "hybrid" solar + storage (new builds or retrofits).

The main application for these plants is "load shifting" (see **Figure 5** on the next page), which involves managing electricity supply and demand so that peak energy use is shifted to off-peak periods.

The table below shows notable solar + storage transactions.

FIGURE 3: WHY THE FUTURE OF COMMERCIAL BATTERY STORAGE IS BRIGHT



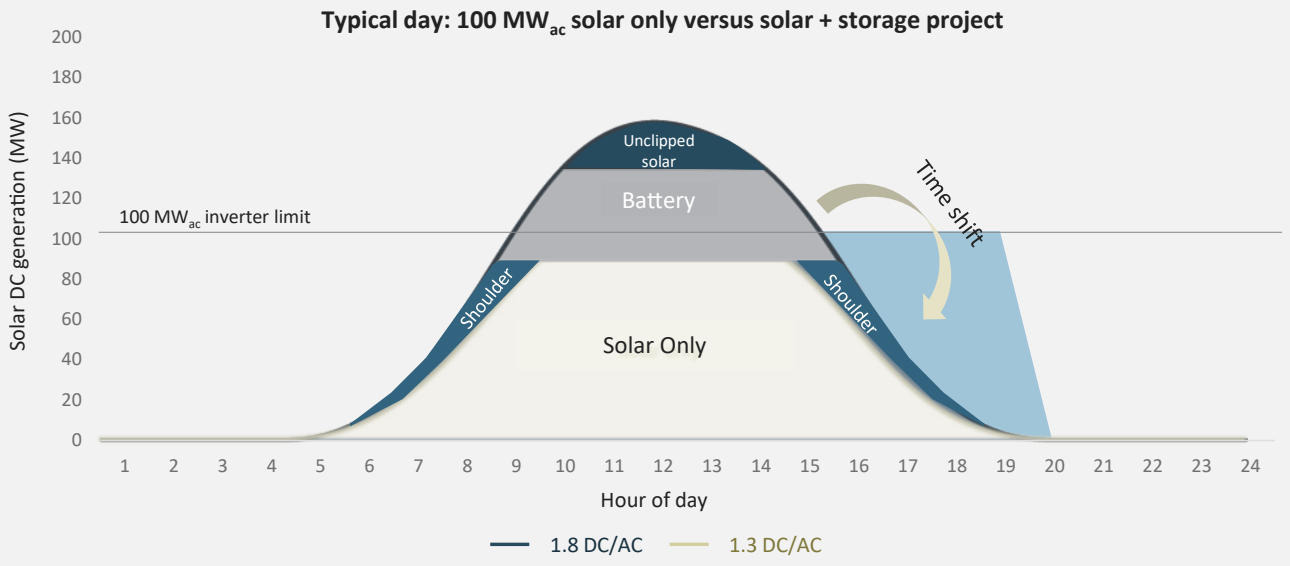
Source: McKinsey & Company, April 2018.

FIGURE 4: NOTABLE SOLAR+STORAGE TRANSACTIONS

Project	Solar (MW)	Storage (MWh)
GEMINI	966	1,500
ELAND*	710	1,200
MCCOY	620	920
SOUTHERN BIGHORN	450	540
ARROW CANYON	260	375
TOWNSITE*	240	360
MANATEE	200	900

* Capital Dynamics Assets.
Source: Greentechmedia.com.

FIGURE 5: LOAD SHIFTING



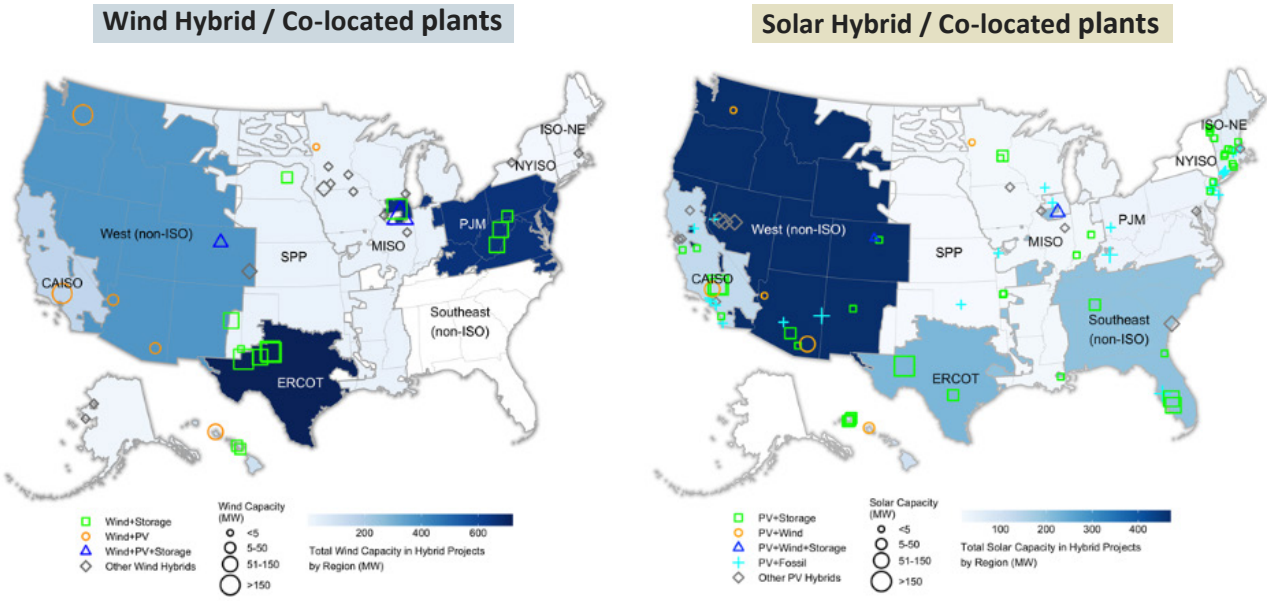
Source: Capital Dynamics.

The combination of solar with a 4-hour battery sized at 50% or less of solar capacity offers a competitive solution for numerous power purchasers. Considering the overexposure to solar delivery ("duck curve") in the middle of the day and the need for renewable energy in the evening, we expect that more and more projects in Western Electricity Coordinating Council (WECC) region will combine solar and storage.

The largest renewable energy investor in the U.S. - NextEra - contracted 6.0GWh of storage projects throughout the U.S. and plans to spend $1bn in 2021 alone in storage. Capital Dynamics is building 2.9GWh of contracted storage and is developing 7.8GWh of new standalone projects.

> **"BATTERIES ENABLE HYBRID PLANTS WITH 'SHAPED' OUTPUT AND INCREASED THROUGHPUT."**

FIGURE 6: ONLINE WIND AND SOLAR HYBRID / CO-LOCATED PROJECTS AT THE END OF 2019



Source: Berkley Labs.

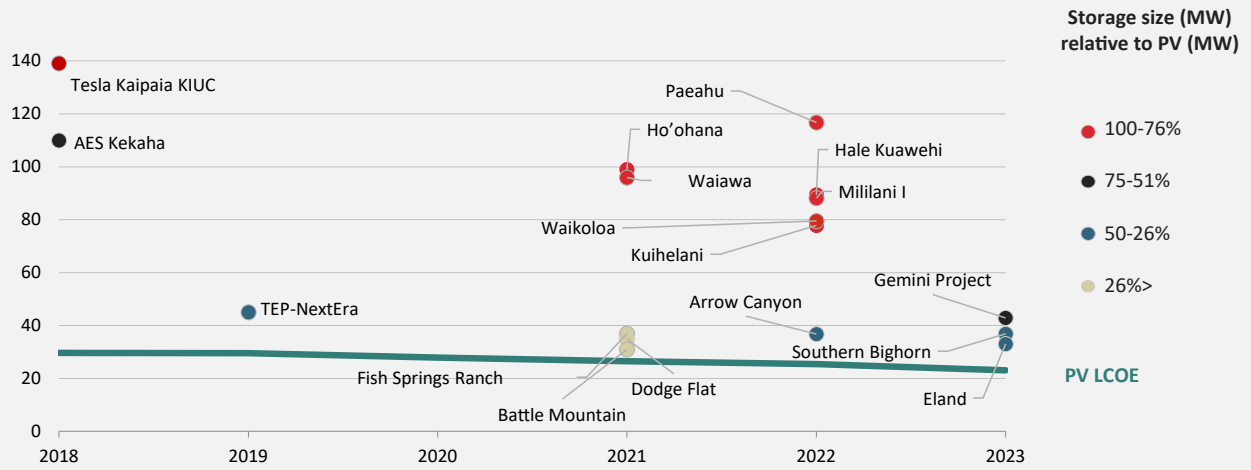
Within the U.S., specifically, one of the reasons co-location of storage is more frequently planned with solar over wind is the ability of solar to pair more effectively with storage, as evidenced in **Figure 7** by more attractive generation capacity ratios and in markets where investors see the most compelling economic opportunities, such as California Independent System Operator (CAISO). Based on interconnection queue filings at the end of 2019 developers in standalone storage are targeting the following markets: CAISO (15.5GW), NYISO (6.8GW), PJM (6.1GW), PacifiCorp (3.0GW) and APS (2.1GW).

FIGURE 7: GENERATION CAPACITY RATIO OF STORAGE

	Wind + Storage	Solar + Storage
CAISO	25%	78%
ERCOT	54%	38%
SPP	23%	38%
NYISO	7%	49%
COMBINED	**27%**	**66%**

Source: Berkley Labs.

FIGURE 8: $/MWH FOR PV-PLUS-STORAGE PROJECTS (4-HOUR DURATION)



Source: Bloomberg New Energy Finance.

The market for standalone storage projects is also growing rapidly, spurred by long-term resource adequacy (RA) contracts, which provides a long-term capacity payment for energy storage.

In June 2020 the Public Utility Commission approved the creation of a Central Procurement Entity (CPE) to conduct a competitive, all-source solicitation for local resource adequacy. The CPE will buy on behalf of all investor-owned utilities (IOUs) and Community Choice Aggregators (CCAs), thereby streamlining the process.

FIGURE 9: GENERATION CAPACITY RATIO OF STORAGE

Project	Peak Capacity (MW)	Total Capacity (MWh)
VISTRA MOSS LANDING	300	1,200
ALAMITOS	300	1,200
GATEWAY	250	1,000
TESLA MOSS LANDING	182.5	730
SATICOY*	100	400
LUNA	100	240
COSO*	60	240

*Capital Dynamics Assets.
Source: S&P Global – March 2020, GTM – April 2020.

REVENUE

Hybrid plants using storage for load shifting generally have traditional PPAs with ($/MWh or $/kW-mo) capacity contracts. Some storage projects have tolling contracts, in effect allowing the customer to use the facility at its discretion. Standalone contracts can also adopt a revenue model with a combination of contracted revenues and market based revenues.

Batteries can derive revenues from multiple stacked revenue sources. We can use the following example of a grid operator in California (CAISO) with three sources of revenue:

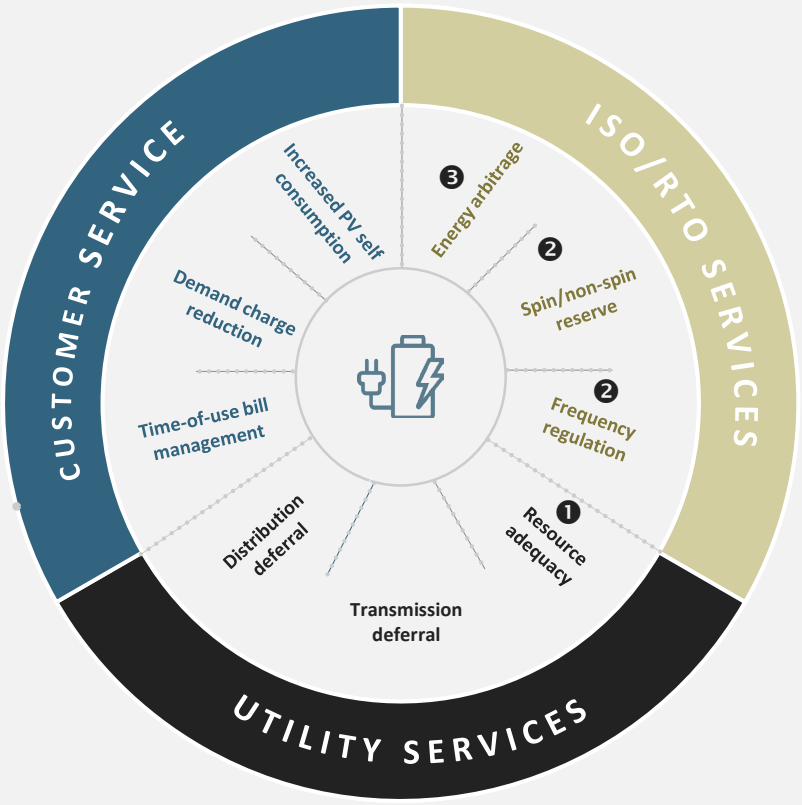
1. Long-term contract with utilities or CCAs for resource adequacy (~80% MOIC)

2. Merchant revenues from ancillary services (frequency regulation, spin)

3. Energy arbitrage (charge when prices are low - discharge when prices are high)

Storage has the ability to provide various services for different users. **Figure 10** shows the value-add of storage for asset owners, energy providers and independent system operators (ISO) and regional transmission organizations (RTO). For grid operators such as CAISO, storage increases reliability and resilience of the power supply. For energy providers, storage provides new revenue, improves customer satisfaction and reduces cost. For asset owners such as Capital Dynamics, storage generates new revenue and reduces cost which improves return on investment (ROI).

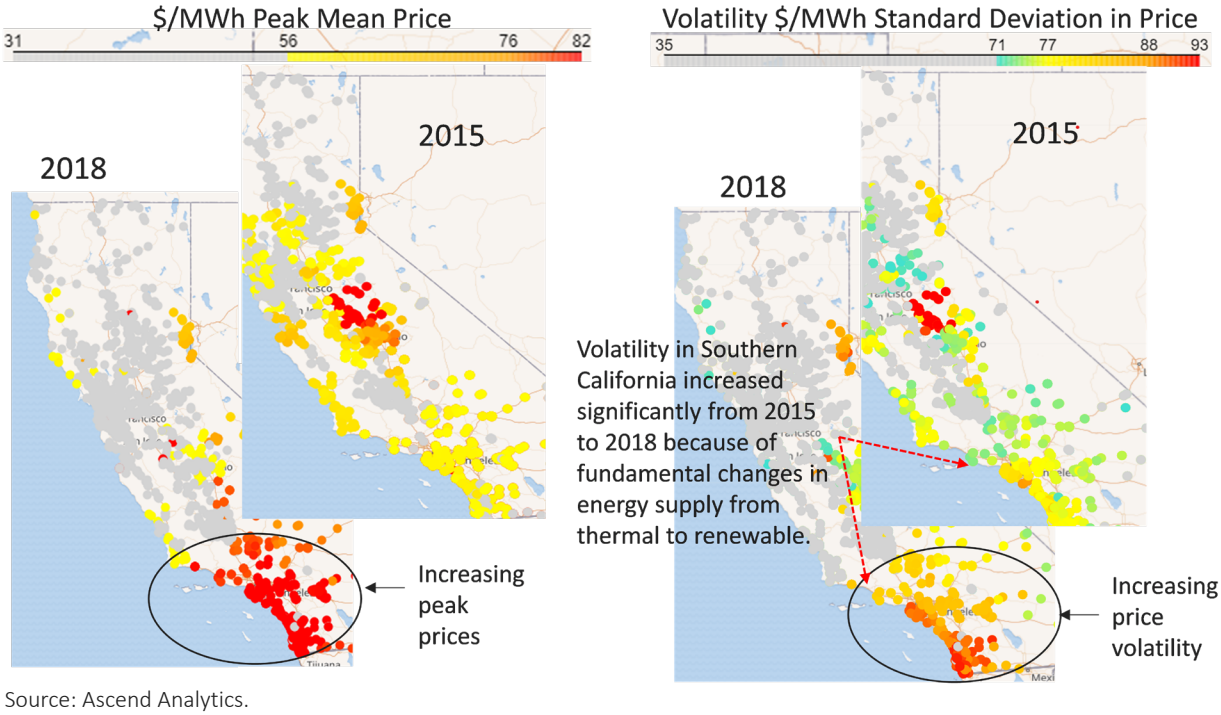
FIGURE 10: MULTIPLE STACKED REVENUE STREAMS



Source: Capital Dynamics.

Standalone storage projects can benefit from price volatility in the wholesale market due to the increase in intermittent resources (solar, wind, etc.) and natural events (heatwaves, fires, earthquakes, etc.). The coastal area will experience increased volatility as local thermal generation retires and is replaced with solar located inland. **Figure 11** below illustrates the energy arbitrage opportunity. The recent August 2020 blackouts in California, with peak energy prices of $1,000/MWh, demonstrate the need for rapid deployment of energy storage to replace thermal generation. Storage is expected to mitigate this risk in the future.

FIGURE 11: PRICE VOLATILITY IN CAISO



Source: Ascend Analytics.

TECHNOLOGY

A project's success depends on the integration of the control software of the battery with the remote monitoring system and the company selected for energy management sending charging / discharging orders based on market conditions.

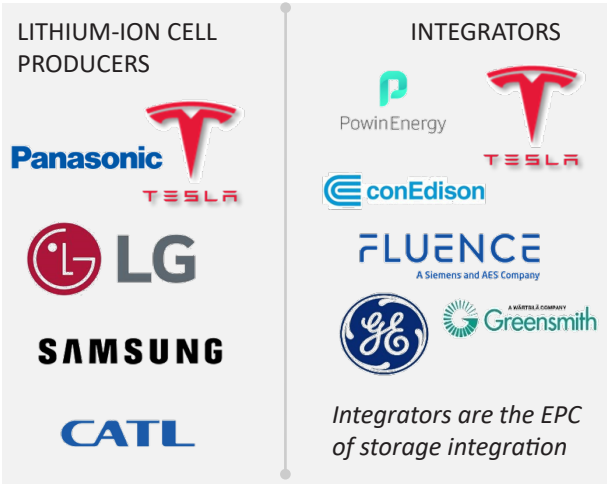
Small footprint
While a 100MW solar project will require approximately 650 acres, a 100MW / 400MWh energy storage system will only need 3 acres. Compared to a natural gas peaker plant, utility-scale battery storage units take up about 40% less space, are easier to permit, are cleaner, and in many cases, are just as effective.


Photo: Capital Dynamics SpringBok 3 Solar + Storage facility.

Suppliers
An energy storage system is composed of three components:

1. Battery cells
2. Balance of plant (cooling system, electronics
3. Control system

A system integrator will assemble and supply the three components and provide guarantees and long-term contractual services. The credit quality of the system integrator is critical. It is also important to carefully negotiate the supply and O&M contracts. Capital Dynamics spent several months designing proprietary contracts with favorable terms and conditions.



A project's success depends on the integration of the control software of the battery with the remote monitoring system and the company selected for energy management sending charging / discharging orders based on market conditions. Most battery projects are developed and owned by experienced investors with proven asset management capabilities, including remote monitoring. Capital Dynamics and its affiliate Arevon Energy has a dedicated storage team keeping up with all technology advancements in battery storage.

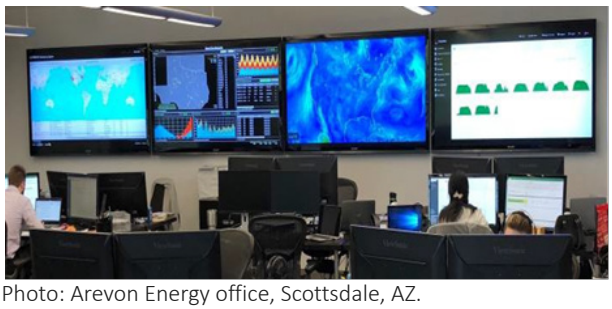


Photo: Arevon Energy office, Scottsdale, AZ.

CONCLUSION

As one of the largest owners of solar, years ago Capital Dynamics identified storage as a dramatic need, and we made a dedicated effort to hire battery storage experts in order to prepare and take advantage of this market opportunity.

This thesis has proven to be true, as solar projects paired with storage are expected to have very high effective load carrying capability, meaning they can ensure the grid remains reliably supplied with power, and standalone storage opportunities also exist in certain markets.

Battery storage technology will continue to improve and disrupt the power market, so it is critical that investors partner with experienced managers who have made efforts to become experts in this space and have proven their capability to invest in storage projects.

CAPITAL DYNAMICS – CLEAN ENERGY INFRASTRUCTURE (CEI)

CEI is one of the largest renewable energy investment managers in the world with USD 6.5 billion AUM,[1] and has one of the longest track records in the industry.

The CEI strategy was established to develop renewable energy infrastructure technologies, with a focus on utility scale and distributed generation solar, wind and storage. The CEI platform's dedicated asset management business provides highly-specialized services to seek to ensure optimal performance and value from projects. The CEI strategy currently manages 7.3 GW of gross power generation across more than 150 projects in the United States and Europe,[2] and is one of the top 3 global solar PV owners.[3]

Since the CEI platform's inception in 2010, over 16 million metric tons of greenhouse gas emissions have been avoided as a result of the firm's renewable investments.[4] This is equivalent to the power needed to supply more than 3 million homes or passenger vehicles for one year.

In 2020, Capital Dynamics was awarded the highest rating (A+) from the UN-supported Principles for Responsible Investment for its CEI strategy. In 2019, the CEI strategy received top rankings from GRESB (the ESG benchmark for real assets) for commitment to sustainability, and was awarded Global Energy PE Firm of the Year by Private Equity International. For more information, please visit: www.capdyn.com.

PRI Principles for Responsible Investment A+
Awarded in 2020 for "Direct Infrastructure"

GRESB
INFRASTRUCTURE
Sector Leader 2019

Private Equity International
AWARDS 2019
Energy private equity firm of the year

S&P GLOBAL PLATTS
GLOBAL ENERGY AWARDS
2019 WINNER

[1] Capital Dynamics as of June 30, 2020. Includes assets in renewable energy projects managed by Capital Dynamics, including USD 4.1bn assets under discretionary management and USD 2.4bn tax equity assets. Tax equity is a financing solution for renewable energy projects. Capital Dynamics makes no representation as to future size or growth of the CEI program.
[2] Capital Dynamics, as of June 30, 2020. Includes operational assets, partially commissioned assets and contracted assets with PPAs secured.
[3] Renewable Assets (Owners) League Tables. Bloomberg New Energy Finance as of June 30, 2020. Includes (i) assets with financing secured / under construction, (ii) partially commissioned assets, and (iii) commissioned assets projects globally, excluding China.
[4] Environmental benefits are based on U.S. Environmental Protection Agency Greenhouse Gas Equivalencies Calculator.

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ABOUT CAPITAL DYNAMICS

Capital Dynamics is an independent global asset management firm focusing on private assets including private equity, private credit, and clean energy infrastructure. Capital Dynamics offers a diversified range of tailored offerings and customized solutions for a broad, global client base, including corporations, family offices, foundations and endowments, high net worth individuals, pension funds and others. The firm oversees more than USD 17 billion in assets under management and advisement.[5] Capital Dynamics is distinguished by its deep and sustained partnerships with clients, a culture that attracts entrepreneurial thought leaders and a commitment to providing innovative ideas and solutions for its clients.

Capital Dynamics' roots go back to 1988, the year our predecessor (Westport Private Equity) was founded in the UK. Our headquarters were established in Zug, Switzerland in 1999. The firm employs approximately 160 professionals globally and maintains offices in New York, London, Tokyo, Hong Kong, San Francisco, Munich, Milan, Birmingham, Dubai and Seoul.

In 2020, Capital Dynamics was awarded the highest rating (A+) from the UN-supported Principles for Responsible Investment for (i) Strategy & Corporate Governance, (ii) private equity strategy, and (iii) clean energy infrastructure strategy. For more information, please visit: www.capdyn.com

[5] As of June 30, 2020.

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