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Energy Storage Global Deployment Overview

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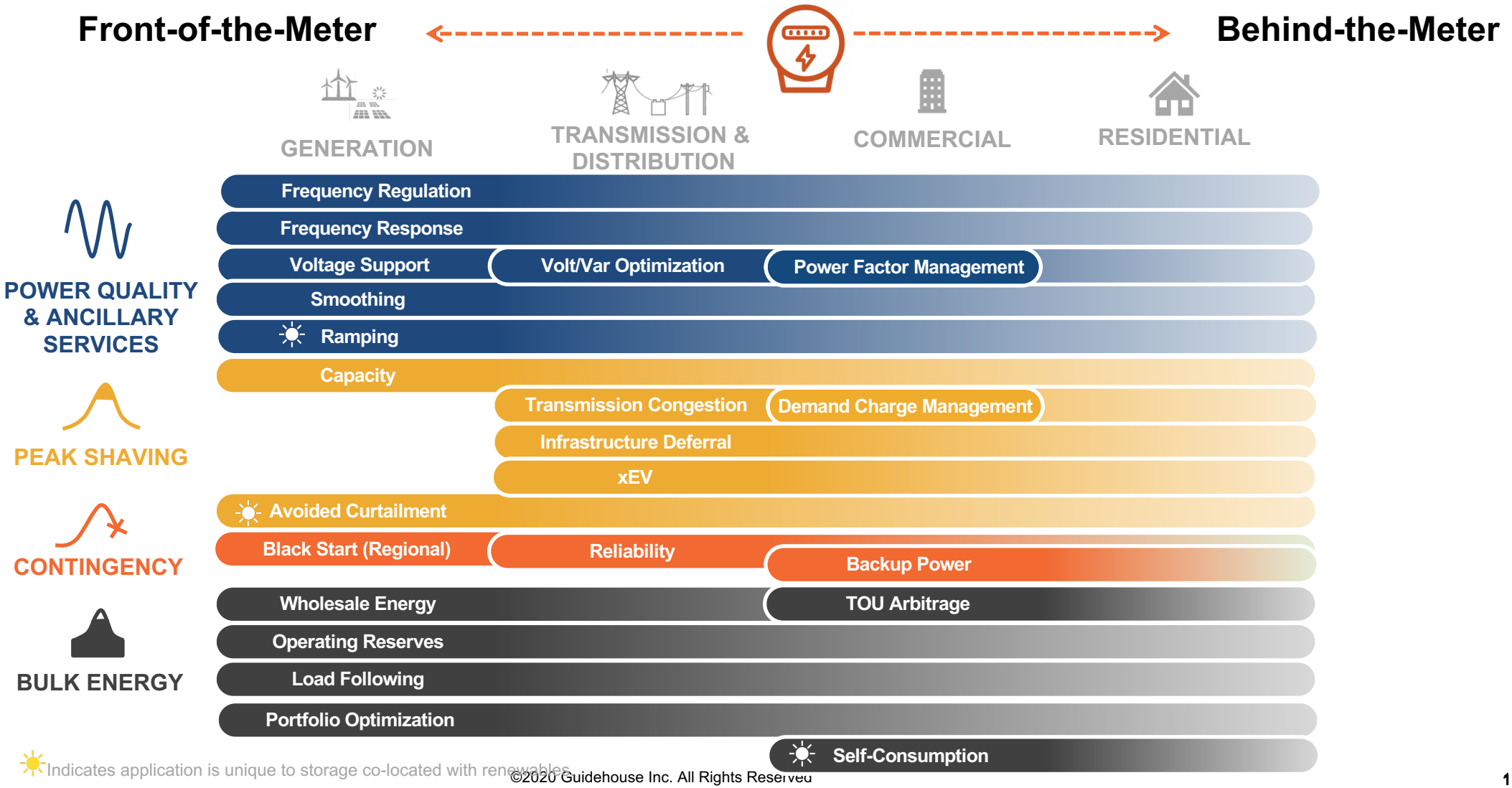
Guidehouse Insights

January 12, 2021

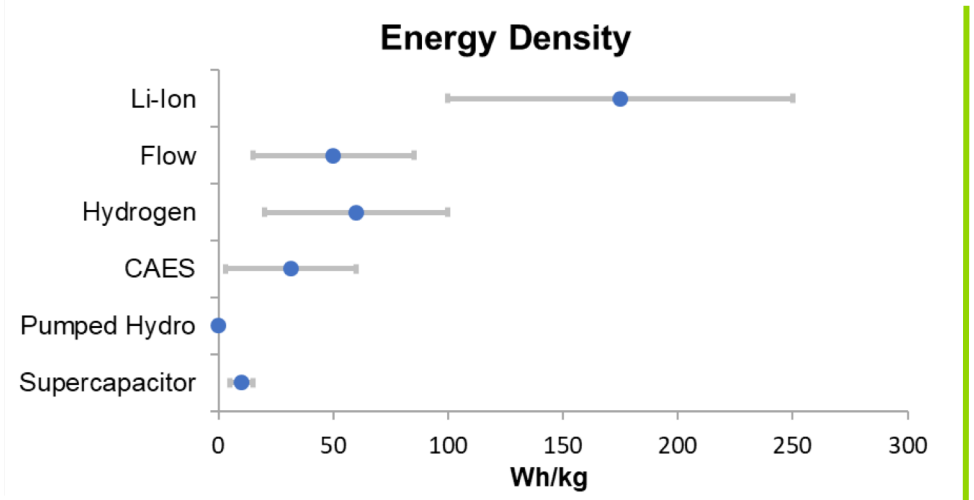
Energy storage applications stack to build a use case

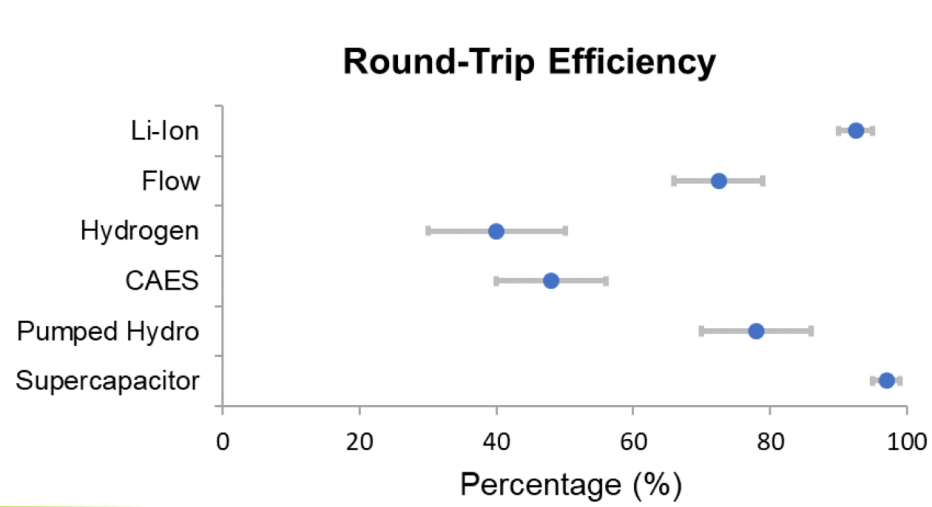


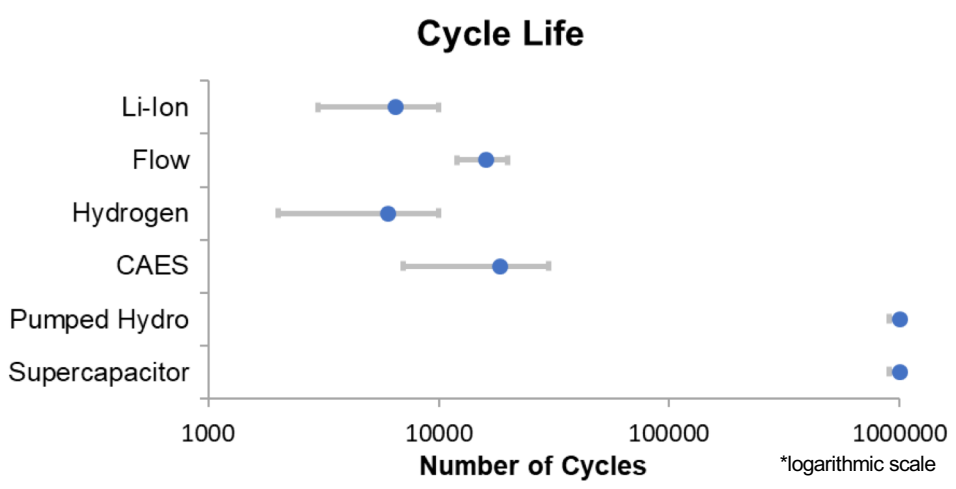
Indicates application is unique to storage co-located with renewables

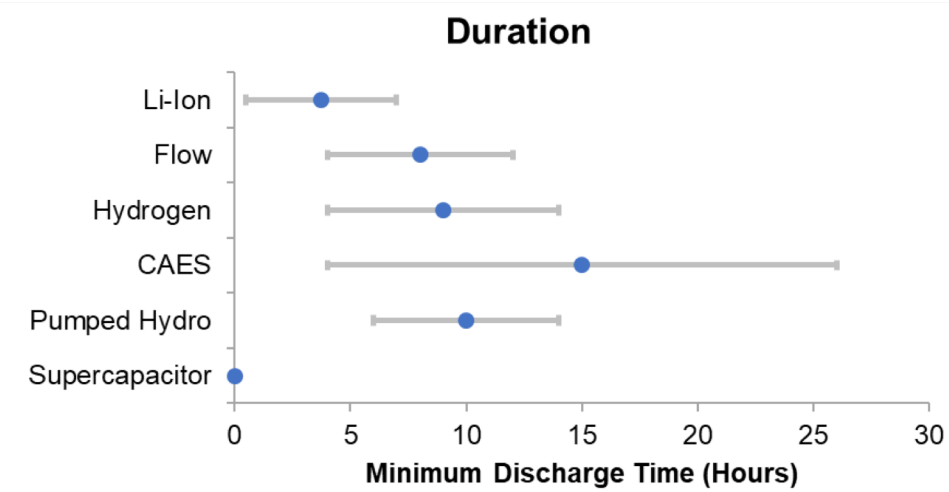
Comparison Between Selected Storage Technologies

Performance Metrics









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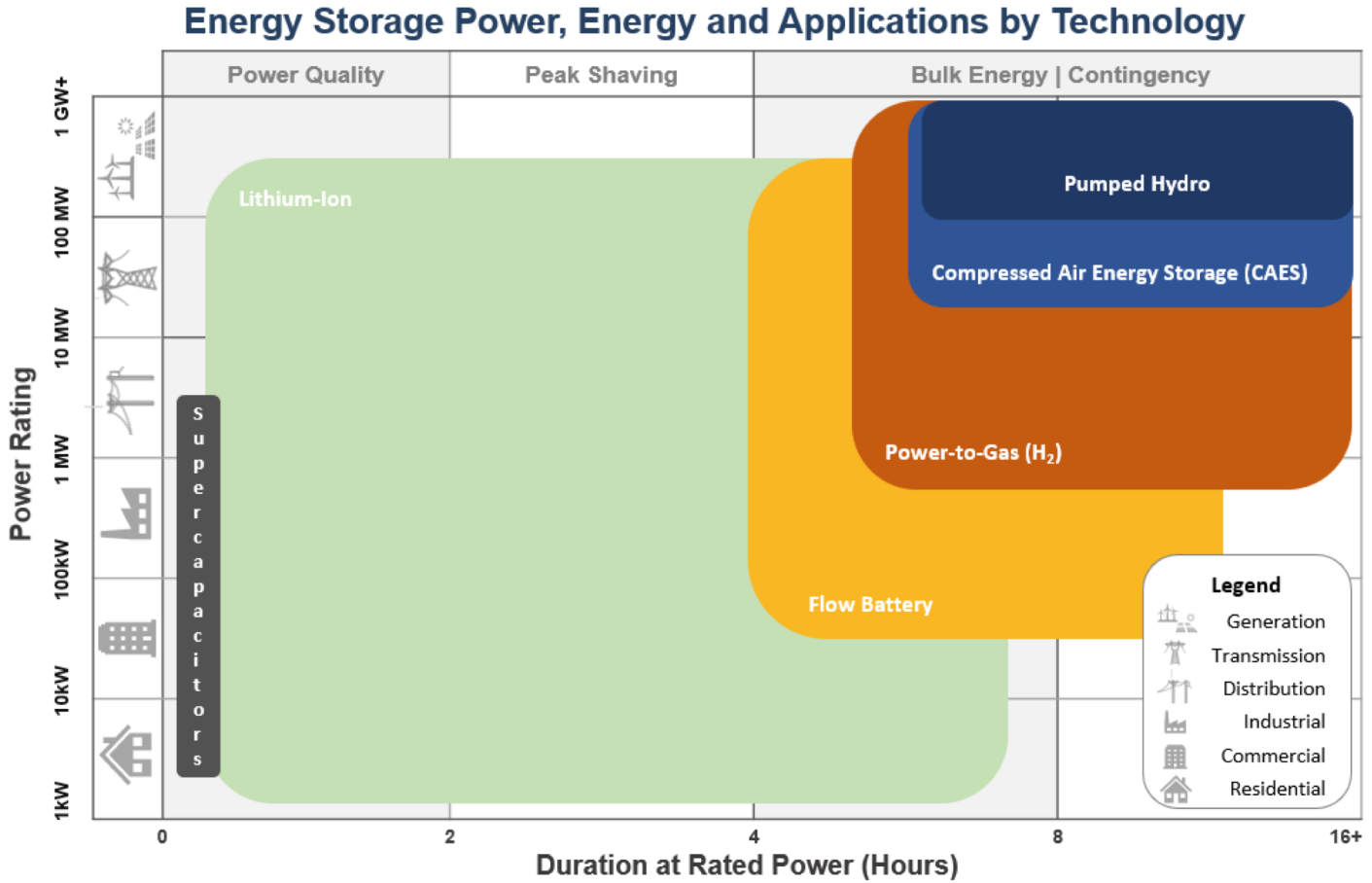
Mapping Storage services and Technologies

Mapping by Power and Duration Requirements

- The selected technologies can be mapped based on their commercially viable power rating and duration at rated power.
- Most technologies are suitable for services within Bulk Energy and Contingency. Lithium-ion can be used for most types of storage services.
- The power rating of CAES and Pumped Hydro storage is usually very high (>10MW). Power to Gas and Flow battery projects start from industrial scale (>100kW). Lithium-ion and Supercapacitors have a wide range of power rating, from residential (>1kW) to industrial and beyond.
- Supercapacitors are only applied commercially for Power Quality services.



Distributed Energy Storage Cost, Capacity and Revenue Forecasts

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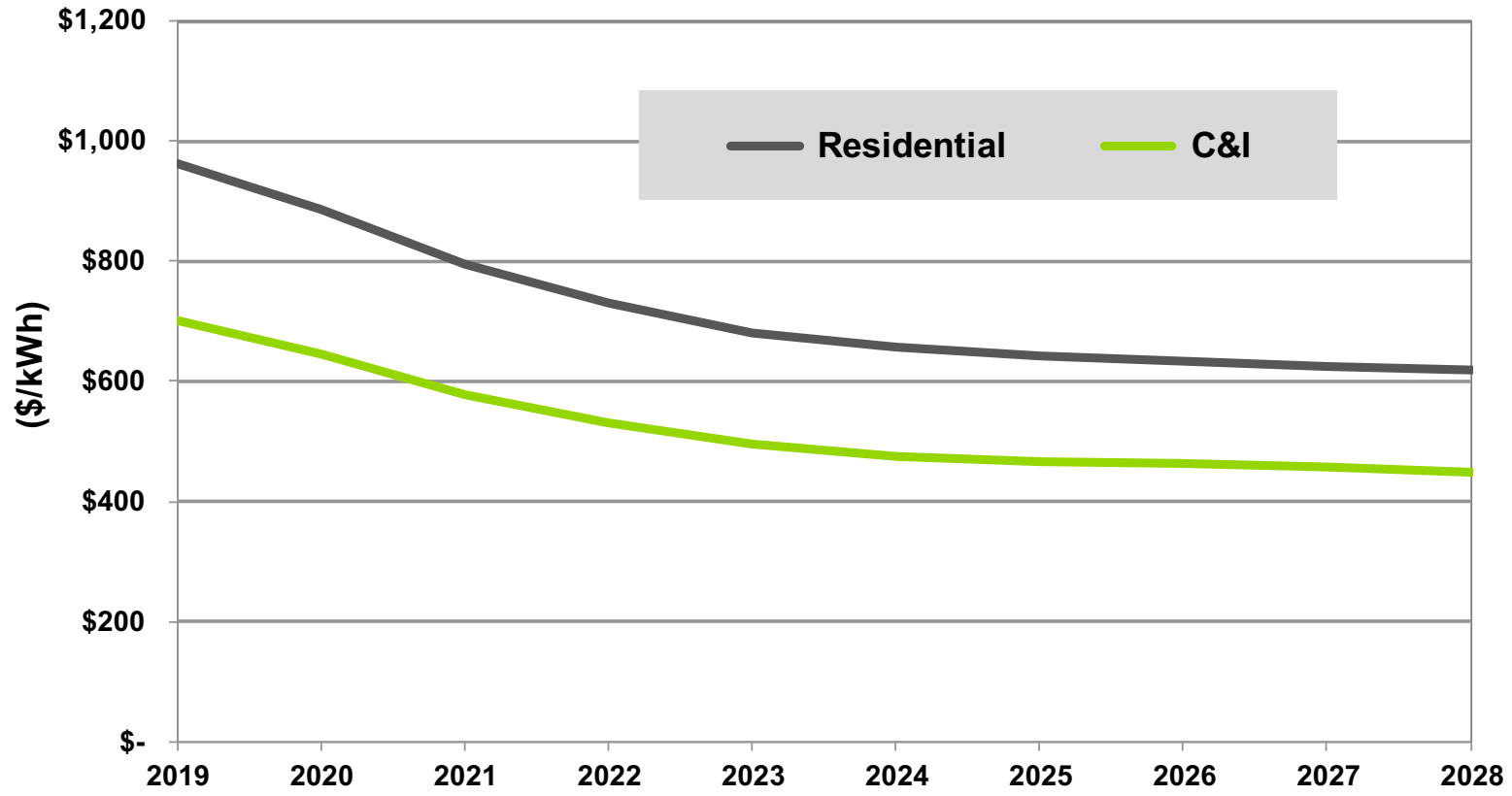
Energy Storage Project Cost Component Definitions

- **Battery Pack**: Includes battery cells, modules, pack battery management systems (BMSs), and racks. Average pricing assumes either NMC, NCA, or LFP cells
- **Power Conversion System (PCS)**: Includes inverter/PCS
- **Energy Management Software**: Include grid interactivity, energy management system, and monitoring; pricing varies depending on complexity of project operation
- **Balance of System**: Includes HVAC, fire suppression, auxiliary power, containers, and additional hardware and electrical balance of systems (BOS) such as transformers, switchgear, cabling, grounding equipment, meters, and fuses/breakers
- **Systems Integration**: Services to design and fully commission system, including calibration and testing of software, hardware, and communications and safety systems. System integration services are not a separate item for C&I projects as many C&I systems are pre-configured products without the same level of customization as utility scale
- **Site Installation**: Goes to the engineering, procurement, and construction contractor; includes preparing the site, clearing land, pouring concrete pad/foundation; enclosing construction if needed; and handling electrical engineering
- **Project Development Fees**: Include interconnection management, margin, land acquisition, and permitting

Distributed Energy Storage Application Costs Curves

DESS CAPEX Assumptions by Segment, Average Installed Costs, World Markets: 2019-2028

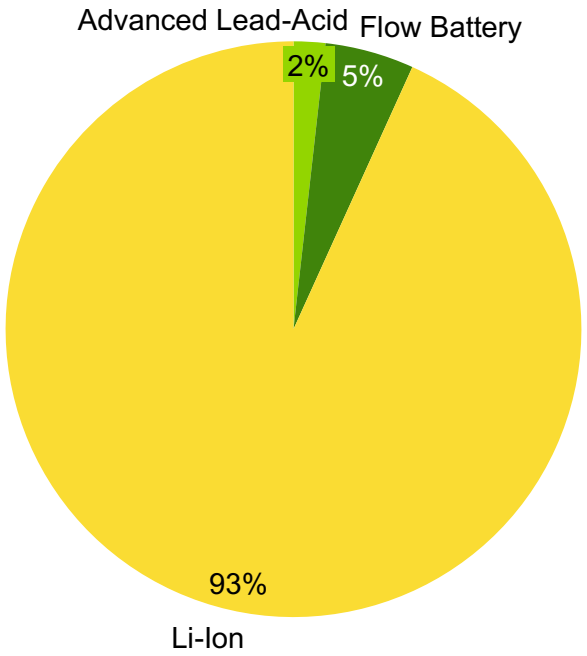


(Source: Guidehouse Insights)

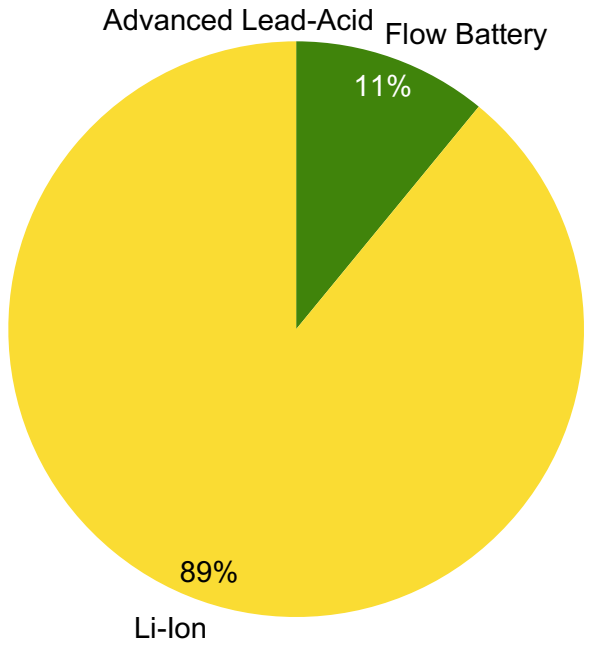
Long Term Technology Trends

Behind-the-Meter

2020 Market Share by Technology, World Markets



2029 Market Share by Technology, World Markets

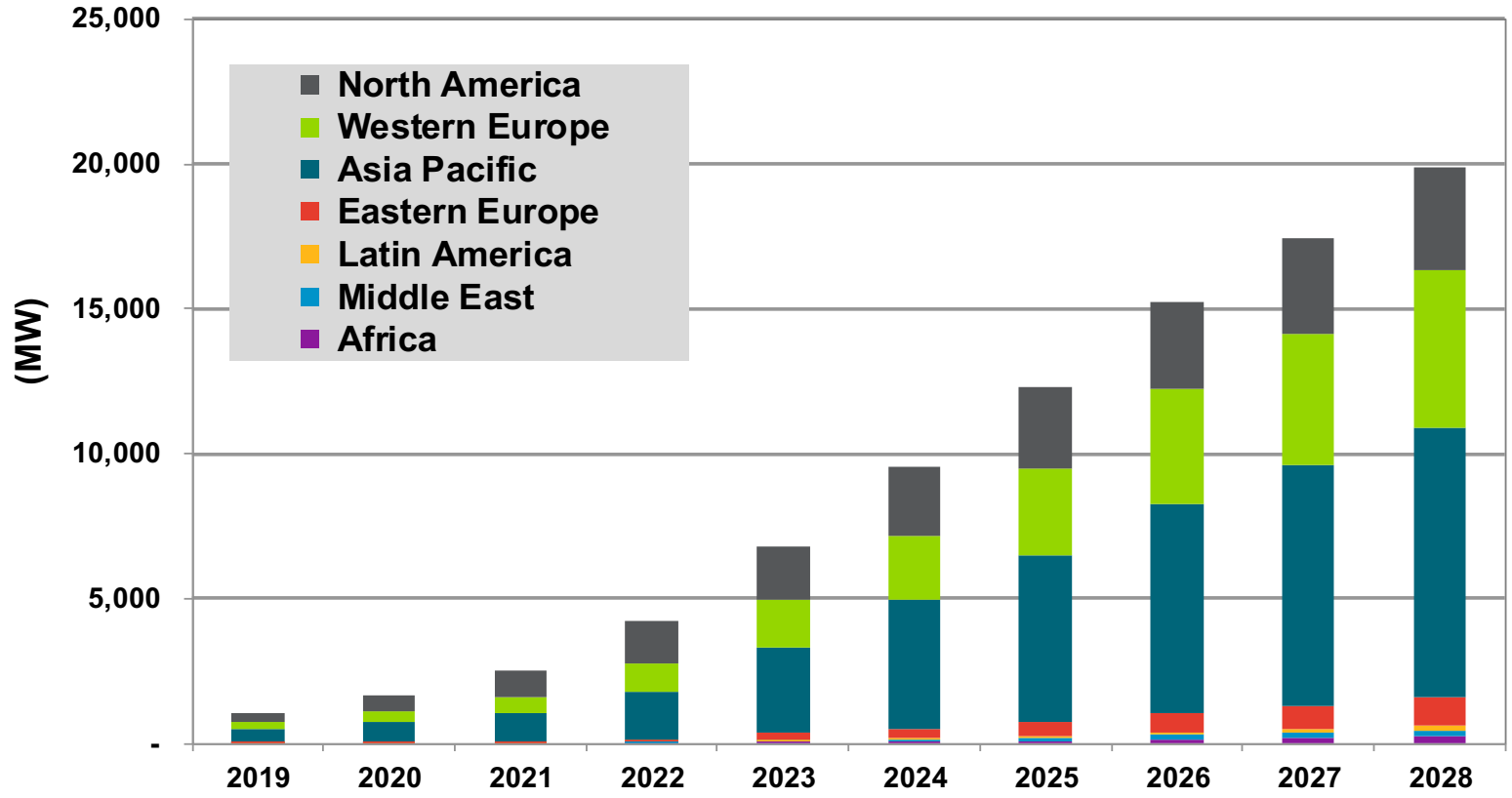


- The behind-the-meter market is comprised only of battery technologies. Here Li-ion is by far the dominant technology, accounting for 93% of the market in MW terms in 2020
- Legacy advanced lead-acid technology remains common for some residential applications and off-grid systems
- Flow batteries are gaining traction in areas where safety is a major concern for customers

- By 2029 Li-ion batteries continue to account for nearly all new projects, with 89% market share
- Flow batteries are projected to account for a growing portion of the market due to safety concerns, reaching 11% market share by 2029
- Advanced lead-acid is expected to see little to no development past 2025 due to low cycle life and falling costs for Li-ion and flow batteries

Distributed Energy Storage Regional Growth Trends

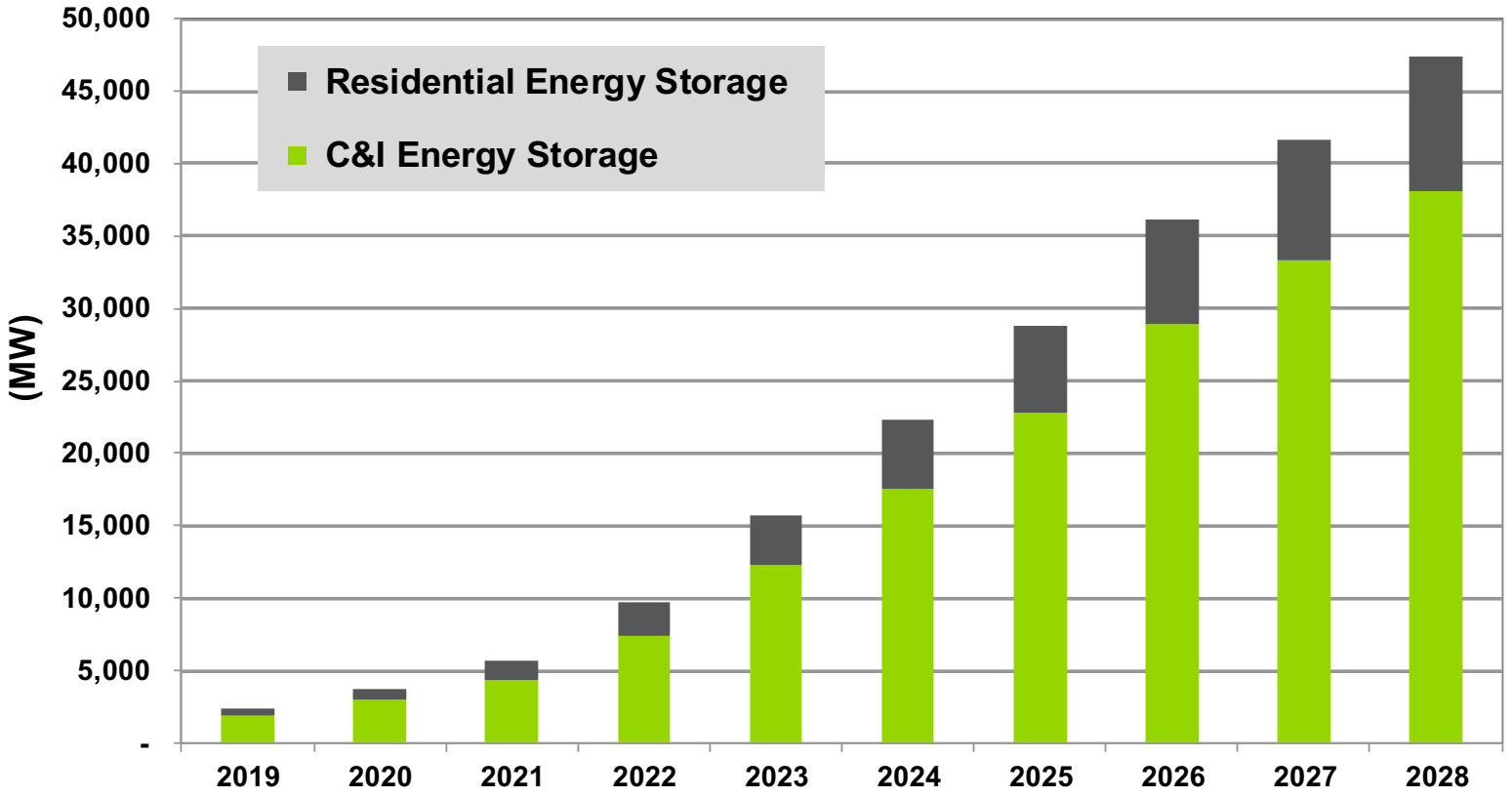
Annual Installed Distributed Battery Energy Storage Power Capacity Additions by Region, World Markets: 2019-2028



(Source: Guidehouse Insights)

Distributed Energy Storage Growth Trends by Segment

Annual Installed Distributed Battery Energy Storage Power Capacity Additions by Segment, World Markets: 2019-2028



(Source: Guidehouse Insights)

Energy Storage for Microgrids

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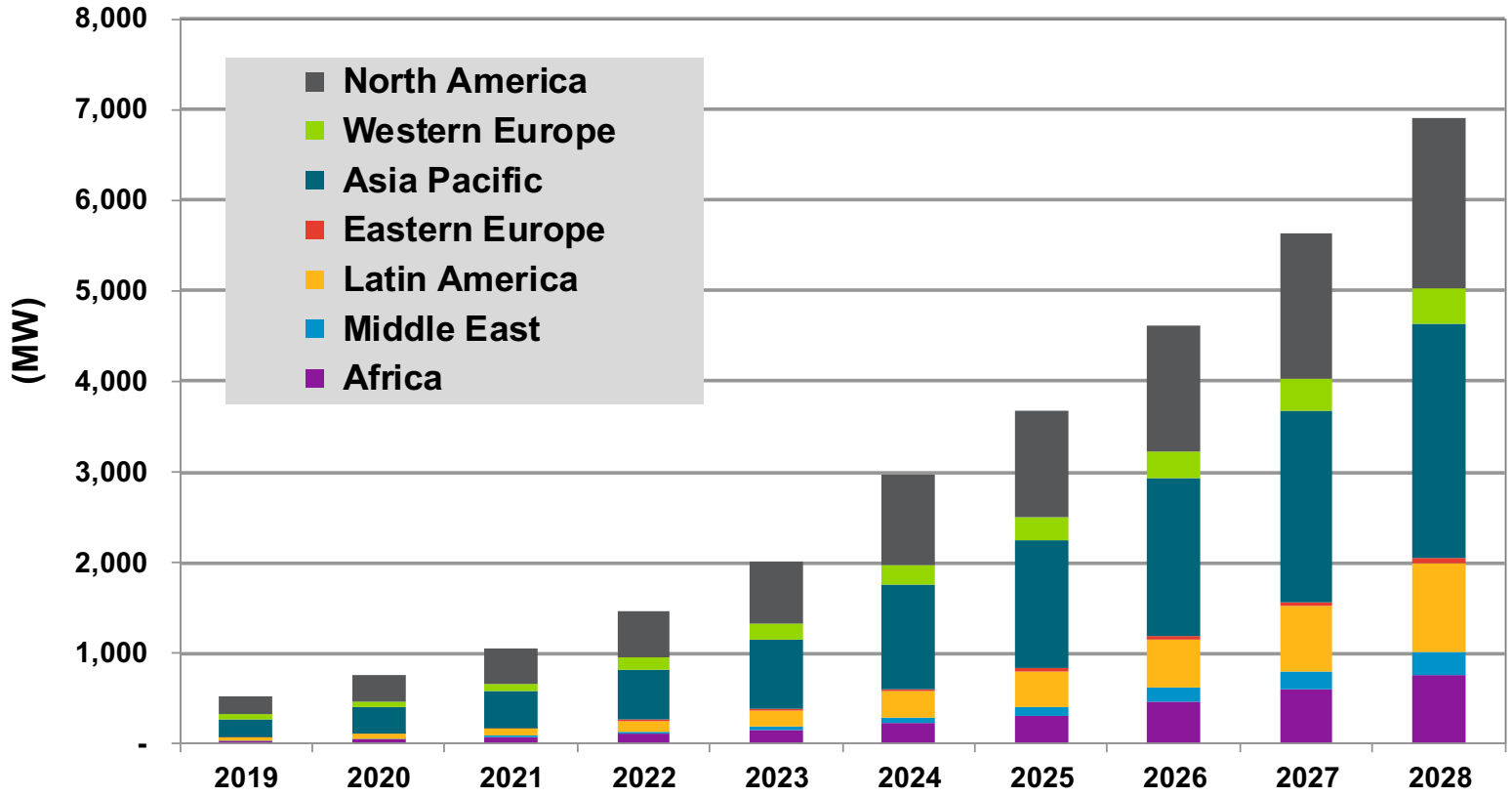
Energy Storage for Microgrids Growth Trends

Annual Installed Distributed Microgrid Energy Storage Power Capacity Additions by Region, World Markets: 2019-2028



(Source: Guidehouse Insights)

Energy storage increases market share over time

Global energy storage DER market share for microgrids grows from 18.7% today to 37.5% by 2029.

Contact

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