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Full Charge

The energy we use today is dependent on our ability to store it in areas such as underground natural gas reservoirs, fuel tankers or hydro dams. However, as our sources of power generation change (from coal and natural gas towards wind and solar) so will the way we store energy. In this piece, we highlight the main demand sources for batteries (particularly the lithium ion battery, or LiB), demand drivers for energy storage, alternative energy storage technologies as well as ways to invest in the space.

Sources of Energy Storage Demand

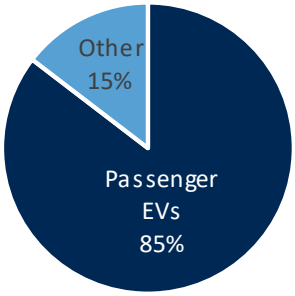
- **Vehicles.** In ten years, almost 85% of LiB demand is expected to come from the production of cars and trucks. There remains plenty of room for growth in the space given that electric vehicle (EV) penetration rates remain low as an overall portion of global auto sales – only 0.5% as at 2018. However, auto makers are increasingly embracing the technology as well as ramping up investments in the space.
- **Power grid.** Renewables like wind and solar plants are intermittent, meaning they are not available all the time (i.e. solar and wind power are not available when there is no sunshine or no wind blowing). Batteries will help grid operators smooth out power supply from wind and solar sources so that any excess production gets stored for sale during peak-demand when power prices are highest.
- **Homeowners and businesses.** Residential and commercial consumers looking to take advantage of local incentives as well as avoid peak-demand electricity may become more interested in LiB. Usage of batteries here is similar to that by grid operators so that any excess production is stored and used during peak-demand or sold back to the grid when prices are higher.

Demand Drivers for Batteries

Given that we live in a world that is seemingly moving towards cleaner fuels, be it from the way we generate our electricity to the cars we drive, we believe energy storage demand powered by LiBs will continue to grow particularly as battery prices decline, governments mandate energy storage targets and offer incentives.

- **Getting cheaper.** Prices for LiBs are declining as battery suppliers bring new production capacity online by building larger factories. While most capacity will remain in China, the world's largest plant (named the Gigafactory), will be built by Tesla (TSLA-US) in the US with an expected capacity of 35 GWh by 2020 and 105 GWh by 2023. Amid the increased capacity, battery prices are expected to drop by almost 50% in four years, not only as a result of economies of scale, but also due to improved manufacturing productivity and advancements in technology as producers improve LiB energy density (more energy stored). As a result of declining battery prices, the cost of

LiB Demand by 2030



Source: Bloomberg, Raymond James Ltd. Other = e-buses, consumer electronics and stationary storage.

Future Grid Powered by Batteries



Source: Shutterstock, Inc.

Batteries at Home



Source: Shutterstock, Inc.

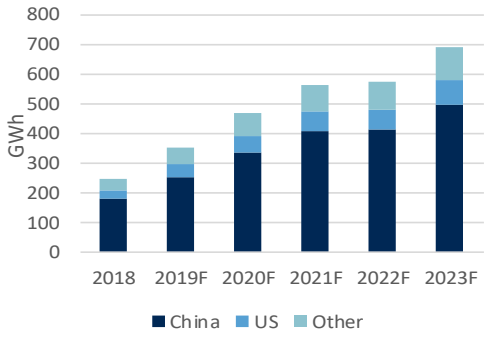
installing residential battery storage is also expected to decline with some expecting the cost to get to $336/kWh by 2025 from $778 in 2017. The price decline is expected to come with a jump in demand with new global residential energy storage set to reach 6.1 GWh by 2025, or a 319% increase from 2018. For utilities, the cost of energy from renewables using batteries is expected to fall below the cost of using natural gas turbines by 2023. In fact, even the US Energy Information Administration's 2020 Annual Energy Outlook expects renewables to account for 38% of electricity generation by 2050 (versus 31% expected in last year's outlook) while natural gas to reach 36% (vs. 39% last year).

- **Targets.** Governments around the world plan to move away from fossil fuels in order to reduce their carbon emissions and be in line with their Paris Accord targets. The EU targets 35% of its power generation to come from renewables by 2030; China targets 35%; India targets 40%; Canada, which currently generates 17.3% of its power from renewables expects to be carbon neutral by 2050. We expect such targets to continue boosting demand for renewables and, in turn, the need for energy storage. In the US, many states have mandated energy storage targets for the future: California mandated 1.3 GW by 2020 and an additional 1.8 GW by 2024; New York, New Jersey, Massachusetts and Oregon have mandated an additional 6 GW by 2030; Arizona may target 3 GW by 2030.
- **Incentives.** Governments are also offering incentives to those investing in renewables and integrating energy storage either at home, on commercial sites or within the grid. In North America, the US leads the way in incentive programs with the Federal government offering a 26% solar tax credit to residential and commercial consumers, which expires in 2022. There is also a tax credit of up to $7,500 for electric vehicles or plug-in hybrids purchased in or after 2010. For developers, there is the Business Energy Investment Tax Credit (or ITC), which remains in effect for solar projects out until 2023. Through the Energy Storage Tax Incentive and Deployment Act, introduced in April 2019, the ITC may also be made available for homeowners, commercial property owners and utility-scale that are investing in renewables-driven energy storage. In Canada, the only nation-wide solar power incentive program is the federal tax provision for clean energy, extended until 2025, which allows businesses to depreciate the cost of their solar systems at an accelerated rate. In terms of EV incentives, depending on the province, some may be eligible for an incentive of up to $5,000. In Europe, Germany offered a subsidy program to residential customers between 2016 and 2018 that amounted to up to 25% of the cost of a battery connected to a 20kW solar panel. By 2018, residential battery installation increased by almost 400% to +26,000 units versus around 5,000 in 2013. Despite the incentive program expiring, demand is expected to remain strong, hitting over 49,000 units by 2025, as battery prices decline.

Alternative Technologies

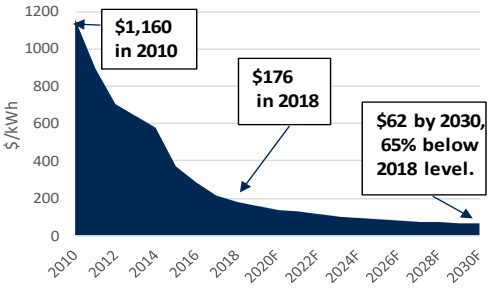
While LiB is the go-to energy storage technology due to its attractive cost, the flow battery could be one of its largest competitors. Energy here is stored in large tanks filled with positively charged and negatively charged liquid that flow together. These batteries are expected to be a solid alternative to LiB as they can be easily scaled simply by building a bigger tank and adding more liquid solution. This is in contrast to LiB, which require more cells, cooling systems,

72% of LiB Capacity in China as at 2018



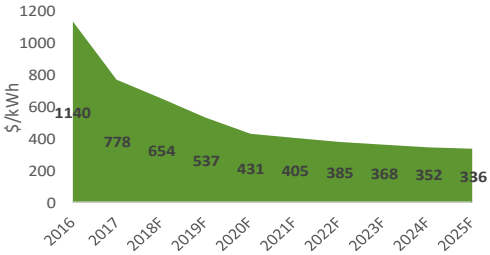
Source: Bloomberg, Raymond James Ltd.

EV Battery Cost Decline



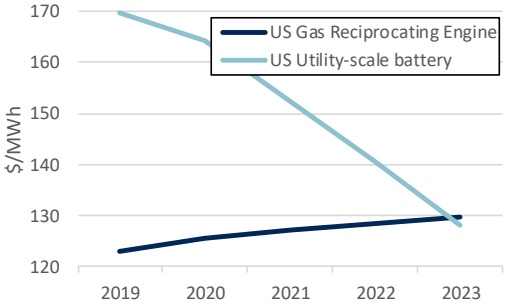
Source: Bloomberg, Raymond James Ltd.

Energy Storage Cost for Homeowners



Source: Bloomberg, Raymond James Ltd.

Gas vs. Battery Levelized Cost of Energy



Source: Bloomberg, Raymond James Ltd.

wiring etc. Flow batteries use vanadium, a commodity that has experienced a +160% increase in price since 2016 and exceeding 1200% in 2018. Given the increased costs, research is currently being conducted to find liquid alternatives for use inside flow batteries. As at Q2/19, the cost to install a flow battery was almost double that of a LiB. Despite the cost, the ability to scale these batteries makes them a viable alternative and is an area that warrants watching for those following the energy storage space. At the moment, they are being used for residential and utility-scale systems. Other energy storage methods include pumped hydropower, hydrogen energy storage, compressed air energy storage, thermal energy storage, flywheels and the gravity battery. However, LiBs are simply the most widely used, cost effective and have multiple end uses.

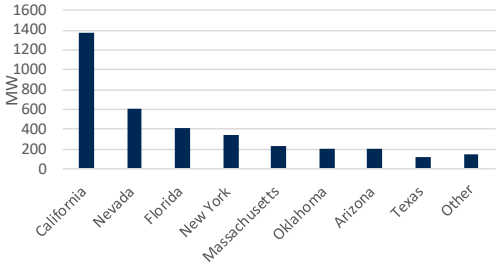
Investing in the Space

There are multiple avenues to put money to work in this area. Battery manufacturers include LG Chem, **Samsung SDI (SSDIY-US)**, **Tesla (TSLA-US)** and **BYD Company (BYDDY-US)**, which are continuously investing in R&D to improve their batteries. Flow batteries are being developed by Australia-based small cap stock **Redflow Limited (REFXF-US)** and private company Primus Power. Car manufacturers are expected to be the largest source of demand for batteries. Tesla is an obvious player in the game, but other major car makers have jumped on the EV bandwagon. **Volkswagen (VWAGY-US)** plans to electrify all of its 300 car models by 2030, requiring a 33 bln EUR investment. **Daimler's (DMLRY-US)** Mercedes plans on 50 EV models by 2022 for a 10 bln EUR investment. **BMW (BMWYY-US)** has committed to 25 EV models by 2023 and **Renault (RNLSY-US)** will have 8 EVs by 2022. That said, car manufacturers such as **Toyota Motor (TM-US)**, BMW and **Hyundai Motor (HYMTF-US)** are also exploring alternatives to LiB in favour of solid-state batteries. Companies that offer residential/commercial storage solutions are also a great way to play the space including Tesla and LG Chem. Tesla has come out with Powerwall, an energy storage battery, and solar shingles, which the company claims are three times stronger than regular shingles while LG Chem has its RESU ESS systems. Developers that build solar and wind projects with a storage component include **Vivint Solar (VSLR-US)**, which is building full solar and storage projects within the residential market using LG Chem's batteries. Vivint Solar's business model consists of either the full sale of solar panels or the installation of solar panels for customers at no upfront cost, but contractually selling the power back to the property owners through 20-year power purchase agreements, generating a consistent stream of cash flow. Among the utilities leveraging energy storage, we highlight **NextEra Energy (NEE-US)**, which is operating/developing energy storage sites in 12 states and Canada, has 145 MW of operational energy storage at the moment and a solid pipeline of projects in North America. While the electric power and energy infrastructure company is currently using batteries due to their declining costs, NEE is also gauging other storage technologies.

Conclusion

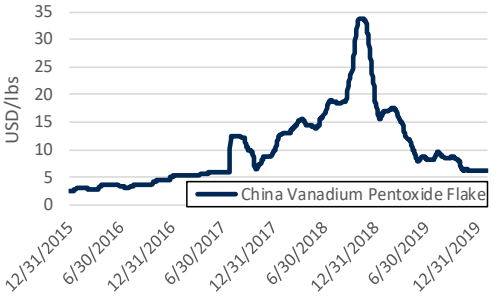
As the energy storage game is still in its early innings, new technologies are continuously being explored. While there exist other energy storage methods, LiB remains the most cost effective, holding a large portion of the energy storage capacity worldwide. We prefer focusing on companies that leverage energy storage technology as part of their business model as they may likely face less pricing pressure, rather than owning LiB manufacturers as we believe this space will eventually become commoditized.

Nameplate Battery Capacity by State



Source: US Energy Information Administration, Raymond James Ltd. Includes batteries under construction, planned or pending regulatory approval.

Rise and Fall of Vanadium



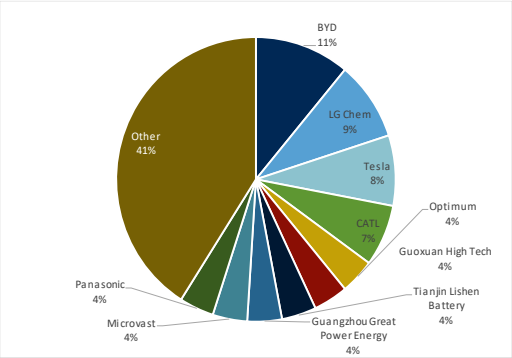
Source: Bloomberg, Raymond James Ltd.

Alternative Technologies

	Max Power Rating (MW)	Discharge time	*Max cycles* or lifetime	Energy density (Wh/L)	Efficiency
Pumped hydro	3,000	Up to 16h	30 – 60 years	0.2 – 2	70 – 85%
Compressed air	1,000	Up to 30h	20 – 40 years	2 – 6	40 – 70%
LiB	100	Up to 8h	*1,000 – 10,000*	200 – 400	85 – 95%
Lead-acid battery	100	Up to 8h	6 – 40 years	50 – 80	80 – 90%
Flow battery	100	NA	*12,000 – 1 4,000*	20 – 70	60 – 85%
Hydrogen	100	NA	5 – 30 years	600	25 – 45%
Flywheel	20	NA	*20,000 – 100,000*	20 – 80	70 – 95%

Source: The World Energy Council, Raymond James Ltd.

LiB Market Share by Capacity



Source: Bloomberg, Raymond James Ltd.

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