

# Thematic Investing

## Transforming World: Energy Storage Primer Picks

Thematic Investing

Bank of America  
Merrill Lynch



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### Transforming World: Energy Storage has arrived

In our [Transforming World Energy Storage Primer](#), we argue that energy storage (ES) will herald the next major phase in the transition to clean energy, with 50% ES cost reduction by 2025 vs. 2018 a key catalyst. We expect this will trigger new investments and business models and disrupt the fossil economy over the long term. Renewables help lower emissions, but they need ES to smooth the output and provide on-demand clean energy. Fortunately ES costs are falling, helped by EV battery cost reductions, new ES products are emerging and adoption is picking up, underpinned by changing policies, attitudes and needs. The annual energy storage (ES) market could grow at 16% 2020-30 CAGR, reaching \$27bn by 2030 and \$58bn by 2040, according to BNEF. We highlight some of the sub-segments exposed to the theme in the long term.

### 2020-30 to see rise of energy storage & electric vehicles

2010-20 saw a >70% fall in wind and solar costs, leading to wide adoption. We think 2020-30 will similarly see a rise in energy storage and electric vehicles, thanks to falling battery costs. With annual carbon emissions, atmospheric CO2 concentration and temperatures still rising, the only way to cut global emissions in the electricity+heat and transport sectors is to create an energy ecosystem primarily comprised of renewables, energy storage and electric vehicles, three interlinked solutions for reducing emissions.

### Exposures to ES: renewables, batteries, electrical

**Renewable equipment:** Wind and solar equipment suppliers are exposed to higher demand due to ES in the long term (e.g. Siemens Gamesa, First Solar, Goldwind).

**Renewable developers:** Developers or utilities with renewable focus can benefit from higher capacity growth and smoother pricing (e.g. NextEra, Enel, China Longyuan).

**Battery & ES suppliers:** Battery players (e.g. Samsung SDI, LG Chem) and battery material players (e.g. Albemarle, Norilsk Nickel, Umicore) are exposed to ES growth.

**Industrials - electrical:** Electrical names exposed to growth in renewables and energy storage, such as cables, inverters, controls (e.g. ABB, Siemens, Prysmian, Nexans).

### Challenged by ES: fossil equipment, coal power/mining

**Fossil equipment suppliers:** Equipment suppliers to fossil plants face headwinds, particularly coal, but even gas in some cases. Gas is a bridge option in some situations (e.g. Germany, China) but battery projects are starting to compete with gas (e.g. in US).

**Mining equipment suppliers:** Equipment suppliers to coal mining face headwinds as renewables + ES become competitive vs. coal in many locations.

**Fossil generation:** Fossil generators that are still heavily reliant on coal generation face risks of long-term decline, especially those with merchant exposure.

**Alternative to batteries:** As battery ES becomes mainstream, alternatives like back-up generators or fuel cells could face headwinds.

### TransformingWorld Thematic Research

Global  
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### Jargon Buster

**ES** – Energy Storage

**KW** – Kilowatt (measure of power capacity)

**KWh** – Kilowatt hour (measure of energy)

**MW, GW, TW** – Mega, Giga, Tera (increments of 1,000 from KW)

**V2G** – Vehicle to Grid

**V2H** – Vehicle to Home

**EV** – Electric Vehicle

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# 4 reasons why Energy Storage will win

## Energy Storage to herald next leg in clean energy in 2020s

Energy storage (ES) is set to herald the second major phase in the transition towards clean energy in the 2020s, the first being renewables reaching cost parity with fossil fuels before 2020. The share of wind and solar in power generation is already expected to rise from c10% today to >30% by 2030, but ES could speed this up and lead to a greater share of clean energy as renewables become more reliable with ES. We could see wind and solar's share of electricity demand rise to >60% by 2050 enabled by ES, 10-15% percentage points higher than would otherwise have been possible.

### 1 Falling EV battery costs to help deliver affordable energy storage

EV battery costs are expected to fall significantly, helped by scale from electric vehicles. Battery packs used in EVs can be used in ES, too (in different configurations), so ES system costs should also fall significantly, increasing affordability. Lithium batteries are expected to be the mainstay in ES/EV but other breakthroughs may emerge.

### 2 Cheap and abundant wind + solar will require energy storage

Wind/solar are cheaper than fossil in many locations and costs keep falling. Economics and policy support a faster transition to renewables, and ES fits well with this, thanks to its ability to absorb excess renewables, meet peak demand and stabilise the grids.

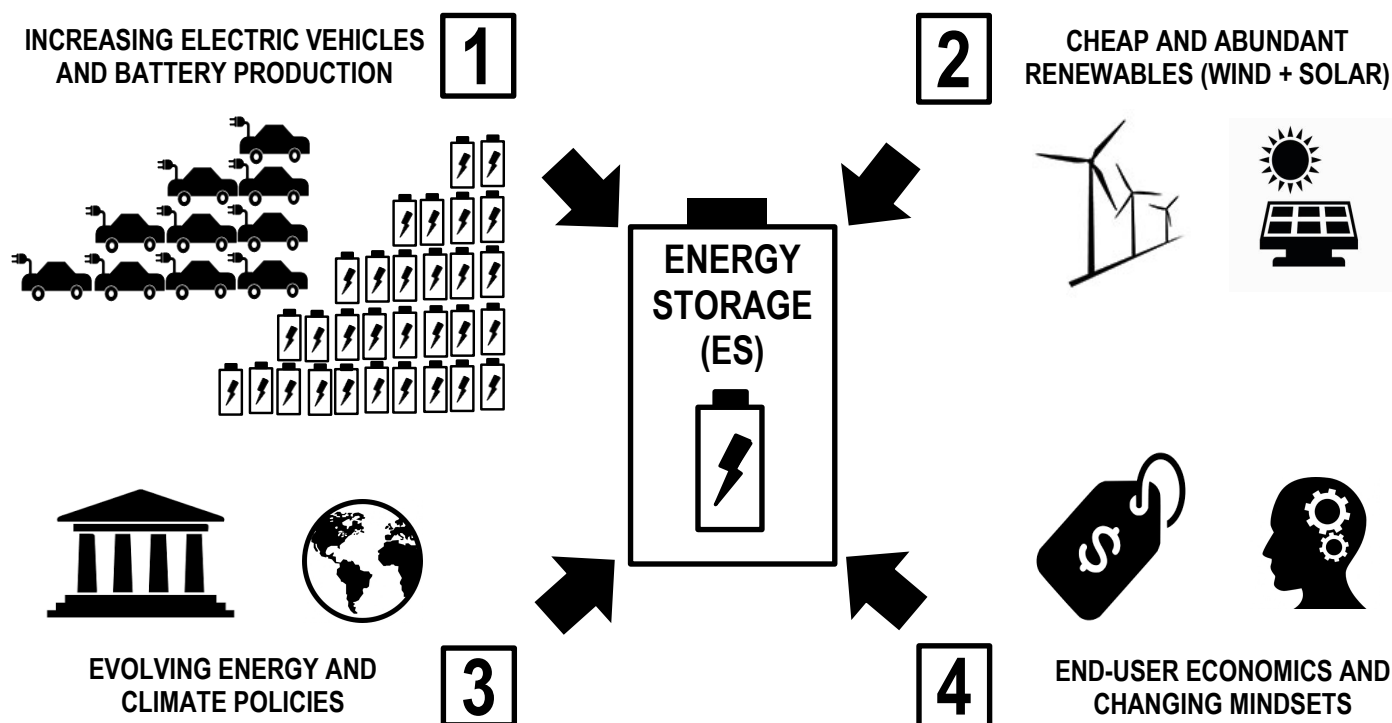
### 3 Government energy & climate policies to support energy storage

Some US states are embracing ES with long-term targets, allowing ES to bid vs. fossil for peak and approving plans to replace fossil with renewables + ES. Such policies are likely to spread to global markets, especially in regions with a high share of renewables.

### 4 Economics and consumer/corporate mind-sets to favour energy storage

Household/business consumers can lower their energy bills with ES (especially as system costs fall) and consumers are progressively favouring clean energy and self-generation (good fit with ES). Energy companies are embracing ES over fossil fuels.

#### Exhibit 1: 4 reasons why Energy Storage will win

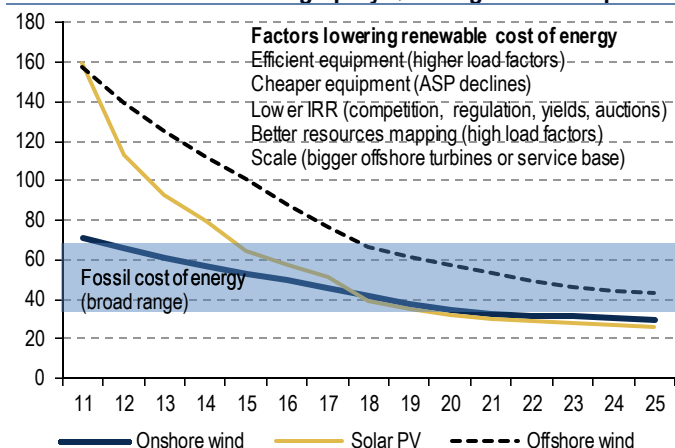


Source: BofA Merrill Lynch Global Research

## Renewables are now inexpensive but can be unreliable

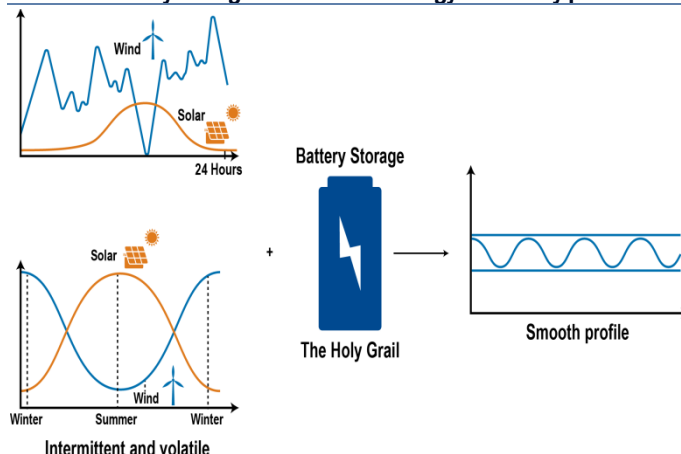
After dramatic cost reductions in the last decade, new renewable energy is now at parity with, or cheaper than, fossil fuels in most global regions and costs are expected to fall further. The key renewable energy options are onshore wind, solar PV and offshore wind globally, but all have problems such as intermittency (not always available), lack of dispatchability (cannot be called upon on demand) and excesses (producing too much during times of low demand).

**Chart 1: Renewable costs falling rapidly & heading below fossil pre 2020**



Source: BofAML Global Research, LCOE is levelised cost of energy

**Exhibit 2: Battery storage smoothes the energy availability profile**



Source: BofAML Global Research

## Energy storage makes renewables more reliable

Despite progress, the share of wind and solar in total electricity generation is still low (c10% globally, 20-25% in some leading regions). To date, old fossil plants have been relied upon for back-up. But as the share of renewables rises significantly over the next decade (up to 30 percentage points in some regions) and older fossil plants are simultaneously shut down, energy storage will be needed to handle the variability of renewables. Battery energy storage cannot be used for seasonal variations (summer to winter) or for prolonged periods of imbalance (e.g. two weeks of no wind or extreme cold winters), so some fossil back-up will always be required, especially gas. However, energy storage in its various forms (Home ES, Grid ES, Renewables+ES etc) can help smooth renewable generation and meet a significant portion of peak demand during a year, lessening the reliance on fossil fuel electricity.

## Harder to cut emissions without Energy Storage

Step changes in renewable generation are the only way to reduce annual carbon emissions, which have continued to rise in recent years. Some regions, like Germany and California, are targeting 60-65% renewable generation by 2030, up from c.35% today. In addition, electric vehicles are expected to increase demand for electricity longer term. We believe that without energy storage, materially increasing the share of renewable energy in electricity generation would not be feasible unless there were significant investment in new back-up fossil generation, which would be counterproductive for emissions. Gas would still have a role to play, however, even with energy storage.

## ES technology/costs coming together, helped by EVs

The electric vehicle (EV) revolution has helped bring down the costs of lithium batteries dramatically: average prices have fallen 80% since 2010. This is also helping energy storage, as the EV batteries can be used for ES and big battery suppliers now also offer energy storage products. After some early successes (e.g. Australia 100MW battery), we think ES technology is ready to be scaled up, which should bring down costs. Global battery supply capacity is key to ES being adopted more widely, in our view, and there could be further technology breakthroughs even if Lithium batteries are the mainstay for now (e.g. graphene-based ultra-capacitors, flow batteries or hydrogen).

# Energy Storage: Primer Picks, Challenged

## Beneficiaries of rise of energy storage

### Renewable equipment suppliers: potential for higher annual demand long-term

The rise of energy storage should benefit wind and solar equipment suppliers via greater demand for their equipment. ES would smooth energy flows from intermittent renewables and open up a larger market for equipment suppliers than is currently the case. Renewable demand is already well supported by low costs and climate policy but ES is likely to provide an extra boost. Currently, some consultant forecasts for the 2050 share of wind and solar stand at c.50% (e.g. Bloomberg New Energy Finance or BNEF), but we think it could reach 60-65% by 2050, helped by storage. This extra 10-15ppt higher share could imply c.30% annual volume uplift for both on average (see Table 1).

**Table 1: Could energy storage lift annual renewable demand by 30%?**

	2020	2050	Cumulative share gain	Years	Annual share gain
Wind & solar share in generation on current path (Source: BNEF 2019)	10.0%	50.0%	40.0%	30	1.33%
Wind & solar share in generation with energy storage (BofAML illustrative scenario)	10.0%	62.5%	52.5%	30	1.75%
<b>Potential average annual volume uplift for renewables due to energy storage</b>					<b>31.3%</b>

Source: BNEF, BofAML Global Research

### Renewable developers – higher capacity growth and more stable pricing

Renewable developers or utilities with large renewable portfolios can benefit from energy storage in two ways

1. By being able to expand capacity more as renewables + ES starts to become competitive and takes share from conventional generation – this extra capacity could be similar to higher annual demand for renewables.
2. Existing generation capacity, especially old projects coming off fixed contracts, could add ES to smooth out pricing to benefit from more stable earnings and, as a result, command higher valuations due to better visibility.

### Battery & energy storage solutions suppliers to benefit from high CAGRs

Energy storage systems would be supplied by the big battery players as well as other system integrators who procure batteries and focus on the full system (including balance of plants). As we highlighted in our companion **energy storage primer**, we see potential for the energy storage market to expand at a 16% CAGR in 2020-30 to >\$27bn by 2030 (Source: BNEF) and further to >\$100bn by 2050. As a result, battery supplies and energy storage full system suppliers ought to benefit in the long term from the pick-up in energy storage demand.

### Industrials involved in electrical equipment

The enormous growth in battery energy storage should also help industrial companies focused on electrical equipment such as cabling, connectors, inverters, control systems etc. On the flipside, if the same companies are supplying to fossil plants, then there would be some share losses there. The net benefit would depend on how these electrical-focused industrial companies shift their business models to focus more on renewables, energy storage and other new energy businesses (like electric vehicles and EV charging) relative to legacy fossil fuel power plants.

## Primer Picks for Energy Storage theme

Below we show some of the companies under BofAML fundamental analyst coverage which are exposed to the energy storage theme in the long term. Energy storage is still in its infancy, meaning no company has high exposure to the theme currently. But as we expect costs to come down and technology/adoption to increase in the coming 3-5 years, we see scope for a number of companies potentially to have medium exposure to the theme. We also consider the long-term growth of energy storage, e.g. 16% revenue CAGR of the market to 2030 towards c.\$27bn pa according to BNEF. The universe of stocks is likely to evolve in the mid-to-long term as companies change strategies and shift their business models to focus on, or benefit from, energy storage (and related areas like renewables).

### Methodology

For each company, we have estimated the level and materiality of companies' exposure to the energy storage theme in the mid-to-long term products.

For each company, we have characterised their exposure as follows:

**Low** – Sub-theme-related products, technologies, services, and solutions are not material to global revenues and/or growth but are one factor, among others, for the business model, strategy & R&D of the company (i.e. single digit, <10% of sales).

**Medium** – Sub-theme-related products, technologies, services, and solutions are an important factor for the business model, strategy and R&D of the company; material to sales and/or growth (i.e. 10-50% of sales).

**High** – Sub-theme-related technologies, services, and solutions are core to the business model, strategy and R&D of the company; material sales and/or growth driver; pure play (i.e. >50% of sales).

To be included as a Primer Pick, the stock must be ranked as having material i.e. either High or Medium exposure to the relevant theme. The primer pick must also be covered by a BofAML Global Research fundamental analyst and have a Buy rating as of the date we publish this report.

Although it is difficult to accurately gauge the link between such exposure and share price performance (as many factors outside the scope of this analysis are likely to play a role in short- and long-term price development), we still consider energy storage as an important theme to track in light of climate change and given reducing emissions materially will require a 3-way solution via renewables, energy storage and electric vehicles.

In our Primer Picks report, we present a list of global stocks covered by BofAML that have exposure to the energy storage theme. Our Buy-rated stocks with material exposure to the theme are detailed in that report as is our full list of stocks with thematic exposure to the theme.

**Table 2: Energy Storage Primer Picks**

Company	BofAML Ticker	BBG Ticker	Location	Mkt. Cap US\$m	Q-R-Q	Sub-sector	Energy Storage Exposure	Stock Profiles
<b>Renewables</b>								
SunRun	RUN	RUN US	United States	2,288	C-1-9	Solar	Medium	US residential solar, finances, installs and services solar power arrays on customer premises, majority of the company's solar installations are leased from SunRun by its customers
Vivint Solar	VSLR	VSLR US	United States	943	C-1-9	Solar	Medium	US residential solar, finances, installs, and services solar power systems on customer premises, majority of the company's installations are leased from Vivint by its customers.
First Solar	FSLR	FSLR US	United States	7,002	C-1-9	Solar	Medium	Based in Phoenix Arizona, designs and manufactures solar modules, leading producer of thin film solar cells..
Xinyi Solar	XYPJF	968 HK	China	3,493	C-1-7	Solar	Medium	#1 solar glass manufacturer in China, expanding into the solar farm segment rapidly, company has 26% of the solar glass market share in China.
China Longyuan	CLPXF	916 HK	China	5,143	B-1-7	Wind	Medium	#1 wind power generator in China, wind farms are mainly located in the 3 Chinese northeast provinces and the southeast coastal areas. The company could see higher growth prospects as energy storage makes renewables more compelling.
Datang Renewable	XGDRF	1798 HK	China	735	C-1-9	Wind	Medium	Subsidiary of Datang Corp, #2 wind-farm developer in China and the #8 globally in terms of installed capacity. The company could see higher growth prospects as energy storage makes renewables more compelling and could also benefit from energy storage via less curtailment.
Huaneng Renewable	XNUGF	958 HK	China	2,714	B-1-7	Wind	Medium	One of the 3 largest wind power generators in China, commercially operational and based out of Beijing.
Siemens Gamesa	GCTAF	SGRE SM	Spain	11,248	C-1-8	Wind	Medium	Merger between Gamesa and Siemens Wind Power, one of the world's largest wind turbine manufacturers with a c.15% market share, strong positions in DMs and EMs as well as in onshore and offshore. SGRE has also experimented with combined renewable + energy storage projects.
Goldwind	XJNGF	2208 HK	China	4,456	C-1-8	Wind	Medium	Goldwind is the largest wind turbine producer in China and among the top 4 in the world. While the majority of its sales is from wind turbine production, it also provides services and develops wind farms itself. China Three Gorges, a centrally-controlled SOE, is Goldwind's largest shareholder, holding a 24.3% stake in the Company.
NextEra Energy	NEE	NEE US	United States	100,026	B-1-7	Utilities	Medium	Two main business segments: the Florida Power & Light regulated utility (FPL) and NextEra Energy Resources - deregulated generator of predominantly wind, natural gas, nuclear and solar powered assets in Nam. FLP has planned one of the biggest energy storage projects in the world (c.400MW battery in Florida). The Group can start to install energy storage in existing and new renewable projects in a big way. In its corporate presentations, NextEra has been publishing economics of energy storage for many years now given how important energy storage would be for its assets.
Enel	ESOCF	ENEL IM	Italy	61,730	B-1-7	Utilities	Medium	Major European integrated utility, formerly the state electricity monopoly in Italy, global renewables through listed subsidiary Enel Green Power, leading EV charging utility co. Enel is one of the leaders in renewable energy and therefore ought to embrace energy storage in the long term.
<b>Batteries &amp; Storage</b>								
Samsung SDI	SSDIF	006400 KS	Korea, Republic Of	14,091	C-1-7	Batteries & energy storage systems	Medium	EV batteries, energy storage, company investing up to Won 3tn until 2020 on EVs, secondary batteries are ~44% of sales. Energy Storage would be a growth area for battery suppliers.
LG Chem	LGCLF	051910 KS	Korea, Republic Of	20,309	B-1-7	Batteries & energy storage systems	Medium	EV batteries, energy home storage; expansion of its large-size battery along with x EV applications. Energy Storage would be a growth area for battery suppliers.
Albemarle	ALB	ALB US	United States	7,653	B-1-7	Battery Materials	Medium	Albemarle is among the largest and lowest-cost producers in lithium which we expect will see meaningful volume expansion due to growth in electric vehicles. Albemarle operates two other stable global specialty chemical businesses, Bromine and Catalysts, in oligopolistic market structures
Umicore	UMICF	UMI BB	Belgium	9,218	B-1-7	Battery Materials	Medium	Umicore is the joint leader globally in emissions controls for the automotive industry but is also exposed to the battery value chain, both battery recycling and battery materials like cathodes. Batteries would be a key part of energy storage.
Norilsk Nickel	NILSY	MNOD LI	Russian Federation	35,026	C-1-7	Battery Materials	Medium	Leading supplier of nickel, a key battery material for lithium ion technology. Norilsk Nickel also produces other materials like palladium, platinum, and copper, as well as by-products such as cobalt, rhodium, silver and gold.

**Table 2: Energy Storage Primer Picks**

Company	BofAML Ticker	BBG Ticker	Location	Mkt. Cap US\$m	Q-R-Q	Sub-sector	Energy Storage Exposure	Stock Profiles
								Energy storage ought to boost demand for batteries and therefore nickel.
<b>Industrials - Electrical</b>								
ABB Ltd.	ABLZF	ABBN SW	Switzerland	44,503	A-1-7	Smart Grid	Medium	Global leader in electrical products (controls, connectors, inverters, EV charging, energy storage) and automation technologies (factory automation). Energy storage would be a growing area of interest overlapping with renewables and EV charging.
Siemens	SMAWF	SIE GR	Germany	97,867	A-1-7	Smart Grid	Medium	Global leader in electrical engineering, focuses on energy (power transmission), industry (automation), and infrastructure and cities (transport, building technologies, power distribution). Energy storage could become a focus area given big global opportunity and the Group's presence in related areas. Siemens is a JV partner (with AES) in Fluence, a leading player in grid battery systems.
Prysmian	PRYMF	PRY IM	Italy	4,406	C-1-7	Smart Grid	Medium	Global leader in cable manufacturing for the energy and telecoms industries, addresses three end-markets that are infrastructure, industrial and buildings. Ought to benefit from higher renewable demand due to energy storage.
Nexans	NXPRF	NEX FP	France	1,414	C-1-7	Smart Grid	Medium	Global manufacturer of copper cables for the infrastructure, industry and building markets. They produce high, medium and low-voltage cables for the energy and telecoms markets. Ought to benefit from higher renewable demand due to energy storage.

Source: BofA Merrill Lynch Global Research. Note the Q-R-Qs above are from BofAML fundamental equity analysts.

## Full universe of stocks for Energy Storage theme

Table 3: Full Universe of companies exposed to Energy Storage

Company	BofAML Ticker	BBG Ticker	Location	Mkt. Cap US\$m	Q-R-Q	Climate Change Sub-sector	Energy Storage Exposure	Primer Picks	Stock Profiles
<b>Renewables</b>									
SunRun	RUN	RUN US	United States	2,288	C-1-9	Solar	Medium	Yes	US residential solar, finances, installs and services solar power arrays on customer premises, majority of the company's solar installations are leased from SunRun by its customers
Vivint Solar	VSLR	VSLR US	United States	943	C-1-9	Solar	Medium	Yes	US residential solar, finances, installs, and services solar power systems on customer premises, majority of the company's installations are leased from Vivint by its customers.
First Solar	FSLR	FSLR US	United States	7,002	C-1-9	Solar	Medium	Yes	Based in Phoenix Arizona, designs and manufactures solar modules, leading producer of thin film solar cells.
Xinyi Solar	XYPJF	968 HK	China	3,497	C-1-7	Solar	Medium	Yes	#1 solar glass manufacturer in China, expanding into the solar farm segment rapidly, company has 26% of the solar glass market share in China.
SunPower Corp.	SPWR	SPWR US	United States	1,776	C-3-9	Solar	Medium	No	SunPower Corporation (NASDAQ: SPWR) designs and manufactures solar panels and systems which it sells to residential, business, government and utility customers. Total SA, one of the largest integrated oil and gas companies in the world, owns c.55% of SunPower.
China Longyuan	CLPXF	916 HK	China	5,148	B-1-7	Wind	Medium	Yes	#1 wind power generator in China, wind farms are mainly located in the 3 Chinese northeast provinces and the southeast coastal areas. The company could also benefit from energy storage via less curtailment.
Datang Renewable	XGDRF	1798 HK	China	736	C-1-9	Wind	Medium	Yes	Subsidiary of Datang Corp, #2 wind-farm developer in China and the #8 globally in terms of installed capacity. The company could see higher growth prospects as energy storage makes renewables more compelling and could also benefit from energy storage via less curtailment.
HuanengRenewable	XNUGF	958 HK	China	2,717	B-1-7	Wind	Medium	Yes	One of the 3 largest wind power generators in China, commercially operational and based out of Beijing.
Siemens Gamesa	GCTAF	SGRE SM	Spain	11,244	B-1-8	Wind	Medium	Yes	Merger between Gamesa and Siemens Wind Power, one of the world's largest wind turbine manufacturer with a c.15% market share, strong positions in DMs and EMs as well as in onshore and offshore. SGRE has also experimented with combined renewable + energy storage projects.
Vestas	VWSYF	VWS DC	Denmark	17,411	B-2-8	Wind	Medium	No	World leader in wind turbine manufacturing with a c.20% global market share in 2016, diversified geographic exposure and product portfolio with scale advantages. Vestas has also experimented with combined renewable + energy storage projects.
Iberdrola	IBDSF	IBE SM	Spain	65,446	A-2-7	Wind	Medium	No	Spain-based utility with generation & supply, distribution and renewable (mostly onshore and offshore wind) operations mainly in Europe and Americas, US listed subsidiary
Goldwind	XJNGF	2208 HK	China	4,460	C-1-8	Wind	Medium	Yes	Avangrid. Iberdrola's large renewable asset portfolio, some older assets and US exposure (including regulated assets) puts in a solid position to embrace and benefit from energy storage in the long term.
NextEra Energy	NEE	NEE US	United States	100,026	A-1-7	Utilities	Medium	Yes	Goldwind is the largest wind turbine producer in China and among the top 4 in the world. While the majority of its sales is from wind turbine production, it also provides services and develops wind farms itself. China Three Gorges, a centrally-controlled SOE, is Goldwind's largest shareholder, holding 24.3% stake in the Company. Goldwind could see higher growth prospects as energy storage makes renewables more compelling and reduces wind curtailment in China.
									Two main business segments: the Florida Power & Light regulated utility (FPL) and NextEra Energy Resources - deregulated generator of predominantly wind, natural gas, nuclear and solar powered assets in Nam. FPL has planned one of the biggest energy storage projects in the world (c.400MW battery in Florida). The Group can start to install



Table 3: Full Universe of companies exposed to Energy Storage

Company	BofAML Ticker	BBG Ticker	Location	Mkt. Cap US\$m	Q-R-Q	Climate Change Sub-sector	Energy Storage Exposure	Primer Picks	Stock Profiles
Avangrid	AGR	AGR US	United States	15,770	A-3-7	Utilities	Medium	No	energy storage in existing and new renewable projects in a big way. In its corporate presentations, NextEra has been publishing economics of energy storage for many years now given how important energy storage would be for its assets. US subsidiary of Iberdrola, Avangrid renewables business operates in over half of the states and owns primarily wind assets, with some solar and conventional assets as well. Major European integrated utility, formerly the state electricity monopoly in Italy, global renewables through listed subsidiary Enel Green Power, leading EV charging utility co. Enel is one of the leaders in renewable energy and therefore ought to embrace energy storage in the long term.
Enel	ESOCF	ENEL IM	Italy	61,711	B-1-7	Utilities	Medium	Yes	World's #1 developer, owner and operator of offshore wind parks, with operational assets and development projects in Europe, the US and Taiwan. It has also recently entered the US onshore wind and solar PV market. Orsted has long term fixed priced contracts for its primary offshore wind assets and therefore does not need to invest in energy storage in a big way. However, the company has started some pilot projects in energy storage and at least for the limited 10-15% merchant exposure, energy storage could be beneficial.
Orsted	DOGEF	ORSTED DC	Denmark	37,987	A-1-7	Wind	Low	No	Brazil company focused on operating renewable energy and ranks as the #5 renewable generator in Brazil, Wind Power Plants and Hydro Plants. Could look to add energy storage into renewables.
Omega Geracao	XBZYF	OMGE3 BZ	Brazil	636	B-1-9	Wind	Low	No	#1 electricity operator in France, present in generation, supply, transmission and distribution (nuclear etc), one of the only European utilities to have established major positions in France, the UK and Italy. EDF is also a big player in wind and could invest in energy storage.
EDF	ECIFF	EDF FP	France	42,987	B-1-8	Nuclear	Low	No	RWE is an integrated power and gas utility with a major presence in Central Europe and the UK. It has entered into an asset swap with E.ON, which will provide it with a significant renewable power generation portfolio in Europe and the US. Given a sizeable proportion of older renewable capacity is coming off fixed contracts, RWE may benefit by investing in energy storage.
RWE	RWNFF	RWE GR	Germany	15,646	B-1-7	Utilities	Low	No	
<b>Batteries &amp; Storage</b>									
CATL	XMOQF	300750 CH	China	23,040	C-3-7	Batteries & energy storage systems	Medium	No	CATL is China's largest lithium battery maker. It focuses on R&D, manufacturing, and sales of EV battery and energy storage systems (ESS). CATL supplies EV batteries for most of leading EV manufacturers in China, including SAIC, BAIC, Geely, GWM, NIO, etc. CATL's battery shipment totaled 21GWh in 2018, ranked No.1 and followed by BYD and Guoxuan. CATL was listed on Shenzhen Stock Exchange on 11 June 2018.
Samsung SDI	SSDIF	006400 KS	Korea, Republic Of	14,172	B-1-7	Batteries & energy storage systems	Medium	Yes	EV batteries, energy storage, company investing up to Won 3tn until 2020 on EVs, secondary batteries are ~44% of sales.
LGC	LGCLF	051910 KS	Korea, Republic Of	21,219	B-1-7	Batteries & energy storage systems	Medium	Yes	EV batteries, energy home storage; expansion of its large-size battery along with xEV applications..
Panasonic	PCRFF	6752 JP	Japan	19,797	B-2-7	Batteries & energy storage systems	Medium	No	Lithium-ion batteries, storage; global leader with partnership in Tesla Gigafactory (32% ownership).
Albemarle	ALB	ALB US	United States	7,653	B-1-7	Battery Materials	Medium	Yes	Albemarle is among the largest and lowest cost producers in lithium which we expect will see meaningful volume expansion due to growth in electric vehicles. Albemarle operates two other stable global specialty chemical businesses, Bromine and Catalysts, in oligopolistic market

**Table 3: Full Universe of companies exposed to Energy Storage**

Company	BofAML Ticker	BBG Ticker	Location	Mkt. Cap US\$m	Q-R-Q	Climate Change Sub-sector	Energy Storage Exposure	Primer Picks	Stock Profiles
Livent	LTHM	LTHM US	United States	1,323	C-2-9	Battery Materials	Medium	No	structures with 30% EBITDA margins and low growth rates. Energy Storage could be a growth area for battery material suppliers. Livent entered the lithium business in the 1940s, was acquired by FMC in the 1980s, and now trades as a stand-alone public company following its IPO in 2018. Livent is among the largest battery grade lithium hydroxide producers and one of the lowest cost producers in lithium, which we expect will see meaningful volume expansion due to growth in electric vehicles.
Sociedad Quimica	SQM	SQM US	Chile	8,604	B-2-8	Battery Materials	Medium	No	#1 global supplier of lithium with market shares of 30%, lithium is around 13% of sales, mining in South America (Chile & Bolivia). Energy Storage could be a growth area for battery material suppliers.
Norilsk Nickel	NILSY	MNOD LI	Russian Federation	35,026	C-1-7	Battery Materials	Medium	Yes	Leading supplier of nickel, a key battery material for lithium ion technology. Norilsk Nickel also produces other materials like palladium, platinum, and copper, as well as by-products such as cobalt, rhodium, silver and gold. Energy storage ought to boost demand for batteries and therefore nickel.
Tesla	TSLA	TSLA US	United States	41,841	C-3-9	Batteries & energy storage systems	Medium	No	Tesla is a leading electric vehicle manufacturer but also a leader in energy storage (launched among the first commercial home & grid batteries). Tesla already had >1GWh sales of energy storage products in 2018, a fast growing segment even if EVs represent bulk of activities. Tesla installed a 100MW battery in South Australia post grid outages, with a "within 100 days or free" promise on Twitter.
BYD	BYDDF	1211 HK	China	16,637	C-3-7	Batteries & energy storage systems	Low	No	BYD is among China's largest lithium battery makers and also EV maker. BYD also has energy storage products which could be a growth area for the company.
Exide Industries	XEDRF	EXID IN	India	2,582	B-3-7	Batteries	Low	No	Established in 1946, Exide Industries is the largest manufacturer of lead acid storage batteries in India with batteries ranging from 2.5Ah to 20,000Ah. It also manufactures inverters. Exide's products find use in both automotive and industrial applications globally. Exide derives about 65% of its revenues from automotive segment and the remaining 35% from industrial segment. Energy Storage could be a growth area even for lead acid battery suppliers.
Amara Raja	XAMFF	AMRJ IN	India	1,956	B-3-7	Batteries	Low	No	Amara Raja (AMRJ) is the second largest manufacturer of lead acid storage batteries in India. The Galla family of India and Johnson Controls Inc, USA both hold 26% equity stake each in the company. Energy Storage could be a growth area even for lead acid battery suppliers.
<b>Industrials - Electrical</b>									
ABB Ltd.	ABLZF	ABBN SW	Switzerland	44,757	A-1-7	Smart Grid	Medium	Yes	Global leader in electrical products (controls, connectors, inverters, EV charging, energy storage) and automation technologies (factory automation). Energy storage could be a growing area of interest overlapping with renewables and EV charging.
Siemens	SMAWF	SIE GR	Germany	97,836	A-1-7	Smart Grid	Medium	Yes	Global leader in electrical engineering, focuses on energy (power transmission), industry (automation), and infrastructure and cities (transport, building technologies, power distribution). Energy storage could become a focus area given big global opportunity and the Group's presence in related areas. Siemens is a JV partner (with AES) in Fluence, a leading player in grid battery systems.
Eaton Corp PLC	ETN	ETN US	United States	33,628	B-2-7	Smart Grid	Medium	No	Eaton Corp. (ETN) is a leading diversified industrial manufacturer of fluid power systems, electrical control products, automotive systems, and medium- and heavy-duty truck transmissions. Eaton has tied up with automaker Nissan to roll out energy storage solutions using both new and used EV batteries (from Nissan's EVs).
Schneider	SBGSF	SU FP	France	51,803	A-2-7	Smart Grid	Medium	No	A global leader in electrical distribution (medium and low

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AES Corp	AES	AES US	United States	11,451	B-2-7	Smart Grid	Medium	No	voltages) and automation & control, Schneider offers products and services for the residential, buildings, industry, energy and infrastructure markets. With revenues of EUR24.7bn in 2017, its 153,000 employees serve customers in about 100 countries. Global power company with operations in 24 countries, 4 main business segments: contracted generation, competitive supply, large utilities, and growth distribution (smart grid). Energy storage could become a focus area given big global opportunity and the Group's presence in related areas. AES is a JV partner (with Siemens) in Fluence, a leading player in grid battery systems.
Prysmian	PRYMF	PRY IM	Italy	4,405	B-1-7	Smart Grid	Medium	Yes	Global leader in cable manufacturing for the energy and telecoms industries, addresses three end-markets that are infrastructure, industrial and buildings. Ought to benefit from higher renewable demand due to energy storage.
Nexans	NXPRF	NEX FP	France	1,414	B-1-7	Smart Grid	Medium	Yes	Global manufacturer of copper cables for the infrastructure, industry and building markets. They produce high, medium and low-voltage cables for the energy and telecoms markets. Ought to benefit from higher renewable demand due to energy storage.
<b>YieldCo</b>									
Atlantica Yield	AY	AY US	Spain	2,081	B-1-7	YieldCo	Low	No	Atlantica Yield operates as a total return company and owns a diversified portfolio of contracted renewable energy (77% of EBITDA in 2018), power generation, and electric transmission assets. Atlantica Yield offers its services in North America, South America, and Europe. By adding energy storage, Yieldcos could stabilise pricing and therefore cashflows which is key, although majority assets are long term contracted.
Clearway Energy	CWEN	CWEN US	United States	584	B-1-8	YieldCo	Low	No	Clearway Energy, Inc. owns, operates, and acquires renewable and conventional generation and thermal infrastructure projects. About half of its sales and operating income is from renewables. By adding energy storage, the company could stabilise pricing and therefore cashflows which is key, although majority assets are long term contracted.
Terraform	TERP	TERP US	United States	2,798	B-3-7	YieldCo	Low	No	TERP owns and operates 2.6 GW of wind and solar generation mainly across the US and Canada. The operating fleet is largely located in the US (90% of total capacity), with wind being the primary fuel (60% of total capacity), in addition to utility-scale solar and solar DG (25% and 15% of total capacity, respectively). The portfolio has a weighted average remaining contract life of 15 years. By adding energy storage, Yieldcos could stabilise pricing and therefore cashflows which is key.
NextEra Partners	NEP	NEP US	United States	2,592	B-2-7	YieldCo	Low	No	NextEra Energy Partners (NEP) owns roughly 3.15 GW of Wind generation and 700 MW of solar capacity in North America as of 12/31/17. NEP also owns an interest in a network of natural gas pipelines in Texas. All of NEP's assets have long-term contracts with an average remaining contract life of 18 years across the portfolio. NextEra Energy (NEE) owns 65.1% of NEP as of 12/31/17, with the remaining ownership interest being publicly traded. By adding energy storage, Yieldcos could stabilise pricing and therefore cashflows which is key, although majority assets are long term contracted.
Pattern Energy	PEGI	PEGI US	United States	2,055	B-2-8	YieldCo	Low	No	Pattern Energy Group (PEGI) owns and operates 2,880 MW of long-term contracted wind generation mainly across the US and Canada. The portfolio has a weighted average remaining contract life of 16 years. By adding energy storage, Yieldcos could stabilise pricing and therefore cashflows which is key, although majority assets are long term contracted.

**Table 3: Full Universe of companies exposed to Energy Storage**

Company	BofAML Ticker	BBG Ticker	Location	Mkt. Cap US\$m	Q-R-Q	Climate Change Sub-sector	Energy Storage Exposure	Primer Picks	Stock Profiles
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Source: BofAML Global Research

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