ESS INC

Catalyzing a Clean Future. Every Day.

May 2022

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The Global Imperative to Transition to Renewable Energy

Extreme climate-driven weather events are now the norm. Deadly extreme weather for US cost at least $145 billion in 2021.

The world's appetite for electricity is growing unabated. Global electricity demand rose by 6% or 1,500 terawatt hours (TWh) in 2021.

The risks of today's aging energy infrastructure are readily apparent – and more dangerous. Today's solutions need to last for decades.

Increasing concern for energy and national security.

The cost for utility-scale solar PV power has declined 82% since 2010 and the costs for onshore and offshore wind have declined 39% and 29%, respectively *(both are cheaper sources of electrons than burning fossil fuels).*

A global transition to a decarbonized world is underway. To preserve a livable climate, greenhouse-gas emissions must be reduced to net 0 by 2050.

The Challenge: Stabilize the Grid and Accelerate Renewables

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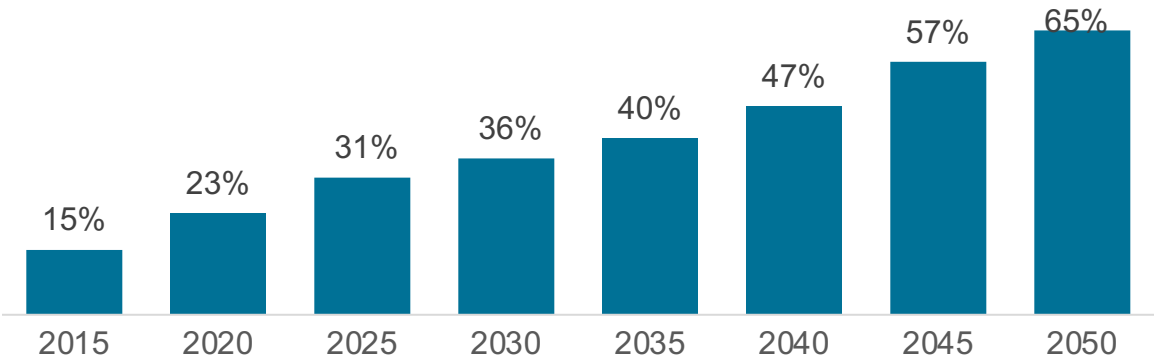
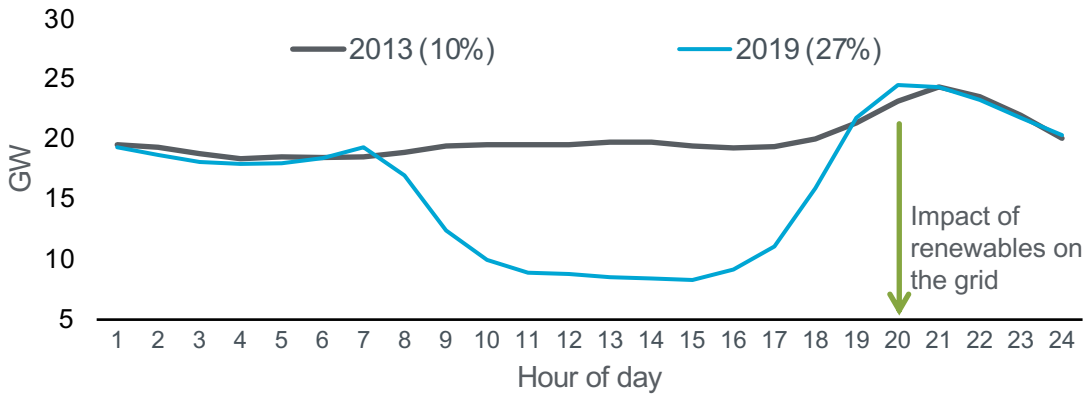
US Renewable Energy Penetration (2015-2050)[1]



California Duck Curve and % Renewable Penetration[1,2]



Renewable intermittency creates challenges for the grid, particularly >25% penetration

- Decarbonization is the goal
- Intermittency and curtailment are barriers
- 4-hour storage does not efficiently bridge the duck curve
- Lithium-ion batteries are toxic, hazardous and not practical to address 6+ hours of storage
- Despite the increase of renewables, approximately 60% of electricity generation is still from gas. LDES helps to get to net-zero.

1 BloombergNEF.
2 IEA, "The California Duck Curve", December 2019. % figures represent solar and wind power penetration in each year.

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140 TWh of Long Duration Energy Storage Needed

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COP26

COP 26: Major global report by McKinsey declared that LDES is key to energy transition

LDES sits between lithium batteries and hydrogen

LDES defined as two categories: 8-24h and >24h storage

Lithium will continue to play a role for <6h but too expensive for longer durations

LDES is the largest single storage category needed

1 TWh of LDES needed by 2025 to stay on track

140 TWh needed by 2040 for full decarbonization

Initial study shows that full decarbonization is technically and commercially feasible

Long-duration energy storage is essential – decarbonization not feasible without it

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With LDES, total energy system costs can go down
Renewable power with LDES can be cost effective

More information www.ldescouncil.com

Longer duration

Non-toxic, non-hazardous

Ultra-low cost at high cycle levels

Flexible and easy to deploy

Commercially available

Made in America

Simple but revolutionary technology purpose-built to solve energy storage, now and for decades to come

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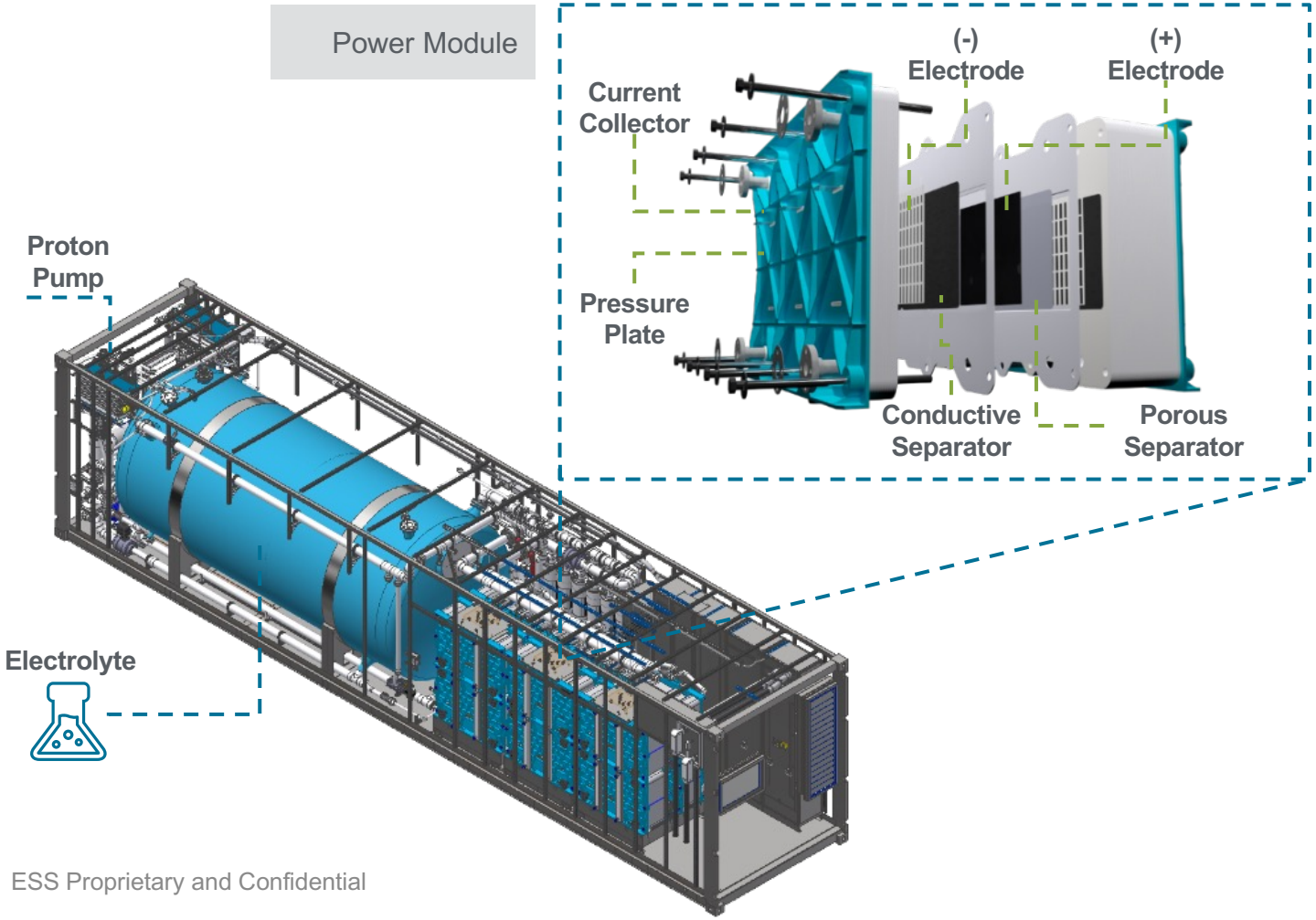
ESS Benefits

What Customers Demand	ESS INC	How ESS Transforms the Grid
Longer Duration	• Up to 12 hours (current version) • No capacity fade • No power fade	• Can replace coal and gas with solar and wind • Designed for utility-scale applications
Low Cost	• Lower LCOS than other technologies • Incremental cost of storage <$20/kWh	• The first truly low-cost flow battery • Field-proven, in commercial production today
Power On Demand	• <1 second response time • >20,000 cycle life – $0 marginal cost per cycle • Flexibility allows multiple revenue streams	• Improved grid resiliency and flexibility • Enables multiple use cases
Safety, Reliability, and Bankability	• Non-flammable, non-toxic, no explosion risk • Wide operating temperature range • Munich RE insures technology risk	• Can deploy in a wide range of geographies • No HVAC needed – cuts CAPEX and OPEX • Customers have a bankable solution
Sustainability	• Easily sourced materials; recyclable components • “Plug and play” with 25-year operating life	• Environmentally sustainable • Accelerates clean energy transition

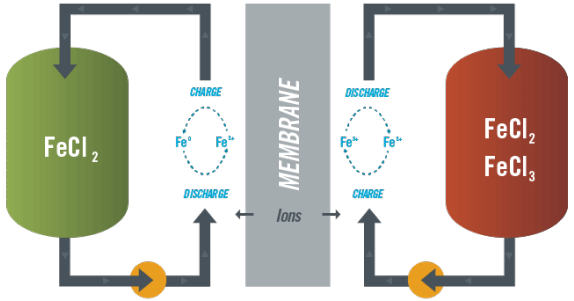
How the Technology Works

ESS Battery Technology

ESS technology



Electrochemistry



$$Fe^{2+} + 2e \underset{discharging}{\overset{charging}{\rightleftarrows}} Fe^{0} \qquad E^{0}=-0.44V$$

$$2Fe^{2+} - 2e \underset{discharging}{\overset{charging}{\rightleftarrows}} 2Fe^{3+} \qquad E^{0}=+0.77V$$

- ✓ During charging iron collects (electroplates) on the negative electrode
- ✓ During discharging iron dissolves back into solution
- ✓ Passive design proton pump continuously refreshes electrolyte in closed-loop system

Scalable, Low Cost, Long Duration Energy Storage

Iron flow battery scaling

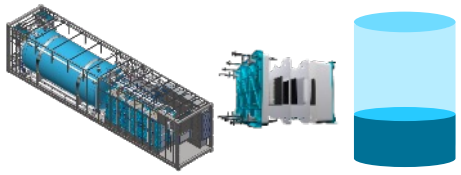
A theoretical 100kW/400kWh ESS battery contains

Component	Number	Cost
Fixed Equipment: i.e., power electronics, tank, structure/supports	1x	▲
Power Module	1x	■
Electrolyte	4x	●●●●

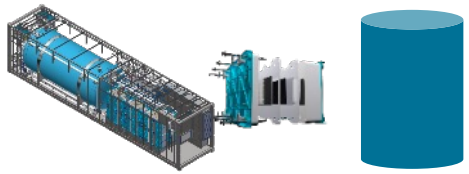
- More electrolyte – Longer duration
- ESS electrolyte is low cost – made from iron, salt and water
- Incremental cost of increasing storage duration is low

Increasing storage duration = same system, more electrolyte

400kWh configuration



1,000kWh configuration



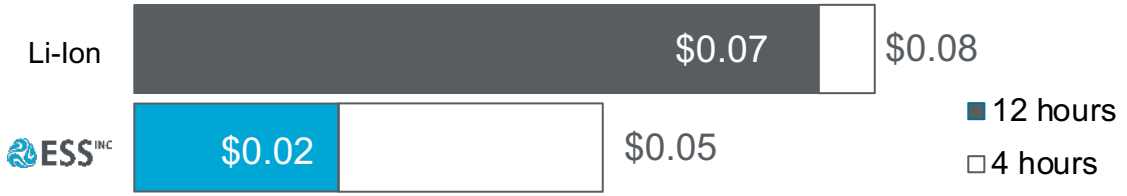
400kWh cost[1]

▲ + ■ + ●●●●

1,000kWh cost

▲ + ■ + ●●●●●●●●

LCOS at 12 hours vs 4 hours[2]



ESS Decouples Energy from Power

1 Figures shown are illustrative
2 Economics based on Levelized Cost of Storage (LCOS).

$$\text{LCOS} = \frac{\sum.\text{CapEx} + \sum.\text{Installation} + \sum.\text{Disposal} + \sum.\text{O\&M}}{\sum.\text{Annual Usable KWh}}$$

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Investment Grade Warranty

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Industry-leading warranty

Product cover	10-year extended warranty on entire technology stack
Project cover	Assignable warranty provides additional surety to owners and financiers

"The ability to ensure battery performance is a key piece of the puzzle in decarbonizing our energy sector."

- Peter Röder, Member of the Board of Management, Munich RE

Bankability

Munich RE

Warranty backed by investment grade insurer that covers every product, every where.

US Export-Import Bank Qualified

Pre-qualified financing available for overseas buyers

Energy Warehouse™ Overview

Product Summary

Behind-the-meter solution

First commercial deployment in 2015

Generation II launched in 2020

Containerized fully-integrated design for turnkey delivery

Easy to permit = Fast to deploy and commission

Current Specifications

Configurable Range	75kw – 90kW (peak power)
Rated Capacity	400 kWh
Total Capacity	500kWh
Response Time	<1 second
Module Cycle Life	>20,000 cycles
Ambient Temperature	-5°C to +50°C (*Additional weatherization option available)
Expected Life	25-year service life
Warranty	1 year comprehensive, 10-year extended warranty on battery modules and electrolyte management sys

Stackable
Seismic Rated

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Energy Center™ Overview

Product Summary

Front-of-the-meter solution

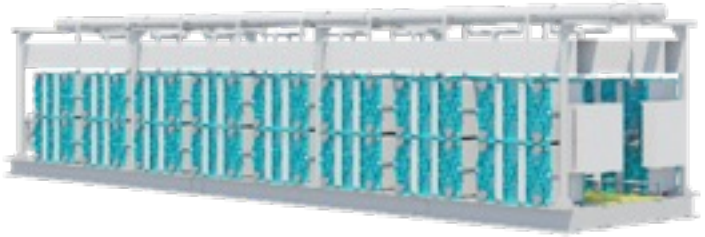
Deployments starting in Fall 2022

Modular design for utility-class

Power capacities starting at 3MW

Same Technology as Energy Warehouse

Power Train

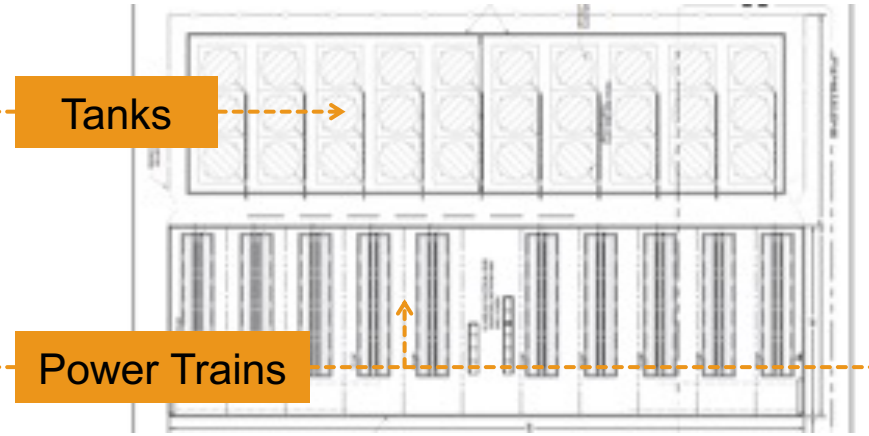


Quad Pods

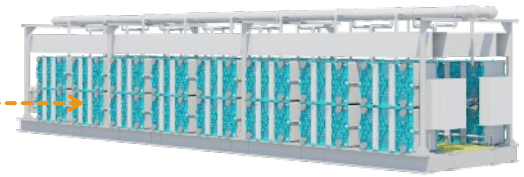
Current Specifications

Configurable Range	Customizable up to GW scale
Rated Capacity	10MWh / MW
Total Capacity	12 MWh / MW
Response Time	<1 second
Module Cycle Life	>20,000 cycles
Ambient Temperature	-5°C to +50°C (*Expandable range)
Expected Life	25-year service life
Warranty	1 year comprehensive, 10-year extended warranty on battery modules and electrolyte management system

Energy Center™ Overview



3MW - 36MW
30 Tanks; 10 Power Trains



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Competitive Comparison for Long Duration Storage

	ESS INC	Li-Ion	Li Metal	Vanadium, Zinc Bromine	Sodium Sulfur	Compressed Air	Pumped Hydro
Low cost at 4-12 hours	●	○	○	●	○	○	○
Commercially available [1]	●	●	○	●	●	○	●
Earth abundant materials	●	○	○	●	●	●	●
Unlimited cycling	●	○	○	○	○	●	●
Zero capacity face	●	○	○	○	○	●	●
Wide operational temperature range	●	○	○	●	○	●	●
Environmentally sustainable	●	○	○	○	●	●	○
No fire/ explosion risk	●	○	○	●	○	○	●

Note Internally developed table based on company data and publicly available information.
1 Based on our Generation I products, which are no longer deployed.

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Benefits of Iron Flow Batteries

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Enabling Renewable Energy to be Baseload Energy. All Night. Every Day.

Flexible

One long duration energy storage solution that address multiple use cases

- Resiliency and ancillary services
- Reliability and green hydrogen production

Durable

25-year design life, no capacity fade

Cost Effective

Lowest cost of storage

Easy

Easy to site and deploy. Easy to augment, increase capacity (just add water)

Proven

Field tested

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Sustainability Advantages

Sustainability Focus Areas	ESS INC
Responsibly sourced materials	Iron, salt and water are earth-abundant
Global warming potential (GWP)	67% lower CO_2 emissions than Li-Ion[1]
Recyclability	Contains no toxic materials and requires no special permits for disposal[2]

Note GHG impact is dependent on specific Li-Ion chemistry.

1 He, H. et al. "Flow Battery Production: Materials Selection and Environmental Impact." Journal of Cleaner Production. Vol. 269. 1 October 2020. Noguera, E., Comparative LCA of stand-alone power systems applied to remote cell towers, 2014.

2 No hazardous materials compliance plan required.

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Case Studies

FTM Microgrid (Utility-Owned)

Customer	Domestic Utility
Project Location	California
Use Case	• Microgrid solutions required to mitigate Public Safety Power Shutdown impacts • Solar + storage microgrid • Energy Warehouse™ product (540kW/3MWh storage)
Project Benefits	• Multi-day resiliency for critical needs customers during PSPS events
Why ESS Won	• Safety (non-flammability, non-explosive) • Ability to participate in CAISO market • Ability to provide distribution grid ancillary services during non-PSPS events

BTM Microgrid (Customer-Owned)

Customer	Medical Device Manufacturer
Project Location	Southern California Multiple sites
Use Case	• Behind the meter microgrid owned by customer • Customer is a vertically integrated medical device manufacturer • Multiple project sites and generation sources (microturbines, solar) • Energy Warehouse™ product
Project Benefits	• Reduced energy costs • Operational resiliency (PSPS events)
Why ESS Won	• Lowest total cost of ownership • Battery safety characteristics • Ease in permitting

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FTM Microgrid (Utility-Owned)

Use Case

Customer	Utility
Project Location	Chile
Use Case	• Remote grid served by RoR hydro and diesel gensets • Storage systems will minimize genset usage • Energy Warehouse™ product (300kW/2MWh)
Project Benefits	• $3.1M incremental savings over LIB • Avoids 12 years of diesel genset emissions
Why ESS Won	• 3x greater savings over LIB • Sustainability and environmental friendliness of IFB