Sandia National Laboratories

Battery-Based Stationary Energy Storage

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U.S. DEPARTMENT OF ENERGY NNSA

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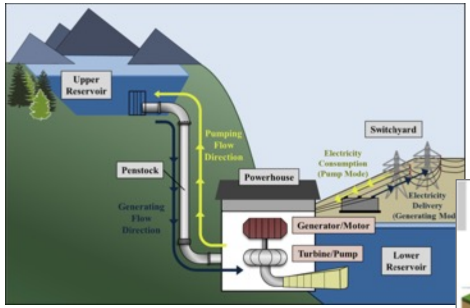
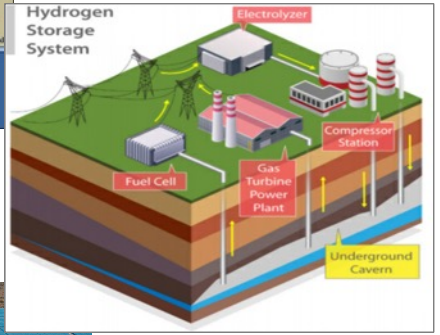
SAND No.: SAND2024-00484PE

What Are Our Technology Options for Stationary Storage?

- Gravity-Based/Mechanical Storage
- Chemical and Hydrogen Storage
- Thermal Storage
- Electrochemical (Batteries) Storage





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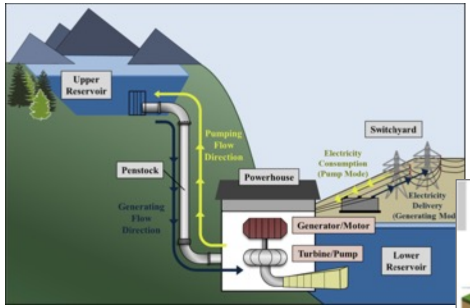

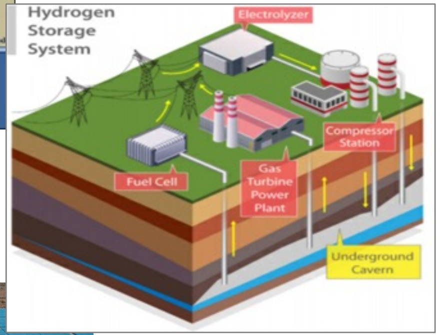

Energy, Power and Applications

Power (kW) – can be thought of as rate of flow of electricity
Energy (kWh) – can be thought of as capacity (power x time)

Power Applications involve relatively shorter discharge durations (seconds to minutes) with fast recharging and often require many cycles per day.

- **Applications include** frequency and voltage regulation, power quality, renewables generation smoothing and ramp rate control and trackside regulation for electric rail operators. For example: Li ion batteries

Energy Applications involve continuous discharges over extended durations (hours or more) with extended recharge times.

- **Applications include** peak shaving, load-leveling, transmission and distribution upgrade deferral, customer demand charge and energy charge reduction, renewables generation shifting and energy arbitrage or commodity storage.

Slide Adapted from Ramesh Koripella

Batteries for Stationary Energy Storage?

- Lithium-Ion Batteries
- Pb-Acid
- Sodium-Ion Batteries
- Molten Sodium Batteries
- Zn-Based Batteries
- Metal-Air Batteries
- Metal-H_2 Batteries
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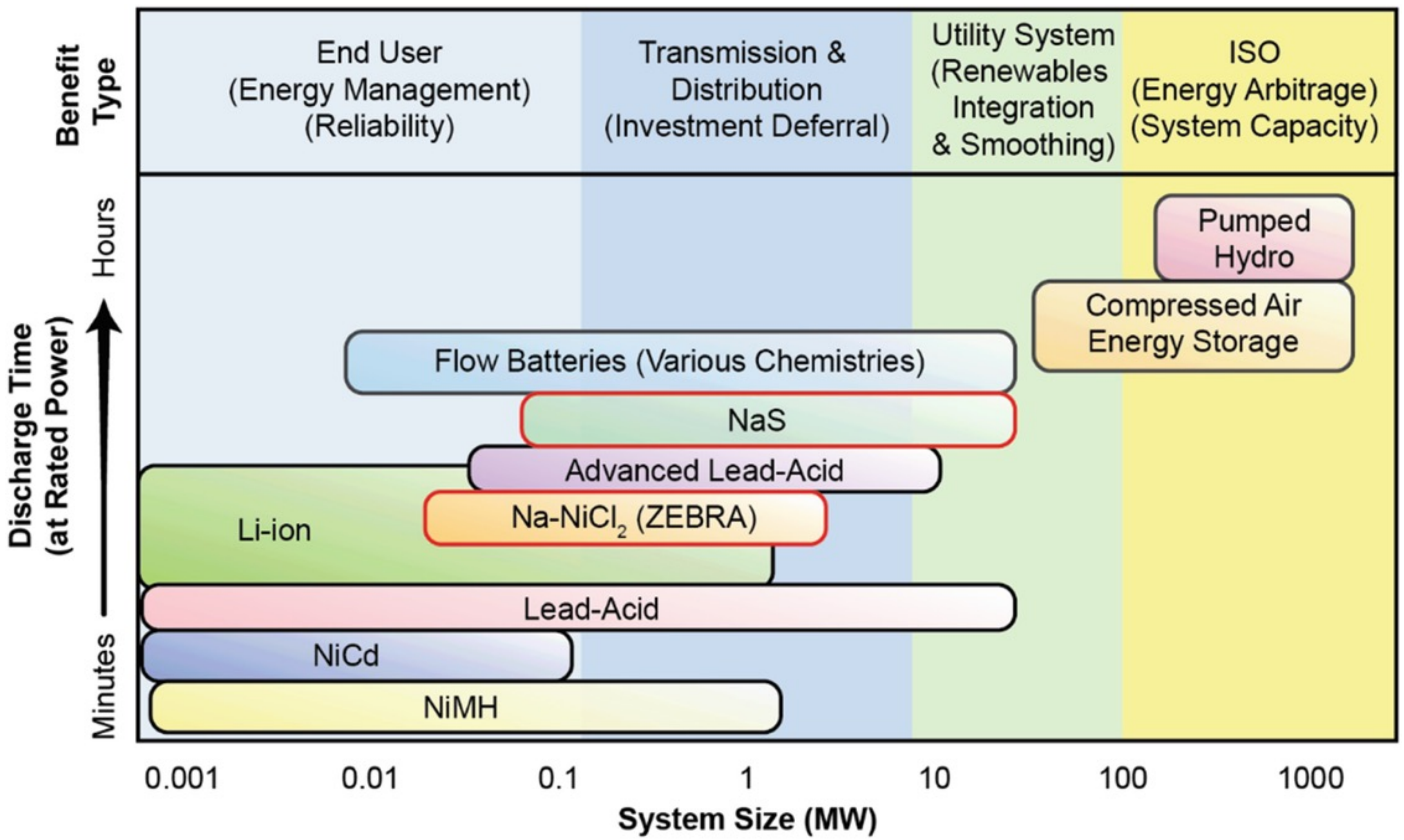

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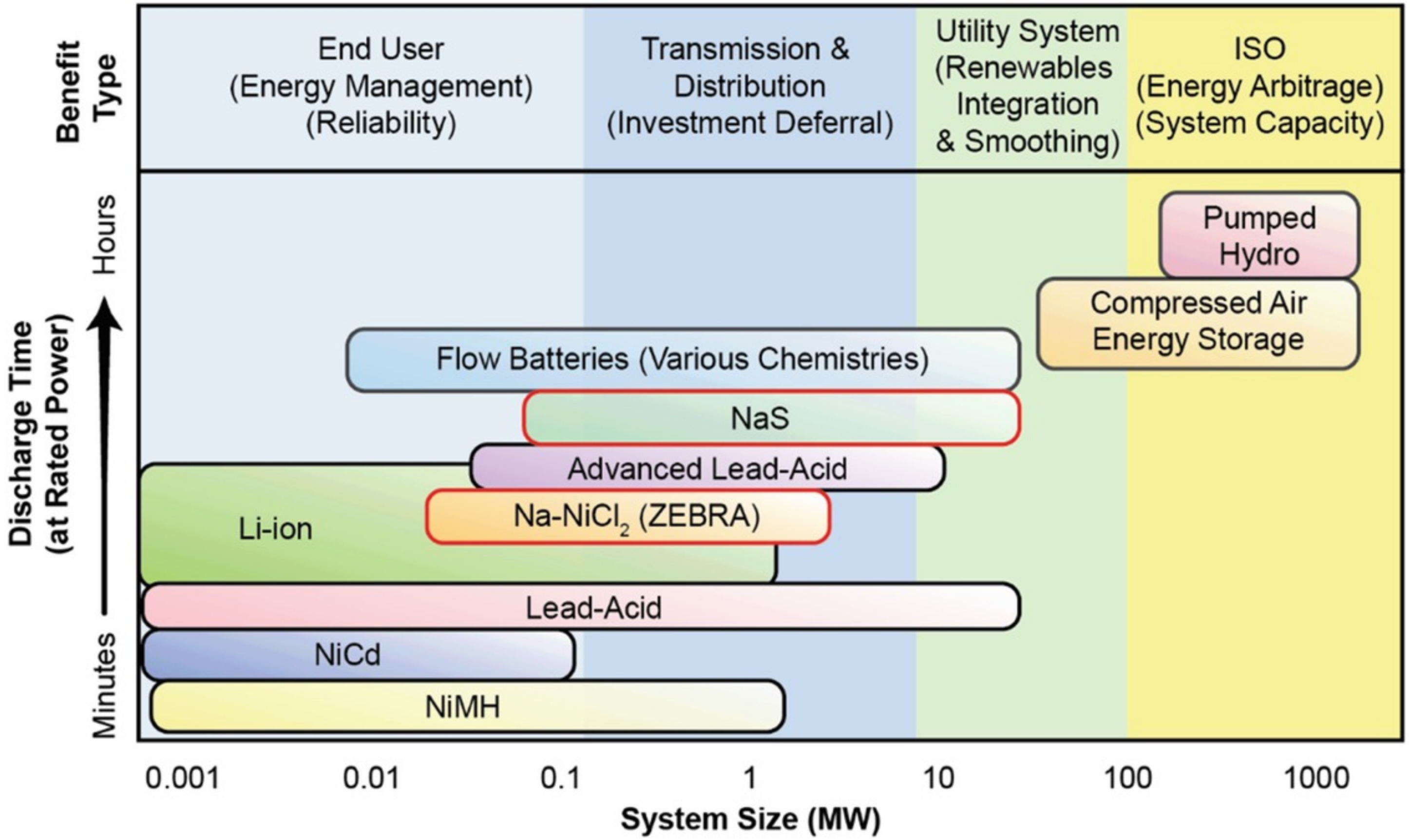
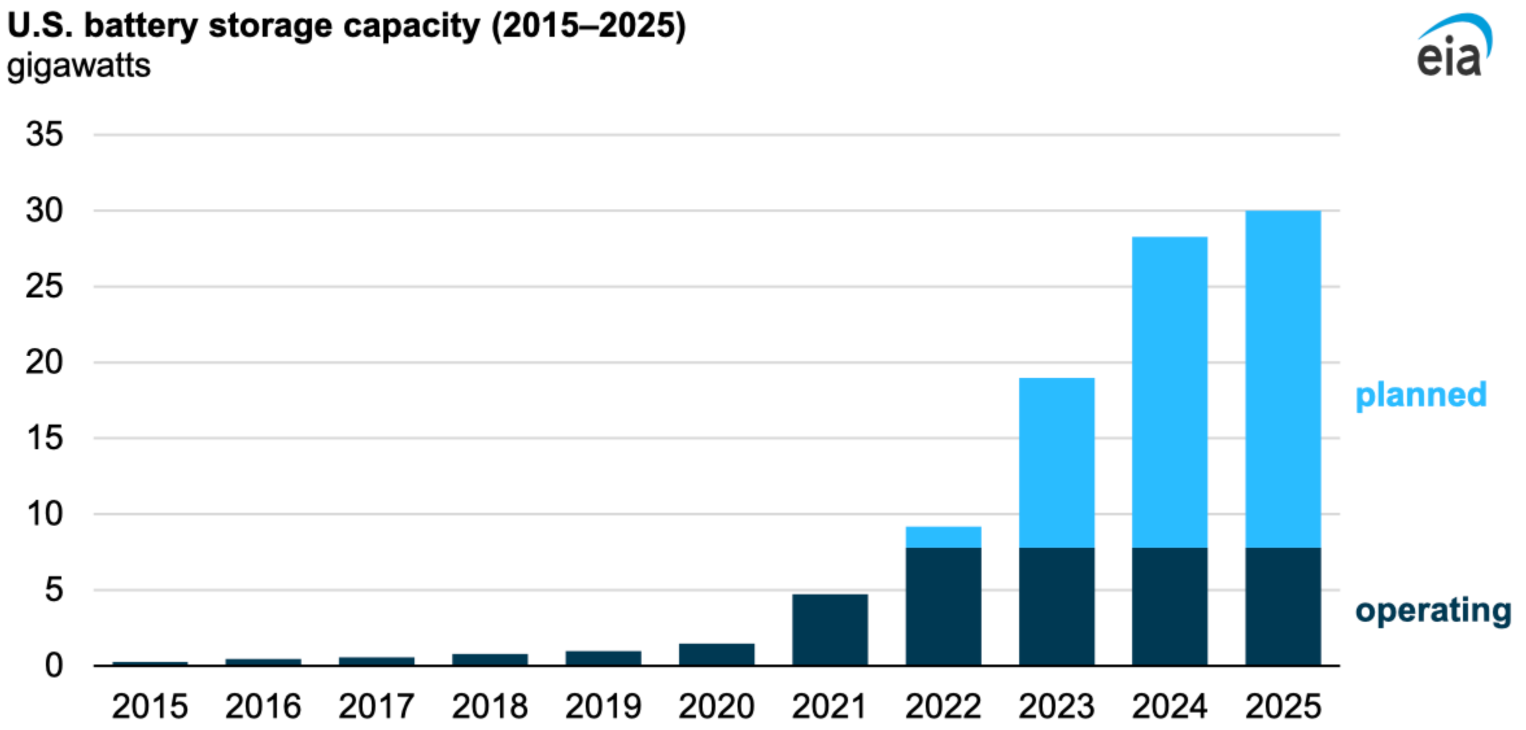


Where Are We?

DECEMBER 8, 2022

U.S. battery storage capacity will increase significantly by 2025



Data source: U.S. Energy Information Administration, *Preliminary Monthly Electric Generator Inventory*, October 2022

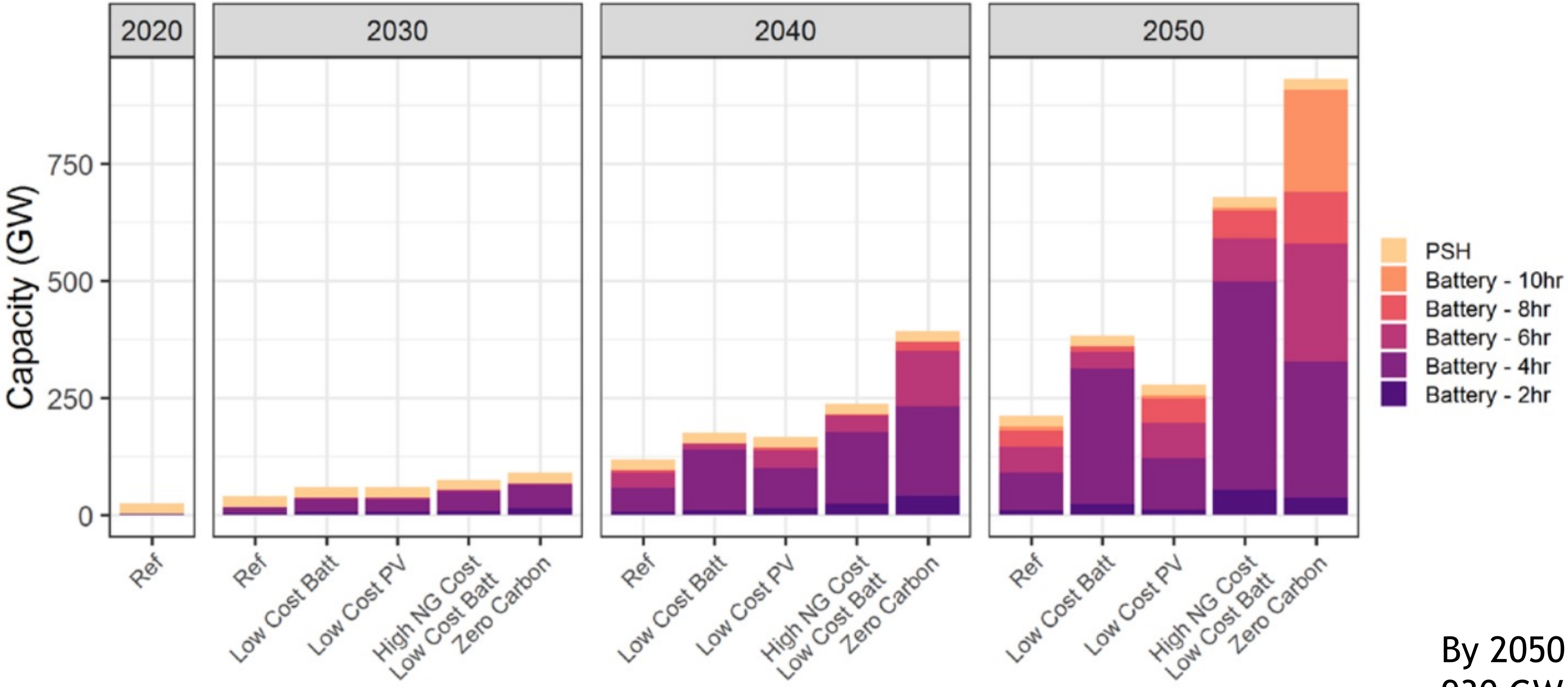
At the end of 2022, U.S. had 9GW/25GWh of installed battery storage.

By Q2 of 2023, U.S. had reached 11 GW/31GWh installed.

Almost All U.S. Battery Storage is in Li-ion (more than 90%).

U.S. Still maintains about 22GW/550GWh of Pumped Storage Hydro.

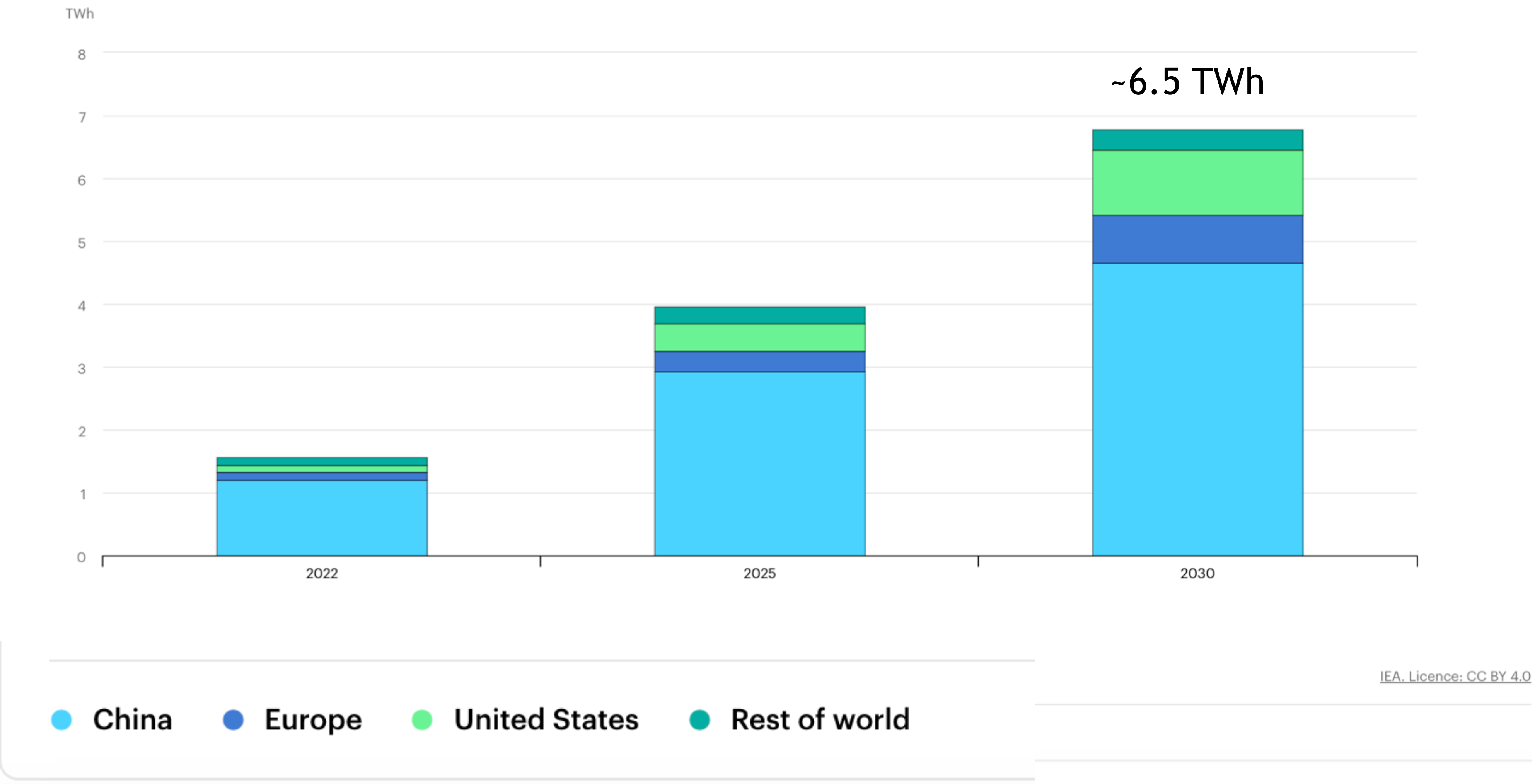
Where Do We Need To Go?



By 2050, U.S. will need 930 GW/6TWh of storage. (85X Increase over today) to hit 94% renewables targets.

2023 NREL Report: “Storage Futures Study Grid Operational Impacts of Widespread Storage Deployment”
https://www.nrel.gov/docs/fy22osti/80688.pdf

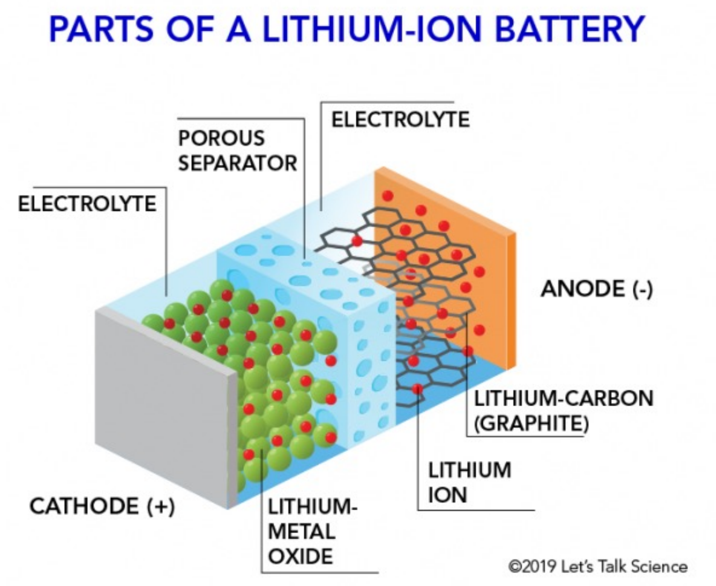
Can we Make Enough Batteries?



EV Battery demand by 2030 is expected to be 4.5TWh!

(McKinsey & Co.)

GWh size Li-Ion BESS Plants No Longer at the Conceptual stage!

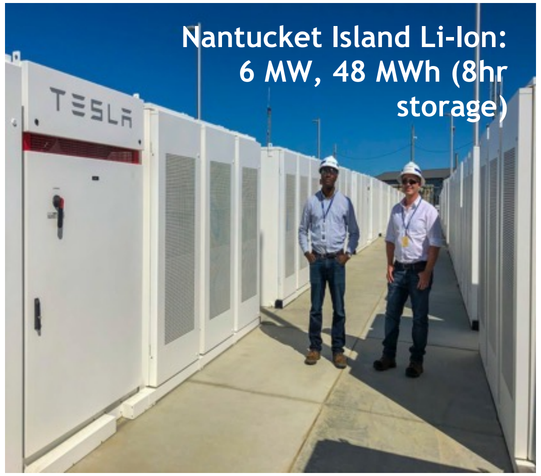


Saft 6 MW / 4.2 MWh ESS
Kauai - Grid Stability

AES 30 MW / 120 MWh ESS, Escondido, CA
Peaker replacement

Tesla 100 MW / 129 MWh ESS
Australia - Grid stability

Vistra Energy, Moss Landing, Monterey, CA - 300 MW / 1200 MWh – Peaker Replacement, Grid Reliability



Slide adapted from Babu Chalamala
Images: Company websites and Wikipedia

But Challenges Remain!


Aerial picture of the 2021 fire incident at Victorian Big Battery, which was thought to be the first incident of its type involving Tesla Megapacks. Image: Country Fire Authority.

One of 40 Tesla Megapacks caught fire at the 50MW/100MWh grid-scale battery storage project in Queensland, Australia. (Sept, 2023)

https://www.energy-storage.news/tesla-megapack-on-fire-in-minor-incident-at-battery-storage-site-in-australia/

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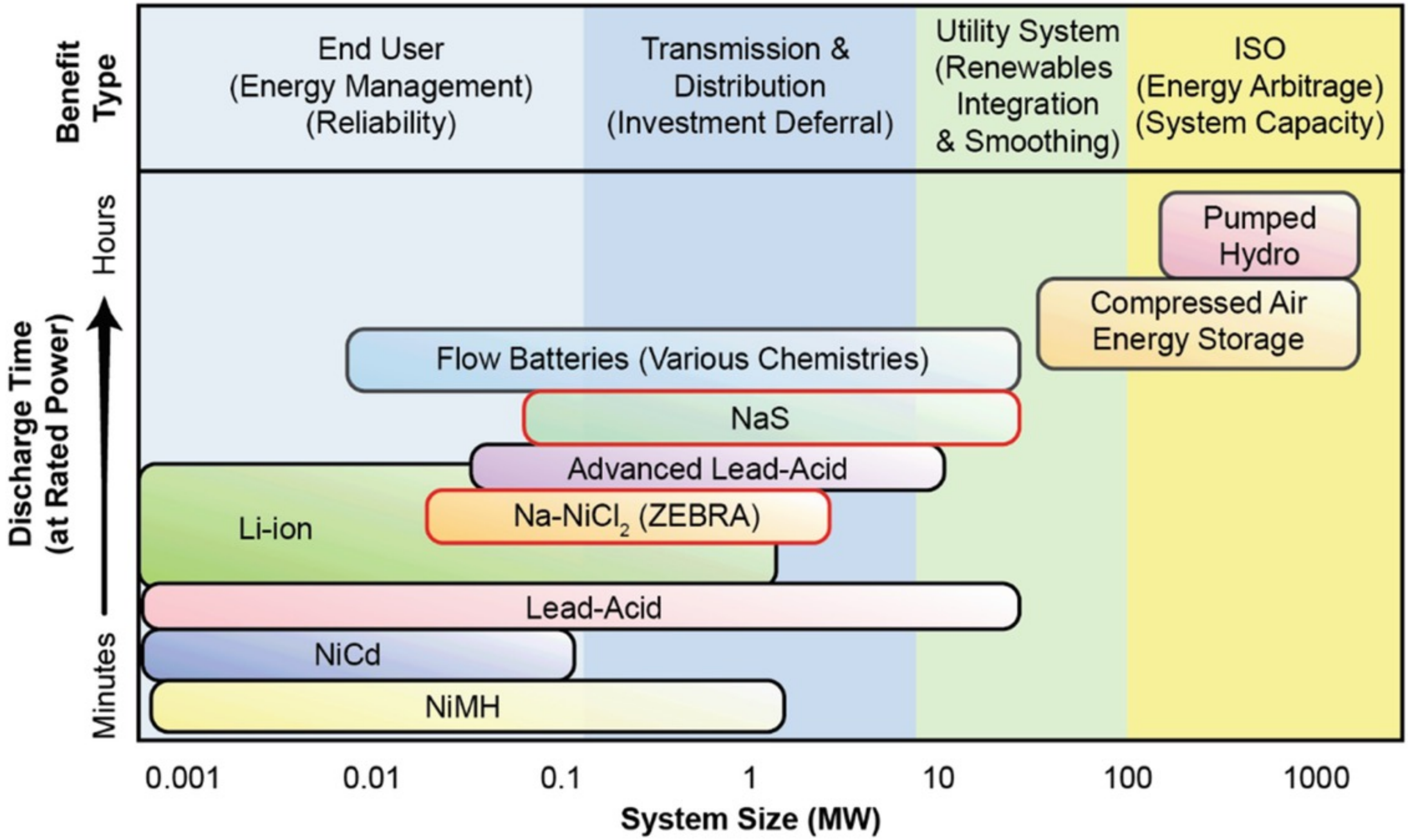
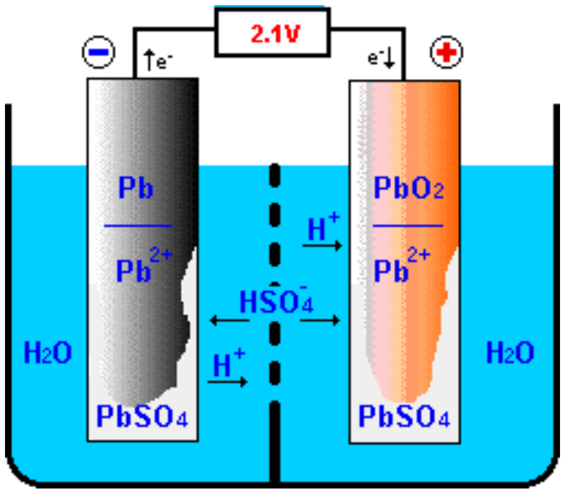


Lead Acid Batteries

- Invented in 1859 by Gaston Planté
- Energy Density ~30-50 Wh/kg
- Typically hundreds of cycles

- The 2020 global market for PbA batteries was ~500 GWh (70% of global energy storage) and $40 billion*

- Automotive/mobile applications
- Off-grid use (e.g., traffic signal and lighting, railroad communications, uninterruptable power supply (UPS), and telecommunications)
- Grid-integrated applications (e.g., renewable integration, load smoothing, time-shifting, etc.)



S.R. Salkuti, DOI:10.11591/ijece.v11i3.pp1849-1856

Battery Operation

- Anode: Pb
- Cathode: PbO_2
- Electrolyte: H_2SO_4

- During discharge, oxidation and reduction reactions at each electrode produce $PbSO_4$.

*DOE SI 2030 Technology Assessment on Pb-Acid Batteries (Sue Babinec)

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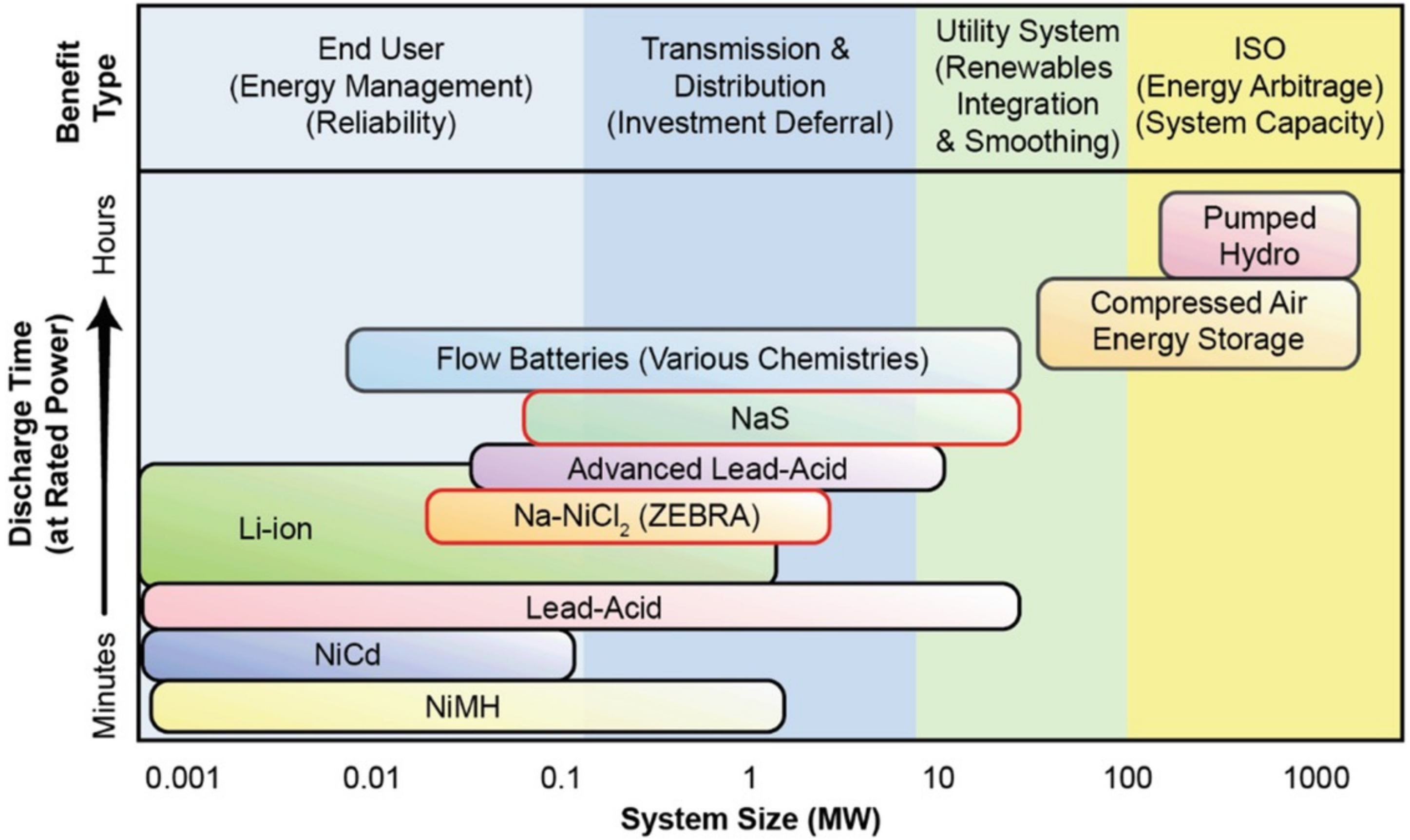
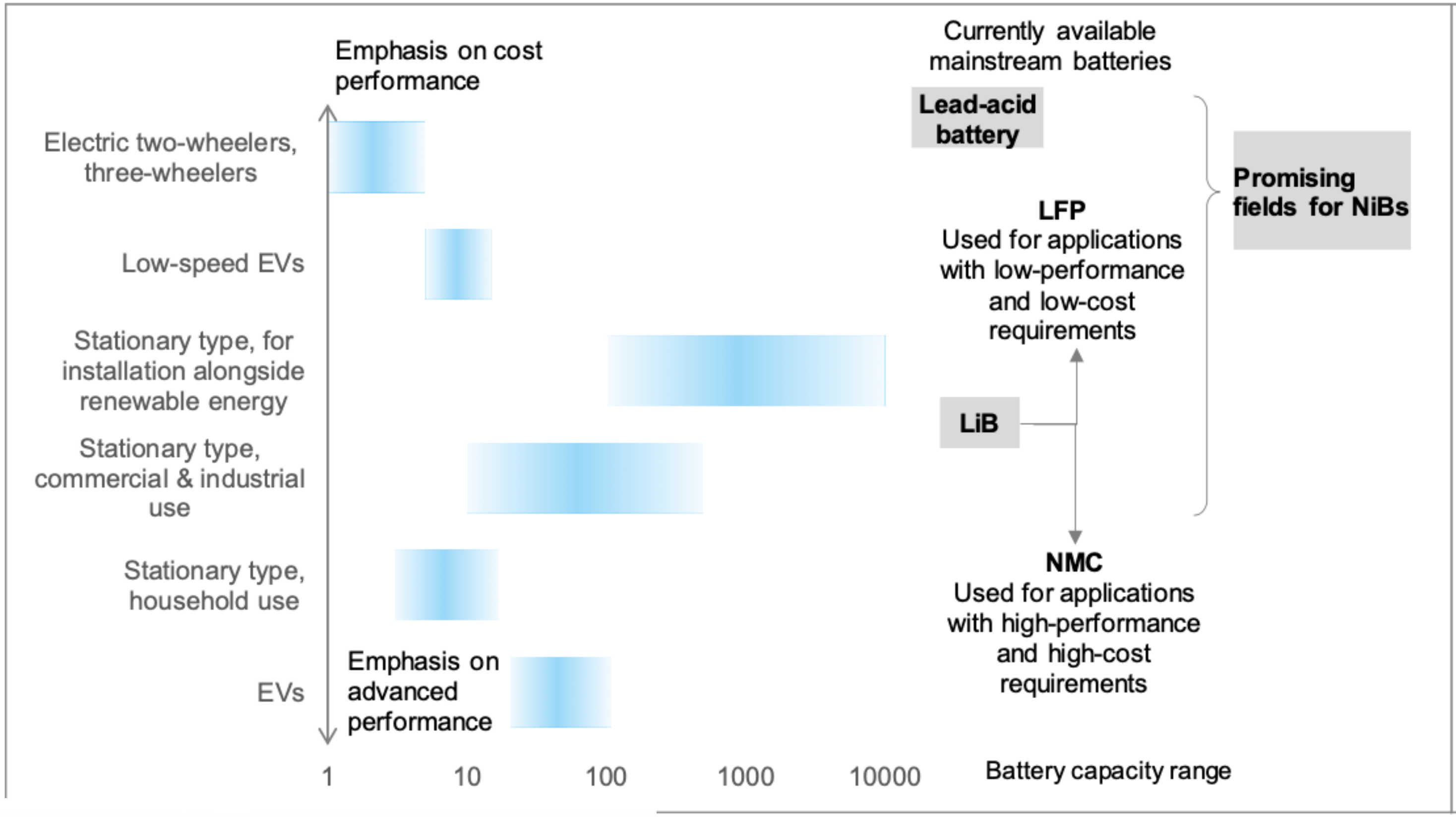
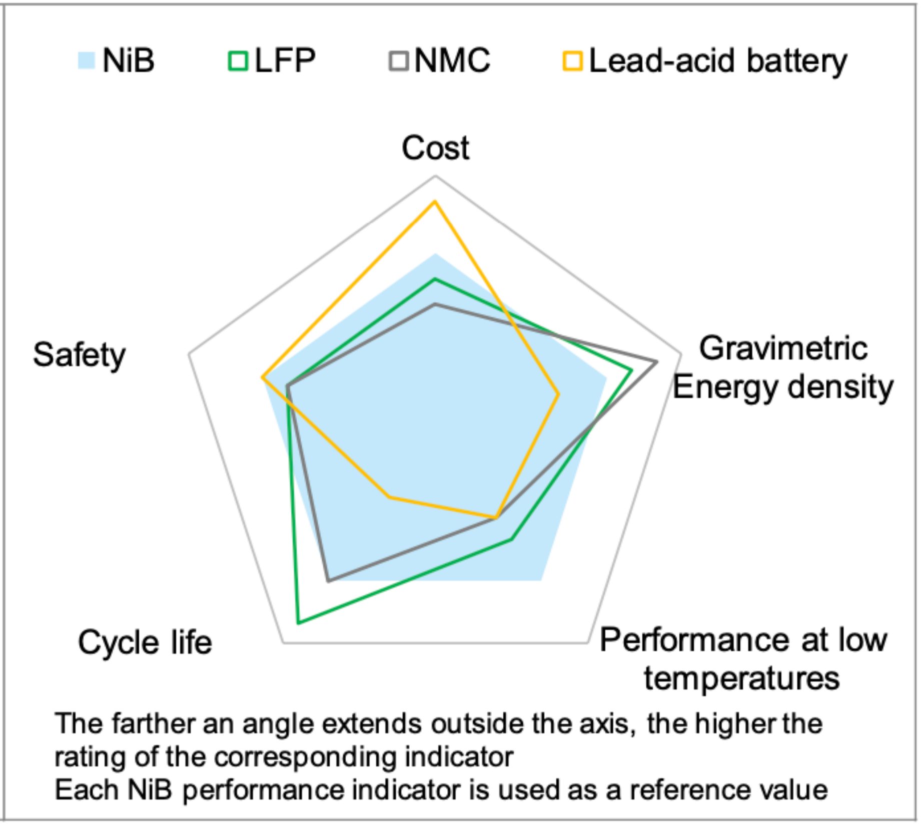
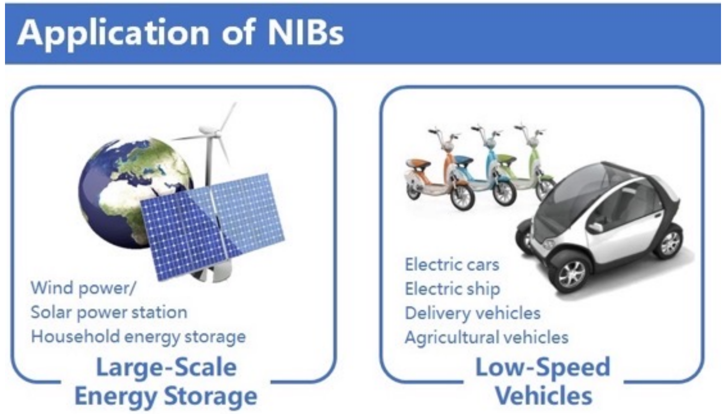


Na-Ion Battery (NaIB, NIB, NiB) Opportunity Space





Mitsui & Co., June 2022



- Projected lower cost, simplified cell architectures, and improved safety are benefits of NaIBs.
- While NaIBs are unlikely to replace LiBs for high power (e.g., EV) applications, low-speed vehicles and stationary storage is likely to be a growing market.
- Woods Mackenzie anticipates growth of 40GWh of NaIBs alone by 2030, but up to an additional 100GWh of manufacturing capacity is projected if the market is successful by 2025

Woods Mackenzie. “Sodium-ion update: A make-or-break year for the battery market disruptor.” Jan., 2023

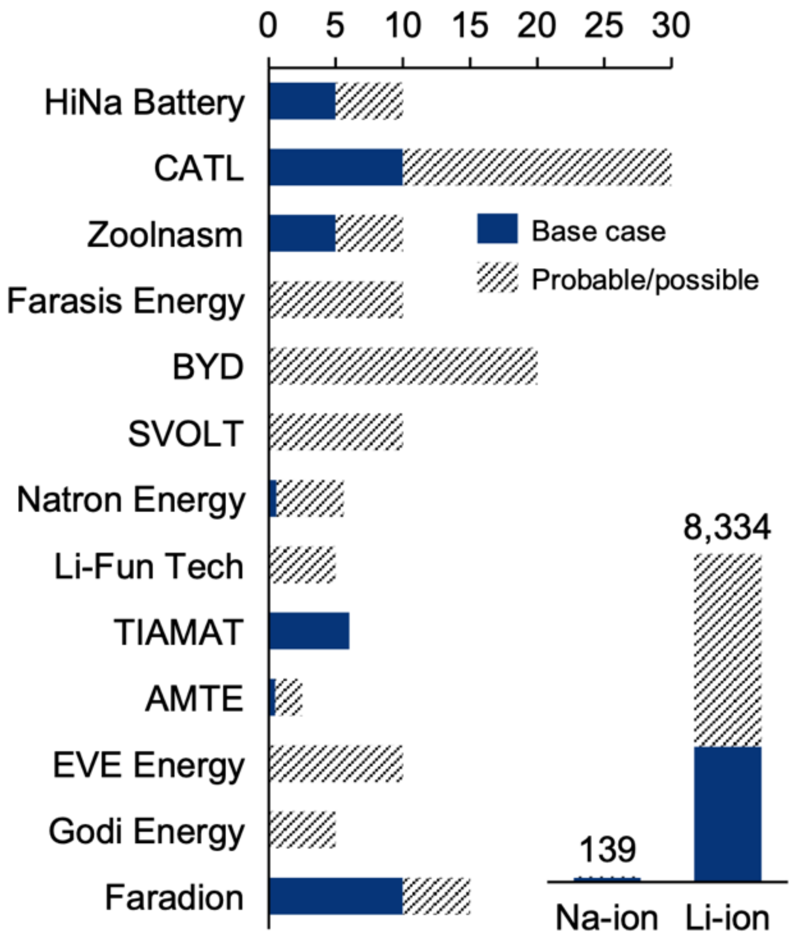
Emerging/Evolving Sodium Ion Batteries

Na-ion cell producers

Year	GWh	Producer	Production details
2022	1-5	中科海钠 HiNa BATTERY	First Na-ion production at GWh scale last year
2023	>10	CATL	Planned GWh-scale production this year
2023	5	ZOOLNASM	Building a factory in Jiangsu, China
2023	-	FARASIS	Partnered with the **JMEV** to develop Na-ion EVs
2023	-	BYD	May launch a Na-ion-based EV this year
2023	-	SVOLT	Expects to develop Na-ion cells this year
2023	0.6	Natron Energy	**Clarios** will manufacture cells this year
2023	-	LiFUN 立方新能源	Planned production in 2023
2020s	6	TIAMAT	**Neogy** will mass produce Na-ion cells
2020s	0.5	amte	Building a factory in Scotland, UK
2020s	-	EVE	Developing cells further before production
2020s	-	GODI	Planning a 5 GWh Li-ion factory before Na-ion
2020s	>10	faradion	Planning double-digit production under **Reliance**

Source: Wood Mackenzie

Pipeline capacity

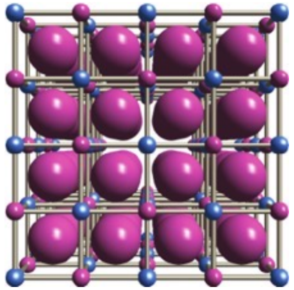


Significant NaIB manufacturing capacity is projected to 40-100 GWh by 2030.

Alternative Sodium Ion Batteries

Prussian Blue Analogs (PBAs)

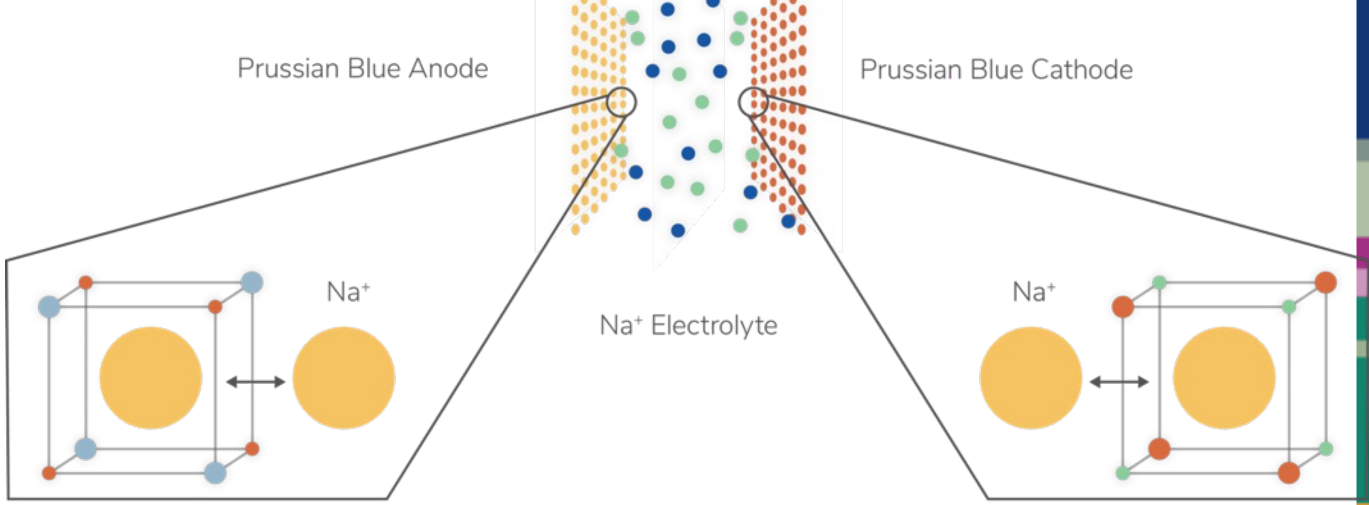
- Utilize ferric ferrocyanide salts as electroactive materials



Y. Moritomo, *Adv. Cond. Matt. Phys.* (2013) 539620.

- **Natron Energy** is developing PBA-NaIBs (with Clarios in Michigan)
  - Aiming for 600MW annually starting in 2023.
  - Focus on High Power
    - 25kW, 48V module, scalable to 812V with full charging in 15 minutes.
    - 4kW at 48V for 2 mins with a 6kW peak power rating and 8-minute recharge time.
  - As many as 100,000 cycles projected!
  - -20C to +45C Operation

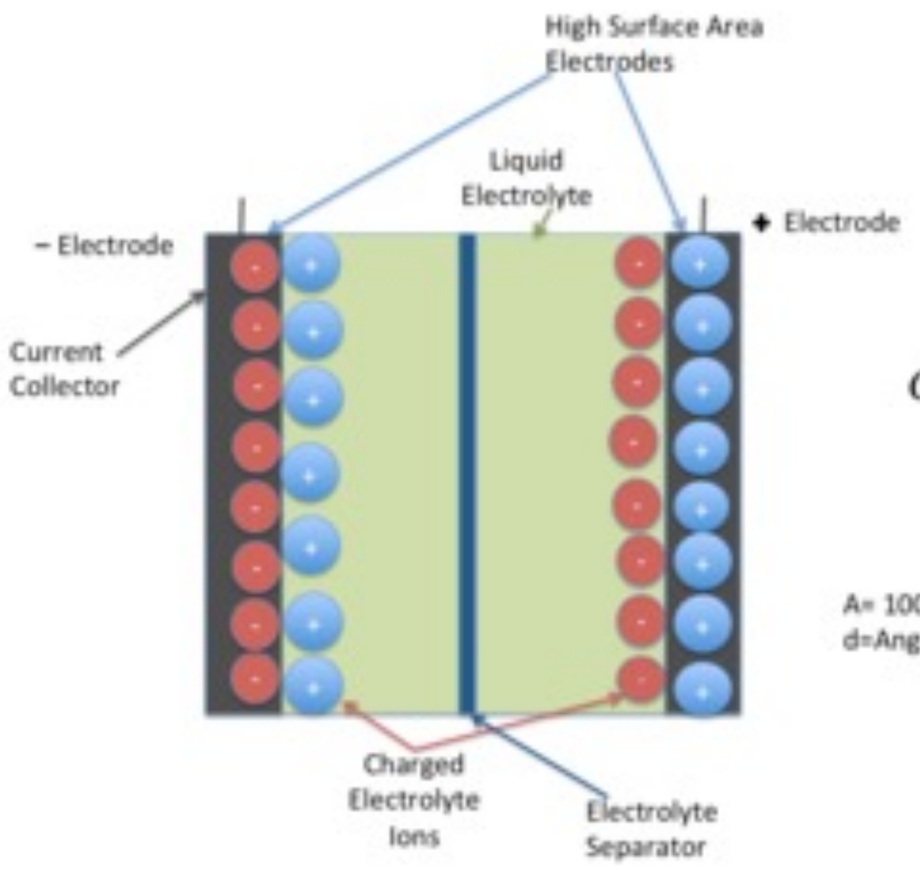
Natron Energy



- **Altris** (Sweden) (Focus on sustainable materials)
  – Prussian White (Fully Reduced and sodiated PB)
  (Pilot Line underway)

*For Supercapacitors Technology Assessment:https://www.energy.gov/oe/storage-innovations-2030

SuperCapacitors



$$C \propto \frac{A \uparrow\uparrow}{d \downarrow\downarrow}$$

A= 1000 or more m^2/g
d=Angstroms

- Critical infrastructure: provide ride-through power (e.g. during generator start up).
- Industrial and manufacturing: ensure constant voltage in variable-frequency drives that operate critical manufacturing; provide quick peaking power (e.g., for seaport cranes).
- Microgrids: used along with battery energy storage in microgrids and off-grid remote facilities to buffer current during equipment start-up and during line faults.
- Bulk power systems: used in a flexible alternating current transmission system (FACTS) and in high-voltage direct current transmission to alter the impedance of the line in order to regulate power factor and transmission capabilities by injecting or absorbing reactive power; used in renewable systems integration for improving power quality.

*For Supercapacitors Technology Assessment:https://www.energy.gov/oe/storage-innovations-2030

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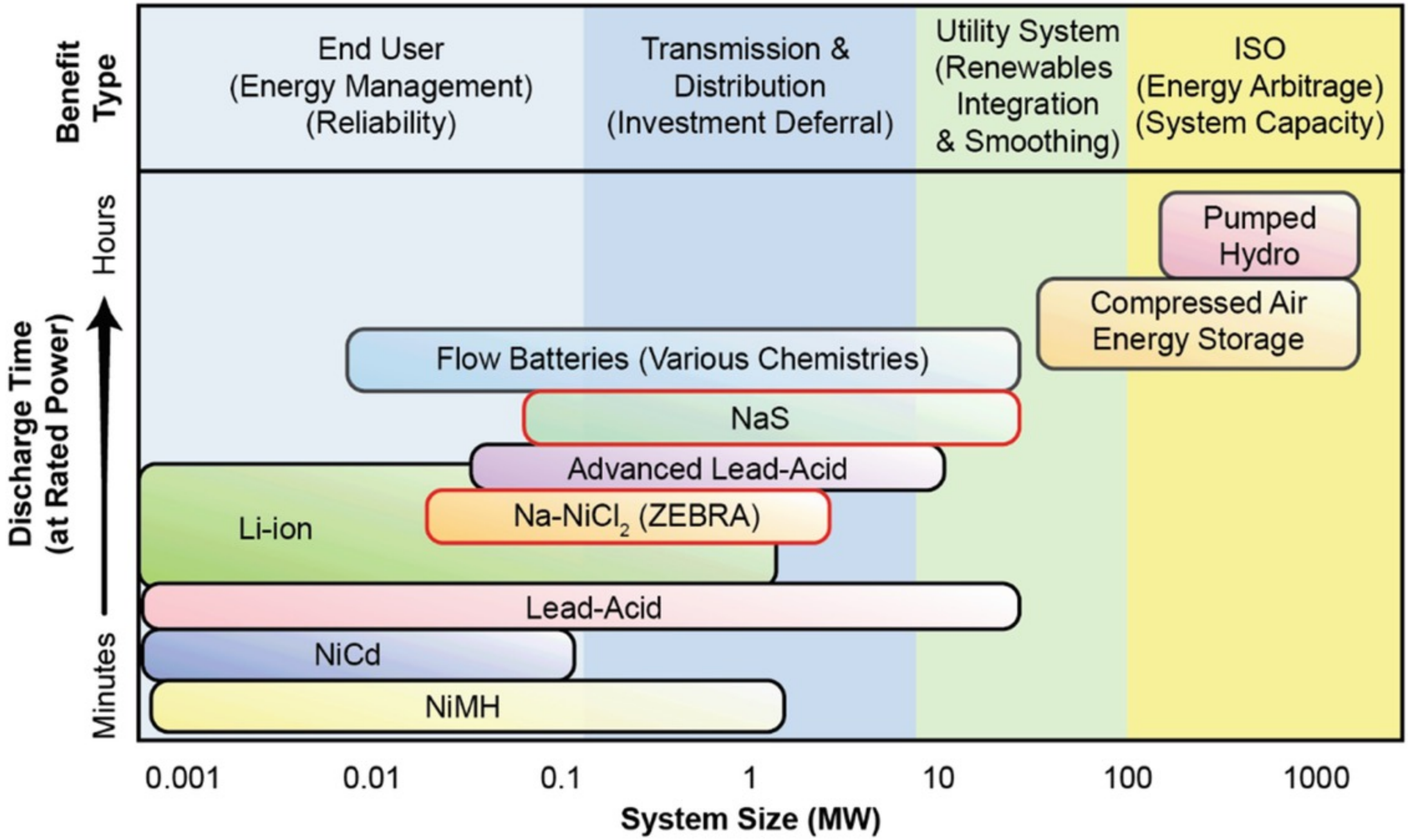
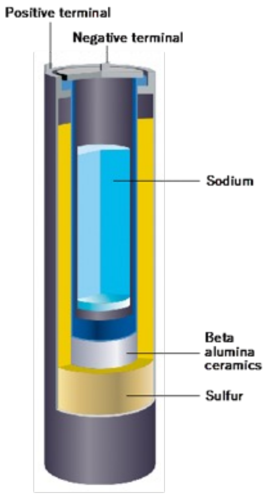
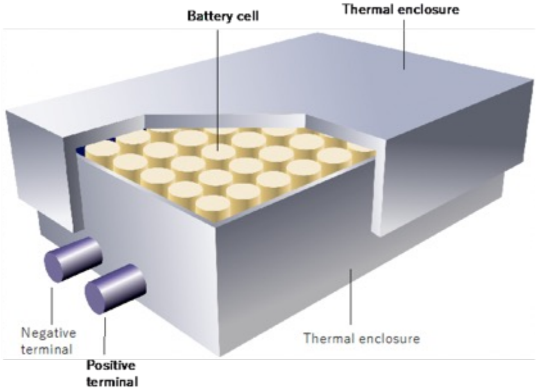


Molten Sodium Batteries





	Practical Energy Density (Wh/L)	Expected Cycle Life (cycles at 80% DOD)	Expected Lifetime (years)	Operating Temperature (°C)	Suitable Ambient Temperature (°C)	Discharge Duration (at rated power)	Round Trip Efficiency
NaS	300-400	7,300	15	300-350	-20 to + 40	6-7 hours	80%
Na-NiCl$_2$	150-190	>4500	20	270-300	-20 to +60	2-4 hours	80-85%

NaS and Na-NiCl$_2$ batteries are used today for Renewables Integration, Grid Services, Consumer Applications, and Microgrids

Na-S

NGK INSULATORS — BASF We create chemistry

xS + 2Na ←→ Na$_2$Sx (3 ≤ x ≤ 5)   E$_{cell}$ ~2.08 V at 350ºC

- ✓ 700 MW/4.9 GWh of deployed storage in over 200 cites globally
- ✓ Recent 108 MW, 648MWh system in Abu Dhabi

Na-NiCl$_2$

FZSoNick

NiCl$_2$ (s) + 2Na (l) ←→ 2NaCl + Ni (s)   E$_{cell}$ ~2.58 V at 300ºC

- ✓ Extensive global deployments for grid-based and BTM use.
- ✓ Recyclable
- ✓ UL1973, UL9540A, other safety certifications

50MW Fukuoka Installation (Japan)

Storage for PV support in South America

- Na-S takes advantage of low cost materials, but introduces some safety concerns.
- Na-NiCl$_2$ is a safer, greener chemistry, but high, variable cost of Ni is a challenge.

Molten Sodium Batteries In Practice

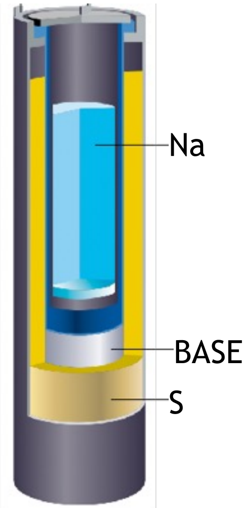


Image from NGK Insulators

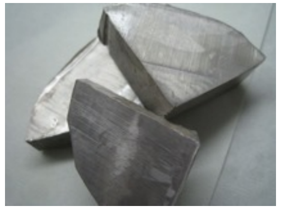
"Mature" High-Temperature NaS and Na-$NiCl_2$ deployments support:

- Renewables Integration
- Grid Services
- Microgrids
- Behind-the-Meter Applications
- Select Mobility

BASF We create chemistry

NGK INSULATORS

FZSoNick

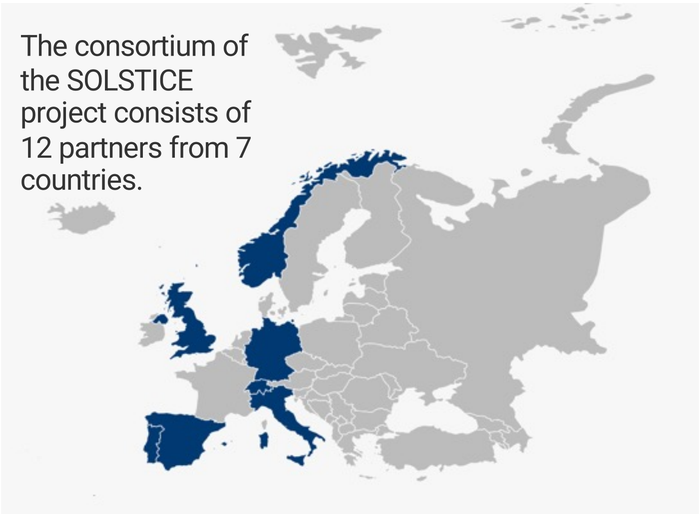


SOLSTICE

Sodium-Zinc molten salt batteries for low-cost stationary storage

SOLSTICE

(Na-Zn) high temperature batteries (molten and ZEBRA



Emerging systems show promise

- Low-temperature molten salt
- Molten Na flow batteries
- Solid State Na batteries

INLYTE ENERGY

ENLIGHTEN®

ADENA POWER

LiNa Energy

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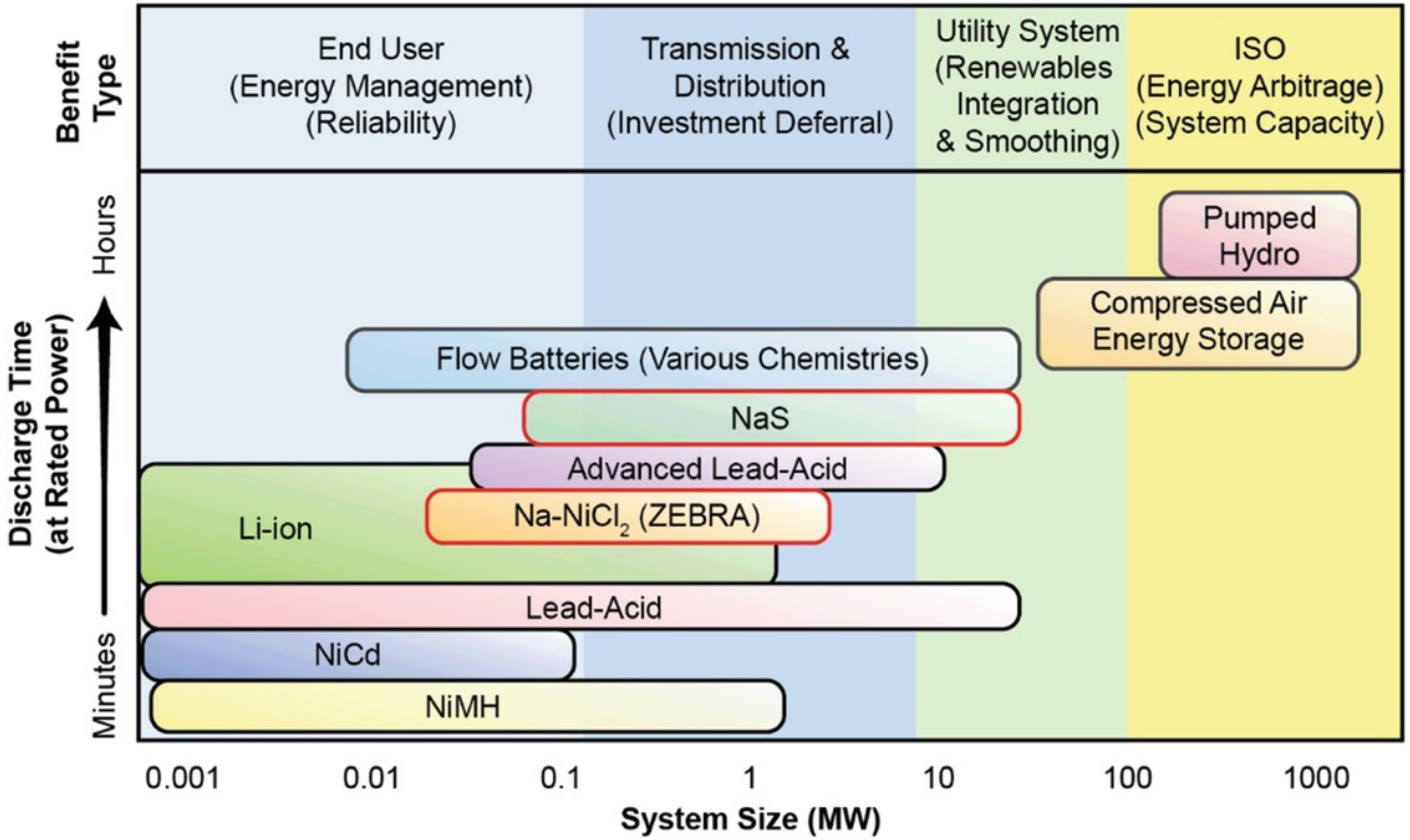


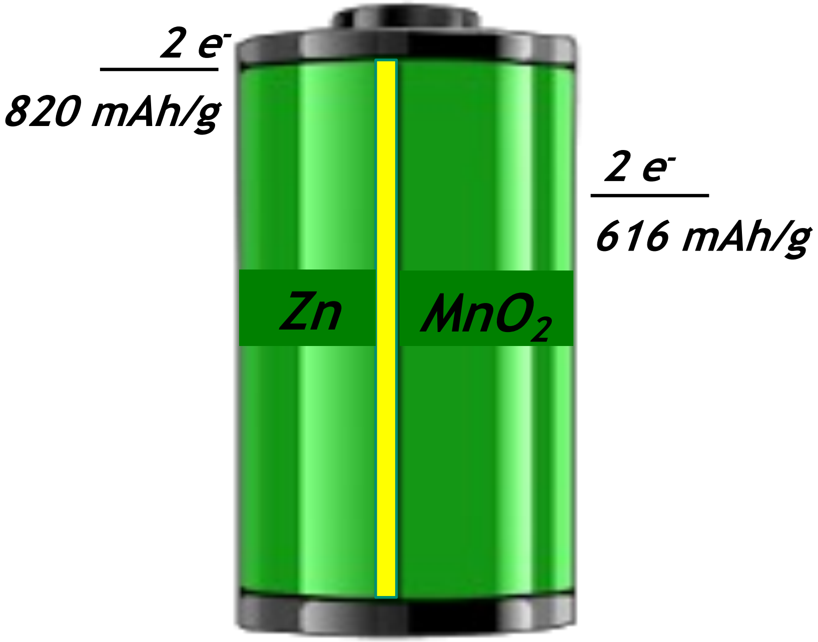
Rechargeable Alkaline Zn-MnO_2 Batteries

Promising large-scale storage candidate

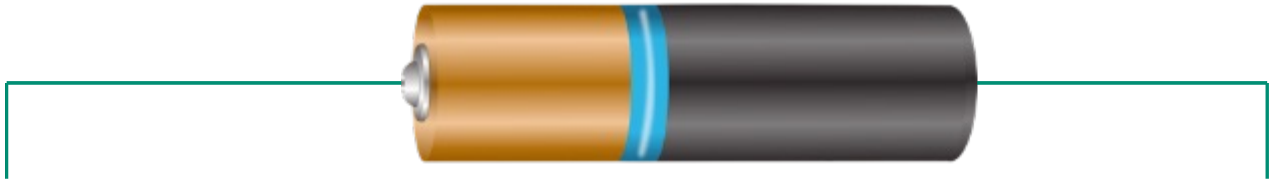
- Low cost: traditional primary batteries @ $18/kWh
- Long shelf life, lowest cost of materials, lowest manufacturing expenses, established supply chain
- Can be scaled to large form factors
- Limited thermal management required compared to Pb or Li
- Safer, environmentally friendly (EPA certified for landfill disposal, non flammable)

Challenge: Re-chargeability = Battery Lifetime & Cost

Energy density of up to 400 Wh/L or 150 Wh/kg: comparable to Li-ion



Zn-MnO_2



MnO_2

- ~ $1-2 per lb
- Mn, 12th most abundant
- 16,000,000 tons (2012)
- Safe

KOH

- Potash ~ $260 per ton
- Abundant
- Aqueous
- > Safety than Li-organics

Zn

- ~ $1 per lb
- 25th most abundant
- 13,000,000 tons (2012)
- Safe

SNL Principal Investigator: Dr. Tim Lambert (tnlambe@sandia.gov)

Rechargeable Zn-based Batteries

- Low-cost, high energy density, safety, and global availability have made Zn-based batteries attractive for more than 220 years!
- *Diverse* Zn-batteries offer a range of properties to meet growing demand across varied applications:

✓ Renewables integration (including microgrids)

✓ Backup power (assurance for data centers, telecom, etc.)

✓ Grid stability and resilience

✓ Behind-the-meter applications for residential and commercial applications (Lower energy cost, power quality, etc.)

Zn-MnO_2

URBAN ELECTRIC POWER

1 MWh UEP alkaline battery backup system for the San Diego Supercomputer Center (CA).

ZĒLOS

Zn-Ni

ZincFive

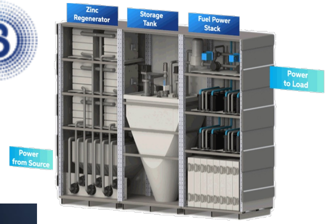
ZAF Energy Systems

Æsir Technologies, Inc.

ENZINC

Zn-Air

ZINC8

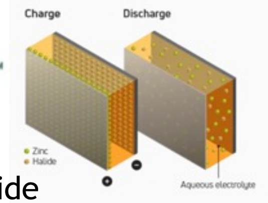


ZAF Energy Systems

e-zinc

Zn-Br

eos



35 MWh EOS Zn-Br system planned to provide 10 hour storage for solar-plus-storage microgrid with Indian Energy (CA).

redflow

Zn-Br flow battery installation

Zn-ion

SALIENT ENERGY

enerpoly

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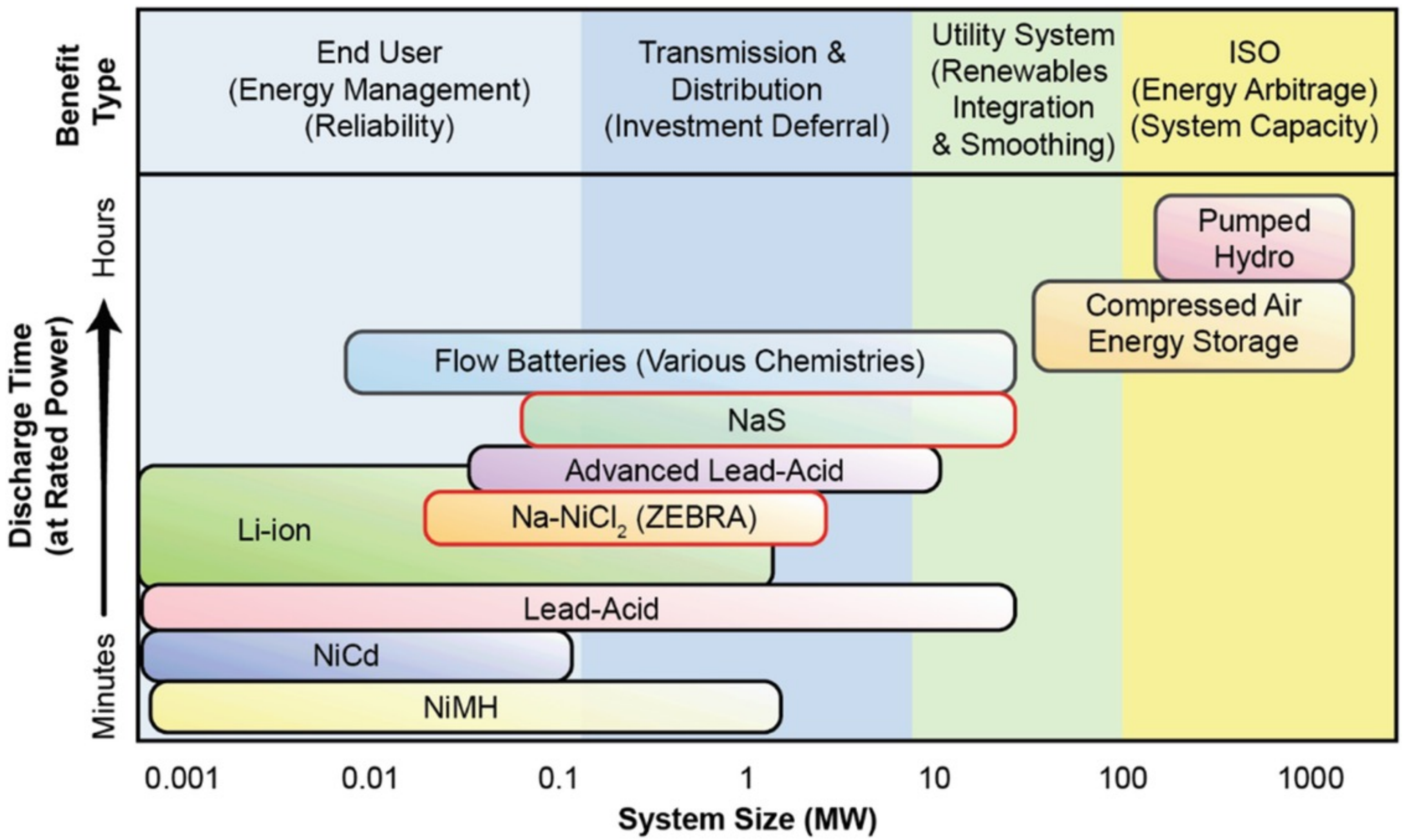

Air-Based Batteries

- Utilize air-based cathode and earth-abundant metal anode.
- Challenges around reversible, fast kinetics of oxygen evolution reaction (OER) or oxygen reduction reaction at cathode(s).
- Air-breathing cathodes also must address side reactions with variable atmospheric conditions.

ZINC8

e-zinc

ZAF Energy Systems (Portable electronics)

Zn-Air Batteries targeting scalable storage up to 24 hours.

Zinc8

- Demonstration project at 32-building Fresh Meadows Community Apartments in Queens, NY was announced in early 2022 as Zinc8's first private-sector installation: 100kW/1.5MWh storage system. (BTM - Powered by solar, combined heat and power system will minimize peak demand.)
- Zinc8 is planning U.S. manufacturing site (late 2024, 2025): Projected to create 500 Jobs Through a 5-year $68 Million Investment Plan in the Mid-Hudson Region (Ulster County) and Build Environmentally and Economically Friendly Zinc-air Long Duration Energy Storage Systems.

e-Zinc

- CEC installation (2022, Camarillo, CA) targeted 40kW with 24 to 48 hours of duration. Capture solar generation to discharge during peak hours and to power irrigation at night and provide backup power.
- Demonstration project for Toyota Tsushu Canada Inc. (TTCI) is planned at Eurus Energy America Corporation's (EEAC) Bull Creek wind facility in Borden County, Texas (Bull Creek). Pilot program will store excess wind generation capacity and is expected to store power for 24 hours.

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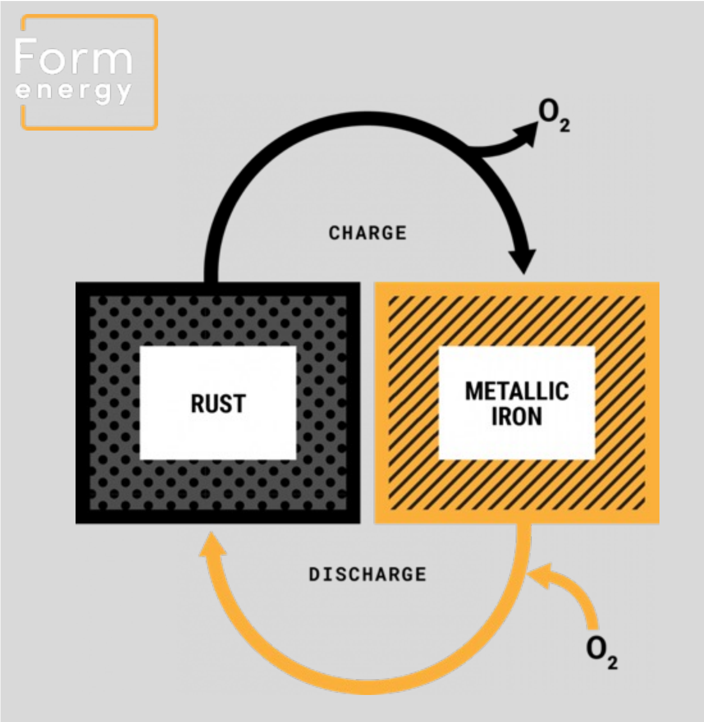
Fe-Air: Targeting 100 hour storage



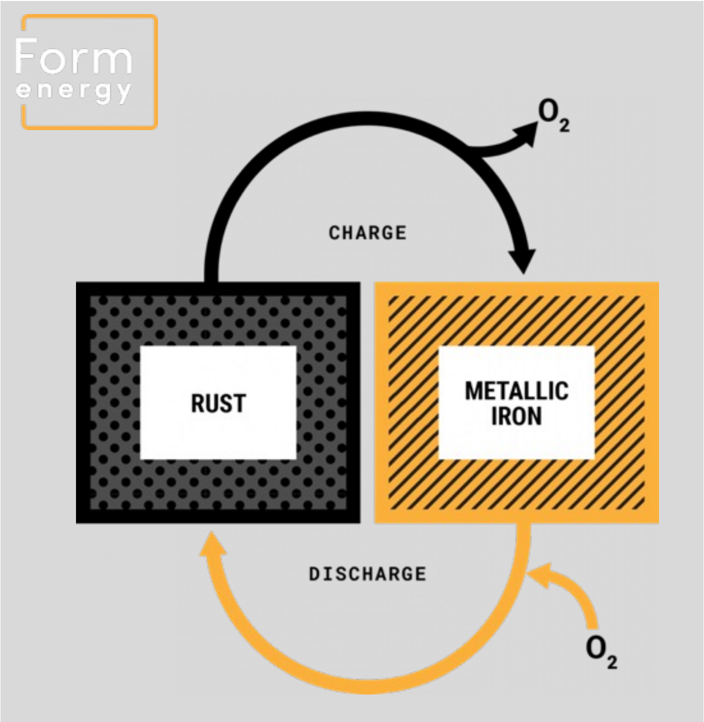
Form Energy's large-scale manufacturing facility in Weirton, WV

August…

…December

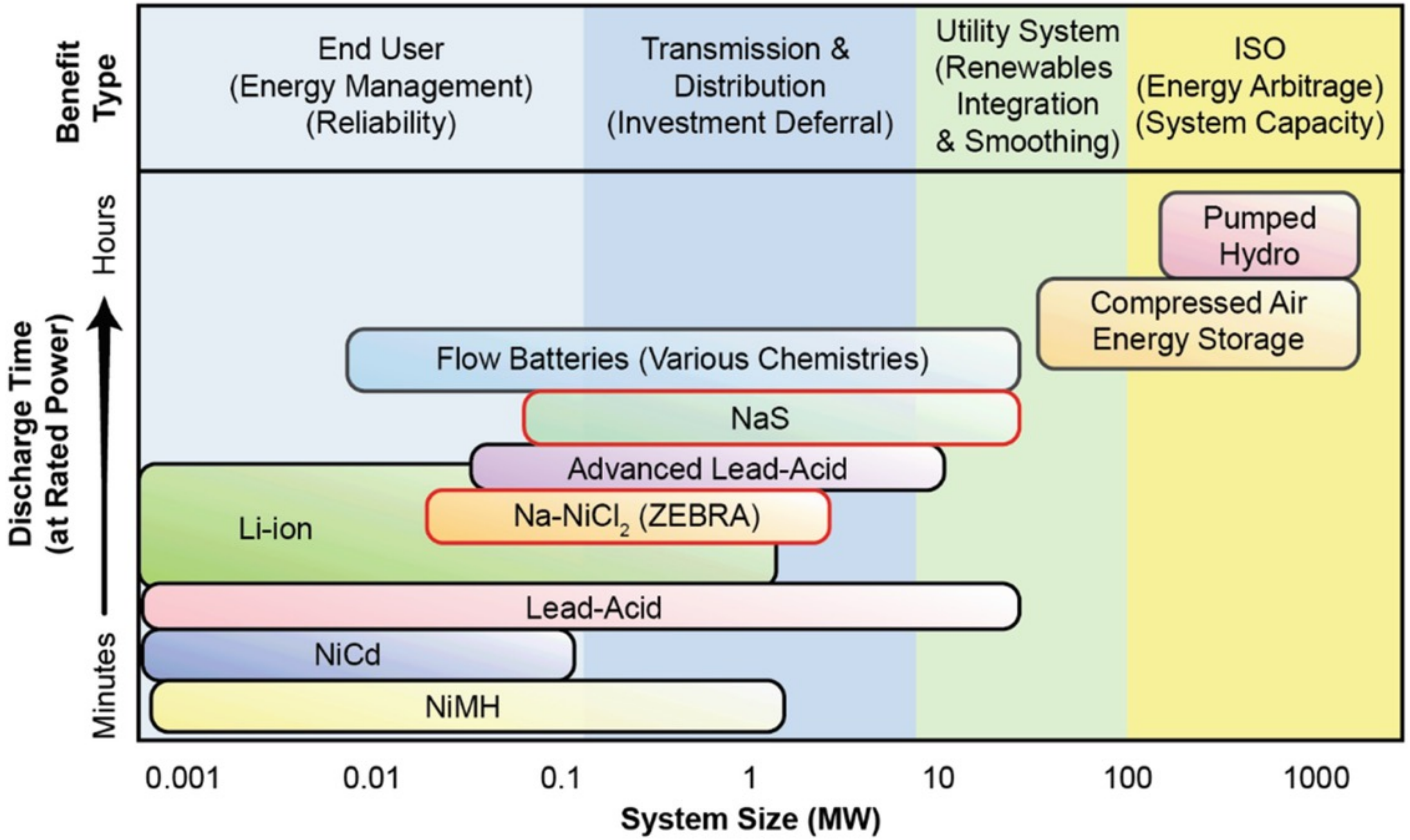
Fe-Air Planned Deployments

- Xcel Energy in MN (Sherco site)
  - 10 MW, 1000 MWh system
  - 5 acres of land, near solar plant being developed to provide 710 MW of power.
  - Construction to begin Q2 of 2024, expected to come online as early as 2025.
  - 15-20 construction jobs and $9M in local tax revenue.
- Comanche Generating Station in Pueblo, CO
  - 10 MW, 1000 MWh system
  - Expected to come online as early as 2025.
- NYSERDA
  - Location TBD
  - 10MW/1000MWh
  - Expected to come online by 2026.
- Pacific Gas and Electric Company (PG&E) (CA)
  - 5 MW, 500MWh
  - electric substation in Mendicino County
  - expected to come online by 2025.
  - (Supported through the CEC)



Batteries for Stationary Energy Storage?

- Lithium-Ion Batteries
- Pb-Acid
- Sodium-Ion Batteries
- Molten Sodium Batteries
- Zn-Based Batteries
- Metal-Air Batteries
- Metal-H_2 Batteries
- Flow Batteries
- Molten Metal Batteries

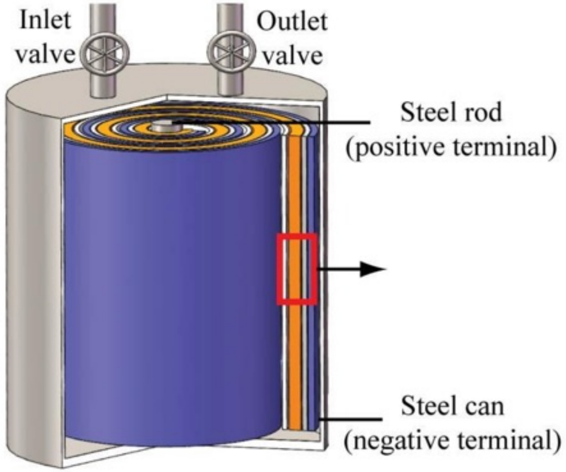


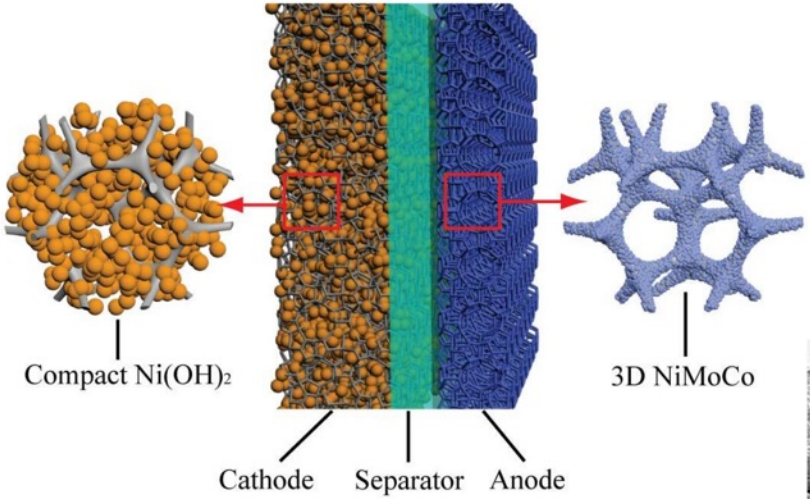
Metal-H2 Batteries

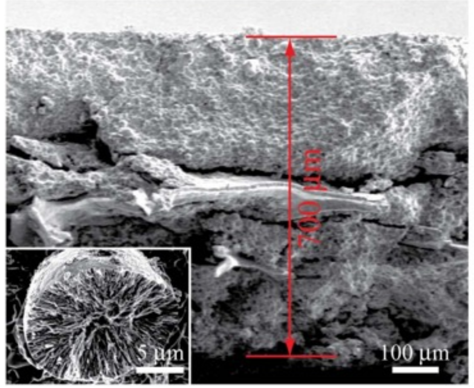
NASA has used this technology for more than 30 years.

Ni-H_2 battery: design and principle

Stanford | ENGINEERING
Materials Science & Engineering







$$\text{Cathode: } Ni(OH)_2 + OH^- \underset{\text{discharge}}{\overset{\text{charge}}{\rightleftharpoons}} NiOOH + H_2O + e^-,$$

$$\text{Anode: } H_2O + e^- \underset{\text{NiMoCo, discharge}}{\overset{\text{NiMoCo, charge}}{\rightleftharpoons}} \frac{1}{2} H_2 + OH^-,$$

$$\text{Overall: } Ni(OH)_2 \underset{\text{NiMoCo, discharge}}{\overset{\text{NiMoCo, charge}}{\rightleftharpoons}} NiOOH + \frac{1}{2} H_2.$$

Wei Chen, Yi Cui*, *et al. Proc. Natl. Acad. Sci.* 2018, 115 (46), 11694-11699.

Metal-H2 Batteries

ENERVENUE

2-12 hours of storge with deep cycle discharge
3 daily cycles
30 year life
30,000 cycles

Energy Storage vessels

- March 2023, announced Gigafactory will be built in Shelby County, KY. Plan to ultimately produce 20 GWh/year.
- May 2023, Completed UL9540A Fire Safety Testing and Achieves Certification to UL 1973 for Battery Energy Storage Systems.
- June, 2023 – will partner with High Caliber Energy (LNG company) to produce 25 MWh for an undisclosed client in SE U.S. by Q4 2024.
- October, 2023 – With VedantaESS, will procure and deploy 525 MWh of storage (Energy Storage Vessels) over the next 3 years in Brazil (São Paulo).
  - 75MWh in 2024, 150 MWh in 2025, 300 MWh in 2026.

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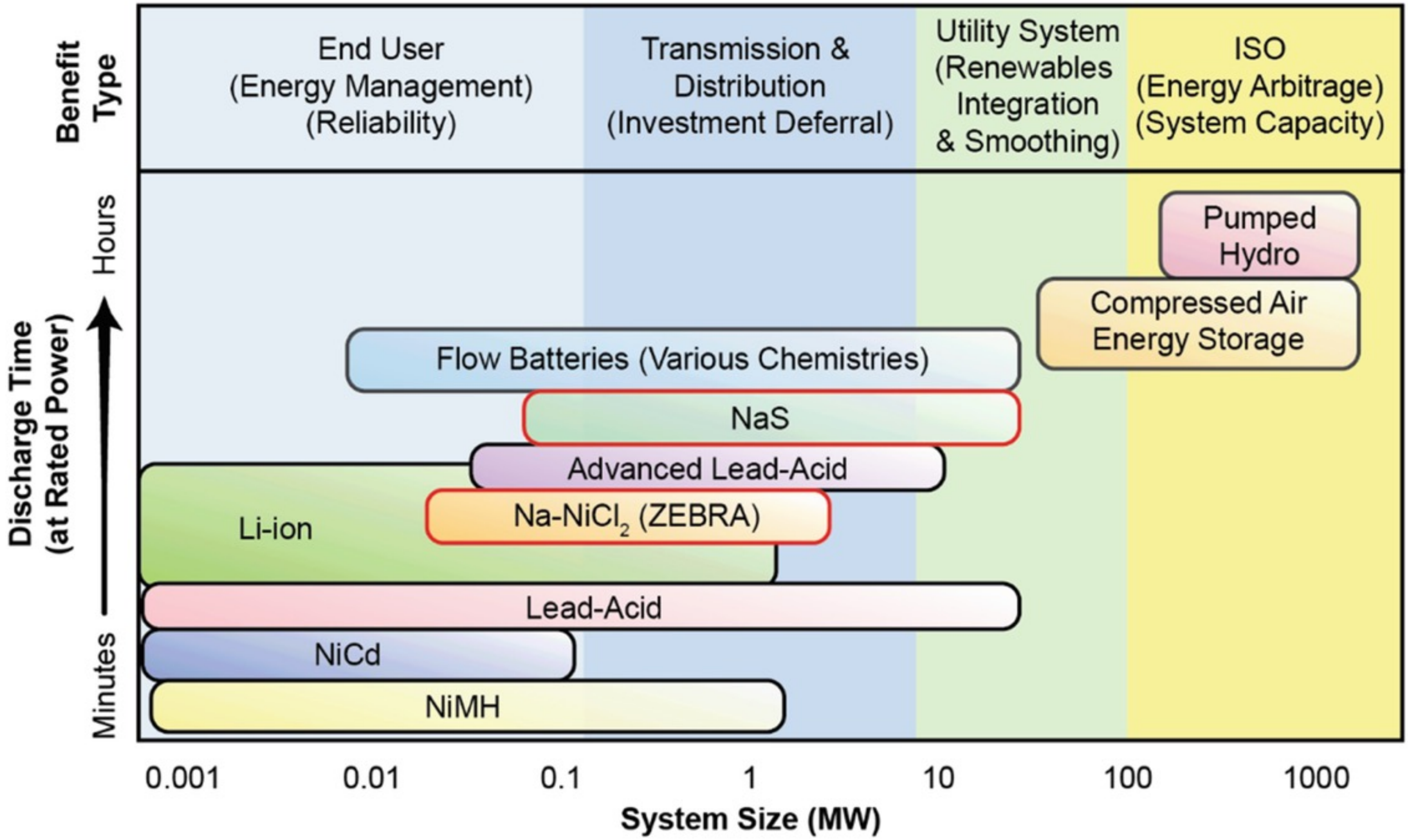
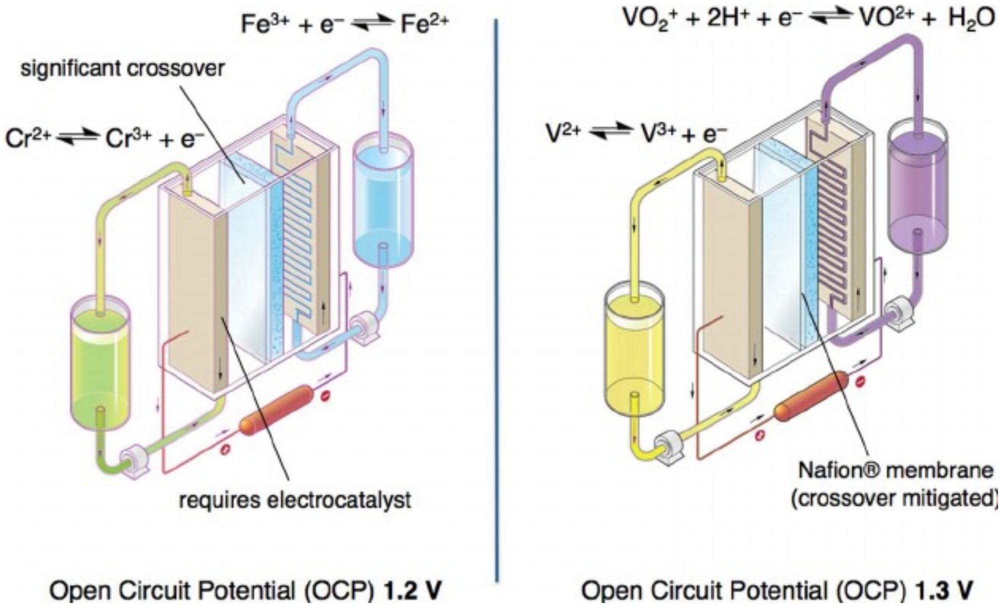


Redox Flow Batteries

- Widely commercialized (>100 companies)
  - **Vanadium** (Largest: 100MW / 400MWh (Dalian, China))
  - Zn-Br (~500kW/2MWh) – RedFlow
    - 2,959 MWh stored energy
    - 285 active deployments
  - Fe-Cr (~250kW / 1MWh)
  - Fe-Flow (ESS, Inc.)
  - Transition Metal-Chelate Chemistry
  - Non-aqueous RFBs?
    - Higher voltages possible, but more expensive



- Independently tunable power and energy
- Challenges
  - Energy Density
  - Cost
  - Reliability

- Dalian Flow Battery Energy Storage Peak-shaving Power Station
- Power up to 200,000 residents per day

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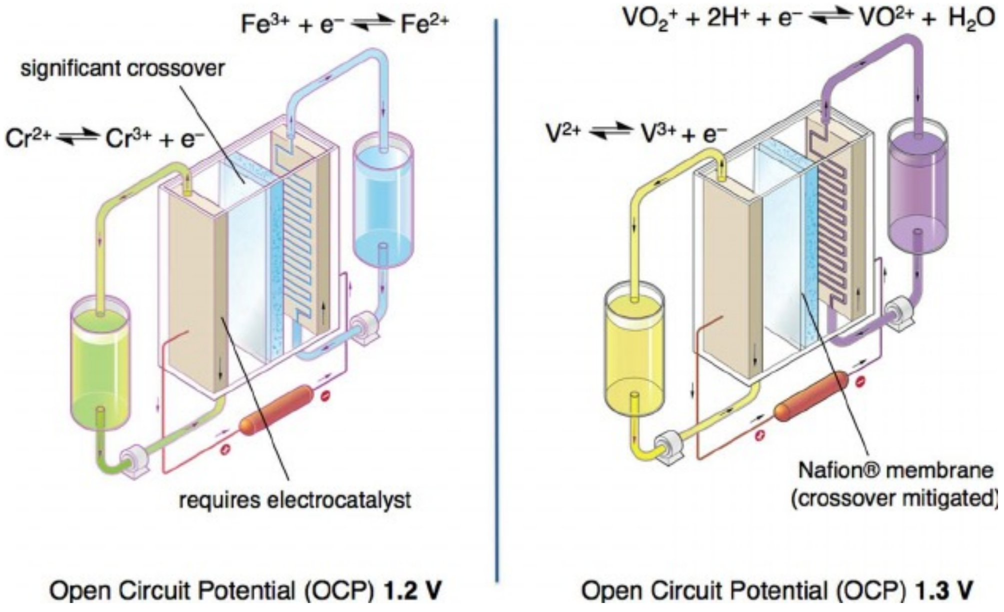

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redflow

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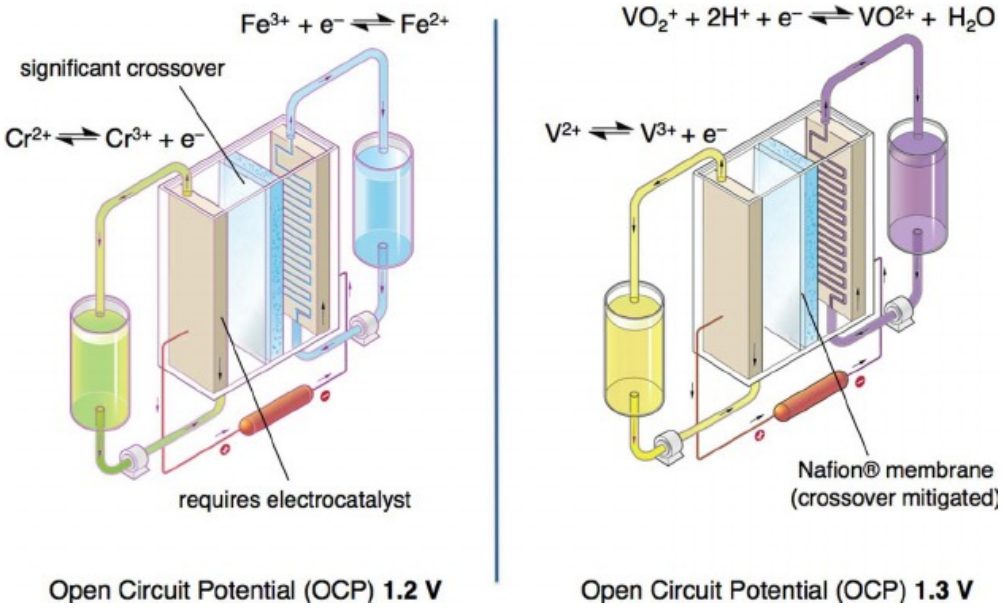

- Independently tunable power and energy

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ESS INC
CATALYZING A CLEAN FUTURE. EVERY DAY.

25 year lifetime

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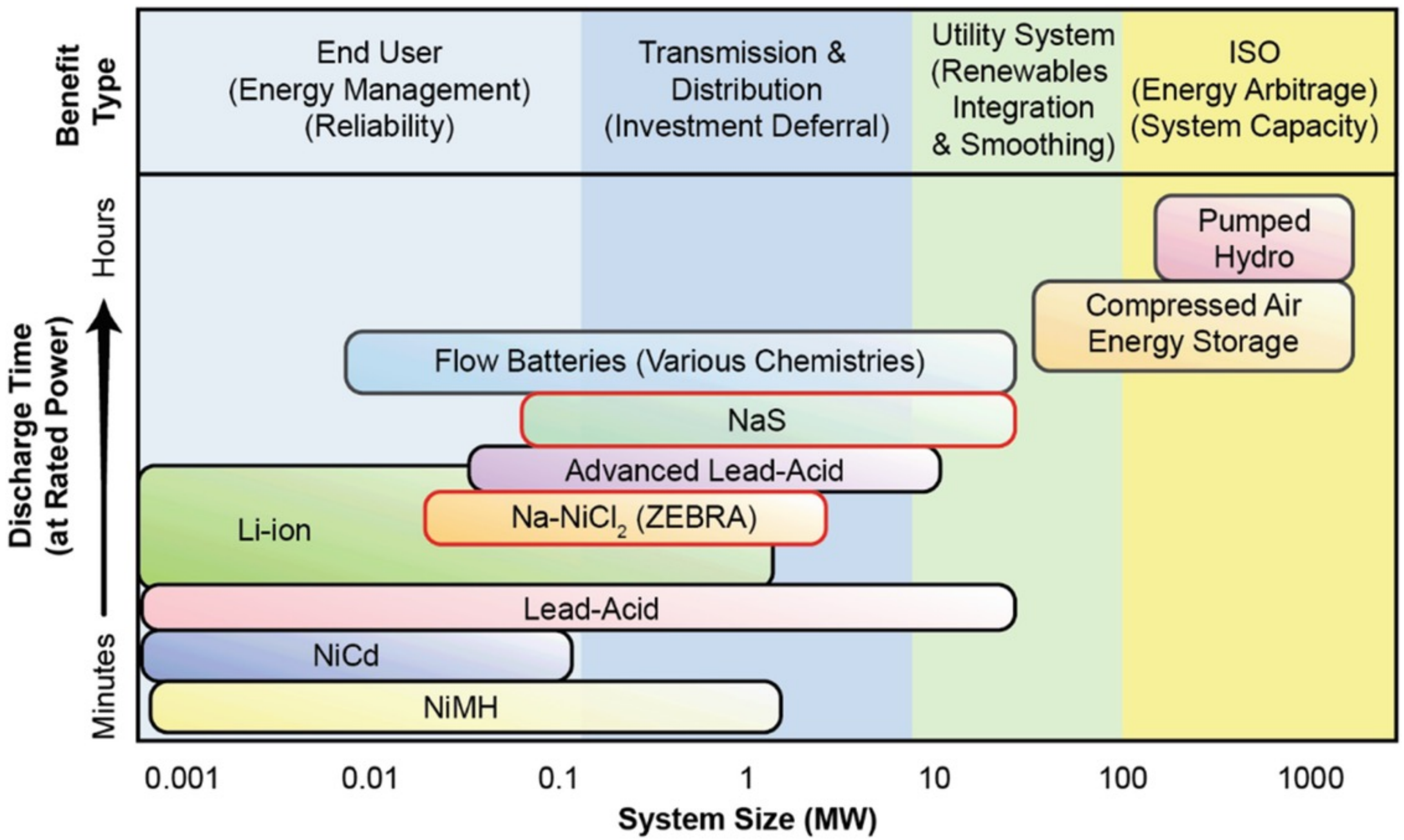
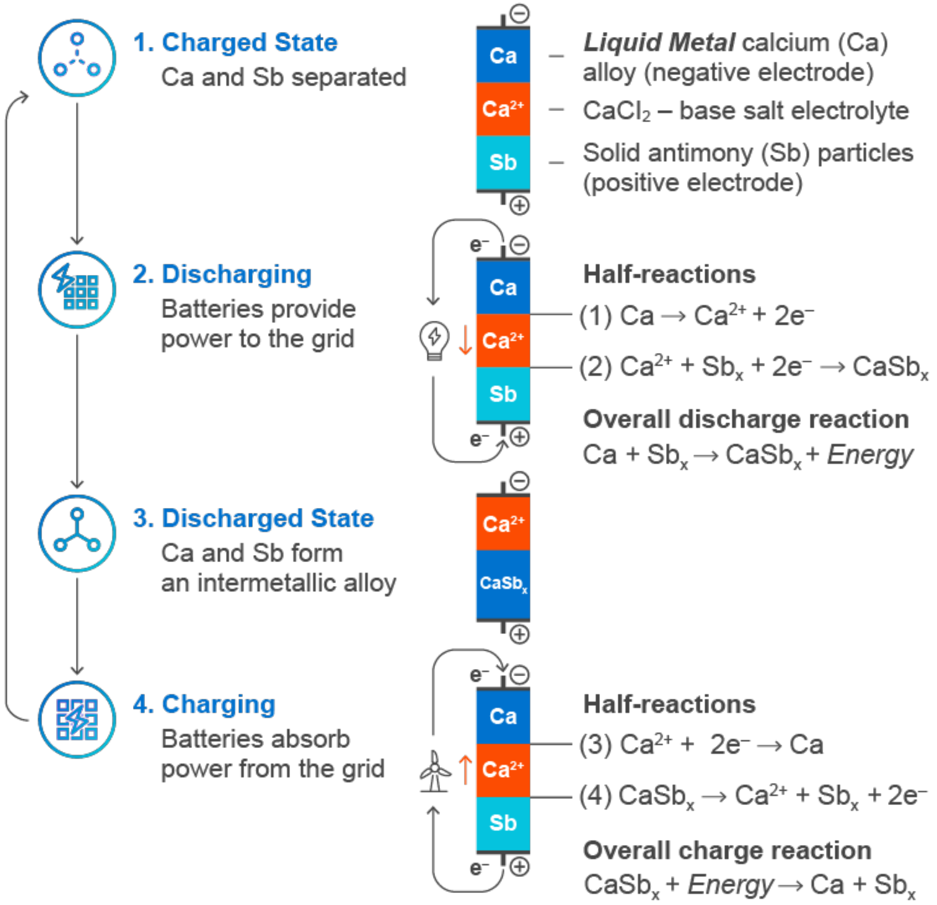


Liquid Metal Batteries



Ambri-based system

Insulated container with outer wall at ambient temperature

Projected System Specifications

Power at rated energy	250 kW
Energy at Cp/4	1 MWh
Voltage	550 - 1150 VDC
External temperature range	-50°C to 100°C
DC-DC Efficiency	80% to 90% from C/4 to C/12
Internal operating temperature	485-525°C
Response time	Instantaneous
Dimensions	10' x 10' x 8' container
Design life	20 years

Currently supporting datacenters (e.g., Microsoft), and renewable energy demonstrations by Xcel energy (CO). A 300MW, 1.2GWh system that will be installed to support wind and solar renewables integration South Africa beginning in 2024.

Ambri

What Sandia Does

Support communities, state energy offices, utilities, academia, and the overall ES industry to demonstrate and validate the use of resilient and secure energy storage systems on and off the grid through demonstration projects.

Sandia's work in innovative demonstration projects advances DOE's goals of facilitating decarbonization of the grid by improving acceptance and understanding of energy storage systems and serving communities by enabling equitable clean energy access.

Waylon Clark
SNL Demonstrations Team Lead

Sandia Demonstrations Support Academia

Santa Fe Community College, Santa Fe, New Mexico

Waylon Clark

Sandia Demonstrations Support Utilities

Cordova Electric Cooperative, Cordova, Alaska

Waylon Clark

Sandia Demonstrations Support Communities

Navajo Tribal Utility Authority, Dilkon, Arizona

Waylon Clark

Sandia Demonstrations Support Resilience

Poudre Valley Rural Electric Assoc., Red Feather Lakes, Colorado

Waylon Clark

Current Sandia Demonstration Projects Map

State or Territory	Partner
Alaska	Alaska Village Electrical Cooperative
Arizona	Navajo Tribal Utility Authority
Arizona	Native Renewables, Inc
Florida	Seminole Tribe
Georgia	Harambee House
Hawaii	Natural Energy Laboratory of HI Authority
Hawaii	Ho' ahu (ES4SE)
Mississippi	Coast Electric Power Association
New Mexico	Albuquerque Public Schools
New Mexico	Picuris Pueblo
Puerto Rico	Villalba Municipality
South Dakota	Ellsworth AFB West River Electric Association
Tennessee	Electric Power Board of Chattanooga
Vermont	Green Mountain Power

Albuquerque Public Schools – Atrisco Heritage Academy High School – Albuquerque, NM

Project Information:

- Largest energy footprint for any school in the district with a large percentage due to peak load demand charges.
- Future Resilience Hub - The school also functions as a community gathering center during emergencies and hosts an onsite health clinic. Cost avoidance funds will go toward student programs and other expenses for the school.
- 721kW/4hr battery storage and 850kW rooftop PV project to reduce school's demand charges.

Challenges (Interconnection):

- Battery system installation is complete (for over a year) and has completed initial commissioning
- Solar PV systems have been installed and are awaiting "permission to operate" from local utility to complete inspection and commissioning
- Interconnection process delays. Original interconnection request was submitted Sept. 2021 and completed April 2023 (1 ½ years). Utility identified the need to upgrade protection systems due to project. Substation relay upgrades planned to be completed by Dec. 2023.

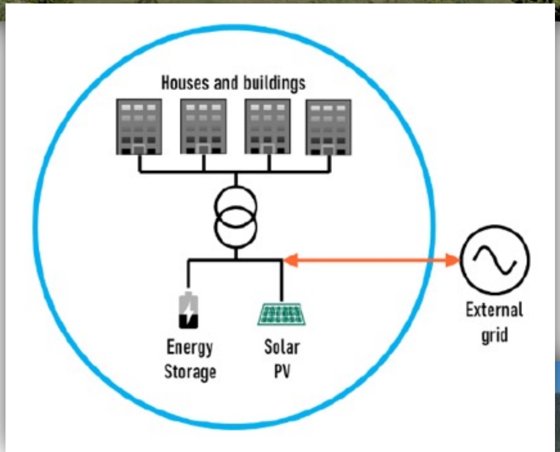
Picuris Pueblo –
Northern New Mexico

Project Information:

- The Picuris Pueblo is located in San Juan Mountains of Northern New Mexico. Due to their remote location, power system outages are a frequent occurrence and utility maintenance travel long distances to fix damaged equipment and restore power.
- Picuris Pueblo will be installing a battery energy storage system (estimated at least 400kW/4hr) to enable microgrid operation for resiliency when combined with the planned Picuris Phase II Community Solar system

Challenges (Interconnection):

- Need to coordinate with the local co-op to define operational plan for the battery (utilize co-op distribution lines during a grid outage)



Municipality of Villalba – Villabla, Puerto Rico

Background:

- The Municipality of Villalba is creating a local resiliency hub by installing a storage plus solar system at the local theater building. The theater currently serves as a backup emergency operations center for the Municipality.
- Villalba is one of five municipalities that formed the Mountain Energy Consortium (CEM) post Hurricane Maria

Challenges (Too much work, not enough people?):

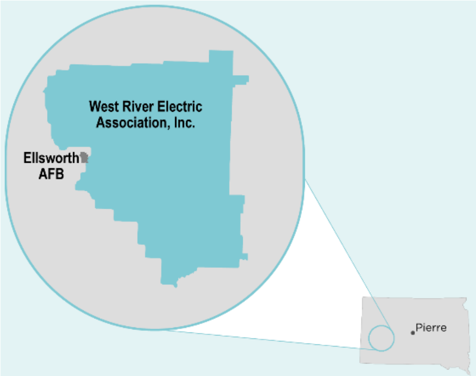
- Much larger projects/efforts take priority over smaller projects often from a select few individuals

Microgrid Location

Ellsworth Air Force Base (NRECA) – Rapid City, SD

Background:

- This project is a National Rural Electric Cooperative Association (NRECA) Rural Energy Storage Deployment Program (RESDP) Project, in partnership with West River Rural Electric Association (WREA), Sandia, PNNL, and Ellsworth Air Force Base.



Challenges (CSR's, Location):

- Location shown is not the original one – location changed due to a change in DOD Unified Facilities Criteria (UFC) stating energy storage could not be located within 100' of a building
- The battery energy storage system supplier has spent most of 2023 designing and building an NFPA 855 compliant application which is difficult and uncommon for smaller energy storage systems of this size today
- Multiple entities involved, National Labs, DOE, DOD, FFA, NRECA, WREA, …

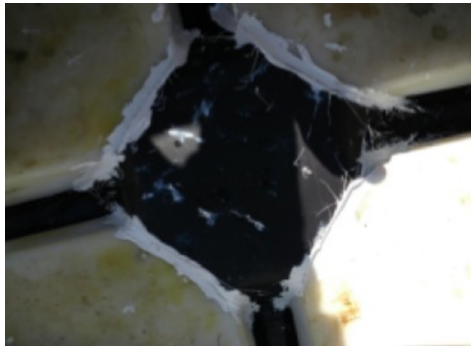
Natural Energy Laboratory of Hawaii Authority (NELHA) – Kona, Hawaii

Project Information:

- NELHA installed a 100kW/400kWh UET Vanadium Redox flow battery in Kona, Hawaii for demonstration of its use for renewable firming and other applications. The battery was installed within the NELHA research campus and to be operated by HELCO. The system has operational issues and UET was to replace the initial system prior to going bankrupt. NELHA now has a non-functional system that needs to be decommissioned.

Challenge (Decommissioning):

- Initial bid ($0 – too good to be true?) from a company resulted in a delay of nearly a year as the company eventually became completely unresponsive
- Secondary bidder had to ‘refresh’ their bid after a nearly year-long delay and is currently working with Sandia as we are decommissioning the same kind of flow battery system at the Sandia NM campus (Sandia’s system is twice as big)
- Sandia sent electrolyte samples to multiple recyclers to find out who and if they can recycle the mixed-acid vanadium electrolyte
  - Only one company we found can do it (with the right permits)



The UET ESS suffered significant damage in 2019, resulting in split seam on the top of main holding tank and the escape of electrolyte and electrolyte vapors from the otherwise closed system. UET patched the seam as seen on left to prevent further escape of vapors.

Sandia flow battery system in Albuquerque, NM – seal failure leading to electrolyte leaking and emergency decommissioning of the system

Thanks!

Erik Spoerke's and Waylon Clark's work at Sandia National Laboratories is supported through the U.S. Department of Energy's Office of Electricity Energy Storage Program, managed by Dr. Imre Gyuk.

Contact: Erik Spoerke (edspoer@sandia.gov)