



Renewable Energy Storage

Global energy demand is expected to increase by 30 percent between 2018 and 2040, the equivalent of adding another China and India to our planet.¹ Renewable energy sources will help meet that demand and will require not one, but a robust mix of energy storage technologies to lower the planet's carbon footprint, create efficient energy models and stabilize the grid.

Introduction

Analysts predict huge growth in the global demand for renewable energy, and rightly so. Renewable – or green – energy is critical to help lower the world's carbon footprint and move toward zero greenhouse gas emissions. Many states within the U.S. already have ambitious renewable energy mandates.

But harvesting intermittent green energy such as wind and solar isn't enough. The need to efficiently store and regulate energy distribution currently outweighs energy storage capacity. We will need several types of battery chemistries to capitalize on green energy's potential and achieve a disruption-proof electric power grid.

This information brief is intended to explain:

1. The importance of advancing a mix of energy storage technologies.
2. The necessity of lead batteries within that mix.
3. Factors to consider in comparing current energy storage options: performance, cost, scalability, sustainability, safety and reliability.



A Call to Action

In reporting this information, we ask policymakers to:

- + Prevent regulation that would prematurely eliminate battery chemistries, especially established options such as lead batteries, from the market.
- + Support government investment to research all battery chemistries.
- + Consider the importance of the full-life-cycle impacts of all battery chemistries, especially their rates of recycling and reuse of materials.
- + Recognize the urgency in taking these action steps to slow climate change.



The Renewables Outlook: Growth

- + **More than 55%** The amount of electricity generation capacity added to the U.S. grid from renewable resources in 2017, primarily from wind and solar resources.³
- + **40%** The amount of total power generation expected from renewable energy sources by 2040.¹
- + **\$10.2 trillion** The predicted spending on new power generation worldwide through 2040.⁴
- + **72%** Of that \$10.2 trillion, the amount that will be invested in renewables.⁴
- + **35 GW** The predicted amount of new energy storage deployed by 2025.⁵ That's enough to power nearly 23 million homes.⁶

U.S. Hits Major Milestone for Energy Storage

The United States has now added the capacity to store a billion watts of power for one hour and may double that total in 2018. Much of that growth has been in residential use, but also at the scale of the electric grid, where energy stored in batteries provides power companies with options for when to deploy their electrical stores from renewable sources.²



Six Factors in Comparing Battery Chemistries

Energy storage makes renewables work. But our electrical system is complex and has varied needs, which requires a mix of battery storage chemistries. Here are some deciding factors when comparing different chemistries.



Performance*

Significant innovation in lead battery R&D has dramatically improved their technical performance.

- + **Up to 18 years** A lead battery's demonstrated lifespan.⁷
- + **100%** By 2030, the cycle life of current lead battery energy storage systems is expected to double.⁸
- + **104°F** Lead batteries can withstand temperatures this high.⁹
- + **-22°F** Lead batteries can reliably operate in conditions this cold.⁹

Cost

Compared to other battery technologies, lead batteries are a more affordable storage option in terms of upfront and overall lifetime costs. (Lifetime battery cost will vary depending on battery application.)

- + Once installed, lead batteries can be **one-third the cost** of comparable energy storage systems.⁹
- + The **end-of-life cost**, including decommissioning, for lead batteries is a fraction of other battery chemistries such as lithium ion batteries.

Scalability

An established infrastructure exists to handle the growing demand for the manufacture, distribution, collection and recycling of lead batteries.

- + The World Bank forecasts a **1,200% increase** in lead demand for batteries in energy storage.¹⁰
- + The lead in lead batteries can be **recycled infinitely**, with no loss of performance.

*Operating for long durations in extreme temperatures can impact battery performance.

Six Factors in Evaluating Battery Chemistries



Sustainability

Lead batteries add to the sustainability of renewable energy. They are made of three distinct components. All are recyclable.

- + **Over 99%** of spent lead batteries in the U.S. are recycled.¹¹ Estimates show fewer than 3% of lithium ion batteries in similar uses are recycled.¹²
- + On average, a new lead battery is comprised of **over 80%** recycled material.¹³



Safety

The safer makeup of lead batteries compared to other chemistries makes them a preferred choice for system installations near schools, hospitals, apartment buildings and in residential areas.

- + They have a **very low risk of fire or explosion** resulting from overcharge, heat exposure, mechanical damage and short-circuiting.
- + Lead batteries have an **intrinsically non-flammable** electrolyte and active material compared to other battery chemistries.



Reliability

Lead batteries are a proven, 150-year-old technology that has advanced significantly over the last 20 years.

- + They are the **most widely used electricity storage system on earth**, comprising 75% of the worldwide rechargeable battery market share.¹⁴
- + They are already the **preferred solution** for numerous renewable installations and critical backup energy applications.

The Recycling Leader: Lead Batteries



99% The percentage of lead batteries recycled in the U.S.¹¹ (As compared to fewer than 3% of lithium ion batteries.¹²)



Over 80% The percentage of recycled material in a new lead battery.¹³



The lead in lead batteries is **infinitely recyclable**.

Lead Battery Applications

Lead batteries' reliability means they are increasingly used for the most essential aspects of energy storage:

- + Grid-scale storage
- + Frequency regulation
- + Residential and small commercial energy storage
- + Smart grids
- + Load leveling

How Lead Batteries Maximize Renewables



Regulate Variability

The fluctuations in renewable electricity generation (reliant on sunlight and wind speeds) can make electric grids unstable and create low-quality power.

+ Reserve capacity

Lead batteries dramatically improve power quality by storing excess energy when demand is low and releasing it when it is needed.

+ Frequency response

Lead batteries smooth power variability by releasing energy to the grid when demand is high.



Stabilize the Grid

Renewable energy can pose challenges for grid operations that are traditionally designed to send baseload power out from central power stations.

- + Lead batteries can bolster the grid, so that utilities can avoid replacing or making expensive upgrades to transmission lines.



Bridge the Transition

Increasing numbers of people want to source their power from nature for environmental reasons.

- + Utilities can use a mix of conventional and renewable energy, relying on lead batteries to store and smooth out distribution.



Reach Remote Areas

Remote geographical areas that are off the grid need a way to reliably store renewable energy.

- + Lead batteries have unique attributes that make them well-suited to help bring electricity to the nearly 25% of the population of all developing countries (over 1 billion people¹⁵) who have no electricity.¹⁶
- + Lead batteries are deployed in remote, small-scale hydro-electric systems to help provide essential, clean energy for food storage and communications.

Case Studies: Lead Battery Technology Systems that Enable Renewable Energy

(Access the full case studies listed here and additional stories at [EssentialEnergyEveryday.com/case-studies](https://www.essentialenergyeveryday.com/case-studies).)



Springfield, MO, Delivers 35 Percent Renewable Energy

City Utilities of Springfield installed a lead battery energy storage system that will allow renewable energy to charge the batteries during off-peak times and discharge at peak demand. In 2017, it was estimated that over 35 percent of the energy delivered to the community would come from renewable energy. The system could show that battery storage can be economical in the central U.S.



Meeting Minnesota Requirements

Minnesota's renewable energy standards are among the nation's strongest, requiring utilities to provide 25 percent of their electrical generation from renewable sources such as wind, hydrogen and solar power by the year 2025. In turn, this will help create next-generation industries with high-quality, good-paying jobs in Minnesota.



Powering Alcatraz Island's Tourism

Alcatraz has always been cut off from the mainland, with no power lines. Today, its tourism business benefits from solar panels connected to a battery bank and power inverters that help power the island instead of relying solely on diesel generators. The system has reduced the island's fuel consumption by 45 percent since its 2012 installation. It also saves more than 25,000 gallons of diesel fuel a year.

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Trusting Lead Batteries for First Microgrid Powered Entirely by Solar

Stafford Hill Solar Farm in Rutland, VT, carries a unique distinction beyond its nearly 7,800 solar panels. It's the first solar microgrid funded by the U.S. Department of Energy (DOE) and the first system in the country that maintains mission-critical power on renewables and storage alone for extended periods of time. The farm can generate enough electricity to power 2,000 homes during full sun.



Fostering African Economic Activity and Increased Standard of Living

Solar microgrid installations in Nigeria and Tanzania are providing reliable electricity to remote communities with no access to the grid. Doing so is boosting local businesses by extending their operating hours. Additional lighting is also improving living conditions, with better security, social connections and medical care.



Managing Variability of Renewable Energy in New Mexico

The leading electric utility company in New Mexico serving over 500,000 residents and businesses is capitalizing on lead battery technology. Public Services Company has integrated lead batteries with a solar energy-generating farm, which allows solar input to be fully smoothed and time shifted. Power is now stable and ready when needed.

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Lead Carbon Batteries Chosen for Tibetan Power Plant

Advances in technology, cost benefits and recycling led energy storage company China Shoto Energy Storage to forgo lithium ion batteries and instead install a 20MWh lead carbon battery in Tibet. The system will ensure the quality of energy supply from intermittent solar generation to the grid by providing frequency and voltage services.



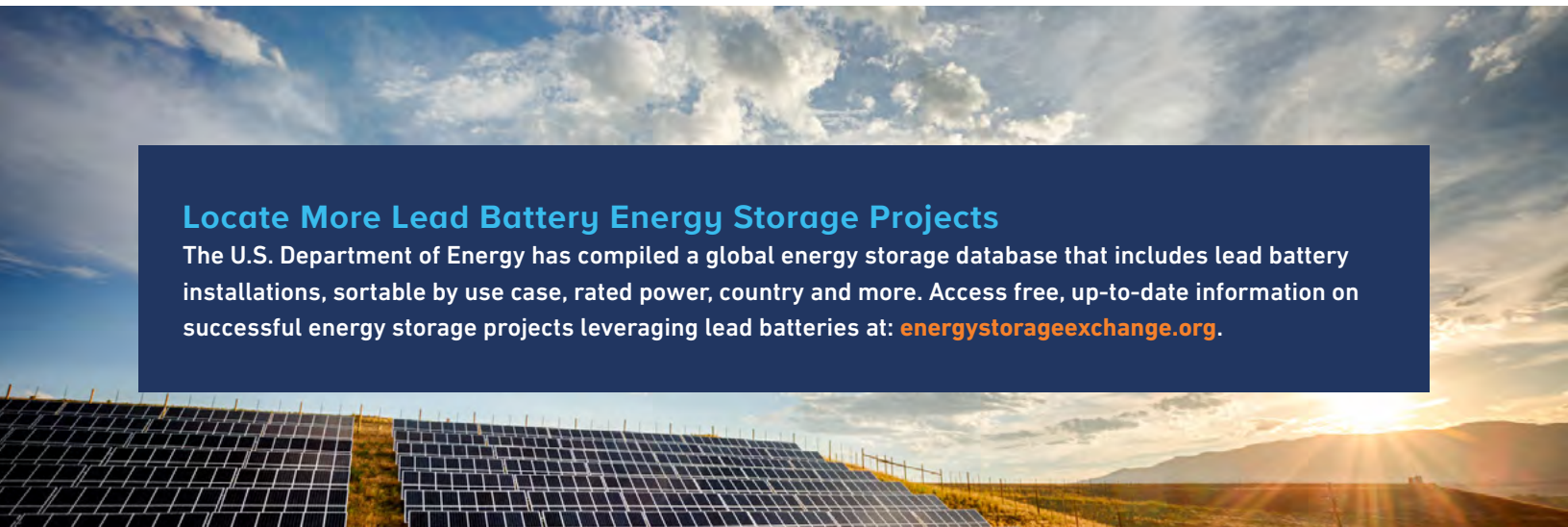
Living Off the Grid

Using wind, water and solar power, Eigg – an island off the coast of Scotland – has become one of the world's first island communities to implement a completely renewable power grid supported by lead batteries.

Above Photo | Daniella Zalczman

Locate More Lead Battery Energy Storage Projects

The U.S. Department of Energy has compiled a global energy storage database that includes lead battery installations, sortable by use case, rated power, country and more. Access free, up-to-date information on successful energy storage projects leveraging lead batteries at: energystorageexchange.org.



Conclusion

The global demand for renewable energy storage is increasing. As stated earlier in this report, 40 percent of total power generation by 2040 is expected from renewable energy sources.¹ This makes it essential for policymakers to create a level playing field that supports a mix of storage technologies, including lead batteries. New applications of this proven, highly sustainable technology will help lead the green energy transition and meet the urgent need to slow climate change.



Essential Energy Everyday exists to increase awareness of the critical importance of lead batteries to power our daily lives. We encourage continued investment in sustainable lead battery technology to store and provide energy on demand. Our initiative is supported by the two global trade associations that represent the lead battery industry, **Battery Council International** and the **International Lead Association**.

Learn more at EssentialEnergyEveryday.com

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