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Omaha Public Power District

OPPD BOARD OF DIRECTORS

BOARD MEETING MINUTES

June 15, 2023

The regular meeting of the Board of Directors of the Omaha Public Power District ("OPPD" or "District") was held on Thursday, May June 15, 2023 at 5:00 p.m. at the Omaha Douglas Civic Center, 1819 Farnam Street, 2nd Floor Legislative Chamber, Omaha, Nebraska and via WebEx audio and video conference.

Present in person at the Civic Center were Directors A. E. Bogner, M. J. Cavanaugh, M. R. Core, S. E. Howard, J. M. Mollhoff, C. C. Moody, M. G. Spurgeon and E. H. Williams. Also present in person were L. J. Fernandez, President and Chief Executive Officer, S. M. Bruckner of the Fraser Stryker law firm, General Counsel for the District, E. H. Lane, Sr. Board Operations Specialist, and other members of the OPPD Board meeting logistics support staff. Chair E. H. Williams presided and E. H. Lane recorded the minutes. Members of the executive leadership team present in person included: J. M. Bishop, K. W. Brown, C. V. Fleener, T. D. McAreavey, K.S. McCormick, L. A. Olson, M. V. Purnell, B. R. Underwood, and T. R. Via. S.M. Focht joined the meeting via WebEx.

Board Agenda Item 1: Chair Opening Statement

Chair Williams gave a brief opening statement, including reminders for using the WebEx audio and video conferencing platform.

Board Agenda Item 2: Safety Briefing

Josh Clark, Manager Protective Services provided physical safety reminders. President Fernandez provided psychological safety reminders, including current safety focus reminders about: (i) Fitness for duty; (ii) Increase sprain/strain/tear awareness; and (iii) Roadway reminders.

Board Agenda Item 3: Guidelines for Participation

Chair Williams then presented the guidelines for the conduct of the meeting and instructions on the public comment process in the room and using WebEx audio and video conferencing features.

Board Agenda Item 4: Roll Call

Ms. Lane took roll call of the Board. All members were present in person.

Board Agenda Item 5: Announcement regarding public notice of meeting

Ms. Lane read the following:

> *"Notice of the time and place of this meeting was publicized by notifying the area news media; by publicizing same in the Omaha World Herald, OPPD Outlets newsletter, oppd.com and social media; by displaying such notice on the Arcade*

Level of Energy Plaza; and by e-mailing such notice to each of the District's Directors on June 9, 2023.

A copy of the proposed agenda for this meeting has been maintained, on a current basis, and is readily available for public inspection in the office of the District's Corporate Secretary.

Additionally, a copy of the Open Meetings Act is available for inspection on oppd.com and in this meeting room."

Board Consent Action Items:

6. Approval of the January through April 2023 Financial Reports, May Board Meeting Minutes and the June 15, 2023 Agenda.
7. SD-15: Enterprise Risk Management Monitoring Report – Resolution No. 6573
8. Annual Health Plan Report – Resolution No. 6574
9. SD-2: Rates Monitoring Report – Resolution No. 6575
10. External Audit Services Vendor Recommendation – Resolution No. 6576
11. Sale of Property Near 43rd and Center St – Resolution No. 6577
12. 161kV Substation Electrical Equipment Installation – Resolution No. 6578
13. Jones Street Station & Sarpy County Station Generator Protective Relay Upgrade – Materials Contract Award – Resolution No. 6579
14. Sarpy County Station Unit 1 -- Repair Parts and Services -- Engineer's Certification – Resolution No. 6580

It was moved and seconded that the Board approve the consent action items.

Chair Williams noted the Board discussed the action items during the All Committees meeting held on Tuesday, June 13, 2023.

Chair Williams also noted Director Moody has asked that we note for the consent items, he should be listed as abstaining from the vote on item 11, the Sale of Property near 43rd and Center St, due to a potential conflict of interest involving his spouse's service on a non-profit organization that may have a business relationship related to the property.

Chair Williams then asked for public comment. There was no comment from the public in attendance at the meeting. There was one comment from an attendee via WebEx.

Mr. John Pollack, 1412 N. 35th Street, Omaha, provided comments on SD-2: Rates monitoring report.

Chair Williams thanked him for his comments.

Thereafter, the vote was recorded as follows: Bogner – Yes; Cavanaugh – Yes; Core – Yes; Howard – Yes; Mollhoff – Yes; Moody – Yes (with abstention recorded for consent item 11); Spurgeon – Yes; Williams – Yes. The motion carried (8-0).

Board Agenda Item 15: President's Report

President Fernandez next presented the following information:

- May Baseload Generation
- May Balancing Generation
- May Renewables
- Annual Customer Meeting
- Patriotic Parade
- Memorial Park 75th Anniversary
- In Memoriam – Lawrence F. Wood

Board Agenda Item 16: Opportunity for comment on other items of District Business

Chair Williams asked for comments from the public on other items of District business.

Mr. David Begley, 4611 S. 96th Street, Omaha, provided comments on IRS credits and presented the Board with materials attached to these minutes.

Mr. Laverne Treahn, Omaha, NE, provided comments on battery technology and hydrogen power production and presented the Board with materials attached to these minutes.

Mr. David Corbin, 1002 N. 49th Street, representing the Nebraska Sierra Club, provided comments on the Near Term Generation Recommendation and energy efficiency.

Mr. Ken Winston, Omaha, NE, provided comments on the Board's decision to delay the vote on the Near Term Generation Recommendation and concerns for low income energy burden.

Mr. John Pollack, 1412 N. 35th Street, Omaha, provided a weather update.

There were no additional comments from the public in attendance at the meeting or via WebEx.

There being no further business, the meeting adjourned at 5:43 p.m.

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S. M. Focht
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S. M. Focht
Vice President – Corporate Strategy and Governance and Assistant Secretary

DocuSigned by:
Erin Lane
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E. H. Lane
Sr. Board Operations Specialist

Six days left
until the end of the world!

RMI

The Business Case for New Gas Is Shrinking

The Inflation Reduction Act makes clean energy cheaper than more than 90 percent of proposed gas plants.

December 8, 2022

By Lauren Shwisberg

As the dust settles following the

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Clean Energy 101: All

passage of the Inflation Reduction Act (IRA), the electricity industry is only beginning to understand its true impacts. One of those impacts is the continued erosion of the business case for new gas power plants.

Over the past decade, fossil gas power plants became the default resource option for utility investment, making up a majority of capacity additions. While over the past few years the total capacity of plants built has **declined** and high **profile cancellations** have increased, the IRA's tax incentive provisions will accelerate deployment of cleaner, cheaper electricity – making gas an even less competitive choice.

New RMI analysis shows just how much the IRA changes the game.

The Analysis

We used our Clean Energy Portfolios Model – updated to include resource cost projections that reflect post-IRA levels of tax credits – to identify the lowest cost portfolio of wind, solar, battery energy storage, energy efficiency, and demand flexibility that can provide the same estimated services as a proposed fossil gas plant.

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Understanding California's Advanced Clean Cars II Regulation

Women Changemakers Are Accelerating the Energy Transition in Belize

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When we ran 76 GW of fossil gas plants proposed before 2035 through our Clean Energy Portfolios Model, we found that the vast majority of plants were more expensive than their respective clean energy portfolios (CEPs), shown in Exhibit 1. In a scenario where clean energy resources use the 30 percent Investment Tax Credit or the Production Tax Credit at $26/MWh, clean energy outcompetes 93 percent of proposed fossil gas plants – more than 20 percent more than pre-IRA.

With additional bonuses for investment in energy communities, use of domestically sourced resources, or siting in low-income communities, in nearly every instance, clean energy beats gas on cost alone. That means that when taking full advantage of the tax credits in the IRA, clean, renewable sources will be cheaper than 99 percent of proposed gas plants – plants that are contributing to price volatility in American household energy bills.

When taking full advantage of the tax credits in the Inflation Reduction Act, clean,

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renewable sources will be cheaper than 99 percent of proposed gas plants.

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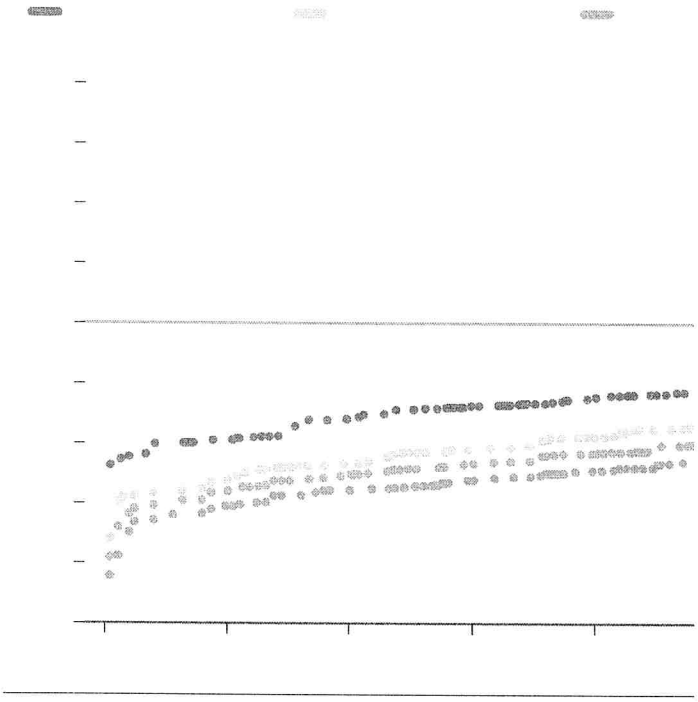


The Power of Financial Incentives

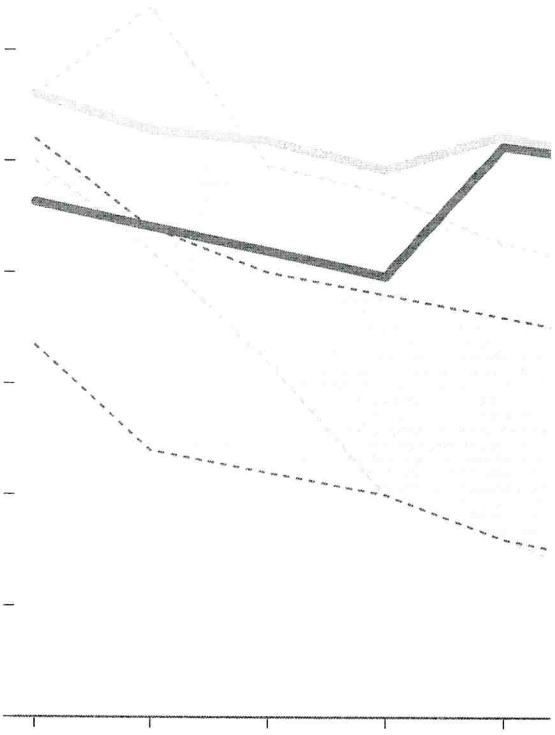
One of the main reasons for this is that post-IRA solar and wind costs are expected to plummet. Analysts are projecting that renewables costs will continue to fall – with jaw-droppingly low prices for wind and solar by the end of the decade.

Credit Suisse, for example, made headlines when it projected $5/MWh wind and solar by 2029. S&P Global and IHS Markit projected numbers nearly as low – with about $10/MWh solar in 2030

falling to $5/MWh by 2035. Consulting firm ICF's **projections**, though slightly less bullish, still predict that a levelized cost of energy for solar and wind in 2030 will be 20-35 percent and 38-49 percent lower, respectively, than pre-IRA.

In most of these forecasts, renewable costs fall below the go-forward cost of a combined cycle gas plant – generally expected to be at least $30-$40/MWh. This means it will be cheaper on a per megawatt hour basis to build new wind and solar than to continue to operate existing gas.

Exhibit 3 aggregates these projections (Credit Suisse, S&P Global and IHS Markit, and ICF's low projections for 2030) into charts that show an indicative range of levelized cost of energy for wind and solar post-IRA, compared with NREL's 2022 Annual Technology Baseline pre-IRA.



While our analysis in the Clean Energy Portfolios Model only looked at battery energy storage and demand flexibility to provide firm, dispatchable energy, a host of new resource options may also be **cost-competitive** with fossil gas by the end of the decade. A range of "clean firm" technologies will increasingly compete directly with fossil gas, such as alternative energy storage technologies, geothermal, advanced nuclear, hydrogen-fired turbines, and carbon capture and storage.

Updated Resource Plans and Procurement Processes Can Unlock $5 Billion per Year in Savings

RMI's analysis and other independent analysts are showing that the IRA can fundamentally change the math on the next right utility investment – and deliver substantial savings to customers. These aren't far-off future projections either. Cheaper, cleaner energy is the result of strong policy we passed this year.

There are actions regulators and utilities can take today to realize the IRA's projected $5 billion per year in savings for their ratepayers. New resource plans can include updated resource costs that accurately represent the new tax credits, seek to represent the full range of resources that may be commercially available within the planning horizon, and demonstrate how they will use additional IRA funding sources such as the Energy Infrastructure Reinvestment program. While costs remain uncertain, regulators and utilities can use all-source procurement – a competitive process that solicits bids from all types of resources – for

near-term needs to discover the market prices and relative competitiveness across resources.

As these changes begin to make their way into utility planning and procurement, we're starting to see results:

- DTE Energy in Michigan filed its Integrated Resource Plan in early November, with a scenario that factored in IRA tax incentives. Utility executives **reported** that they expected the IRA to lower the price tag of their 20-year plan for customers about $500 million.
- The Minnesota Public Utilities Commission approved Xcel's request this week to build 460 MW of solar at a retiring coal plant site – part of a CEP that will avoid a new gas plant. Xcel **reported** that the IRA was anticipated to save ratepayers 30 percent over its initial estimate of project costs.
- **Duke Energy** in Florida is providing customers with a $56 million refund as a result of solar tax credits.
- **Ameren** is proposing to lower customer rates by 4.5 percent.

To fully realize the benefits of the IRA, now is the time for utilities and regulators to reevaluate plans for investing in new fossil gas power plants and take advantage of the opportunity to deliver ratepayer savings with cleaner options.

RMI

The Hidden Health Costs of Gas-Fired Power Plants

A growing number of states and regulators are directing utilities to look for alternatives to proposed gas-fired power plants, citing environmental justice and community health impacts. Clean energy portfolios reduce energy costs while saving billions of dollars in community health burdens.

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Waste Methane 101: Driving Emissions Reductions from Landfills

Clean Energy 101: All

October 18, 2022

By Caitlin Odom, Lauren Shwisberg

As utilities and investors prepare to build over 88 GW of new gas-fired power plants before 2030, communities across the country are asking for healthier options.

Just this past April, regulators in Arizona made the surprising call to reject a proposed gas plant – not only on the basis of economic risk and insufficient process, but also because it would have significant negative health consequences for local communities already suffering environmental injustice.

This is one recent example of a growing number of regulators that have referenced community health and environmental justice in decisions that direct utilities to look for alternatives to proposed gas plants. And in many cases, this has been successful, helping utilities uncover more creative and cheaper alternatives. In Oxnard California, for example, pushback from the community and city around a proposed gas peaker plant caused the state and utility to review alternatives

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and instead build cost-effective demand response and storage solutions. Prior to its 2021 policy update, the Oregon PUC denied new gas power plants amid overwhelming community opposition, and instead issued a competitive solicitation for non-emitting options.

Over the past few years, more states have also passed policies that make environmental justice and equity explicit goals for utility regulation, systematically putting new proposed fossil gas plants under further scrutiny. Legislation passed in New Jersey in 2020, for example, mandates permit

lysis shows that new urther harm overburdened communities, and in Washington, the 2019 Clean Energy Transformation Act requires utilities to assess the consequences of their decisions on vulnerable and highly impacted communities.

Avoiding $23–$74 Billion in Health Impacts while Lowering Rates

Most of the time, cleaner options to a new gas plant are available at a lower cost. Our research at the end of 2021 showed that 80 percent of proposed gas could be avoided with a cheaper

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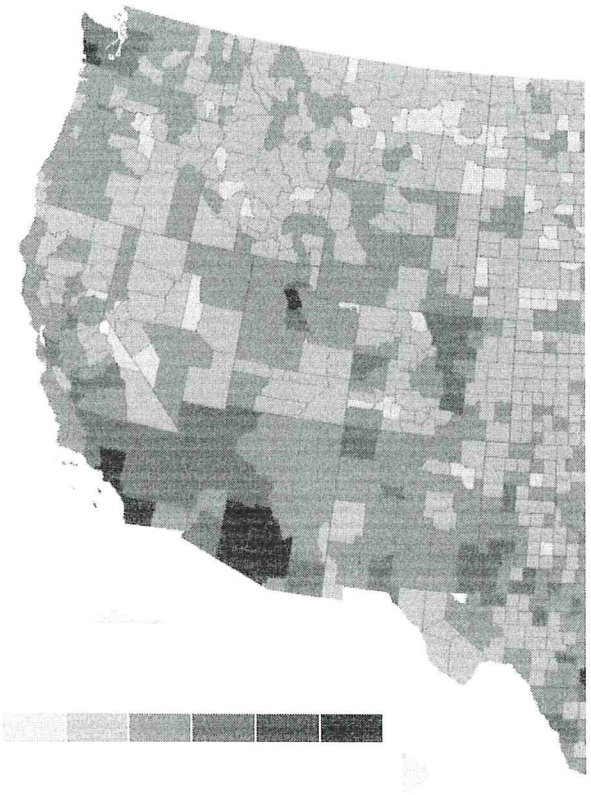
clean energy portfolio (CEP) – a combination of wind, solar, energy efficiency, demand response, and battery energy storage that can provide the same services as a gas-fired power plant – saving $22 billion over their lifetimes. Both the percentage and cost savings are expected to be even higher when factoring in Inflation Reduction Act tax credits and current forecasted gas prices.

In addition to these cost savings, avoiding the gas plants that were proposed at the end of 2021 could prevent $23–$74 billion in *health impacts* over their assumed 20-year lifetimes (see Exhibit 1). Health impacts are concentrated near proposed plant sites but felt nationwide, with more acute impacts in population-dense areas and areas with unfavorable wind patterns. Our analysis found that about 60 percent of the health impacts would fall in low-income communities and communities of color, especially in the population-dense Northeast.



Adding the cost of health impacts shown in Exhibit 1 into the direct plant-by-plant comparison between CEPs and proposed gas makes gas plants significantly less competitive. When we include the cost of total health impacts, CEPs are more competitive than 94 percent of proposed plants, compared with 80 percent at baseline.

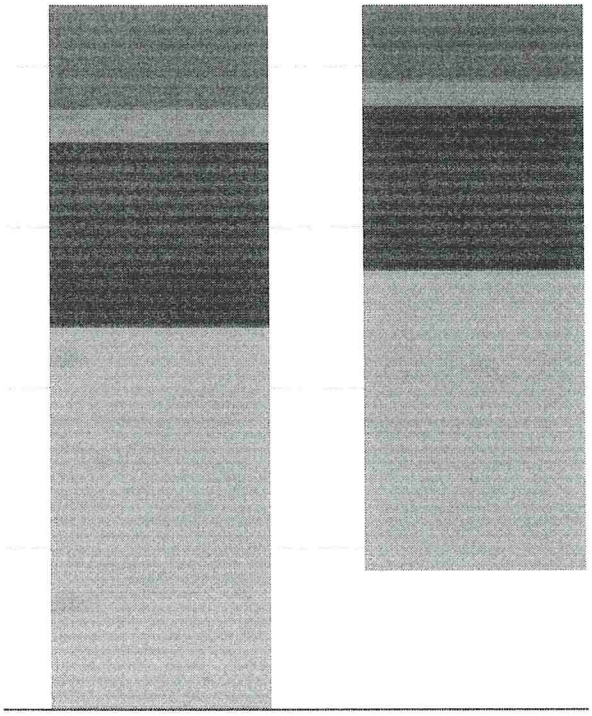
The $23–$74 billion in health impacts modeled here only account for avoided emissions from combustion at proposed fossil gas plants. Including construction and upstream emissions would result in

even greater negative health impacts from proposed gas facilities, further solidifying the case for cleaner alternatives. Additionally, CEPs produce more energy than the proposed gas plants, so deployment of CEPs would also further reduce emissions from existing fossil generators, and avoid even greater health impacts.

Equity Considerations Mean Even More Risk for Gas Plants

When environmental justice impacts are considered, proposed gas plants face additional risk.

Almost half (33 GW) of the 70 GW of fossil gas plants we determined had cheaper, cleaner alternatives, are expected to be sited in low-income communities and communities of color (defined by interim federal definitions) and could be avoided. An additional 7 GW of proposed plants expected to be sited in low-income communities and communities of color could be at risk when policy or regulation prioritizes avoiding impacts in those communities.

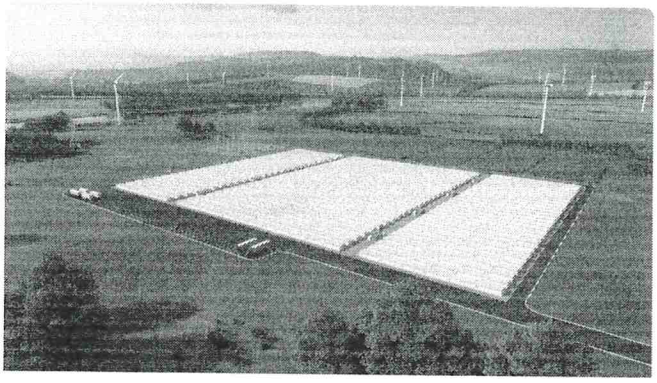


Making the Impacts of New Gas Clearer

For communities that have been historically impacted by pollution, avoiding gas with clean energy can be an opportunity to both reduce electricity bills and future healthcare bills. Both of these opportunities are becoming clearer, which will make it increasingly difficult for utilities and investors to justify new gas investment.

In states with explicit equity and environmental justice goals for utility regulation, regulators can require utilities to quantify the health impacts of proposed plants and how they are distributed to make public interest tradeoffs clearer. States like Michigan are in the process of incorporating these metrics into their decision-making processes, with pending planning requirements that would require utilities to assess air pollution health impacts using the EPA's CO-Benefit Risk Analysis (COBRA) tool.

In states where affordability is central but environmental justice and equity have not been incorporated as explicit objectives of utility regulation, utilities best sharpen their pencils. With the IRA's suite of updated tax credits for storage, and bonus incentives for projects in low-income communities and energy commissions, CEPs will be even cheaper – especially in the communities that need them most.



Battery Storage Technology

Our first commercial product is an iron-air battery capable of storing electricity for 100 hours at system costs competitive with legacy power plants. Made from iron, one of the most abundant minerals on Earth, this front-of-the-meter battery will enable a cost-effective, renewable energy grid year-round.

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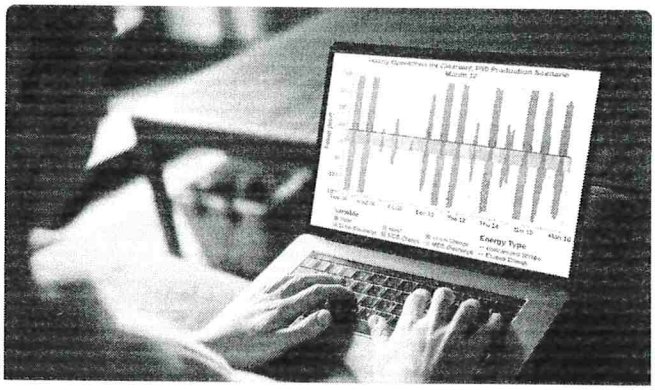

Grid Modeling Toolkit

Formware™ is our next generation investment and operational model for power grids. It has the ability to optimize over multi-year, hourly resolution data sets to capture real-world weather variability, resulting in more reliable and cost effective designs for renewables-driven power systems.

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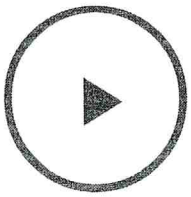
Transforming the grid to be reliable, resilient, and fully renewable

The electric grid now faces a challenge: how to manage the multi-day variability of renewable energy without sacrificing reliability or cost. We are developing a multi-day energy storage technology that will enable the grid to run on low-cost renewables year-round. Our pioneering battery technology will reshape the global electric system and give it new form.

TAKE A LOOK INSIDE OUR LAB IN SOMERVILLE, MA

Learn more about our iron-air technology by taking a virtual tour of Form Energy's Somerville lab and U.S. operations with Co-founder and Chief Technology Officer, Billy Woodford.



ESS INC
CATALYZING A CLEAN FUTURE. EVERY DAY.

How We Stack Up

ESS transforms the value proposition for long-duration storage

As renewable energy resources proliferate, energy storage is becoming critical to a secure, resilient and reliable grid that provides clean energy 24/7. There are many options for energy storage and customers are faced with different needs and use cases. ESS iron-flow batteries meet the broadest range of requirements and deliver value where it matters: to commercial/industrial customers, utilities, and energy consumers who depend upon reliable, clean energy.

What Customers Demand	ESS Inc. Provides	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	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, bankability	Safe and non-toxic 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 design life	Environmentally sustainable Accelerates clean energy transition

ESS delivers performance, price and sustainability

At ESS Inc., we have led the industry as the need for long-duration energy storage has become clear and economic models have evolved. As long-duration storage technologies proliferate, we have driven a shift from traditional calculations of cost per kWh to a holistic capital efficiency model. Today, ESS technology offers >15% improvement in capital efficiency than lithium-ion, is bankable thanks to our industry-leading guarantee from Munich RE and delivers superior flexibility to deliver not

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only reliable backup power, but critical grid ancillary services.

How can you utilize a battery designed for a 25-year operating life 24 hours a day?

A battery doesn't generate revenue or a return if it is sitting idle. With unlimited cycling and no capacity degradation, ESS iron flow technology maximizes revenue opportunities by not only providing long-duration energy storage, but also key grid ancillary services and serving peak demand periods. Without cycle limitations or capacity degradation, you can charge and discharge daily or even multiple times per day. Let us show you how to maximize the benefits and unique characteristics of our iron-flow battery storage solutions, the Energy Warehouse™ (EW), and the Energy Center™ (EC).

Energy storage capacity in ESS systems is easily scalable through the addition of low-cost electrolyte to an existing platform

A typical lithium-ion battery use case includes four hours of charging, four hours of discharging and sitting idle for 16 hours a day. This is due to the limited cycle life and degradation in capacity inherent to the lithium-ion technology.

ESS technology offers unlimited cycling which means you never have to let your ESS system sit idle.

ESS technology makes it possible to stack multiple use cases and value streams for more than four hours of discharge and more than one cycle per day from a single battery asset. No future capacity augmentation is required and the more you use the battery, the greater your ROI on your ESS battery asset.

ESS solutions are designed for a 25-year operating life, which aligns with typical IPP and utility wind and solar project lifespans of 25+ years. This results in a significantly lower cost of delivered energy over the life of the project compared to alternatives.

The ESS cost and performance advantage

The economic viability of many projects is enhanced when an additional cycle is added. The cost of ownership of an ESS iron flow battery system can be up to 40% less than competing technologies over a 25 year project life due to no capacity degradation, no need for HVAC, and a lower OpEX than Li-ion systems.

Can cycle when needed with no impact on asset life.	No heating/cooling systems required.
Operates at peak efficiency independent of ambient temperature.	Safe for deployment in urban areas or harsh and pristine environments.

ESS wins on sustainability

ESS iron flow batteries are the cleanest, most environmentally friendly storage technology on the market today. As the world works to decarbonize energy systems and confront the climate crisis, reliance upon sustainable solutions is a top priority. ESS technology is the clear, sustainable choice:

Earth abundant materials: raw ingredients are iron, salt and water.	Lowest cradle-to-gate global warming potential (GWP): one-third the embodied CO2 emissions of lithium-ion batteries.	Recyclability: contains no toxic materials, and is fully recyclable at end of life.

Global warming potential

In collaboration with UC-Irvine, a Lifecycle Analysis (LCA) was performed on the ESS Energy Warehouse™ iron-flow battery (IFB) system and compared to vanadium redox

For detailed information, Download our

flow batteries (VRFB), zinc bromine flow batteries (ZBFB) and lithium-ion technologies. Researchers assessed the manufacturing, use and end-of-life phases of the battery lifecycle. Their findings were clear:

Iron flow batteries proved to be the cleanest technology with the lowest global warming potential (GWP).

LCA comparison of iron-flow batteries to lithium-ion and other types of flow batteries.

ESS wins on bankability: The only insured battery in its class

ESS has partnered with Munich Re to launch an industry first insurance cover for ESS iron flow batteries. This industry-leading policy means our long-duration energy storage solutions are backed by a 10-year performance warranty regardless of project size or location. ESS has also collaborated with Munich Re to develop a separate Project Cover to ensure a bankable product offering. The Cover directly offers more comprehensive coverage and can be extended in order to provide long-term assurance of project performance to system owners and financiers.

Investment-grade warranty	Investment-grade project insurance	US export-import bank qualified
10-yr extended warranty covering battery modules	Warranty continuity insurance provides additional surety to customers and financiers	Pre-qualified financing available for overseas buyers

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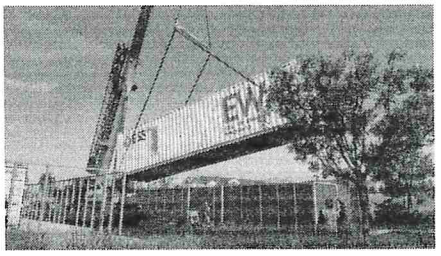
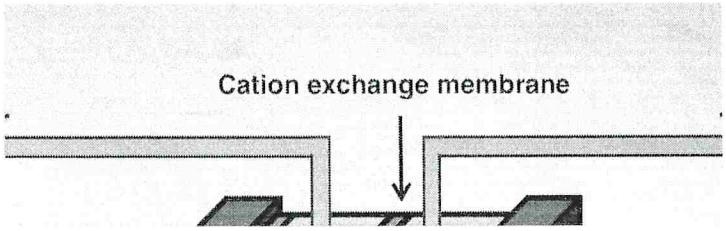
ESS Iron Flow Chemistry



Powerful technology transforming the utility grid

ESS iron flow battery solutions are mature, second-generation systems that offer unmatched cost and sustainability with performance guaranteed through an independent insurer: Munich Re.

Conventional battery



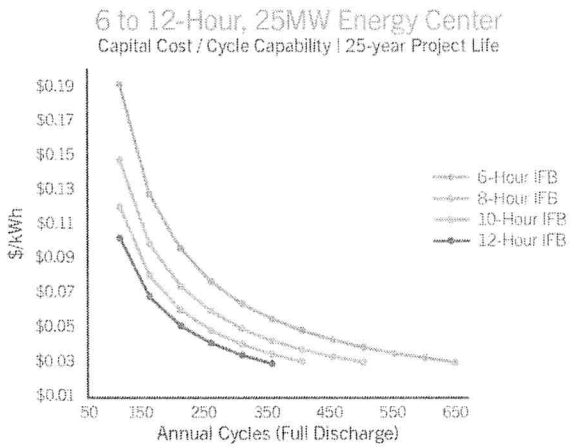
A flow battery is an electrochemical cell where two chemical solutions are separated by a membrane. Ions are exchanged across this membrane, producing chemical energy and electricity.

chemistries, with limited cycle life, deliver a 7- to 10-year lifecycle before requiring augmentation. ESS iron flow chemistry delivers 25 years or more with no capacity fade or degradation.

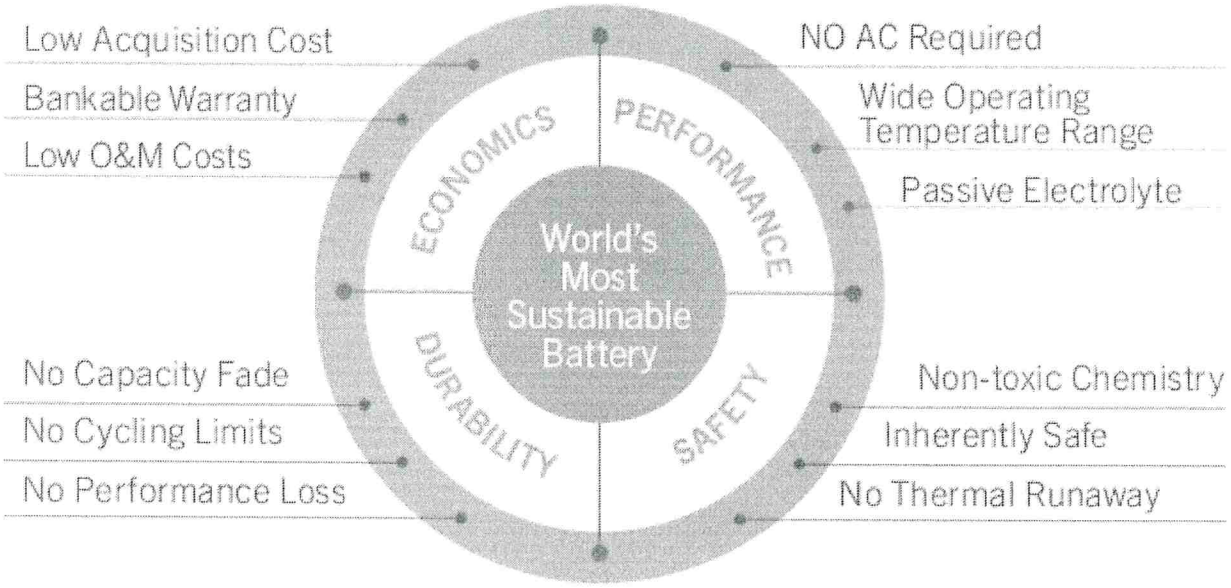
...more sustainable

ESS batteries are easy to site and safe to operate. Iron flow chemistry doesn't use critical minerals such as vanadium, lithium, or cobalt, reducing the environmental impacts associated with the supply chain and reducing their lifecycle greenhouse gas footprint.

Lowest cost per kWh: *For applications that use 6+ hours of discharge and frequent cycling, the ESS systems deliver the lowest cost per KWh over a 25-year operating design life.*



The superiority of iron flow



Zero degradation over 20,000 cycles: Iron flow batteries circulate liquid electrolytes to charge and discharge electrons via a process called a redox reaction. The word "redox" is a contraction of the words "reduction," which represents a gain of electrons, and "oxidation," or a loss of electrons. ESS uses the same electrolyte on both the negative and positive sides of the equation, eliminating cross-contamination and degradation. This is why ESS chemistry remains stable for an unlimited number of deep-cycle charge and discharge cycles.

Our patented electrode design and control system, coupled with our simple electrochemistry, allows ESS systems to operate longer, at deeper discharge levels. Unlike typical batteries packaged as fixed cells or modules, a flow battery has more energy storage capacity, which gives the user the flexibility to align both the power output and energy storage capacity precisely to a project's requirements.

Safety by design

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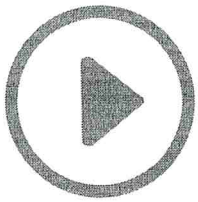
ESS iron flow batteries are safe and sustainable, reducing the need for fire suppression equipment, secondary containment, or hazmat precautions. Iron flow chemistry has a pH similar to soda or wine and contains no toxic materials. In addition, the battery system is substantially recyclable at end-of-life.

Designed to meet customer needs

Scalable: ESS power modules' streamlined architecture allows them to power our turnkey Energy Warehouse product line and still be scalable enough to support Energy Center deployments delivering MWh or GWh of storage. An enhanced power module architecture also allows double the plating capacity of prior generations, extending the module-level discharge duration to up to 16 hours. In addition, the entire ESS battery assembly is designed to facilitate robotic manufacturing for precision quality.



Join Eric Dresselhuys, CEO and Vince Canino, COO of ESS Inc. as they take you on a tour of the ESS factory in Wilsonville, Oregon.

Easy operation and maintenance: Each ESS power module is individually controlled and power

conditioned through independent DC-DC converters and stack level monitoring. Stacks run at their ideal operating point and can be monitored for battery health and optimal performance. Any faults can be detected early and isolated from the rest of the system, allowing for enhanced uptime and system safety.

Enhanced electrolyte health management: The ESS electrolyte health management system cleans and rebalances the electrolyte in real-time, eliminating the need for frequent downtime for recovery or rebalancing required with other flow battery systems. The system also works in conjunction with the closed-loop plumbing system to prevent electrolyte evaporative losses and to allow the system to run at near-atmospheric pressures. This improves safety, increases scalability, and eliminates the need for electrolyte augmentation during the life of the product.

The ESS iron flow battery uses the same electrolyte on both positive and negative sides. And the proton pump maintains the state of charge and battery health.

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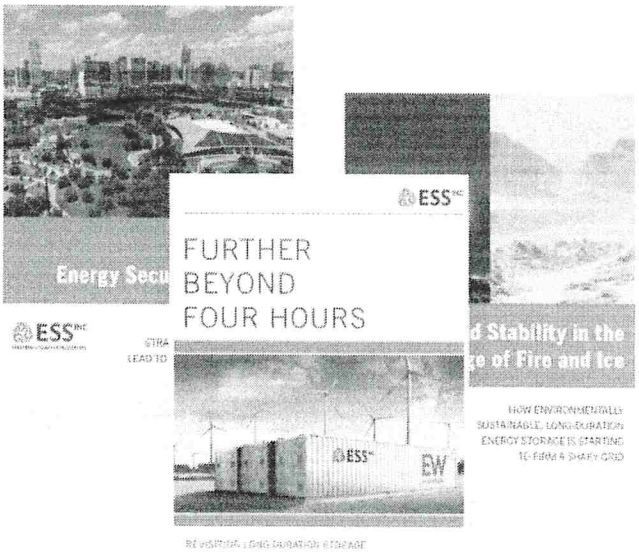
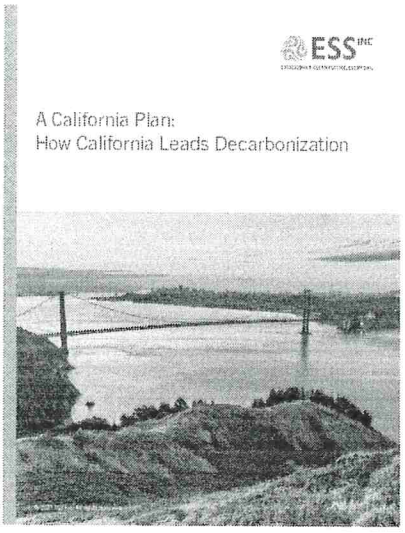
White Papers



Welcome to the ESS white paper library. Our white papers tackle a variety of complex issues that utilities, independent power producers, project developers, and other large energy users face, including energy security, grid stability, renewable integration and more.

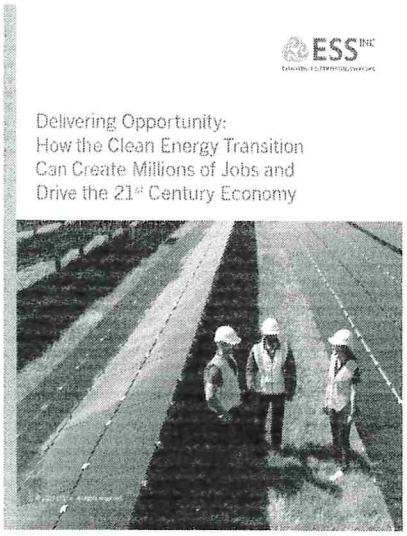
Long- duration energy storage is essential to providing the reliability and resiliency we need when the sun is not shining and the wind is not blowing.

A California Plan: How California Can Decarbonize



California has long been a leader in the clean energy transition. But today, the state sits at a crucial crossroads. The early success of renewable energy deployment is creating headwinds to continued progress. High prices, energy shortages during periods of peak demand, curtailments, and the increasing threat of Public Safety Power Shutoffs all amid increasing climate-driven disasters such as heatwaves, wildfires, floods and drought, are raising concerns about the costs and reliability of the state's energy system. But, there is a path forward that builds on the state's early success by incorporating new technologies, such as long-duration energy storage, which can quickly enable the deep decarbonization of the Golden State's energy system while delivering reliability and resiliency in the face of climate threats. Learn more about how reforms to existing systems and new technologies can continue to enable California to continue to lead the global clean energy transition.

Download



Economy

The global energy economy is undergoing a radical transformation. Energy systems, technologies, and economic models which developed over the past 150 years are now rapidly evolving from year to year. Meanwhile, advancements in clean energy technology and the urgent need to address climate change are combining to drive deep decarbonization of the global economy.

This transition has the potential to deliver substantial economic benefits and opportunities to people and communities across the United States. In this white paper, ESS provides a discussion of the opportunities that recent legislation, such as the Inflation Reduction Act, and new technologies, such as long-duration energy storage, stand to unleash, and some of the challenges that remain to realizing a prosperous clean energy future.

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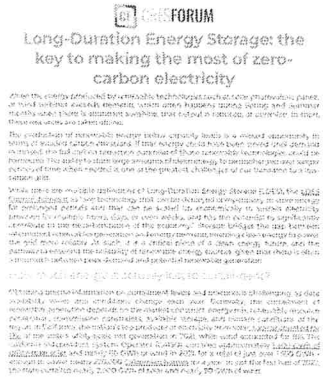
FORUM
Long-Duration Energy Storage: the key to making the most of zero-carbon electricity

LDES: the key to making the most of zero-carbon electricity

ESS, in partnership with Citizens for Responsible Energy Solutions and the U.S. Energy Association released an issue brief detailing the critical need for long-duration energy storage

(LDES) to create an efficient, low-carbon energy system and avoid the curtailment of renewable energy resources. The brief which analyzes curtailment data from grid operators nationwide, illustrates the mismatch between renewable energy supply and grid demand and demonstrating the need for long-duration energy storage to decarbonize the energy system.

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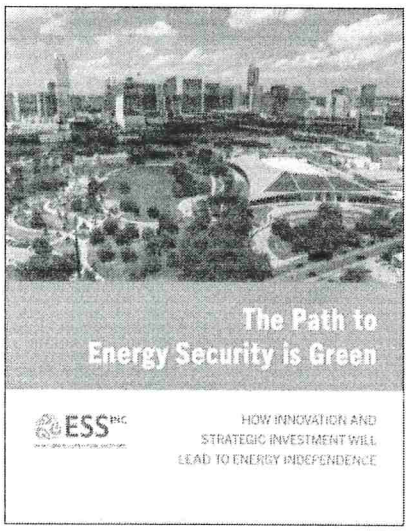

The Path to Energy Security is Green

Reliance on fossil fuels has long created energy insecurity, and today we also face new threats from extreme weather, cyberattacks on energy infrastructure and unstable energy supply chains. To truly achieve energy independence, we need to create a resilient energy system powered by renewable energy and built using flexible supply chains that do not rely upon politically unstable regions of the world. This transformation should be backed by a strategic transition plan, government/industry collaboration and investment in innovation.

This is not a distant possibility; technologies commercially available today can underpin this transition to a clean, resilient energy system. Learn more in this latest white paper how innovation and strategic investment will lead to energy independence.

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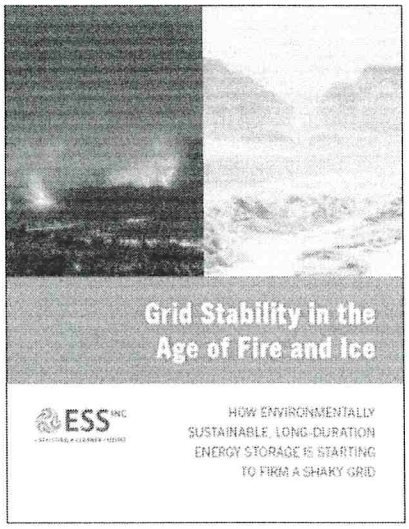
Grid Stability in the Age of Fire and Ice

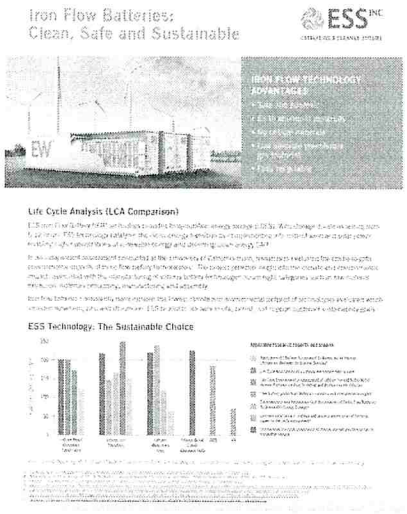


The difficulties plaguing the grid that left millions of people without power in early 2021 have not gone away. In fact, the Electric Reliability Council of Texas, which manages the Texas grid, reported in July 2021 that there had already been 1,280 unplanned summer outages.

The latest ESS white paper, Grid Stability in the Age of Fire and Ice: How Environmentally Sustainable, Long-Duration Energy Storage is Starting to Firm a Shaky Grid, explains why ESS long-duration iron flow batteries that use safe, earth-abundant and recyclable materials are best positioned to drive market growth in renewables, stabilize the grid and address climate change in the years ahead.

Download

Life Cycle Analysis of ESS Inc.



Iron Flow Battery

Reliance on fossil fuels has long created energy insecurity, and today we also face new threats from extreme weather, cyberattacks on energy infrastructure and unstable energy supply chains. To truly achieve energy independence, we need to create a resilient energy system powered by renewable energy and built using flexible supply chains that do not rely upon politically unstable regions of the world. This transformation should be backed by a strategic transition plan, government/industry collaboration and investment in innovation.

This is not a distant possibility; technologies commercially available today can underpin this transition to a clean, resilient energy system. Learn more in this latest white paper how innovation and strategic investment will lead to energy independence.

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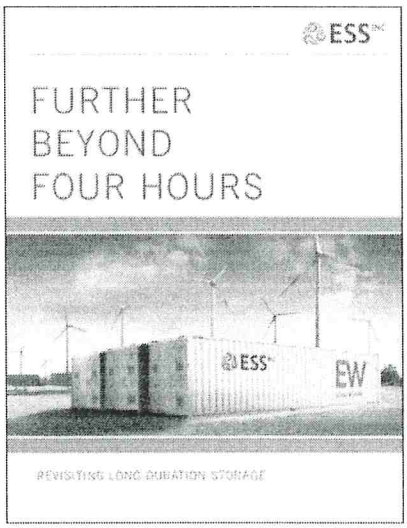
Further Beyond Four Hours

Key findings include:

- Long-duration storage is now commonly viewed as having a delivery time of at least four hours, and the need for it is growing.



- Renewable energy self-consumption is seen as the most promising application for long-duration storage. But many other applications, from backup power to short-term operating reserves, were also cited, highlighting the potential for revenue stacking.
- The most promising technology for long-duration storage is flow batteries and the key criterion for selecting a given asset is cost, particularly the level of capital expenditure required.

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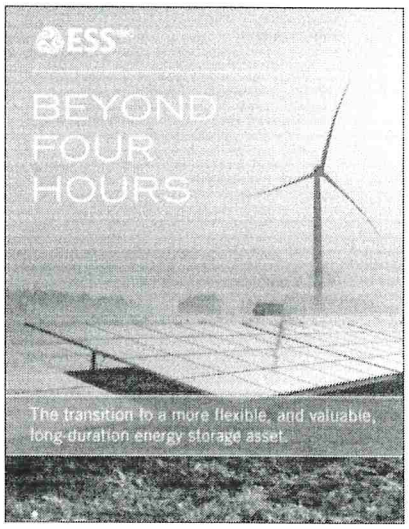

Beyond 4 Hours: The Transition to a More Flexible, Valuable, Long-Duration Storage Asset

Key findings include:

- Smart storage purchasers are beginning to look beyond capital expense to more effective measures of lifetime cost and flexibility.
- Long-duration storage's capability to seamlessly integrate energy and power applications.
- Long-duration storage's ability to provide substantial flexibility in dealing with ever-changing regulatory and legislative landscapes, not to mention commercial

volatility.

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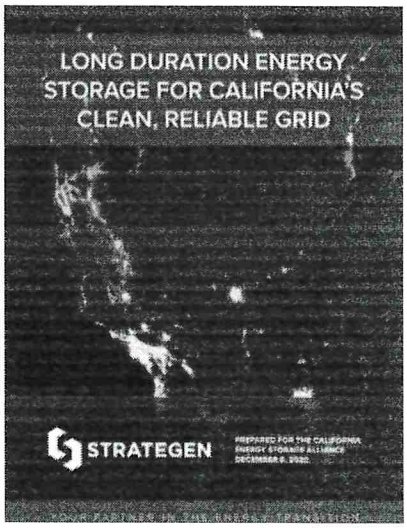

- ESS was part of a select group of CESA members to contribute to the ground-breaking study: Long-Duration Energy Storage for California's Clean, Reliable Grid.
- California alone will need to increase its long-duration energy storage capacity by deploying 2-11 GW by 2030, and 45-55 GW by 2045.
- Significant procurement activities for long-duration storage need to happen before 2025 to ensure that California has a sufficient pipeline of long-duration storage projects to meet future grid needs.
- Regulatory changes could unlock the value of energy storage beyond 4-hours and
  The flexibility that comes with long-duration storage can strengthen a grid that is increasingly being populated with "use-limited" assets.

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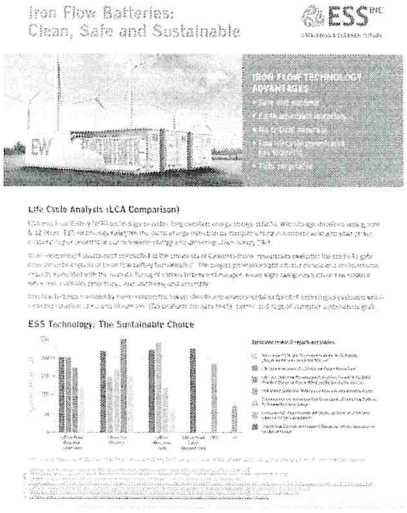
Battery



In an independent assessment conducted at the University of California-Irvine, scientists evaluated the cradle-to-gate environmental impact of three different flow battery types. Iron-flow batteries tested to be the cleanest technology compared to batteries using vanadium and zinc. They're also significantly less harmful to the environment over their entire life cycle compared to lithium-ion batteries.

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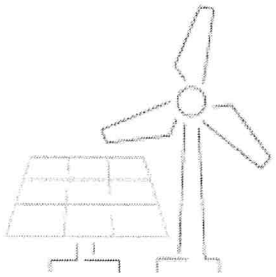
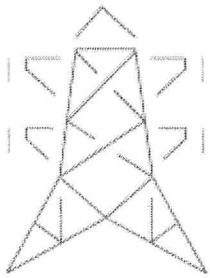
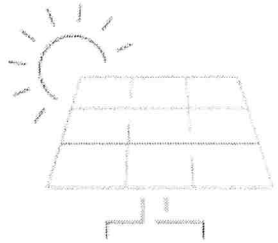
ESS, other energy storage manufacturers announce safety certification for competitive edge

UTILITY DIVE







Long-duration storage

Flexible capacity

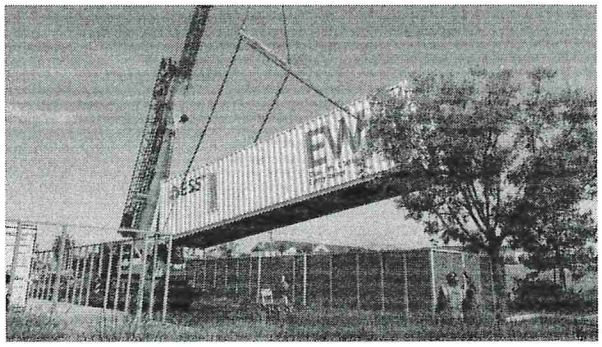
is critical to create a decarbonized grid powered by renewable energy. ESS solutions, available now, enable the growing penetration of renewables and can deliver clean energy 24/7.

enables the time shifting of intermittent renewables from supply peaks to demand peaks, balancing load and transforming the grid.

Distributed generation using microgrids and VPPs is fundamental to a cleaner, safer, and more resilient grid. Long-duration storage deployed globally enables this.

Iron Flow Batteries

The right technology at the right time



Lowest Cost Over Time

By combining easy-to-scale technology with low-cost chemistry, ESS delivers the lowest cost across 6-12 hours of storage.

Optimal Performance

Fast response time, unlimited cycle life and no capacity degradation over a 25-year design life delivers operational flexibility.

Safe & Sustainable

ESS batteries are safe, water-based, non-hazardous, fully recyclable and have a low carbon footprint. Use of earth-abundant

LEARN HOW WE STACK UP

LEARN MORE ABOUT FLOW BATTERIES

resources ensures sustainable production too.

READ THE LIFE CYCLE ANALYSIS

We stand firmly behind ESS Inc.'s iron flow battery technology as a commercially ready solution for long-duration energy storage at commercial and utility scale. Our goal in providing a comprehensive policy is to enable ESS Inc. to expand deployment of its environmentally sustainable energy storage solution at scale globally.

MICHAEL SCHREMPP

Global Head of Green Tech, Munich RE

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