

**STATE OF RHODE ISLAND
PUBLIC UTILITIES COMMISSION**

**IN RE: THE NARRAGANSETT ELECTRIC CO. d/b/a RHODE ISLAND ENERGY
REQUEST FOR PROPOSALS FOR OFFSHORE WIND - DOCKET NO. 22-22-EL**

October 7, 2022

**FUELCELL ENERGY, INC.’S COMMENTS IN RESPONSE TO
NOTICE TO SOLICIT COMMENT**

FuelCell Energy, Inc. (“FuelCell Energy” or “FCE”) hereby submits comments in response to the Notice to Solicit Comments and Public Hearing (“Notice”) issued by the Rhode Island Public Utilities Commission (“PUC”) in the above-referenced docket on September 10, 2022.

The Notice provided as follows:

In July 2022, Governor McKee signed amendments to the Affordable Clean Energy Security Act that were passed by the General Assembly in June. Specifically, R.I. Gen. Laws §39-31-10 requires Rhode Island Energy to solicit proposals for “at least six hundred megawatts (600 MW) but no greater than one thousand megawatts (1,000 MW) of newly-developed offshore wind capacity no later than October 15, 2022.” Rhode Island Energy was required to develop a request for proposals (RFP) in consultation with the Rhode Island Office of Energy Resources and the Rhode Island Division of Public Utilities and Carriers for comment by the public prior to its issuance. The law contains certain minimum requirements for the RFP. On September 7, 2022, Rhode Island Energy filed with the Public Utilities Commission (PUC) a copy of the draft RFP.

Notice at 1.

I. Introduction

FuelCell Energy commends and supports the goals of the Affordable Clean Energy Security Act (the “Act”) and Rhode Island Electric’s (“RIE”) RFP for 600 to 1,000 MW of offshore wind capacity. FuelCell Energy submits these comments regarding the capabilities of hydrogen and fuel cells to support both the Act’s and RFP’s goals.

Wind power is an essential component of a clean energy economy. However, wind power is intermittent in nature and must be properly managed to provide maximum benefit while limiting

costs. This is where hydrogen can and should play a key role. Hydrogen can provide both long term storage to solve the intermittency issue and also provide hydrogen to multiple offtakers. The world, the nation and Rhode Island are moving towards a hydrogen economy.¹ Rhode Island has shown that it intends to be a part of that economy² and can show its leadership here by including hydrogen as a critical component of RIE's offshore wind projects under the Act.

II. FuelCell Energy's Leadership in Hydrogen Energy and Fuel Cells

FuelCell Energy has leveraged five decades of research and development to become a global leader in delivering environmentally responsible distributed baseload power platform solutions through its proprietary fuel cell technology. As an innovator and an American manufacturer of fuel cell clean power platforms, FuelCell Energy's current commercial technology delivers clean, distributed generation, distributed hydrogen, as well as heat, carbon separation and utilization, and produced water. FuelCell Energy is planning to increase investment to develop and commercialize future technologies expected to deliver hydrogen and long duration hydrogen energy storage through its solid oxide technologies, as well as carbon capture solutions.

As a leading global manufacturer of proprietary fuel cell technology platforms, FuelCell Energy is uniquely positioned to serve customers worldwide with sustainable products and solutions for businesses, utilities, governments, and municipalities. FuelCell Energy's solutions are designed to enable a world empowered by clean energy, enhancing the quality of life for people around the globe. FCE's customer base includes utility companies, municipalities, universities, hospitals, government entities/military bases and a variety of industrial and commercial

¹ See <https://www.post-gazette.com/business/powersource/2022/09/22/global-clean-energy-action-forum-2022-pittsburgh-hydrogen-hub-pennsylvania-doe/stories/202209220175> (last visited October 7, 2022); <https://www.rechargenews.com/energy-transition/analysis-us-unveils-draft-national-clean-hydrogen-strategy-and-roadmap-with-three-key-priorities/2-1-1308355> (last visited October 7, 2022).

² See <https://www.nyserda.ny.gov/About/Newsroom/2022-Announcements/2022-08-25-Governor-Hochul-Announces-Maine-and-Rhode-Island-Join-Multi-State-Agreement> (last visited October 7, 2022).

enterprises. FuelCell Energy's leading geographic markets are currently the United States and South Korea and it is pursuing opportunities in other countries around the world. FuelCell Energy's offerings drive its mission to help customers realize their environmental goals, strengthen resiliency, manage energy and other commodity costs, and deliver valuable goods and services to their customers.

FuelCell Energy's multi-featured platforms can be configured to provide a number of value streams, including electricity, high quality usable heat, water and hydrogen, and to concentrate and separate CO₂ from industrial applications using fossil fuels. FuelCell Energy is focused on using its proprietary technology to pursue the following four significant industry applications, each of which is important to the achievement of the global energy transition currently underway:

- Distributed generation (commercially available);
- Distributed hydrogen (commercially available);
- Solid oxide based long-duration hydrogen energy storage, and electrolysis (under development); and
- Carbon Capture (under development), Sequestration and Utilization (CCSU).

The flexibility of FuelCell Energy's product offerings allows energy storage systems to adapt to the variability of renewable energy sources while meeting energy demands.

III. FuelCell Energy's Ability to Complement and Support Wind Power in Rhode Island

FuelCell Energy can provide particularized support for the development and deployment of wind power in Rhode Island. Of particular note here is FCE's product's unique capability of swapping between electrolysis mode and fuel cell mode, creating a long duration energy storage

platform via a Reversible Solid Oxide Fuel Cell (RSOFC). *See* FuelCell Energy Technical Presentation on Energy Storage, attached as Exhibit A, at 2.

FCE's RSOFC provides long duration essential power during critical times of need by creating and storing hydrogen from curtailed power and producing power when needed. The RSOFC thus creates a "virtual" battery. *Id.* at 3. By working with renewable generation sources such as wind power, the RSOFC provides long-duration energy storage in the form of hydrogen, creating firm, dispatchable assets from intermittent renewable generation. *Id.* at 4.

Short duration and long duration storage are complementary in the transition to a 100% renewable grid. Long duration storage can provide the most demand levelling benefits, combined with the most resiliency benefits. Storage resources can provide benefits through a variety of structures – whether through stand-alone grid services or tied to a specific renewable resource. *Id.* at 6.

FuelCell Energy is currently in the process of commercializing a solution for long-duration energy storage, using its proprietary solid oxide technology which will enable production of hydrogen with high electrical efficiency. FCE's platform will deliver higher efficiency than other competitors and competing technologies with or without the addition of waste heat. FCE's solid oxide stacks are designed to alternate between electrolysis and power generation mode. FCE's design goal is better integration of the intermittent power generation sources of wind and solar into the modern electrical system. Instead of producing power from fuel and air, a solid oxide fuel cell stack in electrolysis mode splits water into hydrogen and oxygen using supplied electricity. The hydrogen can be stored as compressed gas, creating the ability to produce a virtually limitless supply. When the grid needs to discharge power, the stored hydrogen will be sent back to the same

solid oxide stacks, which react it with air to produce power and to regenerate the water, which will be stored for the next cycle.

Long duration hydrogen-based energy storage can be achieved without the need to add excessive amounts of conventional battery capacity, a capacity that is reliant on rare earth minerals such as Lithium and Cobalt, both of which have supply constraints for broad adoption, require extensive mining and present long-term disposal challenges post-use. Long duration hydrogen-based energy storage is expected to be required at large scale to manage the forecasted high penetration of intermittent renewable resources globally, and this water/hydrogen-based approach of our solid oxide fuel cell/solid oxide electrolysis cell/reversible solid oxide fuel cell technology has the potential to be a key enabler of long duration hydrogen-based energy storage. FCE believes hydrogen as an energy storage medium is superior to mineral-based storage platforms.

FCE is also developing advanced electrolysis systems based on our solid oxide electrolysis platform, which can operate at higher electrical efficiency than currently available electrolysis technologies. Applications for this technology include hydrogen for production for mobility, industrial users, repowering existing combustion generation assets, as well as large scale hydrogen production from curtailed renewable or nuclear power.

FCE is currently operating a sub scale demonstration project of this technology in its Danbury test facility and has been awarded a pilot program to provide a packaged 150 kg/day system for demonstration at Idaho National Laboratory, which it expects to be placed in service during 2022. FCE looks to provide commercially available long duration energy storage as a pilot or at utility scale in accordance with the requirements of the Act and RFP.

IV. The Relationship Between Wind Power and FuelCell Energy in Rhode Island

Given the above background and description of the capabilities of FCE's RSOFC products, the interplay between RSOFCs and wind power is clear. Wind power, while integral to a clean energy economy, is intermittent. Additionally, it must be brought onshore and managed to maximize benefits.

The experience of Europe in 2021 is instructive. Europe came to rely increasingly on renewable energy, including wind power; however, a lack of wind contributed to Europe's energy crisis last year.

Wind speeds were milder than usual in Europe this year, so windmills across the bloc generated less electricity which worsened a crunch that sent power prices to record highs as utilities had to buy more coal and scarce, costly, natural gas.

The situation illustrated a challenge facing the European Union as it tries to boost renewable power and meet its climate targets: Power prices can soar when the wind dies down, so **generators need ways to store some of the excess power when winds are strong.**³

FuelCell Energy's systems can provide the long-term energy storage solution needed to harness the intermittent nature of wind power. Power, stored as hydrogen, can then be converted back to electricity and used on the grid as demand warrants.

In addition, hydrogen can serve several other purposes, including for transportation, building heat, and power generation. Regarding transportation, hydrogen is one of the keys to electrifying the transportation sector and achieving the goal of a zero-carbon electric supply. Hydrogen has the ability to power fuel cells in zero-emission vehicles and/or produce the electricity needed to power lithium-ion electric vehicles.

As for power generation, hydrogen-fueled energy can address resilience and solve regional winter reliability issues in the electricity sector. Hydrogen fuel cells can power any device that

³ See <https://www.reuters.com/markets/commodities/weak-winds-worsened-europes-power-crunch-utilities-need-better-storage-2021-12-22/> (last visited October 4, 2022) (emphasis added).

uses electricity and unlike conventional batteries, they do not need to be recharged and will not run down, so long as they have a continuous supply of fuel. Further, like any type of fuel cell, hydrogen fuel cells have a higher capacity factor than other renewable energy technologies, no intermittency when providing baseload power on-site, can help maintain grid stability, increase grid reliability and resiliency, and operate as independent generators of electricity and/or heat, among others.

Finally, hydrogen can also help meet thermal decarbonization goals. Fuel cells that are configured to operate as combined heat and power sources and hydrogen boilers are capable of producing heat from hydrogen. Fuel cells, specifically FCE's Carbonate - Tri Gen platform, produce hydrogen, electricity, low grade heat and water from a single gaseous fuel input. Therefore, existing technologies are not only capable of producing heat from hydrogen, but can also concurrently produce heat and hydrogen from the same fuel input, thereby deploying clean heat resources and lessening the state's reliance on natural gas.

V. Conclusion

FuelCell Energy, Inc. appreciates the opportunity to submit these written comments and the opportunity to participate in this proceeding.

Respectfully submitted,
FUELCELL ENERGY, INC.,
By its counsel,

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Exhibit A

STATE OF RHODE ISLAND PUBLIC UTILITIES COMMISSION DOCKET NO. 22-22-EL

October 7, 2022



FuelCell Energy and Energy Storage

- FuelCell Energy is a Connecticut based company which has been providing fuel cell power solutions commercially since 2003
- Projects have utilized a carbonate fuel cell platform with natural gas or renewable fuels both behind or in front of the meter with > 250MW installed worldwide
- FCE is developing systems based on solid oxide technology providing power generation - Solid Oxide Fuel Cell (SOFC) and hydrogen production - Solid Oxide Electrolysis Cell (SOEC)
- FCE unique capability of swapping between **electrolysis mode** and **fuel cell mode**, creates a long duration energy storage platform via Reversible Solid Oxide Fuel Cell (**RSOFC**).

Carbonate Power Platform



Solid Oxide Power Platform



Solid Oxide Electrolysis Platform



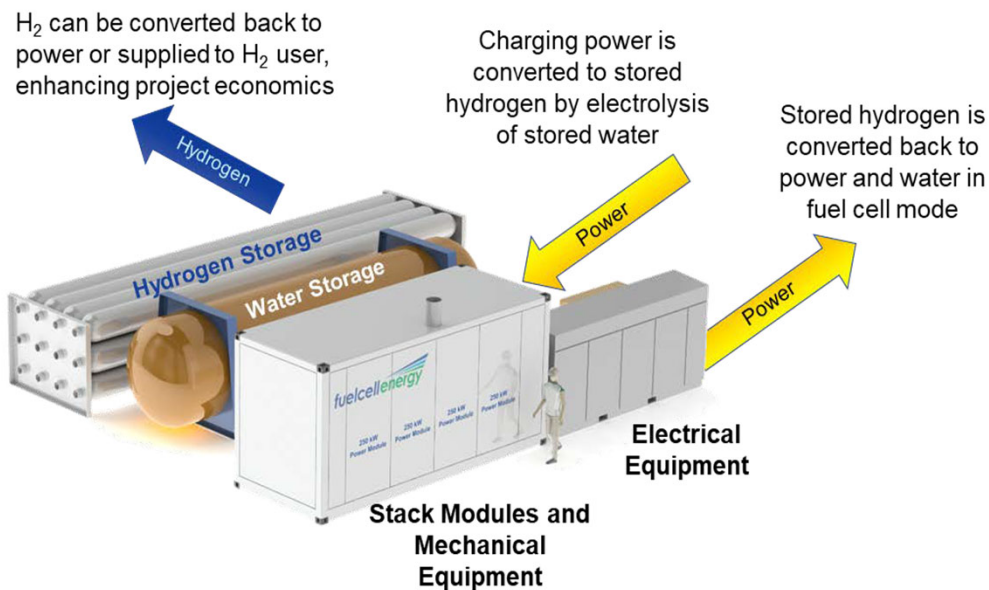
Solid Oxide Energy Storage Platform



FuelCell Energy

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Solid Oxide - Hydrogen Based Long Duration Energy Storage System



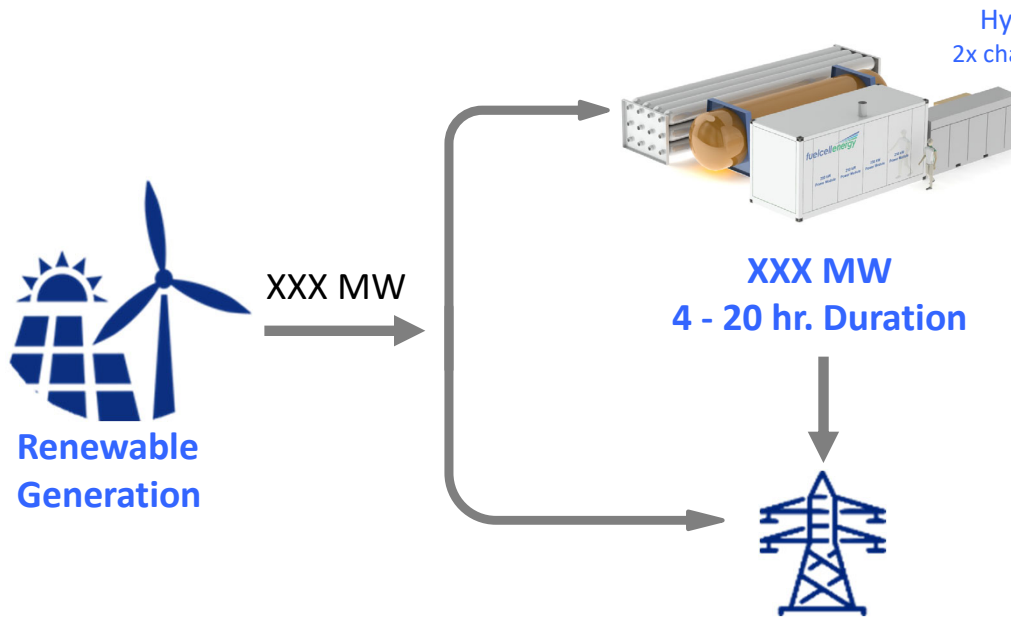
**Reversible Solid Oxide Energy Storage System
Scalable from kw to GW size**

- Provides long duration essential power during extreme weather events and other critical times of need
- Capable of BTM or FTM configuration
- Creates and stores hydrogen from curtailed power then produces power when needed creating a “virtual” battery
- High efficiency electrolysis and fuel cell performance creates high round-trip efficiency
- Cost of power (\$/MWh) drastically decreases with increased storage duration, accomplished by simply increasing storage capacity (H₂O, H₂)
- Geological storage of hydrogen can provide weekly or seasonal storage
- Superior economics vs Li-ion batteries beyond 4 hrs duration

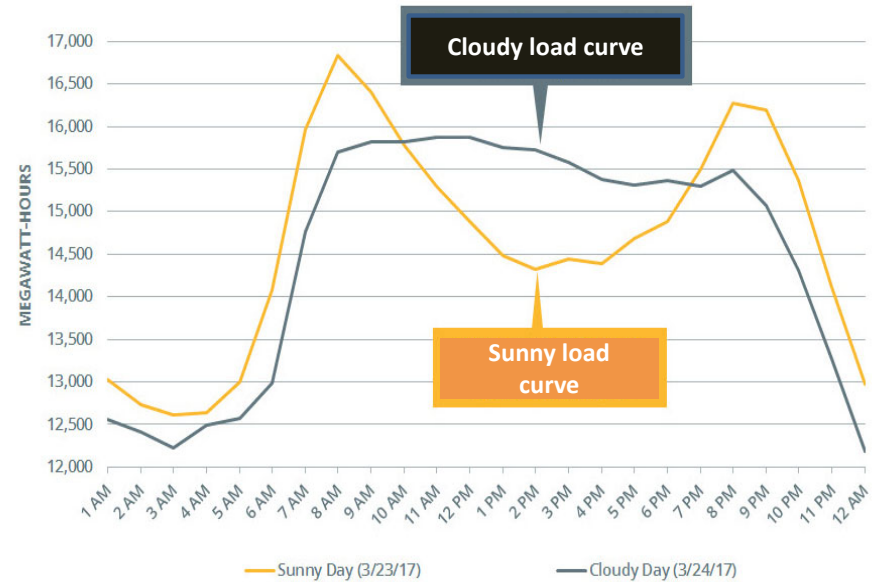


FCE Perspective on Energy Storage in RI

Renewable Scenario – Art of the possible



Creating firm, dispatchable assets from intermittent renewable generation

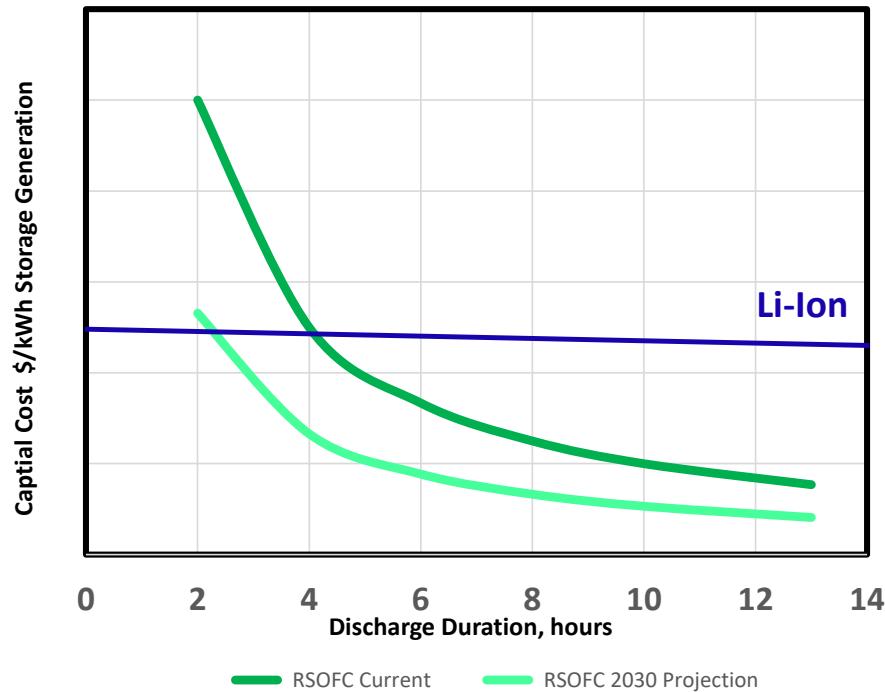


Source: ISO New England



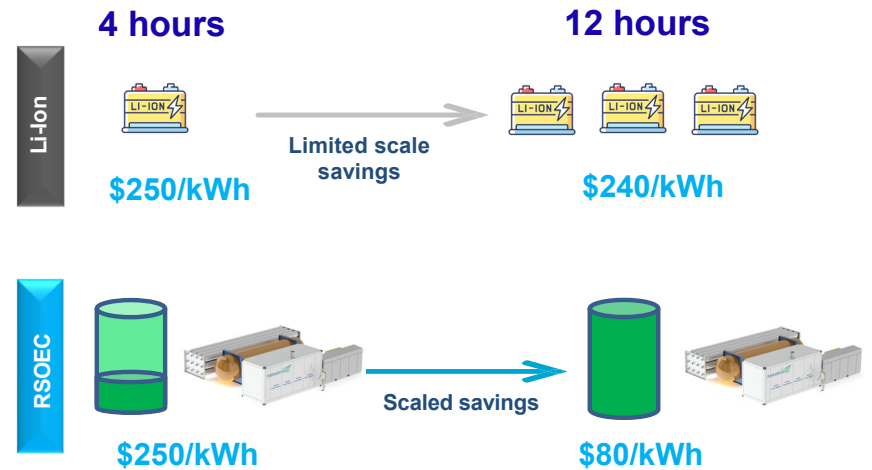
Solid Oxide - Hydrogen Based Long Duration Energy Storage System

RSOEC vs. Li-Ion Battery Storage for Long-Duration Duty

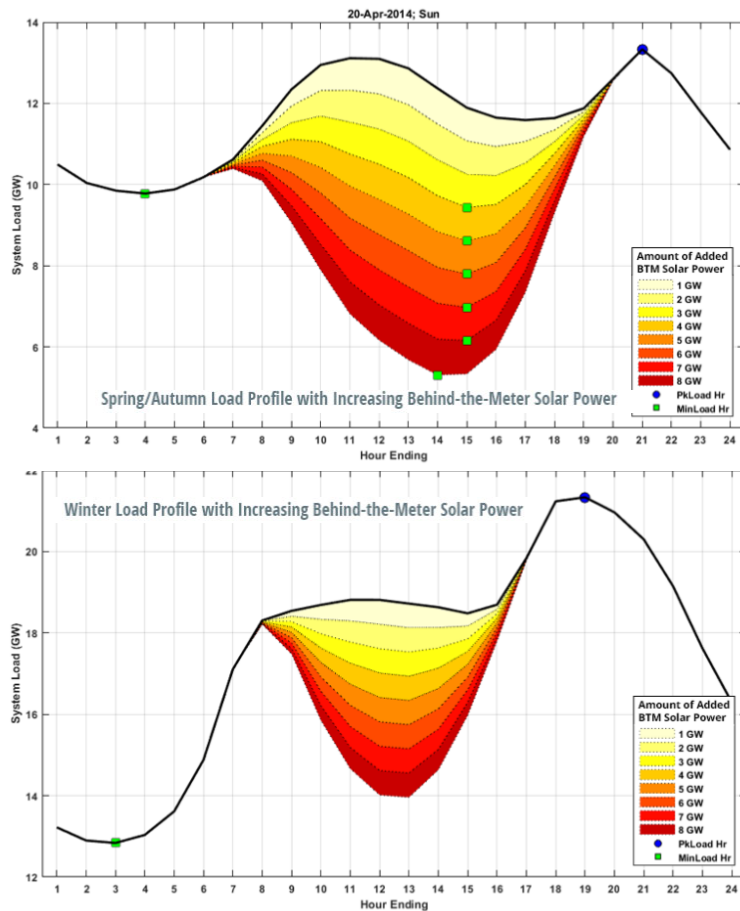


RSOFC based on company projections
 Li projections based on NREL estimates from
 Cole, Wesley, and A. Will Frazier. 2020. Cost Projections for Utility-Scale Battery Storage:
 2020 Update National Renewable Energy Laboratory. NREL/TP-6A20-75385

RSOEC Vs. Li-Ion – Long Duration Economics



FCE Perspective on Energy Storage in RI



- Shoulder seasons renewable contributions lead to rapid evening ramp - energy storage can levelize demand curve, shifting mid day excess renewables to evening and morning
- Relatively high PV output in winter combined with high peak demand creates severe evening ramp – energy storage can reduce evening ramp and evening peak with stored mid-day energy
- Short duration and long duration storage are complimentary in the transition to a 100% renewable grid.
- Long duration storage can provide the most demand levelling benefits, combined with the most resiliency benefits
- Storage resources can provide benefits through a variety of structures – providing stand alone grid services or can be tied to a specific renewable resource.

Source for charts: ISO NE

<https://www.iso-ne.com/about/what-we-do/in-depth/solar-power-in-new-england-locations-and-impact>



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Thank you

Enable the world
to live a life
empowered by
clean energy