Pacific Northwest
NATIONAL LABORATORY

Battery Storage for Solar Systems

February 9, 2023

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Rural Energy Conference & Workshop

U.S. DEPARTMENT OF ENERGY BATTELLE

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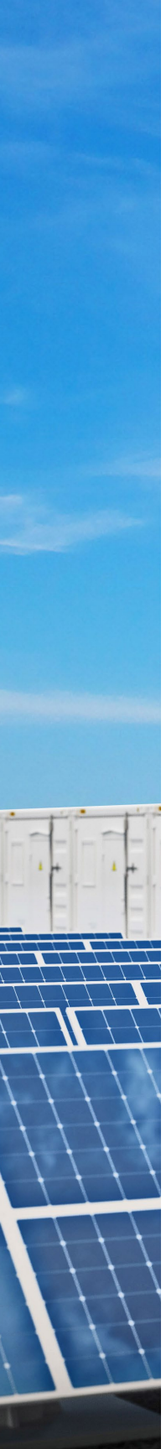

Acknowledgment

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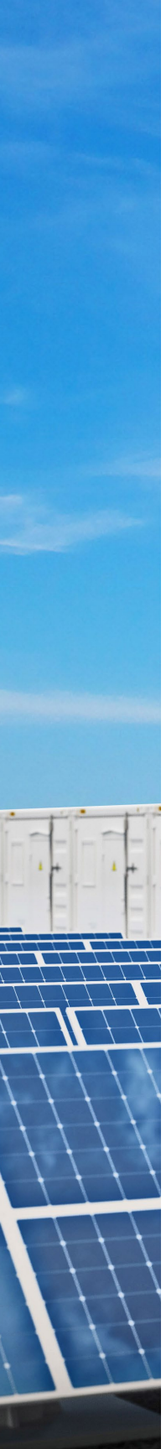
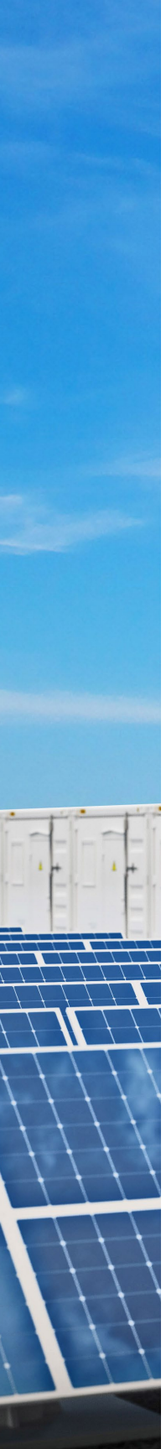


Agenda

- The Inflation Reduction Act
- Key Federal Energy Regulatory Commission (FERC) Orders
- Analytical Tools



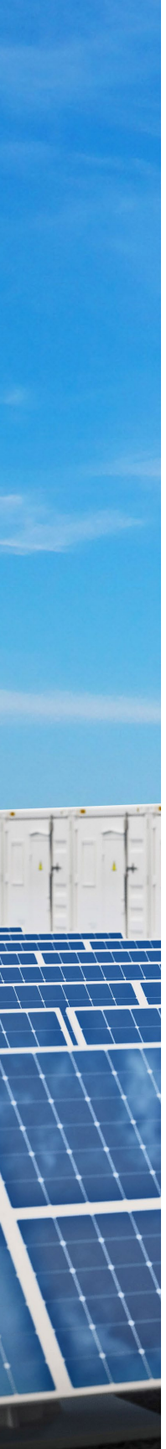
The Inflation Reduction Act

What We Had: The Investment Tax Credit (ITC)

The ITC applied to energy storage assets only when connected to solar generation and charged by that solar at least 75 percent of the time, forcing asset owners to make tradeoffs between economics and operations.

An illustrative, hypothetical example for two, four-hour batteries – one standalone and one hybrid:

- Without a charging constraint, the device provides a full suite of services for most of the day, prioritizing capacity during peak and ancillary services during off-peak hours
- Nighttime recharge is the only time the device is limited
- When only 25% of its charge may come from the grid, the device's ability to provide ancillary services is limited
- Interconnection (AC or DC coupled), increased ratio of solar to storage will affect the available services

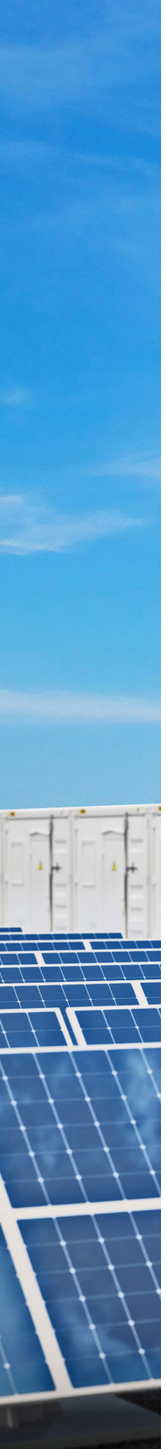


What we Have: The Inflation Reduction Act

The Inflation Reduction Act created the Clean Energy Investment Credit (CEIC), a new incentive that applies to non-emitting sources of energy generation and energy storage.

Where the ITC provided a flat, 30% credit based on the asset's cost, the CEIC has a multi-tiered structure with many possible outcomes:

Project Type	Base	Energy Community Adder	Domestic Content Adder	Low-Income Bonus	Total Possible
< 1 MW	30%	10%	10%	10% or 20%	70%
> 1 MW	6%	2%	2%	< 5 MW: 10 or 20%	< 5 MW: 30%
				> 5 MW: N/A	> 5 MW: 10%
> 1 MW that meets prevailing wage and apprenticeship requirements	30%	10%	10%	< 5 MW: 10 or 20%	< 5 MW: 70%
				> 5 MW: N/A	> 5 MW: 50%



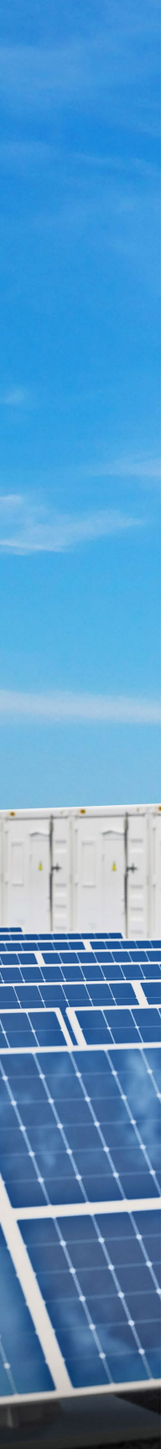
Clean Energy Investment Credit Terminology

To get the Energy Community adder, a project must be built in:

- A brownfield site;
- A metropolitan/non-metropolitan statistical area that has, at any time after 2009, had at least 0.17 percent direct employment or derived at least 25% of its tax revenue from fossil fuel industries, and has an unemployment rate above the national average; or
- Census tracts that contained, or were adjacent to a census tract that contained, a coal mine that has closed after 1999 or a coal plant that has retired after 2009

To get the Domestic Content adder, a project must:

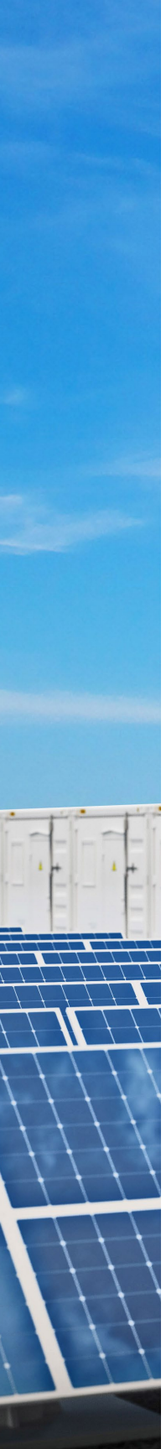
- Be built with steel, iron, and manufactured products that were produced in the U.S.
  - If 40 percent of the content of the manufactured products used in a project used materials produced or manufactured in the U.S., it complies with the manufactured products requirement
- The Treasury Department may waive these requirements if compliance would increase total project costs by more than 25 percent or if qualifying steel and iron are not available in satisfactory amounts or quality



Clean Energy Investment Credit Terminology

There are two tiers of low-income credits; a project may only be eligible for one. Only projects of 5 MW or less are eligible for these credits.

- 10% credit: Applies to any eligible project built within a low-income census tract
- 20% credit: Applies to eligible projects that:
  - Are installed on a low-income housing facility; OR
  - Direct at least 50 percent of their benefits to low-income households (less than 200 percent of federal poverty line or less than 80 percent of area median gross income)



Other Important Notes about the CEIC

“Energy storage” is a technology-neutral term:

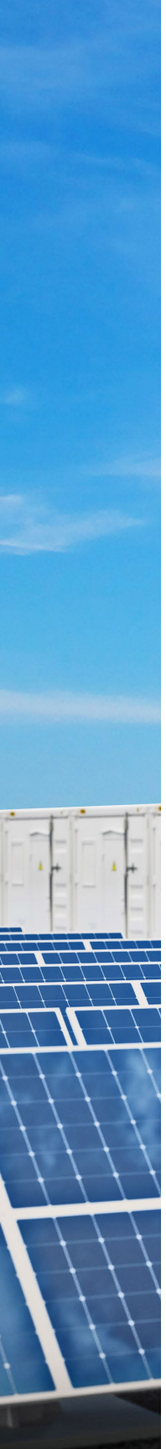
- Defined as any technology “that receives, stores, and delivers energy for conversion to electricity”
- Pumped storage hydropower, hydrogen projects are eligible
- No size restrictions

The credits will be less dependent on tax equity partners:

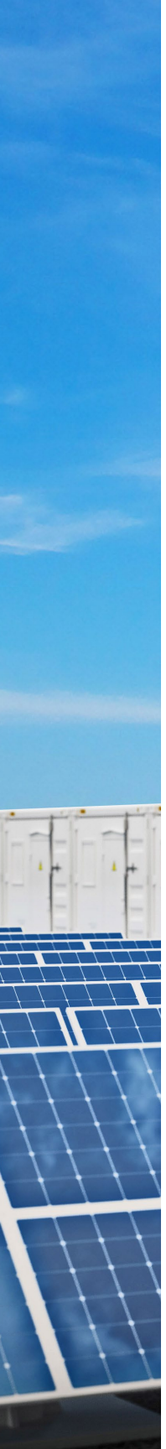
- Historically, tax credits have required financing by a partner with enough of a tax appetite to monetize the credits
- The CEIC allows tax-exempt entities to convert the credits into direct payments

Phaseout schedule:

- Begins at the later of the year that electric sector emissions are reduced by 75 percent from a 2022 baseline or 2032
- Decreases to 75 percent the following year, 50 percent the year after that, and terminates the year after that



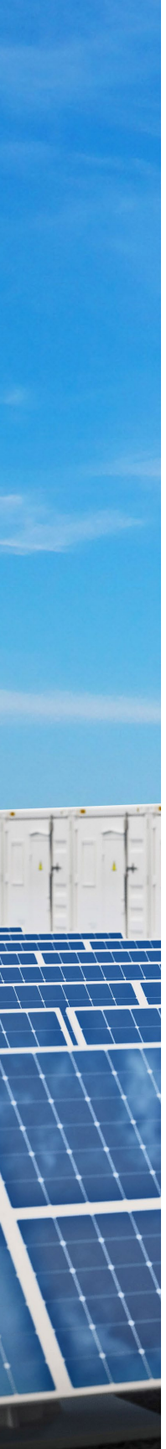
Key Federal Energy Regulatory Commission (FERC) Orders



FERC Order 845

Order 845 (April 2018)**:** Large generator interconnection agreements

- Establishes the standard practices that utilities and market operators follow when connecting large (>20 MW) generation resources to the grid
- Defines storage as a “generating resource” for interconnection purposes and allows facilities to interconnect at less than their nameplate capacity
- **What it means**: Before, if I wanted to build a 20 MW solar facility with a 5 MW battery, I had to connect as a 25 MW facility (even though I would never, ever put 25 MW on the grid)
  - Now, I don’t have to count the battery’s capacity when interconnecting
- Implications:
  - Faster, more accurate interconnection studies
  - More optimal use of transmission system (no more unnecessary allocation of transmission capacity to facilities that will never use it)



FERC Order 2222

FERC issued Order 2222 on Sept. 17, 2020 to build on Order 841 by requiring regional market operators to allow distributed energy resources to participate in markets on an aggregated basis.

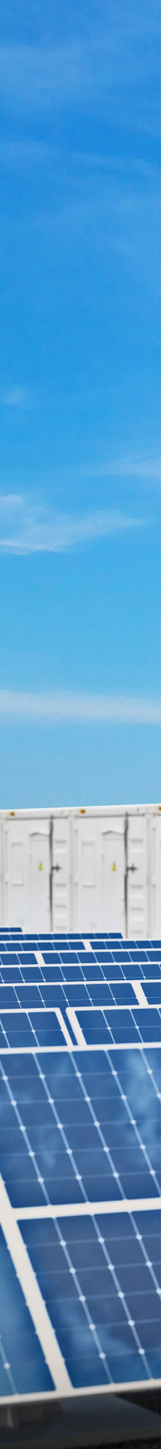
FERC identified several goals in enacting the policy:

- Improve the representation of DERs in load and capacity forecasts and reduce the risk of over-procurement
- Allow DERs to respond to locational price signals in a way that large-scale resources cannot
- Meet near-term generation and transmission needs more quickly and cost effectively

Compliance filings were required to:

- Identify DER aggregators as eligible market participants and establish a threshold for participating aggregations that is no larger than 100 kW;
- Address locational requirements for DER aggregations; and
- Coordinate with relevant retail regulators.

MISO has proposed an implementation date of 2030, which FERC is still considering.



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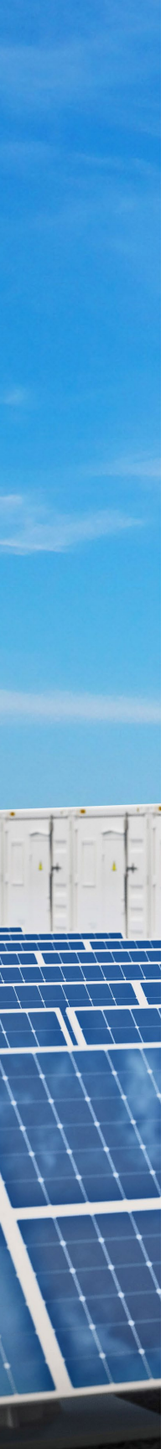
Analytical Tools



Right-sizing Storage with Solar Can be a Challenge

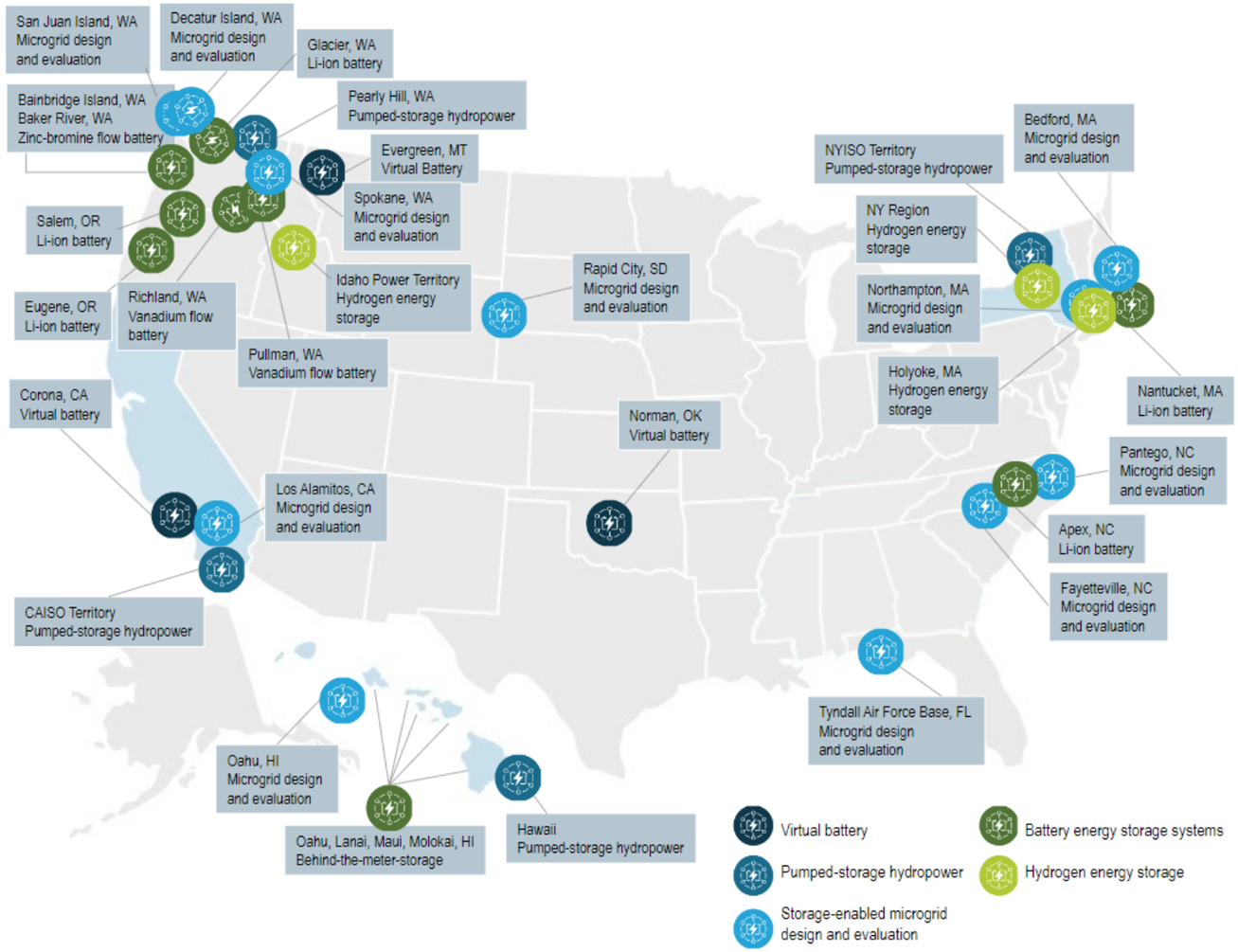
Determining the optimal size of energy storage paired with solar depends on a lot of things:

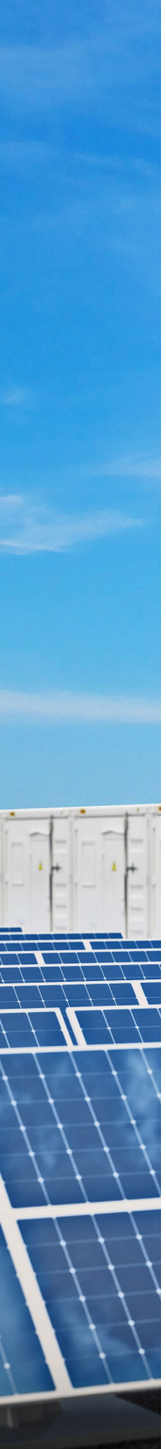
- Size of the solar array
- Interconnection requirements/export limitations
- Compensation mechanisms
- Resilience objectives
- Customer load
- And others…

Storage Analytical Tools

Energy Storage Evaluation Tool (ESET), PNNL

- Suite of 5 energy storage analytical tools (batteries, pumped storage, buildings as virtual batteries, hydrogen, and microgrids)
- Free, licensable software
- Microgrid component can be used to size solar + storage projects
- https://eset.pnnl.gov/





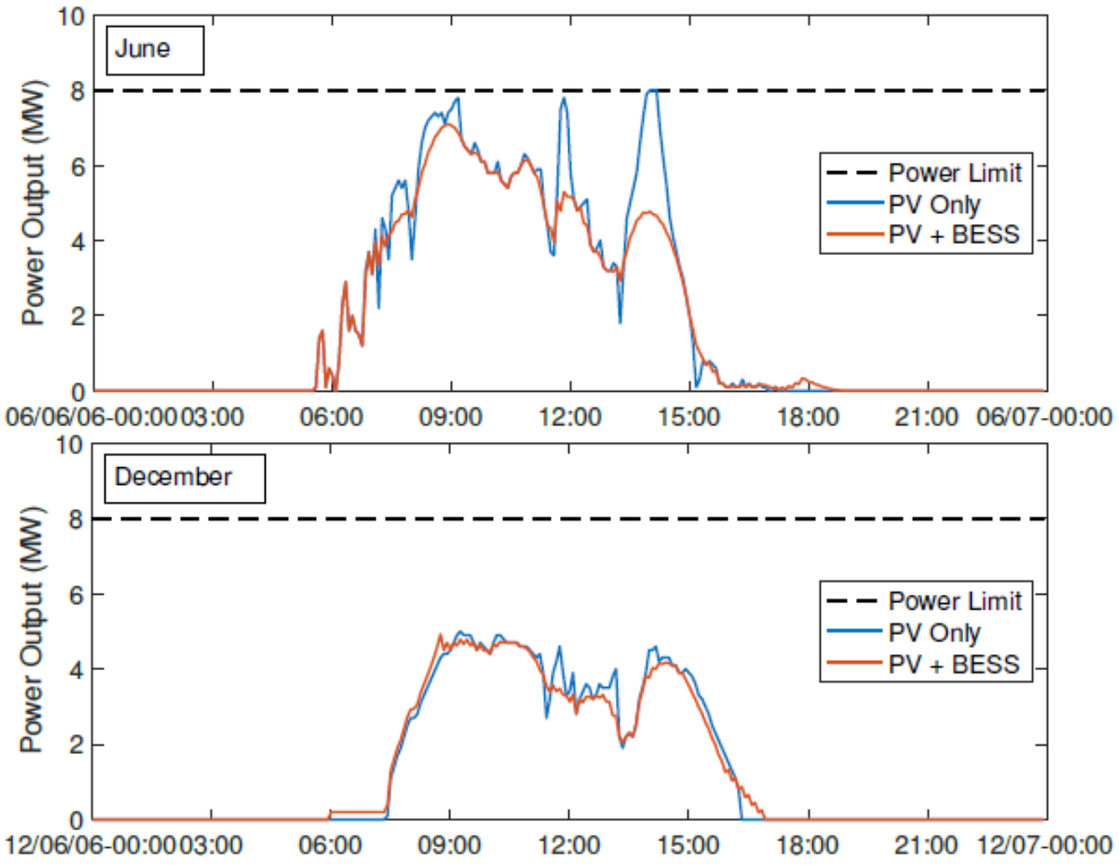
Storage Analytical Tools

DER-VET (EPRI)

- Analytical tool designed to optimize the size and control of storage when paired with other distributed resources (solar, demand response, diesel generators, etc.)
- Free, open-source software
- https://www.der-vet.com/

Analytical Example: Solar Smoothing

- Duke Energy implemented a tariff for third-party solar providers, offering them increased compensation if they reduce the variability of their output
- Utility objective: Cost-effectively reduce ancillary service needs
- We analyzed the tariff structure to determine whether the increased rates for smoother production would justify the addition of energy storage
- Adding ~1 MW of one-hour storage to a 10 MW solar facility achieves the required level of smoothing



Paper: [Optimal Sizing and Operation of a Hybrid Clean Energy Center]

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Thank you

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