Santee Cooper IRP Stakeholder Process 2024-2026

Battery Energy Storage Systems (BESS) Technical Meeting – Meeting Summary

Date: July 17, 2024
Time: 1:30-3:00 EDT
Location: Virtual Meeting via Zoom, Vanry Associates hosting

Topics and Presenters

AES Indiana Battery Energy Storage Overview

Erik Miller, Director Resource Planning, AES Indiana

Erik began the presentation by providing background on AES Indiana and the Company's Integrated Resource Plan (IRP) requirements. Erik then provided an overview of how AES Indiana models BESS and solar plus storage resources in the IRP. Finally, Erik provided an overview of 3 BESS projects AES Indiana is currently implementing.

Some key takeaways from Erik's presentation and Q&A, as captured by the Coastal Conservation League representative, are provided below:

- AES Indiana (AES IN) allocates 95% capacity accreditation for BESS in all years for its IRP optimization modeling.
- AES IN issued an all-source Request for Proposals (RFP) in 2023 in advance of its IRP to price out BESS.
  - Averaging the cost of the bids resulted in a near-term cost of $1,130/kW.
    - This was very well aligned with price forecasts from Bloomberg and Wood Mackenzie. Those forecasts show costs declining over time and dropping below $800/kW by 2031 (nominal).
  - Developers started to switch bids from solar toward storage based on winter capacity need in RFPs and near-0 capacity accreditation for solar in the winter (vs. 50% capacity accreditation in the summer).
- AES IN utilizes Encompass for IRP modeling and does not limit the amount of BESS the model can select in later years of the planning period but limits the maximum capacity additions of renewables and BESS for the first 5-7 years based on RFP results and lead time in the Midcontinent Independent System Operator (MISO) interconnection queue.
  - They included 4-hour and 6-hour storage and plan to include longer-duration storage in future IRPs. For 6-hour storage, they scaled up the cost of 4-hour storage proportionally, treating it like building a bigger battery.
  - BESS was assigned a 16% capacity factor and went through about one charging cycle per day.
  - AES IN models Demand Side Management (DSM) as a selectable resource and is looking at adding distributed BESS as a selectable resource in future IRPs.

Cypress Creek Renewables | Santee Cooper BESS Technical Discussion

Demitri Moundous, Director Energy Storage Revenue Strategy, Cypress Creek Renewables

Demitri began the presentation by providing background on Cypress Creek Renewables, including an overview of 2 BESS projects currently under development. Demetri then provided US projections for BESS growth, recent grid-scale quarterly deployments going back to 2022, and a view of current US battery power plants online. Finally, Demetri provided an overview of the benefits BESS projects are providing to markets, the role BESS could play in the US Southeast, potential BESS contracting structures, and BESS dispatch by Independent System Operators and utilities.

Some key takeaways from Dmitri's presentation and Q&A, as captured by the Coastal Conservation League representative, are provided below:

- A Wood Mackenzie report forecasts rapid BESS growth, with 10 GW cleared annually from this year to next year. California and Texas have had the most recent growth.
- BESS deployment will be highest in areas with higher solar penetration.
- BESS can be cycled up to twice per day but no more than 365 times per year.
- BESS provides winter morning capacity, which is a big driver for its selection in certain markets.
- In Texas and California, BESS is dispatched to ease the ramping of summer peaks in evening, and a similar pattern is expected in the Southeast.
- 8-10 hour BESS is expected to come into play in the 2030s, driven in part by carbon mitigation policy.
- BESS charging can help to keep the substantial nuclear fleet in the Carolinas above minimum generation levels in times of low demand.
- Contracting structures with developers are evolving to provide greater dispatch flexibility, including dispatching twice in a day and better providing winter peaking capacity.
- Energy Management Systems (EMS), such as Fractal EMS, can integrate BESS with utility EMS.

Slide decks for each presentation are attached to this summary.

Meeting Action Items

The following is a summary of action items agreed to at the close of the meeting.

ACTION ITEMS	RESPONSIBLE PARTY
No action items were identified.	

AES Indiana Battery Energy Storage Overview

July 17, 2024

Erik Miller, Director, Resource Planning

aes Indiana

Agenda

AES Indiana Overview

AES Indiana IRP Requirements

Modeling Battery Energy Storage & Solar + Storage in the IRP

- MISO Construct & Storage Accreditation
- Battery Energy Storage as a Capacity Resource
- Battery Energy Storage Modeling Assumptions from 2022 IRP
- Solar + Battery Energy Storage Modeling Assumptions from 2022 IRP

Overview of AES Indiana Projects

- Harding Street Battery Energy Storage System
- Petersburg Energy Center
- Pike County Battery Energy Storage System

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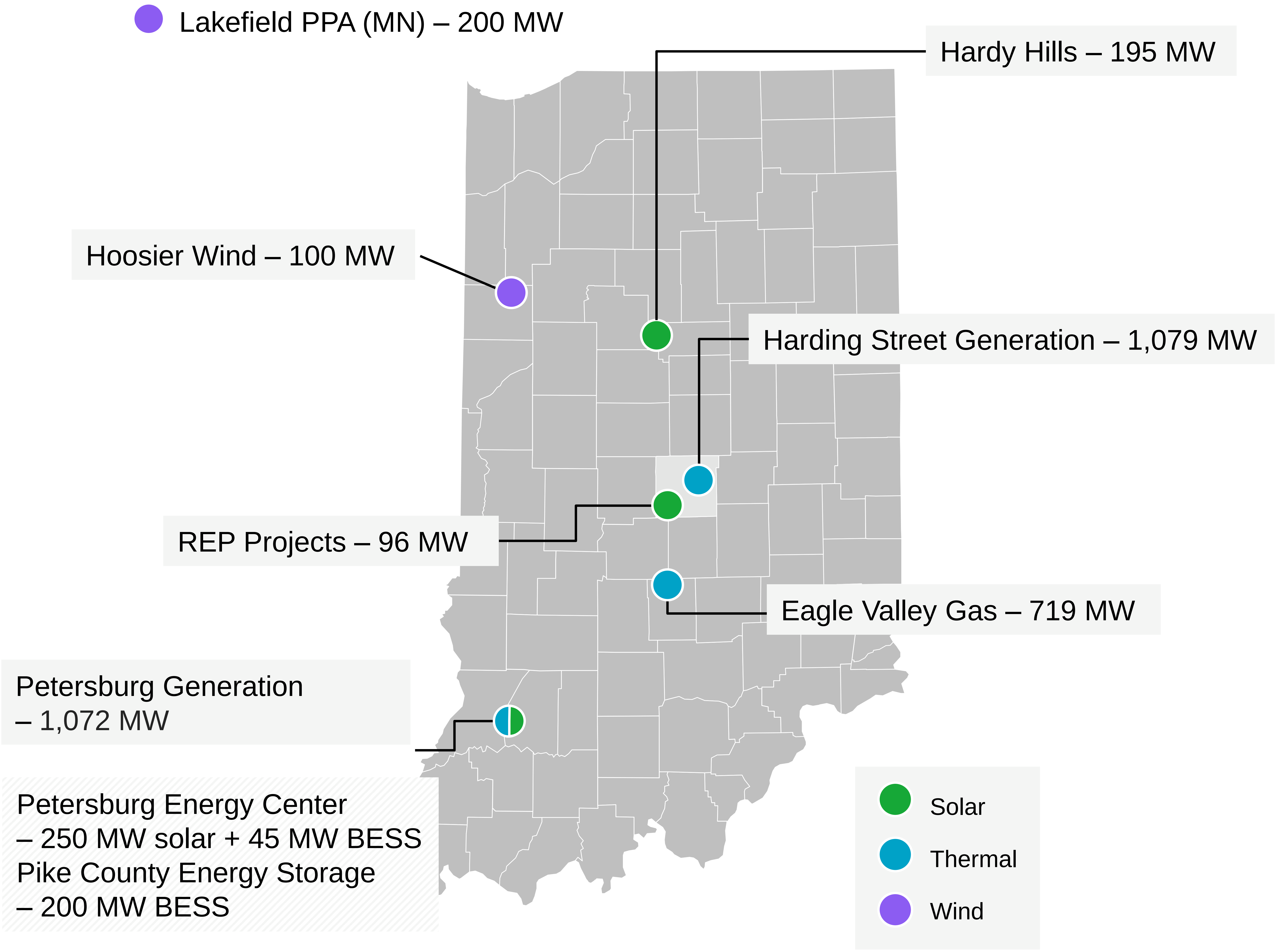
528
square miles

521,00
customers

3,956
MW of Generation



What is an IRP and Preferred Resource Portfolio?

"Five Pillars of Electric Service"
IC 8-1-2-0.6 (2023)

- Affordability
- Reliability
- Resiliency
- Stability
- Sustainability

Integrated Resource Plan (IRP) in Indiana –> 170 IAC 4-7-2

- 20-year look at how AES Indiana will serve load
- Submitted every three years
- Plan created with stakeholder input
- Modeling and analysis culminates in a preferred resource portfolio and a short-term action plan

What is a preferred resource portfolio?

"'Preferred resource portfolio' means the utility's selected long term supply-side and demand-side resource mix that safely, reliably, efficiently, and cost-effectively meets the electric system demand, taking cost, risk, and uncertainty into consideration."
IAC 4-7-1-1-cc

Stakeholders are critical to the process

AES Indiana is committed to providing an engaging and collaborative IRP process for its stakeholders:

- Five Public Advisory Meetings for stakeholders to engage throughout the process
- Five Technical Meetings available to stakeholders with nondisclosure agreements (NDA) for deeper analytics discussion
- Additional ad hoc meetings to review comments and questions from stakeholders with NDAs
- Planning documents and modeling materials were shared with stakeholders with NDAs including Encompass model database
- The Preferred Resource Portfolio determined after full consideration of stakeholder input

IRP rules link: http://iac.iga.in.gov/iac/iac_title?iact=170&iaca=&submit=+Go Article 4. 170 IAC 4-7-2

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Integrated Resource Planning within MISO

Accreditation for 4-hour storage could be impacted under MISO's seasonal construct and proposed accreditation methodology

MISO Seasonal Resource Adequacy Construct

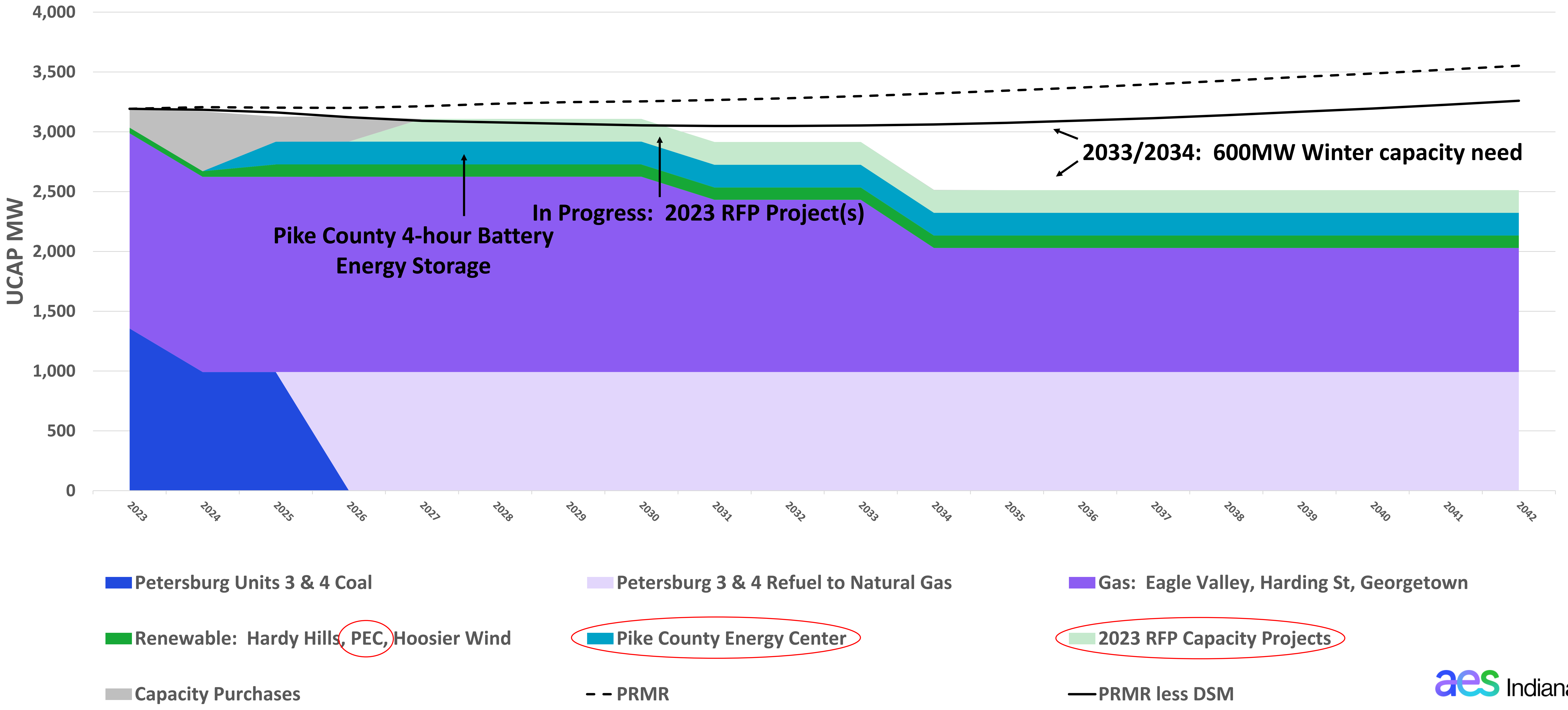
- → AES Indiana plans for capacity requirements in winter and summer seasons to align with MISO's Seasonal Resource Adequacy Construct which began in 2023/2024 planning year.
- → The Seasonal Construct is intended to ensure resource adequacy across all seasons after a significant increase in MaxGen events resulting from the retirement of baseload generation, increased intermittent resources and extreme weather events.
- → Seasonal planning reserve margins in 2024/2025 planning year:

PRM% Summer	9%
PRM% Fall	14.2%
PRM% Winter	27.4%
PRM% Spring	26.7%

MISO Energy Storage Accreditation

- → MISO has filed with FERC to switch to a direct loss of load-based (DLOL) methodology for determining energy storage accreditation beginning in 2028/2029 planning year.
- → The MISO DLOL-based accreditation poses potential risk to the accreditation for 4-hour battery energy storage as this technology becomes more prevalent on the system.

AES Indiana Winter Capacity Position



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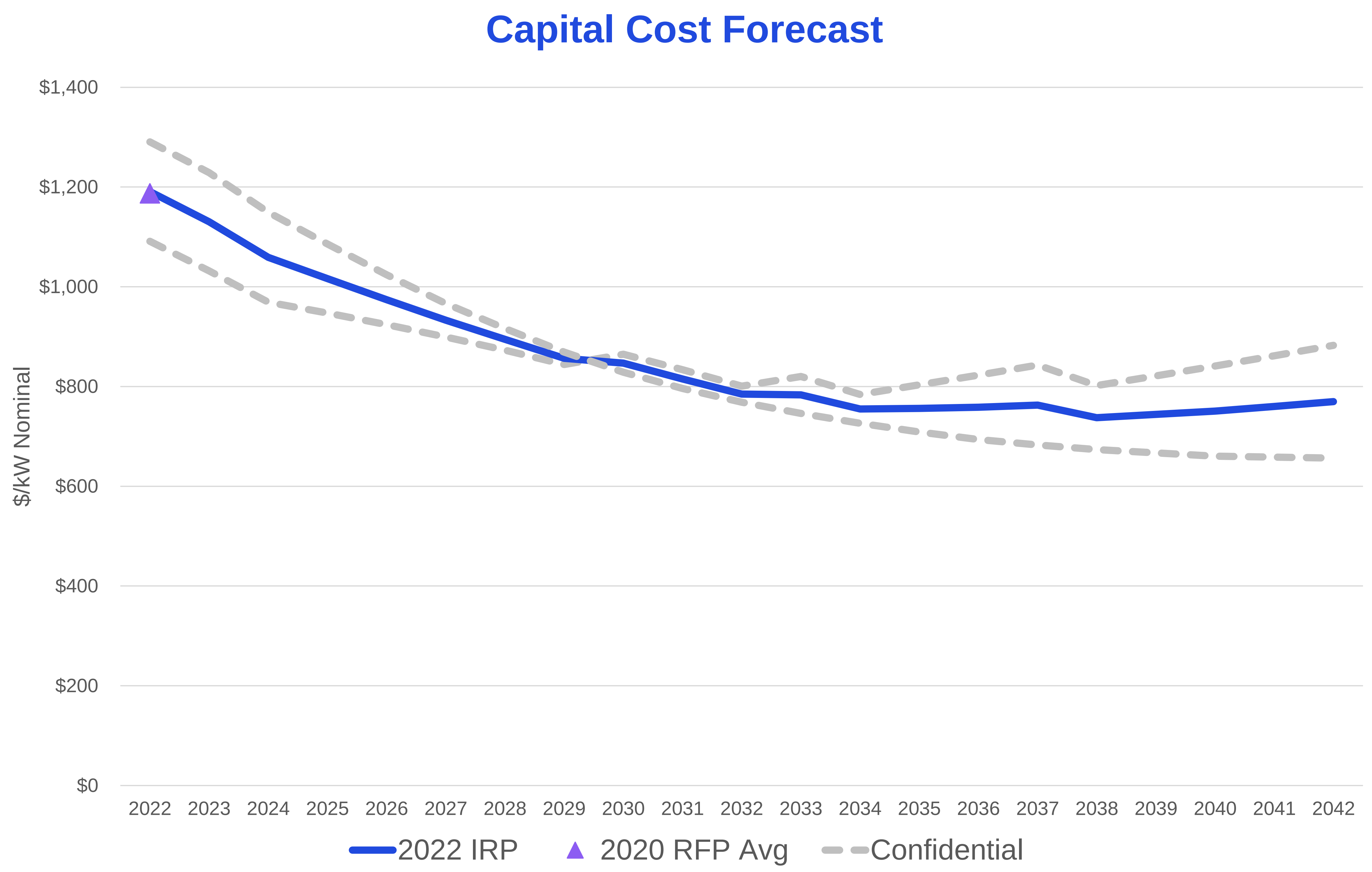
Storage Capital and Operating Costs

Capital Cost ($/kW)	Fixed O&M ($/kW)	Variable O&M ($/MWh)
$ 1,130	$ 27	$ -

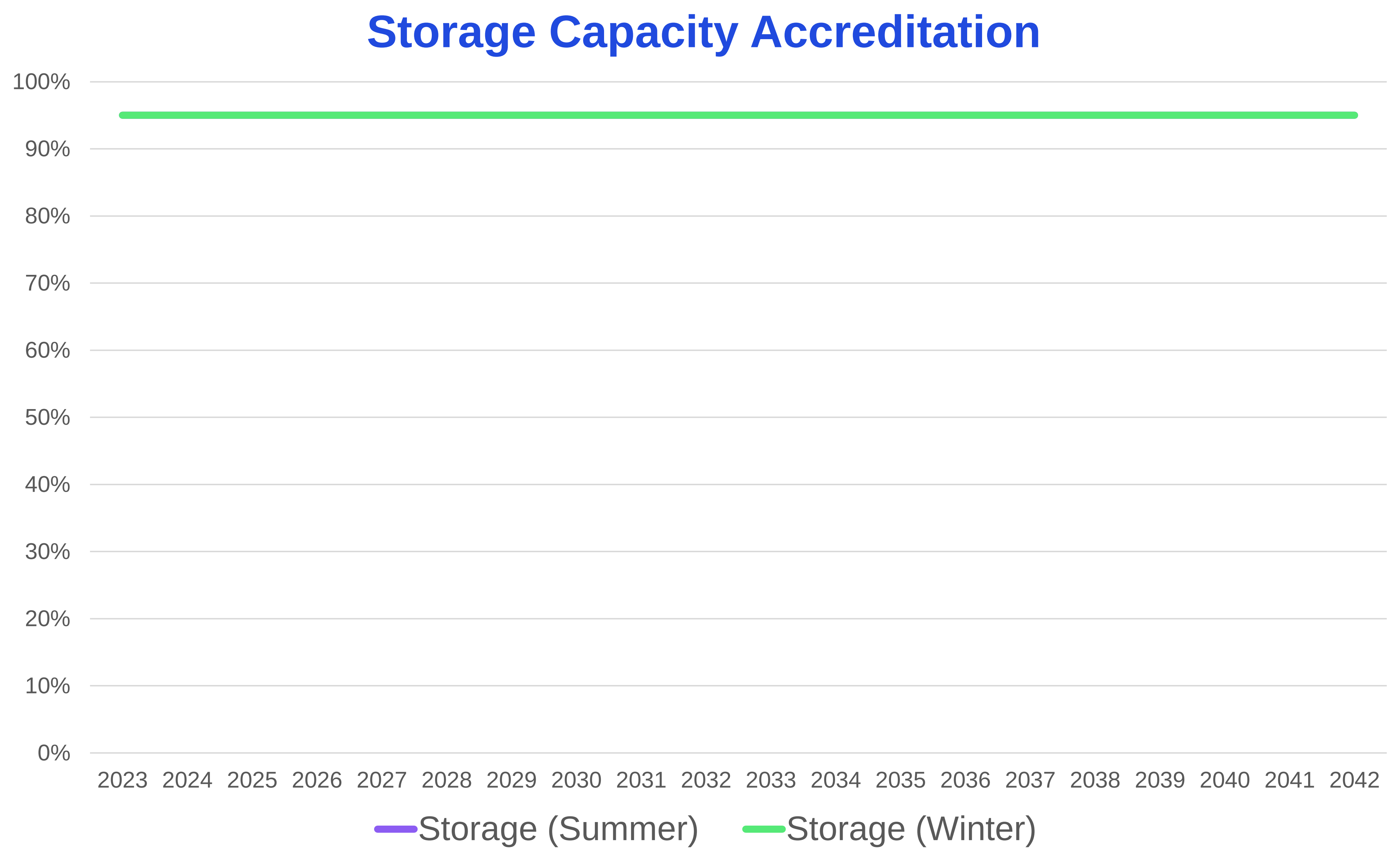


Note: Capital Cost estimates presented here are without federal tax credits. Federal tax credits will be included in modeling based on the IRP scenario assumptions.

Note: Confidential cost forecasts in chart include forecasts from Wood Mackenzie and BNEF

Storage Modeling Parameters

- **Location:** Indianapolis, Indiana
- **Project Size:** 20 MW ICAP | 80 MWh (4-hour)
- **Round Trip Efficiency (RTE):** 85%
- **Storage Capacity Factor:** Target ~16%
- **Useful Life:** 20 years
- **Summer/Winter Capacity Accreditation:** 95% (19 MW)
- **Investment Tax Credit:** available for standalone; varies by scenario



Note: 6-hour Storage also modeled and scaled off of the 4-hour Storage assumptions

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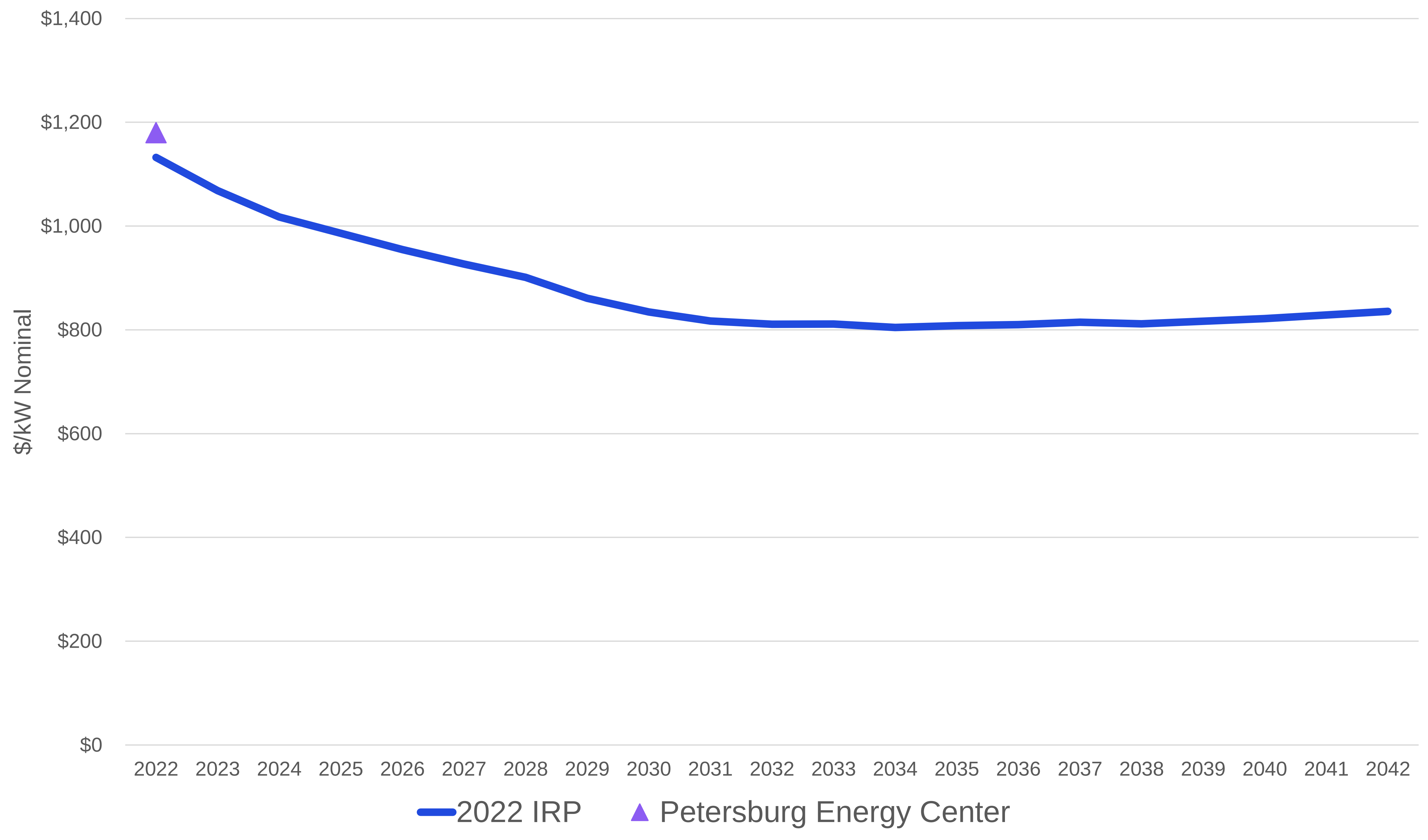
Solar + Storage Capital and Operating Costs

Capital Cost ($/kW)	Fixed O&M ($/kW)	Variable O&M ($/MWh)
$1,069	$17	$0

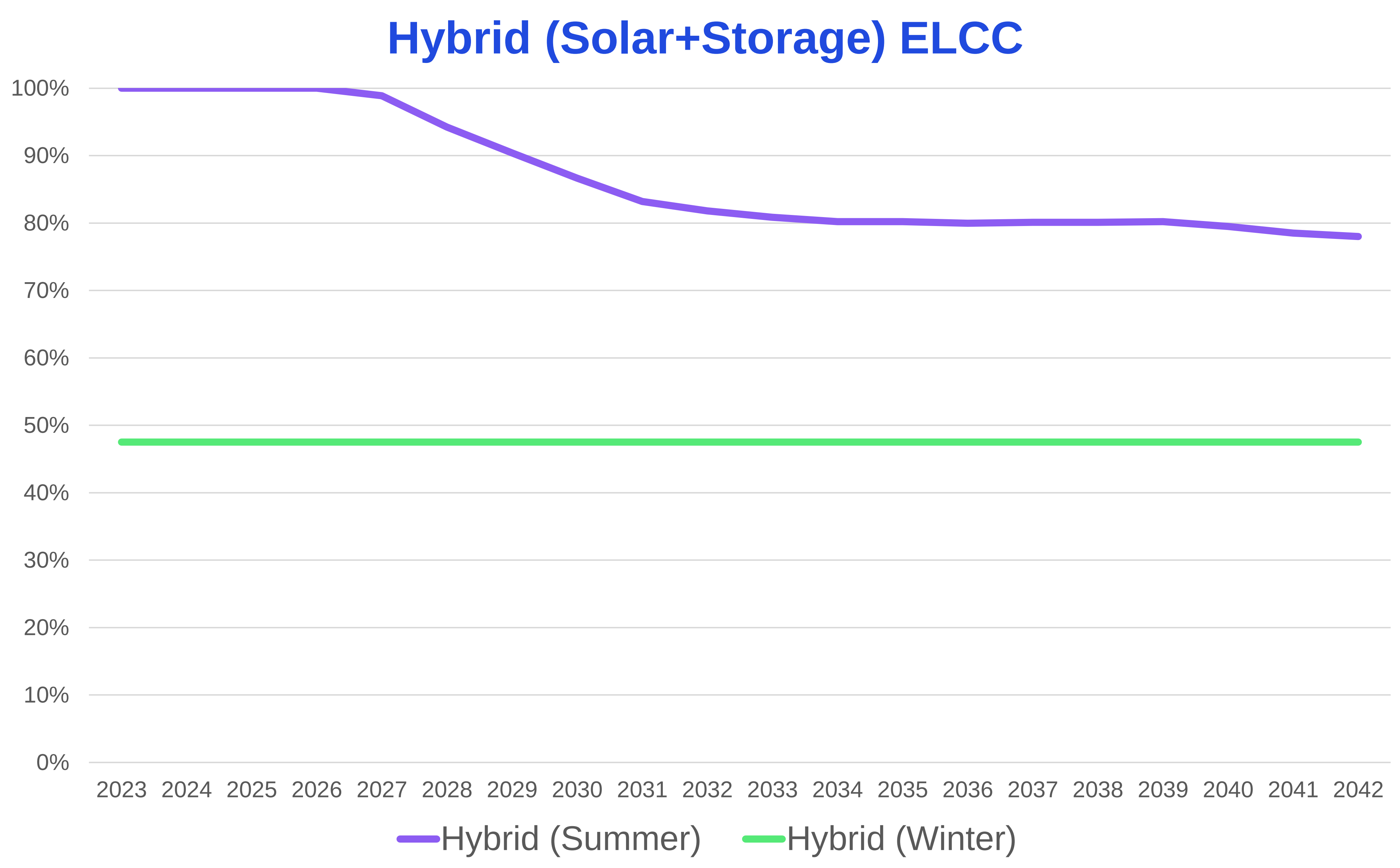
Capital Cost Forecast



Note: Capital Cost estimates presented here are without federal tax credits. Federal tax credits will be included in modeling based on the IRP scenario assumptions.

Solar + Storage Modeling Parameters

- **Location:** Petersburg, Indiana
- **System:** DC Coupled Solar + Storage System, Storage charges exclusively from the solar array
- **Solar Component:** Identical to stand-alone solar (25 MW ICAP)
- **Storage Component:** 12.5 MW ICAP | 50 MWh
- **RTE:** 87%
- **Storage Capacity Factor:** Target ~16%
- **Synergies:** 4.3% reduction in capital costs, 2% improvement of RTE
- **Summer ELCC (2025):** 100%
- **Winter ELCC:** 48%
- **Useful Life:** 35 yr solar; 20 yr storage
- **Investment Tax Credit:** Varies by scenario



*Summer forecast presented in chart above is from the Horizon Custom Reference Case – forecast will vary by custom scenario

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BESS & Solar + Storage Projects

Harding Street Battery Energy Storage System

- **System:** Battery Energy Storage System; Lithium-Ion Chemistry
- **Size:** 20MW 1-hour
- **Location:** Harding Street Station in Indianapolis, Indiana
- **Inservice Date:** Spring 2015
- **Notes:** Harding Street BESS is used for grid frequency stabilization and is not registered as a capacity resource with MISO.

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Petersburg Energy Center

- **System:** DC Coupled Solar + Battery Energy Storage System; Lithium-Ion Chemistry
- **Size:** 250 MW Solar and 45 MW 4-hour battery
- **Location:** Petersburg, Indiana
- **Inservice Date:** January 2026
- **Notes:** Project developed in accordance with the results of the 2019 IRP to serve a partial capacity replacement for the retirement of Petersburg Coal units 1 & 2.

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Pike County Energy Storage

- **System:** Battery Energy Storage System; Lithium-Ion Chemistry
- **Size:** 200 MW, 4-hour; 800 MWh
- **Location:** Petersburg, Indiana
- **Inservice Date:** December 2024
- **Notes:** Project developed in accordance with the results of the 2022 IRP to serve a winter capacity resource in MISO's Seasonal Resource Adequacy Construct.

Summary

- AES Indiana views storage as a viable near-term capacity resource until sustainable baseload dispatchable technology becomes available.
- In our modeling of storage, we capture both the capacity value and energy arbitrage value.
- Capturing the IRA Investment Tax Credit for standalone storage makes it a cost-effective option for AES Indiana.
- Longer duration storage will be needed as more storage gets added to the system.

Thank You

CYPRESS CREEK RENEWABLES

Santee Cooper BESS Technical Discussion

Dmitri Moundous, P.E.
Director, Energy Storage Revenue Strategy

DEVELOPMENT EXPERIENCE

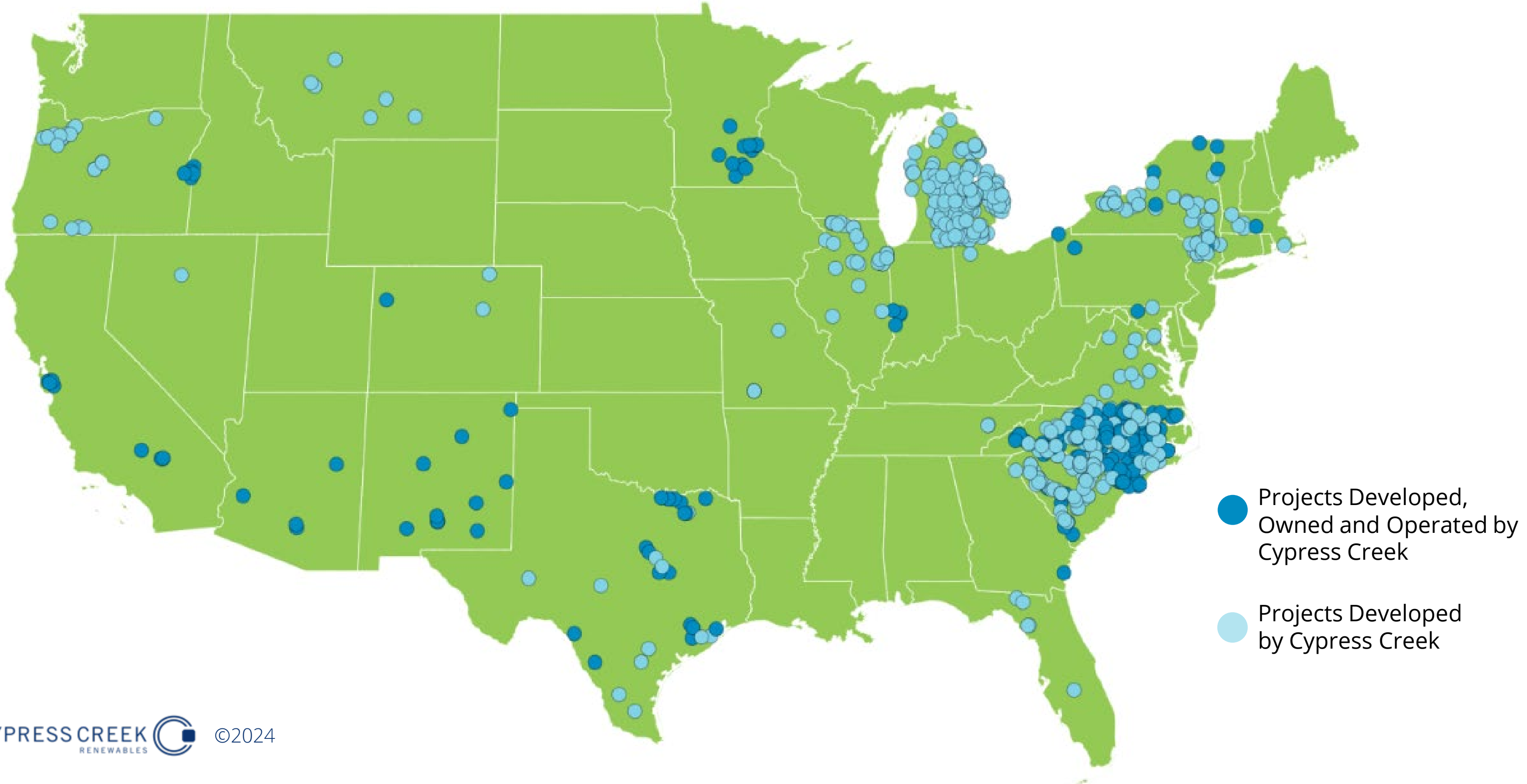
Our capabilities have been refined through years of successful development

12GW Solar Energy Developed to Date

850 Projects in **22** States

Transmission-Scale and Community Solar Projects

Standalone and co-located storage



SPOTLIGHT

Our Approach to Development

- We are a fully integrated platform, from development to operations
- Our team includes Project Development, award winning Structured Finance, Project Execution, Operations and Maintenance and Fleet Services all with a **long-term owner mindset**
- We use a holistic approach to development that includes an operational feedback loop.
- Our >2GW Fleet and >4GW O&M provide opportunities for continuous improvement.
- As we gain experience in any given market, that experience is used to inform our ongoing development work to provide the best projects

IPP with Operational Focus

Storage Development Expertise

Cypress Creek was one of the early movers of North Carolina solar, with our first projects coming online in 2016.

- ***200 MW operational BESS*** in TX, NY, MA and NC, including:
- ***12 solar + storage projects in operation since 2018*** providing clean energy and peak management to Brunswick EMC
- ***Over 6GW*** of hybrid and standalone energy storage under development nationally – transmission and community scale

Best-in-Class Solar and Storage Operations and Asset Management

Cypress Creek monitors asset performance 24/7, 365 days a year across our entire fleet from our **NERC-certified Cypress Creek Control Center ("C4") located in Durham, NC**. In addition to our own operating assets, Cypress Creek provides ***O&M Services for over 4 GW of solar and storage projects***.

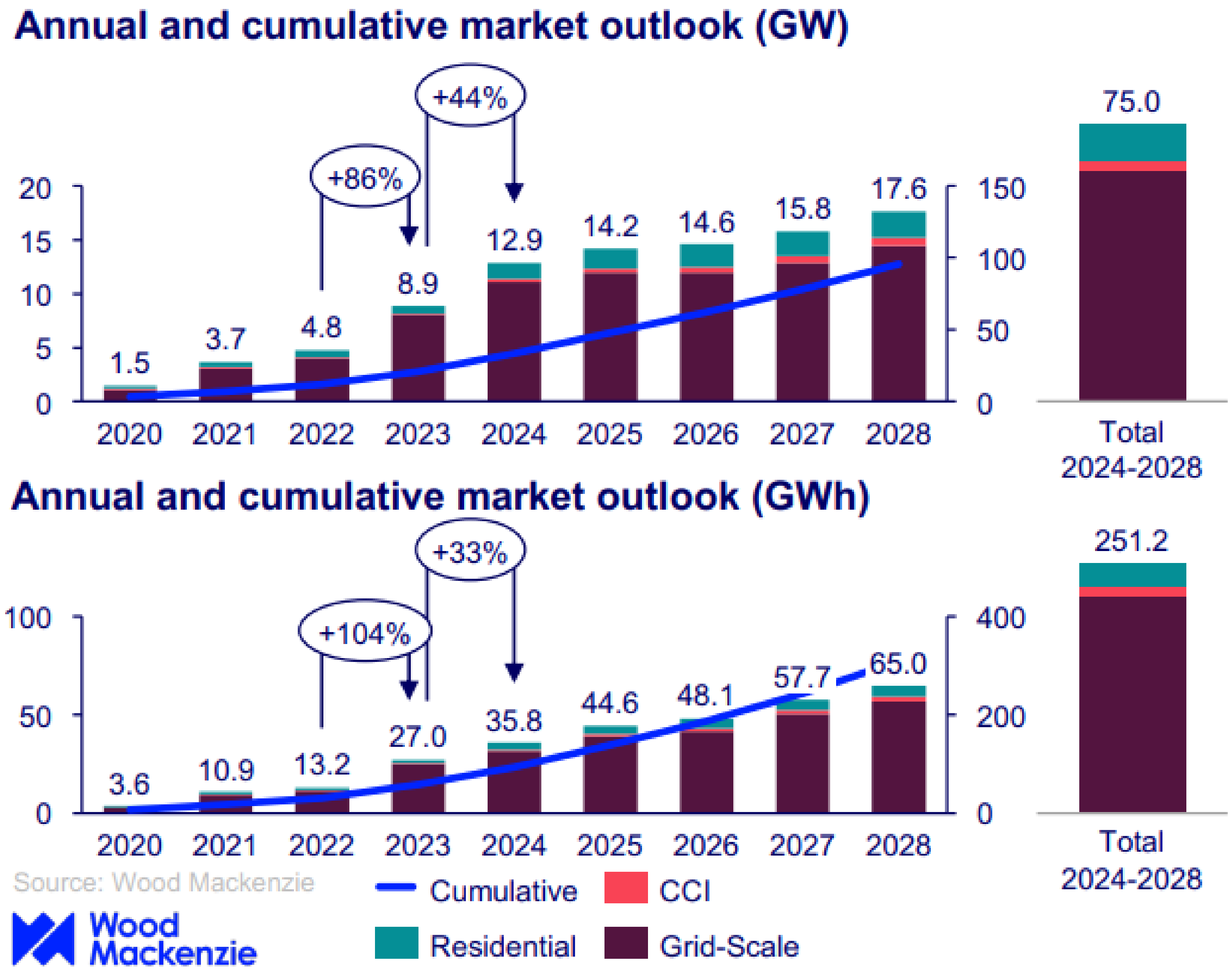
Zier PV (208MW) +BESS (40MW / 80MWh), Brackettville, TX
BESS OEM: Tesla
EMS: Norcal
Status: Operating

Use case:
Provides Contingency Reserves and Frequency Regulation in West Hub of ERCOT market


Brazos Bend BESS (100MW / 135MWh), Fort Bend, TX
BESS OEM: Sungrow
EMS: Fractal EMS
Status: Pre-operational
Use case:
Operating Reserves and Frequency Regulation
in Houston Hub of ERCOT market

US Battery Storage Growth

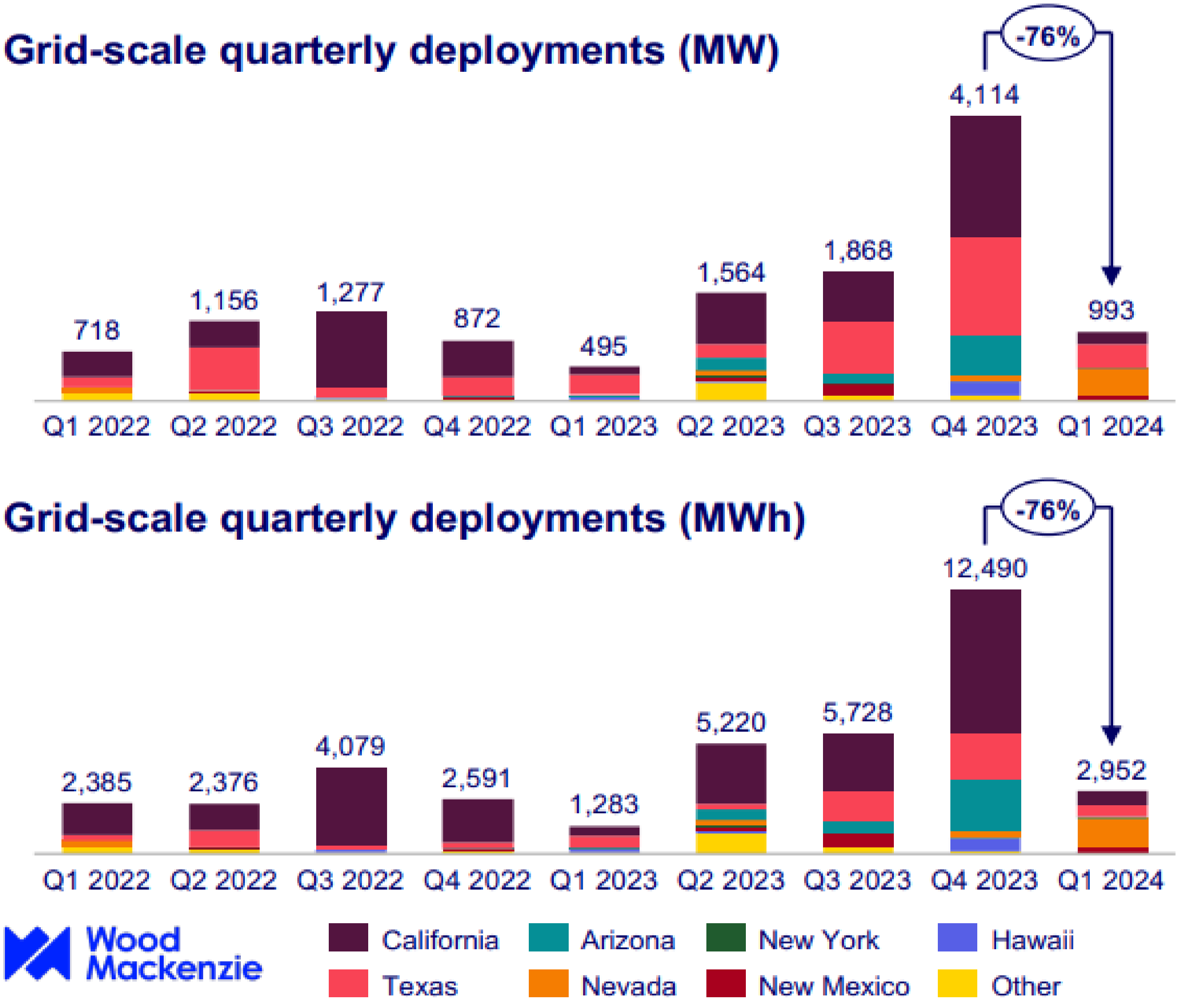
Utility Scale BESS



- Near-term deployment uptick driven by IRA, declines in storage costs, and primarily in ERCOT and CA markets
- Flattened growth attributed to delays in interconnection, cost of capital, and new tariffs

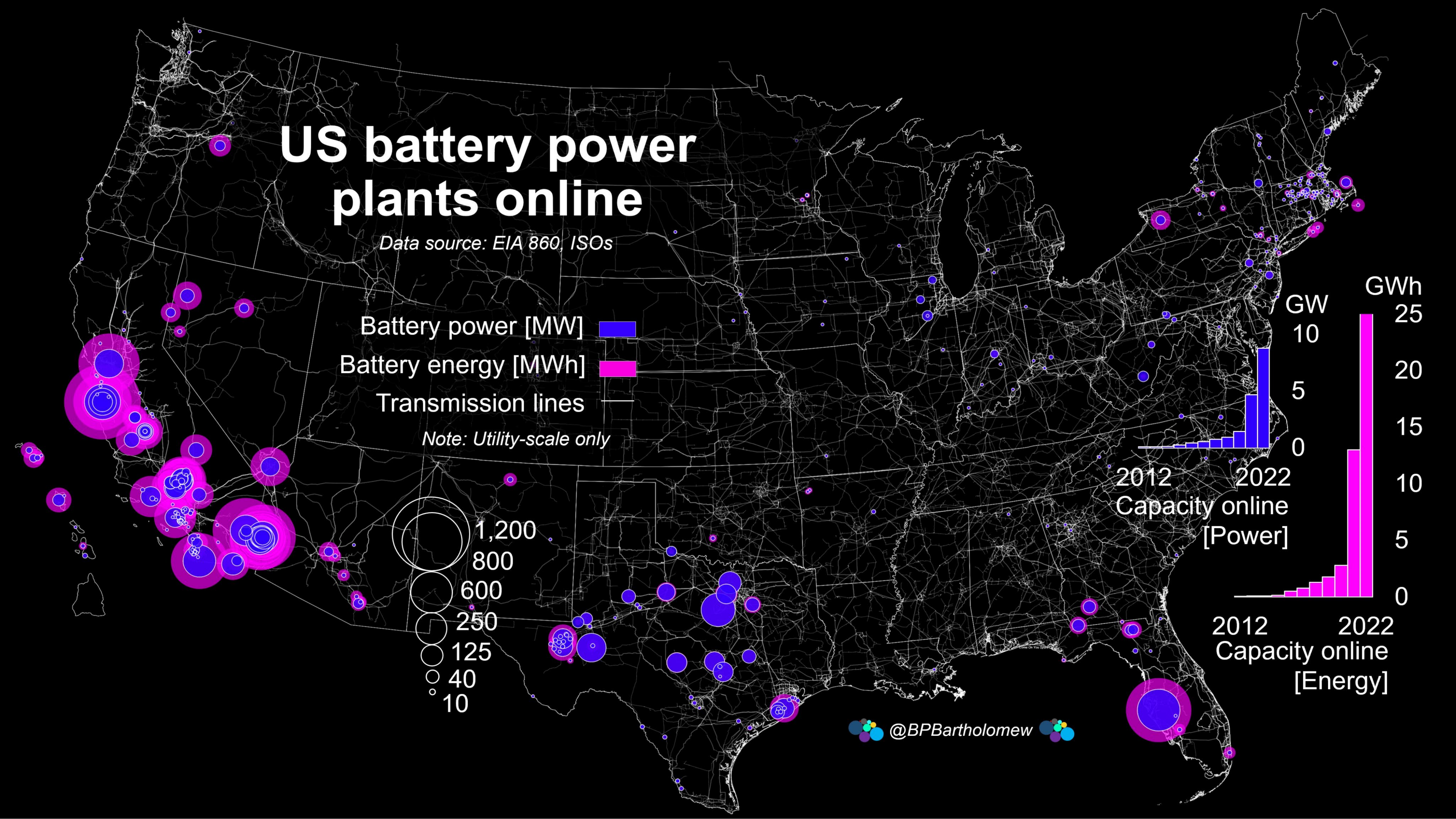
Source: Wood Mackenzie Power & Renewables/ACP U.S. energy storage monitor, Q2 2024

Where are BESS being built today?



- CA and TX primary leading US utility-scale deployments to date
- Emergence in desert Southwest as a 3rd contender – "four corners" states
- Regions of high solar penetration will see highest BESS deployments
- Utility contracts, while a small fraction of operating BESS today, will likely comprise majority of BESS offtake by 2030

Source: Wood Mackenzie Power & Renewables/ACP U.S. energy storage monitor, Q2 2024



US battery power plants online
Data source: EIA 860, ISOs
Battery power [MW]
Battery energy [MWh]
Transmission lines
Note: Utility-scale only
1,200
800
600
250
125
40
10
GW
10
5
0
2012
2022
Capacity online
[Power]
GWh
25
20
15
10
5
0
2012
2022
Capacity online
[Energy]
@BPBartholomew

Evolving Storage Value

NREL SFS, Key Learnings (2022)

KEY LEARNING 3: The ability of storage to provide firm capacity is a primary driver of cost-competitive deployment.

KEY LEARNING 5: Storage and photovoltaics (PV) complement each other.

KEY LEARNING 7: Storage durations will likely increase as deployments increase.

KEY LEARNING 8: Seasonal storage technologies become especially important for 100% clean energy systems.

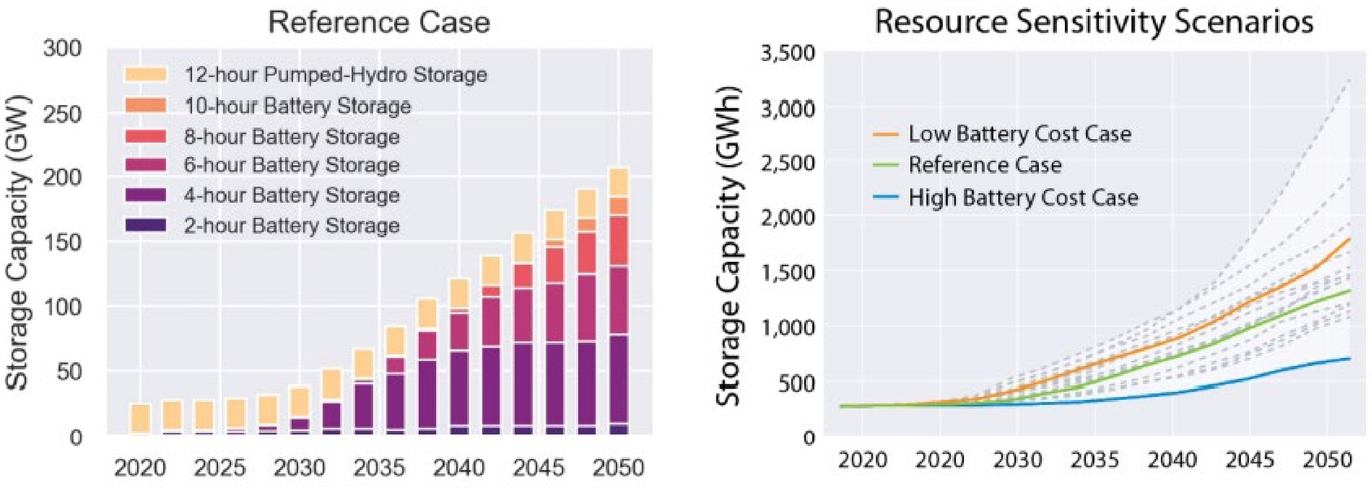


Figure 1. National storage capacity in the reference case grows to about 200 GW by 2050, deploying a range of durations (left) This translates to about 1,200 gigawatt-hours (GWh) of stored energy (right), with a wide range of deployments.

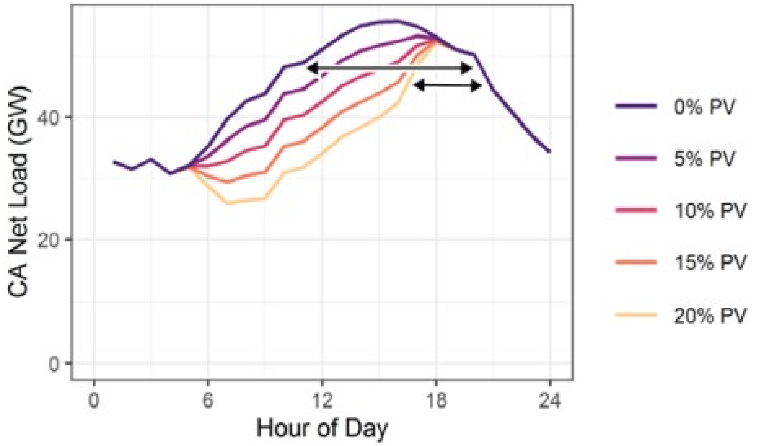


Figure 8. Increased deployment of PV demonstrates the reduced duration of net load peaks

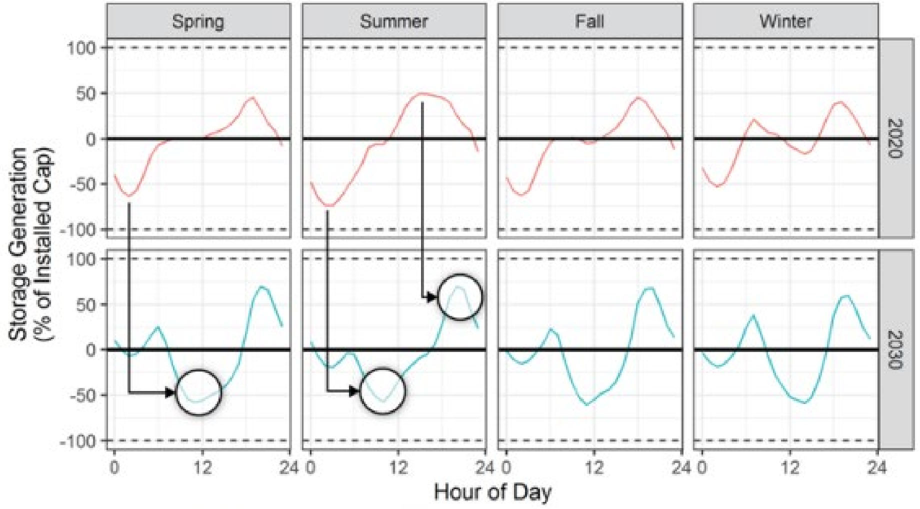
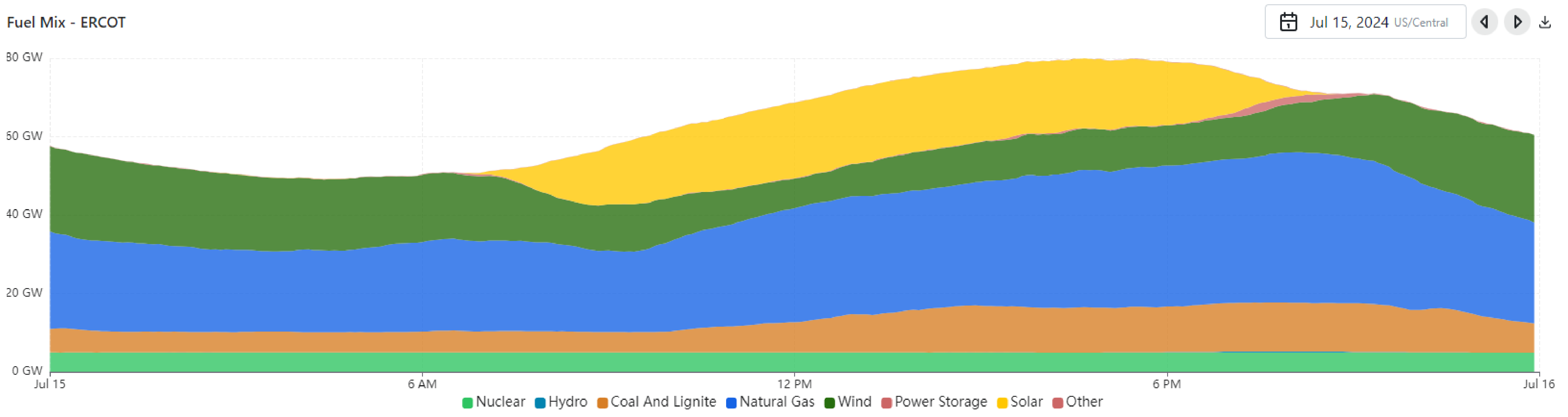
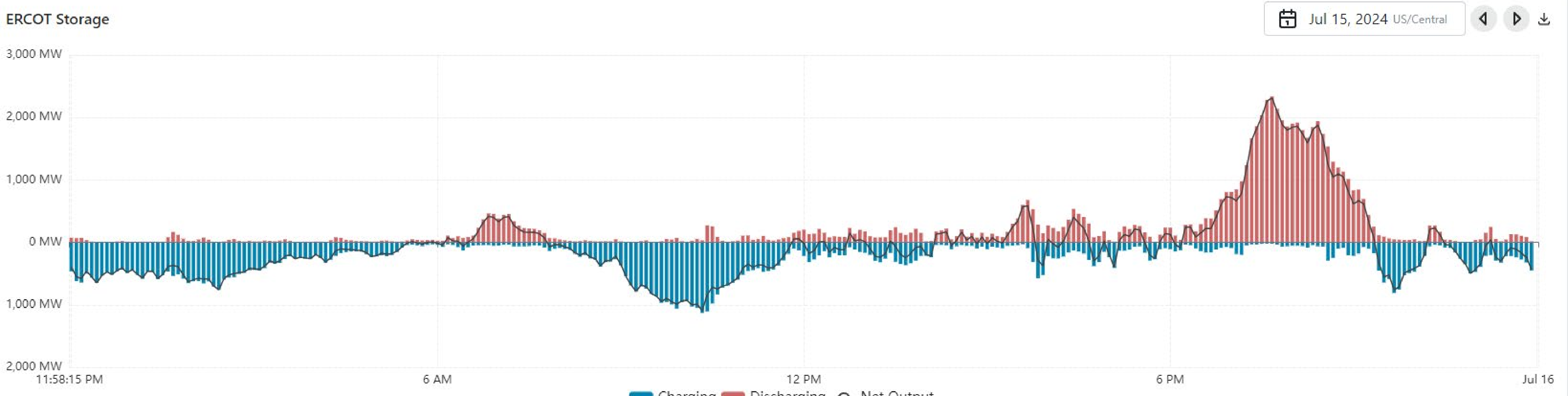


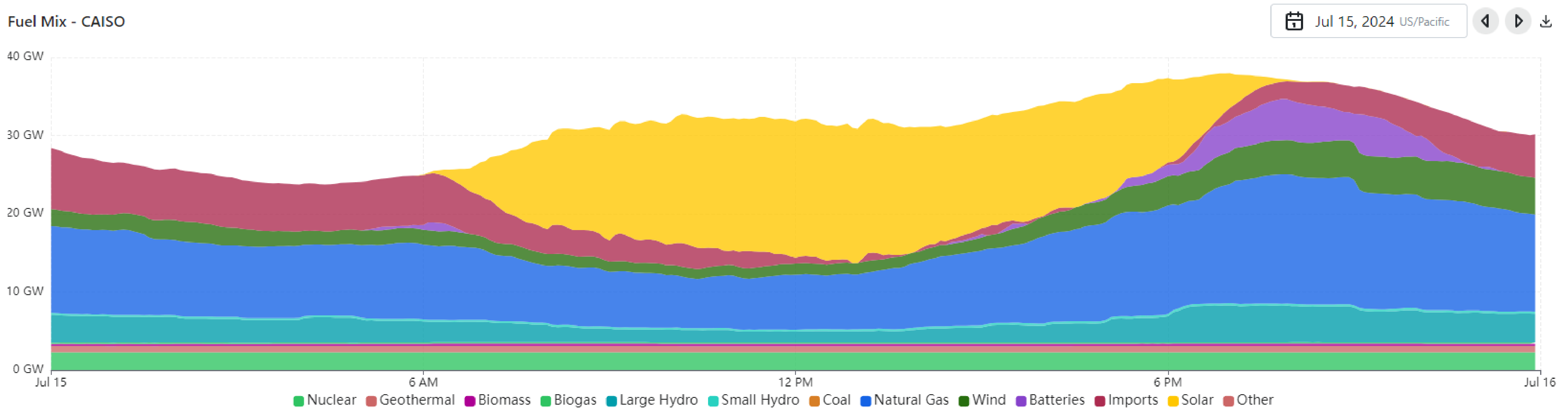
Figure 9. Increased deployment of PV demonstrates the reduced duration required for energy storage to provide firm capacity.

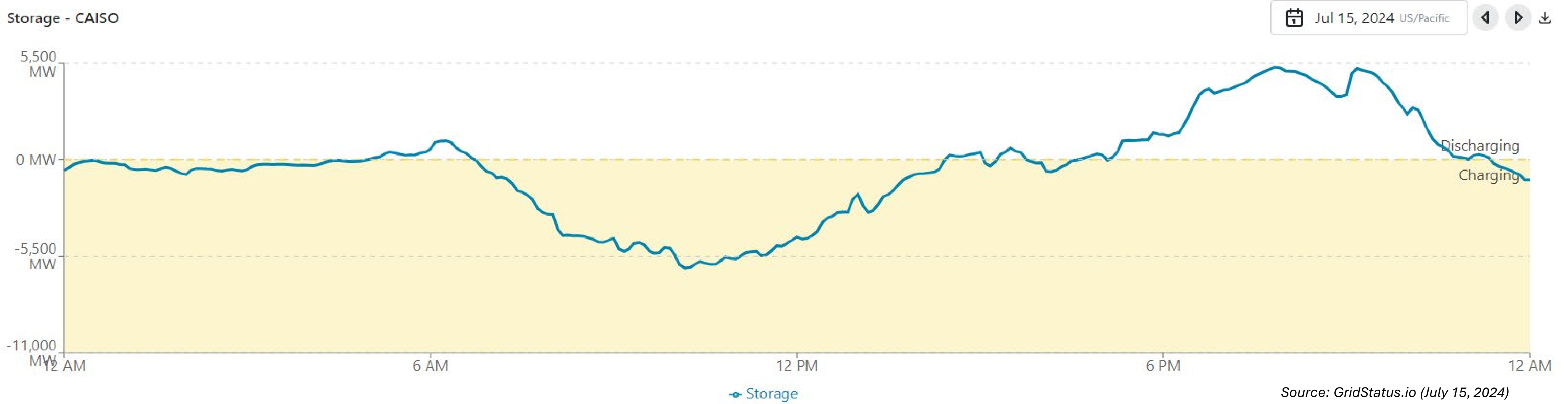
Source:
https://www.nrel.gov/analysis/storage-futures.html





Source: GridStatus.io (July 15, 2024)





Source: GridStatus.io (July 15, 2024)

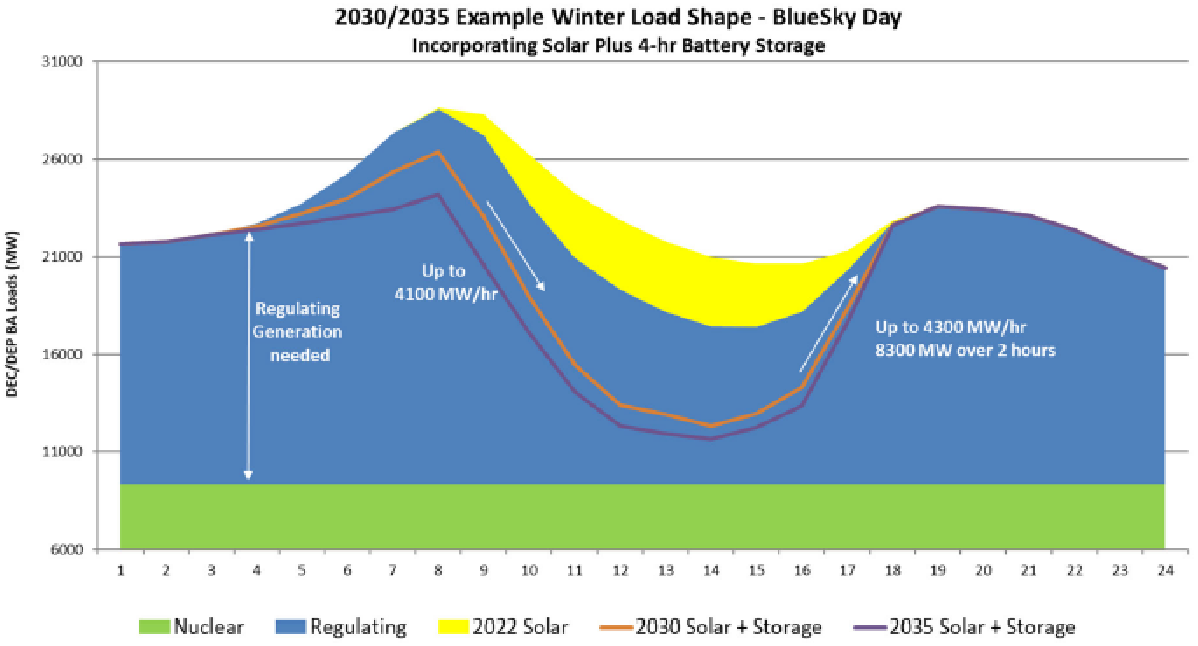
Source: https://starw1.ncuc.gov/NCUC/page/Dockets/portal.aspx

Role of energy storage in Southeast

Production cost savings and operational flexibility

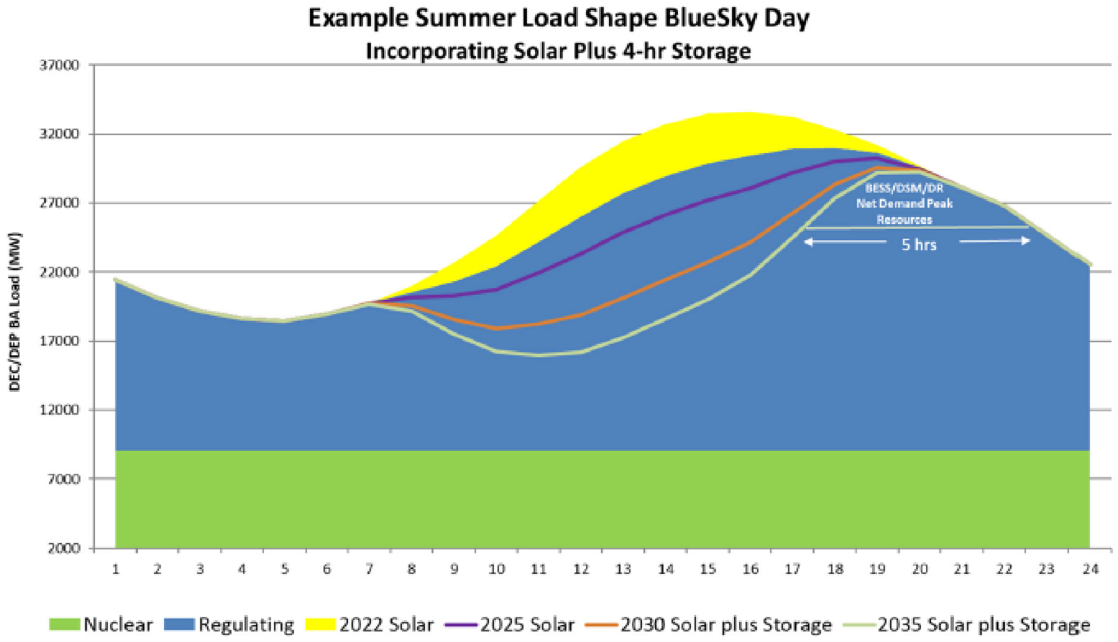
Duke Energy Carolinas, LLC
Duke Energy Progress, LLC
Docket No. E-7, Sub 1290
Docket No. E-2, Sub 1317

Figure 2 – Positive Impacts of Solar Paired With Storage for Moderating Future Winter Net Demand Ramping



*Storage mitigates impact on inflexible generation at low load in **Winter Peak***

Figure 3 – Role of Solar Paired With Storage in Moderating Future Summer Ramping Requirements



*Storage uses excess midday PV production to shift to evening load in **Summer peak***

Contracting Structures

Utility-Scale Energy Storage

evolving to provide greater flexibility and customer/system value

Energy Storage 1.0 – Owner scheduled

Scheduled dispatch

Pre-determined charging and discharging based on peak hours and seasons; manual scheduling

- **Offtake:** Utility, BTM (C&I / EMCs)
- **Type:** hybrid or standalone
- **Structure:** $/MWh, net of charging costs
- **Pros:** simple, predictable, easy integration
- **Cons:** inflexible over time, unnecessary cycling
- **Examples: 4CP/BTM, Demand Response**

PPA

Owner-dispatched and optimized to generate production into select premium / peak hours seasonally

- **Offtake:** Utility, EMCs, state programs
- **Type:** hybrid or standalone
- **Structure:** $/MWh, with diurnal and seasonal pricing
- **Pros:** predictable, simple interconnection
- **Cons:** not adaptable, unnecessary cycling, non-curtailable, metering challenges
- **Examples: Standard Offer PPA / Avoided Cost**

Energy Storage 2.0 – Customer dispatched

Peak Incentive

Basic integration for customer dispatch to manage peak demand, owner can earn additional revenues in wholesale market if available

- **Offtake:** Utility, BTM (C&I / EMCs)
- **Type:** standalone
- **Structure:** $/kW-mo
- **Pros:** simple toll, limited integration, optimizes value for highest cost hours
- **Cons:** limited grid services, multiple sources required for revenue requirement
- **Examples: TB2 swap, MA Clean Peak, NY VDER**

Tolling Agreement

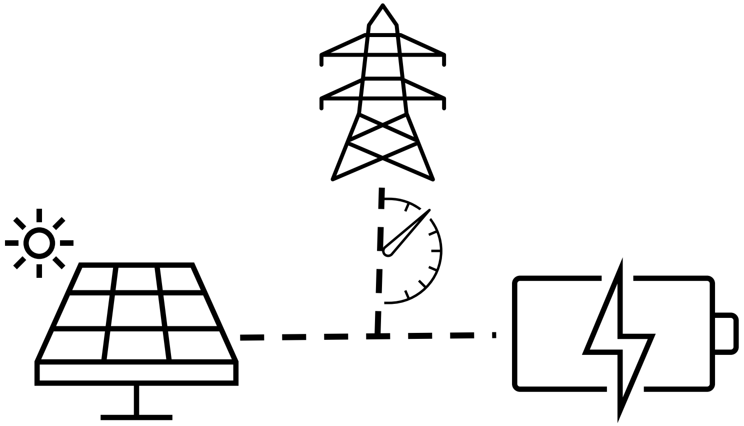
Customer-optimized dispatch to maximize ESS value and adapt to system operational needs, present and future

- **Offtake:** Utility, EMCs
- **Type:** hybrid or standalone
- **Structure:** $/kW-mo
- **Pros:** maximizes resource value, adapts to bulk system operational needs over project life, incentives aligned with performance
- **Cons:** varying contract complexity, can be limited/shorter tenor
- **Examples: APS, Consumers, DTE, Duke Energy**

Hybrid vs co-located PV+BESS

Contract structures

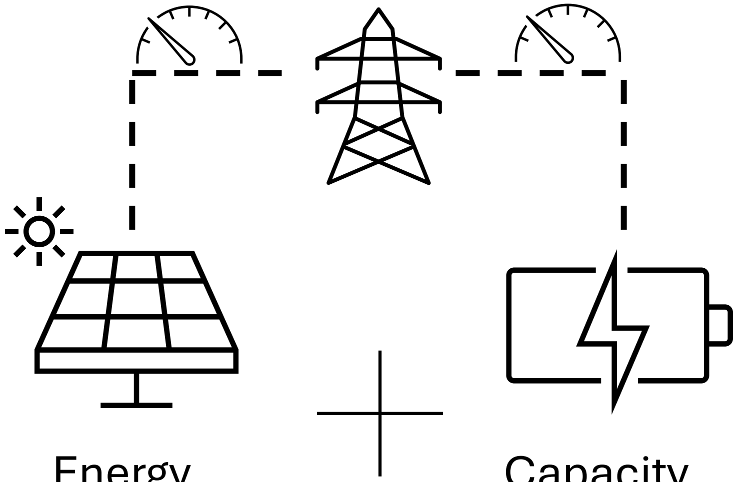
Blended PPA
(hybrid)



Energy only, $/kWh

- ***Energy only***
- Owner-scheduled BESS
- Duration optimized on PPA structure
- Grid or PV charging
- Best for maximizing solar production capture and high value arbitrage hours

PPA + Tolling Agmt
(co-located)



Energy,
$/kWh

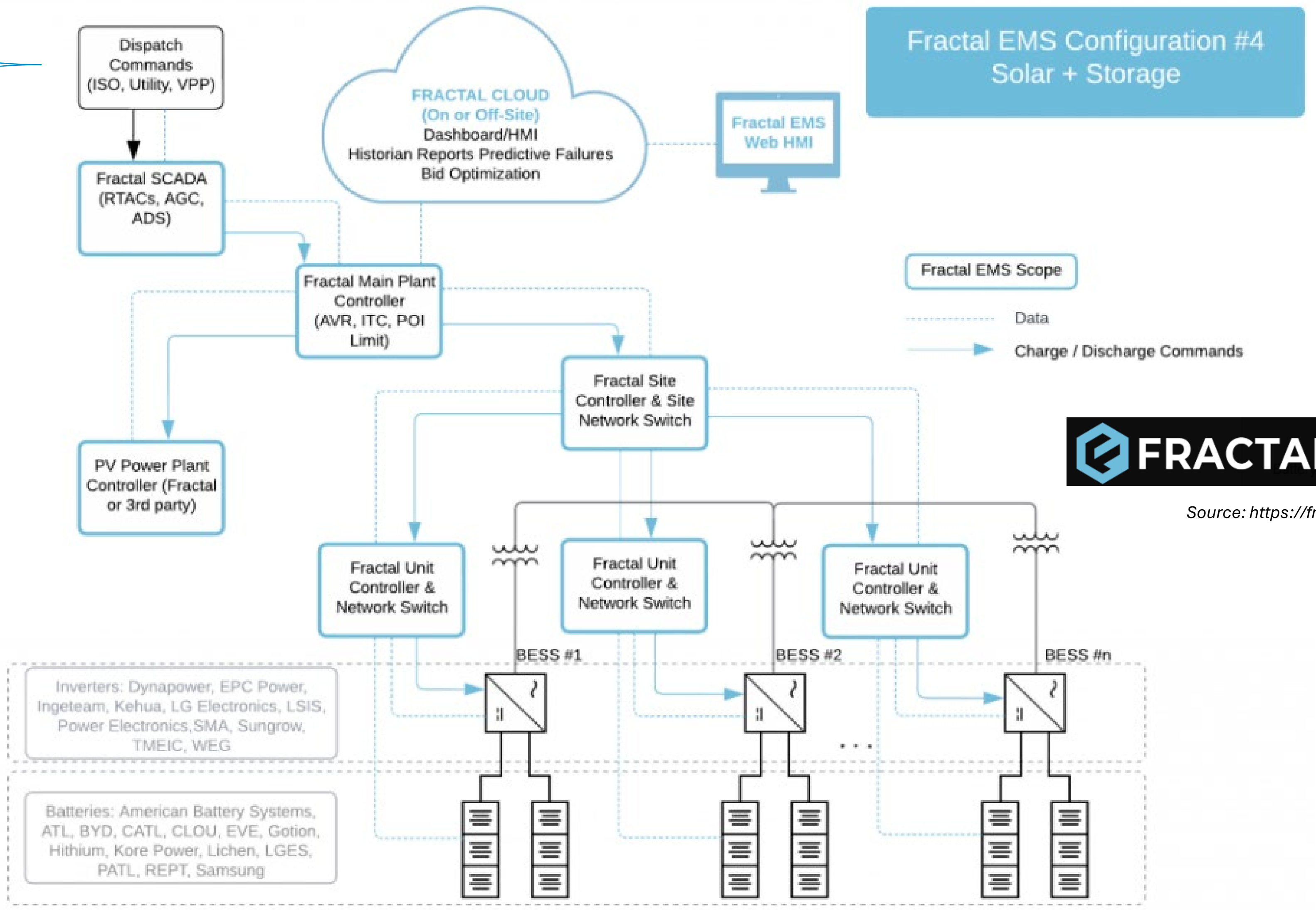
Capacity,
$/kW

- ***All BESS attributes***
- User-dispatched
- BESS duration specified by offtaker (e.g. IRP or production cost modeling)
- Grid charging is optimal
- Best for tolling agreement + PPA or separate offtake for energy and capacity

How are IPP BESS dispatched by ISOs and utilities?

ISO / utility provides:
- Day-ahead and/or real time schedule / signal for:
    - Daily solar arbitrage
    - Operating Reserves
    - Frequency control
- Transmission outage schedule
- Critical / peak season dates

IPP maintains:
- 24/7 monitoring of asset health and status, including plant security
- Real-time plant telemetry data, including SoC forecast, to ISO/utility
- RTE, capacity, availability, and signal response time within contract requirements
- Outage status and communications to utility/ISO
- Long term asset management contracts for BESS, inverters, and BOP (or self-performs)
- Communications, control, reporting, and compliance contracts
- Capacity maintenance and augmentation strategy / expenses



FRACTAL EMS

Source: https://fractalems.com/