Update on Effective Load Carrying Capability for Intermittent Resources and Limited Duration Resources

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March 26, 2020

Markets and Reliability Committee

ELCC Timeline

Oct. 17 2019
- PJM compliance w/ Order 841 largely accepted.
- FERC opens Sec. 206 proceeding: 1) time-related capability rules of all resources and 2) paper hearing on capability rules for ESR ("10 hour rule").

Apr. – Oct.
New Sr. Task Force to cover ELCC—Phase I (wind, solar, energy storage resources)

Jan. 29, 2021
Deadline requested for filing with FERC an ELCC solution on (at minimum) ESR

Mar. 31, 2021
PJM contingent target for latest completion of upcoming 2022/23 Base Residual Auction.

Dec. 2019 – Feb. 2020
PJM invites proposed alternatives to the 10-hour rule, holds special sessions of the MIC to discuss.

Feb. 27
PJM requests FERC hold paper hearing in abeyance in order to consider an "Effective Load Carrying Capability" alternative via stakeholder process.

PENDING

2021+
New Sr. Task Force to cover ELCC —Phase II (all other limited duration resources and Intermittent Resources)

Sep. 31, 2021
PJM contingent target for latest start of subsequent 2023/24 Base Residual Auction.

Relation to Prior Discussions at Planning Committee

- Sep. 13, 2018 Planning Committee: PJM presents ELCC analysis of wind.
- Nov. 8, 2018 PC, and special sessions on Nov. 26 and Dec. 21: PJM adds analysis of solar, opens discussion on use of ELCC to set the capability values of wind and solar in the capacity market.
- Feb. 7, 2019 PC: PJM proposal for ELCC for wind and solar.
- March 7, 2019 PC and March 21, 2019 MRC: first read of revisions to Manual 21.
- April 11, 2019 PC: pause in ELCC discussions.
- Oct. 17, Nov. 14, & Dec. 12 2019 PC: ELCC review I, review II, & review III.
- **New capability senior task force will start with a blank slate (albeit informed by prior efforts).**

ELCC and Upcoming Capacity Auctions

- If PJM files ELCC by the Jan. 29, 2021 target, and FERC approves within 60 days, then PJM could start providing official ELCC results for resources by March 31, 2021.
  - ELCC results for resources could be used in capacity market Base Residual Auctions (BRAs) some time after this date, with an allowance of time for pre-auction activities.
- Timing of upcoming BRAs is contingent on FERC and potentially state actions.
- PJM would include in its Jan. 29 ELCC filing a future BRA schedule for the transition to ELCC.
  - The BRA delivery year to be run with ELCC values will depend on the auction schedule yet to be set.
  - Based on discussion with stakeholders.
- In general: there are 6 months of pre-auction activities.
- ELCC values would likely impact Minimum Offer Price Rule (MOPR) floor prices, for which pre-auction activities begin 150 days (approximately 5 months) prior to auction.
- Consideration of impacts on ELCC-type resources that are vs. are not subject to MOPR.

Draft Issue Charge (redlined vs. March 11 MIC draft)

Issue Content

The work will develop the provisions necessary to establish an ELCC method for calculating the capability of ~~certain capacity resources (including~~ limited duration resources, such as energy storage resources, and ~~i~~Intermittent ~~r~~Resources, such as wind, solar, hydroelectric power with and without storage reservoirs, and other renewable resources~~)~~. Because there are nearly 10,000 megawatts of generation + storage hybrids in the PJM interconnection queue, the capability of hybrids will also be addressed in this effort. The provisions to be ~~established~~ considered include, among other things:

a. Timing of ELCC analysis for a given delivery year
b. Allocation of ELCC capability of a resource class to a specific unit
c. The simulated dispatch of energy storage resources and hybrid resources
d. Determination of resource classes

Draft Issue Charge (redlined vs. March 11 MIC draft)

Definitions for Scoping Purposes

The below definitions are solely for the purposes of clarifying the scope of this issue charge.

Limited duration resources have limited duration capability. These include, but are not limited to, energy storage resources that receive energy from the grid and store the energy for later injection to the grid (e.g., pumped storage hydro units, compressed air energy storage units, flywheel energy storage units and battery storage units) and hydroelectric generating units with reservoir storage capability.

Intermittent Resources are generating units with output that varies as a function of an energy source that is non-continuous and that cannot be directly controlled. Such resources are unable to provide a stated level of output on demand and are unable to maintain a stated level of output for any specified period of time. Intermittent resources include, but are not limited to, wind units, solar units, run-of-river hydroelectric units (without reservoir storage capability) and landfill gas units (without alternate fuel capability).

Together, the categories of Intermittent Resource and limited duration resource encompass all resources that do **not** have the ability to maintain output at stated capability continuously on a daily basis without interruption. Generating units that **do** have the ability to maintain output at stated capability continuously on daily basis without interruption include, but are not limited to, nuclear and fossil-fired steam units, combined cycle units, combustion turbine units, reciprocating engine units, and fuel cell units.

Hybrids are generating units that host both an energy storage resource and a different type of intermittent resource or limited energy resource at the same site, both behind a single point of interconnection.

~~**Demand response resources** are resources that reduce load to participate in PJM markets using PJM demand response rules.~~

Out of Scope

Changes to provisions in the following domains are **out of scope** of this effort:

- The interconnection process
- Demand response resources, i.e., ~~**Demand response resources** are~~ resources that reduce load to participate in PJM markets using PJM demand response rules.

Draft Issue Charge (redlined vs. March 11 MIC draft)

Key Work Activities and Scope

Work activities that this group will need to perform to accomplish its work in resolving the issue:

Phase I

1. Brief review of existing education on ELCC provided recently at the Planning Committee and the MIC Special Session on Capacity Market Capability of energy storage resources. As needed, additional education on ELCC.
2. Education on the status quo for retaining, increasing, and transferring capacity interconnection rights.
3. Education on the interaction of resource capability, the Installed Reserve Margin study, and other features of resource adequacy planning and the capacity market.
4. ~~Development~~ Consider ~~of~~ the general provisions necessary to establish the ELCC method for determining the capability of all intermittent and limited duration resources.
5. ~~Development of~~ Consider the resource-specific provisions necessary to establish the ELCC method for determining the capability of wind, solar, and energy storage resources (including batteries and pumped hydro).
6. ~~5.~~ PJM to present an analysis of the impact of large-scale limited duration resource and Intermittent Resource deployment on the other aspects of resource adequacy apart from capability rules, assuming an ELCC framework. This analysis would include, among other things, the reliability requirement and forecast pool requirement, and any impacts due to shifts in the daily hours of peak risk relative to today.

Phase II

7. ~~6.~~ ~~Development of~~ Consider the resource-specific provisions necessary to establish an ELCC method for calculating the capability of other intermittent resources and limited duration resources, including intermittent non-pumping hydroelectric power with and without storage reservoirs, landfill gas units (without alternate fuel capability), and hybrids of wind-storage and solar-storage.

Draft Issue Charge (redlined vs. March 11 MIC draft)

Expected Duration of Work Timeline

Given the pending FERC paper hearing on the capability of energy storage resources in FERC Docket No. EL19-100, for which PJM – as supported by various stakeholders – has asked FERC to hold in abeyance for a limited period to engage in this stakeholder process, and given that there are several forthcoming Base Residual Auctions, this issue is high priority with an immediate start. Meetings should be at least monthly as meeting availability allows. It is anticipated that any governing document revisions will be set for voting in the December or January time frame – at least as to Phase I -- to support a filing of any such revisions with FERC by January 29, 2021. Work on Phase II is estimated to take 12 months, and will begin after the Senior Task Force completes its work on Phase I.

~~Phase II of this effort will commence upon FERC acceptance and implementation of Phase I stated work.~~

- Feedback is requested and questions are welcome:

  ESR@pjm.com

APPENDIX SLIDES

Order 841, Paper Hearing, and Stakeholder Engagement

Oct. 17 FERC Acceptance Order

Initial proposed PJM Energy Storage Resource (ESR) participation model — Live Dec. 3

Duration and Capacity Capability ("10 hour rule")

ER20-584 **1. RPM capability for all resources in tariff** — Dec. 12 filing

EL19-100 **2. Paper hearing on capacity capability of ESR** — Apr. 27 brief

Nov. 23 PJM request for 90-day extension on initial brief deadline:
https://elibrary.ferc.gov/idmws/file_list.asp?accession_num=20191126-5288

"Such dialogue will allow PJM to explore potential alternative approaches, as well as to ensure that all sides better understand each other's respective positions…PJM is open to additional dialogue with any stakeholder group wishing to meet with PJM to discuss its proposed ten-hour duration requirement in light of the specific section 206 investigation and questions posed by the Commission's October 17 Order."

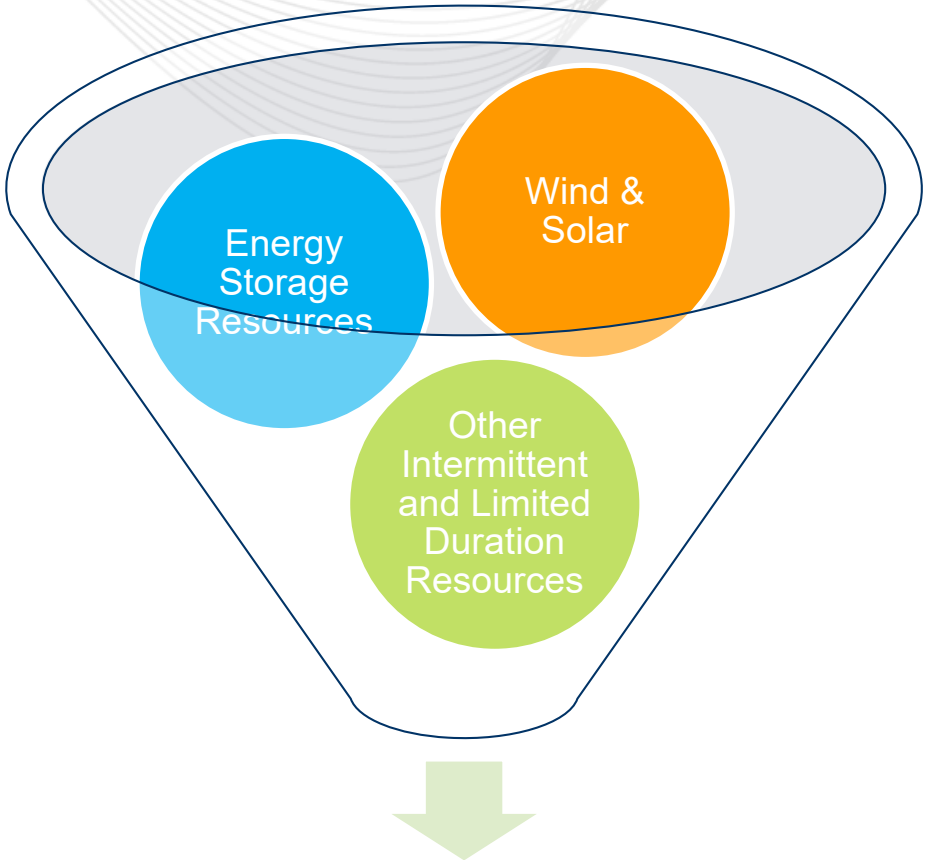
Dec. **Stakeholder proposals and special sessions of MIC** ***Mar.***

PJM Motion for Abeyance

- *"PJM is submitting this Motion in order to pursue an Effective Load Carrying Capability ("ELCC") construct with PJM stakeholders for calculating the capability of resources (such as Energy Storage Resources) in the PJM Reliability Pricing Model ("RPM")."*
- *"…PJM respectfully requests that the Commission hold the above-captioned proceedings (EL19-100-000 and ER20-584-000) in abeyance until January 29, 2021."*
- *"In the event that PJM is unable to submit such a filing by January 29, 2021, PJM proposes as part of this Motion that the 'abeyance period' requested herein would end in Docket Nos. EL19-100-000 and ER20-584-000, with the Commission then timely establishing a new briefing schedule for the associated paper hearing pursuant to which parties (including PJM) could submit initial and reply briefs in due course."*
- FERC subsequently set a new deadline for initial briefs in the paper hearing of April 27, as well as a deadline of March 11 to reply to PJM's motion for abeyance.

https://www.pjm.com/-/media/documents/ferc/filings/2020/20200227-el19-100-000-and-er20-584-000.ashx

Consolidating Efforts

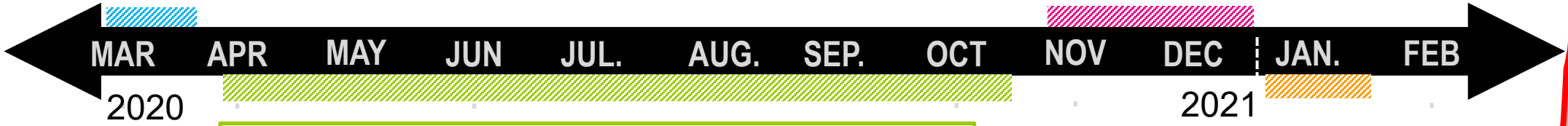


Senior Task Force

ELCC Timeline, Phasing, and Scope

March
- Preview Issue Charge at MIC & PC
- MRC First Read & Vote Issue Charge

November- December
- MRC First Read of Proposals
- MRC & MC Vote on Proposals



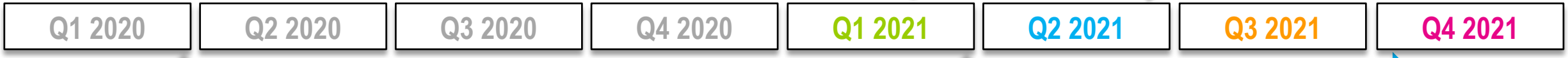
Phase II
ELCC for other Intermittent Resources and limited duration resources.

April– October (Phase I)
- Education
- Develop provisions of ELCC method applicable to all resources
- Develop provisions to establish ELCC method for Phase I resources (wind, solar, storage)

January 29, 2021
- Proposed deadline for FERC filing

Queue Timing considerations

Late Feb. 2021+
- Earliest that AF2 Queue applicants could sign Facility Study Agreements
- Executed FSA (>20MW) or ISA/WMPA ≤20 MW) required to participate in BRA



Mar. 31, 2020
- AF2 Queue window closes

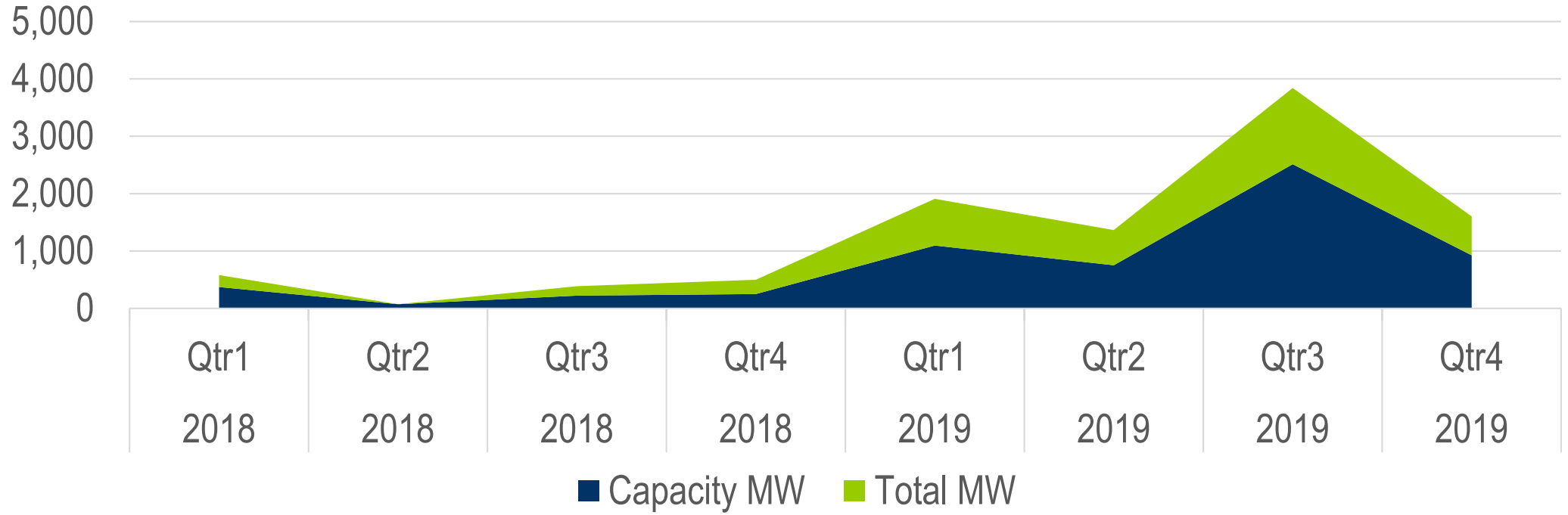
Late Mar. 2021+
- Earliest possible opportunity for AF2 MW to offer into the Capacity market

ELCC Features to Consider

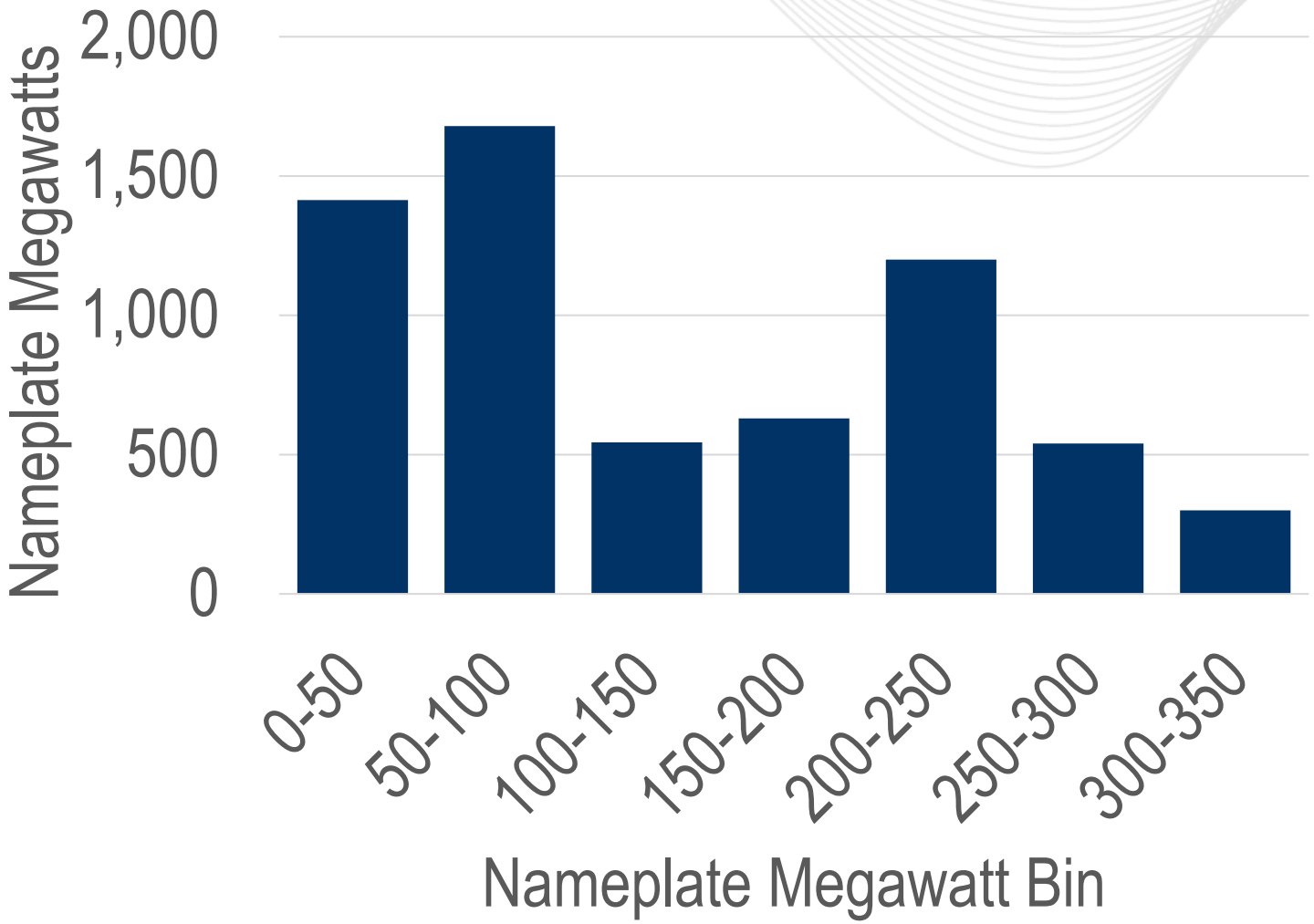
1. Timing of ELCC analysis for a given year
2. Allocation of ELCC capability of a fleet to a units: marginal vs. legacy vs. average
3. ELCC variations: “load” style vs. “gen” style, etc.
4. Dispatch of limited-duration and Energy Storage Resources
5. Translating ELCC analysis into an ESR capability policy: duration classes vs. value of a MWh vs. etc..
6. Accounting for actual performance/availability

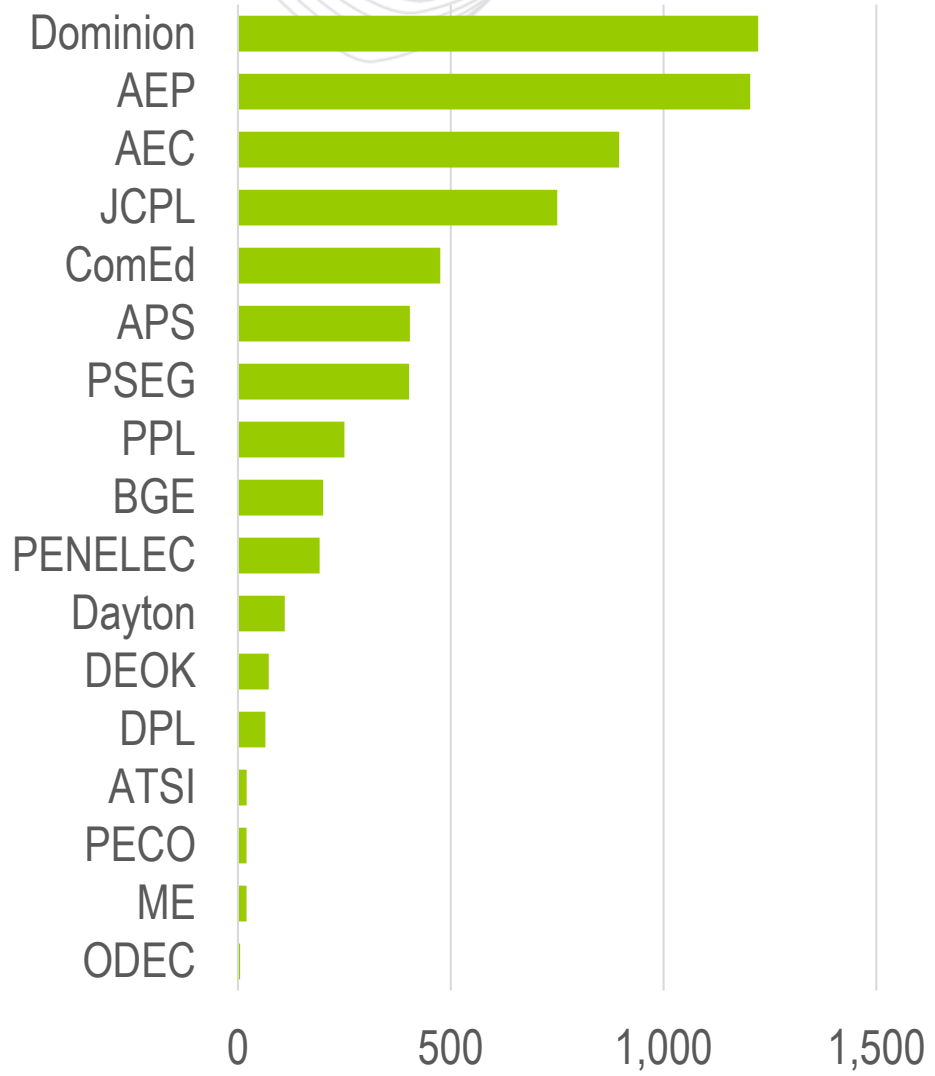
Energy Storage Resources in the Queue

- (Excluding Withdrawn, In Service, and Deactivated)
- Total: 6 GW of Energy, 4 GW of Capacity
- Megawatts by date of queue entry, as of Jan. 27, 2020:

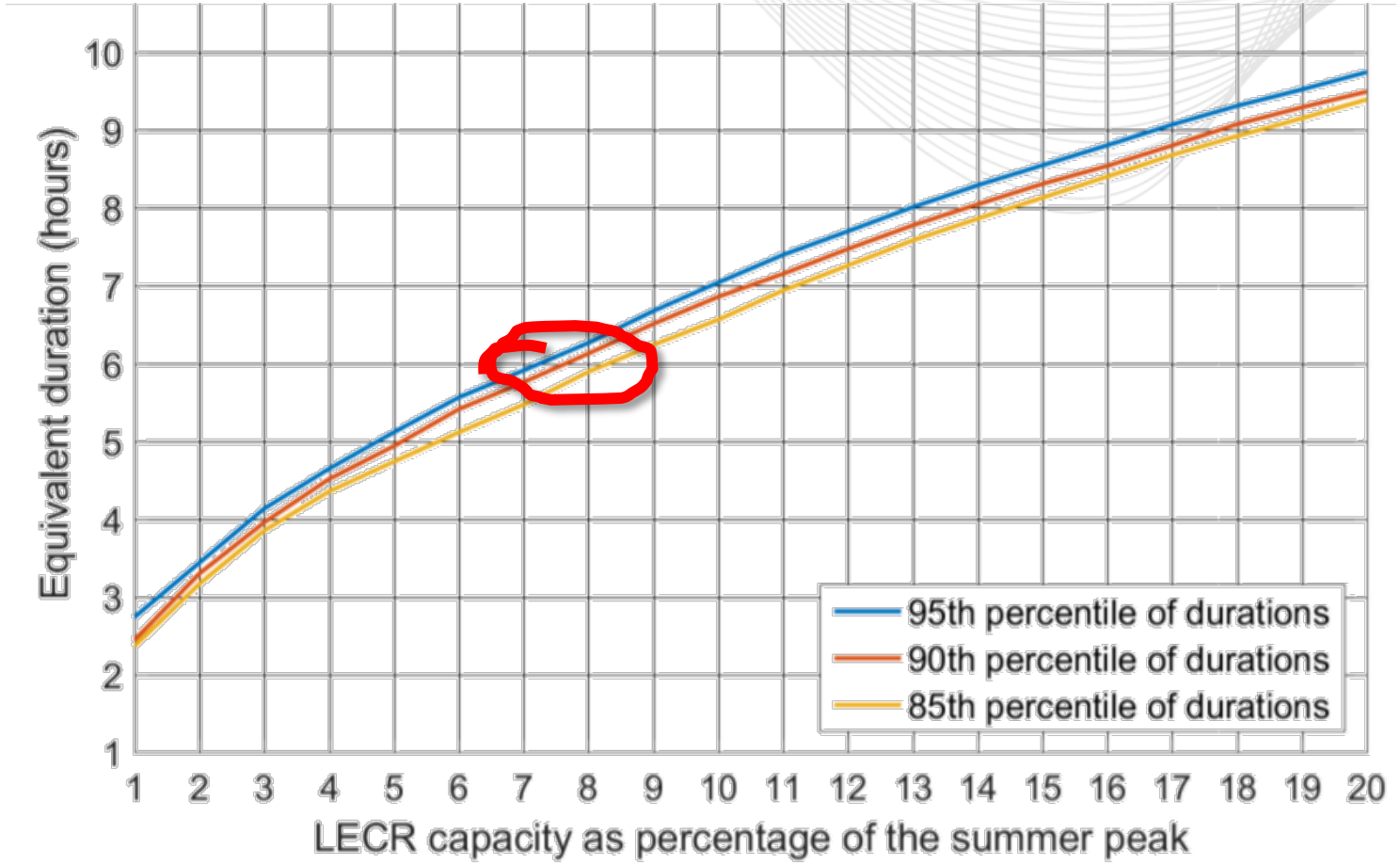


ESR in the Queue by Size and Interconnected TO





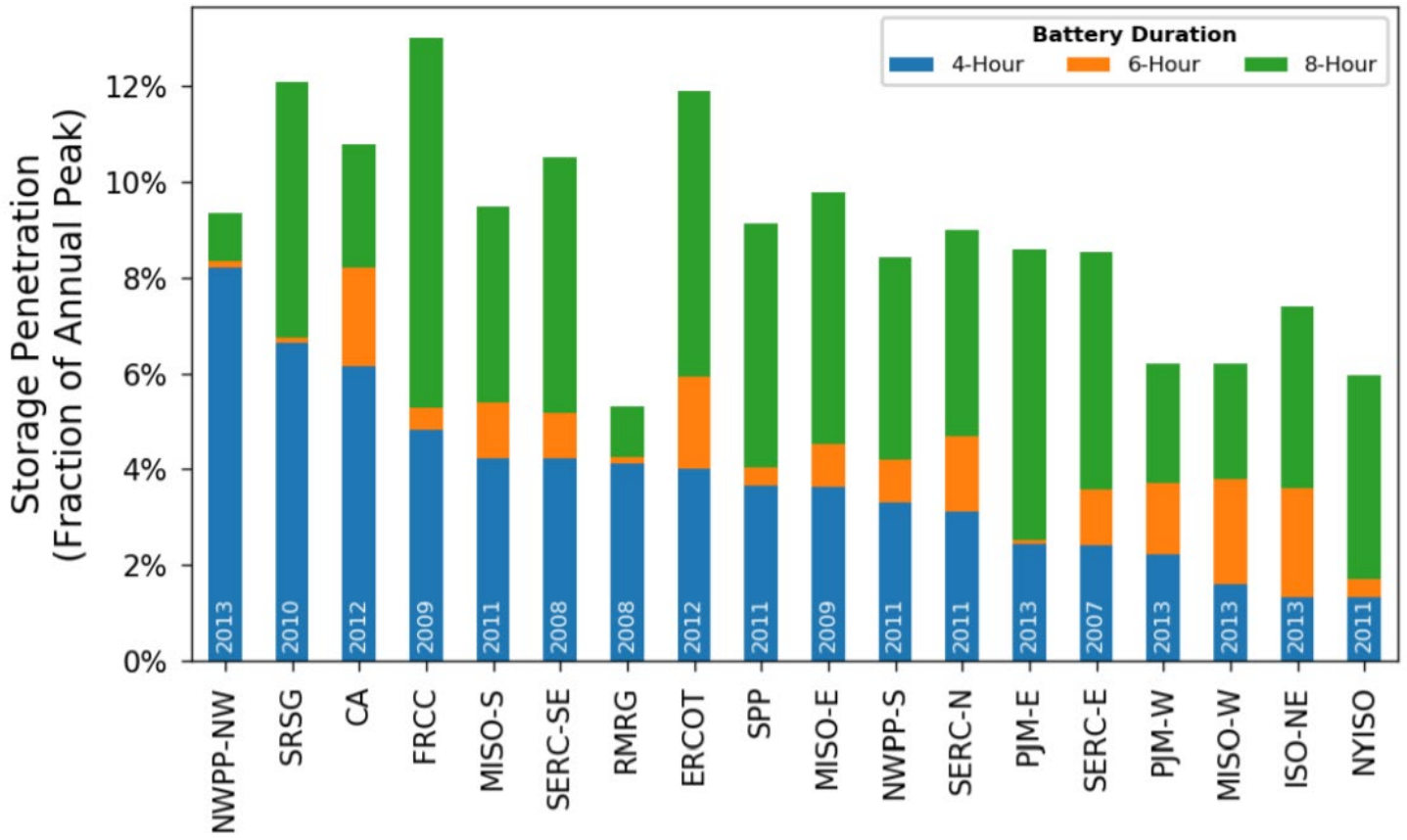
PJM IEEE Paper



- 6-hour resources could cover about 7% of the peak for nearly all peak shapes.

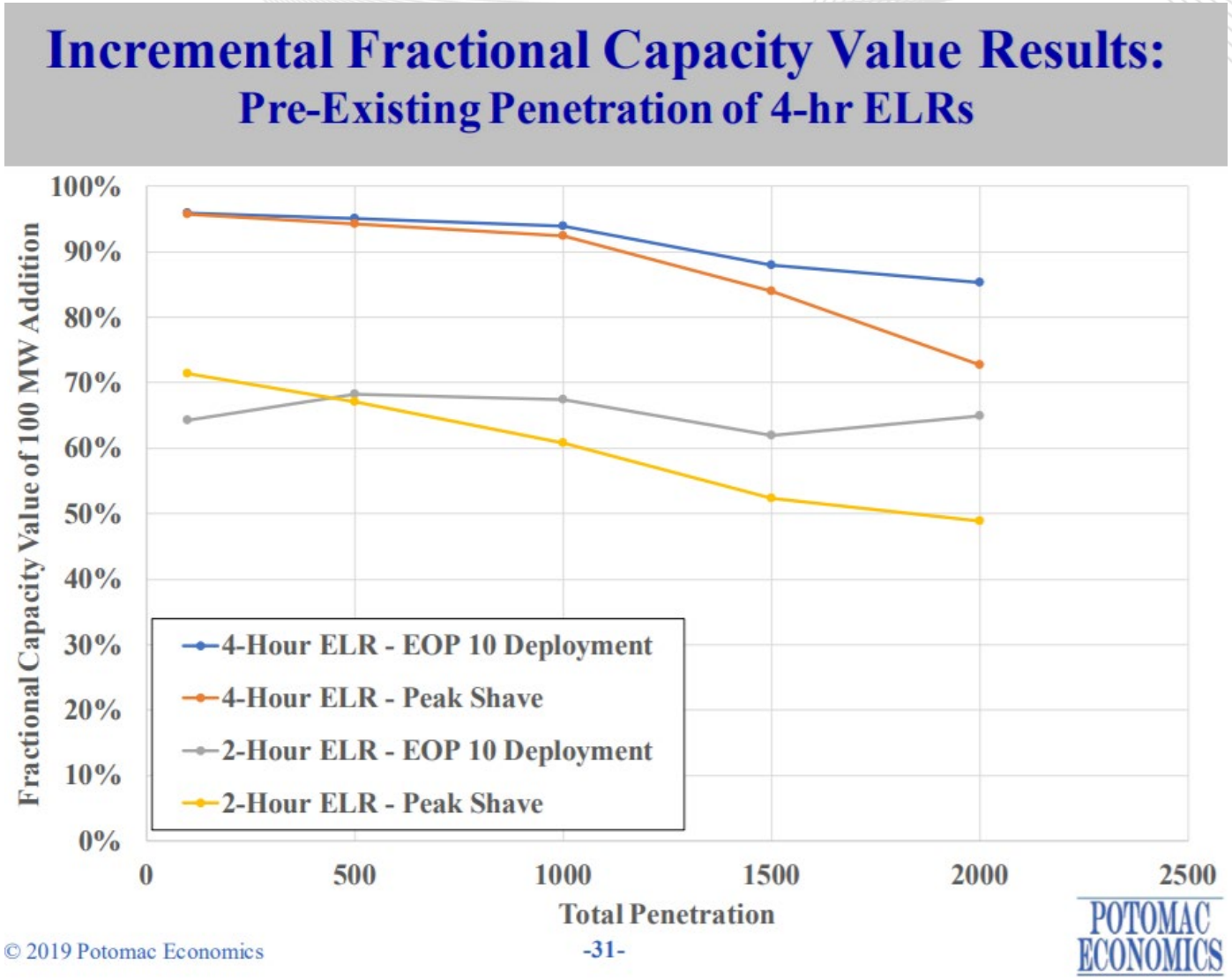
Limited Energy Capability Resource Duration Requirement for Participation in PJM Capacity Market
https://www.pjm.com/-/media/library/reports-notices/special-reports/2019/esr-duration.ashx?la=en
https://www.pjm.com/-/media/committees-groups/committees/mic/20180914-special/20180914-item-05-esr-duration-slidedeck-0914.ashx
https://ieeexplore.ieee.org/abstract/document/8791630

NREL Peak Shaving Study



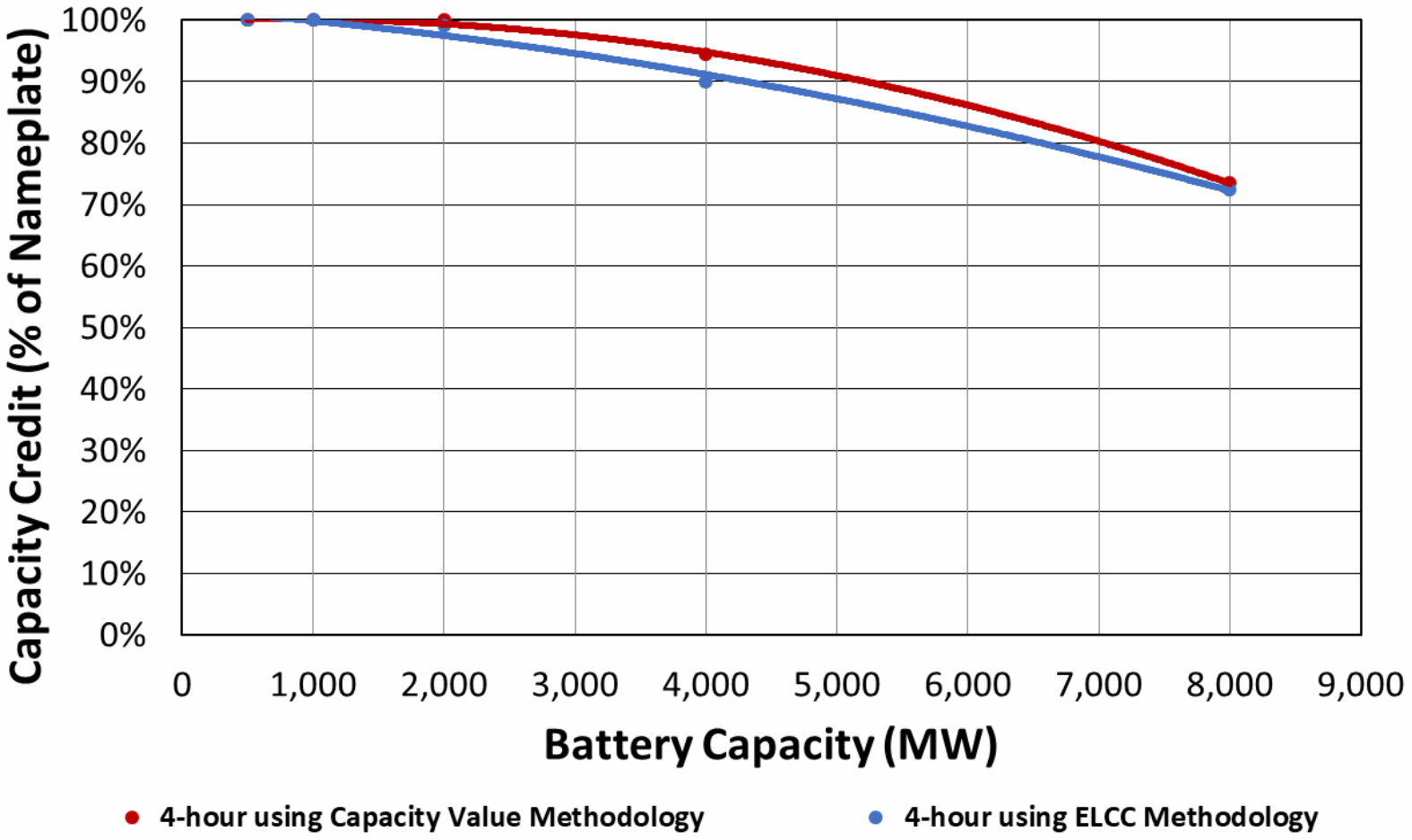
The Potential for Battery Energy Storage to Provide Peaking Capacity in the United States. 2019. Paul Denholm, Jacob Nunemaker, Pieter Gagnon, and Wesley Cole. https://www.nrel.gov/docs/fy19osti/74184.pdf

Potomac Economics NYISO Study



https://www.nyiso.com/documents/20142/4615689/MMU+ELR+Capacity+Value+Study+012419.pdf

Astrape ELCC for SPP



https://www.spp.org/Documents/61378/SAWG%20Agenda%20and%20Background%20Materials%2020200129.zip