



Capacity Value of Storage Resources

July 10, 2020

PJM CCSTF

Sustainable FERC

Environmental Groups' Positions

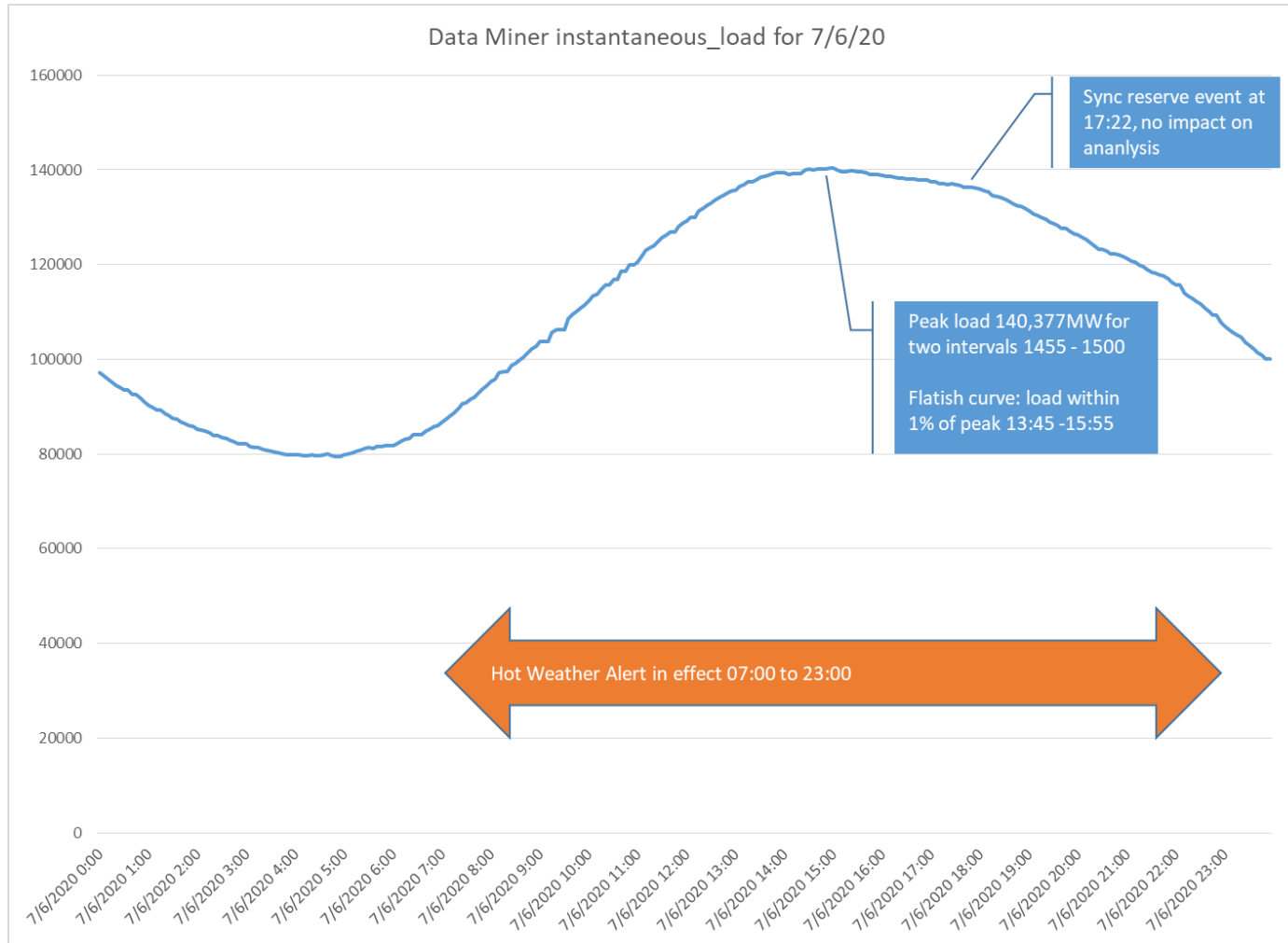
- The goal of this task force should be to develop the most accurate, unbiased measure of the reliability value of storage and intermittents.
- Order 841 compliance requires using storage in a way that makes use of its unique attributes.
 - Analysis that assumes inefficient use of storage leads to unjust and unreasonable results.
 - Capacity value must consider storage's ability to deliver high power for short periods, to follow load, and to charge and discharge.

1. Duration classes undervalue storage

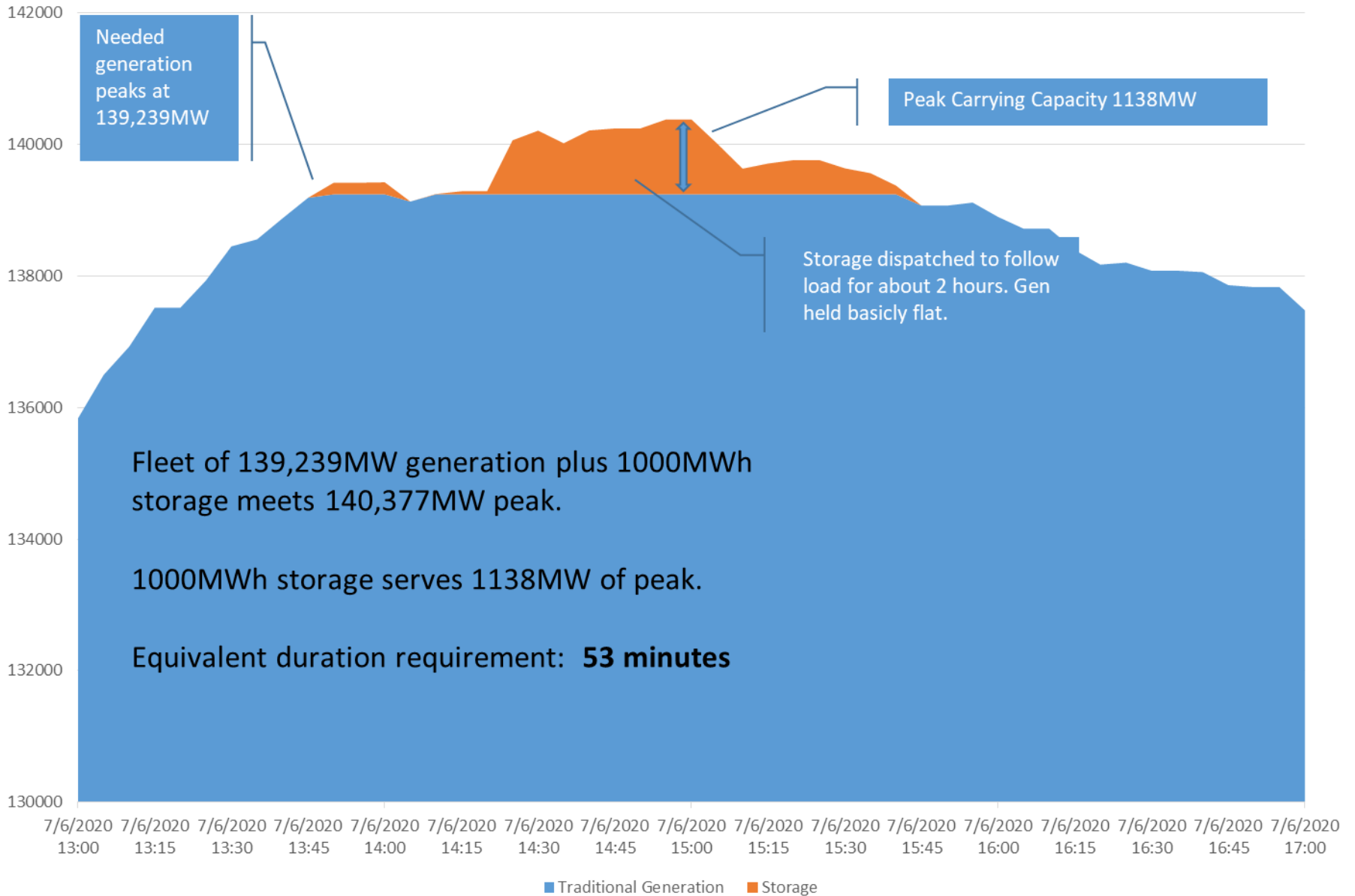
This analysis gives an example of how the proposed duration class approach undervalues storage.

- Use Monday's (7/6/2020) load curve
- Assume 1000MWh of storage, more than 10x PJM's current fleet.
- Make no assumptions about storage duration—that's a result.
- Find the peak load that amount of storage can carry as a simplified proxy for ELCC. (Call that PLCC—peak load carrying capability.)
- Simple model: storage plus generic UCAP.

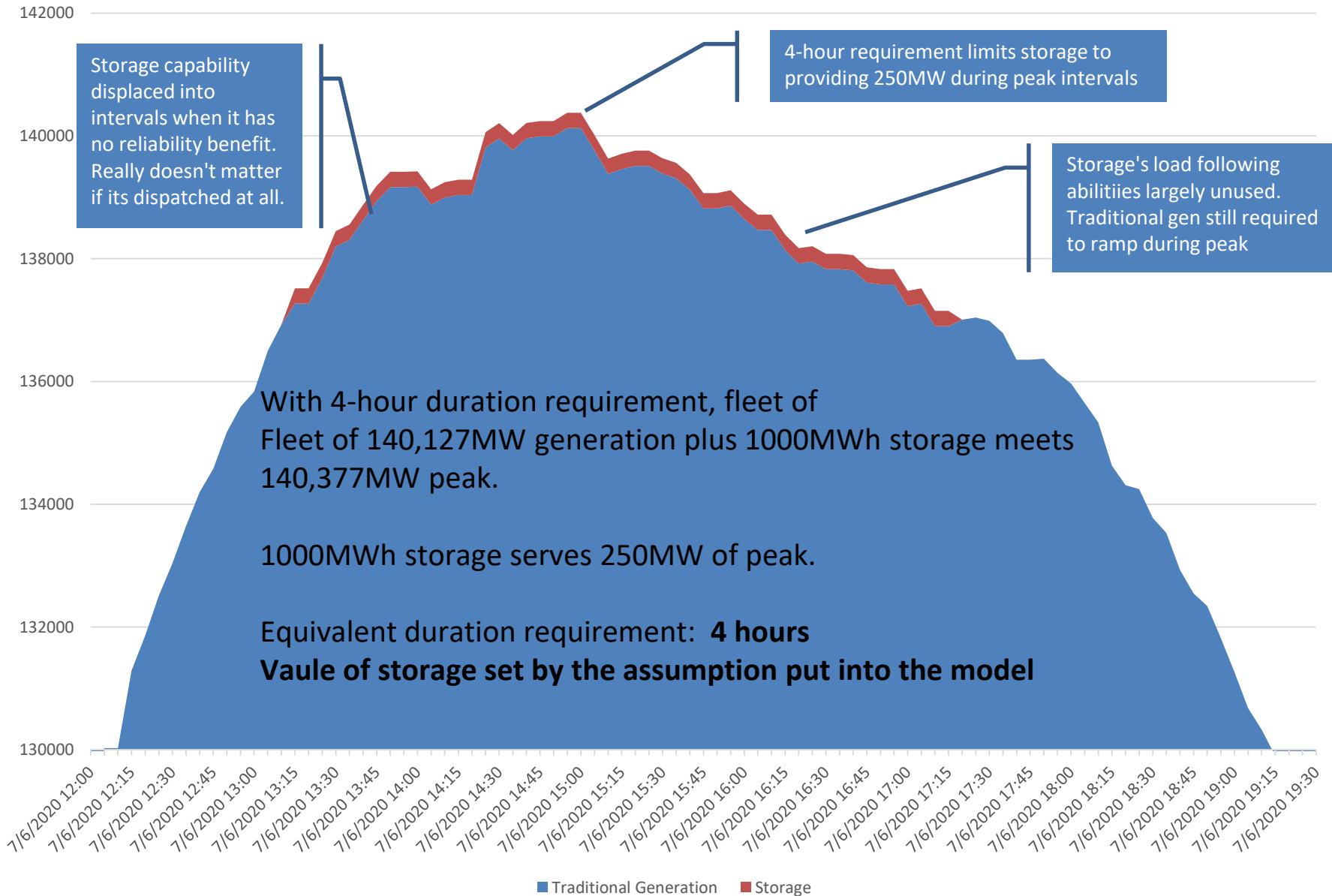
July 6, 2020



Optimal Use of Storage



Same day, storage with 4-hour duration requirement

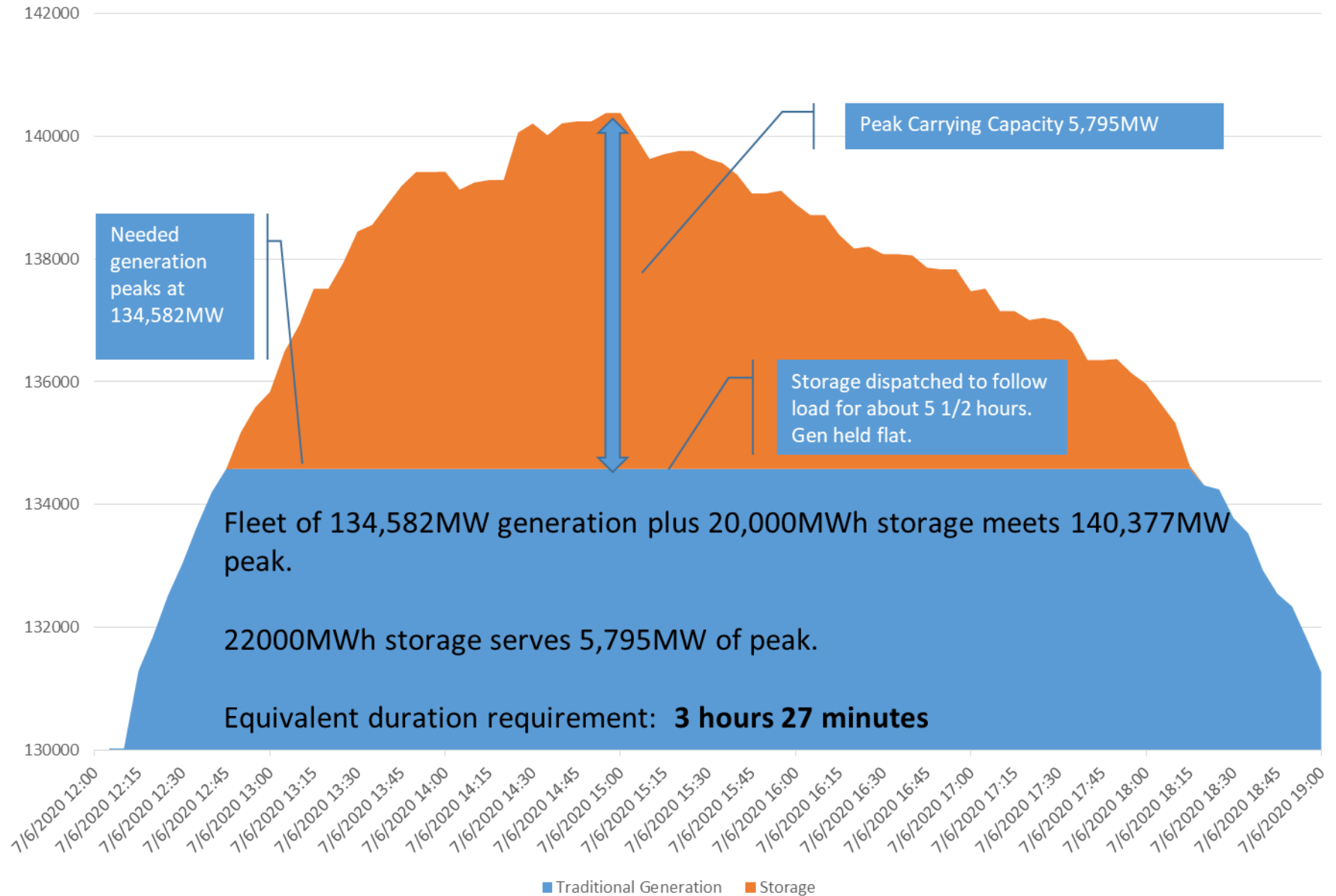


With more storage

Above values reflect the very high capacity value of storage when there's only a relatively small amount on the system.

Same analysis with 20,000MWh of storage, around 200 times PJM's current fleet.

Optimal Use of Lots of Storage



Take-aways on duration classes

- Setting a duration is equivalent to limiting output.
- Up to many times current storage levels, short duration power and load following is more important than extended run time.
- Under current conditions, starting with a 4-hour duration potentially loses most of storage's capacity value
- A 4-hour minimum duration may be inaccurate until the amount of storage in PJM increases 100-fold or more.
- Modeling intra-hour dispatch may matter

An approach that does not reflect storage's ability to deliver short term power does not comply with Order 841.

PIO Proposal

Our solution component for “ELCC by MWh” follows these examples:

- Start with a pool of storage MWh and no assumptions about duration.
- Determine the ELCC of that pool of MWh.
- Divy up this total ELCC to resources by MWh
- Resources with an MFO < this ELCC are “power limited,” and have a UCAP equal to their MFO.
- EFORd applied as usual in both cases.

With the data we have now, we only have confidence that proposal C (hourly duration classes) and this one will give accurate results.

PJM or outside consultant should perform “zero assumption” modeling and report on the impact of choosing different duration classes BEFORE any further CCSTF votes.

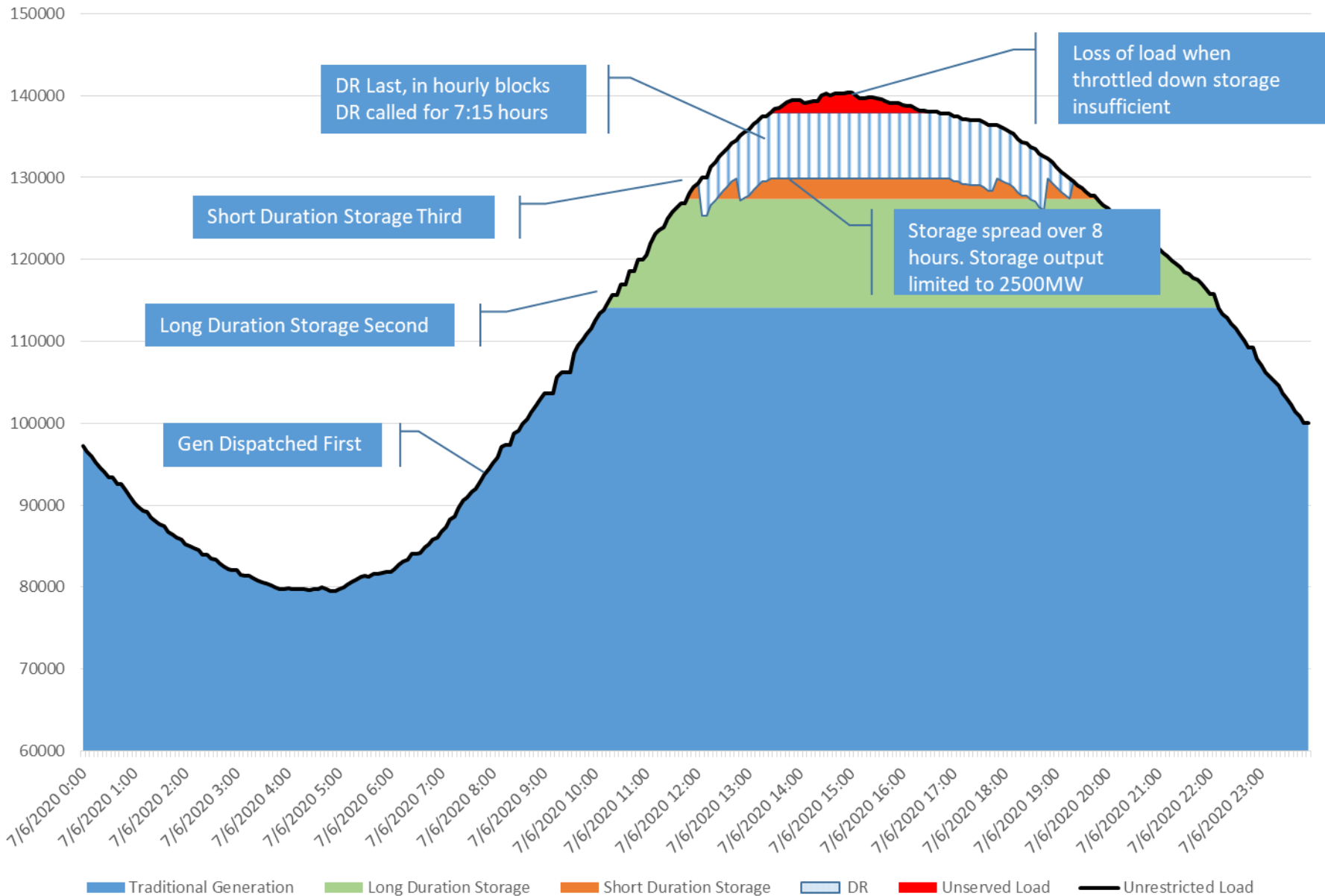
2. DR and Storage Interaction

The ELCC analysis should reflect optimal use of resources.

PJM proposes to model storage as dispatched before DR, and storage continuing to discharge after DR is called. Better coordination of DR and storage dispatch can serve more load with the same resource mix.

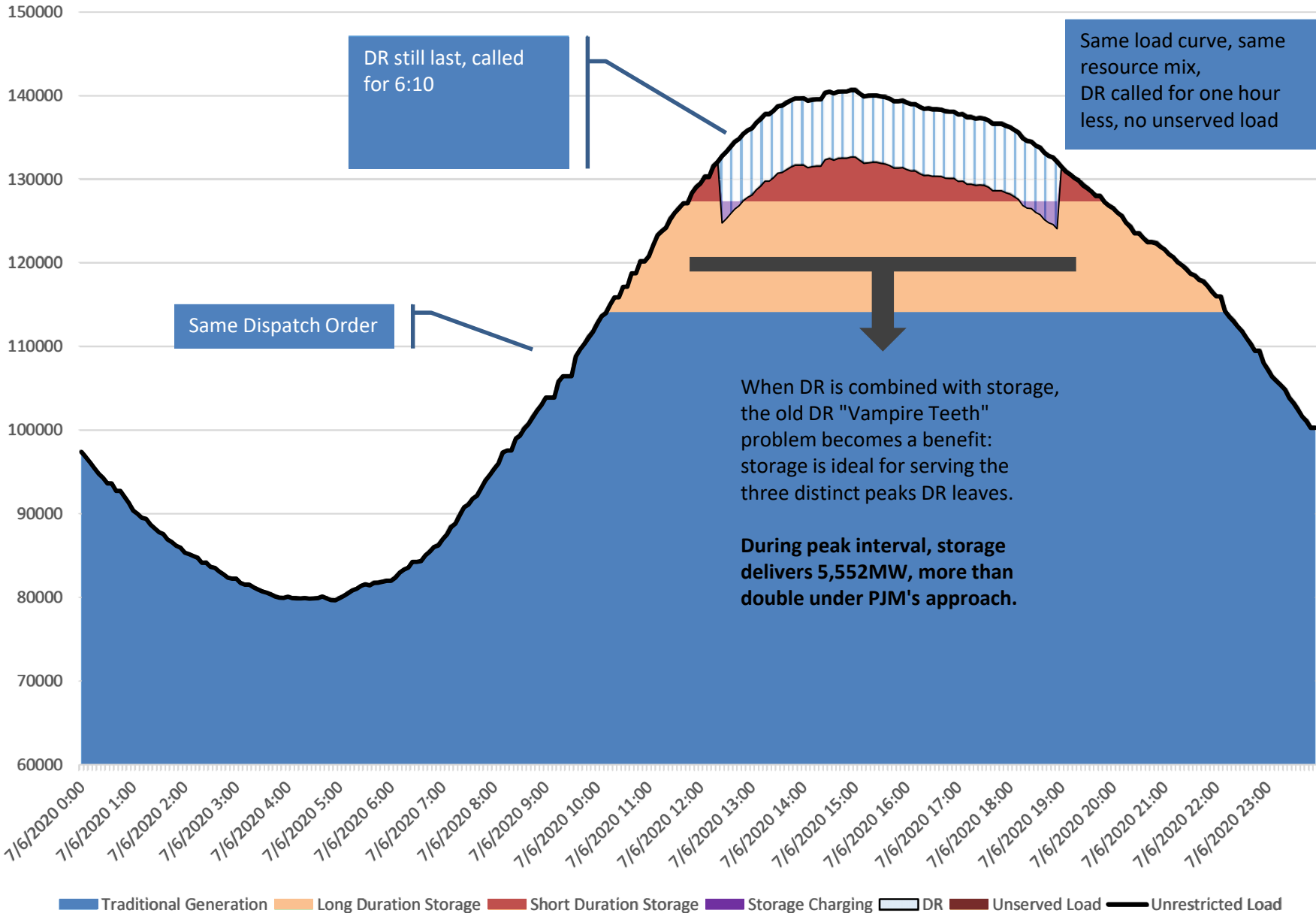
- DR not used is lost forever; storage not used is available. Storage's signature ability is moving energy from one time to another. This must be used.
- Changes from PJM approach:
 - Do not throttle down storage
 - Once DR is needed, call as much as can be used
- Example using 7/6 load, 20GWh storage, 8GW DR, other resources set so total ICAP just matches peak load.

Storage and DR Dispatch, PJM Approach



■ Traditional Generation ■ Long Duration Storage ■ Short Duration Storage ■ DR ■ Unserved Load — Unrestricted Load

Storage and DR Dispatch, Alternative Approach



Dispatch Comparison

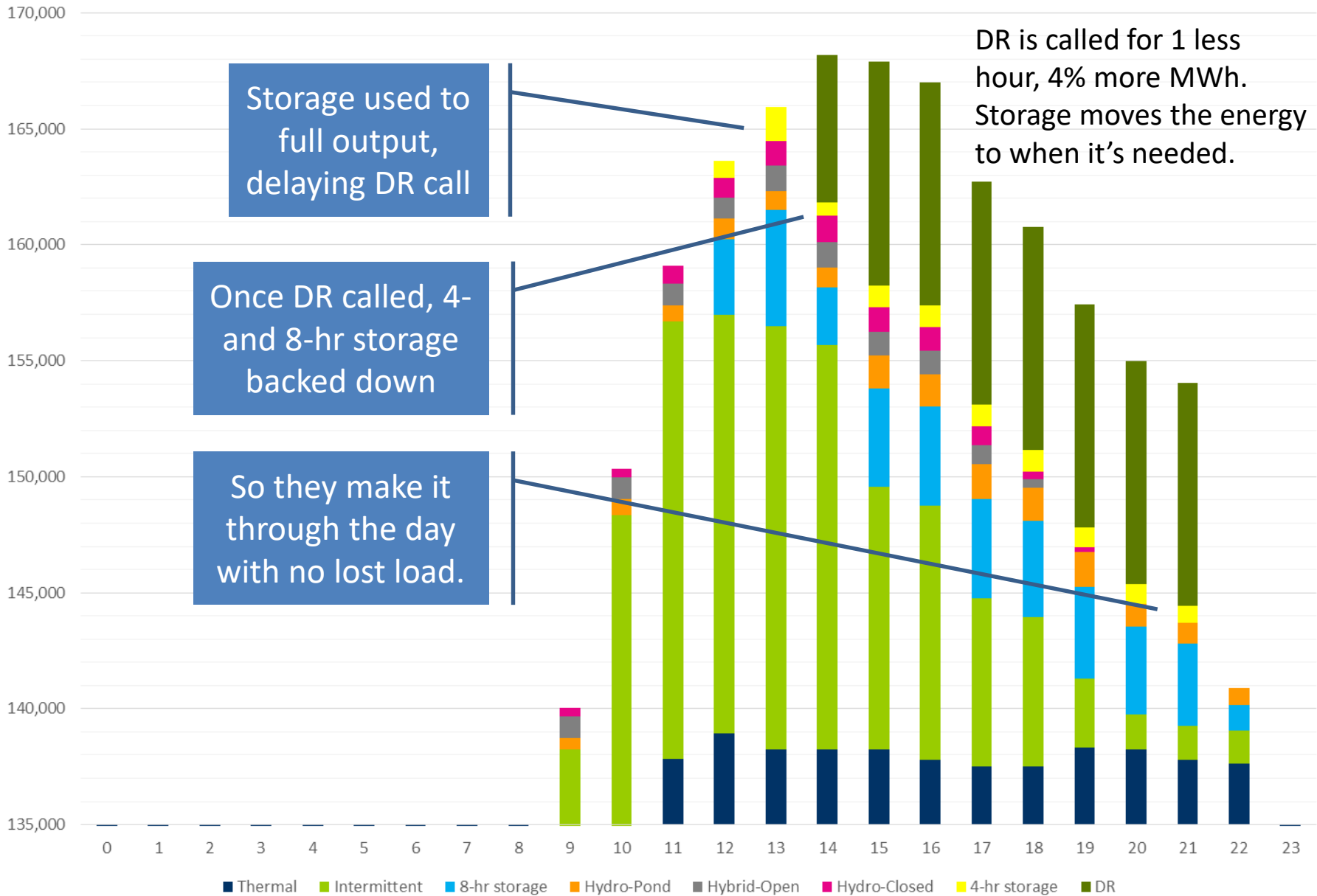
	Proposed	Alternate
DR duration	7 hours 15 min	6 hours 10 min
Energy from DR	51.2GWh	52.7GWh
Unserved load	54.9GWh	none
Serviceable Peak	137,850MW	140,658MW
Non-storage capacity	135,125MW	135,125MW
PLCC of storage	2,726MW	5,533MW

Under actual conditions, coordinated dispatch of storage and DR prevents 54.9GWh of lost load at a cost of calling 1.5GWh (3%) more DR

Coordinated dispatch **more than doubles** the PLCC of storage.

Uncoordinated dispatch fails to account for storage's flexibility and ability to recharge. This is not in compliance with Order 841.

Hourly Results for Day 46, Alternative Dispatch



Storage used to full output, delaying DR call

Once DR called, 4- and 8-hr storage backed down

So they make it through the day with no lost load.

DR is called for 1 less hour, 4% more MWh. Storage moves the energy to when it's needed.