



Limited Energy Capability Resource (LECR) Duration Requirement for the Capacity Market

Scott Benner

Sr. Lead Engineer, PJM

Market Implementation Committee – Electric
Storage Resources

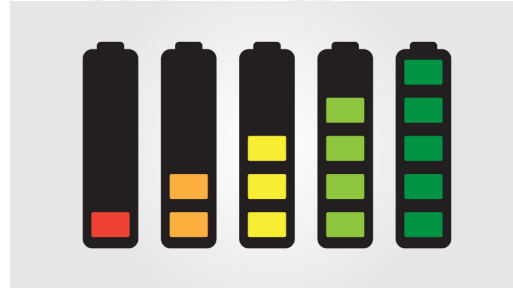
September 14, 2018

- This presentation is based on a paper submitted to IEEE for review.
- Publication Title: 2019 IEEE PES Innovative Smart Grid Technologies Conference N.A. (ISGT N.A.)
- Article Title: Limited Energy Capability Resource Duration Requirement for Participation in PJM Capacity Market
- Author(s): Aramazd Muzhikyan, Laura Walter, Scott Benner, Anthony Giacomoni

- Problem Statement
- The Method of Equivalent Duration
- Incorporation of Behind the Meter Solar Data
- LECR Capacity Range
- Equivalent Duration for Different LECR Penetration
- Peak Start and End Consideration for DR
- Conclusions



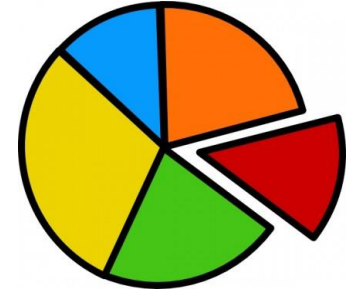
What should the duration requirement for electric storage be for participating in the capacity market?

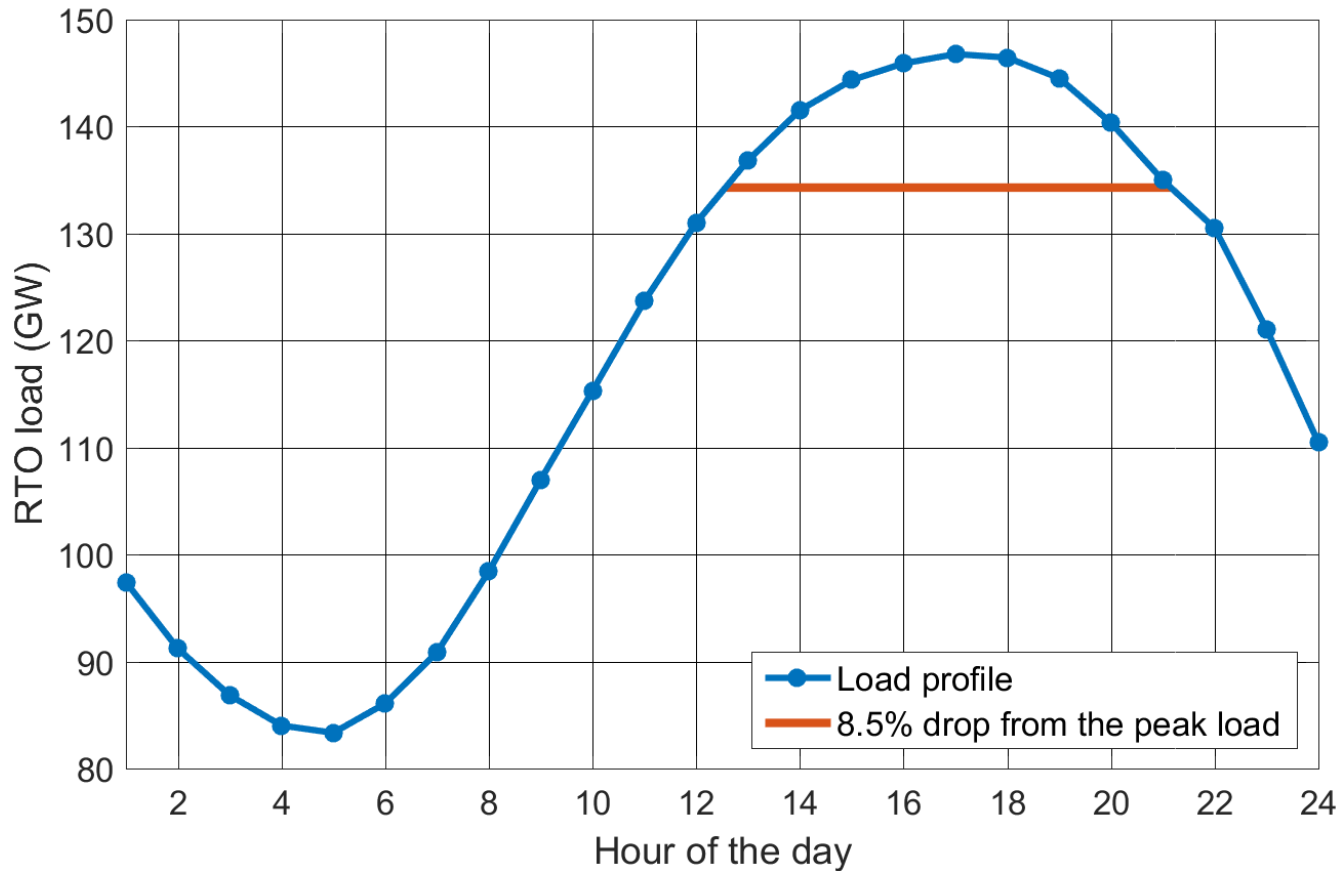


How the capacity of electric storage should be calculated in the capacity market?



What's the maximum electric storage capacity the system can accommodate?

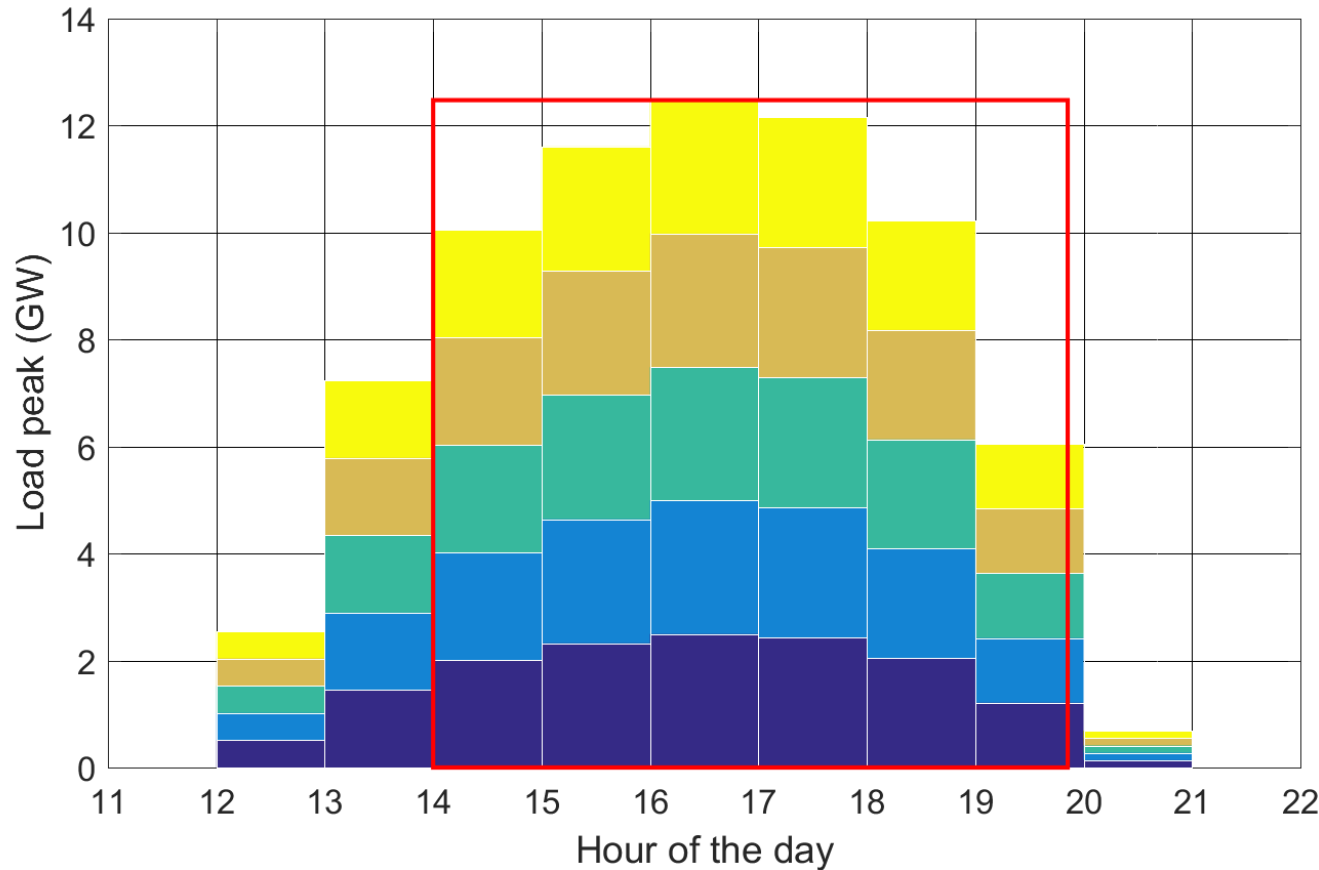




The procured LECR capacity is assumed to be 8.5% of the peak, represented by the red line.

The conventional wisdom suggests a 9-hour duration requirement which translates into LECR with $12.47 \times 9 = 112.23$ GWh energy capacity.

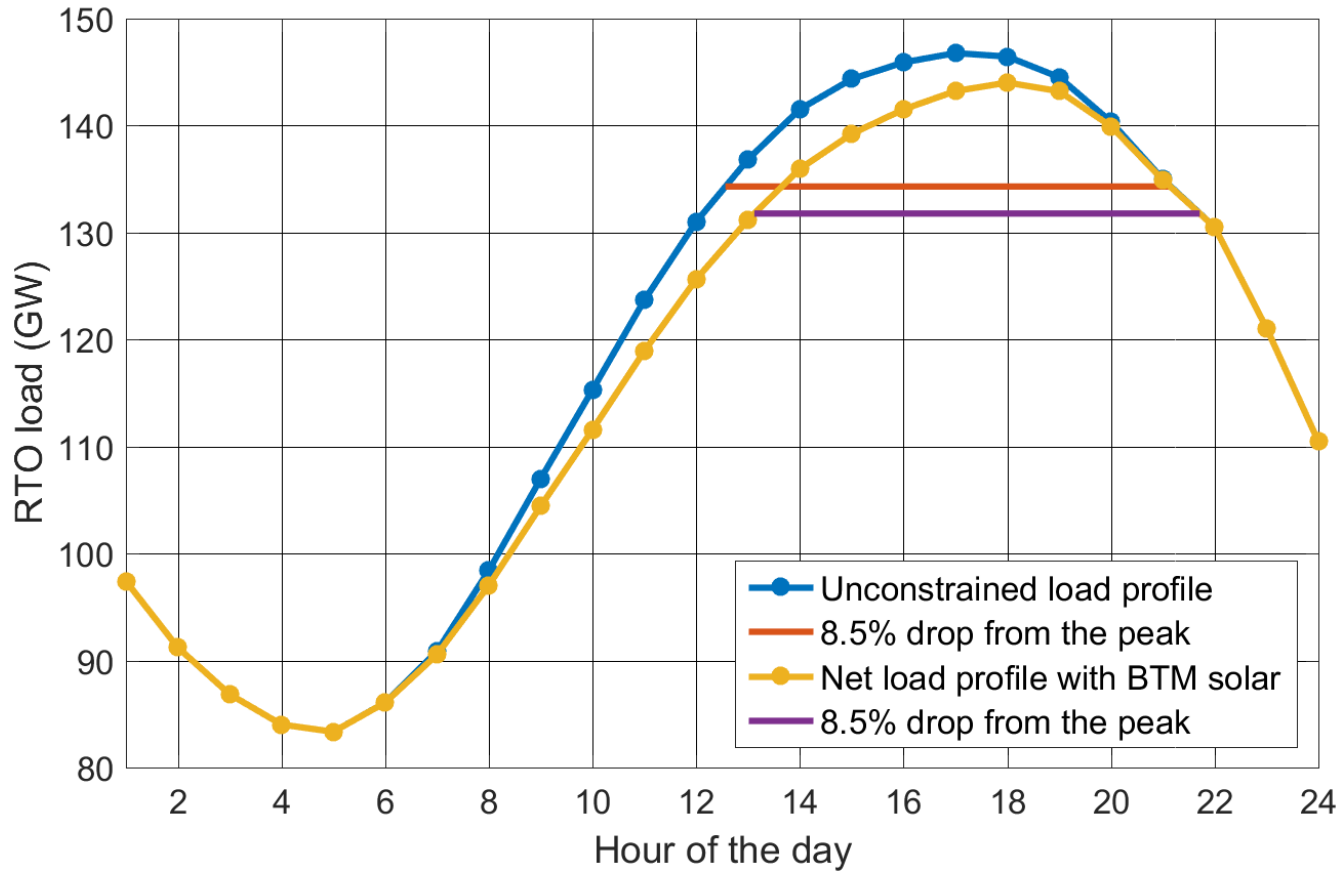
The total energy in the peak is 73.03 GWh.



The peak is sliced into geometrically similar strips, where individual pieces follow the same shape but have different heights.

The capacity compensation is defined by the maximum power the resource provides while following the required shape.

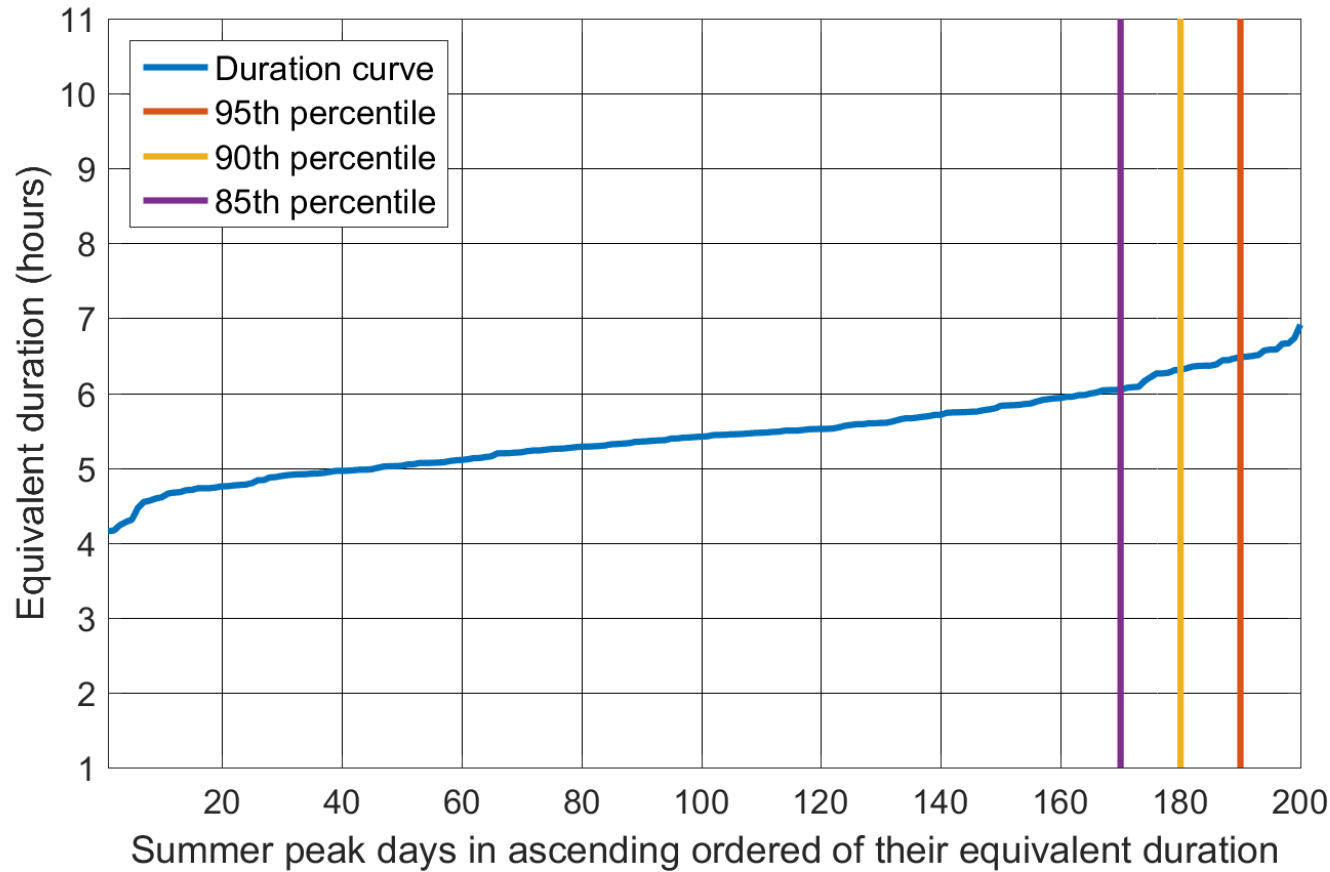
The concept of equivalent duration is defined as the amount of energy in the peak divided by its maximum MW value.



Incorporation of BTM solar moves the peak more to the right and reducing its maximum MW value.

These effects are amplified as more BTM solar is added.

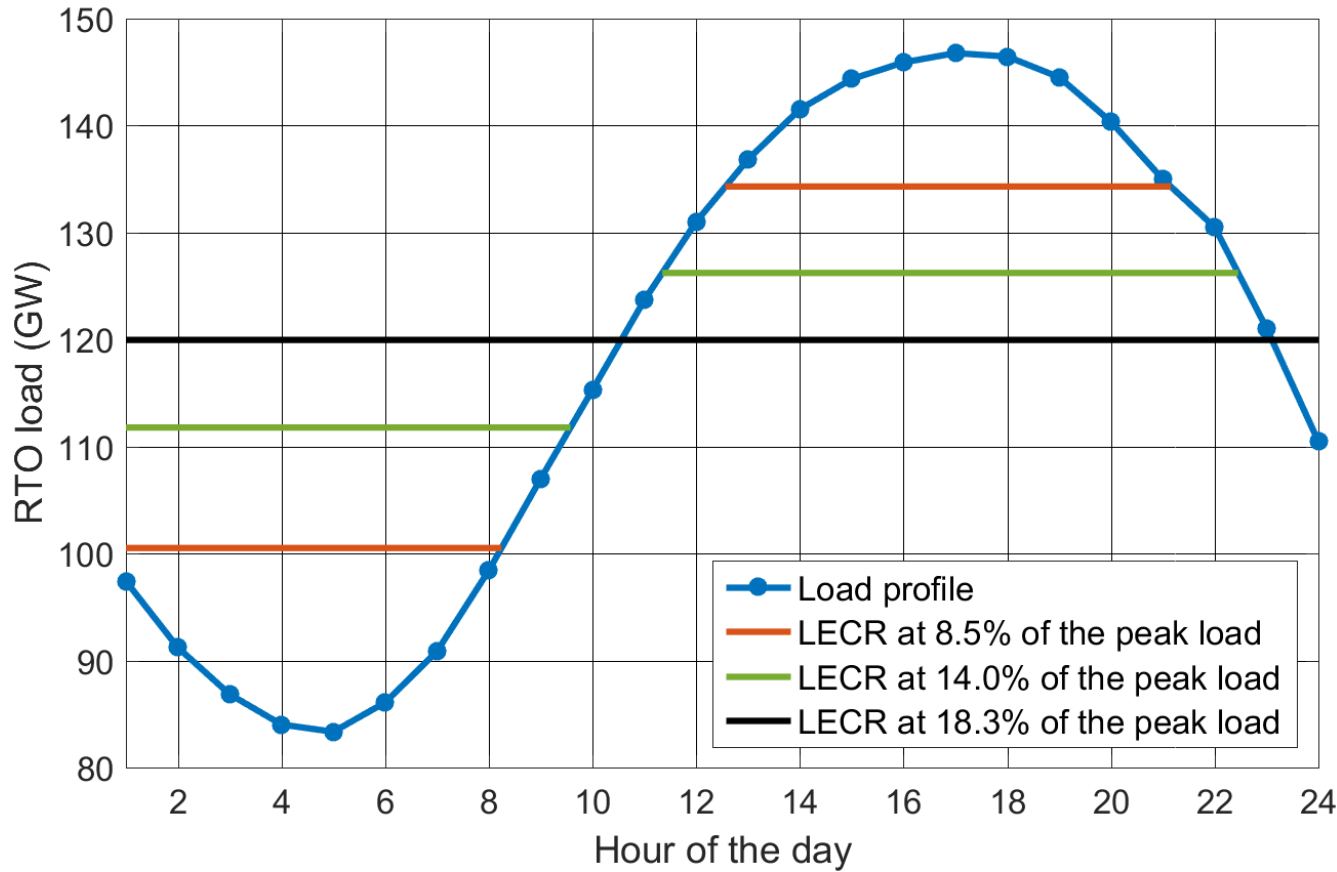
BTM solar integration leaves equivalent duration estimations largely unchanged.



The data pool is expanded by including load profiles for the last 10 years of 2008-2017.

Total of $20 \times 10 = 200$ summer peak days are analyzed to obtain their equivalent duration values.

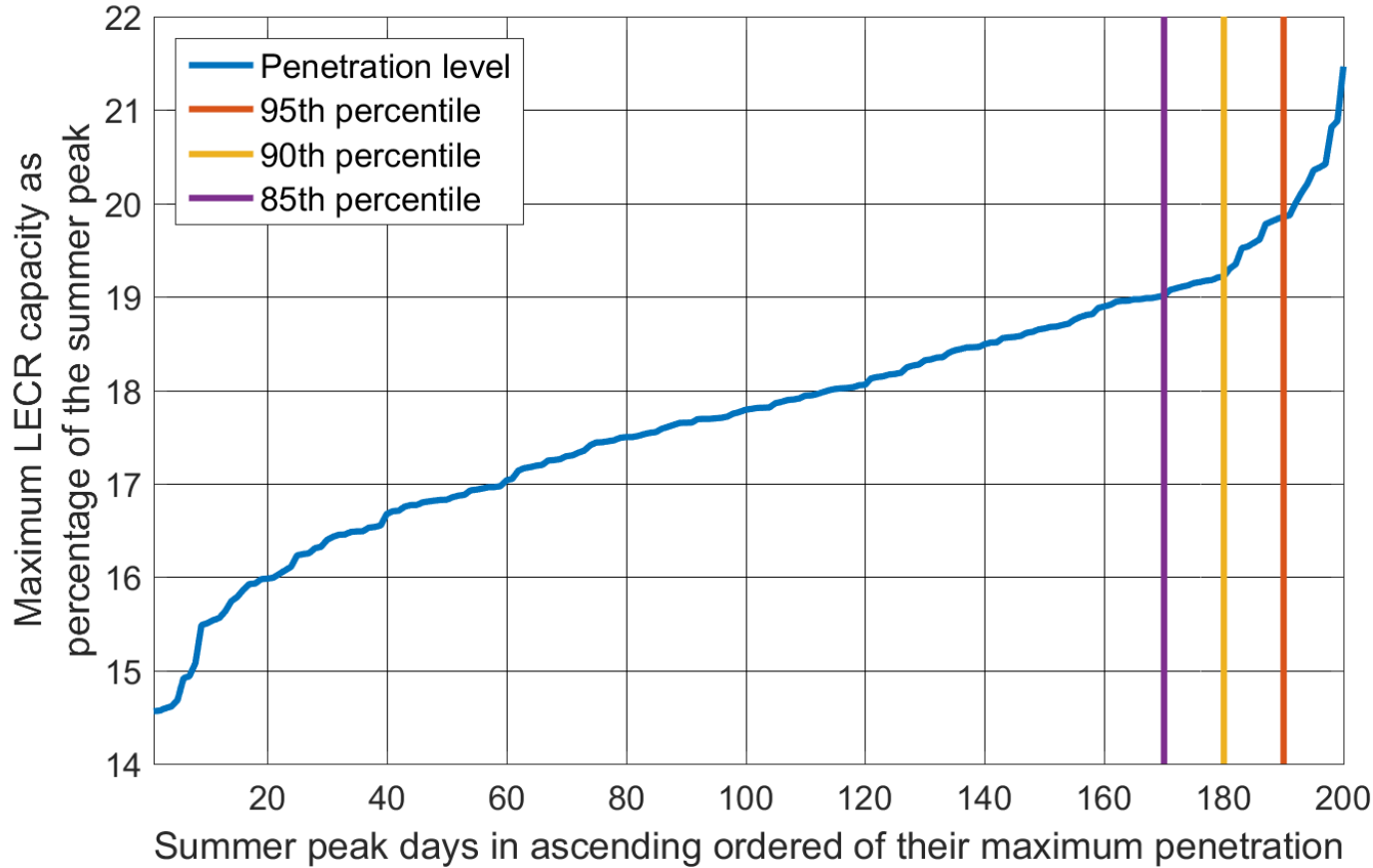
For 8.5% LECR penetration, the equivalent duration reaches a maximum of 7 hours.



The energy stored during the valley period is used to serve the peak.

As the percentage of LECR in the system increases, both peak and valley widen.

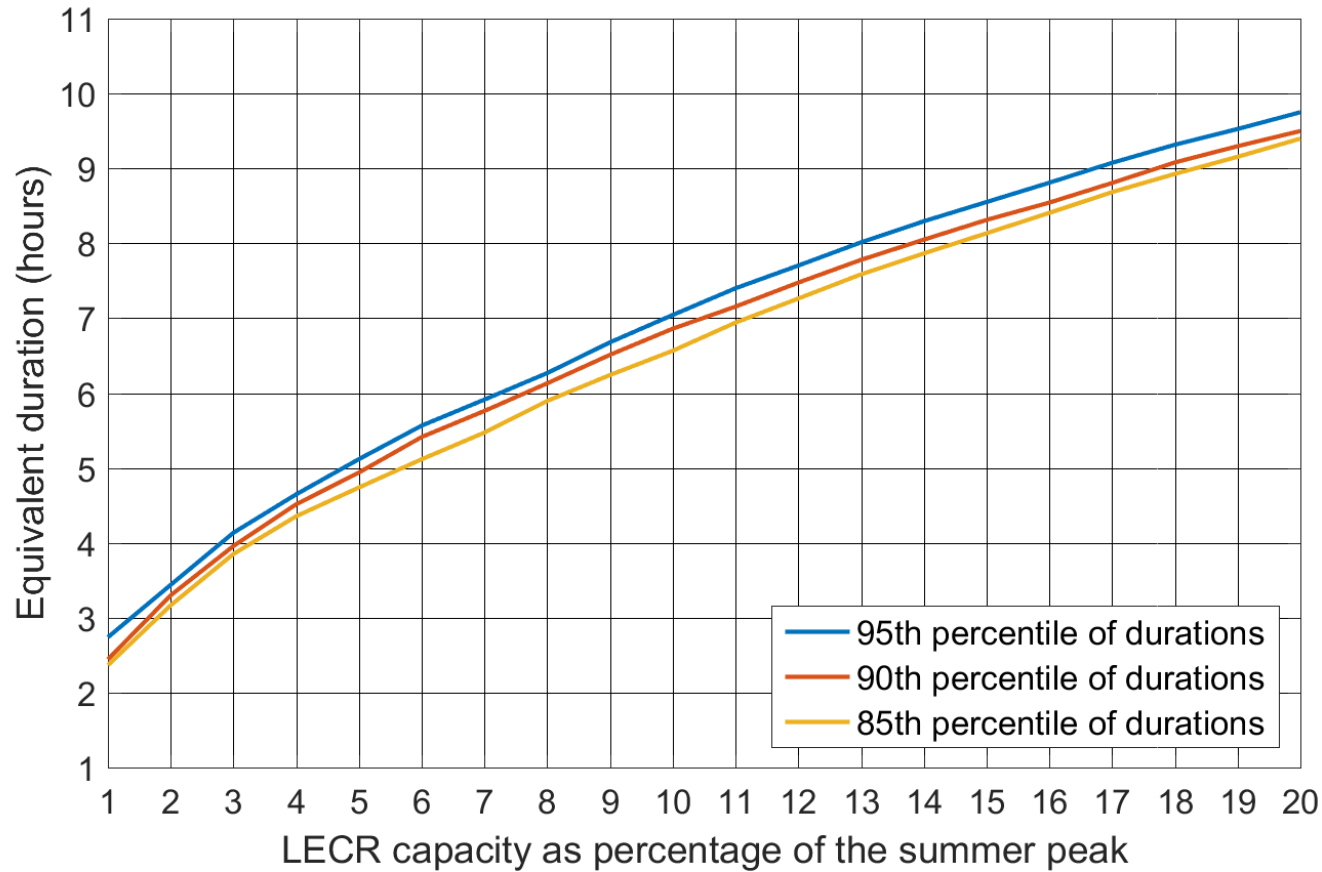
At some point, the intervals of charging and discharging occupy the whole day.



Capacity range estimates are obtained for the 200 summer peak days considered here.

The system can economically accommodate up to about 20% of LECR.

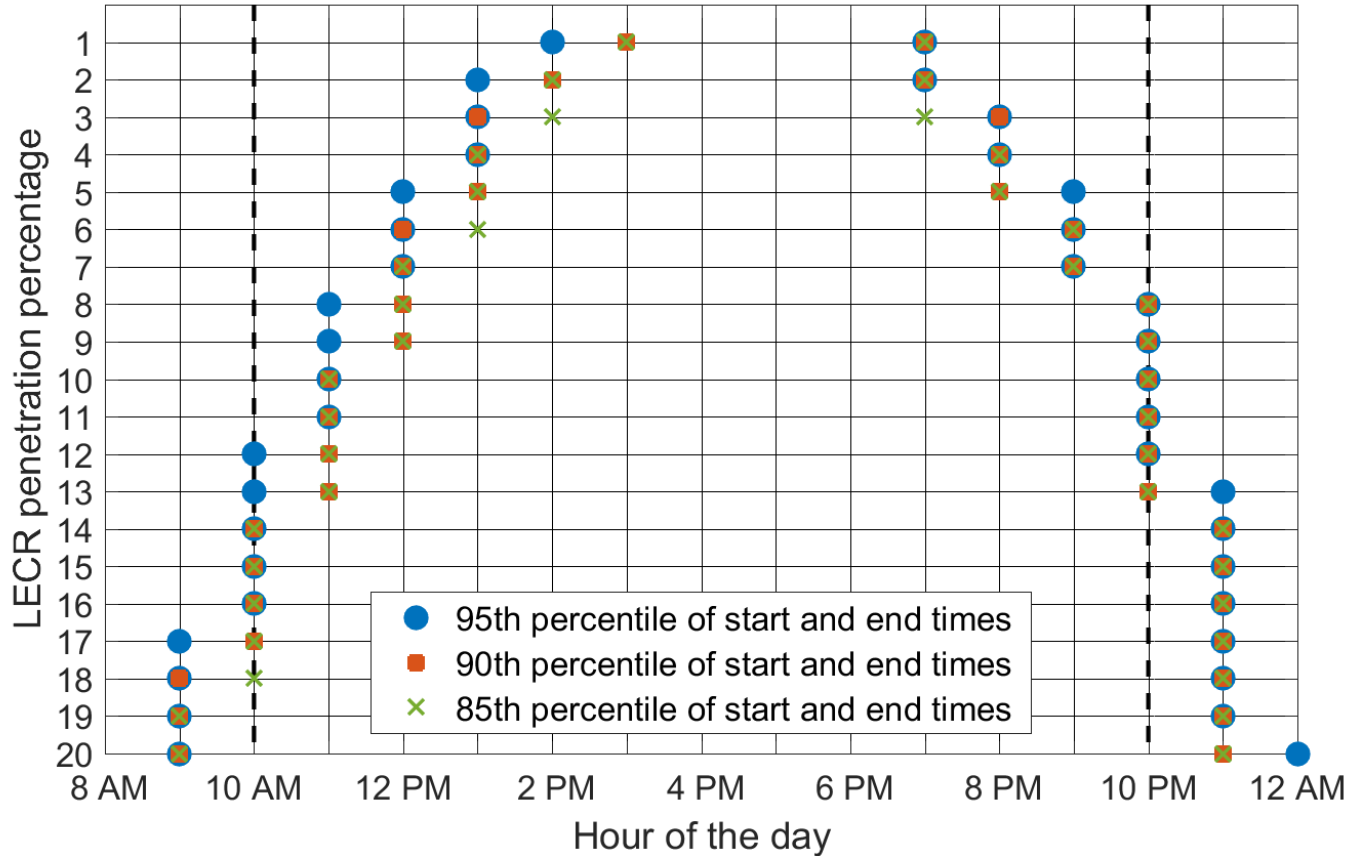
Additional LECR capacity beyond 20% will be used in less than 5% of instances.



Equivalent durations are obtained for up to 20% LECR penetration.

4-hour duration requirement limits the LECR capacity to about 3% of the annual peak.

When LECR penetration reaches 20%, the equivalent duration is about 10 hours.



CP DR resources are required to be capable of maintaining each such interruption between the hours of 10:00AM to 10:00PM in the summer.

The system with BTM solar corresponding to 2028 ICAP projections can accommodate maximum of 12% LECR.

- Limited Energy Capability Resources (LECR) participating in the capacity market should meet 10-hour equivalent duration requirement.
- 10-hour duration requirement allows the system to reasonably accommodate maximum of 20% LECR.
- At 4-hour equivalent duration requirement, the system is able to accommodate less than 5% LECR.