Capacity Accreditation for All

Ensuring Non-Discriminatory Accreditation for All Resource Types

FACT SHEET

A primary objective of capacity accreditation, regardless of the specific metric used, is to provide a technology-agnostic means of comparing resource adequacy contributions across different resources. This allows system planners to develop a portfolio of resources that serves load in a reliable and least-cost manner and to compensate resources fairly for their specific contribution to reducing resource adequacy risk.

Capacity Accreditation Is Often Applied Only to Wind, Solar, and Storage

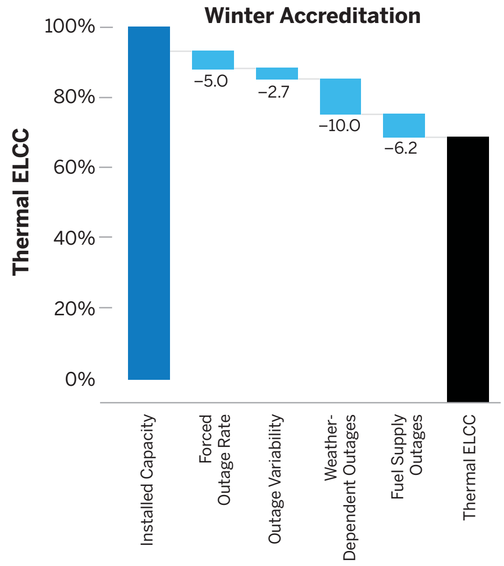
In most regions today, however, capacity accreditation is applied to only a subset of new resources and technologies, namely wind, solar, and battery energy storage. Industry practitioners have become adept at recognizing the uncertain and variable nature of wind and solar resources, and increasingly consider energy limitations associated with battery energy storage.

But the same rigor is rarely applied to other resources, specifically thermal generators like coal and natural gas resources. Instead, these resources are often counted on to provide either their nameplate capacity or unforced capacity (capacity minus a forced outage rate) toward resource adequacy. Much like wind and solar, however, thermal generators have periods of unavailability due to extreme weather events, from either weather-related outages or fuel supply disruptions (see Figure 1). And their unavailability can be highly correlated with that of other resources and with periods of higher demand.

At best, these omissions over-compensate gas and coal resources for their reliability contributions; at worst, they pose an unrecognized reliability challenge for the grid.

FIGURE 1

Additional Factors for Capacity Accreditation for Thermal Resources (Winter Example)



Source: Energy Systems Integration Group; data from Astrapé (Dison, Dombrowsky, and Carden, 2022).

All Resources Have Limitations

All resources have attributes that can sometimes limit their ability to serve load during critical risk periods. Wind and solar are limited by weather variability. Hydro can be limited by normal seasonal fluctuations as well as extreme drought conditions. Battery storage can be limited by the duration of charge and availability of charging energy. Large nuclear, coal, and natural gas plants, in addition to being affected by weather, can have disproportionate impact on resource adequacy due to the blocky nature of outages, where a large unit is either off or on.

This fact sheet is adapted from the ESIG report *Ensuring Efficient Reliability: New Design Principles for Capacity Accreditation*.

Methods Should Be Applied Across Resource Types in a Similar Manner

If capacity accreditation is used to measure the performance of one type of resource, it should be applied to all types of resources in a similar manner. The fair application of methods across resources ensures that the capacity credits are technology-neutral, ensures they provide accurate incentives for improved performance and innovation through plant design and hybridization, and increases the likelihood that the capacity accreditation leads to a reliable and least-cost portfolio of resources. Care should also be taken to ensure that individual resources that can materially differentiate themselves from the resource class average—by location, technology, or plant configuration—are assigned a different capacity credit in order to incent improved availability for reliability.

The resource adequacy analysis necessary for capacity accreditation is already time consuming and labor intensive. If the accreditation process is to be applied to all resource types, the process will become increasingly burdensome. Simplification of the accreditation process can be considered—while it might forgo precision, it can still provide an accurate investment and planning signal.

FIGURE 2
Calculation of Marginal Reliability Improvement

$$\text{Capacity Value} = \frac{LOLE_i - LOLE_m}{LOLE_i - LOLE_p} = \frac{\Delta LOLE_{resource}}{\Delta LOLE_{perfect\ capacity}}$$

Source: E. Ibanez and M. Bringolf, “ELCC and MRI Overview,” Presentation to the NYISO ICAP Working Group (Schenectady, NY: GE Energy Consulting, 2022).

These simplifications could reduce the effort required, both computationally and analytically. Two options include the marginal reliability improvement (MRI) process and an average output during a sliding risk window (loss-of-load probability (LOLP) capacity factor) approach. Both have been shown to track well with marginal effective load-carrying capability (ELCC) metrics, but require significantly fewer computational resources.

Marginal Reliability Improvement: Rather than iterate across multiple cases to calculate ELCC, the marginal reliability improvement technique compares how the loss-of-load expectation (LOLE) (or alternative resource adequacy metric) changes for a resource relative to the equivalent amount of perfect capacity (Figure 2).

LOLP Capacity Factor: The LOLP capacity factor method calculates the average availability of a resource during a sliding risk window, identified by loss-of-load hours or low margin periods. This methodology calculates the average availability of a generator or generator type during loss-of-load hours. The key difference between this and a deterministic peak load window approach is that it only considers resource availability during periods of shortfall or tight margin, regardless of when they occur (Figure 3, p. 3).

Both the marginal reliability improvement method and the LOLP capacity factor method show promise in reducing the computational and analytical effort in capacity accreditation. Their use would free up resources that can be applied toward more robust underlying resource adequacy analysis, and allow the methods to more easily be applied across all resource types and even individual resource configurations. More effort is needed to calibrate these metrics on test systems and develop other analytical simplifications.

FIGURE 3

Illustration of the LOLP Capacity Factor Accreditation for a Solar Resource

System Unserved Energy

	Weather Year 1			Weather Year 2		
Hour of Year	Sample 1	Sample 2	Sample N	Sample 1	Sample 2	Sample N
1	0	0	0	10	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	20	0	0	0	0	0
5	40	0	0	0	30	0
6	10	0	0	0	10	0
7	0	0	0	0	5	0
8	0	0	0	0	2	0
9	0	0	0	0	1	0
10	0	0	0	0	0	0
...	0	0	6	0	0	0
8758	0	0	10	0	0	0
8759	0	0	2	0	0	0
8760	0	0	0	0	0	0

Two weather years, six outage samples
LOLE = 0.67 days/year
LOLH = 2 hours/year
EUE = 24.3 MWh/year

Generator Availability (installed capacity = 10 MW)

	Weather Year 1			Weather Year 2		
Hour of Year	Sample 1	Sample 2	Sample N	Sample 1	Sample 2	Sample N
1	0	0	0	**0**	0	0
2	0	0	0	0	0	0
3	1	1	1	0	0	0
4	**4**	4	4	2	2	2
5	**8**	8	8	3	**3**	3
6	**3**	3	3	1	**1**	1
7	1	1	1	0	**0**	0
8	0	0	0	0	**0**	0
9	0	0	0	0	**0**	0
10	1	1	1	2	2	2
...	5	5	**5**	6	6	6
8758	10	10	**10**	0	0	0
8759	6	6	**6**	6	6	6
8760	3	3	3	1	1	1

Average output during events = 3.33 MW
Nameplate capacity = 10 MW
Capacity accreditation = 33%

The matrix on the left shows unserved energy across six probabilistic samples, with unserved energy events highlighted in orange. These windows are the ones against which resources are measured for accreditation purposes. The matrix on the right illustrates the availability of a generator (solar, in this case) over the same weather years and chronology. The blue shading illustrates periods where the generator is available; however, only the generation during the unserved energy events (denoted by the black boxes) is counted toward the generator's accreditation. The final calculation is provided in the text below the chart.

Notes: LOLE = loss-of-load expectation; LOLH = loss-of-load hours; EUE = expected unserved energy.

Source: Energy Systems Integration Group.

This fact sheet was adapted from *Ensuring Efficient Reliability: New Design Principles for Capacity Acccreditation*, a report by the Energy Systems Integration Group's Redefining Resource Adequacy Task Force. Three fact sheets and the full report are available at https://www.esig.energy/new-design-principles-for-capacity-accreditation.

To learn more about the recommendations described here, please send an email to info@esig.energy.

The Energy Systems Integration Group is a nonprofit organization that marshals the expertise of the electricity industry's technical community to support grid transformation and energy systems integration and operation. Additional information is available at https://www.esig.energy.