GRID UTILIZATION – HYPE VS REALITY

Defining realistic Grid utilization metrics requires careful understanding of grid characteristics and an assessment of the true potential to realize an affordable, efficient, and reliable grid

Industry is desperate to connect large loads (i.e., data centers), turning over every stone to find grid capacity. In this pursuit, they are deploying novel legislative tools and passing laws to force change in utilities' behavior. The whole premise rests on the belief that utilities are hiding something and are highly inefficient. While we can't say for sure, at the very least we know that utilities are not incompetent grid operators! In fact, challenging utilities on complex technical and operational issues such as grid utilization without deep technical understanding is risky. Using basic economic analysis confuses the issue, creates false expectations for politicians and advocates, and may ultimately backfire by delegitimizing utilities' investment in the traditional grid, making necessary upgrades more difficult.

In March 2026, a report for the Utilize Coalition projected up to $170B in consumer savings over ten years by better utilizing the existing grid. By April, Virginia had enacted SB621 (Senate Bill) directing utilities to develop utilization metrics, with New York and North Carolina following within weeks. States are no longer contemplating whether to measure utilization but rather how to measure it, and that question is far from settled.

Grid utilization is not new. Power system engineers already use two established metrics to assess whether a system can absorb more load (**load factor**) and whether generation is operating near its potential (**capacity factor)**. Recent reports have also established a **'system utilization metric'**. This metric applies at each level of the system, measuring generation against unforced capacity, transmission against firm transfer capability, and distribution as equipment loading against limits.

Measured this way, most utility grids land between 40% and 50% utilization. Regulators and policymakers should not read this as evidence of idle infrastructure. <u>How utilization is calculated and interpreted today produces a percentage that does not reflect a power system's true characteristics</u>. One needs to understand a few key details while developing grid utilization metrics, including:

- ***Grid utilization is dynamic.*** Equipment ratings shift with ambient temperature, and a single annual utilization figure obscures the seasons when the system is used more heavily.
- ***Low utilization does not justify adding inflexible loads.*** Off-peak headroom is only an opportunity for flexible loads that can shift or curtail.
- ***Grid utilization may appear lower due to reliability criteria (NERC standards).*** While it is debatable whether current NERC design criteria, or their application, remain relevant given advancements in distributed technologies, current N-1 design reserves a portion of the grid to carry load during a contingency.
- ***Higher utilization is not an indicator of a healthy grid.*** Equipment running near or above its thermal limit continuously loses reserve margin, degrades faster, and fails sooner.
- ***Targeting higher utilization can disincentivize energy efficiency measures.*** A metric that rewards higher utilization penalizes efficiency and demand response programs that reduce load on the same infrastructure.
- ***Systemwide utilization metrics have limited diagnostic value.*** One territory-wide number identifies neither where capacity is exhausted nor where load could be added.

So, what do we need to understand about grid utilization, and what would it take to measure it? The first step is to understand grid utilization potential, which depends on factors such as equipment vintage, weather, external operating constraints, and more. In this publication, team Vrinda presents key issues, analysis, and recommendations to develop metrics to measure real grid utilization or, at a minimum, establish what it is not!

In this Issue

KEY ISSUES WITH HOW PROPOSED GRID UTILIZATION METRICS ARE VIEWED

① **Proposed utilization metrics do not capture dynamic system characteristics.** Equipment ratings shift with ambient temperature (e.g., transformers and line ratings are typically higher in winter and lower in summer); a single annual utilization figure obscures the seasons when the system is stressed—for example, in analyses using IEEE modeling equations.[1] demonstrates that transformer rating decreases by ~5-7% with a 5°C increase in temperature (**Error! Reference source not found.Error! Reference source not found.**). Utilization metrics can capture this variation by reporting seasonally, with utilities developing an accreditation-style adjustment factor to reflect the rating in effect for each season. Utilities need to account for these temperature variations while allowing grid utilization without load curtailment.

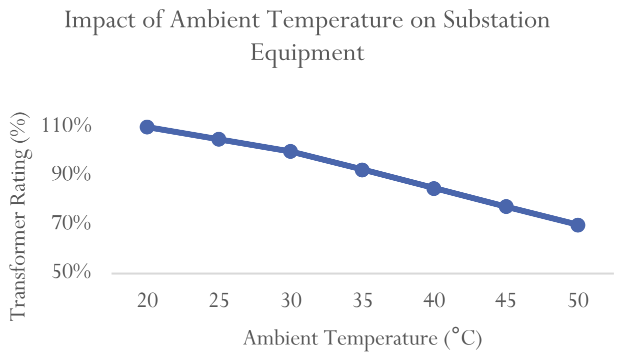

Figure 1 Impact of Temperature on Equipment Rating

② **Low utilization does not automatically justify adding continuous (inflexible) load.** The current view holds that utilization improves by adding new load. In practice, low utilization signals an opportunity for ***flexible loads*,** not just any load. The principle behind the utilization metric is that load driving the system peak can be flattened or shifted into hours of lower demand. This is a valid strategy, employed by utilities across the country through Dynamic Load Management programs. But these programs work only on flexible load: load that can be shifted to another time, curtailed, or supplied from an alternate source like on-site battery storage, allowing continued operation without the grid.

Most loads do not meet that definition, and the current program and regulatory framework are not designed to change that. Utilities are compensated for building capacity, not procuring flexibility, which keeps enrollment in dynamic load management programs relatively small. Adding loads that cannot shift raises the peak that drives infrastructure investment, regardless of how much off-peak headroom exists. **Error! Reference source not found.** below illustrates the difference. Two scenarios add the same quantity of loading to the same feeder and produce the same gain in reported utilization. However, only the flexible case leaves the peak unchanged. In contrast, the continuous load raises the peak that drives infrastructure investment.

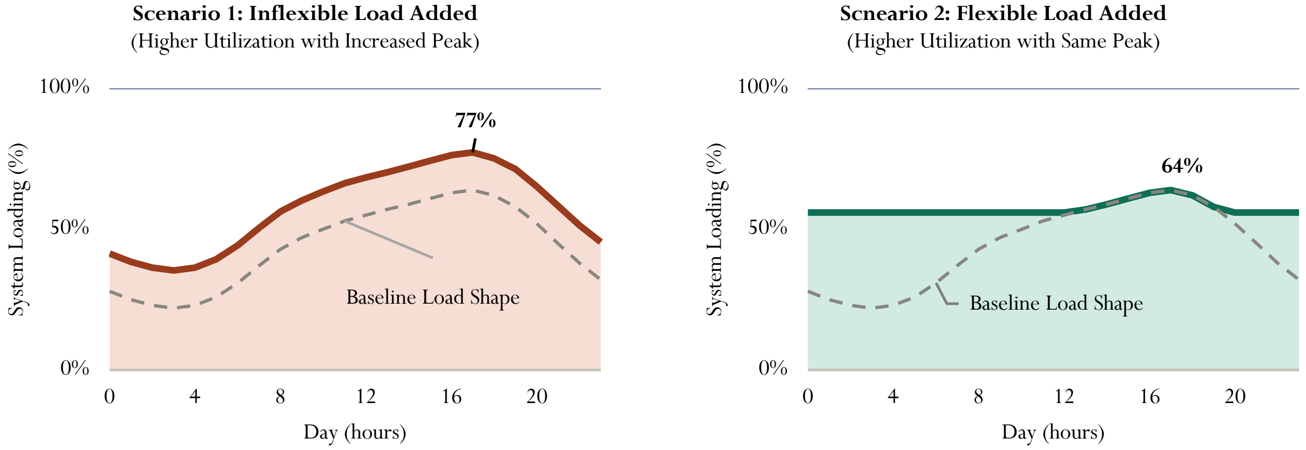

Figure 2 Scenarios of system loading (flexible and continuous load) – Values are representative

[1] Modeled used equations in IEEE C57.91-2025 Guide

③ **Grid utilization may appear lower because of reliability criteria (NERC standards).** Reliability criteria require utilities to build redundant infrastructure to ensure the system continues serving load when a single piece of critical equipment fails. For example, a substation serving critical load may have a second transformer, allowing either unit to carry the full load if the other is lost. This redundancy is not surplus; it is a system reliability requirement. Utilization metrics may not recognize this extra capacity reserved for contingencies. It is debatable whether current NERC design criteria, or their application, remain relevant given advancements in distributed technologies, but for now they must be accounted for.

④**Higher utilization is not a sign of a healthy grid.** Some treat higher utilization as an end goal, but very high utilization can indicate a system with little reserve margin and reduced ability to withstand contingencies (e.g., N-1 events). Electrical equipment also needs periods of reduced loading to cool down. Transformers and lines that run consistently near their thermal limits degrade faster and are more prone to failure, since heat is a primary driver of insulation breakdown and long-term wear. Overly high utilization can therefore increase reliability risk and accelerate equipment damage.

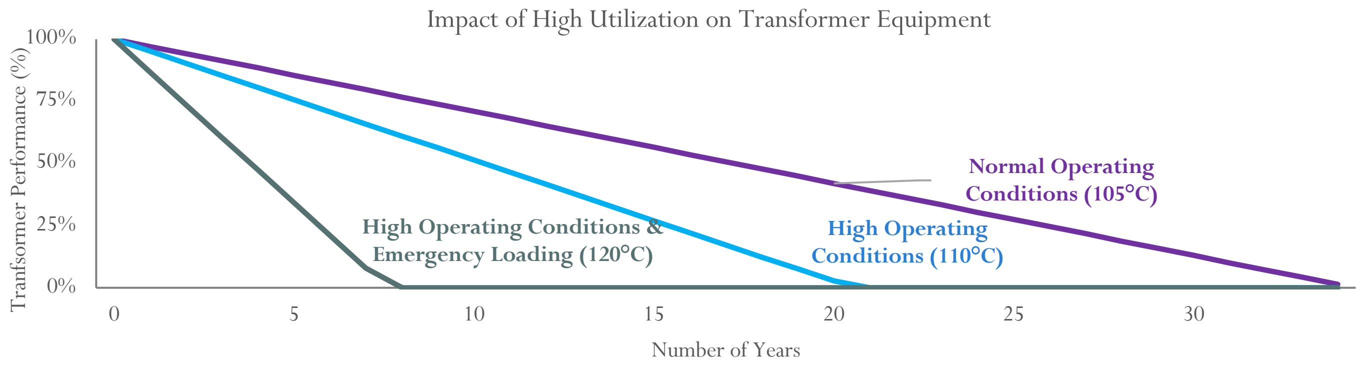

Figure 3 Impact of aging and high utilization on equipment capacity

Moreover, as transformers and other grid assets age, their effective capacity can decline. If utilization is calculated against nameplate capacity rather than derated capacity, true utilization is understated, and the understatement is most severe on the oldest infrastructure. IEEE standards and utility data on equipment degradation curves can inform an aging-adjustment factor in any utilization metric. Figure 3 represents transformer performance derating due to aging and different usage scenarios. It shows that:

- **Transformer performance declines with age even under normal operating conditions,** meaning nameplate may not be the correct benchmark. Under nominal operating conditions, Figure 3 shows transformer equipment approaching its end of life by ~35 years.
- **Higher operating temperatures sharply reduce equipment life.** Increasing hot-spot temperature from 105°C to 120°C shortens useful life to under 10 years.

⑤**Utilization calculations should account for load reductions from energy-efficiency measures.** In proposed metrics, energy delivered sits in the numerator, so any measure that reduces consumption lowers reported utilization. Treating a higher utilization percentage as the goal therefore rewards shifting consumption over reducing it, even though efficiency remains among the least expensive resources for decreasing system demand. Nationally, efficiency initiatives delivered ~16,000 GWh in savings in 2025 (EIA-861). Verified efficiency savings should be held neutral in the calculation, with the new available capacity counted as additional headroom for connecting load rather than as a drop in utilization.

⑥**Utilization metrics are not reported at the substation level and have limited diagnostic value.** A single territory-wide figure provides no actionable information because constraints are local. Report utilization by substation area to identify where capacity is exhausted and where new load can be accommodated. Reported this way, utilization becomes a leading indicator for system planning rather than a retrospective summary.

RECOMMENDATIONS TO REPRESENT GRID UTILIZATION

Utilization can be defined as loading against practical available capacity, meaning nameplate capacity net of N-1 reservation, seasonal and aging derates, non-thermal limits, and committed load, reported seasonally and by substation area rather than as a single annual system figure. Below are key recommendations and visual representations as shown in Figure 4.

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❶**Consider capacity required for N-1 compliance:** Contingency criteria require redundant equipment to remain available during the loss of any single element. Utilization measured against total installed capacity counts mandatory reserve as idle infrastructure, negatively viewing systems with the strongest redundancy.

- Regulators can require that the N-1 reservation be quantified, excluded from available capacity, and reported separately.
- NERC can also revisit its existing reliability criteria and factor in how other flexible resources can help meet contingency requirements rather than redundant infrastructure.

❷**Factor Seasonal and thermal derates:** Transformer and conductor ratings fall materially in summer relative to winter. A fixed annual rating understates loading during the months the system is actually constrained, which are the months that drive capital investment.

- Regulators can require utilization to be reported for summer peak, winter peak, and shoulder periods against the rating in effect for each.

❸**Incorporate equipment aging and condition derates:** Nameplate ratings remain fixed while the effective capacity of aging assets declines. Measuring against the original nameplate rather than the current derated capacity understates true loading, especially for the oldest infrastructure.

- Regulators can require that reported capacity reflect condition assessment and established loading guidance, so the metric does not reward deferring or under-reporting derates.

❹**Develop granular reporting:** Constraints are local and seasonal; reported utilization is typically systemwide and annual. A single territory-wide average hides both where constraints occur and where load could be added, which are the only questions the metric can answer.

- Regulators can require reporting by substation area and season, with the underlying duration curve made available.

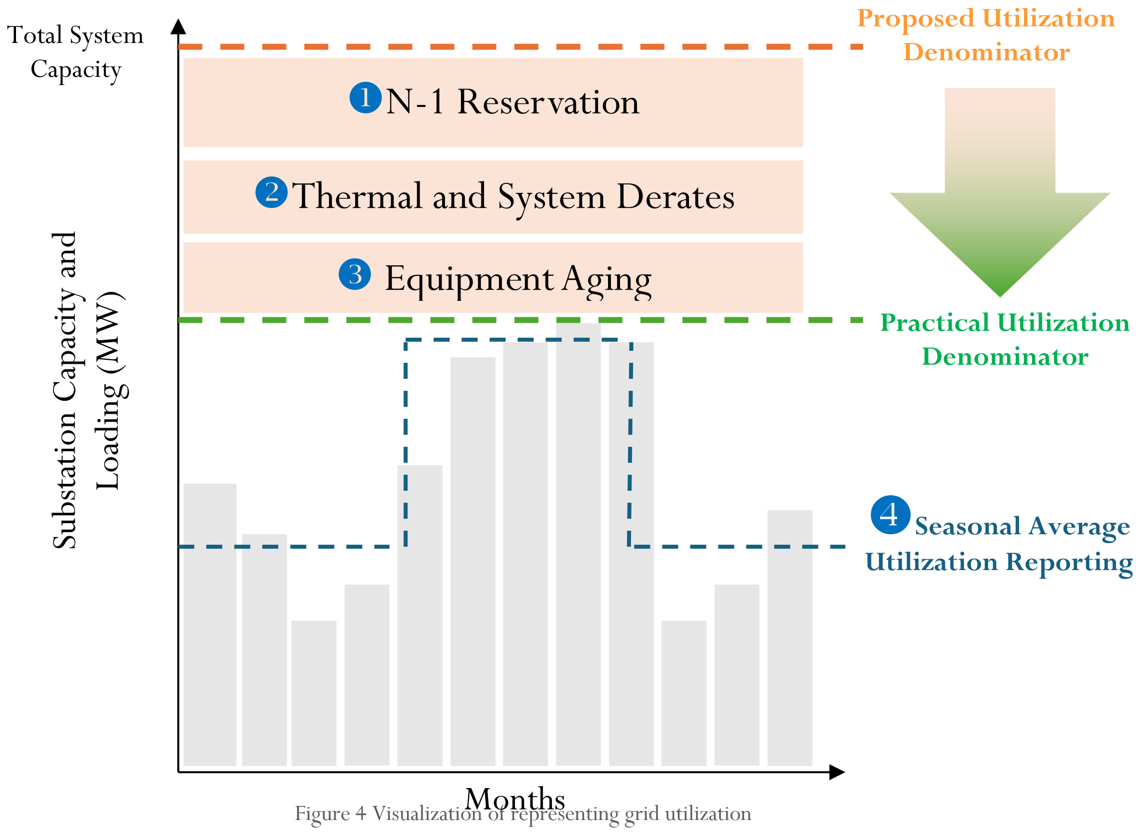

Figure 4 Visualization of representing grid utilization

ABOUT AUTHORS

About Vrinda Inc.

Vrinda Inc. is a New York-based Energy Transition strategy implementation consulting. Vrinda creates success for your business through a focus on value creation by providing trusted, actionable advice, and practical solutions. Vrinda provides strategy, business and implementation consulting services to the Utilities, Developers and Technology Providers. Vrinda operates in the United States and Latin America and brings innovative expertise. www.vrindainc.com

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