Customer-Focused Reliability Metrics: A Complement to System-Average Reporting

Prepared by:

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Executive Summary

Many electric utilities have made measurable progress on reliability in recent years, yet system-average metrics that underpin most regulatory reporting (SAIFI, SAIDI, and CAIDI) do not, on their own, reveal whether that progress is reaching every customer. Localized areas of persistently poor reliability can remain obscured by improving averages, leaving some customers to experience repeated or extended outages. Two complementary customer-focused metrics defined in IEEE Standard 1366, Customers Experiencing Multiple Interruptions (CEMI) and Customers Experiencing Long Interruption Duration (CELID), directly address this gap by measuring the share of customers whose service falls below a defined threshold. Approximately fifteen U.S. jurisdictions and British Columbia have adopted requirements through rules, guidelines, or proceedings to report one or more customer-focused reliability metrics and adoption is expanding. In this paper, Forrest Small examines how utilities and regulators can adopt and apply these metrics to better align infrastructure investments with customer outcomes.

Key Questions

This paper answers the following questions:

- What do customer-focused reliability metrics measure, and what can they reveal?
- How can CEMI and CELID complement SAIFI and SAIDI?
- What role can customer-focused reliability metrics play in measuring resilience?
- Where are customer-focused reliability metrics being reported?
- How can utilities practically implement CEMI and CELID?

1. The Limits of System-Average Metrics

Delivering safe, reliable electricity service has always been a foundational obligation of electric utilities. Even as utilities face affordability pressures, data center growth, and the clean energy transition, ensuring reliability remains a top priority. For decades, electric utilities have tracked power outages across their systems using standardized reliability metrics defined by the IEEE Standard 1366, defining reliability indices that remain in wide use today:

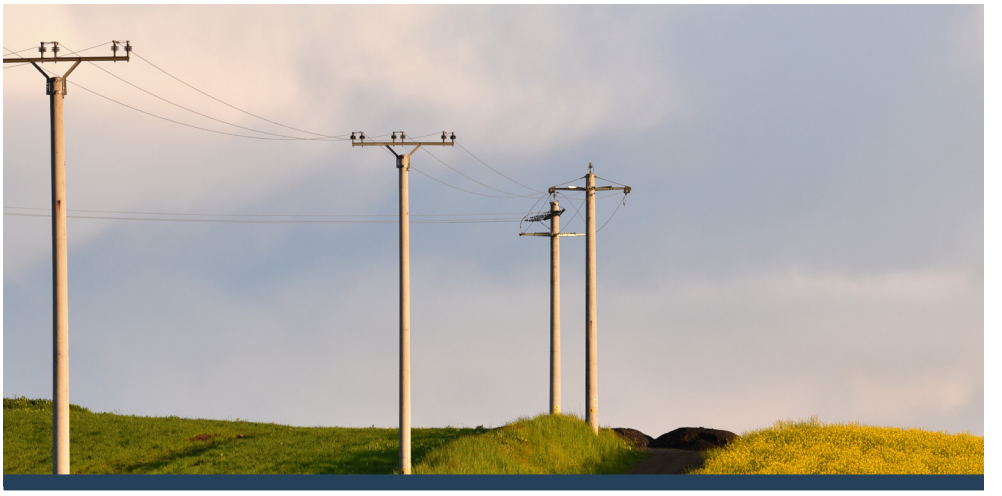
- **System Average Interruption Frequency Index (SAIFI)** indicates how many power outages the average customer experiences over a given period.
- **System Average Interruption Duration Index (SAIDI)** indicates the total length of time the average customer was without power over a given period.
- **Customer Average Interruption Duration Index (CAIDI)** is derived from SAIFI and SAIDI and indicates the average time to restore service.

"Pockets of poor reliability can persist beneath these numbers, even as average reliability appears to improve."

These system-average metrics are widely used, and many utilities in the United States are required to report them as part of an annual filing with the U.S. Energy Information Administration (EIA).[1,2] Beyond this federal requirement, many states mandate these metrics within their own service quality or reliability reporting frameworks. SAIFI, SAIDI, and CAIDI provide utilities and regulators a straightforward way to observe average system reliability over time and across regions.

These standard metrics provide a widely understood baseline for tracking overall system reliability. The challenge, however, is that they describe average system reliability, not what individual customers may actually experience. Furthermore, on their own, they are not designed to indicate where reliability challenges are concentrated, so additional, more granular measures are typically needed to inform investment targeting to the portions of the system that need them most. Pockets of poor reliability can persist beneath these numbers, even as average reliability appears to improve.

In the sections that follow, we explore customer-focused metrics that complement standard system-average metrics, offering utilities and regulators a more complete picture of reliability performance and an additional way to confirm that system improvements reach customers.



2. A Complement: Customer-Focused Metrics

2.1 Scope of Customer-Focused Metrics

SAIFI and SAIDI answer system-average questions about frequency and duration. These are valuable measures of overall system performance, but they are not designed to reveal what is happening at the level of individual customers.

Customer-focused metrics measure the interruptions that specific customers are experiencing. Two such metrics are being adopted in a growing number of jurisdictions, each defined by a designated threshold.

Customers Experiencing Multiple Interruptions (CEMI), introduced in IEEE Standard 1366-2003, measures the percentage of a utility's customers who have experienced more than a defined number of outages in a given period.[3] A utility reporting CEMI-4, for example, tracks the share of its customers who experienced four or more sustained interruptions.

Customers Experiencing Long Interruption Duration (CELID), introduced in IEEE Standard 1366-2012, measures the percentage of customers whose total interruption duration exceeded a defined threshold in a given period. A utility reporting CELID-8 tracks the share of customers who experienced eight or more cumulative hours of outage in a year.

Both metrics are defined in IEEE Standard 1366-2022 and can be calculated at any threshold a utility or regulator selects. What distinguishes them from system-average metrics is their unit of analysis. SAIFI and SAIDI describe the system, and CEMI and CELID describe the customers whose interruptions exceed a defined threshold.

2.2 Relationship between Customer-Focused and System-Average Metrics

System-average metrics such as SAIDI and SAIFI remain essential for tracking overall system performance, benchmarking among utilities, and maintaining baselines for regulatory review. CEMI and CELID offer an additional lens that reveals whether system improvements are reaching all customers, including those served by portions of the system that may be underperforming.

In some cases, a utility could demonstrate gains in SAIDI and SAIFI while pockets of customers continue to experience repeated or lengthy outages. CEMI and CELID work in concert with system-average metrics to provide a more complete reliability picture. CEMI supports SAIFI, and CELID complements SAIDI.

	Focus on outage **frequency**	Focus on outage **duration**
System-level reliability metrics	SAIFI Indicates how **often** the average customer experiences a sustained interruption over a predefined period of time.	SAIDI Indicates the total **duration** of interruption for the average customer during a predefined period of time.
Customer-focused reliability metrics	$CEMI_n$ Indicates the ratio of individual customers experiencing more than a defined number sustained interruptions (n) to the total number of customers.	$CELID_t$ Indicates the ratio of individual customers that experience interruptions with durations longer than or equal to a given time (t).

"CEMI and CELID ask a fundamentally different question: what share of all customers is experiencing service below a defined threshold?"

2.3 CAIDI or CAIFI in Context

Two other standard IEEE metrics, CAIDI and CAIFI, are sometimes discussed as alternatives for understanding customer-level reliability. Both narrow the scope to customers affected by outages, but they still focus on averages, meaning neither serves the same function as CEMI or CELID.

Customer Average Interruption Duration Index (CAIDI) measures the average restoration time for customers who experienced an outage. It is widely used as an indicator of restoration efficiency. However, CAIDI's behavior can be counterintuitive. Because it is calculated as SAIDI divided by SAIFI, CAIDI can increase even when both SAIDI and SAIFI are improving. If outage frequency drops faster than total outage duration, the average duration per remaining outage rises, even though the system is performing better overall. This makes CAIDI difficult to interpret as a standalone indicator of customer experience. The potential for misinterpretation is significant enough that the IEEE working group added Annex D to the 2022 revision of Standard 1366 specifically to address how CAIDI behaves and the cautions that should accompany its interpretation.

Customer Average Interruption Frequency Index (CAIFI) measures the average number of outages experienced by customers who had at least one outage. Its denominator includes only customers who were interrupted, not all customers served. This means that as reliability improves and fewer customers experience outages, the denominator shrinks, and CAIFI can increase even as the system improves. Like CAIDI, CAIFI provides useful information but can move in directions that do not reflect changes in customer experience.

While CAIDI and CAIFI focus on customers affected by outages, both remain system-average metrics. They place a customer who experiences one 30-minute outage in the same calculation as a customer who endures five outages lasting hours. CEMI and CELID ask a fundamentally different question: what share of all customers is experiencing service below a defined threshold? That threshold-based approach is what makes CEMI and CELID actionable as planning and reporting tools, and it is why our analysis centers on them.

2.4 Relationship to Grid Resilience

Given the increasing frequency and intensity of severe weather and catastrophic storms, utilities and regulators are actively exploring ways to measure grid resilience. While recent studies have examined various metrics, there is not yet a single, widely adopted set of resilience metrics used consistently across jurisdictions.

Of the customer-focused metrics discussed here, CELID is often viewed as the most relevant to certain aspects of resilience because it highlights customers experiencing the longest outage durations. However, CELID is typically calculated from data that excludes Major Event Days (MEDs), meaning it captures the tail of the duration curve under normal operating conditions, not during severe weather.[4]

Measuring resilience with standard IEEE indices requires rethinking how MEDs are handled. Two jurisdictions illustrate how this is unfolding in practice. Connecticut has developed a framework that uses CEMI and CELID to prioritize circuits for reliability improvement programs, while addressing resilience investments through a separate track that uses climate change vulnerability studies and predictive models.[5] Massachusetts is updating its service quality guidelines and explicitly distinguishing between blue-sky reliability and resilience. The Massachusetts Department of Public Utilities' proposed reporting framework calls for SAIFI, SAIDI, CAIDI, and CAIFI to be reported in three categories: blue-sky, all-in (inclusive of major events), and MEDs. This structure is intended to support evaluation of day-to-day reliability and storm-event performance within a single reporting framework, using separate data sets.[6]

A 2025 EPRI study evaluated fifteen metrics for their ability to track distribution resilience improvements from climate adaptation investments.[7] EPRI organized the metrics into three categories (scale, duration, and response), with CELID in the duration category alongside SAIDI, CAIDI, and customer minutes of interruption (CMI). Using a simulated 1-in-25-year wind event as a case study, EPRI tested each metric before and after a system hardening project was applied. In EPRI's case study, CELID tracked changes in the number of customers experiencing long outages before and after the hardening project. The study also found that a range of threshold values offered more insight than a single threshold.

The important distinction is that EPRI used CELID to measure change associated with a resilience event, the kind of event that IEEE 1366 would classify as a MED. This represents a different application of the same metric. When CELID is applied to event-level data from major storms, it can serve as a tool for evaluating how effectively resilience investments have reduced the duration tail for the most severely affected customers.

CEMI and CELID are well suited for identifying persistently poor customer experience under normal operating conditions. CELID may also provide additional insight when applied within reporting frameworks that incorporate MEDs and "all-in" metrics to assess resilience. A clear understanding of what these metrics measure, and what they do not, is essential to evaluating the practical benefits they offer utilities and regulators.

3. Value and Practical Applications

3.1 Implications of System-Average Metrics for Reliability Assessment

System-average metrics such as SAIFI and SAIDI are the industry-standard approach to reporting distribution system reliability. These metrics are widely measured and reported, and they are well understood by regulators and utility management. Because they are averages, system-level indices may not fully reflect localized reliability challenges: long rural feeders, areas with heavy vegetation, or infrastructure exposed to high winds, storm surge, or other hazards.

Many utilities address this gap through "worst-performing circuit" programs that identify circuits with the highest frequency and duration of outages. These programs target underperforming infrastructure even when average system performance may be improving. However, the worst-performing circuit approach still operates at the circuit level. A circuit that does not appear on the worst-performing list can still serve customers who are experiencing undesirable outage frequency or duration, so long as the circuit's average performance remains desirable.

CEMI and CELID address this gap by changing the unit of measurement from system or circuit performance to the reliability of individual customers experience relative to defined thresholds. As a result, these metrics can reveal persistent reliability issues among subsets of customers even when system averages improve, contributing to a more complete reporting framework. In its most recent annual reliability report, Southern California Edison stated that it began evaluating CEMI and CELID in 2025, noting that the metrics "provide a constructive view of reliability impacts at the customer level and serve as a complement to the traditional SAIDI and SAIFI indices."[8]

3.2 Investment Targeting Under Customer-Focused Metrics

Affordability has become a critical constraint in utility capital planning. The focus on reducing rate increases is intensifying, particularly in states where electricity prices are already high. At the same time, aging infrastructure, grid resilience, and electrification are competing for limited capital budgets. When capital is constrained, the metrics used to prioritize investments influence both what infrastructure is built and how the benefits are distributed.

System-average metrics can exert a significant influence on that allocation. Because SAIFI and SAIDI are calculated across all customers served, the greatest improvement in these metrics can often be achieved in areas serving the most customers, where reliability may already be adequate. Because system-average indices are customer-weighted, they can create an incentive to prioritize investments where they move the average most, potentially leaving some lower-density areas with persistent issues unless complemented by customer-focused measures.

Customer-focused metrics like CEMI and CELID address this dynamic by changing the focus of what the metrics are designed to optimize. Rather than measuring system-wide averages, these metrics identify the portion of customers exceeding a defined outage threshold, revealing where reliability falls short of a desirable standard. Industry practitioners have observed that targeted investments at the feeder level consistently deliver greater reliability improvement per dollar than large blanket distribution projects. In Florida, FPL has used CEMI-3 to identify areas where distribution automation can reduce the number of customers experiencing multiple outages in a year. Over a six-year period, FPL's CEMI-3 dropped from over 5% in 2014 to 3% by 2020, a measurable outcome driven by a metric that directed investment to where it was needed most.[9]

3.3 Insights Into Customer Experience

SAIFI is designed to answer one question: how many outages does the average customer experience in a year? That is useful for tracking system performance, but it cannot reveal what is happening to customers who experience outages well above that average. A utility can report a stable or improving SAIFI while a subset of its customers endures repeated interruptions, and the metric will not register the difference.

Research by CEA Analytics has identified a nonlinear relationship between outage frequency and customer satisfaction.[10] Dissatisfaction does not increase proportionally with each additional outage; instead, it is triggered when the number of outages a customer experiences exceeds a threshold. Where SAIFI aggregates outage experiences across customers, CEMI differentiates among customers based on whether their outage experience exceeds a defined threshold.

3.4 Relationship to Worst-Performing Circuit Programs

Most states require utilities to identify and report on their worst-performing circuits, typically those with the highest frequency or longest duration of outages. This approach focuses attention on underperforming infrastructure and creates accountability for corrective action. Interpreting worst-performing circuit reports, however, often requires significant technical analysis and sustained engagement by commission staff. Assessing how circuits were identified, the criteria applied, the investments undertaken, and the resulting outcomes may be resource-intensive, which may limit the ongoing collaboration between utilities and regulators on reliability improvement efforts.

Customer-focused metrics offer a different kind of oversight tool. CEMI and CELID offer standardized, year-over-year indicators that regulators can monitor consistently across reporting periods. A commission can observe whether the percentage of customers experiencing more than a given number of outages is declining, or whether the share of customers enduring extended interruptions is improving, and draw meaningful conclusions about whether reliability programs are reaching the customers who need them most, without auditing the engineering details of each project.

This does not mean customer-focused metrics should replace worst-performing circuit programs. The two approaches operate at different levels and serve complementary purposes. Worst-performing circuit analysis remains a core component of reliability engineering. Customer-focused metrics give regulators and utility executives a way to connect those targeted reliability programs to their desired outcome: improved customer experience. Connecticut has formalized this relationship, structuring its reliability framework so that customer-centric metrics drive Tier 1 investment priorities while a redesigned worst-performing circuit program addresses Tier 2 needs.[11] That model treats the two approaches as complementary layers rather than alternatives.

"Targeted investments at the feeder level consistently deliver greater reliability improvement per dollar than large blanket distribution projects."

4. Adoption and Use

w4.1 Current State of Reliability Reporting

Regulatory requirements, annual utility filings, and benchmarking surveys across North America and internationally rely on SAIDI and SAIFI as the foundation of distribution reliability reporting. These metrics provide a common reference point for assessing overall system performance, and their continued use reflects both their long history and their relative simplicity.

Industry experience has also demonstrated the limitations of relying on system averages alone. Utilities and regulators have repeatedly observed that customers served by long feeders, heavily vegetated areas, or infrastructure exposed to frequent storm impacts can experience substantially worse service than system-average metrics suggest. In response, customer-focused metrics have emerged as supplements to traditional reporting, intended to reveal reliability outcomes that system averages can obscure.

This shift has been enabled by improved data availability. Advances in outage management systems (OMS) and customer information systems (CIS) have made it possible to track interruptions at the individual customer level with sufficient consistency and scale. As a result, metrics such as CEMI and CELID have moved from conceptual tools to practical reporting measures, supporting a layered reporting framework in which system averages provide context and customer-focused metrics describe how reliability performance is distributed across customers.

4.2 Jurisdictional Adoption of Customer-Focused

Customer-focused metrics are most often adopted where regulators have worked closely with utilities to address underperforming portions of the distribution system, or where customer equity is a central concern. Some states have added these metrics to general reporting requirements for all regulated electric utilities. Others have incorporated reporting requirements as part of individual regulatory proceedings such as rate cases. Table 1 summarizes the reporting of customer-focused reliability metrics by state and province.

Table 1. Summary of customer-focused reliability metrics reporting by state and Canadian province.

State/Province	CEMI	CELID	CAIFI	Notes
California	Voluntary	Voluntary		SCE evaluating CEMI-5 and CELID-4
Colorado	Required	Required		PSCo of CO, CEMI-6 and CELID-18
Connecticut	Required	Required		CEMI-3 to 10 and CELID-8
D.C.	Required			CEMI-3
Delaware	Required	Required		CEMI-8 and CELID-8
Florida	Required			CEMI-5
Illinois	Voluntary	Voluntary	Required	ComEd and Ameren Illinois address CEMI and CELID in Integrated Grid Plans
Maryland	Required			CEMI-2, 4, 6, 8
Massachusetts	Required	Required		
Michigan	Required	Required		CEMI-0 to 10+ and CELID-8, 24, 48
Minnesota	Required	Required		Minnesota Power reports
Missouri			Required	
New Mexico		Required		CELID-12 and 24
South Carolina	Required	Required		Duke Energy Carolinas in SC, CEMI-4, 8, and CELID-6
Washington	Required		Required	Avista, CEMI-0, 3, Max, CAIFI by feeder type
British Columbia	Required			

As shown in Table 1, most states that report CEMI also report CELID, although D.C. and Maryland require only CEMI. CAIFI reporting is rare, with only Illinois, Missouri, and Washington utilities reporting it.[12, 13, 14]

Across jurisdictions, CEMI thresholds typically range from three to eight interruptions per year; CELID thresholds typically range from four to eight hours, though longer durations are also used.

International experience follows a comparable pattern. Regulators in Europe and Australia have employed customer-specific reliability measures to complement system-average indices, particularly where minimum service standards or repeated-outage concerns are central to oversight.[15, 16] Across jurisdictions, thresholds and terminology vary, but the underlying objective is consistent: identifying the share of customers whose service falls below an desirable reliability standard.

4.3 Impacts on Utility and Regulatory Practice

Incorporating customer-focused metrics into reporting supports two distinct outcomes: a more targeted operational screening tool for utilities, and a more tractable oversight mechanism for regulators.

For utilities, CEMI and CELID results provide a customer-level cross-check on circuit performance. Rather than relying solely on circuit rankings (which aggregate outage experience across all customers on a feeder), utilities can use customer-focused metrics to identify specific locations where service has been persistently poor. JEA, the public utility serving Jacksonville, Florida, has used CEMI-5 since 2014 to identify customers experiencing six or more sustained outages in the preceding twelve months, then dispatched crews to those locations for targeted interventions: tree trimming, pole replacement, equipment upgrades, and transformer inspection.[17] As CEMI-5 results improved over time, JEA tightened its standard further, implementing a CEMI-4 process to continue surfacing customers with recurring service problems. The utility reports that this approach has produced significant reductions in outage frequency over the past decade and contributed to national recognition for reliability performance.

"Customer-focused metrics have moved from conceptual tools to practical reporting measures."

For regulators, standardized customer-focused metrics offer something that worst-performing circuit programs do not: a standardized outcome measure that reduces dependence on the specific circuit-ranking methods utilities may use. Worst-performing circuit programs require regulators to evaluate how a utility selects and ranks circuits, criteria that are internally defined, technically complex, and difficult to compare across filings. CEMI and CELID report a straightforward result: the share of customers experiencing more than a defined number of interruptions or hours of outage in a year. Tracked over time, that result tells regulators whether conditions for the worst-served customers are improving, holding steady, or deteriorating, without requiring regulators to reconstruct the utility's analytical process.

Neither outcome requires replacing existing tools. Utilities that report CEMI and CELID continue to rely on system- and circuit-level metrics for vegetation management, asset condition programs, and worst-performing circuit analysis. Customer-focused metrics function as a cross-check on those programs: they confirm whether improvements reflected in system averages are reaching the customers who have historically experienced the poorest service, or whether performance gains are concentrated elsewhere in the system. Early experience from adopters suggests these metrics can be implemented in a practical way and can provide useful additional insight.

5. Practical Implementation

5.1 Initial Implementation Considerations

The first step is tracking. Utilities and regulators should adopt CEMI and CELID as tracked metrics before considering benchmarks, targets, or performance incentive mechanisms. The effort and associated costs of data collection, analysis, and reporting will vary depending on each utility's situation. Each utility can assess how tracking and reporting new metrics might affect ongoing operations and resource requirements. Understanding how these metrics enhance the reliability picture will inform subsequent decisions about reporting requirements and connections to related programs.

Both metrics include a threshold that determines the frequency and duration of the outages under consideration. Selecting the appropriate thresholds has implications for any subsequent use of the metrics in system improvement investments and performance incentives. The threshold has the potential to influence decision-making near the cutoff point rather than focusing on the tail of the distribution. Gaining experience with tracking and reporting will help utilities and regulators design targets that drive the desired outcomes.

Regulatory proceedings in Massachusetts illustrate the value of starting with tracking. More than ten years ago, the Massachusetts utilities and Department of Public Utilities recognized that CEMI and CELID held value for measuring service quality as experienced by customers, but determined that they should be "reporting-only" metrics.[18] A decade later, utilities and regulators agree that CEMI and CELID should now be formally reported on an annual basis, with continued measurement of circuit performance.[19] Utilities have expressed interest in evaluating whether customer-focused metrics can drive more efficient targeting of reliability investment. Collecting and analyzing data for these metrics will continue to improve with the deployment of advanced metering infrastructure (AMI).

Once reporting is underway, the next implementation decision is how to set the thresholds that define what these metrics measure.

5.2 Threshold Selection Considerations

Threshold selection determines which customers the metric makes visible and influences how investments are prioritized. The appropriate threshold depends on each utility's service territory and current reliability distribution. As Table 1 shows, jurisdictions that have adopted CEMI use thresholds ranging from zero (Michigan) to eight (Delaware). CELID thresholds range from four hours to twenty-four. That variation reflects differences in what each jurisdiction determined to be the relevant standard.

Factors that bear on the decision include customer satisfaction and complaint data, historical outage distributions across the service territory, peer utility practices, and the potential effect on investments to reduce the number of customers above the threshold. These metrics will not register improvements that do not move customers across the threshold. A reduction from ten outages to five leaves CEMI-4 unchanged. The threshold focuses attention squarely on the boundary between desirable and undesirable service.

A straightforward approach is to start with a single threshold based on existing data and expand to multi-threshold reporting as experience grows. A broader approach could include reporting across a range of thresholds rather than at a single value. Connecticut's 2022 Decision requires utilities to track customer-focused metrics in tranches: for customers experiencing three or more, five or more, seven or more, and nine or more sustained interruptions.[20] Using multiple thresholds acknowledges differences within a utility's customer base and service territory, and supports more robust prioritization of investments.

"Understanding how these metrics enhance the reliability picture will inform subsequent decisions about reporting requirements and connections to related programs."

5.3 Data and Systems Requirements

System-average metrics can be calculated from outage event records that estimate the number of customers downstream of a protective device. CEMI and CELID require a more granular approach: tracking which specific customers were interrupted, how many times, and for how long. That identifying information must be retained over the full reporting year to calculate the metrics. This connection between outage data and individual customer records may represent a gap for some utilities.

Utilities need to ensure that their existing operational systems can link outage records to individual customer accounts. Smart meters record when each customer loses and regains power. A geographic information system maps customers to the feeders and equipment that serve them. An outage management system validates those interruptions against other monitoring data. When these systems are integrated with the customer information system, each outage can be assigned to the affected accounts with the record preserved. That makes it possible to identify which customers exceeded a CEMI or CELID threshold and trace the contributing events back to specific distribution system elements.

5.4 Integration With Existing Reliability Programs

CEMI and CELID function as a reporting layer that connects existing reliability programs to customer outcomes.

Worst-performing circuit programs typically identify problem areas using SAIDI, SAIFI, or related circuit-level metrics (CKAIDI or CKAIFI). As described earlier, CEMI and CELID identify customers, not circuits. A utility can use CEMI to find customers experiencing repeated outages on circuits that may not appear on the worst-performing list, even if the circuit's average performance is desirable. It can use CELID to find customers with long cumulative outage durations that may be masked by average metrics. Connecticut formalized this in its 2022 Reliability Framework, directing utilities to use customer-focused metrics to identify Tier 1 investment priorities while a redesigned worst-performing circuit program addresses Tier 2 needs.

In Massachusetts, utilities noted potential overlap between CEMI/CELID and existing circuit-level metrics (CKAIFI and CKAIDI), both aimed at identifying poor-performing areas.[21, 22] Some utilities expressed an intention to evaluate whether the two sets of metrics identify the same circuits and zones. This further underscores the value of gaining experience with reporting before setting targets.

Annual reliability reports that include CEMI and CELID should cross-reference reliability improvement programs to compare trends with threshold levels. A declining CEMI-4 coupled with a stable or improving SAIFI could indicate that reliability programs are reaching the customers who need them most. A stable CEMI-4 alongside an improving SAIFI could mean that system-average gains are concentrated elsewhere while persistently underperforming areas remain. Both insights are valuable, and neither is available from system-average metrics alone.

The result is a layered reporting structure: system-average metrics provide context, circuit-level metrics guide engineering priorities, and customer-focused metrics confirm whether improvements are reaching the worst-served customers. Utilities and regulators that adopt this structure can move from tracking overall performance to also monitoring outcomes for customers experiencing the poorest reliability.

Conclusion

System-average metrics provide an effective measure of overall system performance, but they do not reveal whether reliability improvements are experienced consistently across all customers. Customer-focused metrics such as CEMI and CELID address this limitation by identifying the portion of customers whose service experience exceeds defined thresholds. Approximately fifteen U.S. jurisdictions and British Columbia now require some form of customer-focused metric reporting, and adoption continues to expand. These metrics are not intended to replace existing reporting frameworks; rather, they supplement standard system-average measures by strengthening the connection between reliability investments and customer outcomes. Their adoption supports more targeted oversight and provides utilities and regulators with a clearer basis for assessing reliability performance. Implementation can proceed incrementally, beginning with tracking and reporting, with consideration of targets or incentives informed over time by experience with the data.

Concentric Energy Advisors was founded over two decades ago, and many of our team members have been forging paths together since the 1980s. Throughout this time, we have remained both passionate about and deeply committed to serving the energy industry.

We take great pride in leading a dedicated team of professionals who are bright, energetic, and possess an insatiable thirst for knowledge, along with an unwavering work ethic. A defining characteristic of Concentric is the collective willingness of our entire team, from the Chairman of the Board to the newest hire, to roll up their sleeves, engage deeply with their work, and deliver impactful results.

Our commitment to continuous learning is embodied in our labyrinth, where we continuously reflect on challenges, discover solutions, apply them strategically, and repeat this process to enhance the value we provide to our clients. This cycle—navigating the path, generating solutions, delivering value, and repeating the process— captures our team's commitment to service excellence and continuous improvement.

Information about Concentric Energy Advisors is available at www.ceadvisors.com.

Endnotes

1 IEEE Std 1366-2022 IEEE Guide for Electric Power Distribution Reliability Indices. Definitions are provided in Sections 3 and 4.

2 United States Energy Information Administration, Form EIA-861, Annual Electric Power Industry Report.

3 IEEE Std 1366-2022.

4 IEEE Std 1366-2022 defines a "Major Event" as an event that exceeds reasonable design and/or operational limits of the electric power system. A "Major Event Day" is a day in which the daily system SAIDI exceeds a threshold value. Detailed definitions can be found in Section 3 of the standard.

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10 Canadian Electricity Association, CEA Analytics, CAIFI and CEMI Reporting, 2013.

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12 Public Service Company of Colorado, 2024 Annual Quality of Service Report (April 1, 2025). Note that PSCo reports Customers Experiencing Long Interruptions (CELI) rather than CELID.

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14 For calendar years 2022–2024, Avista reported electric reliability metrics as part of a set of 92 metrics across multiple categories in a Performance Based Ratemaking framework.

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19 Joint Reply Comments of the Utilities, D.P.U. 24-53, p. 3 (October 18, 2024).

20 Connecticut PURA, 17-12-03RE08.

21 Massachusetts D.P.U. 24-53, Joint Initial Comments of National Grid, Unitil, and Liberty, p. 6 (September 18, 2024).

22 Massachusetts D.P.U. 24-53, Eversource Energy Initial Comments, p. 5 (September 18, 2024).