GMAC MEETING BACKGROUND:

ELECTRICITY DISTRIBUTION RELIABILITY

GMAC
Grid Modernization Advisory Council

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WHAT IS ELECTRIC SYSTEM RELIABILITY?

Electric distribution companies (EDCs) build, maintain, and operate the electric grid and are charged with providing reliable electric service to all customers. In other words, EDCs are responsible for preventing power outages and "keeping the lights on." Power outages can be caused by many factors, such as fallen trees, extreme weather, equipment failure, or planned outages.

RELIABILITY VERSUS RESILIENCY

Reliability is defined as the ability to consistently provide electric service to customers under normal operating conditions. In contrast, resiliency is defined by how well the grid can handle and recover from unexpected challenges, such as hurricanes, wildfires, or cyber-attacks. This topic brief focuses on reliability; a future topic brief will focus on resiliency.

MEASURING RELIABILITY

Two industry standard measurements of electric reliability are System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI). These metrics can be measured for an entire utility system or on a smaller scale. Additionally, these metrics are often reported on a monthly or annual basis but can cover other time periods.

SYSTEM AVERAGE INTERRUPTION DURATION INDEX (SAIDI)

SAIDI measures the total number of minutes of interruption that an average customer experiences during a specified period. A higher SAIDI indicates worse reliability. SAIDI is defined as:

$$SAIDI = \frac{\sum Customer\ Minutes\ of\ Interruption}{Total\ Number\ of\ Customers\ Served}$$

SYSTEM AVERAGE INTERRUPTION FREQUENCY INDEX (SAIFI)

SAIFI measures how frequently an average customer is interrupted during a specified period. A higher SAIFI indicates worse reliability. SAIFI is defined as:

$$SAIFI = \frac{\sum Total\ Number\ of\ Customers\ Interrupted}{Total\ Number\ of\ Customers\ Served}$$

Event Exclusions

- Outages due to major event days, i.e., days in which the outage duration was significantly higher than usual, are generally excluded from EDC reliability metric calculations
- Major event days are often due to extreme events such as a hurricane or wildfire.
- Generation and transmission-related outages are also generally excluded from reliability metric calculations.

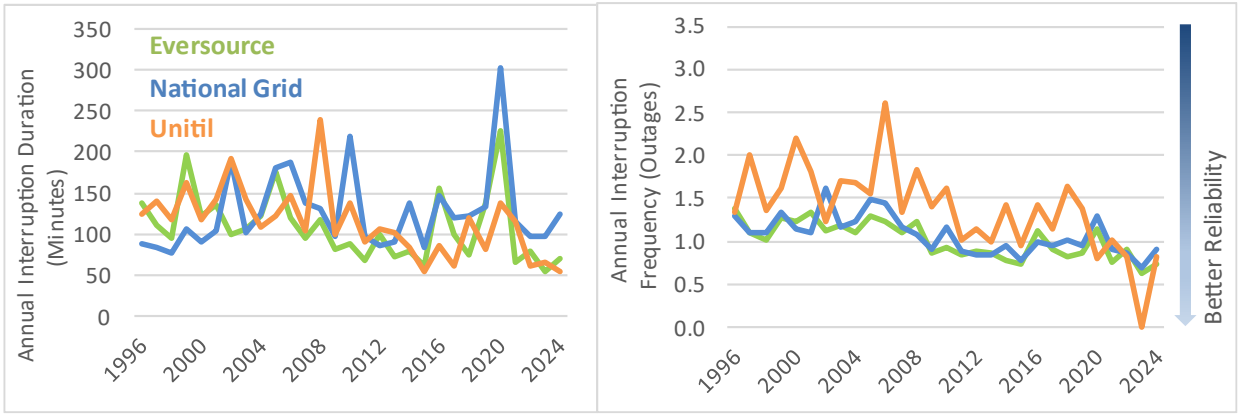
OTHER RELIABILITY METRICS

Other common reliability metrics include customer average interruption duration index (CAIDI), which measures the average time to restore service to an average customer for a typical outage, and momentary average interruption frequency index (MAIFI), which measures the average frequency of momentary (i.e., brief) outages experienced by an average customer.

MASSACHUSETTS EDC HISTORICAL SYSTEM RELIABILITY

Massachusetts Electric Distribution Companies (EDCs) must meet annual service quality standards established by the Department of Public Utilities. If the EDCs fail to meet the standards, they are subject to a penalty. The EDCs report on system reliability in annual service quality reports. The figure below displays annual EDC system SAIDI and SAIFI since 1996. Lower values indicate better reliability.

Historical EDC Annual System SAIDI (Left) and SAIFI (Right) Performance

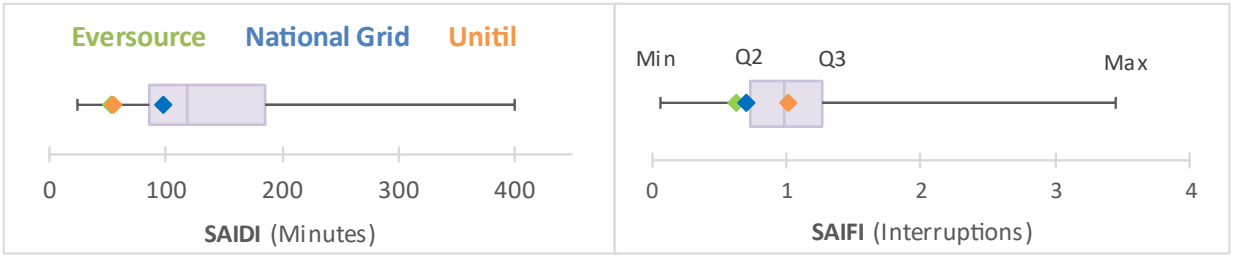


Data Source: *2024 Annual Service Quality Report Year Ending, D.P.U. 25-SQ-10/11/13*

COMPARISON OF EDC RELIABILITY TO NATIONAL UTILITY PERFORMANCE

The Institute of Electrical and Electronics Engineers (IEEE) conducts an annual benchmark survey of key reliability metrics. The 2023 results include data from 73 distribution companies. As shown in the figures below, Eversource, National Grid and Unitil are among the top performing utilities for SAIDI and SAIFI.

2023 EDC Performance Compared to 2023 IEEE Reliability Benchmark Results



Note: Eversource SAIDI overlaps with Unitil marker. Data Sources: *IEEE Benchmark* Survey Results: https://cmte.ieee.org/pes-drwg/benchmarking/; EDC 2023 Performance data: *2024 Annual Service Quality Report Year Ending, D.P.U. 25-SQ-10/11/13.*

ENSURING AND PLANNING FOR RELIABILITY

EDCs ensure current and future system reliability through routine system monitoring and maintenance activities, planning, and infrastructure investment.

On a day-to-day basis, EDCs conduct vegetation management activities, such as tree trimming, to prevent outages. They also conduct inspections and routine maintenance of infrastructure such as power lines and substations and continuously collect data and monitor the performance of the grid.

EDCs also plan for future reliability needs, and consider anticipated changes in the number, types, and location of customers over the next ten years. They use these forecasts and other planning inputs to anticipate what future investments such as substations, transformers, and circuit breakers, will be needed to ensure reliability.