Shakopee Public Utilities Commission

2023 ANNUAL BENCHMARKING REPORT

eRELIABILITY TRACKER

DEED PUBLIC POWER RESEARCH & DEVELOPMENT
American Public Power Association

AMERICAN PUBLIC POWER ASSOCIATION
Powering Strong Communities

I. About This Report

This report focuses on distribution system reliability across the country and is customized to each utility that participates in the American Public Power Association's eReliability Tracker service. APPA created the eReliability Tracker Annual Report to assist utilities in their efforts to understand and analyze their electric system. In 2012, APPA developed the eReliability Tracker thanks to a grant from the Demonstration of Energy & Efficiency Developments (DEED) program.

This report reflects data in the eReliability Tracker from January 1, 2023 to December 31, 2023. This analysis might not properly reflect your utility's statistics if you do not have a full year of data in the system. The report includes data recorded as of March 15, 2024.

Reliability reflects both historic and ongoing engineering investment decisions within a utility. Proper use of reliability metrics ensures that a utility is performing its intended function and is providing service in a consistent and effective manner.

While the primary use of reliability statistics is for self-evaluation, you can use these statistics to compare your utility with similar utilities. However, differences such as electrical network configuration, ambient environment, weather conditions, and number of customers served typically limit most utility-to-utility comparisons. Due to the diverse range of utilities that use the eReliability Tracker, this report endeavors to improve comparative analyses by grouping utilities by size and region.

Since this report contains data for all utilities that use the eReliability Tracker, it is important to consider how a particularly large or small utility can affect comparative benchmarks. To ease the issues associated with comparability, each utility's reliability statistics are weighted based on customer count when aggregated. This means that all utilities are equally weighted, and all individual statistics are developed on a per customer basis.

The aggregate statistics in this report are calculated from the 324 utilities with verified 2023 outage data. Utilities that experienced no outages in 2023, or did not upload any data, will have NULL, None, or "0" values in their report for utility-specific data and were not included in the aggregate analysis. Also note that log-normal data with a z-score[1] greater than 3.25 may be excluded if it significantly distorts the aggregate statistics.

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1. A z-score indicates how much a data point differs from the mean. For instance, a z-score of 3.25 indicates that the data point is three and one-quarter standard deviations from the mean. A z-score of 0 indicates that the data point is identical to the mean.

Utility Classifications

This report separates utilities into groups according to geographic region and the number of customers served. Table 1 shows the range of customer counts for utilities that use the eReliability Tracker by five distinct groups of approximately 105 utilities per group.

Your utility is in size class 5 and region 3.

Table 1. Customer count range per size class

	Customer Count Range
Class 1	[0, 1518)
Class 2	[1518, 3480)
Class 3	[3480, 7325)
Class 4	[7325, 14489)
Class 5	[14489, 503649)

Each utility is also grouped with all other participating utilities within their region. Figure 1 shows the number of utilities using the eReliability Tracker in each region and Figure 2 shows the states and territories included in each region.

Figure 1. Number of utilities subscribed to the eReliability Tracker by region

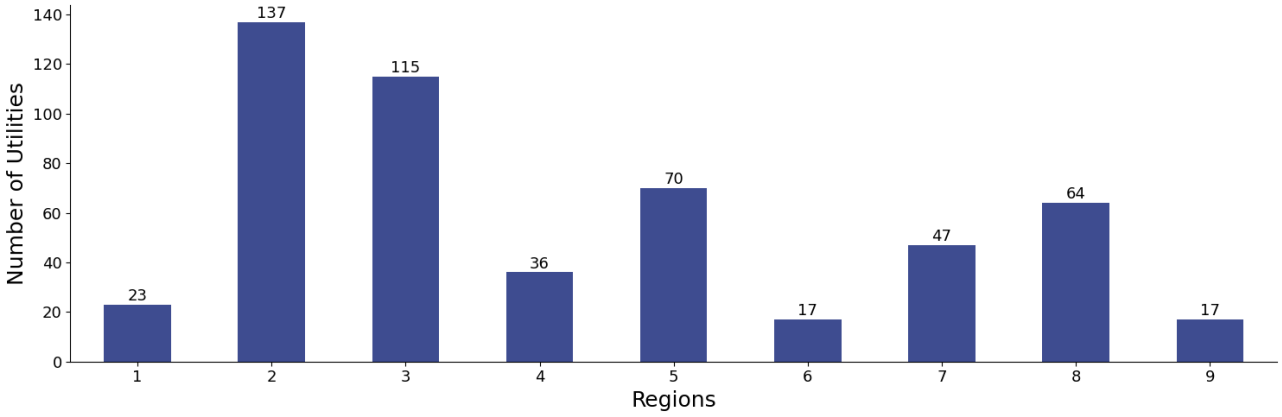
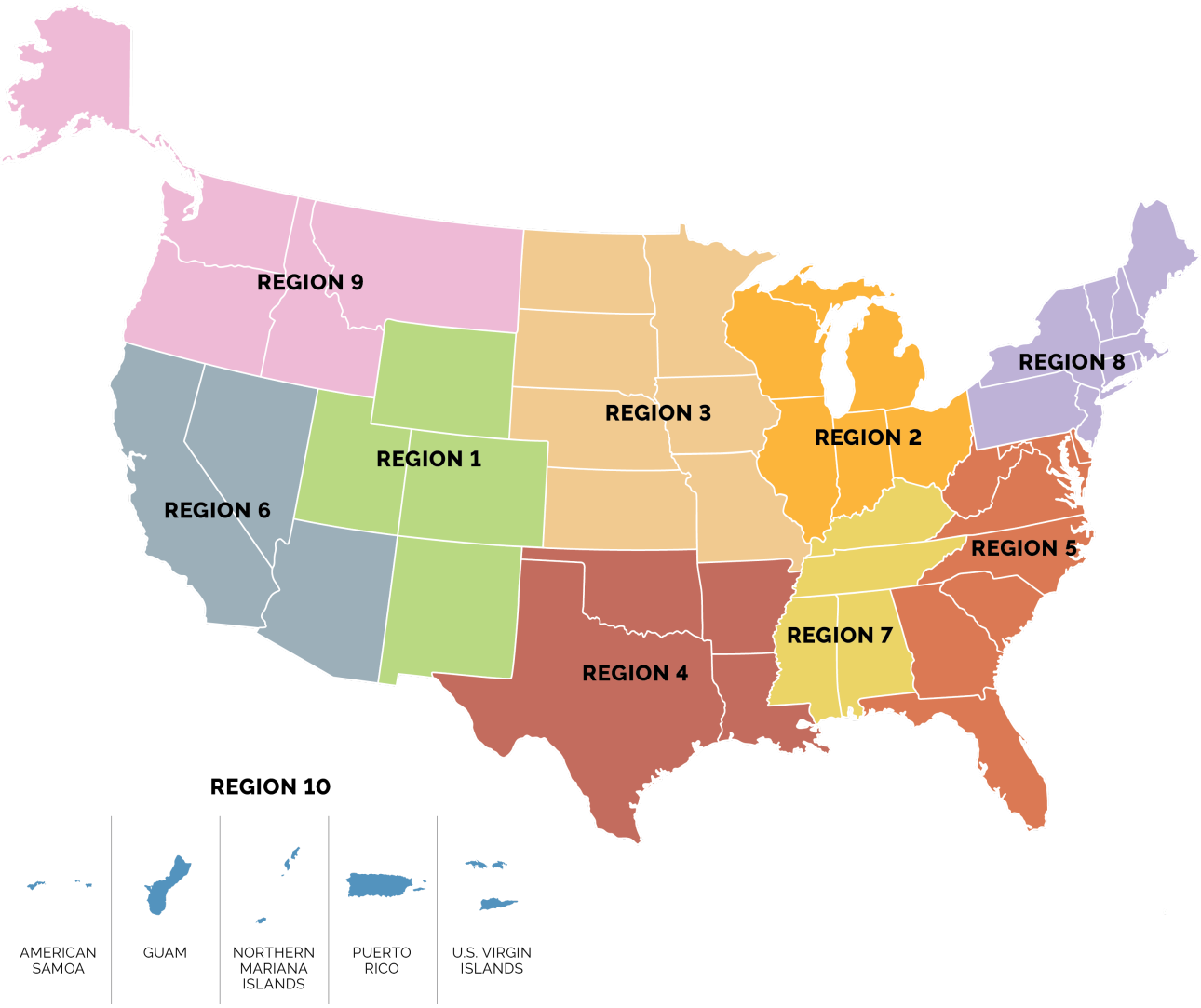


Figure 2. Regions



II. IEEE Statistics

When it comes to reliability, the industry standard metrics are defined in the Institute for Electrical and Electronics Engineers' Guide for Electric Power Distribution Reliability Indices, or IEEE 1366 guidelines. For each utility, the eReliability Tracker performs IEEE 1366 calculations for System Average Interruption Duration Index (SAIDI), System Average Interruption Frequency Index (SAIFI), Customer Average Interruption Duration Index (CAIDI), Momentary Average Interruption Frequency Index (MAIFI) and Average Service Availability Index (ASAI).

It is important to note how major events (MEs) are calculated and used in this report. An example of a ME includes severe weather, such as a tornado or hurricane, that leads to unusually long outages in comparison to your distribution system's typical outage. This report uses the **APPA ME threshold**, which is based directly on the SAIDI for specific outage events, rather than a daily SAIDI. The APPA ME threshold allows a utility to remove outages that exceed the IEEE 2.5 beta threshold for outage events, which considers up to 10 years of the utility's outage history. In the eReliability Tracker, if a utility does not have at least 36 outage events prior to the year being analyzed, then no threshold is calculated. If this is the case for your utility, then you will have a NULL value in the following field and the calculations without MEs in the SAIDI, SAIFI, CAIDI, and ASAI sections of this report will be the same as the calculations with MEs for your utility. More outage history will provide a better threshold for your utility.

Your utility's APPA major event threshold is 4.45 minutes.

For each of the reliability indices, this report displays your utility's metrics alongside the mean values for all utilities using the eReliability Tracker and within the same class and region as your utility. The first table within each of the following subsections allows you to better understand the performance of your electric system relative to other utilities nationwide and to those within your same region or size class. The second table breaks down the national data into quartile ranges, a minimum value, and a maximum value.

All indices, except MAIFI, are calculated for outages with and without MEs. Furthermore, the tables show indices for scheduled and unscheduled outages. Note that scheduled and unscheduled calculations include MEs. Also note that wherever MEs are excluded, the exclusion is based on the APPA ME threshold for your system.

II.1. System Average Interruption Duration Index

SAIDI is the average duration (in minutes) of an interruption per customer served by the utility during a specific time frame.

Since SAIDI is a sustained interruption index, only outages lasting longer than five minutes are included in the calculations. SAIDI is calculated by dividing the sum of all customer minutes of interruption[1] within the specified time frame by the average number of customers served during that period. For example, a utility with 100 customer minutes of interruption and 100 customers would have a SAIDI of 1.

Note that in the tables below, scheduled and unscheduled calculations include MEs. Also note that wherever MEs are excluded, the exclusion is based on the APPA ME threshold for your system.

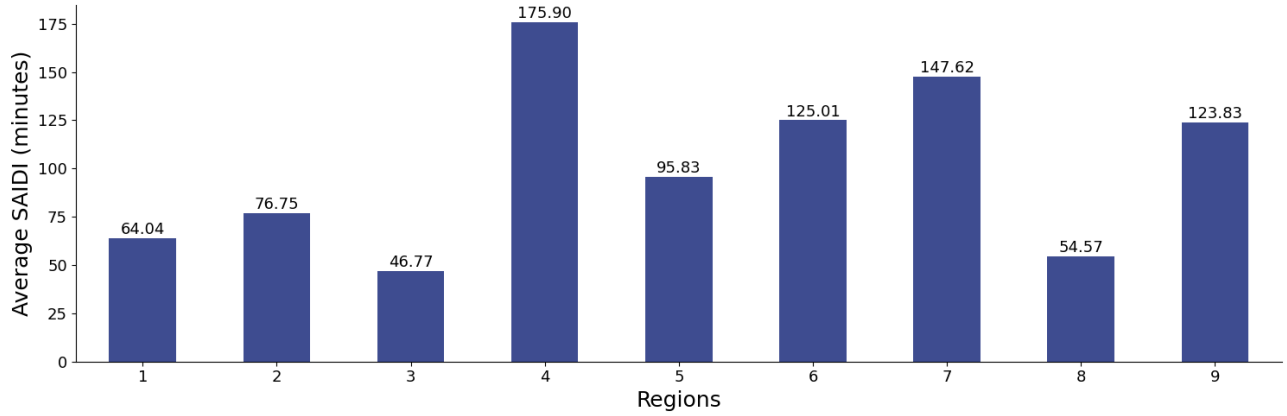
Table 2. Average SAIDI with and without MEs
In minutes

	All	No MEs	Unscheduled	Scheduled
Your utility	4.89	4.89	4.16	0.72
Utilities that use the eReliability Tracker	88.97	47	84.06	8.95
Utilities in your region	46.77	26.83	44.13	5.4
Utilities in your size class	108.95	53.57	105.81	5.33

Table 3. Summary SAIDI data from the eReliability Tracker
In minutes

	All	No MEs	Unscheduled	Scheduled
Minimum	0.2	0.04	0.04	0
First Quartile	18.2	11.89	15.9	0.19
Median	50.54	27.57	45.7	1.04
Third Quartile	111.3	58.28	106.4	4.44
Maximum	1028.99	691.25	1028.75	480.88

Figure 3. Average SAIDI by region



1. Customer minutes of interruption is calculated by multiplying total customers interrupted and total minutes of interruption.

II.2. System Average Interruption Frequency Index

SAIFI is the average instances a customer on the utility system will experience a sustained interruption during a specific time frame.

Since SAIFI is a sustained interruption index, only outages lasting longer than five minutes are included in the calculations. SAIFI is calculated by dividing the total number of customers that experienced sustained interruptions by the average number of customers served during that period. For example, a utility with 150 customer interruptions and 200 customers would have a SAIFI of 0.75.

Note that in the tables below, scheduled and unscheduled calculations include MEs. Also note that wherever MEs are excluded, the exclusion is based on the APPA ME threshold for your system.

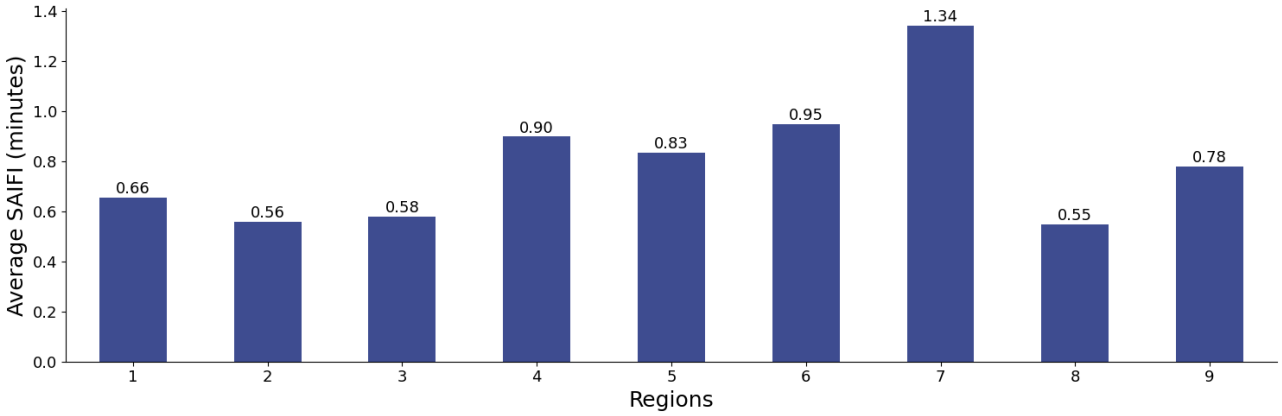
Table 4. Average SAIFI with and without MEs
In interruptions

	All	No MEs	Unscheduled	Scheduled
Your utility	0.1	0.1	0.07	0.03
Utilities that use the eReliability Tracker	0.74	0.51	0.7	0.06
Utilities in your region	0.58	0.39	0.56	0.05
Utilities in your size class	0.92	0.62	0.87	0.07

Table 5. Summary SAIFI data from the eReliability Tracker
In interruptions

	All	No MEs	Unscheduled	Scheduled
Minimum	0	0	0	0
First Quartile	0.22	0.16	0.22	0
Median	0.56	0.37	0.52	0.01
Third Quartile	1.07	0.71	1.01	0.04
Maximum	3.47	2.86	3.47	1

Figure 4. Average SAIFI by region



II.3. Customer Average Interruption Duration Index

CAIDI is the average duration (in minutes) of an interruption experienced by customers during a specific time frame.

Since CAIDI is a sustained interruption index, only outages lasting longer than five minutes are included in the calculations. CAIDI is calculated by dividing the sum of all customer minutes of interruption by the number of customers that experienced one or more interruptions during that period. This metric reflects the average customer experience (minutes of duration) during an outage.

Note that in the tables below, scheduled and unscheduled calculations include MEs. Also note that wherever MEs are excluded, the exclusion is based on the APPA ME threshold for your system.

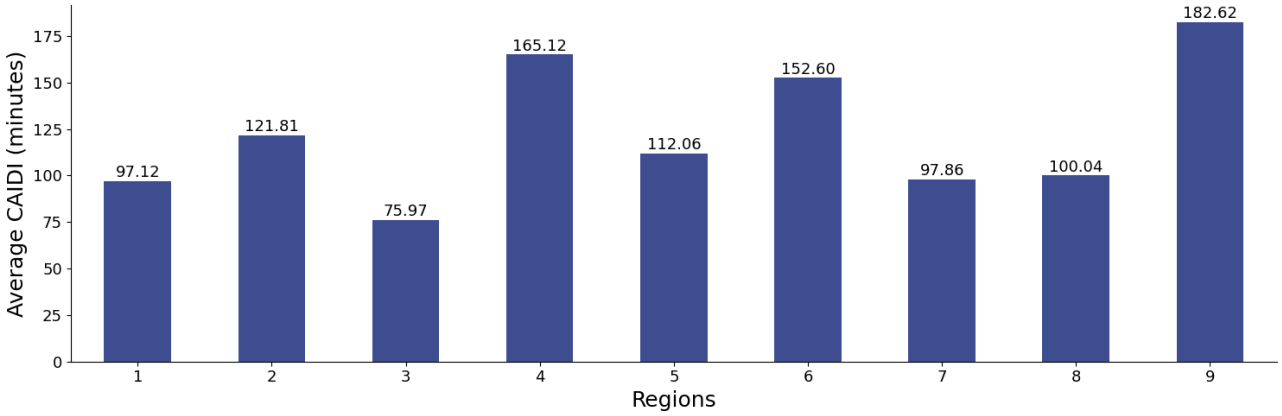
Table 6. Average CAIDI with and without MEs
In minutes

	All	No MEs	Unscheduled	Scheduled
Your utility	47.87	47.87	60.35	21.88
Utilities that use the eReliability Tracker	111.62	87.71	110.38	130.83
Utilities in your region	75.97	61.96	78.04	103.9
Utilities in your size class	108.6	81.95	107.97	132.24

Table 7. Summary CAIDI data from the eReliability Tracker
In minutes

	All	No MEs	Unscheduled	Scheduled
Minimum	15.04	13.65	14.74	6.68
First Quartile	64.3	53.52	63.02	59.83
Median	88.91	75.24	89.51	85.93
Third Quartile	130.35	106.26	129.46	140.8
Maximum	716.84	482.79	777.49	1373.7

Figure 5. Average CAIDI by region



II.4. Momentary Average Interruption Frequency Index

MAIFI is the average number of momentary interruptions a utility customer will experience during a specific time frame.

In this report, an outage with a duration of five minutes or less is classified as momentary. MAIFI is calculated by dividing the total number of customers that experienced momentary interruptions by the total number of customers served by the utility. For example, a utility with 20 momentary customer interruptions and 100 customers would have a MAIFI of 0.20.

Momentary interruptions can be more difficult to track and utilities without an automated outage management system might not log these interruptions; therefore, some utilities have a MAIFI of zero.

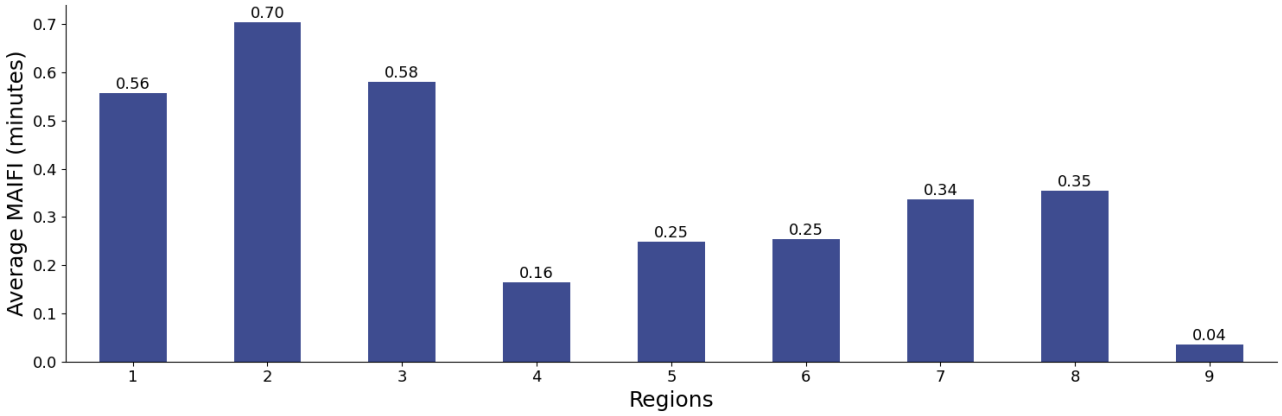
Table 8. Average MAIFI
In interruptions

	All
Your utility	0
Utilities that use the eReliability Tracker	0.41
Utilities in your region	0.58
Utilities in your size class	0.33

Table 9. Summary MAIFI data from the eReliability Tracker
In interruptions

	All
Minimum	0
First Quartile	0
Median	0.06
Third Quartile	0.43
Maximum	4.45

Figure 6. Average MAIFI by region



II.5. Average Service Availability Index

ASAI is the percentage of time the sub-transmission and distribution systems are available to serve customers during a specific time frame.

This load-based index represents the percentage availability of electric service to customers within the period analyzed. It is calculated by dividing the total hours in which service is available to customers by the total hours that service is demanded by the customers. For example, an ASAI of 99.99% means that electric service was available for 99.99% of the time during the given period. Note that the higher your ASAI value, the better the performance.

In the tables below, scheduled and unscheduled calculations include MEs. Also note that wherever MEs are excluded, the exclusion is based on the APPA ME threshold for your system.

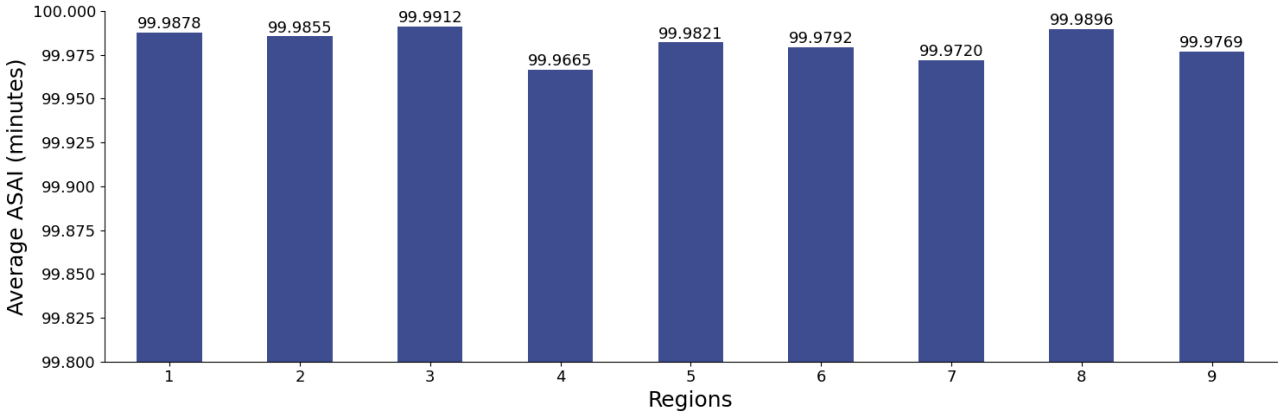
Table 10. Average ASAI with and without MEs
In percentage

	All	No MEs	Unscheduled	Scheduled
Your utility	99.999	99.999	99.9992	99.9998
Utilities that use the eReliability Tracker	99.9833	99.9912	99.9842	99.9982
Utilities in your region	99.9912	99.9949	99.9917	99.9989
Utilities in your size class	99.9797	99.99	99.9803	99.999

Table 11. Summary ASAI data from the eReliability Tracker
In percentage

	All	No MEs	Unscheduled	Scheduled
Maximum	99.9999	99.9999	99.9999	99.9999
First Quartile	99.9965	99.9977	99.9969	99.9999
Median	99.9907	99.9947	99.9916	99.9998
Third Quartile	99.979	99.989	99.9804	99.9991
Minimum	99.8042	99.8684	99.8042	99.9085

Figure 7. Average ASAI by region



II.6. Energy Information Administration Form 861 Data

Form EIA-861 collects annual information on electric power industry participants involved in the generation, transmission, distribution, and sale of electric energy in the United States and its territories.

In 2014, EIA began publishing reliability statistics in Form EIA-861; therefore, APPA included these statistics in this report for informational purposes. Please note that the following data includes 174 investor-owned, 465 rural cooperative, and 324 public power utilities that were large enough to be required to fill out the full EIA-861 form. The statistics do not include data from utilities that complete the EIA 861-S form, which smaller entities complete. Note that the 324 participating public power utilities include entities classified by EIA as municipal, political subdivision, and state. In addition, since the collection and release of EIA form data lags by a year, the data is based on 2022 data that was published October 5, 2023. Therefore, we suggest you only use the aggregate statistics contained herein as an informational tool for further comparison of reliability statistics.

In Form EIA-861, an entity provides SAIDI and SAIFI including and excluding ME days in accordance with the IEEE 1366-2003 or IEEE 1366-2012 standard.

Although EIA collected other reliability-related data, the tables below only include SAIDI and SAIFI data including and excluding ME days. You can download the full set of data at: www.eia.gov/electricity/data/eia861/.

Table 12. Your utility's SAIDI and SAIFI with and without IEEE ME days

SAIDI with IEEE ME days (minutes)	SAIDI without IEEE ME days (minutes)	SAIFI with IEEE ME days (interruptions)	SAIFI without IEEE ME days (interruptions)
4.89	4.89	0.1	0.1

Table 13. Summary SAIDI data from Form EIA-861, 2022
In minutes

	All	No MEs
Average	363.98	148.09
Minimum	0.08	0
First Quartile	79.8	54.64
Median	176.36	105.13
Third Quartile	369.21	178.96
Maximum	11949.11	1760.49

Table 14. Summary SAIFI data from Form EIA-861, 2022
In interruptions

	All	No MEs
Average	1.74	1.3
Minimum	0	0
First Quartile	0.85	0.64
Median	1.42	1.07
Third Quartile	2.25	1.66
Maximum	15.96	12.07

III. Outage Causes

Equipment failure, extreme weather events, wildlife, and vegetation are some of the most common causes of electric system outages.The following pie chart shows the percentages of the primary causes of outages for all utilities using the eReliability Tracker in 2023.

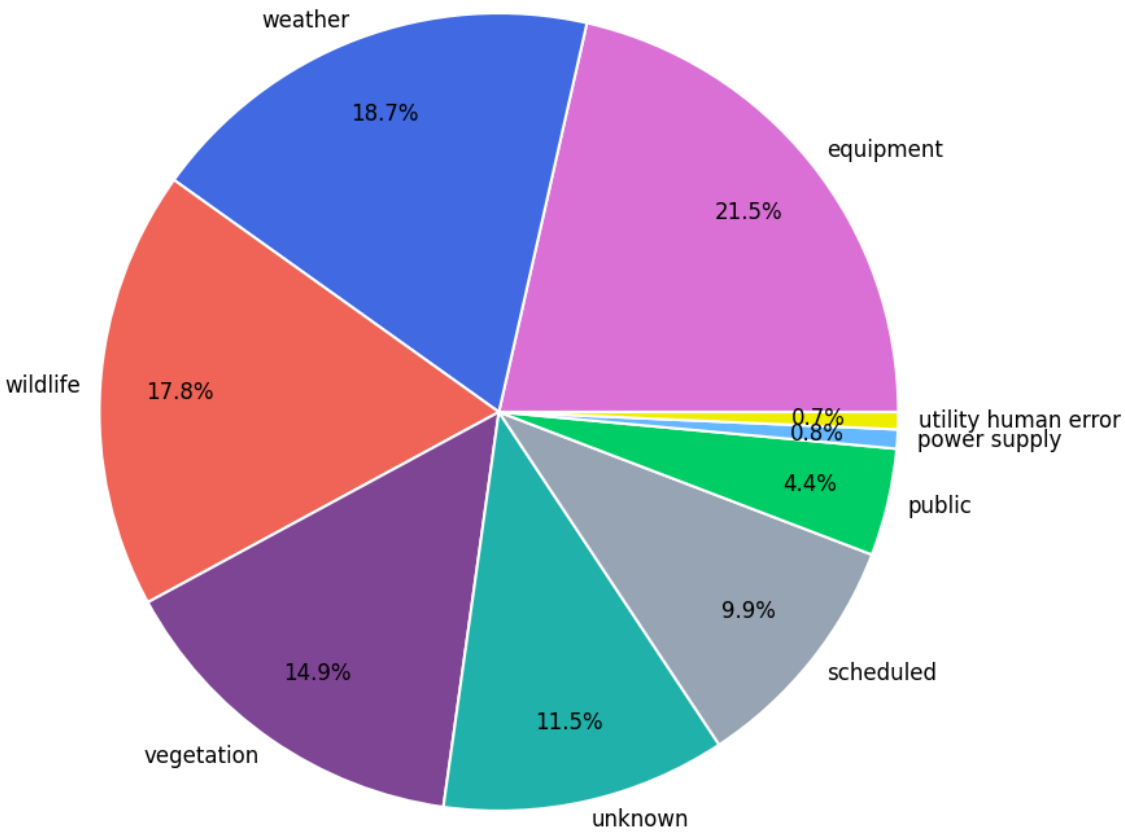


Figure 8. Primary causes of outages in 2023

Certain factors, such as regional weather and animal/vegetation patterns, can make some causes more prevalent for a specific group of utilities. The following section includes graphs depicting common causes of outages for your utility, all utilities in your region, and all utilities using the eReliability Tracker.

Charts containing aggregate information are customer-weighted to account for differences in utility size for a better analytical comparison. For example, a particularly large utility may have a large number of outages compared to a small utility. To avoid skewing the data toward large utilities, the number of cause occurrences is divided by customer size to account for the

differences. In Figures 9 to 14, the data represent the number of occurrences for each group of 1,000 customers. A customer-weighted occurrence rate of "1" means an average of one outage from that cause occurred per 1,000 customers in 2023.

Note that the sustained outage cause analysis is more comprehensive than the momentary outage cause analysis due to a larger and more robust sample size for sustained outages. Regardless, tracking both sustained and momentary outages helps utilities understand and reduce outages. To successfully use the outage information tracked by your utility, it is imperative to classify and record outages in detail. The more information provided per outage, the more conclusive and practical your analyses will be.

III.1. Sustained Outage Causes

In general, sustained outages are the most commonly tracked outage type. In analyses of sustained outages, utilities tend to exclude scheduled outages, partial power, customer-related problems, and qualifying major events from their reliability indices calculations. While this is a valid method for reporting, these outages should be included for internal review to make utility-level decisions. In this section, we evaluate common causes of sustained outages for your utility, corresponding region, and for all utilities that use the eReliability Tracker. It is important to note that sustained outages are classified in this report as outages that last longer than five minutes, as defined by IEEE 1366.

Figure 9. Top five causes of sustained outages for all utilities that use the eReliability Tracker

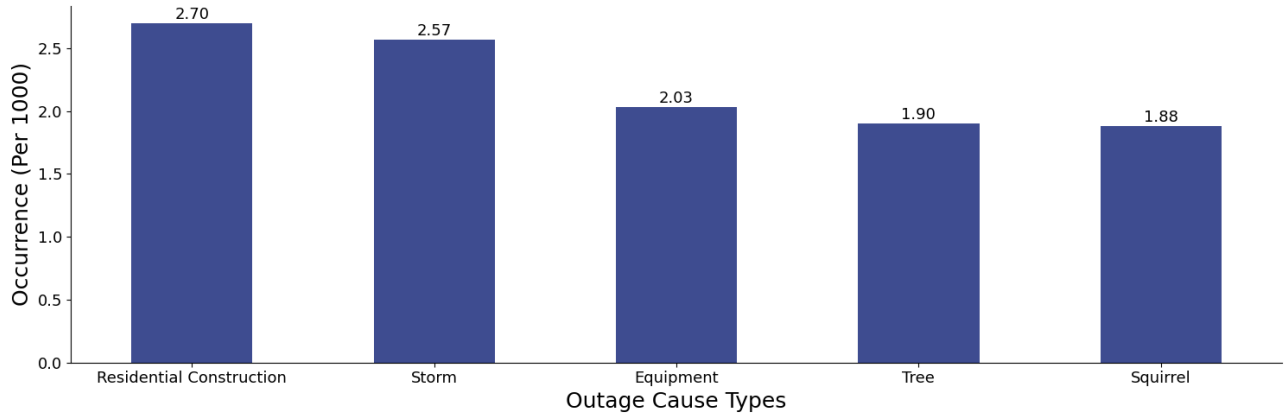


Figure 10. Top five causes of sustained outages for your utility[1]

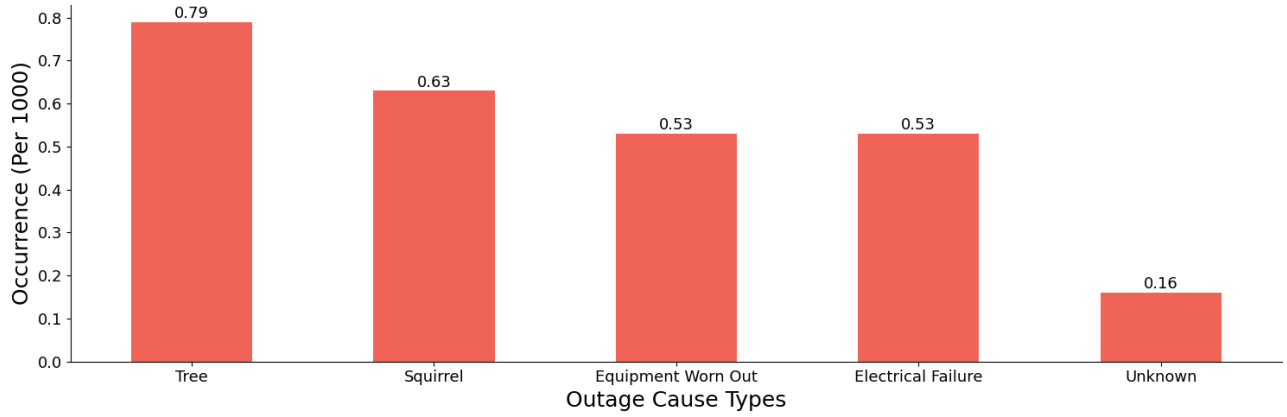
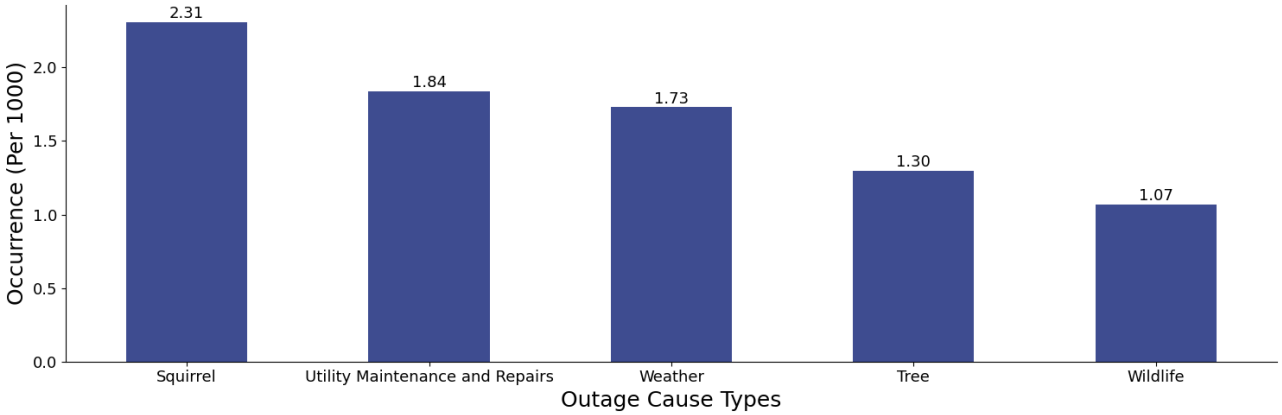


Figure 11. Top five causes of sustained outages in your region



1. The number of occurrences for each cause is divided by the utility's customer count (in thousands) to create an occurrence rate that can be compared across different utility sizes.

III.2. Momentary Outage Causes

The ability to track momentary outages can be difficult or unavailable on some systems, but due to the hazard they pose for electronic equipment, it is important to track and analyze the causes of momentary outages. This section evaluates the common causes of momentary outages for your utility, region, and size class as well as common causes for all utilities that use the eReliability Tracker. Please note that only outages lasting less than five minutes are classified as momentary, as defined by IEEE 1366. In Figures 12–14, for each utility, the number of occurrences for each cause is divided by that utility's customer count (in thousands) to create an occurrence rate that can be compared across different utility sizes.

Figure 12. Top five causes of momentary outages for all utilities that use the eReliability Tracker

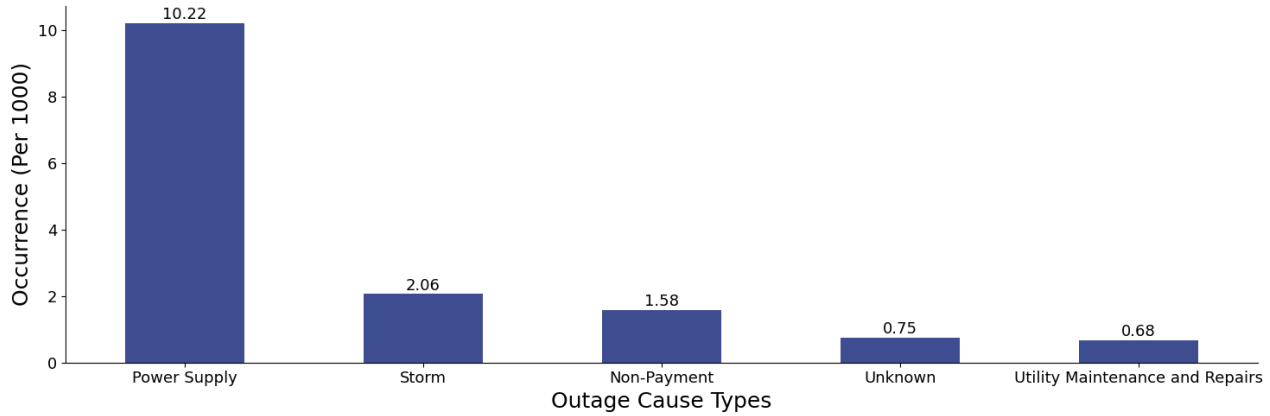


Figure 13. Top five causes of momentary outages for your utility

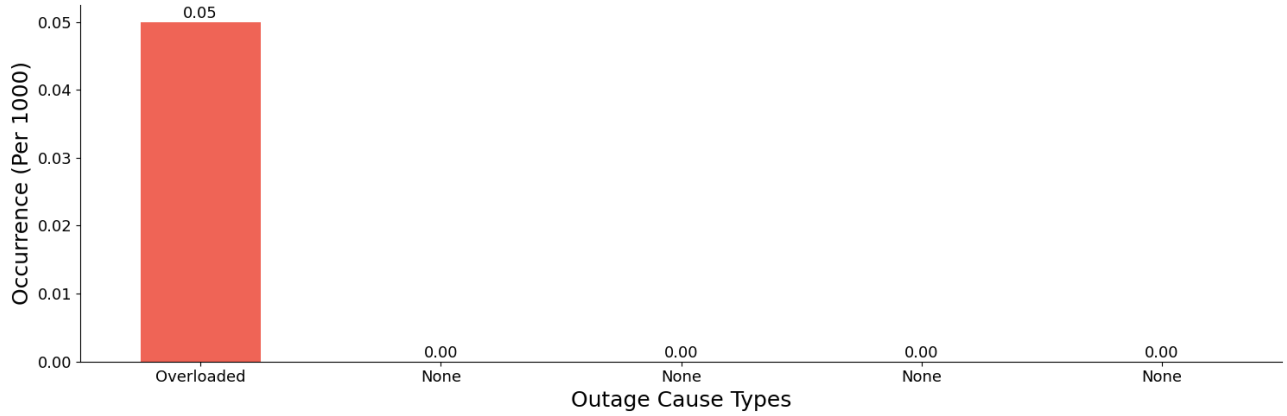
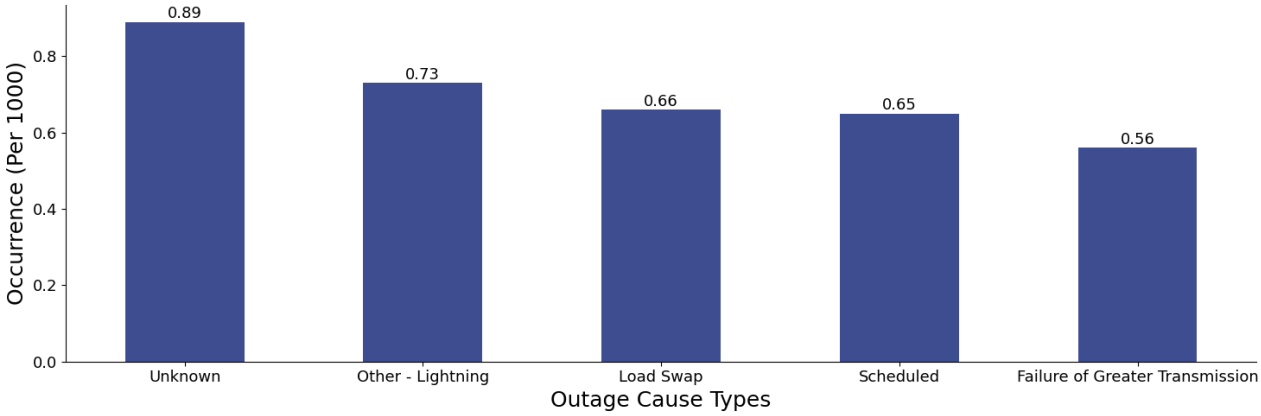


Figure 14. Top five causes of momentary outages in your region



Thank you for your active participation in the eReliability Tracker service. We hope this report is useful to your utility in analyzing your system. If you have any questions regarding the material provided in this report, please contact:

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