McPherson Board of Public Utilities

2019

ANNUAL BENCHMARKING REPORT

eRELIABILITY TRACKER

I. General Overview

Funded by a grant from the Demonstration of Energy & Efficiency Developments (DEED) Program, the eReliability Tracker Annual Report was created by the American Public Power Association (the Association) to assist utilities in their efforts to understand and analyze their electric system. This report focuses on distribution system reliability across the country and is customized to each utility. The data used to generate this report reflect activity in the eReliability Tracker from January 1, 2019 to December 31, 2019. Note that if you currently do not have a full year of data in the system, this analysis may not properly reflect your utility's statistics since it only includes data recorded as of February 23, 2020; therefore, any changes made after that date are not represented herein.

Reliability reflects both historic and ongoing engineering investment decisions within a utility. Proper use of reliability metrics ensures that a utility is not only performing its intended function, but also is providing service in a consistent and effective manner. Even though the primary use of reliability statistics is for self-evaluation, utilities can use these statistics to compare with data from 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 group utilities by size and region to improve comparative analyses while reducing differences.

Since this report contains overall data for all utilities that use the eReliability Tracker, it is important to consider the effect that a particularly large or small utility can have on the rest of the data. To ease the issues associated with comparability, reliability statistics are calculated for each utility with their respective customer weight taken into account prior to being aggregated with other utilities. This means that all utilities are equally weighted and all individual statistics are developed on a per customer basis.

The total number of active utilities for 2019 is 502. The aggregate statistics displayed in this report are calculated from 310 utilities that provided or verified their data and experienced more than two outages in 2019. Also, utilities that experienced no outages this year, or did not upload any data, will have NULL or "0" values in their report for their utility-specific data and were not included in the aggregate analysis.

This report separates utilities into groups of equal numbers of utilities according to their number of customers served. As seen in Table 1, the customer size distribution of utilities that use the eReliability Tracker is split into five distinct customer size class groups of approximately 100 utilities per group.

**Your utility belongs to customer size class 4 and region 3.**

Table 1. Customer size range per customer size class

Class 1	0 -1,207
Class 2	1,208 - 2,880
Class 3	2,881 - 6,599
Class 4	6,600 - 12,465
Class 5	12,466 - 468,522

Since the utilities considered in this report represent a wide variety of locations across the United States, each utility is also grouped with all others located in their corresponding American Public Power Association region. Figure 1 shows the number of utilities using the eReliability Tracker in each Association region and Figure 2 displays the Association's current United States map of regional divisions.
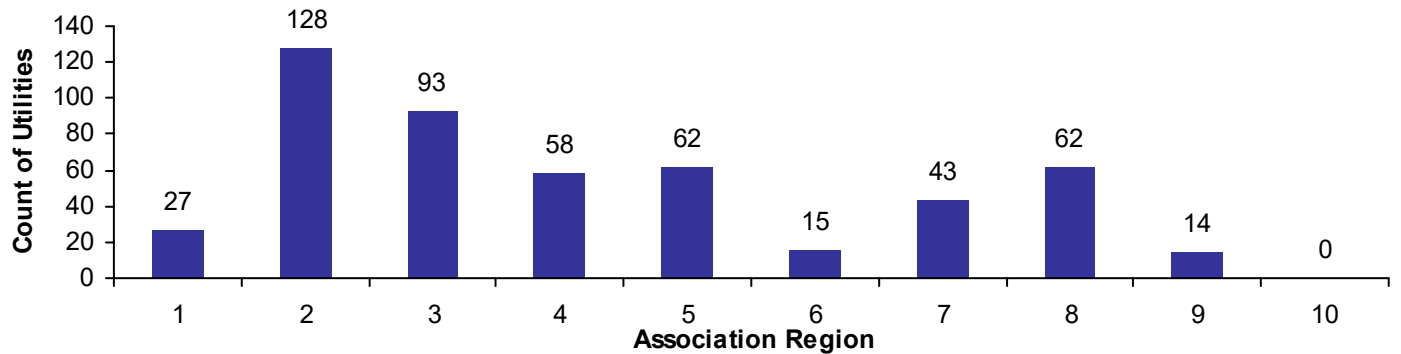
Figure 1. Number of eReliability Tracker utilities per Association region
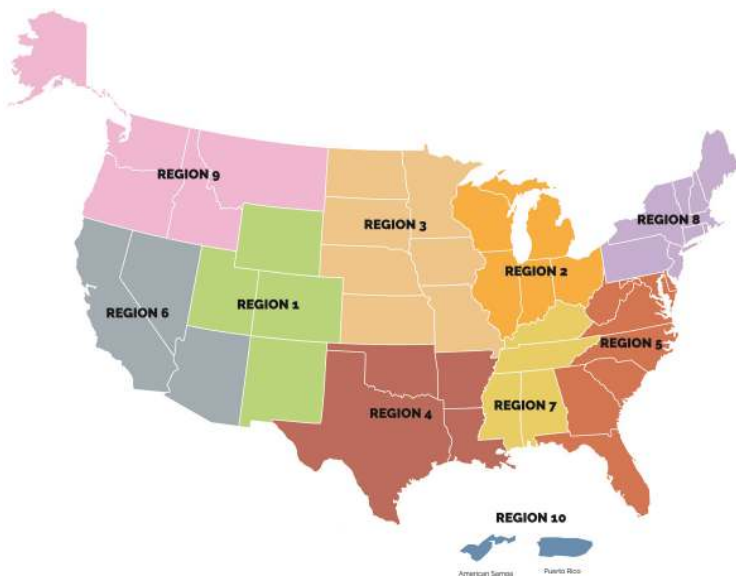
Figure 2. Association map of regions

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II. IEEE Statistics

When using reliability metrics, a good place to start is with the industry standard metrics found in the IEEE 1366 Guide. For each individual 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).

Due to the differences in how some utilities analyze major events (MEs) relative to their base statistics, it is important to note how they are calculated and used in this report. An example of a major event includes severe weather, such as a tornado or hurricane, which can lead to unusually long outages in comparison to your distribution system's typical outage. In the eReliability Tracker and in this report, the Association's major event threshold is used, which is a calculation based directly on the SAIDI for specific outage events, rather than daily SAIDI. The major event threshold allows a utility to remove outages that exceed the IEEE 2.5 beta threshold for outage events, which takes into account the utility's past outage history up to 10 years. In the eReliability Tracker, if a utility does not have at least 36 outage events prior to the year being analyzed, no threshold is calculated; therefore, the field below showing your utility's threshold will have NULL value and the calculations without MEs in the SAIDI section 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 _____4.52_____ (minutes).

The tables in this section can be used by utilities to better understand the performance of their electric system relative to other utilities nationally and to those within their region or size class. In the SAIDI section, indices are calculated for all outages with and without major events; furthermore, the data are broken down to show calculations for scheduled and unscheduled outages. For each of the reliability indices, the second table breaks down the national data into quartile ranges, a minimum value, and a maximum value.

II.1. System Average Interruption Duration Index (SAIDI)

SAIDI is defined as the average interruption duration (in minutes) for customers served by the utility system during a specific time period.

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 major events. Also note that wherever major events are excluded, the exclusion is based on the APPA major event threshold.

Table 2. Average SAIDI for all utilities that use the eReliability Tracker (with and without MEs), belong to your region, and are grouped in your customer size class

	All	No MEs	Unscheduled	Scheduled
Your utility's SAIDI	50.45	25.99	50.18	0.27
Average eReliability Tracker SAIDI	116.73	55.63	110.08	10.74
Average SAIDI for Utilities Within Your Region	75.23	41.38	73.45	2.64
Average SAIDI for Utilities Within Your Customer Size Class	97.42	42.12	94.32	5.22

Table 3. Summary statistics of the SAIDI data compiled from the eReliability Tracker

	All	No MEs	Unscheduled	Scheduled
Minimum Value	0.00	0.00	0.00	0.00
First Quartile (25th percentile)	21.84	11.56	20.32	0.18
Median Quartile (50th percentile)	56.57	26.81	54.88	0.91
Third Quartile (75th percentile)	111.86	62.19	110.54	4.65
Maximum Value	1197.79	988.99	1165.45	988.99
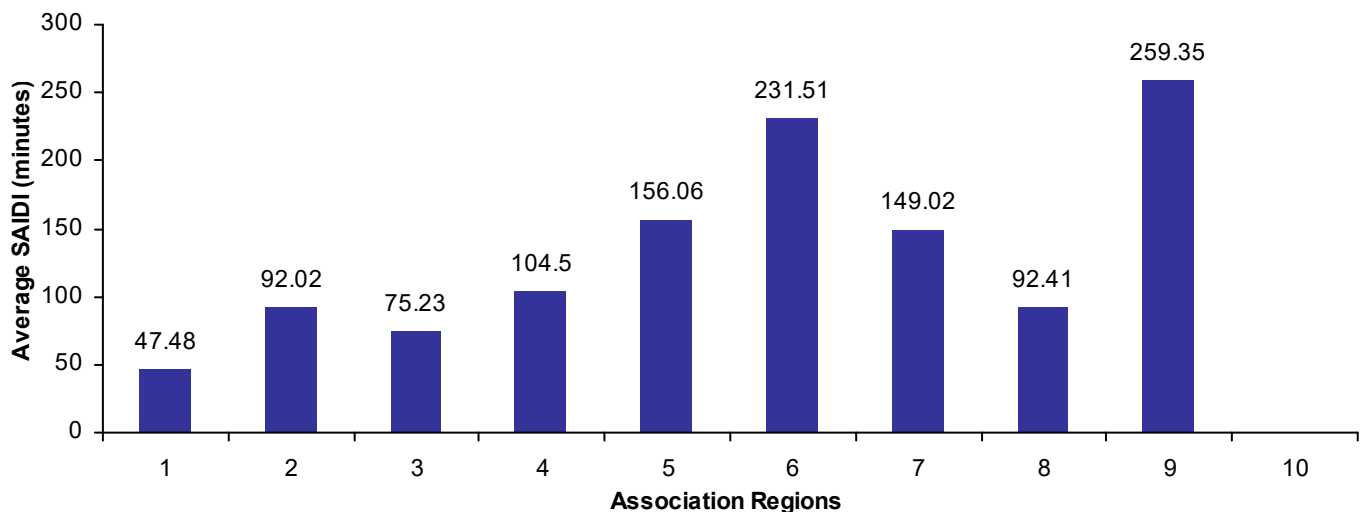
Figure 3. Average SAIDI for all utilities that use the eReliability Tracker per region

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)

SAIFI is defined as the average number of instances a customer on the utility system will experience an interruption during a specific time period.
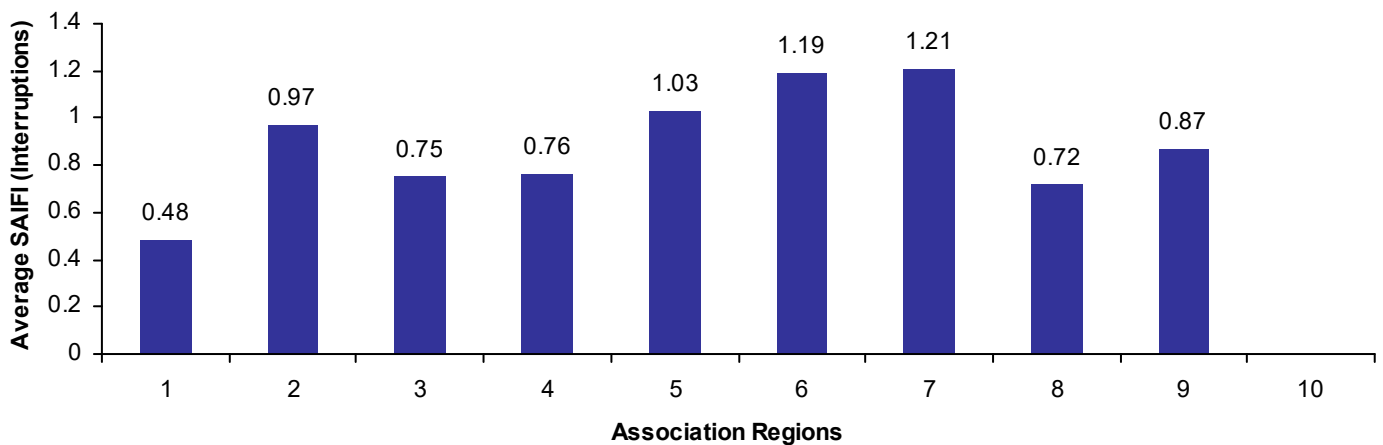
Since SAIFI is a sustained interruption index, only outages lasting longer than five minutes are included in the calculations. SAIFI is calculated by dividing the total number of customer interruptions by the average number of customers served during that time period. For example, a utility with 150 customer interruptions and 200 customers would have a SAIFI of 0.75 interruptions per customer.

Table 4. Average SAIFI for all utilities that use the eReliability Tracker, belong to your region, and are grouped in your customer size class

Your utility's SAIFI	0.63
Average eReliability Tracker SAIFI	0.90
Average SAIFI for Utilities Within Your Region	0.75
Average SAIFI for Utilities Within Your Customer Size Class	0.81

Table 5. Summary statistics of the SAIFI data compiled from the eReliability Tracker

Minimum Value	0.00
First Quartile (25th percentile)	0.25
Median Quartile (50th percentile)	0.57
Third Quartile (75th percentile)	1.22
Maximum Value	16.45

Figure 4. Average SAIFI for all utilities that use the eReliability Tracker per region

II.3. Customer Average Interruption Duration Index (CAIDI)

CAIDI is defined as 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. It is calculated by dividing the sum of all customer minutes of interruption[1] during that time period by the number of customers that experienced one or more interruptions during that time period. This metric reflects the average customer experience (minutes of duration) during an outage.

Table 6. Average CAIDI for all utilities that use the eReliability Tracker, belong to your region, and are grouped in your customer size class

Your utility's CAIDI	79.96
Average eReliability Tracker CAIDI	169.35
Average CAIDI for Utilities Within Your Region	99.62
Average CAIDI for Utilities Within Your Customer Size Class	115.75

Table 7. Summary statistics of the CAIDI data compiled from the eReliability Tracker

Minimum Value	0.00
First Quartile (25th percentile)	67.42
Median Quartile (50th percentile)	92.94
Third Quartile (75th percentile)	139.83
Maximum Value	11512.06
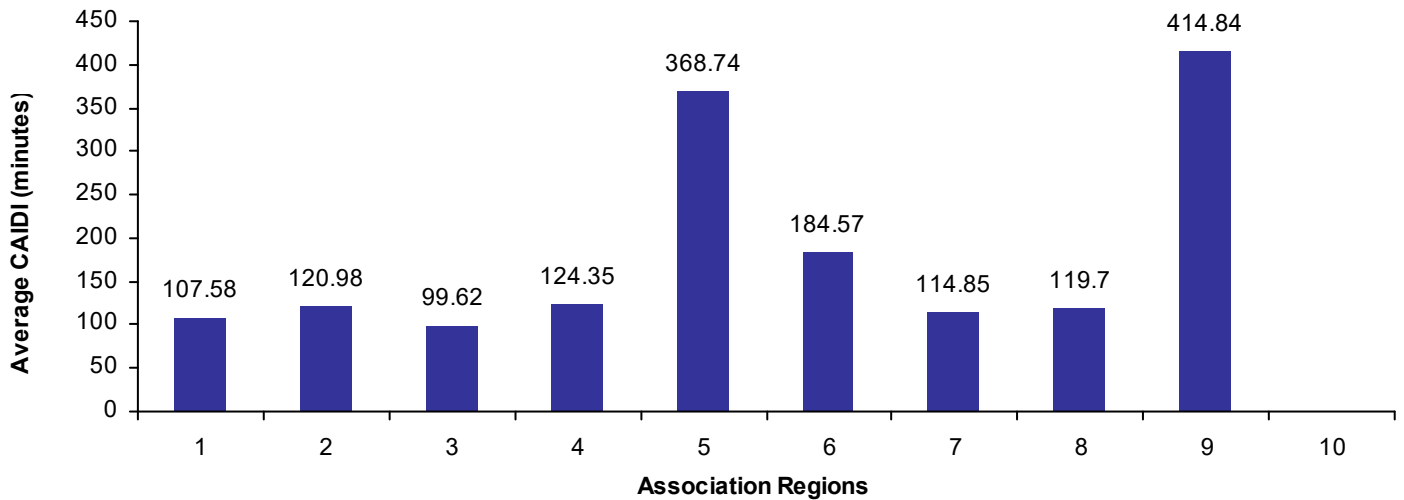
Figure 5. Average CAIDI for all utilities that use the eReliability Tracker per region

II.4. Momentary Average Interruption Frequency Index (MAIFI)

MAIFI is defined as the average number of times a customer on the utility system will experience a momentary interruption[2]

In this report, an outage with a duration of less than five minutes is classfied as momentary. The index is calculated by dividing the total number of momentary customer 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 outages can be more difficult to track and many smaller utilities may not have the technology to do so; therefore, some utilities may have a MAIFI of zero

Table 8. Average MAIFI for all utilities that use the eReliability Tracker, belong to your region, and are grouped in your customer size class

Your utility's MAIFI	NULL
Average eReliability Tracker MAIFI	0.65
Average MAIFI for Utilities Within Your Region	0.72
Average MAIFI for Utilities Within Your Customer Size Class	0.41

Table 9. Summary statistics of the MAIFI data compiled from the eReliability Tracker

Minimum Value	0.00
First Quartile (25th percentile)	0.00
Median Quartile (50th percentile)	0.08
Third Quartile (75th percentile)	0.49
Maximum Value	26.13
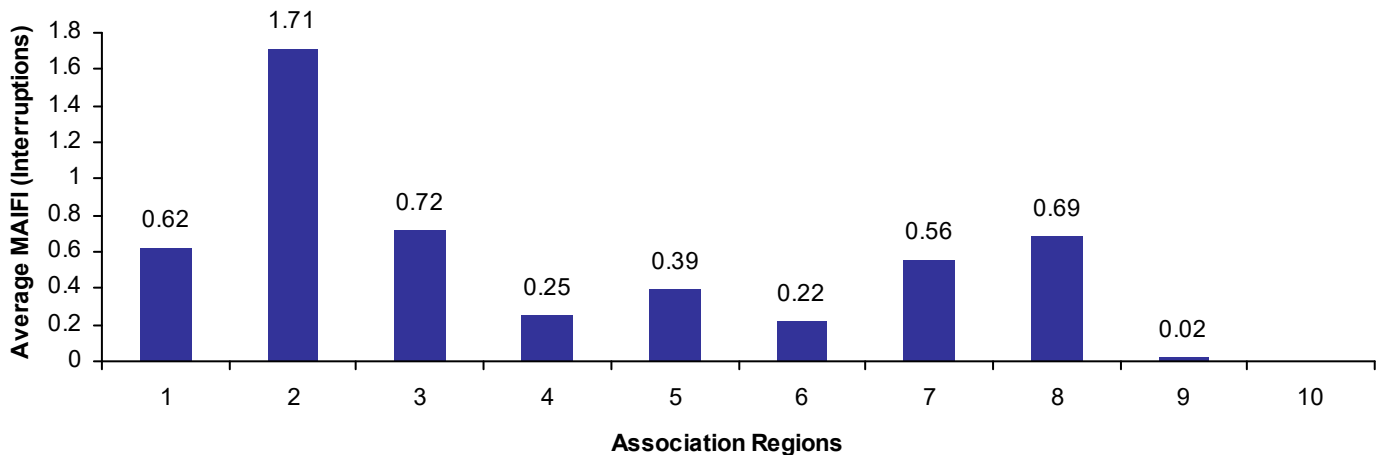
Figure 6. Average MAIFI for all utilities that use the eReliability Tracker per region

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2 Momentary outages can be more difficult to track and many smaller utilities may not have the technology to do so; therefore, some utilities may have a MAIFI of zero.

II.5. Average Service Availability Index (ASAI)

ASAI is defined as a measure of the average availability of the sub-transmission and distribution systems that serve customers.

This load-based index represents the percentage availability of electric service to customers within the time period analyzed. It is caclulated by dividing the total hours 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 time period.

Table 10. Average ASAI for all utilities that use the eReliability Tracker, belong to your region, and are grouped in your customer size class

Your utility's ASAI (%)	99.9904
Average eReliability Tracker ASAI	99.9778
Average ASAI for Utilities Within Your Region	99.9856
Average ASAI for Utilities Within Your Customer Size Class	99.9815

Table 11. Summary statistics of the ASAI data compiled from the eReliability Tracker

Minimum Value	99.7721
First Quartile (25th percentile)	99.9787
Median Quartile (50th percentile)	99.9892
Third Quartile (75th percentile)	99.9958
Maximum Value	100.0000
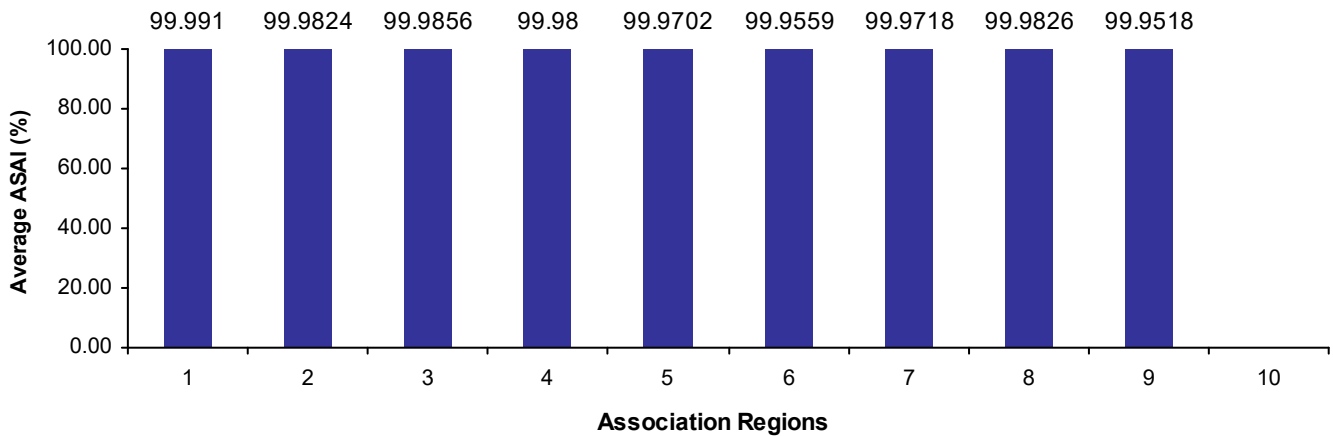
Figure 7. Average ASAI for all utilities that use the eReliability Tracker per region

II.6. 2018 Energy Information Administration (EIA) Form 861 Data

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

EIA surveys electric power utilities annually through EIA Form 861 to collect electric industry data and subsequently make that data available to the public. In 2014, EIA began publishing reliability statistics in their survey from utility participants; therefore, the Association included EIA reliability statistics in this report for informational purposes. Please note that the following data includes 174 investor-owned, 553 rural cooperative, and 389 public power utilities[3] that were large enough to be required to fill out the full EIA 861, not the EIA 861-S form (for smaller entities). In addition, since the collection and release of EIA form data lags by a year, the data provided here is based on the 2018 data that was published in October 1, 2019. Therefore, it is suggested that the aggregate statistics contained herein be used only as an informational tool for further comparison of reliability statistics.

In Table 12 and Table 13, an entity calculates SAIDI, SAIFI, and determines major event days in accordance with the IEEE 1366-2003 or IEEE 1366-2012 standard.

For more general information on reliability metrics you can see the Association's website at http://publicpower.org/reliability. Although EIA collected other reliability-related data, the tables below only include SAIDI and SAIFI data. The full set of data can be downloaded at: http://www.eia.gov/electricity/data/eia861/

Table 12. Summary statistics of the SAIDI data collected in 2018 and published in 2019 by EIA

	IEEE Method	
	All	No MEDs
Average	327.85	142.76
Minimum Value	1.13	0.00
First Quartile (25th percentile)	80.82	52.94
Median Quartile (50th percentile)	154.91	100.36
Third Quartile (75th percentile)	320.10	161.20
Maximum Value	8092.00	6356.07

Table 13. Summary statistics of the SAIFI data collected in 2018 and published in 2019 by EIA

	IEEE Method	
	All	No MEDs
Average	1.64	1.27
Minimum Value	0.03	0.00
First Quartile (25th percentile)	0.83	0.65
Median Quartile (50th percentile)	1.33	1.06
Third Quartile (75th percentile)	2.03	1.56
Maximum Value	13.03	11.31

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3 389 public power utilities include entities classified by EIA as municipal, political subdivision, and state.

II.7. Analysis of Miles of Line and Interruptions

Benchmarking metrics were created to help utilities explore the relationship between outages, line exposure, and customer density. This analysis separates utilities into groups of similar average customer density (customers served per mile). As seen in Table 15, the customer density distribution of utilities that use the eReliability Tracker is split into five distinct customer density size groups of approximately 64 utilities.[4] By using the miles of line-related metrics shown in Table 14 and Table 15, utilities can benchmark reliability against system characteristics along with the customer normalized metrics included in the rest of the report. These system topography-related metrics can be helpful in understanding, for example, utility reliability against weather and animal-related outages relative to similarly dense and exposed utilities.

Your utility's total miles of line: 551.189

Your utility's overhead miles of line: 523.329

Your utility's underground miles of line: 27.86

Table 14. Analysis of total miles of line and interruptions

	Interruptions per Mile	Customers Interrupted per Mile	Minutes of Interruption per Mile
Your Utility	0.32	9.98	62.96
Average for eReliability Tracker Utilities	0.43	38.50	137.37
Average for Utilities Within Your Region	0.50	38.14	90.81

Your utility's average customer density (customers per mile):   15.83

Your utility belongs to customer density class 1

Table 15. Total miles of line analysis by customer density class

Customer Density Class (Customers per Mile)	Customer Density Range	Interruptions per Mile	Customers Interrupted per Mile	Minutes of Interruption per Mile
Class 1	1 -30	0.23	18.49	108.43
Class 2	31 - 45	0.35	22.79	56.89
Class 3	46 - 62	0.48	28.05	304.29
Class 4	63 - 88	0.50	40.75	132.25
Class 5	89 - 1660	0.59	82.47	93.46

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4 Customer density classes include eReliability Tracker utilities that either provided their miles of line data to Platts or recorded their data in the eReliability Tracker.

III. Outage Causes

Equipment failure, extreme weather events, wildlife and vegetation are some of the most common causes of electric system outages. However, certain factors, such as regional weather and animal/vegetation patterns, can make a different set of causes more prevalent to a specific group of utilities. The following section of this report include graphs depicting common causes of outages for your individual utility, all utilities in your region, and all utilities using the eReliability Tracker. The 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; in order to avoid skewing the data towards large utilities, the number of cause occurrences is divided by customer size to account for the differences. In Figures 8-13, the data represent the number of occurrences for each group of 1,000 customers. For instance, a customer-weighted occurrence rate of "1" means 1 outage of that outage cause per 1,000 customers on average in 2019.

Note that the sustained outage cause analysis is more comprehensive than the momentary outage cause analysis due to a bigger 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 many 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 in this report, sustained outages are classified as outages that last longer than five minutes, as defined by IEEE 1366.
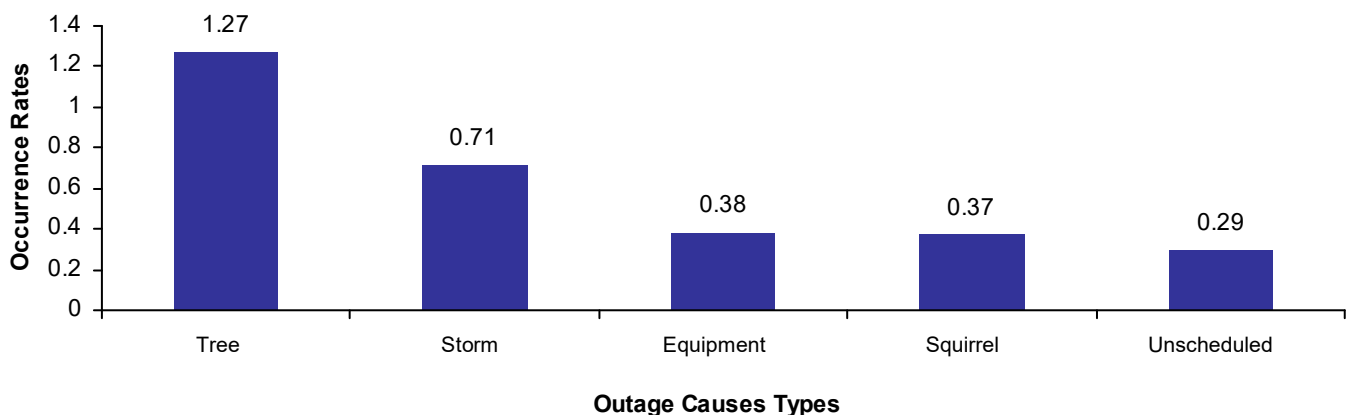
Figure 8. Top five customer-weighted occurrence rates for common causes of sustained outages for all utilities that use the eReliability Tracker Service[5]

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5   For each utility, the number of occurrences for each cause is divided by that utility's customer size (in 1,000s) to create an occurence rate that can be compared across different utility sizes.
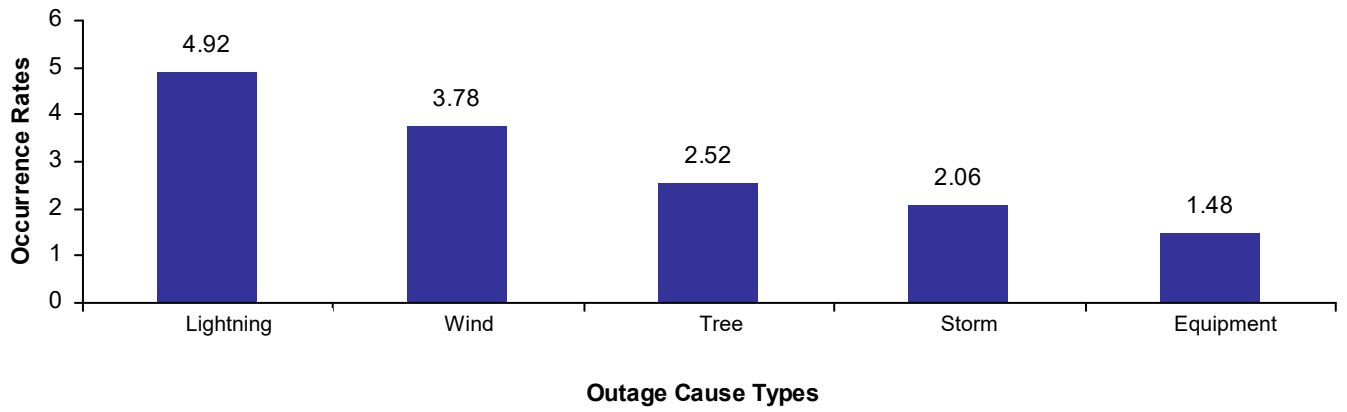
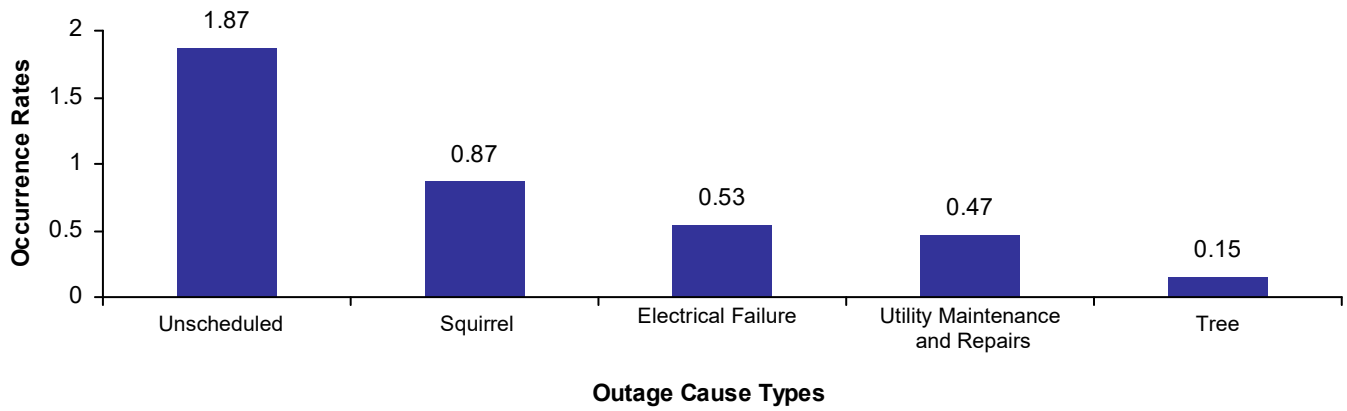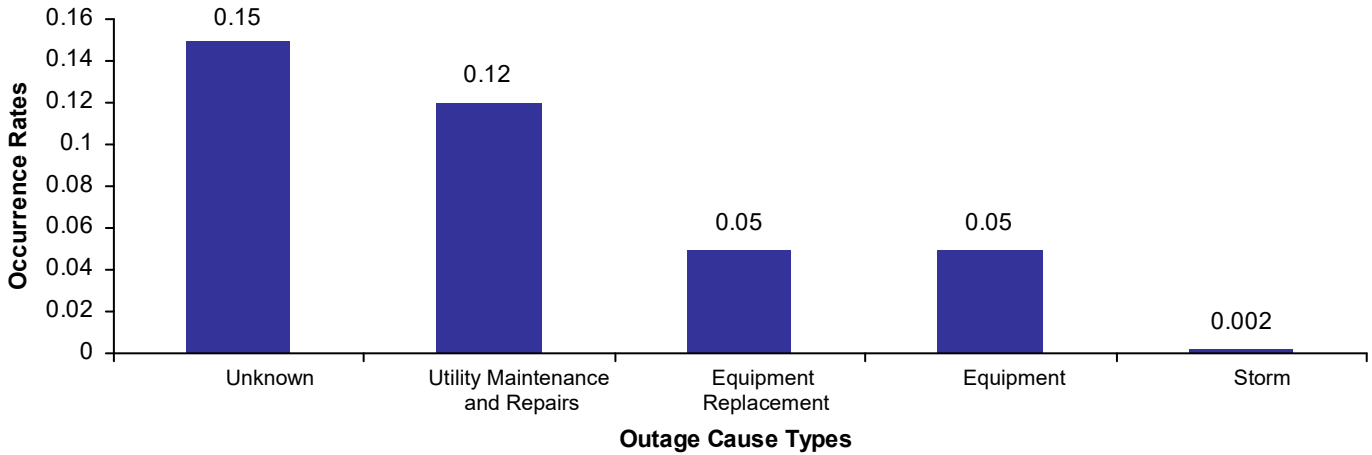**Figure 9. Top five customer-weighted causes of sustained outages for your utility** [5]
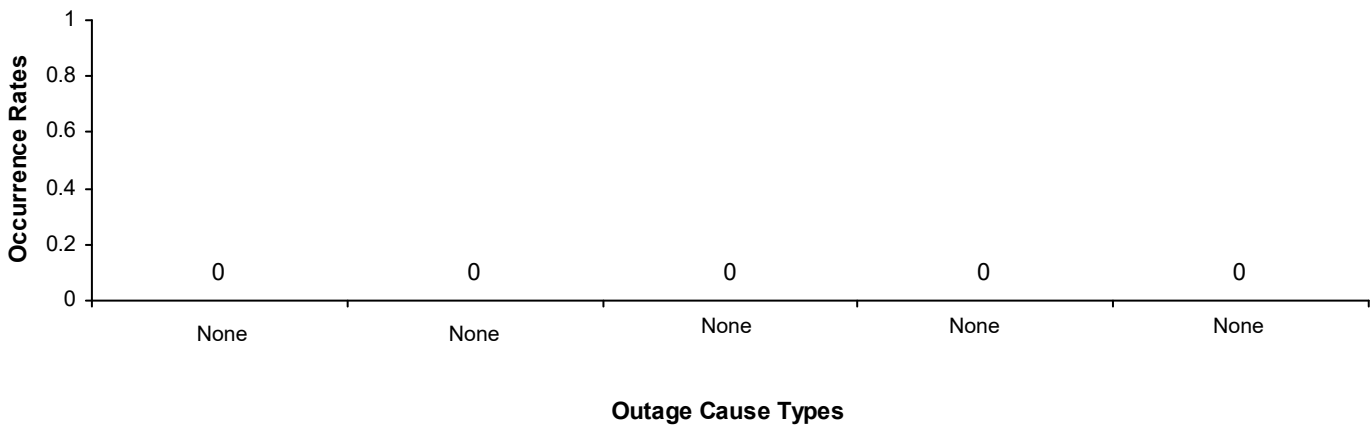

Figure 10. Top five customer-weighted occurrence rates for sustained outage causes in your region [5]

II.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 momentary causes. In this section, we evaluate common causes of momentary outages for your utility, region and customer 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.
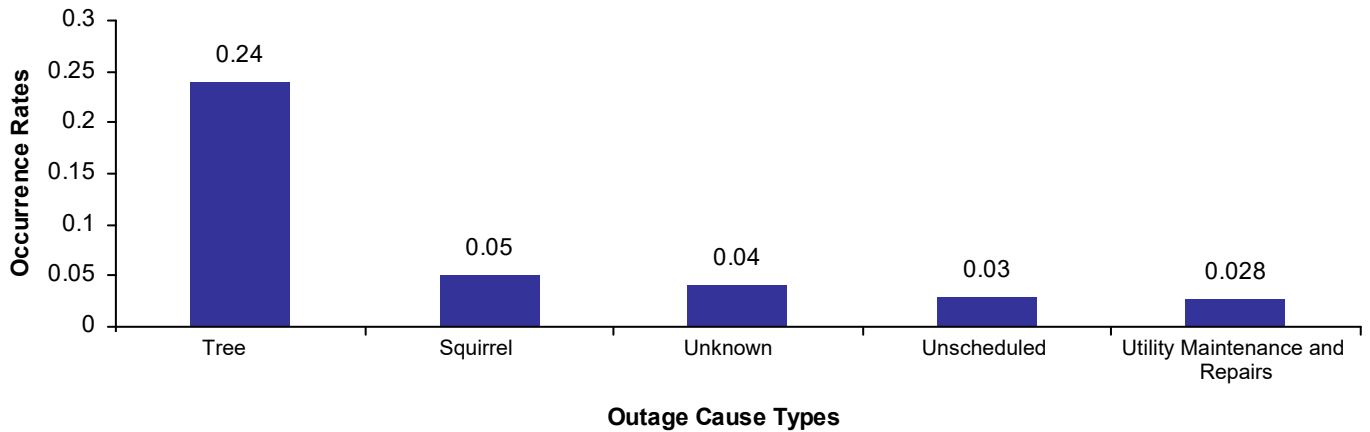

Figure 11. Top five customer-weighted occurrence rates for common causes of momentary outages for all utilities that use the eReliability Tracker Service [5]

Figure 12. Top five customer-weighted causes of momentary outages for your utility[5, 6]

6   If your utility has less than eight momentary outages recorded in the eReliability Tracker, this graph will be blank.

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Figure 13. Top five customer-weighted occurrence rates for momentary outage causes in your region [5]

Thank you for your active participation in the eReliability Tracker service, and 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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