

■ ANNUAL
2018 BENCHMARKING
REPORT **eRELIABILITY** TRACKER

Ipswich Municipal Light Plant

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, 2018 to December 31, 2018. 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 18, 2019; therefore, any changes made after that date are not represented herein.

I. General Overview

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 2018 are 460. The aggregate statistics displayed in this report are calculated from 277 utilities that provided or verified their data and experienced more than two outages in 2018. Also, utilities that experienced no outages this year, or did not upload any data, will have None/Null 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 92 utilities per group.

Your utility belongs to customer size class **4** and region **8**.

Table 1
Customer size range per customer size class

Class 1	0 -1,337
Class 2	1,338 - 3,003
Class 3	3,004 - 6,679
Class 4	6,680 - 12,262
Class 5	12,263 - 650,000

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

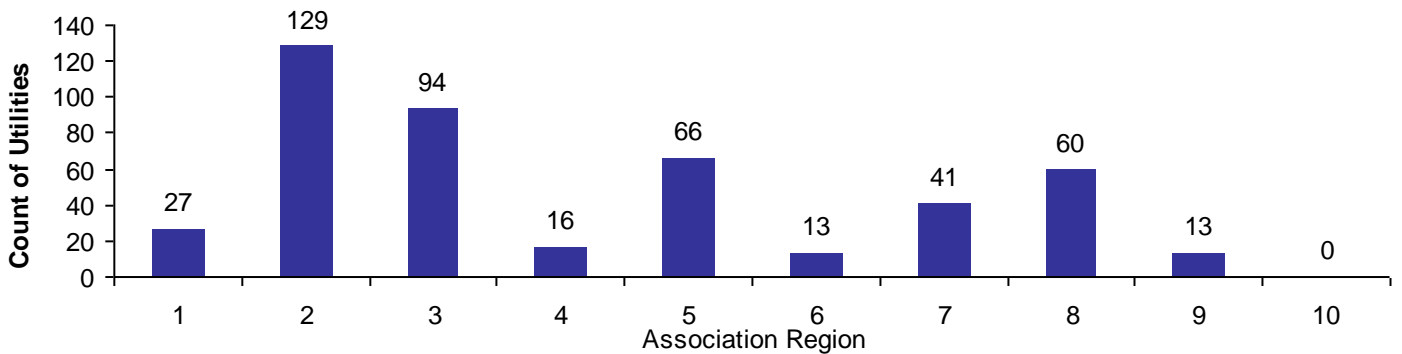
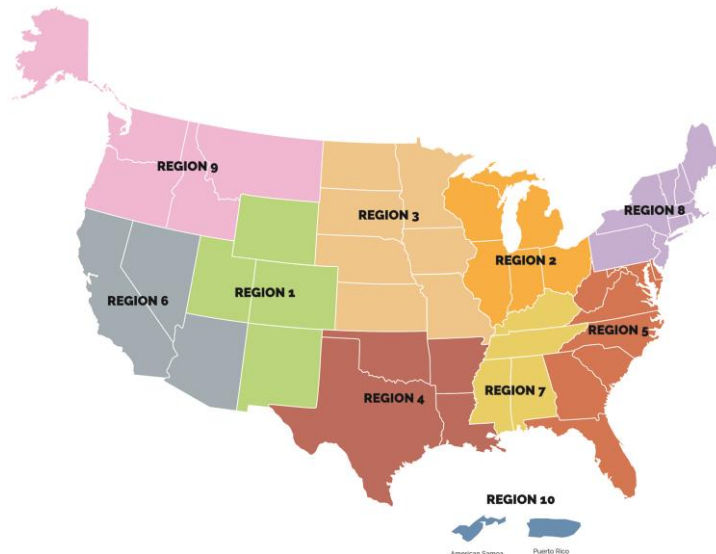


Figure 2
Association map of regions



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).

When collecting the necessary data for reliability indices, utilities often take differing approaches. Some utilities prefer to include information as detailed as circuit type or phases impacted, while others include only the minimum required. In all cases, the more details a utility provides, the more practical their analysis will be. As a basis for calculating these statistics in the eReliability Tracker, the following are required:

- Total number of customers served on the day of the outage
- Start and end date/time of the outage
- Number of customers that lost power

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 could be severe weather, such as a tornado or thunderstorm, 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 outage events, rather than event days. The major event threshold allows a utility to remove outages that exceed the IEEE 2.5 beta threshold for 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 be blank 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 20.5516 (minutes).¹

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.

¹ If there is no major event threshold calculated for your utility, these fields are left blank and the calculations in this report including Major Events and excluding them will be the same. Your utility must have at least 36 outage events recorded in the eReliability Tracker in order to calculate a Major Event Threshold.

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 interruption durations within the specified time frame by the average number of customers served during that period. For example, a utility with 100 customer minutes of outages 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.

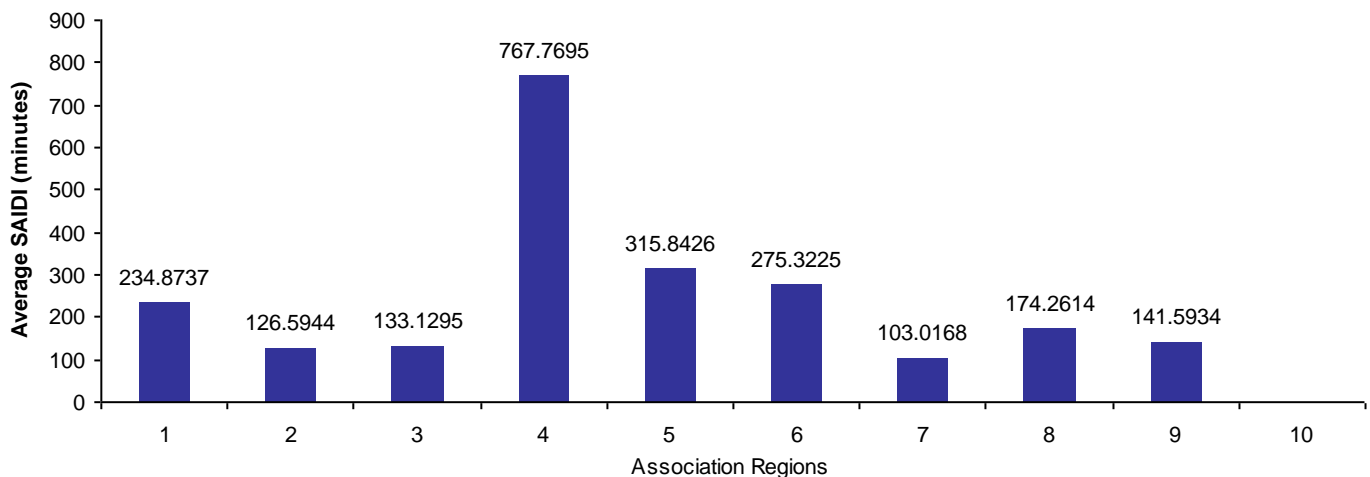
Table 2
Average SAIDI for all utilities that use the eReliability Tracker (with and without MEs), belong to your region, and are grouped in your customer size class

	All	No MEs	Unscheduled	Scheduled
Your utility's SAIDI	32.696	32.696	32.696	0
Average eReliability Tracker SAIDI	202.449	69.0185	185.0572	17.463
Average SAIDI for Utilities Within Your Region	174.2614	62.1269	171.2486	3.0237
Average SAIDI for Utilities Within Your Customer Size Class	221.2008	34.0534	206.258	14.9341

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

	All	No MEs	Unscheduled	Scheduled
Minimum Value	0.283	0.283	0.186	0
First Quartile (25th percentile)	21.647	12.203	19.69	0
Median Quartile (50th percentile)	53.2225	27.084	52.313	0.134
Third Quartile (75th percentile)	141.0617	63.238	131.51	2.086
Maximum Value	8746.1	1843.61	8743.182	1580.062

Figure 3
Average SAIDI for all utilities that use the eReliability Tracker per region



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.

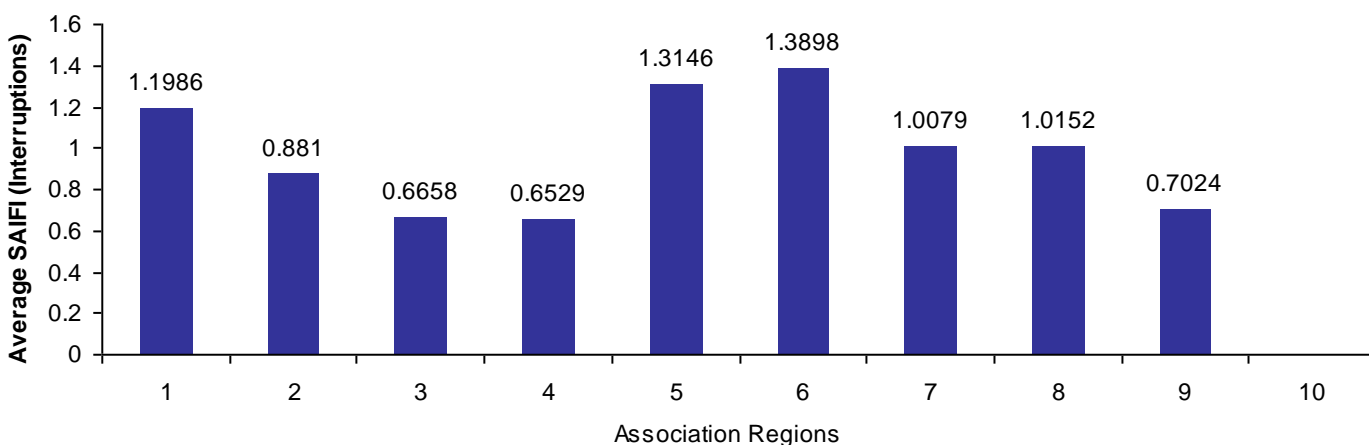
Table 4
Average SAIFI for all utilities that use the eReliability Tracker, belong to your region, and are grouped in your customer size class

Your utility's SAIFI	0.548
Average eReliability Tracker SAIFI	0.9541
Average SAIFI for Utilities Within Your Region	1.0152
Average SAIFI for Utilities Within Your Customer Size Class	0.7373

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

Minimum Value	0.0071
First Quartile (25th percentile)	0.284
Median Quartile (50th percentile)	0.667
Third Quartile (75th percentile)	1.223
Maximum Value	7.535

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



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 interruption durations 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.

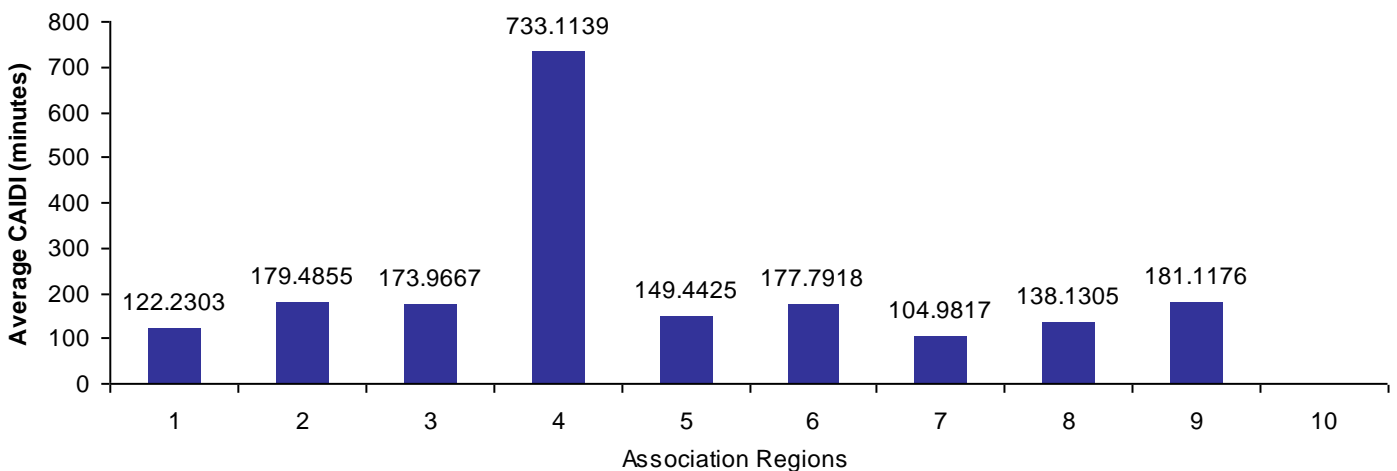
Table 6
Average CAIDI for all utilities that use the eReliability Tracker, belong to your region, and are grouped in your customer size class

Your utility's CAIDI	59.628
Average eReliability Tracker CAIDI	180.7475
Average CAIDI for Utilities Within Your Region	138.1305
Average CAIDI for Utilities Within Your Customer Size Class	276.669

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

Minimum Value	10.413
First Quartile (25th percentile)	60.692
Median Quartile (50th percentile)	86.822
Third Quartile (75th percentile)	137.545
Maximum Value	7981.064

Figure 5
Average CAIDI for all utilities that use the eReliability Tracker per region



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.

In this report, an outage with a duration of less than five minutes is classified 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. 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.

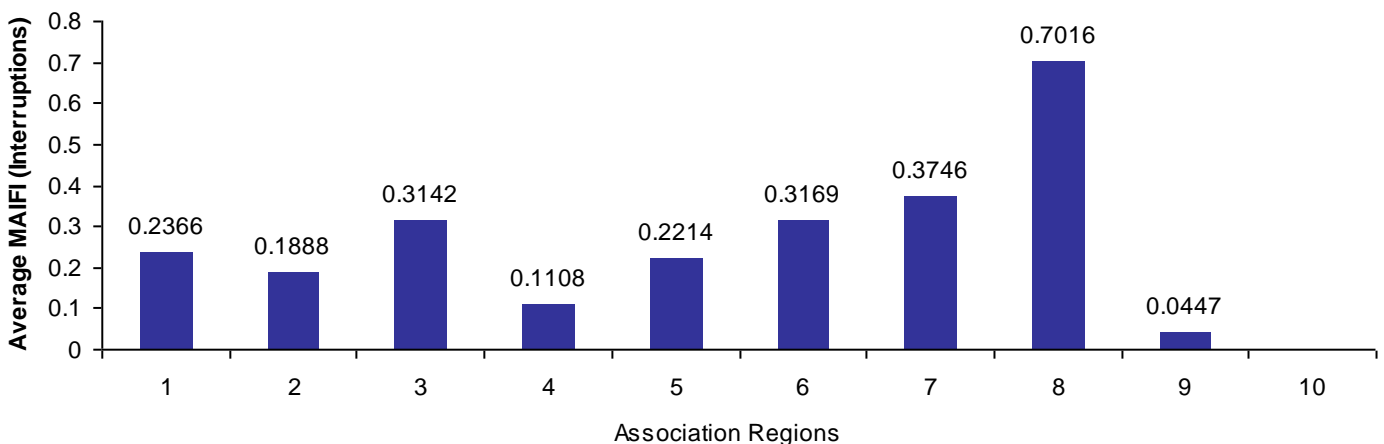
Table 8
Average MAIFI for all utilities that use the eReliability Tracker, belong to your region, and are grouped in your customer size class

Your utility's MAIFI	2
Average eReliability Tracker MAIFI	0.2938
Average MAIFI for Utilities Within Your Region	0.7016
Average MAIFI for Utilities Within Your Customer Size Class	0.2548

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

Minimum Value	0
First Quartile (25th percentile)	0
Median Quartile (50th percentile)	0
Third Quartile (75th percentile)	0.143
Maximum Value	7.687

Figure 6
Average MAIFI for all utilities that use the eReliability Tracker per region



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 calculated 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.

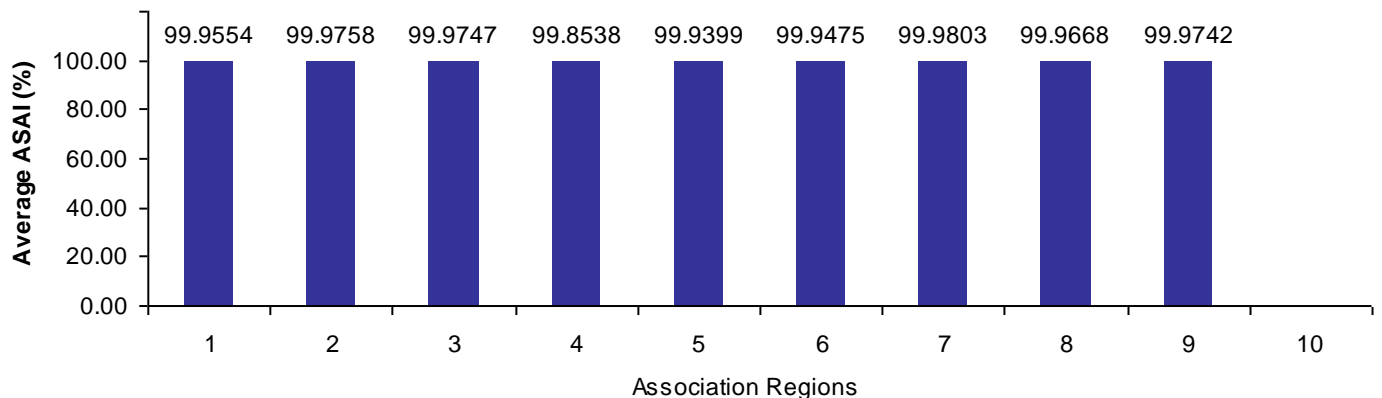
Table 10
Average ASAI for all utilities that use the eReliability Tracker, belong to your region, and are grouped in your customer size class

Your utility's ASAI (%)	99.9937
Average eReliability Tracker ASAI	99.9615
Average ASAI for Utilities Within Your Region	99.9668
Average ASAI for Utilities Within Your Customer Size Class	99.9579

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

Minimum Value	98.3359
First Quartile (25th percentile)	99.9731
Median Quartile (50th percentile)	99.9899
Third Quartile (75th percentile)	99.9961
Maximum Value	99.9999

Figure 7
Average ASAI for all utilities that use the eReliability Tracker per region



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 investor-owned, rural cooperative, and public power utilities 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 more than a year, the data provided here is based on 2017 data only. Therefore, it is suggested that the aggregate statistics contained herein be used only as an informational tool for further comparison of reliability statistics.

In the table, if an entity calculates SAIDI, SAIFI, and determines major event days in accordance with the IEEE 1366-2003 or IEEE 1366-2012 standard, they are included under the "IEEE Method" columns. If the entity calculates these values via another method, they are included under the "Other Method" columns.

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 this link: <http://www.eia.gov/electricity/data/eia861/>

Table 12
Summary statistics of the SAIDI data collected in 2017 and published in 2018 by EIA

	IEEE Method		Other Method	
	All	No MEDs	All	No MEDs
Average	377.6190	134.5683	383.0213	132.7504
Minimum Value	0.2750	0.0000	0.3000	0.0000
First Quartile (25th percentile)	83.2050	55.4410	41.5000	27.5873
Median Quartile (50th percentile)	169.6020	94.9580	102.2580	78.0145
Third Quartile (75th percentile)	321.0500	161.9000	247.5543	150.7025
Maximum Value	16472.0710	2796.1870	17182.0000	2796.1870

Table 13
Summary statistics of the SAIFI data collected in 2017 and published in 2018 by EIA

	IEEE Method		Other Method	
	All	No MEDs	All	No MEDs
Average	1.7178	1.3091	1.4603	1.0628
Minimum Value	0.0030	0.0000	0.0040	0.0000
First Quartile (25th percentile)	0.9000	0.6900	0.5770	0.3940
Median Quartile (50th percentile)	1.3700	1.0870	1.0090	0.8370
Third Quartile (75th percentile)	2.0010	1.5200	1.8930	1.4545
Maximum Value	83.2050	55.4410	12.8000	9.0480

Analysis of Miles of Line and Interruptions

Benchmarking metrics were created to help utilities explore the relationship between outages, overhead/underground line exposure, and customer density. More specifically, by using interruptions per overhead/underground mile of line and customers per mile 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 overhead miles of line as reported by Platts: 103

Table 14
Analysis of overhead miles of line and interruptions

	Interruptions per Mile	Customers per Mile	Minutes per Mile
Your Utility	0.8252	69	59.2621
Average for eReliability Tracker Utilities	0.984	100.745	186
Average for Utilities Within Your Region	1.1098	103.1589	169.853

Your utility's underground miles of line as reported by Platts: 3

Table 15
Analysis of underground miles of line and interruptions

	Interruptions per Mile	Customers per Mile	Minutes per Mile
Your Utility	28.3333	2369	2034.6666
Average for eReliability Tracker Utilities	8.6341	613.4802	1340
Average for Utilities Within Your Region	8.9197	665.17	1420.4043

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 sections 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 the figures below, the data represent the number of occurrences for each group of 1000 customers. For instance, a customer-weighted occurrence rate of "1" means 1 outage of that outage cause per 1000 customers on average in 2018.

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.

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 Service²

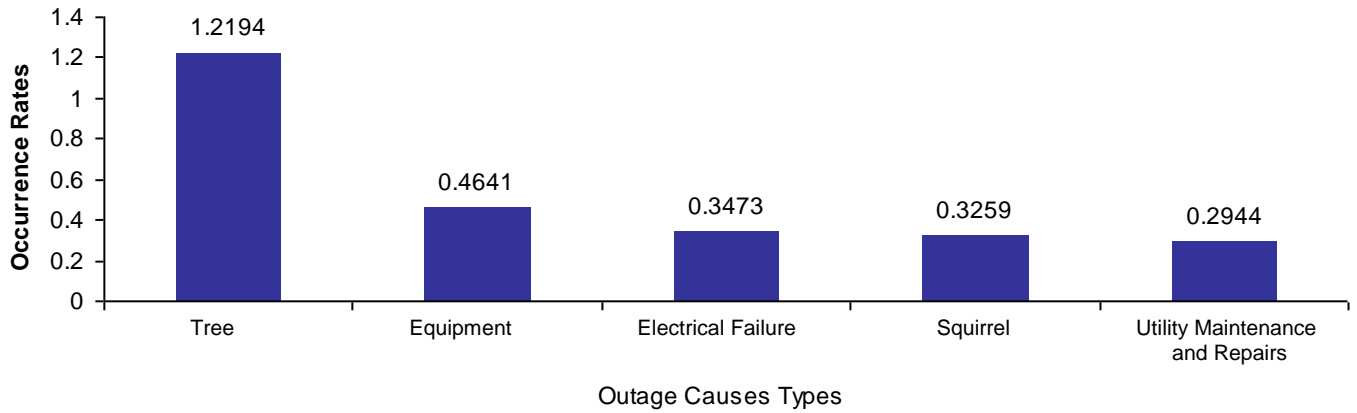


Figure 9

Top five customer-weighted causes of sustained outages for your utility²

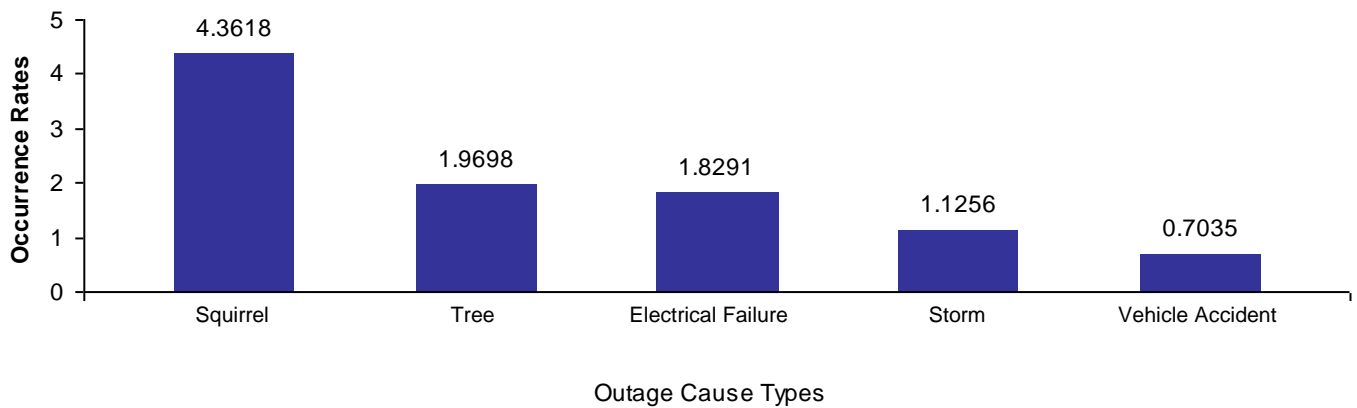
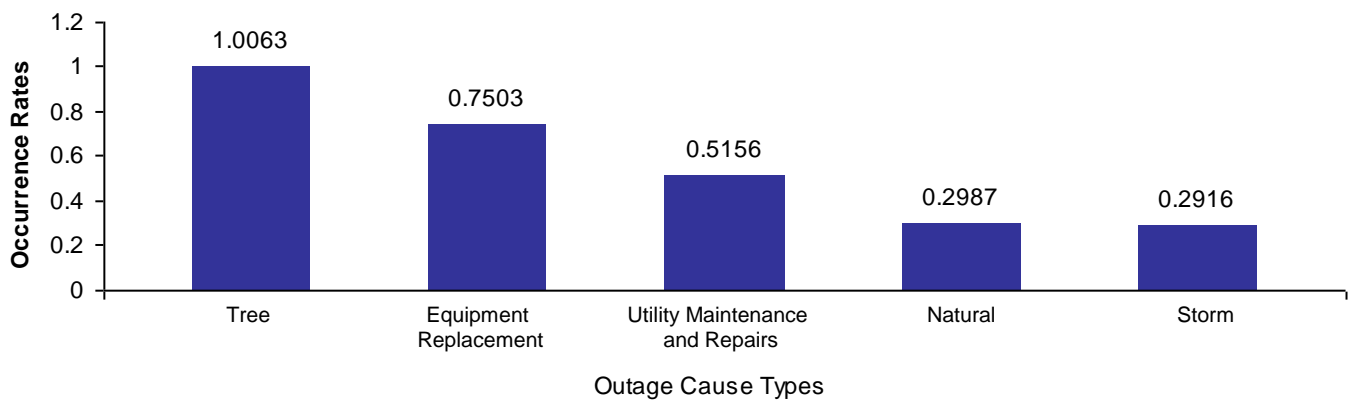


Figure 10

Top five customer-weighted occurrence rates for sustained outage causes in your region²



² For each utility, the number of occurrences for each cause is divided by that utility's customer size (in 1000s) to create an occurrence rate that can be compared across different utility sizes.

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 Service²

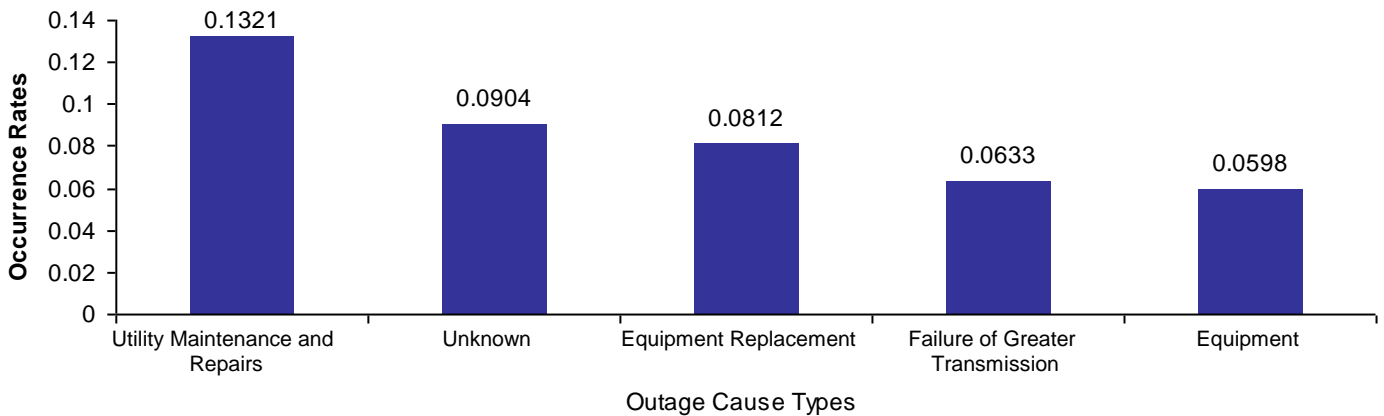
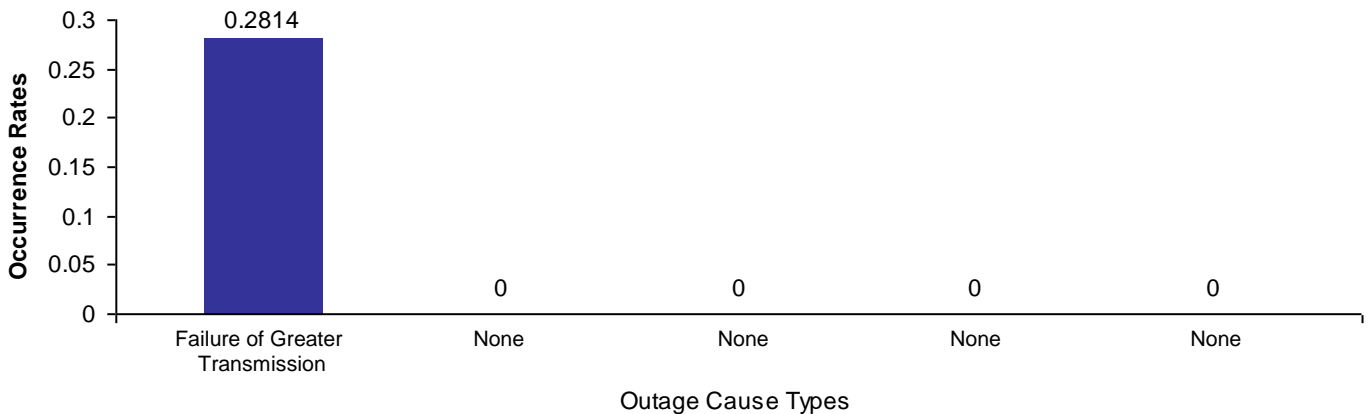


Figure 12

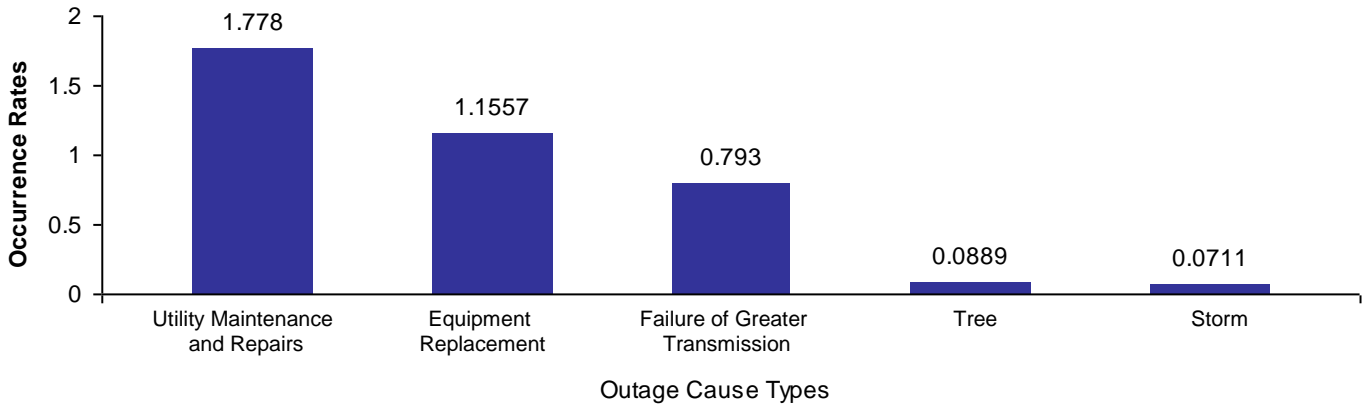
Top five customer-weighted causes of momentary outages for your utility^{2,3}



³ If your utility has less than eight momentary outages recorded in the eReliability Tracker, this graph will be blank.

Figure 13

Top five customer-weighted occurrence rates for momentary outage causes in your region²



Thank you for using the eReliability Tracker, 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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