2017 ANNUAL BENCHMARKING REPORT eRELIABILITY TRACKER

AMERICAN PUBLIC POWER ASSOCIATION™
Powering Strong Communities

APPA Sample Utility

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, 2017 to December 31, 2017. 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 3, 2018; 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 aggregate statistics displayed in this report are calculated from utilities that experienced more than two outages in 2017. 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.

The aggregate statistics provided in the following sections of the report are based on data from 253 utilities.

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 85 utilities per group.

Your utility belongs to customer size class 2 and region 3.

Table 1
Customer size range per customer size class

Class 1:	0 -1,497
Class 2:	1,498 - 3,126
Class 3:	3,127 - 6,797
Class 4:	6,798 - 12,695
Class 5:	12,696 - 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
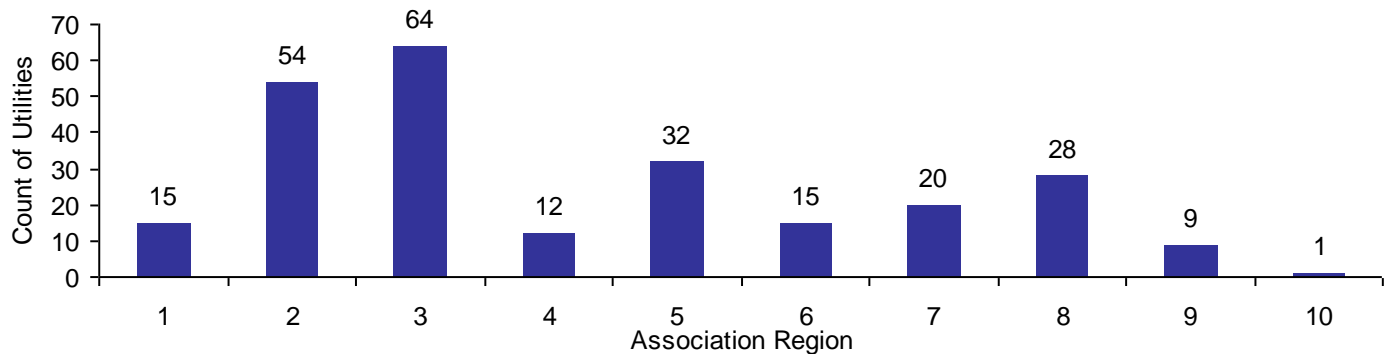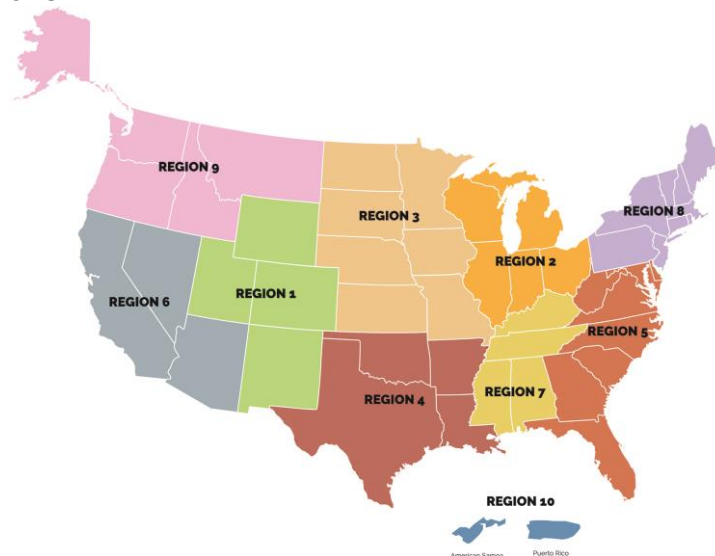**Number of eReliability Tracker utilities per Association region**

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 ____10.3697____ (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.

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[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:	4.8963	0.4257	0.5336	52.1577
Average eReliability Tracker SAIDI	154.3214	55.3214	134.384	19.6325
Average SAIDI for Utilities Within Your Region	125.3523	30.4227	92.3014	1.2305
Average SAIDI for Utilities Within Your Customer Size Class	385.6664	49.6535	301.2872	2.8924

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

	All	No MEs	Unscheduled	Scheduled
Minimum Value	0.1563	0.1268	0.1362	0
First Quartile (25th percentile)	26.0065	12.8502	15.9547	0
Median Quartile (50th percentile)	49.6331	30.4215	48.3697	0.0078
Third Quartile (75th percentile)	112.3968	54.3697	103.3697	1.8961
Maximum Value	3268.321	1036.5441	4136.3141	243.2147

Figure 3
Average SAIDI for all utilities that use the eReliability Tracker per region
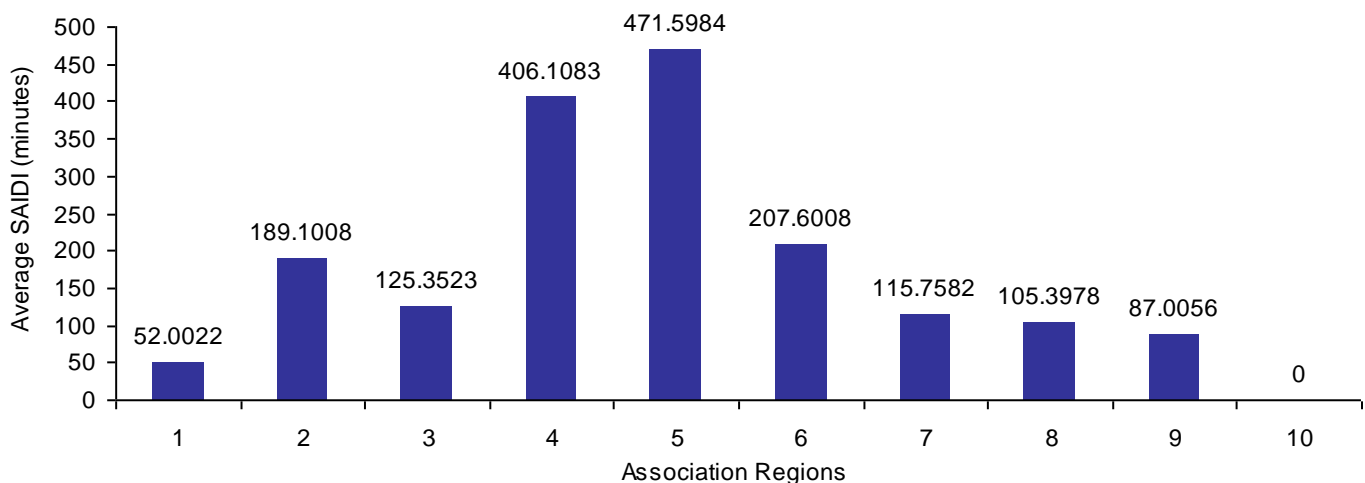
System Average Interruption Frequency Index (SAIFI)

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:	0.8645
Average eReliability Tracker SAIFI	0.9741
Average SAIFI for Utilities Within Your Region	1.2036
Average SAIFI for Utilities Within Your Customer Size Class	0.6624

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

Minimum Value	0.0004
First Quartile (25th percentile)	0.1475
Median Quartile (50th percentile)	0.7548
Third Quartile (75th percentile)	1.1258
Maximum Value	5.0369

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

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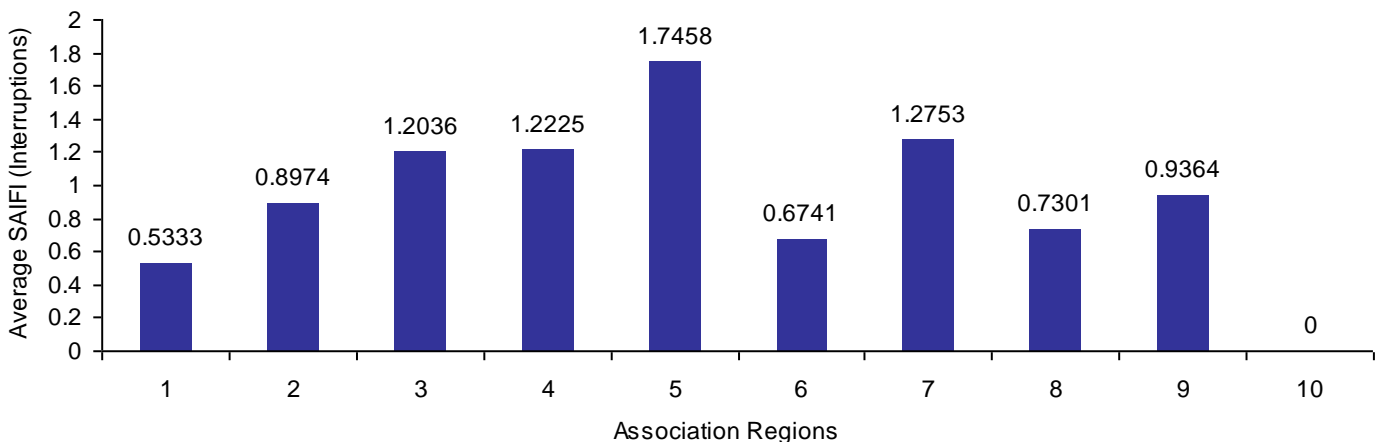
Customer Average Interruption Duration Index (CAIDI)

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:	16
Average eReliability Tracker CAIDI	298.1147
Average CAIDI for Utilities Within Your Region	85.2147
Average CAIDI for Utilities Within Your Customer Size Class	425.1287

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

Minimum Value	15.3698
First Quartile (25th percentile)	52.0036
Median Quartile (50th percentile)	83.6698
Third Quartile (75th percentile)	138.3994
Maximum Value	2849.18

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

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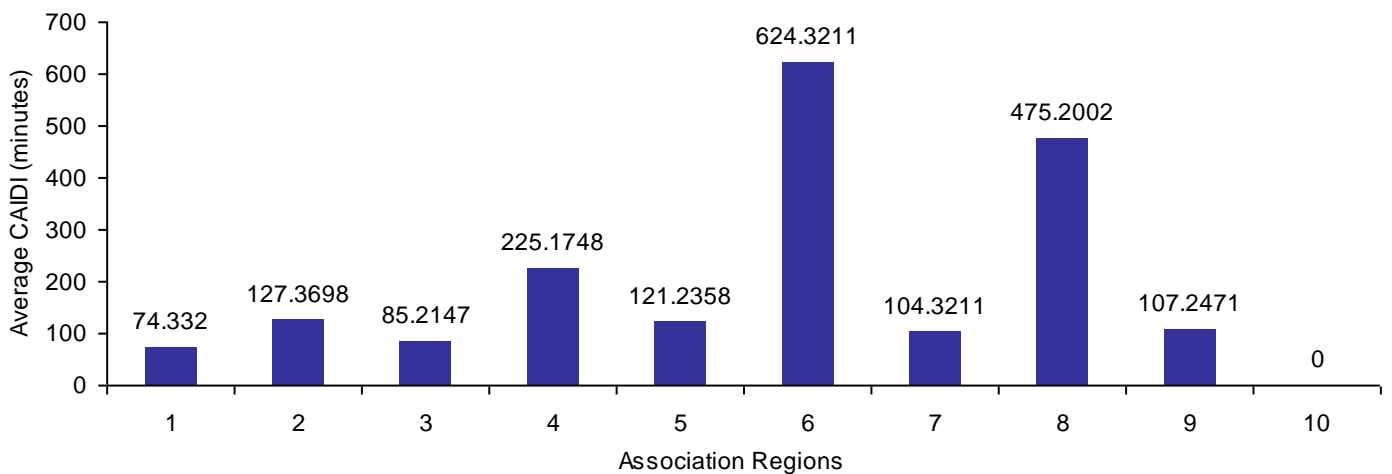
Momentary Average Interruption Frequency Index (MAIFI)

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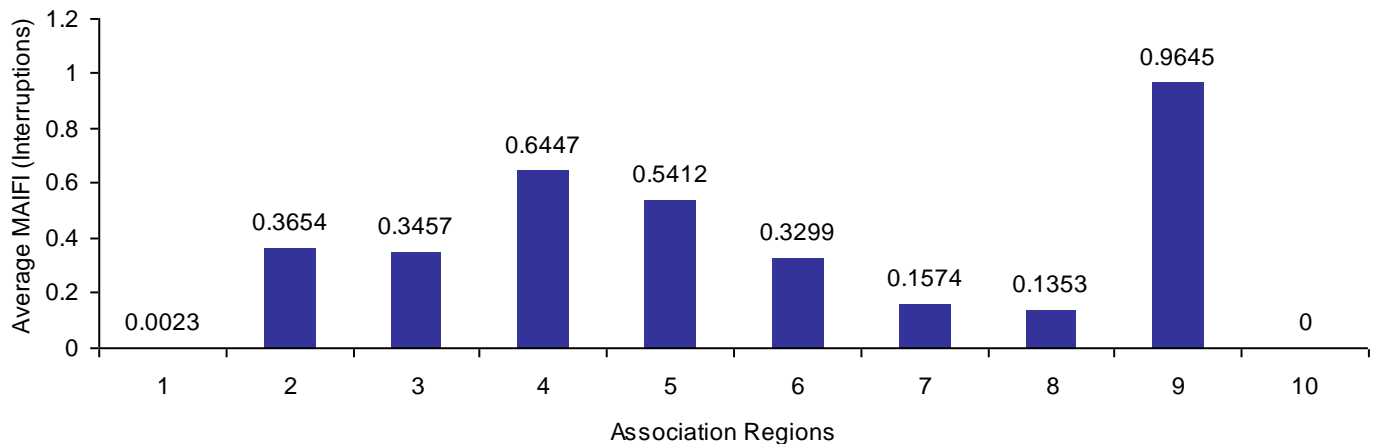
Table 8
Average MAIFI for all utilities that use the eReliability Tracker, belong to your region, and are grouped in your customer size class

Your utility's MAIFI:	15.2478
Average eReliability Tracker MAIFI	0.4715
Average MAIFI for Utilities Within Your Region	0.3457
Average MAIFI for Utilities Within Your Customer Size Class	0.2228

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)	0.1596
Maximum Value	15.0399

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

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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 (%):	99.9924
Average eReliability Tracker ASAI	99.9695
Average ASAI for Utilities Within Your Region	99.9718
Average ASAI for Utilities Within Your Customer Size Class	99.9992

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

Minimum Value	99.0091
First Quartile (25th percentile)	99.9879
Median Quartile (50th percentile)	99.9897
Third Quartile (75th percentile)	99.9953
Maximum Value	99.9999

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

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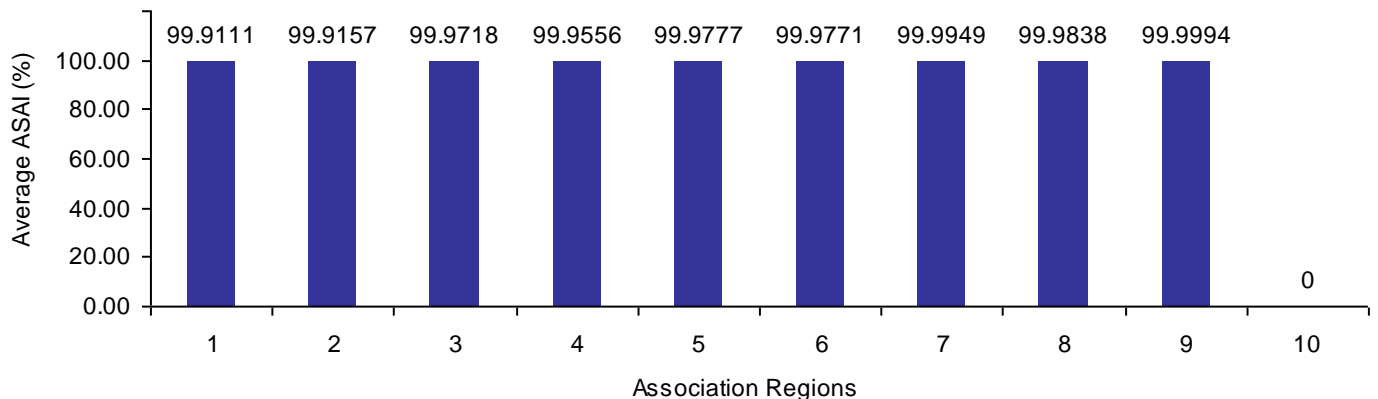
2016 Energy Information Administration (EIA) Form 861 Data

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 2016 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.

Additionally, it looks as though a number of utilities submitted incorrect data, which shows itself most in the average SAIFI numbers. 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 compiled from 2016 data collected by EIA

	IEEE Method		Other Method	
	All	No MEDs	All	No MEDs
Average	314.2593	128.6160	210.6055	111.4045
Minimum Value	0.2840	0.0000	0.1740	0.1740
First Quartile (25th percentile)	81.7025	54.3800	31.4225	23.5100
Median Quartile (50th percentile)	154.8600	101.9000	97.0000	80.9000
Third Quartile (75th percentile)	292.7500	164.5150	205.1620	153.3400
Maximum Value	6957.4700	1099.0700	3163.4000	648.0000

Table 13
Summary statistics of the SAIFI data compiled from 2016 data collected by EIA

	IEEE Method		Other Method	
	All	No MEDs	All	No MEDs
Average	1.6569	1.2989	1.3222	1.0575
Minimum Value	0.0040	0.0000	0.0000	0.0000
First Quartile (25th percentile)	0.8800	0.6700	0.4740	0.3900
Median Quartile (50th percentile)	1.3400	1.0700	1.0540	0.9300
Third Quartile (75th percentile)	2.0600	1.5600	1.7920	1.4400
Maximum Value	29.0000	28.0200	13.0000	5.8800

Analysis of Miles of Line and Interruptions

Benchmarking metrics were created to help utilities explore the relationship between outages, overhead line exposure, and customer density. More specifically, by using interruptions per overhead 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: 257.31

Table 14
Analysis of overhead miles of line and interruptions

	Interruptions per Mile	Customers per Mile
Your Utility:		21.45
Average for eReliability Tracker Utilities	0.9053	112.3967
Average for Utilities Within Your Region	0.8678	36.8674

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 2017.

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 Service [2]
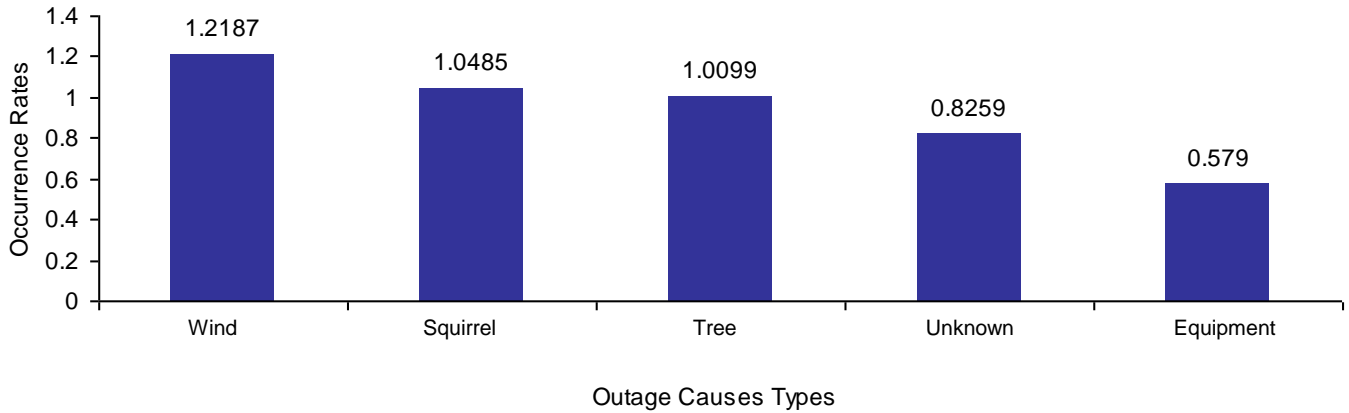

Figure 9
Top five customer-weighted causes of sustained outages for your utility [2]
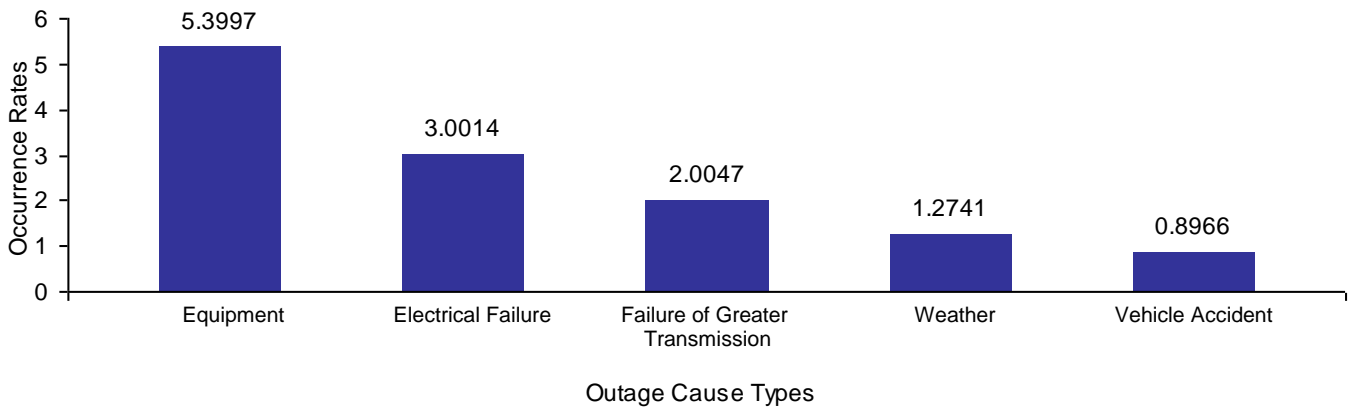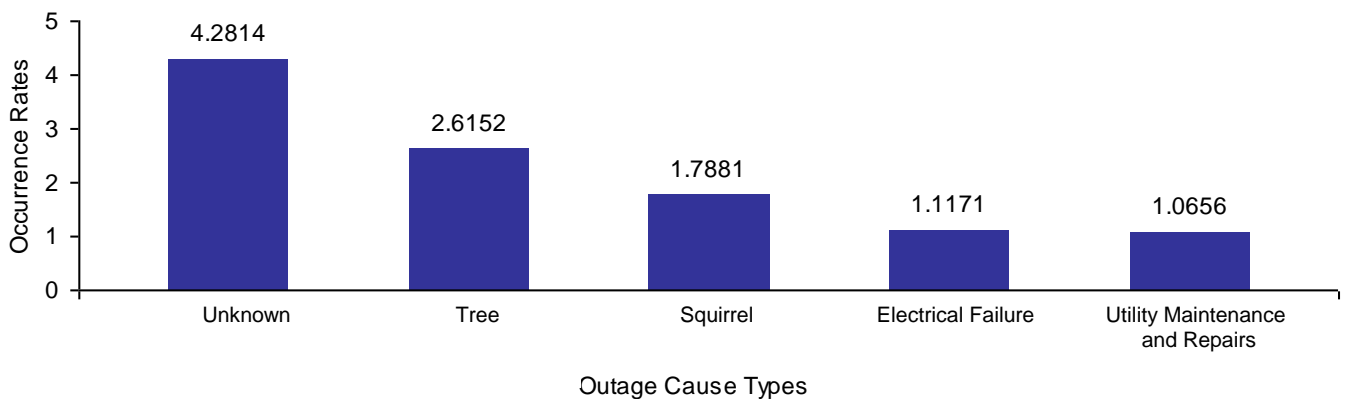

Figure 10
Top five customer-weighted occurrence rates for sustained outage causes in your region [2]

[2] For each utility, the number of occurrences for each cause is divided by that utility's customer size (in 1000s) to create an occurence 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 Service [2]
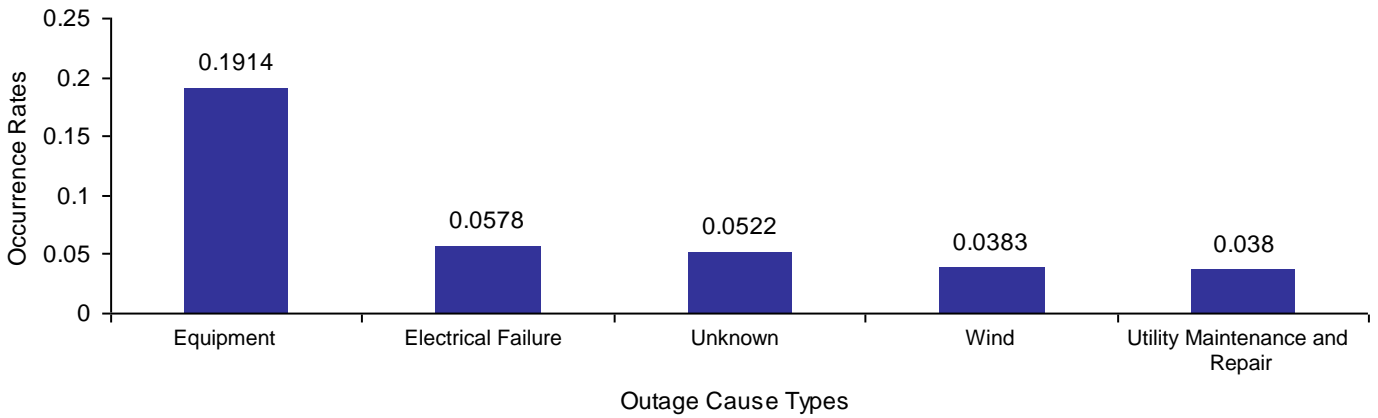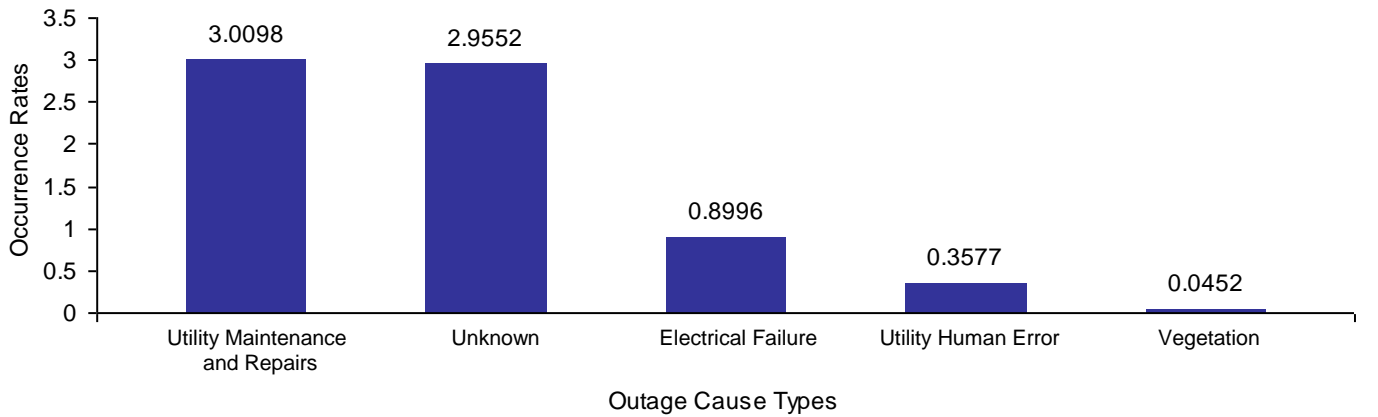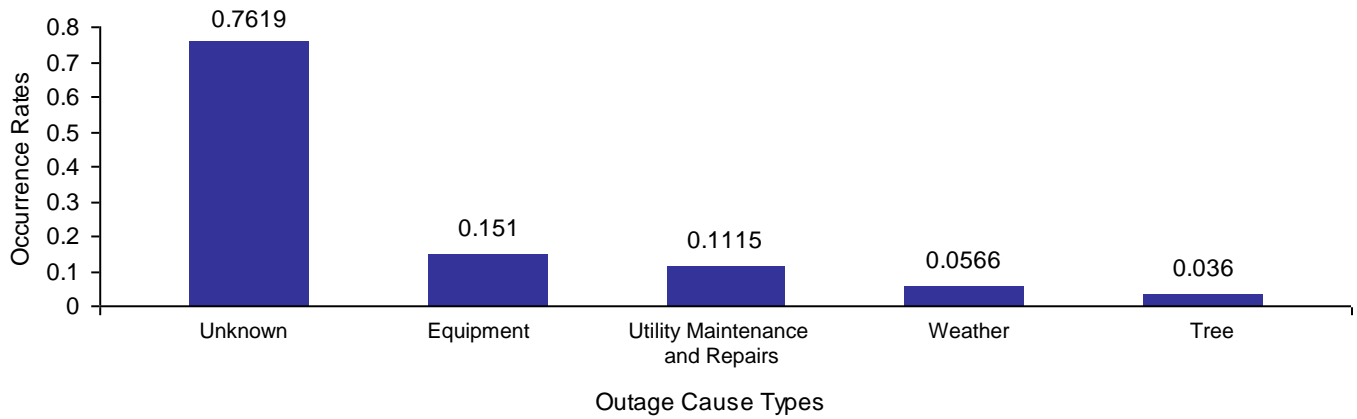

Figure 12
Top five customer-weighted causes of momentary outages for your utility [2, 3]

[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 region[2]

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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