2018 ELECTRIC RELIABILITY PERFORMANCE REPORT

Electric Distribution Systems

Office of Electric, Gas, and Water

June 2019

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The attached report presents the assessment by Department of Public Service Staff (Staff) of electric reliability performance in New York State for 2018. The Public Service Commission (Commission) primarily relies on two metrics commonly used in the industry to measure reliability performance: the System Average Interruption Frequency Index (SAIFI or frequency) and the Customer Average Interruption Duration Index (CAIDI or duration).[1] Frequency is influenced by factors such as system design, capital investment, maintenance, and weather. Decisions made by utilities today on capital expenditures and maintenance policies, however, can take several years before being fully reflected in the frequency measure. Duration, on the other hand, is affected by work force levels, management of the workforce, and geography.

Several means have been established to monitor the levels of service. First, utilities are required to submit detailed monthly interruption data to the Commission.[2] Next, the Commission adopted Service Standards, which among other things, set minimum performance levels for both the frequency and duration of service interruptions for each major electric utility's operating divisions. Each utility's performance is then compared with its Reliability Performance Mechanisms (RPMs), which is established in the most recent rate order for that utility. The RPMs include company-wide targets for outage frequency and duration; some RPMs have additional measures to address specific concerns unique to an individual company. RPMs are designed such that companies are subject to negative revenue adjustments for failing to meet electric reliability targets excluding major storms.[3]

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1 SAIFI is the average number of times that a customer is interrupted for five minutes or more during a year. CAIDI is the average interruption duration time in hours for those customers that experience an interruption during the year.

2 The regulated electric utilities consist of Con Edison, Central Hudson Gas & Electric Corporation (Central Hudson), New York State Electric & Gas Corporation (NYSEG), Niagara Mohawk Power Corporation, d/b/a National Grid (National Grid), Rochester Gas and Electric Corporation (RG&E), and Orange & Rockland Utilities, Inc. (Orange & Rockland). PSEG LI provides interruption data that is used to calculate statewide performance in this report.

3 Negative revenue adjustments are paid by shareholders and not by rate payers.

NYSEG narrowly met its target for frequency and failed to meet its target for duration; resulting in a revenue adjustment of approximately $3.5 million. Central Hudson did not meet its RPM target for frequency; resulting in a revenue adjustment of approximately $2.0 million. However, Central Hudson's duration performance was at a 10-year best. Con Edison met its frequency and duration targets on both its radial and network distribution systems, but frequency and duration performance declined compared to last year and the five-year average on both systems. National Grid met its targets for frequency and duration although its duration performance declined slightly since last year. While Orange & Rockland and RG&E also met their targets for frequency and duration; their frequency performance declined slightly since last year. Unlike the investor-owned utilities, PSEG LI does not have rate orders or RPMs set by the Commission but does have performance metrics associated with reliability set as part of an Operating Service Agreement. PSEG LI met both its frequency and duration performance metrics in 2018.[4]

In addition to Staff's review, the utilities are required to perform a reliability analysis. The utilities must submit a report by March 31 of each year containing detailed assessments of performance, including historic performance for the preceding five years, outage trends in the utility's various geographic regions, reliability improvement projects, analyses of worst-performing feeders, and, where needed, corrective action plans. Recent data is also compared with historic performance to identify positive or negative trends.

By compiling the interruption data provided by the individual utilities, the average statewide frequency and duration of interruptions can be reviewed to assess the overall reliability of electric service in New York State. Excluding major storms, the statewide interruption frequency for 2018 declined slightly compared to last year, as well

[4] Amended and Restated Operations Services Agreement between Long Island Lighting Company d/b/a LIPA and PSEG Long Island LLC, Dated as of December 31, 2013. (http://www.lipower.org/papers/agreements.html).

as compared to the statewide five-year average (as shown in Figure 1, page 7).[5] Declines were seen in Central Hudson's, Orange & Rockland's, and RG&E's performance. Statewide, the three major causes for interruptions, excluding storms, were equipment failures, tree contacts, and accidents or events not under the utility's control. These three categories combined account for approximately 83 percent of all interruptions. Equipment failures saw a jump due to a unique substation event in Central Hudson's territory. Central Hudson, National Grid, and NYSEG reported tree contacts as the main driver for interruptions in their service territories. Central Hudson and National Grid reported equipment failure as the second leading cause of interruptions, while NYSEG reported accidents its second leading cause.

In 2018, the statewide duration performance, excluding major storms, was longer than the 2017 duration performance, as well as the statewide five-year performance average (as shown in Figure 3, page 9). RG&E, National Grid, Con Edison, Orange & Rockland, and PSEG LI's duration performance declined from 2017 contributing to the overall statewide decline, however, they met their duration targets. Central Hudson's average duration was significantly better than last year and the five-year average. NYSEG's duration performance was worse than its performance last year, its five-year average, and RPM target, resulting in a $3.5 million negative revenue adjustment.

With respect to major storms, 2018 had more customer hours of interruption than 2017. The state experienced 36 separate major storm events in 2018; the five largest storms occurred between March 2 and May 20, 2018. Winter Storm Riley impacted most of New York State on March 2, 2018 with heavy, wet snow, particularly in the lower Hudson Valley Area. As a result, electric utilities incurred peak outages of nearly 500,000 statewide. Shortly after that, on March 7, 2018 another significant event,

[5] Major Storm is defined as any storm which causes service interruptions of at least ten percent of customers in an operating area, or if the interruptions last for 24 hours or more. To balance between service interruptions under a utility's control, such as equipment failures, and those which a utility's control is more limited, such as an ice storm, Staff reviews reliability data both including and excluding severe weather events.

Winter Storm Quinn, impacted many of the same areas causing additional peak outages of 162,000. There were two windstorms, one on April 4, 2018 and one on May 4, 2018 causing peak outages of 126,000 and 160,000 respectively. The final event was a severe thunderstorm system with confirmed tornados on May 15, 2018 that affected multiple counties causing peak outages of 188,000.

During these events, Staff observed and documented utility restoration and communication activities. Because of the extended length of restoration and deficiencies observed at the time of these events, Staff commenced an extensive investigation. Staff's investigation resulted in over 90 recommendations detailing actions to be taken by the utilities to improve future storm preparation and restoration performance. Findings and recommendations of the investigation are in a document titled *2018 Winter and Spring Storms Investigation.*[6]

INTRODUCTION

The Commission's regulations require utilities delivering electricity in New York State to collect and submit information to the Commission regarding electric service interruptions on a monthly basis.[7] The Commission also adopted electric service standards addressing the reliability of electric service provided to end-use customers in New York. The standards contain minimum acceptable performance levels for both the frequency and duration of service interruptions for each major electric utility's operating divisions.[8] Then, company-wide performance expectations are set in RPMs established by the Commission in rate orders for each utility, except for PSEG LI, which are set in the Operating Service Agreement. The RPMs are designed such that companies are

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[6] Case 19-M-0285, In the Matter of Utility Preparation and Response to Power Outages During the March 2018 Winter and Spring Storms, 2018 Winter and Spring Storms Investigation (filed April 18, 2019).

[7] 16 NYCRR Part 97, Notification of Interruption of Service, requires utilities to keep detailed back-up data for six years.

[8] There are no revenue adjustments for failure to meet a minimum level under the electric service standards; utilities are, however, required to include a corrective action plan as part of the annual report.

subjected to negative revenue adjustments for failing to meet the associated reliability targets.

The interruption data the utilities provided enables Staff to calculate two primary performance metrics: SAIFI or frequency and CAIDI or duration. The information is grouped into 10 categories that delineate the nature of the cause of interruption (cause code).[9] Analysis of the cause code data enables the utilities and Staff to identify areas where increased capital investment or maintenance is needed. As an example, if a circuit were shown to be prone to lightning-caused interruptions, arrestors could be installed on that circuit to try to minimize the effect of future lightning strikes. In general, most of a utility's interruptions are a result of major storms, equipment failures, tree contacts, and accidents.[10] Staff maintains interruption data from 1989 to the present in a database, which enables the observation of trends. The utilities must submit a formal reliability report by March 31 of each year that compares data against both the system-wide RPM targets and the operating division targets established in the Commission's Service Standards. The RPMs include company-wide targets for outage frequency and duration. Some RPMs have additional measures to address specific concerns unique to an individual company.[11]

2018 RELIABILITY PERFORMANCE

The following sections provide a summary discussion of the reliability performance statewide and for each of the major utilities. Individual company

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[9] 16 NYCRR Part 97, Notification of Interruption of Service, specifies and defines the following ten cause codes that reflect the nature of the interruptions: major storms, tree contacts, overloads, operating errors, equipment failures, accidents, prearranged interruptions, customers equipment, lightning, and unknown. There are an additional seven cause codes used exclusively for Con Edison's underground network system.

[10] The accident cause code covers events not entirely within in the utilities' control including vehicular accidents, sabotage, and animal contacts. Lightning is reported under a separate cause code.

[11] National Grid has a project estimating target, which it missed, resulting in a $2 million negative revenue adjustment for 2018.

discussions identify issues or actions within each company that influenced performance levels for 2018 and indicate company-specific trends where applicable. Each year, Staff prepares an Interruption Report summarizing the monthly interruption data submitted by New York's utilities. The *2018 Interruption Report* contains detailed interruption data for each utility and statewide statistics for the past five years. The Interruption Report for 2018 is attached as an Appendix to this Memorandum.

Interruption data is presented in two ways in this report – with major storms excluded and with major storms included. Major storm interruptions are excluded from the data used in calculating performance levels for service standards and reliability performance mechanisms. This exclusion achieves a balance between service interruptions under a utility's control, such as equipment failures and line maintenance, and those over which a utility's control is more limited, such as a severe ice storm or a heavy wet snowstorm. Reliability performance data inclusive of major storms reflects the overall customer experience during a year.

STATEWIDE - Excluding Major Storms

For many years, Staff has combined individual utility performance statistics into overall statewide statistics. By doing so, Staff is able to evaluate the level of reliability provided statewide and identify statewide trends. Since Con Edison's system includes many large, highly concentrated distribution networks that are generally less prone to interruptions than overhead systems, its interruption frequency is extremely low (better) compared to the other utilities. This, combined with the fact that it serves the largest number of customers in the state, typically results in a skewing of the performance measures. As a result, Staff examines and presents aggregated data both including and excluding Con Edison's data.

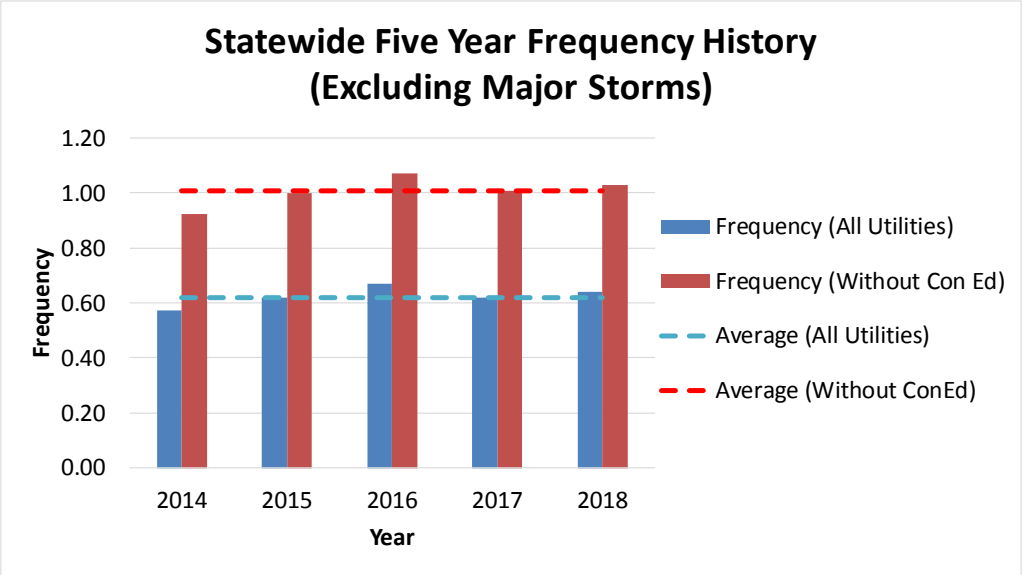


Figure 1: Statewide Frequency Performance

Statewide, as shown in Figure 1, the frequency of interruptions excluding major storms was 0.64 in 2018, which is slightly worse than 2017 and the statewide five-year average of 0.62. The frequency performance in 2018, for all utilities other than Con Edison, was 1.03, which is also slightly worse than 2017 and the five-year average of 1.01. As discussed later, extensive major storms had a negative effect on reliability in New York in 2018. When including major storms, the 2018 statewide frequency performance was 1.01 and 1.62 for utilities other than Con Edison, indicating the effect major storms had on the upstate utilities.

The major causes for interruptions excluding storms were equipment failures and tree contacts. To reduce the frequency of interruptions, the utilities invest in numerous capital projects, inspections, and maintenance activities. Projects targeted at reducing equipment failures include adding, updating, or replacing equipment and strengthening transmission and distribution lines. For example, to reduce the possibility of outages, fuses and other protective devices are being installed on circuits. More detailed projects descriptions can be found in the utility specific sections.

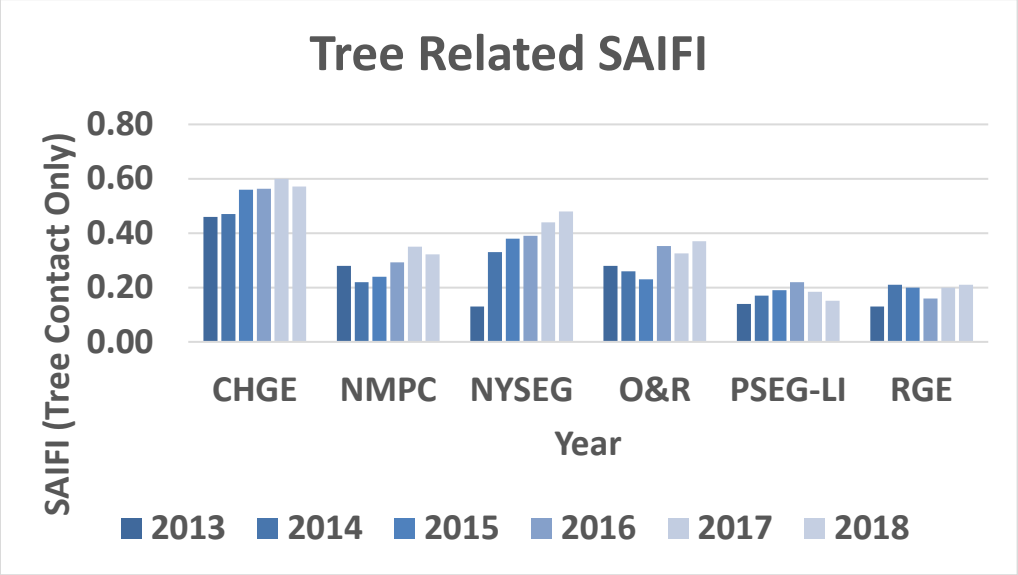


Figure 2: Tree Related SAIFI

Several companies have taken proactive measures to address this worsening trend in the frequency of tree related interruptions. Five years ago, PSEG LI improved its tree trimming program by increasing the clearance between vegetation and overhead wires and increasing the removal of hazard trees. Figure 2 shows the positive effects on reliability PSEG LI's program has had in 2017 and 2018. National Grid and Central Hudson both implemented emerald ash borer danger tree removal programs in 2017; National Grid began in January and Central Hudson began in September. Under these programs, the companies identify and remove danger Ash trees posing an imminent threat from outside the clearance zone to electric distribution infrastructure. Figure 2 shows reliability improvements in 2018 tree related SAIFI for both companies. In March, Orange & Rockland began implementation of its *Ash Tree Mitigation Program*.[12] National Grid, Central Hudson, and Orange & Rockland expect these programs will have a positive impact on reliability in the coming years.

Figure 3, below, shows the historical statewide interruption duration index, excluding major storms. The 2018 overall statewide interruption duration index of 1.96

[12] Case 18-E-0067, Orange & Rockland – Electric Rates.

hours is 4.8 minutes longer than the 2017 duration index of 1.88 hours and 2.4 minutes longer than the statewide five-year average of 1.92 hours. The statewide interruption duration index, excluding Con Edison, was 1.88 hours in 2018, which is 4.2 minutes longer than the 2017 duration index of 1.81 hours and 2.4 minutes longer than the statewide five-year average of 1.84 hours. NYSEG, Orange & Rockland, and PSEG LI's duration performance declined from 2017 contributing to the overall statewide decline. The utilities attribute their decline in performance to minor storm events that did not meet the major storm exclusion.

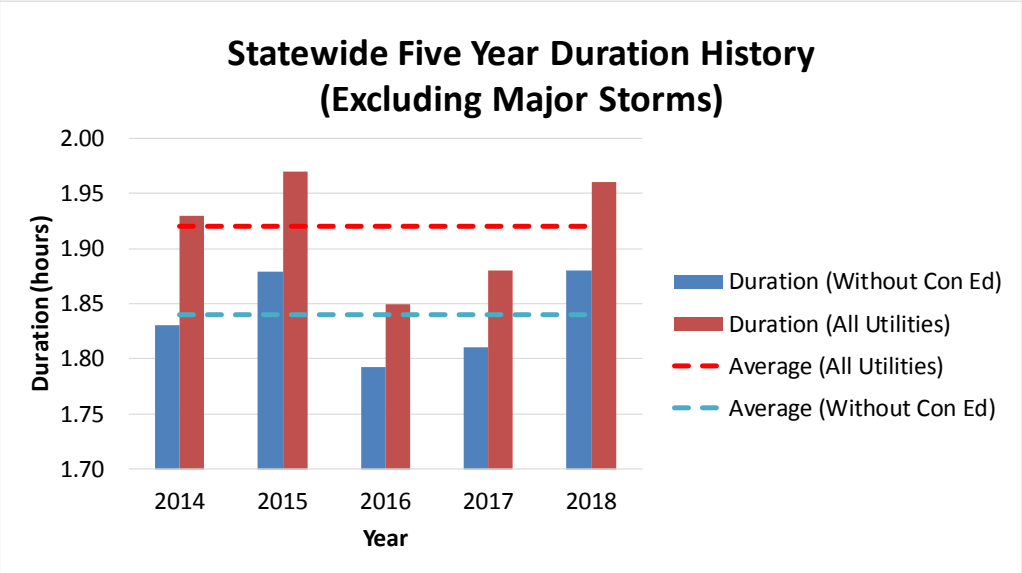


Figure 3: Statewide Duration Performance

STATEWIDE - Including Major Storms

The majority of storm related outages during 2018 were caused by five storms which occurred between March 2 and May 20. The first storm event, Winter Storm Riley, impacted most of the State on March 2, 2018 and included heavy, wet snow, particularly in the lower Hudson Valley area. Winter Storm Riley also impacted Western New York more than expected with snow accumulations up to 22 inches when forecasts called for approximately 12 inches. As a result, electric utilities incurred peak outages of

approximately 500,000 statewide. On March 7, 2018, Winter Storm Quinn, caused 162,000 additional outages in the lower Hudson Valley and delayed on-going restoration efforts by Con Edison, NYSEG, and Orange & Rockland.

There were two windstorms, one on April 4, 2018 and one on May 4, 2018. The April windstorm brought damaging winds and widespread rain to many areas of the State including Western New York, Finger Lakes, Central New York, Mohawk Valley, Southern Tier, North Country, Capital Region, and Mid-Hudson regions. National Grid, NYSEG, and RG&E were the most significantly impacted by this event. The April windstorm caused peak outages of approximately 126,000. The May windstorm affected the North Country, Mohawk Valley, Capital Region, as well as areas along Lakes Erie and Ontario. The May windstorm caused approximately 160,000 outages in National Grid's and NYSEG's service territory. Customers within the other utility service territories were not significantly affected by this event. The final event was a severe thunderstorm system with confirmed tornados on May 15, 2018 that affected multiple counties causing peak outages of 188,000. This event impacted many of the same communities previously affected by Winter Storms Riley and Quinn. During these events, Staff observed and documented utility restoration and communication activities.

Because the outages lasted for more than three days and deficiencies were observed at the time of these events, Staff commenced an extensive investigation. In addition, the utilities were required to file with the Commission a storm report and scorecard for each event lasting longer than three days in their service territory. [13]

Staff's investigation included 20 public statement hearings across the State where numerous customers and public officials provided comments; interviews with many county, city, and town officials; meetings and comments from customers and

[13] 16 NYCRR §105.4(c), requires utilities to file reports reviewing all aspects of its preparation and system restoration performance for outages lasting longer than three days. These reports, as well as Staff's may be found on the Department's website: http://www.dps.ny.gov; see Case 19–M-0285, In the Matter of Utility Preparation and Response to Power Outages During the March 2018 Winter and Spring Storms. Order Approving the Scorecard for Use by the Commission as a Guidance Document to Assess Electric Utility Response to Significant Outages (issued December 23, 2013).

stakeholders; and extensive public outreach to better understand the issues experienced during these storms. Staff also issued over 700 information requests; evaluated complaint data filed with the Department's Office of Consumer Services; and reviewed other significant information. Staff's investigation resulted in over 90 recommendations detailing actions to be taken by the utilities to improve future storm preparation and restoration performance. The most substantial recommendations related to road clearing, damage assessment, estimated times of restorations, and utility communications with customers and county and local officials. As stated previously, findings and recommendations of the investigation are in a document titled *2018 Winter and Spring Storms Investigation.*

In 2018, major storms accounted for over 80 percent of the total customer-hours of interruptions and 36 percent of the overall number of customers affected. As can be seen in Figure 4, calendar year 2018 had more customer hours of interruption when including major storms than calendar year 2017. Calendar year 2018 ranks third in customer hours of interruption in the last twenty years following Hurricane Irene and Tropical Storm Lee in 2011 and Hurricane Sandy in 2012. As previously discussed, the five largest storms occurring between March 2 and May 20, 2018 accounted for the majority of the change in performance. Additionally, numerous fronts passed through the state in 2018 resulting in damaging winds, thunder storms, heavy snow, and/or ice. The state experienced 36 separate events in 2018 that qualified as major storms. Of the 36 major storm events, 34 impacted National Grid, 25 impacted NYSEG, 13 impacted Con Edison, 10 impacted PSEG LI, nine impacted RG&E, nine impacted Central Hudson, and five impacted Orange & Rockland. Sustained interruptions associated with major storms in 2018 increased approximately 76 percent over 2017. The storms generally affected upstate service territories more than downstate.

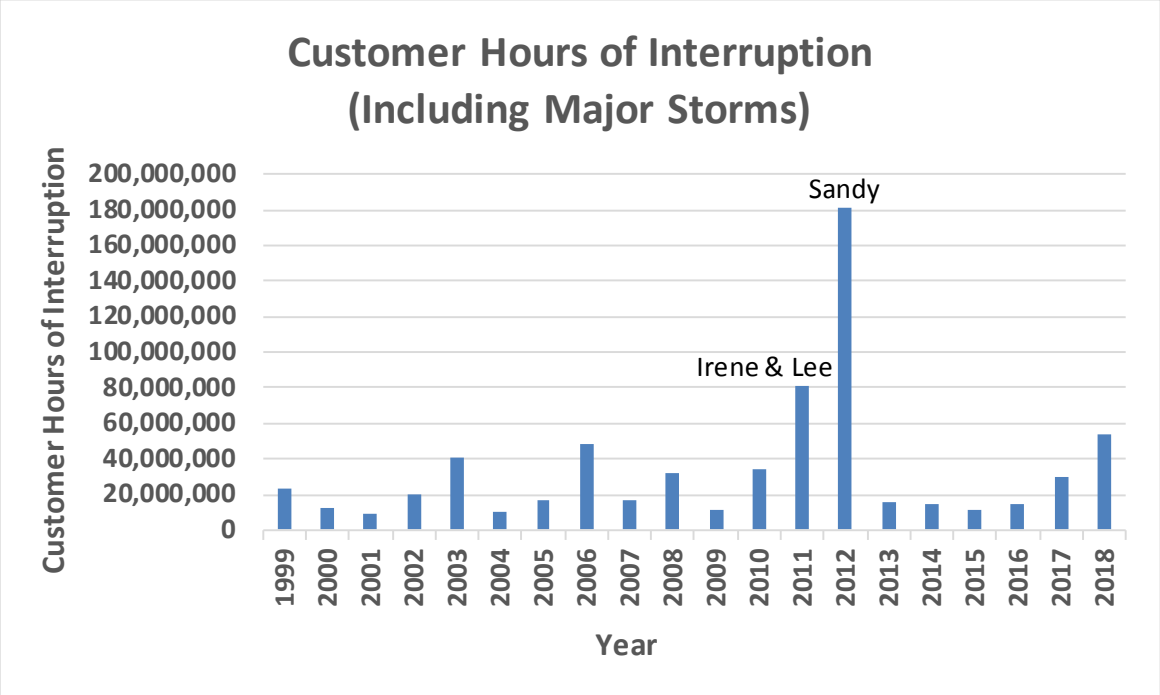


Figure 4: Customer Hours of Interruption (Including Major Storms)

CON EDISON

Table 1: Con Edison's Historic Performance Excluding Major Storms

Performance Metric	2014	2015	2016	2017	2018	Current RPM Target	Five-Year Average
Network Systems							
Frequency Customer Interruptions per 1,000 Customers	2.36	2.30	2.26	2.32	2.40	2.50	2.33
Duration Avg Interruption Hours	4.92	4.58	4.16	4.61	4.64	4.70	4.58
Radial System							
Frequency (SAIFI)	0.33	0.35	0.43	0.36	0.40	0.495	0.37
Duration (CAIDI)	1.83	1.95	1.89	1.92	1.99	2.04	1.92

Note: Data presented in red represents a failure to meet the RPM target for a given year.

Con Edison serves approximately 3.46 million customers in New York City and Westchester County. Electricity is supplied to 2.57 million customers by network systems, while the remaining 896,000 customers are supplied by radial systems. The network system is mostly underground wires housed in conduits, whereas the radial system is the typical overhead configuration. The two systems are subject to different reliability metrics specifically designed for their configurations. The number of interruptions per 1,000 customers served and average interruption duration is used to gauge network performances, while the radial system is measured in the same manner as other utilities.

Network Systems Performance

For network outage frequency, Con Edison met its RPM target of 2.50 in 2018, with a performance of 2.40. The 2018 network outage frequency performance is a slight decrease in performance over last year and is above the five-year average. For network outage duration, the Company met its RPM target of 4.70 with a performance of 4.64. Con Edison's network performance for duration in 2018 also declined slightly from its performance last year but was still below the company's RPM performance target. When compared to 2017 performance, network systems in Brooklyn, Queens, Manhattan,

and Westchester experienced less frequent outages. While duration improved on the Brooklyn and Manhattan network systems.

Con Edison is planning to improve reliability to its underground distribution systems through its *Smart Sensors* program. *Smart Sensors* is based on a 2017 pilot project and will be deployed on a targeted basis beginning in 2020. The program will use sensing technology, which will provide greater situational awareness of the electric system and data analytics to more effectively plan and operate the system. Con Edison will deploy three different types of sensors: structure observation system, embedded sensors, and pressure sensors. The structure observation system is an environmental sensor that will monitor combustible gases, stray voltage, overheating, and visible deterioration in structures such as manholes and service boxes. Embedded sensors in cable equipment will collect electrical data such as current, phase angle, and temperature of primary and secondary cable. Pressure sensors will help to determine if there are leaks or faults in the network protector housing that would lead to failed operations. These sensors will reduce risks by identifying and notifying faulty conditions that exceed pre-determined values. The *Smart Sensors* program provides reliability benefits through greater visibility of equipment performance.

Con Edison is also developing an *Underground Network Resiliency* program, which will use auto isolating interrupters to improve the resiliency of the underground distribution system. Currently, isolation switches across the underground system allow Con Edison to manually reconfigure and isolate a fault, after the breaker trips open. If the fault is on the load side of the switch, the switch allows Con Edison to partially restore the primary distribution feeder by manually reconfiguring the system and dispatching a crew. The auto isolating interrupters will improve reliability by automatically sensing, reconfiguring, and restoring portions of the primary feeder after a primary feeder fault. The auto isolating interrupter eliminates the time traditionally spent to reconfigure and restore equipment to service. Beginning in 2020, the program will be deployed on a targeted basis starting in areas with the greatest reliability gains and the lowest cost.

Radial Performance

On its radial system, Con Edison met its system-wide RPM frequency target of 0.495 and its duration performance target of 2.04 with performances of 0.398 and 1.99, respectively. However, both Con Edison's frequency and duration performance declined since last year. As shown in Figure 5, the majority of interruptions were caused by company equipment failure. The next leading contributors were tree contacts and accidents outside the company's control.

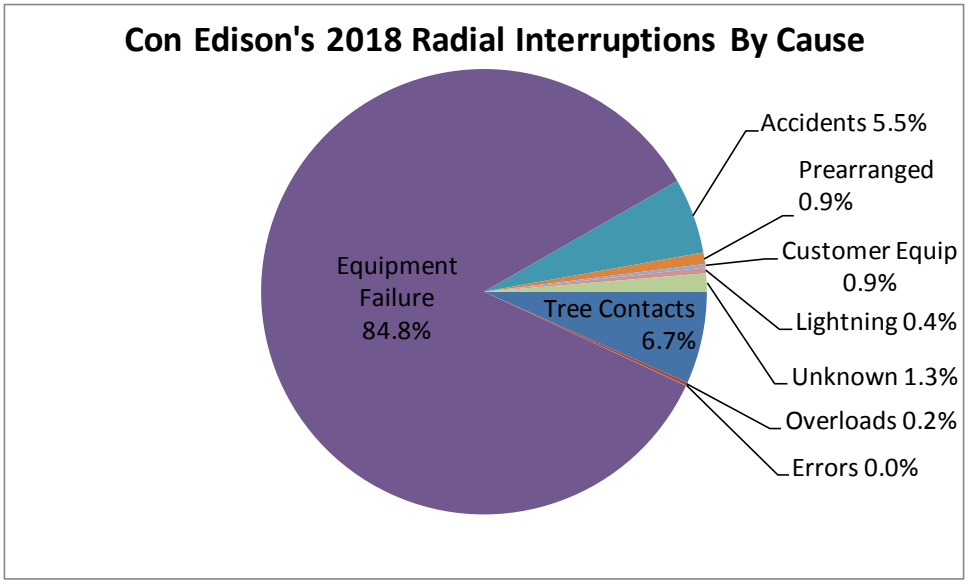


Figure 5: Con Edison's 2018 Radial Interruptions by Cause (Excluding Major Storms)

When compared to 2017 performance, the Bronx experienced less frequent outages on its radial systems and duration improved on the Brooklyn radial system. In Bronx, Queens, Westchester, and Staten Island, the company's 2018 radial duration performance was not as good as its 2017 performance. The decline in radial duration performance is primarily driven by equipment failures. One of the main obstacles in achieving duration targets is the travel time required for Brooklyn/Queens construction crews to travel from existing service centers to events in Southern Queens. As a result, Con Edison is planning a new service center on its Brinkerhoff Avenue property in Queens. Staging crews directly from the new service center will reduce response times between 30 and 60 minutes and help reduce overall event durations. Design work

associated with the proposed service center will begin in 2022. In the interim, Con Edison is maintaining consistent staffing levels around the clock within all response groups and is supplementing off-shift response crews with overhead constructions crews during the peak summer months.

To maintain the reliability of its radial system, Con Edison will continue to invest in the resiliency of its overhead distribution system. The company will replace some existing poles with stronger H1 class poles, upgrade specific sections of overhead wires with more resilient cable, split large auto loops into smaller auto loops, and incorporate breakaway hardware and detachable service cable into the overhead system. Smaller auto loops minimize the customer impact and allow for quicker restoration. Breakaway hardware reduces the likelihood of pole and customer equipment damage; it also reduces restoration times by eliminating running new lines or splicing. Con Edison is also expanding its tree trimming program to include preemptive removal of hazardous/danger trees outside of its right-of-way.

NATIONAL GRID

Table 2: National Grid's Historic Performance Excluding Major Storms

Performance Metric	2014	2015	2016	2017	2018	Current RPM Target	Five-Year Average
Frequency (SAIFI)	0.96	1.02	1.05	1.03	1.02	1.13	1.01
Duration (CAIDI)	1.94	2.04	2.02	1.99	2.04	2.05	2.00

National Grid's electric territory in New York is composed of eight divisions: Capital, Central, Frontier, Genesee, Mohawk Valley, Northeast, Northern, and Southwest. National Grid serves a total of approximately 1.6 million customers. For 2018, the company met both the frequency and duration RPM reliability targets. The 2018 frequency level of 1.02 is an improvement over recent years and its best performance since 2015. The 2018 duration performance of 2.04 hours is a slight decrease in performance over the previous year and is above the five-year average.

At the division level, the company met its frequency targets in seven of the eight divisions, with only the Genesee Division coming in below its target for frequency. Customers in the Mohawk Valley, Northeast, Northern, and Southwest Divisions experienced improvements in frequency in 2018. The company met its duration targets in five of the eight divisions across the State, with the Capital, Genesee, and Mohawk Divisions coming in below their targets in 2018. Customers in the Northeast, Northern, and Southwest Divisions experienced improvements in duration in 2018.

As shown in Figure 6, tree contacts at 29.6 percent, equipment failure at 28.2 percent, and accidents at 16.7 percent are the predominant causes of interruptions throughout National Grid's service territory. Historically, the leading cause of interruptions has been either equipment failure or tree contacts, with each accounting for approximately 30 percent of total customer interruptions.

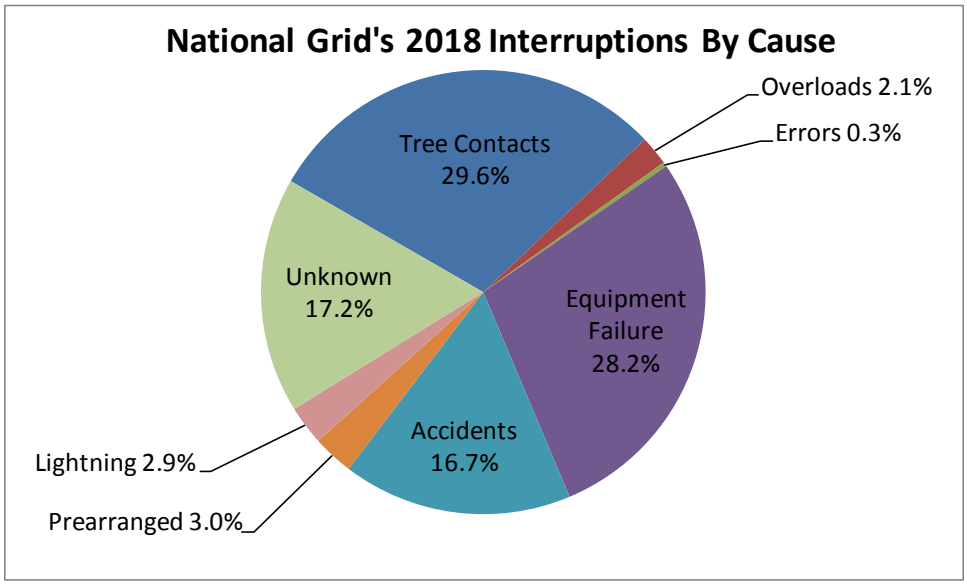


Figure 6: National Grid's 2018 Interruptions by Cause (Excluding Major Storms)

With respect to tree contact interruptions, National Grid has been working to enhance its vegetation management program with additional efforts and programs such as aggressive removal of hazardous trees found outside the regular trimming specifications and its proactive Emerald Ash Borer (EAB) program. Although the EAB program only began in January of 2017, results from the 2017 efforts showed that

approximately 3 percent of the total tree interruptions were cause by ash trees. Of those ash tree interruptions, approximately a third of those ash trees were identified with EAB. These initial numbers seem to support the efforts of this proactive program being justified and effective in the coming years.

In 2018, tree contacts decreased by 8 percent from 2017, the number of customers interrupted by tree contacts decreased by 18 percent, and the customer-hours associated with tree contacts decreased by 18 percent. The company's tree related SAIFI decreased by 19 percent, while the CAIDI increased by 1 percent in 2018. Overall, Staff is satisfied and optimistic for continued improvement with tree related efforts and results by National Grid.

In addition to National Grid's vegetation management efforts, the company has a number of capital and maintenance programs in place to help ensure reliability on the electric system is maintained. Some worst performing circuits are selected for an Engineering Reliability Review (ERR) that gives a more in-depth review/analysis of the characteristics and performance of the circuit. Examples of improvements identified through these efforts could be some of the following: adding fault indicators, feeder ties, capacitor banks, switches, reclosers, load balancing, and reconductoring. The company has also begun the installation of cutout mounted reclosers in 2018 that are aimed at reducing the number of sustained interruptions related to temporary faults on fused portions of the distribution system.

These actions are expected to increase feeder reliability and reduce the number of customers affected by future equipment failures. National Grid also uses its Inspection and Maintenance Program to identify and correct equipment issues. Motor Vehicle Accidents (MVA) continue to be the next largest cause of interruptions, and in 2018, MVA interruptions increased from the previous year and are higher than the five-year average. National Grid investigates all poles that are involved in vehicle accidents to identify hazardous locations and relocates poles if considered necessary.

NYSEG

Table 3: NYSEG's Historic Performance Excluding Major Storms

Performance Metric	2014	2015	2016	2017	2018	Current RPM Target	Five-Year Average
Frequency (SAIFI)	1.03	1.17	1.19	1.18	1.20	1.20	1.15
Duration (CAIDI)	1.97	1.97	2.02	2.06	2.17	2.08	2.04

Note: Data presented in red represents a failure to meet the RPM target for a given year.

NYSEG serves approximately 891,000 electric customers across upstate New York and some areas of Westchester and Putnam Counties. The company serves a primarily rural area that covers approximately 40 percent of New York. NYSEG's Divisions are Auburn, Binghamton, Brewster, Elmira, Geneva, Hornell, Ithaca, Lancaster, Liberty, Lockport, Mechanicville, Oneonta, and Plattsburgh. For reliability reporting purposes, the Lockport Division is combined with Lancaster.

In 2018 NYSEG failed to meet its target for duration. NYSEG had its worst performance since 2007. The 2018 outage duration of 2.17 hours is above the RPM target of 2.08 hours. As a result, NYSEG will be subject to a negative revenue adjustment of $3.5 million for not meeting the RPM target. Since faster outage troubleshooting and switching are key to restoring customers in less time; NYSEG is planning to increase staffing and hours of coverage in its Binghamton, Brewster, and Lancaster Divisions through its 24x7 trouble shooter program. The company is targeting a Summer 2019 roll out of this program. During 2018, supervisory control and data acquisition (SCADA) devices were installed at 80 locations in the Lancaster Division. These sectionalizing devices are capable of communicating back to the control center and will aid in quickly identifying the location of faults on 3-phase lines. The result is fewer customers affected and reduced outage durations. NYSEG plans to install 80 additional SCADA controlled devices in 2019.

NYSEG continues to install system fault indicators in locations that will assist crews in determining the location of faults. NYSEG has installed over 5,000 fault indicators on its system. These devices monitor conductor current and indicate faults with a flag, target, or flashing light. The indicators significantly reduce outage response

time by identifying the location of faults, which reduces circuit patrol times and customer outage durations. For example, on radial circuits, fault indicators help to quickly locate areas with system damage. This reduces the need to patrol whole circuits or long segments of a circuit. NYSEG also continues to install fuses, reclosers, or sectionalizers to segment faults to reduce restoration time.

For 2018, NYSEG narrowly met its RPM frequency target. The 2018 frequency level of 1.20 is above the five-year average of 1.15 and is in line with the RPM target. It should be noted that the company has been experiencing a decline in overall service reliability over the last three years. To address this concern, Staff requested that NYSEG perform a self-assessment to identify the needed actions and tools to improve its performance. Accordingly, the company filed its self-assessment with Staff on August 31, 2018. NYSEG has begun to develop the tools identified to improve its reliability performance. Due to the timing of the self-assessment report its impact has not yet been reflected in NYSEG's frequency and duration performance. In its 2018 reliability report, NYSEG discussed various distribution reliability projects completed in 2018 such as reconductoring, voltage conversion, SCADA/automation, and recloser projects. Staff will continue to interact with the company to ensure changes are implemented as well as monitor and report on the effectiveness of these efforts in future reports.

As shown in Figure 7 below, tree contacts, accidents, and equipment failure were the predominant causes of interruptions throughout NYSEG's service territory. Historically, trees have had the greatest impact on NYSEG's frequency rate; in 2018 approximately, 47 percent of all interruptions were caused by tree contacts. NYSEG continues to focus its tree trimming efforts in the Brewster and Liberty Divisions due to the tree density in these areas. NYSEG is three years into its five-year trimming cycle in the Brewster Division. In 2018, the company completed approximately 340 miles and 325 miles of distribution line clearance in the Brewster and Liberty Divisions, respectively. The company also has scheduled trimming on an additional 11 circuits in Brewster and 11 circuits in the Liberty Divisions during 2019. The company continues to trim hot spots in the Binghamton, Ithaca, Mechanicville, and Oneonta Divisions, as these areas experienced a higher than normal incidence of tree contact interruptions in 2018. In

the future, NYSEG should explore more aggressive and proactive approaches to mitigating tree contacts. The company should also consider implementing a more aggressive danger tree plan focused on identifying and removing danger trees, which pose a risk to distribution infrastructure from outside the clearance zone. With respect to motor vehicle accidents, NYSEG continues to review accident data to determine if changes or modifications to its systems can help mitigate these incidents. Potential solutions include relocating poles or adding reflective tape to increase visibility. In addition, based on the results from its distribution facility inspection program, there will be more investments to maintain equipment and improve reliability.

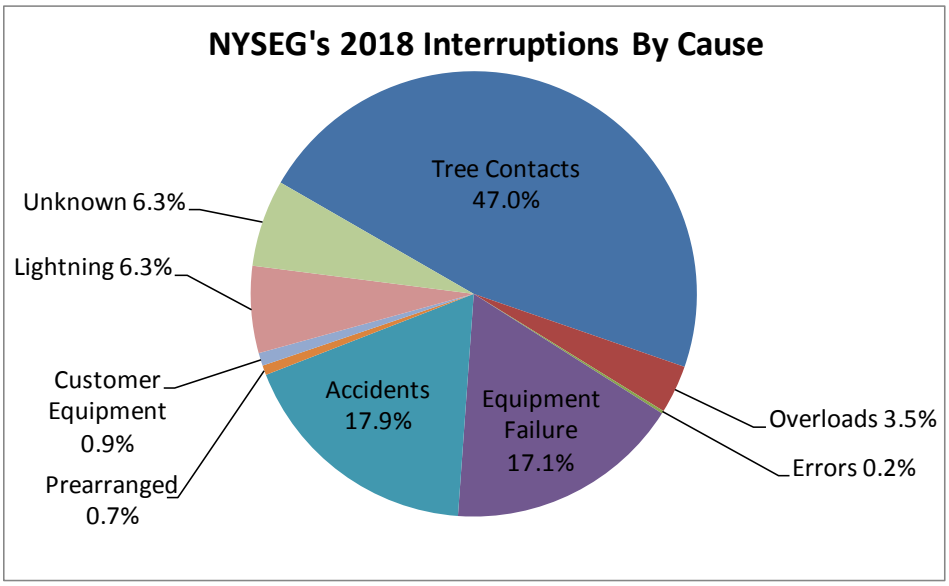


Figure 7: NYSEG's 2018 Interruptions by Cause (Excluding Major Storms)

At the division level, the Binghamton, Liberty, Geneva, and Ithaca Divisions all met their established frequency and duration targets. The Auburn, Hornell, and Lancaster Divisions met their frequency targets but failed the duration targets. The Brewster and Elmira Divisions failed their frequency targets but met the duration targets, while the Oneonta, Mechanicville, and Plattsburgh Divisions failed both indices. The company attributes its substandard performance to minor storm events that did not meet the major storm exclusion. NYSEG also experienced a large number of uncontrollable

events in 2018 including 12 motor vehicle accidents that impacted over 1,000 customers per event.

RG&E

Table 4: RG&E's Historic Performance Excluding Major Storms

Performance Metric	2014	2015	2016	2017	2018	Current RPM Target	Five-Year Average
Frequency (SAIFI)	0.76	0.75	0.58	0.59	0.75	0.90	0.69
Duration (CAIDI)	1.74	1.82	1.79	1.77	1.79	1.90	1.78

RG&E serves approximately 378,000 electric customers over its franchise area, located in and around Rochester. The company's territory is comprised of four divisions: Canandaigua, Genesee Valley, Lakeshore, and Rochester, with the Rochester Division accounting for approximately 80 percent of its customer base.

For the past five years, RG&E has consistently maintained high levels of electric service reliability for both frequency and duration. In 2018, RG&E surpassed its RPM targets of 0.90 for frequency and 1.90 for duration. While RG&E met its reliability targets at the corporate level in 2018, only the Rochester and Canandaigua Divisions satisfied both the frequency and duration targets at the division level. The Genesee and Lakeshore Divisions did not meet their frequency and duration performances targets. The Genesee and Lakeshore Divisions' duration indices both declined.

Overall, the three major causes for interruptions throughout RG&E's service territory were equipment failures, tree contacts, and accidents, as shown in Figure 8. RG&E is implementing a thermographic inspection program in an effort to reduce its high rate of equipment failures. With regard to tree related interruptions, RG&E will continue its hot spot trimming and maintenance clearing. The company is also implementing corrective actions to reduce the number of motor vehicle accidents such as relocating poles and installing reflectors on poles to increase visibility.

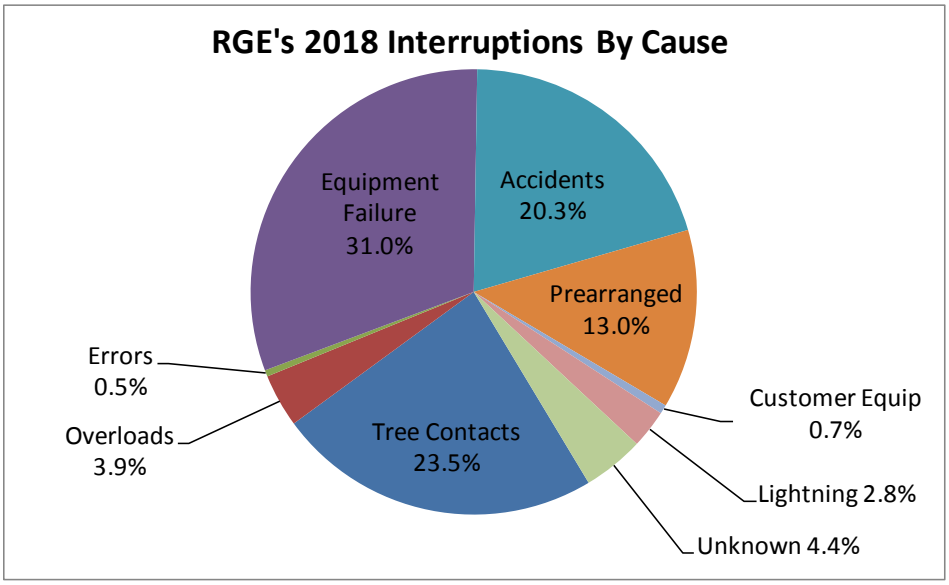


Figure 8: RG&E's 2018 Interruptions by Cause (Excluding Major Storms)

CENTRAL HUDSON

Table 5: Central Hudson's Historic Performance Excluding Major Storms

Performance Metric	2014	2015	2016	2017	2018	Current RPM Target	Five-Year Average
Frequency (SAIFI)	1.24	1.28	1.34	1.18	1.50	1.38	1.31
Duration (CAIDI)	2.27	2.07	2.33	2.20	2.04	2.50	2.18

Note: Data presented in red represents a failure to meet the RPM target for a given year.

Central Hudson serves approximately 300,000 customers in parts of the Hudson Valley Region. Central Hudson's divisions are Catskill, Fishkill, Kingston, Newburgh, and Poughkeepsie. About 70 percent of Central Hudson's territory is within the Kingston, Newburgh, and Poughkeepsie Divisions.

In 2018, Central Hudson's frequency performance of 1.50 did not meet the RPM target of 1.38. Tree contacts were the number one cause of interruptions for 2018 followed by accidents, and equipment failure. While interruptions due to tree contacts and accidents remained at comparable levels to prior years, interruptions due to equipment failures increased substantially. Equipment failure frequency saw an increase

over last year predominantly due to a transmission line opening in the Fishkill Division on July 12. The event was a unique outage that occurred while a portion of Central Hudson's transmission system was being operated radially due to a transmission line rebuild project. This transmission system event interrupted all circuits out of the Forgebrook, Tioronda, Merritt Park, Conway Place, and Shenandoah substations and over 21,000 customers. This single event accounted for 20 percent of equipment failure in 2018. With these outages backed out of the data, interruptions due to equipment failures would have been just above the five-year average.

To reduce the impact of substation and transmission-related outages, Central Hudson is taking risk mitigation steps on planned work. This includes alternative work methods such as live line techniques; reducing risk duration by scheduling longer and/or weekend workdays; using mobile transformers and generation in areas with high customer count; ensuring all prep work is completed before the planned outage begins; and ensuring the optimal crew composition to fit the specific task.

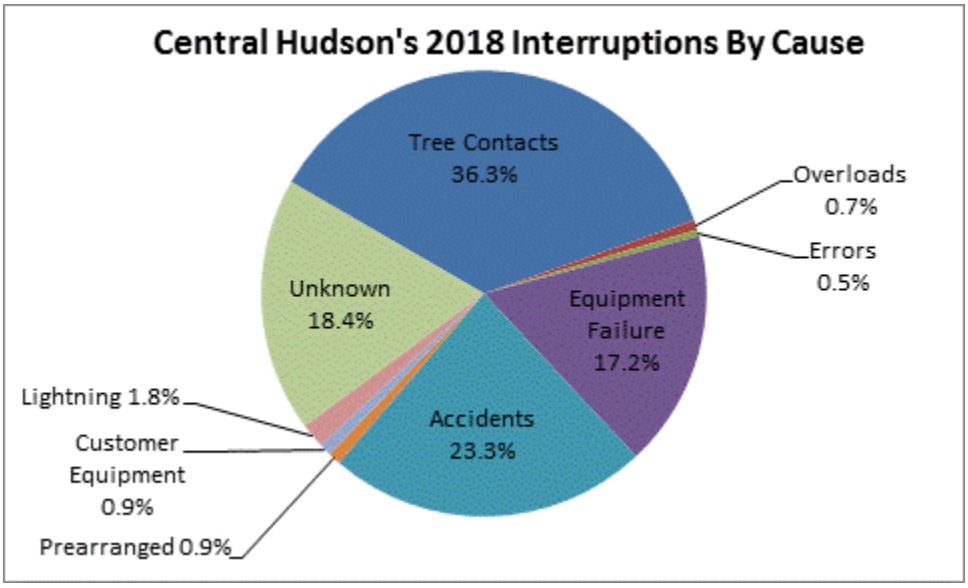


Figure 9: Central Hudson's 2018 Interruptions by Cause (Excluding Major Storms)

Figure 9 shows the breakdown of interruptions by cause. Tree contact interruptions remain the leading cause of interruptions throughout Central Hudson's service territory. After progressively increasing over the past five years, tree contact

interruptions were down 4.8 percent when compared to 2017 and 3.3 percent lower than the 5-year average. Approximately 50 percent of tree contact interruptions continues to be limbs and trees outside the clearance zone. The improvement in the frequency of tree contact interruptions from previous years can be attributed in part to Central Hudson's EAB danger tree removal program. Interruptions caused by trees from outside of the clearance zone improved in 2018 by 8.5 percent from 2017. Staff is pleased with the EAB program's initial impact on reliability but realize it may take several years to be fully reflected in the frequency metric.

Outages resulting from vehicle accidents remain at historically high levels, increasing by 3.2 percent when compared with 2017. The adverse trend within the accidents or events not under the utility's control cause code – can be attributed to an increase in the number of outages caused by squirrel contacts. To combat this trend, in addition to continued installation of animal guards and covered tap wire, Central Hudson has greatly increased its use of electronic reclosers to protect the distribution system. Additionally, based on research performed in 2018, Central Hudson has moved to a more effective type of animal guard in 2019. Primary drivers of equipment failures were at substations followed by cable failures and automatic splices.

The company has implemented several mitigation strategies in an attempt to address the root causes of these issues and improve system reliability. A *Reliability Improvements Team* was formed in 2018 to review reliability trends, develop solutions, and lead implementation of large-scale system reliability improvements. To date, the team has launched a pilot program for first-zone infrastructure hardening based on reliability needs; improved the prioritization method for reliability related dispatch orders and expedited completion of these orders; prioritized pending electronic recloser installations based on reliability needs; and leveraged the annual inspection program to identify infrastructure needs for planned improvement projects. Staff is pleased Central Hudson's management is taking a proactive, balanced approach to improving system reliability.

At the division level, the Catskill, Kingston, Poughkeepsie, and Fishkill Divisions all had frequencies that failed their established targets, only the Newburgh

Division met its frequency target. The Poughkeepsie Division exceeded its frequency target slightly. The Fishkill Division exceeded its frequency target, mostly due to the substation equipment failure on July 12. The Catskill Division exceeded its frequency target, primarily due to tree contacts and accidents. The Kington Division exceeded its frequency target, primarily due to tree contacts. The company states that the Kingston Division has been the hardest hit by the Emerald Ash Borer infestation due to its large population of ash trees, severely impacting reliability in the area. The company will continue to trim trees and remove danger trees to improve tree contact issues, some of which is due to Emerald Ash Borer beetle infestation.

Central Hudson's duration performance of 2.04 met the established target of 2.50. Duration performance was significantly better than last year and the five-year average. Central Hudson's improved its response time by scheduling additional crews after hours and on weekends based on the weather forecast. Repair times were improved through the identification of additional switching opportunities. Duration targets were met by all divisions with the exception of Newburgh, which exceeded its duration target only marginally. Tree contacts and pre-arranged outages were the drivers behind Newburgh's duration exceeding its target. The company's overall duration performance was at a 10-year low (better).

ORANGE & ROCKLAND

Table 6: Orange & Rockland's Historic Performance Excluding Major Storms

Performance Metric	2014	2015	2016	2017	2018	Current RPM Target	Five-Year Average
Frequency (SAIFI)	1.08	1.01	1.06	0.92	1.14	1.20	1.04
Duration (CAIDI)	1.62	2.44	1.70	1.68	1.82	1.85	1.85

Note: Data presented in red represents a failure to meet the RPM target for a given year.

Orange & Rockland serves approximately 300,000 customers in Rockland, Orange, and Sullivan Counties in southern New York. The company has three operating divisions: Western, Central, and Eastern. Orange & Rockland met both its established frequency and duration targets for 2018. The company's frequency performance of 1.14

was better than the established target of 1.20 but above the five-year average of 1.04. The company's duration performance of 1.82 was lower than the established target of 1.85 and below the five-year average of 1.85.

As shown in Figure 10, equipment failures and tree contacts continue to be the major cause of interruptions for the company, with both experiencing increases from 2017 levels. In 2018, these two categories accounted for approximately 54 percent of all interruptions, customers affected, and customer hours of interruption. Motor vehicle accidents continue to be the third leading cause of interruptions.

The total number of interruptions due to equipment failure for the past three years are above the five-year average. While the company did not attribute this to the failure rate of any single component of its system, primary and secondary wire failure rates in both the overhead and underground systems were above historical levels. Orange & Rockland will perform infrared thermal inspection on all three-phase circuits and 10 worst performing circuits in 2019. Infrared inspection quickly locates problems and determines the severity of the problem. This leads to reduced maintenance costs, fewer equipment failures and improved system reliability and power quality. In addition, the company states that it will continue to monitor the performance of all equipment to identify trends in any single system component and take mitigating actions as necessary. Orange & Rockland will continue to address tree contact issues through distribution trimming. In March, Orange & Rockland began implementation of its *Ash Tree Mitigation Program*. Orange & Rockland continues to install distribution automation equipment such as reclosers and automatic switches. Automated equipment will be installed on five circuits in 2019. This equipment combined with auto-loop design reduces customer outage duration and provides the control center with immediate notification of system issues. Staff expects these programs will have a positive impact on reliability in the coming years.

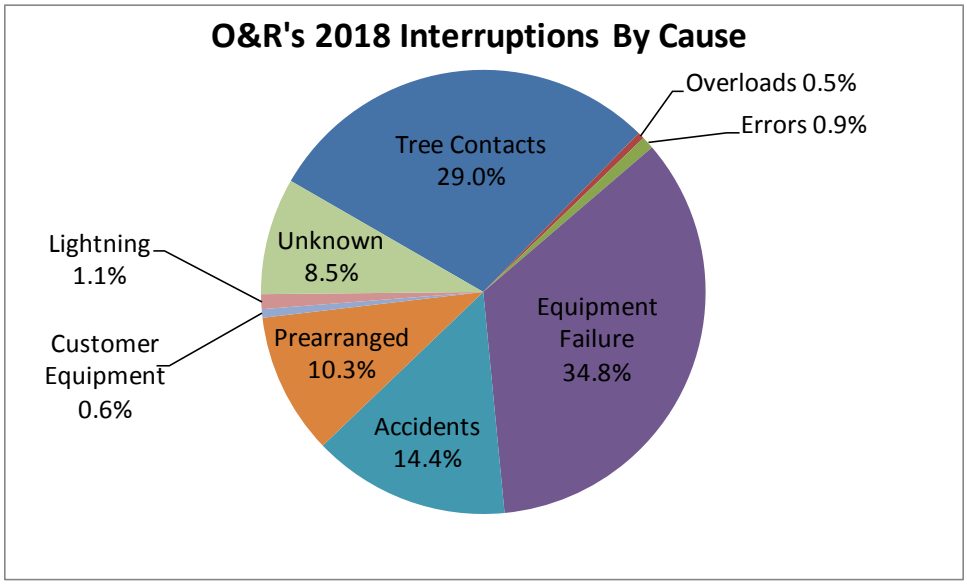


Figure 10: Orange & Rockland's 2018 Interruptions by Cause (Excluding Major Storms)

The performance trends related to equipment failures and tree contacts remained consistent for each division. The year-end frequency for the Eastern Division was better than the division's five-year average and better than the established target. The Eastern Division's duration performance was worse than the target and the five-year average. The Central Division met both its frequency and duration targets, however, the frequency performance was worse than its five-year average. The Western Division also met its frequency target, but it was worse than the five-year average. The Western Division's duration performance was better than the established targets and the five-year average. The two major causes of interruption for all three divisions were equipment failure and tree contacts.

PSEG LI

Table 7: PSEG LI's Historic Performance Excluding Major Storms

Performance Metric	2014	2015	2016	2017	2018	Current OSA Target	Five-Year Average
Frequency (SAIFI)	0.72	0.84	1.11	0.95	0.86	0.92	0.90
Duration (CAIDI)	1.36	1.31	1.14	1.16	1.27	1.42	1.25

Note: Data presented in red represents a failure to meet the RPM target for a given year.

PSEG LI serves approximately 1,122,000 customers on Long Island. The utility's territory includes Nassau County, Suffolk County, and the Rockaway Peninsula in Queens County. PSEG LI began operating and maintaining the electric system on Long Island on January 1, 2014. PSEG LI operates the system on behalf of the Long Island Power Authority (LIPA) and it supplies interruption data to the Department to assist in its statewide analysis. Unlike the other utilities, the Commission does not issue rate orders for PSEG LI, thus the Commission has not imposed an RPM on it. Instead, performance metrics were set as part of PSEG LI's Amended Operating Service Agreement (OSA) with the LIPA.[14]

In 2018, PSEG LI met its OSA targets for both outage duration and frequency. PSEG LI's outage frequency level improved by almost 10 percent in 2018, allowing the company to achieve the OSA target for the first time in three years. In fact, the company's 2018 performance in this category was better than its five-year average. While PSEG LI's duration performance of 1.27 hours achieved the current OSA target, it was, however, worse than the five-year average. Despite meeting its OSA target, 2018 was the third consecutive year that the company saw an increase in its outage durations. Figure 11, below, shows equipment failures are by far the leading cause of interruptions, followed by tree contacts, and accidents.

[14] Amended and Restated Operations Services Agreement between Long Island Lighting Company d/b/a LIPA and PSEG Long Island LLC, Dated as of December 31, 2013. (http://www.lipower.org/papers/agreements.html)

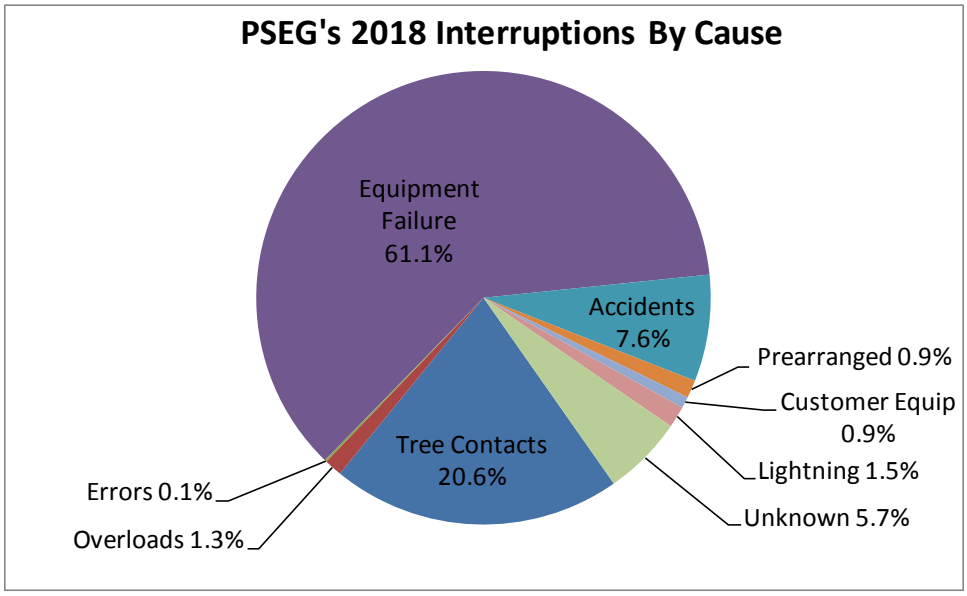


Figure 11: PSEG LI's 2018 Interruptions by Cause (Excluding Major Storms)

PSEG LI reports that it continues to target reliability enhancements through various programs and initiatives to improve its outage frequency and duration performance. This effort includes programs such as a *Circuit Improvement Program*, *Multiple Device Operations Program*, *Multiple Customer Outages Program*, *Underground Distribution Cable Replacement Program*, and a *Pole Inspection Program*. PSEG LI states that in 2019 it will also implement over $526 million in capital projects to improve the transmission and distribution (T&D) system. PSEG LI also continues to implement a $729 million *Federal Emergency Management Agency Storm Hardening Program* that consists of raising substation equipment in flood prone areas, reconstructing over 1,000 miles of main-line distribution using stronger poles, shorter cross arms and tree-resistant wire, and installing additional automated sectionalizing devices to minimize customers interrupted in the event of a fault.

In addition, over the last five years, PSEG LI has enhanced its tree trimming program by increasing the clearance to overhead mainline distribution wires and increasing the removal of hazard trees. The enhanced *Vegetation Management Program* is having a positive effect on reliability for those circuits that are being trimmed under the increased clearance specification. Specifically, for the circuits with a full year of history of being trimmed to the new specification there has been a 47.8 percent

reduction, on average, in customers interrupted and a 43.2 percent reduction in customer minutes interrupted (excluding major storms).

APPENDIX

The 2018 Interruption Report

Office of Electric, Gas, and Water
June 2019

ATTACHMENT
Definitions and Explanations of Terms Used in The
Statewide Electric Service Interruption Report

Interruption is the loss of service for five minutes or more.

Customer Hours is the time a customer is without electric service.

Customers Affected is the number of customers without electric service.

Customer Served is the number of customers as of the last day of the current year. For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

Frequency (SAIFI) measures the average number of interruptions experienced by customers served by the utility. It is the customers affected divided by the customers served at the end of the previous year.

Duration (CAIDI) measures the average time that an affected customer is out of electric service. It is the customer hours divided by the customers affected.

Availability (SAIDI) is the average amount of time a customer is out of service during a year. It is the customer hours divided by the number of customers served at the end of the year. Mathematically it is SAIFI multiplied by CAIDI.

Interruptions per 1,000 Customers Served is the number of interruptions divided by the number of customers served at the end of the previous year, divided by 1,000.

Major Storm is defined as any storm which causes service interruptions of at least ten percent of customers in an operating area, or if the interruptions last for 24 hours or more.

Operating Area is the geographical subdivision of each electric utilities franchise territory. These are also called regions, divisions, or districts.

Most of the data is presented in two ways, with major storms included and major storms excluded. Major storms tend to distort a utility's performance trend. Tables and graphs that exclude major storms illustrate interruptions that are under a utility's control. It portrays a utility's system facilities under normal conditions, although this can be misleading because interruptions during "normal" bad weather are included and it is difficult to analyze from year to year.

The first two tables show frequency and duration indices for the last five years for each utility and Statewide with and without Con Edison data. Much of the Con Edison distribution system consists of a secondary network. In a secondary network, a customer is fed multiple supplies, significantly reducing the probability of interruptions.

COMPARISON OF SERVICE RELIABILITY INDICES
(EXCLUDING MAJOR STORMS)

	2014	2015	2016	2017	2018	5 YR AVG
CHGE						
FREQUENCY	1.24	1.28	1.34	1.18	1.50	1.31
DURATION	2.27	2.07	2.33	2.20	2.04	2.18
CONED						
FREQUENCY	0.11	0.11	0.13	0.11	0.12	0.12
DURATION	3.02	3.11	2.49	2.77	2.75	2.83
PSEG-LI *						
FREQUENCY	0.72	0.84	1.11	0.95	0.86	0.90
DURATION	1.36	1.31	1.14	1.16	1.27	1.25
NAT GRID						
FREQUENCY	0.96	1.02	1.05	1.03	1.02	1.01
DURATION	1.94	2.04	2.02	1.99	2.04	2.01
NYSEG						
FREQUENCY	1.03	1.17	1.19	1.18	1.20	1.15
DURATION	1.97	1.97	2.02	2.06	2.17	2.04
O&R						
FREQUENCY	1.08	1.01	1.06	0.92	1.14	1.04
DURATION	1.62	2.44	1.70	1.68	1.82	1.85
RG&E						
FREQUENCY	0.76	0.75	0.58	0.59	0.75	0.69
DURATION	1.74	1.82	1.79	1.77	1.79	1.78
STATEWIDE (WITHOUT CON EDISON)						
FREQUENCY	0.92	1.00	1.07	1.01	1.03	1.01
DURATION	1.83	1.88	1.79	1.81	1.88	1.84
STATEWIDE (WITH CON EDISON)						
FREQUENCY	0.57	0.62	0.67	0.62	0.64	0.62
DURATION	1.93	1.97	1.85	1.88	1.96	1.92

COMPARISON OF SERVICE RELIABILITY INDICES
(INCLUDING MAJOR STORMS)

	2014	2015	2016	2017	2018	5 YR AVG
CHGE						
FREQUENCY	1.62	1.38	1.45	1.54	2.59	1.72
DURATION	3.74	2.09	2.51	3.24	8.14	3.94
CONED						
FREQUENCY	0.11	0.11	0.14	0.12	0.20	0.14
DURATION	3.09	3.14	2.67	2.90	17.01	5.77
PSEG-LI *						
FREQUENCY	0.76	1.00	1.34	1.10	1.13	1.07
DURATION	1.42	1.95	1.46	1.70	2.24	1.75
NAT GRID						
FREQUENCY	1.17	1.06	1.18	1.42	1.53	1.27
DURATION	2.87	2.07	2.41	4.14	4.34	3.17
NYSEG						
FREQUENCY	1.34	1.28	1.57	1.83	2.31	1.66
DURATION	2.97	2.14	2.89	3.98	9.18	4.23
O&R						
FREQUENCY	1.19	1.01	1.21	1.06	1.76	1.25
DURATION	2.40	2.44	1.96	2.10	7.78	3.34
RG&E						
FREQUENCY	0.85	0.87	0.70	1.34	1.00	0.95
DURATION	2.32	2.14	2.09	18.32	3.64	5.70
STATEWIDE (WITHOUT CON EDISON)						
FREQUENCY	1.10	1.09	1.28	1.40	1.62	1.30
DURATION	2.67	2.08	2.25	4.60	5.87	3.49
STATEWIDE (WITH CON EDISON)						
FREQUENCY	0.68	0.67	0.79	0.85	1.01	0.80
DURATION	2.70	2.16	2.28	4.50	6.81	3.69

STATEWIDE (WITHOUT CON EDISON)

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	53,723	53,551	57,960	56,766	61,441	56,688
Number of Customer-Hours	7,535,845	8,408,508	8,636,377	8,223,141	8,838,401	8,328,454
Number of Customers Affected	4,117,993	4,474,728	4,815,522	4,555,618	4,689,214	4,530,615
Number of Customers Served	4,480,215	4,494,878	4,517,887	4,543,176	4,577,274	4,522,686
Average Duration Per Customer Affected (CAIDI)	1.83	1.88	1.79	1.81	1.88	1.84
Average Duration Per Customers Served	1.69	1.88	1.92	1.82	1.95	1.85
Interruptions Per 1000 Customers Served	12.03	11.95	12.89	12.56	13.52	12.59
Number of Customers Affected Per Customer Served (SAIFI)	0.92	1.00	1.07	1.01	1.03	1.01

STATEWIDE (WITH CON EDISON)

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	69,760	70,017	71,704	72,376	78.098	72,391
Number of Customer-Hours	8,624,342	9,582,883	9,710,475	9,275,141	9,983,360	9,435,240
Number of Customers Affected	4,478,047	4,852,363	5,246,331	4,935,045	5,105,730	4,923,503
Number of Customers Served	7,842,410	7,880,054	7,928,059	7,978,073	8,042,233	7,934,166
Average Duration Per Customer Affected (CAIDI)	1.93	1.97	1.85	1.88	1.96	1.92
Average Duration Per Customers Served	1.10	1.22	1.23	1.17	1.25	1.20
Interruptions Per 1000 Customers Served	8.93	8.93	9.10	9.13	9.79	9.17
Number of Customers Affected Per Customer Served (SAIFI)	0.57	0.62	0.67	0.62	0.64	0.62

** Customer Served is the number of customers as of the last day of the current year.
For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

STATEWIDE (WITHOUT CON EDISON)

Including Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	62,009	56,723	66,790	71,951	89,665	69,428
Number of Customer-Hours	13,143,570	10,190,618	12,917,487	29,114,338	43,261,363	21,725,475
Number of Customers Affected	4,930,250	4,892,482	5,738,707	6,329,697	7,373,442	5,852,916
Number of Customers Served	4,480,215	4,494,878	4,517,887	4,543,176	4,577,274	4,522,686
Average Duration Per Customer Affected (CAIDI)	2.67	2.08	2.25	4.60	5.87	3.49
Average Duration Per Customers Served	2.94	2.27	2.87	6.44	9.52	4.81
Interruptions Per 1000 Customers Served	13.88	12.66	14.86	15.93	19.74	15.41
Number of Customers Affected Per Customer Served (SAIFI)	1.10	1.09	1.28	1.40	1.62	1.30

STATEWIDE (WITH CON EDISON)

Including Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	78,436	73,468	80,994	88,151	113,241	86,858
Number of Customer-Hours	14,300,945	11,381,657	14,148,142	30,293,340	54,866,948	24,998,207
Number of Customers Affected	5,304,278	5,271,638	6,199,042	6,735,617	8,055,529	6,313,221
Number of Customers Served	7,842,410	7,880,054	7,928,059	7,978,073	8,042,233	7,934,166
Average Duration Per Customer Affected (CAIDI)	2.70	2.16	2.28	4.50	6.81	3.69
Average Duration Per Customers Served	1.83	1.45	1.80	3.82	6.88	3.15
Interruptions Per 1000 Customers Served	10.04	9.37	10.28	11.12	14.19	11.00
Number of Customers Affected Per Customer Served (SAIFI)	0.68	0.67	0.79	0.85	1.01	0.80

** Customer Served is the number of customers as of the last day of the current year. For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

CENTRAL HUDSON

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	6,608	6,387	7,407	7,129	8,011	7,108
Number of Customer-Hours	844,753	797,184	938,066	785,105	926,783	858,378
Number of Customers Affected	371,442	384,364	402,140	357,572	454,343	393,972
Number of Customers Served	300,225	300,647	302,432	302,187	304,382	301,975
Average Duration Per Customer Affected (CAIDI)	2.27	2.07	2.33	2.20	2.04	2.18
Average Duration Per Customers Served	2.82	2.66	3.12	2.60	3.07	2.85
Interruptions Per 1000 Customers Served	22.06	21.27	24.64	23.57	26.51	23.61
Number of Customers Affected Per Customer Served (SAIFI)	1.24	1.28	1.34	1.18	1.50	1.31

CENTRAL HUDSON

Including Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	8,160	6,587	7,802	8,344	11,334	8,445
Number of Customer-Hours	1,810,447	867,550	1,096,082	1,512,967	6,380,295	2,333,468
Number of Customers Affected	483,848	414,932	436,716	466,830	783,881	517,241
Number of Customers Served	300,225	300,647	302,432	302,187	304,382	301,975
Average Duration Per Customer Affected (CAIDI)	3.74	2.09	2.51	3.24	8.14	3.94
Average Duration Per Customers Served	6.04	2.89	3.65	5.00	21.11	7.74
Interruptions Per 1000 Customers Served	27.24	21.94	25.95	27.59	37.51	28.04
Number of Customers Affected Per Customer Served (SAIFI)	1.62	1.38	1.45	1.54	2.59	1.72

** Customer Served is the number of customers as of the last day of the current year.
For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

CON EDISON (SYSTEM)

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	16,037	16,466	13,744	15,610	16,657	15,703
Number of Customer-Hours	1,088,498	1,174,375	1,074,098	1,052,001	1,144,959	1,106,786
Number of Customers Affected	360,054	377,635	430,809	379,427	416,516	392,888
Number of Customers Served	3,362,195	3,385,176	3,410,172	3,434,897	3,464,959	3,411,480
Average Duration Per Customer Affected (CAIDI)	3.02	3.11	2.49	2.77	2.75	2.83
Average Duration Per Customers Served	0.33	0.35	0.32	0.31	0.33	0.33
Interruptions Per 1000 Customers Served	4.79	4.90	4.06	4.58	4.85	4.63
Number of Customers Affected Per Customer Served (SAIFI)	0.11	0.11	0.13	0.11	0.12	0.12

CON EDISON (SYSTEM)

Including Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	16,427	16,745	14,204	16,200	23,576	17,430
Number of Customer-Hours	1,157,376	1,191,039	1,230,655	1,179,002	11,605,586	3,272,732
Number of Customers Affected	374,028	379,156	460,335	405,920	682,087	460,305
Number of Customers Served	3,362,195	3,385,176	3,410,172	3,434,897	3,464,959	3,411,480
Average Duration Per Customer Affected (CAIDI)	3.09	3.14	2.67	2.90	17.01	5.77
Average Duration Per Customers Served	0.35	0.35	0.36	0.35	3.38	0.96
Interruptions Per 1000 Customers Served	4.91	4.98	4.20	4.75	6.86	5.14
Number of Customers Affected Per Customer Served (SAIFI)	0.11	0.11	0.14	0.12	0.20	0.14

CON EDISON (NETWORK)

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	10,080	10,523	6,980	9,462	9,187	9,246
Number of Customer-Hours	543,158	569,966	348,053	441,055	434,540	467,354
Number of Customers Affected	63,013	67,966	46,918	62,005	59,620	58,904
Number of Customers Served	2,473,101	2,497,705	2,510,320	2,545,351	2,568,843	2,519,064
Average Duration Per Customer Affected (CAIDI)	8.62	8.39	7.42	7.11	7.29	7.77
Average Duration Per Customers Served	0.22	0.23	0.14	0.18	0.17	0.19
Interruptions Per 1000 Customers Served	4.10	4.25	2.79	3.77	3.61	3.70
Number of Customers Affected Per Customer Served (SAIFI)	0.03	0.03	0.02	0.02	0.02	0.02

** Customer Served is the number of customers as of the last day of the current year.
For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

CON EDISON (RADIAL)

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	5,957	5,943	6,764	6,148	7,470	6,456
Number of Customer-Hours	545,339	604,408	726,044	610,945	710,418	639,431
Number of Customers Affected	297,041	309,669	383,891	317,422	356,896	332,984
Number of Customers Served	889,094	887,471	899,852	889,546	896,118	892,416
Average Duration Per Customer Affected (CAIDI)	1.84	1.95	1.89	1.92	1.99	1.92
Average Duration Per Customers Served	0.61	0.68	0.82	0.68	0.80	0.72
Interruptions Per 1000 Customers Served	6.71	6.68	7.62	6.83	8.40	7.25
Number of Customers Affected Per Customer Served (SAIFI)	0.33	0.35	0.43	0.35	0.40	0.37

CON EDISON (RADIAL)

Including Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	6,347	6,222	7,224	6,738	14,398	8,184
Number of Customer-Hours	614,218	621,073	882,602	737,947	11,171,045	2,805,377
Number of Customers Affected	311,015	311,190	413,417	343,915	622,467	400,401
Number of Customers Served	889,094	887,471	899,852	889,546	896,116	892,416
Average Duration Per Customer Affected (CAIDI)	1.97	2.00	2.13	2.15	17.95	5.24
Average Duration Per Customers Served	0.69	0.70	0.99	0.82	12.56	3.15
Interruptions Per 1000 Customers Served	7.15	7.00	8.14	7.49	16.18	9.19
Number of Customers Affected Per Customer Served (SAIFI)	0.35	0.35	0.47	0.38	0.70	0.45

** Customer Served is the number of customers as of the last day of the current year.
For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

NATIONAL GRID

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	13,271	13,385	13,978	13,743	14,447	13,765
Number of Customer-Hours	2,979,765	3,343,062	3,398,634	3,333,796	3,408,167	3,292,685
Number of Customers Affected	1,537,355	1,640,947	1,684,257	1,671,096	1,670,265	1,640,784
Number of Customers Served	1,608,164	1,609,787	1,622,512	1,635,856	1,650,922	1,625,448
Average Duration Per Customer Affected (CAIDI)	1.94	2.04	2.02	1.99	2.04	2.01
Average Duration Per Customers Served	1.85	2.08	2.11	2.05	2.08	2.04
Interruptions Per 1000 Customers Served	8.26	8.32	8.68	8.47	8.83	8.51
Number of Customers Affected Per Customer Served (SAIFI)	0.96	1.02	1.05	1.03	1.02	1.01

NATIONAL GRID

Including Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	16,377	13,789	16,104	18,881	22,653	17,561
Number of Customer-Hours	5,374,356	3,543,893	4,597,543	9,513,770	10,882,228	6,782,358
Number of Customers Affected	1,874,011	1,711,850	1,906,370	2,296,097	2,510,027	2,059,651
Number of Customers Served	1,608,164	1,609,787	1,622,512	1,635,856	1,650,922	1,625,488
Average Duration Per Customer Affected (CAIDI)	2.87	2.07	2.41	4.14	4.34	3.17
Average Duration Per Customers Served	3.34	2.20	2.86	5.86	6.65	4.18
Interruptions Per 1000 Customers Served	10.19	8.57	10.00	11.64	13.85	10.85
Number of Customers Affected Per Customer Served (SAIFI)	1.17	1.06	1.18	1.42	1.53	1.27

** Customer Served is the number of customers as of the last day of the current year.
For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

NYSEG

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	9,925	10,628	10,375	10,441	11,349	10,544
Number of Customer-Hours	1,738,911	1,992,932	2,108,879	2,141,108	2,310,303	2,058,427
Number of Customers Affected	884,683	1,012,506	1,042,453	1,037,330	1,063,122	1,008,019
Number of Customers Served	867,392	875,383	879,066	884,136	891,168	879,429
Average Duration Per Customer Affected (CAIDI)	1.97	1.97	2.02	2.06	2.17	2.04
Average Duration Per Customers Served	2.03	2.30	2.41	2.44	2.61	2.36
Interruptions Per 1000 Customers Served	11.60	12.25	11.85	11.88	12.84	12.08
Number of Customers Affected Per Customer Served (SAIFI)	1.03	1.17	1.19	1.18	1.20	1.15

NYSEG

Including Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	12,332	11,203	13,025	14,289	20,937	14,357
Number of Customer-Hours	3,391,684	2,381,242	3,977,003	6,390,928	18,716,707	6,971,513
Number of Customers Affected	1,143,341	1,110,385	1,374,336	1,604,622	2,038,575	1,454,252
Number of Customers Served	867,392	875,383	879,066	884,136	891,168	879,429
Average Duration Per Customer Affected (CAIDI)	2.97	2.14	2.89	3.98	9.18	4.23
Average Duration Per Customers Served	3.97	2.75	4.54	7.27	21.17	7.94
Interruptions Per 1000 Customers Served	14.42	12.92	14.88	16.25	23.68	16.43
Number of Customers Affected Per Customer Served (SAIFI)	1.34	1.28	1.57	1.83	2.31	1.66

** Customer Served is the number of customers as of the last day of the current year.
For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

PSEG-LI

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	17,721	17,214	20,139	19,009	20,697	18,956
Number of Customer-Hours	1,096,866	1,222,162	1,408,373	1,229,618	1,223,074	1,236,019
Number of Customers Affected	805,693	934,097	1,237,719	1,064,452	963,985	1,001,189
Number of Customers Served	1,113,474	1,116,191	1,118,963	1,122,011	1,124,900	1,119,108
Average Duration Per Customer Affected (CAIDI)	1.36	1.31	1.14	1.16	1.27	1.25
Average Duration Per Customers Served	0.98	1.10	1.26	1.10	1.09	1.11
Interruptions Per 1000 Customers Served	15.88	15.46	18.04	16.99	18.45	16.96
Number of Customers Affected Per Customer Served (SAIFI)	0.72	0.84	1.11	0.95	0.86	0.90

PSEG-LI

Including Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	18,586	19,061	23,292	21,288	26,277	21,701
Number of Customer-Hours	1,210,719	2,166,956	2,183,379	2,092,168	2,847,012	2,100,047
Number of Customers Affected	853,209	1,111,055	1,495,619	1,228,334	1,271,447	1,191,933
Number of Customers Served	1,113,474	1,116,191	1,118,963	1,122,011	1,124,900	1,119,108
Average Duration Per Customer Affected (CAIDI)	1.42	1.95	1.46	1.70	2.24	1.75
Average Duration Per Customers Served	1.09	1.95	1.96	1.87	2.54	1.88
Interruptions Per 1000 Customers Served	16.66	17.12	20.87	19.02	23.42	19.42
Number of Customers Affected Per Customer Served (SAIFI)	0.76	1.00	1.34	1.10	1.13	1.07

** Customer Served is the number of customers as of the last day of the current year.
For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

ORANGE & ROCKLAND

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	3,226	2,900	3,223	3,287	3,709	3,269
Number of Customer-Hours	387,054	545,813	398,964	345,072	465,474	428,475
Number of Customers Affected	238,230	224,054	234,934	205,585	255,706	231,702
Number of Customers Served	221,579	221,542	223,048	224,400	227,959	223,706
Average Duration Per Customer Affected (CAIDI)	1.62	2.44	1.70	1.68	1.82	1.85
Average Duration Per Customers Served	1.75	2.46	1.80	1.55	2.07	1.93
Interruptions Per 1000 Customers Served	14.61	13.09	14.55	14.74	16.53	14.70
Number of Customers Affected Per Customer Served (SAIFI)	1.08	1.01	1.06	0.92	1.14	1.04

ORANGE & ROCKLAND

Including Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	3,398	2,900	3,547	3,533	4,571	3,590
Number of Customer-Hours	633,345	545,813	523,975	496,654	3,069,852	1,053,928
Number of Customers Affected	263,634	224,054	267,191	236,698	394,557	277,227
Number of Customers Served	221,579	221,542	223,048	224,400	227,959	223,706
Average Duration Per Customer Affected (CAIDI)	2.40	2.44	1.96	2.10	7.78	3.34
Average Duration Per Customers Served	2.87	2.46	2.37	2.23	13.68	4.72
Interruptions Per 1000 Customers Served	15.39	13.09	16.01	15.84	20.37	16.14
Number of Customers Affected Per Customer Served (SAIFI)	1.19	1.01	1.21	1.06	1.76	1.25

** Customer Served is the number of customers as of the last day of the current year.
For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

RG&E

Excluding Major Storms

	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	2,972	3,037	2,838	3,157	3,228	3,046
Number of Customer-Hours	488,496	507,355	383,461	388,442	504,600	454,471
Number of Customers Affected	280,590	278,760	214,019	219,583	281,793	254,949
Number of Customers Served	369,381	371,328	371,866	374,586	377,943	373,021
Average Duration Per Customer Affected (CAIDI)	1.74	1.82	1.79	1.77	1.79	1.78
Average Duration Per Customers Served	1.33	1.37	1.03	1.04	1.35	1.23
Interruptions Per 1000 Customers Served	8.09	8.22	7.64	8.49	8.62	8.21
Number of Customers Affected Per Customer Served (SAIFI)	0.76	0.75	0.58	0.59	0.75	0.69

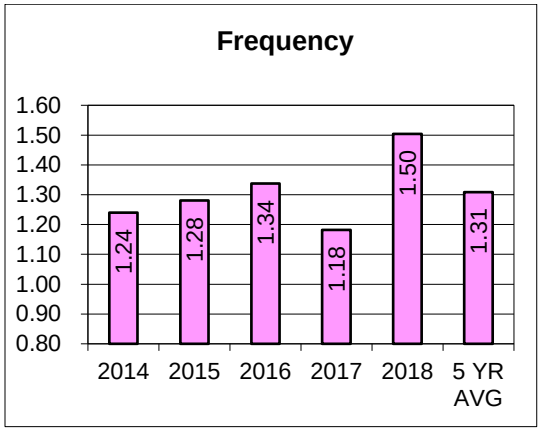
RG&E

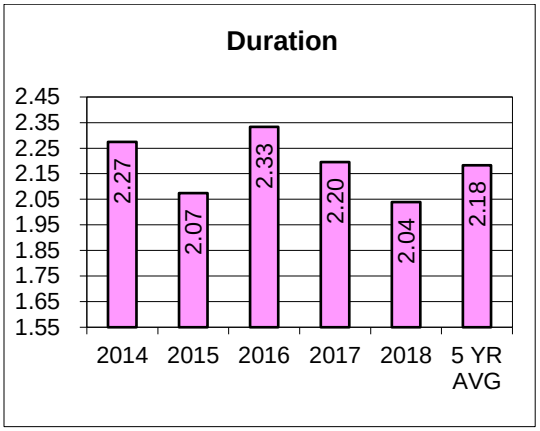
Including Major Storms

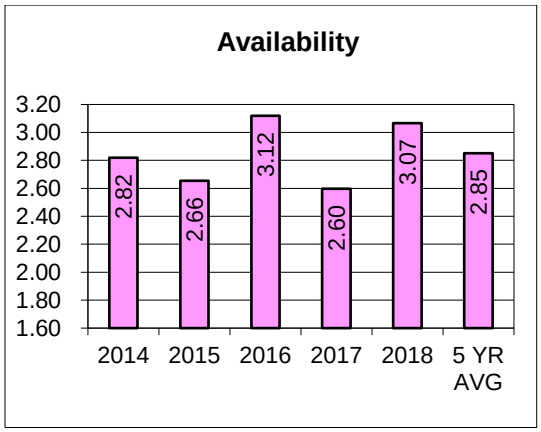
	2014	2015	2016	2017	2018	5 YR AVG
Number of Interruptions	3,156	3,183	3,020	5,616	3,893	3,774
Number of Customer-Hours	723,019	685,163	539,505	9,107,851	1,365,269	2,484,161
Number of Customers Affected	312,207	320,206	258,475	497,116	374,955	352,592
Number of Customers Served	369,381	371,328	371,866	374,586	377,943	373,021
Average Duration Per Customer Affected (CAIDI)	2.32	2.14	2.09	18.32	3.64	5.70
Average Duration Per Customers Served	1.97	1.85	1.45	24.49	3.64	6.68
Interruptions Per 1000 Customers Served	8.59	8.62	8.13	15.10	10.39	10.17
Number of Customers Affected Per Customer Served (SAIFI)	0.85	0.87	0.70	1.34	1.00	0.95

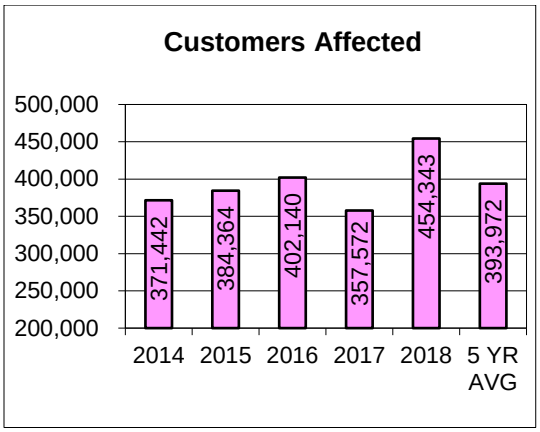
** Customer Served is the number of customers as of the last day of the current year.
For example, for the calendar year of 2018, customers served is the number of customers as of December 31, 2018. For indices using customers served, the previous year is used.

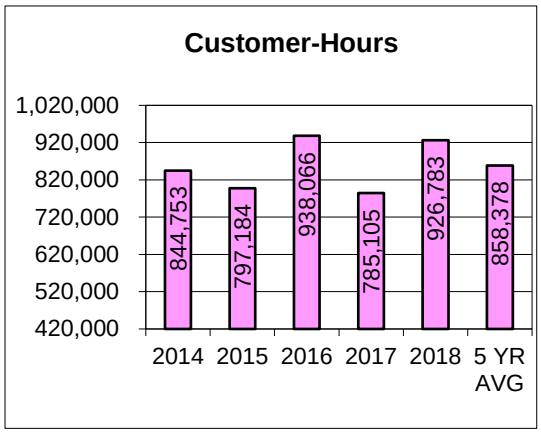
Central Hudson Gas and Electric
(Excluding Major Storms)

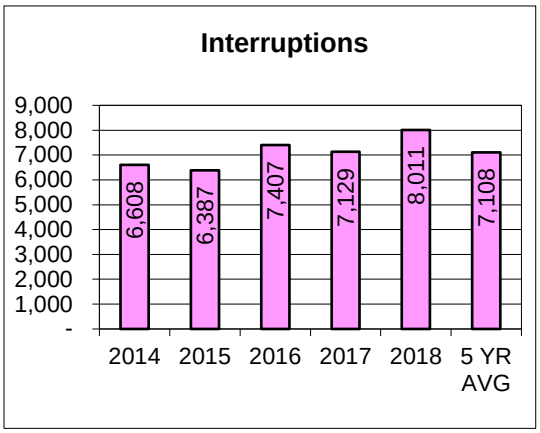




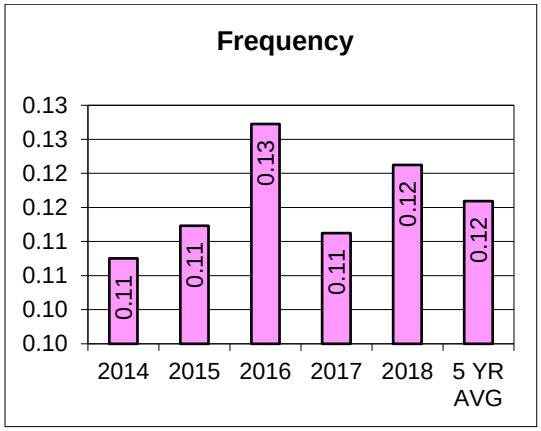


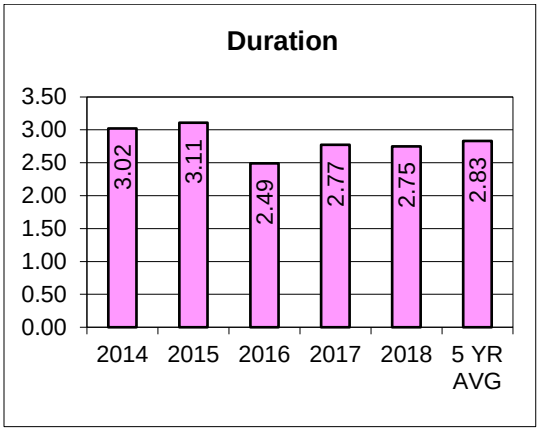


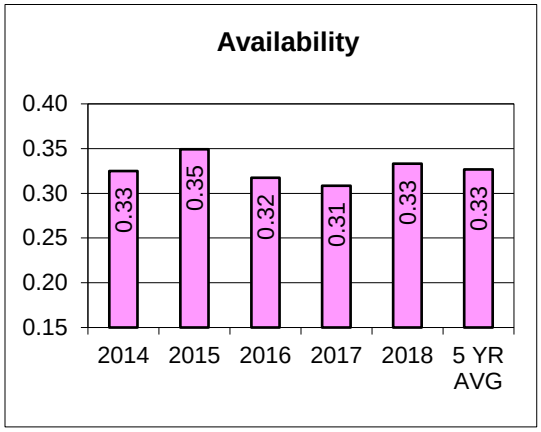


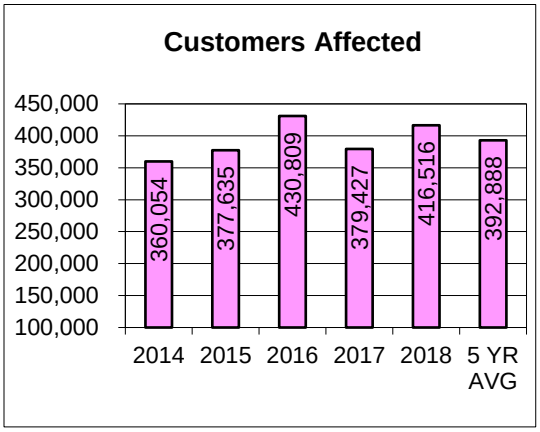


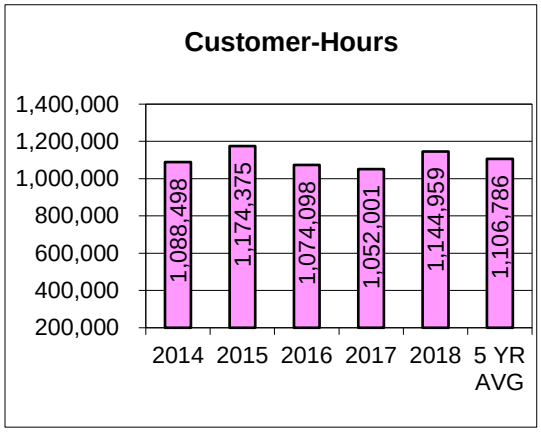
Con Edison – System
(Excluding Major Storms)

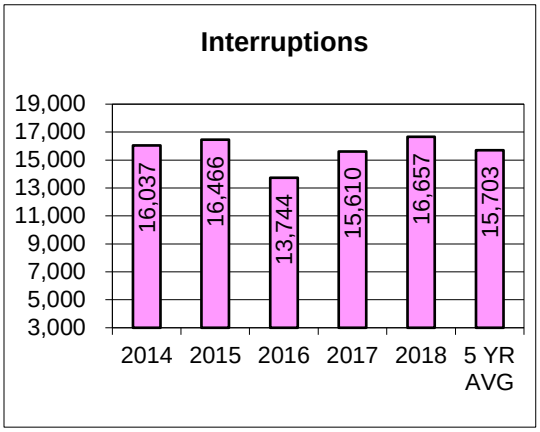




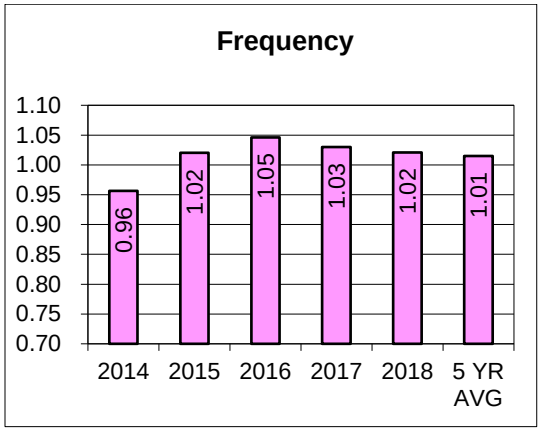


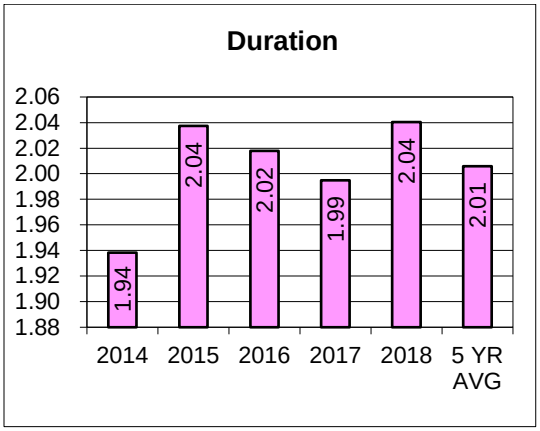


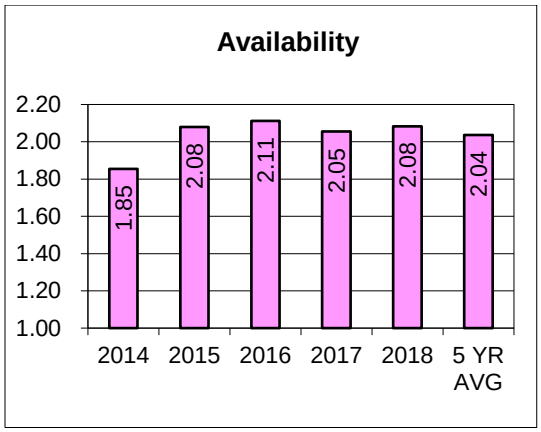


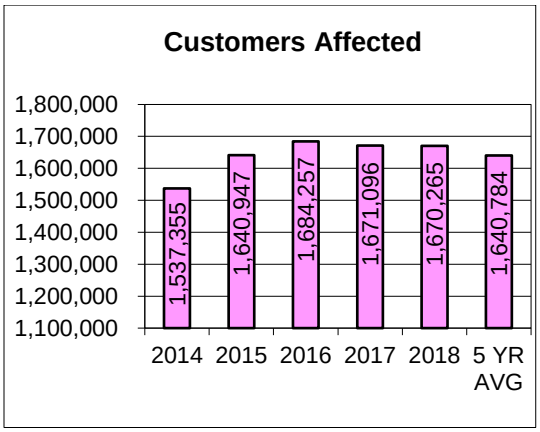


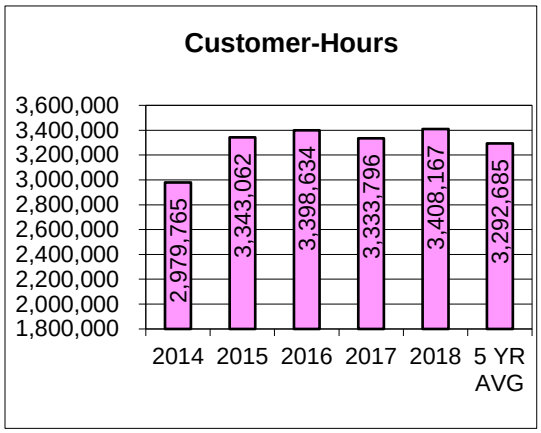
National Grid
(Excluding Major Storms)

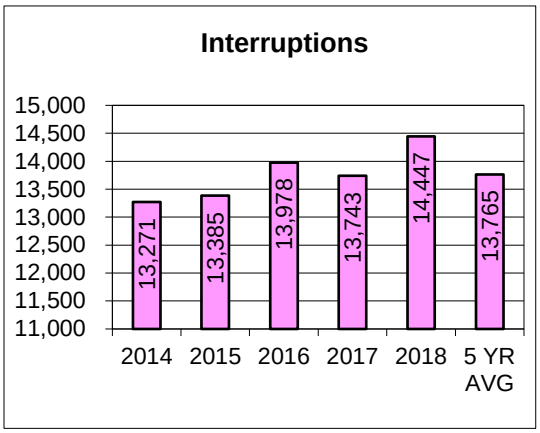




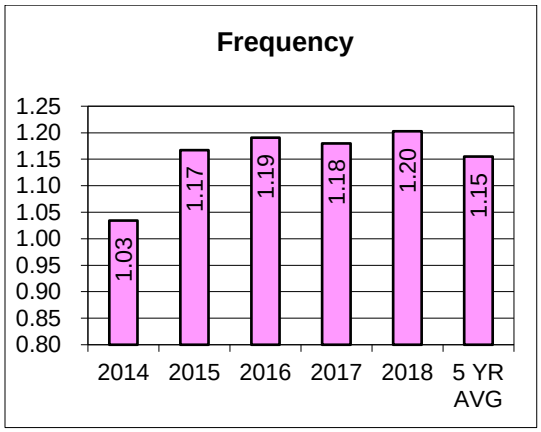


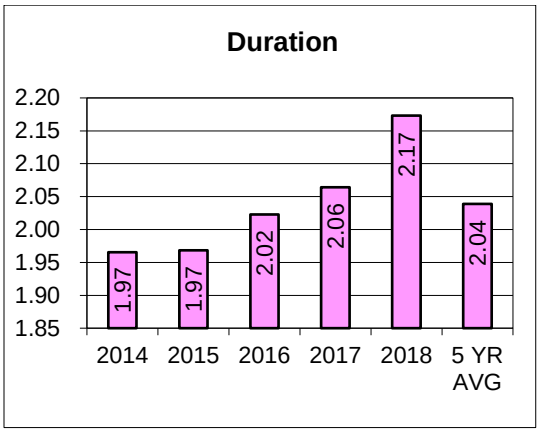


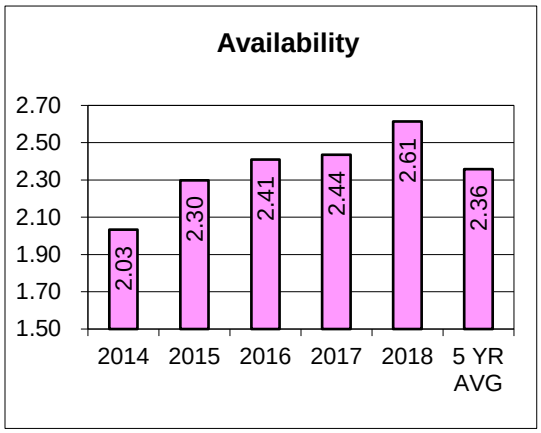


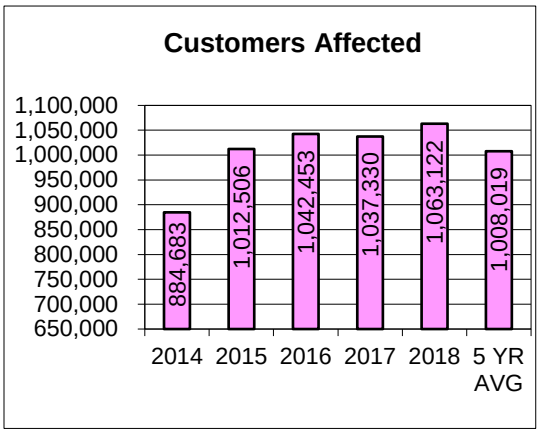


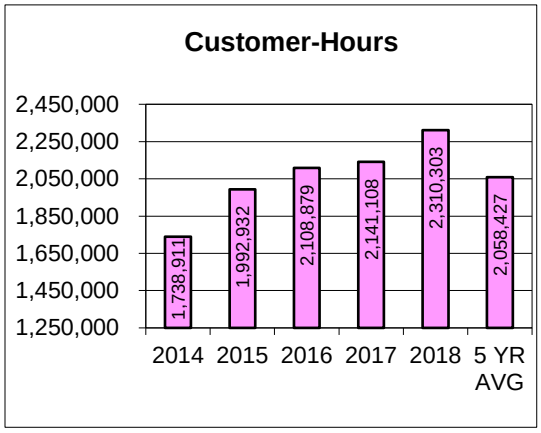
NYSEG
(Excluding Major Storms)

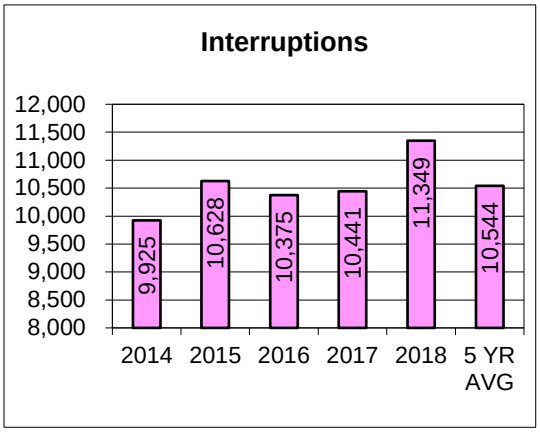




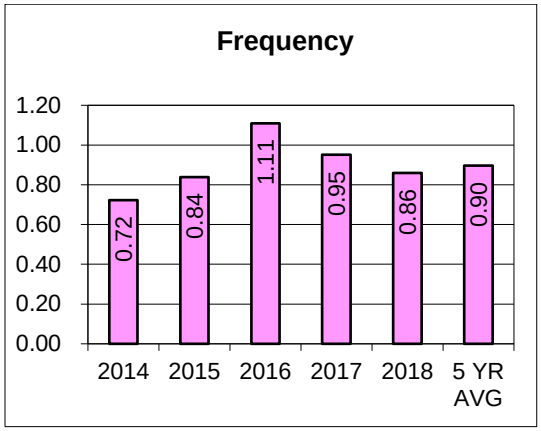


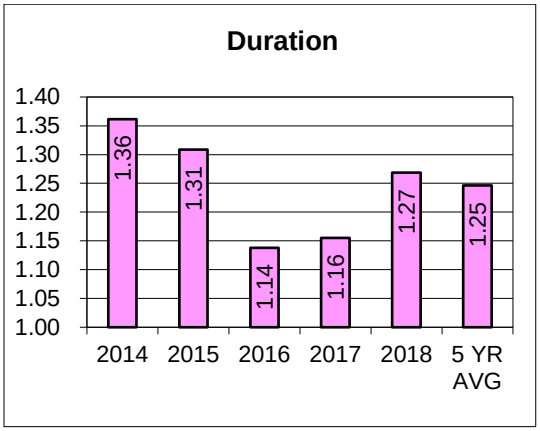


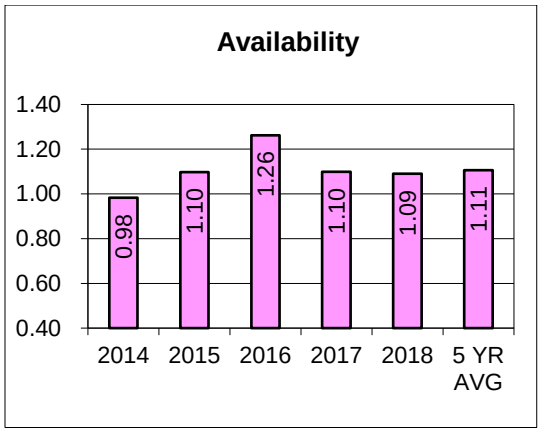


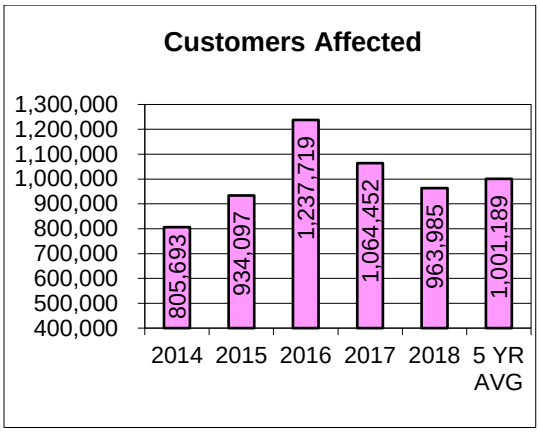


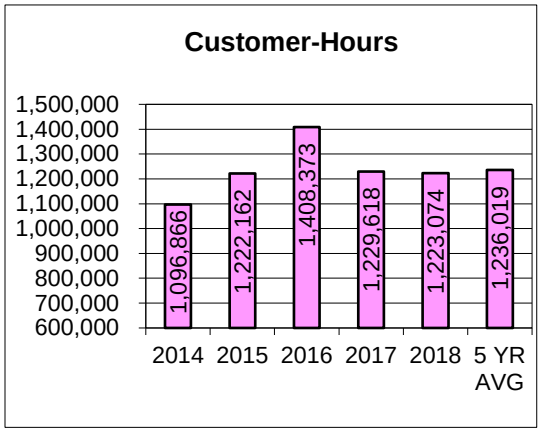
PSEG-LI
(Excluding Major Storms)

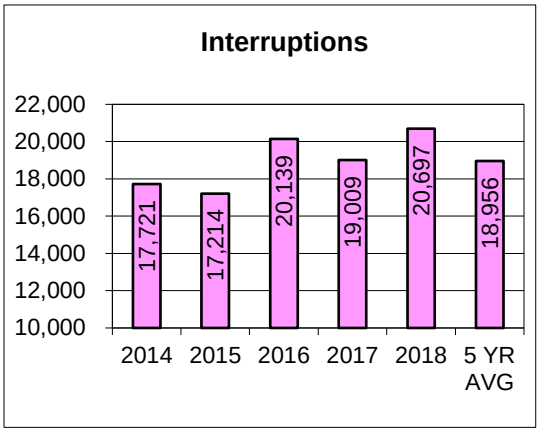




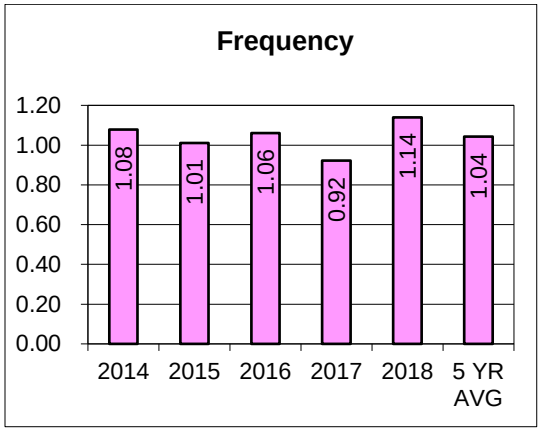


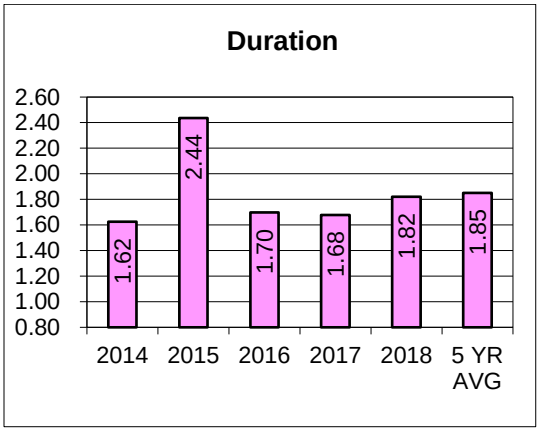


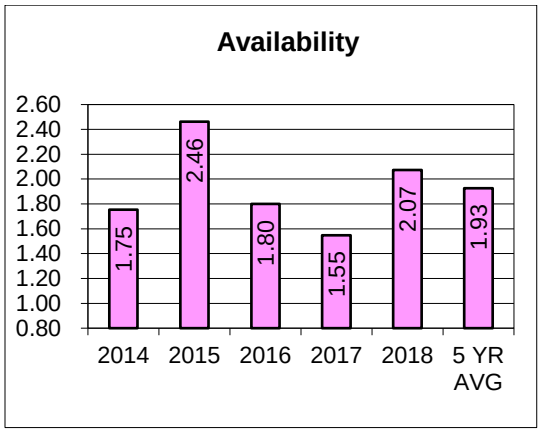


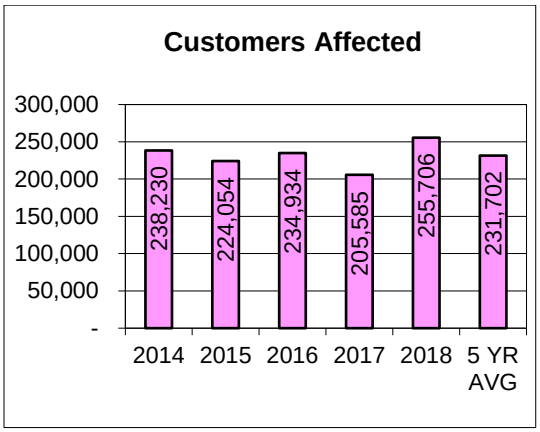


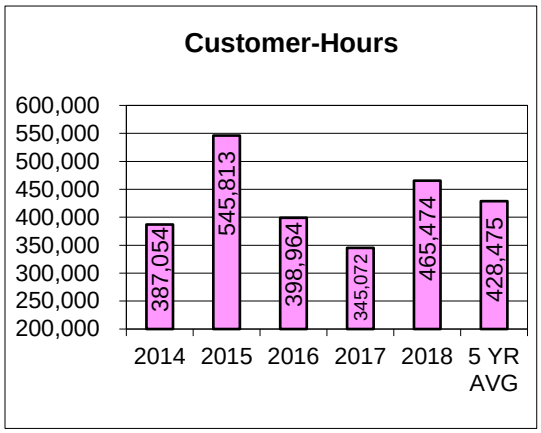
Orange & Rockland
(Excluding Major Storms)

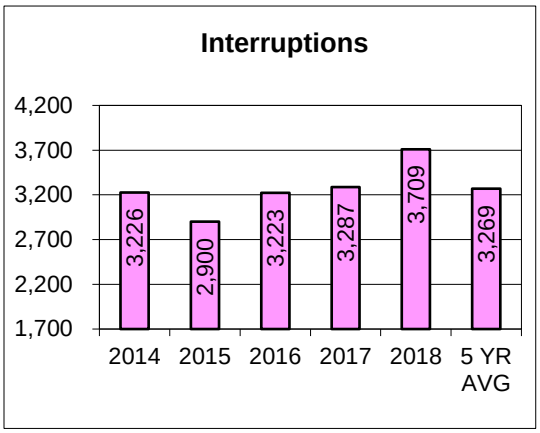












RG&E
(Excluding Major Storms)