

# **Commonwealth Edison Company's Infrastructure Investment Plan**

**2016 Annual Update**

**April 1, 2016**

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## **Executive Summary**

### **Plan Overview**

On November 8, 2011, Commonwealth Edison Company (“ComEd”) filed its proposed performance-based formula rate, Rate DSPP – Delivery Service Pricing and Performance (“Rate DSPP”), with the Illinois Commerce Commission (“Commission”) pursuant to Section 16-108.5 of the Public Utilities Act (“Act”). The Commission commenced Docket No. 11-0721 to review that filing. In making that filing, ComEd confirmed that it elected to become a “participating utility”, and committed to undertake the investments described in Section 16-108.5(b) of the Act. Section 16-108.5(b) also called on ComEd, within 60 days of such filing, to submit a plan for satisfying its infrastructure investment program commitments, which must include information regarding scope, schedule and staffing. ComEd submitted its Infrastructure Investment Plan (“Plan”) to the Commission on January 6, 2012. Section 16-108.5(b) further requires ComEd, no later than April 1 of each subsequent year, to submit to the Commission a report that includes any updates to the Plan, a schedule for the next calendar year, the expenditures made for the prior calendar year and cumulatively, and the number of full-time equivalent jobs created for the prior calendar year and cumulatively.

Accordingly, ComEd submits to the Commission this 2016 Annual Update to its Plan (“2016 Annual Update”), for informational purposes, as prescribed by the Act. Consistent with ComEd’s Plan and subsequent annual updates, this 2016 Annual Update organizes individual projects under two broad categories of investment:

Reliability-Related Investments: Section I of the 2016 Annual Update sets forth electric system upgrades, modernization projects, and training facilities; and

Smart Grid-Related Investments: Section II of the 2016 Annual Update describes the Smart Grid electric system upgrades and transmission and distribution infrastructure upgrades and modernization.

This 2016 Annual Update includes actual expenditures to date, as well as revisions to ComEd's 2015 Annual Update to its Plan ("2015 Annual Update") with corresponding explanations. Consistent with ComEd's Plan and subsequent annual updates, the 2016 Annual Update includes an estimated cumulative total of approximately \$1.3 billion of capital investment plus associated expenses in electric system upgrades, modernization projects, and training facilities ("Reliability-Related Investments") over the planned five-year period plus the permitted ramp-up and ramp-down time. The 2016 Annual Update also includes an estimated cumulative total of approximately \$1.3 billion of capital investment plus associated expenses in Smart Grid electric system upgrades ("Smart Grid-Related Investments") over the planned ten-year period including the permitted ramp-up and ramp-down time.

As required by Section 16-108.5(b), the total estimated \$2.6 billion of cumulative capital investment under the Plan will be incremental to ComEd's total annual capital investment program, as defined in Section 16-108.5(b). That is, over the term of the Plan, ComEd will invest an estimated cumulative total of \$2.6 billion more capital than a capital investment program that invested at an annual rate defined by ComEd's average capital spend for calendar years 2008, 2009, and 2010, as reported in ComEd's applicable Federal Energy Regulatory Commission ("FERC") Form 1s. If the forecasted

capital investment costs exceed \$3.0 billion, then a report will be submitted to the Commission that identifies the increased costs and explains the reasons. The report shall be submitted no later than the year in which the forecasts will exceed capital investment costs of \$3.0 billion. In no case will \$3.0 billion in capital investment costs be exceeded without the approval of the General Assembly.

During 2012, 2013, 2014 and 2015 - the first four years of the Plan, ComEd gained many insights in the implementation of specific programs, which now inform the estimates reflected in the 2016 Annual Update. These insights have resulted in changes to certain programs, including changes in scope, budget, and schedules. These changes, however, have not resulted in a material change to the overall program budget, and ComEd's Plan remains on track.

Finally, in the event that Section 16-108.5 becomes inoperative or Rate DSPP is terminated, then the Plan, including but not limited to all programs and investments, will also become inoperative and terminate immediately.

## **Summary Plan Scope**

***Reliability-Related Investments.*** These programs are described in detail in Section I of this 2016 Annual Update, and include, but are not limited to, the following specific programs briefly described below:

- **Underground Residential Cable (“URD”) injection and replacement.**

This program is designed to remediate an estimated 3,879 miles of bare concentric cable, some of which was installed as early as 1966. The scope for URD injection and replacement is essentially the same as that presented in

ComEd's 2015 Annual Update. This work will reduce long duration outages experienced primarily in residential subdivisions.

- **Mainline cable system refurbishment and replacement.** As noted in ComEd's Plan, this is the most complex of all the Reliability-Related Investments, and is primarily targeted at the testing and replacement of lead cable in urban areas. Over the course of the program, ComEd plans to assess all manholes on its system (an estimated 32,026) and perform refurbishment within the parameters of the Act. In addition, ComEd will replace an estimated 672 miles of mainline underground cable, and test an estimated 931 sections of mainline cable over the course of the program. The scope for mainline cable system refurbishment and replacement is essentially the same as that presented in ComEd's 2015 Annual Update. Because remediation scope is based on inspection results, the complex nature of the underground system, interrelationship of multiple circuits within a manhole, and certain potential moratoriums on work, this program also continues to contain the highest degree of scope uncertainty of all the Reliability-Related Investments. Future-year plans will continue to incorporate insights gained through implementation.
- **Ridgeland 69kV cable replacement.** The Ridgeland 69kV Cable Replacement program was completed in 2015 and involved replacement of 10.2 miles of high voltage (69kV) underground cable, a majority of which was installed in the early 1950's, and some as early as 1927.

- **Construction of training facilities.** The Training Facilities program was substantially completed in 2015 and provided for construction of two new facilities – one in Chicago and one in Rockford – to provide electric and customer operations training. These facilities provide the ability to offer year-round practical, hands-on training to ComEd’s field employees and enable them to practice classroom theory on real equipment and technology.
- **Wood pole inspection, treatment, and replacement.** There are approximately 1.5 million wood poles on the ComEd system, which translates to approximately 149,000 poles inspected per year. This program entails planned inspection and treatment of an estimated 737,263 wood poles over the five-year program period, and replacement or reinforcement of an estimated 19,947 poles over the course of the program. Over the course of the program, ComEd expects to inspect, treat, and replace or reinforce essentially the same volume of poles identified in ComEd’s 2015 Annual Update. This program will reduce customer interruptions due to wood pole failures by programmatically assessing the strength and integrity of ComEd’s wood poles, and represents the first five years of a multi-year plan to transition ComEd to a multi-year inspection cycle for wood poles.
- **Storm hardening.** This program is designed to further reduce the susceptibility of certain circuits to storm-related damage, and will include deployment of a variety of engineered solutions, including, but not limited to, overhead-to-underground conversion, installation of tree-resistant conductors, and additional vegetation management. In order to optimize customer

benefits, certain circuits will be prioritized based on historical susceptibility to storm-related damage. Engineered solutions will be designed specifically for each circuit. This scope is the same as that presented in ComEd's 2015 Annual Update.

These programs are planned to be completed over a five-year period plus reasonable ramp-up and ramp-down periods. More detailed descriptions of each of these programs, including scope, schedule, capital budget, staffing and units of work are included in Section I of this 2016 Annual Update.

***Smart Grid-Related Investments.*** These programs are described in detail in Section II of this 2016 Annual Update, and include, but are not limited to, the following specific programs briefly described below:

- **Distribution Automation (“DA”).** DA technology uses “sectionalizing” devices and remote communications to detect issues on the distribution system and automatically re-route power to minimize the number of customers impacted. This is commonly referred to as the self-healing nature of the Smart Grid. ComEd's DA program includes planned installation of approximately 2,608 DA devices, and also encompasses the replacement of the older 900 megahertz (“MHZ”) radio system with a new higher security communication system that meets newly-established government regulations. In addition, the older 34kV field devices will be upgraded to the newer Intelli-team (“IT-2”) software to allow for better flexibility with fault isolation and operation with the new radio system. This scope is the same as that presented in ComEd's 2015 Annual Update.

- **Substation micro-processor relay upgrades.** This program is designed to modernize 16 ComEd substations, including upgrade of electro-mechanical protective relays to modern microprocessor-based devices, replacement of aging circuit breakers, two-way communications between ComEd’s control center and each substation, and installation of technology to remotely monitor the health of ComEd’s largest assets, its transformers. This program provides for fault detection, remote asset monitoring and improved site security. Partial upgrades may be applied across the service territory. ComEd has over 250 transmission-fed substations, and over 800 substations in total. This scope is the same as that presented in ComEd’s 2015 Annual Update.
- **Smart Meters.** At the completion of this program, all retail meters on the ComEd distribution system will have been replaced with Smart Meters, including deployment of an Advanced Metering Infrastructure (“AMI”), which provides a two-way communications infrastructure to support other customer services and Smart Grid applications. Expected benefits include reductions in the number of estimated bills, unaccounted for energy, consumption on inactive meters, and uncollectible expense. Deployment of AMI will occur pursuant to the Advanced Metering Infrastructure Deployment Plan approved by the Commission in Docket Nos. 12-0298 and 13-0285, and later accelerated in Docket No. 14-0212, hereafter referred to as the “AMI Plan”. The AMI Annual Implementation Progress Report filed on April 1, 2016 provides further detail on the deployment results thus far and the remaining scope of the program.

- **Associated cyber-secure data communications network.** A cyber-secure data communications infrastructure will be incorporated into each functional area of the Smart Grid. It includes implementation of a robust security model that is aligned with industry best practices and existing security standards. This security model will address confidentiality, integrity, availability and non-repudiation of data transport through the network.

Descriptions of each of these programs, including scope, schedule, capital budget, staffing and units of work are included in Section II of this 2016 Annual Update.

These descriptions, as with the forecasts generally included within this 2016 Annual Update, are illustrative of the investments that ComEd currently proposes to make pursuant to Section 16-108.5 of the Act over its five- and ten-year horizons (exclusive of ramp-up and ramp-down periods). Of course, as time passes, specific investment needs, customer electric use patterns, customer applications, customer attitudes, and commercially available equipment and technologies will all evolve. Section 16-108.5 recognizes that change will occur as ComEd implements its Plan, including in its annual reporting process, its emphasis on technological interoperability, and its innovative test bed feature. Moreover, the effects of change and the need for adaptability in a plan only increase the further out the planning horizon extends. Over periods as long as those called for by Section 16-108.5, specific work plans must be conceptual. A sound operating plan thus must not only retain the flexibility to adapt to such an evolutionary environment, it must embrace it, while still providing overall guidance and vision.

This 2016 Annual Update includes actual work completed during the 2012 – 2015 period and revised estimates of projected work scope in future years. These revisions are based on insights gained from 2015 actual experience, outcomes of long-term contracts, and better alignment of program scopes. Consistent with this structure, those estimates are planning tools. They are not benchmarks. They will continue to evolve both as new information becomes available, and as ComEd gains actual experience. In particular, the actual work plans will be developed on the quarterly cycles. The purpose of this work in any given period may evolve from that now planned, schedules may be either accelerated or delayed, and implementation may require either fewer or more units of work at lower or higher cost, even if the scope and timing of the planned work does not change. The Plan is not to limit or confine the ability of that process to function. Moreover, such change does not imply any flaw in ComEd's Plan, nor any imprudence or unreasonableness in its execution. To the contrary, planning without flexibility would be unwise and unreasonable.

### **Summary Plan Schedule**

In order to establish a framework to plan for and schedule future work while efficiently addressing this inherent change and uncertainty, ComEd is employing a proven iterative planning structure. Under this structure, work plans will be developed on a rolling basis for each quarter of the investment period. Each work plan will outline a series of tasks comprising: project and work planning, design, regulatory and public affairs functions where required (e.g., permitting), project implementation, and review. Consistent with ComEd's Plan and previous annual updates, this quarterly cycle is illustrated throughout this 2016 Annual Update in a series of Gantt charts showing

repeating cycles of work planning and management activity. Please note that while this work planning and management cycle repeats on a quarterly basis, the activities associated with each quarter's iteration may take longer than a quarter to complete. This structure allows ComEd to implement its multi-year Plan effectively and rigorously, while retaining the required flexibility. The Gantt charts that appear in this 2016 Annual Update are illustrative and are not intended to establish specific milestones.

The individual program schedules included in this 2016 Annual Update explain when each program is planned to start and end. Most include both a rolling quarterly work plan process and a high-level task list. It is recognized that scope priorities will be adjusted over the course of the programs as new information is obtained.

ComEd's entire Plan covers a ten-year time period. Reliability-related investments are planned for completion within the first five years, and Smart Grid-related investments are planned for completion within the complete ten-year period. The Smart Meter program is planned to be completed over a seven-year period with deployment of meters taking place pursuant to the AMI Plan. All program schedules include reasonable ramp-up and ramp-down periods.

Figure B.1 in Appendix B presents a high level schedule to complete the entire scope of work associated with the Plan. Detailed schedules are provided in the sections that follow for specific program areas.

## **Summary Plan Budget**

The program budget identifies the estimated annual capital cost for each program. The Plan budget total is estimated to be approximately \$2.6 billion in capital

investments plus associated expenses. As prescribed by the Act, the estimated \$2.6 billion of capital investment under the Plan must be incremental to ComEd's annual capital investment program, which the Act defines as ComEd's "average capital spend for calendar years 2008, 2009, and 2010 as reported in the applicable Federal Energy Regulatory Commission ('FERC') Form 1." 220 ILCS 5/16-108.5(b). The annual capital expenditures for calendar years 2008, 2009, and 2010 are \$951.6 million, \$848.7 million, and \$955.8 million, respectively, as reflected in the statement of cash flows from each year's respective FERC Form 1. This results in an annual baseline of \$918.7 million, derived by summing \$951.6 million + \$848.7 million + \$955.8 million = \$2.8 billion and dividing \$2.8 billion by 3. Thus, the baseline over the multi-year period is \$9.2 billion.

This 2016 Annual Update includes actual expenditures during the 2012 – 2015 period, as well as revised estimates of projected expenditures in future years. The budget and work scope for the remaining years of certain programs have been modified to increase or accelerate the completion of the program work scope. Table B.1 in Appendix B presents a summary of the Plan's estimated total capital budget by program, and Figure B.2 in Appendix B presents, as applicable, the actual and estimated total capital budgets by year associated with the Plan.

### **Summary Plan Staffing**

Program staffing identifies the annual full-time equivalent employees ("FTEs") required for completion of program scope of work. See Appendix A.

FTEs have been calculated by taking the estimated Direct and Contractor worker-hours to execute the Plan and dividing by 2,080 hours. Estimated worker-hours

for Direct jobs and Contractor positions are each composed of the following two sub-categories:

- **Assigned:** Worker-hours assigned to specific work orders associated with Plan program scopes of work; and
- **Support:** Worker-hours charged on timesheets in support of the Plan

Support FTEs are not allocated to specific Plan scopes of work, and are not presented in the FTE sections for individual programs in this 2016 Annual Update.<sup>1</sup> Rather, Figure B.3 in Appendix B presents, as applicable, the actual and estimated Assigned FTEs and Support FTEs to execute the entire scheduled scope of work associated with the 2016 Annual Update. This format for presentation of Assigned FTEs and Support FTEs is consistent with ComEd's timekeeping approach and represents how Support FTEs are allocated to Plan execution. Estimates for Support FTEs in the 2016 Annual Update are based on the 2015 actual proportion of Assigned FTEs to Support FTEs.

Job classifications associated with Assigned FTEs and Support FTEs may include, but are not limited to, engineers, technicians, work planners, finance support, safety support, scheduling support, legal support and craft. FTEs are not defined as employee head counts, and should not be confused with employment levels and trends.

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<sup>1</sup> While this format is consistent with that presented in ComEd's prior annual updates, please note that this is a change in format from ComEd's Plan, in which Support FTEs were allocated to specific scopes of work proportionally, based on estimated investments for specific scopes of work.

The actual and estimated FTEs presented in this 2016 Annual Update include Direct and Contractor FTEs; however, they do not include any Induced FTEs. ComEd's 2015 Energy Infrastructure Modernization Act Annual Jobs Creation Report, submitted on April 1, 2016, includes actual Direct, Contractor, and Induced FTEs for 2015.

## **Summary Plan Quantity of Units**

The program quantity of units describes the estimated number of work units, where applicable, that are planned to be completed each year for each program area. This 2016 Annual Update includes actual units of work completed during the 2012 – 2015 period and revised estimates of units of work that are projected to be completed in future years. All units of work associated with the identified work scopes are included in the estimated quantities in this 2016 Annual Update, and will be counted towards achievement of the Plan goals. However, this does not limit additional units from being completed as part of the baseline spend at ComEd's discretion.

## **Attachments**

This 2016 Annual Update includes, for informational purposes, a 2015 Plan Review, included as Attachment 1 to this Update. The 2015 Plan Review provides more information on the actual annual and cumulative capital expenditures and units of work completed in 2015, as compared to those estimated in the 2015 Annual Update, with corresponding explanations of changes.

This 2016 Annual Update also includes, for informational purposes, a schedule and staffing plan for the calendar year 2016 investments ("2016 Plan") included as Attachment 2 to this 2016 Annual Update. The 2016 Plan provides more information on

scope, schedule, budget, staffing, and units of work that are planned to be completed in 2016 in association with the Plan. The monthly targets listed are not intended to be firm milestones, but rather to provide directional guidance towards accomplishment of the annual goals.

## **SECTION I: Reliability-Related Investments**

### **SECTION I.A: Underground Residential Cable (“URD”) Injection and Replacement**

#### **I.A.1: Summary of Program Revisions**

Over the course of the program, ComEd expects to inject or replace essentially the same miles of cable as presented in ComEd’s 2015 Annual Update.

#### **I.A.2: Program Scope**

ComEd’s URD system has approximately 8,700 miles of bare concentric neutral cable that was installed between 1966 and 1985, which is primarily used to serve residential and commercial areas. The URD Injection and Replacement program excludes mainline cable, which is covered under the Mainline Cable System Refurbishment and Replacement program described in Section I.B below. URD cable failures mainly occur within the population of bare concentric neutral cable. The number of annual failures in this type of cable has been trending up in recent years as this cable continues to age. ComEd currently projects injection or replacement of an estimated 3,879 miles of the problematic cable over the course of the program.

ComEd anticipates that, by the end of the program, the number of annual failures in this type of cable will be significantly reduced. This reduction in faults will reduce long-duration outages primarily experienced in residential subdivisions. The program consists of two major components:

- URD Cable Injection
- URD Cable Replacement

Each of these components is described in more detail below.

### URD Cable Injection

Cable injection fills in cable insulation voids and avoids cable failures. In general, URD cables that are candidates for injection typically have intact concentric neutral conductors, are not solid cable or strand-filled cable, and have a low number of cable splices. Where it is practical, cable injection is typically a more cost beneficial way to avoid URD cable failures than cable replacement. Based on ComEd's past experience with URD cable injection, ComEd currently estimates that during the course of the program 411 miles will be injected. This scope is the same as that presented in ComEd's 2015 Annual Update.

### URD Cable Replacement

URD cables that cannot practically or economically be injected will be replaced on a schedule prioritized to replace the worst-performing URD cables first. It is expected that at the end of the program approximately 3,468 miles of URD cable will have been replaced. The scope for the URD cable replacement reflects essentially the same scope as that presented in ComEd's 2015 Annual Update.

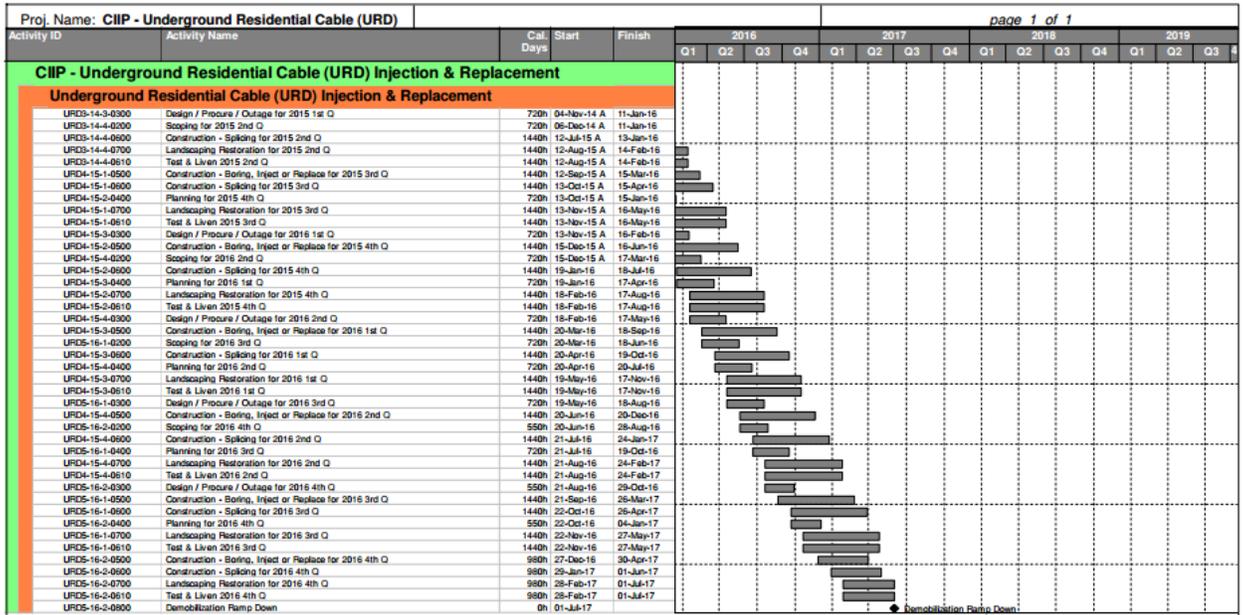
### **I.A.3: Program Schedule**

This program is planned to be completed over a five-year period plus reasonable ramp-up and ramp-down periods. Estimates of cost, units of work, and schedules for that work, may evolve over time.

Figure I.A.3 presents the estimated remaining schedule to complete the URD Injection and Replacement program. The schedule is essentially a rolling quarterly work plan consisting of the following key remaining tasks:

- Mobilization and ramp-up
- Establish priority for the calendar year
- Perform scoping
- Perform design tasks, procure material, and identify required outages in schedule
- Planning (develop work packages and secure permits)
- Construction – Boring, injection or replacement
- Construction – Splicing where required
- Test and liven
- Landscaping restoration
- Demobilization and ramp-down period

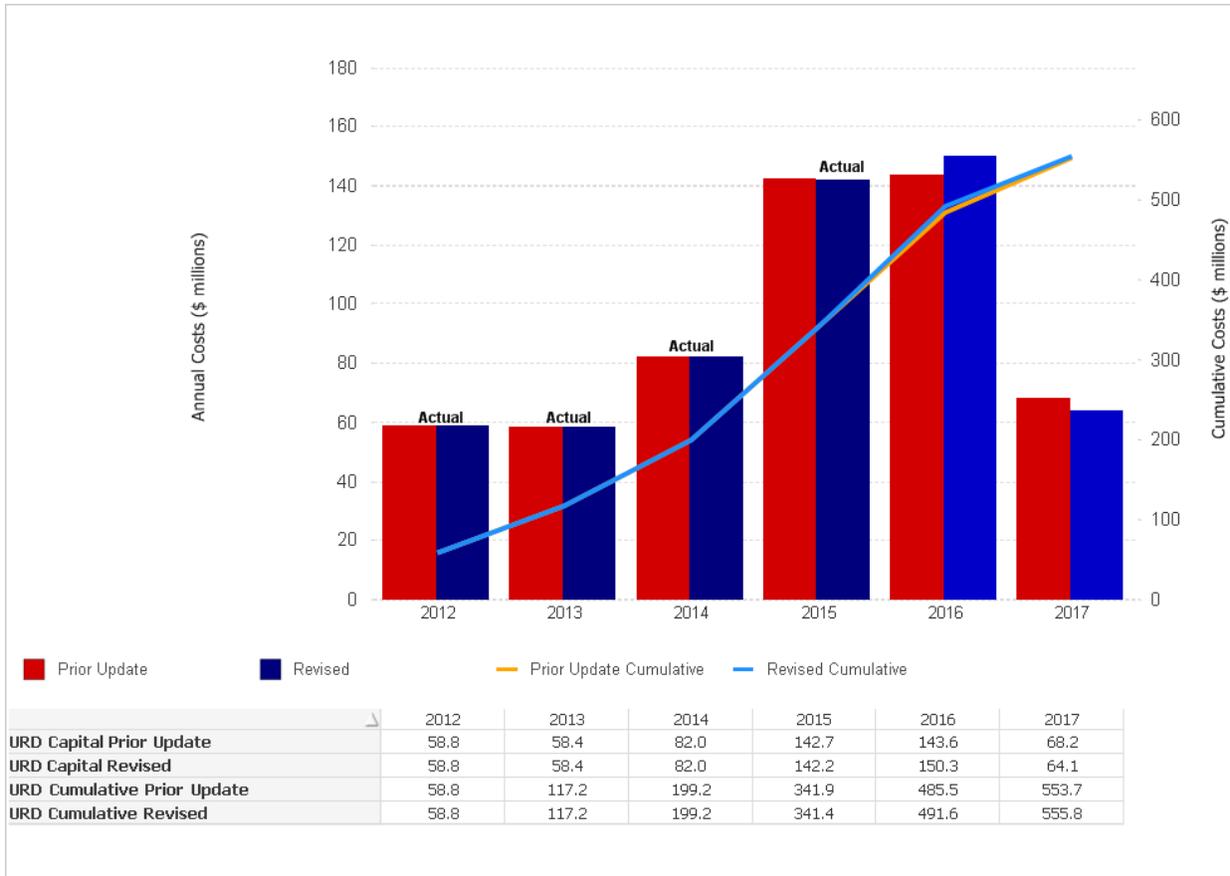
**Figure I.A.3: URD INJECTION AND REPLACEMENT SCHEDULE**



**I.A.4: Program Budget**

Figure I.A.4 presents, as applicable, the actual and estimated capital budgets by year for the URD Injection and Replacement program as compared with ComEd’s 2015 Annual Update. ComEd estimates the program cost to be capital investments of \$556 million plus associated expenses over the program period. This budget is essentially the same as that presented in ComEd’s 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time.

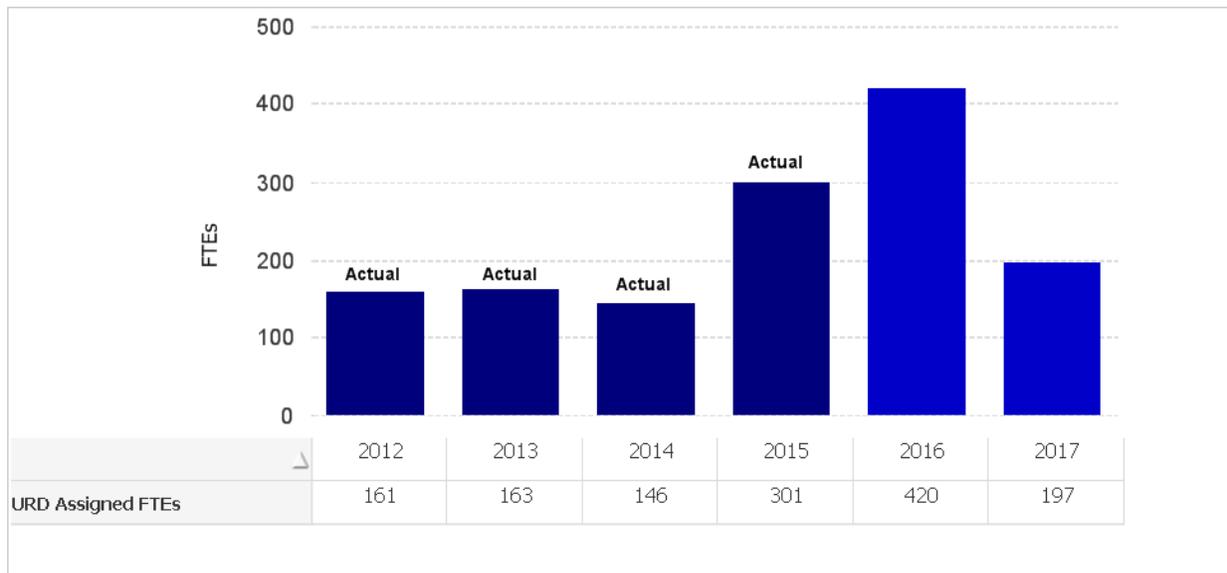
**FIGURE I.A.4: URD INJECTION AND REPLACEMENT CAPITAL BUDGET**



### I.A.5: Program FTEs

Figure I.A.5 presents, as applicable, the actual and estimated Assigned Direct and Assigned Contractor FTEs required to perform the specific scheduled scope of work. Assigned FTEs have been calculated by taking the estimated worker-hours assigned to execute the scope of work and dividing by 2,080 hours. The actual and estimated FTEs presented in Figure I.A.5 include Assigned FTEs; however, they do not include Support FTEs or Induced FTEs.

**FIGURE I.A.5: URD INJECTION AND REPLACEMENT ASSIGNED FTEs**



## I.A.6: Program Units

Figure I.A.6.A shows the miles of URD cable injected or estimated to be injected, as applicable. This chart serves as a tracking mechanism over the course of the program, and reflects the scope of work accomplished, as well as the scope of work left to be performed. As explained in Section I.A.2, it is estimated that 411 miles of URD cable will be injected over the course of the program, which is the same scope that was presented in ComEd’s 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time.

**FIGURE I.A.6.A: URD CABLE INJECTION UNITS (IN MILES)**

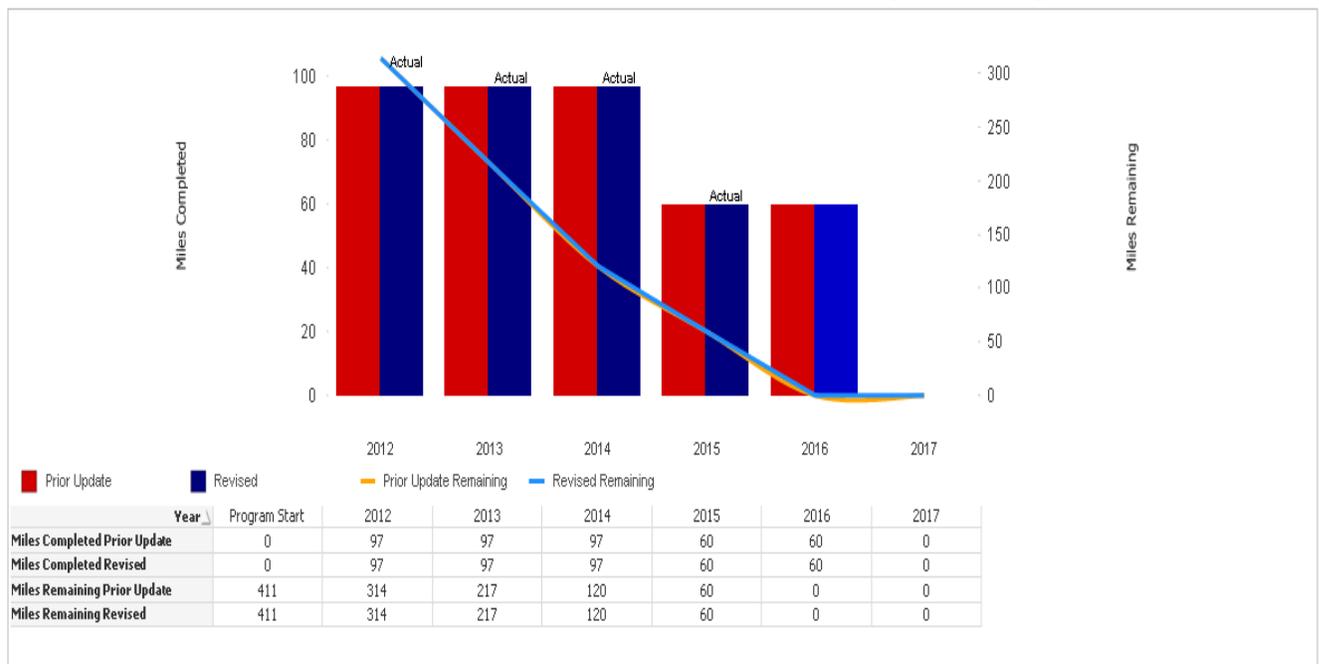
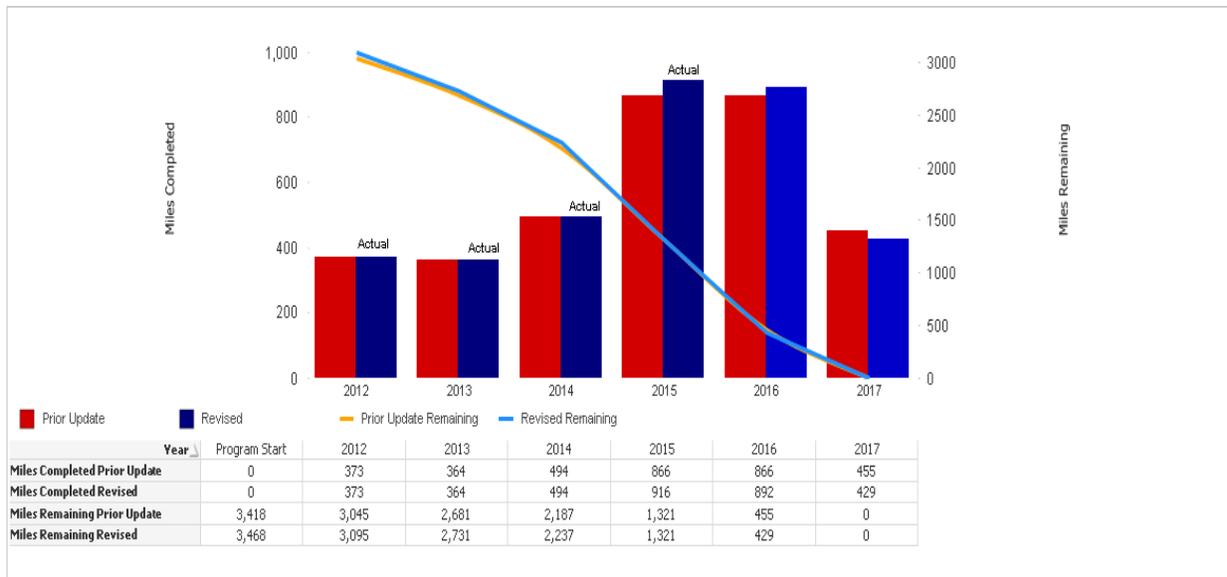


Figure I.A.6.B shows the miles of URD cable replaced or estimated to be replaced, as applicable. This chart serves as a tracking mechanism over the course of the program, and reflects the scope of work accomplished each year, as well as the scope of work left to be performed. It is estimated that 3,468 miles of URD cable will be replaced over the course of the program. As Figure I.A.6.B illustrates (and Section I.A.2

explains), the scope for the URD cable replacement is essentially the same as that presented in ComEd’s 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time.

**FIGURE I.A.6.B: URD CABLE REPLACEMENT UNITS (IN MILES)**



## SECTION I.B: Mainline Cable System Refurbishment and Replacement

### I.B.1: Summary of Program Revisions

Over the course of the program, ComEd expects to perform essentially the same scope of work as that presented in ComEd’s 2015 Annual Update.

### I.B.2: Program Scope

The ComEd mainline underground system includes approximately 8,300 miles of cable installed in conduit systems or direct buried. Mainline cable system refurbishment

and replacement has the most complex scope of work of all the programs. The scope is composed of three main work categories:

- Manhole assessment and refurbishment of manholes and cable systems
- Cable replacement
- Cable testing

The accomplishment of this scope is highly dependent on the ability to obtain necessary permits and to schedule equipment outages. Certain periods of time or certain work restrictions, such as summer moratoriums, may limit the types of work that can be performed due to the need to maintain system configuration. Such periods will be reflected in ComEd's annual or summer critical work plans. Because remediation scope is based on inspection results, the complex nature of the underground system, interrelationship of multiple circuits within a manhole, and certain potential moratoriums on work, this program continues to contain the highest degree of scope uncertainty of all the Reliability-Related Investments. Future-year plans will continue to incorporate insights gained through implementation.

#### Manhole Assessment and Cable System Refurbishment

ComEd has an estimated 32,026 manholes on its system. Over the course of the program, ComEd plans to assess all manholes on its system and perform refurbishment within the parameters of the Act. This scope is the same as that presented in ComEd's 2015 Annual Update.

Assessment includes the evaluation of the overall condition of the manhole, cables, and cable support systems. Refurbishment includes replacing or repairing cable systems in the manhole, and addressing other structural issues as required. Manhole

structural work may range from minor refurbishment to replacement of an entire manhole.

Concurrent with manhole assessments, cable joint issues discovered within the manholes (e.g., bulging or leaking joints) will be addressed primarily with cable replacement. As assessments are performed, work plans will be generated to address the findings.

### Cable Replacement

Replacement criteria will be based, in part, on the method of original installation. Replacement of cable in conduit will be based on manhole assessment findings. Direct buried mainline cable will either be replaced without testing, or replaced after testing, based on cable length and prior fault history. It is estimated that 672 miles of mainline cable will be replaced over the course of the program. The scope for the mainline cable replacement is essentially the same as that presented in ComEd's 2015 Annual Update.

### Cable Testing

Underground cable is divided into sections largely as a result of limits placed on cable lengths by the manufacturers and limits due to the physical configuration of the circuits.

An estimated 931 circuit sections will be selected for Very Low Frequency ("VLF") Testing per the Institute of Electric and Electronics Engineers ("IEEE") standard 400.2 to validate the serviceability of the section of cable following manhole refurbishment and mainline cable replacement. The scope for the mainline cable testing is the same as that presented in ComEd's 2015 Annual Update. The scope is focused on performing "proof tests" at the conclusion of repair activities to validate the serviceability of the section of cable, diagnostic testing for long direct buried sections,

and some re-tests following a failure of proof tests or diagnostic tests. It is estimated that cable tests will result in replacement of cable sections, which are included in the estimate shown in the “Cable Replacement” section above. This estimate is based on assumptions concerning inspection results, which will be adjusted over time as actual data become available. Because of their inherent reliance on assumptions, estimates of cable testing contain a high degree of uncertainty and are not intended to reflect firm scope.

### **I.B.3: Program Schedule**

The overall Mainline Cable System Refurbishment and Replacement program is planned to be completed over a five-year period plus reasonable ramp-up and ramp-down periods. Estimates of cost, units of work, and schedules for that work, may evolve over time. The remaining schedule for each of the three program areas is described below.

Figure I.B.3.A presents the estimated remaining schedule to complete the Manhole Assessment and Cable System Refurbishment program. The schedule is essentially a rolling quarterly work plan consisting of the following key remaining tasks:

- Establish manhole inspection priority for the calendar year
- Perform scoping and configuration analysis; review sequence for capacity issues
- Perform design tasks, procure material, and identify required outages in schedule; include identified joint issues in evaluation
- Planning (develop work packages and secure permits)

- Construction - Manhole cleaning (environmental) if required
- Construction - Conduct manhole assessments and refurbish cable systems as necessary
- Evaluate results
- Develop cable replacement plans as necessary
- Demobilization ramp-down

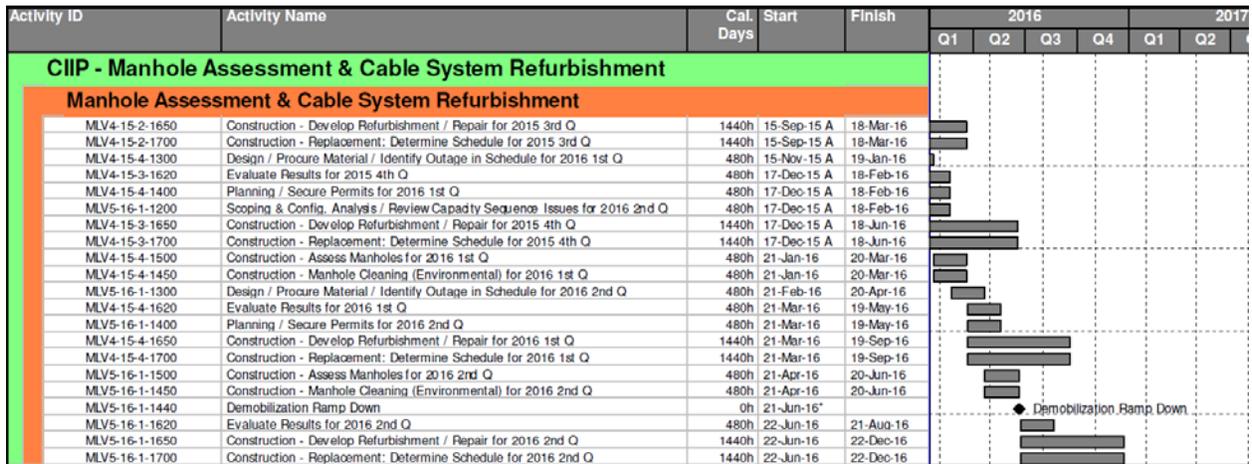
Figure I.B.3.B presents the estimated remaining schedule to complete the Mainline Cable Replacement program. The schedule is essentially a rolling quarterly work plan consisting of the following key remaining tasks:

- Establish replacement priority for the calendar year
- Perform scoping and configuration analysis; review sequence for capacity issues
- Perform design tasks, procure material, and identify required outages in schedule; include identified joint issues in evaluation
- Planning (develop work packages and secure permits)
- Construction - Walkdown manhole
- Construction - Remove or replace cable / repair leakers
- Construction - Complete terminations
- Test cable and liven

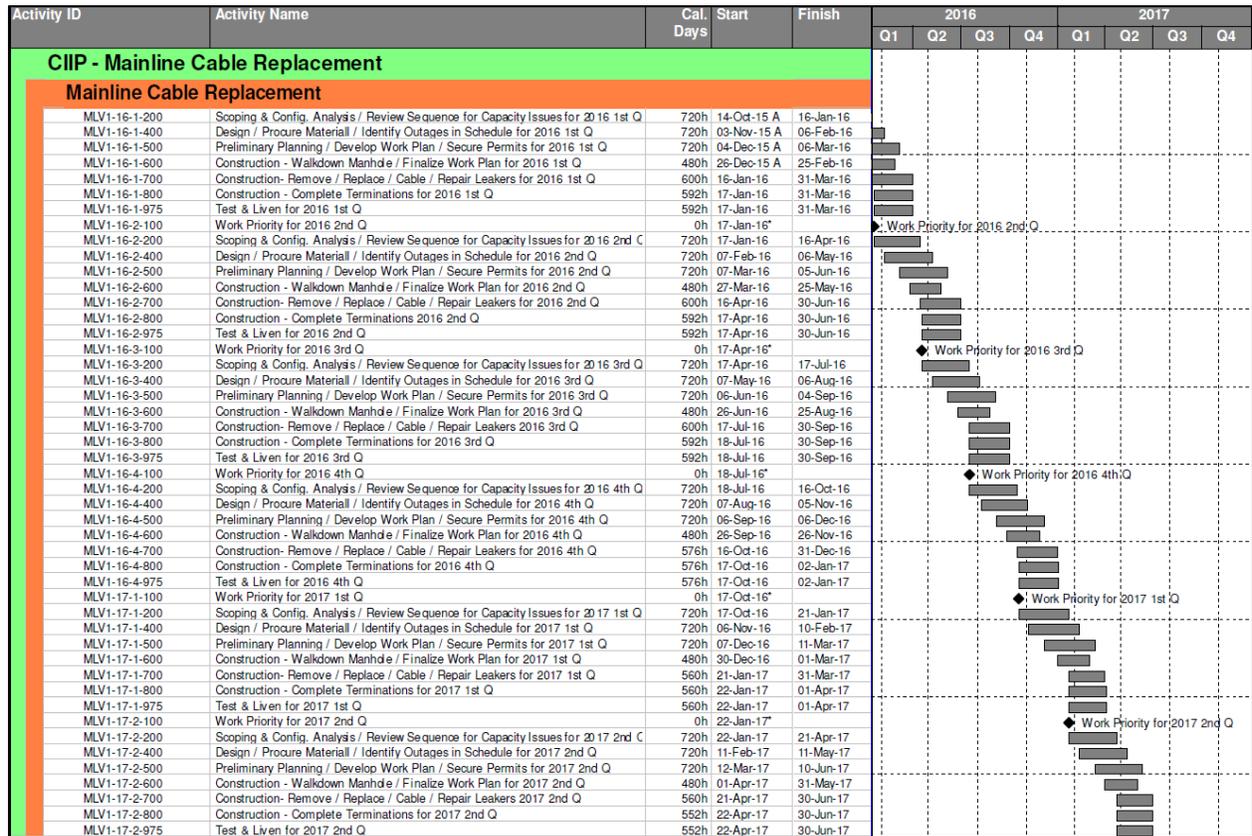
Figure I.B.3.C presents the estimated remaining schedule to complete the Mainline Cable Testing program. The schedule is essentially a rolling quarterly work plan consisting of the following key remaining tasks:

- Establish testing priority for the calendar year
- Perform scoping and configuration analysis; review sequence for capacity issues
- Perform design tasks, procure material, and identify required outages in schedule; include identified joint issues in evaluation
- Planning (develop work packages)
- Perform testing
- Evaluate results
- Develop work program for testing failures (*i.e.*, cable replacement) based on results
- Demobilization ramp-down

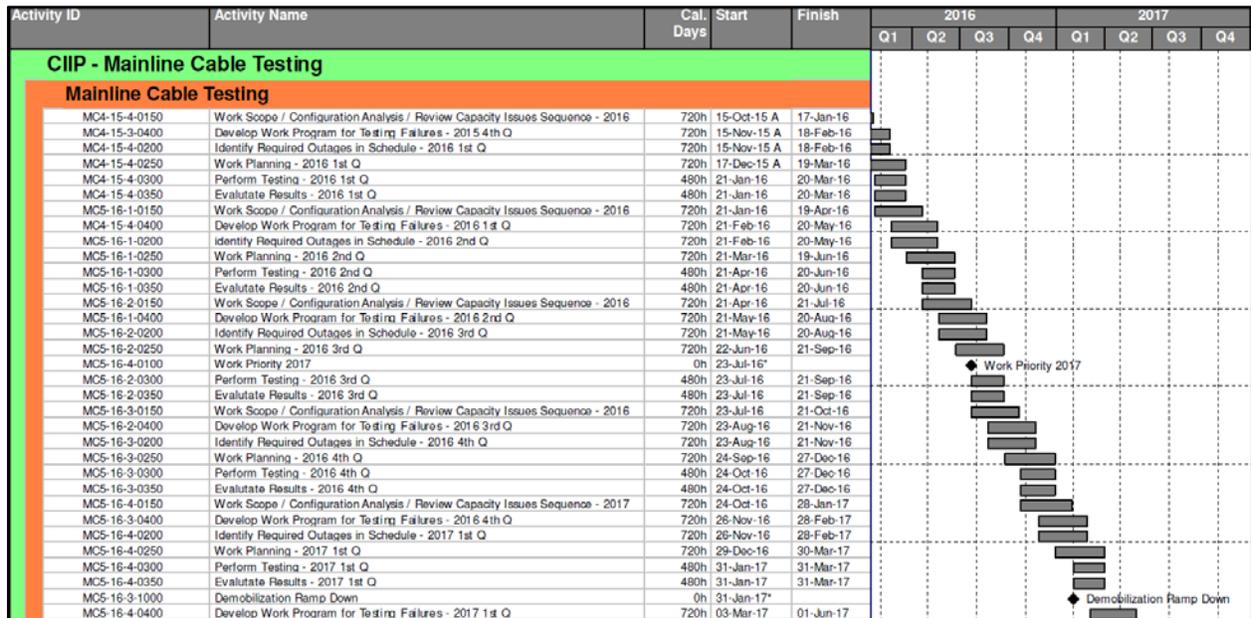
**FIGURE I.B.3.A: MANHOLE ASSESSMENT SCHEDULE**



**FIGURE I.B.3.B: MAINLINE CABLE REPLACEMENT SCHEDULE**



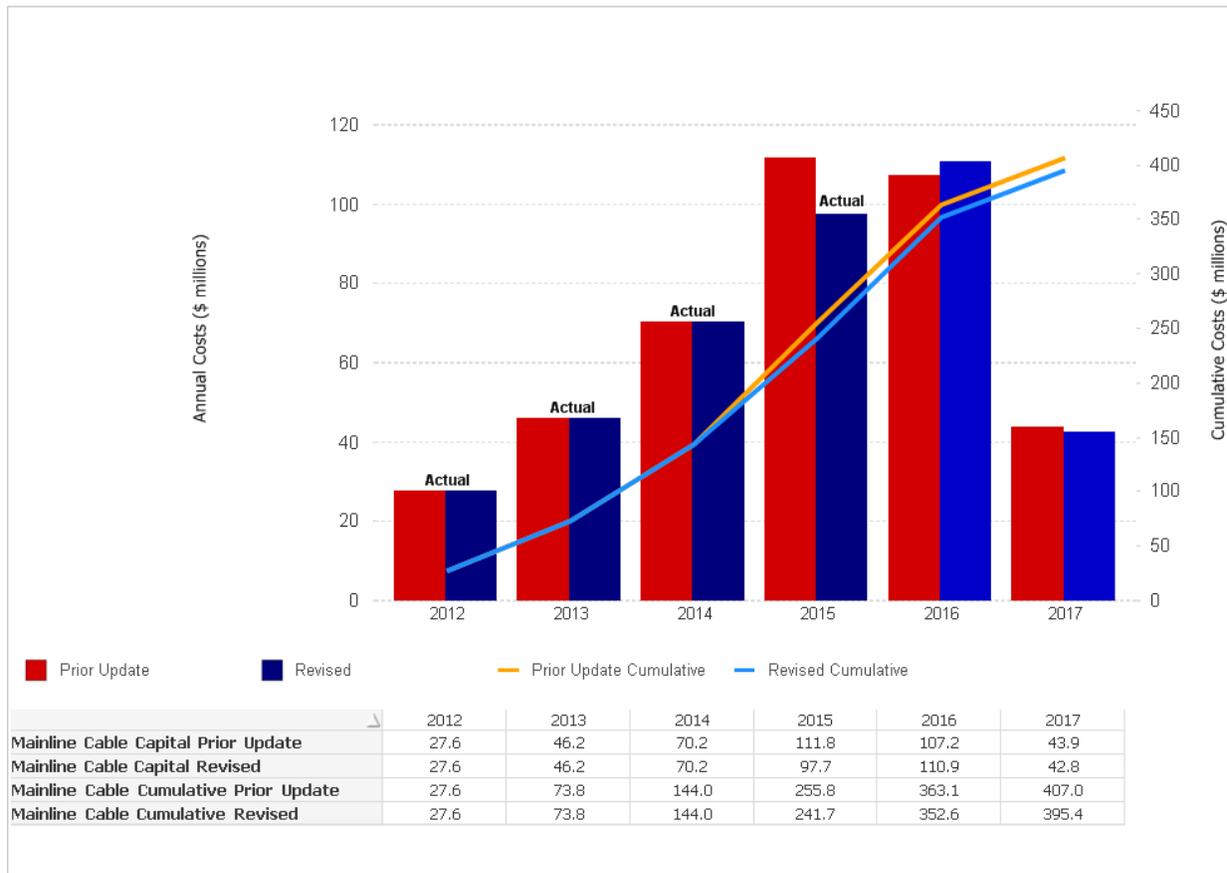
**FIGURE I.B.3.C: MAINLINE CABLE TESTING SCHEDULE**



**I.B.4: Program Budget**

Figure I.B.4 presents, as applicable, the actual and estimated capital budgets by year for the Mainline Cable System Refurbishment and Replacement program. ComEd estimates the program cost to be capital investments of \$395 million, plus associated expenses over the program period. This represents a decrease of approximately \$12 million as compared to ComEd’s 2015 Annual Update, which is attributable to material commodity pricing reduction, material delivery improvement and construction volume efficiencies. Estimates of cost, units of work, and schedules for that work may evolve over time.

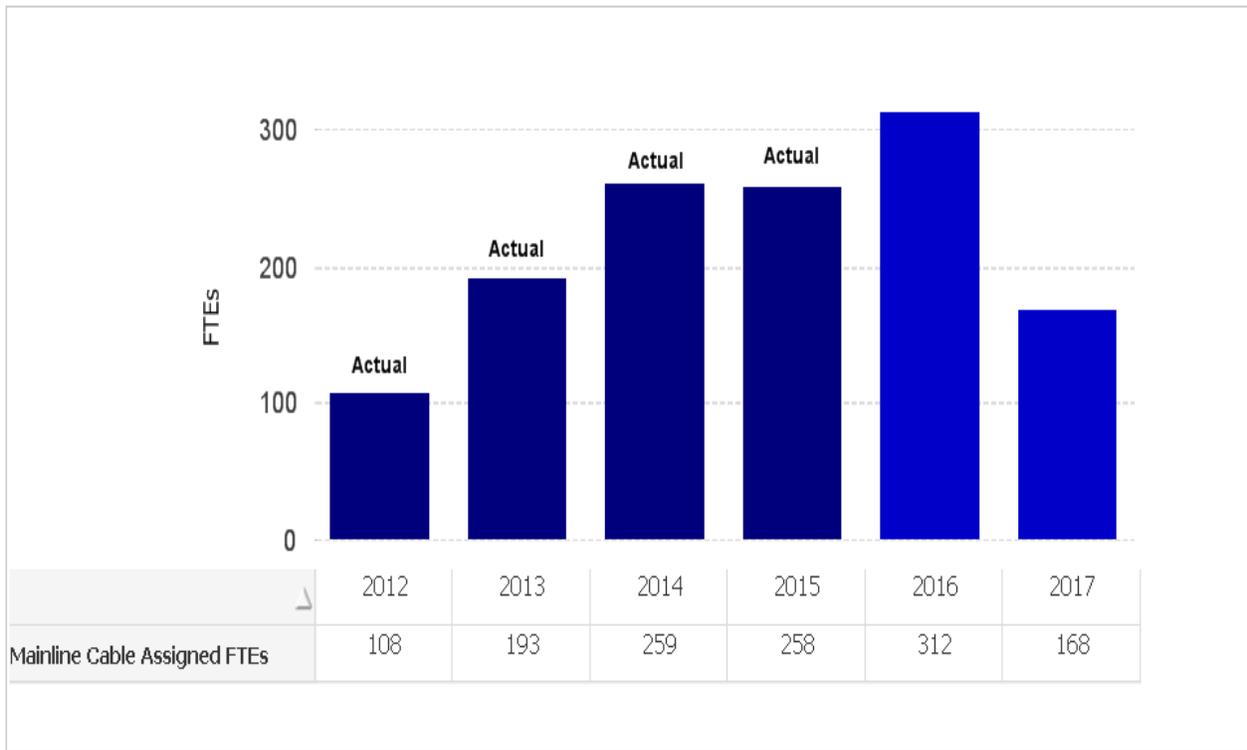
**FIGURE I.B.4: MAINLINE CABLE SYSTEM REFURBISHMENT AND REPLACEMENT CAPITAL BUDGET**



**I.B.5: Program FTEs**

Figure I.B.5 presents, as applicable, the actual and estimated Assigned Direct and Assigned Contractor FTEs required to perform the specific scheduled scope of work. Assigned FTEs have been calculated by taking the estimated worker-hours assigned to execute the scope of work and dividing by 2,080 hours. The actual and estimated FTEs presented in Figure I.B.5 include Assigned FTEs; however, they do not include Support FTEs or Induced FTEs.

**FIGURE I.B.5: MAINLINE CABLE SYSTEM REFURBISHMENT AND REPLACEMENT ASSIGNED FTES**

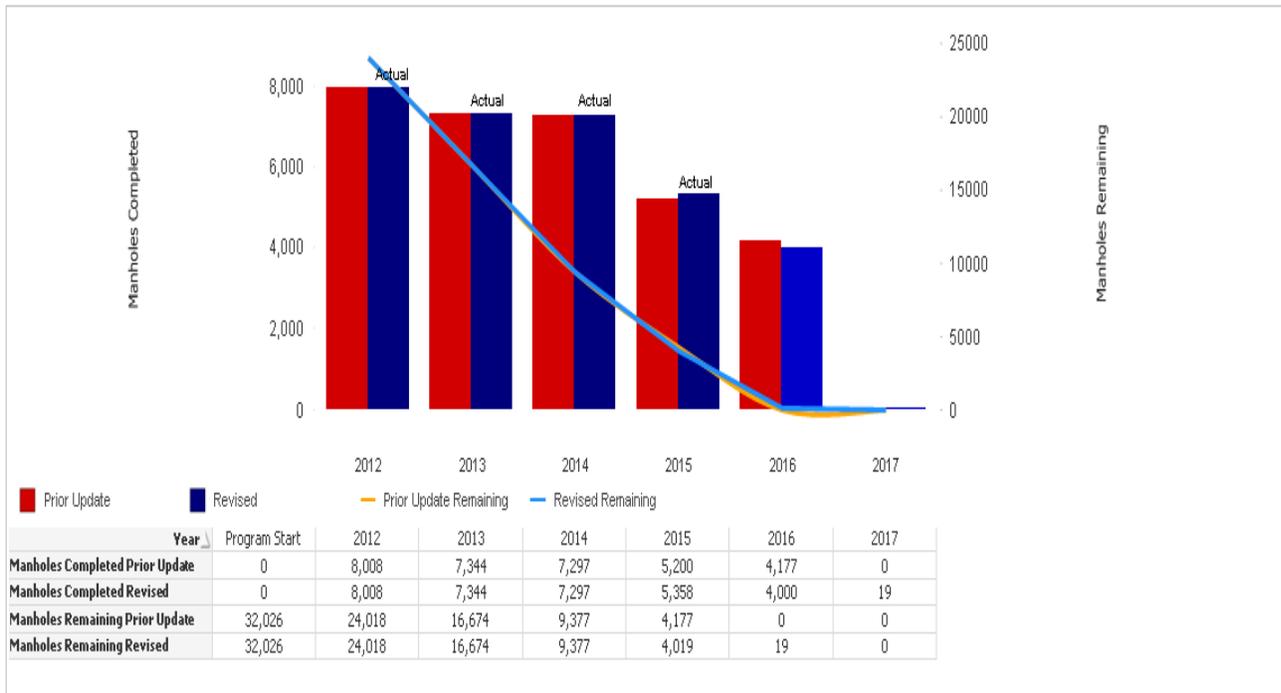


**I.B.6: Program Units**

Manhole Assessment

Figure I.B.6.A shows the number of manhole assessments completed or estimated to take place, as applicable, over the course of the program at 32,026, which is the same as that presented in ComEd’s 2015 Annual Update. This chart serves as a tracking mechanism over the course of the program, and reflects the scope of work accomplished each year, as well as the scope of work left to be performed. Estimates of cost, units of work, and schedules for that work may evolve over time.

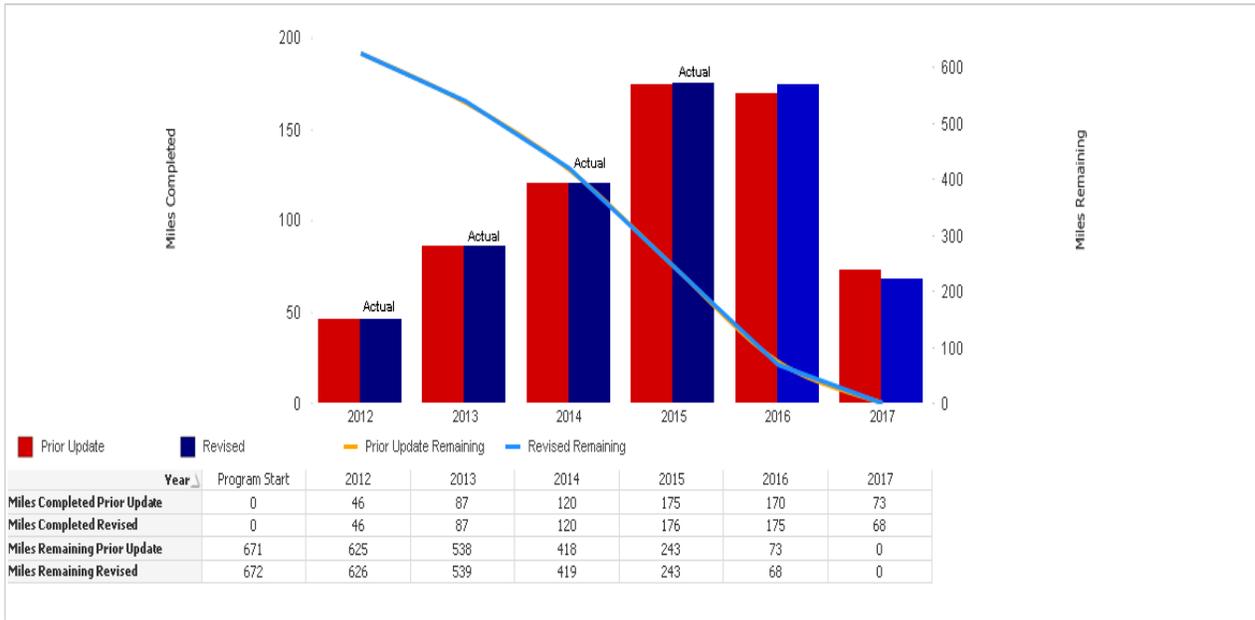
**FIGURE I.B.6.A: MANHOLE ASSESSMENT UNITS (IN MANHOLES)**



**Cable Replacement**

Figure I.B.6.B shows the miles of mainline cable replaced or estimated to be replaced, as applicable. It is expected that some cables will be replaced based on historical performance of the cable. This chart serves as a tracking mechanism over the course of the program, and reflects the scope of work accomplished each year as well as the scope of work left to be performed. The current estimate for replacement is 672 miles of mainline underground cable, which includes cables replaced and those that may fail VLF testing. The scope for the mainline cable replacement is essentially the same as that presented in ComEd’s 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time.

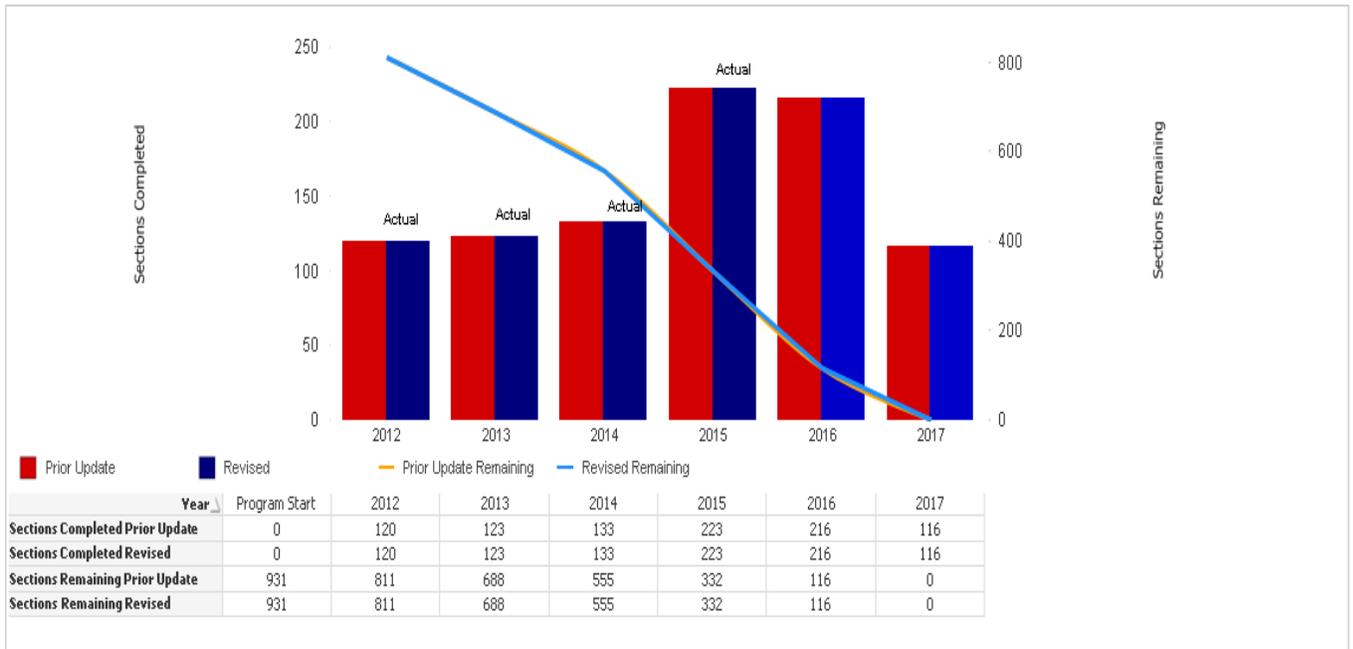
**FIGURE I.B.6.B: MAINLINE CABLE REPLACEMENT UNITS (IN MILES)**



Cable Testing

Figure I.B.6.C shows the number of sections of mainline cable VLF tested or estimated to be tested, as applicable. This chart serves as a tracking mechanism over the course of the program, and reflects the scope of work accomplished as well as the scope of work left to be performed. It is estimated that 931 sections of mainline cable will be VLF tested over the course of the program. The scope for the mainline cable testing is the same as that presented in ComEd’s 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time.

**FIGURE I.B.6.C: MAINLINE CABLE TESTING UNITS (IN SECTIONS)**



## SECTION I.C: Ridgeland 69kV Cable Replacement

### I.C.1: Summary of Program Revisions

The Ridgeland 69kV Cable Replacement program was completed in 2015, and over the course of the program ComEd performed the same scope of work as that presented in ComEd’s 2015 Annual Update.

### I.C.2: Program Scope

The Ridgeland 69kV cable system is approximately 40.5 circuit miles, composed of four cable subsystems: Solid Paper Lead (“PL”), Cross-Link Polyethylene (“XLPE”), Low Pressure Fluid Filled (“LPFF”), and High Pressure Fluid Filled (“HPFF”).

The cable replacement program for the Ridgeland area began in 1998, targeting poor performing paper insulated lines. The majority of the paper insulated lines that are being replaced were installed in the early 1950's, although some were installed as early as 1927. Replacement of circuits with the reliable XLPE cable systems will increase the long-term reliability in the area.

The focus of this program was to replace five circuits with XLPE cable systems, representing a total of 10.2 circuit miles, which is the same scope that ComEd presented in its 2015 Annual Update.

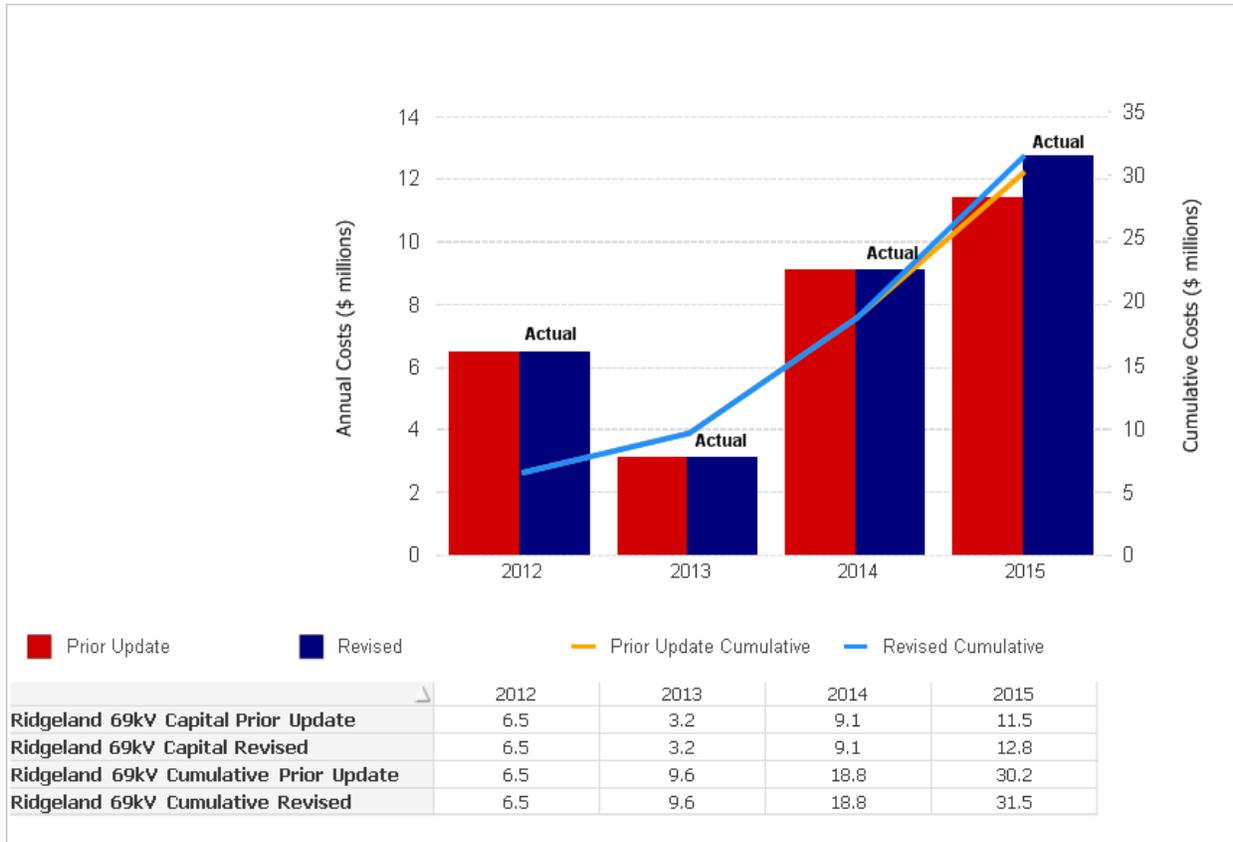
### **I.C.3: Program Schedule**

The Ridgeland 69kV Cable Replacement program was completed over a four-year period.

### **I.C.4: Program Budget**

Figure I.C.4 presents the actual capital budgets by year for the Ridgeland 69kV Cable Replacement program. The total program cost was capital investments of approximately \$32 million, plus associated expenses over the program period. This represents an increase of approximately \$1 million as compared to ComEd's 2015 Annual Update, which relates to additional conduit installed to house the upgraded cable.

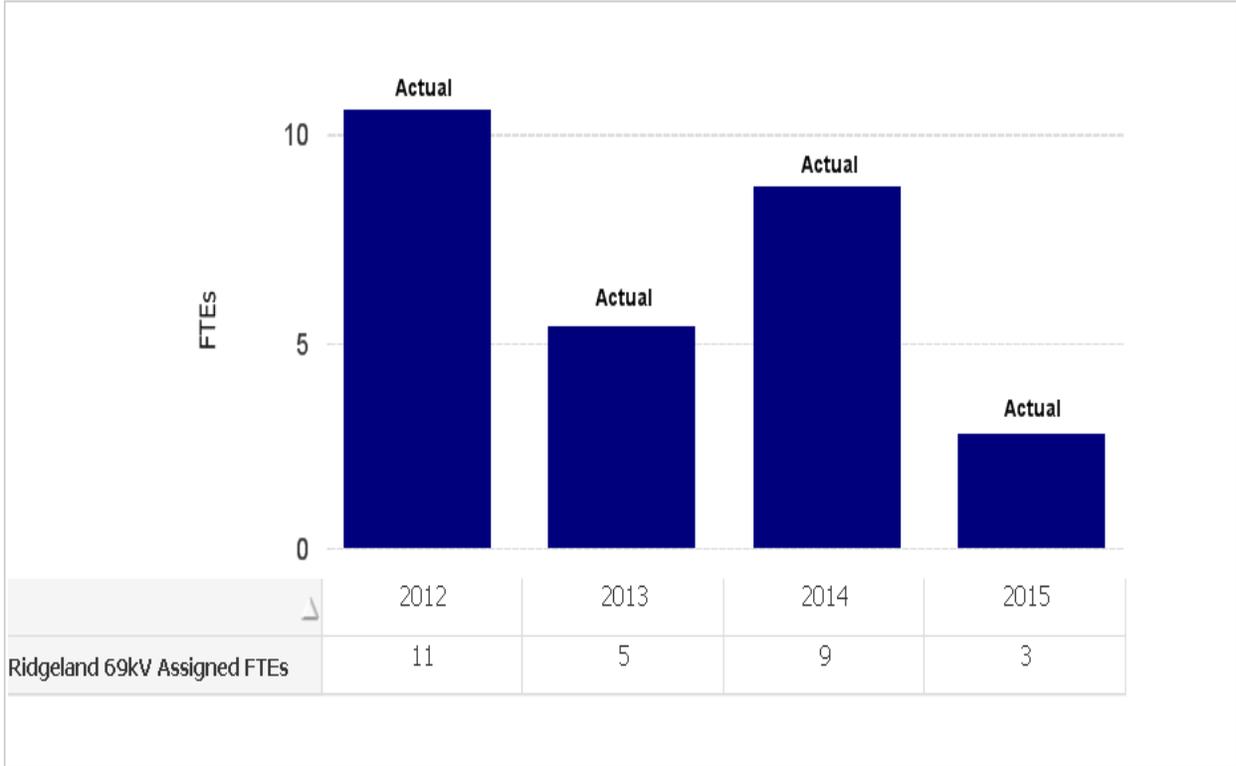
**FIGURE I.C.4: RIDGELAND 69KV REPLACEMENT CAPITAL BUDGET**



**I.C.5: Program FTEs**

Figure I.C.5 presents the actual Assigned Direct and Assigned Contractor FTEs required to perform the specific scheduled scope of work. Assigned FTEs have been calculated by taking the estimated worker-hours assigned to execute the scope of work and dividing by 2,080 hours. The actual FTEs presented in Figure I.C.5 include Assigned FTEs; however, they do not include Support FTEs or Induced FTEs.

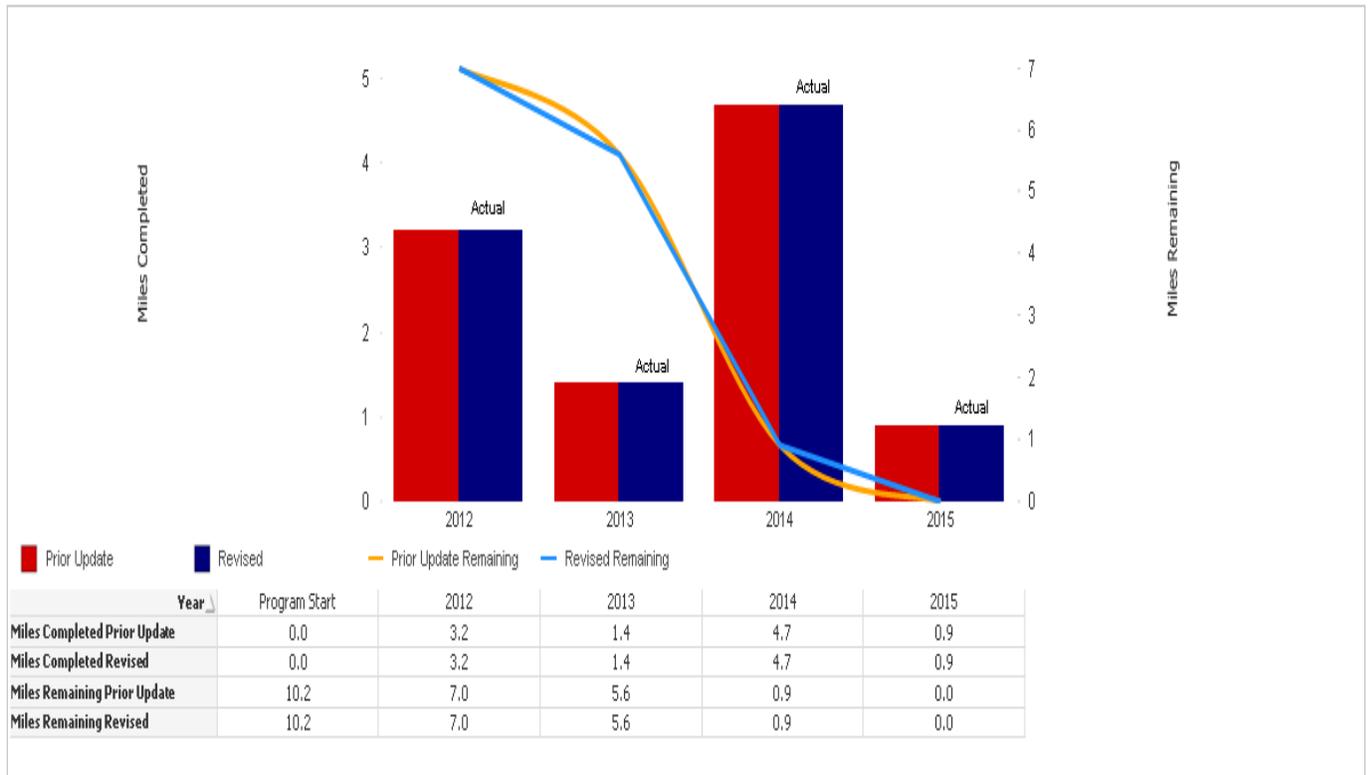
**FIGURE I.C.5: RIDGELAND 69KV CABLE REPLACEMENT ASSIGNED FTES**



**I.C.6: Program Units**

Figure I.C.6 shows the miles of 69kV cable replaced. This chart served as a tracking mechanism over the course of the program, and reflects the scope of work accomplished each year. A total of 10.2 circuit miles of 69kV cable was replaced over the course of the program. This is the same scope as presented in ComEd’s 2015 Annual Update.

**FIGURE I.C.6: RIDGELAND 69KV CABLE REPLACEMENT UNITS (IN MILES)**



## SECTION I.D: Construction of Training Facilities

### I.D.1: Summary of Program Revisions

The Training Facilities program funded with investments called for by Section 16-108.5(b) of the Act was substantially completed in 2015. Over the course of the program, ComEd performed the work as described in ComEd’s 2015 Annual Update, and added enhanced functionality and features related to training and community outreach initiatives.

## **I.D.2: Program Scope**

ComEd currently provides electric and customer operations training at six locations within its service territory. While investment in training facilities and programs has been and will remain a core utility function funded as part of ComEd operations, under Section 16-108.5(b)(1)(A)(ii), ComEd must, as one of its EIMA commitments, invest an incremental estimated total of \$10,000,000 in training facility construction or upgrade projects. This Section further provides that, at a minimum, one such facility in which the EIMA investment is made must be located in a municipality having a population of more than 2 million residents and one facility must be located in a municipality having a population of between 150,000 and 170,000 residents. In compliance with this requirement, the Training Facilities program provided for construction or upgrade of two training facilities - one facility located in Chicago (approximately 2.7 million residents) and one facility located in Rockford (approximately 153,000 residents). For reasons including overall efficiency and cost savings, the buildings and locations housing those Training Facilities also provide other functions.

### Chicago Facility

The construction of the Chicago facility was substantially completed in 2015. The facility was designed to qualify for certification under the United States Green Building Council's Leadership in Energy Efficiency Design (LEED) Green Building Rating System. ComEd has submitted its application for LEED certification of this facility. The Chicago facility is an overhead, underground, substation construction, transmission underground, area operating and distribution operations training facility with the following characteristics, among others:

- Indoor space consisting of classrooms, lecture hall, instructor office space, restroom and locker facilities, indoor equipment area, new technology area, storage, conference room, student break area, meter shop, 26 indoor underground cable splicing bays, customer education area, and an indoor pole yard.
- Outdoor yard area consisting of approximately 60 poles and associated overhead primary and secondary conductors, overhead equipment, distribution automation equipment, URD distribution equipment, underground manholes and conduit, and substation equipment.
- The facility also will serve as an auxiliary emergency and storm preparedness center to enhance ComEd's resource coordination during significant outage events.
- Provide necessary meeting and conference space for community outreach initiatives, including partnering with the Chicago Public Schools and After School Matters to provide high school students with training and educational opportunities.

### Rockford Facility

ComEd's Rockford Training Center opened in 2012, and is an overhead construction training facility with the following characteristics, among others:

- Indoor area consisting of classrooms, lecture hall, instructor office space, restroom and locker facilities, storage, customer education area, student break area, and meter and substation shop area.

- Indoor pole yard consisting of 16 poles, Smart Grid equipment, 28 foot transmission tower, and a manhole.
- Outdoor yard area consisting of 60 poles and associated overhead primary and secondary conductors, overhead equipment, Distribution Automation equipment, two underground manholes and conduit, and URD distribution equipment. The yard size is approximately 85,000 square feet.
- Through 2015, the Rockford Training Center has completed 226 training sessions and hosted 57 field trips at the ComEducation Center.
- The facility also includes an auxiliary storm training center from which additional manpower can be dispatched to enhance storm restoration capabilities.

### **I.D.3: Program Schedule**

The Training Facilities program was conducted in two phases. The Rockford Facility was completed in 2012, and the Chicago Facility was substantially completed in 2015.

### **I.D.4: Program Budget**

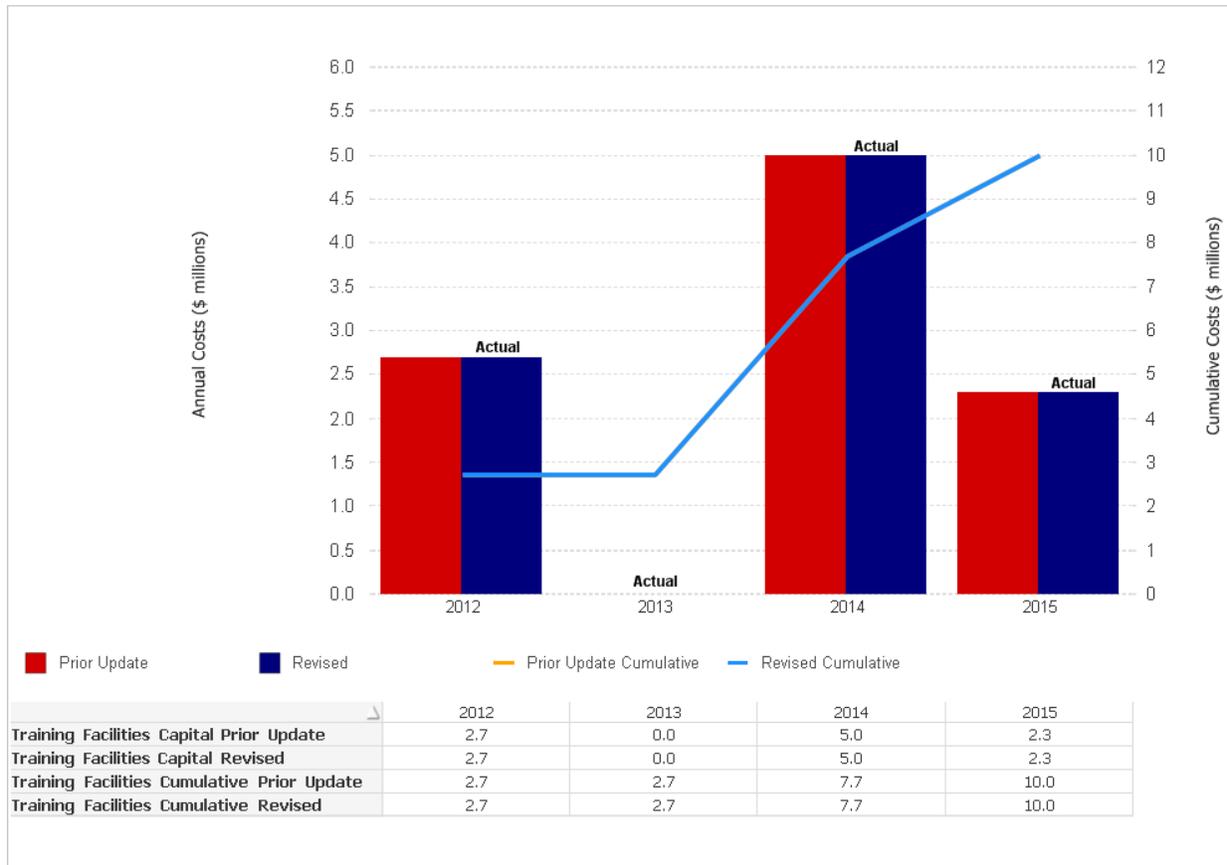
ComEd's capital construction and upgrade costs for the Chicago Facility through December 31, 2015 totaled \$38.3 million and, for the project totaled \$41.4 million.<sup>2</sup> This

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<sup>2</sup> Although the Plan includes capital investments of \$10 million in Training Facilities, plus associated expenses, pursuant to Section 16-108.5(b) of the Act, this does not limit ComEd's ability to make additional capital investments in Training Facilities through baseline capital investments at ComEd's discretion.

total includes the incremental investment called for by Section 16-108.5(b)(1)(A)(ii) of the Act, plus additional baseline capital investment funds. Figure I.D.4 presents the actual capital budgets by year for the Training Facilities program that were accounted for under the Plan.

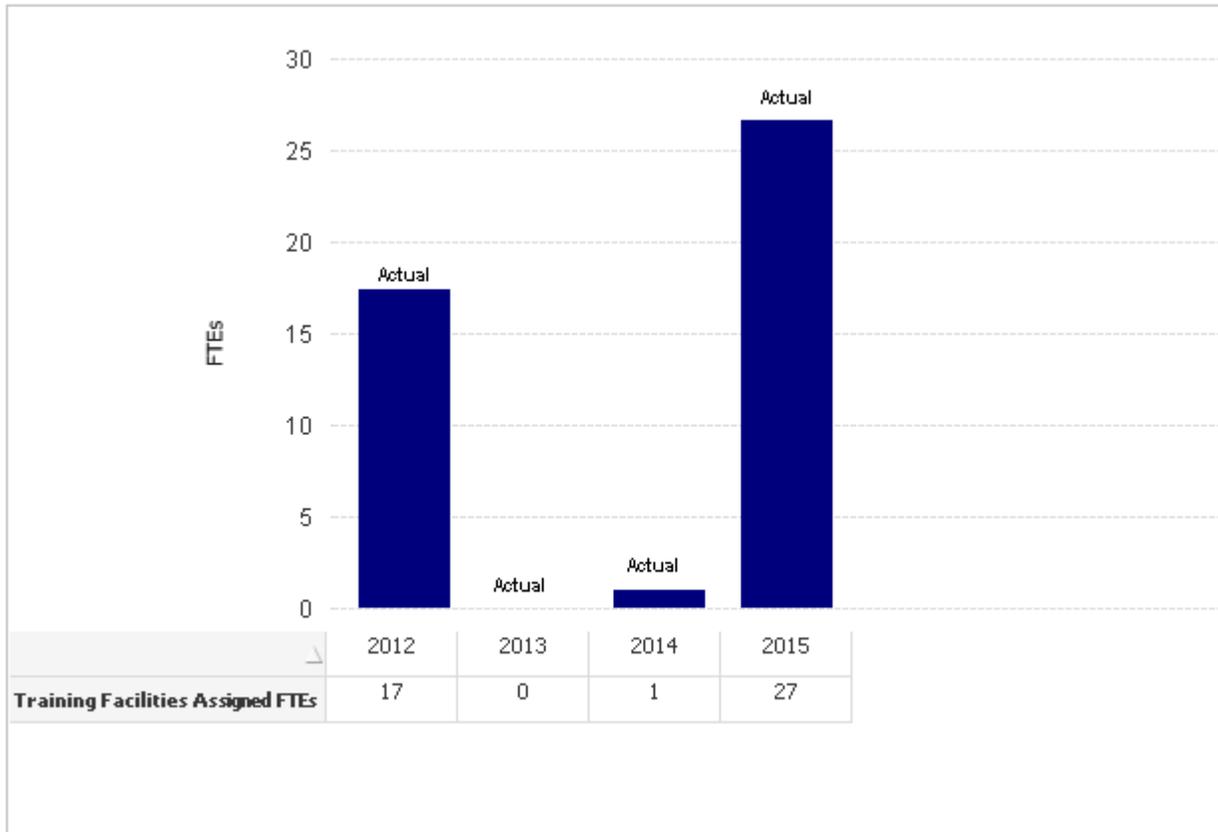
**FIGURE I.D.4: TRAINING FACILITIES CAPITAL BUDGET UNDER PLAN**



**I.D.5: Program FTEs**

Figure I.D.5 presents the actual Assigned Direct and Assigned Contractor FTEs required to perform the specific scheduled scope of work. Assigned FTEs have been calculated by taking the estimated worker-hours assigned to execute the scope of work and dividing by 2,080 hours. The actual FTEs presented in Figure I.D.5 include Assigned FTEs; however, they do not include Support FTEs or Induced FTEs.

**FIGURE I.D.5: TRAINING FACILITIES Assigned FTES**



**SECTION I.E: Wood Pole Inspection, Treatment and Replacement**

**I.E.1: Summary of Program Revisions**

Over the course of the program, ComEd expects to inspect, treat, and replace or reinforce essentially the same volume of poles identified in ComEd’s 2015 Annual Update.

### **I.E.2: Program Scope**

The Wood Pole Inspection, Treatment and Replacement program entails inspection and required treatment of an estimated 737,263 wood poles over the five-year program period. Based on ComEd's past inspection experience, an estimated 19,947 pole replacements or reinforcements are projected to be identified from the inspections over the five-year program period. This represents essentially the same scope of poles inspected, treated, replaced and reinforced as compared with ComEd's 2015 Annual Update. This program represents the first five years of a multi-year plan to transition ComEd to a multi-year inspection cycle for wood poles.

### **I.E.3: Program Schedule**

Figure I.E.3 presents the estimated remaining schedule to complete the scope of work associated with the Wood Pole Inspection, Treatment and Replacement program during the five-year period. Estimates of cost, units of work, and schedules for that work may evolve over time. The schedule is essentially a rolling quarterly work plan consisting of the following key remaining tasks:

- Ramp-up period
- Establish work priority for the calendar year
- Perform inspections
- Perform scoping and configuration analysis for pole treatments or replacements
- Perform design tasks, procure material, and identify required outages in schedule

- Planning (develop work packages and secure permits)
- Construction – replace, treat or reinforce poles

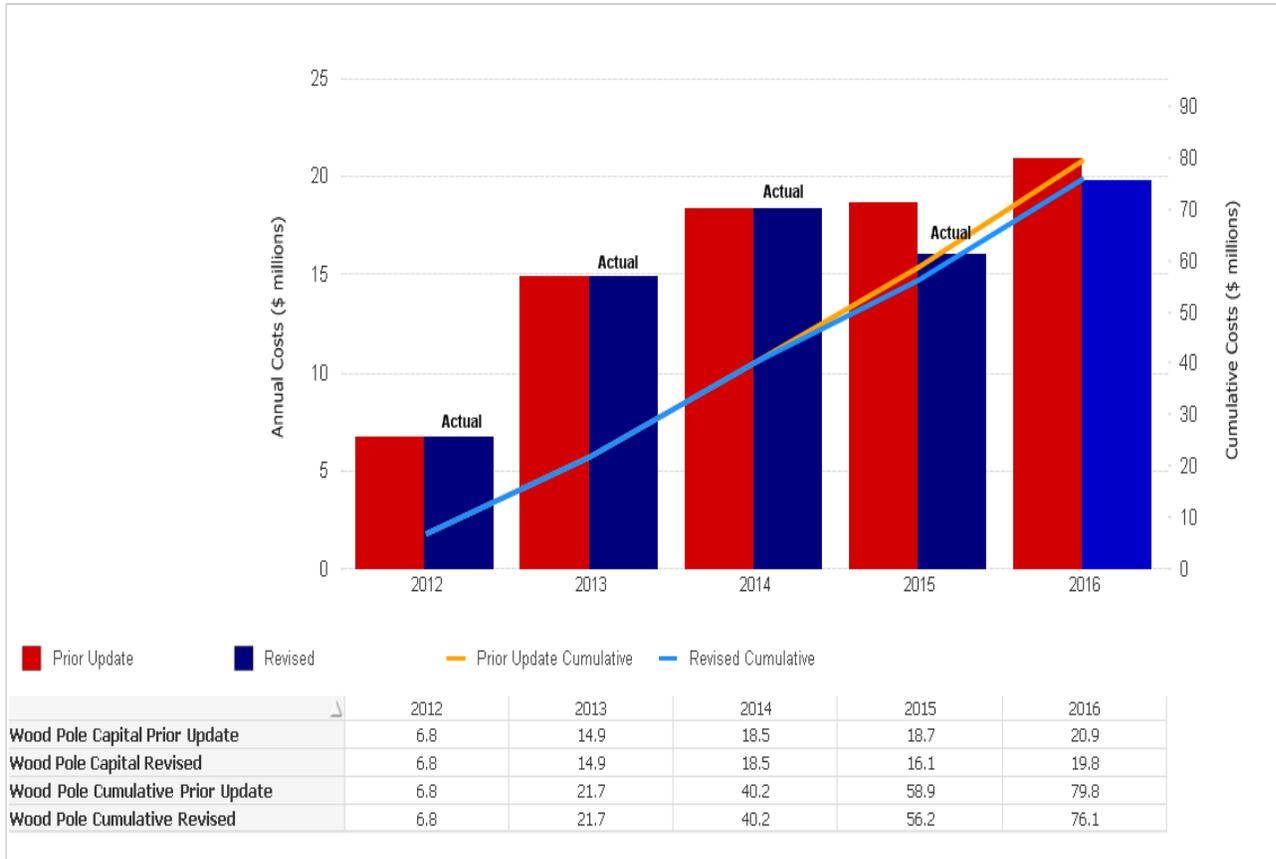
**FIGURE I.E.3: WOOD POLE INSPECTION, TREATMENT AND REPLACEMENT SCHEDULE**



**I.E.4: Program Budget**

Figure I.E.4 presents, as applicable, the actual and estimated capital budgets by year for the Wood Pole Inspection, Treatment and Replacement program. ComEd estimates the program cost to be capital investments of approximately \$76 million, plus associated expenses over the program period. This represents a decrease of approximately \$4 million as compared to ComEd’s 2015 Annual Update, which is due to ComEd performing the majority of the pole replacements at a reduced cost as compared to contractors performing the work. Estimates of cost, units of work and schedules for that work may evolve over time.

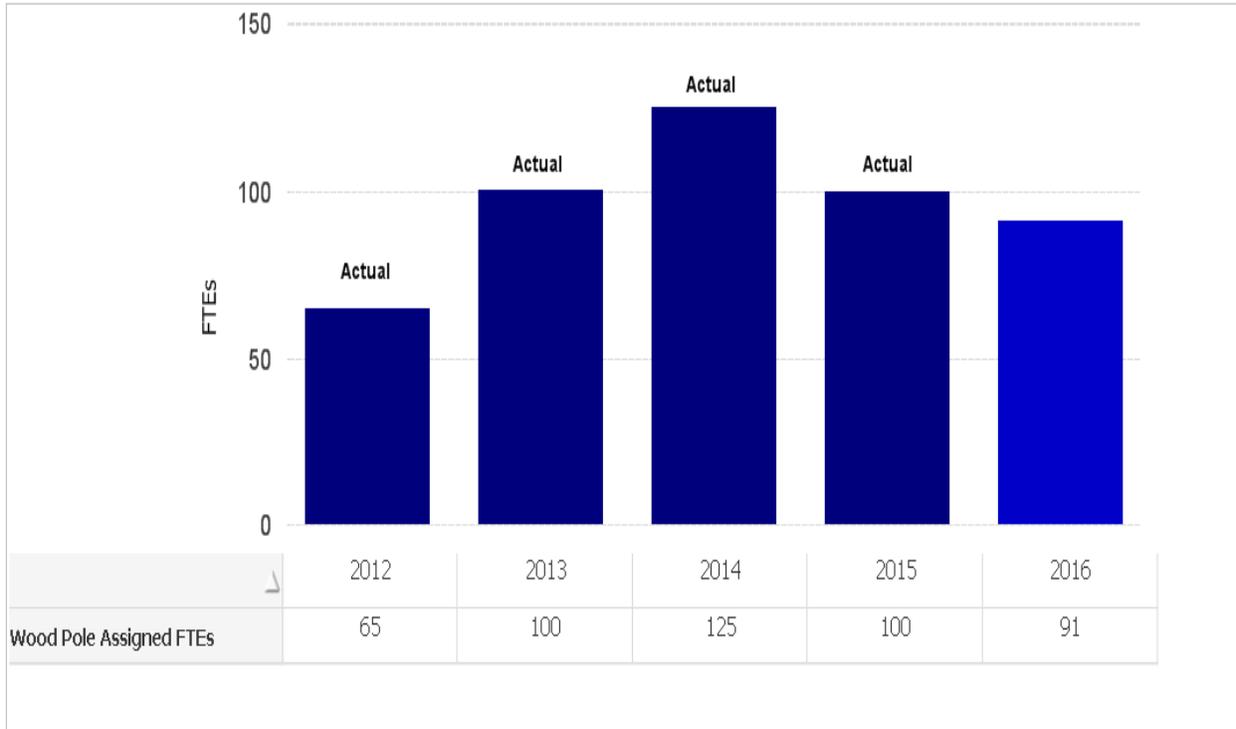
**FIGURE I.E.4: WOOD POLE INSPECTION, TREATMENT AND REPLACEMENT CAPITAL BUDGET**



**I.E.5: Program FTEs**

Figure I.E.5 presents, as applicable, the actual and estimated Assigned Direct and Assigned Contractor FTEs required to perform the specific scheduled scope of work. Assigned FTEs have been calculated by taking the estimated worker-hours assigned to execute the scope of work and dividing by 2,080 hours. The actual and estimated FTEs presented in Figure I.E.5 include Assigned FTEs; however, they do not include Support FTEs or Induced FTEs.

**FIGURE I.E.5: WOOD POLE INSPECTION, TREATMENT AND REPLACEMENT ASSIGNED FTES**

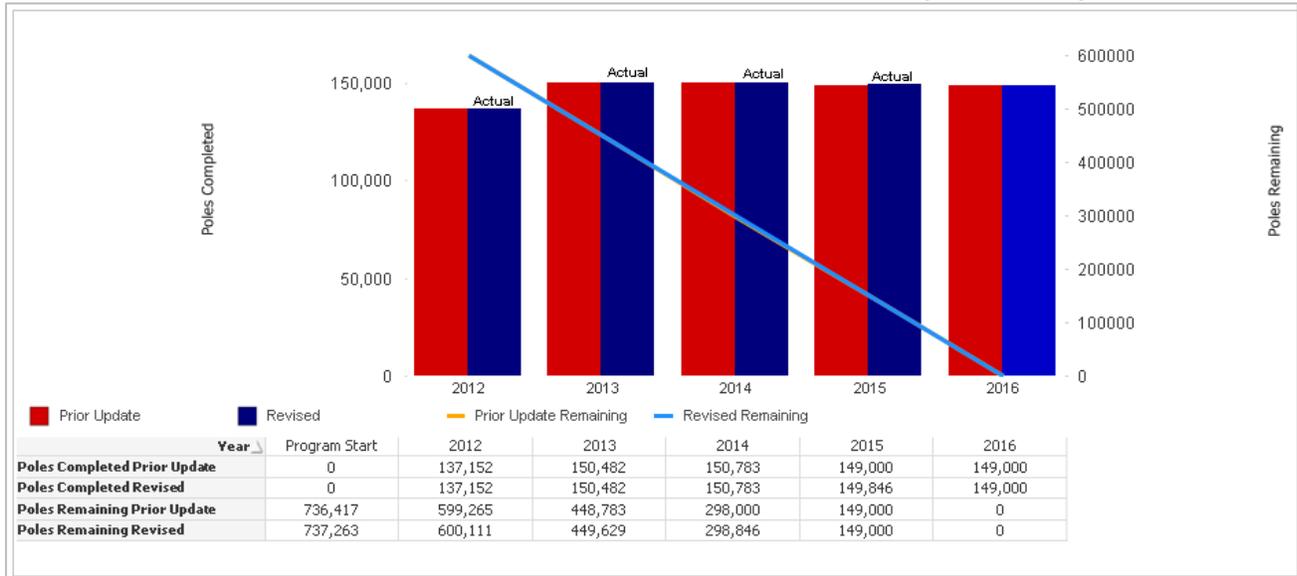


**I.E.6: Program Units**

Wood Pole Inspections

Figure I.E.6.A shows the quantity of wood poles inspected or estimated to be inspected, as applicable. This chart serves as a tracking mechanism over the course of the program, and reflects the scope of work accomplished each year, as well as the scope of work left to be performed. It is estimated that 737,263 wood poles will be inspected over the course of the program. This represents essentially the same scope of poles inspected as compared with ComEd’s 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time.

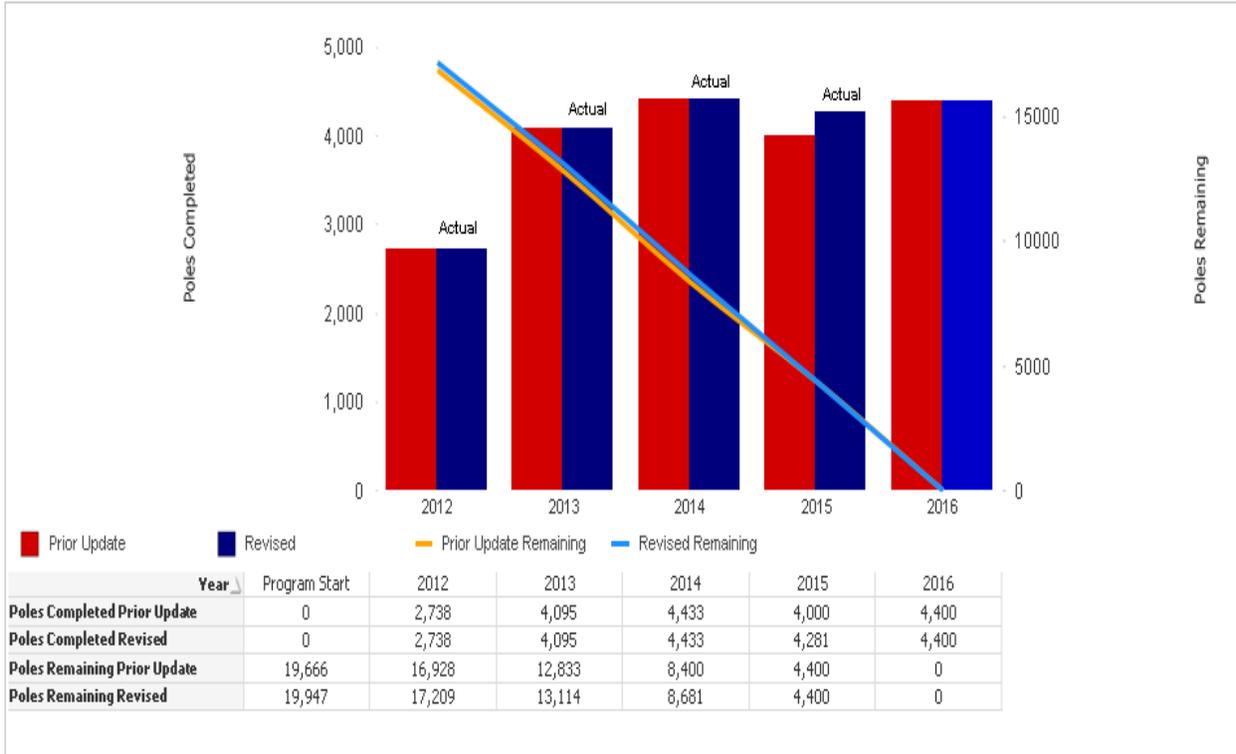
**FIGURE I.E.6.A: WOOD POLE INSPECTION UNITS (IN POLES)**



Wood Pole Replacements/Reinforcements

Figure I.E.6.B shows the estimated quantity of wood poles replaced or reinforced, or estimated to be replaced or reinforced, as applicable. This chart serves as a tracking mechanism over the course of the program, and reflects the scope of work accomplished each year, as well as the scope of work left to be performed. It is estimated that 19,947 wood poles will be replaced or reinforced over the course of the program. This represents essentially the same scope of poles presented in ComEd’s 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time. This estimate is based on assumptions concerning inspection results, which will be adjusted over time as actual data become available. Estimates of wood pole replacements/reinforcements contain a high degree of uncertainty and are not intended to reflect firm scope.

**FIGURE I.E.6.B: WOOD POLE REPLACEMENT/REINFORCEMENT UNITS (IN POLES)**



## **SECTION I.F: Storm Hardening**

### **I.F.1: Summary of Program Revisions**

Over the course of the program, ComEd expects to perform the same scope of work as that presented in ComEd's 2015 Annual Update.

### **I.F.2: Program Scope**

Storm hardening is designed to further reduce the susceptibility of circuits to storm-related damage, including but not limited to high winds, thunderstorms, and ice storms. Improvements may include, but are not limited to, overhead to underground conversion, installation of tree-resistant cable, additional vegetation management and other engineered solutions. This program is aimed at hardening facilities in accordance with the directives of Section 16-108.5(b)(1)(A)(iv) of the Act, and is not directed at any defect or failure to properly design, engineer, construct, or maintain the existing system. Additionally, while storm hardening is designed to further reduce the susceptibility of circuits to storm-related damage, it does not make circuits immune to damage from storms or other sources.

Circuits will be prioritized based on each circuit's historical susceptibility to storm-related damage and the ability to provide the greatest customer benefit upon completion of the improvement.

For a circuit to be eligible for improvement, ComEd's ability to maintain proper tree clearances surrounding the overhead circuit must not have been impeded by third parties.

Considerations for storm hardening of circuits include, but are not limited to:

- Mainline Circuits (Focus on circuits with the highest customer storm impact)

- 4kV and 12kV overhead circuits
- Prioritized by weighted reliability (SAIFI, Customers Served) and vegetation scores from 2008 to 2012
- Circuits with fewer than 500 customers
- Engineering review for determining targeted mainline portions and hardening solution
- Circuit Taps (Focus on circuits with pocket area storm duration impact)
- Circuit tap must meet vegetation outage and CAIDI gates
- Engineering review for determining tap portions and hardening solutions (*e.g.*, URD, spacer cable, and enhanced trimming)

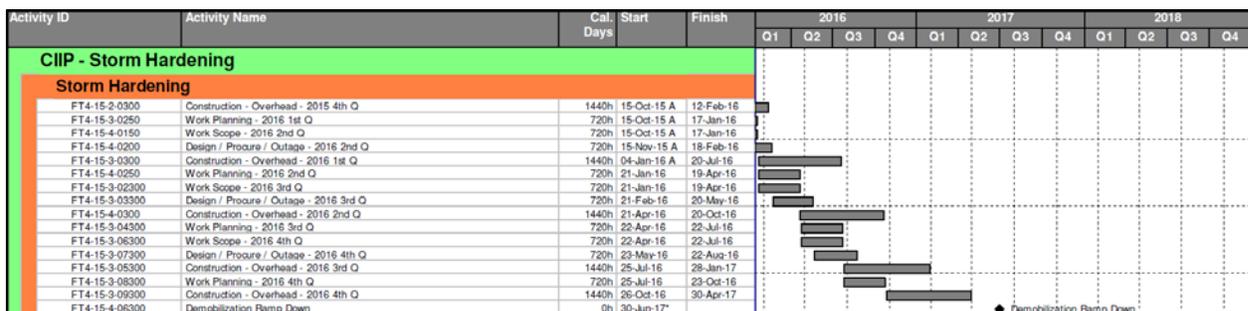
### I.F.3: Program Schedule

The Storm Hardening program is planned to be completed over a five-year period plus reasonable ramp-up and ramp-down periods. Estimates of cost, units of work, and schedules for that work may evolve over time.

Figure I.F.3 presents the estimated remaining schedule to complete the Storm Hardening program. The schedule consists of essentially a rolling quarterly work plan consisting of the following key remaining tasks:

- Perform design tasks, procure material, and identify required outages in schedule
- Work planning
- Construction
- Demobilization ramp-down

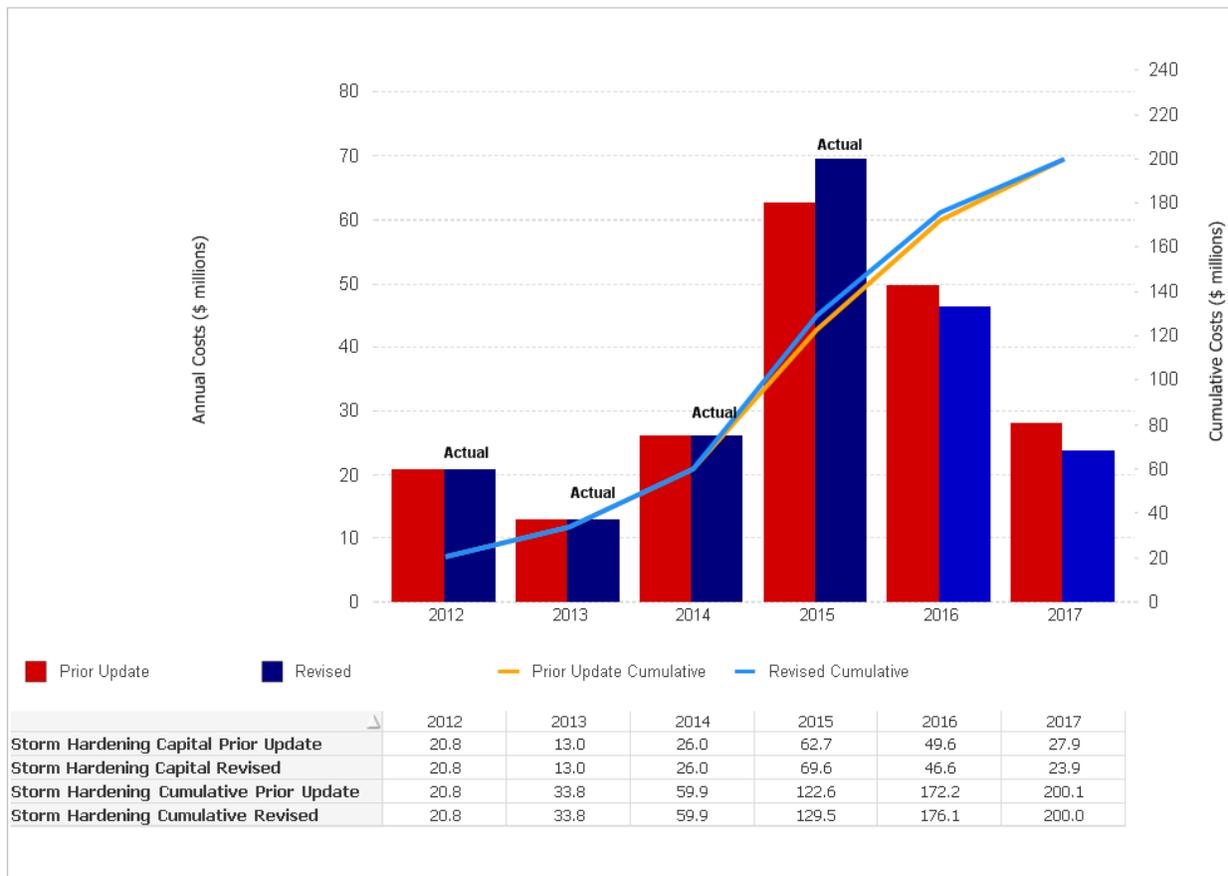
**FIGURE I.F.3: STORM HARDENING SCHEDULE**



## I.F.4: Program Budget

Figure I.F.4 presents, as applicable, the actual and estimated capital budgets by year for the Storm Hardening program. ComEd estimates the program cost to be capital investments of \$200 million, plus associated expenses, over the program period. This budget is the same as that presented in ComEd’s 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time.

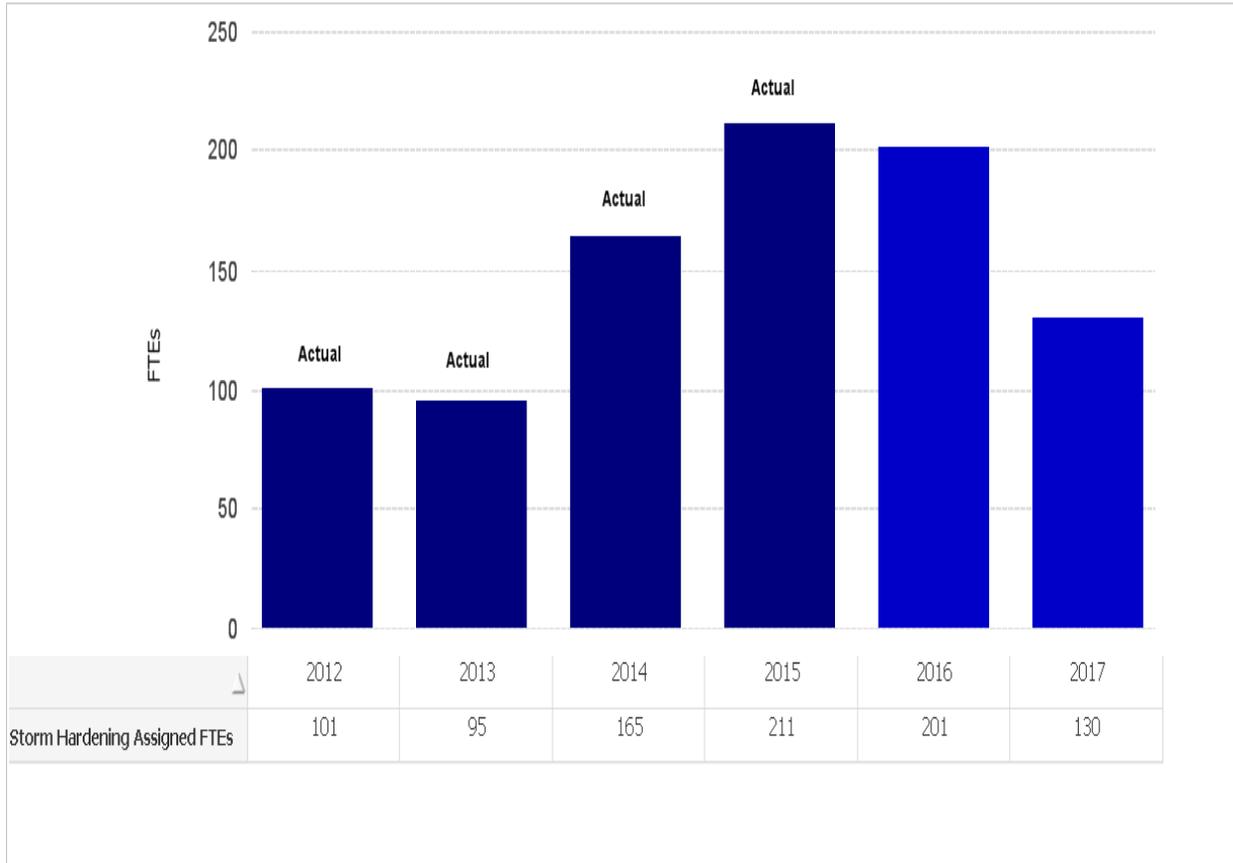
**FIGURE I.F.4: STORM HARDENING CAPITAL BUDGET**



**I.F.5: Program FTEs**

Figure I.F.5 presents, as applicable, the actual and estimated Assigned Direct and Assigned Contractor FTEs required to perform the specific scheduled scope of work. Assigned FTEs have been calculated by taking the estimated worker-hours assigned to execute the scope of work and dividing by 2,080 hours. The actual and estimated FTEs presented in Figure I.F.5 include Assigned FTEs; however, they do not include Support FTEs or Induced FTEs.

**FIGURE I.F.5: STORM HARDENING ASSIGNED FTEs**



## **SECTION II: Smart Grid-Related Investments**

### **SECTION II.A: Distribution Automation**

#### **II.A.1: Summary of Program Revisions**

Over the course of the program, ComEd expects to complete essentially the same scope of Distribution Automation (“DA”) work that was presented in ComEd’s 2015 Annual Update. Details of these revisions are presented in the sections that follow.

#### **II.A.2: Program Scope**

DA technology uses “sectionalizing” devices and remote communications to detect issues on the distribution system and automatically re-route power, accordingly, to minimize the number of customers impacted. This is commonly referred to as the self-healing nature of the Smart Grid.

The ComEd DA technologies include:

- Field sectionalizing devices to detect and isolate faults at various segments of the distribution system;
- A radio system to remotely transmit and relay control functions and indicate the status of various system parameters; and
- The computer systems that control, operate, monitor and store the data for the DA system.

The DA program targets installing DA field devices, and also encompasses the replacement of the older 900 MHZ radio system with a new higher security system that meets the cyber security requirements of the Act. In addition, the older 34kV field devices will be upgraded to the newer Intelli-team (“IT-2”) software to allow for better

flexibility with fault isolation and operation with the new radio system. The DA program includes the planned installation of approximately 2,608 new DA devices.

### **II.A.3: Program Schedule**

This program is planned to be completed over a five-year period plus reasonable ramp-up and ramp-down periods. Estimates of cost, units of work, and schedules for that work, may evolve over time.

Figure II.A.3 presents the estimated remaining schedule to complete the DA program. The schedule consists of essentially a rolling quarterly work plan consisting of the following key remaining tasks:

- Ramp-up period
- Establish priority for the calendar year
- Perform scoping
- Perform design tasks, procure material, and identify required outages in schedule
- Planning (develop work packages and secure permits)
- Construction – install reclosers
- Construction – install radios, repeaters
- Test and liven
- Demobilization ramp-down period

**FIGURE II.A.3: DISTRIBUTION AUTOMATION SCHEDULE**

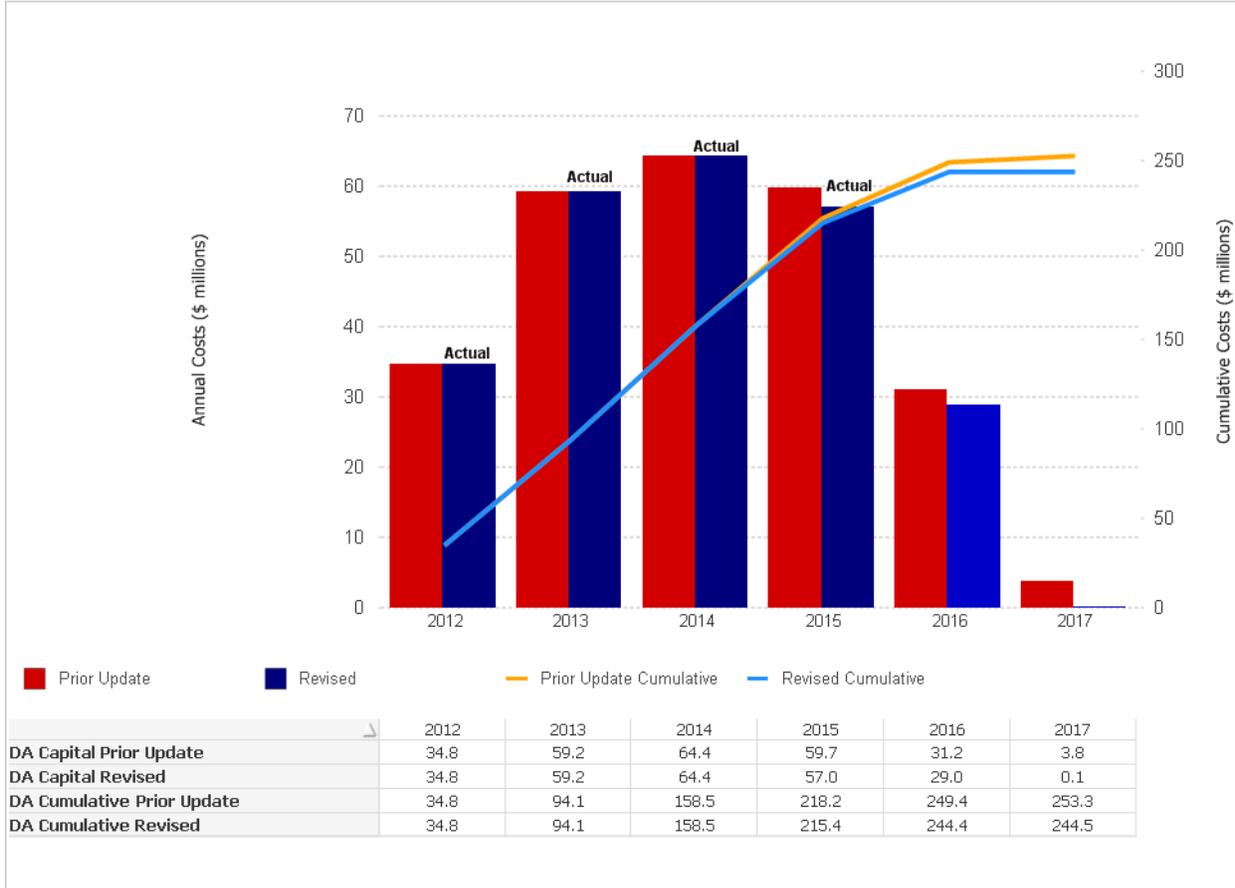
Activity ID	Activity Name	Cal. Days	Start	Finish	2016			
					Q1	Q2	Q3	Q4
<b>CIIP - Distribution Automation</b>								
<b>Distribution Automation</b>								
DA2-13-2-0600	Construction - Reclosers for 2013 - 4th Q	1440h	01-Oct-13 A	11-Jan-16				
DA2-13-2-0650	Construction - Install Radio / Repeater for 2013 - 4th Q	1440h	01-Oct-13 A	11-Jan-16				
DA2-13-2-0700	Testing & Liveness for 2013 - 4th Q	1440h	01-Nov-13 A	11-Jan-16				
DA2-13-3-0400	Planning for 2014 - 1st Q	720h	01-Nov-13 A	11-Jan-16				
DA2-13-4-0300	Design / Procure / Outage for 2014 - 2nd Q	720h	01-Dec-13 A	11-Jan-16				
DA3-14-1-0600	Construction - Reclosers for 2014 - 3rd Q	1440h	09-Jul-14 A	11-Jan-16				
DA3-14-1-0650	Construction - Install Radio / Repeater for 2014 - 3rd Q	1440h	09-Jul-14 A	11-Jan-16				
DA3-14-1-0700	Testing & Liveness for 2014 - 3rd Q	1440h	09-Aug-14 A	11-Jan-16				
DA3-14-2-0600	Construction - Reclosers for 2014 - 4th Q	1440h	10-Oct-14 A	11-Jan-16				
DA3-14-4-0200	Scoping (Scheme, Relay Setting Order & Repeater) for 2015 - 2nd Q	720h	10-Oct-14 A	11-Jan-16				
DA3-14-2-0650	Construction - Install Radio / Repeater for 2014 - 4th Q	1440h	10-Oct-14 A	11-Jan-16				
DA3-14-2-0700	Testing & Liveness for 2014 - 4th Q	1440h	10-Nov-14 A	11-Jan-16				
DA3-14-3-0400	Planning for 2015 - 1st Q	720h	10-Nov-14 A	11-Jan-16				
DA3-14-4-0300	Design / Procure / Outage for 2015 - 2nd Q	720h	12-Dec-14 A	11-Jan-16				
DA4-15-4-0300	Design / Procure / Outage for 2016 - 2nd Q	720h	21-Dec-15 A	23-Mar-16				
DA4-15-3-0600	Construction - Reclosers for 2016 - 1st Q	720h	02-Jan-16 A	01-Apr-16				
DA4-15-3-0650	Construction - Install Radio / Repeater for 2016 - 1st Q	720h	02-Jan-16 A	01-Apr-16				
DA4-15-5-0200	Scoping (Scheme, Relay Setting Order & Repeater) for 2016 - 3rd Q	720h	14-Jan-16	13-Apr-16				
DA4-15-4-0400	Planning for 2016 - 2nd Q	480h	02-Feb-16*	01-Apr-16				
DA4-15-3-0700	Testing & Liveness for 2016 - 1st Q	720h	05-Feb-16	04-May-16				
DA4-15-5-0300	Design / Procure / Outage for 2016 - 3rd Q	720h	17-Mar-16	15-Jun-16				
DA4-15-4-0600	Construction - Reclosers for 2016 - 2nd Q	720h	03-Apr-16	02-Jul-16				
DA4-15-4-0650	Construction - Install Radio / Repeater for 2016 - 2nd Q	720h	03-Apr-16	02-Jul-16				
DA4-15-6-0200	Scoping (Scheme, Relay Setting Order & Repeater) for 2016 - 4th Q	720h	14-Apr-16	14-Jul-16				
DA4-15-5-0400	Planning for 2016 - 3rd Q	472h	02-May-16*	30-Jun-16				
DA4-15-4-0700	Testing & Liveness for 2016 - 2nd Q	720h	04-May-16	03-Aug-16				
DA4-15-6-0300	Design / Procure / Outage for 2016 - 4th Q	720h	16-Jun-16	15-Sep-16				
DA4-15-5-0600	Construction - Reclosers for 2016 - 3rd Q	720h	01-Jul-16*	30-Sep-16				
DA4-15-5-0650	Construction - Install Radio / Repeater for 2016 - 3rd Q	720h	01-Jul-16	30-Sep-16				
DA4-15-6-0400	Planning for 2016 - 4th Q	480h	01-Aug-16*	30-Sep-16				
DA4-15-5-0700	Testing & Liveness for 2016 - 3rd Q	720h	02-Aug-16	31-Oct-16				
DA4-15-6-0650	Construction - Install Radio / Repeater for 2016 - 4th Q	640h	03-Oct-16*	23-Dec-16				
DA4-15-6-0600	Construction - Reclosers for 2016 - 4th Q	640h	03-Oct-16*	23-Dec-16				
DA4-15-6-0700	Testing & Liveness for 2016 - 4th Q	440h	02-Nov-16	31-Dec-16				

**II.A.4: Program Budget**

Figure II.A.4 presents, as applicable, the actual and estimated capital budgets by year for the DA program. ComEd estimates the program cost to be capital investments of \$244 million, plus associated expenses, over the program period. This represents a decrease of approximately \$9 million as compared to ComEd’s 2015 Annual Update. As a whole, the Distribution Automation program found opportunities to bundle work within the program itself and with other Plan programs, such as the Mainline Cable System Refurbishment and Replacement program, which resulted in savings during 2015.

As Figure II.A.4 illustrates, ComEd expects to complete investments related to this program in the same year presented in the 2015 Annual Update. Estimates of cost, units of work and schedules for that work may evolve over time.

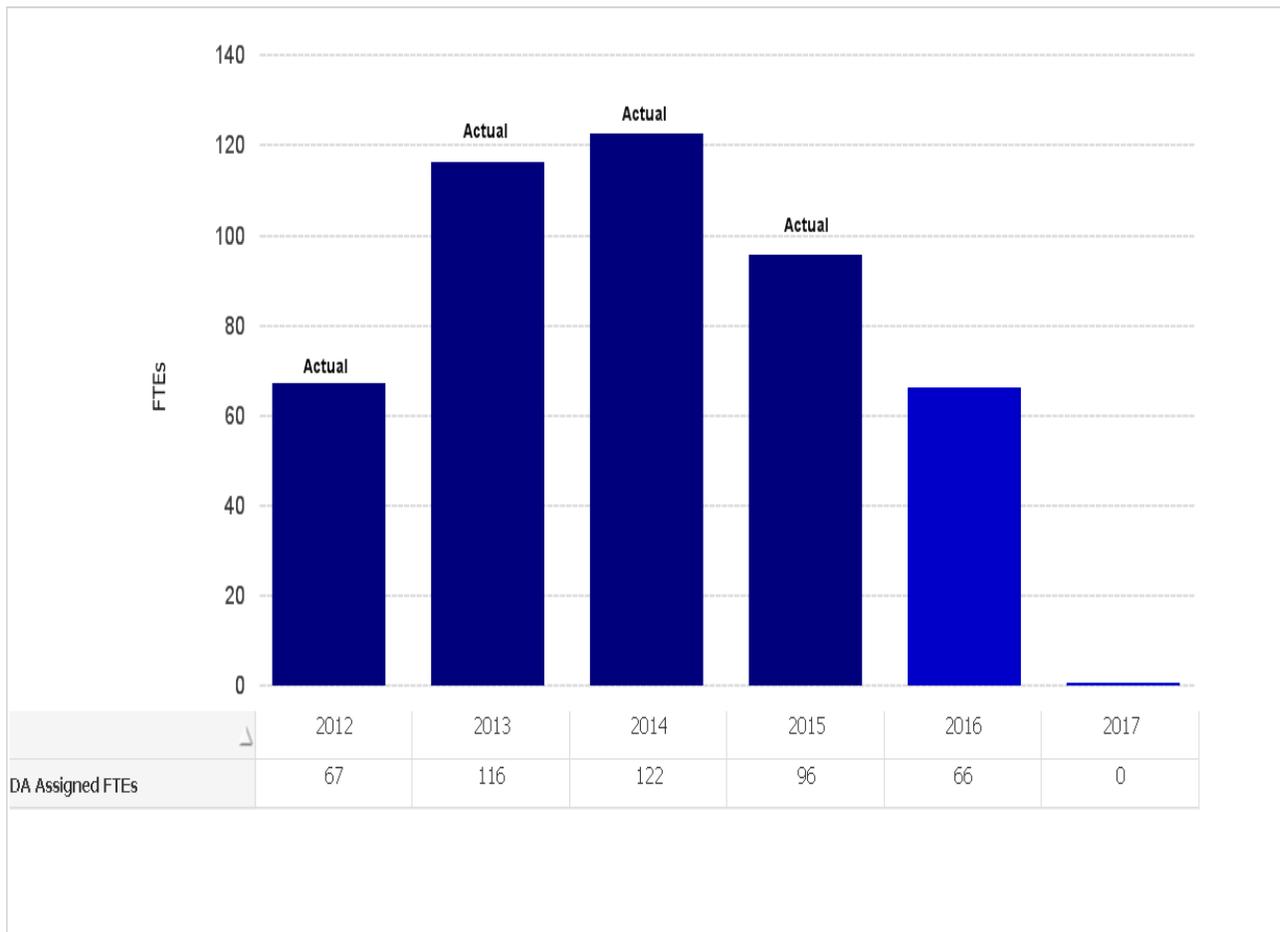
**FIGURE II.A.4: DISTRIBUTION AUTOMATION CAPITAL BUDGET**



## II.A.5: Program FTEs

Figure II.A.5 presents, as applicable, the actual and estimated Assigned Direct and Assigned Contractor FTEs required to perform the specific scheduled scope of work. Assigned FTEs have been calculated by taking the estimated worker-hours assigned to execute the scope of work and dividing by 2,080 hours. The actual and estimated FTEs presented in Figure II.A.5 include Assigned FTEs; however, they do not include Support FTEs or Induced FTEs. Furthermore, the 2016 Annual Update includes Assigned IT FTEs associated with the DA program.

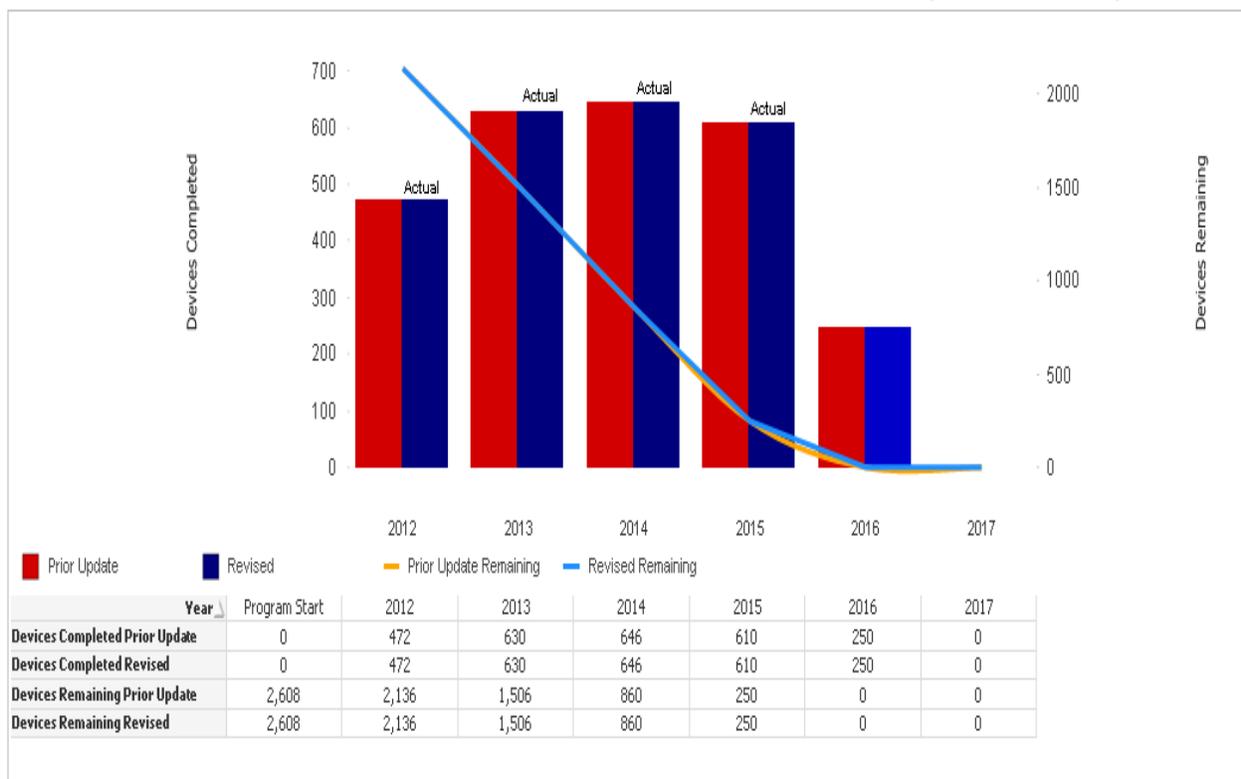
**FIGURE II.A.5: DISTRIBUTION AUTOMATION ASSIGNED FTES**



## II.A.6: Program Units

Figure II.A.6 shows the quantity of DA devices installed or estimated to be installed, as applicable. This chart serves as a tracking mechanism over the course of the program, and reflects the scope of work accomplished each year, as well as the scope of work left to be performed. It is estimated that 2,608 DA devices will be installed over the course of the program. This scope is the same as that presented in ComEd's 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time.

**FIGURE II.A.6: DISTRIBUTION AUTOMATION UNITS (IN DEVICES)**



## **SECTION II.B: Substation Micro-Processor Relay Upgrades**

### **II.B.1: Summary of Program Revisions**

Over the course of the program, ComEd expects to complete the same scope of substation work that was presented in ComEd's 2015 Annual Update.

### **II.B.2: Program Scope**

This program is planned to modernize 16 ComEd substations, including upgrade of electro-mechanical protective relays to modern microprocessor-based devices, replacement of aging circuit breakers, enabling two-way communications between ComEd's control center and each substation, and installation of technology to remotely monitor the health of ComEd's largest assets, its transformers. This program provides for fault detection, remote asset monitoring, improved site security, and dynamic voltage regulation. For circuits or feeders originating from a modernized substation that are networked together through a common connection point or remote end, installation of monitoring equipment at the remote end, as required, is included in the scope of the program. Partial upgrades may be applied across the service territory. ComEd has over 250 transmission-fed substations, and over 800 substations in total.

### **II.B.3: Program Schedule**

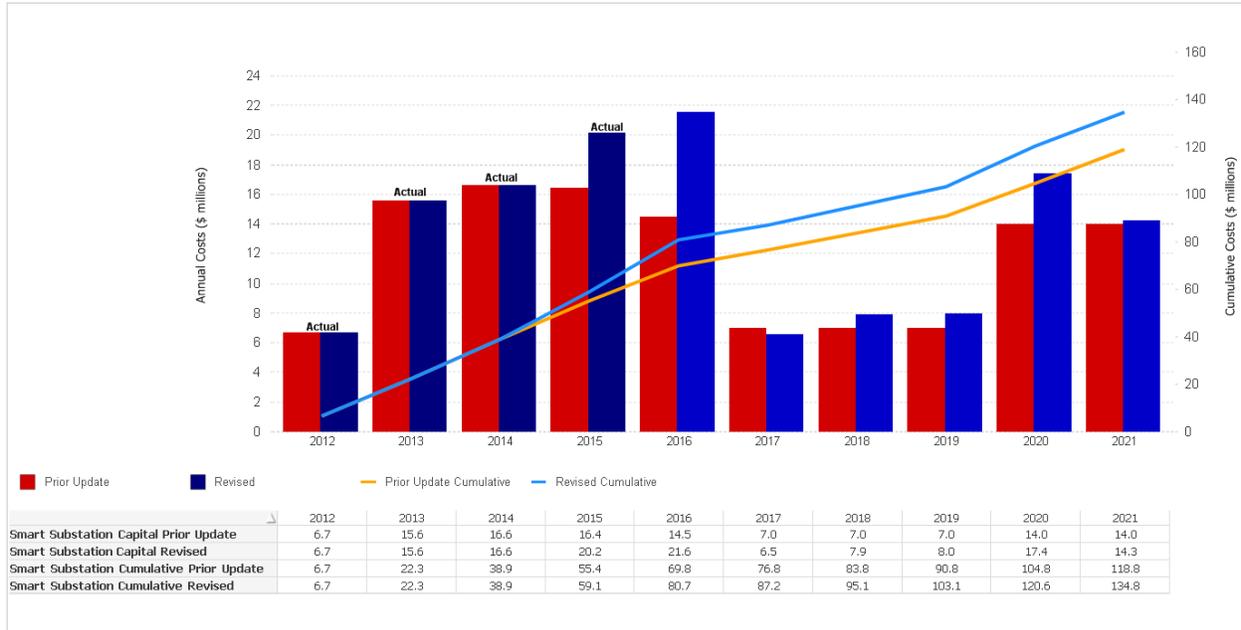
This program is planned to be completed over a ten-year period including reasonable ramp-up and ramp-down periods. Estimates of cost, units of work, and schedules for that work may evolve over time.

Figure II.B.3 presents the estimated remaining schedule to complete the Substation Micro-Processor Relay Upgrade Program. The schedule is essentially a rolling quarterly work plan consisting of the following key remaining tasks:

- Develop work scope
- Design and engineer
- Procure long lead materials
- Identify and request required outages in schedule
- Review and issue construction drawings
- Mobilization
- Construction
- Testing and commissioning
- Develop dashboard
- Demobilization and ramp-down



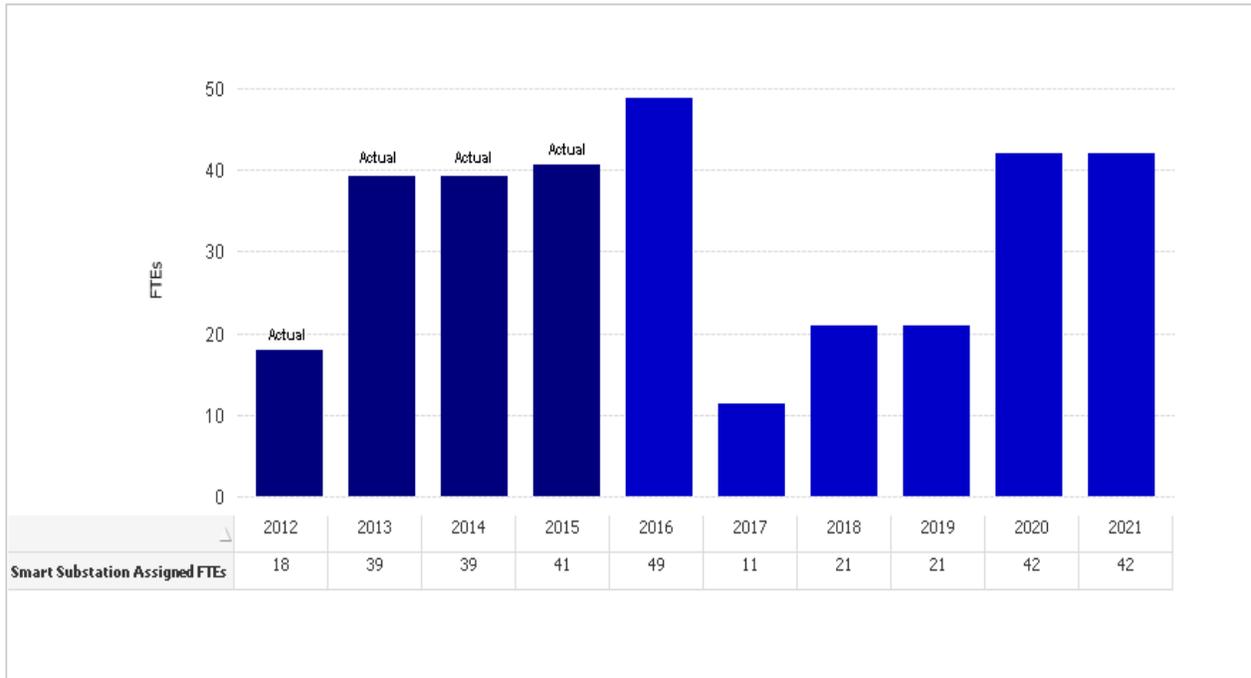
**FIGURE II.B.4: SUBSTATION MICRO-PROCESSOR RELAY UPGRADE CAPITAL BUDGET**



**II.B.5: Program FTEs**

Figure II.B.5 presents, as applicable, the actual and estimated Assigned Direct and Assigned Contractor FTEs required to perform the specific scheduled scope of work. Assigned FTEs have been calculated by taking the estimated worker-hours assigned to execute the scope of work and dividing by 2,080 hours. The actual and estimated FTEs presented in Figure II.B.5 include Assigned FTEs; however, they do not include Support FTEs or Induced FTEs.

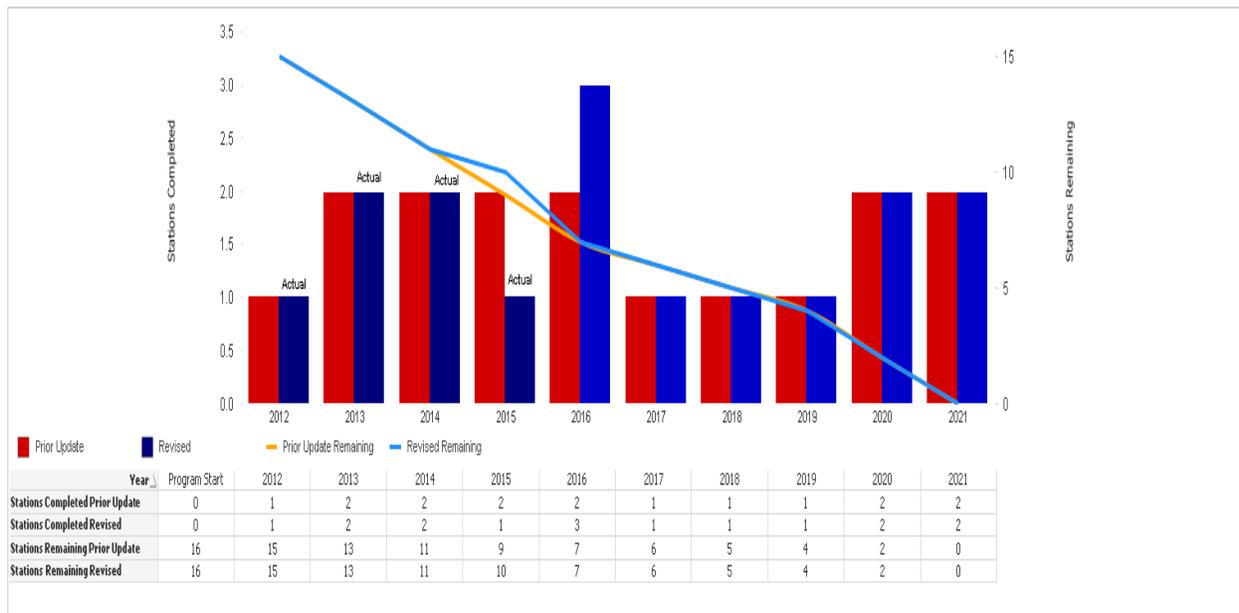
**FIGURE II.B.5: SUBSTATION MICRO-PROCESSOR RELAY UPGRADES  
ASSIGNED FTES**



## II.B.6: Program Units

Figure II.B.6 shows the quantity of substation upgrades completed or estimated to be completed, as applicable. This chart serves as a tracking mechanism over the course of the program, and reflects the scope of work accomplished each year as well as the scope of work left to be performed. An estimated 16 substations will be upgraded over the course of the program. Partial upgrades may be applied across the service territory. This is the same scope of work that was presented in ComEd's 2015 Annual Update. Estimates of cost, units of work, and schedules for that work may evolve over time.

**FIGURE II.B.6: SUBSTATION MICRO-PROCESSOR RELAY UPGRADES UNITS (IN STATIONS)**



## **SECTION II.C: Smart Meters**

### **II.C.1: Summary of Program Revisions**

ComEd expects to complete essentially the same scope of work that was presented in ComEd's 2015 Annual Update. ComEd's AMI Annual Implementation Progress Report filed on April 1, 2016, provides additional detail on the remaining scope of the program, as well as on the results of deployment thus far.

### **II.C.2: Program Scope**

ComEd will install retail Smart Meters across its entire service territory over a multi-year period, as further described in the AMI Annual Implementation Progress Report. Deployment of AMI will continue pursuant to the AMI Plan with full deployment essentially completed in 2018.<sup>3</sup>

### **II.C.3: Program Schedule**

Following the anticipated completion of full AMI deployment in 2018, the overall program is planned to be completed in 2019, which allows additional time for the exchange of the remaining legacy meters that remain in the field once full-deployment is completed (e.g., meter refusals and locations that could not previously be accessed). This timeline includes an efficient and reasonable ramp-down of resources. Estimates of cost, units of work, and schedules for that work may evolve over time.

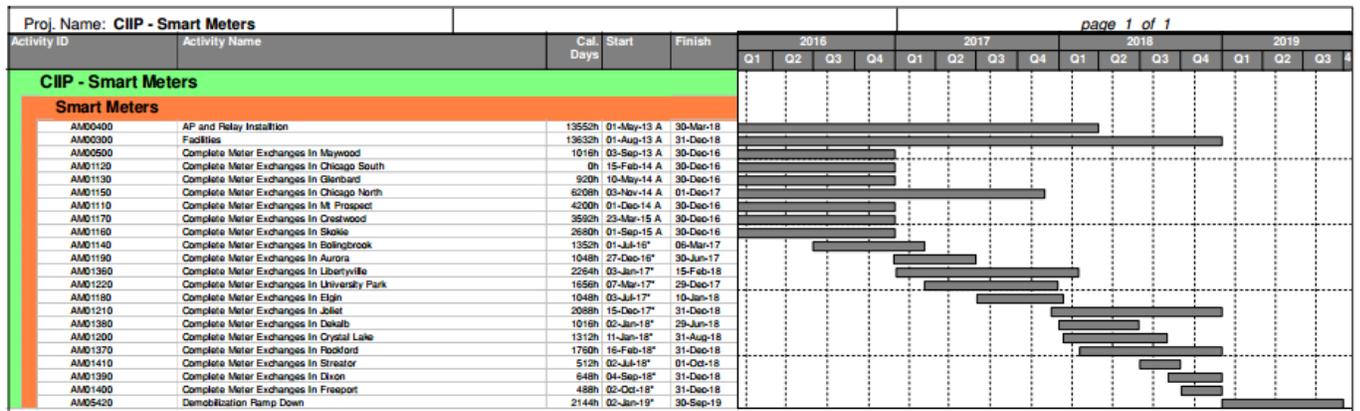
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<sup>3</sup> Section 16-108.8(f) of the Act, states that an independent evaluation of the Smart Grid Test Bed must be conducted after the fourth year of operation. At this time, ComEd is seeking a third party evaluator to complete this work and expects the results to be included with the 2017 Annual Update to its Plan.

Figure II.C.3 presents the estimated remaining schedule to complete the Smart Meter program. The schedule consists of remaining tasks that are essentially repeated for each of ComEd's operating regions, including the following:

- Procurement of required materials and services
- Facilities and logistical preparation
- Staff hiring, management, geographic positioning, and subsequent ramp-up
- Network design and device (access point and relay) installation
- Completion of meter exchanges
- Demobilization ramp-down

**FIGURE II.C.3: SMART METER SCHEDULE**

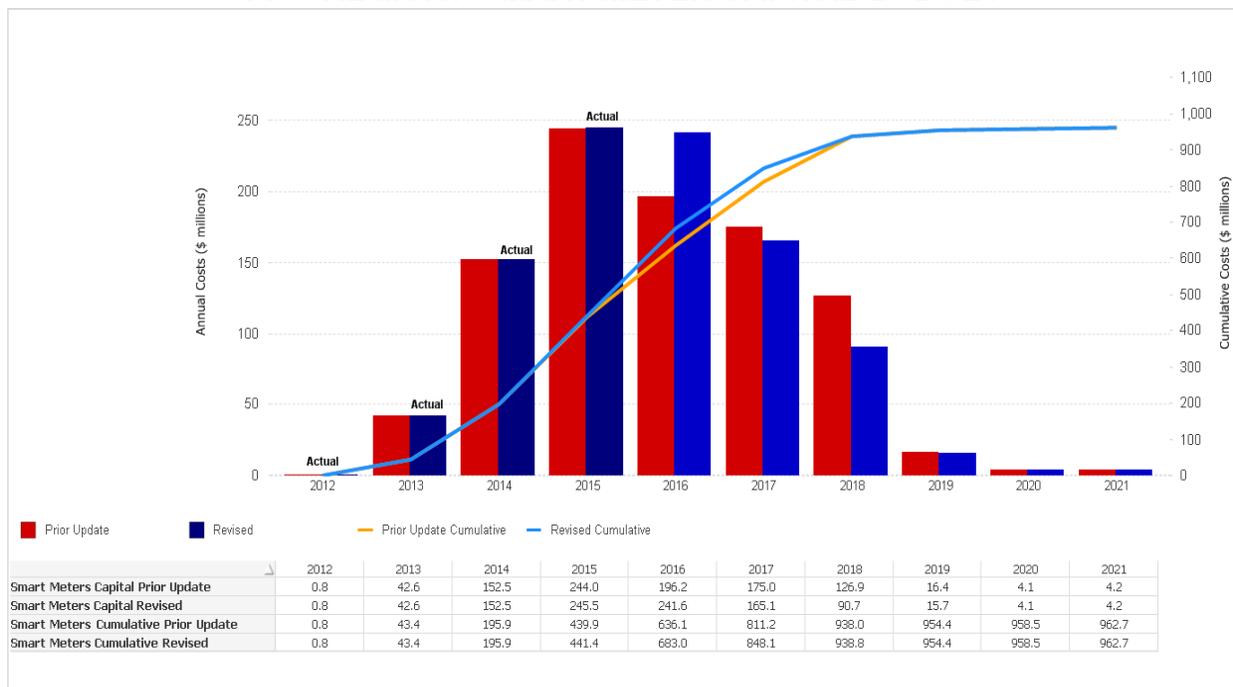


\* The above schedule is subject to change. ComEd continuously seeks improvements and efficiencies in deployment optimization.

## II.C.4: Program Budget

Figure II.C.4 presents, as applicable, the actual and estimated capital budgets by year for the Smart Meter program. All work associated with the program will be covered by this budget. ComEd estimates the program cost to be capital investments of approximately \$963 million, plus associated expenses, over the program period. The Smart Meter program budget presented in this 2016 Annual Update includes costs associated with a Peak Time Rebate program consistent with ComEd’s 2015 Annual Update. The updated Smart Meter program budget, exclusive of the Peak Time Rebate program, is presented in ComEd’s AMI Annual Implementation Progress Report. Estimates of cost, units of work, and schedules for that work may evolve over time.

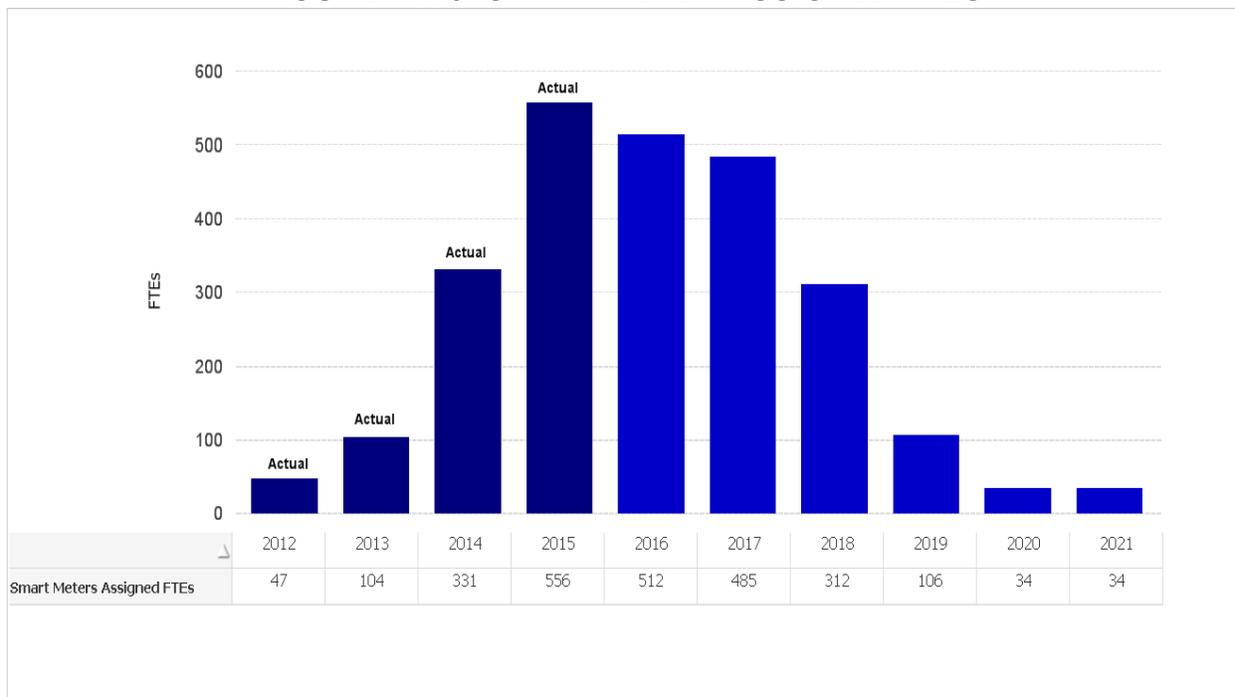
**FIGURE II.C.4: SMART METER CAPITAL BUDGET**



## II.C.5: Program FTEs

Figure II.C.5 presents, as applicable, the actual and estimated Assigned Direct and Assigned Contractor FTEs required to perform the specific scheduled scope of work. Assigned FTEs have been calculated by taking the estimated worker-hours assigned to execute the scope of work and dividing by 2,080 hours. The actual and estimated FTEs presented in Figure II.C.5 include Assigned FTEs; however, they do not include Support FTEs or Induced FTEs.

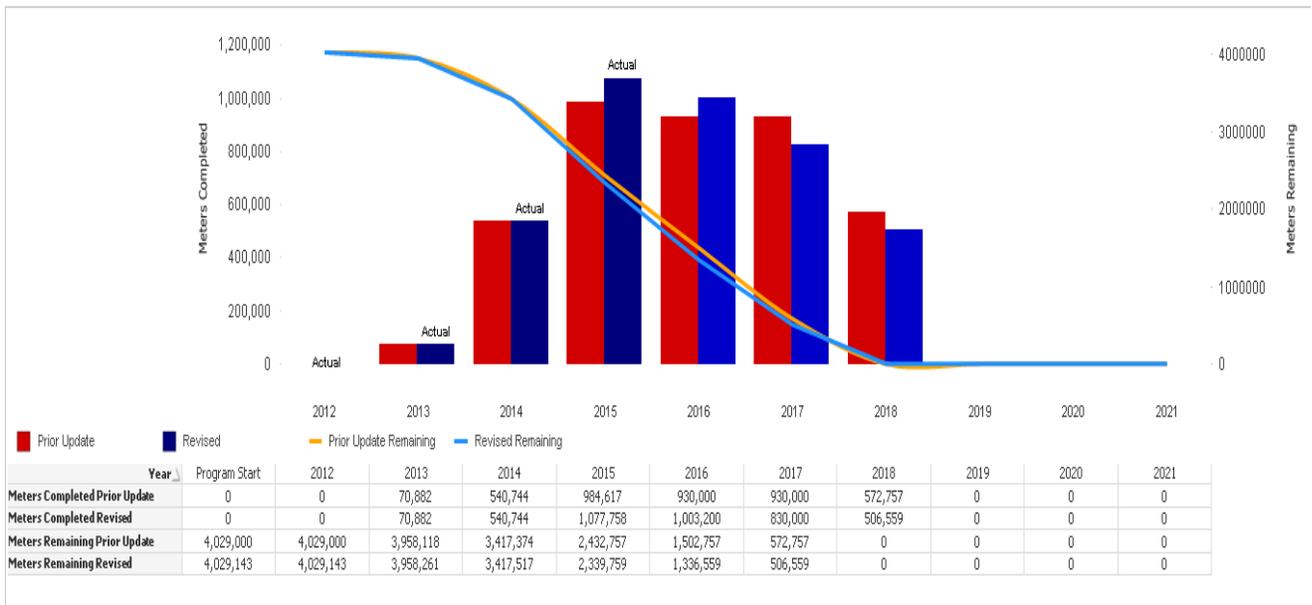
**FIGURE II.C.5: SMART METER ASSIGNED FTEs**



## II.C.6: Program Units

Figure II.C.6 shows the quantity of Smart Meters installed or estimated to be installed, as applicable. This chart reflects the scope of work currently planned to be accomplished each year, as detailed in ComEd’s AMI Annual Implementation Progress Report. As Figure II.C.6 illustrates, full deployment of Smart Meter installations began in 2013, and is planned to be completed by 2018, in alignment with the AMI Plan. Estimates of cost, units of work, and schedules for that work may evolve over time.

**FIGURE II.C.6: SMART METER UNITS (IN METERS)**



## **SECTION II.D: Associated Cyber-Secure Data Communications Network**

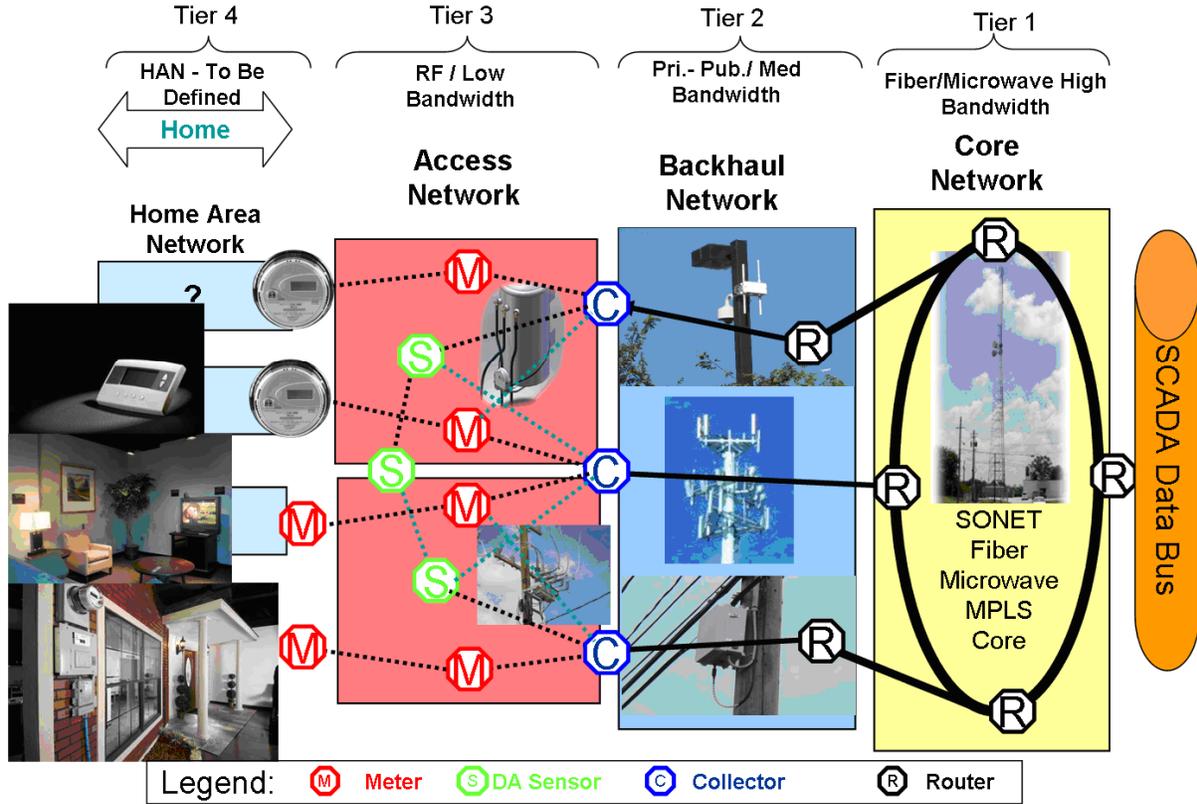
Communications infrastructure forms the foundation platform for enabling Smart Grid technologies and applications because it transcends each functional area of the Smart Grid. Consequently, the ComEd Smart Grid Communications Infrastructure will provide a secure tiered, robust and deterministic communications architecture with adequate capacity to meet the current and foreseeable future performance requirements of the Plan's Smart Grid Application portfolio.

A cyber-secure communications infrastructure is a system that includes and implements a robust security model that is aligned with industry best practices and existing security standards (such as NISTIR 7628 developed by the National Institute of Standards and Technology). The security model will address confidentiality, integrity, availability and non-repudiation of data transport through the network.

Figure II.D depicts the high-level architecture for the four tiers of the proposed ComEd communication network that would support Smart Grid communication.

FIGURE II.D: SMART GRID COMMUNICATION TIERS

# Smart Grid Communication Tiers



## **Appendix A: Full-Time Equivalent Jobs**

### **Requirements of 220 ILCS 5/16-108.5**

As required by Section 16-108.5(b) of the Act, ComEd will demonstrate that at least 2,000 full-time equivalent jobs in Illinois were created in a “peak program year,” which is defined as the consecutive 12-month period with the highest number of full-time equivalent (“FTE”) jobs that occurs between January 1, 2013 and December 31, 2015. These jobs will include Direct jobs, Contractor positions, and Induced jobs. A portion of the FTE jobs created will include incremental personnel hired subsequent to the effective date of Section 16-108.5.

### **Reporting Schedule**

ComEd will submit, no later than April 1 of each year, an Energy Infrastructure Modernization Act Annual Jobs Creation Report that includes the number of FTE jobs created for the prior calendar year and cumulatively, including Direct, Contractor, and Induced FTE jobs.

Further, ComEd will report no later than 45 days after the last day of the first, second and third quarter of each year, which equates to the dates of May 15, August 14 and November 14 of each year, a verified quarterly report for the prior quarter including:

1. Total number of FTE jobs created during the prior quarter;
2. Total number of employees as of the last day of the prior quarter;
3. Total number of FTE hours in each job classification or job title; and

4. Total number of incremental employees and contractors in support of the investments included in the Plan for the prior quarter.

The quarterly reporting will not include Induced FTE jobs. However, ComEd's Annual Jobs Creation Report submitted on April 1 of each year will include actual Direct, Contractor, and Induced FTEs for the applicable year and cumulatively.

### **Definition of Full-Time Equivalent (FTE)**

The full-time equivalent ("FTE") metric is a calculation used to convert full-time, temporary and part-time jobs into comparable metrics. Full-time equivalent (FTE) employment is a standard concept used by the Department of Energy and other government agencies which follows the general formula:

$$\frac{\text{Total Number of Hours Worked and Funded by the Plan within the Annual Period}}{\text{Annual Hours in a Full-time Schedule}}$$

### **Total Number of Hours Worked and Funded within the Annual Period:**

In order to perform the calculation, ComEd has estimated the total worker-hours in support of the Plan on an annual basis. Estimated worker-hours for Direct jobs and Contractor positions are each composed of the following two sub-categories:

- **Assigned:** Worker-hours assigned to specific work orders associated with Plan program scopes of work; and
- **Support:** Worker-hours charged on timesheets in support of the Plan

Support FTEs are not allocated to specific Plan scopes of work, and are not presented in the FTE sections for individual programs in this 2016 Annual Update.<sup>4</sup> Rather, Figure B.3 in Appendix B presents the estimated Assigned FTEs and Support FTEs to execute the entire scheduled scope of work associated with the 2016 Annual Update. This revised format for presentation of Assigned FTEs and Support FTEs is consistent with ComEd's timekeeping approach and represents how Support FTEs are allocated to Plan execution. Estimates for Support FTEs in the 2016 Annual Update are based on the 2015 actual proportion of Assigned FTEs to Support FTEs.

Job classifications associated with Assigned FTEs and Support FTEs may include, but are not limited to, engineers, technicians, work planners, finance support, safety support, scheduling support, legal support and craft.

**Annual Hours in a Full Time Schedule:**

For ComEd, the full-time hours for an annual period are 2,080 (52 weeks per year \* 40 hours per week). This same calculation will be applied on a quarterly basis for the purpose of reporting requirements.

However, FTEs are not defined as employee "head counts" and should not be confused with employment levels and trends. This is because the 2,080 hours number used in the denominator includes compensable hours for approved time off such as

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<sup>4</sup> While this format is consistent with that presented in ComEd's previous annual updates, please note that this is a change in format from ComEd's Plan, in which Support FTEs were allocated to specific scopes of work proportionally, based on estimated investments for specific scopes of work.

vacation time, holidays, sick leave, jury duty and other approved time off, and does not just represent hours available to work in support of the Plan.

For this reason, in addition to the calculation above, and in order to provide a more accurate estimate of employment levels that result from work in support of the Plan, ComEd will also report FTE jobs on a quarterly basis using the following formula:

Total Number of Hours Worked and Funded by the Plan within Reporting Quarter  
for ComEd and its affiliates

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Quarterly Hours available for work in a ComEd Full-time Schedule

**Plus**

Total Number of Hours Worked and Funded by the Plan within Reporting Quarter  
for Contractors

---

Quarterly Hours available for work in a Contractor Full-time Schedule

The numerator calculation is the same as above.

Quarterly Hours available for work in a ComEd full-time schedule is defined as 260 days in a year minus 13 paid holidays, 20 days average vacation, 3 average sick days, and 4 average other days (jury duty, funeral leave, etc.) for a net of 220 days per year. This value is then converted to a number of quarterly hours using the following formula:

$$(220 \text{ days} * 8 \text{ hours per day}) / 4 \text{ quarters per year} = 440 \text{ hours per quarter}$$

Quarterly Hours available for work in a Contractor full-time schedule is defined as 2,000 hours in a year divided by 4 quarters per year.

## Definition of FTE Job Categories

- Direct jobs includes employees of ComEd and its affiliates.
- Contractor positions of ComEd or its affiliates includes non-employees, for example staff augmentation, project labor, outsourcing, consulting, physical craft contractors, clerical/administrative contractors, and construction of training facilities.
- Induced jobs means jobs that are econometrically estimated using a statistical “jobs multiplier” of annual capital spending by program and actual Direct and Contractor FTE jobs created over time under the Plan. FTEs described above in each sub-part of the 2016 Annual Update, however, do not include Induced jobs. ComEd’s 2015 Energy Infrastructure Modernization Act Annual Jobs Creation Report, submitted on April 1, 2016, includes actual Direct, Contractor, and Induced FTEs for 2015.



Table B.1 presents a summary comparison of the revised estimated Plan capital budget to the estimated capital budget set forth in ComEd's 2015 Annual Update by program, and Figure B.2 presents a graphical comparison of the revised estimated total Plan capital budget to the estimated total capital budget set forth in ComEd's 2015 Annual Update by year.

**TABLE B.1: SUMMARY OF PLAN 10-YEAR CAPITAL COSTS BY PROGRAM**

<b>Program</b>	<b>2015 Annual Update Capital Total (\$M)</b>	<b>2016 Annual Update Capital Total (\$M)</b>
<i>URD Injection and Replacement Program</i>	\$554	\$556
<i>Mainline Cable System Refurbishment and Replacement Program</i>	\$407	\$395
<i>Ridgeland 69Kv Cable Program</i>	\$30	\$32
<i>Training Facilities Program</i>	\$10	\$10
<i>Wood Pole Program</i>	\$80	\$76
<i>Storm Hardening Program</i>	\$200	\$200
<b>Total Reliability-Related Investments</b>	<b>\$1,281</b>	<b>\$1,269</b>
<i>Distribution Automation Program</i>	\$253	\$244
<i>Substation Micro-Processor Relay Upgrade Program</i>	\$119	\$135
<i>Smart Meter Program (7-year)</i>	\$963	\$963
<b>Total Smart Grid-Related Investments</b>	<b>\$1,335</b>	<b>\$1,342</b>
<b>Total Plan Investments</b>	<b>\$2,615</b>	<b>\$2,611</b>

**FIGURE B.2: PLAN 10-YEAR CAPITAL COSTS BY YEAR**

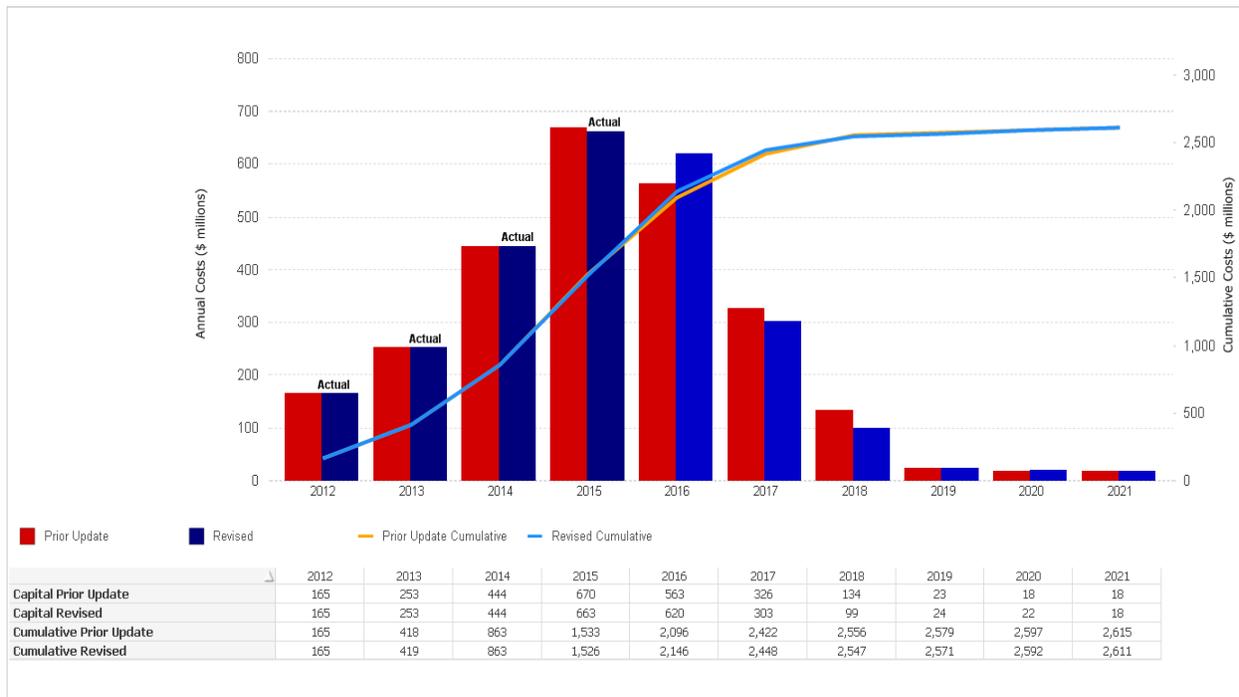


Figure B.3 presents the estimated Assigned FTEs and Support FTEs to execute the entire scheduled scope of work associated with the 2016 Annual Update. Estimates for Support FTEs in the 2016 Plan are based on the 2015 actual proportion of Assigned FTEs to Support FTEs. The actual and estimated FTEs presented in this 2016 Annual Update include Direct jobs and Contractor positions; however, they do not include any Induced FTEs.

**FIGURE B.3: PLAN 10-YEAR ASSIGNED AND SUPPORT FTES**

