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**E-File**

March 1, 2022

Rosemary Chiavetta, Esquire  
Pennsylvania Public Utility Commission  
Commonwealth Keystone Building  
400 North Street  
Harrisburg, PA 17120

**Re: PPL Electric Utilities Corporation  
2022 Annual Asset Optimization Plan  
Docket No.**

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Dear Ms. Chiavetta:

Enclosed for filing on behalf of PPL Electric Utilities Corporation is its 2022 Annual Asset Optimization Plan.

Copies have been provided as indicated on the Certificate of Service.

Pursuant to 52 Pa. Code § 1.11, the enclosed document is to be deemed filed on March 1, 2022, which is the date it was filed electronically using the Commission's E-filing system.

If you have any questions or need additional information, please contact me or Steven Selkregg, Manager - Distribution Planning & Asset Management, at (610) 774-6545.

Respectfully submitted,

  
Kimberly A. Klock

Enclosures

cc: Certificate of Service

## CERTIFICATE OF SERVICE

I hereby certify that true and correct copies of the foregoing have been served upon the following persons, in the manner indicated, in accordance with the requirements of § 1.54 (relating to service by a participant).

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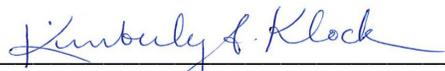
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Date: March 1, 2022

  
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Kimberly A. Klock

**PPL Electric Utilities Corporation**  
**Annual Asset Optimization Plan**  
**March 2022**

# PPL Electric Utilities Corporation

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# **PPL Electric Utilities Corporation**

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## **Introduction**

PPL Electric Utilities Corporation (“PPL Electric” or the “Company”) files this Annual Asset Optimization Plan (“AAO Plan”) in compliance with 66 Pa.C.S. § 1356. Section 1356 requires a utility with an approved distribution system improvement charge (“DSIC”) and long-term infrastructure improvement plan (“LTIP”) to file an AAO Plan. Consistent with the requirements of Section 1356, PPL Electric’s AAO Plan will provide:

- (1) A description that specifies all eligible property repaired, improved and replaced in the immediately preceding 12-month period pursuant to the utility's long-term infrastructure improvement plan and prior year's asset optimization plan; and
- (2) A detailed description of all the facilities to be improved in the upcoming 12-month period.

The AAO Plan is part of PPL Electric’s overall strategy to proactively repair and replace its aging distribution infrastructure to ensure that its system continues to be safe, reliable, and able to meet the needs and expectations of its customers. PPL Electric’s plans reflect the Company’s ongoing commitment to accelerate its investment, while managing finite resources and ensuring that its portfolio of activities is cost effective. As a result, PPL Electric’s plans for the upcoming 12-month period have been developed incorporating the lessons learned from the Company’s experience with an effective LTIP and DSIC.

## **Procedural History**

On February 14, 2012, Governor Corbett signed into law Act 11 of 2012 (“Act 11”), which amends Chapters 3, 13 and 33 of the Public Utility Code. Act 11 authorizes electric distribution companies (“EDCs”), natural gas distribution companies (“NGDCs”), water utilities, wastewater utilities and city natural gas distribution operations to establish a DSIC. The DSIC allows utilities to recover reasonable and prudent costs incurred to repair, improve or replace certain eligible property that is part of the utility’s distribution system. Eligible property for EDCs is defined in Section 1351 of the statute. See 66 Pa.C.S. § 1351. As a precondition to the initial implementation of a DSIC, each utility must file and obtain approval of a LTIP that is consistent with the provisions of Section 1352 of the statute. See 66 Pa.C.S. § 1352(a). Act 11 also requires a yearly compliance filing known as an Annual Asset Optimization Plan. See 66 Pa.C.S. § 1356.

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On August 2, 2012, the Commission issued its Final Implementation Order establishing procedures and guidelines necessary to implement Act 11. The Final Implementation Order adopted the requirements established in Act 11, provided additional standards that each utility must meet in developing an LTIP and DSIC, and gave guidance to utilities for meeting the Commission's standards.

On March 14, 2013, the Commission entered a Proposed Rulemaking Order at Docket No. L-2012-2317274 in *Review of Long-Term Infrastructure Improvement Plan*. In its Order, the Commission provided proposed regulations regarding the LTIP, including information on modification of a utility's LTIP, and the annual review process for the AAO Plan. On May 23, 2014, after review of comments from interested stakeholders, the Commission issued a Final Rulemaking Order which set forth the elements an LTIP must contain and outlines the procedure and process for filing and review of LTIPs and AAOPs. The Final Rulemaking Order was published in the *Pennsylvania Bulletin* on December 20, 2014 (44 Pa.B. 7856) and the final regulations at 52 Pa. Code §§ 121.1-121.8 became effective upon that publication.

On September 21, 2016, the Commission entered a Supplemental Implementation Order at Docket No. M-2012-2293611 in *Implementation of Act 11 of 2012*. In its Order, the Commission addressed issues regarding the implementation, operation and computation of the DSIC. Specifically, the Commission addressed the requirement of quarterly financial reports for all utilities that use the DSIC mechanism; filing and computation issues for when the DSIC is reset to zero; treatment of over/under collections, or E-factor, after the DSIC is reset to zero; computation issues for determining the DSIC rate cap; and the requirement to file an LTIP by water utilities that use the DSIC.

PPL Electric has been a long-time supporter of implementing a DSIC for EDCs and has actively participated in the Commission's process to develop the procedures and policies surrounding the Commission's implementation of Act 11. PPL Electric was a participant in the Commission's working groups and filed comments to both of the Commission's Tentative Implementation Orders.

### **Background**

PPL Electric is a public utility and an EDC as defined in Sections 102 and 2803 of the Pennsylvania Public Utility Code, 66 Pa. C.S. §§ 102, 2803. PPL Electric furnishes electric distribution, transmission, and default service electric supply services to

PPL Electric Utilities Corp.

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approximately 1.4 million customers throughout its certificated service territory, which includes all or portions of twenty-nine counties and encompasses approximately 10,000 square miles in eastern and central Pennsylvania.

On January 10, 2013, PPL Electric's first LTIIP ("First LTIIP") was approved by the Commission at Docket No. P-2012-2325034. PPL Electric's First LTIIP covered the years 2013 through 2017. PPL Electric filed a petition seeking approval of a DSIC on January 15, 2013, which was approved in an Order entered on May 23, 2013, at Docket No. P-2012-2325034. PPL Electric's second LTIIP ("Second LTIIP") was filed with the Commission on August 31, 2017, and was approved in an Order entered on December 21, 2017, at Docket No. P-2017-2622393. The Company's Second LTIIP covers the years 2018-2022. In preparing its LTIIPs, PPL Electric followed the guidelines established in the Commission's August 2, 2012 Final Implementation Order.

Within the First and Second LTIIPs, PPL Electric categorized its distribution system infrastructure planned for replacements into 32 and 30 asset groups, respectively, and provided a description of the DSIC eligible projects. Details on each of the asset groups included factors used to identify the need for the project, average age of the asset, scope of the project including the number of units to be replaced or improved over the next five years, the approximate location by geographic region for the projects and the yearly expenditures for five years period covered by the LTIIPs for each asset class.

### **Executive Summary**

In developing its AAOP, PPL Electric has included all of the 30 asset groups originally included in its Commission-approved Second LTIIP. The AAOP provides projected and actual replacement numbers for 2021, and original and revised projections for 2022. PPL Electric maintained the project description provided in the Second LTIIP but has added comments to describe the progress of the programs and to explain any deviations from the original projections. While some programs have been modified due to changing circumstances, PPL Electric does not propose to eliminate any of its programs at this time.

As the table on page 10 shows, in 2021 PPL Electric has underrun the original amount it projected to spend on DSIC eligible projects. The Company anticipates this underrun will continue as compared to the Second LTIIP projections in 2022.

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Since the 1994-1998 benchmark period, which defines PPL Electric's reliability performance targets, PPL Electric's service reliability has significantly improved; however, on comparison year over year our reliability performance is mainly impacted by varying weather conditions. Since the PUC benchmark period, PPL Electric's overall reliability performance is ranked 2<sup>nd</sup> in the mid-Atlantic with continued strong customer satisfaction as a result of reducing permanent outages. We have been recognized by JD Power with thirty awards for customer satisfaction, making PPL Electric a top performer among large utilities in the East region for residential satisfaction 18 of the past 22 years.

Overall, PPL Electric is nationally ranked as a 1<sup>st</sup> quartile SAIFI performer over the past 7 consecutive years by IEEE, and 8 consecutive years by EEI as a result of a decade of reducing permanent customer outages. In 2021 a significant increase in weather related system events (42 in 2021 versus 27 in 2020) caused a slight decrease in PUC SAIFI (0.91 versus 0.84), but performance remained in top quartile industry reliability. The continued focused investment in our distribution system and assets around improving reliability ensure our ability to provide top industry reliability performance for our customers.

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The table below illustrates PPL Electric's past 5-year reliability performance as it compares to both PUC benchmark and IEEE 1366-2012 standard.

		2017	2018	2019	2020	2021
<b>Average Number of Customers Served</b>		1,417,978	1,422,558	1,429,035	1,438,204	1,445,611
<b>PUC METRICS</b>	<b>SAIFI (Benchmark = 0.98; rolling 12-month Std. = 1.18)</b>	0.71	0.84	0.85	0.84	0.91
	<b>CAIDI (Benchmark = 145; Rolling 12-month Std. = 174)</b>	146	168	176	137	187
	<b>SAIDI (Benchmark = 142; Rolling 12-month Std. = 205)</b>	104	141	150	116	170
	<b>MAIFI</b>	6.5	7.2	5.7	5.3	2.6
	<b>Number of Sustained Customer Interruptions (Trouble Cases)</b>	17,388	21,007	21,497	20,877	24,241
	<b>Number of Customers Affected</b>	1,009,780	1,201,596	1,213,340	1,212,136	1,308,569
	<b>Customer Minutes of Interruptions</b>	147,223,227	201,484,665	231,915,481	166,414,603	245,413,282
	<b>Number of Customer Momentary Interruptions</b>	9,178,611	10,198,199	8,083,974	7,639,856	3,817,912
<b>IEEE METRICS</b>	<b>SAIFI</b>	0.60	0.74	0.66	0.69	0.68
	<b>CAIDI</b>	116	112	112	99	124
	<b>SAIDI</b>	70	83	74	69	85
	<b>MAIFI</b>	5.6	5.4	4.3	4.2	2.1
	<b>Number of Sustained Customer Interruptions (Trouble Cases)</b>	18,850	23,680	22,728	23,495	24,032
	<b>Number of Customers Affected</b>	855,800	1,047,381	943,894	990,900	988,372
	<b>Customer Minutes of Interruptions</b>	99,315,873	117,367,484	106,186,418	98,721,644	122,230,348
	<b>Number of Customer Momentary Interruptions</b>	7,876,494	7,692,877	6,095,576	6,066,279	3,100,572

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Approximately 49% of the capital dollars for distribution operations is allocated to Act 11 projects, therefore the assumption was made that 49% of the FTE (Full Time Equivalent) positions would be used for Act 11 purposes as well. The only break down available is between PPL Electric (PPL) and contract (COC) employees; there is no further drill down available at a field/supervisory level. The data shown below are for FTE only.

<b>Year</b>	<b>PPL</b>	<b>COC</b>	<b>Total</b>
2021	199	131	330
2022	218	134	352

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LTIP	2021 LTIP	2021 Actuals	2022 LTIP	2022 Forecast
Copper Weld Copper	\$2.54	\$0.02	\$2.04	\$0.00
Cross-Yard 12 kV Underground Tie	\$2.99	\$0.74	\$2.05	\$0.94
C-Truss Distribution Poles	\$4.48	\$0.57	\$5.05	\$2.79
Customers Experiencing Multiple Interruptions	\$4.35	\$0.09	\$3.81	\$0.00
Distribution Animal Guarding	\$0.75	\$0.82	\$0.77	\$0.89
Distribution Automation Development	\$18.13	\$6.76	\$6.02	\$8.03
Distribution Failed Equipment	\$17.69	\$17.23	\$17.90	\$17.69
Distribution Pole Replacements	\$18.46	\$10.45	\$19.09	\$15.59
Distribution Reliability Preservation	\$11.10	\$6.95	\$11.23	\$10.19
Distribution Substation Circuit Breakers	\$5.78	\$11.35	\$4.65	\$17.57
Distribution Substation DC Equipment	\$0.25	\$0.16	\$0.27	\$0.13
Fiber Wrap Distribution Poles	\$2.15	\$0.10	\$2.43	\$1.58
Improve System Reliability Projects	\$65.50	\$34.29	\$45.12	\$36.08
Line Cutouts	\$1.51	\$2.85	\$1.02	\$0.46
Low Tension Network Primary Cable, Equipment and Structures	\$5.79	\$7.13	\$3.09	\$2.66
LTN Automation	\$4.67	\$2.67	\$0.00	\$14.74
Miscellaneous Substation Equipment	\$2.23	\$0.05	\$2.06	\$0.28
New Hydraulic Reclosers	\$0.23	\$0.00	\$0.25	\$0.00
Protection and Control	\$5.05	\$7.34	\$5.18	\$5.28
Reliability Preservation Emergent	\$1.74	\$1.95	\$1.74	\$2.35
Replace Deteriorated/Failed Low-Tension Network Equipment and Structures	\$1.21	\$0.79	\$0.81	\$0.74
Replace Deteriorated/Failed Area Supply Substation Equipment	\$3.02	\$1.79	\$2.48	\$2.05
Replace Failed 12kV Underground Getaway Cable	\$1.51	\$0.56	\$1.53	\$1.30
Replace Failed Underground Cable	\$14.69	\$12.73	\$14.86	\$13.31
Substation 69/12 kV Transformer Replacement	\$4.08	\$3.65	\$4.39	\$6.63
Substation Animal Guarding	\$0.51	\$0.26	\$0.26	\$0.81
Underground Cable Replacement and Life Extension	\$8.33	\$2.99	\$7.40	\$3.72
Underground Getaway Cable Replacements and Life Extension	\$7.05	\$3.67	\$6.10	\$5.78
Unreimbursed Highway Relocations	\$4.56	\$4.25	\$3.85	\$4.22
Volt Var Optimization	\$4.79	\$1.43	\$5.25	\$0.00
<b>Total</b>	<b>\$225.15</b>	<b>\$143.63</b>	<b>\$180.70</b>	<b>\$175.80</b>

*In Millions*

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## *Distribution Assets*

The following pages set forth actual results for calendar year 2021 and revised projections for calendar year 2022. These assets include, but are not limited to, the following:

- Structures
  - Poles
  - Crossarms
  - Vaults
  - Manholes
- Overhead Conductors and Hardware
- Underground Cables and Hardware
- Switching Devices
  - Air Break Switches
  - Disconnect Switches
  - Switching Cabinets
- Protective Devices
  - Fuses
  - Reclosers
  - Network Protectors
  - Lightning Arresters
- Transformers
  - Overhead
  - Pad-Mounted
  - Submersible
  - Low Tension Network

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## Distribution Pole Replacements

### Program Description and Purpose

Replacement of distribution wood poles identified as non-restorable (cannot be reinforced) during the annual inspect and treat program or during a spot inspection in an effort to improve public and employee safety, as well as service reliability. This program contributes to storm hardening efforts and aims to improve public and employee safety, as well as service reliability, by reducing potential pole failures.

### Identification/Justification Process

PPL Electric inspects approximately 75,000 poles per year. Historical data suggests an approximate 10% rejection rate from the population of yearly inspections; of those rejected, 80% are candidates for reinforcement while 20% are candidates for replacement. Replacing rejected poles avoids property damage and risk of accidental injury, and it mitigates the costs associated with extended service outages. Replacement rates are expected to fall as a result of PPL Electric's pole treatment program. The average age of an in-service wooden distribution pole is 38 years.

### Scope

The scope of the program is a direct correlation to the number of wood pole inspections.

<b>Replacements in Units</b>	<b>2021</b>	<b>2022</b>
Second LTIP	2900-3200	2900-3200
Current YR Actual/ Future YR Forecast	<b>1090</b>	<b>2600-3000</b>

### Locations

Specific locations are a direct correlation to the wood pole inspection plan. Inspection locations are identified yearly primarily as a function of previous inspection dates, as well as ensuring cost-effectiveness of the program and minimizing inspection crew movements.

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$18.46	\$19.09
Current YR Actual/ Future YR Forecast	<b>\$10.45</b>	<b>\$15.59</b>

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## Comments:

Most pole replacements are identified by the previous year's pole inspections. In 2020, PPL Electric started the second 12-year pole inspection cycle, resulting in fewer poles being inspected annually (compared to the previous 10-year pole inspection cycle). As a result of moving to a 12-year pole inspection cycle with fewer poles being inspected annually in the second cycle, the forecast for 2022 will be less than the Second LTIP forecast.

## **C-Truss Distribution Poles**

### Program Description and Purpose

Steel reinforcement (C-Trussing) of deteriorated distribution wood poles in order to restore the pole's original strength, ensure public safety, and maintain reliable electric service through the reduction of potential pole failures. This program contributes to storm hardening efforts by reducing potential pole failures.

### Identification/Justification Process

PPL Electric inspects approximately 90,000 poles per year. Historical data suggests an approximate 10% rejection rate from the population of yearly inspections, of which historically 75% are candidates for steel reinforcement. When applicable, this method achieves a significant savings over pole replacement.

### Scope

<b>Reinforcements in Units</b>	<b>2021</b>	<b>2022</b>
Second LTIP	5260-5815	5260-5815
Current YR Actual/ Future YR Forecast	<b>2135</b>	<b>5260-5815</b>

### Locations

Locations identified for C-trussing are a direct correlation to the number of wood pole inspections.

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$4.48	\$5.05
Current YR Actual/ Future YR Forecast	<b>\$0.57</b>	<b>\$2.79</b>

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## Comments:

In 2020, PPL Electric started its second 12-year pole inspection cycle, resulting in fewer poles being inspected annually (compared to the previous 10-year pole inspection cycle). While this lower number of inspections is expected in 2022, part of the 2021 scope of work for reinforcements were reprioritized reducing the total number of reinforcements completed. For these reasons, the 2022 forecast is in alignment with the Second LTIP. The 2022 planned expenditures will be updated to reflect the new 2022 scope of work.

## **Fiber Wrap Distribution Poles**

### Program Description and Purpose

Fiber reinforcement of deteriorated distribution wood poles to improve the pole's strength, ensure public safety and maintain reliable electric service through the reduction of potential pole failures. Fiber wrapped poles are restored to 85% original strength. Fiber wrap is a reinforcement method by which a standing pole in Pennsylvania Department of Transportation (PennDOT) right of way is wrapped and cured in fiber reinforcement materials. This program contributes to storm hardening efforts and aims to improve public and employee safety, as well as service reliability, by reducing potential pole failures.

### Identification/Justification Process

Fiber wrap candidates are selected from a pool of restorable poles in PennDOT's right-of-way on the basis of the condition of pole, the age of pole and the cost of replacement. Historically, reinforcement of poles within PennDOT right-of-way was not practiced and all poles that did not pass inspection were replaced. In an effort to increase cost-effectiveness, PPL Electric began fiber wrap reinforcement during 2012 and reduced the number of pole replacements from 30% of rejected poles to 25%. Shifting capital from replacement to fiber wrap allows capital to be invested in more effective areas.

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## Scope

<b>Fiber Wrap in Units</b>	<b>2021</b>	<b>2022</b>
Second LTIP	585-645	585-645
Current YR Actual/ Future YR Forecast	<b>15</b>	<b>100-200</b>

## Locations

Locations identified for fiber wrap are a direct correlation to the wood pole inspection plan.

## Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$2.15	\$2.43
Current YR Actual/ Future YR Forecast	<b>\$0.10</b>	<b>\$1.58</b>

## Comments:

Restrictions on poles classified as reinforceable by fiber wrap have lowered the total number of reinforceable poles. In 2021, PPL Electric reviewed the benefits and long-term performance for utilizing fiber wrap as a pole remediation program. This review determined that a portion of the poles originally qualified to be fiber wrapped would have improved long term reliability performance and reduced O&M maintenance cost by replacing the pole instead.

## *Line Cutouts*

### Program Description and Purpose

Replacement of porcelain cutouts on the 12kV system to avoid tracking along freeze/thaw cycle cracks, which can eventually lead to pole top fires.

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## Identification/Justification Process

Porcelain cutouts are identified via regularly scheduled line patrols (EOR, WPC, pole inspections). Locations are then prioritized via system exposure and historical locational propensity to pole top fire events.

## Scope

<b>Cutouts in Units</b>	<b>2021</b>	<b>2022</b>
Second LTIP	400-500	400-500
Current YR Actual/ Future YR Forecast	<b>619</b>	<b>450</b>

## Locations (2021 Actual)

<b>Region</b>	<b>Units</b>
Lehigh	120
Northeast	75
Central	85
Susquehanna	74
Harrisburg	94
Lancaster	171

## Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$1.51	\$1.02
Current YR Actual/ Future YR Forecast	<b>\$2.85</b>	<b>\$1.00</b>

## Comments:

Line Cutout replacements are used as smaller-sized work for crews that need to be available to respond to outages as they occur. In 2020, PPL Electric increased the number of line cutout replacements, due to crew availability. In 2021, more line cutout replacements were completed than originally anticipated due to variability in executing smaller-sized work. In 2022, we anticipate returning to the scope originally set forth in the Second LTIP.

## **Volt Var Optimization**

### Program Description and Purpose

Installation of capacitors on the 12 kV system to achieve a near unity power factor on the high side of the distribution substation transformers ensuring required overall power quality.

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## Identification/Justification Process

Capacitors are installed on the 12 kV system using VAR requirements that are identified annually by PPL Electric's distribution planning resources. PJM requires a minimum power factor of 0.97 as measured at the transmission/distribution interface point. Scope is determined by voltage and MVAR requirements to support any system shortages. Regional splits are analyzed annually based on need.

## Scope

<b>Installations in Units</b>	<b>2021</b>	<b>2022</b>
Second LTIP	250-300	250-300
Current YR Actual/ Future YR Forecast	<b>32</b>	<b>0</b>

## Locations (2021 Actual)

<b>Region</b>	<b>Units</b>
Lehigh	0
Northeast	0
Central	2
Susquehanna	25
Harrisburg	0
Lancaster	5

## Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$4.79	\$5.25
Current YR Actual/ Future YR Forecast	<b>\$1.43</b>	<b>\$0</b>

## Comments:

The Volt Var Optimization program has reached completion for the installation of telemetering devices on all three-phase switched capacitors. The final units were placed into service in Q1 2021.

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## New Hydraulic Reclosers

### Program Description and Purpose

Proactive installation of new hydraulic reclosers to improve reliability performance by increasing circuit sectionalizing ability. Reclosers minimize the number of customers affected by a sustained outage.

### Identification/Justification Process

Locations are requested by regional reliability engineers and prioritized annually based on anticipated SAIDI savings. A gradual scope reduction was assumed in the outer years as a result of saturation of reclosers and other distribution automation equipment resulting in 0 units projected.

### Scope

<b>Installations in Units</b>	<b>2021</b>	<b>2022</b>
Second LTIP	15-20	15-20
Current YR Actual/ Future YR Forecast	<b>0</b>	<b>0</b>

### Locations (2021 Actual)

<b>Region</b>	<b>Units</b>
Lehigh	0
Northeast	0
Central	0
Susquehanna	0
Harrisburg	0
Lancaster	0

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$0.23	\$0.25
Current YR Actual/ Future YR Forecast	<b>\$0</b>	<b>\$0</b>

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Comments:

The installation of any new reclosers is being included under the Distribution Automation Program. Replacement of vintage OCR devices will be managed under the Distribution Automation program.

## *Distribution Animal Guarding*

Program Description and Purpose

Proactive installation of animal guards on existing distribution overhead transformers and air break switches to improve circuit reliability. Animal guards help prevent animal-related contacts which cause service interruptions.

Identification/Justification Process

Air break switches have animal guarding installed as part of their inspection process. Transformers are identified both by opportunistic installation of guarding during other non-related work, and by on-the-spot or follow-up orders after responding to animal-caused outages.

Scope

Areas To Address	2021	2022
Second LTIP	300-400	300-400
Current YR Actual/ Future YR Forecast	<b>269</b>	<b>461</b>

Locations (2021 Actual)

Region	Units
Lehigh	59
Northeast	25
Central	26
Susquehanna	46
Harrisburg	50
Lancaster	63

## PPL Electric Utilities Corporation

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### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$0.75	\$0.77
Current YR Actual/ Future YR Forecast	<b>\$0.82</b>	<b>\$0.89</b>

### Comments:

Distribution animal guarding installations are used as smaller-sized work for crews that need to be available to respond to outages as they occur. In 2020 and 2021, more animal guards were installed than anticipated due to a shift in workload for these crews. More animal guard installs are expected in 2022 to maintain reliability as a result of animal contacts.

### **Distribution Failed Equipment**

#### Program Description and Purpose

Replacement or repair of failed or deteriorated capital units of distribution equipment, excluding underground cable, in order to maintain adequate service reliability.

#### Identification/Justification Process

Candidates are identified via inspections, both planned and ad-hoc, as well as actual outages and power service problems. Budget allocations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures. Examples include, but are not limited to, failed reclosers, poles, capacitor banks, and air breaks.

#### Scope & Locations

Scope and locations are determined as equipment fails.

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$17.69	\$17.90
Current YR Actual/ Future YR Forecast	<b>\$17.23</b>	<b>\$17.69</b>

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## Comments:

Failed equipment expenditures in 2021 were in line with historic averages and are forecast to continue at those averages in the future.

## **Replace Failed Underground Cable**

### Program Description and Purpose

Replacement of failed underground residential primary cables in order to maintain adequate service reliability.

### Identification/Justification Process

Candidates are identified via actual failures. Budget recommendations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures.

### Scope & Locations

Scope and locations are determined as cable fails.

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$14.69	\$14.86
Current YR Actual/ Future YR Forecast	<b>\$12.73</b>	<b>\$13.31</b>

## Comments:

Though proactive cable replacements and cable curing life extension programs have cushioned the rate of failed underground cable against considerable increases as the system ages, there was a slightly larger amount of work under these programs in 2021 than in the previous year. However, the actual cost of the work came in lower than expected. The 2022 forecast accounts for the lower average cost to perform this work.

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## Replace Failed 12 kV Underground Getaway Cables

### Program Description and Purpose

Replacement of failed 12 kV underground getaway cables in order to maintain adequate service reliability. Getaway failures can result in long duration outages. Getaway cables connect substations to outgoing feeders beyond the substation perimeter.

### Identification/Justification Process

Candidates are identified via actual failures and cables with severely poor testing results. Budget recommendations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures.

### Scope & Locations

Scope and locations are determined as cables fail in-service or fail testing.

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$1.51	\$1.53
Current YR Actual/ Future YR Forecast	<b>\$0.56</b>	<b>\$1.30</b>

### Comments:

In 2021, program expenditures came in lower than the Second LTIP forecast due to fewer underground getaway failures, and fewer unanticipated construction complications. No significant change in 2022 workload or schedules is anticipated for 2021.

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## Replace Deteriorated/Failed Low Tension Network Equipment and Structures

### Program Description and Purpose

Replacement or repair of deteriorated and failed equipment related to low-tension networks, including submersible transformers, network protectors, manholes, and vault tops in order to maintain adequate service reliability. Low-tension networks are low voltage underground distribution facilities found in urban areas.

### Identification/Justification Process

Candidates are identified via actual failures, inspections, testing, or work on the system. Budget recommendations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures.

### Scope & Locations

Scope and locations are determined as cable fails.

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$1.21	\$0.81
Current YR Actual/ Future YR Forecast	<b>\$0.79</b>	<b>\$0.74</b>

### Comments:

The 2021 actuals came in lower than the original budget due to an increase in proactive replacements resulting in reduced equipment failures. This trend is anticipated to continue as PPL Electric moves forward with further proactive replacements of high-risk assets in 2022.

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## Underground Cable Replacement and Life Extension

### Program Description and Purpose

Programmatic replacement and/or treatment of deteriorated underground cable to maintain reliable electric service. Specifically for underground residential developments (“URD”), PPL Electric’s course of action is to treat the entire URD, where possible.

### Identification/Justification Process

Candidates are selected based on history of cable failures. Once the initial failure is treated, remaining cable sections of the same vintage in the area are tested. Test results drive the decision to either replace the cable or treat it with a compound to restore cable insulation, known as cable curing. The profile of URD cable varies across URDs, thus making it difficult to predict whether cable curing or replacement will be the prevalent course of action in a given URD. On a system-wide basis, however, historical experience indicates that of the total number of cables in troubled URD locations, typically 35% can be cured, 25% require replacement, and 40% do not require immediate remediation.

Regional allocation of cable remediation is based on historical regional percent contribution to system-wide cable failures.

### Scope

Scope In Cable Segments	Treatment	2021	2022
Second LTIP	<b>Replacement After Test</b>	220-280	220-280
Current YR Actual/ Future YR Forecast	<b>Replacement After Test</b>	0	0
Second LTIP	<b>Cure</b>	800-900	850-950
Current YR Actual/ Future YR Forecast	<b>Cure</b>	0	0
Second LTIP	<b>Proactive Replacement</b>	150-175	150-175
Current YR Actual/ Future YR Forecast	<b>Proactive Replacement</b>	234	216

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## Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$8.33	\$7.40
Current YR Actual/ Future YR Forecast	<b>\$2.99</b>	<b>\$3.72</b>

## Comments:

The current URD data and performance supports a continued approach to test when a cable shows signs of degradation and conduct proactive replacements based on specific URD cable performance. The 2022 scope of URD proactive replacements is anticipated to be similar to prior years of URD proactive replacements. The Cable Curing programs remain inactive since ending after having reached their benefit.

## **Low Tension Network Primary Cable, Equipment and Structures**

### Program Description and Purpose

Programmatic replacement of deteriorated equipment related to low-tension networks, including paper insulated lead cable (PILC), submersible transformers, network protectors, manholes, and vault tops. The purpose of this program is to ensure public safety and service reliability through the replacement of underground facilities that have reached the end of their expected life or show signs of premature age from prolonged exposure to corrosive environments.

### Identification/Justification Process

Vintage PILC cable has a documented history of problems and was deemed prudent to replace entirely. Replacement and repair of manhole and vault tops is determined by regular inspection. Transformer and network protector replacements are determined through inspection and age, where assets exceeding 40 years in service are considered highest priority.

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### Scope

<b>Replacements in Units</b>		<b>2021</b>	<b>2022</b>
Second LTIP	<b>Lead Cable</b>	1-5	1-5
Current YR Actual/ Future YR Forecast	<b>Lead Cable</b>	<b>0</b>	<b>0</b>
Second LTIP	<b>LTN Equipment</b>	15-30	15-30
Current YR Actual/ Future YR Forecast	<b>LTN Equipment</b>	<b>25</b>	<b>59</b>

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$5.79	\$3.09
Current YR Actual/ Future YR Forecast	<b>\$7.13</b>	<b>\$2.66</b>

### Comments:

The 2021 actuals came in over what was originally targeted as work deferred from previous years was completed. In 2022, this program's focus is on installing new fixed ladders as a part of a safety initiative by the company, as well as doing any capital work not covered by the LTN Automation program. There is no current scope for the replacement of primary lead cable because all primary lead cable has been removed from the system.

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## LTN Automation

### Program Description and Purpose

The purpose of the program is to install remote monitoring and control equipment in all Low Tension Network (LTN) vaults. This will allow for safer operation of LTNs, a reduction in maintenance costs, a reduction in failed equipment requiring replacement, and better data for asset planning and investment.

### Identification/Justification Process

Rollout of this program began in the Leigh and Harrisburg regions. By the completion of this program, all LTN vaults will receive automation.

### Scope

<b>Replacements in Units</b>	<b>2021</b>	<b>2022</b>
Second LTIP	2-3	0-1
Current YR Actual/ Future YR Forecast	<b>19</b>	<b>117</b>

### Locations (2021 Actual)

<b>Region</b>	<b>Units</b>
Lehigh	0
Northeast	3
Central	0
Susquehanna	0
Harrisburg	16
Lancaster	0

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$4.67	\$0.00
Current YR Actual/ Future YR Forecast	<b>\$2.67</b>	<b>\$14.74</b>

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## Comments:

The 2021 actuals came in lower than the original budget due to challenges around scheduling and an updated schedule timeline to better account for unseen cost increases and workload balancing. This reshuffle meant that less of the original scope was completed in 2021 than originally expected. This program has been rescoped to better reflect changes to the construction schedule resulting in work being moved into 2022 and anticipated through 2024. The 2022 scope is reflected based on this adjustment to the schedule.

## **Underground Getaway Cable Replacements and Life Extension**

### Program Description and Purpose

Programmatic replacement of aging 12 kV underground getaway cables, with an emphasis on conversion to overhead design, to prevent service outages and reduce outage durations for improved reliability.

### Identification/Justification Process

Getaways are selected on a basis of failure history, cable test results, and age. Cables that are older than 40 years and serve a large number of customers, are given highest priority. The average age for UG cables identified for replacement is 38 years. PPL Electric also plans to incorporate treatment methods for getaways that are currently implemented for URD cables on the distribution system.

### Scope

<b>Replacements in Units</b>	<b>2021</b>	<b>2022</b>
Second LTIP	40-50	35-45
Current YR Actual/ Future YR Forecast	<b>21</b>	<b>25-35</b>

### Locations (2021 Actual)

<b>Region</b>	<b>Units</b>
Lehigh	6
Northeast	2
Central	4
Susquehanna	0
Harrisburg	3
Lancaster	6

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## Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$7.05	\$6.10
Current YR Actual/ Future YR Forecast	<b>\$3.67</b>	<b>\$5.78</b>

## Comments:

In 2021, the number of units proactively replaced was less than originally forecasted in the Second LTIP. This decrease in 2021 proactive underground getaway replacement quantity was due to program reprioritizations based on cable risk evaluations. The 2022 forecasted proactive underground getaway replacement quantity is also less than originally forecasted in the Second LTIP. This is again due to program reprioritizations based on cable risk evaluations.

## **Copper Weld Copper**

### Program Description and Purpose

Programmatic replacement of overhead #6 Copper, and #6, #6A and #7A Copper Weld overhead conductor to improve reliability of service by reducing potential for long-duration conductor failures. Such vintages of conductor are known to anneal and are often found in heavily wooded areas of the service territory where relocation, along with reconductoring, help to ensure future outages can be restored more quickly. PPL Electric currently is evaluating expanding this program to include other types of vintage cables/conductors.

### Identification/Justification Process

Circuits are prioritized by an algorithm that weighs the amount of copper on the line and historic customer service interruptions.

### Scope

<b>Planned Projects</b>	<b>2021</b>	<b>2022</b>
Second LTIP	3-5	3-5
Current YR Actual/ Future YR Forecast	<b>0</b>	<b>0</b>

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### Locations (2021 Actual)

Region	Projects
Lehigh	0
Northeast	0
Central	0
Susquehanna	0
Harrisburg	0
Lancaster	0

### Planned Expenditures (in millions)

Planned Expenditures	2021	2022
Second LTIP	\$2.54	\$2.04
Current YR Actual/ Future YR Forecast	<b>\$0.02</b>	<b>\$0</b>

### Comments:

This program has ceased active work, as the reliability gains from the program could more easily be found in other programmatic work.

### **Customers Experiencing Multiple Interruptions**

#### Program Description and Purpose

Improve reliability for customers experiencing multiple interruptions (“CEMI”) and customers experiencing multiple momentary interruptions (“CEMMI”) via upgrades to their circuits. The purpose of the program is to prevent future outages from occurring and to increase communication with customers who experience five or more service outages within a one year period, or two or more momentary interruptions per month on average for a year.

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## Identification/Justification Process

Projects are identified by regional distribution planners and regional reliability supervisors once a circuit has customers who exceed a threshold of five or more service interruptions within a calendar year, or are downstream of devices that momentarily interrupt customers more than set thresholds for various time frames. Projects are vetted at cross-functional task force meetings (both for CEMI and CEMMI) for approval and ranked systematically based on historical CEMI performance, year-to-date CEMI performance, cost per customer benefit, and expected reliability improvements. CEMMI projects are ranked based on cost and number of customers affected, along with severity of issue. Examples include, but are not limited to, reconductoring lines, replacing and/or relocating protective equipment with new equipment, and building new tie lines to improve switching capabilities. It should be noted that sizes of projects vary significantly which can result in material swings in the number of planned projects.

## Scope

<b>Replacements in Units</b>		<b>2021</b>	<b>2022</b>
Second LTIP	<b>CEMI</b>	20-40	20-40
Current YR Actual/ Future YR Forecast	<b>CEMI</b>	<b>2</b>	<b>0</b>
Second LTIP	<b>CEMMI</b>	125-140	125-140
Current YR Actual/ Future YR Forecast	<b>CEMMI</b>	<b>1</b>	<b>0</b>

## Locations

Locations are identified based upon emergent reliability needs.

## Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$4.35	\$3.81
Current YR Actual/ Future YR Forecast	<b>\$0.09</b>	<b>\$0</b>

## Comments:

These programs are ceasing as independently funded programs, and instead will have programmatic goals met by overall Distribution Reliability programs that focus on and address specific sections and feeders that show degraded reliability performance. These programs will prioritize CEMI and CEMMI customers within the overall systematic approach to reliability. The work that was completed in 2021 was a result of

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carryover work that was not fully completed in 2019 when these programs were combined into an overall reliability preservation budget.

## Distribution Reliability Preservation

### Program Description and Purpose

Upgrades to the distribution system as justified by regional reliability supervisors to improve reliability. Improvements are targeted towards WPCs, circuits with a history of customer complaints, or recommendations as a result of EORs. EORs are detailed reliability and operational analysis performed on 25% of a region's distribution circuits per year.

These projects are outside the scope of the Worst Performing Circuit program because they are smaller in nature and can be more quickly engineered and constructed.

### Identification/Justification Process

Regional reliability supervisors identify and submit requests for small-scale circuit improvement projects. Projects under \$50,000 are directly identified by the regions, approximately 60% of the budget is allotted towards these small improvements. Projects over \$50,000 are ranked utilizing PPL Electric's investment prioritization tool to ensure funds are directed towards the most cost-effective projects. The number of projects and locations may vary depending on areas with reliability concerns. Examples include, but are not limited to, installation of fuses, fault indicators, reconductoring of vintage conductor, upgrading conductor to reduce impact of vegetation related service outages, and relocating sections of lines that may be inaccessible or prone to vegetation related service outages.

It should be noted projects vary significantly in size, which can result in material swings in the number of planned projects.

### Scope

<b>Planned Projects</b>	<b>2021</b>	<b>2022</b>
Second LTIP	35-55	35-55
Current YR Actual/ Future YR Forecast	<b>373</b>	<b>350-400</b>

### Locations

Locations are identified based upon emergent reliability needs.

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$11.10	\$11.23

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Current YR Actual/ Future YR Forecast	<b>\$6.95</b>	<b>\$10.19</b>
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### Comments:

In order to facilitate PPL Electric second shift crew's need for smaller, more readily accomplished work, PPL Electric changed the procedure for creating fusing work orders. This created one work order per location. These work orders constitute the bulk of the work orders above and are individually small jobs. Additionally, as stated in the section above, CEMI and CEMMI work has been prioritized and incorporated into PPL Electric's overall reliability focus, within this program.

### **Reliability Preservation Emergent**

#### Program Description and Purpose

Remediation of issues primarily associated with secondary voltage and emergent small-scale customer reliability needs in order to improve reliability.

#### Identification/Justification Process

Work is identified by line crews, as well as through customer calls, and is completed to avoid potential service outages, power quality concerns and safety issues. Examples include, but are not limited to, modifying capacitance to address voltage concerns, installing fusing to aid in sectionalizing, installing animal guards after multiple animal caused outages, and replacing transformers to resolve transformer overload. Budget recommendations are based on historical trends of hours charged.

#### Scope & Locations

Scope and locations are determined as emergent needs arise.

#### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$1.74	\$1.74
Current YR Actual/ Future YR Forecast	<b>\$1.95</b>	<b>\$2.35</b>

### Comments:

In 2019, PPL Electric reconstituted this program to include not only secondary voltage and smaller scale customer reliability needs but also power quality remediation work, resulting in a higher spend than forecast. This spend increase is reflected in 2021 and will continue in 2022.

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## Distribution Automation Development

### Program Description and Purpose

Upgrade existing air breaks, vacuum circuit reclosers (“VCRs”), and SCADA (“Supervisory Control and Data Acquisition”) at distribution substations, and identify new locations to install automated air breaks and VCRs to improve circuit reliability. This will allow for automatic sectionalizing and restoration of customers during service outage conditions. This plan meets the recommendation the Commission issued on August 7, 2012, regarding outage mitigation techniques during storm events.

#### Recloser Replacements:

Prior to 2014, PPL Electric inspected and refurbished all reclosers (single and three-phase) on an eight-year cycle, pursuant to PUC Inspection and Maintenance Standard 52. Pa. Code § 57.198 (n)(7). In 2015, to improve reliability and move the company toward condition-based maintenance, PPL Electric Utilities began replacing all three-phase reclosers with electronic vacuum devices on a ten-year cycle. This plan was approved by the PUC in January 2014, and was filed as part of PPL Electric’s 2016-2017 Inspection and Maintenance Plan filing.

### Identification/Justification Process

#### Areas selected for deployment:

- Have concentrations of distribution feeders that have been identified as WPCs.
- Have the operational flexibility to allow transfers and restoration of customers when service outages occur.
- Have significantly contributed to system SAIDI and SAIFI.

#### Customer Benefits:

- 500,000 customers (36%) will be covered under the distribution automation deployment.
- Significant reductions in system SAIDI and SAIFI.
- Reduction of the number of customers experiencing long duration service interruptions. Distribution automation will sectionalize the service interruption to the smallest possible area in under five minutes.
- Major Event improvements:
  - Fewer resources needed for switching (trouble crews can focus on cutting loops and performing repairs).
  - Reduction in call volume due to automatic restoration of customers.

Approximately 16-28 distribution substations will be upgraded per year and approximately 223-532 distribution devices will be upgraded per year.

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### Scope

<b>Device Upgrades</b>	<b>2021</b>	<b>2022</b>
Second LTIP	300-350	150-200
Current YR Actual/ Future YR Forecast	<b>272</b>	444

Distribution devices include reclosers, air breaks, and communication infrastructure.

### Locations (2021 Actual)

<b>Region</b>	<b>Distribution Devices</b>
Lehigh	30
Northeast	52
Central	53
Susquehanna	31
Harrisburg	64
Lancaster	42

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$18.13	\$6.02
Current YR Actual/ Future YR Forecast	<b>\$6.76</b>	<b>\$8.03</b>

### Comments:

In 2020, PPL Electric made a fundamental shift of its automation strategy, with a higher focus on single phase reliability performance, as the three-phase portion of this strategy is nearly complete and reaching diminishing reliability returns. This shift in work type drove a lower unit rate observed in 2020. This trend continued in 2021, as single-phase work constituted the bulk of the Distribution Automation Development work in 2021. Additionally, PPL Electric replaces existing recloser devices based on vintage and asset health. The same is expected as PPL Electric continues to increase the amount of single-phase work in 2022.

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## Improve System Reliability Projects

### Program Description and Purpose

Large-scale improvements to distribution circuits with a history of poor reliability. This program addresses long-term projects, primarily aimed at WPCs. However, other proactive long-term projects with proven reliability benefit are included.

### Identification/Justification Process

Each quarter, distribution planners and regional reliability supervisors meet to propose projects to improve WPCs. Projects are approved by distribution planning supervisors and vetted against other projects for scheduling based on historical reliability, potential benefit, and cost. Projects may span multiple years and are listed in the years they are planned to go in service. Scope is expected to increase in outer years as circuits and projects are identified. Examples include, but are not limited to, circuit reconfigurations with new tie lines, new lines and terminals, or the installation of substations for increased reliability.

Additionally, PPL Electric monitors large customer impact outages on a daily basis. A circuit that begins to show reliability deterioration and notable impact on reliability metrics requires a root cause analysis. Such analysis can result in the identification of a long-term project.

Note that the projects vary significantly in size, which can result in material swings in the number of planned projects.

### Scope

<b>Planned Projects</b>	<b>2021</b>	<b>2022</b>
Second LTIIP	30-50	10-20
Current YR Actual/ Future YR Forecast	<b>162</b>	<b>25</b>

### Locations (2021 Actual)

<b>Region</b>	<b>Projects</b>
Lehigh	17
Northeast	16
Central	16
Susquehanna	11
Harrisburg	49
Lancaster	53

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## Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$65.50	\$45.12
Current YR Actual/ Future YR Forecast	<b>\$34.29</b>	<b>\$36.08</b>

## Comments:

Due to reprioritization of work, 2021 actuals were below forecast. 2022 projects are driven by addressing the worst performers in the service territory as well as addressing reliability and restoration on the primary system and secondary networks.

## **Unreimbursed Highway Relocations**

### Program Description and Purpose

Unreimbursed customer requested relocations of PPL Electric distribution facilities in support of highway and bridge projects throughout service territory.

### Identification/Justification Process

The customers (project sponsors) include PennDOT, the PA Turnpike Commission, and various counties and municipalities. PPL Electric and the project sponsor execute a reimbursement agreement, and PPL Electric is reimbursed for its work based on the "pole count method", as defined in PennDOT's DM-5 manual. Historically, reimbursement for distribution projects is approximately 35%.

To accommodate highway relocations and other municipal projects, approximately 70-120 projects per year are placed in service. PPL Electric typically is notified of distribution relocation work 12 months or less before the start of requested utility relocation activities.

### Scope & Locations

Scope and locations are determined as requests are received.

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## Planned Expenditures (in millions)

PPL Electric's expenditures to complete highway relocation projects are the net of total expenditures minus the project sponsor's reimbursements.

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$4.56	\$3.85
Current YR Actual/ Future YR Forecast	<b>\$4.25</b>	<b>\$4.22</b>

## Comments:

PennDOT adjusted project schedules this year into next year to accommodate pandemic precautions and accommodate PennDOT budget conditions. Forecasting utility relocations more than six months out continues to be challenged by PennDOT construction schedules throughout the year, and ongoing highway design development after project receipt within the year. Initial highway plans tend to underestimate utility impacts leading to increase scope during design and progressing to construction. PennDOT and municipalities tend to allow utilities less than one year from notification to construction completion which adds a number of projects after yearly budget development. Highway relocation project schedules also often slip into later years. The quantity of expected highway relocation projects is starting to level off compared to previous years, but with higher costs than previously estimated as projects move between years and change scope.

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## Substation Assets

The following pages detail 5-year projections for Long-Term Infrastructure Improvements initiatives that apply to distribution substation assets. These assets include, but are not limited to, the following:

- Structures
  - Enclosures
  - Fences
- Overhead Conductors and Hardware
- Underground Cables and Hardware
- Switching Devices
  - Air Break Switches
  - Disconnect Switches
- Protective Devices
  - Circuit Breakers
  - Fuses
  - Reclosers
  - Lightning Arresters
- Transformers
  - Power
  - Station Service
  - Instrument

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## Distribution Substation Circuit Breakers

### Program Description and Purpose

Programmatic replacement of substation circuit breakers (“CBs”) based on age and other factors to ensure reliable service. This program includes the replacement of 12 kV circuit breakers, as well as 69 kV circuit breakers that are classified as distribution facilities and equipment.

### Identification/Justification Process

Candidates for replacement are identified based on age, operating issues, availability of spare/repair parts, and the availability of vendor technical support. Once identified, replacement of these facilities is coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window.

The average age of the 12 kV circuit breakers that have been identified for replacement through 2017 is 48 years; the life expectancy is 50 years.

The average age of the 69 kV circuit breakers that have been identified for replacement through 2017 is 47 years; the life expectancy is 50 years.

### Scope

Projects	Voltage	2021	2022
Second LTIP	12 kV	26-31	26-31
Current YR Actual/ Future YR Forecast	12 kV	<b>57</b>	<b>87-93</b>
Second LTIP	69 kV	0-2	0-2
Current YR Actual/ Future YR Forecast	69 kV	<b>0</b>	<b>0-2</b>

### Locations (2021 Actual)

Region	Projects
Lehigh	15
Northeast	6

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Central	12
Susquehanna	12
Harrisburg	3
Lancaster	9

Planned Expenditures (in millions)

Planned Expenditures	2021	2022
Second LTIP	\$5.78	\$4.65
Current YR Actual/ Future YR Forecast	<b>\$11.35</b>	<b>\$17.57</b>

Comments:

In 2021, no 69kV circuit breakers were proactively replaced because the older and most at-risk units were already replaced in the past 10-12 years. The 2021 actual and the 2022 forecasted 12 kV circuit breaker units and expenditures are both higher than originally forecasted in the Second LTIP due to the reevaluation and reprioritization of PPL Electric’s 12 kV circuit breaker strategy.

**Substation 69/12 kV Transformer Replacement**

Program Description and Purpose

Programmatic replacement of distribution substation transformers to maintain reliable service.

Identification/Justification Process

Candidates for replacement are identified based on age and/or maintenance condition, both indicators of potential failure. Once identified, replacement of these facilities is coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window. Replace approximately 5 per year, averaged over a five-year period.

The average age of assets identified for replacement is 52 years; 13 of these are beyond their expected life. These assets are of vintages between 1947 and 1973.

Scope

Projects	2021	2022
Second LTIP	3-5	3-5

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Current YR Actual/ Future YR Forecast	<b>6</b>	<b>8-10</b>
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## Locations (2021 Actual)

Region	Projects
Lehigh	1
Northeast	0
Central	0
Susquehanna	5
Harrisburg	0
Lancaster	0

## Planned Expenditures (in millions)

Planned expenditures fluctuate due to timing of long lead material purchases.

Planned Expenditures	2021	2022
Second LTIP	\$4.08	\$4.39
Current YR Actual/ Future YR Forecast	<b>\$3.65</b>	<b>\$6.63</b>

## Comments:

In 2021, the actual quantity of power transformer replacements was slightly below what was planned and forecasted in the Second LTIP. The 2022 forecasted transformer replacement quantity and expenditure is higher than previously forecasted in the Second LTIP as a result of updated data analytics models for transformer risk assessment, and a reprioritization of PPL Electric's transformer replacement strategy to align with the updated data models.

## **Protection and Control**

### Program Description and Purpose

Programmatic replacement of protection and control equipment to maintain reliable distribution service to customers. Replacement of relays with modern microprocessor relays will enhance the ability for self-diagnostics, as well as continuous monitoring of the health of the device. Replacement of obsolete SCADA protocols and equipment will enable relays to perform properly.

### Identification/Justification Process

Candidates for replacement are identified based on obsolescence, availability of vendor support, and age. Once identified, replacement of these facilities is coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window.

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## Scope

<b>Planned Projects</b>	<b>2021</b>	<b>2022</b>
Second LTIP	196-201	195-200
Current YR Actual/ Future YR Forecast	<b>72</b>	<b>30-35</b>

## Locations (2021 Actual)

<b>Region</b>	<b>Projects</b>
Lehigh	13
Northeast	11
Central	10
Susquehanna	20
Harrisburg	8
Lancaster	10

## Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$5.05	\$5.18
Current YR Actual/ Future YR Forecast	<b>\$7.34</b>	<b>\$5.28</b>

## Comments:

In 2021, fewer units were scoped for replacement than previously forecasted in the Second LTIP as a result of a revamp to PPL Electric's feeder protection strategy. The same trend is expected to continue through 2022. This strategy reprioritization is also associated with increases in the unit cost as newer protection schemes are introduced to the distribution substation network.

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## Cross-Yard 12 kV Underground Ties

### Program Description and Purpose

Programmatic replacement of underground substation cables to maintain reliable service.

### Identification/Justification Process

Candidates for replacement are identified based on age and/or maintenance condition, both indicators of potential failure. Assets with an age significantly greater than 29 years are deemed good candidates for replacements. In addition, assets with unfavorable test results, which indicate the likelihood of failure, are prioritized for replacement. Currently, there is an average of 23 replaced per year over a five-year period. The average age of assets identified for replacement is 40 years. These assets were installed between 1960 and 1989; 124 of these assets are over 40 years old.

### Scope

<b>Planned Projects</b>	<b>2021</b>	<b>2022</b>
Second LTIP	40-45	25-30
Current YR Actual/ Future YR Forecast	<b>3</b>	<b>3-5</b>

### Locations (2021 Actual)

<b>Region</b>	<b>Projects</b>
Lehigh	0
Northeast	0
Central	0
Susquehanna	1
Harrisburg	0
Lancaster	3

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$2.99	\$2.05
Current YR Actual/ Future YR Forecast	<b>\$0.74</b>	<b>\$0.94</b>

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## Comments:

Fewer jobs were completed in 2021 than previously forecasted in the Second LTIP due to an effort to prioritize work on assets with a higher risk of failure and reliability impact. This same reprioritization effort will influence 2022 as well.

## **Replace Deteriorated/Failed Area Supply Substation Equipment**

### Program Description and Purpose

Replacement of failed or deteriorated equipment at area supply substations with in-kind equipment to maintain safe and reliable service.

### Identification/Justification Process

Candidates are identified via actual failures, inspections, testing or work on the system. Budget recommendations are based on historical trends of hours charged to corrective work, in addition to projected trends of future equipment failures.

### Scope & Locations

Scope and locations are determined as equipment fails.

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$3.02	\$2.48
Current YR Actual/ Future YR Forecast	<b>\$1.79</b>	<b>\$2.05</b>

## Comments:

PPL Electric has condition-based replacement programs to proactively identify aging/deteriorated equipment and replace prior to failure. As a result, expenditure on failed equipment is expected to decrease each year considering high-risk assets are being removed from the system prior to failure. Planned expenditure on replacing failed equipment for 2022 is expected to remain mostly consistent with expenditure in recent years, yet less than that previously forecasted in the Second LTIP.

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## Distribution Substation DC Equipment

### Program Description and Purpose

Programmatic replacement of distribution substation DC equipment to maintain reliable service. This program includes the replacement of 24V, and 48V batteries, as well as battery chargers.

### Identification/Justification Process

Candidates for replacement are identified based on age, operating issues, and availability of spare parts. Once identified, replacement of these facilities is coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window. Currently, there is an average of 25 pieces of DC equipment scheduled to be replaced per year over the next five-year period. The average age of the DC equipment scheduled to be replaced through 2017 is 31 years; life expectancy of this type of equipment is 20 years. Of the devices being replaced, 80 devices will be beyond their expected life by the time of replacement.

### Scope

<b>Planned Projects</b>	<b>2021</b>	<b>2022</b>
Second LTIP	15-22	15-22
Current YR Actual/ Future YR Forecast	<b>4</b>	<b>5-7</b>

### Locations (2021 Actual)

<b>Region</b>	<b>Projects</b>
Lehigh	0
Northeast	0
Central	1
Susquehanna	2
Harrisburg	0
Lancaster	1

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$0.25	\$0.27
Current YR Actual/ Future YR Forecast	<b>\$0.16</b>	<b>\$0.13</b>

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Comments:

In 2021, fewer conventional DC equipment replacements were completed based on a reprioritization of asset strategies and failure/risk assessment. As a result, the actual expenditure was less than that previously forecasted in the second LTIP. The number of DC equipment replacement projects forecasted for 2022 is mostly in alignment with the actual quantity of projects completed in 2021. The 2022 forecasted project quantity and expenditure is less than that previously forecasted in the second LTIP as a few of the projects involve larger capital scopes than conventional DC equipment replacements.

**Miscellaneous Substation Equipment**

Program Description and Purpose

Programmatic replacement of older substation equipment, including air breaks, potential transformers (“PTs”), capacitive-coupled voltage transformers (“CCVTs”), circuit switchers, lightning arresters, voltage regulators, and DC panels in order to prevent future maintenance concerns and to maintain reliable service.

Identification/Justification Process

Candidates for replacement are identified based on age and/or maintenance condition, both indicators of potential failure. Once identified, replacement of these facilities is coordinated and aligned with the replacement of other assets at the same substation within the five-year planning window. Currently, there is an average of 44 pieces of equipment scheduled to be replaced per year over the next five-year period. The average age of assets identified for replacement is 47 years. These assets are of vintages between 1947 and 2000. Approximately 194 of these assets are projected to have exceeded their expected life by the time they are replaced.

Scope

<b>Planned Projects</b>	<b>2021</b>	<b>2022</b>
Second LTIP	46-50	38-42
<b>Future YR Adjusted / Current YR Actual</b>	<b>1</b>	<b>1-3</b>

Locations (2021 Actual)

<b>Region</b>	<b>Projects</b>
Lehigh	1
Northeast	0
Central	0
Susquehanna	0
Harrisburg	0
Lancaster	0

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## Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$2.23	\$2.06
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$0.05</b>	<b>\$0.28</b>

## Comments:

In general, substation asset replacement now occurs under planned maintenance programs or capital projects resulting in a decrease in planned expenditures needed for this program.

## *Substation Animal Guarding*

### Program Description and Purpose

Improvements to existing distribution substation equipment via the proactive installation of animal guards. Guarded equipment includes transformer bushings, circuit breakers, fuse/disconnect switches, bus supporting insulators, surge arresters, station service transformers, PTs, and cable terminators.

### Identification/Justification Process

Distribution substations are regionally prioritized based on historical animal-related service outages, number of customers served, substation load, and substation type. High priority substations are animal guarded first with the lower priority substations guarded in outer years.

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### Scope

<b>Planned Installations</b>	<b>2021</b>	<b>2022</b>
Second LTIP	<b>0-2</b>	<b>0-2</b>
<b>Future YR Adjusted / Current YR Actual</b>	<b>3</b>	<b>3-8</b>

### Locations (2021 Actual)

<b>Region</b>	<b>Units</b>
Lehigh	0
Northeast	2
Central	0
Susquehanna	0
Harrisburg	1
Lancaster	0

### Planned Expenditures (in millions)

<b>Planned Expenditures</b>	<b>2021</b>	<b>2022</b>
Second LTIP	\$0.51	\$0.26
<b>Future YR Adjusted / Current YR Actual</b>	<b>\$0.26</b>	<b>\$0.81</b>

### Comments:

In 2021, PPL reprioritized its animal guarding strategy for distribution substations which involved scoping animal guarding installations in alignment with a data analytics project regarding historic animal contacts. The 2022 scope will also address these high-risk locations with animal guarding deficiencies.