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May 18, 2016

Via E-filing
Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street
Harrisburg, PA 17105-3265

Subject: Petition of PECO Energy Company for: (1) approval of its Microgrid Integrated Technology Pilot Plan and (2) Issuance of a Declaratory Order Regarding the Recovery of Microgrid Costs, Docket No. P-2016-________

Application for Construction of Microgrid Distributed Energy Resources Fueled by Natural Gas, Docket No. A-2016-________

Dear Secretary Chiavetta:

PECO Energy Company ("PECO" or the "Company") is filing the above-referenced **petition and the related application** as the basis for PECO's Microgrid Integrated Technology Pilot ("Microgrid Pilot" or "Pilot") in which PECO will construct, own and operate a community microgrid in its service territory. By this Petition, PECO requests that the Pennsylvania Public Utility Commission (the "Commission"), pursuant to Sections 501 and 331(f) of the Public Utility Code ("Code"), 66 Pa. C.S. §§ 501 and 331(f), and Sections 5.41 and 5.42 of the Commission's regulations, 52 Pa. Code §§ 5.41-42, approve PECO's Microgrid Pilot, and issue a declaratory order that PECO may seek to recover the costs of the Pilot that are not recoverable through its electric Distribution System Improvement Charge ("DSIC") in a future distribution base rate case filed under Section 1308 of the Code, 66 Pa.C.S. § 1308. Under the Pilot, PECO is proposing to construct, own and operate several distributed energy resource ("DER") technologies to power the proposed microgrid, including natural gas engines. Accordingly, PECO also is applying for approval to construct microgrid DER fueled by natural gas in accordance with Section 519 of the Public Utility Code, 66 Pa. C.S. § 519.

As more fully explained in the petition and in the Microgrid Integrated Technology Pilot Plan (the "Plan") and testimony accompanying this Petition, PECO is exploring emerging microgrid technology investment opportunities to enhance system reliability, resiliency and security as envisioned under the Company's electric Long-Term Infrastructure Improvement ("LTIIP"). After extensive analysis, PECO is proposing to develop and deploy a community microgrid in Concord Township, Pennsylvania ("Concord Township Project" or "Project") which will be integrated with PECO's distribution system. The Project will focus on improving the distribution system's ability to sustain and recover from adverse events (including severe weather) and on providing reliable access to essential services during power outages. The resulting information, in turn, will be shared with the Commission and other stakeholders to facilitate the successful deployment of additional microgrids and DERs in the Commonwealth. Because the Project would be the first community microgrid under the Code, approval of the Plan by the Commission and issuance of a declaratory order that utility-owned DERs, installed as part of a microgrid, constitute public utility distribution plant assets are appropriate and necessary for the Project to proceed.

PECO respectfully requests that notice of the filing of the Microgrid Petition and a date for intervention be published in the May 28, 2016 issue of the Pennsylvania Bulletin.

If you have any questions, please do not hesitate to contact me directly at 215-841-5777.

Sincerely,

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Enclosures

Cc: Per Certificate of Service
The Honorable Gladys M. Brown, Chairman
The Honorable Andrew G. Place, Vice Chair
The Honorable John F. Coleman, Jr., Commissioner
The Honorable Robert F. Powelson, Commissioner
Cheryl Walker-Davis, Director, Office of Special Assistants
Paul T. Diskin, Director, Bureau of Technical Utility Services

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

PETITION OF PECO ENERGY COMPANY FOR: (1) APPROVAL OF ITS MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN AND (2) ISSUANCE OF A DECLARATORY ORDER REGARDING THE RECOVERY OF MICROGRID COSTS	:	**DOCKET NO. P-2016-_______**
APPLICATION FOR CONSTRUCTION OF MICROGRID DISTRIBUTED ENERGY RESOURCES FUELED BY NATURAL GAS	:	**DOCKET NO. A-2016-_______**

CERTIFICATE OF SERVICE

I hereby certify and affirm that I have this day served copies of the **Petition of PECO Energy Company for: (1) Approval of Its Microgrid Integrated Technology Pilot Plan and (2) Issuance of a Declaratory Order Regarding the Recovery of Microgrid Costs; and Application for Construction of Microgrid Distributed Energy Resources Fueled by Natural Gas** on the following persons, in the manner specified below, in accordance with the requirements of 52 Pa. Code § 1.54:

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Dated: May 18, 2016

For PECO Energy Company

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

PETITION OF PECO ENERGY COMPANY FOR: (1) APPROVAL OF ITS MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN AND (2) FOR ISSUANCE OF A DECLARATORY ORDER REGARDING THE RECOVERY OF MICROGRID COSTS	:	**DOCKET NO. P-2016-**
APPLICATION FOR CONSTRUCTION OF MICROGRID DISTRIBUTED ENERGY RESOURCES FUELED BY NATURAL GAS	:	**DOCKET NO. A-2016-**

PECO MICROGRID INTEGRATED TECHNOLOGY PILOT

May 18, 2016

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BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

PETITION OF PECO ENERGY COMPANY FOR: (1) APPROVAL OF ITS MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN AND (2) ISSUANCE OF A DECLARATORY ORDER REGARDING THE RECOVERY OF MICROGRID COSTS	:	**DOCKET NO. P-2016-**
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PETITION OF PECO ENERGY COMPANY FOR: (1) APPROVAL OF ITS MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN AND (2) ISSUANCE OF A DECLARATORY ORDER REGARDING THE RECOVERY OF MICROGRID COSTS; AND APPLICATION FOR CONSTRUCTION OF MICROGRID DISTRIBUTED ENERGY RESOURCES FUELED BY NATURAL GAS

PECO Energy Company ("PECO" or the "Company") is filing the above-referenced petition and the related application as the basis for PECO's Microgrid Integrated Technology Pilot ("Microgrid Pilot" or "Pilot") in which PECO will construct, own and operate a community microgrid in its service territory. By this Petition, PECO requests that the Pennsylvania Public Utility Commission (the "Commission") pursuant to Sections 331(f) and 501 of the Public Utility Code ("Code"), 66 Pa.C.S. §§ 331(f) and 501, and Sections 5.41 and 5.42 of the Commission's regulations, 52 Pa. Code §§ 5.41-42, (i) approve PECO's Microgrid Pilot and (ii) issue a declaratory order that PECO may seek to recover the costs of the Pilot that are not recoverable through its electric Distribution System Improvement Charge ("DSIC") in a future distribution base rate case filed under Section 1308 of the Code, 66 Pa.C.S. § 1308. Under the Pilot, PECO is proposing to construct, own and operate several distributed energy resource

(“DER”) technologies to power the proposed microgrid, including natural gas engines. Accordingly, PECO is also submitting this Application for approval to construct microgrid DER fueled by natural gas in accordance with Section 519 of the Public Utility Code, 66 Pa.C.S. § 519.

As more fully explained below, and in the Microgrid Integrated Technology Pilot Plan (the “Plan”) and testimony accompanying this filing, PECO is exploring emerging microgrid technology investment opportunities to enhance system reliability, resiliency and security as envisioned under the Company’s electric Long-Term Infrastructure Improvement Plan (“LTIIP”). After extensive analysis, PECO is proposing to develop and deploy a community microgrid in Concord Township, Pennsylvania (“Concord Township Project” or “Project”) which will be integrated with PECO’s distribution system. The Project will focus on improving the distribution system’s ability to sustain and recover from adverse events (including severe weather) and on providing reliable access to essential services during power outages. The resulting information, in turn, will be shared with the Commission and other stakeholders to facilitate the successful deployment of additional microgrids and DERs in the Commonwealth. Because the Project would be the first community microgrid under the Code, approval of the Plan by the Commission and issuance of a declaratory order that utility-owned DERs, installed as part of a microgrid, constitute public utility distribution plant assets are appropriate and necessary for the Project to proceed.[1]

[1] PECO is not seeking a declaratory order in this proceeding that it is entitled to recover the actual costs of the Microgrid Pilot. Instead, as discussed in Section IV *infra*, in light of the lack of applicable Commission precedent, PECO is seeking a declaratory order to remove any uncertainty regarding its ability to seek recovery of a return on and of its investment in the DER components of the Microgrid Pilot as used and useful distribution plant assets through distribution base rates established in a subsequent Section 1308 base rate case proceeding.

I. INTRODUCTION

1. PECO is a corporation organized and existing under the laws of the Commonwealth of Pennsylvania with its principal office in Philadelphia, Pennsylvania. PECO provides retail electric delivery service to approximately 1.6 million customers and natural gas delivery service to over 500,000 customers in southeastern Pennsylvania. PECO furnishes electric service within its authorized service territory in Bucks, Chester, Delaware, Montgomery and York Counties and the City of Philadelphia. PECO is a "public utility," as defined in 66 Pa.C.S. § 102, and, with respect to its provision of electric service, an "electric distribution company," ("EDC") as defined in 66 Pa.C.S. § 2803.

2. The names and addresses of PECO's attorneys in this matter who are authorized to receive notices and communications on their clients' behalf are:

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3. The United States Department of Energy ("DOE") defines a microgrid as a group of interconnected loads and DERs within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and can connect and disconnect from the grid to enable it to operate in both grid connected or island mode.

4. The Commission has also developed a definition of "microgrid" for its final regulations implementing Pennsylvania's Alternative Energy Portfolio Standards, 73 Pa.C.S. 1648.1 *et seq*. The Commission defines a microgrid to be "[a] system analogous to the term distributed resources (DR) island system, when parts of the electric distribution system have DR and critical infrastructure load in such a combination so as to give the EDC the ability to safely and intentionally disconnect that section of the distribution system from the rest of the distribution system and operate it as an island during emergency situations." 52 Pa. Code § 75.1. The Commission has also explained that, by definition, a microgrid "must be able to island itself from the grid and continue to provide power to the customers and facilities connected to that microgrid."[2]

5. As discussed by Dr. John Caldwell, the Director of Economics for the Edison Electric Institute ("EEI"), in PECO Statement No. 2, microgrids offer a variety of benefits to utility customers, including most significantly, enhanced distribution system resiliency and reliability. With the ability to seamlessly disconnect critical portions of the electric distribution grid and rapidly restore power to them, microgrids can ensure that first responders, medical providers, and other essential services remain up and running during major outages and emergencies.

6. On October 22, 2015, the Commission approved PECO's electric LTIIP to invest an additional $274 million over a five-year period (2016 through 2020) for infrastructure improvements designed to enhance reliability by strengthening and modernizing PECO's electric

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[2] *See* Final Rulemaking Order, *Implementation of the Alternative Energy Portfolio Standards Act of 2004*, Docket No. L-2014-2404361 (Order entered Feb. 11, 2016) ("*AEPS Final Regulations*"), p. 57. The Commission's final regulations are under consideration by the Independent Regulatory Review Commission.

distribution system.[3] In its LTIIP, PECO indicated that it intended to develop one or more microgrid projects in the 2017-2020 period, and the Commission stated that PECO may file a petition for a Major Modification or an amended LTIIP in order to implement a future microgrid.[4]

7. PECO has closely monitored microgrid developments across the nation and the increasing interest of customers in microgrid technologies. In light of these developments and customer interest, PECO believes that a community microgrid pilot project to facilitate the exploration of microgrid technology and best practices for integration of microgrids with electric distribution systems in Pennsylvania communities is timely and appropriate.

8. This Petition summarizes PECO's proposed Plan and, in so doing, describes the benefits to PECO's customers from the proposed Microgrid Pilot, the site selection process, the conceptual design of the Project and implementation plan, preliminary cost estimates, and mechanisms to recover costs incurred by PECO to implement the Plan. The Petition also incorporates the following statements, which are attached hereto:

PECO Statement No. 1 – Testimony of William J. Patterer

Mr. Patterer is PECO's Director of Regulatory Strategy and Revenue Policy. His testimony discusses the objectives and key components of PECO's Microgrid Pilot, including the site selection process, conceptual design, implementation plan and estimated costs, and describes the proposed litigation schedule for these proceedings and public notice.

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3 See Petition of PECO Energy Co. For Approval Of Its Long-Term Infrastructure Improvement Plan And To Establish A Distribution System Improvement Charge For Its Electric Operations, Docket No. P-2015-2471423 (Order entered Oct. 22, 2015) ("LTIIP Order").

4 As explained by Mr. Cohn in PECO Statement No. 3, PECO intends to file an amended electric LTIIP to include Microgrid Pilot property eligible for recovery through PECO's electric DSIC.

PECO Statement No. 2 – Testimony of Dr. John Caldwell

Dr. Caldwell is the Director of Economics for the Edison Electric Institute. Dr. Caldwell describes the growth of microgrids in the United States, the benefits of pilot programs and utility involvement, and the ways in which PECO's Microgrid Pilot will provide important experience, data and other information to support future microgrid deployment.

PECO Statement No. 3 – Testimony of Alan B. Cohn

Mr. Cohn is PECO's Manager of Regulatory Strategy. Mr. Cohn presents PECO's proposed mechanisms to allocate and recover the costs associated with the Microgrid Pilot.

II. PETITION FOR APPROVAL OF PECO'S MICROGRID PILOT

A. Overview Of Microgrid Benefits

9. As previously explained, a microgrid is a group of interconnected loads and DERs, which can operate both in parallel with the larger distribution system and as a self-supplying island. While DERs themselves can provide significant value to the customers that own them, the fundamental purpose of a microgrid is to improve the resiliency and reliability of the local distribution system. Resiliency refers to a utility's ability to maintain or restore service to customers after its facilities have suffered damage from storms or other causes. Reliability is the degree to which power is delivered to customers adequately and securely within accepted frequency and duration standards and in the amount desired. By ensuring continued operation of electric facilities and service following a major storm or other disruptive event, microgrids can deliver levels of resiliency and reliability for customers that cannot be achieved solely through system hardening and other similar investments.

10. Microgrids are undergoing a transformation from a unique solution for remote communities to a grid modernization tool for utilities, cities and other large communities, businesses and institutions. As discussed by Dr. Caldwell, the total generating capacity of all

microgrids either in operation or under development in 2012 was just over 2,000 MW. But, less than three years later, by the second quarter of 2015, this capacity had more than doubled, to 4,600 MW. The worldwide growth trend has been even more significant with microgrid capacity during that same time period growing from just over 3,000 MW to 12,000 MW. Interest in community microgrids designed to improve system reliability and resiliency in specific geographic areas and promote and integrate community participation is particularly strong across the United States.

11. Notably, the involvement of electric utilities in microgrid projects has been significant in recent years: over 50 percent of the 74 microgrid projects currently planned, proposed, or operational in the United States involve utilities as either project leaders or partners. As Dr. Caldwell further explains, utility leadership in the development of microgrids is appropriate and benefits customers by avoiding unnecessary redundancies and duplicative investments in distribution infrastructure. Moreover, projects that might face challenges to implementation can be justified from a broader system perspective when other more comprehensive benefits are taken into account, including improved overall system resiliency and grid technological development.

12. As the Commission is aware, PECO, like other regional EDCs, has experienced a number of significant weather events in recent years, including hurricanes and tropical storms, such as Irene and Sandy, and extreme winter weather, such as Winter Storm Nika. As Mr. Patterer explains in PECO Statement No. 1, severe weather is a leading cause of power outages in PECO's service territory. For example, as a consequence of Hurricane Sandy in 2012, approximately 850,000 PECO customers experienced interruptions of service, some for as many as eight days. More recently, on June 23, 2015, nearly all of the customers located within the

geographic area that will be supported by the Concord Township Project experienced multi-day outages of up to four days due to damage from a strong thunderstorm.

13. In the face of these developments, PECO is taking significant steps under its LTIIP to reinforce and upgrade its electric distribution infrastructure to better withstand extreme weather events. Under the Plan, PECO will evaluate the potential of microgrids to further enhance the capability of PECO's distribution system to withstand and recover from major storms, help ensure that critical government facilities and public accommodations will maintain power during outages, improve overall system reliability, and heighten customer satisfaction.[5]

14. In light of the potential benefits to PECO's customers and the Commonwealth described above, PECO proposes to construct, own and operate a community microgrid site in its service territory to obtain "real world" results through testing and integration of new technologies and microgrid operations architecture at the proposed site. The data and results of the Pilot will be publicly available to the Commission, PECO's customers, and other stakeholders through regular reports filed with the Commission to facilitate the development of future microgrid policy and planning decisions in the Commonwealth. The lessons learned from PECO's Microgrid Pilot will create a roadmap for the deployment of microgrids and integration of DER that maximizes public benefits. PECO's Microgrid Pilot is discussed in greater detail by Mr. Patterer in his direct testimony and is summarized below.

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[5] Locally, PECO is partnering with the Philadelphia Industrial Development Corporation ("PIDC"), Philadelphia's public-private economic development corporation, on its independent campus electric system at The Navy Yard in Philadelphia to coordinate activities regarding capacity expansion, distribution design and smart grid applications. Pursuant to a DOE-sponsored project, a microgrid network controller technology will be tested in a subgrid at The Navy Yard. As part of its Microgrid Pilot, PECO will continue its strategic partnership with PIDC to identify future microgrid investment opportunities and integrate any lessons learned from that project into PECO's Microgrid Pilot. City of Philadelphia representatives have also confirmed their interest in development of an urban, campus-based microgrid project that supports critical operations and large public events through enhanced reliability and resiliency. PECO looks forward to working in good faith with the City of Philadelphia to identify an appropriate location for consideration. Any such additional microgrid will be the subject of a future petition.

B. Major Components Of The Microgrid Pilot And PECO's Site Selection Process

15. As discussed in detail in Section II.B.2 of the Plan, the proposed microgrid will be comprised of six major components: (1) Distribution Infrastructure; (2) the Microgrid Controller; (3) the Communications Network; (4) DERs; (5) Switching, Isolation and Control Equipment; and (6) the Information Technology ("IT") Systems. DERs that can operate in island mode are essential elements of a microgrid to ensure operation of local distribution facilities when those facilities are disconnected from the larger utility distribution system. As explained in the Plan, as part of the Microgrid Pilot, PECO will examine various microgrid research and development issues, including the feasibility of integrating microgrid technology with the distribution system and expanded microgrid capabilities and applications (i.e., integration of customer-owned DER).

16. As described by Mr. Patterer, PECO used a well-designed and carefully-implemented three-step process to select its proposed microgrid pilot site in Concord Township. PECO first conducted a scoping process to identify prospective locations with the opportunity to enhance reliability and resiliency capabilities and support critical government facilities (e.g., fire stations) and public accommodations (e.g., hospitals, schools, gas stations and grocery stores) during major disruptions to PECO's distribution system. Second, PECO retained Quanta Technology LLC ("Quanta"), a highly experienced consulting firm with microgrid expertise, to evaluate the potential for microgrid deployment at four prospective sites identified through PECO's scoping process. Quanta then developed a feasibility analysis, including electrical configuration boundaries and a preliminary analysis of costs and benefits, for each of the four prospective locations. Finally, PECO evaluated Quanta's feasibility analysis and, on the basis of the potential for reliability and resiliency improvements, high population density and

accessibility of critical government facilities and public accommodations, selected Concord Township from among the four finalists as the site for PECO's initial demonstration microgrid.

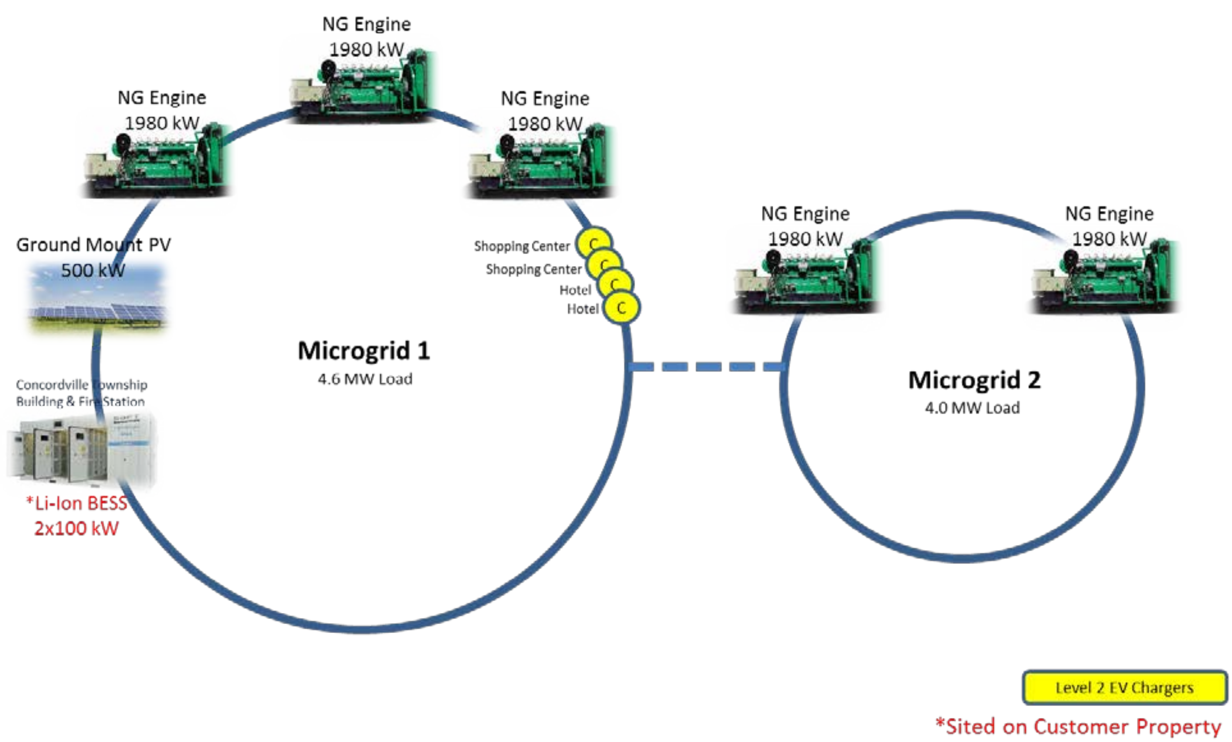
C. Conceptual Design And Benefits Of The Concord Township Project

17. Under the conceptual design developed by Quanta, PECO is proposing two integrated microgrids to support a footprint of approximately 388 acres in a high density area of Concord Township with a variety of essential public service loads, including healthcare, local emergency services, a retirement community, hotels and gas stations to form a microgrid capable of supplying power to three critical government facilities and twenty-seven public accommodations with a typical aggregate peak load of 8.6 MW. The microgrid at the Concord Township Project will contain each of the elements of an integrated microgrid described in Section II.B.2 of the Plan. In addition, the foundation of the microgrid will be PECO's existing distribution infrastructure within the Project's boundaries with upgrades where necessary to support microgrid functionality as described in detail by Mr. Patterer.

18. Under the Plan, PECO proposes to install a microgrid controller to operate the Concord Township microgrids during grid-connected and island modes and during the transition period between those modes. The microgrid controller receives real-time data from distribution equipment, metering equipment and DERs to identify voltage, capacity and load on the microgrid and PECO's distribution system. A key functionality of the microgrid controller is the ability to automatically operate DERs and configure switchgear to maintain or restore energy to the Concord Township Project in the event of power loss or interruption on PECO's system. The microgrid controller connects to PECO's distribution system management platform through communications technology but retains the ability to operate independently without external communications.

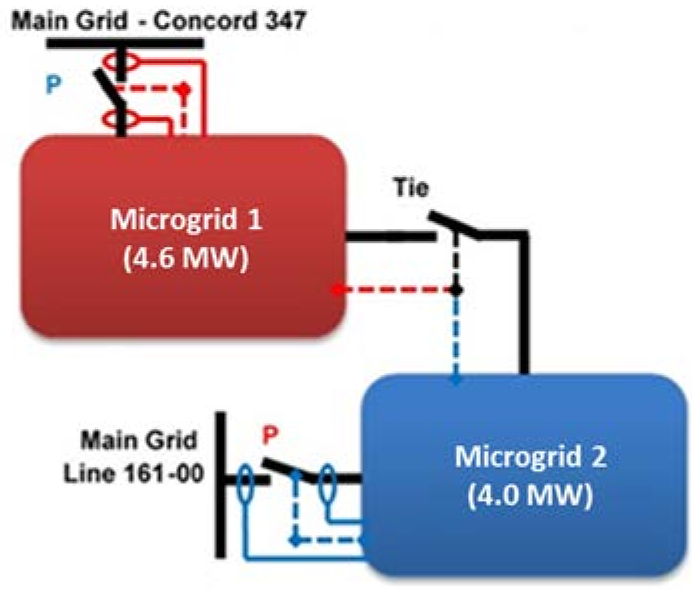
19. The Concord Township Project will be powered by a variety of DER technologies. As shown in Figure 1 below, PECO proposes to initially install and test natural gas reciprocating engines, ground-mounted solar photovoltaic ("PV") installations, two batteries and four dual-port electric vehicle ("EV") charging stations ("Preliminary Base Design").

Figure 1



The use of natural gas reciprocating engines ensures that the microgrid will have sufficient generation to meet typical customer peak load during an outage at all times, with the 500 kW of solar PV and 200 kW of batteries included to investigate the use of intermittent resources and storage in microgrid operation. The batteries will also be available to provide uninterruptible power supply to critical government facilities. Figure 2 illustrates how PECO anticipates that the microgrid will be connected with its local distribution grid (with "P" indicating the points of interconnection):

Figure 2



20. The proposed microgrid will be able to separate from PECO's distribution system in response to external faults and power quality issues. In addition, during a service disruption, the microgrid controller will be able to disconnect the microgrid from the distribution grid and transition from grid-connected to island mode by opening the point of interconnection. When operating in island mode, the Project will be able to provide uninterrupted service to the Concordville fire station and Township building within the Project's boundaries and is expected to restore power within fifteen minutes to other services and customers within the microgrid. As a result, services accessible and relied upon by more than 86,000 Commonwealth residents who live within a five-mile radius of the major traffic routes within the microgrid footprint will be able to continue to operate during severe storms and other widespread power interruptions.

21. In addition to ensuring customers access to essential services during power outages, the Project will provide a marked improvement in reliability within the microgrid footprint in terms of the average power restoration time for interruptions in service (Customer

Average Interruption Duration Index or "CAIDI") and the average length of time customers are without service (System Average Interruption Duration Index or "SAIDI"). Over the past five years, Concord Township has experienced longer than average outage durations (*see* PECO Statement No. 1). As a result of the foundational hardened infrastructure and DER components of the proposed microgrid, PECO projects an approximate 90% improvement in CAIDI and SAIDI (calculated with major storm events included) within the microgrid footprint. As Mr. Patterer explains, microgrid solutions provide greater resiliency than conventional infrastructure improvements to address interruptions caused by faults outside of the microgrid footprint and provide significant value to customers during a major event.

22. The DER in the Preliminary Base Design will be owned and operated by PECO. During Plan implementation, PECO will evaluate options for an upgraded microgrid design with additional DER sited on customer property to meet future load growth and expand microgrid functionality, including rooftop and carport PV facilities, wind turbines, community battery energy storage systems ("BESS") and EV charging stations with faster charging capabilities. As part of this investigation, PECO will explore opportunities for customer and third-party ownership of microgrid DER assets sited on customer property. PECO also expects to test additional control features, which are necessary to ensure that solar PV installations deployed within a microgrid can maintain high-quality power during times of resource intermittency.

D. Implementation Plan

23. PECO proposes to commence initial work on the Microgrid Pilot as soon as practicable after Commission approval of the Plan. This work will include (1) engineering and design studies, including DER interconnection studies and circuit hardening and reconfiguration which will reflect the results of stakeholder collaboration and consensus on enhanced design

features; (2) procurement of the microgrid infrastructure and technology; (3) technology acceptance testing, including a microgrid controller simulation; (4) utilization of a Distributed Energy Resource Management System; and (5) deployment of the Communications Network. PECO anticipates that such initial work will be completed by 2018. PECO will then construct, install, test and commission the Concord Township Project, with operations commencing in 2020.

24. To procure the Microgrid Controller, Communications Network, IT Systems, Switching, Isolation and Control Equipment and DER components of the microgrid, PECO will utilize a structured competitive vendor selection and contracting process which, as described by Mr. Patterer, contemplates one or more requests for proposals ("RFP") to select its microgrid technology, vendors and project developers.

25. PECO will continue to actively solicit interested parties, including statutory advocates, microgrid technology vendors, customers and government entities, to share information and best practices regarding microgrids.

E. Microgrid Operation

26. The Concord Township Project microgrid will operate in one of two modes in response to system conditions. During times of outages and other service disruptions, the microgrid will transition to island mode as described in Section III.C. PECO anticipates that the Concord Township Project will be in island mode for approximately 28 hours per year (in addition to any necessary testing period). At all other times, the Project will be connected to the grid.

27. During island mode, electricity will be provided to customers from the Microgrid Pilot DERs (as well as from customer-sited DERs if those DERs are integrated to operate with the microgrid). The energy delivered to each customer will be recorded by the customer's Advanced Metering Infrastructure retail meter in the same manner as during grid-connected mode, and each customer will continue to be billed by its electric generation supplier ("EGS") for generation delivered during island operation in the same manner as they are billed by their EGS for generation delivered during grid-connected mode. The operation of the microgrid in island mode will not interfere with the relationship between an EGS and its customers, as EGSs will continue to be provided with meter readings of their customers within the microgrid footprint, which reflect their customers' electric usage during island operation. Because the microgrid will not be electrically connected to PJM Interconnection, L.L.C. ("PJM") when operating in island mode, EGSs will not be allocated load serving entity responsibilities at PJM for their customers' load within the microgrid footprint during those periods.

28. During grid-connected mode, the DERs owned by PECO are expected to participate in PJM wholesale markets when it is economic to do so and will not be used to provide default service supply. The net proceeds from any PJM wholesale market transactions involving the DERs will be flowed back to PECO distribution customers.

29. PECO will keep the Commission and stakeholders informed regarding the development and operational performance of the Project through annual reporting. Such annual reports will provide details of the final design, implementation costs and the metrics outlined in Section II.B.10 of the Plan, microgrid controller response time, reliability performance indices (e.g., CAIDI) and the number of hours the microgrid operates in island mode. In addition, three

years after the Project's commercial operation date, PECO will submit a final report which will summarize the key findings from the Microgrid Pilot.

30. Because the Microgrid Pilot will create the first community microgrid in the Commonwealth and provide reliability and resiliency for customers that cannot be achieved solely through system hardening or other similar investments, PECO is requesting that the Commission find that the Pilot is in the public interest.

III. PETITION FOR ISSUANCE OF A DECLARATORY ORDER REGARDING COST RECOVERY

31. The Company estimates the costs to implement the Preliminary Base Design will be approximately $35 million. As described by Mr. Patterer, the Microgrid Pilot costs fall into three categories: (1) one-time development costs; (2) one-time engineering, procurement and construction ("EPC") costs; and (3) annual operation and maintenance ("O&M") expense. PECO proposes to recover these costs from all customers because the Project will provide insight into the future deployment of microgrids and integration of DERs across PECO's service territory, and thereby benefit all PECO customers. PECO estimates the costs of an upgraded microgrid design to be approximately $13 million, which may be reduced through participation of customer or third-party DERs sited on customer property.

32. PECO proposes to recover Plan costs through two different mechanisms. In accordance with its LTIIP, PECO will seek to recover the costs incurred to repair, improve or replace property that is part of the Company's distribution system totaling approximately $15.3 million, along with the Company's other electric LTIIP investments approved by the

Commission in Docket No. P-2015-2471423, through the Company's DSIC.[6] These DSIC-eligible investments are expected to have a minor impact on the DSIC rate (i.e., approximately, 0.17 percent) as shown by an illustrative revenue impact calculation described by Mr. Cohn. Consistent with Section 1358(b)(1) of the Code, the costs that PECO proposes to initially recover through its DSIC would be rolled into base rates in a subsequent base rate case, at which point the DSIC would be reset to zero.

33. PECO proposes to recover the remaining Plan costs of implementing the Preliminary Base Design, totaling approximately $19.6 million and consisting primarily of DERs on PECO property that will power the proposed microgrids and related information technology systems, communications networks and control equipment and annual operating and maintenance expense, in a subsequent electric distribution base rate case. As described in detail by Mr. Cohn, the annual revenue requirement associated with these assets will include four components: (1) a pre-tax return on, and a return of, PECO's net investment in the microgrid that reflects the effect of deferred taxes to account for tax-book timing differences; (2) operating and maintenance expense, including the fuel needed to support DERs during island mode; (3) the flow-through of state income tax benefits; and (4) a credit for the revenues PECO receives from selling the microgrid's energy output into PJM markets. Based on the revenue requirement calculations discussed by Mr. Cohn, the maximum impact on base rates would be, on average, 0.43 percent of total distribution revenue.

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6 As noted above, following the Commission's final Order in this proceeding, PECO will file a petition to amend its LTIIP in Docket No. P-2015-2471423 to include DSIC-eligible microgrid expenditures approved by the Commission in its final Order in this proceeding. PECO will also include such Commission-approved investments in the applicable quarterly updates to the DSIC calculation at such time the associated plant is placed in service.

34. Recovery of these non-DSIC-eligible Microgrid Pilot costs through distribution rates is appropriate because the distribution benefits of the microgrid described by Mr. Patterer and detailed in the Plan cannot be realized without DERs that are able to provide power when the microgrid is in island mode. The primary function of these DERs is to help ensure reliability consistent with other distribution system improvements and not to meet the on-going energy and capacity needs of retail customers within the microgrid footprint. As the Commission itself has found, a microgrid "must be able to island itself from the grid and continue to provide power to the customers and facilities connected to that microgrid";[7] without that generation capability, the "islanding" benefits for customers of a microgrid during outages cannot be obtained.

35. Under the Electricity Generation Customer Choice and Competition Act, 66 Pa.C.S. §§ 2801 et seq. (the "Competition Act"), the Commonwealth unbundled the three traditional functions of electric utilities in Pennsylvania – generation, transmission, and distribution – to allow for greater competition in the electricity generation market and provide cost savings to customers. See *PP&L Industrial Customer Alliance v. Pa. P.U.C.*, 780 A.2d 773, 774 (Pa. Cmwlth. 2001). As the Competition Act itself explained:

> The purpose of this chapter is to modify existing legislation and regulations and to establish standards and procedures in order to create direct access by retail customers to the competitive market for the generation of electricity while maintaining the safety and reliability of the electric system for all parties. Reliable electric service is of the utmost importance to the health, safety and welfare of the citizens of the Commonwealth. Electric industry restructuring should ensure the reliability of the interconnected electric system by maintaining the efficiency of the transmission and distribution system.

66 Pa.C.S. § 2802(12).

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[7] See ¶ 3, supra (citing Final AEPS Regulations, p. 57).

36. The Competition Act defined "Reliability" as follows:

> "Reliability." Includes adequacy and security. As used in this definition, "adequacy" means the provision of sufficient generation, transmission and distribution capacity so as to supply the aggregate electric power and energy requirements of consumers, taking into account scheduled and unscheduled outages of system facilities; and "security" means designing, maintaining and operating a system so that it can handle emergencies safely while continuing to operate.

66 Pa.C.S. § 2803.

37. Notably, the Competition Act did not prohibit EDCs from owning generation or otherwise require them to divest existing generation facilities. *See generally* 66 Pa.C.S. §§ 2802 and 2804. Furthermore, the Competition Act did not repeal or eliminate provisions of the Code that clearly envision the ownership of generation by electric utilities. *See, e.g.*, 66 Pa.C.S. §§ 515 and 519.

38. The Competition Act did, however, provide that "[t]he generation of electricity will no longer be regulated as a public utility function except as otherwise provided for in [Chapter 28 of the Code]. . . .". This provision deprives the Commission of authority to regulate EGS rates, including the ability to compel EGSs to file tariffs or ensure that EGS rates are not unlawfully discriminatory. *See, e.g.*, *Coalition For Affordable Utility Services And Energy Efficiency In Pa.*, *et al. v. Pa. P.U.C.*, 120 A.3d 1087, 1103 (Pa. Cmwlth. 2015).[8]

39. While PECO believes that the inclusion in distribution base rates of the costs of DERs necessary to operate a microgrid is appropriate given the benefits of the Microgrid Pilot for all distribution customers, there is no existing Commission precedent which clearly authorizes such rate treatment. PECO cannot undertake the significant expense of constructing

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[8] A Petition for Allowance of Appeal from the Order of the Commonwealth Court was denied on April 5, 2016. *See* 658 MAL 2015 and 659 MAL 2015.

the Project to enhance reliability and resiliency without certainty that recovery of DER costs in distribution rates is permissible under the Code. Therefore, PECO requests that the Commission issue a declaratory order finding and determining that utility-owned DERs installed as part of a microgrid constitute distribution plant assets that may lawfully be included in a public utility's distribution rate base in a rate case filed under Section 1308 of the Code, 66 Pa.C.S. § 1308, subject to the same review conducted, and approval granted, by the Commission with respect to any other distribution plant asset claimed for inclusion in a public utility's rate base (e.g., whether the plant is "used and useful" and its costs prudently incurred).

40. In requesting the declaratory order described in Paragraph No. 39, PECO emphasizes that the DERs that will be constructed, owned and operated by PECO are narrowly tailored to achieve the Pilot's goals and maintain reliable electric service when customers cannot receive default service supply from PECO or generation supply from their EGSs. Moreover, the Plan contemplates investigating DERs owned and operated by customers and third parties and customers can rely on their DERs in island mode if those DERs are integrated to operate with the microgrid.

41. The Commission has authority, pursuant to 66 Pa.C.S. § 331(f), to issue declaratory orders. Section § 331(f) states that:

> (f) Declaratory orders. — The commission, with like effect as in the case of other orders, and in its sound discretion, may issue a declaratory order to terminate a controversy or remove uncertainty.

42. The Commission's regulations, 52 Pa. Code §5.42, also provide for the issuance of declaratory orders, stating that:

> Petitions for the issuance of a declaratory order to terminate a controversy or remove uncertainty shall state clearly and concisely the controversy or uncertainty which is the subject of the petition,

> shall cite the statutory or other provision involved and shall include a complete statement of the facts and grounds prompting the petition, along with a full disclosure of the interest of the petitioner.

43. Consistent with these requirements and for the reasons set forth herein, PECO requests that the Commission issue a declaratory order making the findings and determinations requested in Paragraph No. 39, *supra*, so that the Pilot may proceed.

IV. APPLICATION FOR CONSTRUCTION OF MICROGRID DISTRIBUTED ENERGY RESOURCES FUELED BY NATURAL GAS

44. Section 519 of the Code requires an electric utility to seek approval of the Commission prior to construction of a generation facility fueled by natural gas. *See* 66 Pa.C.S. § 519. The purpose of Section 519 is to promote coal-fired generation. *See Diamond Energy, Inc. v. Pa. P.U.C.*, 653 A.2d 1360, 1366 (Pa. Cmwlth. 1995). Even though the small generation systems fueled by natural gas that will be used in the Pilot have no relation to possible coal-fired generation, PECO is requesting approval to construct the 10 MW of natural gas reciprocating engines which will be integrated into the Project in order to comply with the express statutory requirements of Section 519.

V. PROCEDURAL SCHEDULE

45. PECO proposes the following schedule for this proceeding:

May 18, 2016	Petition Filing
June 13, 2016	Intervention Deadline
June 16, 2016	Prehearing Conference
August 4, 2016	Other Parties' Direct Testimony Due

August 25, 2016	Rebuttal Testimony Due
September 8, 2016	Surrebuttal Testimony Due
September 12-14, 2016	Oral Rejoinder and Hearings
October 6, 2016	Initial Briefs
October 20, 2016	Reply Briefs
December 8, 2016	Recommended Decision
February 2017	Commission Order

VI. NOTICE

46. In accordance with Section 53.45(g) of the Commission's Regulations, PECO is providing public notice of this filing to its customers in several ways. First, PECO will include an insert in all customer bills over a thirty-day period beginning on June 1, 2016. This bill insert will notify customers of this filing, where they may obtain copies of the filing, and how they may participate in this proceeding by filing complaints with the Commission. In addition, PECO will publish notices containing similar information in all of the major newspapers serving its service territory. Finally, all notices will refer to PECO's website (peco.com/rates) where a copy of the entire filing will be maintained.

47. In addition to the above notices, PECO is serving copies of this filing on the Pennsylvania Office of Consumer Advocate, the Pennsylvania Office of Small Business Advocate, the Commission's Bureau of Investigation and Enforcement, and all parties of record in PECO's electric LTIIP proceeding at Docket No. P-2015-2471423 and PECO's most recent electric base rate case proceeding at Docket No. P-2015-2468981.

48. Finally, PECO respectfully requests that the Commission publish notice of this filing in the *Pennsylvania Bulletin* on May 28, 2016 and further direct interested parties that they

may seek to intervene in this proceeding by filing appropriate petitions on or before June 13, 2016. Should the Commission conclude that further notice of this filing is appropriate, PECO will provide such additional notice as directed by the Commission.

VII. CONCLUSION

Based upon the foregoing, including the attached testimony and exhibits, PECO respectfully requests that the Commission grant this Petition and Application and enter an Order:

(1) Finding that PECO's Microgrid Integrated Technology Pilot is in the public interest and approving the Pilot;

(2) Declaring that utility-owned distributed energy resources installed as part of a microgrid constitute distribution plant assets that may lawfully be included in a public utility's distribution rate base in a rate case filed under Section 1308 of the Code, 66 Pa.C.S. § 1308, subject to the same review conducted, and approval granted, by the Commission with respect to any other distribution plant asset claimed for inclusion in a public utility's rate base; and

(3) Approving the commencement of construction by PECO of electric generating units fueled by natural gas as described herein and in PECO's Microgrid Integrated Technology Pilot Plan pursuant to Section 519 of the Code, 66 Pa.C.S. § 519.

Respectfully submitted,

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Counsel for PECO Energy Company

Dated: May 18, 2016

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

PETITION OF PECO ENERGY COMPANY FOR: (1) APPROVAL OF ITS MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN AND (2) FOR ISSUANCE OF A DECLARATORY ORDER REGARDING THE RECOVERY OF MICROGRID COSTS	:	**DOCKET NO. P-2016-______**
APPLICATION FOR CONSTRUCTION OF MICROGRID DISTRIBUTED ENERGY RESOURCES FUELED BY NATURAL GAS	:	**DOCKET NO. A-2016-______**

VERIFICATION

I, Richard G. Webster, Jr., hereby declare that I am the Vice President, Regulatory Policy and Strategy, PECO Energy Company; that, as such, I am authorized to make this verification on its behalf; that the facts set forth in the foregoing Petition are true and correct to the best of my knowledge, information and belief; and that I make this verification subject to the penalties of 18 Pa.C.S. § 4904 pertaining to false statements to authorities.

Richard G. Webster, Jr.

Date: May 18, 2016

PECO ENERGY COMPANY
STATEMENT NO. 1

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

PETITION OF PECO ENERGY COMPANY FOR:
(1) APPROVAL OF ITS MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN AND (2) ISSUANCE OF A DECLARATORY ORDER REGARDING THE RECOVERY OF MICROGRID COSTS

DOCKET NO. P-2016-

APPLICATION FOR CONSTRUCTION OF MICROGRID DISTRIBUTED ENERGY RESOURCES FUELED BY NATURAL GAS

DOCKET NO. A-2016-

DIRECT TESTIMONY

WITNESS: WILLIAM J. PATTERER

SUBJECT: PECO ENERGY COMPANY'S MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN

DATED: MAY 18, 2016

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DIRECT TESTIMONY
OF
WILLIAM J. PATTERER

I. INTRODUCTION AND PURPOSE OF TESTIMONY

1. Q. Please state your name and business address.

A. My name is William J. Patterer and my business address is 2301 Market Street, Philadelphia, Pennsylvania 19103.

2. Q. By whom are you employed and in what capacity?

A. I am Director of Regulatory Strategy and Revenue Policy for PECO Energy Company ("PECO" or the "Company").

3. Q. Mr. Patterer, what are your current duties and responsibilities as Director of Regulatory Strategy and Revenue Policy?

A. I am responsible for developing policies and strategies for the Company's regulatory initiatives, including electric and gas distribution rate cases before the Pennsylvania Public Utility Commission ("Commission"), transmission rate cases before the Federal Energy Regulatory Commission ("FERC"), electric and gas long-term infrastructure improvement plans and smart meter deployment.

4. Q. Please describe your educational background.

A. I hold a Bachelor of Science in Mechanical Engineering from Villanova University and Masters of Science in Engineering from Catholic University. In addition, I have a Masters of Business Administration in Finance from Villanova University. I have also completed the Basic Rate Design Course offered by New Mexico State

University and the Edison Electric Institute ("EEI") Advanced Rate Course offered by Indiana University.

5. Q. Please describe your professional experience.

A. I have been employed by PECO for over 15 years. I began my career in 1998 in PECO Nuclear serving as a Systems Engineer. I then transferred into the Rates Department as a Senior Rates Engineer where I was responsible for development and implementation of new regulatory strategies and pricing policies, including new rates and demand side initiatives. In 2004, I was promoted to Senior Rates Specialist in the same group with project management responsibility for major regulatory projects, including PECO's filing to obtain regulatory approval of Exelon Corporation's proposed merger with Public Service Enterprise Group, Inc. In 2007, I was promoted to Manager of Regulatory Strategy with responsibility for managing base rate case filings and other major regulatory filings such as default service procurement. In 2012, I was promoted to my current position.

6. Q. Have you previously testified before the Commission?

A. Yes. A listing of the cases in which I have submitted testimony is attached hereto as Exhibit WJP-1.

7. Q. What is the purpose of your testimony?

A. The purpose of my testimony is to describe PECO's plan for a Microgrid Integrated Technology Pilot ("Microgrid Pilot" or "Plan"), which is attached to my testimony as Exhibit WJP-2. My testimony is divided into several parts.

First, I provide a general introduction to microgrid technologies and the associated distribution system benefits, including enhanced reliability and resiliency. Second, I discuss the objectives and key components of PECO's Microgrid Pilot and explain the process by which PECO selected its proposed pilot site in Concord Township, Pennsylvania (the "Concord Township Project" or "Project"). Third, I present the Project's conceptual design and implementation plan for the Microgrid Pilot, including PECO's proposed competitive bidding process to select technology vendors and project developers. Fourth, I describe the estimated costs of PECO's Microgrid Pilot. Finally, I describe PECO's proposed schedule for these proceedings and the public notice of PECO's Microgrid Pilot filing.

8. Q. Please identify the other witnesses providing direct testimony on behalf of PECO in this proceeding.

A. In addition to myself, the following two witnesses are presenting direct testimony on behalf of the Company:

Dr. John Caldwell (PECO Statement No. 2) is the Director of Economics for EEI and an expert in microgrid industry trends and policies. Dr. Caldwell describes the growth of microgrids in the United States, the benefits of pilot programs and utility involvement, and the ways in which PECO's Microgrid Pilot will provide important experience, data and other information to support future microgrid deployment.

Alan B. Cohn (PECO Statement No. 3) is PECO's Manager of Regulatory Strategy. Mr. Cohn presents PECO's proposed mechanisms to allocate and recover the costs associated with the Microgrid Pilot.

9. Q. Have you prepared any exhibits to accompany your testimony?

A. Yes. PECO Exhibits WJP-1 to WJP-5 were prepared at my direction and under my supervision and are described in detail in my testimony.

II. OVERVIEW OF MICROGRID BENEFITS

10. Q. What is a microgrid?

A. The United States Department of Energy defines a microgrid as a group of interconnected loads and distributed energy resources ("DERs") within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and can connect and disconnect from the grid to enable it to operate in both grid connected or island mode. While DERs themselves can provide significant value to the customers that own them, the fundamental purpose of a microgrid is to improve the resiliency and reliability of the local distribution system. With the ability to disconnect critical portions of the electric distribution grid and rapidly restore power to them, microgrids can ensure that first responders, medical providers and other essential services remain up and running during major outages and emergencies.

11. Q. What do you mean by "reliability" and "resiliency"?

A. "Reliability" is the degree to which power is delivered adequately and securely to consumers within accepted interruption frequency and duration standards and in the amount desired. Typically, three major performance indices are used to assess a utility's reliability over a broad range of day-to-day operating conditions: the System Average Interruption Frequency Index ("SAIFI"), the System Average Interruption

Duration Index ("SAIDI") and the Customer Average Interruption Duration Index ("CAIDI").[1]

The term "resiliency" refers to a utility's ability to maintain or restore service to customers after its facilities have suffered damage from storms or other causes. Resiliency measures do not prevent damage but, instead, enable electric facilities to continue operating despite incurring damage and also promote a rapid return to normal operations if storm damage causes service interruptions.

12. Q. Please describe PECO's overall system reliability performance.

A. PECO has demonstrated excellent reliability performance over a broad range of day-to-day operating conditions as measured by the major performance indices I described previously. Pursuant to its electric service regulations at 52 Pa. Code §§ 57.191 – 57.198, the Commission has established performance standards for reliability consisting of a "Benchmark" and a "Standard," with the Benchmark being the more rigorous of the two. As evidenced by its quarterly and annual reports to the Commission, PECO has achieved Benchmark performance in most of the past eleven years. In 2014 (the most recent year for which statewide data are available), PECO ranked second among large electric utilities in Pennsylvania for its twelve-month rolling CAIDI, SAIFI and SAIDI.[2] Moreover, PECO was the only large electric utility in Pennsylvania with reliability performance better than its baseline score prior

[1] SAIFI measures the average frequency of interruptions per total number of customers. It is the number of interruptions divided by the total number of customers served. SAIDI measures the average duration of service interruptions per total number of customers, and equals the minutes interrupted divided by the total number of customers served. CAIDI measures the average duration of service interruptions for affected customers and represents the minutes interrupted divided by the number of customers affected.

[2] Pennsylvania Public Utility Commission, Electric Service Reliability in Pennsylvania 2014 (August 2015), pp. 24-25, available at: http://www.puc.state.pa.us/General/publications_reports/pdf/Electric_Service_Reliability2013.pdf.

to restructuring (i.e., 1994-1998 five-year average of annual system wide metrics) in every quarter in 2014. Finally, as described in Section I of the Plan, in 2015, PECO achieved its best annual CAIDI and SAIDI performance.

13. Q. Why is PECO proposing a Microgrid Pilot given the excellent reliability performance PECO has already achieved?

A. In accordance with the Commission's electric service regulations the major reliability performance metrics do not capture the impact of major events, including severe weather. However, severe weather is a leading cause of power outages in PECO's service territory. As shown in the table below, there have been eleven major weather events[3] that affected PECO's service area over the last ten years (2006-2015), nine of which occurred in the past five years:

Storm	Customers Affected	Longest Customer Outage Duration	CAIDI (minutes)
July 18, 2006 - Wind Rain Lightning Storm	483,131	4d 14h 42m	781
June 10, 2008 - Wind Rain Lightning Storm	195,582	2d 21h 29m	430
February 10, 2010 - Wind Snow Storm	170,643	3d 8h 37m	529
June 24, 2010 - Wind Lightning Storm	326,019	4d 10h 46m	826
August 27, 2011 - Hurricane Irene	508,048	5d 7h 59m	922
October 29, 2011 - Snow/Rain Storm	266,671	3d 19h 9m	639
October 29, 2012 - Hurricane Sandy	842,950	8d 9h 46m	1651
February 5, 2014 - Winter Storm Nika	713,802	6d 11h 50m	1661
July 3, 2014 - Rain Lightning Storm	180,157	2d 12h 47m	379
July 8, 2014 - Rain Lightning Storm	232,078	2d 20h 3m	460
June 23, 2015 - Wind Lightning Storm	345,518	4d 21h 54m	805

PECO, along with the Commission and other utilities, has recognized that the frequency and severity of major storm events have elevated the need for

[3] In general, a major event affects at least ten percent of an electric distribution company's customers, which in PECO's case, establishes a major event threshold at approximately 160,000 customers.

improvements to the distribution system to better withstand extreme weather events and to more quickly recover from storm-related damage. To that end, PECO is investing approximately $124 million under its electric Long-Term Infrastructure Improvement Plan ("LTIIP")[4] in measures focused on aerial storm hardening and recently implemented more aggressive vegetation management practices (e.g., additional mid-cycle trimming) to increase the resiliency of the Company's distribution system.

By ensuring continued operation of critical electric facilities and rapid restoration of service following a major storm or other disruptive event, microgrids can deliver levels of reliability and resiliency for customers that cannot be achieved solely through traditional system hardening and other investments (including back-up generation owned by individual customers which may not meet peak demand requirements during a major outage). Under the Plan, PECO will evaluate the potential of community microgrids to enhance the capability of PECO's distribution system to withstand and recover from major storms, help ensure that critical government facilities and public accommodations can operate during major outages, achieve higher levels of system reliability and heighten customer satisfaction.

14. Q. Please describe the type of microgrid PECO selected for its Plan.

A. PECO considered deployment of two types of microgrids in its service territory to evaluate the potential of microgrid technology to improve the reliability and resiliency of the Company's local distribution system and incorporate DERs.

[4] See Petition of PECO Energy Co. For Approval Of Its Long-Term Infrastructure Improvement Plan And To Establish A Distribution System Improvement Charge For Its Electric Operations, Docket No. P-2015-2471423 (Order entered October 22, 2015) ("LTIIP Order").

Community microgrids are designed to improve system resiliency and reliability in defined geographic areas and to enable the continued provision of critical government services and public accommodations within the community when major events occur. Campus microgrids incorporate the DER of large institutions (such as universities) that are located on single or adjacent parcels of land and may sell excess power into the grid to reduce overall costs. As I will describe, PECO is proposing to employ the community microgrid model to create a microgrid that is integrated with its existing distribution system.

15. Q. Is PECO currently involved in any microgrid projects under development?

A. Yes. PECO is partnering with the Philadelphia Industrial Development Corporation ("PIDC"), Philadelphia's public-private economic development corporation, on its independent campus electric system at The Navy Yard in South Philadelphia to coordinate activities regarding capacity expansion, distribution design and smart grid applications. The Navy Yard system infrastructure is an integral part of the revitalization and redevelopment of the 1,200-acre former naval shipyard and supports 70 customers, including a leading commercial shipbuilder, the 14-building headquarters for a global retailer, several U.S. Navy manufacturing, engineering and research facilities, a large-scale bakery and numerous multi-tenant office buildings. At The Navy Yard, PECO is also collaborating with PIDC, GE Grid Solutions, Lawrence Berkley National Lab and others on the U.S. Department of Energy Microgrid Development and System Design project. This project will test microgrid network controller technology in a subgrid and is expected to provide useful knowledge regarding microgrid control technology and utility system integration including microgrid islanding, synchronization and reconnection, protection, and system resiliency. As part of its Microgrid Pilot, PECO will continue its strategic partnership with PIDC to identify future microgrid investment opportunities at The Navy Yard and integrate the lessons learned from that project into PECO's Microgrid Pilot.

In addition to its work with PIDC, PECO is also collaborating with the City of Philadelphia ("City") on a potential future campus microgrid in the City. As explained in Section III of the Plan, PECO believes that the potential exists to pursue future microgrid deployments in the City to support critical operations and large public events. City representatives have confirmed their interest in development of an urban, campus-based microgrid project that supports critical operations and major public events through enhanced reliability and resiliency. PECO looks forward to working in good faith with the City of Philadelphia to identify an appropriate location for consideration. Any such additional microgrid will be the subject of a future petition.

III. PECO'S MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN AND SITE SELECTION PROCESS

16. Q. Why is PECO seeking approval of the Microgrid Pilot?

A. On October 22, 2015, the Commission approved PECO's electric LTIIP to invest an additional $274 million over a five-year period (2016 through 2020) for infrastructure improvements designed to enhance reliability by strengthening and modernizing PECO's electric distribution system. In its electric LTIIP, PECO indicated that it intended to develop one or more microgrid projects in the 2017-2020 period, and the

Commission stated that PECO may file a petition for a Major Modification or an amended electric LTIIP in order to implement a future microgrid.[5]

PECO has closely monitored the state of microgrid development across the nation and the increasing customer and stakeholder interest in microgrid technologies. In light of these developments, PECO believes that a utility community microgrid pilot project to facilitate the exploration of microgrid technology and best practices for integration of microgrids with electric distribution systems in Pennsylvania communities is timely and appropriate.

17. Q. Please summarize the principal objectives of PECO's Microgrid Plan.

A. PECO proposes to construct, own and operate a microgrid site in its service territory to obtain "real world" results through testing and integration of new technologies and microgrid operations architecture at the proposed site. Thereafter, the microgrid will continue to operate as designed to provide regional reliability and resiliency benefits. As detailed in the Plan, the Microgrid Pilot will generate technical and economic data on the performance and technical specifications for a well-functioning integrated microgrid and its components. The data and results of the Pilot will be publicly available to the Commission, PECO's customers, and other stakeholders through regular reports filed with the Commission to facilitate the development of future microgrid policy and planning decisions in the Commonwealth.

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[5] LTIIP Order, p. 8. As explained by Mr. Cohn, PECO intends to file an amended LTIIP to include the Microgrid Pilot property that is eligible for recovery through PECO's distribution system improvement charge ("DSIC"). The remaining costs will be recovered as described further by Mr. Cohn in his testimony.

18. Q. What are the major components of the integrated microgrid system proposed by PECO's Plan?

A. As described in Section II.B.2 of the Plan, the major components of the Project fall into six categories: (1) Distribution Infrastructure; (2) the Microgrid Controller; (3) the Communications Network; (4) DERs; (5) Switching, Isolation and Control Equipment; and (6) the Information Technology ("IT") Systems. Under the Plan, PECO will also explore deployment of electric vehicle ("EV") charging stations, smart street lighting and upgrades to traffic lighting within the microgrid footprint.

Distribution Infrastructure

The existing **Distribution Infrastructure** within the microgrid footprint will be upgraded in several respects to enable microgrid functionality, including additional automated switchgear to rapidly restore power to groups of customers on the Concord Township system. PECO will also employ hardening measures, including deploying new technology, upgrading equipment and constructing protective barriers, to retrofit existing distribution facilities to make them less susceptible to the impact of extreme weather conditions.

The Microgrid Controller

The **Microgrid Controller** serves as the brain of the microgrid. It is responsible for real-time monitoring, tracking and forecasting of voltage, capacity and load throughout the microgrid and with PECO's distribution system.

The Communications Network

The **Communications Network** is comprised of: (1) fiber optics to enable fast switching and load balancing to operate the microgrid; and (2) additional communications solutions to integrate existing grid communications systems (e.g., the Company's Distribution Management System ("DMS")) and enable real-time control of portions of PECO's distribution network within the microgrid footprint.

DERs

DERs are the grid-connected devices, which generate or store energy used to power the microgrid. Initial generation DERs for the Pilot are expected to include natural gas reciprocating engines and solar photovoltaic facilities. Storage DERs are expected to include batteries to maintain service for individual customers during a power interruption until local microgrid DERs are able to provide service to those customers.

Switching, Isolation and Control Equipment

Switching, Isolation and Control Equipment are the physical devices within key points of the microgrid that will be used for real-time monitoring, disconnection and reconnection of electric loads.

Microgrid IT Systems

A **Distribution Energy Resource Management System ("DERMS")** is a layered software tool that integrates with traditional utility systems such as the DMS and Supervisory Control and Data Acquisition ("SCADA") systems and coordinates the dispatch of DERs that power the microgrid. Key DERMS functionalities include load forecasting and optimization of DER, bulk renewable DER integration, and data analytics.

19. Q. Can PECO deploy a microgrid without generation?

A. No. A microgrid must have generation facilities that can operate in island mode to ensure operation of local distribution facilities when those facilities are disconnected from the larger utility distribution system. Batteries can also play an important role in providing power to the microgrid, but battery technology remains comparatively expensive and its ability to continuously meet customer load requirements during an extended outage is an area that requires further investigation. As explained in the Plan, PECO anticipates integrating some battery storage in the Pilot to examine these issues.

20. Q. How will PECO test the components of the Microgrid Pilot?

A. The underlying technologies (Microgrid Controller, Communications Network, DERs, etc.) first will be tested to ensure they can be successfully integrated with PECO's existing distribution system and that they exhibit appropriate performance characteristics. Following such acceptance testing, data will be collected to field-prove the capabilities of current technologies outlined in Section II.B.6 of the Plan, including the ability of the microgrid to "island" and resynchronize with the distribution grid, and the operation of uninterruptible power supplies for critical emergency service centers and high speed bidirectional data communications regarding outages and service restoration. The results of such testing will help identify fundamental performance requirements and needed but unmet capabilities. As described in Section II.B.10 of the Plan, PECO will be providing annual reports to the Commission regarding the microgrid design and operational performance of the Project. In addition, three years after the Project's commercial operation date, PECO will submit a final comprehensive report summarizing the key findings from the Microgrid Pilot.

21. Q. Please summarize PECO's process to select its proposed microgrid pilot site in Concord Township.

A. PECO engaged in a careful and thorough three-stage process to evaluate and select the proposed pilot microgrid site. Of particular importance was the opportunity to enhance reliability and resiliency capabilities and support critical government facilities and public accommodations during major disruptions to PECO's distribution system. First, the Company gathered customer data and identified prospective areas in its service territory that could benefit from a microgrid. This initial scoping process considered the mix of services, accessibility and size of population within a prospective location, with a focus on population and commercial centers near critical government facilities (e.g., fire stations) and public accommodations (e.g., hospitals, schools, gas stations and grocery stores). PECO also reviewed the current reliability performance of the Company's system at each prospective location. PECO's scoping process resulted in a short-list of four potential candidates for microgrid sites.

22. Q. Please describe the Company's analysis of system performance.

A. PECO analyzed five years' worth of historical outage records in order to determine the potential reliability benefit of implementing a microgrid. PECO performed focused analysis on all circuits that could be contained in the microgrid footprint. For each circuit, the reliability performance was evaluated by examining all historical outage events that have affected the circuit in the past five years, including outage events during storms. The average outage duration was calculated for each circuit on a per customer basis. All circuits that could be contained in the microgrid footprint were analyzed collectively to establish an overall improvement in the duration of future interruptions likely seen by customers to be contained in the microgrid footprint.

23. Q. What was the second step in PECO's site selection process after scoping narrowed the prospective locations?

A. PECO retained Quanta Technology LLC ("Quanta"), a highly experienced consulting firm with microgrid expertise, to evaluate the potential for microgrid deployment and evaluate the four prospective sites identified through PECO's scoping process. Quanta then developed a feasibility analysis, including electrical configuration boundaries and a preliminary cost-benefit analysis, for each of the four prospective locations.

24. Q. Explain the final step in PECO's site selection process.

A. Following the review of Quanta's feasibility analysis, PECO assessed each of the four potential sites based on numerous factors, including reliability and resiliency benefits, population density, public purpose benefit, accessibility and cost. After evaluating these potential sites, PECO ultimately selected the Concord Township site because it scored particularly well in terms of the potential for reliability and resiliency improvements and proximity to critical government facilities and public accommodations.

IV. MICROGRID PILOT CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN

25. Q. How did PECO develop a conceptual design for the Microgrid Pilot?

A. Once the Concord Township site had been prioritized, PECO requested Quanta to assist with technology selection and conceptual design of a microgrid for that location. Quanta's preliminary design for the Project included recommendations regarding: (1) the DER mix and operating capability; (2) opportunities to provide demand response and peak shaving capabilities to microgrid customers; (3) the microgrid control and communications systems; (4) the scope of reconfiguration of the Company's existing distribution system; and (5) a sectionalizing and load management strategy that addresses the transition between operating modes.

26. Q. Please describe the footprint of the proposed Concord Township microgrid pilot project and PECO's electric distribution system currently serving that area.

A. Under the conceptual design developed with Quanta, two integrated microgrids will be constructed to support a high density geographic area of approximately 388 acres in Concord Township with a variety of essential public service loads, including healthcare, local emergency services, a retirement community, hotels, and gas stations, to form a microgrid capable of supplying power to three critical government facilities and twenty-seven public accommodations with a typical aggregate peak load of 8.6 MW. These microgrids can operate separately or jointly during both parallel and island modes as described in the Plan.

In the past five years, Concord Township has experienced longer than average outage durations because it is served primarily by aerial distribution facilities that are exposed to weather, vegetation and other environmental factors. For example, on June 23, 2015, 91 percent of customers located within PECO's proposed microgrid footprint experienced multi-day outages, for up to four days, due to severe thunderstorms and high winds which severed trees and tree limbs and caused extensive damage to PECO's distribution system. The table below compares all-in five-year (2011-2015) average reliability indices for customers within the Concord Township Project footprint before and after deployment of the microgrid.[6]

	CAIDI	SAIFI	SAIDI
Concord Township Five-Year Average (2011-2015)	905	0.42	380
Concord Township Five-Year Average (2011-2015) – Adjusted for Microgrid	96	0.38	36

Most of the interruptions affecting Concord Township customers in the last five years were caused by faults outside of the proposed microgrid footprint. These faults involved the operation of a circuit breaker or recloser to isolate the fault, protect the adjacent circuit sections from experiencing additional fault currents and allow distribution automation schemes to restore power to undamaged sections of the circuit.

27. Q. Please provide an overview of the regional benefits that the Concord Township Project is expected to produce.

A. The paramount benefits of the Project in Concord Township will be a reliable source of power for critical government facilities and public accommodations serving customers within the region surrounding Concord Township. According to the 2014 Pennsylvania Department of Transportation annual report, the major arteries leading

[6] PECO's "all-in" reliability indices include major events described earlier in my testimony, which are excluded under the Commission's calculations of SAIFI, SAIDI, and CAIDI.

into the microgrid footprint (i.e., Route 202 and Route 1) comprise the busiest non-interstate traffic corridor in Delaware County with, on average, more than 40,000 vehicles traveling along these routes daily. When operating in island mode during a service disruption, the DERs and battery technologies incorporated in the Project will provide uninterruptible service to the Concordville fire department and Township building and will rapidly restore power to public accommodations (e.g., grocery stores and gas stations) within the Project's boundaries, which can then be accessed, via Route 202 and Route 1, by more than 86,000 Commonwealth residents who live within a five-mile radius of those traffic routes.

The Concord Township Project will also benefit the customers within its footprint through a marked improvement in reliability by reducing the average duration of outages for those customers by approximately 90 percent. In particular, PECO projects an improvement in "all-in" CAIDI from 905 minutes to 96 minutes and a similar improvement in SAIDI from 380 minutes to 36 minutes. Additionally, the average time to restore service to customers within the microgrid's boundaries during a sustained outage is expected to decrease to within fifteen minutes as a result of islanding functionality.

28. Q. What is the proposed structure of the Concord Township Project?

A. The microgrid at the Concord Township Project will contain each of the elements of an integrated microgrid described earlier in my testimony. In addition, the foundation of the microgrid will be PECO's existing distribution infrastructure within the Project's boundaries. The Concord Township microgrid footprint, which currently has a typical summer peak load of approximately 8.6 MW, is supplied by 5 feeders delivering 34 kV from 4 feeders with the remaining feeder delivering 4 kV collectively sourced from one substation. As part of construction of the Concord Township Project, PECO plans to upgrade these distribution facilities where necessary to support microgrid functionality and improve the resiliency of the local distribution grid.

29. Q. What kinds of distribution system improvements will be made to implement microgrid functionality?

A. PECO plans to harden the Concord Township Project system and increase its resiliency through three principal measures. The first measure involves replacing existing overhead conductors of bare open-wire construction with more durable overhead cable that increases resistance to falling trees, branches and other vegetation (i.e., spacer cable). Second, PECO will utilize automated switchgear to rapidly restore power to groups of customers on the Concord Township Project system and make circuits more resilient. Third, PECO will install new infrastructure with automated fault location and isolation capabilities or upgrade existing distribution system equipment to provide islanding and load restoration functions.

30. Q. How will the reliability-related benefits of the Concord Township Project be produced?

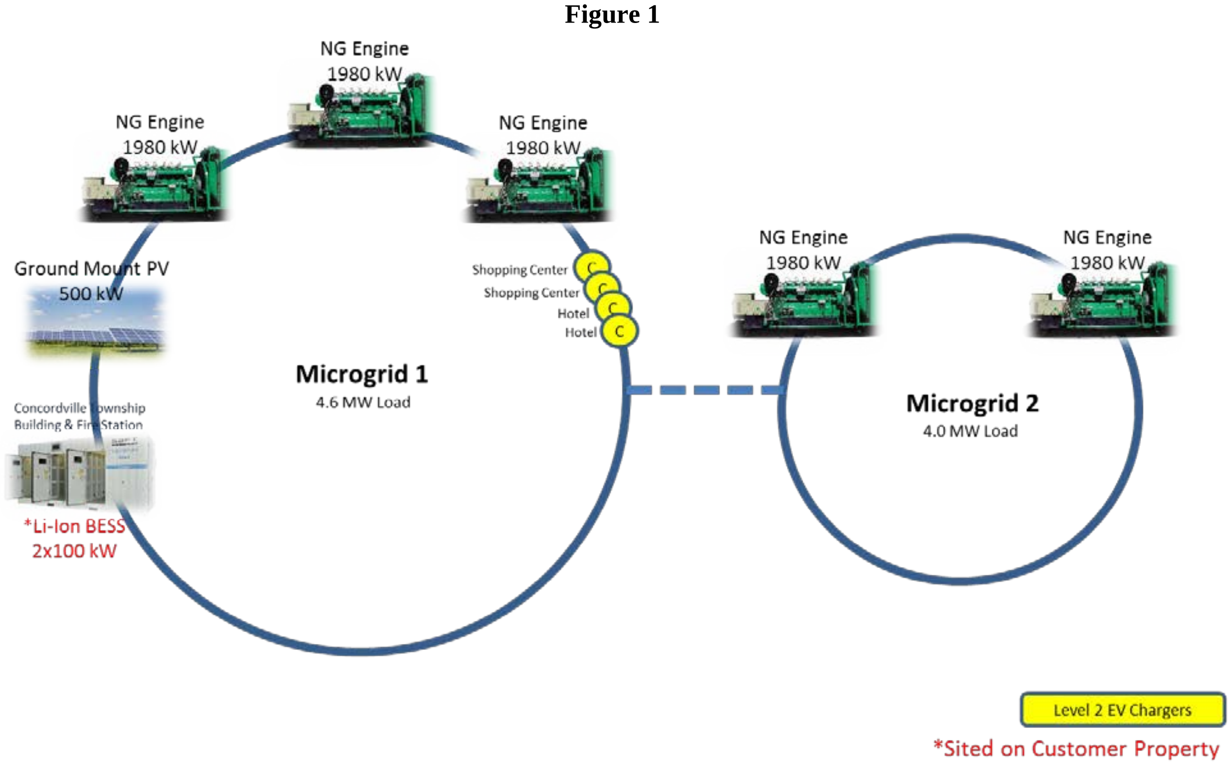
A. The estimated improvement in CAIDI and SAIDI metrics for customers within the Concord Township Project footprint is driven, in large part, by two components of the microgrid. First, the foundational hardened infrastructure and islanding capabilities of the microgrid decreases the likelihood of system faults caused by falling trees and branches and distribution automation improves the efficiency of outage management.

Second, the DER component of the microgrid provides an alternative power source when the main utility grid is unavailable. Microgrid solutions provide greater resiliency than conventional infrastructure improvements to address interruptions caused by faults outside of the microgrid footprint and provide significant value to customers during a catastrophic event.

31. Q. Please describe the proposed configuration of the Concord Township Project's DERs under the Plan's preliminary design.

A. The Concord Township Project will be powered by a variety of DER technologies. As shown on Figure 1 below, PECO proposes to initially install and test natural gas reciprocating engines, ground-mounted solar photovoltaic ("PV") installations, two batteries and four dual-port EV charging stations (the "Preliminary Base Design").

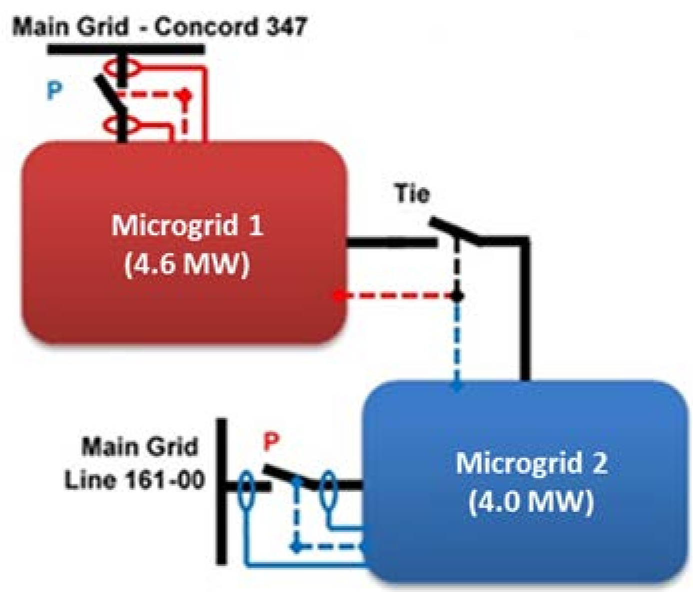
Figure 1



The use of natural gas reciprocating engines ensures that the microgrid will have sufficient generation to meet typical customer peak load during an outage at all times, with the 500 kW of solar PV and 200 kW of batteries included to investigate the use of intermittent resources and storage in microgrid operation. The batteries will also be available to provide uninterruptible power supply to critical government facilities.

Figure 2 illustrates how PECO anticipates that the microgrid will be connected with its local distribution grid (with "P" indicating the points of interconnection):

Figure 2



32. Q. How will PECO control the Concord Township Project?

A. A microgrid controller will be installed on-site to operate the Concord Township microgrids during parallel and island modes and during the transition period between those modes. The microgrid controller receives real-time data from distribution equipment, metering equipment and DER to identify voltage, capacity and load on the microgrid and PECO's distribution system. A key functionality of the microgrid controller is the ability to automatically operate DER and configure switchgear to maintain or restore energy to the Concord Township Project in the event of power loss or interruption on PECO's system. The microgrid controller connects to PECO's distribution system management platform through communications technology but retains the ability to operate independently without external communications.

33. Q. Please describe the Project's operating capabilities.

A. The Concord Township Project microgrid will operate in one of two modes in response to system conditions. During times of outages and other service disruptions, the microgrid will transition to island mode. During island mode, the microgrid will be able to separate from PECO's distribution system in response to external faults and power quality issues. During a service disruption, the microgrid controller will be able to disconnect the microgrid from the distribution grid and transition from grid-connected to island mode by opening the point of interconnection. When operating in island mode, the microgrid DERs will be able to provide uninterrupted service to the local fire department and township building within the Project's boundaries and is expected to restore power within fifteen minutes to other services and customers within the microgrid. PECO anticipates that the Project will be in island mode for approximately 28 hours per year (in addition to any necessary testing period). At all other times, the Project will be connected to the grid.

34. Q. Will the DER installed as part of the Concord Township Project be used to provide default service supply to customers?

A. No. The DERs installed by PECO as part of the microgrid and interconnected to PECO's distribution system are expected to participate in the wholesale energy markets operated by PJM Interconnection, L.L.C. ("PJM") in accordance with PJM's tariffs but will not be used for default service supply. Any net wholesale market revenues will be used to offset the costs of the project. When the microgrid is in island mode and not connected to PECO's distribution system as a result of an outage, the DERs will operate to provide power to customers only within the microgrid for the duration of the interruption when customers would not otherwise be able to receive generation service from PECO (as the default service provider) or from their electric generation suppliers ("EGSs").

35. Q. Please describe the Company's proposed billing procedures when the Project is operating in island mode.

A. During island mode, electricity will be provided to customers from the Microgrid Pilot DERs (as well as from customer-sited DERs if those DERs were integrated to operate with the microgrid). The energy delivered to each customer will be recorded by the customer's Advanced Metering Infrastructure retail meter in the same manner as during grid-connected mode, and each customer will continue to be billed by their EGS for generation delivered during island operation in the same manner as the customer is billed by its EGS for generation delivered during grid-connected mode. The operation of the microgrid in island mode will not interfere with the relationship between an EGS and its customers, as EGSs will continue to be provided with meter readings of their customers within the microgrid footprint, which reflect their customers' electric usage during island operation. During island mode, because the microgrid will not be electrically connected to PJM, EGSs will not be allocated load serving entity responsibilities at PJM for their customers' load within the microgrid footprint. The fuel needed to support DERs during island mode will be recovered in the manner described by Mr. Cohn in PECO Statement No. 3.

36. Q. Please provide an overview of PECO's implementation strategy for the Microgrid Pilot.

A. The Microgrid Pilot will commence as soon as practicable after Commission approval of the Plan. The initial work will include: (1) engineering and design studies, including DER interconnection studies and circuit hardening and reconfiguration; (2) procurement of the microgrid infrastructure and technology; (3) technology acceptance testing, including a microgrid controller simulation; (4) utilization of a DERMS; and (5) deployment of the Communications Network, all of which should be complete by 2018. PECO will then construct, install, test and commission the Concord Township Project, which is expected to be completed in 2020.

37. Q. How does PECO intend to procure the Microgrid Controller, Communications Network, IT Systems and Switching, Isolation and Control Equipment components of the Microgrid Pilot?

A. PECO will conduct a structured competitive vendor selection and contracting process, which contemplates one or more requests for proposals ("RFP") to select its microgrid technology and vendors. The process will include vendor qualification criteria (e.g., creditworthiness), technology performance requirements, vendor interviews and demonstration sessions, and appropriate scoring criteria to select bidders for contract negotiations.

38. Q. How does PECO intend to procure the DER component of the Microgrid Pilot?

A. The Company will also issue an RFP for project developers interested in permitting, engineering, procuring, and constructing a DER facility included in the Microgrid Pilot. Bids will be evaluated based on a variety of factors, including pricing, conformance to performance specifications, and project team experience. A short list of qualifying bidders will be selected and additional information may be requested prior to contract negotiations.

39. Q. Why is PECO proposing to own the DERs in the Pilot?

A. PECO ownership of competitively-procured DERs in the Pilot is appropriate for several reasons. As I have explained, the primary function of the microgrid DERs is to enhance reliability and resiliency of PECO's distribution system, not to provide generation service to customers. PECO's ownership of microgrid DERs in the Preliminary Base Design, which will all be located at PECO substations on PECO property (with the exception of batteries located at the Concord Township buildings for operational reasons), is consistent with PECO's ownership of other distribution-related equipment. From a technical perspective, PECO anticipates that the design, implementation and initial operation of the microgrid and the integration of the microgrid components with PECO's existing distribution system is likely to raise a variety of novel issues during the Pilot, and its ownership of the DERs will facilitate cost-effective resolution of those issues, while also ensuring that PECO meets its continuing obligations of providing safe and reliable electric service within the microgrid area.

40. Q. Does PECO expect to integrate customer DERs and DERs owned by third parties in the Pilot?

A. Yes. During Plan implementation, PECO will explore opportunities for an upgraded microgrid design with additional DER sited on customer property to meet future load growth and expanded microgrid functionality, including rooftop and carport PV facilities, wind turbines, community battery energy storage systems ("BESS") and EV charging stations with faster charging capabilities. As part of this investigation, PECO will explore opportunities for customer and third-party ownership of microgrid DER assets (located on customer property). The Company also expects to test additional control features which are necessary to ensure that solar PV installations deployed within a microgrid can maintain high-quality power during times of resource intermittency.

41. Q. Will stakeholders have an opportunity to provide input regarding PECO's Plan and its implementation?

A. Yes. PECO will continue to actively solicit interested parties, including statutory advocates, microgrid technology vendors, customers and government entities, to share information and best practices regarding microgrids. Notably, Concord Township and a number of commercial customers within the microgrid footprint, including Wawa, Staples and Maris Grove, all support the Project. *See* Exhibit WJP-3. In addition, the City supports the urban, campus-based microgrid pilot project envisioned under the Plan. *See* Exhibit WJP-4.

V. COSTS OF PECO'S MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN

42. Q. Did Quanta estimate the costs to implement the Microgrid Pilot?

A. Yes. As part of its feasibility analysis, Quanta prepared a preliminary cost estimate based on its recommended conceptual design for the Concord Township project described earlier in my testimony. As shown on Exhibit WJP-5, using Quanta's analysis, the Company estimates the costs to implement the Preliminary Base Design is approximately $35 million. PECO estimates the costs of an upgraded microgrid design to be approximately $13 million, which may be reduced through participation of customer or third-party DERs sited on customer property. These costs are preliminary, and it is the actual costs based on the final design of the Project that will be recovered in the manner described by Mr. Cohn in PECO Statement No. 3.

43. Q. How did Quanta estimate these costs?

A. Quanta based its estimates on its experience and information from several sources, including (i) PECO-provided costs for circuit reconfiguration; (ii) distributor quotes for additional distribution system components; and (iii) pricing for similar equipment obtained by Quanta and scaled for the size of the Pilot. A contingency cost was then added based on Quanta's level of confidence in the estimates.

44. Q. What types of costs does PECO expect to incur as a result of its proposed Plan?

A. The Company will incur three broad categories of costs associated with the Project: (1) one-time development costs; (2) one-time engineering, procurement and construction ("EPC") costs; and (3) annual operation and maintenance ("O&M") expense.

Development costs include costs associated with permits, land agreements, purchase agreements, training, and financing.

For the microgrid's distribution infrastructure, EPC costs encompass capital expenditures for circuit reconfiguration, controllers and load centers, medium voltage switchgear, transformers, support equipment and accessories, and EV charging stations. DER EPC costs are comprised of capital expenditures in the DER facilities that will power the microgrid. Both the distribution- and DER-related EPC costs include an allocated portion of engineering and project management costs, civil works, installation and commissioning costs, investments in communications systems, interconnection costs, cost contingencies and indirect costs ("Common EPC Costs"). The Common EPC Costs were allocated in proportion to the Company's direct investments in distribution and DER assets to deploy the microgrid.

Annual O&M expense includes operations, fuel costs, service and maintenance of all equipment, spares, lease agreements, taxes, and general and administrative expense.

45. Q. What are cost contingencies?

A. When estimating the cost of the Microgrid Pilot, like any other major capital project, PECO included a 30 percent cost contingency to address risk associated with the uncertainty as to the precise content of all items in the estimate, how work will be performed and what work conditions will be presented when the Plan is implemented. PECO added the contingency amount to its estimate of Common EPC Costs to allow for items outside the scope of Quanta's cost estimate (e.g., a DERMS and the communications infrastructure), unanticipated market conditions, scheduling delays and other uncertain items, conditions or events that experience shows will likely result in additional costs.

46. Q. What are indirect costs?

A. Indirect costs are costs for activities or services that benefit more than one project. Such indirect costs include costs associated with back office functions (e.g., project management, accounting and human resources), Allowed Funds for Use During Construction, and capitalized administrative costs.

VI. PROCEDURAL SCHEDULE AND NOTICE

47. Q. Please describe the procedural schedule PECO is proposing for this proceeding.

A. PECO proposes the following schedule for this proceeding:

May 18, 2016	Petition Filing
June 13, 2016	Intervention Deadline
June 16, 2016	Prehearing Conference
August 4, 2016	Other Parties’ Direct Testimony Due
August 25, 2016	Rebuttal Testimony Due
September 8, 2016	Surrebuttal Testimony Due
September 12-14, 2016	Oral Rejoinder and Hearings
October 6, 2016	Initial Briefs
October 20, 2016	Reply Briefs
December 8, 2016	Recommended Decision
February 2017	Commission Order

48. Q. How will PECO provide public notice of this filing?

A. PECO is providing extensive public notice of this filing to its customers. First, PECO will include an insert in all customer bills over a thirty-day period beginning on June 1, 2016. This bill insert will notify customers of this filing, where they may obtain copies of the filing, and how they may participate in this proceeding by filing complaints with the Commission. In addition, PECO will publish notices containing similar information in all of the major newspapers serving its service territory. Finally, all notices will refer to PECO's website (peco.com/rates) where a copy of the entire filing will be maintained. PECO is also serving copies of this filing on the Pennsylvania Office of Consumer Advocate, the Pennsylvania Office of Small Business Advocate, the Commission's Bureau of Investigation and Enforcement and parties of record in PECO's electric LTIIP proceeding at Docket No. P-2015-2471423 and PECO's most recent base rate case proceeding at Docket No. P-2015-2468981 and requesting that the Commission publish notice of this filing in the *Pennsylvania Bulletin*.

VII. CONCLUSION

49. Q. Does this conclude your direct testimony?

A. Yes.

Listing of Prior Case Testimony

Pennsylvania

Docket No. P-2008-2062739 – *Petition of PECO Energy for Approval of Its Default Service Program and Rate Mitigation Plan*

Docket No. M-2009-2123944 – *Petition of PECO Energy Company for Approval of its Initial Dynamic Pricing and Customer Acceptance Plan*

Docket No. M-00021689 – *Demand Side Response Working Group*

Docket No. R-00016938 – *PECO Energy Company Wind Service Energy Rider*

Docket No. A-110550F0160 – *Joint Application of PECO Energy Company and Public Service Electric and Gas Company for Approval of the Merger of Public Service Enterprise Group, Inc. with and into Exelon Corporation*

PECO ENERGY COMPANY'S

MICROGRID INTEGRATED

TECHNOLOGY PILOT PLAN

May 18, 2016

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I. EXECUTIVE SUMMARY

On October 22, 2015, the Pennsylvania Public Utility Commission ("Commission" or the "PUC") approved the *Petition of PECO Energy Company for Approval of its Electric Long Term Infrastructure Improvement Plan and to Establish a Distribution System Improvement Charge for its Electric Operations* at Docket No. P-2015-2471423.[1] PECO Energy Company's ("PECO's" or the "Company's") Electric Long Term Infrastructure Improvement Plan ("LTIIP")[2] is designed to increase projected capital investments by $274 million (between 2016 and 2020) on, among other things, infrastructure improvements related to storm hardening and resiliency. In its electric LTIIP, PECO indicated that it intended to develop one or more microgrid projects in the 2017-2020 period, and the Commission stated that PECO may file a petition for a Major Modification or an amended LTIIP in order to implement a future microgrid.

In recent years, PECO's reliability performance has been materially better than the Commission's reliability benchmarks for the System Average Interruption Frequency Index ("SAIFI"), the System Average Interruption Duration Index ("SAIDI") and the Customer Average Interruption Duration Index ("CAIDI")[3] as shown in the following charts. PECO's

[1] *See* Petition of PECO Energy Company for Approval of its Long Term Infrastructure Improvement Plan and to Establish a Distribution System Improvement Charge for its Electric Operations, Docket No. P-2015-2471423 (Opinion and Order entered on October 22, 2015).

[2] On February 14, 2012, former Governor Corbett signed into law Act 11 of 2012 ("Act 11"). Act 11 amended the Public Utility Code in several respects, including the addition of Subchapter B (66 Pa. C.S. §§ 1350-1360), which authorizes the Commission to approve a Distribution System Improvement Charge ("DSIC") upon petition by an electric distribution company ("EDC"), a natural gas distribution company, a water utility or a wastewater utility. In addition, Subpart B sets forth various requirements that must be satisfied by a qualifying utility in order to establish a DSIC and to recover the reasonable and prudent costs to repair, improve or replace eligible property.

[3] SAIFI measures the average frequency of interruptions per total number of customers. It is the number of interruptions divided by the total number of customers served. SAIDI measures the average duration of service interruptions per total number of customers. It is the minutes interrupted divided by total number of customers served. CAIDI measures the average duration of service interruptions for affected customers. It represents the minutes interrupted divided by the number of customers affected.

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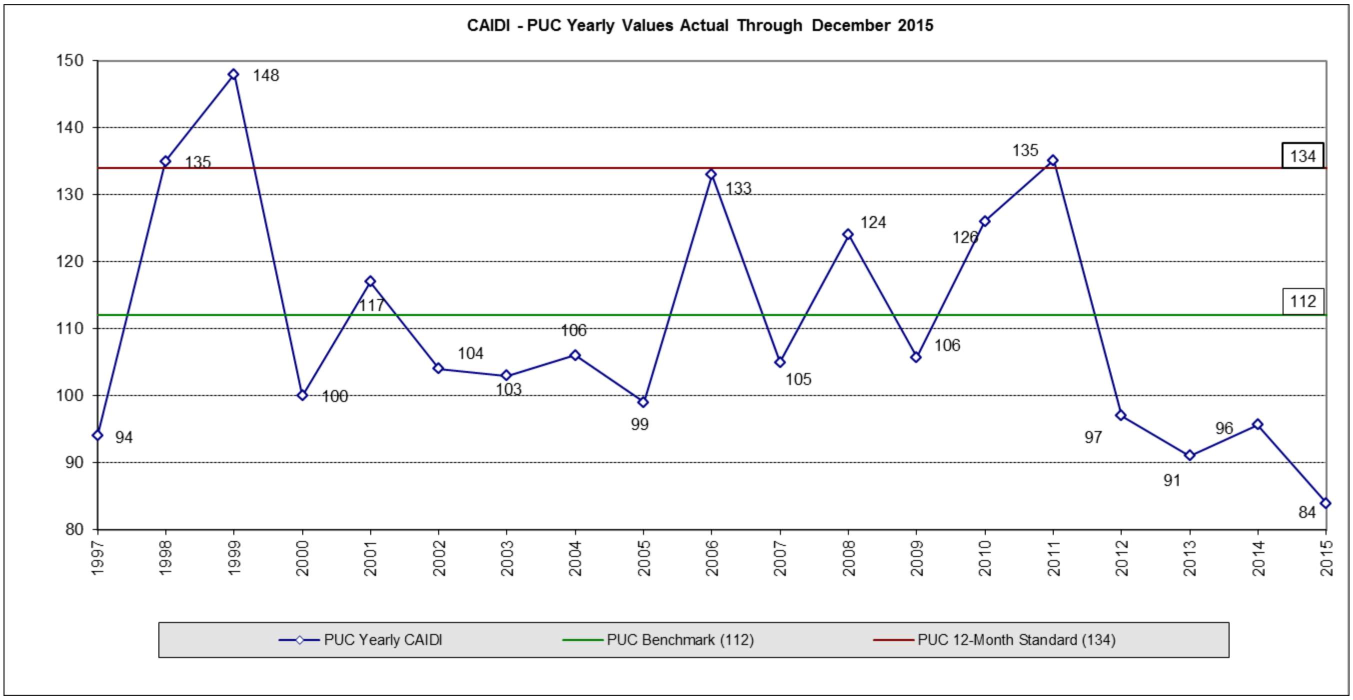
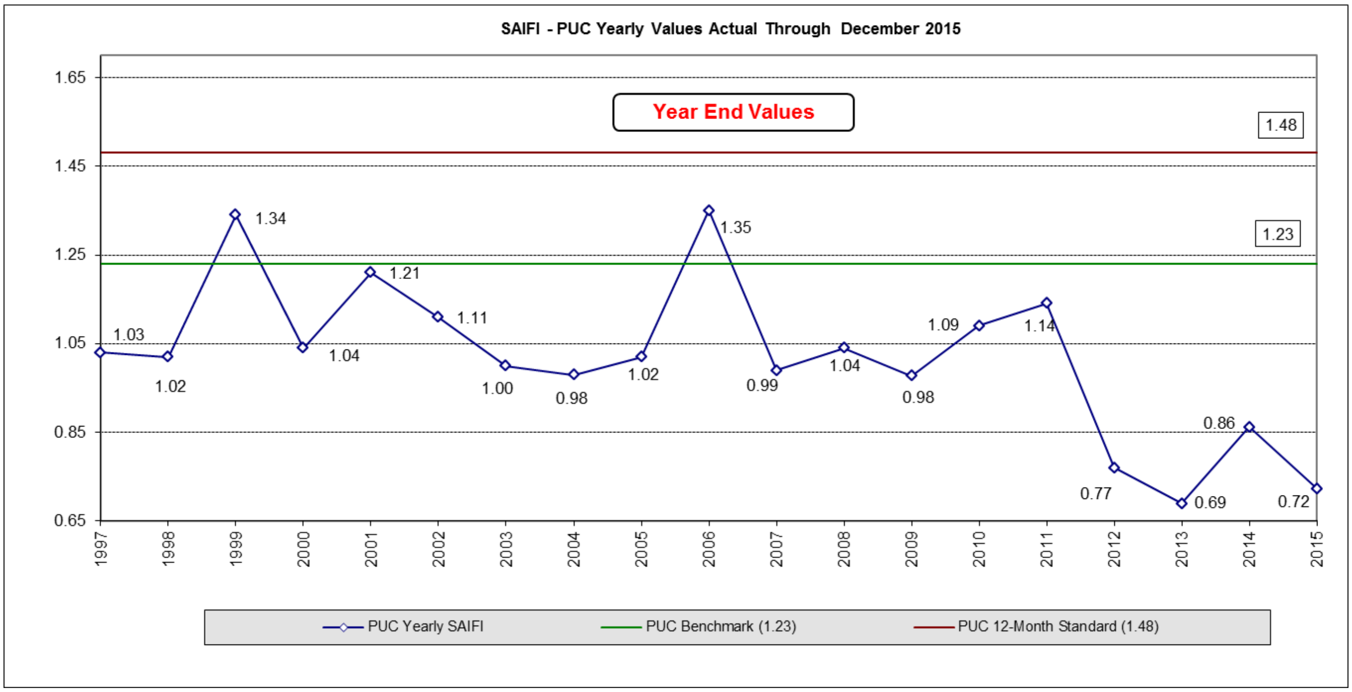
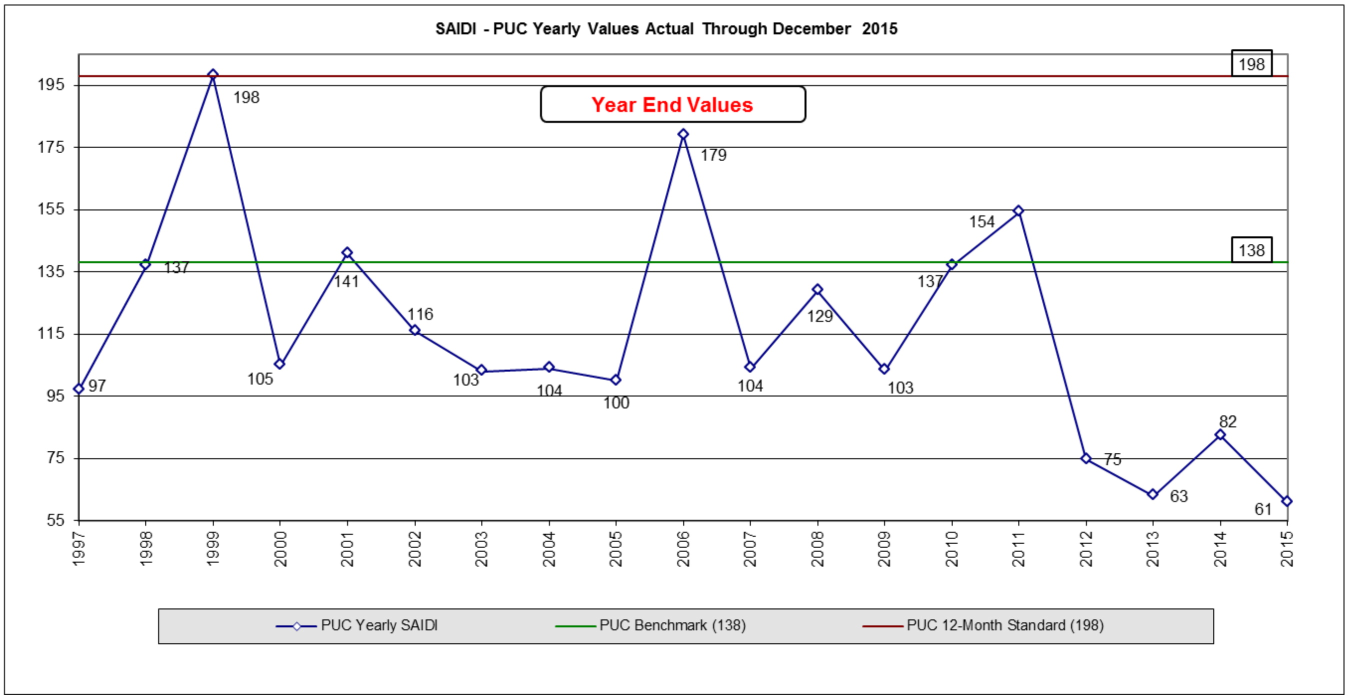
ongoing initiatives to integrate advanced grid technologies into its distribution operations has played an important role in achieving these performance improvements.







During this time, however, the Company has experienced a number of significant weather events, which are excluded from PUC indices. These events include hurricanes and tropical storms, such as Irene and Sandy, and extreme winter weather, such as Winter Storm Nika.[4] The frequency and severity of these major storms have increased over the last ten years.[5] The impact of these storms has elevated the need for PECO to reinforce and upgrade its distribution infrastructure to better withstand extreme weather events. The Company also is interested in making the grid more resilient to other causes of long-term interruptions (e.g., cybersecurity attacks or physical threats to the distribution system) and identifying options for better integrating distributed energy resources ("DERs") into the distribution grid.

[4] To illustrate, as a consequence of Hurricane Sandy, approximately 850,000 of PECO's customers experienced interruptions of service. In the aftermath of Hurricane Sandy, PECO had to replace or repair over 140 miles of conductors and 2,538 cross-arms. Winter Storm Nika caused interruptions and storm damage of similar magnitude.

Accordingly, PECO seeks Commission approval to implement a Microgrid Integrated Technology Pilot (the "Pilot") in which PECO will design and construct an integrated microgrid in Concord Township, Pennsylvania, and study the resulting improvements to system reliability and resiliency. As envisioned, the Microgrid Pilot will focus on improving the electric grid's ability to sustain and recover from severe weather and other adverse events while maintaining reliable access to critical government facilities and public accommodations. The Pilot will offer the benefit of "real world" testing of the fundamental operational characteristics of a microgrid integrated with PECO's distribution system (e.g., islanding of the microgrid and resynchronization), expanded microgrid capabilities and applications (e.g., integration of DER) and the reliability benefits produced by microgrids. The lessons learned from the Pilot will facilitate the successful deployment of additional microgrids in the Company's service territory and create a roadmap for development of microgrids in the Commonwealth to maximize public benefits.

The Pilot is designed to achieve the following specific objectives:

- Reliable integration of DERs (e.g., natural gas powered generators and solar photovoltaic systems) and storage devices (e.g., batteries) in a populated area of the distribution system;
- Development of best practices for incorporating and utilizing the increasing capabilities of DERs in microgrids;
- Successful disconnection and re-connection of a community microgrid from the distribution system, with actual "island mode" operation;

[5] From 2005 through 2009, PECO experienced two major storms that affected 684,000 customers. During the subsequent five years (2010-2014), there were eight major storms – with the two largest occurring in the last three years – affecting a total of 3,297,000 customers.

- Significant reduction of outage durations for the customers within the microgrid footprint to enable the continued provision of critical government facilities and public accommodations within the community when major events occur;

- Economic participation of integrated microgrid DER in wholesale markets to offset project costs and maximize customer benefits;

- Creation of new opportunities to work with suppliers and customers to learn from emerging technology; and

- Reporting of the Pilot's progress, accomplishments, and challenges, including recommendations to the PUC and stakeholders.

The initial design of the Pilot (the "Preliminary Base Microgrid Design") consists primarily of distribution system infrastructure, DERs owned and installed by PECO on PECO property, energy storage equipment (i.e., batteries to serve the Concord Township building and fire station) installed on Concord Township property, and electric vehicle charging stations. The Preliminary Base Microgrid Design will allow the Company to significantly reduce outage durations to customers within the microgrid footprint, and PECO's preliminary cost estimate indicates that it will cost approximately $35 million to implement.

As the Pilot proceeds, PECO will evaluate options for an upgraded microgrid design with additional DER sited on customer property to meet future load growth and expand microgrid functionality. These additional DERs could include rooftop solar photovoltaic ("PV") systems, wind microturbines, a community battery storage system, and level three electric vehicle fast charging stations. PECO expects that the integration of these additional DERs may create opportunities for customer-generators and third-party DER developers to participate directly in the Pilot with the ability to understand and evaluate the interconnection and operating scenarios for multiple DER owners and operators.

II. MICROGRID PLAN

A. Background

According to the Department of Energy ("DOE"), a microgrid is "a group of interconnected loads and distributed energy resources (DER) within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid [and can] connect and disconnect from the grid to enable it to operate in both grid connected or island mode." In 2013, the National Electrical Manufacturers Association ("NEMA") issued a report entitled *Storm Reconstruction: Rebuild Smart, Reduce Outages, Save Lives, Protect Property*, which explains the important role that microgrids can play to ensure the continued provision of essential human services:

> Resilient and reliable power is critical for first responders, communications, healthcare, transportation, financial systems, water and wastewater treatment, emergency food and shelter, and other vital services. When smart technologies [such as microgrids] are in place, power outages are avoided and lives, homes, and businesses are protected.

Consistent with this understanding of microgrids, PECO engaged in a detailed site selection and initial design for the Pilot microgrid as described below.

B. PECO's Microgrid Plan

1. Location & Site Selection

PECO carefully and thoroughly evaluated potential sites before ultimately selecting Concord Township as the location for this Pilot ("Concord Township Project" or "Project"). Locations which provided an array of critical government facilities and public accommodations were reviewed along with reliability performance to determine how much benefit could be derived by installing DERs and other microgrid-related distribution infrastructure.

Opportunities to enhance the reliability and resiliency of such areas were also investigated through a review of the Company's reliability performance at each prospective site. For each circuit, the reliability performance was evaluated by examining all historical outage events that have affected relevant circuits in the past five years, including outage events during major storms. The average outage duration was calculated for each circuit on a per customer basis. Relevant portions of circuits that could be contained in the microgrid footprint were analyzed collectively to establish an overall improvement in the duration of future interruptions likely seen by customers to be included in the microgrid footprint. As a result of this analysis, a short list of potential locations was developed.

PECO retained Quanta Technology LLC ("Quanta"), a highly experienced consulting firm with microgrid expertise, to evaluate the potential for microgrid deployment in the prospective sites identified through PECO's initial scoping process. Quanta developed a feasibility analysis, including electrical configuration boundaries and a preliminary cost-benefit analysis for each of the prospective locations.

Following the review of Quanta's feasibility analysis, PECO assessed each of the potential short list sites based on public purpose and benefit, reliability and resiliency, population density and ease of access, and other factors. After evaluating these sites, PECO ultimately selected the Concord Township site due to the potential for reliability and resiliency improvements and proximity to critical government facilities and public accommodations. A map of the microgrid footprint is provided in Appendix A.

The Concord Township microgrid footprint will support three critical government facilities and twenty-seven public accommodations, including the following:

Critical Government Facilities

- Township Municipal Complex
- Fire Department
- Sewage Treatment Plant

Public Accommodations

- Town Center
- Surgery Center
- Medical Buildings
- Hotels and Restaurants
- Shopping Centers with Grocery Stores
- Restaurants
- Convenience Store and Gas Station
- Retirement Community
- Clothing Stores
- Home Improvement and Appliance Store
- Pharmacies
- Retail Supply Store
- Wholesale Supply Store

2. Microgrid Components

PECO's Preliminary Base Microgrid Design will include the following components/devices, each of which is required to create a functioning microgrid. The foundation of the microgrid will be PECO's existing distribution infrastructure within the Project's boundaries with upgrades where necessary to support microgrid functionality.

a. Microgrid Controller

A local Microgrid Controller will be the main component used to operate the microgrid. It will be responsible for operation, management, and monitoring of all microgrid system equipment and coordination with PECO's distribution system. The controller will island and resynchronize the microgrid in response to system conditions (e.g., outages and restorations outside the microgrid footprint) as described below.

- Normal – Parallel / Grid Connected Mode: During this mode of operation, the microgrid will be connected to PECO's distribution system through a point of (common) interconnection ("POI"). The operation of DERs will be economically optimized and managed by the local microgrid controller using Distribution Energy Resource Management System ("DERMs") information (e.g., load forecasting data).

- Emergency – Islanded Mode: This mode of operation is intended to provide service to customers within the microgrid during storm or other events that threatens the reliability of the utility grid. Island mode is established by physically disconnecting the microgrid network and its customers from the utility grid by opening the POI. When in island mode, the customers within the microgrid will be physically isolated from the utility grid and served by the local microgrid system. The transition to island mode and the load restoration process will be enabled by the distribution system operator, microgrid controller, remotely controlled switches, relays, distribution automation schemes, local distributed resources, energy storage assets and the communications architecture. Once the transition to island mode is completed, power to the customers within the microgrid will be maintained independent of the utility grid.

- Transition from Island to Parallel Mode: The microgrid will need to be transitioned back into Normal Parallel Mode when grid power is restored. The microgrid will be designed and built with the capability to perform this transition using the same assets and personnel as listed above.

b. Switching, Isolation and Control Equipment

The Microgrid Controller will communicate with switching, isolation and control equipment – physical devices at key points of the microgrid that will be used for real-time monitoring, disconnection and reconnection of electric loads. This equipment synchronizes the physical devices, relays, and controllers required to manage and integrate the distribution of energy in all modes of operation. The DERs within the microgrid will be efficiently sized and coordinated to meet the specific load requirements of the microgrid footprint (when in island mode) with this equipment.

c. Communications Network

The microgrid will require a communications network to support the operations of each individual microgrid component. The network will be comprised of: (1) fiber optics to enable fast switching and load balancing to operate the microgrid; and (2) additional communications solutions to integrate existing grid communications systems (e.g., the Company's Distribution Management System ("DMS")) and enable real-time control of portions of PECO's distribution network within the microgrid footprint.

d. IT Systems

A DERMS is a layered software tool that integrates with traditional utility systems such as the DMS and Supervisory Control and Data Acquisition ("SCADA") systems and coordinates the dispatch of DERs that power the microgrid. Key DERMS functionalities include load forecasting and optimization of DER, bulk renewable DER integration, and data analytics.

e. DER Equipment

DERs are the grid-connected devices which generate or store energy used to power the microgrid, and are expected to include natural gas reciprocating engines and solar photovoltaic facilities. Battery storage will maintain service to the local fire station and township building during a power interruption until local microgrid DERs are able to serve to those customers.

f. Smart Street Lights

The Pilot also will explore technology to support adoption of controllable LED lighting for streets, parking lots and building areas within the microgrid footprint. PECO plans to investigate using a web-based tool for measuring and monitoring usage, life of the fixture and enable interactive functions including scheduling and flashing.

g. Traffic Lights

The Pilot also will evaluate options that support critical traffic light operations in the microgrid footprint to ensure safe access and transit during island operation.

h. EV Charging Stations

The Pilot also will provide customers who own electric vehicles an opportunity to charge their vehicles during major system outages through the inclusion of several electric vehicle chargers in the Preliminary Base Microgrid Design.

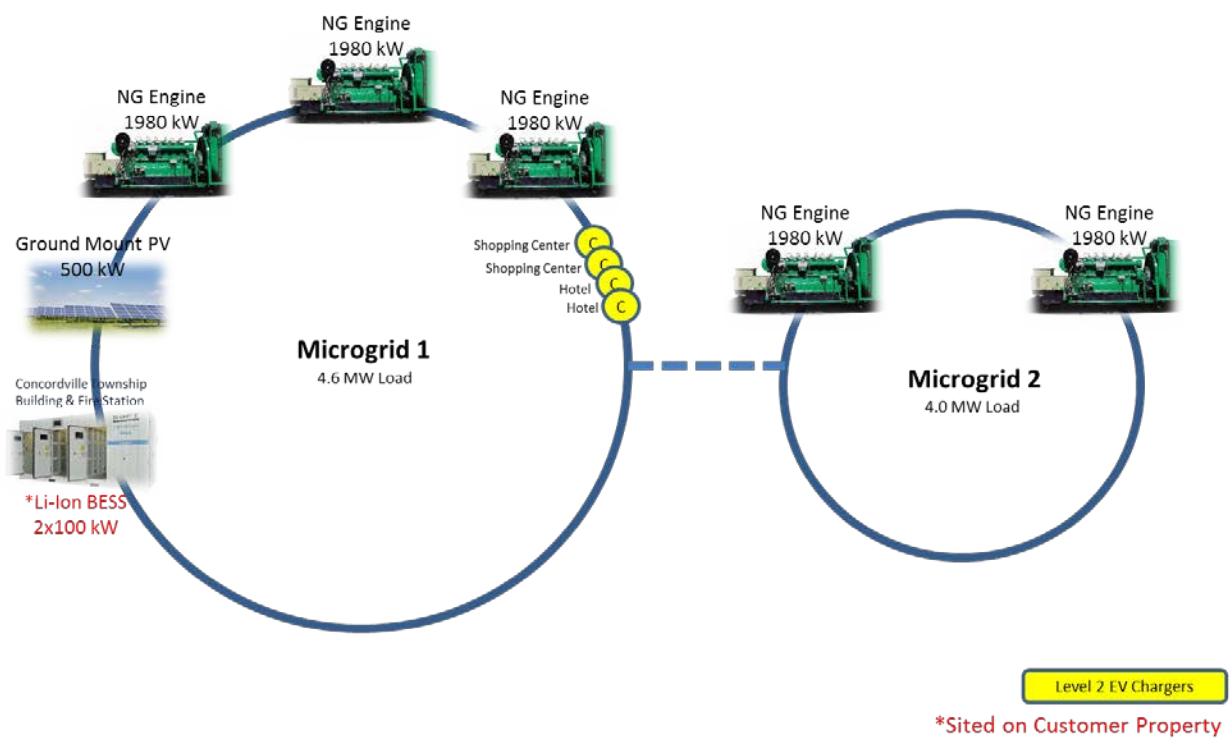
3. PECO's Microgrid Design

PECO's preliminary design for the Pilot calls for two integrated microgrids to be constructed. Each microgrid will be designed to operate in island mode independently of each other. The microgrids can operate separately or jointly during parallel mode to participate in wholesale markets and potentially reduce costs.

a. Preliminary Base Microgrid Design

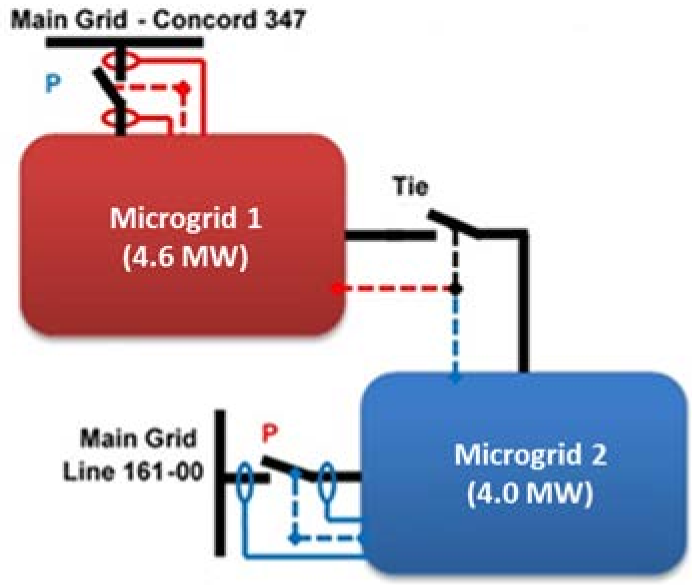
Under the Preliminary Base Microgrid Design, the Concord Township Project will be powered by a variety of DER technologies. As shown in Figure 1 below, PECO proposes to initially install and test natural gas reciprocating engines, ground-mounted solar photovoltaic ("PV") installations, two batteries and four dual-port EV charging stations

Figure 1



The use of natural gas reciprocating engines ensures that the microgrid will have sufficient generation to meet typical customer peak load during an outage at all times, with the 500 kW of solar PV and 200 kW of batteries included to investigate the use of intermittent resources and storage in microgrid operation. The batteries will also be available to provide uninterruptible power supply to critical government facilities. Figure 2 illustrates how PECO anticipates that the microgrid will be connected with its local distribution grid (with "P" indicating the points of interconnection):

Figure 2



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The Preliminary Base Microgrid Design incorporates natural gas-powered reciprocating engines because that technology efficiently converts natural gas to electricity, compares favorably against other forms of DERs on an economic basis, and will consistently produce enough electricity to meet peak demand requirements during an unanticipated outage. Additionally, PECO can utilize locally sourced Marcellus Shale supplies to fuel the onsite DERs. In a more limited fashion, solar PV will be used as an additional resource to support efforts to test integration of an intermittent resource in the microgrid. Battery storage will be deployed to the local fire department and township building to maintain uninterrupted service during a power outage until local microgrid DERs are able to provide service, and the EV charging stations will provide services to customers in the region who would otherwise be unable to charge their vehicles.

b. Upgraded Microgrid Design

The DER in the Preliminary Base Design will be owned and operated by PECO. During Plan implementation, PECO will evaluate options for an upgraded microgrid design with additional DERs (e.g., rooftop PV) sited on customer property to meet future load growth and expanded microgrid functionality. PECO will also explore faster electric vehicle charging stations, which reduce charging time significantly (i.e., from hours to minutes). As part of this investigation, PECO will explore opportunities for customer and third-party ownership of microgrid DER assets located on customer property. In addition, PECO will consider incorporation of a community battery energy storage system to demonstrate how customer-owned solar PV installations deployed within a microgrid can maintain power during times of resource intermittency.

4. Competitive Procurement

PECO plans to implement a competitive bidding process for materials and services related to the engineering, design and system components of the Project as required for the successful implementation of the Plan. This process will implement optimal sourcing strategies designed to obtain competitively favorable pricing. Prudent business practices, such as requests for proposals, will be used to ensure that purchase processes are fair and reasonable.

5. Initial Estimated Cost

As shown in the table below, using Quanta's analysis, the Company estimates the costs to implement the Preliminary Base Design is approximately $35 million. PECO projects that it will incur an incremental cost of up to $13 million to implement an upgraded microgrid design, subject to reductions in costs through participation of customer DERs.

Preliminary Base Microgrid Design – Summary of Estimated Costs ($000)

	Distribution	Generation	Total Estimated Project Cost
Capital			
Feasibility Study	$ 500		$ 500
Development Costs	$ 1,763	$ 2,367	$ 4,130
EPC Direct Costs	$ 9,717	$ 12,221	$ 21,938
EPC Indirect Costs	$ 534	$ 672	$ 1,207
Contingencies	$ 2,915	$ 3,666	$ 6,581
Total Estimated Capital Costs	$ 15,430	$ 18,927	$ 34,357
1st Year O&M			
Fuel (Island Mode)		$ 10	$ 10
Op Expense and Other	$ 211	$ 387	$ 597
Total Estimated O&M Costs	$ 211	$ 397	$ 607

The estimated project costs include:

1) **Development Costs** – These are costs associated with obtaining permits, land agreements, purchase agreements, training and financing.

2) **Engineering, Procurement and Construction ("EPC") Direct Costs** - For the microgrid's distribution infrastructure, EPC costs encompass capital expenditures for circuit reconfiguration, controllers and load centers, medium voltage switchgear and transformers, and accessories, as well as EV charging stations. DER EPC costs are comprised of capital expenditures in the DER facilities that will power the microgrid.

3) **EPC Indirect Costs** – This category includes costs associated with back office functions (e.g., PECO project management, accounting and human resources) that are not directly charged to the project, Allowed Funds for Use During Construction, and any capitalized administrative costs.

4) **Contingencies** – This addresses risks associated with the uncertainty as to the precise content of all items in the estimate, how work will be performed and what work conditions will be encountered when the Plan is implemented. PECO added the contingency amount to its estimate of Common EPC Costs to allow for costs outside the scope of Quanta's preliminary estimate (e.g., a DERMS and the communications infrastructure), unanticipated market conditions, scheduling delays and other uncertain items, conditions or events that experience shows will likely result in additional costs.

Upon approval of the Plan, PECO will consult with customers to gauge interest in potential enhancements to the Preliminary Base Microgrid Design and then begin detailed project designs to incorporate agreed-upon enhancements. These detailed designs will allow PECO to develop more refined cost estimates required to construct and integrate the microgrids within the Company's existing distribution system.

6. Implementation Schedule

PECO proposes to commence initial work on the Microgrid Pilot as soon as practicable after Commission approval of the Plan. This work will include (1) engineering and design studies, including DER interconnection studies and circuit hardening and reconfiguration which will reflect the results of stakeholder collaboration and consensus on enhanced design features; (2) procurement of the microgrid infrastructure and technology; (3) technology acceptance testing, including a microgrid controller simulation; (4) utilization of a DERMS; and (5) deployment of the Communications Network. PECO anticipates that such initial work will be completed by 2018. PECO will then construct, install, test and commission the Concord Township Project, with operations commencing in 2020.

7. Reliability

PECO and Quanta conducted a joint review of Concord Township's reliability performance (within the microgrid footprint), examining all outage events that affected microgrid footprint customers in the past five years, including major storms. Concord Township has experienced longer than average outage durations because it is served primarily by aerial distribution facilities that are exposed to conditions such as vegetation, weather and other environmental factors. The following table lists the major storm events that have affected Concord Township, in part, over the last five years.

System Wide Excludable Events 2010 - 2015

Storm	Customers Affected	Total Customer Hours	Longest Customer Outage Duration	CAIDI (minutes)	Affected Potential Concord Township Microgrid Customers
February 10, 2010 - Wind Snow Storm	170,643	1,504,814	3d 8h 37m	529	Yes
June 24, 2010 - Wind Lightning Storm	326,019	4,488,141	4d 10h 46m	826	Yes
August 27, 2011 - Hurricane Irene	508,048	7,810,642	5d 7h 59m	922	Yes
October 29, 2011 - Snow/Rain Storm	266,671	2,841,711	3d 19h 9m	639	No
October 29, 2012 - Hurricane Sandy	842,950	23,201,058	8d 9h 46m	1651	Yes
February 5, 2014 - Winter Storm Nika	713,802	19,758,091	6d 11h 50m	1661	No
July 3, 2014 - Rain Lightning Storm	180,157	1,137,191	2d 12h 47m	379	Yes
July 8, 2014 - Rain Lightning Storm	232,078	1,778,778	2d 20h 3m	460	Yes
June 23, 2015 - Wind Lightning Storm	345,518	4,638,311	4d 21h 54m	805	Yes

All but two of these storms resulted in extended service interruptions to customers within the microgrid footprint. As an example, on June 23, 2015, strong thunderstorms swept across the PECO service territory carrying winds in excess of 70 mph, which uprooted trees and severed limbs, causing extensive facility damages. Delaware County was hardest hit and customers suffered multi-day outages. Approximately, 91 percent of the customers located within PECO's proposed microgrid footprint for Concord Township experienced extended outages. Several customers experienced multi-day outages, as long as nearly four days, including the Concord Township Building and Youth Club.

Had the Concord Township microgrid been in place during these events, the duration of the outages would have been greatly reduced for customers within its footprint. According to Quanta's analysis, the customers within the microgrid footprint would have experienced only an approximately fifteen minute interruption (the time needed to restore customers with distribution automation and onsite DERs) instead of the actual outage time of up to nearly four days and customers outside the footprint would have benefited from access to critical government facilities and public accommodations available within the microgrid.

The following table provides a comparison of reliability metrics over the past five years for customers within the microgrid footprint (including major storm events). The comparison demonstrates that significant reliability improvements could be achieved in a comparable event as a result of the proposed microgrid pilot.

	CAIDI	SAIFI	SAIDI
5-Year Average Reliability (2011 - 2015)	905	0.42	380
5-Year Average Reliability (2011-2015) – Adjusted for Microgrid*	96	0.38	36

*Approximately 75 percent of the interruptions involved the operation of a circuit breaker or recloser. Thus, the faults originated outside of the proposed microgrid footprint. The remaining 25 percent of interruptions stemmed from within the microgrid footprint. PECO anticipates even better CAIDI performance due to storm hardening efforts.

Accordingly, PECO estimates that the Concord Township Project will benefit the customers within its footprint through a marked improvement in reliability by reducing the average duration of outages from 905 minutes to 96 minutes - a 90 percent improvement.

The Project will also deliver additional public interest benefits to citizens in the nearby Delaware County and Chester County regions because the microgrid will be able to sustain critical government facilities and public accommodations. The 2014 Pennsylvania Department of Transportation annual report indicates that the major arteries leading into the microgrid footprint (i.e., Route 202 and Route 1) comprise the busiest non-interstate traffic corridor in Delaware County with, on average, more than 40,000 vehicles traveling along these routes daily. When operating in island mode during a service disruption, the Project will provide uninterruptible service to the Concordville fire station and Township building and will rapidly restore power to other public accommodations (e.g., grocery stores and gas stations), which can then be accessed, via Route 202 and Route 1, by more than 86,000 Commonwealth residents who live within a five-mile radius of the traffic routes within the microgrid footprint.

8. PJM Market Participation

During grid-connected mode, the DERs owned by PECO are expected to participate in PJM wholesale markets when it is economic to do so and will not be used to provide default service supply. The net proceeds from any PJM wholesale market transactions involving the DERs will be flowed back to PECO distribution customers.

9. Cost Recovery

PECO proposes to use two methodologies to recover the actual costs of the Pilot. For those costs which are for “eligible property” under PECO’s Distribution System Improvement Charge (“DSIC”), PECO will seek approval to recover those costs through an amended electric LTIIP filing in Docket No. P-2015-2471423 after PECO has performed detailed engineering design to arrive at more refined implementation costs. These costs are expected to include overhead and underground cables, transformers, switching devices (such as circuit breakers and reclosers), battery systems, communication equipment, and other related capital costs (i.e., engineering, procurement and construction costs).

PECO proposes to recover other (non-DSIC) costs through distribution base rates. These costs will consist primarily of the DER facilities necessary to support the microgrid, and the information technology ("IT"), communications systems and control equipment that support those facilities. These costs will also include EV charging stations. The fuel needed to support the DERs during island mode[6] and other Operations and Maintenance ("O&M") expenses would also be recovered through base rates.

10. Annual Reports & Final Report to the Commission

PECO will track and report to the Commission annually regarding development of the final design and implementation costs, as well as specific performance metrics (once the microgrid is deployed) including, but not limited to:

1) Instances in which the microgrid controller operates (i.e., monitors outages and restorations that impact the microgrid footprint);

2) Period required for the microgrid controller to successfully respond to system conditions;

3) Comparison of reliability metrics between customers served by microgrid connected circuits and customers served by the general grid. The report also will include a summary of microgrid operating practices and reliability enhancements to customers within the footprint;

4) Cost mitigation achieved by optimizing distributed resources in wholesale markets operated by PJM and opportunities to leverage grant funding;

5) Instances in which storage devices dispatch supply;

[6] When in parallel operation mode, the cost of fuel required to run the generators (for purposes of bidding generation into PJM markets) will be subtracted from the net proceeds flowed back to customers.

6) Operational efficiencies in balancing, sectionalizing, storing and dispatching generation to all customers within the microgrid; and

7) Monitoring of intermittent resource impacts on the distribution grid, and testing of integration and control technologies.

Additionally, at the end of the Pilot, PECO will provide a summary report of the Company's experiences and learnings three years after operation of the microgrid commences.

III. FUTURE OPPORTUNITIES FOR MICROGRIDS

In recent years, PECO and the City of Philadelphia ("the City") have collaborated on numerous clean and advanced technology initiatives, including, but not limited to, energy efficiency programs through Pennsylvania Act 129 of 2008, smart grid infrastructure deployments, commercial building benchmarking and alternative fuel vehicle projects.

Beginning in summer 2015, PECO and representatives of the Mayor's Office of Sustainability (now the Office of Sustainability) began discussions regarding the potential to apply microgrid technologies to create a campus-based environment where multiple critical City functions could be co-located and linked together with a self-sustaining microgrid network and with dedicated generation that can operate independent of the existing utility grid. The microgrid network would deliver enhanced reliability and resiliency in support of critical services such as police, fire, emergency management, government administration, telecommunications and IT systems. A microgrid also could be extended to provide other services such as community shelters depending on local conditions.

In February 2016, the Office of Sustainability and other City agencies with critical public facilities responsibilities were asked to review major City capital project plans to ensure cost-effectiveness and internal alignment. While the City's internal analysis is ongoing, PECO has communicated its continuing interest in identifying an appropriate collaboration opportunity. City of Philadelphia representatives have confirmed their interest in development of an urban, campus-based microgrid project that supports critical operations and major public events such the Papal Visit through enhanced reliability and resiliency.

While an urban, campus-based microgrid offers many potential benefits, there are also significant opportunities for learning associated with developing this type of project. The project likely also will involve deploying microgrid technologies into underground utility infrastructure where communications and performance monitoring systems will be essential to success. Also, the project will also potentially involve more complex circuit configurations and switching requirements.

PECO looks forward to working in good faith with the City of Philadelphia to identify an appropriate location to host the urban, campus-based microgrid pilot project envisioned in this proposal and is pleased to be joined by the City in this initiative.

IV. CONCLUSION

In summary, PECO seeks approval of its Microgrid Integrated Technology Pilot in which PECO will construct a community microgrid in Concord Township integrated with PECO's distribution system. The microgrid will be able to connect and disconnect from PECO's existing distribution system to maintain reliable access to electricity during severe weather and other adverse events, with significantly enhanced reliability benefits for customers within the microgrid and in surrounding areas. As explained herein, PECO will seek to recover costs of the Pilot through its Distribution System Improvement Charge and electric distribution base rates in a future rate case. During the Pilot, PECO will submit annual reports to the Commission detailing progress and performance metrics and, upon completion, submit a summary report of the Company's experiences and learnings after the Pilot.

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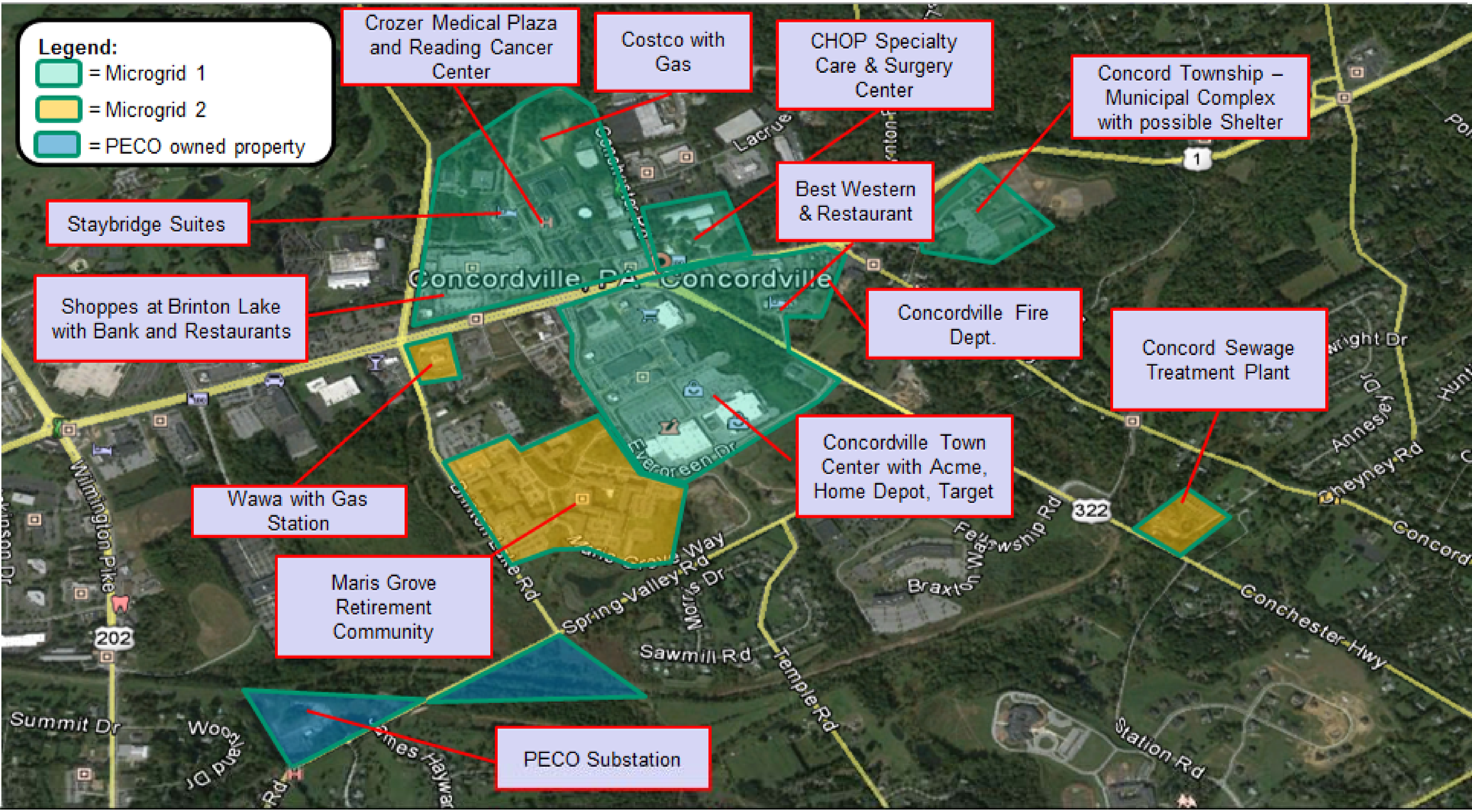
APPENDIX A


Legend:
= Microgrid 1
= Microgrid 2
= PECO owned property
Crozer Medical Plaza and Reading Cancer Center
Costco with Gas
CHOP Specialty Care & Surgery Center
Concord Township – Municipal Complex with possible Shelter
Staybridge Suites
Best Western & Restaurant
Shoppes at Brinton Lake with Bank and Restaurants
Concordville Fire Dept.
Concord Sewage Treatment Plant
Concordville Town Center with Acme, Home Depot, Target
Wawa with Gas Station
Maris Grove Retirement Community
PECO Substation
Concordville, PA
Concordville
Wilmington Pike
Spring Valley Rd
Sawmill Rd
Temple Rd
Conchester Hwy
Station Rd
Summit Dr
Evergreen Dr
Cheyney Rd
Fellowship Rd
322
202
1

Brenda L. Lamanna
Township Manager

Pennoni Associates Inc.
Township Engineer

Hugh A. Donaghue
Township Solicitor

Township *of* Concord

DELAWARE COUNTY

May 4, 2016

Ladies & Gentlemen:

On behalf of the Concord Township Board of Supervisors, I am writing to express the Township's support for PECO's proposed microgrid filing as part of its System 2020 Long-term Infrastructure Improvement Plan (LTIIP). This microgrid project would create a valuable resource to ensure the ability to deliver critical services to Concord Township and Delaware County residents in the event of a significant disruption to the regional power grid.

PECO's Microgrid project team has collaborated with Concord Township to identify a location for this project that will ensure citizens across the area have access to a broad range of essential services – municipal government, emergency response, food, shelter, health care, fuel, hardware and home repair, and financial services -- during an extended system outage. The pilot will enable PECO to develop a model technology platform to maintain essential electric services to communities in a manner that can be replicated throughout the company's service territory. The Board of Supervisors supports PECO's plan to integrate clean technologies such as solar energy, battery storage, and electric vehicle charging infrastructure in the microgrid plan as part of achieving our shared environmental goals.

Concord Township Board of Supervisors is committed to working with PECO, property owners, businesses, and residents to ensure that this project can be executed in a timely manner. The microgrid project provides a unique opportunity for Concord Township and Delaware County to play a leading role in advancing innovative, energy technology solutions that will ultimately benefit communities throughout the region and the Commonwealth.

We are looking forward to a review by the Township Engineer and Fire Marshal/Emergency Management Coordinator and a public presentation by PECO representatives, once approved by the PUC.

Very truly yours,

Brenda L. Lamanna

Brenda L. Lamanna
Township Manager

43 Thornton Road • Glen Mills, PA 19342
Phone: 610-459-8911 • Fax: 610-459-8917 • Email: office@concordtownship.org • **www.twp.concord.pa.us**

ACME
75 Valley Stream Parkway
Malvern, PA 19355
P 610.889.4000
www.acmemarkets.com

April 7, 2016

Chris Cavaliero
PECO

Dear Chris,

On behalf of ACME Markets, I am writing to express our support for PECO's proposed microgrid filing as part of its System 2020, Long-Term Infrastructure Improvement Plan (LTIIP). PECO's Concord Township microgrid project would be a valuable resource to assist ACME in delivering critical services to our customers.

Additionally, we support PECO's plan to integrate clean technologies such as solar energy, battery storage, and electric vehicle charging infrastructure in the microgrid plan as part of a long-term strategy to meet our shared environmental goals.

The microgrid project provides a unique opportunity for ACME to continue service to the community and provide them with needed essentials if an extended outage were to take place.

Thank you for your consideration of this letter of support.

Sincerely,

Danielle D'Elia
Communications Manager
ACME Markets

Erickson LIVING

Maris Grove

Add more Living to your Life®

Matthew Miller
610-387-4560
Director of General Services

Richard Ulmer
610-387-4559
Senior Facilities Manager

Joseph Turnbach
610-387-4557
Facilities Manager Housekeeping & Laundry

John Grimes
610-387-4576
Facility Manager Security & Communications

Mary O'Connor
610-387-4556
Office/Customer Service

David Williams
610-387-4628
Facilities Coordinator

To whom it may concern;

On behalf of Maris Grove, I am writing to express our support for PECO's proposed Microgrid filing as part of its System 2020, Long-Term Infrastructure Improvement Plan (LTIIP). PECO's Concord Township Microgrid project would create a valuable resource to ensure the ability to deliver critical services to Maris Grove Residents, in the event of a significant disruption to the regional power grid.

PECO's Brandywine Microgrid project team has collaborated with the Township to identify a location for this project that will ensure citizens across the area have access to a broad range of essential services – municipal government, emergency response, food, shelter, health care, fuel, hardware and home repair and financial services – during an extended system outage. The Microgrid plan will assist in the care of over 1,500 residents within our community. The pilot will also enable PECO to develop a model technology platform to maintain essential electric services to communities in a manner that can be replicated throughout the company's service territory. Additionally, we strongly support PECO's plan to integrate clean technologies such as solar energy, battery storage and electric vehicle charging infrastructure in the Microgrid plan as part of a long-term strategy to meet our shared environmental goals.

Maris Grove is committed to working with PECO, within the project footprint, and Township residents to ensure that this project can be executed in a timely manner. The Microigrid project provides a unique opportunity for US, Concord Township and Delaware County to play a leading role in advancing innovative, energy technology solutions that will ultimately benefit communities throughout the region and the Commonwealth.

Thank you for your consideration of this letter of our support.

Sincerely,

Matthew Miller, Director of General Services

General Services Office, 100 Maris Grove Way, Glen Mills, PA 19342
610-387-4551 | fax: 610-387-4565
EricksonLiving.com

STAPLES
MAKE more HAPPEN

Good Morning,

On behalf of Staples Inc., I am writing to express our support for PECO's proposed micro grid filing as part of its System 2020, Long-Term Infrastructure Improvement Plan (LTIIP). PECO's Concord Township micro grid project would create a valuable resource to ensure the ability to deliver critical services to Staples and other customers in the event of a significant disruption to the regional power grid.

PECO's Brandywine Micro grid project team hopes to ensure citizens across the area have access to a broad range of essential services – municipal government, emergency response, food, shelter, health care, fuel, hardware and home repair and financial services – during an extended system outage. The pilot will enable PECO to develop a model technology platform to maintain essential electric services to communities in a manner that can be replicated throughout the company's service territory. Additionally, we strongly support PECO's plan to integrate clean technologies such as solar energy, battery storage and electric vehicle charging infrastructure in the micro grid plan as part of a long-term strategy to meet our shared environmental goals.

Service reliability is an integral component in the successful operation of our business. We are very excited about participating in this endeavor in advancing innovative, energy technology solutions that will ultimately increase service reliability for our business and the community.

Thank you for your consideration of this letter of support.

Sincerely,

Bob Valair, CEM

Director

Energy & Environmental Management

Office:508-253-5484 Cell: 781-405-2190

500 Staples Drive, Framingham, MA 01702

ENERGY STAR AWARD 2012
PARTNER OF THE YEAR

Wawa

April 27, 2016

Re: Letter in Support of PECO's Microgrid Project

To Whom It May Concern:

I am pleased to express the support of Wawa, Inc. ("**Wawa**") for PECO's proposed microgrid filing as part of PECO's System 2020, Long-Term Infrastructure Improvement Plan. PECO's Concord Township micro grid project would create a valuable resource in its ability to ensure the delivery of electricity to Wawa and other customers in the event of a significant disruption to the regional power grid. As you may be aware, in most instances, Wawa operates 24 hours a day, 7 days a week. Many times a loss of electricity may have resulted from a weather event or natural disaster. Wawa is proud of our history serving the first responders to these disasters with fuel and food – however, we cannot serve the community without electricity.

PECO's microgrid project team will enable PECO to develop a model technology platform to maintain essential electric services to communities in a manner that can be replicated throughout the company's service territory. Additionally, we are encouraged by PECO's plan to integrate clean technologies such as solar energy, battery storage and electric vehicle charging infrastructure in the micro grid plan as part of a long-term strategy to meet environmental goals.

Service reliability is essential to the conduct of Wawa's business. We are happy to support PECO's endeavor to advance innovative, energy technology solutions that will ultimately increase service reliability for our business and the community.

Thank you for your consideration of this letter of support.

WAWA, INC.

James P. Morey
Senior Vice President & Chief Operations Officer

Wawa, Inc. / 260 West Baltimore Pike, Wawa, PA 19063 / 610.358.8000 / www.wawa.com

CITY OF PHILADELPHIA

OFFICE OF THE MAYOR
215 City Hall
Philadelphia, PA 19107
(215) 686-2181
FAX (215) 686-2180

JAMES F. KENNEY
Mayor

May 10, 2016

Dear Ms. Brown,

On behalf of the City of Philadelphia, I am writing to express support for PECO's proposed microgrid filing as part of its System 2020, Long-Term Infrastructure Improvement Plan (LTIIP). The City of Philadelphia views microgrids as potentially valuable tools to support future reliability, resiliency, emergency and physical and cyber security needs, as well as economic development and job creation opportunities.

PECO has proactively engaged with the City of Philadelphia to discuss the value of microgrids and opportunities for deployment of an urban microgrid to support critical City functions. I commend PECO for not only realizing that these technologies offer outstanding opportunities, but also specific challenges in terms of deployment into a densely-populated, urbanized area. The City also is pleased that PECO's proposal includes plans to test the integration of advanced energy resources such as solar, battery storage and electric vehicle technologies in its pilot microgrid in order to provide valuable lessons related to the integration of these resources into the larger electric grid.

As the City moves forward with its review of its plans related to public safety, emergency response and other essential functions, we look forward to working collaboratively with PECO to identify options to apply the enhanced reliability and resiliency that microgrids can provide to improve critical public services. In addition to the direct benefits and learnings that will be achieved through the development of an urban microgrid in the City, Philadelphia and other municipalities in the region will gain valuable experience from the proposed Concord Township pilot where governmental and commercial services can continue to be provided to the public, even following an event that results in widespread, long-term loss of electric service in the region.

The City of Philadelphia is committed to working with PECO and City residents and businesses to maximize the benefits of the microgrid project described in PECO's project filing. The microgrid project provides a unique opportunity for the City of Philadelphia to play a leading role in advancing innovative, energy technology solutions that will ultimately benefit communities throughout the region and the Commonwealth.

Thank you for your consideration of this letter of support.

Sincerely,

James Kenney
Mayor

Microgrid Pilot Preliminary Base Design Costs ($000)

Line	Item		Cost
	Estimated Capital Expenditures		
1	**Development**		
2	Permits	$	298
3	Land	$	490
4	Purchase/Off Take Agreement	$	265
5	Financing	$	329
6	Legal Fees	$	658
7	Training and Standards	$	100
8	Conceptual Engineering	$	491
9	Development Team	$	1,500
10	**Total Development Cost w/o Site Assessment**	$	4,130
11			
12	**EPC Direct Costs**		
13	Engineering	$	1,095
14	Project Management	$	1,187
15	Civil Works	$	1,844
16	Equipment: Gas	$	8,000
17	Equipment: Battery	$	720
18	Equipment: Solar	$	1,250
19	Installation: Gas	$	1,200
20	Installation: Battery	$	108
21	Reconfiguration -Cable & Labor	$	2,093
22	Reconfiguration -Controller	$	2,056
23	EV Charging Station	$	70
24	MV Switchgear & Transformer	$	766
25	Control House & Accessories	$	1,031
26	Interconnection & Commissioning	$	519
27	**Total EPC Direct Costs**	$	21,938
28			
29	**EPC Indirects**	$	1,207
30			
31	**Contingency**	$	6,581
32			
33	**Feasibility Study**	$	500
34			
35	**Total Estimated Capital Expenditures**	$	34,357
36			
37			
38	**Estimated 1st Year Operating and Maintenance Expenses**		
39	Fuel (Island Mode)	$	10
40	Operating Expense and Other	$	597
41	**Total Estimated O&M Expenses**	$	607

PECO ENERGY COMPANY
STATEMENT NO. 2

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

PETITION OF PECO ENERGY COMPANY FOR:
(1) APPROVAL OF ITS MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN AND (2) ISSUANCE OF A DECLARATORY ORDER REGARDING THE RECOVERY OF MICROGRID COSTS

DOCKET NO. P-2016-

APPLICATION FOR CONSTRUCTION OF MICROGRID DISTRIBUTED ENERGY RESOURCES FUELED BY NATURAL GAS

DOCKET NO. A-2016-

DIRECT TESTIMONY

WITNESS: JOHN CALDWELL, Ph.D.

SUBJECTS: MICROGRID DEVELOPMENT AND DEPLOYMENT

DATED: MAY 18, 2016

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Page

DIRECT TESTIMONY
OF
JOHN CALDWELL, Ph.D.

I. INTRODUCTION AND PURPOSE

1. Q. Please state your name and business address.

A. John Caldwell, 701 Pennsylvania Avenue NW, Washington, DC 20004-2696.

2. Q. By whom are you employed and in what capacity?

A. I am employed by the Edison Electric Institute as the Director of Economics for that organization.

3. Q. Please summarize your educational and professional background.

A. I received a Bachelor of Science Degree in Electrical Engineering from the University of Illinois at Champaign-Urbana in 1985. In 1989, while employed as a Planning Engineer at the Illinois Power Company (now Ameren Illinois), I received an M.B.A. at the University of Illinois at Springfield. I left Illinois Power in 1989 to attend graduate school full-time at the University of Iowa, and received an M.S. in Mathematics there in 1990. I received a PhD in Economics from the University of Illinois at Chicago in 2001, while employed at NiSource, a gas and electric utility headquartered in Merrillville, Indiana. I worked at NiSource for over fifteen years, principally in the areas of forecasting, strategic planning, regulatory affairs, and marketing. For the past nine years I have been at the Edison Electric Institute, a trade association representing investor-owned electric utilities, where my activities have mainly involved examining the interrelationship of the economy with energy supply, demand, and pricing, and exploring new business and regulatory models that will enable an effective and efficient transition to a more decentralized, transactive electricity grid that can accommodate a significant presence of distributed energy resources.

4. Q. What is the purpose of your testimony in this proceeding?

A. My purpose is to discuss general trends impacting the development of microgrids, and recommended methods for their utilization in the electricity system.

II. TRENDS IN MICROGRID DEVELOPMENT AND DEPLOYMENT

5. Q. What trends have you observed in microgrid development?

A. According to a quarterly report prepared by Navigant Research which tracks microgrid projects in the U.S. and the rest of world, the recent rate of growth of these facilities has been very significant. According to these reports, in the fourth quarter of 2012, the total generating capacity for all microgrids either in operation or under development in the U.S. was just over 2,000 MW, but less than three years later, by the second quarter of 2015, this capacity had more than doubled, to 4,600 MW. The worldwide growth trend has been even more significant, with capacity during that same time period growing from just over 3,000 MW to 12,000 MW: a fourfold increase. There has also been an interesting change in the composition of microgrid users. Ten years ago, military installations accounted for nearly half of all projects by capacity, with “campus” facilities (i.e., organizations with multiple buildings located close to one another, such as schools, hospitals, and research centers) accounting for a third, and remote sites (for which traditional utility service was unavailable or expensive to provide) making up a tenth of the total. Commercial/industrial customers showed little interest back then in microgrids. By 2015, the composition of microgrid customers had significantly changed. Commercial/industrial customers now account for about 20% of the market. And while the share of military microgrid installations has been eclipsed by this and the other sectors, now accounting for only about 15% of all projects, demand in this segment continues to grow. The involvement of utilities in microgrid projects has also become significant in recent years. According to a report by the Electric Power Research Institute published earlier this year ("Program on Technology Innovation: Microgrid Implementations: Literature Review," January 2016), of the 74 microgrid projects currently planned, proposed, or operational in the U.S., 42 of them, or over 50%, involve utilities as either project leaders or partners.

6. Q. What, in your opinion, have been the drivers for these trends?

A. The original driver for microgrids was the protection of facilities for which an uninterrupted supply of electricity was critical. These were principally military installations, and in cases where these facilities were given islanding capability, the Department of Defense had concluded that the costs necessary to create near perfect resiliency by the construction of such facilities was justified. However, concerns about reliability became heightened and affected a broader spectrum of customers as a result of extended outages due to extreme weather events – such as Hurricane Sandy in 2012, which left more than 1 million homes without power for over a week. The prospect of being without power for days, even if still considered to be a remote possibility, prompted many businesses to consider investing in systems that would improve resiliency. Growing concerns about cybersecurity and a general cyberattack that might cripple the electrical grid also engendered an increased interest in being part of an electrical system that could separate itself from the overall grid. In recent years, microgrids have been explicitly referenced as potential elements of a modernized, transactional electricity system by federal, state, and local regulatory and legislative organizations:

- The Department of Energy's Quadrennial Energy Review has established a number of grants and programs to support grid modernization and improved resiliency, and many of these at least indirectly promote the development of microgrids. As a part of this initiative, the DOE formed a joined task force with the Institute of Electrical and Electronics Engineers (IEEE) to explore the quantifiable benefits of microgrids and how to achieve them.

- In July 2014, the California Energy Commission offered $26.5 million in grants to microgrid projects targeted to three general categories: $6 million dollars was earmarked for projects that include plug-in hybrid electric vehicle charging; the remaining money was to be divided between "low-carbon-based microgrids for critical facilities (e.g., hospitals, fire stations) and "high-penetration renewable-based microgrids" which are able to rely upon up to 100% renewable resources through the use of advanced microgrid controller and energy management systems.

- New York is holding a "NY Prize" microgrid competition to stimulate a new generation of community-based microgrid applications in the state. In July of 2015, 83 communities were awarded $100,000 each for feasibility studies. Recipients include local governments, community organizations, non-profit entities, for-profit companies and municipally-owned utilities. All winning projects must be integrated into utility networks and serve multiple customers, including at least one "critical infrastructure" customer, such as a hospital, police station, fire station or water treatment facilities.

- In Maryland, the Governor's Task Force empaneled after Hurricane Sandy released the *Resiliency Through Microgrids Task Force Report* (June 2014), which concluded that utility-owned and operated microgrids for uninterrupted electric service to critical community assets such as community centers, commercial hubs, and emergency services are in the interest of public policy and practical under current law.

- The Connecticut Department of Energy and Environment (DEEP) awarded $18 million to 9 pilot microgrid projects in July of 2013 to support the cost of design, engineering, and the development of interconnection infrastructure. Recipients are campus type applications (e.g., schools, police stations.) Two more Round 2 winners were announced in October 2014.

- Minnesota conducted a major study, *Minnesota Microgrids: Barriers, Opportunities, and Pathways Toward Energy Assurance*, to examine regulatory barriers to and opportunities for MG development in the state (December 2013). Subsequently, the E 21 Initiative proposed a shift to greater reliance on distributed energy resources and greater customer choice (December 2014).

- The city of Pittsburgh signed a memorandum of understanding with the DOE in July of 2015 to be a federal test-case for a city-scale combined heat and power microgrid.

- The city of Boston is jointly developing a multi-user microgrid with a combined heat and power-based district energy system as part of an urban redevelopment project. The objective of this project is to create a more sustainable and reliable system to attract technology firms and meet city climate change goals. Other smart and sustainable city developments, such as Pittsburgh's, are pursuing multi-user microgrids as part of their redevelopment initiatives.

While these projects have mainly involved research into the potential of microgrids and how this potential might be realized, the PECO Microgrid Pilot involves the design and operation of a fully-functional microgrid which will provide important actual data on its operational characteristics, and on how new technologies can be most effectively integrated to optimize the performance of the system and expand its capabilities.

Another driver of microgrid development – particularly in the commercial/industrial sector, has been environmental sustainability. Nearly half of Fortune 500 and 60% of Fortune 100 companies have established aggressive clean energy goals. Microgrids that are composed of renewable distributed energy resources present a viable means of attaining these objectives, and one that is increasingly being considered by large commercial/industrial customers. Economic factors have also been contributing to microgrid development, as the cost of distributed energy resources that could be part of a microgrid system – particularly solar power – have been steadily declining. Technological factors, too, have played a role in this development, with the continued improvement in microgrid control technologies.

7. Q. What are the benefits of utility involvement in microgrids?

A. Non-utility entities that build, own, and operate microgrids encounter significant regulatory complications if these facilities are involved in the sale and/or delivery of electricity outside of its boundaries. Under these circumstances, depending upon the jurisdiction, the entity may have to be recognized as an electricity marketer, or, in the case of large facilities, it may even have to be classified as a public utility and receive regulatory authority to separate itself from the franchise territory of the local utility that had been serving the customers connected to the microgrid. There may be restrictions against the facility running electricity wires across public rights-of-way, or, in non-restructured states, against the entity simply trying to sell electricity directly to a utility's customers. These challenges disappear if the microgrid is owned and/or operated by the local utility, along with the risks of unnecessary redundancies involving duplicative investments in distribution infrastructure. And the utility's involvement presents further distinct benefits. In particular, utility projects can be optimally sized to produce the maximum benefits for the users of the facility as well as for the entire distribution grid. But from a more fundamental perspective, the regulatory construct under which utilities have always operated have given them the mission to provide safe and reliable power in the most efficient and cost-effective manner possible. Utility involvement in microgrid projects will ensure that these projects will be implemented and operated in a manner that will be of optimal benefit to all customers. Similarly, projects that might face challenges to implementation, because from a limited, case-specific perspective they do not present sufficiently favorable benefit/cost ratios, may be justified from a broader system perspective, as utility projects, when other more comprehensive benefits are taken into account, such as improved overall system reliability and resiliency and/or the contribution to grid technological development. In any case, utility-supported microgrid projects will comprise a mutually beneficial approach (i.e., to the microgrid and its users in particular, as well as to the overall grid) for addressing the growing presence of distributed energy resources, by providing an avenue for effectively incorporating and utilizing these resources within the electricity system.

8. Q. What are the benefits of engaging in a pilot program?

A. A pilot program provides an effective venue for demonstrating new technologies, observing their operational characteristics, and optimizing their performance under controlled conditions. Microgrids are nascent technologies, and with such technologies there is always the possibility that there will be unforeseen challenges or complexities involved with installing and operating them. With a pilot program, any such unforeseen challenges can be addressed at a manageable level. And it is much easier, with pilots, to make alterations to the design in order to correct or even improve the operation of the facilities. Making such design and operational changes and improvements at the pilot level could result in significant savings when subsequent, larger scale projects are implemented. Also, the net value of projects involving new technologies and/or operational characteristics has to be estimated based on projections of costs and benefits, and at least some of these projections may have to be derived from assumptions that have a limited set of experiential data to draw from. A pilot program will provide – again on a manageable scale – a method for measuring the actual capital and operational costs necessary to install and operate the system, and will also provide a means of measuring the actual benefits that are accruing to customers and other stakeholders. Projected costs and benefits of larger projects will have a much firmer grounding when these projections can draw from the experience of a pilot program. The pilot will also provide opportunities to clarify the roles and responsibilities of the utility and entities that are being served by the microgrid. Finally, a pilot program will provide information that can guide future development of microgrids.

9. Q. What are examples of successful utility microgrid pilot programs?

A. The Borrego Springs substation microgrid, developed by San Diego Gas & Electric ("SDG&E") at a total cost of $18 million, is one of the early microgrid successes. It was completed in 2013, and integrated five technologies: 1) a variety of distributed energy resources, including energy storage and solar PV, 2) a feeder automation system, 3) a microgrid controller that was co-developed by SDG&E and a third-party, 4) an advanced substation storage system, and 5) supervisory control and data acquisition. The system was originally designed to serve 500 residential, commercial, and industrial customers in a remote location in order to determine if they could be served at less cost with a microgrid configuration as compared to a traditional line extension, and also to demonstrate that energy storage could effectively mitigate the impact of electricity supply from intermittent resources such as solar power. The storage facilities exceeded expectations, and the microgrid itself proved effective in maintaining power during planned shutdowns of transmission lines to the remote community and in repowering distribution feeders after a major storm. The project also highlighted some areas for further improvement in microgrid design, such as the need for a better means of re-synchronizing frequencies after the microgrid had been isolated from the general system.

Another example of a microgrid pilot is the system that Oncor has built at one of its service centers in Lancaster Texas, which utilizes ten different distributed energy power sources, including natural gas, solar, and community storage. The system is designed so that the microgrid is automatically dispatched using pricing signals and has state-of-the-art inverter technology. It is providing Oncor with hands-on experience in building and operating microgrids.

10. Q. What benefits do you foresee from the PECO Microgrid Pilot?

A. As William J. Patterer describes in his testimony, the PECO Microgrid Pilot will go well beyond these recent successes to deploy a "real world" community microgrid integrated with PECO's distribution system. The Pilot will enable a testing of the underlying technologies (Microgrid Controller, Communications Network, and IT systems) to ensure that they will effectively interface with the existing distribution system and perform as anticipated. The pilot will also allow the ongoing evaluation of the fundamental operational characteristics of the microgrid, including islanding and resynchronization, and maintaining and restoring power supply, and highlight areas for system improvement or development. The pilot will also provide an avenue for testing expanded capabilities and applications, particularly with respect to the incorporation and management of a variety of distributed energy resources that are owned by customers. It will also provide data on the comparative level of reliability improvement which occurs among customers served by it. In addition to performance data, economic data will be collected which will make possible a better assessment of the costs and benefits of operating the system. The insights gained from operating this pilot will ensure that future microgrid projects in Pennsylvania and elsewhere can be designed and operated in a way that provides maximal benefit to all customers and stakeholders associated with them.

III. CONCLUSION

11. Q. Does this conclude your direct testimony at this time?

A. Yes.

PECO ENERGY COMPANY
STATEMENT NO. 3

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

PETITION OF PECO ENERGY COMPANY FOR:
(1) APPROVAL OF ITS MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN AND (2) ISSUANCE OF A DECLARATORY ORDER REGARDING THE RECOVERY OF MICROGRID COSTS

DOCKET NO. P-2016-

APPLICATION FOR CONSTRUCTION OF MICROGRID DISTRIBUTED ENERGY RESOURCES FUELED BY NATURAL GAS

DOCKET NO. A-2016-

DIRECT TESTIMONY

WITNESS: ALAN B. COHN

SUBJECTS: RECOVERY OF MICROGRID INTEGRATED TECHNOLOGY PILOT PLAN COSTS AND COST ALLOCATION

DATED: MAY 18, 2016

TABLE OF CONTENTS

DIRECT TESTIMONY
OF
ALAN B. COHN

I. INTRODUCTION AND PURPOSE

1. Q. Please state your full name and business address.

A. My name is Alan B. Cohn. My business address is PECO Energy Company, 2301 Market Street, Philadelphia, Pennsylvania 19103.

2. Q. By whom are you employed and in what capacity?

A. I am employed by PECO Energy Company ("PECO" or the "Company") as Manager of Regulatory Strategy.

3. Q. Please describe your educational background.

A. I received a Bachelor of Science Degree in Commerce and Engineering from Drexel University in 1980. In 1985, I received a Master of Business Administration from Drexel. In addition, I have completed the American Gas Association ("AGA") Gas Rate Fundamentals Course at the University of Wisconsin and the AGA Advanced Gas Rate Course at the University of Maryland.

4. Q. Please describe your work experience with PECO.

A. Upon graduation from college in 1980, I was hired by PECO as a Rate Analyst in the Cost and Load Analysis Section of the Rate Division. In 1987, I was appointed Supervisor of the Economic Analysis Section in PECO's Rates and Regulatory Affairs Division. Since that time, I have held various management positions in PECO's Rates and Regulatory Affairs Department and Strategic

Planning Department with responsibility for managing base rate case filings, cost of service studies and financial and economic analyses.

5. Q. Have you previously testified before this Commission or other regulatory bodies?

A. Yes. I have testified in regulatory proceedings before the Pennsylvania Public Utility Commission ("Commission"), the Federal Energy Regulatory Commission ("FERC") and the Maryland Public Service Commission. A listing of the cases in which I have submitted testimony is attached hereto as Exhibit ABC-1.

6. Q. What is the purpose of your direct testimony?

A. The purpose of my direct testimony is to describe the Company's proposed methodologies to allocate and recover the costs associated with PECO's Microgrid Integrated Technology Pilot Plan ("Microgrid Pilot" or "Plan") to construct and operate a microgrid on a proposed pilot site in Concord Township, Pennsylvania ("Concord Township Project" or the "Project").. My testimony is divided into three parts. First, I describe PECO's proposal to recover the projected costs of its Microgrid Pilot from all customers and opportunities to offset those costs, including participation in the markets operated by PJM Interconnection, L.L.C. ("PJM"). Second, I discuss PECO's proposal to recover the distribution-related costs associated with eligible microgrid property through the Company's Distribution Service Improvement Charge ("DSIC") and explain how those costs will be allocated among customer classes. Finally, I describe PECO's request to recover the balance of Plan costs, comprised primarily of distributed energy resource-related costs, in a future electric distribution rate case.

7. Q. Have you prepared any exhibits to accompany your testimony?

A. Yes. PECO Exhibits ABC-1 to ABC-6 were prepared at my direction and under my supervision and are described in detail in my testimony.

II. ALLOCATION OF MICROGRID PILOT COSTS

8. Q. Has PECO identified the costs of its Microgrid Pilot that it will seek to recover from customers?

A. Yes. PECO's preliminary projections of costs associated with the Microgrid Pilot are identified in Exhibit WJP-5 and explained by Mr. Patterer in PECO Statement No. 1. Exhibit WJP-5 provides a detailed breakdown of those estimated costs.

9. Q. Is PECO proposing to recover Microgrid Pilot costs from all customers?

A. Yes. As Mr. Patterer explains, the Microgrid Pilot includes key investments in distribution infrastructure as well as new microgrid technology that will permit the microgrid to operate in "island mode" during a service interruption. When the microgrid is operating in island mode, the Concord Township Project will provide uninterruptible service to the local fire department and township building and will rapidly restore power to other public accommodations accessible to more than 86,000 Commonwealth residents who live within a five-mile radius of major traffic routes within the microgrid footprint. The Microgrid Pilot will also generate important new microgrid development and performance information that will be highly useful in the future deployment of microgrids throughout PECO's service territory and, ultimately, across the Commonwealth. Allocating the associated costs of the Microgrid Pilot to all customers is consistent with the

Commission's long-standing approval of this manner of allocating the costs of infrastructure improvement projects, including investments designed to improve reliability in specific areas of PECO's service territory.

10. Q. Will PECO have any offsetting cost savings associated with the implementation of the Microgrid Pilot?

A. Yes. During grid-connected mode, the DERs owned by PECO are expected to participate in PJM wholesale markets when it is economic to do so and will not be used to provide default service supply. The net proceeds from any PJM wholesale market transactions involving the DERs will be flowed back to PECO distribution customers. In addition, as Mr. Patterer explained, the DERs in the Preliminary Base Design will be owned and operated by PECO. PECO anticipates that siting all microgrid DERs in the Preliminary Base Design, except for batteries located at Concord Township buildings, on PECO property will further reduce the land costs associated with the Project identified on Exhibit WJP-5.[1]

11. Q. Does PECO intend to pursue state and federal funding sources to further offset Plan costs recovered from customers?

A. Yes, but PECO's estimate of the total costs of the Microgrid Pilot does not assume the receipt of any grant money. PECO will actively monitor federal and state funding opportunities during the term of the Microgrid Pilot and pursue appropriate opportunities to obtain additional financing to reduce costs. Any grants awarded through PECO's efforts, net of taxes and costs to achieve the

[1] The Project's Preliminary Base Design is described in detail by Mr. Patterer in PECO Statement No. 1.

grant, will be applied to offset the Company's capital investments in the Pilot's microgrid generation assets. Accordingly, such awards will be treated as contributions in aid of construction ("CIAC") for ratemaking purposes. Consistent with CIAC treatment, taxes paid by PECO on any grants will be deferred and netted against the rate base deduction from the grant. This deferred tax asset will be reduced to zero over the tax life of the assets funded by the grant.

III. RECOVERY OF ELIGIBLE MICROGRID PILOT COSTS THROUGH THE DISTRIBUTION SERVICE IMPROVEMENT CHARGE

12. Q. Mr. Cohn, please describe PECO's proposed mechanism to recover the Microgrid Pilot's distribution-related costs.

A. PECO proposes to recover the reasonable and prudent Microgrid Pilot costs incurred to repair, improve or replace eligible property that is part of the Company's distribution system, along with the Company's other electric Long-Term Infrastructure Improvement Plan ("LTIIP") investments approved by the Commission in Docket No. P-2015-2471423, through the Company's DSIC. Consistent with Section 1358(b)(1) of the Pennsylvania Public Utility Code ("Code"), the costs that PECO proposes to initially recover through its DSIC would be rolled into base rates in a subsequent electric base rate case, at which point the DSIC would be reset to zero.

13. Q. Why is it appropriate for PECO to recover eligible microgrid property through the DSIC?

A. The purpose of a DSIC is to allow utilities to timely recover the capital costs of DSIC-eligible property that is placed in service between base rate cases in order to ensure and maintain adequate, efficient, safe, reliable and reasonable service. As explained by Mr. Patterer, customers within the Concord Township Project's boundaries have experienced longer than average outage durations in the past five years and this location was selected for PECO's initial microgrid site, in part, because of the potential for reliability and resiliency improvement following the deployment of the proposed microgrid.

14. Q. Has PECO identified Microgrid Pilot costs which are eligible for recovery through PECO's DSIC?

A. Yes. As shown on Exhibit ABC-2, distribution-related microgrid investment totaling approximately $15.3 million under the Microgrid Pilot Plan consists of "eligible property" as defined in Section 1351 of the Code. Those microgrid investments constitute distribution-related equipment and facilities, including overhead and underground cables, transformers, switching devices such as circuit breakers and reclosers, and other related capitalized costs. Other distribution-related capitalized costs include a portion of engineering, procurement and construction ("EPC") costs allocated in proportion to the DSIC-eligible property's percentage of total capital investments under the Microgrid Pilot Plan and communications and control property used to operate the microgrid, as well as battery storage systems supporting the reliability of the distribution system. This classification of Quanta Technology LLC's ("Quanta")[2] cost estimates as DSIC-

[2] Mr. Patterer explains Quanta's role in the development of the Plan (PECO Statement No. 1, p. 27).

eligible is preliminary, and only the costs associated with eligible microgrid property actually in service when the microgrid is operational will be recovered through the DSIC.

15. Q. Is PECO proposing any changes to its LTIIP or DSIC Tariff in this proceeding?

A. No. Following the Commission's final Order in this proceeding, PECO will file a petition to amend its electric LTIIP in Docket No. P-2015-2471423 to include DSIC-eligible microgrid expenditures based on the final design of the Project. PECO will also include those investments in the applicable quarterly updates to the DSIC calculation at the time the associated plant is placed in service.

16. Q. Did you estimate the impact of the Company's proposal to reflect eligible microgrid investments in the DSIC?

A. Yes. As shown for illustrative purposes on Exhibit ABC-3, based on preliminary cost estimates, inclusion of eligible Plan costs are expected to have a minor impact on the DSIC rate (i.e., approximately 0.17 percent).

17. Q. How will DSIC-eligible Microgrid Pilot costs be allocated to customer classes?

A. Consistent with the Commission's Model Tariff,[3] the fixed costs of investments in the Plan eligible for recovery under the Company's DSIC will be reflected as a percentage of distribution revenue and will be applied to all customers' bills for distribution service.

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[3] The Commission adopted the model tariff as part of its August 2, 2012 Final Order in *Implementation of Act 11 of 2012* at Docket No. M-2012-2293611.

IV. RECOVERY OF DISTRIBUTED ENERGY RESOURCE-RELATED MICROGRID COSTS IN A FUTURE ELECTRIC BASE RATE CASE

18. Q. Has PECO identified Microgrid Pilot costs that are not eligible for inclusion in the Company's DSIC?

A. Yes. The remaining costs of the Project's Preliminary Base Design are detailed in Exhibit ABC-4 and consist primarily of distributed energy resources ("DER") that will power the proposed microgrids and any related information technology systems, communications networks and control equipment ("Non-DSIC Microgrid Costs"). The Non-DSIC Microgrid Costs also include EV charging stations. PECO proposes to recover the Non-DSIC Microgrid costs in a subsequent electric distribution rate case.

19. Q. Has PECO calculated the anticipated effect on distribution base rates of the costs of implementing the Preliminary Base Design using its estimated costs?

A. Yes. First, I determined PECO's annual revenue requirement associated with the Project in its Preliminary Base Design. This requirement will consist of five general components: (1) the microgrid rate base; (2) a return on PECO's net investment in the microgrid; (3) O&M expense, including fuel costs; (4) state tax flow-through; and (5) a credit for microgrid-related revenues received from PJM. I will describe each element in more detail below. Exhibit ABC-5 also provides illustrative calculations of the annual revenue requirement of the Preliminary Base Design, including both the DSIC-eligible and non-DSIC eligible components, for the first year of the Project's operation, assuming its in-service date coincides with the effective date of new base rates.

Microgrid Rate Base. The microgrid rate base will be the total capital investment to design and construct the microgrid, less accumulated depreciation and accumulated deferred income taxes ("ADIT"). To determine microgrid rate base, I first separated the Non-DSIC Microgrid Costs into three FERC account functions: distribution plant, DER plant and general plant. For illustrative purposes, the depreciation expense for distribution plant, generation plant and general plant was based on a service life of 50 years, 20 years and 50 years, respectively. The actual depreciation rate will be based upon the engineering determination of useful life of the applicable microgrid investments and the FERC account to which those costs are recorded. For illustrative purposes, PECO's tax depreciation and ADIT will be based on a 20-year tax-depreciable life, with the exception of solar facilities which have a 5-year tax-depreciable life. Tax depreciation will be recorded in the year incurred. Like book depreciation, actual tax depreciable lives will be based on the final design of the Microgrid Pilot.

Return on Net Investment. The Company's base rate revenue requirement will include its cost of capital, which will be calculated based on PECO's microgrid rate base described above, its weighted average cost of capital ("WACC"), and an allowance for income taxes on the equity portion of its return, as determined in its subsequent base rate cases. Exhibit ABC-6 provides a calculation of the pre-tax WACC that was used to develop the illustrative revenue requirement. The illustrative WACC is based on the capital structure and cost rate for long-term debt reflected in PECO's latest quarterly earnings report submitted to the Commission and the equity cost rate determined by the Bureau of Technical

Utility Service for use in calculating the DSIC for electric distribution companies as set forth in its Report On The Quarterly Earnings of Jurisdictional Utilities. The illustrative WACC also reflects an appropriate gross-up for income taxes at the statutory rates associated with the equity portion of the cost of capital. Prior to being placed in service, any capital expenditures under the Plan will accrue an allowance for funds used during construction.

State Tax Flow Through. The capital investment included in the microgrid rate base receives the benefit of accelerated tax depreciation. Pennsylvania requires the flow through of the benefit of accelerated tax depreciation used in calculating state income taxes.

O&M Expense. O&M expense consists of all expenses the Company incurs in connection with the operation and maintenance of the microgrid. This includes operations, service and maintenance of all microgrid equipment, fuel costs to operate DER during island mode (i.e., approximately $10,000 per year) and real estate taxes.

Market Sales Credits. As previously noted, PECO will sell the energy output and capacity of the microgrid into PJM markets when it is economic to do so. All revenues PECO receives from these sales net of fuel costs will flow back to customers as a credit against the total revenue requirement for the microgrid. Additionally, the value of solar renewable energy credits sold from the microgrid's solar units will be netted against the revenue requirement.

20. Q. Have you estimated the impact on distribution revenue of the proposed Microgrid Pilot?

A. Yes. Exhibit ABC-5 provides an estimate of the base rate impact of the Preliminary Base Design microgrid plant assuming it is placed in service on the effective date of new base rates. Based on the revenue requirement for the calculations for the preliminary cost estimate detailed in Exhibit ABC-5, the estimated maximum impact on base rates would be, on average, 0.43 percent of total distribution revenue.

21. Q. How will the Non-DSIC Microgrid Costs (and DSIC costs, when they are rolled-in to base rates) be allocated among rate classes?

A. PECO will use well-established cost of service principles to allocate the Non-DSIC Microgrid Costs in a subsequent rate case. The costs will be allocated consistent with the methodology for the FERC account in which they are recorded. DER-related costs will be allocated to PECO's rate classes in proportion to their non-coincident peak demands consistent with the Company's methodology used to allocate distribution plant, which from a design and operational perspective is sized to meet the maximum kW load (demand) requirements of customers.

22. Q. Why is PECO proposing to classify the DER cost components of the Microgrid Pilot as distribution costs for purposes of allocation?

A. As explained by Mr. Patterer, the central purpose of the proposed microgrid demonstration project is to improve distribution system reliability and resiliency. The primary function of the microgrid's DER facilities is to help ensure that critical government facilities and public accommodations maintain power and are accessible to customers within the region during major service disruptions, not to meet the on-going energy and capacity needs of retail customers. Accordingly, PECO proposes to classify associated costs as distribution costs in a subsequent rate case as I have described.

V. CONCLUSION

23. Q. Does this conclude your direct testimony?

A. Yes.

Listing of Prior Case Testimony

Maryland

Conowingo Power Company Case No. 7982 – Revenue, expense, rate base and taxes
Conowingo Power Company Case No. 8352 – Revenue, expense, rate base and taxes

Federal Energy Regulatory Commission

Docket No. ER91-478 – Revenue, expense, rate base, taxes, cost of service and rate design
Docket No. ER04-156 – Revenue Requirement under Schedule 12 of the PJM OATT

Pennsylvania

Docket No. R-891364 – Revenue, expense, rate base and depreciation
Docket No. I-900005 – Impact of demand side management on off-system sales
Docket No. R-922479 – Appropriate ratemaking treatment of SFAS 106
Docket No. R-973877 – Quantification of assets, jurisdictional allocation, revenue requirement and allocation of revenue requirement
Docket No. R-973953 - Quantification of assets, jurisdictional allocation, revenue requirement and allocation of revenue requirement
Docket No. C-20016610- Appropriate discount rate for use in determining a CTC buyout
Docket No. P-072260 – Appropriate cost recovery mechanism for providing full and current recovery of cost of complying with the Alternative Energy Portfolio Standards
Docket No. P-2008-2062739 – Default Service Tariff Changes
Docket No. P-2008-2062741 – Market Rate Transition Phase-In Rider and Cost Recovery
Docket No. M-2009-2093215 – Energy Efficiency and Conservation Plan, Avoided Cost Projections
Docket No. M-2009-2123944 – Cost Allocation and Cost Recovery Mechanism for Smart Meter Costs
Docket No. R-2010-2161575 – Rate Design/Revenue Allocation/Tax Repair
Docket No. R-2010-2161592 - Merchant Function Charge/Tax Repair
Docket No. P-2012-2283641 - Default Service Program Rate Design and Tariff Changes
Docket No. M-2009-2123944 – Ratemaking Treatment of Accelerated Depreciation of Automated Meter Reading Investment
Docket P-2012-2283641 – Recovery of Customer Assistance Program Shopping Plan Costs and Retail Tariff Changes
Docket No P-2014-2409362 – Default Service Rate Design and Tariff Changes
Docket P-2014-2451772 – Proposed tariff changes for a new gas main extension policy and a new Neighborhood Gas Pilot program.
Docket P-2013-2347340 – Implementation of a Gas Distribution System Improvement Charge
Docket R-2015-2468981 – Cost of Service
Docket P-2015-2471423 – Electric Distribution System Improvement Charge
Docket P-2016-2534980 - Default Service Rate Design and Tariff Changes

Estimated DSIC Eligible Recovery ($000)

Cost Item		Estimated Distribution Costs
Development		
Permits	$	203
Land	$	32
Purchase/Off Take Agreements	$	5
Financing	$	146
Legal Fees	$	292
Training and Standards	$	44
Conceptual Engineering	$	378
Development Team	$	664
Total Development Cost w/o Site Assessment	$	1,763
EPC Direct Costs		
Engineering	$	485
Project Management	$	526
Civil Works	$	1,344
Equipment: Battery	$	720
Installation: Battery	$	108
Reconfiguration - Cable & Labor	$	2,093
Reconfiguration - Controller	$	2,056
EV Charging Station	$	70
MV Switchgear & Transformer	$	766
Control House & Accessories	$	1,031
Interconnection & Commissioning	$	519
Total EPC Direct Costs	$	9,717
EPC Indirects	$	534
Contingency	$	2,915
Feasibility Study	$	500
Total Estimated Distribution Costs	$	15,430
Estimated DSIC Eligible FERC Distribution Plant Accounts 360 to 369 and 397	**$**	**15,283**
Estimated Non-DSIC Eligible FERC Distribution Plant Account 396 (EV Charging Station and Allocated Common Cost)	$	146
Total Estimated Distribution Costs	$	15,430

Estimated Capital Expenditures ($000)

			Category							
			Directly Assigned		Allocated		Total		Total	
Line	Item	Cost	Distribution	Distributed Energy Resources	Distribution	Distributed Energy Resources	Distribution	Distributed Energy Resources	Project Cost	Allocation Method
1	**Development**									
2	Permits	$ 298	$ 203	$ 95			$ 203	$ 95		Direct
3	Land	$ 490	$ 32	$ 458			$ 32	$ 458		Direct
4	Purchase/Off Take Agreement	$ 265	$ 5	$ 260			$ 5	$ 260		Direct
5	Financing	$ 329			$ 146	$ 183	$ 146	$ 183		Based on EPC Direct Costs directly assigned (see line 38 for the allocation ratio)
6	Legal Fees	$ 658			$ 292	$ 367	$ 292	$ 367		Based on EPC Direct Costs directly assigned (see line 38 for the allocation ratio)
7	Training and Standards	$ 100			$ 44	$ 56	$ 44	$ 56		Based on EPC Direct Costs directly assigned (see line 38 for the allocation ratio)
8	Conceptual Engineering	$ 491	$ 378	$ 113			$ 378	$ 113		Based on EPC Direct Costs directly assigned (see line 38 for the allocation ratio)
9	Development Team	$ 1,500	$ -	$ -	$ 664	$ 836	$ 664	$ 836		Based on EPC Direct Costs directly assigned (see line 38 for the allocation ratio)
10	**Total Development Cost w/o Site Assessment**	$ 4,130	$ 617	$ 926	$ 1,146	$ 1,441	$ 1,763	$ 2,367		
11										
12	**EPC Direct Costs**									
13	Engineering	$ 1,095			$ 485	$ 610	$ 485	$ 610		Based on EPC Direct Costs directly assigned (see line 38 for the allocation ratio)
14	Project Management	$ 1,187			$ 526	$ 661	$ 526	$ 661		Based on EPC Direct Costs directly assigned (see line 38 for the allocation ratio)
15	Civil Works	$ 1,844	$ 1,344	$ 500			$ 1,344	$ 500		Direct
16	Equipment: Gas	$ 8,000		$ 8,000			$ -	$ 8,000		Direct
17	Equipment: Battery	$ 720	$ 720				$ 720	$ -		Direct
18	Equipment: Solar	$ 1,250		$ 1,250			$ -	$ 1,250		Direct
19	Installation: Gas	$ 1,200		$ 1,200			$ -	$ 1,200		Direct
20	Installation: Battery	$ 108	$ 108				$ 108	$ -		Direct
21	Reconfiguration -Cable & Labor	$ 2,093	$ 2,093				$ 2,093	$ -		Direct
22	Reconfiguration -Controller	$ 2,056	$ 2,056				$ 2,056	$ -		Direct
23	EV Charging Station	$ 70	$ 70				$ 70	$ -		Direct
24	MV Switchgear & Transformer	$ 766	$ 766				$ 766	$ -		Direct
25	Control House & Accessories	$ 1,031	$ 1,031				$ 1,031	$ -		Direct
26	Interconnection & Commissioning	$ 519	$ 519				$ 519	$ -		Direct
27	**Total EPC Direct Costs**	$ 21,938	$ 8,706	$ 10,950	$ 1,011	$ 1,271	$ 9,717	$ 12,221		
28										
29	**EPC Indirects**	$ 1,207			$ 534	$ 672	$ 534	$ 672		Based on EPC Direct Costs directly assigned (see line 38 for the allocation ratio)
30										
31	**Contingency**	$ 6,581			$ 2,915	$ 3,666	$ 2,915	$ 3,666		Based on EPC Direct Costs directly assigned (see line 38 for the allocation ratio)
32										
33	**Feasibility Study**	$ 500	$ 500				$ 500	$ -		Direct
34										
35	**Project Total Costs**						$ 15,430	$ 18,927	$ 34,357	
36										
37	EPC Direct Costs Directly Assigned						$ 8,706	$ 10,950		
38	Ratio Used to Allocate Costs Not Directly Assigned						44.3%	55.7%		
39										
40	**Distribution Plant**									
41	DSIC Eligible - FERC Accounts 360 to 369 and 397						$ 15,283			
42	Non-DSIC Eligible - FERC General Plant Account 396 (EV Charging Station & Allocated Common Cost)						$ 146			
43										
44	**Distributed Energy Resources**									
45	FERC Accounts 340 to 344							$ 18,927		

Estimated Impact on the DSIC
($000 Except Rates)

Item		Impact
Estimated Microgrid Investment Eligible for DSIC Recovery	$	15,283
Pre-tax Rate of Return[1]		11.33%
Pre-tax Return	$	1,732
Annual Depreciation[2]	$	306
Total Annualized DSIC	$	2,037
Adjustment for Gross Receipt Tax	$	2,165
Total Distribution Revenue[3]	$	1,288,000
Impact on the DSIC		**0.17%**

Notes:
1. See PECO Exhibit ABC-6
2. 50-year depreciation life
3. From 2015 Rate Case Settlement

Estimated Non-DSIC Eligible Costs ($000)

Cost Item	Estimated Cost
Development	
Permits	$ 95
Land	$ 458
Purchase/Off Take Agreements	$ 260
Financing (Construction Closing)	$ 183
Legal Fees	$ 367
Training and Standards	$ 56
Conceptual Engineering	$ 113
Development Team	$ 836
Total Development Cost w/o Site Assessment	$ 2,367
EPC Direct Costs	
Engineering	$ 610
Project Management	$ 661
Civil Works	$ 500
Equipment: Generation excluded Solar	$ 8,000
Equipment: Solar	$ 1,250
Installation: Generation Equipment	$ 1,200
Total EPC Direct Costs	$ 12,221
EPC Indirects	$ 672
Contingency	$ 3,666
Total Estimated Distributed Energy Resources Cost	$ 18,927
Estimated Non-DSIC Eligible	
FERC Distributed Energy Resources Accounts 340 to 344	$ 18,927

Revenue Requirement ($000)

	Year 1
O&M	
Fuel (Island Mode)	$ 10
Microgrid Operating and Maintenance	$ 597
Depreciation	$ 1,249
Return on Rate Base[1]	$ 3,742
State Tax Flow Through[2]	$ (26)
Revenue Requirement	$ 5,572
Less: Estimated Market Sale Revenue net Fuel (Non-Island Mode)	$ 329
SRECs	$ 66
Net Revenue Requirement prior to GRT	$ 5,177
Net Revenue Requirement with GRT	$ 5,502
Revenue Requirement Impact on Distribution Revenue	0.43%

Rate Base ($000)

	Year End
Gross Plant	$ 34,357
Less: Accumulated Depreciation	$ 1,249
Accumulated Deferred Tax	$ 81
Net Rate Base	$ 33,027

Notes:

1. Rate base multiplied by weighted average pre-tax cost of capital (see PECO Exhibit ABC-6);
2. The difference between tax depreciation and book depreciation multiplies state tax flow through rate of 6.5% , then gross up for tax.

Weighted Average Cost of Capital

	Capitalization Ratio	Cost	Wieghted Cost	Combined FED & State Tax Rate	Weighted Average Pre-tax Cost of Capital
Long-term Debt	45%	4.49%	2.02%		2.02%
Common Equity	55%	9.90%	5.45%	41.49%	9.31%
Total	100%				11.33%