

**PPL Electric Utilities**

**2014 Regional Transmission Expansion Plan (“RTEP”)  
Project Proposal Window 1**

## **Project Compass**

*A comprehensive, integrated solution  
to set new direction for power delivery*

*Solving 2014 RTEP violations while developing a long term PJM solution*

**REDACTED VERSION**

**Submitted July 28, 2014**

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## **A.1 Name and Address of Proposing Entity**

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(610) 774 – 5151

Point of Contact:

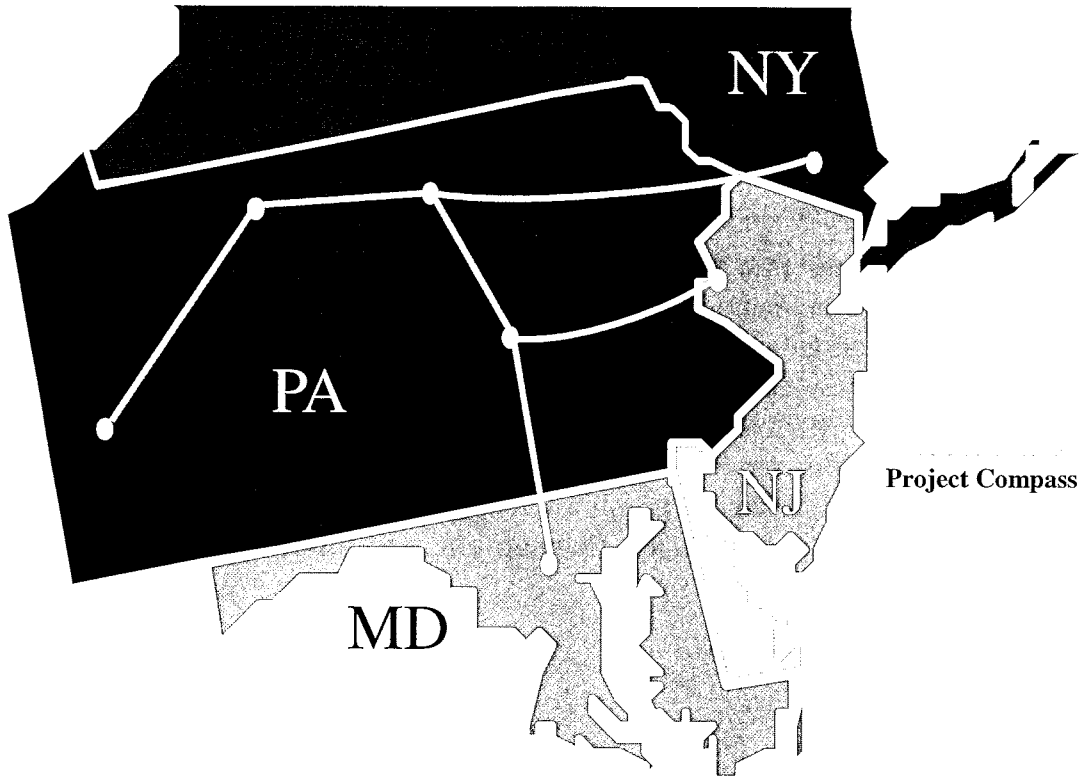
Vincent J. Cuce  
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Business: (610) 774 – 6580  
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## **A.2 Description of Proposed Solution**

PPL Electric Utilities Corporation (PPL EU) is pleased to present Project Compass, a comprehensive, integrated solution that will set a new direction for power generation and delivery in the Mid-Atlantic region. When fully implemented, Project Compass will span across Pennsylvania to demand centers in New York, Pennsylvania, New Jersey and Maryland, delivering a variety of significant near and long term reliability, grid security, cost, and environmental benefits to customers and stakeholders.

Project Compass was conceived by PPL EU's Transmission Planning organization and consists of three primary transmission line segments (northern, southern and central), totaling approximately 725 transmission miles and stretching from western Pennsylvania to eastern New York and New Jersey and from central Pennsylvania to Maryland.

**Figure A2-1: Project Compass Geographic Illustration**



The northern segment includes an east to west constructed double circuit 500kV transmission line from approximately [REDACTED]. The southern segment includes a north to south single circuit 500kV transmission line from approximately [REDACTED]. The central segment includes a single circuit 500kV line from approximately [REDACTED].

This proposal will describe Project Compass in its entirety – 1) the relevant benefits to customers and stakeholders; 2) the associated investment required to enable these benefits, and 3) PPL EU’s unique and differentiating capabilities to lead this effort. This innovative solution alleviates line overload conditions identified in the 2014 RTEP Proposal Window and also unlocks long term strategic benefits to states across the Mid-Atlantic. The complete solution has been conceived with a modular approach to construction providing valuable flexibility to address the region’s current and future needs. We have formatted our response to largely conform to the requirements in the PJM Greenfield Proposal Template but caution that, because of the multi-regional and multi-driver aspect of this proposed solution, certain details will be further developed as PPL EU communicates the significant advantages Project Compass provides to affected stakeholders.

As part of our transmission planning efforts we have also delineated two discrete alternatives derived from the comprehensive Project Compass solution. We describe the benefits and associated costs for these alternatives for consideration by PJM with the intent to describe complementary, but less comprehensive, solutions that create meaningful value to stakeholders. PPL EU has also evaluated a number of smaller alternatives based on the Project Compass solution but believe our proposal results in the most comprehensive set of benefits to stakeholders.

### **PPL EU Recommendation**

PPL EU recognizes that Project Compass does not conform to current PJM project classification and evaluation protocols; however, the compelling nature of this solution provides an opportunity for PPL EU, PJM, and affected stakeholders to work together to further evaluate how the development of this project would advance the current and long term objectives of PJM and its system members. An accelerated approval, planning and construction process provides the most economical solution to achieve the Project Compass benefits over the long-term as compared to an ad hoc or fragmented approach. PPL EU will lead a coordinated planning effort to further develop this long lasting solution.

## **A.3 Project Summary**

### **A.3.1 Benefits Summary**

Project Compass is a multi-faceted solution that, first and foremost, results in significant reliability benefits to both PJM and NYISO. PPL EU is submitting this proposal during the 2014 RTEP Proposal Window #1 as we are confident that this project not only solves violations in the PJM 2014 Proposal Window but also provides additional longer term benefits.

Project Compass alleviates two Overloaded Facilities as listed on the 2019 PJM Generation Deliverability Result list (2014 RTEP Proposal Window #1):

1. [REDACTED]  
[REDACTED] **addresses the Lackawanna-North Meshoppen 230 kV line overload** as identified in 2019 RTEP generator deliverability analysis.
2. [REDACTED]  
[REDACTED] **addresses the Montour-Sunbury 230 kV line overload** as identified in 2019 RTEP generator deliverability analysis.

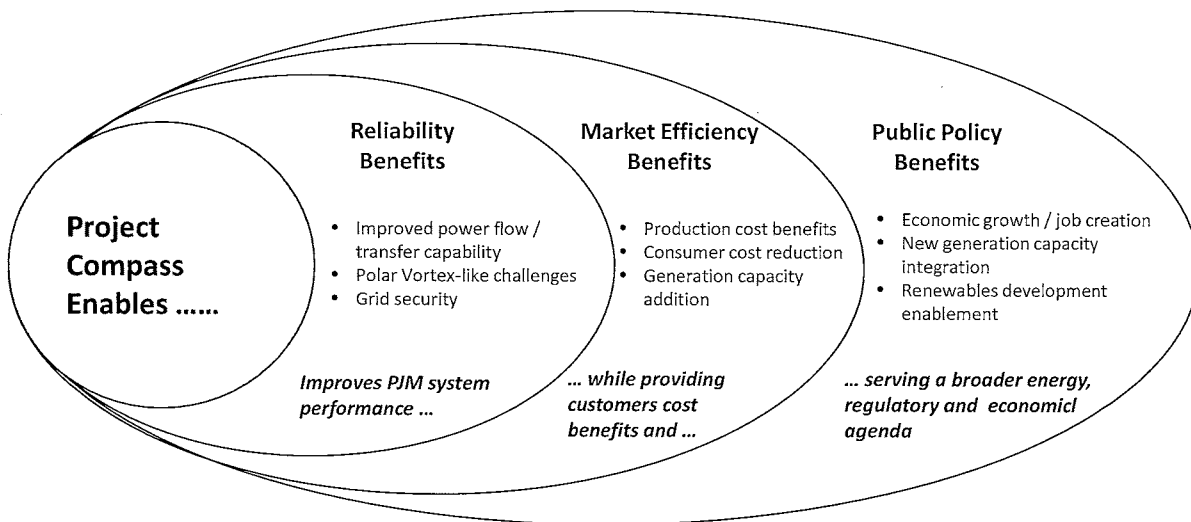
This solution also solves a line overload previously identified by PPL:

\_\_\_\_\_ addresses the Siegfried-Frackville 230 kV line overload.

The details of these solutions are provided in accordance with the PJM 2014 RTEP Proposal Template (Excel spreadsheet).

Because of the comprehensive nature of this integrated solution, Project Compass not only addresses identified reliability challenges but also enables many market efficiency and public policy benefits as indicated in Figure A3.1-1 below.

**Figure A3.1-1: Project Compass Benefits Summary**



### A.3.2 Reliability Benefits

#### Improved power flow / transfer capability improvement

Transmission capacity is a critical element of a robust and resilient transmission system. The ability to move power inter- and intra-regionally contributes to a more reliable and robust system, and to a system able to recover from problems more efficiently and effectively. Project Compass contributes significantly to PJM’s ability to operate a more reliable and robust system. Our analysis suggests that building Project Compass reduces the amount of flow on the existing 230kV through 765kV network by approximately 12,400MW, therefore increasing the overall amount of MW that could be transferred across the 230kV through 765kV network.

Additionally, our modeling concluded that the Power-Voltage (P-V) transfer limits for a west to east transfer increased by approximately 2,300MW. This benefit provides the opportunity to transfer additional power from west to east (a historically constrained PJM power flow) and relieves congestion from western PA to northern New Jersey.

### **Polar Vortex-like challenges**

The PPL EU Project Compass addresses many of the issues encountered in last winter's Polar Vortex. During the early 2014 winter, the Northeast and the Midwest did not receive enough gas to efficiently serve generation, resulting in price spikes and near outages. This solution uses electric transmission to alleviate some of the gas transportation constraints; put in a different way, Project Compass provides "gas by wire." During the Polar Vortex, there were numerous related issues regarding market scheduling and nomination timetables but easing pressure on eastern gas-fired generation would reduce the impact of future weather events similar to the Polar Vortex.

### **Grid Security**

NERC has developed a new standard to address physical security at critical substations (NERC CIP 014-1) in response to the April 2013 attack on the Metcalf substation. Investing in improvements to physical security at critical substations is a prudent decision that will quickly reduce the likelihood of an event; however, it does not provide reduction in the severity of an event if it were to occur. Security improvements also do not mitigate the risk of coordinated attacks that may occur on transmission lines outside of the substation.

Project Compass provides a more permanent and complete solution for grid security by reducing the number of critical assets. Three substations classified as "critical" by PJM are addressed by Project Compass. The continued operation of these substations is essential to the system and their loss would have adverse impact to grid reliability. Our analysis indicates that Project Compass alleviates this reliability concern on these three substations thereby removing the "critical" designation of these substations.

A summary of the analysis and modeling performed to assess the reliability based benefits as a result of Project Compass is included as Appendix 1.

### ***A.3.3 Market Efficiency Benefits***

Project Compass delivers substantial economic benefits to electricity consumers throughout PJM and NYISO. Reduced electricity costs will result from congestion relief, improved system flexibility, and new generation capacity in lower fuel cost areas.

The economic benefits of building transmission lines from Western PJM to Eastern PJM include delivery of lower cost power from the West to the more constrained areas in the East. Project Compass provides access to alternative gas resources along the west-to-east



path extending this lower cost power far enough into Eastern PJM constrained areas to provide broad access and allow maximum flexibility.

To capture and quantify the likely market efficiency benefits of Project Compass, PPL EU completed modeling in the following areas:

1. Decreasing production costs by improving dispatch flexibility for the system operator and opening access to more efficient generators.
2. Relieving congestion allowing for a better balancing of electricity prices across the grid, leading directly to lower prices for millions of consumers, particularly during peak demand periods.
3. Enabling the construction of new capacity with greater reliability and lower gas basis costs due to siting near the gas resource.

A summary of the analysis and modeling performed to assess the market efficiency benefits as a result of Project Compass is included as Appendix 2 with the results briefly described below.

### **Production Cost Benefits**

We have developed an initial schedule to design, build and construct Project Compass with the full solution in operation by 2023 to 2025. Our analysis indicates that Project Compass allows a more efficient portfolio of generation to serve load and reduce congestion. These benefits grow over time as Project Compass provides increased access and transfer capacity within PJM allowing for greater utilization of the lowest cost generation. As fuel prices fluctuate, Project Compass provides the flexibility to reconfigure the generation mix to optimize overall cost levels. The table below displays the production cost savings in both PJM and NYISO in the initial year and over a five year average once Project Compass is operational.

**Figure A3.3-1: Annual Production Cost Savings**

\$ Millions<sup>1</sup>

<b>Area / Region</b>	<b>First Year</b>	<b>Five Year Average</b>
<b>NYISO</b>	<b>\$ 48</b>	<b>\$53</b>
<b>PJM</b>	<b>\$ 75</b>	<b>\$104</b>
<b>TOTAL</b>	<b>\$123</b>	<b>\$157</b>

### **Consumer Cost Benefits**

<sup>1</sup> Shown in nominal dollars

Project Compass also lowers consumer costs in both PJM and NYISO. This benefit is calculated as the reduction of locational prices throughout the year multiplied by the amount of load at those locations<sup>2</sup>. These benefits are displayed by region in the following table.

**Figure A3.3-2: Annual Consumer Cost Savings**

\$ Millions<sup>3</sup>

Area / Region	First Year	Five Year Average
NYISO	\$ 184	\$ 202
PJM	\$ 771	\$ 978
<b>TOTAL</b>	<b>\$ 955</b>	<b>\$1,180</b>

Benefits to consumers are mostly concentrated in the Eastern portion of PJM and in NYISO, where the line relieves constraints and helps to lower prices. The consumer cost benefit by state was estimated based on the share of load in each zone across states. The following table represents each state's share of the consumer cost benefit that accrues to the states within the Project Compass footprint.

**Figure A3.3-3: Relative State Distribution of Benefits**

State	First Year	Five Year Average
PA	38%	37%
NY	31%	30%
NJ	17%	17%
MD	14%	16%
<b>TOTAL</b>	<b>100%</b>	<b>100%</b>

As this analysis indicates, a predominant share of the consumer cost reductions created by construction of Project Compass inure to the benefit of customers within PJM states.

<sup>2</sup> Consumer cost savings includes savings derived from production.

<sup>3</sup> Shown in nominal dollars

## **Generation Capacity Additions**

Finally, we modeled changes in the generation capacity mix resulting from Project Compass' construction. By enabling lower cost generation to meet load requirements in PJM, retirement is accelerated for older, less efficient and less environmentally desirable generation (primarily coal-fired generation).

Project Compass will likely result in significant new gas plant development opportunities along its footprint, particularly near existing and future gas pipelines and processing plants located near lower cost gas resources. The ultimate scale of this development will depend on a variety of market and environmental policy outcomes. In a policy-driven carbon price scenario, an incremental 9GW of less efficient generation in PJM is retired and an incremental 12GW of more efficient generation is constructed over approximately the next twenty years. The new generation capacity would locate where the gas price basis is expected to be lowest, with approximately 4-6GW of the new capacity locating along Project Compass.

### ***A.3.4 Public Policy Benefits***

Project Compass provides a number of benefits related to advancing public policy objectives. These encompass employment and other spending-related benefits, environmental, generation additions and market development amongst others.

A more detailed description of the analysis performed relating to the public policy benefits enabled by Project Compass is provided in Appendix 3 with the results briefly described below.

#### **Employment and Other Spending-Related Benefits**

The Mid-Atlantic states, and in particular the states in which Project Compass will have a footprint, will benefit significantly from the investment and spending associated with constructing and operating the transmission line. The infrastructure investment will be funded within the PJM and NYISO regions and then redeployed into the same region through construction and operations expenditures. This benefit is even more substantial when considering that direct spending on labor, materials, services, taxes, and land will lead to additional economic activity in the regional economy.

Of the investment required to develop the Project Compass solution, over half will be spent directly in the regional economy. The expenditures will directly lead to an average of 2,000 to 3,000 full-time equivalent jobs over the construction period. A large number of these jobs are in skilled trades, and are paid at rates higher than the regional average.

There is an equal sized benefit along the related supply chain and elsewhere in the economy. Indirect employment is also expected to range from 2,000 to 3,000 full-time workers that, when combined with direct jobs, results in 4,000 to 6,000 full-time jobs. At its peak, construction of Project Compass could create as many as 9,000 jobs in the region.

## **Capacity Market Impacts**

In addition to the PJM reliability and market efficiency benefits, Project Compass will have beneficial impacts on the Reliability Pricing Model (RPM), PJM's capacity market. RPM is designed to recognize the value of capacity where it is needed most. In congested areas (in PJM east, for instance) capacity prices may separate because of localized demand and restricted imports resulting in higher prices. By reducing constraints between zones, the Compass solution will help potentially mitigate these price increases. Furthermore, Project Compass may lead to an overall reduced need for capacity through a decrease in the Installed Reserve Margin (IRM), leading to more consumer benefits.

## **Renewable Development Support**

Significant Renewable Portfolio Standards ("RPS") requirements have been established by Pennsylvania and the surrounding states impacted by Project Compass requiring upwards of 28GW to be built to meet requirements. The construction of Project Compass provides increased flexibility to source renewable capacity across the PJM and NYISO systems that would otherwise not be available.

Similar to other regions (e.g. ERCOT and the Competitive Renewable Energy Zone) that have created mechanisms to incent transmission development enabling renewable energy development, Project Compass supports Pennsylvania and the surrounding states with additional transmission capacity that provides developers new options to site and construct renewable resources.

## **Generation Development Enablement**

Project Compass advances the opportunity for new, efficient generation to more easily interconnect to the transmission grid, specifically the 500kV system in PJM, which is the least congested part of the system. Allowing developers to site generation projects in the Marcellus Shale region, where low gas prices exist, will provide a competitive generation source that can be integrated into the PJM and NYISO system.

### ***A.3.5 Estimated Project Costs***

PPL EU has developed a range of cost estimates for the significant components of Project Compass, as shown in the table below:

**Figure A3.5-1: Range of Estimated Project Costs**

<b>Project Component</b>	<b>Total \$ B</b>	<b>Transmission \$ B</b>	<b>Substation \$ B</b>
<b>Total</b>	<b>~\$4.0 - \$6.0</b>		

This range has been developed using PPL EU estimating methodology and tools, standard designs for both transmission lines and 500kV-230kV substations, and based on our experience in constructing large, complex transmission projects. These estimates will be refined as the scope and timing of the project is reviewed with other impacted stakeholders. Additional detail regarding the buildup of these costs is provided in Section C.

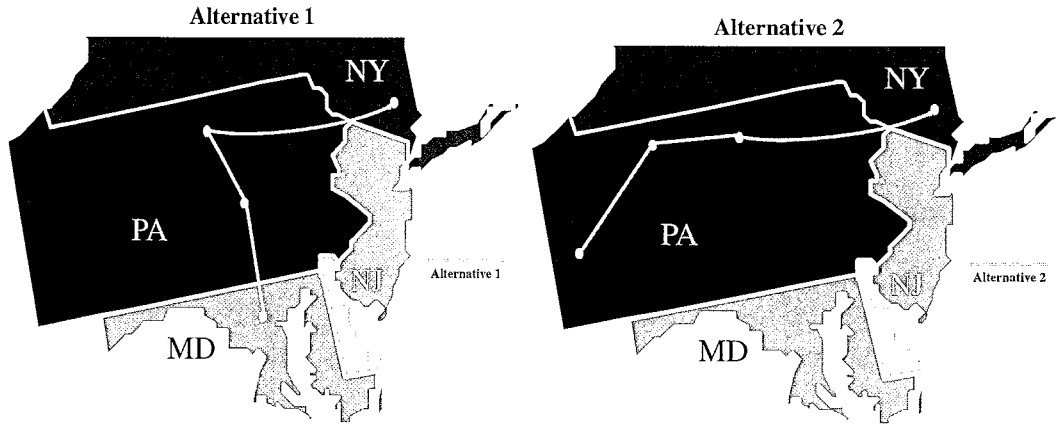
**A.3.6 Overall Schedule Duration**

PPL EU has also developed a high level schedule for each primary activity of Project Compass. The schedule was constructed to focus initially on the Siegfried-Frackville, Montour-Sunbury and Lackawanna-North Meshoppen overload issues identified by PPL EU and in the 2019 RTEP generator deliverability analysis. To solve the Montour-Sunbury and Lackawanna-North Meshoppen 230kV line violations identified in the 2014 PJM RTEP Generator Deliverability analysis, we have assumed PJM awarding the construction responsibility to PPL EU for building the 500kV lines and corresponding substation scope in those segments by January 2015. To address the remaining violations and build the entire solution we anticipate planning to begin in 2017 with the balance of construction to continue through 2023 - 2025

PPL EU expects that once Project Compass is further understood by affected stakeholders, a revised schedule can be developed that can sequence the required development and construction activities in a more efficient and time effective way.



**Figure A3.7-1: Project Compass Geographic Alternatives**



PPL EU has assessed the differences amongst the three options – the integrated Project Compass, Alternative 1, and Alternative 2 – in the primary benefit categories as summarized in the table below.

**Figure A3.7-2: Project Compass Alternative Benefits Summary**

Benefit	Option	Project Compass	Alternative 1 (North – Southern)	Alternative 2 (North)
<b>Reliability</b>				
Lackawanna-North Meshoppen 230 kV line overload		✓	✓	✓
Montour-Sunbury 230 kV line overload		✓	✓	
Siegfried-Frackville 230 kV line overload		✓	✓	
Improved power flow / transfer capability		<b>12,438 MW</b>	6,331MW	4,721MW
Critical substation reduction		<b>3</b>	3	0
Increase in West to East Transfer Limit		<b>2,250MW</b>	225MW	570MW
Increase in East to West Transfer Limit		<b>2,025MW</b>	720MW	2,360MW
<b>Market Efficiency (\$M)</b>				
Average Annual Customer Cost benefits		<b>\$1,180</b>	\$537	\$811
<b>Public Policy</b>				
Job Creation		<b>4,000-6,000</b>	2,000-3,000	2,000-3,000

Further information describing Alternatives 1 and 2 is provided in Appendix 4.

#### ***A.3.8 Statement of Designated Entity Consideration***

PPL EU seeks, through the proposal herein, to be considered the Designated Entity to construct, own, and finance the proposed project. Operations and maintenance will be coordinated with incumbent transmission owners for those assets outside of PPL EU's footprint.

#### ***A.3.9 Affirmation of Pre-Qualification Information***

PPL EU's pre-qualification information on record with PJM and as posted on PJM's website, submitted on June 28, 2013 through the Office of the Interconnection prior to the opening of the Market Efficiency project proposal window, reflects the company's current qualifications to be eligible for Designated Entity status as defined in the PJM Amended and Restated Operating Agreement ("PJM OA") in Section 1.5.8(a) (PJM Designation 13-12).



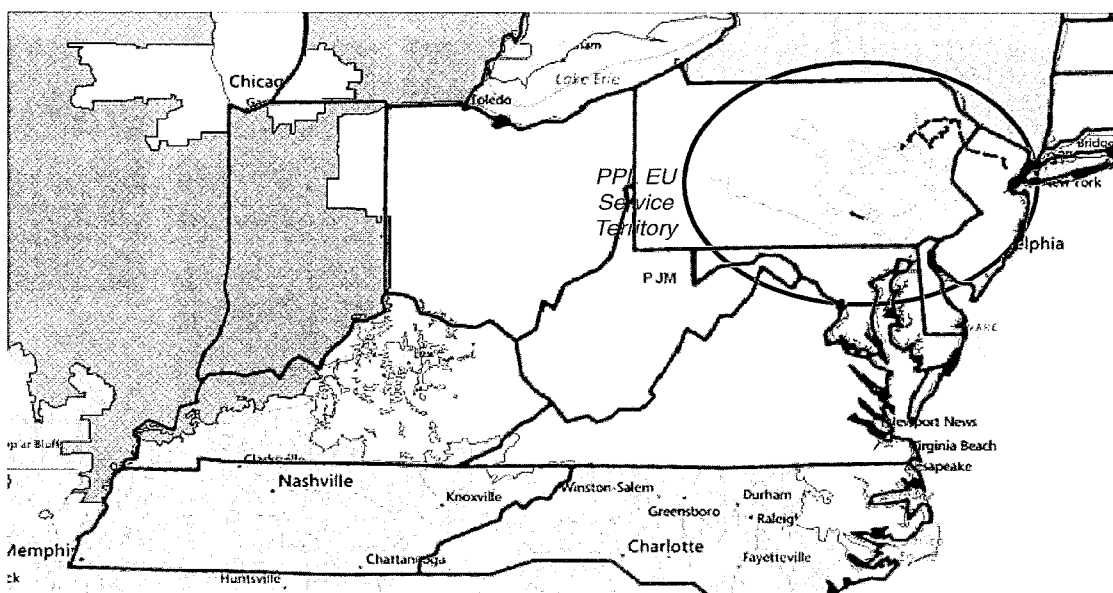
## B. Company Evaluation Information

### B.1 PPL EU Differentiating Capabilities to execute Project Compass

PPL EU engages in the regulated transmission and distribution of electricity, providing high-quality, safe, reliable and cost effective service to customers across central and eastern Pennsylvania. With the support of its parent company, PPL Corporation, PPL EU has access to the best practices and leading capabilities of one of the largest investor-owned companies in the U.S. utility sector.

PPL EU owns and operates a large transmission system within the PJM footprint, including 62 substations with a total capacity of 18.3 million kVA and approximately 4,000 transmission pole miles in service. Figure B1-1 depicts the Company's existing transmission service territory within the broader PJM footprint.

**Figure B1-1: PPL EU Transmission Footprint in PJM**



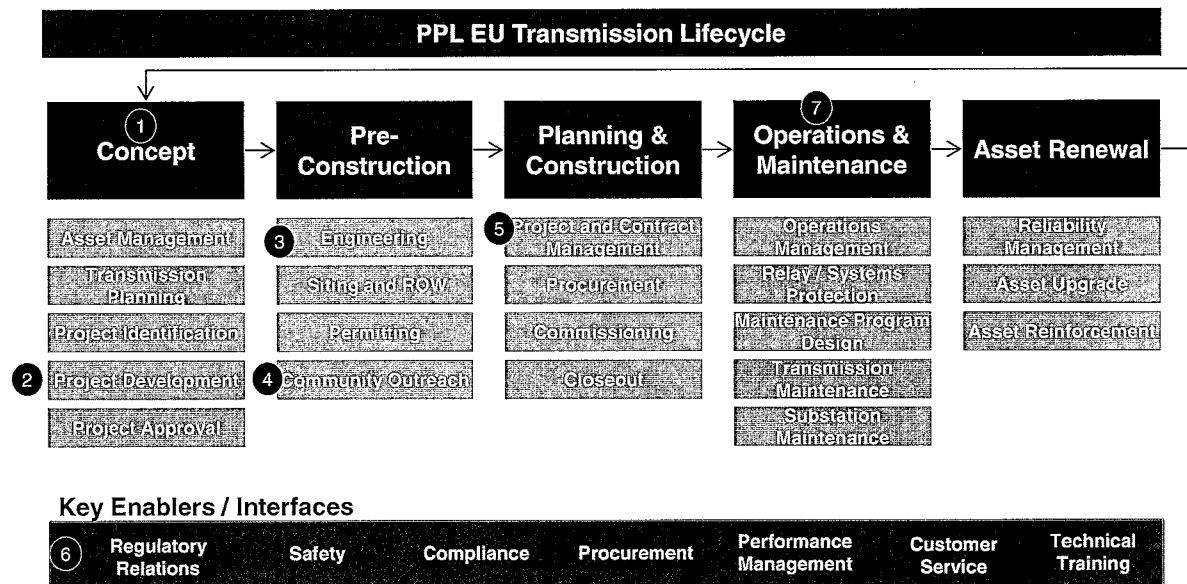
Management of this extensive transmission system, and the project experience gained through constructing these assets, has enabled PPL EU to establish unique capabilities that are directly relevant to the proposed Project Compass solution. PPL EU brings a well-established and strong relationship with PJM, robust financial backing, extensive project experience, a scalable contractor model, engineering expertise, partnering experience, and the culture of operational excellence that all together position PPL EU as the ideal leader of this effort.

PPL EU has nearly 100 years of experience in transmission development and construction, building everything from core 69kV connection projects to 500kV lines. With processes

that are continually refined and optimized to manage the complexities inherent in all types of transmission projects, PPL EU organizes and operates with project execution in mind. Project control is maintained through strong governance, clear project review processes, and stringent project estimating and control tools. The early phases are grounded in the principles of constructability, cross-functional collaboration and front-loaded engineering and design to avoid or minimize future scope, schedule or cost changes. For example, during the Concept phase the operations and maintenance teams provide input into new project development related to optimal design and construction in terms of ease and cost to maintain the assets. PPL EU utilizes a blended approach of internal teams and approved contractor resources to allow for high quality project execution at the lowest overall cost.

We would like to highlight certain capabilities that are particularly relevant for consideration of a comprehensive solution such as Project Compass.

**Figure B1-2: PPL EU’s Unique Capabilities Supporting Project Compass**



### B.1.1 Concept

The boom in Marcellus Shale gas production in northern Pennsylvania has created significant interest in bringing additional gas-fired generation to the region. The retirement of older, coal-fired generation as a result of increasing environmental compliance requirements and the relative cost disadvantage for coal-fired generation versus natural gas emphasizes the attractiveness of building more efficient generation in this region. However, the existing transmission infrastructure and capacity in this area is not adequate to accommodate this new generation nor does the current infrastructure allow for additional bulk power generated in the Marcellus area to be transmitted to key load centers in Pennsylvania and surrounding states.

The lack of existing infrastructure is a significant deterrent to the development of new generation in the region; companies are unwilling to invest in generation if they cannot get power transmitted to demand centers thereby resulting in stranded or underutilized investments.

As PPL EU's Transmission Planning department contemplated this dilemma, the Project Compass solution was born. The Compass project alleviates both current constraints and accommodates long term needs, thereby bridging the current needs of PJM while supporting the future growth of new efficient generation.

### ***B.1.2 Project Development***

PPL EU has extensive experience identifying and executing transmission projects, ranging from simple upgrades to large scale greenfield development. More than \$600 million in transmission grid investment is planned in 2014 and \$4.7 billion in the delivery infrastructure over the next five years. Completing these projects requires extensive technical expertise, effective project management capabilities, the ability to work with numerous stakeholders, and effective cost controls being deployed. The in-flight 500kV new line build Susquehanna–Roseland and 230kV new line build at Northeast–Pocono are both large projects that demonstrate PPL EU's ability to successfully execute the complexities of large projects concurrently. The Susquehanna–Roseland project is now 80% complete and meeting both schedule and cost budgets. Furthermore, the organization has recently expanded contractor support to handle the heightened workload required for these large projects. A description of the two major transmission projects and a list of recently completed large transmission projects are included later in Section B.4.

### ***B.1.3 Engineering Capability***

With the increase in infrastructure investments, the Engineering department has gained a broad mix of recent design experience including both new capacity additions and upgrades, as well as varied electrical system specifications, weather and geographic topography conditions. PPL EU has designed over 1,000 miles in support of new line builds, existing transmission rebuilds, reconductoring and fiber optic cable additions.

Transmission Engineering utilizes current industry standards and adopts new technologies to improve process efficiency and effectiveness. Updated standards incorporate industry leading lightning resilience and line hardening to provide high reliability and low ongoing cost. New state-of-the-art technology such as a Power Line Computer Aided tool called PLS – CADD acts as a centralized tool for designing and drafting. PPL EU is also a member of key industry forums such as the Electrical Power Research Institute (EPRI) and the EHV Engineering Committee, which build capabilities through collaboration with other members.

PPL EU's Engineering group not only leverages extensive experience in-house, but also has vast experience in managing contracted engineering services with 12+ Engineering

Firms: [REDACTED]

among others. These contractors have extensive knowledge and experience designing all transmission line voltage classes with significant experience both within PJM as well as outside the PJM territory.

#### ***B.1.4 Community Outreach***

##### **Siting and Right-of-Way**

PPL EU has established a siting process that is consistent with PA PUC guidelines and requirements. The siting process includes the determination of a Project Study Area, identification of Alternative Corridors, identification of Alternative Routes within these Corridors, and Selection of the Preferred Route. The focus and scope of these processes are dependent on and specific to the landscape of the region as well as the available opportunity corridors and the constraints which are present. Through early stakeholder engagement and public outreach, we have been successful at avoiding constraints and leveraging opportunities to minimize impact to the public and environment, while maintaining reasonable costs and preserving engineering and construction feasibility. PPL EU has an excellent success rate for securing approval for siting applications from the PA PUC.

PPL EU prides itself in taking a property owner perspective of siting and Right-of-Way. This is manifested in our increased focus on community outreach and consensus on route development. In the past six years, the Company has successfully acquired over 140 Right-of-Way miles. PPL EU tries to accommodate landowner requests whenever practical, and works with landowners to achieve a solution that is mutually agreeable to all parties involved. Acquiring Right-of-Way is a complex process that requires the coordination of many stakeholders, but PPL EU's Right-of-Way team has demonstrated success through the limited number of condemnations that have been necessary.

##### **Local Utility Partnership**

Partnerships are integral to the success of regional transmission projects and the proposed Compass project is no different. The ability to partner with the incumbent utilities is required for the effective and efficient construction and operation and maintenance of the proposed facilities.

PPL EU is currently working with the Public Service Electric & Gas Company (PSE&G) on the Susquehanna–Roseland project as PPL EU constructs the 101-mile line in Pennsylvania and PSE&G constructs the 45-mile route in New Jersey. PPL EU and PSE&G have cooperated closely on the design, siting and other aspects of the project, and have formed a joint team to accomplish construction of a four-mile segment that passes through three National Park Service units that lie in both Pennsylvania and New Jersey. The project has also required coordination with UGI and First Energy as the line crosses

and connects with both utilities. PPL EU has had additional project development experience in partnering through its Manor-Graceton 230 kV line replacement project, which requires close coordination with Baltimore Gas and Electric (BG&E) as BG&E owns 1.4 miles of the line.

PPL EU also has experience coordinating the operation and maintenance of transmission assets that it owns. For the TMI – Peach Bottom asset, PPL EU owns neither terminal and coordinates with two utilities, First Energy and PECO, for maintenance and emergency response. At the Hummelstown – Middletown Junction, PPL EU owns and maintains the terminal facilities at Hummelstown Substation and Steelton Tap while First Energy maintains the Hummelstown-Middletown Junction 230kV line.

### **Non-PPL EU Jurisdiction Experience**

In addition to extensive experience within PPL EU’s existing footprint and participating in PJM’s regional planning processes, PPL EU has built a diverse capability through its employees and contractor base that will allow PPL EU to successfully plan and maintain the proposed project outside of its existing jurisdiction (e.g., NYISO, in the case of Project Compass).

#### ***B.1.5 Scalable Contractor Model***

PPL EU’s ability to execute both large and small projects is built on leveraging a scalable contractor model across the transmission asset lifecycle while maintaining stringent standards related to safety, quality, and delivery. PPL EU has established a preferred set of contractors, Contractors of Choice (COC), through an extensive, formal RFP process. The Contract Management team has established relationships with contractors nationwide which allows PPL EU to effectively source the best contractor(s) for project work required by PPL EU. This contracting process delivers a best practice contracting approach that complies with the National Contract Management Association standards and processes.

#### ***B.1.6 Regulatory Relations***

##### **PJM Membership**

PPL EU and its predecessors have participated as an active transmission owner and load serving entity in the PJM Regional Transmission Organization, and its predecessor organizations, since its founding in 1927. PPL EU prides itself on its engagement with PJM through its committee structures, evidenced by active membership on 20 committees, working groups and task forces including the Transmission Expansion Advisory Committee (TEAC), Planning Committee (PC), Operating Committee (OC) and the Transmission Owners Agreement – Administrative Committee (TOA-AC). As an active member of PJM and its governance structures, PPL EU is well versed in the challenges of managing a reliable high voltage grid and identifying efficient and cost effective

transmission improvements. PPL EU understands PJM's challenges and is committed to being a superior Transmission Owner and Load Serving Entity.

### **Federal and State Government Relations**

Strong relationships with Federal, state and local government and regulatory agencies have facilitated successful development and operation of transmission projects. PPL EU has built longstanding relationships in Harrisburg and Washington that have resulted in solid working relationships needed to obtain timely approval and all required permits for transmission projects. For example, the Susquehanna-Roseland line crosses three national parks: the Delaware Water Gap National Recreation Area, the Appalachian National Scenic Trail and the Middle Delaware National Scenic River. PPL EU worked with the U.S. Department of Energy, the U.S. Army Corps of Engineers, the White House Rapid Response Team for Transmission, the U.S. Department of the Interior, the U.S. Fish and Wildlife Service, the Federal Aviation Administration and the National Park Service. Following receipt of the final permit from the park service, PPL earned the praise of that agency for the manner in which its project team built the power line and restored the Right-of-Way while minimizing impact to park visitors and the environment.

Additionally, PPL EU has developed a strong interfacing capability with the PA PUC where the siting team has an outstanding track record of siting success with over 280 applications submitted to the PA PUC since the 1970s. PPL EU is also an active member of the North American Transmission Forum (NATF) and the Edison Electric Institute (EEI), providing two significant opportunities to share best practices and leverage reference material from members across the U.S. and Canada.

#### ***B.1.7 Operational Excellence***

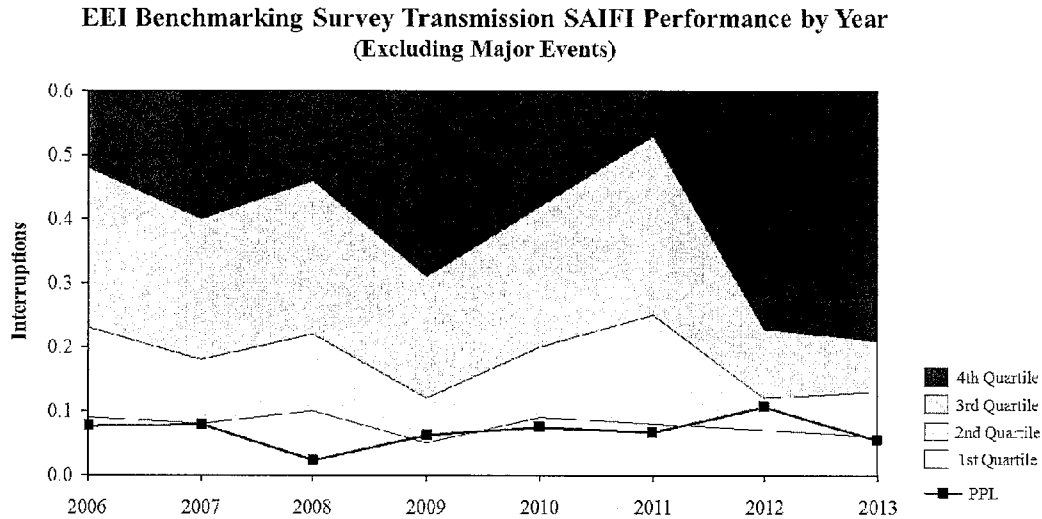
PPL EU has a strong history of execution excellence, as demonstrated by our exemplary track record of compliance, safety, reliability, and cost containment. Compliance with NERC standards has always been, and continues to be, a high priority and PPL EU has routinely been recognized by ReliabilityFirst (RF) as a benchmark for compliance. In 2012, RFC audited PPL EU on behalf of NERC for both Reliability Standards associated with Operations and Critical Infrastructure Protection (CIP) Reliability Standards receiving high marks in both. PPL EU adopts standards and processes in advance of compliance requirements and offers regular training programs.

Safety is a PPL EU core value embedded throughout PPL EU. The Safety program strives to minimize Occupational Safety and Health Administration (OSHA) designated Recordable Events and results are consistently better than industry peers.

Commitment to system performance through effective preventive and real-time operations and maintenance programs is evidenced in the reliability performance metrics for PPL EU's system. As shown in Figure B1.7-1, Transmission System Average Interruption Frequency Index ("T-SAIFI") performance has been at or near top-quartile performance

for the past six years, averaging less than 0.1 interruptions over the period from 2006 through 2013 (excluding major events).

**Figure B1.7-1: PPL EU T-SAIFI Historical Trend (In Interruptions)**

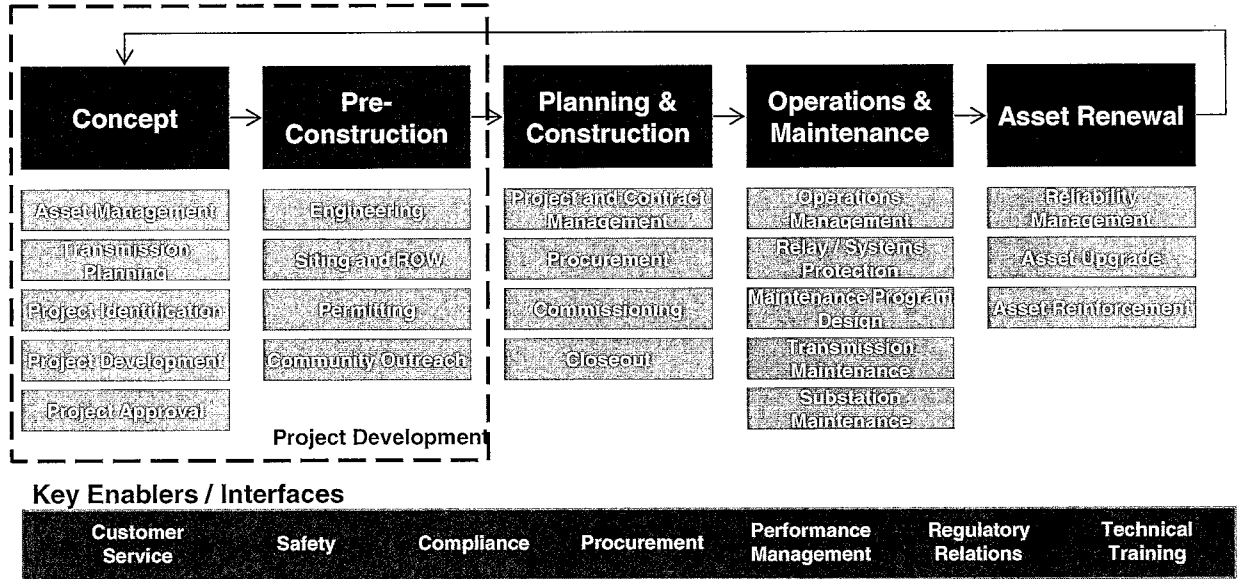


PPL EU has put in place a transmission operating model designed to efficiently and effectively invest in, and manage, its transmission system. The transmission operating model establishes clear roles, responsibilities, processes and procedures to ensure accountability, facilitate timely decision-making, and optimize overall execution. A senior management team with almost 200 years of collective experience is responsible for overseeing an integrated transmission and distribution operating model, which allows for close collaboration along all steps of the transmission project lifecycle including project development, engineering, construction, commissioning, and operations and maintenance. A set of PPL EU-designed operating principles ensures safe and reliable execution of its transmission strategy by aligning and focusing the organization on critical areas for success. Both the management team and the supporting organization have the requisite capabilities to advance transmission as a strategic priority for the company.

## **B.2 Technical Qualifications and Experience**

Proven success in large capital projects such as the recent Susquehanna–Roseland project illustrates PPL EU’s effectiveness in executing large scale transmission projects. Certain elements of our end-to-end transmission operating model are highlighted below.

**Figure B2-1: PPL EU's Transmission Asset Lifecycle**



### ***B.2.1 Widespread Contractor Support***

With recent project experience on the Susquehanna–Roseland and Northeast–Pocono lines, PPL EU has built strong relationships with many large firms that have nation-wide delivery capabilities. These relationships allow access to talent with additional familiarity related to the rules and regulations in impacted Compass states. In the event that the current vendor base cannot adequately support the project needs, the Sourcing organization has developed an extensive RFP process that comprehensively vets potential contractors for safety programs, performance, quality, and safety incidents.

### ***B.2.2 Secure and Cost Effective Supply***

Due to the significant volume of projects executed over the last several years, the Company receives preferred customer prices that are equal to, and often better than, its peers, and has secured supply when others in the industry were unable to find needed resources and materials. For example, materials management for Susquehanna–Roseland was outsourced to HD Supply, a model that would likely be replicated for Project Compass. HD Supply’s widespread footprint positions them to effectively manage equipment purchasing, product tracking, and securing lay down yard(s) in the planned construction areas.

### ***B.2.3 Siting, Right-of-Way, and Permitting***

The Siting, Right-of-Way, and Permitting departments have built a strong set of capabilities to support the proposed solution. The internal siting team has conducted most site and route selection work with a consistent team of contractors. PPL EU has



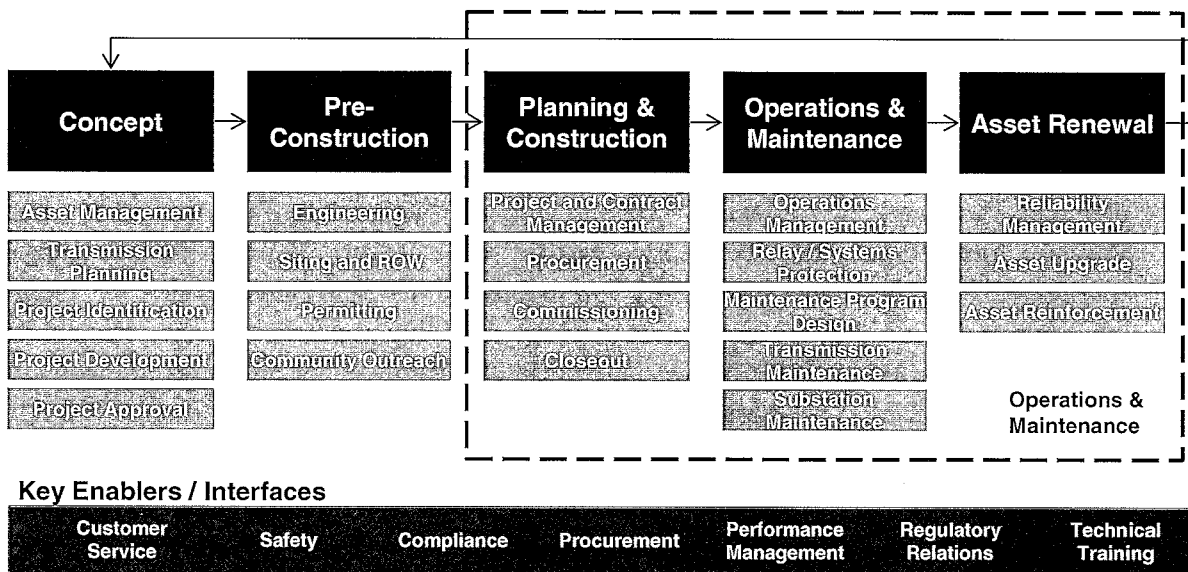
established relationships with several siting and environmental firms which allows for easy scaling based on the volume, size and complexities of projects being undertaken. External contractors are also able to provide supplemental environmental assessment reports on plants, wildlife, threatened and endangered species, cultural / historical resources and land use impacts.

The Right-of-Way team is heavily integrated with the siting team, which facilitates more effective community outreach and greater consensus on route development. In the past six years, the Company has successfully acquired over 140 Right-of-Way miles. PPL EU prides itself on taking a “property owner perspective” when acquiring Right-of-Way and accommodates landowner requests when practical. Acquiring Right-of-Way is a complex process necessitating coordination of many stakeholders. PPL EU’s capability will be especially important for Project Compass and we will deploy our internal teams and external support with expertise in this function to progress the Project Compass solution.

### B.2.4 Operations & Maintenance Qualifications and Experience

PPL EU is committed to achieving leading operations reliability and system performance for its transmission system. Figure B2.4-1 depicts the functions that support the operations and maintenance portion of the transmission asset lifecycle.

**Figure B2.4-1: PPL EU’s Transmission Asset Lifecycle**



### ***B.2.5 Operations Model***

PPL EU facilities will be operated at the direction of PJM and controlled and maintained consistent with the current PPL EU operations and maintenance practices.

To operate and maintain the transmission grid reliably, PPL EU manages a Transmission Control Center (TCC) that adheres to the guiding principles of safety, reliability and production.

In addition to real time operations, PPL EU develops a construction and maintenance outage plan. TCC Planning processes requests to upgrade transmission facilities and translates those to equipment outages using the PJM outage criteria timelines. The TCC plans all outage requests, limits risks to the electric system and customer base, and responds to any unplanned events. Transmission outage planning, including risk and conflict analysis, is crucial to promoting safety, preserving the reliability of the bulk and non-bulk transmission system, and eliminating volatility in the work portfolio.

### ***B.2.6 Maintenance Model***

PPL EU, as the owner of the transmission assets, will ensure that all required maintenance is performed according to its established standards. The Company's stringent prioritized maintenance programs are developed based on established reliability standards, asset management optimization driven programs, and overall equipment criticality. While all transmission operators face tradeoffs related to optimizing capital, O&M, reliability and overall value, PPL EU has developed a proactive asset renewal program that carefully weighs the most prudent and cost-effective methods to ensure superior system performance at a sustainable cost. This focus on reducing the number of degraded elements, as well as reducing system vulnerabilities, identifies the most critical infrastructure and prioritizes the most important renewal work. A programmatic approach to preventive maintenance facilitates improvements to field productivity by reducing emergent work initiated by equipment failures, allowing workers to focus on scheduled work. PPL EU's maintenance model and vegetation management programs are well suited to efficiently and effectively maintain the proposed project.

A flexible maintenance model allows the Company to provide maintenance support free of geographic constraints. Currently, the company retains asset management responsibilities centrally while outsourcing in-field maintenance work. Even within PPL EU's core footprint, the majority of maintenance work is outsourced: approximately one-third of the work performed on transmission lines is conducted internally while the remaining two-thirds of the work is contracted out to regional Contractors of Choice. The maintenance team relies on electronic communications from inspectors, including detailed inventory and images of each structure, allowing PPL EU to easily scale the operation to any geographic area. This model is utilized across the PPL EU service territory where pictures are taken from helicopters to manage the maintenance requirements remotely. Trips to the

field are the exception and usually do not extend beyond a detailed walk down of the line at the end of construction. The proposed project's scheduling work will be integrated into the existing maintenance system with contractors qualified to work in the Compass footprint. PPL EU is confident that its successful experience managing maintenance contractors will allow it to capably manage the maintenance requirements of the proposed project.

### ***B.2.7 Vegetation Management***

PPL Vegetation Management leverages “open book,” long-term, managed business relationships with two of the largest vegetation management contractors in North America ( [REDACTED] ). Over the last three years, 100% of the vegetation management plan has successfully been completed for 138kV, 230kV and 500kV lines. PPL has had zero tree-related events on 230kV and 500kV transmissions facilities during that timeframe. PPL EU will be able to utilize its contractor base to maintain the same high standards for Project Compass.

### ***B.2.8 Non-jurisdictional Operations***

Operations for the proposed assets outside of the PPL Zone will be coordinated with the incumbent owners. This approach is a proven model that PPL EU currently employs on three separate transmission assets:

**TMI – Peach Bottom:** PPL EU has successfully employed the proposed Compass operations and maintenance model at TMI – Peach Bottom. On this line, PPL EU does not own either terminal and faces increased complexity because the company must coordinate with two utilities. PPL EU owns and maintains the 500kV line section from deadends at the TMI 500kV switchyard to PL tower 53/09. The TMI 500kV switchyard is owned by First Energy and the Peach Bottom substation is owned by PECO. When an Energy Control Permit is required for the PPL EU portion of the line, PPL EU must submit a clearance request to both First Energy and PECO. PPL EU also coordinates with First Energy and PECO's operating personnel during emergency conditions.

**Hummelstown – Middletown Junction and Juniata – Alburdis:** PPL EU also understands the perspective of operating the line without ownership, which will allow the company to better anticipate potential coordination issues. At the Hummelstown – Middletown Junction, PPL EU owns and maintains the terminal facilities at Hummelstown Substation and Steelton Tap while First Energy maintains the Hummelstown-Middletown Junction 230kV line. PPL EU and the First Energy dispatcher cooperate closely in the operation of the line, requiring full knowledge and consent of both parties for any dispatch change – except in emergencies. PPL EU also coordinates with First Energy for any clearance requests. A similar arrangement with First Energy also exists for the Juniata – Alburdis 500kV line, though PPL EU does retain maintenance responsibilities for a section of the line.

### ***B.2.9 Emergency Response Model***

PPL EU has an industry leading emergency preparedness and response program, led by a dedicated Emergency Preparedness group which develops and maintains comprehensive emergency response plans and supports the effective execution of these plans. PPL EU's recent experience in major storms, particularly Hurricane Sandy, Hurricane Isaac, a major snow storm in October 2012, and extremely high winds in May 2012 have improved our emergency response processes. We have demonstrated the ability to quickly restore our own assets under various scenarios. PPL EU's award recognition in emergency response can be found in Figure B2.9-1.

**Figure B2.9-1: Summary of Major Award Recognition**

PPL EU's Award Recognition
2013 North East PA Manufacturers and Employers Association Process Improvement Award for improvements related to storm response processes
2013 Electric Light and Power Utility of the Year Award (same recognition in 2008)
J.D. Powers and Associates conducted a national survey of consumers to rate performance of utilities and local, state and federal government actions prior to and following Hurricane Sandy. In February 2013, J.D. Power recognized PPL EU as one of only three utilities that performed "Particularly well"
2012 EEI Emergency Recovery Award for Hurricane Sandy
2012 EEI Emergency Assistance Award, for tremendous support in the recovery from Hurricanes Isaac and Sandy.

### ***B.2.10 Cost / Schedule Adherence***

PPL EU has implemented processes, governance, and project management tools to ensure projects are delivered on-time and on-budget.

The Project Controls Department is responsible for monitoring project progress to compare actual versus baseline resource usage, and analyze project variances utilizing statistical techniques such as Earned Value Metrics and Reporting to identify trends, develop forecasts, and expose potential problems. The Project Controls Department also implements process controls, monitors and audits projects to control project risks, ensures adherence to Generally Accepted Accounting Principles (GAAP) guidelines, and compliance to Federal Energy Regulatory Commission (FERC) and Sarbanes Oxley Act (SOX) regulations.

### B.3 Proposed Project Financing

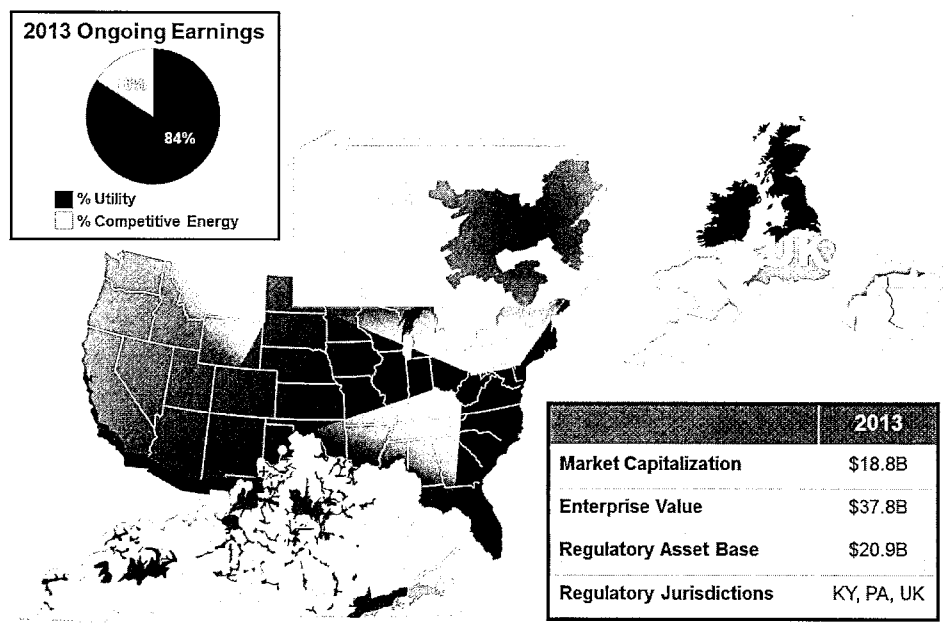
PPL and PPL EU propose to finance Project Compass across its capital structure using approximately 50% debt and equity, including cash from operations. We expect to utilize the commercial bank lending and debt capital markets, using a variety of short-term and long-term securities.

#### Financial Strength

PPL is one of the largest public utility owners in the US with over \$1.5 billion in ongoing earnings and \$2.9 billion of cash from operations in 2013. The majority of PPL’s ongoing earnings and cash flows stemmed from stable, regulated utility operations in the US and UK with over \$20 billion in regulated asset base. This diverse base of regulated cash flows supports PPL’s strong balance sheet and enables it to maintain a credit profile that supports consistent access to the equity and debt capital markets and bank markets for additional financing needs at cost effective rates.

PPL EU had over \$500 million of cash flow generated from operations during 2013, and \$300 million of available liquidity, primarily through its commercial paper program and/or bank syndicated credit facilities. PPL EU also has consistent access to the commercial bank lending markets and debt capital markets. Through its parent, PPL, PPL EU has access to appropriate amounts of equity to provide efficient financing resulting in the lowest cost of capital for the ratepayers. A financial summary is provided in Figure B.3-1 below.

**Figure B.3-1: PPL Financial Summary**



## Credit Metrics

PPL and PPL EU have a strong financial foundation that enables the development, operation and maintenance of transmission facilities. To manage financing costs and access to credit markets, a key objective of PPL's strategy is to maintain a strong investment grade credit profile and strong liquidity position. Additionally, PPL has put in place financial and operational risk management programs that, among other things, are designed to monitor and manage its exposure to earnings and cash flow volatility related to changes in energy and fuel prices, interest rates, counterparty credit quality and the operating performance of its generating units.

PPL EU is focused on timely recovery of costs, efficient operations, strong customer service and constructive regulatory relationships. PPL EU has a low-risk, fully regulated business profile with significant borrowing capacity and stable cash flows. Both PPL and PPL EU maintain investment grade credit ratings from the major credit rating agencies. PPL EU's financing plan would be executed in a manner that does not negatively impact its current credit ratings. Prospectively, PPL EU will maintain appropriate levels of liquidity including a \$300 million commercial paper program and/or bank syndicated credit facilities to ensure funding of short-term liquidity needs, if and when necessary. Current credit ratings are in the table below.

**Figure B.3-2: PPL Credit Ratings**

Issuer	Rating	Moody's	S&P
<b>PPL Corporation</b>	LT Issuer Rating	Baa3	BBB
<b>PPL Electric Utilities Corporation</b>	Senior Secured Debt	A2	A-
<b>PPL Electric Utilities Corporation</b>	Commercial Paper	P-2	A-2

Because of our strong investment grade credit ratings and ability to finance using a wide variety of funding sources, PPL and PPL EU expect the cost of financing to be extremely competitive.

## B.4 Other Supporting Documentation

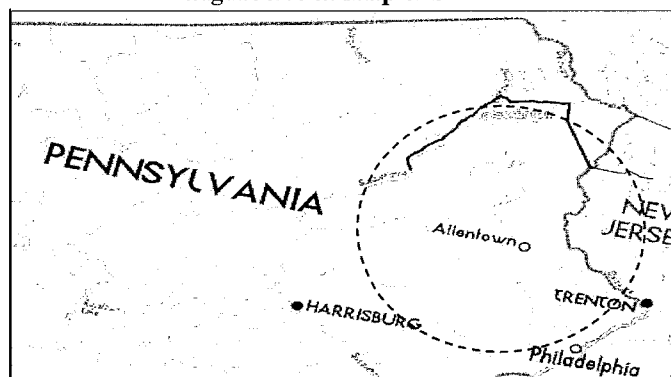
### PPL Recent Transmission Project Highlights

PPL in its nearly 100-year existence has developed the capability to design, deliver, operate, and maintain transmission projects successfully. Projects are executed using a lifecycle approach (described in Section B) and a combination of experienced leadership, deep expertise, and clear accountability to enable on-time and on-budget delivery. Two recent projects that exemplify PPL's capability to execute significant transmission projects are Susquehanna-Roseland and Northeast Pocono.

Figure B.4-1: Map of SRP 1

#### Susquehanna Roseland Project (SRP)

Approved by PJM in 2007 as essential to the long-term reliability of the Mid-Atlantic electricity grid, SRP is a multi-million dollar, 145-mile, 500kV transmission line project between the Susquehanna substation in Pennsylvania and the Roseland substation in New Jersey. PJM directed PPL to



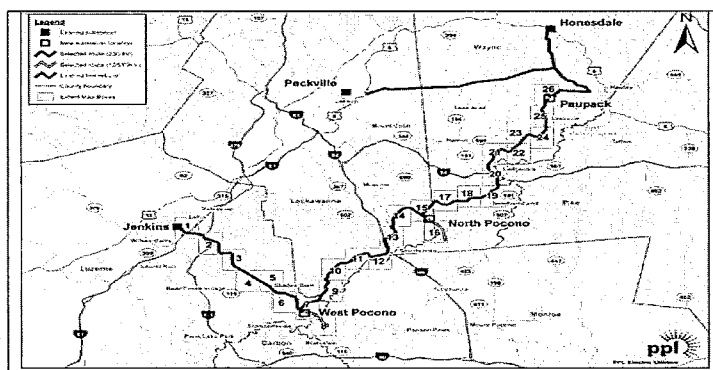
construct the portion of the Susquehanna – Roseland (SR) line in Pennsylvania and the Public Service Electric & Gas Company (PSE&G) to construct the portion of the line in New Jersey. As of May 2014, with PPL's \$630M portion of the project 80% complete, the project is both on-budget and on-schedule.

One of the most significant challenges for this project was the ability to schedule, design, and construct the interconnection of PPL and PSE&G facilities. This included a 230kV and 500kV line at the interconnection point with PSE&G in the Delaware Watergap National Recreation Area, over the Delaware River. PPL was responsible for engineering at the interconnection point, which included design of the PSE&G structures and optimization of standards. PPL completed the design successfully and ultimately installed the challenging river crossing span to the PSE&G structures in New Jersey.

#### Northeast Pocono Project (NEPOC)

As part of NEPOC, PPL will build three new electrical substations and a connecting power line to meet growing demand and improve reliability. PPL will also be rebuilding an existing power line and making other related

Figure B.4-2: Map of NEPOC



improvements to the existing electric delivery system.

The construction will include approximately 57 miles of new 230kV power line from the Wilkes-Barre area to an area west of Hawley, Wayne County to supply these substations with the power customers need. Also, PPL will rebuild an existing 69kV line that runs from the Peckville area in Lackawanna County to Honesdale, Wayne County. As of May 2014, with PPL’s portion of the project 30% complete, the project is both on budget and on schedule.

One of the greatest challenges of this project was the land acquisition for this 57-mile development. PPL successfully, secured 75% of the necessary right of way within 9 months by proactively engaging key stakeholders early and effectively. For example, PPL created a 24-hour hotline for the community, held 13 public open houses, and developed an interactive website to enable residents to enter their address and determine the distance from their home to the line route. Successful outreach enabled agreements with stakeholders, approvals for permits, and development to move forward, keeping the project on schedule.

**Figure B.4-3: PPL Project Highlights**

	Susquehanna Roseland Project Schedule 2007-2015  <i>Improves transmission system reliability by preventing overloads on regional power lines</i>	Northeast Pocono Reliability Project Schedule 2011-2017  <i>Increases transmission supply and reliability in PPL's Northeast territory</i>
Project Cost	<b>\$630M</b>	<b>\$335M</b>
Status	Over 80% complete; on budget and on schedule for May 2015 completion	Over 30% complete; on budget and on schedule for May 2017 completion
Key Successes	<ul style="list-style-type: none"> <li>• Completed work ahead of schedule, returning segments back to service, reducing outage durations</li> <li>• No environmental citations received</li> <li>• Selected for fast-track permitting treatment by the Obama administration’s Rapid Response Team for Transmission</li> <li>• Implemented innovative double-circuit steel monopole design to reduce right-of-way needs and use existing corridors</li> <li>• Developed cutting edge FAA and</li> </ul>	<ul style="list-style-type: none"> <li>• Adhered to schedule despite severe 2014 winter weather</li> <li>• Completed first greenfield 230/69kV substation (Paupack) ahead of schedule</li> <li>• Reduced permitting requirements through iterative design and siting process</li> <li>• Optimized steel pole and foundation designs to reduce total pole and foundation expenditure</li> <li>• Coordinated with Gas Transmission Pipeline to</li> </ul>



	Avian monitoring systems • Successful oversight and coordination of more than 90 contractors including environmental, design, materials, and construction.	effectively utilize utility corridor
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### Other Large Transmission Projects Placed in Service

The following figure summarizes the largest capital budget transmission projects placed in-service since 2010.

**Figure B.4-4: Large Transmission Capital Projects Placed In-Service Since 2010**

In-Service	Project	Driver	Cost (\$M)
5/30/2013	Brunner Island-West Shore 230 kV Line to Double Circuit 230 kV	Capacity violations for N-1-1 contingency overloads	\$45.2
9/21/2013	Rebuild Manor-Graceton 230kV Line	Reliability – aging infrastructure	\$31.6
6/6/2014	Rebuild Peckville-Varden 69 kV line for future Double Circuit 138 kV operation	Reliability Violation for maximum allowable load interruption. Also a capacity expansion for improved load restoration.	\$31.2
3/27/2014	Rebuild Blooming Grove-Hemlock 69 kV line to Double Circuit (future 138 kV)	Reliability Violation for maximum allowable load interruption.	\$22.7
5/30/2014	Build new 69 kV UG Tie between Carlisle and West Carlisle Substations (future 138 kV Double Circuit)	Reliability Violation for maximum allowable load interruption.	\$22.5
6/20/2013	Build new Coopersburg #1 & #2 69 kV Double Circuit Taps	Capacity Violations for N-1 condition and reliability	\$17.6

	(future 138 kV operation)	violation for maximum allowable load interruption.	
6/21/2014	Install new Paupack 230-138-69kV Substation & Connecting Lines	Capacity Expansion to relieve heavily loaded lines and reduce line exposure.	\$17.2
11/28/2012	Rebuild Sunbury-Dalmatia 69 kV Line for future Double Circuit 69 kV	Capacity Violation under normal summer peak conditions.	\$16.0
3/21/2014	Install new Double Circuit 69 kV line from Jackson to Lake Naomi Tap (future 138 kV operation)	Capacity Violation under normal winter peak conditions.	\$15.7

## C. Proposed Project Constructability Information

### C.1 Project Plan

Successful completion of Project Compass will require coordination between engineering, Right-of-Way / land acquisition, long-lead time equipment procurement, CPCN / permitting, and construction activities. The following describes our initial planning across these components.

#### C.1.1 Siting, Permitting, Right-of-Way, Land Acquisition & CPCN

Our schedule is based on a preliminary understanding of the topographical and ownership variances in the area. Specifically, the estimated number of tracts, unique tax owners, road crossings, streams / river crossings, and railroad crossings.

The schedule also includes plans extensive environmental studies and permitting . While it is very difficult to predict the extent of required permits for a new transmission line project prior to the siting, route selection, field surveys, and agency consultations, PPL EU expects to require a combination of federal, state, and county permits.

Figure C1.1-1 lists the permits that may be required for the proposed Compass project.

**Figure C1.1-1: Potential Environmental Studies and Permits**

<b><i>Environmental Studies and Permits</i></b>
<i>Siting Study and Public Outreach</i>
<i>PA PUC Certificate of Public Convenience</i>
<i>Desktop Review</i>
<i>Wetland and Waterway/Stream Delineation/Habitat Assessment</i>
<i>T&amp;E Species Coordination</i>
<i>Project-Specific Avian Protection Plan</i>
<i>Cultural Resources-Surveys and Coordination</i>
<i>USACE Section 404/ PADEP Chapter 105 JPA</i>
<i>PADEP Chapter 102 E&amp;S Control Plans and NPDES Permit</i>
<i>PennDOT HO Utility and MUD Permits</i>
<i>FAA – Obstruction Determination and Coordination (OH and PA)</i>

### ***C.1.2 Engineering***

The development of the solution would include identifying pole and substation locations, conducting core borings, finalizing steel pole orders, designing the foundation, and finally, completing the line and substation engineering release.

Engineering activities will span a variety of disciplines:

- Surveying: Site selection and physical arrangement utilizing aerial (LiDAR) surveys
- Civil: Foundation, ground grid design, water and water retention designs
- Environmental: Environmental effects, access road design, spill response, SPCC plans in close conjunction with the ROW/Siting/Permitting team
- Geo-Technical: Soil investigation and earth resistivity
- Structural: Structural loading, component and hardware analysis including equipment standards, procurement, factory acceptance testing, equipment ratings, insulation ratings
- Mechanical: Conductor Sag/Tension design
- Electrical: Grounding, clearances analysis, insulation design, lightning performance
- Telecommunication: Fiber optics design (OPGW)

### ***C.1.3 Equipment Procurement & Construction***

Site clearing, prep and delivery as well as site restoration, crop damage, and landscape work are performed in coordination with the Right-of-Way team.

Construction will follow the standard processes and activities over the construction schedule:

- Site Clearing/Prep/Delivery: Clearing / grubbing prep, access road completion, site delivery
- Mechanical: site pad construction, mechanical work foundation
- Electrical: substation construction, pole and conductor construction, conductor/device removal, pole testing for ground resistance, structure removal, communication, splicing & testing
- Demobilization: site restoration, crop damage, landscaping

## C.2 Project Cost Estimate

Proposed costs for project Compass include elements from engineering, permitting, Right-of-Way / land acquisition, environmental, material procurement, construction and contractor / project management activities. These estimates were developed using PPL EU’s estimating methodology and tools, PPL EU standard designs for both transmission lines and 500kV - 230kV substations, and PPL EU experience in constructing large, complex transmission projects. These estimates will be refined as the scope and timing of the project is reviewed with other impacted stakeholders.

### C.2.1 Design

In order to support the proposed project, costs will be incurred for Rights-of-Way / Siting / Environmental / Permitting and Engineering to complete the design of the transmission system and substations which is illustrated in Figure C2.1-1.

**Figure C2.1-1: Summary of Estimated Design Costs**

Project Component	Total \$ B	Transmission \$ B	Substation \$ B

### C.2.2 Execution

Cost estimates relating to equipment procurement and construction, including EPC costs, are largely materials driven. Estimates for the labor and materials are based on average cost from suppliers utilized in previous PPL EU projects. Construction, Project Management, PPL EU internal and EPC estimates are based on past experience benchmarking of per mile multipliers for initial estimation, assuming standard construction designs and construction methods. This estimate is summarized in Figure C.2.2-1 below.

**Figure C2.2-1: Summary of Execution Costs**

Project Component	Total \$ B	Transmission \$ B	Substation \$ B

### C.2.3 Management & Governance

Project Management, Contractor Management and back-office costs pertaining to the overall management, governance and support of the project will be incurred and are largely labor driven and based on scope and duration of the project. The estimates for

labor are based on similar costs incurred in previous PPL EU projects and can be found in Figure C2.3-1.

**Figure C2.3-1: Summary of Construction & Project Management Costs**

<b>Project Component</b>	<b>Total \$ B</b>	<b>Transmission \$ B</b>	<b>Substation \$ B</b>
[REDACTED]			

### **C.3 Work to be performed by Incumbent Transmission Owners**

PPL EU will coordinate closely with incumbent transmission owners who will be responsible for the design, engineering, and construction required for installation of new breakers and remote substation work in existing sites.

### **C.4 Risk**

Given that the estimated project cost and schedule is a high level planning estimate, PPL EU used conservative assumptions throughout its estimating process. The assumptions are based on recent experience with similar projects and ranges have been provided to reflect the state of planning to date. As described earlier, PPL EU will embark on a comprehensive stakeholder engagement plan to further refine Project Compass.

### **C.5 Project Compass Major Assumptions**

Key assumptions related to the development of project Compass are outlined below:

[REDACTED]







**ALL APPENDICES ARE REDACTED**