STATE OF NEW JERSEY
BOARD OF PUBLIC UTILITIES

IN THE MATTER OF THE PETITION OF
PUBLIC SERVICE ELECTRIC AND GAS
COMPANY FOR A DETERMINATION
PURSUANT TO THE PROVISIONS OF
N.J.S.A. 40:55D-19
(SUSQUEHANNA-ROSELAND)

BPU DOCKET No. : EM09010035

TESTIMONY OF BENJAMIN K. SOVACOOL ON BEHALF OF MUNCIPAL INTERVENERS IN OPPOSITION TO SUSQUEHANNA-ROSELAND TRANSMISSION LINE PROJECT

I. Background

Q. Please state your name and business address

A. My name is Benjamin K. Sovacool, and my business address is 6781 Amsel Avenue Northeast, North Canton, Ohio, 44721-2606.

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

A. I am a Research Fellow in the Energy Governance Program at the Centre on Asia and Globalisation, an Assistant Professor at the Lee Kuan Yew School of Public Policy at the National University of Singapore, and an Adjunct Assistant Professor at the Virginia Polytechnic Institute & State University in Blacksburg, Virginia. In my position at the Centre on Asia and Globalisation and the Lee Kuan Yew School of Public Policy, I manage research projects relating to energy policy and energy security, particularly dealing with the costs and benefits of electric power systems. In my position at Virginia Tech, I work with the Consortium on Energy Restructuring and the School of Public and International Affairs.

Q. Please describe your professional experience and educational background.

A. I have a Ph.D in Science & Technology Studies from the Virginia Polytechnic Institute & State University in Blacksburg, Virginia, where I completed my dissertation on the role that distributed generation and renewable electricity resources could play in enhancing electricity reliability and energy security. I have also served in advisory and research capacities at the U.S. National Science Foundation's Electric Power Networks Efficiency and Security Program, Virginia Tech Consortium on Energy Restructuring, Virginia Center for Coal and Energy Research, New York State Energy Research and Development Authority, Oak Ridge National Laboratory, Semiconductor Materials and Equipment International, U.S. Department of Energy's Climate Change Technology Program, and the International Institute for Applied

Systems and Analysis near Vienna, Austria. I have published more than 80 academic articles relating to electricity, energy policy, and energy security and presented at more than 30 international conferences and symposia.

Q. Please describe the purpose of your testimony.

A. I have been asked by the Municipal Interveners to challenge the New Jersey segment of the Susquehanna to Roseland 500 kV line (the "Project"). The purpose of my testimony is threefold. First, I believe that the Public Service Electric & Gas Company's (PSEG) justification for the Project is unsound, and that the Project is not needed due to reductions in electricity demand and diminished economic growth. Second, I will demonstrate that, even if there is a proposed need for electricity, energy efficiency and demand side management, along with the deployment of distributed generation, offer much better alternatives than the Susquehanna-Roseland project. Third, I will describe how the Project appears to violate reasonable standards for electricity reliability, and that it conflicts with New Jersey's stated energy policy due to the substantial environmental and social costs of the project.

Q. Pertaining to your first point, please explain your belief that the justification behind the Project is unsound.

A. Unanticipated reductions in electricity demand make the Project unnecessary. PSEG's original rationale for the Susquehanna-Roseland line was based on an anticipated 4 percent increase in peak demand in 2008. However, actual demand for electricity was down and continues to decline. In a November 12, 2008 report, PJM revealed that actual unrestricted peak demand for the summer of 2008 was 10,591 megawatts (MW) and 7.8% lower than summer 2007 demand rather than a 4% increase.[1]

[1] Exhibit BKS-1, cited in Brief of Piedmont Environmental Council in Piedmont Environmental Council v. Virginia Electric Power Company, *et al.*, on Motion to Virginia Supreme Court, at 8. In BKS-2, PJM states that their

PSEG has acknowledged that the current economic downturn has decreased consumer demand over the last year relative to expectations. In its 2008 Annual Report, PSEG noted that for the year ending December 31, 2008, among the primary reasons for over $16 million in decreased income from Continuing Operations were lower revenues due to lower customer demand resulting from the current economic conditions and lower electric and gas sales volumes.[2]

Declining electricity demand during 2008 has continued well into 2009. NERC reported on May 19, 2009 that the current economic downturn has contributed to an overall reduction in the demand for electricity this summer, leading to higher reserve margins across North America. Indeed, 2009 summer peak demand in North America is projected to be nearly 15 gigawatts (1.8 percent) lower than 2008. Summer energy use is projected to decline by over 30 terawatt hours, trending towards levels not seen since 2006.[3]

Q. Don't PSEG's most recent load forecasts take these changes into account?

A. Apparently not. Despite its efforts to improve its load forecasting data and modeling, PSEG has acknowledged that its updated sales forecasts projected demand reductions that are *four times greater* than previously forecasted. During PSEG's Q1 2009 Earning Call, Ms. Corina Dorsa, PSEG Executive Vice President and Chief Financial Officer declared:

> PSEG is expected to experience a decline in 2009 operating earnings. Demand is expected to remain weak in response to our contracting economy. We have adjusted our forecast of electric sales for the year and we are currently forecasting a 1.5 percent to 2 percent reduction in electric sales for the full year compared with our prior forecast of about a 0.5 percent to 1 percent decline in sales.[4]

---

weather adjusted peak demand in 2007 was 136,100 MW. 10,591 MW out of a peak of 136,100 MW is about a 7.8 percent reduction.

[2] Exhibit BKS-3 - PSE&G 2008 Annual Report, S.E.C. Form 10-K, p.58.

[3] Exhibit BKS-4 -North American Electric Reliability Corporation (NERC) . Reduced Electricity Demand Bolsters Reserve Margins throughout North America for the Coming Summer. May 19, 2009.

[4] Exhibit BKS-5, Dorsa, Corina. PSEG 2009n Q1 Earning Call Transcript, p. 7

These revisions project decreased consumer demand even before taking into account the substantial reductions in electricity consumption expected as a result of the BPU's incentives for CHP, microturbines and demand-response. Nor do they include the potential impacts of New Jersey Clean Energy's Pay for Performance program, which provides incentives for large commercial, industrial and institutional customers to upgrade their facilities with more energy efficient components.

PSEG's modified demand forecasts are mirrored in PJM's own updated load projections. In January, 2009, PJM released its draft 2009 Load Forecast in which PJM assumed a 4,929 megawatt *decrease* in the projected electric load for the region in the 2011 timeframe.[5] In testimony submitted to the BPU on January 12, 2009, Mr. Reynolds of PJM stated:

> Based on the current economic outlook, PJM expects the 2009 Load Forecast Report, currently in draft form, to show lower summer peak loads for all Zones and LDAs for the years 2009 through 2011. PJM expects loads to rebound to levels that are approximately one to two percent lower than the loads in the 2008 Load Forecast Report for the years 2012 through 2016. PJM expects summer peak loads for the PS zone to be approximately one percent lower and the PLGrp zone to be three to four percent lower in those years compared to the 2008 Load Forecast Report.[6]

PJM's most updated load forecasts assume that a financial recovery beginning in 2010 will induce a return to pre-recession levels of electricity consumption. But this is a risky bet using New Jersey ratepayers' funds and relying on inherently uncertain economic forecasts. As recently as June, 2009, Eric Rosengren, President of the Federal Reserve Bank of Boston, observed that a poor understanding of the linkages between financial intermediaries, markets and the real economy has led many forecasters to underestimate the size, severity and length of the current economic downtown. Speaking at a Federal Reserve conference in Washington,

[5] Exhibit BKS-6, PJM Interconnection 2009 Load Forecast Report

[6] Reynolds, John M. Pre-Filed Direct Testimony on behalf of Public Service Electric & Gas Company for a Determination Pursuant to N.J.S.A. 40:55D-19 , p. 9-10.

Rosengren warned that liquidity disruptions were likely to have longer-term repercussions than most forecasters have assumed.[7]

Q. What is your opinion of PJM's claim that short-term events should not affect long-term transmission planning?

A. While PJM claims that near-term reductions in consumer demand and recent economic downturns are not factored into its long-term load forecasts and should not impact the need for long lead-time expansions like the Susquehanna-Roseland line, recent transmission expansion delays attest otherwise. On May 19, 2009, PEPCO announced that it was delaying the in-service date of its planned Mid-Atlantic Power Pathway (MAPP) transmission line from 2013 to 2014 on PJM's recommendation that the line *would not be needed* until demand for electricity increases and the economy recovers.[8] Consideration of near-term demand reductions induced by current economic conditions also factored into PJM's decision to abandon altogether a section of the MAPP line that would have run from Delmarva Power's Indian River substation to Salem, New Jersey.

While the timing of an economic turn-around and its affect on future electricity demand is unknown to PJM, the RTO is committed to pursuing planned RTEP projects as economic investments should it have the opportunity to capitalize on a recovery and attendant increases in consumer demand. Indeed, in PJM's 2008 Annual Report, President and Chief Executive Officer Terry Boston exclaimed:

> It is still not clear how long or to what degree the current recession will affect electricity demand or how the recovery of financial markets will proceed. The

---

[7] Exhibit BKS-7, *Fed's Rosengren: Need better research on mrkts, economy link.* Reuters, June 5, 2009. Available at http://www.reuters.com/article/bondsNews/idUSNYS00512520090605

[8] Exhibit BKS-8, *PJM Reinforces MAPP Need; Adds Year to Schedule.* Pepco Holdings, Inc. Press Release. May 19, 2009.

current decline in electricity use can buy us time to get the extra-high-voltage lines built that have already been approved in the RTEP.[9]

It appears that economic considerations rather than reliability concerns are driving PJM's decision to proceed with the Susquehanna-Roseland project. Despite projections of reduced demand over the decision-critical time period, overbuilding of transmission infrastructure in the face of sustained reductions in consumer demand could result in needless expenses to New Jersey ratepayers just as they are absorbing the burdens of a contracting economy. Overbuilding at this time would also set our path in steel and concrete when much is changing in energy planning, development and use.

The unexpected drop in electricity demand is widespread, and may be indicative of a permanent shift in consumption rather than a byproduct of the economic downturn. It also may be prescient of the impacts of conservations mandates enacted by many states and contemplated at the federal level. As early as October 2008, Xcel Energy, which operates utilities in Colorado and Minnesota, saw home-energy use drop by 3 percent from August through September, 2008. Xcel's peak demand dropped over 11% in the years 2007 and 2008. Duke Energy Corp's Q3 2008 electricity sales were down 5.9 percent in the Midwest compared to the same period in 2007, including a 9 percent decline in residential consumption. American Electric Power (AEP), which operates utilities in 11 states, saw total Q3 2008 electricity consumption drop 3.3 percent, with total 2008 drop at a similar level. Because consumption dropped even in places where prices were flat or declining, some power companies are questioning the reliability of weather-

---

[9] Exhibit BKS-9, Boston, Terry. *2008 PJM Annual Report,* p.7.

adjusted forecasting models altogether.[10] Some companies are also questioning the prudency of investments in infrastructure at this time.[11]

Q. PSEG bases much of its transmission planning on load forecasts from PJM. Isn't PJM data more reliable?

A. PSEG justifies both the need and the in-service date of the Susquehanna-Roseland Project using PJM's 2008 RTEP analysis, a Regional Transmission Expansion Plan, which relies on PJM's 2007 Load Forecast Report for projecting the likelihood and severity of reliability criteria violations in the context of transmission planning. However, these reports are outdated. PJM's 2007 Load Forecasting Report uses 2006 data for projecting consumer demand in 2011 and beyond. Not only does this data fail to consider reduced consumption due to the current recession, it does not consider substantial efforts by the BPU and others since 2006 to reduce consumer demand through increased efficiency, improved time-of-use metering and expanded demand response. PJM also does not factor in the probability of mandated efficiency standards and conservation efforts.

In December, 2006, The Brattle Group was asked to evaluate PJM's demand forecasting model after PJM's official forecast for the year 2006, made in February 2006, fell far short of the actual RTO peak demand that was observed on August 2, 2006. PJM had predicted coincident peak demand of 133,500 MW. However, the actual coincident peak demand was 146,000 MW, representing a forecasting error of -9.36 percent.

While extreme weather conditions encountered during the summer of 2006 may have accounted for the discrepancy, The Brattle Group simulated PJM's model using actual weather

[10] Exhibit BKS-10, Smith, Rebecca. *Surprise Drop in Power Use Delivers Jolt to Utilities.* Wall Street Journal. November 21, 2008. See also Exhibit BKS-11, p. 15, Xcel 2008 10-K; Exhibit BKS-12, Duke Energy Corp. 2008 10-K; Exhibit BKS-13, American Electric Power 2008 10-K.
[11] Id.

and actual economic conditions to isolate the main cause of the problem and test whether the discrepancy was due to an inherent bias in the forecasting model. Their results suggest that flawed inputs accounted for the forecasting error rather than any inherent bias in the model.[12] In other words, The Brattle Group found that the accuracy of PJM's load forecasting hinged on the accuracy of the data input into the model. The Brattle Group's findings should highlight the inherent uncertainty of planning transmission infrastructure in 2010 based on limited and demonstrably flawed data from 2006.

Q. Please describe how the Brattle Group's study suggests that PJM has not adequately addressed deficiencies in its load forecasting.

A. To enhance the ability of PJM's forecasting model to more accurately predict peak demands, The Brattle Group suggested a number of changes. Since the model is being used to make fairly long-term forecasts, the Brattle Group advised that PJM introduce additional features that would allow the model to better consider impacts associated with new technologies and dynamic pricing programs. They also suggested the use of "bootstrapping" methods to quantify inherent uncertainties in the forecast and to incorporate those uncertainties into projections of future demand.[13] Despite demonstration of how these refinements would avoid the types of forecasting errors that the Brattle Group identified as contributing to flaws in the 2006 Load Forecast Report, PJM has yet to adopt either of these suggestions.[14]

In its 2008 RTEP re-tool, PJM began to recognize Demand Side Management as an explicit adjustment to the unrestricted load forecast.[15] But even this adjustment is problematic

[12] Exhibit BKS-14, The Brattle Group. *An Evaluation of PJM's Peak Demand Forecasting Process,* prepared for the Capacity Adequacy Department, PJM Interconnection, LLC. December, 5, 2006. p.25.
[13] Id, p.30.
[14] Response to BPU Staff Request, S-PP-42
[15] PSE&G Exhibit ___, PJM 2008 RTEP retool,

and likely to overestimate projected demand since PJM requires that any load management resource fully commit through the Reliability Pricing Model (RPM) before it is considered in load forecasting. As of 2007, PJM requires any interested parties with demand resources to submit the demand response modification to PJM for its approval prior to the opening of the RPM auction window. Further, load management resources certified as Interruptible Load for Reliability (ILR) resources must be registered by March of the upcoming delivery year, and PJM will not consider late registrations. Because these requirements were not established prior to 2007, PJM's 2008 RTEP Analysis, which is based on its 2007 Load Forecast Report, cannot fully reflect load management resources that will be available to mitigate or eliminate projected reliability criteria violations in 2011 and beyond.

Because PJM zones were experiencing declining amounts of load management at the time of the 2007 Load Forecast Report, and because PJM had not yet established criteria for demand resources to participate in the RPM auction, PJM assumed that only the amount of load management available in 2007 would be available in future years.[16] This assumption was made despite public policy mandates of load management, conservation and efficiency. The assumption of future load management resources on the basis of past available resources is surprising since Mr. Reynolds claims not to consider historical load growth trends when developing PJM load forecasts.[17] By using historical data to limit the assumption of available resources but ignoring historical data for determining load growth, the result was a 2007 Load Forecast Report that severely underestimates PJM's available resources and load management in

[16] Response to BPU Staff Request, S-PP-43

[17] Response to BPU Staff Request, S-PP-8. This claim is puzzling on its face. In response to BPU Staff request for further explanation on how efficiency gains were included in PJM load forecasting, Mr. Reynolds stated, "as more efficient equipment has been installed, it served to lower the historical loads which are used in the forecast model, and therefore the load forecast" (see Mr. Reynolds, Response to BPU Staff Request, S-PP-44). It is unclear in what manner PJM *does* consider how efficiency gains impacted historical load growths in developing its load forecast but does *not* consider historical load growth trends when developing the same forecast.

2011 and beyond. Because this flawed load forecasting is the basis for PJM's calculation of load deliverability and generation deliverability tests, PJM's projection of reliability criteria violations is also flawed and likely to bear little relation to PJM's actual ability to meet reliability criteria in 2011 and beyond.

Q. Please describe the impact of using flawed load forecasting on reliability criteria tests.

A. Partially to address deficiencies that The Brattle Group recognized in its load forecasting model, PJM is currently conducting its 2009 RTEP re-tool using an improved load forecasting model as well as updated data regarding generation, demand response and transmission topology. Despite having substantially modified its load forecasting model since the 2007 Load Forecast Report and despite evidence that its 2008 RTEP analysis significantly underestimates projected generation, demand response and efficiency gains, Mr. Herling, in his testimony, claims that PJM anticipates that the Susquehanna-Roseland Project still will be needed. He bases this claim solely on the number and severity of reliability criteria violations at issue.[18]

Mr. Herling's assertion is specious since the number and severity of reliability criteria violations used to justify the Susquehanna-Roseland line is a house of cards founded entirely on the accuracy of PJM's past load forecasts. The outcome of PJM's load deliverability test, for example, hinges on the definition of an acceptable loss of load expectation (LOLE), which cannot be calculated without an accurate projection of load for a given study area in a given year – it is a location specific reliability gauge, in contrast to PJM's broad criteria violation claims.. And the accuracy of PJM's defined LOLE determines its calculation of Capacity Emergency Transfer Objectives (CETO) and Capacity Emergency Transfer Limits (CETL), the two most

[18] Response to BPU Staff Request, S-ENR-87

critical variables in PJM's deliverability testing methodology.[19] Indeed, the veracity of any claim made on the basis of the outcome of PJM's load deliverability tests depends almost entirely on the accuracy of the inputs, as noted by Brattle Group, which are determined in large part through PJM's load forecasting.

If the number and severity of projected reliability criteria violations is not a function of projected load, the only logical alternative is that they are constants. But acceptance of the constancy of the number and severity of future violations would turn on its head Mr. Herling's assertion that the 2009 RTEP re-tool could result in a change in the in-service date of the Project. In short, if more accurate load forecasting data can delay the need for the Susquehanna-Roseland Project, even more accurate data could render it unnecessary altogether.

In fact, PJM already has acknowledgedm regarding other projects, that reduced near-term demand can delay or eliminate projected reliability criteria violations and obviate the need for transmission expansions. PJM originally cited projected reliability concerns to justify substantial transmission expansions through the Potomac-Appalachian Transmission Highline (PATH) project. However, on October 31, 2008, American Electric Power (AEP) and Allegheny Energy reported a one-year delay in the identified in-service date of PATH after PJM updated its load forecasts and determined that reduced demand deferred reliability concerns.[20] On April 15, 2009, AEP and Allegheny Energy announced a *second* one-year delay of its scheduled construction of the PATH after PJM's updated its reliability analysis to include 2009 load forecasting.[21]

---

[19] Exhibit BKS-15, PJM Manual 14B: PJM Region Transmission Planning Process, Revision 12. Prepared by PJM Planning Division, Transmission Planning Department, 2006, p.41.

[20] Exhibit BKS-16, Stock Analyst. *PATH Announces Change to Transmission Line In-Service Date,* October 31, 2008.

[21] Exhibit BKS-17, *PATH Announces Change to Transmission Line Completion Date.* Potomac-Appalachian Transmission Highline Press Release, April 15, 2009.

Despite its previous calling for the Mid-Atlantic Power Pathway (MAPP) to address projected reliability concerns, in May, 2009, PEPCO shelved the easterly portion of the Mid-Atlantic Power Pathway (MAPP) project because PJM's later and more accurate modeling indicated that low consumer demand would reduce congestion and avoid projected reliability criteria violations. After determining that reliability concerns in Delaware (Mid-Atlantic) had eased because of lower than expected consumer demand in the near-term, PJM staff moved the Indian River, Delaware substation to Salem, New Jersey segment of the MAPP line from "active consideration" to "continuing study" status, effectively deferring its application and construction indefinitely.[22]

Even PJM's 2009 draft Load Forecast Report fails to adequately assess the contribution of demand response programs to PJM's load management resources in the project-critical time period. Indeed, PJM's assumption that future available load management include only the demand resources cleared in past RPM auctions, plus the 5-year average of interruptible load for reliability/active load management, and no estimate of even conservative increases in demand response, results in an absurd 2009 Report projection of static or decreasing resources placed under PJM coordination for all years after 2010.[23] Yet even despite this oversight, PJM's 2008 RTEP retool[24], which utilized more recent data for determining load forecasts and available load management resources, excluded 12 reliability criteria violations that had been identified in earlier RTEP analyses. This more accurate estimate of projected reliability criteria violations provides empirical evidence that more accurate load forecasting data is likely to reduce further or

[22] Exhibit BKS-18, Nathans, Aaron. *Low electricity demand delays power line,* The News Journal, May 29, 2009.
[23] Exhibit BKS-6, 2009 PJM Load Forecast Report, Table B-7.
[24] See PSE&G Exhibit ____, PJM 2008 RTEP.

even eliminate entirely the number and severity of reliability criteria violations that PJM cites as continued justification for the Project.[25]

The lesson is simple: without inclusion of a more accurate determination of projected load in the areas affected by the Susquehanna-Roseland Project, PJM cannot accurately project the criteria reliability violations that the Project is meant to address or even if the Project in-service date can ensure that those projected violations will be addressed. Given this, the project is clearly for some other purpose than addressing criteria reliability violations.

Q. Pertaining to your second point, please describe how energy efficiency and demand side management offer better alternatives to the Project.

A. Energy efficiency and demand side management programs would have three benefits over the Project: they would be more cost effective, more reliable, and more secure.

Q. P**lease describe how energy efficiency and demand side management would be more cost effective.**

A. Many studies have found that demand side management is the cheapest way to respond to increases in demand for electricity when compared with building new sources of electricity supply or associated infrastructure such as transmission lines to access generation. Increasing energy efficiency, one study concluded, "is generally the largest, least expensive, most benign, most quickly deployable, least visible, least understood, and most neglected way to provide energy services."[26] Or, as Jon Wellinghoff, the Commissioner of the FERC, put it, "the potential benefits from the incorporation of demand response into wholesale markets indicate that a considerable margin of gain is possible from accelerating such activity."[27]

[25] Response to Stop the Lines Request, STL-McGlynn-72

[26]. Exhibit BKS-19, Amory B. Lovins, Energy End-Use Efficiency 1 (2005)(selected) .

[27]. Exhibit BKS-20, John Wellinghoff & David L. Morenoff, *Recognizing the Importance of Demand Response: The Second Half of the Wholesale Electric Market Equation*, 28 Energy L.J. 389, 396 (2007).

Currently, PSEG admits that the cost of transmitting and distributing electricity in New Jersey is about one-third the average residential customer's electricity bill of 16 cents/kWh[28], meaning that transmission and distribution costs roughly 5.3 cents/kWh and generation 10.6 cents/kWh. Demand side management programs, by contrast, displace the need for generation and transmission infrastructure at a small fraction of this cost. The International Energy Agency reviewed forty large-scale commercial DSM programs found that they saved electricity at an average cost of 2.1 to 3.0 ¢/kWh.[29] Similarly, the Institute of Electrical and Electronics Engineers found an average cost of 2.6 ¢/kWh for demand-side management, load management, and energy efficiency programs in Vermont.[30] Another 2009 study found that the total cost for DSM programs ranged from 2.6 to 4.0 cents per kWh.[31]

Compare these financial benefits with transmission and distribution lines, which are expensive to build, operate, and maintain, and are prone to cost overruns. In his pre-filed testimony, for example, Mr. Herling noted that transmission upgrades and additions cost ratepayers in the PJM region $13.2 billion from 1999 to 2008.[32] This project is an example of much greater expenditures for ratepayers.

New Jersey has an immense amount of untapped energy efficiency potential. One study from the American Council for an Energy-Efficient Economy noted that cost effective investments in energy efficiency in New Jersey, New York, and Pennsylvania could reduce

---

[28] Exhibit BKS-21, U.S. Energy Information Administration, Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, March 2009 and 2008, June 12, 2009.

[29] Exhibit BKS-22, Howard Geller & Sophie Attali, The Experience With Energy Efficiency Policies and Programs in IEA Countries: Learning from the Critics (2005).

[30].Exhibit BKS-23, Susan Chang, *The Rise of the Energy Efficiency Utility*, IEEE SPECTRUM, May, 2008, *available at* http://spectrum.ieee.org/print/6216.

[31] Exhibit BKS-24, Peter Cappers, Charles Goldman, Michele Chait, George Edgar, Jeff Schlegel, Wayne Shirley, *Financial Analysis of Incentive Mechanisms to Promote Energy Efficiency: Case Study of a Prototypical Southwest Utility* (Berkeley: Lawrence Berkeley National Laboratory, March 2009, LBNL-1598E, p. xvi).

[32] Exhibit SRH-1, PRE-FILED DIRECT TESTIMONY OF STEVEN R. HERLING ON BEHALF OF PUBLIC SERVICE ELECTRIC AND GAS COMPANY IN SUPPORT OF SUSQUEHANNA-ROSELAND TRANSMISSION LINE PROJECT, p. 18.

electricity use by 33 percent in aggregate.[33] Another assessment from the Center for Energy, Economic and Environmental Policy at the Bloustein School of Public Policy and Planning at Rutgers University evaluated New Jersey's Reduced Energy Demand Options Program and found that virtually no customers had yet taken advantage of it, implying that significant savings could still be reached through promotion and participation.[34] The Northeast Energy Efficiency Partnership went even further and noted in 2009 that New Jersey could cost effectively save 19,000 GWh per year, including 5,700 MW of peak demand, through energy efficiency and demand side management programs.[35] The study calculated that such programs could collectively realize $16.8 billion in net savings by 2020.

PSEG has captured only a small fraction of this potential. According to Response to Municipal Interveners Request Munis-General-7/8, PSEG spent a total of $134 million on energy efficiency and demand side management in 2007 to save 733,352 MWh, and $142 million in 2008 to save 672,016 MWh. PSEG operates a power portfolio of 13,576 MW, capable of providing 107,033,184 MWh of electricity per year at a 90 percent capacity factor.[36] This means PSEG's energy efficiency offset only *0.6 percent* of potential electricity generation in 2008. A recent 2009 assessment found that of the 75 largest utilities that offered energy efficiency

---

[33] Exhibit BKS-25 Steven Nadel, Skip Laitner, Marshall Goldberg, Neal Elliott, John DeCicco, Howard Geller, and Robert Mowris, Energy Efficiency and Economic Development in New York, New Jersey, and Pennsylvania (Washington, DC: ACEEE, February, 1997).

[34] Exhibit BKS-26, Center for Energy, Economic and Environmental Policy Edward J. Bloustein School of Public Policy and Planning Rutgers, The State University New Brunswick, New Jersey and the Aspen Systems Corporation, PROCESS EVALUATION of the RENEWABLE ENERGY PROGRAMS ADMINISTERED AND MANAGED by the NEW JERSEY BOARD OF PUBLIC UTILITIES OFFICE OF CLEAN ENERGY, November, 2004.

[35] Exhibit BKS-27, Northeast Energy Efficiency Partnership, An Energy Efficiency Strategy for New Jersey Achieving the 2020 Master Plan Goals, March, 2009.

[36] Unfortunately, the PSEG website did not list the amount of MWh generated in 2007 or 2008. Instead, they only listed their total installed capacity, necessitating a rough estimate of their total generation for any given year. See Exhibit BKS-28, PSEG, "Total PSEG U.S. Generation Assets Existing, In Construction, or Announced Late Stage Development," May, 2009.

programs in 2007, PSEG did not even make the list of the top 50.[37] PSE&G should market, promote, solicit, recruit and institute basic energy efficiency programs.

Q. Please describe how energy efficiency and demand side management would be more reliable than the Project.

A. PSEG's underinvestment in energy efficiency is unfortunate, as one kWh saved is more reliable and valuable than one kWh generated and transmitted. The National Association of Regulatory Utility Commissioners has documented that every dollar invested in energy efficiency and demand side management and found that these measures:

- Mitigated against uncertainty and lowered load, wear, and maintenance needs on the entire electricity system, from coal mines and power plants to transmission lines and substations, even in hours when reliability problems were not anticipated by system managers;
- Depressed the costs of locally used fuels such as oil, coal, and natural gas;
- Reduced demand across peak hours, the most expensive times to produce power;
- Lessened costly pollutants and emissions from generators;
- Improved the reliability of existing generators;
- Moderated transmission congestion problems;
- Operated automatically through customers coincident with the use of underlying equipment or load, meaning they are always "on" without delay or the needed intervention by system operators to schedule or purchase the resource.[38]

These findings have been confirmed by a number of peer-reviewed studies. To cite just a few, the National Research Council found that existing energy efficiency programs could reliably displace the need to continue operating units 2 and 3 of the 2,000MW Indian Point nuclear

---

[37] Exhibit BKS-29, John D. Wilson, *Energy Efficiency Program Impacts and Policies in the Southeast* (Southern Alliance for Clean Energy, May, 2009), p. 12.
[38]. EXHIBIT BKS-30, RICHARD COWART, EFFICIENT RELIABILITY: THE CRITICAL ROLE OF DEMAND-SIDE RESOURCES IN POWER SYSTEMS AND MARKETS 64 (2001).

facility near New York City.[39] Another study found that energy efficiency and demand side management programs were just as "firm" and reliable as building new power plants and operating conventional sources of electricity supply.[40] These studies show that residential energy efficiency improvements in lighting, cooling, refrigeration, electronics, space heating, and hot water heating, along with commercial and industrial improvements in lighting, refrigeration, cooling, ventilation, office equipment, manufacturing, water heating, space heating, and building controls, could cost-effectively and reliably displace the need to build electricity infrastructure.

Even data from PJM disprove PSEG's argument that DSM programs are unreliable. Voluntary energy efficiency and DSM programs reliably offset all load growth from 2008 to 2009 within the PJM service area. Thomas Falin, manager of capacity adequacy planning for PJM, recently noted that their electricity load forecast was down 1.5 percent from 2008 to 2009 and that voluntary curtailment and demand response displaced the need for more than 7,000 MW of supply within PJM region.[41]

Q. Please describe how energy efficiency and demand side management would be more secure than the Project.

A. By displacing the need to erect transmission and distribution lines, energy efficiency measures improve energy security. By contrast, the physical vulnerabilities inherent in the proposed T&D infrastructure do not fulfill definitions of energy security provided by the Department of Defense (DoD) and the International Energy Agency.

---

[39].Exhibit BKS-31, NATIONAL RESEARCH COUNCIL, ALTERNATIVES TO THE INDIAN POINT ENERGY CENTER FOR MEETING NEW YORK ELECTRIC POWER NEEDS 283-298 (2006), *available at* http://www.nap.edu/catalog.php?record_id=11666.

[40] Exhibit BKS-32, Marilyn A. Brown & Benjamin K. Sovacool, *Promoting a Level Playing Field for Energy Options: Electricity Alternatives and the Case of the Indian Point Energy Center*, 1 ENERGY EFFICIENCY 35 (2008).

[41] Exhibit BKS-33, Platts Megawatt Daily, "Economy Trumps Summer in PJM Forecast," June 22, 2009, p. 8.

For example, energy efficiency measures save electricity in ways that are practically immune from attack and disruption. It is much more difficult for terrorists and attackers to dismantle more-efficient electric appliances and alter consumer behavior than to attack a transmission line with balloons or a substation with grenades and mortars. A comprehensive, three-year DoD and Federal Emergency Management Agency study noted that reliance on centralized power plants and transmission and distribution lines creates unavoidable and costly vulnerabilities.[42] The study noted that transmission and distribution systems constituted "brittle infrastructure" and create tempting targets for terrorists because attackers would need to destroy only a few, poorly guarded facilities to cause large, catastrophic power outages. These types of security risks to the Susquehanna-Roseland project are y amplified given its current route, which would traverse places like the Picatinny Arsenal, a U.S. Army munitions depot. In its complementary study, the International Energy Agency highlighted that transmission and distribution infrastructure can be easily disrupted and dismantled by accidents, intentional attack and sabotage, and even small animals.[43] Transmission is inherently unstable and fragile, especially when compared to energy efficiency measures and distributed generation (which will be discussed below).

Q. Because of these benefits relating to cost, reliability, and security, has PSEG seriously considered demand-side management as an alternative to the Project?

A. Sadly, despite the clear economic benefits of energy efficiency to both PSEG and the public, PSEG and PJM have practically ignored the value of utilizing demand-side management to displace the need for the Project. By their own admission, PSEG has stated that "voluntary curtailment of customer load … typically results in very small amounts of load reduction and is

[42] Exhibit BKS-34, A. Lovins *et. al.*, *Brittle Power Energy Strategy for National Security* (1982)(selected).
[43] Exhibit BKS-35, International Energy Agency, Distributed Generation in Liberalised Electricity Markets, (2002).

not a reliable means to resolve violations of reliability criteria,"[44] and later that "there is no documentation to assert that demand reduction will be implemented when called-upon."[45] That is a very disturbing statement, as mechanistic demand reduction is a "flick of the switch" matter, and generalized demand reduction is New Jersey policy. Also, PJM admits that its professionals have "not analyzed" the potential for smart/interval metering[46] which is being used on distribution systems in other areas of the country for peak shaving, load shifting and peak demand reduction.

Q. Pertaining to your second point, please describe how distributed generation offers a better alternative to the Project.

A. All too often electricity planners and system operators sharply demarcate supply options, such as building power plants, demand options such as changing consumer behavior, and transmission options, such as building new T&D lines, from each other, rather than identify and address needs holistically. This demarcation by planners and operators obscures that some types of supply options, such as building distributed generation or deploying solar photovoltaic panels, can actually obviate the need for new transmission infrastructure.

For instance, distributed generation—small-scale power supply devices that produce electricity close to its point of consumption—can improve grid reliability, lessen the need to build expensive transmission infrastructure, reduce congestion, offer important ancillary services, and improve energy reliability and security through geographic diversification. Deploying distributed generation units offers an effective and economic alternative to constructing new transmission and distribution lines, transformers, local taps, feeders, and

[44] Response to Municipal Interveners Request Munis-General-16.
[45] Response to Municipal Interveners Request Munis-McGlynn-2.
[46] Response to Municipal Interveners Request Munis-General-20.

switchgears, especially in congested areas or regions where the permitting of new transmission networks is difficult.

Consider three examples. First, Pacific Gas and Electric Company (PG&E), the largest investor-owned utility in California, built an entire power plant in 1993 in a specific location to test the grid and transmission benefits of a 500 kW distributed power plant. PG&E found that the distributed generator improved voltage support, minimized power losses, lowered operating temperatures for transformers on the grid, and improved transmission capacity. The benefits were so large that the small-scale generator was twice as valuable as estimated, with projected benefits of 14 to 20 ¢/kWh.[47]

Second, PG&E has used solar PV devices *as a substitute* for greater investments in T&D infrastructure. Back in the early 1990s, PG&E was in a situation very similar to PSEG. Using conventional approaches, PG&E planners proposed an upgrade of 230-kV and 60-kV lines serving seven substations in the San Francisco area, estimated to cost PG&E $355 million, in 1990 dollars. However, PG&E ultimately discovered that a cheaper alternative was to strategically site and deploy distributed 500-kW solar PV plants connected to distribution feeders. By investing in such locally sited solar PV projects, PG&E found that it could defer a significant number of its transmission upgrades and ultimately saved $193 million, or more than half the present cost of the expansion plan, by installing solar panels.[48]

Third, distributed generation can provide utilities with a variety of important ancillary services as well, including system control, reactive power supply, and spinning reserves.

---

[47] See Exhibit BKS-36, Howard J. Wenger, Thomas E. Hoff, and Brian K. Farmer, ''Measuring the Value of Distributed Photovoltaic Generation: Final Results of the Kerman-Grid Support Project'' (presentation at the First World Conference on Photovoltaic Energy Conversion Conference Proceeding, Waikaloa, Hawaii, December 1994) (Washington, DE: IEEE, 1994), 792–796.

[48] Exhibit BKS-37, Charles D. Feinstein, Ren Orans & Stephen W. Chapel, The Distributed Utility: A New Electric Utility Planning and Pricing Paradigm, 22 ANN. REV. ENERGY & ENV'T 155, 159-60 (1997).

Because of their smaller size, these generators have lower outage rates, decreasing the need for reserve margins and excess transmission capacity. Indeed, researchers at the University of Albany and the National Renewable Energy Laboratory determined that dispersed solar photo-voltaic (PV) resources are so valuable they could have prevented the $6 billion 2003 blackout that affected 40 million people spread across Canada and the eastern United States. After running thousands of simulations, they found that had distributed solar PV facilities been operating on August 14, the blackout most likely would have been avoided.[49] The researchers noted that the indirect cause of peak demand on that day—hot temperatures and greater air conditioning loads—are also the best source for solar PV generation. If a few hundred MW of solar PV had been operating, the researchers concluded that power transfers and losses would have been reduced, voltage support enhanced, and uncontrolled events would not have cascaded into a complete blackout.[50]

Q. Dr. Sovacool, do you believe that PSEG has even considered the option of using distributed generation to displace the need for the T&D line?

A. Absolutely not. When asked by municipal interveners to discuss location and capacity of solar PV within the PSEG system, respondents indicated that "PSE&G objects to this question as unduly burdensome and irrelevant."[51] Clearly, PSEG planners have not considered the role solar PV can play in eliminating the need for the Project.

Q. Wouldn't the Project still be more reliable than deploying a collection of distributed generation facilities, Dr. Sovacool?

[49] For a full accounting, see Exhibit BKS-38, NERC Blackout Report, Chap. 5, How and why the blackout began in Ohio, details the multiple stages where controllers failed to take action, required under NERC reliability standards, that could have avoided the blackout..

[50] See Exhibit BKS-39, Richard Perez, Marek Kmiecik, Tom Hoff, John G. Williams, Christy Herig, Steve Letendre, and Robert M. Margolis, *Availability of Dispersed Photovoltaic Resource During the August 14th 2003 Northeast Power Outage* (Albany, NY: University of Albany, 2007).

[51] Response to Municipal Interveners Request Munis-General-10.

A. Actually, there are strong reasons distributed generation has numerous reliability *benefits* compared to the Project. Consider one type of important ancillary service, reactive power.

To understand reactive power, it is important to briefly discuss one of the key components of the electric power system, voltage. Many types of customer equipment require voltage to fall within a narrow range in order to function properly. If delivered voltage is too low, electric lights dim and electric motors function poorly and can overheat. Overly high voltages shorten lives of lamps substantially and increase motor power, which can damage attached equipment. Unlike frequency, which is the same at all locations in the power system, voltage varies from point to point. The voltages throughout a power system depend on the voltage output of individual generators and voltage control devices, as well as the flow of power through the system. Maintaining voltage involves balancing the supply and demand of reactive power in the system. Reactive power is created when current and voltage in an alternating current system are not in phase due to interactions with electric and magnetic fields around circuit components. Reactive power is often referred to as VARS (for volt amperes reactive), and is regulated by adjusting magnetic fields within the generators.

The problem with reactive power is that power transfers across long transmission lines often depress voltage. Transmission in a "central station" framework with generators far from load inherently requires more reactive power than that of a system using more evenly distributed generation.[52] The Project, quite simply, has several negative implications for reliability.

First, remote generation of reactive power requires a reduction in a generating unit's real-power generating capacity, reducing profit margins for generators supplying PJM. PJM's standard practice is to estimate that every 5 percent reduction in voltage will represent 1.7

[52] See Exhibit BKS-40, Providing Reactive Power from Generating Resources.

percent of load in the affected area at the time of voltage reduction.[53] That means PJM generators must supply an additional 1.7 percent of load for every 5 percent reduction in voltage without additional compensation. It was this reduction in voltage and the economic disincentive to supply reactive power that the U.S Department of Energy Power Outage Study Team (POST) identified as a primary contributing factor in dangerously depressed voltage within PJM that occurred during peak loads associated with two heat waves in the summer of 1999. At the time of peak load during these disturbances, the market price for real power was over $900 per megawatt-hour, whereas the price for reactive power was $0 per megaVar-hour. This price difference provided no incentive for the local production of reactive power and directly contributed to PJM's unacceptably low voltages during the system disturbance.[54]

Second, when PJM relies on remote generation of reactive power, during periods of low voltage the need increases for importation of real-power generation from outside PJM to compensate. This increases the cost of electricity on the spot market and may contribute unnecessary costs to New Jersey ratepayers.

Third, reactive power lost to longer and larger transmission networks creates additional likelihood that projected low voltage and voltage drop violations must be avoided with costly regulated infrastructure upgrades rather than market-based solutions. For example, in July and August of 2004 and 2005, the West Orange 138kV station experienced low bus voltages that necessitated PSEG's installation of an expensive dynamic capacitor at the station[55]. At the March 19, 2009 PJM Transmission Expansion Advisory Committee (TEAC) meeting, PJM presented re-tool results for its 2013 analysis that identified voltage drop violations in the Lincoln, Landis

---

[53] See exhibit JMR-2, page 24.
[54] Exhibit BKS-41, Loose, Verne W. and Dowell, L. Johnathan. *Economic and Engineering Constraints on the Restructuring of the Electric-Power Industry,* Los Alamos National Laboratory Paper, Electricity-Infrastructure Simulation System (ELISIMS) Project, 2000.
[55] Response to BPU Staff Request, S-PP-67.

and Sherman areas for several 138 kV line contingency combinations, low voltage magnitude violations in the Motts Farm and Ocean Bay areas, low voltage and voltage drop violations in the 138th Street area, and multiple low voltage and non-convergence violations during contingencies involving the loss of the Steele-Wye Mills + Steele-Easton 138 kV lines, the loss of Pocomoke-Kings Creek + Piney-N. Church 138 kV lines, and the loss of Pocomoke-Oak Hall + Piney-N. Church 138 kV lines. PJM does not yet know the total cost to ratepayers for the recommended transmission upgrades needed to address these reactive power issues, but it is likely to exceed $30 million.[56]

On the other hand, distributed generation and renewable energy resources can provide reactive power locally, while energy efficiency and demand response programs eliminate the need for additional reactive power supply altogether. Researchers at the National Renewable Energy Laboratory, for example, have documented how improved wind turbine and distributed generation power control technologies are creating VAR support capabilities that can be used to enhance the voltage regulation and stability of local grids.[57]

PJM's reliability criteria tests, which discount the ability of planned generation to alleviate reliability concerns, coupled with its transmission planning process, which is biased toward identifying transmission solutions to reliability concerns, results in the overbuilding of transmission infrastructure in ways that cost New Jersey ratepayers and actually may reduce reliability. Without more accurate load forecasting data that properly considers the contribution of non-transmission infrastructure to the alleviation of projected reliability violations, the

[56] TEAC Committee Meeting Notes, March 13, 2009.
[57] Exhibit BKS-42, Romanowitz, H., et. al. *VAR Support from Distributed Wind Energy Resources,* Preprinted Conference Paper presented at the World Renewable Energy Congress VII, National Renewable Energy Laboratory, July 2004, p.1.

Susquehanna-Roseland Project could be a prime example of ratepayers spending more money for less reliable service.

Q. Dr. Sovacool, are those the only negative implications for reliability at risk from the Project?

A. No, there are more. Not only does PJM's overreliance on transmission solutions to identified reliability violations represent an unnecessary expense for New Jersey ratepayers, it likely triggers its own reliability concerns by increasing the risk of voltage instability within the PJM interconnection. It is well known that reactive power is more difficult to transfer than real power. Larger transmission lines generate greater line losses. But power lost through transmission is not equally distributed. At high loadings relative losses of reactive power on transmission lines are significantly greater than relative real power losses. Reactive power losses increase exponentially with the distance transmitted. So the difference between reactive power losses and real power losses becomes even greater the more transmission line between generator and load. As the distance between the generating unit and the customer increases, the reactive power required to maintain stable voltage increases.

In the modern electrical power grid, catastrophic failures are rarely the result of inadequate supplies of real power to load pockets. More often, outages result from, singularly or in combination, human error, inadequate diagnostics, and voltage instability caused by insufficient reactive power. Because long, large lines make it difficult to supply necessary reactive power locally, it must be supplied remotely by increasing currents to compensate for the reactive power lost in transmission.

FERC has documented in its February 4, 2005 Staff Report regarding Principles for Efficient, Reliable Reactive Power Supply and Consumption[58] how inadequate reactive power leading to voltage collapse has been a causal factor in major power outages worldwide. Voltage collapse was responsible for blackouts on the West Coast on July 2, 1996 and August 10, 1996. Voltage collapse also factored into major blackouts in Paris (1978), Tokyo (1987), Quebec (1989), and London (2003), and in Sweden, Denmark, and Italy during the 2003 European heat wave.

Multiple assessments of the August 14, 2003 East Coast blackout found that the cause of the outage was not a lack of raw power or available transmission. Indeed, the Harding-Chamberlain 345kV line that was wheeling some of the power lost when Cleveland's East Lake power plant tripped offline was operating at only 45 percent of its allowable limit when the cascading outage that triggered the 2003 blackout began. Instead, as the FERC Report concluded, the unfortunate series of events that led to the power losses for much of the East Coast was precipitated by mounting voltage instability resulting from insufficient reactive power during the period leading up to the blackout.

While the 2003 blackout was not due to a voltage collapse (as that term has traditionally been used by power system engineers), the Task Force charged with investigating the incident said in its Final Report that "insufficient reactive power was an issue in the blackout." The FERC Report also cites "overestimation of dynamic reactive output of system generators" as a common factor among major outages in the United States.[59]

Given the complexity of the modern electrical system, and what we know about the role reactive power has played in recent outages, there are several reasons why relying on longer and

[58] Exhibit BKS-43, *Principles for Efficient, Reliable Reactive Power Supply and Consumption,* Federal Energy Regulatory Commission (FERC), Staff Report, Docket No. AD05-1-000, February 4, 2005.
[59] Id, p. 20.

larger transmission networks to wheel greater amounts of real power is perhaps the *worst* strategy for ensuring system reliability.

First, reactive power losses on long-distance transmission lines are proportional to the length of the line. The farther generation is located from load, the more current is necessary to make up for reactive power losses due to line length. But greater current also risks larger voltage drops along the path.[60] FERC has investigated how inadequate reactive power supplies lower voltage in long transmission lines. As voltage drops, current must increase to maintain the power supplied, causing lines to consume more reactive power and the voltage to drop further. If current increases too much, transmission lines trip, overloading other lines and potentially causing cascading failures. PSEG has documented ho such an incidence occurred on July 27, 2005, when the trip of a large generator near Baltimore, Maryland invoked a voltage reduction.[61] If voltage drops too low some generators will automatically disconnect to protect themselves. This further loss in generation causes further reduction in reactive power from capacitors and line charging, creating a positive feedback loop that results in still further voltage reductions. The result is a progressive and uncontrollable collapse of voltage, all because the power system is unable to provide reactive power locally to meet real power demand. Indeed, FERC has investigated how this scenario – rather than overloading – has been a causal factor in major blackouts over the last 20 years.

Second, reactive power lost on transmission lines is exponential to the flow of the line and linear to the length of the line. The result is that reactive power supplied by capacitors connected to the lines decreases with the square of the voltage of the line. Thus, either more capacitors are necessary to stabilize voltage along the line (adding significant cost to the system),

---

[60] *Id, p.* 19.
[61] Response to BPU Staff Request, S-PP-67.

or greater dynamic response is demanded of each capacitor. However, recent studies have found that the dynamic response of capacitors is problematic under system disturbance. Professor David I. Eromon has noted, for example, that "excessive use of capacitors can aggravate the imbalance of reactive power and can actually become one of the causes of voltage collapse."[62]

Third, if our experience with nearly 100 years of centralized generation and transmission has taught us anything, it is that "if you build it, it will be filled." Building longer and larger transmission systems to solve the system reliability problems inherent in transmission congestion is much like addressing the problems of addiction with more drugs. It is reasonable to assume that the proposed Project, in time, will face the same congestion issues that PJM claims the Susquehanna-Roseland Line is now needed to solve. At some point, future demand will load the new lines and create an even larger reactive power feedback loop that must be resolved during periods of voltage disturbance.

Q. Pertaining to your third and final point, Dr. Sovacool, please describe how the Project appears to violate reasonable standards for reliability, and how it would have serious environmental and social costs that conflict with New Jersey's stated energy policy.

A. Let me begin by discussing the importance of standards. The PJM reliability criteria that PSEG rely upon to justify the project appear to violate NERC reliability standards. NERC Reliability Standard TPL-002 requires the Planning Authority and Transmission Planner each to demonstrate through a valid assessment that the Network analyzed can be operated to supply projected customer demands and projected Firm (non-recallable reserved) Transmission Services, at all demand levels over the range of forecast system demands, under contingency conditions defined in the Standard. To be valid, assessments must, among other things, consider

[62] Exhibit BKS-44, Eromon, David I. *Voltage Regulation: Making Use of Distributed Energy Resources (DER),* International Journal of Modern Electrical Engineering, v.6:2, Spring 2006.

existing *and planned* facilities, including the protective characteristics of planned facilities, backup or redundant systems and planned control devices.[63]

The load deliverability and generator deliverability tests are PJM's documented method of testing system reliability under "critical system conditions" as provided for in NERC Standard TPL-002. Under these tests, PJM expressly excludes the protective characteristics of planned facilities, which not only produces test results that inaccurately assess system performance under critical system conditions, but contravenes NERC validity requirements.

The PJM RTEP process baseline analyses include previously processed generators and transmission modifications as starting point assumptions. Once an interconnection customer has executed a Facilities Study Agreement, PJM includes the generator along with all of its identified network upgrades in its base case in order to allow the generator to contribute to generator deliverability problems; however PJM excludes from its base case the capacity of generators that have a signed Facilities Study Agreement, along with their planned protection systems and control devices, to relieve system problems.[64]

PJM justifies this modeling approach because of the considerable uncertainty regarding whether a new generator will ultimately go into service. But the certainty or uncertainty of any generator with an executed Facility Study Agreement to relieve system problems is equal to the certainty or uncertainty of its ability to contribute to system problems. Both the burdens and benefits of planned facilities rest on the same contingency: the "considerable uncertainty regarding whether a new generator will ultimately go into service."

PJM's consideration of the system problems introduced by planned facilities while ignoring the system relief benefits of these same facilities, despite equal uncertainty of both, is

[63] Exhibit BKS-45, NERC Standard TPL-002, B.R1.3.8-R1.3.11 – System Performance Under the Loss of a Single BES Element

[64] see McGlynn, direct, p.9.

not consistent with NERC requirements that testing protocols include planned facilities as well as the effects of planned protection systems, including backup or redundant systems and planned control devices. As such, the deliverability tests upon which PJM relies as evidence of projected reliability criteria violations are invalid assessments of NERC reliability standards and cannot provide sufficient justification for transmission expansions that are not otherwise needed.

Additionally, by failing to consider the protective characteristics of planned generation and transmission expansions, PJM lacks a valid assessment of system performance under critical system conditions as required by NERC Standard TPL-002. Until PJM performs such a valid assessment, the Commission cannot be confident that the Susquehanna-Roseland Project will adequately address projected reliability criteria violations should they arise.

PJM recognizes that its load deliverability test, which assesses the delivery of energy from the aggregate of available capacity resources in one PJM electrical area and adjacent non-PJM areas to another PJM area experiencing a capacity deficiency, is both the more common test of system reliability and the test that PJM has historically used to ensure that energy can be delivered to each PJM load area from the aggregate of resources available to PJM. More importantly, PJM's Deliverability Testing Methods acknowledge that load deliverability tests address reliability only, without regard for the economic performance of the system.[65] Moreover, PJM's Load Deliverability Procedures acknowledge that the Load Deliverability Study alone verifies that PJM can meet its specified reliability objective regarding each study area's ability to import needed and available capacity assistance.[66]

PJM's supplemental Generation Deliverability Study, on the other hand, is designed to ensure that bottled capacity conditions during a single contingency do not limit the economic

[65] Exhibit BKS-15, PJM Manual 14B: PJM Region Transmission Planning Process, Revision 12. Prepared by PJM Planning Division, Transmission Planning Department, 2006, Attachment C (only), p.41.
[66] Id., p.53.

dispatch of certified capacity resources. PJM acknowledges that in actual operating conditions, energy-only resources may displace capacity resources in the economic dispatch that serves load. Indeed, PJM acknowledges that congestion itself is not an indication of mitigated reliability, but merely could be a precursor for the need for future upgrades for reliability.[67] In actual operating conditions, PJM system operators respond to congestion with corrective actions, including dispatch of generation out of merit order to control power flows.[68] PJM's Load Deliverability Study alone should establish the deliverability of necessary capacity to respond to single contingencies in any given study area where PJM system operators are responding with these standard corrective actions.

PJM's Generation Deliverability Study goes far beyond testing the ability of PJM system operators to dispatch necessary capacity to respond to single contingencies affecting any particular electrical area as required by NERC Standard TPL-002. The Generation Deliverability test, rather, is designed to demonstrate that a magnitude of resources equal or greater than the installed capacity in any given electrical area could simultaneously deliver energy to the remainder of PJM.[69] The Generation Deliverability Study requires that enough energy be deliverable to any study area experiencing a single contingency that it does not limit any other electrical area's ability to export the total amount of its installed capacity to other areas. Put simply, the Generation Deliverability Study does not test the ability of any study area to weather a single contingency without triggering additional contingencies so much as the ability of PJM to weather single contingency conditions without negatively affecting its economic dispatch. In short, it is a test of profitability, not reliability.

[67]Exhibit BKS-9, 2008 PJM Annual Report, p.17.
[68] Response to Stop the Lines Request, STL-Herling/McGlynn-32
[69] Exhibit BKS-15, PJM Manual 14B: PJM Region Transmission Planning Process, Revision 12. Prepared by PJM Planning Division, Transmission Planning Department, 2006, Attachment C, p.53.

Q. Dr. Sovacool, are there any other problems with PJM's reliability criteria?

A. Yes, disparities in PJM's reliability criteria tests seem actually to encourage the overbuilding of transmission. In addition to overly stringent reliability criteria tests, PJM's current RTEP process creates a modeling disparity by considering the contribution of planned generation facilities to deliverability problems while ignoring the ability of those same generation facilities to relieve system problems. Assessing the burdens of planned facilities while discounting their benefits skews PJM's planning process toward the overbuilding of transmission capacity and/or the prioritizing of transmission upgrades in non-optimal areas.

Mr. McGlynn testified that this disparity is addressed by updating the baseline analysis to reflect the removal of any planned generator that drops out of the queue after executing a Facility Study Agreement, but before executing an Interconnection Service Agreement.[70] According to Mr. McGlynn, this group represents as much as 5 percent of proposed generators entering the queue.[71] But because RTEP Planning Reports are only updated once, and often (as with the Susquehanna-Roseland Project) revised analyses are unavailable before Commissioners consider PSEG's petitions for infrastructure expansion, Commissioners and interveners are asked to depend on deliverability tests that do not reflect any of the corrections Mr. McGlynn suggests occur as a result of removing planned generators from the original baseline analysis.

The revision of baseline analyses to reflect removal of the network upgrades required by these planned facilities would not avoid the skewing in any case. PJM's modeling disparity does not currently consider these network upgrades in assessing the ability of planned facilities to relieve system problems. Indeed, PJM's testing protocol does not consider *any* component of a

[70] Response to Stop the Line Request, STL-McGlynn-38.
[71] Response to Stop the Lines Request, STL-McGlynn-40.

planned generation facility that might relieve system congestion, even though it is required under NERC Standard TPL-002.

At best, PJM could argue that an updated baseline analysis that reflected removal of a generator from PJM's queue, might correct the modeling skew by considering how the planned facility *would have* contributed to deliverability problems. But even this explanation is rendered nonsensical if, as Mr. McGlynn has testified, PJM already included in the original baseline the network upgrades identified for the proposed generator through the interconnection study process.[72] If the network upgrades were identified in order to alleviate any reliability concerns presented by the proposed facility, the inclusion of the facility in the baseline analysis could not have contributed additional reliability concerns justifying transmission solutions. Therefore, the removal of the proposed generator from the baseline in any subsequent update of the deliverability tests could not correct for the modeling skew inherent in the original tests. By design, the tests assign much greater value to variables likely to contribute to deliverability problems and ignore variables likely to alleviate them.

By ignoring the reliability benefits of planned generators and the network upgrades that they require, PJM employs skewed deliverability tests to justify transmission solutions to reliability problems that are unlikely to materialize.

Mr. Herling has conceded that PJM's transmission planning process is designed to specify regulated transmission solutions to reliability problems and does not consider alternatives to transmission *not otherwise proposed though the market.*[73] However, PJM's deliverability tests preclude the possibility of non-transmission solutions because the tests are designed to ignore the reliability benefits of proposed generators until they have progressed through PJM's

---

[72] Response to Stop the Lines Request, STL-McGlynn-38.
[73] Response to BPU Request, S-PP-28.

interconnection queue to the point of executing an Interconnection Service Agreement. Indeed, prior to executing an ISA, the tests are designed to consider any non-transmission solution proposed by the marketplace as an additional burden likely to magnify rather than alleviate reliability concerns. Under such conditions, few if any non-transmission alternatives could compete with the regulated transmission solutions specified by PJM's planning process.

Q. Are there any other ways in which the project appears to violate procedural rules and standards?

A. Yes, one final one. N.J.S.A. 40:55D-19 Requires PSEG to Consider Non-Transmission Alternatives. However, Mr. Herling stated that PJM does not have the authority to direct the construction of generation or the implementation of demand resources and so considered non-transmission alternatives to the Susquehanna-Roseland Project in the context of the PJM RTEP process. While there is no evidence that non-transmission alternatives were actually publicly discussed and subject to stakeholder review and participation, Mr. Herling has indicated that PJM would have considered such alternatives only to the extent that proposed generation projects had executed an ISA or demand response programs had cleared an RPM auction.

The petition before the BPU is filed on behalf of PSEG, a supplier of electric generation. The relevant statute under which that petition is heard places a particular burden on electric power generators and implies the requirement to consider non-transmission alternatives that are reasonably available. New Jersey Statute 40:55D-19 reads in part:

> *A hearing on the appeal of a public utility to the Board of Public Utilities shall be had on notice to the agency from which the appeal is taken and to all parties primarily concerned, all of whom shall be afforded an opportunity to be heard. If, after such hearing, the Board of Public Utilities shall find that the present or proposed use by the public utility or electric power generator of the land described in the petition is necessary for the service, convenience or welfare of the public, including, but not limited to, in the case of an electric power generator, a finding by the board that the present or proposed use of the land is*

> *necessary to maintain reliable electric or natural gas supply service for the general public and that no alternative site or sites are reasonably available to achieve an equivalent public benefit, the public utility or electric power generator may proceed in accordance with such decision of the Board of Public Utilities, any ordinance or regulation made under the authority of this act notwithstanding.*

Use of the phrase "in the case of an electric power generator," by the Legislature is telling because it implies a particular burden placed upon PSEG as the generators of electricity. With the break-up of vertically integrated utilities and the advent of regional transmission organizations, the Legislature was afforded the opportunity to amend N.J.S.A. 40:55D-19 to apply a specific obligation to all electric utilities – including transmission and distribution organizations – that they consider all reasonably available alternatives to proposed land uses. But the wording remains in part because the Legislature recognized a special obligation to consider the siting of electrical power generation in supplying reliable electric service for the general public. While the statute certainly allows for transmission solutions to reliability concerns, it omitted transmission and distribution suppliers from the expressed obligation to consider all reasonable alternatives. The Legislature deemed generation unique.

Compliance with N.J.S.A. 40:55D-19 cannot be met through a transmission planning process that claims to consider only non-transmission solutions that are already integrated into the assessment of future reliability criteria violations anyway. It requires that the BPU grant PSEG's petition only if the Susquehanna-Roseland Project is deemed optimal after an open forum where PSEG, stakeholders and all affected parties may compare the Project with reasonably available generation-based alternatives. There is no evidence that such a comparison has occurred.

Q. Finally, Dr. Sovacool, describe how the Project may inflict social and environmental costs at odds with New Jersey's stated energy policy.

A. The *Energy Master Plan* from the State of New Jersey, among other things, calls for an energy policy that (1) keeps prices low, (2) minimizes the emission of greenhouse gases and pollutants, (3) invests in energy efficiency and cleaner forms of electricity supply.[74] The Project seems to violate each of these three tenets within the master plan.

First, as discussed above, PSEG has not demonstrated that the Project will in anyway keep prices low. In fact, recent events suggest that PSEG uses the rhetoric of keeping prices low and benefitting the public when in reality they attempt to *increase* prices and returns for their shareholders, even at the expense of *decreasing* electricity reliability within their service area. PSEG recently proposed to take their Bergen 2 unit offline to sell power to New York in order to maximize profits to the company, even though doing so would decrease reliability and raise electricity prices for New Jersey ratepayers. As Jeanne M. Fox, President of BPU articulated, "While PSEG claim that this project is in the public interest, it appears to only benefit the citizens of New York City, leaving New Jersey ratepayers behind."[75] The same motive could exist regarding the project, where PSEG has the ability to "cook the books" to generate future reliability criteria violations that justify expensive transmission expansions. By moving available generation infrastructure around in ways that reduce reliability, PSEG can increase immediate profits at the expense of New Jersey ratepayers who must underwrite the necessary transmission upgrades.

Second, the Project, as part of a much larger plan developed at the behest of FERC, ostensibly would be used to transmit and distribute electricity from fossil fuel-fired generators, something directly at odds with New Jersey's goal of reducing pollution and mitigating climate

---

[74] Exhibit BKS-46, New Jersey Master Energy Plan, October 2008, pp. 6-10.
[75] Exhibit BKS-47, New Jersey Board of Public Utilities, "Board Protests PSEG's Bid to Make Power Plant Unavailable to New Jersey Ratepayers," Press Release, February 20, 2008.

change.[76] Using the best data available, when roughly quantified and put into monetary terms, the current negative externalities associated with coal-fired power plants are almost 20 additional cents per kWh, or 74 times greater than those for wind farms.[77] Continuing to generate electricity from these polluting and climate endangering sources has negative implications for human health, social stability, and the quality of the environment. Facilitation of coal generation with transmission is contrary to New Jersey's Master Energy Plan.

Third, as discussed above, PSEG does not appear to be adequately investing in energy efficiency and demand side management programs that would lower costs for New Jersey ratepayers and alleviate any claim of need for the Project.

Q: Does this conclude your testimony?

A: Yes

[76] See BKS-48TESTIMONY OF KARL PFIRRMANN, PRESIDENT PJM WESTERN REGION PJM INTERCONNECTION, L.L.C. Promoting Regional Transmission Planning and Expansion to Facilitate Fuel Diversity Including Expanded Uses of Coal-Fired Resources, Docket No. AD05-3-000, for a description of how the project could be used to transmit coal-fired electricity from West Virginia as part of "Project Mountaineer."

[77] Exhibit BKS-49, Benjamin K. Sovacool and Charmaine Watts, "Going Completely Renewable: Is it Possible (Let Alone Desirable)?,", *Electricity Journal* 22(4) (May, 2009), p. 100.