United States Senate

Energy and Natural Resources Committee

Testimony of Terry Boston, President and Chief Executive Officer

PJM Interconnection

July 31, 2008

Executive Summary

Transmission will play a critical role in enabling virtually any of the public policy goals the Congress may embrace to strive for energy independence and meet environmental goals, including renewable energy, nuclear energy, clean-coal technology or plug-in hybrid electric vehicles.

To adopt some of the ambitious renewable energy and climate change goals that are being discussed will require a *substantial* investment in new transmission and new grid technology. The electricity industry can deliver, as it has done in the past, but only if we get beyond endless debate over yesterday's issues and instead partner with the states, the federal government, consumers and industry to focus on truly deploying the 21st century grid.

PJM now has over 90,000 megawatts (MW) of new generation in our interconnection queue made up of a mix of resources, including more than 40,000 MW of wind generation. This level of new interest in generation in our region is a good sign and is most welcome. New generation is beneficial because it can meet load growth and displace older, more inefficient and in some cases environmentally challenged generation. We also have seen a 300 percent increase in demand response resources from 2006 to 2012.

The development of renewable energy resources will require significantly more transmission investment than has been made since the construction peak in the mid 1970s. While other technologies are promising, the greatest promise for renewable energy in our region is wind generation. Additional long-haul interstate transmission will be needed to move these wind resources to load centers in the east.

The grid of the future will be impacted by the policy choices you make in key areas such as climate change, energy independence and encouragement of plug-in hybrid electric vehicles and Smart Grid technology. PJM would like to encourage you in your deliberations to consider these principles:

- *Focus on what's doable:* It is important to take into account the need for adequate time, R&D and resources to ensure that the grid can serve that policy goal in a reliable and cost-effective fashion.

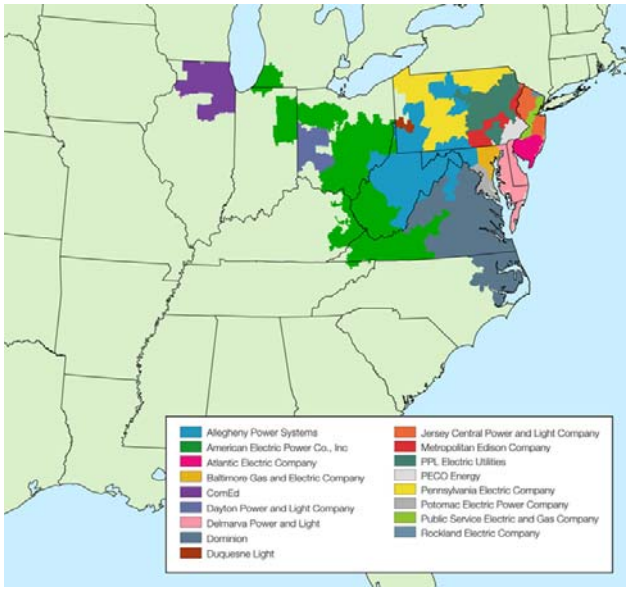
- *Acknowledge the trade-offs:* There have been several calls for the adoption of ambitious renewable targets and mandates. The development of renewable energy resources will require a significant expansion of the grid, as well as a significant increase in needed operating reserves given the intermittent nature of wind and other resources.

- *Understand the real-time impacts of policy decisions:* We are in the process of modeling the impact of various climate change scenarios on power flows and system reliability. I urge you to be open to information from PJM and others as you weigh these difficult policy choices.

- *Look forward not backwards:* From a legislative viewpoint, I would urge focus on the next generation of issues outlined above since, if left unaddressed, they could rapidly overwhelm the traditional issues that this industry has concentrated on in years past.

After the New York blackout of 1965, this nation and this industry came together and built transmission that made the electric reliability in the United States the envy of the world from the mid 1970s through the mid 1990s. We must work together to control our destiny on energy adequacy and reliability. We can do it again.

Thank you for the opportunity to testify today. I am Terry Boston, President and CEO of PJM Interconnection. PJM is the regional transmission organization serving all or part of 13 states and the District of Columbia. Our job is to ensure reliability of the bulk power grid and operate a competitive wholesale market for electricity serving more than 50 million Americans. We do this by operating the grid to meet the highest level of reliability standards, administering a Day-Ahead and Real-Time Market for electricity, and planning the long-term adequacy of the bulk power system.



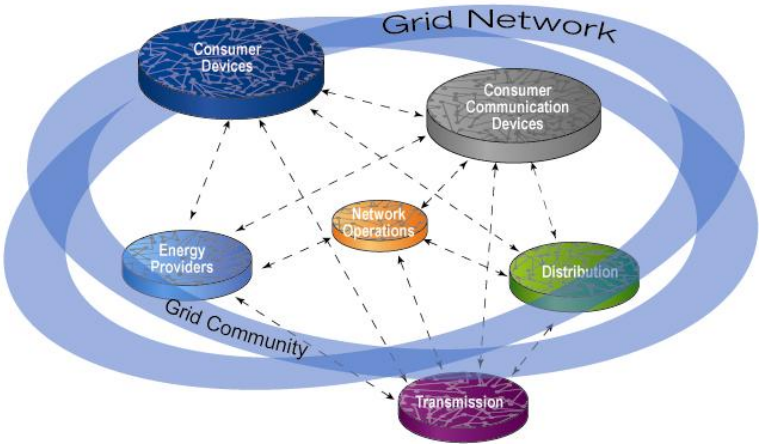
This hearing is very timely as the industry must, more than ever, "connect the dots" as to the critical role that transmission plays in meeting the public policy goals that are being debated in Washington D.C. and throughout the country. In a nutshell:

- If one is for renewable generation to power America's economy, which I am, we need more transmission;
- If one is for more nuclear energy to power America's economy, which I am, we need more transmission;
- If one is for the development of clean coal technology with carbon sequestration, which I am, we need more transmission;
- If one is for the development of plug-in hybrid electric vehicles that improve overall system efficiency and reduce oil imports and carbon emissions, which I am, we need more transmission.

First we must understand that electricity is the common currency of many sources of energy. Transmission is the enabler of virtually any of the public policy goals the Congress may embrace striving for energy independence and meeting environmental goals. This focus on transmission does not mean that other resources, such as new generation, demand-side response and energy efficiency, are not also sorely needed to feed the nation's appetite for electricity, the fuel of our digital economy. In the U. S., the forecast for peak demand for power is expected to increase by over 135,000 megawatts (MW) or 17.7 percent in the next ten years. (We generally estimate one megawatt of electricity is enough to power between 800 and 1,000 homes.)

My second message is equally basic: We don't have the luxury of time for continuous debates over corridors, cost allocation or the respective role of the states and the federal government in these areas. Although enhancements can certainly be made to the statutory mechanisms you established in the Energy Policy Act of 2005 (EPACT 2005) to address these issues, the more important task in my view is to focus on the future – ensuring a complementary integration of the *next* generation of technology with the next generation of issues you are already addressing, such as climate change and energy independence.

The grid does not operate in a vacuum and there is no free lunch. To adopt some of the ambitious renewable energy and climate change goals that are being discussed will require a *substantial* investment in new transmission and new grid technology. It will require us to obtain additional operating reserves from fossil-based generation, at the very least, as an interim resource given the intermittent nature of wind generation and uncertainty of other alternative energy resources. And it will require rapid deployment of Smart Grid technologies. They include phasor measurement units at the transmission level and sophisticated two-way communication between the market and grid operator and appliances in the home as well as batteries in future plug-in hybrid electric vehicles – all of which will help to meet rising demand in a more fuel-efficient, environmentally responsible manner.



As illustrated by a number of recent comments from both sides of the aisle, starting with Senator Lamar Alexander, we will need a 21st century "Manhattan Project" and an ambitious goal like putting a man on the moon combined to ensure we can solve our new energy and environmental public policy problems. I am confident that this industry can deliver, as it has done in the past, but only if we get beyond endless debate over yesterday's issues and instead partner with the states, the federal government, consumers and industry to focus on truly deploying and enhancing the 21st century grid.

The State of the Grid Today

What We Have Achieved

At the outset, I think it's important to paint an accurate picture of the grid today — both its strengths and weaknesses. Although grid reinforcement is clearly needed, I would not want the Committee to walk away with a one-sided picture. I am pleased to report that in the PJM region the system has been performing extremely well so far this summer as well as during the past few summers. To date, the summer of 2008 has been characterized by typical summer weather conditions. However, tornados caused line outages in early June in Virginia and Maryland and as far north as Michigan. This stressed the system and our members raced against the clock to restore transmission lines that allowed PJM to meet a peak load of 130,000 MW. These extreme conditions demonstrate the importance of a robust grid but also illustrate how increased demand is stressing the system.

I don't want to ignore the fact that we are approaching the fifth anniversary of the blackout of August 14, 2003 − a blackout caused by basic problems that have tripped up this industry before – lines sagging into trees, and inadequacies in operator training and communication and control systems. The industry has moved forward since then and your adoption [and the Federal Energy Regulatory Commission's (FERC) implementation] of laws establishing mandatory reliability standards has helped immensely. My thanks to this Committee for its leadership and to the FERC for its leadership in implementing those provisions of the EPACT 2005.

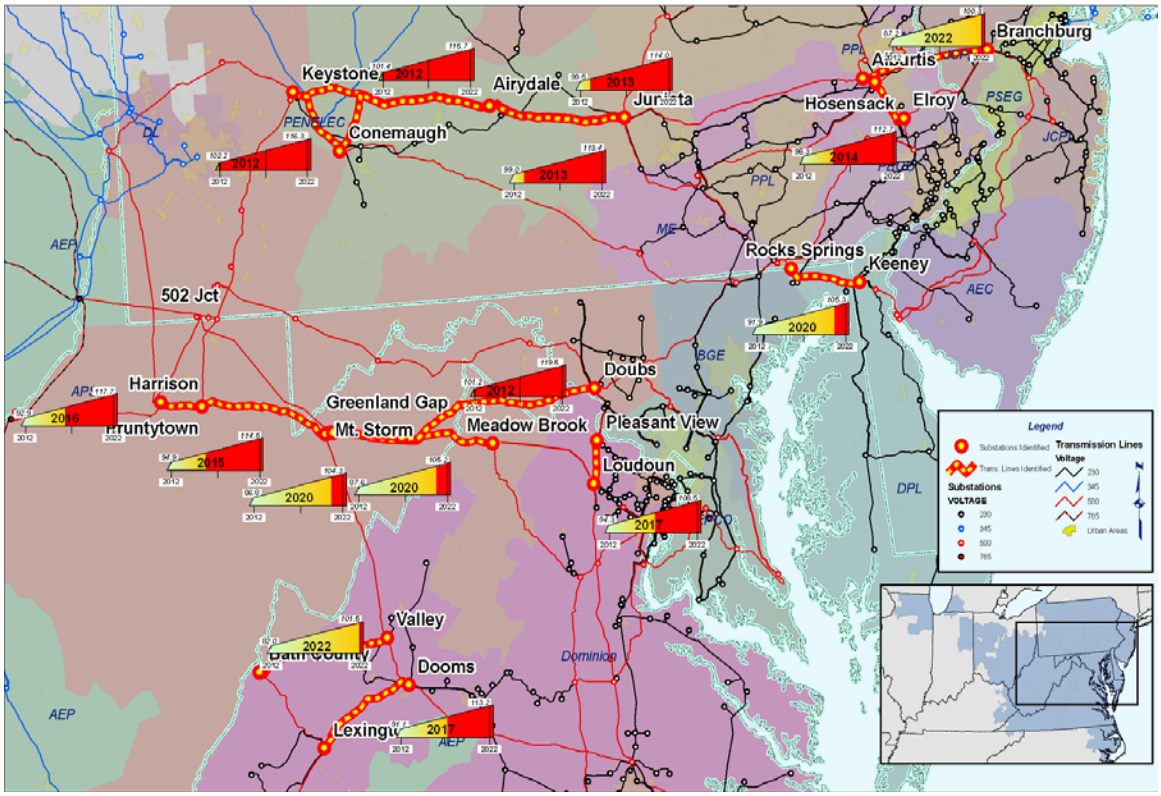
It is often stated that the grid is being used in ways for which it was never originally designed. This statement, which you will inevitably hear again, is true but only tells half the story. We have far more sophisticated operations and market-based tools to manage flows on the grid than we have ever had. These tools include our state estimator which monitors and reports on the state of the system every two minutes. They include our ability to redispatch generation (achieved through sending locational price signals) which allows us to proactively clear congestion before reliability is threatened by overloads on a given line or set of lines. In short, we have been able to develop technology to help manage power flow.

Future Drivers of Grid Enhancement

Although there is much that we have achieved, there are significant challenges facing us that require considerable grid improvements and deployment of advanced technology. To meet these challenges, there are three principle drivers, each of which affect the grid slightly differently but all of which must ultimately work in harmony and be rationalized through a transparent, robust regional planning process.

1. Meeting reliability requirements is paramount : The North American Electric Reliability Corporation (NERC) and regional reliability entities establish reliability criteria, among other things, how robust the system is to respond to the loss of any given transmission line or generating unit. We analyze flows on the system against the thermal ratings of each of the transmission lines to test when the line might become overloaded or reaches a voltage limit such that additional transmission is needed to meet rising demand. Our planning process looks forward 15 years to determine, for each line, when that point is reached (and thus a reliability violation triggered) based on projections of growth in customer usage of electricity. As part of our ongoing assessment of the PJM system, we have identified the need for significant reinforcement of the bulk power grid in our region as a result of forecasted overloads and violations of reliability criteria. The following map shows overloads that we would expect to see on the major 500kV lines in the PJM region if the system is not strengthened.

Map Highlighting Critical Overloads over the 2012-2022 Planning Horizon and the Year the Overload Occurs



Our independent board reviews these findings, along with the input from stakeholders through our open and transparent regional planning process. Based on these reviews, we have determined that significant new transmission investment will be required to ensure future reliability. The transmission owners in the PJM region

have stepped up to the plate and proposed significant new projects, some of which await siting approval by the states in pending proceedings. The major lines authorized to be built are the Trans-Allegheny Interstate Line (TrAIL), which runs from Pennsylvania to West Virginia and to northern Virginia; the Amos to Kemptown line connecting West Virginia and Maryland, and the Susquehanna to Roseland line, connecting northern Pennsylvania to northern New Jersey.

Each of these projects, which are reliability-related, is critically important to ensuring compliance with these reliability standards and maintaining reliability for the region. You are likely most familiar with TrAIL which has received considerable media coverage in this area. This project is the most advanced and we are hopeful our members building this project receive favorable siting decisions from the Virginia State Corporation Commission, the Pennsylvania Public Utility Commission and the West Virginia Public Service Commission so the very real- and near-time reliability challenges outlined above can be adequately addressed.

2. Strengthening the grid provides future value to customers: In total, nearly $10 billion in new transmission has been approved by the independent PJM Board since 2000, all of which is in various stages of development. Part of this investment is for the interconnection of new generation and part is for addressing the reliability requirements of the region in light of ever increasing growth in demand for electricity. Presently, we have over 90,000 MW of new generation in our interconnection queue made up of a mix of resources. Most notably, we presently have almost 40,000 MW of wind generation in the queue.

Recently, PJM proposed revisions to its process that would expedite the review of interconnection of new generation projects. Pending FERC approval, system impact studies for certain similarly affected projects now will be reviewed as a “cluster.” PJM will determine system upgrades required by adding the entire group to the system, rather than looking at each project incrementally, a process which will save time and money.

This level of new interest in generation in our regional capacity market is a good sign and is most welcome. New generation is beneficial because it can meet our load growth and displace older more inefficient, and in some cases, environmentally challenged generation. I am pleased to report that with the support of the FERC, our members and stakeholders, we are now implementing an economic planning process which proactively identifies new transmission projects, not just to meet reliability requirements, but also to reduce customer congestion costs. This process will provide the critical information that will empower states and customers to build out the grid to meet their economic and reliability needs.

3. Strengthening the grid helps to meet energy and environmental public policy goals: Both state Renewable Portfolio Standard (RPS) requirements and climate change goals have the potential to significantly add to the need for grid enhancement. For example, the price of carbon allowances will affect the marginal costs and thus the dispatch of different resources and, as a result, change the dominant power flows that have characterized the system to date. By the same token, state RPS and regional greenhouse gas initiatives also work to change the portfolio of what type of generation is built in the future and where it is located.

The development of renewable energy resources will require significantly more transmission investment than has been made in a long time. Although other technologies are promising, the greatest promise for renewable energy in our region is wind generation. The best opportunity for that development is often off-shore or on mountain passes far from the major load centers. If carbon prices curtail coal generation at the margin, then the sources of generation become even farther away from load centers as we begin to depend on more distant and abundant wind resources, such as those projects being discussed in the Dakotas, Iowa, Wisconsin and Minnesota. Additional transmission, over and above the transmission to serve the projects already in the queue, will be needed to move these more abundant wind resources to load centers in the east.

As I noted previously, wind is a resource that does not blow steadily at the same rate throughout the day. In the long run, storage technology, including plug-in hybrid electric vehicles (PHEV)s, must be developed to take advantage of these intermittent resources. However, they will be in service long before storage of electricity in large quantities is commercially viable. There will be significant operational challenges that must be understood and overcome to maintain reliability during this time period. Moreover, the best location for storage could well be different and far removed from the best location for wind and other intermittent resources. In short, the transmission grid of the future will need to be even more robust and flexible to handle the variability of wind resources.

Looking Forward: Getting Ahead of the Next Generation of Issues

For purposes of your deliberations, I would urge this Committee to focus on the next generation of issues that will impact the grid and make sure that your decisions are informed by the realities of what is doable within the timeframes you set. We face the following challenges:

- We face a welcome but difficult task regarding those generation projects proposed for construction to the system. We must complete studies of more than 90,000 MW of new generation, including almost 40,000 MW of wind generation, pending in the queue. The queue process provides reliability evaluations of proposed generation projects.

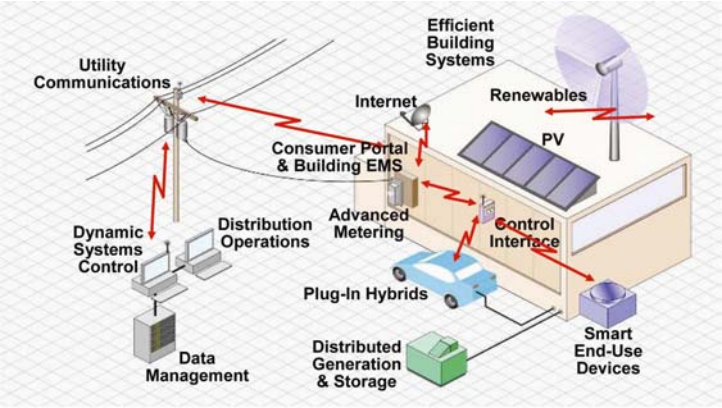
- Overall demand for electricity continues to climb. The average hourly load in PJM has increased nearly two and a half percent each year from 2005 to 2006 and continues upward. We have seen a jump start to demand response in the region since instituting our new capacity market model but the industry and customers still have a way to go until demand response and energy efficiency can significantly impact the need for more resources to meet this increasing load growth.

- Plug-in hybrid vehicles represent an exciting new opportunity to provide both ancillary services to the grid and utilize the power system assets more efficiently. If done right, plug-in hybrid vehicles can enhance the efficiency of the grid by shifting load to off-peak nighttime hours. On the other hand, if everyone plugs in their car at 5 p.m. and there are no economic incentives or communication and control technology to drive different customer behavior, then we could be worse off.

- The auto industry and the electric industry also must work together to make the future PHEVs deliver on their potential to reduce oil imports, to reduce carbon dioxide and to reduce the cost of transportation.

Developing the Tools for the Toolbox

There are a number of tools which are in various stages of development to meet these challenges:



Tomorrow's Intelligent Power Delivery Infrastructure Must Enable PHEV

Source: EPRI

- Smart Grid Deployment – Deployment of Smart Grid technology, a goal which you adopted in the 2007 Energy Policy Act (EPACT 2007), will be a significant step forward. One of the main features of the Smart Grid is two-way communication with active participation by customers in controlling energy consumption. This can be done through the development of "smart" appliances that are pre-programmed by the consumer to respond to market price and operational signals from the grid operator. Deployment of the Smart Grid can be accelerated through regulatory encouragement at the state level, accelerated depreciation of Smart Grid investment, development of interoperability protocols as you called for in EPACT 2007. Consideration in any carbon legislation should also be given to the development of a pool of allowances for the Smart Grid, similar to what was done to jump start deployment of demand side resources in the 1990 Clean Air Act (CAIR) amendments.

- Phasor Measurement Technology – We also need to continue research and deployment of phasor technology. In essence, phasor technology allows more granular control of power flows on the grid and more accurate determination of operating limits in real time. PJM is working with our stakeholders and various industry organizations to not only get more phasor measurement units installed in the PJM footprint, but also to determine how best to employ this data. It is very promising—seeing 30 samples of data per second versus three-second scan rate of data through the Supervisory Control and Data Acquisition (SCADA) is like comparing an MRI to an x-ray in the medical field.

- Plug-In Hybrid Electric Vehicles – If successfully deployed, the dividends are substantial. For example, PJM's off-peak market can provide the equivalent cost of gasoline at 60 cents per gallon on most nights as highlighted in the chart below. PJM has joined with the University of Delaware, Pepco Holdings Inc. and its affiliate utilities, AC Propulsion, Comverge Inc. and the Atlantic County Utilities Authority to form the Mid-Atlantic Grid Interactive Car (MAGIC) consortium. MAGIC is demonstrating and evaluating vehicle-to-grid (V2G) technology that allows plug-in, battery-operated vehicles to charge *from* the grid and to discharge their stored power *to* the grid based on regulation signals from PJM. PJM is participating in a technology and information exchange with automotive and battery manufacturers, energy storage companies and electric utilities to understand the potential business opportunities, value propositions and necessary standards to advance understanding and support for PHEVs to participate in grid markets. We plan to have another demonstration of the state of PHEV technology on the PJM campus this fall.

Electric Vehicle – Equivalent Electric "Price Per Gallon"

Electric Fuel Economy in kWhs per Mile		0.25	0.30	0.35	0.40
Price of Electricity ($/kWh)	$0.05	$0.31	$0.38	$0.44	$0.50
	$0.06	$0.38	$0.45	$0.53	$0.60
	$0.07	$0.44	$0.53	$0.61	$0.70
	$0.08	$0.50	$0.60	$0.70	$0.80
	$0.09	$0.56	$0.68	$0.79	$0.90
	$0.10	$0.63	$0.75	$0.88	$1.00

Source: Duke Energy

- Regional Planning – We have a strong regional transmission planning process in PJM, a process that analyzes both economic upgrades, as well as reliability upgrades. We have developed protocols with the Midwest ISO on joint planning and cost allocation. We also have a joint TVA/MISO/PJM reliability coordination agreement which expands that coordination of planning over an even larger area. We are committed to developing the same kind of regional planning arrangements, with appropriate cost allocation, between PJM and New York and other neighbors to recognize that planning of an interconnected grid should not stop at a given regional transmission organization border.

The Role of the Policymaker: Some Recommended Principles

The grid of the future will be impacted by the policy choices you make in key areas such as climate change, energy independence and the encouragement of plug-in hybrid vehicles and Smart Grid technology. We at PJM are not policymakers, but can serve as a resource to this Committee and other state and federal policymakers, providing independent analysis of the impacts of potential decisions on the reliability of the grid and the economics of power supply to investors and wholesale consumers. In summary, I would like to leave you with a few recommended principles as you deliberate on these issues:

Focus on what's doable: It is important that we all ensure that adequate transmission infrastructure can be put in place to meet the policy goals that the Congress sets. This does not mean that you should accept the status quo − the industry should be challenged to respond to meet these policy initiatives. But it is important to make sure that any legislation takes into account the need for adequate time, research and development and resources to ensure that the grid can serve that policy goal in a reliable and cost-effective fashion.

Acknowledge the trade-offs: There have been several notable calls for the adoption of ambitious renewable targets and mandates. However, there is no free lunch − the development of renewable energy resources will require a significant expansion of the grid, as well as a significant increase in needed operating reserves given the intermittent nature of wind and other resources. There are a number of sources of operating reserves, including demand response, but traditional fossil fuel generation will remain one of the key sources in the near future.

Understand the real-time impacts of policy decisions: We at PJM are in the process of modeling the impact of various climate change scenarios on power flows and system reliability. We are still working through the issues and assumptions in undertaking this exercise. I urge you to be open to such information from the PJM region and other regions so that you have full, unbiased resources available to you as you weigh these difficult policy choices. At the end of the day, Ohm's and Kirkoff's laws of physics will govern the grid. It is vitally important that we build transmission and have a robust grid to protect our economy . . . to serve our customers. We will be glad to model the impacts of policy changes and provide information to this committee.

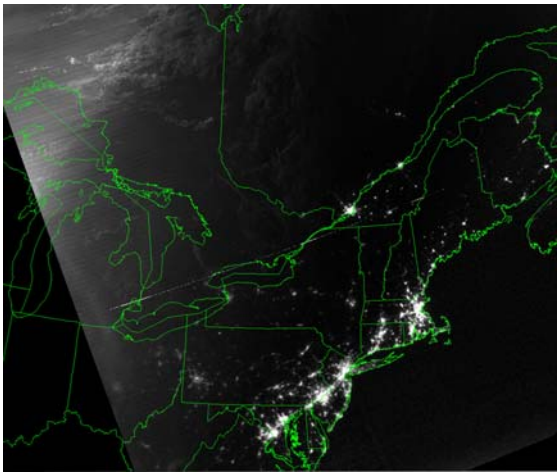
Look forward not backwards: We are continuing to work with our states and stakeholders on difficult issues such as cost allocation and state siting of large interstate projects. We've worked with this Committee to ensure that heritage area and other land-use priorities are respected but also compatible with the region's infrastructure needs. But in the transmission area, it is easy to endlessly replow old ground on issues where consensus has

proven elusive. I have personally pledged to work with our states, stakeholders and the FERC on these issues. But from a legislative viewpoint, I would urge focus on the next generation of issues outlined above since, if left unaddressed, they could rapidly overwhelm the traditional issues that this industry has concentrated on in years past.

We need a new focus for energy adequacy for the future. We can debate all day whether the solution is supply-side or demand-side, but as oilman T. Boone Pickens said last week, "we cannot drill our way out of this problem" nor, I might add, can we save our way out of our energy adequacy problem. We must work on both the supply-side and the demand-side of the problem.

The societal cost is estimated at $6 billion per day for the August 14, 2003 blackout. It is vitally important we build transmission and have a robust grid to protect our economy … to serve our customers … to provide the innovation and efficiency that power markets bring to the nation. But we also must recognize that without reliability, we shut down our economy … without reliability, we jeopardize our customers livelihood and sometimes even their lives …and without reliability, there can be no markets, electricity or otherwise.

Satellite view during the August 14, 2003 blackout.



Following the New York blackout of 1965, this nation and this industry came together and built transmission that made the electric reliability in the U.S. the envy of the world from the mid 1970s through the mid 1990s. We must work together once again to control our own destiny on energy adequacy and reliability.

Finally, let me extend an invitation to each of you and your staff to visit PJM, see the control room and observe how we manage this very large 13-state grid minute-by-minute, hour-by-hour on a 24/7 basis.

I thank you for this opportunity to testify and look forward to your questions.