# Asset Management Challenges and Options, Including the Implications and Importance of Aging Infrastructure

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Power & Energy Society®

Building Careers & Shaping Public Policy

# Trends: Resilience and Asset Investments

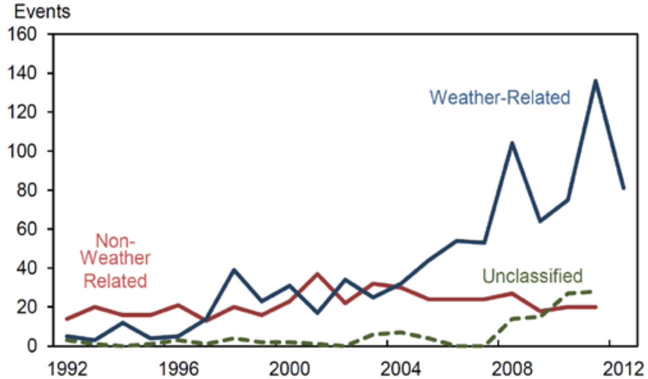
Complex grid structures require "Smart Grid" solutions

Achieving Electric System Resilience

– Energy Sector is uniquely critical infrastructure as it provides an "enabling function"

- Aging Infrastructure ***Investment***
- Reliability/Hardening ***Investment*** – Outage cost of $125B/y (DOE), with weather-related ~ ($18B - $33B)/y
- Natural Gas, Renewable, Microgrids, Electric Vehicles, Storage, and Demand response ***Investment***
- Electrical – Natural Gas Interdependency

Observed Outages to the Bulk Electric System, 1992-2012




Source: Energy Information Administration

# Many challenges facing the energy and power infrastructure

- Aging assets
- Severe weather events
- Physical and cyber attacks
- Dependencies and inter-relationships with other infrastructures (gas, telecommunications, etc)
- Market and policy including recovery of investments

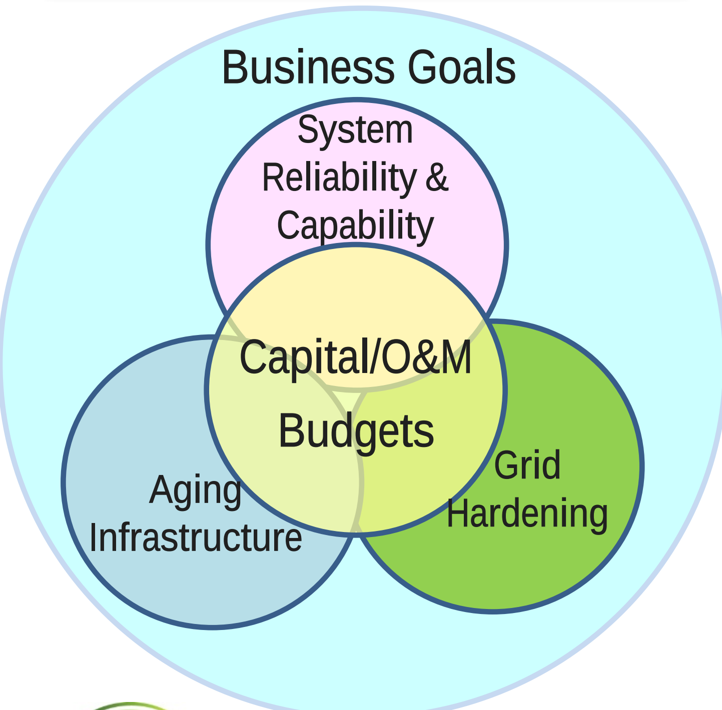
# Holistic Asset Management

**Asset management: Predictability of Cost & Reliability**

Average systems 40 to 60 years old

25% of electric infrastructure is of an age and situation where condition is a concern

Demand for maintenance double over the next 10-20 y




- As system ages, operating cost increases and reliability decrease – limited resources for wholesale replacements
- How to manage Smart Grid assets?
- Need for sound strategy for controlling the symptoms of aging within the utility's overall business plan – maintain ***accepted levels of performance***

# Asset Management & Infrastructure needs

- Although the age of our power infrastructure – particularly underground city networks – is a major issue, the focus should be on a holistic asset management approach to address grid resilience
- Tailor grid resiliency investments to focus on facilities with the greatest risk for future events
- A dynamic risk landscape requires annual updating to ensure the protection of pertinent assets

# Asset Management & Aging Infrastructure

- Asset Management is a key enabler for a secure and affordable electricity infrastructure
- Asset Management has brought value to other industries, including electric generation
- Asset Management requires coordination across the breadth and depth of a utility organization

*Rigorous Asset Management process is a key enabler for a secure and affordable electric infrastructure*

# Managing Aging Infrastructure

- Promote the application of widespread condition monitoring
- Add select elements of Smart Grid to increase situational awareness, reduce outage propagation and improve response to disturbances
- Increase coordination between electrical and gas infrastructures
- Increase levels of R&D available to electric sector

*Coordination between Electrical and Gas Infrastructures is required to ensure Electric System Reliability*

# Electrical-Gas Interdependency

- There has been a proliferation of natural gas
- This has resulted in a shift to use gas for generation, especially as older plants using other fuels are retired
- Pipeline capacities are an issue during cold weather
- New England governors and other parties are bringing forward creative ideas to make long-term commitments to build new capacity

*Additional gas pipeline capacity, accompanied by supply contracts, is required to meet the growing demand for natural gas for power generation*

# Security needs

- Physical Security
  - Transmission Equipment
  - System Security: Preventing system impact and Protecting critical substations
  - Standards
- Cyber Security

# Security:
# What should we be trying to protect

- Fuel Supply and Generation Assets
- Transmission and Distribution
- Controls and Communications
- Other Assets

# Security:
# What issues impede Protection

- Inability to share information
- Increased cost of security
- Widely dispersed assets
- Widely dispersed owners and operators
- Finding training and enpowering security personnel
- Commercial off-the-shelf (COTS) controls and communications
- Siting constraints
- Long lead-time equipment
- Availability of restoration funds
- R&D focused on vulnerabilities

# Asset Strategies 1 (3)

- Generation
  - Reference NRC methodologies & standards for non-nuclear, where appropriate
- Transmission Lines
  - **Physical security is not the answer here** because there are too many transmission lines and mostly in the open. Vulnerabilities should be addressed through redundancy or risk mitigation strategies.
  - The Federal government could facilitate redundancy approach by expedited siting and work with state and local governments to facilitate **coordinated regional planning of more redundant and less vulnerable transmission grid**
  - The use of safe, **energized work techniques** is one solution **to reduce congestion and associated costs and minimize service disruptions**
  - R&D using sensors to create appropriate alarms for line sag, temperature, etc.
  - Encourage designs for easier repair, stockpiling of assets and agreements to facilitate recovery following events

# Asset Strategies 2 (3)

- Key substations and Switchyards
  - **The correct level of security needs to be determined via a triage process under which utilities protect their most valuable resources**
  - **Recovery from attack is impeded by long lead-time to obtain transformers and other components**.
  - Assist with addressing constraints on movements of equipment, especially large assets
  - Support the **implementation of spare equipment programs and initiatives**
  - Continue to work with industry and manufacturers **to expand the existing self-healing transformer and grid programs and on standardization and modularization of key equipment to make replacement easier**

- Distribution of National Significance
  - **Strengthen federal, state and local coordination on distribution systems of national significa**nce to make replacement easier

# Asset Strategies 3 (3)

- Controls and Communications
  - Increase R&D so as to **increase security without decreasing reliability and functionality**
  - Federal outreach and awareness and **the development of standard requirements, e.g. for control system personnel, procedures and technology**
  - Secure communications requires coordination between federal agencies such as U.S. DOE and FCC
  - The Federal Government could **promote and facilitate communications and cyber security audits, redundancies, and back-up systems**
  - **Communications and controls systems could be designed for more limited failure**
  - **Evaluating communications and controls for EMP withstand capabilities**

# Pertinent IEEE Standards 1 (2)

- End of Life Assessment for Protection and Control Devices
- Criteria for Security Systems for Nuclear Power Generating Stations
- IEEE Guide for Assessing, Monitoring and Mitigating Aging Effects on Electrical Equipment Used in Nuclear Power Generating Stations and other Nuclear Facilities
- IEEE 1402 – Minimum requirements and practices for physical security of electric power substations
- IEEE 1686 – Standard for Intelligent Electronic Devices Cyber Security Capabilities

# Pertinent IEEE Standards 2 (2)

- Working Group C10 – Requirement and Application of the Substation Cyber Security Standard: 1646
- Working Group C6 – Trial Use Standard for a Cryptographic Protocol for Cyber Security of Substation Serial Links
- 1815-2012 – IEEE Standard for Electric Power Systems Communications Distributed Network Control (DNP3)
- Working Group C16 – P2030.102.1 Interoperability of IPSEC Utilized within Utility Control Systems

# Recommendations – *Asset Management 1 (2)*

- Increased federal R&D for emerging technologies that may impact T&D grids, including new types of generation, new uses of electricity and energy storage, with an additional focus on deployment and integration of such technologies to improve the reliability, efficiency and management of the grids
- Application of pro-active widespread condition monitoring, integrating condition and operational data, has been shown to provide a benefit to real-time system operations, both in terms of asset use and cost-effective planned replacement of assets

# Recommendations – *Asset Management 2 (2)*

- Infrastructure security requires a **new model for private sector-government relationships**.
  - Overlapping and inconsistent roles and authorities hinder development of productive working relationships and operational measures
- Perform **critical spares and gaps analysis**
  - A detailed inventory is needed of critical equipment, the number and location of available spares and the level of interchangeability between sites and companies.
  - Mechanisms need to be developed for stockpiling long lead-time equipment and for reimbursement to the stockpiling authority, be it private or government. Other approaches include standardizing equipment to reduce lead times and increase interchangeability

# Recommendations – *Security, Privacy, and Resilience 1 (4)*

- Facilitate, encourage, or mandate that secure sensing, "defense in depth," fast reconfiguration and self-healing be **built into the infrastructure**.
- Continue developing **regional planning of a more redundant and less vulnerable transmission grid**
- Continue developing operational tools to more accurately **forecast the availability of natural gas supply** for generators and improve unit commitment decisions

# Recommendations – Security, Privacy, and Resilience 2 (4)

- Mandate consumer data **privacy and security for AMI systems** to provide protection against personal profiling, real-time remote surveillance, identity theft and home invasions, activity censorship and decisions based on inaccurate data
- Support alternatives for Utilities that wish to **eliminate the use of wireless telecom networks and the public Internet** to decrease grid vulnerabilities
  - Include options for utilities to obtain private spectrum at a reasonable costs

# Recommendations – Security, Privacy, and Resilience 3 (4)

- Improve the **sharing of intelligence and threat information** and analysis to develop proactive protection strategies,
  - Includes development of coordinated hierarchical threat coordination centers – at local, regional and national levels
  - May require either more security clearances issued to electric sector individuals or treatment of some intelligence and threat information and analysis as sensitive business information, rather than as classified information

# Recommendations – *Security, Privacy, and Resilience 4 (4)*

- Speed up the development and enforcement of **cyber security standards**, compliance requirements and their adoption. Facilitate and encourage design of security from the start and include it in standards
- **Design communications and controls systems** for more limited failures including better EMP withstand capabilities
- Increase investment in the grid and in R&D areas that assure the security of the cyber infrastructure (algorithms, protocols, chip-level & application-level)

# Recommendations – *Markets and Policy 1 (2)*

- Use the National Institute of Standards and Technology Smart Grid Collaboration or the NARUC Smart Grid Collaborative as models to **bridge the jurisdictional gap** between the federal and the state regulatory organizations on issues such as technology upgrades and system security
- More transparent, participatory and **collaborative discussion** among federal and state agencies, transmission and distribution asset owners, regional transmission operators and independent system operators and their members and supporting research to improve understanding of mutual impacts, interactions and benefits

# Recommendations – *Markets and Policy 2 (2)*

- Continue working at a federal level on better **coordination of electricity and gas markets** to mitigate potential new reliability issues due to increasing reliance on gas generation
- Update the wholesale market design to reflect the speed at which a generator can increase or decrease the amount of generation needed to complement variable resources

# Summary Recommendations

- Support **holistic, integrated approach** in simultaneously managing fleet of assets to best achieve optimal cost-effective solutions addressing the following:
  - **Aging infrastructure**
  - **Grid hardening (including weather-related events, physical vulnerability, and cyber-physical security)**
  - **System reliability**
- **Urgently address managing new Smart Grid assets** such as advanced metering infrastructure (AMI) and intelligent electronic devices

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