DOE Research on Extreme Weather Impacts to the Electricity Sector – Implications for Planning

EPRI and NYSERDA Workshop:

"Climate Change Vulnerabilities of and Adaptation Strategies for New York State's Future Electric System"

Presentation by:

James Bradbury, Ph.D.

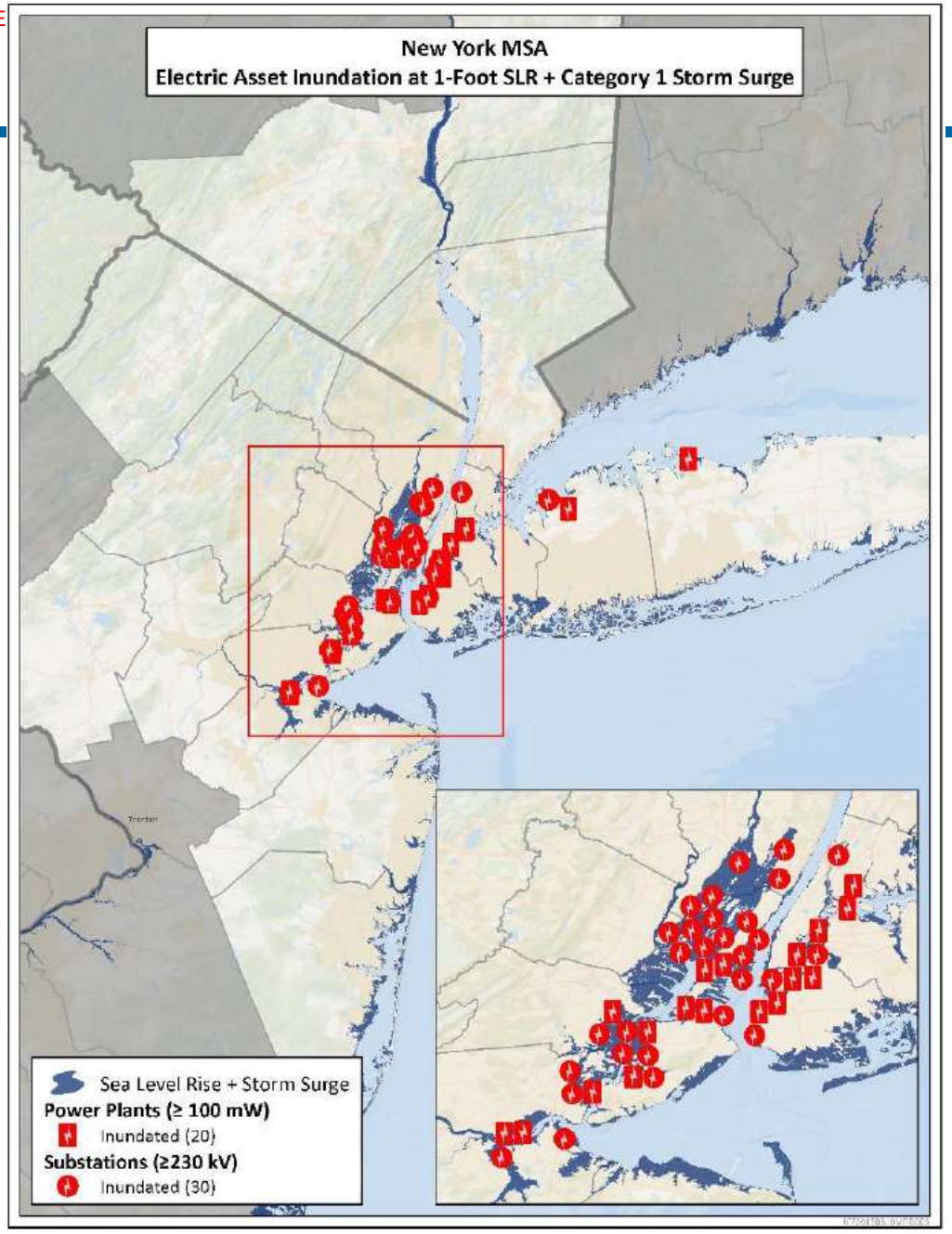
Office of Energy Policy and Systems Analysis

U.S. Department of Energy

Managing Risks from All Hazards - Resilience

Improve resilience through research, analysis and convening

DOE is developing tools and analytical methods to help inform risk-based strategies for increasing energy sector resilience and managing risks from all hazards.

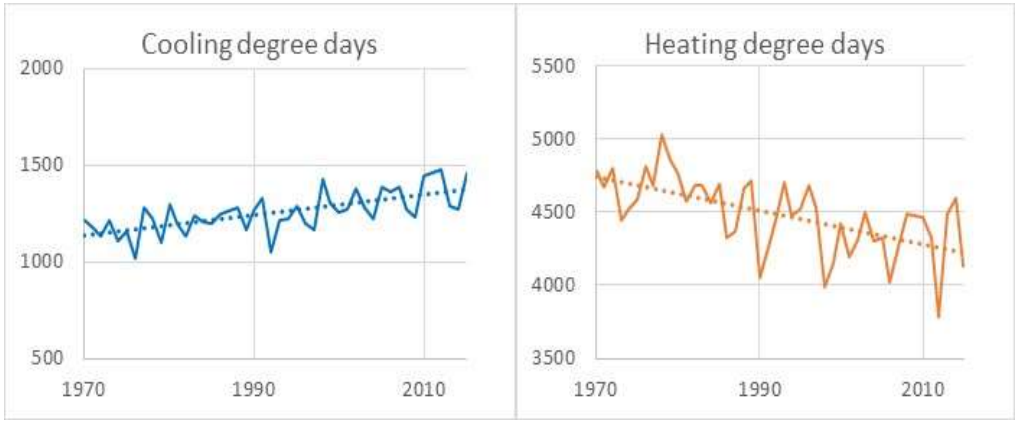


Source: DOE, 2015

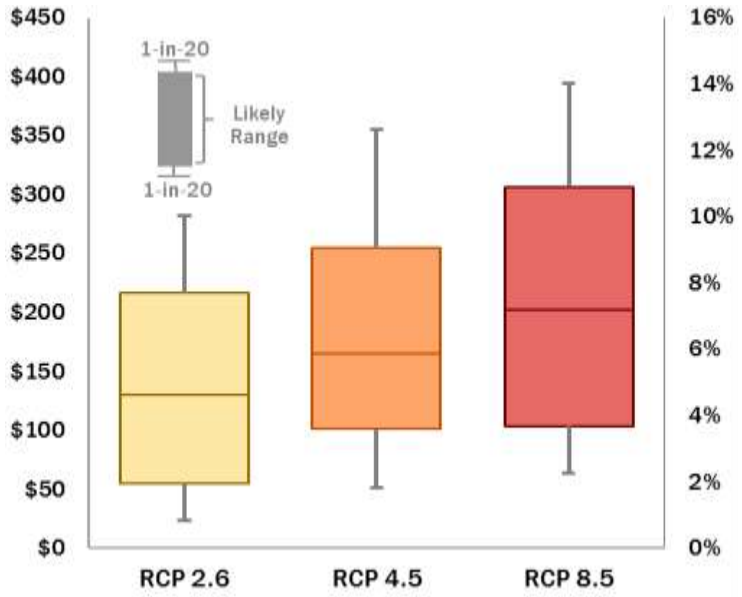
Rising Temperatures Have Implications for Power Sector Planning

- Energy sector costs from more frequent, intense and longer-duration heat waves:
  - **Demand**: changes in cooling degree days and heating degree days (left figure)
  - **Generation**: lower efficiencies, capacity deratings, damaged equipment.
- Air conditioning needs during peak summer temperatures drive significant system costs
- Projected costs are larger under higher emissions scenarios

Since 1970 the number of cooling degree days increased in the U.S. by roughly 20 percent, while the number of heating degree days have declined.



Projected total power system costs (2016 – 2040) projected to increase more under higher emissions scenarios ($ Billions)



Sources: NOAA, 2016; EPSA Analysis, Rhodium Group, 2017

Component Level Impacts: Transmission & Distribution

Transmission Line Capacity.

- Higher temperatures cause transmission lines to sag, leaving less room for additional sagging due to power flow

Transmission System Climate Impacts

	+1℃	+2℃	+5℃
Line Capacity	-0.6%	-1.1%	-2.9%

Effect of temperature on load factor for transformers

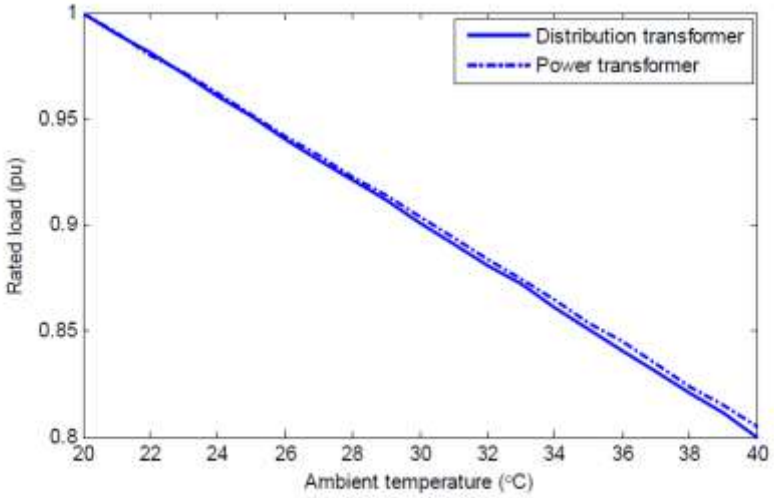


Fig. 4. Effect of ambient temperature on load factor for distribution and power transformers

Transmission and Distribution Transformers

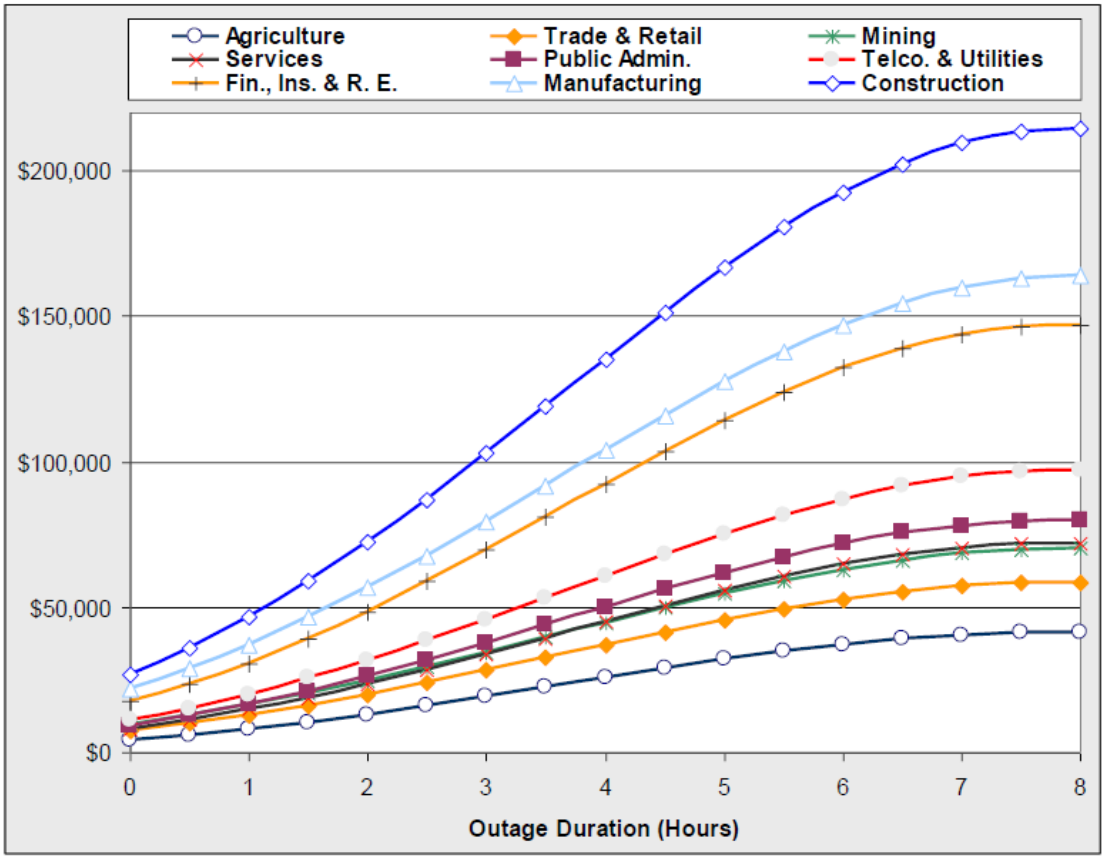
- Capacity decreases due to efficiency losses
- Heat waves can lead to distribution transformer failures of all ages (not necessarily old ones only)
- Loss of life when overloaded to meet peak demand, particularly when simultaneously exposed to high temperatures.

EPSA - Improve Methodologies and Tools for Valuation of Resilience Investments

- Developing tools for estimating costs of power interruption and value of resilience investments: (e.g., ICE calculator)

- Developing uniform methods for economic analysis of costs and benefits of resilience investments.

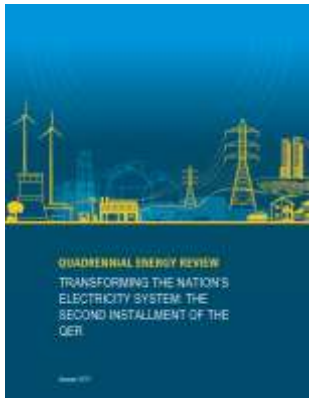
Customer Damage Functions for
The Interruption Cost Estimate (ICE) Calculator



Source: Sullivan, M., J. Schellenberg, M. Blundell. 2015. Updated Value of Service Reliability Estimates for Electric Utility Customers in the United States. LBNL-6941e

Opportunities for Progress on Grid Resilience to Extreme Weather

- Develop uniform methods for cost-benefit analysis of resilience investments for the electricity system.
- Account for emerging threats (including climate change) in reliability planning and standards.
  - Integrated Resource Planning
  - NERC transmission planning
  - Technical standards for equipment
- Integrate "All Hazards" Resilience into Energy Sector Investments, Including Grid Modernization



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Back-up Slides

Relationships between electric reliability and resilience