



Microgrid Systems Design, Optimization, and Risk Drivers

IDEA Campus Energy 2017
February 21, 2017
David R. Tine



Hartford Steam Boiler

Standard Insurance Coverage



Equipment
Breakdown



Business Income
Extra Expense



Spoilage Damage
Utility Interruption

Typical Insurance vs. Performance Insurance



Property Insurance:

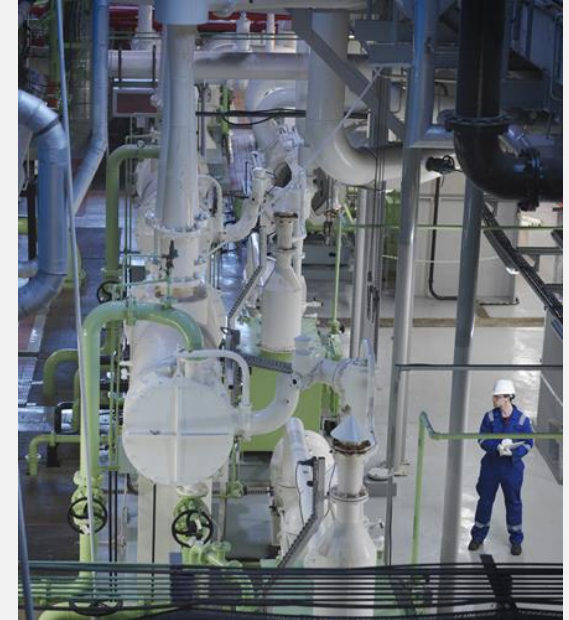
- Insures equipment & business Interruption (BI) losses for covered events
- Deductibles are financial for physical loss and time-based for BI
- Event based, i.e. deductibles are not accrued over policy period
- Common product today

Performance Insurance:

- Insures a minimum level of overall system performance
- Extends Property Insurance to cover performance variables
e.g. annual availability or lost kWh
- Broader Coverage:

For property insurance, four 2 hour downtime events may be below the BI time deductible versus performance insurance, an annual cumulative 8 hour downtime would trigger a performance shortfall

Microgrid Risks/Barriers



Regulatory*

- Business Enterprise Law
- Land Use Rules
- Public Utility Laws

Financial

- Design funding
- Project/equipment funding

Technology

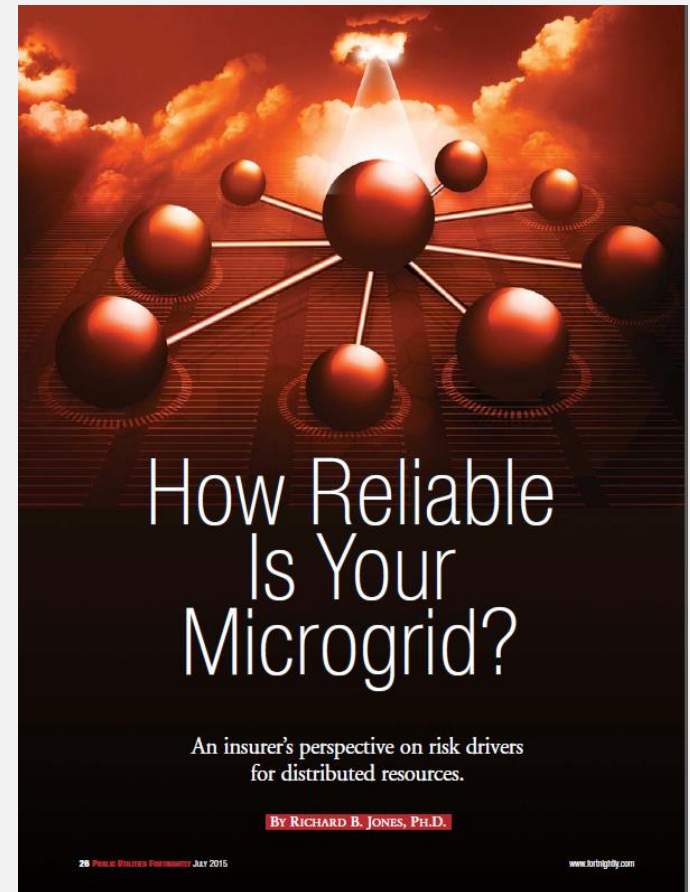
- Rapid technology advances
- Cyber security

*Sara Bronin, Professor, University of Connecticut School of Law - *State Regulations of Microgrids* – ACORE Webinar 12-18-13

Microgrid Opportunities/ Threats



- Insurance companies are central to the revitalization efforts of communities and businesses as they respond to the effects of natural disasters.
- Two models utilized from the perspective of risk mitigation and insurance:
 - Blackout Risk Modeling
 - Microgrid Reliability Model

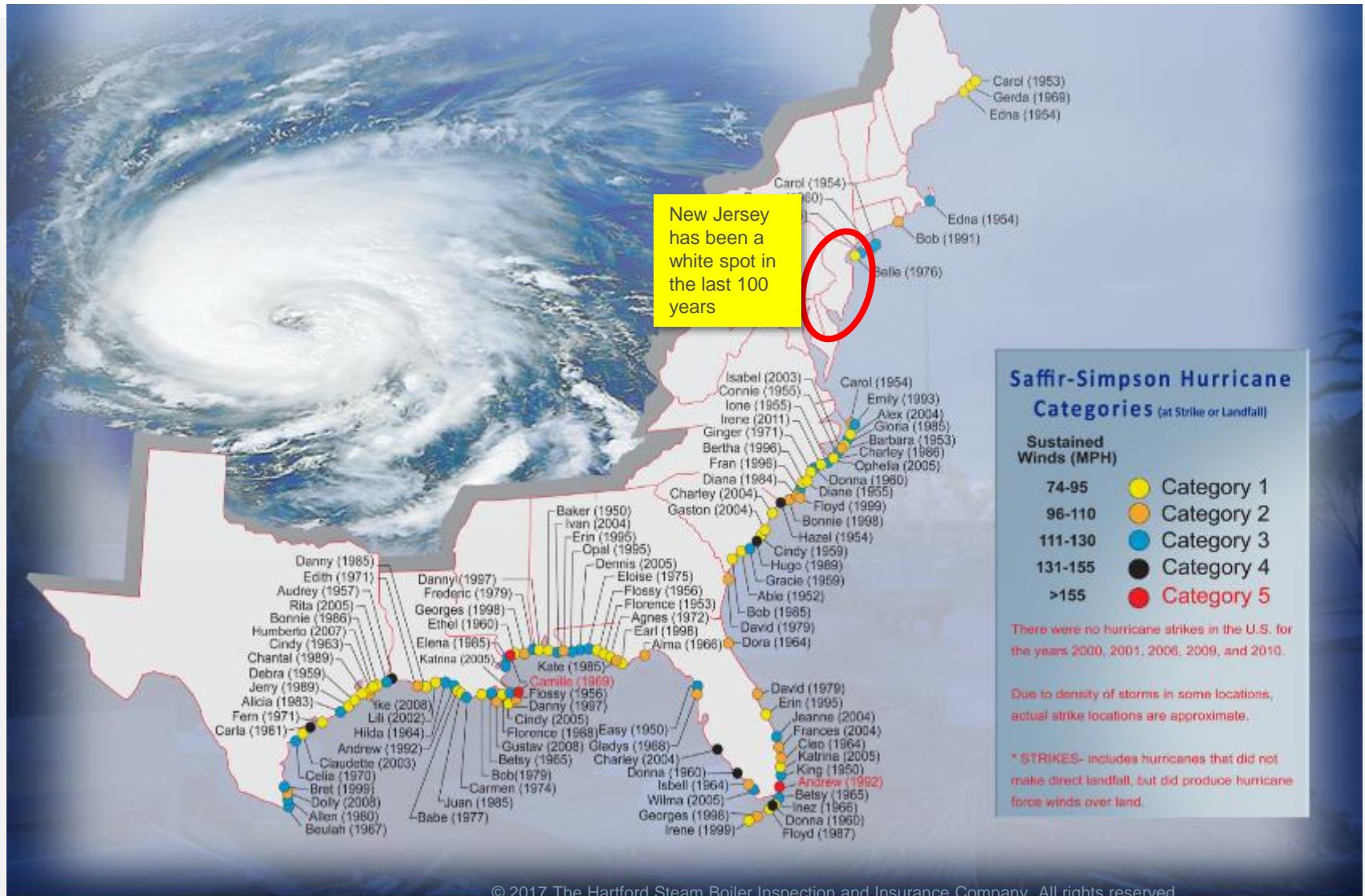


“How Reliable is Your Microgrid?” by Richard Jones, Public Utilities Fortnightly, July 2015

Historical Hurricane landfalls 1950 - 2011

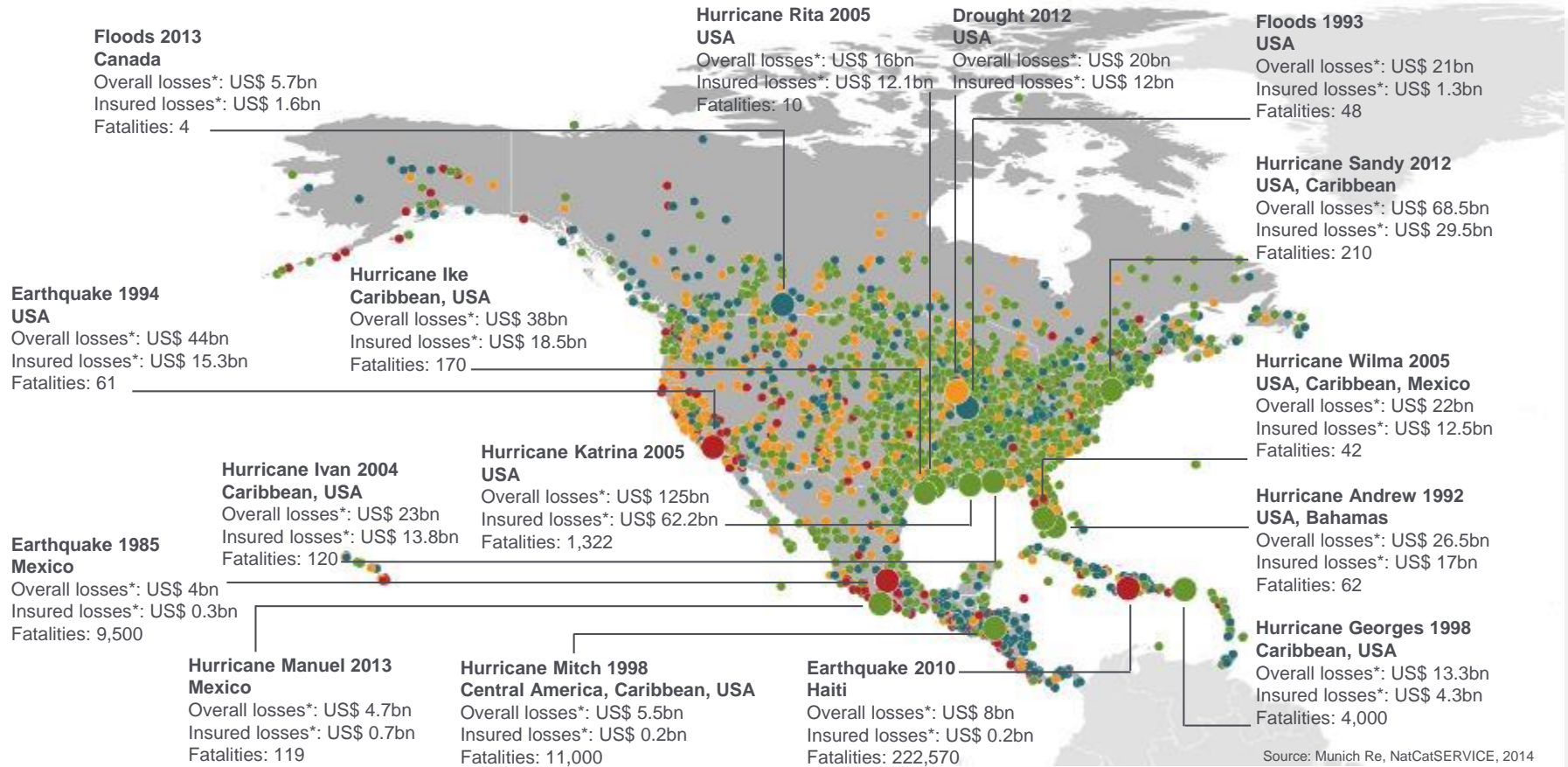


Hartford Steam Boiler



© 2017 The Hartford Steam Boiler Inspection and Insurance Company. All rights reserved.

Courtesy of NOAA's NATIONAL CLIMATIC DATA CENTER ■ ASHEVILLE, N.C.



© 2014 Münchener Rückversicherungs-Gesellschaft, Geo Risks Research, NatCatSERVICE – As of February 2014

Loss events

Selection of catastrophes

*Losses in original values

● **Geophysical events**
(Earthquake, tsunami, volcanic activity)

● **Meteorological events**
(Tropical storm, extratropical storm, convective storm, local storm)

● **Hydrological events**
(Flood, mass movement)

● **Climatological events**
(Extreme temperature, drought, wildfire)

Blackout Risk Model™



Focuses on the U.S. power grid and incorporates extensive data on four peril categories: Hurricanes, winter storms, thunderstorms, and equipment failure or operator error. Wild fires and terrorism attack loss scenarios can also be tested. This includes:

- **Severe weather events**
- **Electrical grid**
- **Tree proximity to power lines**

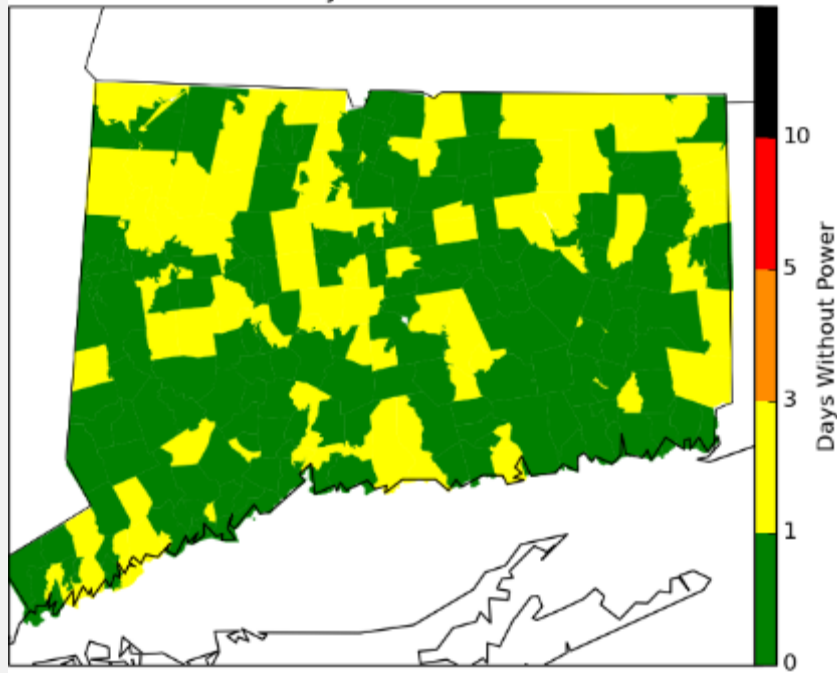


Blackout Risk Model™ Simulated Power Outage Risk – 5 Yr



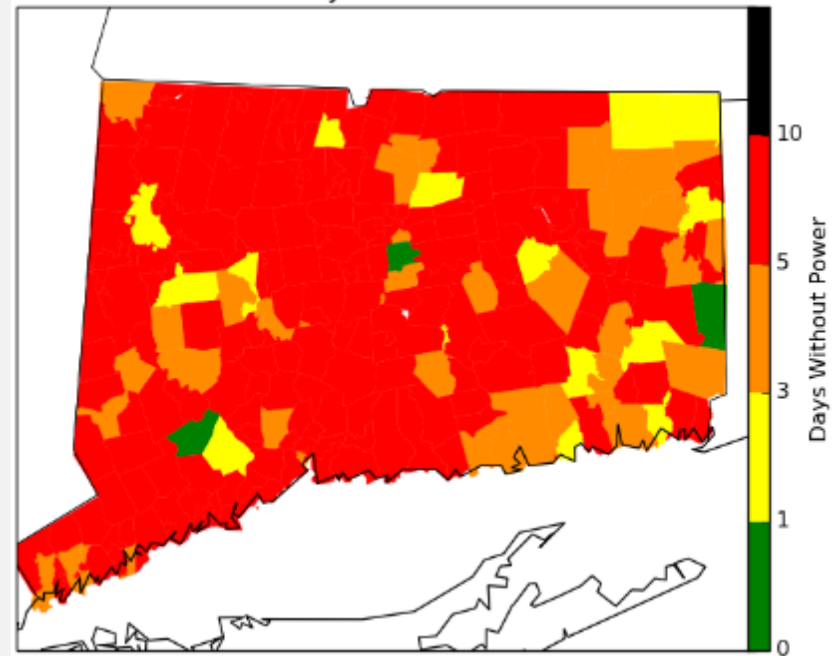
Summer

5 year storm



Winter

5 year storm

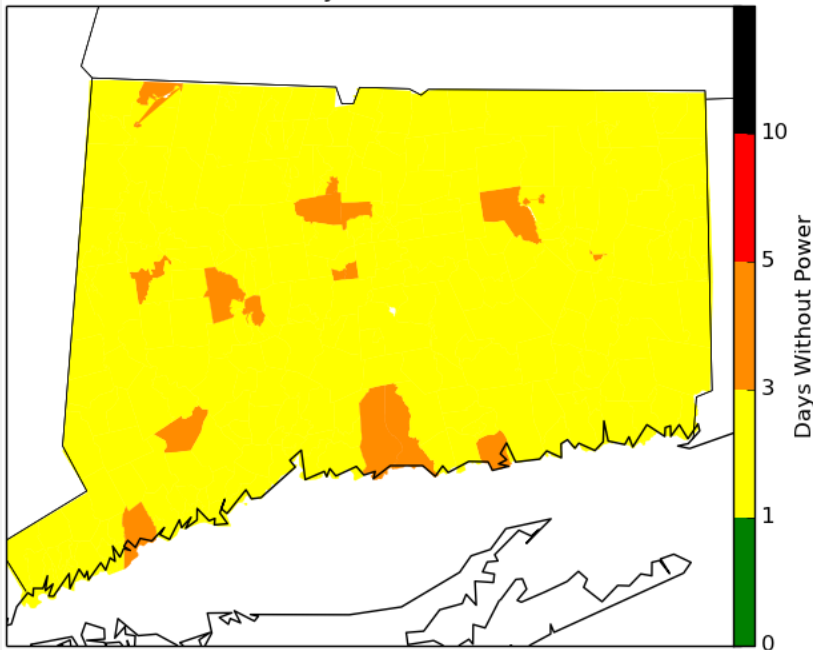


Blackout Risk Model™ Simulated Power Outage Risk – 10 Yr



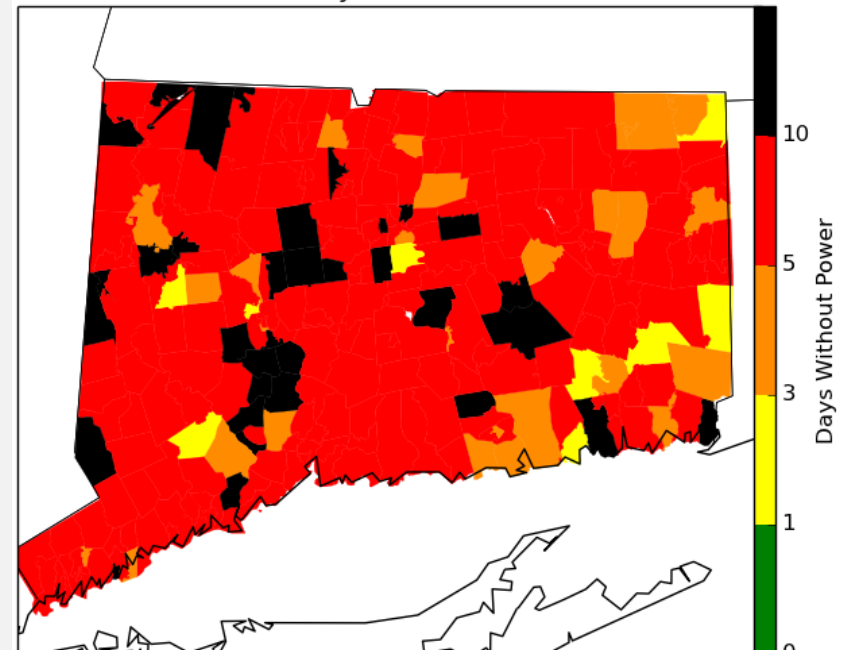
Summer

10 year storm



Winter

10 year storm

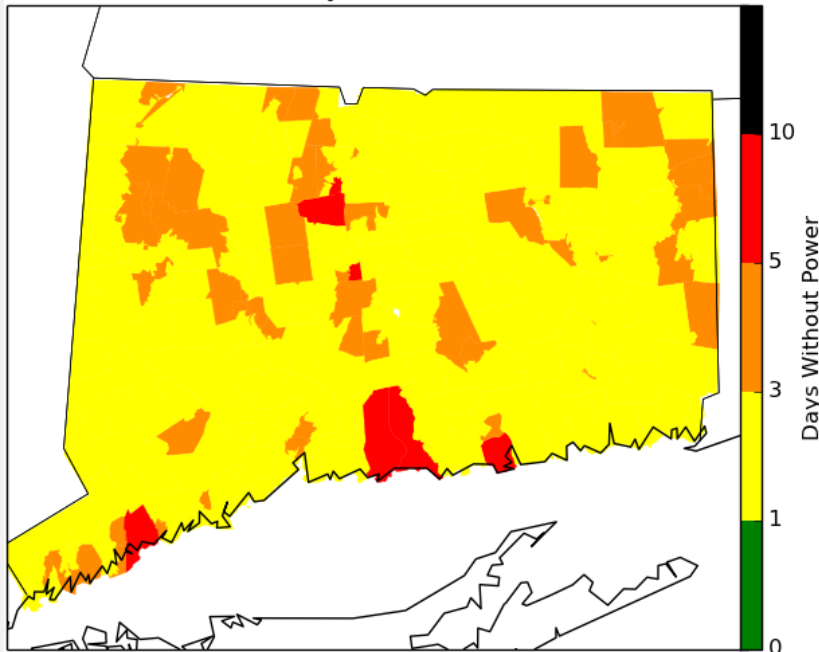


Blackout Risk Model™ Simulated Power Outage Risk – 15 Yr



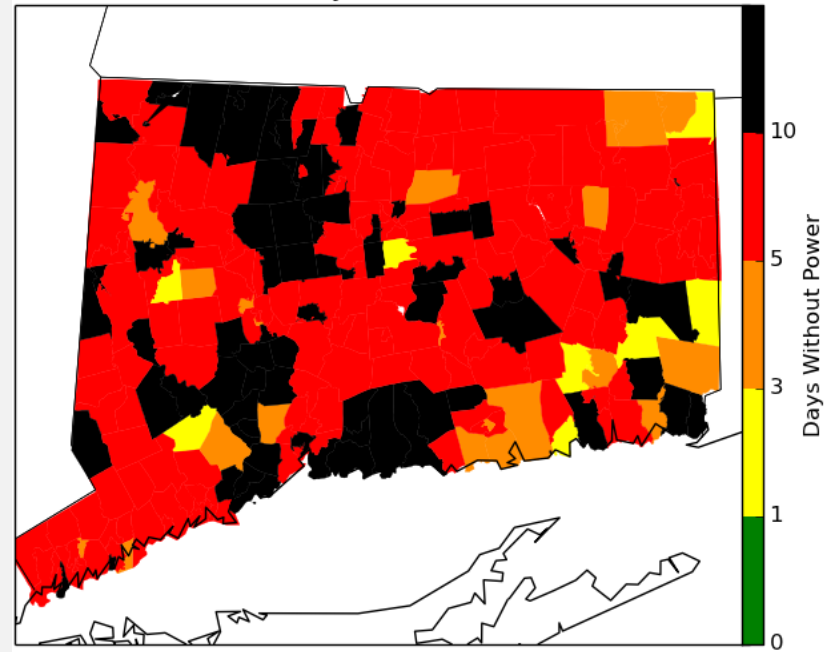
Summer

15 year storm



Winter

15 year storm

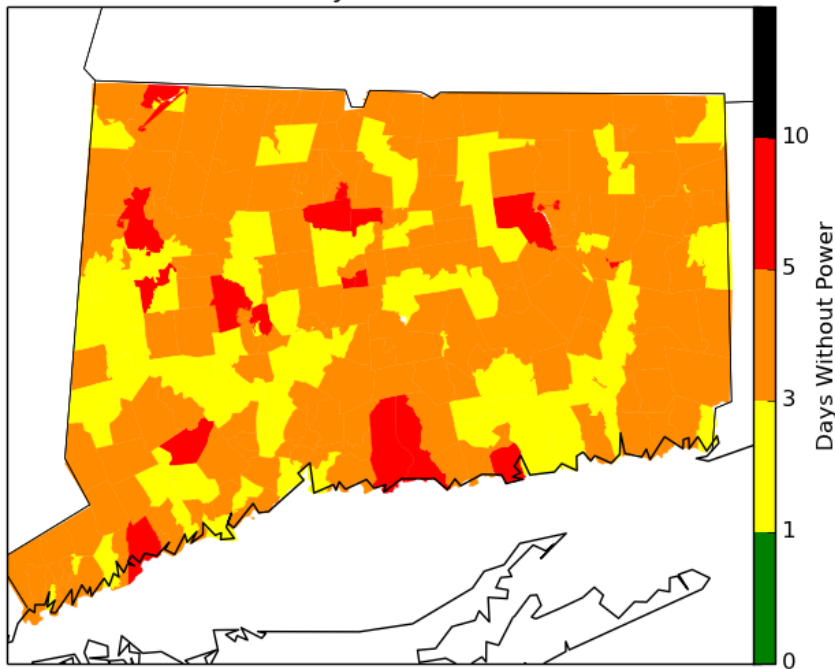


Blackout Risk Model™ Simulated Power Outage Risk – 20 Yr



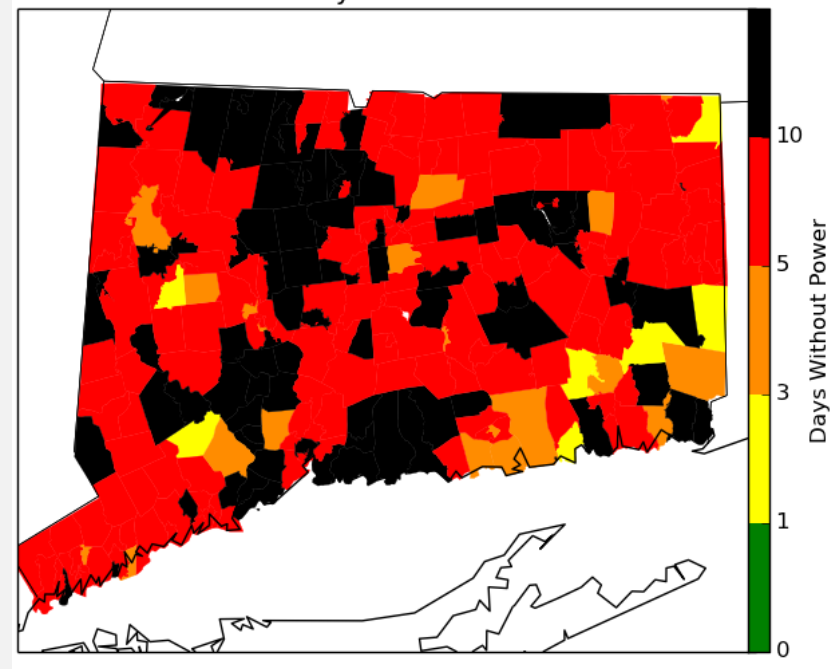
Summer

20 year storm



Winter

20 year storm

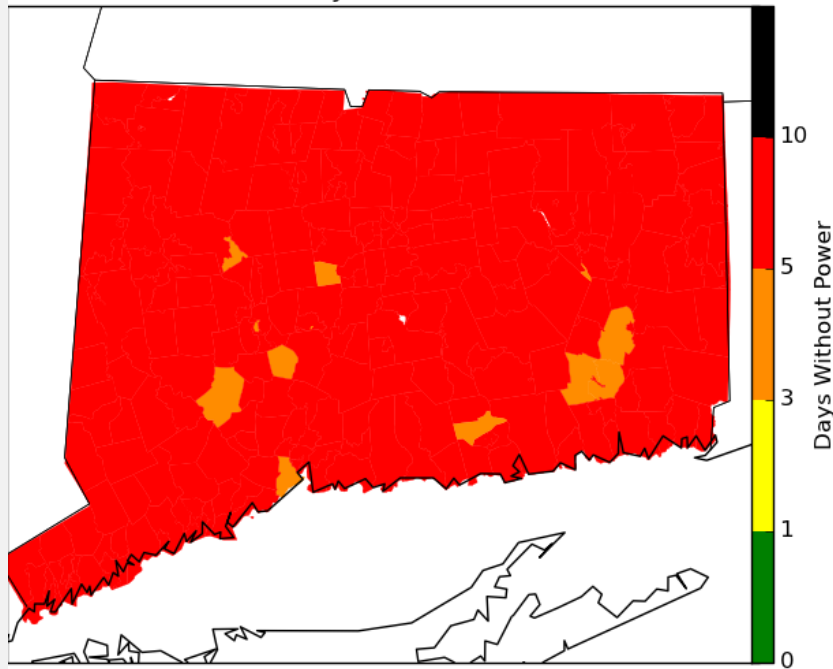


Blackout Risk Model™ Simulated Power Outage Risk – 50 Yr



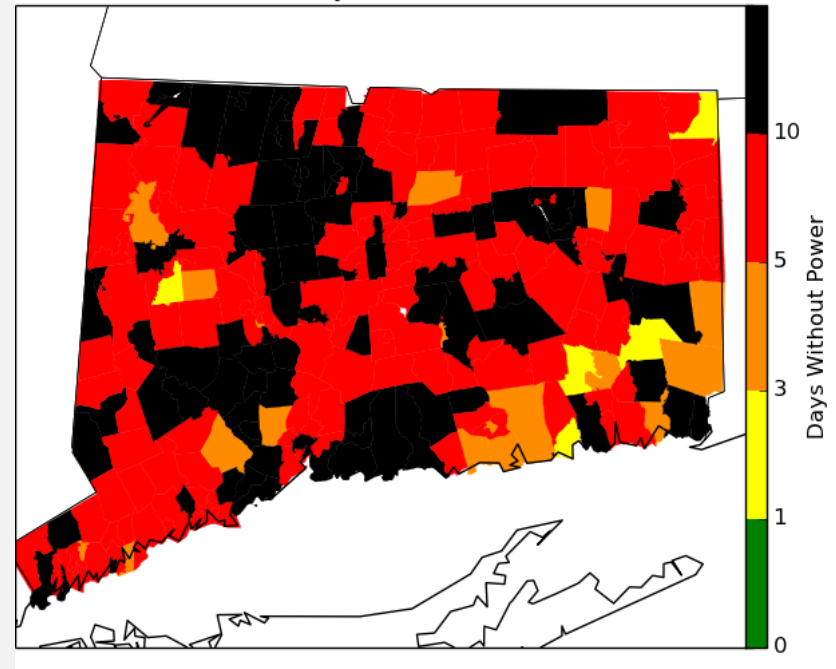
Summer

50 year storm



Winter

50 year storm

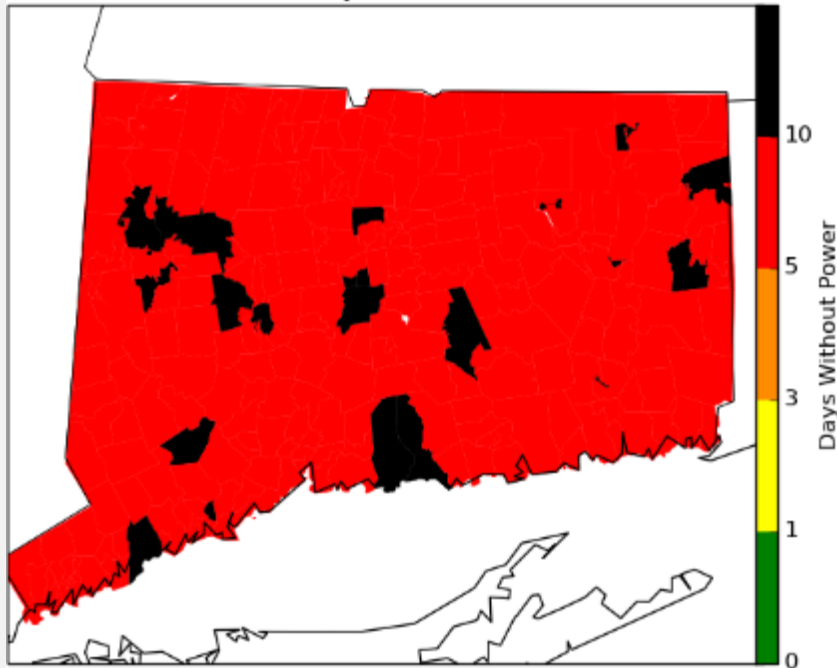


Blackout Risk Model™ Simulated Power Outage Risk – 100 Yr



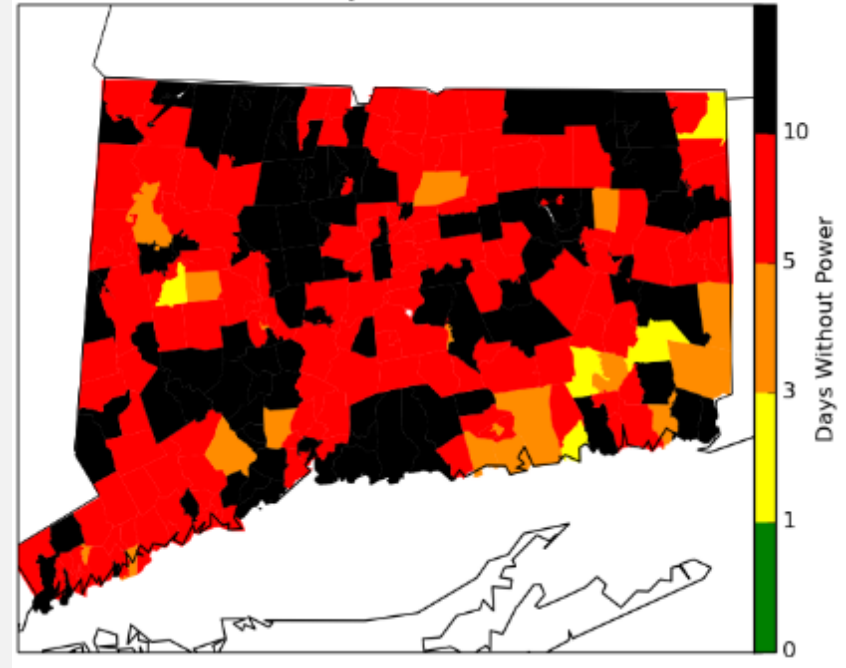
Summer

100 year storm



Winter

100 year storm

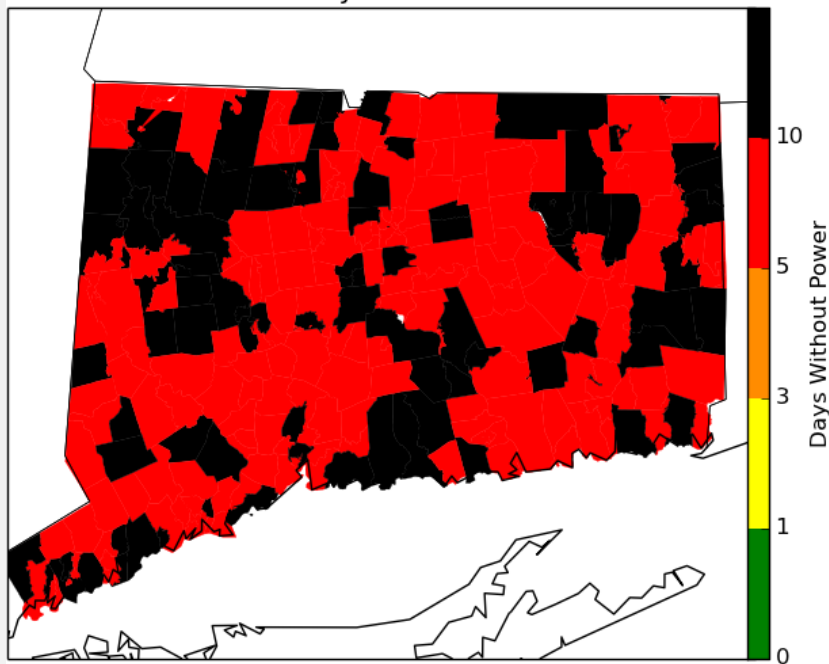


Blackout Risk Model™ Simulated Power Outage Risk – 150 Yr



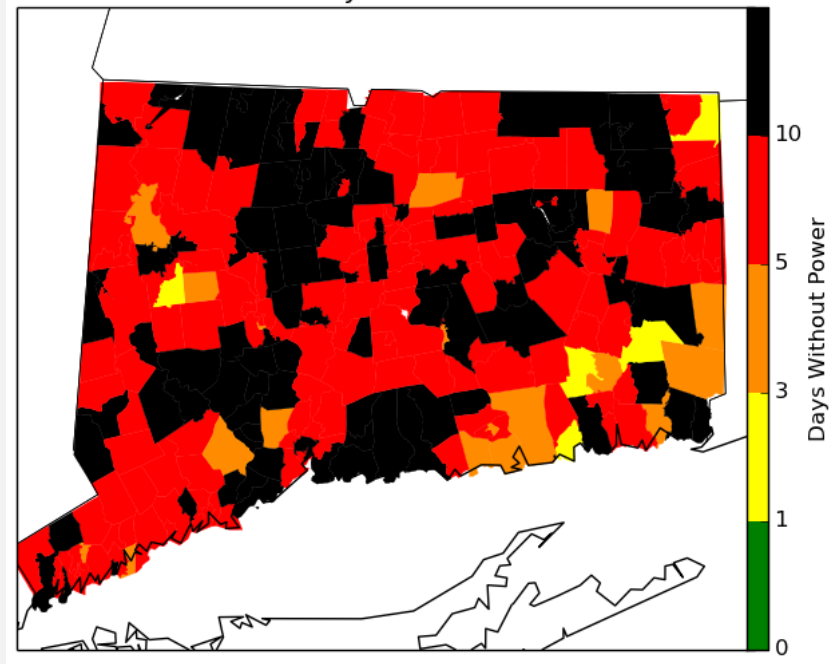
Summer

150 year storm



Winter

150 year storm



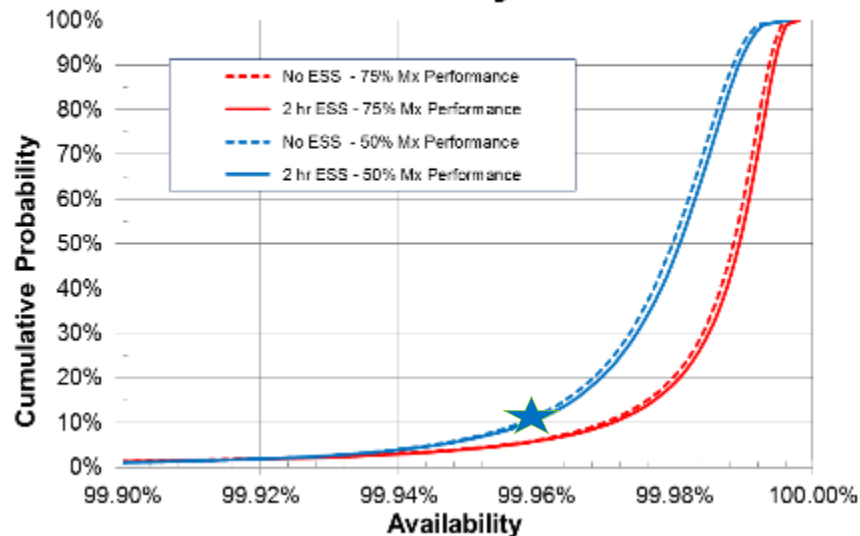
Some typical risk model results

NY Prize Microgrid: illustration only



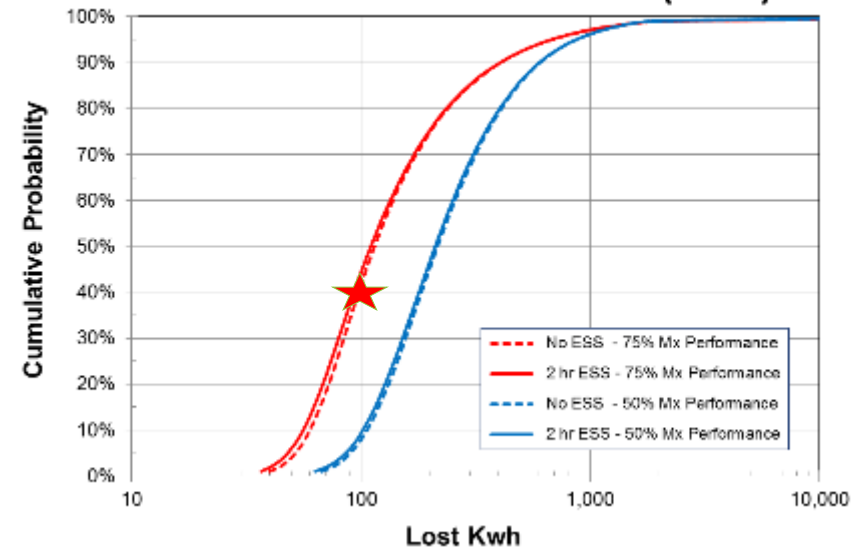
Energy Storage (ESS) Duration of 2 Hours – For this situation (modeled in this case only) ESS has significantly less value risk reduction value than the Component Repair Strategy

Availability Risk



There is ~ 10% chance that the annual availability will be < 99.96%.

Lost Production Risk (kwh)



There is ~ 40% chance that the annual Lost Kwh will be < 100.

General Project Results for Complete NY Prize Microgrid Design



1. Energy storage has a small but significant risk reduction benefit.
2. Weather influences need to be considered during design and construction specifications.
3. A robust, fast response repair program has a major risk reduction effect for both availability and lost production risk.
4. A Risk Analysis Model can help direct resources to the major risk drivers.
5. Standard property insurance is prudent but system performance insurance may help in funding if performance can be related to revenue.



Q&A

David R. Tine
Tel. 860 722 - 5749
eMail: david_tine@hsb.com



Hartford Steam Boiler

Risk Solutions

Munich RE 