EPRI | ELECTRIC POWER RESEARCH INSTITUTE

New Resiliency Challenges – How to Use Smart Grid Technologies to Meet Them

National Summit on Smart Grid and Climate Change

Becky Wingenroth

Technical Leader, Principal

Electric Power Research Institute

December 3, 2014

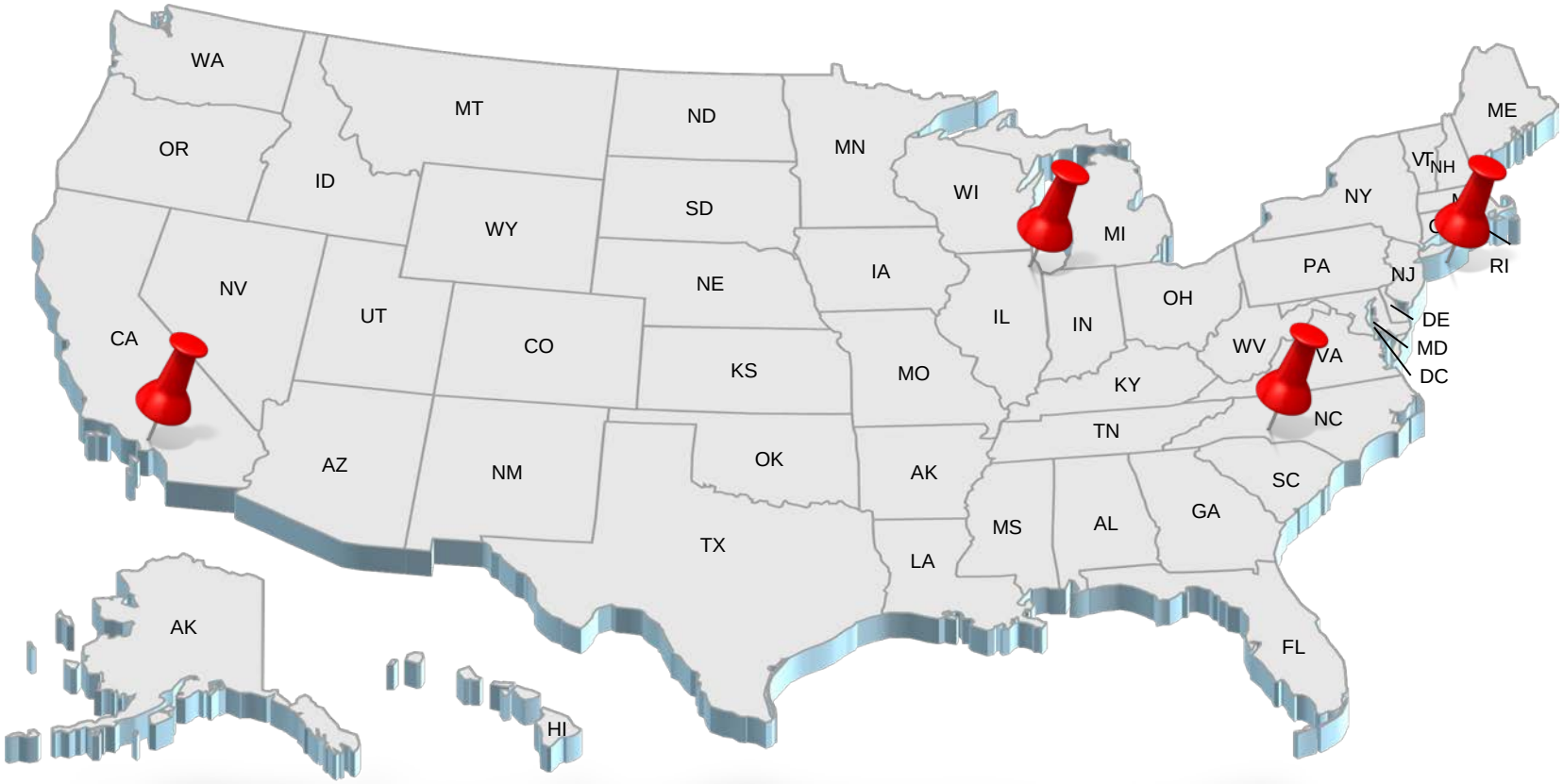
Why Distribution Grid Resiliency?

Recent Events

Year	Event Name	Outages	Location	Damage ($ Million)
2012	Sandy	8,500,000	Northeast US	~100,000
2012	Derecho	4,200,000	Mid-Atlantic	4,000
2011	Irene	6,400,000	Eastern US	10,000
2011	Blizzard	650,000	Mid-Atlantic	1,800
2009	Ice Storm	2,000,000	Midwest	700
2008	Ice Storm	1,700,000	Northeast	80
2008	Ike	2,000,000	Gulf Coast	29,500
2008	Gustav	1,300,000	Gulf Coast	7,000
2007	Ice Storm	900,000	Midwest	200
2007	Wildfires	600,000	California	2,500
2006	Wind Storm	1,800,000	Pacific Northwest	220
2005	Katrina	2,000,000	Gulf Coast	100,000
2005	Rita	1,300,000	Gulf Coast	12,000

40 million outages
Costing $270 Billion

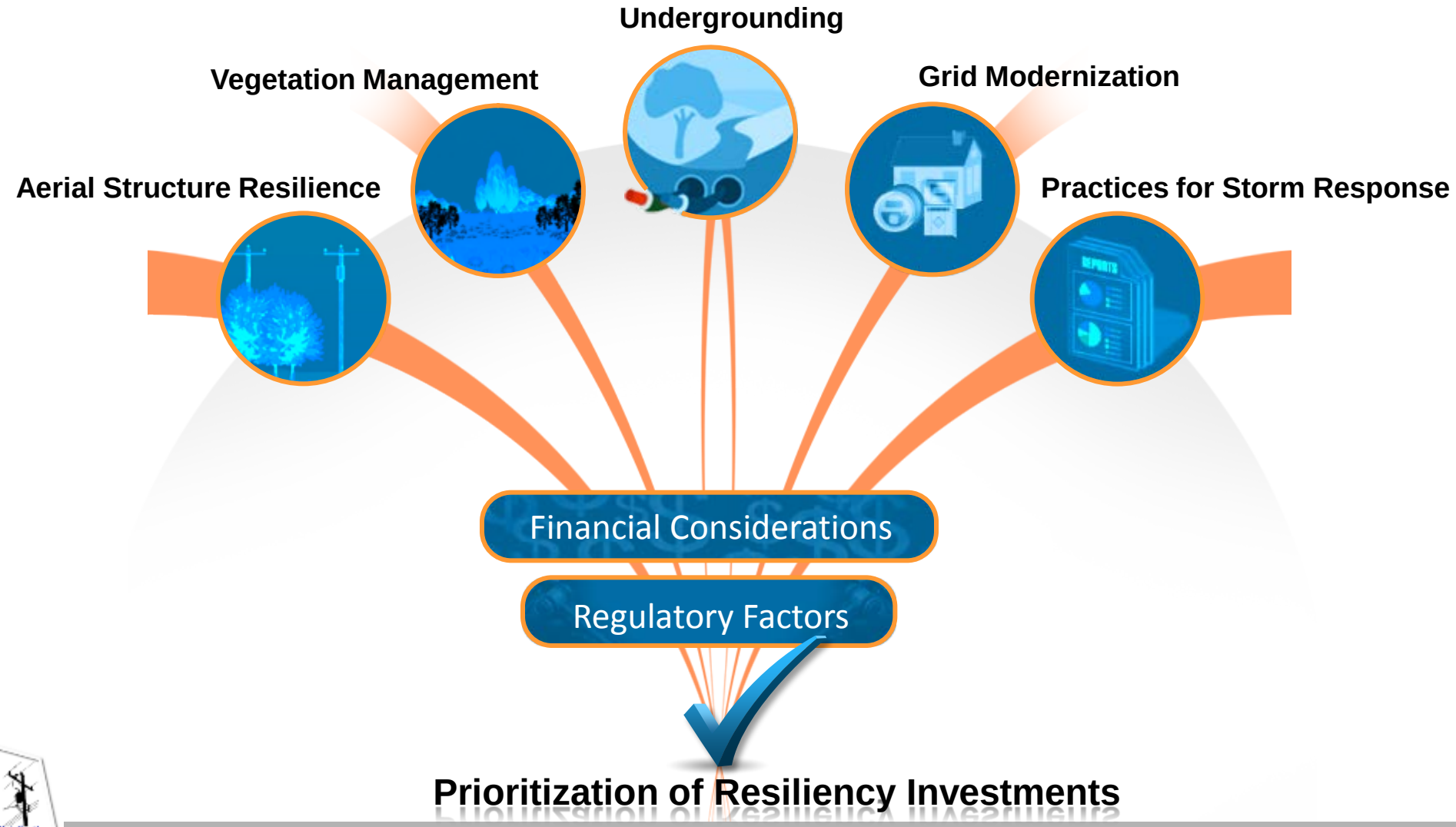
Subject Matter Workshops



EPRI ELECTRIC POWER RESEARCH INSTITUTE

System Resiliency
Terminology

Distribution Grid Resiliency Project Tasks



Damage Example

Preliminary Data from One Utility Major Event Day (MED) Results

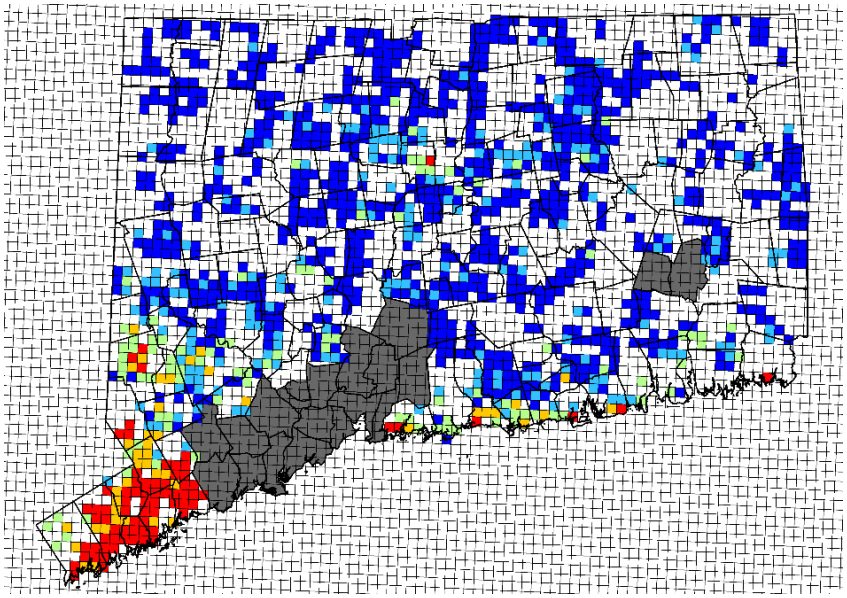
- 64% of outage events on the distribution system were from trees (sample of 926 events)
  - 30% Tree falls, healthy (79% fell from more than 20' from the line)
  - 21% Tree falls, defective (85% fell from more than 20' from the line)
  - 20% Tree limb, healthy
  - 10% Tree falls, dead
  - 19% Other tree issues
- For every 1 pole broken, there were 5.9 cases of trees removed without significant damage.

Modified Conductor Attachment

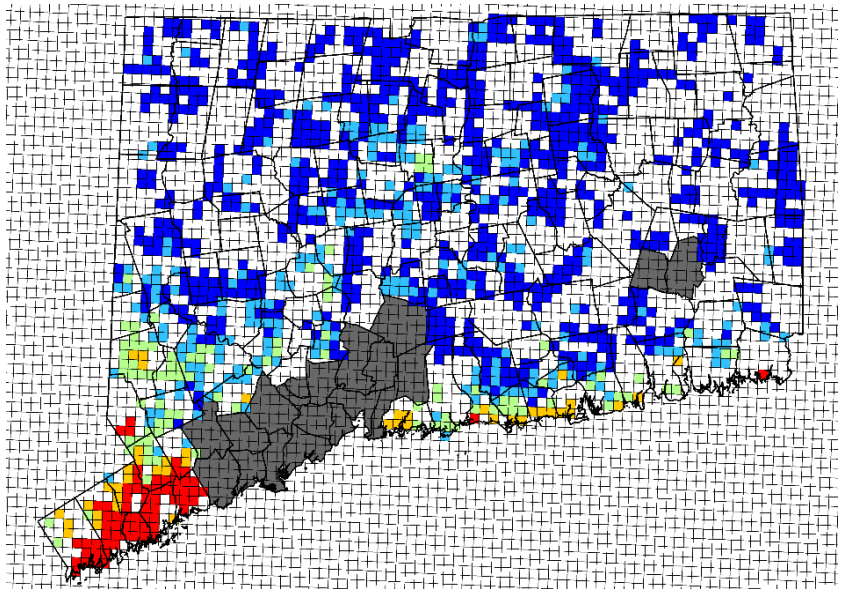
Vegetation Management

EPRI-Funded Research by UCONN

- Current Damage Prediction Model Accuracy (trouble spots)



Actual Hurricane Sandy Damage (8,688 TS)



Calibration – SMT Linear Decay Model (8,615 TS)

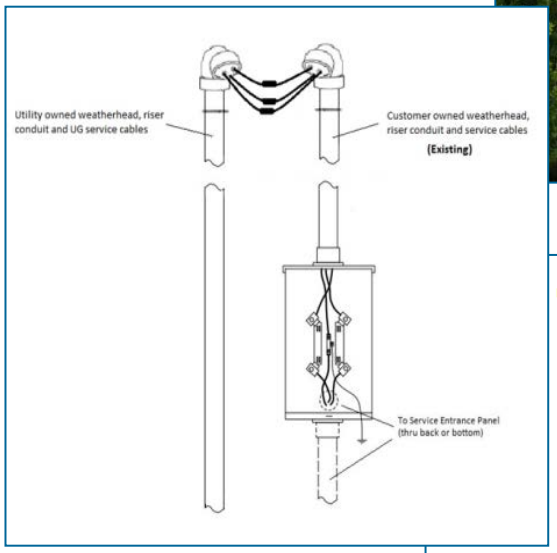
EPRI Distribution Grid Resiliency

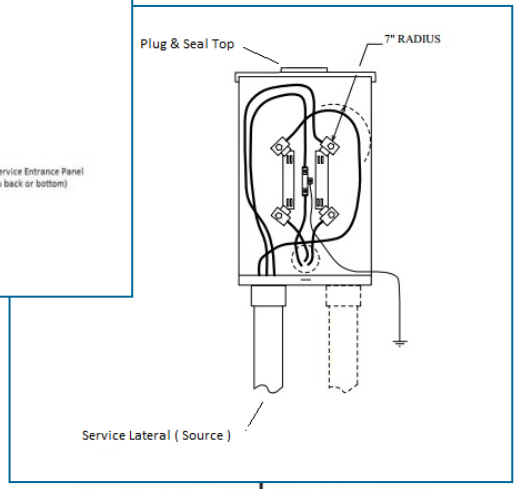
DGR Task 3: Undergrounding

- Document practices
- Perform Updated OH vs UG Analysis
  - Identify Cost/Reliability Drivers
  - Opportunities for targeted undergrounding
- New technologies / installation approaches
- Summarize costs, resiliency benefits

Undergrounding
Customer side challenges

- Construction costs may not include customer costs
- Customer buy in required
- Costs to convert a service entrance may be expensive
- Seek to devise and test options for the utility to promote and keep customer costs down





EPRI Distribution Grid Resiliency

Task 4: Modern Grid Technology

- Technology focus:
  - Distribution Automation
  - Automated Metering
  - Advanced Sensing
  - Outage Management System

EPRI ELECTRIC POWER RESEARCH INSTITUTE

EPRI Distribution Grid Resiliency

Task 5: Storm Response Practices

Identify, document and share leading practices for major storm response

- Gather and document practices
- Identify noteworthy practices and lessons learned
- Develop industry database
- Workshop(s)

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Comparing Strategies to assist in Prioritization

Resiliency Improvement Strategy	Cost / unit	Improvement in Broken Poles
Stronger poles - upgrade class to class 2	**$40000 / Mile**	80% improvement
Vegetation Management	**$25000 / mile** (medium tree density)	20% improvement
Underground facilities	**$1,200,000 / mile** (Suburban)	100% improvement

Together…Shaping the Future of Electricity

EPRI ELECTRIC POWER RESEARCH INSTITUTE