

Highly Resilient and Utilized Energy Infrastructure

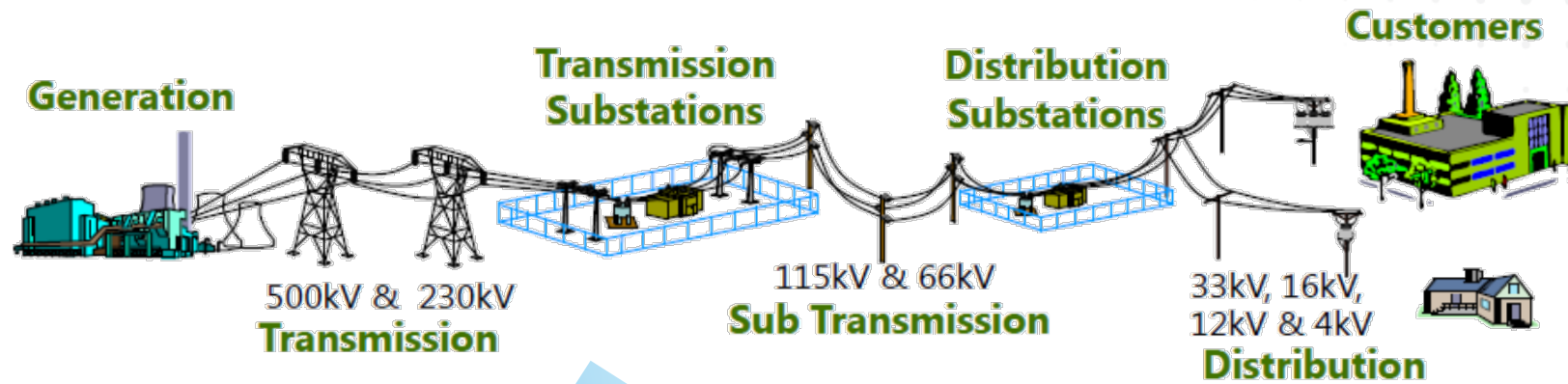
Dr. Sonja Glavaski
Program Director

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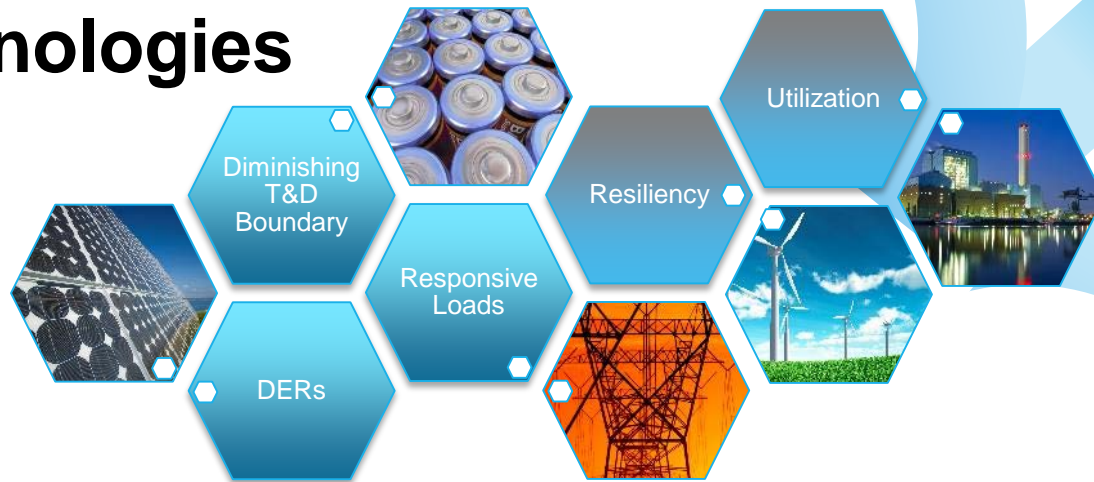


The US Grid is Changing!

Current Grid Structure

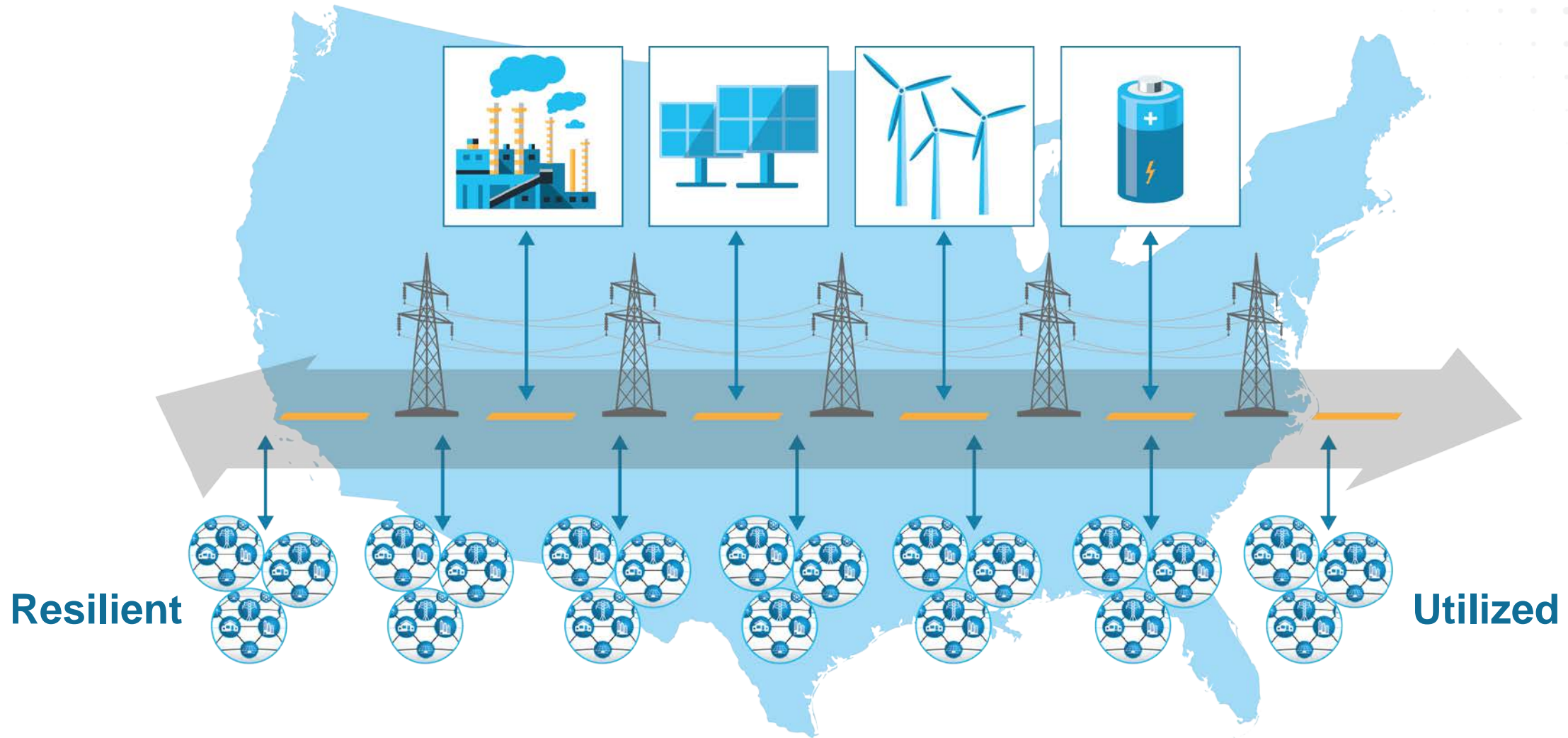


Emerging Technologies



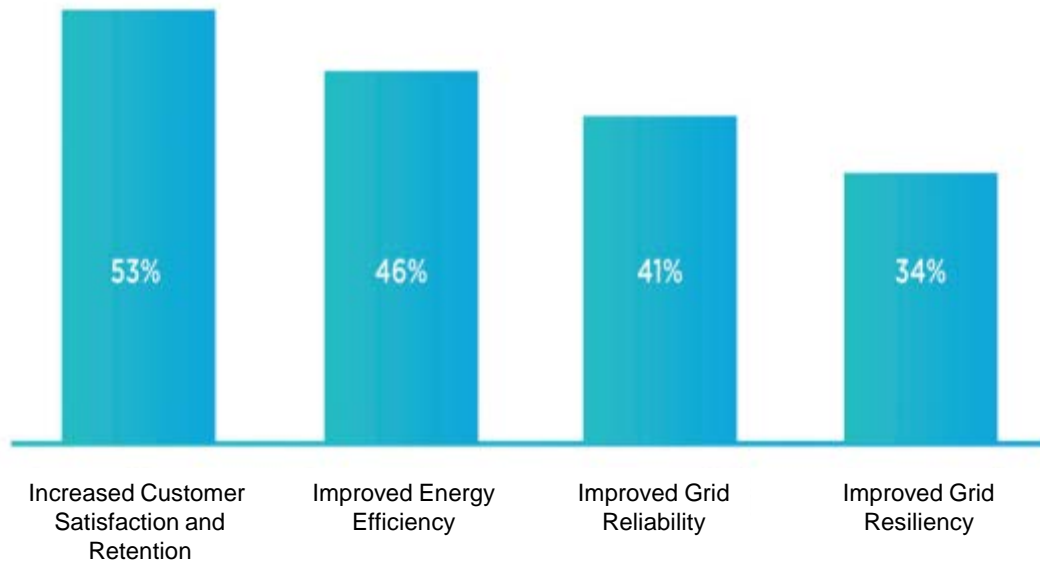
Points of Entry

Arriving at a Cheap Power Super Highway?

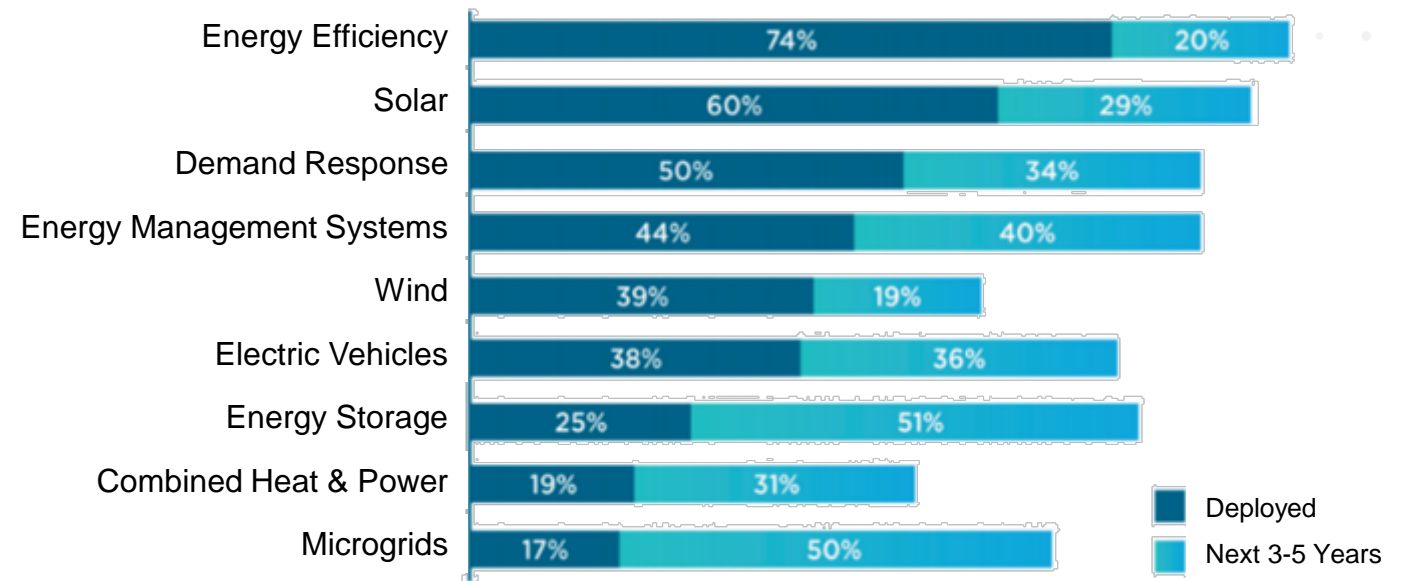


DERs and Rise of the Grid's Edge

Benefits of DERs



DER Deployment Status



SIEMENS “The Utility View of Achieving Agility in the Distributed Energy Era Through a Holistic and Flexible Digitalization Approach”, 2017

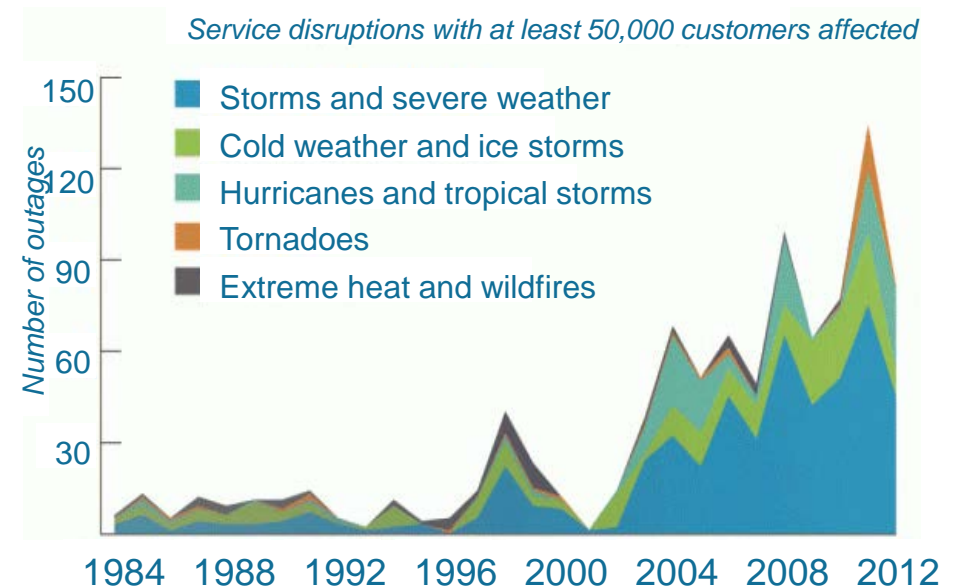
The Increasing Importance of Resiliency



Resiliency - System improvements that prevent or reduce the impact on reliability and ability of the system to recover quickly after adverse events

- Prevent and minimize damage
- Enable continued operation
- Rapidly return to normal

**RESILIENCY IS MORE
THAN RELIABILITY**



<http://www.climatecentral.org/news/weather-related-blackouts-doubled-since-2003-report-17281>

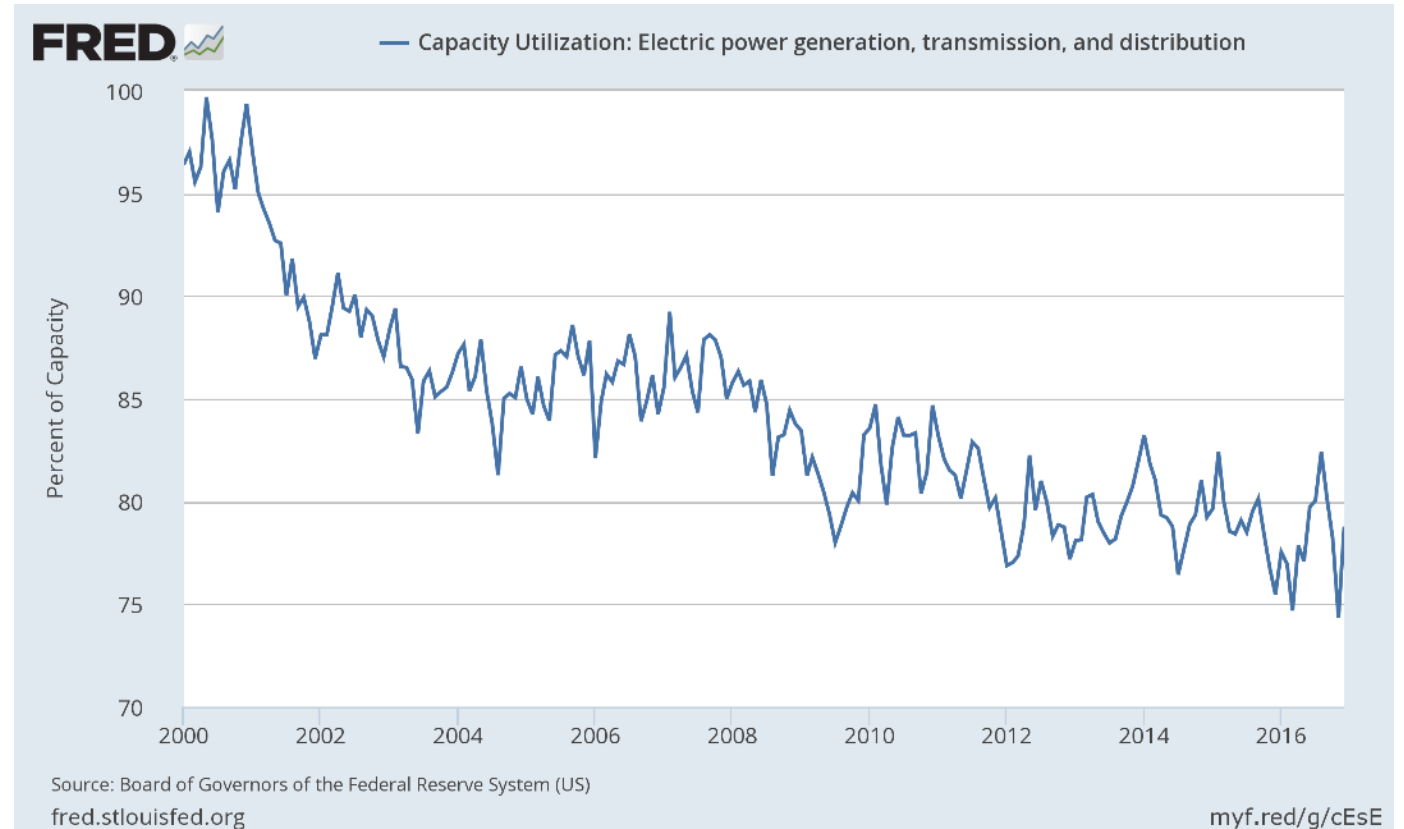
\$18B to \$33B annual cost

“Economic Benefits of Increasing Electric Grid Resilience to Weather Outages”, EOP 2013

Utilization of Grid Assets

Power Line Utilization = Maximum Demand / Rated Capacity

- ▶ 45%-55% due to contingency (NERC standards)
- ▶ Power losses increase with line utilization (4% vs. 20%)
- ▶ Transmission system is near peak loading for 40% of year
- ▶ Distribution system is near peak loading for 10% of year



Tight T&D Integration is Critical!

► Plan T&D jointly

- Incorporate local resources into broader area planning & analysis
- Determine optimal location and sizing of grid assets
- Account for supply and demand flexibility

► Operate T&D jointly

- Dispatch distributed generation in coordination with bulk generation
- Coordinate flexible loads & DERs with bulk generation & storage
- Mitigate the effects of extreme operating conditions



Technology Gaps – Tools Missing

Simulation

- Develop multi-scale simulation tools accounting for increasing DER deployment and “edge” effects

Planning

- Enable optimal, cost-effective grid asset additions and upgrades

Market Design

- Conduct T&D market analysis and design

Operation

- Balance the system over larger areas and across T&D

Outcomes



Streamlined DERs deployment



Improved Grid Resiliency

**All while managing system
reliability & consumer costs!**



High Utilization of T&D infrastructure

Thank You!

