

Electric Sector Resilience in the Face of Threats

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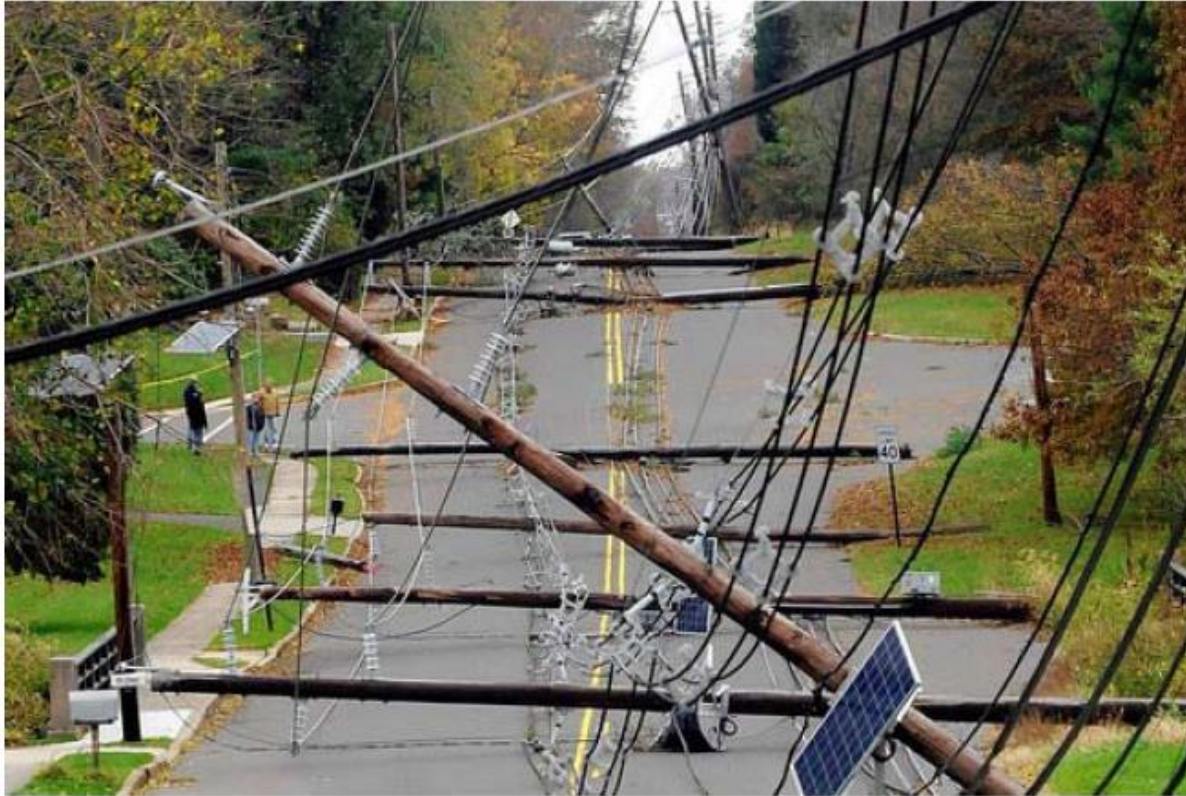
Tuesday, October 10, 2017

IEA Experts Workshop: Challenges in Electricity Decarbonization Paris

Electrification is a critical element of sustainability

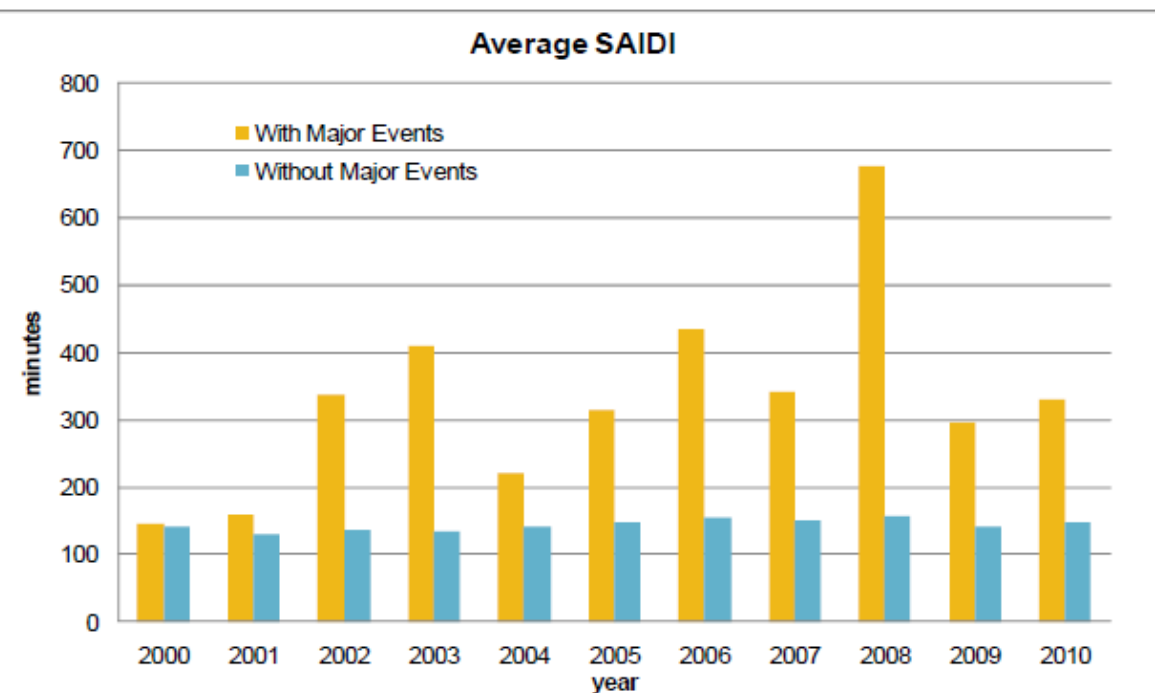


But what about the risks of outages?



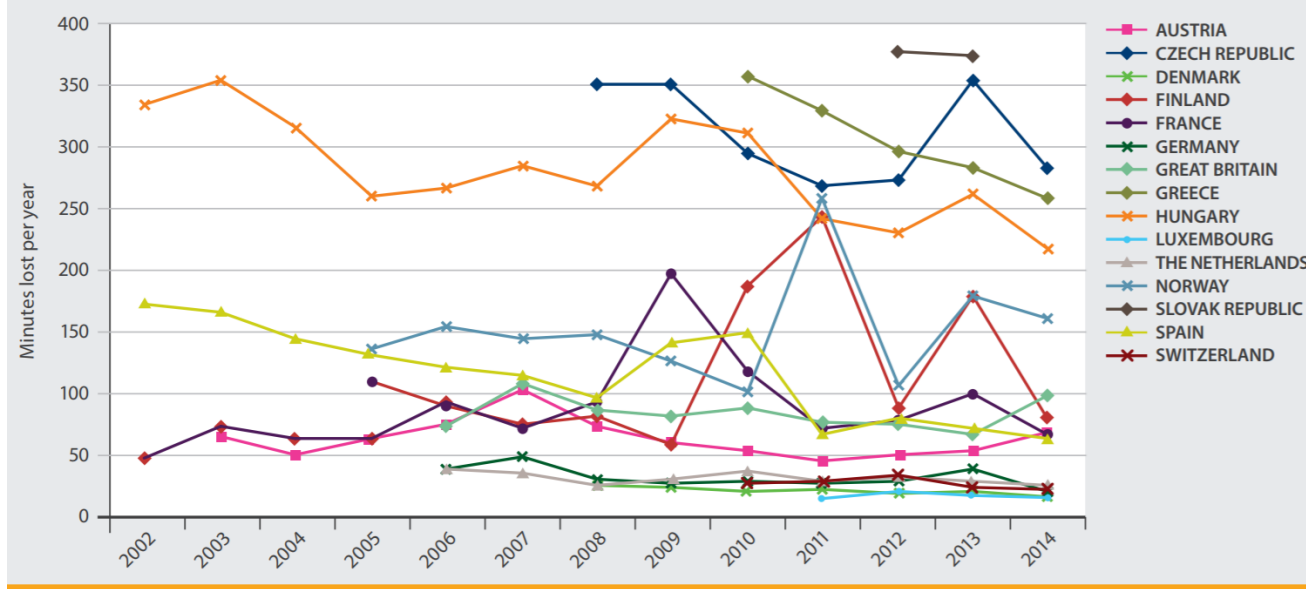
We have built a reliable system

United States



Europe

FIGURE 2.2 OVERALL PLANNED AND UNPLANNED LONG INTERRUPTIONS (MINUTES LOST PER YEAR); ONLY COUNTRIES NOT EXCEEDING 400 MINUTES



Resilience not the same as Reliability

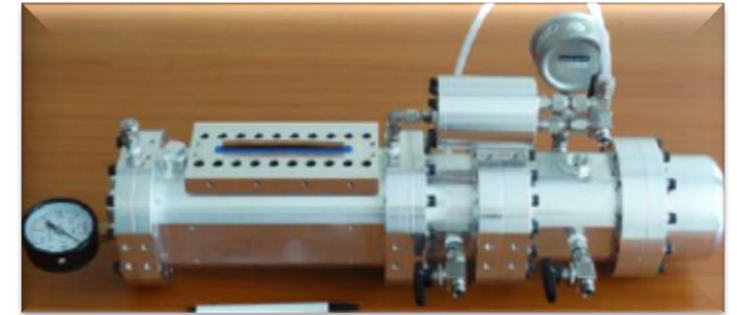


**Weather
Events**

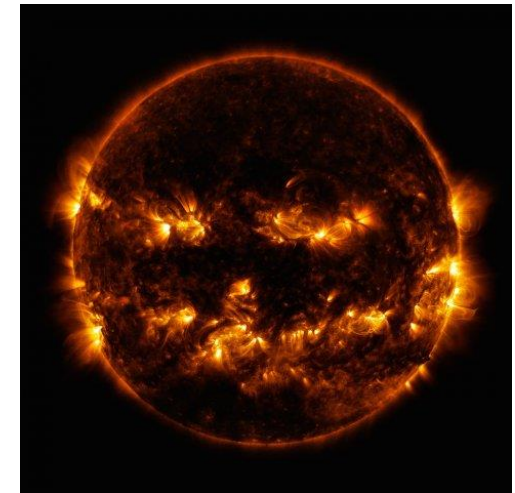


Cyber Events

Electro-Magnetic Pulse



**Equipment and Protection
System Failures**



Solar Storms

Storms - Just this year

Hurricane Harvey Strikes a Powerful Blow to Texas, and Lingers



Irma causes one of the largest natural disaster power outages in U.S. history



Hurricane Maria knocks out power to entire island of Puerto Rico, population 3.5m

People fear the long term damage to the already bruised economy as they are hit by the worst storm in 80 years



Cyber Security

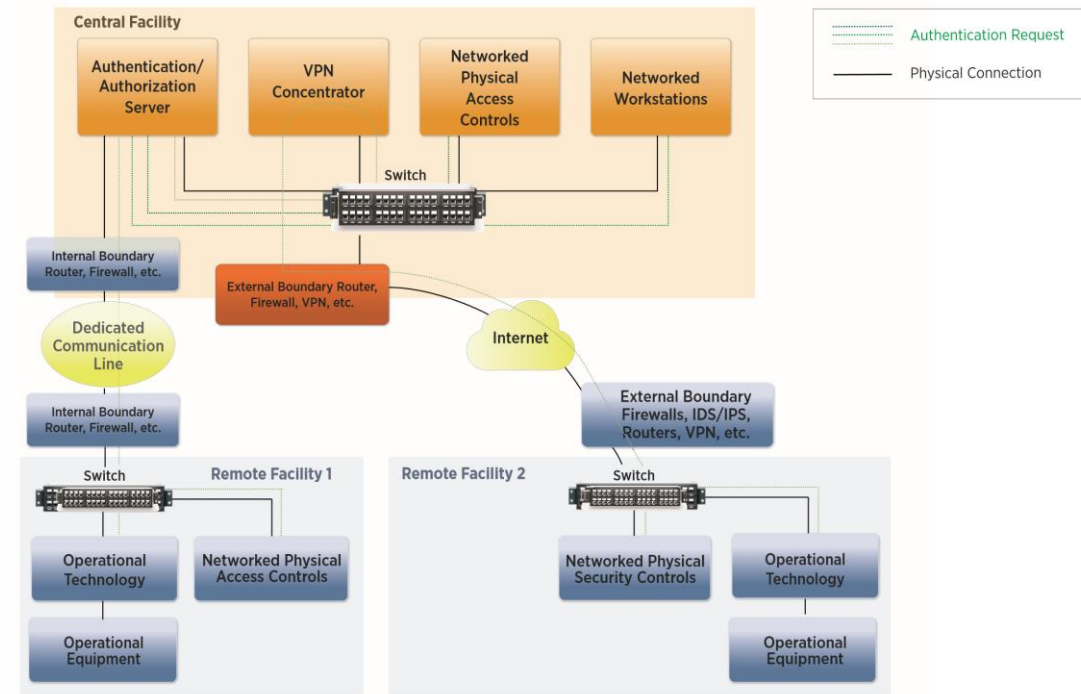
12 JAN 2017 NEWS

Ukraine Power Outage Confirmed as Cyber Attack

Cyber firms warn of malware that could cause power outages

Security concerns rising for Internet of Things devices

Call it the Attack Vector of Things



Physical Security

Assault on California Power Station Raises Alarm on Potential for Terrorism

April Sniper Attack Knocked Out Substation, Raises Concern for Country's Power Grid

SECURITY

Substation attack is new evidence of grid vulnerability

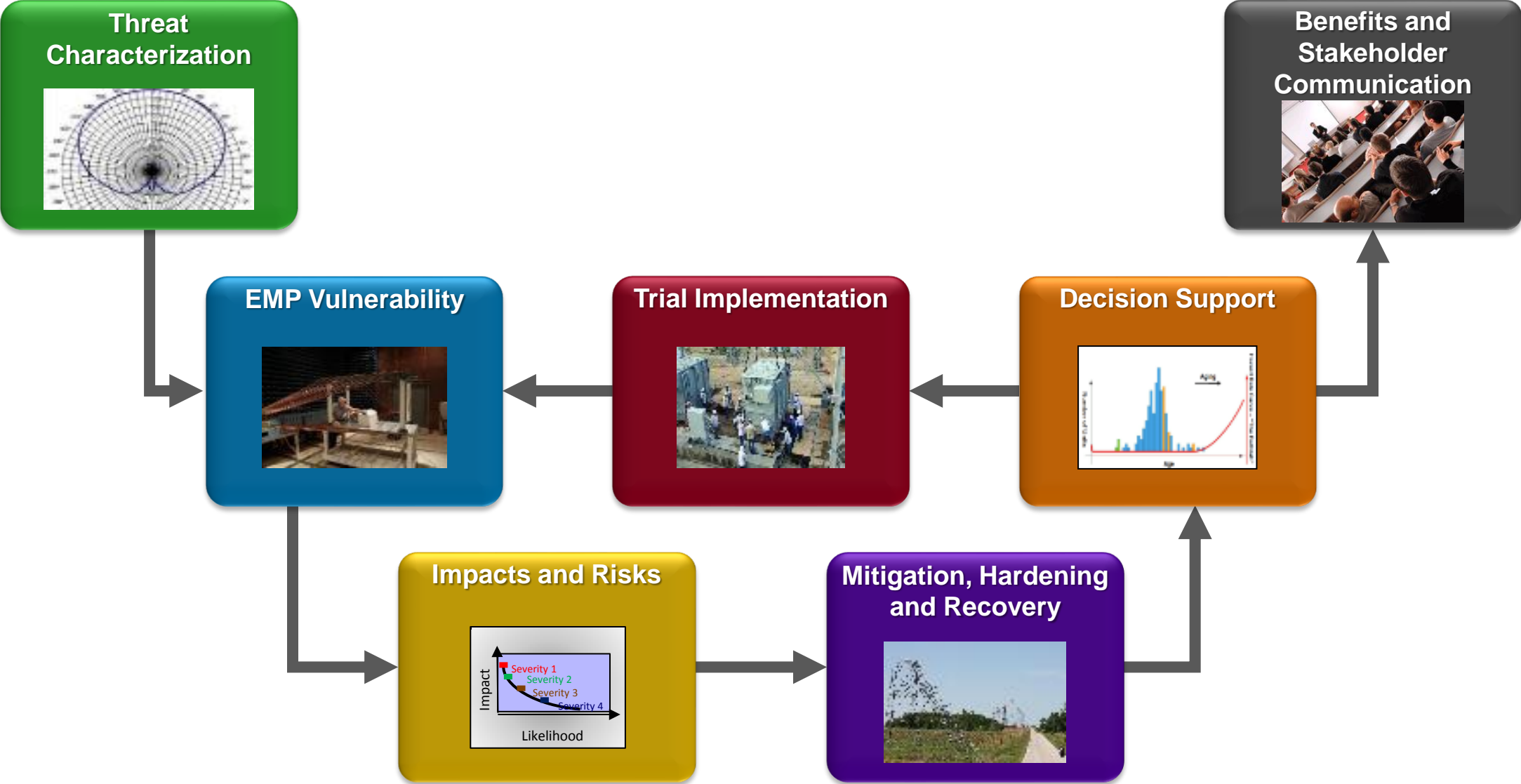
Peter Behr, E&E News reporter

Energywire: Thursday, October 6, 2016

With just a few shots from a high-powered rifle, an unknown gunman knocked out an electric power substation in rural south-central Utah last month, cutting off electricity to 13,000 customers for a day and forcing the utility to wait at least six months until the station's disabled transformer is repaired or replaced.



Electro-Magnetic Pulse (EMP)



Improving Grid Resilience – Multiple Approaches



Investing in the Grid – Grid Hardening and Grid Modernization

Insulated Conductors and Steel/Concrete Poles



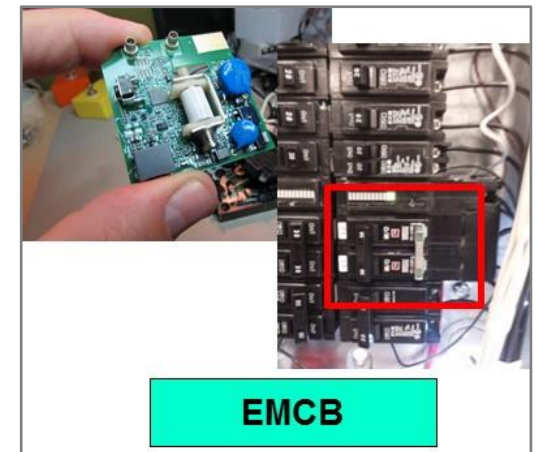
Vegetation Management



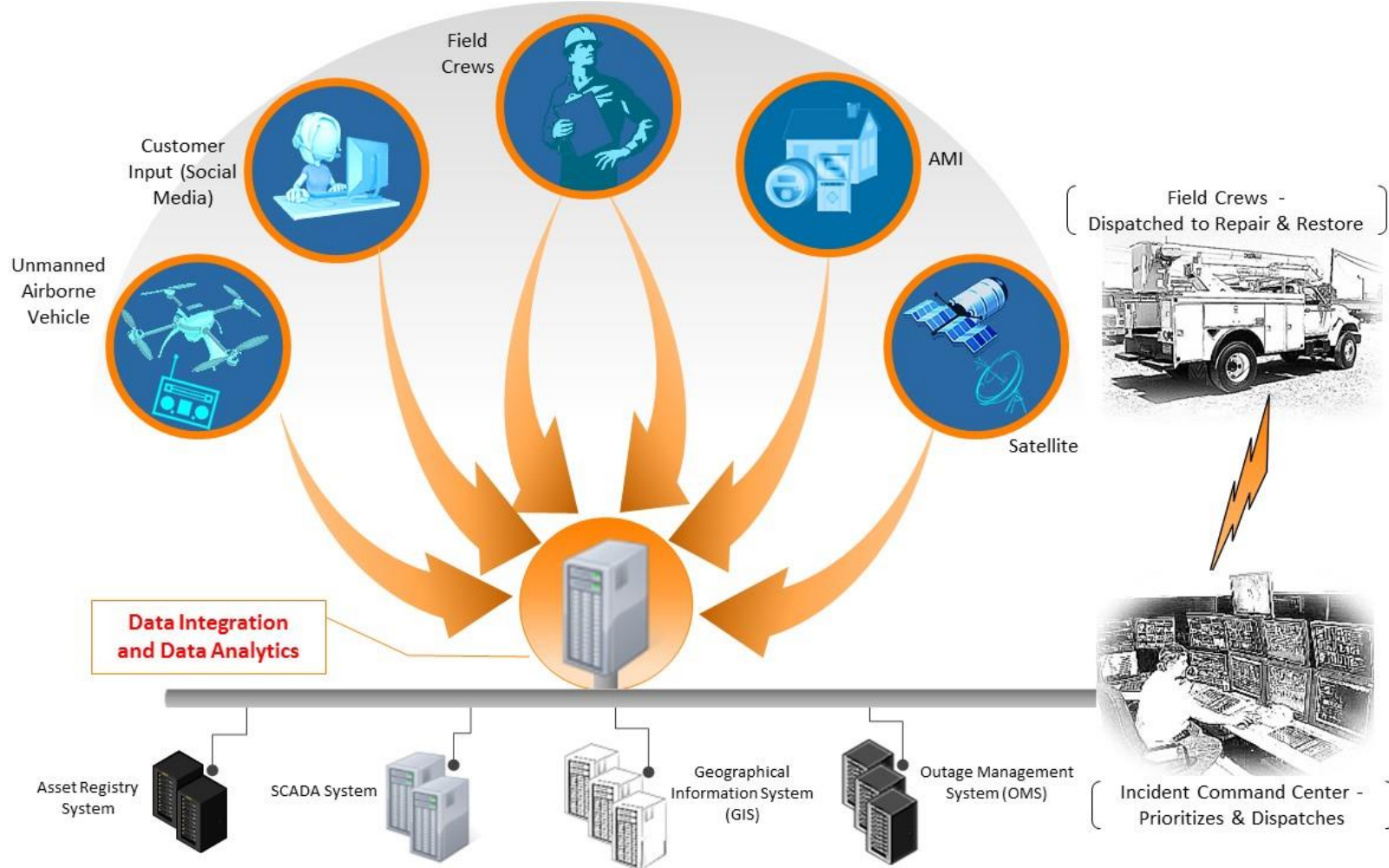
Undergrounding



Sensors and Automation

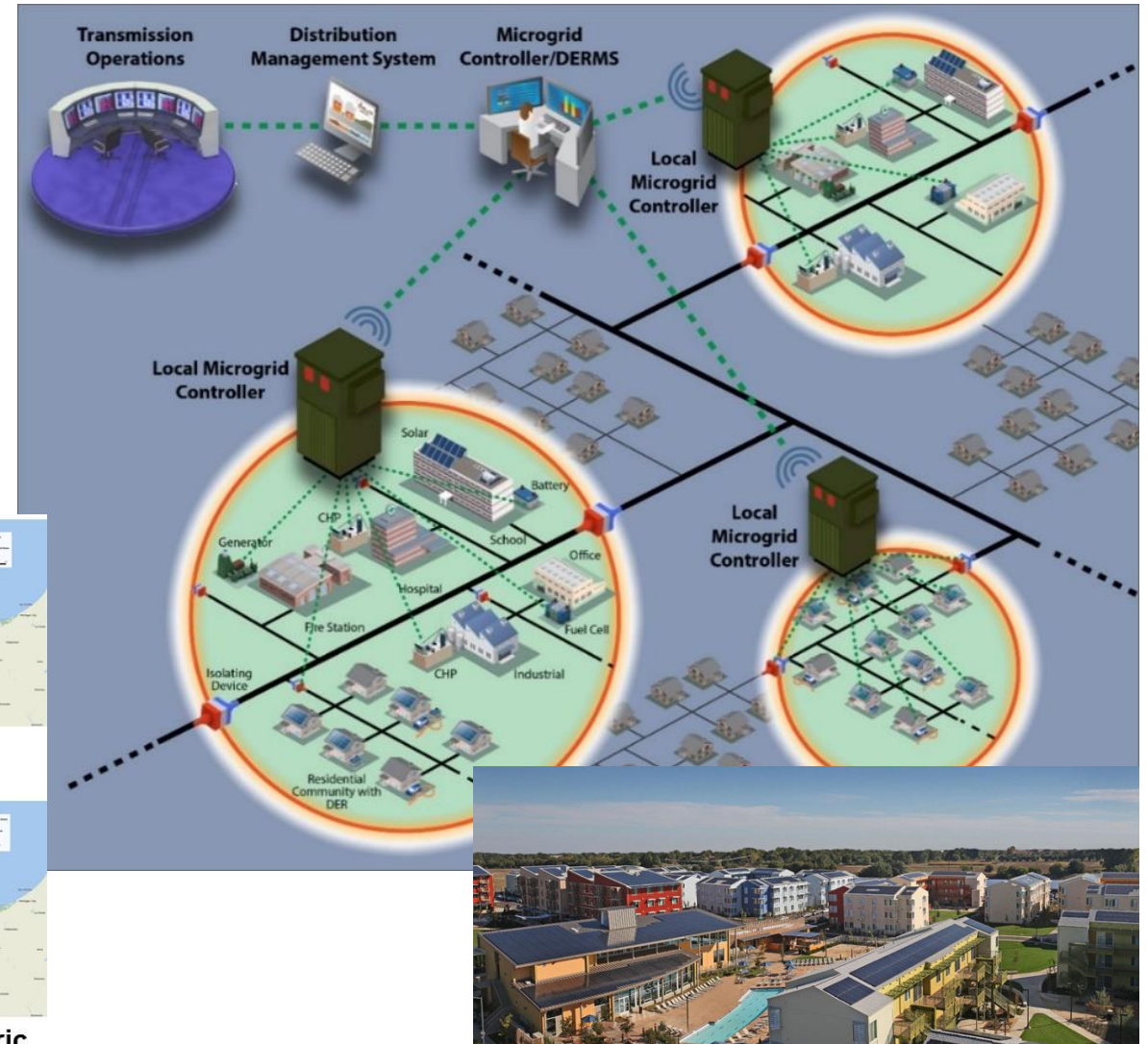
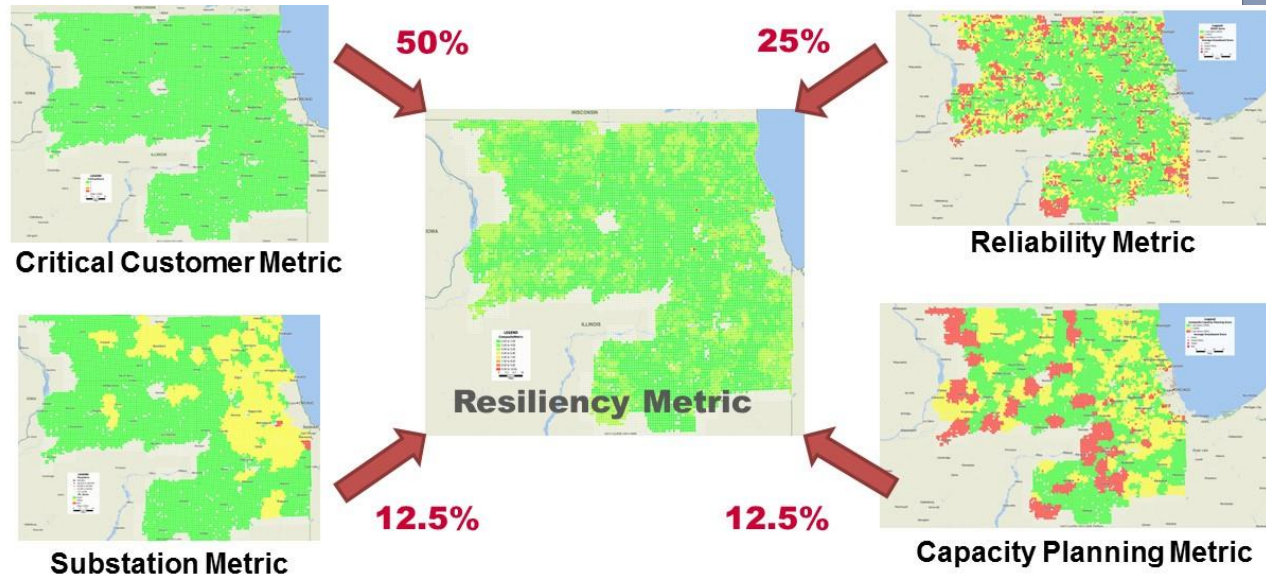


Using technology to respond faster

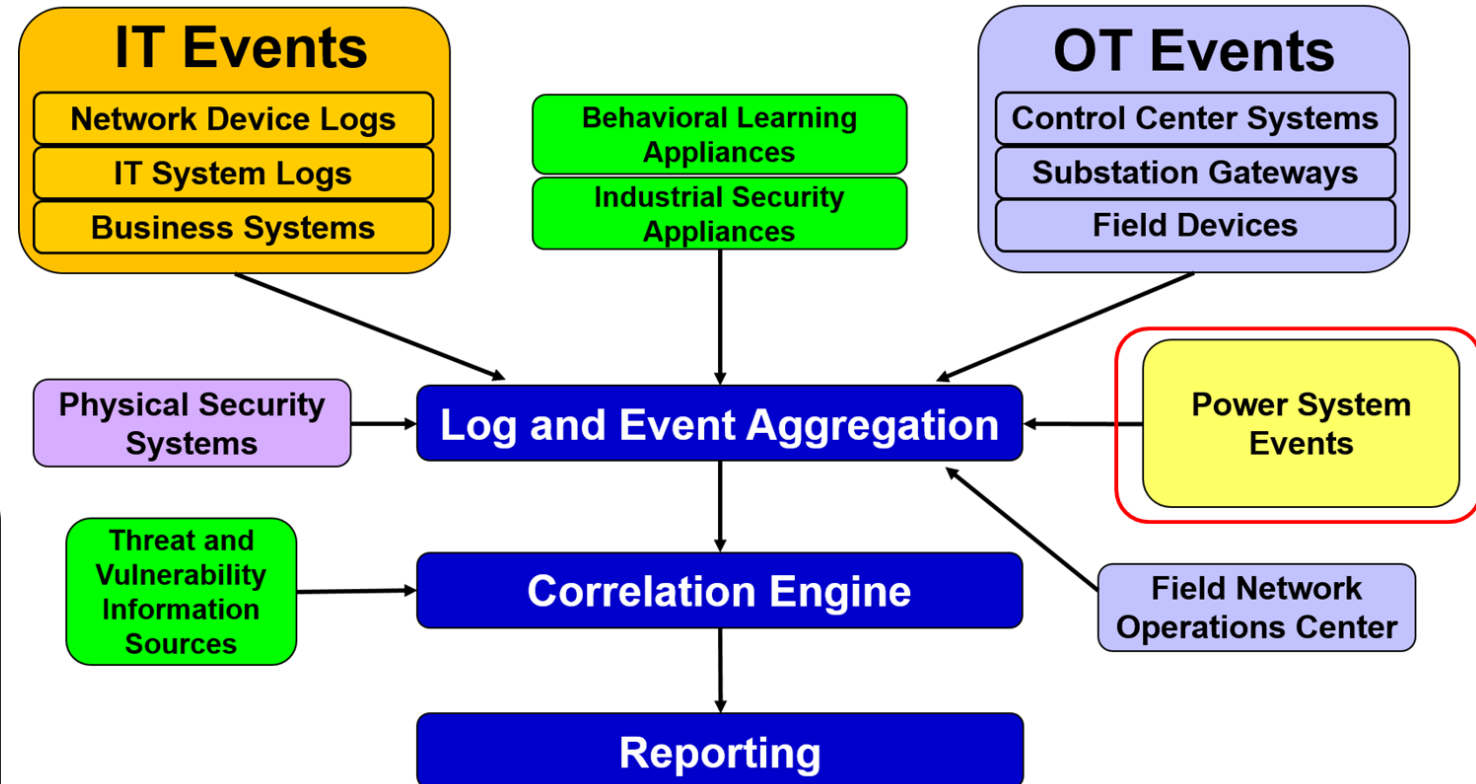


New approach – advanced energy communities

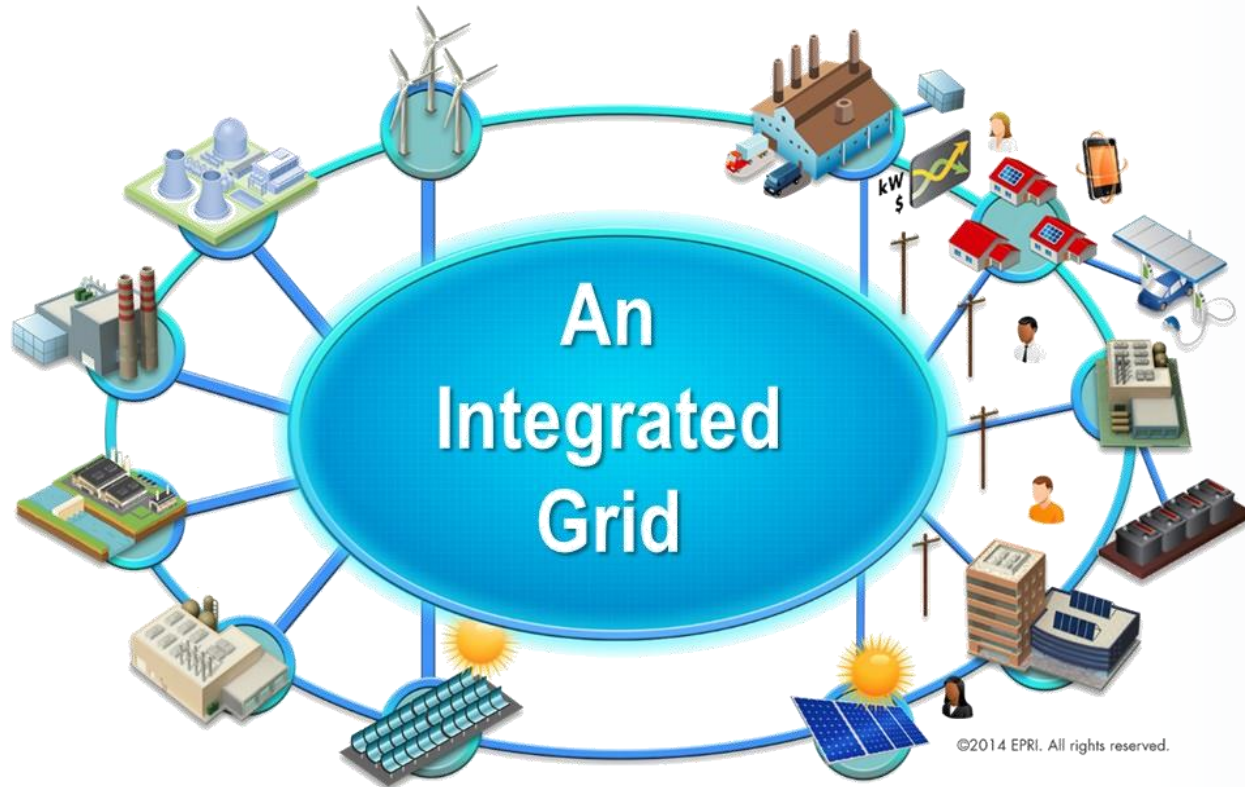
Local energy systems can incorporate local storage, generation, and advanced energy management to optimize energy use while also providing local resilience.



Combining IT and OT – Integrated Threat Analysis Facility (ITAF)



The Vision – An Integrated Grid



Integration of:
Electricity,
Telecommunications,
and Customer Local
Energy Networks

The Integrated Grid Enables Optimization of Local and Central
Resources with Customer Needs



Together...Shaping the Future of Electricity