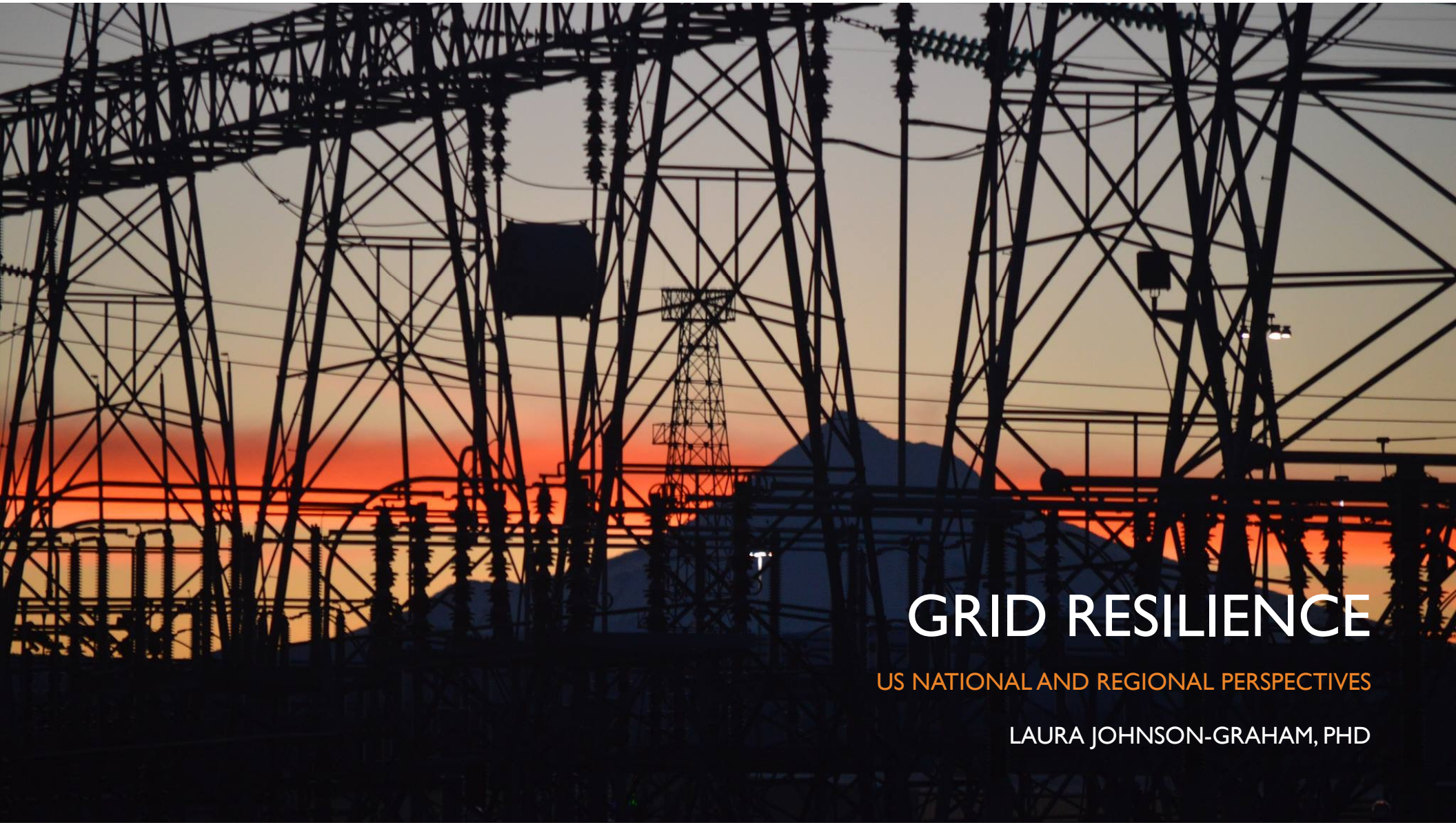


GRID RESILIENCE

US NATIONAL AND REGIONAL PERSPECTIVES

LAURA JOHNSON-GRAHAM, PHD

GRID RESILIENCE: NATIONAL AND REGIONAL PERSPECTIVES

Agenda

- Perspectives on Grid Vulnerability
- National Grid Resilience Initiatives
- Regional Priorities
- Resilient Operations

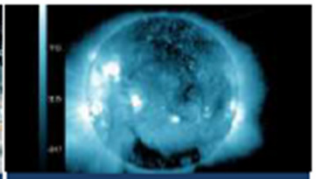
GRID RESILIENCE:
NATIONAL AND
REGIONAL
PERSPECTIVES

Grid Vulnerabilities

GRID VULNERABILITIES

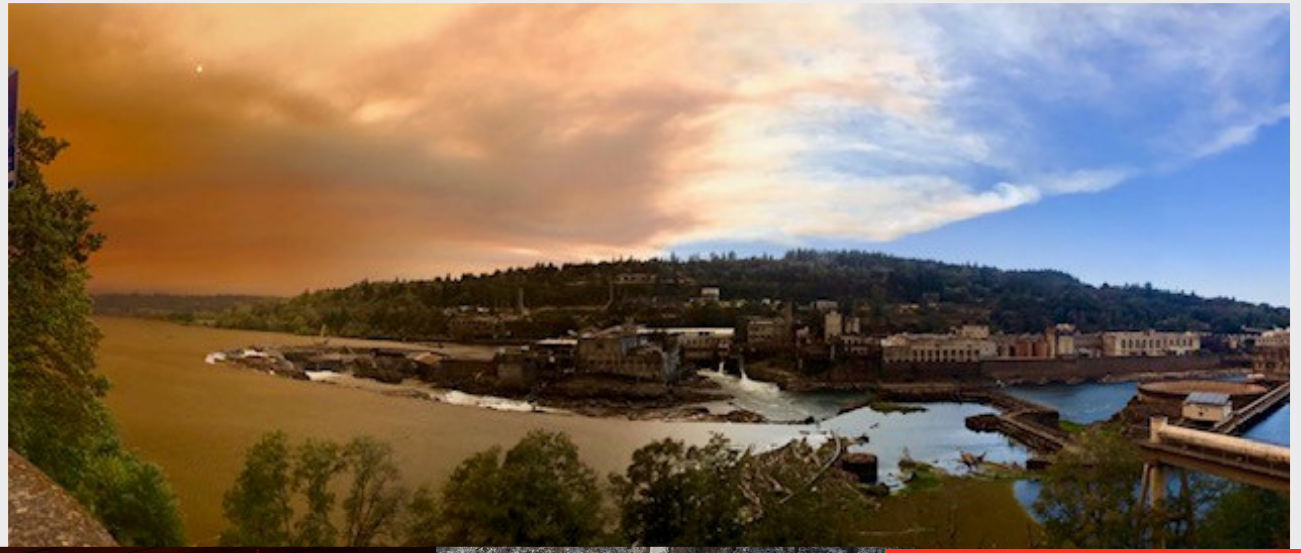
- Extreme Weather & Natural Disasters
- Physical Attacks
- Cyber Attacks
- EMP Attacks and Geomagnetic Disturbance

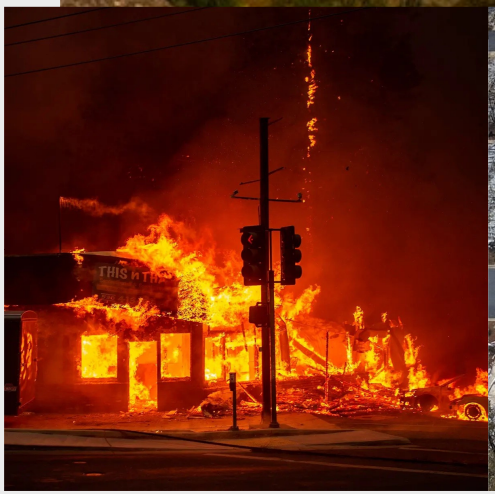
CATASTROPHIC THREATS

	 Extreme Weather and Natural Disasters	 Physical Attacks	 Cyberattacks	 Electromagnetic Pulse Attacks and Geomagnetic Disturbance
Examples/Definition	Hurricanes, superstorms, cold spells, high winds, wildfires, earthquakes.	Bombings, shootings, wire cutting, arson.	Deliberate exploitation of computer systems in order to gain control of or damage the grid.	An electromagnetic pulse (EMP) is caused by high-altitude detonation of a nuclear device. A geomagnetic disturbance (GMD) is caused by a severe solar storm.
Scope of Potential Damage	Damage or destroy infrastructure; cause precautionary power outages to avoid wildfires.	Most attack effects would be limited to local grid; coordinated attack potentially catastrophic.	Disable or limit access to grid control systems, resulting in outages and/or infrastructure damage, potentially widespread and long-lasting.	Wide-area damage to transmission and distribution infrastructure. In the case of EMP, indiscriminate damage to unhardened electronic equipment.

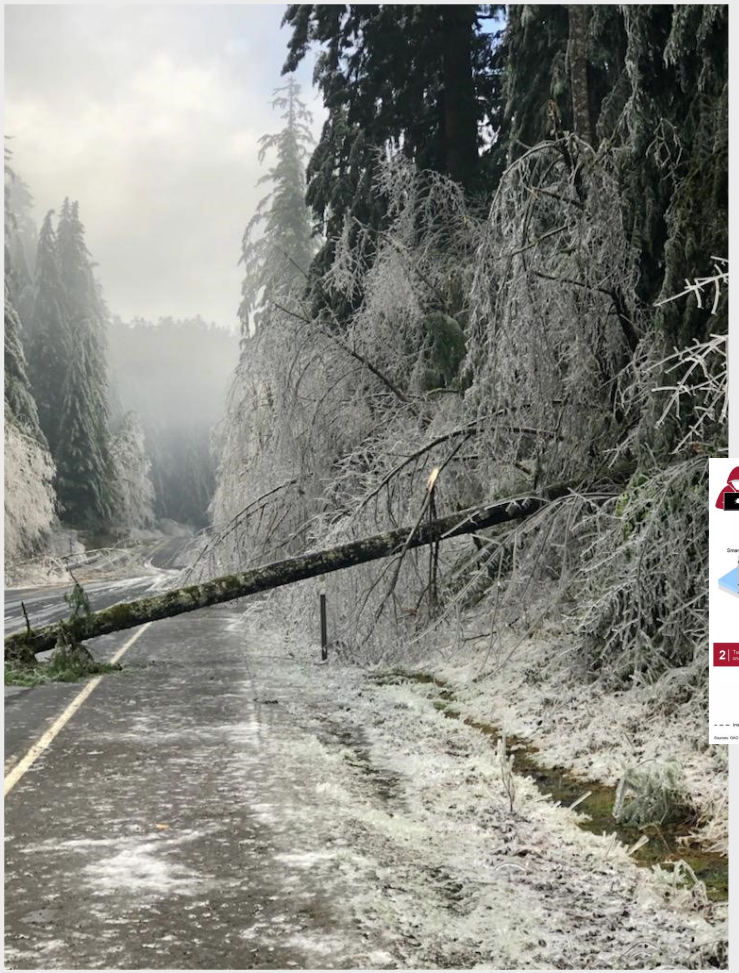
Reimagining Grid Resilience, Rocky Mountain Institute, 2020

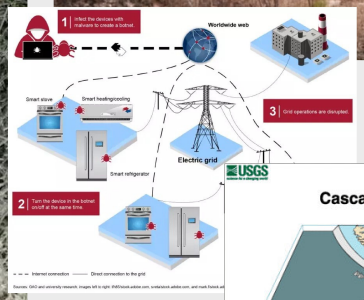
GRID VULNERABILITIES

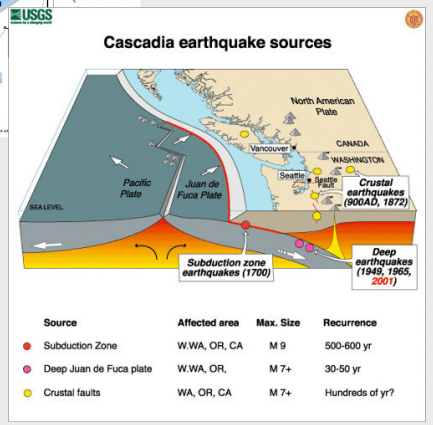




GRID VULNERABILITIES







GRID RESILIENCE: NATIONAL AND REGIONAL PERSPECTIVES

National Grid Resilience Initiatives

NATIONAL GRID RESILIENCE INITIATIVES

- Building a Better Grid
  - $20bn in grants and other financing tools
  - Address the Climate Crisis at national, state and local level
  - Deliver clean energy from where it is produced to where it is needed
  - Two focal areas
    - National transmission & distribution requirements
    - Interstate high voltage lines

NATIONAL GRID RESILIENCE INITIATIVES

- Grid Resilience & Innovation Partnerships
  - $10.5 bn in grants
  - Three focal areas
    - Grid Resilience ($2.5bn): Reduce impacts from extreme weather and natural disasters
    - Smart Grid Grants ($3bn): Increase capacity of transmission system, integrate renewables and Evs
    - Grid Innovation ($5bn): grants to tribes, local governments and public utility commissions to innovate in transmission and storage capacity and system resilience and reliability

GRID RESILIENCE: NATIONAL AND REGIONAL PERSPECTIVES

Regional

Grid

Resilience

REGIONAL GRID RESILIENCE

Operational Context:

- Regional Federal Power Marketing Agency
- Federal hydro system
- 31 dams
- 1 nuclear power plant
- 22k megawatts installed capacity
- 15k miles high voltage transmission lines
- >280 substations
- Statutory obligations to regional customers

RESILIENCE FRAMEWORK

RESILIENCE FRAMEWORK

System Recovery, Learning & Adaptation

Exercise, Respond

Program Funding, Design & Implementation

Enterprise Risk Management

Vet and Prioritize Resilient Solutions, COOP

Strategic Asset Management Plans Enterprise Architecture

RESILIENCE PLANNING AND MONITORING

- Asset Management
  - Strategic Asset Management Plans across asset categories
  - Supply Chain availability
- Continuity
  - Business Continuity Plans in place and exercised
- Power Services
  - Hydro unplanned outage rates
  - Generation Reliability
- Transmission Services
  - Transmission unplanned outage rates
  - Public Safety Power Shutoff
- Information Technology
  - Critical Business Systems
  - Cyber Disruption response time
  - Network Services Performance
  - Remote Access Availability
- Finance
  - Reserves – cash on hand
  - Debt to asset ratio
- Human Resources
  - Mission Critical Occupations
  - Succession Planning
  - Eligible to retire

REGIONAL GRID RESILIENCE PRIORITIES

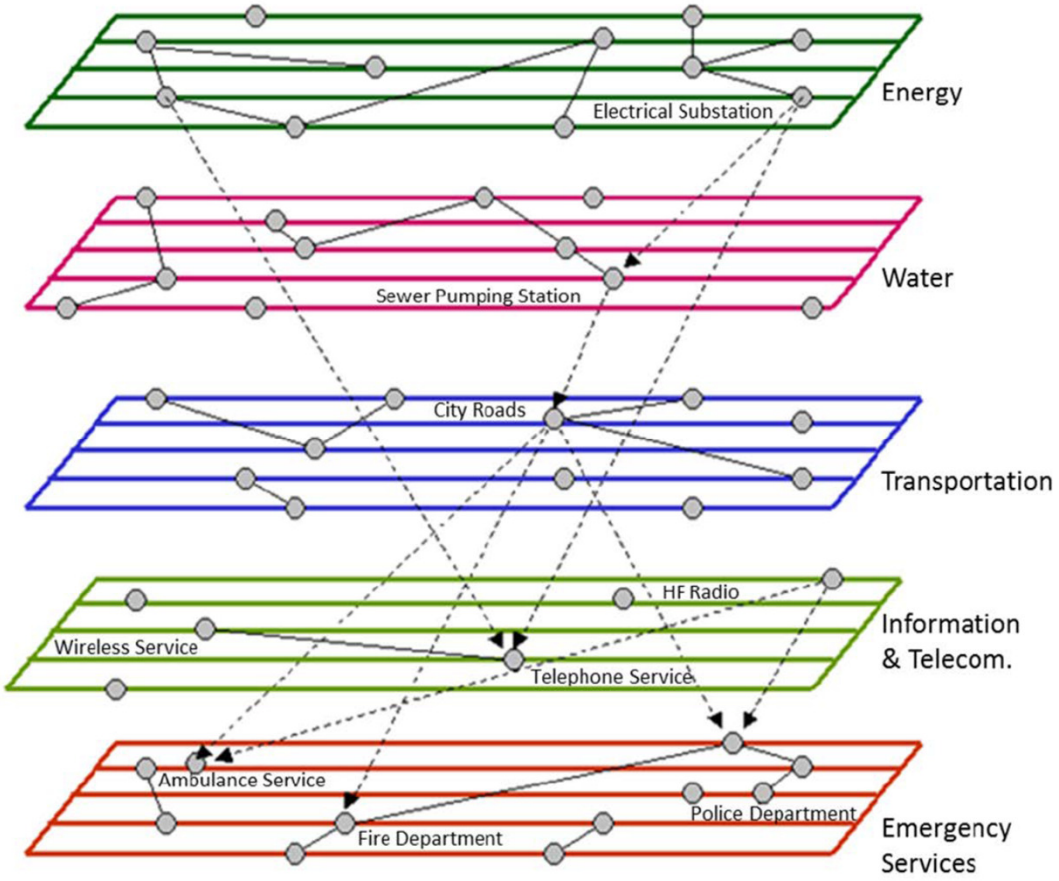
Planning Priorities in the Western Region

- High Probability Medium Consequence Threats
  - Extreme Weather
  - Physical Attacks
  - Cyber Attacks
- Low Probability High Consequence Threats
  - Cascadia Subduction Zone Event

RESILIENCE OPERATIONS – MAJOR INITIATIVES

- Entry into Energy Imbalance Markets
  - System reliability benefits
  - Secondary energy market
- Wildfire Operations
  - Aggressive use of Public Safety Power Shutoff in fire season
  - Public Awareness
  - Vegetation management
- Cyber hardening
  - Federal government move to Zero Trust Architecture
- Transmission Asset Security
  - Increased security at substations
  - Public Awareness and Hotline

MULTI-JURISDICTIONAL COLLABORATION IS CRITICAL



Source: National Institute of Standards and Technology, *Community Resilience Planning Guide for Buildings and Infrastructure Systems: Volume II*

TOP DOWN, BOTTOM UP

- The US is working to reorient our power grid in response to emerging catastrophic threats
- The US government is investing heavily in grid modernization and resilience initiatives
- Much of the transformative work is taking place at the operational and field level
- Vertical and horizontal partnerships are critical to the success of resilience investments and practices

GRID RESILIENCE

THANK YOU

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