FERC Technical Conference:

Climate Change, Extreme Weather & Electric System Reliability. June 1-2, 2021

R. Clayton's Notes on Conference

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Agenda

- Introduction – More Frequent & Expensive Extreme Weather Effects
- Panel 1 – Planning for a Future that Diverges from Historical Trends
- Panel 2 – Best Practices for Long-Term Planning: Assessing & Mitigating the Risk of Climate Change & Extreme Weather Events
- Panel 3 – Operating Practices for Addressing Climate Change & Extreme Weather
- Panel 4 – Recovery & Restoration
- Panel 5 - Coordination

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More Frequent & Expensive Extreme Weather Effects

For interactive data, charts, mapping and disaster summaries:
www.ncdc.noaa.gov/billions

New annual report: 2020 U.S. billion-dollar weather and climate disasters in historical context
www.climate.gov/disasters2020

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For more detail on data, methodology and uncertainty, see:

- Smith A.B. and J.M. Matthews, 2015: Quantifying Uncertainty and Variable Sensitivity within the U.S. Billion-dollar Weather and Climate Disaster Cost Estimates. *Natural Hazards*, 77, 1829-1851 (https://www.ncdc.noaa.gov/billions/docs/smith-and-matthews-2015.pdf)

- Smith, A.B. and R.W. Katz, 2013: U.S. Billion-dollar weather and climate disasters: Data sources, trends, accuracy and biases. *Natural Hazards*, 67, 387–410 (https://www.ncdc.noaa.gov/billions/docs/smith-and-katz-2013.pdf)

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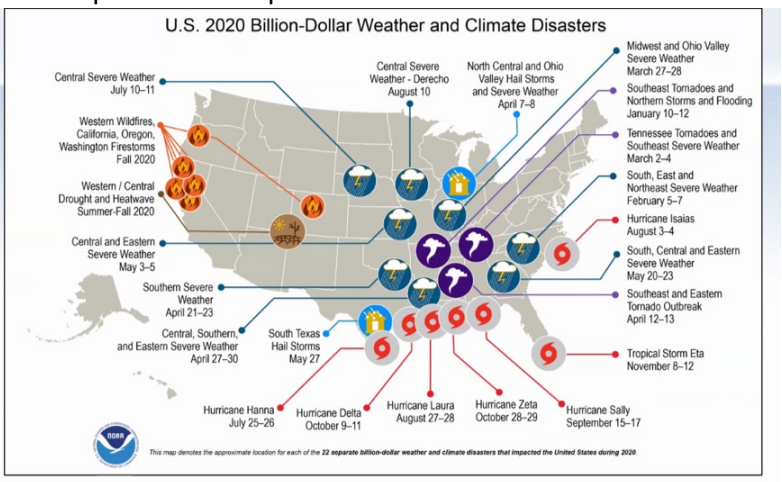
More Frequent & Expensive Extreme Weather Effects



During **2020**, the U.S. experienced **22 separate billion-dollar disaster events** with impacts from hurricanes, severe storms (i.e., tornadoes, hail and/or high wind), drought and wildfires. Total current cost for 2020 events: **$96.4 billion**

Record-breaking hurricane & wildfire seasons. Central **derecho event** also of **historic intensity and damage**

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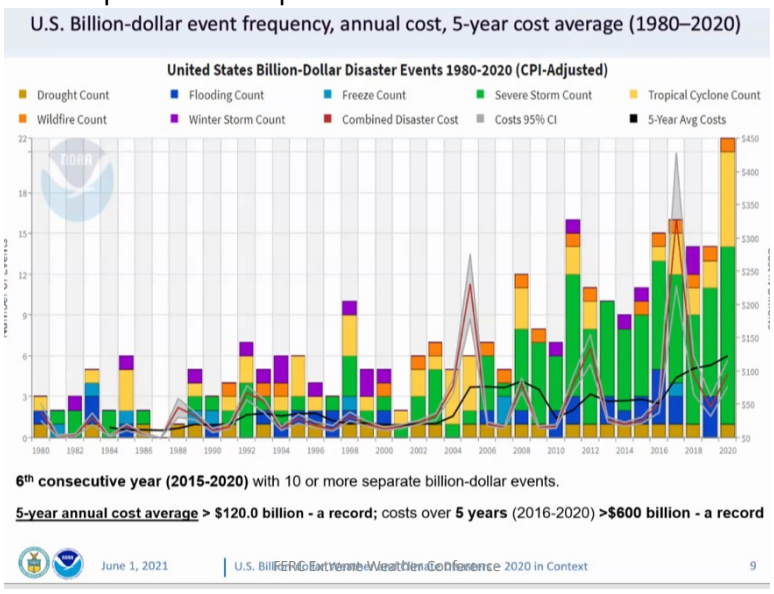
More Frequent & Expensive Extreme Weather Effects



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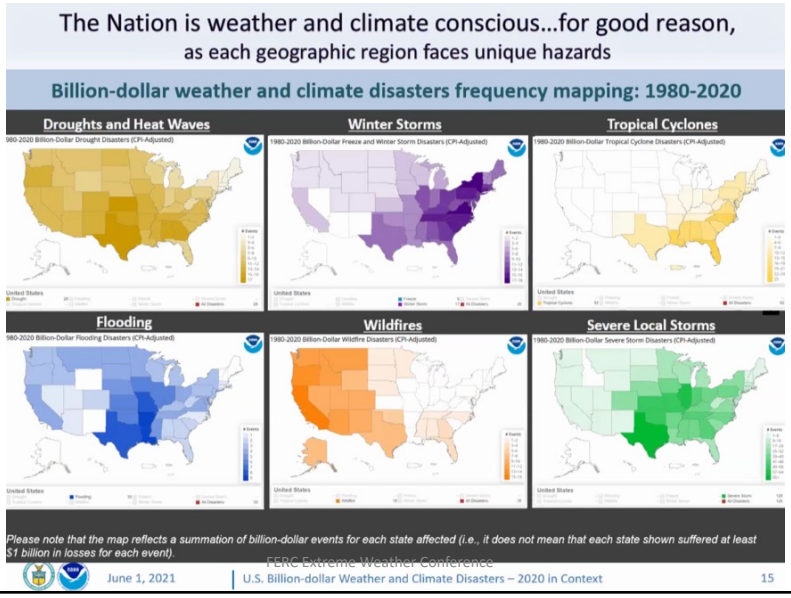
More Frequent & Expensive Extreme Weather Effects



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Panel 1 – Planning for a Future that Diverges from Historical Trends

- Adaptive capacity (resilience) to handle change
- Cannot rely on historical trends
- Importance of interregional coordination & ties
- Apply risk tolerance criteria
- Need for granular (local) weather data & consistent methodology
- Resource adequacy methodology needs to change
  - Whole year analysis
  - Incorporate climate trends (do not rely on historical trends)
  - Scenario risk analysis

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Panel 1 – Planning for a Future that Diverges from Historical Trends

- Consistency of data & analysis
- EW resiliency vs cost
- Micro-grids may be a solution
- 1 in 10 criterion is not an appropriate criterion for EW analysis (need frequency & duration of outage)

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Panel 2 – Best Practices for Long-Term Planning: Assessing & Mitigating the Risk of Climate Change & Extreme Weather Events

- Demand response is a valid option to meet resiliency requirements
- Resource adequacy criteria & analytical method
  - 1 in 10 criterion outmoded (generator centric)
  - Ignores demand response
  - Concentrates on capacity not energy
  - Customer discrimination (risk tolerance)
  - Method should include EW scenario analysis (like extreme contingencies)
  - Ignores common mode failures (e.g. gas & electric)
  - Extreme cold associated with wide spread low wind (no interregional support)
- National transmission planning authority

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Panel 3 – Operating Practices for Addressing Climate Change & Extreme Weather

- Market structures & rules
  - Carbon pricing
  - Extreme cold is NYCA concern
  - EW are low frequency events and should be handled by shortage pricing
- Demand response
  - Mitigation of EW events
  - Nano grid controllable
  - Virtual power station
  - Flexible energy
  - Prioritization of load type (risk tolerance)

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Panel 4 – Recovery & Restoration

- Best practices
  - Harden & raise substations
  - Mutual aide resources
  - Update SCADA & protection systems
  - Update communications
  - Importance of interregional ties

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Panel 5 - Coordination

- Coordination between regulatory organizations emphasized

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