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Incorporating Resilience into Distribution System Planning

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Distribution Grid Planning

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Distribution planning across the U.S. addresses unique areas of focus regarding planning considerations often within these three areas to meet customer needs.

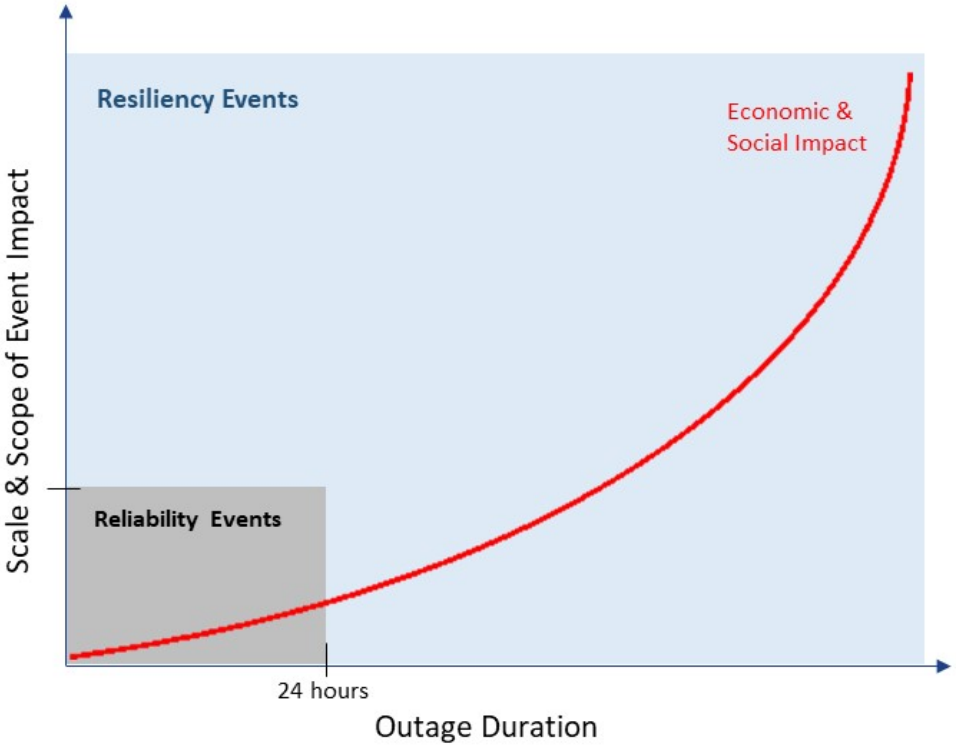
Resilience – Reliability Event Continuum

The fundamental difference is the scale, scope and complexity of an event's impact and subsequent outage duration.

Distribution resiliency events involve similar types of infrastructure failures (e.g., wire down, poles broken, transformer failure, fuses blown, etc.) involved with reliability events, but at a greater scale, which creates significant complexity to address. Additionally, adversarial threats pose an increasing level of risk to distributed power networks.

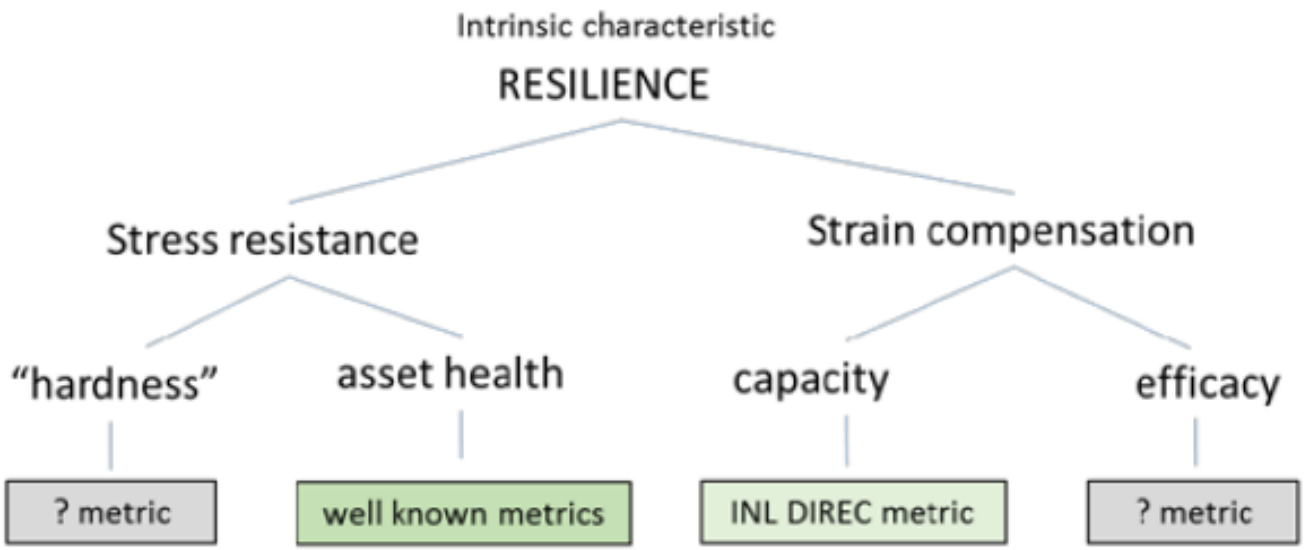
Resilience Events: Larger geographic impact on distribution and/or bulk power system with long duration outage (typically greater than 24 hours & classified as "Major Events" following IEEE Std. 1366)

Reliability Events: Local impact with short duration outage (generally less than 24 hours & not classified as "Major Events" following IEEE Std. 1366)



Architectural View of Resilience

Architecturally, "resilience" is a characteristic of a system in its ability to withstand an impact from cyber and physical threats.



Distribution investment planning needs to incorporate grid architectural analysis to systemically develop a resilient grid.

Distribution Reliability-Resilience Lifecycle

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Overall process is fundamentally the same; difference is in addressing the variation, scale and complexity of major events

Distribution resiliency planning requires a different set of methods and capabilities to address the variation and complexity.

Integrating Resilience Into Grid Planning

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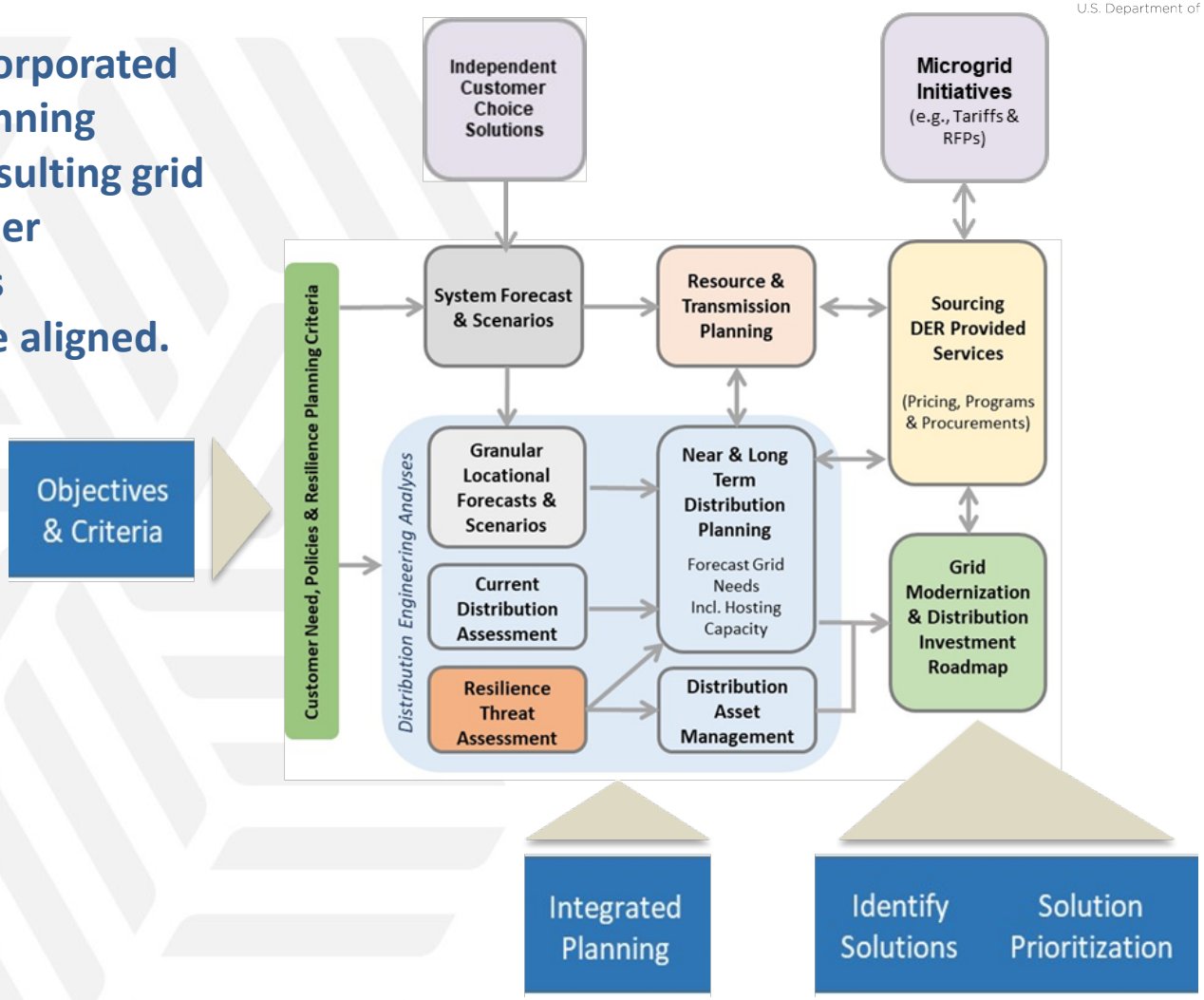
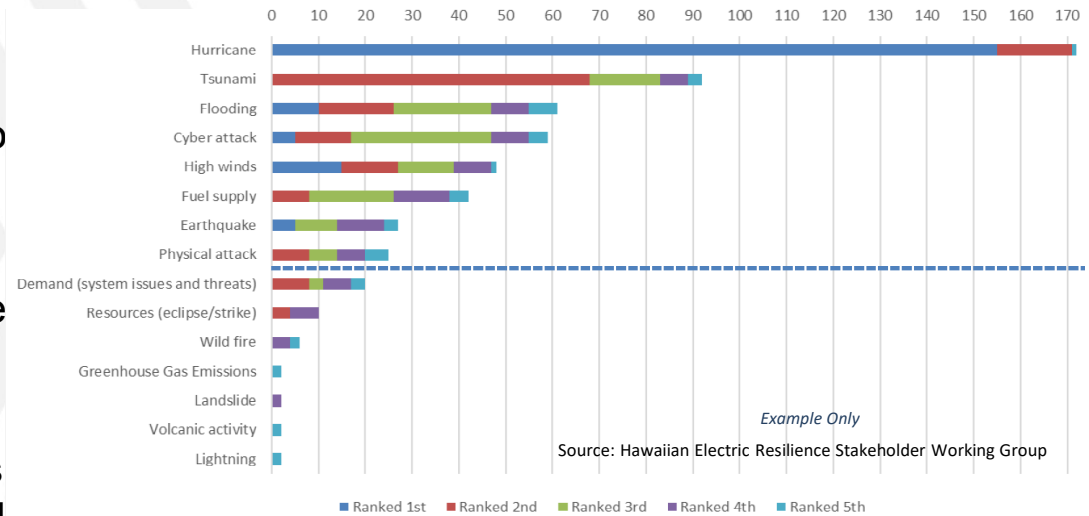
Resilience should be incorporated into the distribution planning process to ensure the resulting grid investments and customer programs/procurements and any DER services are aligned.

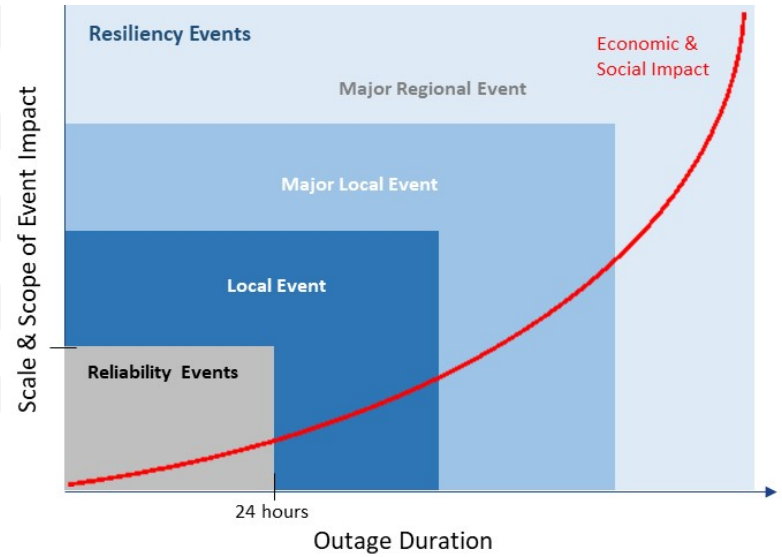


Assessing Threats

No single set of distribution resilience planning criteria for any single utility

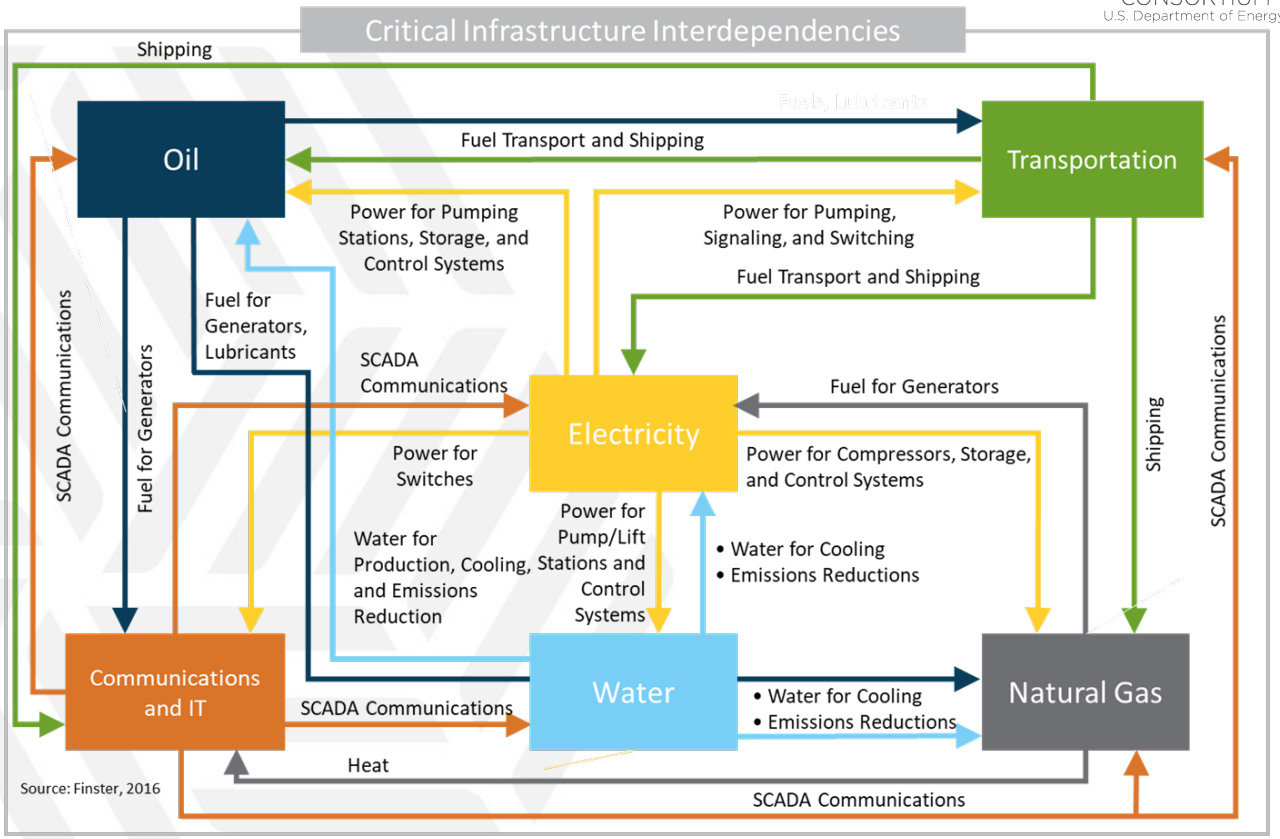
- Threat assessments are integral to understanding the potential impact o various physical and cyber threats.
- Distribution resilience events involve various potential scales and scopes based on different events.
  - Scale and scope of potential events inform structural considerations and functional requirements.
  - Scale and scope shape the economic impact and related value of solutions.
- Need to also unpack distribution resilience to gain insights into the nature of grid failures and potential structural/design options





Critical Infrastructure Interdependencies

Electrification and distributed resources necessitate closer examination of the interdependencies among critical infrastructure and the distribution grid.



Context: Distribution grids in the United States are on average ~30-years old (of ~40-year asset life), with increasing demands from electrification, large scale adoption of unregulated distributed generation & storage, or use of distributed resources to provide critical grid operational functions. That places significant challenges on a system that was not structured & designed for this new reality.

Tools That Can Be Leveraged

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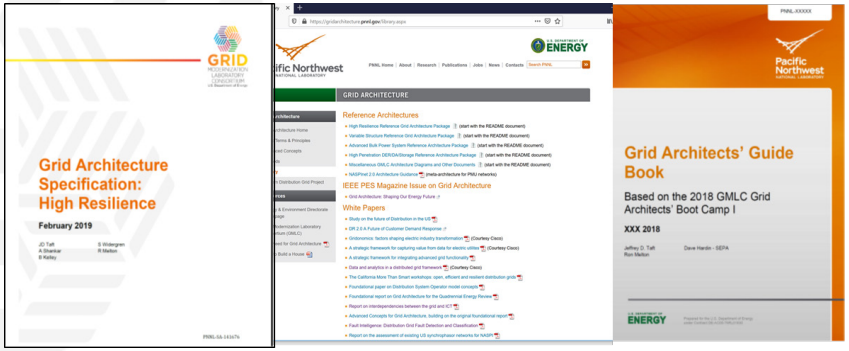
Starting with a solid set of analytical tools and methods to address key issues

Modern Distribution Grid (DSPx)

- Systematic Grid Investment Planning Process
- Logical Structural Analysis of Needs
- Application by regulators, utilities & consultants in at least 26 states
- Extensive stakeholder engagement provides excellent channels for industry influence

Grid Architecture

- Structural analysis methods to assess interdependencies and considerations
- Practical adaptations have been used nationally by utilities, ISOs and EPRI
- National and global recognition



Distribution Investment Objectives & Categories

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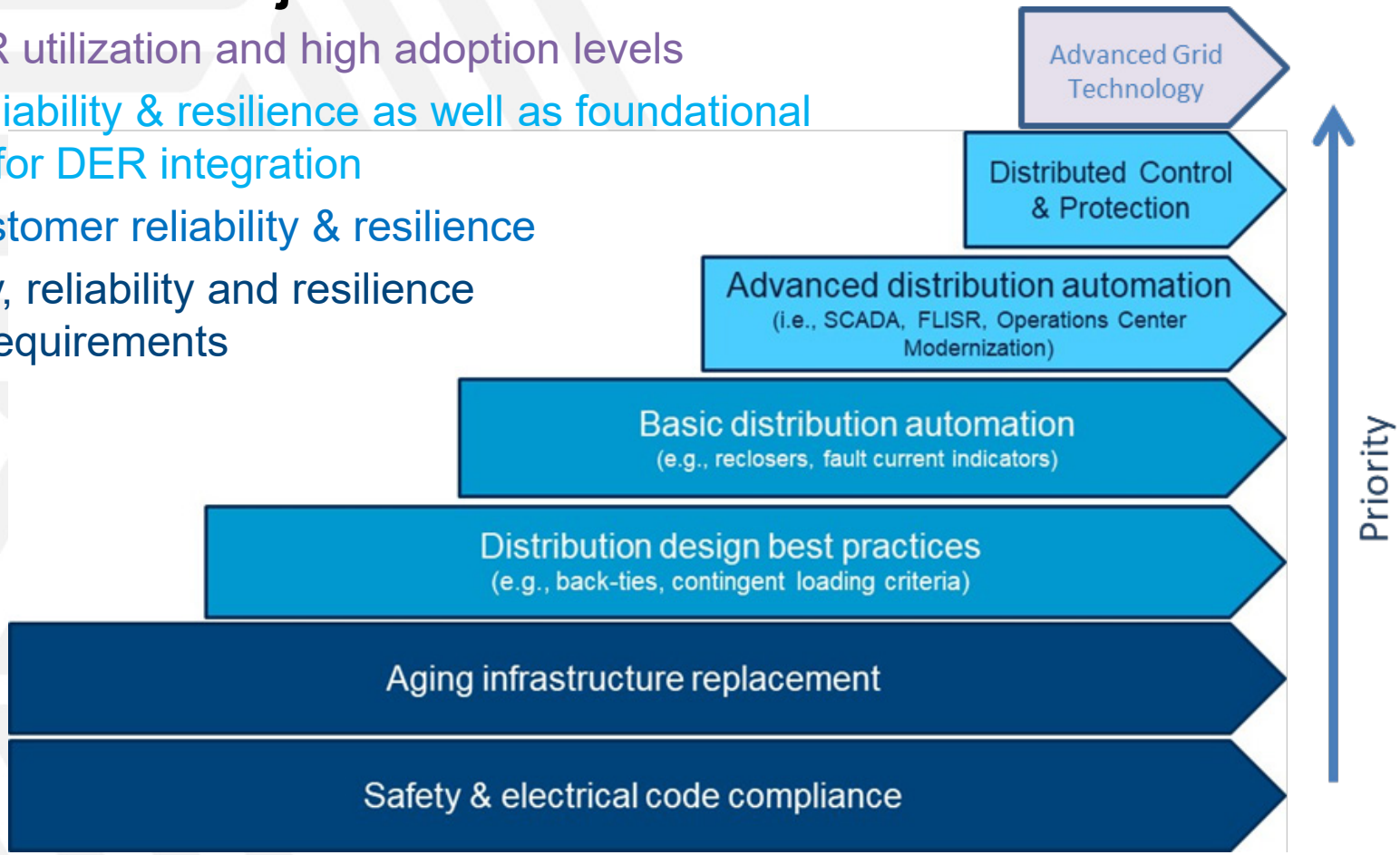
Typical investment objectives:

- Enable DER utilization and high adoption levels
- Enhance reliability & resilience as well as foundational investment for DER integration
- Improve customer reliability & resilience
- Basic safety, reliability and resilience hardening requirements



Distribution Resilience Solution Categories

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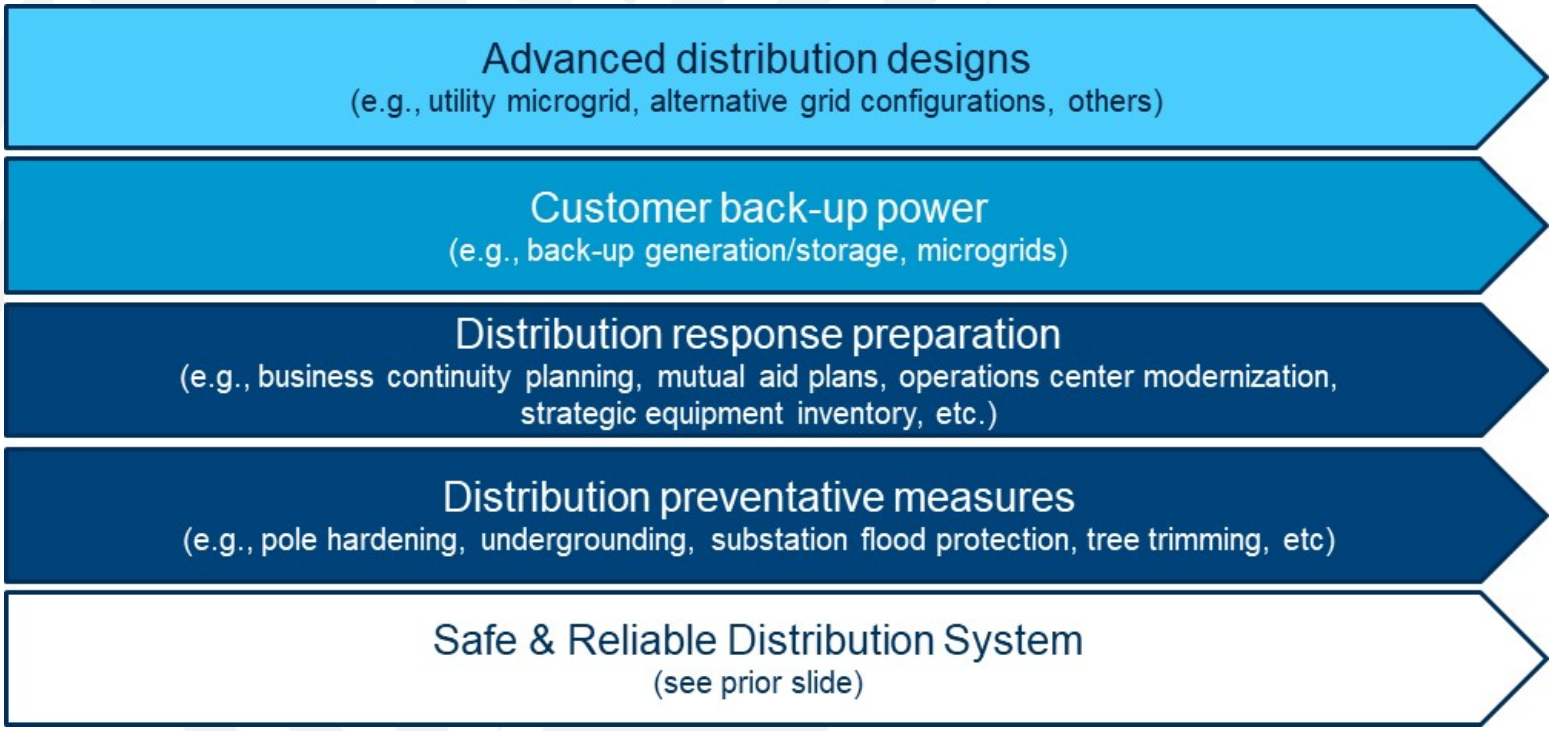
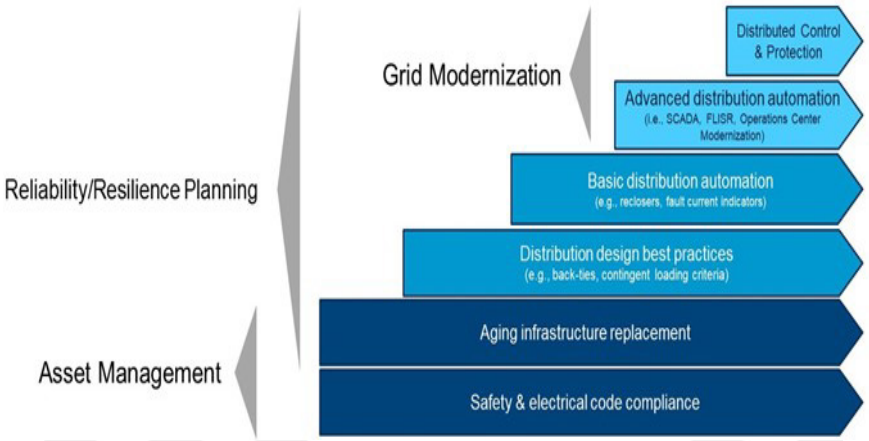
Typical solution categories:

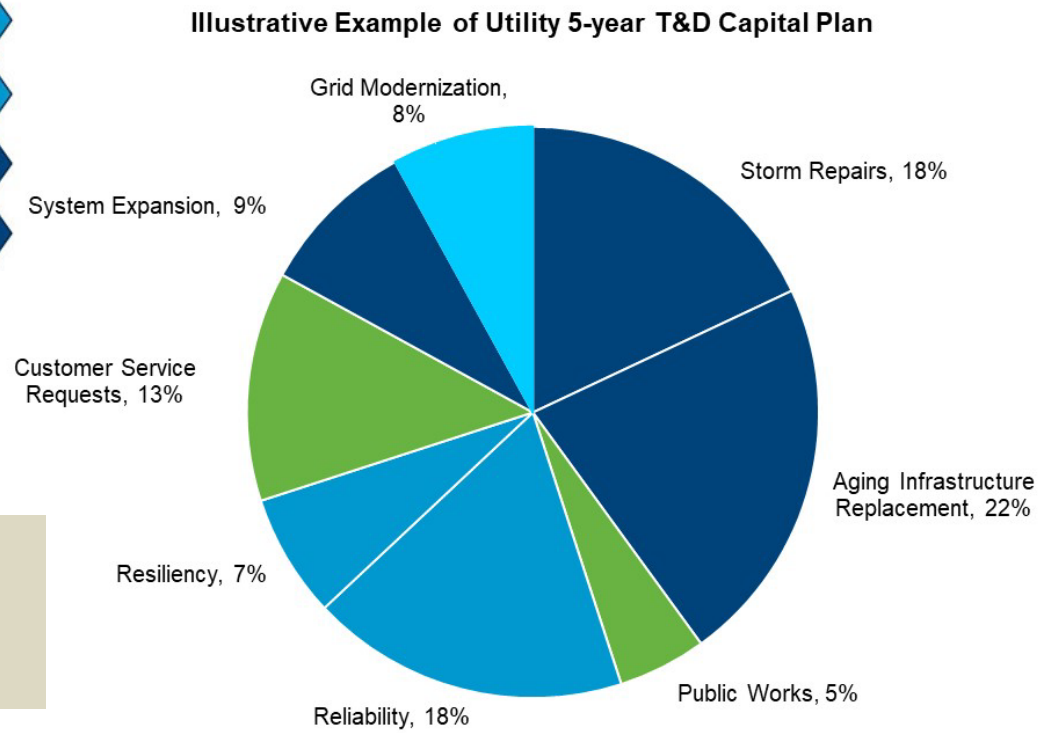
- Infrastructure hardening to provide foundational resilience
- Enhance customer resilience
- Enhance distribution local area resilience



Distribution Planning

Multiple planning efforts involved with distribution investment planning





Physical & Cyber Resiliency considerations factor directly into most distribution investments.

Determining Resilience Solutions

- **Policymakers, regulators, utilities and customers are considering and implementing various point & community solutions.**
  - **Community**: Cyber-physical grid hardening, mini-grids, multi-user microgrids, etc.
  - **Point Solutions**: Back-up generation, energy storage, customer microgrid, etc.

- **Specific solutions don't necessarily solve all the needs – a portfolio is needed**
  - Solutions usually address specific functional resilience needs
  - Solutions have different potential societal benefits based on type of event and severity

- **How to determine an effective portfolio?**
  - Structural analysis of existing system resilience (what is the current state?)
  - Architectural-Engineering analysis of potential solutions regarding resilience improvements (or not)
  - Least-cost engineering-economic analysis to determine portfolio of solutions
    Note: *Reliability economics don't apply, and alternative economic methods focused on local societal and customer benefits are in development.*

Roles and Responsibilities

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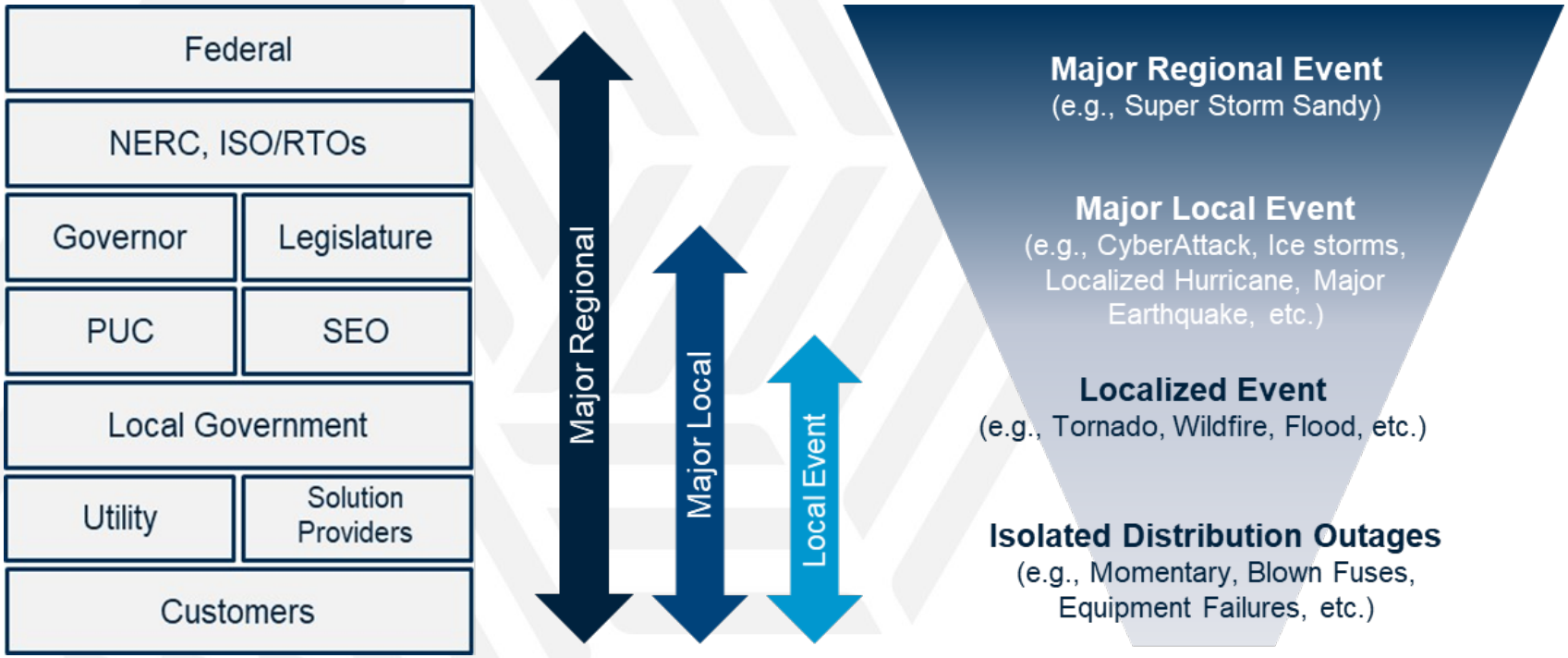
Scale of potential impact shapes who will likely be involved in process.



Consider how should roles, responsibilities and coordination be considered in an integrated, resilient distribution planning process.

Considerations

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The majority of distribution grid investments affect a system's physical and/or cybersecurity resilience capability.

- How are potential threats being assessed and translated into planning considerations?
- Is there clear logical explanation of how a proposed investment directly or indirectly supports resiliency?
- Is there sufficient transparency in the distribution planning process to understand how resiliency is being addressed and reflected in investment plans?
- How are grid investments and customer/independent solutions like microgrids being considered as part of an overall resilience portfolio?
- Are all of the key stakeholders (e.g., community officials, DoD) involved in an effective engagement process?

Thank you

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