Grid Modernization Planning

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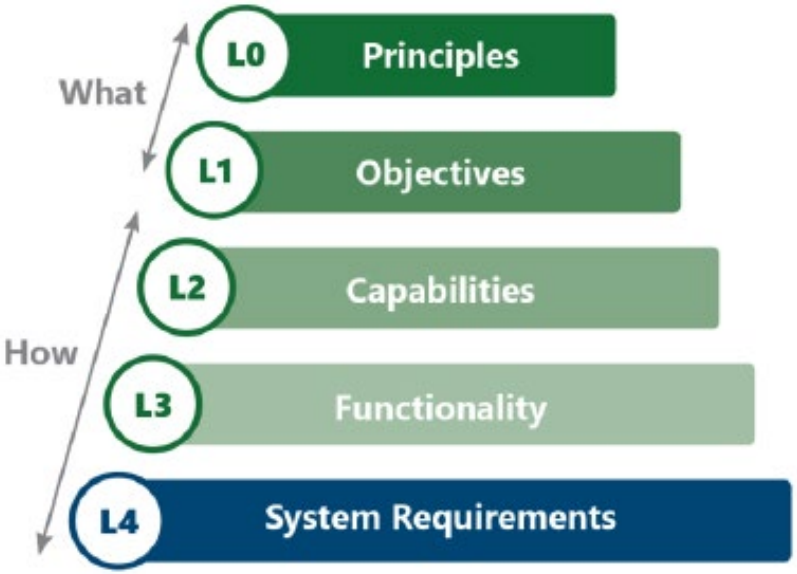
Newport Consulting

Integrated Distribution System Planning Training for Western States
March 5, 2021

Grid Architecture Approach

- Grid modernization planning starts with objectives & capabilities needed
- Scale and scope of needs require a holistic architectural approach.
- Resist temptation to start with technology choices



Grid Mod Strategy & Planning Process

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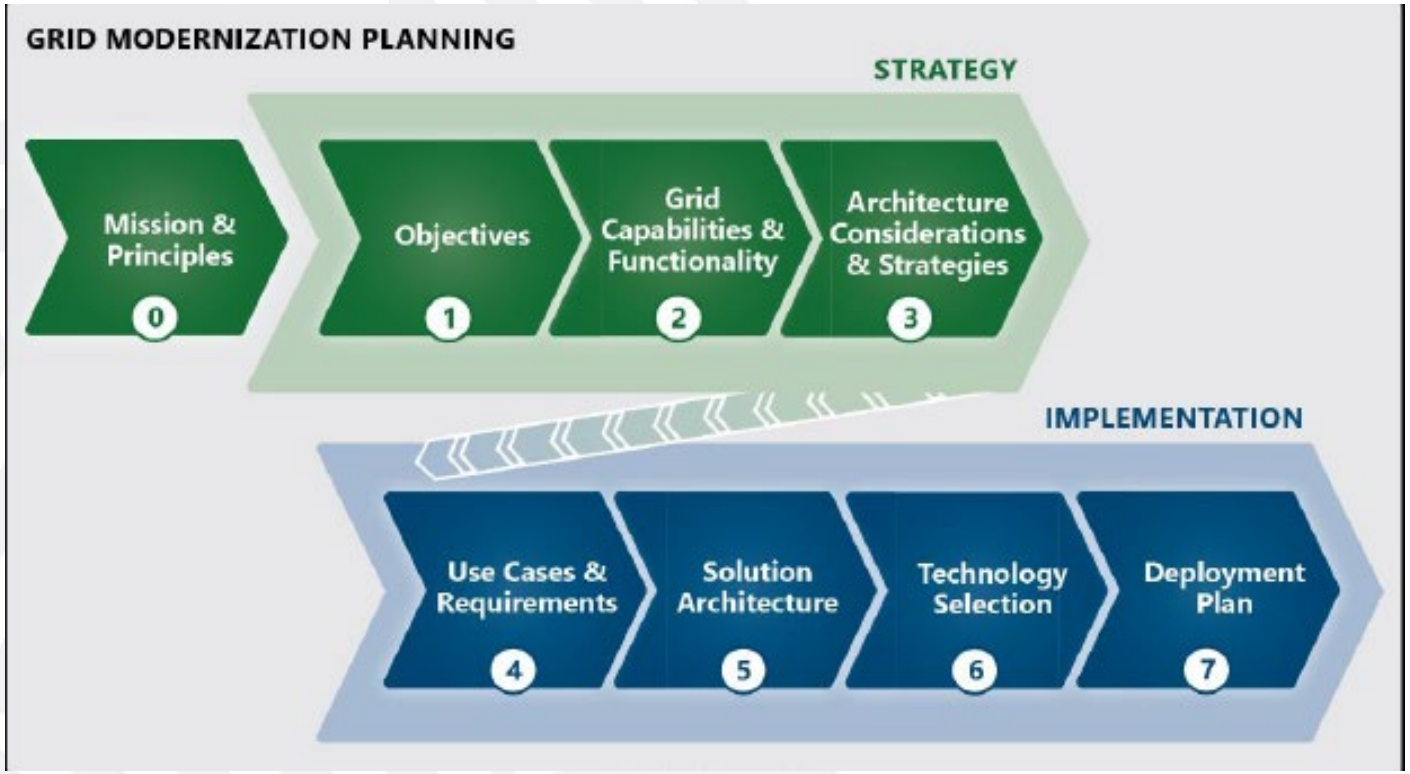
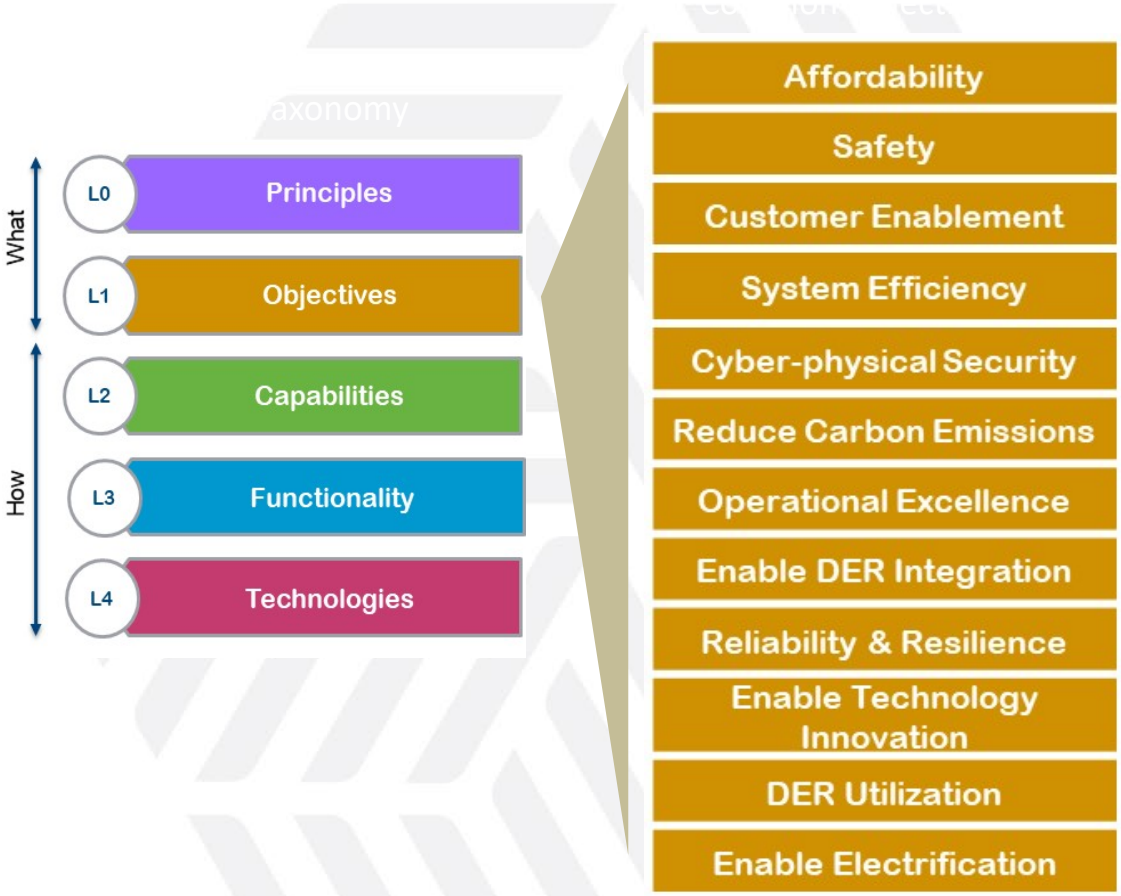
What, Why, How, When & How Much



DSPx Guidebook, Vol. 4, 2020

While encouraged, it is not essential to start with a grid mod strategy. But, a clear set of objectives is necessary to develop and assess implementation plans.

Objectives Drive Grid Mod Planning



PUC Ohio example:

- **A Strong Grid: A distribution grid that is reliable and resilient, optimized and efficient and planned in a manner that recognizes the necessity of a changing architectural paradigm.**
- **The Grid as a Platform: A modern grid that serves as a secure open access platform—firm in concept and as uniform across our utilities as possible—that allows for varied and constantly evolving applications to seamlessly interface with the platform.**
- **A Robust Marketplace: A marketplace that allows for innovative products and services to arise organically and be delivered seamlessly to customers by the entities of their choosing.**
- **The Customer's Way: An enhanced experience of the customer's choosing on the application side, whether for reasons arising from financial, convenience, control, environmental, or any other chosen consideration.**

Note: The 'safe, reliable, and affordable' components were included in the mission statement, which was incorporated into the principles of the PowerForward Roadmap.

Grid Modernization Capabilities

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Customer Needs & Policy drive grid capabilities and corresponding enabling business functionality and technology

● New
● Existing

Capabilities	Objectives: Safety & Operational Efficiency	Objectives: Reliability & Resilience	Objectives: DER Integration & Utilization
Market Operations	●	●	●
Grid Operations	●	◐	●
Planning	●	◐	●

This analysis helps to identify the core platform functions and related technologies as well as the applications linked to specific policies/customer needs/locational value realization

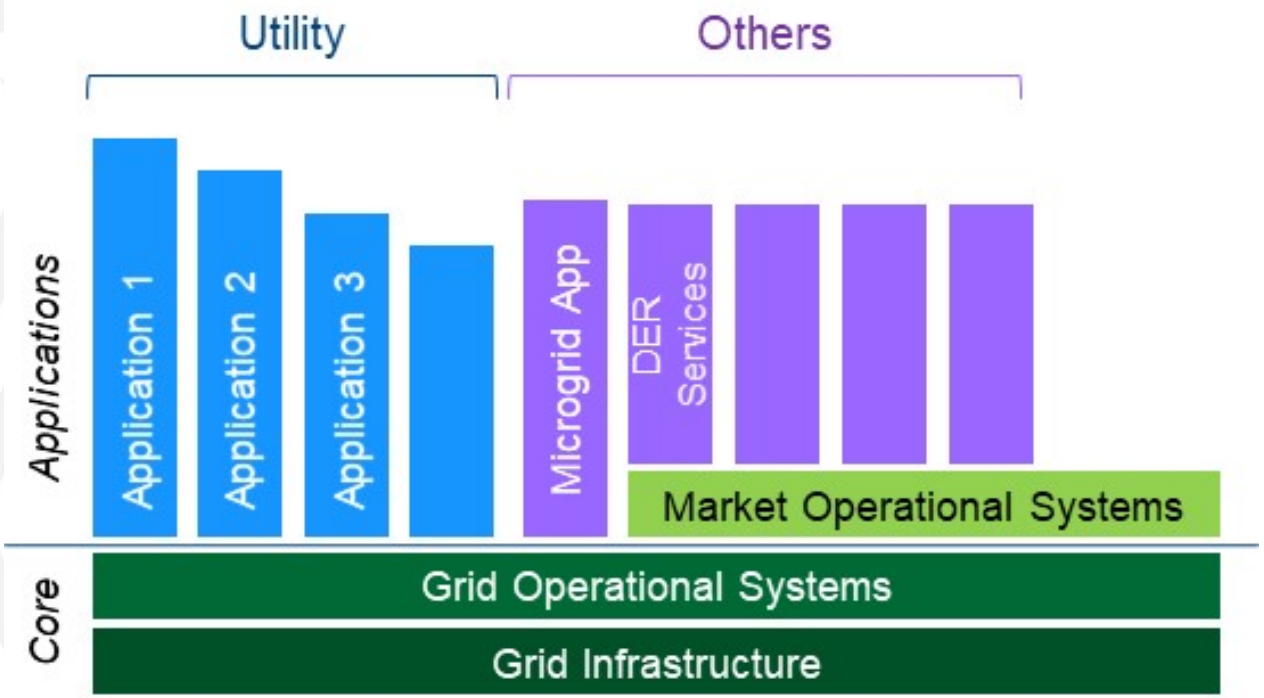
Taxonomy Example

Objective	Capability	Function	Technology
Reliability improvement by reducing customer unplanned outage durations Achieve 2nd Quartile CAIDI Performance by 2025	Improve outage identification and customer service restoration	Fault Identification Fault Location Fault Isolation Service restoration	Fault Current Indicators Outage Notification from Meters Outage Management System Geospatial Information System Distribution Management System and/or SCADA Automated Switches Work Management System

Distribution Grid as a Platform

The Grid as a Platform: A modern grid that serves as a secure open access platform—firm in concept and as uniform across our utilities as possible—that allows for varied and constantly evolving applications to seamlessly interface with the platform.

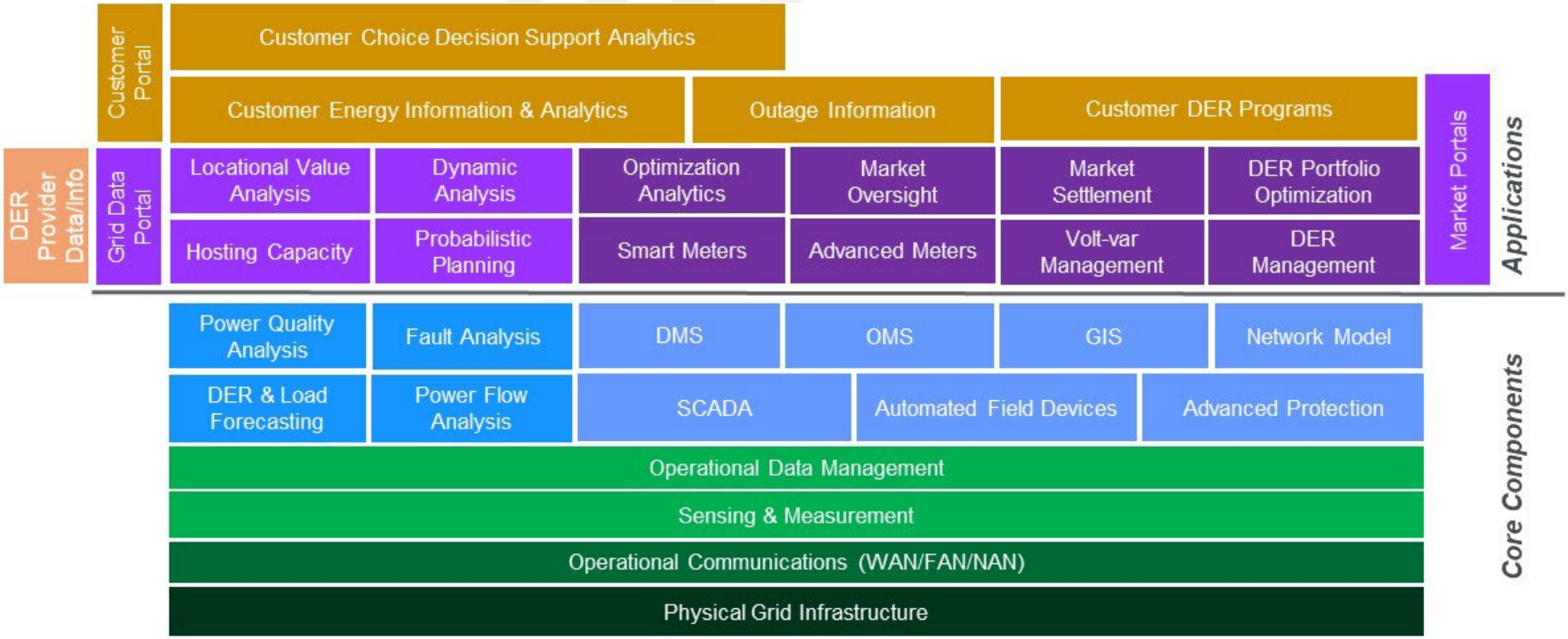
— Public Utility Commission of Ohio



Source: P. De Martini

Distribution System Platform

Logical layering of core components that enable specific applications



Green - Core Cyber-physical layer
Blue - Core Planning & Operational systems
Purple - Applications for Planning, Grid & Market Operations
Gold - Applications for Customer Engagement with Grid Technologies
Orange - DER Provider Application

Source: U.S. Department of Energy-Office of Electricity Delivery and Energy Reliability, 2017. *Modern Distribution Grid, Volume III: Decision Guide*.

Identify Starting Point for Grid Investment

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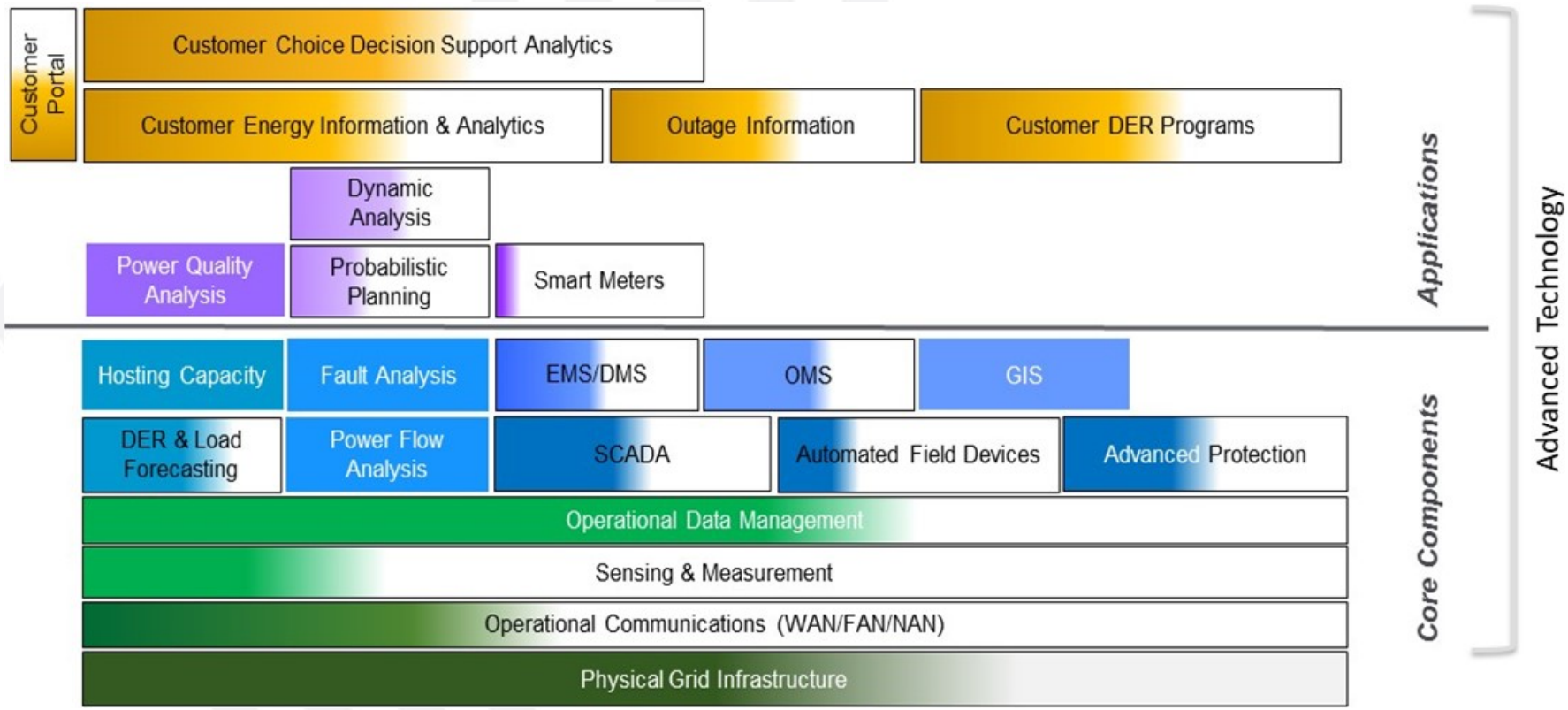
U.S. Department of Energy

This graphic is a summary illustration of a more complete assessment documented in narrative and tables to enable a gap analysis against objectives and identified capabilities & functionalities.



Source: Hawaiian Electric 2017

Distribution & Modernization Investment Categories

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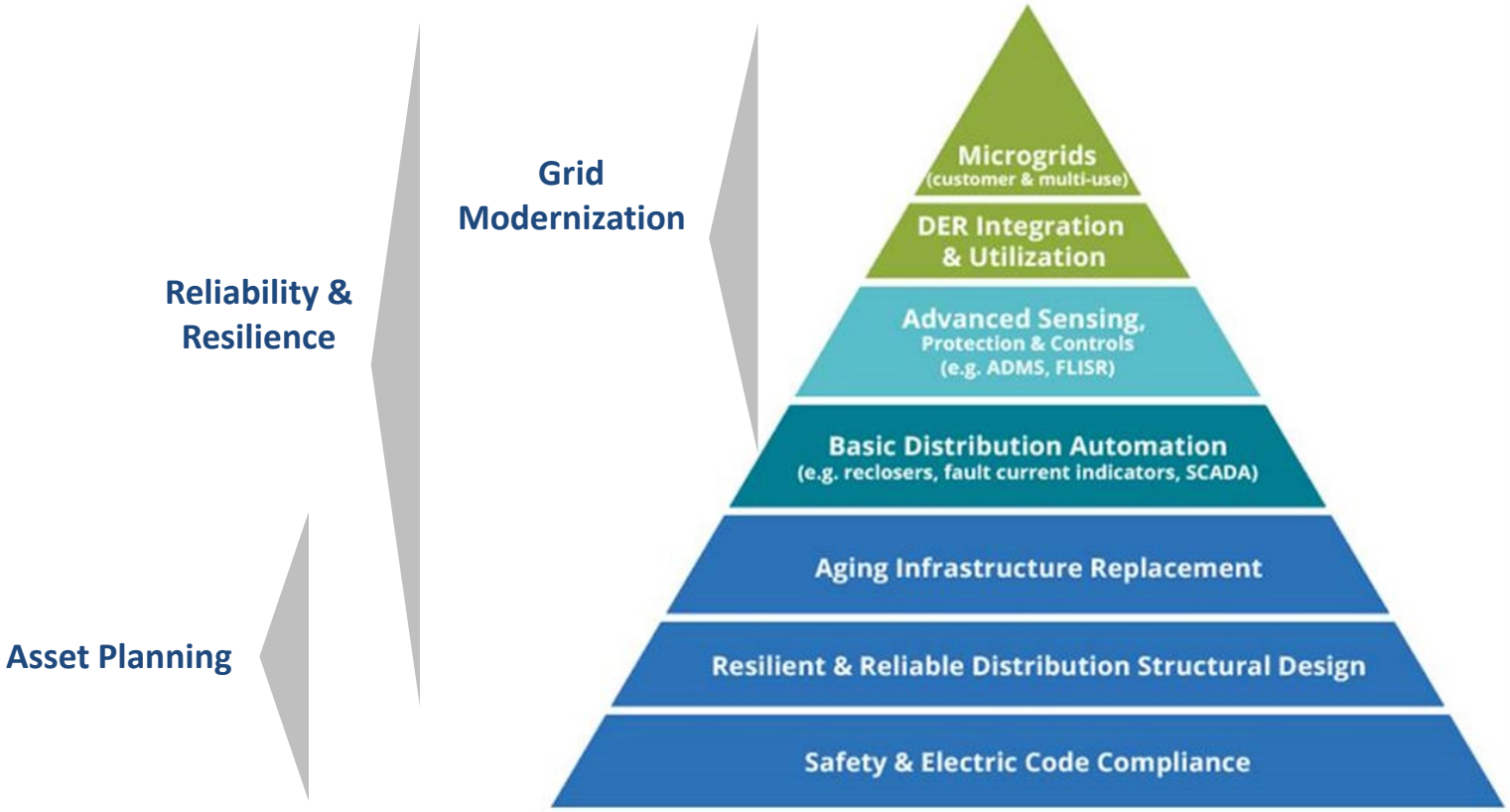
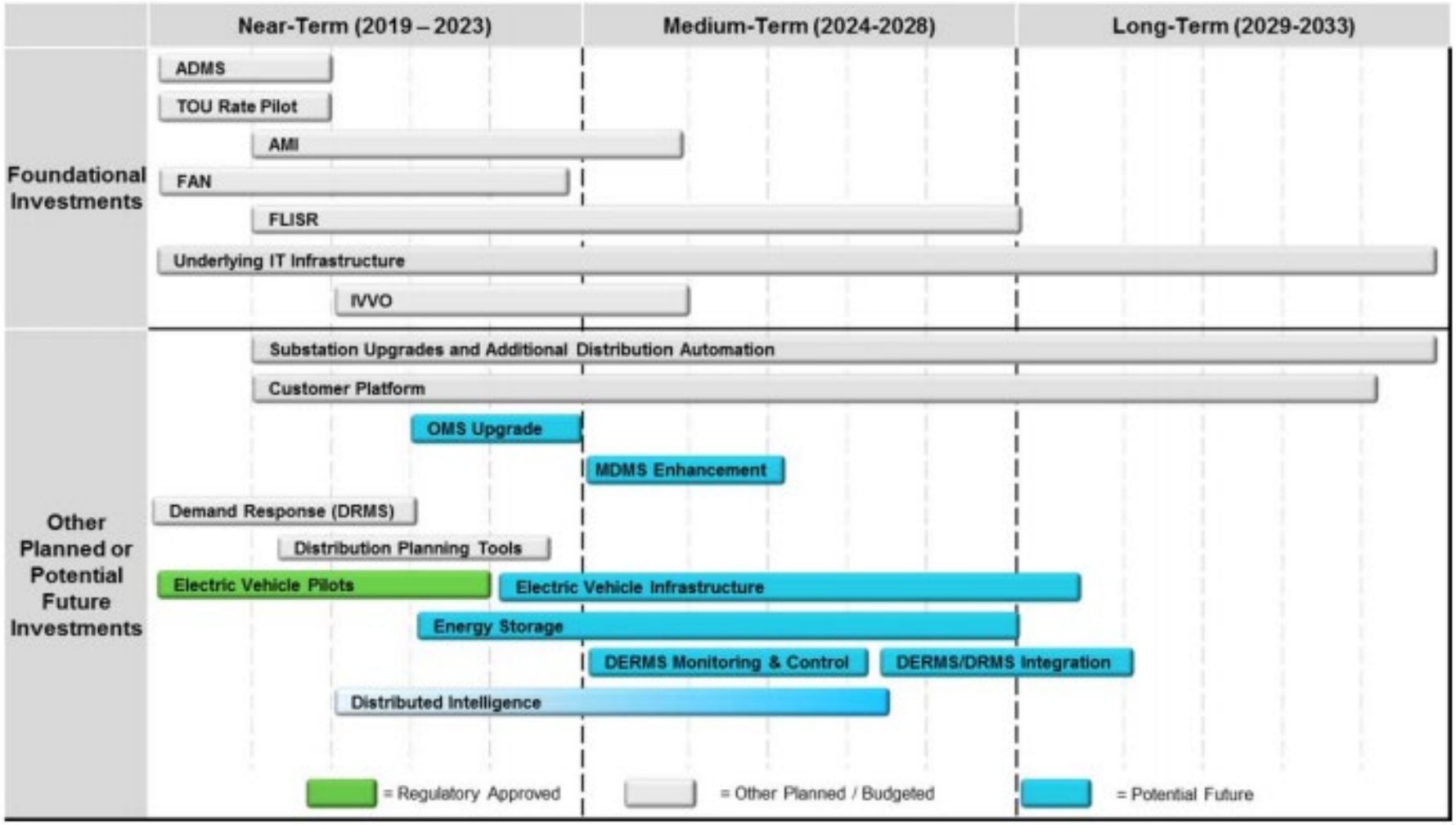
Grid Modernization technologies layer on top of & integrate with foundational physical grid infrastructure.



Source: De Martini

Sequencing of Investments

Long-term strategic plan of distribution grid investments



From Xcel Energy's 2019 Integrated Distribution Plan

Considerations

- Have clear modernization objectives been established in policy or regulation, or proposed by the utility?
- Has a clear starting point for modernization been identified?
- What is the pace and scope of change expected over the planning period & does the grid mod plan address the needs?
- Are grid mod plans aligned and integrated with asset management and resilience planning?
- Do grid mod plans incorporate flexibility needed for the uncertainty in needs and emergent grid technologies?

Resources

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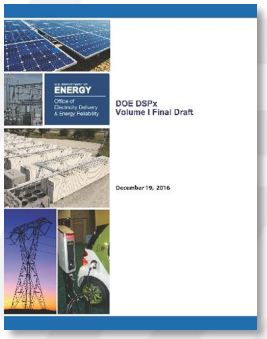
U.S. Department of Energy

Contact:

Joe Paladino, joseph.paladino@hq.doe.gov

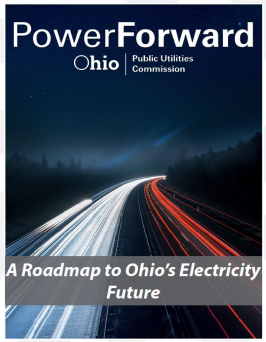
References:

Modern Distribution Grid Report



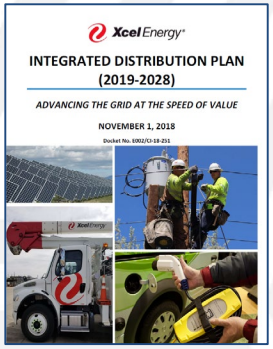
https://gridarchitecture.pnnl.gov/modern-grid-distribution-project.aspx

PUCO Grid Mod Roadmap



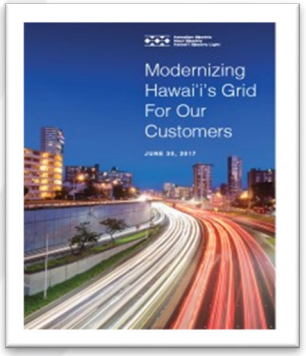
https://puco.maps.arcgis.com/apps/Cascade/index.html?appid=59a9cd1f405547c89e1066e9f195b0b1

Grid Modernization Strategy Using DSPx



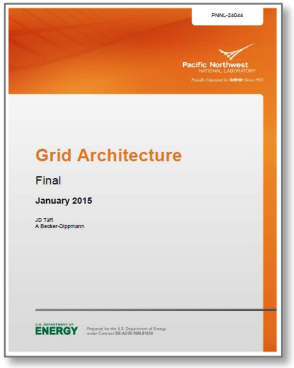
https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={E098D466-0000-C319-8EF6-08D47888D999}&documentTitle=201811-147534-01

Grid Modernization Strategy Using DSPx



www.hawaiianelectric.com/gridmod

Grid Architecture



http//gridarchitecture.pnnl.gov

Distribution Resilience Planning

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Electric Grid Resilience is a Top Planning Priority

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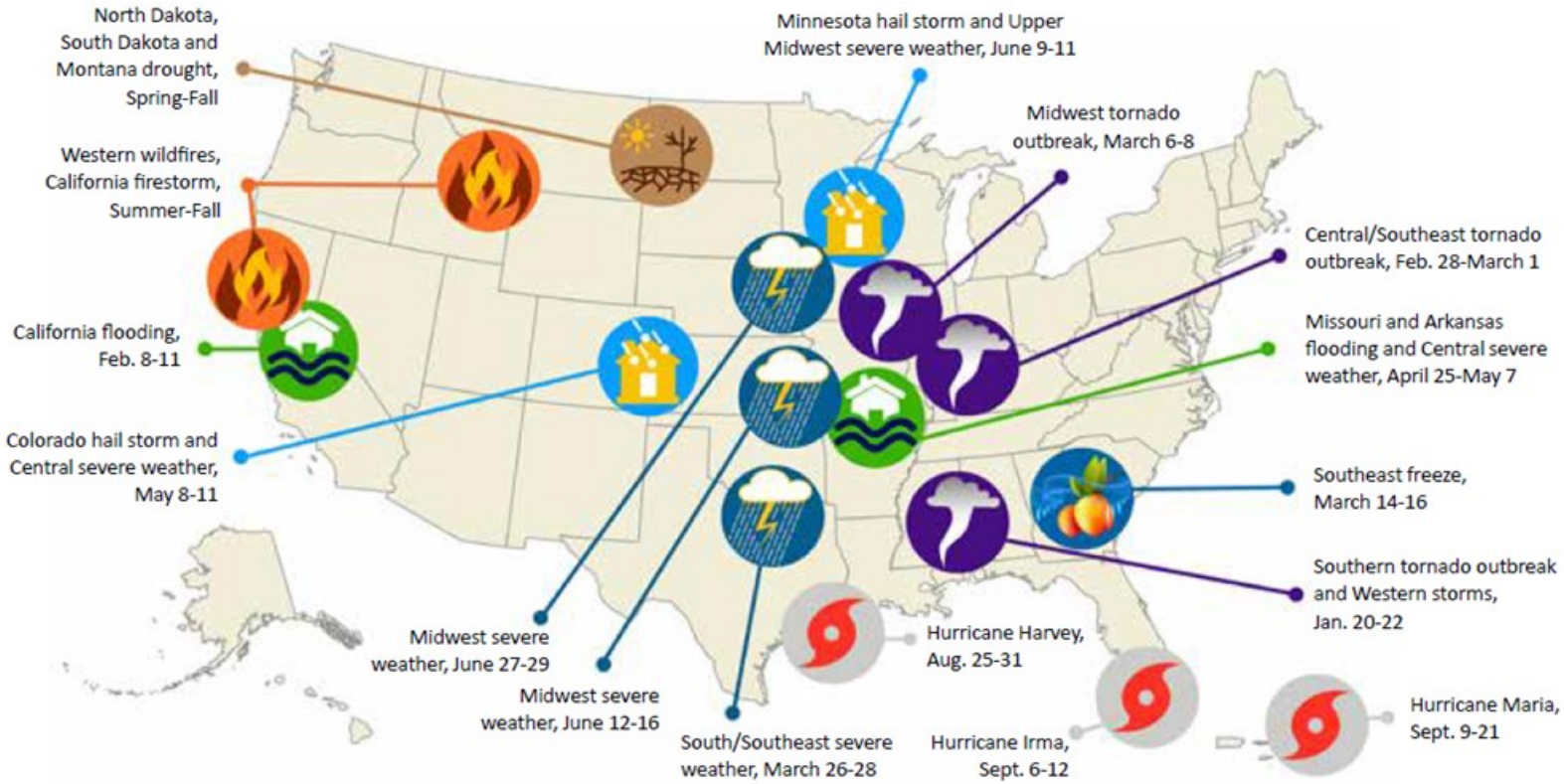
2017 U.S. Billion-Dollar Weather and Climate Disasters



This map denotes the approximate location for each of the 16 billion-dollar weather and climate disasters that impacted the United States in 2017.

Source: NOAA

Source: NCSL 2017 “Hardening the Grid” Report

Electric Distribution Grid Planning

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Distribution planning across the U.S. addresses 3 key overlapping areas of focus to meet customer needs

Critical Infrastructure Interdependencies

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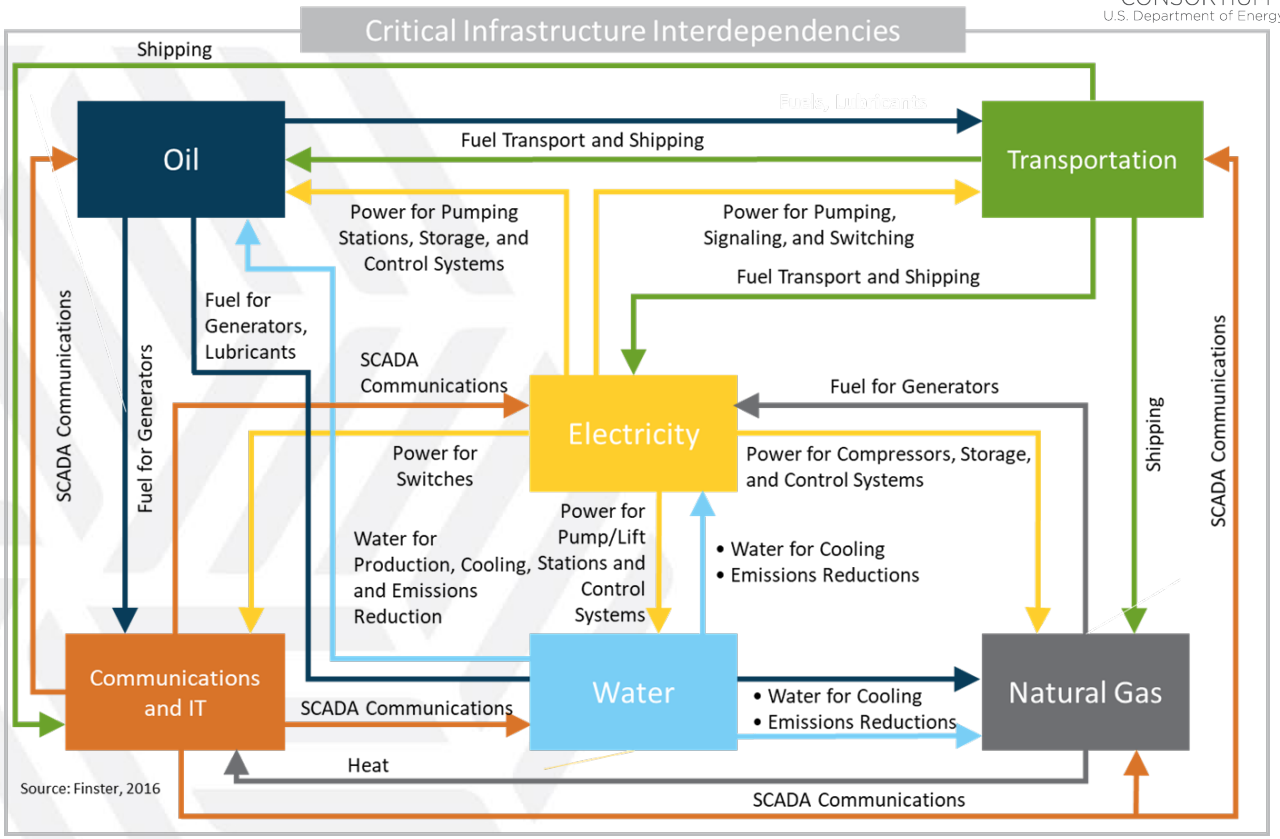
Electrification and distributed resources necessitate closer examination of the interdependencies among critical infrastructure and the distribution grid.



Context: **Distribution grids in the United States are on average ~30-years old (of ~40-year asset life), with increasing demands placing significant challenges on a system that was not structured & designed for this new reality.**

Distribution Planning-Operations Lifecycle

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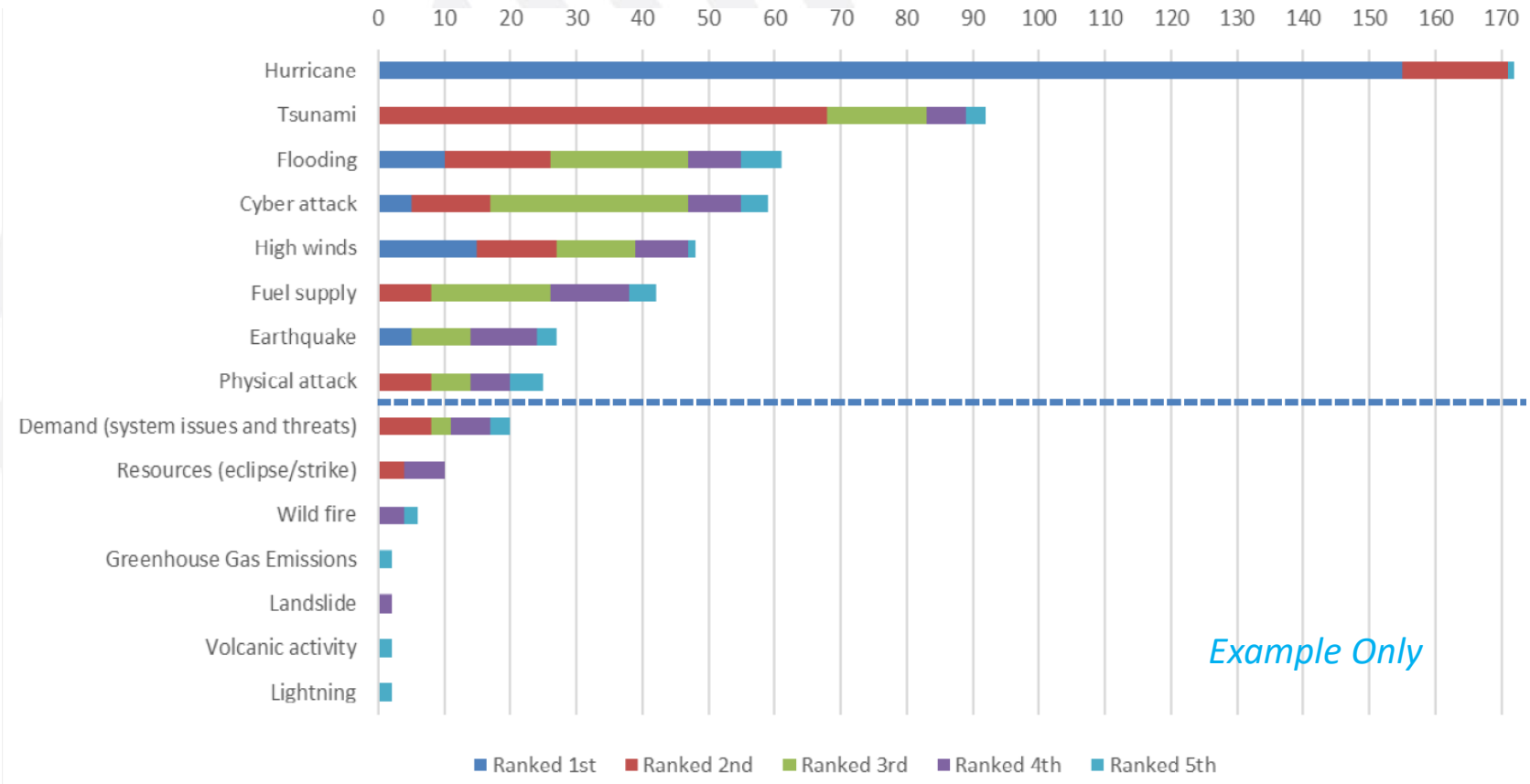
Threat & Risk Assessments Inform Planning Objectives & Criteria

"Resilience" in an engineering context is the grid's ability to withstand an impact from cyber and physical threats.

Assessing Resilience Threats

Threat assessments are integral to understanding the potential impact of various physical and cyber threats.

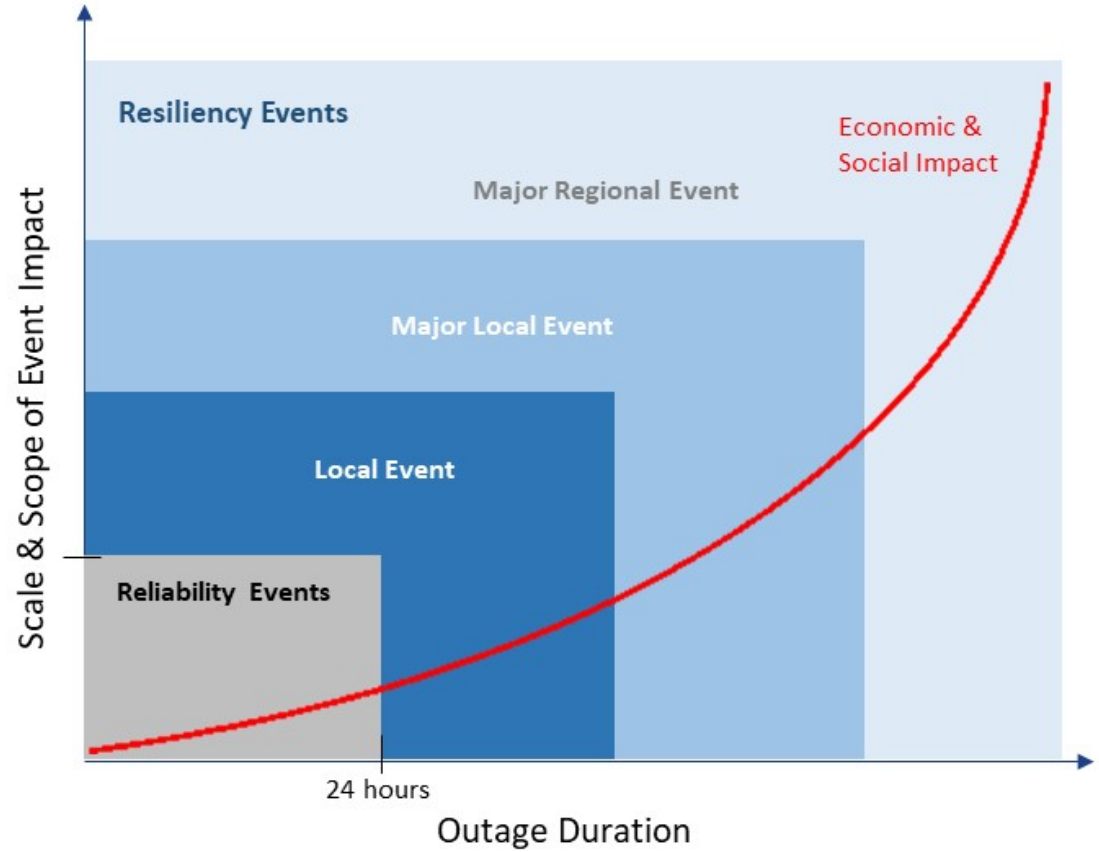


Source: Hawaiian Electric Resilience Stakeholder Working Group

Assessing Resilience Threats

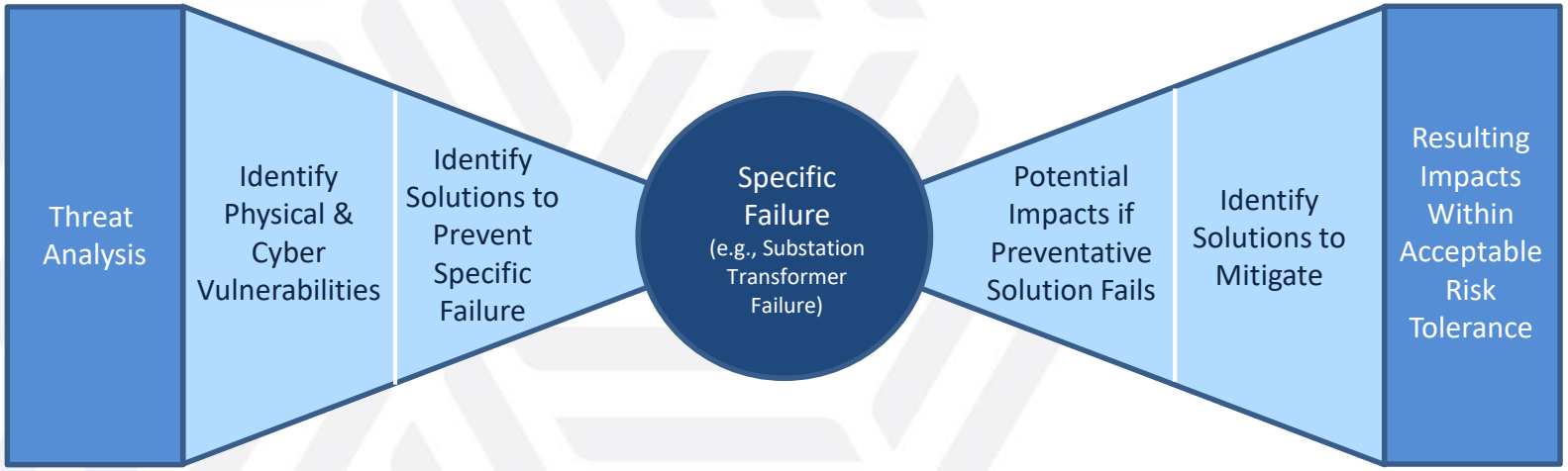
Distribution resilience events involve various potential scales and scopes based on different events.

- Scale and scope of potential events inform requirements.
- Scale and scope shape the economic impact and related value of solutions.
- Need to unpack threats to gain insights into the nature of grid failures and potential structural/design options.



Bow-tie Threat-Risk Mitigation Analysis

Threat analysis provides input into a "Bow-tie" Assessment which is a process to identify potential vulnerabilities ("needs") that will cause a specific failure and appropriate mitigations.



Source: DOE

Challenges involve identifying the additional risk exposure from a range of threats and the system impacts given the increasing complexity of distribution systems along with the potential overlapping set of grid needs identified in the other planning analyses

Resilience Dependency on Distribution Investment

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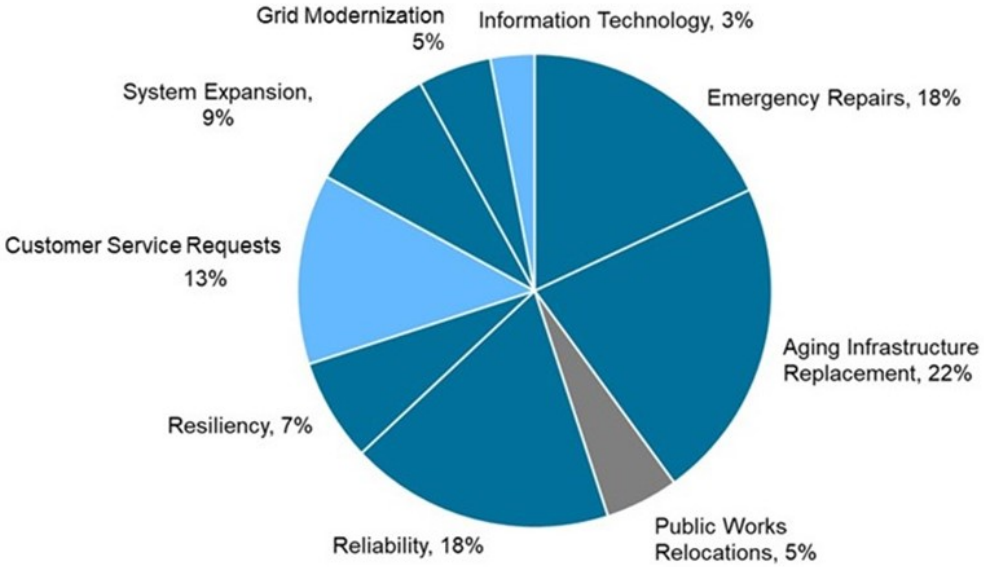
Most distribution capital investments factor into overall grid resilience capability

Distribution Resilience Considerations need to be integrated into distribution expansion, upgrade & asset planning

- Systematic engineering analysis of grid architecture, design practices, observability, protection & controls
- Grid interfaces with and dependencies on DER & Microgrids need risk-based operational performance and security assessment



Blue shaded areas impact resilience & reliability

Distribution Investment Pyramid

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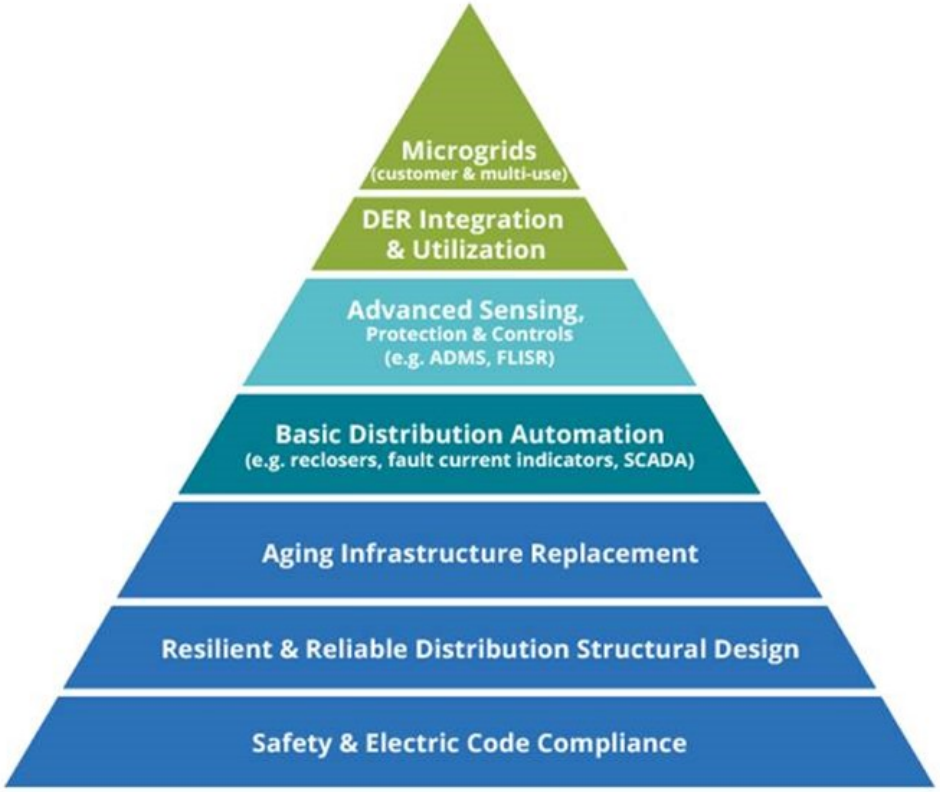
Modern Grids are dependent on a resilient foundation

Holistic View Required to Address Both Normal Conditions & Resilience Needs to Optimize Investments

Distribution investment categories:

- Enable community and customer resilience solutions
- Enhance reliability & provide additional resilience functionality
- Improve customer reliability
- Foundational safety, resilience & service quality requirements



Source: De Martini

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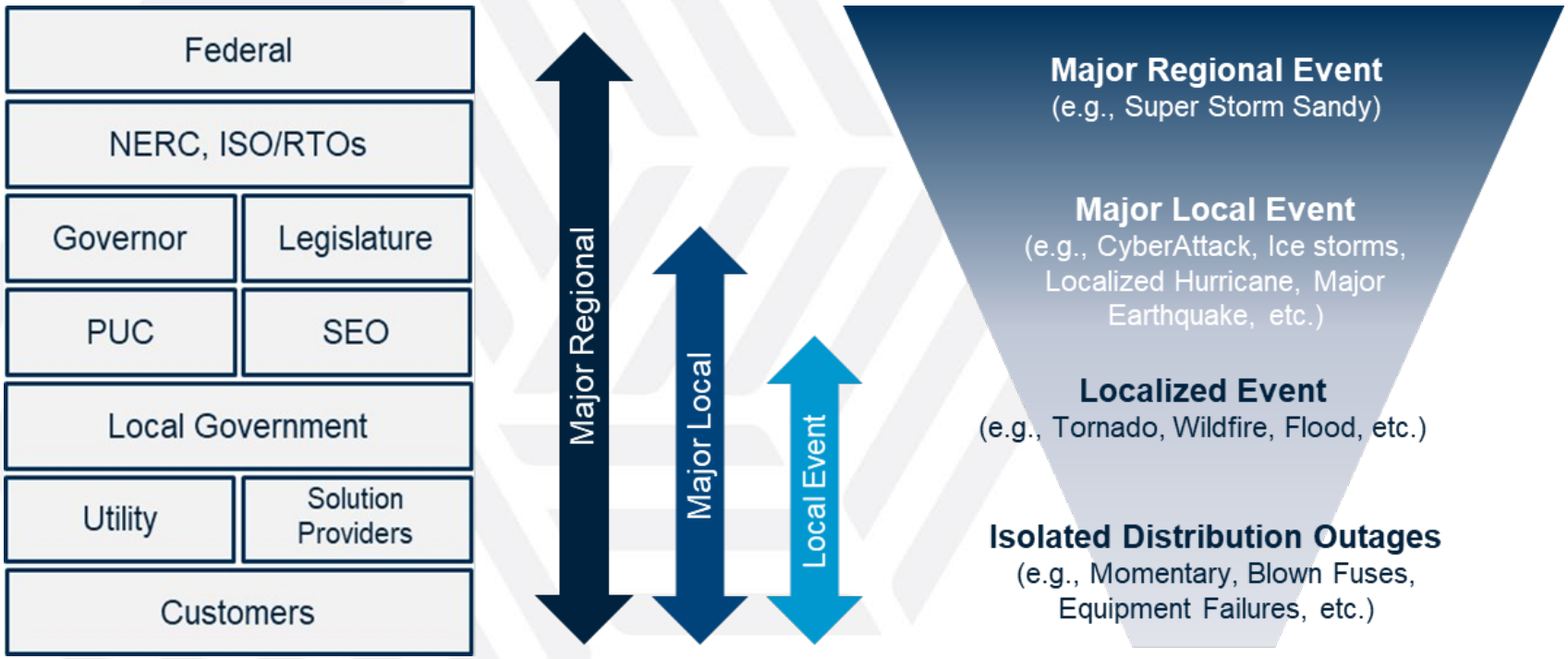
Scale of potential impact shapes who will likely be involved in process.



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

Coherence Among Roles and Responsibilities Across Domains

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State Policy Makers and Implementers --- System Owners & Operators

Legislatures, Governors / Energy Advisors and State Energy Officials

- **Develop policy goals**
- **Require plans and objectives**
- **Fund improvements**
- **Require coordination and oversight** (ex: coordination & data-sharing among state agencies, eg, sharing cybersecurity information and practices, and conducting independent evaluations)
- **Facilitate specific risk mitigation strategies**
- **Develop further recommendations** (ex: establishing commissions, boards and state offices with specific charges)

Public Utility Commissions

- **Set substantive and procedural requirements for plans, including**
  - **Set objectives**, based on state policy goals and customer expectations
  - Establish **scope and timing requirements** based on priorities
  - Establish **metrics** to measure performance
  - Determine **cost recovery** mechanisms
- **Approve or accept plans** (cost recovery approval through and/or outside General Rate Case)

Utilities

- **Develop plans**
  - **Align objectives**
  - Develop **long-term strategy** and **short-term implementation plans** integrated with current planning processes
  - **Prioritize** short-term vs long-term needs through **risk assessments**
  - Establish staged, **technology deployment plans and cost estimates**
- **Implement approved plans**

Stakeholder Processes

Hawaii Resilience Planning

State & Community Actions Toward Greater Resilience

- Hawaii Act 181, 2011 - Required development of a sustainability-resilience planning and coordination program to liaise among state and local government as well as private or non-profit organizations.
- PUC required resilience planning incorporated into system planning & rate making considerations
- Hawaiian Electric formed state/community resilience working group in 2019 to inform planning criteria and priorities
- Hawaii Act 200, 2018 – Enabled the development of microgrids as another solution for addressing resilience for critical facilities and communities.

https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-engagement/working-groups/resilience-documents

Michigan Resilience Planning

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Improving Resilience by Transforming Electric Grid

- Governor Ordered Michigan Statewide Energy Assessment Report, 2019
- Grid Security and Reliability Standards https://www.michigan.gov/mpsc/0,9535,7-395-93307_93312_93593_95590_95596_95597-508672--,00.html
- MI Power Grid Initiative
  - Improved Integrated Electric System Planning https://www.michigan.gov/mpsc/0,9535,7-395-93307_93312_93593_95590_95596_95599-508714--,00.html
  - Updated Utility Distribution Plans with a Resilience focus by September, 2021

MPSC
Michigan Public Service Commission

Michigan Statewide Energy Assessment

Final Report

September 11, 2019

Sally A. Talberg, Chairman
Daniel C. Scripps, Commissioner
Tremaine L. Phillips, Commissioner

LARA

https://www.michigan.gov/documents/mpsc/2019-09-11_SEA_Final_Report_with_Appendices_665546_7.pdf

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 involved in an effective engagement process?

Thank you

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