NARUC
National Association of Regulatory Utility Commissioners

NARUC-NASEO TASK FORCE ON COMPREHENSIVE ELECTRICITY PLANNING

NASEO
National Association of State Energy Officials

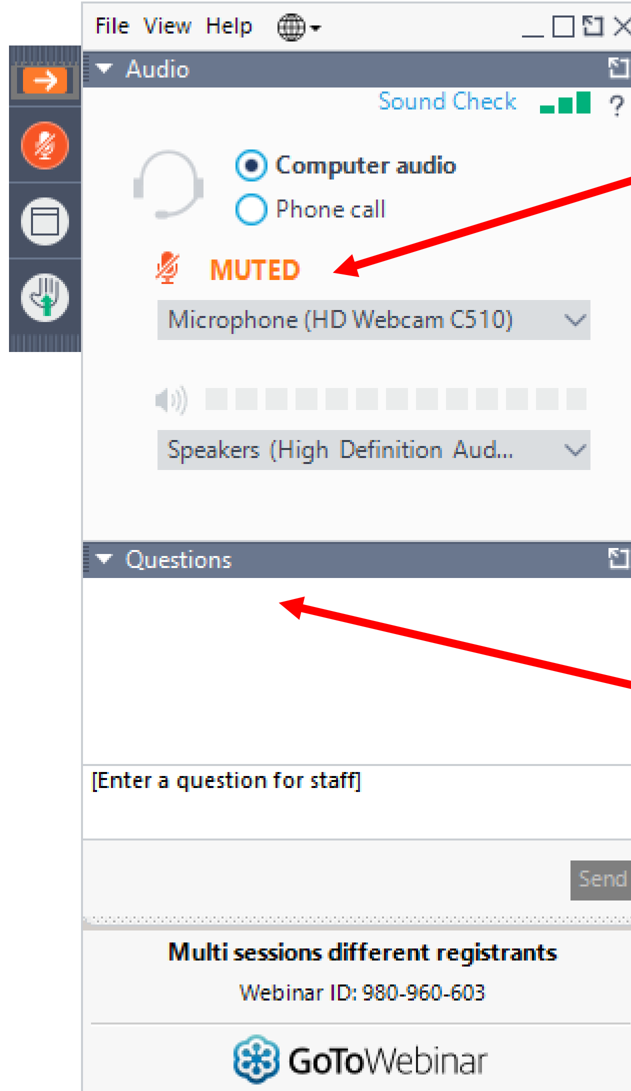
Integrated, Resilient Distribution Planning

Moderator: Sushma Masemore, North Carolina Department of Environmental Quality
Speaker: Paul DeMartini, Newport Consulting Group, LLC

May 26, 2020
NARUC-NASEO Task Force on Comprehensive Electricity Planning Webinar

Agenda and Housekeeping

- Moderator: Sushma Masemore, North Carolina Department of Environmental Quality
- Speaker: Paul DeMartini, Newport Consulting Group, LLC
- Q&A



Participants are muted.

Questions can be asked in the Question Box

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U.S. DEPARTMENT OF ENERGY
Office of Electricity

Integrated, Resilient Distribution Planning

Paul De Martini
Newport Consulting

NARUC-NASEO

May 26, 2020

Distribution System Planning

- 3 principle aspects of modern distribution planning need to be integrated into a unified process
  - Resilience & Reliability
  - DER Integration & Utilization
  - Safety & Operational Efficiency

- Requires combining the grid needs identified from the 3 different planning analyses to assess overlapping needs
  - Resilience/Reliability Planning
  - Asset Planning
  - Grid Expansion/Modernization Planning

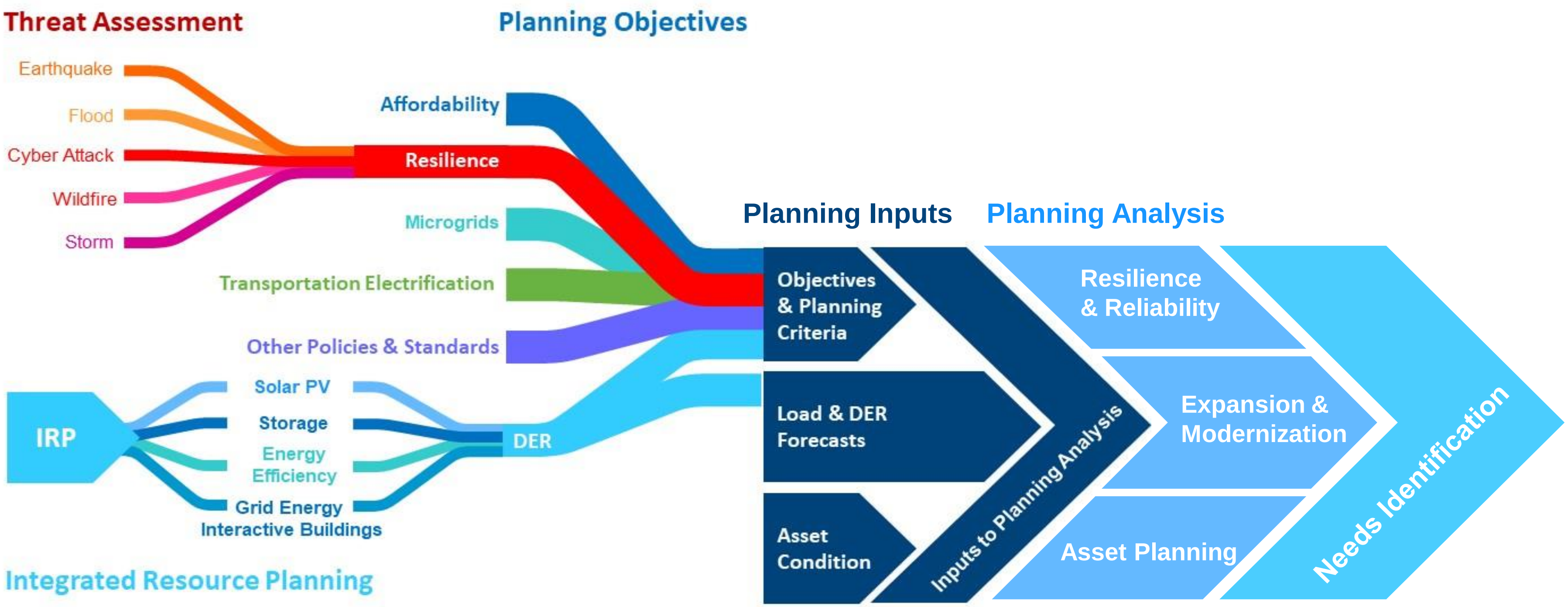
Simplified View of Distribution Planning Cycle

Overall planning lifecycle is the fundamentally the same for each dimension (Resilience/Asset Planning/Grid Upgrades)

Differences are largely in the Planning Inputs and Analysis Methods – there is a need to converge in the Needs Identification step

DSP Planning Inputs

Planning Objectives & Criteria, DER & Load Forecast and Current Asset Condition are the Primary Planning Inputs



Resilience Threat Assessment and IRP inform Objectives/Criteria & Forecasts

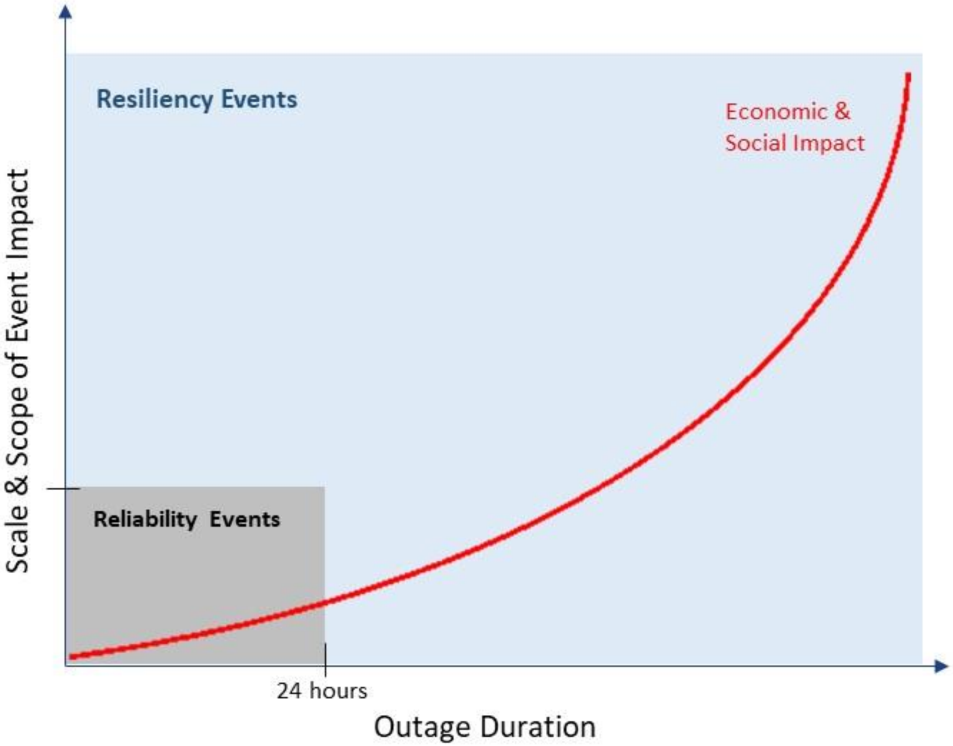
Resilience – Reliability Analysis

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.

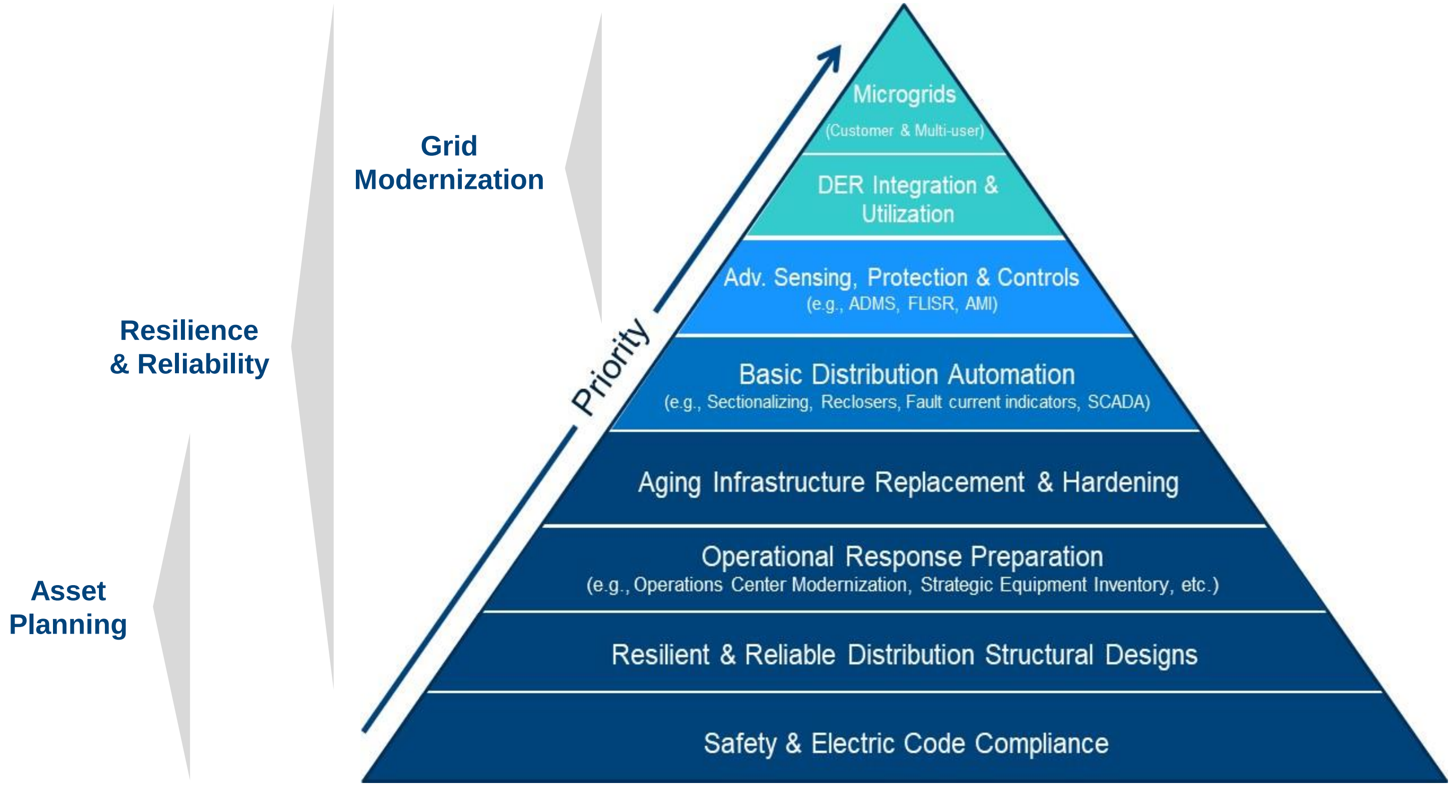
Resilience Events: Larger geographic impact on distribution and/or bulk power system with long duration outage (typically greater than 24 hours & classified as "Major Events" following IEEE Std. 1366)

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



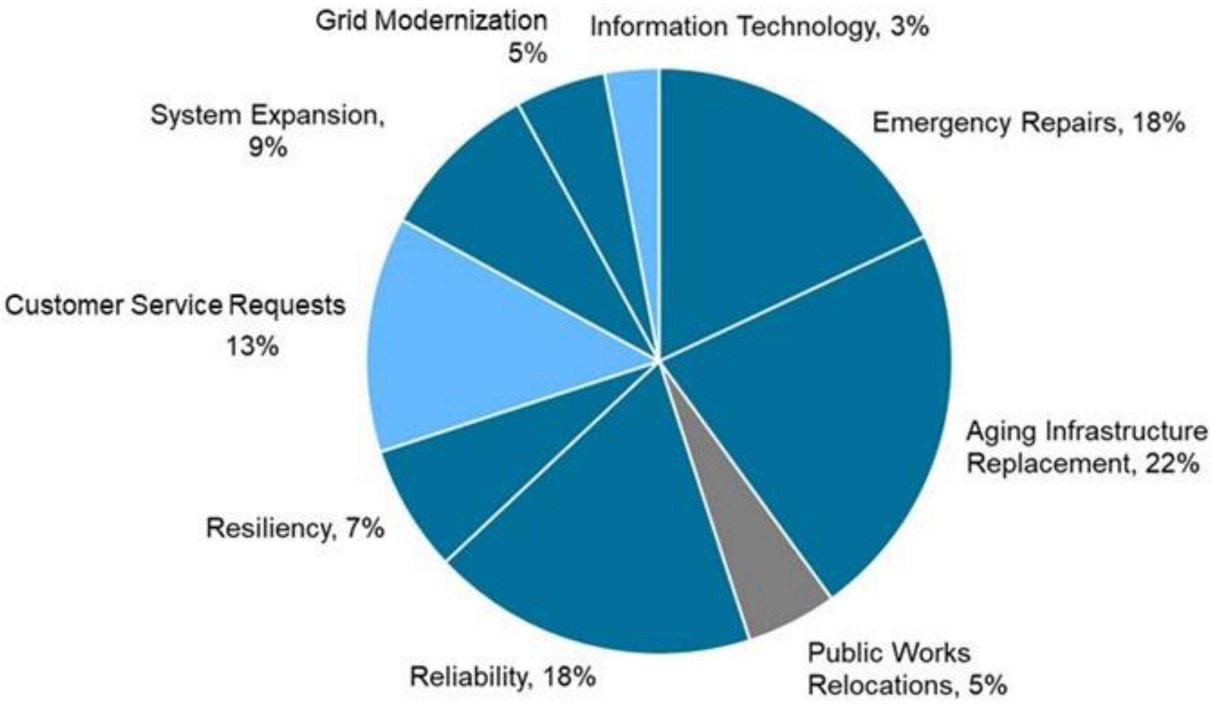
Distribution System Planning

Traditionally multiple utility distribution planning efforts often involved – converge to ensure optimal grid investments & non-utility solutions



Distribution Capital Budget Allocation

What is the scope of a DSP in relation to distribution capital spend



Conceptual Budget Allocation Example

Most distribution capital investments factor into overall grid resilience

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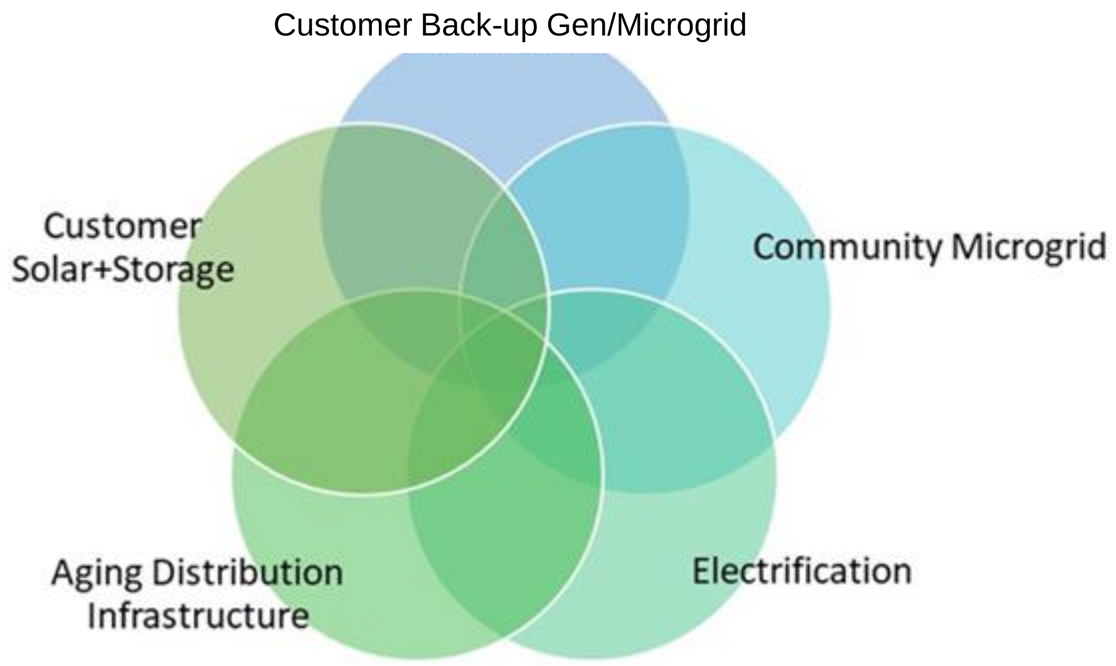
Multi-objective Distribution Planning

Integrate the planning "criteria" and needs for each of the relevant objectives

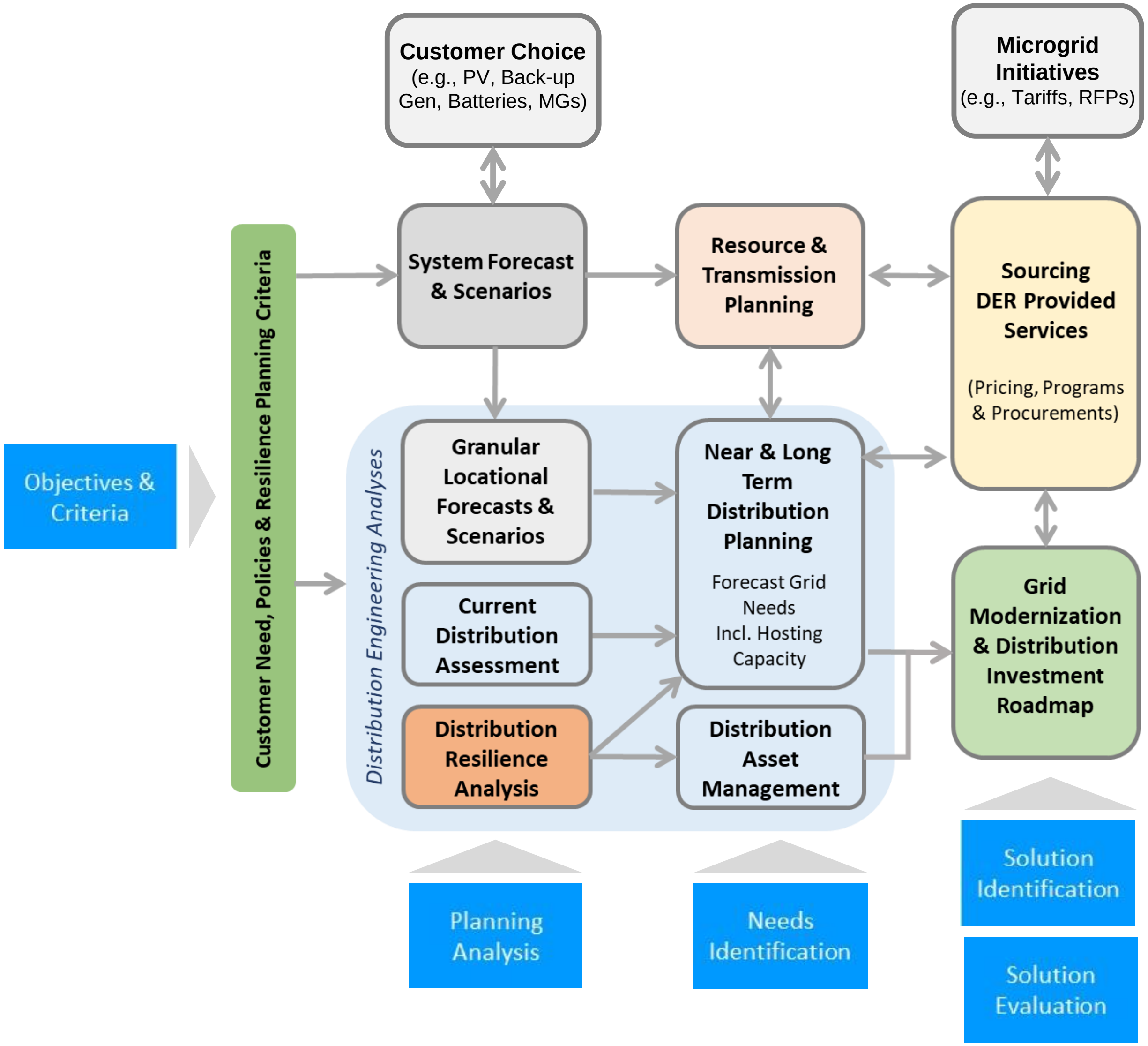


Integrated Distribution System Planning

- **Incorporating resilience analysis into a distribution planning process ensures the resulting grid investments and customer programs & procurements and any DER services are aligned**

- **Customer adoption of resilience measures should be incorporated into system forecasts & scenarios**

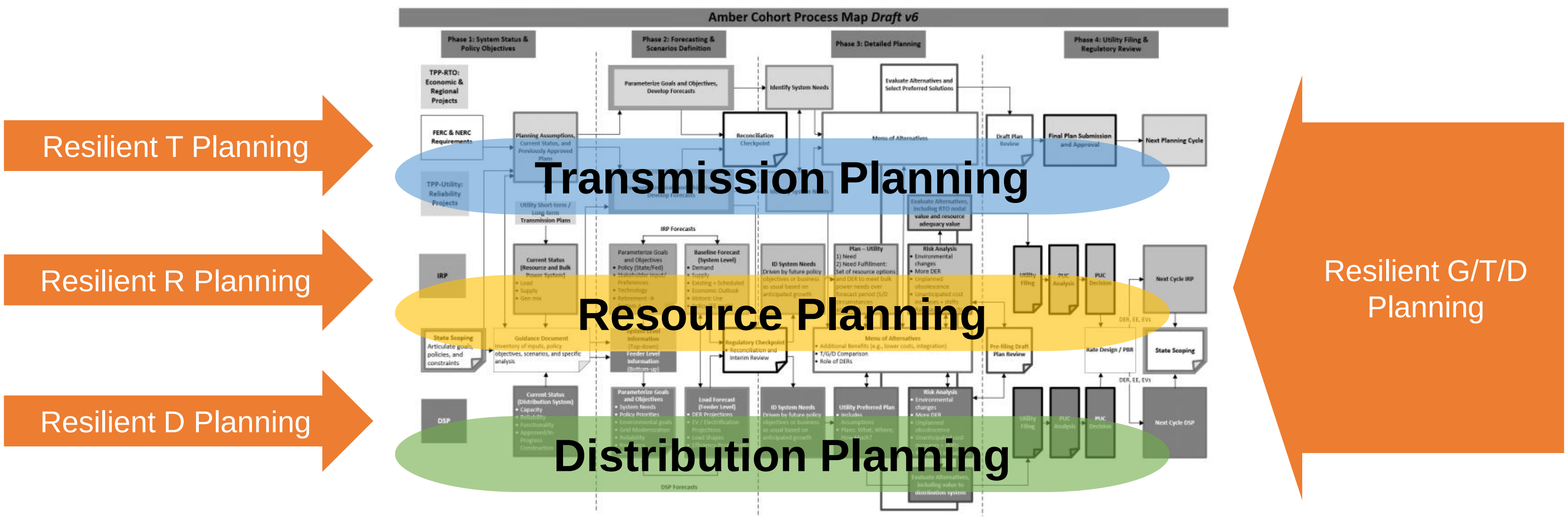
- **Solutions should be expanded to include utility and 3rd party microgrids**



How does resilient distribution planning align with transmission, resource planning?

Do T, D and G planning integrate resilience independently?

Or is it better to address resilient planning as an overlay across T, D and G?



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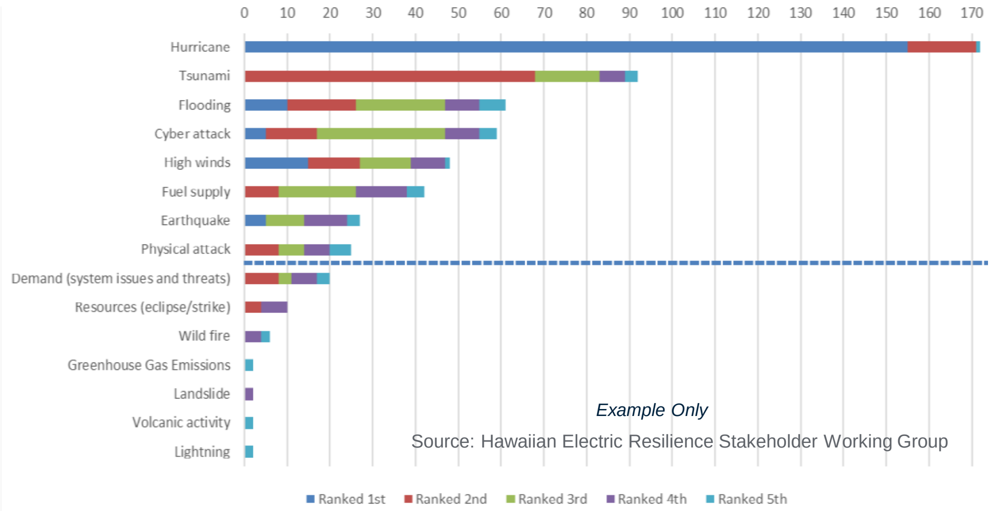
Questions?

Assessing Threats

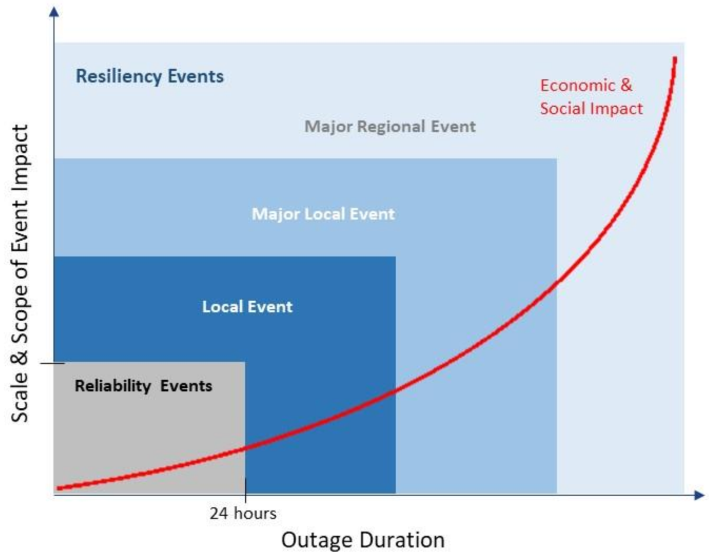
No single set of distribution resilience planning criteria for any single utility

Threat based risk assessments are integral to understanding the potential impact of 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

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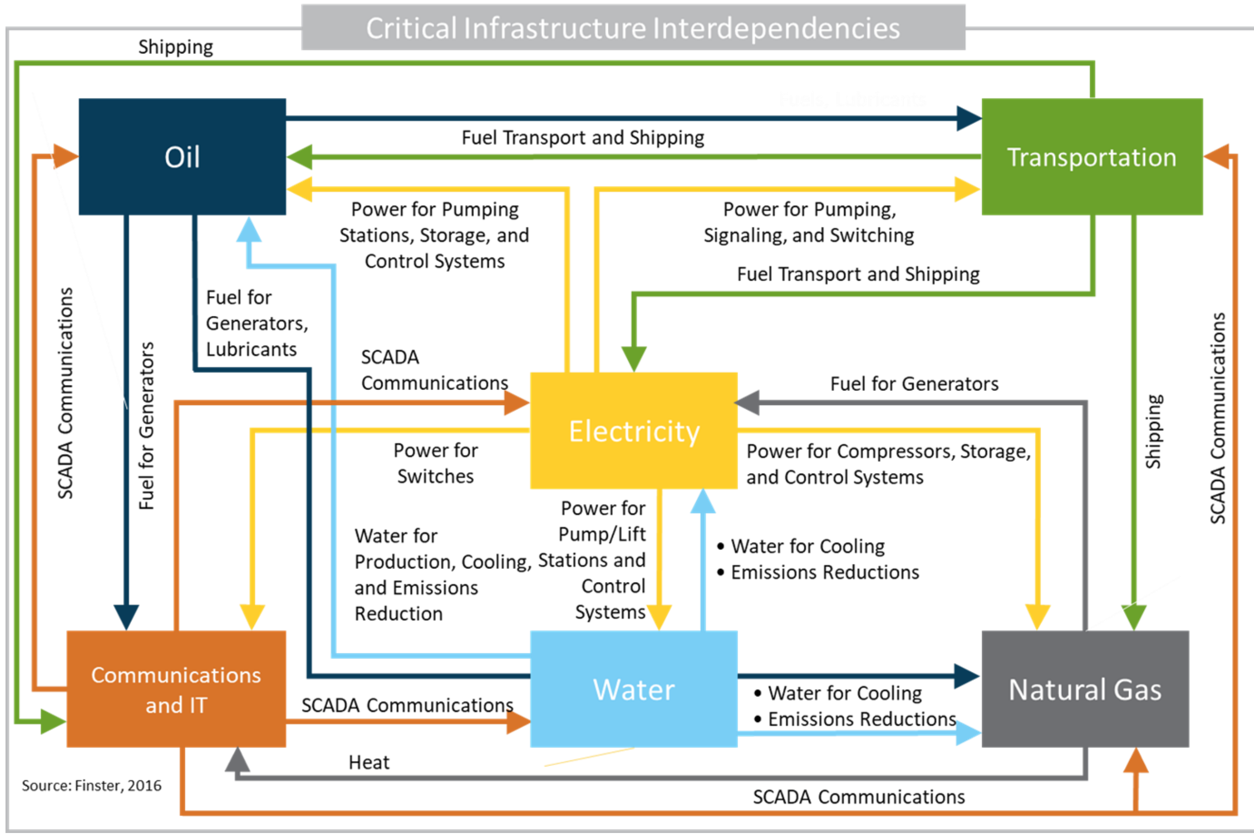
Critical Infrastructure Interdependencies

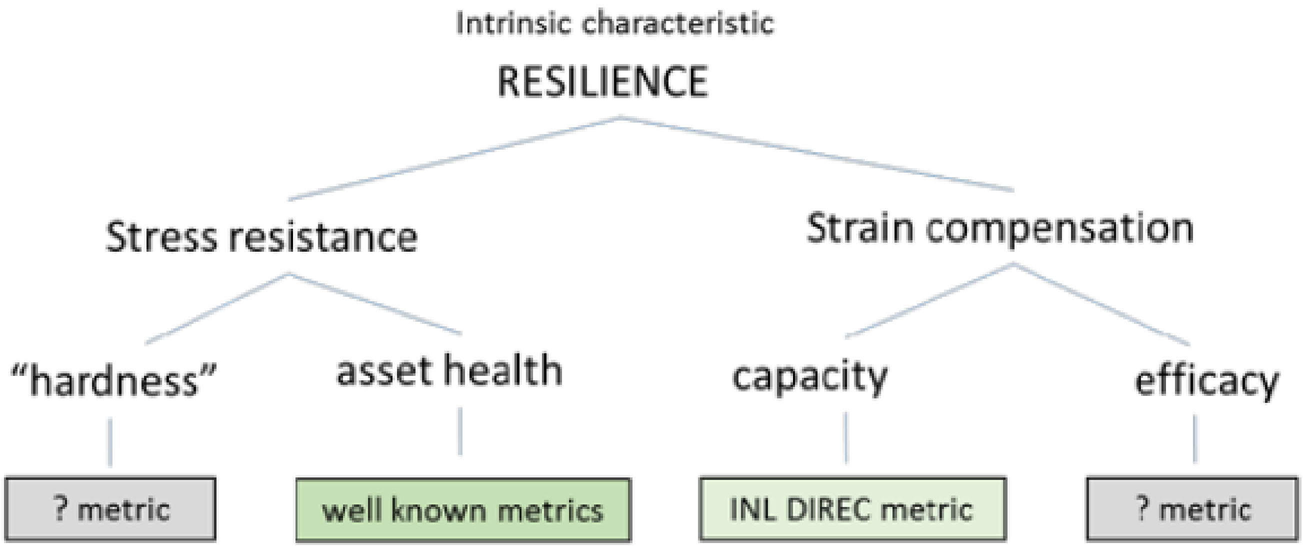
Electrification and distributed resources necessitate closer examination of the interdependencies among critical infrastructure and the distribution grid.



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.

Architectural View of Resilience

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



Source: J. Taft, PNNL

Distribution investment planning incorporates grid architectural analysis to develop a resilient grid

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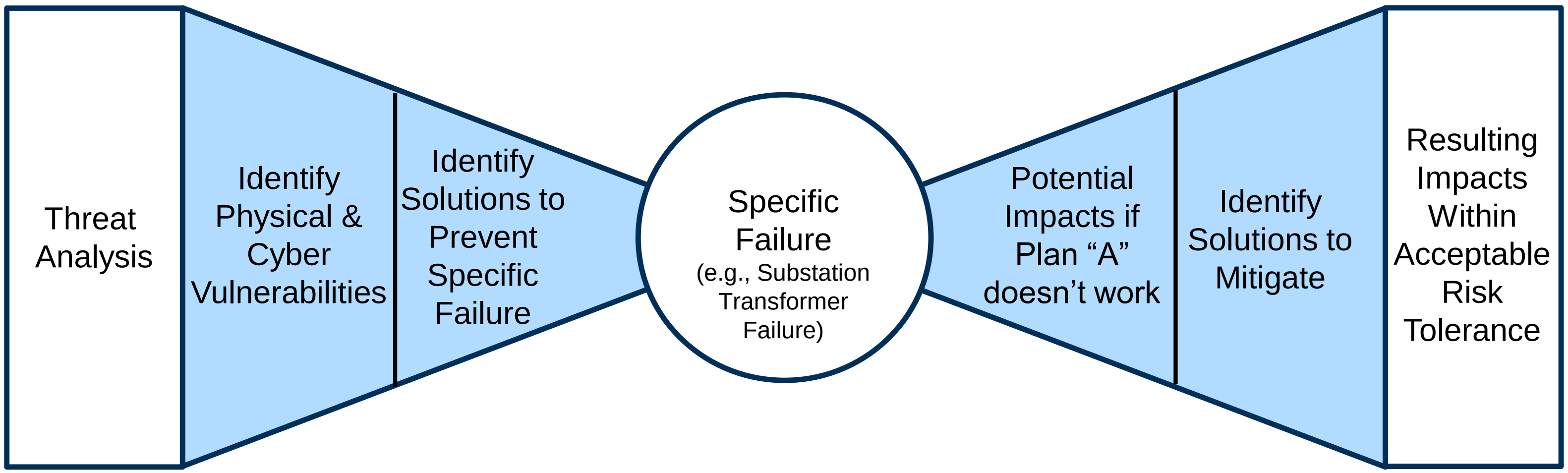
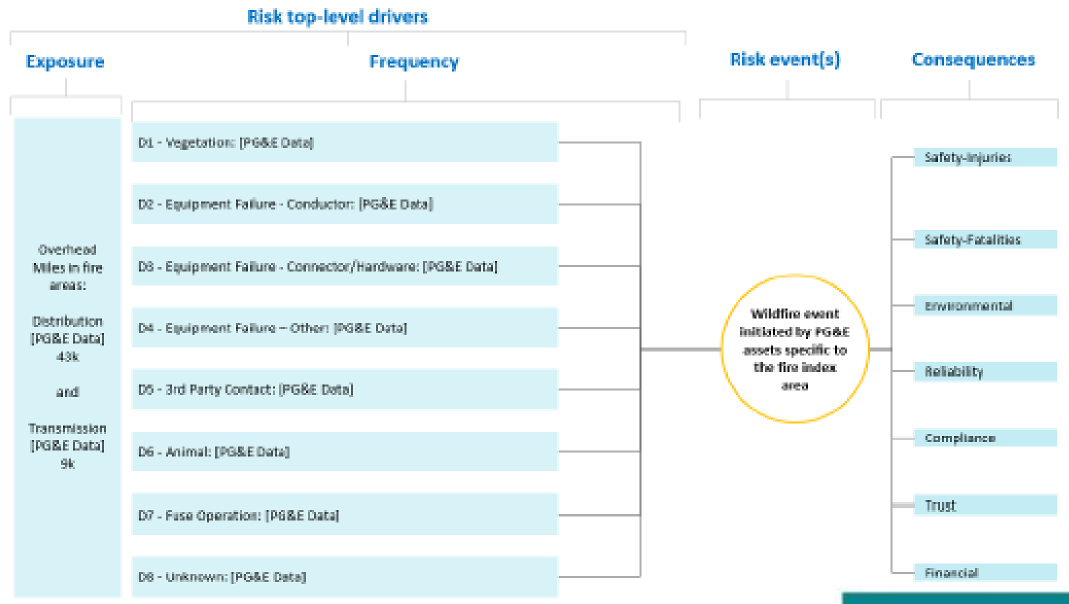
Bow-tie Threat-Risk Mitigation Analysis

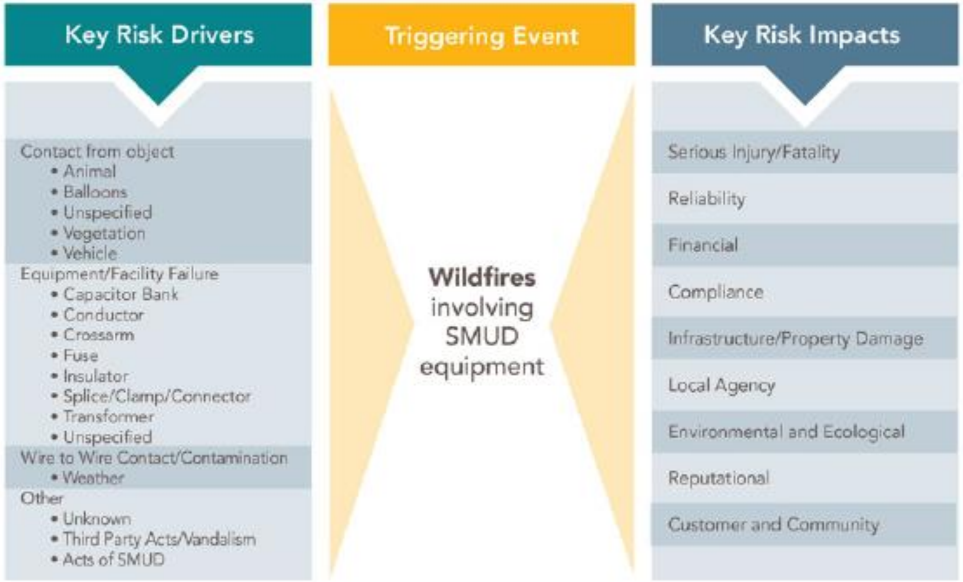
Threat analysis provides input into Bow-tie Assessment which is a process to identify potential vulnerabilities ("needs") that will cause a specific failure. Then determine both a Plan "A" to prevent the failure and a Plan "B" to mitigate the effects of the failure in case Plan "A" doesn't work.



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

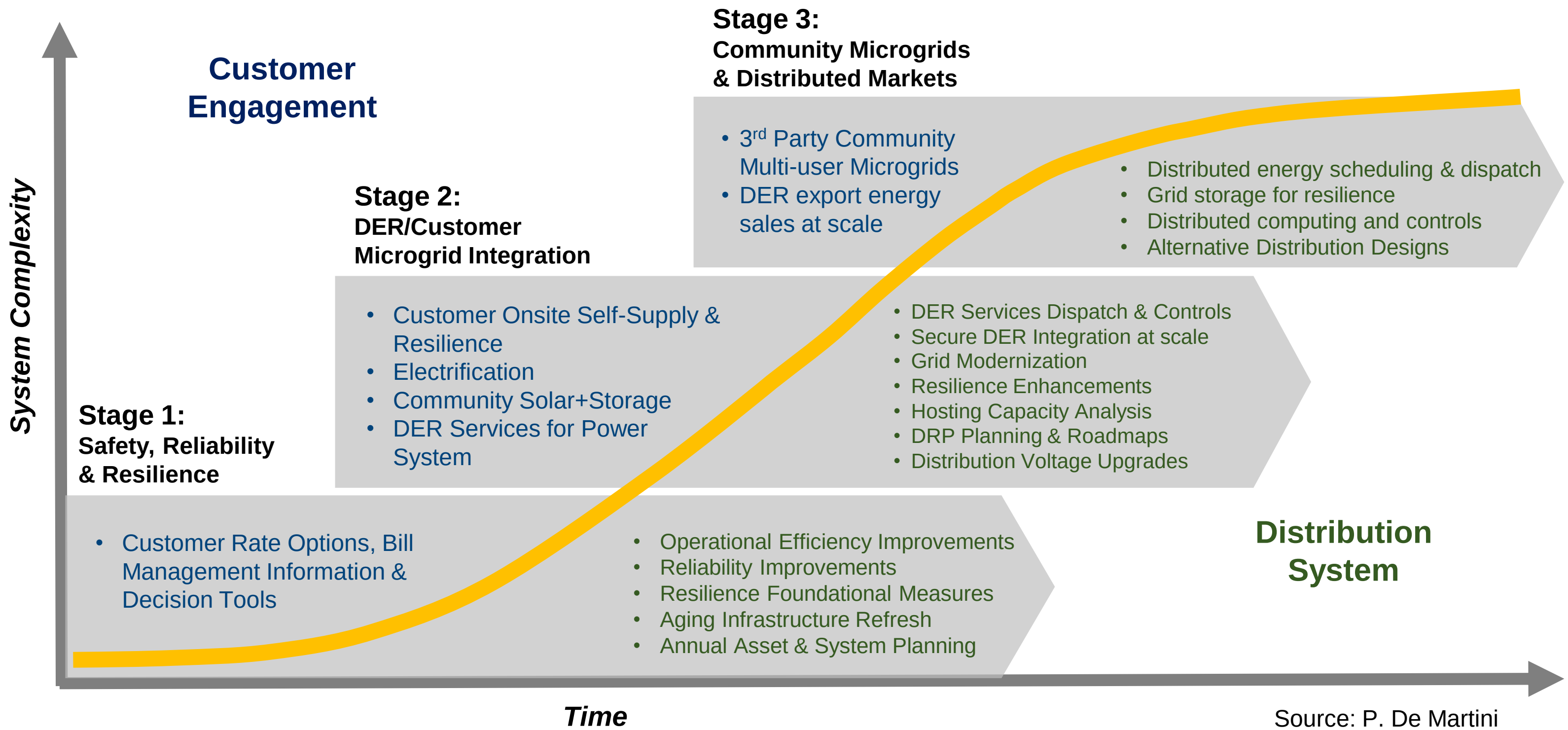
Bow-tie Threat-Risk Analysis





DER & Microgrid Development

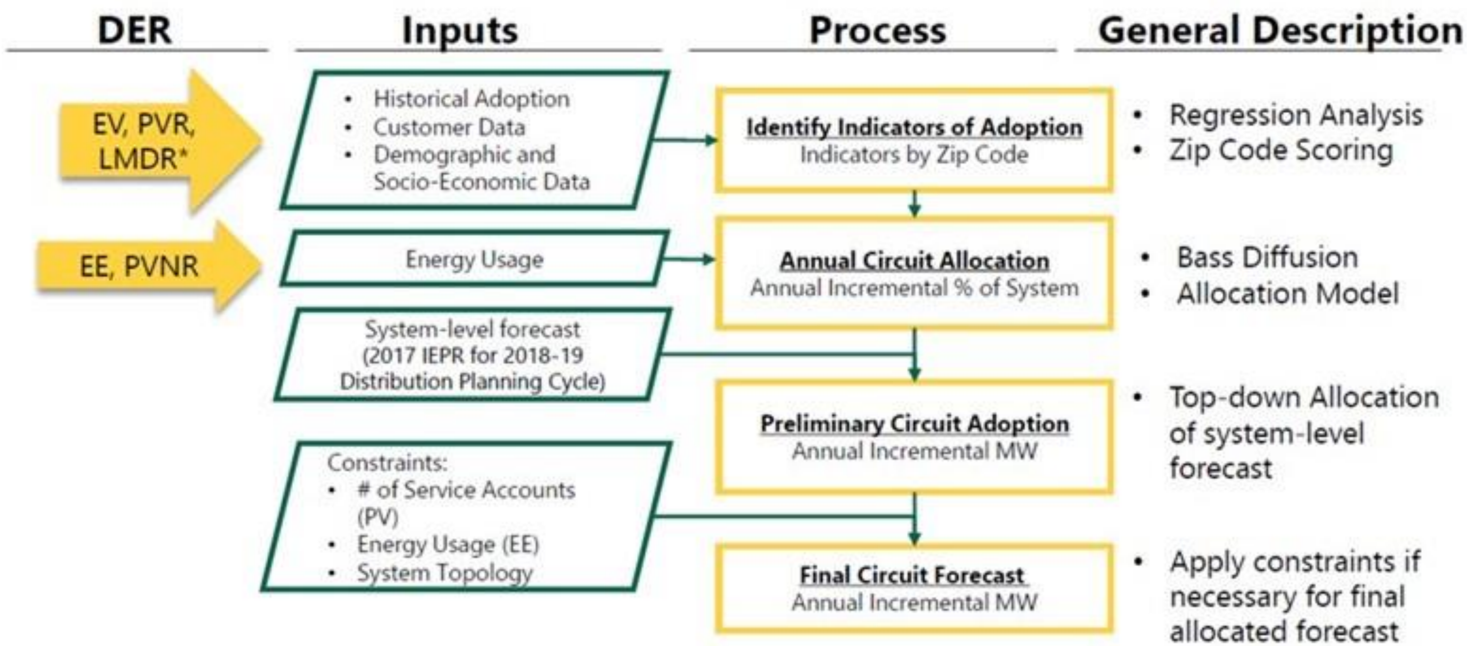
Increasing DER/Microgrid Development & Utilization Drive Infrastructure, Planning & Operational Requirements



Source: P. De Martini

Distribution DER & Load Forecasting

Adaptation of Top Down System Forecast with Bottom-up Locational Considerations



LMDR: Load Modifying Demand Response

PVR: Residential Solar PV
PVNR: Non-Residential Solar PV
*LMDR Follows the same process but scoring/development of indicators is done at the customer Level

Source: Southern California Edison

Example only – as various approaches have been developed across the US to align IRP and DSP planning assumptions

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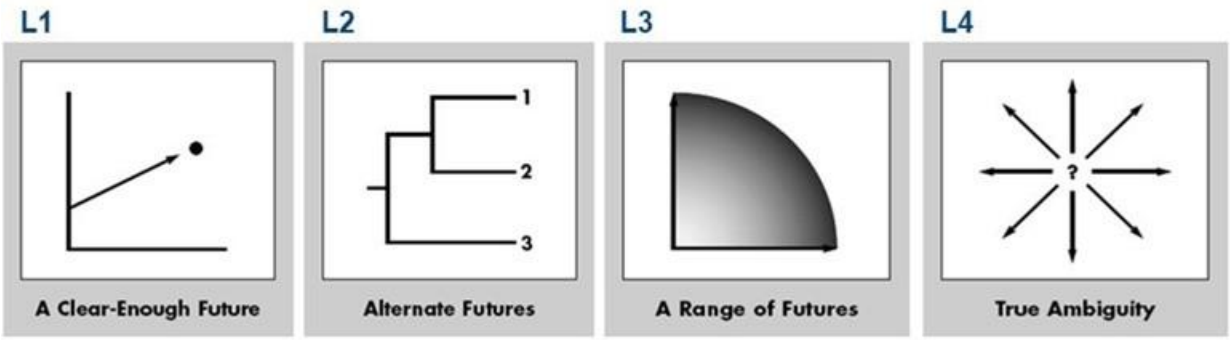
Forecast Uncertainty

Distribution level forecasts beyond 3 years are highly uncertain



Source: Harvard Business Review

Various methods to help assess uncertainty at different levels from relatively known to true ambiguity.

- **Level 1: "A Clear Enough Future"** is associated with the use deterministic "point" forecasts. This is similar to the approach distribution planners traditionally used in planning.
- **Level 2: "Alternative Futures" (scenarios)** or sensitivities are effective for most distribution systems experiencing/ anticipating higher DER/EV adoption over the next decade.

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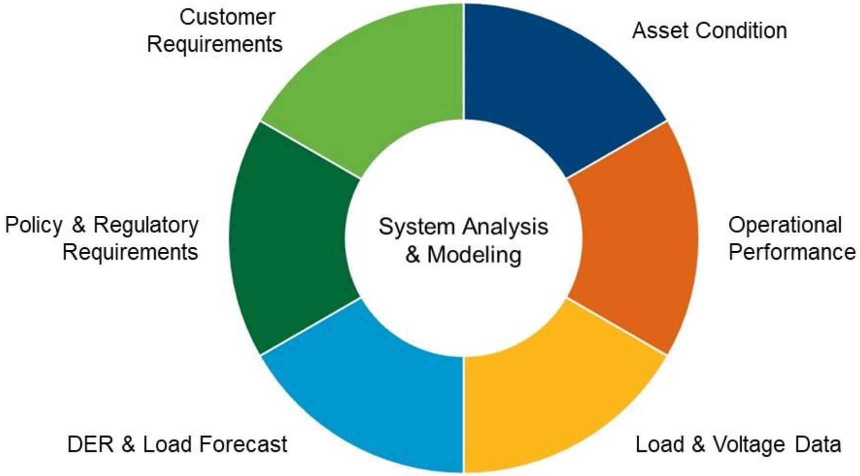
System Planning Analysis

Analyses Support Near-term and Longer-term Distribution System Planning

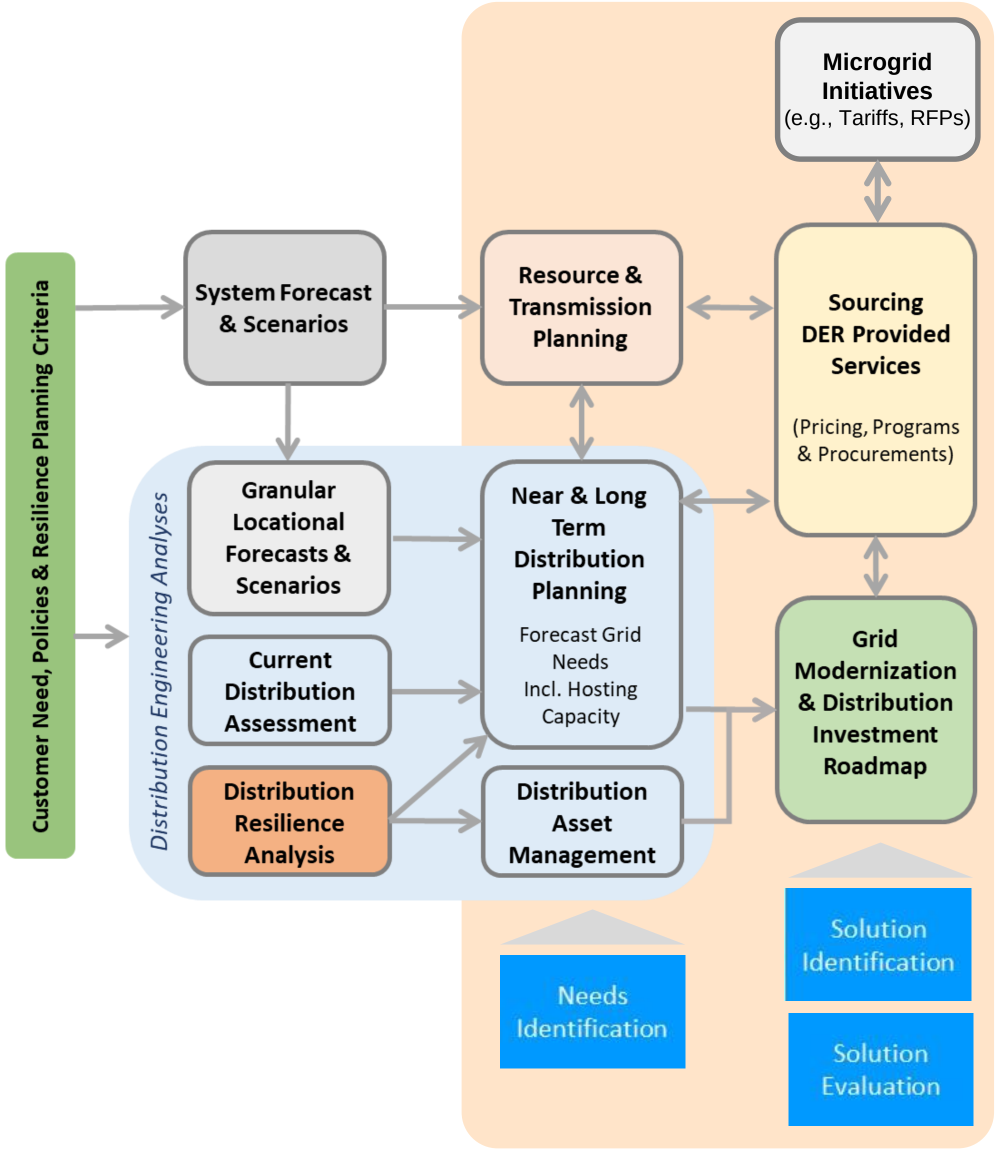
Involves assessing five key aspects:

- Thermal loading analysis,
- Power quality analysis (voltage)
- Protection analysis
- Contingency analysis
- Forecast hosting capacity



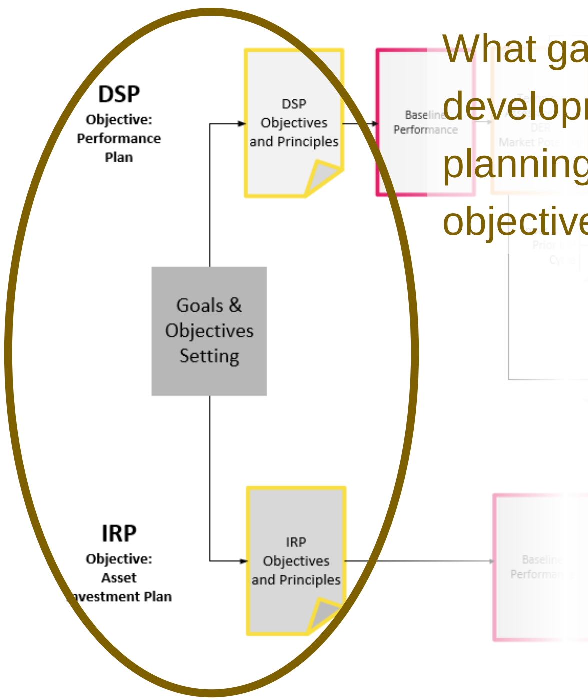
Source: Adapted from Minnesota Power

Grid Needs & Solutions



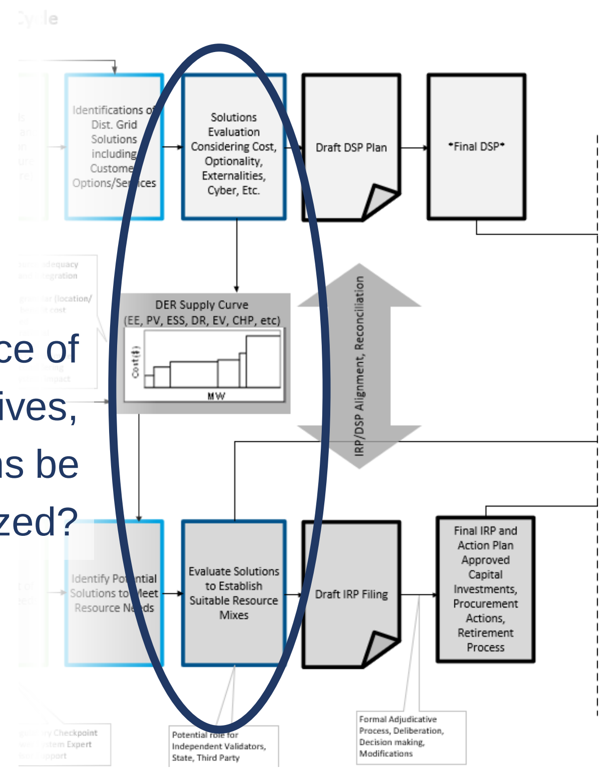
- **Near & Longer Term Planning Identify Engineering Needs and Potential Solutions**
  - Infrastructure Upgrades
  - NWA Opportunities
  - Grid Modernization
- **Distribution Asset Planning Identifies Infrastructure Replacements & Other Infrastructure**

Resilience criteria/metrics, planning objectives and solutions



What gaps exist in the development of resilience planning criteria to inform objectives?

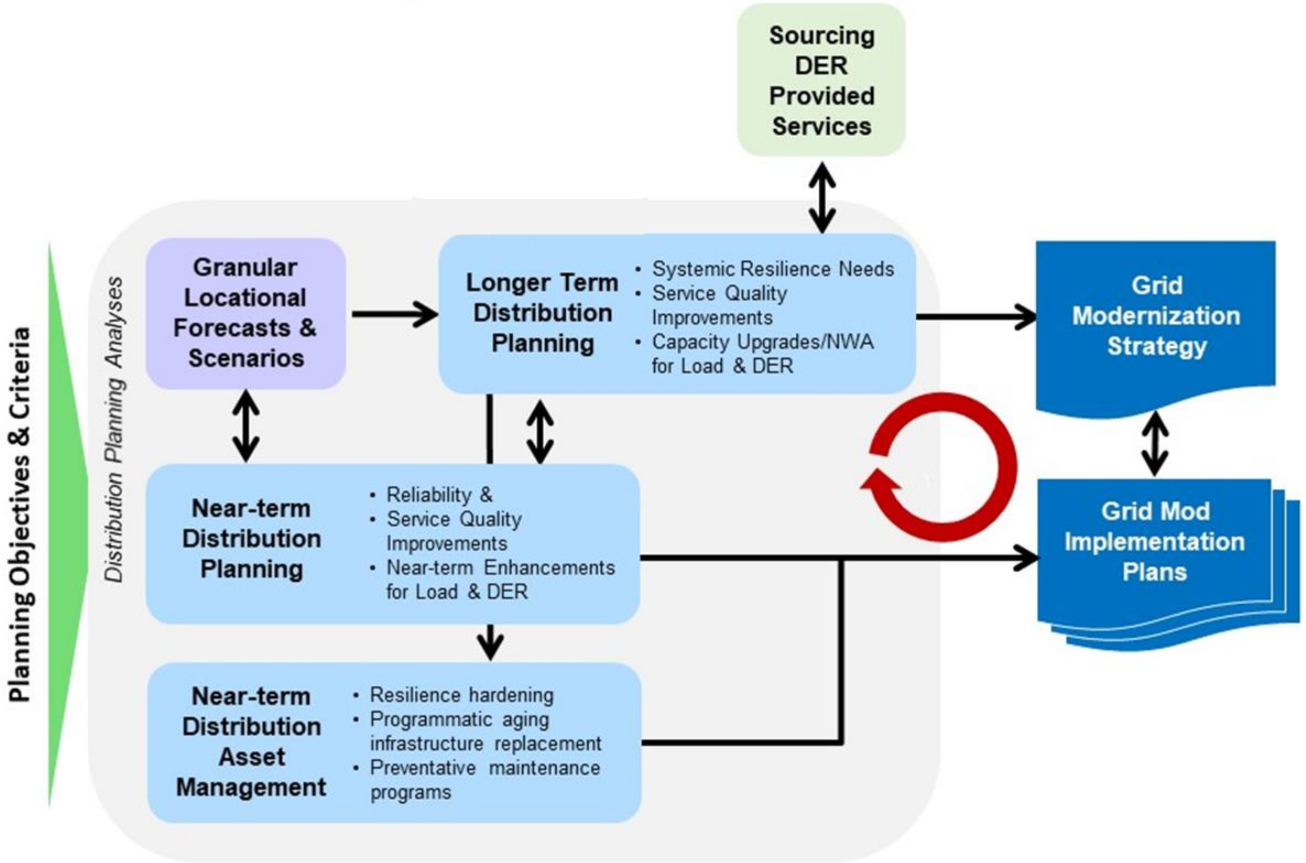
In the absence of quantifiable objectives, how can solutions be evaluated, prioritized?



Questions?

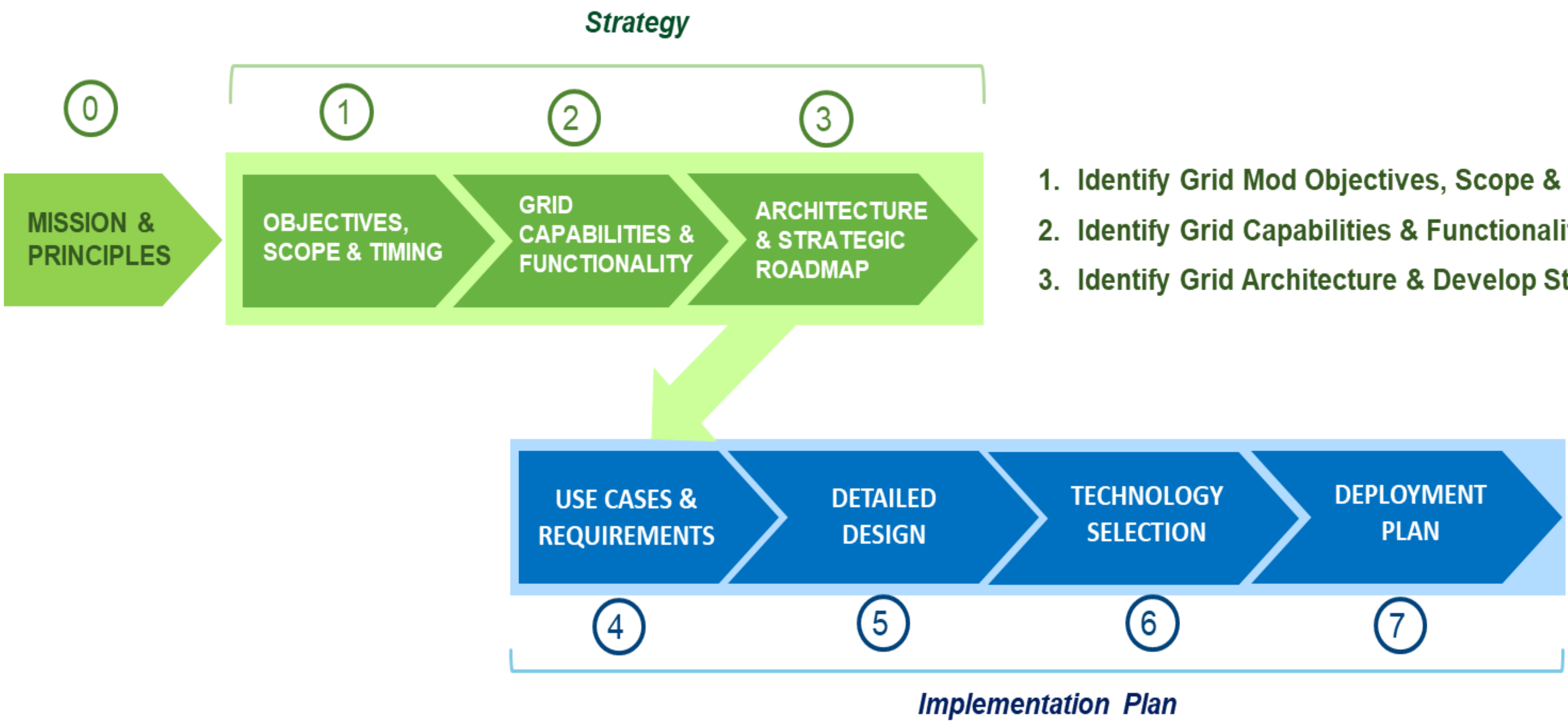
Distribution System Planning for a Modern Grid

Grid Modernization (Smart Grid) Planning is Based on the Engineering Needs Identified and the Use of DER for NWA, Microgrid & Other Services



Grid Mod Strategy & Planning Process

What, Why, How, When & How Much

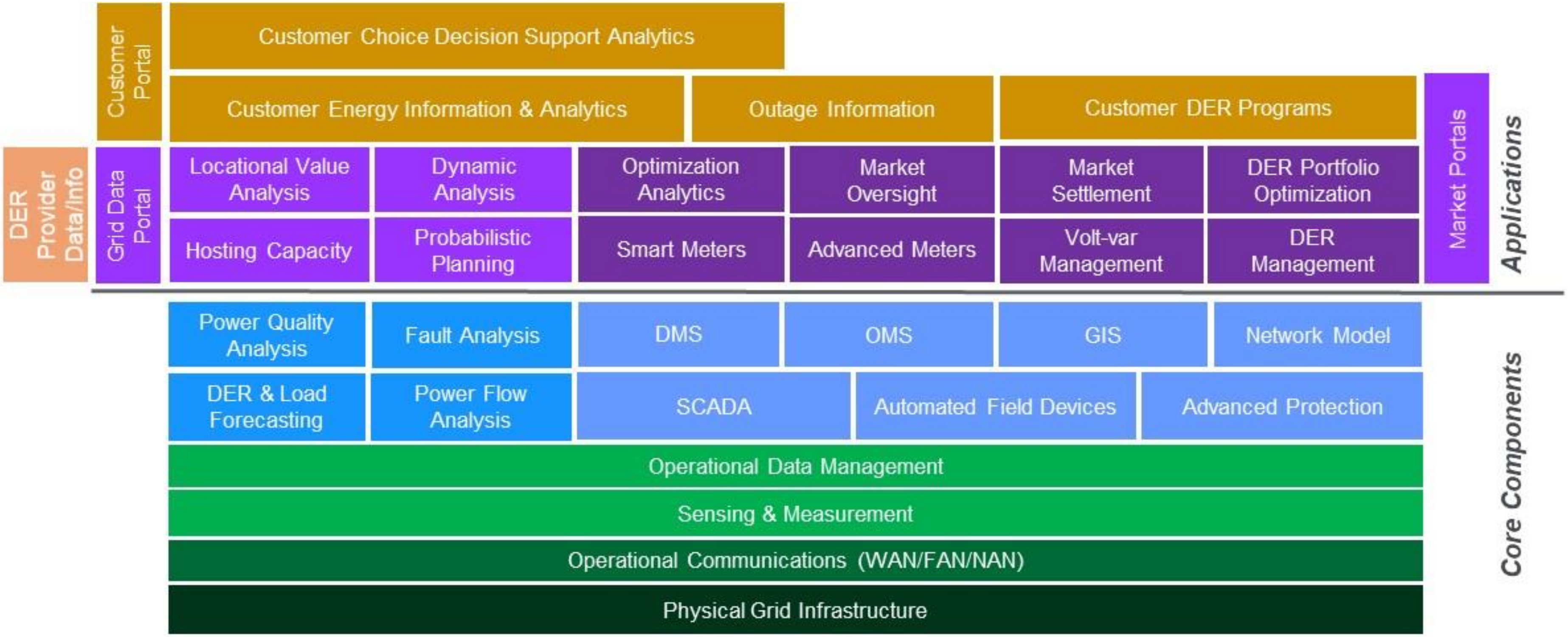


1. Identify Grid Mod Objectives, Scope & Timing
2. Identify Grid Capabilities & Functionality Needed
3. Identify Grid Architecture & Develop Strategic Roadmap

4. Develop Functional Use Cases to Identify Detailed Business & Technical Requirements
5. Develop Detailed Architecture & Design
6. Technology Assessment & Selection
7. Develop Deployment Plan & Cost Effectiveness Assessment

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*.

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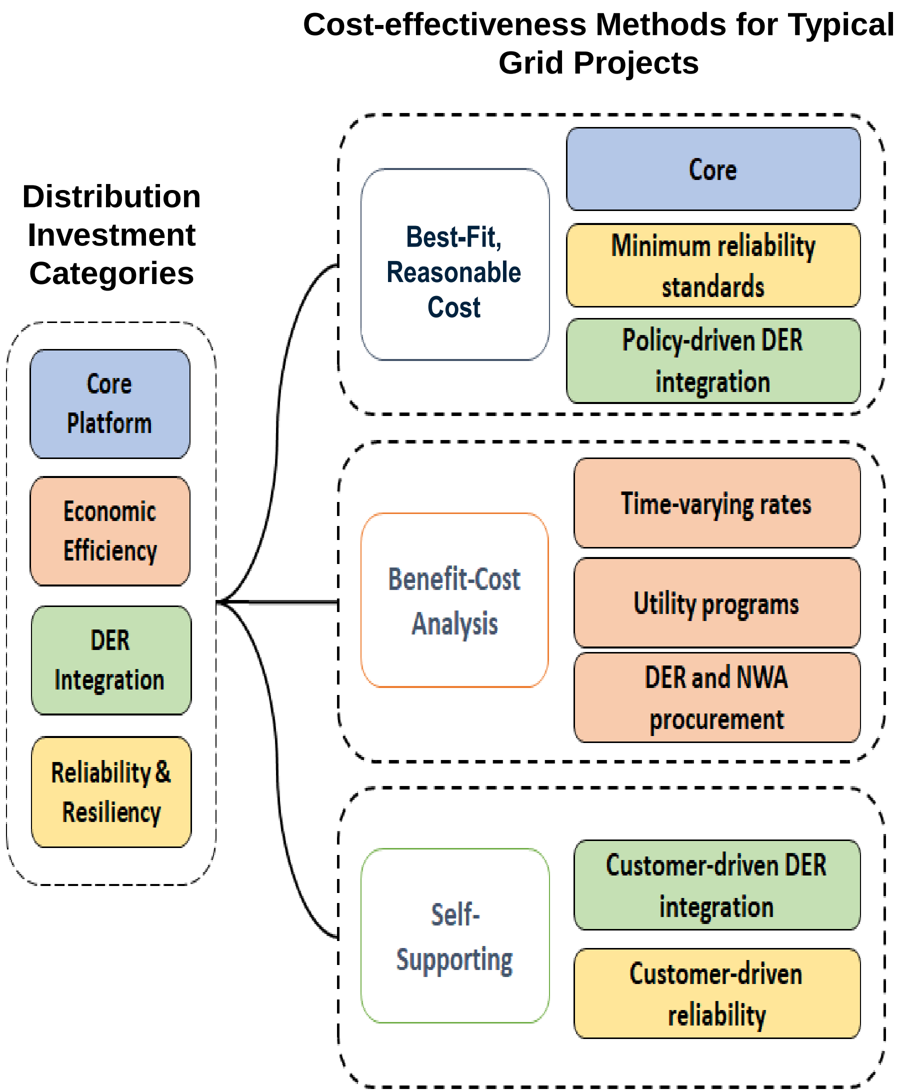
Distribution Cost-Effectiveness Framework



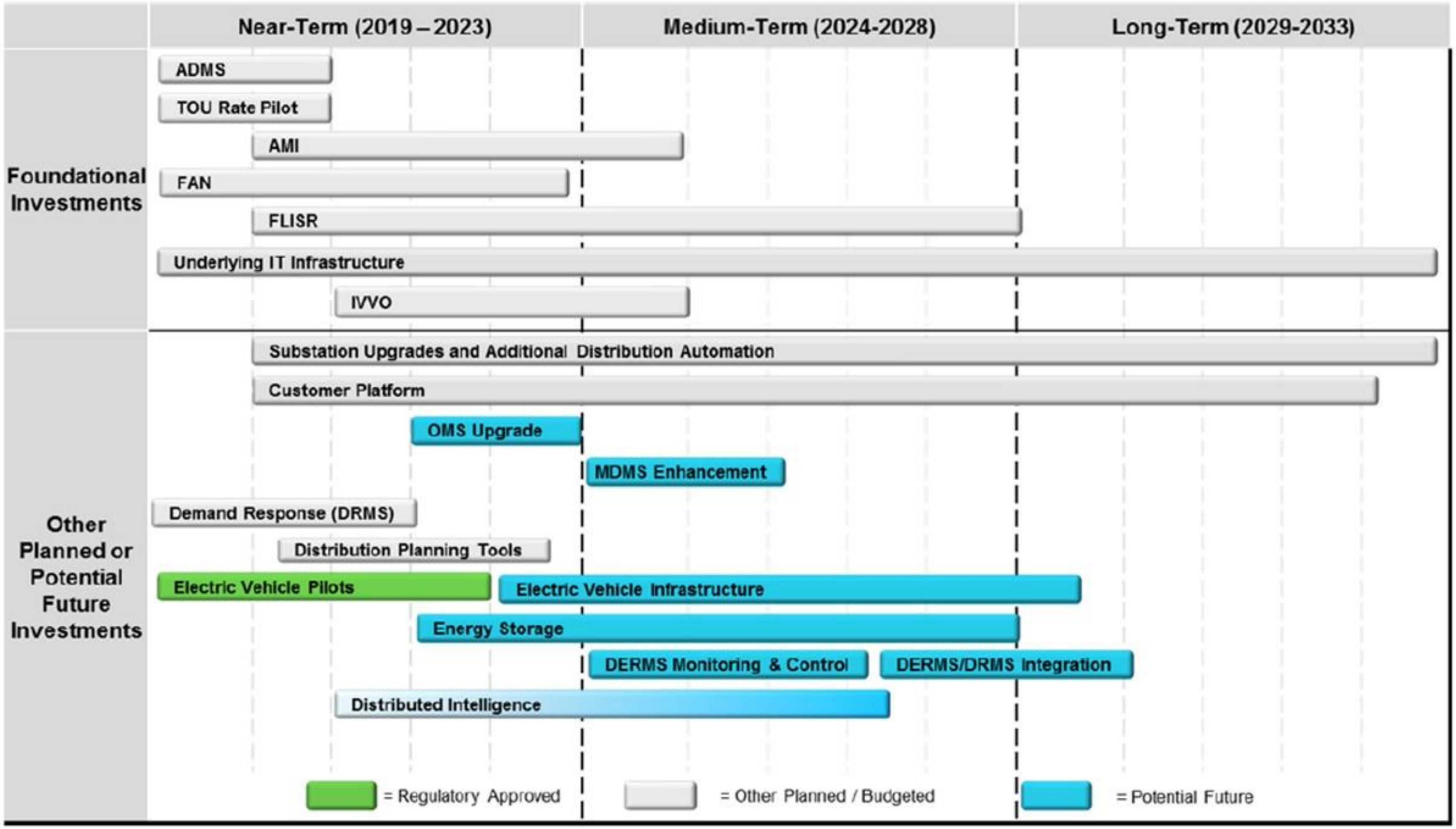
Best-Fit, Reasonable Cost for core grid platform and grid expenditures required to maintain or reliable operations as well as integrate distributed resources connected behind and in front of the customer meter that may be socialized across all customers.

Benefit-Cost Analysis for grid expenditures proposed to enable public policy and/or incremental system and societal benefits to be paid by all customers. Grid expenditures are the cost to implement the rate, program or NWA. Various methods for BCA may be used.

Customer Self-supporting costs for projects that only benefit a single or self-selected number of customers and do not require regulatory benefit-cost justification. For example, DER interconnection costs not socialized to all customers. Also, undergrounding wires at customers' request.

Roadmaps: Sequencing of Investments

Conceptual View of Planned and Expected Investments in a Logical Sequence



From the Xcel Energy 2019 Integrated Distribution Plan. Link: https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/IntegratedDistributionPlan.pdf

Determining Portfolio of Resilience Solutions

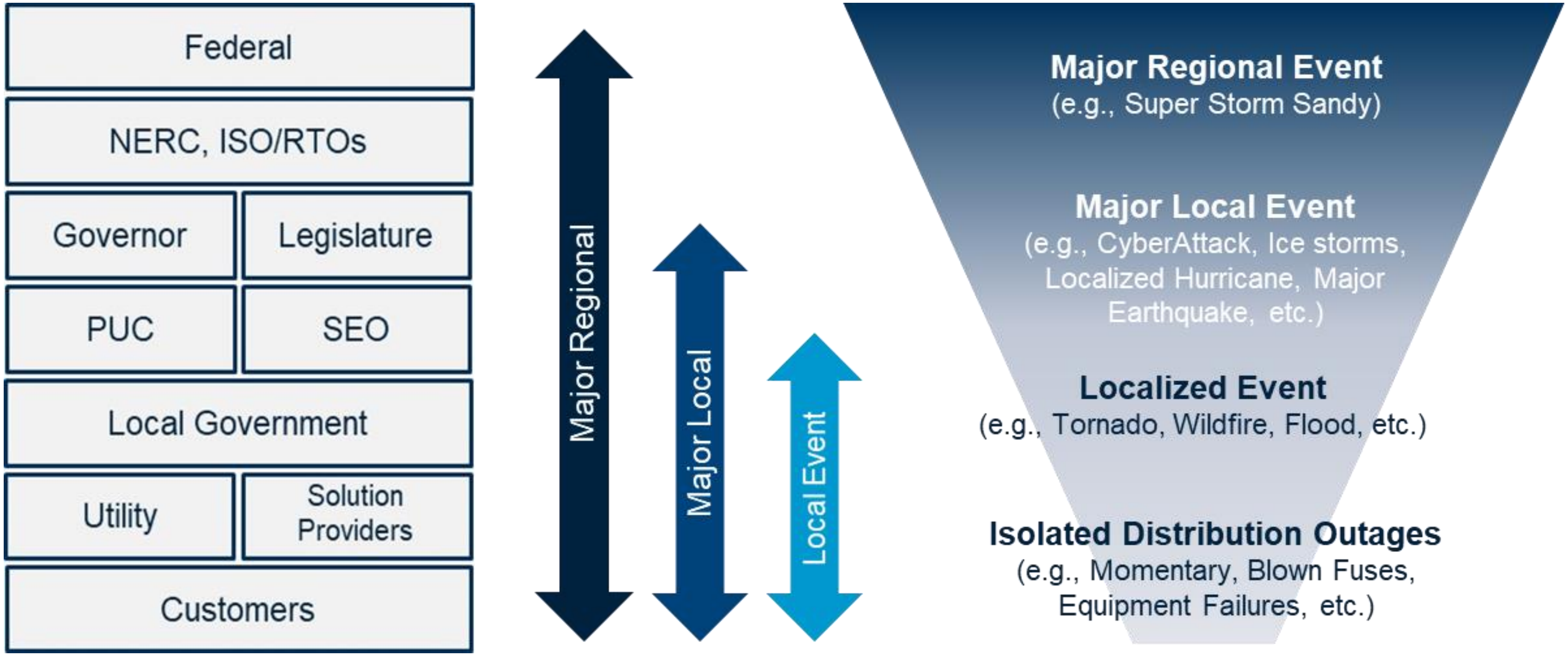
- **Proactive, collaborative approach that aligns development by 3rd parties, customers and utility**

- **Otherwise, utilities, 3rd parties and customers may each independently pursue 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?

Roles and Responsibilities

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

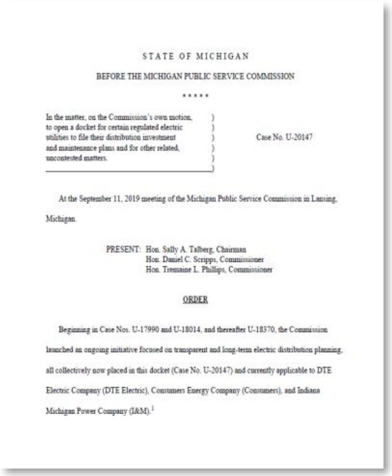
The majority of distribution grid investments affect a system's physical and/or cybersecurity resilience capability

- 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

References:

Michigan PSC
2019 IDP Order


STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

* * * * *

In the matter, on the Commission's own motion, to open a docket for certain regulated electric utilities to file their distribution investment and maintenance plans and for other related, uncontested matters.) Case No. U-20147

At the September 11, 2019 meeting of the Michigan Public Service Commission in Lansing, Michigan.

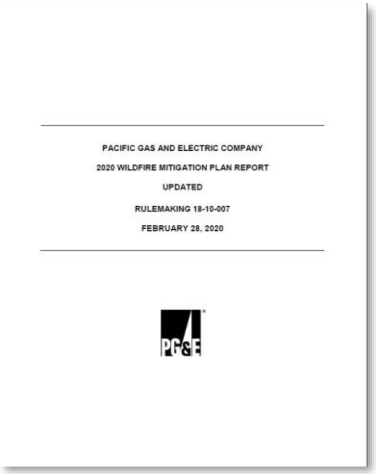
PRESENT: Hon. Sally A. Talberg, Chairman
Hon. Daniel C. Scripps, Commissioner
Hon. Tremaine L. Phillips, Commissioner

ORDER

Beginning in Case Nos. U-17990 and U-18014, and thereafter U-18370, the Commission launched an ongoing initiative focused on transparent and long-term electric distribution planning, all collectively now placed in this docket (Case No. U-20147) and currently applicable to DTE Electric Company (DTE Electric), Consumers Energy Company (Consumers), and Indiana Michigan Power Company (I&M).[1]

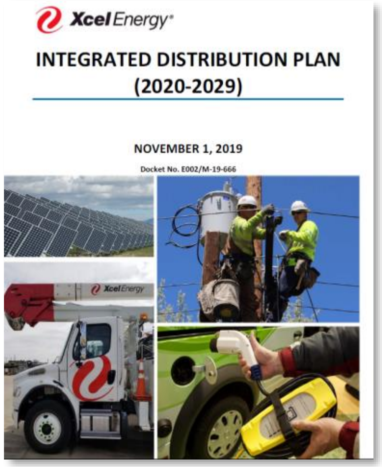
https://mi-psc.force.com/sfc/servlet.shepherd/version/download/068t0000005XvREAA0

PG&E Wildfire
Mitigation Plan 2020


PACIFIC GAS AND ELECTRIC COMPANY
2020 WILDFIRE MITIGATION PLAN REPORT
UPDATED
RULEMAKING 18-10-007
FEBRUARY 28, 2020

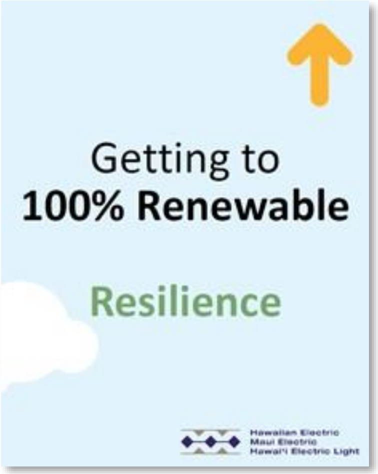
https://www.pge.com/pge_global/common/pdfs/safety/emergency-preparedness/natural-disaster/wildfires/wildfire-mitigation-plan/2020-Wildfire-Safety-Plan.pdf

Xcel Energy
2019 IDP



https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/IntegratedDistributionPlan.pdf

HECO Resilience
Planning



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