U.S. DEPARTMENT OF ENERGY
Office of Electricity

Coordinated Grid Planning with Considerations for Resilience and Equity

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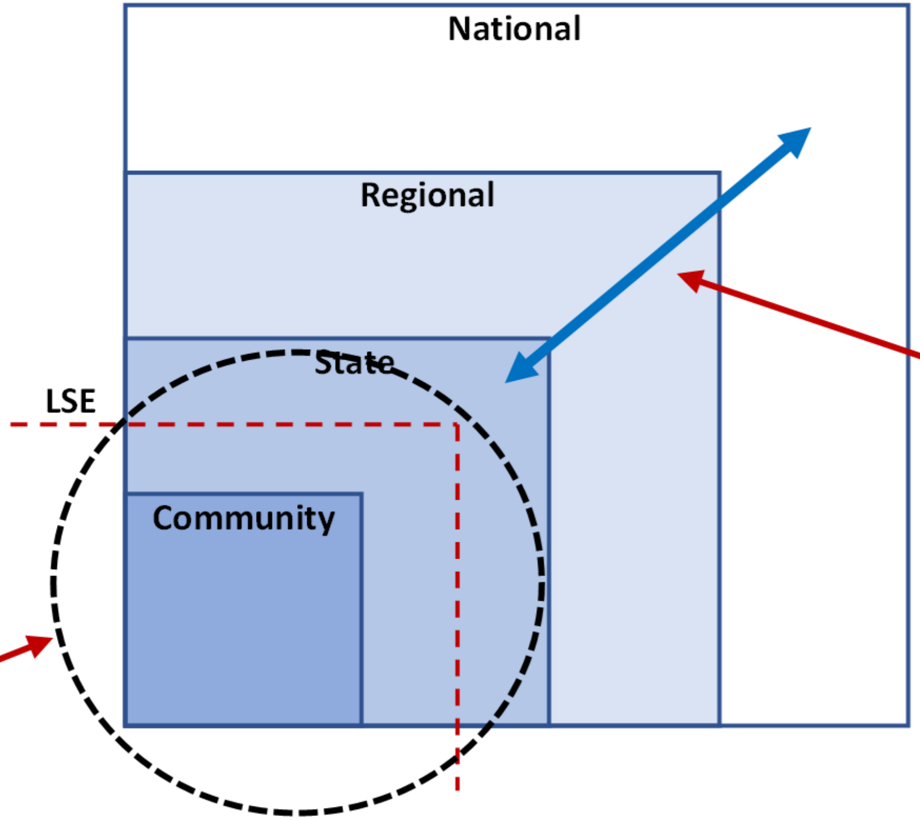
2022 NASUCA Annual Conference, New Orleans
November 15, 2022

Addressing Scale within Integrated Planning Processes

Address state/community objectives through an IDSP process and align with regional planning efforts



Alignment of community and state strategies with regional, multi-state strategies

IDPs align community and state policy goals into multi-year investment strategies

Integrated Distribution System Planning

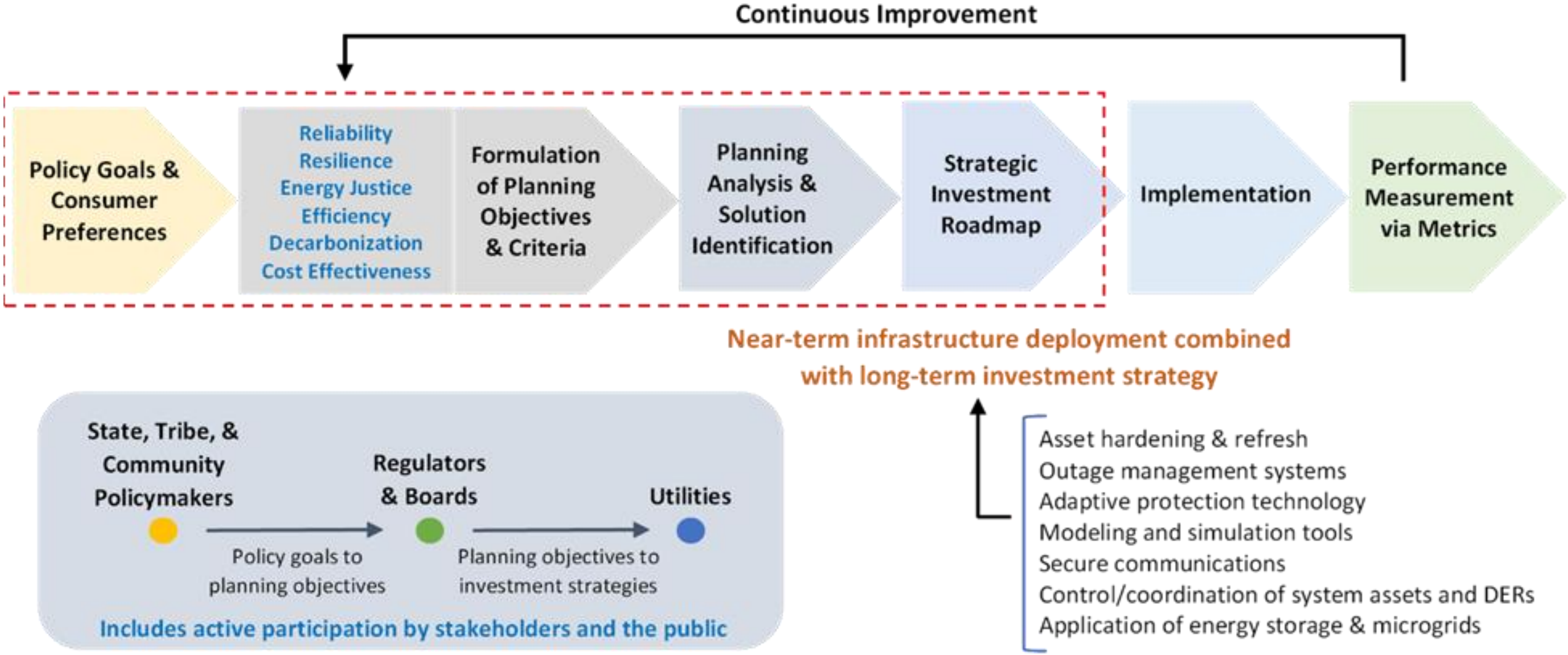
Distribution planning across the U.S. addresses 3 key overlapping areas of focus to meet customer needs

Key considerations:

- Convergence of state energy policy objectives and priorities with utility/3rd-party planning processes
- Integration of customer and 3rd-party systems with utility systems
- Coordination, control, and application of distributed energy resources (DERs)
- Improvement in reliability, resilience and operational efficiency
- The application of advanced sensing, communications, control, information management, and computing technologies to enable the above
- The application of grid architecture to ensure the building of a coherent system that is scalable
- Business process redesign to support effective planning, grid operations, and market operations

Objectives-Based Planning

Creating a shared understanding among stakeholders of strategies for incorporating resilience and equity into current grid modernization practices is essential. Without clear objectives, it becomes difficult to assess whether resulting plans are responsive and if key stakeholders will accept them.



Spectrum of Resilience Measures

Less sophisticated, yet foundational

More sophisticated, requires advanced grid capabilities

- Hardening infrastructure
- Ensuring adequate emergency management capabilities
- Back-Up provisions (e.g., fuel)

Robust Asset Management:

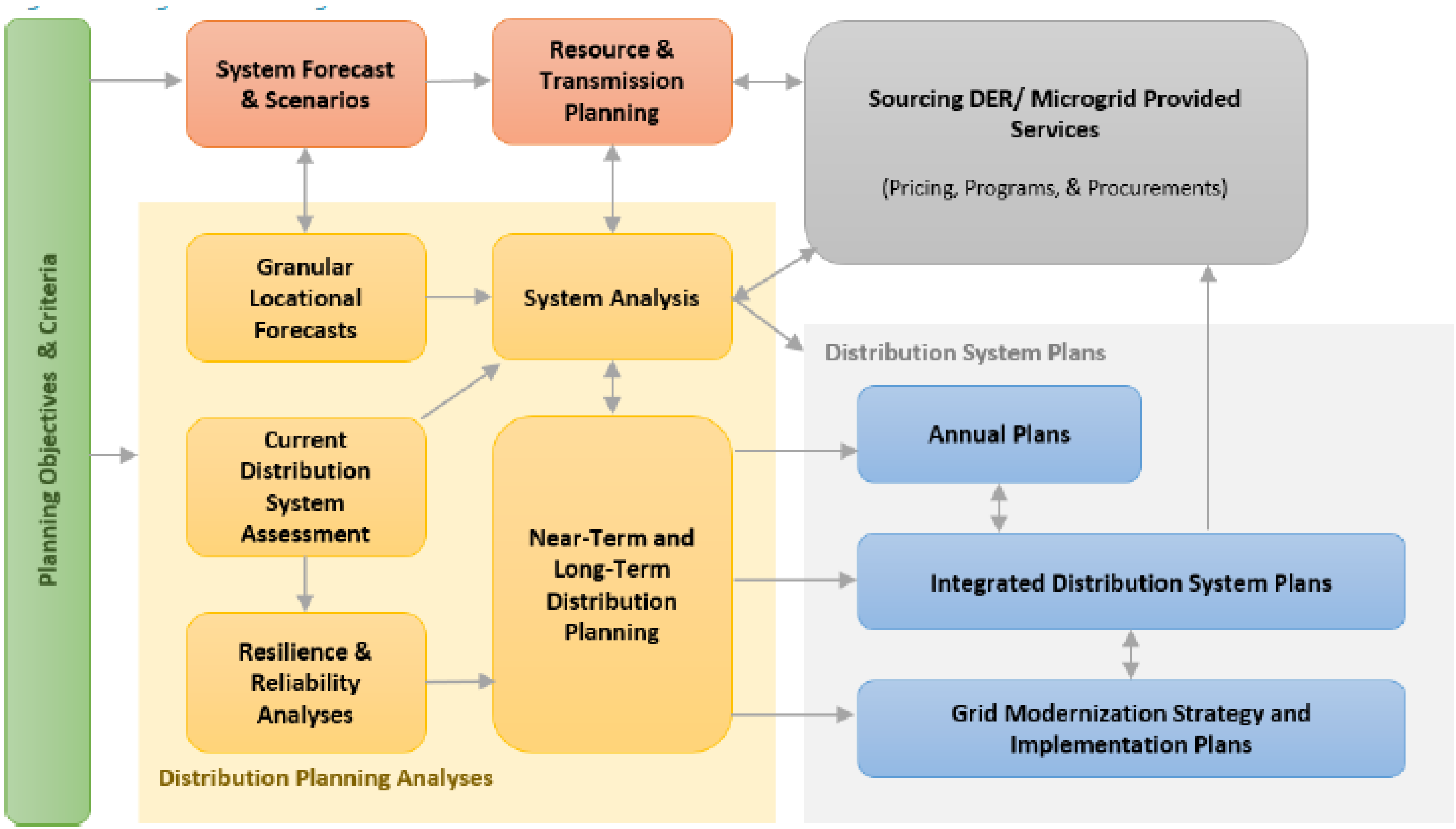
- Asset monitoring
- Failure prediction
- Data analysis (GIS)

Monitoring and control of system state to enable adaptive response capabilities in real-time and for predictive analysis (modeling, simulation, and analytical platforms)

Real-time control and coordination of system assets, including inverter-based resources (DERs), and microgrids to adapt to emergency situations

<u>Note</u>: FPL and more advanced utilities undertake continuous improvement of hardening and asset management practices and have built information platforms for emergency crews. Utilities e.g., PJM and Austin Energy are also implementing real-time sensing and controls to mitigate wildfires and control assets under emergency conditions. All the above activities are in play and best practices are available.

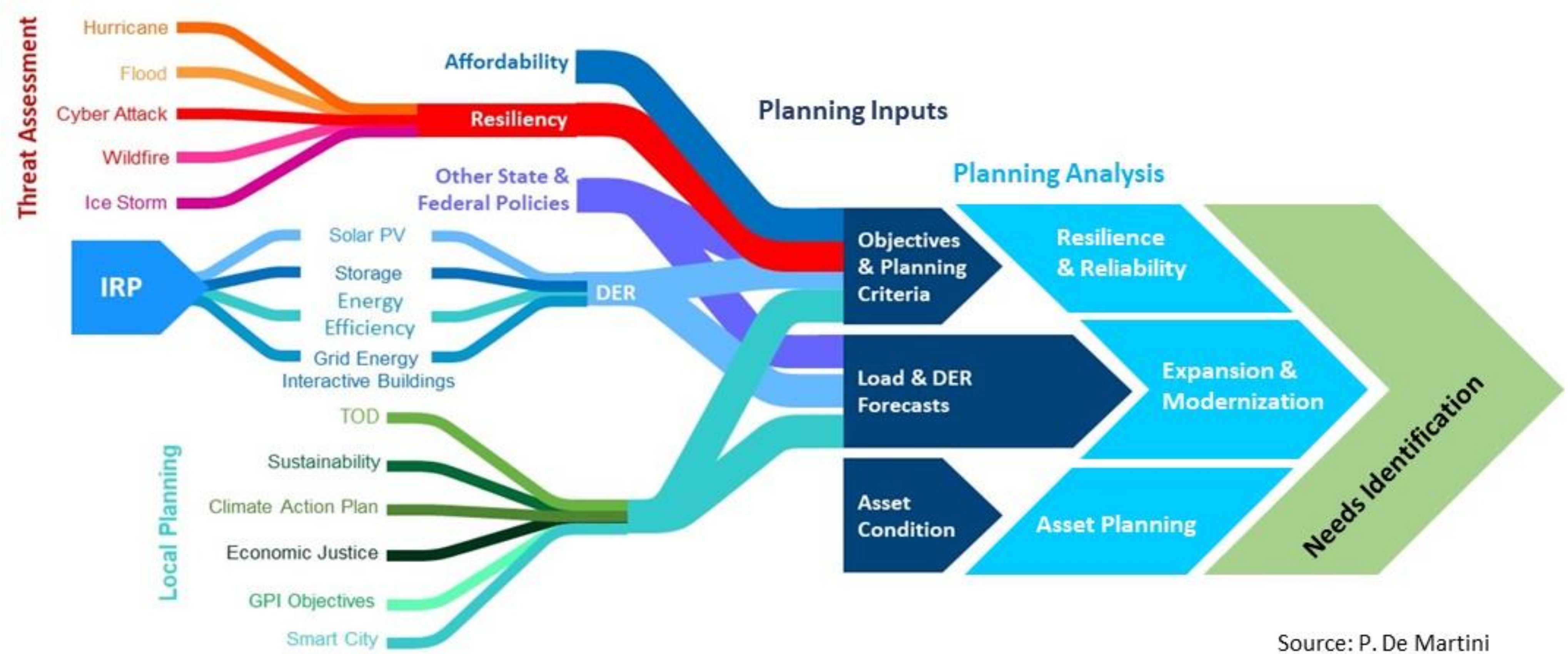
IDSP Essential Components



Source: DSPx Guidebook, Vol. 4 (final draft), 2020

Emerging Distribution System Planning Inputs

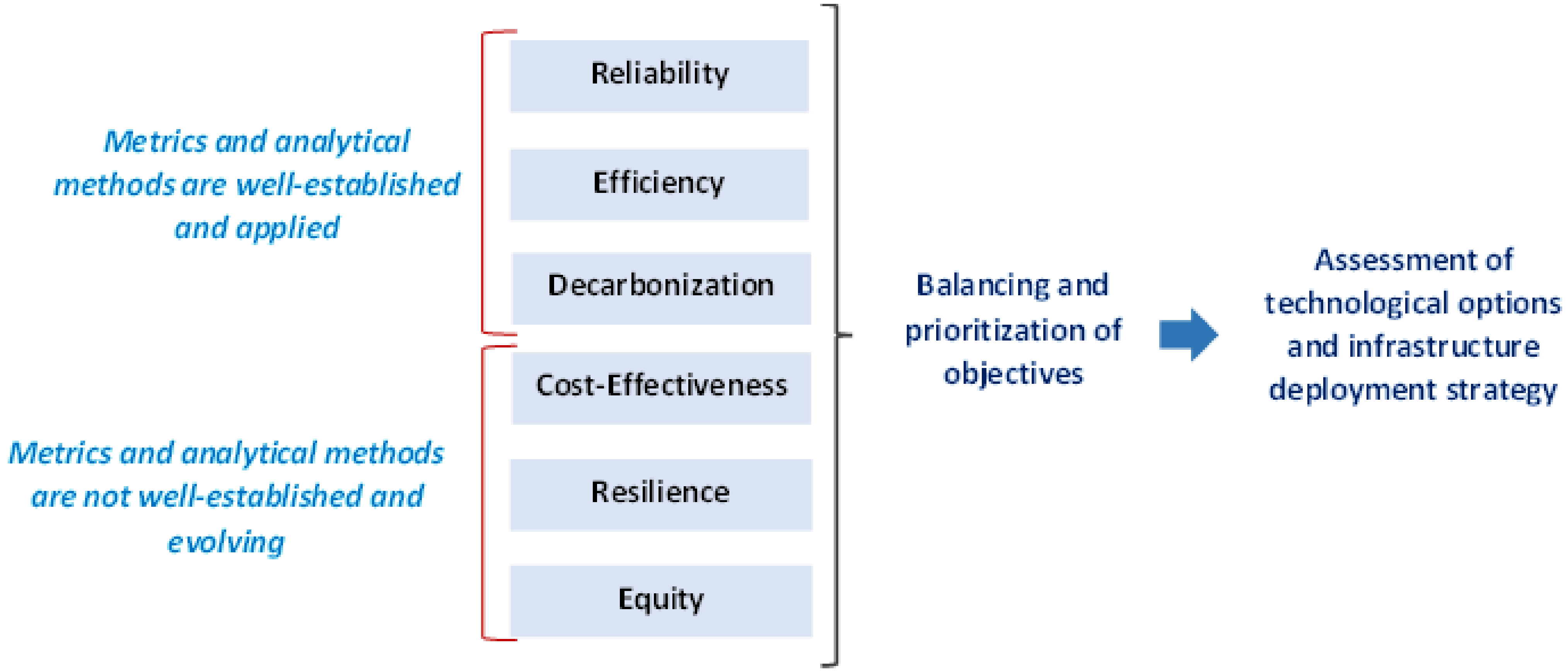
Distribution planning increasingly dependent upon IRP/bulk power planning, local sustainability & resilience plans, and use of DER



Source: P. De Martini

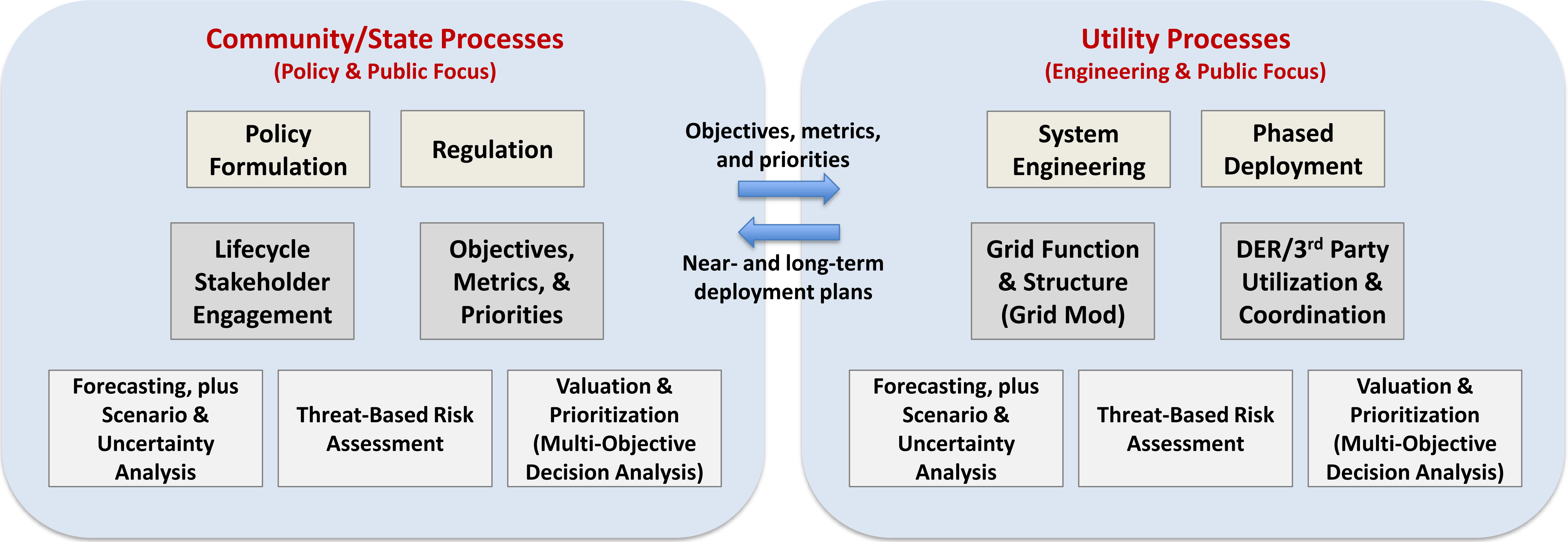
Planning Objectives

A well-designed integrated distribution system planning process provides a framework for translating policy objectives into holistic infrastructure investment strategies



Coordinated Processes within IDSP

Given the need to deploy technological solutions that address current socio-economic concerns, distribution system planning now requires a coordinated effort across the policy, regulatory, and utility decision domains with active stakeholder engagement throughout



Threat-Based Risk Assessment

Policy Development	Regulation
E.G., policies on: • Tax-based funding for resilience measures • Treatment of vulnerable or disadvantaged populations • Establishment of special committees, studies, and working groups	• Provision of planning objectives and criteria to utilities, plus metrics • Integrated planning guidelines • Evaluation and approval of utility plans • Establishment of working groups

Planning guidance to utilities

Utility Planning and Analysis

Utility annual and long-term plans to address resilience and grid modernization

Tiering of key infrastructure and populations

Formulation of resilience-based objectives and metrics

Threat-Based Risk Assessment	
Where: risk = f(threat, vulnerability, consequence)	
Threat assessment: identification and prioritization	Threat scenarios: assessment of impact of threat on infrastructure and populations

Forecasting of threat severity (low, medium, and high)

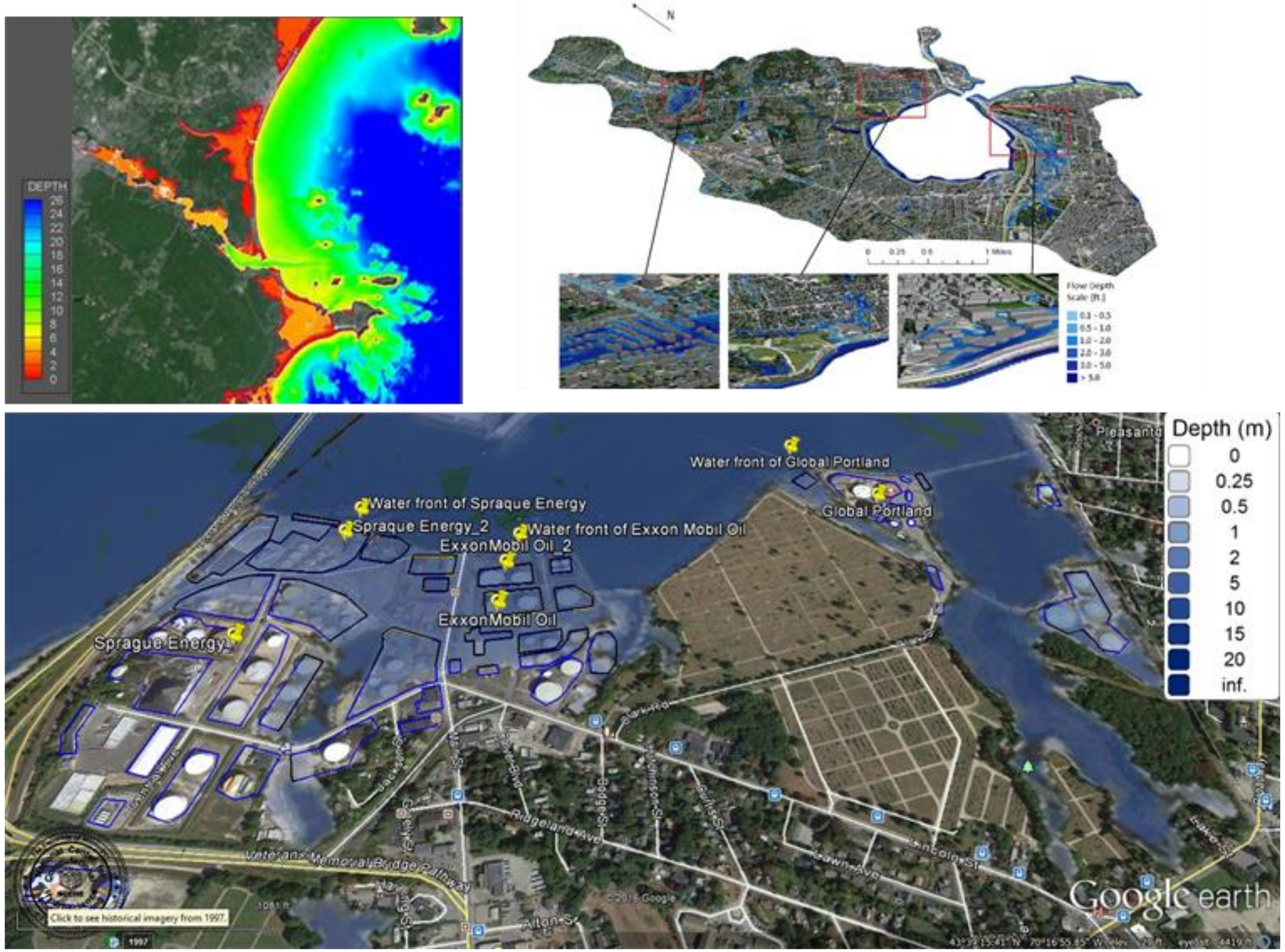
Reference HECO IGP Resilience Working Group Report, June 1, 2020: https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/working-groups/resilience-documents.

Informing Decisions

Critical Infrastructure in Maine

COASTAL FLOOD RISKS TO COASTAL ASSETS AND ENERGY INFRASTRUCTURE

- Projected coastal flood risks due to sea-level rise and a “Sandy-like” hurricane storm surge
- Projected asset-level inundation depths to energy and fuel infrastructure
- Assigned risk scores based on projected exposure and severity of impacts
- Developed visualization tools to enable stakeholders to investigate asset-specific risks in post-analysis



From Tom Wall, Center for Climate Resilience and Decision Science, Argonne National Laboratory

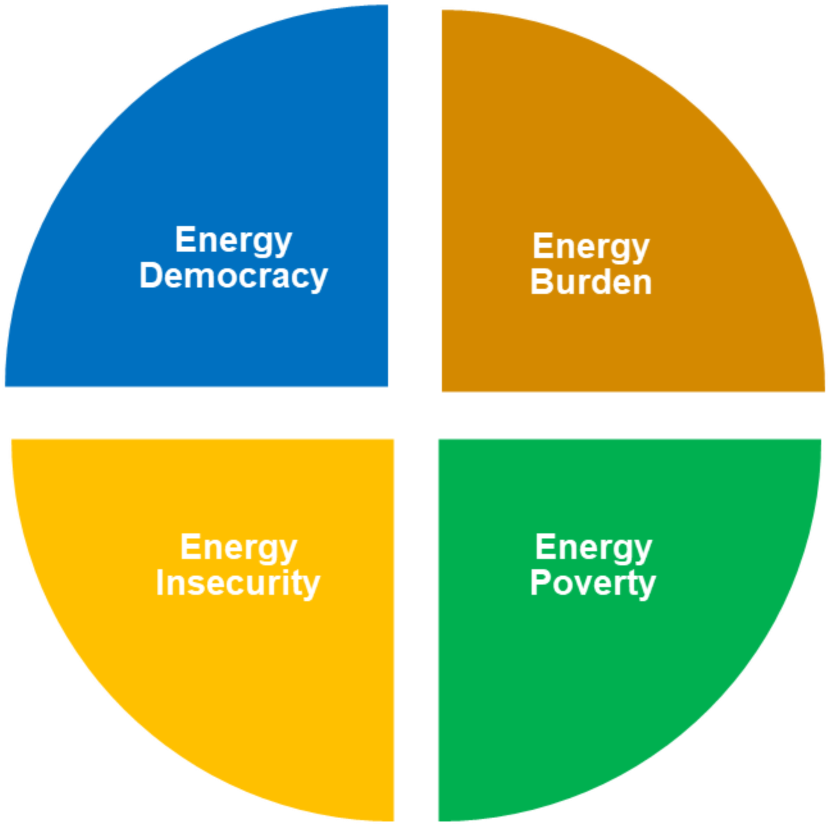
Resilience Planning Components (from HECO RWG)

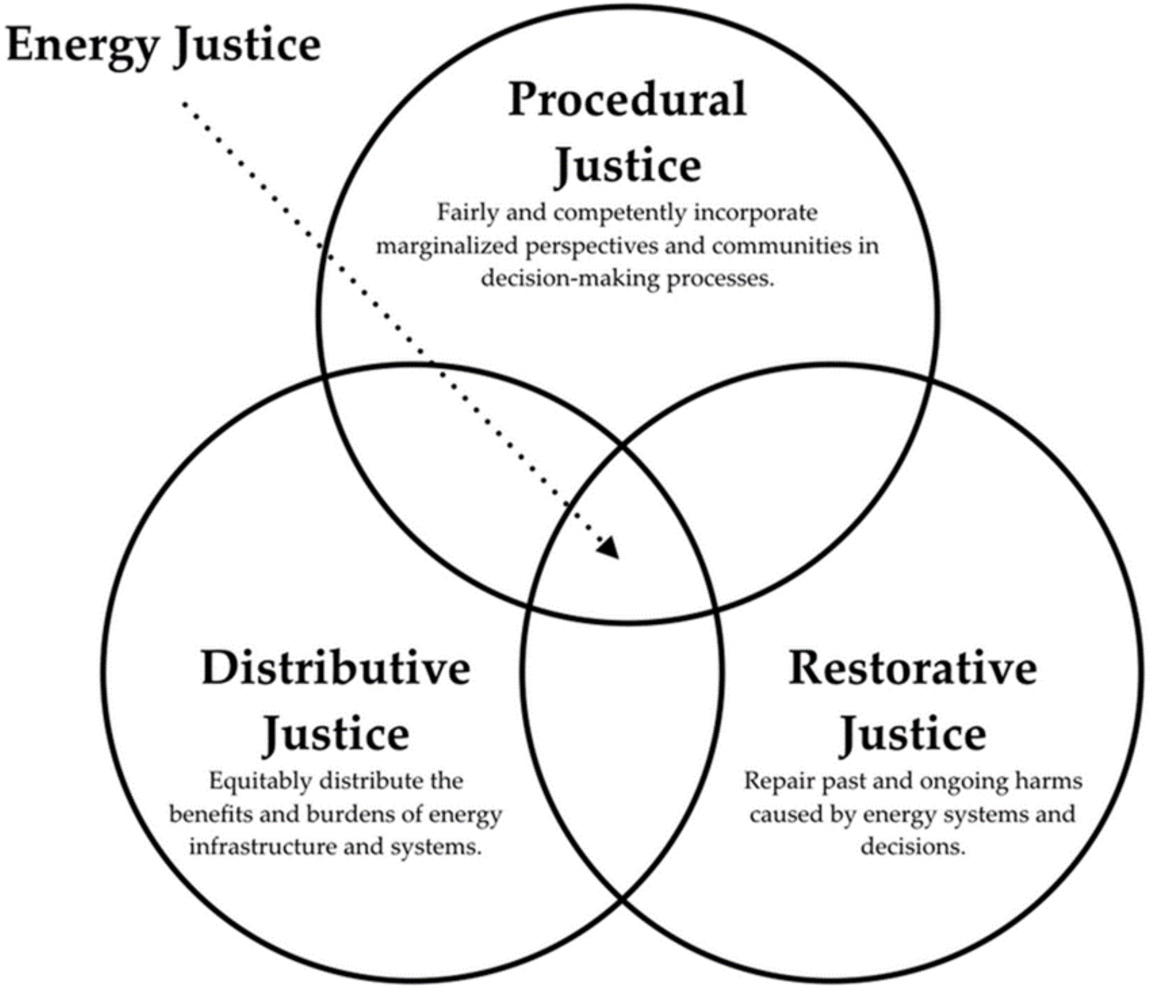
Conducted jointly with stakeholders.* Utilities perform engineering analysis to determine impacts, assess gaps, and develop solution options

*Hawaii set up a Resilience Working Group. See June 1, 2020 report: https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-engagement/working-groups/resilience-documents

Determine planning objectives and metrics	Sample Objectives (from Hawaii RWG): • Reduce outage risk during severe events • Increase ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially catastrophic event • Reduce restoration and recovery time following a severe event • Optimize cost (including capital and operating costs) • Return critical and priority customers' power within specified time • Return power to other customers within specified time Resilience Metric (from Hawaii RWG): Resilience Index that tracks restoration times with stated targets for critical, priority, and other customers
Identify and prioritize threats	Perform a threat assessment with key federal, state, and local stakeholders, as appropriate, to identify the potential threats and assess the risk of their probable impacts. See: FEMA Comprehensive Preparedness Guide (CPG) 201, Table 1, for a comprehensive list of threats (https://www.fema.gov/sites/default/files/2020-04/CPG201Final20180525.pdf)
Develop threat scenario reference cases	Develop reference cases for each threat scenario (e.g., low, moderate, severe) that characterize the threat and its impact on the grid, customers, and other critical infrastructures (e.g., hospitals, water/wastewater treatment, vulnerable individuals/populations, telecommunications, energy, and emergency services). Apply forecasts of future weather/climate threats.
Tiering and prioritization of key customers and infrastructure	Identify and prioritize key customers and infrastructure sectors with focus on system recovery and public safety and well-being: • Develop and apply criteria for identifying/prioritizing key customers and infrastructure based on priority and urgency. Categorize by tiers, e.g., Tier 1 represents critical customers/infrastructures, Tier 2 represents priority customers/infrastructures, and Tier 3 represents all others. (Hawaii criteria are on page 40.) Criteria development is a shared responsibility of the critical infrastructure sectors. • Alignment of tiering and prioritization needed with sectors/customers under existing emergency management, homeland security, and hazard mitigation/resiliency frameworks.
Determine capability gaps and solutions	Determine gaps in capabilities, including utility capabilities and self/back-up supply capabilities and requirements, and develop solutions. Apply cost-effectiveness framework (BCA vs least-cost/best-fit). Key customers and critical infrastructure owners/operators partner with utilities, other energy companies, and the government in developing local resilience solutions that can provide resilient power for essential service providers and enhance the overall resilience of the grid for all customers in mutually beneficial projects. Considerations include: • Implementing asset hardening practices, where needed • Developing and implementing load management/load curtailment capabilities • Maintaining ample onsite fuel supplies • Deployment of temporary emergency power generators • Partnering with utilities and the government to develop local microgrids • Utilizing grid-forming inverters so that renewables and DERS can provide a black-start capability • Ensuring availability of adequate road clearing equipment to speed recovery of key roads, etc.

Dimensions & Approaches of Energy Equity





Source: [Wallsgrove et al. 2021https://iejusa.org/section-1-defining-energy-justice/](https://iejusa.org/section-1-defining-energy-justice/)

Energy Equity Metrics

Procedural and Recognition (due process and accountability)	**Distributive** (affordability and availability)	**Restorative** (intra- and inter-generational sustainability and responsibility
• Representativeness and inclusiveness of planning processes for all affected stakeholders • Responsiveness of planning processes to public participation and fairness of decisions • Transparency of planning processes and decisions	• Electricity cost burden (i.e., household electricity bills/income) • Electricity affordability gap • Electricity quality (e.g., geographic disaggregation of outage frequency/severity; restoration efficiency) • Electricity program (e.g., tax credits; energy efficiency) and technology (e.g., BTM solar and storage) accessibility and performance (e.g., participation/investment demographics; distribution of savings/costs, reliability/resilience, or other benefits/burdens) • Social burden (i.e., effort and ability to access critical services)	• Economic (e.g., job training/job quality; energy resource ownership/governance; reparation of electricity cost burden shouldered by energy burdened communities) • Environmental (e.g., natural resource replenishment; generation/storage resource siting) • Social (e.g., improvements in household-human development index; establishment of safeguard/grievance redress mechanisms)

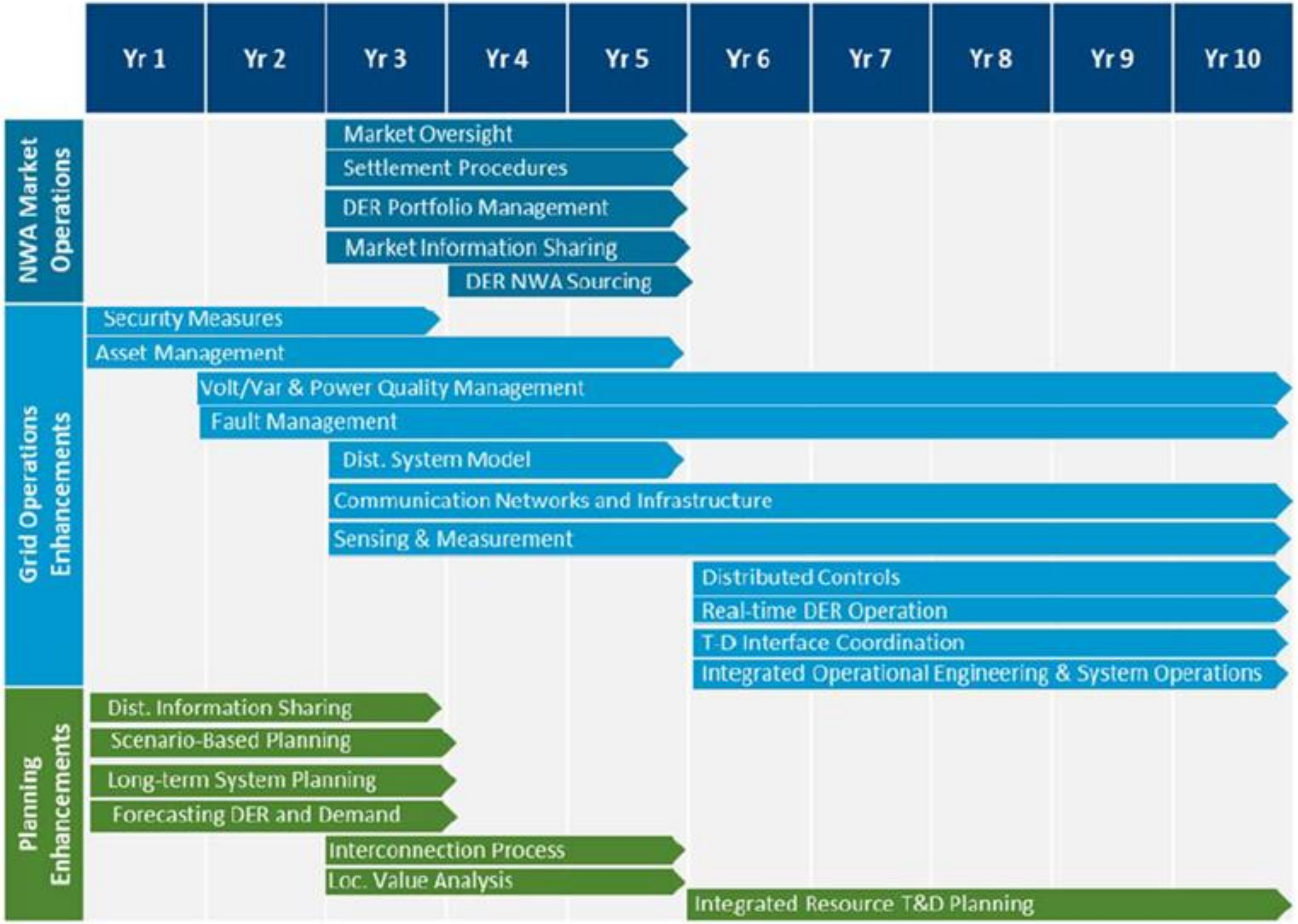
[Section 40101(d) Formula Grants to States & Indian Tribes | netl.doe.gov]

Taxonomy Example

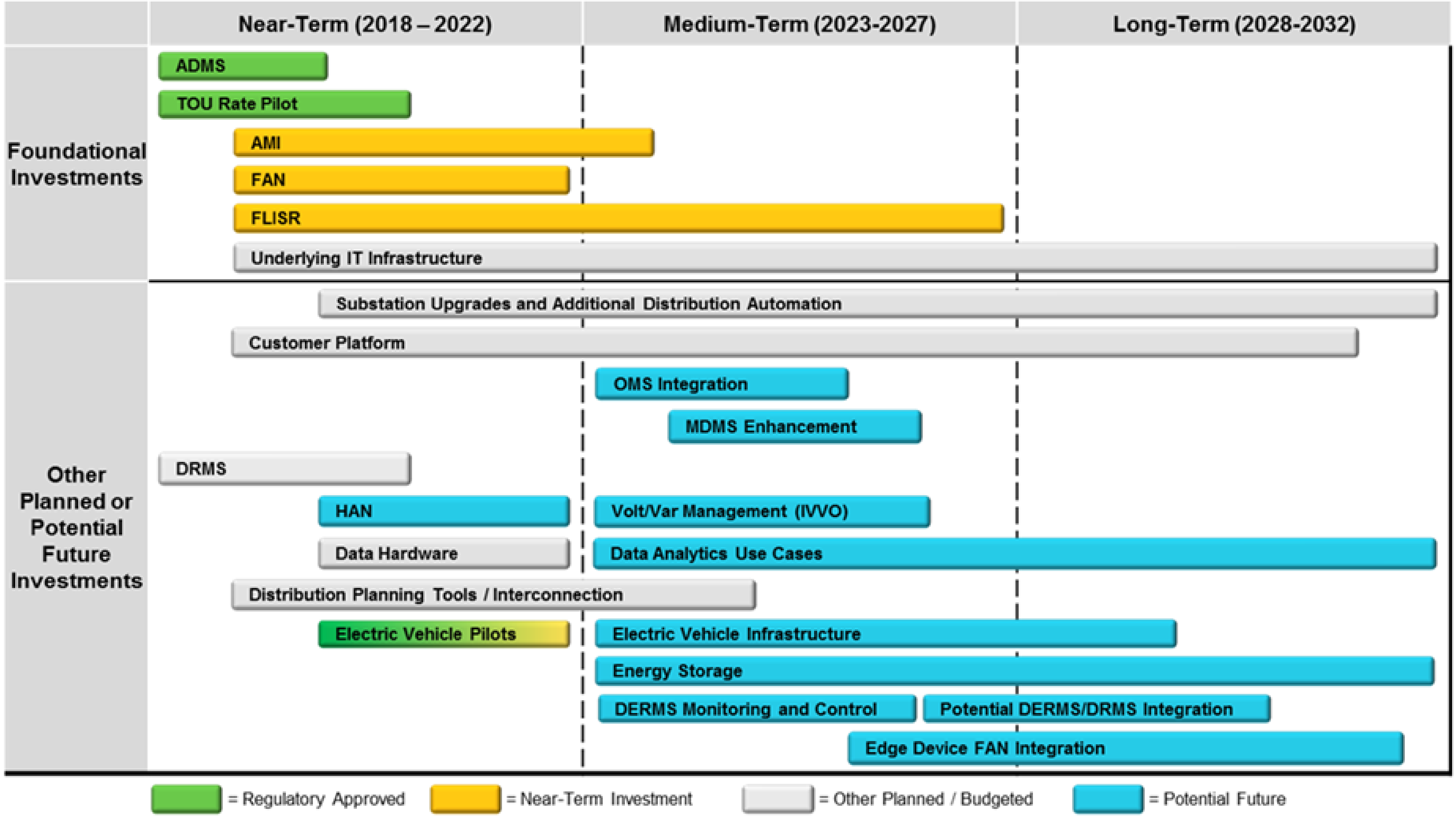
Objective	Attribute	Capability	Function	Technology
Enable customer choice	Information to support customer decisions	Provide online customer access to relevant & timely information by 2020 for small business & residential customers	Remote meter data collection & verification Customer data management Energy management & DER purchase analysis	Customer Portal Customer analytic tools Greenbutton Time interval metering Meter Data Management System Customer Info System Data Warehouse Meter communications

Source: DOE-OE, 2017. *Modern Distribution Grid, Volume I: Customer and State Policy Driven Functionality*. Available online at: https://gridarchitecture.pnnl.gov/media/Modern-Distribution-Grid_Volume-I_v1_1.pdf

NH PSC's Staff Conceptual Functional Roadmap



Xcel Energy 15-Year Grid Mod Roadmap (2019)



Questions