U.S. DEPARTMENT OF ENERGY
Office of Electricity

Integrated Distribution System Planning with Considerations for Resilience

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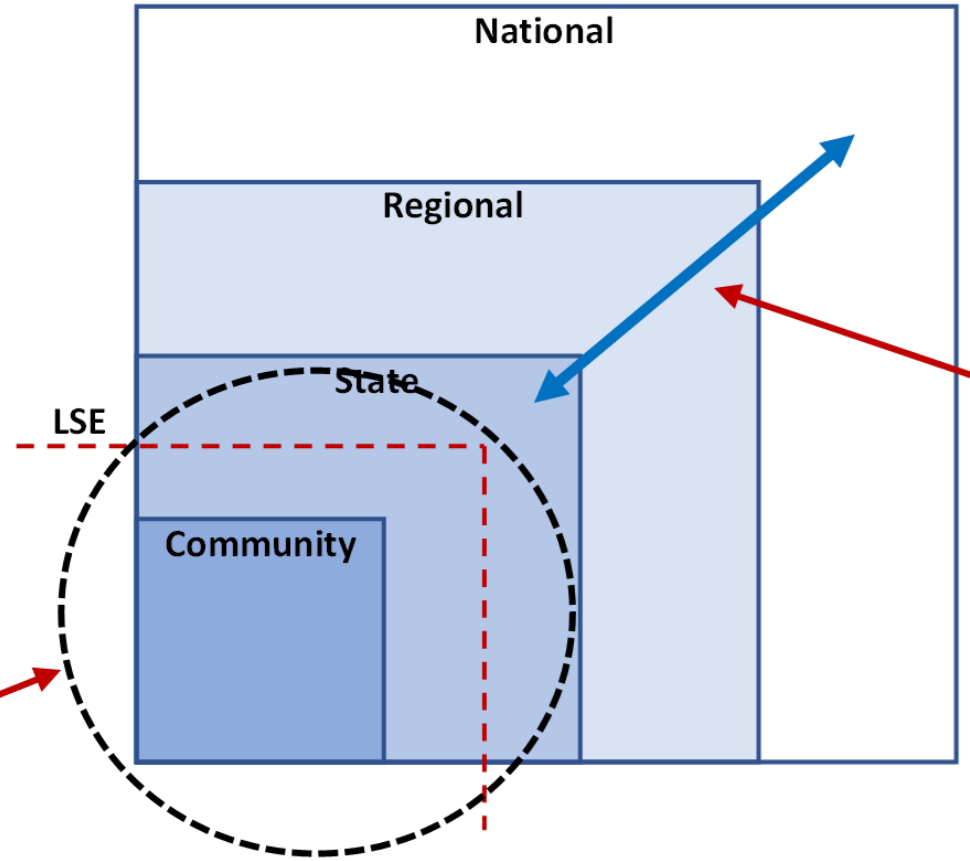
Resilience Training for the Southeast
Public Service Commission of South Carolina
May 9, 2023

Scale of Integrated Planning

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



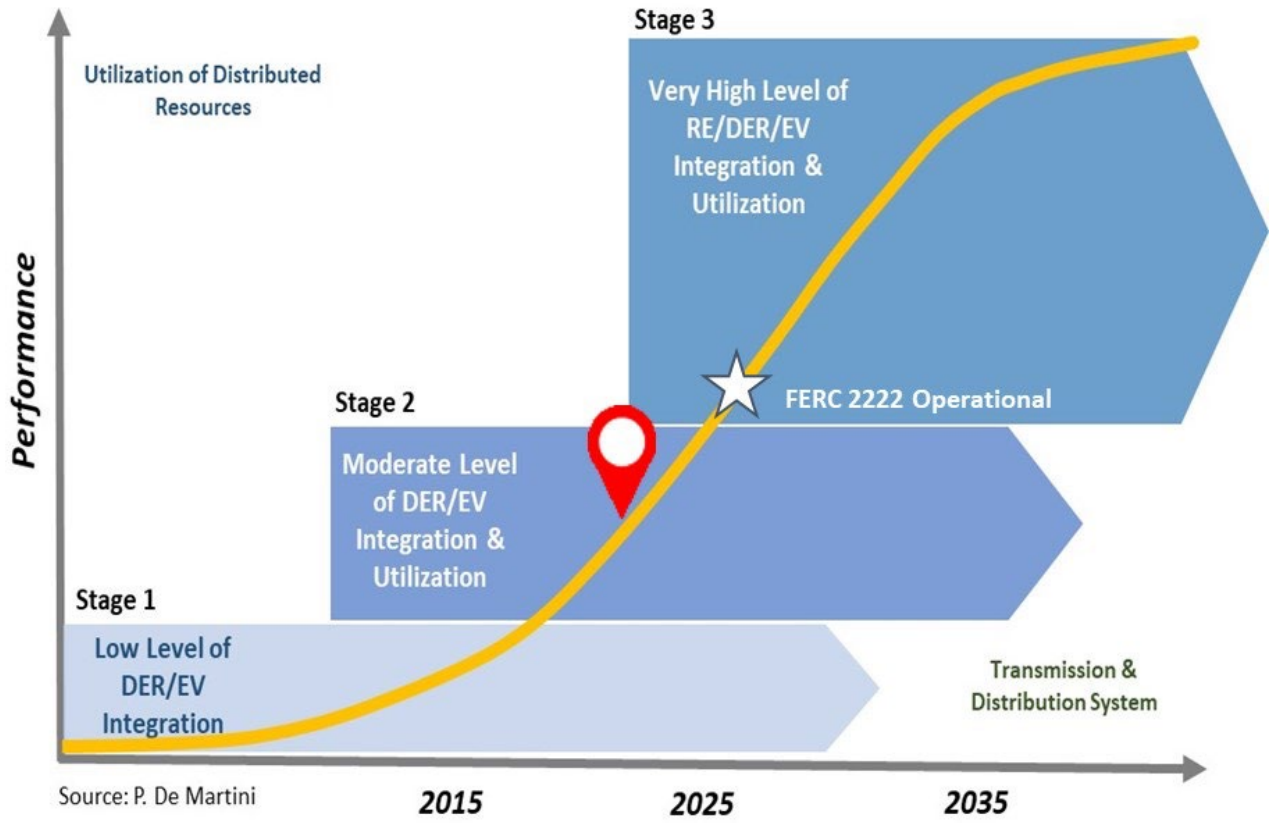
Alignment of community and state strategies with regional, multi-state strategies

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

Distribution System Evolution

Increased use of distributed energy resources means additional complexity in grid planning and operations

Stage 1: *Low DER adoption (<5% of peak*)*. DER levels can be accommodated within existing distribution systems without material changes to infrastructure, planning and operations. Grid modernization addresses reliability, resilience, safety, and operational efficiency and enabling DER integration and utilization at low levels.
Stage 2: *Moderate adoption of DERs (5-20% of peak) including for wholesale & distribution services.* DERs — individually and in aggregations — are increasingly used as load-modifying resources for both distribution non-wires alternatives (NWAs) and wholesale capacity and ancillary services. Integrated distribution system planning and grid modernization are needed to enable real-time observability and operational use of DERs.
Stage 3: *Large-scale adoption of DERs (>20% of peak), including for wholesale & distribution services, plus community microgrids.* Utilization of DER aggregations (virtual power plants) is optimized to support grid service requirements for distribution and transmission systems. Multiuse/ community microgrids help support local energy supply and resilience. Ultimately, distribution system-level energy transactions are enabled. This stage of DER utilization requires coordination across jurisdictions (e.g., FERC Order 2222) and infrastructure to support both grid and market operations.

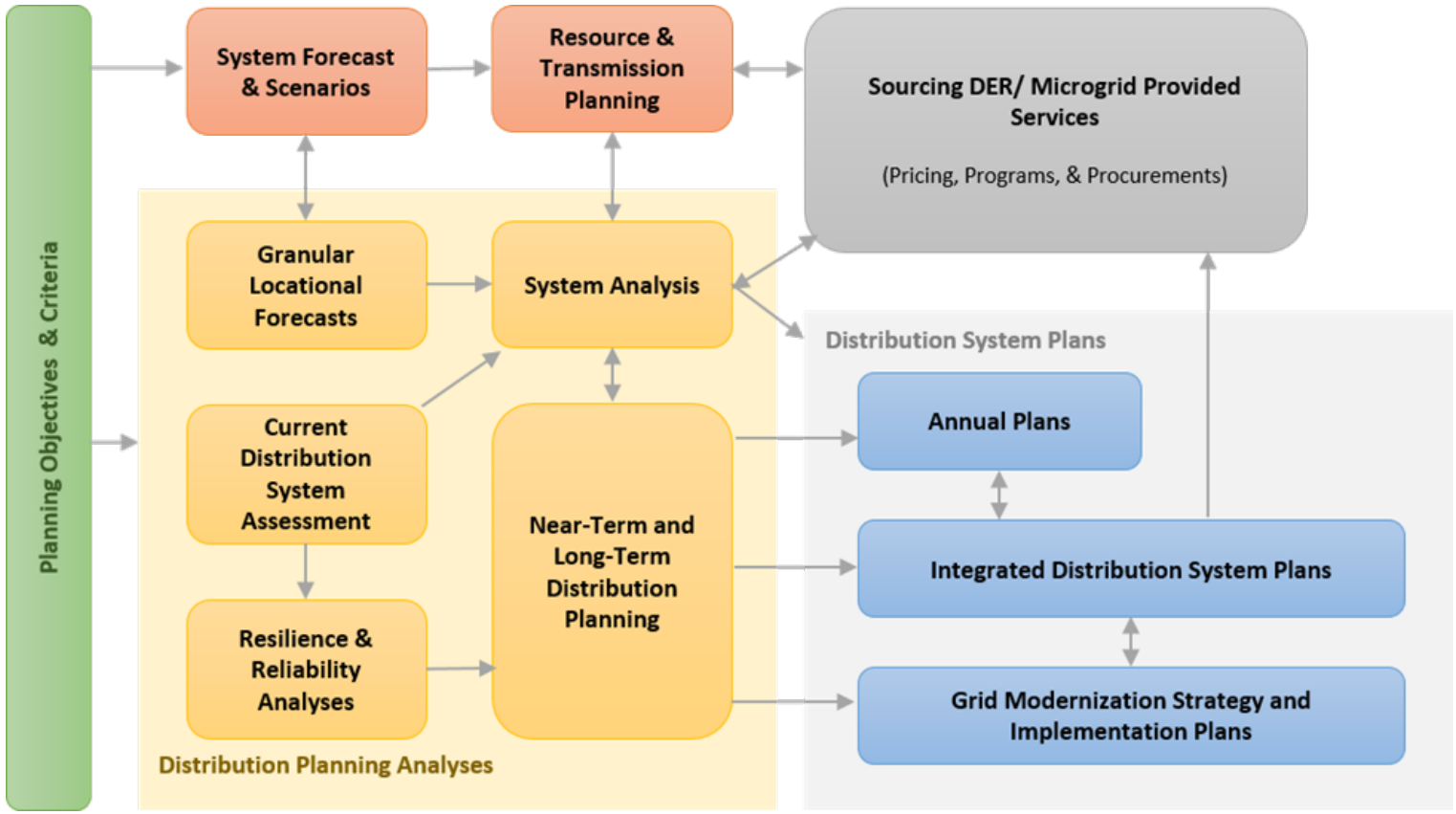


*Installed DER capacity as a percent of distribution system peak

Objectives-Based Planning

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

Planning objectives, metrics, and priorities are derived from state & community policies and customer needs.



Regulators* review and approve plan with input from stakeholders

*The term "regulators" includes the approving boards of cooperative and municipal utilities, as well as regulators of investor-owned utilities.

From Modern Distribution Grid Guidebook, DSPx Volume IV, June 2020, PNNL: Grid Architecture - Modern Distribution Grid Project

Considering Equity and Resilience

Policy Development	Regulation
For example, policies on: • Public 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 annual and long-term plans to address resilience and grid modernization

Utility Planning and Analysis

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)

Source: 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.

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)

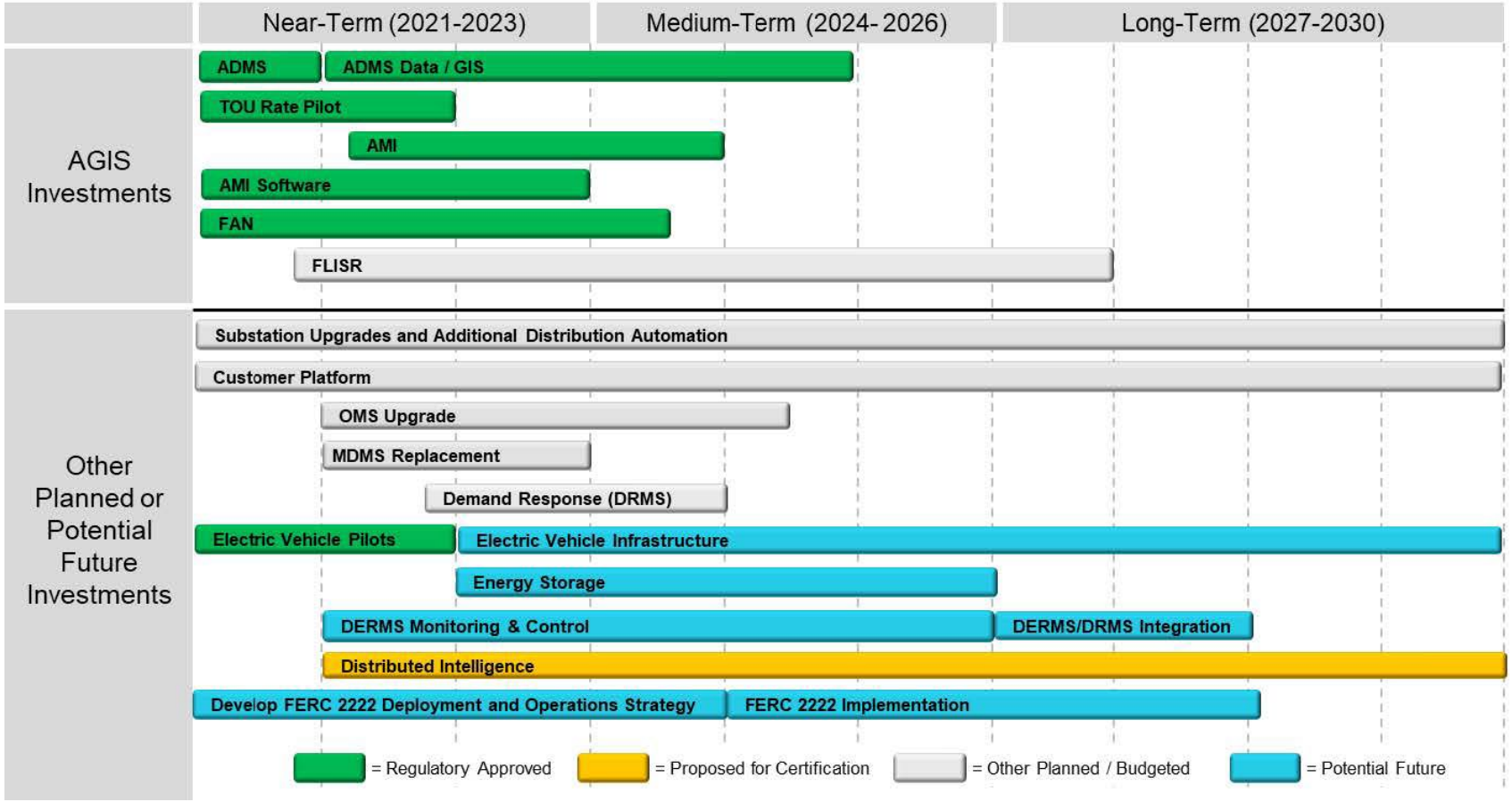
Monitoring and control of system state to enable adaptive response capabilities in real-time and for predictive analysis (modeling, simulation, and analytical platforms)

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

Note: Best practices are available for each of these measures. FPL is an example of a utility that continuously improves its hardening and asset management practices and information platforms for emergency crews. Utilities such as Austin Energy, as well as PJM, are implementing real-time sensing and controls to mitigate wildfires and control assets under emergency conditions.

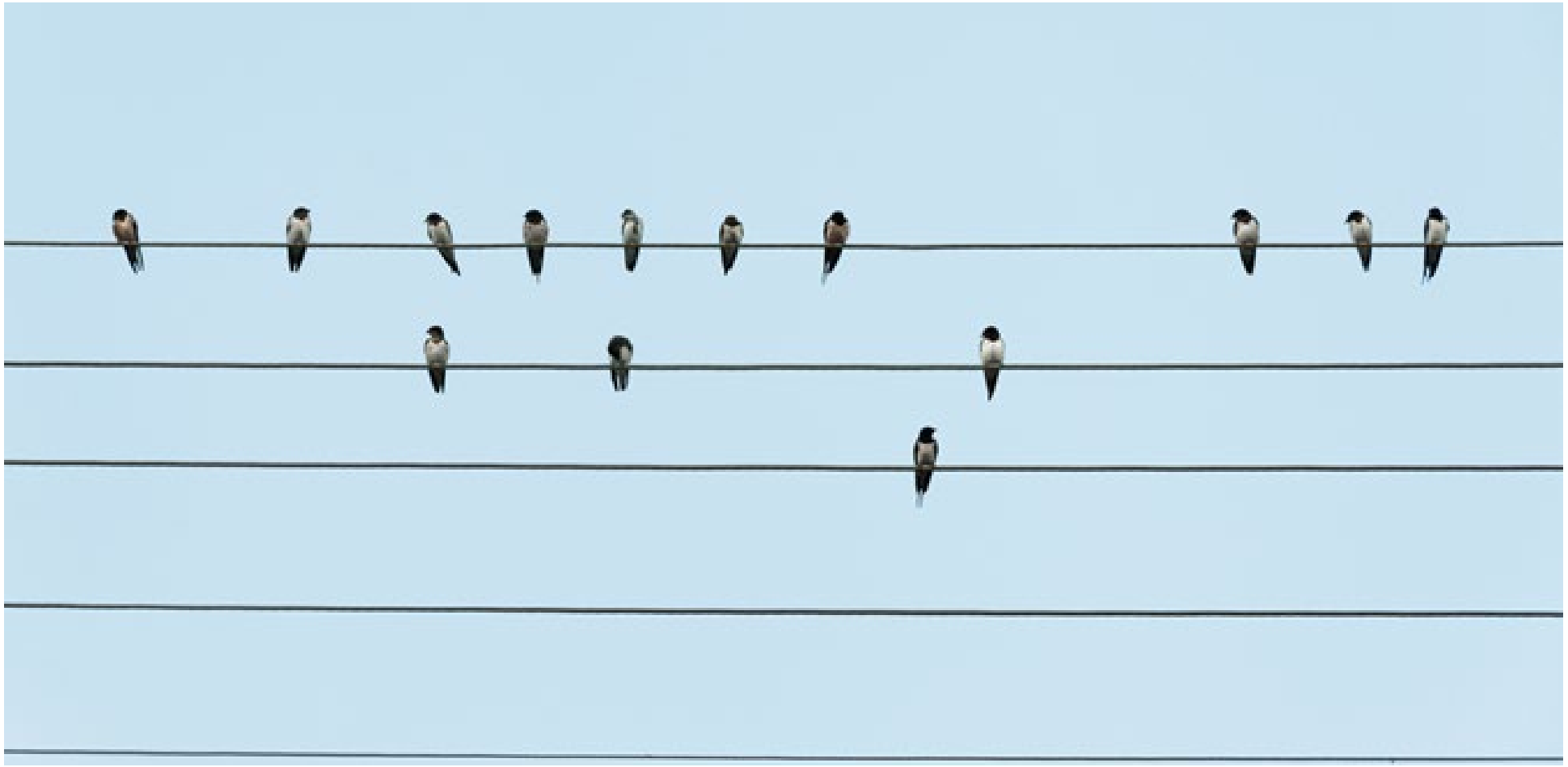
Xcel Energy 10-Year Grid Modernization Roadmap (2021)

Xcel Energy's roadmap reflects a staged and proportional technology deployment strategy based on need



Source: [Integrated Distribution Plan 2022-2031](), Northern States Power Company, Xcel Energy, November 1, 2021

Thank You



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