Item 5.3: Grid Transformation Update

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Vice-President, DevOps and Grid Transformation

Technology and Security Committee Meeting
Public Session

ERCOT Public
June 23, 2025

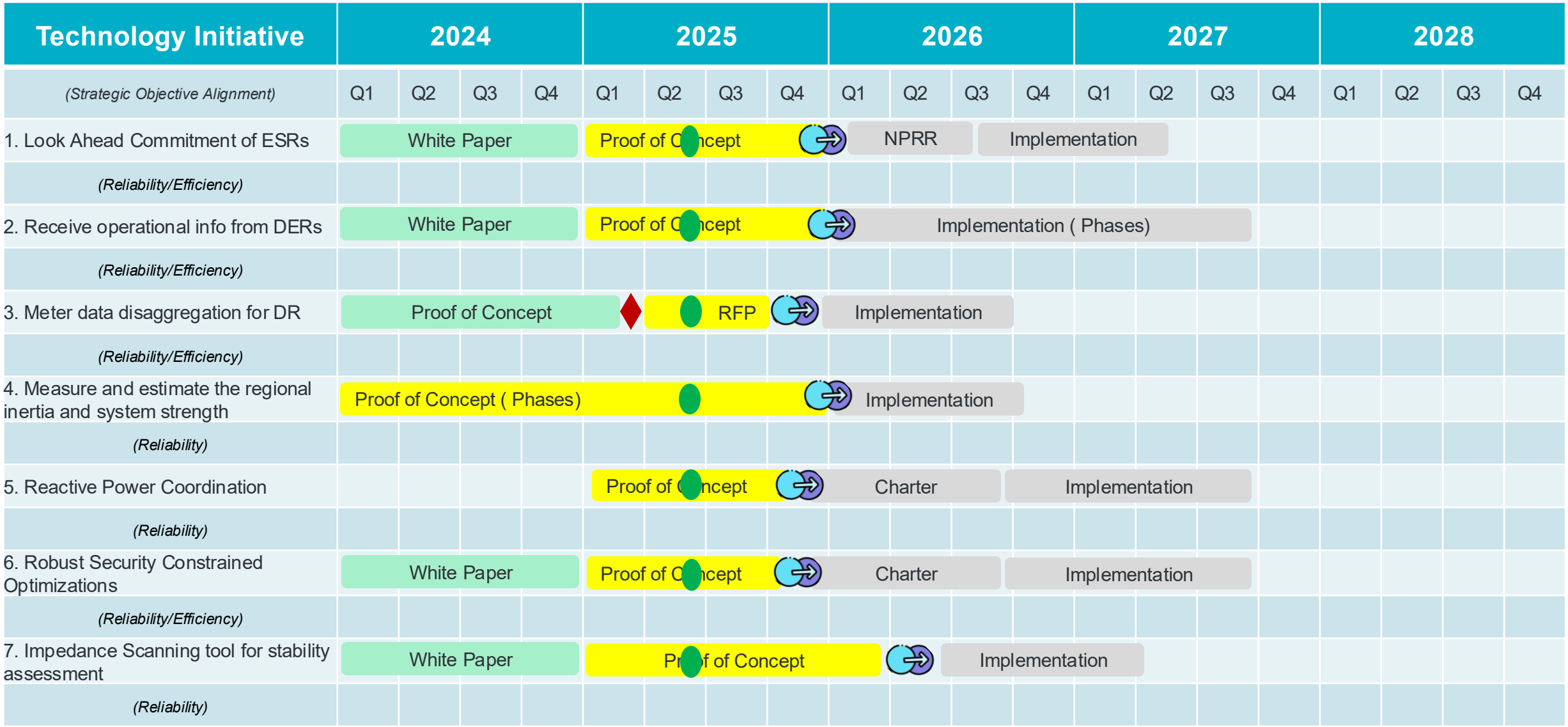
Overview

- **Purpose**
  Provide an update on the unbudgeted expense for the Innovation Summit

- **Voting Items / Requests**
  No action is requested of the ERCOT Board; for discussion only

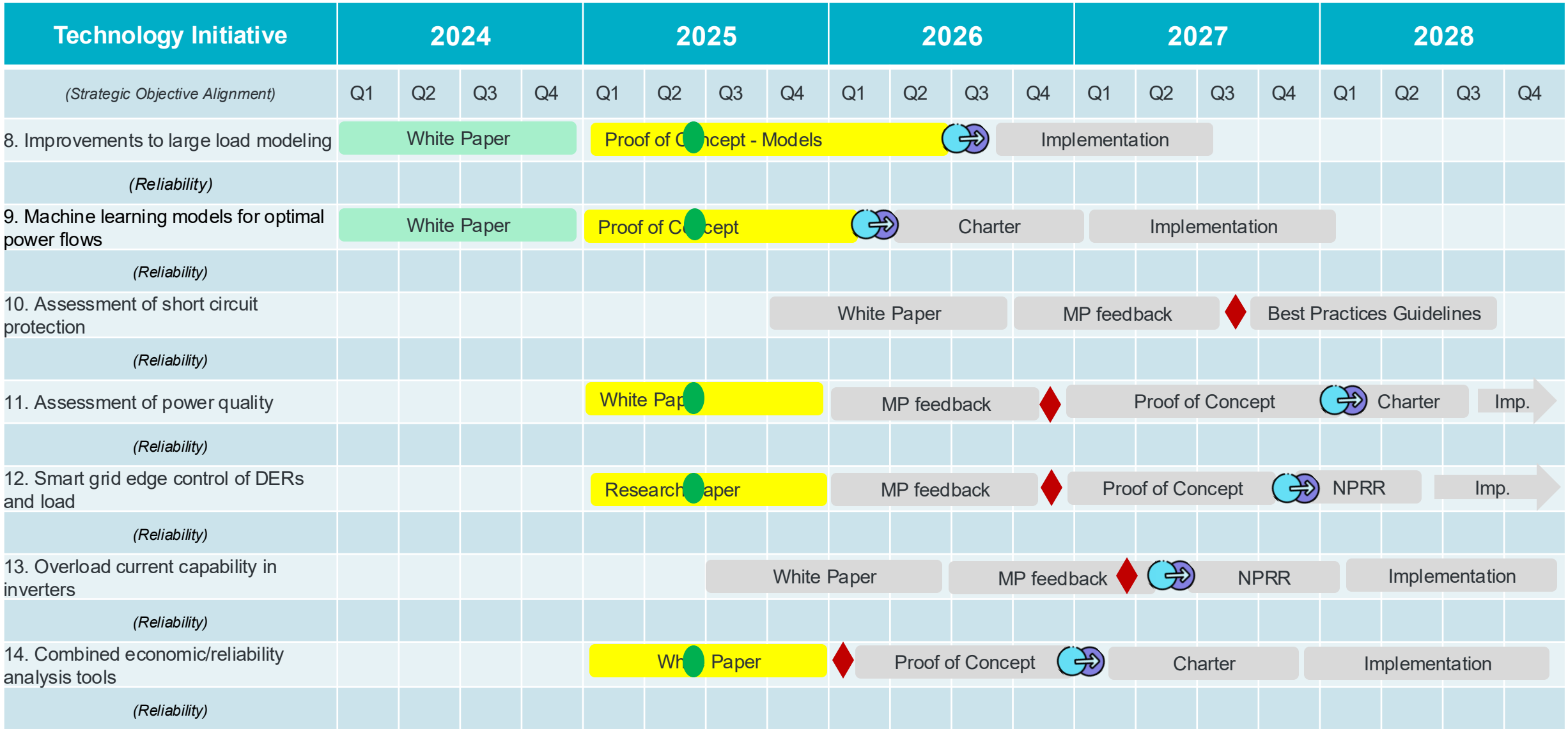
- **Key Takeaway(s)**
  - Grid Transformation Initiatives are all trending to plan
  - 2025 Innovation Sumit was successful

Grid Transformation – Technology Initiatives – Roadmaps



Legend: Complete | In-Progress | Potential Next Steps | On Track | Transition | Decision

Grid Transformation – Technology Initiatives – Roadmaps



Legend: Complete | In-Progress | Potential Next Steps | On Track | Transition | Decision

ERCOT Second Annual Innovation Summit

Positive Feedback

- 66% - "Excellent" & 33% - "Good“

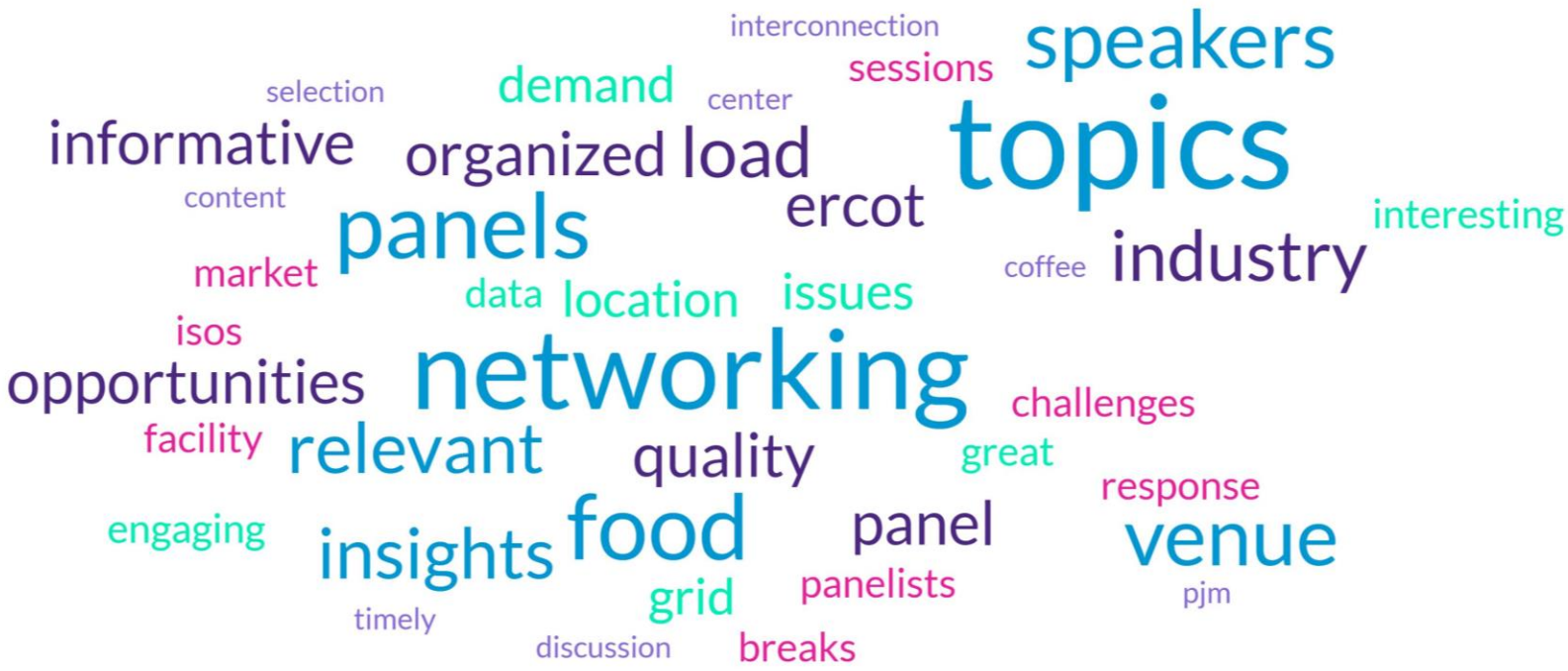
Suggestions for Improvement

- Improving audience engagement
- Enhancing the format of panels

Interest in Future Innovation Summit

- 92% Yes – Will Attend

Survey – Tell us what you liked?

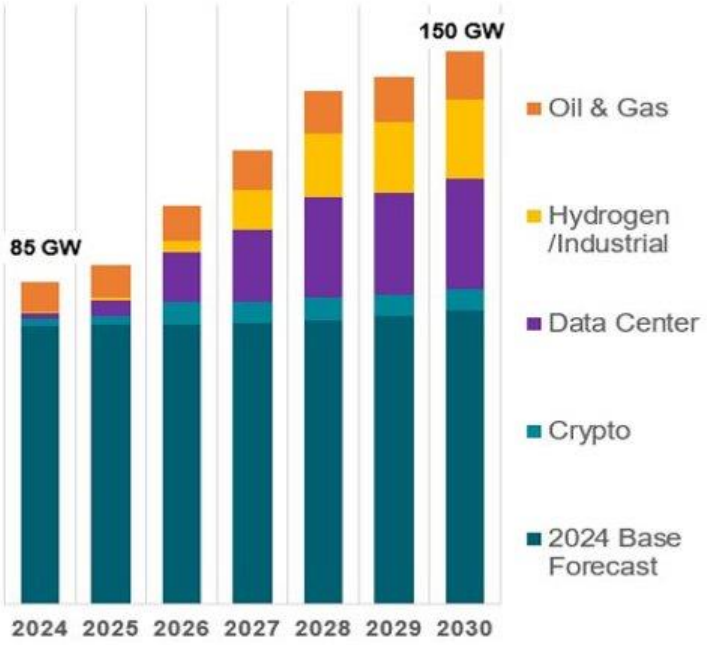


Survey – Suggestions on how we could improve?

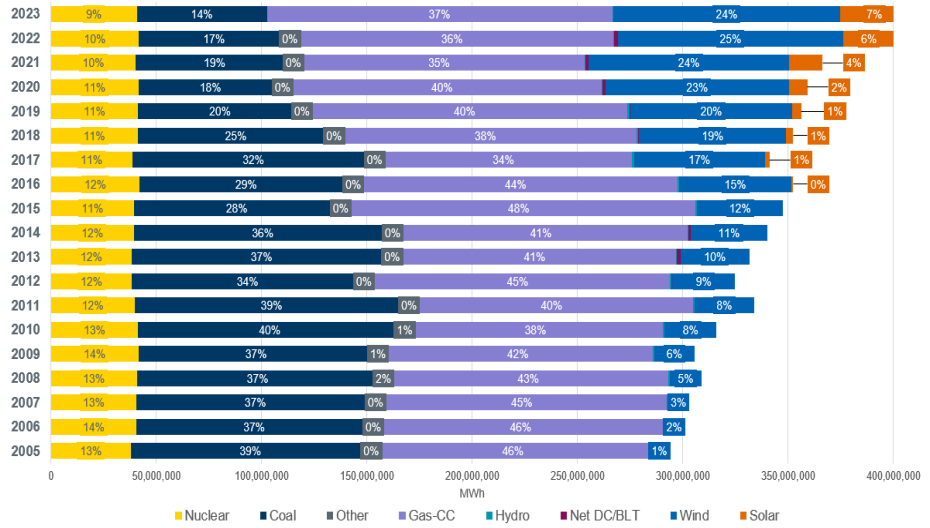
Appendix

Grid Transformation (GT)

Projected demand is growing



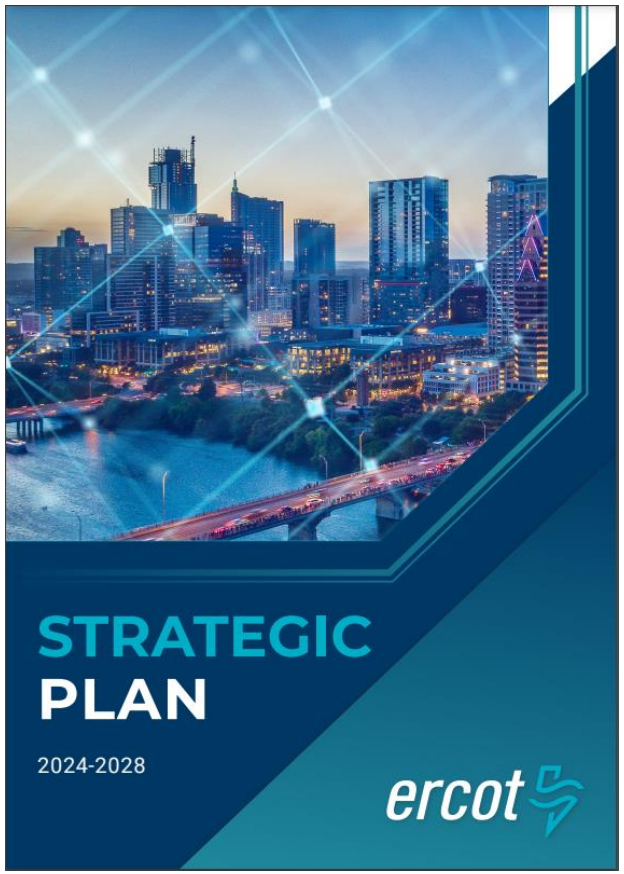
Energy Fuel mix is changing



Distributed Energy Resources are increasing

Grid Transformation – The mix of energy sources and locations where electricity is generated are changing to keep up with demand

ERCOT Strategic Objectives

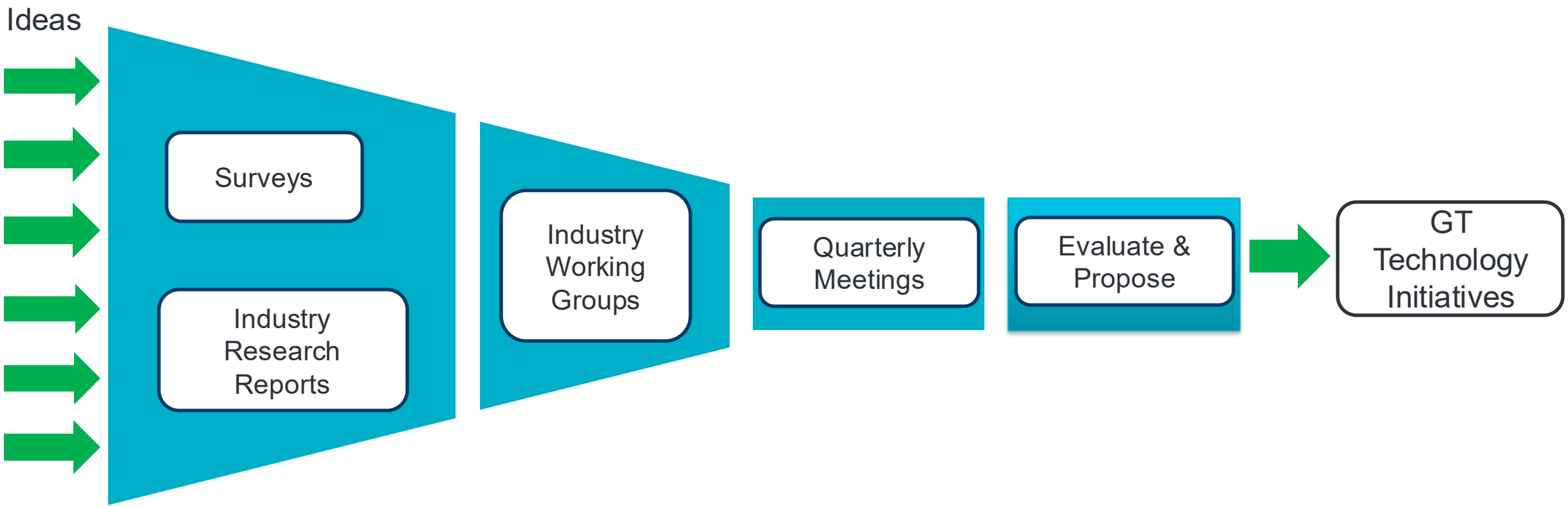


Website Link - Plan

- Be an industry leader for grid reliability and resilience
- Enhance the ERCOT region's economic competitiveness with respect to trends in wholesale power rates and retail electricity prices to consumers
- Advance ERCOT, Inc. as an independent leading industry expert and an employer of choice by fostering innovation, investing in our people, and emphasizing the importance of our mission

Grid Transformation organizational function's role is to evaluate and propose technology pathways to enable ERCOT to efficiently and effectively achieve these strategic objectives.

Grid Transformation – Technology Initiatives – Stage Gate Process

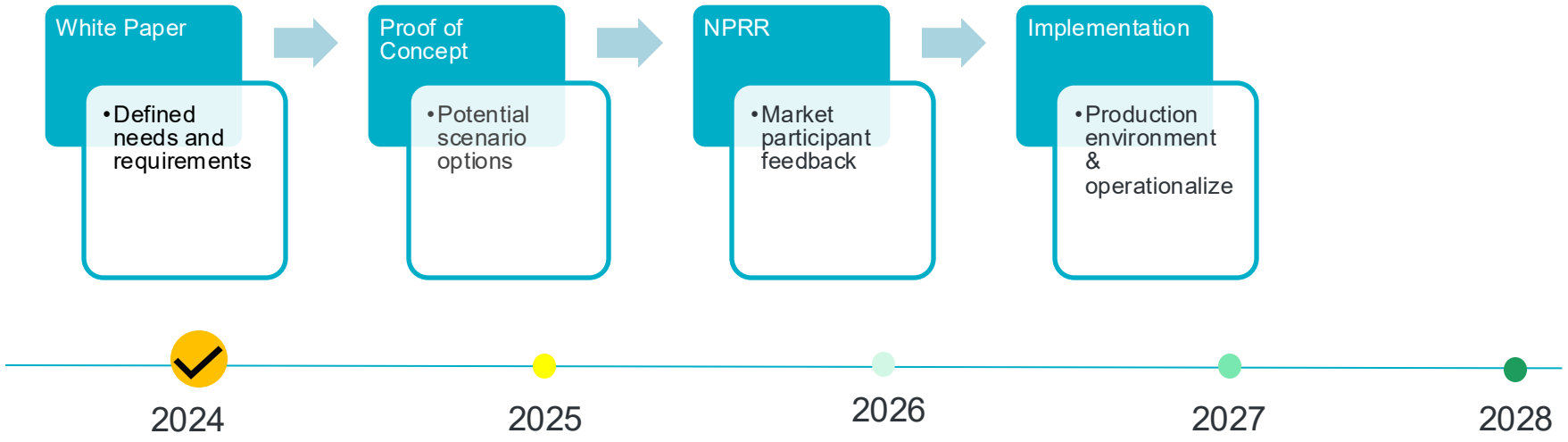


Process in place to strategically pick, focused initiatives from lot of ideas along with periodic review to access progress and impact

GT How: 1. Look Ahead commitment of Energy Storage Resources (ESR)

Problem: Large penetration of Energy Storage Resources which operate differently than traditional energy sources

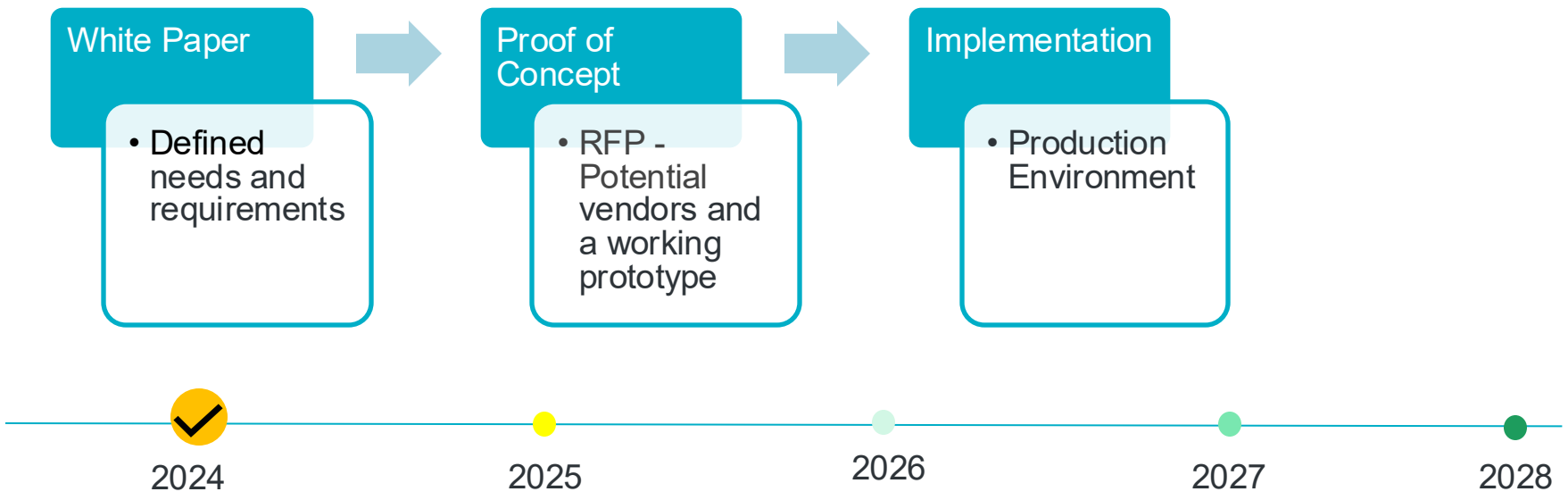
Solution: Look ahead commitment and dispatch of ESRs leveraging state of charge



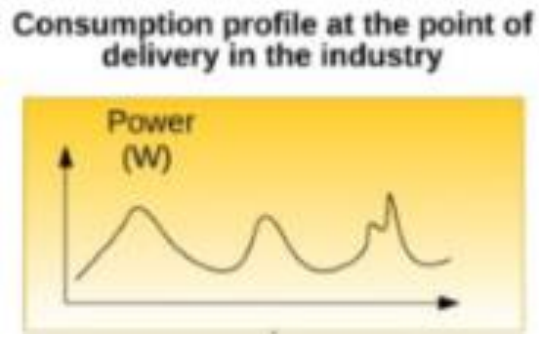
GT How: 2. Receive operational info from Distributed Energy Resources (DER)

Problem: Lack of situational awareness in a DERs dominated grid

Solution: ERCOT Distribution Awareness Platform (EDAP) to bring operational data into ERCOT systems

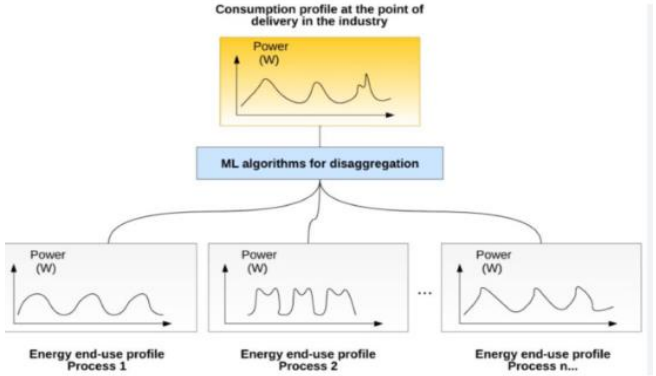


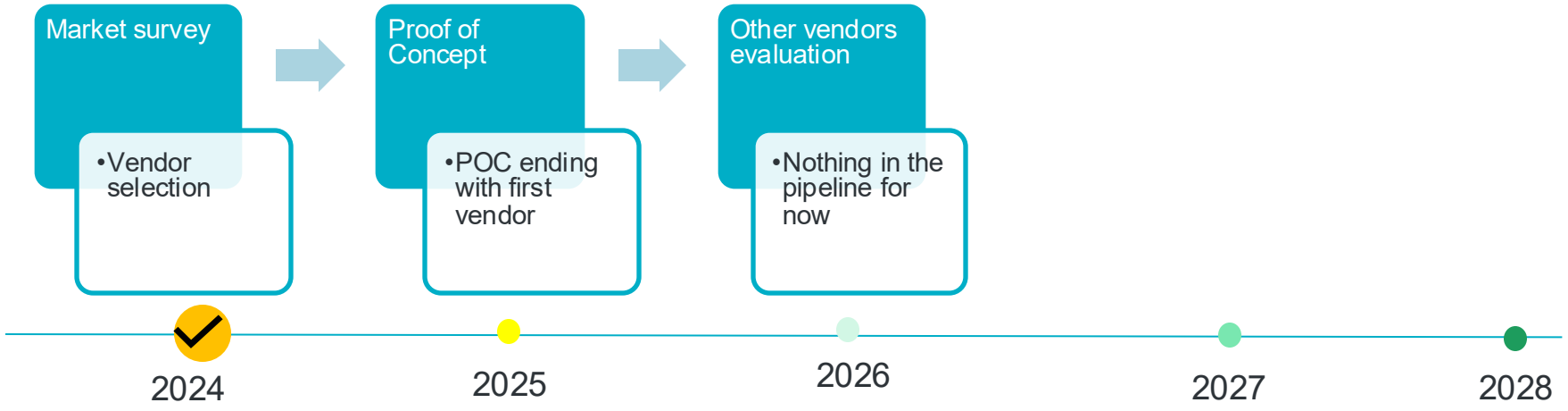
GT How: 3. Meter Data disaggregation for demand response



Problem: Lack of situational awareness of behind the meter assets

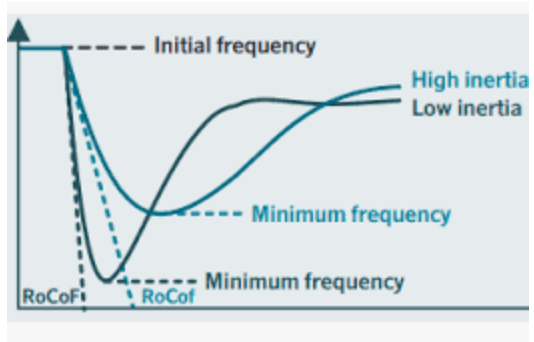
Solution: Meter Data disaggregation using AI/ML techniques





GT How: 4. Measure and estimate regional inertia and system strength

Problem: Inertia and system strength are measure of system stability. With high IBR penetration, it is important to measure them real time as they might decrease to critical levels during operations



Solution: On-line tools for operations to measure inertia and system strength

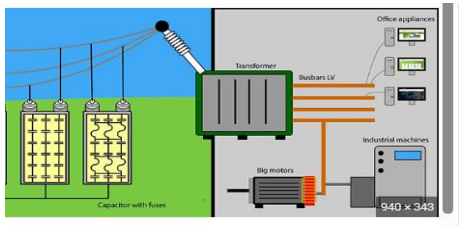
Vendor evaluation
- Defined requirements and market survey

Proof of Concept
- Test tool in the operations setting

Implementation
- Production environment and operationalize processes and procedures

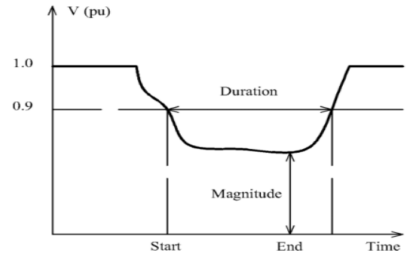
2024 2025 2026 2027 2028

GT How: 5. Reactive Power Coordination



Problem: Need to ensure reliable system voltages with changes in generation mix

Solution: Look ahead multi-time interval reactive power coordination to ensure reliable system voltages



Proof of Concept
- Potential vendors and a working prototype

Project charter
- Design feedback

Production
- Implementation

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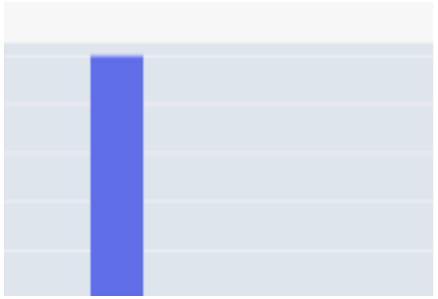
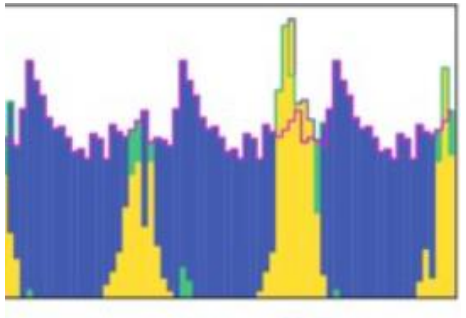
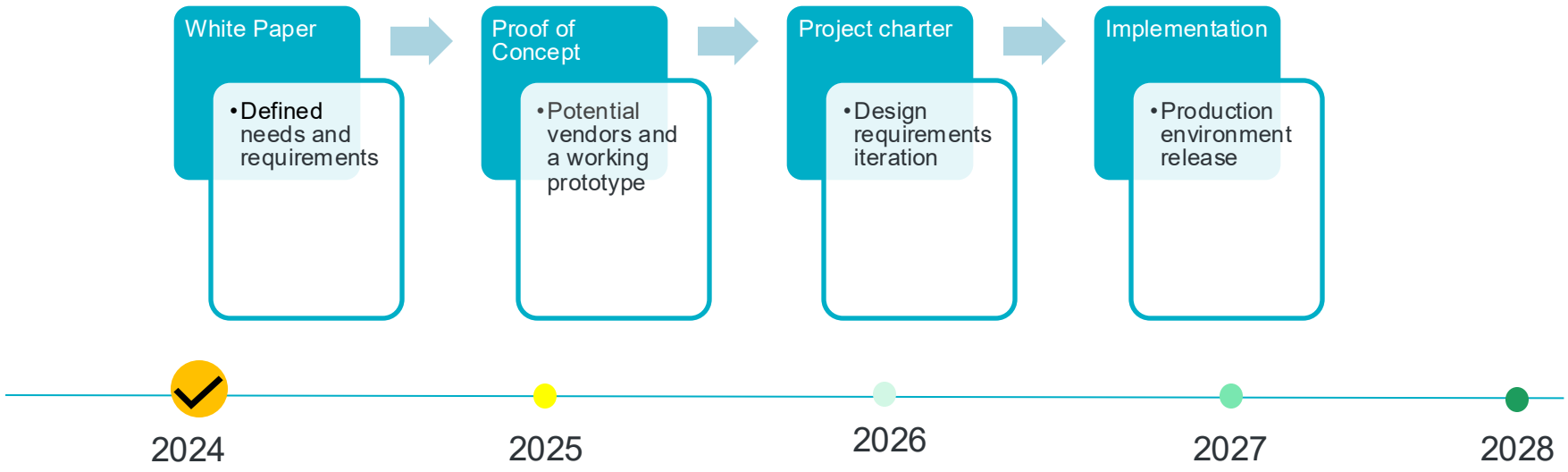
GT How: 6. Robust Security Constrained Optimizations



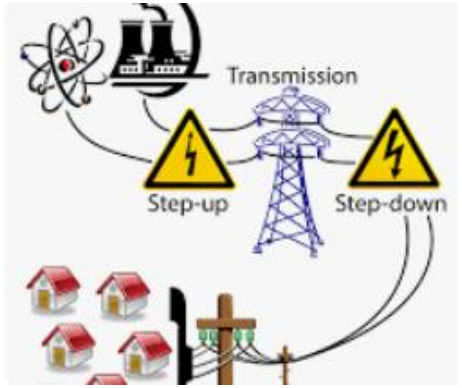
Problem: Need for intra-hour fast security constrained AC OPF analysis due to increased uncertainty & variability

Solution: Fast & robust techniques/tools to move to intra-hour analysis



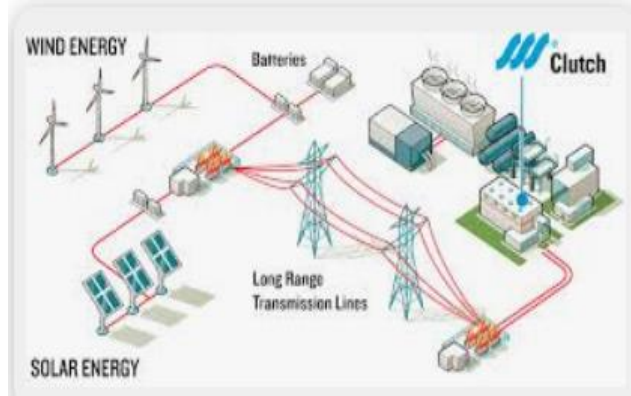


GT How: 7. Impedance scanning tool for stability assessment



Problem: Existing stability studies tools are hitting the limits with high IBR penetration making analysis complicated

Solution: Fundamentally understand tools vs actual grid issues and implement new tools for stability studies



White Paper
- Defined needs and requirements

POC
- Test cases and tools testing

Implementation
- Adoption of the tools for system studies

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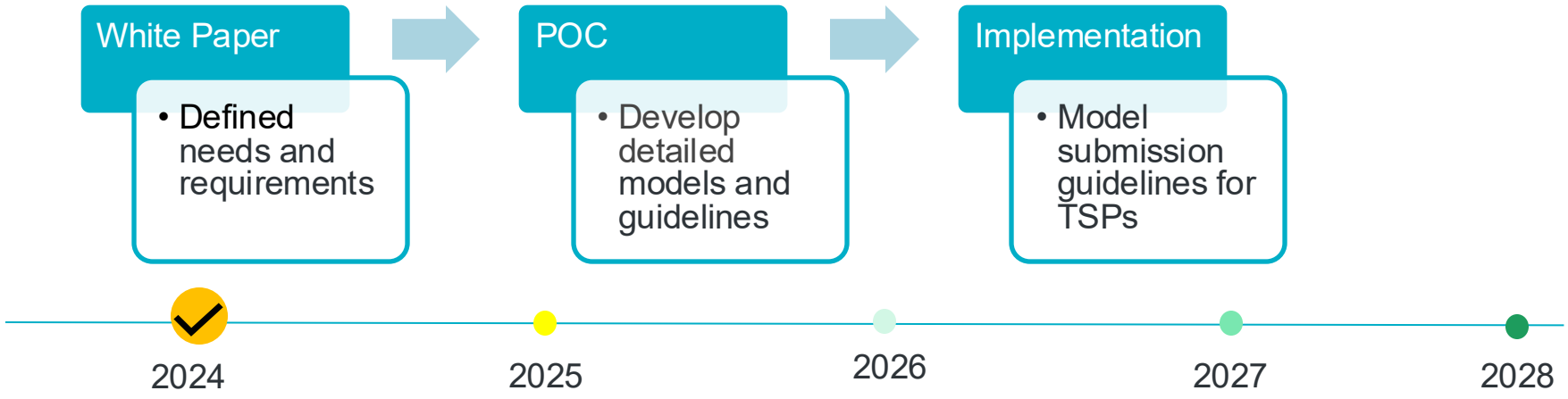
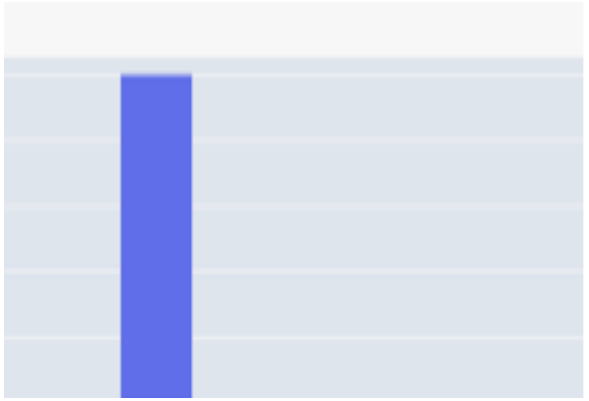
GT How: 8. Improvements to large load modeling

Problem: Large power electronics-based loads behave differently then conventional loads and are large enough to impact grid reliability

Solution: Understand how crypto, data centers, and Electrolyzers work; develop models and model submission guidelines

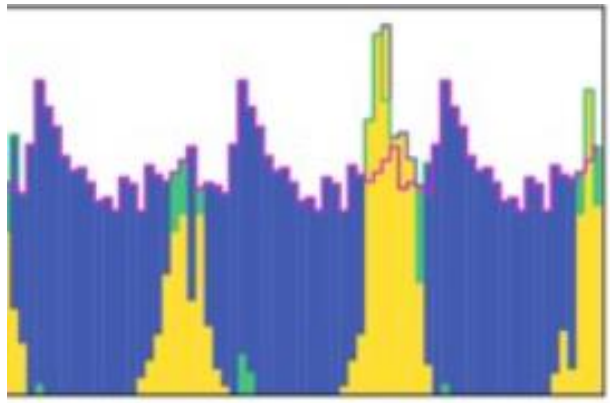


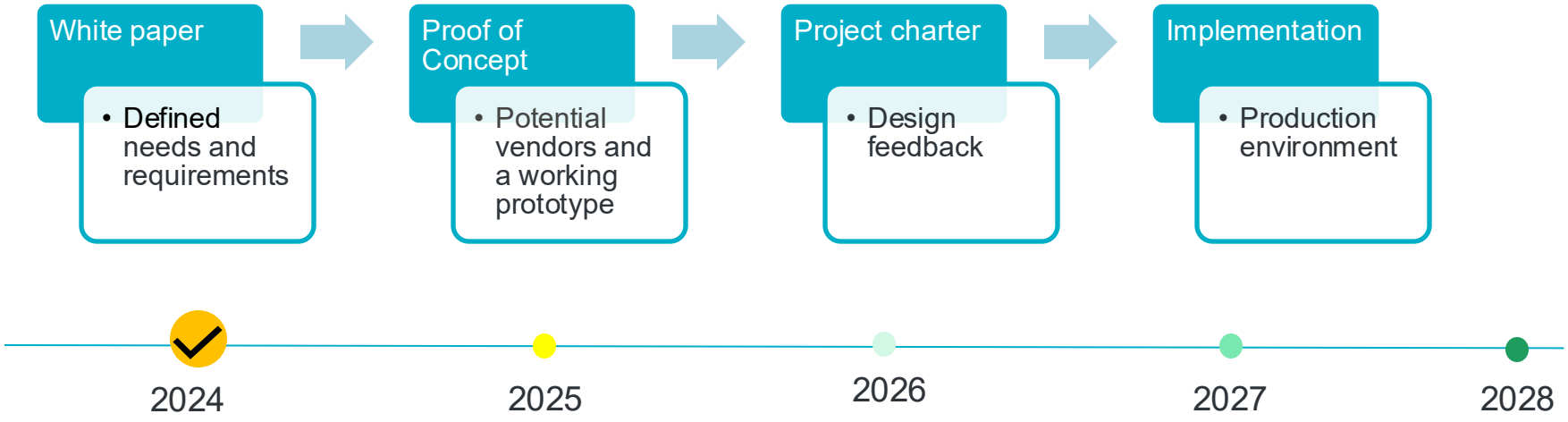
GT How: 9. Machine Learning models for optimal power flows



Problem: Power systems simulations requires complex optimization and can limit the run time of the simulation tools and hence how the grid is studied

Solution: Experiment fast AI/ML techniques to make the tools fast

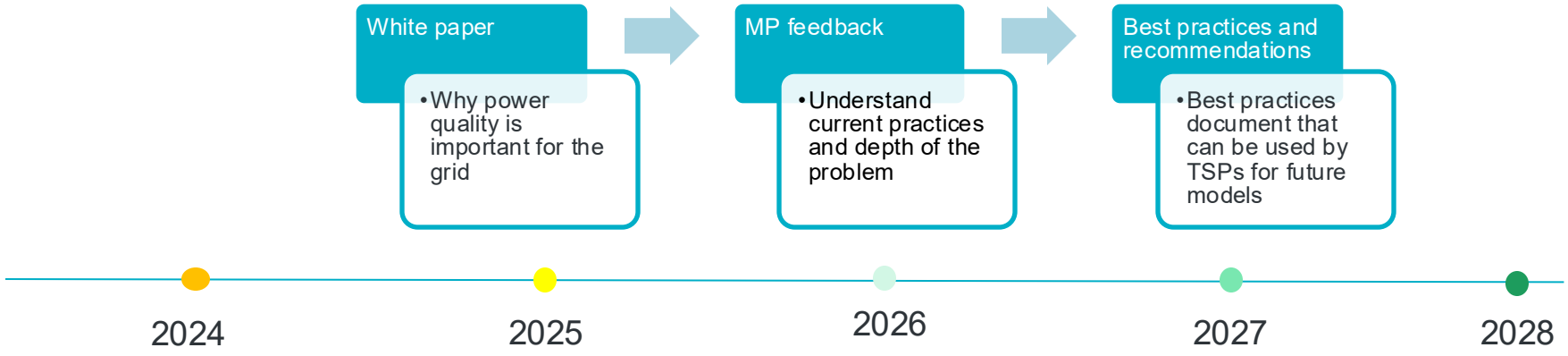




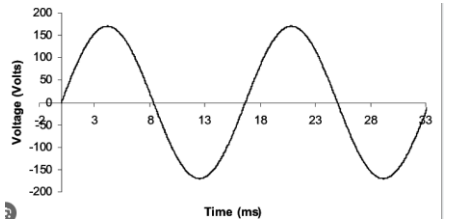
GT How: 10. Assessment of short circuit protection

Problem: With high IBR penetration, system short circuit contribution is changing which can impact how protection system operates

Solution: Investigate protection study models and methodologies, and best practices guideline for future improvements

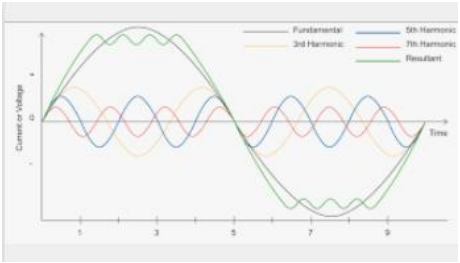


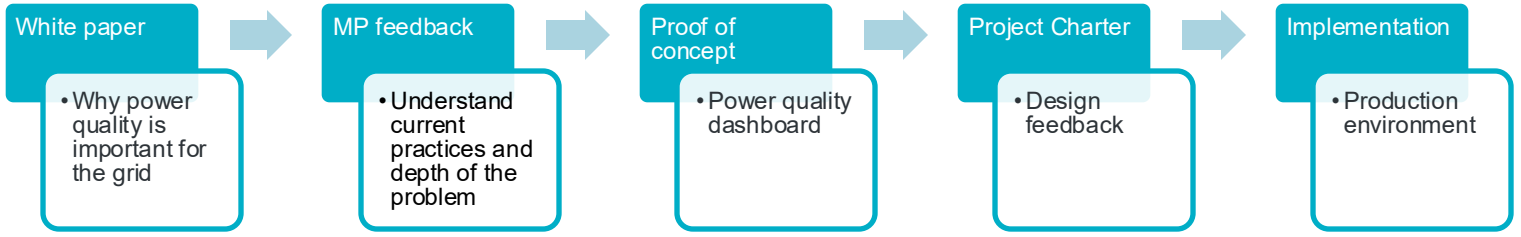
GT How: 11. Assessment of Power Quality

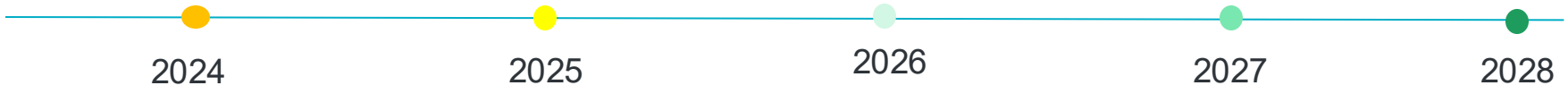


Problem: IBRs and large loads create harmonics which are required to be within the 519 standard limits but with the increasing penetration, there can higher background harmonics in some areas of the grid

Solution: White paper on importance of power quality, current practices, and operational dashboard



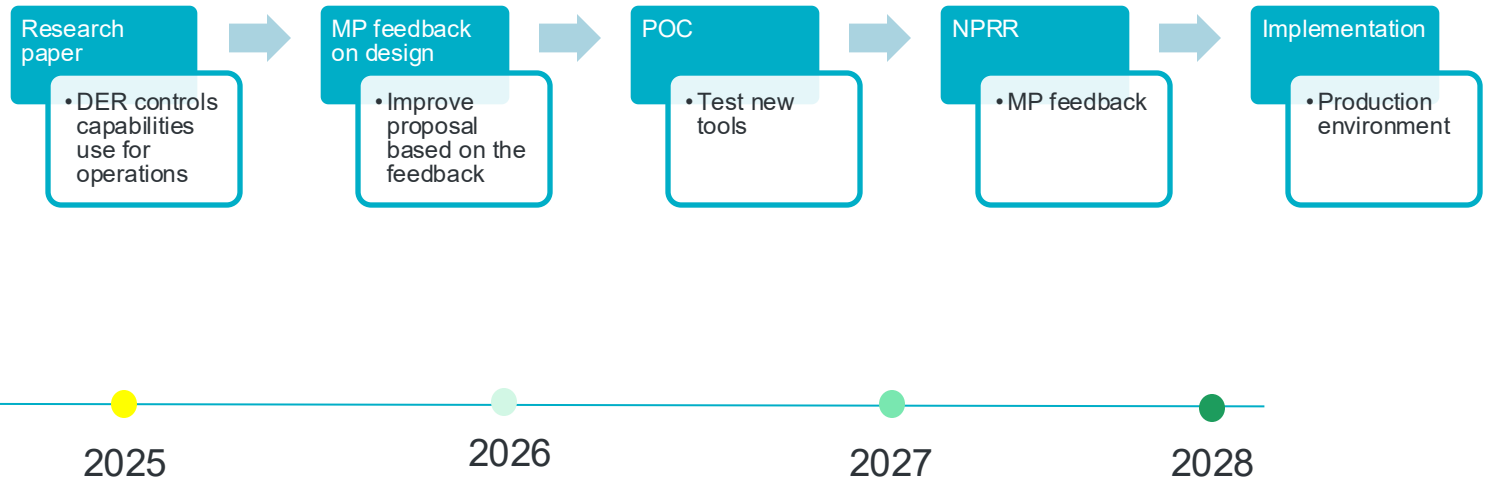




GT How: 12. Smart Grid edge control of distributed energy resources

Problem: DERs are increasing in the system and ERCOT might need to control the DERs if their net impact on the grid is significant in some parts of the grid

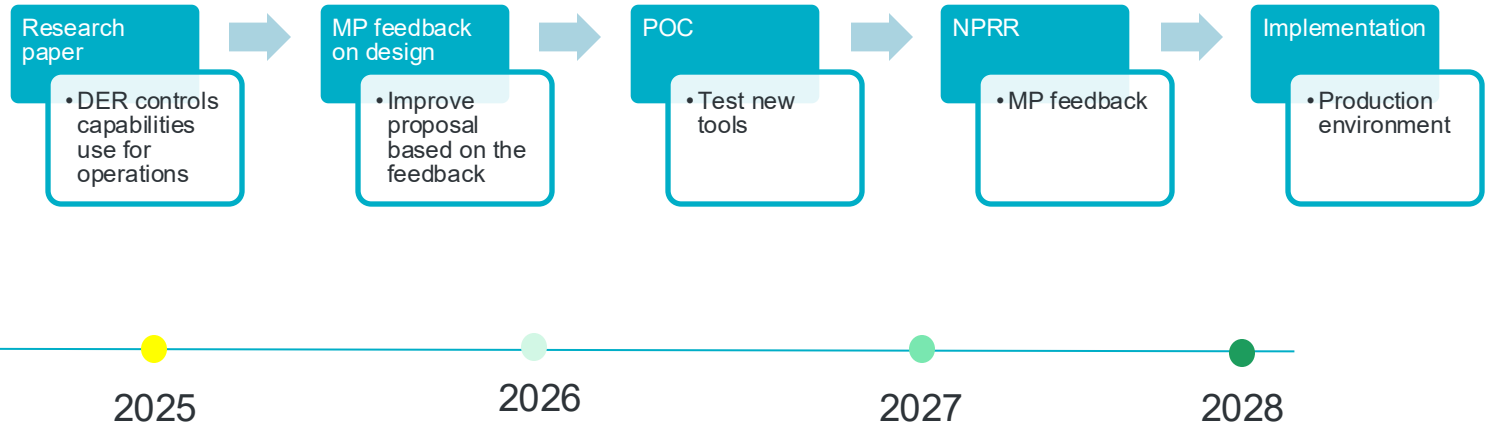
Solution: DER operational controls capabilities for high penetration areas



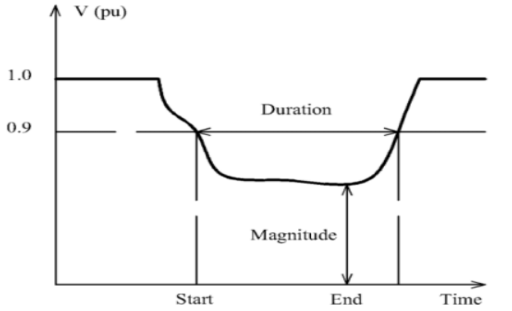
GT How: 12. Smart grid edge control for surgical load shed

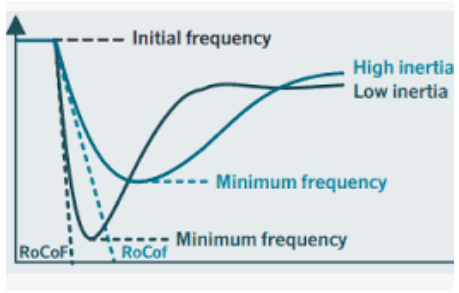
Problem: Emergency load shed is currently managed by TSPs and is done on a feeder level. With AMIs, it might be possible to have customer sign-up for remote disconnection incentive during emergency conditions

Solution: AMI meter remote disconnection/reconnection, market incentive, and program development



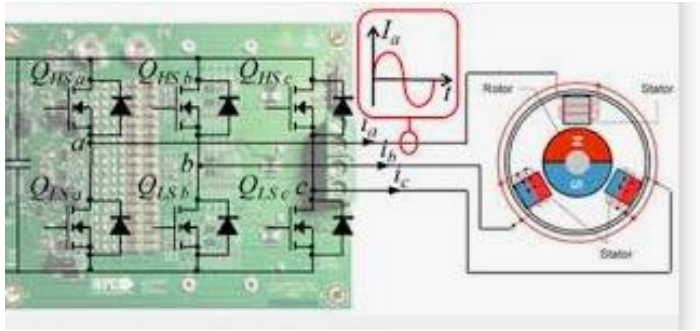
GT How: 13. Overload current capability in inverters





Problem: Inertia and system strength are decreasing with IBR penetration. IBRs however can support both by having higher overcurrent capability if there are requirements/incentives

Solution: IBR overcurrent capability needs, requirements, market incentives and a path to operationalization



- **Research paper**
  - Define needs and market incentives
- **MP feedback on the concept**
  - System wide studies to show the benefits
- **NPPR**
  - MP feedback on the proposed rules
- **Implementation**
  - Adoption for new IBRs

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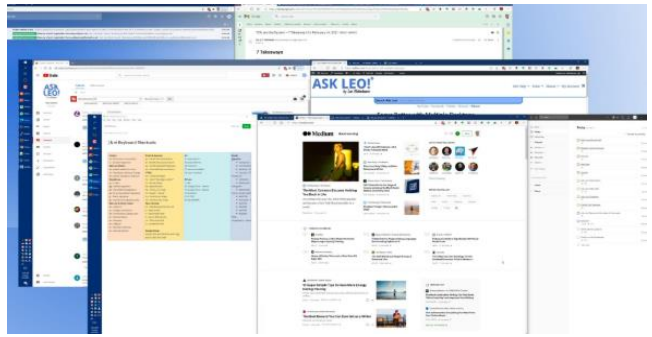
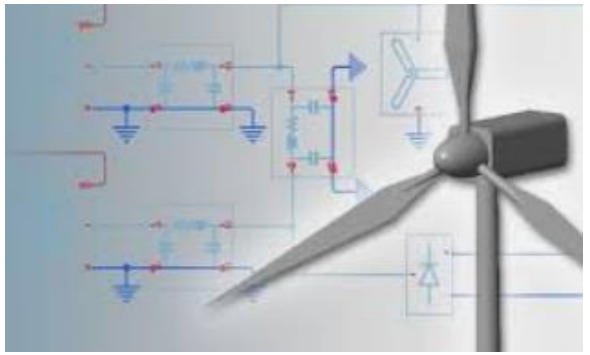
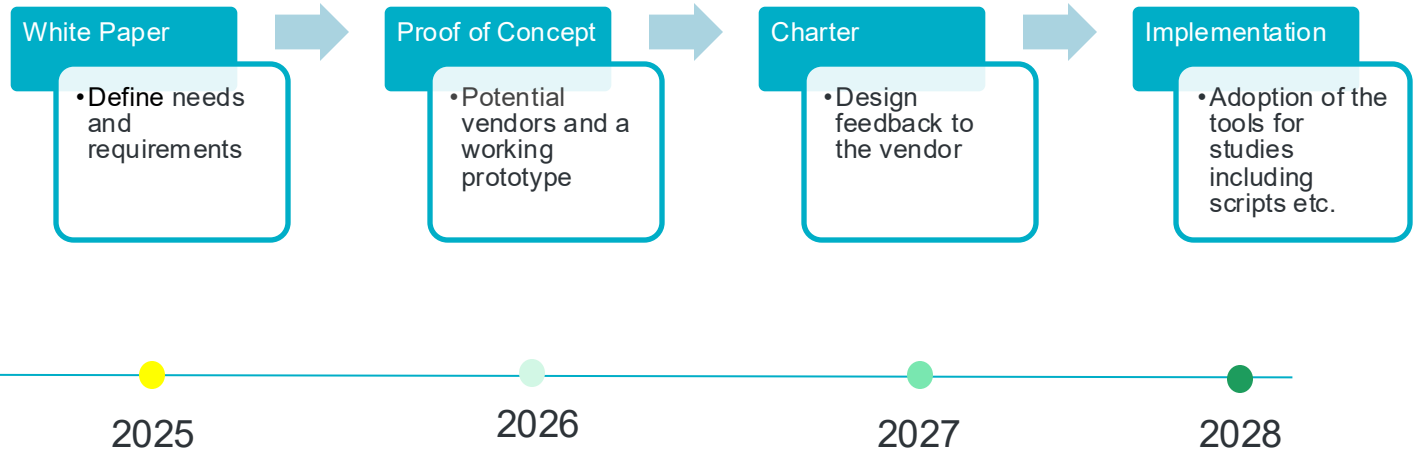
GT How: 14. Combined economic/reliability analysis tools



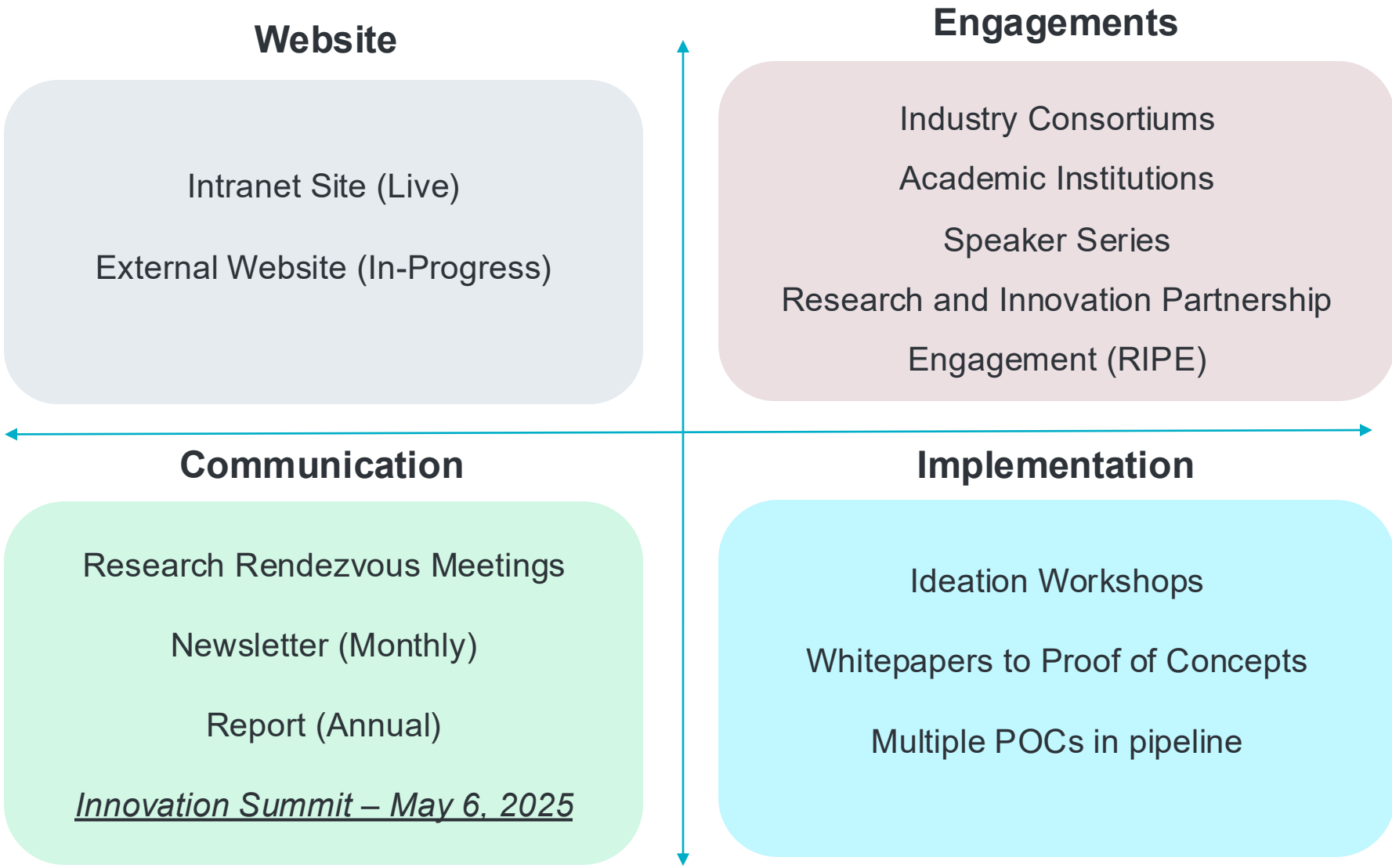
Problem: Need for intra-hour studies with same assumptions in economic and reliability analysis due to increasing supply variability

Solution: Single tool that performs both economic and reliability analysis

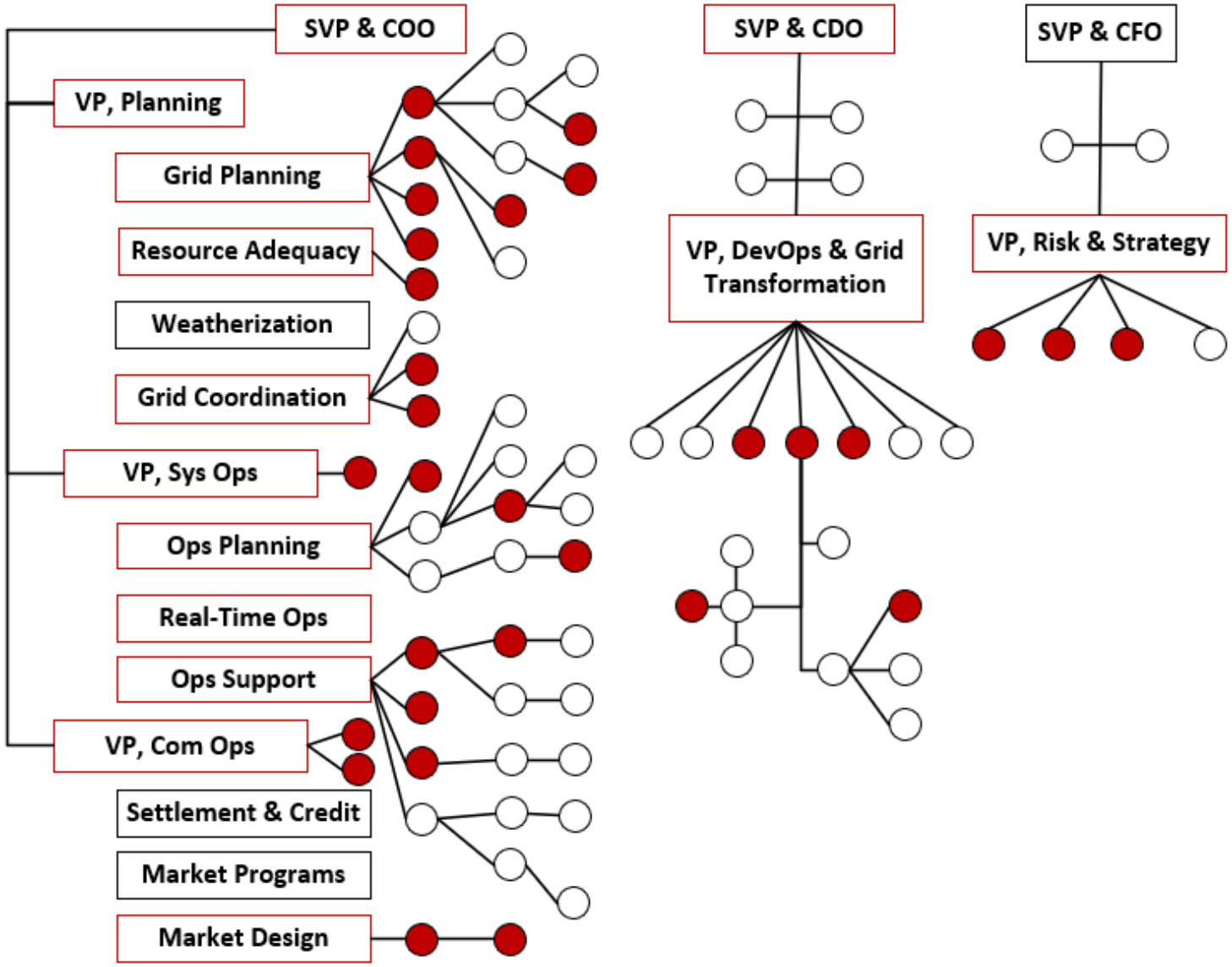




Grid Transformation – Sustaining Focus



Grid Transformation – Technology Initiatives – Matrixed Org Structure



Legend: Active GT Team Member

Grid Transformation – Technology Initiatives – Team Members

Grid Operations

Fred Huang – Director, Operations Support
Jeff Billo – Director, Operations Planning
Jimmy Hartmann – Sr. Director, Control Room Operations
Luke Butler – Manager, Resource Forecasting & Analysis
Sam Morris – Manager, Load Forecasting & Analysis
Vamsi Madam – Manager, Operations Engineering
Jimmy Zhang – Principal, IBR Integration
Yunzhi Cheng – Manager, Ops Stability Analysis
AJ Albaaj – Senior Operations Engineer
Marilyn Jayachandran – Principal, Sys Ops Improvement
Ali Yazdanpanah – Senior Stability Planning Engineer

Commercial Operations

Sai Moorty – Principal, Market Design & Analysis
Kenneth Ragsdale – Principal, Market Design
Ryan King – Manager, Market Design
Gordon Drake – Director, Market Design & Analysis

Enterprise Risk & Strategy

Janice Ayson – Lead, Strategic Advisor
Lauren Fleming – Lead, Strategic Advisor
Weihui Fu – Principal, System Development

Grid Planning

Bill Blevins – Director, Grid Coordination
Joel Koepke – Sr. Mgr., Grid Coordination
Prabhu Gnanam – Director, Grid Planning
Thinesh Mohanadhas – Principal, Emerging Technologies
John Schmall – Principal, Grid Planning
Sun Wook Kang – Sr. Manager, Dynamic Studies
Jonathan Rose – Lead Planning Engineer
Mehdi Daryabak – Lead Planning Engineer
Jose Conto – Principal, Dynamic Studies
Ping Yan – Sr. Manager, Transmission Strategy
Julie Jin – Supervisor, Modelling & Analysis
Tyler Long – Senior Planning Engineer
Priya Ramasubbu – Lead Planning Engineer

Digital Team

Prashant Kansal – Director, Grid Transformation
Sathya Krishnan – GMS Application Developer Lead
Sreenivas Badri – Director, Grid and Market Solutions
Seshu Rampalli – GMS Architect Lead
Vamsi Paruchuri – GMS Application Engineer Lead

A cross-functional, collaborative effort spanning the organization within a matrixed structure.