

ERCOT Grid Research, Innovation, and Transformation

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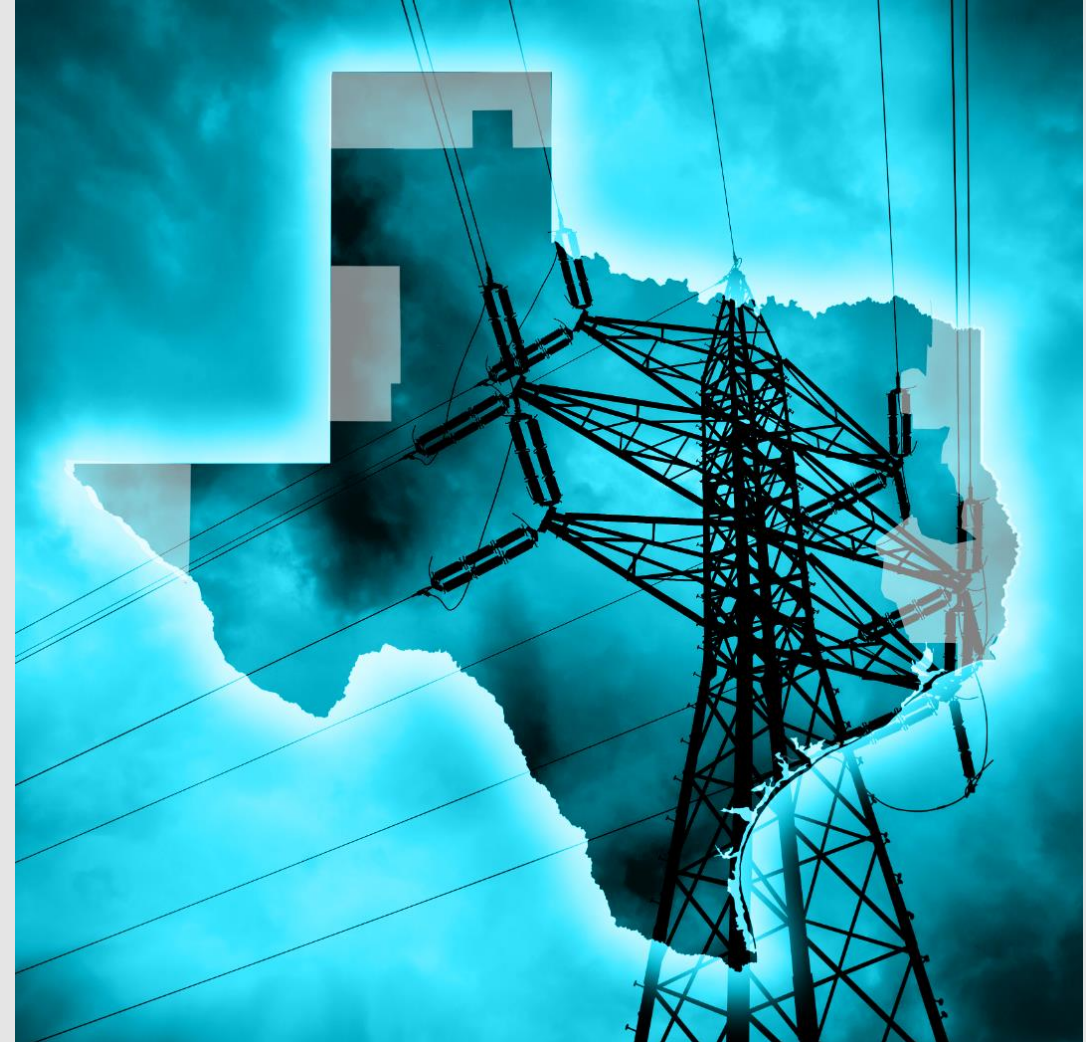
Director, Grid Transformation

Overview

- **Purpose**
Provide an update on ERCOT's Grid Research, Innovation, and Transformation (GRIT) initiatives
- **Requests**
Review and provide feedback on the GRIT process and initiatives

Key Takeaways

- The goal of GRIT is to address emerging grid challenges through cutting-edge research and innovation.
- GRIT initiatives are aligned with ERCOT's strategic objectives.



Grid Transformation: Unprecedented Confluence of Many Change Drivers

Grid Evolution

Grid-Enhancing Technologies

Technologies improving grid efficiency and capacity



Solar/Wind/Battery Power

Power generation using renewable energy sources



Distributed Generation

Expansion of local energy generation sources



Load Increase/Data Centers

Growing demand and change in load characteristics



Weather Conditions

Impact of climate on grid stability

Operation Technologies Evolution

Simulation Tools

Planning and operations are enhanced by simulations



Artificial Intelligence

AI solves complex problems in grids



Massive Data Growth

Operations and visibility benefit from data



Computational Capabilities

Cloud and GPUs accelerate data processing



The grid and its supporting operational technologies are evolving rapidly, necessitating deliberate focus and specialized expertise to ensure future readiness.

Grid Research, Innovation, and Transformation (GRIT)



Purpose

Advance research and prototyping of emerging concepts and solutions to deeply understand the implications of rapid grid and technology evolution, positioning ERCOT to lead in the future energy landscape



Vision

To be a world-class innovation team that enables ERCOT to lead the power grid transformation and deliver strategic impact in a rapidly changing energy environment



Mission

Drive cross-functional coordination, foster internal and external partnerships, develop proofs-of-concept, build expertise, and deliver a unified perspective on emerging innovations to proactively lead industry transformation

GRIT Function Serves ERCOT's Strategic Objectives



Be an industry leader for grid reliability and resilience



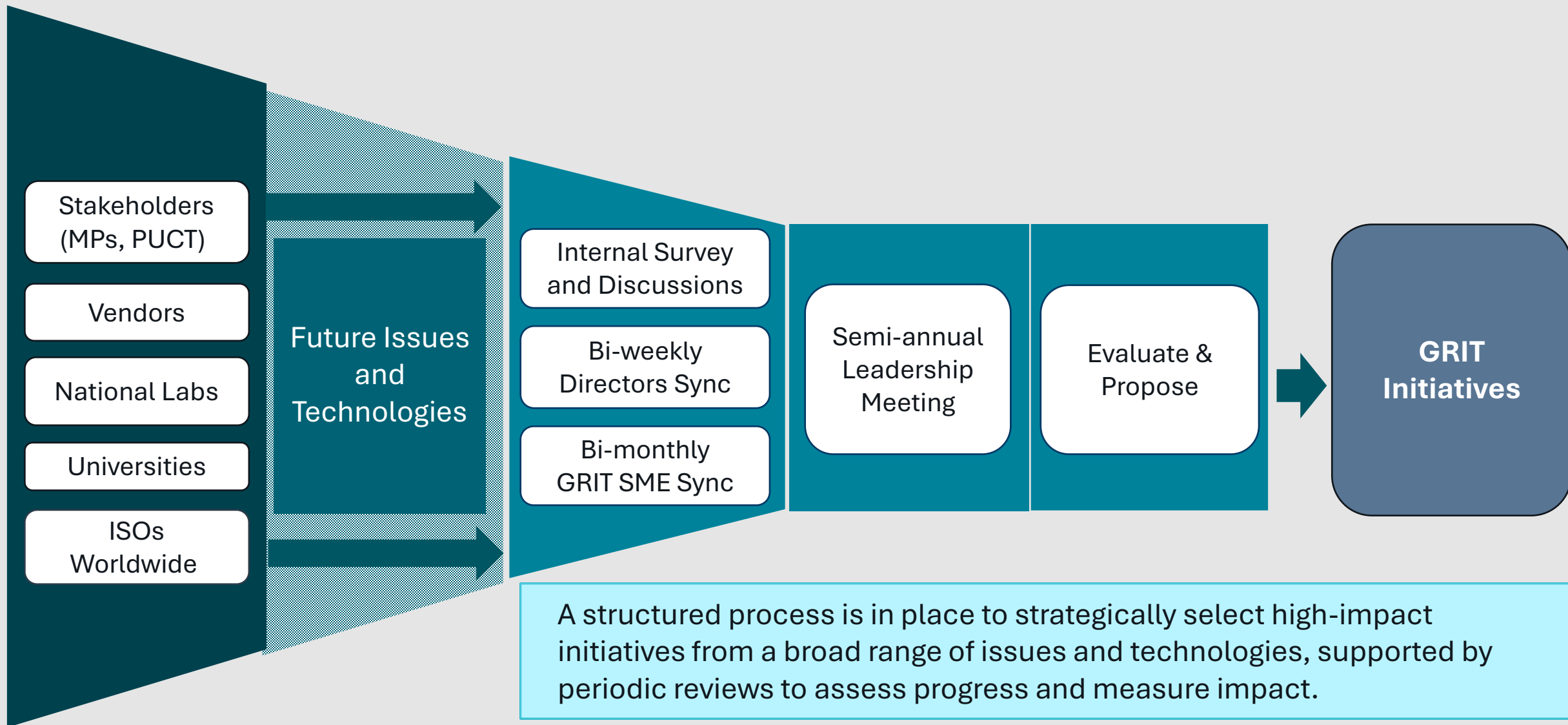
Enhance the ERCOT Region's economic competitiveness with respect to trends in wholesale power prices and retail electricity rates to consumers



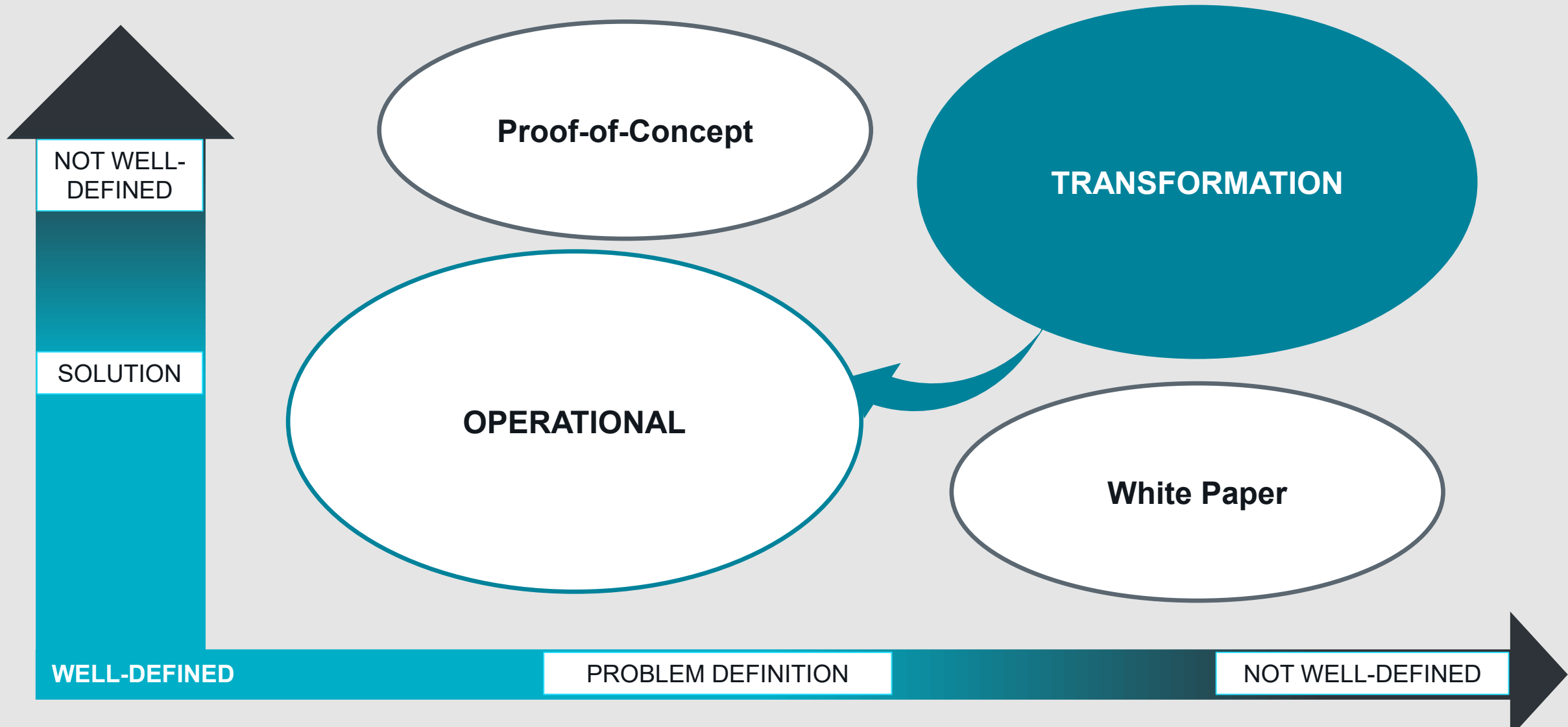
Advance ERCOT Inc. as an independent leading industry expert and an employer of choice by fostering innovation, investing in our people, and emphasizing the importance of our mission

GRIT's purpose, vision, and mission are fully aligned with ERCOT's strategic objectives — driving innovation that enhances grid reliability, improving market efficiency, and ensuring readiness for a rapidly evolving energy landscape.

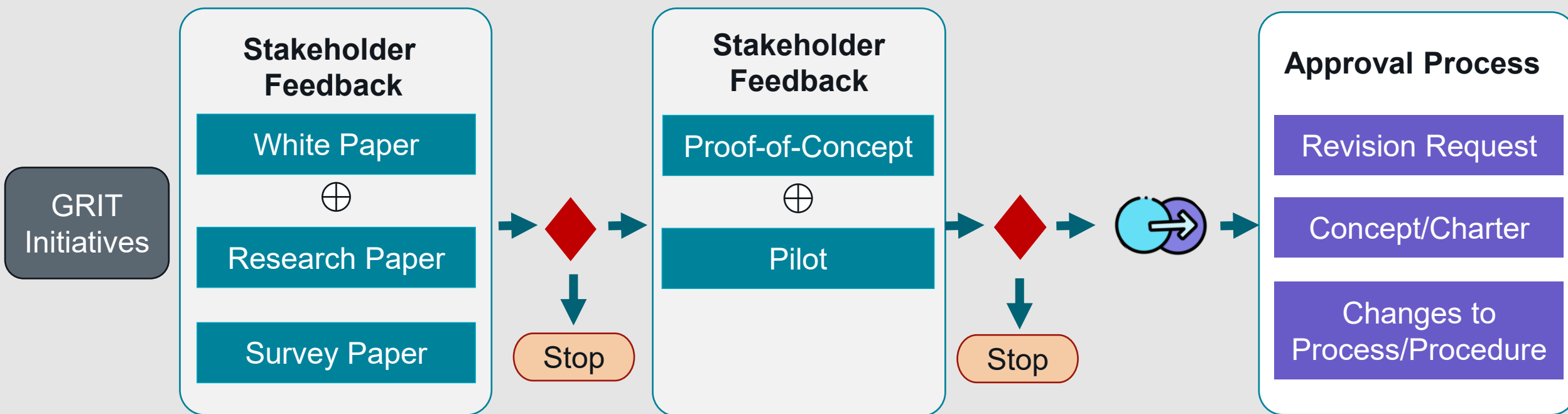
GRIT Initiatives – Stage Gate Process for Identification



GRIT Initiatives – Operational vs. Transformational



GRIT Initiatives – Process Flow



Stakeholder Feedback: Feedback on white papers and POCs solicited using GRIT webpage and TAC meetings

Approval Process: ERCOT stakeholder or internal ERCOT process

Case Study 1: Look-Ahead Reactive Power Optimization

Problem:

- With growing penetration of Inverter-Based Resources (IBRs), changing load profiles, and variations in software-based controls, there can be challenges in maintaining voltage stability and reactive power balance across the grid.
- Without a robust look-ahead voltage optimization, there can be blind spots with risk of insufficient reactive power leading to voltage violations or inefficient switching of reactive devices.



Solution:

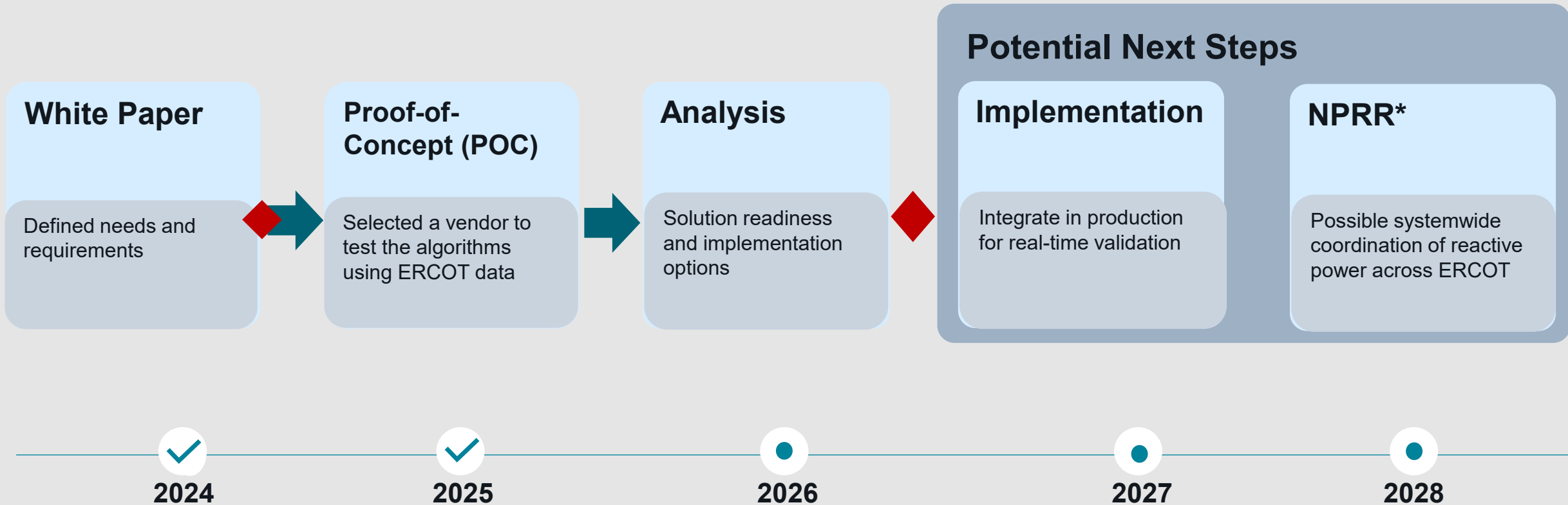
- A tool that can optimally schedule reactive power resources and voltage set points over future time horizons (8- to 24-hour look ahead) using advanced optimization strategies with configurable control priorities (shunts, transformers, static var compensator (SVC), generators)

Benefit:

- Improving grid reliability and operational efficiency using optimal control strategy



Case Study 1: Look-Ahead Reactive Power Optimization

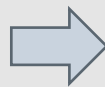


*NPRR - Nodal Protocol Revision Request
Transition Decision

Case Study 2: Receive Operational Info from Distributed Energy Resources (DERs)

Problem:

- Distributed Energy Resources (DERs), like rooftop solar and batteries, are increasing
- Currently, for ERCOT's grid studies, DERs are netted out of the load forecasting with no visibility of separate generation/load at the distribution level
- As DER penetration increases, planning and operations will become challenging without the ability to forecast and model the impact of distributed load and generation separately
- Mechanism to get DER information will be different from transmission-connected resources due to the volume and cost of sending the data using transmission protocols

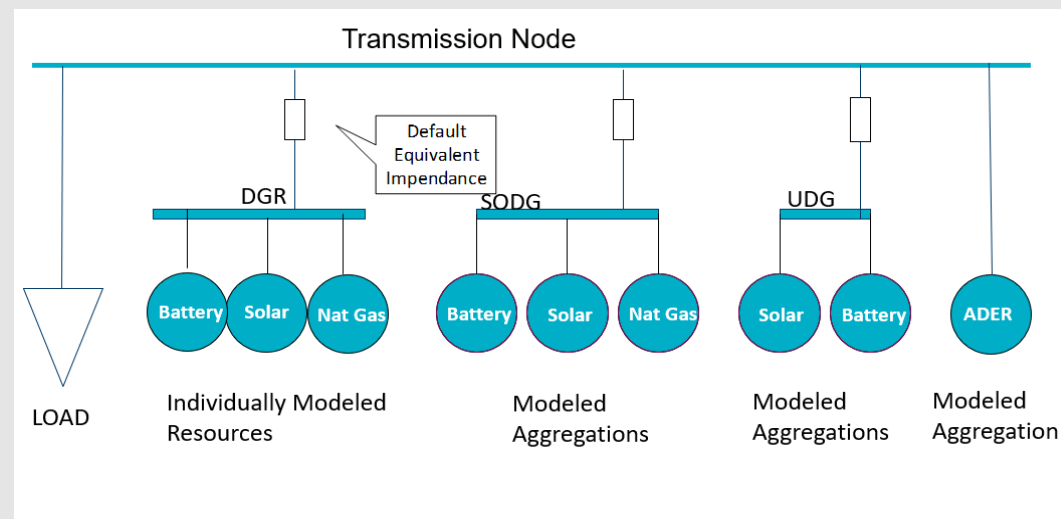


Potential Solution:

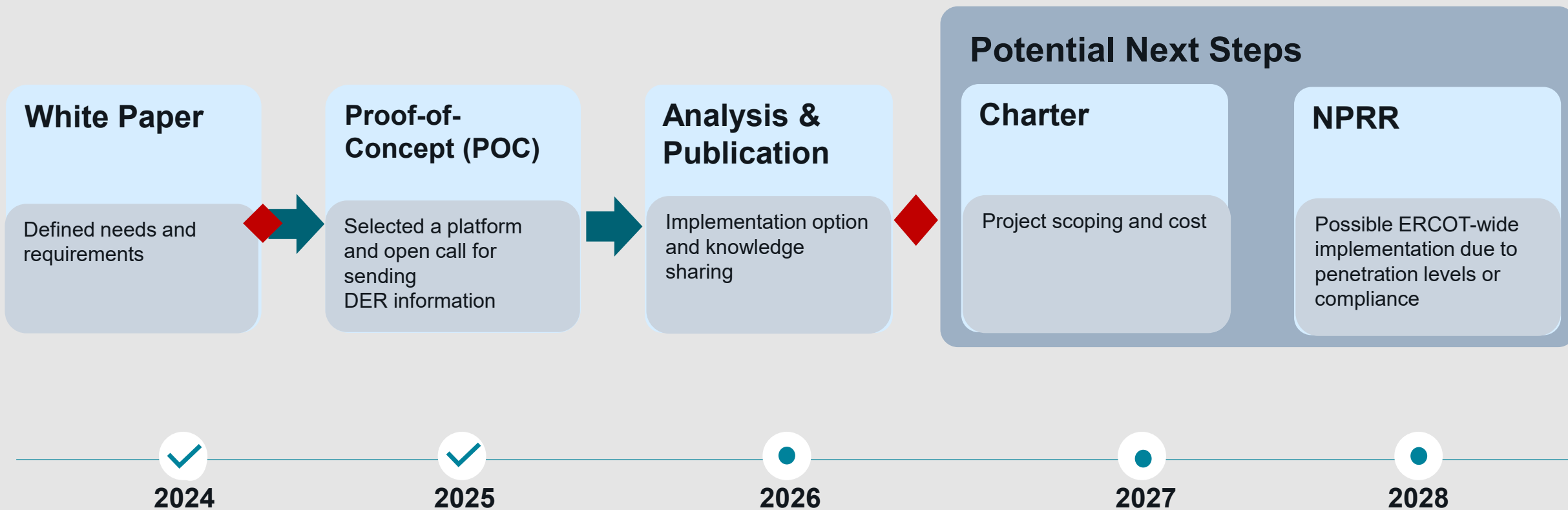
- Build a technology platform with an innovation partner to communicate with DERs with low-cost, API-based solutions that can manage volume
- Use the platform to improve forecasts and situational awareness

Benefit:

- Grid reliability and infrastructure planning



Case Study 2: Receive Operational info from Distributed Energy Resources (DERs)
















GRIT Roadmap








Technology Initiative	2025				2026				2027				2028			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Look-Ahead Commitment of ESRs <i>(Reliability/Efficiency)</i>	Proof-of-Concept				Publications → Charter				Implementation							
2. Receive operational info from DERs <i>(Reliability/Efficiency)</i>	Proof-of-Concept				Publications → Charter				Implementation							
3. Meter data disaggregation for DR <i>(Reliability/Efficiency)</i>	POC				RFP → Charter				Implementation							
4. Measure and estimate the regional inertia and system strength <i>(Reliability)</i>	Proof-of-Concept				Analysis											
5. Reactive Power Coordination <i>(Reliability)</i>	Proof-of-Concept				Analysis											
6. Robust Security Constrained Optimizations <i>(Reliability/Efficiency)</i>	Proof-of-Concept				Analysis											
7. Impedance Scanning tool for stability assessment <i>(Reliability)</i>	Proof-of-Concept				Analysis											

Transitioning to internal processes

GRIT Roadmap

Technology Initiative	2025				2026				2027				2028			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
8. Improvements to large load modeling 	Proof-of-Concept Models															
<i>(Reliability)</i>																
9. Machine learning models for optimal power flows 	Proof-of-Concept 															
<i>(Reliability)</i>																
10. Assessment of short circuit protection 	Survey				Feedback				White Paper							
<i>(Reliability)</i>																
11. Assessment of power quality 	White Paper				Research Paper				Feedback 							
<i>(Reliability)</i>																
12. Smart grid edge control of loads 	Research & Feedback 															
<i>(Reliability)</i>																
13. Grid forming controls and overload current capability in inverters 	White Paper				Research Paper				Feedback 							
<i>(Reliability)</i>																
14. Combined economic/reliability analysis tools 	White Paper 				Proof-of-Concept 				Charter				Implementation			
<i>(Reliability/Efficiency)</i>																

GRIT Roadmap

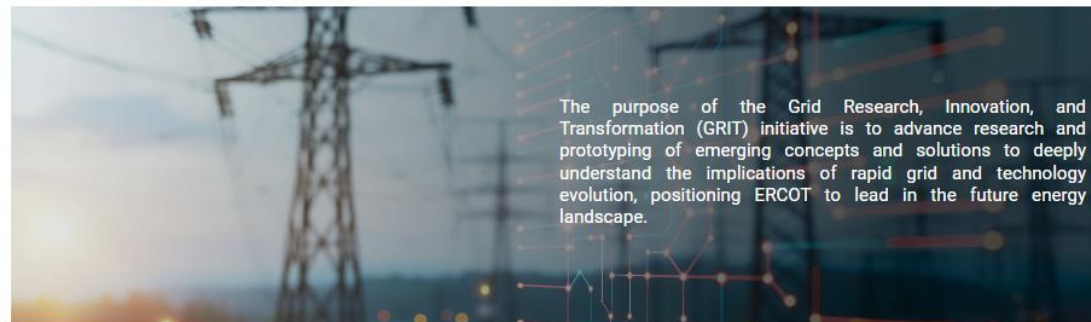
Technology Initiative	2026				2027				2028				2029			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
15. Dynamic Ancillary Services 	White Paper				Implementation 											
(Strategic Objective Alignment)																
16. Large scale EMT need and strategy 	White Paper				POC 				Charter				Implementation			
(Reliability/Efficiency)																
17. Open-source data and models 	Synthetic network				Data sets											
(Reliability)																
18. Topology Optimization 	Proof-of-Concept				Implementation 											
(Reliability/Efficiency)																

GRIT Webpage Updates

GRIT Webpage



Grid Research, Innovation, and Transformation



The purpose of the Grid Research, Innovation, and Transformation (GRIT) initiative is to advance research and prototyping of emerging concepts and solutions to deeply understand the implications of rapid grid and technology evolution, positioning ERCOT to lead in the future energy landscape.



GRIT Roadmap
See what's on the horizon

[LEARN MORE](#)



GRIT White Papers
Problems & solutions

[LEARN MORE](#)

RIPE PROGRAM

RESEARCH AND INNOVATION PARTNERSHIP ENGAGEMENT (RIPE)

[LEARN MORE](#)

Engage with ERCOT. We are seeking partnerships to solve for emerging challenges and opportunities to meet ERCOT's goal of providing a reliable grid, efficient electricity markets, open access, and retail choice.

Latest Grid Transformation

Proof-of-Concept Case Studies

Large Load Modeling



Developing generic Electromagnetic Transient (EMT) models of crypto miners, datacenters, and electrolyzers to develop deeper understanding of how these facilities work and how they can impact grid stability.

[LEARN MORE](#)

Innovation White Papers

Artificial Intelligence and Machine Learning: A Strategic Review of Technology, and Opportunities and Challenges for Adoption

Beyond the Snapshot: A Case for Multi-Interval Security-Constrained Optimal Power Flow

Distributed Energy Resources Operational Data

Research & Innovation Partnership Engagement (RIPE)

The **RIPE program** was launched on September 4, 2025. **40 requests** have been received so far.

Emerging technologies: Some proposals involve novel technologies requiring significant evaluation effort and may not be time aligned with the current priorities

Multi-party coordination: Several proof-of-concept proposals involve TSP dependencies.

Endorsement: Some requests are about endorsement and less about technology proof-of-concept

ERCOT is developing screening criteria to identify the highest value opportunities and continue monitoring the activity.

Research and Innovation

Research and Innovation Partnership Engagement

ERCOT's Research and Innovation Partnership Engagement (RIPE) program is designed to work with partners to solve for emerging challenges and opportunities to meet ERCOT's goal of providing a reliable grid, efficient electricity markets, open access, and retail choice. The RIPE program is focused on market-ready technologies that have potential for grid-wide deployment. The program is not about testing minor improvements in existing technology, data requests for research or early-stage development, or technologies with no clear merits for grid reliability, operations, or markets.

Ready to partner with ERCOT?

Simply click the 'RIPE Program Form' button below to access our Public Portal and get started!

[RIPE Program Form](#)

Note: First-time users will need to register. You will receive a response within 30 calendar days with initial feedback.

RIPE Program FAQs

+ What is considered a RIPE project?

+ Roles and Responsibilities of ERCOT