TGO Alliance

Orchestrating the Grid to Enhance Reliability and Unlock Grid Resources

Welcome

to the 2025 TGO Fall Summit

We will begin promptly at 8:30am

TGO Alliance

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TGO Alliance

Time	Activity	Description
7:30 - 8:30am	Breakfast & Check-In	Check-in, breakfast buffet, and networking
8:30 - 9:00am	Welcome	Co-Chair welcome and overview of summit agenda
9:00 - 9:30am	Keynote Address	Forward-looking address from Mark Ortiz of Schneider Electric highlighting how emerging technologies are transforming utility operations
9:30 - 10:15am	TGO Alignment	Intro to TGO and alignment on Alliance focus areas
10:30 - 11:30am	TGO Framework	Review working group progress to advance TGO focus areas
11:30 - 12:00pm	Case Study	National Grid Case Study: Flexible Connections
12:00 - 1:00pm	Lunch	Catered lunch provided on-site
1:00 - 3:00pm	Localized Grid Flexibility	Review working group progress and assess your organization's LGF maturity level
3:00 - 3:30pm	Case Study	Rappahannock Electric Cooperative: Innovative Distribution Planning
3:45 - 4:45pm	Digital & Data Readiness	IT/OT implications for TGO capabilities and tools
6:00 - 8:00pm	Social Event	Dinner and networking event at Flight Club Atlanta

Alliance in Action

Today's Agenda

TGO Alliance

2025 Fall Summit

Welcome and Opening Remarks

8:30 – 9:00

Joe Zhou

Co-Chair, TGO Alliance
Infrastructure Advisory Markets Group Leader

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Allie Broussard

Market Specialist, Electric Markets

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Alliance in Action

Today's Agenda

Total Grid Orchestration Alliance

Facilitate collaboration and cooperation

Drive continuous improvement and technology advancement

Promote the development of requirements and best practices

Enable the adoption of innovative technologies and practices

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Colorado Springs Utilities
It's how we're all connected

cps ENERGY

ESSEX POWER CORPORATION

evergy

GRIDIENT

HydroOttawa

Landis+Gyr

nationalgrid

PNM

PUC SERVICES

Rappahannock Electric Cooperative

Schneider Electric

Survalent.

SYNERGY NORTH

ThinkLabs

Unitil

uplight

- ✓ Open Dialogue
- ✓ Radical Transparency
- ✓ Better Questions
- ✓ Active Listening
- ✓ Enjoy the Process

TGO Alliance

2025 Fall Summit

Keynote

9:00 – 9:30

Mark Ortiz

Senior Director and Chief Architect, Power and Grid

Schneider Electric

TGO Alliance

2025 Fall Summit

TGO Alignment

9:30 – 10:15

Joe Zhou

Co-Chair, TGO Alliance
VP of Infrastructure Advisory

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Background

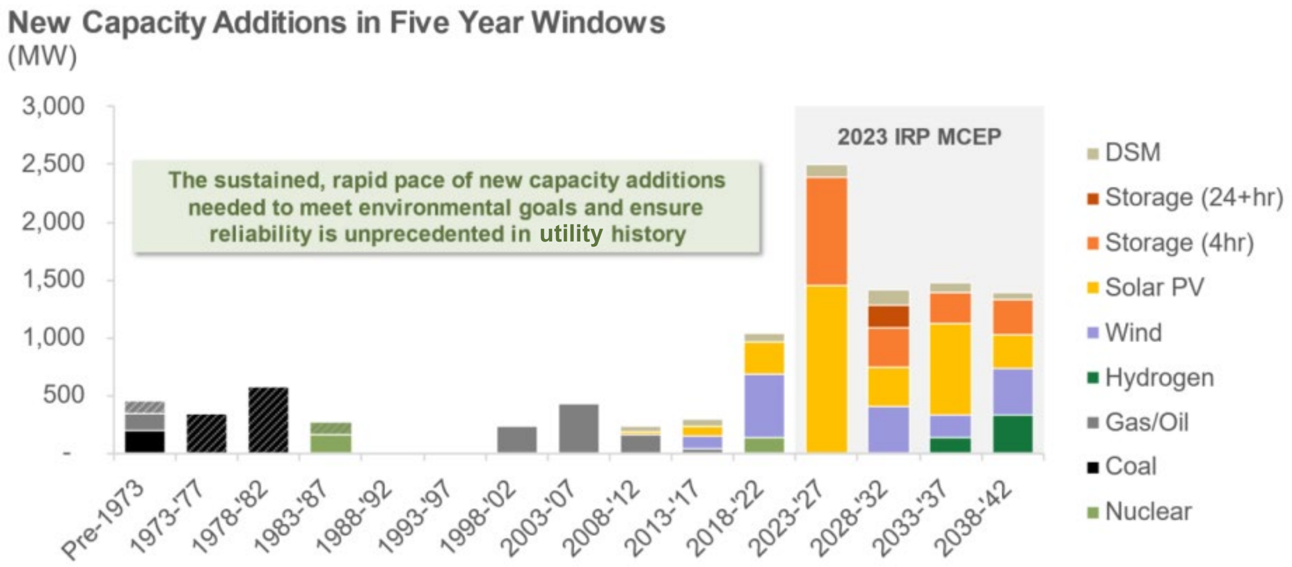
The Carbon Free Journey – Representative Utility

2040 Carbon Free Commitment through sustained retirements of rotating mass

→ 2.5 GW Summer Peak against 4 GW DER by 2025
- Addressed through 900 MW of bulk, 700 MW of Distribution storage

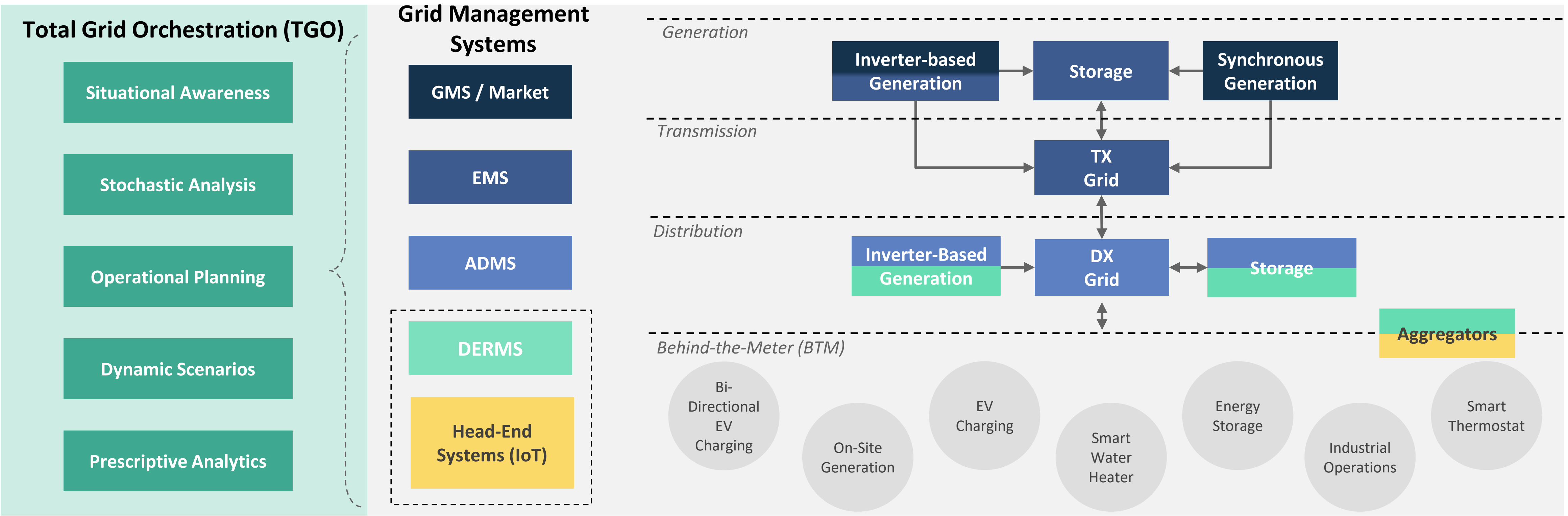
→ Combined with base load retirements, creates new system risks:
- Dependence on energy limited resource pool
- Coordination of many small resources to meet local and grid level needs
- Increasing susceptibility to climate related events

→ Increasing complexity of grid operation requires a more empowered, better coordinated workforce



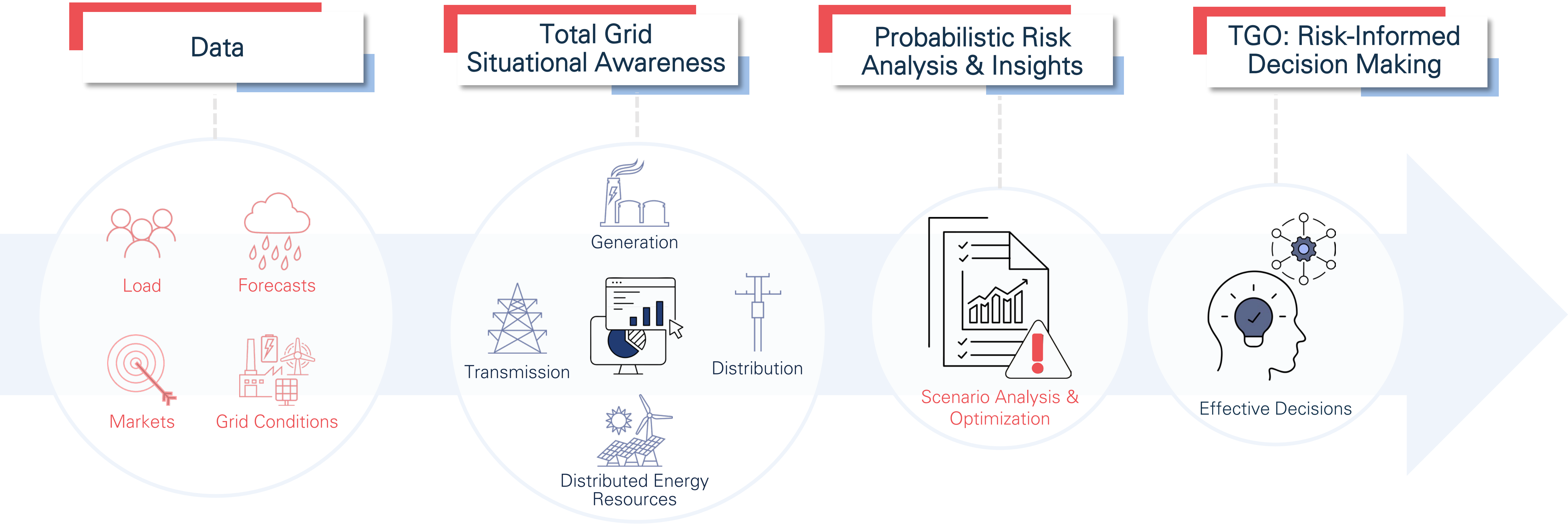
The Concept of "Total Grid Orchestration" (TGO)

TGO is a coordinated approach to manage the risks across the entire grid, thereby optimizing the performance of the energy grid, especially in extreme reliability and resiliency situations.



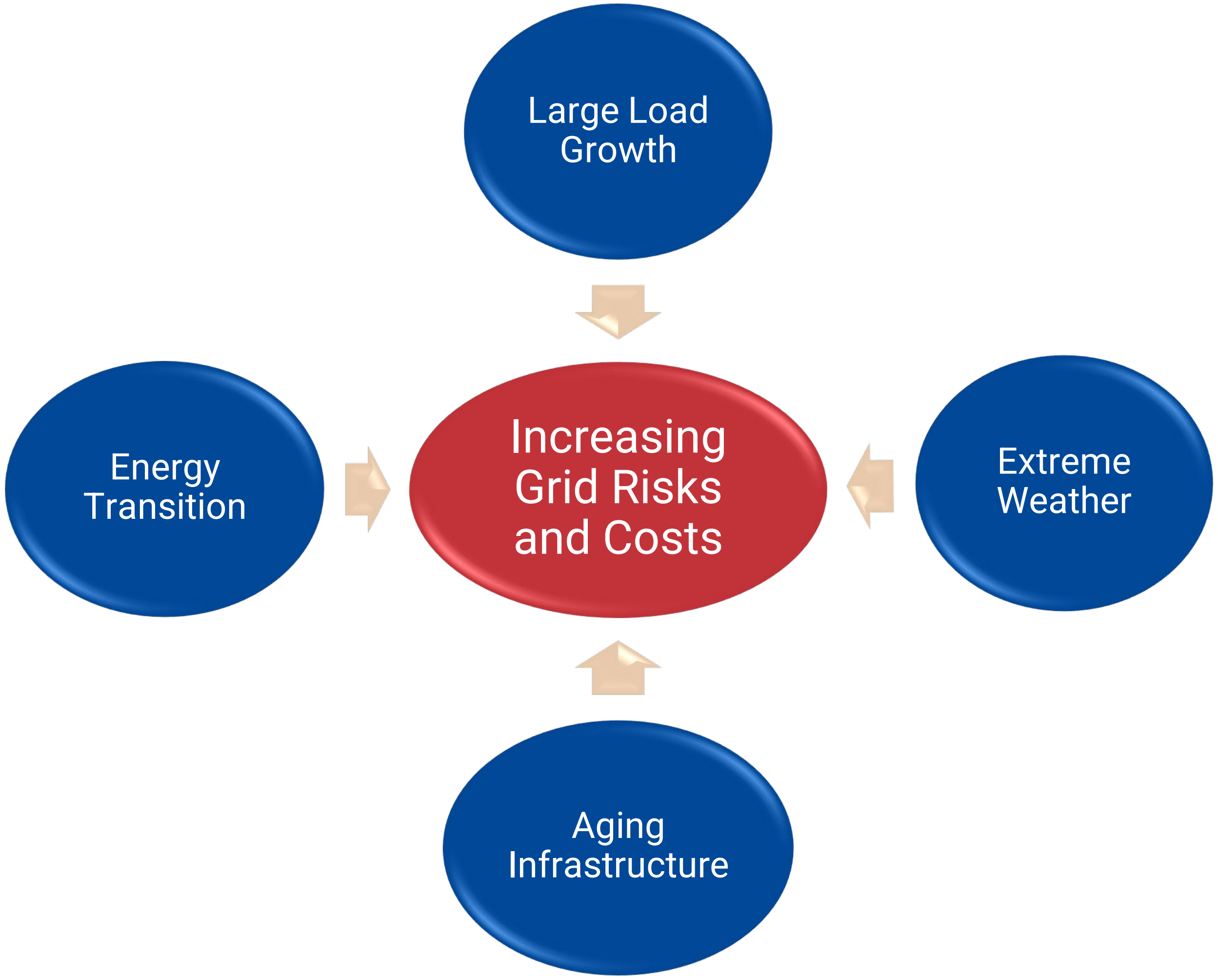
TGO's aims to inform and improve situational awareness and provide risk-informed decision-making capabilities for grid operations across G, T, D and BTM assets, such that distributed and variable energy supply and demand optimization can be maximized.

Evolution of Total Grid Orchestration



Bridging the Gap between Planning and Operation to Unlock Grid Capacity and Reduce Risks

Why TGO is Even More Critical Today?



- Our industry is driving towards an affordability crisis
- Soaring cost of the service will make other options more attractive (DER/VPP, onsite generation, large scale demand response, etc.)
- Utilities investing the TGO solutions can get ahead of the challenges

The Strategic Value of TGO

TGO, through system- & risk- based planning and operation approach, can increase capacity, reduce grid risks, while keeping the services affordable.

TGO Alliance

Orchestrating the Grid to Enhance Reliability and Unlock Grid Resources

2024

2025

2026

TGO Alliance Launch

Mobilize Working Groups

Working Group Progression

1. TGO Framework

2. Localized Grid Flexibility

What will be our key priorities?

- Focus will be key for us to make meaningful progress and contribution to the industry


Break
15-minute
We will regroup promptly at 10:30am
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2025 Fall Summit

TGO Framework

Working Group 1

10:30 – 11:30

Paul Moran

Integrated Solutions Strategist

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Discussion Topics

- Working Group 1 Overview
- Total Grid Orchestration (TGO) Concepts
- Why Develop a TGO Framework?
- Business Objectives & Value Proposition
- System Level Objectives
- Market Analysis
- Maturity Model
- Framework Summary
- Key Takeaways

TGO Working Group Members

Joe Barile
Essex Power

Nick Bennett
CPS Energy

Kevin Brannan
Evergy

Justin Eisfeller
Unitil

Nils Frenkel
Uplight

Laurie Huff
Hydro Ottawa

Gautam Kakaiya
CPS Energy

Mitchell Paradis
PUC

Manuel Sanchez
PNM Resources

Marcelo Sandoval
Landis & Gyr

Ngo Young
Survalent

Paul Moran
Black & Veatch

Marty Glose
Black & Veatch

What is Total Grid Orchestration?

System of Systems approach to drive new **Grid Architecture** to bridge gaps between legacy systems and **modern grid needs**

Comprehensive Management of **Real Time Operational Risks** cross the grid hierarchy

Integrated Framework to align operations, short-term, and long-term planning

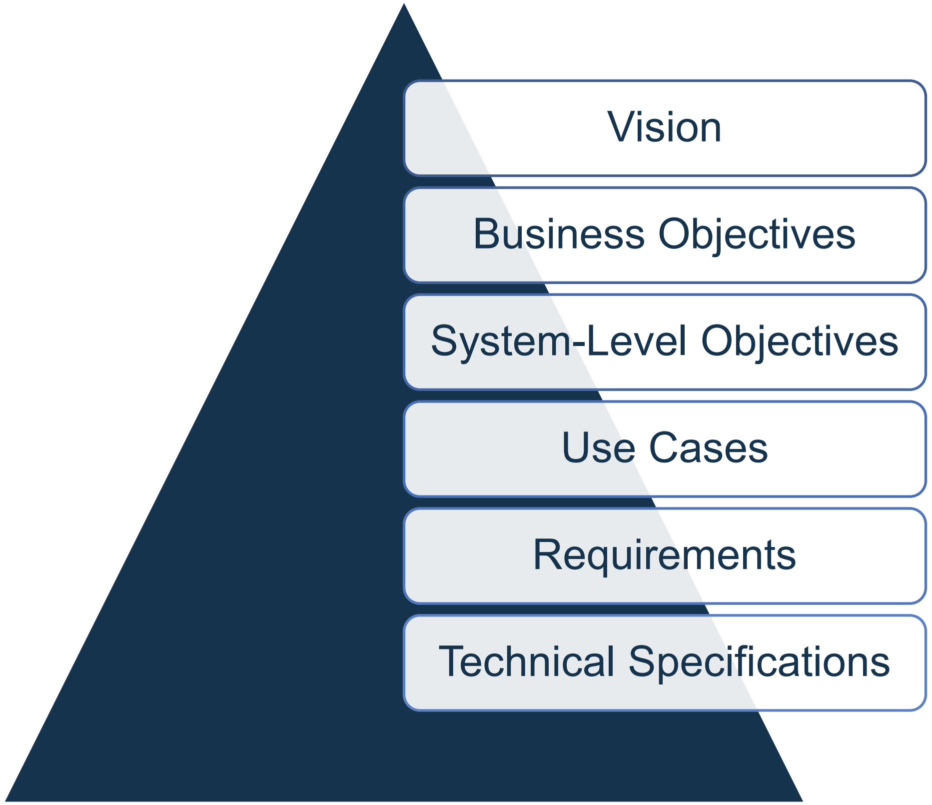
Enable **Optimization** across all layers to improve reliability, flexibility and resilience

Foster **new solutions** and **shared direction** for addressing today's grid challenges through enhanced visibility, coordination, and integration

Why Develop a TGO Framework?

The value of a framework: Bringing Order to Complexity and Guiding Systematic Problem Solving

The TGO framework organizes complexity, guides problem solving, fosters clear communication, and enables actionable recommendations.



If something is hard, the first step is not small enough

TGO Framework Components

Framework Summary: Defined business objectives, boundaries, system-level objectives, solution market analysis.

Value Proposition: TGO value, benefit map, measurement methodology.

Maturity Model: Pre-conditions, benefit scenarios, maturity model template.

To be Developed: Deployment Playbook: Playbook templates, framework playbook, WG1 closeout.

TGO Framework Hierarchy

In Scope for Working Group 1: Concept Definition, Business Objectives, System Level Objectives

Concept Definition	Vision (aspiration) and Goal (specific outcomes)
Business Objectives	Description of specific needs or conditions necessary to achieve the Concept
System Level Objectives	Functions, features, and constraints of the system
Use Cases	Defines how users interact with the system to achieve specific outcomes
Non-Functional Requirements	Specifies operational constraints and performance metrics
Technical Requirements	Provides detailed implementable specifications

Framework Hierarchy and Personas

Framework Hierarchy Structure

The hierarchy translates vision into actionable components, from concept to technical requirements ensuring clarity and alignment.

Key Personas in Framework

Operator, Planner, and Prosumer personas have distinct roles and financial biases within the framework.

Orchestration for Coordination

Orchestration balances persona biases to enable coordinated decision-making and enhance framework applicability.

TGO Business Objectives and Value Proposition

Core Business Objectives

TGO Framework defines eight objectives aimed at optimizing grid control, flexibility, resilience, and market coordination.

Value Proposition Benefits

TGO delivers improved reliability, cost efficiency, safety, decarbonization support, and inertia balancing benefits.

Stakeholder Value Mapping

Benefits are aligned with multiple stakeholder personas for broad impact and enhanced decision-making.

TGO Business Objectives

Total Grid Orchestration (TGO) TGO is a coordinated approach to manage the risks across the entire grid, thereby optimizing the performance of the energy grid, especially in extreme reliability and resiliency situations.

WG 1 identified **8 core objectives** of Total Grid Orchestration

Holistic Visibility and Control: Achieve comprehensive and secure situational awareness and real-time control of all grid assets.

Integrated Planning & Operations: Foster collaboration across generation, transmission, distribution and customer (as applicable) for synchronized planning and operations.

Localized Grid Flexibility: Utilize flexible resources to balance supply and demand, ensuring grid stability.

Ability for Enhanced Resilience and Reliability: Strengthened ability to respond to disturbances and support grid resilience.

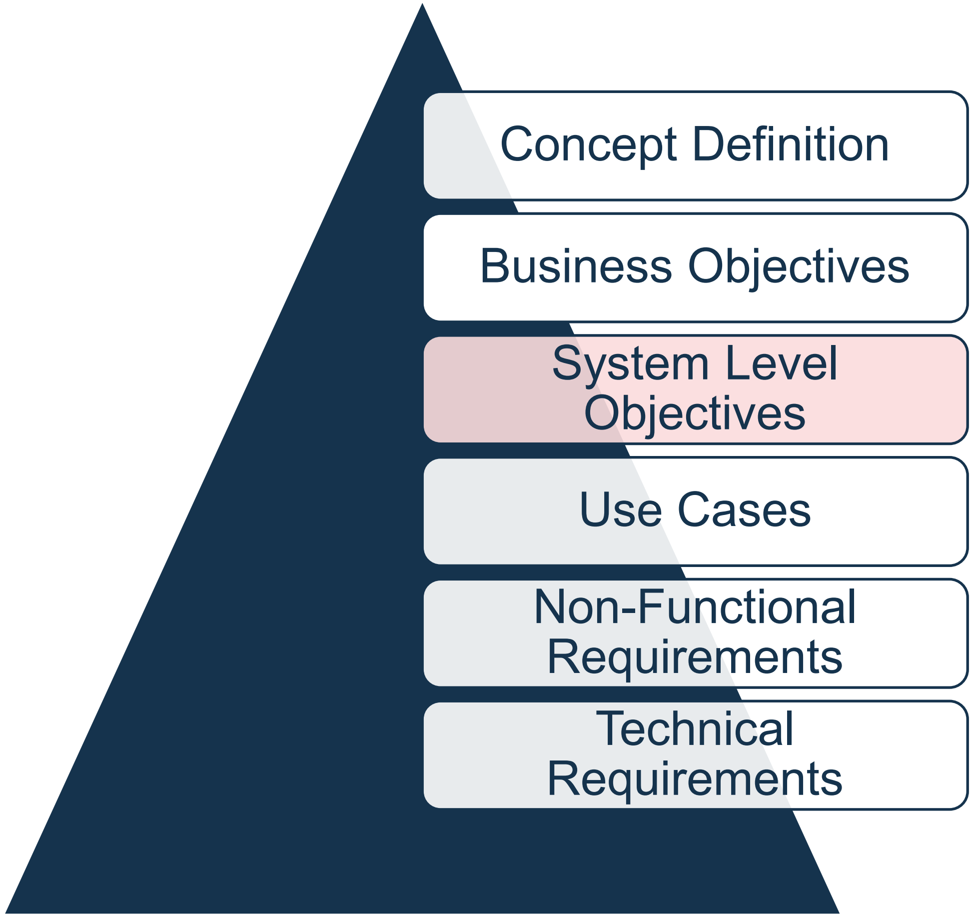
Customer and Prosumer Integration: Empower consumers and distributed energy resources to participate in grid services while respecting their preferences.

Asset Optimization Capabilities: Enable optimization of grid assets.

Market Enablement and Coordination: Support and incentivize flexible and reliable behavior in grid services markets.

Risk-Informed Decision-Making Capabilities: Quantified and predictive grid analysis to inform near real-time operational actions.

System Level Objectives



- Vision (aspiration) and Goal (specific outcomes)
- Description of specific needs or conditions necessary to achieve the Concept
- Functions, features, and constraints of the system
- Defines how users interact with the system to achieve specific outcomes
- Specifies operational constraints and performance metrics
- Provides detailed implementable specifications

System Level Objectives

Defining the functions feature of the constraints of the system that would enable the vision of Orchestration.

Legend
Operations & Analytics
Planning & Capital Improvement
Market & Policy Design
Data Collection & Situational Awareness

Risk-Informed Decision-Making

Situational Analytics & Modeling
Quantified and coalesced operating envelope influences within each business objective value measure.

Risk Framework
A common quantitative scale to measure, weigh, assess, and prioritize risk for determining action.

Decision Support Systems
The platform to act on the outputs of situational awareness based on quantifiable risk.

Holistic Visibility and Control

Real-time Data Acquisition
Implemented sensors and IoT devices across the grid for continuous data collection.

Unified Monitoring Platform
Developed centralized system for real-time visualization.

Interoperability
Ensure compatibility with grid components, including DERs, electric vehicles, and flexible loads, as well as control of these grid assets.

Integrated Planning & Operations

Data Integration
Shared data platform for TSOs and DSOs to access and exchange information seamlessly.

Coordinated Control Systems
Implemented systems that allow synchronized control actions across transmission and distribution networks.

Joint Planning Tools
Developed tools for collaborative forecasting, planning, and decision-making.

Localized Grid Flexibility *(WG2)*

Demand Response Mechanisms
Established protocols for activating demand response and other flexible resources.

Energy Storage Integration
Incorporated energy storage systems to manage supply and demand fluctuations.

Advanced Forecasting
Use of predictive analytics to anticipate demand and supply variations.

Ability for Enhanced Resilience and Reliability

Automated Fault Detection
Deployed advanced analytics and machine learning for early detection of grid disturbances.

Self-Healing Networks
Implemented automation for rapid isolation and restoration of grid sections.

Resilience Planning
Develop strategies for islanding, black start, and microgrid operations.

Customer and Prosumer Integration

Dynamic Pricing Models
Created pricing structures that incentivize consumer participation in grid services.

Virtual Power Plant
Enabled aggregation of distributed resources to act as single entities in the grid.

User-Friendly Interfaces
Developed platforms that allow consumers to easily engage with grid services.

Asset Optimization Capability

Advanced Analytics
Utilize emerging technologies for proactive and predictive maintenance and optimization.

Data Interoperability
Ensure seamless data exchange between different platforms and stakeholders.

Scenario Analysis Tools
Developed tools for simulating and analyzing various grid scenarios.

Market Enablement and Coordination

Real-Time Market Platforms
Created platforms for real-time trading of grid services.

Incentive Structures
Designed market mechanisms that reward flexible and reliable behavior.

Regulatory Compliance
Ensure alignment with regulatory requirements and standards.

TGO Market Analysis

Identifying Solutions, Platforms, and/or Standards of the Industry for each respective System Level Objective.

1. Holistic Visibility and Control	Real-time Data Acquisition: EMS/RTU, PI Data, MD-90 Metering, AMI
	Unified Monitoring Platform: SCADA, EMS, OMS, DERMS
	Interoperability: ADMS, IEEE 2030.5
2. Integrated Planning & Operations	Data Integration: Enterprise Service Bus (ESB), Data Lakes, ETL Tools, CIM-based integration platforms
	Coordinated Control Systems: ADMS, DERMS, EMS, Microgrid Controllers
	Joint Planning Tools: Integrated Resource Planning (IRP) software, Grid Simulation Tools (e.g., PSS®E, CYME), Load Flow and Contingency Analysis Tools
3. Localized Grid Flexibility	Demand Response Mechanisms: DRMS, Smart Thermostats, Aggregator Platforms
	Energy Storage Integration: BESS Management Systems, EMS with storage modules, Inverter Control Systems
	Advanced Forecasting: AI/ML-based Load and Renewable Forecasting Tools, Weather Data Integration, Predictive Analytics Platforms
4. Enhanced Resilience and Reliability	Automated Fault Detection: Fault Location, Isolation, and Service Restoration (FLISR), Smart Sensors, Line Monitoring Systems
	Self-Healing Networks: ADMS with self-healing algorithms, Reclosers with automation, Grid Edge Intelligence
	Resilience Planning: GIS-based Risk Assessment Tools, Scenario Planning Software, DERMS with resilience modules
5. Customer and Prosumer Integration	Dynamic Pricing Models: TOU (Time-of-Use) Pricing Engines, Real-Time Pricing Platforms, Customer Portals
	Virtual Power Plants (VPPs): VPP Platforms, DER Aggregation Software, Blockchain for Peer-to-Peer Energy Trading
	User-Friendly Interfaces: Mobile Apps, Web Portals, Home Energy Management Systems (HEMS), IEEE 2030.5
6. Asset Optimization Capability	Advanced Analytics: APM (Asset Performance Management), Predictive Maintenance Tools, AI/ML Platforms
	Data Interoperability: Digital Twins, IoT Platforms, CIM/IEC 61970/61968 Standards
	Scenario Analysis Tools: Grid Simulation Software, Risk Modeling Tools, Planning and Forecasting Suites
7. Market Enablement and Coordination	Real-Time Market Platforms: ISO/RTO Market Interfaces, Energy Trading Platforms, Blockchain Marketplaces
	Incentive Structures: DRMS, Customer Engagement Platforms, Billing and Settlement Systems
	Regulatory Compliance: NERC CIP Compliance Tools, Reporting Automation Software, Audit Trail Systems
8. Risk-Informed Decision-Making	Situational Analytics & Modeling: RTCA
	Risk Framework:
	Decision Support Systems: RTCA

TGO Value Proposition

The Total Grid Orchestration (TGO) framework offers a comprehensive approach to optimizing grid control, flexibility, resilience, and market coordination.

Benefits of TGO

Reliability	• Resiliency • Thermal, Voltage, & Frequency Support
Affordability Capital Efficiency	• Asset Optimization • Non-Wires Solutions
Affordability O&M Reduction	• Reduced Labor • Supply Competition
Safety	• Wildfire & Climate Risk Mitigation • Conductor Clearances
Security	• Supply Diversification & Flexibility
Decarbonization Support	• Carbon Credits • Renewable Integration & Climate Mitigation
Inertia Balancing	• Protection with IBR

Stakeholder Benefits

Operator

Reliability
- Thermal
- Voltage
- Frequency

Resiliency
- Event LAR Support
- Islanding Control

Affordability – O&M
- Reduced Labor
- Competitive Supply Pricing

Safety & Security
- Wildfire Risk Mitigation
- Conductor Clearance Mitigation

Planner

Affordability – Capital
- No Overbuild
- Non-Wires Solutions

Accelerated Interconnections
- EAM Goals Achieved
- Decarbonization Support

Accelerated Demand Service
- Increased Metered Revenue

Inertia Balancing
- Avoided Protection-driven Capital Upgrades

Prosumer

Wholesale Market Revenue

Retail Market Revenue

BTM Rebates
- Aggregator Models

Sustainability
- Decarbonization

TGO Maturity Model

Four Maturity Levels

The model defines Foundational, Integrated, Orchestrated, and Adaptive levels showing progressive sophistication.

Business Objective Mapping

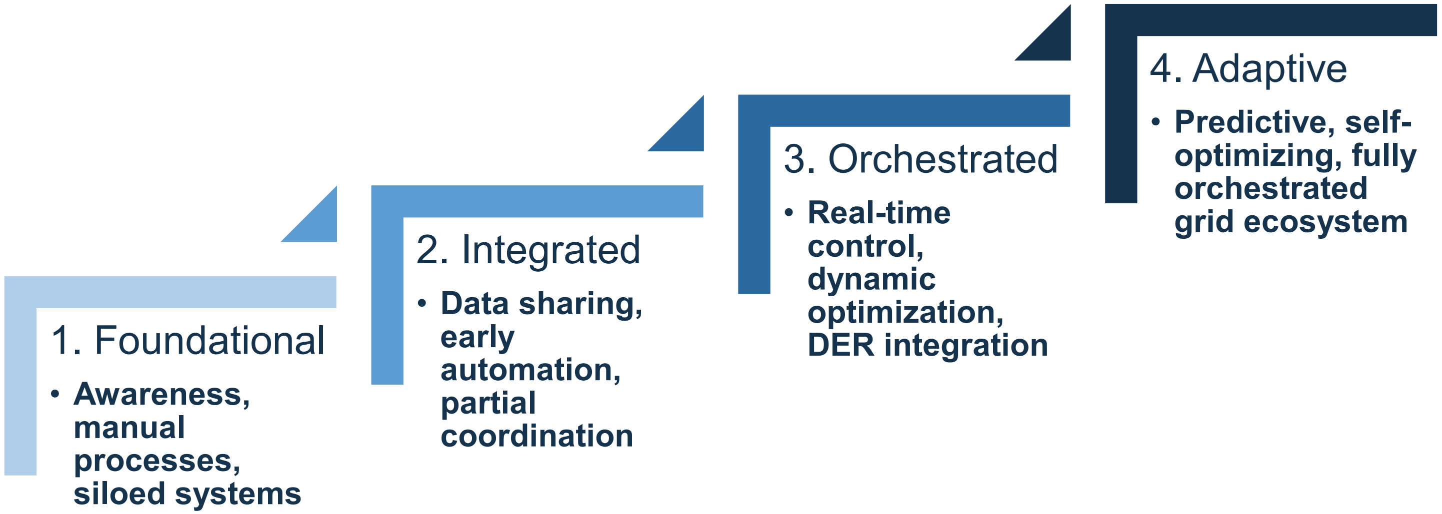
Each business objective is aligned with maturity levels to detail key features and value realization.

Holistic Visibility Evolution

Visibility develops from siloed data to AI-driven real-time control, enhancing operational insight.

Customer Integration Progression

Customer roles evolve from passive consumers to active prosumer orchestration within the ecosystem.



TGO Maturity Model Definitions

Maturity Level	Description	Key Characteristics	Value Realization
1. Foundational (Awareness & Enablement)	**Basic capabilities and awareness of orchestration potential.**	- Manual processes - Siloed systems - Limited visibility - Minimal DER integration	- Initial reliability improvements - Basic O&M cost savings
2. Integrated (Data-Driven Coordination)	**Systems and data begin to integrate across domains.**	- Shared data platforms - Early-stage DERMS, ADMS - Some demand response - Basic forecasting & analytics	- Improved asset utilization - Moderate O&M and capital efficiency - Early resilience planning
3. Orchestrated (Dynamic Optimization)	**Real-time orchestration across grid layers and actors.**	- Real-time/locational situational awareness - Coordinated TSO/DSO operations - Automated fault detection - Virtual Power Plants (VPPs) - Risk-informed decision-making	- High reliability & resilience - Capital deferral via non-wires solutions - Enhanced market participation
4. Adaptive (Predictive & Proactive Ecosystem)	**Fully adaptive, self-optimizing grid ecosystem.**	- AI/ML-driven analytics - Self-healing networks - Dynamic pricing & incentives - Full prosumer integration - Regulatory-aligned orchestration	- Maximum grid flexibility - Decarbonization & sustainability - Resilient, affordable, secure grid

TGO Maturity Model Expanded Definitions

	Maturity Level			
Objective	Foundational	Integrated	Orchestrated	Adaptive
Holistic Visibility & Control	Basic SCADA, siloed data, limited DER visibility	Unified dashboards, partial DERMS, AMI integration	Real-time situational awareness, DERMS + ADMS, IoT sensors	Predictive grid state modeling, AI-driven control, full DER orchestration
Integrated Planning & Operations	Separate TSO/DSO planning, manual coordination	Shared data lakes, joint planning sessions	Coordinated control systems, integrated forecasting	AI-assisted co-optimization, dynamic planning with real-time feedback
Localized Grid Flexibility	Manual DR programs, limited BTM visibility	Aggregator platforms, early VPP pilots	Automated DR, storage dispatch, flexible load orchestration	Fully modular flexibility, AI-optimized dispatch, prosumer-led balancing
Enhanced Resilience & Reliability	Manual outage response, basic redundancy	FLISR, automated switching, resilience planning tools	Self-healing networks, microgrid integration, black start readiness	Predictive failure analytics, adaptive islanding, climate risk mitigation
Customer & Prosumer Integration	TOU pricing, basic portals, passive consumers	Real-time pricing, DER enrollment, mobile apps	VPPs, DER aggregation, active market participation	Full prosumer orchestration, dynamic incentives, sustainability dashboards
Asset Optimization Capability	Time-based maintenance, siloed asset data	Predictive maintenance, digital twins, APM tools	Scenario-based planning, cross-platform analytics	AI-driven optimization, real-time asset orchestration, lifecycle extension
Market Enablement & Coordination	Manual settlements, limited DR markets	Real-time trading platforms, DRMS integration	Dynamic pricing, flexible market rules, DER market access	Fully transactive energy markets, blockchain-enabled P2P trading
Risk-Informed Decision-Making	Qualitative risk logs, manual assessments	Quantitative scoring, early modeling tools	Real-time risk dashboards, decision support systems	Predictive risk optimization, AI-driven orchestration under uncertainty

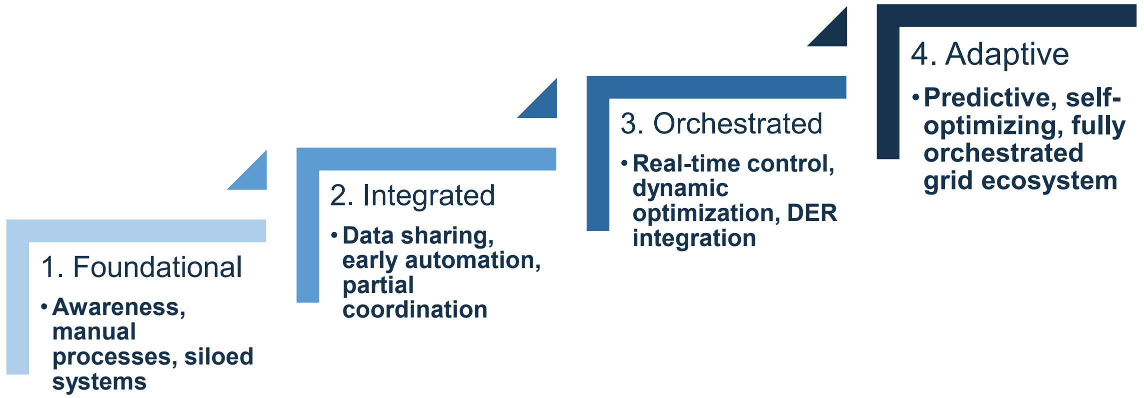
TGO Framework

Defining the Vision: From Business Objectives to a Scalable Maturity Model – WG1 identified eight core business objectives and their supporting system requirements—then developed a maturity model to guide progressive capability building and value realization across the orchestration journey

TGO Objectives

1. Holistic Visibility and Control
2. Integrated Planning & Operations
3. Localized Grid Flexibility
4. Enhanced Resilience and Reliability
5. Customer and Prosumer Integration
6. Asset Optimization Capability
7. Market Enablement and Coordination
8. Risk-Informed Decision-Making

TGO Maturity Model Definitions



TGO Utility Reference Model

The TGO Utility Reference Model organizes the **essential capabilities** for grid orchestration into **four core domains**—spanning from planning through operations. These domains are **enabled by five key supporting functions**, which together ensure utilities can deliver a resilient, flexible, and optimized grid. This integrated approach brings together planning, operations, market coordination, customer engagement, regulatory compliance, IT infrastructure, and risk management, all underpinned by robust cyber and physical security.

- Grid Engineering, Planning & Procurement
- Generation Operations
- Transmission Operations
- Distribution Operations

- Market Design & Coordination
- Customer & Prosumer Engagement
- Regulatory & Policy
- IT & Communications Infrastructure
- Risk & Decision Support

We identified four domains that span from planning to operations supported by five supporting functions

TGO Utility Reference Model

Grid Engineering, Planning & Procurement
- Integrated resource and systems planning
- Asset investment prioritization
- Hosting capacity and load forecasting
- Resource Procurement
- Scenario modeling and probabilistic risk assessment

Generation Operations
- Generation dispatch optimization
- Unit availability forecasting
- Fuel mix and emissions tracking
- Inertia balancing and frequency support
- Risk-informed dispatch decisions

Transmission Operations
- Congestion management
- Grid stability and reliability
- Transmission constraints modeling
- Coordination with ISO/TSO for bulk system operations
- Risk Informed Constraint Management

Distribution Operations
- Real-time and day-ahead dispatch
- Outage Response
- DERMS/ADMS integration
- Situational awareness and DER control systems
- Risk-Informed Localized grid flexibility

Indicates existing capability

Indicates needed capability for TGO

Market Design & Coordination
- Dynamic pricing and bidding mechanisms
- Real-time energy markets
- Bilateral and programmatic flexibility services
- Measurement, verification, and settlement

Customer & Prosumer Engagement
- DER onboarding and flexible grid connection
- Demand response programs
- Peer-to-peer energy trading
- Customer portals and choice mechanisms

Regulatory & Policy
- Compliance with evolving TGO regulations
- Investment proposal criteria
- Risk-informed decision frameworks

IT & Communications Infrastructure
- Substation and field area networks
- Edge computing and telemetry
- Data interoperability, analytics & governance
- Integrated network management

Risk & Decision Support
- Scenario analysis and modeling
- AL& ML Driven Digital twin simulations /
- Value realization frameworks
- Resilience planning and operational risk profiling

+ Cyber & Physical security

+ Change Management & Workforce Enablement

TGO Framework Summary

Core Business Objectives

WG1 identified eight key business objectives critical for advancing the TGO Framework.

Scalable Maturity Model

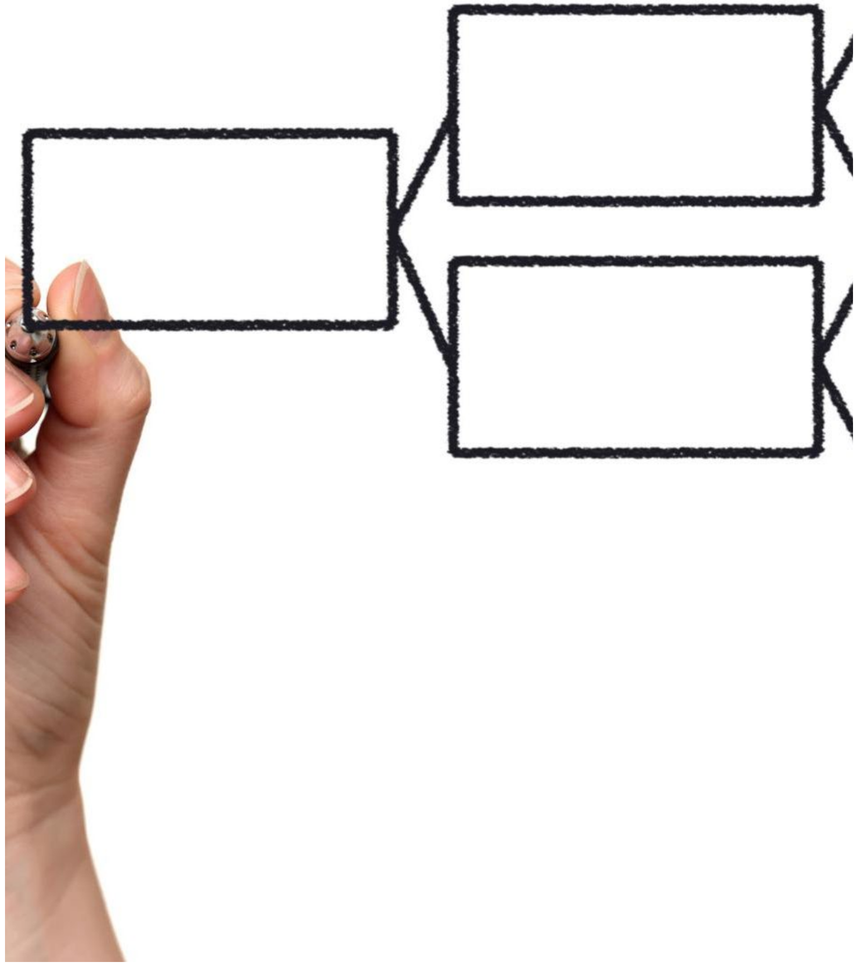
A scalable maturity model guides capability building from foundational to adaptive orchestration stages.

Framework Components

The framework includes hierarchy, strategic components, reference models, and market analysis to support TGO vision.

Positioning for Success

This comprehensive framework positions the TGO Alliance to engage on needed capabilities to activate TGO



TGO Alliance

2025 Fall Summit

Flexible Connections

Case Study

11:30 – 12:00

Joe Ciccarello

Lead Engineer
Electrical Planning and Design

nationalgrid

EV Flexible Connections – Why?

Private Fleet customers were not satisfied with National Grid's service offerings for their large load needs

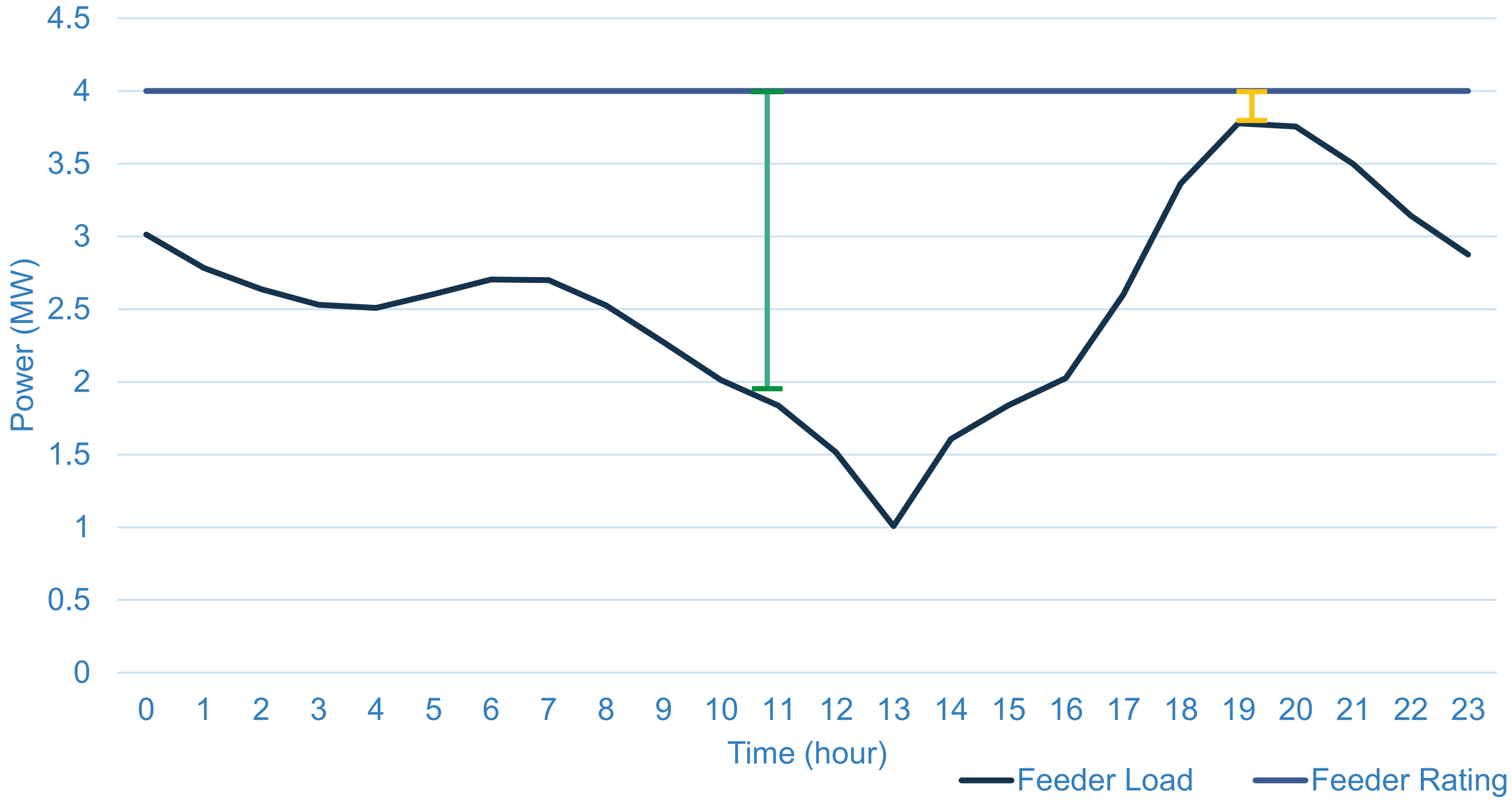
Customer Engagement

- Customers were coming to National Grid looking for large loads to charge their electric vehicles, some upwards of 7MW
- Connection costs and timelines were beyond customer's means
  - School Districts were unable to afford upgrade costs
  - Trucking Companies were unwilling to accept connection timelines

Experience with Flexible Interconnections

- National Grid is piloting:
  - Two Solar Flexible Interconnection sites in New York
  - One collocated Solar / BESS Flexible Interconnection site in Massachusetts
  - One BESS Flexible Interconnection site in New York (early stages)

EV Flexible Connections – Example Feeder Peak Day



- Traditional services would need to plan for the worst-case scenario, only allowing additional **250kW** of new customer load
- There is a lot of **additional capacity** available on the feeder, but the customer needs grid visibility and control measures to safely access it

EV Flexible Connections – High Level Requirements

A variety of use cases show a benefit to providing customers a choice in solution-type:

Scheduled Solution

Targeted customer has the same routes and hours of operation each day (example: School buses)

Load is limited at the same hours every day

- System must be able to monitor site load
- System must be able to ingest a pre-determined schedule
- System must be able to communicate the site load limit to the customer based on the schedule
- Contract must be agreed upon by NG & Customer to define expectations
- System must be able to mitigate customer noncompliance (notification, curtailment, disconnect)

Dynamic Solution

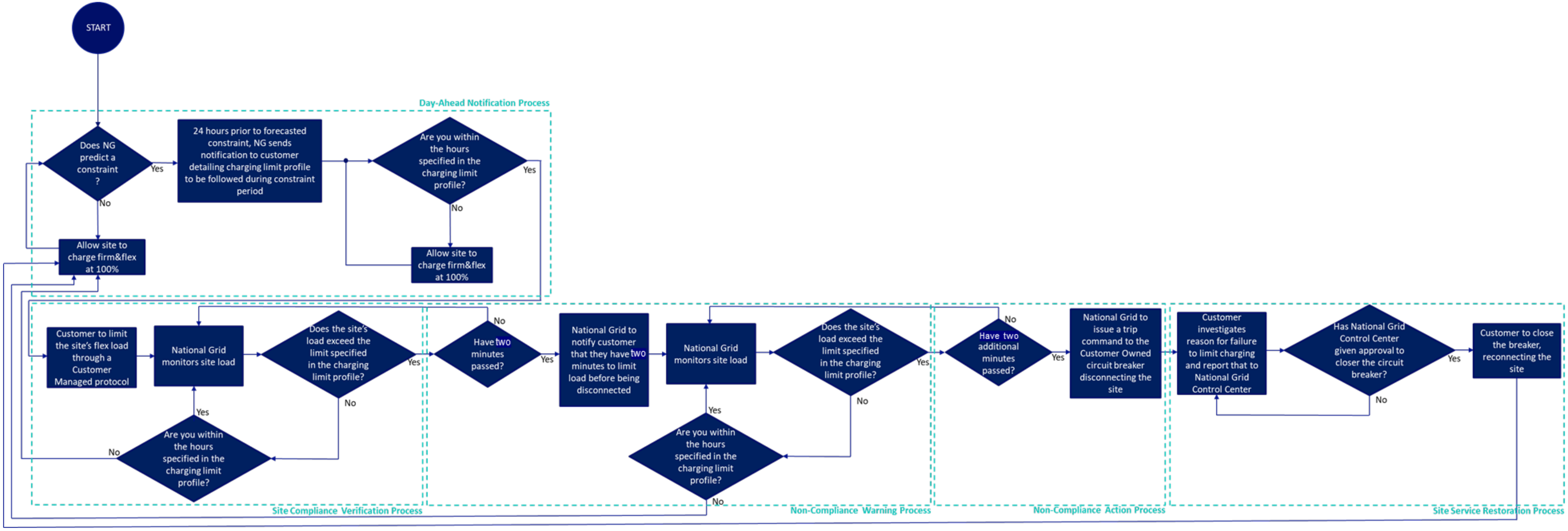
Targeted customer has varying routes and hours of operation each day (example: delivery trucks)

Load is limited based forecasted constraints

- System must be able to monitor site load
- System must be able to ingest hourly Short Term Forecasting data
- System must be able to calculate the allowable site load limit from the STF data
- System must be able to communicate the allowable site load limit to the customer based on the STF data
- Contract must be agreed upon by NG & Customer to define expectations
- System must be able to mitigate customer noncompliance (notification, curtailment, disconnect)

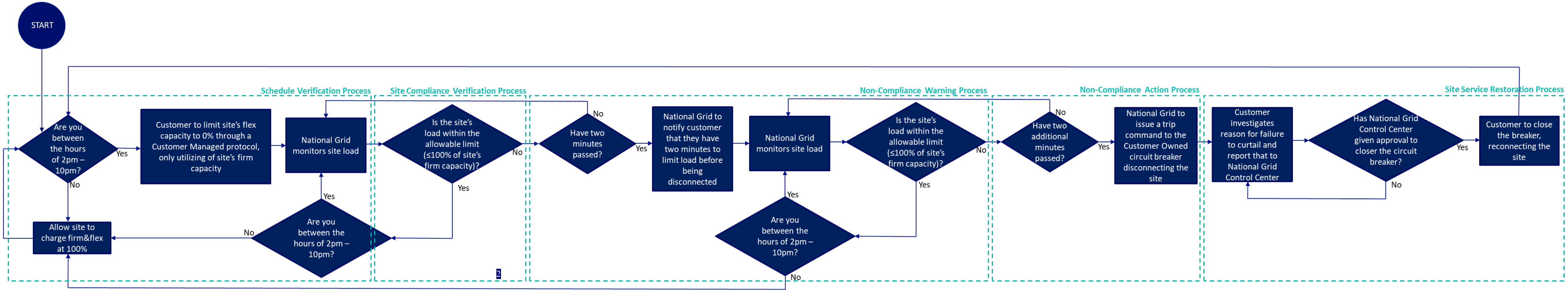
EV Flexible Connections

Dynamic Limiting Process Map



EV Flexible Connections

Scheduled Limiting Process Map



EV Flexible Connections – Customer Compliance

To ensure customer compliance, a control cabinet is required at the customer location and a contract must be signed

On-Site Controls

- A Remote Terminal Unit (RTU) will have awareness of allowable charging limits, and will send these to the customer's Fleet Manager
  - For Scheduled, these limits will be pre-programmed
  - For Dynamic, these limits will be sent daily from National Grid
- Monitoring equipment is required to measure the site's load
- A disconnect device will be tripped should a customer be non-compliant for any reason

Customer Agreement

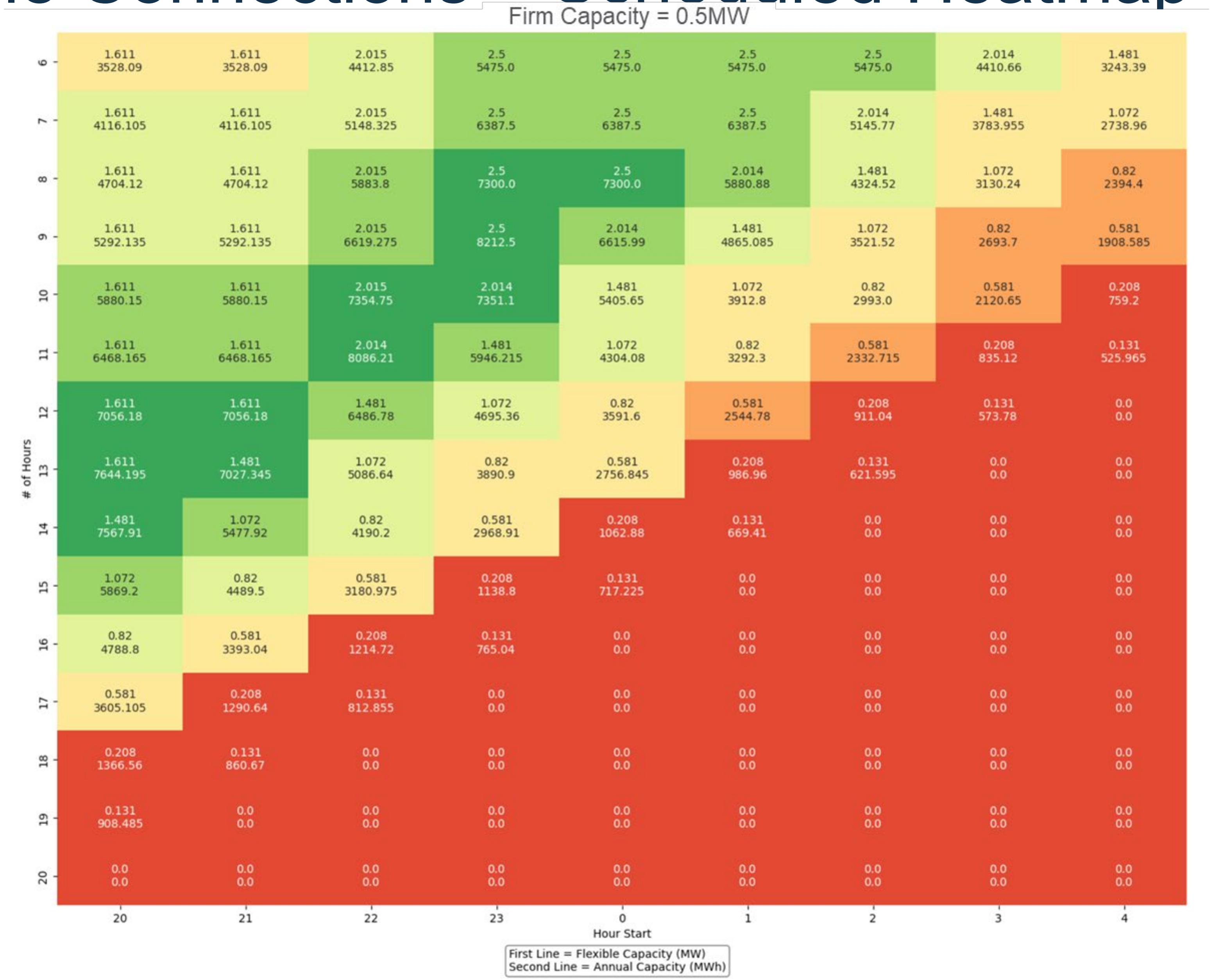
- The allowable charging limits are agreed up within this contract
  - For Scheduled, the contract states the maximum limit for each hour of the day
  - For Dynamic, the contract states the maximum total site capacity and the guaranteed load limit
- A Fleet Electrification Plan is shared
  - The customer outlines a yearly plan of vehicle purchases to reach full site capacity

EV Flexible Connections – Dynamic Heatmap

Hour \ Month	1	2	3	4	5	6	7	8	9	10	11	12
0	100.00%	100.00%	100.00%	100.00%	100.00%	94.79%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
1	100.00%	100.00%	100.00%	100.00%	100.00%	98.34%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
2	100.00%	100.00%	100.00%	100.00%	100.00%	99.11%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
3	100.00%	100.00%	100.00%	100.00%	100.00%	99.53%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
4	100.00%	100.00%	100.00%	100.00%	100.00%	99.49%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
5	100.00%	100.00%	100.00%	100.00%	100.00%	98.99%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
6	100.00%	100.00%	100.00%	100.00%	100.00%	95.68%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
7	100.00%	100.00%	100.00%	100.00%	100.00%	93.52%	99.73%	100.00%	100.00%	100.00%	100.00%	100.00%
8	100.00%	100.00%	100.00%	100.00%	100.00%	90.78%	98.93%	100.00%	100.00%	100.00%	100.00%	100.00%
9	100.00%	100.00%	100.00%	100.00%	100.00%	86.05%	95.79%	99.60%	100.00%	100.00%	100.00%	100.00%
10	100.00%	100.00%	100.00%	100.00%	100.00%	85.48%	90.70%	97.79%	100.00%	100.00%	100.00%	100.00%
11	100.00%	100.00%	100.00%	100.00%	100.00%	85.25%	86.12%	95.90%	100.00%	100.00%	100.00%	100.00%
12	100.00%	100.00%	100.00%	100.00%	100.00%	81.54%	77.48%	93.24%	100.00%	100.00%	100.00%	100.00%
13	100.00%	100.00%	100.00%	100.00%	100.00%	83.08%	69.63%	91.96%	100.00%	100.00%	100.00%	100.00%
14	100.00%	100.00%	100.00%	100.00%	100.00%	79.96%	61.18%	91.04%	100.00%	100.00%	100.00%	100.00%
15	100.00%	100.00%	100.00%	100.00%	100.00%	80.18%	56.00%	88.07%	100.00%	100.00%	100.00%	100.00%
16	100.00%	100.00%	100.00%	100.00%	100.00%	72.35%	55.12%	88.73%	100.00%	100.00%	100.00%	100.00%
17	100.00%	100.00%	100.00%	100.00%	100.00%	62.78%	55.48%	91.29%	100.00%	100.00%	100.00%	100.00%
18	100.00%	100.00%	100.00%	100.00%	100.00%	57.98%	60.35%	94.01%	100.00%	100.00%	100.00%	100.00%
19	100.00%	100.00%	100.00%	100.00%	100.00%	56.69%	65.23%	96.38%	100.00%	100.00%	100.00%	100.00%
20	100.00%	100.00%	100.00%	100.00%	100.00%	58.23%	74.40%	97.38%	100.00%	100.00%	100.00%	100.00%
21	100.00%	100.00%	100.00%	100.00%	100.00%	61.45%	81.41%	99.10%	100.00%	100.00%	100.00%	100.00%
22	100.00%	100.00%	100.00%	100.00%	100.00%	71.92%	93.83%	99.98%	100.00%	100.00%	100.00%	100.00%
23	100.00%	100.00%	100.00%	100.00%	100.00%	84.22%	98.96%	100.00%	100.00%	100.00%	100.00%	100.00%

Limiting Events:	3.06% of annual MWh
	536 hours limited
	6.12% hours of the year

EV Flexible Connections – Scheduled Heatmap



EV Flexible Connections – Where are we today?

Challenges

- "Goldilocks Solution" – If a circuit has too much capacity available, the solution is not needed. If a circuit has too little capacity available, the infrastructure upgrades will be necessary regardless.
- Disappearing EV incentives are resulting in slowed interest

Customer Engagement

- Ongoing conversations detailing specific service offerings
- Seeing customer interest from Trucking Companies, School Districts, and Municipal Services across New York and Massachusetts

Technology Testing

- On-Site cabinet is built and ready for testing
- Software vendor contract is being finalized
- Testing beginning this month

Lunch

12:00 – 1:00

We will regroup promptly at 1:00pm

TGO Alliance

TGO Alliance

2025 Fall Summit

Localized Grid Flexibility

Working Group 2

1:00 – 3:00

Andrew Fawcett

Supervisor, Distribution Systems Integration

Hydro Ottawa

Allie Broussard

Market Specialist, Electric Markets

BLACK & VEATCH

Working Group 2 Team Members

Joe Ciccarello
Lead Engineer, Integrated Planning & Solutions
National Grid

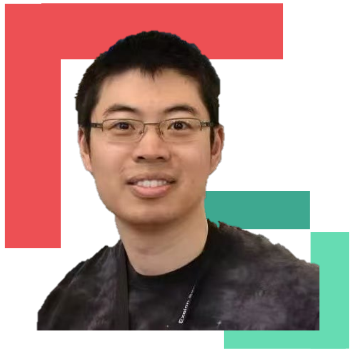
AJ Biron
Electrical Engineer, Electrical Engineering
PUC Services, Inc.

Andrew Fawcett
Supervisor, Distribution Systems Integration
Hydro Ottawa

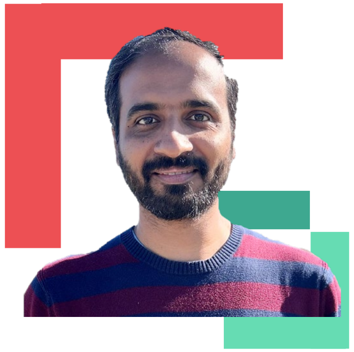
Allie Broussard
Market Specialist, Electric Markets
Black & Veatch

Matt Seibert
Principal Consultant, Operational Technology
Black & Veatch

Karan Patel
Managing Director, Energy Solutions & Clean Energy
Rappahannock Electric Coop



Kevin Chen
Co-Founder & Chief Technology Officer
Gridient



Chaitanya Baone
Head of Product
ThinkLabs AI

Working Group #2: Localized Grid Flexibility

Our Mission

Develop a framework for tools, processes, and governance for developing and deploying Localized Grid Flexibility solutions. Document best practices and guard rails for TGO members to develop and implement Localized Grid Flexibility solutions.

Key Objectives (workstreams)

- Finalize definition & scope of Localized Grid Flexibility.
- Define Localized Grid Flexibility value proposition or business case for implementation.
- Develop maturity model for Localized Grid Flexibility to enable incremental benefits.
- Develop deployment playbook that provides guidance to implement Localized Grid Flexibility.

Target Outcomes

- Present draft deliverables to TGO Alliance for review and feedback to support future operationalism.
- Enable member utilities (with vendor support) to drive innovation for new tools or collective application of existing tools to develop and pilot LGF.

Localized Grid Flexibility Defined

The orchestration of multiple Grid Services to alleviate constraints in the distribution network to balance energy supply and demand at the local level by providing real-time reporting and analytics and control on localized Grid Services to evaluate effectiveness and optimize dispatch.

GOALS

- ✓ Alleviate localized constraints by orchestrating Grid Services and resources in the most efficient way possible.
- ✓ Effectively prepare grid resources based on constraints identified in the short-term forecast.
- ✓ Leverage a single platform to plan and orchestrate all available Grid Services in the short-term (operational) time horizon (<10 days).
- ✓ Orchestrate solutions for a single or set of constraints to support local solutions and enable more granular usage of Grid Services.

IN SCOPE

Distribution system from the distribution service transformer, up to the sub-transmission (34.5 - 100kV) level.

Grid Services

- *Volt Var Optimization (VVO)*
- *Conservation Voltage Reduction (CVR)*
- *Load Balancing (Grid Reconfiguration)*
- *Demand Response Programs*
- *Flexible Interconnections*
- *BESS*
- *Asset Optimization*
- *Virtual Power Plant*

OUT OF SCOPE

- ❑ System Planning
- ❑ Multiple Violations (System-wide grid management)

PRE-CONDITIONS

#1 – Multiple Grid Services

2 or more Grid Services must be available for orchestration.

#2 – Organization Structure

- ✓ Visibility to real-time grid constraints
- ✓ Access to multiple services that can be managed to alleviate constraints
- ✓ Ability to directly manage Grid Services in real-time

#3 – Regulation and Market Structure

Contract or rate recovery mechanisms that allow multiple Grid Services to be used to remediate reliability or power quality issues on the localized system.

#4 – Available Flexibility

Knowledge of location and amount of flexibility available to alleviate grid constraints across different time scales.

Working Group #2 Progress To Date

What should be included in a Deployment Playbook?

1 Definition & Scope

- ✓ LGF concept
- ✓ Scope guardrails
- ✓ Pre-conditions
- ✓ Stakeholders

Localized Grid Flexibility Overview

Localized Grid Flexibility (LGF) is the orchestration of multiple grid services to alleviate constraints in the distribution network to balance energy supply and demand at the local level by providing real-time reporting and analytics and control on localized Grid Services to evaluate effectiveness and optimize dispatch. The scope of application includes the distribution system from the distribution service transformer, up to the sub-transmission (34.5 - 100kV) level.

Goals

1. Alleviate localized constraints by orchestrating grid services and resources in the most efficient way possible.
2. Effectively prepare grid resources based on constraints identified in the short-term forecast.
3. Leverage a single platform to plan and orchestrate all available Grid Services in the short-term (operational) time horizon (<10 days).
4. Orchestrate solutions for a single/set of constraints to support local solutions and enable more granular usage of Grid Services.

Scope

The Grid Services identified for orchestration include, but are not limited to the following:

- Volt VAr Optimization (VVO)
- Conservation Voltage Reduction (CVR)
- Load Balancing (Grid Reconfiguration)
- Demand Response Programs
- Flexible Interconnections
- BESS
- Asset Optimization
- Virtual Power Plant

Scope Guardrails & Common Questions

The following topics are expected to be pulled into scope in future enhancements for the LGF use case framework.

System Planning: While system planning is very closely related to LGF, the initial scope of this use case is constrained to the current state infrastructure. LGF may expand in the future to consider the impact on long term planning and the ability to optimize long term planning based on the capabilities of LGF.

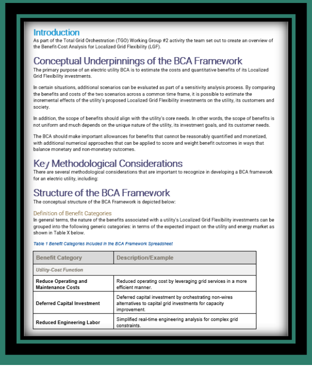
Multiple Violations: LGF will be limited to addressing and mitigating single system constraints initially to build confidence and clarity around a simplified solution. Once that clear approach to Grid Service orchestration is established, the LGF use case can easily be expended to address multiple constraints and system-wide grid management.

Why Localized Grid Flexibility Matters

As the energy landscape evolves, utilities and grid operators are increasingly turning to advanced technologies to address specific operational challenges—whether it's managing voltage, integrating distributed energy resources (DERs), or responding to localized demand surges. However, while these point solutions are valuable, the market has yet to see the emergence of scalable, standardized approaches that can orchestrate these capabilities holistically across the distribution system.

2 Value Proposition

- ✓ Costs
- ✓ Benefits
- ✓ BCA framework guidance



Introduction

As part of the Total Grid Orchestration (TGO) Working Group #2 activity the team set out to create an overview of the Benefit-Cost Analysis for Localized Grid Flexibility (LGF).

Conceptual Underpinnings of the BCA Framework

The primary purpose of an electric utility BCA is to estimate the costs and quantitative benefits of its Localized Grid Flexibility investments.

In certain situations, additional scenarios can be evaluated as part of a sensitivity analysis process. By comparing the benefits and costs of the two scenarios across a common time frame, it is possible to estimate the incremental effects of the utility's proposed Localized Grid Flexibility investments on the utility, its customers and society.

In addition, the scope of benefits should align with the utility's core needs. In other words, the scope of benefits is not uniform and much depends on the unique nature of the utility, its investment goals, and its customer needs.

The BCA should make important allowances for benefits that cannot be reasonably quantified and monetized, with additional numerical approaches that can be applied to score and weight benefit outcomes in ways that balance monetary and non-monetary outcomes.

Key Methodological Considerations

There are several methodological considerations that are important to recognize in developing a BCA framework for an electric utility, including:

Structure of the BCA Framework

The conceptual structure of the BCA Framework is depicted below:

Definition of Benefit Categories

In general terms, the nature of the benefits associated with a utility's Localized Grid Flexibility investments can be grouped into the following generic categories: in terms of the expected impact on the utility and energy market as shown in Table X below.

Table 1 Benefit Categories Included in the BCA Framework Spreadsheet

Benefit Category	Description/Example
Utility-Cost Function	
Reduce Operating and Maintenance Costs	Reduced operating cost by leveraging grid services in a more efficient manner.
Deferred Capital Investment	Deferred capital investment by orchestrating non-wires alternatives to capital grid investments for capacity improvement.
Reduced Engineering Labor	Simplified real-time engineering analysis for complex grid constraints.

3 Maturity Model

- ✓ Capabilities
- ✓ Maturity measures
- ❑ Method to assess

90%

4 Requirements

- ✓ High-Level architecture
- ❑ Non-functional
- ❑ Functional

10%

5 Data Readiness

6 Field Infrastructure

7 Organizational Structure

8 Market Construct

Localized Grid Flexibility Moving Forward

LGF Working Group Guardrails → **Expanding LGF Scope Moving Forward**

IN SCOPE	OUT OF SCOPE
Current State Infrastructure	Long Term System Planning
Single System Constraints	System-Wide Grid Orchestration

Planning & Design
- Changes to the distribution planning model to better leverage LGF capability

System Wide Application
- Orchestration of many constraints across the distribution and sub-transmission system

LGF Deployment
- Utility pilot for LGF in partnership with a vendor or simulated pilot in a lab environment

Scoping the Maturity Model

Maturity Measures

- System Integration
- Visibility
- Control Capability
- Local vs System Control
- Grid Service Prediction and Forecasting Analysis
- Load Prediction and Forecasting Analysis
- Orchestration Analysis and Optimization
- Network Model
- Data Management

Sample Progression

Minimum Maturity — Manual analysis and orchestration using existing tools and mechanisms

Level 2

Level 3

Full Maturity — Automated orchestration for all Grid Services using a single purpose-built platform for short-term planning and real-time operations

Utility Complexity & Non-Linearity

Localized Grid Flexibility Maturity Measures

CAPABILITY / MEASURE	LEAST MATURE LEVEL	MOST MATURE LEVEL
System Integration	Data from Grid Services is siloed; requires manual extraction and analysis.	Data flows seamlessly across systems into a single operational interface with full automation.
Visibility	Minimal or no real-time monitoring through SCADA, field sensors, or Grid Service monitoring.	Sensors have high penetration providing clear view of the telemetered state of the system and Grid Services.
Control Capability	No centralized dispatch; Grid Services may require manual field operation.	Centralized platform can issue automated, secure dispatch commands to all Grid Services at any scale.
Local vs. System Control	Grid Services can only be dispatched at a system-wide level.	Grid Services are dispatchable at any level of granularity, from system-wide to individual device.
Grid Service Prediction & Forecasting Analysis	Service availability is estimated manually with limited accuracy.	Grid Services data in a single platform automatically shows current state, predicted capacity and availability.
Load Prediction & Forecasting Analysis	Constraints are assessed using historical data and manual calculations.	Ability to accurately predict and identify expected local system constraints within the short-term planning period.
Orchestration Analysis and Optimization	Manual analysis using spreadsheets; no optimization across services.	Automated, closed-loop optimization of multiple grid services within a single platform.
Network Model	No detailed distribution model; connectivity and asset attributes are incomplete.	High-fidelity, continuously updated network model enabling confident forecasting and control.
Data Management	Data is fragmented, error-prone, and difficult to access across systems.	Data is accurate, current, and seamlessly integrated using industry-standard practices.

Why Localized Grid Flexibility Matters to TGO

TGO ALLIANCE INSIGHTS

Survey Approach

Provided list of LGF key capabilities at the most mature levels.

Respondents asked to provide perspectives on the current state of the market:

- The solution is widely available and mature
- The solution is being deployed at multiple utilities
- The solution exists in pilots or unique deployments
- I know of developing solutions
- Solution is immature or utilizing legacy capabilities

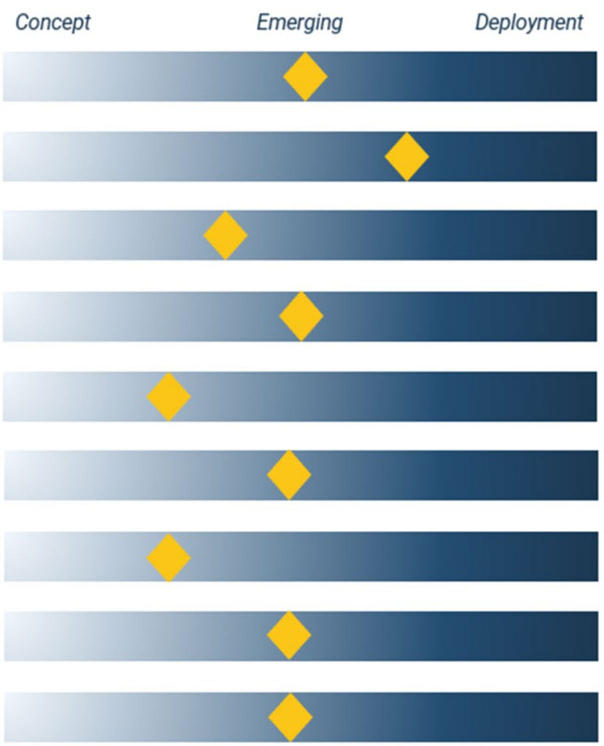
Survey Responses

24%
Response Rate

50 Alliance Members Surveyed

12 Responses Received

SURVEY RESULTS



Capability	SCORE	STD. DV.
System Integration	3.09	0.94
Visibility	3.75	0.62
Control Capability	2.55	1.29
Local vs System Control	3.00	0.82
Grid Service Prediction & Forecasting	2.09	0.94
Load Prediction & Forecasting	2.91	1.14
Orchestration Analysis & Optimization	2.00	1.00
Network Model	2.91	1.14
Data Management	2.92	1.00

Results varied widely, suggesting a lack of common frameworks, shared language, and interoperable LGF solutions → an **opportunity for TGO**.

LGF Benefit and Cost Analysis Journey

Set out to develop a BCA workbook

- ✓ Develop methodology to measure benefits
- ✓ Include sample calculations
- ✓ Test/validate calculations with sample data

Reduction in Maintenance Costs

Asset Type: Distribution Transformer

$MX_{\text{Annual Reduction}} = (COST_{\text{Avg. PRVM DXFMR}} - COST_{\text{Avg. PRDM DXFMR}})\, DXFMR_{\text{Pop.}}$

$DXFMR_{\text{Pop.}}$ = Distribution transformer population size

$COST_{\text{Avg. PRVM DXFMR}}$ = Annual average cost of preventative maintenance program per distribution transformer

$COST_{\text{Avg. PRDM DXFMR}}$ = Annual average cost of predictive maintenance program per distribution transformer (Taking into account the reduced annual maintenance required per transformer, reduced number of maintenance events required due to a lack of overload situations)

$MX_{\text{Annual Reduction}}$ = Annual reduction in maintenance costs

Identified limitations to measuring

- ✓ Quantifying and comparing individual Grid Services programs against LGF
- ✓ Utility variability in systems, data, and approaches
- ✓ Difficult to predict until LGF criteria, design, and configurations is fully developed
- ✓ Need to develop an understanding of LGF behavior to predict costs and benefits

Developed a high-level framework

- ✓ Establish expected costs and benefits with qualitative justification
- ✓ Create a lightweight, high-level framework that utilities can leverage to develop their own calculations
- ✓ Provide guidance on considerations for measuring

Localized Grid Flexibility Benefits

Localized Grid Flexibility (LGF) enables utilities to orchestrate grid services at the distribution level to alleviate constraints, optimize dispatch, and improve system performance. By leveraging real-time visibility and control, LGF supports more resilient, cost-effective, and scalable grid operations.

Value Offered	Benefits Generated
• Orchestrates non-wires alternatives • Targeting location-specific load reductions • Optimize asset performance	**Capital Investment Deferral** ✓ Reduce need for traditional infrastructure upgrades ✓ Defer or avoid investments in distribution capacity ✓ Extends asset lifecycle
• Real-time dispatch of multiple Grid Services • Dynamically balance supply and demand • Ability to island and reroute energy flows	**Reliability & Resiliency** ✓ Real time stabilization of operations ✓ Minimizes outages and load-shed events ✓ Flexibly mitigate weather, security, and system threats
• Targeted, localized dispatch • Prioritizes lower-cost local Grid Services • Ability to island and reroute energy flows	**Lower Customer Program Costs** ✓ Reduce payouts and customer fatigue ✓ Preserving program cost-effectiveness and relief ✓ Optimize compensation and reduce overhead

LGF Utility Maturity Self-Assessment Overview

Maturity Assessment Objectives

1. Help utilities evaluate readiness for implementing LGF across 9 capabilities areas.
2. Benchmark your current capabilities against LGF maturity framework and industry best practices.
3. Provide a clear view of the current state, gaps, and areas for improvement to deploy LGF.

Utility Maturity Self-Assessment Activity

1. Answer a set of targeted questions on Orchestration Analysis & Optimization.

ORCHESTRATION ANALYSIS & OPTIMIZATION	LEAST MATURE LEVEL	MOST MATURE LEVEL
Ability to analyze and optimize the availability and dispatch of the grid services with considerations for the load forecast.	Manual analysis using spreadsheets; no optimization across services.	Automated, closed-loop optimization of multiple grid services within a single platform.

2. This is not a data collection survey but a tool to independently gauge LGF maturity.
3. Allow for open feedback to help guide Working Group tool refinement and finalization.

Standardize LGF readiness criteria and provide actionable feedback for utilities considering LGF deployment.

Localized Grid Flexibility Readiness & Maturity Assessment

Score	Maturity
0 – 9	Not Ready - Foundational
10 – 29	Ready – Integrated
30 – 50	In-Flight – Orchestrated
51+	Mature – Adaptive

1. Can your organization dispatch two or more of the following Grid Services in real-time or near real-time conditions?

a. No, services can only be dispatched based on pre-set schedules or conditions

b. Yes, two or more services can be dispatched in real-time

c. No, only one or none can be dispatched in real-time

2. Do all Grid Services have clearly defined triggers, cost/market impact, and grid impact (reliability, efficiency, customer)?

a. Yes, all services have defined triggers and impacts.

b. No, some or none have defined triggers and impacts.

3. Are objective functions (cost, reliability, emissions, customer impact) and constraints (thermal/voltage, limits, contracts) explicitly modeled for grid services being considered for Orchestration and Optimization?

a. No, they are not explicitly modeled.

b. Yes, objective functions and constraints are explicitly modeled.

4. Do you have a tool or platform that can compare candidate actions across multiple services (e.g., DR vs. VVO vs. BESS) for a single grid constraint?

a. No, such a tool/platform is not available.

b. Yes, a comparison tool/platform is available.

5. Does the tool produce coordinated dispatch plans (sequence, timing, magnitude) and execute them automatically?

a. No, plans are not coordinated or not executed automatically.

b. Yes, coordinated plans are produced and executed automatically.

6. Are post-event analyses run to measure realized impact vs. plan and to tune strategies (closed-loop optimization)?

a. No, post-event analyses are not performed.

b. Yes, post-event analyses and closed-loop optimization are performed.

7. Can you run what-if scenarios (e.g., if DR isn't available, how much VVO + reconfiguration covers the gap)?

a. No, what-if scenarios cannot be run.

b. Yes, what-if scenarios can be run.

8. Is there integration between grid flexibility tools and other utility systems (e.g., outage management, asset management, customer information)?

a. Yes, integration exists between grid flexibility and utility systems.

b. No, integration does not exist.

9. Is there a process or mechanism for updating grid service models and dispatch strategies? (ex: Can you adjust how/when you dispatch Demand Response?)

a. Yes, there is a mechism or process for updating grid service dispatch strategies or models?

b. No, there is no documented update process.

10. Are customer program rules (e.g., comfort, cost, participation) explicitly considered in grid operations short-term planning?

a. No, customer impacts are not explicitly considered.

b. Yes, customer impacts are explicitly considered.

TGO Alliance

2025 Fall Summit

Innovative Distribution Planning

Case Study

3:00 – 3:30

Karan Patel

Managing Director - Energy Solutions and Clean Energy

Rappahannock Electric Cooperative

About REC

RAPPAHANNOCK
ELECTRIC COOPERATIVE

22
Counties

$ 1.3B
Assets

4,000
square-mile Territory

18,000
Miles of Power Lines

186,000+
Primary Poles

100,000+
Transformers

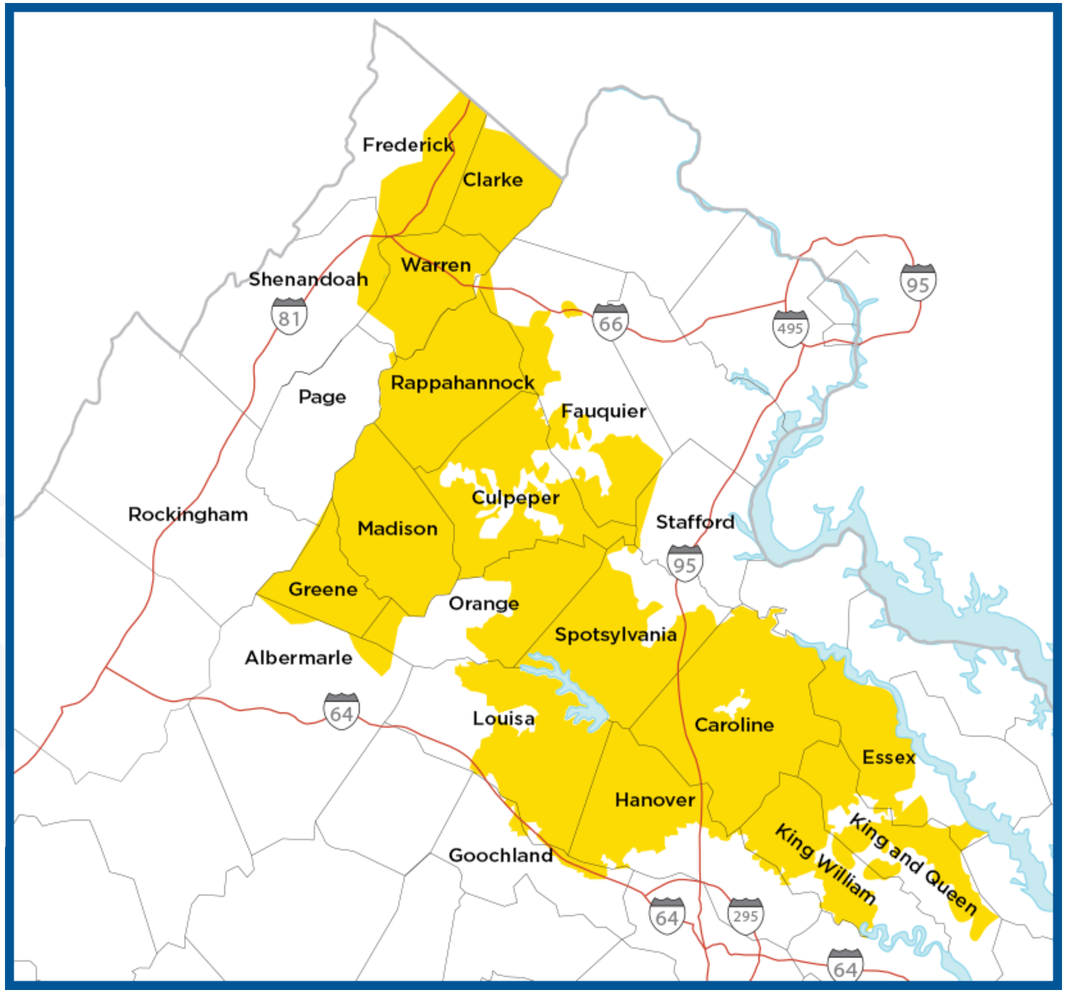
180,000
Accounts

$500M
Annual Revenue

450+
Dedicated Employees

820
Miles of Backbone Fiber

2,650
Miles of Leased FTTH



Electric Cooperative Background

- Not-for-profit organization owned by the members that we serve
- Governed by a locally member-elected Board of Directors
- Rural Electrification Act (REA) was established in 1936
    - Provided loans and assistance to rural organizations to set up their own power systems
    - REA was absorbed by the Rural Utility Services (RUS) under USDA as part of the 1994 Department of Agriculture Reorganization Act
- REC is predominately an RUS borrower

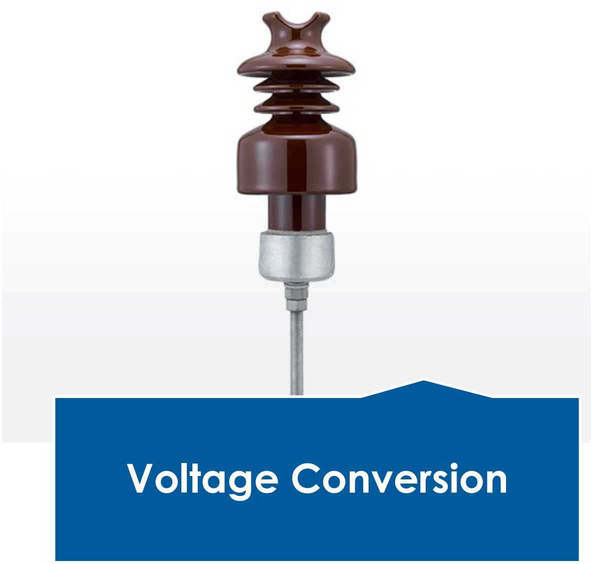
Electric Cooperative Stats

- 13.5% of the nation's electric customers are served by electric co-ops
- Co-ops added over 394,000 new consumers in 2023

System Planning Studies

Long Range System Studies (LRSS) / Long Range Plans (LRP)

- Determines major system improvements needed to serve the 20-30 year projected load growth
- System upgrades would like include:



- Required by RUS to have an in-effect and approved LRSS but not submitted

Construction Work Plans (CWP)

- Major component of integrated system planning (ISP) - details the system improvement projects needed to serve the 2-5 year projected load growth
- Specifies T&D plant investment the Cooperative can expect to make
- Must be approved by the Cooperatives' Board and submitted to RUS in order to secure loans
- RUS provides a framework for what the CWP must include
- Projects are influenced directly by the LRSS / LRP
- Goal is to get at least 2-3 CWP's out of 1 LRSS / LRP

Current Distribution Planning Methods

Load Forecasting

- Usually 10-year forecasts provided by the Generation and Transmission (G&T) Cooperative
- REC utilizes historic loading to trend and project future peak demands
- Loading is generally correlated with weather
- <u>With climate change and extreme weather unpredictability, it's becoming more difficult to use the past to predict the future</u>

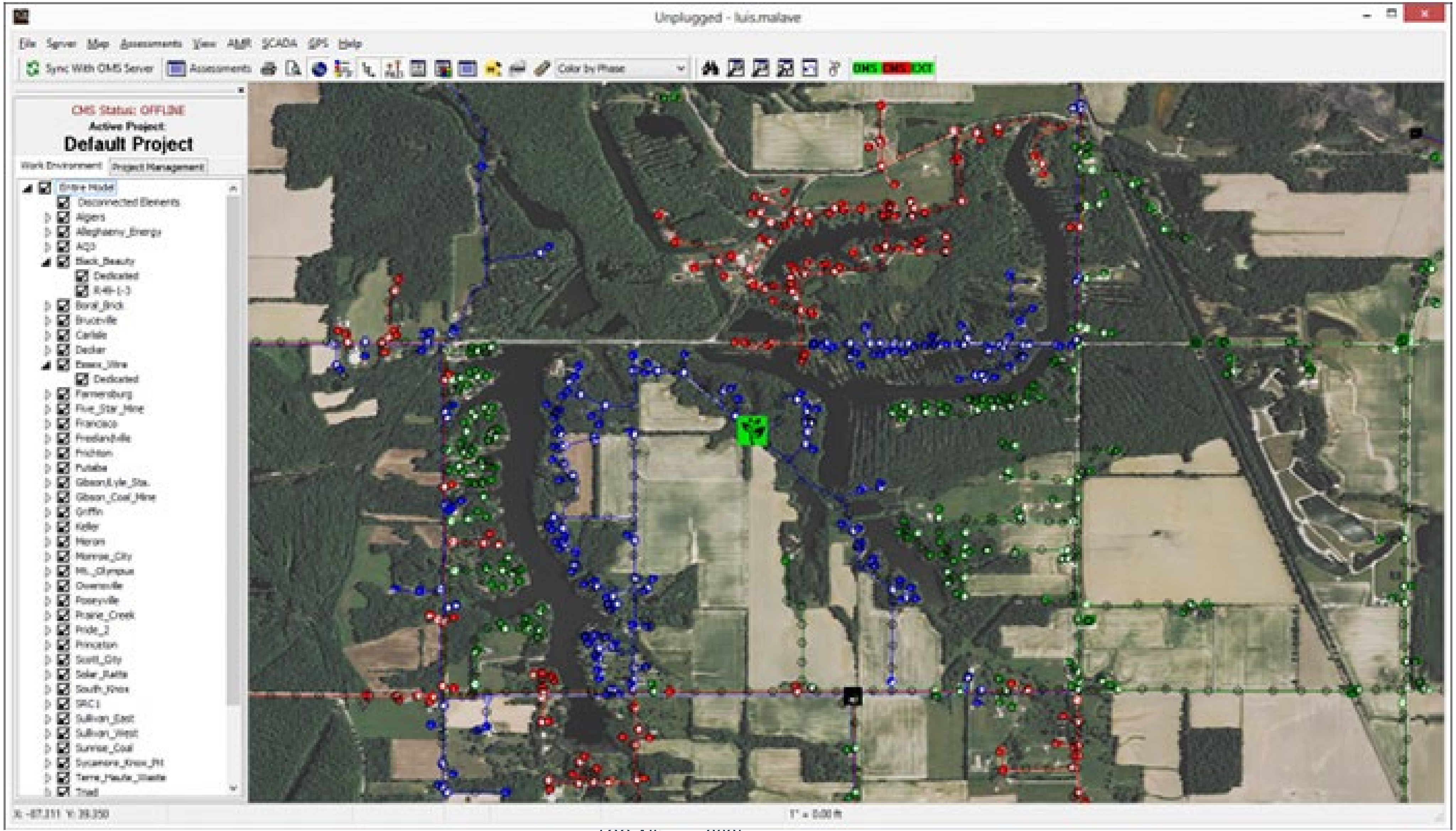
Metering and SCADA Data

- SCADA data: Non-coincident seasonal peaks at the feeder level
  - Sets the Load Control Points (LCP) in power flow model
  - Do not receive feeder-level power factor information
- Metering data exported from Meter Data Management (MDM) system for the month in which the system peak occurred
  - Usually December, January, February or June, July, August
  - Residential: 1 hour kWh interval reads with no kW demand
  - C&I: kW demand available
  - Reduction from residential demand response becomes negligible
  - Multiple billing cycles

Power Flow Modeling Software

- Power flow models created from GIS extracts
- Metering data imported into each consumer-element
- SCADA data imported into each feeder protection device and assigned as LCPs
- "Load Allocation" analysis pushes load into each individual consumer-element based the LCP values
  - Residential: load is ratioed using the monthly kWh information
  - C&I: kW demand allocated 1x1
- Load zones based on where the growth is expected
  - C&I is typically assigned little-to-no growth
- Known spot loads are added into the model
- Model is then grown match the Load Forecast

Power Flow Modeling Software



Future of Distribution Planning

Dynamic Load Forecasting

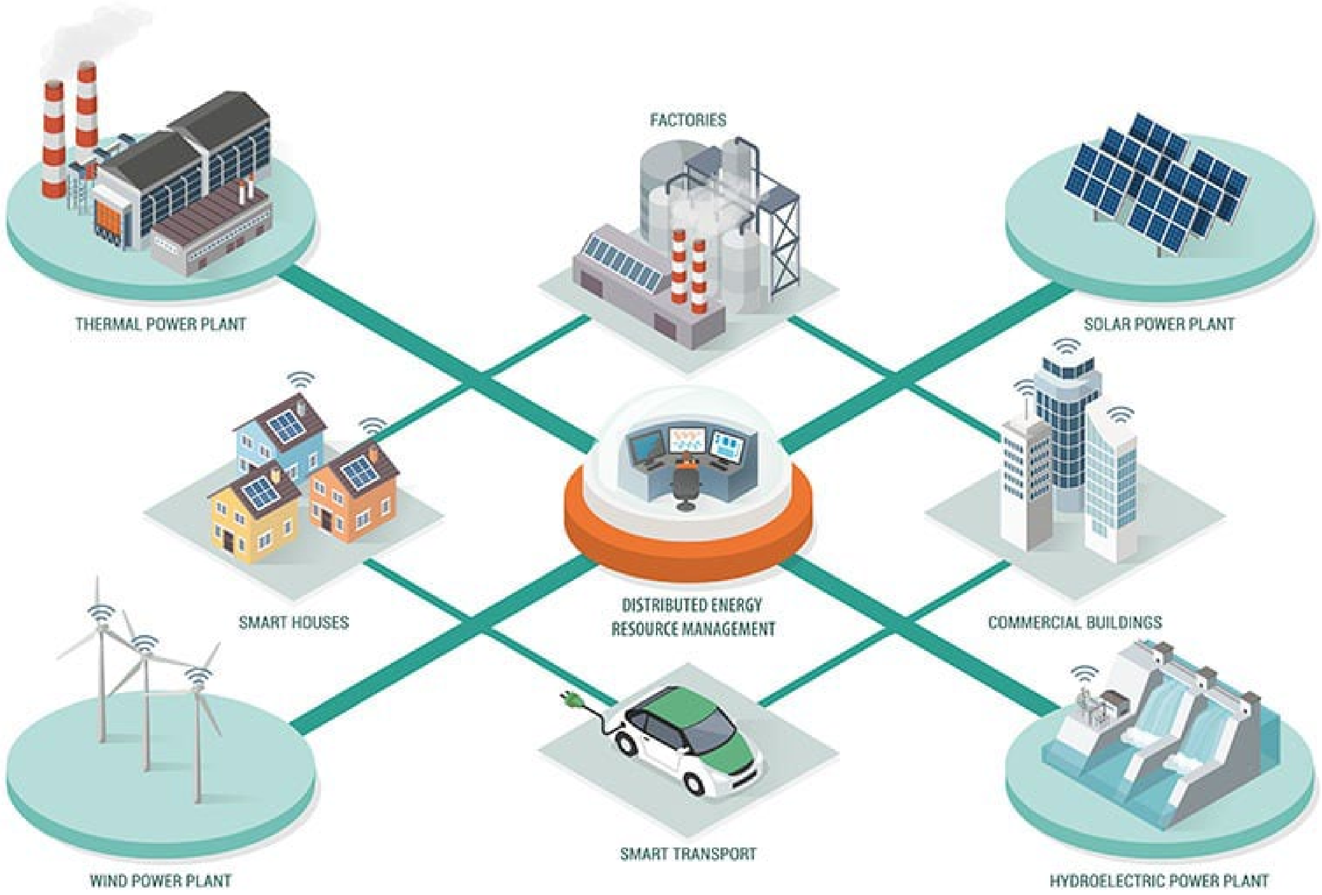
- Utilize both historical values and weather forecasting models to better predict load
- Accurately forecast 20-30 years
- Adaptive as conditions or data sources change/update
- Model climate risk at a localized level
    - System improvement projects can then be prioritized accordingly

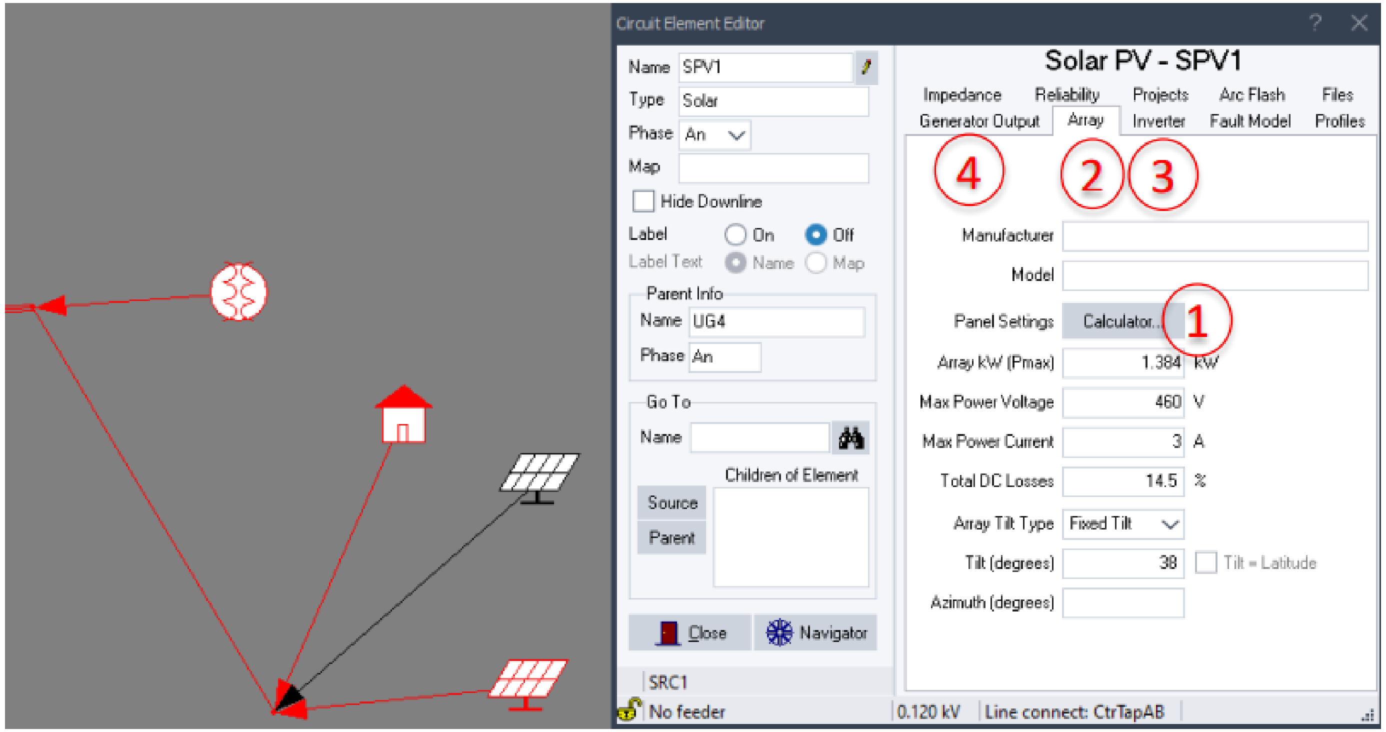
Metering Data – AMI 2.0

Source: Deloitte analysis. For a more in-depth analysis, see *Enabling the clean energy transition: Planning for next-generation advanced metering infrastructure and grid technologies*.

- Feeder-level snapshot of each meter's actual demand during the seasonal feeder non-coincident peak
  - Demand response reflected in metering data
- Additional data points - voltage and power factor (PF)
  - Depends on communication and MDM system's capabilities
  - Helps analyze power quality issues
- Near real-time energy usage information
- DER detection and monitoring
  - Potentially lead to system improvement deferrals
- Predicative Analytics

Distributed Energy Resources Management System (DERMS)





Power Flow Modeling – Software Enhancements

- **Milsoft's new Behind-the-Meter (BTM) module**
  - **Currently limited to solar & batteries + inverters**
  - **Future could include EVs, smart thermostats, and other DERs**
- **DERs will need to be modeled in GIS**

QUESTIONS?

Alliance in Action

Break

15-minute

We will regroup promptly at 3:10PM

TGO Alliance

TGO Alliance

2025 Fall Summit

Digital & Data Readiness

3:45 – 4:45

Marcelo Sandoval

Director of Innovation and Technology Strategy

Landis+Gyr

Paul Moran

Integrated Solutions Strategist

BLACK & VEATCH

Why Become Digital and Data Ready now? The Energy Transition

Electricity customers want quick resolutions, reliable power, flexible billing, personal energy insights

Changing energy flows

Volatile generation

Increased voltage disturbances

Stringent regulations for quality, emissions, safety, security and privacy

Erratic EV charging

Prosumers generating power into the grid

Increased sensitivity to voltage, power quality

Unpredictable supplies and harmonics from renewables

Datacenter Load Growth, DERs, Digitalization, Decarbonization, & Deregulation are Transforming the Industry

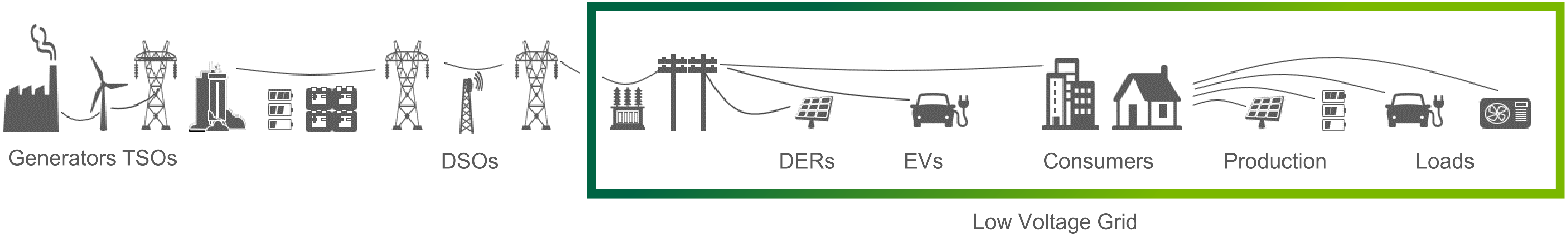
The Grid Data Explosion: Millions of Smart Meters, Sensors, and Resources Interconnected to the Grid

…bringing a number of new challenges for utilities

Enormous increase of **energy consumption due to electrification**

Increased **Distributed Energy Resources** leading to distributed power supply

Unpredictable **Intermittent EVs** and unpredictable renewables to be integrated cost-efficiently into the network



To deal with these new challenges, electric utilities need to **model, monitor, analyze their impact and plan for solutions** from the grid edge to the enterprise level to achieve **reliability, resiliency, sustainability and economic objectives.**

Current Challenges

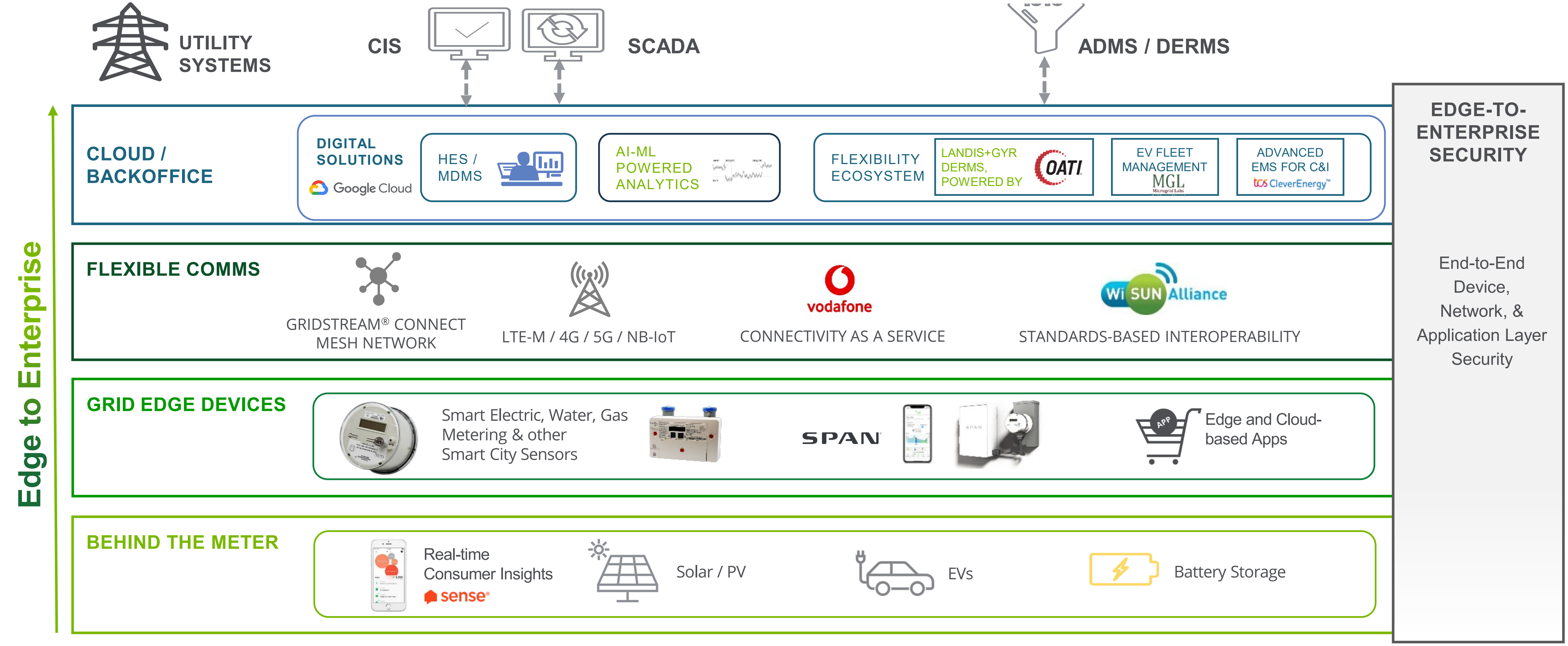
Foundational data sensing and communication, Siloed legacy systems, data quality, limited analytics maturity, workforce skill gaps and cybersecurity and compliance risks.

Data Sensing	Model	Monitor	Identify	Impact Analysis	Solutions
Data Acquisition and Communication: How to manage meter data ingestion and flow? **Customer Engagement:** How to utilize data to drive decision making that improves reliability and resiliency?	**Data integration:** How to integrate models from different systems (GIS, CIS, AMI, SCADA)? **Data Management & Governance, Security:** What is your data strategy, governance, security? **Data Validation**: How to validate the models?	**Data latency, frequency, granularity:** What is the power quality of the network? What substations, feeders, transformers have power quality issues?	**Descriptive Analytics:** What Distributed Energy Resources (EVs, solar, heat pumps) are connected, when and where? How to identify losses and energy diversion? What meters are suspicious of energy theft?	**Predictive Analytics:** What (thermal, voltage, power) impacts are created by Distributed Energy Resources, when and where? What if analysis? How to generate more accurate and granular load & DER forecasts?	**Prescriptive Analytics:** Can flexibility management be used to mitigate grid impacts? How to reduce long interconnection analysis times and increase customer satisfaction? How to use insights to create work orders for field crews?

Digital Readiness: Ability to adopt and scale new digital platforms and applications,
Data Readiness: Ensuring data is accurate, accessible, governed, and secure

Key Pillars of Digital Readiness

End-to-End Orchestration is Enabled by Establishing Sensors, Actuators, AMI, IoT, Communication Data foundation, Data Management and Governance, Analytics & AI, Digital Platforms, Workforce & Culture, Cybersecurity & Regulatory Compliance



Example: Landis+Gyr's Analytics & Grid Edge Apps

Next generation AI-powered, Edge to Cloud Analytics Software

Turn data from disparate systems...

- AMI
- Edge App Data
- GIS
- MDM
- CIS
- OMS
- SCADA

Landis+Gyr

Data Integration, Visualization, & Exploration

Integrated Grid and Edge Data Dashboard

Data Validation

Meter to Transformer Mapping

Phase Identification

Grid Location Awareness

Full GIS Model Validation

Revenue Protection

Pattern Detection

Energy Diversion

Planning

EV & DER Detection
Capacity Contribution
Loading Performance
Transformer Loss of Life

Operations

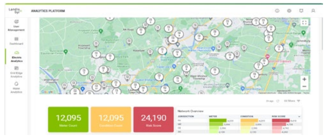
Power Quality
Intelligent Voltage Monitoring
Voltage Performance
Reliability Performance

Modernization

DER Planning & Scheduling
Traditional & Non-Wires Alternatives Project Prioritization

...into actionable insights and outcomes

Continously Integrated and Validated Model

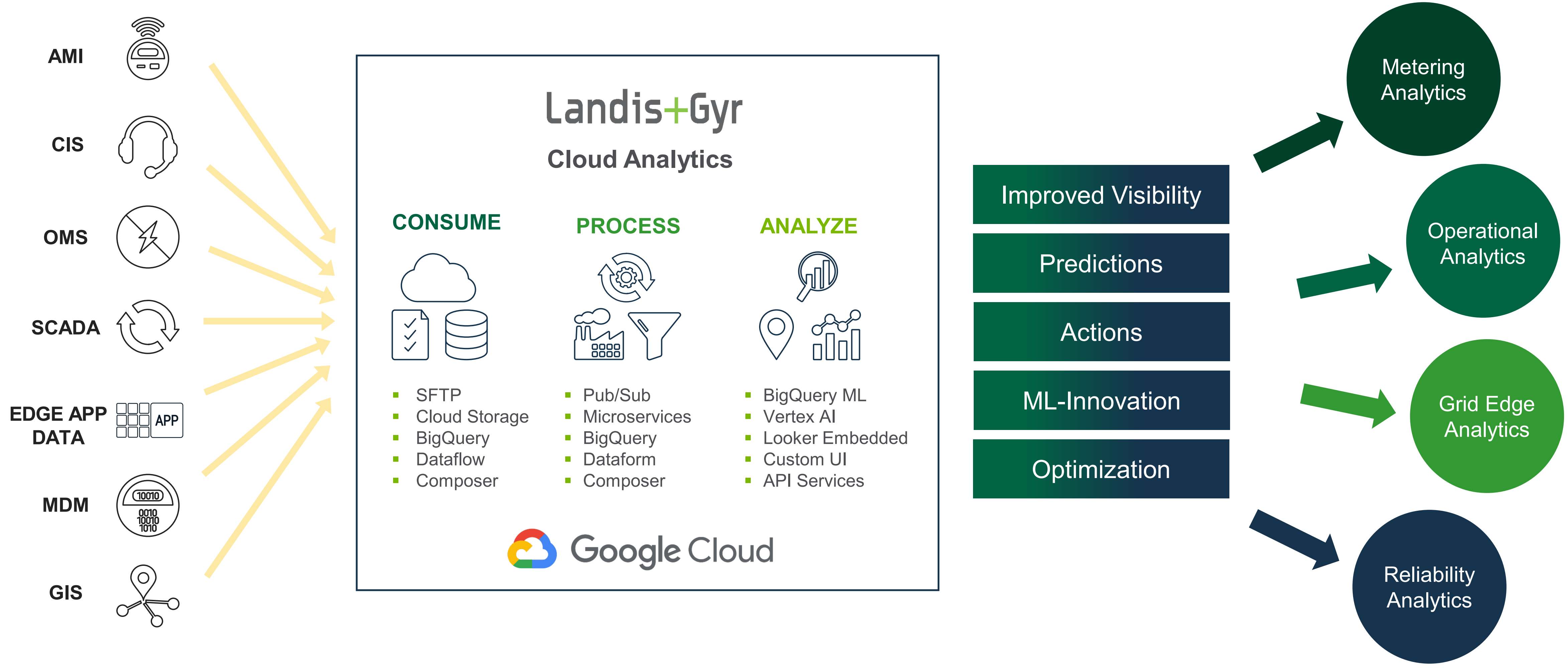


Descriptive Analytics

Predictive and Prescriptive Analytics

Example: Cloud Analytics – How Does It Work?

Turn data from disparate systems... **...into actionable insights and outcomes**



Use Case: Grid Location Awareness

Provide updates of meter-to-transformer mapping and meter phase to source systems like CIS and GIS. Meter-to-transformer mappings can also be provided to other systems like ADMS or DERMS.

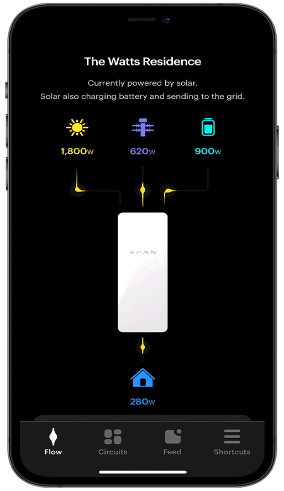
Use Case: Real-time energy usage at the grid edge

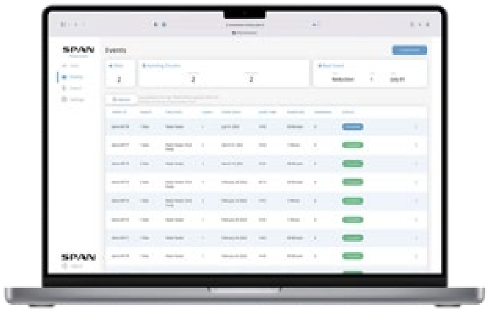
Revelo is the only grid sensor on the market running the full real-time consumer experience app, offering improved efficiency and enhanced reliability for utilities & consumers with a never-before-seen **view of real-time energy usage.**

Use Case: NWAs and Home Energy Management

The SPAN® Edge Intelligent Service Point™ is an at-the-meter device designed for utilities to better manage the distribution grid and rapidly enable home electrification. SPAN mobile app facilitates whole home energy management and creates an intuitive interface for the consumer.

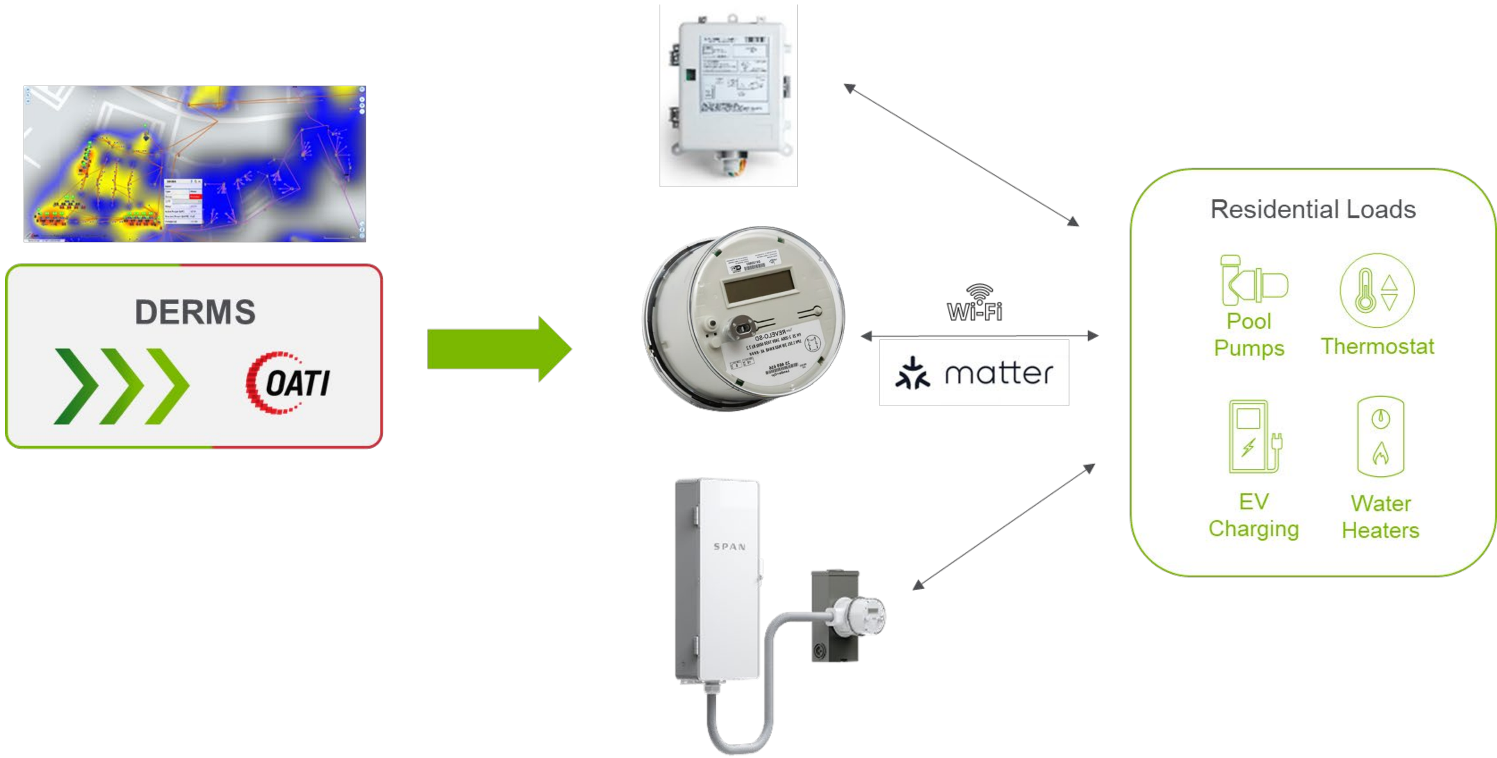
SPAN Edge





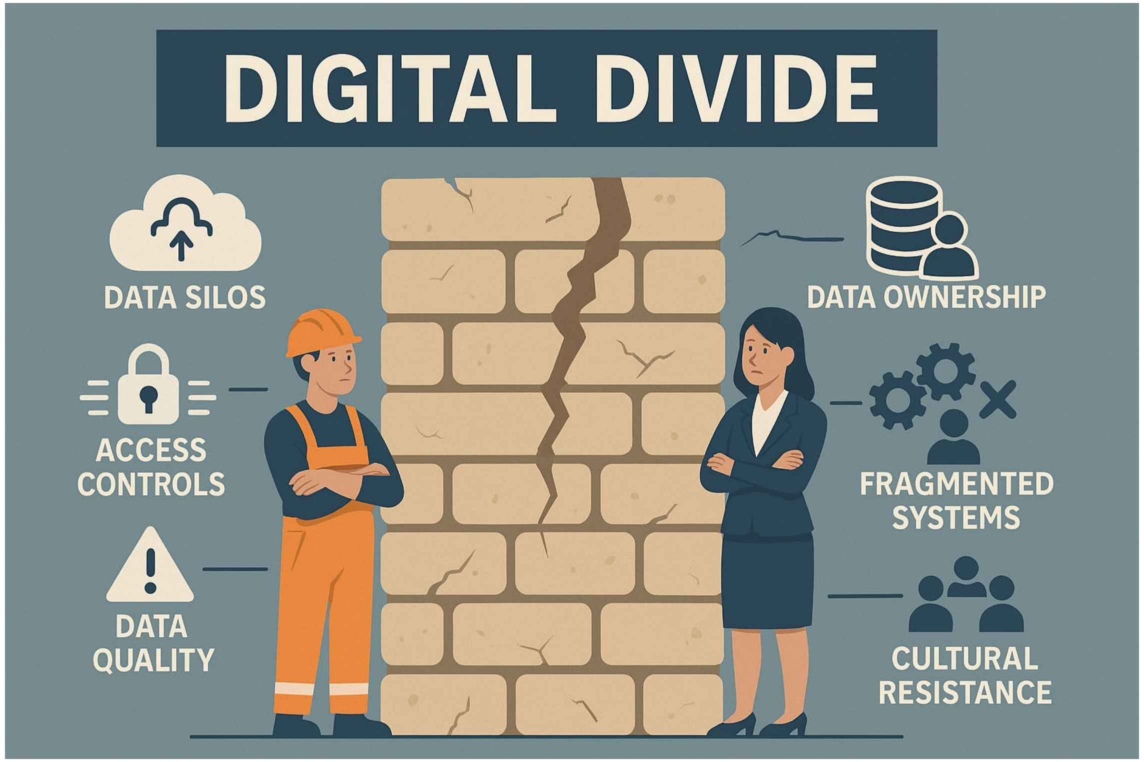
Use Case: Advanced Local Flexibility Management

Leverage AMI network and connected grid edge devices for enhanced visibility and control, including DER Management and **Advanced Demand Response**



Organizational Barriers to Effective Data Utilization

Challenge Type	Example/Description
Data Silos	AMI data owned by customer group, needed by planning/operations
Data Quality	Inaccurate mappings, missing intervals, outdated asset info
Real-Time Processing	Millions of devices, latency, legacy infrastructure
Cybersecurity/Privacy	Sensitive customer data used for operational analytics
Standardization	Different formats, lack of interoperability
Data Ownership	Data managed by one group, needed by another (e.g., customer vs. planning)
Access Controls	Permissions restrict cross-group data access
Governance	No clear policies for sharing, stewardship, or accountability
Cultural Resistance	Reluctance to share, concerns about data misuse
IT Fragmentation	Separate systems/vendors/support across groups



Crossing the Digital Divide

From Fragmentation to Integration: Enabling Cross Functional Data Use

Begin with a Readiness Assessment

Build a clear roadmap with prioritized investments

Foster a culture of data-driven decision-making

Prepare the grid for the next decade of transformation

Digital & Data Readiness Use Cases & Challenges

Top Use Case
Grid Location Awareness
Real-time energy usage at the grid edge
NWA and Home Energy Management
Advanced Local Flexibility Management

Top Data Challenges
Data Acquisition
Data Utilization & Analytics
Data Integration
Data Management, Governance & Security
Data and Model Validation
Data Latency, Frequency and Granularity
Organizational Barriers

Results and Discussion

Why This Matters

Your input will help the TGO Alliance

- Focus on the most relevant use cases for digital and data readiness.
- Target the most pressing data challenges for future solutions and investments.
- Align priorities across the group for maximum impact.

Daily Wrap Up

with Allie Broussard

TGO Alliance

Advancing TGO

Tomorrow's Agenda

Time	Title	Description
7:30 - 8:30am	Breakfast & Check-In	Check-in, breakfast buffet, and networking
8:30 - 8:45am	Welcome	What to expect for the day and logistics
8:45 - 9:05am	Industry Rising Trends	Introduction to pressing issues affecting TGO needs and upcoming breakout session
9:05 - 10:00am	Rising Trend Breakout	Evolving Energy Models (DSO) | AI for Grid Operations | Data Centers as Flexible Load
10:00 – 10:45am	Rising Trend Regroup	Regroup to summarize rising trends and issues discussed
11:00 - 12:00pm	Case Study	PNM: Transmission Real-Time Contingency Analysis and Applications for TGO
12:00 - 1:00pm	Lunch	Catered lunch provided on-site
1:00 - 1:45pm	Case Study	Schneider Electric: One Digital Grid Platform
1:45 – 2:45pm	Working Group Planning	Plan for future work phases and mobilizing TGO vision
2:45 - 3:15pm	Debrief	Summit debrief and Alliance next steps
4:00 - 5:00pm	Social Event	Happy Hour at Dos Bocas, Hilton Garden Inn Atlanta Downtown

Join us!

6:00 – 8:00

1055 Howell Mill Rd Ste 140,
Atlanta, GA 30318

Food and Drinks Provided

FLIGHT CLUB®
SOCIAL DARTS®

Welcome

to the 2025 TGO Fall Summit

We will begin promptly at 8:30am

TGO Alliance

TGO Alliance

Orchestrating the Grid to Enhance Reliability and Unlock Grid Resources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Landis+Gyr
Schneider Electric
ThinkLabs
uplight
Thank you to our sponsors!
TGO Alliance

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Alliance in Action

Today's Agenda

TGO Alliance

2025 Fall Summit

Welcome and Todays Logistics

8:30 – 8:45

Joe Zhou

Co-Chair, TGO Alliance
Infrastructure Advisory Markets Group Leader

BLACK & VEATCH

Allie Broussard

Market Specialist, Electric Markets

BLACK & VEATCH

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Advancing TGO

Today's Agenda

TGO Alliance

2025 Fall Summit

Industry Rising Trends

8:45 – 9:05

Eric Seiter

Client Account Partner

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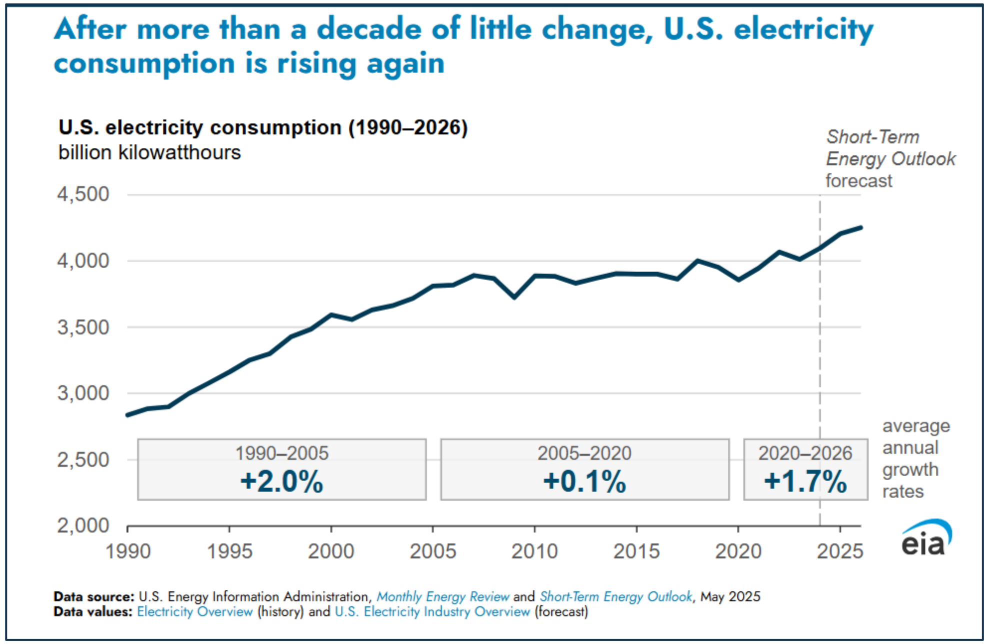
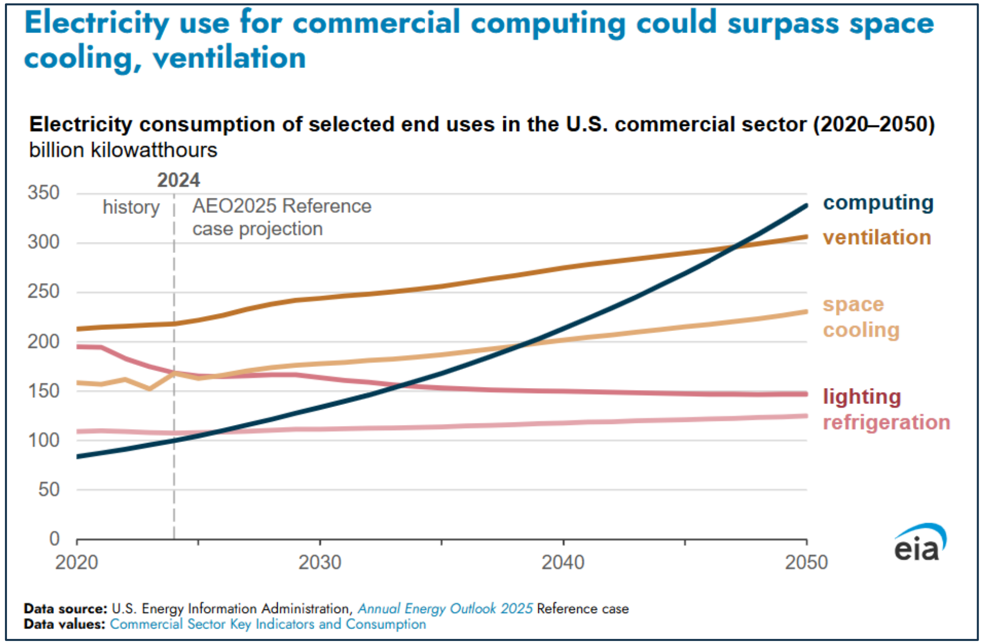
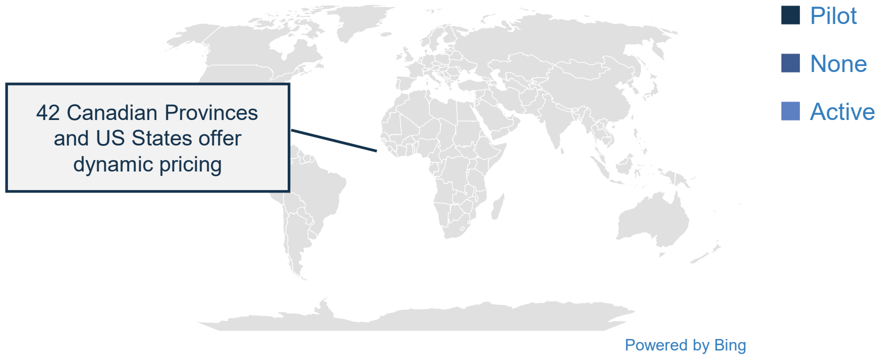
TGO Rising Trends Introduction





Canadian Provinces and US States with TOU or Dynamic Pricing Electric Rates



- **Growing electricity Demand:** According to the EIA, U.S. energy demand is expected to rise after experiencing a prolonged phase of sluggish growth between 2005 and 2025
- **Commercial computing is the driver of growth:** The 2025 EIA annual energy outlook projects electricity consumed for commercial computing will increase faster than any other end use in buildings. Computing accounted for an estimated 8% of commercial sector electricity consumption in 2024 and grows to 20% by 2050.
- **Increasing adoption of time-variable pricing:** 42 US states and Canadian provinces offer dynamic pricing or TOU rates (including specific TOU rates for EV charging) indicates growing momentum for grid flexibility.
- **Enhanced Load Flexibility**: TOU rates incentivize consumers to shift usage to off-peak periods, enabling grid operators to better balance supply and demand without relying on costly peaker plants.
- **Accelerated DER Integration**: Time-based pricing supports the economic case for distributed energy resources (DERs) like solar, storage, and smart appliances, which can respond dynamically to price signals and grid needs.
- **Data-Driven Grid Optimization**: Utilities and system operators will need to gain access to granular consumption data, enabling predictive analytics, real-time control, and more precise orchestration of grid assets across transmission and distribution.

Session Topics

1 Data centers and impact to demand growth and utility business

2 Artificial intelligence as an enabler for utility operations and digital transformation

3 Evolving Energy Models to address grid orchestration challenges

Rising Trend Breakout Sessions

9:05 – 10:00

Break

15-minute

We will regroup promptly at 10:15am

TGO Alliance

Session Topics

1. Data centers and impact to demand growth and utility business
2. Artificial intelligence as an enabler for utility operations and digital transformation
3. Evolving Energy Models to address grid orchestration challenges

Rising Trend Regroup

10:15 – 11:00

TGO Alliance

2025 Fall Summit

Real-Time Contingency Analysis (RTCA)

Case Study

11:00 – 12:00

Cesar Miron

Manager of Operations Engineering

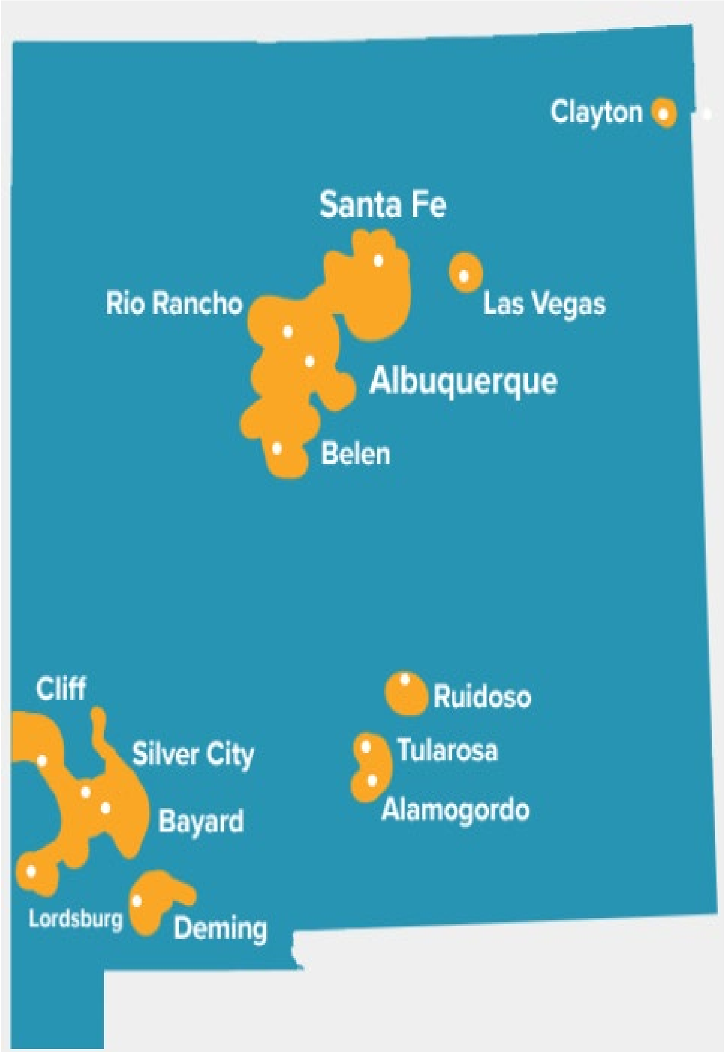
PNM

About PNM

Powering New Mexico Homes and Businesses Since 1917

PNM serves more than 550,000 New Mexico customers in Albuquerque, Rio Rancho, Los Lunas, Belen, Santa Fe, Las Vegas, Alamogordo, Ruidoso, Silver City, Deming, Bayard, Lordsburg and Clayton

PNM also serve the New Mexico tribal communities of the Tesuque, Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, Isleta and Laguna Pueblos



Power mix

- On average about 50% renewables and 70% carbon-free

Transmission

- ~ 3500 miles of transmission circuits

Workforce

- ~1,600 employees who work for PNM across New Mexico and Texas

What is RTCA?

Real-time Contingency Analysis is a tool used to monitor the transmission system for unexpected events (contingencies) and analyze their impact if they occur.

RTCA enables operators to implement corrective action pre-contingencies to prevent or reduce the impact of these events

What is a Contingency?

A contingency refers to an unplanned event, such as a transmission line, transformer, or generator tripping offline that can disrupt the normal operation of a Power System

PNM monitors N-1 conditions in RTCA

N-1 refers to a single element tripping off-line

How does RTCA Works?

Data Acquisition: Continuous collection of real-time data such as Breaker and Disconnect status, MWs, MVARs, and Voltages. This data provides the current state of the system

Network Modeling: A detailed equivalent electrical model that represents all components of the transmission network such as generators, transformers, transmission lines, loads, and voltage control devices (Capacitors, Reactors, Static Var Compensator), and using their electrical characteristics such as voltage limits and conductor ratings

Contingency Definition: A comprehensive list of potential contingencies is defined

How does RTCA Works?

Simulation and Analysis: When a potential contingency is identified (or even proactively simulated), the system model is used to predict the consequences. This involves running simulations to see how the system would react to the contingency. At PNM RTCA runs every 6 minutes

Impact Assessment: The analysis determines the severity of the impact, such as low or high voltages or high limit rating violation on a transmission line or transformer

Visualization and Alerting: Operators are provided with real-time dashboards, alerts, and visualizations to quickly understand the situation and make informed decisions

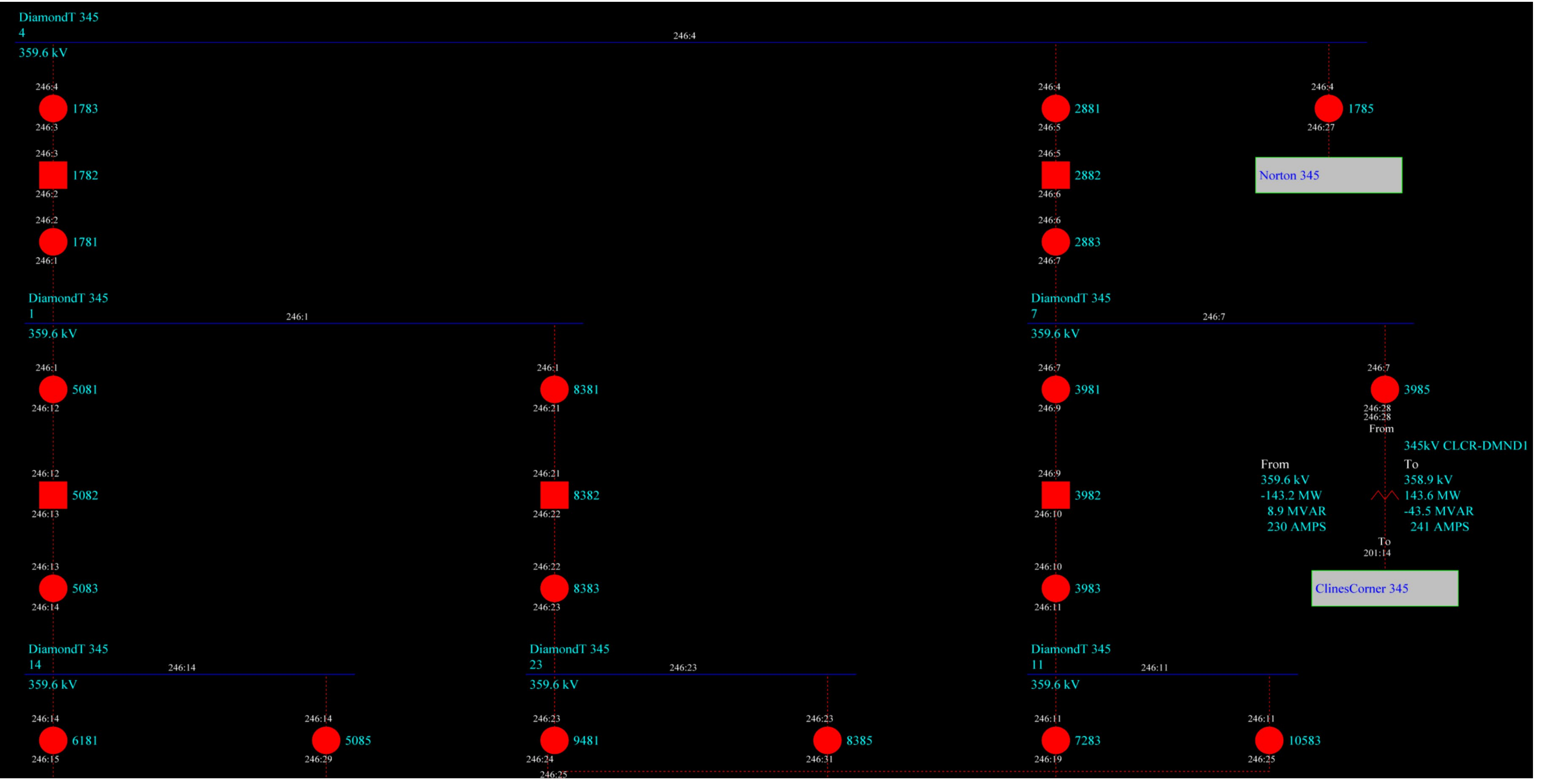
Energy Management System Applications Needed for RTCA

SCADA	Supervisory Control and Data Acquisition: A system used for real-time monitoring and control of the transmission system. Scans data every 2 seconds monitoring and control of the Transmission System and Generation resources
Inter-Control Center Communications Protocol (ICCP)	A standard protocol that enables secure and reliable exchange of real-time data between different control centers EMS systems
Network Application	EMS application for modeling the equivalent electrical model

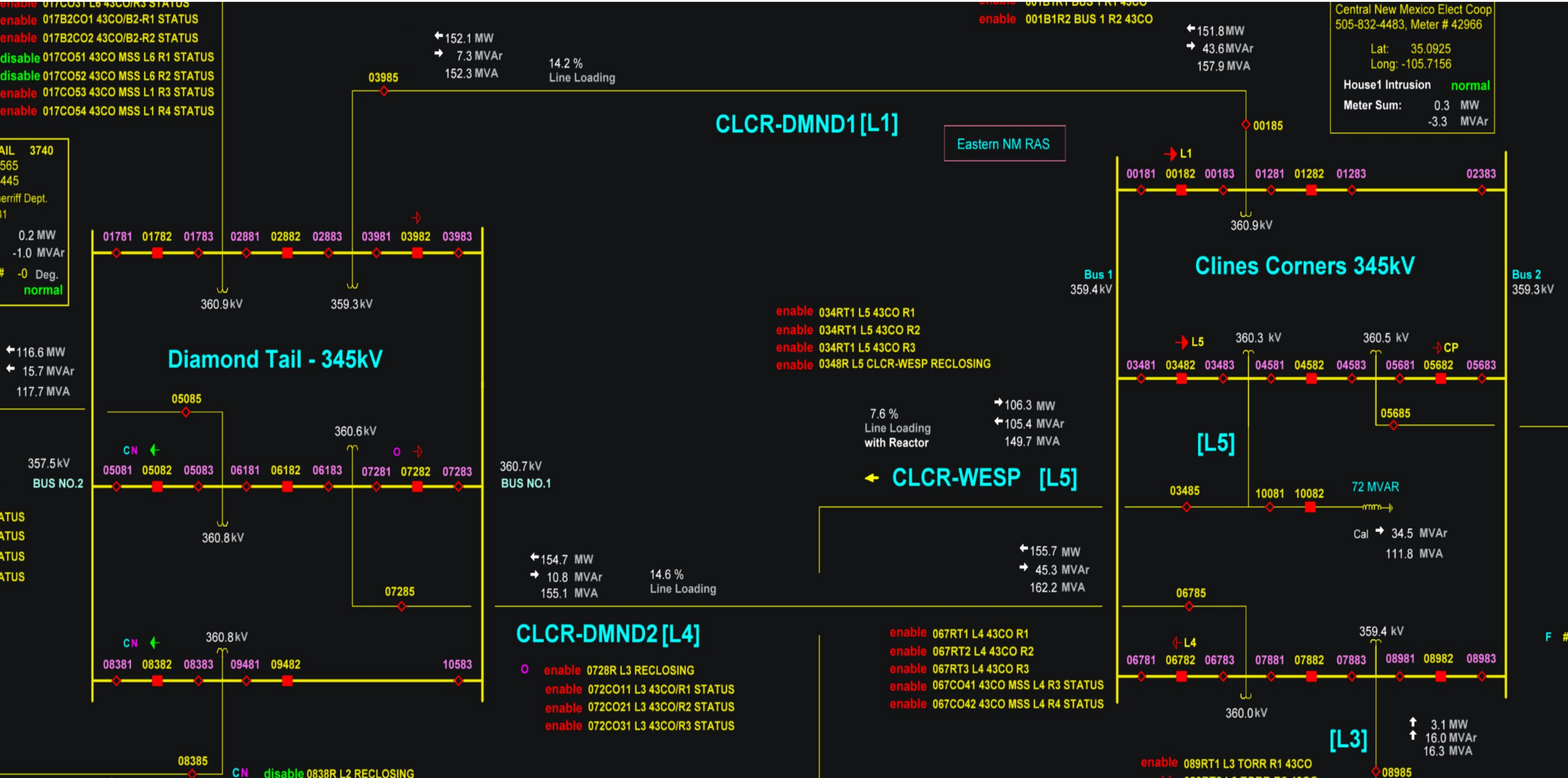
Operations Engineering Role

System Modeling	Develop the electrical model of the transmission system • Nodes (Buses): Represent connection points for generators, loads, transformers, and transmission lines • Branches: Transmission lines and transformers • Generators: Modeled with max and min MW control limits • Loads • Voltage Control Devices: Capacitors, Reactors, and Static Var Compensator (SVC)
SCADA/ICCP	• Program all real-time points (Analogs/Status) for the model

Network Model



Operator One-Line Display



Operators Rtca Screen

File Tools Favorites Help

Search Displays...

Contingency Analysis

Last CA Solution Status	Converged
Last CA Solution Time	09/26/25 13:36:09
Measurement Snapshot Time	09/26/25 13:36:07

Create Save Case Snapshot

Not Fully Converged

Non-converged	0
Partially Converged	0
Diverged	0
Total	0

View

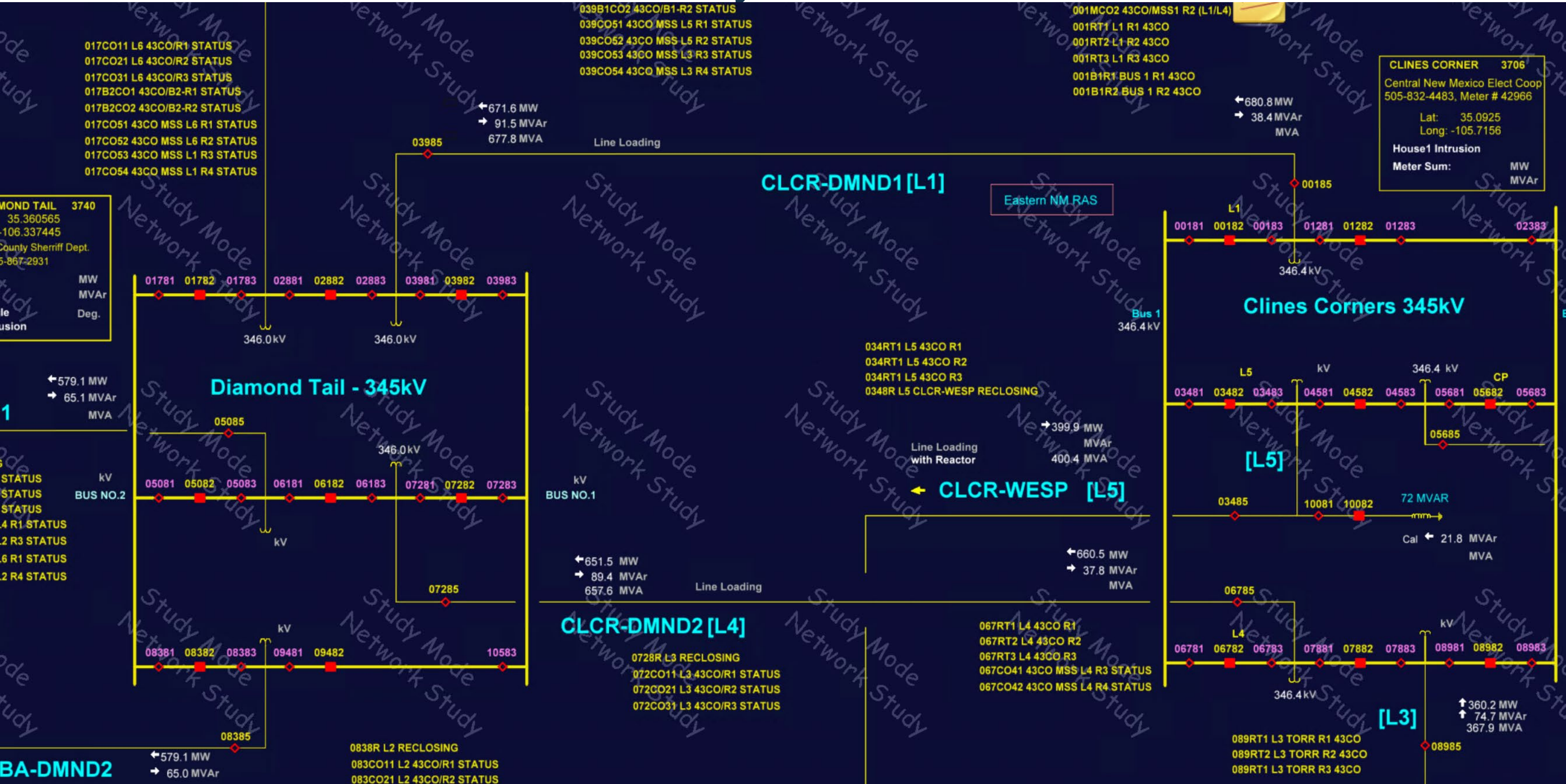
Violations Ranking

No. of Contingencies analyzed 179

NTP	Completed	09/26/25 13:37:49
SE	Converged	09/26/25 13:37:59
CA	Converged	09/26/25 13:36:09
PF	Converged	09/25/25 20:18:36

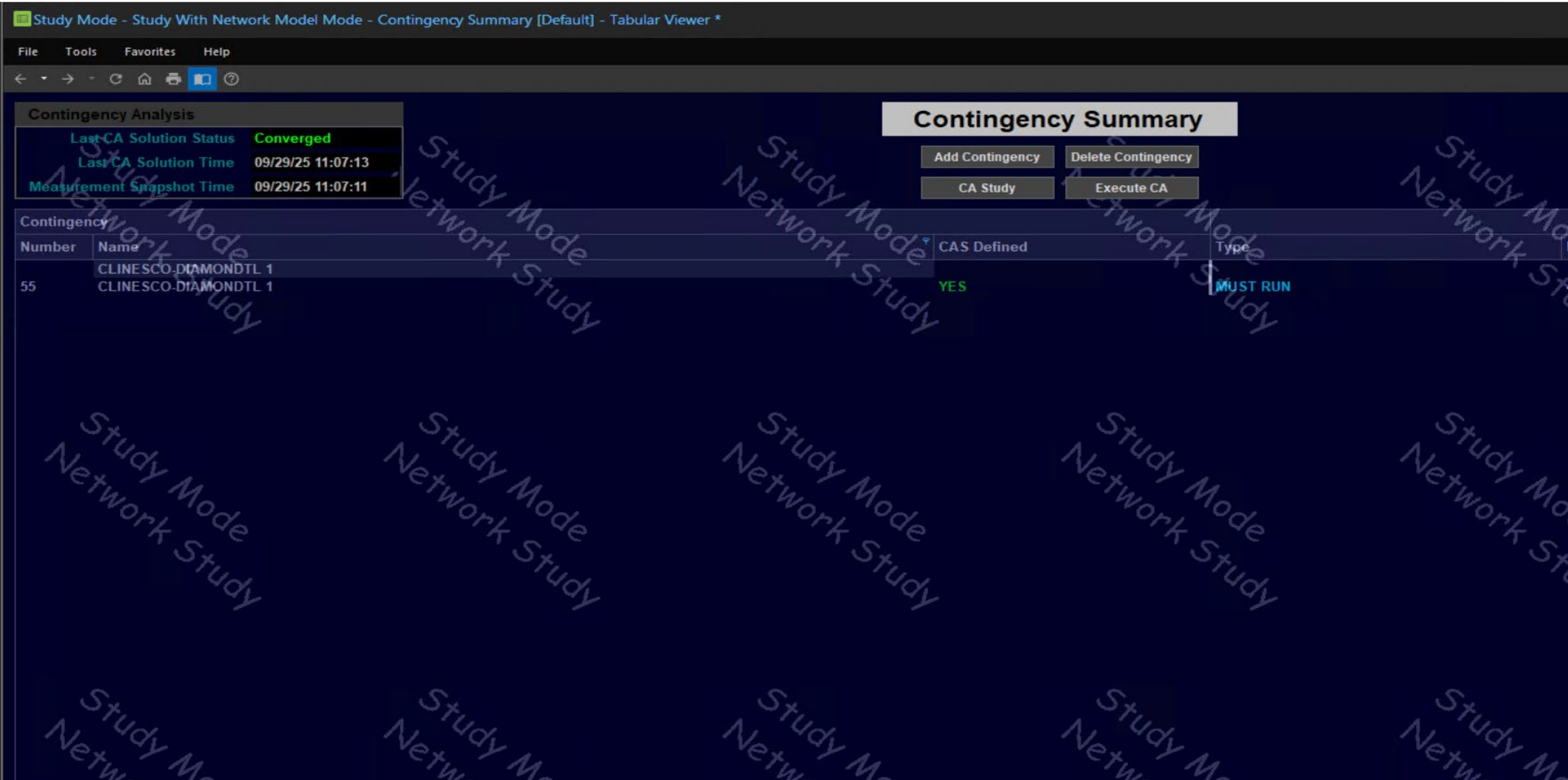
Contingency Number	Contingency Name	Violated Device Number	Violated Device Name	Type	First Occurred Time	Company	Station	Violation Type	Value	Violated Limit Level	Violated Limit Value
52	Walsenburg Comanche 230 KV	219	Arriba 115	Bus	09/26/25 13:36:09	PNM	ARRIBA	Voltage	103.0	Limit 3 - Low	103.5
52	Walsenburg Comanche 230 KV	220	Arriba T 115	Bus	09/26/25 13:36:09	PNM	ARRIBA T	Voltage	103.0	Limit 3 - Low	103.5
52	Walsenburg Comanche 230 KV	223	Valencia 115	Bus	09/26/25 13:36:09	PNM	VALENCIA	Voltage	103.0	Limit 3 - Low	103.5
52	Walsenburg Comanche 230 KV	380	Storrie 115	Bus	09/26/25 13:36:09	PNM	STORRIE	Voltage	103.0	Limit 3 - Low	103.5
142	NL 115 KV Norton ETA	353	TA_3 115	Bus	09/26/25 13:30:05	PNM	TA_3	Voltage	103.3	Limit 3 - Low	103.5
142	NL 115 KV Norton ETA	352	LA_MPF 115	Bus	09/26/25 13:30:05	PNM	LA_MPF	Voltage	103.4	Limit 3 - Low	103.5
142	NL 115 KV Norton ETA	348	ETA 115	Bus	09/26/25 13:30:05	PNM	ETA	Voltage	103.4	Limit 3 - Low	103.5

Study Mode

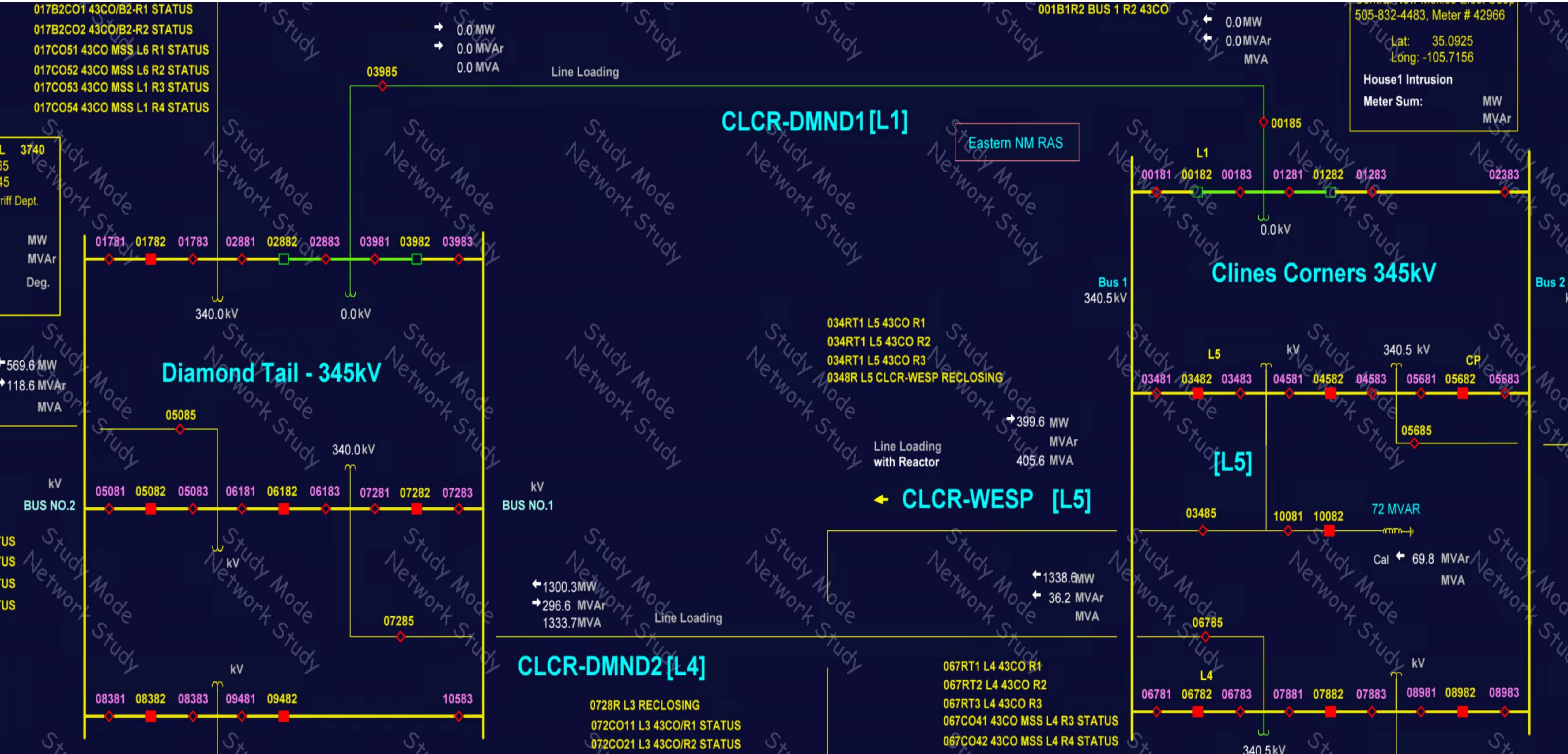


CLCR-DMND1 [L1]
Diamond Tail - 345kV
Clines Corners 345kV
CLCR-WESP [L5]
CLCR-DMND2 [L4]
Eastern NM RAS
Line Loading
Line Loading with Reactor
CLINES CORNER 3706
Central New Mexico Elect Coop
505-832-4483, Meter # 42966
Lat: 35.0925
Long: -105.7156
House1 Intrusion
Meter Sum:
671.6 MW
91.5 MVAr
677.8 MVA
680.8 MW
38.4 MVAr
579.1 MW
65.1 MVAr
399.9 MW
400.4 MVA
651.5 MW
89.4 MVAr
657.6 MVA
660.5 MW
37.8 MVAr
360.2 MW
74.7 MVAr
367.9 MVA
579.1 MW
65.0 MVAr
72 MVAR
21.8 MVAr
346.0kV
346.4kV
BUS NO.1
BUS NO.2
Bus 1
017CO11 L6 43CO/R1 STATUS
017CO21 L6 43CO/R2 STATUS
017CO31 L6 43CO/R3 STATUS
017B2CO1 43CO/B2-R1 STATUS
017B2CO2 43CO/B2-R2 STATUS
017CO51 43CO MSS L6 R1 STATUS
017CO52 43CO MSS L6 R2 STATUS
017CO53 43CO MSS L1 R3 STATUS
017CO54 43CO MSS L1 R4 STATUS
039B1CO2 43CO/B1-R2 STATUS
039CO51 43CO MSS L5 R1 STATUS
039CO52 43CO MSS L5 R2 STATUS
039CO53 43CO MSS L3 R3 STATUS
039CO54 43CO MSS L3 R4 STATUS
001MCO2 43CO/MSS1 R2 (L1/L4)
001RT1 L1 R1 43CO
001RT2 L1 R2 43CO
001RT3 L1 R3 43CO
001B1R1 BUS 1 R1 43CO
001B1R2 BUS 1 R2 43CO
034RT1 L5 43CO R1
034RT1 L5 43CO R2
034RT1 L5 43CO R3
0348R L5 CLCR-WESP RECLOSING
067RT1 L4 43CO R1
067RT2 L4 43CO R2
067RT3 L4 43CO R3
067CO41 43CO MSS L4 R3 STATUS
067CO42 43CO MSS L4 R4 STATUS
0728R L3 RECLOSING
072CO11 L3 43CO/R1 STATUS
072CO21 L3 43CO/R2 STATUS
072CO31 L3 43CO/R3 STATUS
0838R L2 RECLOSING
083CO11 L2 43CO/R1 STATUS
083CO21 L2 43CO/R2 STATUS
089RT1 L3 TORR R1 43CO
089RT2 L3 TORR R2 43CO
089RT1 L3 TORR R3 43CO
BA-DMND2

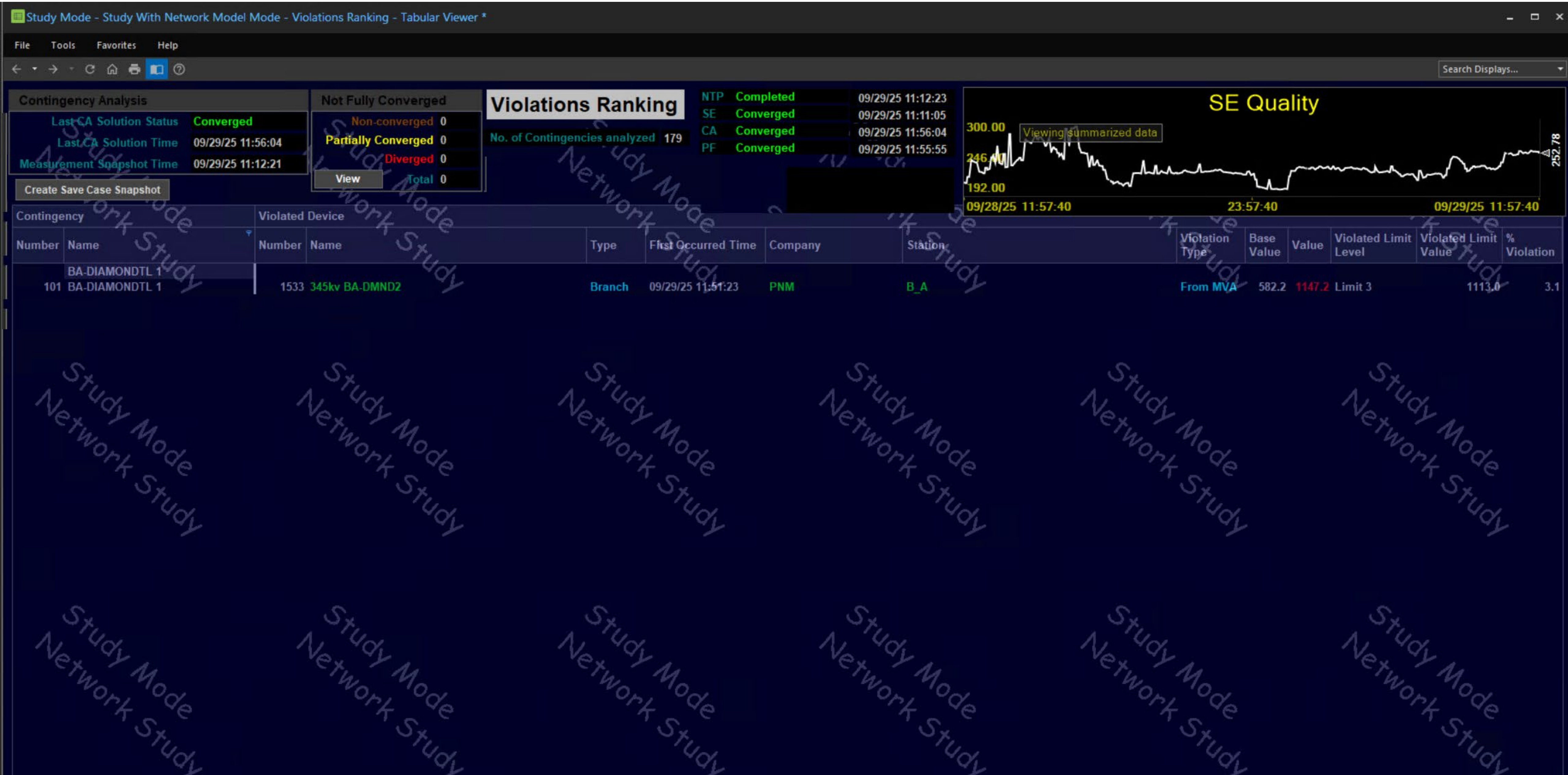
Study Mode


Study Mode - Study With Network Model Mode - Contingency Summary [Default] - Tabular Viewer *
File
Tools
Favorites
Help
Contingency Analysis
Last CA Solution Status
Converged
Last CA Solution Time
09/29/25 11:07:13
Measurement Snapshot Time
09/29/25 11:07:11
Contingency Summary
Add Contingency
Delete Contingency
CA Study
Execute CA
Contingency
Number
Name
CAS Defined
Type
CLINESCO-DIAMONDTL 1
55
CLINESCO-DIAMONDTL 1
YES
MUST RUN
Study Mode
Network Study

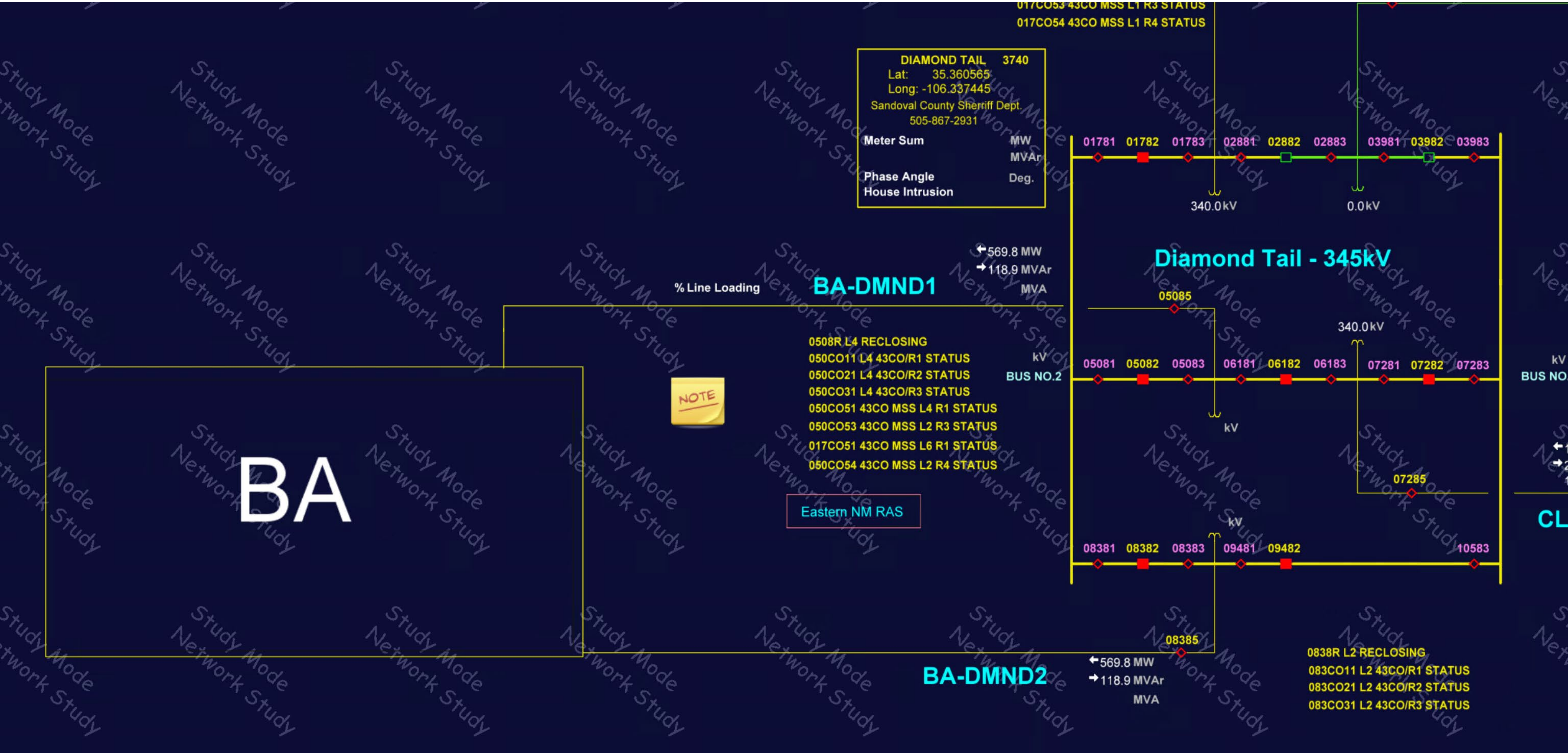
Study Mode


017B2CO1 43CO/B2-R1 STATUS
017B2CO2 43CO/B2-R2 STATUS
017CO51 43CO MSS L6 R1 STATUS
017CO52 43CO MSS L6 R2 STATUS
017CO53 43CO MSS L1 R3 STATUS
017CO54 43CO MSS L1 R4 STATUS
0.0 MW
0.0 MVAr
0.0 MVA
03985
Line Loading
001B1R2 BUS 1 R2 43CO
0.0 MW
0.0 MVAr
MVA
505-832-4483, Meter # 42966
Lat: 35.0925
Long: -105.7156
House1 Intrusion
Meter Sum: MW MVAr
CLCR-DMND1 [L1]
Eastern NM RAS
00185
Diamond Tail - 345kV
Clines Corners 345kV
Bus 1 340.5kV
Bus 2
340.0kV
0.0kV
569.6 MW
118.6 MVAr
MVA
034RT1 L5 43CO R1
034RT1 L5 43CO R2
034RT1 L5 43CO R3
0348R L5 CLCR-WESP RECLOSING
399.6 MW
MVAr
405.6 MVA
Line Loading with Reactor
CLCR-WESP [L5]
[L5]
72 MVAR
Cal 69.8 MVAr MVA
BUS NO.2
BUS NO.1
1300.3MW
296.6 MVAr
1333.7MVA
Line Loading
1338.6MW
36.2 MVAr
MVA
CLCR-DMND2 [L4]
0728R L3 RECLOSING
072CO11 L3 43CO/R1 STATUS
072CO21 L3 43CO/R2 STATUS
067RT1 L4 43CO R1
067RT2 L4 43CO R2
067RT3 L4 43CO R3
067CO41 43CO MSS L4 R3 STATUS
067CO42 43CO MSS L4 R4 STATUS
340.5kV
Study Mode Network Study

Study Mode


Study Mode - Study With Network Model Mode - Violations Ranking - Tabular Viewer *
File Tools Favorites Help
Search Displays...
Contingency Analysis
Last CA Solution Status Converged
Last CA Solution Time 09/29/25 11:56:04
Measurement Snapshot Time 09/29/25 11:12:21
Create Save Case Snapshot
Not Fully Converged
Non-converged 0
Partially Converged 0
Diverged 0
View
Total 0
Violations Ranking
No. of Contingencies analyzed 179
NTP Completed 09/29/25 11:12:23
SE Converged 09/29/25 11:11:05
CA Converged 09/29/25 11:56:04
PF Converged 09/29/25 11:55:55
SE Quality
300.00
Viewing summarized data
246.00
192.00
252.78
09/28/25 11:57:40
23:57:40
09/29/25 11:57:40
Contingency
Violated Device
Number Name Number Name Type First Occurred Time Company Station Violation Type Base Value Value Violated Limit Level Violated Limit Value % Violation
BA-DIAMONDTL 1
101 BA-DIAMONDTL 1 1533 345kv BA-DMND2 Branch 09/29/25 11:51:23 PNM B_A From MVA 582.2 1147.2 Limit 3 1113.0 3.1
Study Mode
Network Study

Study Mode


017CO53 43CO MSS L1 R3 STATUS
017CO54 43CO MSS L1 R4 STATUS
DIAMOND TAIL 3740
Lat: 35.360565
Long: -106.337445
Sandoval County Sherriff Dept.
505-867-2931
Meter Sum MW MVAr
Phase Angle Deg.
House Intrusion
01781 01782 01783 02881 02882 02883 03981 03982 03983
340.0kV
0.0kV
569.8 MW
118.9 MVAr
MVA
% Line Loading
BA-DMND1
Diamond Tail - 345kV
05085
340.0kV
0508R L4 RECLOSING
050CO11 L4 43CO/R1 STATUS
050CO21 L4 43CO/R2 STATUS
050CO31 L4 43CO/R3 STATUS
050CO51 43CO MSS L4 R1 STATUS
050CO53 43CO MSS L2 R3 STATUS
017CO51 43CO MSS L6 R1 STATUS
050CO54 43CO MSS L2 R4 STATUS
kV
BUS NO.2
05081 05082 05083 06181 06182 06183 07281 07282 07283
BA
NOTE
Eastern NM RAS
07285
08381 08382 08383 09481 09482 10583
08385
BA-DMND2
569.8 MW
118.9 MVAr
MVA
0838R L2 RECLOSING
083CO11 L2 43CO/R1 STATUS
083CO21 L2 43CO/R2 STATUS
083CO31 L2 43CO/R3 STATUS
Study Mode
Network Study

Who uses Study Mode?

Engineers:

Used to perform Next-Day studies

Transmission Operators:

Used to perform simulation of emergency outages

Challenges

External Network Data:

Incorrect data provided by external Transmission Provider

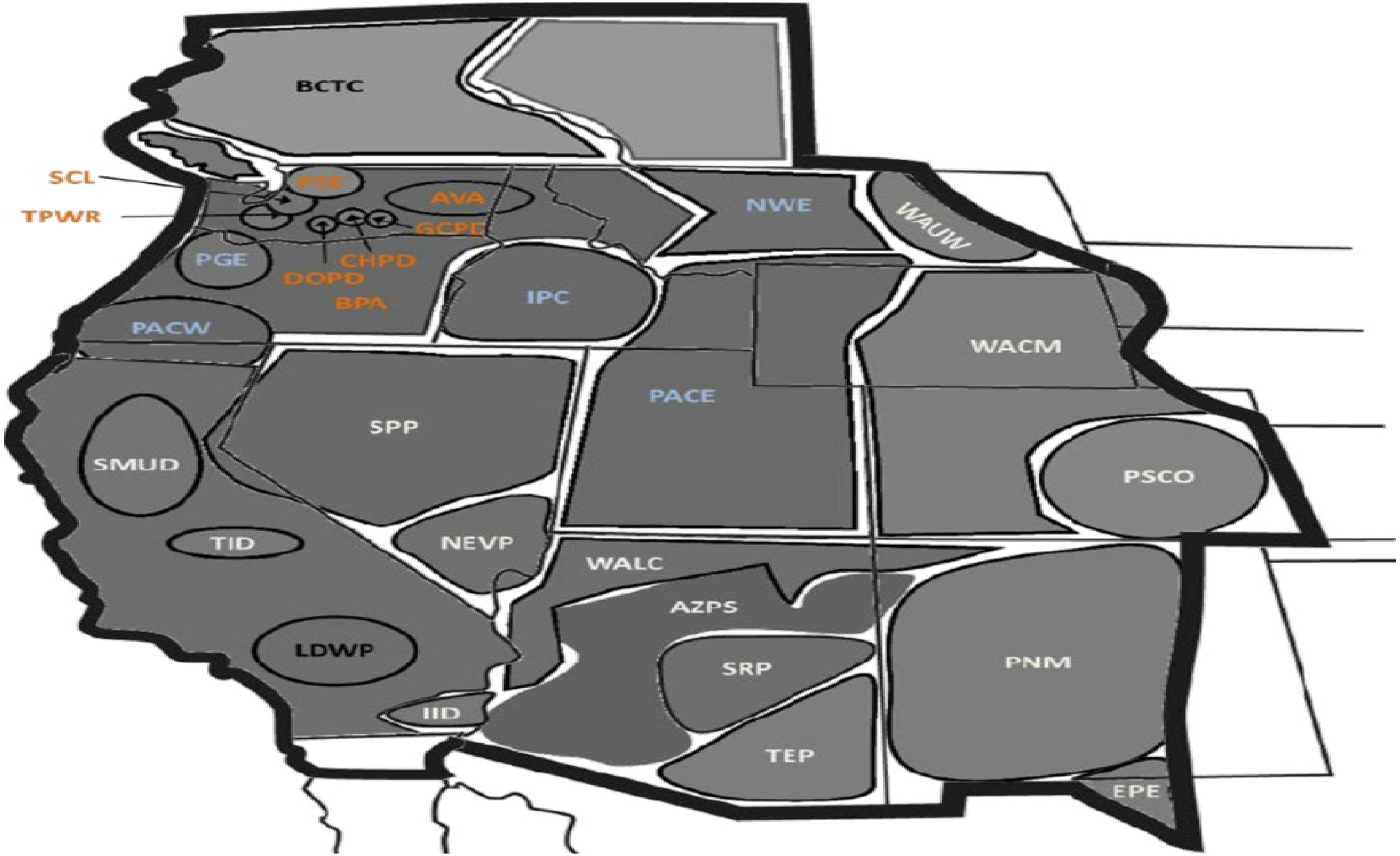
For example, incorrect topology diagrams

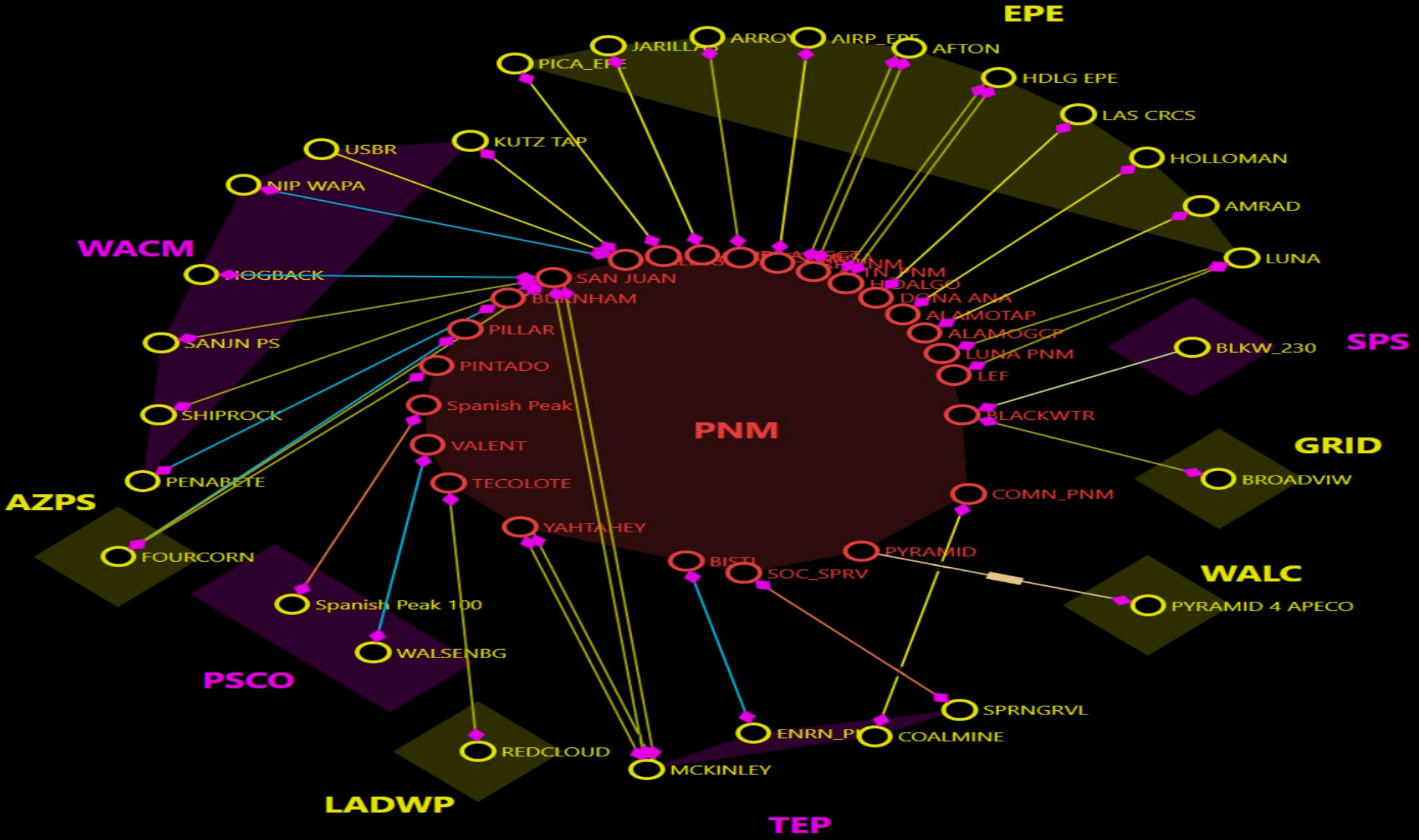
External ICCP Data:

Dependency on other Balancing Authorities or Transmission Providers

Maintenance of the external network model:

Developing a new reduced equivalent external network model is a very time-consuming task


BCTC
SCL
PSE
AVA
TPWR
GCPD
NWE
WAUW
PGE
CHPD
DOPD
BPA
IPC
PACW
WACM
PACE
SPP
SMUD
PSCO
NEVP
TID
WALC
AZPS
LDWP
SRP
PNM
IID
TEP
EPE



EPE
AFTON
HDLG EPE
LAS CRCS
HOLLOMAN
AMRAD
LUNA
KUTZ TAP
USBR
NIP WAPA
WACM
SANJN PS
SHIPROCK
AZPS
FOURCORN
Spanish Peak 100
WALSENBG
PSCO
REDCLOUD
LADWP
MCKINLEY
TEP
COALMINE
SPRNGRVL
WALC
PYRAMID 4 APECO
GRID
BROADVIW
SPS
BLKW_230
PNM
SAN JUAN
PILLAR
PINTADO
Spanish Peak
VALENT
TECOLOTE
SOC_SPRV
PYRAMID
COMN_PNM
BLACKWTR
LEF
LUNA PNM
ALAMOGCP
ALAMOTAP

QUESTIONS?

Alliance in Action

Lunch

12:00 – 1:00

We will regroup promptly at 1:00pm

TGO Alliance

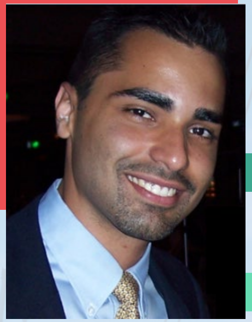
TGO Alliance

2025 Fall Summit

2026 One Digital Grid Platform

Case Study

1:00 – 1:45



Gio Herazo

Head of Solution Architecture – Digital Grid

Schneider Electric

Schneider Electric – Global Industrial Technology Leader with Strong Local Presence

440M tons
of avoided CO_2 emissions to our customers since 2018

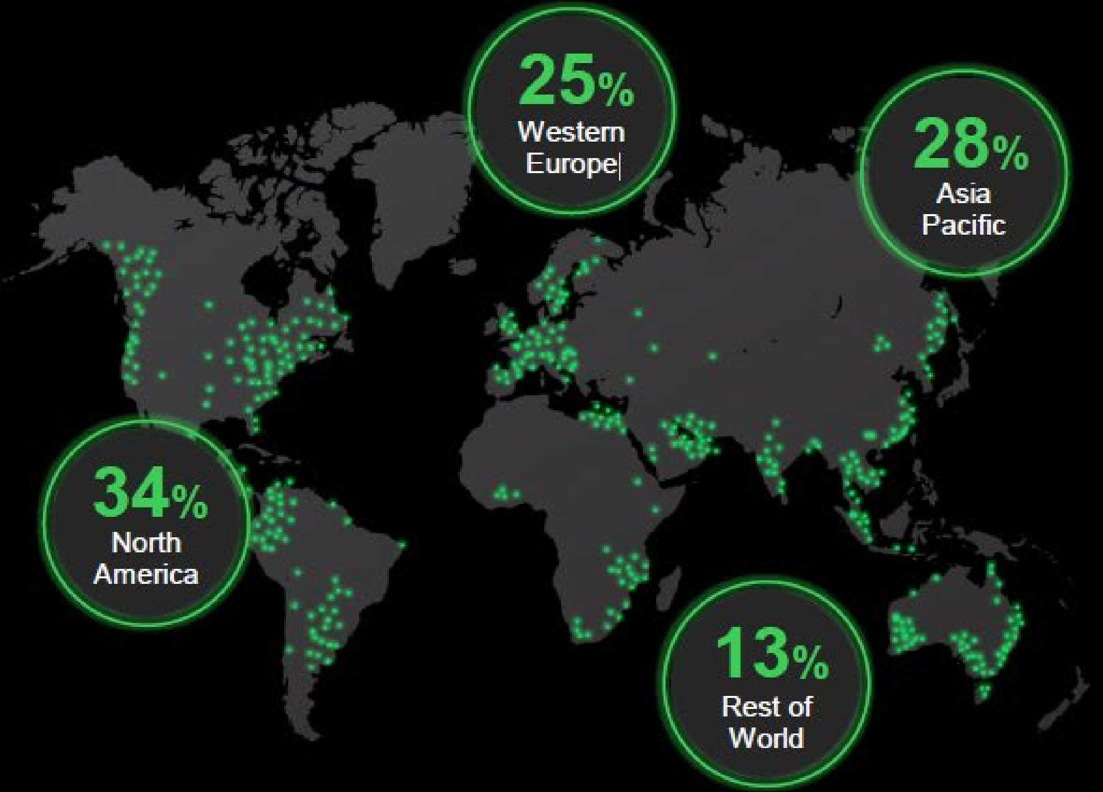
$40.0B
in 2024 revenue

#1
most sustainable company

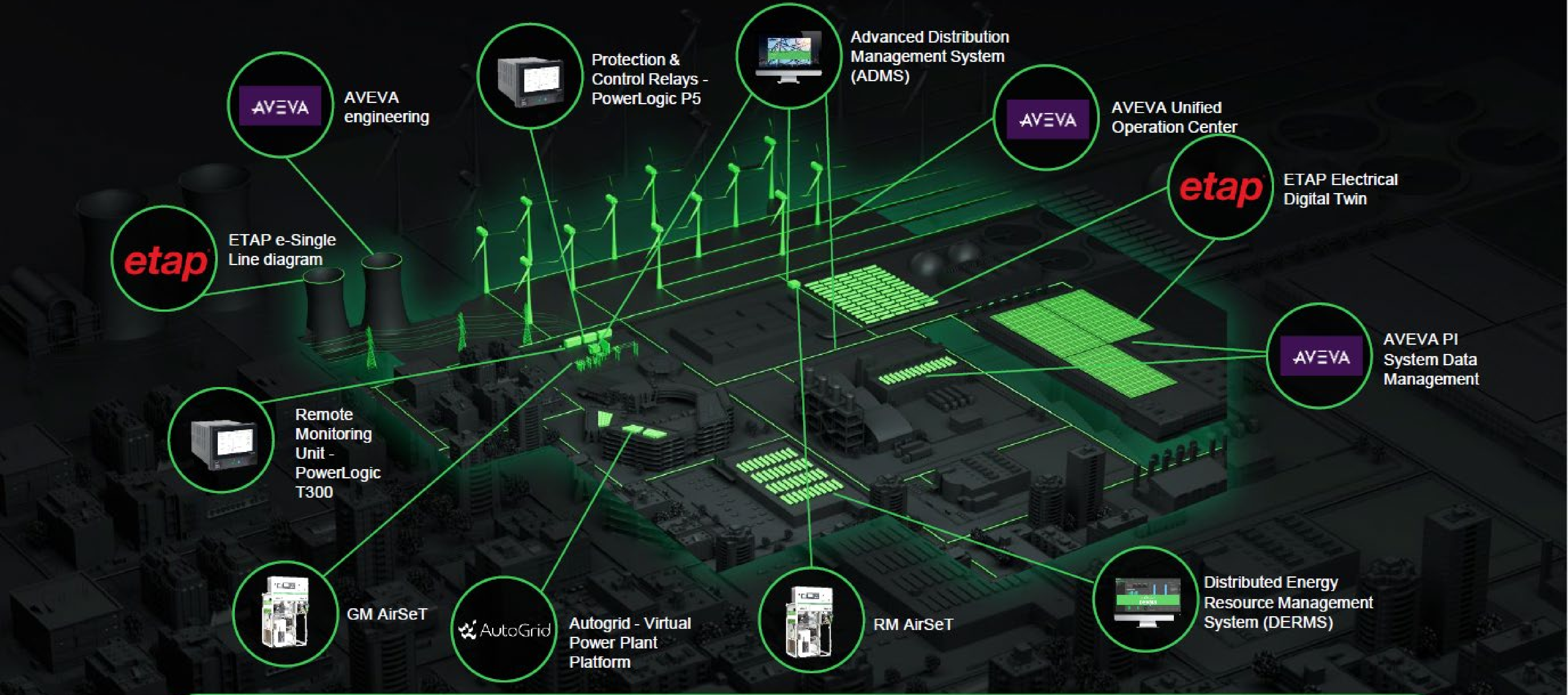
650k+
service providers and partners

6%
of sales to R&D annually

135,000+
employees across 100+ countries

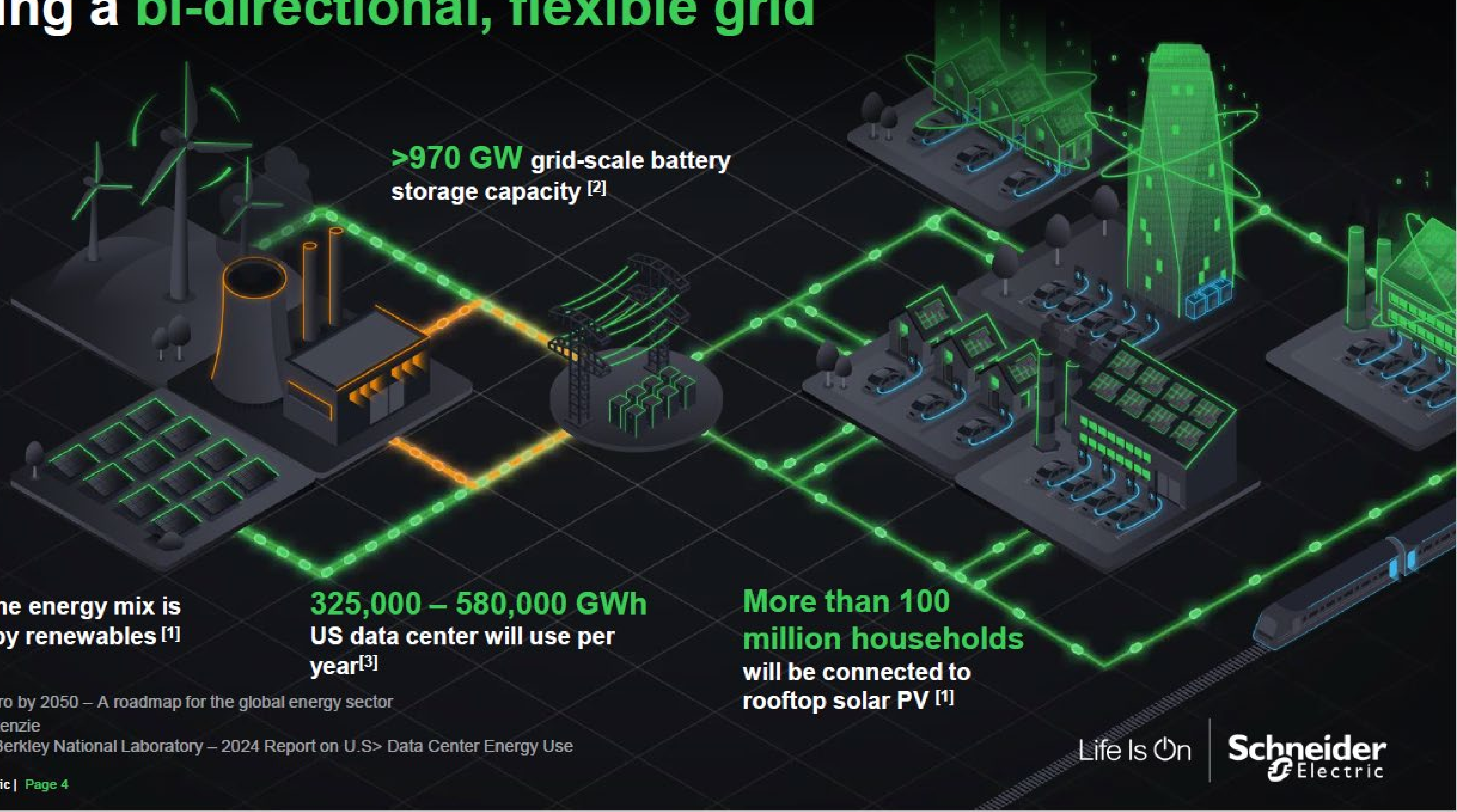


Power & Grid Offers for a Smart Grid



Impact[1] Up to **60%** Productivity increase | Up to **20%** LCOE optimization | Up to **50%** Operational efficiency increase

By 2030, a more complex grid with actors and prosumers feeding a bi-directional, flexible grid



>970 GW grid-scale battery storage capacity [2]

70% of the energy mix is supplied by renewables [1]

325,000 – 580,000 GWh US data center will use per year[3]

More than 100 million households will be connected to rooftop solar PV [1]

1. IEA Net Zero by 2050 – A roadmap for the global energy sector
2. Woodmackenzie
3. Lawrence Berkley National Laboratory – 2024 Report on U.S> Data Center Energy Use

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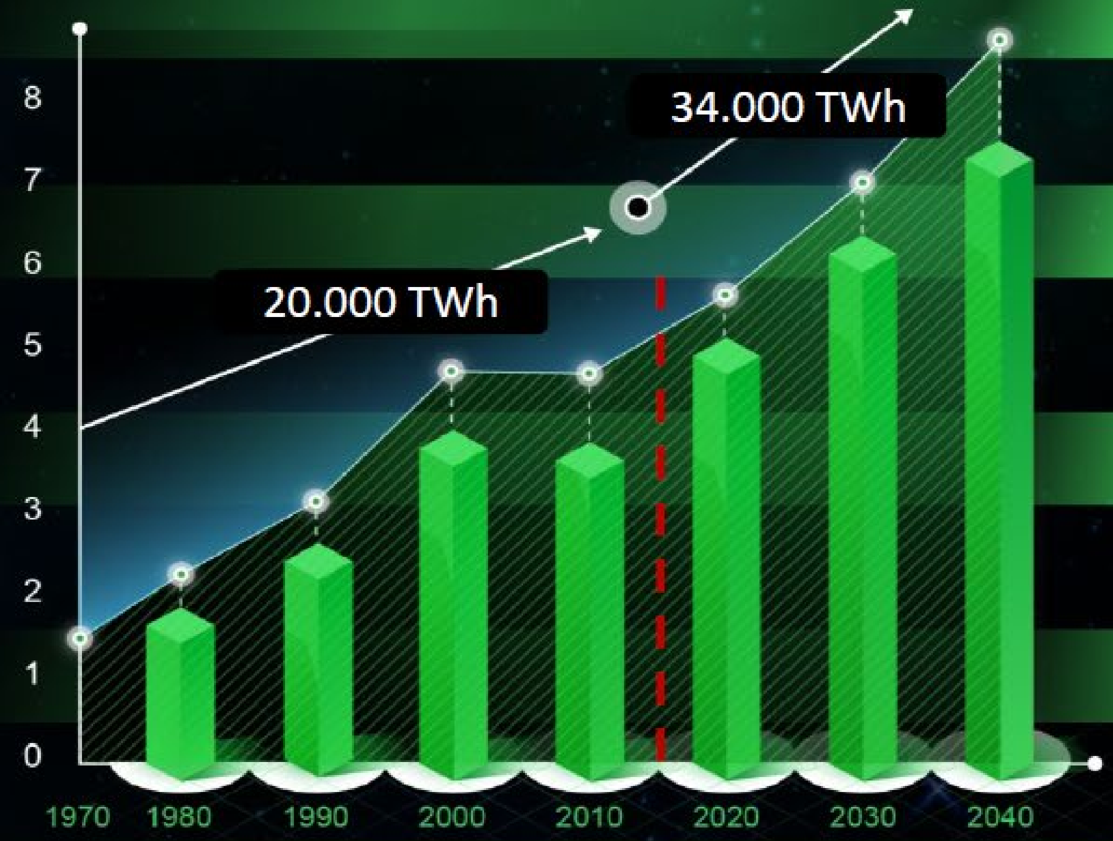
A Stressed Grid Needs Transformation



Worldwide Energy Consumption : led by AI, Data Centers & Electrification *IEA*

Soaring Energy Demand	**50M** Miles of power lines by 2030
Surge in Renewables Integration	**>6X** by 2030 EV, PV
Aging Infrastructure *IEA, 2024*	**60%** Nearing end of life
Major Weather Events *Bloomberg*	**83%** Power Outages attributed to extreme Weather
Aging Workforce *IEA, 2024*	**50%** Utility Workforce is set to retire

Accelerating Grid Modernization

System-wide coordination

Ensuring all parts of the grid work together seamlessly to balance supply and demand in real-time

Holistic situational awareness

Utilizing advanced monitoring and analytics to understand the current grid state and predict future conditions.

Elevated risk management

Identifying and mitigating potential issues before they impact grid stability and reliability

Integrated planning and operations

Bridging the gap between long-term planning and operations for optimal investments and decisions

By implementing these strategies utilities can create a more **holistic and efficient approach to grid management**, ultimately benefiting both the utility and its customers.

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Step-change in managing the grid is inevitable

Planners

Must manage the greater uncertainly of future demand caused by technology, DER adoption, electrification etc.

▼

Need a holistic approach to planning, leveraging greater extents of operational data.

Designers

Must create & maintain highly accurate network models from HV to LV and even customer-owned BTM assets.

▼

Need a to develop a fully digitised modelling & asset registry process at a vast scale.

Asset Teams

Must manage the impact of more volatile & unpredictable storms exacerbated by an ageing asset base.

▼

Leverage IoT data to improve decision making & coordinate with control rooms

Operators

Must manage huge data volumes & embrace automation to manage DERs & improve operational performance.

▼

'Operators' must become 'Analysts', configuring, assessing & tuning grid systems rather than operating it themselves.

Customer Teams

Must embrace customers as critical players in the energy system, integrating them & their assets into utility processes.

▼

Need to build 'customer journeys' with the capacity to inform, enroll & control customers & their assets.

Procurement | IT | Business Intelligence

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The future of Grid management is an ecosystem

To **enable** growth of this ecosystem a ***modular, inclusive, AI-enabled*** **software platform** providing ***secure, end-to-end connectivity*** *and* ***digitization*** from ***grid to prosumer*** *is required*

Interoperability with external systems in a standardized way

Advanced cybersecurity to ensure safe operations

Plug-and-play Digital Grid product integration

Simplified deployment for new workloads

Strong tech partner and ISV support

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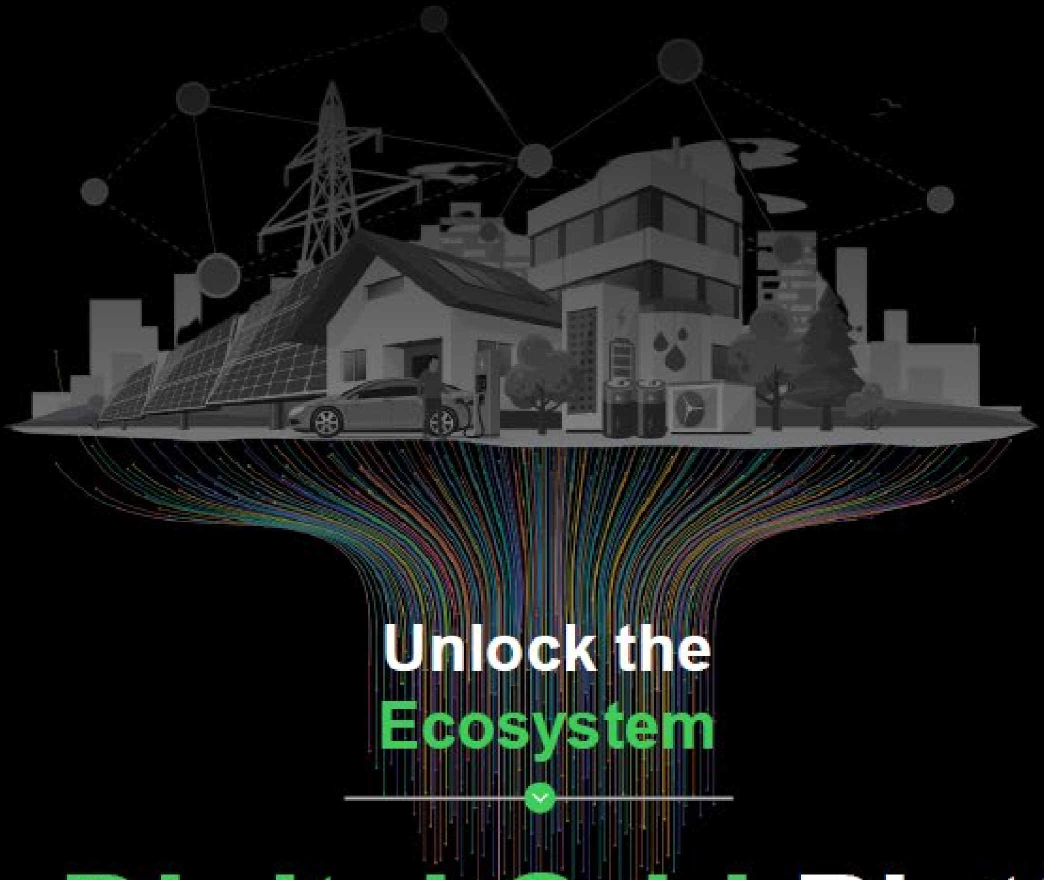
1 Commitment to Platform Evolution

Common
Data Hub



Software Lifecycle
Improvements

Unlock the
Ecosystem

One Digital Grid Platform

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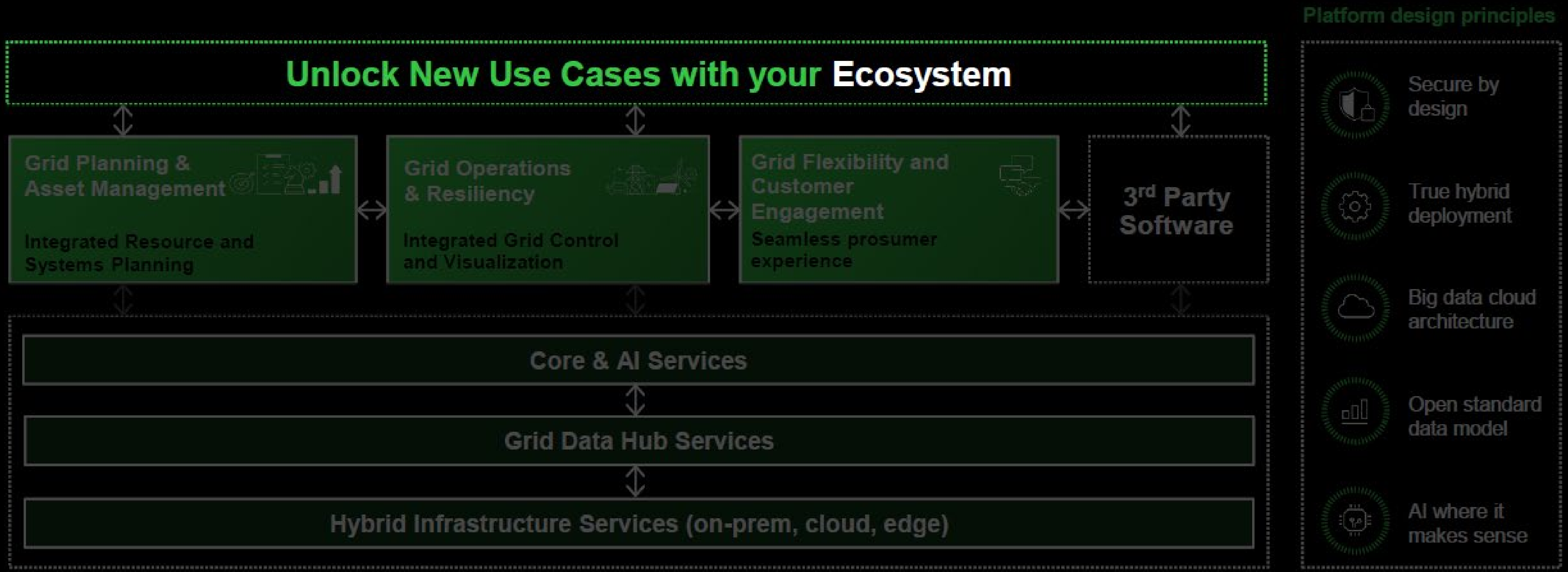
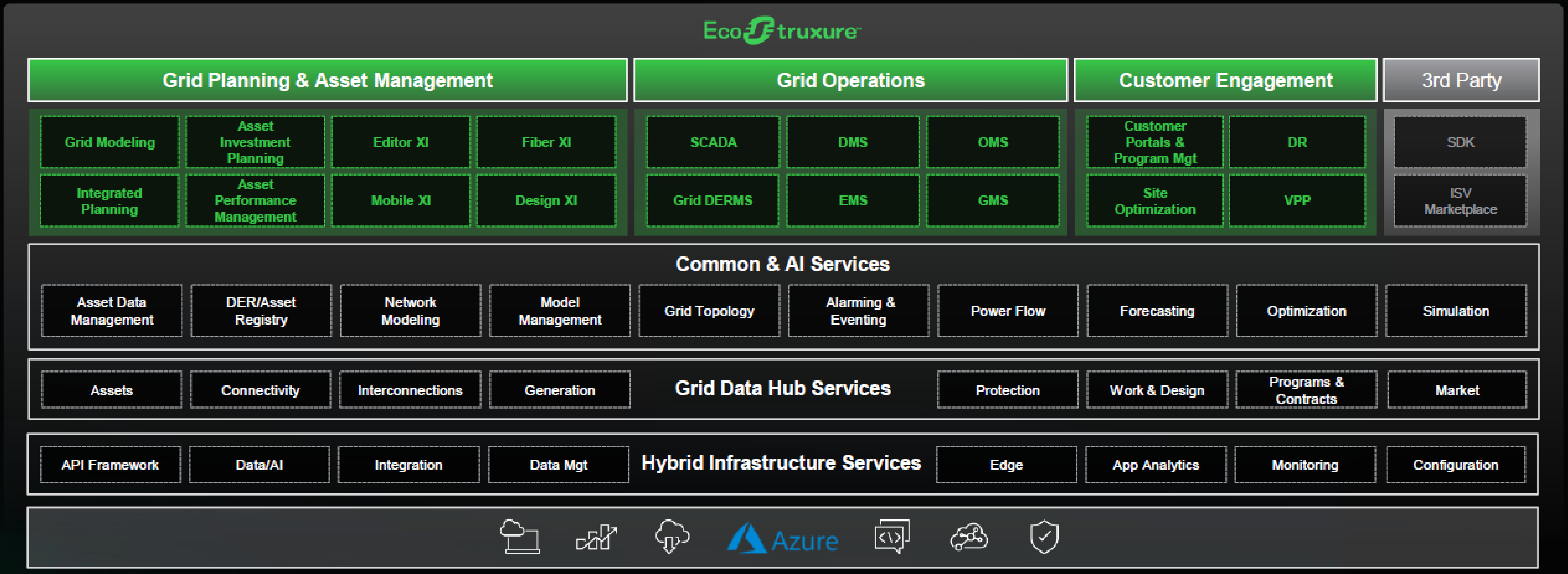
One Digital Grid Platform Enables Unprecedented Grid Management Capabilities



Grid Management Platform with Data-Centric Architecture



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2 Unified Communication & Collaboration

Simplified **Engagement & Packaging**

Services & Support Clarity

Certified **Partner Ecosystem**

3 Modern Network Management Readiness

Innovative & Elevated Functionality

Forward-looking features gathered directly from customers to improve productivity & efficiency

Enabled for Ease of Implementation

Resources and tools built to add flexibility and agility to our products to improve implementation

Well-Architected for Reliability & Security

Technology advancements and architectural improvements aimed at improving the security and reliability of our software.

- ✓ Advanced Network Intelligence
- ✓ 13+ Certified EcoXperts
- ✓ Performant Data Model
- ✓ Unlock Holistic Major Event Management

4 Strategic AI Integration

Enable DG Intelligence

- ✓ Leverage AI to secure high(er) data quality, to enable intelligent apps to deliver value

Boost Simplicity

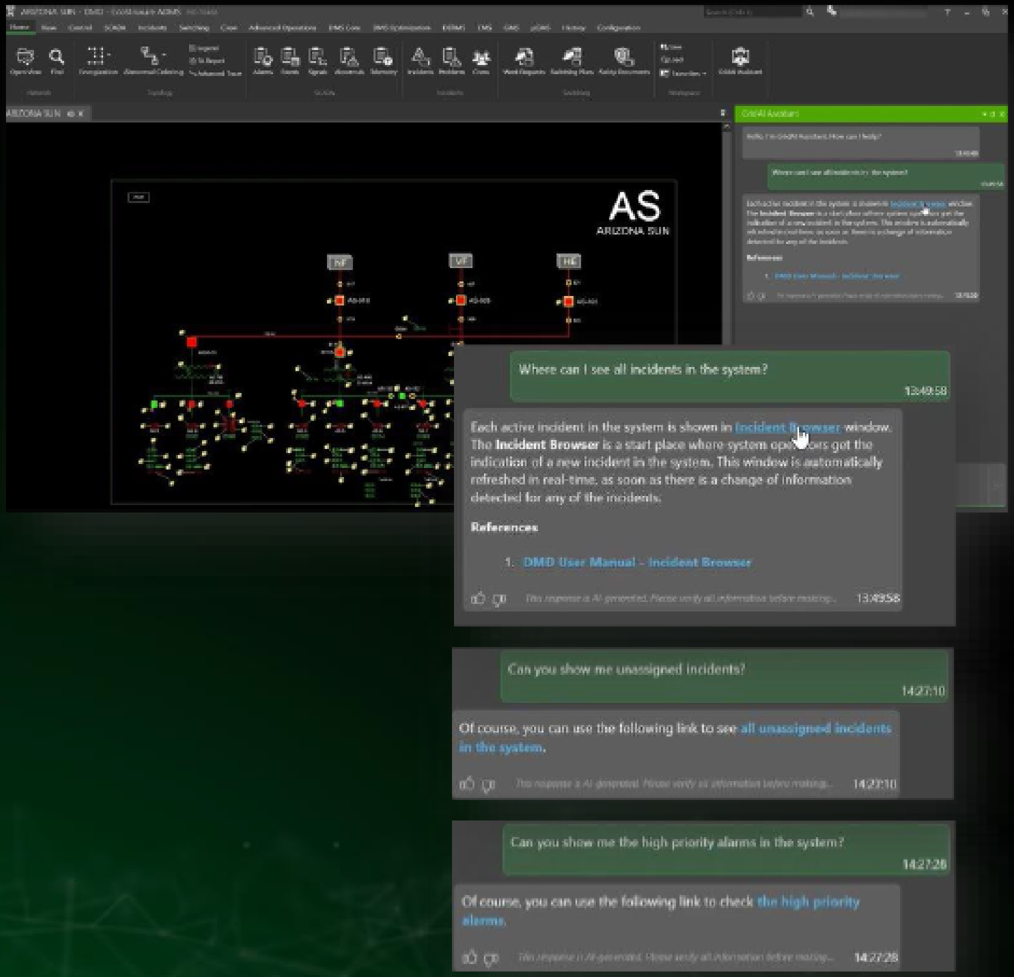
- ✓ Leverage AI to make easier use of SW i.e. faster onboard of new users to grid management paradigms

Enhance Resilience

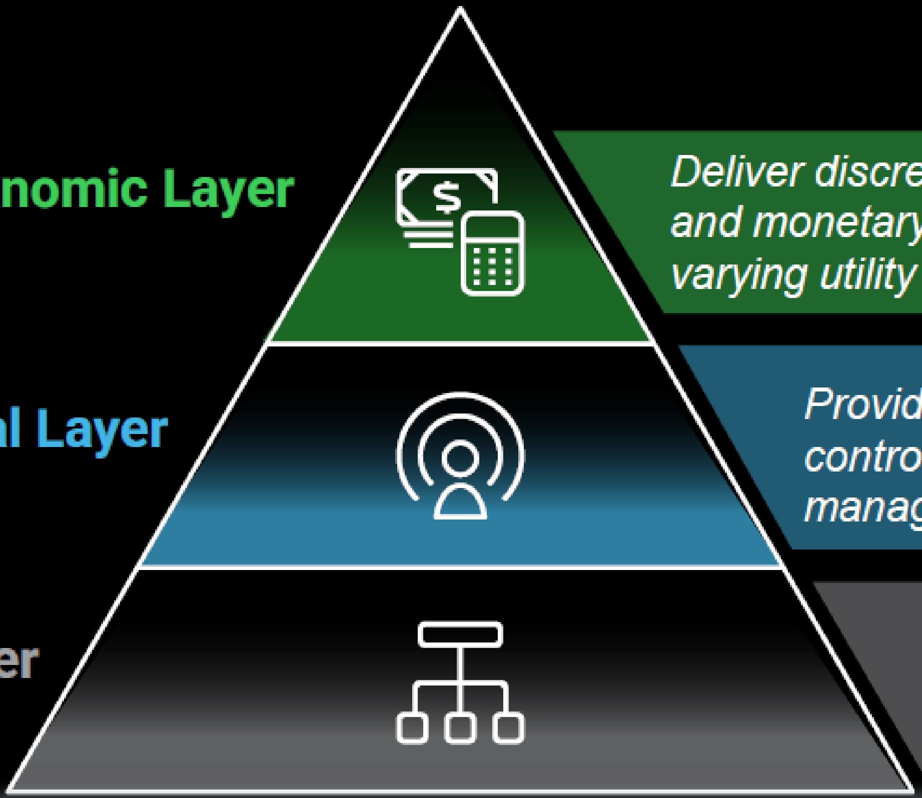
- ✓ Leverage AI to unlock power of predictive major event management & accelerate restoration

Increase Flexibility

- ✓ Leverage AI to enable intelligent grid flexibility management



Technology to Support Your Business Needs



Economic Layer

Deliver discrete outcomes and monetary benefits for varying utility use cases.

Operational Layer

Provide real-time telemetry, control, and state estimation to manage and optimize the grid.

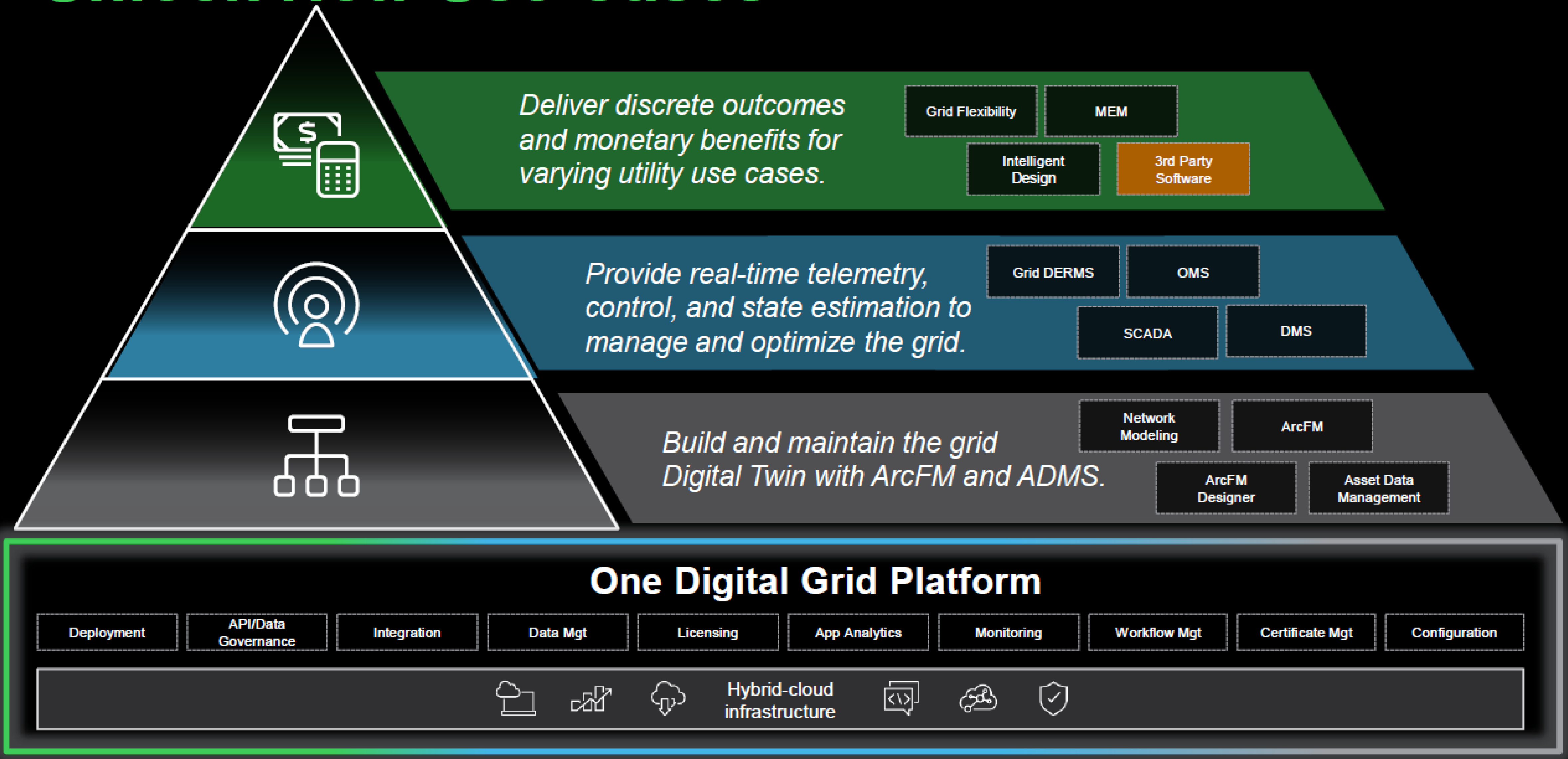
Topological Layer

Build and maintain the grid Digital Twin with ArcFM and ADMS.

One Digital Grid Platform

Facilitates interoperability, unified network model and execution engine

Unlock New Use Cases

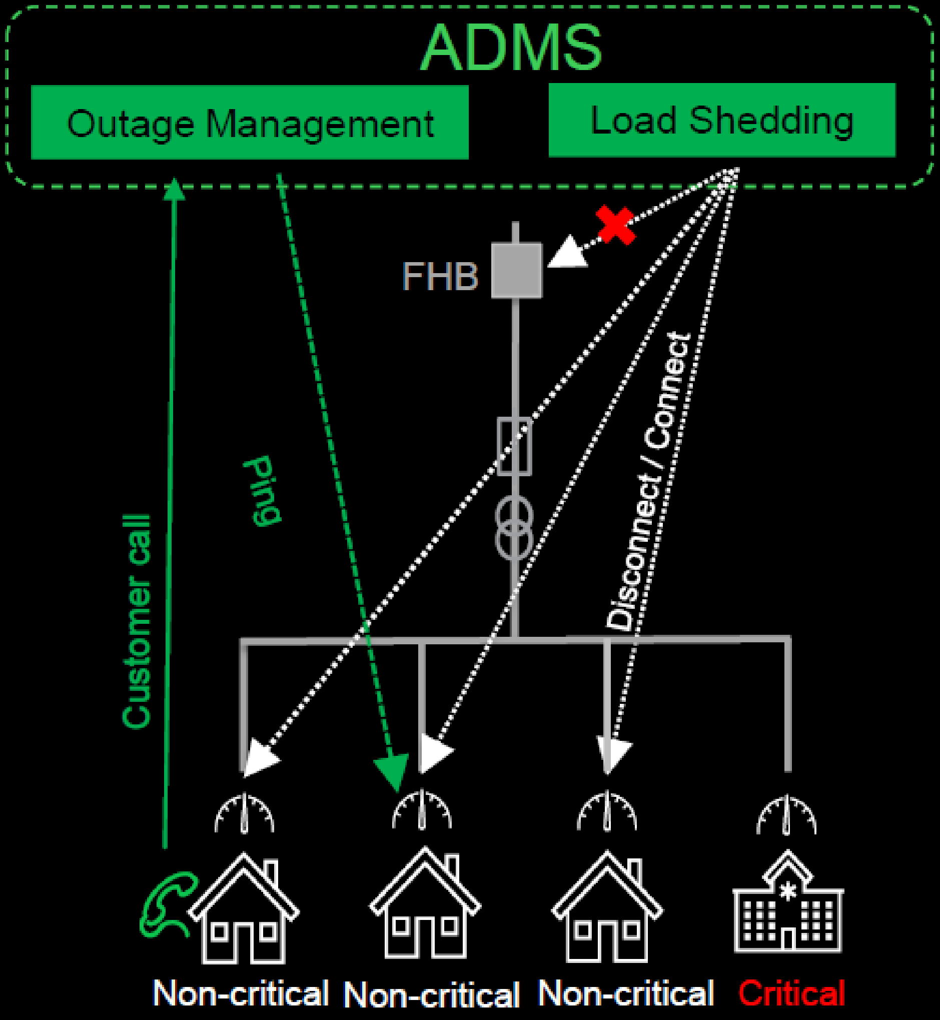


Enhancing Reliability and Resiliency

AMI 2.0: Improved Outage Management & Load Shedding

Improved outage mgmt.

- Fast detection of outage extent through Intelligent automatic ping
- Validation of customer interruptions times
- New types of AMI events\requests
  - Disconnect\reconnect request
  - Partial power (Wire down) event
  - 3-phase open neutral & high impedance faults
  - Voltage problem event
  - Non-outage events (tamper, temperature, etc.)
  - Unlocated event



More resources for LS

- Increased number of feeders with critical customers → reduced available LS resources (FHB)
- Shedding only non-critical customers through AMI's "remote disconnect/connect" capability

Public

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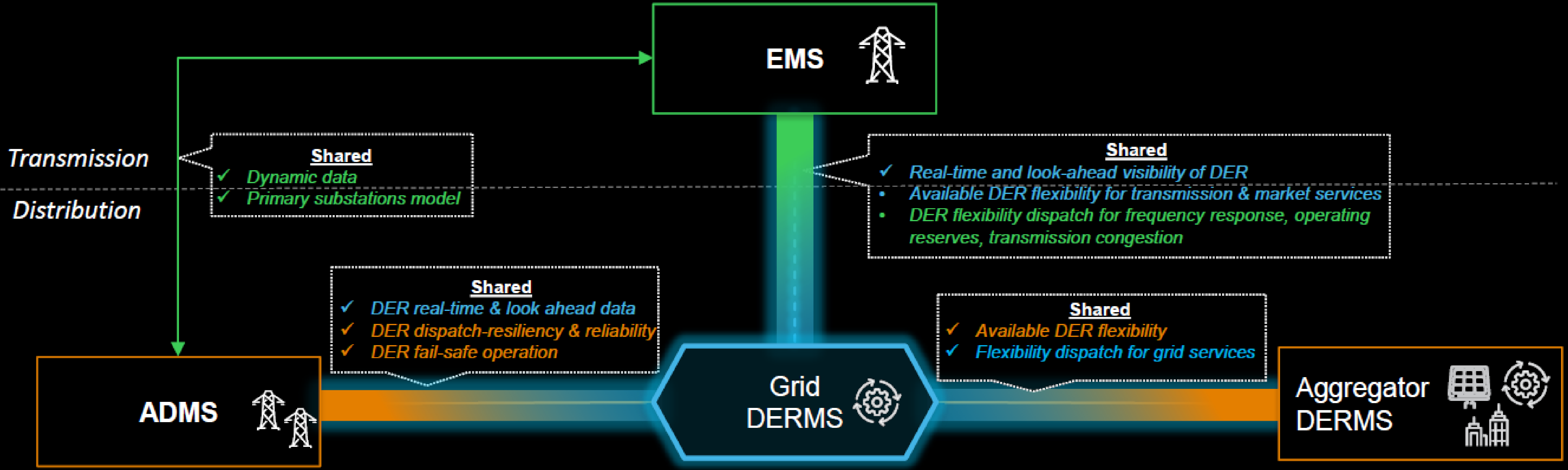
T&D coordination – Grid DERMS at the center



Grid DERMS: An Interoperable Coordinator delivering valuable insights across systems

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Public

Our Offers Deliver Tangible Economic Benefits

Return on Investment

184%

Forrester TEI Report

Payback

16 *months*

Leading the Way with Analyst Recognition of our Grid Technology

#1 Vendor

2025 ABI Research for Grid Digitalization

TGO Alliance

2025 Fall Summit

Working Group Planning

1:45 – 2:45

Allie Broussard

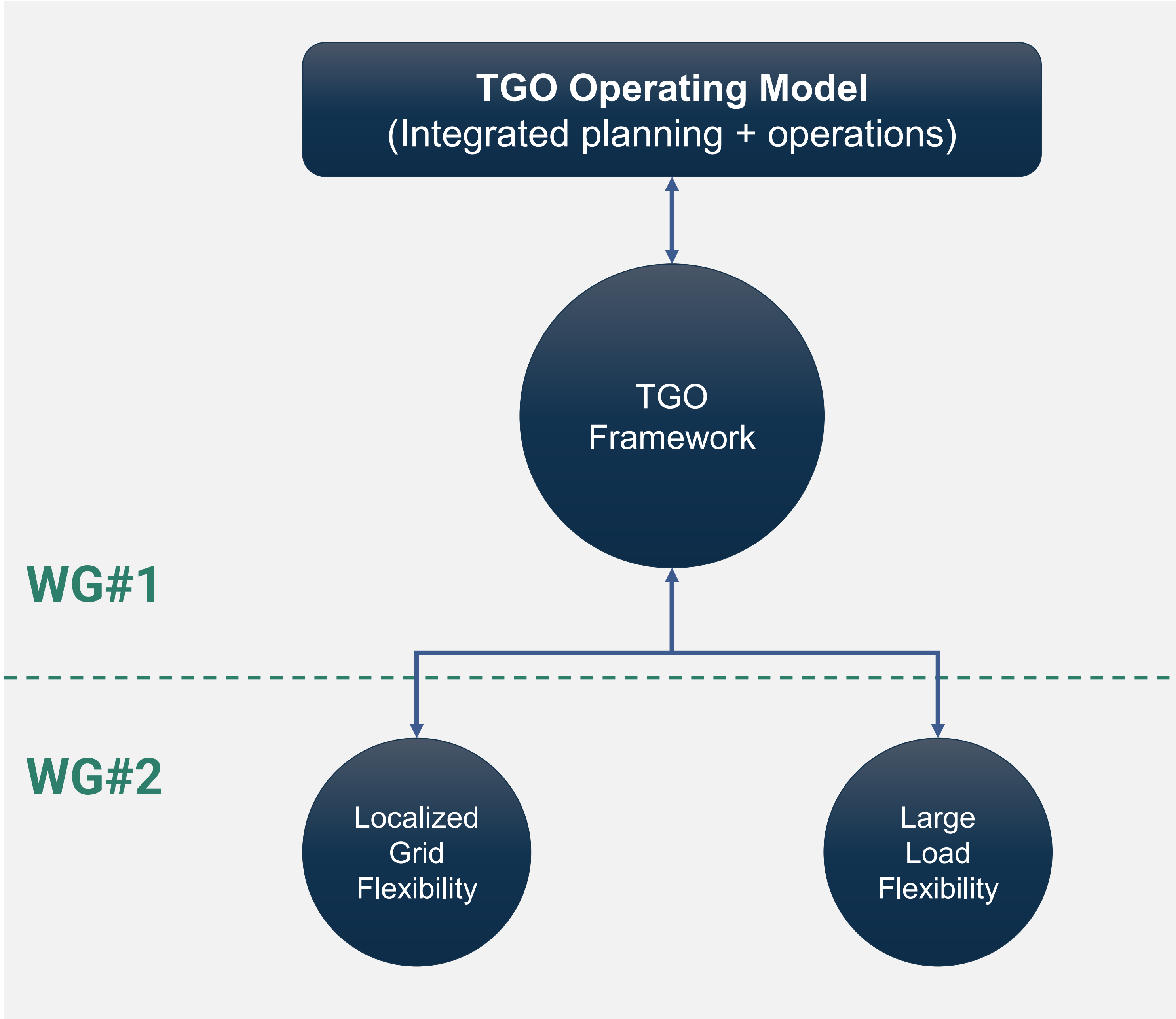
Market Specialist, Electric Markets

BLACK & VEATCH

Paul Moran

Integrated Solutions Strategist, Electric Markets

BLACK & VEATCH


TGO Operating Model
(Integrated planning + operations)
TGO
Framework
WG#1
WG#2
Localized
Grid
Flexibility
Large
Load
Flexibility

Total Grid Orchestration Alliance

Working Group Rapid Lessons

Design Principles to Carry Forward

Start from Member Pull
Prioritize topics aligned with utility pain points and/or funding

Stay Narrow, Ship Fast
Define 1–2 shippable deliverables per Working Group per quarter

Artifact-First Agendas
Every working group session drives a specific named deliverable

Asynchronous by Default
Convert big work into small tasks and use live time for decisions not drafting

Make it Easy to Contribute
Provide templates/examples and consider additional stakeholder support needs

Potential 2026 TGO Areas of Focus

Defining and validating the risk model

- Risk Model Parameters
- Telemetry Requirements
- Asset Inventory
- Risk Profile/Confidence Interval

Operationalizing TGO as a tool to help Grid Operations

- Distribution Planning
- Near Real Time Operations Support (LGF)

Create the TGO Operational Model, defining how business units or entities can coordinate using the tool and framework

- Considerations for Vertically Integrated or Non-Vertically Integrated Utilities

Translating Areas of Focus into Action

TGO Member Priority Driven

- Prioritize member-driven topics and utility pain points to maximize engagement and impact.

Problem Statements

- Translate each area of focus into a specific problem statement to guide solution development and working group activities.

Rapid Deliverables

- Apply rapid, focused working group principles to each area of focus—define clear, shippable deliverables and assign ownership.

Artifact-Driven

- Use templates and artifact-first agendas to ensure every session produces tangible outputs.

Asynchronous Work

- Encourage asynchronous contributions and feedback to maintain momentum and resilience.

From Focus Areas to Actionable Solutions: Rapid, Member-Driven Problem Solving for TGO Progress”

Developing a 2026 Plan

Development of Problem Statements

Defining and validating the risk model

Risk Model Parameters

Telemetry Requirements

Asset Inventory

Risk Profile/Confidence Interval

- **Risk Model Parameters**
  Problem Statement:
  How can we identify and standardize the parameters that accurately represent grid operational risk across diverse assets and conditions, ensuring they remain adaptable to evolving regulatory and operational requirements?
- **Telemetry Requirements**
  Problem Statement:
  What telemetry data is essential to feed the risk model for real-time accuracy, and how do we ensure data completeness and integrity given heterogeneous systems and legacy infrastructure?
- **Asset Inventory**
  Problem Statement:
  How do we maintain a comprehensive, up-to-date inventory of grid assets that integrates with the risk model and supports dynamic risk scoring?
- **Risk Profile / Confidence Interval**
  Problem Statement:
  How can we quantify uncertainty in risk assessments and define confidence intervals that operators can trust for decision-making under varying grid conditions?

Problem Statements

Operationalizing TGO as a Tool for Grid Operations

- **Distribution Planning**
  Problem Statement:
  How can TGO be embedded into distribution planning workflows to optimize asset utilization and investment decisions while balancing reliability and cost?
- **Near Real-Time Operations Support**
  Problem Statement:
  What mechanisms are needed for TGO to provide actionable insights in near real-time, enabling operators to respond to emerging risks without overwhelming them with data?

Creating the TGO Operational Model

- **Coordination Across Business Units or Entities**
  Problem Statement:
  How do we design an operational model that enables seamless coordination between planning, operations, and risk management teams, ensuring consistent use of TGO outputs across organizational silos?

Considerations for Vertically Integrated vs. Non-Vertically Integrated Utilities

Problem Statement:
How can the TGO framework accommodate structural differences between vertically integrated utilities and those operating in deregulated environments, without compromising interoperability or scalability?

Keys to Success

- Who do we need? What skill sets are necessary?
  - Wider representation across generation, transmission and distribution
  - More Planning resources?
- How can the vendor community best support us?
- What tools or technologies are required to realize the 2026 Plan?

TGO Alliance

2025 Fall Summit

Session Closeout & Debrief

2:45 – 3:15

Joe Zhou

Co-Chair, TGO Alliance
Infrastructure Advisory Markets Group Leader

BLACK & VEATCH

Join us!

6:00 – 8:00

Downstairs on the second floor

Food and Drinks Provided