



NARUC

National Association of Regulatory Utility Commissioners

Bulk Power System Learning Modules: Best Practices and Emerging Tools for Managing Large Loads

Large Load Interconnection Requests

April 30, 2026

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Identifying emerging challenges and connecting state commissions with expertise and strategies to navigate their complex decision making

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<i>Contact Kiera Zitelman</i>		<i>Contact Jeffrey Loiter</i>	
Critical Infrastructure Resilience, Emergency Preparedness, and Cybersecurity			
<ul style="list-style-type: none"> Critical Infrastructure Cybersecurity for Utility Regulators Artificial Intelligence Integrated System Resilience Defense Community Partnerships Energy Emergency Preparedness / Wildfires 			
<i>Contact Lynn Costantini</i>			

**Join a members-only group on this topic for regular learning and peer exchange opportunities.*

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The NARUC CPI team looks forward to engaging with NARUC's members throughout the year—your needs drive our priorities and activities. Reach out at any time!

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www.naruc.org/cpi | Last updated February 2026



UPCOMING EVENTS

Virtual Events

- Distribution System Planning Peer-Sharing Webinar Series: May 14, June 22, August 13; 3:00-4:30pm ET – Open only to state agency staff (NARUC, NASEO, NASUCA, etc.)
- May Innovation Webinar: May 28, 3:00-4:00 pm ET

In-Person Events

- NCEP Annual Meeting: May 5 to 6, 2026, Charleston, South Carolina
- NARUC Summer Policy Summit: July 19 to 22, Minneapolis, Minnesota



See the full list of events and access registration links at: www.naruc.org/events/event-list/

TODAY'S SPEAKERS

- Kyle Thomas, Elevate Energy Consulting – “Interconnection Processes for Large Loads: Current Practices and Recommendations”
- Jeff Billo, ERCOT – “ERCOT Batch Study Process for Large Load Interconnections”
- Scott Anderson, SRP – “Operational Readiness for Data Centers”





Interconnection Processes for Large Loads: Current Practices & Recommendations

NARUC

Kyle Thomas, *VP of Engineering & Compliance Services*

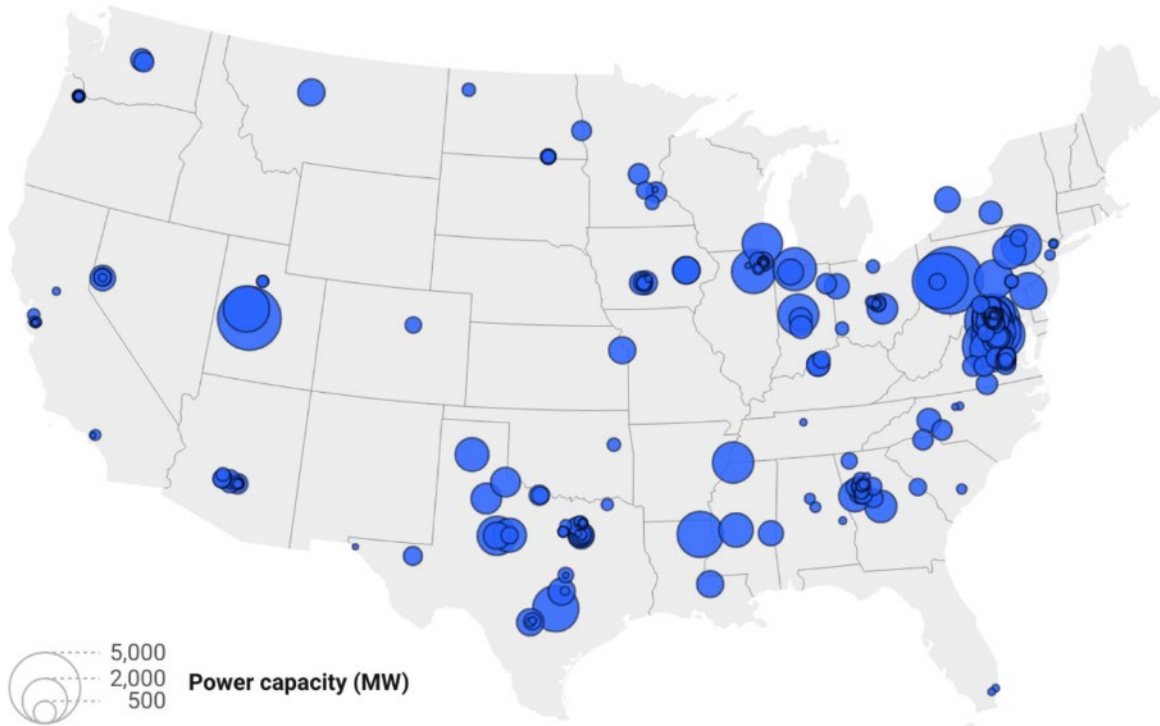
April 30, 2026

Backdrop: Significant Large Load Growth

Driven primarily by Data Centers

Planned data centers

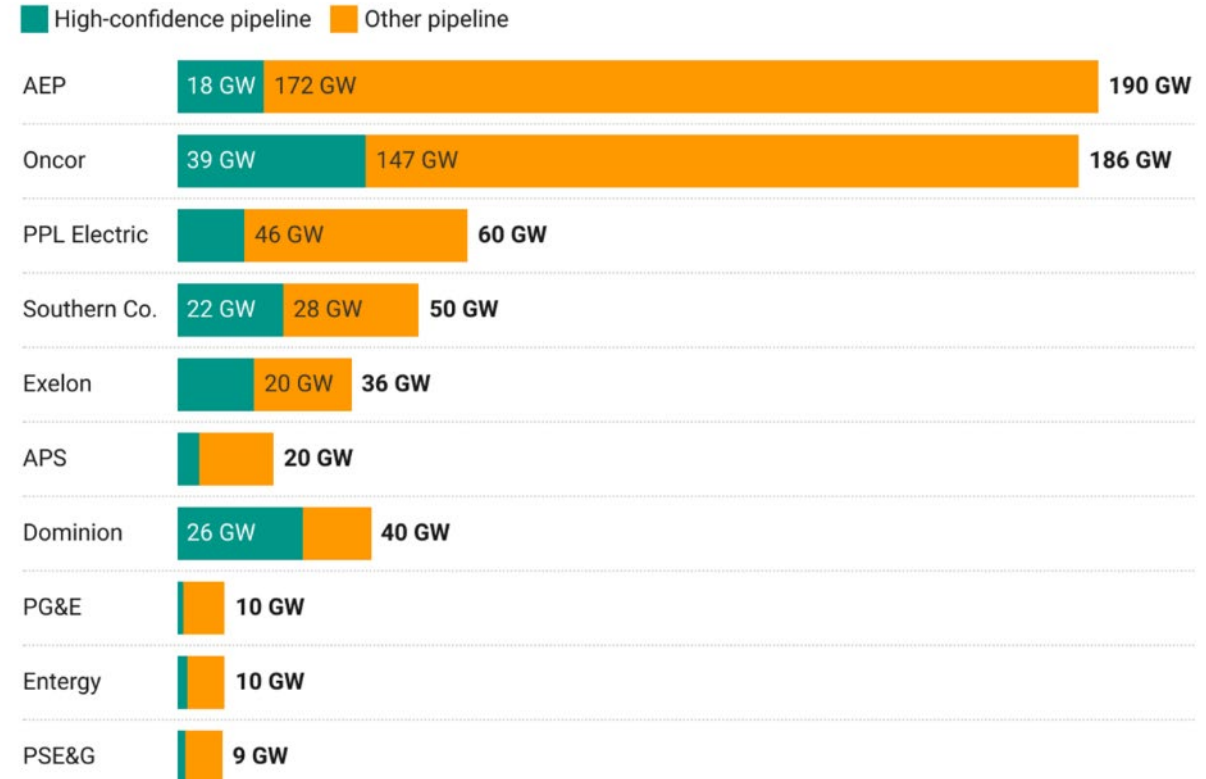
Data centers planned to come online by 2030



Source: Cleanview Data Center Tracker

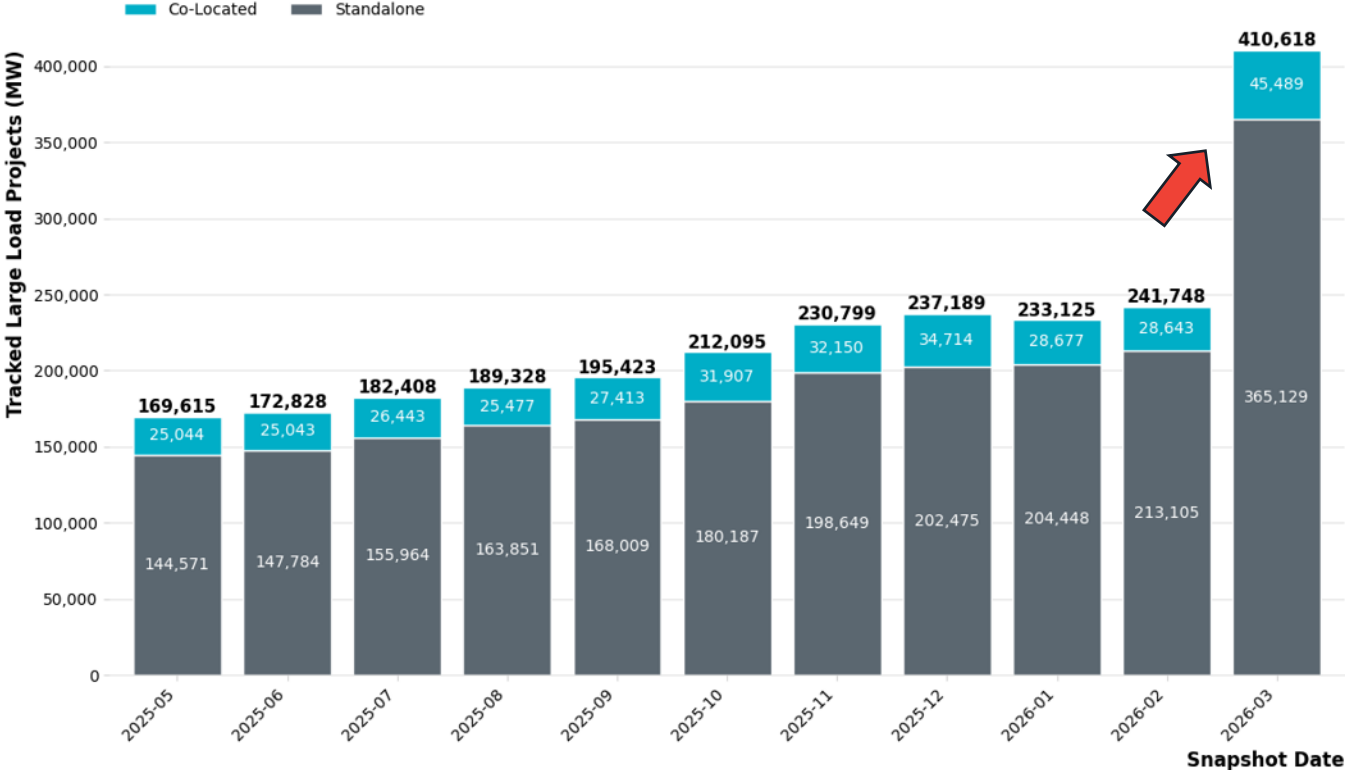
Data center pipeline by utility

The top 10 utilities have 600+ GW of pipeline—145 GW is high-confidence pipeline they expect to be built.



Backdrop: Significant Large Load Growth

Large Load Queue – Past 12 Months



ERCOT's large load queue size almost **doubled** from Feb 2026 to March 2026

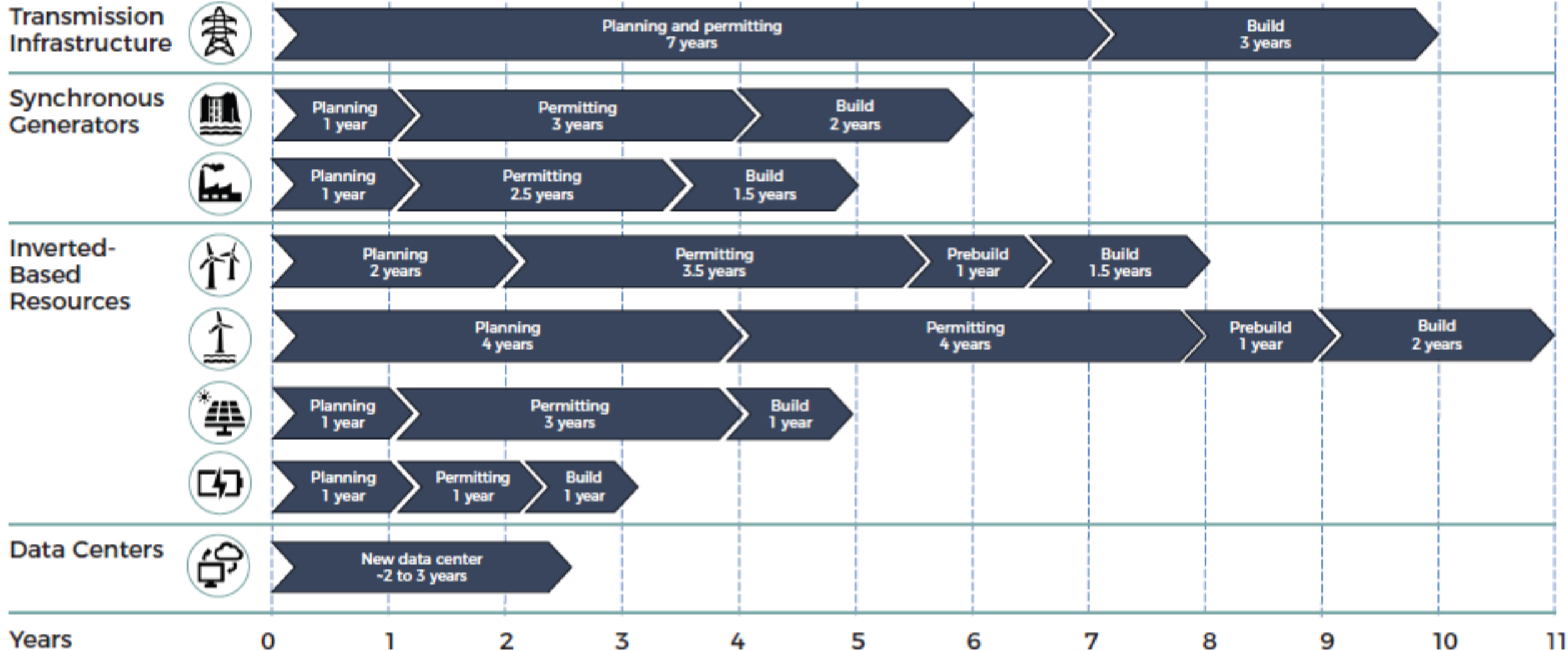


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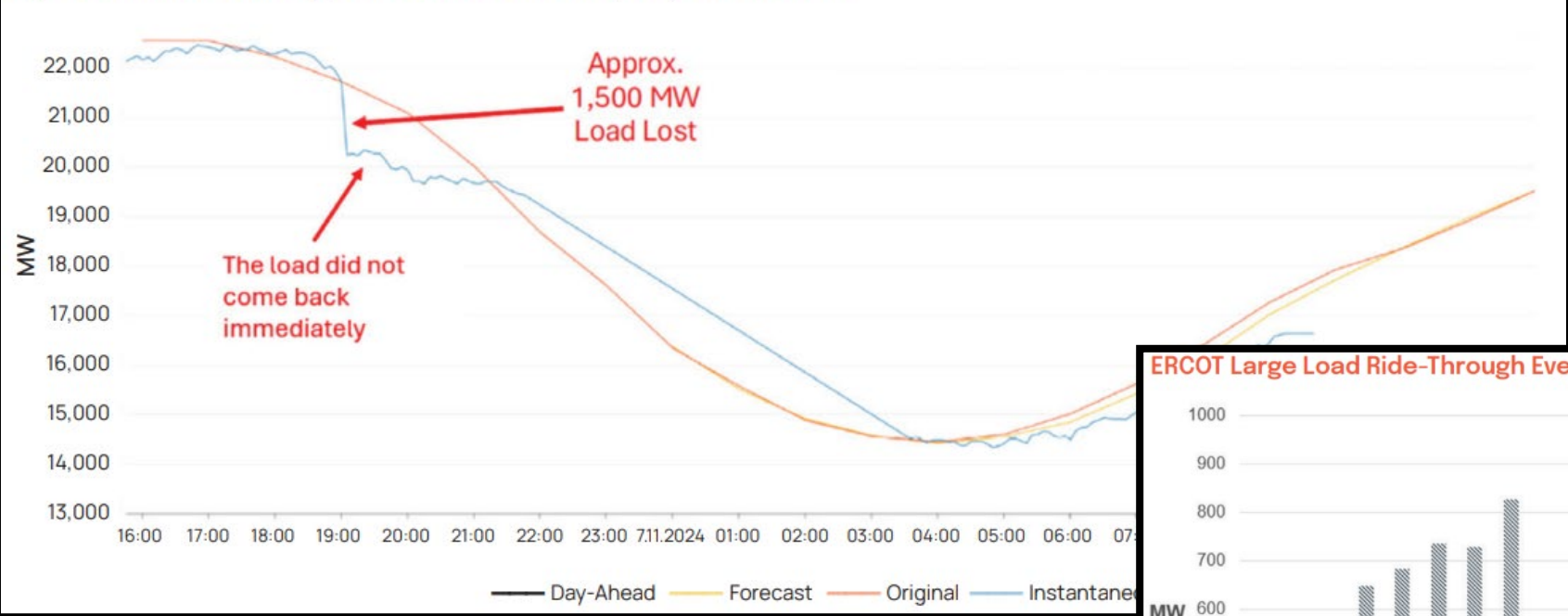
Source: March 2026 [ERCOT LLWG](#)

Timelines for Grid Infrastructure



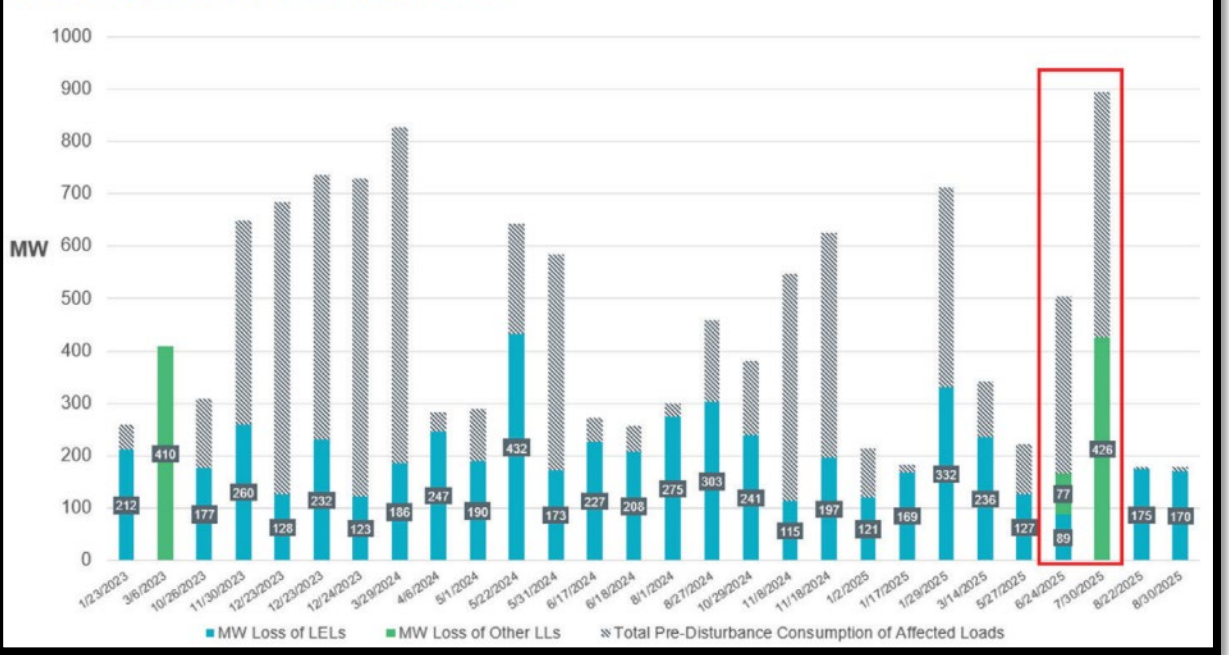
NERC Reports Faint Signals of Data Center Risk

System Load During the Dominion July 10, 2024 Event



Source: NERC Incident Review
Large Load Loss (2025), ESIG LLWG

ERCOT Large Load Ride-Through Events



Source: ERCOT



Grid Reliability Challenges

The Balancing Act: Economics vs. Reliability

ECONOMICS

- Significant long-term, predictable revenue streams for utilities
- Transmission expansion and development
- Enhanced infrastructure utilization
- Potential for demand flexibility
- New service models
- Tax breaks, incentives, and economic development packages
- Local jobs creation

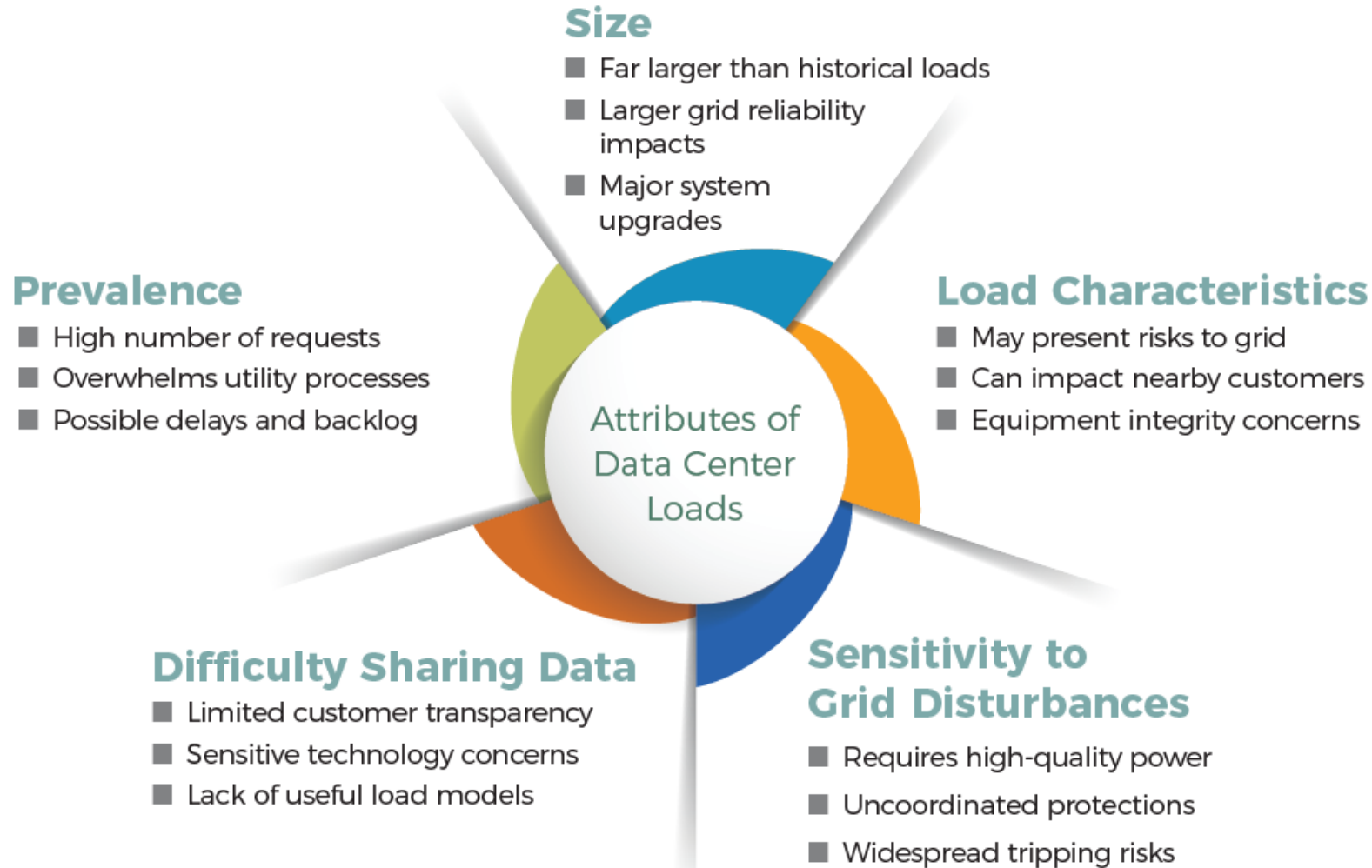


GRID RELIABILITY

- Overloaded or congested transmission infrastructure
- Voltage and frequency stability issues
- Interconnection backlog inundation
- Regulatory risks and hurdles
- Uncertain operating characteristics
- Reliance on baseload generation to serve loads

SOURCE: ELEVATE ENERGY CONSULTING.

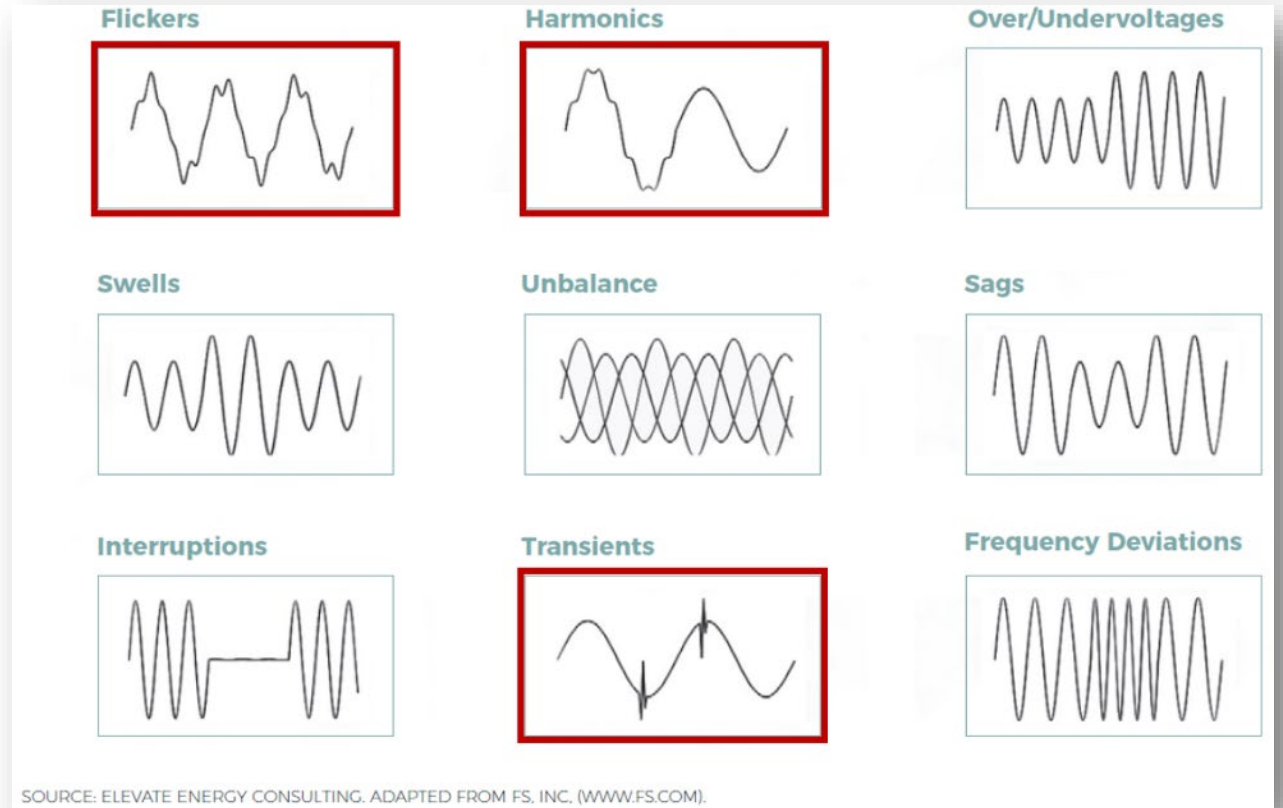
Key Attributes of Data Center Loads



SOURCE: ELEVATE ENERGY CONSULTING.

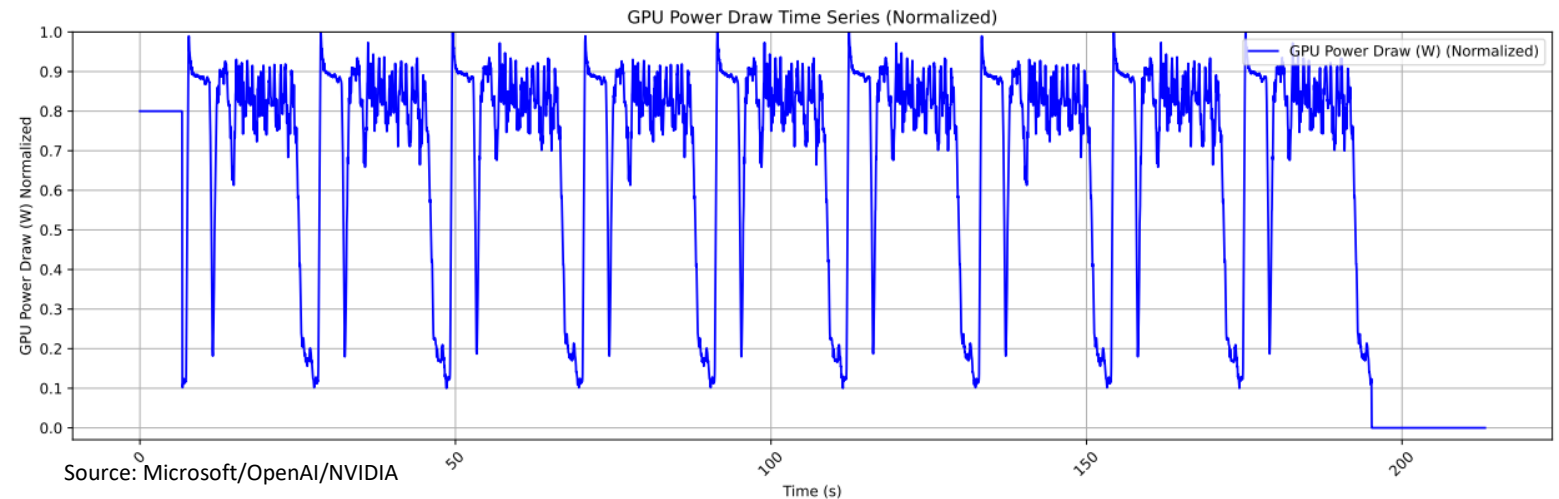
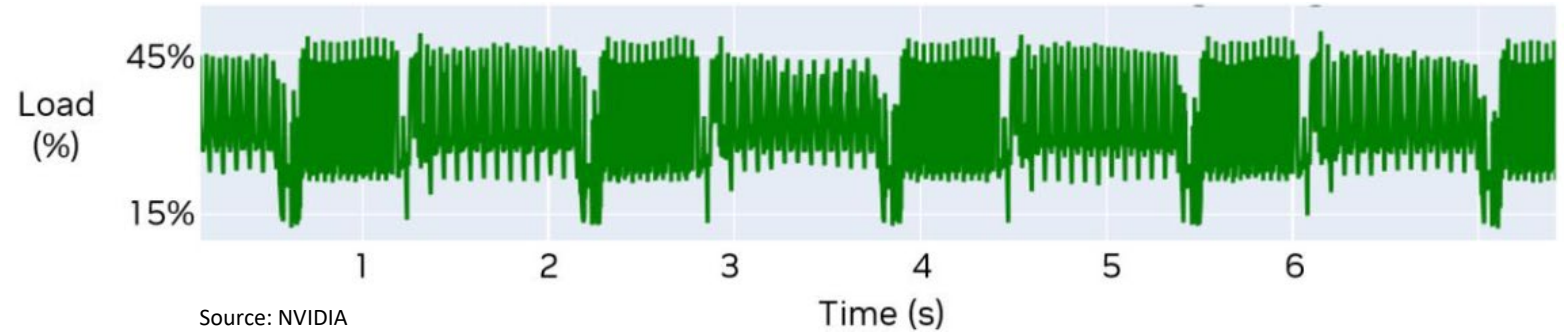
Key Reliability Challenges with Data Centers

- Ramping, variability, and uncertainty
- Impacts on frequency response and voltage control
- Generator cycling and strain
- Transmission utilization constraints
- Ride-through performance and dynamic response
- Power quality issues
- Transient stability impacts
- Subsynchronous oscillations
- Protection system impacts



Example of AI Training Load Cycles

- Fast load ramps
- High load variability (“jitter”)
- Irregularity
- Unpredictability
- Oscillatory
- Lack of data transparency





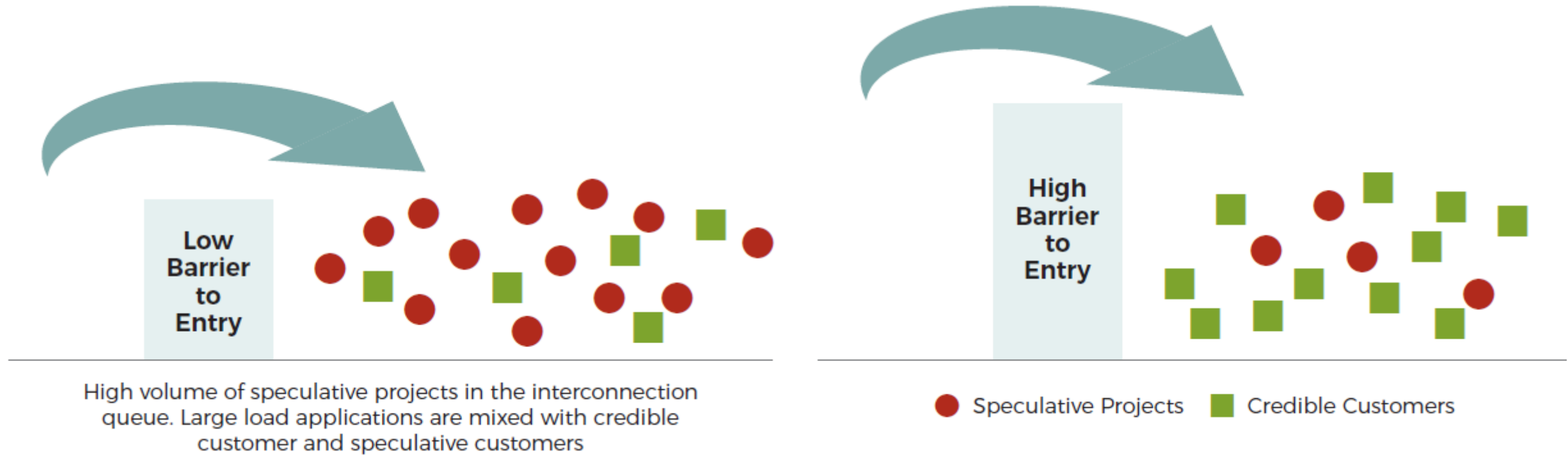
Large Load Interconnection Process

Large Load Interconnection Enhancements



SOURCE: ELEVATE ENERGY CONSULTING.

Avoid Speculative Interconnection Requests



High Barrier Examples:

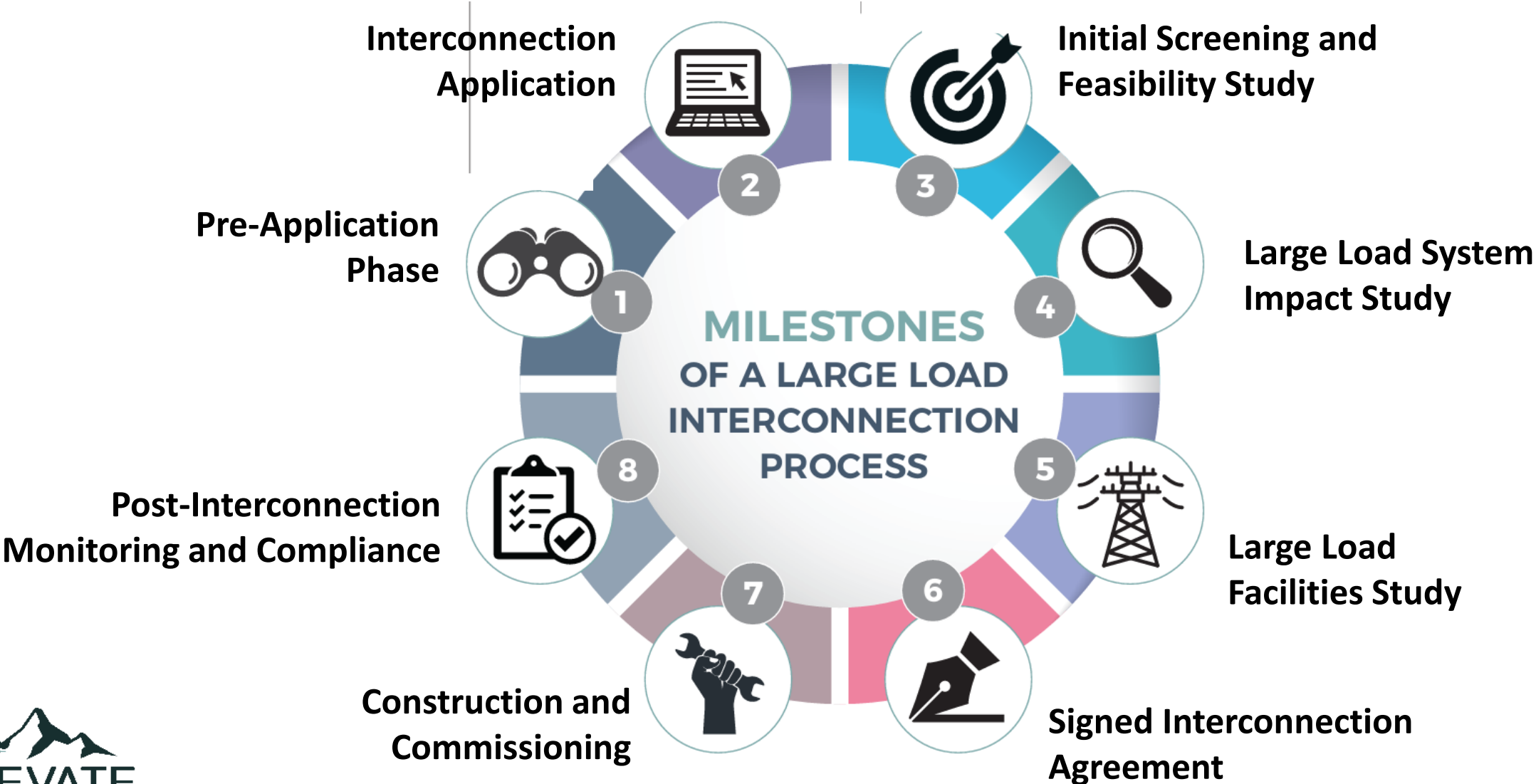
- Robust site control requirements
- Financial guarantees and collateral requirements
- Contractual commitments and exit penalties

Raise the Bar: Technical Requirements

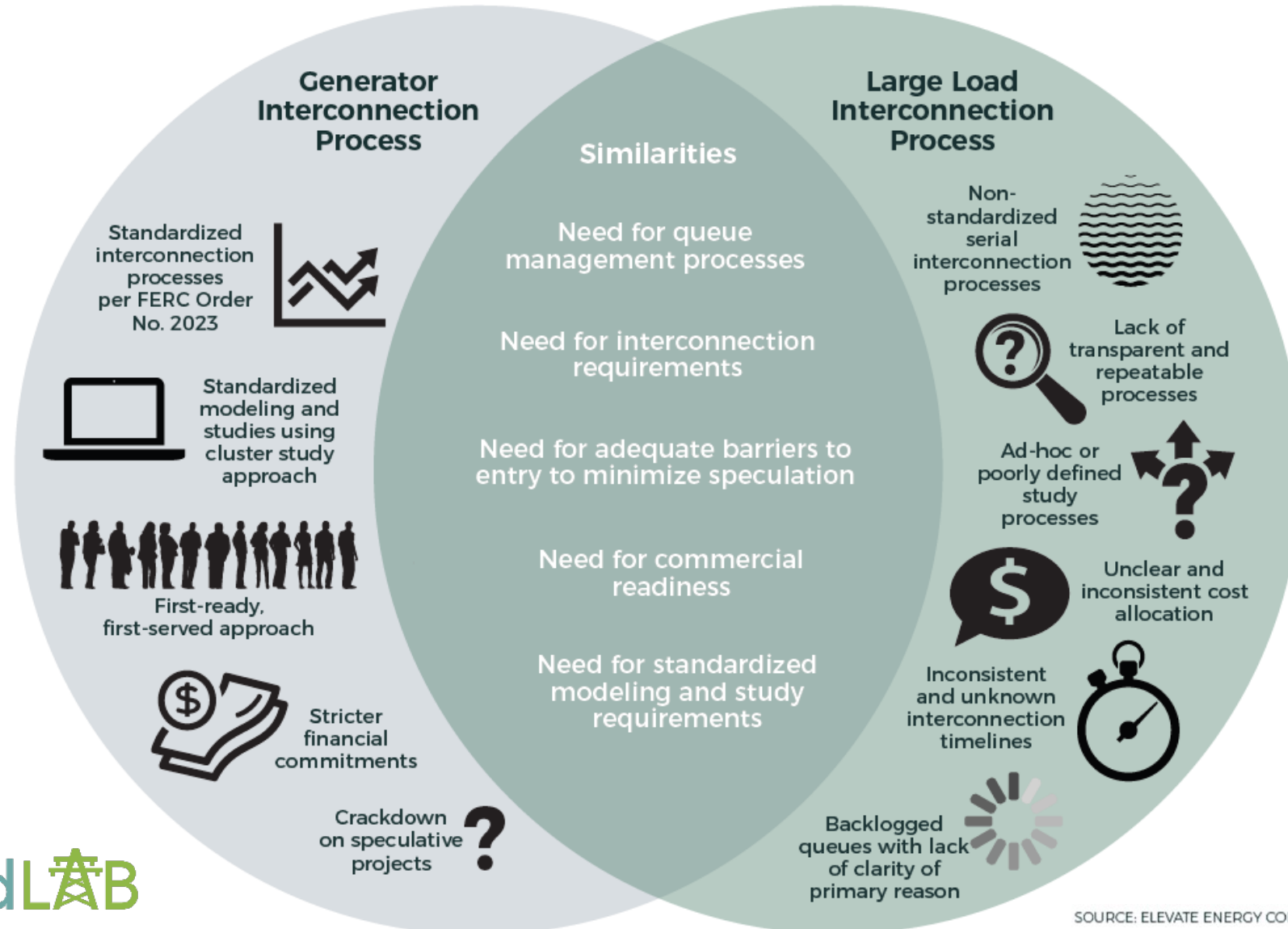
- Load size limits
- Data and model sharing
- Data recording and monitoring
- Ride-through performance
- Power factor/reactive power
- Power quality
- Oscillation Damping
- Short-circuit and protection
- Operational control and communications
- Emergency response
- Operations and maintenance
- Demand response
- Utility right to monitor and enforce requirements



Implement a Clear Interconnection Process



IBRs and Data Centers: More Common Than Not?



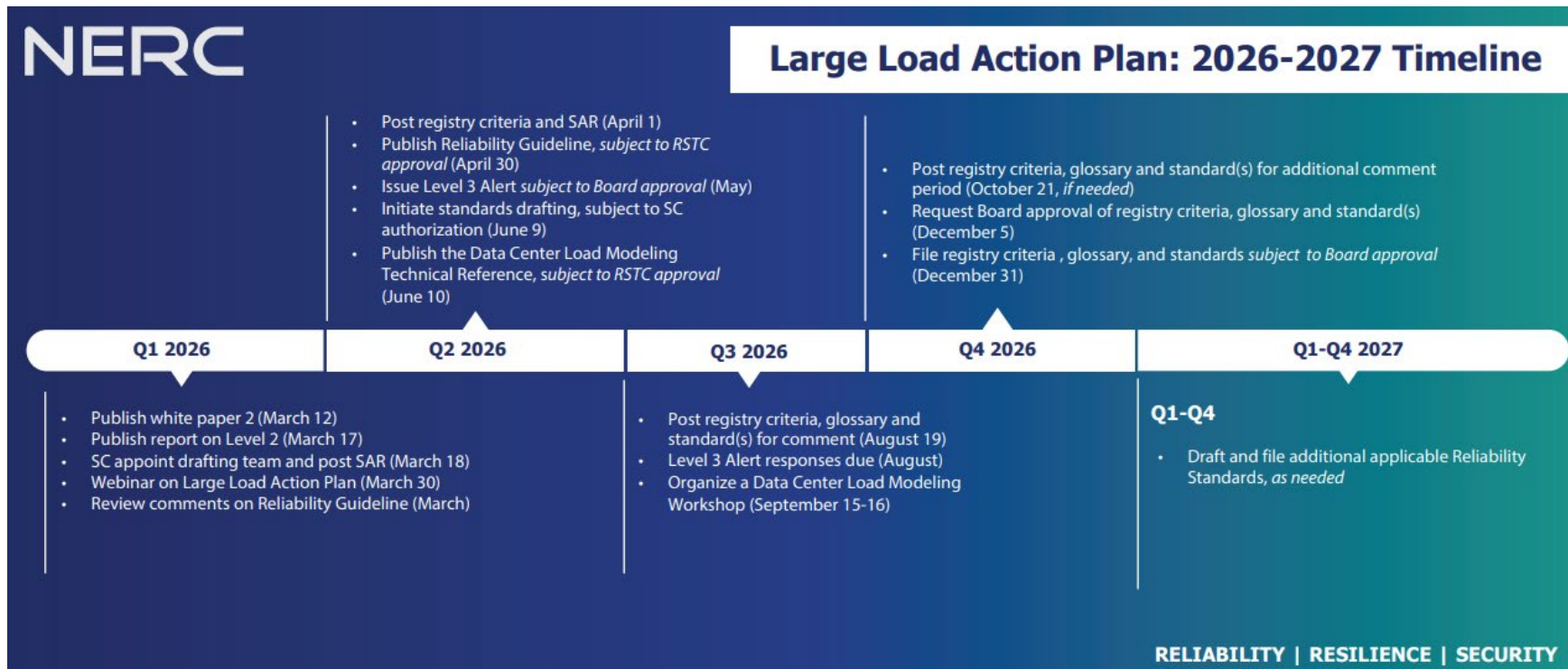


Regulatory Activities



NERC is moving fast with their Large Load Action Plan

- NERC is moving forward with NERC registration criteria for large loads and creating new/modified NERC Standards to address BPS Risks due to Large Loads
- Critically, at this time this work is not looking to address much with the Large Load Interconnection Process
 - **That will largely fall to the states** and potentially FERC(?) – currently we are waiting for FERC to release their NOPR





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ERCOT Batch Study Process for Large Load Interconnections

Jeff Billo
Vice President, Interconnection and Grid Analysis

NARUC Training

April 30, 2026

Agenda

Large Load Interconnection in ERCOT

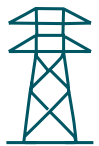
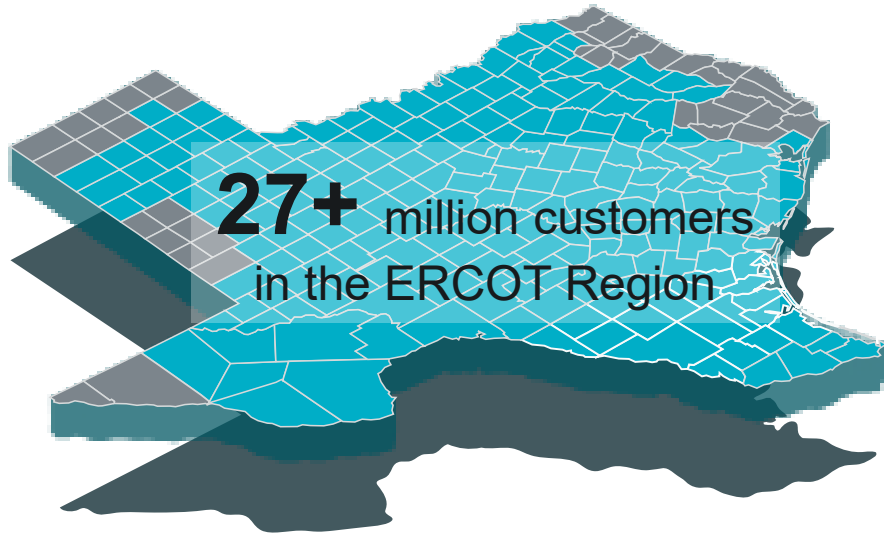
What is a Batch process

What is the transitional Batch Zero process

CLR and BYOG

Path to June Board

ERCOT Facts



~\$14 billion Transmission projects endorsed in 2025



1,460+ generating units, including PUNs



1,928+ active Market Participants that generate, move, buy, sell, or use wholesale electricity

Summer 2026 Installed Capacity

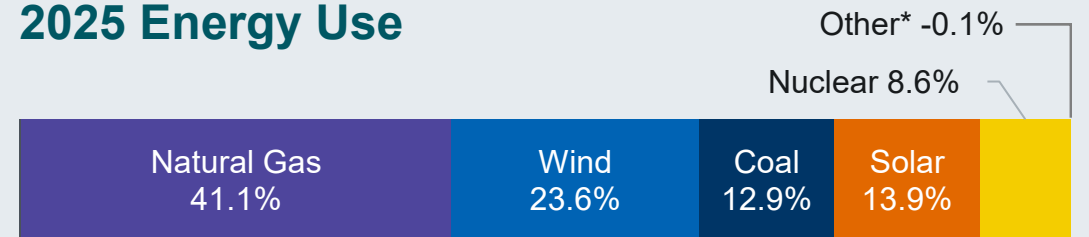
Reflects operational installed capacity for Summer 2026 based on `December 2025 Capacity, Demand and Reserves report.



The sum of the percentages may not equal 100% due to rounding.

**Other includes biomass and Direct Current Tie capacity.*

2025 Energy Use



**Other includes solar, hydro, petroleum coke (pet coke), biomass, landfill gas, distillate fuel oil, net DC-tie and Block Load Transfer imports/exports and an adjustment for wholesale storage load.*

ERCOT Records

Peak Demand Record

85,508 MW
(August 10, 2023)

Weekend Peak Demand Record

85,116 MW
(August 20, 2023)

Expected Capacity for Summer 2026

104,850+ MW
(December 2025 *Capacity, Demand and Reserves report*)

1 MW of electricity is enough to serve about **250** residential customers during ERCOT peak hours.

Wind, Solar & Energy Storage by the numbers



40,739 MW

of installed wind capacity as of March 2026, the most of any state in the nation

28,751 MW

Generation Record (March 14, 2026)

69.15%

Penetration Record (April 10, 2022)



38,608 MW

of utility-scale installed solar capacity as of March 2026

33,477 MW

Generation Record (March 21, 2026)

67.27 %

Penetration Record (March 21, 2026)



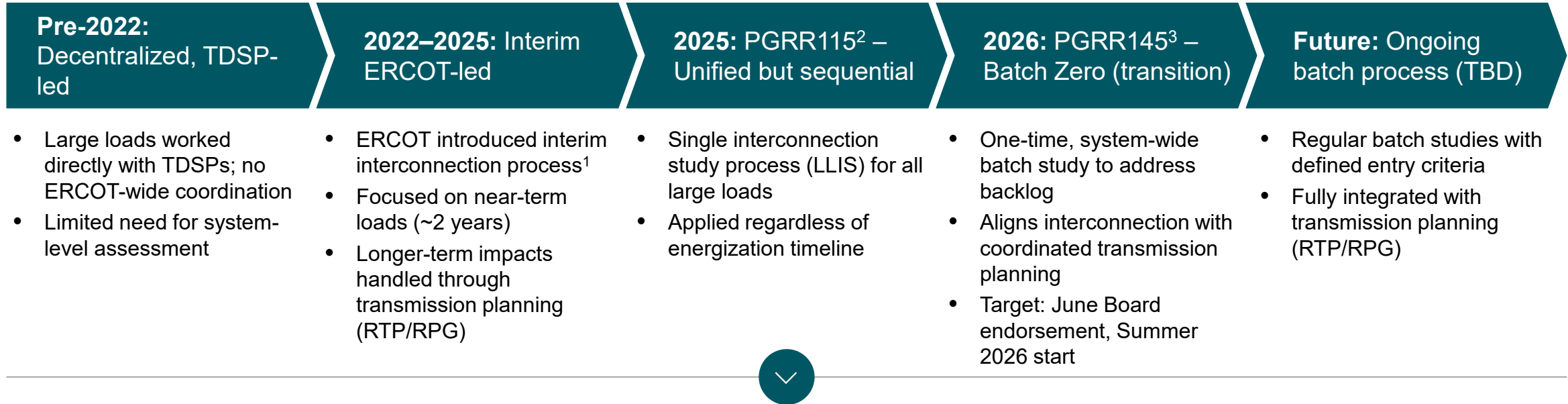
19,693 MW

of installed energy storage capacity as of March 2026

10,515 MW

Energy Storage Generation Record (March 13, 2026)

Evolution of Large Load Interconnection in ERCOT: from ad hoc to batch-based planning



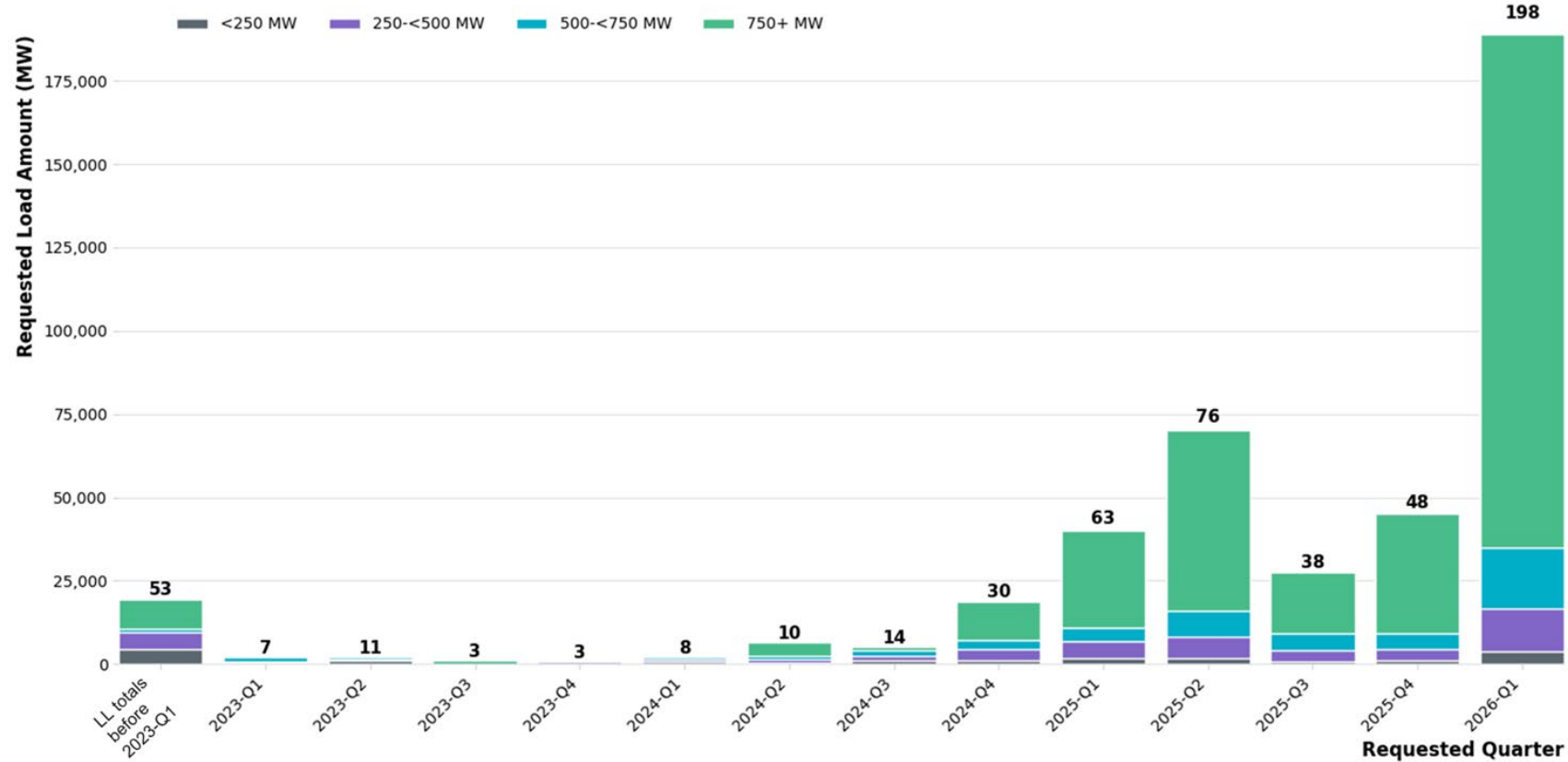
<ul style="list-style-type: none"> Growing demand created risk that system-wide reliability impacts were not fully evaluated 	<ul style="list-style-type: none"> Multiple pathways and fragmented studies led to no single view of system impact 	<ul style="list-style-type: none"> High volume of requests drove frequent restudies and increasing uncertainty 	<ul style="list-style-type: none"> Objective of stabilizing the pipeline and enabling transition to a scalable process 	<ul style="list-style-type: none"> Scalable, predictable, system-wide planning framework
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1. March 2022 Market Notice
 2. Planning Guide Revision Request 115: <https://www.ercot.com/mktrules/issues/PGRR115>
 3. Planning Guide Revision Request 145: <https://www.ercot.com/mktrules/issues/PGRR145>

Large Load Interconnection requests: historical data

Note: Large Loads are defined as ≥ 75 MW in ERCOT

Number of large load requests and requested load amount by quarter, MW and #



Key Takeaways

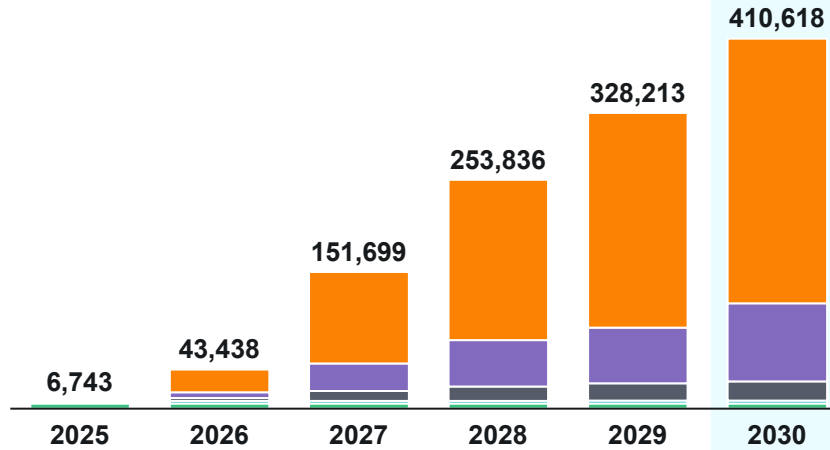
- **Explosive growth in large load requests:** after relatively low and stable activity through 2023–early 2024, requests surged sharply starting in late 2024 and accelerated further in 2025–2026
- **2026 sets a new peak:** latest quarter (~200 requests) represents an order-of-magnitude increase vs. historical levels, signaling unprecedented pressure on the system

Large Load Interconnection requests: projected demand

Note: as of March 26, 2026

Load by year and project status, MW

- No Studies Submitted
- Under ERCOT Review
- Planning Studies Approved
- A2E but not operational
- Observed Energized

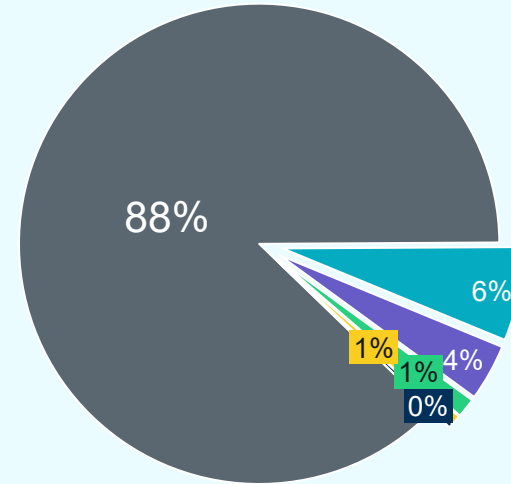


Project Status

Project Status	2025	2026	2027	2028	2029	2030
No Studies Submitted	0	25,253	101,702	177,879	238,188	293,651
Under ERCOT Review	0	6,478	30,539	51,315	61,966	86,605
Planning Studies Approved	30	3,181	10,739	15,923	19,040	21,343
A2E ¹ but not operational	935	2,748	2,941	2,941	3,241	3,241
Observed Energized	5,778	5,778	5,778	5,778	5,778	5,778
Total (MW)	6,743	43,438	151,699	253,836	328,213	410,618

2030 load by segment, %

- Data Center
- Other
- Crypto
- Industrials
- Data Center/Crypto
- Hydrogen



Key Takeaways

- **Massive pipeline of demand (~410 GW by 2030):** ERCOT is facing unprecedented load growth, with demand increasing ~6x 2025 to 2030
- **Pipeline is largely immature:** ~70% of projected load has no studies submitted, indicating high uncertainty and speculative demand
- **Data centers dominate demand** the surge is driven by hyperscale data centers, with other segments remaining marginal

1. Approved to Energize

Transition to a batch process is enabled by structured stakeholder engagement and governance



Broad-based stakeholder input for initial design

Extensive stakeholder outreach (interviews, workshops, surveys, public comments) **to identify key issues in the current process and inform the initial design** of Batch Zero PGRR145



Iterative refinement through stakeholder workshops

Vetting and refinement of initial proposal through stakeholder workshops, testing key elements and incorporating stakeholder feedback to ensure a robust and implementable design



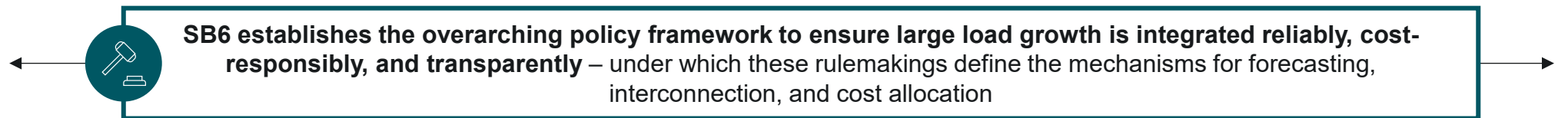
Formal ERCOT governance and approval

Progression through ERCOT governance (PRS, ROS, TAC, Board) and PUCT review, ensuring alignment, technical validation, and approval for implementation

PUCT rulemakings under SB6 are reshaping how large loads are planned, interconnected, and paid for

Relevant PUCT Projects

	No. 58480 – Large Load Forecasting Criteria	No. 58481 – Large Load Interconnection Standards	No. 58479 – Co-location / Net Metering	No. 58484 – Transmission Cost Recovery
Description	Establishes standardized requirements for how large load forecasts are developed and incorporated into ERCOT planning processes	Defines requirements for interconnecting large loads , including financial commitments, study requirements, and reliability criteria	Rulemaking governing arrangements where large loads are co-located with existing generation resources	Evaluates how transmission costs (including those driven by large loads) are recovered and allocated across customers
Why it matters for LLIS..	<ul style="list-style-type: none"> Determines which loads are considered “real” vs. speculative in studies Directly impacts planning assumptions and transmission sizing Reduces risk of over-forecasting (stranded or misallocated infrastructure) 	<ul style="list-style-type: none"> Sets entry criteria for studies Introduces financial commitment as a filter Drives standardization of the interconnection process, addressing inconsistency across TDSPs Core enabler of batch process design and eligibility 	<ul style="list-style-type: none"> Protects system from impact of loss of existing generation due to a new net metering arrangement Requires ERCOT study <i>after</i> load interconnection studies ERCOT may recommend and the PUCT may adopt certain operating conditions 	<ul style="list-style-type: none"> Determines who pays for transmission upgrades Critical to avoiding cost socialization to only residential and commercial ratepayers
Rulemaking stage	Rule effective	Public comment period	Rule effective	Project initiation



Incorporating PUC Project 58481 into Batch Zero: Two Implementation Pathways

Current PGRR145 option

Context

Project 58481 will define readiness and financial commitment standards for Large Loads. ERCOT must determine how to align Batch Zero timing with this rulemaking



Option

Option 1: Replicate the Draft 58481 PFP in the PGRR (proceed in parallel)

Description and implications

Description: embed the PUCT proposal for publication (Project No. 58481) concepts directly into the PGRR language and update the PGRR with the published PFP once available

Implications

- Enables earlier Batch Zero launch
- Uses proposed draft for intermediate agreement and interconnection agreement criteria
- Risk of misalignment if final rule differs from draft

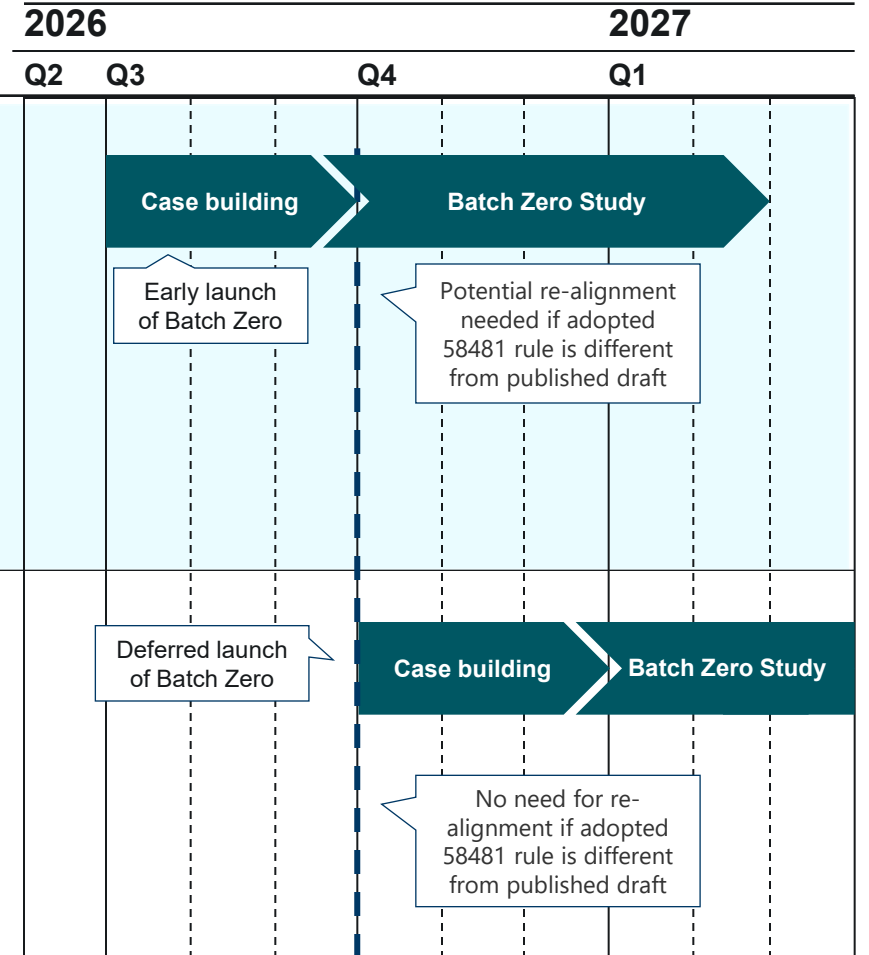
Option 2: Tie PGRR to Final Adopted 58481 Rule (sequential alignment)

Description: draft PGRR to reference the final adopted 16 TAC §25.194 and begin Batch Zero a defined period (e.g., X days) after the rule becomes effective

Implications

- Batch Zero will be aligned with final PUC rule
- May delay Batch Zero start depending on rule adoption timeline

Illustrative timeline



Illustrative publication date of Project No. 58481

Agenda

Large Load Interconnection in ERCOT

What is a Batch process

What is the transitional Batch Zero process

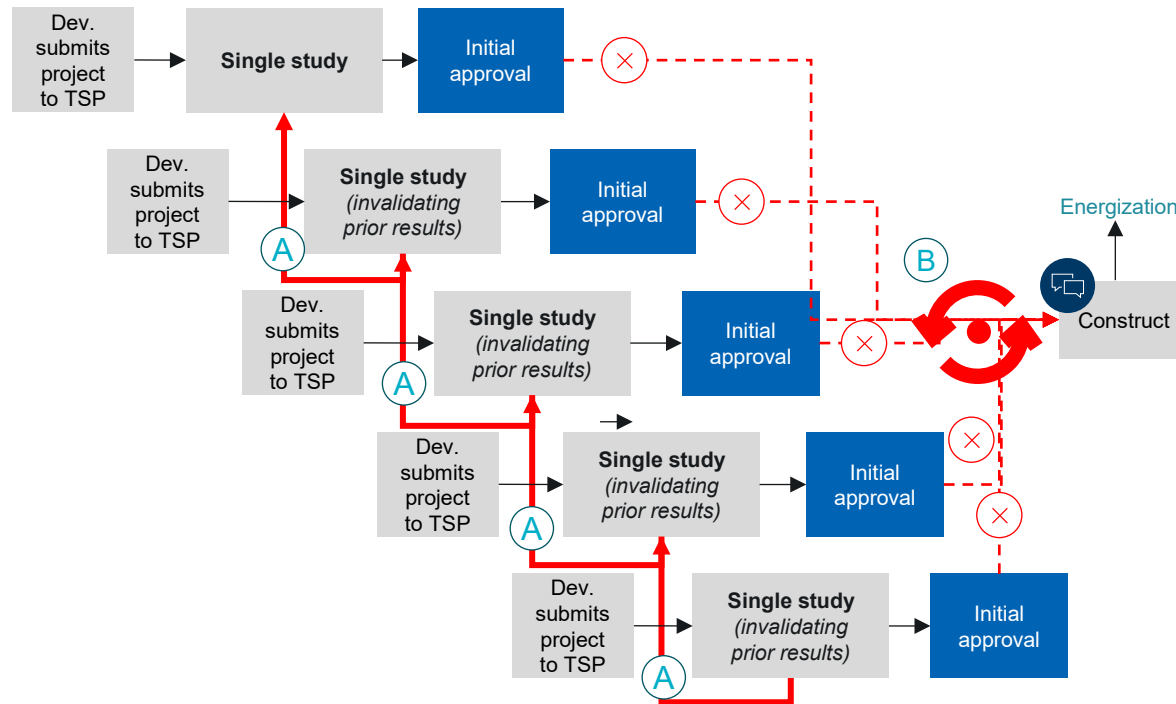
CLR and BYOG

Path to June Board

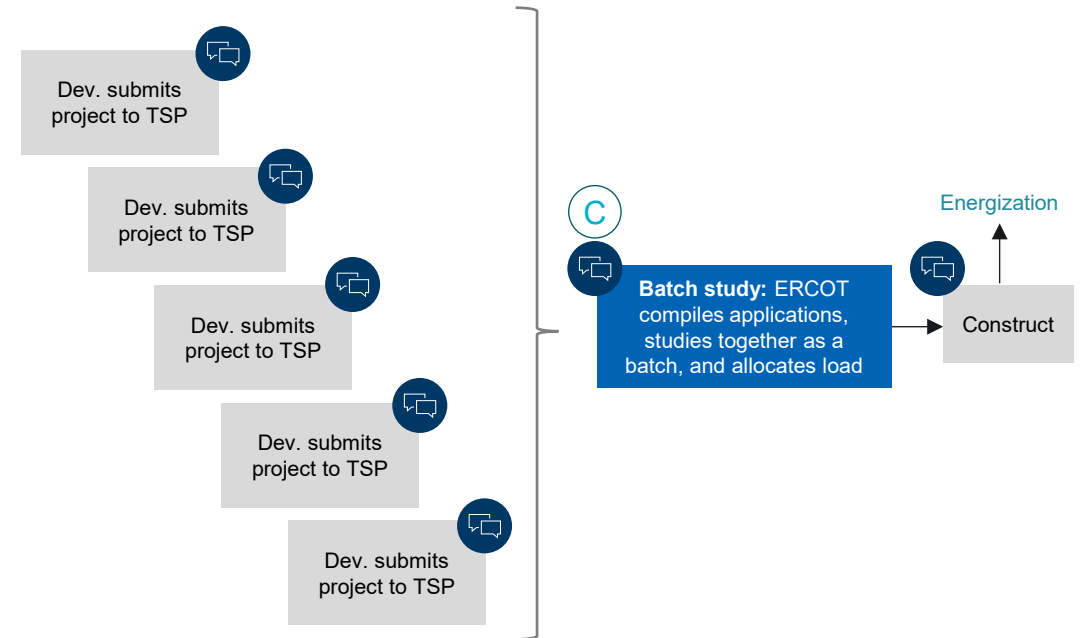
The batch study process increases outcome certainty and transparency while limiting restudy risk

Communication point
 Non-ERCOT action
 ERCOT action

From the existing single study process...

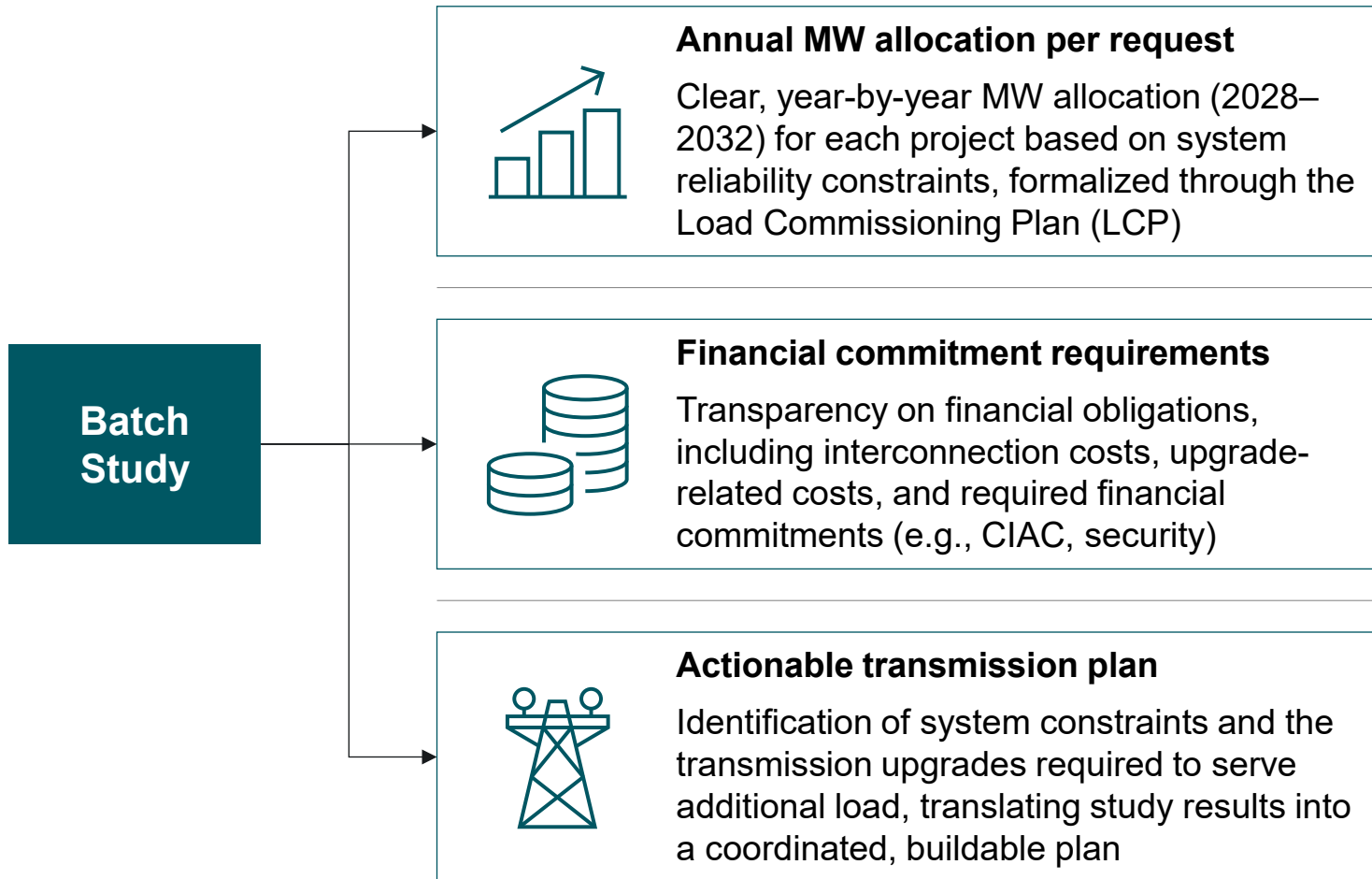


...to the new batch study process



- A Frequent restudies required**
 If another project impacts the same transmission zone, all previous studies are invalidated and impacted projects which haven't yet energized must be restudied
- B Restudy loop**
 In the absence of capacity reservation, projects can be repeatedly pulled into restudies as new requests enter the system, delaying approvals and potentially extending timelines by years
- C Batching process**
 Periodic, all submitted requests are clustered and studied together; allocated capacity coming out of the study is "reserved" to prevent restudies
- Transparent communications**
 Along with the new batch study process, ERCOT is redesigning the study communication process to have clearly defined touchpoints and transparent information handovers

A Batch Study delivers three key outputs to enable investment certainty and system reliability



Annual MW allocation per request
 Clear, year-by-year MW allocation (2028–2032) for each project based on system reliability constraints, formalized through the Load Commissioning Plan (LCP)

Financial commitment requirements
 Transparency on financial obligations, including interconnection costs, upgrade-related costs, and required financial commitments (e.g., CIAC, security)

Actionable transmission plan
 Identification of system constraints and the transmission upgrades required to serve additional load, translating study results into a coordinated, buildable plan



How SB6 objectives are enabled

Economic development: MW allocation and cost visibility provide the certainty developers need to proceed with investments while protecting ratepayers

System reliability: Actionable transmission plan aligns load growth with system capability and enables timely development of required upgrades to protect the grid

Agenda

Large Load Interconnection in ERCOT

What is a Batch process

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CLR and BYOG

Path to June Board

Batch Zero is a bridge between existing and new processes

Today

PGRR115

- Under PGRR115, projects are studied one-by-one, with each new request potentially triggering restudies and changing assumptions
- This fragmented approach limits coordination and creates backlog, delays, and uncertainty on available capacity

Transition

PGRR145/ Batch Zero

- **Batch Zero bridges the current and future processes by reassessing existing requests under a consistent, system-wide view and studying them together**
- It introduces coordinated studies, clear eligibility criteria, and produces phased load allocations/an actionable transmission plan
- It ensures projects can continue progressing while establishing the foundation for the future batch process and avoiding a transition “grey zone”

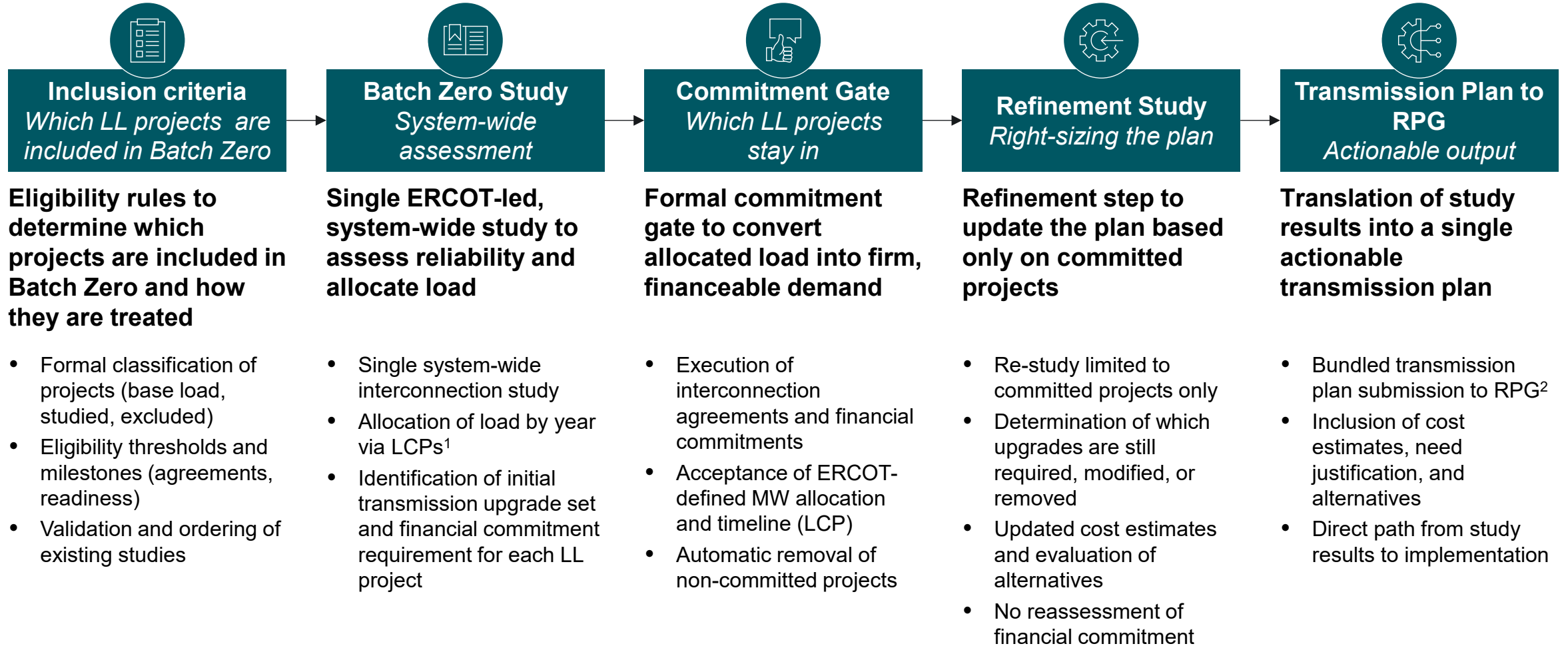
Future

PGRR(TBD) Batch Study Process

- **The future process studies projects in batches, enabling a system-wide view with consistent assumptions and direct linkage to transmission planning**
- This creates a more scalable, transparent, and predictable interconnection framework

PGRR145 defines Batch Zero as a structured process from screening to actionable transmission plan







Batch Zero PGRR145 Building Blocks



1. Load Commissioning Plan | 2. Per NPRR1325

Batch Zero categorizes loads based on readiness, defining MW certainty and timing

ILLUSTRATIVE

Batch Zero cluster	Description	Eligibility criteria	Illustrative allocation, MW
<p>Base Load</p> 	<p>Included as base load with MW effectively locked in, not subject to further study or reallocation</p>	<ul style="list-style-type: none"> Achieved initial energization or demonstrated near-term readiness Complete and valid interconnection studies Executed interconnection agreement Demonstrated site readiness and equipment procurement 	
<p>Studied Load</p> 	<p>Included in Batch Zero, with MW allocation determined through system-wide study based on system capability and reliability constraints</p>	<ul style="list-style-type: none"> Does not meet base load criteria Has executed an intermediate agreement Meets data submission and study requirements by deadlines 	
<p>Excluded Load</p> 	<p>Excluded from Batch Zero, receives no MW allocation, and must wait for a future batch</p>	<ul style="list-style-type: none"> Does not meet base load or study eligibility criteria Fails to provide required information by deadlines Next allocation opportunity: Batch 1 (expected March 2027) 	

Agenda

Large Load Interconnection in ERCOT

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CLR and BYOG

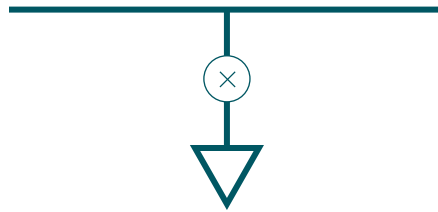
Path to June Board

Potential frameworks under consideration and refinement for addressing Dispatchable Load and BYOG (1/2)

▽ Load ⊗ Point of interconnection

Provisional Controllable Load Resource (CLR)

Illustrative scheme

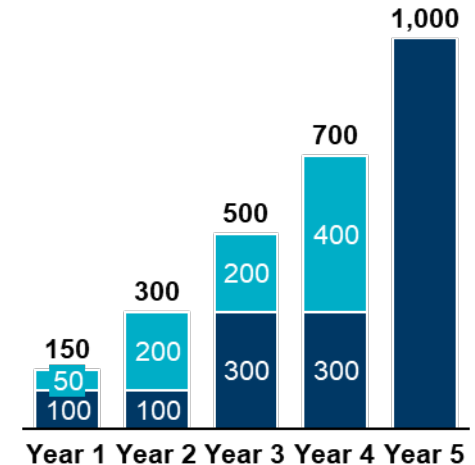


Description

- Large Load participates as a **Provisional Controllable Load Resource (PCLR)**, where a portion of load is firm (LPC) and the remaining load is flexible and subject to dispatch
- The PCLR framework enables Load to consume more energy in unconstrained hours of the day ahead of full transmission build-out, with firm MW defined in the Batch Zero study and non-firm MW managed through SCED

Details

- Split between firm and flexible load defined through the Load Commissioning Plan (LCP) (LPC = firm MW; remaining load operates as PCLR)
- PCLR participates as **dispatchable demand** and must follow SCED basepoints within its operating range
- Full requested load is studied in Batch Zero, with **transmission upgrades identified to transition PCLR to firm service over time**



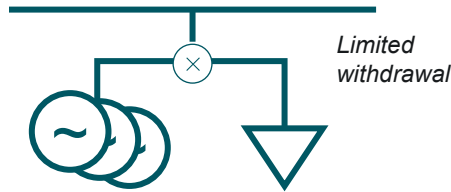
Potential frameworks under consideration and refinement for addressing CLR and BYOG (2/2)

PRELIMINARY

Generator
 Load
 Point of interconnection

BYOG Batch Self-Limiting Facility (SLF)

Illustrative scheme

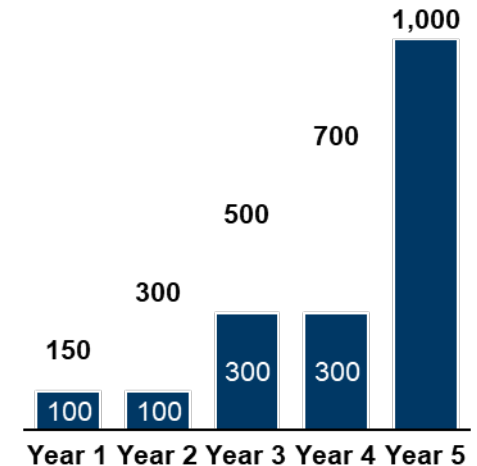


Description

- Site operates with a **fixed transmission withdrawal limit** determined through batch study

Details

- Generation mix may include thermal resources, renewables, and batteries
- A fixed transmission withdrawal limit is established (e.g., 100 MW grid import limit) determined in the batch study
- The **load and generation owners must coordinate operations** to ensure grid imports never exceed the limit
- **Transmission upgrades may be required** if identified by the batch study to meet reliability criteria



Agenda

Large Load Interconnection in ERCOT

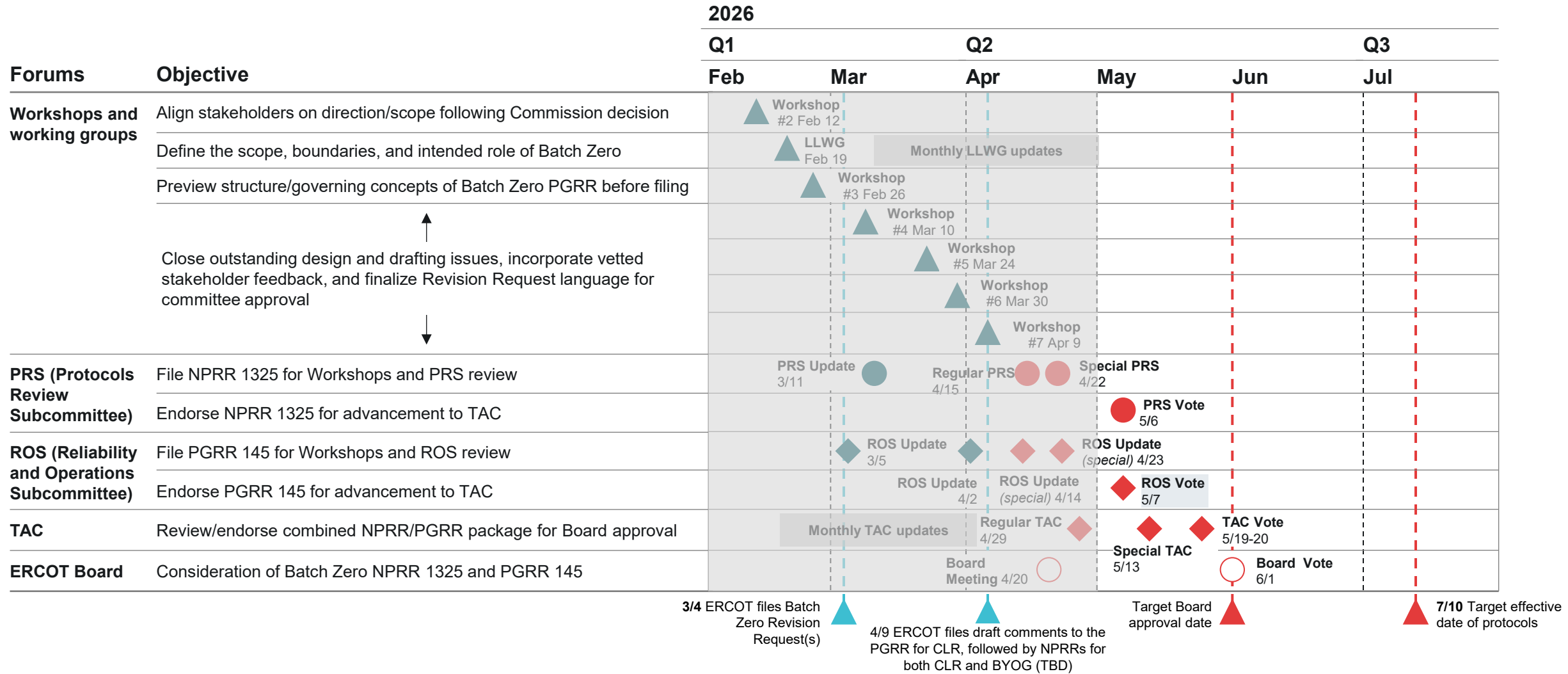
What is a Batch process

What is the transitional Batch Zero process

CLR and BYOG

Path to June Board

Batch Zero Revision Request Timeline



Operational Readiness for Data Centers

Scott Anderson, Salt River Project

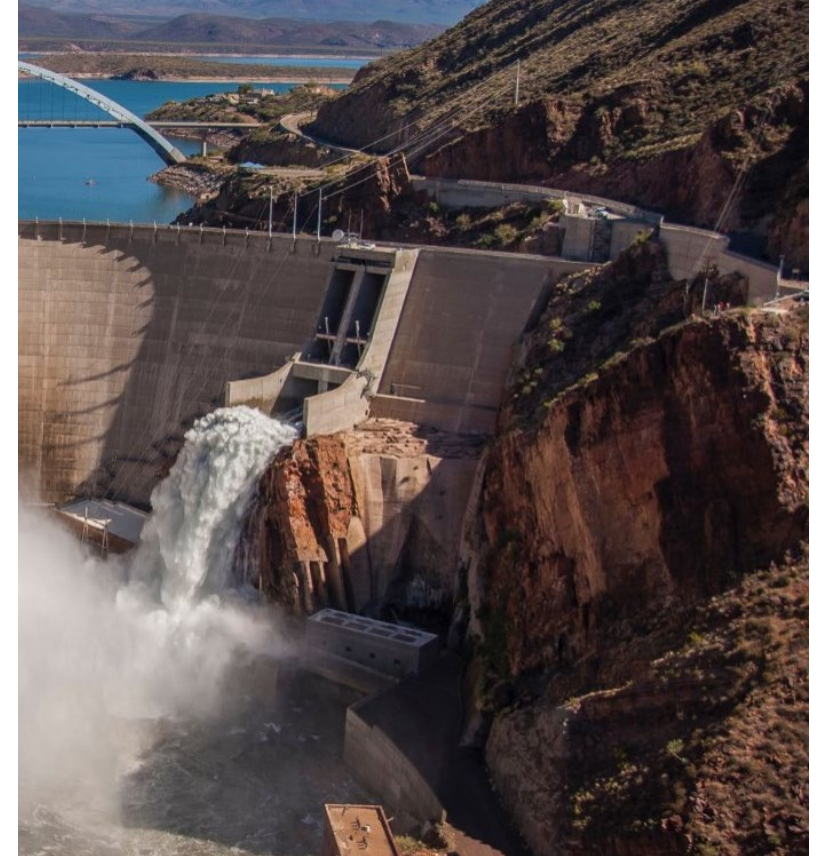
3-19-2026

Outline

- SRP History and Governance
- Defining Operational Readiness (OpR) – It started with IBRs
- Data Center Readiness Challenges and Strategies
- Interconnection Requirements First Revision at SRP
- Key Industry Partnerships

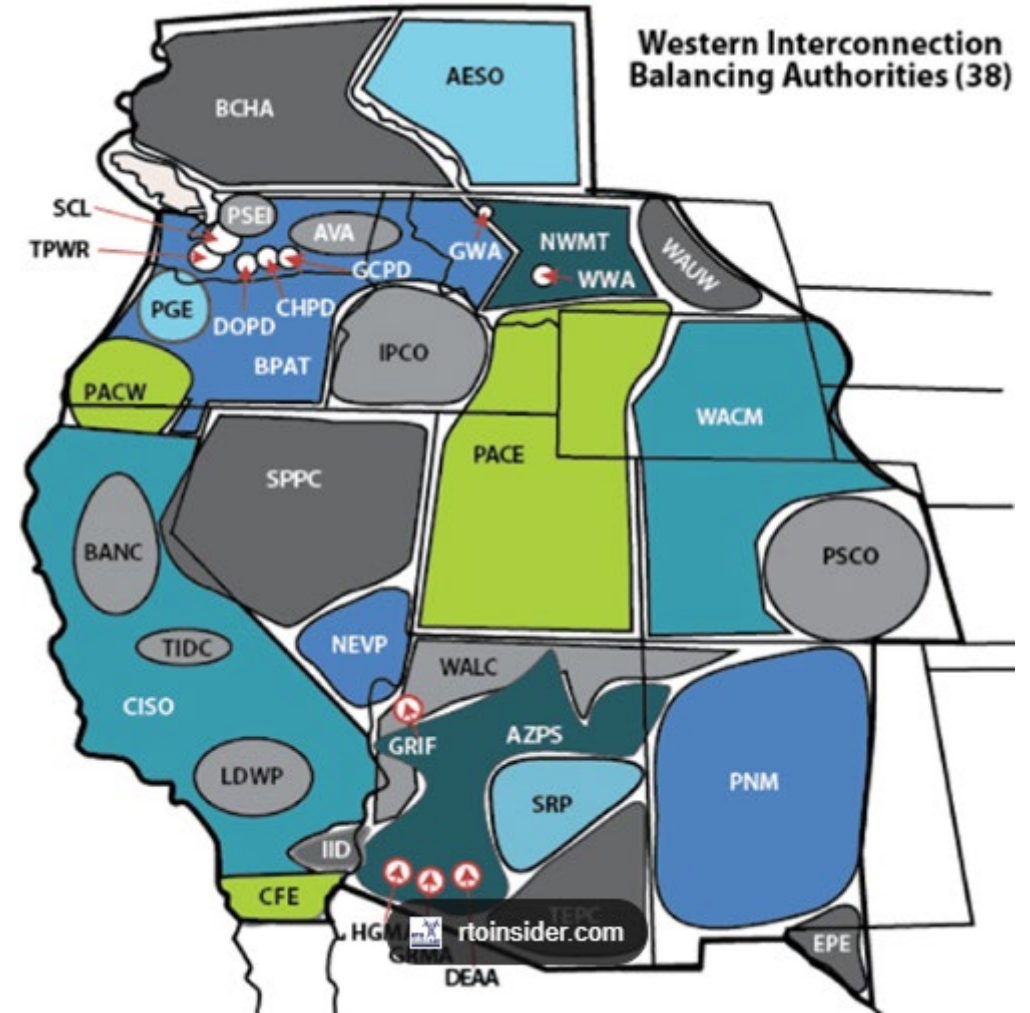
SRP History

- One of the nation's largest **public power** utilities
- Vertically integrated
- SRP wears many **NERC functional entity hats**
 - Balancing Authority
 - Generator Owner/Operator
 - Transmission Owner/Operator/Planner
 - Distribution Operator/Planner
 - Resource Planner



Place in the Western Interconnection

- SRP is one of 38 **Balancing Authorities** in the Western Interconnection
- SRP is a member of the CAISO Energy Imbalance **Market** (transitioning to Southwest Power Pools Markets + in October 2027)
- **Reliability Coordinator** is RC West (transitioning to Southwest Power Pool in October 2027)



Source: RTO Insider
Boundaries are not exact – for illustrative purposes only

How SRP is Governed and Regulated

- **Locally governed** by an elected board and council
- **Non-FERC Jurisdictional**
 - SRP does not meet the statutory requirements under the Federal Power Act
 - Exempt from FERC rate regulation and tariff oversight
 - SRP is subject to NERC regulation – Reliability is mandatory! (Energy Policy Act of 2005)
- **Arizona Corporation Commission (ACC)**
 - ACC regulates investor-owned utilities under the Arizona Constitution
 - SRP retail rates and resource plans are approved by SRP Board, not the ACC
 - All major power plants and transmission lines must obtain a Certificates of Environmental Compliance (CEC) from the ACC

Operational Readiness at SRP (OpR)

- **Operational Readiness** is the capability for SRP to operate the future grid **safely, reliably, and cost-effectively** as variable resources are added
- **Operational Readiness Strategy**
 - Clearly and accurately represents what SRP needs to do to operate this new future grid
 - Address the **who, what, where** and **why** with an emphasis on systems, processes and tools

May 03, 2021







SRP to more than Double its Utility Scale Solar to 2,025 Megawatts by 2025

Salt River Project today announced plans to more than double its 2025 utility-scale solar commitment to now add a total of 2,025 megawatts (MW) of new utility-scale solar energy to its power system by the end of fiscal year 2025, driven in part by dedicated customer demand for new renewables. This is more than 1,000MW beyond SRP's original 2025 commitment of 1,000MW, [announced](#) in November 2018. As part of this 1,025MW solar increase, 450MW is enabled by an SRP commercial customer to meet its renewable energy commitments. All the renewable energy purchased is expected to be from solar energy developments built in Arizona or on the Navajo Nation and will ultimately be used by SRP commercial and residential customers.

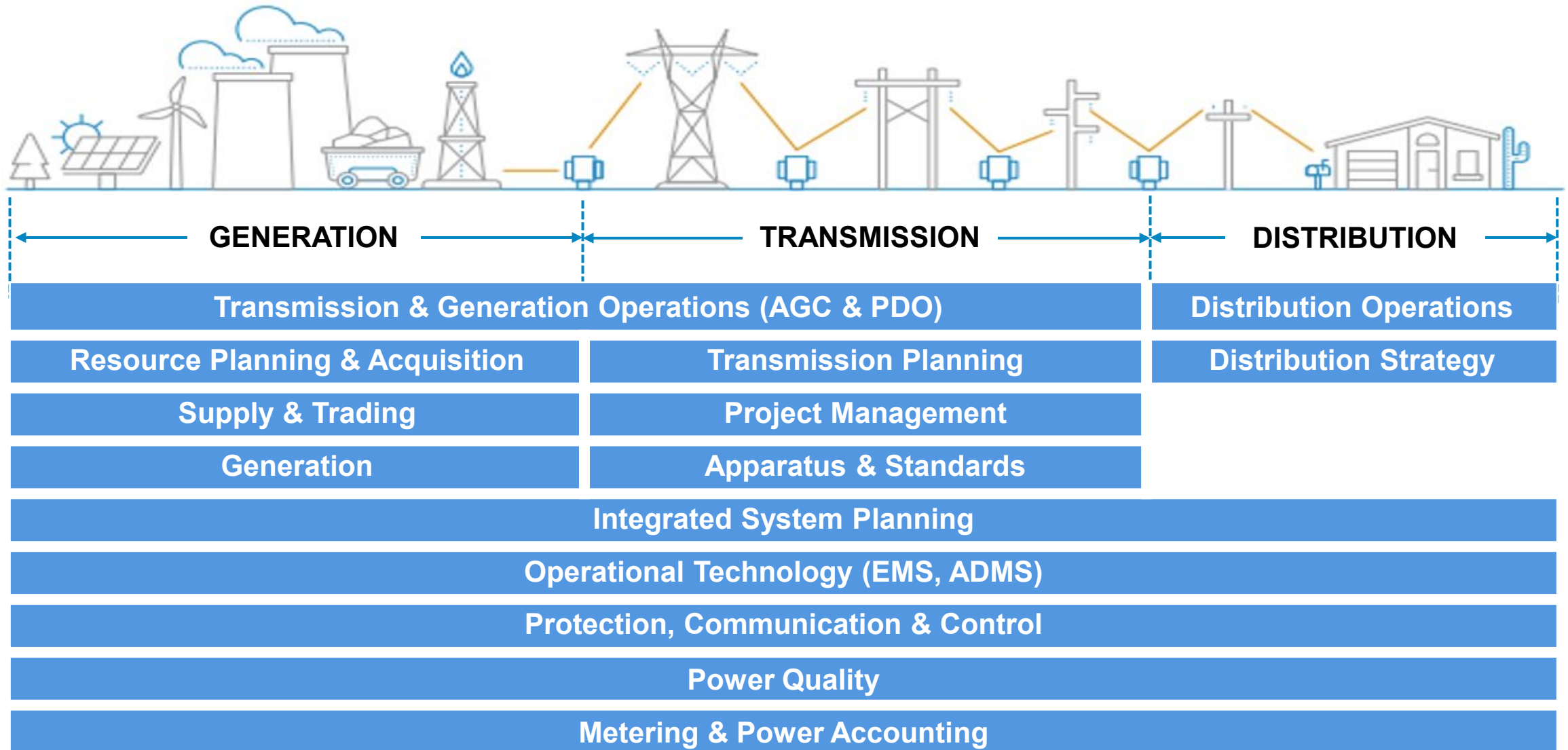
"As we plan for our customers' increasing need for energy and their desire for a cleaner environment, solar energy is a key solution that is significantly growing our sustainable generation portfolio," said SRP's CEO and General Manager Mike Hummel. "Doubling solar purchases over the



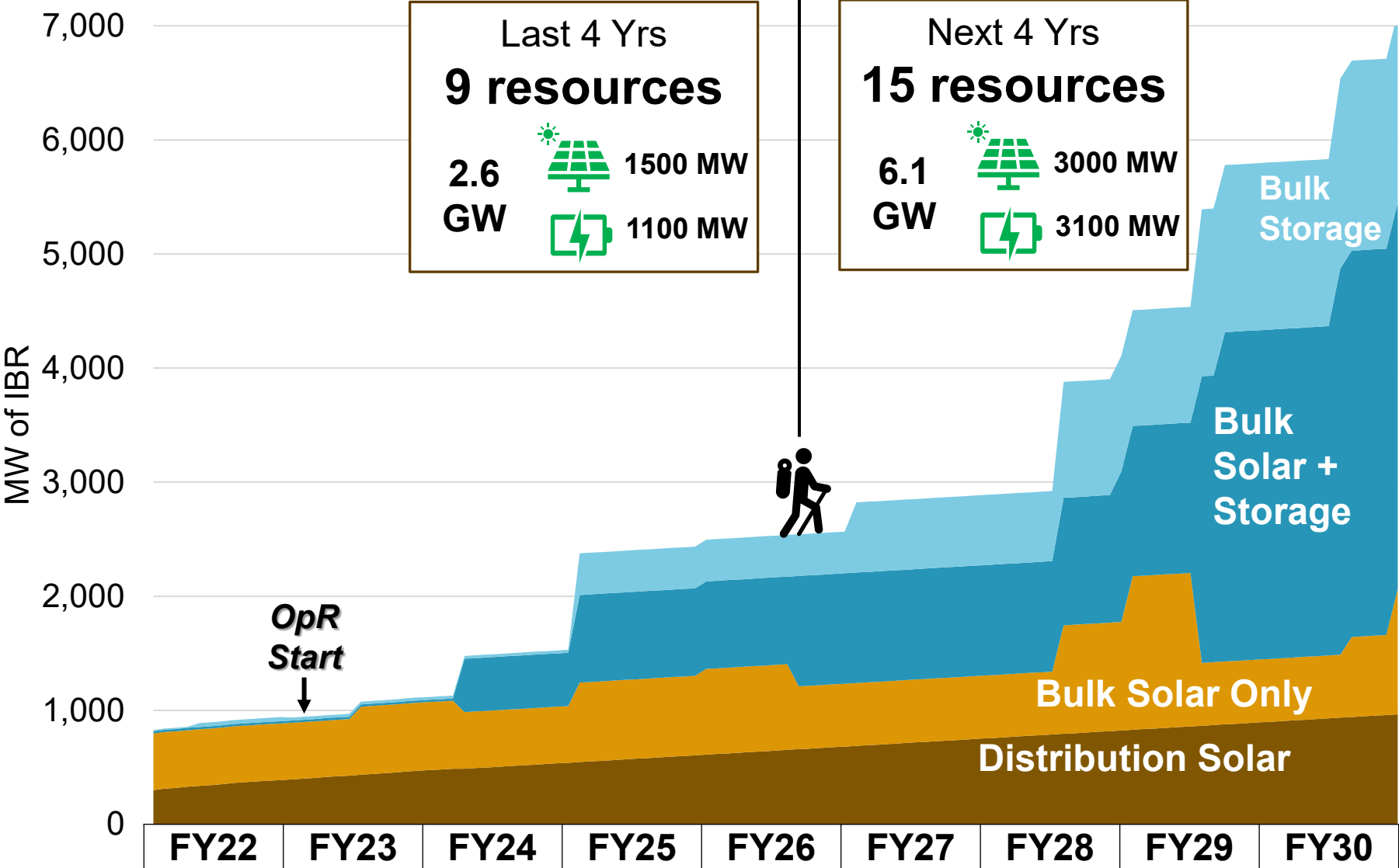
Operational Readiness Projects Today

<ul style="list-style-type: none"> ✓ 1A Bolster testing ✓ EMS Enablement ✓ 1C/D EMT modeling ✓ 2A/B PPA improvements ✓ 11 TGO/DOC coordination ✓ 12B System Protection ✓ 23 Interconnection requirements 	 <p>Fully Leverage New Resource Capabilities</p>	<p>3 / 4 / 13 Value stream analysis*</p> <p>Q4FY26 89%</p>	<p>10 TGO renewables desk</p> <p>Q4FY26 70%</p>	<p>12A Inverter tech standards (Inc Grid Forming)*</p> <p>Q4FY27 65%</p>	<p>24 IBR tech & performance requirements</p> <p>Q4FY26 80%</p>	<p>27 IBR modeling improvements*</p> <p>Q1FY27 50%</p>
<ul style="list-style-type: none"> ✓ 8A IBR data & comms ✓ 8B Displays ✓ 9 Intra-hour solar variability ✓ 18 System power quality & inertia ✓ 19 EIM process & tools ✓ 20 Software ecosystem ✓ 22 Control issues/mitigation 	 <p>Software & Situational Awareness</p>	<p>17 Control room IBR video wall</p> <p>Q4FY26 99%</p>				
<ul style="list-style-type: none"> ✓ 14 Fleet ramping capability analysis 	 <p>Economic Dispatch with Solar + Storage</p>	<p>25 Metrics, contract compliance & settlements*</p> <p>Q1FY27 83%</p>				
<ul style="list-style-type: none"> ✓ 21 Improve IBR deployment (PPAs) 	 <p>Enabling Projects</p>	<p>26 IBR training*</p> <p>Q2FY27 25%</p>				
<ul style="list-style-type: none"> ✓ 6/7 Solar forecasting tools & integration ✓ 16 CAISO load forecasting 	 <p>Advanced Forecasting Tools</p>					
<ul style="list-style-type: none"> ✓ 5 Flex reserves & governance ✓ 15 System variability analysis 	 <p>Risk Adjusted Reserve Requirements</p>					

OpR has Enterprise-Wide Stakeholder Engagement



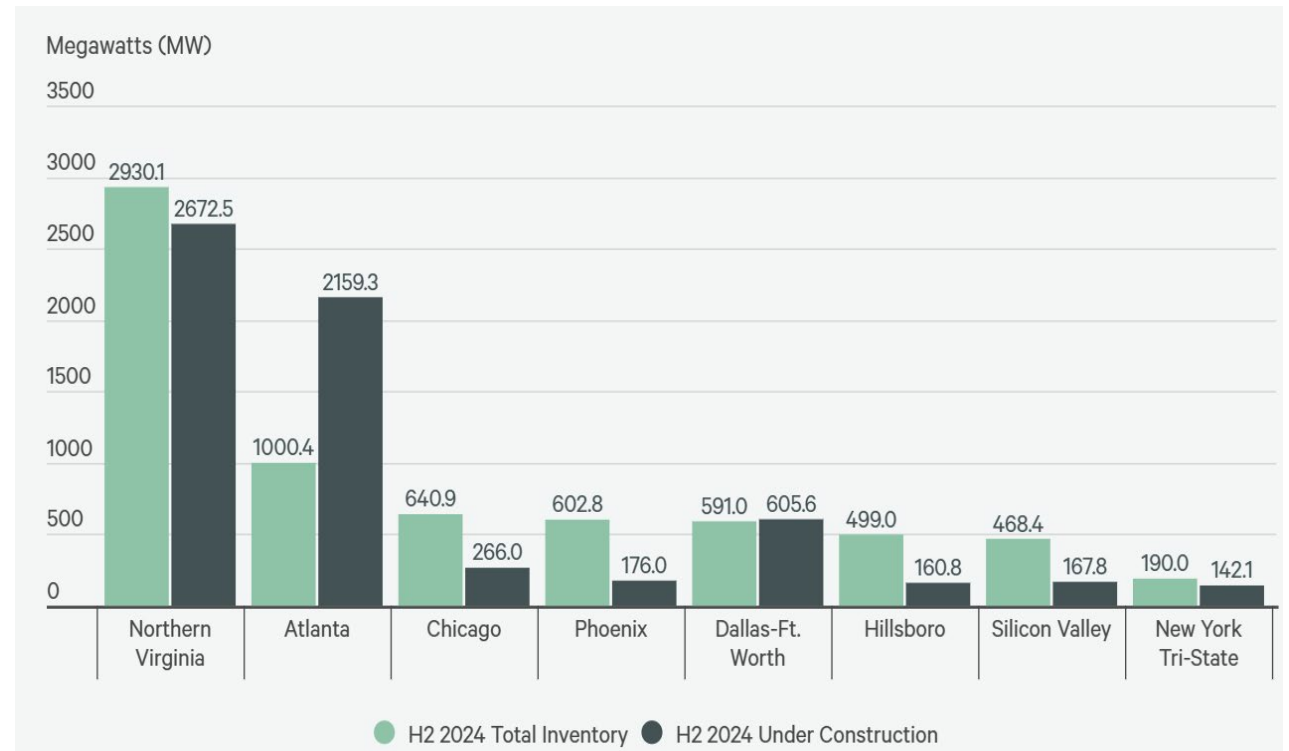
OpR Odyssey with IBRs



Data Centers are Here and Bring Unique Challenges

- Phoenix is a top 5 market
- Unique Challenges
 - Conceived and built quickly
 - Value high reliability and power quality
 - Can cause grid power quality issues and exacerbate grid fault recovery
 - Strong preference for clean energy
 - Artificial Intelligence loads are a game changer; massive load swings possible

Data Center Inventory & Under Construction (MW)



Source: CBRE

Clean Energy Partnerships

SRP Press Release

Meta Teams up with SRP and Ørsted to Support Data Center with Clean Energy from New Solar and Battery Project

Meta and SRP customers will benefit from the solar and stored energy from Eleven Mile Solar Center in Pinal County

December 11, 2023

300 MW 4-HR BATTERY STORAGE



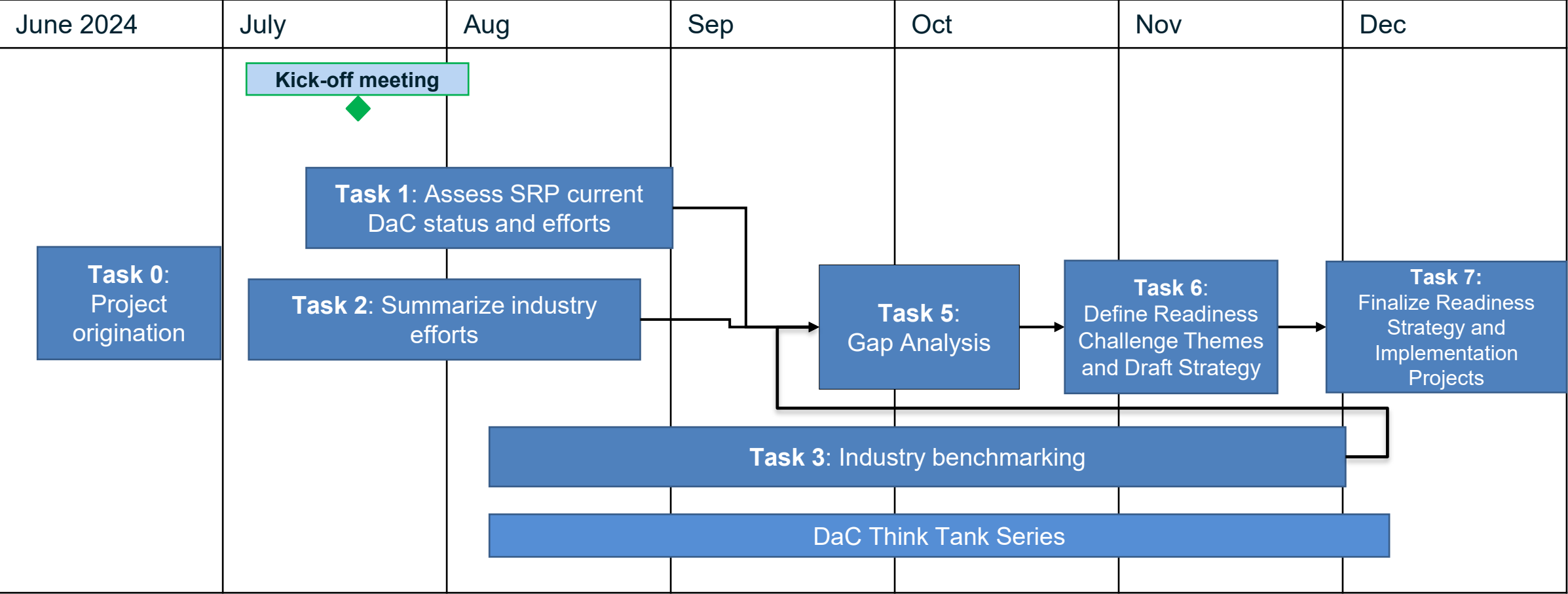
Source: Orsted

300 MW SOLAR

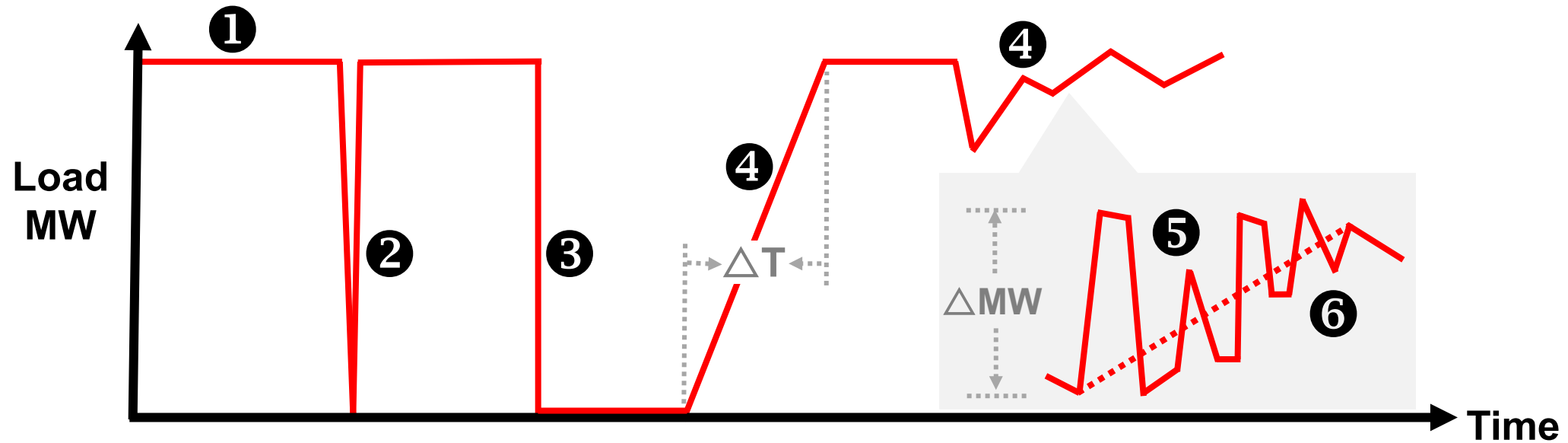


Source: Orsted

Development of the SRP Data Center Readiness (DCR) Strategy

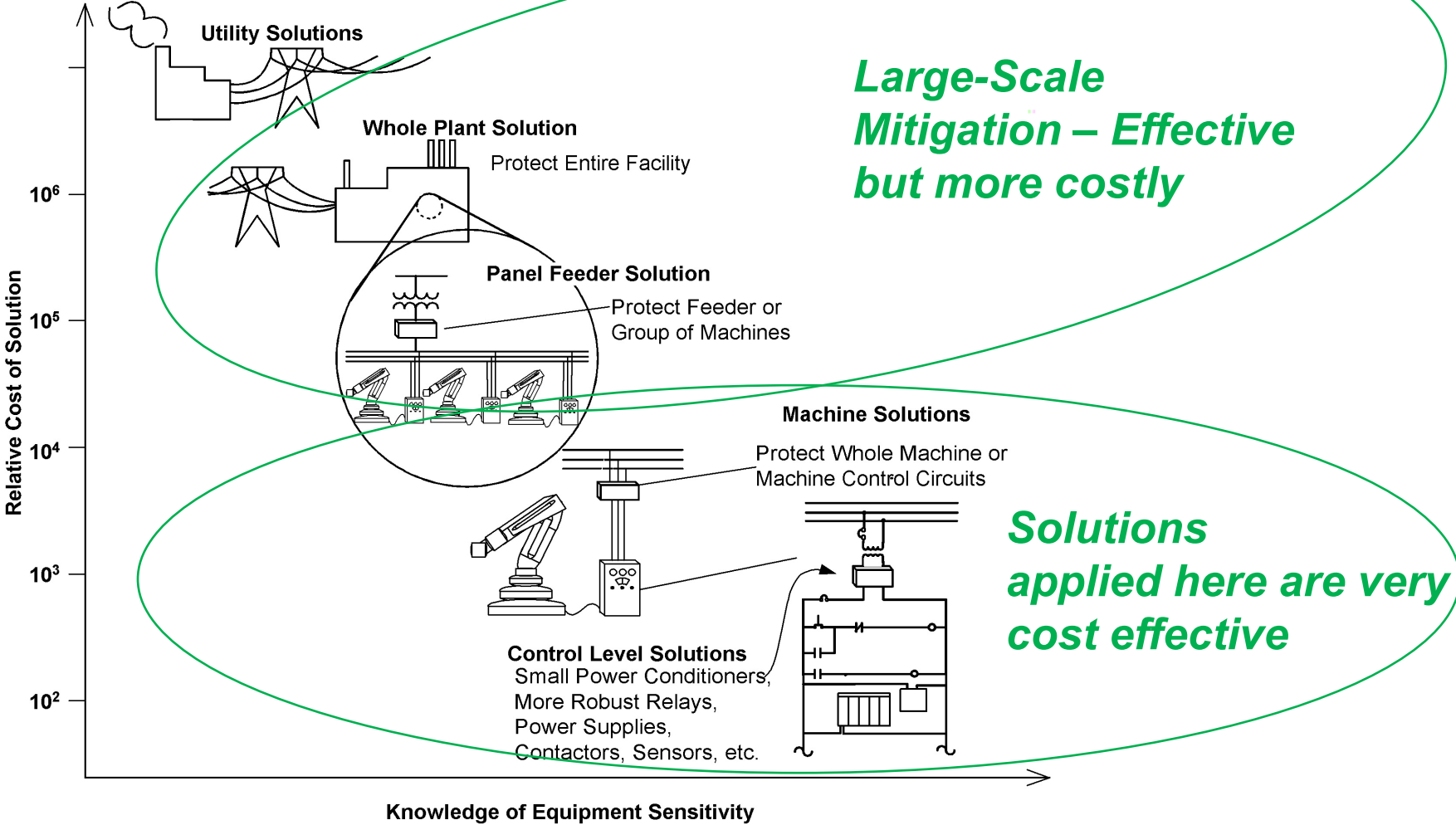


Task 5: Gaps in Serving Data Center Loads Reliably



- | | |
|---|---|
| 1 GW+ Loads: Unprecedented size and scale | Risk: Reduces generation and transmission adequacy |
| 2 Ride-Through: Load dropping out momentarily | Risk: Creates over-generation impacting stability |
| 3 Load-Loss: Loads drop for sustained periods | Risk: Introduces a new single-contingency loss of load |
| 4 Ramps: Slower MW up & down (min) | Risk: Increases cycling and wear on thermal generation |
| 5 Variability: Faster MW up & down (sec) | Risk: Exceeds system ramping and generation capability |
| 6 Oscillations: Fast sustained fluctuations (sub-sec) | Risk: Degrades system stability and risks asset damage |

Mitigation Solutions



Task 6 & 7: Strategy and Implementation Plan

CY25 Q4	CY26 Q1	CY26 Q2	CY26 Q3	CY26 Q4	CY27 Q1	FY27 Q2
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Jumpstart Project:
Sprint effort, large load requirements

Ride-through and Disturbance Response (RT): System analysis of load loss impacts to establish disturbance response and load modeling requirements for data center customers to prevent undesirable behavior. System analysis to identify oscillation risks to SRP synchronous generation fleet from large load operations.

Bulk System Balancing with Variable Large Loads (BA):
System visibility and balancing strategy that allows SRP to monitor and enforce data center active power variability and evaluate reserves practices to maintain system reliability and accommodate load variability.

Monitoring of Local Impacts (LI): A monitoring strategy for power quality, ride-through, power factor, and other local operational concerns for large customers that creates standard procedures and identifies SRP teams responsible for monitoring and enforcing performance requirements.

Oscillation Monitoring and Detection (OM): Development of a PMU-based monitoring strategy for detecting oscillations at large load customers, nearby synchronous generators, and throughout SRP's system. Development of procedures for regular data analysis and operator response.

Customer Interconnection Requirements & Process Documentation (IP): Integration of learnings from other projects into updated customer requirements and SRP study process; documentation of large customer interconnection process.

Draft project schedules, open to changes due to prioritization and resource constraints

DCR Jumpstart: Minimum Requirements

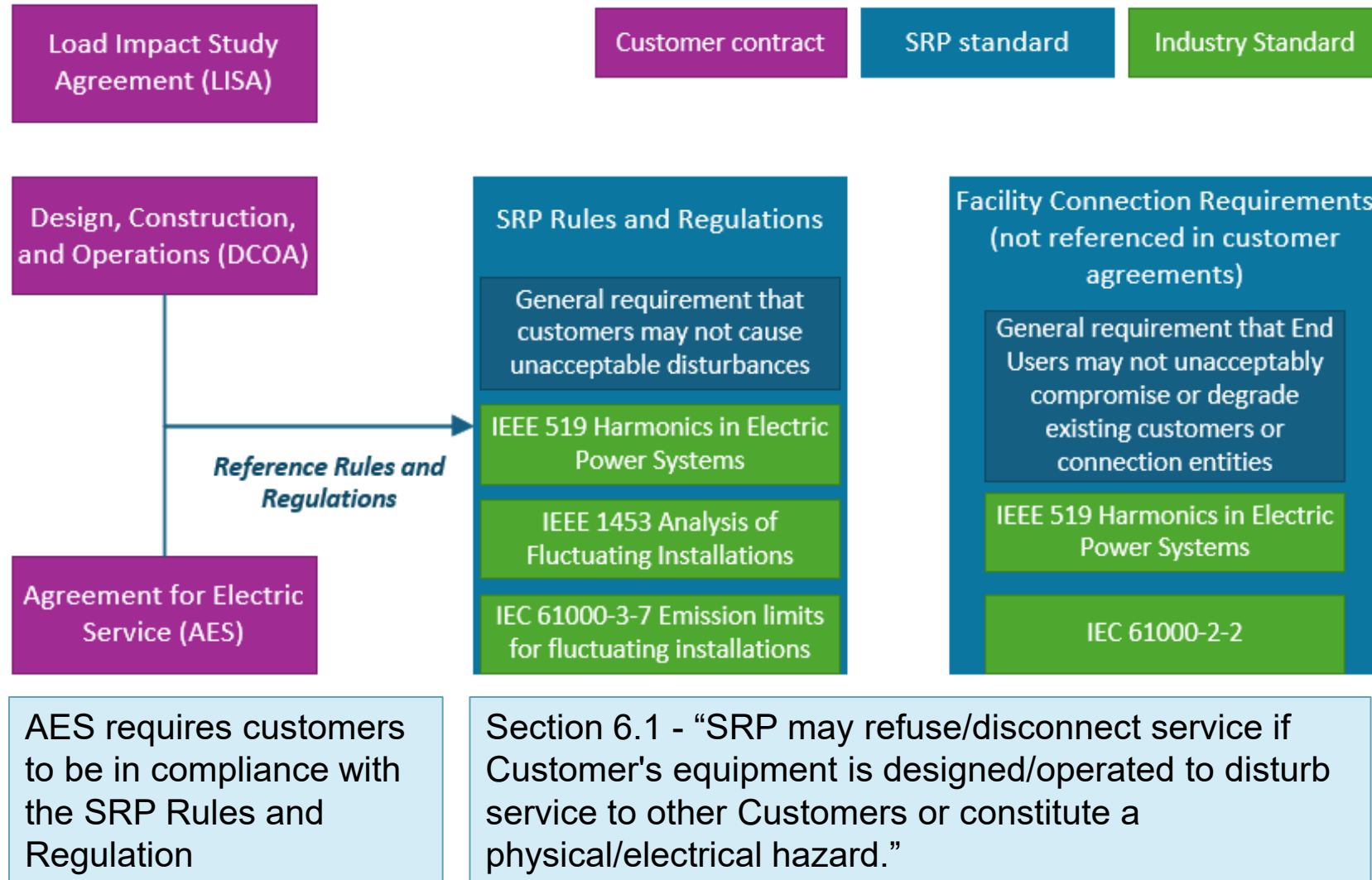
Project Manager/Lead Stakeholder: OpR

Participants: Econ Dev., ISP, PDE, SSP, SEM, TP, TGO, Dist. Perf., OTSS-GPC

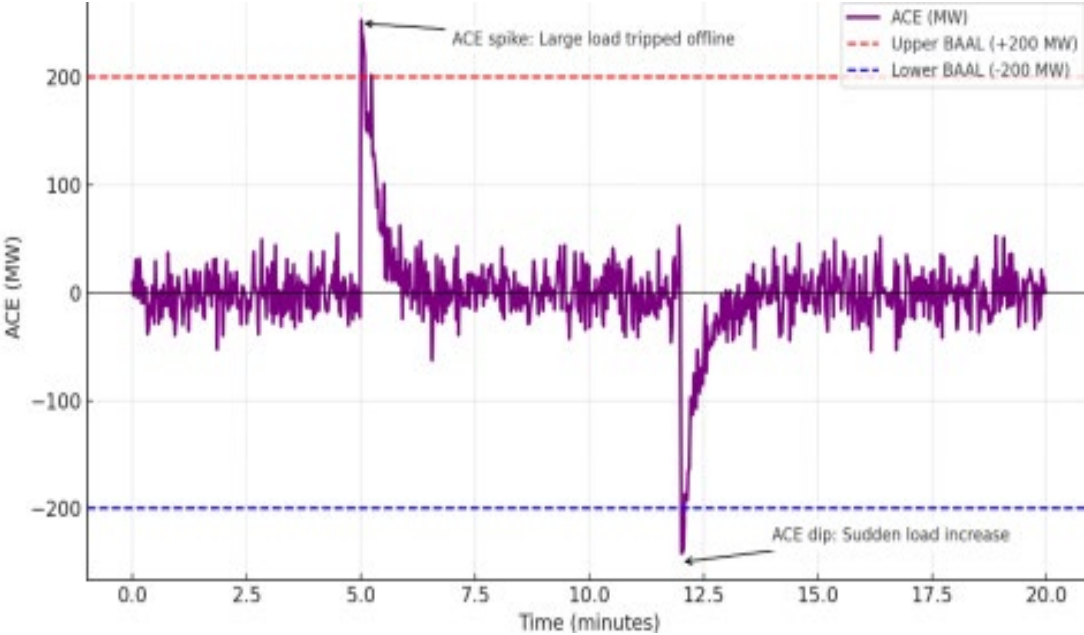
Project Tasks	CY 25				CY 26			
	1	2	3	4	1	2	3	4
1. Summarize the current interconnection process, requirements, and contracts that apply to large data center customers today at SRP. Document any changes to requirements that may be implemented as part of the Large Business Customer Strategy project.		■						
2. Identify relevant industry efforts (EPRI, ESIG, NERC LLTF, ASU) that SRP is already involved in or should consider working with and integrate learnings back into data center readiness program efforts.		■						
3. Determine if power quality and ride-through monitoring and oscillation detection for IBRs can be effectively utilized for monitoring data center customers.		■						
4. Document any new data center concerns that were not identified in the data center strategy development and determine additional minimum requirements that should be implemented for customers immediately.		■						
5. Create a framework for updating technical requirements as they evolve and are refined by other focused data center readiness projects.			■					
6. Review proposed data center readiness project scopes and implementation schedule and revise based on Jumpstart learnings.			■	■				

Outcome	Interim requirements implemented to protect grid reliability while more comprehensive data center requirements are developed.
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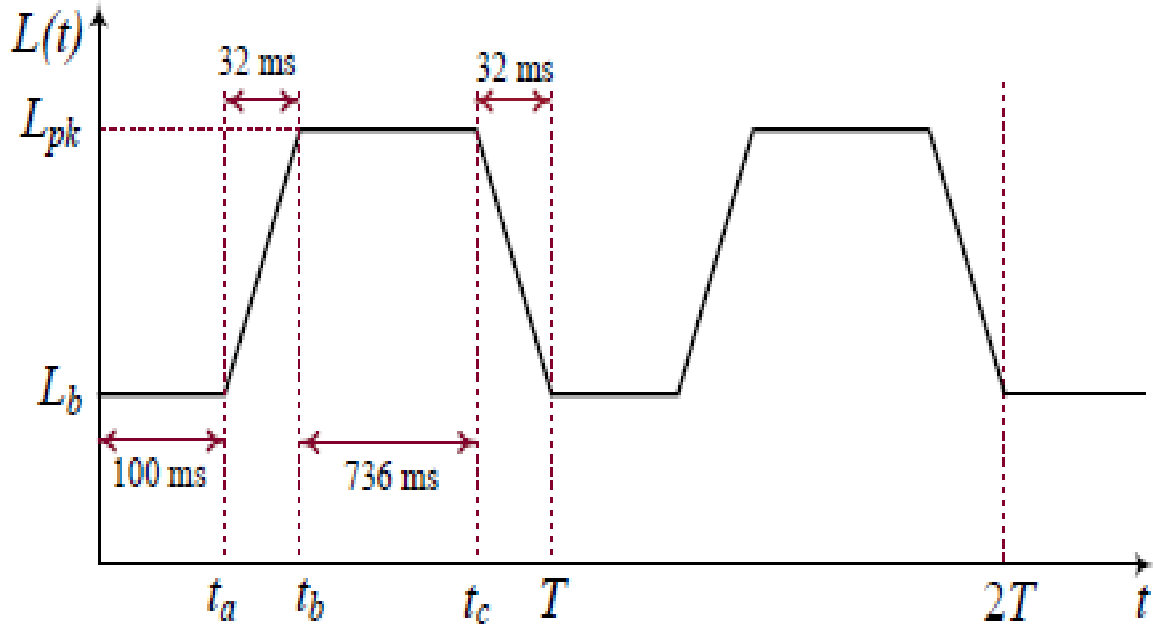
Surveying Customer Interconnection Requirements



Load Variability Impact on Reliability



ACE Variations Due to Large Loads (NERC)



Periodic Load Profile of a Typical AI-Based Data Center (RMS Energy)

Data Center Interconnection Requirements (1 of 2)

Requirement does not exist or is extremely insufficient

Requirement exists but may be insufficient or not monitored

Sufficient Requirement exists, is effectively enforced & monitored

Requirement	Previous	Today	Vision
Load Variability	No limits on operational ramping for customers	Guardrails on allowable ramp rates depending on ramp magnitude, non-binding customer load forecasts	Refined ramp rate limits & SRP balancing strategy; integration of customer load forecasts
Ride-Through (Voltage & Frequency)	No limits on customer disconnection and transfer to back-up power	Customers must coordinate protection and transfer settings with SRP	Ride-through standard specific to SRP system & impacts of data center disturbance responses are well understood
Power Factor	Minimum 0.85, SRP can request customer install corrective mitigation or pay for corrections if worse than 0.85	Work in progress to improve power factor	Require close to unity power factor at all times
Harmonics	Comply with IEEE Std. 519	Comply with current IEEE & IEC standards.	Jumpstart requirements align with most comparable utility interconnection requirements reviewed. Local Power Quality monitoring project will determine if different requirements are needed.
Voltage Disturbances, Flicker	Customer loads may not cause unacceptable voltage fluctuations, distortions to SRP system or other customers. SRP may require corrective equipment to be installed at Customer cost. Comply with IEC 61000-3-7 and IEEE Std. 1453	Customers are required to conduct a harmonics analysis and flicker study and provide results to SRP and install a meter that measures individual harmonics and total harmonic distortion.	

Data Center Interconnection Requirements (2 of 2)

Requirement does not exist or is extremely insufficient

Requirement exists but may be insufficient or not monitored

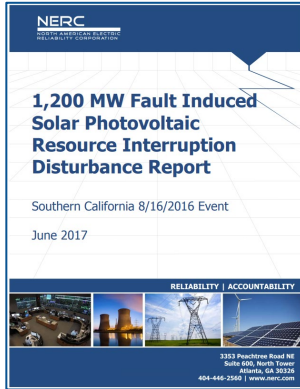
Sufficient Requirement exists, is effectively enforced & monitored

Requirement	Previous	Today	Vision
Monitoring Equipment	SRP PQMs are typically installed at the SRP substation XFMRs for large customers	PQM and PMU installation at Customer XFMR required	PQ monitoring and Oscillation monitoring projects will enhance these requirements if needed
Load Models	Customer provides forecasted monthly capacity & high-level load composition details, representative daily load profile	Representative load profile for data centers; Customer provides dynamic models to support EMT, transient, short circuit studies. Any material changes will be required to be shared w/SRP & accompanied with an updated model	Customer requirements will be updated with the outcomes of the Load Modeling & Interconnection Process project work

The Road to Developing Interconnection Requirements

Utility Scale IBRs

2016+



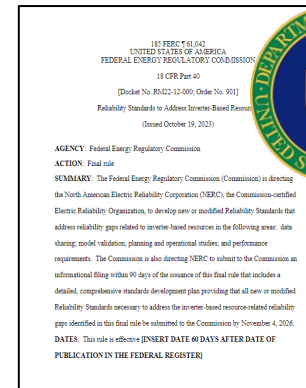
NERC Reports

2022



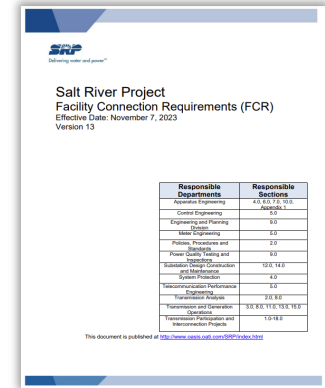
IEEE 2800

2023-2026



FERC Order 901

2024



SRP Requirements

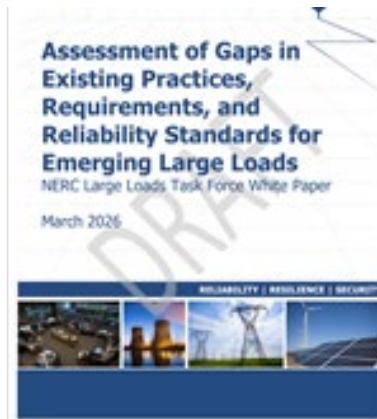
Data Centers Unknown timeline for industry requirements

2024



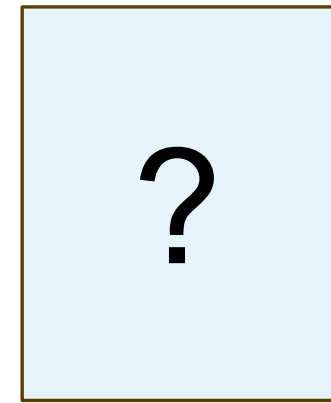
NERC Report: 1500 MW Load Loss Event

March 2026



Whitepaper: Risk Assessment and Requirements

?



SRP Requirements

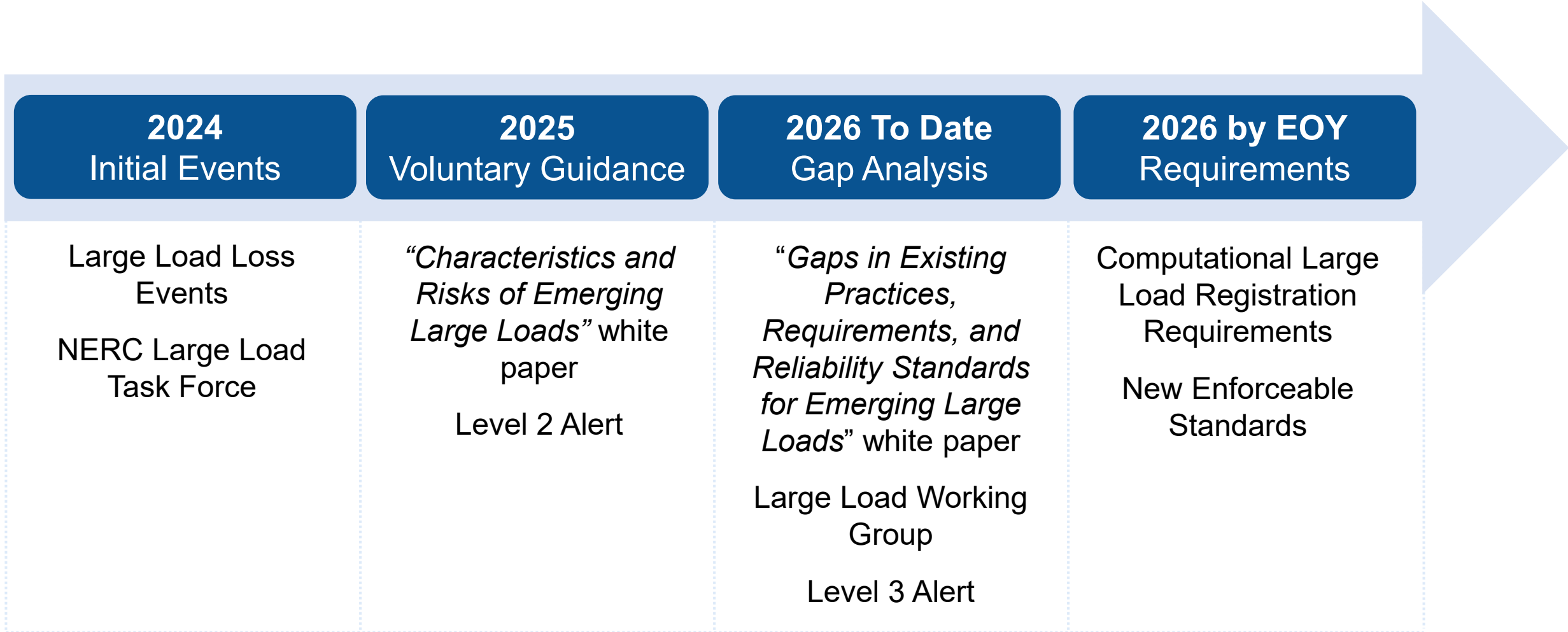
Industry Working Groups Supporting Data Center Readiness

A key part of Data Center Readiness is ensuring SRP is participating in industry activities to implement best practices for managing growing data center loads

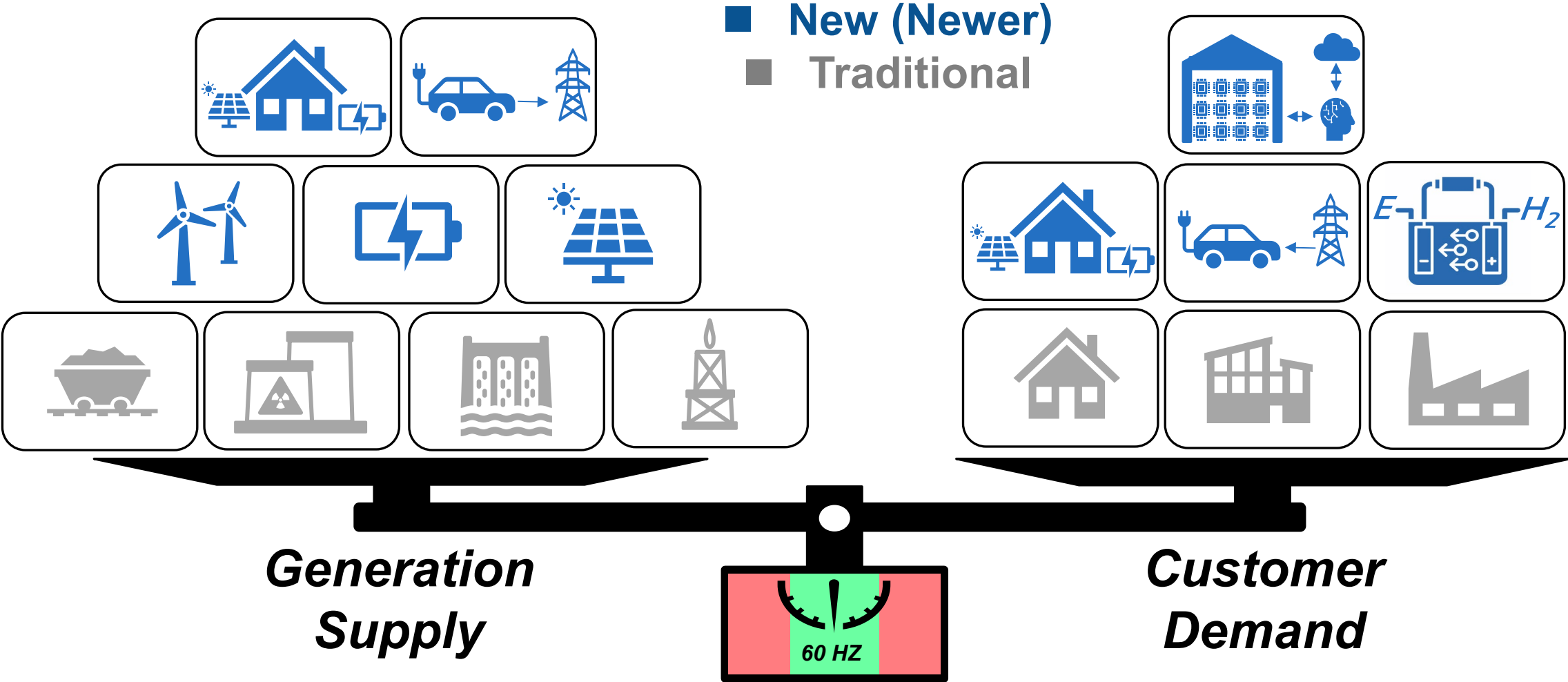
Industry Forum	Summary
ESIG Large Loads Task Force Working Groups	Composed of 8 working groups to focus on grid impacts, challenges, and solutions of large loads. DCR Jumpstart reps assigned to Interconnection Process, Interconnection Requirements, and Modeling working groups
EPRI DC Flex Strategic Advisory Committee	Project aiming to demonstrate how data centers can support and stabilize the grid and improve interconnection and efficiency.
NERC Large Load Task Force (now a Work Group)	Task force under Reliability and Security Technical Committee (RSTC) to better understand impacts (risks) of large loads.
NATF Reliable Addition of Large Datacentric Loads (RALDL)	An industry coordination effort to develop best practice guidelines for Data Centers which intends to publish in November 2025.

Regulatory Context at NERC

Information Sharing to Guidance to Enforcement in 2 years!



Loads Are Changing – So Is Our Generation



thank you!

Scott Anderson

Director Operational Readiness

Salt River Project

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