

# Interconnection and Integration of Large Loads

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# Southern Company

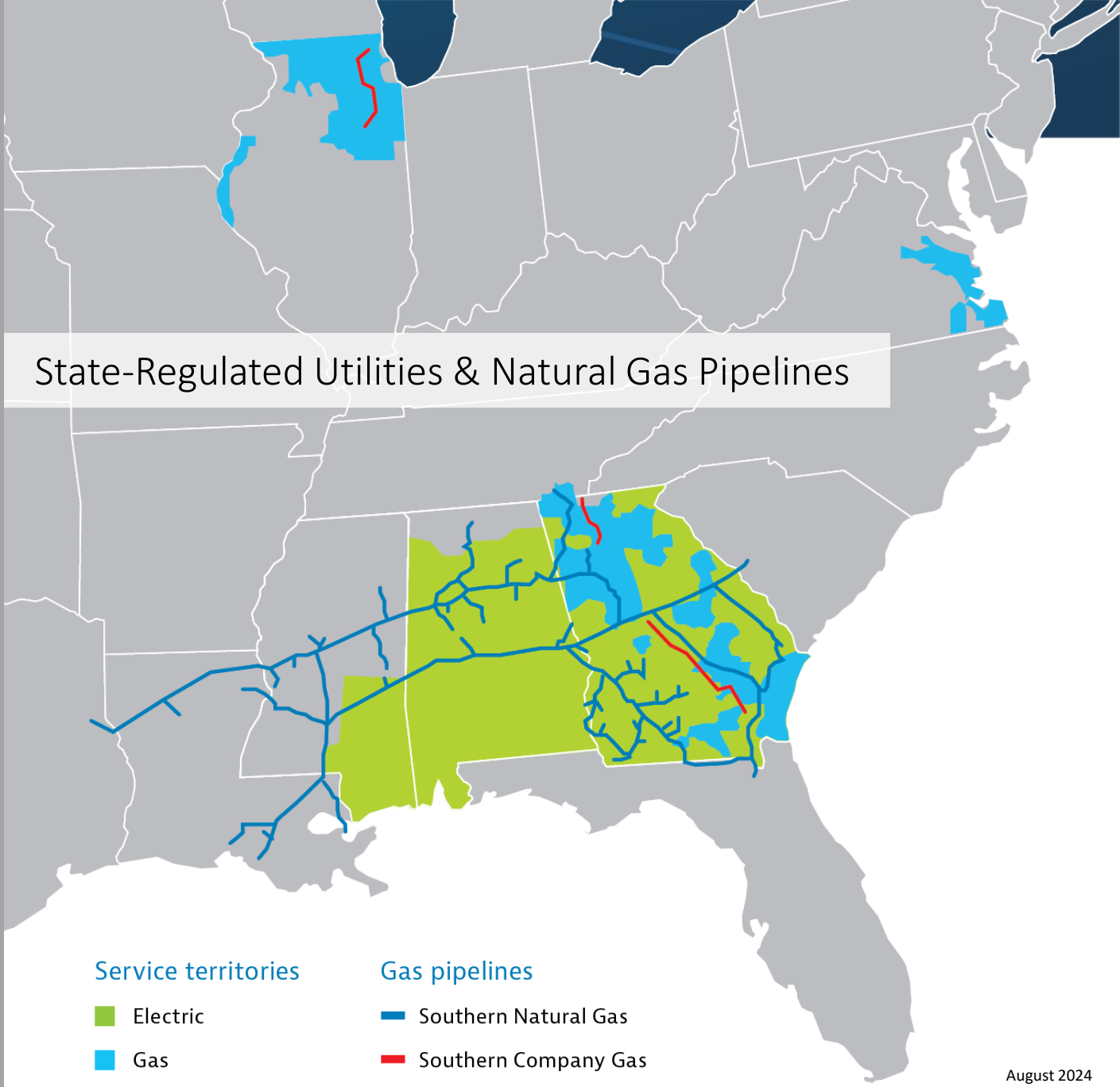
We provide clean, safe, reliable, affordable energy and customized solutions

**7**  
Electric &  
Natural Gas Utilities

**9 Million**  
Customers

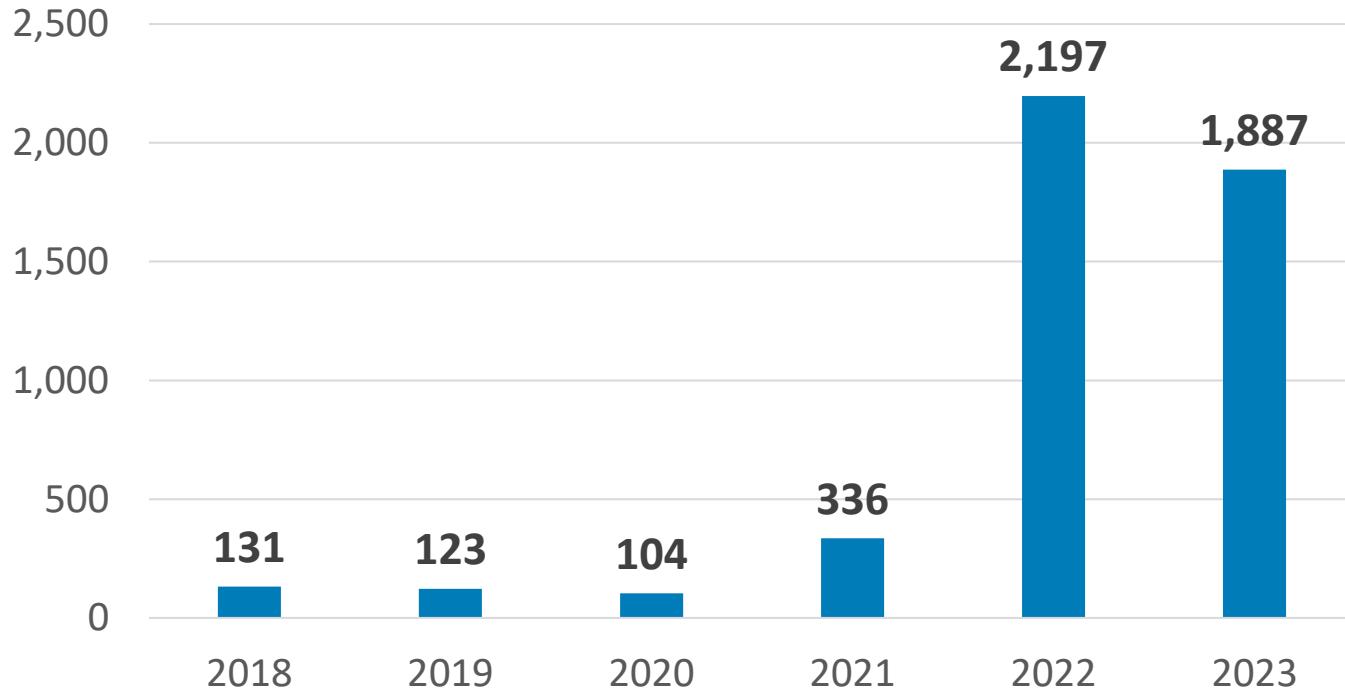
More than  
**28,000**  
Employees

Approximately  
**44,000 MW**  
of Generating Capacity



# Extraordinary Load Growth in Georgia

Load Growth from New Business (MW)



2022 IRP Final Order  
July 2022



**3,600 MW**

Customer Choice load wins since  
2022 IRP Final Order to 2023 IRP  
Update filing

Customer Type	Load Range Per Customer
Data Center	Up to ~1,500 MW
Industrial	Up to ~500 MW

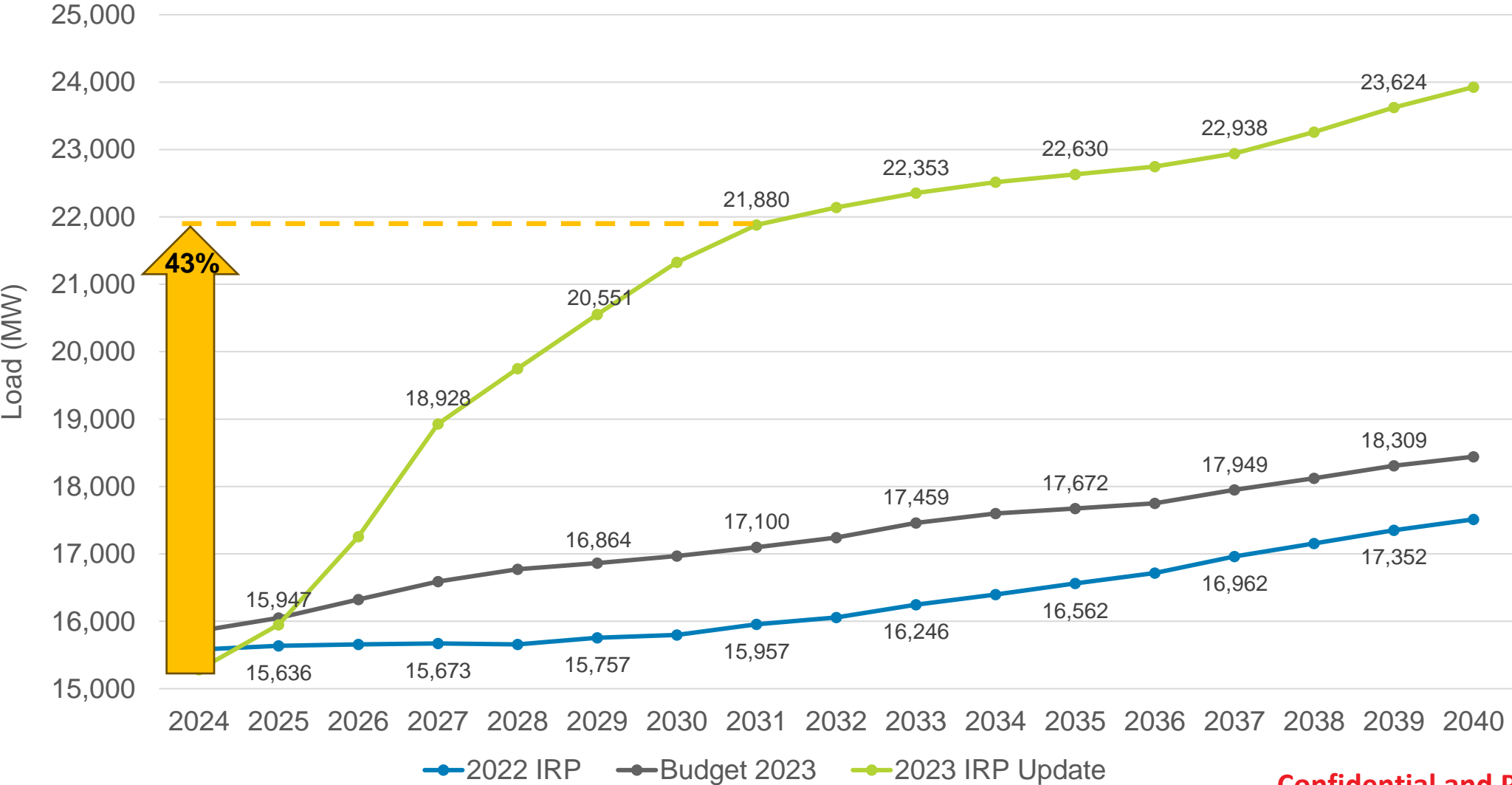
**2,600 MW**

Customer Choice load wins since  
2023 IRP Update filing through  
Summer 2024

Note: Load is reflective of contracts signed – 2023 reflects similar volume.

# Unprecedented Load Forecast Growth

Projected load growth in the 2022 IRP Filing was **less than 400 MW from 2024 to 2031**.  
Projected load growth in the 2023 IRP Update is **now 6,600 MW from 2024 to 2031** – **17 times greater increase**.



# 2023 IRP Update Outcome

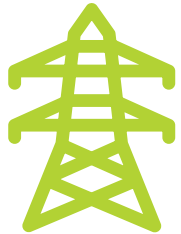


## Entire 3,303 MW Capacity Request Approved

- Includes PPAs, Battery Energy Storage Systems (BESS), Peakers, and DER programs

## Load Forecast Approved

Incremental revenue forecast for the large load customers will be set as a minimum estimate for years 2026-2028 ◦



## Transmission Approved

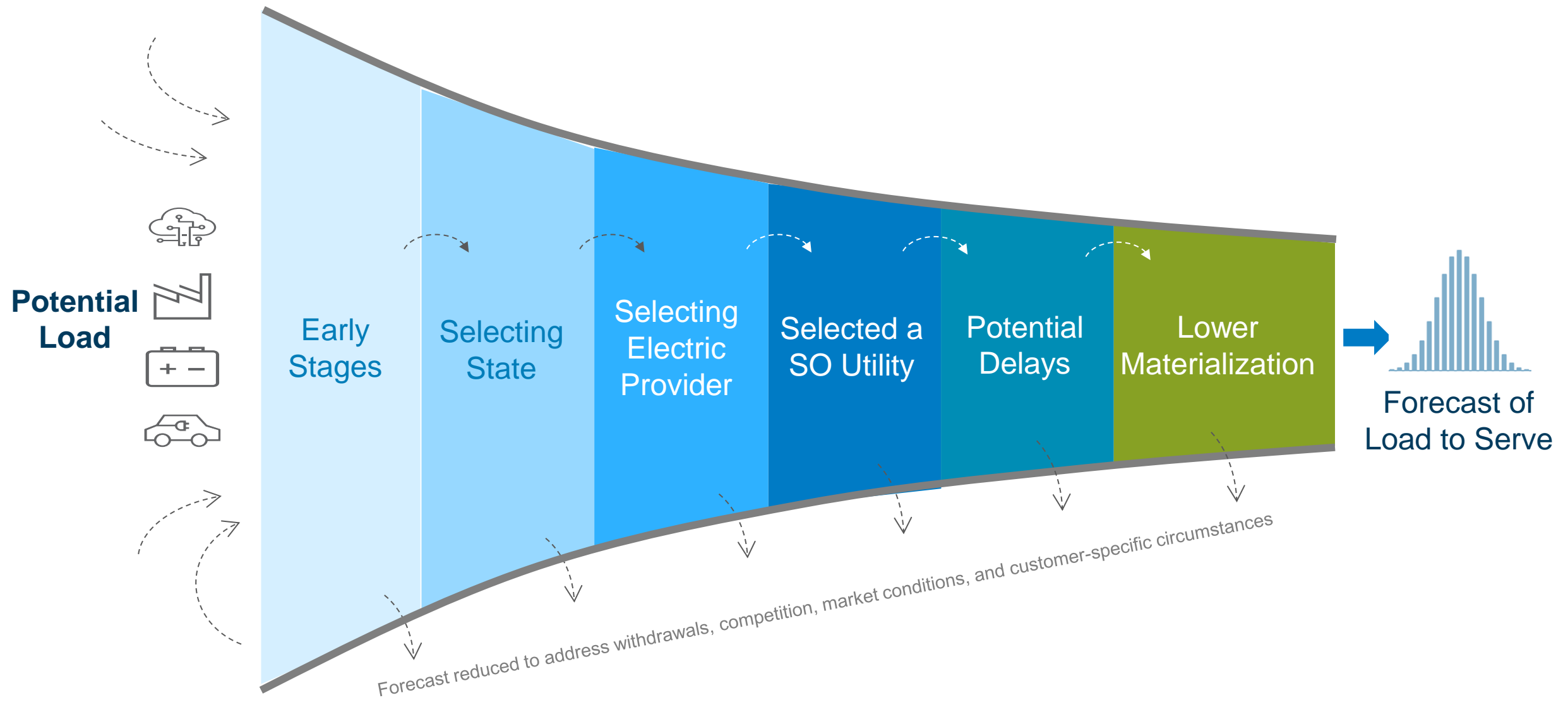
- Projects necessary to accommodate the loads and resource portfolio approved in the 2023 IRP Update

## Additions

The Company will evaluate and develop a residential and small commercial solar & battery pilot program for 2025 IRP approval ◦

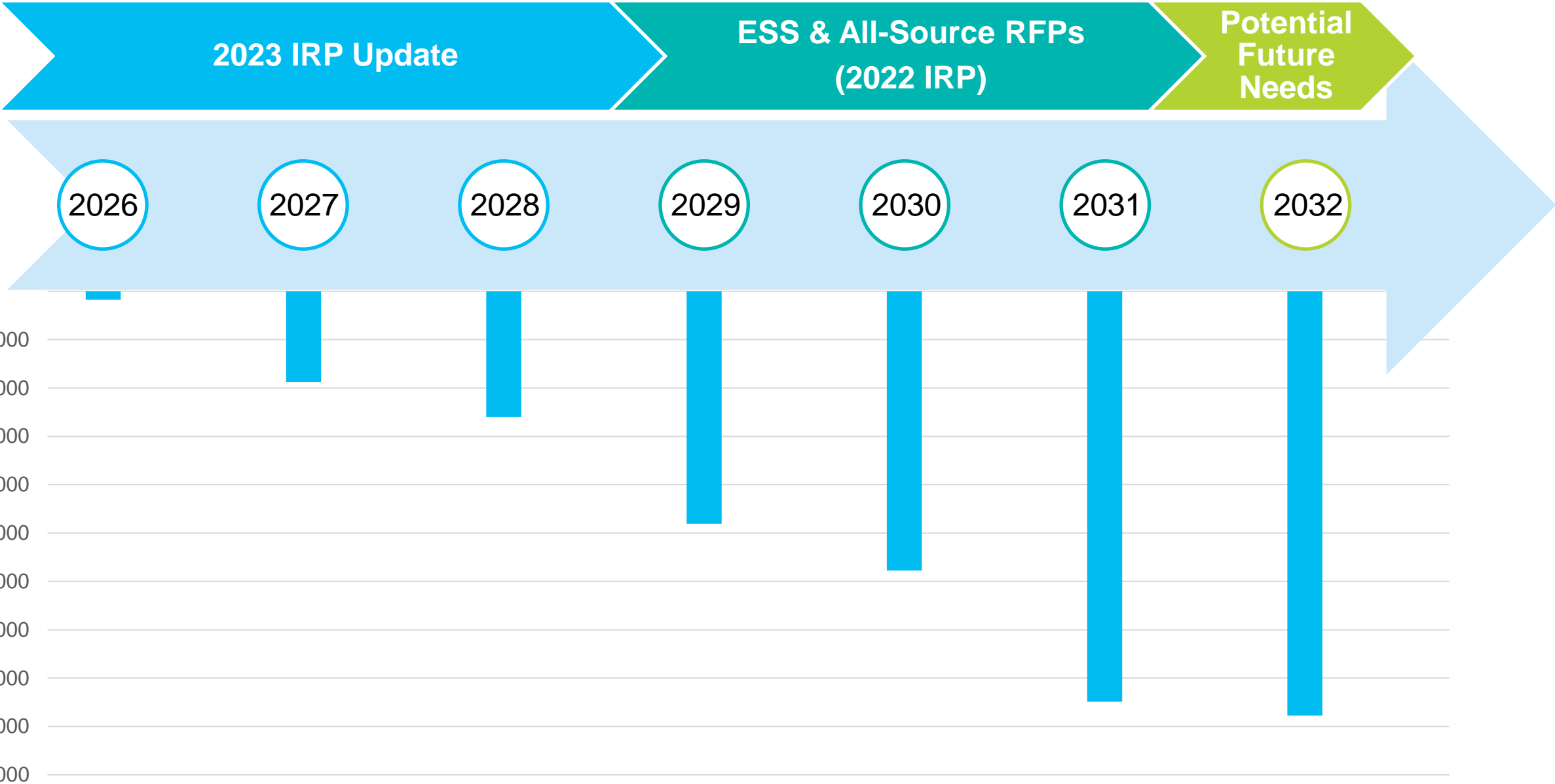


# Our process for risk adjusting the electricity sales forecast



**Adjustments are based on experience and continuous engagement with customers**

# Meeting Capacity Needs



# Transmission in Georgia



- Market structure enables visibility from generation to the customer
- In GA, the ITS is discretely owned; jointly planned.
  - Only Georgia Power Company falls under state- and federal-jurisdiction
- Established planning process to periodically coordinate regional transmission needs with neighboring utilities in AL, FL, TN, SC.
- Constructive Regulatory Environment in State of GA
- Transmission Buildout Timeline
  - ~2-4 Years to build 115 kV transmission system
  - ~3-5 Years to build 230kV transmission system
  - ~7-8 Years to build 500kV transmission system

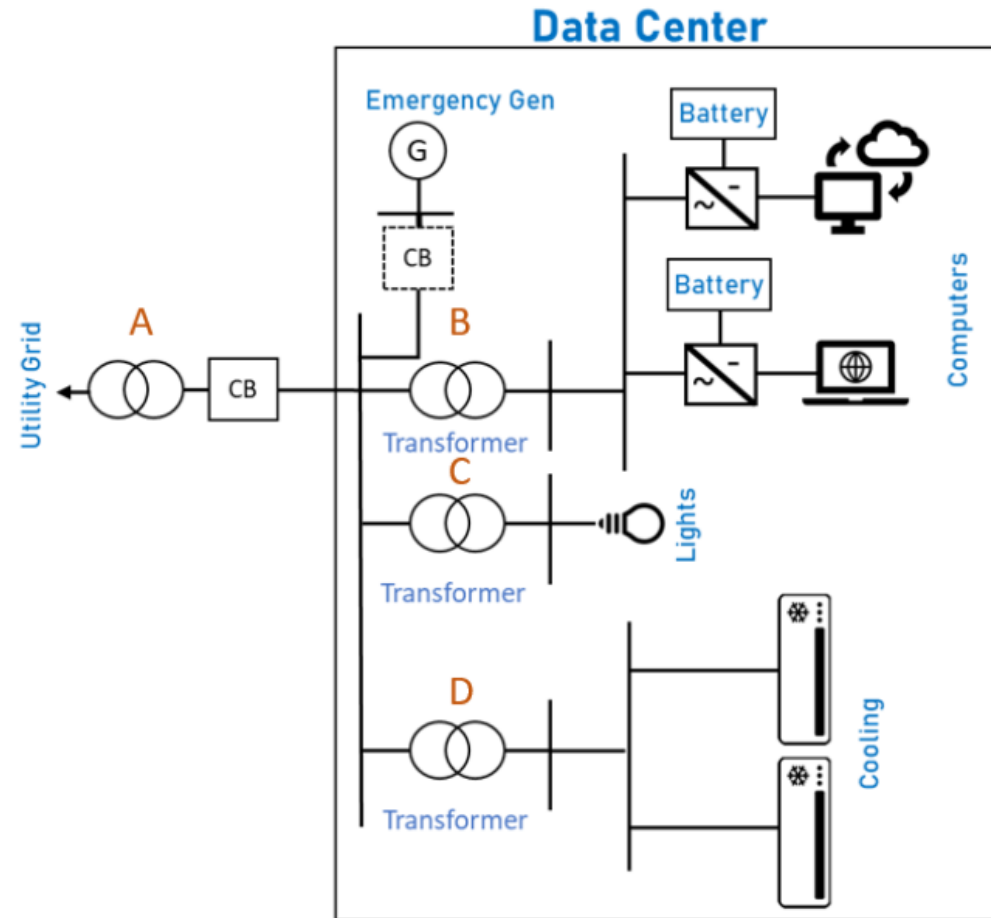


# System Interconnection and Integration – Technical Studies



# Large Data Center Loads – Key Considerations

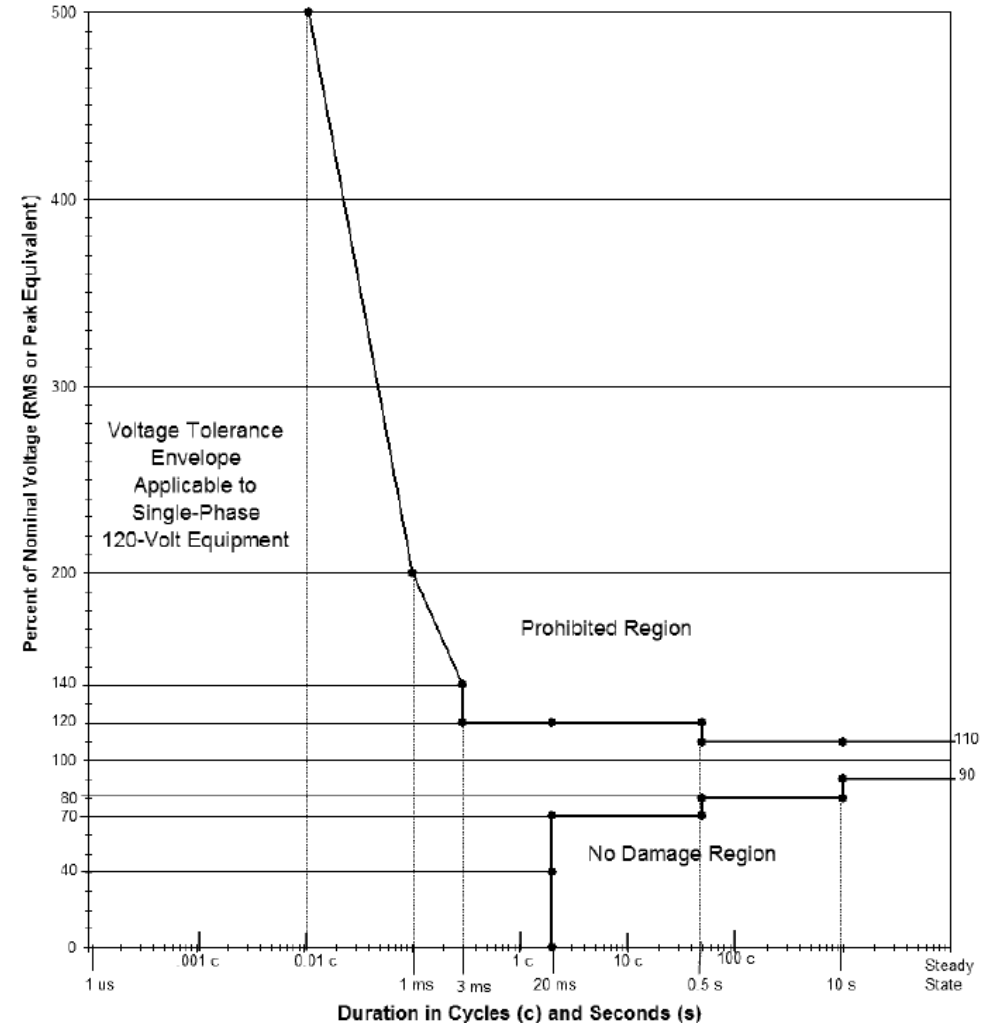
- Power Quality
  - Harmonics, Voltage fluctuations/flicker
- Transient Stability
  - Voltage recovery, frequency
- Small Signal Stability
  - Forced oscillations at low frequencies
- Resonance Stability
  - Exciting torsional modes of nearby units
- Other
  - Ramping rate, ride-through requirements



**Typical Data Center Layout**

# Customer Load Data Requirements

- Questionnaire has been adapted from NERC's Data Center Information Collection Form
  - To be filled by customers
- Total rated load (MW and PF) with the split for individual load components
  - IT equipment (computing/server)
  - Cooling load (motors and drives)
  - Other
- Voltage and frequency ride through response of the IT equipment and the Cooling load during supply voltage/frequency excursions
- Load profile showing variations in active and reactive power

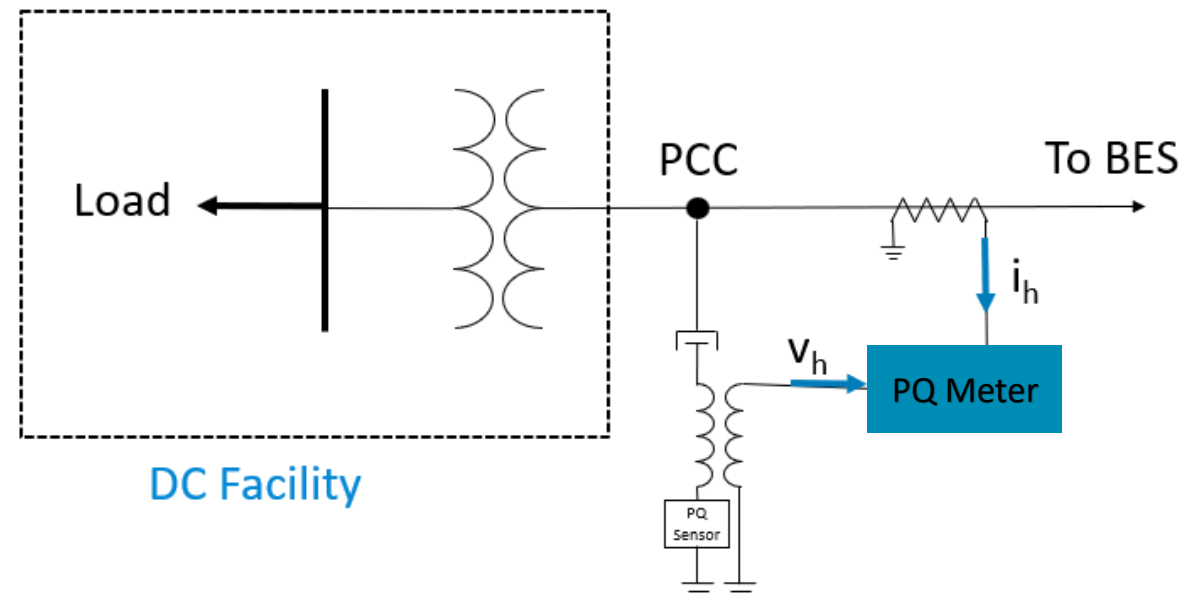


# Harmonics Analysis

- As per Southern Company Power Quality Policy<sup>1</sup>, voltage and current harmonics at Customer's Point of Common Coupling (PCC) need to be limited to acceptable values
- Electromagnetic Transient (EMT) model of the system can be used to estimate expected voltage harmonics at PCC
  - Customer provided current harmonics injection spectrum
  - Background voltage harmonics
- Mitigation options
  - Filter banks

**TABLE I-3a: Odd Harmonics Current Limits for Systems Rated Greater than 161 kV**

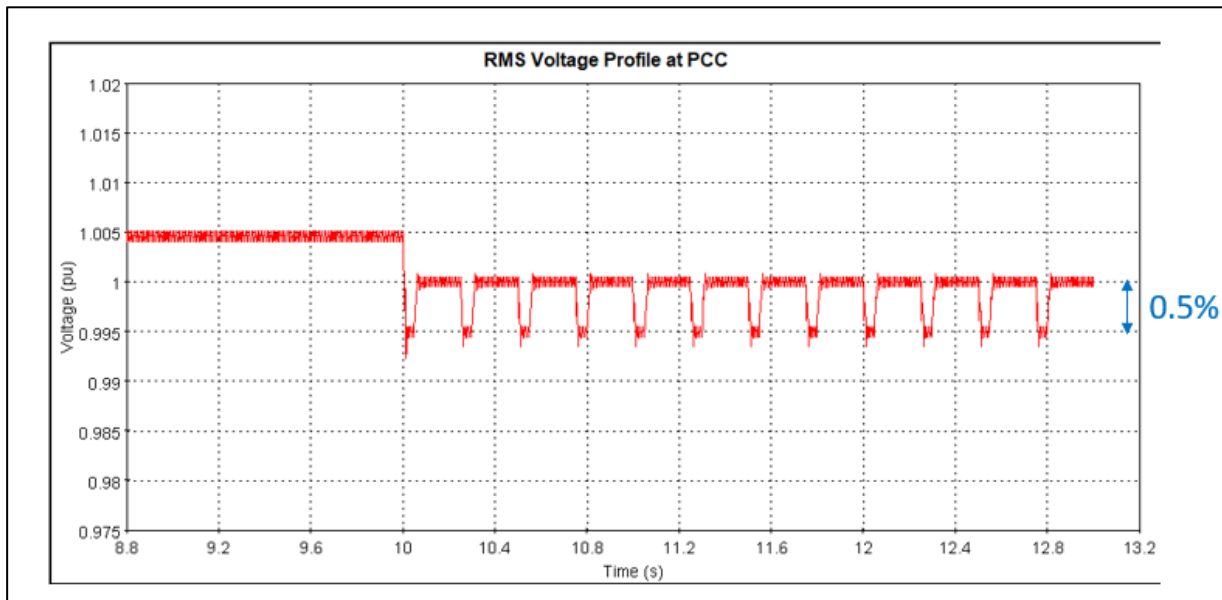
$I_{sc} / I_L$	Individual Harmonic Order					TDD
	$h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h$	
$\leq 25^*$	1.0	0.5	0.38	0.15	0.1	1.5
$25 < 50$	2.00	1.00	0.75	0.30	0.15	2.5
$\geq 50$	3.00	1.50	1.15	0.45	0.22	3.75



<sup>1</sup> <https://www.oasis.oati.com/woa/docs/SOCO/SOCODocs/SoCo-Power-Quality-Policy.pdf>

# Voltage Fluctuations/Flicker Analysis

- System voltage fluctuations is a concern if the load profile is variable
- EMT model can be used to estimate RMS voltage fluctuations and resultant flicker (Pst<sup>1</sup>) at PCC
  - Example results shown below for a preliminary load profile (variable and cyclic)
- Mitigation options in case flicker estimate exceeds the limits in the Power Quality Policy
  - Changes in load profile (magnitude and/or frequency of fluctuations, waveshape etc.)
  - Industrial Static Synchronous Compensator (STATCOM) within the facility

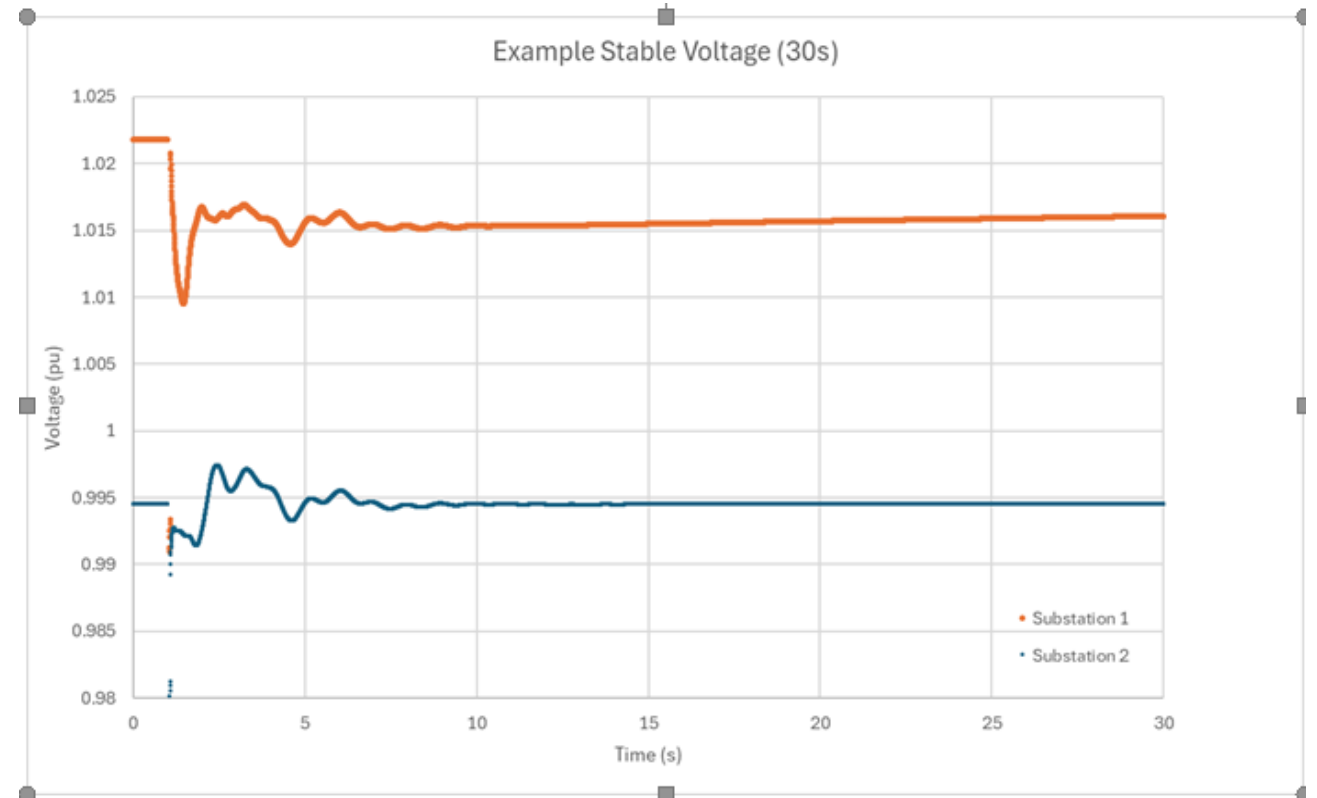


Pst Limit	Customer's Pst Contribution Estimate
0.8	1.04

<sup>1</sup>Pst = A measure of short-term perception of flicker obtained for a ten-minute interval

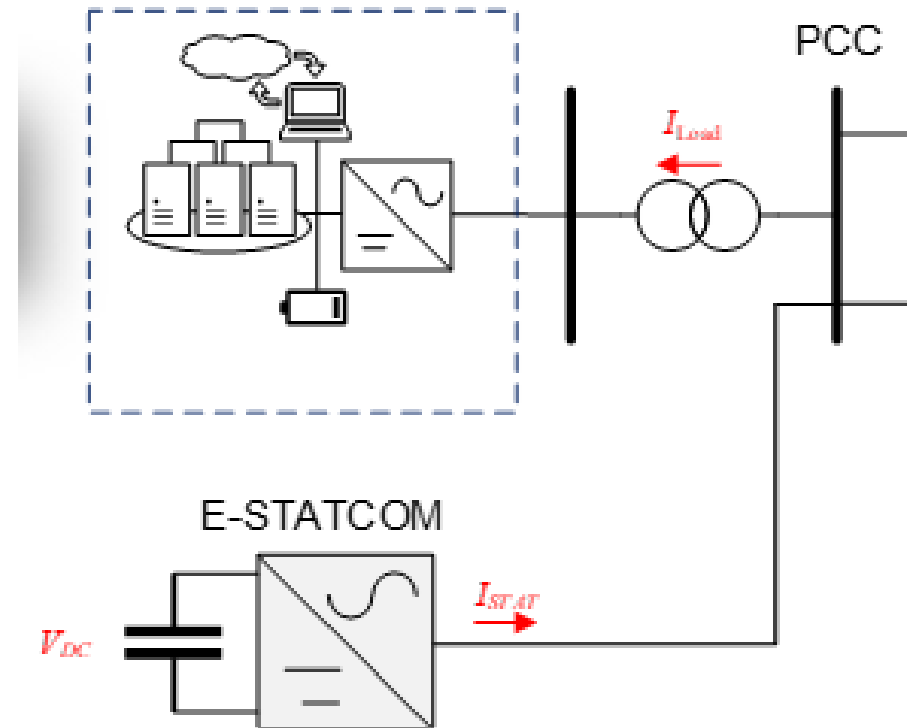
# Transient Stability Analysis

- Key concerns
  - Transient voltage recovery (post-disturbance)
  - Rotor angle stability
  - System frequency regulation
- Need for accurate dynamic modeling
  - Complex/composite load models (e.g. CLOD, CMLD in PSSE)
  - Switchover to backup generation
- A mitigation solution such as a STATCOM may be needed



# Small Signal Stability - Forced Oscillations

- Potential for forced oscillations in system due to periodic changes in active power
- Can interact with natural modes of power system (Interarea: 0.1-0.5 Hz, Sub-regional: 0.5-0.8 Hz, Local: 0.8-2.0 Hz, Units: 5-30 Hz)
  - Propagate over a wide area
  - Energy magnification (resonance)
- Potential solutions
  - Novel technologies like E-STATCOM at PCC
  - Solutions provided by customer at LV level
- Need for appropriate monitoring (e.g., Phasor Measurement Units) and tools to detect oscillations



# Summary

- Large loads such as Data Centers could potentially impact Power Quality and System Stability
- Comprehensive analysis is important to identify potential issues and evaluate mitigation options
- It is important to seek accurate modeling data especially load profile
- Developing study processes, technical requirements and operation protocols for smooth interconnection and integration of large loads
- Pre and Post commissioning monitoring would be important to ensure the load is operating as expected and is meeting requirements





Southern  
Company