Item 8.1: System Planning and Weatherization Update

Woody Rickerson
Vice President, System Planning and Weatherization

Reliability and Markets Committee Meeting

ERCOT Public
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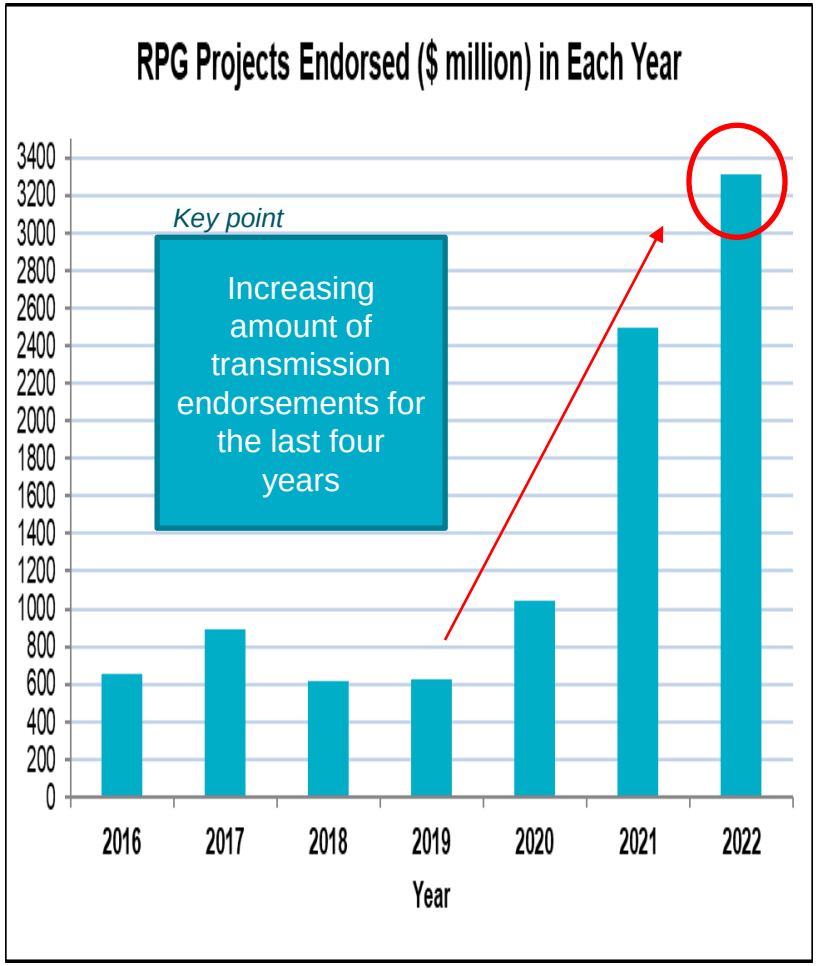
System Planning and Weatherization Update: Overview

- **Purpose**
  - Provide an update on recent activity related to planning, modeling, generation interconnection, resource adequacy, and weatherization
- **Voting Items / Requests**
  - No action is requested of the R&M Committee or Board; for discussion only

- **Key Takeaways**
  - For the fourth year in a row, ERCOT endorsed an increasing amount of new transmission projects.
  - Six new thermal units were added to the grid in February 2023.
  - The recent high number of model changes made in production did not represent a modeling performance issue, but do have some risk.
  - The results of the Large Load Request For Information (RFI) indicate more load growth than expected, as well as the potential for new hydrogen production loads.
  - The new Resource Interconnection and Ongoing Operations (RIOO) continues to provide benefits.
  - Key takeaways include a discussion of generation types in the interconnection queue and their corresponding success rates.
  - ERCOT performs winter weather inspections on over half of ERCOT's Generation Resources.
  - Generation Resource cold weather performance during Winter Storm Elliott shows areas that need some improvement.

Transmission Planning Summary

- As of January 1, 2023 projects energized in 2022 total about $1.567 billion.
  - $2.576 billion energized in all of 2021
- In 2022, ERCOT endorsed transmission projects totaling $3.311 billion.
  - Total endorsed transmission projects in 2021 equaled $2.498 billion
  - Work in 2022 included more than 40 projects
  - Highest amount in several years
- As of January 1, 2023, projects in engineering, routing, licensing, and construction total about $11.885 billion.



Elements Submitted for Operational Modeling (Monthly)

January 2023	February 2023	Rolling Average *Previous 12 Months*
Resources – 0 *(net)* • 2 DESR conversions	Resources – 15 • 6 Thermal* • 0 Wind • 4 Solar • 5 DESR	Resources – 9 • 1 Thermal • 2 Wind • 4 Solar • 2 ESRs
Transmission • 9 Transformers • 64 Breakers • 20 Lines	Transmission • 3 Transformers • 44 Breakers • 11 Lines	Transmission • 7 Transformers • 71 Breakers • 17 Lines
Contingencies • 56	Contingencies • 18	Contingencies • 68

Key point

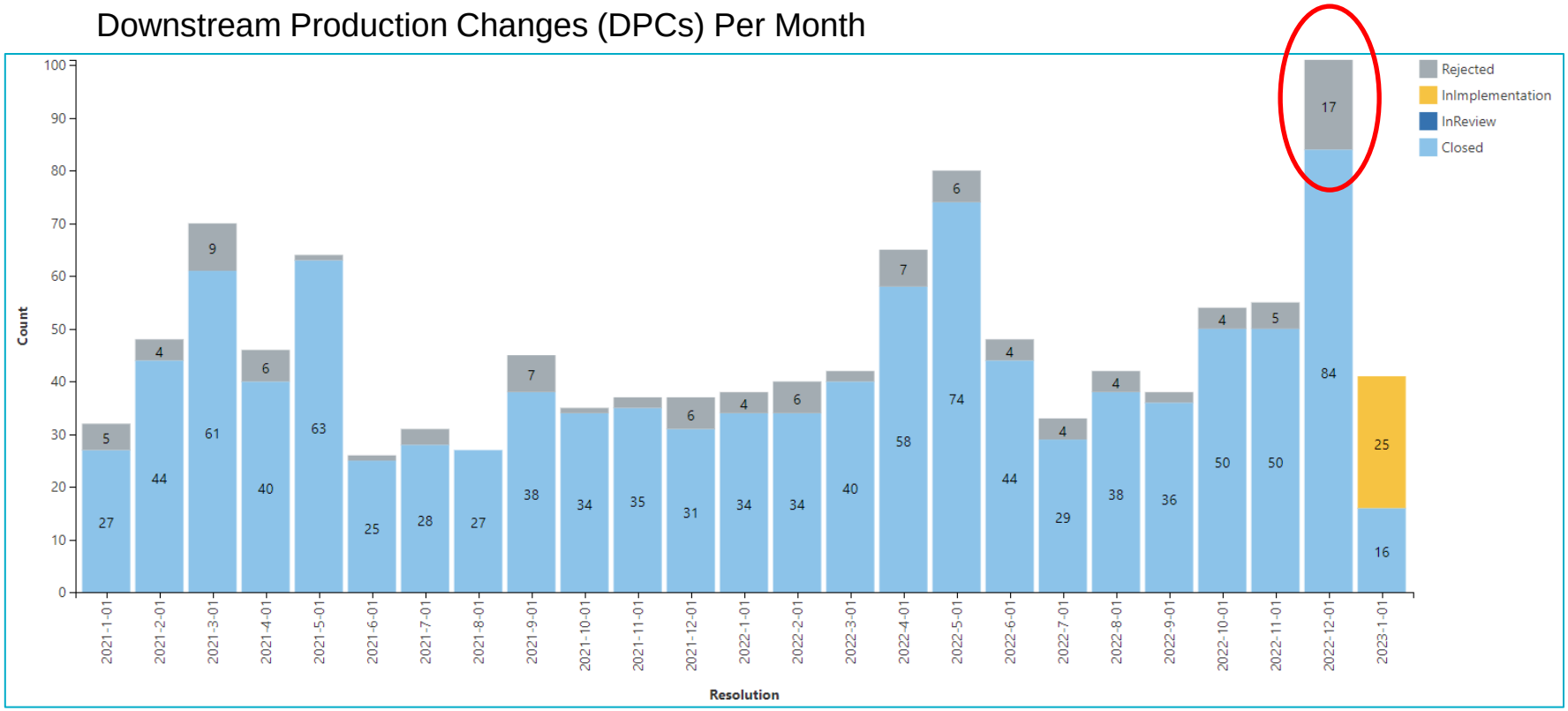
*Six gas turbines at a single site added to model in February. 71.2 MVA each. To become commercial 3/23

Notice for Operational Model Changes

Key point

The unusual number of DPCs were due to the energization of new equipment and equipment testing that required the subsequent modification of contingencies through the DPC process. This is part of the normal modeling process.

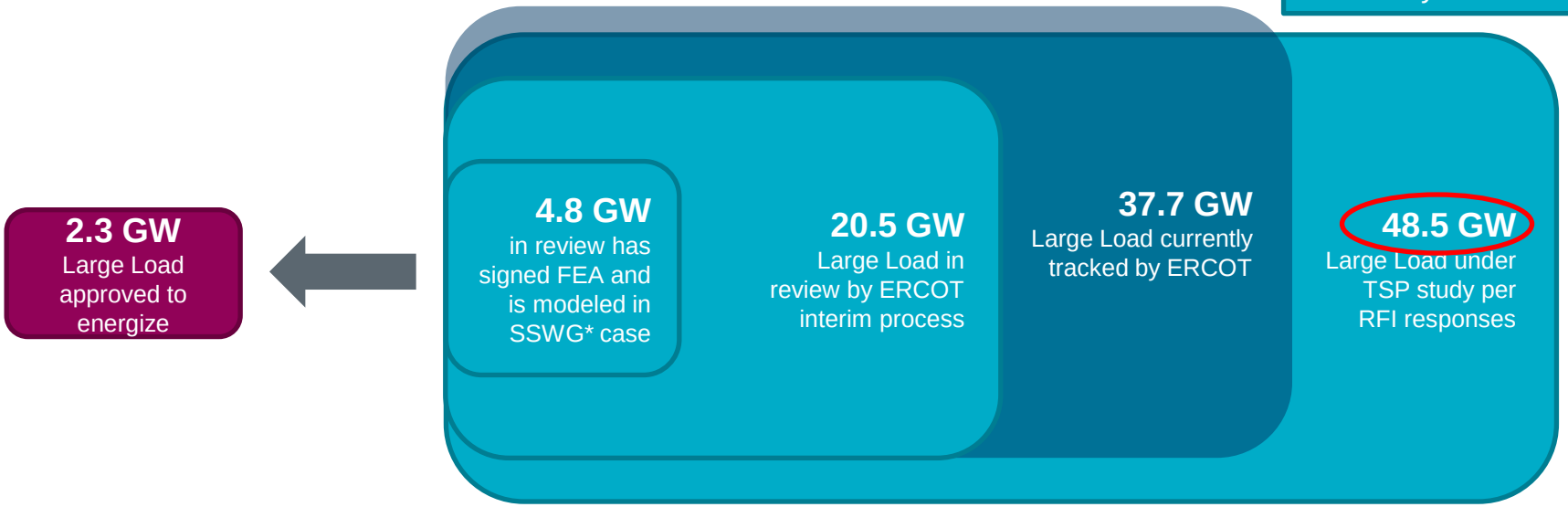
Downstream Production Changes (DPCs) Per Month



Large Load Interconnections in ERCOT

Key point

The RFI responses (48.5 GW) have identified projects not currently tracked by ERCOT.



- ERCOT considers loads 75 MW or larger to be Large Loads. Flexible Loads can rapidly increase or decrease power consumption. Large Flexible Loads (LFLs) have both characteristics.
- ERCOT is currently tracking 37.7 GW of Large Load interconnection requests in its interim process.
  - Of that, 20.5 GW is actively under ERCOT review via the interim Large Load interconnection process
  - Of the 20.5 GW under review, 4.8 GW has signed a Facilities Extension Agreement (FEA) with the TSP and has been modeled in future planning cases
- To date, approximately 2.3 GW of Large Load have been approved by the interim interconnection process. Not all of that load is considered Flexible.

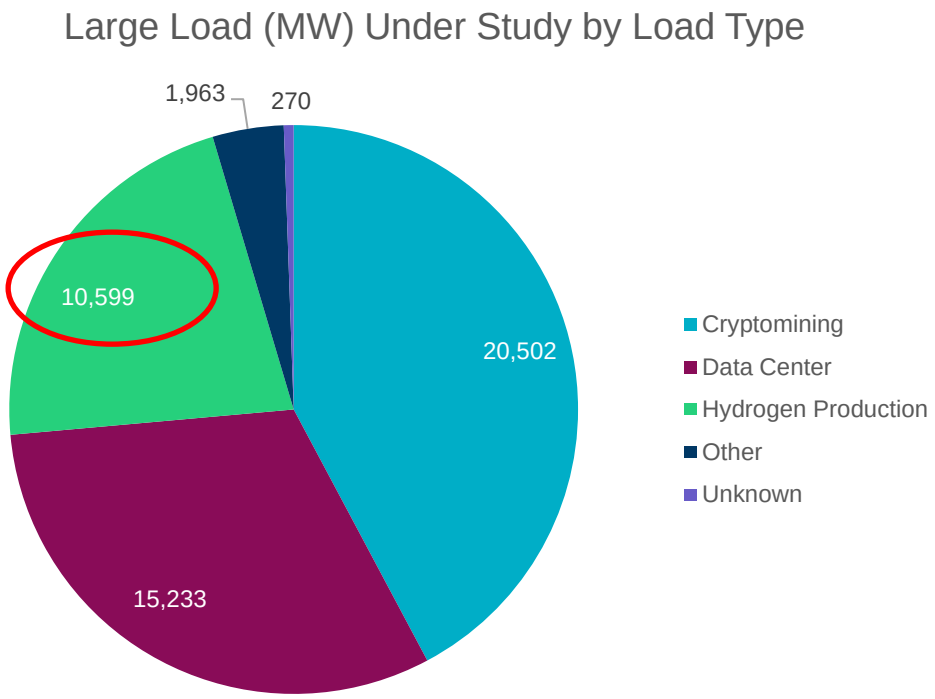
* SSWG – Steady State Working Group

RFI Responses – Large Loads Under Study

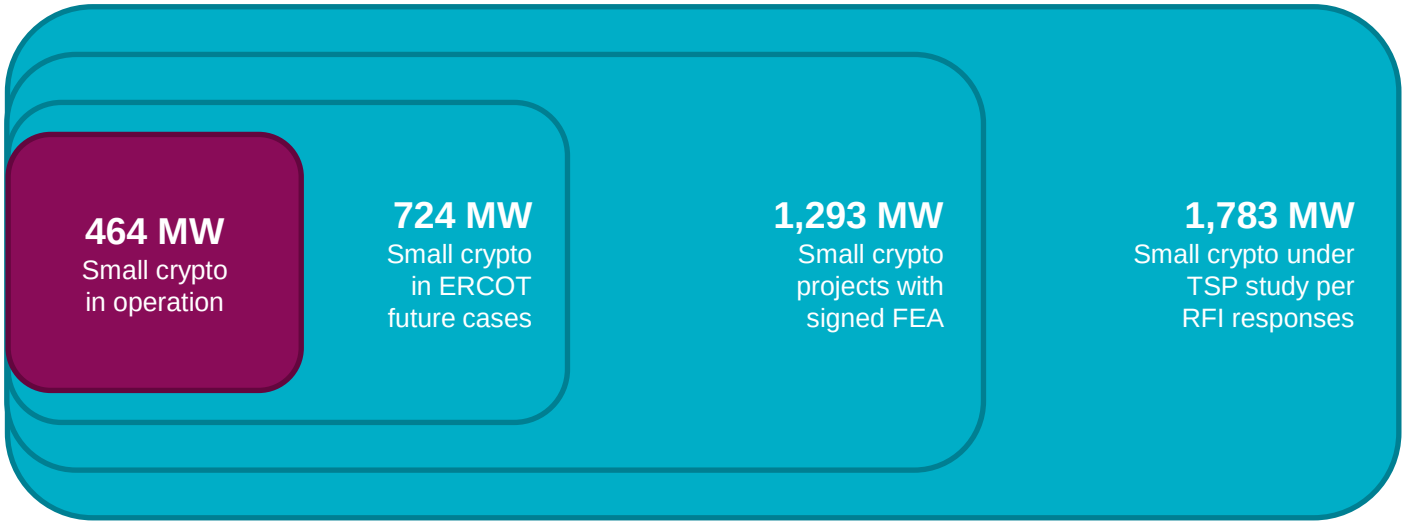
- 48.5 GW of new Large Loads under study by TSPs in various stages of development
- ERCOT also confirmed 1,400 MW of cancelled projects via this RFI

Key point

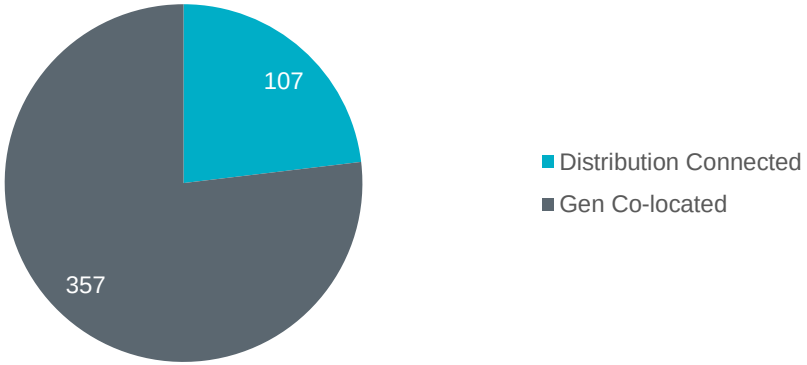
10,599 MW of potential hydrogen-production large loads being reviewed by TSPs



RFI Responses – Crypto Mining Sites that are less than 75 MW



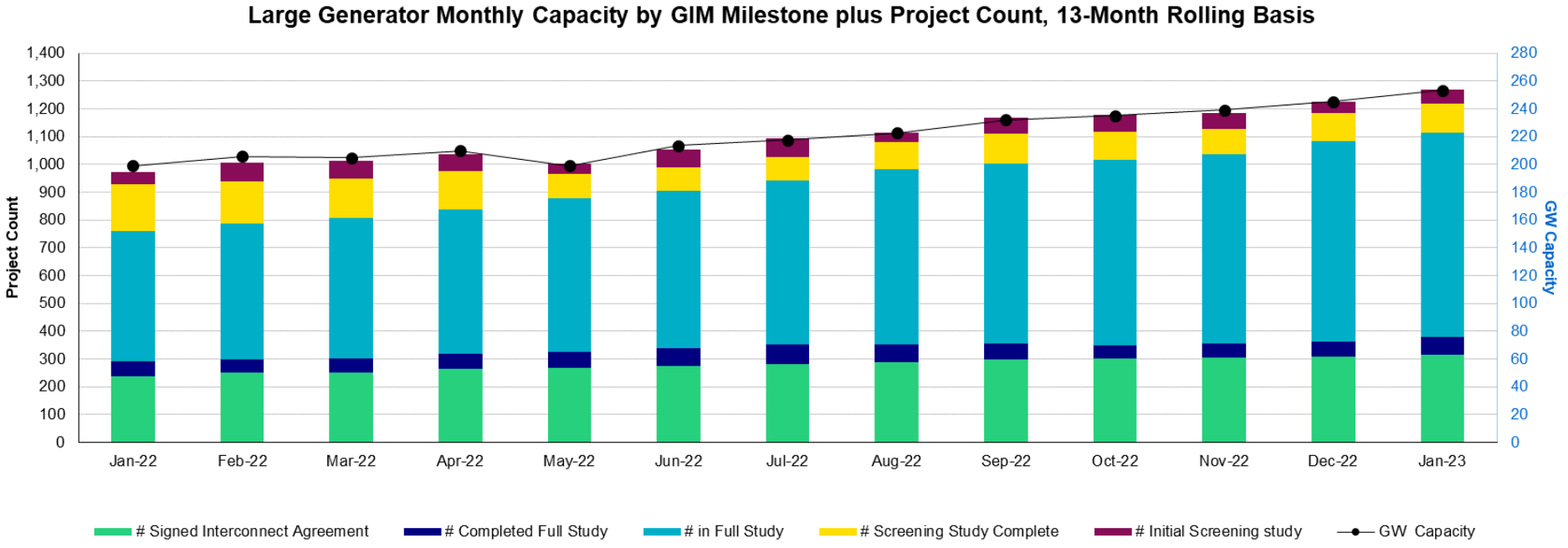
Of the 464 MW currently consuming power



Key point

Small crypto mining sites are not being tracked in the interim ERCOT large load process, but are accounted for in the TSP load interconnection process and the Planning base cases.

Future Generation Interconnection Projects by Interconnection Status



- Number of projects in the interconnection queue is nearing 1,300 and continues to increase.

Key point

Retirement of the Resource Asset Registration Form and the implementation of the new Resource Integration and Ongoing Operations (RIOO) interface enhances both ERCOT and Market Participant efficiency in handling the increasing number of Generation Interconnection projects.

Resource Integration and Ongoing Operations (RIOO) Improvements

- The RIOO project modernized the data entry and payment process for almost 1,700 Resources by replacing a spreadsheet-based data entry with a web-based application.

- Benefits for Market Participants
  - Individual data items are validated as they are entered instead of ERCOT running a validation tool and users fixing and resubmitting the entire Resource Asset Registration Form (RARF)
    - Decrease of several hours (or days) required for most submittals
  - Developers and Owners are now able to log in and see the current status of Resource
    - Decrease of up to a day over the old process of sending them a copy of the latest RARF

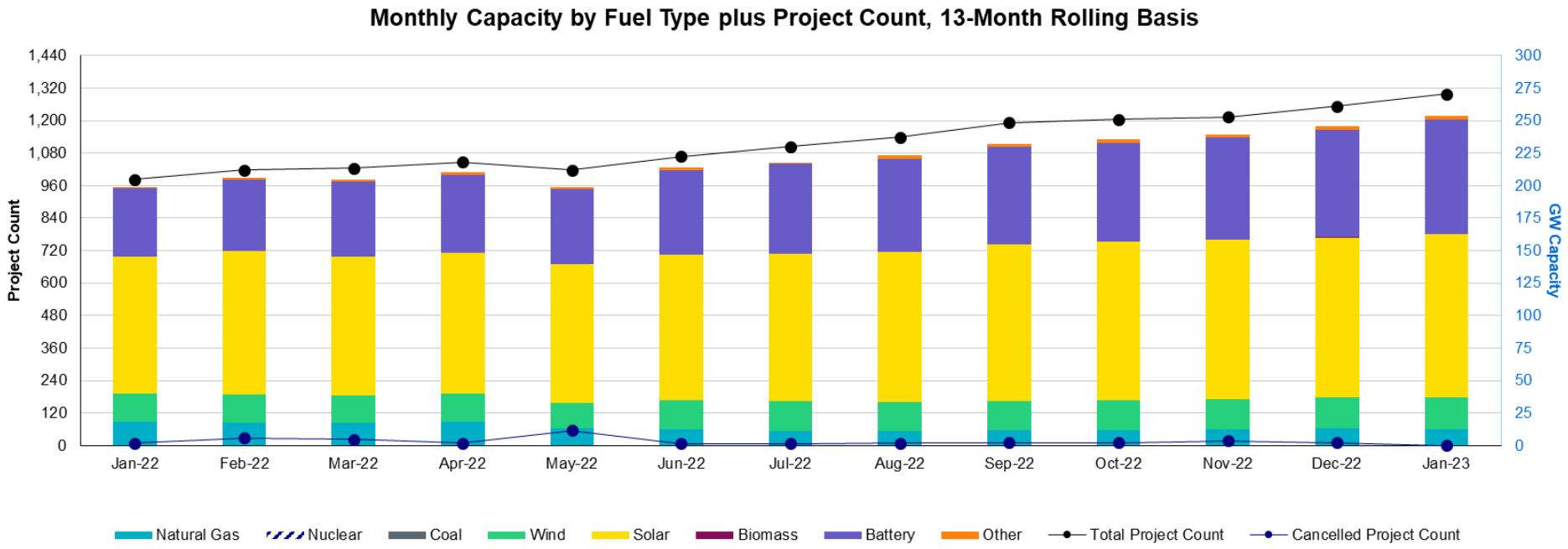
- Benefits for ERCOT staff
  - ERCOT FTE decrease was initially estimated at 3 FTEs, but the recent increase in projects increases the benefit from what was calculated in the original Impact Assessment
  - As new technologies are developed it will be easier to incorporate them in RIOO, instead of continually modifying the RARF
  - Enhances efficiency of ERCOT's team of 15 interconnect engineers and 12 modeling engineers that have multiple RIOO interactions every day
  - ERCOT Engineers can now query a modern database instead of the outdated RARF hub
  - Eliminated process used to repeatedly transfer data from the RARF to a database

Key point

RIOO efficiencies are shared by ERCOT, Resource owners, and New Developers.

Return

Future Generation Interconnection Projects by Fuel Type



Key point

Not all fuel types in the interconnection queue share the same success rate in eventually becoming commercial.

Success rates of planned generation projects in ERCOT queue

		Number of Requested Projects	Number of Successful Projects	Success Rate by Number of Projects	Success Rate by Installed Capacity (RTG_MW)
All Projects		1,272	352	28%	24%
Fuel Type Breakdown	Battery Energy Storage	87	22	25%	22%
	Solar	443	76	17%	17%
	Wind	536	177	33%	28%
	Natural Gas	161	65	40%	28%
	Coal	31	11	35%	25%
	Biomass	3	1	33%	15%
Technology Type Breakdown for Natural Gas Projects	Gas-CC (Combined Cycle)	81	33	41%	30%
	Gas-GT (Combustion Gas Turbine)	61	19	31%	21%
	Gas-ST (Steam Turbine)	6	4	67%	35%
	Gas-IC (Internal Combustion Engine)	9	8	89%	99.5%
Breakdown by Interconnection Milestone Achievement	Signed Interconnection Agreement (IA)	548	337	61%	53%
	Section 6.9(1) Condtions Met	227	158	70%	66%
	Quarterly Stability Assessment (QSA)	120	91	76%	66%
Breakdown by Signed Interconnection Agreement Achievement, by Fuel Type	Signed Interconnection Agreement (IA)	548	337	61%	53%
	Battery Energy Storage	35	22	63%	55%
	Solar	174	76	44%	38%
	Wind	238	173	73%	69%
	Natural Gas	78	56	72%	52%
	Coal	19	9	47%	38%
	Biomass	1	1	100%	100%

Key point

Natural gas-fueled projects in the interconnection queue have approximately a 40% prospect of becoming commercial. This translates to about 28% of the natural gas-fueled MW capacity becoming commercial.

To account for the development cycle of generation projects, the success rate statistics in this analysis were limited to projects requested between 2002 and 2019

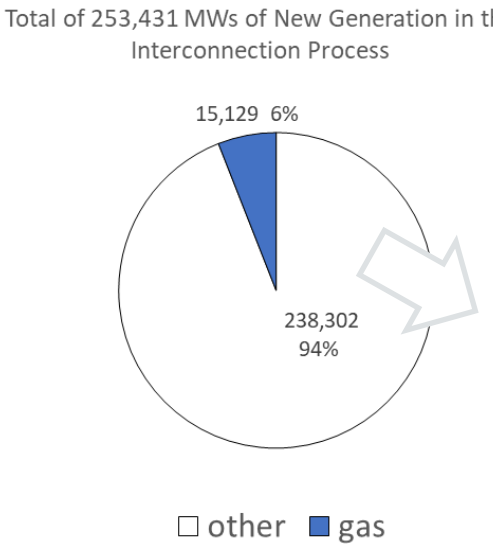
History of Gas Generation MW Submitted to the Interconnection Queue

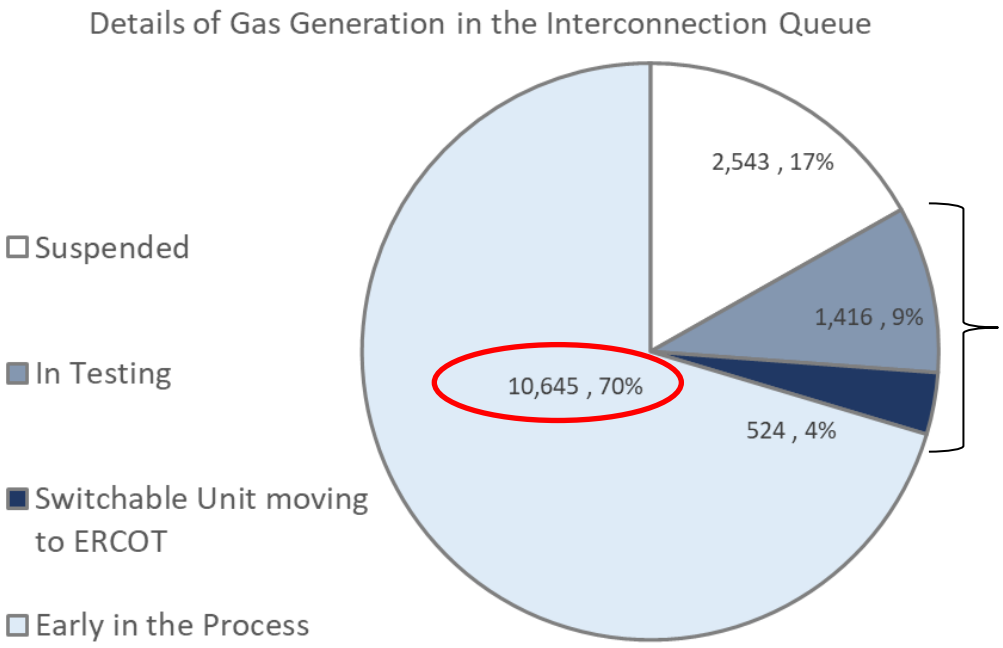
	Combustion Turbine	Combined-Cycle	Combined-Cycle (upgrade projects)	Other Gas Technologies	Grand Total
2002		620		1,820	2,440
2003		66		16	82
2004		665			665
2005		1,985		610	2,595
2006		9,090		45	9,135
2007		19,389	966	487	20,842
2008		9,119		275	9,394
2009		1,286		58	1,344
2010		615	90	380	1,085
2011	86	1,884		566	2,536
2012	2,372	4,958		369	7,699
2013	2,505	5,128	88		7,721
2014	8,519	7,209	210	66	16,004
2015	1,813	2,989		226	5,028
2016	549	1,340			1,889
2017	862				862
2018	3,550	1,499	75	388	5,512
2019	3,500		260	651	4,411
2020	1,348	1,974	215	453	3,991
2021	11,756		230	1,678	13,665
2022	1,954	538	321	734	3,548
Grand Total	38,814	70,354	2,454	8,824	120,446

Key point

The average gas interconnection amount submitted into the interconnection process from 2002 through 2022 was 5,762 MW

What is in the Queue Today – Gas Generation Currently in the Interconnection Queue by Technology





~ 1,900 MW of new gas capacity in final stages of the interconnection process

Representing about 0.8% of the total MWs in the interconnection queue.

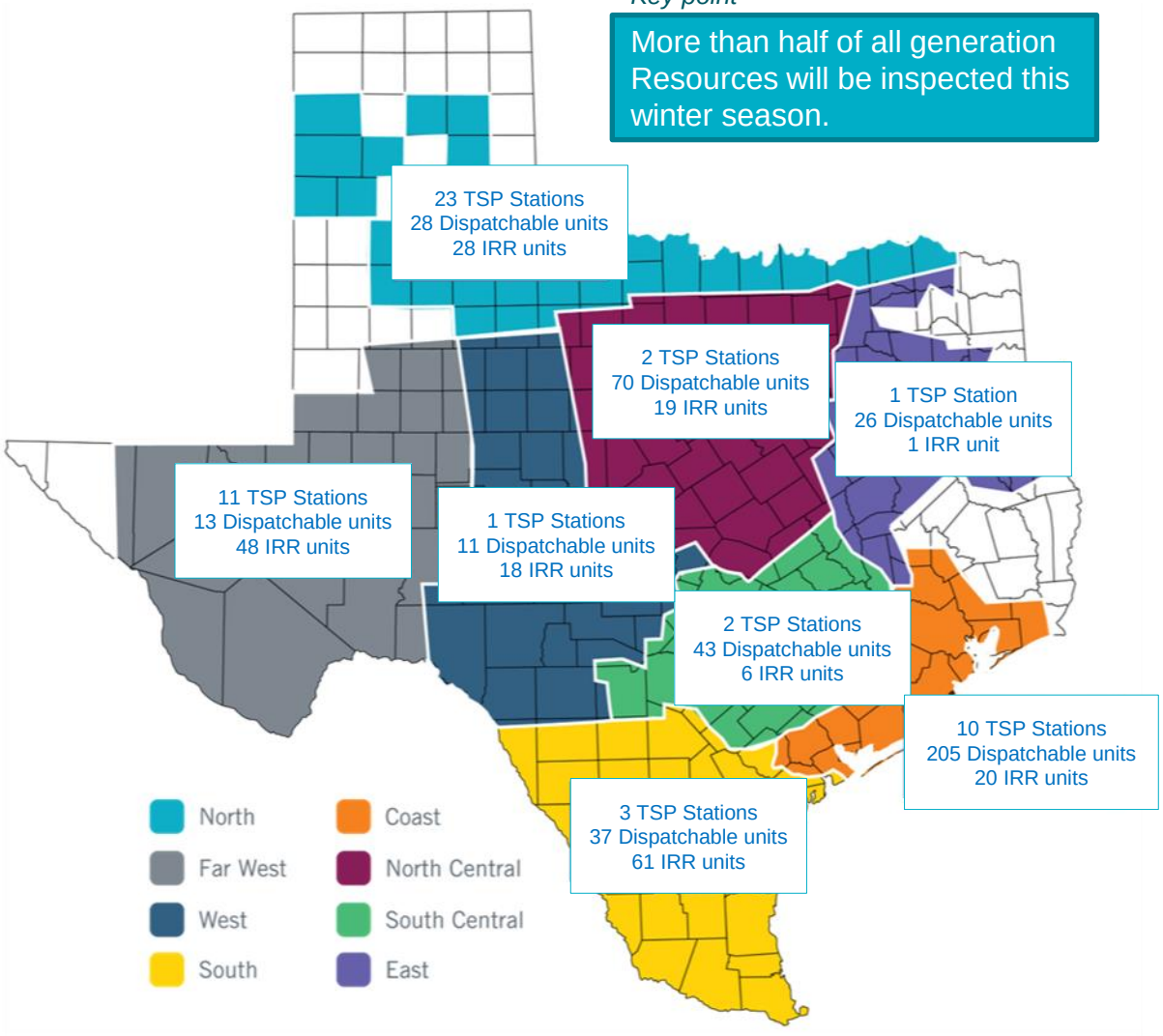
Key point

Over 10,000 MW of Natural Gas projects are currently in the early stages of the interconnection process

Weatherization -- Winter 2022-2023 On-Site Inspections

Key point

More than half of all generation Resources will be inspected this winter season.



On-site Inspections

Inspections Completed between December 2, 2022, and January 31, 2023

53 Transmission
433 Dispatchable
201 IRR*
687 Total

Less than 2% of inspected facilities will require additional compliance work

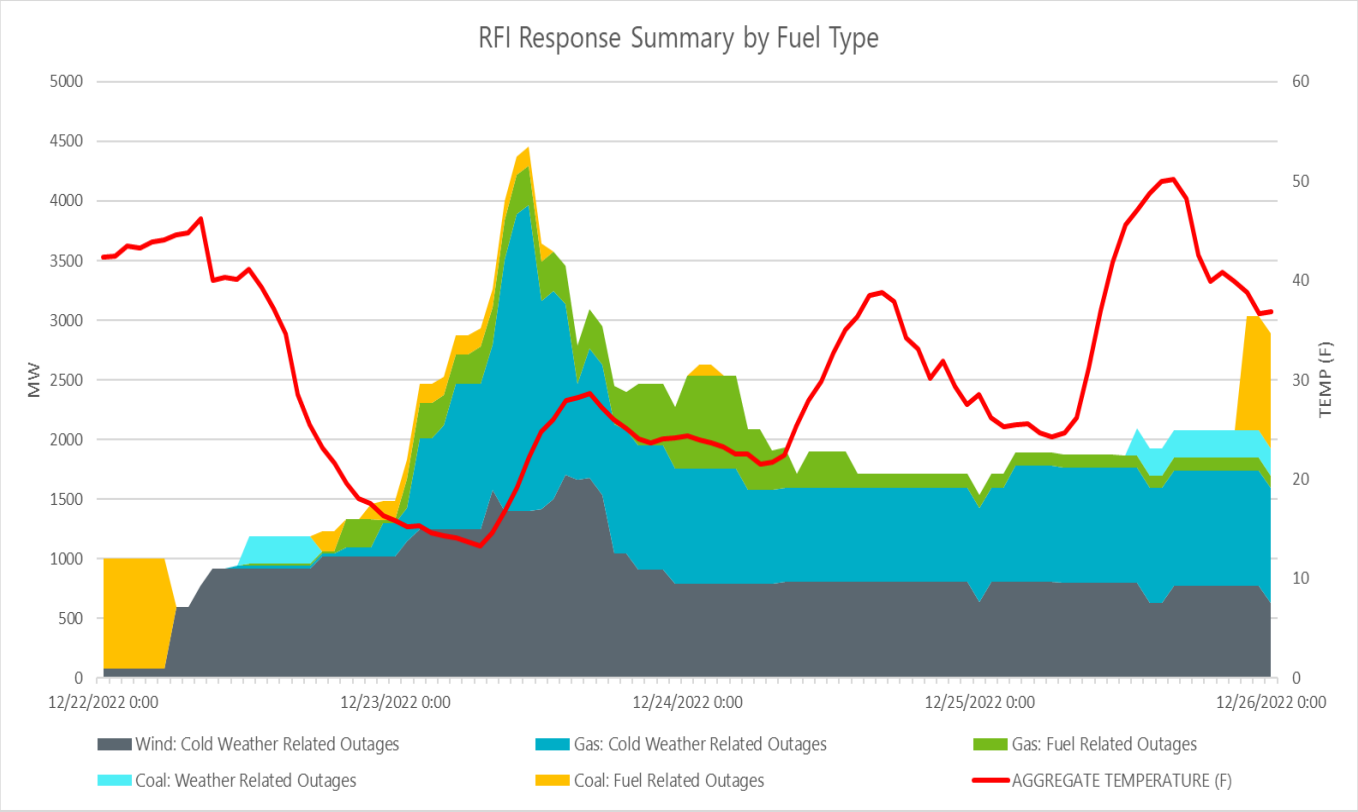
Another 80 Inspections are expected to be completed in February 2023.

Winter Storm Elliott Update

*IRR – Intermittent Renewable Resources

Winter Storm Elliott Update

- Initial “Outage Scheduler” (OS) data included 655 individual outages at 348 units
  - Total outages peaked at close to 20,000 MW
  - Initially 127 outages were considered weather or fuel supply related (peaking at ~4,500 MW)
    - Outages or derates at 97 units were considered weather related (35 were wind)
    - Outages or derates at 30 additional units were caused by fuel issues
      - 4 were coal, 3 were lignite, 23 were natural gas



Key point

Weather-related outages during Elliott peaked at ~4,500 MW. During Uri, weather-related outages peaked at over 30,000 MW. While the storms differed in severity, duration, and precipitation, there does appear to be improvement in the overall ability of the generation fleet to operate during extreme cold weather.

Winter Storm Elliott Update

- RFIs were issued to the Market Participants associated with those 127 units.
- RFI Responses provided further insight into the Elliott outages.

	Weather Related	Fuel Related
Wind	26	0
Coal	5	4
Lignite	0	3
Natural Gas	37	23

- Pre-Elliott Inspections
  - By December 22, ERCOT had inspected 255 Resources.
  - 4 were subsequently found to have weather related outages/derates (part of the 127).
    - All were gas units
    - Examples included multiple units at the same site experiencing the same issue

Key point

Weather related outages that occurred on units that had recently been inspected for winter weather readiness will receive additional scrutiny and any lessons learned will be included in future inspections.