



Long-Term Impact of Large Load Growth at ERCOT

2024 Fall ESIG Technical Workshop

Pengwei Du

ERCOT Supervisor, Economic Analysis & Long-Term Studies

Fred Khodabakhsh

ERCOT Senior Planning Engineer

Julie Jin

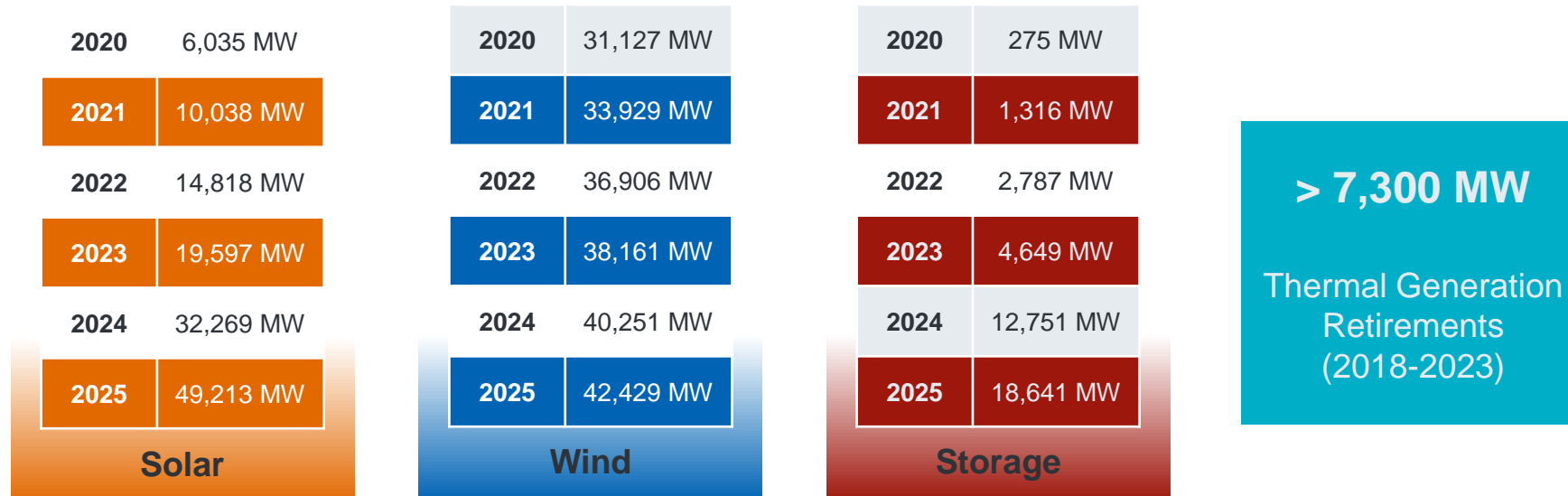
ERCOT Supervisor, Modeling & Analysis

Ping Yan

ERCOT Manager, Transmission Planning Assessment

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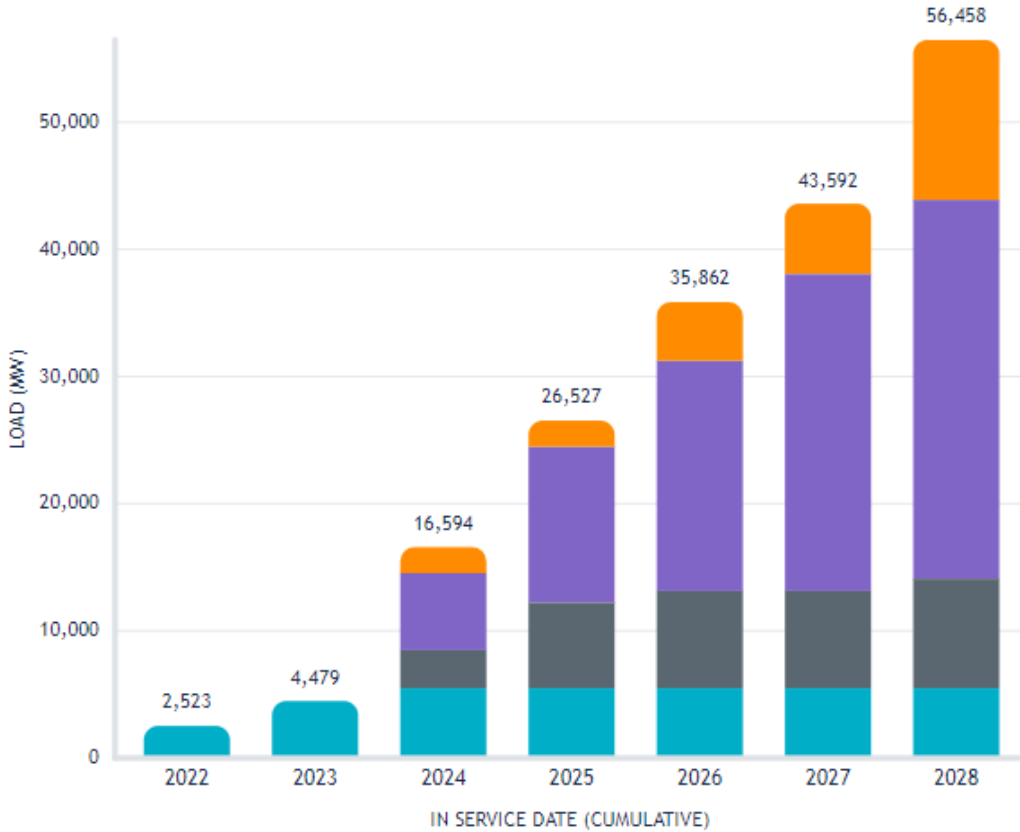
The Changing Grid – Generation Installed Capacity



- ERCOT continues to experience a rapid shift in the type and location of generation available to serve demand.
- Robust growth of inverter-based resources (IBR) has continued. Total IBR capacity has the potential to exceed 110 GW in 2025.
- Over 7,300 MW of coal and natural gas generation has retired since 2018.
- The change in generation mix has also resulted in increased distance between generation sites and demand centers. Retired coal and gas generation were closer to large cities, whereas the most abundant wind and solar resources tend to be in more distant locations.

Current Large Load Interconnection Queue

Actual and Projected Large Load Growth 2022-2028

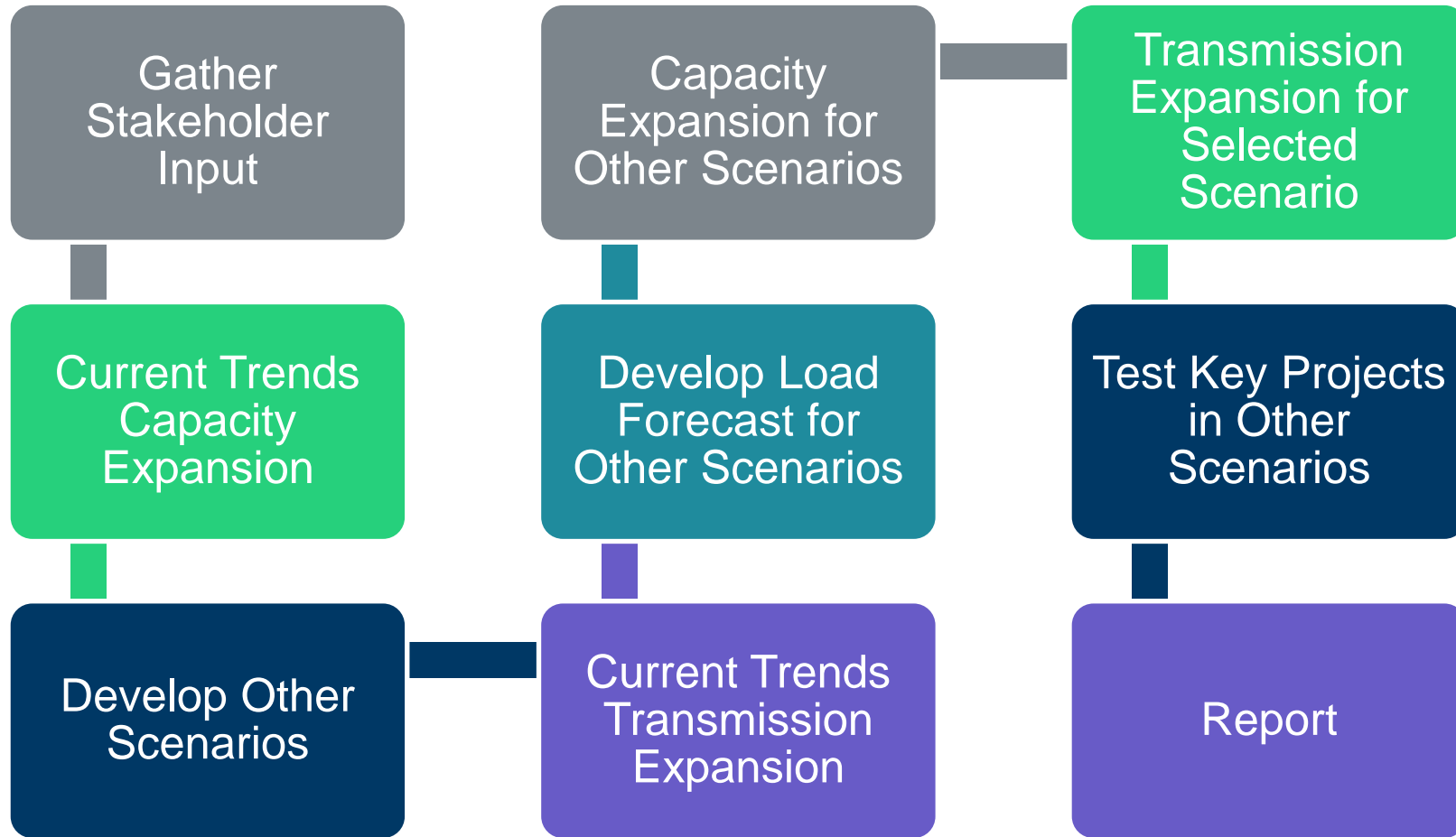


Project Status	2022	2023	2024	2025	2026	2027	2028
No Studies Submitted	-	-	2,040	2,040	4,640	5,540	12,582
Under ERCOT Review	-	-	6,077	12,276	18,087	24,917	29,782
Planning Studies Approved	-	-	2,981	6,715	7,639	7,639	8,598
Approved to Energize	2,523	4,479	5,496	5,496	5,496	5,496	5,496
Total (MW)	2,523	4,479	16,594	26,527	35,862	43,592	56,458

NOTE: In July 2024 ERCOT expanded the queue to include projects with projected in-service dates of 2028. Previously, projects without an in-service date were assigned a default ISD of 12/31/2027. Those projects were reassigned a default ISD of 12/31/2028.

- **Approved to Energize** – Projects that have received Approval to Energize from ERCOT Operations. NOTE: not all MWs in this category have been observed to be operational (see next slide)
- **Planning Studies Approved** – Projects that have received ERCOT approval of required interconnection studies. Any MWs that were not approved are reclassified as No Studies Submitted.
- **Under ERCOT Review** – Projects that have studies under review by ERCOT
- **No Studies Submitted** – Projects that are tracked by ERCOT but that have not yet provided sufficient information for ERCOT to begin review. Additionally, MWs that were not approved by ERCOT after review of planning studies are included in this category until a path to interconnect these MWs is identified, or the customer cancels the interconnection request.

2024 Long-Term System Assessment (LTSA) Process



The LTSA provides an evaluation of the potential needs of ERCOT's extra-high voltage (345-kV) system in the 10-to-15-year planning horizon.

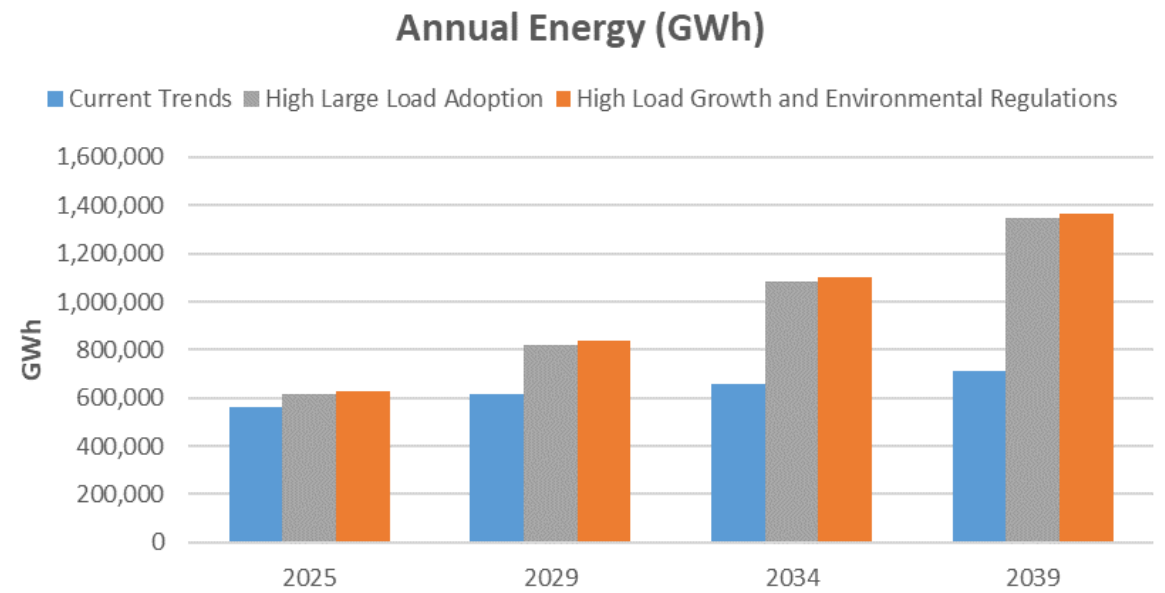
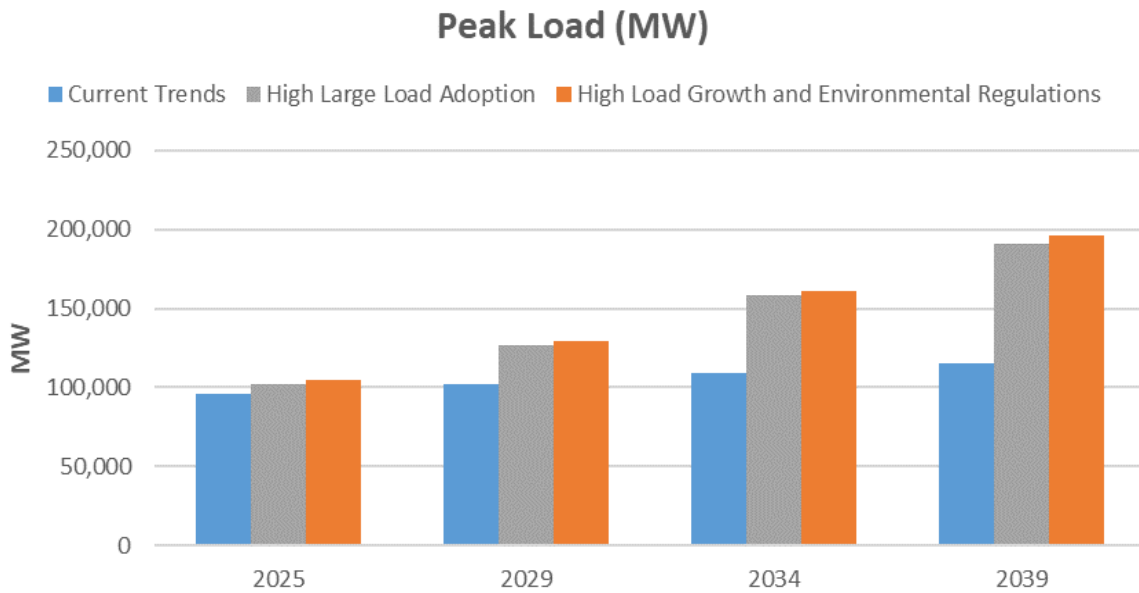
Scenarios Developed for 2024 Long-Term System Assessment (LTSA)

Scenario	Descriptions
Current Trends	<p>The Current Trends scenario was designed to study a future trajectory consistent with what is known and knowable today (e.g., demand growth, economic trends, fuel prices, etc.). Two significant assumptions were made for the Current Trends scenario in the 2024 LTSA:</p> <ol style="list-style-type: none">1. An iterative process was adopted to co-optimize capacity expansion and transmission expansion.2. No significant impact of EPA rules for gas units was modeled.
High Large Load Adoption	<p>The High Large Load Adoption scenario investigated the impacts of increasing large loads in the ERCOT System.</p>
High Load Growth and Environmental Regulations	<p>The High Load Growth and Environmental Regulations scenario investigated the impact of large load growth and the regulatory policies impacting the development of dispatchable resources on the ERCOT System.</p>

ERCOT studies different scenarios in its long-term planning process to account for the inherent uncertainty of planning the system beyond 6 years.

Load and Demand

- In 2023, ERCOT contacted Transmission Service Providers (TSPs) to obtain a list of the loads seeking interconnections that have not signed an interconnection agreement but are likely to be connected in the next 10 to 15 years.
- TSPs projected a total of 70,273 MW additional load (Price Responsive Load: 4,050 MW*, Flat Load: 66,223 MW) in the next 10 to 15 years, which has not been included in Current Trends.
 - This part was added to both the **High Large Load Adoption** and **High Load Growth and Environmental Regulations** scenarios.



15-Year Input Assumptions (2025-2039)

15-Year Input Assumptions (2025-2039)		Current Trends	High Large Load Adoption	High Load Growth and Environmental Regulations
Load/Energy Forecast	Weather Condition	2013 Weather Condition	2013 Weather Condition	2011 Weather Condition
	Peak Demand for 2039 (MW)	115,734	191,100	195,976
	Annual Energy for 2039 (GWh)	711,078	1,346,200	1,363,494
Environment Regulation Rules	Carbon Price (\$/ton)	0	0	0
	Impact of EPA Rules for Gas Units	None	None	1) carbon capture and storage (CCS) needed for new combined cycles (CCs) 2) capacity factor of existing CCs (>300 MW/unit) < 50% 3) new combustion turbines' capacity factor < 20%
	Coal Retirement	10,228 MW coal retirement by 2032 and 10,987 MW by 2039	10,228 MW coal retirement by 2032 and 10,987 MW by 2039	12,697 MW coal retirement before 2035

New Unit Capital Costs for 2024 LTSA, Overnight Costs, Nominal \$/KW

	Combined Cycle single-shaft	Combined Cycle multi-shaft	Combustion turbine	Combustion Turbine Advanced	Nuclear light water reactor	Wind	Solar	Battery storage 2 hours	Battery Storage 4 hours	Battery Storage 8 hours
2023	975	862	925	561	11,200	1,362	1,050	891	1,535	2,822
2024	987	850	936	543	11,062	1,379	1,022	888	1,529	2,811
2025	997	847	946	536	11,142	1,393	1,015	883	1,520	2,795
2026	1,009	849	957	534	11,230	1,409	1,016	878	1,512	2,780
2027	1,019	850	967	531	11,305	1,423	1,011	872	1,501	2,760
2028	1,029	854	976	531	11,373	1,437	1,009	865	1,489	2,738
2029	1,037	859	984	534	11,428	1,449	1,007	857	1,475	2,712
2030	1,045	863	991	535	11,472	1,460	1,005	847	1,459	2,682
2031	1,053	868	999	538	11,518	1,471	1,004	838	1,442	2,652
2032	1,061	873	1,006	540	11,562	1,481	1,006	828	1,425	2,620
2033	1,069	877	1,014	541	11,609	1,493	1,008	818	1,408	2,589
2034	1,077	882	1,022	544	11,659	1,505	1,011	808	1,391	2,557
2035	1,085	889	1,029	548	11,701	1,516	1,012	797	1,372	2,522
2036	1,093	896	1,036	552	11,738	1,526	1,013	789	1,358	2,497
2037	1,101	904	1,045	557	11,785	1,538	1,016	798	1,373	2,525
2038	1,109	911	1,052	562	11,827	1,549	1,017	806	1,388	2,552
2039	1,117	918	1,060	567	11,867	1,561	1,019	815	1,403	2,579

- Sources of capital cost assumptions:
 - Lazard’s Levelized Cost of Energy Analysis (V16), April 2023
 - NREL Cost Projections for Utility-Scale Battery Storage 2022
 - EIA AEO 2022

Sources:

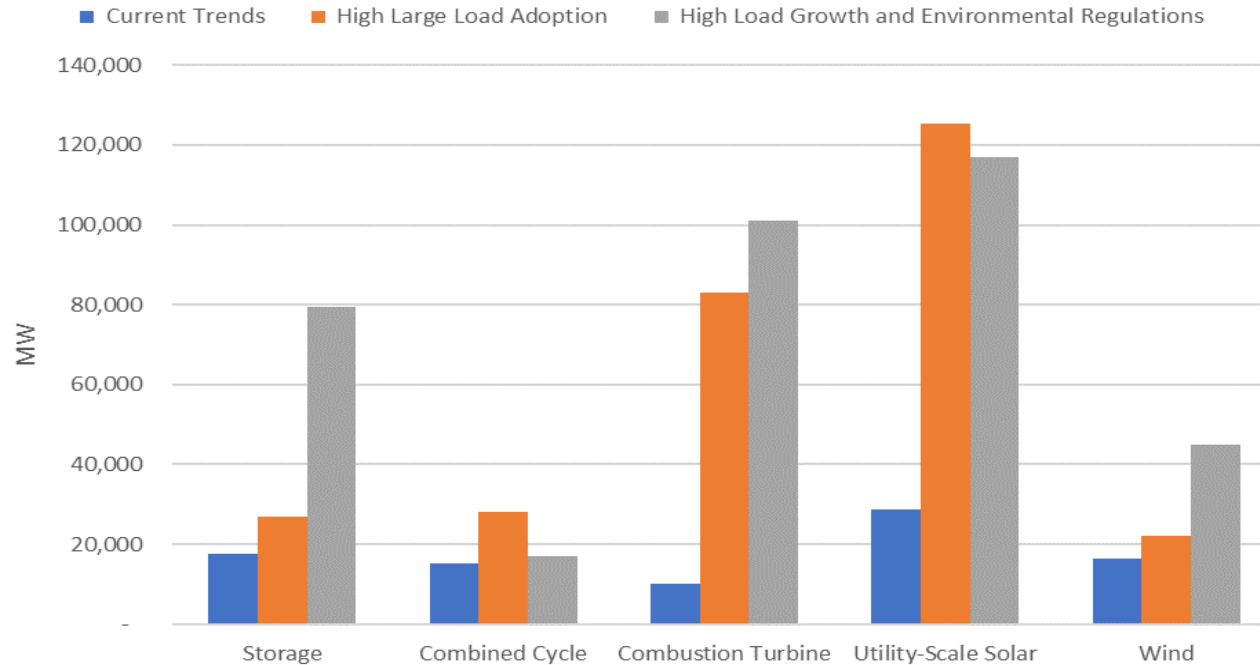
<https://www.lazard.com/research-insights/levelized-cost-of-energyplus/>

https://atb.nrel.gov/electricity/2022/utility-scale_battery_storage

<https://www.eia.gov/outlooks/aeo/>

Capacity Addition by 2039

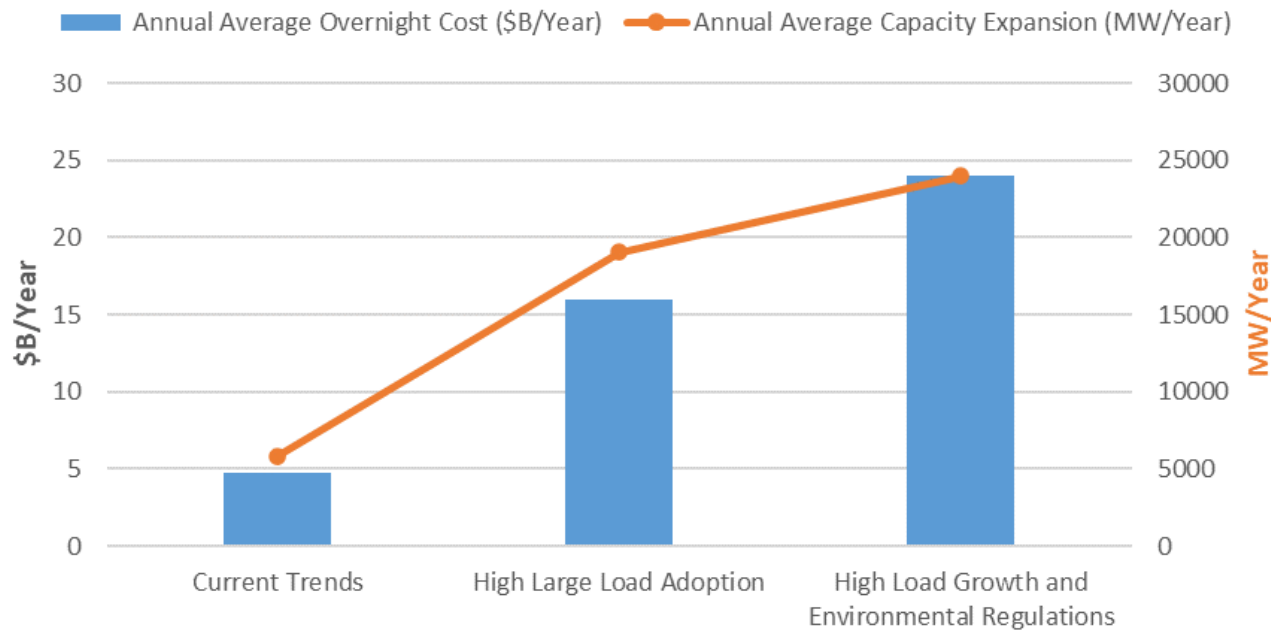
- A total of 87.7 GW, 285.8 GW, 359.2 GW of new resources added to Current Trends, High Large Load Adoption, and High Load Growth and Environmental Regulations scenarios by 2039, respectively.



	Current Trends	High Large Load Adoption	High Load Growth and Environmental Regulations
Storage	17,514	26,911	79,307
Combined Cycle	15,162	28,158	16,965
Combustion Turbine	9,951	83,187	100,962
Utility-Scale Solar	28,800	125,368	116,994
Wind	16,300	22,200	45,000

Future Investment Need

- To serve the future demand, significant investment will be needed across all three scenarios.
 - The annual capacity expansion, on the average, is 5,848 MW/year for Current Trends, 19,055 MW/year for High Large Load Adoption, and 23,949 MW/year for High Load Growth and Environmental Regulations scenarios, respectively.

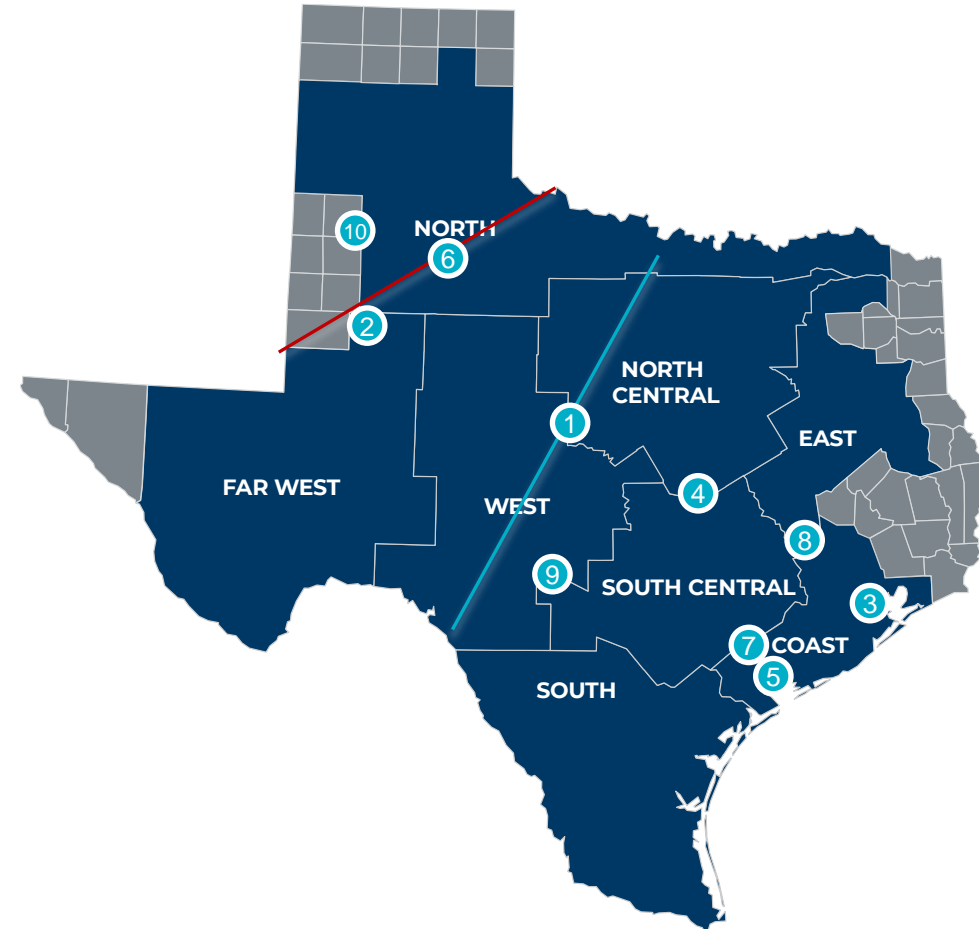


	Current Trends	High Large Load Adoption	High Load Growth and Environmental Regulations
Annual Average Overnight Cost (\$B/Year)	4.7	16	24
Annual Average Capacity Expansion (MW/Year)	5,848	19,055	23,949

Top Congested Constraints from 2034 and 2039 Study Years for Current Trends

- The total congestion rent for 2034 and 2039 is \$2.2B and \$3.2B, respectively.

Index	Constraint	Congestion Rent* (\$M)	
		2034	2039
1	West Texas Export Interface	556	821
2	Farmland - Wett Long Draw 345-kV Line	134	233
3	Meadow - PH Robinson 345-kV Line	162	155
4	Bell County East Switch - Sandow Switch 345-kV Line	121	153
5	South Texas Project - Jones Creek 345-kV Line	55	143
6	Panhandle Interface	142	140
7	Refuge - Jones Creek 345-kV Line	49	112
8	North - Houston Interface	60	108
9	Kendall - Welfare 138-kV Line	15	81
10	MacKenzie Substation - Northeast Substation 115 kV Line	55	79



*Congestion rent indicates areas of the system where economic transmission projects may be beneficial. It is not an indication of whether a project to reduce specific congestion would or would not meet the ERCOT economic planning criteria.

Key Takeaways

- With the retirement of conventional generation continuing, the high large load growth will drive the new and planned Generation Resources being mostly solar, combustion turbine, and battery energy storage.
 - This will result in increased reliance on renewable generation to meet the system demand.
 - To comply with more restrictive environmental regulations, we need to add 79,307 MW of battery energy storage by 2039.
 - A total of 83,187 MW and 100,962 MW of new combustion turbine capacity is needed by 2039 for High Large Load Adoption scenario and High Load Growth and Environmental Regulations scenario, respectively.

Questions

- Send questions or comments to:
 - [Pengwei.du@ercot.com](mailto: Pengwei.du@ercot.com)