
60 PROUD CANADIAN YEARS
February 15, 1965 to February 15, 2025

Welcome to
Calgary Renewable Energy Meetings
February 15, 2025

Wind and Solar Success in Texas!

Why?

Presentation by Ken Hogg M.Eng., P.Eng.
Founder
Alberta Renewable Energy Alliance

But first

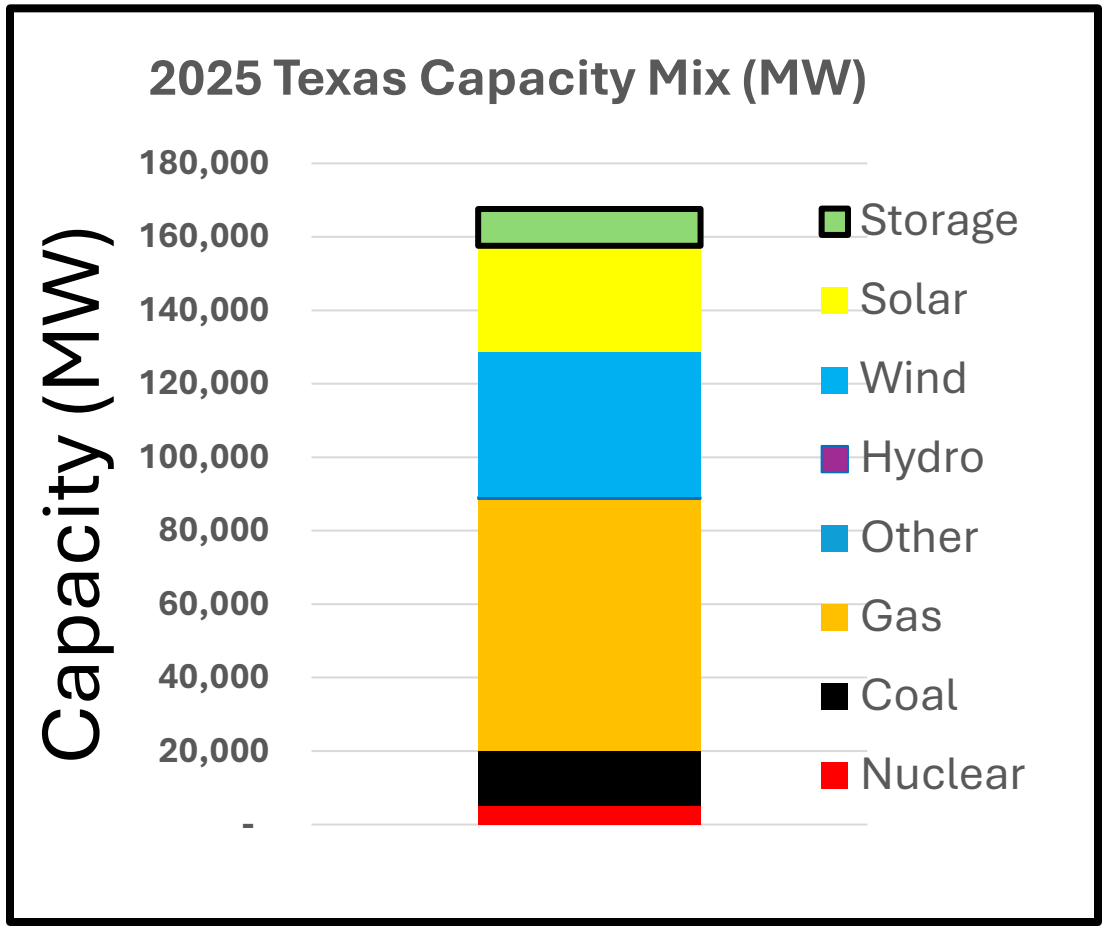
Overview (after acknowledging the elephant)

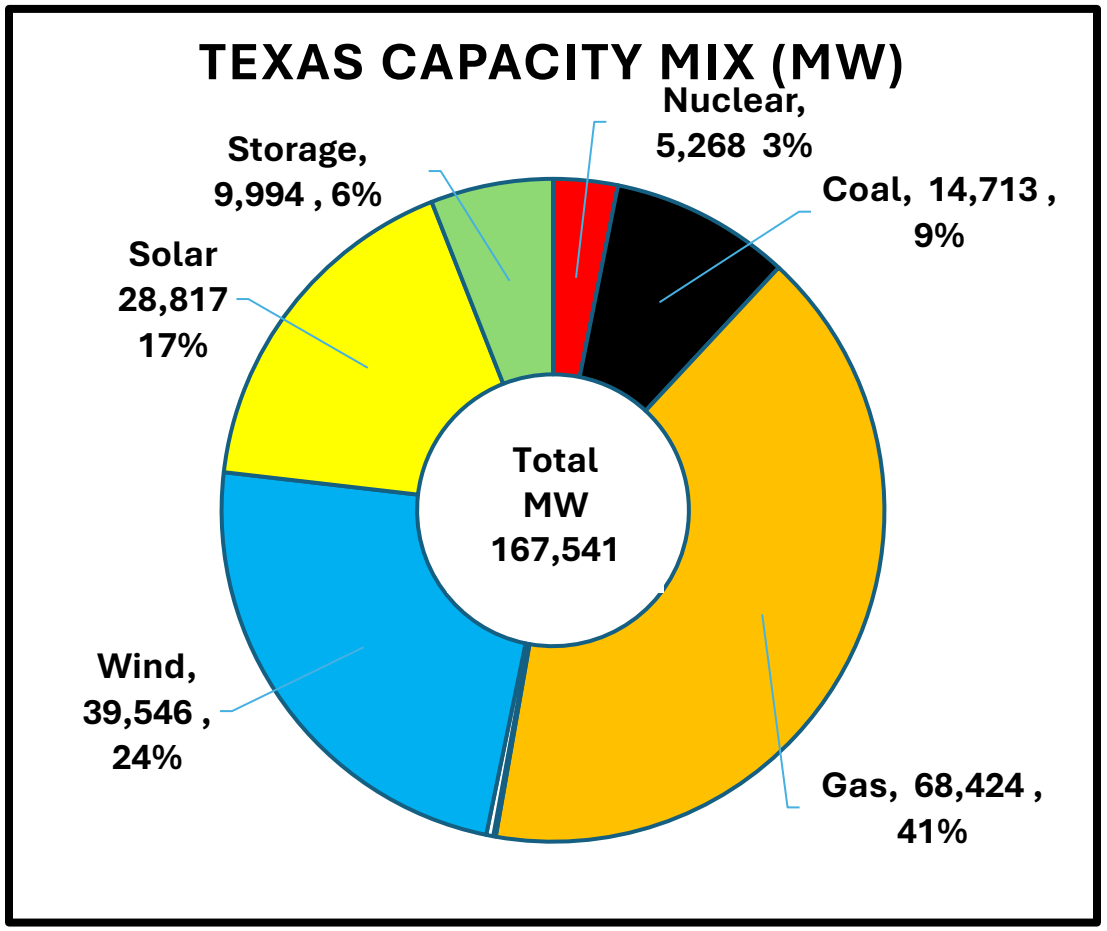
- Rapid Deployment of Wind and Solar in Texas
- What has enabled this Progress?
- What enablers might work in Alberta?
  - AESO (Alberta Electric System Operator)?

In West Texas, wind turbines and pump jacks have been sharing the same landscape for more than a decade, during which Texas has led the U.S. in wind power capacity and production.

USDA, NATURAL RESOURCES CONSERVATION SERVICE, TEXAS

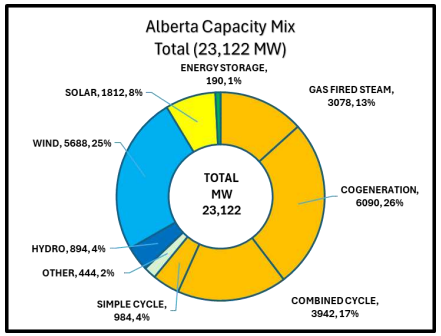
ERCOT (Electric Reliability Council of Texas) Total Capacity (167,541 MW)



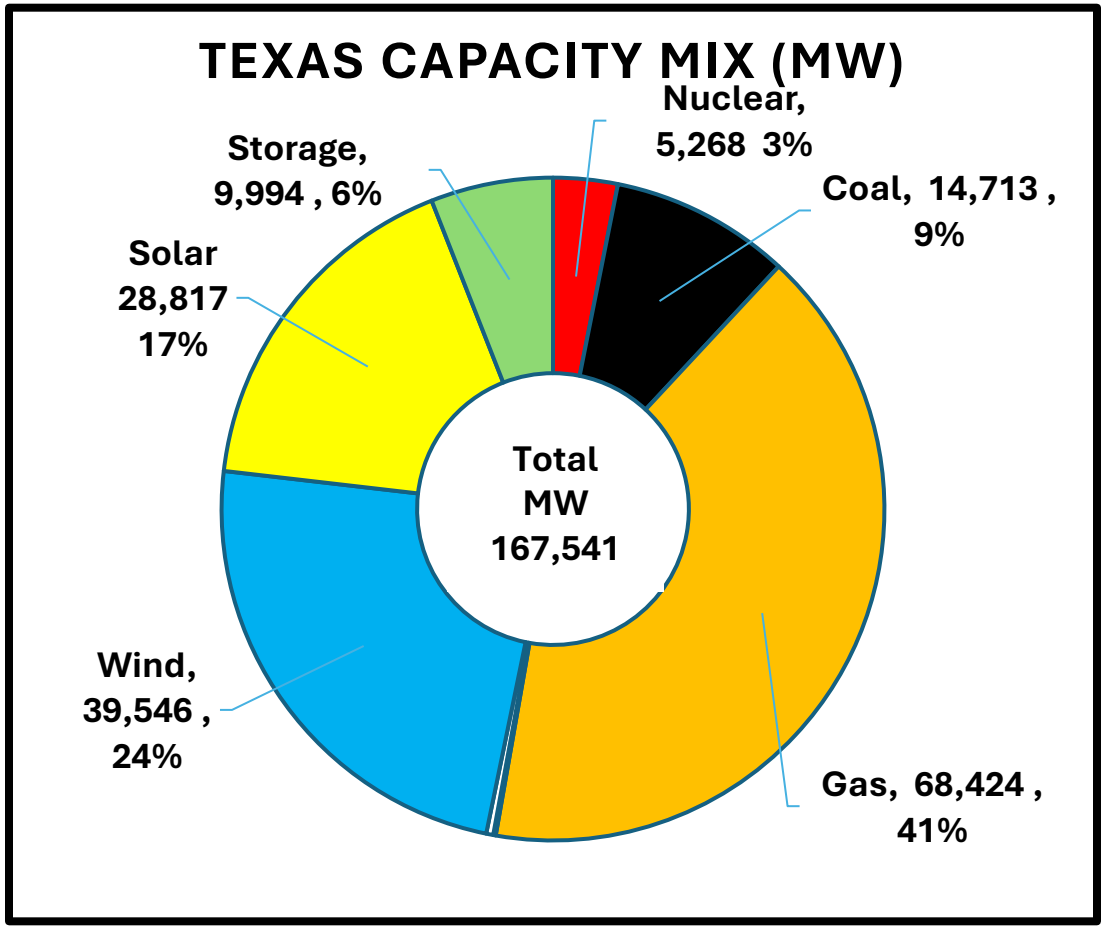


Texas Capacity is 7.5 times larger than Alberta

Alberta

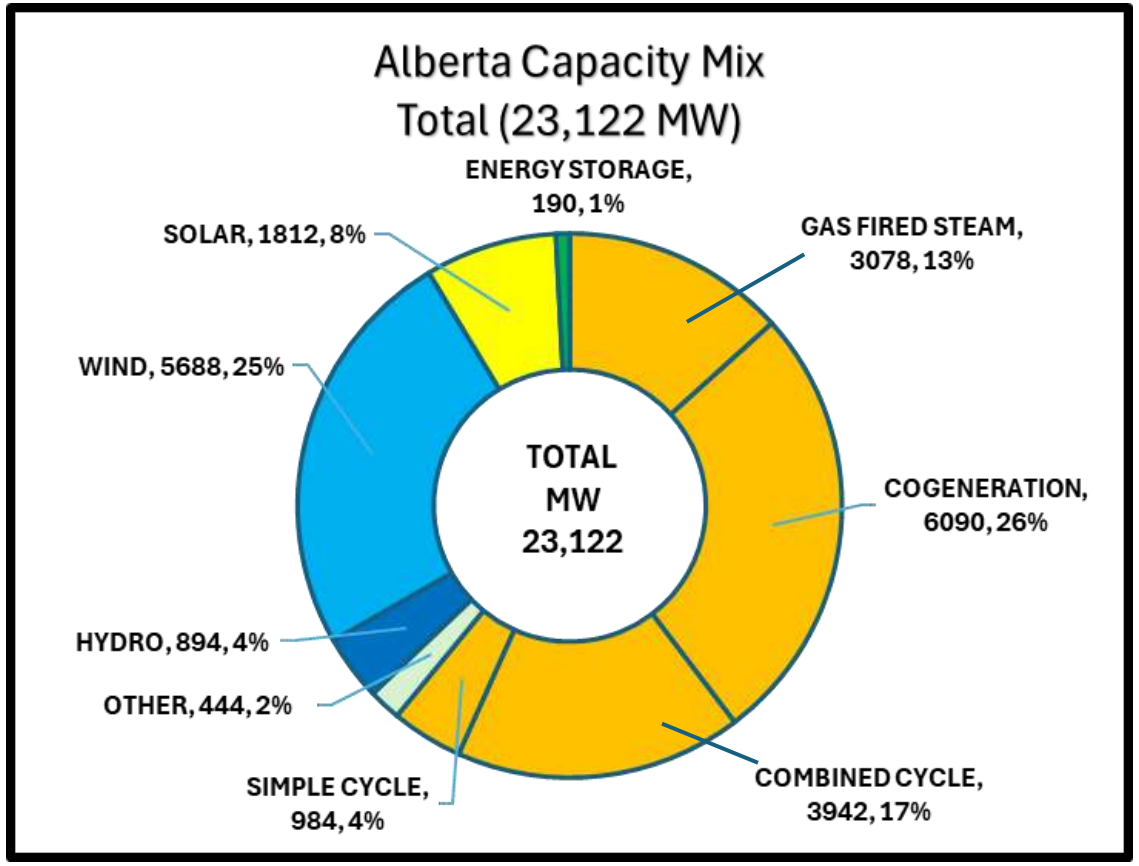


Texas

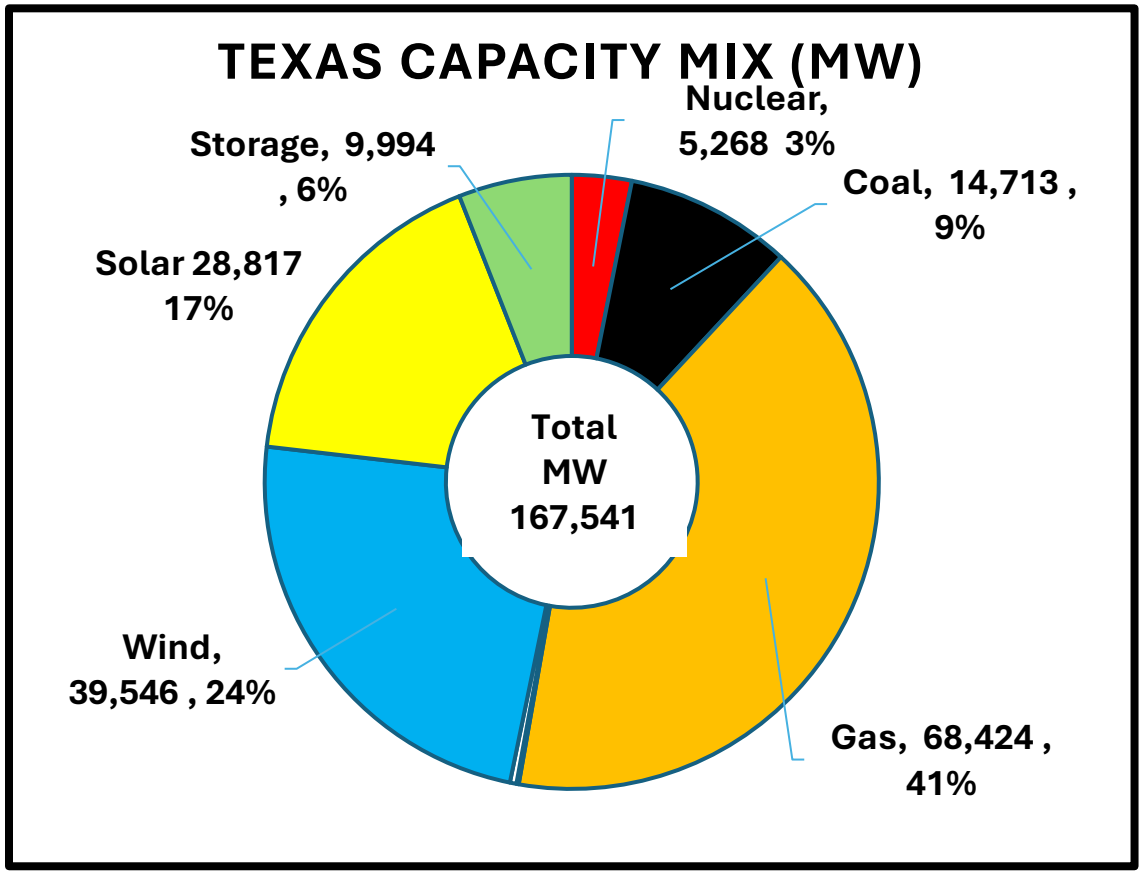


2025 Systems Capacity Comparison

Alberta (23 GW)

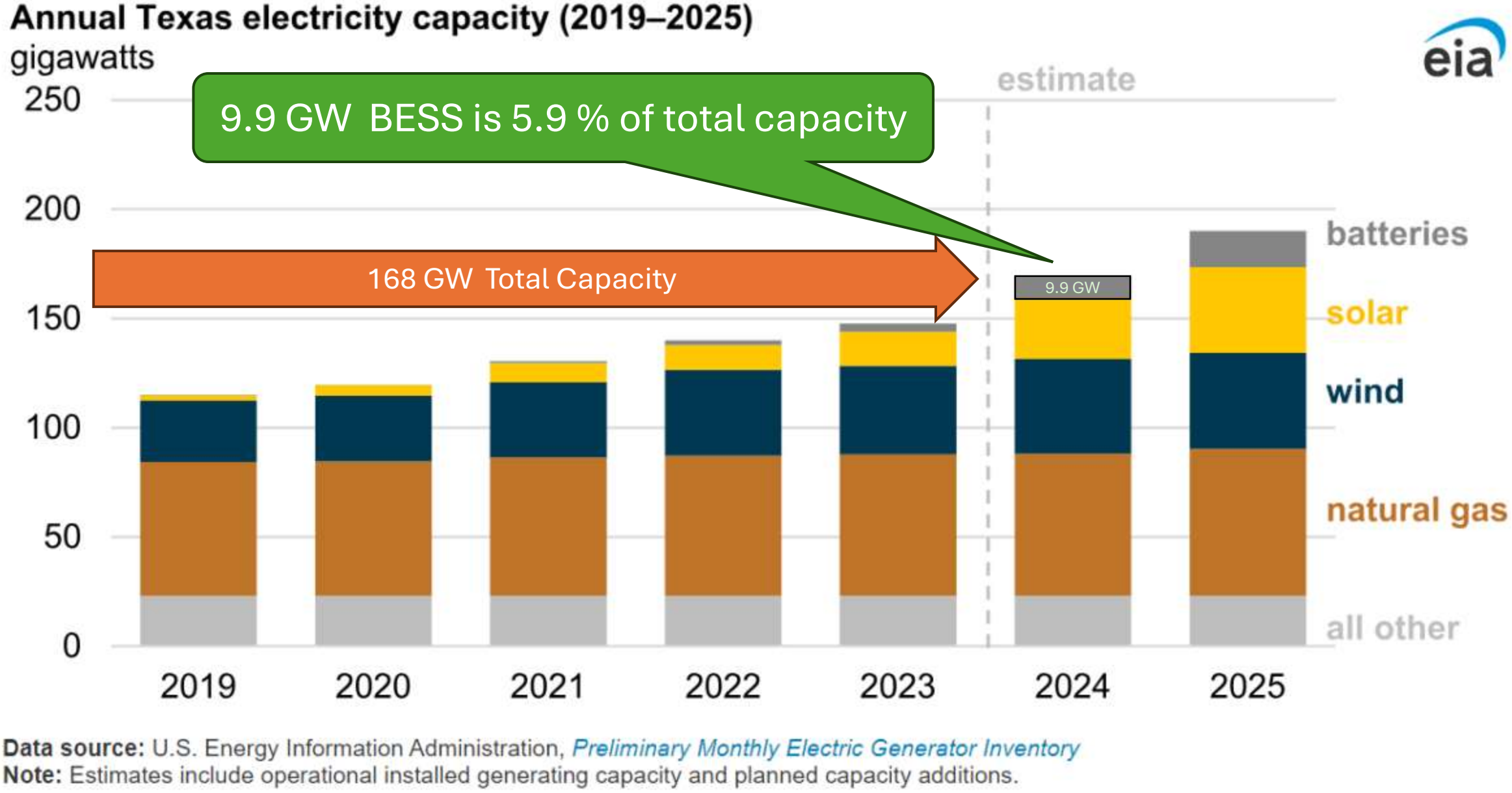


Texas (168 GW)



Overview

- Rapid Deployment of Wind and Solar in Texas
- What has enabled this Progress?



Data source: U.S. Energy Information Administration, *Preliminary Monthly Electric Generator Inventory*
Note: Estimates include operational installed generating capacity and planned capacity additions.

Alberta Electric System Operator (AESO)
Current Supply Demand Report (Feb. 14, 2025, 21:22)
http://ets.aeso.ca/ets_web/ip/Market/Reports/CSDReportServlet

9,994 MW BESS is 5.9 % of total Texas Capacity

COMPARE

190 MW BESS is 0.8 % of total Alberta capacity

GENERATION			
GROUP	MC	TNG	DCR
COGENERATION	6090	4966	0
WIND	5688	333	0
COMBINED CYCLE	3942	3555	0
GAS FIRED STEAM	3078	1390	70
SOLAR	1812	0	0
SIMPLE CYCLE	984	538	30
HYDRO	894	339	226
OTHER	444	302	12
ENERGY STORAGE	190	0	123
TOTAL	23122	11423	461

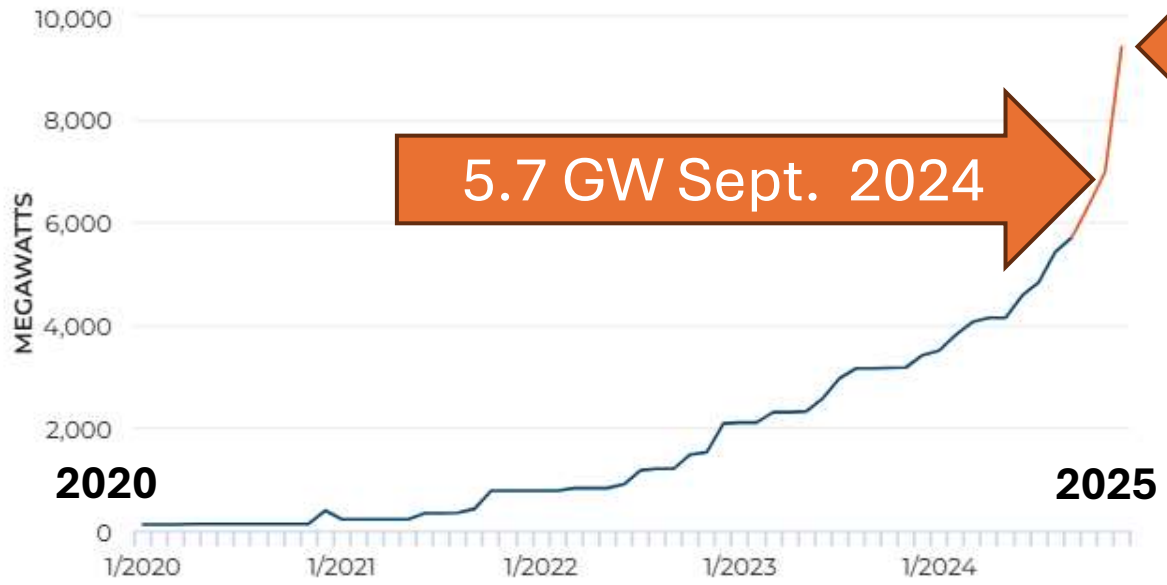
Battery energy storage in Texas

comptroller.texas.gov/economy/fiscal-notes/infrastructure/2024/battery-store/

Enter battery energy storage systems (BESS).

When intermittent energy sources like wind and solar go offline, batteries can release stored energy and provide greater reliability and stability to the Electric Reliability Council of Texas (ERCOT) system. Batteries also can be quickly deployed to shore up grid stability in tight conditions, like when a power plant suddenly trips offline. From September 2020 to September 2024, Texas' total operational capacity of utility-scale batteries — large storage systems that plug directly into the grid or generation sources — increased more than 4,100 percent to 5,707 megawatts (MW) (**Exhibit 1**).

EXHIBIT 1: CUMULATIVE OPERATIONAL BESS CAPACITY BY RATED POWER IN ERCOT, IN MEGAWATTS (MW)



▶ Exhibit 1 data

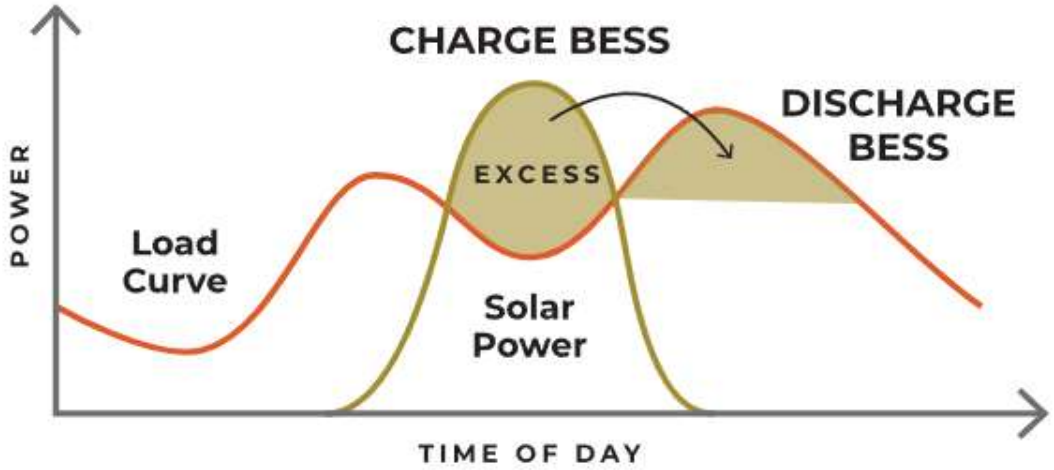
Source: U.S. Energy Information Administration

Exponential buildout of BESS (Battery Energy Storage Systems) since 2020

peak demand periods and lowers grid strain, it also reduces energy costs.

EXHIBIT 4: PEAK LOAD SHIFTING

BESS
Provides Peak
Load Shifting



While the available supply of battery storage in Texas is around 3 percent of total capacity, BESS can have a large impact on stabilizing grid operations and lowering costs for developers and consumers alike (**Exhibit 5**). For example, when Winter Storm Heather impacted Texas in January 2024, BESS units generated $750 million in market savings by delivering ancillary services and freeing up to 3 GW of gas generation to meet demand and lower prices. And when record hot temperatures strained the grid in September 2023, energy stored by BESS supplied electricity to approximately 434,000 homes and helped avoid grid failure.

Source

pv-magazine.com/2024/04/10/solar-is-starting-to-sunset-use-of-natural-gas-in-texas/

pv-magazine.com/2024/04/10/solar-is-starting-to-sunset-use-of-natural-gas-in-texas/

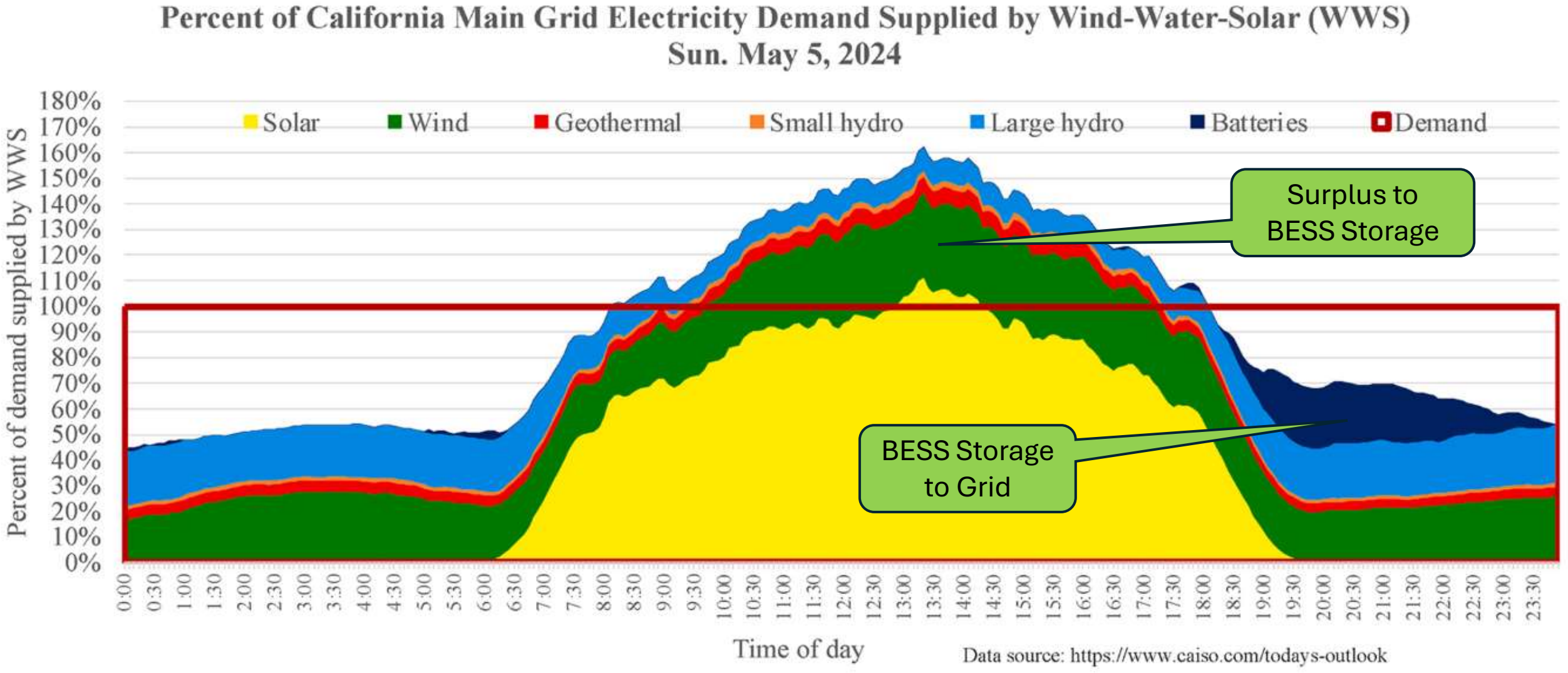
> "As solar power generation declines later in the afternoon, natural gas is dispatched to meet the electricity demand," said the EIA. "Wind generation also increases in the evening, limiting the need for additional generation from natural gas or other dispatchable resources."

Energy storage is increasingly important in closing this supply and demand gap and negating the need for emissions-causing natural gas burning. Many energy storage projects being deployed in Texas today range between one to four hours of duration, serving the use case of dispatching electricity when it is needed most.

pv-magazine.com/2024/04/10/solar-is-starting-to-sunset-use-of-natural-gas-in-texas/

Natural gas peak demand plants or "peaker" plants are among the most inefficient uses of natural gas reserves. A study from Sandia National Laboratories explores this issue and how energy storage is expected to replace natural gas peakers.

This is reflected in the capacity additions planned for ERCOT. The EIA expects 13 GW of battery storage capacity to be added between the time of this report and 2025. Over the same period, 3 GW of natural gas additions are expected.


Percent of California Main Grid Electricity Demand Supplied by Wind-Water-Solar (WWS)
Sun. May 5, 2024
Solar
Wind
Geothermal
Small hydro
Large hydro
Batteries
Demand
Surplus to BESS Storage
BESS Storage to Grid
Percent of demand supplied by WWS
180%
170%
160%
150%
140%
130%
120%
110%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0:00
0:30
1:00
1:30
2:00
2:30
3:00
3:30
4:00
4:30
5:00
5:30
6:00
6:30
7:00
7:30
8:00
8:30
9:00
9:30
10:00
10:30
11:00
11:30
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
18:00
18:30
19:00
19:30
20:00
20:30
21:00
21:30
22:00
22:30
23:00
23:30
Time of day
Data source: https://www.caiso.com/todays-outlook

Overview

- Would this enabler work in Alberta?
  - AESO (Alberta Electric System Operator) ?

AESO 2025
Long-Term Transmission Plan

JANUARY 2025

LTO Scenarios Evaluated in the LTP

The LTP evaluates four scenarios developed in the AESO's 2024 LTO, including:

- Reference Case
- Decarbonization by 2035
- Alternative Decarbonization
- High Electrification

Table 9 below summarizes the 2024 LTO's four scenarios.

The Reference Case serves as the base scenario for the AESO's transmission planning assessment.

We also developed additional scenarios based on the LTO's Decarbonization by 2035, Alternative Decarbonization and High Electrification scenarios to capture uncertainties stemming from the pace and extent of electrification, new generation technologies, increased intertie connections, and the federal government's proposed *Clean Electricity Regulations* (CER).[10]

The LTO Reference Case projects that peak load growth will average an annual rate of 1.4 per cent over the next 20 years.

Energy Storage

Energy storage, as a non-wires solution, offers valuable services and capabilities. Because of its potential, we consider energy storage an essential tool in the AESO's planning framework. We will continue to explore its diverse applications within the planning domain, guided by the regulatory framework.

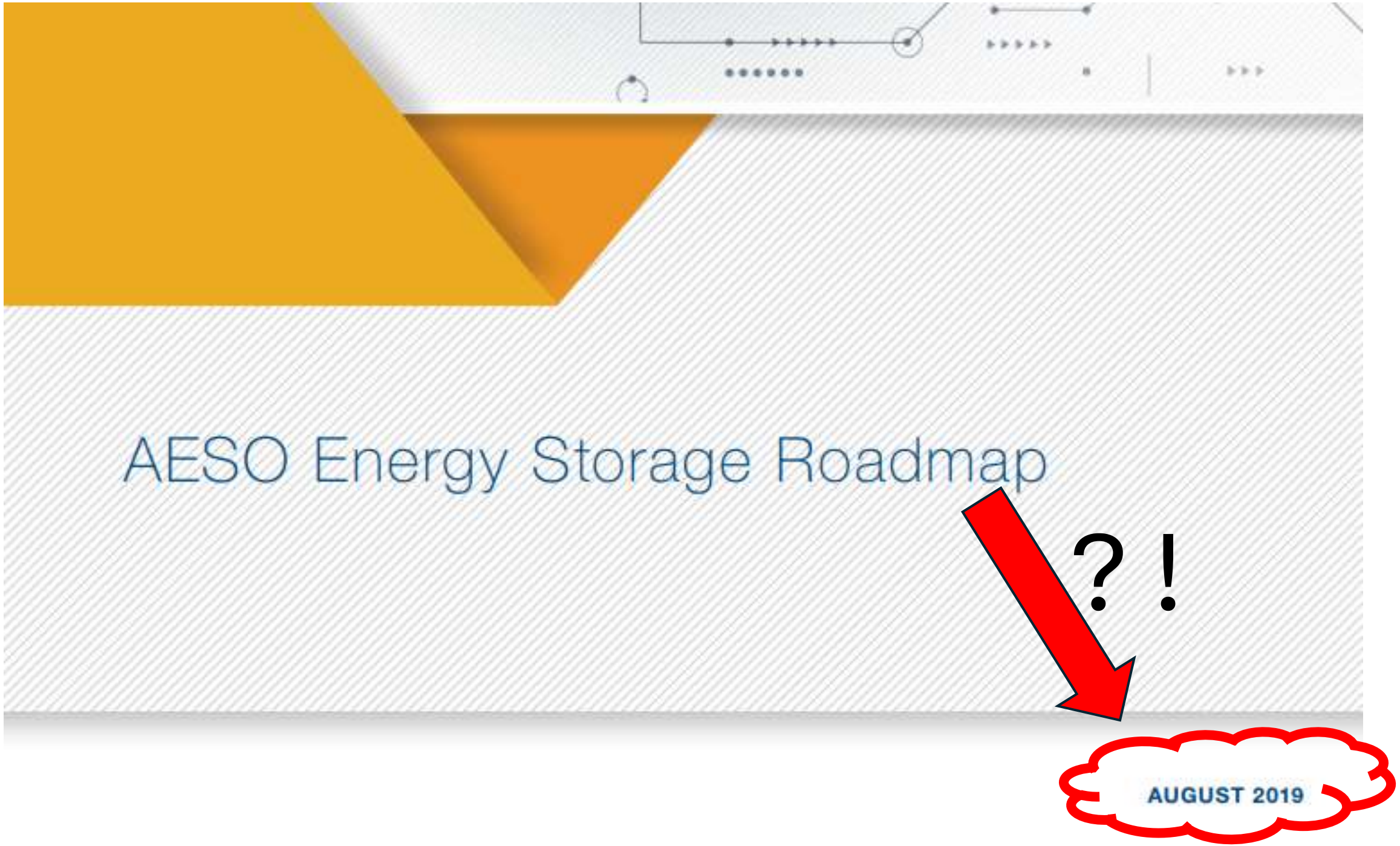
Possible energy storage uses include:

- Frequency regulation
- Voltage support
- Congestion management
- System inertia support
- System strength support

An energy storage facility often has the versatility to provide several of the services listed above.

Since the inception of the *Energy Storage Roadmap*, several battery energy storage projects have come online in Alberta and more are in the project connection list.

ROADMAP ?


AESO Energy Storage Roadmap
? !
AUGUST 2019

AESO 2024
Long-Term Outlook

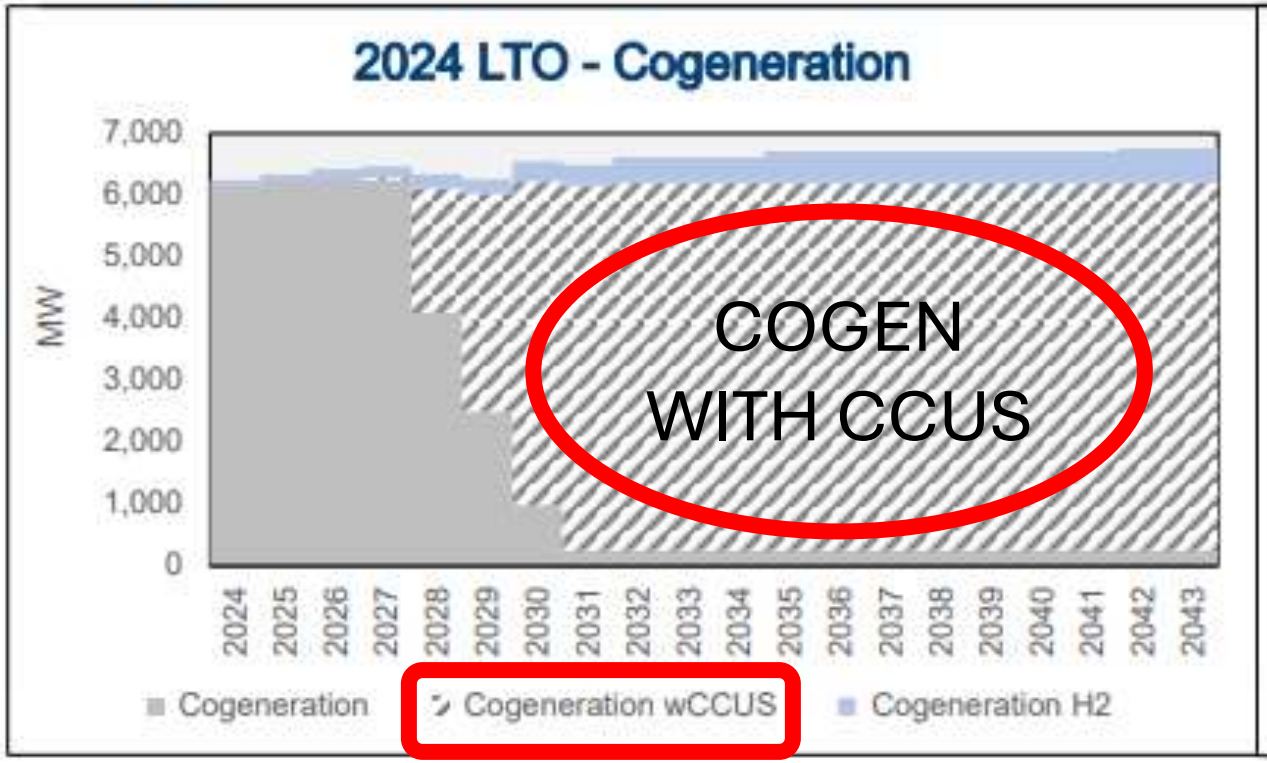
MAY 2024

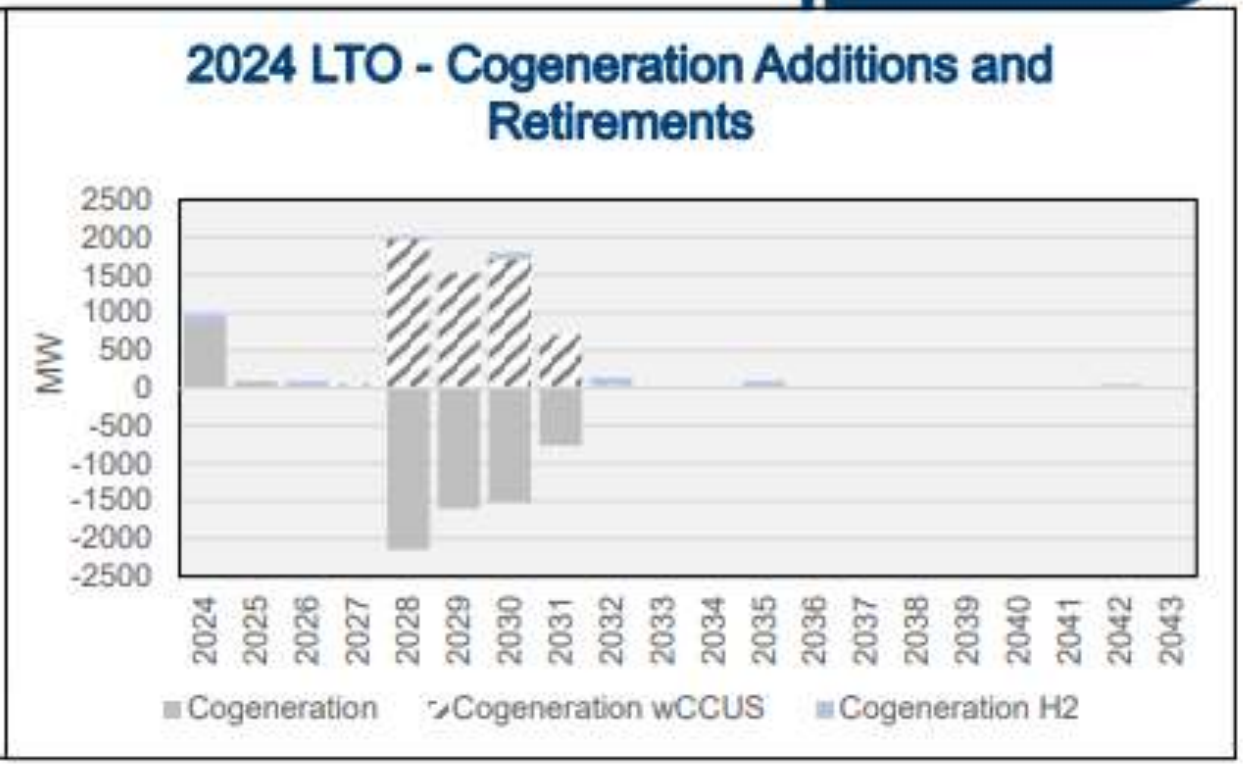
2024 Long-Term Outlook (LTO) Final Results

May 22, 2024

Public

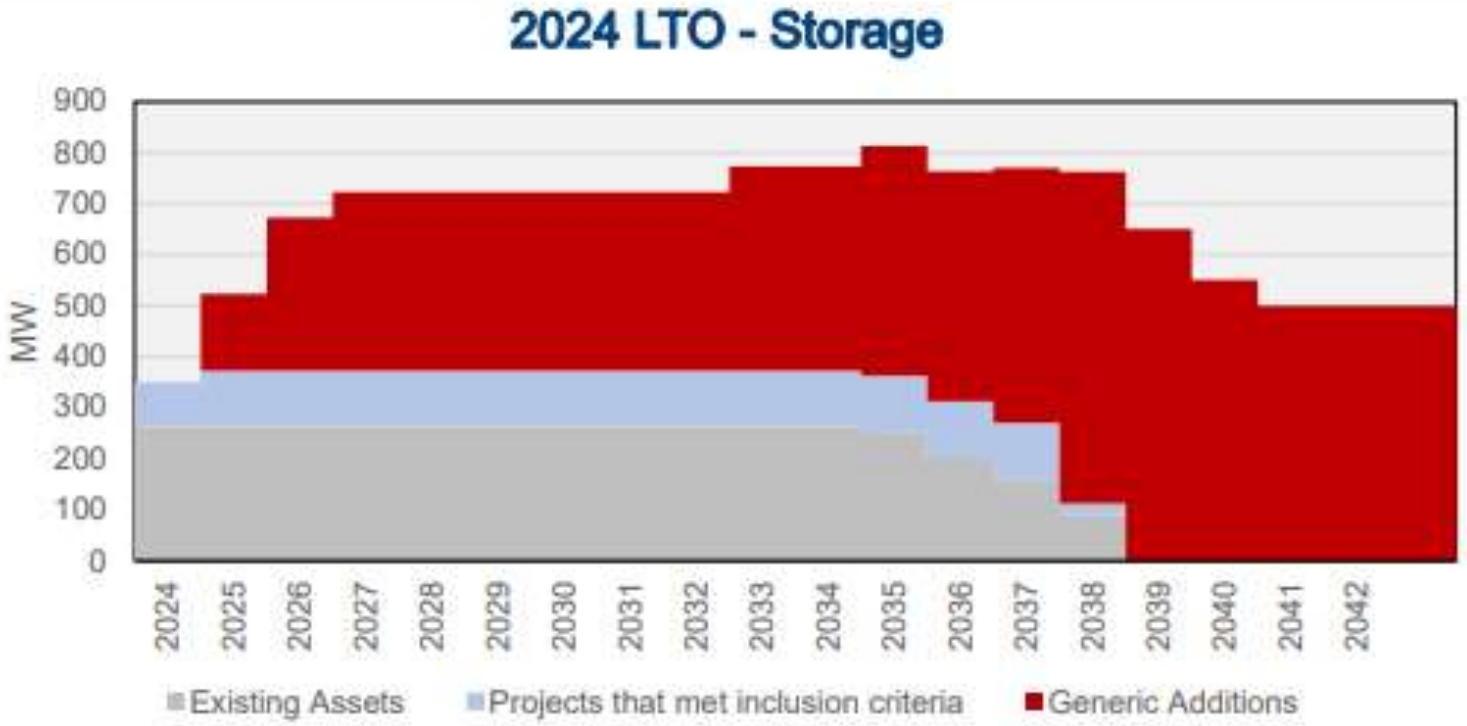
Cogeneration Forecast





- Oilsands cogeneration forecast is aligned with the load forecast, insights from IHS Markit, and the expectation of no new greenfield oilsands projects going forward within the forecast horizon
  - Cogeneration facilities are expected to retrofit with CCUS between 2027 and 2031
- Hydrogen cogeneration forecast developed in tandem with hydrogen production load forecast
  - Assumes that electricity production from cogeneration would meet approximately half of the electrical load

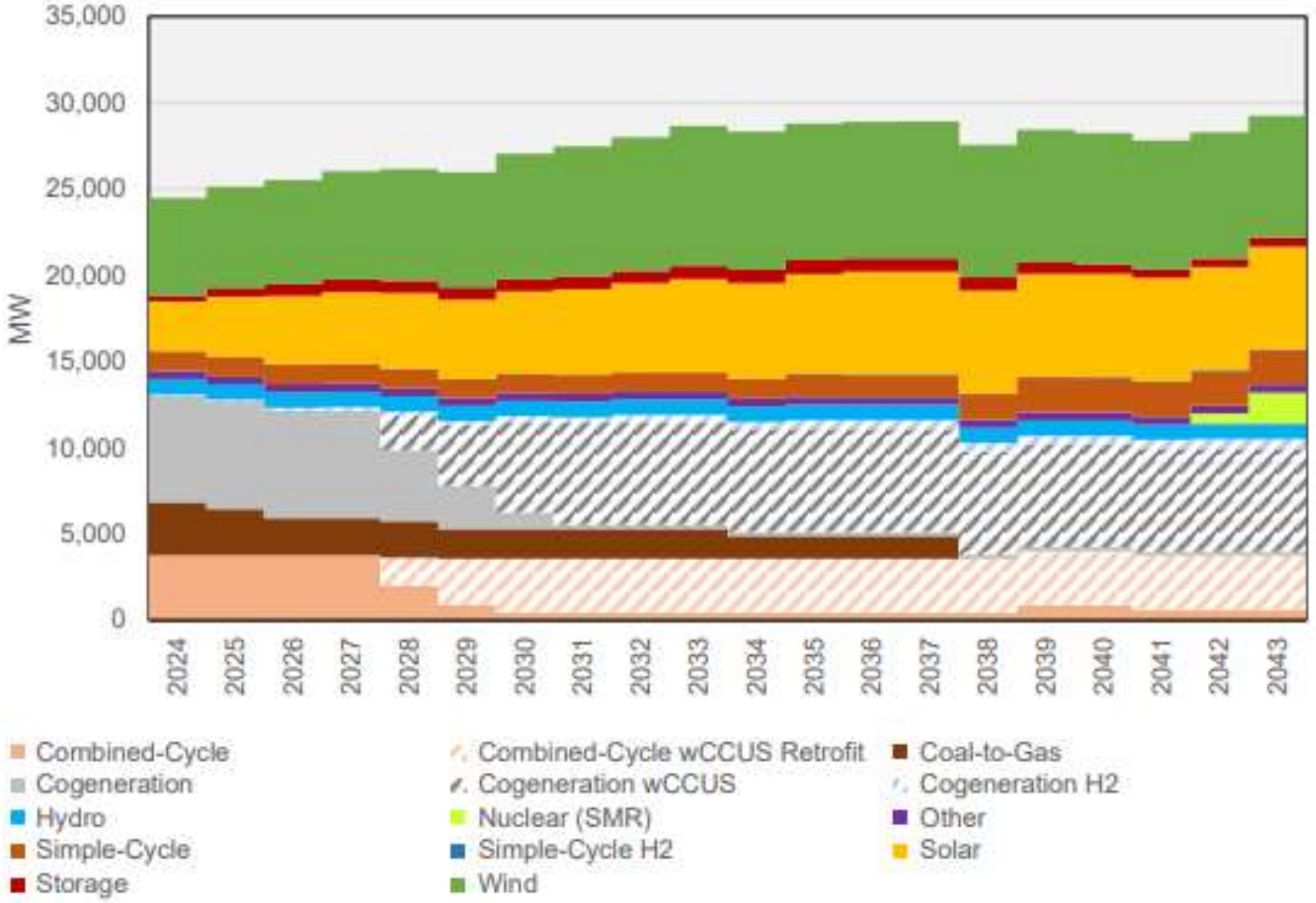
Storage Forecast



- Storage forecast largely driven by participation in ancillary service markets
  - 850 MW of "generic" storage added between 2025 and 2040
  - Lithium-ion storage assumed to be replaced at 14-year intervals
- Economic modelling does not support storage development for the exclusive purpose of energy arbitrage in the existing market framework with forecast capital costs for storage

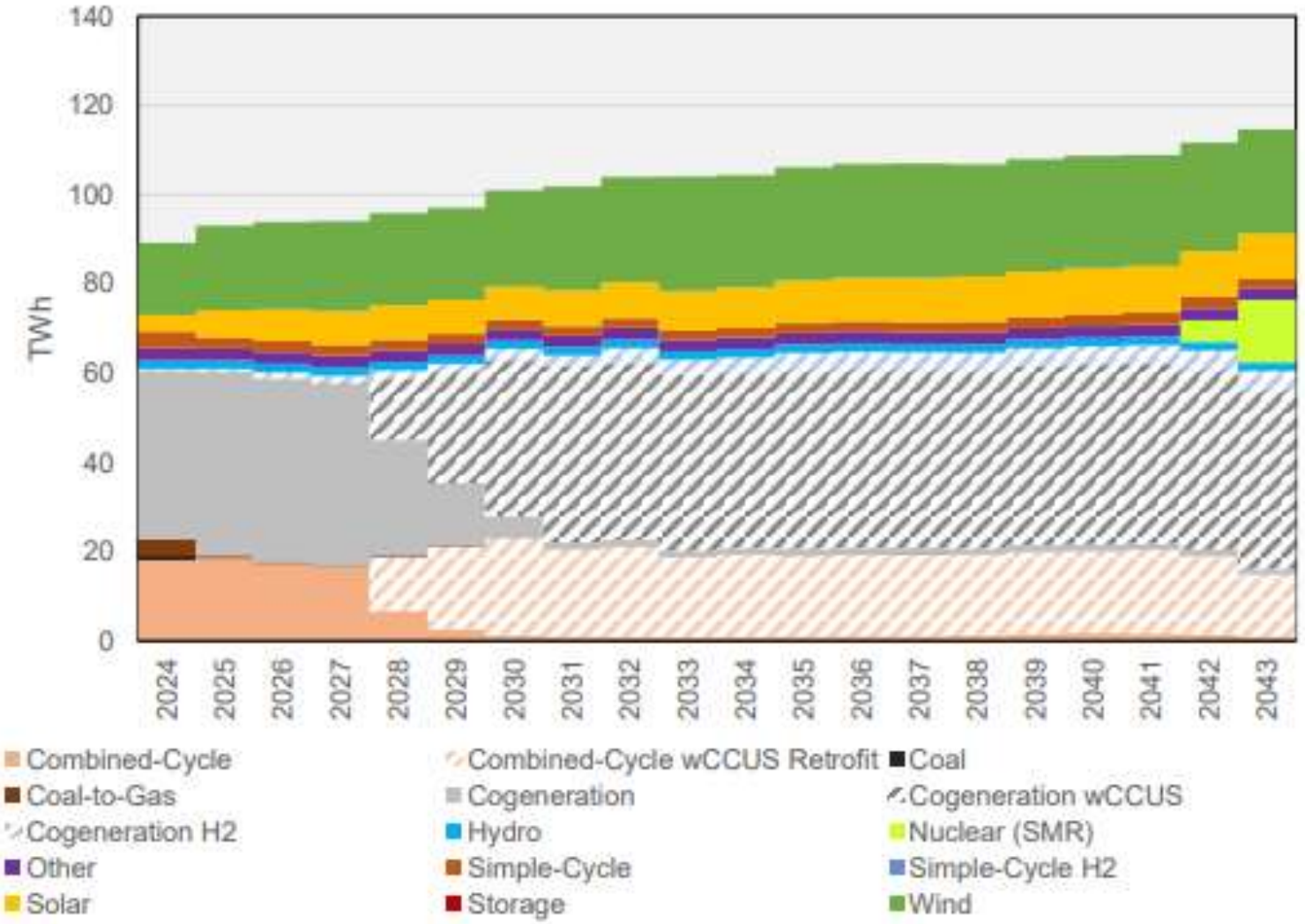
Reference Case – Total Capacity

- Wind, solar, and cogeneration and combined-cycle with CCUS are dominant technologies
- By 2035:
  - 7,934 MW of wind
  - 5,765 MW solar
  - 5,944 MW cogeneration with CCUS
  - 3,121 MW combined-cycle with CCUS retrofits
- Wind and solar reach 44% of total capacity by 2030 and 50% of total capacity by 2038



Reference Case - Annual Energy Forecast

- Wind and solar account for approximately 30% of generation throughout the forecast, reaching a maximum of 33% from 2033 to 2040
  - Generation from all renewable energy sources reaches 30% of generation by 2025, increasing to 35% by 2033
- Natural gas-fired generation supplies 60 to 70% of overall energy
  - By 2031, over 90% of natural gas-fired generation is abated
  - Unabated natural gas simple- and combined-cycle generation makes up a small portion of generation despite no CER in effect
- In 2042 and 2043, generation from nuclear SMRs begins to displace some natural gas-fired generation



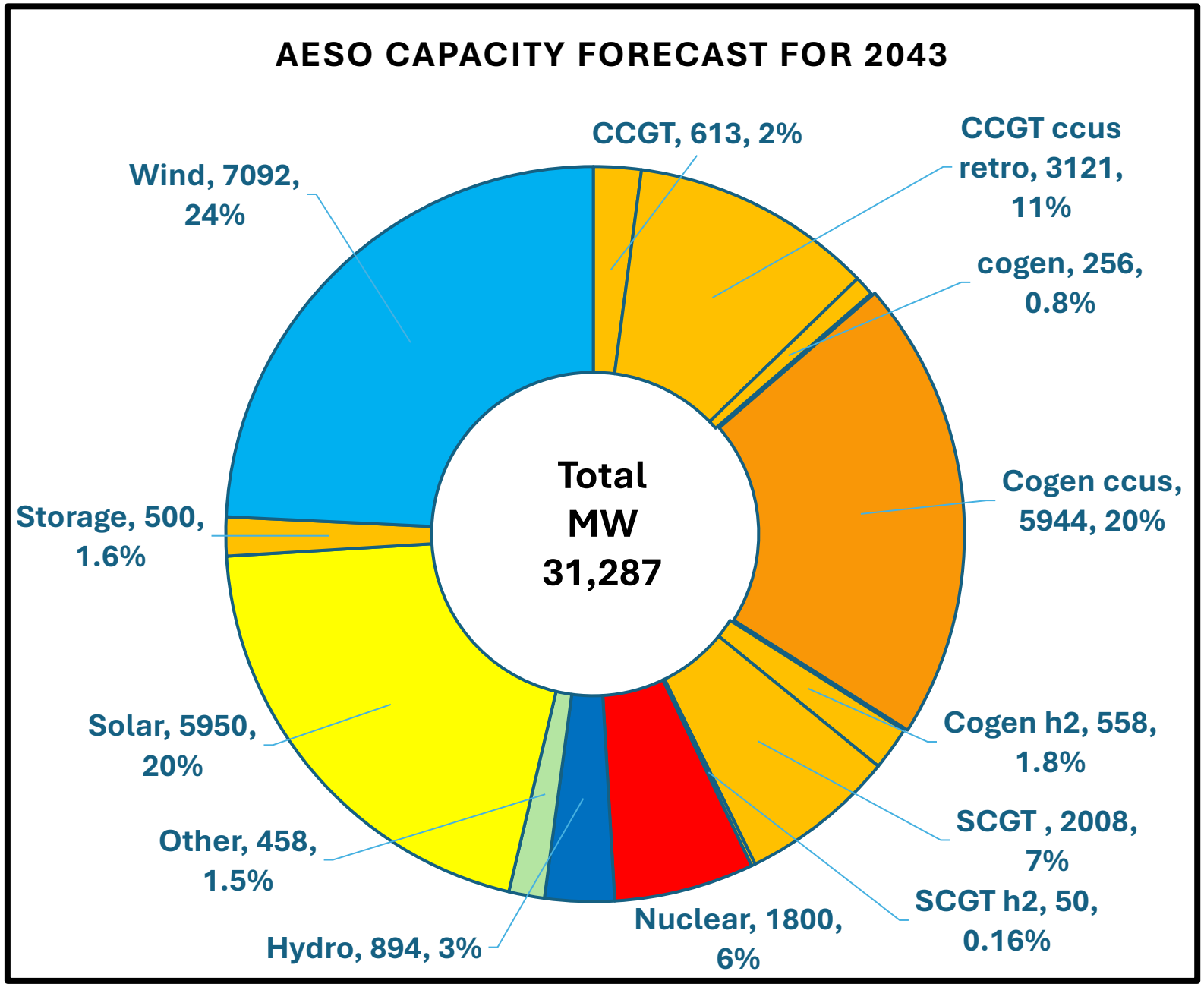
Generation Total Capacity Scenario Comparison

	Total Capacity Reference Case				Difference from Reference Case											
					Decarbonization by 2035				High Electrification				Alternative Decarbonization			
	2024	2028	2035	2043	2024	2028	2035	2043	2024	2028	2035	2043	2024	2028	2035	2043
Combined-Cycle	3,765	1,997	435	613		104	300	- 118						900	1,096	766
Combined-Cycle with CCUS	0	0	0	0				754			377	2,262				1,131
Combined-Cycle with CCUS Retrofit	0	1,622	3,121	3,121		- 77	- 270	- 270						- 840	- 1,033	- 1,033
Coal	0	0	0	0												
Coal-to-Gas	3,075	2,124	1,329	0		6	401			401	801			- 400		
Cogeneration	6,152	4,100	256	256												
Cogeneration with CCUS	0	2,009	5,944	5,944												
Cogeneration H2	93	233	512	558												
Hydro	894	894	894	894												
Nuclear (SMR)	0	0	0	1,800				- 300				900				- 1,800
Other	458	458	458	458												
Simple-Cycle	1,161	1,161	1,296	2,008		- 201	- 617	- 1,157		- 161	- 406	- 209		- 153	- 394	- 995
Simple-Cycle H2	0	0	50	50			233	465				233			- 50	- 50
Solar	2,869	4,365	5,765	5,950												
Storage	350	723	813	500			50	150			50	50			50	100
Wind	5,662	6,462	7,934	7,092							- 100	- 100			- 100	- 100

AESO Total Capacity Reference Case 2043

Cogen ***with CCUS*** (Carbon Capture Utilization and Storage) represents 20% of total capacity

Energy Storage represents 1.6% of total capacity



Alternatives ? (*Can we budge the elephant?*)

We can work toward structural change

- *by writing or calling our elected officials;*
- *by writing letters to the Editor;*
- *by phoning the media to ask for the kind of coverage that we want to see;*
- *by getting involved with groups like AREA, or*
- *by listening to an excellent podcast like Volts, or Energy vs Climate, or Energi Media, or Zero, or Outrage + Optimism, or the renewables-related episodes on Alberta at Noon or West of Centre.*

- *Subscribing to or commenting on these helps grow an audience. These all pop the oil-and-gas tinted bubble that surrounds us and prevents us from learning how fast the rest of the world is moving away from fossil fuels to cleaner, cheaper options that are equally or more reliable."*

Alternatives ? (*Can you budge the elephant?*)

- Home grown DIY (Do It Yourself)
- One option:
  - Ensure that municipalities encourage ***backyard*** solar PV;
  - This will allow homeowners of a house/roof with poor solar exposure to site and orient an economical ground mounted solar array in an optimal location to offset ***some*** of their power loads -
  - (e.g air conditioning during hot summers under a blazing sun……..that powers a solar PV system)