

Electrifying the Permian Basin –

Prepared for ERCOT planning committee

Upstream Consulting

March 22, 2023

S&P Global

Commodity Insights

Agenda

Introduction and objectives

Summary results of the 2022 report

ERCOT – follow up items and questions

Summary conclusions

Appendix

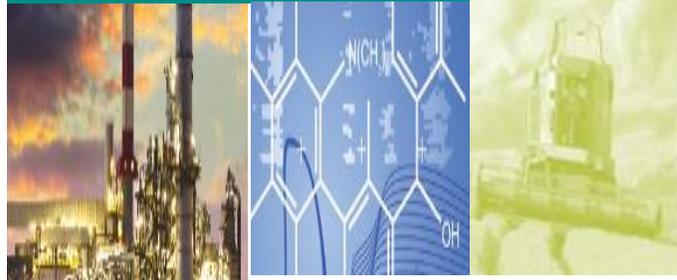
S&P Global Commodity Insights (formerly IHS Markit) – submitted 2019 report (Texas Only at Oncor's request)

Upstream Oil & Gas



- Data and Analytics,
- Geoscience and Engineering,
- Research Market Analysis and Forecasting

Oil Markets – Midstream, Downstream and Chemicals



- Data and Analytics – infrastructure and industrial
- Research, Market, Analysis and Forecasting

POWER, GAS, COAL & RENEWABLES



- Data and Analytics – Power Generation
- Research, Market, Analysis and Forecasting

Expertise, data and tools, internal and external contacts
ENERGY-WIDE PERSPECTIVES

Update - Permian Basin forecast of future load demand

Objectives of this report

- Apply similar bottom up – holistic assessment of future industrial load demand
- Include New Mexico portion of the Permian Basin
- Update the 2019 production forecast with future growth trajectories
- Incorporate information from sponsor companies including grid-connect strategies
- Embrace new grid-connect requirements associated with corporate emission reduction targets

Key Themes

- Access to electrical grid service continues to materially lag demand, especially in the Delaware Basin, where substantial growth is expected
- Operators continue to strongly prefer the electrical grid (and electric utilities have an obligation to serve)
- Corporate emission reduction targets will substantially add to future load demand over and above previous forecasts

Since 2019, global oil markets and company electrification priorities have changed, necessitating a significant increase in electric load demand within the Permian basin

2022 report key takeaways

Energy Transition

- Since 2019, most major Permian Basin operators have made public commitments to emission reduction targets. Electrification is seen as a critical part of meeting these targets.

Increased Electrification Requirements

- In order to meet strategic targets, Projected Load Demand within the basin, will need to increase from the current (2022) on grid 4.2 GW to 17.2 GW (**ERCOT: 11.9 GW**; SPP: 5.3 GW) by 2032 and reach 17.6 GW by 2040.

Align Grid Connect Pace with Targets

- If the recent historical annual oil and gas industrial load additions of 300 to 350 MW were to continue, less than half of the Targeted Grid Connection would be met by 2032. Grid load additions are predicted to be accelerated three to four-fold over historical rate.

Significant Future Resources

- With remaining resources of 71.5 billion barrels of oil and 289 trillion cubic feet of associated gas from undrilled locations, the Permian Basin will continue to be a viable resource for years to come.

Delaware Basin Focus

- While the Midland Basin will require growth in load addition, much of the future Projected Load Demand growth will be in the **Delaware Basin** where production outlooks are double that of the Midland Basin and where associated gas and water ratios are also higher.

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Report includes the Permian Basin in both Texas and New Mexico and covers five regions in 31 counties –

➤ Midland Basin

- Maturing unconventional petroleum province with partial grid access, but production is expected to plateau in the next two to three years

➤ Delaware Basin-Texas

- Developing unconventional petroleum province where grid access is increasing, but substantially lags demand and where production is expected to increase

➤ Delaware Basin-New Mexico

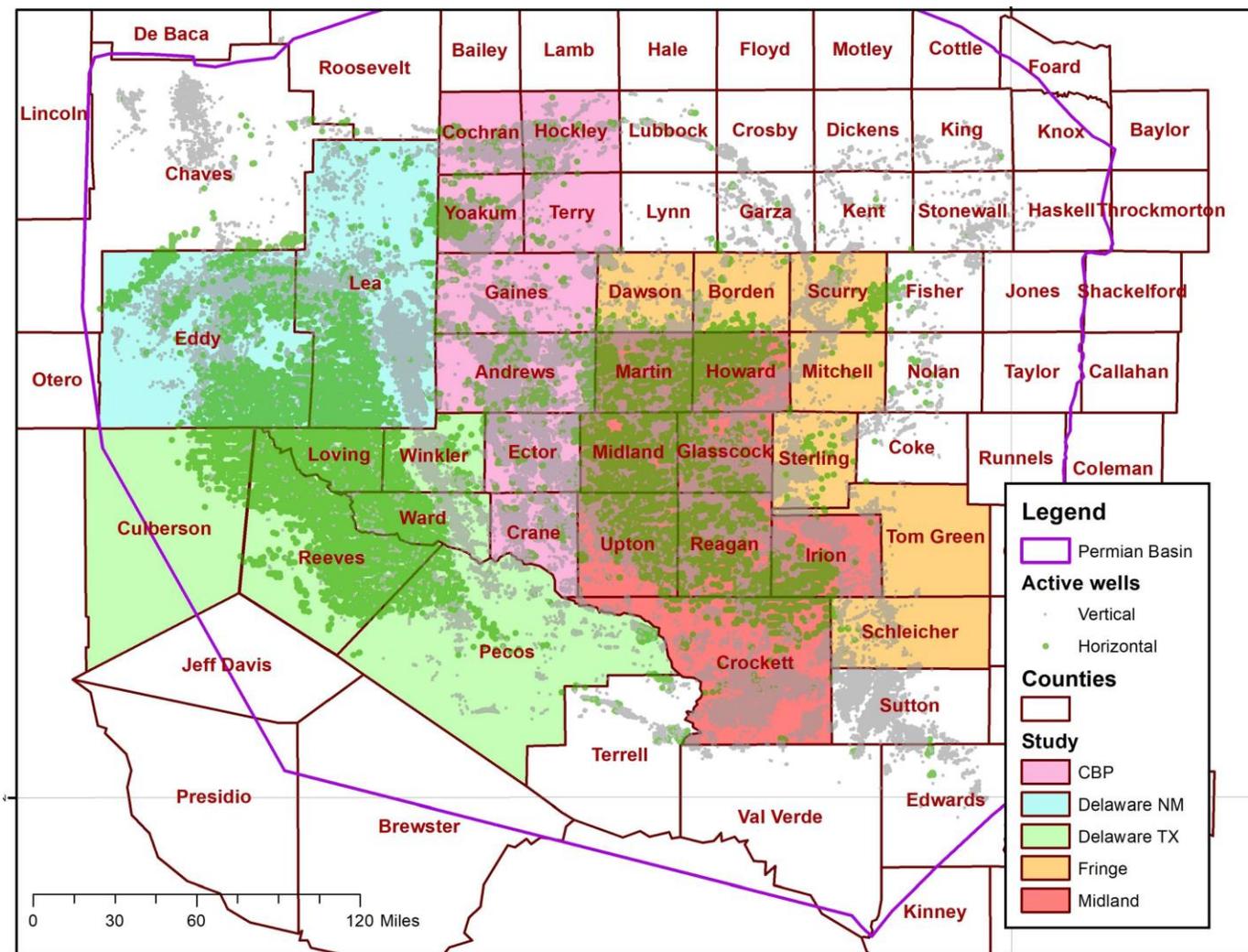
- Similar to Delaware Basin-Texas but may see even stronger production growth and need for additional load

➤ Central Basin Platform

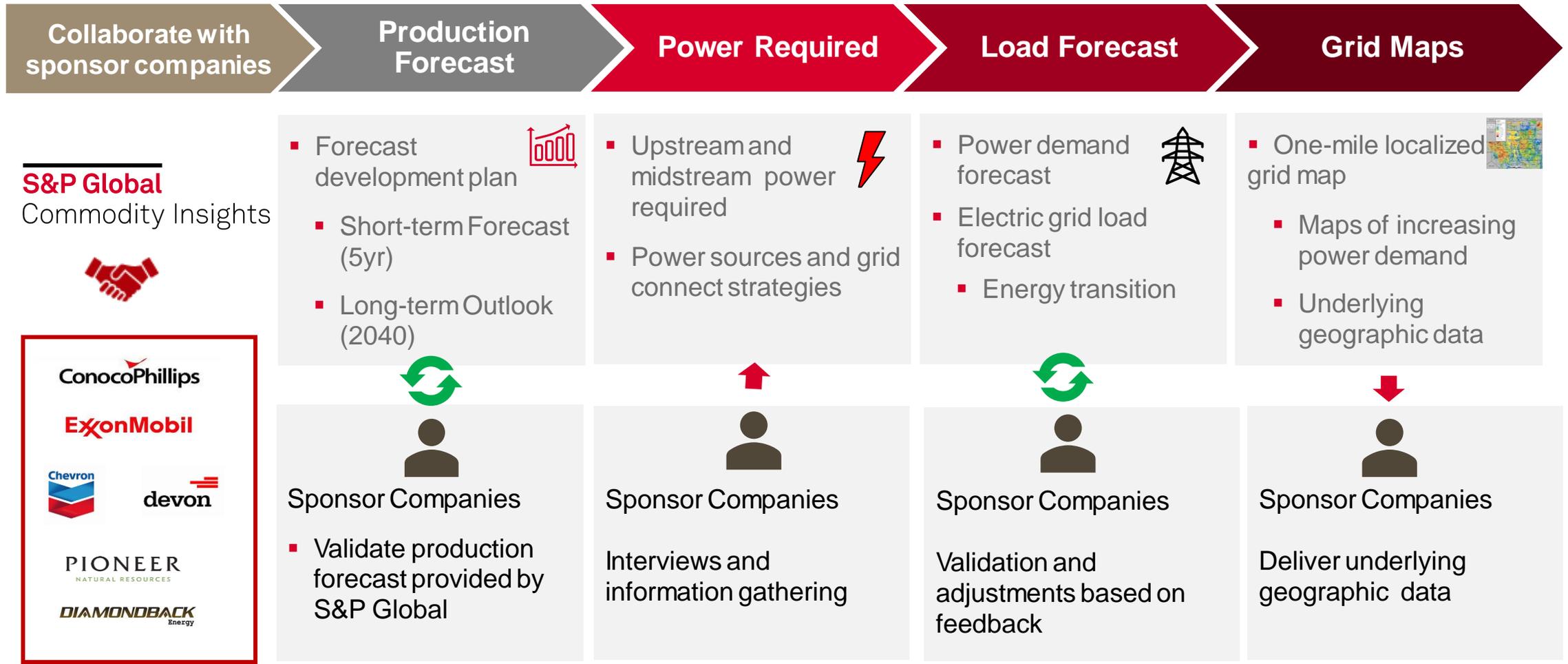
- Mature conventional petroleum province with production from vertical wells mostly connected to the grid with production expected to decline

➤ Fringe

- Mature petroleum province – minimal contributions and future declines in production and load demand



Workflow and validation / collaboration with sponsor companies

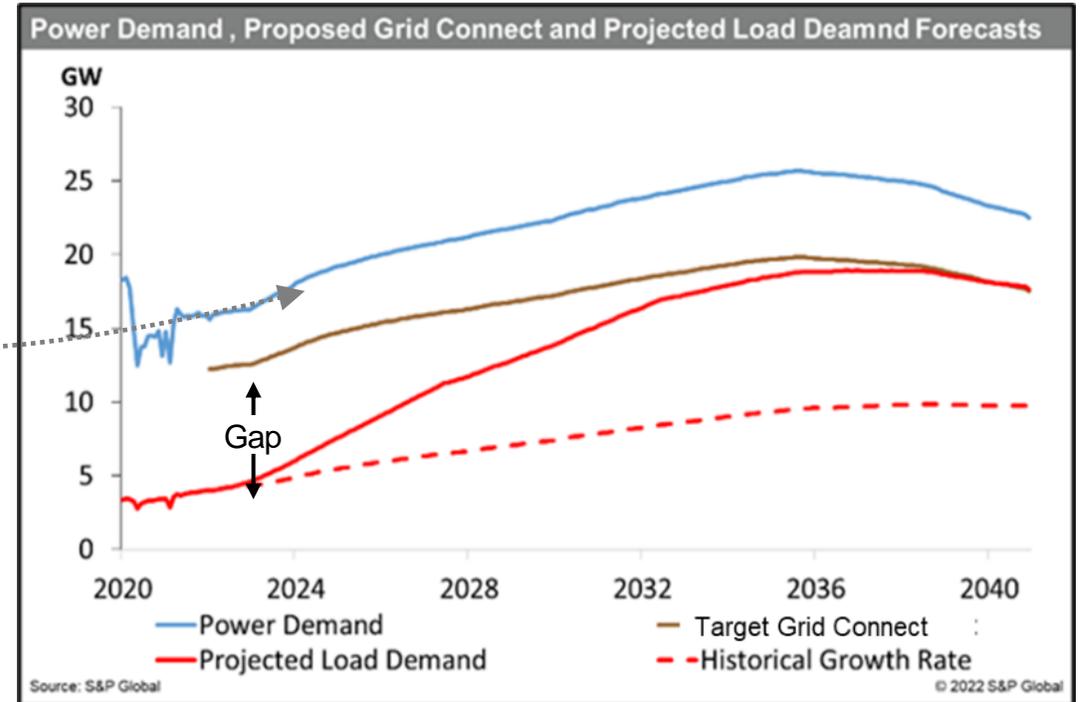
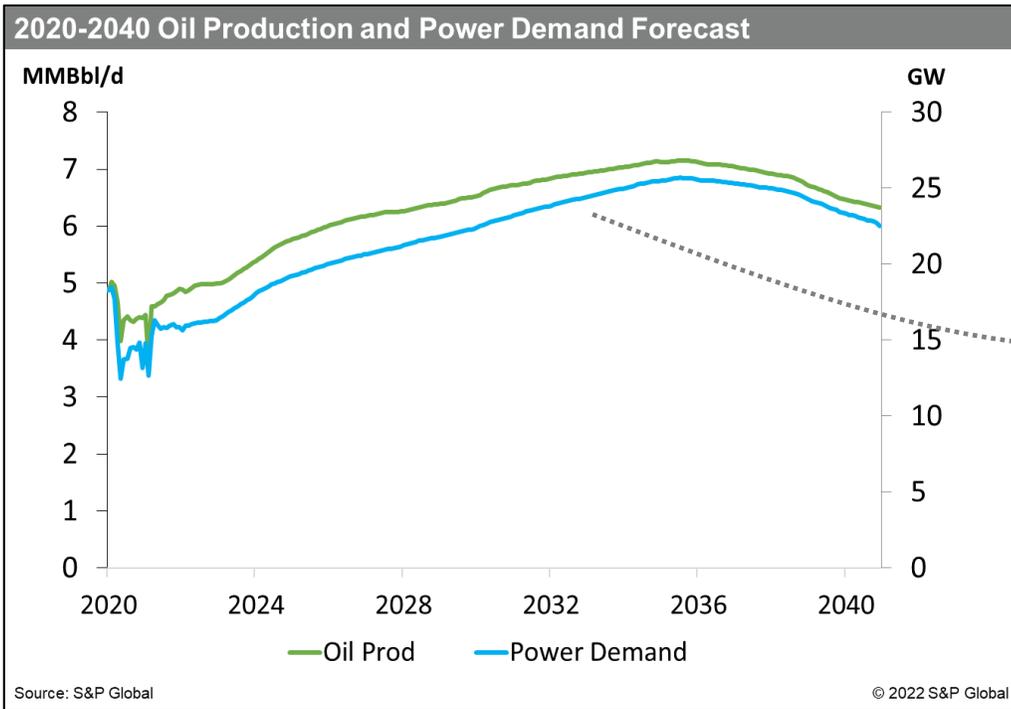


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The Projected Load Demand forecast requires closing most of the gap with the Target Grid Connect in the next 10 to 15 years



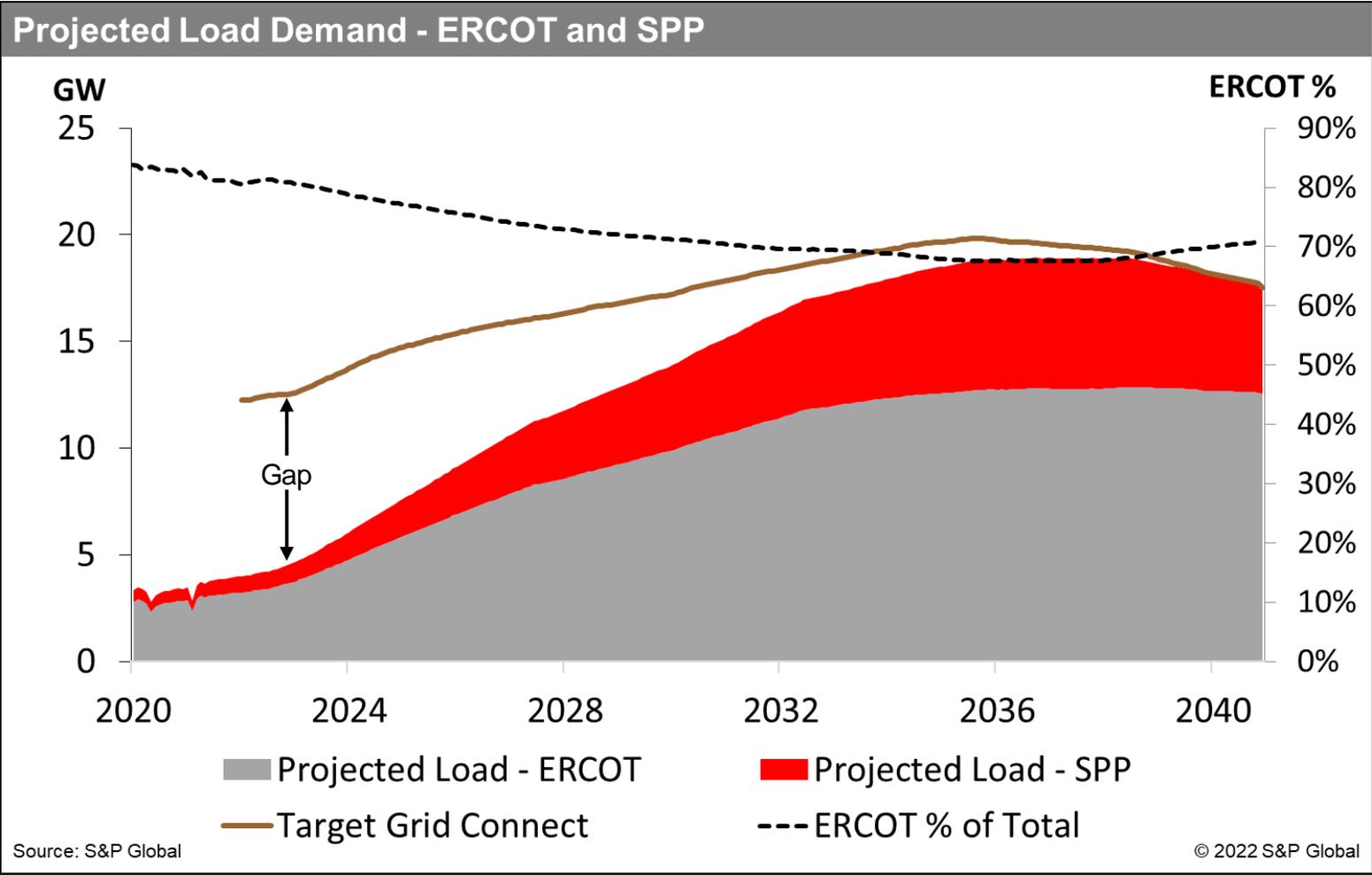
- Target Grid Connect is that portion of Power Demand that S&P Global has determined is required to be powered by the electric grid based on upstream and midstream company feedback and its own research

The Projected Load Demand (industrial) increases – SPP share is projected to grow somewhat faster than ERCOT

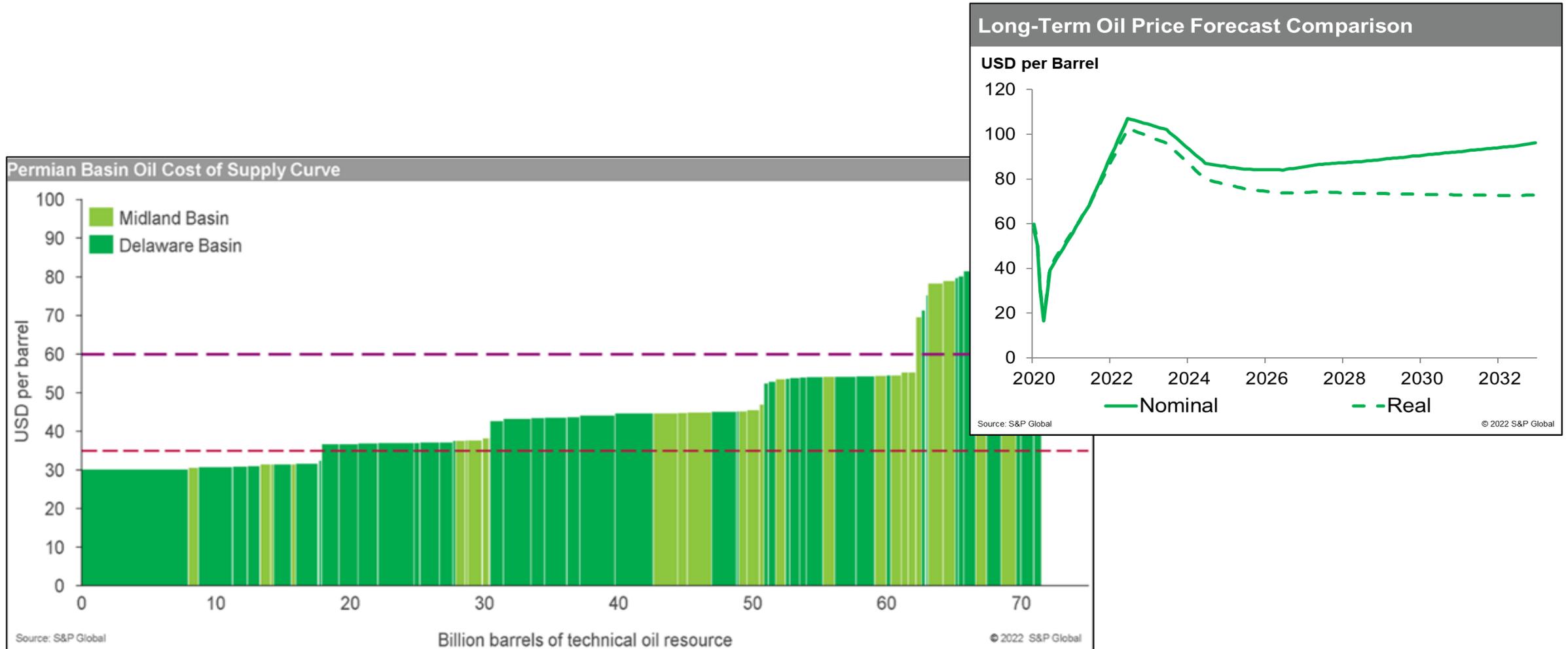
Current Gap

- ERCOT – 6.0 GW
- SPP – 2.3 GW
- Total – 8.3 GW

2032 totals include 11.9 GW to ERCOT and 5.3 GW to SPP



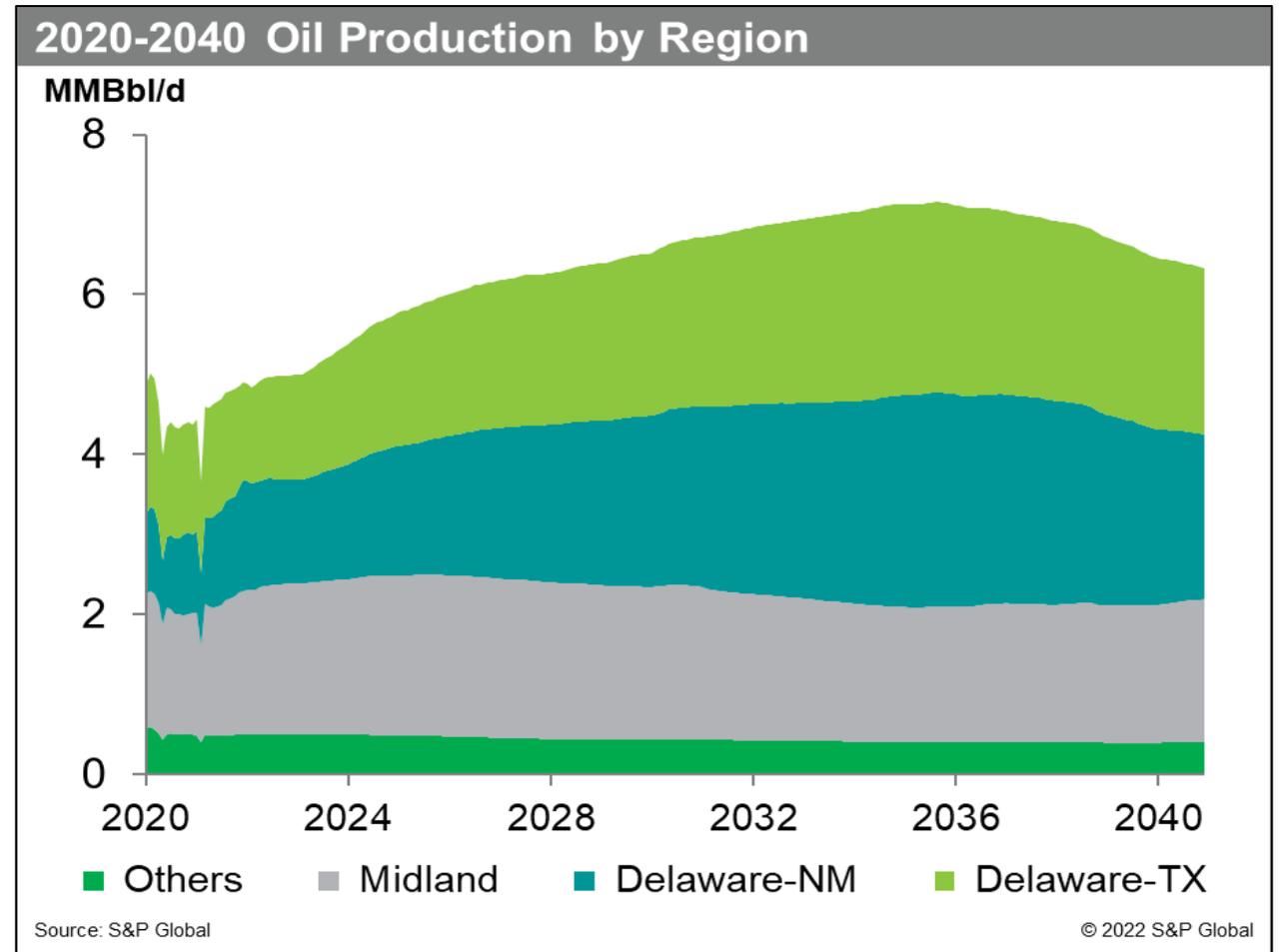
Production forecast: Long-term price forecast of \$70-\$75 / bbl (real) and a Permian Basin resource base of 64 billion barrels of oil producible for under \$60 / bbl underlie forecast



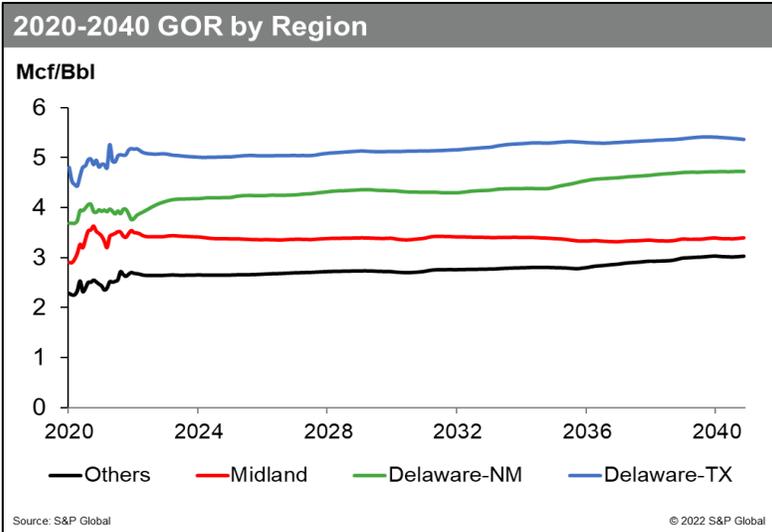
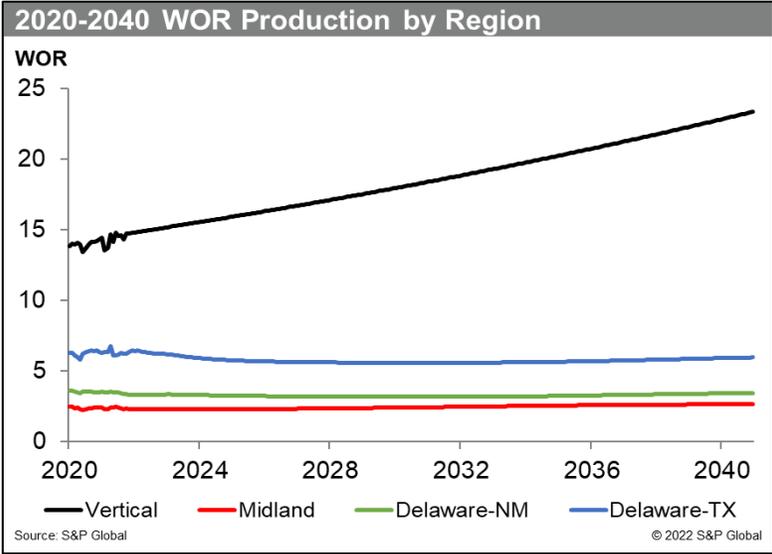
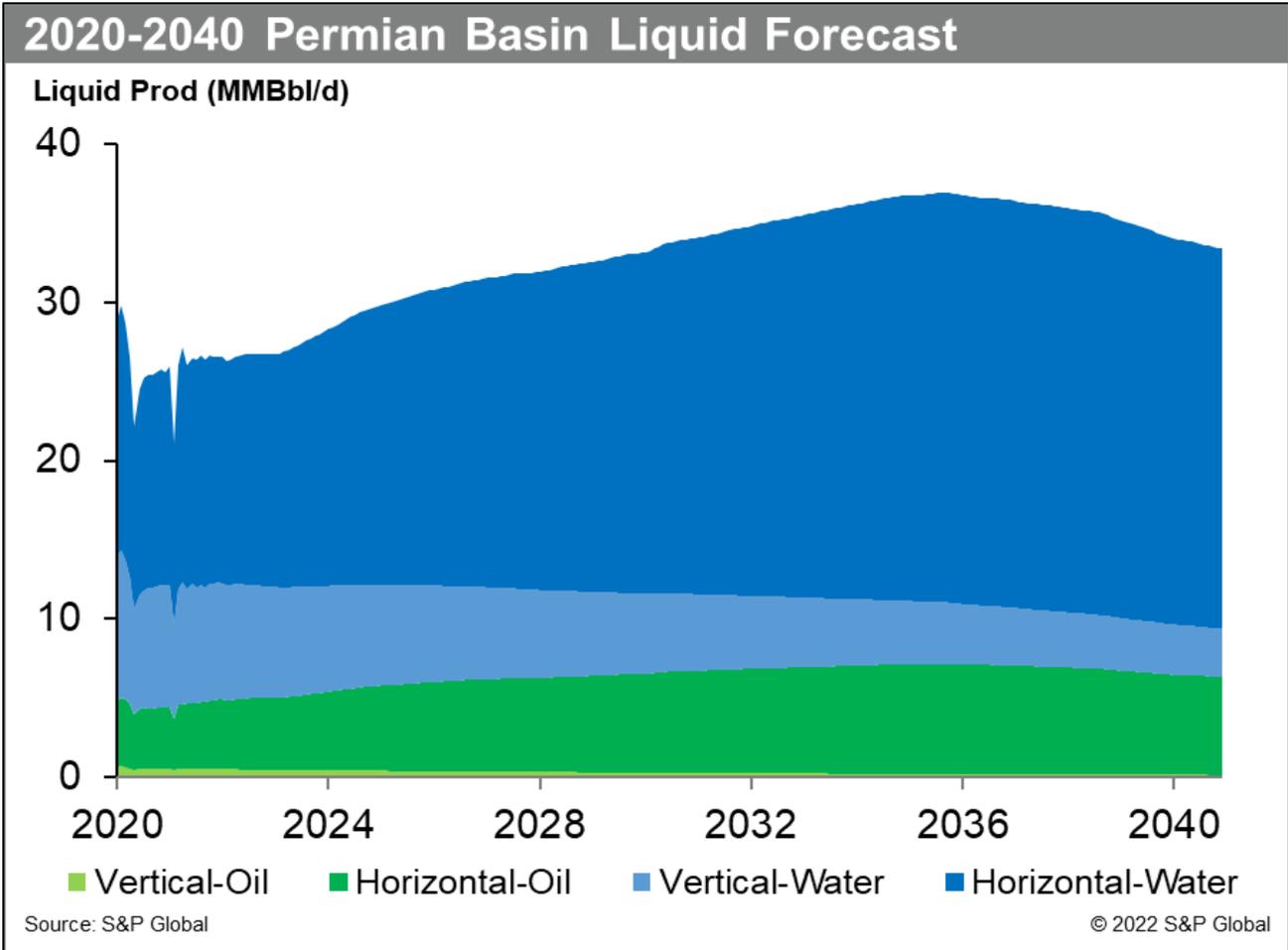
Production forecast calls for an increase from the current 5.0 million barrels/day, peaking at about 7.2 million barrels/day in 2035-6

What has changed since 2019:

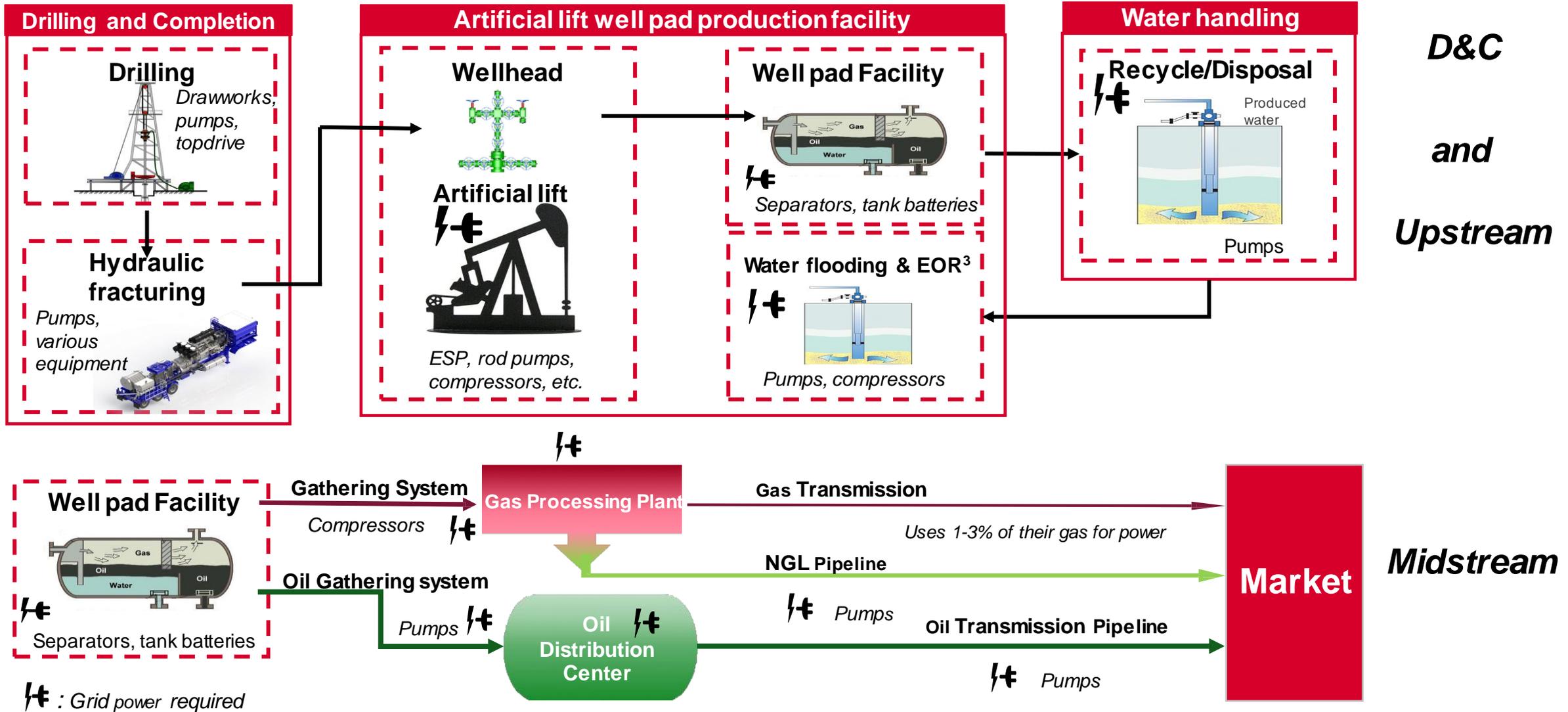
1. Covid-19 Pandemic price decrease and production shut-downs
2. Russia invasion of Ukraine – disruptions and reconfiguration in world oil markets
3. China Covid lock downs and demand decreases
4. Saudi Arabia (OPEX+) – production cuts/increase/cuts
5. Energy transition – reduced long term demand for oil outlook
6. Rapid operating and capital cost increases
7. Labor shortages in the oil patch, especially frack crews
8. Producer shift from a growth business model to a shareholder returns / dividend-based business model
9. Shift from cost reduction to ESG issues – possible new regulations
10. Outlook for less global investment in new long-term oil and gas projects due to lending restraints and expectations of higher future returns on investment – (US unconventional resources will fill some of that gap)



Water management and gas transport and processing also require significant amounts of power – this is especially true in the Delaware Basin where water-oil ratios (WOR) and gas-oil ratios (GOR) are highest

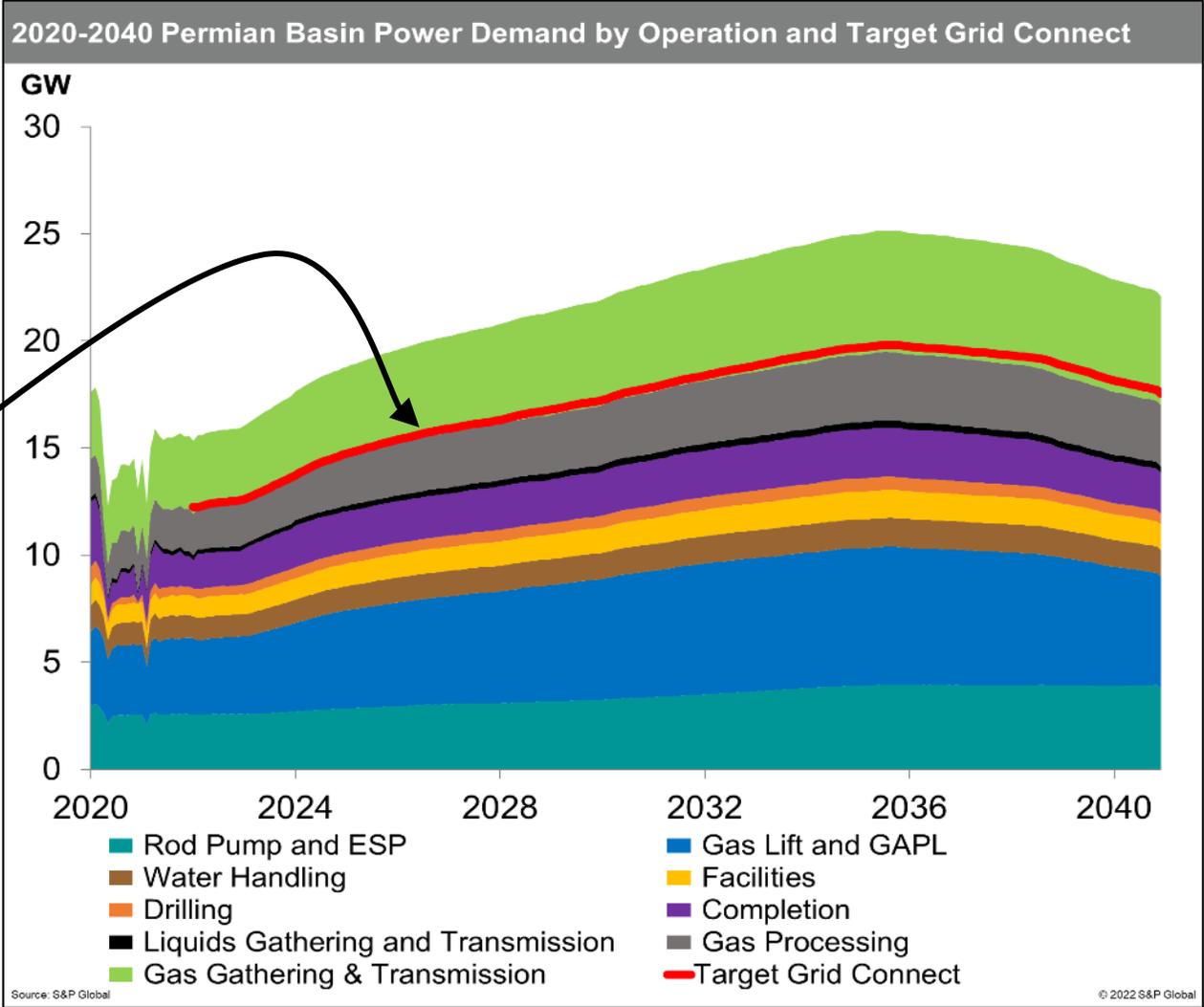


Upstream and midstream power demand – from reservoir to market, multiple operations and equipment require power to produce, handle and transport oil, gas and water



Target Grid Connect – is defined as that portion of the total power demand requirement from oil and gas operations that is intended to be put onto the electric grid

Oil and Gas Operation	Target 2040 Grid Connect %
Rod Pump & ESP	95%
Gas Lift & GAPL	80%
Water Handling	97%
Facilities	97%
Drilling	55%
Completion	15%
Oil/NGL Gathering and Transmission	97%
Gas Gathering	75%
Gas Processing	93%
Gas Transmission	25%



Current grid connection is only fulfilling 33% of the Target Grid Connect which now includes Stakeholder* emission reduction targets

Estimated average monthly industrial load (MW)	2019	2020	2021	2022*	Target Grid Connect (MW)	% of Target Grid connected
Texas	2,603	2,815	3,076	3,357	9,500	35%
New Mexico	636	691	751	816	3,100	26%
Total	3,239	3,506	3,827	4,173	12,600	33%
YOY Increase		267	321	346		

Sources – Analysis using ERCOT D&E, undisclosed NM source, 2019 Report

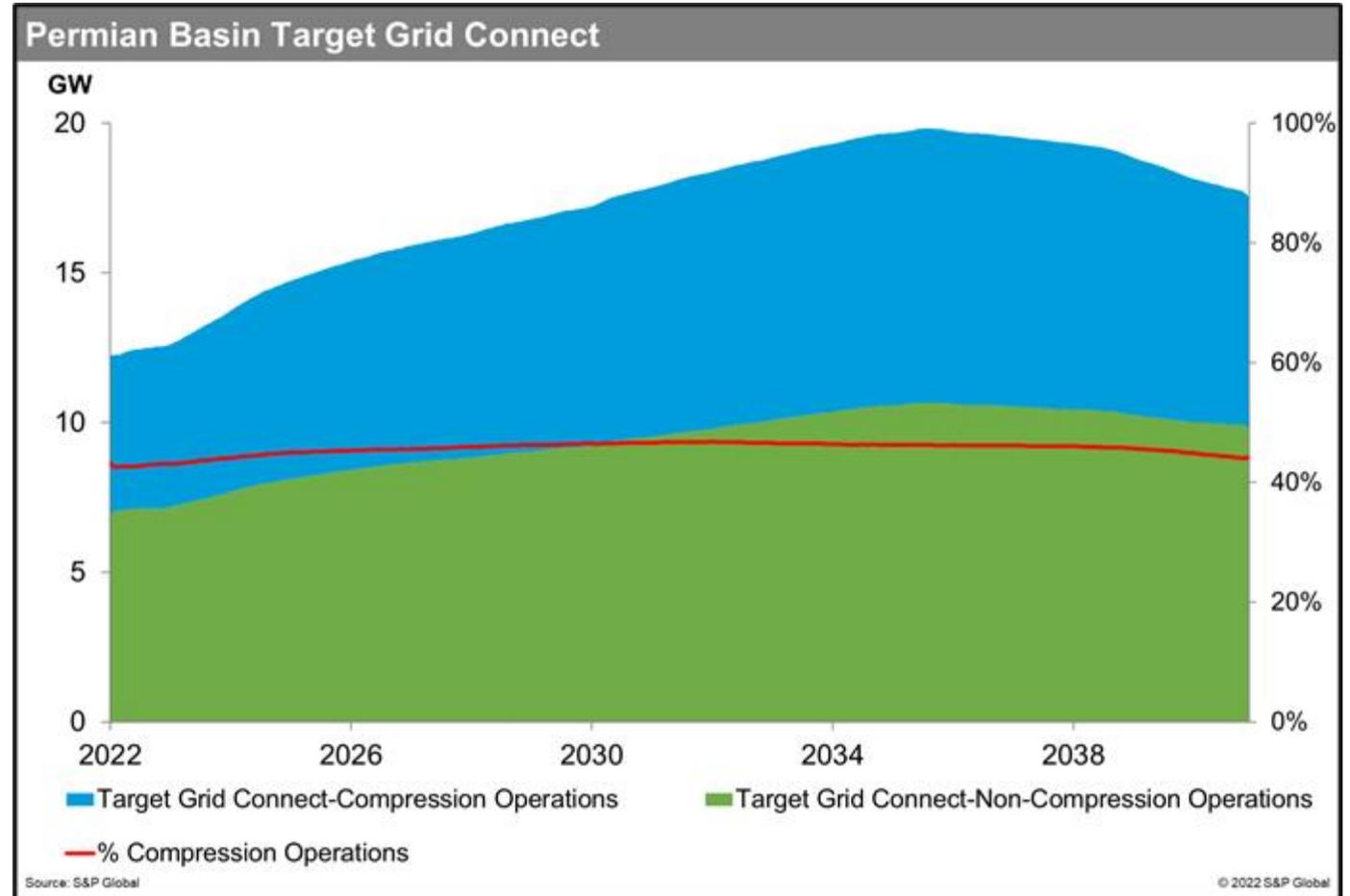
*May 2022

- A 2018 EPA report indicates that lower 48 onshore upstream and midstream operations ((including gas processing contribute ~145 Metric tonnes of CO₂e
 - > Emissions are generated from natural gas and diesel-powered equipment
- Energy companies have publicly announced specific emission reduction targets for scope 1 and 2 emissions reduction by converting most oil field operations to grid power
- Midstream companies **contacted** and announcements suggests that a wider range of emission reduction targets with gathering and processing most likely to convert to grid power

*Stakeholders include upstream and midstream companies, consumers, government agencies and organizations promoting lowered emissions

Stakeholder emission reduction targets immediately lift the Target Grid Connect demand by 50%

Oil and Gas Operation	Current Grid Connect %	Target Grid Connect %
Rod Pump & ESP	51%	95%
Gas Lift & GAPL	8%	80%
Water Handling Facilities	60%	97%
Drilling	7%	55%
Completion	0%	15%
Oil/NGL Gathering and Transmission	97%	97%
Gas Gathering	3%	75%
Gas Processing	63%	93%
Gas Transmission	0%	25%

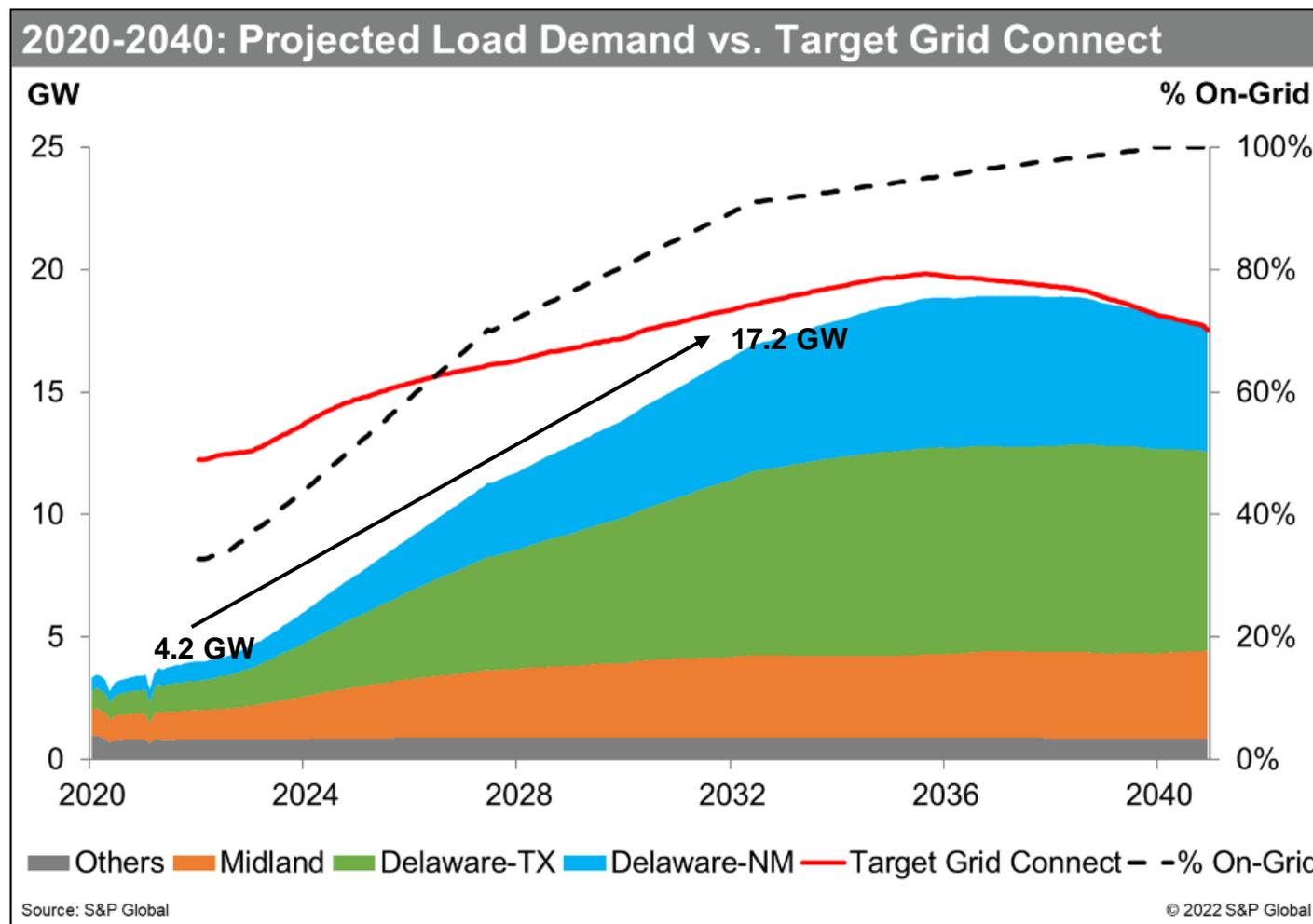


Traditional operation connected to the grid
 New operation to connect to the grid to meet emission reduction goals

Total Permian Basin - The Projected Load Demand forecast entails an eventual four-fold increase from the current 4.2 GW to 17.2 by 2032 to close the Target Grid Connect gap

What does the Projected Load Demand consider?

1. Current gap in grid access for traditional oil and gas operations is significant
2. An increase in the oil and gas production forecast is expected
3. Additional oil and gas operations will need to be put on the grid to meet emission reduction goals for many stakeholders



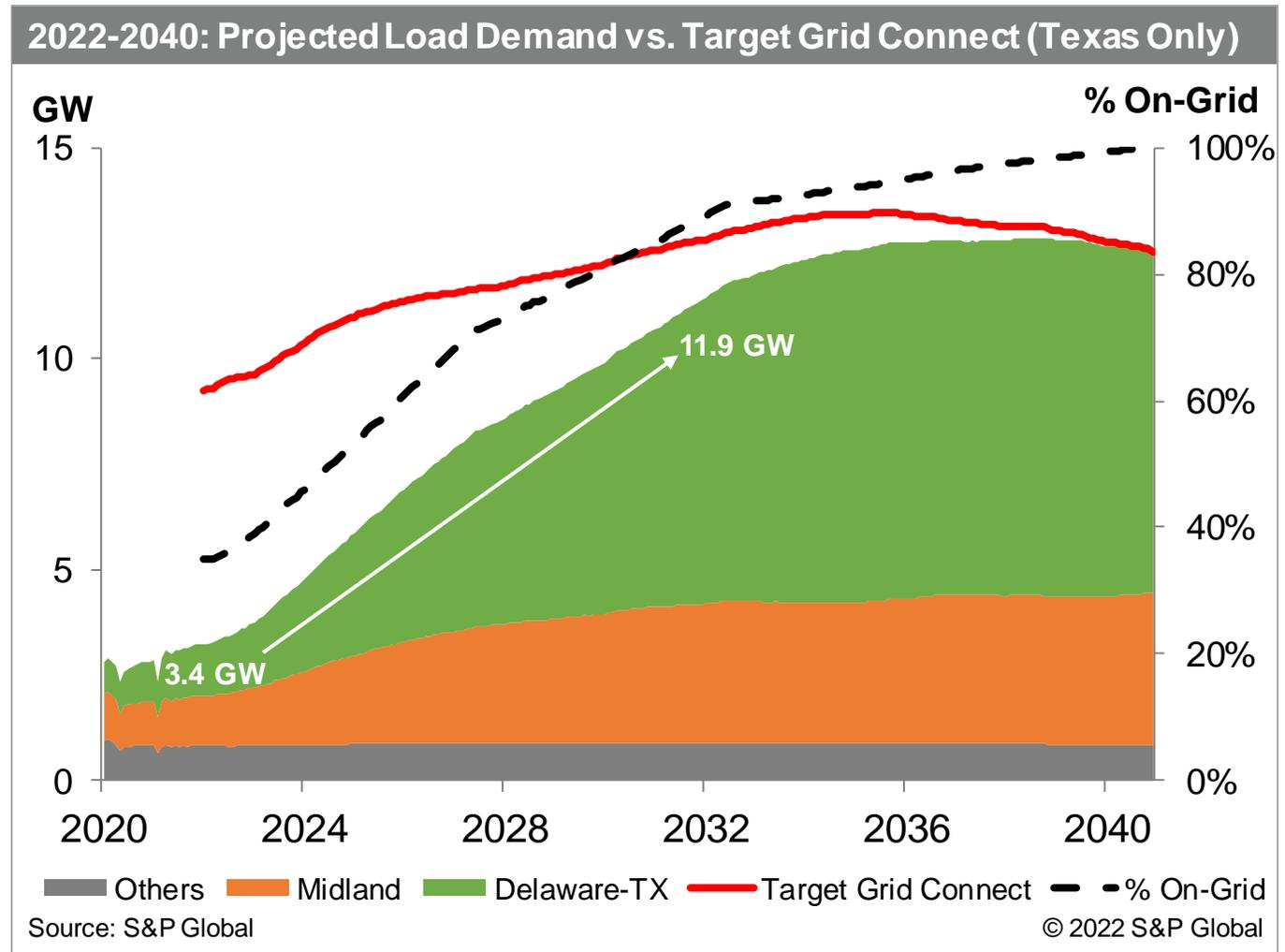
2032 totals include 11.9 GW to ERCOT and 5.3 GW to SPP

ERCOT portion only - The Projected Load Demand forecast entails an eventual four-fold increase from the current 3.4 GW to 11.9 by 2032 to close the Target Grid Connect gap

What does the Projected Load Demand consider?

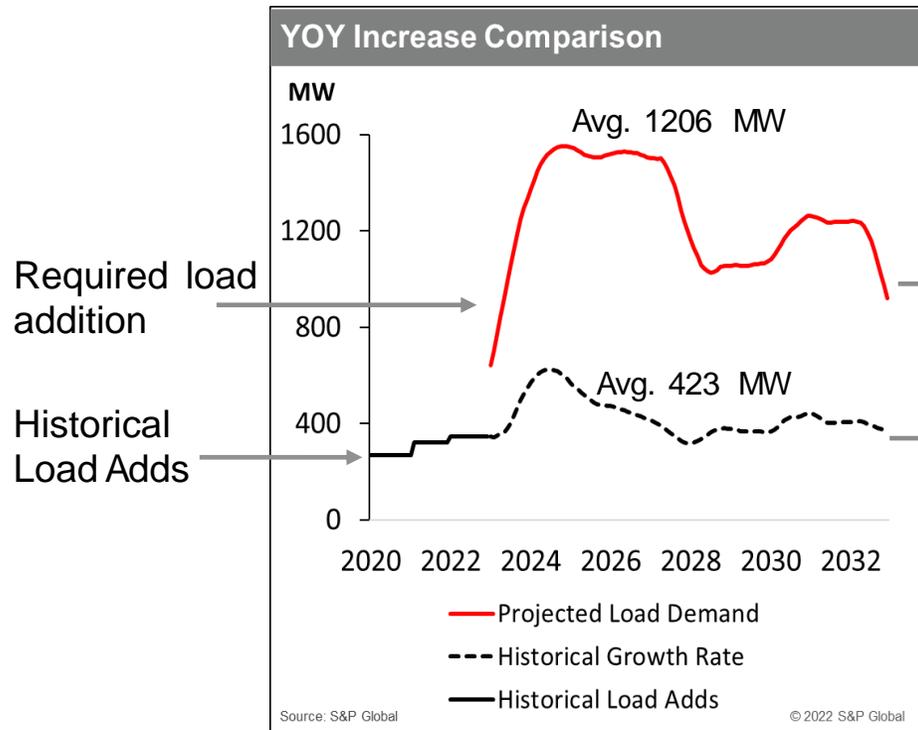
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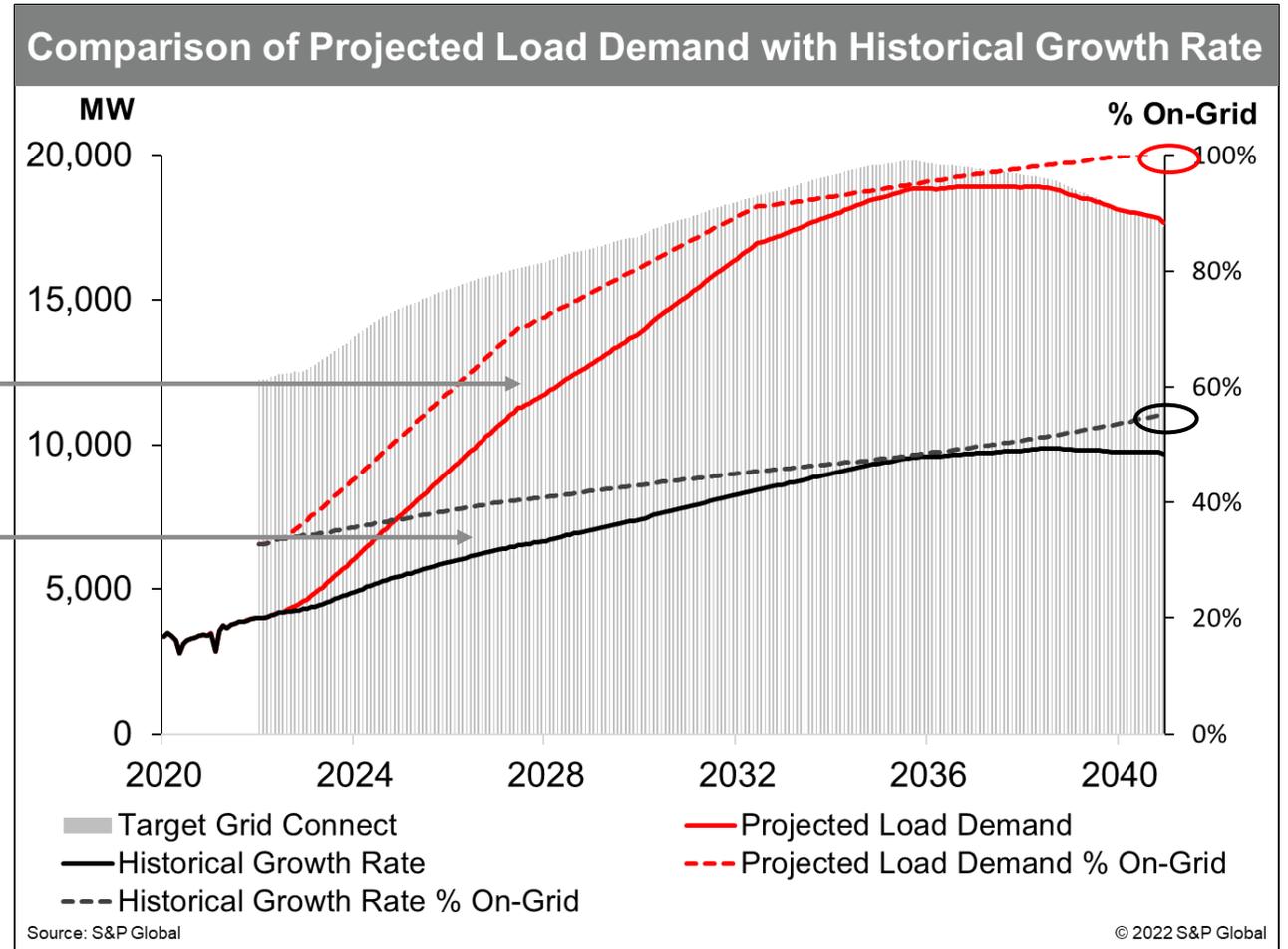


2032 totals include 11.9 GW to ERCOT

If current rates of Permian Basin load addition were to continue, only 55% of the Projected Load Demand forecast would be met by 2040

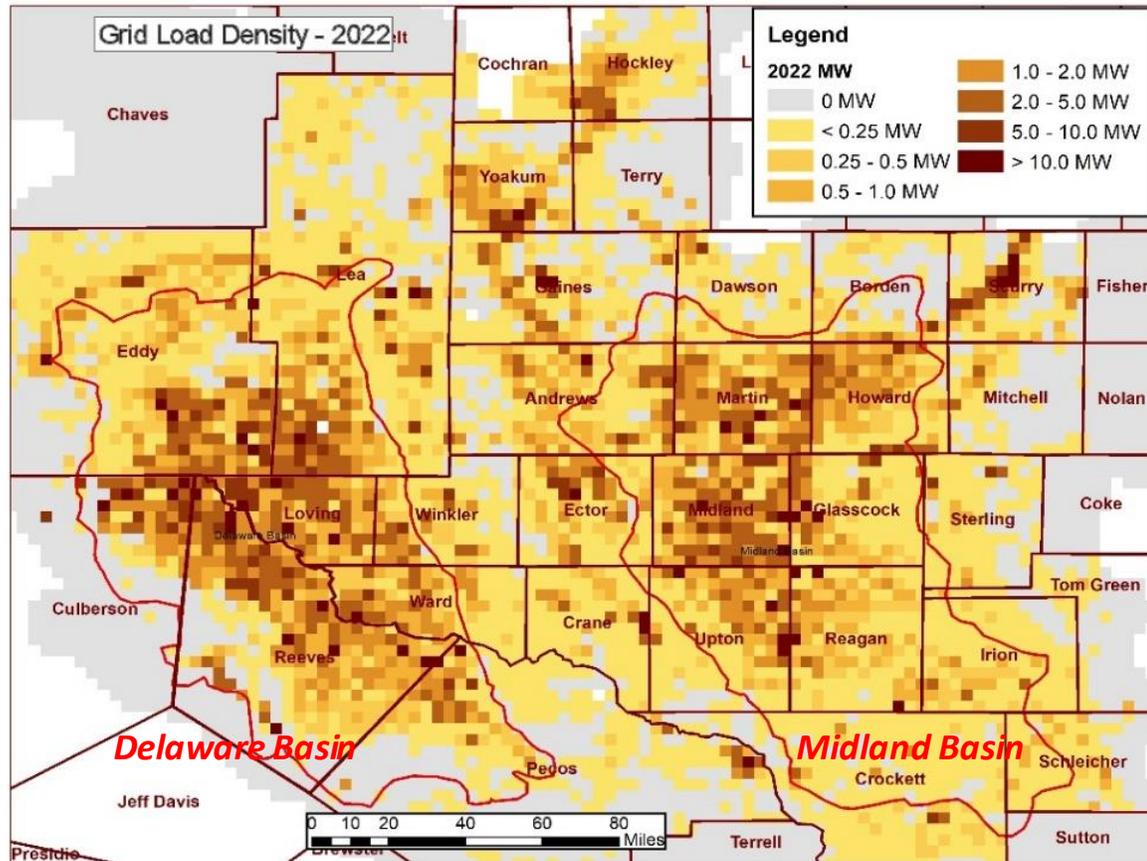


Recent historic rates of industrial load additions are about 300-350 MW per year, but future load addition projections are slightly higher

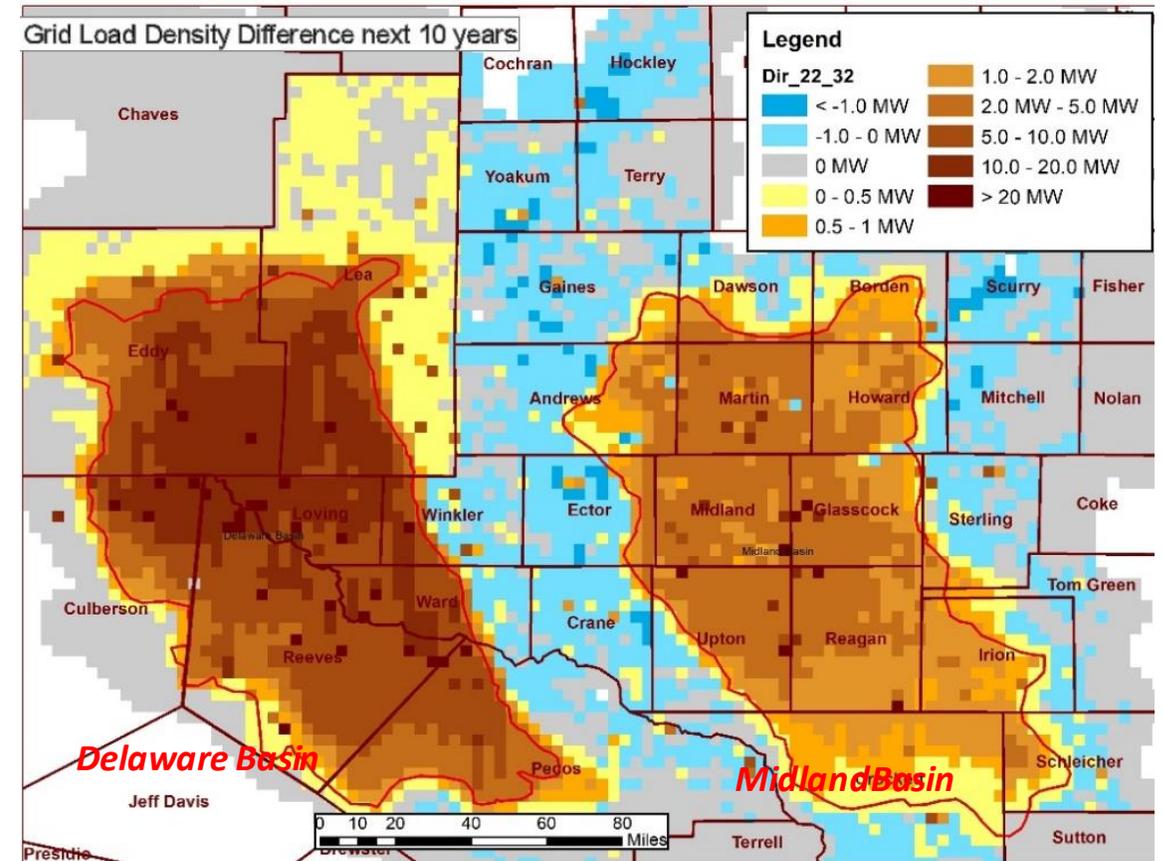


Grid load additions are predicted to be accelerated three to four-fold over the historical rate

Electric load demand is concentrated in both the Midland and Delaware Basins, and growth is expected in both basins, but much more so in the Delaware Basin



Current (2022) load demand distribution

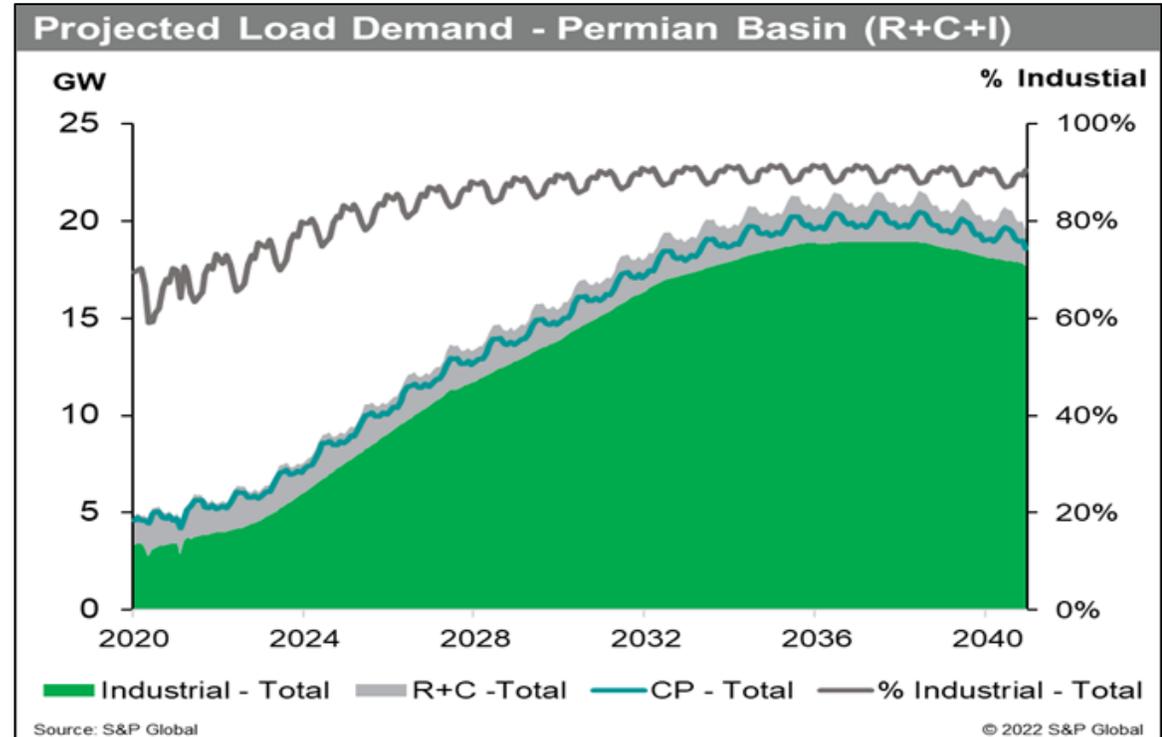


Next 10 years incremental changes – Projected Load Demand Forecast

In 2022 ~4.2 GW is distributed over the Permian Basin and in 2032, ~ 13 GW of new projected load is distributed over the Permian Basin

This report's focus is on the industrial load outlook pertaining to oil and gas related operations, but residential and commercial (R+C) load is also included

1. No adjustments in the industrial load were performed to determine coincident peak
 1. Overall regional O&G operations have fewer peaks and valleys
 2. Operator feedback suggests equipment design and grid planning already includes CP
2. R+C adds about 10% to the load forecast by 2032
3. Five Crypto-currency centers are now located or planned in the Midland Basin. Potential load demand may run from 1 to 1 GW, but may run off-peak hours



	May-22	Dec-27	Dec-32	Dec-36	Dec-40
Power Demand (GW)	16.1	21.2	24.4	25.3	22.5
Target Grid Connect (GW)	12.4	16.2	18.8	19.6	17.6
Projected Load Demand (GW)	4.2	11.7	17.2	18.9	17.7
Historical Growth Rate (GW)	4.2	6.7	8.6	9.7	9.7
Projected Load Demand (R+C+I) (GW)	6.1*	13.0*	18.4*	20.4*	19.7*

* June – when peak demand occurs

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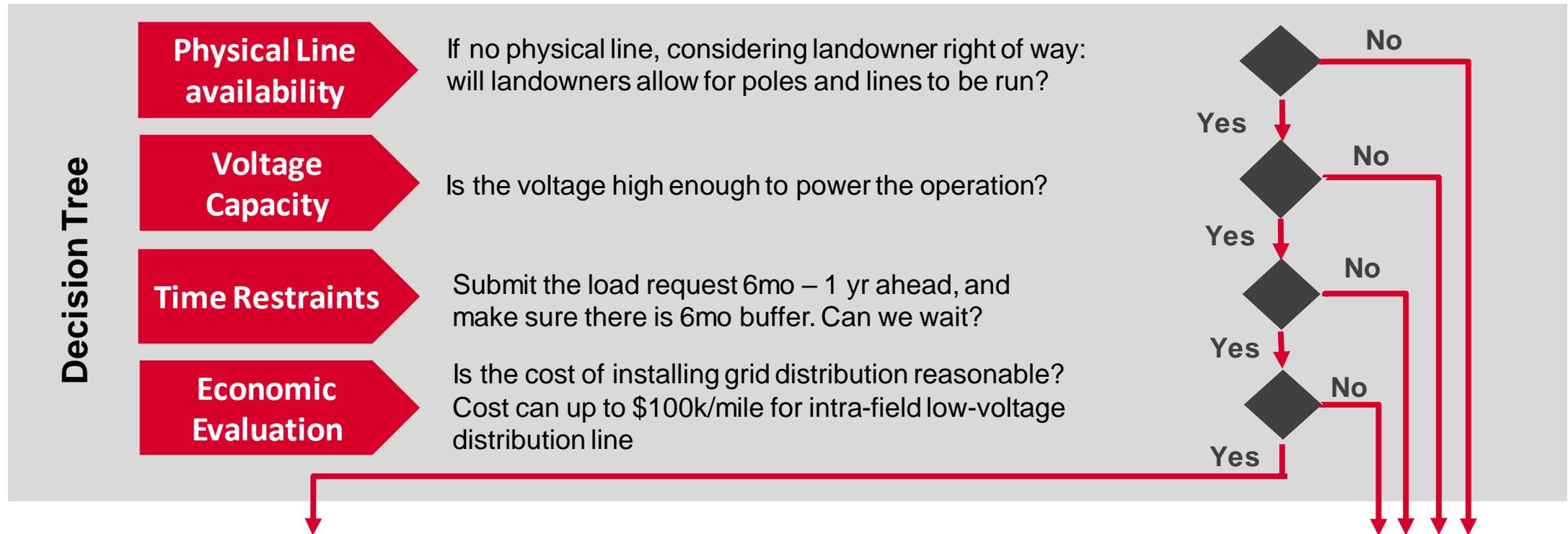
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1. Explain the 8.6 GW gap (ERCOT 6.0 GW gap) in current grid connection and Target Grid Connect
2. Address the ESG issues and provide some quantification
3. Compare results of this 2022 report with results from the 2019 report
4. Compare results with the TORA study

Why are more operations not currently on the grid? - Operators often undergo several key decision points to assess the electrification feasibility; this is a process that will evolve over time



Grid Power

- Established areas typically have minimal difficulty in distributing grid power
- Some companies plan far in advance to have grid power available for operations
- Acreage position: a continuous acreage position with a high well/facility density is most economically effective for grid power infrastructure
- Electrification provides more cost saving for larger and more sustainable load

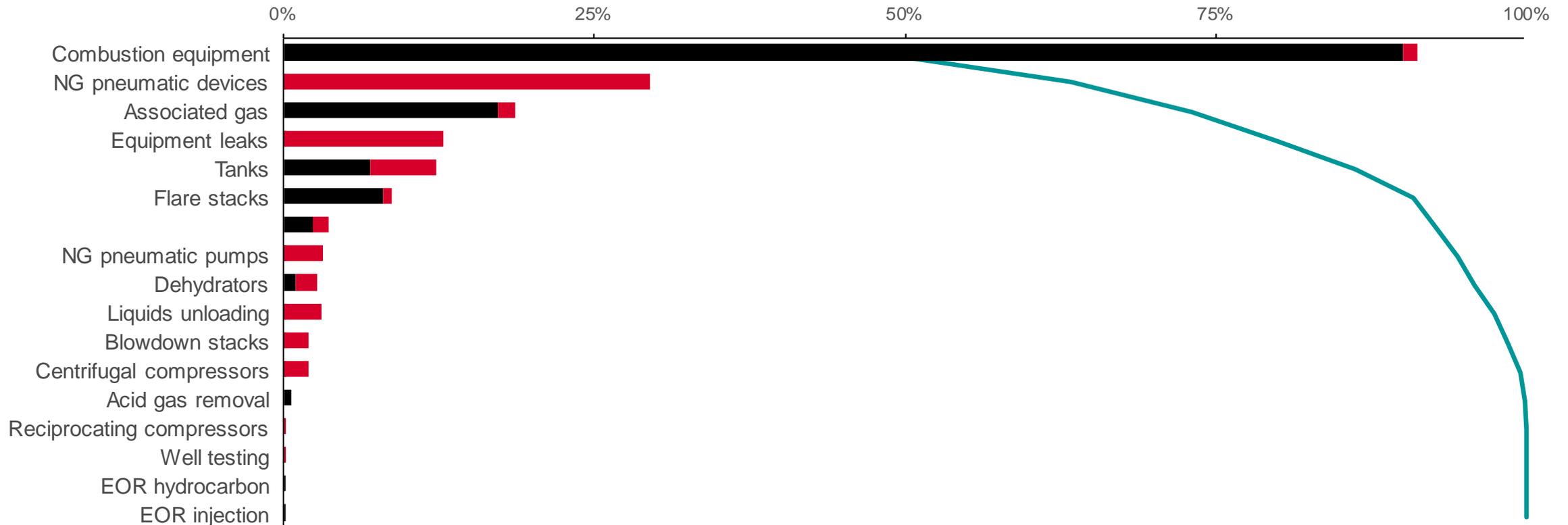
Genset or turbine – temporary solution

- Economics of the field are typically clear as to whether upfront cost is reasonable
- Often, long lead times for grid installation mean that other power generation methods are used on a temporary basis
- Remote locations are often a challenge

Scope 1 and 2 emissions reduction, combustion equipment used for most midstream operations dominates CO2 emissions at ~45% of all emissions and a much higher percentage of CO2 emissions

US Lower 48 Onshore E&P, gathering & boosting GHG emissions (2018)

Million metric tons CO2e



Notes: CH4 emissions considered to have global warming potential of 25 (IPCC 4)
 Source: EPA Greenhouse Gas Reporting Program (GHGRP); IHS Markit

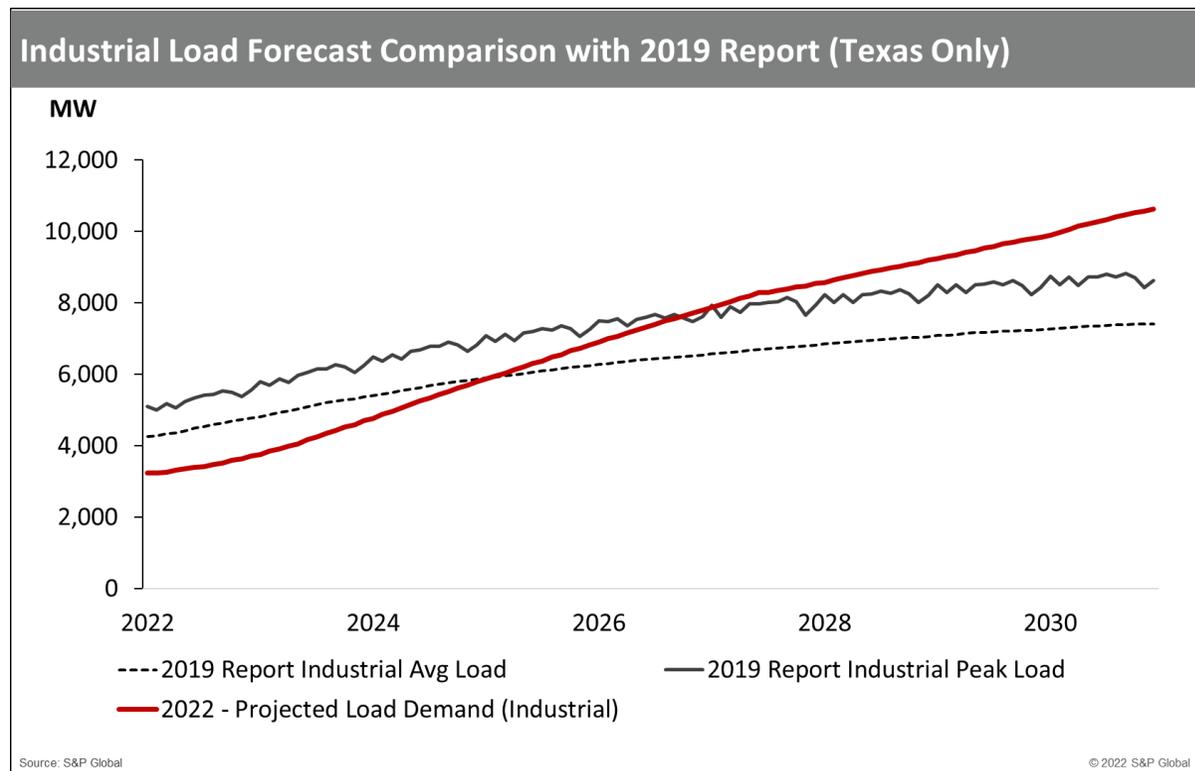
■ CO2 ■ CH4 — Cumulative emissions (%)

Average Industrial load and R+C+I CP load outlooks - Current report compared to the 2019 report

– Driven by emission reduction current outlook is higher

Projected Load Demand (GW)	Current Report June-22	Current Report June-30	Current Report June-35	2019 Report Peak
Industrial-Delaware TX	1.3	6.2	8.4	4.8
Industrial-Midland	1.2	3.2	3.4	2.5
Industrial-Fringe	0.6	0.6	0.5	0.6
Industrial-CBP	0.3	0.3	0.4	0.7
Total Industrial-TX Portion	3.4	10.3	12.7	8.6
(R+C+I)-Delaware TX - CP	1.5	6.4	8.6	4.9
(R+C+I)-Midland - CP	2.1	4.1	4.3	3.2
(R+C+I)-Fringe - CP	0.7	0.7	0.6	0.7
(R+C+I)-CBP	0.8	1.0	1.2	1.4
Total (R+C+I)-TX - CP	5.1	12.2	14.7	10.2

Note that values may be slightly different than the Current report as these reflect June of each year, whereas the report reflects May 2022 and December of 2030 and 2035



The comparison in section 16 of the 2022 report appendix compares the results of the 2022 report with the average monthly results of the 2019 report – Here we are comparing the 2022 results with the 2019 peak results which is a better apples to apples comparison.

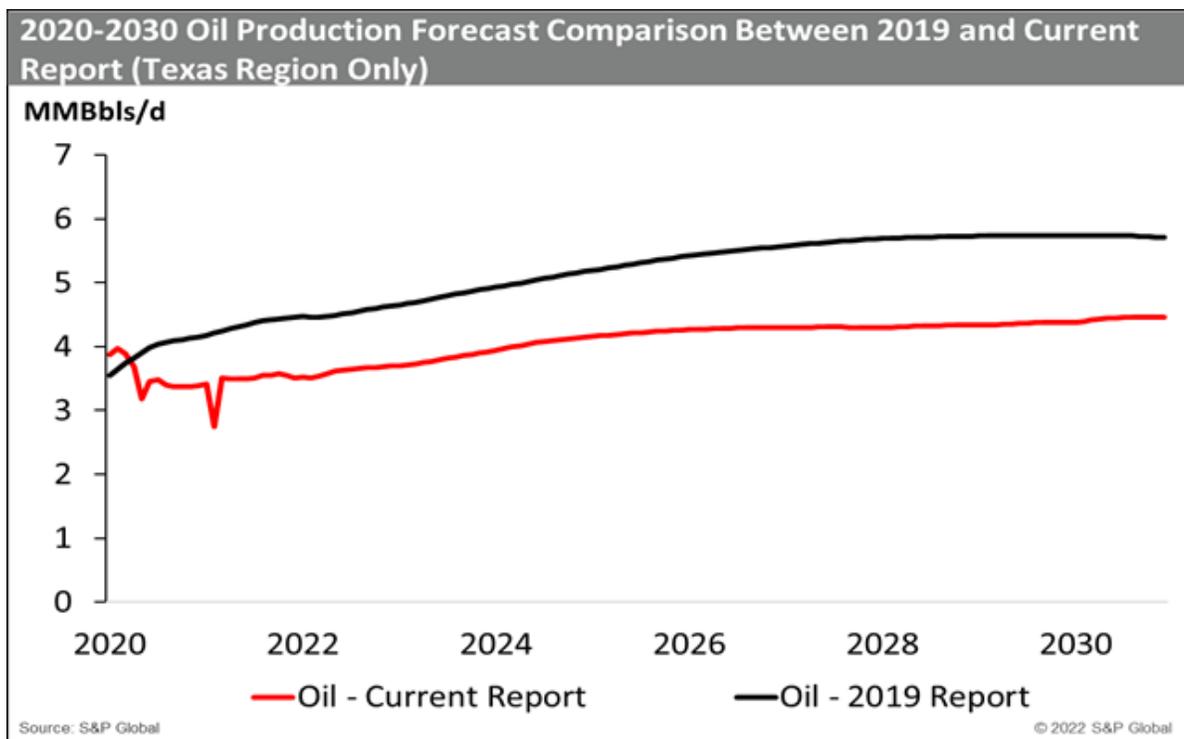
Average Industrial load and R+C+I CP load outlooks – Main drivers for the change in the outlook

Production outlook is diminished

- Drop in production and drilling due to the Pandemic
- More conservative investment levels to produce vast resource

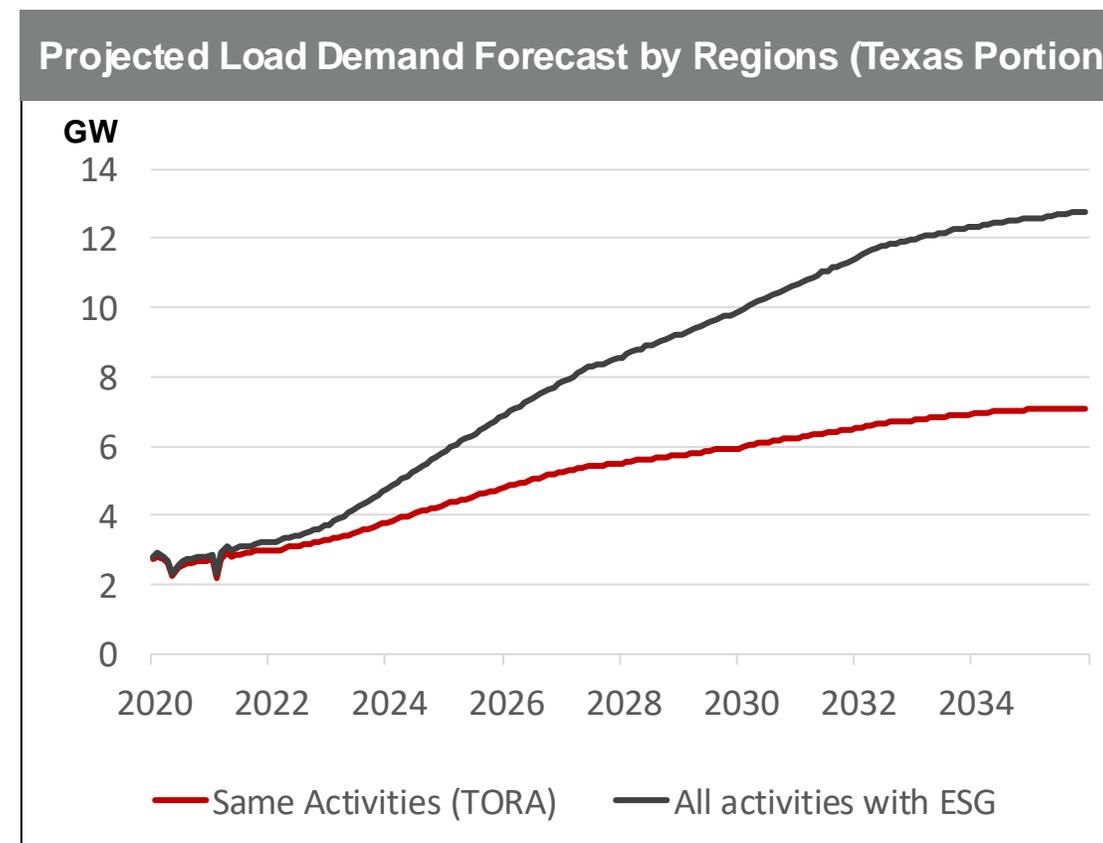
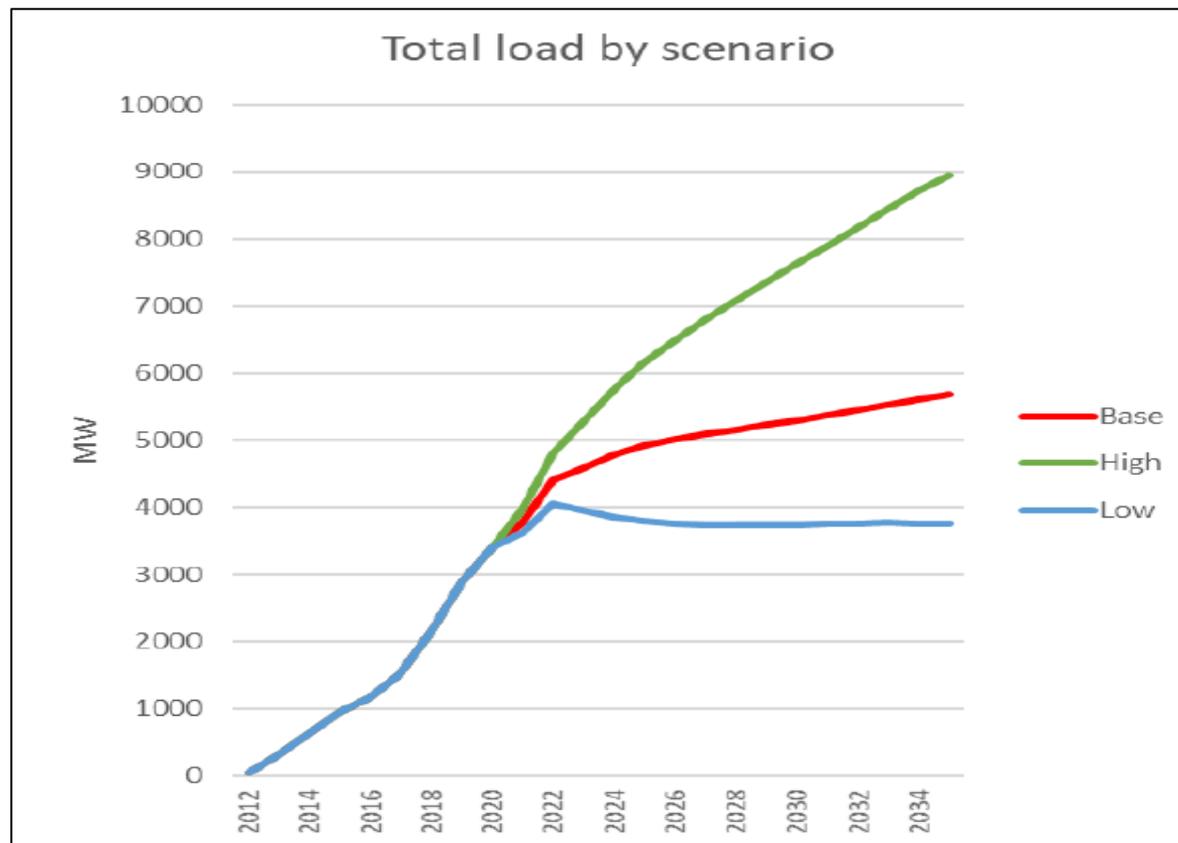
Offset by

More operations requiring grid connect access for upstream and midstream companies to meet emission reduction targets



Oil and Gas Operation	Target 2030 Grid Connect % 2019 Report	Target 2040 Grid Connect % Current Report
Rod Pump & ESP	97%	95%
Gas Lift & GAPL	0%	80%
Water Handling Facilities	97%	97%
Drilling	0%	55%
Completion	0%	15%
Oil/NGL Gathering and Transmission	97%	97%
Gas Gathering	25%	75%
Gas Processing	60%	93%
Gas Transmission	0%	25%

S&P and TORA industrial load forecast comparisons – when comparing same activities S&P is about 18-20% higher than the TORA base case, but much lower than the high case



S&P and TORA industrial load forecast comparisons – when comparing the additional operations that need to go onto the grid due to emission reduction goals, the S&P forecast is higher than the TORA forecast

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Bolstered by a large economic resource base, an increasing production forecast and a need to close the gap between current Target Grid Connect and Projected Load Demand, the outlook calls for significant increases in grid connection rates, particularly over the next 10 years

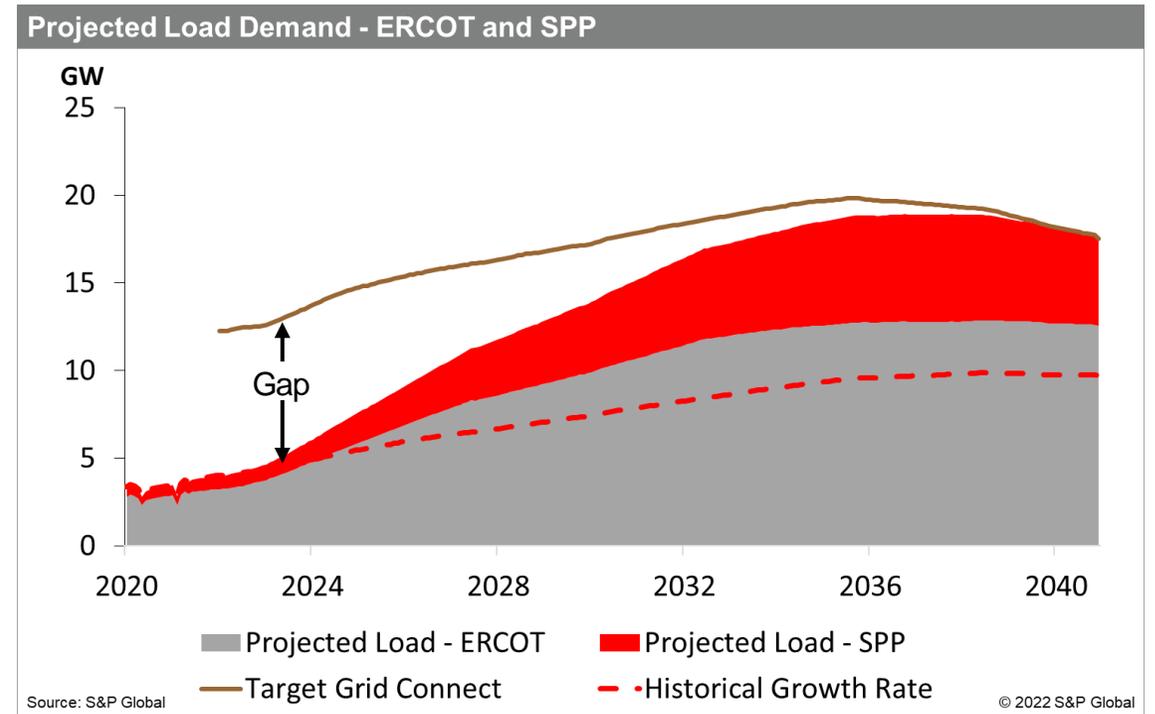
Energy Transition – Increased electrification critical to achieving announced emission reduction targets

Increased Electrification Requirements – Projected Load Demand to increase from 4.2 GW to 17.2 GW

Align Grid Connect Pace with Targets - The pace of electrification needs to increase three to four-fold

Significant Future Resources underlay about 40% production growth over the next 12-14 years

Delaware Basin Focus – Split fairly evenly between ERCOT and SPP



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Address the reasons for the 8.2 GW difference in Target Grid Connect and Projected Load demand shown in Table 1-1: Data shows that large operators have moved more aggressively to the grid

- For the Texas portion of the Permian Basin, the difference in Target Grid Connect and the Projected Load Demand is 6.0 GW (9.4 GW – 3.4 GW)*
- Of the 9.4 GW of Target Grid Connect the breakdown for demand is shown to the right
- Please note that the Target Grid Connect is a goal to strive for in order to reach the projected emission reduction targets.
 - In other words, if all targets were instantaneously attained in 2022 by connecting to the grid, then this would constitute the 2022 grid connect. The goal is for the Projected Load Demand to close the gap over time
- The operation table provides a breakout of the GW pertaining to each operation which contribute to the Target Grid Connect. Since ESG operations have not been implemented we estimate that the Expected Current Load Demand for oil and gas operations to be about 5.0 GW, which is 1.6 GW higher than the 3.4 GW of estimated industrial load
- Possible reasons for this gap may include
 - Mid-sized and small operators with smaller percentages of operation not connected to the grid due to operational, expense and reliability issues (see next slide)
 - Increasing grid connection in the latter half of 2022 (beyond May) may also contribute to gap closure

Texas Portion	22-May	27-Dec	Dec-32	Dec-36	Dec-40
Power Demand (GW)	12.2	15.1	16.8	17	16
Target Grid Connect (GW)	9.4	11.6	13.1	13.3	12.5
Projected Load Demand (GW)	3.4	8.5	11.9	12.8	12.6
Historical Growth Rate (GW)	3.4	5.2	6.4	7	7.2
Projected Load Demand (R+C+I) (GW)	4.8	9.5	12.7	13.8	13.9

Operation	GW	% of Total	New for ESG
Drilling	0.3	3.6%	Yes
Completion	0.2	2.0%	Yes
Gas Lift & GAPL	1.9	20.1%	Yes
Rod Pump & ESP	2.0	21.6%	No
Facilities	0.7	7.4%	No
Water Handling	0.8	8.5%	No
Gas Gathering	1.8	19.1%	Partly
Liquid Gathering & Transmission	0.2	1.7%	No
Gas Processing	1.5	15.8%	Partly
Gas Transmission	0.0	0.3%	Yes
Total	9.4	100%	

Traditional to put on grid (No)	3.7	➔	Expected Current Load Demand	5.0
New for ESG (Yes)	2.5			
New for ESG but partly on grid	3.3		New Load Demand if ESG were implemented now	4.4
On grid	1.3			
Not on grid	2.0			

Quantification of emission reduction – high level calculations and examples if there were no grid connection

Permian Basin CO2-e estimation	Value	Unit
CO2e - Per MMMBoe (2020)	47,000	Tonnes
Permian Basin - Daily Oil	5.00	MMbbls/d
Permian Basin - Daily Gas	19.50	Bcfd
Permian Basin - Daily Boe	8.25	Mmboe/d

Daily CO2e emmsions	387,750.00	Tonnes
Annual CO2e emmsions	141.53	MMTonnes

Total US CO2e emmsions	4,818	MMTonnes
Permian Basin % of US	2.9%	

Source: S&P Global

CO2e from Equipment and Power Generation	Fuel g/kWhr	Equipment use - g/kWhr*	Tonne/ GWhr	tonne/ day/GW	Permian power demand (GW)	Daily CO2e emmsions (tonne)
Dual fuel	220	897	897	21,528	16.1	346,601
Diesel	250	892	892	21,408	16.1	344,669
Gas turbine - 3rd gen	180	857	857	20,568	16.1	331,145

*Assumes 70% load factor: Thermal efficiency: gas turbine 30%, diesel 50%, DGB 35%

Source: "EVALUATION OF NEXT GENERATION OF FRACTURING FLEETS: TIER IV DIESEL, TIER IV DUAL FUEL AND ELECTRIC" – Liberty White Paper

Approximate Current CO2e from leading Permian Basin Companies if there were no grid connect

Company	MMbbls/d	Bcf/d	MMBoe/ day	Horiz. Wells	Adjustme nt to daily average	*Ave Tonne/MMBOE – no grid connect	*Ave daily CO2 emission (tonnes) with no grid connect
Exxon	0.3143	1.429	0.552	1860	0.948	44,574	24,626
Chevron	0.1749	0.884	0.322	982	0.858	40,348	13,001
Pioneer	0.4797	1.532	0.735	3291	1.261	59,279	43,572
Oxy	0.2261	0.667	0.337	1212	1.012	47,578	16,047

- We recognize that a portion of the operation that may potentially use CO2 emitting fuel is on the grid, so these values only represent a hypothetical no grid connect
- Each company has a specific amount of the CO2 emitting operations connected to the grid, but, this information along with plans to connect to the grid is held confidential

There is no great discrepancy after comparing the power intensity assumptions for each operation in upstream and downstream sectors between SPG and TORA

Power Intensity Comparison				
Section	Operation	S&P	TORA	Unit
Upstream	Rod Pump	30	15	HP/100 bbl/d
	Gas Lift	67	57	HP/100 bbl/d
	ESP	21	18	HP/100 bbl/d
	GAPL	7	N/A	HP/100 bbl/d
	Water Recycling	0.009	0.009	KWH/gallon
	SWD	0.009	0.009	KWH/gallon
	EOR Water Flooding	0.01	0.009	KWH/gallon
	Facilities	4.8	1	HP/100 bbl/d
Downstream	Gas Gathering	0.17	0.22	KW/mcf/d
	Oil Gathering	0.016	0.03	KW/bbl/d
	Gas processing	0.115	0.15	KW/mcf/d
	Gas Transmission	0.01	N/A	KW/mcf/d
	Oil Transmission	0.019	N/A	KW/bbl/d
	NGL Transmission	0.016	N/A	KW/bbl/d

➤ Comments

- Rod pump for S&P is higher based on operator feedback and rod pumps being applied later in well life when flows are less, thus increasing HP/unit
- Higher S&P facilities values may reflect central facilities design as provided by participating companies; however, overall power consumption here is relatively small
- S&P midstream somewhat lower than TORA

➤ Upstream power intensity source

- S&P: average values of the data collected from participating companies
- TORA: ERCOT west Texas load study – March 2022

➤ Downstream power intensity source

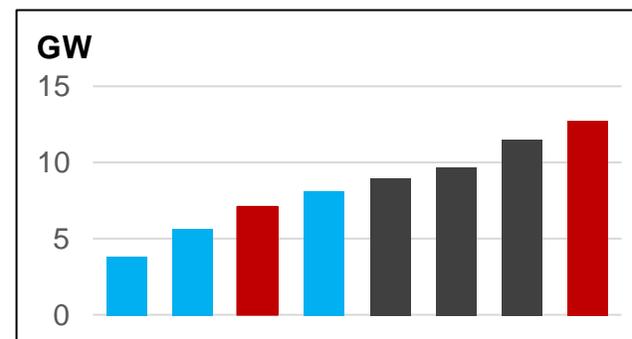
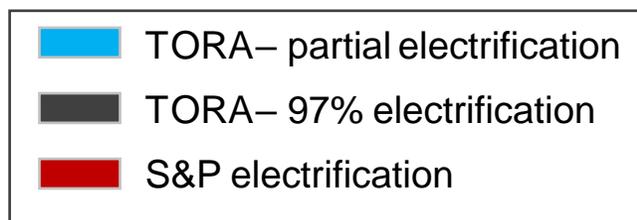
- S&P: average values of the data calculated by QUE\$TOR Modeling and Machine Learning results
- TORA: average values calculated by the matrix details in appendix of ERCOT west Texas load study-March 2022

SPG forecasts Industrial load (Texas portion) in 2035 is either 7.1 GW or 12.7 GW depending on which operations are compared.

Scenario	Approximate Average GW Forecast in 2035 ¹
Scenario 1 (\$35/bbl, 10% electrification)	~3.75
Scenario 2 (\$70/bbl, 30% electrification)	~5.682
Scenario 3 (\$90/bbl, 30% electrification)	~8.951
Sensitivity Analysis	Approximate Average GW Forecast in 2035 ¹
Scenario 1 (\$35/bbl, 97% electrification)	~8.164
Scenario 2 (\$70/bbl, 97% electrification)	~9.618
Scenario 3 (\$90/bbl, 97% electrification)	~11.52

Oil and Gas Operation	2040 Grid Connect %	Likely include in TORA forecast
Rod Pump & ESP	95%	100%
Gas Lift & GAPL	80%	0%
Water Handling	97%	100%
Facilities	97%	100%
Drilling	55%	0%
Completion	15%	0%
Oil/NGL Transport	97%	100%
Gas Gathering	75%	Part
Gas Processing	93%	Part
Gas Transmission	25%	0%

Note: 1. Only oil and gas industrial load in 18 counties including existing load



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