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Electrification of the Permian Basin

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Upstream consulting

Authors and contributors

Tim Zoba – Project Executive

Curtis Smith – Project Manager

Min Rao – Assistant Project Manager

Ye Hao – Upstream

Ke Li – Upstream and Midstream

William (Rick) Allen – Midstream

Maz Zarea – Bitcoin Mining

Shawn Gallagher – ESG and Regulatory

Mikhail Alekseenko - Upstream

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ELECTRIFYING THE PERMIAN BASIN - EXECUTIVE SUMMARY

Six oil and gas companies (herein referred to as "participating companies") have engaged S&P Global (S&P) to prepare a report addressing the future electric load demand associated with the expanding oil and gas developments in the Permian Basin. This report is an expanded follow-up to a report written in 2019 by IHS Markit (predecessor company, now part of S&P) that was submitted to the Energy Reliability Council of Texas (ERCOT) in March 2020. Since the 2019 report, global oil markets and company electrification priorities have changed, necessitating a significant increase in electric load demand within the basin. Key takeaways include:

- **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 these 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 significant 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.

Information supplied and verified by the participating companies-along with S&P proprietary data, research, modeling tools, and expertise contribute to the assumptions and outlooks in this report. Furthermore, S&P maintains that the information and conclusions set forth herewith are impartial and unbiased. The objective has been to employ a data-driven analytical process in order to generate an electric load demand forecast which will meet the needs of all stakeholders within the Permian Basin.

Future Grid Connection Requirements

Determining which portions of the power forecast will need to be put on the grid for both upstream and midstream companies to meet strategic objectives, including emissions reduction is critically important. Table Ex-1 shows the percentage of each operation that S&P has determined will eventually need to be connected to the grid by the end of the forecast period in order to meet those objectives (herein referred to as "Target Grid Connect").

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%

Table Ex-1: Target Grid Connect for oil and gas operations

Currently, the average oil and gas industrial load of 4.2 GW only provides about 33% of the 12.2 GW of Target Grid Connect access within the basin. Closing this gap will take time as transmission and distribution infrastructure will need to be developed in a way to attend to the greatest priorities. Most importantly, upstream and midstream companies are now in, and will accelerate, the process of converting equipment previously powered by high-emitting diesel and natural gas to be powered by the electric grid.

Nevertheless, as companies have accelerated their electrification efforts, they have indicated a pressing need for utilities and regulatory agencies to speed up the process. Currently oil and gas industrial load is being added at a rate of about 300 – 350 MW annually (see Figure Ex-4) which, as we will see, will not meet important strategic targets. Closing the gap between the current oil and gas industrial load and the Target Grid Connect at a much faster rate that will meet stakeholders' strategic objectives is needed.

Projected Load Demand Forecast

The Projected Load Demand forecast involves closing the gap between the current load and the Target Grid Connect by meeting ~90% of the Target Grid Connect by 2032 and 100% by 2040 (see figure Ex-1). This will require an eventual four-fold increase from the current 4.2 GW to 17.2 by 2032, which includes 11.9 GW to ERCOT and 5.3 GW to SPP. The forecast is driven entirely by unconventional production in the Delaware and Midland Basins, but more especially in the two Delaware Basin regions (TX and NM) where five-fold increases are required and where 75% of Permian Basin future load demand will occur (see Figure Ex-1), owing to a robust production forecast and elevated associated water and gas projections, all of which require substantial power to handle and transport.

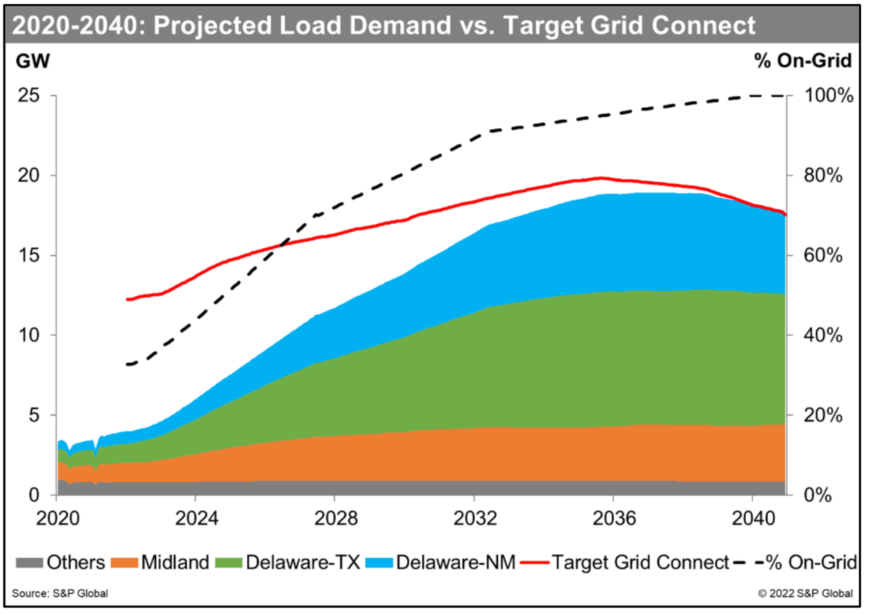

Figure Ex-1: Projected Load Demand and Target Grid Connect

The Projected Load Demand Forecast is intended to show that meeting strategic objectives by increasing grid access is critical, and in order to meet those objectives, future grid access will need to be accelerated three to four-fold over the recent oil and gas industrial load additions of 300-350 MW per year. Figure Ex-2 indicates the year-over-year (YOY)

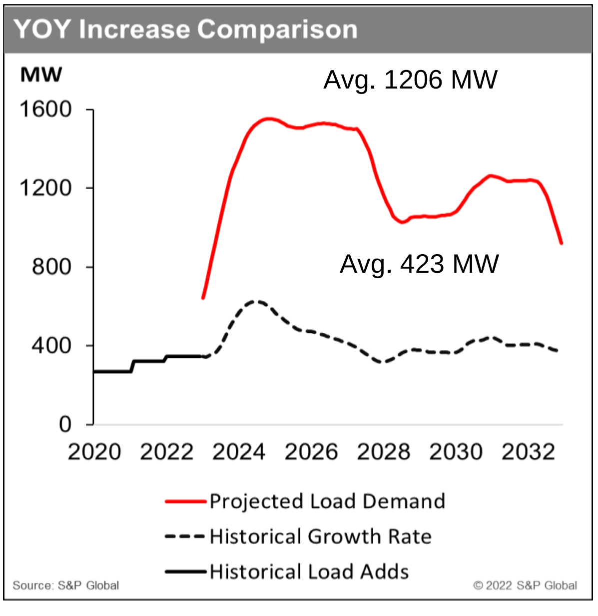

Figure Ex-2: YOY increase comparisons between outlooks

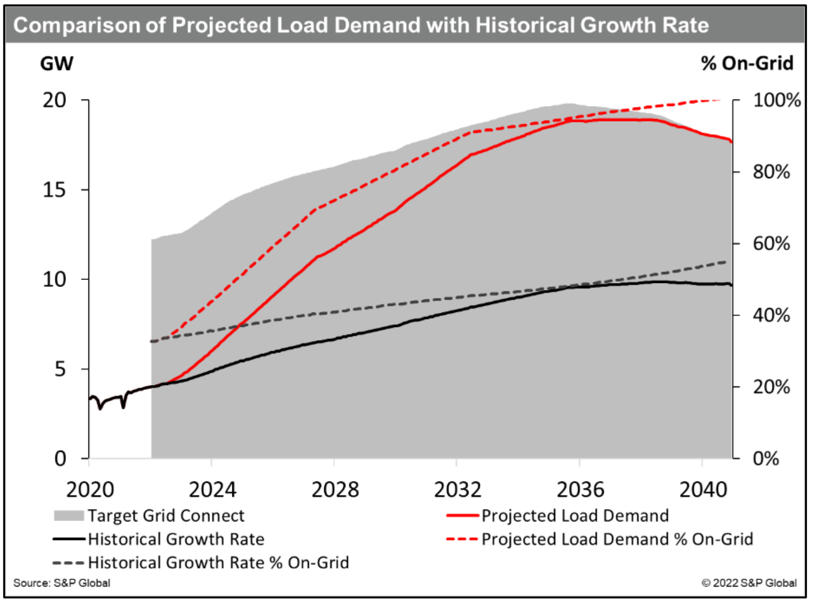

Figure Ex-3: Comparison of the Projected Load Demand Forecast with the Historical Growth Rate Forecast

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load additions required in order to meet the Projected Load Demand Forecast. A much smaller forecast based on historical YOY bulk growth rates is also illustrated by the historical trend growth rates in Figure Ex-2. If these historical growth rates were to be maintained over the next 10 years, the resulting load additions would meet only 46% of the Target Grid Connect in 2032 and 54% in 2040 (Figure Ex-3). This comparison with the Projected Load Demand forecast suggests that recent historical load addition rates will fall far short of meeting Permian Basin stakeholders' strategic objectives.

Geographic Distribution of Load Forecast

S&P has analyzed and mapped the expected increase in oil and gas industrial power demand for the Projected Load Demand forecast as it is projected onto nine-square mile grid blocks (3x3 miles), (herein defined as grid blocks). These maps help determine in more detail where current grid usage is high and where it is most likely to increase over the forecast period. This process also helps to identify future needs for the construction of additional electric transmission and distribution infrastructure in a more detailed, localized manner. Key drivers used to allocate the regional outlooks include acreage quality and future drilling priorities, company size and current grid access, and location of processing plants and compressor stations. Grid blocks with higher current and future loads are located either in highly productive areas or contain processing plants or compressor stations.

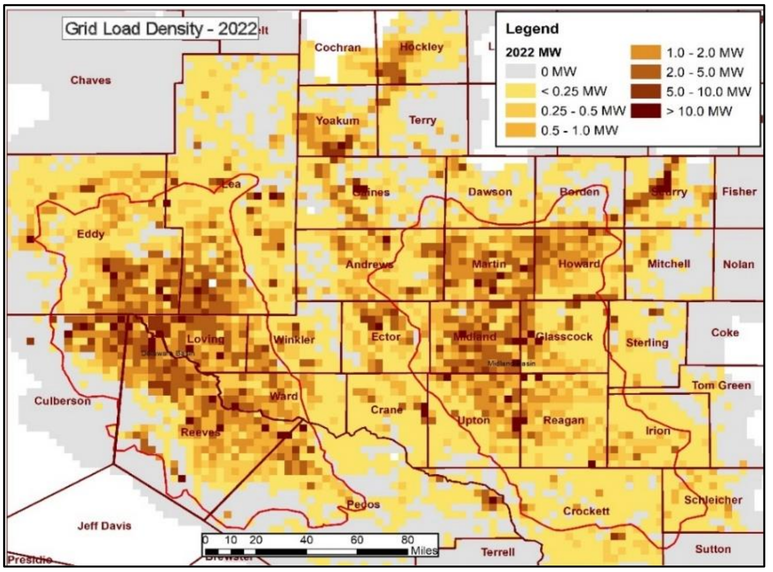

Figure Ex-4: Current (2022) load demand distribution

Figure Ex-4 shows the 4.2 GW of current load throughout the Permian Basin, which is concentrated in the unconventional areas of the Delaware and Midland regions with a few small, concentrated fields in the historically conventional areas. Figure Ex -5 depicts the incremental load growth between now and 2032, where 13.1 GW of new Projected Load Demand Forecast is most likely to occur. Growth will occur in the Midland Basin, but the highest and most dense growth will occur in the Delaware Basin. Areas outside the Delaware and Midland Basins containing conventional production will see a reduction in load demand.

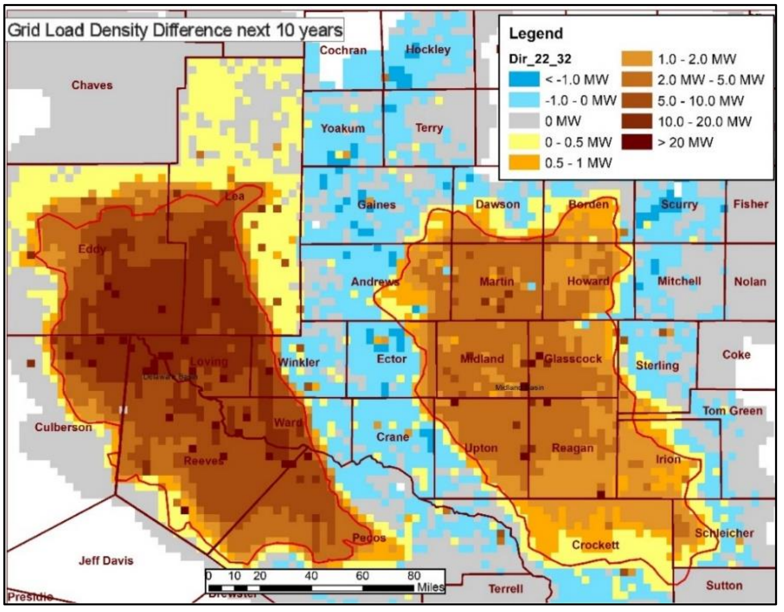

Figure Ex-5: Next 10 years incremental changes Projected Load Demand Forecast

Resource and Production Outlook

Underlying the load forecast is a resource and production outlook focused mainly on the Delaware and Midland Basins, where horizontal drilling and "fracking" have unlocked enormous undeveloped unconventional resources of 71.5 billion barrels of remaining oil, and 289 trillion cubic feet of associated natural gas. The Delaware Basin contains more than double the oil and triple the gas resource of the Midland Basin.

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Most of these resources can be produced economically, for under $60 per barrel. The long-term S&P price outlook indicates that oil prices will remain in the low $70/bbl range, which will make the Permian Basin competitive as a global resource. Overall oil production is expected to gradually increase from current levels of five million barrels per day, topping out at seven million barrels per day by 2036.

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Electrification of the Permian Basin

1 Introduction and Overview

1.1 Introduction to this Report

A consortium of oil and gas companies comprised of Chevron, ConocoPhillips, Devon Energy, Diamondback Energy, ExxonMobil, and Pioneer Natural Resources (herein referred to as "participating companies") has engaged S&P Global (S&P) to prepare a report which will address the future electric load demand associated with the expanding oil and gas developments in the Permian Basin located in West Texas and Southeastern New Mexico. This report is a follow up to an earlier report written by IHS Markit (predecessor company, now part of S&P) that was submitted to the Electric Reliability Council of Texas (ERCOT) in March 2020[1]. That report was commissioned by Oncor Transmission Company ("Oncor"), a key provider of electric transmission to the Texas Portion of the Permian Basin, who retained IHS Markit (now S&P Global) to estimate future electric load requirements in the basin.

Most of the analysis for the bespoke report was performed in late 2019 and is herein referred to as the "2019 Report." Since that time several events have occurred which have affected, and will continue to affect, the demand for electricity in the Permian Basin. These events include (1) the COVID-19 pandemic, which altered the production forecast trajectory, (2) a decrease in high reinvestment rates to more appropriate investment rates by upstream companies, (3) projected long-term changes in world oil markets, which have elevated long-term price forecasts, (4) a prioritization of Scope 1 and 2 emissions reductions by upstream companies operating within the Permian Basin, and (5) the arrival of Winter Storm Uri, which impacted grid service throughout Texas. A key component of the emission reduction strategy is to move several oil and gas operations that have traditionally been powered by diesel and natural gas onto the electric grid. In the 2019 Report, IHS Markit noted a number of operations that at that time required non-grid power (such as gas lift, drilling and completion) but were not included in the load forecast; however, based on recent information provided by several key Permian Basin producers, including the participating companies, they are in the process of moving these operations to the electrical grid in order to meet strategic corporate targets, including emissions reductions. In turn, this redirection has increased the demand for electric load in the basin.

Information from participating companies has been provided to S&P to help assist in the analysis and validate certain study results; nevertheless, conclusions and interpretations set forth in this report have been independently derived by S&P. By integrating the participating company-supplied information along with S&P proprietary data, research, modeling tools and expertise, S&P maintains that the information and conclusions set forth herewith are impartial and unbiased. Due to confidentiality and anti-trust requirements, operator-level analysis will not be presented in this report; rather, results will be presented for each of five regions and rolled up to the basin level (Figure 1-1).

The five regions where forecasts will be provided include (1) the New Mexico portion of the Delaware Basin ("Delaware-NM"), (2) the Texas portion of the Delaware Basin ("Delaware-TX"), the Midland Basin ("Midland"), (4) Central Basin Platform ("CBP") and (5) Fringe areas ("Fringe"). Although geologic basin boundaries don't necessarily coincide with geographic boundaries, much of the analysis has been performed at the county level; hence, regions are defined by the counties which best align with each respective geologic province (see Figure 1-2). Major activity over the past decade has been concentrated in the Delaware and Midland Basins where new unconventional or "tight oil" resources are being developed using horizontal drilling and hydraulic fracturing ("fracking"). Future oil and gas

[1] 1 West Texas Forecasted Load Additions: Oncor Electric delivery company, February 29, 2020; Available on the ERCOT web site

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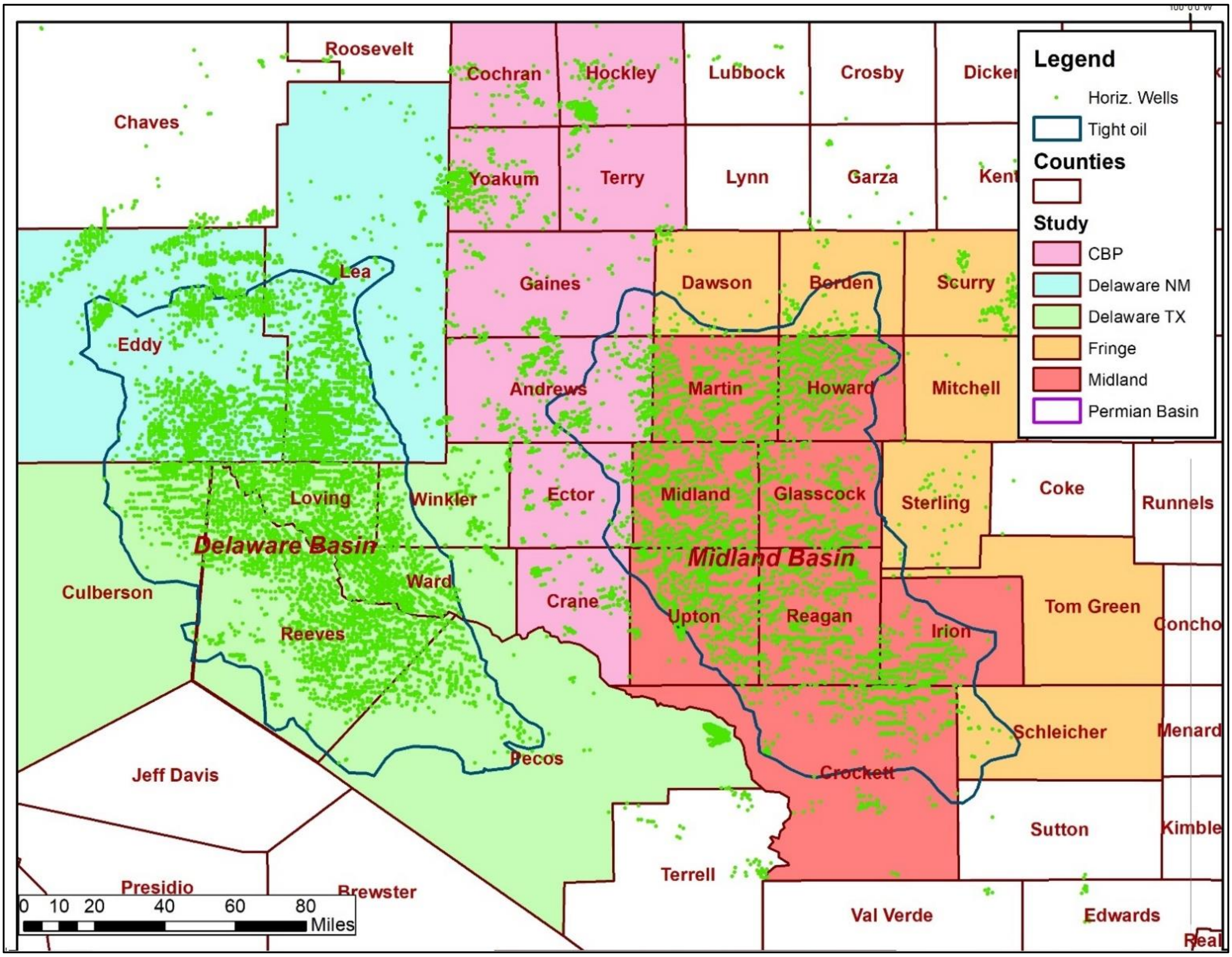

Figure 1-1: Map of study area depicting the five regions

activity and associated power demand is expected to either increase or be maintained within these "tight oil" regions, whereas activity is expected to wane in other regions.

Our goal has been to employ a data-driven analytical process in order to generate a power demand forecast and an associated need for electric load which will meet the needs of all stakeholders within the Permian Basin. The bulk of the analysis is focused on the use of industrial power related to oil and gas operations, with some minor attention to the total residential, commercial, and industrial (R+C+I) loads set forth at the end of the report.

1.2 Summary Conclusions and Forecasts

Overall key findings presented throughout the report include the following:

- In order to meet important strategic targets, including emissions reductions, utilizing the electric grid as the primary power source for operations currently powered by emissions-emitting diesel and natural gas will benefit all stakeholders. Stakeholders include producers, midstream companies, consumers, local and regional government entities and those concerned with emission reductions and ESG matters. In order to meet targets these three areas of increased grid access must be met.

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    - Operators want to put production operations such as rod pumps, ESP, water handling and facilities on the grid in order to reduce costs and increase reliability. We estimate that within the Permian Basin that between 30-45% of these operations currently lack access to electric load.
    - With a remaining resource base of 71.5 billion barrels of oil and 289 TCF of associated gas, current oil production of five million barrels per day (MMbbls/d) is projected to gradually increase to a peak of just over seven MMbbls per day by 2036 which will require additional grid access to meet demand.
    - Compression associated with gas lift and gas gathering is generally powered by gas or diesel, but companies will be increasingly moving compressor power to the grid to meet emissions targets. This move will take up nearly one-half of future grid connections for oil and gas operations.
- In order to meet roughly 90% of projected industrial load demand within the basin within the next 10 years, a four-fold increase of electric load from the currently supplied 4.2 GW to 17.2 GW will be required. Load demand will increase to nearly 19 GW by 2036 when production peaks but will eventually taper off as production begins to decline; nevertheless by 2040, 17.7 GW of load will still be required in order to meet strategic targets from all stakeholders.
- Annual industrial load additions since 2019 have averaged about 300-350 MW and if this trend were to continue, only 46% of the Target Grid Connection demand (demonstrated by the Projected Load Demand Forecast) would be met by the end of 10 years and only 53% would be met by 2040.
- Virtually all of the growth and over 3/4th of future load demand will be in the Delaware Basin, where remaining oil resources and future production outlooks are double that of the Midland Basin and where associated gas and water ratios are also much higher.
- Currently Industrial power takes up about 66% of the total residential-commercial-industrial (R+C+I) load mix in the Permian Basin, but because of the large projected load demand growth of industrial power, it will take up 93% of the total load within the next 10-15 years.

Figures 1-2 through 1-4 illustrate the total Permian Basin forecasts (2020 – 2040) of production, power and load and define their relationships. Each step taken or analysis performed to determine the final results is defined as follows:

1. Production outlook: A forecast of oil, gas, water and drilling is the foundation upon which the outlook is predicated.
2. Power Demand: A forecast of total projected power requirements (horsepower) for all upstream and midstream oil and gas operations regardless of the power source, whether it be the electric grid, natural gas or diesel.
3. Target Grid Connect: A forecast of a portion of the Power Demand forecast which will need to be connected to the grid, for both upstream and midstream companies to meet strategic objectives including emissions reduction. From a practical point of view achieving grid connect targets will take years since infrastructure will have to be built to meet these targets; however, the Target Grid Connect reflects the goal or need for electricity to power the designated oil and gas operations beginning in 2022.

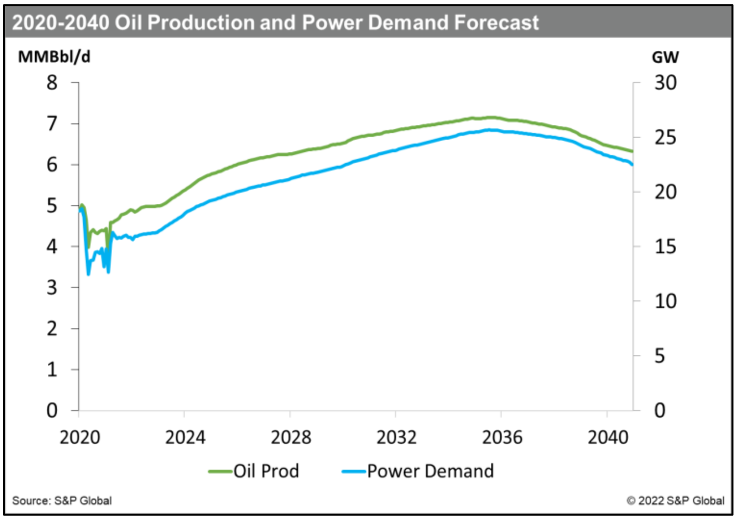

Figure 1-2: Oil production and Power Demand forecasts

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4. Projected Load Demand: A forecast of future industrial electric load additions which are required in order for all Permian Basin stakeholders to meet strategic objectives. This forecast is defined as the base case which sets forth that (1) current demand is not being met, (2) Permian Basin production will continue to increase, and (3) eventually the gap between Projected Load Demand and Target Grid Connect will need to be closed for companies to meet strategic objectives.

5. Historical Growth Rate: An alternative worst case industrial load forecast scenario which projects industrial load additions to continue at the recent YOY bulk rate of connection trend. Its purpose is to show the deficit in meeting stakeholder strategic objectives if grid load additions rates are not significantly increased

6. Projected Grid Connect (R+C+I): While this report focuses almost entirely on the Industrial (I) load forecast (Projected Load Demand), residential and commercial (R+C) load which is being carried over from the 2019 report is added to the industrial forecast in order to estimate total load requirements within the basin.

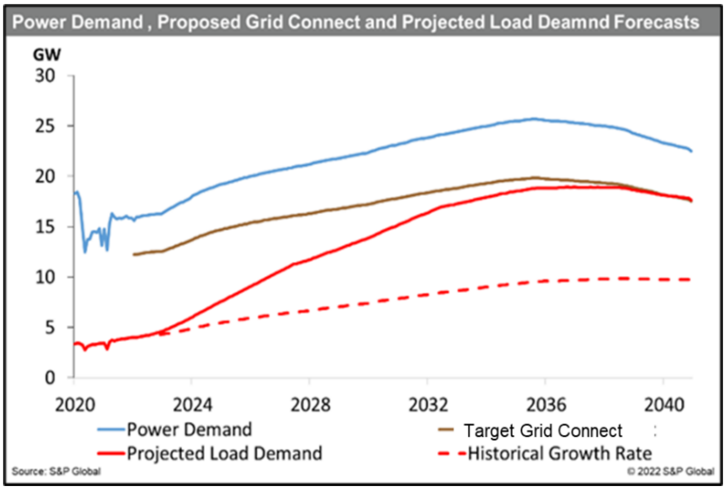

Figure 1-3: Power Demand, Target Grid Connect and Projected Load Demand forecasts

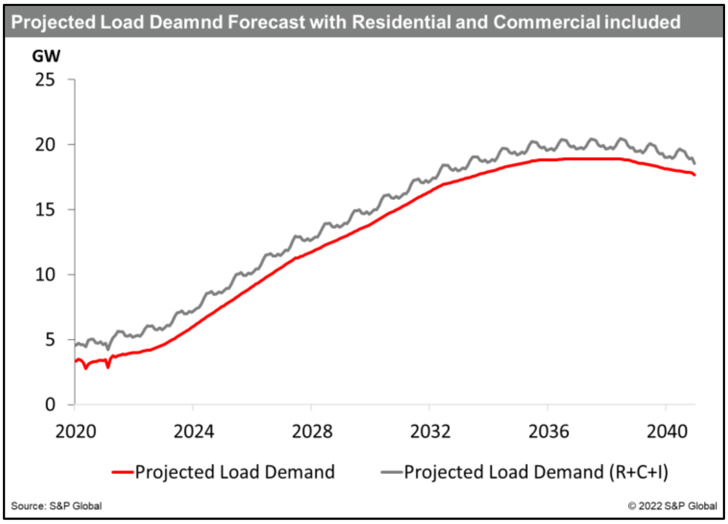

Figure 1-4 Projected Load Demand with R+C+I forecast

Table 1-1 provides the power and load applicable to each respective forecast. We have aligned our beginning point at May of 2022 where we have complete data sets to work with. For comparison purposes, forecast results are provided at the five-year interim (2027) and the ten year interim (2032) and 2036 near the point where maximum results are expected to be attained, and at the end of the forecast period (2040). Bolstered by an increasing production forecast and a need to close the gap between current grid connection and Projected Load Demand, the outlook calls for significant increases in grid connection, particularly over the next 10 years.

	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)	3.7	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*

Table 1-1: Total power and load projections throughout the forecast period
** June of each respective year when R+C is at maximum peak*

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2 Participating Company Input into the Process

2.1 Participating Company Feedback

During the course of the study the participating companies provided answers to specific questions which S&P delivered to each party (see Appendix 1 – Company feedback questions). In addition, S&P held interviews with participating companies and with some midstream companies. While this information and feedback help inform and adjust the assumptions and outlooks set forth in this report, the final results and forecasts have been determined by S&P. Specific information and feedback include the following:

- Initial feedback from questions provided to participating companies and interviews
  - Validation of the oil, gas and drilling forecast
  - Oil and gas operations strategies and power requirements
  - Current Grid Connect strategies and outlooks (includes midstream companies)
- Additional feedback and validation
  - Individual company Projected Load Demand forecast
  - Drafts of this report and Executive Summary

2.2 Report Roadmap and Participating Company Feedback

Figure 2-1 illustrates the workflows that contributed to the load forecast and the stages where company information and feedback were provided. As noted in the introduction, these steps were defined and illustrated, and Permian basin-level forecasts were provided. From left to right each step shown in Figure 2-1 builds on the previous step to obtain the final results. The titles of the following chapters of this report are set forth in each box shown in the figure 2-1 flow chart. These chapters will expand on the conclusions set forth in the Introduction and focus primarily on outlooks for each region, including the entire Permian Basin, and provide some breakout by oil and gas operation where applicable. Methodologies, assumptions and other ancillary information are provided in the Appendices.

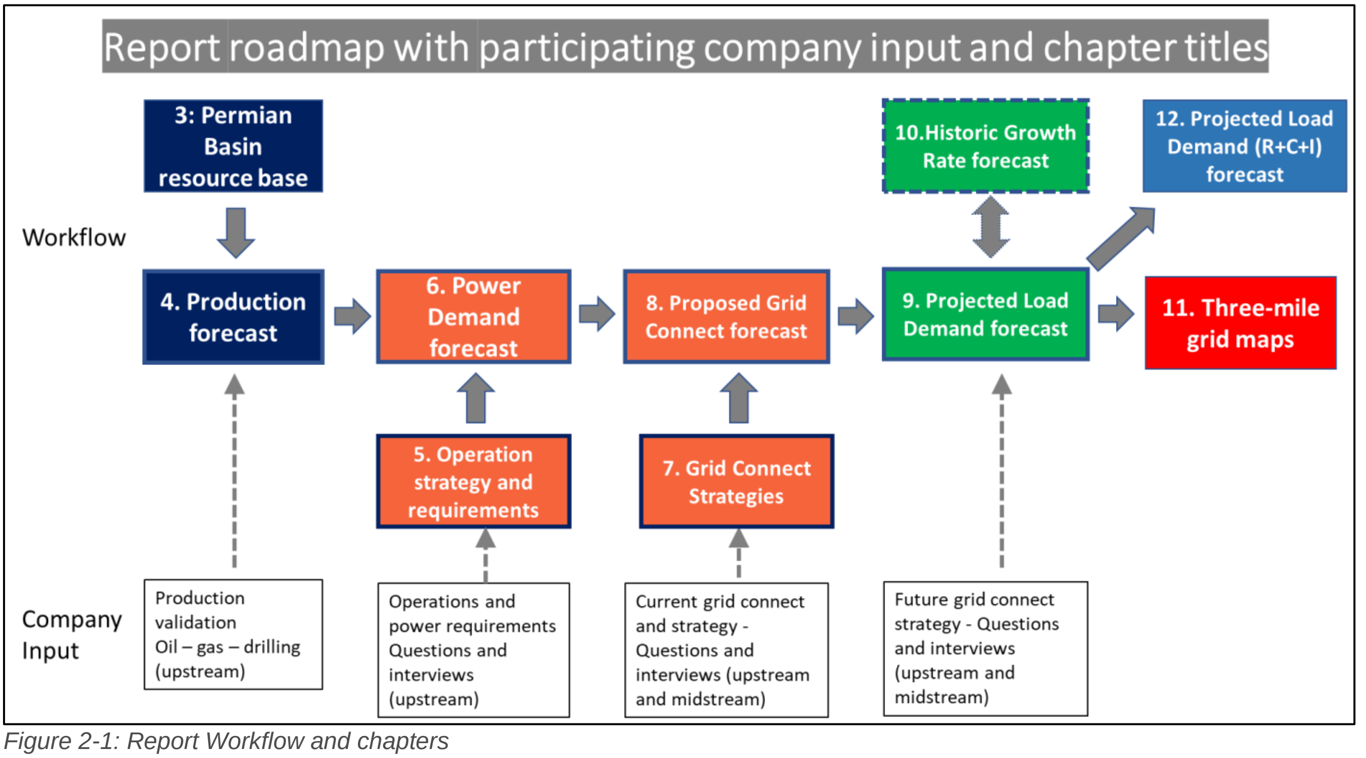

Figure 2-1: Report Workflow and chapters

3 Permian Basin Resource Base

3.1 Summary Outlook

The Permian Basin, located in West Texas and Southeast New Mexico, is the most prolific oil-producing basin in North America. Classified as a super-basin, it is also ranked in the top five oil producing basins world-wide. Currently daily production is just under 5 million barrels (MMbbls) of oil per day and just under 19 billion cubic feet (Bcf) of well head gas per day (or 14.2 Bcf per day of dry gas), up five-fold from 2010.

Up through 2012, production from the basin consisted of conventional production accessed by vertical wells, but as conventional fields were depleted, production in the basin declined. With the advent of horizontal drilling and "fracking," vast new resources, heretofore uneconomic, became accessible and oil and gas production from the basin increased rapidly. These "tight oil" or unconventional resources located in the Delaware and Midland Basins or regions (Figure 3-1) now account for more than 85% of the basin's production and by 2032 will account for nearly 95% of basin output.

Unlike conventional production that declines slowly, unconventional wells decline more rapidly, with first year decline rates of 70-80% in the Permian Basin. This means that to grow or even maintain production, new wells must be drilled continuously and brought on-line to replace the declining volumes. This "treadmill" effect is now well entrenched in the Permian Basin. If sufficient new wells are being developed, we will continue to see stable or increasing production.

3.2 Permian Basin Overview and Resources

In the Delaware and Midland Basins, thick sequences of potential reservoir rocks accumulated, which are being developed using the new technologies of horizontal drilling and hydraulic fracturing (fracking). These thick sequences, averaging between 3,000 and 5,000 feet, could accommodate between six and ten stacked reservoirs developed from a single drill pad. The Delaware and Midland Basins will be responsible for virtually all future production growth from the Permian.

The Delaware Basin consists of up to 5,000 feet of potential pay column in the combined Bone Spring and Wolfcamp formations. The Bone Spring formation contains five to seven potential stacked reservoirs or pay zones and the Wolfcamp formation contains three to five stacked reservoirs or pay zones. Horizontally drilled wells are able to access each of these potential reservoirs. For purposes of this report, we have geologically combined the Bone Spring and Wolfcamp formations together but have sub-divided the Delaware Basin into Texas and New Mexico regions (Figure 2-1).

The Spraberry formation in the Midland Basin has been developed vertically for decades, and now it is also being developed horizontally, although much of the focus is on the underlying Wolfcamp formation. Both the Spraberry and Wolfcamp formations have multiple stacked reservoirs which can be accessed by horizontal drilling. On average, three to six pay zones can be economically developed in this basin. The more productive areas or sweet spots have been identified for most of the reservoirs, and the latest advances in stacked drilling from a single well pad enable development of multiple zones, including those less prospective, at a substantially lower cost per well.

A primary region in the Permian Basin which produces legacy conventional resources is the Central Basin Platform (CBP region). All other producing sub-basins outside the Delaware and Midland Basins and the CBP have been lumped into the Fringe region.

3.3 Remaining resources

Assessments of the recoverable oil and gas resources from unconventional reservoirs (or pay zones) were performed by analyzing the regional geology, reviewing the production performance of areas within the basin, and making assumptions around well spacing and operator behavior. For purposes of this report, recoverable resources

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(sometimes referred to as technical resources) consist of the amounts of oil and gas within the rock bodies that could ultimately contribute to an economic production forecast at current price forecast paradigms.

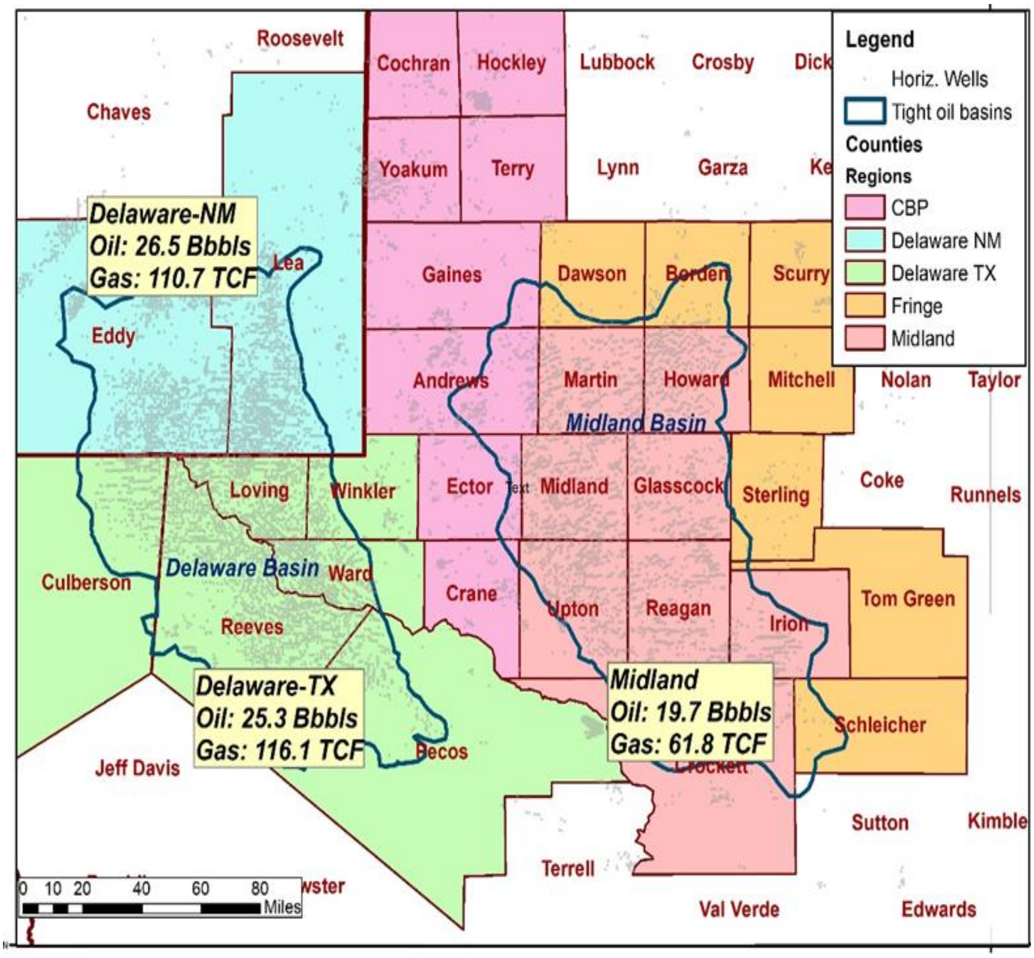

Figure 3-1: Permian Basin map, with regions and remaining undrilled resources in each

In early 2021, S&P performed a reassessment of Permian Basin unconventional resources and determined that there were 71.5 billion barrels (Bbbls) of undrilled oil and 289 trillion cubic feet (Tcf) of undrilled associated gas. In addition, there is approximately 7 Bbbls of oil and 23 Tcf of gas that that remains to be produced from currently active wells ("PDP"). The breakout of remaining undrilled resources within each region is shown on the map depicted in Figure 3-1. Because the Delaware Basin regions have more stacked reservoirs or pay zones and due to somewhat better geologic conditons, these two regions contain 72% of the remaining undrilled oil and 79% of the remaining undrilled gas. Hence S&P sees more long-term development in these regions.

When analyzing what has already been drilled and is currently producing or has been produced, we note a difference between regions. Figure 3-2 indicates that the Midland region has a lower percentage of remaining undrilled locations compared to drilled locations than do the Delaware Basin regions. This means that the Midland Basin is more mature and is likely to deplete faster relative to the Delaware Basin. In particular, the Delaware Basin in New Mexico is even less developed than its Texas counterpart. This means that longer-term potential development is most likely to occur in the Delaware-NM region.

3.4 Low breakeven prices

The 2021 resource assessment also indicates that most of these undrilled resources can be produced economically, with 63 Bbbls or 88% of the 71.5 Bbbls of oil resources producible for under $60 per barrel. If we include the 7 Bbbls of PDP than the total oil resource breaking even under $60/bbl approaches 70 Bbbls. Although a large portion of the resource is economic in today's oil price forecast paradigm, the basin is somewhat more sensitive to oil prices than

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some other global basins where breakeven prices are in the $15-$35/bbl range. For example, if oil prices were to completely collapse, only about 17.5 Bbbls (excluding PDP) or 24.5% of the 71.5 Bbbls would still break even for under $35/bbl (see Figure 3-3). While this price collapse scenario is unlikely, if it were to occur, drilling in the Permian Basin would be severely curtailed, as we saw in April and May of 2020 when oil prices collapsed due to the COVID-19 pandemic.

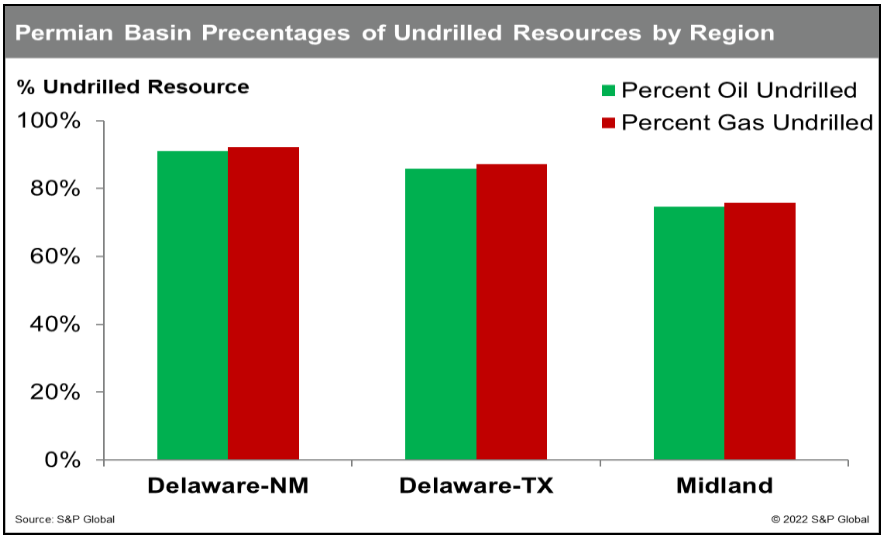

Figure 3-2: Percentages of undrilled resources by region

The Permian Basin has been labeled as a global swing producer because producers can either decide to drill or not drill depending on such criteria as price outlooks, reinvestment rate priorities, and optimization of portfolios. As previously noted, when producers stop drilling, production declines more rapidly compared to other global basins that produce primarily from slower-declining conventional resources. Although the basin is susceptible to “black swan” events, such as the 2020 pandemic, rapid recovery in current and future production outlooks has been demonstrated here, with the overall future long-term outlook calling for increased production. While we have determined that three quarters of the undrilled resources lie within the Delaware Basin, Figure 3-3 also suggests that the cost of supply is lower there, which means that the two regions within this sub-basin are less susceptible to uncertainty and are more likely to be aggressively developed in the future than is the Midland Basin. See Appendix 2 for additional ancillary material related to remaining resources and the contributing formations.

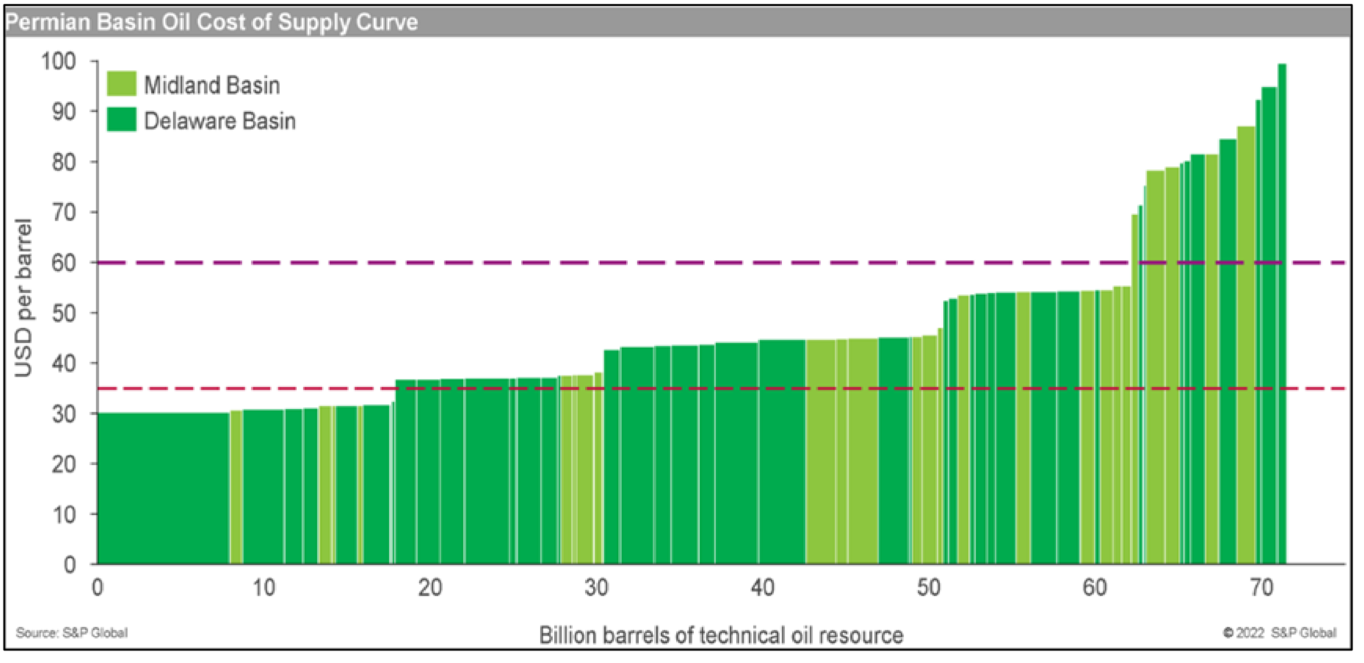

Figure 3-3: Permian Basin cost of the oil supply curve

4 Production Forecast

4.1 Oil Production Forecast by Region

Figure 4-1 provides the total Permian Basin oil production outlook for each of the five regions. Oil production is expected to increase gradually from the current ~5 MMbbls per day peaking at around 7.1 MMbbls per day by 2036. Production is expected to decrease gradually thereafter. During the 2022-2040 period, approximately 43.2 of the 71.5 Bbbls total resource will be produced with most of the increase occurring in the Delaware Basin.

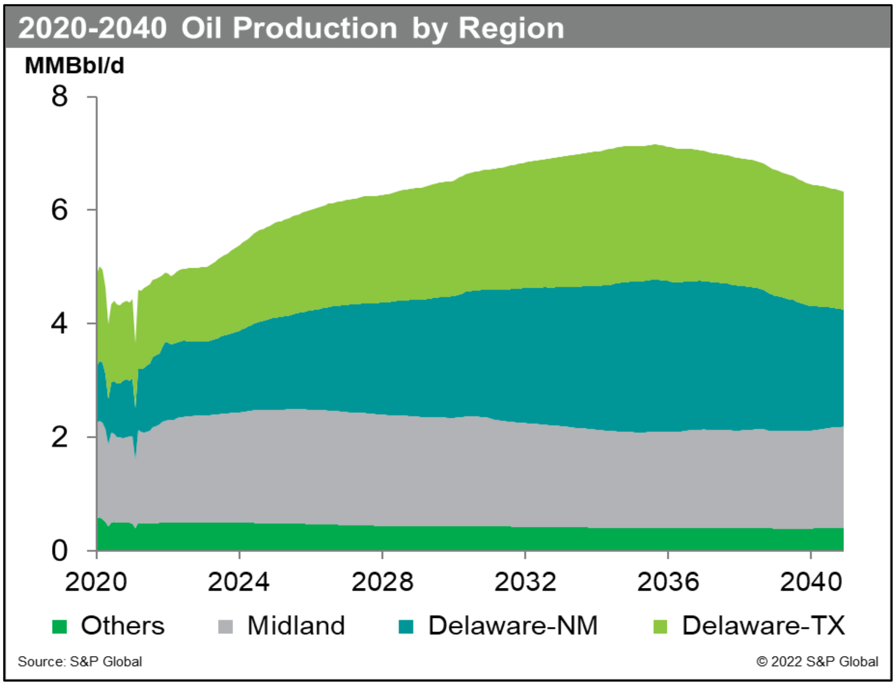

Figure 4-1: Permian Basin oil production forecast by region

In early 2020, production dropped in the basin from nearly 5 MMbbls per day to 4.3 MMbbls per day due to the COVID-19-induced collapse in oil prices but has since rebounded and is expected to continue a growth trajectory throughout the forecast period; nevertheless, conservative re-investment of cash flows will keep production growth from accelerating beyond about 4-5% annually. Daily oil production is foundational to all power use for operations requiring the production and transport of oil and associated products.

4.1.1 Oil forecast by region

Within the Delaware-TX region, oil production is expected to grow from the current rate of around 1.29 MMbbls per day to about 2.08 MMbbls per day by 2040, an increase of 62% and in the Delaware NM region, the outlook calls for production to increase from the current 1.3 MMbbls per day to 2.06 MMbbls per day, an increase of 58%. Production in the more developed Midland Basin is expected to increase slightly to around 1.88 MMbbls per day and remain relatively flat throughout most of the forecast period decreasing to 1.78 MMbbls per day by 2040. Production from the CBP and Fringe regions is considerably smaller and it is forecasted to gradually decline over time from the current 0.5 MMbbls per day to 0.4 MMbbls per day by 2040.

4.2 Gas production forecast and GOR

Associated gas within each region is expected to follow the same trajectory as the oil forecast. The current volume of gas produced at the well-head is expected to grow from 19 bcf/d to about 32 bcf/d when it reaches peak in 2036. The gas oil ratio (GOR) describes the number of Mcf (thousand cubic feet) of gas produced with each barrel of oil. Figure 4-2 suggests that the GOR within CBP, and Fringe region stay relatively constant during the forecast period and are lower than in the unconventional regions. The Delaware Basin GOR is much higher and increases slightly, reaching peak production rate around 2036. The GOR in our outlook is expected to increase slightly over time, especially in those sub-regions that would be heavily drilled during the forecast period.

GOR in a single well tends to increase over time; however, producers are continuously drilling new wells where initial rates of GOR are lower offsetting higher GOR rates in the latter stages of a well's productive life where overall production is much lower. This balancing leads to a relatively flat GOR within each region. Within the overall Texas portion of the Permian Basin, we will see the GOR increase slightly as a higher percentage of the production flows from the more gas-rich Delaware Basin.

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Gas production's importance as a consumer of power occurs mainly in the midstream sector where there are much higher power requirements needed to compress and move gas through transportation systems including gathering systems. As will be noted later on, power requirements to transport gas are an order of magnitude higher than that needed to transport oil. Power is also needed to operate gas processing plants scattered throughout the basin.

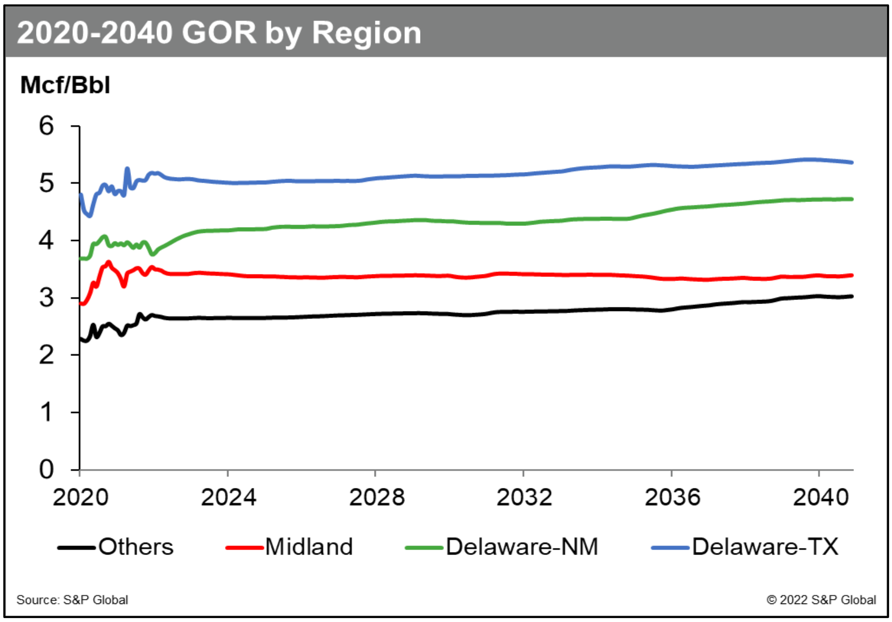

Figure 4-2: Gas oil ratios (GOR) for Permian sub-basins

4.3 Drilling forecast

Figure 4-3 shows that before the pandemic, approximately 500-600 horizontal wells per month were being completed and brought online, requiring 400-500 rigs. This level of activity was sufficient to maintain steady production growth within the entire Permian Basin. After the early 2020 oil price collapse, drilling activity plummeted to about 140 wells per month in the middle months of 2020 and it wasn't until later in the year that rig use began to increase. This rising trend has continued throughout 2021 and into 2022 but has not yet reached the same pre-pandemic levels. Beginning in 2021 there were approximately 2,000 wells that had been drilled, but not completed (referred to as DUCs). Despite the lower rig counts of 2021 and projected rig counts of 2022, this depleting inventory of DUC wells has been contributing to the total number of new wells coming online.

The advantage of a DUC well is that about 40% of the cost has been previously sunk into drilling the well and completing it or bringing it online requires only the remaining 60% of the total cost. Hence, producers have been bringing more production online for lower cost and fewer rigs by tapping into their DUC inventory. By mid-2023, this inventory is projected to be exhausted, and operators will again need to pay the full cost of drilling and completion to bring new production online which could dampen the forecast slightly (Figure 4-3).

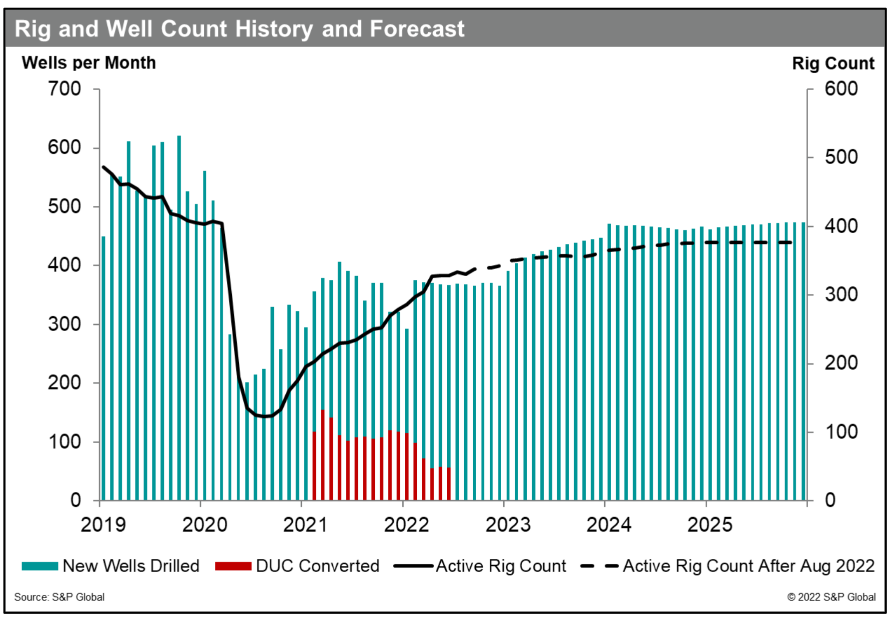

Figure 4-3: Permian Basin horizontal rig activity and well counts

The longer-term outlook for the Permian Basin, is that drilling and completion activity will steadily increase until it reaches pre-pandemic levels by about 2025. Drilling and completion activity is expected to continue to increase mainly in the Delaware regions as indicated in Figure 4-4 which portrays this longer-term drilling and completion outlook for all wells (horizontal and vertical). The lack of longer-term activity growth in the Midland region will be

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due partly to cautious investing of the producers, but also because the better drilling locations, or sweet spots, will begin to be exhausted in this more developed region. On the other hand, more available high-quality locations are still available to be developed in the less-mature Delaware regions.

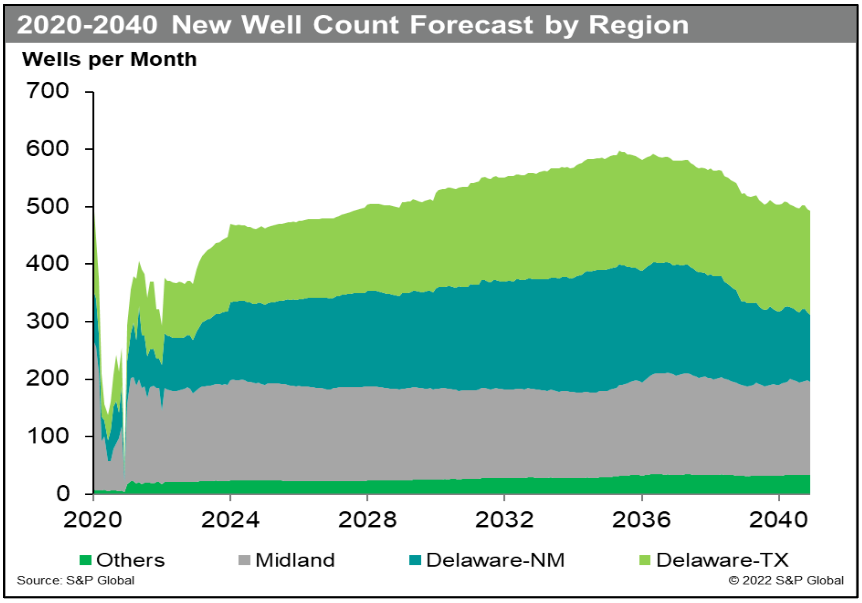

Figure 4-4: Permian Basin (Texas portion) long-term new well forecast

As previously mentioned, tracking the well count outlook is important to assess how and when new production will be coming on stream, as drilling and completion activity go hand in hand with production increases or decreases. Another reason for tracking drilling and completion is due to the substantial power requirements needed to perform these operations. Historically, most of the power supplied to rigs and frack spreads has been provided by generators or gas turbines; however, our outlook indicates that use of the electrical grid for some of these operations is beginning to be more prevalent and will continue in the basin.

4.4 Water forecast

Along with oil production, power is required to lift associated wastewater from the bottom of the well-bore to the surface using some means of artificial lift, such as rod pumps, gas lift or ESP units. Furthermore, power is required to separate water from oil, and either transport it and inject it as wastewater into deep formations or recycle it. Hence, the water production outlook (see Figure 4-5) is critical to assessing future power requirements in the basin. Ironically, over time there will be three to five times more wastewater produced from horizontal wells than oil meaning that a large majority of power requirements are directed at water handling.

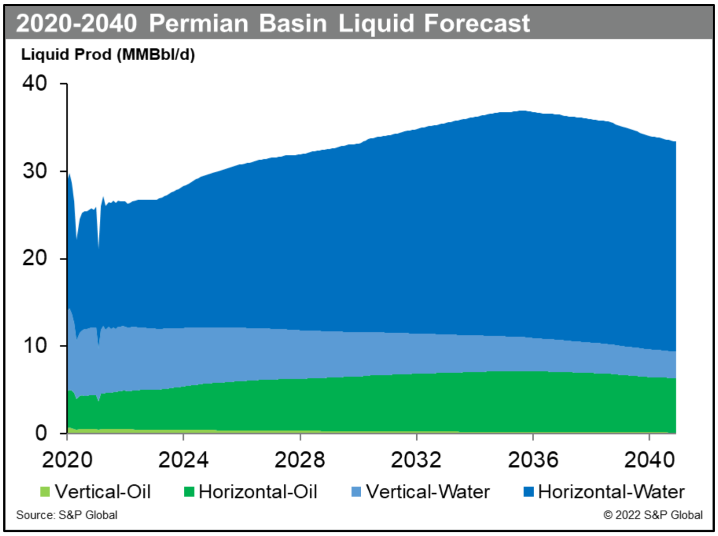

Figure 4-5: Permian Basin produced water forecast

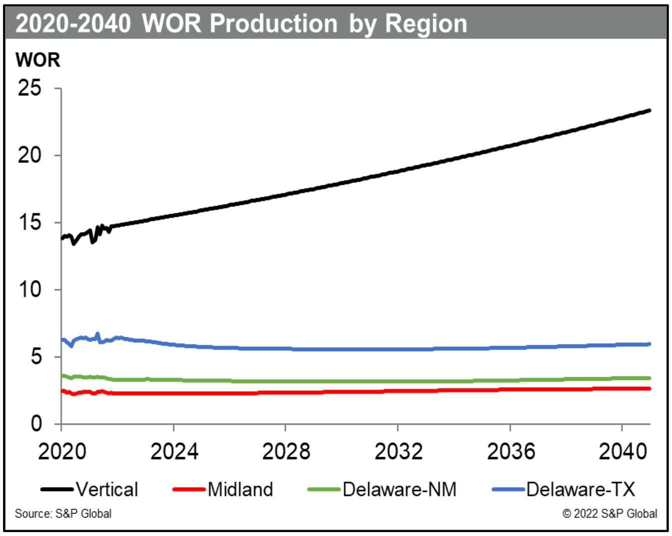

Figure 4-6: Permian Basin water-oil ratio forecast

While vertical oil production will be less important over time, the wastewater production from vertical wells will continue to be a large consumer of power given the overall high and ever-increasing water oil ratios of between 14 and 23 barrels of water per barrel of oil (Figure 4-6). In addition to projected oil production growth in the Delaware

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regions, more power per barrel of oil production will also be needed there, where water-oil ratios are higher there than in the Midland region.

4.5 Long-term price outlook

The longer-term oil price projections are based on continuing trends which include: (1) increasing worldwide oil demand (mostly from India and China) which is expected to peak in 2033, (2) continued restrained re-investment levels and (3) a moderate, but overall, transition away from oil to renewables. These factors will put overall downward pressure on oil prices.

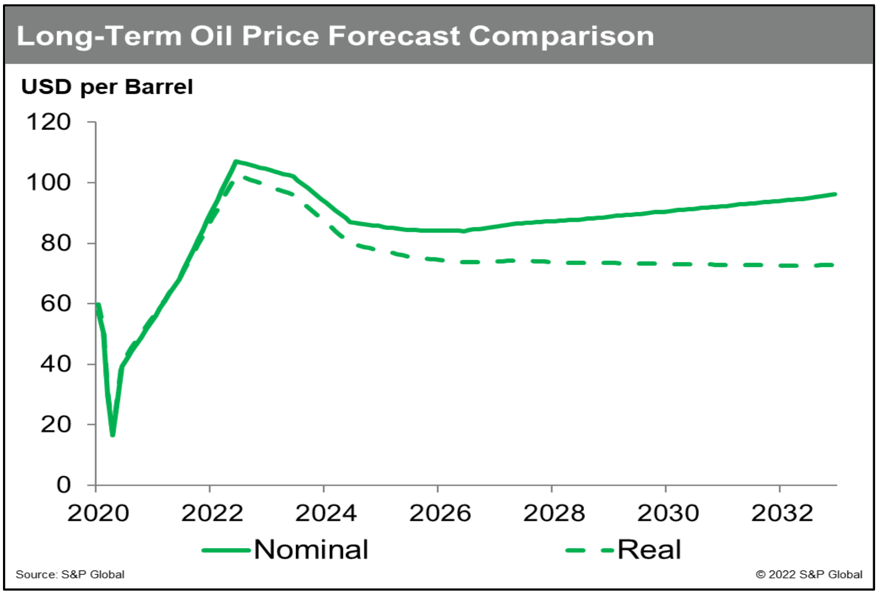

Figure 4-7: WTI long term price forecast

In contrast, because of market uncertainty and high upstream cost inflation, the return required to justify investment has now substantially increased over the average 10% of past decades. In our "break-even analysis" of various sources of oil supply, we have increased the required rate of return from 10% to 20%. This higher required rate of return is not, by itself, a guarantee that prices will stay high or move higher. But it is a force for upward pressure on oil prices over time. These counterbalancing factors suggest that over the next two to three years, oil prices will gradually decrease (in real terms) and ultimately drift downward yet remain in the low $70/bbl range for the longer term (see Figure 4-7). For a more detailed discussion of fundamentals underlying the oil forecast see Appendix 3.

4.6 Impact of Participating Company Production Forecasts

Current oil production from the six participating companies is 1.86 MMbbls per day or about 38% of the total Permian Basin oil production. By 2040, that share is expected to be 2.34 MMbbls per day or 37% . We note that three of the six participating companies, namely ExxonMobil, ConocoPhillips, and Chevron, are classified as global producers, meaning that they are large publicly traded companies that have global portfolios, including a substantial position in the Permian Basin. This means that while these companies have significant resources to devote to investment in the basin, this portion of the portfolio must compete with other priorities. The three other participating companies, namely, Devon Energy, Pioneer and

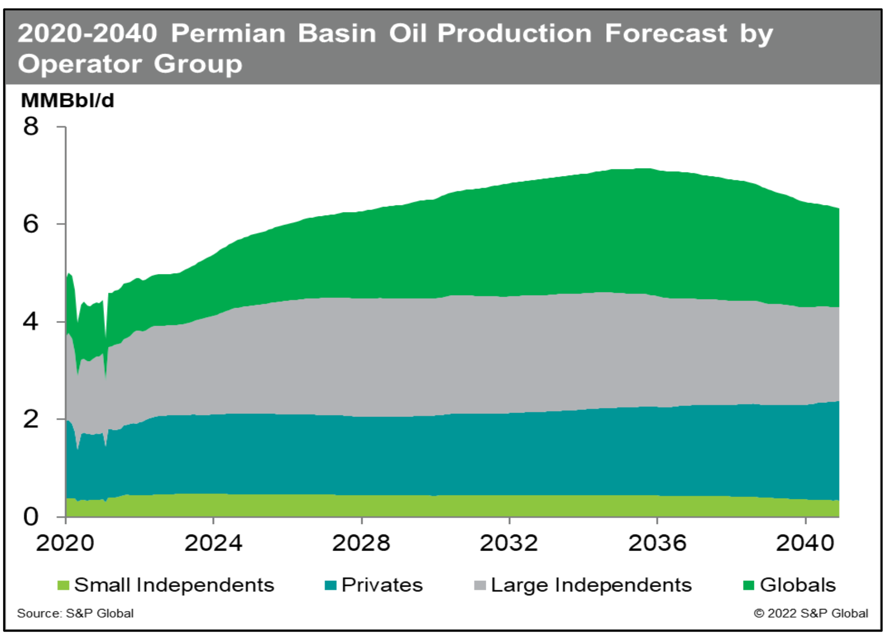

Figure 4-8: Forecast by operator class

Diamondback are considered large independents, meaning they too are large publicly traded companies, but have a much larger share of their respective portfolios in the Permian Basin and that the basin is their largest company priority.

Although these companies are among the largest producers in the basin, they in most instances reflect the behavior of other operators, but in some instances they do not. For example, private companies are re-investing larger shares of their cash flows in new production which is likely to result in higher production growth rates for them. Smaller companies are not as likely to have large tracts of higher quality acreage and thus may lag the larger companies in developing their acreage. The oil production outlook for different company classes, including globals, large independents, large private companies, and small private companies is shown in Figure 4-8. While this classification of projection may be the outlook for the moment, it is likely to change as companies acquire and divest their Permian Basin assets and the mix of company types changes over time.

5 Operational Strategy and Power Requirements

5.1 Oil and Gas Operations Requiring Power

Upstream power demand comes primarily from drilling, completion, artificial lift (ALS), pad facility, and water handling (Figure 5-1). Drilling and completion activities have the highest power demand intensity and are rarely powered by the grid. Upon wells coming online, production operations are preferentially placed on the grid when it is available, as this is the lowest cost option. D&C has the highest power needs but is only needed for short periods of time. Once the oil fields are on production, most of the power demand comes from artificial lift systems (e.g., ESP and rod pump) and from compressors used to power gas lift and maintain pressure in gathering lines.

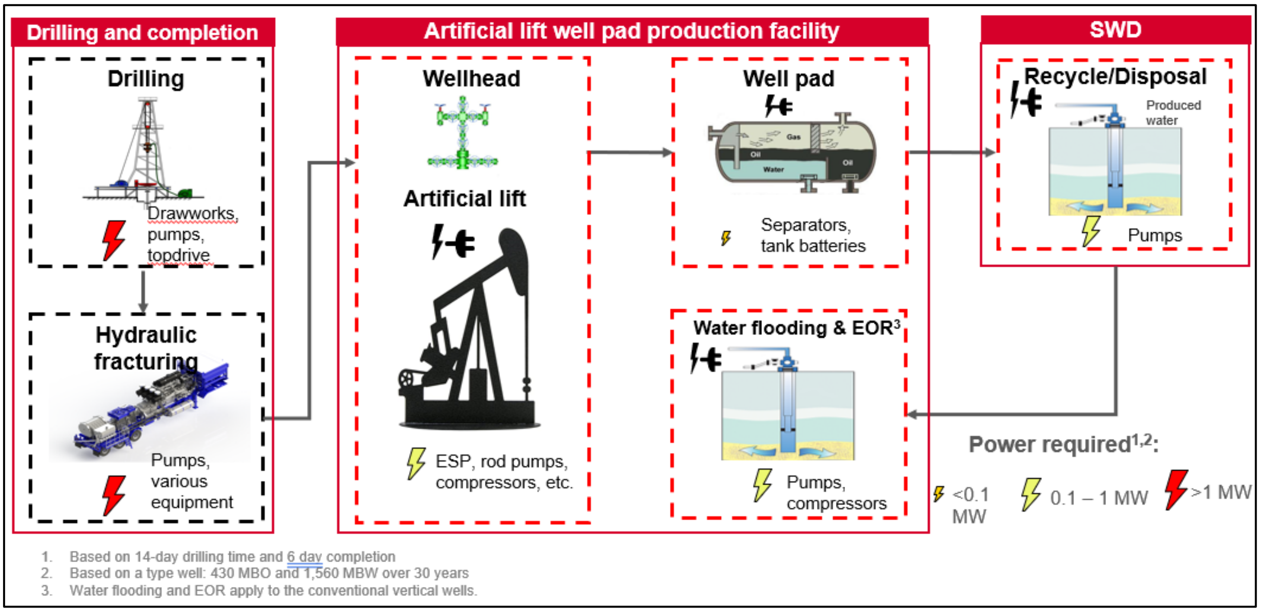

Figure 5-1: Upstream Operation Diagram (power usage is estimated per well)

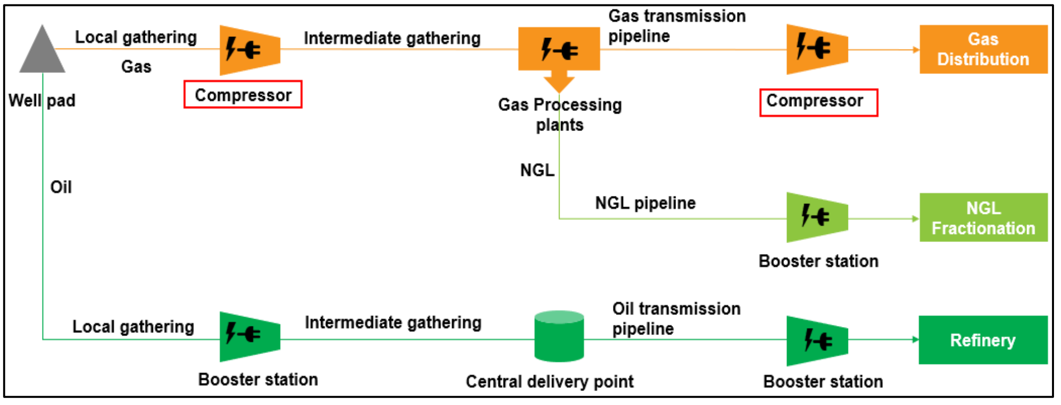

Figure 5-2: Midstream Operation Diagram

Midstream demand comes mainly from gathering systems and natural gas plants (Figure 5-2). Compressors located on gathering lines increase pressure of the gas and deliver it at a specified pressure to the gas processing plants, which process wet gas (produced at the well-head) by removing NGLs (natural gas liquids) and impurities. Once processed, dry gas is transported by transmission pipelines, to the market. Pump-pressured oil gathering lines transport crude oil from the well pad to the central delivery point from where it is transported via transmission line to the refineries. NGL pipelines function similar as crude oil pipelines, except they originate at the gas processing plants. Gas processing plants also use power, but their demand is more consistent over time.

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In the Permian basin, the majority of midstream facilities are operated by midstream companies, although some upstream operators own and operate gathering and processing plants themselves. Transmission lines are all operated by midstream companies. Within the midstream operations, compressors and processing facilities may be powered either by the field gas or by the electric grid, with processing plants more likely to be powered by the grid.

5.2 Upstream and Midstream Operations Power Calculations

Set forth below are summary descriptions of how power values were derived for each of the major oil and gas operations. This information was used in conjunction with participating company feedback to determine final results. See Appendix 4 for a description of the S&P Power Model and Appendix 5 for a detailed description of the methodologies which are summarized in this section 5.3.

5.2.1 Drilling

Power demand required by drilling operations was estimated by multiplying the number of forecasted active drilling rigs by the measured peak and average power demand during drilling operations. Power requirements vary considerably during rig operations but generally range between 1.5 and 4.5 MW. Because of this variability, an range of power use is determined for the maximum power use and is estimated to reflect coincident power requirements. The maximum power is uplifted an additional 10% to approximate the rig specs and is also in line with participating company feedback.

5.2.2 Hydraulic fracturing

The power required for a single frac spread is determined by the number of wells it can frac, stages per well, and the days required per stage per frac spread. First, the number of stages in a well and the completion time required for each stage within each region is determined, then the power required for one frac spread is calculated using a daily frac model that applies one frac spread to frac a four-well pad, which yields a typical power requirement of 30,121 HP or 22.5MW per one frac spread, then the total power required for each operator at the regional level is derived by using power per frac spread times total frac spread needed per month.

5.2.3 Artificial lift

Wells in the Permian Basin can transition to artificial lift even in the first month of production. The power usage of these systems varies based on the amount of oil and water produced, well depth, reservoir pressure, fluid weight, and artificial lift type. Power usage intensity data was provided by participating companies on the basis of either HP/well or HP/barrel of lifted fluid for the various ALS types (Figure 5-3) which include gas assisted plunger lift (GAPL), gas lift (GP) , rod pump (RP) and electric submersible pump (ESP). All inputs were converted to a HP/barrel unit prior to being used in our model to account for reduced power usage as production declines. Power usage estimates used operator data “as-is” for those that provided them; for non-participating companies and where power usage intensity inputs were missing, generalized inputs, based on interview data and other analysis, were used. Generally, these power usage intensity values were similar across the participating companies, although some variability existed. It is important to note that while ESP and GL have higher power requirements per well, these are considered “early life” ALS solutions. The “late-life” ALS, such as GAPL and RP, were observed to have lower power usage per well compared to the “early-life” ALS, such as ESP and GL; however, since “late life” fluid rates are much lower, these “late life” solutions have higher rates per unit of fluid pumped or lifted.

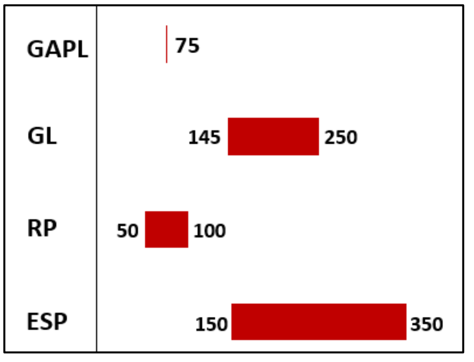

Figure 5-3: Typical ALS Power Intensity, HP/Well

By applying feedback from the participating companies and S&P proprietary data, all operators were segregated into three groups based on company size and perceived access to resources including large scale compression. We

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observed that larger companies (group A) would have access to large compression systems that could be used for gas lift, whereas smaller companies (group C) preferred rod pumps, particularly in the later stages of well life. Gas lift is also more prevalent in the Delaware regions than elsewhere. The ALS production profiles for each basin, formation, and operator were then input into a model, which then applied a percentage of each artificial lift type to the production forecast (Figure 5-4) to generate an overall view of ALS use across the various regions of the Permian basin.

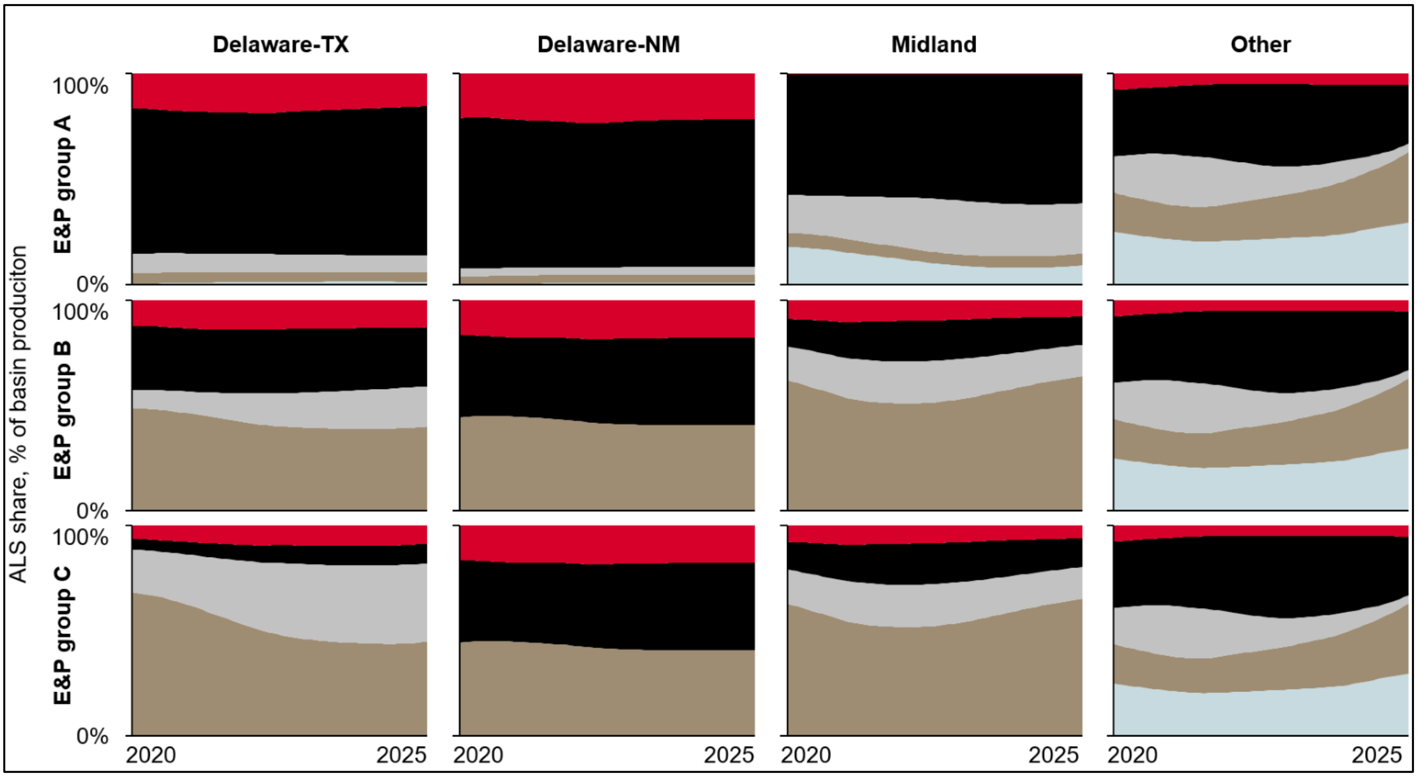

Figure 5-4: Basin-level Volume-Weighted ALS Profiles for Select Operator Groups

5.2.4 Water handing

Water handling power usage intensity and allocation information was provided by participating companies on a HP/100 bbl basis for the various regions (Figure 5-5) and this has been integrated with our own research. Water handling power demand is calculated from water production forecasting, water handling allocation, and power usage intensity. As can be seen in Figure 5-6, water recycling usage continues to increase, which is expected to reach almost 65% by 2040 for both the Delaware and Midland basins due to environmental and water conservation concerns.

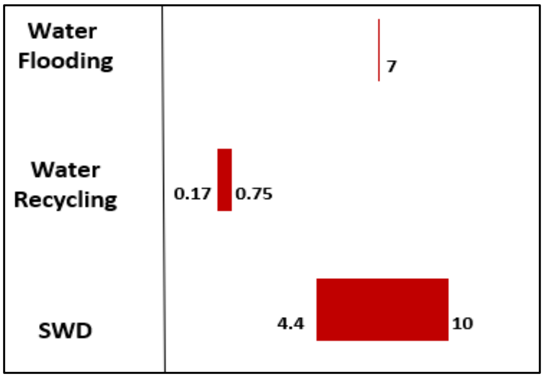

Figure 5-5: Water Handling Power Intensity, HP/100 bbl

The overall water handling forecast indicates that the share of water recycle will increase, while water disposal's (SWD) share will decrease. Since the power requirements for water recycling are only a small fraction of the power requirement for SWD, the overall water handling power forecast will remain flat, even though overall water handling volumes are projected to increase.

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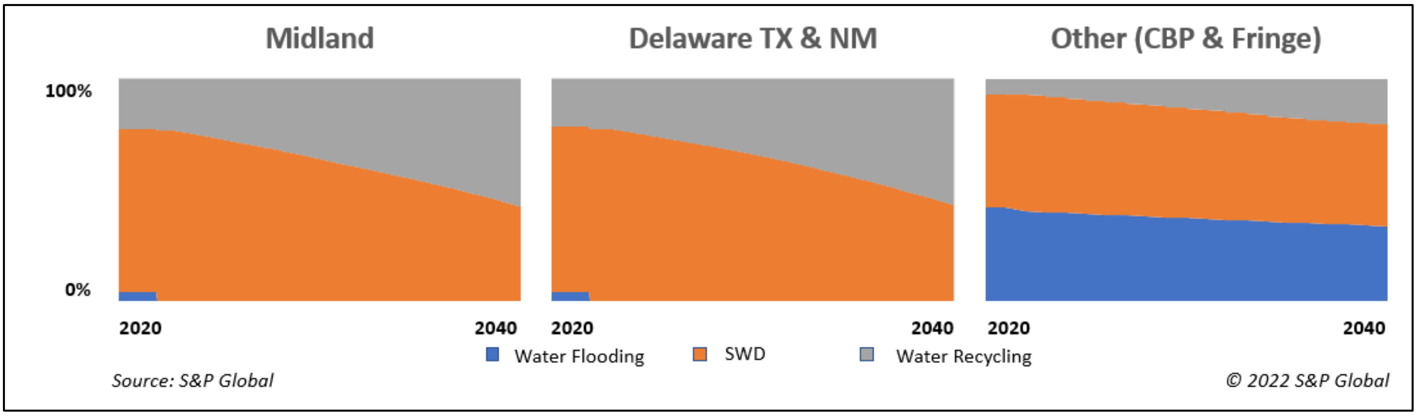

Figure 5-6: Water Handling Allocation by Region

5.2.5 Well pad facilities

Separation of water from oil and gas occurs in a separator located at a well pad. Power demand for separator operation is relatively low due to the low pressures that are involved. Once well pad is connected to the grid, separators are powered via the grid along with the other equipment. Until then, diesel or field-gas power generators can be used. Data provided by participating companies indicates that separators and other equipment require from 0.1 to 5 HP per 100 barrels of liquid (oil and water).

5.2.6 Oil gathering and pumping stations

Gathering pipelines are relatively short – usually less than 20 miles – so the length has limited impact on the power demand. Oil transportation is powered by pumps, and large pumping stations which are located near the transmission lines. The power required ranges from 0.2 to 2.2 HP per 100 barrels of oil transported, or averages of 0.016 kw/bbl.

5.2.7 Natural gas gathering and compression

Natural gas gathering systems are like the oil gathering systems, except that compression is the main driver of power demand. To calculate the power required at various production volumes, we generalized a suction pressure of 55 psi and a discharge pressure of 925 psi which yielded a range of 0.17 kW per Mcf of gas throughput. Note that regardless of whether gas gathering is through a high pressure or low pressure system, we are generally assuming that the produced gas has to be pressured up, whether at the well pad or somewhere along the gathering lines before the gas reaches the processing plant

5.2.8 Gas processing plants

Gas processing plants are a major power user and often rely on grid power, but certain processes, such as gas compression, are sometimes left to self-provided energy from gas turbines. In order to estimate the plant power requirement, we have also taken flaring and fuel usage into consideration, assuming that 97% of gas production forecast is the gas plant throughput forecast. Participating companies provided the gas processing power intensity. Generally, these power intensity values were similar across participated companies averaging 0.1-0.13 kW/mcf/d. S&P maintains a database of processing plants with their respective locations and capacities, which we were able to use to help formulate the power forecast pertaining to gas processing.

5.2.9 Transmission pipelines: gas, oil, and NGL

S&P Global has identified ~6,000 miles of dry gas pipelines, 7,600 miles oil pipelines, and ~1,600 miles of NGL pipelines that flow within and out of the Permian Basin. Gas transmission power requirements are low on only 0.01 kW per mcf, as the gas leaves the processing plant under high pressure and merely requires compressors to move the gas out of the basin.

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6 Power Demand Forecast

6.1 Total Permian Basin Power Demand Outlook

Currently, 16.1 GW of power is required to sustain the oil & gas operations. By 2036, driven by production growth, primarily in the Delaware Basin, oil and gas operational power demand will peak at 25.3 GW (Figure 6-1), representing a 57% increase versus 2022 levels. Afterward it will gradually decline to 22.5 GW by 2040 (Table 6-1). Delaware Basin's power demand will increase by 68%, owing to its robust production forecast and robust associated water and gas projections, which require substantial power to handle and transport. Both the Midland Basin and Fringe areas are expected to have a stable power demand, while the Central Basin Platform is expected to decline through 2040.

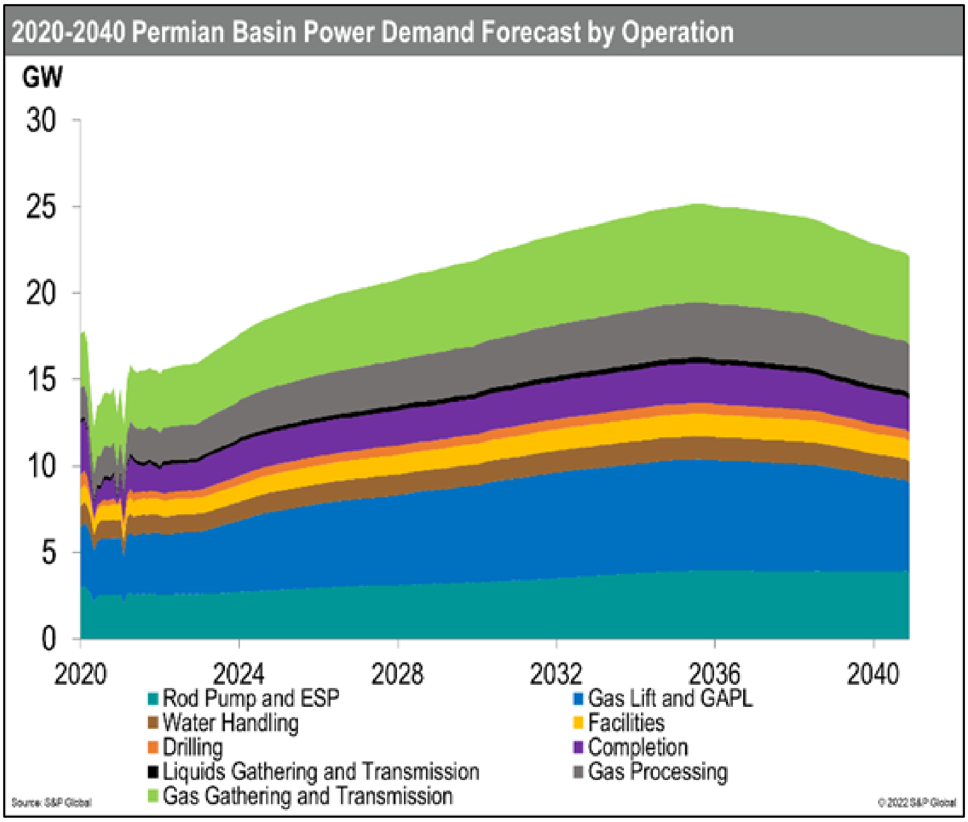

Figure 6-1: 2020-40 Permian Basin Power Demand Forecast by Sector and Operation

Figure 6-1 presents the forecast of power needed to run each of the upstream and midstream operations. Overall, compressors that are used primarily for gas lift and gas gathering and transmission consume the most power, followed by rod pump. Most of these operations are tied to production outlooks and show similar increases in power demand. The exceptions are drilling and completion which are tied to new well forecasts which are not anticipated to increase much compared to production.

6.2 Power Demand Forecast by Region

Table 6-1 sets forth the current and projected Power Demand increases (from oil and gas operations) for each region throughout the forecast period. Not surprisingly, Power Demand trends track the oil, gas and production outlooks in each region, with the largest increases to occur in the Delaware regions. Currently, the two Delaware

Power Demand (GW)	May-22	Dec-27	Dec-32	Dec-36	Dec-40
Midland	4.4	4.9	4.7	4.8	4.7
Delaware-NM	3.9	6.1	7.6	8.3	6.4
Delaware-TX	5.8	8.4	10.3	10.5	9.8
CBP+Fringe	2.0	1.8	1.8	1.7	1.6
Total Permian Basin	16.1	21.2	24.4	25.3	22.5

Table 6-1: Power demand forecasts for selected years by region

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Region	Power demand (GW)		Growth or decline %
	2022	2040	
Delaware TX	5.8	9.8	69%
Delaware NM	3.9	6.4	66%
Midland	4.4	4.7	5%
CBP	1.4	1.0	-26%
Fringe	0.6	0.6	2%
Total	16.1	22.5	40%

Table 6-2: Power demand increases during the forecast period by region

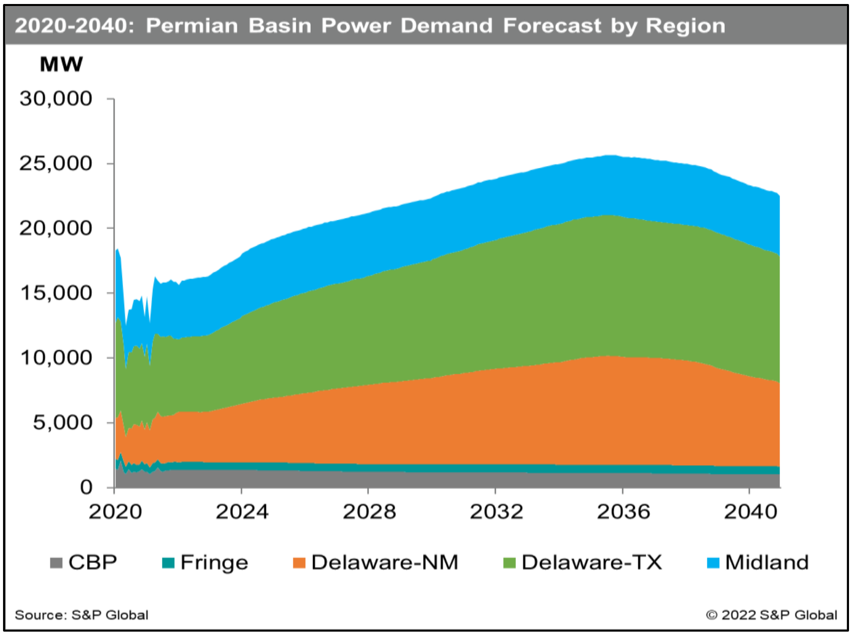

Figure 6-2: Permian Basin Power Demand Forecast by Region

regions comprise 60% of the total power requirements, but by 2032, the two regions will comprise 73% of total Permian Basin power.

Table 6-2 compares the increases in Power Demand for each of the regions. This increase is complemented by the Power Demand forecast plot by region (Figure 6-2). Power demand increases are quite small or declining in each region, except for the two regions of the Delaware Basim where Power Demand increases are in the upper 60-percent range. Power Demand forecast discussions and plots pertaining to each region are discussed in more detail in Appendix 6.

6.3 Midstream Power Forecast Allocations to the Regions

The location of power demand for all upstream operations (production and D&C) is tied directly to the well pads or to nearby facilities, and therefore, when assessing current and future power demand requirements for the five regions (see Figure 6-3) the values remain local to the point of origination for oil, gas water or new wells. For midstream operations, this gets more complicated as oil and gas may be produced in one region and then processed and transported in another region. Thus, the power to handle molecules of oil and gas for some midstream operations may need to be applied in a region other than where the molecules originated.

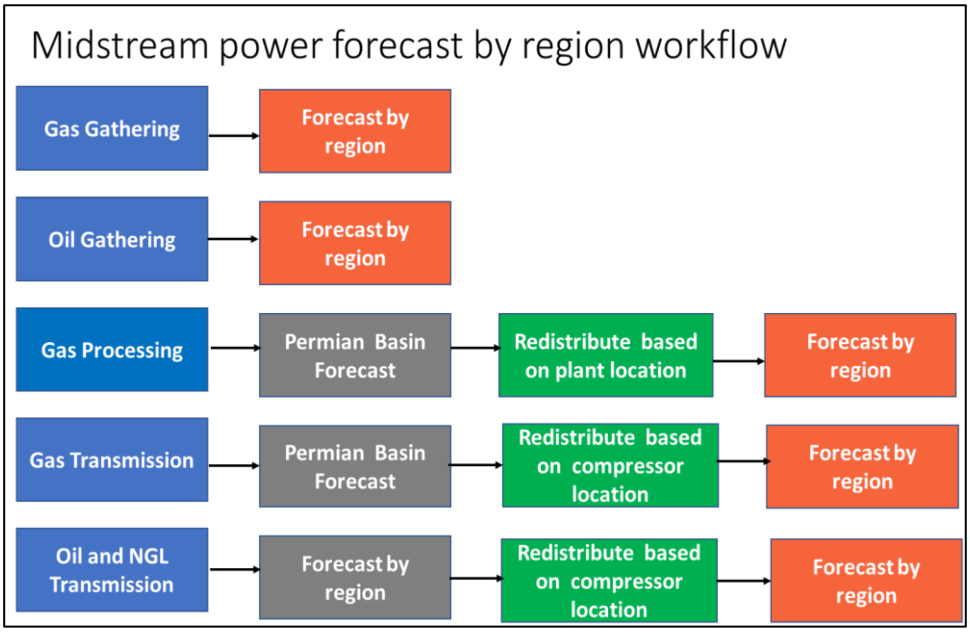

Figure 6-3: Midstream power forecast by region workflow

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Figure 6-3 provides an overview of how power demand has been reallocated to a region other than where the oil or gas originated. We note that both oil and gas gathering power assessments were performed in the same region where the product originated. On the other hand, determining regional outlooks for gas processing required that we allocate the entire Permian Basin forecast based on the total processing plant capacity for that region. Likewise, we also reallocated the total Permian Basin oil and gas transmission to each region based on the number of compressors located in each respective region.

6.4 Recent Trends in Power Sourcing

When selecting a power source, operators usually consider feasibility, economic viability, reliability and ESG considerations to determine the choice. Currently, the most common power sources for drilling and completion operations are fossil fuel generators (diesel, dual-fuel, gas gensets, or gas turbines), while production and some midstream operations frequently rely on electric grid power. With mounting ESG pressures and companies' emissions targets, operators are looking to connect additional operations to the grid, such as drilling, compressors, and even hydraulic fracturing.

6.4.1 Drilling and completion (D&C)

While diesel-powered drilling rigs are still the most common, dual-fuel and e-rigs are being tested or piloted at this time. Each power source has different benefits and challenges. The grid offers improved ESG metrics and can also lead to lower costs, but it can also present operational challenges as planning can be difficult and there could be significant strain on the system. However, driven by emission reduction targets, several leading operators have already used e-drilling in a few development areas. Most participating companies are committed to e-drilling whenever the power lines and conversion equipment are available.

For the hydraulic fracturing operations, diesel turbines have begun to lose market share to dual-fuel and gas-turbine powered e-fracs. Dual-fuel generators are becoming less expensive to operate and reduce emissions. E-fracs generally use gas turbines, with a preference to CNG or line gas over field gas due to consistent quality and cost savings. Using the grid for hydraulic fracturing requires large upfront investment and can strain on the grid, although it has the lowest operational costs and ESG impacts. Some operators, like Coterra, have partnered with service providers to complete wells using grid e-frac. Feasibility and economic viability are the two biggest concerns for grid e-frac given the lack of available power and insufficient transmission line capacity, as grid e-frac operations place a very significant short-term load on a distribution system. The power generation and transmission system would need to be designed to accommodate this load, and safeguards would need to be in place to ensure protection of the remainder of the system, shall grid e-frac gain a larger market share. Feasibility of grid e-frac operations would need to be determined on a case-by-case basis.

6.4.2 Upstream production

Overall, operators prefer grid power for upstream production and are leaning to the grid for gathering and compression. We anticipate this preference to continue due to lower costs, emission reductions, and reduced maintenance demands. Renewable investments may be obtained by buying power purchase agreements (PPAs) from grid-connected projects or by constructing proprietary renewable power generation systems. While renewables cannot fully replace grid connectivity due to intermittency, microgrids can be constructed and used. Some operators have built their own sub-stations and transmission and distribution capabilities to expedite connection to the grid.

If the grid is available, operators will typically access it as soon as possible. Prior to grid-availability, natural gas gensets or diesel gensets are used. While grid connectivity of rod pumps and ESPs is relatively high where grid access is available, compressors, used for gas lift are more challenging to connect to the grid as they require retrofits. Thus, most compressors are still powered by natural gas, although retrofitting compressors to connect them to the grid has become a priority for many operators.

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7 Electric Grid Strategies

7.1 Emissions Challenges and Commitments

In the aftermath of both the COVID-19 pandemic shutdowns and renewed public and government sentiment towards the Paris Climate Treaty, interest and attention to climate change and net carbon neutrality have become more evident in society. The pandemic emphasized the risks associated with climate change and the fragility of supply chains, labor markets, and weaknesses in the financial system. The pandemic also identified the potential impacts of biodiversity loss due to climate change. Climate action is now increasingly influencing strategic choices for energy companies. For long-term sustainability, many energy companies are taking steps to understand and address the full green-house gas (GHG) emissions impact of their operations. Many energy companies have announced emission reduction aspirations for Scope 1&2 emissions. Emissions scope is defined as follows:

- Scope 1: Direct emissions from company owned and controlled operations, vehicles, and facilities
- Scope 2: Indirect emissions from the creation of purchased energy, such as electricity, steam, heat, cooling from a third-party
- Scope 3: All indirect emissions, not already included that occur over the lifecycle of a product or process, both before and after the company's activities

Source: Scope of GHG emissions and goals characterized according to graduated scale from *Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions*, which was jointly developed by IPIECA, API and OGP (2011)

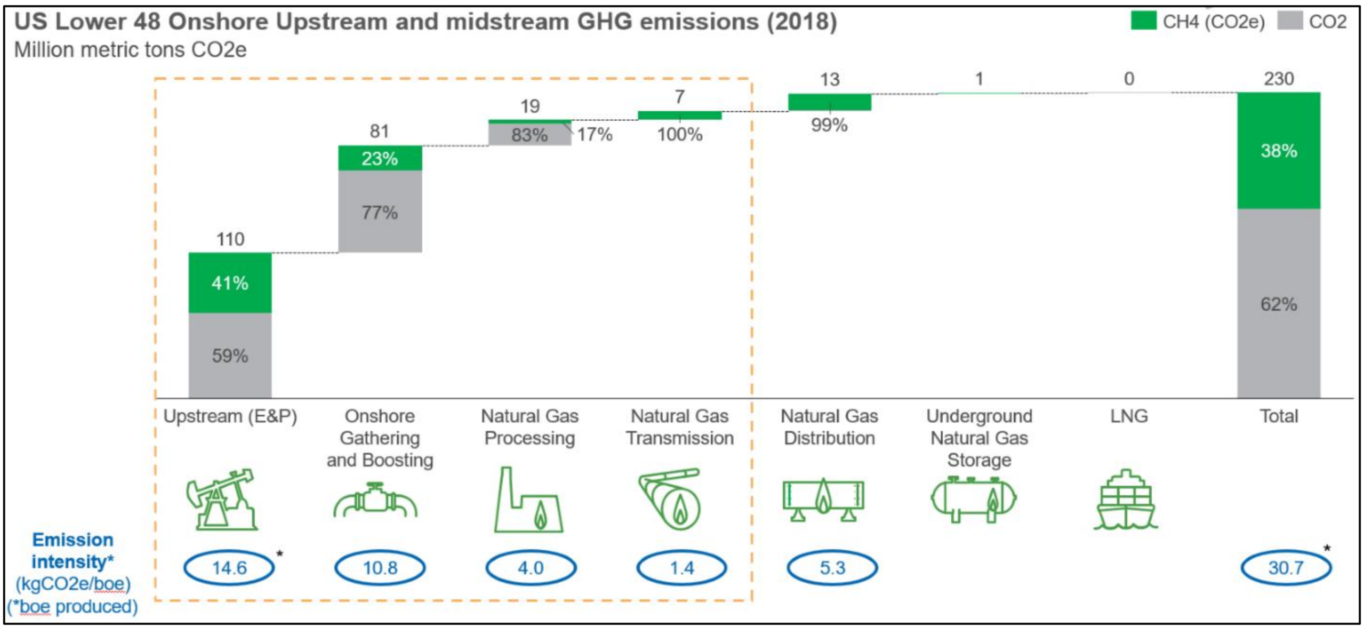

Figure 7-1*:* US Lower 48 Onshore upstream and midstream GHG emissions (2018

Notes: CH4 emissions considered to have global warming potential of 25 (IPCC 4). Data displayed here and all graphs going forward are from 2018, unless otherwise indicated. Upstream E&P concerns emissions from oil & gas operations before gathering & boosting.
*Emission intensity for Upstream and Total emissions considers total production reported by EPA; Processing and Transmission considers total gas production reported; Gathering & boosting and Distribution considers reported received volumes
Source: EPA Greenhouse Gas Reporting Program (GHGRP); IHS Markit

This report addresses Scope 1 and 2 emissions reductions primarily by upstream companies, but also to some extent midstream companies. Furthermore, the scope focuses on companies reducing CO2 emissions. Figure 7-1 presents the breakdown of emissions from oil and gas related activities for the onshore US. In 2018, approximately 143 million metric tons of CO2 emissions came from the US Onshore, of which approximately 65 million metric tons of those CO2

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emissions came from upstream activities. Upstream and onshore gathering emissions total 127 million metric tons which represents 83% of the emissions, mainly from combustion engines.

Within the upstream and gathering segments, combustion equipment dominates emissions. Combustion equipment includes natural gas and diesel-powered generators used in drilling rigs, completion equipment, compression or boosting, and potentially to run production operations. Gas power is generally obtained from nearby field gas and is less emissions-intense than diesel. Portions of the electric grid in West Texas and in Southeast New Mexico are becoming increasingly powered by renewable energy sources, which are primarily wind and to a lesser degree solar. Now that the electric grid is being powered by renewables, companies have recognized that a key emissions reductions strategy is to move field operations which have traditionally been powered by diesel and natural gas to the electric grid.

Much of the combustion equipment can be replaced by grid-powered equipment, but full replacement would be necessary due to the difference in mechanical drives. During the transition process to electrify operational equipment, where the grid is available, companies are generally beginning to implement new equipment that accesses the grid, with the intent to eventually retrofit existing gas and diesel-powered equipment later on. In order to be grid connected, access must reach the wellsite, which may not be available during the drilling and completion phase. Supplying industry with the needed infrastructure to provide for electricity demand will also increase grid reliability and decrease the strain on current grid resources --something that is key for Texas following the events of Winter Storm Uri. Additionally, reliability of the grid power may become an issue, especially if operations are in a remote area or if there are similar demands on the grid nearby. In this instance, backup power through diesel, natural gas, or battery power may be required.

Traditionally, companies have used diesel or gas fired generators to run their operations, in particular, the drilling and completion operations. Once a well shifts to the production phase, most operators will shift to the grid once connectivity is available. During the drilling and completion activities at the well, grid connections may not be available yet due to the lack of grid development in the area. The use of well pads with multiple wells may allow for drilling rigs to connect to the grid if there is already grid-connected production at the well pad. Companies may also choose to develop infrastructure, such as substations and distribution lines, in order to facilitate grid connections rather than wait for the grid operator to establish interconnections.

The shift to the grid takes time as infrastructure must be sited and built and the timelines may not match upstream company timelines for the addition of new wells, yet this shift would lower Scope 1 emissions for west Texas, as the region is a major source of wind energy. According to the Energy Information Administration (EIA), wind is the second largest source of energy in Texas. It supplied 20% of Texas' in-state utility scale (1 MW or larger) generation in 2021. Operators could lower their Scope 2 emissions by using wind power as well and over time as more wind and solar energy is added to the grid, both in West Texas and New Mexico, grid connection will continue to lower both Scope 1 and 2 emissions.

7.2 Current Grid Connection

7.2.1 Determining current operations which are connected

A key requirement for turning qualitative discussions of emissions reduction and electrification strategies into a quantitative electrification forecast is to determine or estimate which oil and gas operations within the five regions are currently accessing the electrical grid. Although the billing data provided by Oncor was not available for this report, S&P made a "best efforts" analysis to determine current grid access. Sources of information include:

- Information, including maps and reported load derived from regulatory organizations such as ERCOT and other non-disclosed sources
- Regional assessments from the 2019 report that were carried forward, and
- Specific information obtained directly from participating companies.

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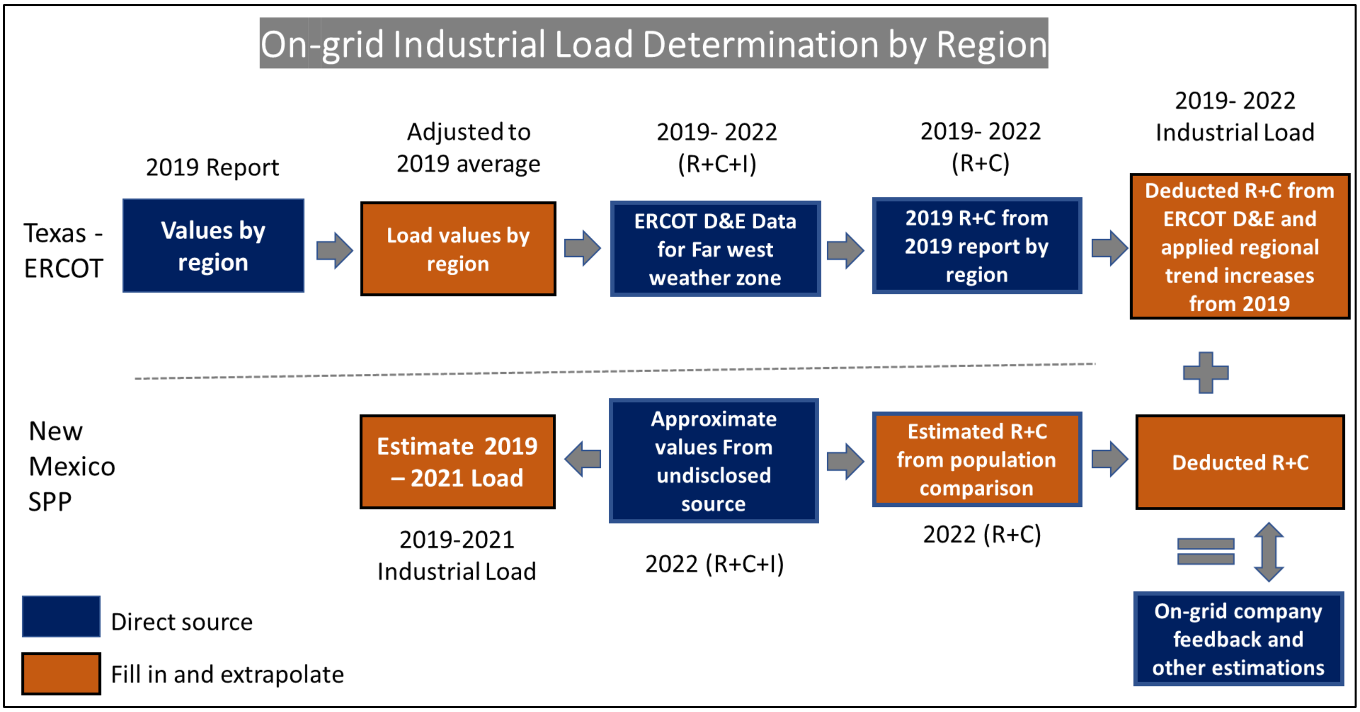

Figure 7-2: Flow chart summarizing the analysis performed to determine current and recent historical industrial load

Information from these sources was integrated and matched with the power assessment discussed in Chapter 6. Figure 7-2 provides a summary of how available information was interpreted and analyzed and how assumptions were made to determine the oil and gas industrial load for each region. Please refer to Appendix 7 – Grid Connections History and Backup for a more comprehensive discussion of this analysis and Appendix 1 for a listing of questions provided to the participating companies to determine their specific grid access

Table 7-1 sets forth a final estimate of annual industrial load for each region. The totals reflect the addition of (1) load located outside the far west weather zone but located in the study area and (2) the addition of the Delaware-NM region. The declining load in the CBP and Fringe regions is a result of declining production and reduced oil and gas operations. Results displayed here have been used to establish a base line estimate of oil and gas operations which are connected to the electric grid, and which will be used as a starting point for determining future grid forecasts for the Projected Load Demand forecasts.

Estimated on-grid for all Permian Basin (industrial)	2019	2020	2021	2022
CBP (MW)	664	608	602	549
Fringe (MW)	385	348	304	265
Delaware-TX (MW)	679	851	1,055	1,319
Delaware-NM (MW)	636	691	751	816
Midland (MW)	875	1,008	1,115	1,224
Total (MW)	3,239	3,506	3,827	4,173
YOY % Increase		8.3%	9.2%	9.0%

Table 7-1: Estimated annual average oil and gas industrial load by region

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7.2.2 Determining current operations which are connected to the grid

Permian Basin	2021	2022
Reported average monthly (MW)	3,827	4,173
On-grid model output (MW)	3,830	4,203

Table 7-2: Comparison totals of MW from reported-grid model output

In order to forecast the current and future on-grid load associated with each oil and gas operation, S&P has developed an "on-grid" model to determine which portions of the power associated with each operation (as described in Chapter 6) are currently or will eventually need to be put on the grid to meet the strategies of both upstream and midstream companies (herein referred to "Target Grid Connect"). The "on-grid" model quantitatively applies the participating company feedback described in the previous paragraph, internal and external research and knowledge of which operations normally connect to the grid to calculate current operations load within each region. The "on grid" model also incorporates feedback from participating companies and other information and assumptions to build quantifiable future forecasts of Projected Load Demand which will be discussed in Chapter 9.

A key requirement for determining a viable starting point or "initial currently on-grid" assessment, the initial or current operations load (MW), results from the "on-grid" model should align with estimated industrial load set forth in Table 7-1. Juxtaposing the regional "on grid" operations load with the estimated industrial load is not likely to yield an exact match, however, both results should show a reasonably close alignment. Both approaches to determining recent and current industrial load rely to some degree on incomplete information and reasonable, yet subjective, assumptions and methods. Furthermore, some slight mismatching of the two approaches occurs because industrial power use over the course of a given month is variable and overall power use is increasing rapidly within the Permian Basin, yet disproportionately within the five respective regions.

With these caveats in mind, the total Permian Basin on-grid comparison is set forth in Table 7-2. Regional on-grid comparisons for years 2021 and 2022 are set forth in Figure 7-3. Similar increasing trends in the unconventional Delaware and Midland regions are observed, while trends in the CBP and Fringe are declining. In summary, the purpose of these estimated industrial load assessments is to provide a starting point for the Projected Load Demand forecast.

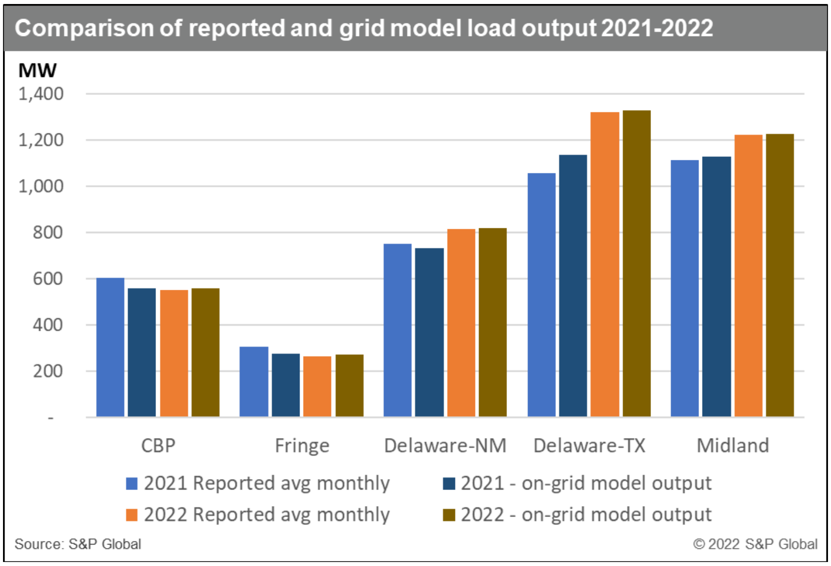

Figure 7-3: Comparison of reported and model output load by region

7.3 Upstream Strategies

7.3.1 On-grid strategy feedback from participating companies

With emission reductions in mind, participating companies were surveyed to assess their strategies and desired outcomes for the level of electrical grid access for their oil and gas operations. Responses to these questions helped guide S&P in creating the Projected Load Demand forecast, whose purpose is to forecast an outcome that allows all Permian Basin stakeholders to achieve their emission reduction goals by moving operations currently powered by diesel and natural gas to the electric grid. Due to confidentiality requirements specific responses are not included in this report; however, some generalized observations are set forth as follows:

- Most of the companies expressed a specific plan to transition more of their operations to the grid. While cost and reliability are still major priorities, moving applicable operations to the electric grid to reduce emissions is a high priority incorporated into each plan.

- Grid connection is not happening fast enough and in order to meet current targets and strategies, grid connection will have to occur at a much faster rate, especially over the next five years.
- Results were mixed on whether companies build their own transmission and distribution infrastructure when grid connection is delayed.
- Companies are moving or planning to move gas powered compressors that lift and transport oil and water from the well bore to the electrical grid.
- New construction of operating equipment including compressors and pumping units is more likely to be grid connected sooner, followed eventually by electrification of existing units
- Electric rigs using the grid will become more prevalent in the years ahead, assuming that the grid is available to accommodate this operation. Completion or “fracking” using the grid is less likely to gain widespread acceptance.
- Operations, such as water transport and disposal sometimes are handled by third parties, and although it may appear that operators have less control over grid connection for these operations, operators have indicated that they intend to preferentially select third party providers who are environmental conscious and have emission reduction.
- Some companies indicated that they do some gathering but that most of the gathering and transport of oil and gas is done by third party midstream companies.

As previously noted, participating companies account for about 38% of total Permian production, which is forecasted to increase, yet account for about the same percentage of total output. As a result, some additional research was performed to determine the disposition of other companies to complement the results from participating companies. As a part of meeting their emissions targets, many upstream companies operating in the Permian Basin have chosen to shift some of their operations to the electric grid, allowing them to reduce both Scope 1 and Scope 2 emissions. Of the top 14 companies in the Permian Basin, nine specifically touted their plans and efforts to electrify operations in the Permian during their most recent earnings calls in 2nd quarter 2022 (See Appendix 8 for specific company plans and goals and statements).

7.3.2 Applying upstream strategy to the forecasts

Participating companies in some respects represent a cross-section of the Permian Basin operators, but in other respects they do not. For example, participating companies have indicated that most of their rod pumps and ESP units were connected to the grid, as well as pad facilities. Yet it became evident from our assessment of historical industrial load that other producers had a lower portion of these operations connected to the grid. Given the lower cost of grid access for these operations, we assumed that these companies were using temporary power sources and would move these operations to the grid as soon as it became available.

Our assessment indicated that participating companies had a much larger share of grid access than smaller companies. This is not surprising as S&P has noted this pattern repeatedly throughout the Permian Basin and other unconventional plays, wherein, producers with the largest acreage invariably have better access to services such as drilling and fracking, gathering and transport, and supply chains. The same would appear to hold true for access to new electrical infrastructure. The TDSPs have indicated that once a request is made for electrical power it may take up to a year (and in some cases much longer) to provide distribution service. If transmission lines are not nearby, it will take much longer. The TDSPs have also indicated that some companies are much better at planning ahead and asking for services well in advance, which appears to be the case with the participating companies.

In determining the rate at which operations would access the grid we (1) utilized the feedback provided by the participating companies, and (2) then divided the remaining Permian operators into two groups and determined a

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reasonable rate of desired grid access for each group. S&P assumptions for these two groups consider that most upstream producers have goals and aspirations to reduce emissions, lower costs and increase reliability, and therefore will ultimately employ similar strategies to gain grid access. Nevertheless, given these two groups of operators' current lack of grid access, the Projected Load Demand forecast contemplates that this grid access is projected to occur at a slower rate than for the participating companies.

Operation	Group	2022 on grid %	2027 on grid %	2032 on grid %	2040 on grid %
Pad Facility	Participant	95%	95%	95%	95%
Pad Facility	Group 1	41%	80%	90%	95%
Pad Facility	Group 2	38%	79%	90%	95%
Gas lift	Participant	11%	66%	76%	80%
Gas lift	Group 1	7%	50%	75%	87%
Gas lift	Group 2	0%	30%	50%	60%
Rod & ESP	Participant	95%	95%	95%	95%
Rod & ESP	Group 1	37%	82%	92%	95%
Rod & ESP	Group 2	33%	79%	90%	95%
Water handling	Participant	92%	94%	93%	95%
Water handling	Group 1	38%	80%	90%	95%
Water handling	Group 2	33%	78%	90%	95%
Completion	Participant	0%	4%	15%	22%
Completion	Group 1	0%	5%	10%	10%
Completion	Group 2	0%	5%	10%	10%
Drilling	Participant	19%	46%	57%	64%
Drilling	Group 1	5%	20%	35%	50%
Drilling	Group 2	0%	20%	40%	50%

Table 7-3: Rate of estimated on-grid connectivity for operator groups – Projected Load Demand

In addition to the participating companies, non-participating companies were placed in the following groups based primarily on company size and scope of operations in the Permian Basin:

Group 1: Apache, BP, Conterra, EOG, Mewbourne, and Oxy

Group 2: BTA Producers, Callon, Centennial, Continental Resources, Crownquest, Endeavor, Laredo, Matador, Ovintiv, SM Energy, Tap Rock, other independents and remaining large and small private companies.

Table 7-3 provides a high-level summary of average grid connection for years 2022, 2027, 2032 and 2040 for upstream operations for each operator group. Ultimately, the Projected Load Demand forecast calls for near 100% grid connectivity for facilities, rod pumps & ESP and water handling for all groups in the next 10 years. Group 2 operators are going to be less committed to gas lift being on the grid; however, we have previously noted that these operators are less likely to have large compression systems and are likely to be less committed to putting their smaller system on the grid. For completion, we see a similar lack of enthusiasm from all groups. E-drilling using the grid for both groups 1 and 2 is likely to catch on, but at a slower rate since future grid access is likely to be more limited for them than for the participating companies. We don't see drilling powered by non-grid sources ever going away completely.

7.4 Midstream Strategies

Midstream operations include oil and gas gathering, oil, gas and NGL transmission and gas processing plants. Previously, we have determined that the power required for midstream gas operations is more than a magnitude greater than that needed for oil transport and that virtually all oil gathering and transmission is powered by the grid. Consequently, this section will address only midstream operations related to natural gas gathering, transport

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and processing. For a detailed discussion of underlying research and company interviews please refer to Appendix 9.

7.4.1 Gas gathering

By using available data and the information gleaned through discussions with industry participants, we assigned the operators into four subgroups based on a qualitative estimation of the aggressiveness with which each operator is likely to adopt electrified compression. Table 7-4 provides an estimate of the approximate percentage of gathering compressor that will be put on the grid by 2032 and 2040. Each operator sub-groups' gathering mileage was then divided into the 5 regions using ArcGIS so that a forecast of midstream grid connection would be performed. Each group is described as follows:

1. **Most aggressive** electrification is the group used to define the midstream operators who have shown or told us that they are eager to electrify as soon as possible and will expand current electrification at a pace that closely matches the expansion of grid and generation capacity. All the Upstream operators who owned gathering miles were assigned to this group, along with some Midstream operators—this category reaches 80% electrification by 2032; 100% by 2040 (see Table 7-4).

Gathering	Current percent on grid--2022	Percent on grid by 2032	Percent on grid by 2040
Most aggressive	4%	80%	100%
Aggressive	2%	60%	80%
Moderate	-	40%	60%
Minimal	-	20%	40%

Table 7-4: Approximation of Gathering Activities on Grid

2. **Aggressive** electrification is the group used to define the midstream operators who have shown or told us that they have an interest in electrification and will expand current electrification at a pace that "makes sense" when considered in light of many factors including cost—this category reaches 60% electrification by 2032: 80% by 2040.

3. **Moderate** electrification is the group used to define the midstream operators who have shown or told us that they are open to considering electrification, yet have not announced plans to definitively move toward with this transition—this category reaches 40% electrification by 2032: 60% by 2040.

4. **Minimal** electrification is the group used to define the midstream operators who have not shown or said anything about electrification of compression—this category reaches 20% by 2032; 40% by 2040.

Applying this trajectory for the electrification of field gathering compression yields an electrification forecast (weighted by operator throughput) of 54% by 2032 and 74% by 2040 (by gas volume). As noted earlier, there is a current total of about 65,000 miles of gathering lines within the 34-county area. Although we expect the gathering mileage to grow, our analysis is predicated on gas throughput, not mileage; therefore, the gathering mileage allocations between the five regions will remain constant throughout the forecast.

7.4.2 Gas processing plants

Table 7-5 provides the on- and off-grid total plant capacities for each region. While total plant processing capacity is about 24,000 MMcf/d, the current daily production of 19 Bcf/d is about 80% of that capacity. We also need to consider further reductions, because even when some plants are on the electric grid, partial power may also be supplied by gas turbines or other dual drive systems. We therefore estimate that average electric power usage is about 70% of total plant capacity. Therefore, we are assuming that with 70% utilization by the electric grid, that the total 14,977 MMcf/d on-grid capacity actually represents 10,483 MMcf/d of processing powered by the electric grid. When we apply the 0.116 kW per MMcf to convert processing throughput to load, we can determine that the actual load being supplied is about 1216.2 MW for all five regions within the basin.

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Because of large load requirements in a relatively small area, processing plants are easier to connect to infrastructure than more widespread operations such as gathering systems or even individual well pads. This would explain the large percentage of processing capability that is already on the grid, especially for newer units. The power and load requirements are predicated on gas throughput, (not capacity), so as the gas production forecast increases so will power requirements. The Projected Load Demand forecast outlook assumes that new processing capability will be added, but this addition will occur in the Midland and Delaware regions either by new builds or by expansion of existing plants. Within these regions the outlook projects that by 2032 all processing capability, including capability not on the grid will access the electrical grid. In the CBP and Fringe areas current grid connectivity is maintained. Conceptually we would anticipate that some older plants will be retired, but that new plants will be built, with access to the grid and that a large portion of new processing capability will be added to locations already on the grid.

Region	Total processing capacity (mmcf/d)	Estimated off-grid (mmcf/d)	Estimated on grid (mmcf/d)	Run @ 70% capacity (mmcf/d)	Total MW required
CBP	1800	1400	400	280	32.5
Fringe	755	342	413	289	33.5
Delaware NM	4385	1170	3215	2250	261.1
Delaware TX	11323	5388	5935	4154	482
Midland	5725	711	5014	3509	407
Grand Total	**23,988**	**9,011**	**14,977**	**10,483**	**1,216**

Table 7-5: Processing plant capacity and grid access

7.4.3 Gas transmission pipeline operators (GTPOs)—the pipelines that take processed gas to market

By using available data and the information gleaned through discussions with industry participants, we assigned each of the transmission companies into three subgroups based on a qualitative estimation of the aggressiveness with which each company is likely to adopt electrified compression for its transmission system as follows (Table 7-6):

1. **Moderate adopters** are the class defined for the midstream operators who have shown or told us that they have an interest in electrification of compression, and will develop compression electrification at a pace that "makes sense" when considered in light of many factors, most importantly reliability, and including cost—this category reaches 20% electrification by 2032: 40% by 2040

2. **Late adopters** are the class we use for the midstream operators who have not shown or said anything about electrification of compression—this category reaches no electric compression by 2032; 20% by 2040. Because of the uncertainty beyond 2032, (we assume that some electrification will occur for this category in the period between 2032 and 2040, even in the absence of any interest stated in the public domain.

3. **Not electrified** is the class we use for the midstream operators who have not shown or said anything about electrification of compression or have spoken negatively regarding it—this category does not electrify at all during the forecast period to 2040

Gathering	Current % on grid--2022	Gathering on grid by 2032	Gathering on grid by 2040
Moderate adopters	0%	20%	40%
Late adopters	0%	0%	20%
Not electrified	-		
Weighted total	**0%**	**6%**	**25%**

Table 7-6: Transmission company grid access

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Applying this trajectory for the electrification of field transmission compression yields an electrification forecast (weighted by operator throughput) of 6% by 2032 and 25% by 2040. We project that new pipelines will need to be built to handle the expected forecast, but the allocations will remain constant, as we do not know where in each region they will be built or where new compressor stations will reside. It is more likely that electrification will occur for future new builds than for existing pipelines, which also suggests that we can expect some transmission electrification in the more distant future when these new builds come on-line.

7.4.4 Summary of methodology for determining current and future connection to the electric grid

The flowchart shown in Figure 7-4 summarizes the calculations, assumptions and methods used to project grid access for midstream operations. This chart shows how we analyzed and applied both in-house pipeline and processing plant data and incorporated outside research and survey feedback to formulate the midstream on-grid connection and load outlook for the Projected Load Demand forecast.

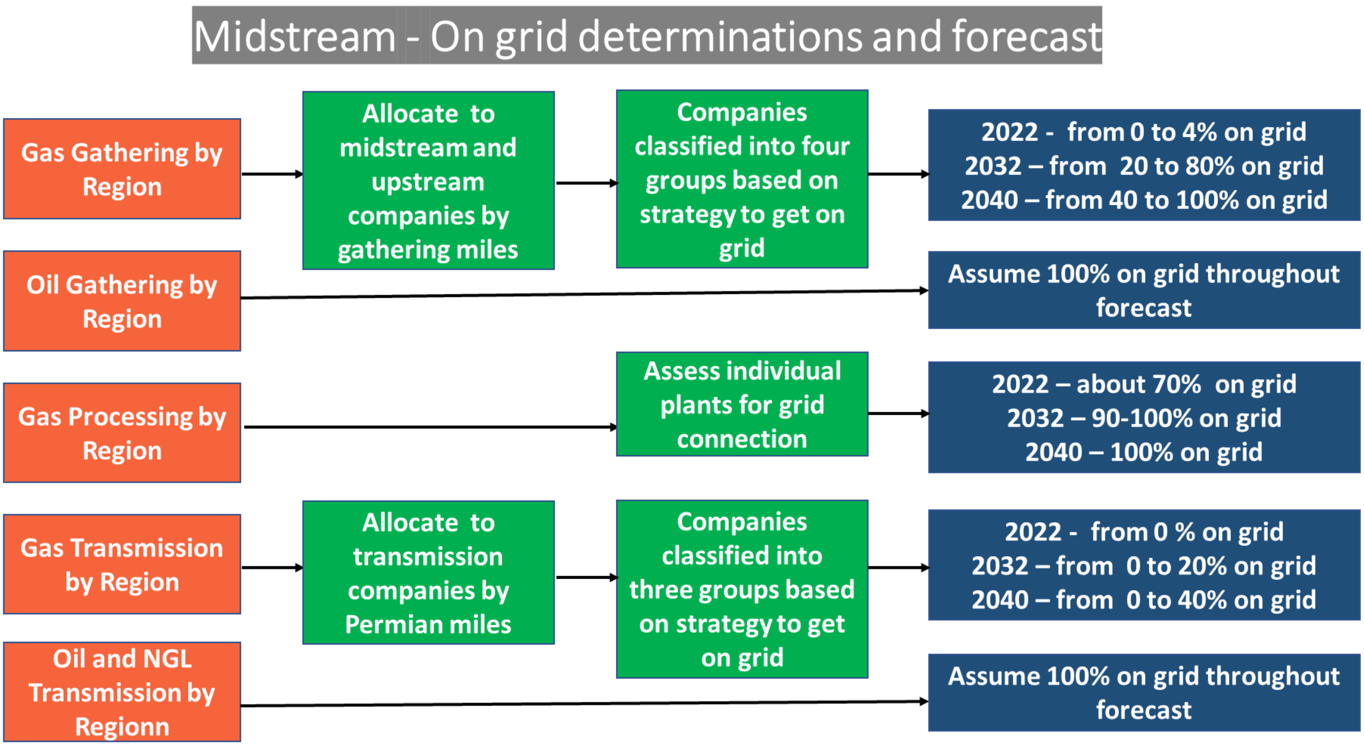

Figure 7-4: Flowchart of workflow for midstream operations accessing the grid

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8 Target Grid Connect Forecast

8.1 Permian Basin Target Grid Forecast

Of critical importance is determining which portions of the power forecast discussed in chapter 6 will choose to be connected to the grid, for both upstream and midstream companies to meet strategic objectives including emissions reduction. Chapter 7 outlined these objectives and projected the degree and timing of connecting upstream and midstream operations to the grid in order to (1) close the current gaps in needed grid access, and (2) meet the strategic objectives of all stakeholders. Using this information, S&P has determined the portion or percentage of each operation that will eventually need to be connected to the grid by the end of the forecast period. (Herein referred to as "Target Grid Connect").

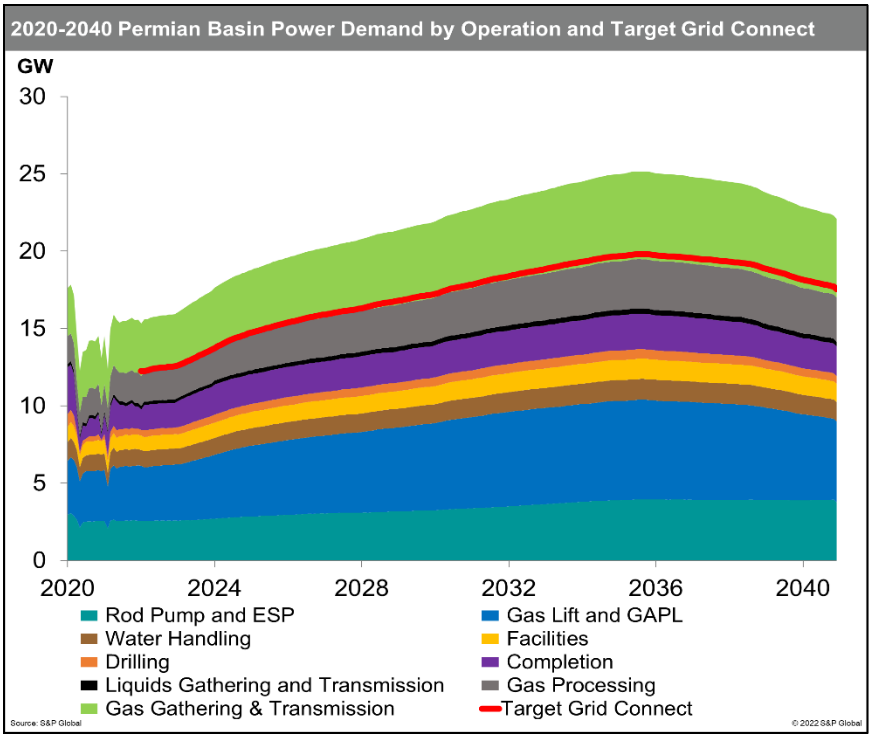

Figure 8-1: Power Demand forecast for oil and gas operations

The Target Grid Connect forecast was created by applying the percentages shown in Table 8-1 to each oil and gas operation (see red line in Figure 8-1) and generally follows the track of the Power Demand Forecast; however, the Target Grid Connect (not the total Power Demand) is the target or objective level for eventual full access to the electric grid. The Target Grid Connect reflects both the current gap between power demand and the desired connection to the electric grid and future aspirations to fill that gap by the end of the forecast period. Currently the average oil and gas industrial load of 4.2 GW only provides about 33% of the 12.2 GW of Target Grid Connect access within the basin. Closing this gap will take time as transmission and distribution infrastructure will need to be

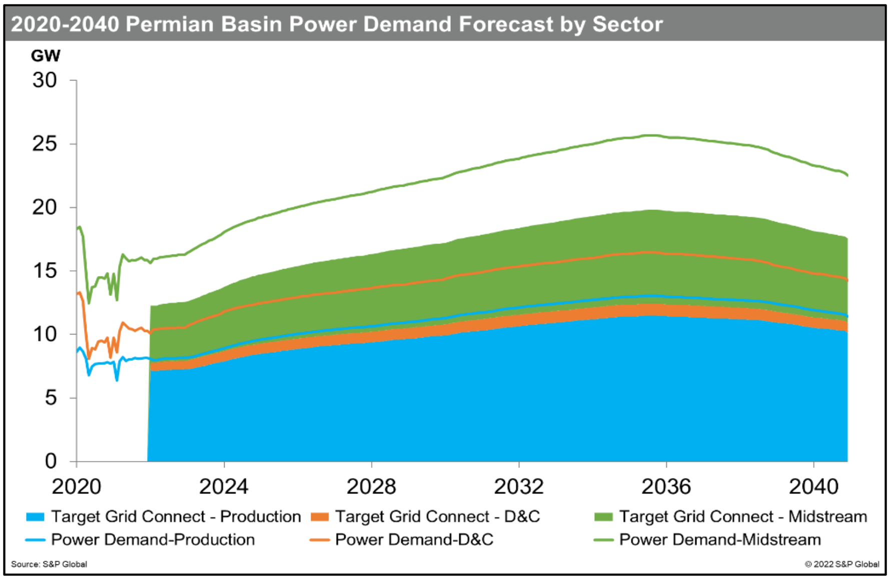

Figure 8-2: Power Demand forecast by operation sector

Oil and Gas Operation	Target 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%

Table 8-1: Percentage of Power Demand allocated to Target Grid Connect

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developed in a way to attend to the greatest priorities. Most importantly, upstream and midstream companies are now in, and will accelerate, the process of converting equipment previously powered by high emitting diesel and natural gas to be powered by the electric grid.

Not all operations will end up being put on the grid to meet strategic objectives as this may not make sense from an economic, practical or reliability perspective for all companies to access the grid for every operation. For example, feedback from various sources indicates that only a small portion of completion and gas transmission will eventually be powered by the end of the forecast period. On the other hand, the very small gap between Target Grid Connect – Production and Power Demand – Production shown in Figure 8-2 suggests that nearly all the power demand needed by upstream production operations, including artificial lift systems, will end up being put on the grid.

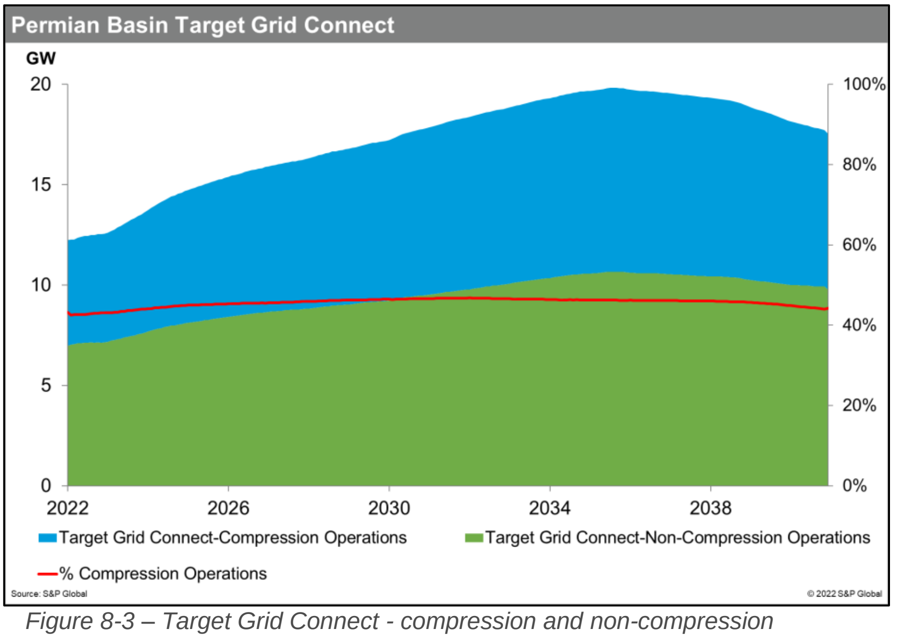

Figure 8-3 – Target Grid Connect - compression and non-compression

A primary objective of attaining strategic targets is to put operations powered by compressors such as gas lift and gas gathering onto the electric grid. In the past, the abundant associated gas in the Permian Basin powered compressors; however, in order to meet strategic targets, we project that by the end of the forecast period 75% of gas gathering and 80% of gas lift will transition to electric power. This transition of compression to electric power will be a key driver in the need for very large and rapid response to providing grid access as these operations make up nearly one-half of the Target Grid Connects (see Figure 8-3).

8.2 Target Grid Connect Forecast by Region

Table 8-2 sets forth the current and projected Target Grid Connect power requirements for each region throughout the forecast period. Unlike the Power Demand forecast which peaks in 2036, the Grid Connect peaks earlier, suggesting that most of the gap closing with new grid connection should occur in each region by 2032, expect in the Delaware-NM region where it can occur by 2036. Target Grid Connect trends generally track the Power Demand in each region, although we have noted some slight variation from region to region. Not surprisingly the two Delaware regions comprise 62% of Target Grid Connect, but by 2032, the two regions will comprise 75%. Delaware Basin's power demand will increase by 68%, owing to its robust production forecast and robust associated water and gas projections, which require substantial power to handle and transport. Target Grid Connect forecast discussions and plots pertaining to each region are discussed in more detail in Appendix 10.

Targeted Grid Connect (GW)	May-22	Dec-27	Dec-32	Dec-36	Dec-40
Midland (GW)	3.2	3.7	3.6	3.6	3.6
Delaware-NM (GW)	3.1	4.6	5.8	6.5	5.2
Delaware-TX (GW)	4.7	6.8	8.4	8.7	8.1
CBP+Fringe (GW)	1.6	1.5	1.4	1.4	1.3
Total Permian Basin*	12.4	16.2	18.8	19.6	17.6

Table 8-2: Target Grid Connect values for selected years
** The addition of region totals is slightly higher than the total Permian Basin total due to operational differences in each region*

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9 Projected Load Demand Forecast

9.1 Total Projected Load Demand

The total Permian Basin forecast of future power demand and the electric load outlooks for each of the three main sectors (Production, D&C, and midstream) is depicted in Figure 9-1. Currently, only 33% of the Target Grid Connect operations are connected to the grid, meaning that there is a 67% gap between the Target Grid Connect and the Projected Load Demand. This gap narrows to 9% by 2032 (with 91% of the Target Grid Connect being on the grid) and by the end of the forecast period the gap is eliminated entirely. The forecast reflects (1) the need to close the current gap or backlog of on-grid infrastructure between upstream production, D&C and midstream, (2) the increasing production of oil and gas and (3) the need for more grid connectivity to meet strategic targets including emission reduction goals.

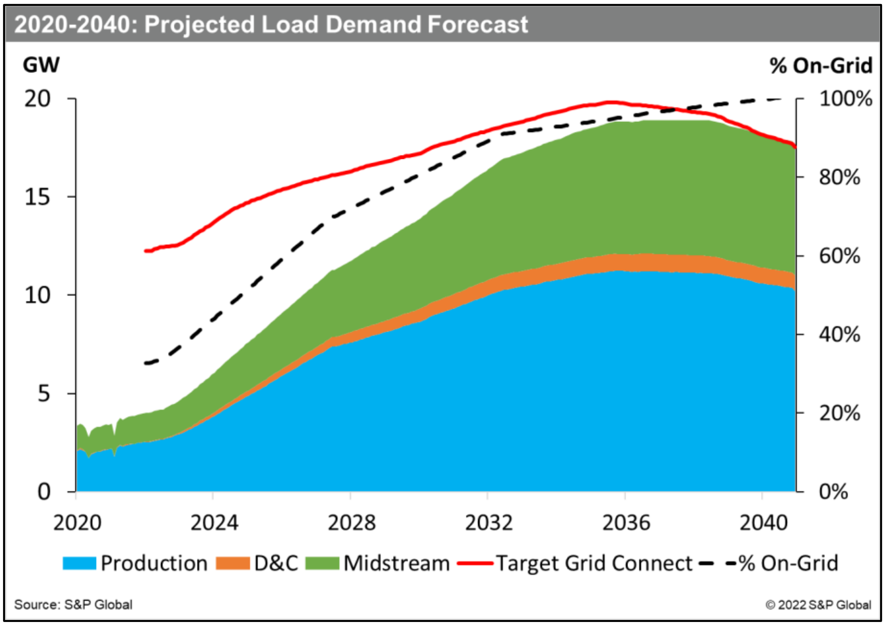

Figure 9-1: Total Permian Basin Projected Load Demand forecast by O&G

Nearly all the upstream production sector is projected to access the grid by 2036. Currently, the upstream production sector takes up about 63% of the grid access, shrinking slightly to 58% by the end of the forecast period as midstream increases slightly. The D&C sector grid access is projected to account for only 4% of connectivity.

9.2 Permian Basin load forecast by region

Specific sweet spot areas where additional load will be most needed occur in both the Midland and Delaware regions, however, future need for additional load will be greatest along the Texas-New Mexico border in the Delaware Basin. Due to production growth, scattered grid blocks that contain processing plants will also require additional load. Figure 9-2 shows the load forecast of each region. Table 9-1 indicates the numeric contribution of each region. Note that in both Delaware regions, the peak demand reaches 18.9 GW in 2036, and then declines thereafter.

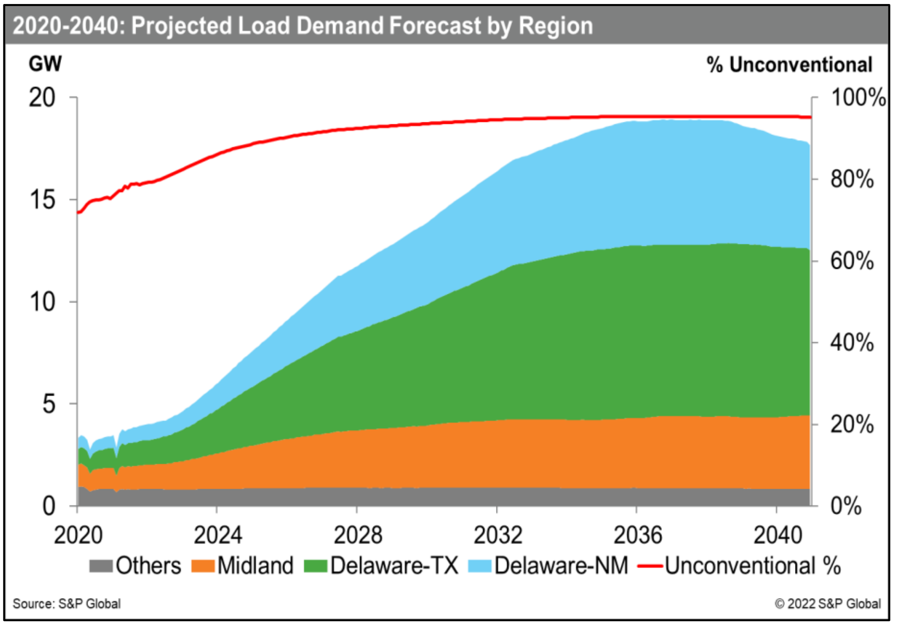

Figure 9-2: Total Permian Basin Projected Load Demand forecast by region

Over time, the CBP and Fringes become less important, accounting for less than 5% of forecasted load by 2040. The largest growth will be in the two Delaware regions where the current percentage of total Permian Projected Load Demand is 50%, but these regions will account for over 76% of the total Permian Projected Load Demand forecast by 2032.

Projected Load Demand (GW)	May-22	Dec-27	Dec-32	Dec-36	Dec-40
Midland (GW)	1.2	2.8	3.4	3.5	3.6
Delaware-NM (GW)	0.8	3.2	5.2	6.1	5.1
Delaware-TX (GW)	1.3	4.8	7.7	8.4	8.1
CBP+Fringe (GW)	0.9	0.9	0.9	0.9	0.9
Total Permian Basin (GW)	4.2	11.7	17.2	18.9	17.7

Table 9-1: Total Permian Basin Projected Load Forecast by region

9.2.1 Midland regional load forecast

Figure 9-3 depicts the Midland region forecast of future power demand and the electric load outlooks for each of the three sectors. The region reflects the overall grid access within the Permian Basin, wherein current grid connection is 37% of the Projected Grid Connect increasing to 93% by 2032 and reaching 100% by the end of the forecast period. By the end of 2032 grid access is projected to reach 3.4 GW, an increase of 174%, which is projected to further increase by 2040 to 3.6 GW, an increase of 192%. Because the forecasted power demand will be relatively flat beginning in 2024, the increases in grid connectivity will not need to be as high as they are in the Delaware regions.

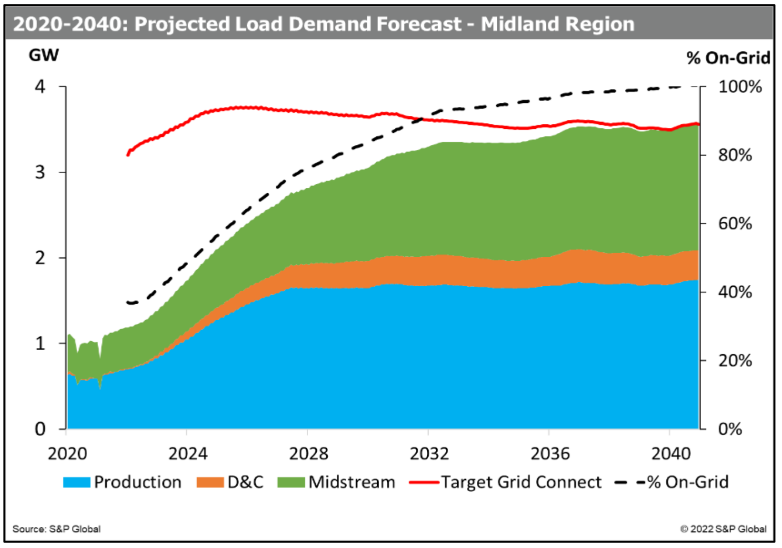

Figure 9-3: Midland region projected load forecast by O&G sector

9.2.2 Delaware-TX region load forecast

Figure 9-4 depicts the Delaware-TX region forecast of future power demand and the electric load outlooks for each of the three main sectors. Current grid connection is 27% of the Projected Grid Connect increasing to 91% by 2032 and reaching 100% by the end of the forecast period. This region will require the most additional grid access of any of the regions to meet current lack of grid connectivity, production increases, and emissions reduction targets, which means that by the end of 2032 grid access will need to reach 7.7 GW, an increase of 491%, and will need to further increase by 2040 to 8.1 MW, an increase of nearly 521%. In addition to the highest projected growth in oil production from the Delaware regions, additional electric

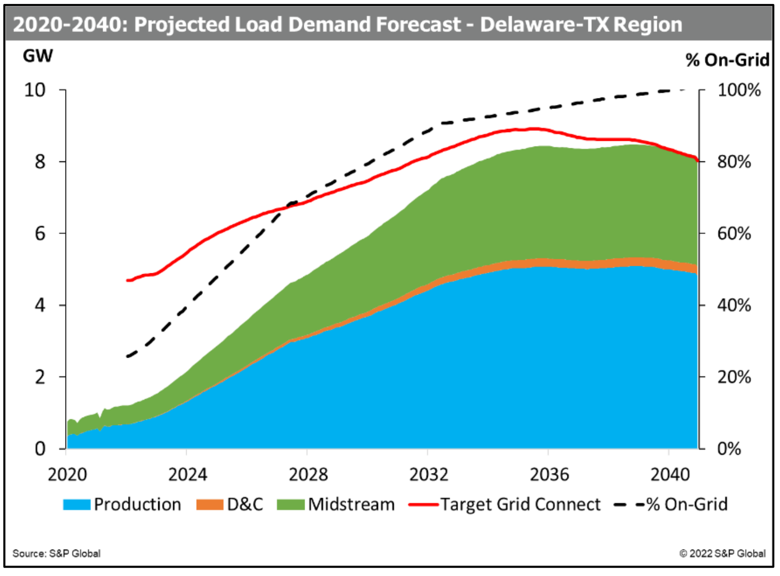

Figure 9-4: Delaware-TX region projected load forecast by O&G sector

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grid power will be needed to manage and transport the much larger volumes of associated gas and water.

9.2.3 Delaware-NM region load forecast

Figure 9-5 depicts the Delaware-NM region forecast of future power demand and the electric load outlooks for each of the three main sectors. Current grid connection is 26% of the Projected Grid Connect increasing to 90% by 2032 and reaching 100% by the end of the forecast period. This region appears to be the most remote of the regions and has less initial grid access than either the Midland or Delaware-TX regions. By the end of 2032 grid access will need to reach 5.2 GW, an increase of 550%, and will peak at 6.1 GW in 2036, but decrease to 5.1 GW by 2040 as load demand will begin to diminish beginning in 2036. Like its Texas cousin, the Delaware-TX region, this region will need additional electric grid power to manage and transport the much larger volumes of associated gas and water.

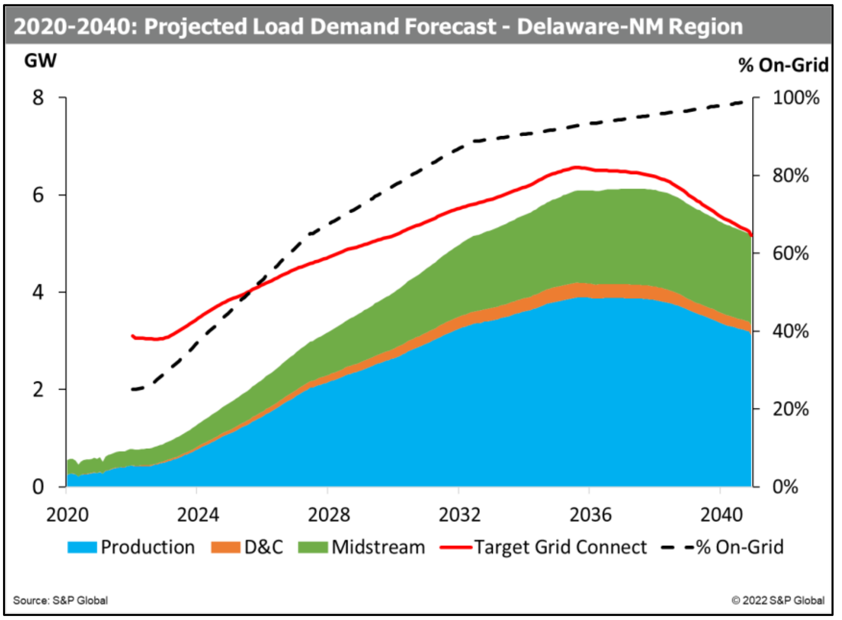

Figure 9-5: Delaware-NM region projected load forecast by O&G sector

9.2.4 CBP and Fringe regional load forecasts

These two regions are far less important to the load forecast than the Midland and Delaware regions, since they are dominated by declining conventional production from vertical wells and their operations are mostly connected to the electrical grid. Fringe growth of 27% by 2032 and 35% by 2040 from current levels of around 0.37 GW is projected. On the other hand, load is expected to decline by around 12% in the CBP as the production outlook and the need for power diminishes. Current load in the CBP is about 0.56 GW. Unlike the unconventional regions, upstream production grid access is 90% in the CBP and 78% in the Fringe region. This is attributable to the many rod pumps that are lifting and disposing the large amounts of associated water in the regions. Drilling of new wells using the grid is not projected here either. As noted earlier, these regions which currently utilize 20% of the industrial load will dwindle to just a 5% share by the end of the forecast period

10 Comparison of Projected Load Demand Forecast with Historical Growth Rate

10.1 Defining the Historical Growth Rate Case

The focus of this report is the Projected Load Demand forecast, which identifies the need to significantly ramp up grid access in order to accommodate production increases and meet strategic targets. Should this outlook come to fruition, then annual year over year (YOY) grid access (bulk rates) would have to increase dramatically to around 1,500 MW (see Figure 10-1). This is over four times the recent annual historical Permian Basin load addition of less of 300-350 annual MW additions. In order to present what will likely occur and the type of outlook we would expect if YOY bulk grid addition rates of about 450 MW were continued, we created a Historical Growth Rate Case which reflects the forecast of operations that would be able to access the grid if this current historical grid connection trend of industrial load were to continue throughout the forecast period. Furthermore, this Historical Growth Rate outlook falls far short of the strategic targets of Permian Basin Stakeholders, and were it to occur, it could adversely affect operations in the basin. This Chapter 10 presents this alternative Historical Growth Rate Case and compares and contrasts the two outcomes and various oil and gas operations that would be able to access the grid within each scenario.

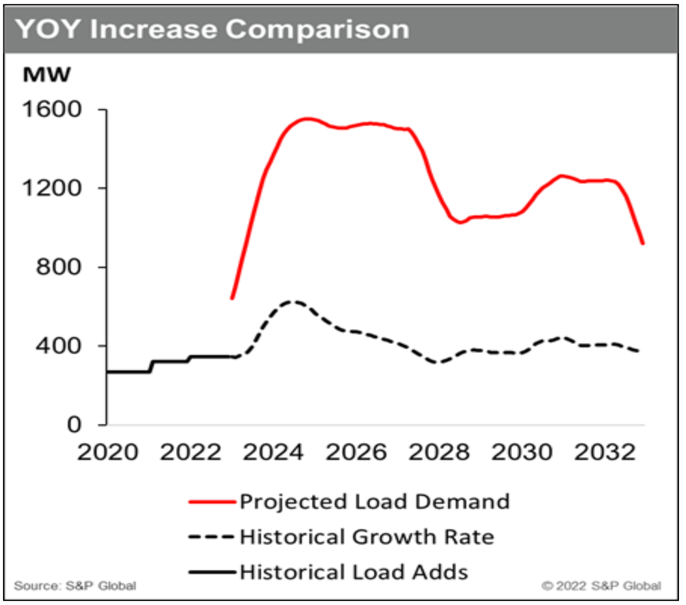

Figure 10-1: YOY bulk increase comparisons between two forecasts.

10.2 Historic Growth Rate forecast for the Total Permian Basin

The Historic Growth Rate forecast for each of the three main sectors is depicted in Figure 10-2. Currently the 67% gap between the Target Grid Connect and grid access narrows only to 54% by 2032 and to 45% by the end of the forecast period. While this forecast primarily reflects the increasing production of oil and gas, the gap between grid availability and future oil and gas operations will narrow only slightly. By the end of 2040 slightly more than half of the production sector is projected to access the grid but virtually no D&C grid connection is anticipated. This alternative but not acceptable scenario, will result in less than 10 GW of load by 2036, compared to the nearly 19 GW that will be needed by that time.

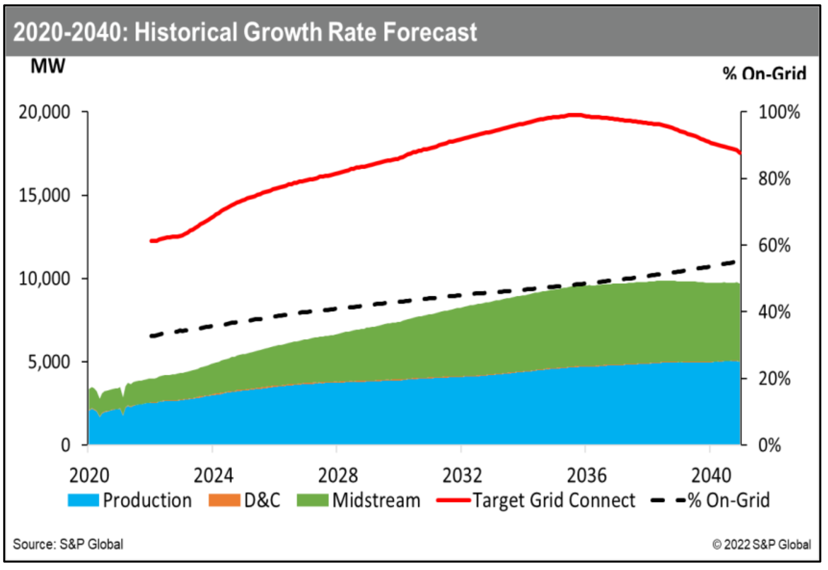

Figure 10-2: Total Permian Basin load forecast by O&G sector (HGR) Case

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10.3 Total Permian Basin load by region

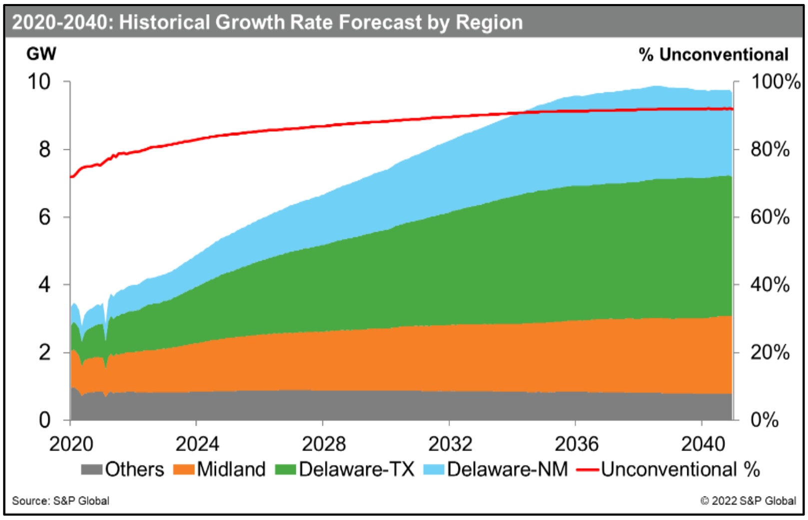

Figure 10-3: Total Permian Basin load forecast by Region (HGR Case)

Figure 10-3 presents the Permian Basin forecast by region. Like the Projected Load Demand forecast, the 2022 split of unconventional resources located in the two Delaware regions and the Midland region account for 80% of the grid access compared to 20% of the conventional grid access from the CBP and Fringe regions. Over time these two areas also become less important, however, at the end of the forecast they account for about 8% of forecasted load as comparatively less grid will be allocated to the unconventional regions. Like the Projected Load Demand forecast, the largest growth will still be in the two Delaware regions where these will account for 67% of the total Permian load forecast by 2032.

Historical Growth Rate (GW)	May-22	Dec-27	Dec-32	Dec-36	Dec-40
Midland (GW)	1.2	1.7	2.0	2.2	2.3
Delaware-NM (GW)	0.8	1.5	2.2	2.7	2.5
Delaware-TX (GW)	1.3	2.5	3.5	4.0	4.1
CBP+Fringe (GW)	0.8	0.9	0.9	0.8	0.8
Total Permian Basin (GW)	4.1	6.7	8.6	9.7	9.7

Table 10-1: Historic Growth Rate forecast by region

10.3.1 Midland regional load forecast

Figure 10-4 depicts the Midland region forecast of future power demand and the electric load outlooks for each of the three main sectors. Current grid connection is 37% of the Projected Grid Connect increasing to 55% by 2032 and reaching 65% by the end of the forecast period compared to 100% in 2040 for the Projected Load Demand forecast. By the end of 2032, grid access is projected to reach 2.0 GW, an increase of 62%, which is projected to further increase by 2040 to 2.32 GW, an increase of 89%, which is less than half of the 192% Projected Load Demand forecast increase. Because the forecasted power demand will be relatively flat beginning in 2024, the projected gaps in grid connectivity will not be nearly as high as they are in the Delaware regions.

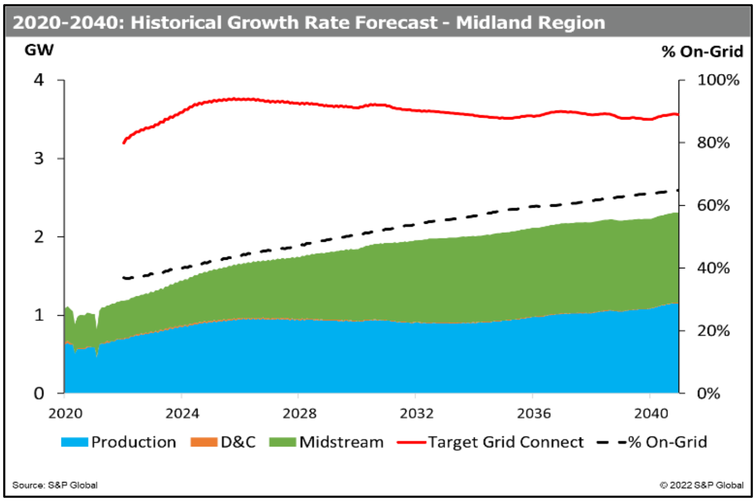

Figure 10-4: Midland region load forecast by O&G sector (HGR Case)

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10.3.2 Delaware-TX load forecast

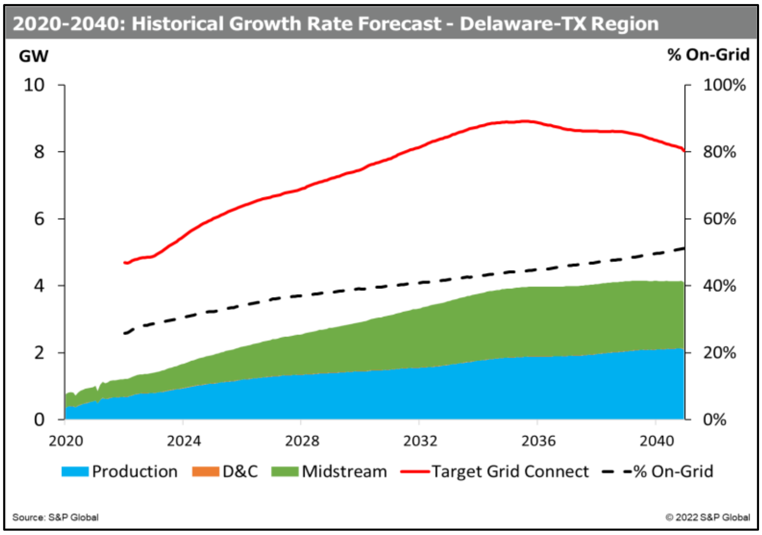

Figure 10-5: Delaware-TX region load forecast by O&G sector (HGR case)

Figure 10-5 depicts the Delaware-TX region forecast of future power demand and the electric load outlooks for each of the three main sectors. Current grid connection is 27% of the Projected Grid Connect increasing to 42% by 2032 and reaching 51% by the end of the forecast period compared to 100% in 2040 for the Projected Load Demand forecast. Because this region will require the most additional grid access of any of the regions, the gap in grid coverage by not implementing the Projected Load Demand forecast grid additions will be felt more acutely here than elsewhere in the basin. By the end of 2032, grid access is projected to reach 3.5 GW, an increase of 171%, and further increase by 2040 to 4.1 GW, an increase of nearly 219%. This compares to a 2040 increase of nearly 521% to 8.1 GW projected by the Projected Load Demand forecast. If this case were to occur, the additional power needed to manage and transport the much larger volumes of associated gas and water would need to come from sources other than the electric grid.

10.3.3 Delaware-NM region load forecast

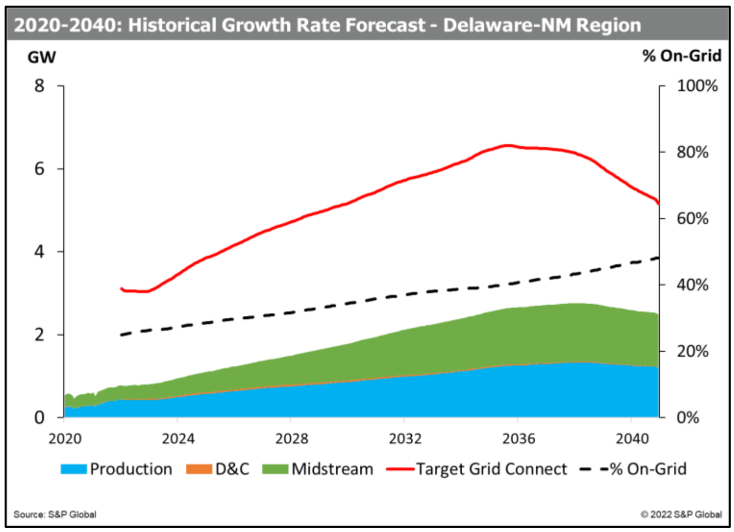

Figure 10-6: Delaware-NM region load forecast by O&G

Figure 10-6 depicts the Delaware-NM region forecast of future power demand and the electric load outlooks for each of the three main sectors. Current grid connection is 26% of the Projected Grid Connect increasing to 38% by 2032 and reaching 48% by the end of the forecast period compared to 100% in 2040 for the Projected Load Demand forecast. As noted earlier, this region appears to be the most remote of the regions and has less initial grid access than other regions. By the end of 2032, grid access will be 2.2 GW, an increase of 188%, and will further increase by 2040 to 2.5 GW, an increase of nearly 219%. This compares to a 2040 increase of nearly 557% to 5.51 GW projected by the Projected Load Demand forecast. Like its Texas cousin, the Delaware-TX region, this region will also lack electric grid power to manage and transport the much larger volumes of associated gas and water.

10.3.4 CBP and Fringe regional load forecast

As in the Projected Load Demand forecast, these two regions are less important to the load forecast than the Midland and Delaware regions, since they are dominated by declining conventional production from vertical wells and their operations are mostly connected to the electrical grid. Overall Fringe growth of 20% by 2032 and 21% by 2040 from current levels of 272 MW to around 3328 MW is projected, which is slightly less than the Projected Load Demand forecast. Load is expected to decline by around 19% in the CBP as the production outlook and the need for power diminishes. Current load in the CBP is about 0.56 MW. Current grid access in the 90% range in the CBP and nearly

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80% in the Fringe region means that not applying projections from the Projected Load Demand forecast will have relatively minor impact in these regions.

10.4 Comparison of the Historic Growth Rate and Projected Load Demand Forecasts

Both the Projected Load Demand and Historical Growth Rate forecasts are depicted in Figure 10-7, and as noted earlier, if the Historical Growth Rate outlook were to be realized, by the mid-2030s critical access to needed electrical power as portrayed by the Target Grid Connect would be about one-half of the Projected Load Demand forecast. With 91% of grid connectivity reached by 2032, the Projected Load Demand forecast additions level out and increase only slightly through the remainder of the forecast period, suggesting that most of the operations deemed critical to meeting emission reduction strategies and other operator priorities will have been met by that time, and that closing the grid connectivity thereafter will be due primarily to lower production increases and eventual decreases. Furthermore, results of the Projected Load Demand forecast as shown in Figure 10-7, also suggest that the critical period for increasing grid connectivity is before 2032

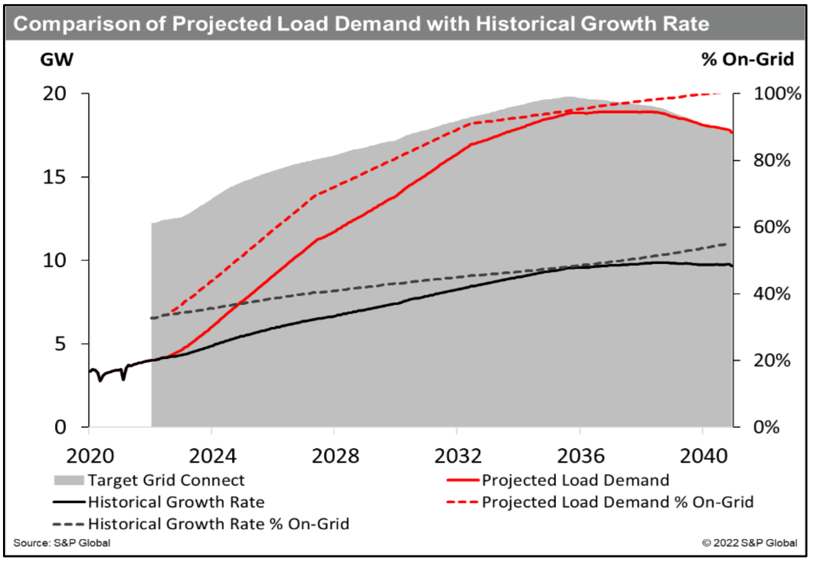

Figure 10-7: Forecasts of the Projected Load Demand and Historic Growth Rate

10.4.1 Grid access for oil and gas operations

Over the past several years operators have focused on connecting certain operations such as rod pumps and ESPs, production facilities, water handling operations and gas processing plants to the grid. Figure 10-8 indicates that these operations are now partially connected to the grid, yet there is still a gap in desired grid access. On the other hand, there is minimal connection for operations such as drilling and completion, gas gathering and gas lift which have heretofore been powered by diesel and natural gas.

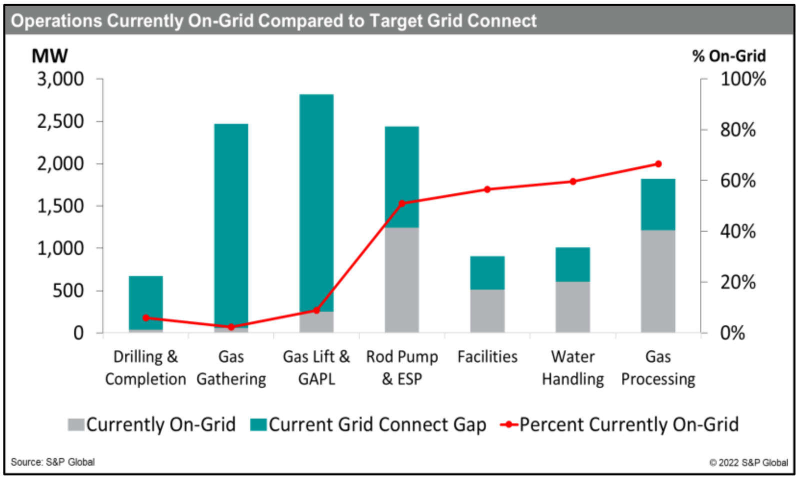

Figure 10-8: Operations Now On-Grid Compared to Target Grid

Meeting operational power demands and emission reduction goals, as expressed by the Projected Load Demand forecast, implies that these operations which have not traditionally accessed grid power, will now need to transition to the grid. Furthermore, these expectations need to be met within the next decade. This does not mean that these operations will achieve 100% grid connection, but certain operations will need to be well underway to 100% connectivity by 2032.

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Figure 10-9 which compares each operation's total power requirements for both the Projected Load Demand forecast and Historical Growth Rate, suggests that if the Historical Growth Rate were to be realized, operations such as gas lift compression, which has not been historically grid powered, would only achieve less than 8% grid connection. This may be because scarce electrical power under that scenario is more likely to be directed to increases in traditionally grid powered operations such as oil gathering and water handling. As noted in Figure 10-10 which shows the percentage of grid access for each operation under both scenarios, the vast majority of gas lift and drilling and completion grid connection can only be achieved by implementing the Projected Load Demand forecast. Furthermore, operations that have accessed the grid in the past when it has been available, such as rod pump and ESP, would also only be partially supplied by the grid if the Historical Growth Rate scenario were to occur. These traditional artificial lift operations also require adding more grid connection to achieve the 97% grid connectivity expectations of the Projected Load Demand forecast. Additional comparative forecasts for each operation are set forth in Appendix 11.

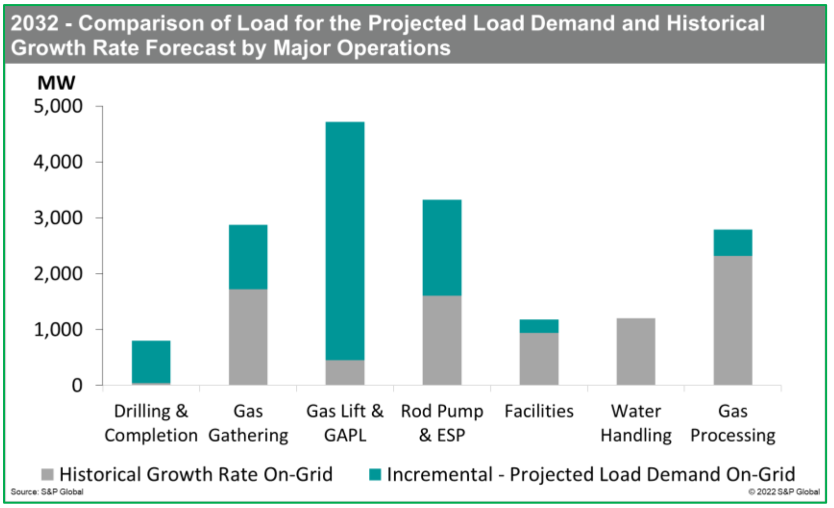

Figure 10-9: 2032-Comparison of Load for two forecasts by operation

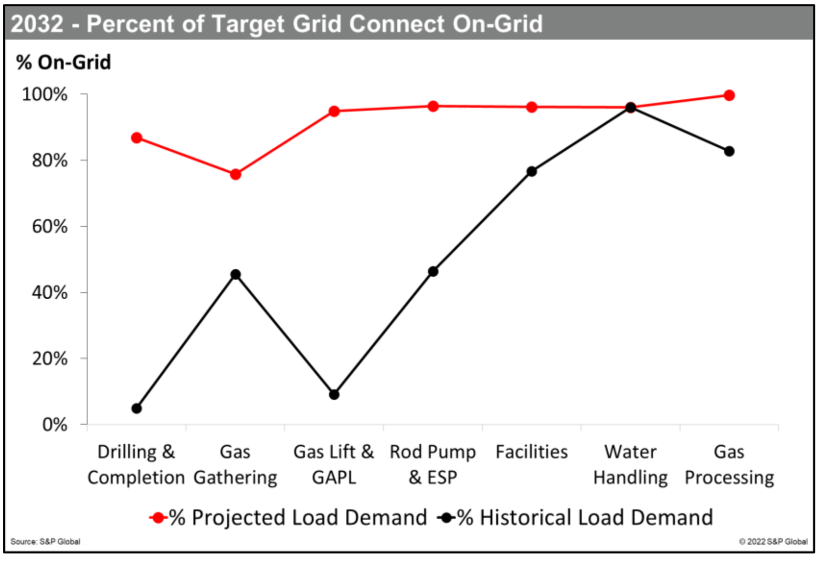

Figure 10-10: 2032-Percent of Target Grid Connect On-Grid

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11 Geographic Distribution of Projected Load Demand

S&P has analyzed the expected increase in oil and gas industrial power demand for the Projected Load Demand forecast as it is projected onto nine-square mile grids (3x3 miles), (herein defined as grid blocks). Creating grid block maps helps us determine in more detail where current grid usage is high and where it is most likely to increase over the forecast period. This process also helps to identify future needs for the build of additional transmission and distribution infrastructure in a more detailed, localized way. In this chapter, we will discuss key drivers that were used to allocate region-level forecasts to the grid blocks and display the current load distribution, the 2032 load distribution and then distribute incremental load additions between now and 2032. Additional maps are shown in Appendix 11.

11.1 Creating the 9-square mile grid blocks

GIS tools provided the means whereby the analysis could take place and grid block maps created. We employed the following steps:

1. Grid block shape files overlying the Permian Basin were initially created using ArcGIS. The following attributes were added to each grid block by aligning and using proprietary information and research:

    a. Upstream production and resources:
        i. Current production of oil, gas and water
        ii. Number of vertical and horizontal producing wells
        iii. Remaining resources of oil, gas and water
        iv. Number of remaining locations
        v. Breakeven prices and acreage quality

    b. Operator classes assigned to each grid block were defined as follows:
        i. Class 1 - Operators more likely to have electric grid access to traditional upstream production operations and which have received the highest priority in the load forecast. These are generally large operators and include participating companies.
        ii. Class 2 – Operators that would have partial electric grid access for traditional upstream production operations and would achieve electric grid access more slowly than Class 1. These are generally mid-sized operators with a substantial presence.
        iii. Class 3 - operators with more limited electrical grid access that would generally include smaller operators.

    c. Processing plant capability in MMcf/day and to a much smaller degree, compressor stations.

2. The load forecast (in MW) for each of the five regions was distributed or allocated to the grid blocks in each respective region using the attributes for each grid block. This procedure used a formula that combined attributes related to production and resources and operator class to perform the allocation for upstream and gathering load. In addition, the load related to processing plants and compressor stations was added to the upstream and gathering load to obtain the total load for each grid block.

3. The current and projected load for each grid block was combined with the original shape file to create maps of accelerated load for years 2022, 2027, 2032 and 2040, as well as maps of incremental changes from 2022 to 2027, 2027 to 2032 and 2032 to 2040.

4. This analysis will be further expanded and refined to create maps (shape files and KML files) of additional years' load and annual incremental load which will be included as part of the deliverables.

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11.2 Current industrial load distribution

Current oil and gas industrial load demand (2022) is concentrated in the unconventional areas of the Delaware and Midland regions with a few small, concentrated fields in the historically conventional CBP and Fringe areas, where oil and associated water production is still occurring. The total industrial power demand for oil and gas activities for 2022 is 4.2 GW, which is scattered throughout the basin in various concentrations as depicted on the map (Figure 11-1).

Blocks with greater than 10 MW are likely to contain processing plants which require much larger concentrations of load. Some high concentration blocks may also contain compressor stations, although the load requirement for these is much less than for processing plants. Blocks with 1 to 10 MW are generally located in the sweet spots of the Delaware and Midland regions where production of oil, gas and water are likely to be higher and where the larger, more active operators are more likely to be located.

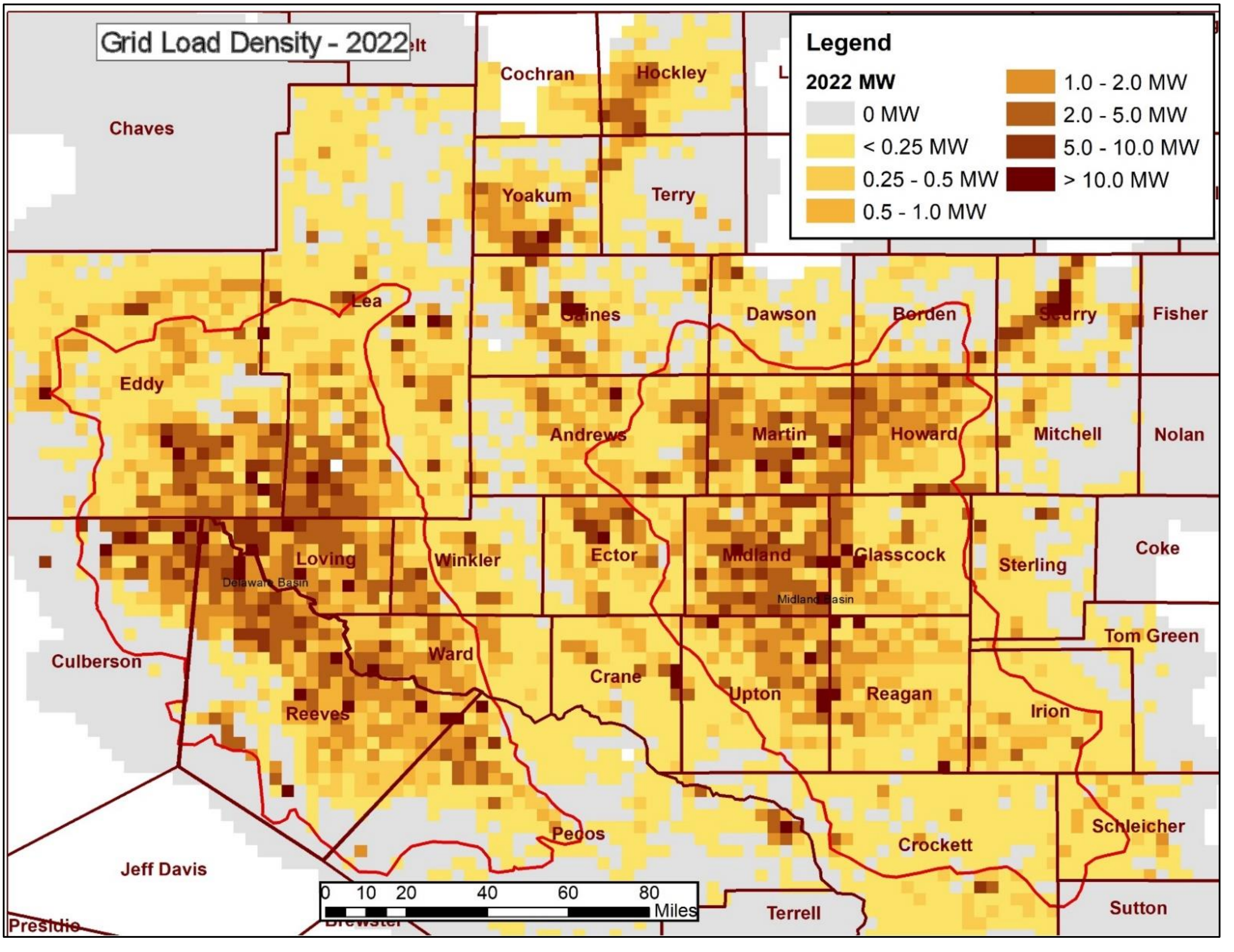

Figure 11-1: Current (2022) Projected Load Demand forecast grid load distribution

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11.3 Future 2032 load distribution for the Projected Load Demand forecast

By 2032, greater power demands are more widespread in the Delaware Basin where production is expected to increase along with associated water and natural gas at a faster rate than the Midland Basin. Nevertheless, rapidly converting operations to the grid will be important in both basins. The total load demand for oil and gas activities is projected to be 17.2 GW, which is more concentrated in the Delaware Basin with its large amounts of associated gas and water (see Figure 11-2). As associated gas increases during the forecast period, so does the need for additional gas processing capacity. Since we cannot predict where new processing plants will be built, we are assuming that processing capability will be added primarily to current units; hence, load concentrations in grid blocks with current processing capacity are shown to increase over time.

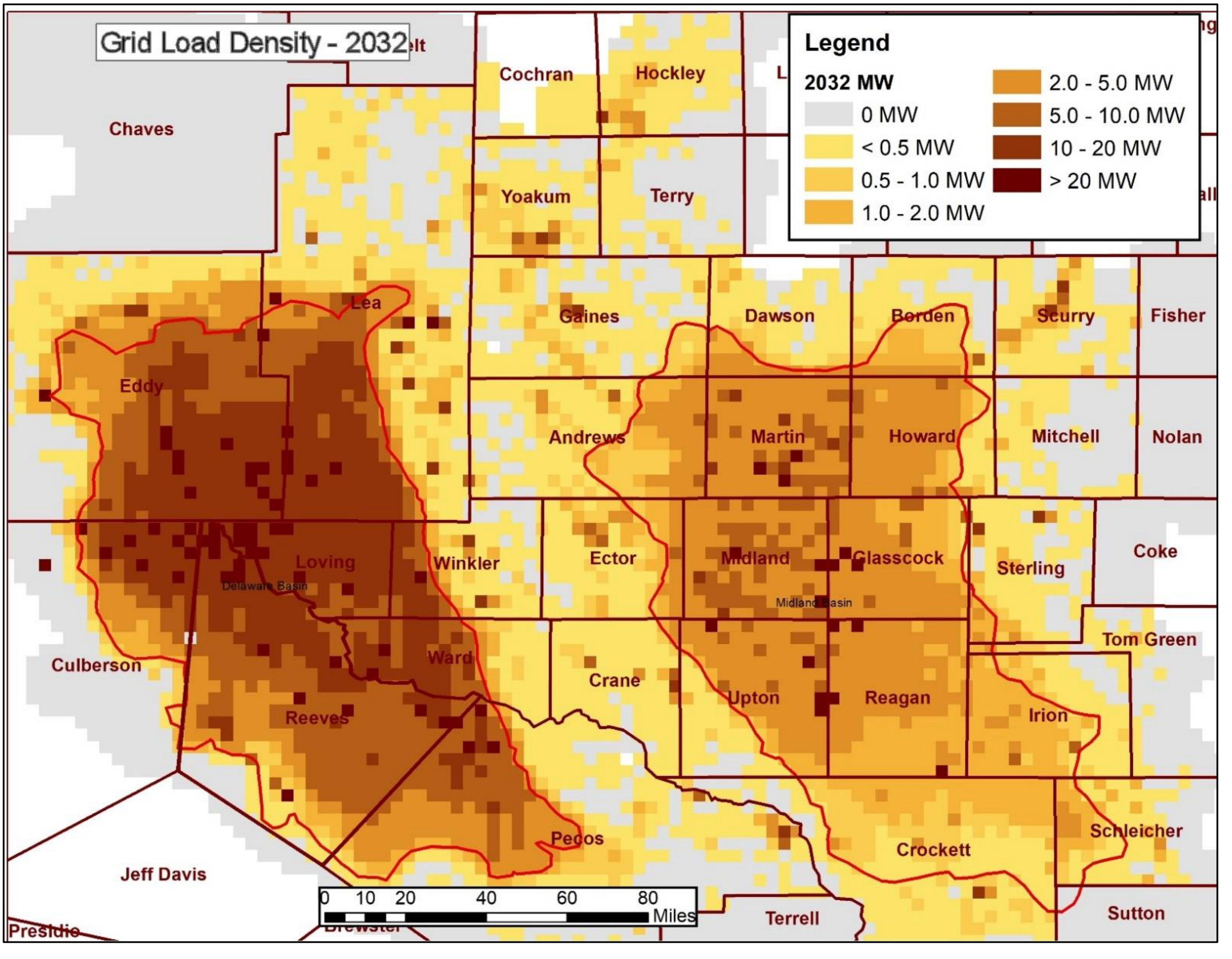

Figure 11-2: 2032 Projected Load Demand forecast grid load distribution

Changes in future load distribution

The grid analysis is a useful tool that can inform the power planning process, but not necessarily determine final outcomes. The analysis is based primarily on showing where oil and gas development is most likely to occur and how intense that development will be. As previously noted, to accomplish the Projected Load Demand forecast, a considerable amount of load additions should lie ahead and by analyzing the magnitude of incremental changes, both positive and negative, planners are able to see specific geographic locations of growth where additional load will be needed and diminished areas where load should be redirected.

From 2022 to 2032 the total incremental load increase is a net increase of 13.3 GW. This includes a load increase of 13 GW in the Delaware Basin both in New Mexico and Texas around the core producing areas. The Midland region will also require load increases mainly in core areas of about 3.4 MW. Slight decreases of load demand will occur in the CBP and Fringe areas as conventional oil and water production wanes (Figure 11-3). Note that grid blocks of > 20 MW scattered throughout both basins are due primarily to increases in processing plant load requirements which have been projected to be increases at current locations.

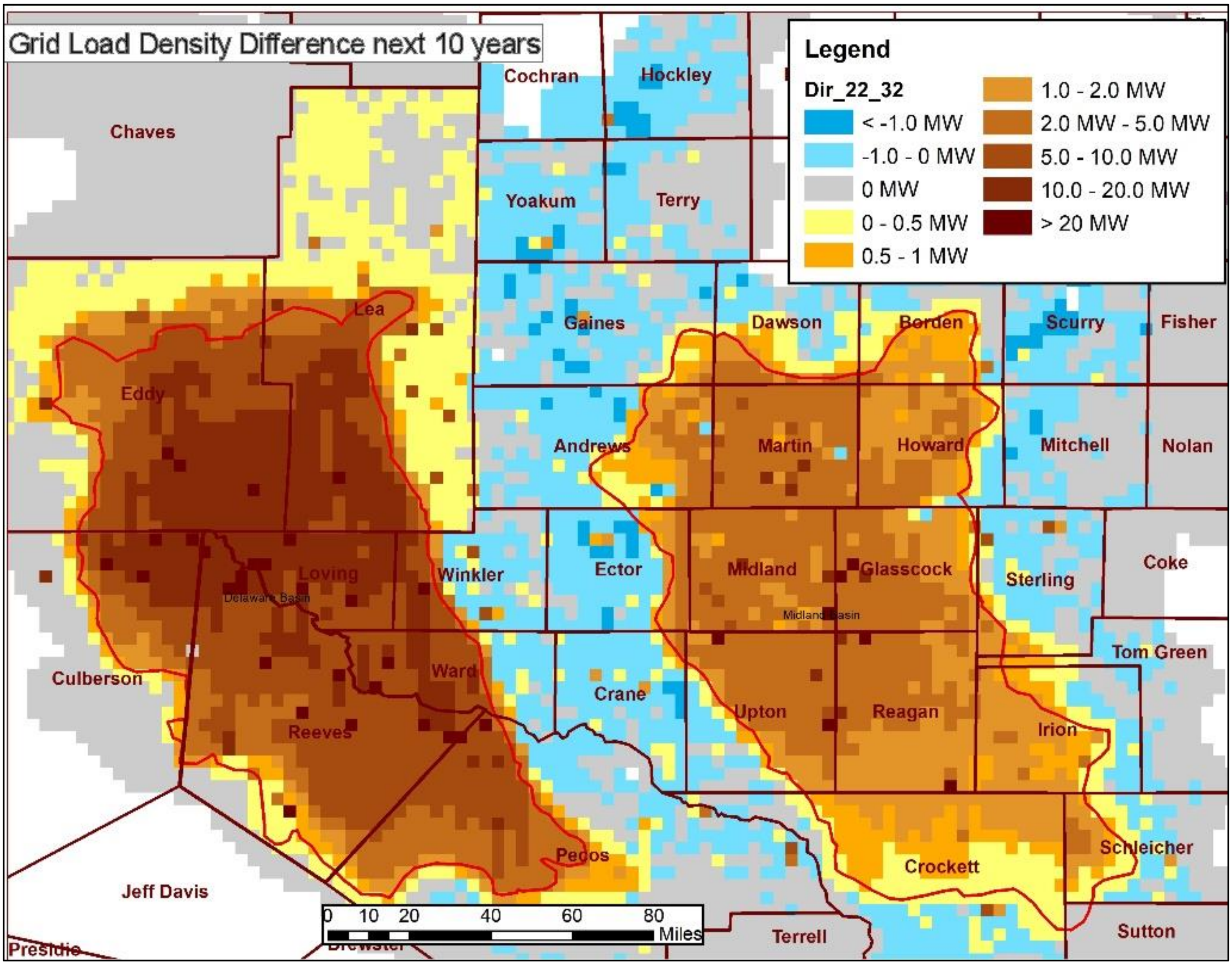

Figure 11-3: Next 10 years incremental changes – Projected Load Demand Forecast

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12 Projected Load Demand (R+C+I) Forecast

12.1 Adjustments to Industrial Load for Coincident Peak Load

12.1.1 Review of Coincident Peak Adjustments

The Projected Load Demand forecast for each region set forth in Chapter 9 reflect average monthly power usage or load from the grid. Yet power usage is generally variable with both peaks and valleys of demand occurring during a given month. Transmission infrastructure capability must be designed to handle the peaks while also considering heat limits on equipment; however, this capability design does not mean that all operations will be running at peak capacity at a given time. Rather, the assumption is made that a certain percentage of operations will be running at peak capacity, while other operations may not even be running or running at a lesser capacity. These occurrences of high grid access by multiple operations are referred to as coincident peak load. This means that generally average load outlooks should be scaled up by a load factor so that infrastructure can be properly designed to meet the load demand during these times of high access or coincident peak.

In the 2019 Report analysis of extensive data provided by Oncor (including 15-minute data) was performed to determine load factors for each county and region. While there was a wide range of load factors determined at the county level in bespoke report, overall average load factors were generally in the 12-18% range, meaning that the average monthly load was uplifted or grossed up by these amounts. Although this detailed data is not available for this report, we referred to recent D&E data provided by ERCOT for the far west weather zone to provide an estimated range of uplifts, which are shown in Table 12-1. As a starting point we may want to consider using these recent percent uplifts to inform our load factor results by applying the following equation.

Far west – yearly load results	2019 (MW)	2020 (MW)	2021 (MW)	2022 (MW)
Coincident peak	3,928	4,026	4,347	4,619
Average monthly	3,453	3,713	4,041	4,433
Percent uplift	13.7%	8.4%	7.6%	4.2%*

Table 12-1: ERCOT far west weather zone annual load
**First half of 2022*

Load Factor = $\frac{kW(average\ electricity\ consumption\ in\ \boldsymbol{Power}\ over\ billing\ period) \times 100\%}{Peak\ kW}$

12.1.2 Adjusting Average Industrial Power Demand to Peak Power

However, there is historical variability in the table that we cannot explain, and the values are lower than what was determined in the 2019 Report. Furthermore, these loads refer to all power, including residential and commercial power (R+C) which is more susceptible than industrial load to peaks and valleys due to the increase and decrease of power use because of changes in the weather. While we expect peaks and valleys to occur in the industrial load, we believe that they are less of a factor than in residential and commercial use. Nevertheless, we note some possibilities for inconsistent load access, particularly where equipment is designed and built for maximum capacity, as has been alluded to by some of the participating companies:

- Flows from wells may be intermittent with wells often being shut-in due to workovers and other maintenance, which will in turn diminish the need for power at the well site, affecting all well head operations including rod pump and ESP artificial lift. We have determined, however, that the somewhat random nature of these shutdowns over the course of time for many wells would level out in such a way that average monthly billing would suffice for determining the demand for electric load. These operations historically have been the largest consumers of electric load; however, as emissions reduction becomes more widespread other operations, such as drilling, which are more likely to incur load variations will become more prevalent.

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- Compression to run gas lift and gathering systems may also be susceptible to peaks and valleys for the simple reason that participating company feedback suggests that they are determining the amount of necessary load for their compressors, based on compressor design and capacity, rather than on natural gas throughput. This suggests that despite relatively large or small throughputs, the loads needed to run the compressors may be less variable regardless of throughput; however, since there is likely to be some variability, we can reasonably assume that some coincident peak upscaling is already built into the Projected Load Demand forecast.

- Load requirements for drilling and completing wells can be highly variable, depending on both timing and intensity of operations. For example, when a rig is drilling during times of maximum penetration, more power or load will be needed, but there are times when rig power use is minimal such as when running well logs, circulating fluids, or moving rigs. This variability may average out over an entire region drilling many wells, but local infrastructure design will be needed to handle the times of higher intensity.

- Some operators are implementing at least a portion of their own electrical infrastructure, by installing sub-stations and distribution lines, and in some cases transmission lines. This also suggest that future load requirement feedback from participating companies includes a load factor in their projections.

These observations suggest that trying to nail down or determine specific load factors for this report would be imprudent given that (1) there is not enough consistency in reported load and a high degree of uncertainty regarding what load factors to apply, and (2) feedback from the participating companies suggests that equipment and expectations of future load is designed for peak capacity and that some load up scaling is already built into the Projected Load Demand forecast. We will therefore not perform any gross up of the industrial load forecasts but will continue to base our industrial load outlooks on the average monthly loads described in Chapter 9.

12.2 Residential and Commercial Outlooks

12.2.1 Residential and Commercial Load Forecasts

Methodologies for determining residential and commercial (R+C) loads from 2019 to 2030 are explained in chapter 4-1 of the 2019 Report. Given the recent growth of towns and cities in the Permian Basin, there is, however, one statement that needs emphasis and is reiterated as follows:

> "In the IHS Markit system each area is modeled individually and then linked into a national system. Thus, our models do not forecast regional growth as simple proportions of U.S. totals but focus on internal growth dynamics and state specific business cycle response. This approach is referred to as "top-down bottom-up." It contrasts sharply with pure share (top-down) models, and models that are not linked to a national macroeconomic model (bottom-up) and contains the best of both approaches."

The load forecasts for each of the Texas regions is also set forth in this bespoke report. The Delaware-NM regional residential-commercial load, which were not a part of the 2019 Report, was derived by comparing the population of the other regions with that of the Delaware-NM region and estimating the 2019-2030 load. The R+C load forecasts for each respective region were then generated to 2040 by projecting the trends of the years 2020-2030, while maintaining seasonality cycles. The residential and commercial load for each region is projected to grow by about 1-2% each year.

12.3 Projected Load Demand (R+C+I) Forecast

To determine a total load forecast for each region, the R+C values have been layered on top of the Projected Load Demand forecast to obtain a forecast of total load requirements for each of the regions as well as the total Permian Basin. When we add residential and commercial (R+C) load to the industrial load, we applied a 95% coincidence

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factor to the combined R+C+I forecast to determine an overall coincident peak load. Comparisons of peak load with peak load will be in the month of June where peak R+C loads have historically occurred in the Permian Basin.

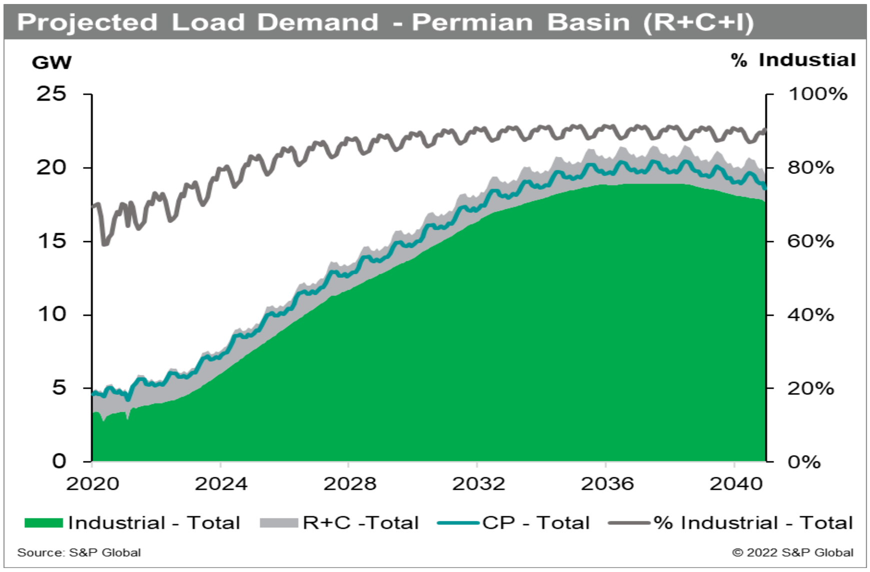

Figure 12-1: Projected Load Demand - Permian Basin (R+C+I)

The total Projected Load Demand (R+C+I) coincident peak electric load forecast for the Permian Basin is depicted in Figure 12-1. The June 2022 load was 6.1 GW increasing to a June 2032 result of 18.4 GW and to a June 2036 maximum load of 20.4 GW which is a 236% increase over 2022. The forecast reflects both the increasing production of oil and gas and the increasing need for more grid connectivity in order to achieve stakeholder strategic targets. Since we anticipate that industrial load will increase at a much faster rate than residential and commercial load, the industrial portion of the total load currently makes up 66%, but it will increase to 93% of the total load by the end of the forecast period.

Table 12-2 presents the Projected Load Demand (R+C+I) of each Permian Basin region for June of each respective year. Major increases are noted for each region, except for the CBP and Fringe regions which show minimal increases. Appendix 13 provides a more detailed discussion and plots of each region's Projected Load Demand (R+C+I) forecast.

Projected Load Demand (R+C+I) (GW)	June-22	June-27	June-32	June-36	June-40
Midland (GW)	2.0	3.5	4.1	4.2	4.3
Delaware-NM (GW)	1.2	3.3	5.4	6.3	5.5
Delaware-TX (GW)	1.4	4.6	7.4	8.2	8.1
CBP+Fringe (GW)	1.4	1.6	1.7	1.7	1.8
Total Permian Basin (GW)	6.1	13.0	18.4	20.4	19.7

Table 12-2: Projected Load Demand (R+C+I) for each region

13 Conclusions

13.1 Review of Recent Permian Basin Production and ERCOT Load history

Even before the ink was dry on the 2019 Report, the COVID-19 pandemic came upon the world in a matter of just days, shutting down the global economy. In consequence of the immediate free-fall in oil prices, Permian Basin production declined sharply from 5 MMbbls/d to about 4.1 MMbbls/d, recovering only slightly to 4.3 MMbbls/d through the remainder of 2020. While it was impossible to foresee the effect of this "black swan" event which caused devastation to the oil markets, neither did anyone predict that oil prices would exceed $100/bbl in the first half of 2022. Now that daily Permian Basin oil production has recovered to 5 MMbbl/d, and is forecasted to trend higher, optimism has once again returned to the oil patch and we anticipate that Permian oil production will continue to grow, albeit at a slower rate than previously projected.

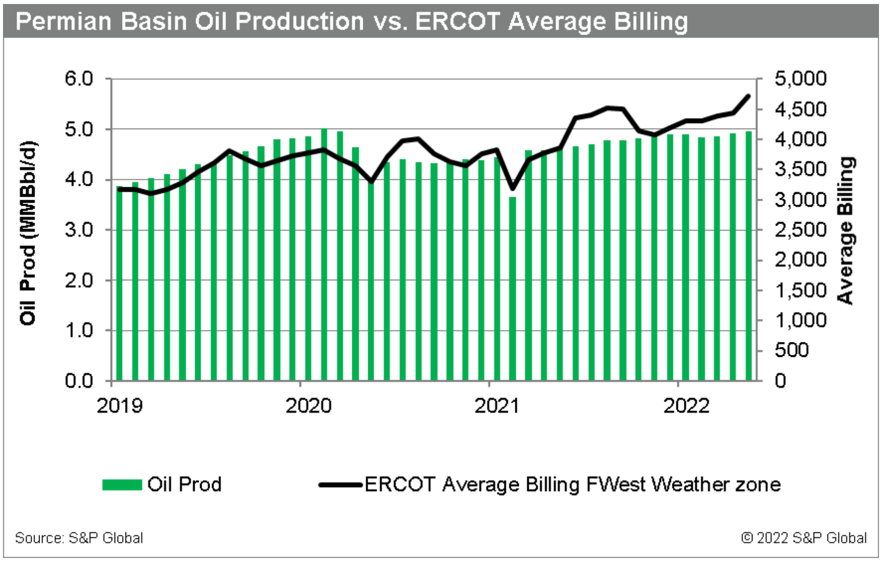

Figure 13-1: Permian Basin production history and ERCOT historical load

What has since been forgotten, is that in the year prior to the pandemic (March 2019-March 2020), Permian Basin oil production grew by one million barrels per day or by 25%. At the same time Far West Weather Zone monthly average load increased from 3112 MW to 3674 MW, an increase of just 18%, indicating that load additions were not keeping up with production increases at that time. In the two years since March 2020, Far West Weather Zone monthly average loads have increased to 4391 MW, an increase of nearly 20%, whereas in that same time interval oil production has recovered and is at about the same 5 MMbbls/d level seen in early 2020, suggesting that there is some gap closure between power demand and actual load.

This history is laid out in Figure 13-1 which compares the actual historical production with the D&E data from ERCOT. How one interprets the data and perceives the events of the past few years is likely to influence how they view the need for additional load in the Permian Basin. Roughly 300-400 MW per year of total load has been added each year to the Far West Weather Zone and one might be tempted to assume that given the uncertainties in the oil markets, this rate of load addition may be sufficient to meet the needs of both upstream and midstream companies. On the other hand, this report has laid out conclusions that tell a different story.

13.2 Report conclusions

Since 2019 several essential elements have not changed which include the following:

- The resource base of 71.5 billion barrels and 289 Tcf of gas will contribute to a production forecast that will continue to increase for at least the next 12-15 years
- Operators prefer to put certain upstream production operations on the grid including rod pumps, ESP units, facilities and water handling operations since this is the most cost-effective and reliable power solution.
- Gas processing plants are another operation that uses extensive industrial load, which we have determined are about 65-70% grid connected.

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- We have determined that with 5 MMbbls/d of oil production, total Permian Basin oil and gas operations require more than 16 GW of power and only 4.2 GW of this is currently grid powered. The Participants have expressed a desire to electrify as much as their current and future operations as soon as possible.
- The Delaware Basin is and will continue to require substantially more electric load, since production is expected to increase substantially there; and more power, including electric load, will be required to handle the increased volumes of associated gas and water.

Building upon the essential elements that have not changed, this report highlights three additional critical elements that suggest that an acceleration of load additions in the Permian Basin is required in order to meet the needs of all stakeholders including producers, midstream companies, consumers, local and regional government entities and those concerned with emission reductions and ESG matters. Of particular note is the acceleration of the 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. This especially applies to the Delaware Basin which will be the growth engine in the Permian Basin.

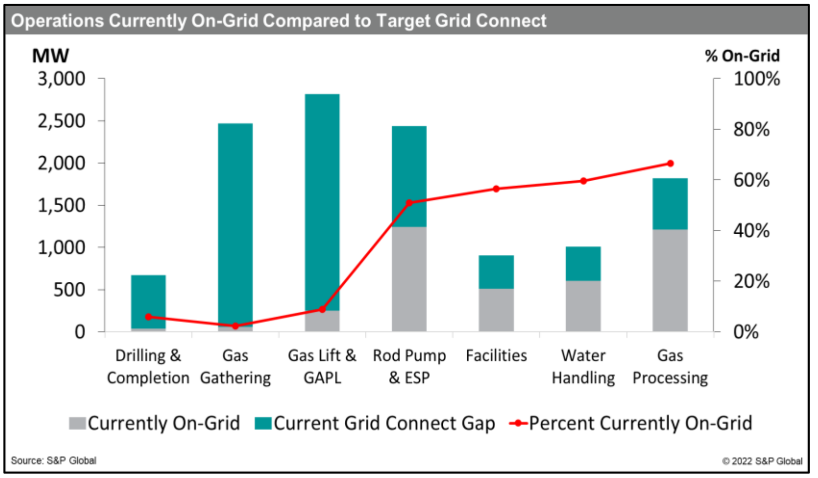

Figure 13-2: Target Grid Connect - compression and non-compression

1. Increased Production: Oil production has now recovered to pre-pandemic levels and is forecasted to increase to about 7.1MMbbls/d by 2036. Since growth will be predominantly in the Delaware Basin, where there are higher amounts of associated gas and water per barrel of oil, the future need for power and potential load will continue to be most acute there.
2. Large gap in needed load: Despite the increase in oil and gas industrial load over the past three years, there is still a gap between grid availability and upstream production operations (such as rod pumps, ESPs, production facilities, and water handling) that operators have traditionally desired to put on the grid in order to reduce costs and increase reliability. While there has been some progress since 2019, Figure 13-2 indicates that approximately 30-45% of these operations still lack grid access.

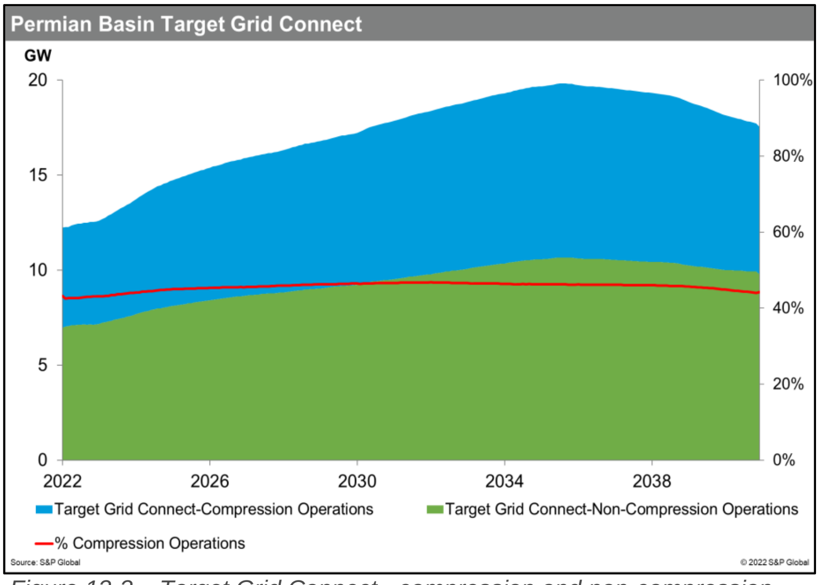

Figure 13-3 – Target Grid Connect - compression and non-compression

3. Strong focus on emissions to meet strategic targets: An emphasis on emission reductions and issues related to neutrality carbon emission reduction has become a high priority. Publicly traded upstream and midstream companies are announcing that they are going to find ways to reduce emissions and these companies are implementing strategies for emissions reduction by moving compressors (which drive gas lift and gas gathering), and e-drilling to the electric grid; these heretofore having been powered by emissions emitting diesel and natural gas. Figure

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13-3 indicates that putting compressors on the electric grid will take up nearly one-half of the power requirement set forth by the Target Grid Connect and go a long way in helping companies meet their strategic targets for reducing emissions. Putting compression on the grid would amount to about 9.5 GW of the nearly 20 GW load needed by 2036, which is more than double the 4.2 GW of oil and gas industrial load currently on the grid

Lurking in the shadows is the possibility that bit-coin mining in the Permian Basin may compete with oil and gas operations for scarce electric load and while new infrastructure may not be needed here, these operations could put a strain on the electric grid. See Appendix 14 for a detailed report on Permian Basin Bit-Coin mining.

In this Report S&P has discussed in detail these three elements and has gathered information, performed critical analysis and quantified assumptions in order to create a Projected Load Demand forecast that would fulfill the requirements of these three critical elements. In conclusion, we have determined the following as it pertains to future electric load in the Permian Basin:

- Increased Electrification Requirements**:** In order to meet these 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. **In order to implement the Projected Load Demand forecast, load additions would need to increase to about 1500 MW per year for the next several years, which is more than a four-fold increase from current load addition rates of around 300-350 MW per year.**

14 Appendix - Content

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2. Ancillary - Resource assessment
3. Fundamentals underlying production forecast
4. Power forecast model
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6. Power Demand forecast by region
7. Grid Connection History and Backup
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