Waiting on Wires

Overcoming Delays in Oil and Gas Electrification Efforts

Waiting on Wires: Overcoming Delays in Oil and Gas Electrification Efforts

The intensifying mandate to reduce methane and carbon dioxide emissions from production and processing operations has many natural gas companies looking to electrify their equipment. However, a significant challenge stands in the way of their electrification efforts: the electrical grid's struggle to keep up.

The strain on electric infrastructure across the United States continues to grow as producers and operators deploy new production, gathering and processing assets. Interconnect applications for new loads create a complicated problem for utilities to solve, requiring new substations and transmission lines equipped with transformers and other electrical equipment.

The time required to conduct and execute actions from interconnect studies for power to arrive onsite has lengthened significantly, creating serious delays for gas infrastructure projects. Once power arrives onsite, companies must then procure generation from an already constrained and volatile wholesale market.

Upstream and midstream companies have a few options to secure bridge power until they can source energy from the grid. This paper explains the dynamics behind grid constraints and explores four solutions operating companies can consider while waiting on wires.

Power demand and supply challenges, explained

Today's grid challenges stem from a mix of generation, transmission and distribution constraints. A massive increase in power demand is driving demand for new generation. Meanwhile, existing wires don't have enough capacity to transmit that energy over long distances, and distribution is constrained by the volatile and geographically diverse deployment of loads coming online.

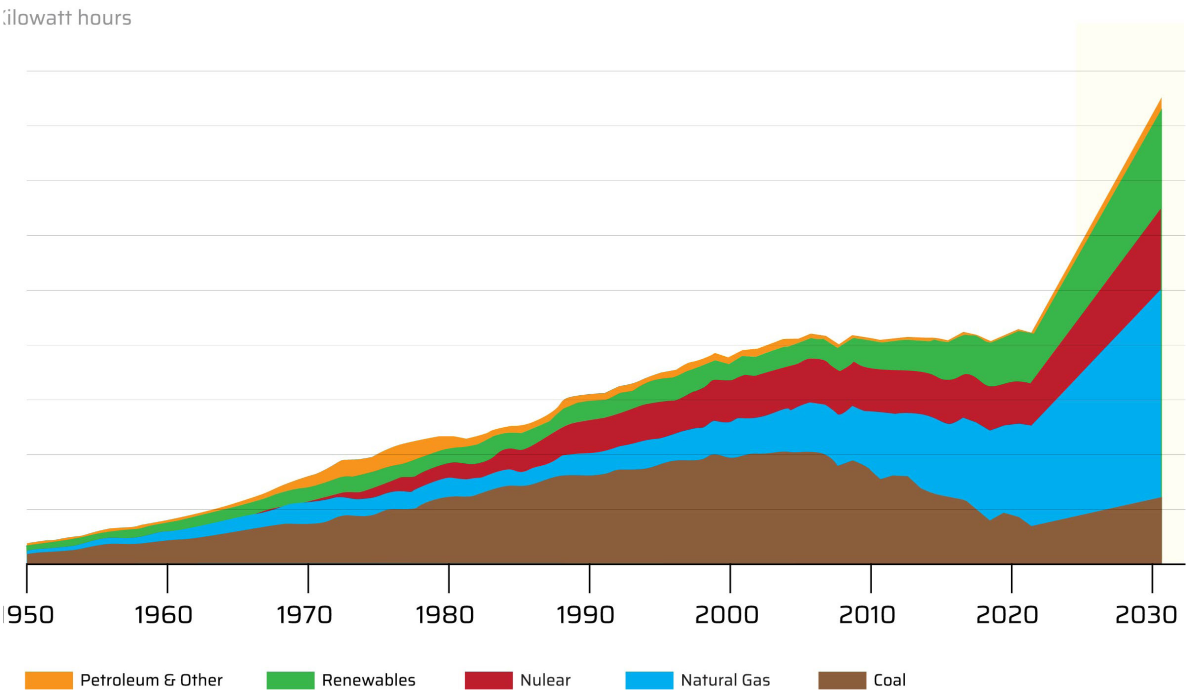
Looking more closely at the demand and supply issues reveals why oil and gas companies should expect continued challenges with getting grid power for electrification projects.

Skyrocketing demand poised to continue

After remaining flat for nearly two decades, power demand across the United States is projected to grow substantially. One particularly aggressive growth estimate from Pickering Energy Partners suggests that demand could double in the next seven years, reaching 8.4 billion kilowatt hours (kWh) in 2030[1] .

Much of this growth is tied to the power demands of artificial intelligence (AI) and data centers, but additional factors are also at play. Increased demand for electric vehicles, heat pumps and the electrification of the oil and gas industry may stress the grid further.

Figure A. One U.S. electricity growth estimate to shows demand doubling by 2030



While demand nationwide has been relatively flat in the 2000s, load growth has recently accelerated in some regions, such as Texas, due to industry and population growth. The effects of this demand growth can include higher peak power prices, longer interconnection times for new power consumers and greater risk of outages. This creates additional challenges for oil and gas companies as they electrify operations.

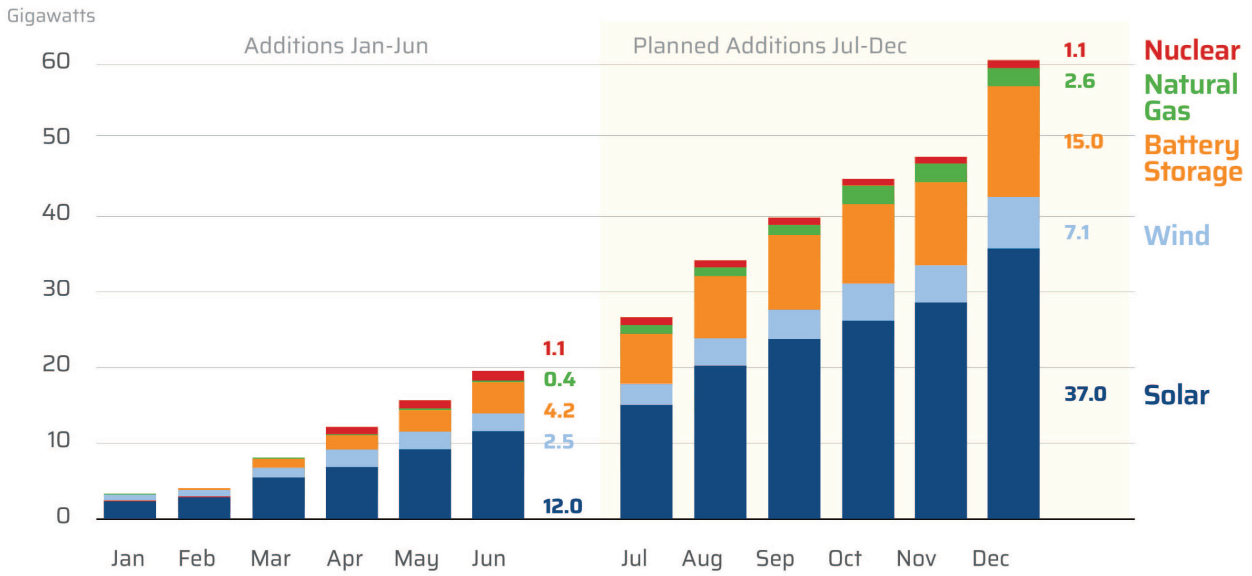
The need for reliable supply

The majority of generating capacity that came online in 2024 was from what are considered non-dispatchable sources, with solar, wind and battery power comprising 59.1 gigawatts (GW) (94%) of new supply. These sources supply only intermittent power, meaning there is a dearth of investment in truly dispatchable, sustained supply coming online to meet increasing demand.

1 Pickering Energy Partners, The U.S. Needs a Bigger (Energy) Boat

RPower believes the need for reliable, sustained power generation will only rise going forward due to the aforementioned demand projections. For oil and gas companies, securing bridge power until new assets can connect to the grid is just step one. They must also consider how to ensure a sustainable source of electricity beyond the bridge period.

Figure B. Cumulative utility-scale electric generating capacity additions in the U.S. (2024)[2]



Solutions to overcome grid constraints

With power demand on the rise and supply struggling to keep up, hydrocarbon production and processing companies face a significant challenge in implementing their electrification strategies. If you have a planned project requiring power from the grid, you should expect getting power to your site to be the longest lead item in your project plan.

It's common for interconnect requests to add **one to three years** to a project timeline.

Waiting on wires doesn't need to mean missing a business opportunity. Several solutions are available to help you get energy to your site when facing grid connection delays, including the following options:

1) Using gas-driven assets wherever possible to reduce or eliminate electrical needs.
2) Using rental power generation equipment as bridge power until line power arrives onsite.
3) Building a microgrid of power-generating assets to provide bridge power and support long-term resiliency once grid power arrives on site.

Each option has advantages and disadvantages, which we explore on the following pages.

2 https://www.eia.gov/todayinenergy/detail.php?id=62864

Option 1:
Engine-driven compression to reduce electricity needs

A natural gas processing plant has a variety of electricity-powered equipment, but power residue compressors (if utilized) often consume the largest electrical load. These compressors take natural gas (primarily methane) stripped of most of its heavier hydrocarbon content and compress it to a sufficient pressure to be injected into a natural gas pipeline.

Installing engine-driven compressors instead of electric drives can reduce a plant's overall power needs by approximately 50%. These lower power demands may enable other electrical loads to be connected with existing infrastructure on a shorter timeline.

Advantages:

- Engine-driven compressors have been used in the industry for decades and are well-understood technology.
- The cost of fuel tracks with natural gas commodity costs, hedging the risk of having low gas prices and high electricity prices.

Disadvantages:

- Greenhouse gas emissions from engine-driven compressors are often higher than those of electric drives, depending on the energy mix of the local grid.
- Engines typically have higher operation and maintenance needs, which can drive lower unit-level availability for planned maintenance events.

Emissions impact:

Using engine drives has a typical carbon dioxide equivalent (CO2e) emission rate of 450-550 grams per brake-horsepower-hour (g/bhp-hr) for the entire life of the asset.

Bottom line:

Installing engine drives addresses the dependence on the grid arriving on time (or at all). However, it largely defeats the emissions reduction purpose of going electric in the first place and would likely thwart progress toward decarbonization goals.

Option 2a:
Rental power generation with turbines to provide bridge power

Simple cycle gas turbines are often used for rental power generation where higher power levels are needed. Various options are available, but some of the more popular designs include 5.7 megawatt (MW) and 16 MW trailer-mounted units.

Advantages:

- Turbines have high power densities, so only a few units are needed to cover a demand of 20-30 MW.
- Trailer-mounted designs allow for a fast and reasonably simple installation with a smaller footprint.
- Rental turbines typically have low operation and maintenance needs and have a reputation for high uptime.

It's important to assess your site conditions to **understand how generators will perform** and how the associated emissions are impacted.

Disadvantages:

- Turbines derate at a high altitude and/or temperature, as illustrated in Figure C. For example, at 3,000 feet of altitude and 110˚F of ambient temperature — conditions common in the Permian Basin — a 16 megawatt electric (MWe) ISO-rated unit derates to less than 12 MWe. Efficiency also drops about 5-10%, meaning CO_2 emissions rise proportionally.
- Because rental rates for power generation equipment are based on nameplated ratings, you could pay approximately 33% more on a $/MW installed basis.
- The heat rate of turbines increases as load is reduced and it's common for them to run below their rated output to match site load, which varies with plant demand.
- Increased demand for these services has driven up rental prices significantly and led to equipment shortages.
- Rental contracts often include additional fees to install, operate and remove equipment, so your quoted rate may not be all-inclusive.

Emissions impact:

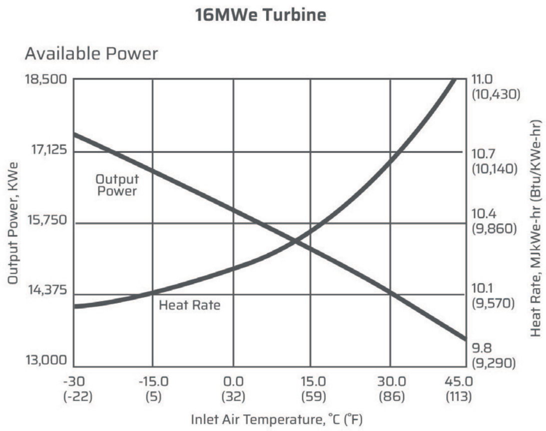
A rental turbine bridge power option typically has a CO_2e of 425 g/bhp-hr for the 16MW trailer-mounted unit and 500 g/bhp-hr for the 6MW option at ISO conditions[2]. As mentioned previously, CO_2e increases by 5-10% at high elevations and temperatures. After the bridge period, your assets would draw power primarily from the electrical grid, which continues to reduce CO_2e (depending on the generation mix of your local grid).

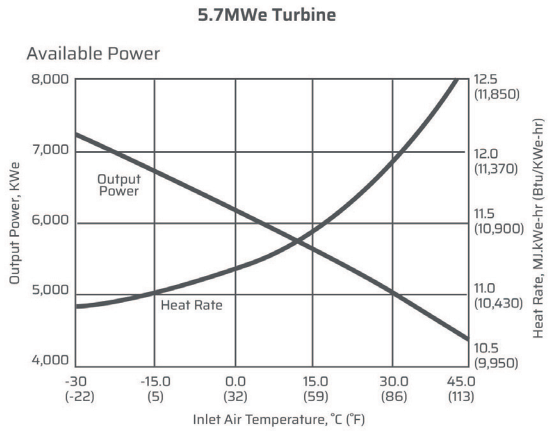
3 As defined by the International Standards Organization, ISO standard day conditions equal atmospheric conditions at a temperature of 59°F (15°C), 60% relative humidity, and zero feet above sea level.

Bottom line:

Rentals can be a relatively easy way to secure bridge power but don't solve long-term resiliency or pricing volatility concerns. You may need bridge power for a few months to a few years, so make sure to calculate the total cost over the expected period, including all fees. It's important to assess your site conditions to understand how turbines will perform and how the associated emissions are impacted.

Figure C. Power derate and heat curve for gas turbines at sea level altitude





Option 2b:

Rental power generation with engines to provide bridge power

Natural gas-fueled reciprocating engines are also commonly used for rental power generation needs. One of the most common sizes has a prime rating of 400 kilowatt-electric (kWe). Other typical power nodes include 1.3, 1.6, and 2.5 MWe.

Advantages:

- Reciprocating engine units are popular for lower power needs because they can be added or subtracted as needed to match site load or N+1 redundancy needs.
- Many available rental units can start, load and unload faster than turbines, leading to quicker response times when plant equipment is started or turned off.
- Some units feature very competitive heat rates below 9,000 British thermal units (Btu)/kWe-hr, although other units have more average rates of 11,000 Btu/kWe-hr, depending on the unit's size and type.

Disadvantages:

- Rental rates for engines are typically higher than turbines on a $/MW basis.
- Reciprocating units typically have higher operations and maintenance needs than turbines and require a larger footprint for a similar amount of power.
- The rental rates are based on nameplate, not site rating, and are typically not all-inclusive.
- Increased demand for these services has driven up rental prices significantly and caused equipment to become scarce at times.

Emissions impact:

For rental reciprocating engine bridge power, the CO_2e is 425 - 550 g/bhp-hr, depending on the size of the generator, whether it uses lean burn or stoichiometric burn combustion and a few other factors. After the bridge period, your assets would draw power primarily from the electrical grid, which continues to reduce CO_2e (depending on the generation mix of your local grid).

Bottom line:

As with turbine rentals, be sure to understand the total cost and emissions impact over the expected rental period. Rental generators using engine drives can be a solid solution for bridge power needs, but do not solve long-term resiliency or pricing volatility concerns.

Option 3:

Build a microgrid to provide bridge power and long-term backup power

A microgrid is essentially a small power plant that serves a distinct geographic area or customer. It includes all necessary components to supply power, including generation equipment, switchgear, transformers (if required), cabling and reclosers. Microgrids can feature a variety of generation technologies, including solar panels, wind turbines, and natural gas or diesel-fueled generators, as well as battery storage systems.

Once grid power arrives, these assets can be used as a tool to provide backup generation, reduce electricity price volatility and provide other grid services, unlocking additional savings or revenue. Providing backup to your site is always the priority, but when the units are available, you can dispatch them to provide critical services to the grid operator, sell power into the wholesale market and avoid peak demand charges.

Advantages:

- A microgrid can provide long-term backup power, generate additional revenue and be used as a bridge if future expansion occurs.
- Microgrids maximize the benefits of the cost and effort involved with installing power generation for a bridge need by utilizing the assets over a longer period.

Disadvantages:

- A microgrid can be capital and resource-intensive to install and requires resources to operate and maintain.
- Operating microgrids requires power generation/energy management expertise, which may not be a core competency for midstream/upstream companies.

Emissions impact:

A microgrid's emissions depend on the type of generation deployed. As one example, a microgrid with reciprocating engine-driven generators has a CO_2e range of 375 - 500 g/bhp-hr. The electric grid would be your primary power source once the interconnect occurs, further reducing carbon emissions depending on the carbon intensity of your grid region.

More broadly, dispatchable power assets in a microgrid enable renewables by firming the grid when needed. An influx of natural gas-powered backup generation could enable the addition of solar and wind assets to take hold without sacrificing the grid's reliability. Other peaking resources typically have higher CO_2 intensities.

Bottom line:

Microgrids come with a longer timescale and commitment but can be a more attractive financial option than rental power. They also deliver resiliency beyond the bridge need and make the greatest impact on decarbonization goals.

Overcoming microgrid challenges

Some of the drawbacks of microgrids can be addressed by leasing a microgrid from a partner, who would lease land from and arrange a gas agreement with the site owner. The microgrid partner owns, operates and maintains the power generation system and also owns the environmental permit, avoiding aggregation with the site.

When the interconnect arrives, the microgrid transitions to an energy management and utility backup asset, which your partner can help manage. Typically, the partner charges a monthly fee for the solution and shares in revenues, providing an incentive to maximize the energy savings and market revenues the microgrid system generates.

Choosing a solution

The best option for you depends on a number of factors, including:

- The location of your project
- Decarbonization goals
- Cost of power and fuel
- The length of your bridge power need
- Available space to support a power generation installation

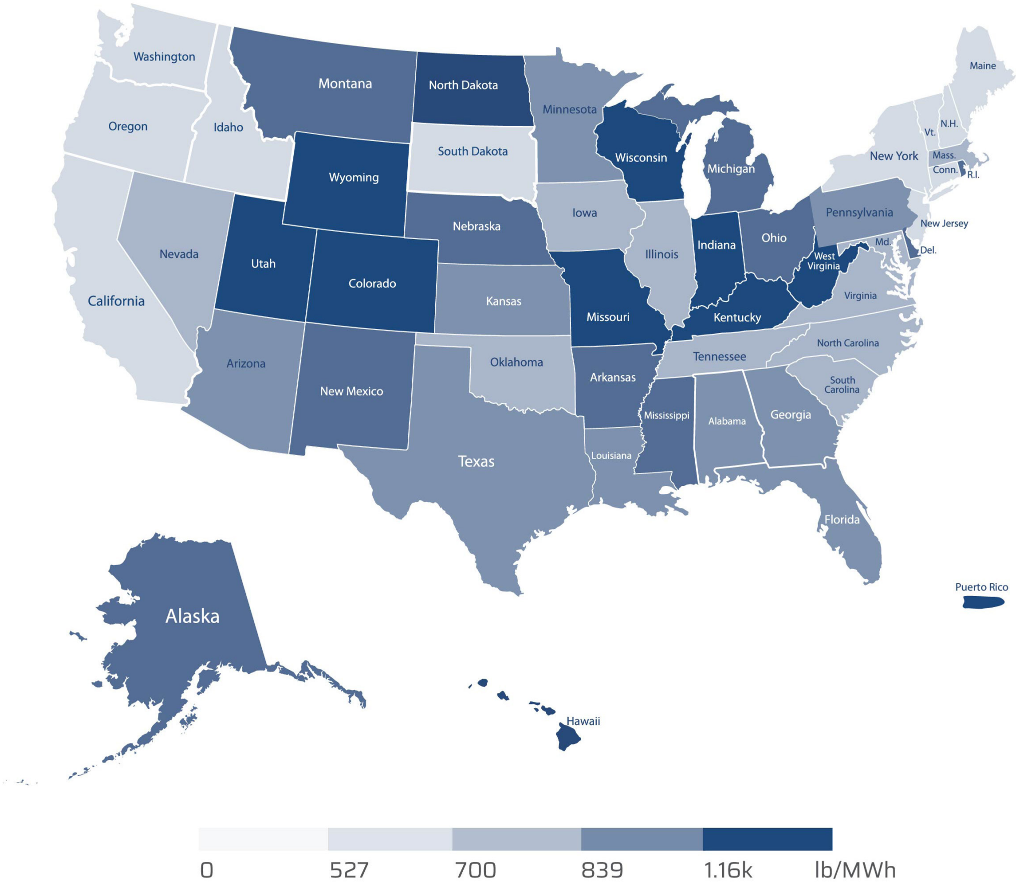
Site conditions also play a role. As previously stated, high altitude and ambient temperatures affect turbine power output more than reciprocating engines. However, if power needs are high and onsite space is tight (as it can be in the hilly regions of the Marcellus shale), turbines may be the best choice. If the carbon intensity of the bridge solution is important, it is helpful to look at the actual site condition-based heat rate of the driver being used.

Microgrids become much more appealing if you expect the power bridge duration to last years rather than months or if you have additional power-related concerns beyond the bridge power need, such as reliability and cost. If your site is in the ERCOT or PJM region, the microgrid can be used not only to back up the facility (helping to reduce the lost revenue from an outage), but also to generate revenue or reduce price volatility risk.

Spotlight on carbon intensity

If carbon intensity is a primary focus, it is important to look at the current and projected carbon intensity of the grid to assess the long-term environmental impact of your options. The abundance of coal-fueled power plants in an area like West Virginia drives a higher CO2e than an engine-driven solution. However, drawing power from the grid is less carbon-intensive in states like Pennsylvania and Texas.

Figure D: Carbon intensity of grid subregions and states



Think beyond bridge power

Grid constraints will likely continue to create challenges for oil and gas companies for the next several years. As you explore bridge power solutions to speed up your project timeline, it's essential to consider each option's long-term impacts and opportunities.

Microgrids can deliver long-term resiliency and cost advantages, and there are ways to ease the complexity of managing your own mini power plant. Working with a partner that can provide the upfront capital, offer energy management expertise and take on the task of installing, operating and maintaining the microgrid can turn a challenge into an opportunity.

If you're exploring ways to meet your bridge power needs, RPower's energy experts can help you evaluate your options. Contact us to set up a meeting.

Ryan Rudnitzki
Senior Vice President of Sales – Energy
+1.414.588.6252
ryan@rpower1.com

About RPower | Founded in 2021, RPower is a power generation company focused on prime and backup power generation solutions. RPower specializes in providing power generation to companies with mission critical loads; with a focus on serving energy intensive business including the Data Center and Oil & Gas segments. The RPower team of analysts and engineers has a proven track record in the electric power industry serving large industrial customers and utilities with power generation project development, asset operations, asset optimization, project financing, and retail energy. RPower is well capitalized and backed by I Squared Capital based in Miami, FL.