

WHITE PAPER / OIL AND GAS

THE BUSINESS CASE FOR ELECTRIFICATION OF THE OILFIELD

BY Dana Steph

Oil and gas production and delivery to midstream refiners consumes significant amounts of energy. The costs associated with this energy routinely rank as a top lease operating expense (LOE) for operators, which offers a significant opportunity for savings.



Energy-related costs for oil and gas production and delivery to midstream refiners typically rank among the highest lease operating expenses because of on-site generation and utilization of equipment fueled primarily by diesel or natural gas.

As producers look for options to reduce costs, energy-related LOEs offer a hidden opportunity for significant cost savings through conversion to electrical power or improvements to existing electrical infrastructure.

Reducing LOEs can often be accomplished while achieving other benefits, such as reductions in greenhouse gas (GHG) emissions, improved resiliency and all-around de-risking of operations. As we explore the factors driving the shift to electrical energy sources, key attributes of areas capturing the greatest value and benefits justifying electrical conversion can be identified.

WHY NOW?

Producing and bringing hydrocarbons to market is no easy task. Because oil and gas reserves are often in remote locations with minimal existing power delivery infrastructure, producers frequently must develop temporary solutions to solve these challenges as quickly as possible. Temporary fixes often become permanent solutions. This is an approach that has worked but it comes with unintended consequences and often creates

high LOE, delivers questionable reliability and develops negative environmental impacts.

The status quo of deploying temporary power options is often considered a cost of doing business. However, significant downward pressure on oil and gas markets challenge producers to think outside the box to reduce costs and improve the market's perception of their environmental stewardship.

The oil field has changed significantly over the last decade. Horizontal well drilling and technology advances drive bigger well pads, requiring more water handling and central facilities, all resulting in increased energy consumption. Acreage positions are changing as companies work to consolidate their operations. Finally, public and investor demands have driven nearly every company to develop and publicly state a commitment to environmental, social and governance (ESG) principles.

Energy consumption and load density are huge drivers behind the economics of electrification. With concentrated and sustained loads, it becomes easier to justify long-term investment in the infrastructure required to distribute power. Nearly every piece of equipment used in oil and gas production is available in an electric option or is already electric powered by on-site generators fueled by diesel or natural gas. Once a well is completed, electricity can be used to power well pads including enhanced oil

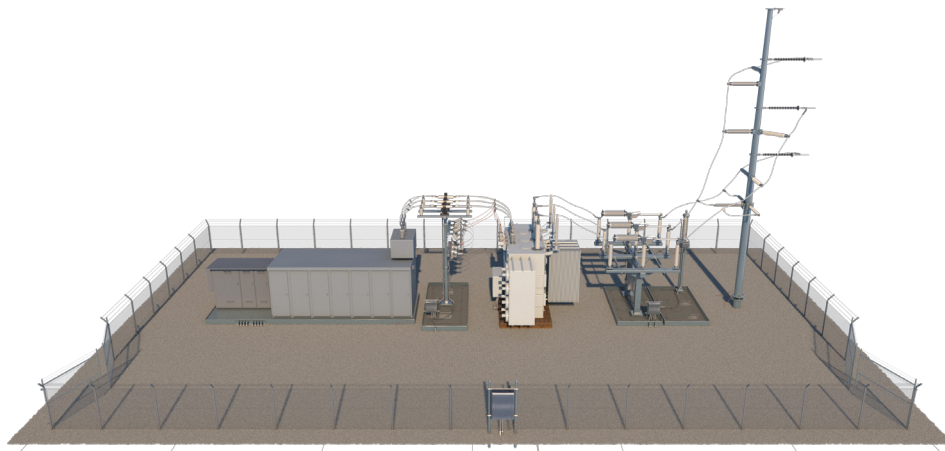


FIGURE 1: In response to the flexibility and mobility requirements of oil and gas development, Burns & McDonnell has developed a modular substation represented by the graphic shown.

recovery equipment such as electric submersible pumps (ESPs). As well pads advance to include multiple wells per pad, and laterals increase in distance, power requirements steadily increase during production.

To understand the potential for electrical power consumption, the business case is established by examining data gathered from the source — oil and gas producers using electricity to power facilities. Based on the response, it becomes clear that power usage varies greatly, driven by the characteristics of the basin and the size/scale of production facilities. No two basins or producers are created equally. So, what is the typical electrical load at each facility? The data reported the following (dynamic) load range:

- Well Pad: 0.25 MW–2.5 MW
- Central Delivery Point (CDP): 15 MW–35 MW
- Water Handling: 0.5 MW–10 MW
- E-frac: 25 MW
- Gas Processing Plant: 5 MW–15 MW

Understanding the specific power requirements for equipment is key in establishing the right approach to electrification. The concept of using electricity to power oil and gas equipment is not new. Electric grid power has long been one of the most cost-effective sources of energy (assuming the capacity and infrastructure exist). Given the often volatile state of the market, the economics behind investing in existing electrical infrastructure upgrades and/or converting to electrically driven equipment is often a value-added proposition.

JUSTIFICATION

Justifying major investments demands a customized approach for many producers. The long- and short-term value of decisions, especially when considering non-core infrastructure, must be presented and defended to get buy-in from stakeholders.

Across the industry, producers are making significant investments in electrical infrastructure. Although the primary justifications as reported by producers vary, the reasoning can be summarized into three major categories:

- Environmental, social and governance (ESG) benefits/greenhouse gas (GHG) reduction

- Resiliency/de-risking
- Economics

The categories identified above include both tangible and intangible components. In all cases, the combination of factors fully justifies the investment in electrical infrastructure solutions using a case study, specific to each producer, that resonates with those invested in the success of the company.

ESG/GHG

Driven by a new wave of socially driven investors, 2018 brought a new way of thinking to the market, catalyzed in part by Larry Fink, CEO of \$7 trillion investment firm BlackRock. BlackRock publicly stated the company would henceforth only invest in companies that truly understand the societal impacts of its business activities. As a result, major institutional investors began analyzing ESG data quantifying environmentally responsible policies on climate change, water management practices, global supply chain management and worker health and safety, among other metrics.

Oil and gas companies immediately went into action and reacted quickly with increased transparency on ESG reports and policy commitment statements. Even with such commitments, investors remain wary and demand action.

The ESG implications of electrification are straightforward. Conversion from inefficient, diesel and/or field gas motors and generators to electrically driven systems will substantially reduce GHG emissions. In addition to the tangible benefits of reduced environmental remediation costs and lower LOE, intangible benefits include:

- Ability to attract investors and investment capital.
- GHG reduction supporting air permitting (thus creating head room for core drilling activities).
- Operational efficiency.
- Added flexibility to develop and distribute power in the form of large-scale generation using field gas (reducing flares), renewables or other alternative power sources.

RESILIENCY/DE-RISKING

A surprising result was the overall added resiliency and de-risking of operations realized when converting to electrically driven systems. The conditions required to achieve this result are as follows:

1. A reliable power source is available or can be created.
2. Producers have solutions for “behind the meter” infrastructure (versus a direct utility connection).
3. Electrical infrastructure was built to a highly reliable standard.
4. Producers properly maintained electrical infrastructure and had a plan for restoring power in the event of an outage.

Producers consistently noted improved uptime resulting in the ability to consistently meet quarterly production goals. Furthermore, most reported decreased maintenance on field equipment (electrically driven vs. fuel driven) and significantly reduced maintenance costs of ESPs.

The intangible benefits:

- Improved ability to deliver consistent quarterly results — many reported 98%+ uptime.
- Added ability to control the outcome when building electrical infrastructure behind the meter.
- Improved remote monitoring and control capability.

The tangible benefits:

- Improved reliability and lifespan of equipment.
- Reduction in vibration induced failures.
- Reduction of production deferment.

ECONOMICS

For companies who prefer avoiding investment in non-core assets without a clear return on investment (ROI), there’s good news. In many — if not most — cases, the economics are very favorable.

To illustrate the potential for ROI, consider the following analysis based on a case study completed in the Permian Basin for a greenfield development.

The study evaluated the potential for cost savings by accelerating electrical infrastructure and eliminating the use of on-site rental natural gas generators. To determine these savings, a baseline power usage was established based on a forecasted drilling and production schedule. To simplify the evaluation, an average electric rate (\$/MW) was established for on-site generators and equivalent grid power. Once the raw power costs savings were calculated, the cost of electrical infrastructure required to electrify well pads and facilities was subtracted to determine the total potential savings.

$$\text{Savings} = \text{On-Site Generation Cost (Rental+Maintenance+Fuel)} - \text{Equivalent Grid Power Cost} + \text{Electrical Infrastructure}$$

	3-Year Summary
Cumulative Operating Load (MW)	25 MW (Year 1) ramping to 500 MW (Year 3)
On-Site Generation Cost	\$163 million
Equivalent Grid Cost	(\$42 million)
Electrical Infrastructure Cost	(\$54 million)
Savings	\$67 million, or 41%

In this case, the producer developed an electrical infrastructure solution for everything behind the utility’s primary meter entrance (PME). Utilities bill customers based on both consumption of power and rate tariff schedules. The calculation of the bills and discounted rate availability varies by region, but in many cases, large power users who develop their own infrastructure to connect to the grid capture additional savings related to their electric rates. In the case study, rate savings are included as part of the calculation.

Results: Using conservative assumptions, the study showed the potential for 40%+ savings over a period of three (3) years when connecting to electrical power.

The tangible benefits:

- Decreased maintenance costs based on a reduced number of diesel/natural gas consuming engines and the simplicity of electric motor maintenance.

- Grid power cost discounts (based on usage and infrastructure).
- Reduced cost of power (on-site generation vs. grid power).

In this specific situation, the tangible economic benefits alone pop off the page. The producer also capitalized on ESG messaging and overall resilience and de-risking of its system.

No producer or basin is created equally. But given the right conditions, the potential benefits of electrification make it worth exploring. The sections below identify key considerations when evaluating your own potential for savings.

IS ELECTRIFICATION RIGHT FOR ME?

Good question. In some cases, there will be insufficient electric load relative to the infrastructure cost. Simply put, the numbers do not work out. In these instances, keep doing what you're doing. Where there is the potential for significant load, the opportunity is likely high.

To determine the opportunity, a detailed study is required to understand specific load requirements, identify potential power source(s) and develop the electrical infrastructure plan required to connect the load with the source. Getting started, consider basin, load, power source and acreage position:

Basin: Your electrification strategy shouldn't be the same for all regions. Evaluate the basin. What electrical infrastructure exists? Is the existing infrastructure adequate? How much power is required to produce and deliver oil and gas? Some basins have a well-developed electrical network with plenty of capacity to connect new wells on a moment's notice. Others are more remote and have less existing infrastructure, which requires more upfront investment. The business case for electrification exists in many scenarios, but solutions vary dramatically.

Load: Start by identifying the facilities to convert or build utilizing electrical power. Develop a load list with

the peak demand and sustained energy requirements. Generally, the larger and more sustainable the load, the greater the potential for long-term savings using electrical infrastructure.

Power source: A good starting point is to identify nearby electrical infrastructure such as substations, high-voltage transmission lines and an adequate distribution system. The farther away you are, the higher the cost in developing electrical infrastructure. Although proximity is a material consideration, it doesn't necessarily dictate the outcome of project economics nor does it mean there aren't other electrification options to consider (such as a microgrid). Keep in mind, even with electrical infrastructure nearby, there may not be adequate capacity available. A grid study is required to identify interconnection potential and may result in a list of utility upgrades required to support the new load(s).

Acreage position: A contiguous acreage position with high well/facility density is the most economical model for most oil and gas infrastructure. Intuitively, electrical infrastructure is no different. High electrical load requiring minimal infrastructure is an ideal candidate for electrification.

There are a lot more considerations to electrification than pure economics. When considering an approach, identify the overall key drivers supporting the need for alternative power solutions: Reliability? GHG reduction/ESG? Long-term planning?

The ideal candidate for electrification likely includes some combination of ESG, contiguous acreage positions, significant loads consisting of wells and facilities with wells utilizing long-term power and an identified need to improve resiliency of the system.

WHAT ARE THE TRAPS?

Let's face it: Electrical solutions are not a core business focus for most producers. Energy consumption is a cost of doing business that hits the bottom line, yet energy is often an afterthought until there is a significant event or disruption to the system.

To maximize the benefit of an electrification strategy, you have to do it right, especially when the producer chooses to own/operate/outsourcing a distribution system behind the PME. In working with producers on various electrification strategies, a deeper understanding of potential pitfalls has been gained. These pitfalls include:

- Inexperience and the inability to properly plan and lay out the system.
- Failure to properly design electrical infrastructure. In some cases, producers have pulled together undersized poles and light-duty crossarms, resulting in catastrophic performance during weather events.
- Improper maintenance. While properly built electrical infrastructure is highly reliable with little maintenance, it is still important to routinely maintain the system and develop contingency plans for outage and scheduled maintenance.

To avoid the traps and realize the full benefit(s) of electrification, verify that you have the resources necessary to plan, design, construct, operate and maintain the system.

GETTING STARTED

The following are steps you can take to identify if electrification is a good strategy for your business:

1. Consider your corporate short-term and long-term strategies to identify the primary objectives of electrification.
2. Go through the key considerations listed in the “Is Electrification Right for Me?” section.
3. Run an economic value analysis to determine if electrification is a viable strategy.
4. Engage resources specializing in grid and power planning consulting.
5. Determine the optimal approach to design, build and operate an electrical system. (Note: It is critical to get this right as it will pay dividends in the long run. Failure to get this right will result in reliability issues, increased maintenance and shortened life span of the system.)
6. Develop a strategy to own and operate the system or look for alternative solutions.

No matter the stage of production within a given basin, it’s never too late to consider electricity as an option, whether you are in a greenfield development or existing oilfield conversion.

Electrification offers significant previously hidden benefits to producers, including the ability to lower LOE, de-risk operations and provide ESG opportunities. Let’s get started.

BIOGRAPHY

DANA STEPH is business development director for the Transmission & Distribution Group in Houston for Burns & McDonnell. As a professional engineer, his background includes the engineering and project management for a variety of transmission and distribution projects and clients nationwide. Successful in both business development and project management, Dana has continually expanded business and led the way to developing several customers into core clients.

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