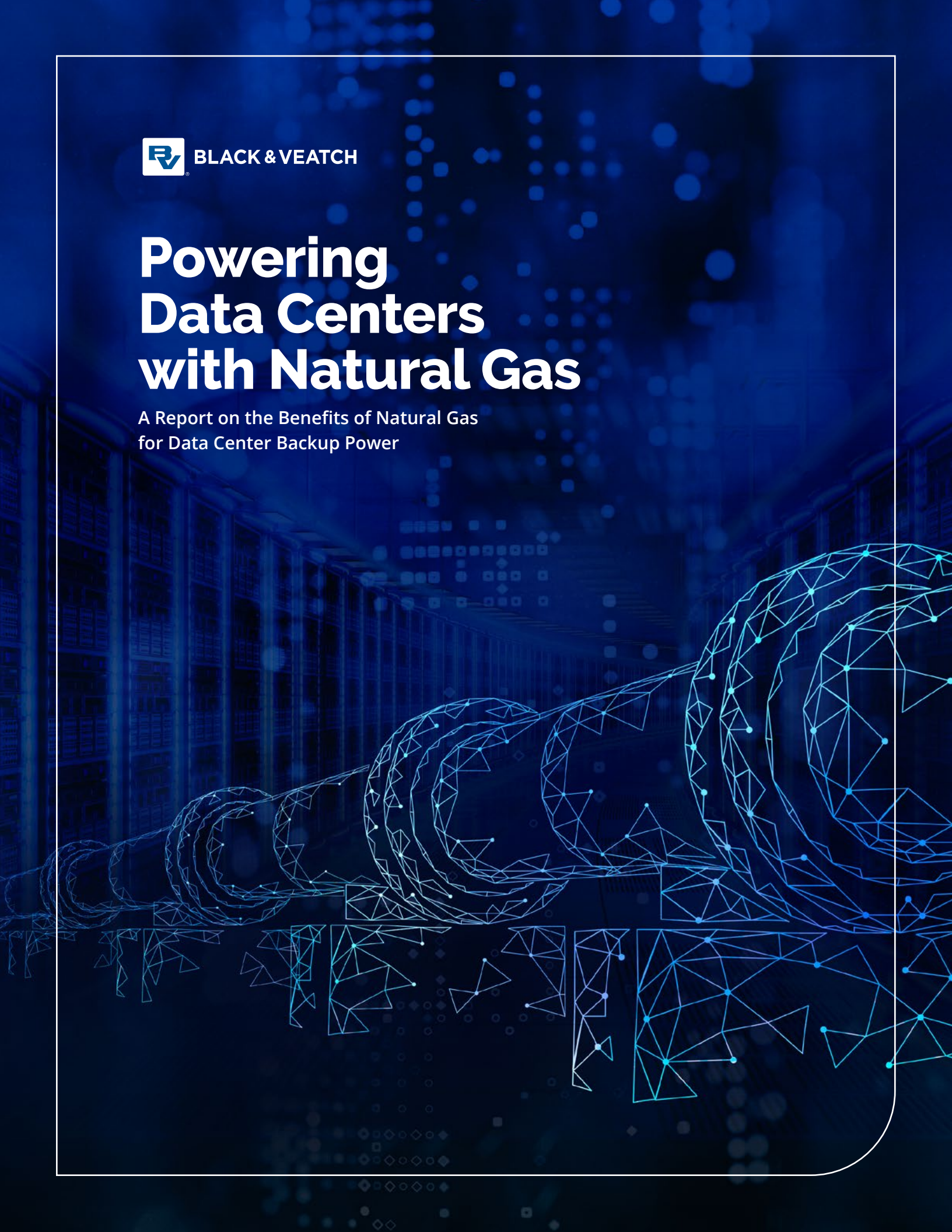




Powering Data Centers with Natural Gas

A Report on the Benefits of Natural Gas
for Data Center Backup Power



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Introduction

Data Centers are becoming more dynamic, reaching monumental scale in both size and complexity, and achieving record levels of power usage. As these data superusers approach zero tolerance for outages, they're calling for resilient and sustainable power solutions. Reliable emergency backup power is critical to maintaining today's standard for 100% uptime.

Avoiding the monetary and reputational risk of service outages is a top priority, and evaluating every option for emergency backup power is simply smart sense. Advances in generator technology make natural gas generators an attractive option to achieve both continuous power and corporate sustainability commitments. Natural gas is reliable, accessible, clean, and when connected to the grid, excess energy can even be a revenue source to offset some of the operational and maintenance costs. For the right data center, natural gas generation is worth investigating as an alternative solution to diesel.





Natural Gas Allows Data Centers to Embrace Sustainability without Losing Reliability

Realizing the environmental impact of their power-intensive data centers, the industry is keen to enact green strategies. Many providers equate wind and solar power purchase agreements with clean energy policy, but data centers should not overlook the sustainability potential of their backup power.

Data centers' reliance on emergency generators is universal, since on-site generation significantly reduces the risk of long-term power outages. Today, data centers must anticipate increasingly frequent and intense weather events, even as many electric utilities are upgrading their infrastructure to improve reliability and resiliency. Diesel generators have traditionally been the go-to option, but it may be time to rethink this strategy. Natural gas is one of the cleanest fossil fuels and can be an excellent backup power choice for companies who value green alternatives. Natural gas for emergency backup power offers some unique advantages.

Permitting

Permitting requirements, including emission standards, are frequently a limiting factor for large-scale data centers. Data centers equipped with natural gas engines may be more successful in obtaining air permits than those equipped with diesel generators. The lower emissions profile of natural gas engines also means data centers can typically provide greater backup capacity before ambient air quality exceeds local standards. Current Federal Environmental Protection Agency rules also allow natural gas-powered generators to operate for longer periods of time.

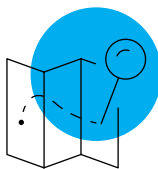
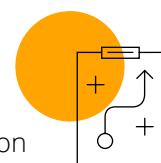
Accessible

Natural gas is delivered through pipelines on demand, which allows data center managers to closely control their supply and budget. Natural gas supply and delivery are extremely reliable, since pipelines are typically underground and protected from the natural elements, although human error or natural disaster induced disruptions sometimes occur. The natural gas pipeline system comprises of a huge network of pipelines, so many pathways are available to transporting gas from one point to another. As the gas supply becomes more interconnected and diversified, the impact of disruptions decreases. Diesel generators, on the other hand, require fuel to be trucked to data centers and stored on premise. To replenish diesel supplies, data centers rely on local shipping and distribution, which can be compromised by external factors including bad weather, labor shortages, equipment malfunctions, etc.

Economical

In many places, natural gas is less expensive than diesel fuel. In markets where electricity costs are higher, like California, New York and New England,¹ locally-generated power, like natural gas, provides reliability, control, and protection over electricity rate hikes.

¹ Administration, U.S. Energy Information. (2020). State Electricity Profiles. March 23, 2020. <https://www.eia.gov/electricity/state/>.





3 Ways Natural Gas Generators Offer Economic Advantages for Data Centers

In addition to the sustainability benefits, there are three main factors dictating whether on-site natural gas generation offers economic advantages over diesel: supply costs, availability of mission critical generators and cost benefits.

1 Supply Costs – Natural gas prices are stable and typically less than diesel. So, although natural gas has a higher fuel burn rate than diesel fuel, i.e., you use a higher volume of natural gas, the lower cost of fuel still allows data center operators to save 38 to 45 percent of the cost to generate the same amount of electricity (kwh) vs diesel.² This cost efficiency would be especially beneficial to hyperscale facilities requiring many large generators.

2 Availability of Mission Critical Natural Gas Generators – Until recently, it could be challenging to find natural gas generators that were suitable for data centers in terms of speed, size or availability. Now there are numerous manufacturers building fast-start natural gas generators that power up in 10 seconds time for emergency systems. Natural gas generators can be provided in similar kW sizes to their diesel counterparts, and are typically designed with the same “N” redundancy requirements.

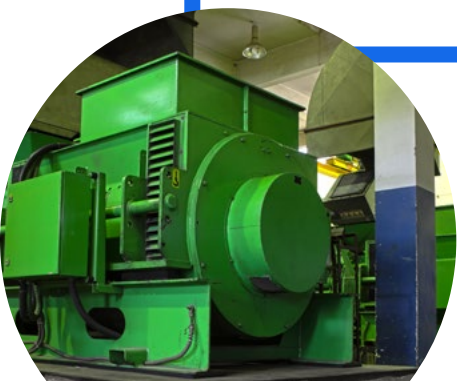
3 Cost Benefits – Utility-connected natural gas generator systems designed for both emergency backup use and to support regular operations can monetize stranded assets when running parallel to the grid and in island mode. Depending on the market location (including region, utility and local regulations), generator sizes and quantities, data center managers might be able to:

- Sell excess power into energy, capacity, or spinning reserve wholesale power markets
- Use backup generation to peak shave and reduce demand charges
- Provide grid emergency response services³

While these types of operation methods can change the permitting requirements, using natural gas generators can be cost effective in the right conditions.

2 Sean Ericson and Dan Olis. (2019). A Comparison of Fuel Choice for Backup Generators. Joint Institute for Strategic Energy Analysis. Denver, CO: National Renewable Energy Laboratory (p. 27).

3 Sean Ericson and Dan Olis. (2019). A Comparison of Fuel Choice for Backup Generators. Joint Institute for Strategic Energy Analysis. Denver, CO: National Renewable Energy Laboratory (p. 22).



Is Natural Gas Right for You? Key Questions to Consider

Conducting a site assessment is the critical first step to decide if it's right for your data center and begin the transition to natural gas.

- 1** What is the size of the Data Center?
- 2** Is natural gas available?
- 3** How old are my current back up generation assets?
- 4** What is the utility tariff structure or net metering policy?
- 5** Is the site conducive to natural gas?
- 6** What are the permitting requirements?



Fueling the Future

Key Decision Criteria for Selecting Natural Gas

On-site natural gas generation may not be the right choice for every data center, but it is certainly worth a fresh look. Tech giant Microsoft made the extraordinary choice to fully rely on natural gas for backup generation in a Cheyenne, Wyoming pilot project.⁴

How do you know if natural gas generators are right for your data center? First consider your location. The installation, operation and maintenance costs are highly dependent upon regional energy costs, pipeline access, regulations and ability to recoup costs through revenues. Weighing these factors, along with your sustainable goals will be a good indicator on whether to move forward. The desire to reduce carbon footprints may outweigh some of these economic factors.

For retrofits, it is also important to assess the existing data center site conditions and backup generation equipment. For example, if diesel generators are in good condition with many useful years left, it may not be worth replacing them with natural gas yet. However, if the data center team is uncomfortable with the reliability of the existing systems or there is insufficient redundancy from multiple sources of power, augmenting the diesel system with natural gas backup may be worth investigating.

⁴ Chansanchai, Athima. (2016). [www.microsoft.com](https://news.microsoft.com/features/as-datacenters-grow-micro-softs-innovative-approach-invests-in-more-clean-energy-to-power-them/). November 14. <https://news.microsoft.com/features/as-datacenters-grow-micro-softs-innovative-approach-invests-in-more-clean-energy-to-power-them/>.

The advantages and disadvantages of natural gas and diesel for backup generation are comparable, with natural gas having a clear advantage of being a cleaner fuel than diesel.



Natural Gas
Generation System

VS



Diesel
Generation Systems



NATURAL GAS

- Burns cleanly with low emissions of carbon dioxide and nitrous oxide
- Costs less to generate the same amount of electricity (kwh) than diesel
- No odor during normal usage
- Higher potential for successful air permit approval
- Less noise pollution
- Fuel stored in pipelines and readily available, on demand
- Low chance of supply disruption
- Increased reliability for areas prone to long power outages
- Ability to monetize

PROS

DIESEL

- Higher power density
- Fast start rate
- Fuel is stored on-site to refuel quickly, as needed
- Proven technology and experienced maintenance staff

NATURAL GAS

DIESEL

CONS

- Must have access to natural gas pipeline
- Natural gas has a higher fuel burn rate
- Potentially higher capital costs
- Slower start rate than diesel, but still meets the 10-second startup time required for emergency backup ⁵

- Fuel must be treated and stored
- Fuel is only usable for up to 24 months
- Temperamental in wet conditions, may lead to wet stacking when unburned fuel enters the exhaust system
- Emits more sulphur, nitrogen oxide and carbon dioxide when burned
- Higher noise pollution
- Limited fuel storage based on space available

⁵ Generac. (n.d.). Natural Gas Performance. Retrieved from <https://www.generac.com/Industrial/all-about/natural-gas-fuel/natural-gas-performance>





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Ignite

Your Backup Power

The vision of a more sustainable and clean data center is achievable. Natural gas offers an alternative solution to data centers looking to make an environmental impact and make their mark as a leader in energy innovation. When considering natural gas, it's important to understand a data center's current power infrastructure, availability of natural gas and the local electric utility environment.

Black & Veatch is an employee-owned consulting, engineering, procurement and construction company with a 100-year legacy of critical infrastructure innovation. We deliver planning, architecture, engineering and construction of data center solutions. When it comes to power, our expertise reaches across the energy spectrum including generation, transmission, distribution and battery storage. Our experience in natural gas led us to successfully design a natural gas generator backup power system for a data center. Contact us today to conduct a site assessment or learn more about developing a natural gas generator system for your data center.