



# Changing the game for oilfield drilling

Our oilfield power generation engines provide the flexibility you need, the cost advantages you expect, and an EPA mobile certification that helps you win in oil and gas operation



## The North American oil and gas industry

Oilfield technology such as horizontal drilling and hydraulic fracturing has unlocked record supplies of natural gas in North America and pushed gas prices to a 10-year low. As a result, producers are actively promoting natural gas as a low-cost, cleaner burning means of fueling vehicles and equipment. Lately, associated gas and transported LNG or CNG are being used to power drilling rigs and other oilfield production equipment. This trend to make natural gas a fuel of choice has drastically reduced fuel costs and cut greenhouse emissions.

### Focused on the challenge

With the growth of unconventional development, remote oilfield power has become critical for reliable operations in the oil and gas industry. The rising price of diesel and the intense focus on reducing emissions have contributed significantly to the increased operating costs of exploration and production.

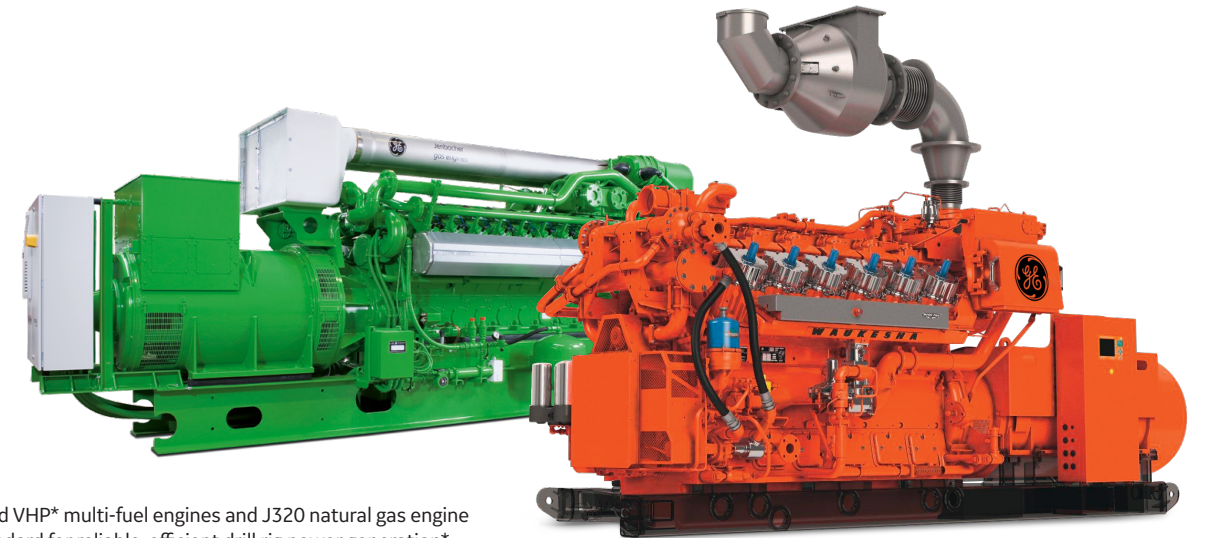
### Setting the new standard for reliable, efficient rig power

The mobileFLEX portfolio is the latest advancement from GE to deliver lower-cost, lower-emission power to drill rigs, artificial lift-enhanced oil recovery, and oilfield equipment. An all-gas alternative to diesel units, mobileFLEX is an EPA mobile-certified solution that provides a cost advantage to energy producers and an operational advantage to drilling contractors by using natural gas.



## Generate power with field gas-powered operations

- Lower fuel costs up to 80 percent compared to diesel
- Lower emissions up to 95 percent compared to diesel
- Operation on LNG, CNG HD-5 propane and high-BTU field gases with little gas treatment
  - Natural gases 950-1650BTU/ft<sup>3</sup> HHV without component changes
  - Propane gas 2606 BTU/ft<sup>3</sup> HHV without component changes
- Application flexibility in high altitudes and high temperatures
  - Up to 8,000 feet (2,400 m) with no derate. Higher altitudes available
  - Up to 105 F (40 C) with no derate. Higher temperatures available



The EPA mobile-certified VHP\* multi-fuel engines and J320 natural gas engine are setting the new standard for reliable, efficient drill rig power generation\*

### Framework requirements

MobileFLEX gas engines require approximately the same footprint as diesel engines. Drilling contractors can retrofit to natural gas engines with no compromises.

Our flexible solutions include:

- Bare engine
- Generator set with skid
- Total package with electrical balance of plant
- Weatherized packages

### Certified to win

The mobileFLEX portfolio is certified by the U.S. Environmental Protection Agency (EPA) for mobile applications running on variable BTU field gas, LNG and propane. This certification allows mobileFLEX engines to move from site to site without re-permitting while meeting the EPA emissions requirements for mobile gas-powered engines.

\*Trademark of General Electric Company

## GE's gas reciprocating technology advantages... an ideal transition from diesel power

For oilfield power generation applications such as drilling and enhanced oil recovery, GE offers both lean burn and rich burn combustion technology to advance your operational efficiency.

### Lean burn characteristics

GE's lean burn J320 increases efficiency on high-quality field gas, LNG and CNG. Lean burn combustion achieves low emissions without after-treatment and without sacrificing efficiency. Users can maintain diesel-like load capability through the use of a load bank.

- Lean burn delivers diesel-like load acceptance with load banks
- Low engine-out NO<sub>x</sub> levels – No catalytic after treatment needed for a NO<sub>x</sub> requirement  $\geq 0.5$  g/bhp-hr (210 mg/Nm<sup>3</sup> @ 5% O<sub>2</sub>)
- Low engine-out CO levels – Generally, no catalytic after-treatment needed for CO if the engine-out level is  $\geq 2.0$  g/bhp-hr (830 mg/Nm<sup>3</sup> @ 5% O<sub>2</sub>)
- Higher power density
- Generally, higher thermal efficiency (higher fuel efficiency)
- Ability to burn biofuels if catalytic after treatment is not needed

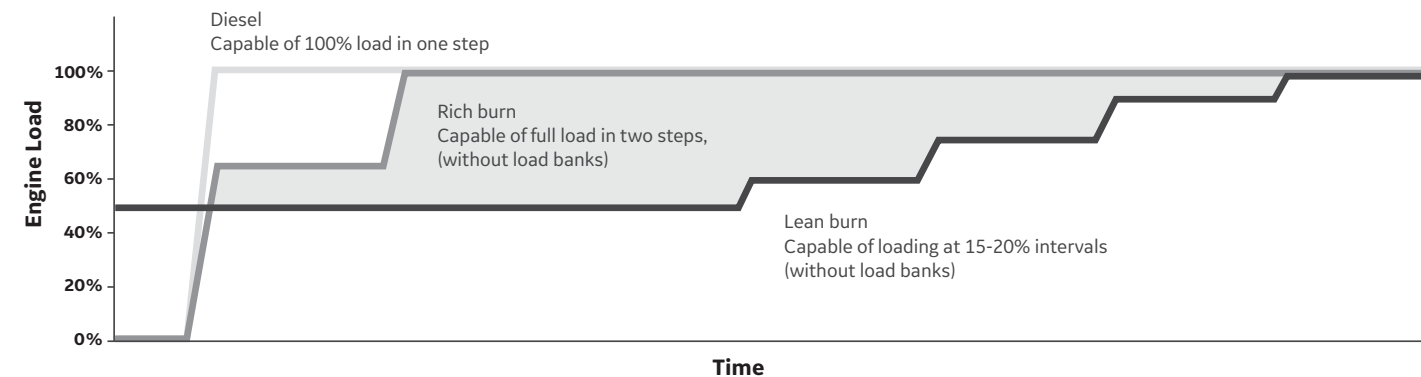
### Rich burn characteristics

GE's rich burn VHP\* engines provide more power on variable quality gases, like high BTU field gas and propane. Rich burn combustion helps achieve ultra-low emissions with a low-cost three-way catalyst and allows operation on a wide variety of field gases without derate. Plus, users benefit from application flexibility in altitude and temperature as well as exceptional transient performance with diesel-like load capability without load banks.

- Up to 65 percent load steps and 100 percent load shed
- Exceptional fuel tolerance with more power on high-BTU field gases
- Emission control with low-cost three-way catalyst
- Low engine-out NO<sub>x</sub> levels – System capable of meeting customers' needs  $\leq 0.5$  g/bhp-hr (210 mg/Nm<sup>3</sup> @ 5% O<sub>2</sub>)
- Low engine-out CO levels – System capable of meeting customers' needs  $\leq 2.0$  g/bhp-hr (830 mg/Nm<sup>3</sup> @ 5% O<sub>2</sub>)
- Reduces dependence on diesel fuel

### Typical loading capabilities operating in island mode – natural gas unique capability

In all, mobileFLEX is the ideal option for oilfield power generation.



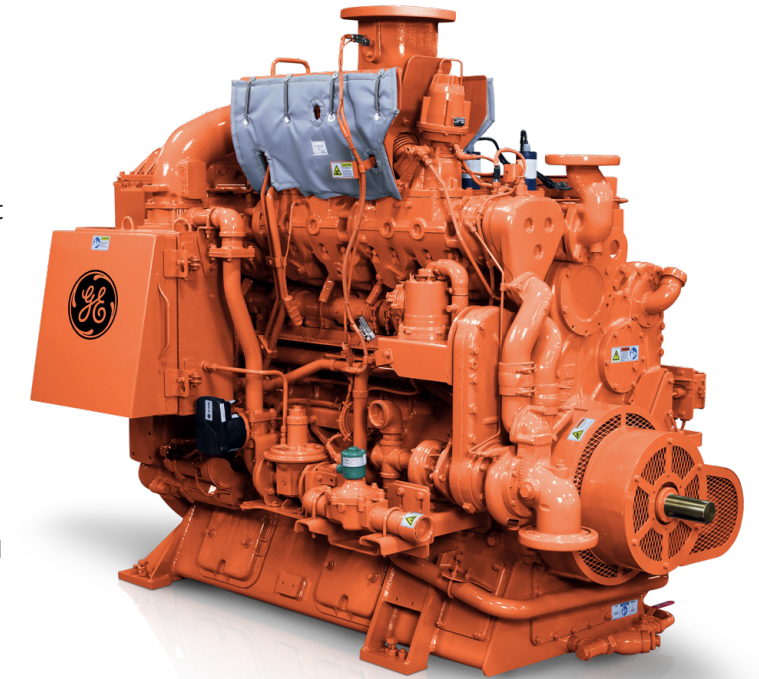
Pipeline quality natural gas ISO standard conditions

## Distributed power gas engines – Mobile oilfield power generation product overview

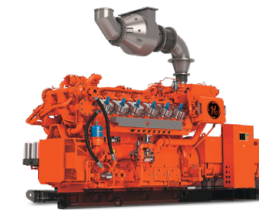
GE's gas engines are redefining oilfield power generation in drill rig and production power applications with a non-road EPA mobile-certified solution that provides diesel-like performance, fuel flexibilities to run on natural gas including field gas, and low emissions output for excellent engine performance.

- **Operation** runs and provides power like a diesel without the cost of diesel fuel
- **Flexibility** provides reliable, proven fuel flexibility across a wide BTU range
- **Emissions** lowers emissions, compared to diesel
- **Mobility** is non-road mobile-certified by the EPA
- **Power** maintains consistent power output across changing field conditions

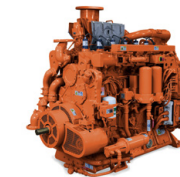
The VGF mobileFLEX engines are also certified for varying speed operation for mobile, gaseous-fueled applications that are non-power generation. This could include applications like mobile air & gas compression.



mobileFLEX  
J320 - 1.1 MW



mobileFLEX  
VHP5794 & 7044  
1 – 1.25 MW



mobileFLEX  
VGF F18SE & H24SE  
300 – 400 kWe

## GE's oilfield power generation package



Reciprocating  
engines



Balance of plant



Services



Complete Installation

## Economic advantages

### Reduced fuel costs

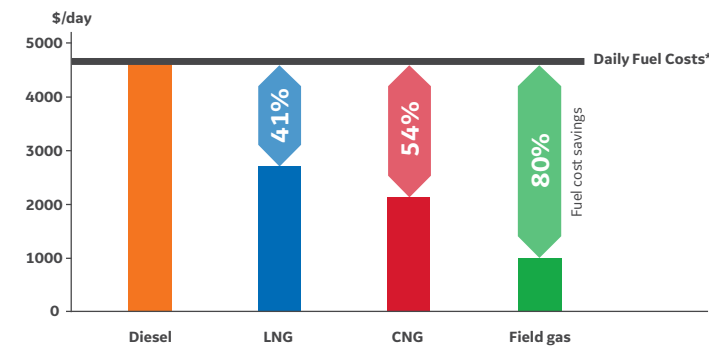
Comparing fuel costs across alternative gas fuels, producers can realize significant savings when using natural gas with a multi-fuel solution that can also run on propane as a backup fuel.

Diesel	\$3.92 per gallon = \$30.45/mmbtu	\$0.186/bhp-hr
Field Gas	\$4.17/mmbtu	\$0.033/bhp-hr
LNG	\$15.00/mmbtu	\$0.118/bhp-hr
Propane	\$2.41 per gallon = \$26.34/mmbtu	\$0.208/bhp-hr
Gas engine fuel	Eff 7881 btu/bhp-hr	
Diesel engine fuel	Eff 6113 btu/bhp-hr	

Source - EIA Short Term Energy Outlook (STEO) dated February 11<sup>th</sup>, 2014

### Diesel-to-gas fuel savings

Gas fuel offers a significant operational cost advantage for producers. The increased availability of field and nearby site gases, as well as LNG and CNG, provides a reliable alternative to diesel fuel for drilling and production. GE's mobileFLEX engines can burn field gas with a wide range of BTU values, offering significant cost savings.



## Cases in point

### J320 gas engine

In southwest Wyoming, a major gas producer has deployed Jenbacher J320 engines to repower a drilling rig using natural gas instead of diesel. In the Jonah field, available site gas allows the producer to capture cost savings and reduce overall site emissions.



### VHP gas engine

A major producer in the Marcellus shale play worked with drilling contractor Patterson UTI to select GE's Waukesha VHP7044GSIEPA gas engines to power several drilling rigs. The three GE gas engines on each natural gas-powered rig provide a flexible fuel solution that runs on rich field gas as well as LNG. Patterson UTI now operates multiple GE-powered rigs with 80 percent fuel savings.



## We are at your service

With a full range of product offerings and a global network of service providers, Distributed Power from GE can help ensure your reciprocating engines or gas turbines run reliably – anywhere and anytime. As a user of GE's Distributed Power products, you can benefit from a comprehensive portfolio of service offerings that can reduce your maintenance costs and help ensure the availability of your equipment.

### Higher asset availability with advanced technology

Our Conversion, Modification and Upgrade (CM&U) offerings provide several performance improvements in reliability, availability, maintainability, efficiency, performance, emissions reduction and safety. Additionally, GE Asset Performance Management software solutions powered by Predix\* solutions harness the power of the Industrial Internet to lift existing assets to new levels of performance and profitability. The collection of Asset Performance Management software solutions powered by Predix assets provide real-time information to forecast service events, analyze issues, and take proactive steps to achieve your desired operating, compliance and safety outcomes.

### Lower costs, less downtime, and 24/7 global service

You operate your equipment around the clock and around the world, and GE is right at your service. Our Remote Monitoring & Diagnostic (RM&D) technology cuts costs and boosts equipment availability with immediate intervention whenever and wherever you need our help. Additionally, GE's services network is supported by our authorized service providers in more than 100 countries. And when your reciprocating engine or gas turbine reaches the end of its life cycle, we can replace it onsite with a new or overhauled engine or gas turbine, or repower your asset with an original GE unit.

### Versatile service agreements fit maintenance to your needs

GE's Contractual agreements (CSAs) help distribute the costs of major maintenance events across the life of your equipment while reducing risk with customizable performance guarantees. CSAs cost-effectively integrate the latest OEM technical knowledge, a full range of remote monitoring and diagnostics solutions, field service, original spare parts and repairs. In addition, we can protect your investment by improving operational productivity through guaranteed availability and reduced costs.



Full range of service offerings... once it starts, we never stop



## [www.gepower.com/distributedpower](http://www.gepower.com/distributedpower)

GE's Distributed Power business is a leading provider of engines, power equipment and services focused on power generation and gas compression at or near the point of use. Distributed Power offers a diverse product portfolio that includes highly efficient, fuel-flexible, industrial gas engines generating 200 kW to 10 MW of power for numerous industries globally. In addition, the business provides life cycle support for more than 48,000 gas engines worldwide to help you meet your business challenges and success metrics – anywhere and anytime. Backed by our service providers in more than 100 countries, GE's global service network connects with you locally for rapid response to your service needs.

GE's Distributed Power business is headquartered in Jenbach, Austria.

## More information on GE's Distributed Power technology

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## Imagination at work

