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FLARING

Flare to Power

A POWERFUL FUTURE

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Topics Covered

01 BUSINESS OVERVIEW

02 FLARING TODAY

03 ADDRESSING THE PROBLEM OF FLARING

04 CUSTOMER SUCCESS

05 APPENDIX: PRODUCT OVERVIEW FEATURED SYSTEMS

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01 Business Overview

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INNIO - Enabling the Energy Transition in More Than 100 Countries

HARNESSING THE POWER OF ENGINEERING, TECHNOLOGY, DIGITIZATION, AND GREEN FUELS

WELLAND, CANADA
Production Units Manufacturing

WAUKESHA, WISCONSIN, USA
Corporate HQ, R&D, Technology Development, Digital Evolution, reUp manufacturing, and Support Function Hub

JENBACH, AUSTRIA
INNIO Group Headquarters and Power Generation Hub for Research, Technology Development, Digital Evolution, and Manufacturing

Main operating sites

Jenbach, Austria (Headquarters)

Waukesha, USA

Welland, Canada

Delivered Fleet

approx. 55,000 units

~61 GW delivered

Our People

4,000 employees

60 distributors
+ about 40 packagers

3,000+ service personnel
(incl. distributors)

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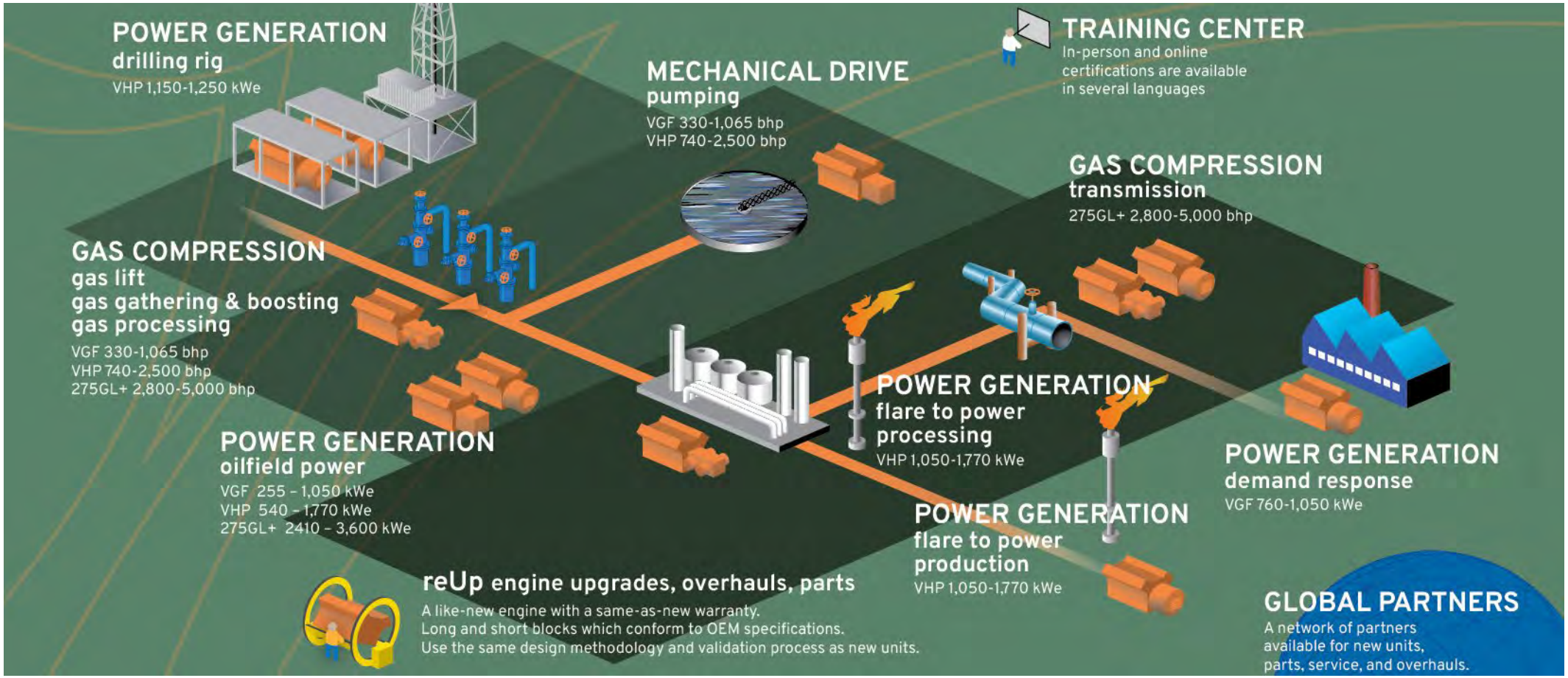
Powering The Worlds Energy Infrastructure

LOW-EMISSION SOLUTIONS TO MEET THE ENERGY CHALLENGES OF TOMORROW, TODAY



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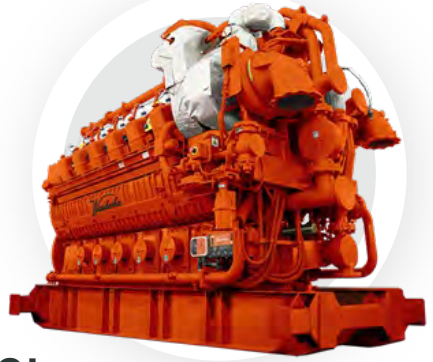
Durability and Reliability – Suited for Demanding Applications

VGF

- Gas compression, power generation, & mechanical drive
- **Output:** 400 - 1,175 bhp (230 - 860 kWe)
- Inline 6 and 8, V12 and V16 cylinder configurations
- **Speed range:** 1,200 rpm – 1,800 rpm
- **Delivered engines: ~6,100**
- Introduced in 1987

VHP

- Gas compression, power generation, & mechanical drive
- Fuel flexible rich- and lean- burn engine
- Outstanding in reliability, durability & efficiency
- **Output:** 740 - 2,500 bhp (540 - 1,770 kWe)
- Inline 6, V12 and V16 cylinder configurations
- **Speed range:** 800 rpm – 1,200 rpm
- **Delivered engines: 18,700+**
- Introduced in 1967



275GL+

- Gas compression & power generation
- Fuel flexible lean-burn engine
- Outstanding in efficiency & emissions
- **Output:** 3,750 – 5,000 bhp (2,410 - 3,600 kWe)
- V12, V16 cylinder configurations
- **Speed range:** 750 rpm – 1,000 rpm
- **Delivered engines: 1,000+**
- Introduced in 2009

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02 Flaring Today

Flaring Today

WHY IS FLARE GAS "WASTED"?

Technological

The infrastructure for capturing and transporting gas is not in place.

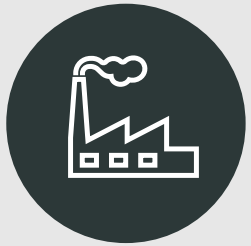
Economic

Marketplace for gas/gas products may be small or non-existent in some areas.

Regulatory

Due to regulations, producers may not have the right to sell gas/gas products due to restrictive production licenses

Operational



Flaring may be necessary during certain parts of production such as during drilling or well testing.

Flaring Today

GAS IS FLARED FOR MANY REASONS AND NOT ALL OF THEM ARE AVOIDABLE

Type of Flaring	Examples
Routine **65-85% of all flaring**	• Oil/gas separators • Gas production that exceeds existing gas infrastructure capacity • Process units such as oil storage tanks, tail gas treatment units, etc.
Safety	• Gas stemming from an accident or incident that jeopardizes the safe operation of the facility • Blow-down gas following emergency shutdown • Gas required for safe and ready condition (purge gas / make-up gas / fuel gas)
Non-Routine	• Irregular (pronounced peaks and lows) gas production profile • Temporary (partial) failure of equipment • Temporary failure of a customer's facilities that prevents receipt of the gas

Routine flaring is the primary target for sustained mitigation initiatives

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Flaring Today

EXPENSIVE AND WASTED GAS

- Flaring: burning waste gas from oil and gas operations, known as flare gas, into the atmosphere
- Harmful for the environment (CH4 emissions)
- Expensive government fines
- Lost revenue opportunities

Equipment KPIs

Maximize Revenue

Low Cost Of Ownership

Minimize Environmental Impact

$82 Billion

Annually in lost gas revenue due to global flaring(1)

The top 12 gas flaring countries flared almost 13 billion cubic feet of gas per day. This amount of energy can power Japan for a year. (1)

$42 Million

Fine for onshore flaring in Nigeria between January and February 2023 (2)

$27.5 Million

Fine to an oil and gas company for flaring violations in the United States (3)

Sources:

(1) (2021) GlobalData: oil-producing countries could lose up to US$82 billion a year due to global gas flaring | Oilfield Technology
(2) (2023) Gas Flaring: FG Imposes N22bn Fine On Oil Firms - Economic Confidential
(3) (2023) Civil Cases and Settlements | Enforcement | US EPA

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Flaring Today

FLARING CONTRIBUTES TO GREENHOUSE GAS (GHG) EMISSIONS

Flaring releases the following chemicals into the atmosphere:

- **Carbon Dioxide (CO_2)[3]** – contributes to climate change and carbon emissions. Remains in the atmosphere for thousands of years.
- **Methane[3]** – Absorbs more energy than CO_2. Global warming potential (GWP) 27 – 30 times higher than CO_2 over 100 years.
- **Other Pollutants** – Such as sulfur dioxide, nitrogen oxides, and particulate matter. Can cause respiratory and other health issues for people living nearby, as well as harm plants and wildlife.

350K Tons

of methane released annually due to flaring[(1)]

28X

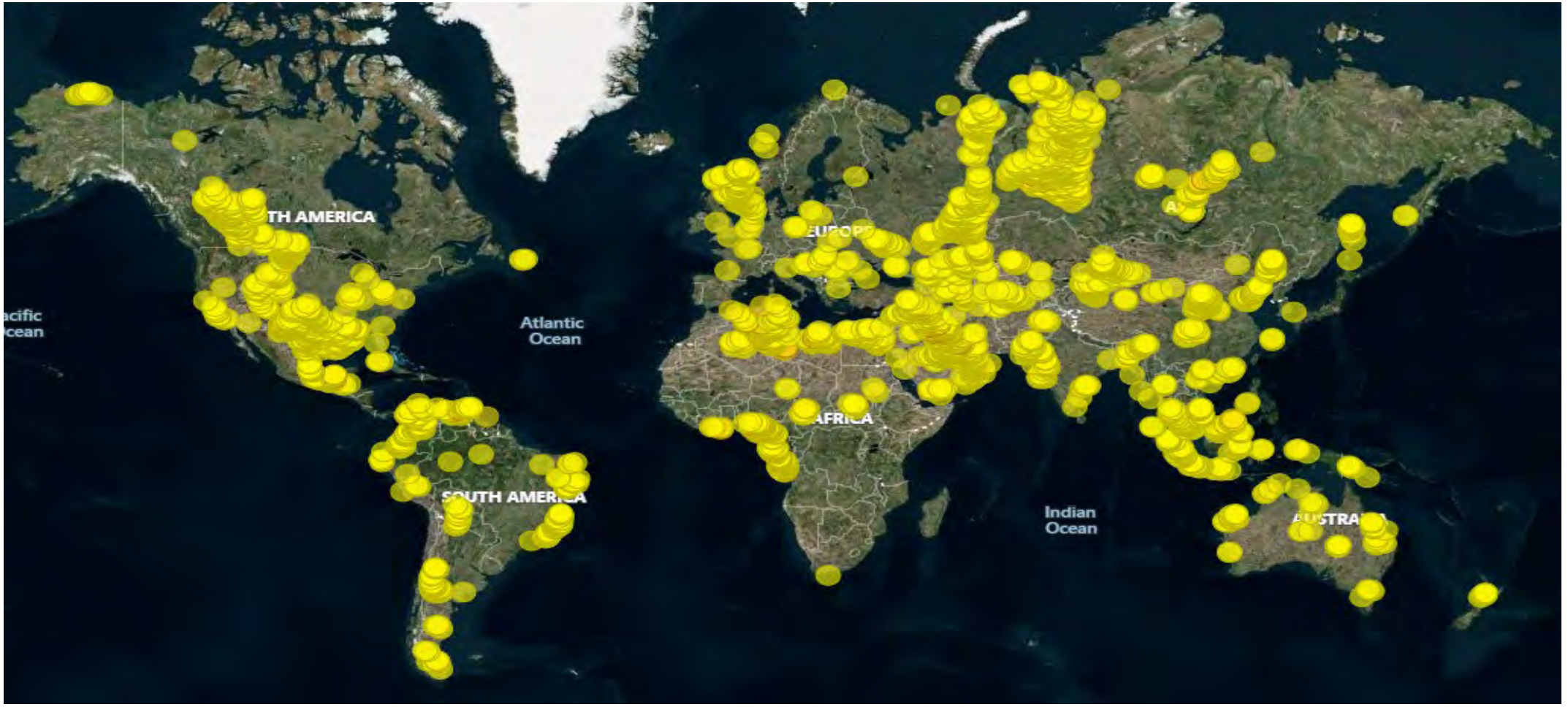
Greater global warming potential for CH_4 versus CO_2 over a 100-year period.[(1)]

5X

Higher actual methane emissions than U.S. EPA estimates, based on 2022 study.[(2)]

Flaring Today

144 BCM OF GAS WAS FLARED GLOBALLY IN 2021 – SAME AS THE TOTAL POWER DEMAND OF CANADA



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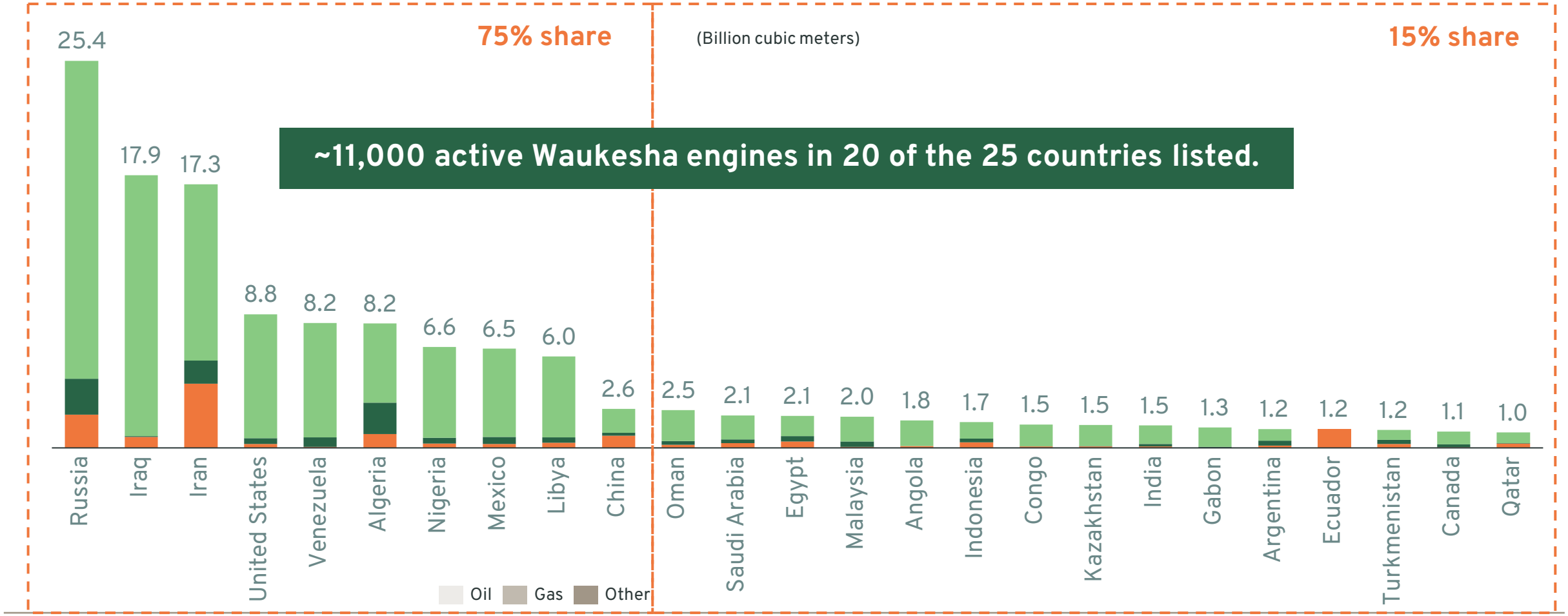
Flaring Today

TOP 10 COUNTRIES ACCOUNTED FOR 75% OF THE TOTAL GLOBAL FLARING VOLUMES IN 2021



Flaring Today

WHAT THE RESEARCH TELLS US ABOUT EMISSIONS | LEAN BURN NATURAL GAS & GAS TURBINES

Colorado State University (2023)[3]

- ARPA-E grant to develop a closed crankcase breather system to eliminate atmospheric venting
- CAT G3512J (1035 hp) lean-burn natural gas engine.
- Open breathers cause this additional methane emission, but it is often not included in methane calculations
- Waukesha closed breather system used on production VHP 12-cylinder engines since 2006

*"According to some estimates, crankcase methane emissions account for **20% or more of total methane emissions** from such engine systems."*[1]
-Gas Compression Magazine, 2022

University of Michigan (2022)[2]

- Looked at flaring across three major U.S. oil and gas basins that collectively represent 80-90% of flaring in the U.S.
- The prevalence of unlit or malfunctioning flares and the finding that average flaring efficiency is only 91% — as opposed to the assumed 98% — point to much more methane being emitted from flaring than previously thought.
- Poor flaring performance is creating excess methane pollution with the same climate impact every year as **three million cars**.

(1) https://gascompressionmagazine.com/2022/02/12/colorado-state-university-and-caterpillar-partner-for-methane-emissions-reduction-project/
(2) New study finds flaring source of five times more pollution than previously thought (edf.org)
(3) https://engr.source.colostate.edu/arpa-e-awards-csu-1-5-million-to-curb-methane-emissions-in-natural-gas-infrastructure/

Flaring Today

POTENTIAL MITIGATION SOLUTIONS | SELL THE GAS BASED ON CAPEX AND PIPELINE AVAILABILITY

Send by pipe

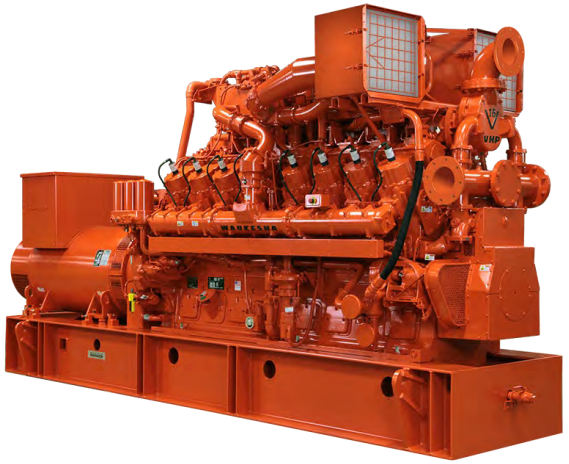
Mitigation solution	Description	Key considerations
Gas export to pipeline	Gas is pre-treated, compressed and sold to a gas pipeline operator with adequate spare capacity	• Availability of gas pipeline nearby • High capex for typically long distances; best for large flares
Gas export to process plant	Gas is compressed and piped to a nearby processing plant	

Send by truck

Mitigation solution	Description	Key considerations
Modular compressed natural gas (CNG)	Gas is pretreated and compressed to be transported on trucks as CNG	• Capex is high and heavily influenced by economies of scale • Any need to separate heavier components further increases capex • Limited transportation distances
Small-scale LNG	Gas is liquefied in a modular liquefaction plant, converted into LNG	

Flaring Today

POTENTIAL MITIGATION SOLUTIONS
UTILIZATION OF FLARE GAS



Mitigation solution	Description	Key considerations
Flare to Power for third party use	Generated power is sold to a grid operator or other off-site off-takers	• Availability of electrical grid infrastructure nearby • Potential consolidation of flare gas supply for enabling economies of scale • Power plant construction, ownership and operation
Flare to Power for on-site use	Generated power is used by O&G field operator to substitute their existing electricity supply either partially or entirely	• Existing electricity prices and PPA • Availability of adequate load • Potential consolidation of flare gas supply for de-risking or (supplemental grid power) • Power plant construction, ownership and operation

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03 Addressing the Problem of Flaring

Addressing the Problem of Flaring

REDUCE EMISSIONS AND MONETIZE THE USE OF FLARE GAS

Lower Emissions

- 1.3 million tons of CO2-equivalent emissions removed annually
- Reduce GHG emissions, as well as VOCs and other regulated pollutants
- Meet government regulations and ESG targets

Utilization of Flare Gas

- Over 200 MW of flare gas to power applications, globally
- Generate power for on-site equipment
- Create new revenue streams.

Fuel Flexibility

- Designed to run on nearly any gas without treatment
- Wide fuel tolerance (700 to 2350 BTU)
- Adjusts to varying fuel qualities without operator intervention.

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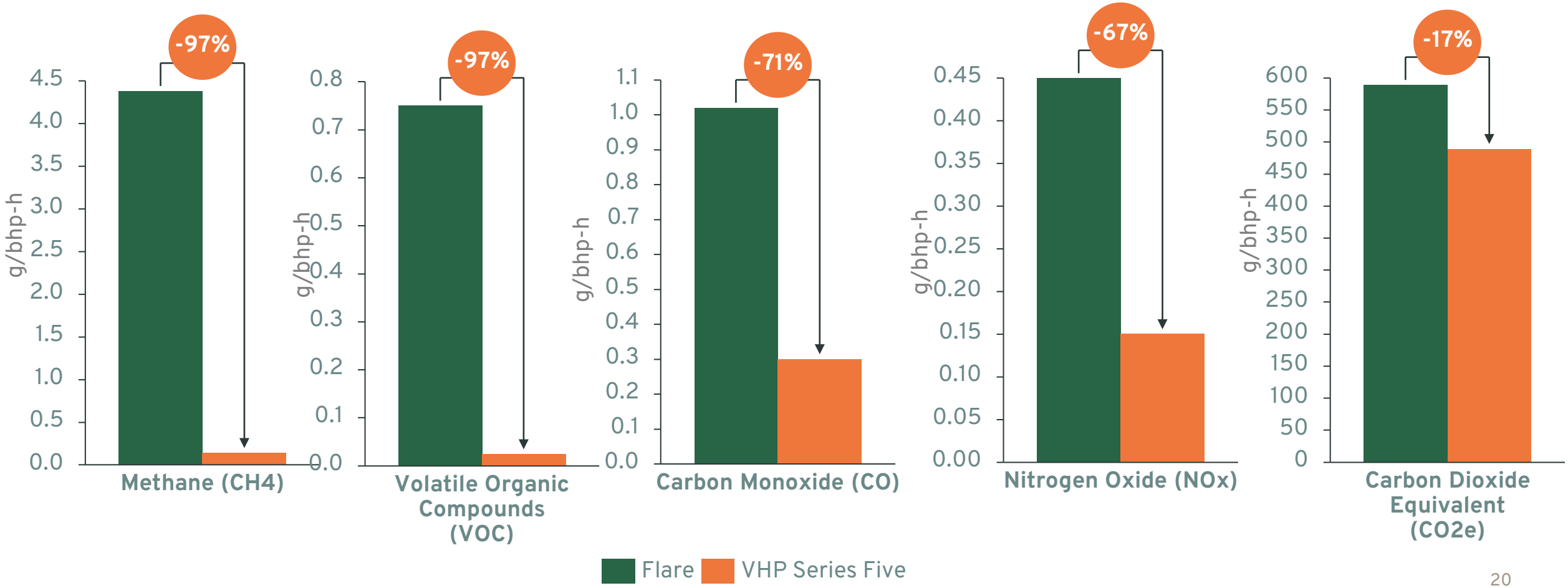
Addressing the Problem of Flaring

97% METHANE REDUCTION VERSUS FLARING WITH VHP SERIES FIVE



Addressing the Problem of Flaring

THE WORLD BANK: ZERO ROUTINE FLARING BY 2030 (ZRF) INITIATIVE

Governments, oil companies and development institutions are making the pledge to eliminate routine flaring by 2030.

Governments that made the Pledge	
Angola	Denmark
Peru	Azerbaijan
Morocco	Russian Federation
Egypt	Netherlands
California (U.S.)	France
South Sudan	Cameroon
Niger	Turkmenistan
Colombia	Kazakhstan
Colorado (U.S.)	Ecuador
Iraq	Bahrain
Norway	Saudi Arabia
Uzbekistan	Indonesia
Mexico	United States
Germany	New Zealand
Gabon	Canada
Mexico	Oman
Nigeria	United Kingdom
Republic of Congo	

Oil Companies that made the Pledge		
BP	Neptune Energy	ONGC
KazPetrol Group	Saudi Aramco	Sonatrach
Pioneer Natural Resources	ConocoPhillips	Galp Energia
Cairn Energy	Niger Delta Petroleum Resources Ltd.	Pan Ocean Oil Corporation Ltd.
Kuwait Oil Company	Seplat Petroleum Development Company Plc	TOTAL
Qatar Petroleum	Ecopetrol	Gazprom Neft
Cepsa	Nigerian National Petroleum Corporation (NNPC)	Petroamazonas
LUKOIL	Seven Energy	Uzbekneftegaz
Range Resources	Eni	Harbour Energy
Chevron	Nile Petroleum Corporation	Petrobras
MOL Group	Shell	Vista
Repsol	Entreprise Tunisienne d'Activités Pétrolières	Hess Corporation
Civitas Resources	Oando Energy Resources	Petroleum Development Oman (PDO)
Occidental	SOCAR	Wintershall Dea
Equinor	EOG Resources	KazMunayGas
Oil India Limited	Societé Nationale des Hydrocarbures (SNH)	Petronas
ExxonMobil	Societé Nationale des Petroles du Congo (SNPC)	Woodside
OMV Group	Frontier Oil Limited	Sonangol

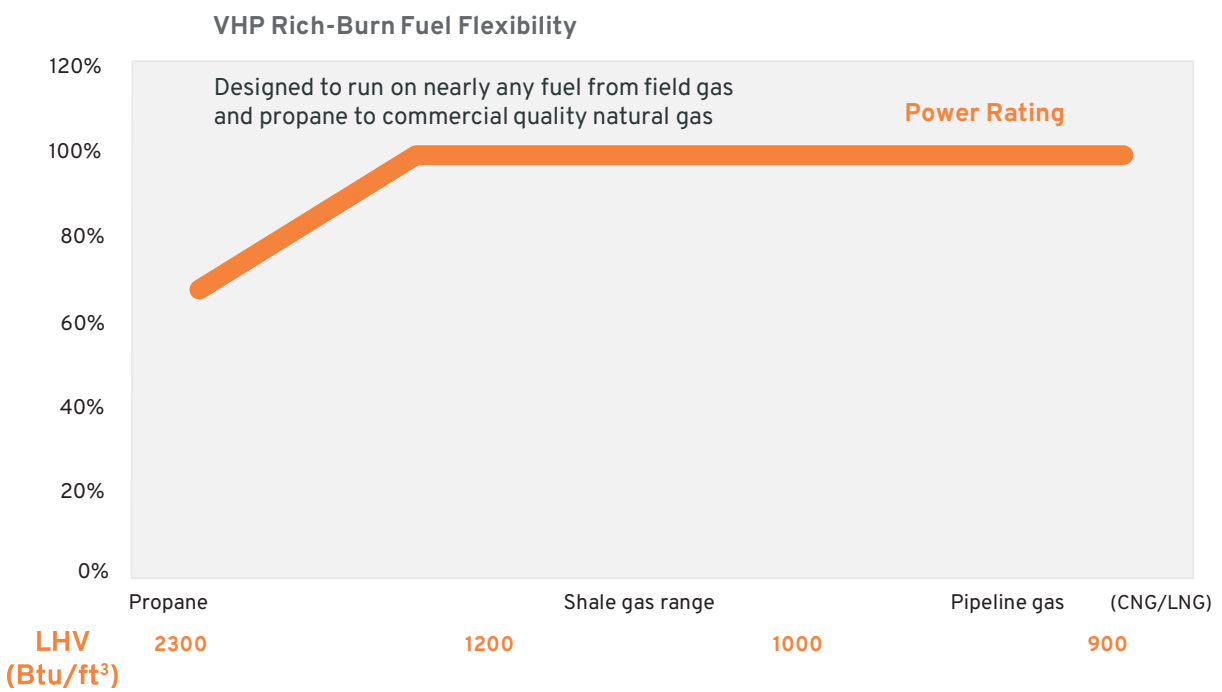
Addressing the Problem of Flaring

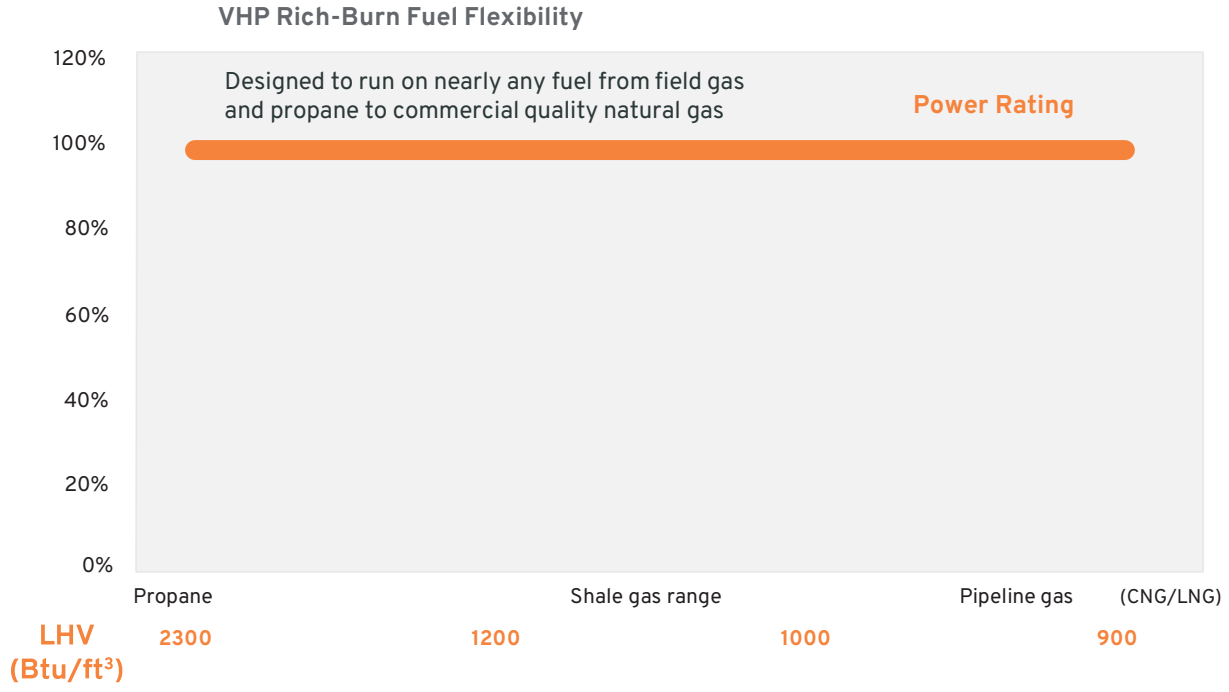
REPLACE EXTERNAL POWER GENERATION SOURCE OR MONETIZE FLARE GAS

Solution	Details
Use on-site as a power source	Generate your own electricity on-site. Eliminate the need for diesel-electric power systems or electric grid connectivity.
Sell for third party use	Monetization of flare gas can take many forms including selling to a grid operator or powering advanced computing systems.

Addressing the Problem of Flaring

DESIGNED TO RUN ON NEARLY ANY GASEOUS FUEL





VHP7044GSI S5 & 9394GSI S5

no derate until 1250 BTU

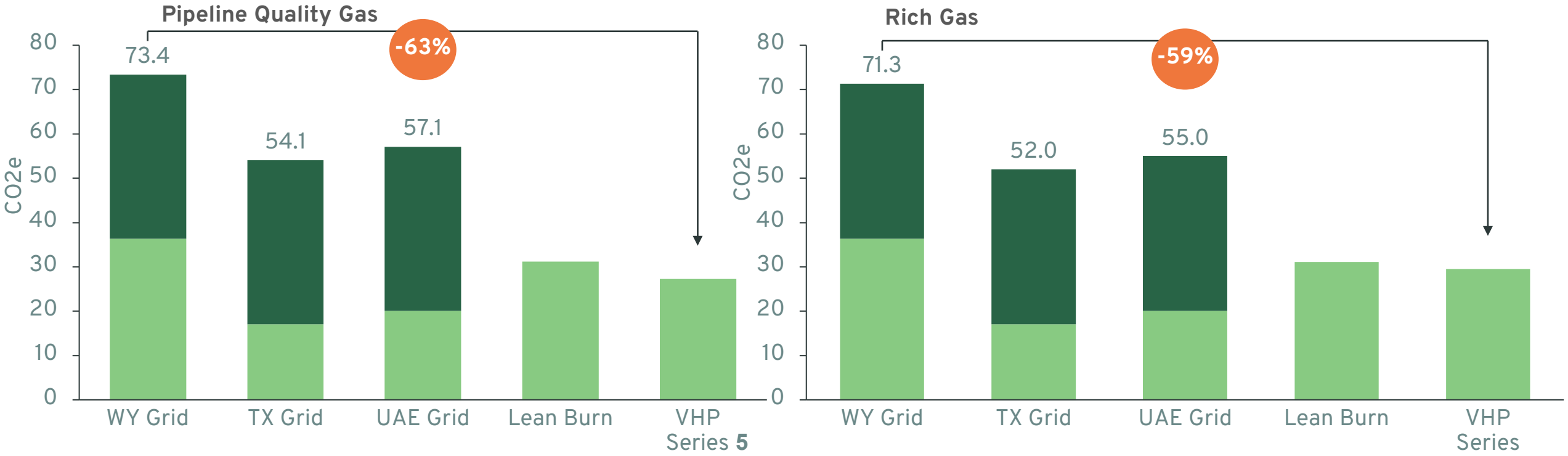
VHP7042GSI S5

no derate until 2350 BTU

Addressing the Problem of Flaring

63% LOWER CO2E THAN THE ELECTRIC GRID

Waukesha's 5MW solution delivers lower emissions while delivering reliable power



Electrical grid related emissions ('000 MT CO2e/yr)

Flaring related emissions ('000 MT CO2e/yr)

Compares the emissions of 5MW of Waukesha engines running on flare gas to the emissions from a burned flare + the emissions reduction due to displacing 5MW of electricity that come from the electric grid.

Note: Assumed flare efficiency @ 95%;

- WY and TX electrical grid carbon intensity calculated using 2021 EPA eGRID data; rich gas @ 1,175 BTU/ft^3
- UAE electrical grid carbon intensity calculated using IRENA Energy Profile 2023 GRID data; rich gas @ 1,175 BTU/ft^3

lb/MW-hr has been converted to MT CO2e/yr by assuming that the engine is working 24 hours per day/365 days a year and methane emissions have a CO2 equivalency of 25x. VHP Series Five is based on 3 x P9394GSI S5 Genset

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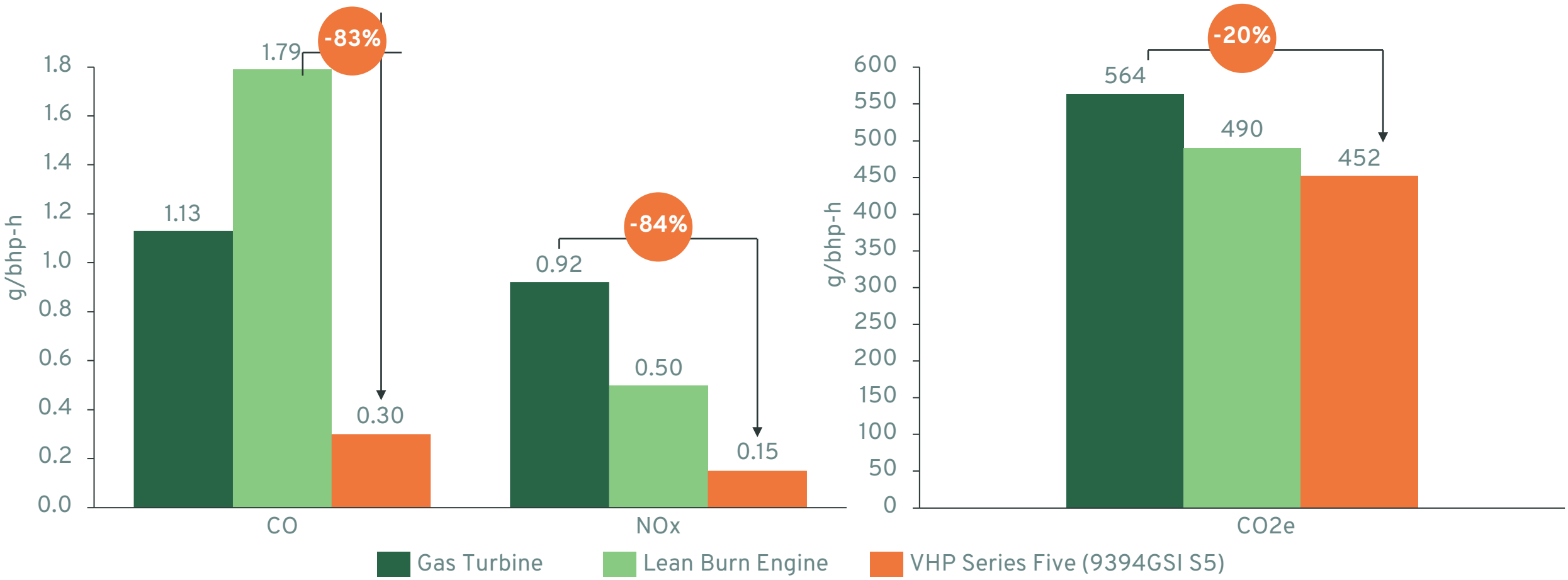
Addressing the Problem of Flaring

LOWER NOX, CO, AND CO2E THAN "TYPICAL" NATURAL GAS ENGINES



Note: Turbine emissions based on US EPA CHP Partnership, Catalog of CHP Technologies 2017, Table 3-8, System 1. Turbine NOx and CO emissions corrected for generation only using factor of 2.09. Data uses methane GWP of 25.

Data for lean burn based on a CAT G3516 engine - G3516 NA Gas Compression Engines | Cat | Caterpillar

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Addressing the Problem of Flaring

OPERATION AND MAINTENANCE

reUp

Full-scope product support

- Dedicated application engineering support
- Genuine OEM service parts
- Remanufactured service parts (reup)
- Life cycle tools
- Startup and commissioning support
- Factory certified technicians
- Global distribution network

Life Cycle Maintenance	VHP Series Five
Oil change, spark plugs, O2 sensor	4,000 hours
Air Filter	8,000 hours
Belts, carb, breather, valve timing	8,000 hours
Coils, extensions, breather	16,000 hours
Top End Overhaul, catalyst elements, cylinder heads	24,000 hours
Bottom End Overhaul	48,000 hours

Addressing the Problem of Flaring

WAUKESHA PRODUCT TRAINING CENTER

Waukesha engine learning

- Online subscription-based learning
- Online user groups and discussion boards
- Advanced reporting capabilities for training administrators
- Over 100 elearning modules
- Online and in-person classes available
- Offerings in multiple languages.
- U.S. And international locations

Multiple learning paths

- Certified operator
- Certified technician
- Factory trained technician

Course Offerings

- Gas Engine Technology (GET)
- Engine System Manager (ESM)
- VHP, VGF, 275GL+
- Service bulletin eLearning
- Failure analysis

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04 Customer Success

Customer Success

WAUKESHA VHP SERIES FIVE BRINGS ELECTRICAL POWER TO REMOTE STRANDED GAS LOCATIONS

Results:

- The VHP deploys over 200 MW of generation capacity for flare mitigation systems
- Nearly 1.3 million tons of co2-equivalent emissions avoided annually due to the VHP series five
- The VHP converts flared natural gas into electricity. This electricity is then consumed in mobile, modular data centers deployed directly at the well site.
- Through the conversion of flared gas to power, clients have avoided thousands of tons of co2-equivalent emissions annually.

Image Credit: Crusoe Energy Systems

Customer Success

PROVEN PERFORMANCE AROUND THE WORLD

The global Waukesha fleet

- Over 23,000 running engines in over 80 countries
- Over 5,000 engines in power generation applications

Colombia

- (2) VHP L7104GSI gensets: 2.4 MWe
- Remote oilfield station

Russia

- (4) L7104GSI rental gensets: 4.4 MWe
- Komsomolskoe oil field

China

- (3) L5794 GSI engines: 4,140 BHP

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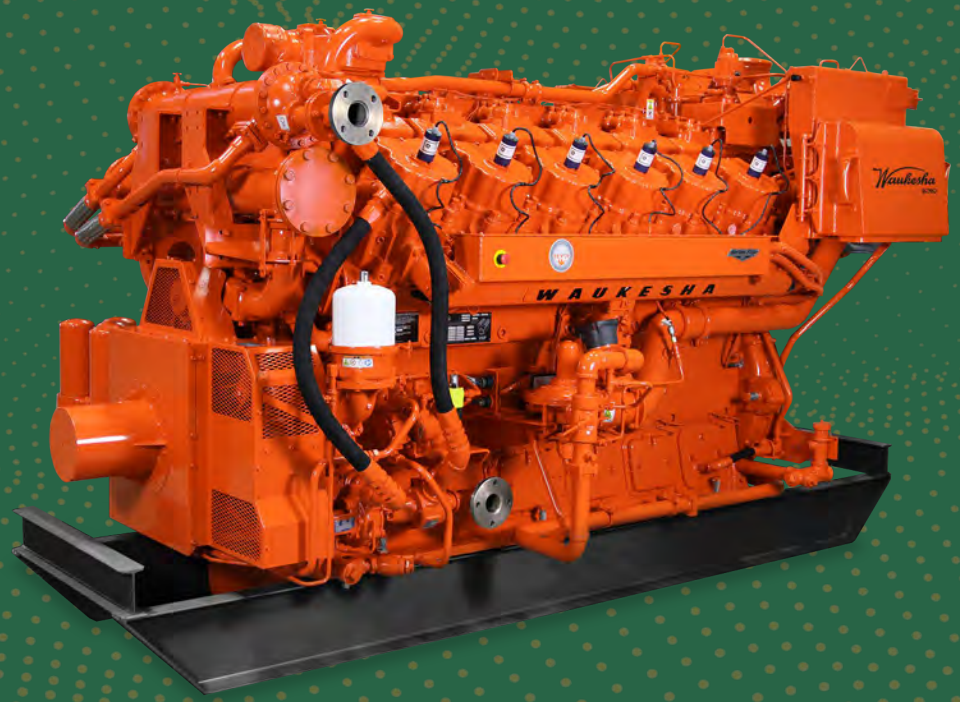
05 Product Overview: VHP Series Five



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VHP Series Five

KEY PRODUCT FEATURES

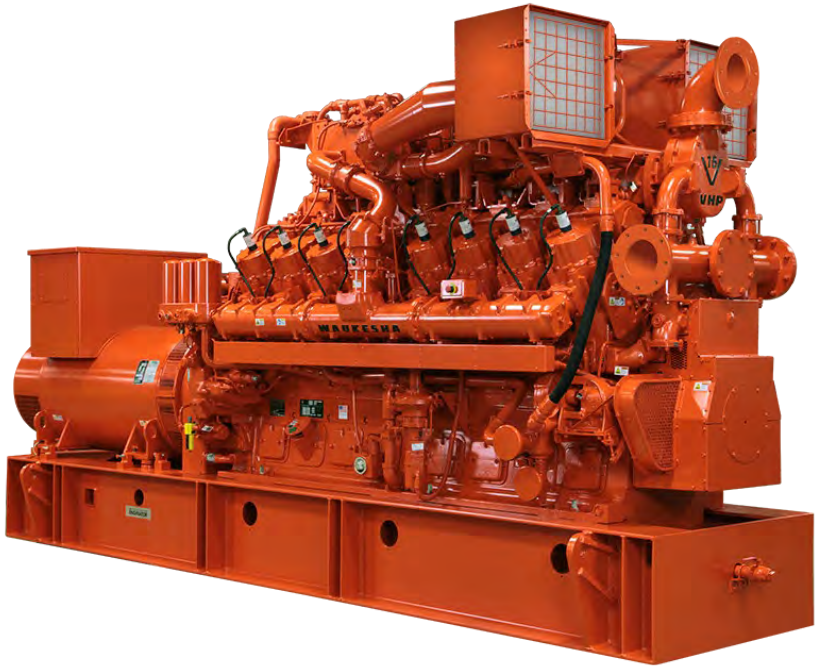
Emissions
0.15 g/hp-hr NOx

Spark Plugs
4,000 hours service intervals with non-precious metal plugs

Lube oil filters
4,000-hr service intervals (with oil analysis)

ESM2/AFR2 Controls
Integrated control system, superior performance and improved diagnostics

emPact catalyst
Factory Supplied. Durable and easy maintenance design. Replaceable catalyst elements



Breather
Advanced closed crankcase breather system removes fugitive methane emissions

Air Filters
Heavy duty design suitable for oil field outdoor environments.

Cylinder Heads
- Enhanced design/improved cooling
- Extended life and improved reliability

Pistons/Rings
- 4,000 hours oil change intervals
- Improved low-load oil consumption
- Improved fuel flexibility

Oilfield Pony Skid
4-point lifting.
3-point mounting

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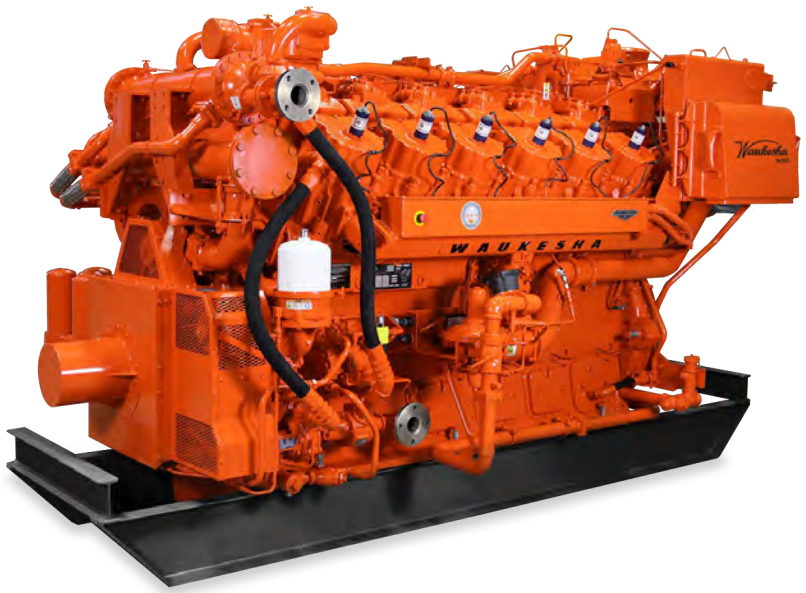
Reduce Emissions with VHP Series Five Gas Engines



VHP Five Series

Enhanced family of engines and gensets @ 1,200 rpm

- –12-cyl: 7042GSI S5 = 1,119 kWb / 1,068 kWe
- –12-cly: 7044GSI S5 = 1,417 kWb / 1,357 kWe
- –16-cyl: 9394GSI S5 = 1,864 kWb / 1,788 kWe

- **Lower Emissions**
- **Utilization of Flare Gas**
- **Fuel Flexibility**

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VHP Series Five Overview

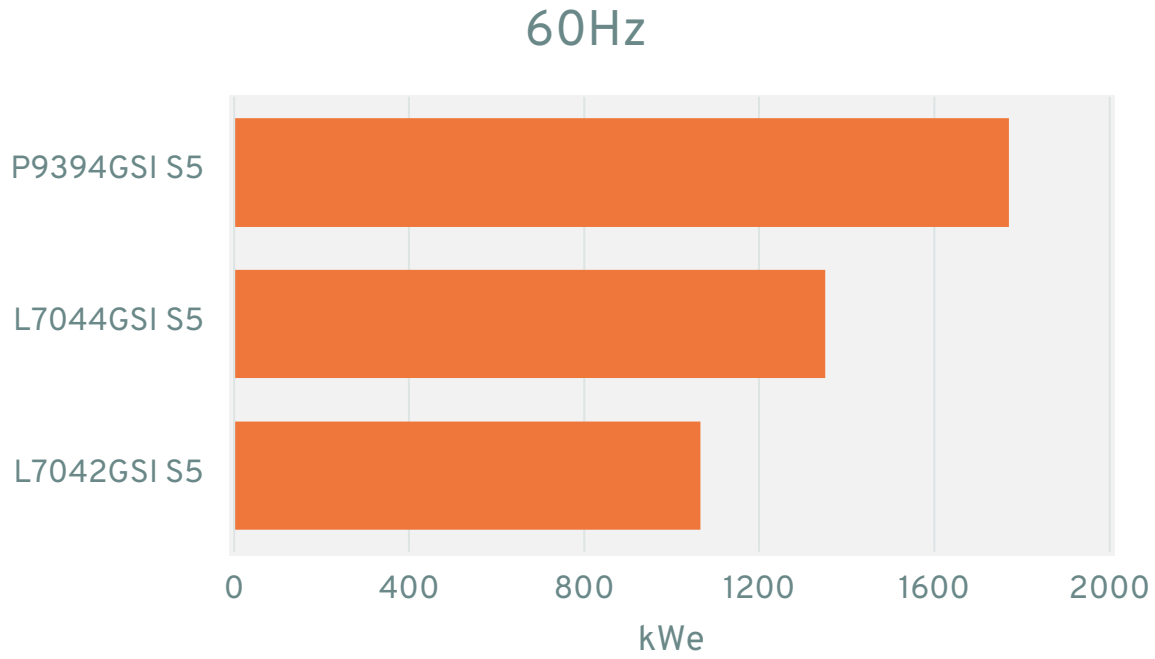
ENHANCED FAMILY OF VHP ENGINES AND ENGINATORS®

	L7042GSI S5	L7044GSI S5	P9394GSI S5
Cylinders	12	12	16
Power Ratings @ 1200 rpm (engine only)	1,119 kWb / 1,068 kWe	1,417 kWb / 1,357 kWe	1,864 kWb / 1,788 kWe

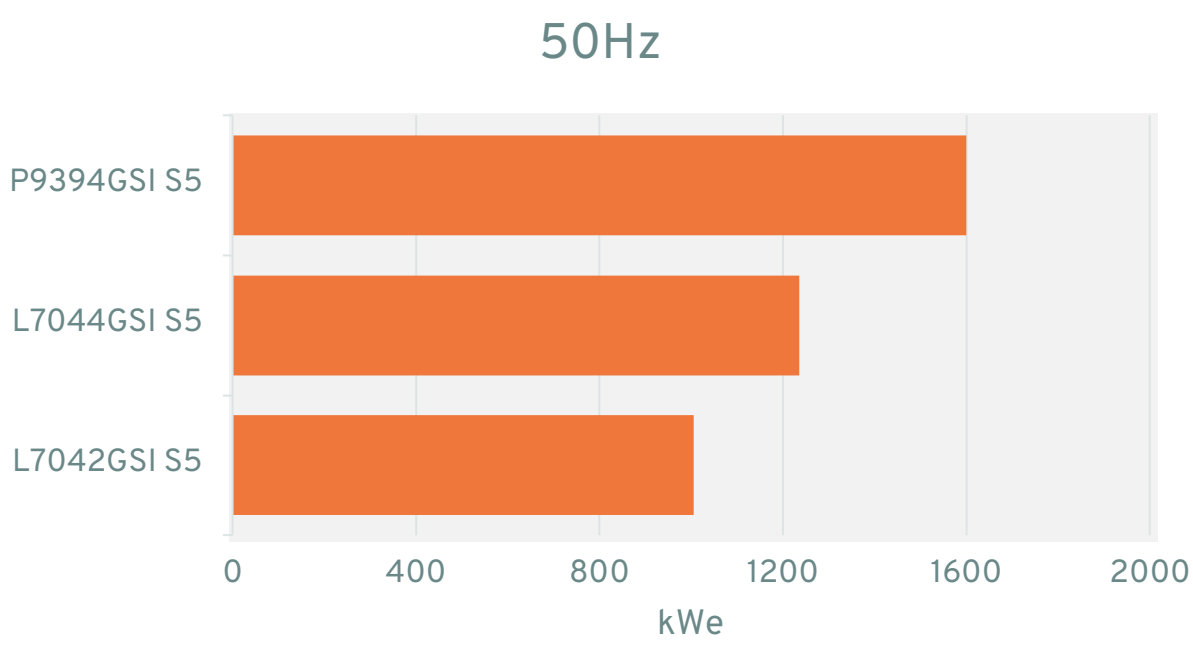
- Miller cycle combustion
- Higher HP & reduced temps
  - Enhanced rich-burn combustion for reduced exhaust temps
  - Cylinder head updated to reduce temps in valve guide/stem region
  - Optimized piston/ring design reduces piston temps
- More fuel flexibility & increased efficiency
- 4k oil & spark plug intervals at higher power

Series Five Waukesha VHP

VHP Series Five Continuous Power Ratings



60Hz at 1200 rpm



50Hz at 1000 rpm

Performance Reliability in the Harshest Environments

High fuel flexibility

- VHP 7042GSI S5 – 1 mwe; no de-rate until 2350 BTU
- VHP 7042GSID S5 – 1 mwe; no de-rate until 2350 BTU
- VHP 7044GSI S5 – 1.3 mwe; no de-rate until 1200 BTU
- VHP 7044GSID S5 – 1.2 mwe; no de-rate until 1200 BTU
- VHP 9394GSI S5 – 1.8 mwe; no de-rate until 1250 BTU

Wide fuel tolerance

- VHP SERIES FIVE: 700+ to 2350 BTU

Hot ambient, high elevation performance (before de-rate)

- VHP 7100GSI S5 – 120°F/6400 ft., 130°F/5100 ft., 100°F/7000 ft.
- VHP 7100GSID S5 – 120°f/7000 ft., 130°F/6700 ft., 100°F/7000 ft.
- VHP 7104GSI S5 - 120°f/4300 ft., 130°F/3000 ft., 100°F/5000 ft.
- VHP 7104GSID S5 – 120°f/1200 ft., 130°F/600 ft., 100°F/2500 ft.
- VHP 9504GSI S5 – 120°f/4200 ft., 130°F/3000 ft., 100°F/5000 ft.

+Low BTU hardware change to get down to 700BTU on VHP's

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VHP Series Five

H2S AND FUEL FLOW

	L7042GSI S5 (1 MWe)	L7044GSI S5 (1.3 MWe)	P9394GSI S5 (1.8 MWe)
Fuel Flow (SCFM)	161	201	257
Fuel Flow (SCFD)	231,840	289,440	370,080
H2S Limit with emPact Catalyst	9 µg/BTU or 257 ppmv		
H2S Limit without emPact Catalyst	50 µg/BTU or 1437 ppmv		

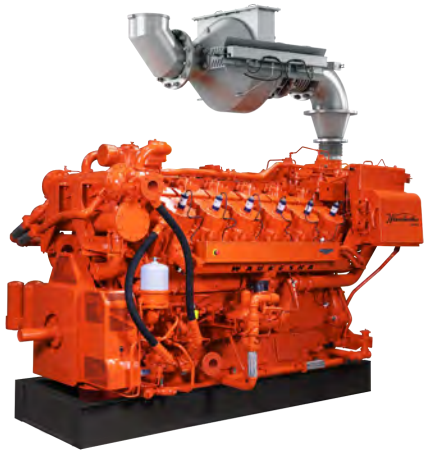
Assumptions: Field gas with the following composition: 70% C-1, 15% C-2, 10% C-3, 2% C-4, 1% N2, 2% CO2. The BTU for this fuel is 1175 LHV.

VHP Series Five for Power Generation

POWER GENERATION SCOPE OF SUPPLY

Standard Engine Configuration:

- xCooled cylinder heads
- Series Five pistons
- ESM2/AFR2 integrated control system
- Touchscreen HMI
- emPact emissions control system (optional)
- Advanced closed crankcase breather
- Ignition Power Module Diagnostics (IPMD)
- Heavy duty air filters
- Spin-on oil filters and engine-mounted oil cooler
- Single fuel inlet
- Main bearing & exhaust thermocouples
- Front stub shaft
- Air/gas starter (electric optional)
- Flywheel machined for generator coupling
- Side inlet jacket water pump header
- Jacket water outlet; Dresser coupling
- Auxiliary water thermostatic valve
- Pony skid (Enginator only)
- Load performance testing and documentation



Generator

Included with Enginator® models

Control Panel

Included with ESM 2 Enginators (except moblieFLEX)
Available separately for ESM & non-ESM models

Switchgear

Low voltage and medium voltage options available

Radiator

Available with select models

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Rich Burn vs Lean Burn Engines

NOT ALL GAS ENGINES ARE CREATED EQUAL...

Feature	WK Series Five Engines	Lean Burn Engines
Air to Fuel Ratio	• Higher concentration of fuel "Rich" to air mixture • Typically operate with λ equal to 0.995	• Higher concentration of air to fuel "lean" mixture • Typically operate with λ anywhere between 1.5 and 2.2
Emissions	• Ultra low NOx emissions with three-way catalyst • Low methane slip in exhaust	• May require SCR and DOC to meet ultra low NOx emissions requirements • High methane slip in exhaust
Transient Performance	• Accept block load and operate at a wide load range	• Typically, do not accept block load well and perform poorly under varying loads
Start Performance	• Fast start performance. Crank to full load in <30sec	• Slow start performance. Crank to full load anywhere between 30 sec and 2 min.
Fuel Flexibility	• Accepts wide range of fuel composition without hardware change. • Capable of running on most wellhead gas fuels	• Narrow range of fuel composition • Typically requires hardware changes to switch from pipeline quality gas to propane.

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ESM 2/AFR2 Controls

INTEGRATED ENGINE CONTROLS, DATA ANALYSIS, AND EMISSIONS MONITORING

Parameter	L7042GSI S5	L7044GSI S5	P9394GSI S5
Combustion	Miller Cycle - Rich Burn	Miller Cycle - Rich Burn	Miller Cycle Rich Burn
Configuration	Vee 12	Vee 12	Vee 16
B x S (in)	9.375 x 8.5	9.375 x 8.5	9.375 x 8.5
Disp (L)	115	115	154
Height x Width x Length (in)	98 x 85 x 147	98 x 85 x 147	101 x 78 x 168
Weight (lbs)	24,250	24,250	34,000
Power (kWb)	1,119	1,417	1,864
Speed Range (RPM)	1,200-900	1,200-900	1200-900
BMEP (psi)	141	178	176
Fuel Consumption (Btu/bhp-hr) -0/+5%	7,209	7,099	6,974
Fuel flex. (WKI # to derate)	34	55	58
Fuel Range w/o Adj	+/- 150 Btu	+/- 150 Btu	+/- 150 Btu
NOx emissions (g/hp-hr)	0.15	0.15	0.15
Ambient Temp before Derate, CQNG (F)	130F @ 4,000 ft	130F @ 3,000 ft	120F @ 2000 ft
Max altitude before derate @ 100F (ft)	7,000 ft @ 100F	5,000 ft @ 100F	4000 @ 100F
Maintenance TBO (K' hr)	36/60	24/48	24/48
Oil Change (hr)	4,000	4,000	4000
Spark Plug (hr)	4,000	4,000	4000

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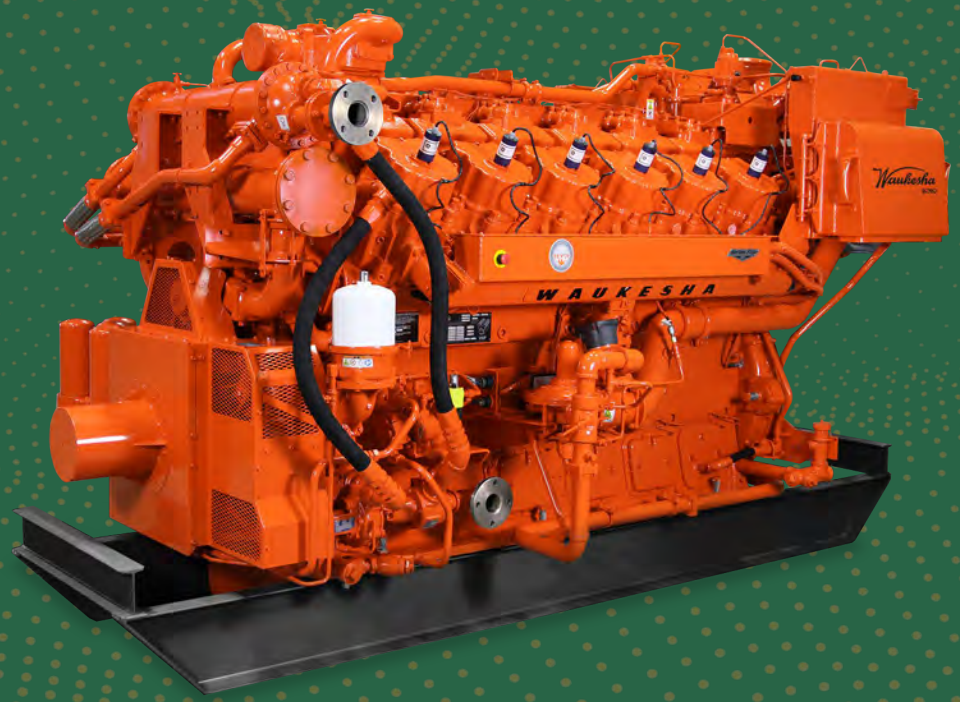
05 Featured Systems: VHP Series Five



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xCooled Cylinder Head

MAXIMUM RELIABILITY AND UPTIM

Redesigned cylinder head casting

- Improved cooling flow to exhaust valves
- Exhaust flow port redesigned to reduce hot spots
- Proprietary casting

New exhaust valve guide

- Provides direct cooling to exhaust valve guide
- Valve guides are reamed to ensure precision tolerances

Improved reliability

- Water cooled guides and seats (S4 only had water cooled seats)
- Valve rotators
- Up to 40% lower exhaust valve temp. Reduces risk of cylinder head failure

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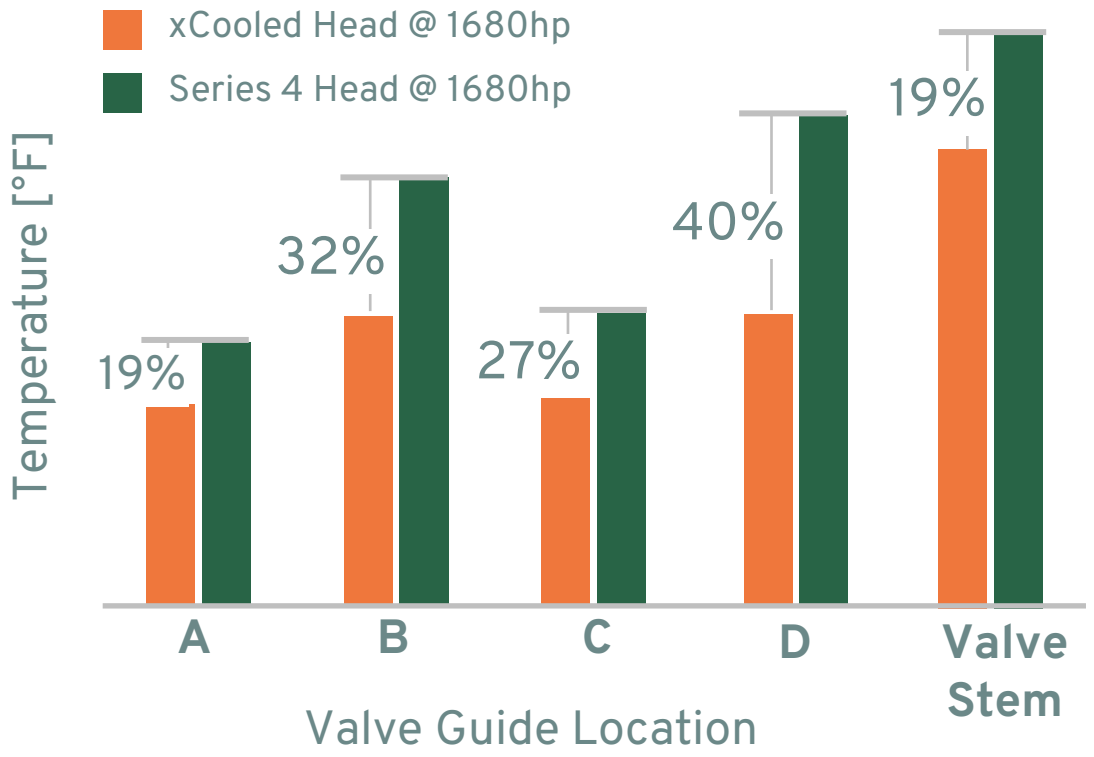
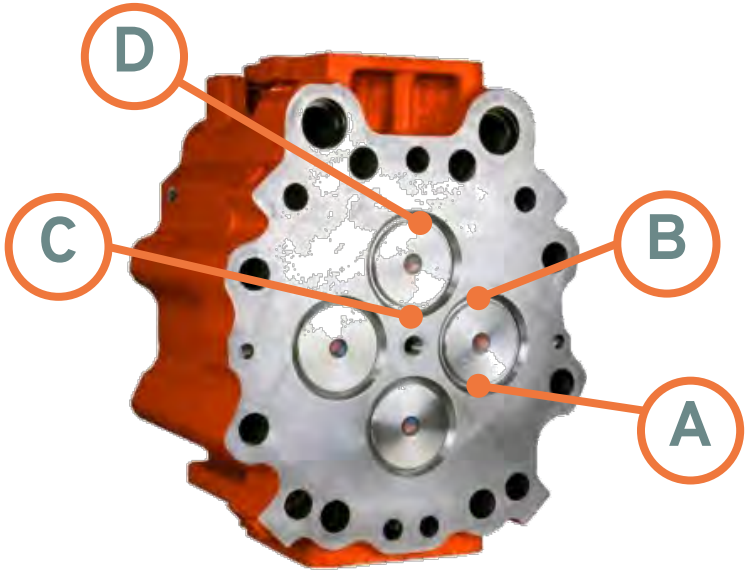
xCooled Cylinder Head

LOWER TEMPERATURES → LONGER LIFE, HIGHER RELIABILITY, MORE POWER





Up to 40% cooler guide temps with less variation increases reliability

ESM 2/AFR2 Controls

INTEGRATED ENGINE CONTROLS, DATA ANALYSIS, AND EMISSIONS MONITORING

Features

- Single, centralized ECU
- Integrated AFR2
- New “smart” power distribution box
- Integrated bearing/exhaust thermocouples and crankcase pressure
- HMI industrial PC touch-screen display (12” standard; 15&19” option)

Benefits

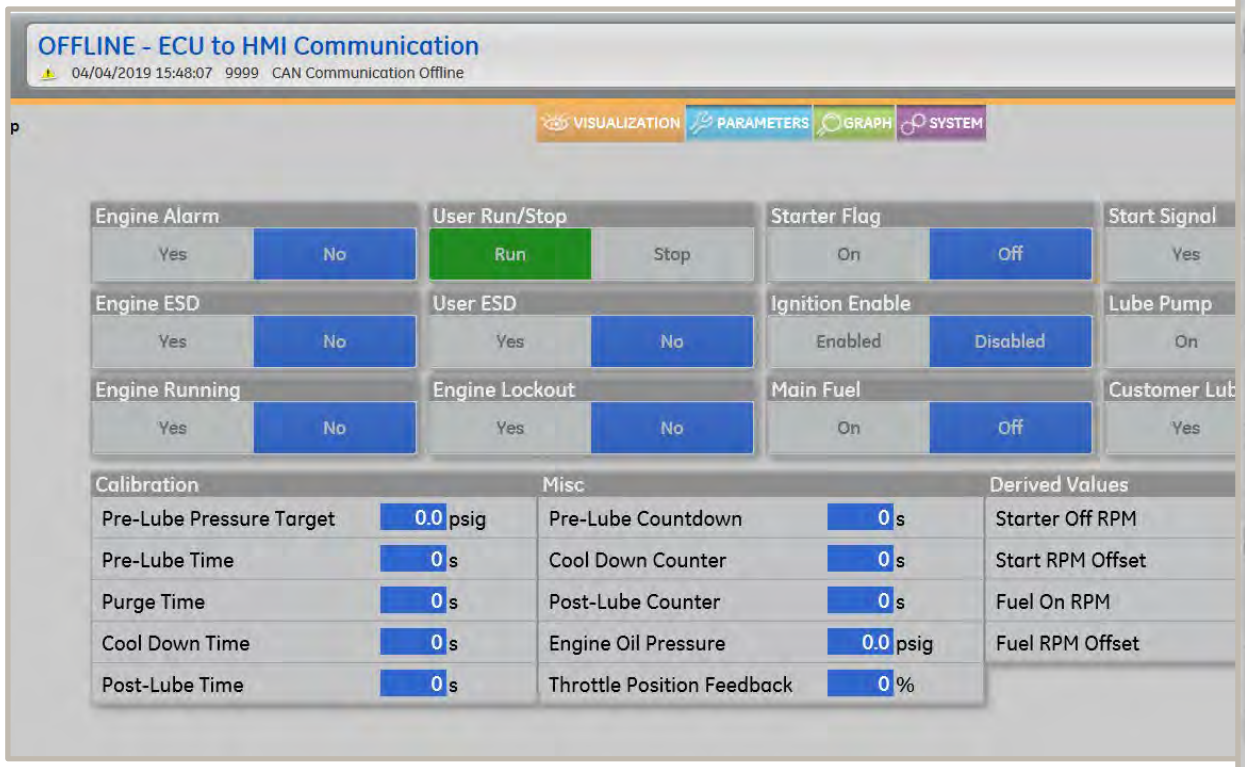
- Improved engine protection (incl. Knock and misfire detection)
- Timing control – for marketing leading fuel flexibility
- Touch screen display - no laptop required for field work
- Integrated e-help with latest service manuals on screen
- Multiple user access levels with custom configurations
- Plant level views when multiple engines on site
- Continuous data log (10 yrs) with trending, reports, storage

Waukesha in-house ESM2 engine control system

HMI Touchscreen display

ESM 2/AFR2 Controls

USER INTERFACE



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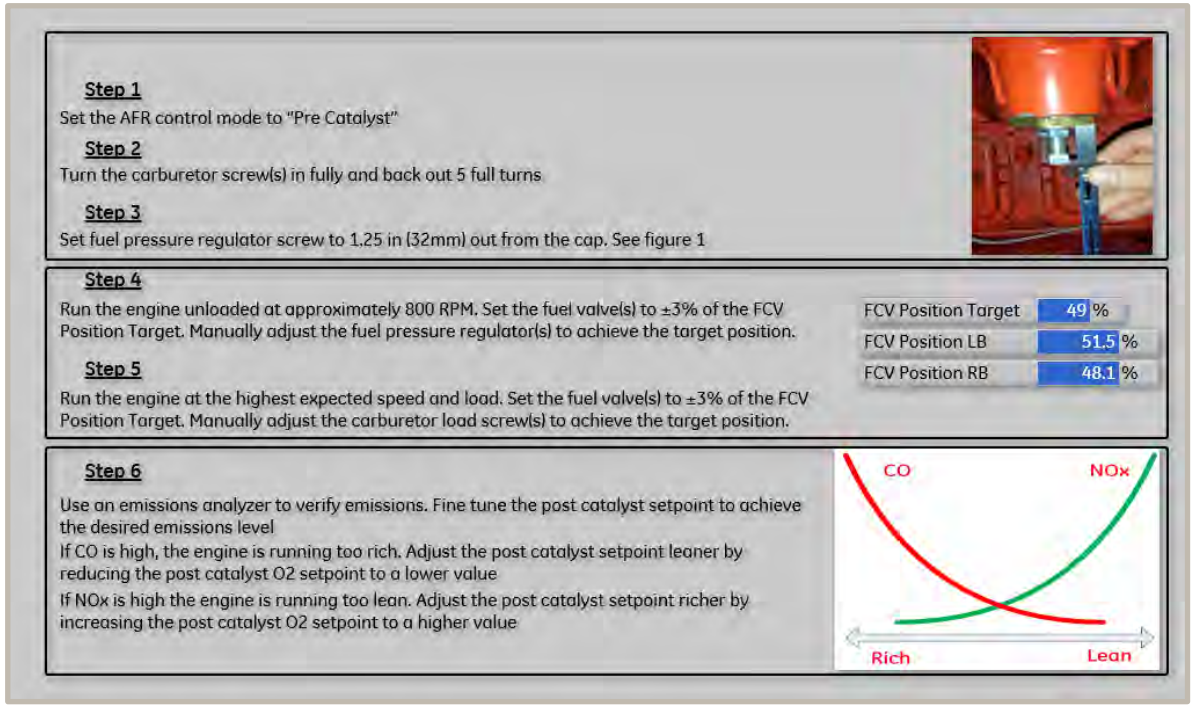
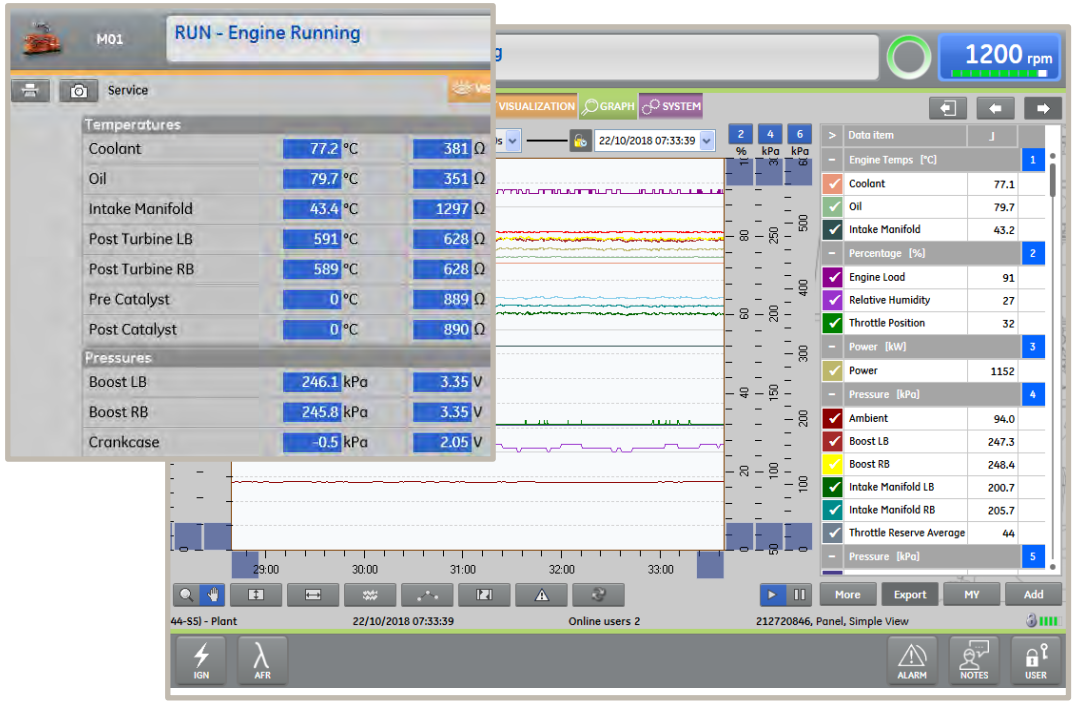
ESM 2/AFR2 Controls

USER INTERFACE

Simple Fuel system setup



Voltage/Ohm Readings and Data Logging



emPact Emissions Control System

FULLY INTEGRATED WITHIN ESM 2

Benefits

- Reliable, effective, and low maintenance
- Easy installation and catalyst replacement
- Wash element once per year; replace every 3 years
- Catalyst health monitoring sensors
- 3-way catalyst + AFR controller **(optimized interaction within ESM 2)**

Three-way catalyst eliminates complex SCR systems

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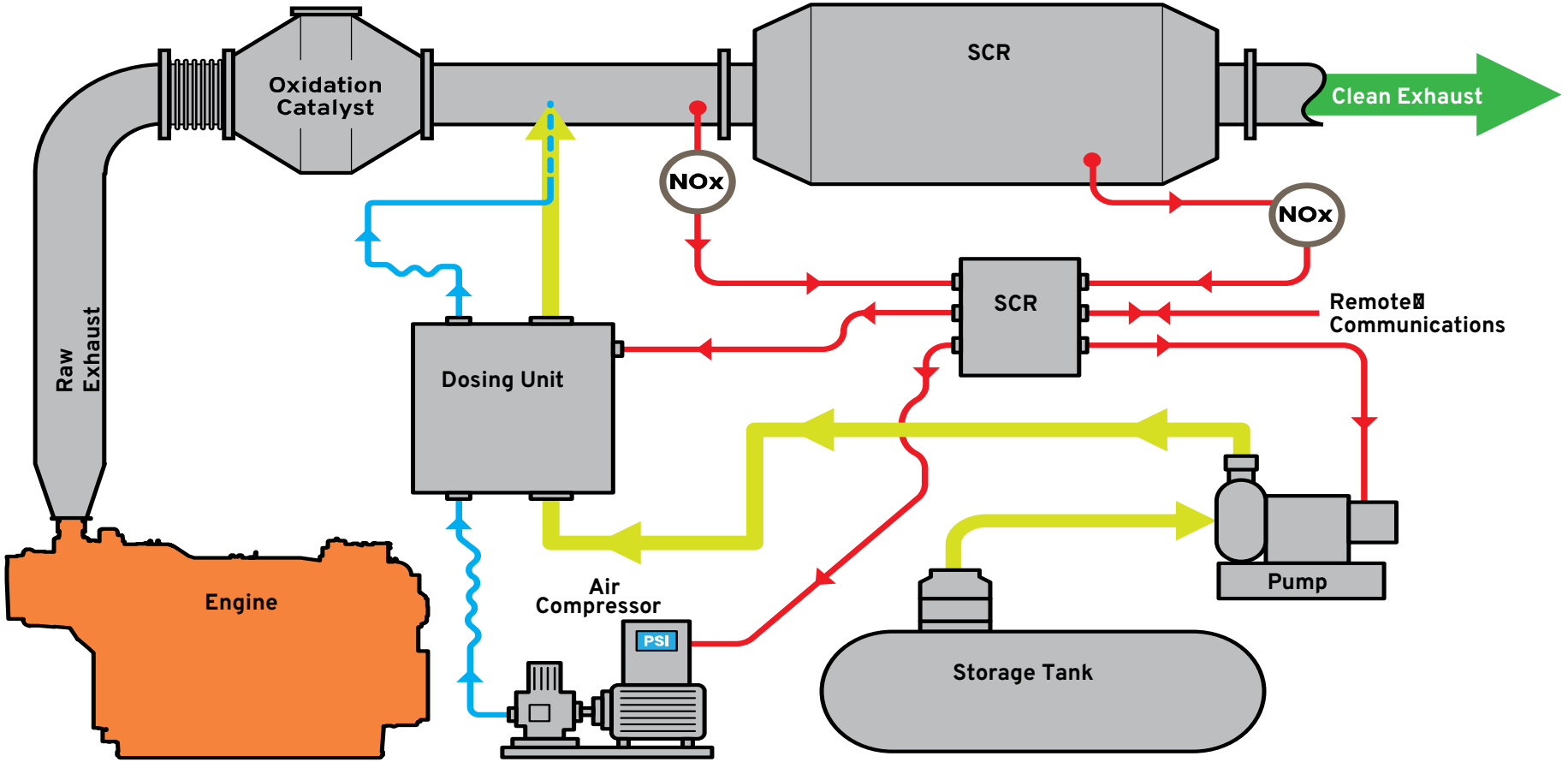
emPact Emissions Control System

SCR AFTERTREATMENT SYSTEMS ARE COMPLEX AND HAVE MULTIPLE POINTS OF FAILURE



Advanced Crankcase Breather

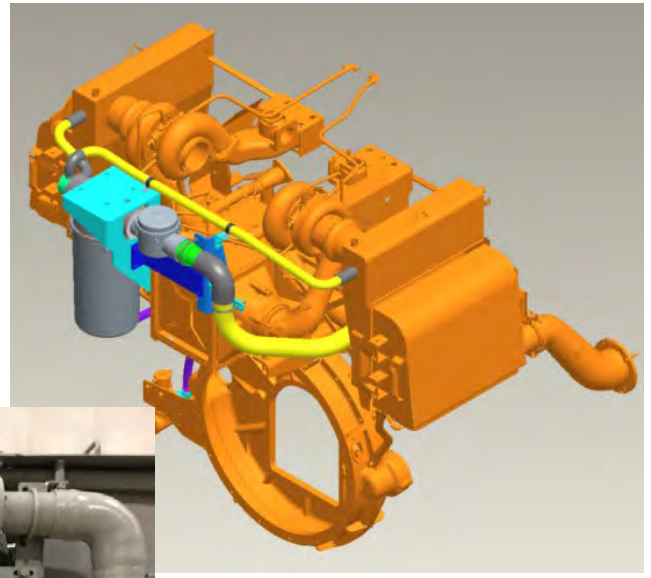
CLOSED BREATHERS PREVENT FUGITIVE METHANE EMISSIONS

Fewer oil leaks due to more consistent crankcase vacuum

- Uses turbocharger for venturi, vice exhaust stream, compared to previous version
- High efficiency coalescing filter reduces oil fouling of catalyst
- Engine safety improvement with efficient removal of exhaust gases
- Prevents coking of intake valve seats, turbocharger and fouling of catalyst

Mounted

on flywheel end of engine



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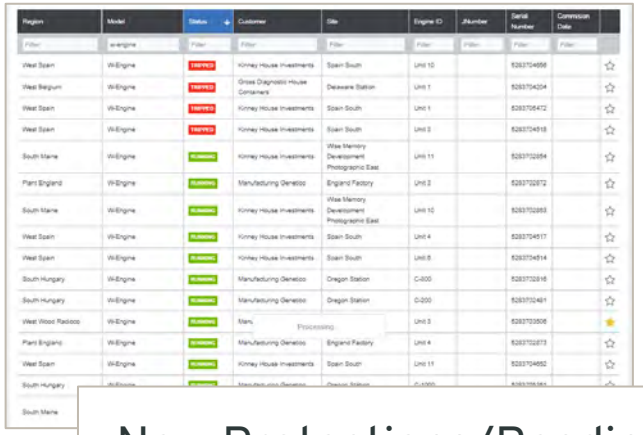
ASSET HEALTH MONITORING MODULE

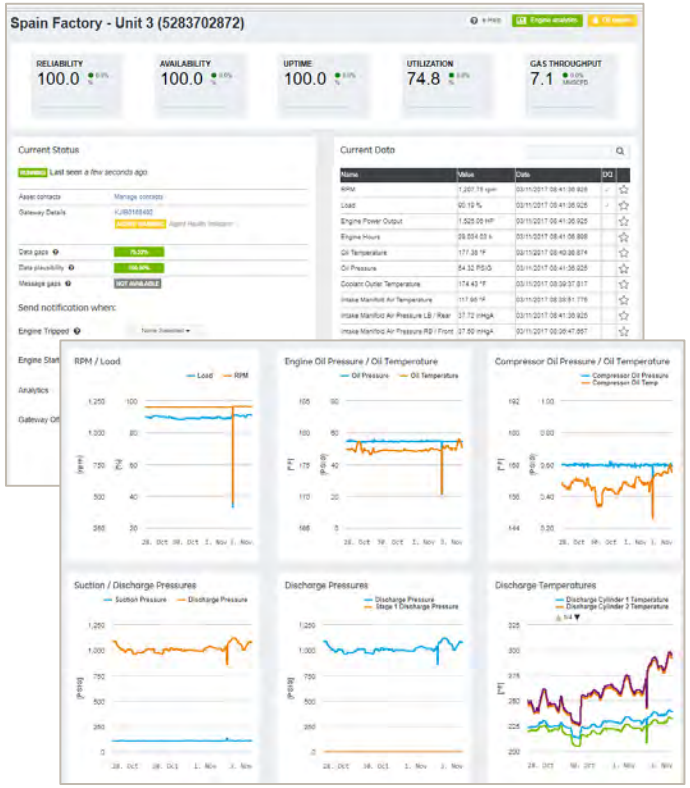
ASSET OPERATING STATUS



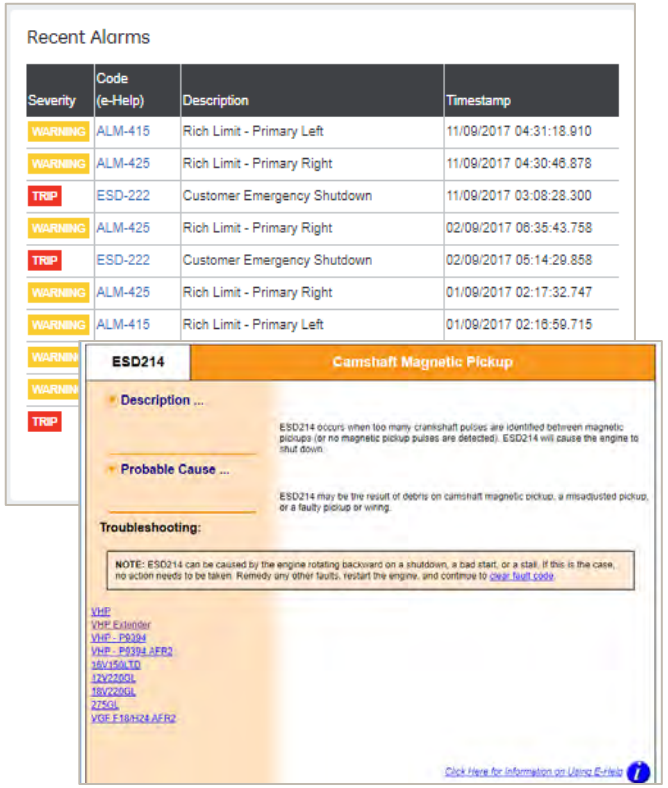
New Protections/Readings

- Crankcase pressure
- Exhaust port & main bearing temperatures
- Oil Filter differential pressure
- Boost Pressure & throttle reserve monitoring
- Oil pressure permissive at start

OPERATIONAL DATA TRENDS



CONTROLLER ALARMS SUMMARY



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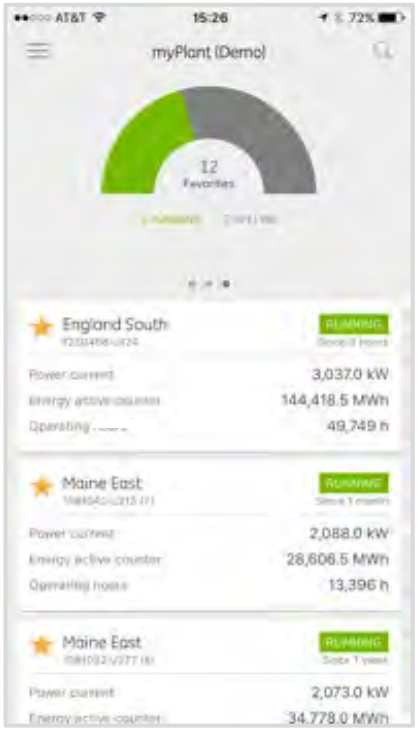
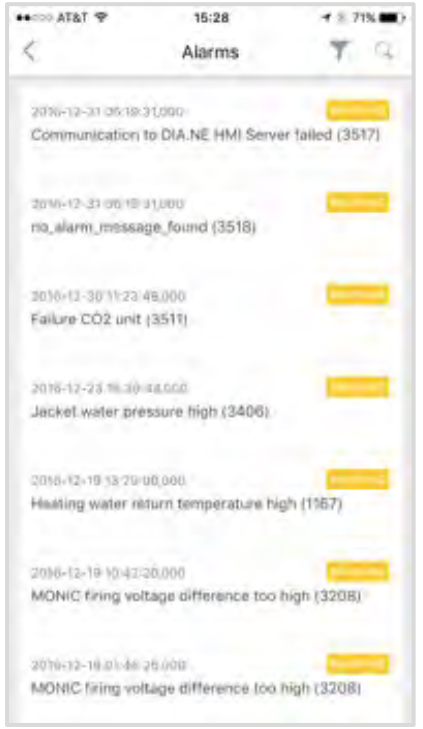
MOBILE APPLICATION

Asset/Fleet summary

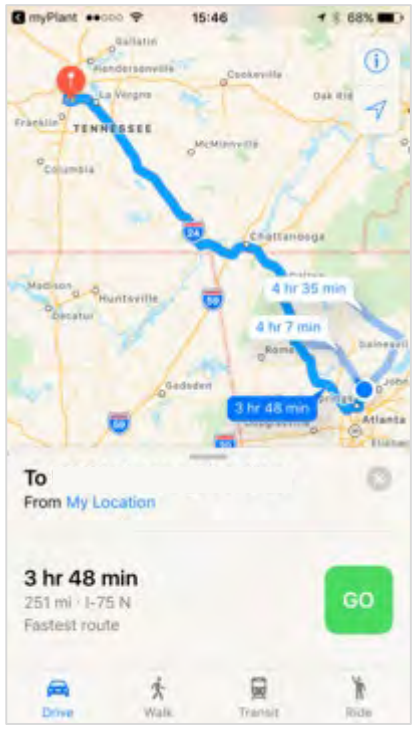


Asset data trends

Asset alarms summary



Navigation



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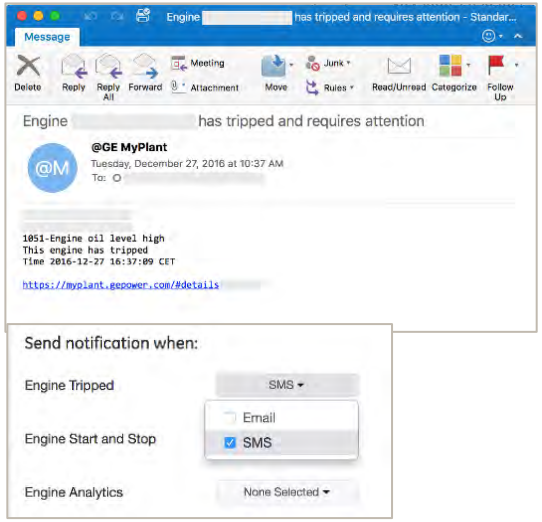
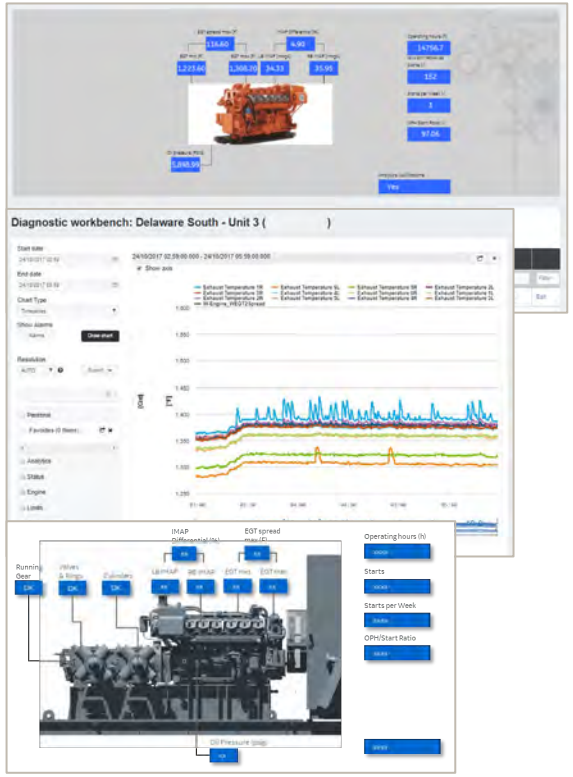
ASSET CONDITION MANAGEMENT

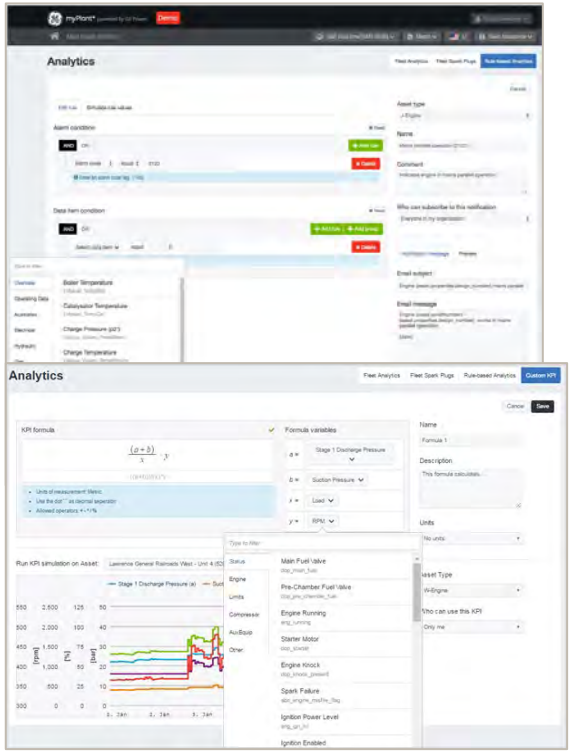
INSTANT EVENT PUSH NOTIFICATIONS



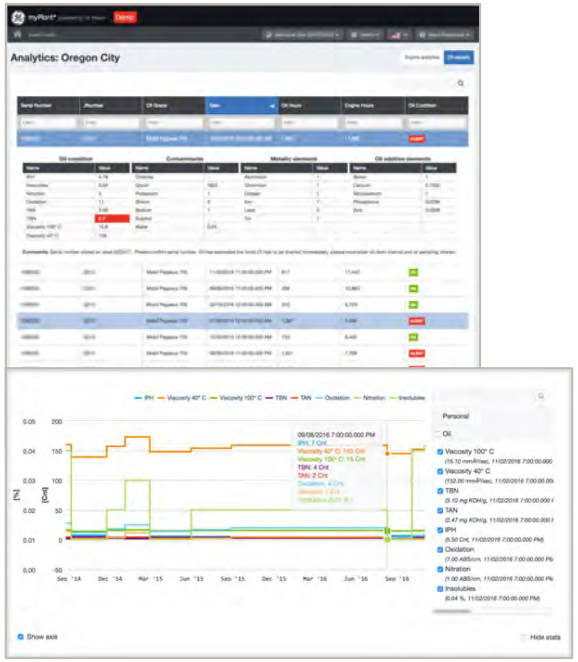
RELIABILITY ANALYTICS PACKAGE



BUILD YOUR OWN ANALYTICS



LUBE OIL ANALYSIS REPORTS INTEGRATION



Contact us

THANK YOU!

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