

# OUR GOAL: TO DELIVER RESPONSIBLE HYDROCARBON PRODUCTION WITH SMART, SUSTAINABLE SOLUTIONS



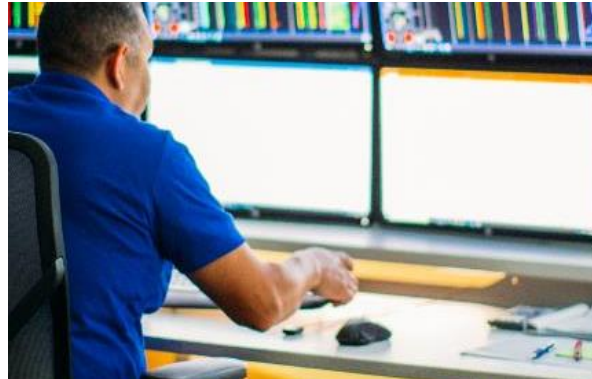
Nabors aims to help innovate the future of energy and accelerate the transition to a lower carbon world. Our Energy Transition Solutions (NETS) portfolio of advanced and automated technologies is purpose-built to improve energy efficiency and reduce emissions. By combining our technology portfolio with heightened employee awareness and understanding of our environmental stewardship initiatives, Nabors is enabling responsible hydrocarbon production.

# Decarbonizing the Oilfield & Beyond



## Advisory & Management Systems

Engine advisory and management solutions to run engines at their most efficient levels and reduce emissions



## Automation & Centralization

Utilization and further development of automation tools and centralization enables the remote execution of operations, fewer days on well, reduced on-site personnel and increased safety.

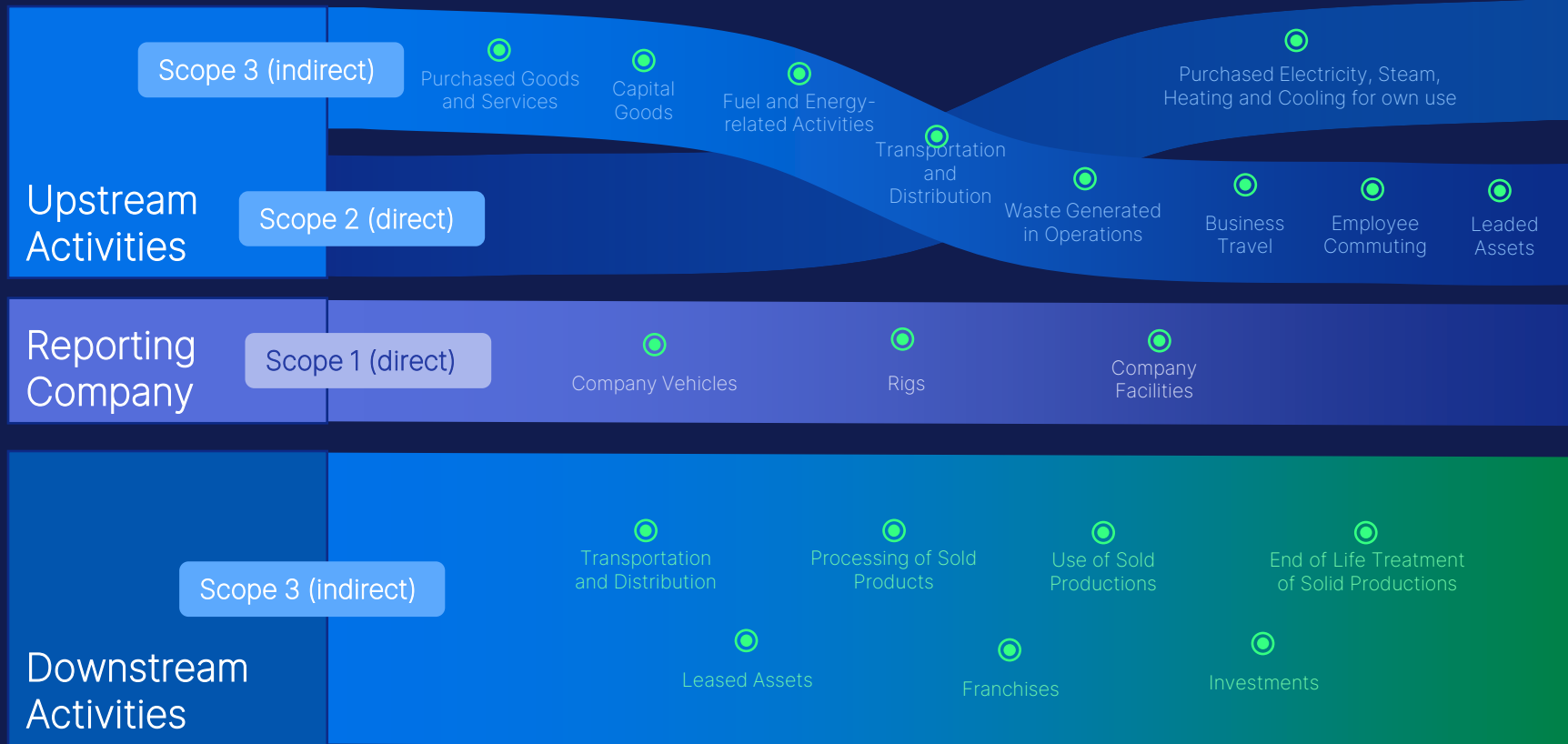


## Technology & Solutions

Technology solutions that reduce fuel consumption and emissions through energy storage and green fuels in an effort to diversify from pure diesel into cleaner fuels.

REDUCING SCOPE 1 EMISSIONS

# Emissions Map



# Oilfield Sustainability Objectives



## Efficient Energy Use and Improved Fuel Economy

Peak shaving, efficient load sharing and regeneration during tripping and casing running operations



## Optimization of Power Distribution

Automated generator operations, reduced power inefficiencies and blackout downtime events



## Reduced Secondary Impact

Fewer diesel delivery trucks, translating into reduced road wear and engine maintenance



## Reduced Rig Emissions

Green house gases, light pollution and noise



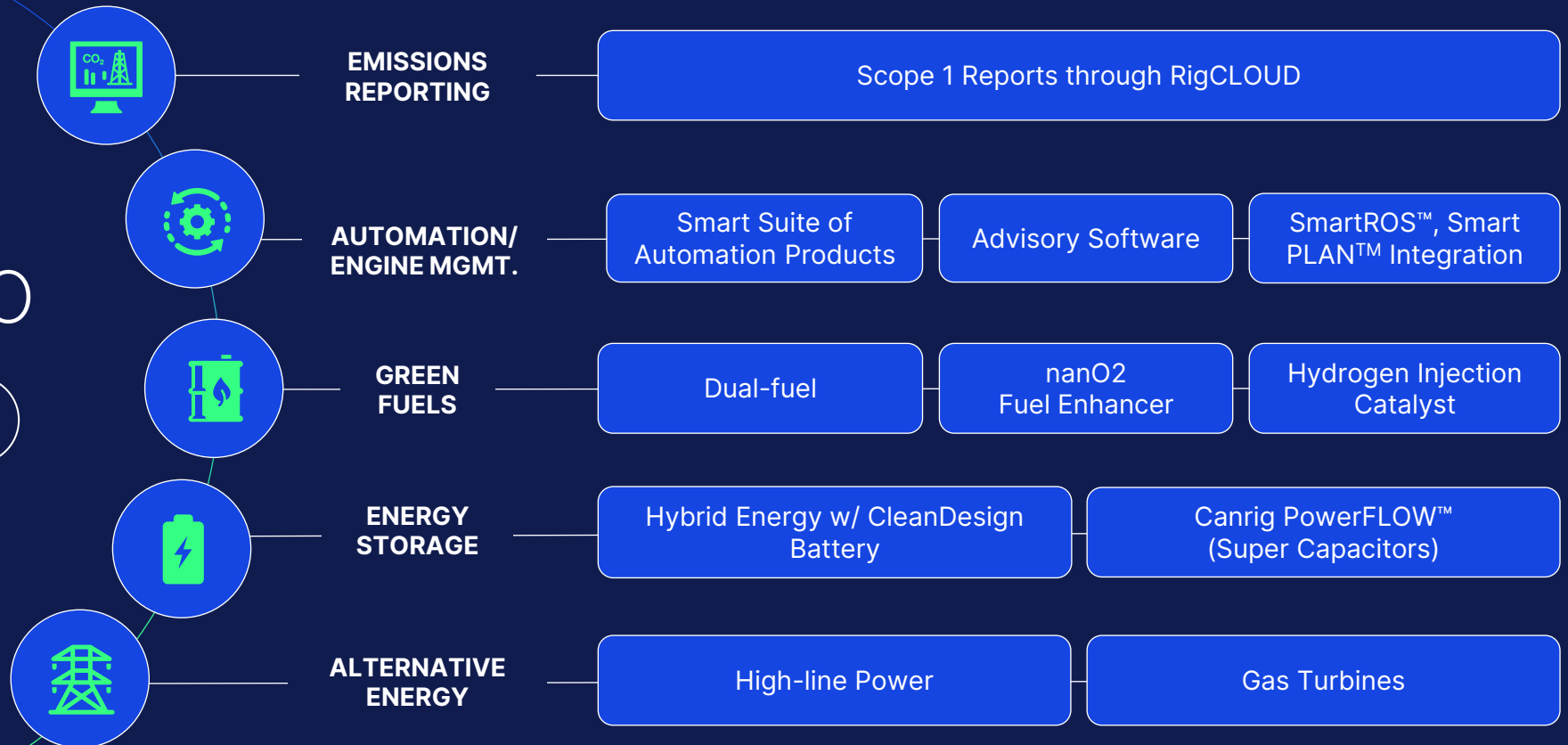
## Green Incentives

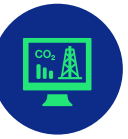
Carbon Credits from government and end-users

# Enhancing Our Portfolio

## Energy Transition Solutions

Our Energy Transition Solutions portfolio of advanced and automated technologies is **purpose built** to reduce carbon emissions and improve fuel efficiencies of drilling operations.





## EMISSIONS REPORTING

# Rig Emission KPIs

The rig is equipped with controls and modules, installed on the engines to track engine loads and transmit the data back to a central server, calculating the fuel usage and emissions information which is afterwards consolidated in the End of Well report.



Breakdown by activity enables identifying engine efficiency improvement opportunities



Live visibility of generator loads can that can be accessed through RigCLOUD®



Monthly reports are generated and distributed throughout the business to:

- Drive reduction in emissions
- Helps identify rigs and areas with improvement opportunities
- Identify where training can be developed to drive a more efficient operations

## POWER & ENGINE MANAGEMENT

# SmartPOWER™

Today, most engines are not actively managed on drilling rigs.

Successfully optimizing engine usage can reduce emissions, provide fuel costs savings, streamline maintenance and enhance energy storage solutions.

Nabors is deploying solutions to provide drillers with recommended number of engines to run for different operations based on historical and EDR data and is bringing to market solutions that automate those controls.



### SmartPOWER™: Advisory

Apply artificial intelligence(AI) based algorithms to real-time drilling data to advise the driller on the optimal number of engines to run per task.



### SmartPOWER™: Controls

Better manage generators by automating the start and stop of engines based on advisories. Develop engine de-rating module to account for altitude, coolant temperature, oil condition and filter condition to further optimize decision making.



### SmartPOWER™: Maintenance

An add on option for both advisory and control tiers of SmartPOWER. Maintenance provides engine-based condition monitoring, alerts, maintenance, run hours tracking, and identifies the best engine to start/stop.

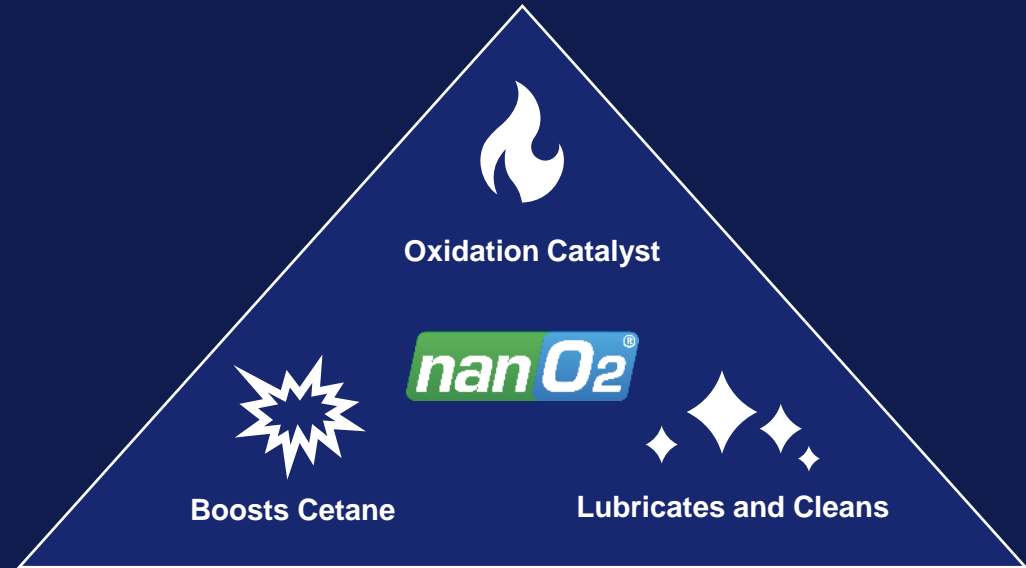


## GREEN FUELS

# Fuel Enhancer

nanO2<sup>®</sup> is a combustion catalyst diesel fuel enhancer that reduces emissions, improves fuel efficiency and increases engine performance; reducing combustion temperatures

Testing in real-world environments has resulted in up to 8% Fuel consumption reduction and 20-50% reductions of emission without the requirement of costly engine modifications.



FUEL CONSUMPTION REDUCTION



CO EMISSION REDUCTION



NOX REDUCTION



EXHAUST OUTLET TEMP REDUCTION



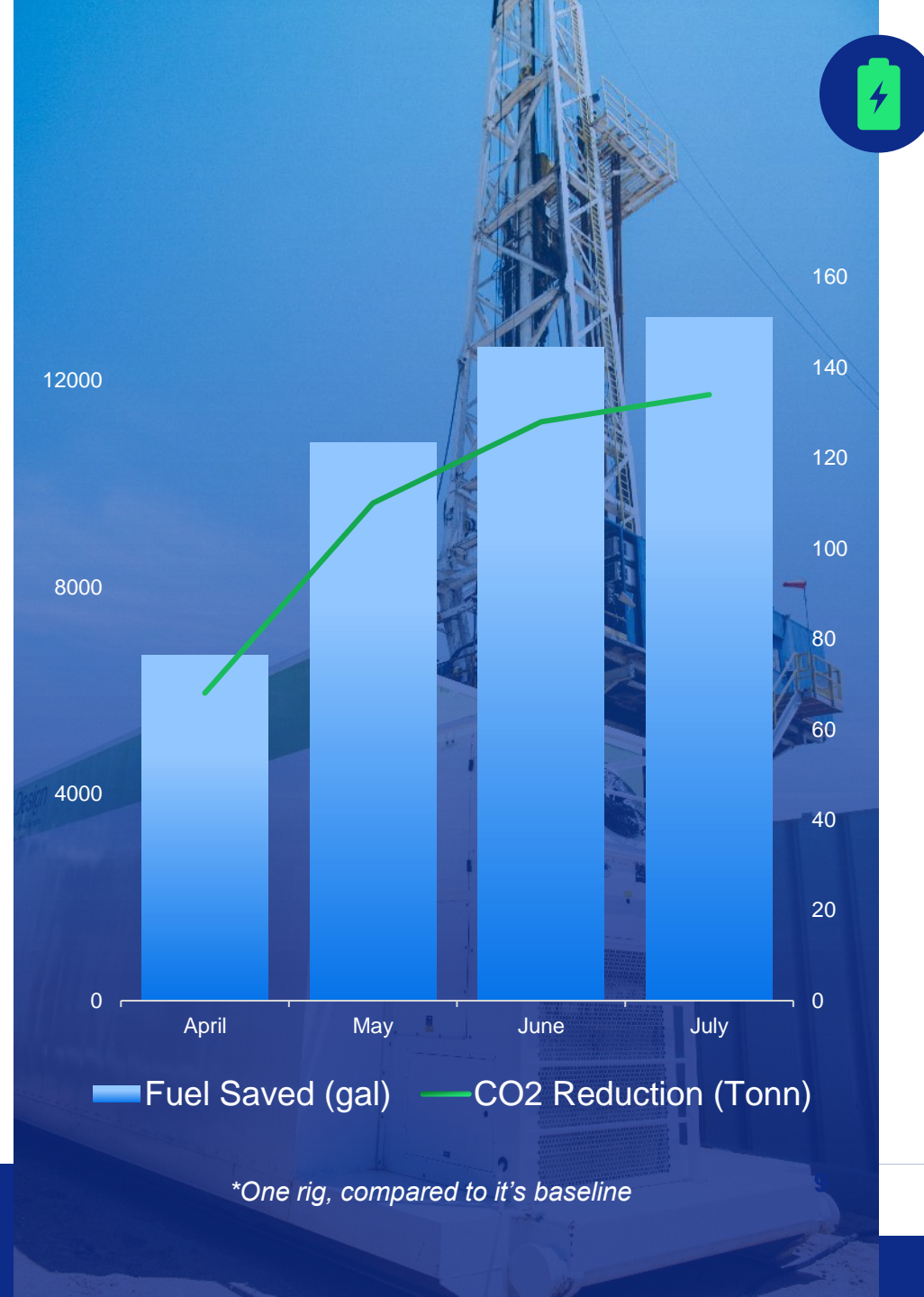
PARTICULATE MATTER REDUCTION



# Hybrid Energy Management System (hEMS) with CleanDesign Battery

The hEMS upgrades any drilling rig into a hybrid rig, using CleanDesign battery energy storage and an automated engine management system to reduce the number of gensets operating.

## Proven Results:



\*One rig, compared to it's baseline



## ENERGY STORAGE

# Canrig PowerFLOW™ Super Capacitor Energy Storage Solution (ESS)

Canrig PowerFLOW™ combines a Super Capacitor Energy Storage Solution (ESS) and a Power Management System to provide a true Peak Shaving® Solution, reducing the required number of online gensets.

Patented DC bus technology, and with the use of Super Capacitors, allows PowerFLOW™ to provide immediate power for load spikes during tripping and other operations, and maximizes energy capture during drawworks braking, improving the drawworks motor acceleration curve and reduces the need for diesel generated power above base load.

Improves Drawworks  
Acceleration

Safer than Lithium-ion Batteries

30+ Year Life

Estimated 25% Fuel  
Savings

The patented DC bus technology provides immediate and highly efficient capture of regeneration during drawworks braking.

No Maintenance Required  
for Capacitors



Where **High-Line power is available**, a Canrig PowerTAP™ module can be installed to accept grid power and interface with the VFD system – directly providing all electric **power to the rig without the need to run engines**.

# Proven Results

**Nabors has successfully:**

- ✔ Implemented hybrid energy storage management systems
- ✔ Tested & utilized fuel additives
- ✔ Tested hydrogen injection as a catalyst
- ✔ Equipped 40 rigs with the capacity to utilize a dual-fuel system



## Diesel Enhancer

**8%** DAILY REDUCTION IN FUEL CONSUMPTION PER RIG PER YEAR



**72 million Smartphones** charged a year

## Battery System

**1,608** TONNES OF CO<sub>2</sub> PER RIG PER YEAR



**194 Homes** powered for a year

## Hydrogen Injection Catalyst

**15%** DAILY REDUCTION IN FUEL CONSUMPTION PER RIG PER YEAR



**2.8 million miles driven in a year** = going 112 times around the globe

Source: <https://www3.epa.gov/carbon-footprint-calculator/>



# Appendix

*ENERGY SOLUTIONS*



## ALTERNATIVE ENERGY

# Dual-Fuel

Dual-fuel (diesel + gas) rig upgrades includes the installation of the required equipment to add natural gas to the engine along with diesel, as well as gas detection and equipment for gas supply shut off.

### Compressed Gas Options

Compressed natural gas or field gas options depending on Operator preference.

### Efficiency (diesel savings)

is dependent on both engine load (which varies gas substitution rate) and gas composition/quality.

### 5% CO2 reductions

Operations have resulted in 5% CO2 reductions against conventional diesel engine

# Engine Oil Consumption Standards

By establishing best-in-class practices, we have improved maintenance performance, while reducing consumption of engine oil.

## OEM Standards

Engine Original Equipment Manufacturers (OEM) traditionally recommend replacing engine oil based on operating hours (e.g. 84 gal every 500 hours).

## Conditioned Based Maintenance Practice

Instead, Nabors developed conditioned based maintenance practices resulting in an increase in oil life by four to eight times. This was accomplished through:

- Added filtration systems to optimize engine's oil life
- Scheduled monthly lubricant analysis

## Benefits

- **Reduction of engine oil consumption**
- **Reduce Maintenance spend by following Conditions Based Engine Maintenance**
- **Reduction of waste engine oil and its associated environmental impact**

**400,000** GAL

CONSUMPTION BASED ON OEM TIME BASED MAINTENANCE RECOMMENDATIONS

— **86,000** GAL

ACTUAL OIL CONSUMPTION BASED ON NABORS CONDITIONED-BASED MAINTENANCE PROCESS

**314,000** GAL

**A 314,000 gallons net savings of engine oil resulted in a reduction in environmental impact by:**

**3,206** METRIC TONES OF CARBON DIOXIDE

**128.74** KGS OF METHANE

**25.12** KGS OF NITROGEN DIOXIDE

*Calculations are based off data collected by Nabors Drilling Technologies USA, Inc. Similar condition-based maintenance is followed on all lubricants, including hydraulic oil, gear oil, engine coolant, etc.*

# Rig LED lighting

Nabors has been using LED lighting on our New Build drilling rigs since **2012**.

**\*77 rigs** have been built with this setup:

- 64 – *US & LATAM*
- 13 – *Saudi*

*\*See Business Case in Appendix*

## Amount of CO2 Reduced

