

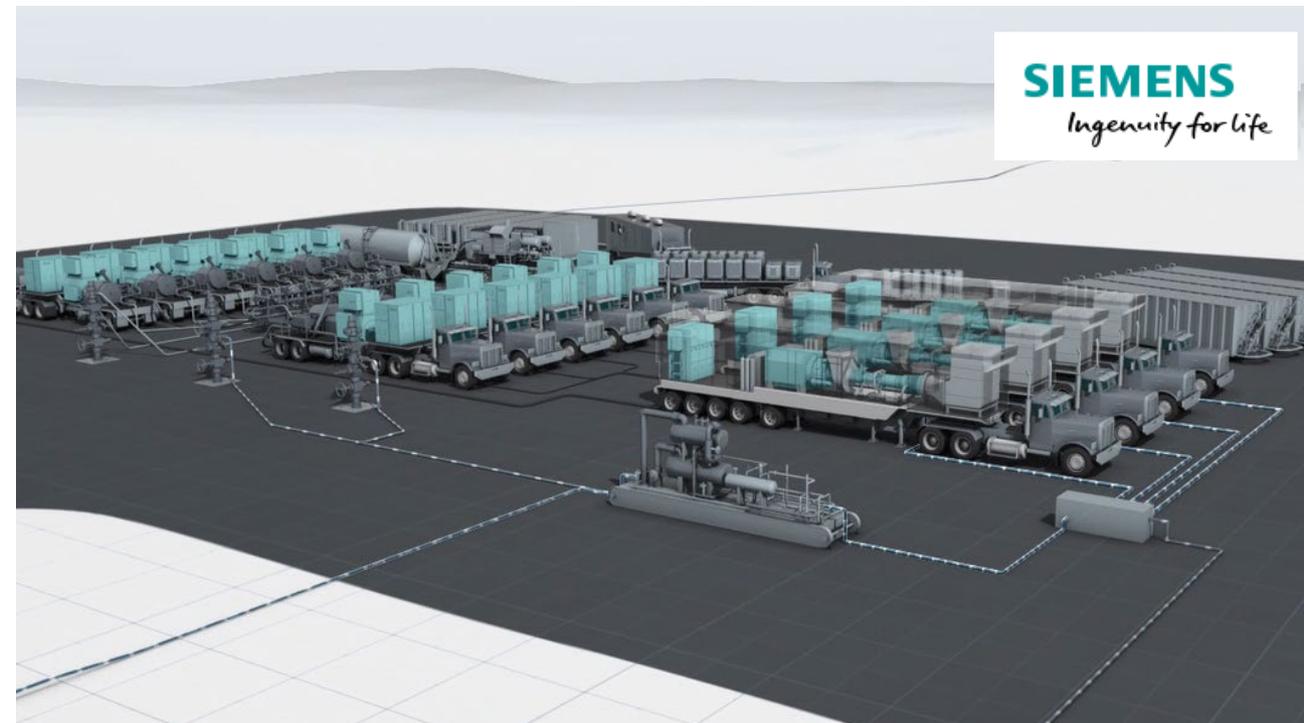


GTEN 2019 Symposium

October 21st - 23rd, 2019

Power to Drive Fracing 2.0: Modular Electrification Solutions that Easily Scale

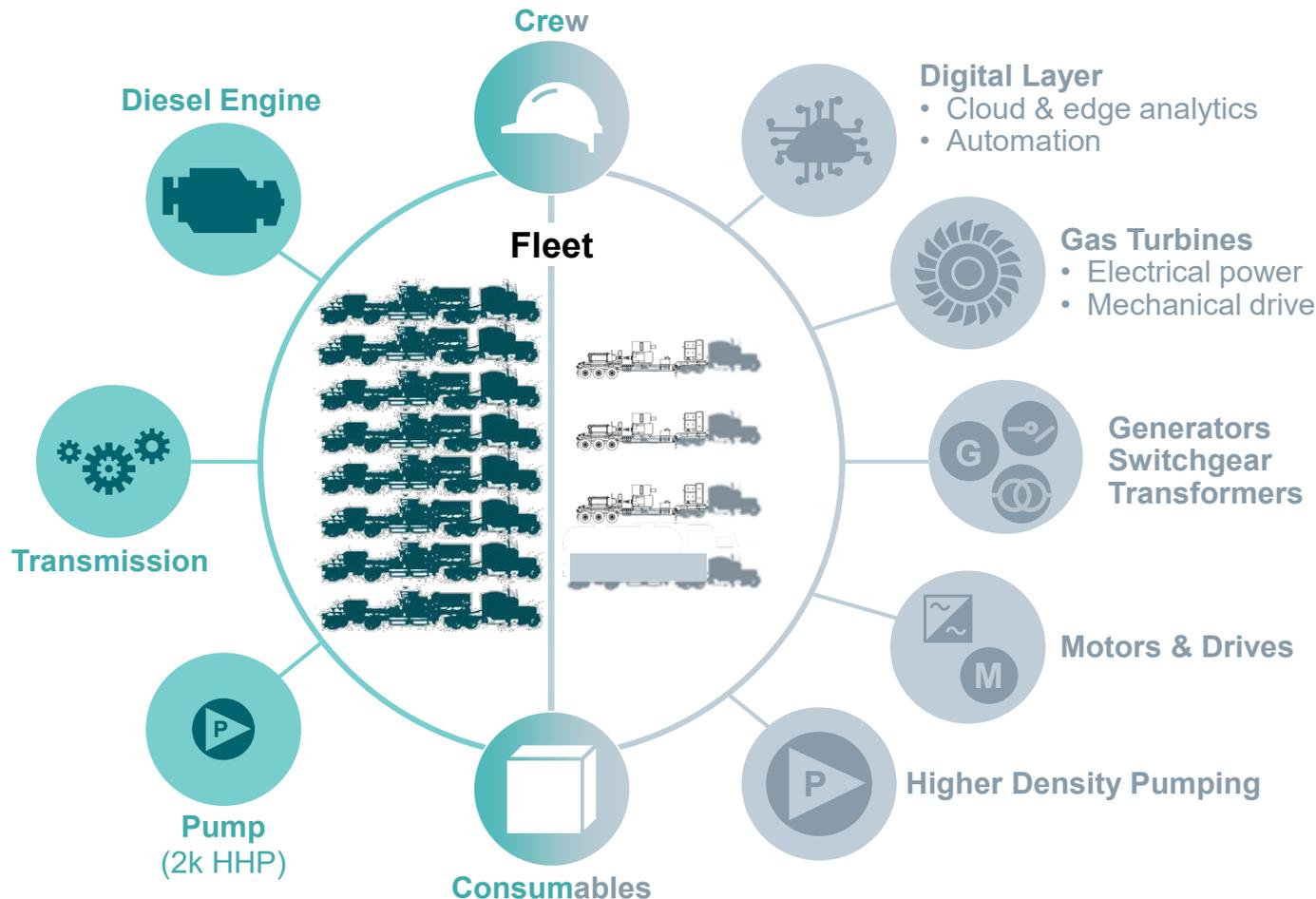
Dalia El Tawy
Director, Global Unconventional Oil and
Gas Solution Development
Siemens Energy, Inc



Electrification and Digitalization of pressure pumping is underway

Interest is growing

INCUMBENT – Frac 1.0 → INNOVATORS – Frac 2.0



First and second generation designs deployed and in commercial operation

- More power density
- Fewer people
- Lower operating cost
- Better environmental performance

Fleet growth accelerating in early adoption phase

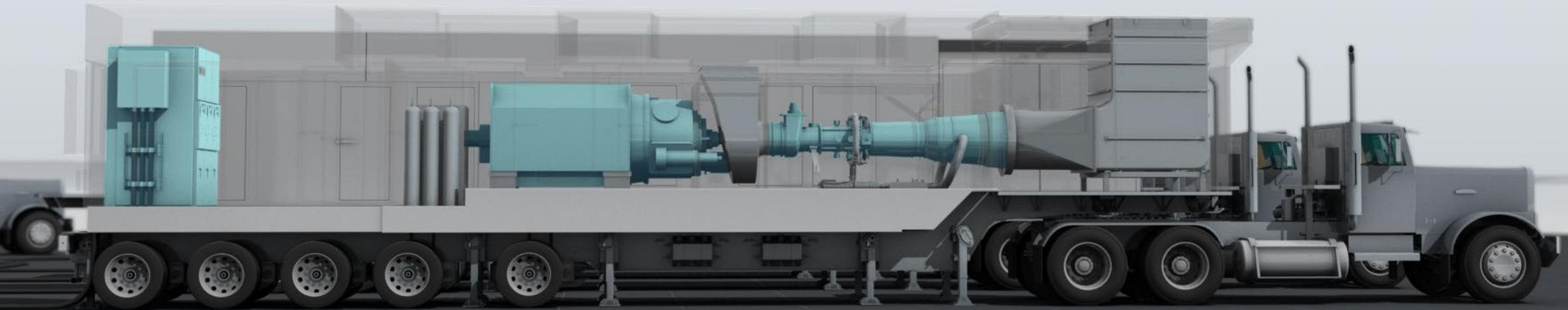
- Pace uncertain

Innovation and creativity evident

- New systems and approaches
- Improved efficiencies

Fast Mobile Power

- Rig up in **under 2 hours**
- Full power **within 1 minute**
- Single trailer design
- **Minimal** maintenance requirements
- DOT permit weight
- **Quiet**
- **Fuel savings** from burning wellhead gas

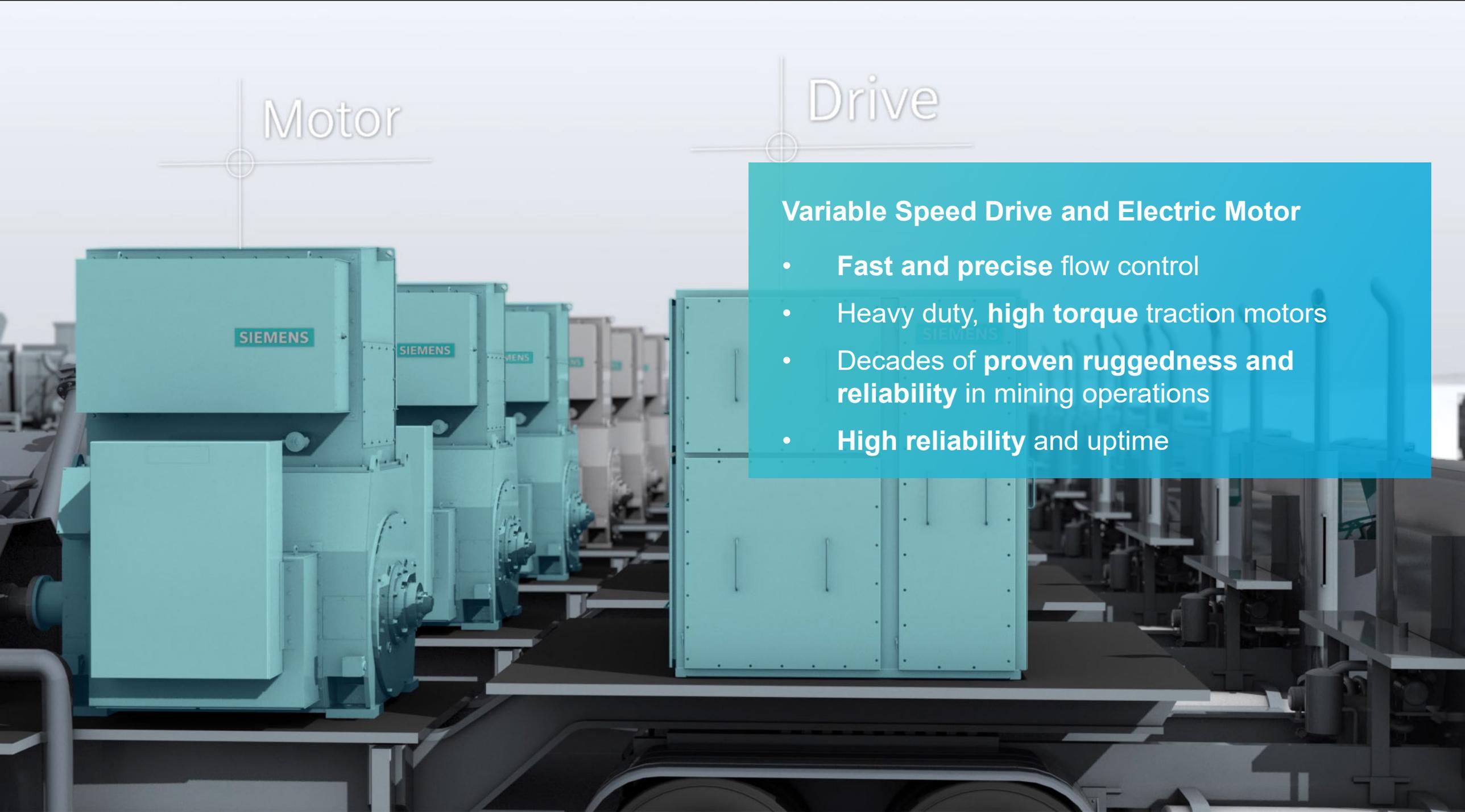


Motor

Drive

Variable Speed Drive and Electric Motor

- **Fast and precise** flow control
- Heavy duty, **high torque** traction motors
- Decades of **proven ruggedness and reliability** in mining operations
- **High reliability** and uptime



SGT-A05 KB7HE

Siemens new and improved SGT-A05 KB7HE
Aero-derivative gas turbine

Simple cycle power generation: 5.8 MW(e)



SGT-A05 Mobile Power key dimensions and Service information

OA Height: 13.79 ft

OA Length: 53.0 ft

OA Width (over door latches): 8.57 ft

Weight: approx. 110,000 lbs

5 axles: with 2 x steerable and 1x lift axle

Mobility implications

- Permit Load
- No flag car
- Bridge ready
- Designed for mobility on well pad site and off-road shock and vibration

Service interval

GT Overhaul:

- 30 000 hrs light overhaul
- 60 000 hrs heavy overhaul

Aero engine fast core swap-out

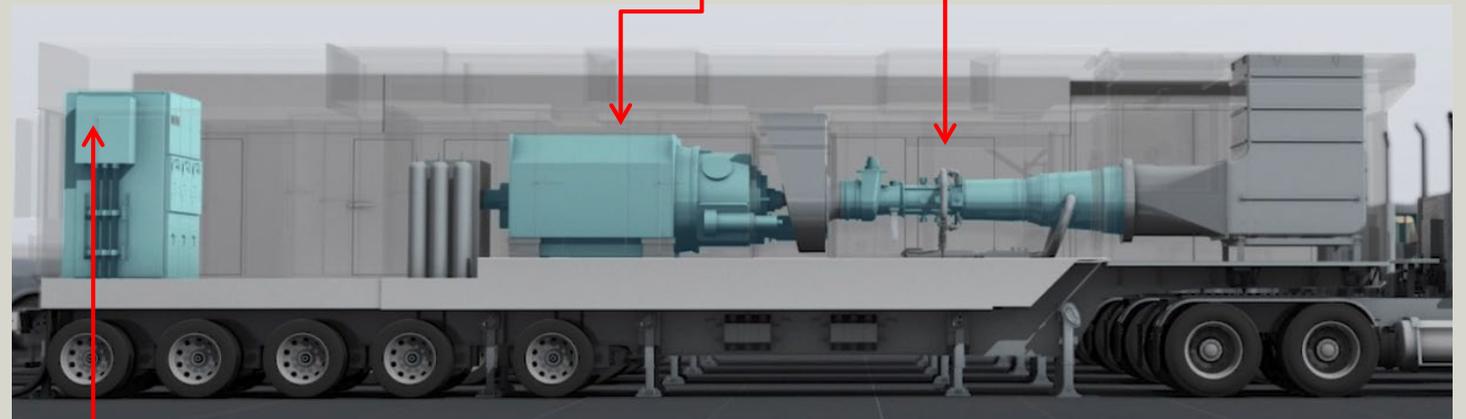


SGT –A05 Mobile Power Configuration



Complex design with three core areas:

- Package Design for mobile applications
- Siemens SGT-A05 Gas Turbine + Gearbox and Generator



- Siemens Gas Insulated MV Switchgear NXPLUS C

SGT-A05 Mobile Power Standard configuration

On site activities

- Level the unit
 - Unlock gearbox
 - Fire suppression activation
 - Connect
 - gas manifold
 - black start generator
 - power cables
 - (Pre-warm lube oil if required)
 - Start to full power in 1 minute
-
- Down to 2 hours rig-in with practiced team.
- ## Noise
- Far Field
 - 59 dBA at 350'
 - 69 dBC at 350'
 - Near field noise limit averaging 85dBA Near Field 3ft at ground level
 - Ultra quiet option available



Mobile Gas Turbine Generator units



Reduce Noise levels



Reduce maintenance costs



Eliminate unplanned asset downtime



Reduce fuel costs



Reduce emissions

Scalable mobile units



SGT A05



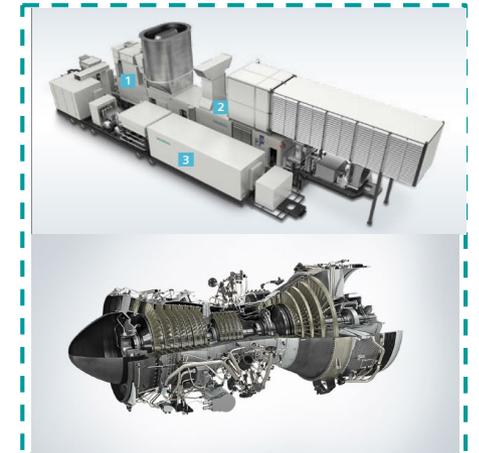
Proven and deployed

SGT 300



In Development

SGT A45



Proven and deployed

- Fuel Flexible
- Emmissions compliant
- Fast rig up and down
- Hot start
- Low community impact
- Compact

SGT 300 Mobile Power Overview – in development

Compact

Single trailer solution

Fast rig up and down

- 4 hours rig-in.

High Availability

- No 'hot lock-out' . Rugged and proven work-horse

Low impact on communities

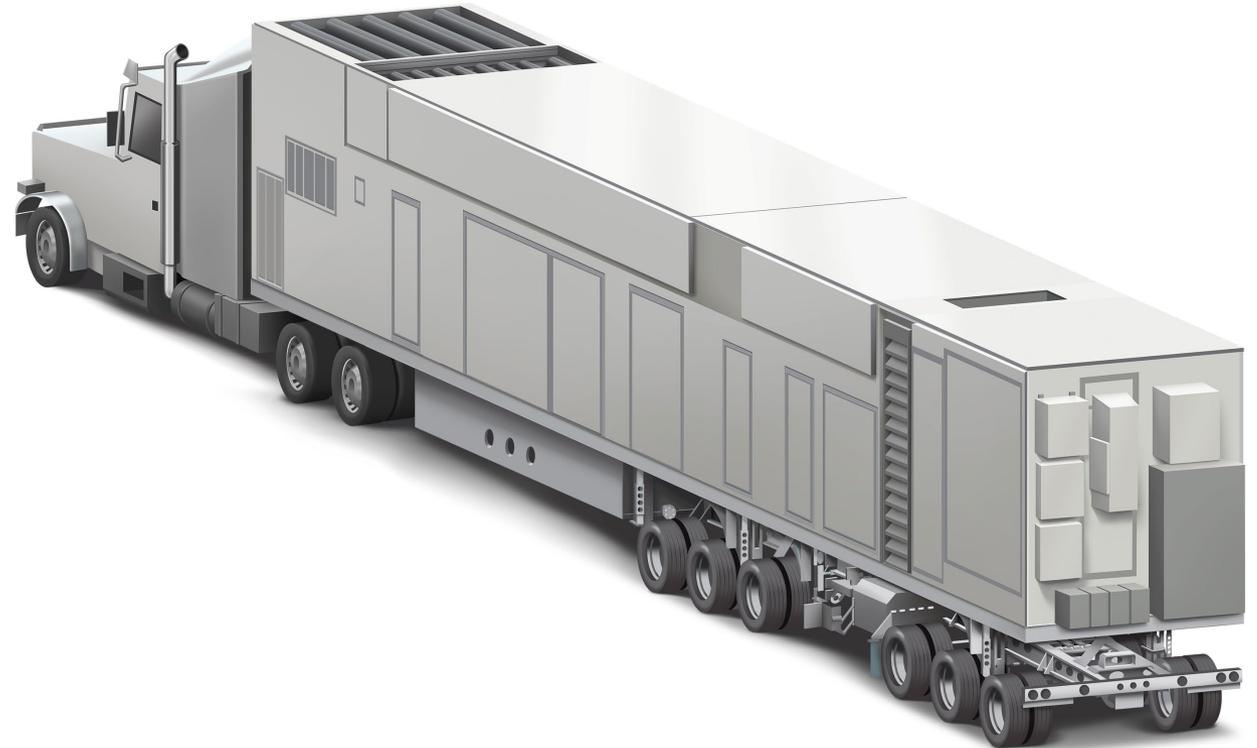
- Quiet, Near field 90 dBA or better

Meets stringent emissions targets

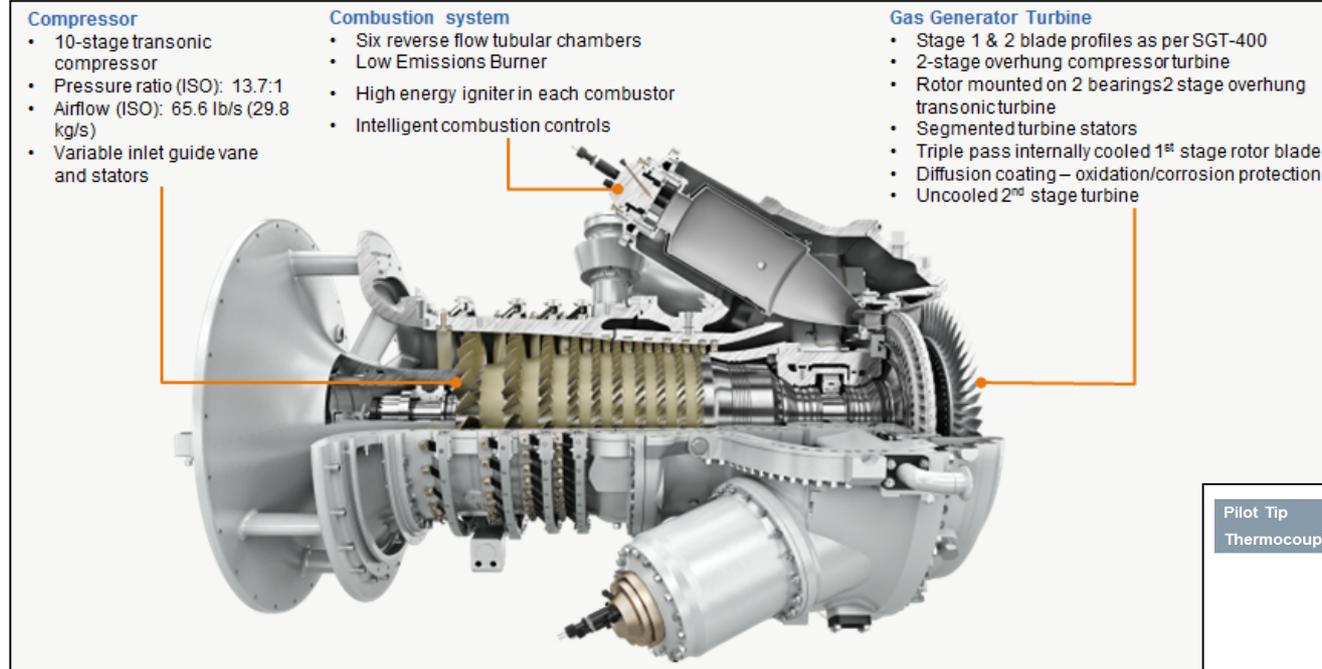
- Dry Low Emissions (DLE) combustion reduction system
- High levels of fuel flexibility. Capable to burn wide range of well head gases

Key Metric

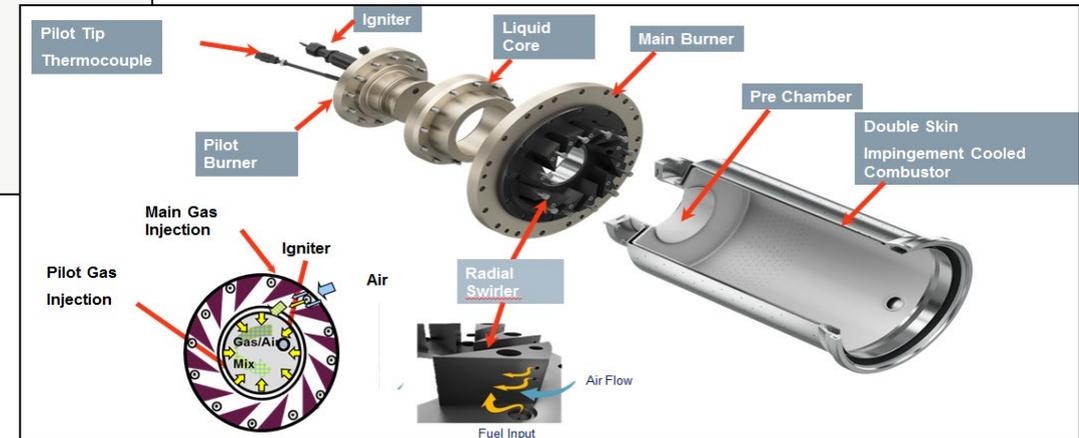
- Turbine 7.9 MWe @ ISO conditions



SGT-300 Dry Low Emissions Combustion



- 7.9 MW (e) at ISO conditions
- 15 ppm NOx @ 15% O2 Dry
- Six reverse flow tubular chambers
- Low Emissions Burner
- High energy igniter in each combustor
- Intelligent combustion controls
- Automatic changeover from primary to secondary fuel
- Wide range of fuel flexibility
- Radial swirl air injection for fuel optimization



SGT-300 DLE – Continuous Research & Development supported by millions of operating hours & rig testing to enhance fuel flexibility and reduce emissions

SGT-300 Fuel Flexibility



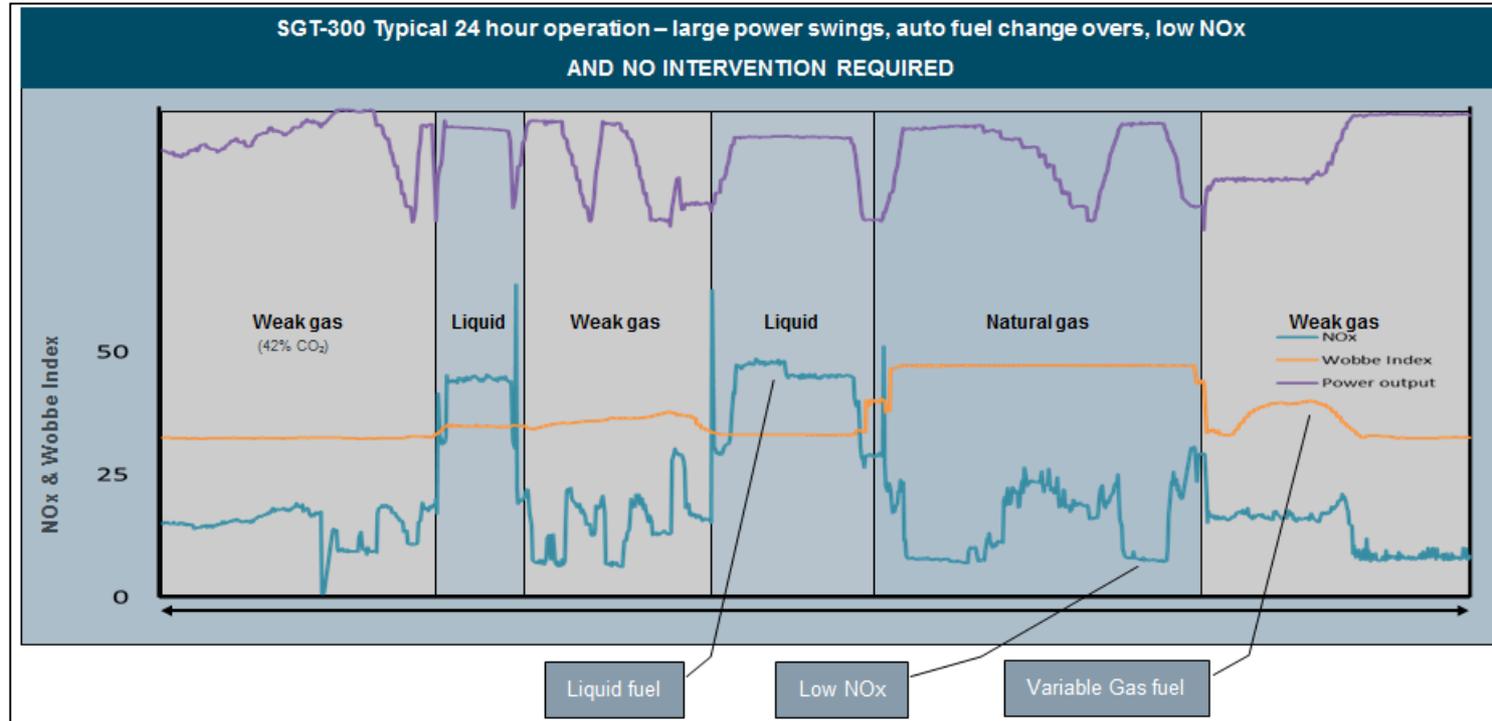
- Experience with traditional and alternative fuels, including landfill and associated gas.
- Detailed specifications driving the fuel requirements to meet performance criteria.
- Pre-treatment of wellhead gas mainly includes:
 - Heating to a minimum of 212 degree F
 - Coalescing filtration to eliminate moisture



154 Siemens SGT-300 are under contract
345 Siemens SGT-400 are under contract

Numbers of sold units | May 2016

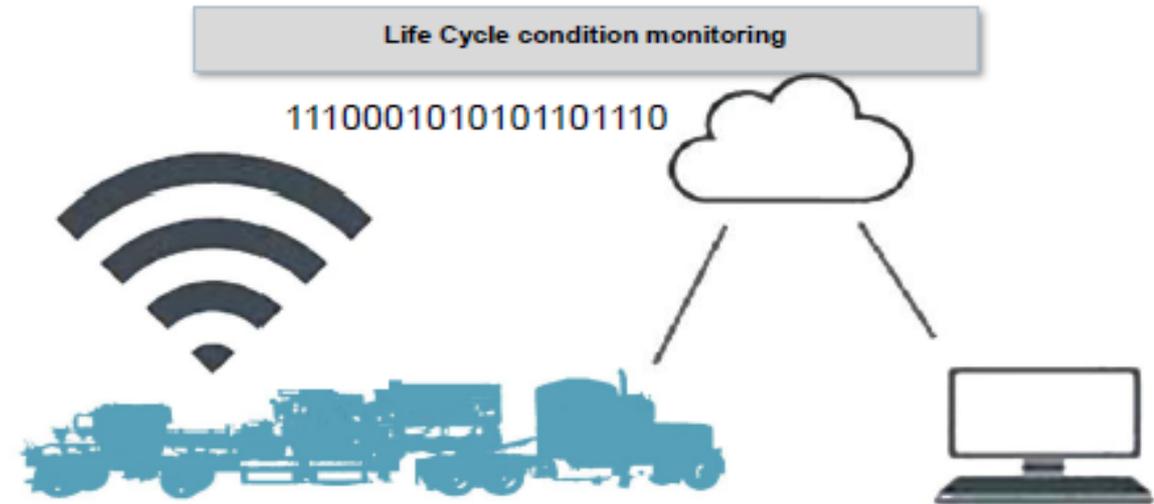
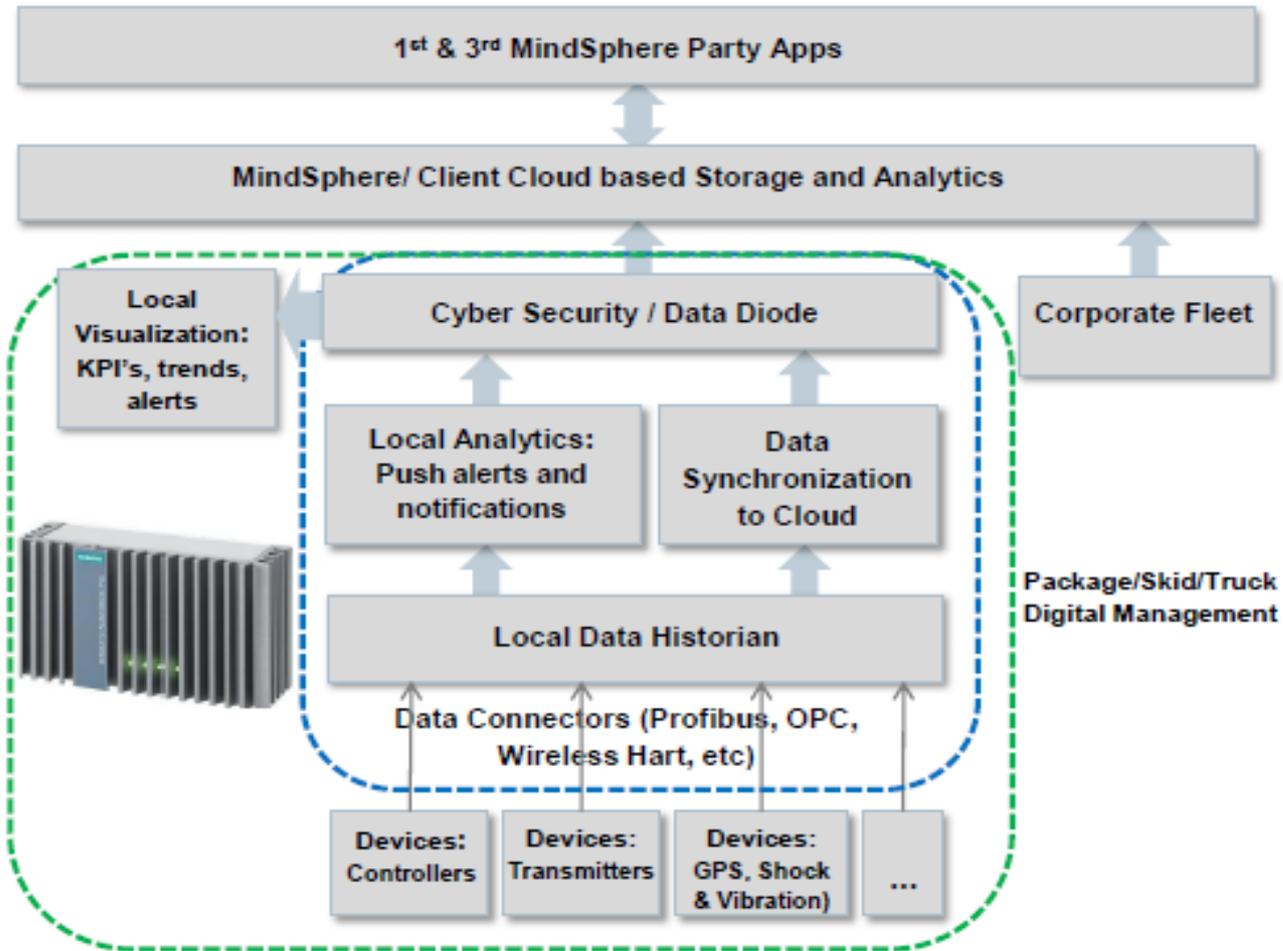
SGT-300 – more than 5.3 million operating hours
 SGT-400 – more than 2.5 million operating hours



Actual operating data of a SGT-300 DLE with a tri-fuel system (natural gas, liquid fuel, and landfill gas)

SGT-300 DLE – Wide range of fuel flexibility and low emissions compliance proven globally

Digital Solutions and Drive Train Analytics



- Life cycle history of transportation conditions (Shock & vibration) with monitoring and alarms in transit
- Pre-mobilization mapping of road conditions for driver awareness and route planning
- Real time situation awareness & updates to driver
- Site level comparison for key equipment of factory operating signature to first start on site with alarms
- Ongoing monitoring and analysis of performance characteristics on site and in cloud

Lower Capex and increase reliability

- High density pumps – more HHP for the same footprint
- High density generators electric motors and integrated drives
- New distribution architectures

Improve environmental performance

Energy efficiency & low carbon intensity

- Hybrid systems for peak load energy mgmt.
- Power management
- Gas turbine exhaust heat recovery
- Grid connections to renewable energy sources

Emissions

- Dry low emissions combustion systems

Reduce Operational costs

- Digital strategies for fleet management – increasing availability and reliability of deployed systems
- More sophisticated process controls and learning systems for optimization
- Remote Monitoring and Operations with increased automation
- Increased use of flare and wellhead gas streams

Sustainability measures addressed

Where is value being created?

Environmental Metrics



Energy Efficiency



Pollution Emissions to air



Traffic pressure



Noise levels

Economic Metrics



Capex per HHP utilized



Opex: maintenance costs



Process optimization through data analytics and better control



Fuel costs



Improved reliability Redundancy and NPT



Capital efficiency Asset availability



Site footprint cost and impact



Manpower requirements



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