



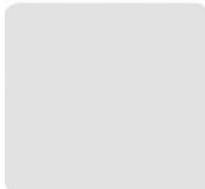
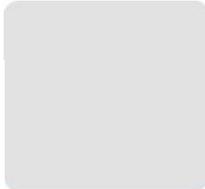
# TRRC Natural Gas Workshop:

# Drilling Rig Natural Gas Technology

Todd Fox

VP- Engineering & Technical Services

February 26, 2014



# MISSION ZERO

Nabors is committed to the safety of our employees worldwide. We strongly believe that all our global operations can and must achieve our goal of zero incidents. We expect every Nabors employee to share this commitment as a condition of employment.



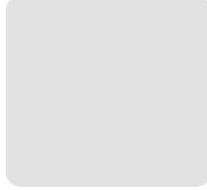
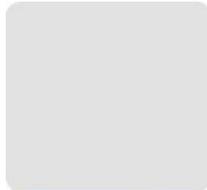
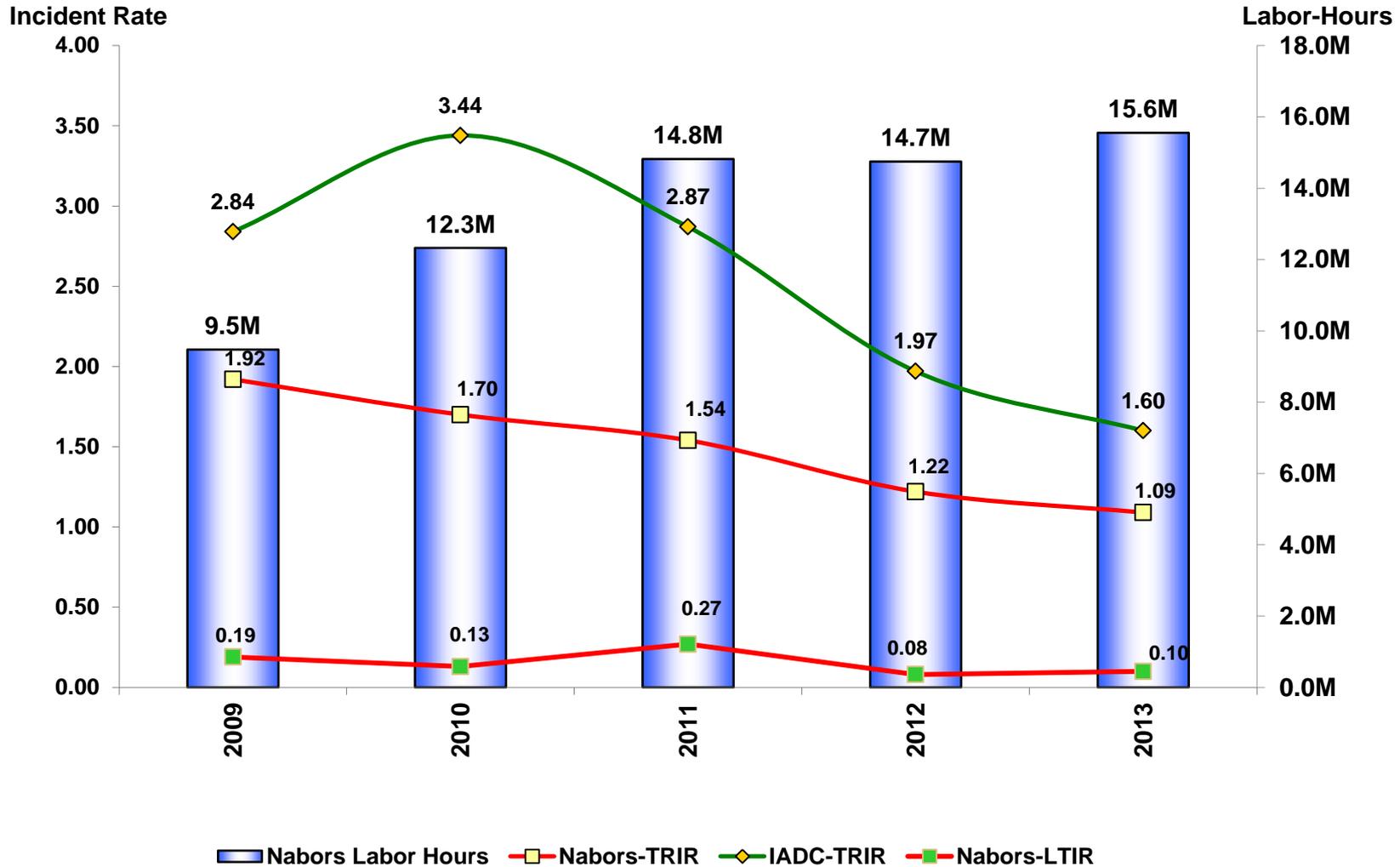
Anthony G. Petrello  
Chairman, President & CEO

MISSION  
ZERO



Safer,  
Smarter –  
Incident Free

# Nabors USA Safety Performance 2009 – 2013

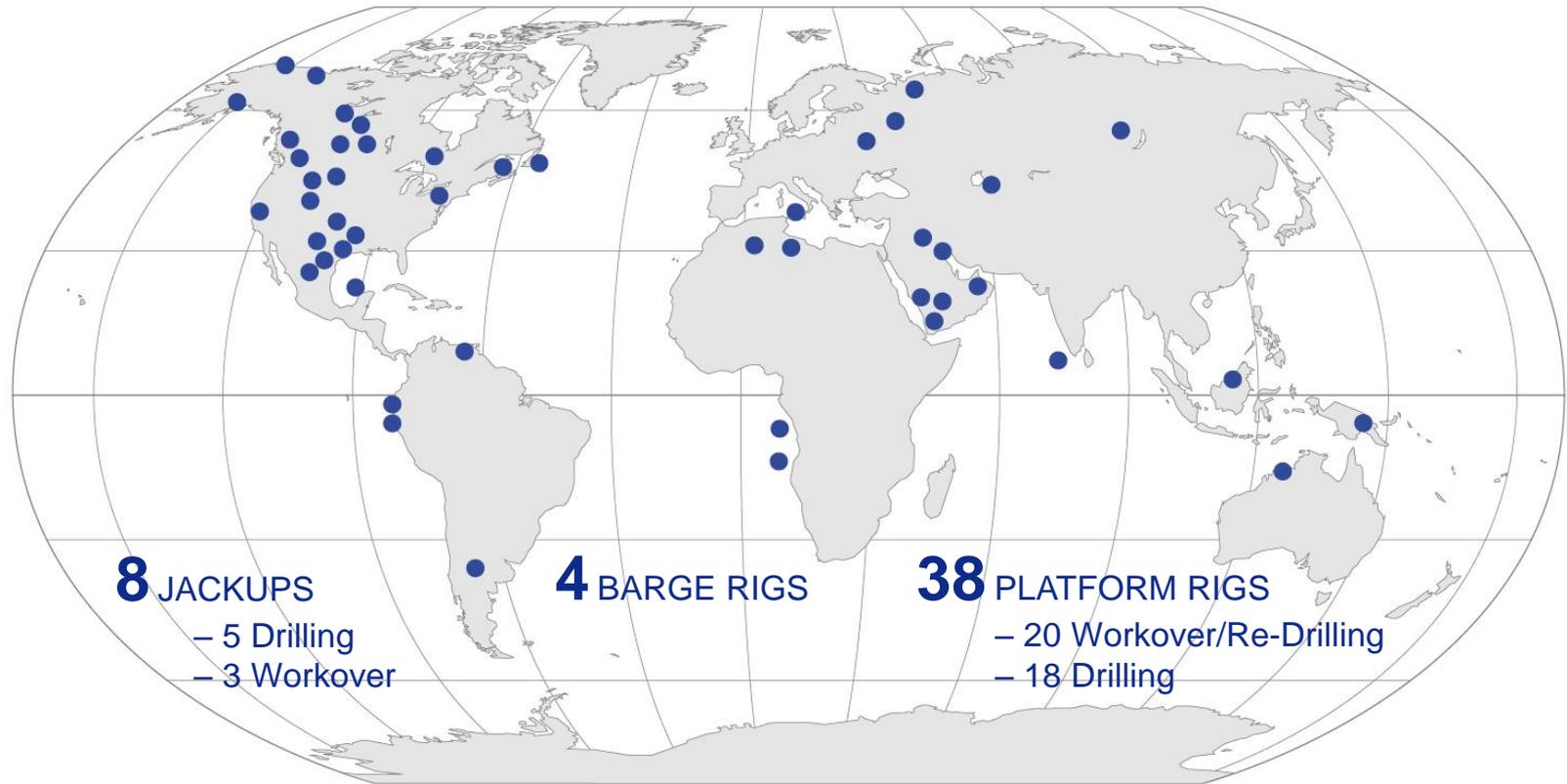




## **Drilling Rig Natural Gas Technology Overview**

# Worldwide Rig Fleet Status

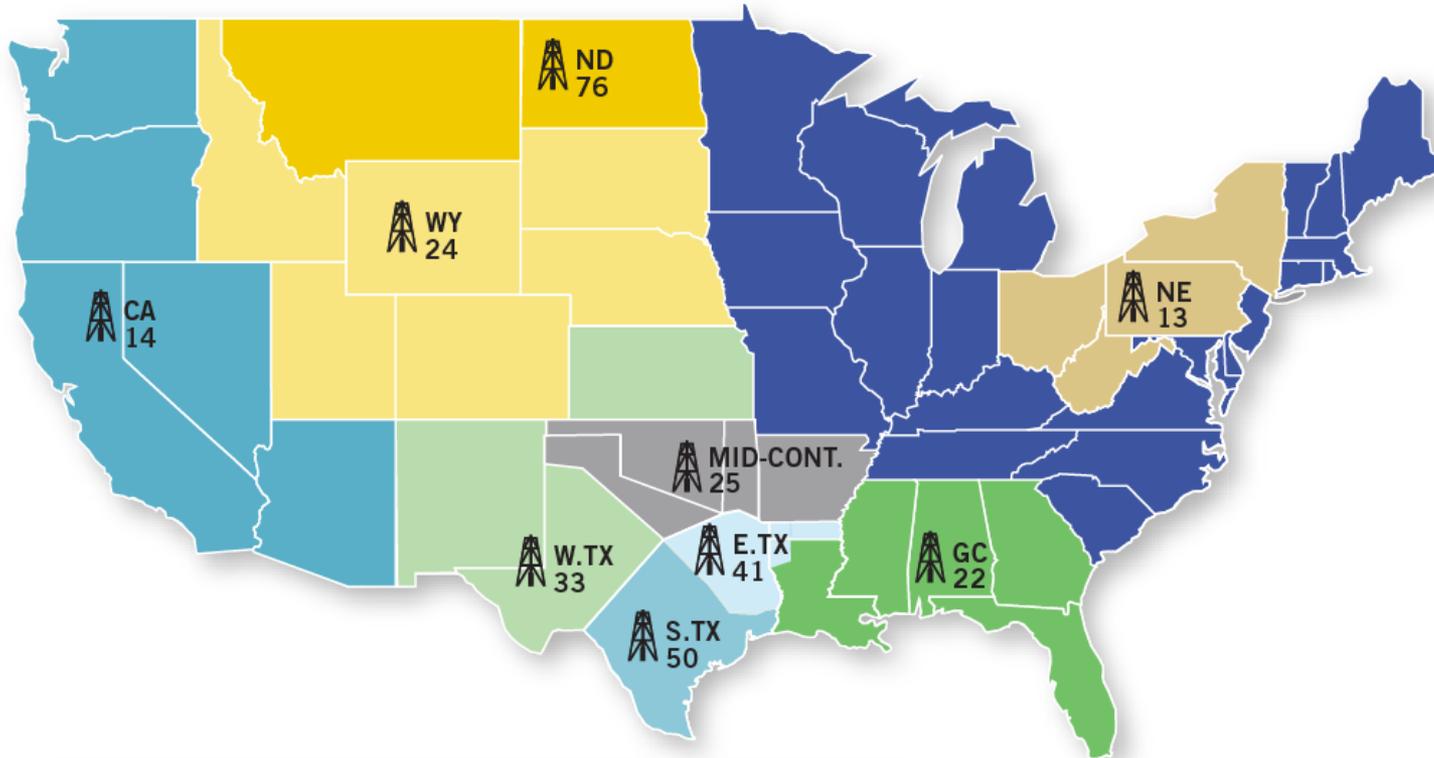
Actively Marketed Rigs Only  
As of December 31, 2013



**549** LAND WORKOVER RIGS

**490** LAND DRILLING RIGS

# US Operations



Northern Division	2002	2012	Southern Division	2002	2012
California	8	14	East Texas	20	41
Mid-Continent	3	25	Gulf Coast	6	22
North Dakota	9	76	South Texas	8	50
Northeast	N/A	13	West Texas	8	33
Wyoming	7	24			

**Actively Marketed Rigs  
As of September 30, 2012**

# A transition to alternative fuel- currently two methods

1. Dual Fuel- add-on to existing engines, 51 rig installations to date.

2. 100% Natural Gas- new engines, 2 rig installations to date (2013).



# Natural Gas Supply- 4 current methods

1. Wellhead

2. Pipeline

3. LNG

4. CNG



# Push Back to Natural Gas

- > **Supply concerns due to lack of reliable infrastructure.**
- > **Safety concerns.**
- > **Few first adopters.**
- > **Concerns regarding return on investment.**
- > **Technology and rig performance barriers.**
- > **Lack of training and technical expertise on natural gas engines.**



# Natural Gas Safety



# Natural Gas Safety



# Natural Gas Safety



# ENGINE FIRE AND GAS DETECTION SENSORS



**Gas Detector  
Gas Supply Line  
at Power House**



**Gas Detector  
Front of #3 Generator**



**Gas Detector  
Middle of #1 Generator**



**Gas Detector  
Gas Supply Line  
at Edge of Location**



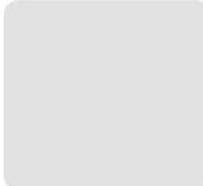
**Gas Detector  
Scrubber Skid and  
Alert Systems Panel**



**Gas Supply Line  
at Power House  
Gas Detector**



**Flame Detector above each Generator  
Set at 190 F.**



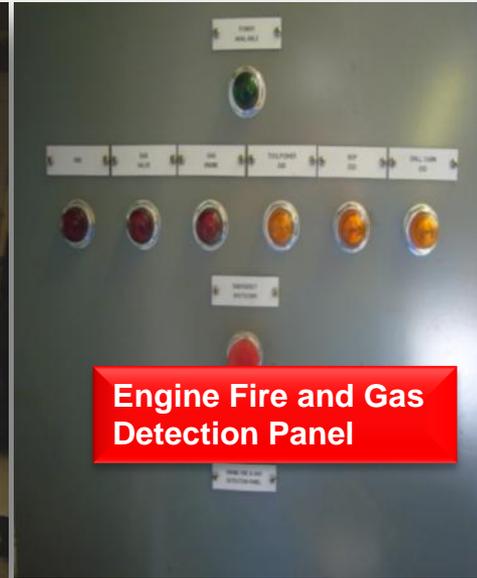
# EMERGENCY SHUTDOWN DEVICES [ESD] LOCATIONS



Driller's Cabin



Rig Manager's Quarters



Engine Fire and Gas Detection Panel



Engine House



Scrubber Skid



# Economics

- > **Primary business driver today for the drilling contractor is increased rig marketability.**
- > **Dual Fuel System savings can be up to 70% yet average 40%. Substitution rate is expected to improve as OEM's enter market.**



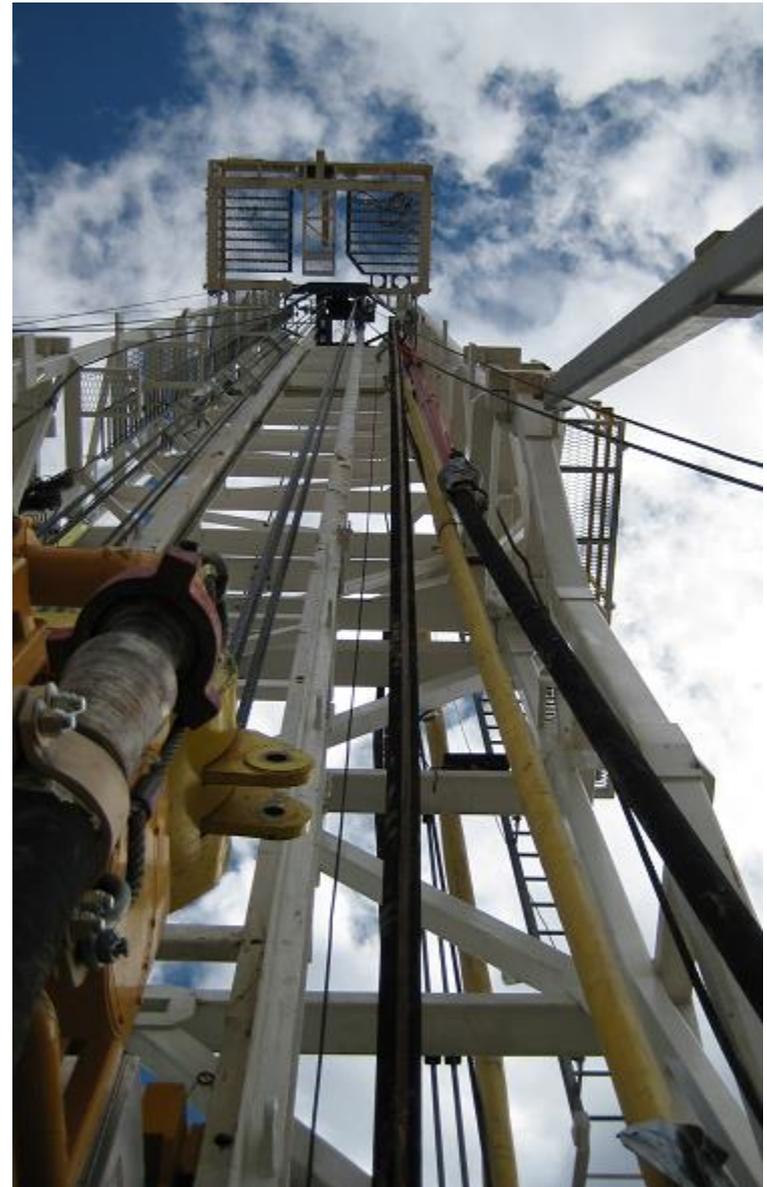
# Economics

- > **Current dual fuel rigs diesel consumption drops by approx. 1,000 gpd.**
- > **DGE (Diesel Gas Equivalent) pricing of natural gas is roughly \$2.10-\$2.50 per gallon.**



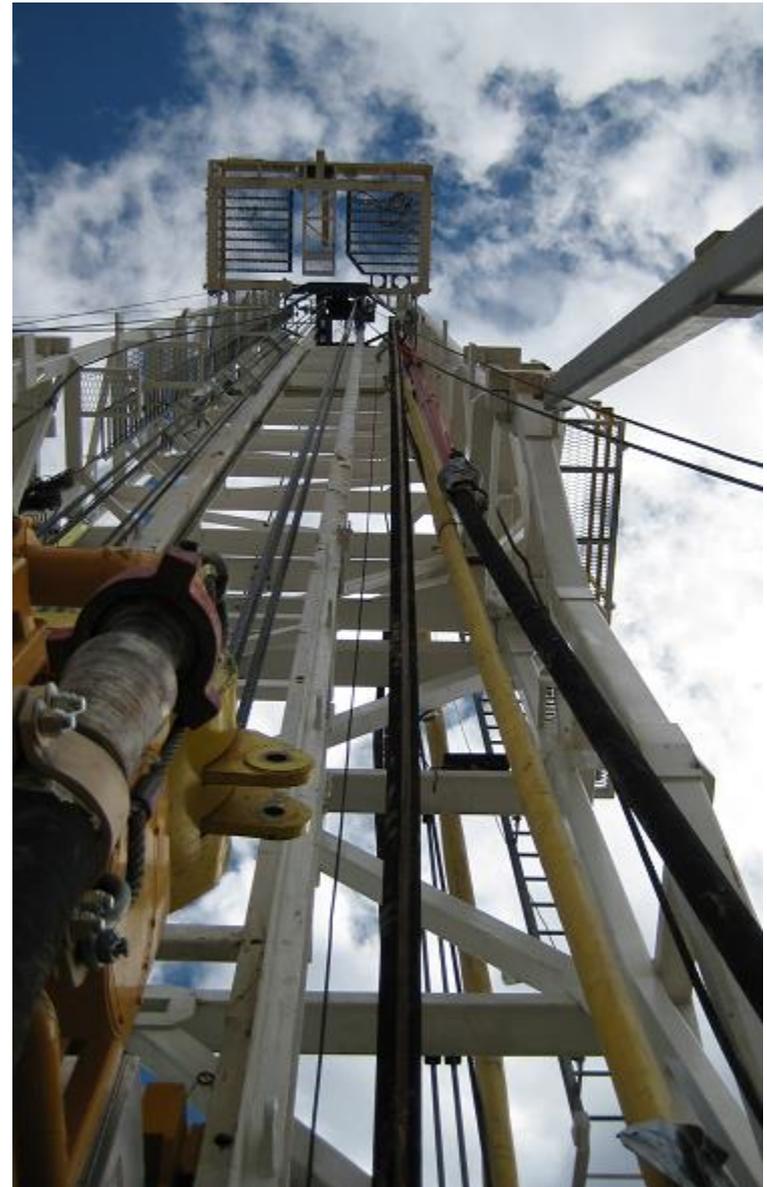
# Forecast for the future (subject to change!)

- > **LNG facilities will become more prevalent, starting with the larger plays- Eagleford and Bakken.**
- > **Frac spreads and trucking fleets will drive the conversion due to better economics. Drilling rigs will benefit as a result due to improved supply chain.**
- > **Engine technology will improve, dual fuel will become a standard feature if the natural price remains low.**



# Forecast for the future (subject to change!)

- > Substitution rates will improve as the OEM's enter the market.
- > As LNG facilities become more prevalent, 100% natural gas engine rigs will become more prevalent.



# Questions?

