

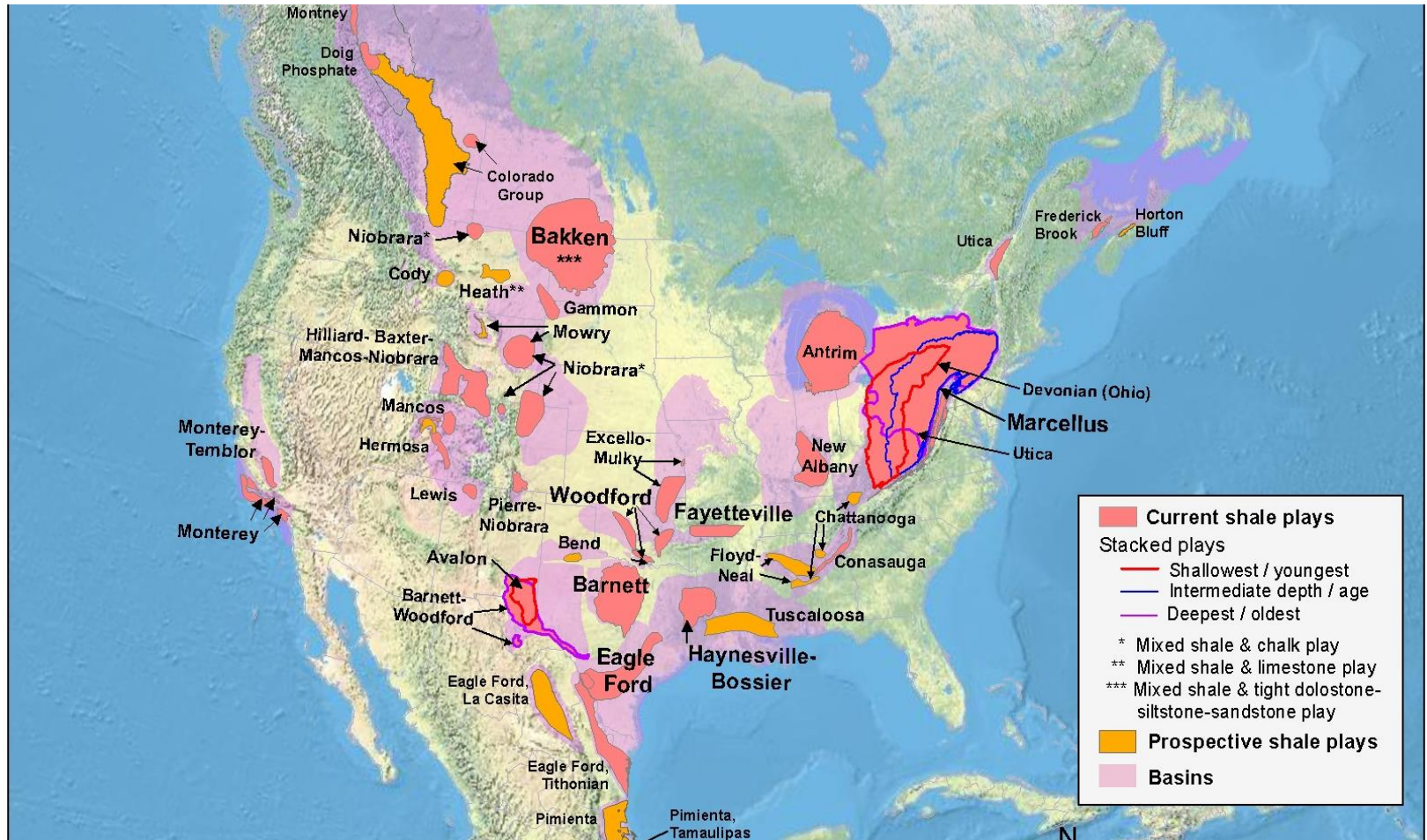
Emerging Markets for Emissions Measurement and Control Technologies in the Natural Gas Industry

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Overview

- ▶ What is oil shale
 - Substitute for conventional crude
 - Very light oil high in sulfur
- ▶ Hydraulic Fracturing
 - Good?
 - Enhanced oil & natural gas recovery
 - Bad?
 - Potential environmental impacts

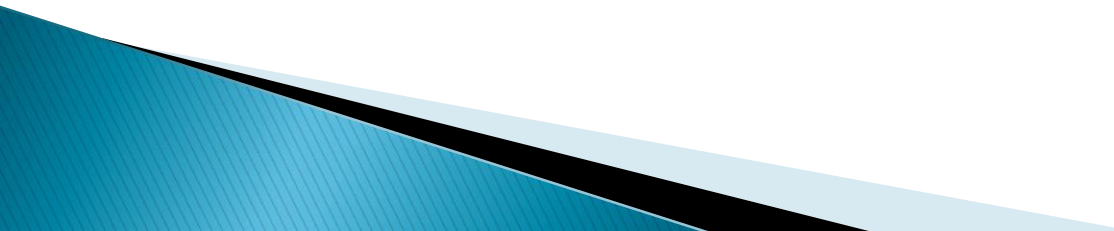
Current Shale Plays in US



Current Exploration

- ▶ Current shale plays
 - Eagle Ford (Texas)
 - Bakken (North Dakota)
 - Marcellus (Pennsylvania, New York)
 - Barnett (Texas)
 - ▶ Perspective shale plays
 - Louisiana/Mississippi
 - Tennessee
 - Permian Basin (Texas)
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Opportunities

- ▶ Boilers
 - ▶ Heat Transfer Medium
 - ▶ Water Treatment (we will not talk here on this subject but worth mentioning in depth)
 - ▶ Air Pollution Control Equipment
 - SCRs
 - Thermal Oxidizers
 - ▶ Monitoring and reporting
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Boilers

- ▶ Package Boilers, Once Through Steam Generators (OTSG)
 - 20K – 200K PPH Steam
 - Applications
 - Both Saturated & High pressure steam
 - Auxiliary Power (Coupled with steam turbines)
 - Enhanced Oil recovery

Heat Transfer Medium

- ▶ Various configurations
 - Typically sized for specific application
 - Shell & Tube, Plate type, & Fluid, etc.
 - Applications
 - Raw Gas Processing
 - Upstream Well Head

Air Pollution Control Equipment

▶ SCRs

- Conventional SCR package
- Applications
 - For NO_x & CO typically
 - All combustion sources upstream & downstream

▶ TOs & RTOs

- Both Thermal Oxidizers & Regenerative Thermal Oxidizers
- Applications
 - For CO, VOCs, GHG

▶ NSCR

- Catalyst & Silencer combinations
- Applications
 - Gas Compression mainly
 - For NO_x, CO, VOCs

Monitoring and Reporting

- ▶ Monitoring
 - CEMS/PEMS
 - CPMS
 - O₂ control
- ▶ Application
 - Boilers
 - TOs & RTOs
 - IC Engines
 - Storage Vessels (Tanks)
- ▶ Reporting
 - Part 63
 - CEMS/PEMS compliance reports
 - CPMS
 - O₂ with Maintenance
 - GHG

Monitoring and Reporting

- ▶ Continuous Emissions Monitoring Systems (CEMS)
 - As defined by Proposed of 40CFR Part 60
 - The total equipment that is used to measure and record a direct reading of all gases such as NO_x, CO, CO₂, VOC, NH₃, and O₂
 - Application
 - Boilers
 - Heat Exchangers
 - RTOs
 - Vents
 - Storage Vessels

Monitoring and Reporting

▶ Predictive Emissions Monitoring Systems (PEMS)

- As defined by Proposed of 40CFR Part 60
- The total equipment that is used to measure and record a direct reading of all gases such as NO_x, CO, CO₂, and O₂
- Application
 - Boilers
 - Heat Exchangers
 - RTOs
 - Vents
 - Storage Vessels

Monitoring and Reporting

- ▶ Continuous Parametric Monitoring Systems (CPMS)
 - As defined by Proposed Performance Specification 17 of 40CFR Part 60
 - The total equipment that is used to measure and record a parameter (currently temperature, pressure, liquid flow rate, gas flow rate, mass flow rate, pH, and conductivity) on a continuous basis in one or more locations.
 - Application
 - Boilers
 - RTOs
 - Vents
 - Storage Vessels

Monitoring and Reporting

O₂ control

- ▶ As per final Rule for Part 63 of ICI Boiler MACT
 - MACT includes oxygen trim systems in the definition of “oxygen analyzer system.” EPA has clarified that operation of oxygen trim systems to meet the oxygen monitoring requirements shall not be done in a manner that compromises furnace safety. The definitions of “oxygen analyzer system” and “oxygen trim system” in 40 CFR 63.11237 read as follows:
 - Oxygen analyzer system means all equipment required to determine the oxygen content of a gas stream and used to monitor oxygen in the boiler flue gas, boiler firebox, or other appropriate intermediate location. This definition includes oxygen trim systems.
 - Oxygen trim system means a system of monitors that is used to maintain excess air at the desired level in a combustion device. A typical system consists of a flue gas oxygen and/or carbon monoxide monitor that automatically provides a feedback signal to the combustion air controller.

Auxiliary Equipment

- ▶ Additional Support Equipment
 - Hot Oil Heaters
 - Cryogenic facilities
 - Amine facilities
 - Ammonia Supply Systems
 - Storage
 - Injection Skids
 - Instrumentation
 - Storage Vessels
 - etc.

Summary

- ▶ Infant industry
 - Fracturing started in the 1950s
 - Last 5–10 years steady but small growth with expected exponential growth
 - Rapid growth in next 5–10 years with US becoming net exporter of Natural Gas
- ▶ Estimated at Trillions of available cubic feet of NG and barrels of Oil
- ▶ Rapidly growing at a rate that is outstretching workforce and materials
 - How do we handle it?

Q & A

