

Progress and Outlook for the Department of Energy's Office of Oil and Natural Gas Midstream and Methane Hydrate Research and Development (R&D) Activities*

Timothy Reinhardt¹

Search and Discovery Article #70382 (2019)**

Posted February 18, 2019

*Adapted from oral presentation given at AAPG 2018 AAPG Annual Convention and Exhibition, Salt Lake City, Utah, May 20-23, 2018

**Datapages © 2019 Serial rights given by author. For all other rights contact author directly. DOI:10.1306/70382Reinhardt2019

¹U.S. Department of Energy, Washington, DC, United States (timothy.reinhardt@hq.doe.gov)

Abstract

This presentation will provide an overview of the Department of Energy's Office of Oil and Natural Gas – Division of Supply and Delivery, and its current and potential R&D activities, with emphasis on new and emerging technologies. R&D areas to be discussed include research activities related to improving the operational efficiency of Natural Gas Infrastructure, assessing the potential of Methane Hydrates as a resource, and examining methane “recycling” for flared and stranded gas.

The Department works to ensure America's energy security and prosperity by addressing energy and environmental challenges with research and technology solutions in support of the President's goals for energy dominance. As part of that effort, the Department is committed to developing advanced, cost-effective technologies to enhance pipeline reliability and security and improve the operational efficiency from natural gas transmission, distribution, and storage facilities. Priority early stage research areas include advanced composite materials, non-reactive coatings with embedded sensors, and a renewed interest in pipeline cybersecurity technologies.

Additionally, the Department is committed to continuing to evaluate the occurrence, nature, and behavior of naturally occurring methane or gas hydrates. The program intends to confirm the nature and regional context of gas hydrate deposits, and the physical properties and characteristics of gas hydrate-bearing sediments.

Finally, natural gas and associated hydrocarbons are produced in oil and gas operations across the United States. In some instances, initial production is accompanied by gas or gas-liquids that cannot be economically transported to markets. DOE is interested in pursuing new R&D pathways to enhance the efficient utilization of our Nation's natural resources.

Progress and outlook for the Department of Energy's Office of Oil and Natural Gas Midstream and Methane Hydrate Research and Development (R&D) Activities

AAPG Annual Convention & Exhibition 2018

Tim Reinhardt

Director, Division of Supply and Delivery

Office of Oil and Natural Gas
U.S. Department of Energy

May 22nd, 2018



Agenda

- Division Mission and Organization
- Program Rationales & Summaries
 - Domestic Crude Oil Landscape
 - Crude Oil Characteristics Study
 - Domestic Natural Gas Landscape
 - Midstream Infrastructure
 - Methane Recycling
 - Gas Hydrates



U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

OFFICE OF OIL & NATURAL GAS

Office of Oil and Natural Gas – Division of Supply and Delivery

Mission

Maximize the value of U.S. oil and gas resources to the public and ensure their responsible development and delivery through policy, research, innovation, and outreach

- Advance America's unconventional oil & natural gas revolution through R&D that enhances energy security, supports economic growth
- Regulate U.S. natural gas trade including liquefied natural gas (LNG)
- Ensure that oil and natural gas operations are safe and sustainable
- Develop technologies to modernize oil and natural gas infrastructure in support of efficiency and safety
- Provide data and tools to ensure transparency to public, states, oil and gas producers and other stakeholders



U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

OFFICE OF OIL & NATURAL GAS

Crude Oil



U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

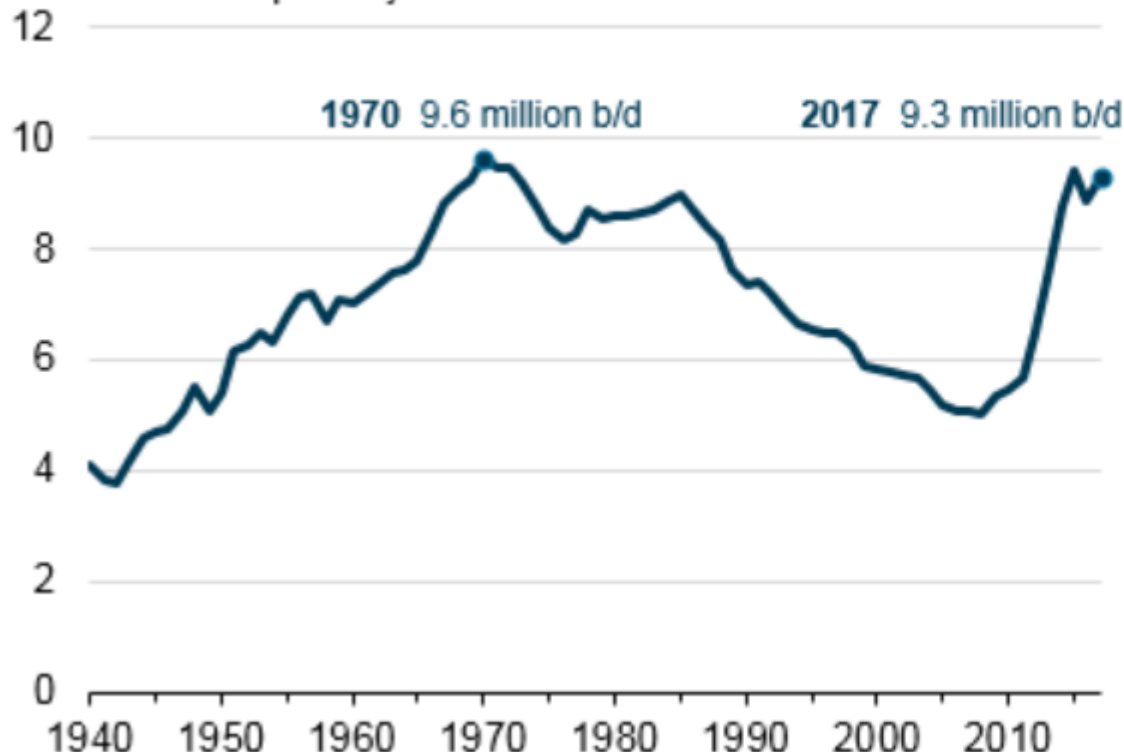
OFFICE OF OIL & NATURAL GAS

U.S. Crude Oil Production

U.S. production of crude oil grew 5% in 2017, likely leading to record 2018 production

Annual U.S. crude oil production (1940-2017)

million barrels per day



Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*

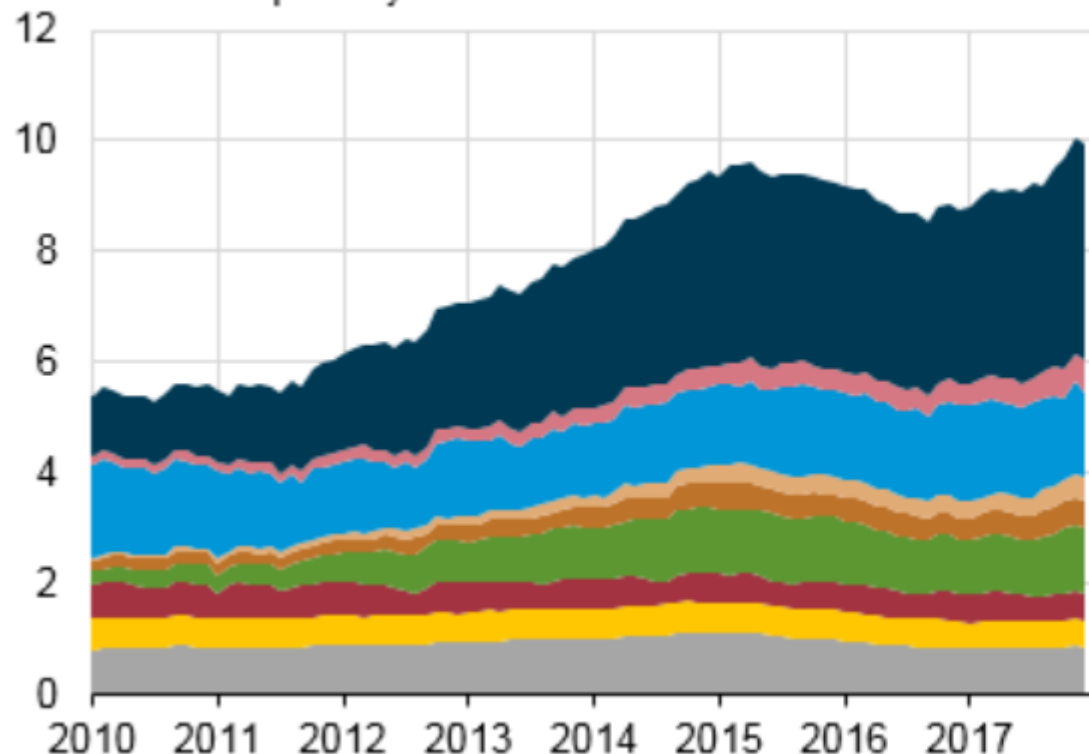
Monthly production (2016-17)

million barrels per day



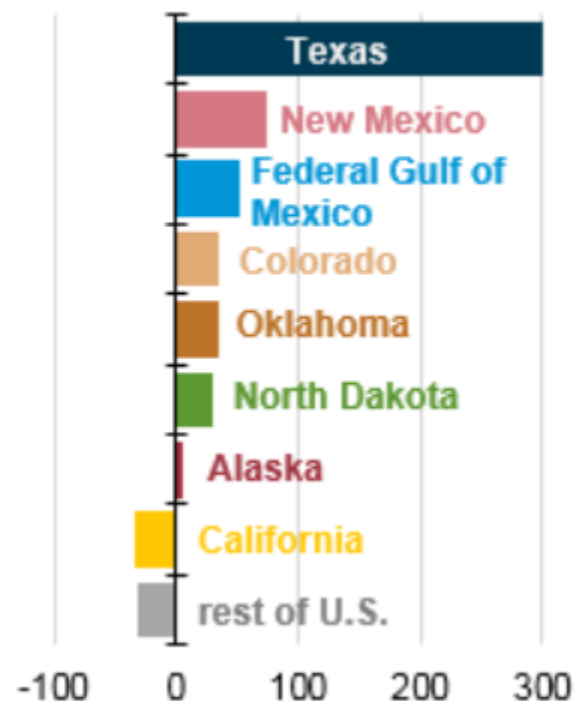
Crude Oil Production by State

U.S. crude oil production by state (2010-2017)
million barrels per day



Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*

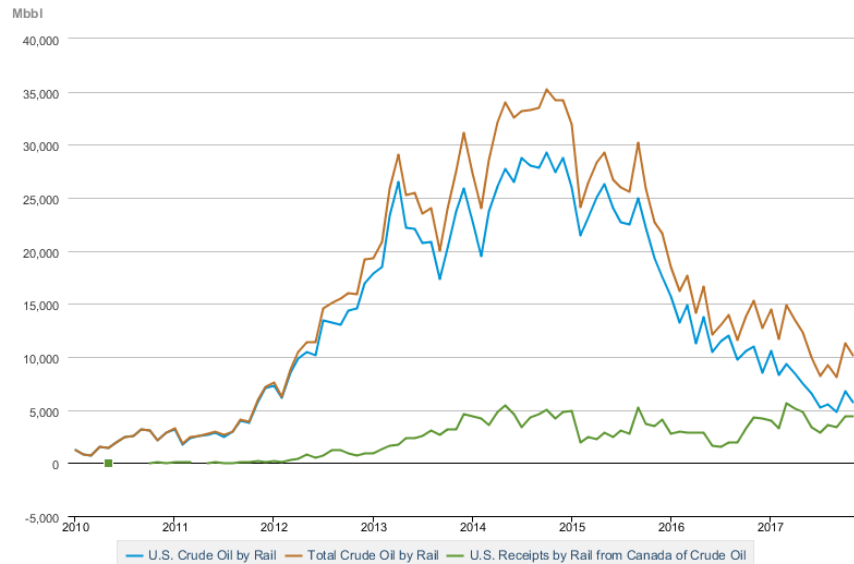
Annual change, 2016-2017
thousand barrels per day



Crude Oil Characteristics (crude-by-rail)

Total crude-by-rail movements in the United States and between the United States and Canada were more than 350,000 barrels per day (bbl/d) in 2017, up from 55,000 bbl/d in 2010. >398,00 bbl/d in January 2018.

Movements of Crude Oil and Selected Products by Rail



Source: U.S. Energy Information Administration

DOE research program includes:

- Identify the most appropriate sampling and testing methods for crude oils
- Sampling, testing and compilation of data on different crude oils using those methods
- Combustion testing to identify relationships between a particular chemical or physical property of crude oil, or combination of such properties, and combustion properties

R & D will evaluate whether crude oils currently transported in North America, exhibit physical or chemical properties that are distinct from conventional crudes, and how these properties associate with combustion hazards that may be realized during transportation and handling.



Research Plan Overview

Purpose: characterize tight and conventional crudes based on key chemical and physical properties, and identify properties that may contribute to increased likelihood and/or severity of combustion events.

Task		Purpose
1	Project Administration & Outreach	<ul style="list-style-type: none">▪ Procurements (sample & testing materials, analytical labs, equipment, etc.)▪ Coordination and outreach (sponsors, SC, and technical associations, etc.)
2	Methods Evaluation	<ul style="list-style-type: none">▪ Determine suitable methods of sample capture and analysis (retaining all volatile light end components in samples is not typically required in crude oil quality sampling protocols)
3	Pool Fire & Fireball Experiments	<ul style="list-style-type: none">▪ Characterize and burn samples to determine if physical and chemical properties affect the oil's combustion properties and hazard levels
4	Tight vs. Conventional Characterization	<ul style="list-style-type: none">▪ Compare tight and conventional crude oils based on volatility-related physical and chemical properties through additional sampling and analysis



Natural Gas



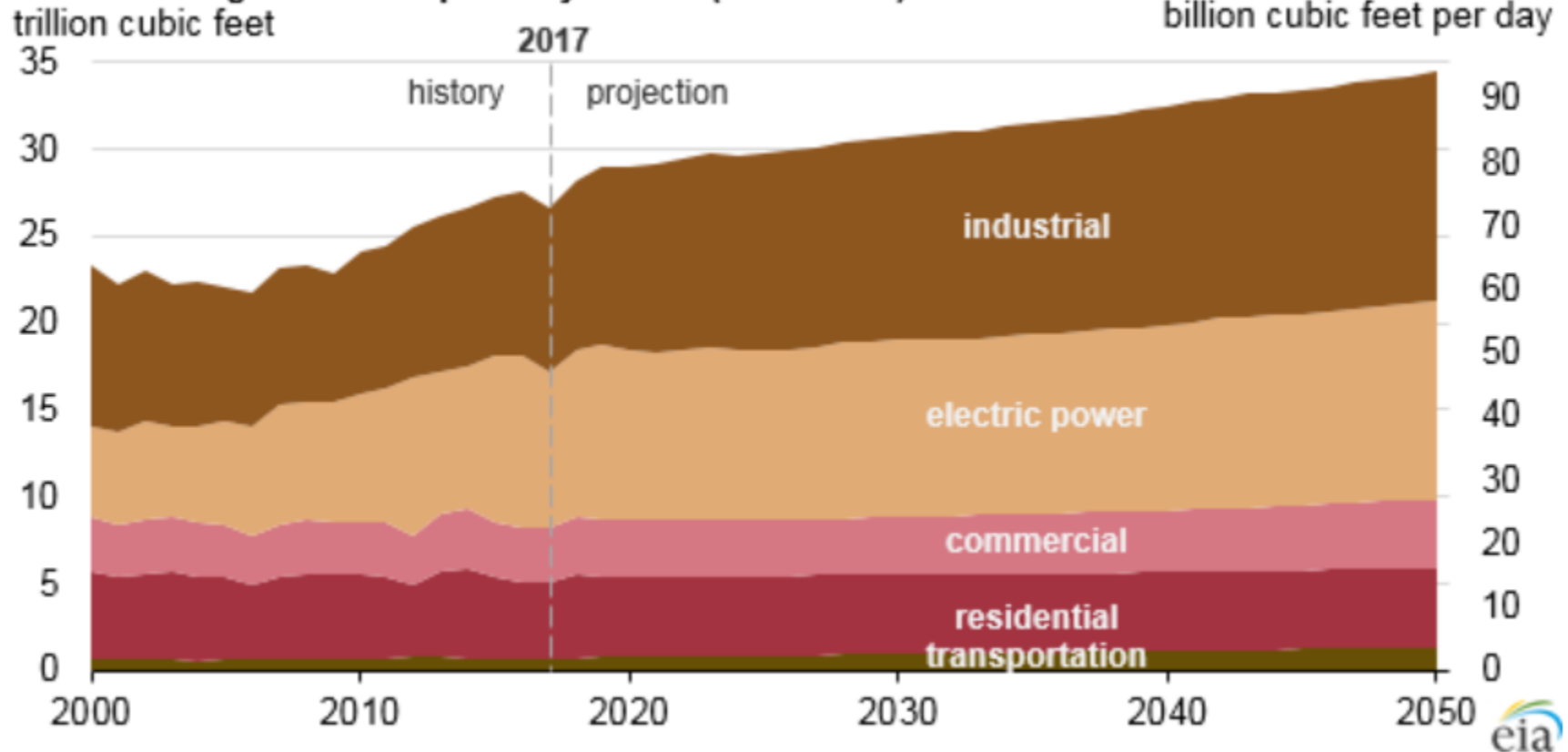
U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

OFFICE OF OIL & NATURAL GAS

U.S. Natural Gas Consumption

U.S. natural gas consumption by sector (2000-2050)



Source: U.S. Energy Information Administration, [Annual Energy Outlook 2018](#)



U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

OFFICE OF OIL & NATURAL GAS

U.S. Natural Gas Exports

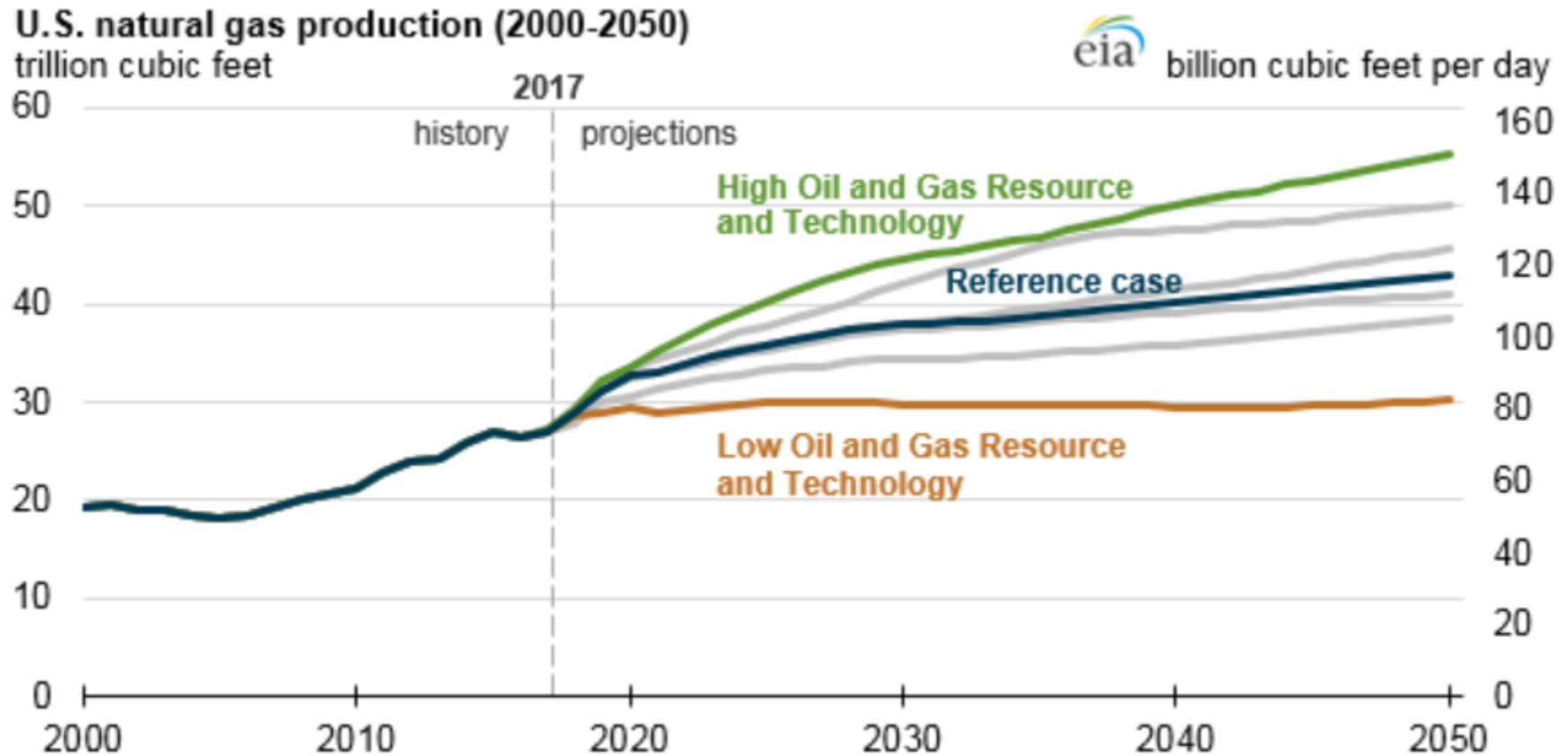
Monthly U.S. natural gas exports (2006-2017)
billion cubic feet per day



Source: U.S. Energy Information Administration, [Natural Gas Monthly](#)



U.S. Natural Gas Production



Source: U.S. Energy Information Administration, [Annual Energy Outlook 2018](#)



U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

OFFICE OF OIL & NATURAL GAS

Midstream Infrastructure

Pipeline Inspection & Repair

- Expand gas loss mitigation into pipeline inspection and repair, valves, controllers, and compressors.

Smart Sensors for Pipeline Operational Efficiency

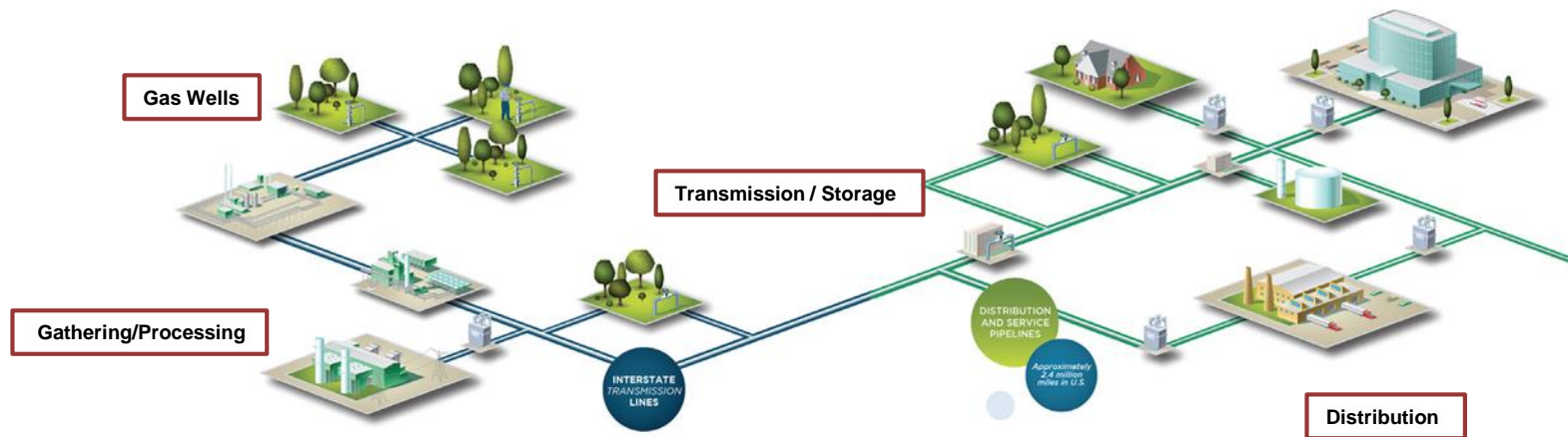
- Continuous in-pipe communication of operational parameters

Advanced Materials Research

- Accelerate advances in materials science that can enhance pipe integrity, reduce gas leaks, and improve the efficiency of midstream infrastructure operations

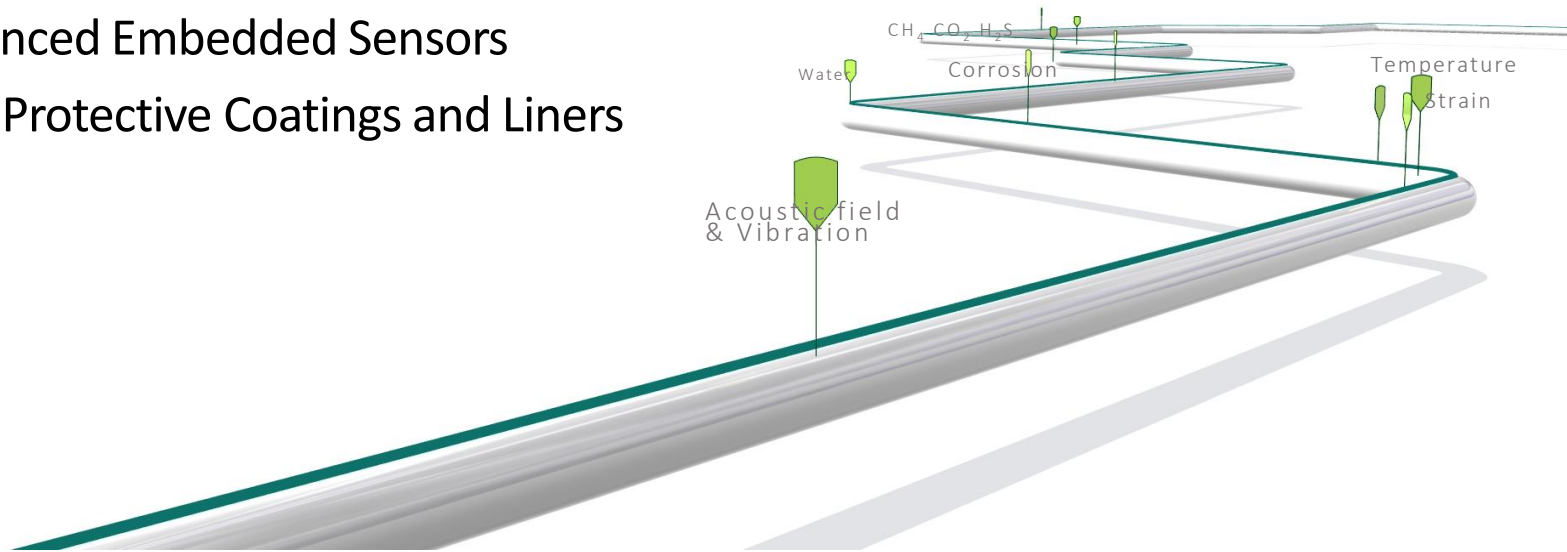
Leak Detection & Monitoring

- Identification and measurement of gas leaks, quantification into gathering lines, underground gas storage facilities, and compressors, and remote sensing of super-emitters



Summary of In-House R&D

- DOE/NETL has an Established Program in New Technology Development for Midstream
- Goal = Enabling a Vision of an “Intelligent Pipeline” Enabled by Advanced Technologies
 - Geospatial Data Analytics
 - Advanced Embedded Sensors
 - New Protective Coatings and Liners



- We are Actively Seeking Industry Partnerships and Collaborations



Midstream: Looking Forward-S&T Needs

- Advanced Materials-that may enable transmission pipelines to transport natural gas along with other critical fuels and fluids
- Data Science and Management - Tools that can employ data to identify pipeline integrity concerns
- Sensors and Controls -Development of sensing controls, automated systems, remote monitoring capabilities, that can also accommodate fuel flexibility in pipelines.
- Pipeline Inspection and Repair -Technologies that improve inside the pipe inspection and with tools that can mitigate leaks and pipe anomalies
- Compressors - More efficient and flexible compressor design to make infrastructure more adaptable to varying pipeline conditions and to accommodate additional fuels and critical fluids



Methane Recycling “Challenge”

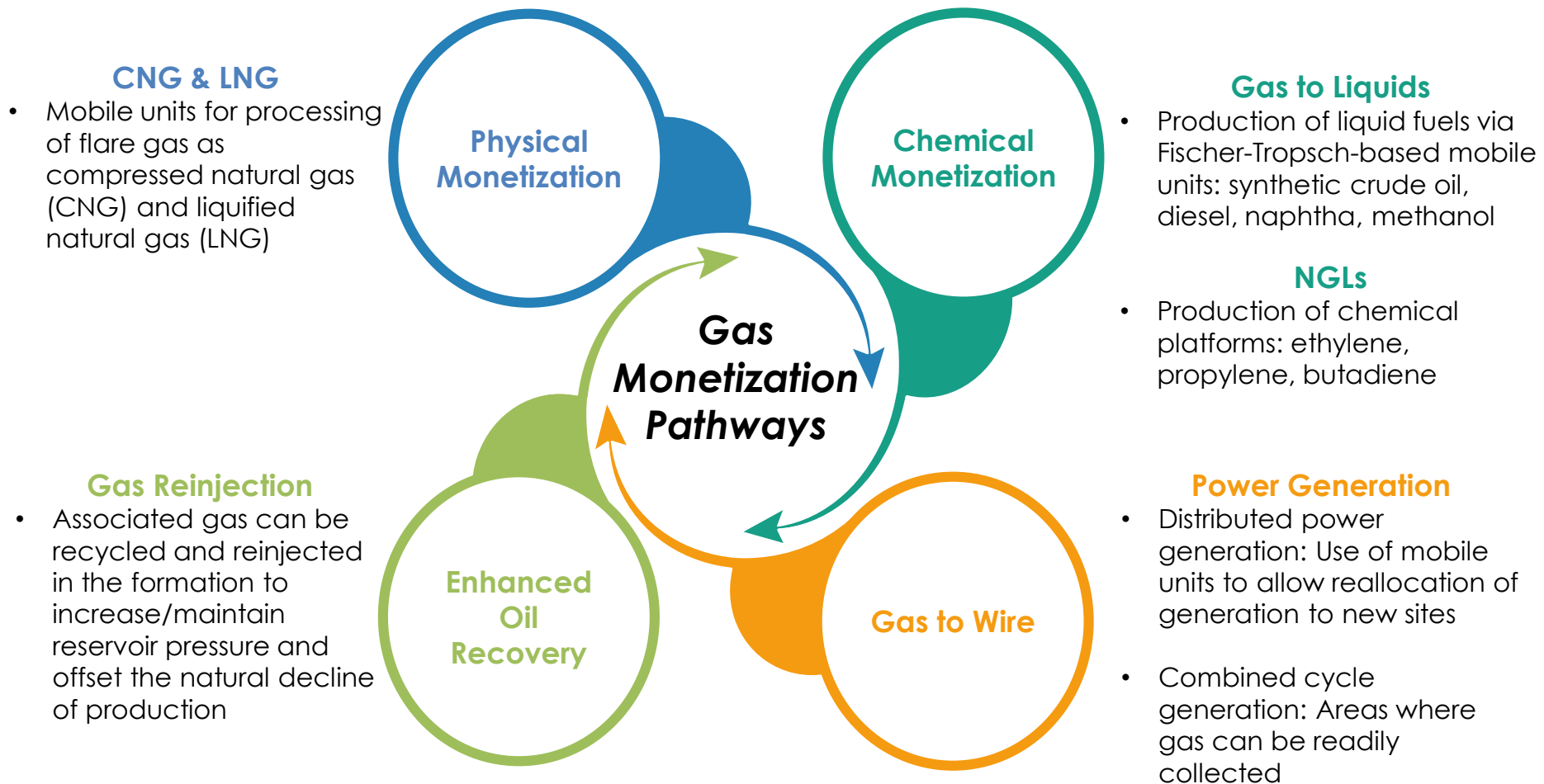
- Practical elimination of all venting and flaring of natural and oil-associated gas coupled with redirection of methane-rich and CO₂-rich waste gas streams toward beneficial uses
- The challenge also envisions substitution of methane-rich waste gas for fuels currently consumed in upstream oil and gas production

DOE Interest: Pursue advanced, high-risk/high-reward research to facilitate NG utilization that

- *Reduces environmental impact*
- *Reduces loss of product*

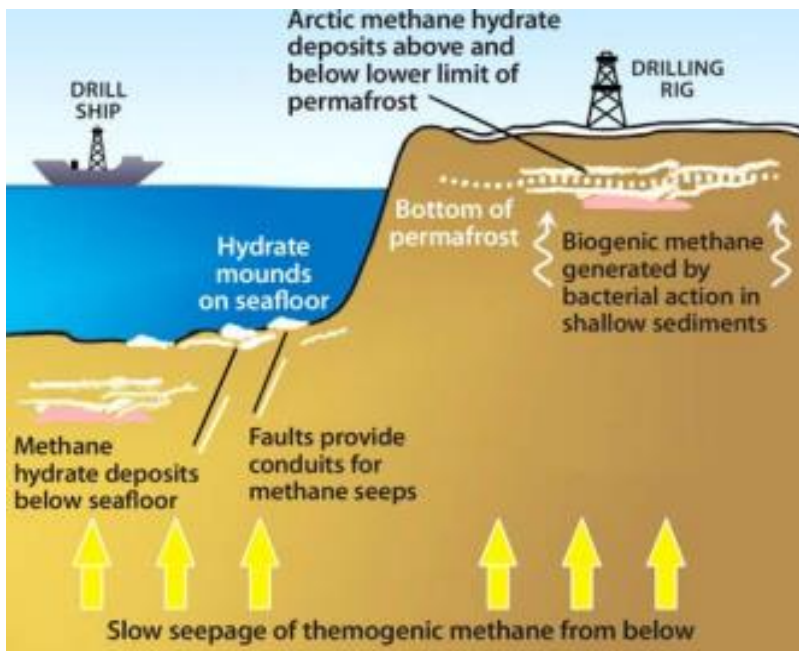


Methane Recycling Opportunities



Methane Hydrate Research

The world's supply of gas hydrates may contain more organic carbon than coal, oil, and other natural gas combined.



- Global resource estimates range from 250,000 to 700,000 trillion cubic feet
- DOE research program includes:
 - Production feasibility
 - Resource characterization and modeling
 - Environmental Impacts
 - International collaboration

Types of methane hydrate deposits

Source: U.S. Department of Energy, National Energy Technology Laboratory



- R&D has the potential to impact gas hydrates just as it did for shale and unconventional resource development over the past 30 years.



Methane Hydrate Program Milestones

KEY MILESTONES

- FY18: Establish viable testing program structure in Alaska; Contribute to deepwater test preparation in India.
- FY19: Conduct stratigraphic test drilling on the ANS
- FY20: Complete multi-site drilling and coring program in the GoM; Initiate long-term production test in AK
- FY21: Complete Long-term Production Test on ANS
- FY22: Establish as needed follow-on demonstration tests in Alaska
- FY25: Participate as possible in marine production testing conducted by other nations; Conduct resource characterization programs on the Atlantic OCS to confirm U.S. resource base



Methane Hydrate Summary

U.S. National Gas Hydrate R&D Program



DOE leads a National R&D program in Gas Hydrate Science & Technology

- Collaboration/coordination with 6 agencies (USGS, BLM, BOEM, NSF, NRL, NOAA)
- Extensive and active international engagements (Japan, Korea, India, New Zealand, others)

U.S. resources are potentially large but very poorly constrained

- 6,000 tcf in the GoM; 10,000+ tcf on the Atlantic Margin. Great uncertainty
- Few sites documented, only one site in the GOM (in process of being) characterized
- We know little about how they form

Alaska North Slope (ANS) is a “natural laboratory”

- Only viable location for long-term scientific production testing
- Substantial interest from the State of Alaska and its congressional delegation
- Best locations are within PBU and leased to industry
- significant challenges in developing a viable project structure
- Results are directly applicable to marine resource development

Key Challenges

- Reservoir Petrophysical and Geomechanical response with time
- Maximizing well productivity: Designing wells that will “survive” (sand/water...)
- Difficulty in gaining industry participation
- Keeping up with Asia – Mounting field programs -- Maintaining scientific expertise



U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

OFFICE OF OIL & NATURAL GAS

Timothy Reinhardt

Office of Oil and Natural Gas, US Department of Energy, 1000
Independence Ave., SW,
Washington, DC 20585

Timothy.Reinhardt@hq.doe.gov



U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

OFFICE OF OIL & NATURAL GAS