

# Minimizing Methane Emissions from Unconventional Natural Gas Development



Scott C. Bartos

U.S. Environmental Protection Agency  
Climate Change Division



Jakarta, Indonesia  
May 7, 2013



# Outline

- 🔥 EPA collaboration via the Global Methane Initiative (GMI)
- 🔥 Hydraulic fracturing and opportunities to reduce air emissions
  - 🔥 Equipment
  - 🔥 Benefits
- 🔥 Related US regulations
  - 🔥 New Source Performance Standards (NSPS)
  - 🔥 Greenhouse Gas Reporting Program (GHGRP)

# Global Methane Initiative

- Started as Methane to Markets in 2004, the **Global Methane Initiative (GMI)** is an international initiative that advances cost-effective, near-term methane recovery and use as a clean energy source in five sectors:



*Oil and Gas Systems*



*Coal Mines*



*Landfills*



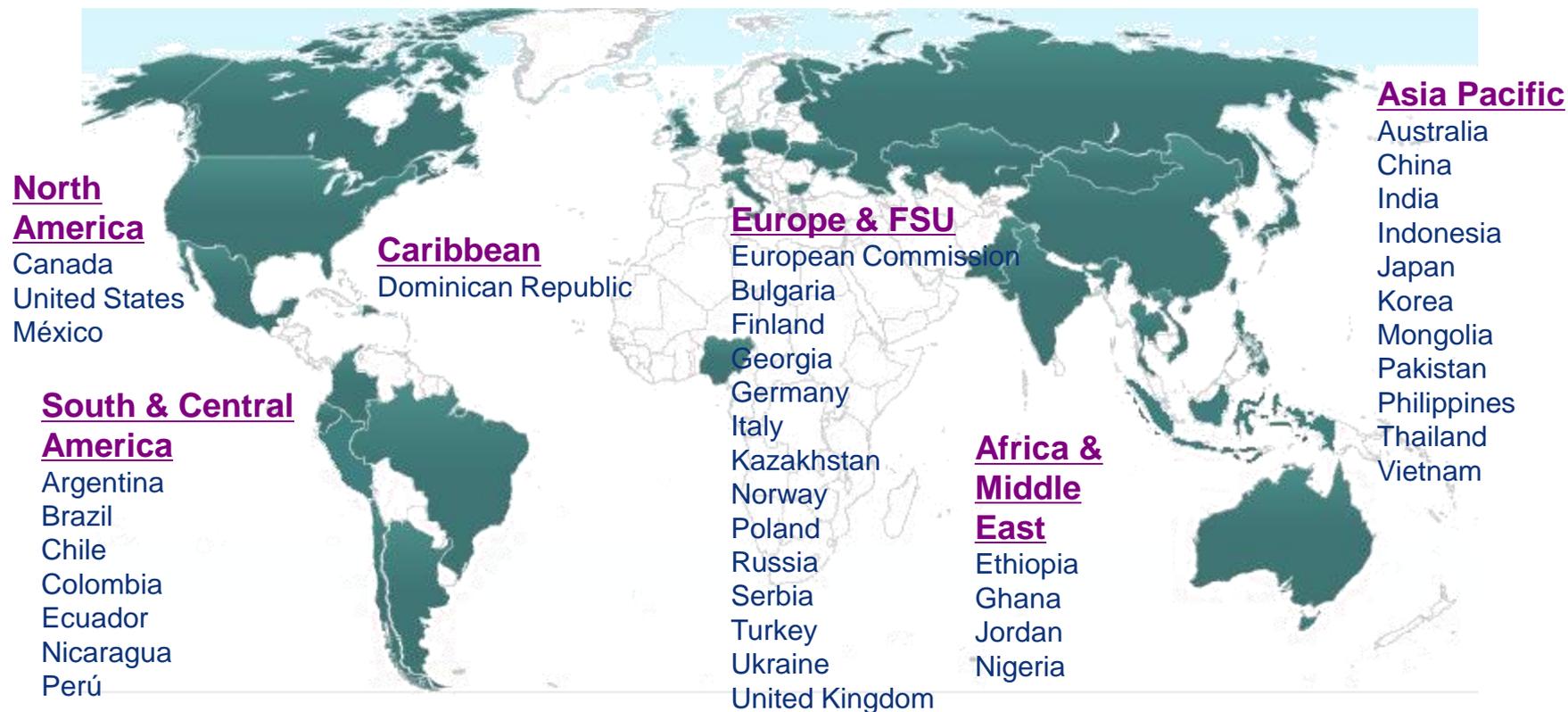
*Agricultural Waste and Wastewater*

- The goals of the Partnership are to reduce global methane emissions to
  - Enhance economic growth
  - Strengthen energy security
  - Improve air quality and industrial safety
  - Reduce emissions of greenhouse gases



# GMI Partner Governments

42 Partner Governments represent nearly 70% global anthropogenic methane emissions and all of the 10 top methane emitting countries



Private companies, multilateral development banks and other relevant organizations participate by joining the **Project Network – over 1,000 organizations now participating**

# EPA's Natural Gas STAR Partnership

- 🔥 Started in U.S. in 1993, expanded internationally in 2006
- 🔥 Today, >100 domestic and 17 international partners
  - 🔥 Identified over 50 cost effective technologies and best practices to reduce methane emissions
  - 🔥 Reduced methane emissions by nearly 30 Bcm, **saving over \$3 billion**



# Overview of Hydraulic Fracturing

- Gas wells in tight formations, coal beds, and shale may require hydraulic fracture to produce gas
  - For new wells or re-fracturing to stimulate production of existing wells (workovers)
- During completion of the well, flowback of fracturing liquids and proppant (often sand) is necessary to clean out the well bore and formation prior to production
  - High volume of liquid and solids are produced at high pressure to expel sand, cuttings, and hydraulic fracture fluids prior to production
- Hydraulic fracturing video: [www.northernoil.com/drilling.php](http://www.northernoil.com/drilling.php)
  - Video is for oil production but well drilling and hydraulic fracture process similar for gas

# Natural Gas Losses During Gas Well Completions and Workovers

- One standard practice is for operators to produce flowback to an open pit or tank to collect sand, cuttings, and fluids for disposal
  - Vent or flare the natural gas
- Typical composition of pollutants in flowback emissions:
  - Methane ( $\text{CH}_4$ )
  - VOCs
  - HAPs



Source: Newfield

# Reduced Emission Completions (RECs)

- Practice to recover natural gas and condensate produced during flowback following hydraulic fracture
- Portable equipment brought to well site
  - Separates sand and water
  - Processes gas and condensate for sales
- Route recovered gas through dehydrator and meter to sales line, reducing venting and flaring while increasing gas sales



*Portable REC Equipment*

Source: Weatherford

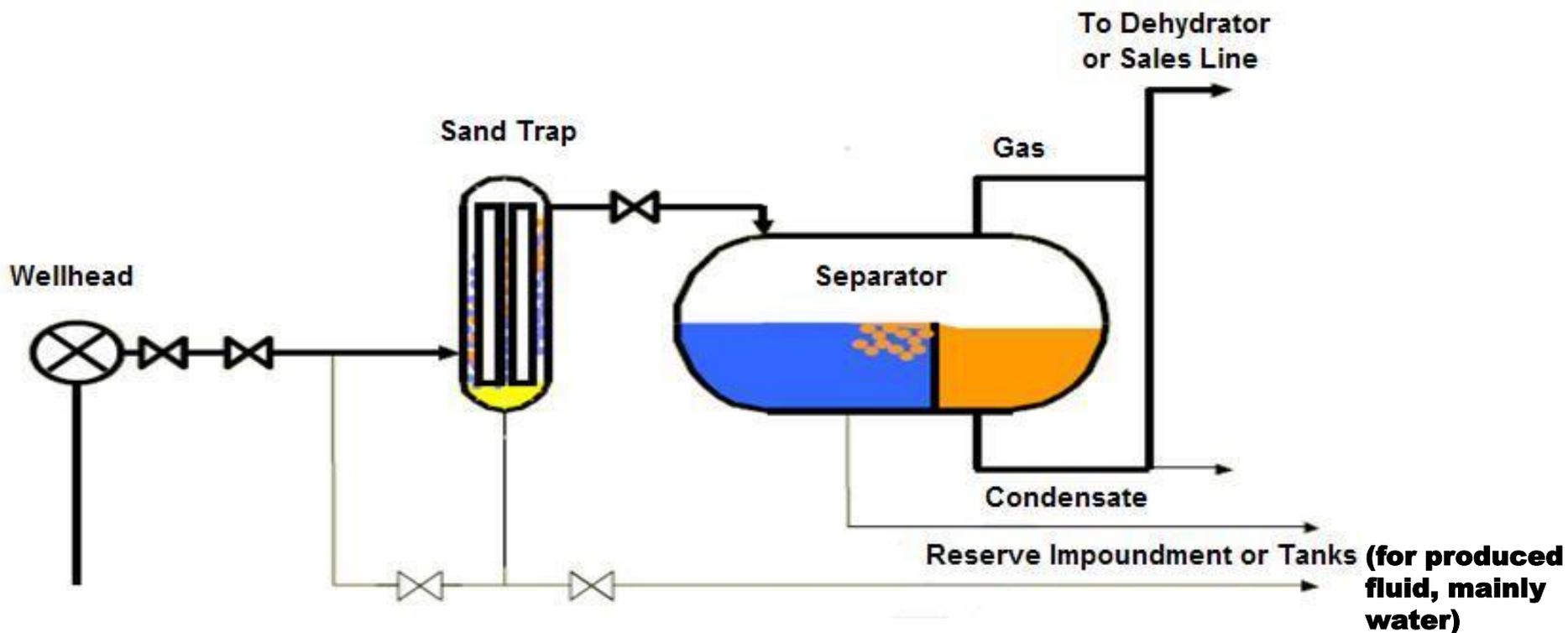
# RECs: Equipment

- 🔥 Skid or trailer mounted portable equipment to capture produced gas during cleanup
  - 🔥 Sand trap
  - 🔥 Three-phase separator
- 🔥 Use portable dehydrator to remove water from the produced gas before it enter sales line



Source: Williams

# RECs: Diagram



Temporary, Mobile Surface Facilities, Adapted from BP

## RECs: Equipment (cont.)

- 🔥 Equipment that will enable processing and sale/use of gas includes
  - 🔥 Nearby gathering system / sales line
  - 🔥 Piping from wellhead to sales line
  - 🔥 Lease meter
  - 🔥 Gas quality meets gathering system specification
    - 🔥 Dehydrator (if needed to process gas to pipeline specifications)
  - 🔥 Stock tanks for wells producing significant amounts of condensate

# RECs: Benefits

- 🔥 Reduced methane and other air emissions during completions and workovers
- 🔥 Increase sales revenue from recovered gas and condensate
- 🔥 Gas STAR Program partners report recovering 500 to 2,000 Mcf/day/well \*
  - 🔥 Some partners also report recovering condensate, which can result in significant additional revenue
  - 🔥 Typical well flowback time is 3 to 10 days
- 🔥 Reduced environmental impact
- 🔥 Reduced disposal costs

\* Natural Gas STAR Lessons Learned document:  
[http://www.epa.gov/gasstar/documents/reduced\\_emissions\\_completions.pdf](http://www.epa.gov/gasstar/documents/reduced_emissions_completions.pdf)

# Natural Gas STAR Partner Experience: Economics

- 🔥 Noble in Ellis County, Oklahoma
  - 🔥 RECs on 10 wells using energized fracturing
  - 🔥 Total cost of \$325,000
  - 🔥 Estimated net profits: \$340,000, or \$34,000 per well on average
- 🔥 BP in Green River Basin, Rocky Mountain region
  - 🔥 RECs on 106 total wells, high and low pressure
  - 🔥 Capital investment of ~\$500,000 per skid (including portable three-phase separators, sand traps, and tanks)
  - 🔥 Conservative net value of gas saved: \$20,000 per well
- 🔥 A Partner Company (Fort Worth Basin, Texas)
  - 🔥 RECs on 30 wells
  - 🔥 Incremental cost of \$8,700 per well
  - 🔥 Conservative net value of gas saved: about \$50,000 per well

\* Natural Gas STAR Lessons Learned document:

[http://www.epa.gov/gasstar/documents/reduced\\_emissions\\_completions.pdf](http://www.epa.gov/gasstar/documents/reduced_emissions_completions.pdf)

# Related Regulations

## New Source Performance Standards (NSPS)

- 💧 On April 17, 2012, EPA issued New Source Performance Standards (NSPS) for VOCs for the oil and gas sector.
  - 💧 Updates standards issued in 1985 and 1999
- 💧 Continues growth in clean domestic energy production, while increasing environmental protection
  - 💧 Reduce emissions of smog-forming VOCs, air toxics, and methane (co-benefit)
- 💧 Relies on available, affordable technology already in use
- 💧 Offsets the cost of pollution controls through the capture of emissions
- 💧 Provides flexibility and transparency
- 💧 EPA estimates the following combined annual emission reductions when the rules are fully implemented:
  - 💧 VOCs: 190,000 to 290,000 tons
  - 💧 Air toxics: 12,000 to 20,000 tons
  - 💧 Methane: 1.0 to 1.7 million short tons (about 19 to 33 million tonnes of CO<sub>2</sub> equivalent (CO<sub>2</sub> e))

# Reducing Pollution from Well Completions (NSPS)

- NSPS limits VOC emissions from gas wells as they are being prepared for production, a process called “well completion.”
- Applies to all hydraulically fractured gas wells, both new wells and existing wells that are fractured or refractured to get more gas out of a well.
- Phases in requirements for capturing natural gas
  - Owners/operators of fractured and refractured wells may reduce pollution through flaring until Jan. 1, 2015; after that, gas capture is required.
- Requires a combination of green completion and flaring for most wells.
  - Achieves 95% VOC reduction and 90% recovery of salable natural gas.
  - Requires flaring in situations not meeting criteria for reduced emissions completion (and where flaring is not a hazard).



Example of Green Completion Equipment  
(Source: Weatherford)



A natural gas well site. EPA photo.

# Related Regulations – Greenhouse Gas Reporting Program (GHGRP)

- 💧 Annual reporting of GHGs by 41 source categories, accounting for about 85-90% of U.S. GHG emissions
  - 💧 33 types of direct emitters
  - 💧 6 types of suppliers of fuel and industrial GHG
  - 💧 Facilities that inject CO<sub>2</sub> underground for geologic sequestration, enhanced oil recovery, or any other purpose
- 💧 25,000 metric tons CO<sub>2</sub> equivalent (CO<sub>2</sub>e) or more per year reporting threshold for most sources
- 💧 Data Collection through EPA's electronic Greenhouse Gas Reporting Tool (e-GGRT)
  - 💧 Web-based application for facilities/suppliers to report directly to EPA via self-guided web forms
  - 💧 Also includes option for direct data upload via XML
- 💧 Electronic Verification
  - 💧 Pre- and post-submittal checks and verification
- 💧 Staff review and direct follow-up

# Related Regulations – GHGRP

- 🔥 Subpart W: Coverage of emissions from venting\*, leakage\*, and flaring \* includes
  - 💧 Carbon dioxide and methane emissions from equipment leaks and vented emissions
  - 💧 Carbon dioxide, methane, and nitrous oxide emissions from gas flares
- 🔥 21 emission source types, including pneumatic devices and pumps, dehydrator vents, storage tanks, associated gas venting and flaring, flare stacks, and centrifugal and reciprocating compressor venting
- 🔥 For hydraulically fractured well completions and workovers, collecting
  - 💧 Total number of completions and workovers
  - 💧 Emissions from these sources
  - 💧 Number of wells using Reduced Emission Completion techniques
- 🔥 Calculation Methods
  - 💧 Direct measurement, engineering calculations, emission factors

\*As defined by Subpart W

# US Facility GHG Emissions Information Now Available <http://ghgdata.epa.gov>

- Easily accessible to public
- Filter GHG data by facility, industry, location, gas, etc.
- Understanding where GHG emissions occur improves ability to make informed policy, business, and regulatory decisions

2011 Greenhouse Gas Emissions from Large Facilities

Other Data Sources | Download | Help

2011 Greenhouse Gas Emissions from Large Facilities

2011 Data Year | Emitters Data Type

Find a Facility or Location | Search | Browse to a State | Choose State

Filter By: Greenhouse Gas | Emission Range

Data View: Map | Satellite

Sector	Power Plants	Petroleum and Natural Gas Systems	Refineries	Chemicals	Other	Waste	Metals	Minerals	Pulp and Paper
2011 GHG Emissions (million metric tons CO <sub>2</sub> e)	2,221	225	182	180	126	103	115	98	44
# of Reporting Facilities	1,594	1,880	145	458	1,377	1,592	297	362	230

This data set does not reflect total U.S. GHG emissions. Learn more about related EPA GHG data sources. Data reported to EPA as of 01/15/2013.

\* Facilities in this source category reported process emissions for the first time in 2011.

# Contact Information

Scott C. Bartos

U.S. Environmental Protection Agency

Washington, DC USA

[bartos.scott@epa.gov](mailto:bartos.scott@epa.gov)

Tel. +1 202 343 9167

<http://www.epa.gov/gasstar/>

<http://www.epa.gov/gasstar/tools/recommended.html>

<http://www.globalmethane.org/>

