Reducing Methane Emissions from Hydraulically Fractured Natural Gas Wells

Beneficios de la reducción de emisiones del metano para el Sector Hidrocarburos Iniciativa Global del Metano en Colombia

Taller de gestión de conocimiento

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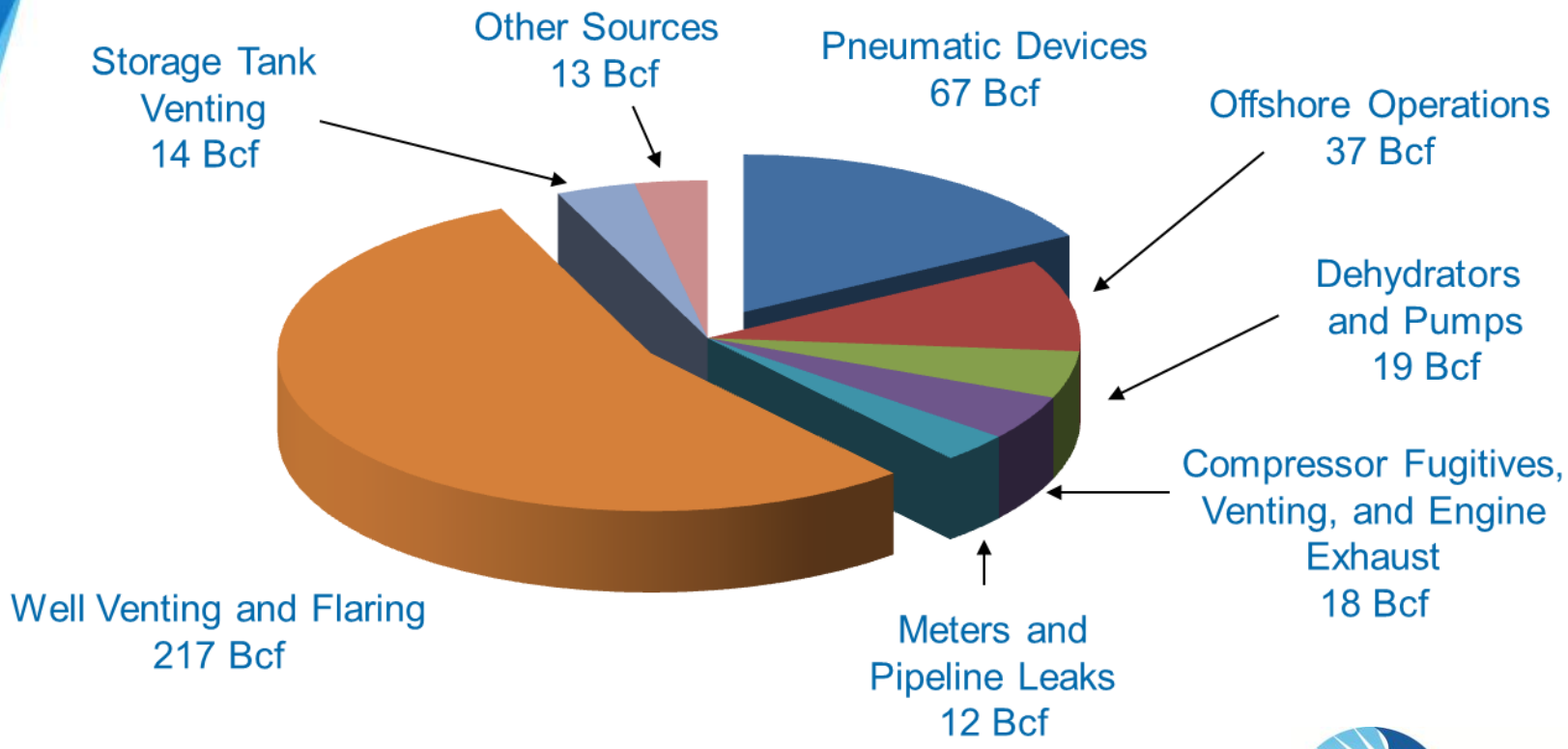
2009 US Oil and Natural Gas Production Emissions Sources

2009 Production Sector Methane Emissions (397 Bcf / 160 million tonnes CO_2e)



Source: EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2009.* April, 2011. Available on the web at: epa.gov/climatechange/emissions/usinventoryreport.html.

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Overview of Hydraulic Fracturing

- Gas wells in tight formations, coal beds, and shale may require hydraulic fracturing 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
  - Video is for oil production but well drilling and hydraulic fracture process similar for gas

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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:
  - Primarily methane (CH_4)
  - VOCs
  - HAPs

Source: Newfield

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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

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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

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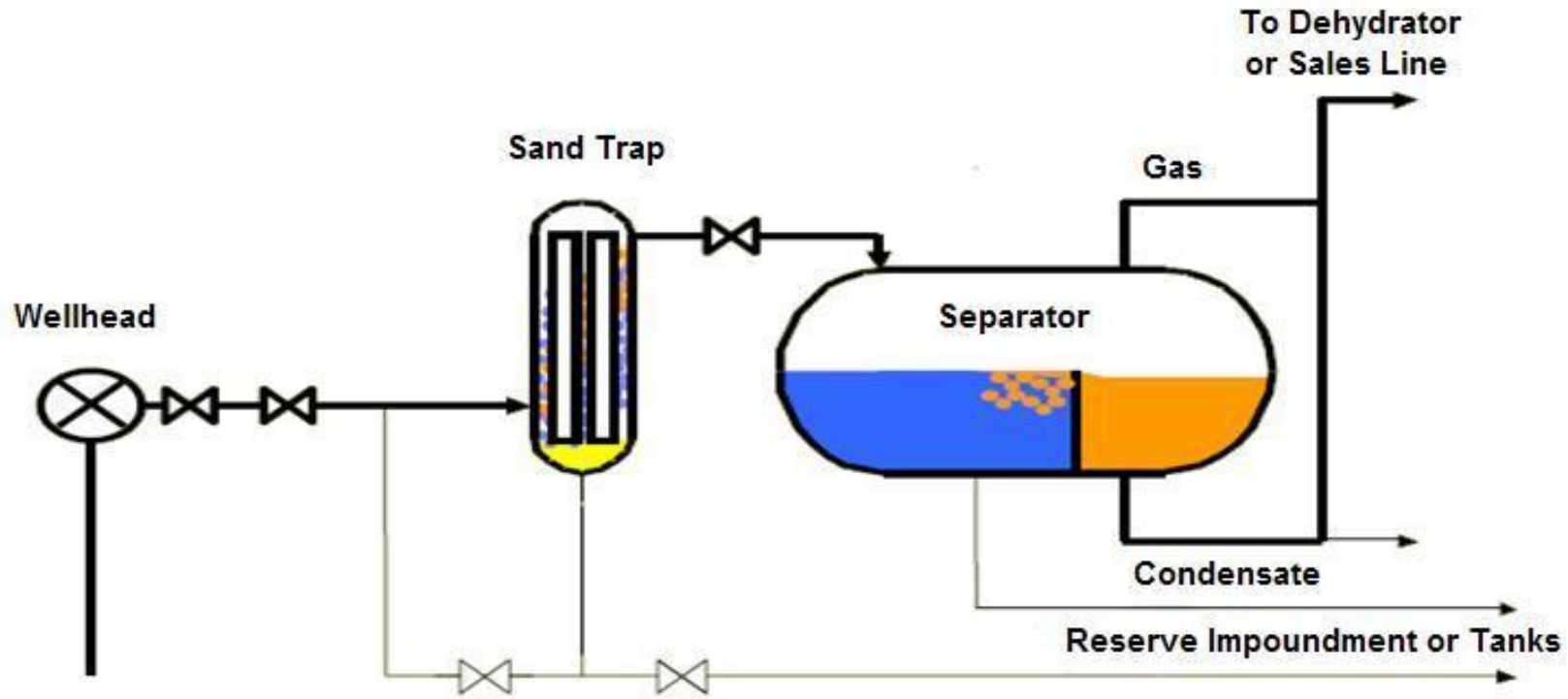
RECs: Diagram



Reserve Impoundment or Tanks
(for produced fluid, mainly water)

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RECs: Other Equipment

- Capture and use of gas depends on presence of key equipment on site before cleanup
  - Nearby gathering system / sales line
  - Piping from wellhead to sales line
  - Lease meter
  - Gas quality meets gathering system specification
  - Stock tanks for wells producing significant amounts of condensate
  - Dehydrator (if needed to process gas to pipeline specifications)

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RECs: Benefits

- Reduced methane and other air emissions during completions and workovers
- Increase sales revenue from recovered gas and condensate
- Partners report recovering 500 to 2,000 Mcf/day/well
  - Partners also report recovering zero to several hundred bbl/day/well of condensate (which can result in significant additional revenue)
  - Typical well flowback time is 3 to 10 days
- Reduced environmental impact
- Reduced disposal costs

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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

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Related Regulations – NSPS

- Review of Clean Air Act New Source Performance Standards (NSPS) and National Emissions Standards for Hazardous Air Pollutants (NESHAP) resulted in a final rule, released April 2012, which includes a revised NSPS regulation for smog-forming volatile organic compound (VOC) emissions
- Flowback emissions from completion of fractured gas wells are included in the NSPS final rule

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Related Regulations – NSPS

- The final rule applies to hydraulically fractured gas wells in the U.S.
  - VOC emissions would be minimized through the use of “green completions,” also called “reduced emissions completions”
  - When gas cannot be collected, VOCs would be reduced through completion combustion, unless it is a safety hazard
  - Nearly 95 percent reduction in VOCs emitted from new and modified hydraulically fractured gas well
  - Co-benefit of significant methane reductions

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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_2 underground for geologic sequestration, enhanced oil recovery, or any other purpose
- 25,000 metric tons CO_2 equivalent (CO_2e) 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

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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

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Related Regulations – State

- Wyoming requires “flareless completions” for wells in Jonah-Pinedale and concentrated development areas
  - Colorado requires sand traps, surge vessels, separators, and tanks as soon as practicable during flowback and cleanout of certain wells
- EPA is also addressing potential water or other impacts under relevant statutes including Safe Drinking Water Act, Clean Water Act, Resource Conservation and Recovery Act

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In Summary – EPA's Approach

- Responsible development of America's shale gas resources offers important economic, energy security, and environmental benefits
- EPA plays an important role in addressing public concerns, ensuring environmental protection, and in working with federal and state partners to manage the benefits and risks of shale gas production
- The Agency is committed to improving scientific understanding of the potential environmental impacts of shale gas extraction and using tools at hand to address any known concerns
- Through U.S. participation in the Global Methane Initiative, EPA seeks to share lessons learned internationally to promote available, cost-effective methane emission reduction activities related to shale gas development as well as the oil and gas sector as a whole

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