Environmentally Friendly Drilling Systems Program

Unbiased Data from an Unbiased Source

EFD

EFD

NETL
NATIONAL ENERGY TECHNOLOGY LABORATORY

RPSEA
Research Partnership to Secure Energy for America

Texas A&M University

L·E·I·D LLC

MONTANA UNIVERSITY

HARC

EFD Team

Management Team

Texas A&M University
L·E·I·D LLC
Montana University
HARC

COLLABORATORS

CEA
HPC
Gulf of Mexico Alliance
GSI Environmental
HART
Groundwater Protection Council
Interstate Oil & Gas Compact Commission
American Association of Petroleum Geologists — An International Geological Organization
AACOG
PTTC
JISEA Joint Institute for Strategic Energy Analysis

ENVIRONMENTAL ORGANIZATIONS

EDF Environmental Defense Fund
The Nature Conservancy
Ducks Unlimited

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National Oilwell Varco
Newpark Resources

Together

Everyone

Achieves

More

EFD Alliance

Awards & Recognition

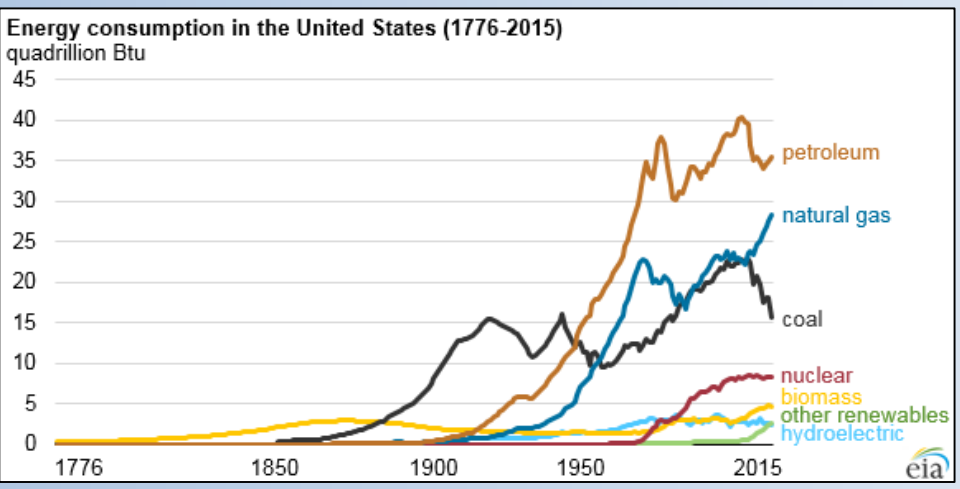
EFD is the # 1 Program in the Energy Industry Developing Innovative Environmental Technology

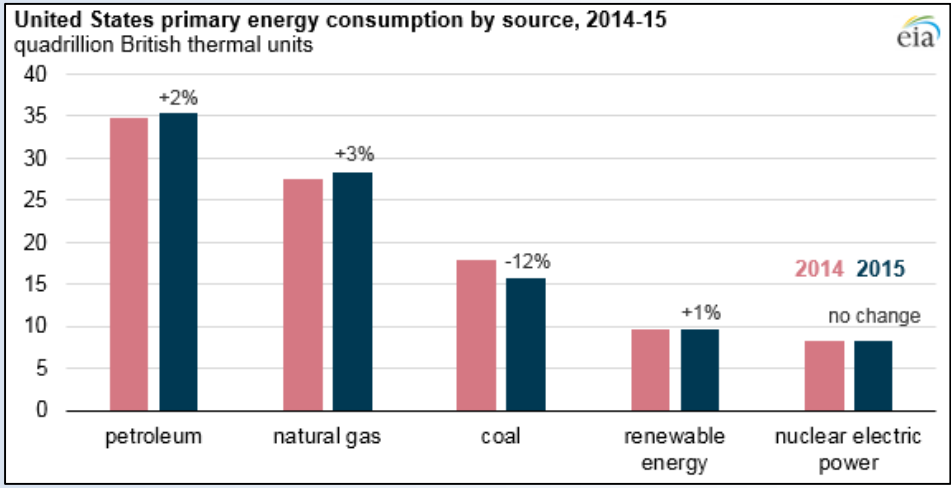
Rig Zone

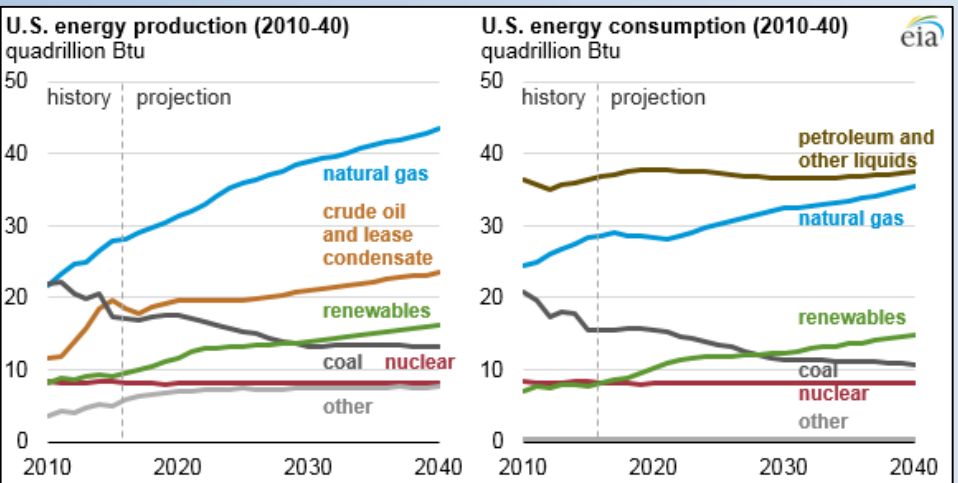
Best Outreach Program
Aramco iExplore: Energy – **Aramco**
EMSI High-Octane Tech Fest – **Weatherford**
Environmentally Friendly Drilling Virtual Site – **Houston Advanced Research Center**
Geoscientists Without Borders – **Society of Exploration Geophysicist**
Veterans Resource Group – **Baker Hughes Incorporated**

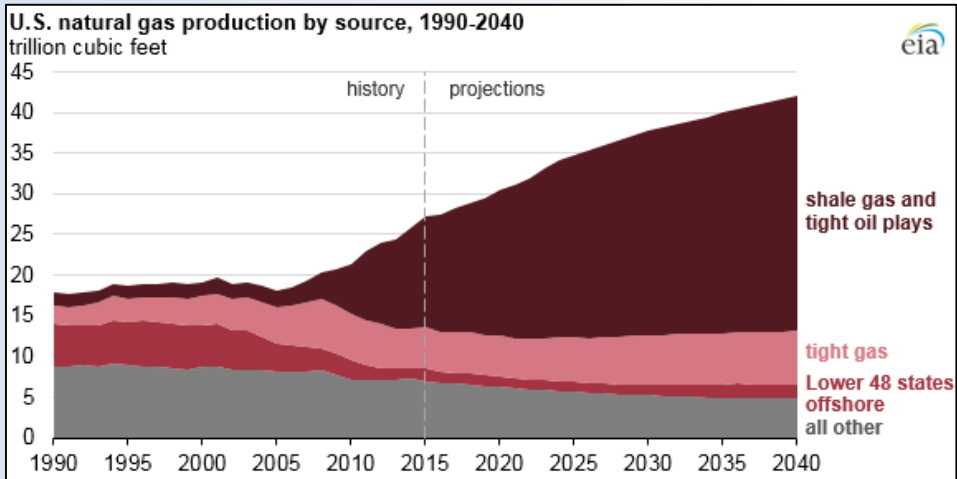
Best Health, Safety, Environment / Sustainable Development - Onshore Award
CleanSpacer™ III Spacer Fluid — **Halliburton**
Electro Water Separation (EWS) — **OriginClear**
EnviroLift — **Weatherford International plc**
Environmentally Friendly Drilling Systems Program - **Houston Advanced Research Center**
Modular Frac-flowback & Produced Water Treatment train technology — **NSERC / ARIS-ET**

Changing US Energy Mix

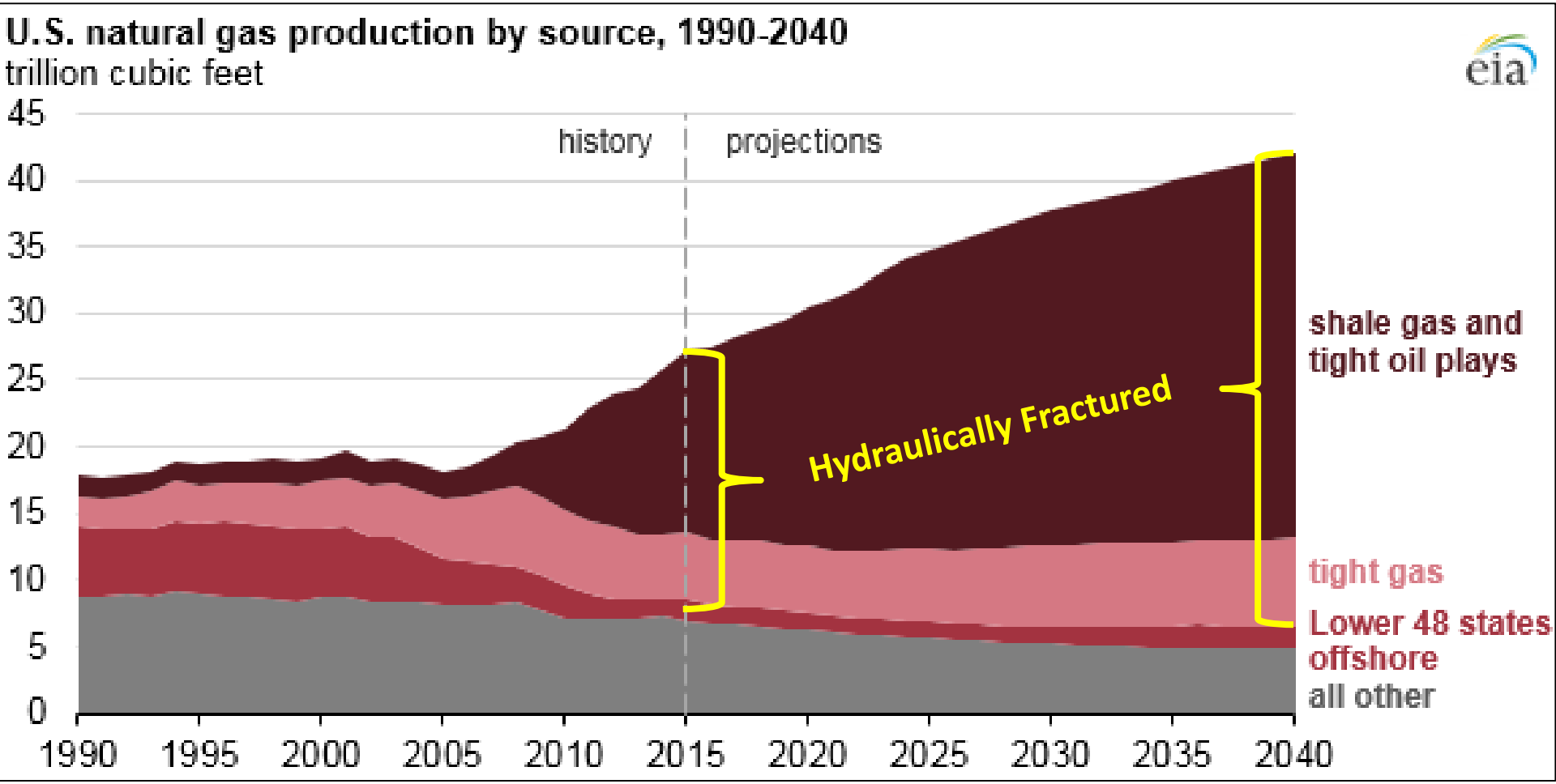




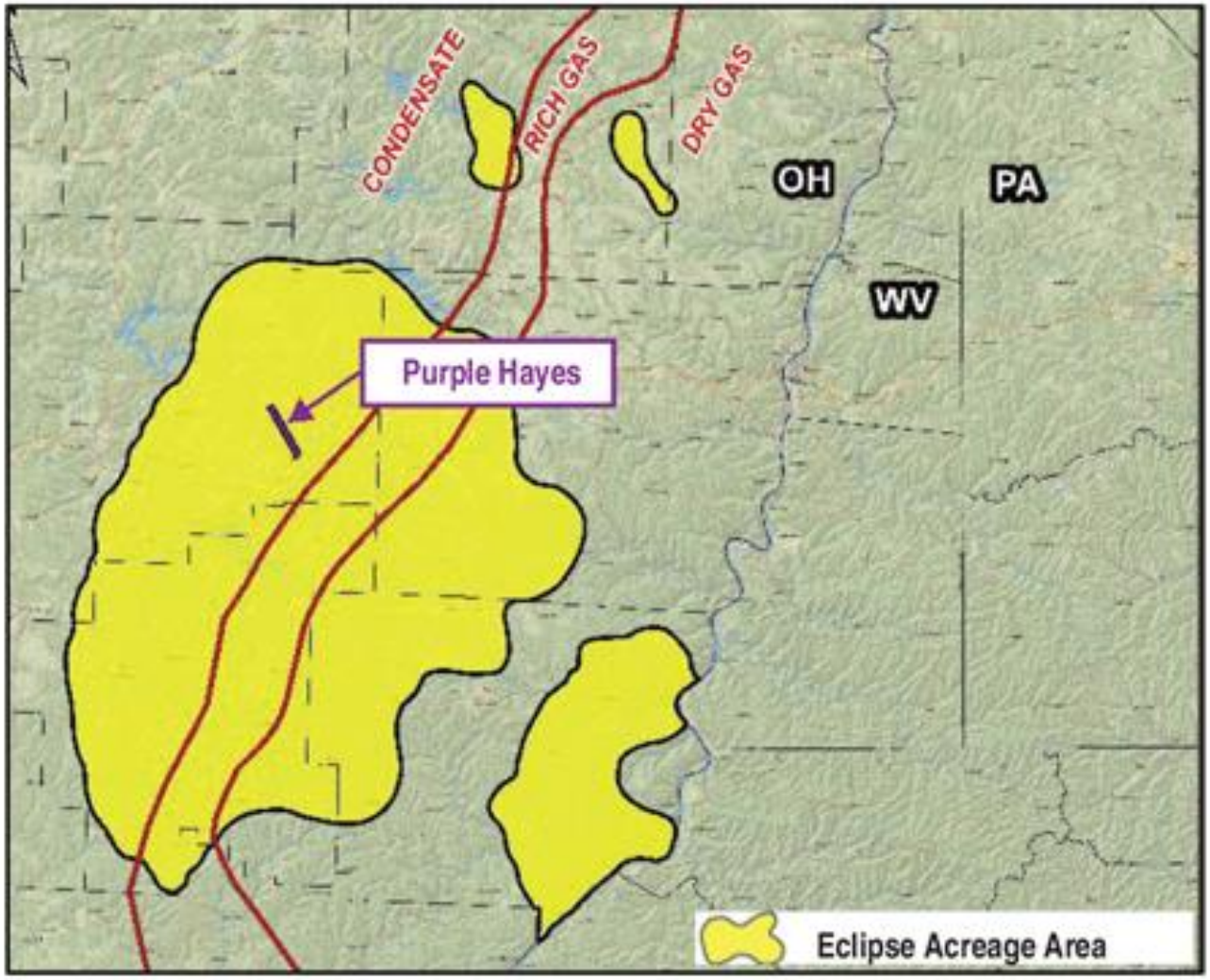




Production from Hydraulic Fracturing

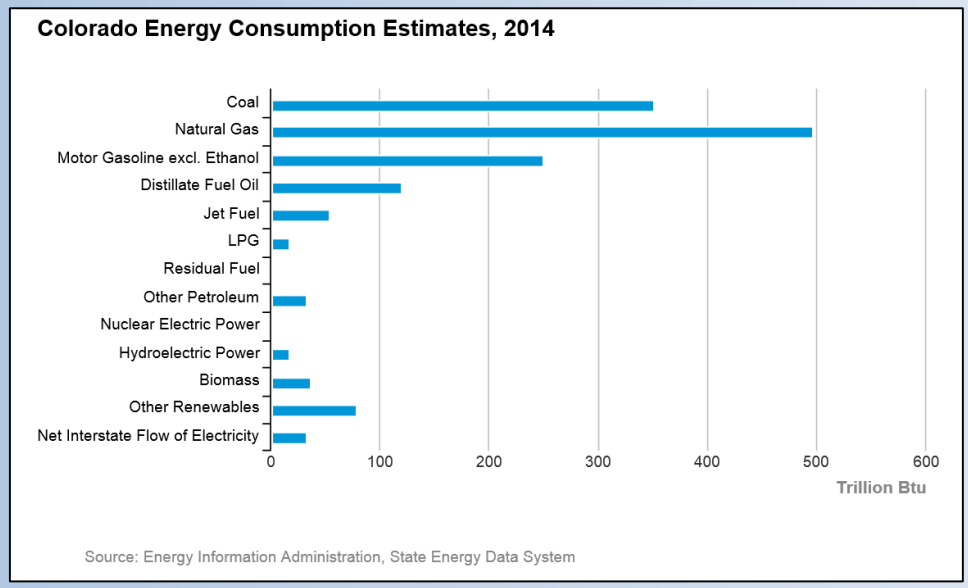


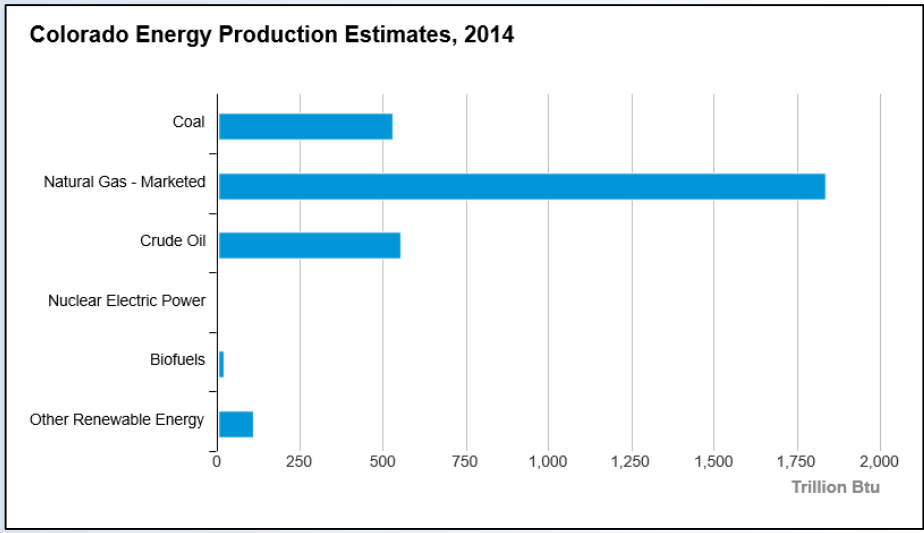
New Record!
Utica Shale

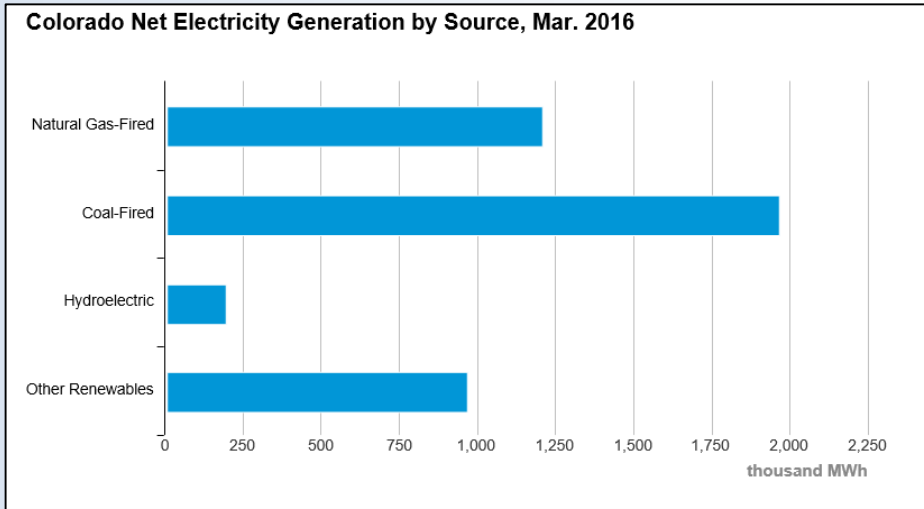


Purple Hayes No. 1H
Guernsey County, Oh.
Longest lateral drilled onshore United States
Lateral length: 18,544 feet (drilled to TD in 17.6 days)
Total measured depth: 27,048 feet
Frac stages: 124 plug-and-perf at 150-foot spacing (completed in 23.5 days)
Total drilling and completion cost = $854/foot of lateral

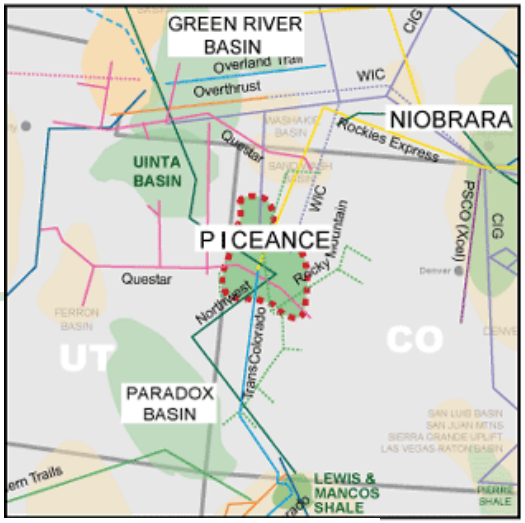
Colorado Energy







Piceance Basin



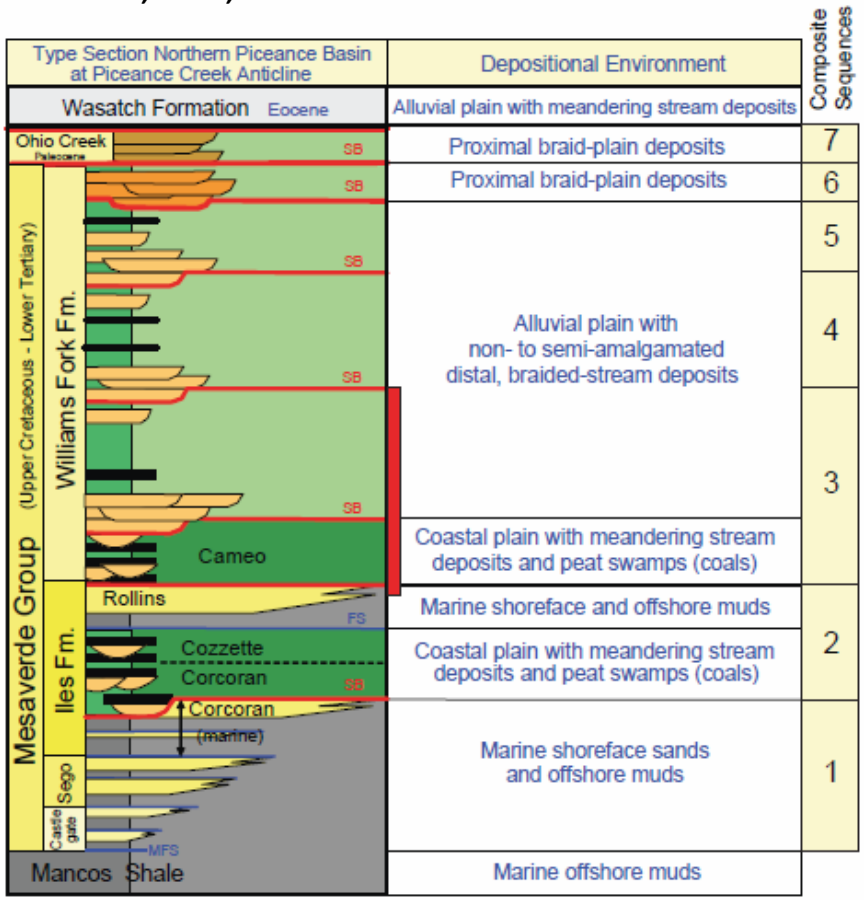
2014 Production

Oil Sales: 7,207,533 Bbls

Gas Sales: 729,515,167 Mcf

Top 20 in 2014

Rank	Operator
1	WPX Energy
2	Encana
3	Occidental Petroleum
4	ExxonMobil/XTO Energy
5	Chevron
6	Bill Barrett Corporation
7	Ursa Operating
8	Caerus
9	Piceance Energy LLC
10	Wexpro
11	Noble Energy
12	Linn Energy
13	Marathon Oil
14	Black Hills Plateau Production Co.
15	SG Interests I, LLC
16	Koch Exploration Co.
17	Axia Energy
18	Whiting Petroleum
19	BOPCO LP
20	Foundation Energy Management



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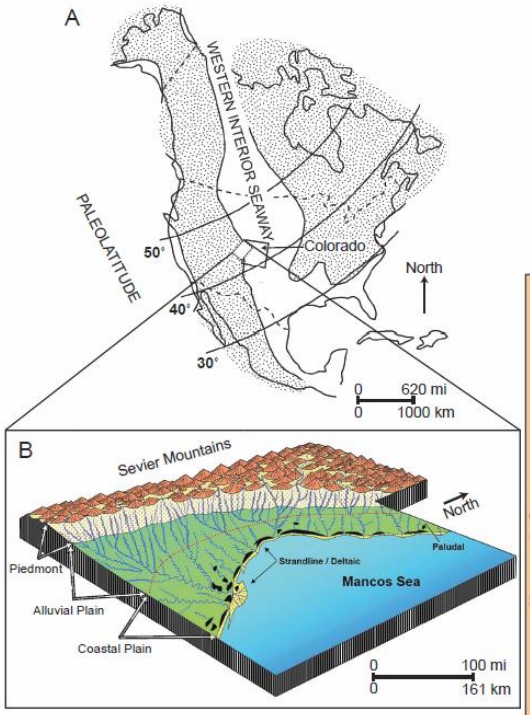
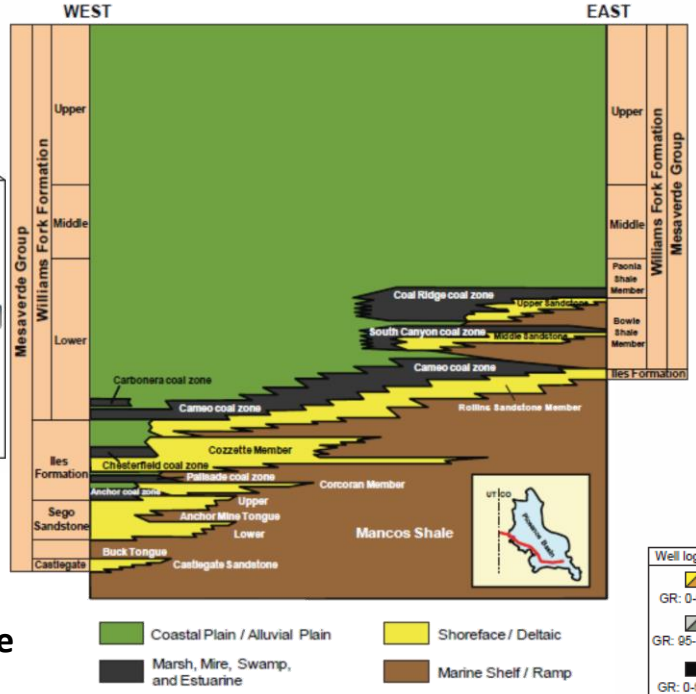
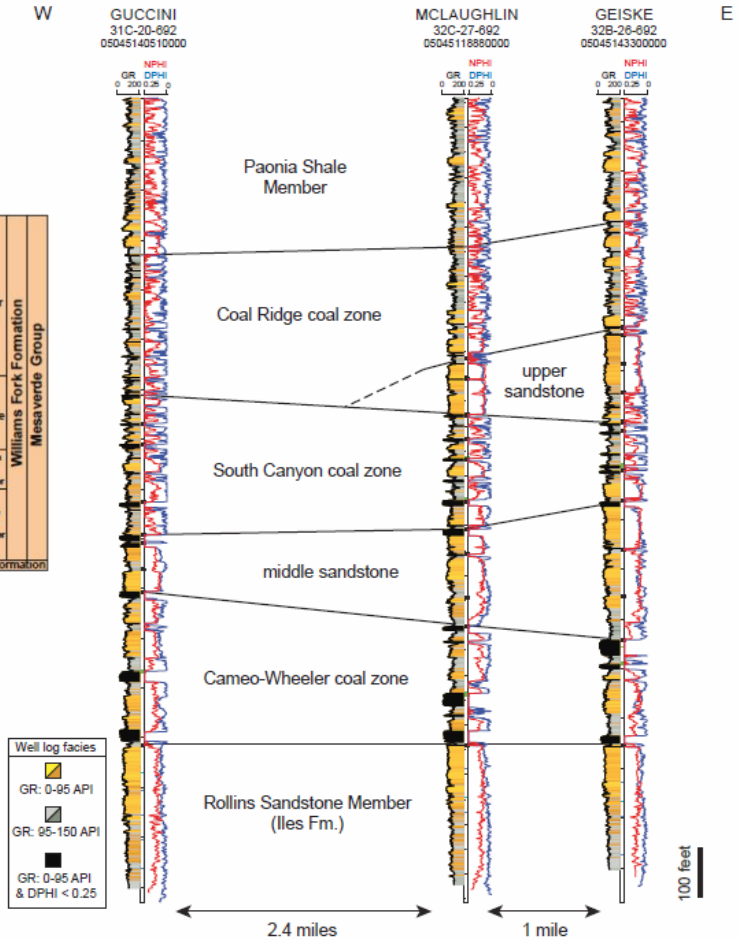


Late Cretaceous Paleogeography showing extent of Western Interior Seaway during the Late Campanian and a depiction of the Late Cretaceous depositional environment in Utah/Colorado.



Stratigraphic cross section – distribution of deposits



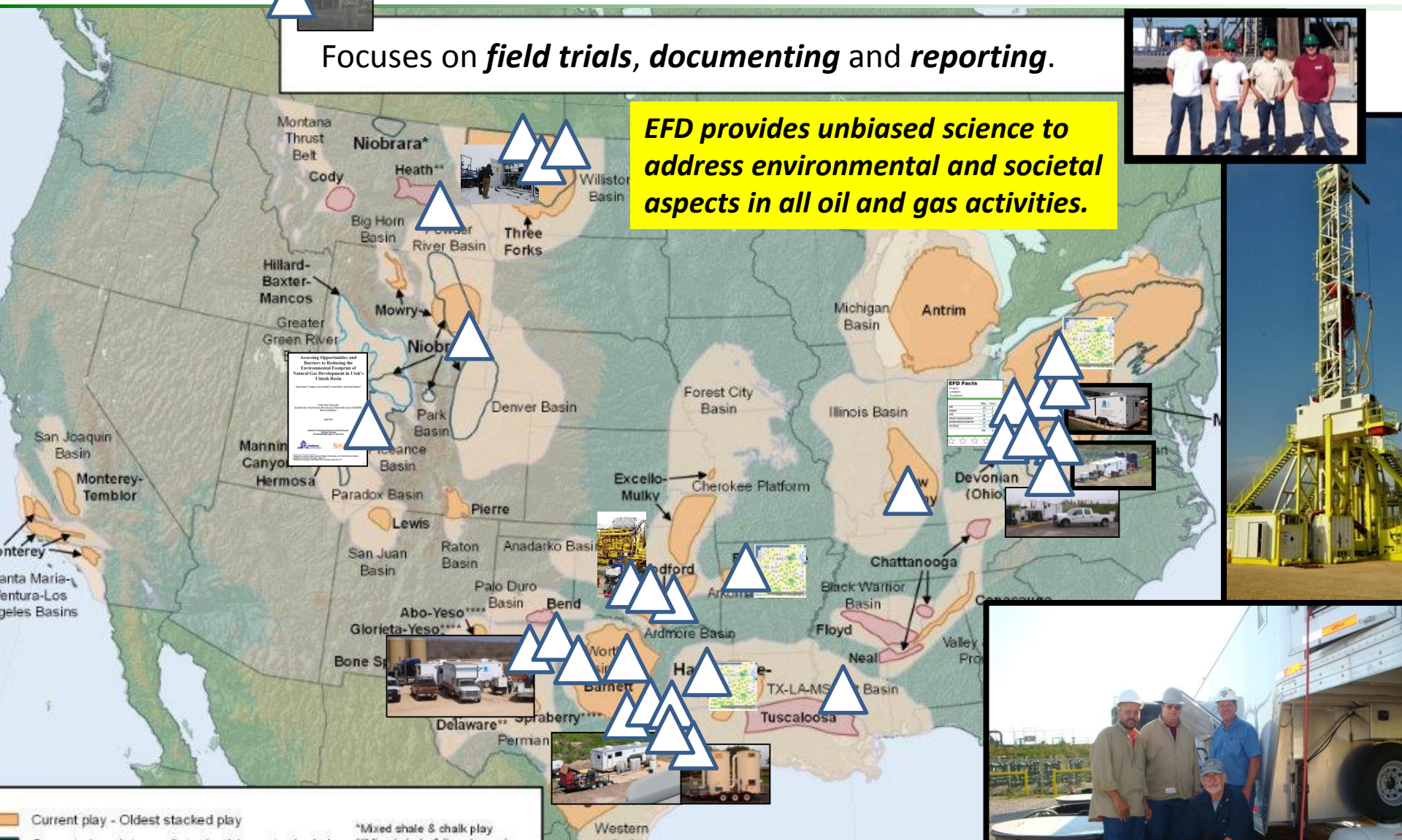
Type Logs for Lower Williams Fork Formation in SE Piceance Basin

EFD Field Trial Sites

Locations of Field Trials

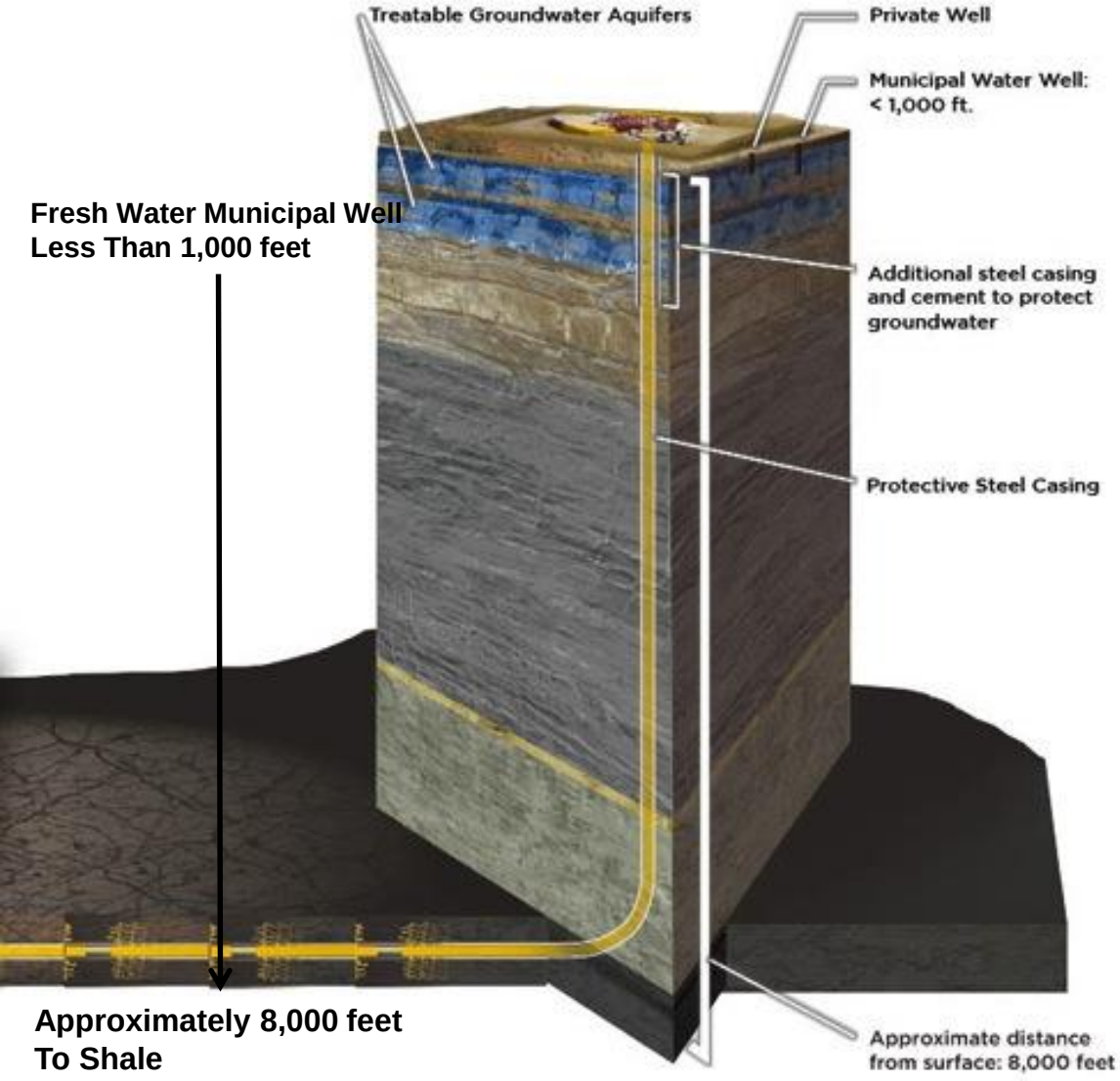
Focuses on ***field trials***, ***documenting*** and ***reporting***.

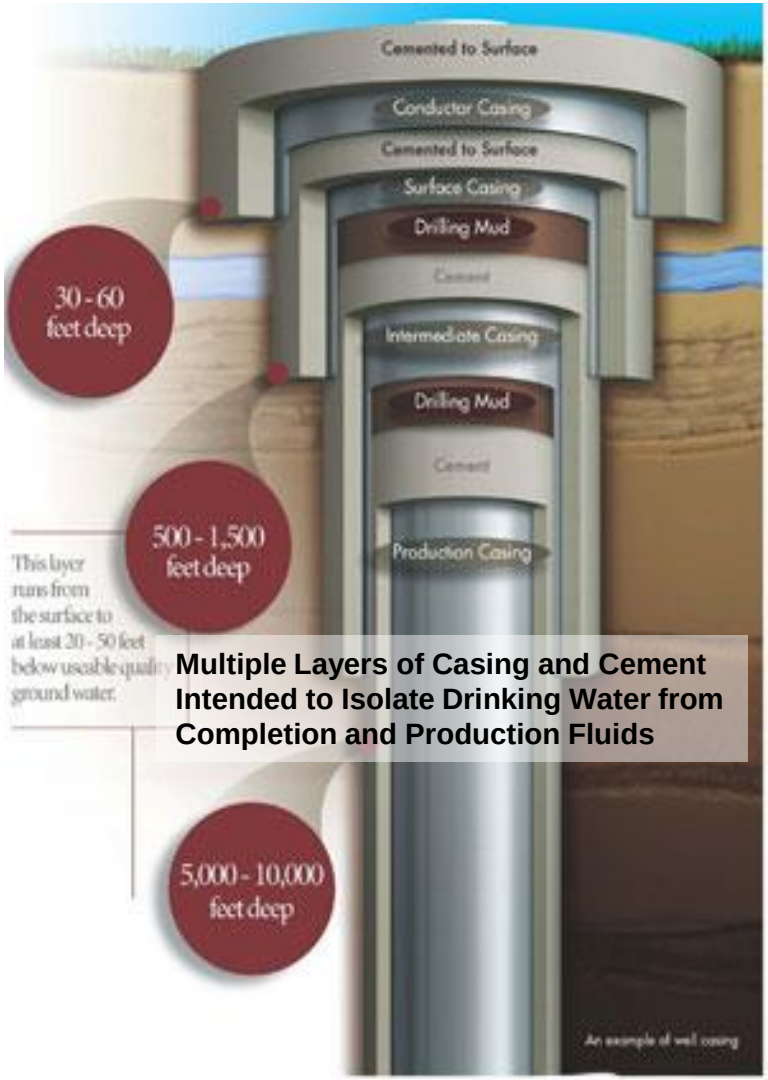
EFD provides unbiased science to address environmental and societal aspects in all oil and gas activities.



Environmental Risks

In Modern Well Design Ground Water is Multiple Protected

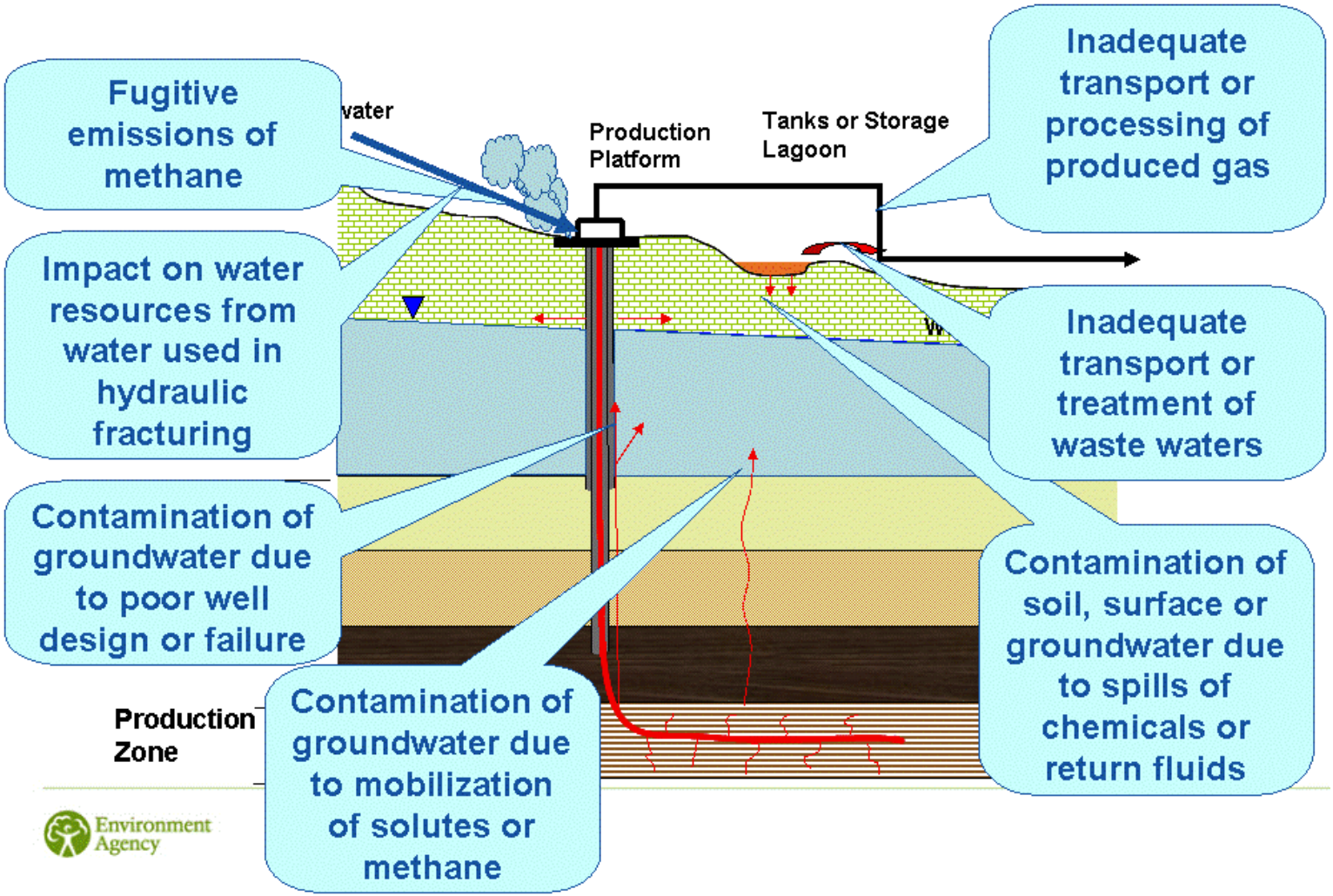




Multiple Layers of Casing and Cement Intended to Isolate Drinking Water from Completion and Production Fluids

Graphic Courtesy of Texas Oil and Gas Association

Shale Gas Production and Theoretical Possible Contamination Risks



MIT Study (2011) on Shale Gas Accidents in the US

Three studies combined - all reported US cases from 2000-2010 analyzed

Source 1

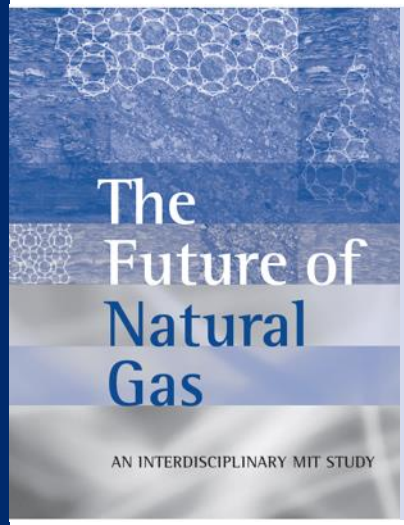
Frac Attack: Risk, Hype and Financial Reality of Hydraulic Fracturing in the Shale Plays; July 8, 2010; A Special Report by Reservoir Research Partners and Tudor Pickering & Holt

Source 2

Hydraulic Fracturing: Preliminary Analysis of Recently Reported Contamination; September 2009; Prepared for: Drinking Water Protection Division (DWPD) Office of Ground Water and Drinking Water (OGWDW) U.S. Environmental Protection Agency (EPA); Prepared by The Cadmus Group Inc.

Source 3

Fractured Communities — Case Studies of the Environmental Impacts of Industrial Gas Drilling; September 2010; Craig Michaels, Program Director; James L. Simpson, Senior Attorney; William Wegner, Staff Scientist; Watershed



Type of incident	Number reported	Fraction of Total
Groundwater contamination by natural gas	20	47%
On-site surface spills	14	33%
Off-site disposal issues	4	9%
Water withdrawal issues	2	4%
Air quality	1	2%
Blowouts	2	4%

40,000+ shale gas wells drilled in the US during this period !

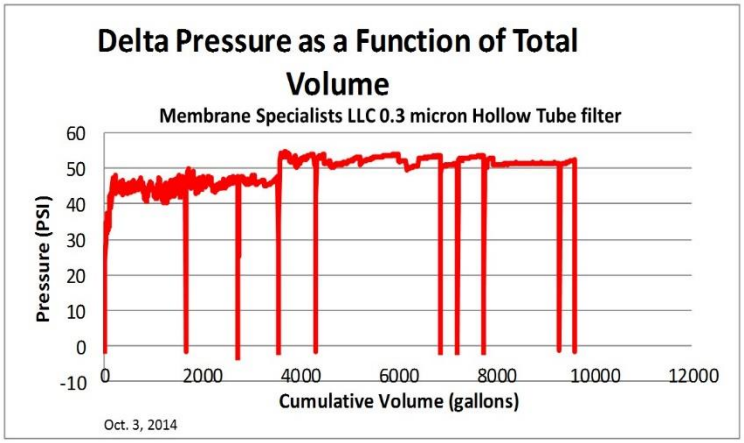
What does an Environmental Monitoring System Look Like?

- Credible, transparent, understandable
- Withstands peer review
- Looks holistically at air, land, water and biodiversity
- Maintains strong linkages to research
- Monitors regional stressors
- Takes advantage of local expertise

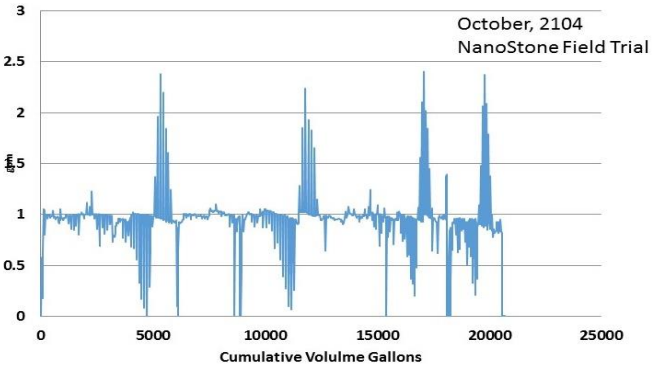
Monitoring Scope of Work

Data	Reason	Location	Measurement Principle	Method
Air Quality/Particulate	Exhaust gases from operations, methane from production, heavy traffic along transport routes	Close to pads, close to surface installation, along heavy traffic transportation routes	Monitoring stations measure CO, NO2, O3, SO2, H2S, methane, particulates	Automated
Water Quality				
Surface Water	Contamination from spills during drilling, production, transport, treatment	Close to pads, along transportation routes, close to populated and agricultural areas, in natural reserves, at sewage plants	Sample containers, laboratory testing on chemistry, total metals, organics, hydrocarbon	Manual
Ground Water	Contamination from surface spills, bad cementing, casing integrity, fracture migration	Close to pads, close to agricultural and populated areas, in natural reserves	Sample containers, laboratory testing on chemistry, total metals, organics, hydrocarbon	Manual
Water Quantity				
Surface Streams/Volumes	Withdrawal for drilling & fracturing	Rivers, streams, etc.	Level/velocity	Automated
Ground Water Level/Streams	Withdrawal may influence ground water level	Close to pads, close to agricultural and populated areas, in natural reserves	Level measurement, different stream flow measurement methods available	Manual
Soil Quality	Deposition of contaminated material	Close to pads	Sample containers, laboratory testing on physical, chemical & biological content	Manual
Noise	Engines required during drilling, production, transport	Close to populated areas	Decibel meter	Automated
Biodiversity	General environmental impacts	Rivers, lakes, forests, agricultural areas, natural reserves	Taxonomic richness	Manual
Seismic Waves	Hydraulic fracturing, heavy transport	Close to pads, close to other industry, close to populated areas	Geophones	Automated
Tectonic Movements	Production and re-injection	Close to pads	Optical level instrument	Manual
Street Conditions	Heavy Traffic	Site access roads	Visual, photographical	Manual
Traffic Density	Liquids and equipment transport	Site access roads	Video traffic detection	Automated
Pipeline Integrity	Corrosion, erosion	Between check stations	Pressure abnormalities	Automated

Water Management – West TX



Microfiltration –Permeate Flow Rates



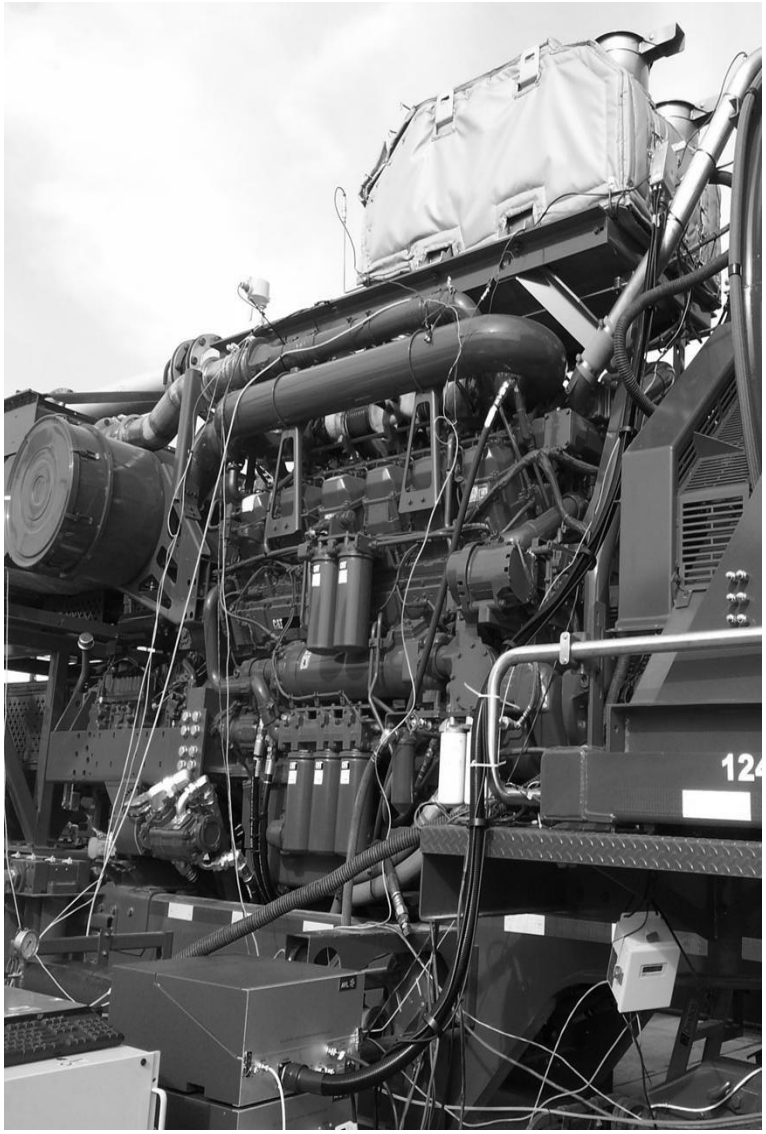
Emissions ?

Questions about Dual Fuel vs. Diesel

- Tail Pipe Emissions
  - NO_x
  - CO
  - CH_4 – Non-Combusted Methane (NCM) aka "Methane Slip"
  - NMHC – Non-Methane Hydrocarbon
  - CH_2O – Formaldehyde (Carcinogen)
  - Soot – Main Component of Particulate Matter (PM)
- Crankcase Emissions
- Emission Control Device Diesel Oxidation Catalyst (DOC) Efficiency

D&C Ops: Field Setup

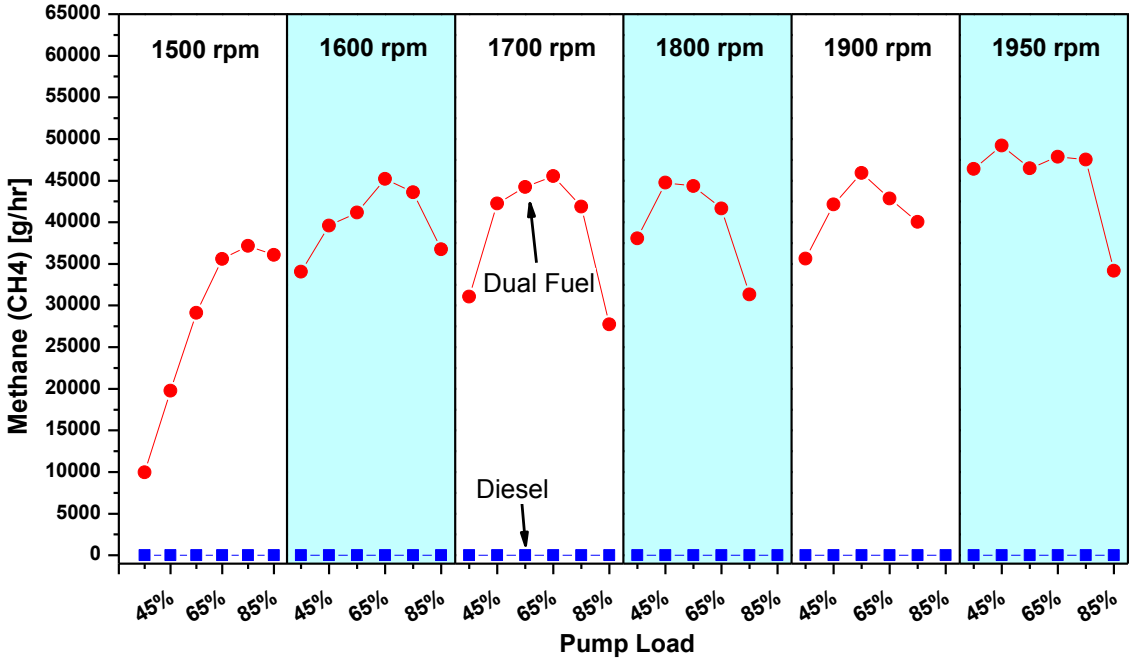
Instruments / Sampling



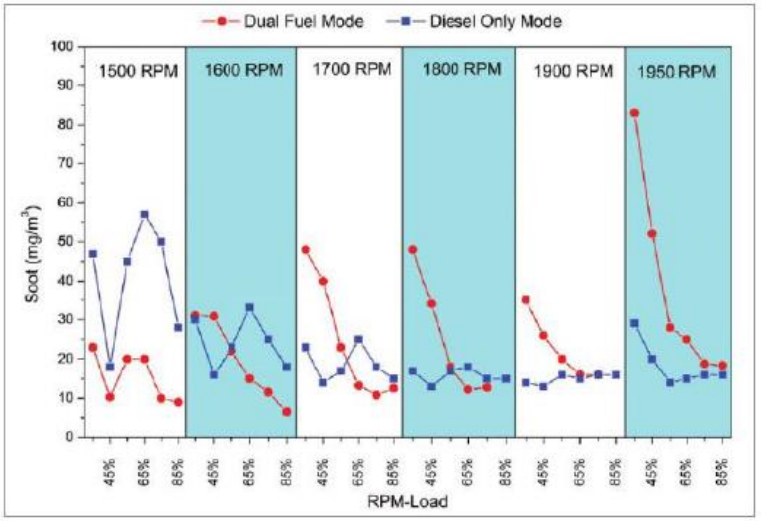
Emissions from Hydraulic Fracturing Engines

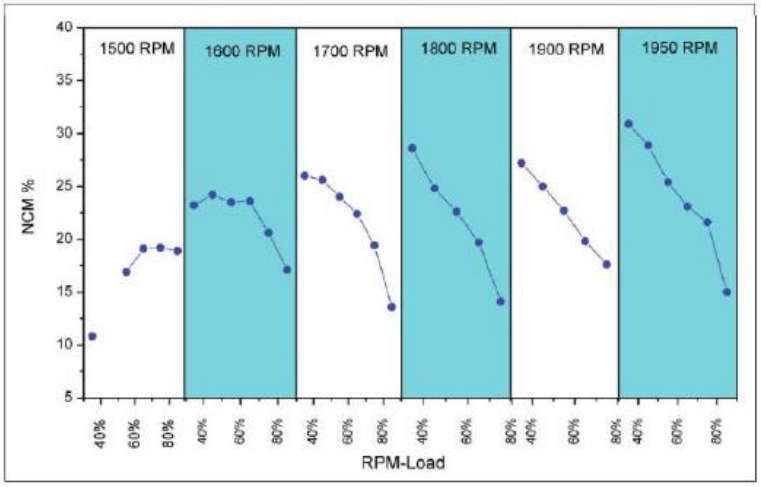
Determined emission differences between hydraulic fracturing engines powered by diesel and engines powered with natural gas/diesel dual fuel.

- Natural gas dual fuel engine does not have clear advantages in emissions compared with diesel, further studies needed
- Un-combusted Methane is up to 30% of total natural gas fuel supply under high substitution rate, reduces fuel economy
- Further research is needed to address these issues
  - *Have tested four different pump engines*



Emissions from Hydraulic Fracturing Engines

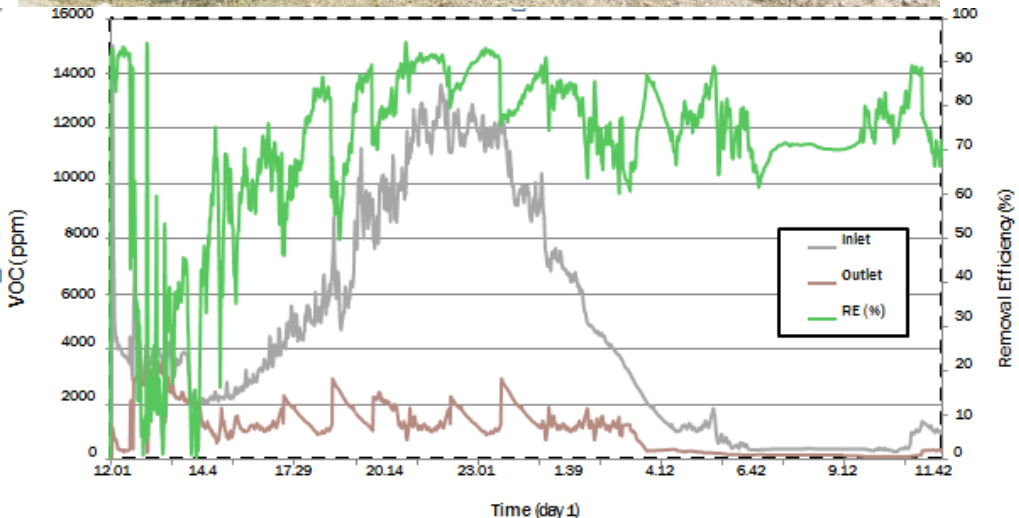




Field Test – Emissions Control System

Successfully developed and tested technology to capture VOC's. System tested at CITGO Refinery.

- *Currently testing at production stock tank.*



Removal Efficiency during field test period

Total VOC Concentration										
Sampling Dates	July 3 - July 4		July 4 - July 5		July 5 - July 6		July 6 - July 7		July 7 - July 8	
Data-log	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Peak (ppm)	15000	3725	1805	321	243	48	183	29	155	11
Minimum (ppm)	66	5	175	17	96	9	67	4	52	1
Average (ppm)	4600	1443	318	75	159	20	115	10	87	3
% Removal Efficiency (Based on Average)	69		76		88		91		96	
% RE Average*	84									

Emission Characterization

- Open Path Fourier Transform Infrared Spectrometer, with integrated weather station in combination with a thermal imaging camera were used to collect emissions from an aging production facility.
- The facility known as “Central” was located in Dimmit County Texas on SHAPE ranch.

Emission Characterization

- Data was collected monthly from March – November 2015
- 256 analytes were measured simultaneously during each sampling event
- Approximately 50 analytes were detected and quantified above trace

SHAPE Ranch Sampling Team

Reducing Dust

SandBox LOGISTICS

"Redefining the Frac Sand Logistics Chain"

Flaring Issues, Solutions, and Technologies (FIST)

Develop and Demonstrate Technologies to monetize stranded gas and to reduce or eliminate gas flaring and/or methane emissions associated with gas production.

Field Test – Flaring Mitigation

Objectives

Identify & test simple/robust technologies to reduce flaring

Location

- Field trials in the Bakken

Field Trial Team

HESS

GC GE GulfCoast GREEN ENERGY

ELECTRATHERM

HARC

Status

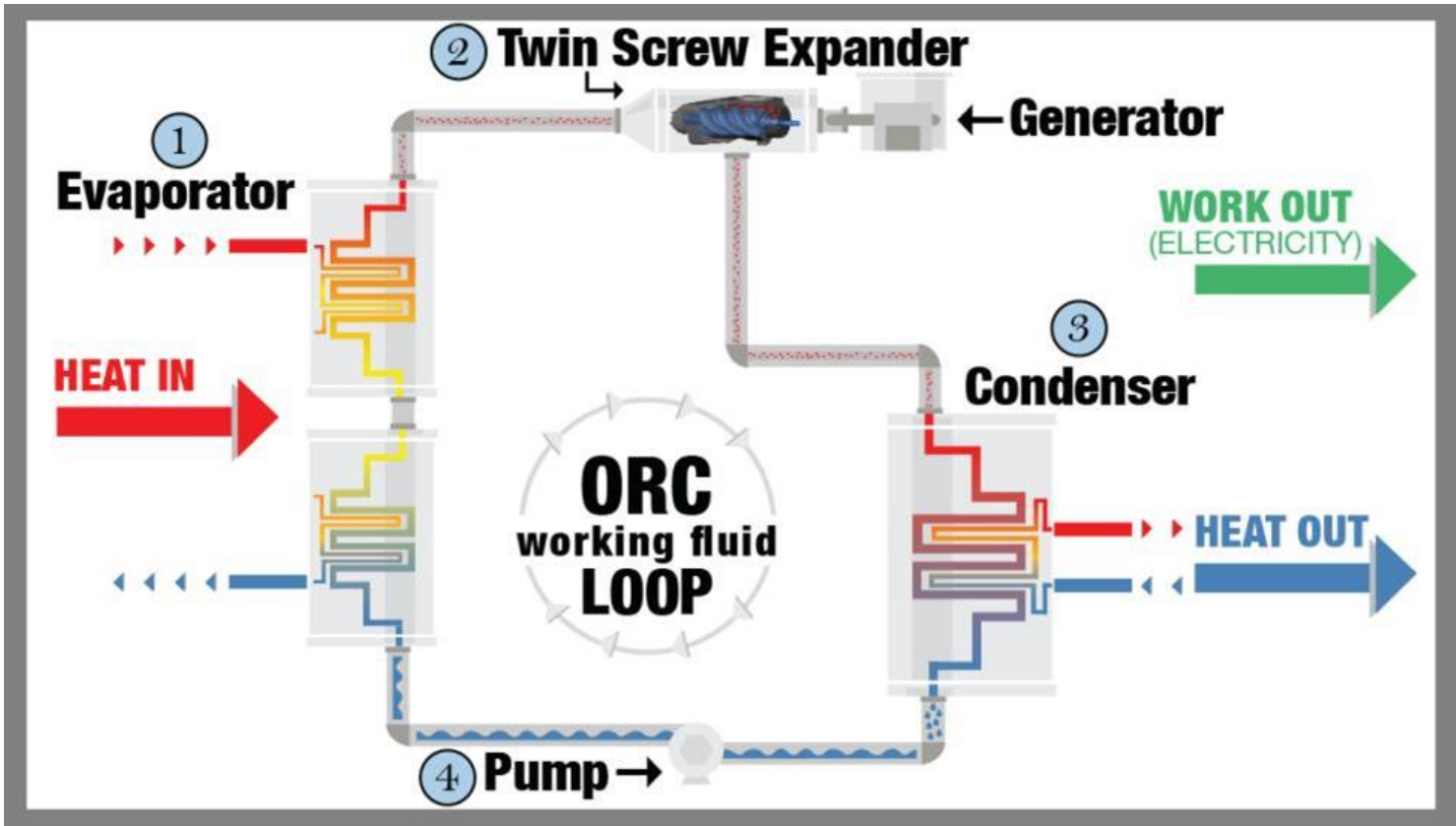
- ORC equipment installed, commissioned, operated.

Technology identified through assessment of RPSEA technologies.

Power From Produced Water (*Previous RPSEA Funded Effort*)

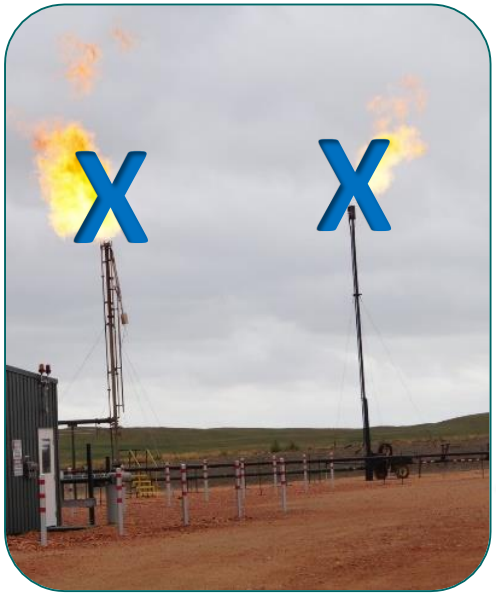
The ORC

- Recover Heat from Flare Gas
- Use the heat to drive an Organic Rankine Cycle System
- Use pressure of expanded working fluid to spin a generator



Provide Beneficial Use for Flare Gas

Gas Fueled Boiler



kW Output

Reduced Flaring

Field Test

- 90 day pilot trial on the HA-ROLFSRUD site
- July 29, 2015 to Nov 11, 2015
- Emissions testing completed Oct 2015

Trial Objectives

- Test simple/robust ORC Technology to reduce flaring
- Demonstrate ability of the Power + to produce electricity from flare
- Demonstrate electricity production does not interfere with well operations
- Determine emissions offset and prove technology works

Results

Total Run Time: 1857 HR

Total kWh Produced: 99,000

Emission Reduction

October 2015

CO2 avg ↓89%

NOx avg ↓ 48%

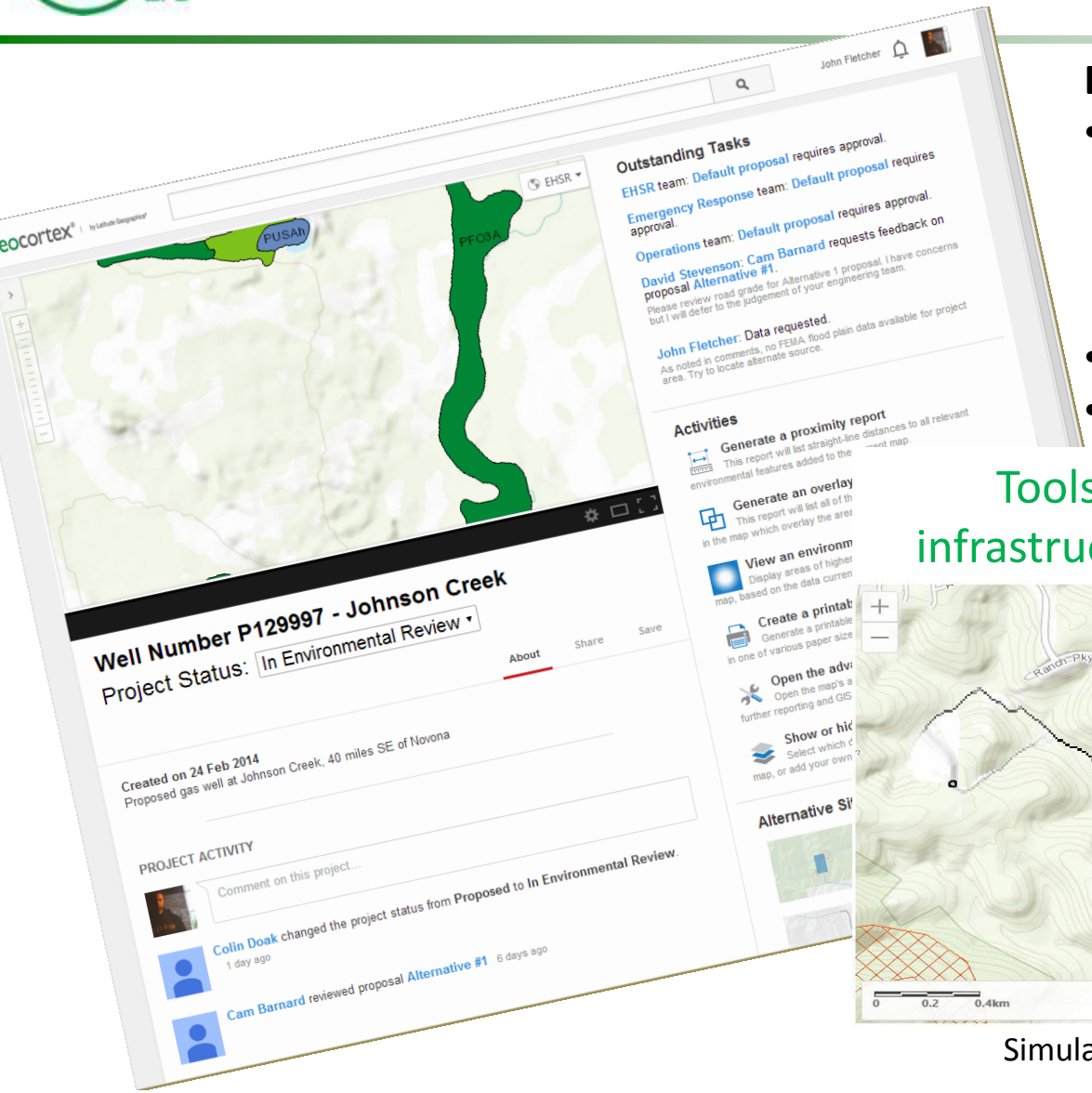
VOC avg ↓ 93%

Summary

- The trial has demonstrated that a beneficial use of flare gas is possible
- The system requires very little maintenance with approx. 1 man hour/week
- The Power+ system is an economical alternative to curtailing oil production due to flaring regulations
- Emissions can be reduced significantly

To further help reduce flaring emissions, the Environmentally Friendly Drilling (EFD) program, Gulf Coast Green Energy and ElectraTherm partnered with Hess to test the ElectraTherm Power+ Generator™, a leading distributed waste-heat-to-power technology, at a Hess North Dakota well site. The pilot project captures the natural gas to generate electricity and reduces or liminates onsite flaring. ElectraTherm's wer+ Generator™ captures the waste t and provides clean methane ation without capital-intensive gas p. At the well site, natural gas that otherwise be flared is instead uel a low-emission industrial boiler heats water to run the nerator™ and produces clean s used for onsite processes, cost of electricity from the ystem operated with an eam reliability of greater nd showed average ns in carbon cent, nitrogen oxides t and VOCs of 93 percent, mpared to flaring.

Land Use Site Selection Information Tool
LUSSIT



Development of LUSSIT

- GIS based analytical tool that aggregates spatially distributed attributes and considerations in the region(s) of interest to support site selection decisions.
- *Tool beta tested in Sept/Oct 2015.*
- Tool now commercial!

Tools for planning and evaluating infrastructure placement anyone can use

Simulate spill flow and termination scenarios

D&C Ops EFD Scorecard

(www.efdscorecard.org)

EFD Facts

Project:
Location:
Ecosystem:

	Max	Score
AIR	13	0
WATER	21	0
SITE	18	0
WASTE MANAGEMENT	20	0
BIODIVERSITY/HABITAT	15	0
SOCIETAL	13	0
	100	0

RESOURCES FOR THE FUTURE

May 29, 2013

Richard C. Haut
rector, EFD Program
Houston Advanced Research Center
4800 Research Forest Drive
The Woodlands, TX 77381

Dear Rich,

I enthusiastically support the creation of the Environmentally Friendly Drilling System (EFD) Scorecard by the Houston Advanced Research Center (HARC), and hope that many publically owned exploration, production and service companies will shape their practices to allow them to achieve four or five star ratings in the near future. The EFD Scorecard reflects an appropriate balance between striving for substantial advances in environmentally desirable exploration and production practices that go beyond current law and regulations with a recognition that the cost effectiveness of such practices needs to be considered as well.

The comprehensive references and explanations in the EFD Scorecard will be useful to all companies seeking to improve their environmental performance whether or not they seek to obtain a star level rating.

I urge HARC to work with state associations of oil and gas producers and associations of service companies to help them encourage their members, in particular the non-publicly owned companies, to seek to use the EFD Scorecard and supporting materials to take steps toward complying with as many aspects of the EFD Scorecard as possible.

Sincerely yours,

Jan W. Mares
Senior Policy Advisor

1616 P St. NW Washington, DC 20036-1400 Tel 202-328- fax 202- @rff.org www.rff.org

HESS CORPORATION
2014 Corporate Sustainability Report

We regularly work with our industry peers on biodiversity-related issues. For example, we are an active member of the Biodiversity and Ecosystem Services working group of IPIECA, the global oil and gas industry association for environmental and social issues. In October we helped lead (and had several staff members participate in) the working group's first peer-to-peer training workshop on managing biodiversity and ecosystem services in the oil and gas industry.

We also participate in the Cross Sector Biodiversity Initiative (CSBI), a partnership of IPIECA, the International Council on Mining and Metals and the Equator Principles Association. This initiative brings the mining, oil and gas and financial sectors together to develop and share good practices for safeguarding biodiversity and ecosystems. In 2014 the CSBI published a timeline tool designed to help align project development, biodiversity impact management, and financial timelines and milestones.

Hess is also a sponsor and active member of the Environmentally Friendly Drilling (EFD) program. The EFD program is a partnership among multiple oil and gas companies, academia and environmental organizations and is coordinated by the Houston Advanced Research Center. It aims to provide unbiased science and develop solutions to address environmental issues associated with oil and gas development. For example, the EFD developed a scorecard that provides oil and gas companies with a means for objectively assessing and continually improving their environmental performance and that of their service providers. In 2014 we used the scorecard to assess and improve practices at our Ohio assets; we plan to use it at our North Dakota assets in 2015.

WASTE

Our operations generate a variety of waste streams, including construction debris; scrap metal and wood; oily tank bottoms; contaminated soil; office and domestic waste such as paper, cardboard and light bulbs; and other waste items specific to drilling and production operations. It should be noted that, consistent with IPIECA reporting guidelines, our waste data do not include mud and cuttings generated in our onshore operations. Wastes are managed according to the waste management plan specific to each operating location. The waste management plan is designed to comply with all applicable regulatory requirements and to protect human health and the environment. Following our lean philosophy, our operations try to minimize waste generation and recycle wherever possible.

In 2014 we generated approximately 188,000 tonnes of waste, nearly all (99 percent) of which was deemed non-hazardous according to applicable regulations. In addition, we disposed of 84,693 tonnes of drill cuttings from our North Dakota and Ohio operations at licensed disposal sites in 2014.

DISCHARGES

Discharges from our offshore facilities include drilling mud, drill cuttings and produced water. At some of these facilities, these waste streams are reinjected for disposal or reservoir management, whereas others discharge directly to the ocean. In some other cases we ship drilling waste to shore for treatment and disposal.

HESS

Community Issues / Public Perception

Energy Sources, Part B, 7:275–281, 2012
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ISSN: 1556-7249 print/1556-7257 online
DOI: 10.1080/15567240903030562

Taylor & Francis

Public Perception of the Natural Gas Industry: Data from the Barnett Shale

G. L. THEODORI[1]

[1]Department of Sociology, Sam Houston State University, Huntsville

SOUTHERN RURAL SOCIOLOGY, 24(1), 2009, pp. 113–129.
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LOCAL LEADERS' PERCEPTIONS OF ENERGY DEVELOPMENT IN THE BARNETT SHALE

BROOKLYNN J. ANDERSON*

MISSISSIPPI STATE UNIVERSITY EXTENSION SERVICE

Pennsylvanian's Perceptions of Natural Gas Development in the Marcellus Shale: A Summary of Findings from a 2012 Survey

Journal of Rural Social Sciences, 26(1), 2011, pp. 92–106.
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PUBLIC PERCEPTION OF DESALINATED PRODUCED WATER FROM OIL AND GAS FIELD OPERATIONS: A REPLICATION*

GENE L. THEODORI

SAM HOUSTON STATE UNIVERSITY

MONA AVALOS

Society and Natural Resources, 22:674–685
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ISSN: 0894-1920 print/1521-0723 online
DOI: 10.1080/08941920802039804

Routledge

Public Perception of Desalinated Water from Oil and Gas Field Operations: Data from Texas

SOUTHERN RURAL SOCIOLOGY, 24(3), 2009, pp. 97–117.
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PARADOXICAL PERCEPTIONS OF PROBLEMS ASSOCIATED UNCONVENTIONAL NATURAL GAS DEVELOPMENT*

GENE L. THEODORI

SAM HOUSTON STATE UNIVERSITY

Final Research Report

PERCEPTIONS OF OIL AND NATURAL GAS DEVELOPMENT IN THE EAGLE FORD SHALE: A SUMMARY OF FINDINGS FROM A 2015 SURVEY

Gene L. Theodori

Sam Houston State University

Assessing Opportunities and Barriers to Reducing the Environmental Footprint of Natural Gas Development in Utah's Uintah Basin

Journal of Rural Social Sciences, 28(2), 2013, pp. 122–134.
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PERCEPTION OF THE NATURAL GAS INDUSTRY AND ENGAGEMENT IN INDIVIDUAL CIVIC ACTIONS*

GENE L. THEODORI

SAM HOUSTON STATE UNIVERSITY

Original research article

Hydraulic fracturing and the management, disposal, and reuse of frac flowback waters: Views from the public in the Marcellus Shale☆

CrossMark

Gene L. Theodori[a,*], A.E. Luloff[b], Fern K. Willits[c], David B. Burnett[d]

[a] Department of Sociology, Sam Houston State University, Box 2446, Huntsville, TX 77341, USA
[b] Department of Agricultural Economics, Sociology, and Education, The Pennsylvania State University, 114 Armsby Building, University Park, PA 16802, USA
[c] Department of Agricultural Economics, Sociology, and Education, The Pennsylvania State University, 113 Armsby Building, University Park, PA 16802, USA
[d] Global Petroleum Research Institute, Texas A&M University, 710 Richardson Building, 3116 TAMU, College Station, TX 77843, USA

Selected Findings

1. Perception is a key factor in explaining:

   a. attitudes toward, and
   b. actions taken – either in support of or opposition to –

   the development of oil and gas.

2. Transparent communication between/ among all stakeholders is paramount

   a) Potentially positive aspects and negative consequences

   b) Industry – share more information about shale gas technologies with government and regulatory officials and the general citizenry

3. Probability of risks exists

   - Of rapid industrialization (boom and bust)
   - Of uneven distribution of cost and benefit
   - Of social-psychological stress

Environmental Friendly Drilling Rig

Technology Transfer

	2016 - YTD	2015	2014	2013	2012
Publications	4	15	13	11	12
Presentations	10	57	48	24	32
Workshops	4	10	18	9	3
Webinars	2	5			
Exhibits	1	2	4	1	1

2016

July ***Nominated*** – Environmental Partnership Category, IOGCC Chairman's Stewardship Awards

2015

October ***Oil and Gas Awards –*** VZ Environmental Award for Excellence in Environmental Stewardship

October ***Finalist – Best Health, Safety, Environmental Program – Onshore***, World Oil Awards

2014

November ***Nominated – Protection of the Environment Prize***, Eni Award

November ***Impact Award Nominee***, 2014 Eagle Ford Excellence Awards, South Texas Energy Economic Roundtable

October ***Finalist – Best Outreach Program***, World Oil Awards

August ***Nominated*** – Energy Education Category, IOGCC Chairman's Stewardship Awards

EFD's CU Law and Engineering Partner

Intermountain Oil & Gas Best Management Practices Project

http://www.oilandgasbmps.org

EFD

COLORADO TEAM RURAL WATER

RPSEA
Research Partnership to Secure Energy for America

COLORADO Energy Office

LawAtlas℠
The Policy Surveillance Portal

Robert Wood Johnson Foundation

GETCHES WILKINSON CENTER
FOR NATURAL RESOURCES, ENERGY, AND THE ENVIRONMENT

AirWaterGas

Sustainability Research Network

Intermountain Oil & Gas BMP Project

- Geographic Scope
  - CO, MT, NM, UT, WY
  - Beyond the Region
- Databases (searchable)
  - BMPs (>10,000)
  - Bibliography (> 800)
  - Laws and Regulations (LawAtlas)
- Website Background Materials
  - Resource Pages
  - Law and Policy (Federal, state, local, tribes)
- Research Services
- Workshops

Intermountain Oil and Gas BMP Project

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Water Quality

Impacts of oil and gas development on water quality are a concern across the Intermountain West. Of particular concern are: storm water runoff from construction activities, pollution from pits, hydraulic fracturing, and use and disposal of CBM produced water. The following resources provide an introduction to the problems and best practices for each of these issues.

For a complete overview of the Clean Water Act, as it addresses these issues visit the Red Lodge Clearinghouse.

SOURCE WATER PROTECTION

Drinking water comes from both ground water and surface water sources. While all fresh water is a precious commodity in the arid West, drinking water sources deserve special protection. Many activities, including oil and gas development, can deplete or contaminate drinking water sources. Surface water can be contaminated by stormwater runoff and spills. Ground water can be contaminated through surface spills, leaking waste pits, or poor disposal practices. In rare circumstances, a poorly constructed oil and gas well may allow gas and other pollutants to escape due to incomplete casing or cement failures. On a national level, EPA provides a variety of resources for mapping source water areas, assessing the potential for contamination, and planning for source water protection. For information on protecting ground water sources during underground injection disposal of wastewater, see the EPA UIC Class II webpage or see "Disposal Issues" on our Water Quantity Resource page.

See Protecting Source Water in Colorado During Oil and Gas Development for a Colorado-specific discussion of both regulatory and non-regulatory protection measures

Stormwater Runoff

Pollution from stormwater is an issue with all types of development from urban to rural areas. Regulation of stormwater discharges from oil and gas exploration, production, processing and treatment activities has been particularly controversial in the last few years. Resources on EPA's web pages address both the problem and some of the solutions.

See Regulating Stormwater – The Role of Federal, State, and Local Governments in Colorado, which uses Douglas County, Colorado to explain the federal, state, and local regulatory schemes in place.

Regulation of Oil and Gas Construction Activities – A summary of the issues, legislation, regulations and litigation

Stormwater Pollution Prevention Plans for Construction Activities – Information on Pollution Prevention Plans, permitting and BMPs

State by State

Comparative Legal Datab

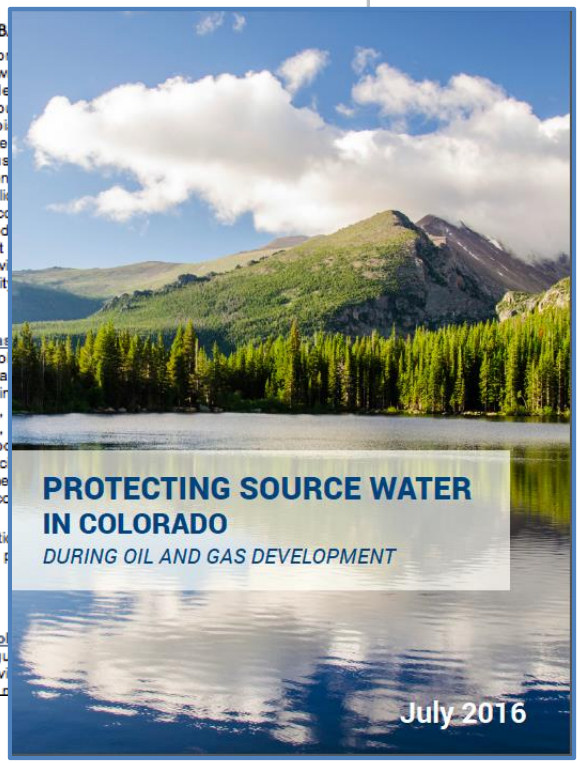
Improved technological develop
fracturing, more commonly know
gas production boom nationwide
Information Administration anno
surpass Russia and Saudi Arabi
natural gas by the end of the ye
development in regions unaccus
that have a century-long relation
wastewater discharges, hydrauli
casing/cementing, and other acc
risks in areas where directional d
are utilized. Rapid development
and suburban areas, coupled wi
sparked concern for water qualit
protect water quality.

This comparative legal databas
Alaska, Arkansas, California, Co
Mexico, New York, North Dakota
Utah, West Virginia, and Wyomin
formations such as the Bakken,
Haynesville, Mancos, Marcellus,
River, San Juan, Uinta, and Woo
these jurisdictions are experienc
development, and there is treme
jurisdictions to guide statutory co

To explore statutes and regulati
related to oil and gas activities, p

Colorado

Protecting Source Water in Col
and Gas Development - This gu
2016, is intended for water prov
members interested in learning



http://www.oilandgasbmps.org/resources/MOU.php

Intermountain Oil and Gas BMP Project

HOME SEARCH BIBLIOGRAPHY RESOURCES LAW & POLICY TRAINING & WORKSHOPS FORUM ABOUT US

Memorandum of Understanding (MOU)

A Memorandum of Understanding (MOU) memorializes an agreement between the parties signing the document. In the oil and gas development context, parties to these agreements may include federal, state or local governments, tribes, and operators. In Colorado, such agreements are often negotiated by a local government and an oil and gas operator and may be called an MOU, a memorandum of agreement (MOA), operator agreement, or development agreement. In these documents (that we collectively call "MOUs"), the parties agree on how the oil and gas operator will develop and/or operate oil and gas facilities within the purview of the local jurisdiction.

Over a decade ago, La Plata County Commissioners and operators started developing MOUs — agreeing to disagree on the authority of local governments to regulate oil and gas beyond the requirements of the Colorado Oil and Gas Conservation Commission (COGCC). Beginning in 2005, La Plata County and several operators negotiated and signed MOUs that recognized this disagreement and agreed to terms of development that would guarantee the county certain operating standards and pay certain road fees. In exchange, the operator could avoid protracted formal hearings of the County's standard land use permitting process. Over the next decade, 10 additional communities negotiated over 40 MOUs with operators.

Just prior to the 2014 elections, Governor Hickenlooper created the Colorado Oil and Gas Task Force, as an alternative to contentious ballot initiatives on local control in order to address conflicts between local and state regulation, multiple-well production areas, and drilling operations near and within communities. The Task Force meetings included discussions of MOUs and several Task Force proposals for action included MOUs.

Read more on the Governor's Task Force and its recommendations.

Anatomy of an MOU

MOUs and the processes used to develop them are as different as the communities, operators and issues that they address. Yet they have commonalities as well.

MOU Negotiations
The process of negotiating MOUs varies substantially from jurisdiction to jurisdiction. Local governments have developed site-specific MOUs after intense negotiation with particular operators and more general MOUs that are subsequently signed by several operators (with minor tweaks). Individual operators, industry groups (e.g., Colorado Oil and Gas Association), and the COGCC have been involved in various negotiations. For some MOUs, the parties have used public information meetings, Council/Commission hearings, and informal discussions to inform community members and other stakeholders. Other MOUs have been negotiated with little if any public participation.

MOU Components: Administrative Clauses and Substantive Elements
MOUs generally begin by naming and describing the parties and setting out the understanding between the parties that have led to signing an MOU (Recitals, Background or "Whereas" sections). Common, but not universal, administrative provisions of the MOUs include an applicable

Databases of MOUs

In response to both the recent interest in and skepticism surrounding MOUs, the BMP Project has developed a repository of information from Local Government / Operator MOUs within the BMP Project's existing searchable database of documents and searchable database of BMPs. These databases allow users to access the MOUs and to compare the BMPs included in them. The databases also allow users to compare the BMPs to state regulatory requirements and to monitor the incorporation of MOU provisions into COGCC permits and orders.

Catalog of MOU Documents:

All known MOUs are included in the BMP Project's searchable bibliography. These MOUs (including draft, final but unsigned, and signed MOUs) were obtained through Internet searches, and contributions from individuals working on these issues, including the COGCC.

These MOUs are accessible via this website's **'SEARCH'** tab. A keyword search (using "MOU") in this bibliographic database will yield a search

Calling all MOUs! *Please help us populate the repository with all of the Local Government – Operator MOUs in Colorado. Have we missed one? Please let us know via the "About Us" tab above.*

LawAtlas Database

Comparative Law Database

- Water Quality – Lifecycle of field development
- Water Quantity – Administration, reporting, conservation, etc.
- Air Quality – Flares, engines, leak detection, storage, etc.

Current Database:

- States (17)
- Federal
  - BLM/BIA, USFS
  - EPA
- Local Jurisdictions (4)

2016 Expansion:

- Setbacks
- Induced Seismicity
- Comparative analysis factsheets

LawAtlas
The Policy Surveillance Portal

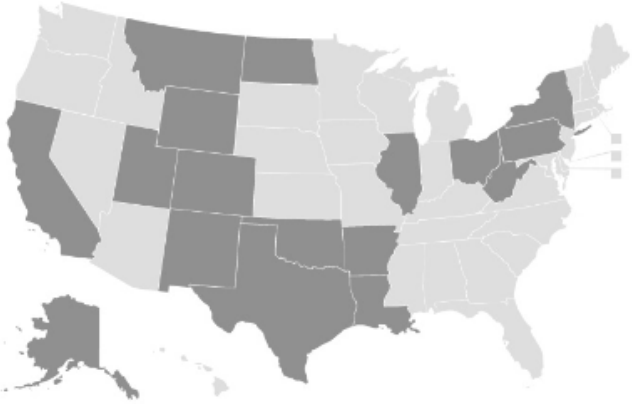
BMPlogo shorter.jpeg

Oil & Gas - Water Quality, Water Quantity, and Air Quality

Improved technological developments in horizontal drilling and hydraulic fracturing, more commonly known as "fracking," have resulted in an oil and gas production boom nationwide. These technological advancements are used to unlock oil and gas from shale deposits across the country, including regions unaccustomed to the industry and those that have a century-long relationship with oil and gas extraction.

Increased shale oil and shale gas development has been accompanied by increased concerns about water quality, water quantity, and air quality issues related to the development. Wastewater discharges, hydraulic fracturing fluid chemicals, improper casing and/or cementing of the bore hole, and accidental spills pose potential water quality risks. The quantity of water used to hydraulically fracture a well also varies widely depending on geologic conditions – 2 to 7 million gallons of water per well – and a well may be fracked more than once. The amount of water consumed and the timing of the water usage are of growing concern nationwide, but particularly in arid regions or in areas experiencing water shortages. Air quality concerns from the waste of methane through leaks and intentional venting and flaring of gas as well as the release of volatile organic compounds and hazardous air pollutants, like benzene and toluene, from well site operations are also prevalent.

This collection of datasets and maps includes water quality, water quantity, and air quality statutes and regulations of four federal agencies (Bureau of Land Management, Bureau of Indian Affairs, U.S. Forest Service, and the Environmental Protection Agency), 17 states (Alaska, Arkansas, California, Colorado, Illinois, Louisiana, Montana, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Texas, Utah, West Virginia, and Wyoming). These jurisdictions



LawAtlas Interactive Maps:

Air Quality: Air Quality Laws Pertaining to Oil and Gas Development

Water Quality: Permitting, Design, and Construction

Water Quality: Well Drilling

Water Quality: Well Completion

Water Quality: Production and Operation

Water Quality: Reclamation

Water Quantity: Quantity

LawAtlas
The Policy Surveillance Portal

Air Quality Laws Pertaining to Oil and Gas Development Map

A production boom in directional drilling and hydraulic fracturing (more commonly known as "fracking") has resulted in shale oil and gas development in regions unaccustomed to the industry as well as in regions that have a century-long relationship with oil and gas extraction. Developing oil and natural gas requires numerous stages – drilling, completion, production, and operation – that have the potential to affect air quality through the release of volatile organic compounds (VOCs) that contribute to the creation of smog, hazardous air pollutants (HAPs), and methane, a potent greenhouse gas.

This comparative dataset focuses on some of the most important law for controlling VOCs, HAPs, and methane, and only examines laws pertaining to air quality for operations and equipment on the well pad site. It does not cover processing, transmission, storage and distribution. The dataset includes federal regulations of the US Environmental Protection Agency (EPA), and statutes and regulations from 17 states. Under authority of the Clean Air Act, EPA rules establish the minimum requirements for the entire country. In many cases, states have adopted the federal rules by reference or explicitly incorporated comparable provisions into their state regulations. Other states, including Arkansas and New York (which are included in this dataset) have not done so, but the requirements of federal law still apply.

To explore the law pertaining to specific air quality issues related to oil and gas activities, current as of November 25, 2015, use the blue "Start here" box below. For a summary of all of the law compiled for a specific jurisdiction, click on the corresponding part of the map.

Curator

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If you have questions, corrections, or additions, please contact Matt Samelson at oilandgasbmps@colorado.edu.

Related Resources

Acronym Glossary

LawAtlas Interactive Maps:
Air Quality: Air Quality Laws Pertaining to Oil and Gas Development
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Water Quantity: Quantity

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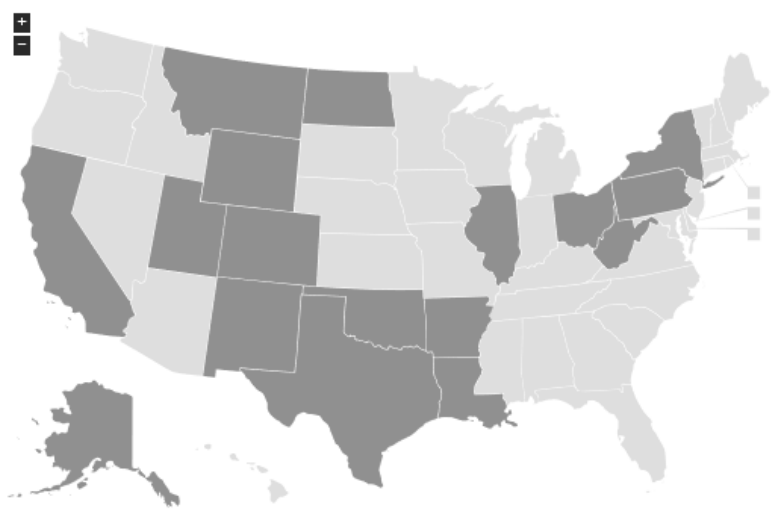
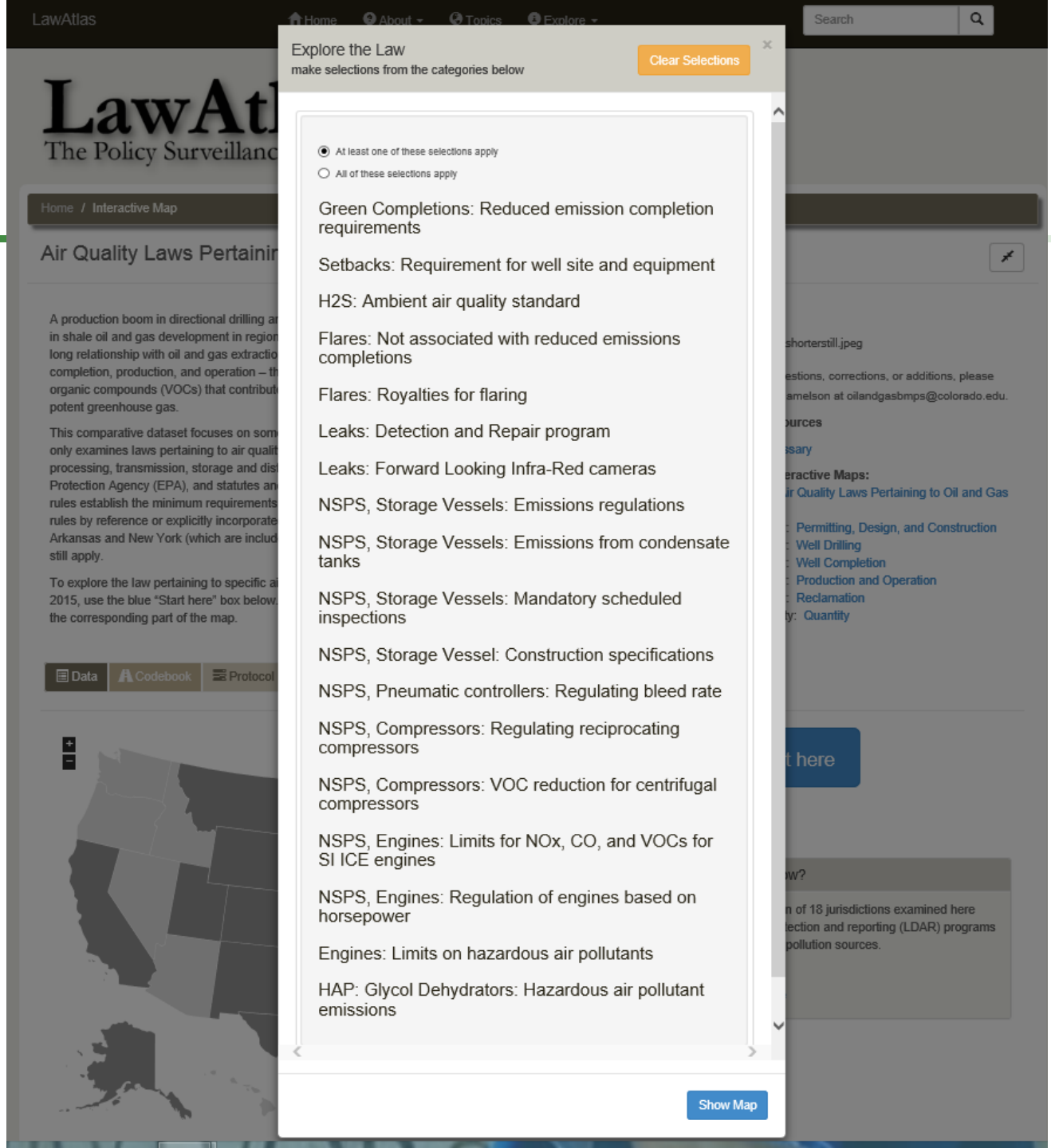


Start here

Did you know?

Laws in seven of 18 jurisdictions examined here have leak detection and reporting (LDAR) programs related to air pollution sources.

Read more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make selections from the categories below
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At least one of these selections apply
All of these selections apply
Green Completions: Reduced emission completion requirements
Setbacks: Requirement for well site and equipment
H2S: Ambient air quality standard
Flares: Not associated with reduced emissions completions
Flares: Royalties for flaring
Leaks: Detection and Repair program
Leaks: Forward Looking Infra-Red cameras
NSPS, Storage Vessels: Emissions regulations
NSPS, Storage Vessels: Emissions from condensate tanks
NSPS, Storage Vessels: Mandatory scheduled inspections
NSPS, Storage Vessel: Construction specifications
NSPS, Pneumatic controllers: Regulating bleed rate
NSPS, Compressors: Regulating reciprocating compressors
NSPS, Compressors: VOC reduction for centrifugal compressors
NSPS, Engines: Limits for NOx, CO, and VOCs for SI ICE engines
NSPS, Engines: Regulation of engines based on horsepower
Engines: Limits on hazardous air pollutants
HAP: Glycol Dehydrators: Hazardous air pollutant emissions
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Air Quality Laws Pertainir

A production boom in directional drilling ar
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organic compounds (VOCs) that contribut
potent greenhouse gas.

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rules establish the minimum requirements
rules by reference or explicitly incorporate
Arkansas and New York (which are includ
still apply.

To explore the law pertaining to specific ai
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the corresponding part of the map.

Data | Codebook | Protocol

Explore the Law

make selections from the categories below

Clear Selections

- At least one of these selections apply
- All of these selections apply

Green Completions: Reduced emission completion requirements

clear

- [x] Yes, for gas wells only
- [ ] Yes, for oil and gas wells
- [ ] Yes, only as of January 2015
- [ ] Yes, implemented prior to NSPS subpart OOOO regulations

Continuous ignition source or auto-ignitor?

clear

- (•) Yes
- ( ) No

Exceptions to REC requirements

clear

- [ ] Wildcat wells
- [ ] Delineation wells
- [ ] Low pressure wells
- [ ] Other
- [x] No exceptions listed in the law

Setbacks: Requirement for well site and equipment

H2S: Ambient air quality standard

Flares: Not associated with reduced emissions completions

Flares: Royalties for flaring

Leaks: Detection and Repair program

Leaks: Forward Looking Infra-Red cameras

NSPS, Storage Vessels: Emissions regulations

NSPS, Storage Vessels: Emissions from condensate

Jurisdiction(s) Found 17

Show Map

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amelson at oilandgasbmps@colorado.edu.

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ir Quality Laws Pertaining to Oil and Gas

: Permitting, Design, and Construction
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: Production and Operation
: Reclamation
ty: Quantity

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pollution sources.

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Air Quality Laws Pertaining to Oil and Gas Development Map

A production boom in directional drilling and hydraulic fracturing (more commonly known as "fracking") has resulted in shale oil and gas development in regions unaccustomed to the industry as well as in regions that have a century-long relationship with oil and gas extraction. Developing oil and natural gas requires numerous stages – drilling, completion, production, and operation – that have the potential to affect air quality through the release of volatile organic compounds (VOCs) that contribute to the creation of smog, hazardous air pollutants (HAPs), and methane, a potent greenhouse gas.

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Curator

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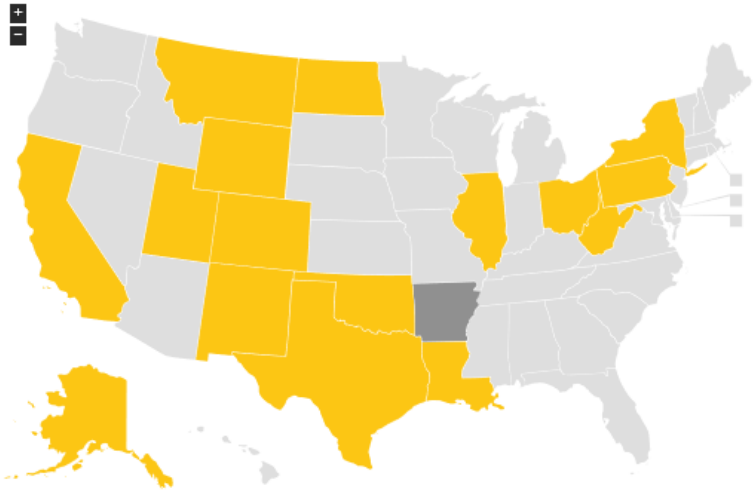
Data | Codebook | Protocol



Start here

Did you know?

Laws in seven of 18 jurisdictions examined here have leak detection and reporting (LDAR) programs related to air pollution sources.

Read more

view table

share results

Where At least one of these selections apply

- Green Completions: Does the jurisdiction require reduced emission completion (REC) with no direct release to the atmosphere (a.k.a. green completion)?: Yes, for gas wells only
- Does the jurisdiction require a continuous ignition source or auto igniter for RECs?: Yes
- Are there exceptions to the REC requirements?: No exceptions listed in the law

17 Jurisdictions Found

Note: This dataset includes Federal policies.

Excel

Jurisdiction	Effective	Valid Through	Law	Green Completions: Reduced emission completion requirements	Continuous ignition source or auto-ignitor?	Exceptions to REC requirements
United States - Federal	09/01/2015	11/01/2015	View Law	Yes, for gas wells only, Yes, only as of January 2015 §	Yes §	Wildcat wells, Delineation wells, Low pressure wells, Other §
Alaska	04/01/2015	11/01/2015	View Law	Yes, for gas wells only, Yes, only as of January 2015 §	Yes §	Wildcat wells, Delineation wells, Low pressure wells, Other §
California	05/17/2006	12/16/2015	View Law	Yes, for gas wells only, Yes, only as of January 2015 ⚠	Yes ⚠ §	Wildcat wells, Delineation wells, Low pressure wells, Other ⚠
Colorado	04/30/2015	11/01/2015	View Law	Yes, for oil and gas wells, Yes, implemented prior to NSPS subpart OOOO regulations §	Yes §	Other ⚠ §
Illinois	11/14/2014	11/30/2015	View Law	Yes, for gas wells only §	Yes §	Wildcat wells, Delineation wells, Low pressure wells, Other §
Louisiana	09/01/2014	11/01/2015	View Law	Yes, for gas wells only, Yes, only as of January 2015 §	Yes ⚠ §	Wildcat wells, Delineation wells, Low pressure wells, Other §
Montana	10/11/2014	11/01/2015	View Law	Yes, for gas wells only, Yes, only as of January 2015 ⚠ §	Yes ⚠ §	Wildcat wells, Delineation wells, Low pressure wells, Other §
North Dakota	04/01/2014	11/01/2015	View Law	Yes, for gas wells only, Yes, only as of January 2015 §	Yes §	Wildcat wells, Delineation wells, Low pressure wells, Other ⚠ §

Where At least one of these selections

Green Completions: Does th… atmosphere (a.k.a. green completion)?: Yes, for gas w…

Does the jurisdiction require…

Are there exceptions to the F…

17 Jurisdictions Found

Note: This dataset includes Federal…

Jurisdiction	Effective				Exceptions to REC requirements
United States - Federal	09/01/2015				Wildcat wells, Delineation wells, Low pressure wells, Other §
Alaska	04/01/2015				Wildcat wells, Delineation wells, Low pressure wells, Other §
California	05/17/2006				Wildcat wells, Delineation wells, Low pressure wells, Other
Colorado	04/30/2015	View Law	implemented prior to NSPS subpart OOOO regulations §	§	Other §

Excel

View Law

US Regulation 40 CFR 60-18-a and g

General control device and work practice requirements.

(a) *Introduction.* (1) This section contains requirements for control devices used to comply with applicable subparts of 40 CFR parts 60 and 61. The requirements are placed here for administrative convenience and apply only to facilities covered by subparts referring to this section.

(2) This section also contains requirements for an alternative work practice used to identify leaking equipment. This alternative work practice is placed here for administrative convenience and is available to all subparts in 40 CFR parts 60, 61, 63, and 65 that require monitoring of equipment with a 40 CFR part 60, appendix A-7, Method 21 monitor.

...

(g) *Alternative work practice for monitoring equipment for leaks.* Paragraphs (g), (h), and (i) of this section apply to all equipment for which the applicable subpart requires monitoring with a 40 CFR part 60, appendix A-7, Method 21 monitor, except for closed vent systems, equipment designated as leakless, and equipment identified in the applicable subpart as having no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background. An owner or operator may use an optical gas imaging instrument instead of a 40 CFR part 60, appendix A-7, Method 21 monitor. Requirements in the existing subparts that are specific to the Method 21 instrument do not apply under this section. All other requirements in the applicable subpart that are not addressed in paragraphs (g), (h), and (i) of this section apply to this

Close

Project Contacts

For more information

Browse the websites at:
www.oilandgasbmps.org and www.lawatlas.org/oilandgas

Contact Kathryn Mutz
Natural Resources LLC
kathryn.mutz@colorado.edu
303-499-1092

“Green” drilling is more than drilling

- Get in, drill and get out safely – as fast as possible with minimal disturbance to the land
- Protect surface and ground water
- Access roads
- Pad Drilling
- Reduce traffic, dust, noise, emissions, excessive lights that disturb nearby residences
- Aesthetics
- Flare/vapor recovery
- Gas captured to pipeline – flare gas only in necessary
- Pipe produced water/oil where feasible

It's not so hard to be green

Questions?

Contact Rich:

rhaut@HARCResearch.org

Thank you

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