

DOCKET

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Environmental impacts of oil and gas production

Amy Mall

Natural Resources Defense Council

Oil and Gas Exploration and Production

- Enormous expansion in recent years
- Industry present in 34 states
- Natural gas wells nationwide went from:
 - 1989: 262,000
 - 2007: 463,000

Future: hundreds of thousands of new wells

Environmental Impacts



Environmental Impacts

- Toxic releases into the environment
- Destruction of wildlife habitat and natural values
- Noise, light and other pollution

Contaminants

Naturally occurring substances:

- Benzene, other BTEX
- Arsenic
- Mercury
- H₂S
- Radioactive materials

Chemical additives:

- Hundreds of chemicals that cause a wide range of adverse health effects ranging from skin irritation to neurotoxicity and cancer.

Toxic Chemicals Released During Oil and Gas Operations

Pollutant	Known Negative Health Effects
Arsenic	Chronic arsenic exposure can cause damage to blood vessels, a sensation of “pins and needles” in hands and feet, darkening and thickening of the skin, and skin redness. It is a known human carcinogen and can cause cancer of the skin, lung, bladder, liver, kidney, and prostate. ⁸
Hydrogen Sulfide	Hydrogen sulfide has been linked to irritation of the eyes, nose, and throat; difficulty in breathing; headaches; dizziness; nausea; and vomiting. Low-level exposure might also lead to poor attention span, poor memory, and impaired motor function. Short-term exposure at high concentrations can lead to loss of consciousness and death. ⁹
Mercury	Mercury can permanently damage the brain, kidneys, and developing fetus and may result in tremors, changes in vision or hearing, and memory problems. Even in low doses, mercury may affect an infant’s development, delaying walking and talking, shortening attention “span,” and causing learning disabilities. ¹⁰
Polycyclic Aromatic Hydrocarbons	Several of the polycyclic aromatic hydrocarbons (PAHs) that can be found in crude oil have caused tumors in laboratory animals and are considered possible or probable human carcinogens. Studies of people have found that individuals exposed for long periods to mixtures that contain PAHs can also develop cancer. In addition, animal tests have found reproductive problems and birth defects. ¹¹

Volatile Organic Compounds (VOCs)

Acetone	Acetone can cause nose, throat, lung, and eye irritation; headaches; light-headedness; and confusion. In animals it has been linked to kidney, liver, and nerve damage, and increased birth defects. ¹²
Benzene	Benzene is a known human carcinogen and causes leukemia. ¹³
Ethylbenzene	Ethylbenzene can cause dizziness, throat and eye irritation, respiratory problems, fatigue, and headaches. It has been linked to tumors and birth defects in animals, as well as to damage in the nervous system, liver, and kidneys. ¹⁴
Toluene	Toluene can cause fatigue, confusion, weakness, memory loss, nausea, hearing loss, central nervous system damage, and may cause kidney damage. ¹⁵ It is also known to cause birth defects and reproductive harm. ¹⁶
Xylene	Xylene can cause headaches; dizziness; confusion; balance changes; irritation of the skin, eyes, nose, and throat; breathing difficulty; memory difficulties; stomach discomfort; and possibly changes in the liver and kidneys. ¹⁷

Radioactive Substances

Radium	Radium is a known human carcinogen, causing bone, liver, and breast cancer. ¹⁸
Radon	Radon can cause an increased incidence of lung diseases such as emphysema, as well as lung cancer. ¹⁹

Air

Hazardous Air Pollutants (HAPs)

- Benzene, formaldehyde, xylenes from natural, chemical or combustion sources. They may be intentionally vented, leaked, or dumped in open air pits and left to evaporate.

Ozone

- Caused by VOCs, NO_x and sunlight

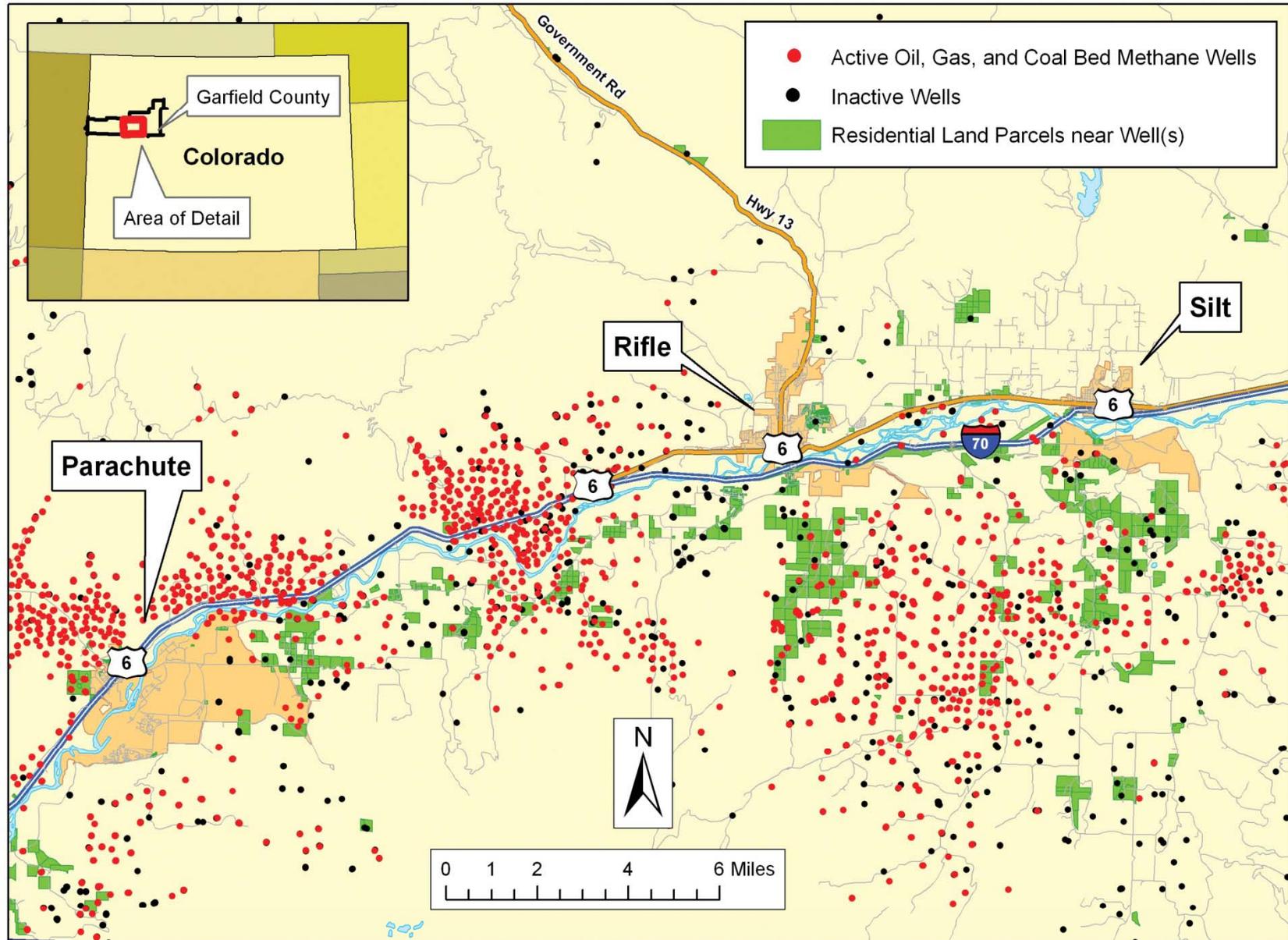
Particulates

- Dust, soot, chemicals from fuel combustion



Why care?

- VOCs can cause: cancer, birth defects, memory loss, eye-throat-nose irritation
- Ozone can cause: asthma attacks, reduced lung function, and premature death.
- Particulates can: cause inflammation that promotes heart attacks and strokes, and contribute to lung and heart disease and premature death.



Greenhouse Gas Emissions

- Carbon dioxide and methane: methane is 21 times more potent
- Sources: leaks/fugitive emissions, venting, combustion, wells and equipment
- In New Mexico and Wyoming, oil and gas drilling operations are the second largest source of statewide GHG emissions.

Water



Groundwater Contamination

Potential sources of contamination

- Drilling activities
- Hydraulic fracturing
- Naturally occurring substances or chemical additives
- Benzene and other contaminants have been found in water wells in Wyoming, Colorado, Pennsylvania, Arkansas, Alabama, Ohio, Texas, and more.

Frac Water Chemicals

Chemical Components (From MSDS)	
2,2-Dibromo-3-Nitrilopropionamide	Glycol Ethers
2-butoxyethanol	Guar gum
2-methyl-4-isothiazolin-3-one	Hemicellulase Enzyme
5-chloro-2-methyl-4-isothiazotin-3-one	Hydrochloric Acid
Acetic Acid	Hydrotreated light distillate
Acetic Anhydride	Hydrotreated Light Distilled
Alphatic Acid	Isopropanol
Alphatic Alcohol Polyglycol Ether	Isopropyl Alcohol
Ammonia Persulfate	Magnesium Nitrate
Aromatic Hydrocarbon	Mesh Sand (Crystalline Silica)
Aromatic Ketones	Methanol
Boric Acid	Mineral Spirits
Boric Oxide	Monoethanolamine
Butan-1-01	Petroleum Distallate Blend
Citric Acid	Petroleum Distillates
Crystalline Silica: Cristobalite	Polyethoxylated Alkanol (1)
Crystalline Silica: Quartz	Polyethoxylated Alkanol (2)
Dazomet	Polyethylene Glycol Mixture
Diatomaceous Earth	Polysaccharide
Diesel (use discontinued)	Potassium Carbonate
Ethane-1,2-diol	Potassium Hydroxide
Ethoxylated Alcohol	Prop-2-yn-1-01
Ethoxylated Alcohol	Propan-2-01
Ethoxylated Octylphenol	Propargyl Alcohol
Ethylene Glycol	Propylene
Ethylhexanol	Sodium Bicarbonate
Ferrous Sulfate Heptahydrate	Sodium Chloride
Formaldehyde	Sodium Hydroxide
Glutaraldehyde	Sucrose
	Tetramethylammonium Chloride

Frac Stage #1

Hydrochloric Acid
Propargyl Alcohol
Methanol
Acetic Acid
Acetic Anhydride

Frac Stage #2

Methanol
Boric Oxide
Petroleum Distallate Blend
Polysaccharide
Potassium Carbonate
Sodium Chloride
Potassium Hydroxide
Ethylene Glycol
Boric Acid
Sodium Bicarbonate
Monoethanolamine

Frac Stage #3

Hydrotreated light distillate
Ethoxylated Alcohol
Glutaraldehyde
Dazomet
Sodium Hydroxide
Methanol
Diesel (use discontinued)
2,2-Dibromo-3-Nitrilopropionamide
Polyethylene Glycol Mixture
Mesh Sand (Crystalline Silica)

Surface water contamination



Surface water contamination

- Leaks
- Spills
- Underground sources of contamination migrating to springs and creeks

Waste management

- Tens of billions of barrels per year
- Land farms
- Pits – buried or evaporation
- Underground injection

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Land Farm





Health impacts

- Individuals from several states report health impacts including neurological symptoms, respiratory conditions, tumors, skin rashes, nosebleeds, and pain.
- Observed livestock effects include reports of stillbirths, low or no milk production, birth defects, low fertility, and smaller litters, as well as death from poisoning.

Wildlife Habitat



Wildlife impacts

- Habitat destruction and fragmentation
- Noise and light
- Contamination of air and water
- Erosion and sedimentation
- Poaching
- Traffic

Wildlife impacts

- Over 25 million acres of big-game habitat in the Rockies has already been leased by the Bureau of Land Management.
- Mule deer numbers declined in one area in the Pinedale anticline by 30 percent overall during a seven-year research project which ran from 2000-2007.
- Sage grouse show reduced breeding populations in breeding areas within 3 miles of active drilling and within 2 miles of existing wells. Eventually they stop using these breeding areas.



Regulatory issues

Exemptions in federal statutes:

- Clean Air Act
- Clean Water Act
- Safe Drinking Water Act
- Resource Conservation and Recovery Act
- CERCLA/Superfund law

Regulatory issues

“....many of the state regulatory schemes date from earlier waves of resource extraction, and have not kept pace with changed technologies, nor with a deepening concern for public health and the environment.”

University of California-Hastings College of the
Law, Center for State and Local Government
Law

Solutions

- CU Law School: Intermountain Oil and Gas BMP project lists thousands of BMPs
- State and federal agencies
- Academic research
- Private companies

Technical innovation

- Capturing air emissions
- Reducing, recycling, or reusing toxic substances
- Using non-toxic substitutes
- Closed-loop pitless drilling instead of pits
- Preventive maintenance and leak prevention
- Well clustering, centralized operations, remote telemetry, piping systems

Results of greener approaches

- Wells fractured with non-toxic fluids were found by Amoco in some cases to produce more gas and cost less to fracture.
- Comparisons have found closed loop drilling to create cost savings of up to \$180,000 per pit.
- Devon Energy spent \$15,000 to capture methane emissions from a well and sold the methane for \$35,000.
- In Alaska a company reduced drilling costs by more than half by reusing drilling fluid.

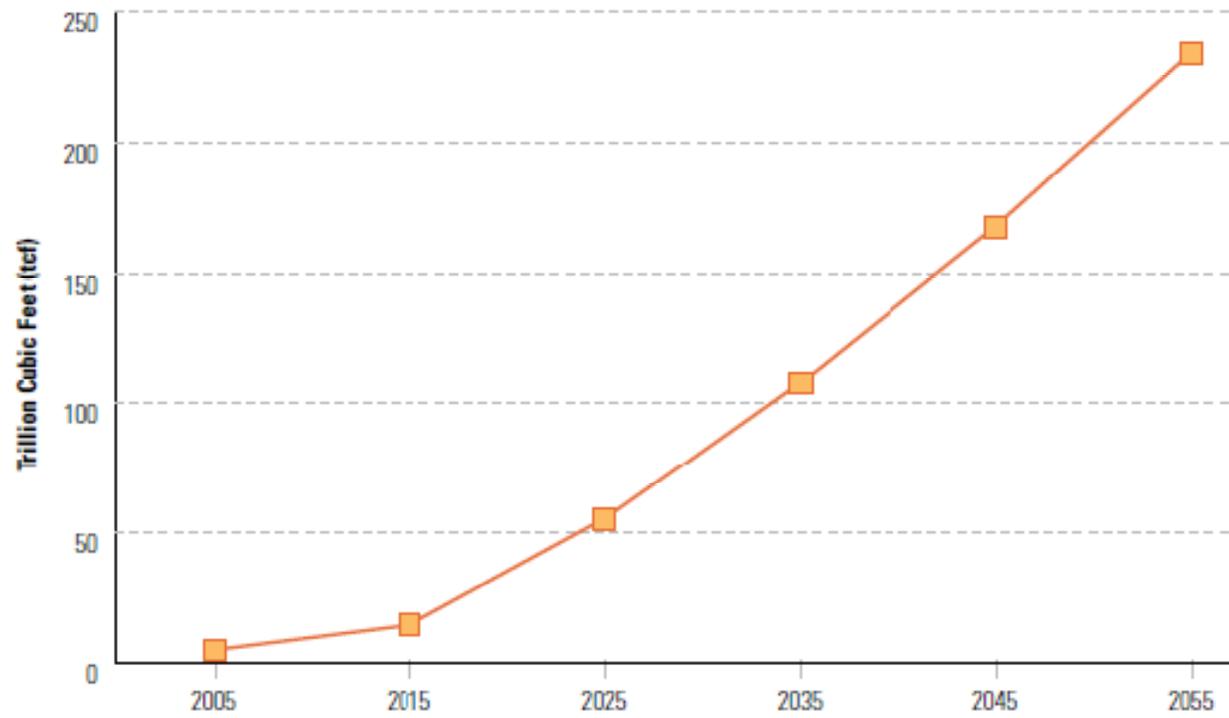
Williams: Hayes Gulch Project

- Two years of planning led to 14-months of drilling instead of 3 years.
- Closed loop pipe system
- Clustered wells and centralized fracturing operation
- Less roads, pads, noise, emissions, dust
- Recycled 100% of produced water
- Eliminated 12,500 truck trips

Efficiency

An aggressive natural gas efficiency program could cumulatively save more than 234 trillion cubic feet of natural gas over the next 50 years.

Natural Gas Savings from Efficiency Measures



“America does not have to choose between a clean and healthy environment and a healthy, growing economy. We can and must have both.”

-- Williams