The shale revolution: Overview, major effects, and regulatory management

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About RFF

Resources for the Future is an independent, nonprofit research institution in Washington, DC. Its mission is to improve environmental, energy, and natural resource decisions through impartial economic research and policy engagement.

RFF is committed to being the most widely trusted source of research insights and policy solutions leading to a healthy environment and a thriving economy.
Agenda

• Overview of the “shale revolution”
• Major economic and environmental effects
• Regulatory approaches and adaptation
• Additional resources
The Shale “Revolution”
Shale has pushed U.S. natural gas production well above historical highs

Data source: U.S. Energy Information Administration
US oil production has grown even more rapidly

Million barrels per day

“Conventional” oil

“Tight” oil

Data source: U.S. Energy Information Administration
Drilling has surged in many regions, with production growth led by the Permian (oil) and Marcellus (gas).
Major economic and environmental effects
In the near term, shale development has had positive economic effects

- Local economic benefits vary by region, but can be very large
  - Economic effects can also be highly volatile
- State-level economic effects have also been substantial in major producing states
- Nationally, lower energy prices benefit US consumers, but hurt producers
Water contamination is relatively rare, but can have major impacts when it occurs

• There are very few cases where chemicals used during fracking have affected water supplies

• However, improper well construction can lead to methane migration, or “stray gas”
  • Methane is essentially the same thing as natural gas, so high concentrations of methane in water can pose an explosive risk
  • There have been hundreds of well-documented cases in Pennsylvania alone
  • In most, though not all cases, the impacts can be mitigated

• Improper wastewater management can also lead to pollution
  • Spills from impoundments and pipelines have caused local contamination
Public health implications diverge at different scales

**Local scale**
- Existing evidence is limited
- But there are known risks
  - Diesel and other air emissions
  - Vehicle traffic
  - Stress
- Most impacts occur near well sites
- More research is needed

**National scale**
- Natural gas has displaced coal
- This has reduced criteria pollutants
- Public health benefits are substantial, but diffuse
In some regions, particularly Oklahoma, wastewater disposal has led to earthquakes

- All oil and gas wells, whether hydraulically fractured or not, produce wastewater that must be carefully managed
  - Much of this water is disposed into deep injection wells
- Under certain circumstances, this can lead to “induced seismicity”
Shale development has reduced US CO₂ emissions, but continued growth will likely increase emissions

- Natural gas has displaced coal in the power sector, reducing emissions substantially
- But it has also displaced nuclear and renewables, leading to higher emissions
- Low energy prices increase consumption and emissions across the economy
- Methane emissions increase the climate effects of natural gas
  - If leaked into the atmosphere, methane is much more powerful than carbon dioxide
- US oil production growth has contributed to lower global oil prices, leading to higher consumption and emissions globally
- Studies find that shale has helped reduce emissions in the past, but production growth will likely increase emissions in the future
Regulation and adaptation
Development of shale resources has led to new regulatory challenges

• States are the primary regulators of oil and gas development
• Some states had substantial experience prior to shale development, some had very little
• However, all producing states have made substantial policy changes to adapt and manage challenges as they have emerged
One example of regulatory adaptation: earthquakes in Oklahoma

- Oklahoma experienced dozens of small earthquakes in 2010, followed by a M5.8 quake in 2011 that caused injuries and property damage.

Data source: U.S. Geological Survey
Earthquakes in Oklahoma

• Initially, there was uncertainty over the cause of the quakes
  • Little action was taken to reduce risks from 2010-2014
• In 2014-2015, state officials brought together a “coordinating council” of regulators, industry, and academic experts
  • The council identified the leading cause of the quakes (wastewater disposal)
  • They implemented restrictions on wastewater disposal
  • They improved data sharing and management
  • And developed new rules to reduce the problem (“stoplight” system)
• New challenges have emerged and been managed more proactively
  • Earthquakes caused directly by hydraulic fracturing have become a larger concern
A few more examples of regulatory adaptation

- Pennsylvania has changed rules on wastewater management in response to pollution in major state rivers
- North Dakota has made major changes in its revenue sharing between state and local governments to manage local impacts
- Several states (including CO, PA, WY) have developed rules to reduce methane emissions from new wells
- Colorado has developed a system for residents to report health concerns from nearby oil and gas operations
A few examples of remaining challenges

• Natural gas flaring is a major concern in North Dakota’s Bakken and Texas/New Mexico’s Permian basin
  • This valuable product is being wasted, with direct implications for landowners, taxpayers, and local public health

• Methane emissions continue to be uncertain, and the largest producing states have refrained from addressing the issue

• “Boom and bust” cycles continue to create challenges in numerous regions
  • Strains on infrastructure and public services, especially education
  • Concern over long-term economic health of producing regions
Additional resources
Additional resources: SHARC

Shale Research Clearinghouse (SHARC)

- Regularly updated collection of peer-reviewed research
- Short summaries of the latest research written for policymakers

www.rff.org/sharc
Additional resources: The Fracking Debate

- Introduction
- What is Fracking?
- Does Fracking Contaminate Water?
- Will Fracking Make Me Sick?
- Does Fracking Cause Earthquakes?
- Is There Any Regulation on Fracking?
- Is Fracking Good or Bad for Climate Change?
- Will Fracking Make the US Energy Independent?
- Is Fracking Good for the Economy?
- Will Fracking Spread Around the World?
- Do People Living Near Fracking Love it Or Hate it?
- What's Next?
Thank you!

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