Study Guide

MilanMUN 2025
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Assessing the Economic and Environmental Impacts of Hydraulic Fracturing

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Last updated 31 Jan 2025

👋 Introduction

Hydraulic fracturing, also known as fracking, is a technique used to extract oil and natural gas from deep underground shale formations. The process involves injecting a mixture of water, sand, and chemicals into the rock under high pressure to create fractures, thereby releasing the trapped hydrocarbons (U.S. Energy Information Administration [EIA], 2020).
This method has become more widespread since the early 2000s, particularly in countries with significant shale deposits, such as the United States, Canada, and Argentina.

Fracking has significantly increased global energy production, particularly natural gas, while also driving down energy costs and enhancing energy security for many countries . The United States, for instance, has transformed into the world's largest

producer of natural gas, significantly reducing its reliance on imported energy (U.S. Energy Information Administration [EIA], 2020). However, hydraulic fracturing also raises concerns due to its environmental risks, including water contamination, air pollution, induced seismicity, and methane leaks, which have prompted growing debates on its sustainability in the context of global climate change (Lehmann, 2019).

🗝️ Definition of Key Terms

- **Hydraulic Fracturing (Fracking)**: A method for extracting oil and gas from underground shale formations by injecting water, sand, and chemicals under high pressure to fracture the rock and release the trapped hydrocarbons (U.S. EPA, 2021).
- **Shale Gas**: Natural gas found within shale formations, typically extracted using hydraulic fracturing and horizontal drilling (Energy Institute, 2020).
- **Methane Leakage**: The unintended release of methane gas, a potent greenhouse gas, into the atmosphere during natural gas extraction, transport, or storage (Alvarez et al., 2012).
- **Induced Seismicity**: The occurrence of earthquakes or tremors caused by human activities, such as hydraulic fracturing or the disposal of wastewater in deep wells (Ellsworth, 2013).
- **Water Contamination**: The contamination of underground aquifers or surface waters by chemicals used in fracking fluids or the migration of methane from extraction operations (Vengosh et al., 2014).
- **Energy Security**: The ability of a country to meet its energy needs reliably from domestic or foreign sources (IEA, 2019).
- **Environmental Regulation**: The body of policies and laws designed to mitigate the environmental impacts of industries, including hydraulic fracturing (European Commission, 2020).

📖 Background Information

Hydraulic fracturing was developed in the 1940s but became a commercially viable method only in the early 2000s, largely due to technological advancements in drilling

and fracking techniques (U.S. EPA, 2014). The extraction of shale gas has reshaped the global energy market by unlocking previously inaccessible natural gas resources, contributing to a substantial rise in energy production in countries like the United States, Canada, and Argentina (IEA, 2019).

Economically, hydraulic fracturing has allowed countries to reduce reliance on imported fossil fuels, creating jobs and boosting local economies. The U.S., for example, has witnessed an energy renaissance due to shale gas production, leading to lower energy prices and greater energy security (U.S. Energy Information Administration [EIA], 2020). Countries such as Argentina and China, with large shale reserves, have turned to fracking to bolster energy independence and economic development (International Energy Agency [IEA], 2020).

However, the environmental impacts of fracking are significant. The process has been linked to water contamination from chemicals used in fracking fluids, the release of methane into the atmosphere, induced seismicity, and air pollution. These concerns have raised alarms among environmental groups and policymakers alike, as the climate implications of increased natural gas production may negate some of the benefits attributed to it, such as the reduction of coal dependency (Greenpeace, 2019).

🗺️ Major Parties Involved

Countries:

The United States is the largest producer of shale gas and oil, and hydraulic fracturing plays a central role in its energy policy (U.S. Energy Information Administration [EIA], 2020).

Canada has significant shale resources, especially in British Columbia and Alberta. Despite the economic benefits, it shares many of the environmental concerns seen in the U.S. (Environmental Defence Canada, 2018).

Argentina and China have invested heavily in fracking to address energy security issues. Argentina, with its Vaca Muerta shale formation, is looking to increase

production, while China continues to expand fracking operations despite mounting environmental concerns (IEA, 2019).

Energy Companies:
Major energy companies such as ExxonMobil, Chevron, and Shell are heavily involved in hydraulic fracturing. These companies lobby for fewer regulatory restrictions to maximize production and profits.

Environmental Organizations:
Groups like Greenpeace, Sierra Club, and Earthworks argue that fracking poses significant environmental and public health risks, including water contamination, air pollution, and seismic activity. These organizations advocate for stricter regulations and a transition to renewable energy sources (Greenpeace, 2019).

Regulatory Bodies:
U.S. Environmental Protection Agency (EPA): The EPA regulates hydraulic fracturing activities in the U.S., focusing on water safety and methane emissions (U.S. EPA, 2021).
European Union: The EU has imposed stringent regulations on hydraulic fracturing, with several member states either banning or severely restricting its use due to environmental concerns (European Commission, 2020).

Local Communities and Indigenous Groups:
Communities near fracking sites, especially Indigenous groups in Canada and Argentina, often bear the environmental and health costs, including contaminated water and air pollution .

⏰ Possible Effects

The long term economic and environmental outcomes of hydraulic fracturing largely depend on the regulatory frameworks and technologies developed to mitigate its impacts:

- Economic Benefits: Increased energy production and job creation, particularly in regions with abundant shale resources.

- Environmental Risks: The most significant risks include water contamination, induced seismicity, methane leakage, and air pollution, which could harm ecosystems and public health, complicating the global fight against climate change (Greenpeace, 2019; Ellsworth, 2013).

🤝 Previous Attempts to Solve the Issue

The regulation of hydraulic fracturing has been inconsistent across different regions:

- U.S. Energy Policy Act of 2005: Exempted fracking from key provisions of the Safe Drinking Water Act, sparking criticism from environmental groups (U.S. Congress, 2005).
- European Union: The EU has implemented non binding guidelines for member states, but some countries have imposed bans, such as France in 2015 due to environmental concerns (European Commission, 2020).
- Argentina: Faced with opposition from local communities, the Argentine government has introduced measures to ensure water safety and limit the environmental impact of fracking (Energía Argentina, 2021).

🌈 Possible Solutions

- Stricter Environmental Regulations: Governments should enforce stronger regulations on methane emissions, chemical disclosures, and wastewater disposal to minimize environmental harm (U.S. EPA, 2021).
- Promoting Renewable Energy: A transition to renewable energy sources like wind, solar, and hydroelectric power can reduce dependence on fossil fuels, including natural gas produced through hydraulic fracturing (IEA, 2020).
- Carbon Capture and Storage (CCS): The development of CCS technologies can help mitigate the climate impact of natural gas by capturing and storing CO_2 emissions (IEA, 2020).

- Public Engagement and Education: Governments should ensure transparency, engage local communities in decision making, and ensure that fracking is done safely and responsibly .

📚 Works Cited and Other Resources

U.S. Energy Information Administration (EIA) https://www.eia.gov

U.S. Environmental Protection Agency (EPA) https://www.epa.gov

Greenpeace https://www.greenpeace.org

International Energy Agency (IEA) https://www.iea.org

U.S. Geological Survey (USGS) https://www.usgs.gov

Canadian Association of Petroleum Producers (CAPP) https://www.capp.ca

Chevron https://www.chevron.com

Sierra Club https://www.sierraclub.org

World Bank https://www.worldbank.org

European Commission https://europa.eu

U.S. Energy Information Administration (EIA). (2020)."Hydraulic Fracturing: Technology, Economics, and Impact." - https://www.eia.gov

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U.S. Congress. (2005). "Energy Policy Act of 2005: Exemptions for Hydraulic Fracturing." - https://www.congress.gov
Energía Argentina. (2021). "Regulatory Measures for Safe Hydraulic Fracturing in Argentina." - https://www.energiaargentina.gov.ar

Other Resources

- Energy Information Administration (EIA): Comprehensive reports on global energy production and the impact of fracking.
- U.S. Environmental Protection Agency (EPA): Information on regulations and studies on hydraulic fracturing's environmental impacts.
- Greenpeace: Reports on the environmental consequences of hydraulic fracturing.
- International Energy Agency (IEA): Energy policies and country profiles related to hydraulic fracturing.