NATURAL GAS RESOURCES: A COMMUNITY DISCUSSION

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August 29, 2016
Boulder Public Library
Boulder, Colorado

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Outline

1. Background– What is natural gas?

2. Production– How long will natural gas supplies last?

3. Price– How long will natural gas be economically viable?
I. WHAT IS NATURAL GAS?

Natural gas is mostly made of methane: $\text{CH}_4$

Natural gas can also contain:

- Heavier hydrocarbons like ethane, propane, and butane
- Hydrogen sulfide
- Carbon dioxide
- Water vapor
NATURAL GAS IS MINED IN MANY WAYS

Conventional Gas: flows easily from pockets in rock

Unconventional Gas: trapped in low permeability rock
In 2015, 67% of US Natural Gas Came From Hydraulically Fractured Wells
Natural gas is used for:

• Heating
• Cooking
• Electricity
• Vehicle Fuel
• Feedstock to make other chemicals (i.e. fertilizers)

In 2015, the US used 27,466,449 Million Cubic Feet (MMcf) of Natural Gas

(That’s almost 30 trillion cubic feet)
• In 2014, global natural gas use was $\geq 120$ trillion cubic feet
• In 2014, EIA predicted $\sim 6973$ trillion total cubic feet of proven, economically recoverable reserves— that would only be 58 years of natural gas!
• But, with 2% growth this would be less than 40 years of supply. ... If reserve estimates are correct
WHY DO PEOPLE CALL NATURAL GAS A “BRIDGE FUEL”?

The EIA reports that natural gas emits about 55% as much CO₂ as coal per unit of energy produced.

Why?
- Higher energy content
- Newer power plants

Source: EIA https://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11
Global warming potential is a method of comparing the total heat trapped per molecule of a gas in the atmosphere compared to a molecule of CO$_2$.

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>20 years</th>
<th>100 years</th>
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<tbody>
<tr>
<td>Global Warming Potential</td>
<td>86x</td>
<td>~32x</td>
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Methane is a much stronger greenhouse gas than CO2 but its lifetime in the atmosphere is shorter.

**IS NATURAL GAS CLEANER THAN COAL?**

Downstream Leakage Rates:

\[ \text{EPA}^1 = 0.9\% \]
\[ \text{Howarth}^2 = 2.5\% \]

Downstream: processing and distribution

3. Figure taken from “A bridge to nowhere: methane emissions and the greenhouse gas footprint of natural gas”, Robert W. Howarth, Energy Science and Engineering (2014)
Review:

1. Production Methods
2. Usage in the United States
3. Greenhouse gas footprint

QUESTIONS? COMMENTS? OTHER INFORMATION?
II. PRODUCTION

Do we really have 100 years of economically recoverable natural gas left?
US NATURAL GAS WITHDRAWALS HAVE INCREASED SUBSTANTIALLY IN THE LAST TWO DECADES

Note: Vertical axes for Texas and U.S. have been offset from zero for clarity.

EIA predicts that U.S. natural gas production will grow through 2040.

CAN WE COUNT ON EIA RESERVE PROJECTIONS?

- Some reports were based on fossil fuel company presentations rather than data
- EIA models are not transparent

Some Questionable Assumptions

- Abundant new plays that haven’t yet been discovered
- 74%-110% recovery of possible + probable reserves but some of these only have a 10% chance of being recoverable

EIA’s 2011 reduction of technically recoverable shale gas estimates based on USGS survey.


• PGC estimates that the U.S. has a 100-year supply of natural gas

• PGC receives support from Potential Gas Agency which is funded by E&P and gas pipeline companies and distributors

![PGC Future Gas Supply Chart]

- **Proved Reserves**: 12.0%
- **Probable Resources**: 29.5%
- **Possible Resources**: 32.5%
- **Speculative Resources**: 20.5%
- **Coalbed**: 5.5%

**PGC Resource Assessment:**
- **Proved Reserves**: Have >90% chance of being produced
- **Probable Resources**: Not proven to exist or be recoverable but have >50% chance of being technically and economically recoverable
- **Possible Resources**: >10% chance of being technically and economically recoverable
- **Speculative Resources**: Undiscovered resources

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2. PGC Website: http://potentialgas.org/about
3. Colorado Oil and Gas Conservation Commission: https://cogcc.state.co.us/COGIS_Help/glossary.htm
The United States is rapidly increasing its dependence on natural gas.

In 26 states, more than half of the power plants being built in the near term will rely on natural gas.

Source: Union of Concerned Scientists Rating the States on Their Risk of Natural Gas Overreliance (2015) p. 4
Review:
Production—How long will natural gas supplies last?

1. EIA resource estimates questionable
2. PGC resource estimates very questionable
3. The U.S. is increasing reliance on natural gas

QUESTIONS? COMMENTS? OTHER INFORMATION?
III. PRICE

How long will natural gas be economically attractive?
HISTORICAL PRICE OF NATURAL GAS

Natural Gas Prices Averaged Annually

Year

Natural Gas Prices (Dollars/MMBtu)

NATURAL GAS PRICES ARE NOTORIOUSLY VOLATILE

Natural Gas Prices Averaged Annually

Year

Natural Gas Prices Averaged Weekly

Year

IS IT ECONOMICAL TO MINE SHALE GAS?

- Goodrich, Sandridge in bankruptcy, Exco and Halcon predicted to follow
- Average debt-to-cash flow ratio for shale gas companies increased almost 4x from 2015 to the first quarter of 2016

Debt-to-cash flow ratio for primary shale gas companies in first quarter of 2016 compared to 2015.

Source: Arthur Berman, OilPrice.com Why Cheap Shale Gas Will End Soon
WILL NATURAL GAS ALWAYS BE CHEAP?

• Price of natural gas is well below the production cost

Berman Forecast

• Natural gas prices will double by January 2017 to stimulate production

Natural gas inventory and EIA predictions (blue), Henry Hub natural gas prices and Berman forecast (red) and EIA price projections (yellow)

Source: Arthur Berman, OilPrice.com Why Natural Gas Prices Could Double From Here
Review:
Price—How long will natural gas be economically viable?

1. Volatility adds risk

2. Shale gas companies in financial distress

3. Price of natural gas may double by 2017