

NATURAL GAS RESOURCES: A COMMUNITY DISCUSSION

Molly May

Research Intern, Clean Energy Action



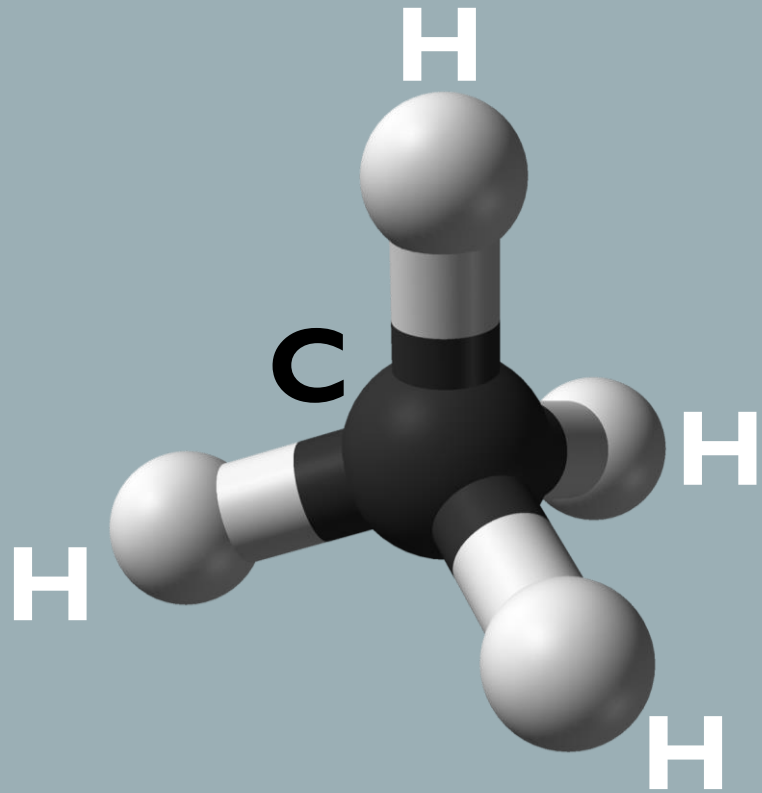
August 29, 2016
Boulder Public Library
Boulder, Colorado

www.cleanenergyaction.org

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: CH_4

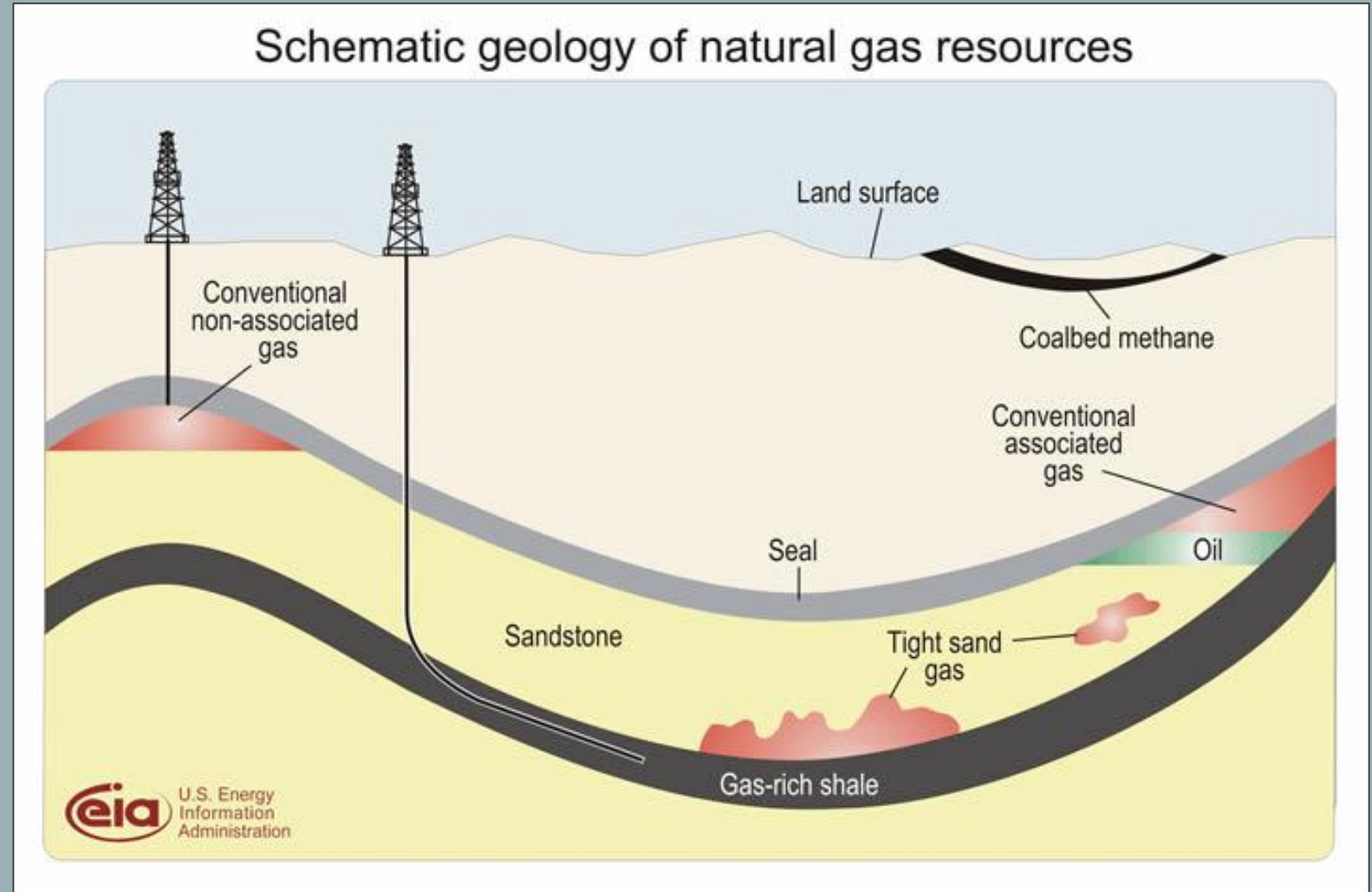
Natural gas can also contain:

- Heavier hydrocarbons like ethane, propane, and butane
- Hydrogen sulfide
- Carbon dioxide
- Water vapor

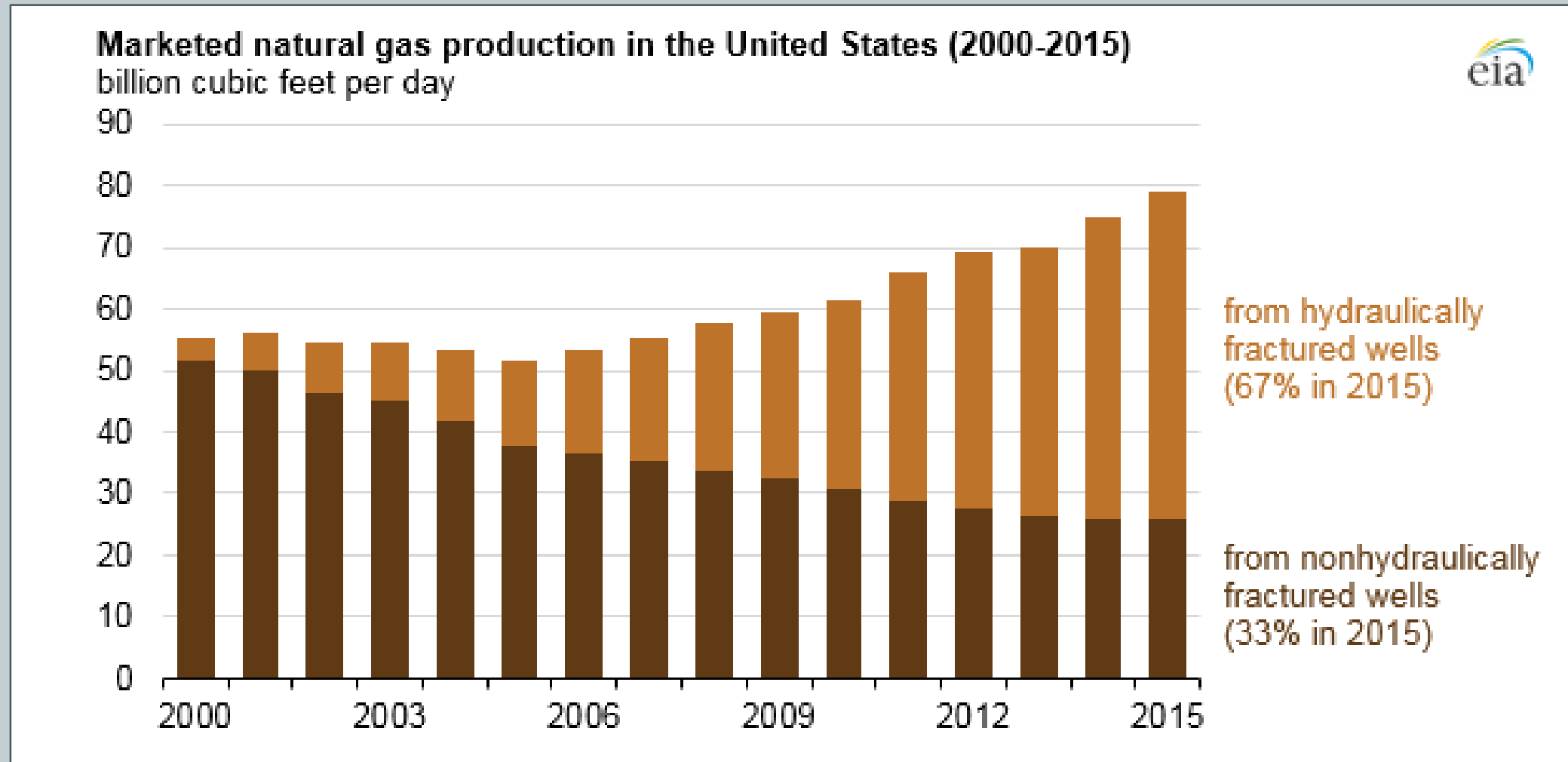
NATURAL GAS IS MINED IN MANY WAYS

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



WHAT IS NATURAL GAS USED FOR?

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

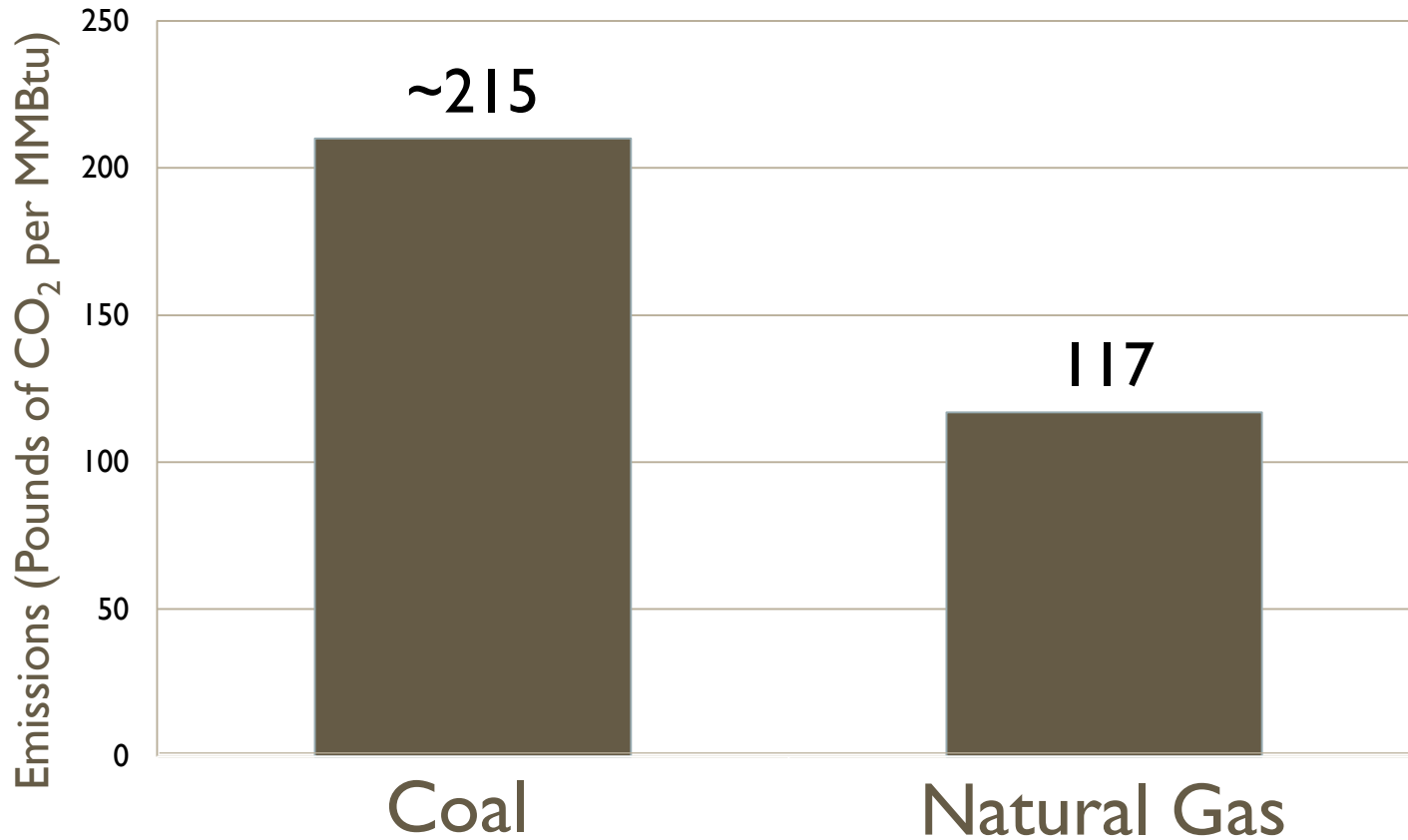
(That's almost **30 trillion** cubic feet)

GLOBAL NATURAL GAS USAGE

- In 2014, global natural gas use was **>120 trillion cubic feet**
- In 2014, EIA predicted ~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”?

Emissions from Combustion of Coal Compared to Natural Gas



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

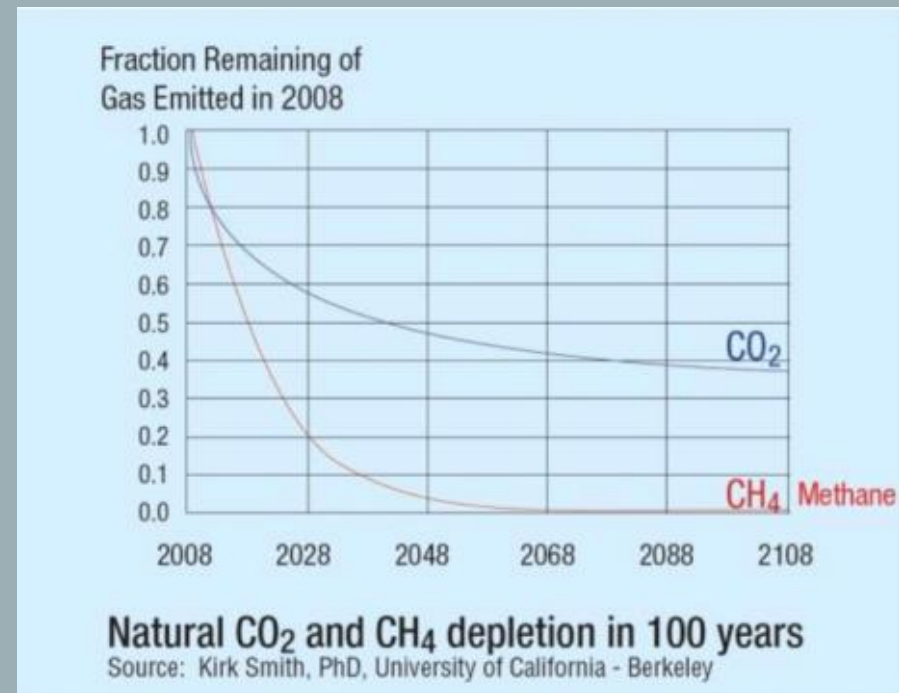
Why?

- Higher energy content
- Newer power plants

WHAT IS THE TRUE ENVIRONMENTAL IMPACT OF NATURAL GAS?

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 CO₂

| Timeframe | 20 years | 100 years |
|--------------------------|----------|-----------|
| Global Warming Potential | 86x | ~32x |



Methane is a much stronger greenhouse gas than CO₂ but its lifetime in the atmosphere is shorter.

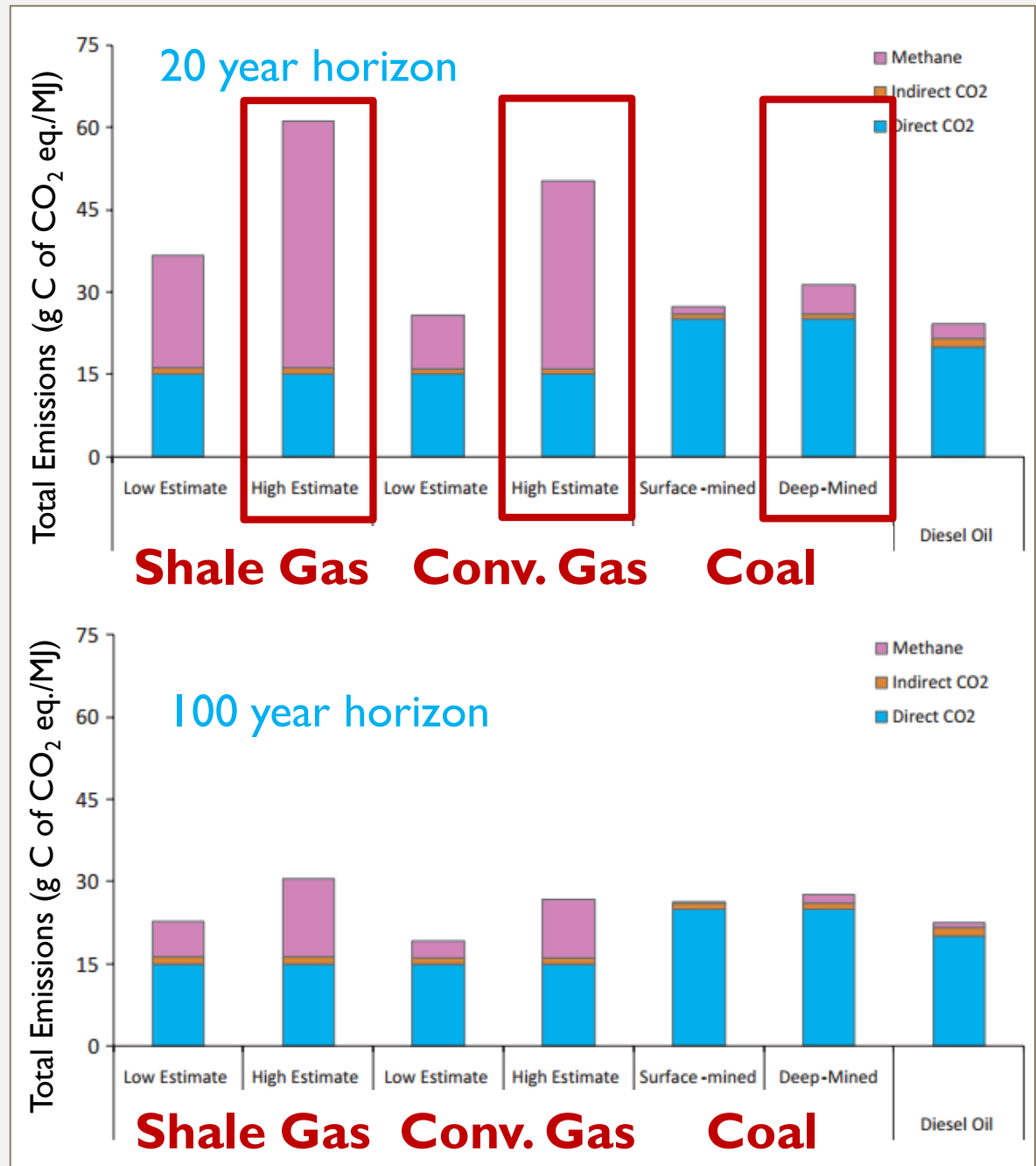
IS NATURAL GAS CLEANER THAN COAL?

Downstream Leakage Rates:

EPA¹ = 0.9%

Howarth² = 2.5%

Downstream: processing and distribution



1. U.S. EPA Office of Inspector General *EPA needs to improve air emissions data for the oil and natural gas production sector* (2013)
2. Howarth, et. al. *Methane and the greenhouse gas footprint of natural gas from shale formations* *Climate Change Letters* (2011)
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

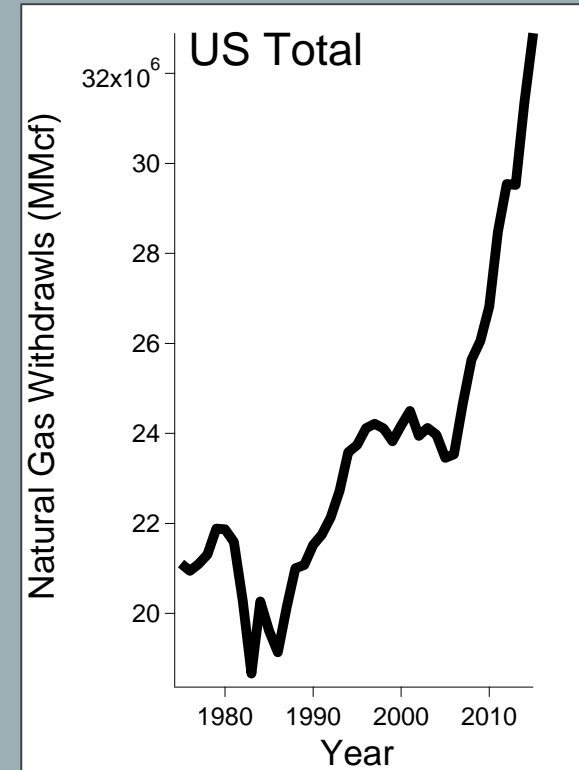
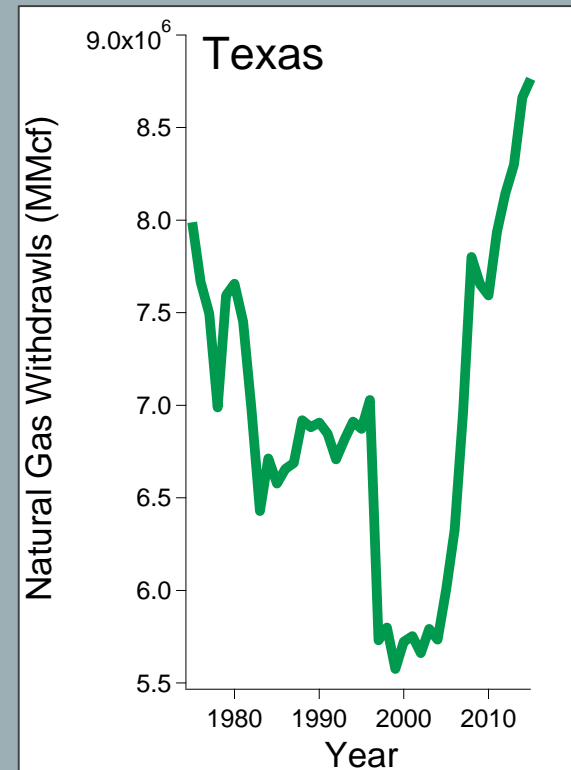
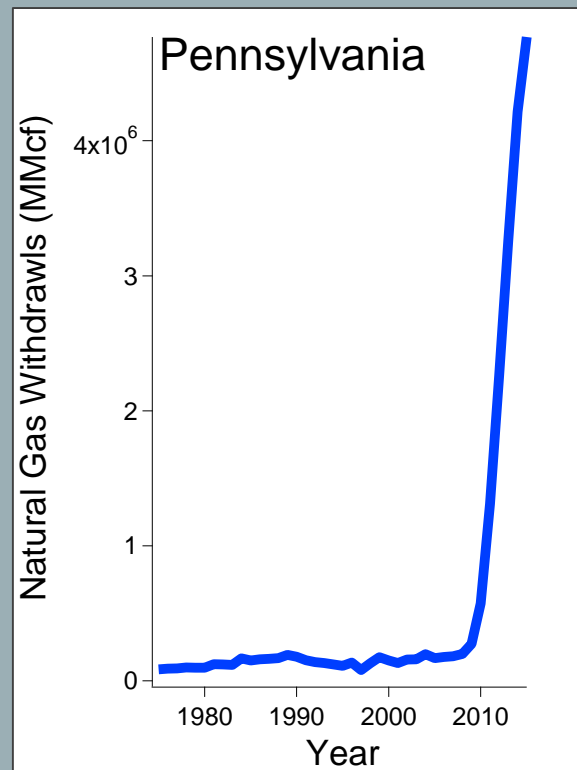
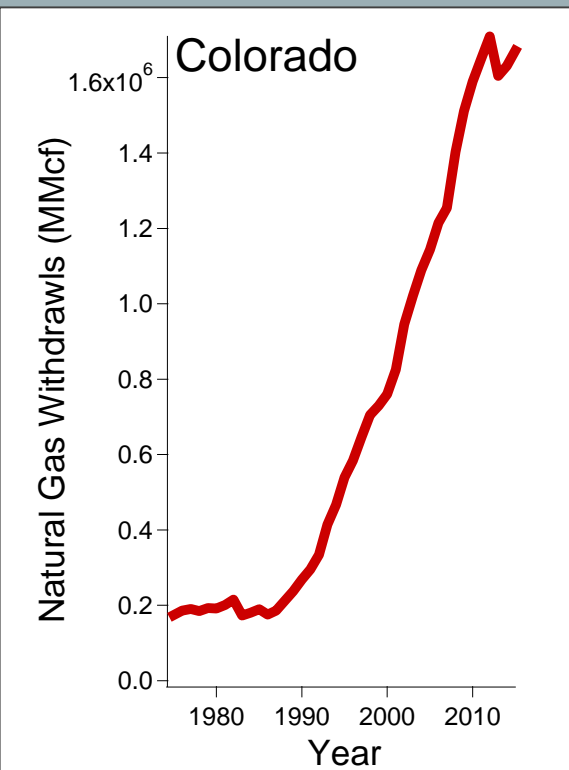
3. Greenhouse gas footprint

**QUESTIONS? COMMENTS? OTHER
INFORMATION?**

II. PRODUCTION

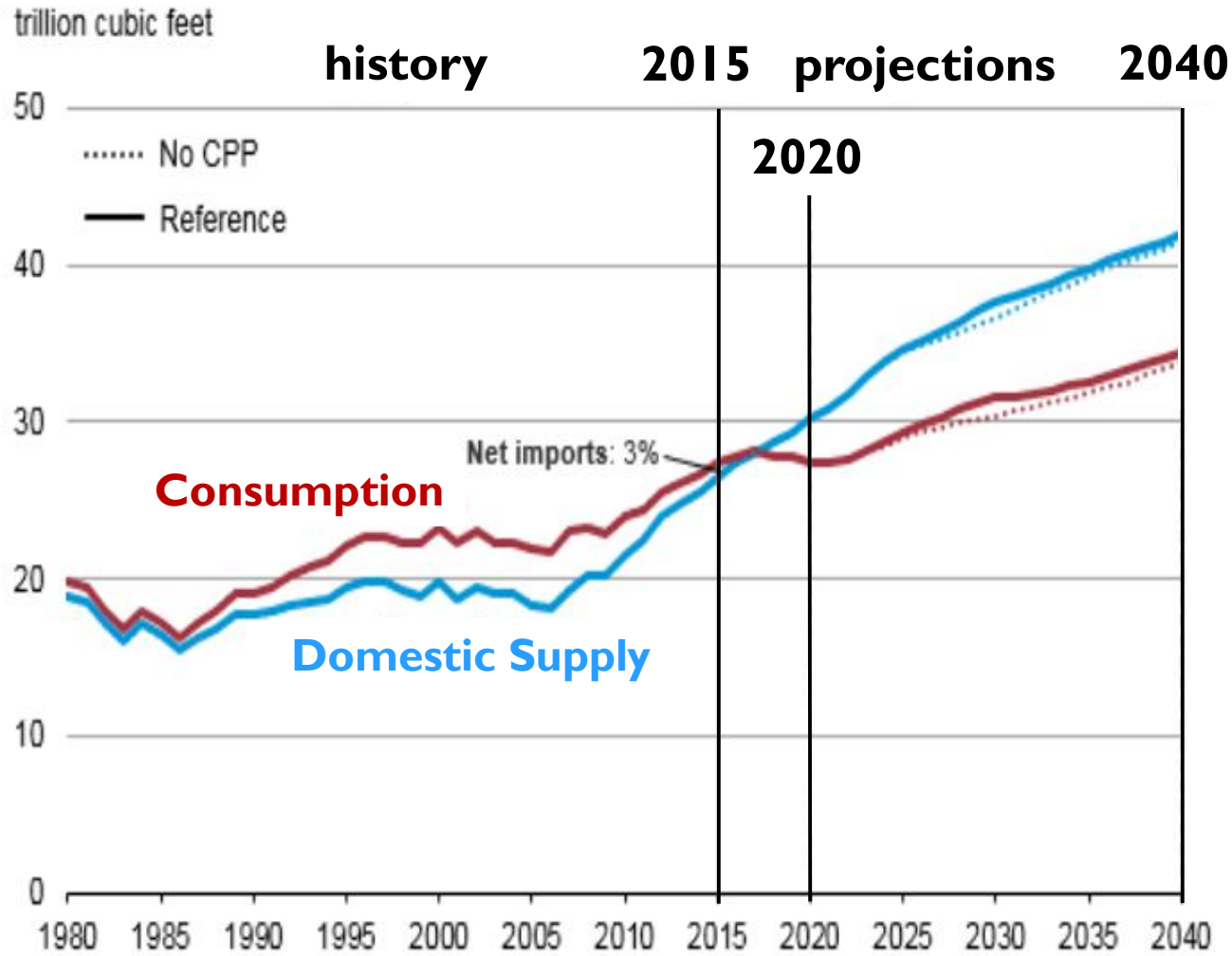
**Do we really have 100 years of
economically recoverable
natural gas left?**

US NATURAL GAS WITHDRAWALS HAVE INCREASED SUBSTANTIALLY IN THE LAST TWO DECADES



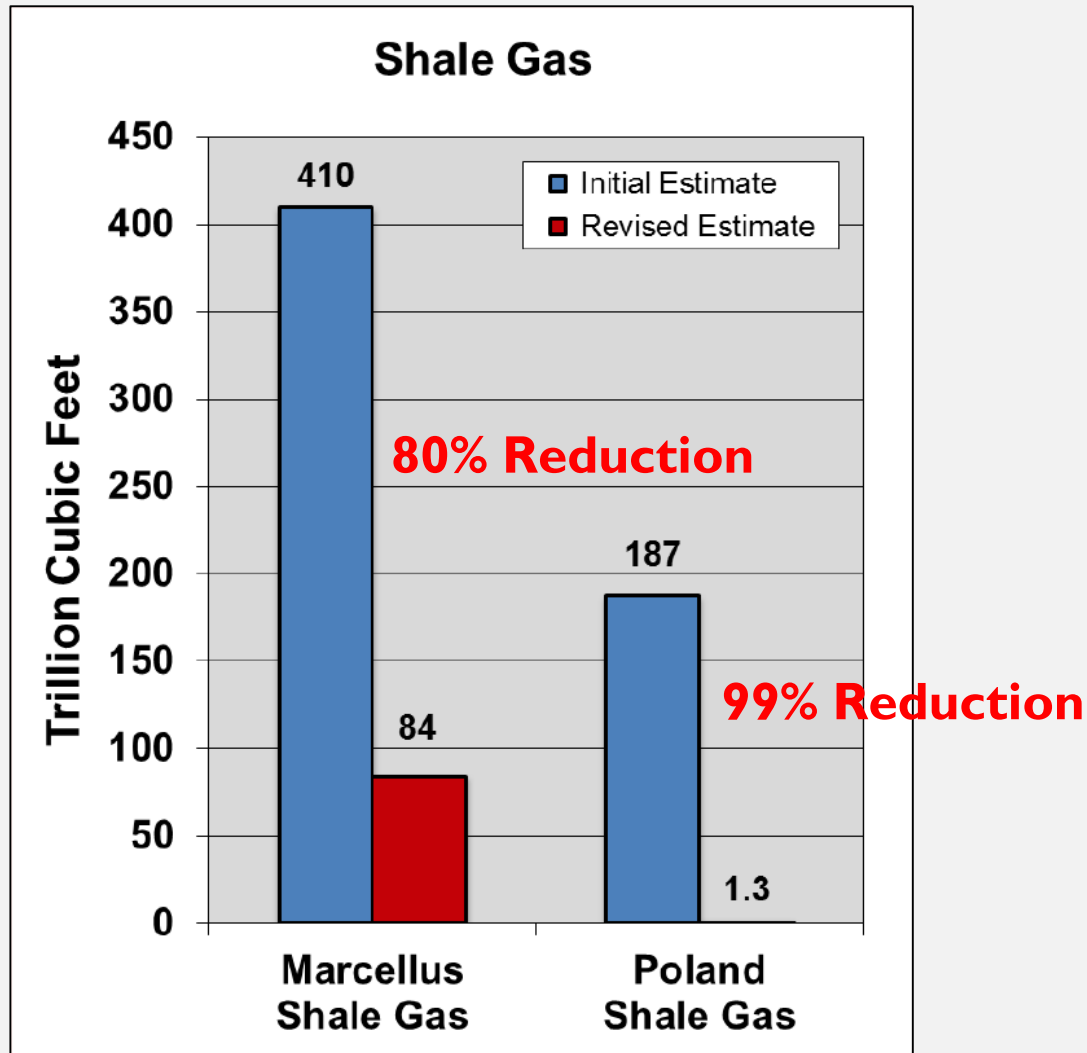
Note: Vertical axes for Texas and U.S. have been offset from zero for clarity.

U.S. Natural Gas Production and Consumption



Source: EIA, Annual Energy Outlook 2016

**EIA PREDICTS
THAT U.S.
NATURAL GAS
PRODUCTION
WILL GROW
THROUGH 2040**



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

Source: Post Carbon Institute *Drilling Deeper: A reality check on U.S. government forecasts for a lasting tight oil and shale gas boom*. J. David Hughes (2014) p. 14 p. 5

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

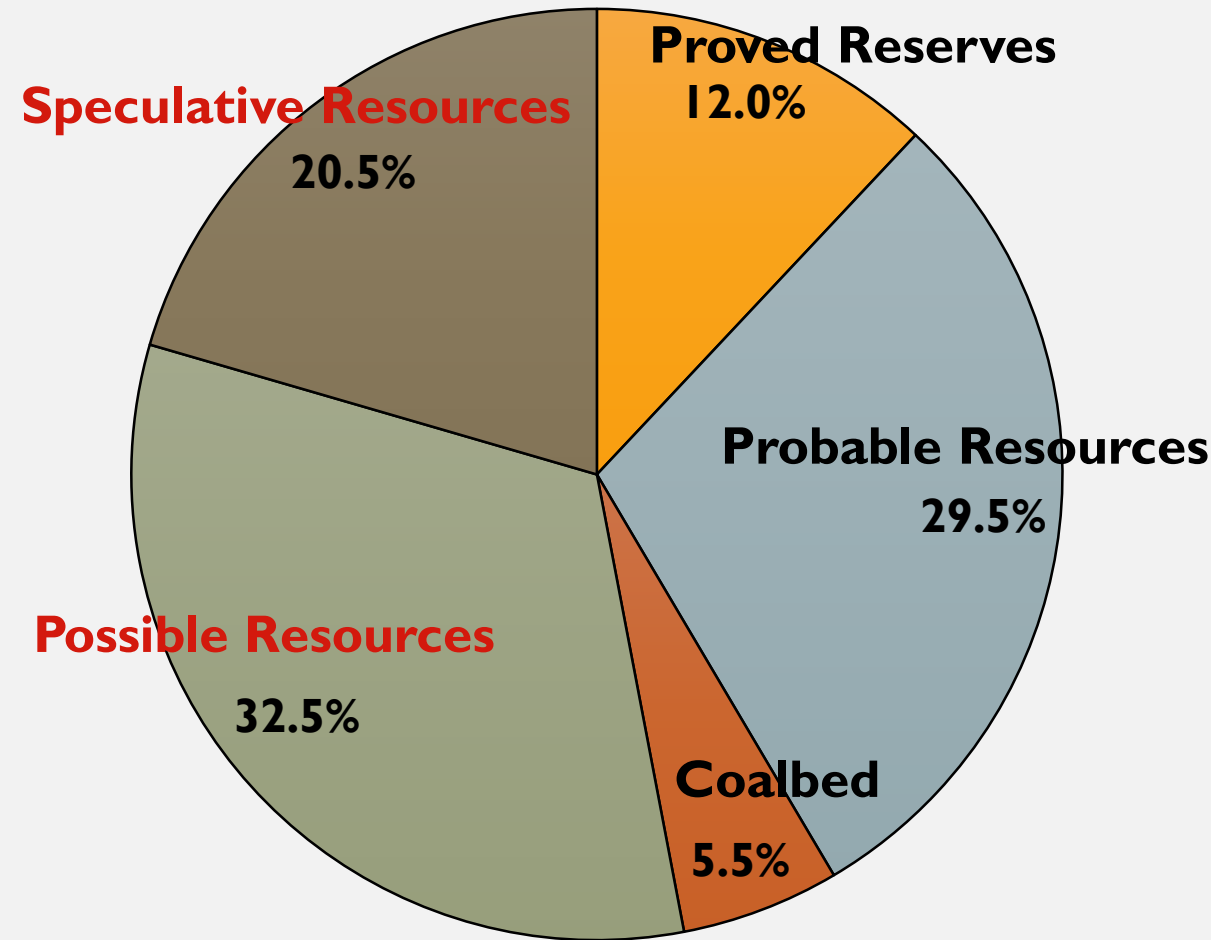
- Abundant **new plays** that haven't yet been discovered
- **74%-110% recovery** of possible + probable reserves but some of these only have a 10% chance of being recoverable¹

1. King Engineering http://gekengineering.com/Downloads/Free_Downloads/Glossary_of_Petroleum_Engineering_Terms_25_August_2010.pdf

POTENTIAL GAS COMMITTEE: OVERLY OPTIMISTIC?

- PGC estimates that the U.S. has a 100-year supply of natural gas¹
- PGC receives support from Potential Gas Agency which is funded by E&P and gas pipeline companies and distributors²

PGC Future Gas Supply⁵

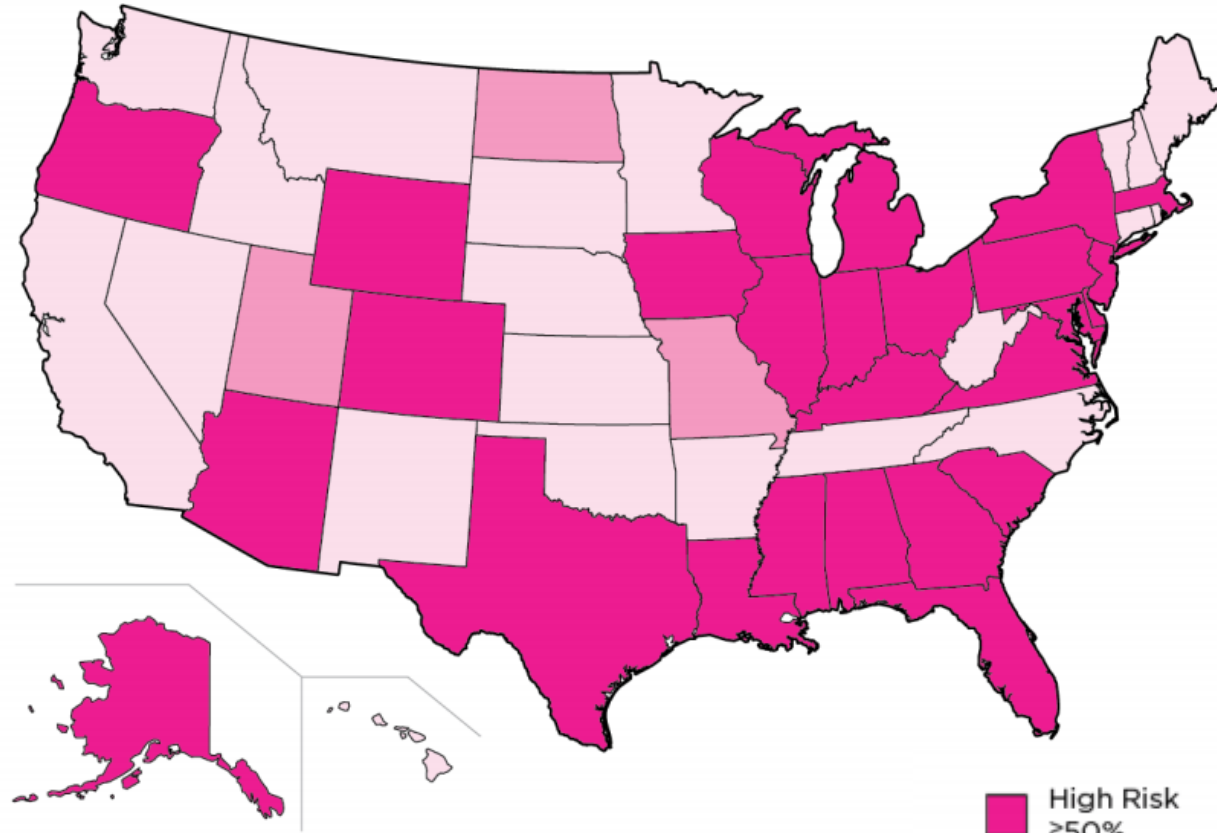


PGC Resource Assessment:

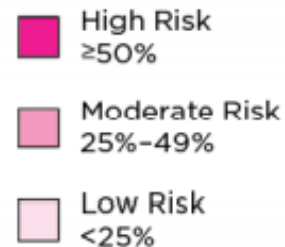
- Proved Reserves: Have >90% chance of being produced
- Probable Resources: Not proven to exist or be recoverable but have >50% chance of being technically and economically recoverable³
- Possible Resources: >10% chance of being technically and economically recoverable⁴
- Speculative Resources: Undiscovered resources

1. Natural Gas Supply Association *Understanding the Size of U.S. Natural Gas Resources* (2013)
2. PGC Website: <http://potentialgas.org/about>
3. Colorado Oil and Gas Conservation Commission: https://cogcc.state.co.us/COGIS_Help/glossary.htm
4. http://gekengineering.com/Downloads/Free_Downloads/Glossary_of_Petroleum_Engineering_Terms_25_August_2010.pdf
5. Data taken from: Source: Potential Gas Committee. Potential Supply of Natural Gas in the United States (2014) Slides 6, 9

Natural Gas Capacity as a Share of Power Plants Being Built (2014-2017)



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



THE UNITED STATES IS RAPIDLY INCREASING ITS DEPENDENCE ON NATURAL GAS

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

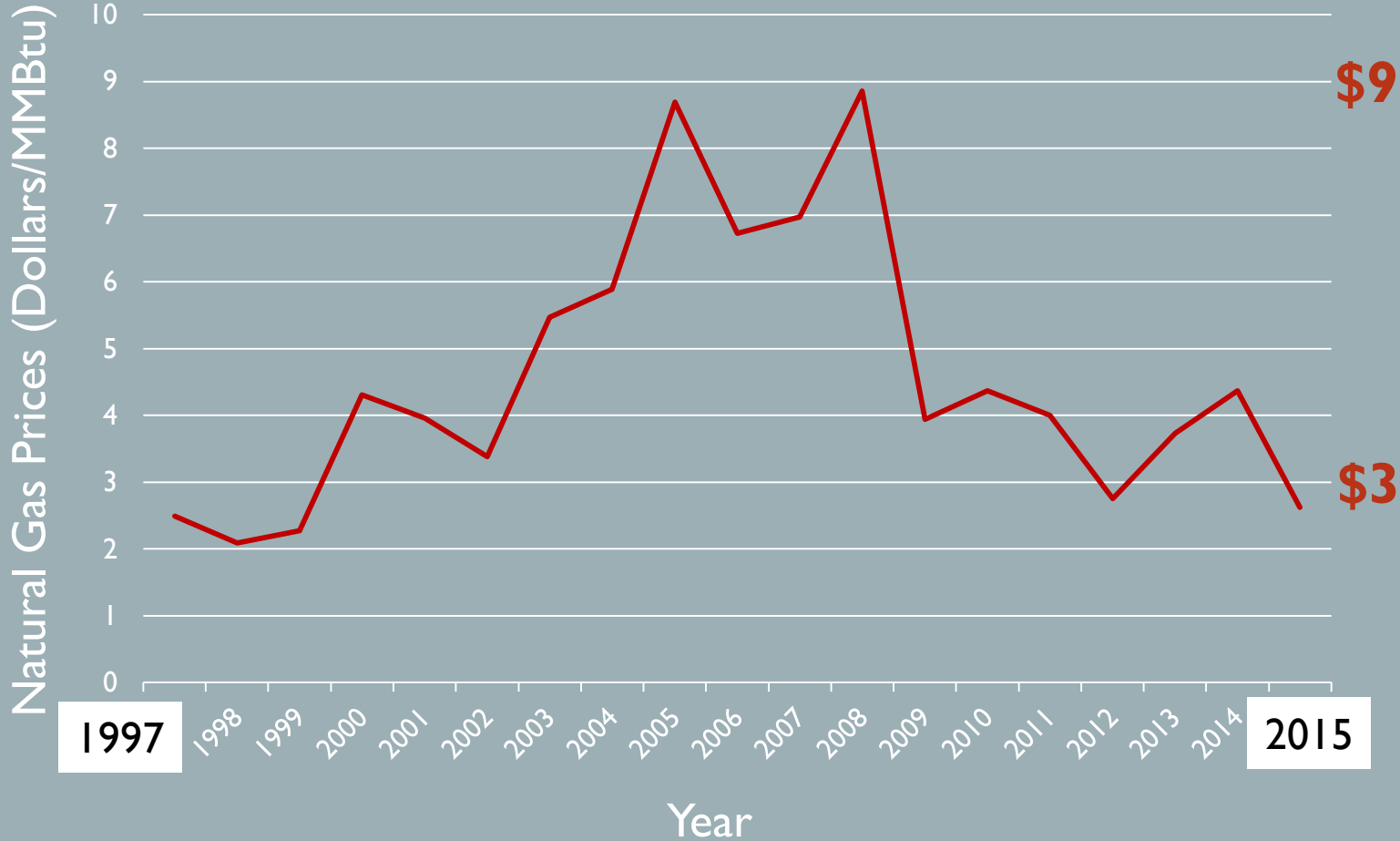
**QUESTIONS? COMMENTS? OTHER
INFORMATION?**

III. PRICE

**How long will natural
gas be economically
attractive?**

HISTORICAL PRICE OF NATURAL GAS

Natural Gas Prices Averaged Annually



Source: Energy Information Administration Henry Hub Natural Gas Spot Price (2016) <https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm>

NATURAL GAS PRICES ARE NOTORIOUSLY VOLATILE

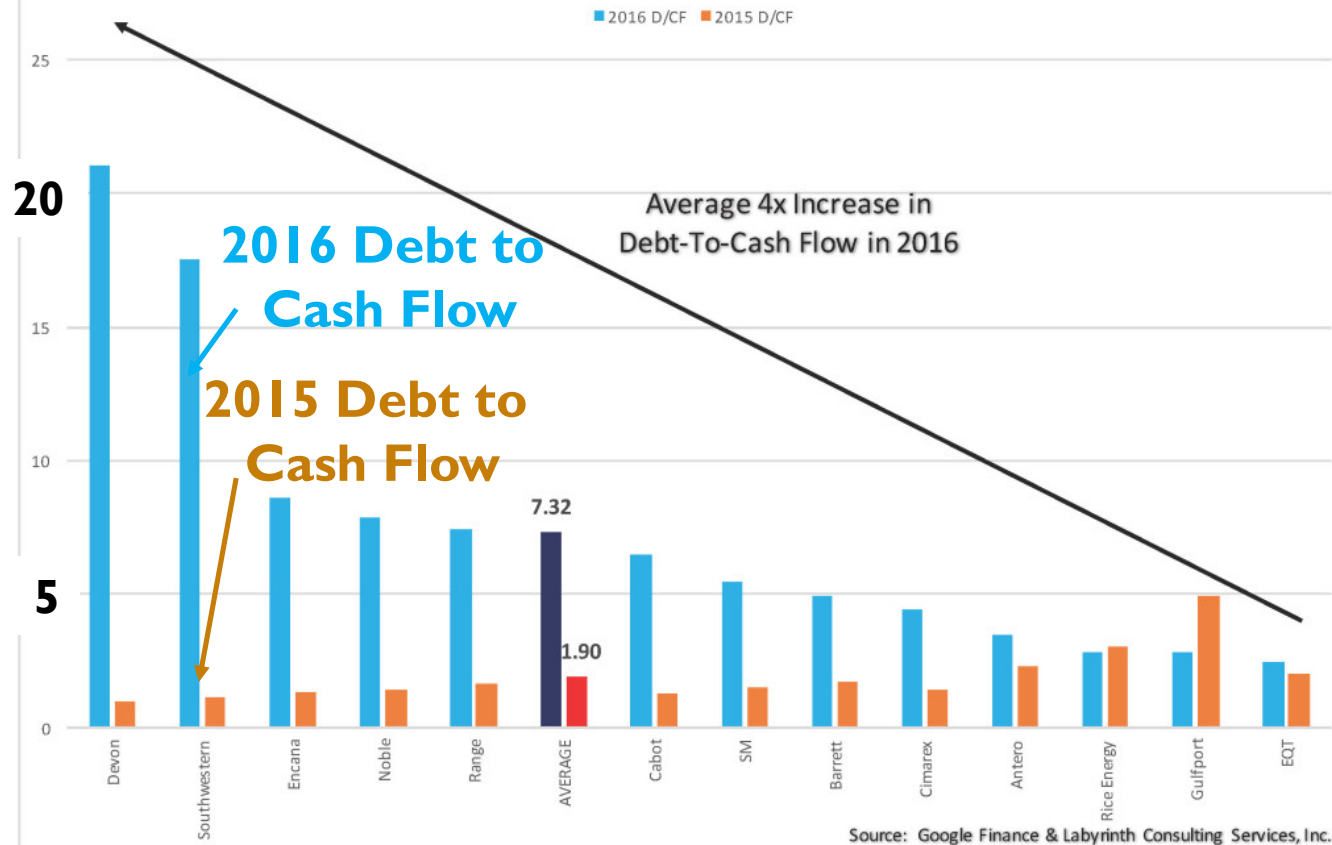
Natural Gas Prices Averaged Annually



Natural Gas Prices Averaged Weekly



IS IT ECONOMICAL TO MINE SHALE GAS?



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

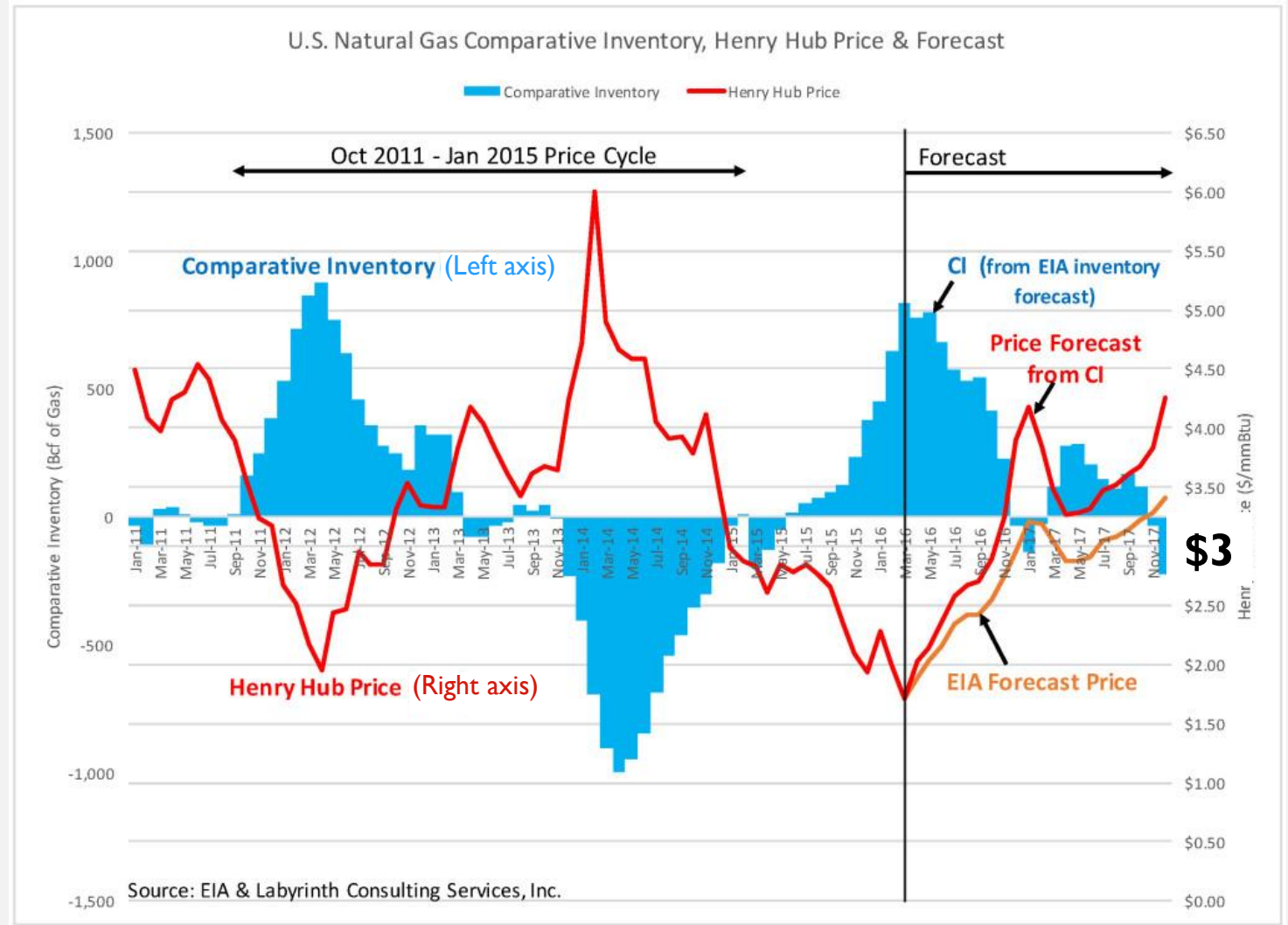
- Goodrich, Sandridge in **bankruptcy**, Exco and Halcon predicted to follow
- Average debt-to-cash flow ratio for shale gas companies **increased almost 4x** from 2015 to the first quarter of 2016

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)

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

**QUESTIONS? COMMENTS? OTHER
INFORMATION?**