

# **Marcellus, Utica/Point Pleasant Provide 91% of U.S. Shale Gas Production Growth since Start of 2012\***

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## **Abstract**

The productivity of natural gas wells in the Marcellus and Utica/ Point Pleasant is steadily increasing because of ongoing improvements in precision and efficiency of horizontal drilling and hydraulic fracturing occurring in the Appalachian region. Since January 2012, natural gas production from the Marcellus and Utica/ Point Pleasant has accounted for 91% of the increase in natural gas production from low permeability formations reported in EIA's Drilling Productivity Report (DPR). The DPR provides a month-ahead projection of both oil and natural gas production for the seven most significant shale formations in the United States. The DPR identifies trends in total production and rig productivity, expressed as new-well gas production per rig. The May 2017 edition of the DPR noted that average new-well gas production per rig in the Marcellus play was 3.2 million cubic feet of natural gas per day (MMcf/d) in January 2012. In June 2017, new-well gas production per rig increased to 13.4 MMcf/d. This trend corresponded with an overall increase in the amount of natural gas produced in the Marcellus play during the same period. The DPR also indicates that the Marcellus play produced an estimated 6.3 billion cubic feet of natural gas per day (Bcf/d) in January 2012, increasing to 19.2 Bcf/d in June 2017. The Utica play also experienced significant gains in rig productivity and production. In January 2012, new-well gas production per rig in the Utica play averaged 0.31 MMcf/d. June 2017 new-well gas production per rig is 10.6 MMcf/d. The DPR also indicates that the play's total natural gas production increased rapidly over the same period: production in June 2017 was almost 30 times higher than in January 2013 (4.4 Bcf/d and 0.15 Bcf/d, respectively). Increases in natural gas production from the Appalachian region occurred because of many factors, including: greater use of advanced drilling techniques; increased number of stages used in hydraulic fracturing operations; increased use of techniques such as zipper fracturing; and use of specific components during well completion. EIA's latest data

show that natural gas produced from U.S. shale formations now accounts for 62% of total U.S. dry natural gas production. Collectively, shale gas production from the Marcellus and Utica plays increased by 17.1 Bcf/d from January 2012 to June 2017, making the Appalachian region the driving force behind overall U.S. natural gas production growth.

## ***Marcellus, Utica/Point Pleasant provide 91% of U.S. shale gas production growth since start of 2012***



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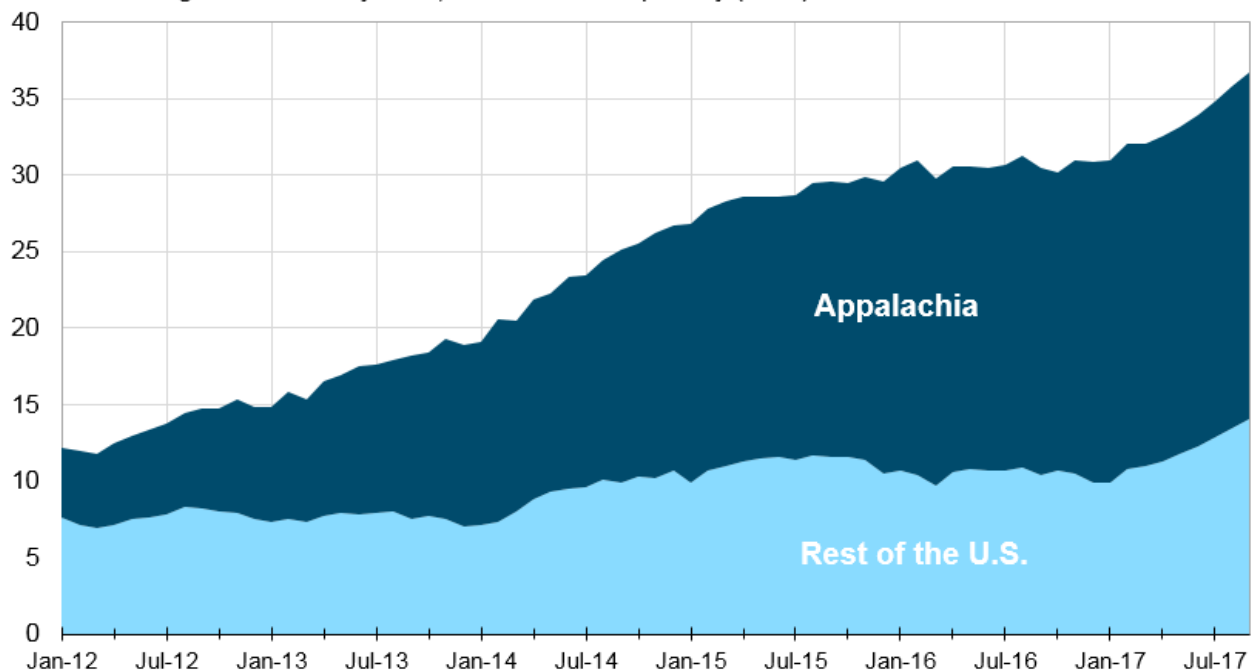
*By Dr. Olga Popova, Gary Long, Jeffrey Little, Christopher Peterson, Dr. Neal Davis, Emily Geary, Andrei Butterfield, Steven Grape, Elizabeth Panarelli, April Volke , Barbara Mariner-Volpe*

*Eastern Section American Association of Petroleum Geologists Annual Meeting  
September 26, 2017 / Morgantown, WV*

- Natural Gas production in the Appalachian region
- National oil and gas production
- How EIA data collection and analysis inform Annual Energy Outlook

### Natural gas production in Utica and Marcellus (Jan 2012 - Aug 2017)

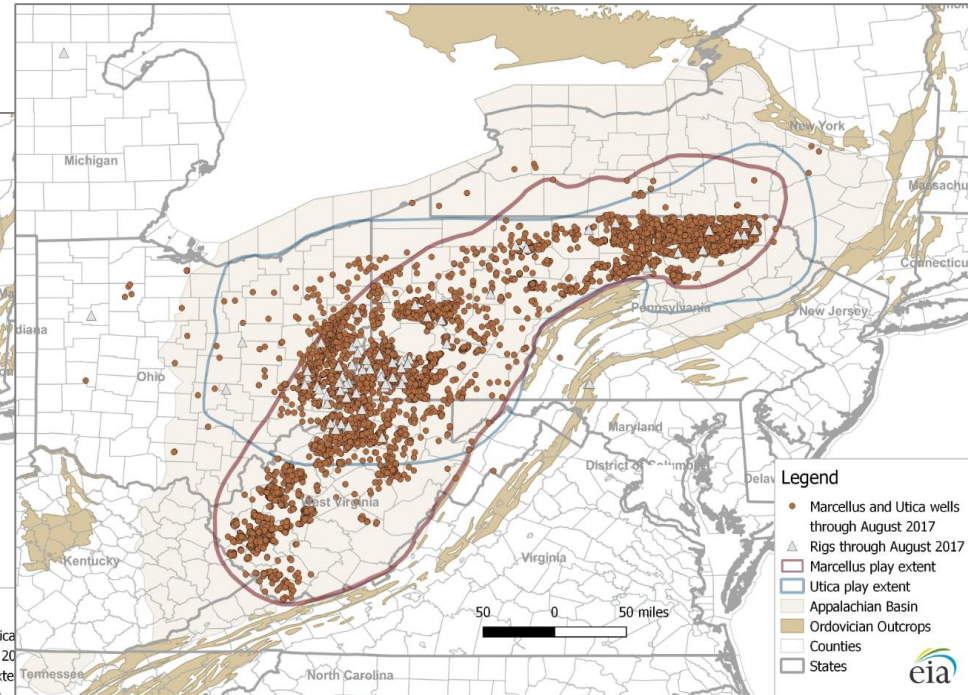
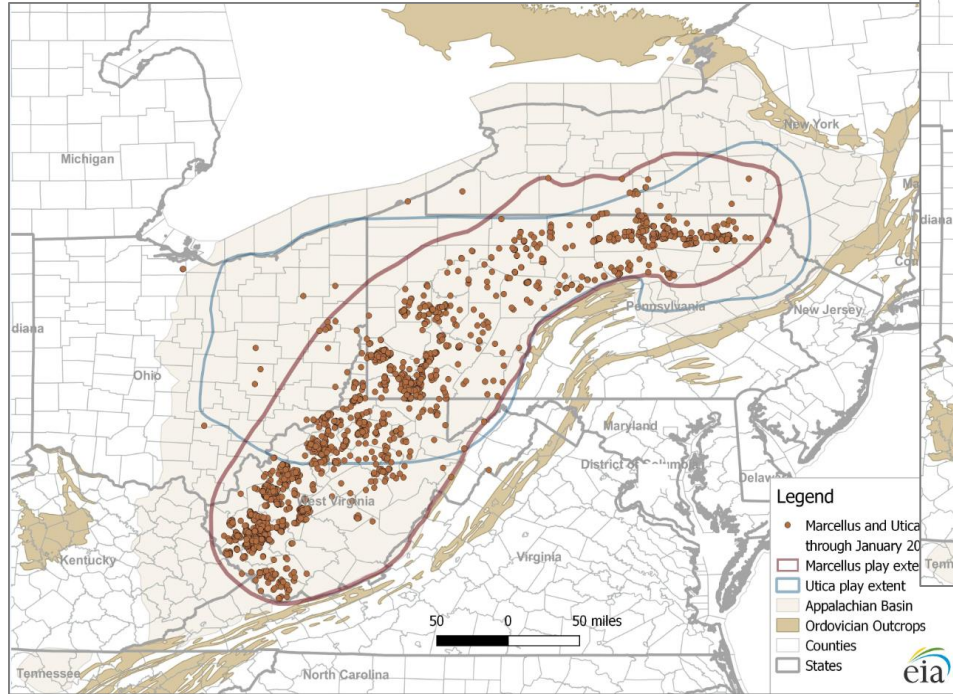
cumulative change since January 2012, billion cubic feet per day (Bcf/d)



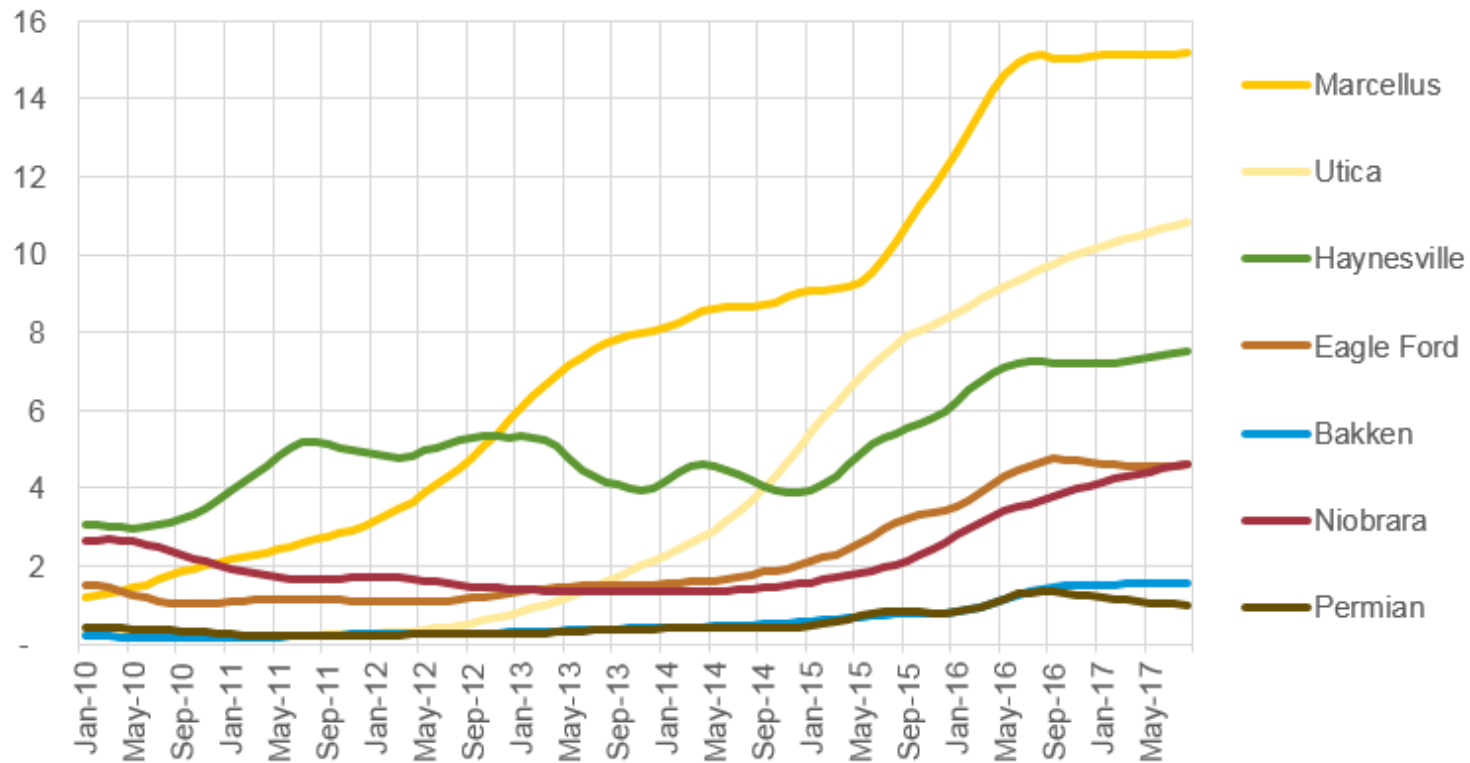
Since the beginning 2012, the Appalachian region has accounted for **74%** of the increase in production from these selected shale gas regions.

# Marcellus and Utica wells through August 2017

## Marcellus and Utica wells through August 2012



**Average monthly natural gas production for new wells per rig by play**  
billion cubic feet per day

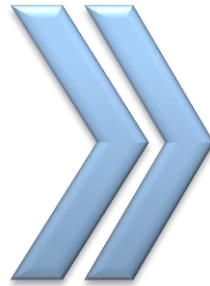
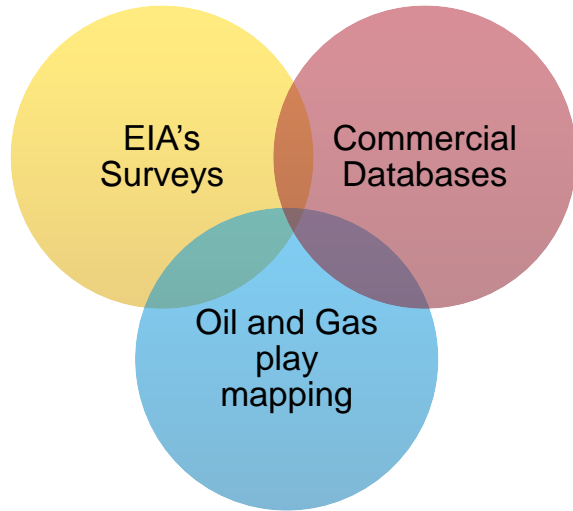


# Introduction

- U.S. hydrocarbon production has increased significantly from 2010 to 2016
- This growth is mainly due to increase in tight oil and shale gas production
  - Estimated U.S. tight oil production was about 4.6 MMbbl/d in June 2017 making up 50% of total oil production as of 9.1 MMbbl/d
  - Estimated U.S. shale gas production was 45.0 Bcf/d in June 2017 accounting for about 62% of total domestic dry gas production as of 72.9 Bcf/d



## Data integration



## EIA's Annual Energy Outlook



## Data side: EIA-914 Survey

In response to major increases in domestic oil and natural gas production EIA began collecting monthly oil production in addition to natural gas production through EIA-914 survey form

- Natural Gas production
- Oil and lease condensate production
- Oil and lease condensate volumes by API gravity categories

EIA is adding and updating geologic information and maps of the major low permeability oil and gas plays

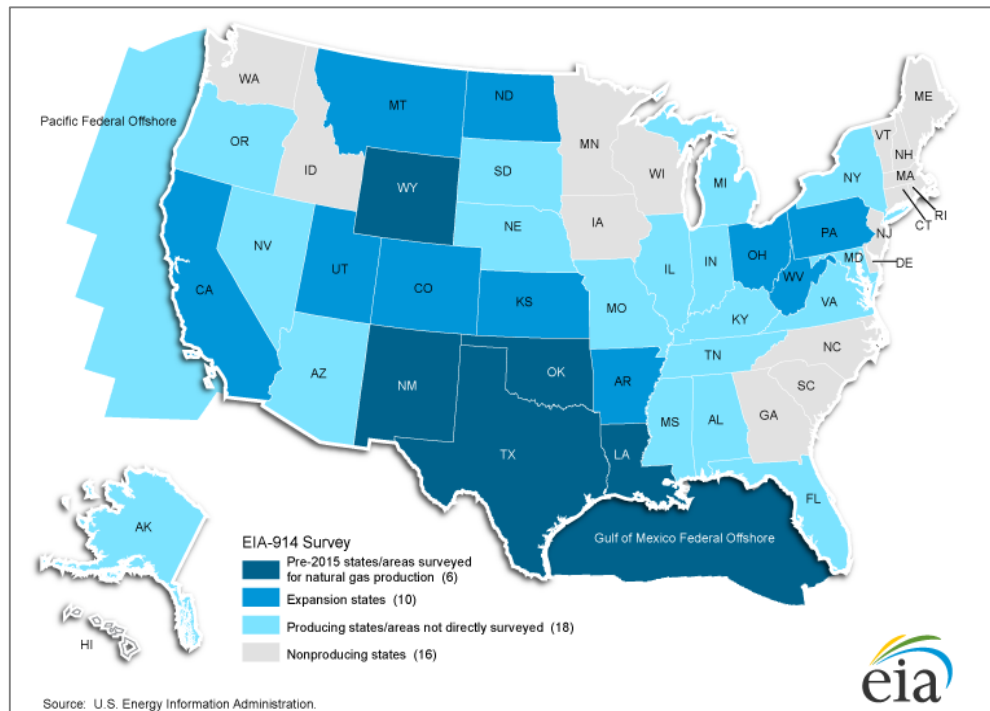
# EIA-914 Survey

- Collect data from only a subset of all oil and gas production companies
- EIA-914 is designed to provide 85 percent coverage for both oil and gas production for the lower 48 states and GOM
  - EIA collects data from a sample of about 400 out of 13,000 currently active operators of oil and natural gas wells
- In fact, EIA-914 covers more than 92 percent of both oil and gas production for lower 48 states and GOM
- Data from this relatively small number of operators make it possible to generate statistically representative estimates of production within two months of the production month

# EIA-914 Survey

## Geographical coverage

- The EIA-914 began collecting **natural gas** production data in 2005 from 5 states (**Louisiana, New Mexico, Oklahoma, Texas, and Wyoming**), federal **GOM**, and other states (as a group). Oil production was not included (5+GOM)
- In 2015, EIA improved the EIA- 914 form to add more states: additional individual states are **Arkansas, California, Colorado, Kansas, Montana, North Dakota, Ohio, Pennsylvania, Utah, and West Virginia** (10)
- “Other States” is much smaller now, reduced from 28 to 17, and only includes Alabama, Arizona, Florida, Illinois, Indiana, Kentucky, Maryland, Michigan, Mississippi, Missouri, Nebraska, Nevada, New York, Oregon, South Dakota, Tennessee, Virginia (17) and federal Pacific Offshore
- EIA does not collect any data for Alaska on this survey



# EIA-914 Survey

- **15 states + GOM +Other States, about 400 operators**

## Information collected by this Survey:

- Natural gas information (accounts for 92% of total U.S. production)
- Crude oil and lease condensate information (accounts for 92% of total U.S. production)
- Oil volumes by API gravity category
- Acquisitions and changes in ownership

EIA uses the survey data to estimate total monthly production for United States

# Publications: 914 report:

<https://www.eia.gov/petroleum/production/#ng-tab>

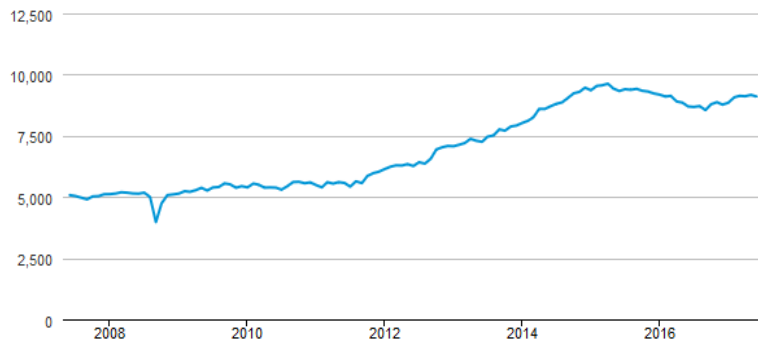
## Monthly Crude Oil and Natural Gas Production

Release date: August 31, 2017 | Next release date: Date: September 29, 2017

Crude oil Natural gas

### U.S. crude oil production

thousand barrels per day



— U.S. Crude Oil (Thousand Barrels per Day)

### CRUDE OIL (thousand barrels per day)

State/area	Jun-17	May-17	Percent change	Jun-16	Percent change
U.S.	9,097	9,170	-0.8↓	8,698	4.6↑
Alabama	18	18	1.6↑	22	-16↓
Alaska	463	508	-8.8↓	470	-1.6↓
Arizona	0	0	33.3↑	0	462.9↑
Arkansas	14	14	-1.7↓	11	28.8↑
California	476	478	-0.6↓	484	-1.7↓
Colorado	324	325	-0.2↓	308	5.1↑
Federal Offshore Gulf of Mexico	1,636	1,659	-1.4↓	1,551	5.5↑
Federal Offshore Pacific	17	16	3.9↑	17	-1.8↓
Florida	5	6	-8.3↓	5	-0.9↓
Idaho	0	0	0.0	1	-70.0↓
Illinois	23	22	5.9↑	25	-6.4↓
Indiana	5	5	9.1↑	5	-6.1↓
Kansas	99	98	1.7↑	108	-7.8↓
Kentucky	7	7	0.3↑	11	-37.8↓
Louisiana	138	141	-2.5↓	155	-11.4↓
Michigan	15	16	-7↓	15	-0.6↓

# Publications: 914 report:

<https://www.eia.gov/petroleum/production/#ng-tab>

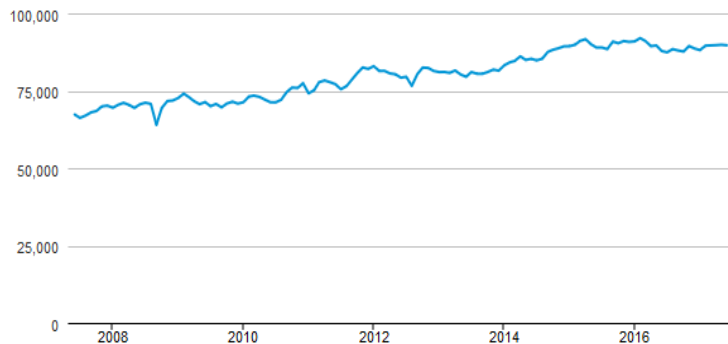
## Monthly Crude Oil and Natural Gas Production

Release date: August 31, 2017 | Next release date: Date: September 29, 2017

Crude oil Natural gas

### U.S. natural gas production (gross withdrawals)

million cubic feet per day



— U.S. Natural Gas Gross Withdrawals (Million Cubic Feet per Day)

### NATURAL GAS (million cubic feet per day)

State/area	Jun-17	May-17	Percent change	Jun-16	Percent change
U.S.	89,689	89,860	-0.2↓	87,833	2.1↑
Alaska	8,294	9,248	-10.3↓	7,794	6.4↑
Arkansas	1,949	1,972	-1.2↓	2,245	-13.2↓
California	561	557	0.7↑	574	-2.3↓
Colorado	4,496	4,490			
Kansas	612	598			
Louisiana	5,698	5,314			
Montana	133	133			
New Mexico	3,618	3,634			
North Dakota	1,857	1,860			
Ohio	4,643	4,349			
Oklahoma	6,875	6,800			
Pennsylvania	14,767	14,818			
Texas	21,862	21,765			
Utah	868	887			
West Virginia	4,324	4,257			
Wyoming	4,710	4,558			
Federal Offshore Gulf of Mexico	3,020	3,196			

### Additional data and methodology

Table 1. Crude oil and lease condensate production in the United States

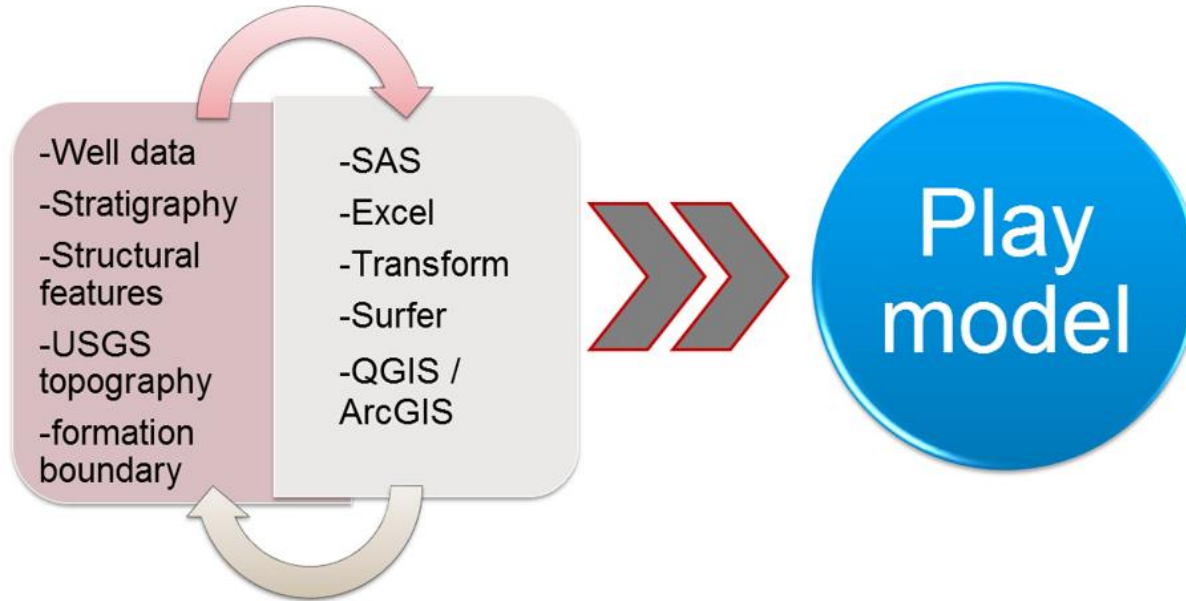
Table 2. Crude oil and lease condensate production in the United States with monthly and annual changes

Table 3. Natural gas gross withdrawals in selected states and the Federal Gulf of Mexico

Table 4. Natural gas gross withdrawals in selected states and the Federal Gulf of Mexico with monthly and annual changes

Table 5. Crude oil and lease condensate production by API gravity category in selected Lower 48 states and the Federal Gulf of Mexico

## EIA low permeability play mapping



EIA is also adding and updating geologic information and maps of major low permeability oil and gas plays

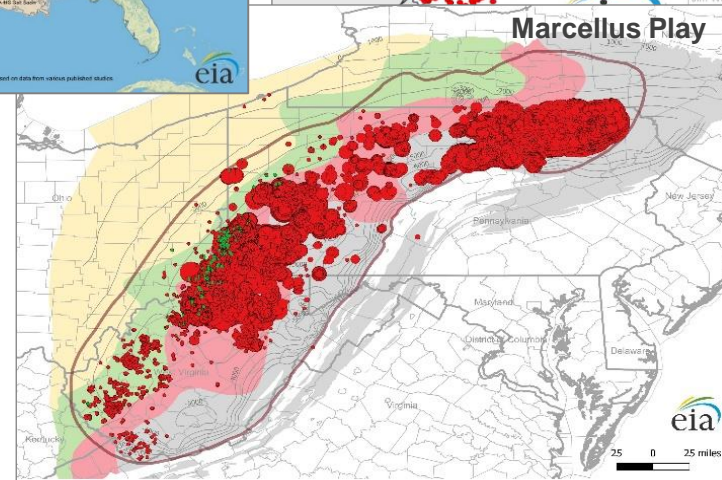
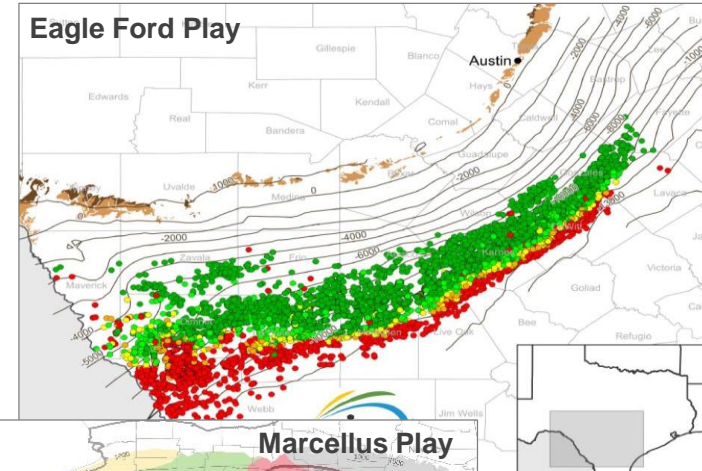
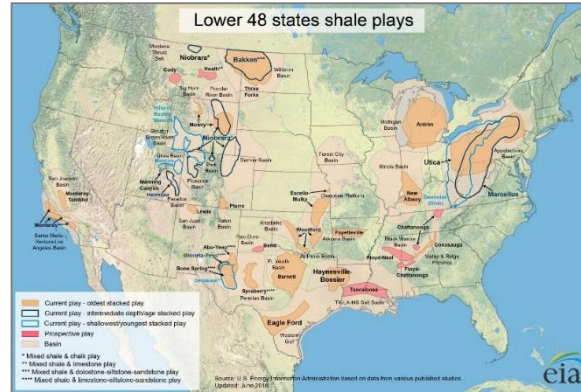


# EIA low permeability play mapping, cont'd

EIA constructed unconventional play map for the Lower 48 states, and series of thematic maps include structure maps, thickness maps, major tectonic features maps, and production maps for several plays:

- Eagle Ford
- Bakken/Three Forks
- Marcellus
- Utica/Point Pleasant

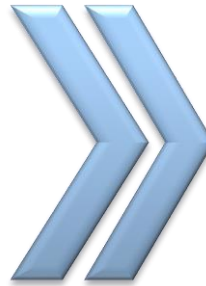
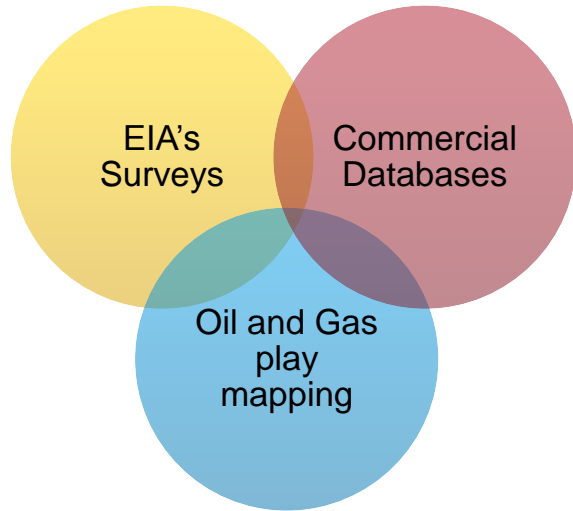
The interactive U.S. Energy Mapping System allows users to explore maps using low permeability play layers



## Data side:

Collectively, [EIA-914 crude oil and natural gas production data](#) and [EIA's mapping project](#) outcomes improves reporting and forecasting, and helps inform policy makers and general public on topics such as hydrocarbon production, refining capacity, and energy legislative initiatives.

## Data integration



## EIA's Annual Energy Outlook

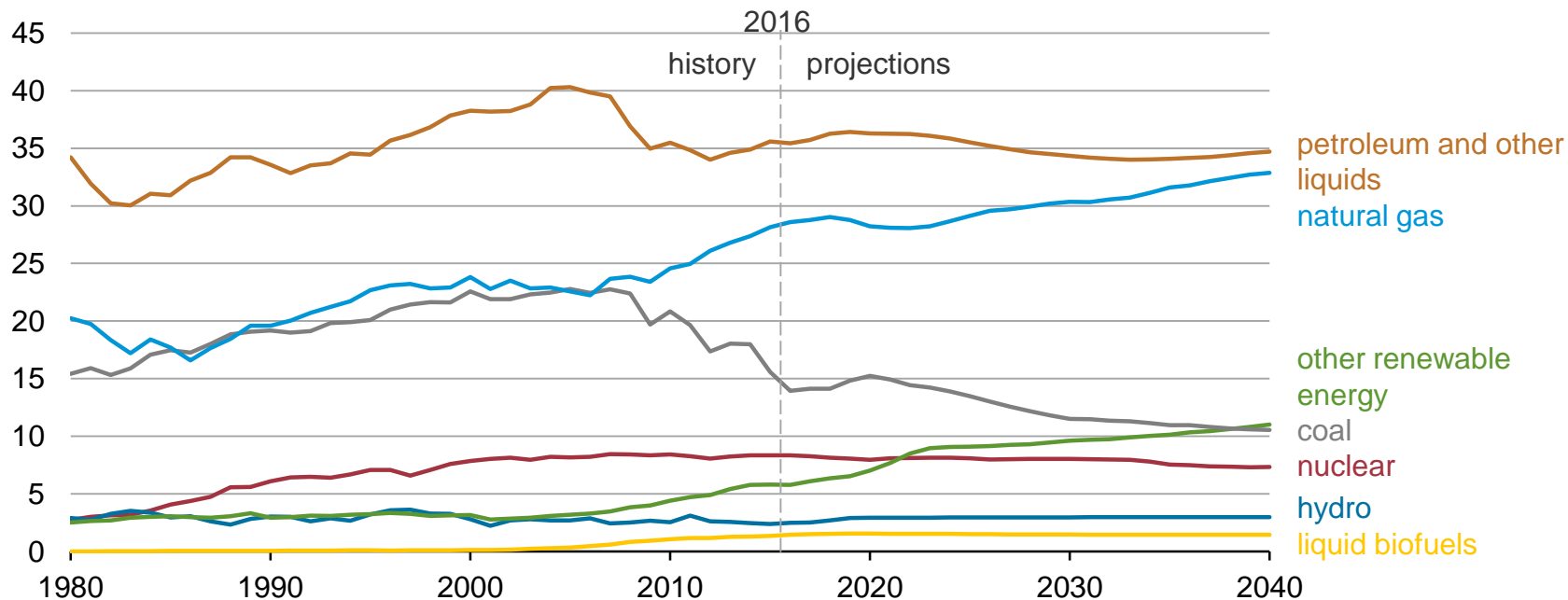


# EIA's projections are not predictions of what will happen

- but rather modeled projections of what may happen given certain assumptions, methodologies, and analytical techniques
- The Annual Energy Outlook (AEO) is developed using the National Energy Modeling System (NEMS), an integrated model that aims to capture various interactions of economic changes and energy supply, demand, and prices
- The hydrocarbon module of NEMS is designed to provide forecasts of U.S. production, consumption, refinery inputs, net imports, and inventories
- Energy market projections are subject to much uncertainty, as many of the events that shape energy markets and future developments in technologies, demographics, and resources cannot be foreseen with certainty

# Domestic energy consumption remains relatively flat in the Reference case, but the fuel mix changes significantly

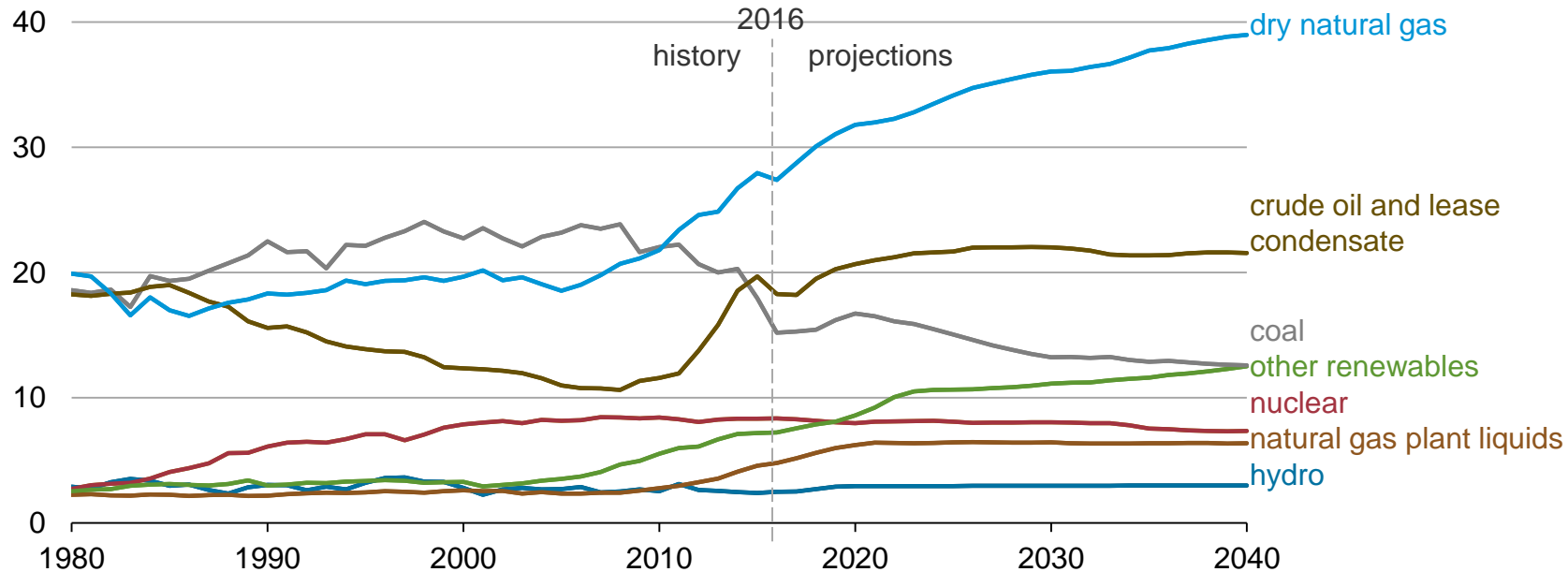
Energy consumption (Reference case)  
quadrillion British thermal units



Source: EIA, Annual Energy Outlook 2017

# United States energy production continues to increase in the Reference case, led by growth in natural gas and renewables

Energy production (Reference case)  
quadrillion British thermal units

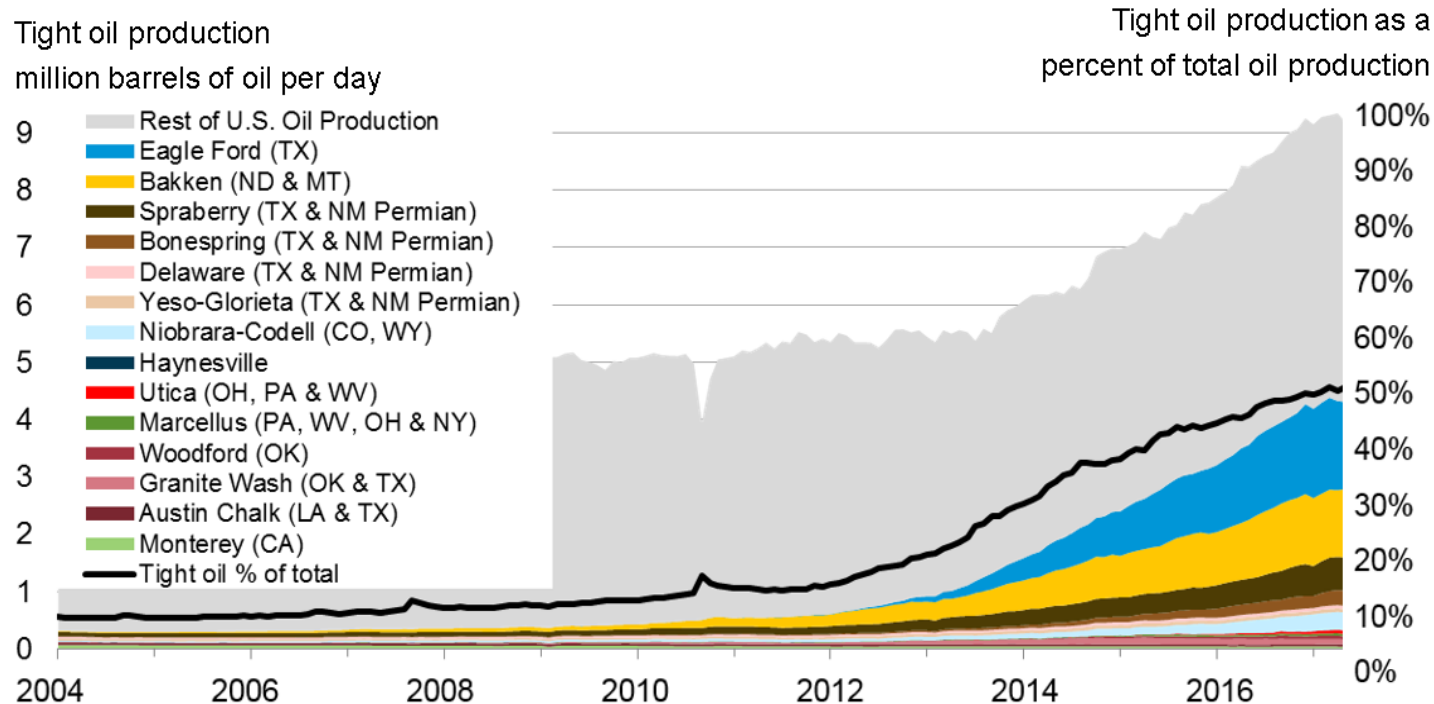


Source: EIA, Annual Energy Outlook 2017

# Petroleum

# Crude Oil

Estimated U.S. tight oil production was 4.4 million barrels per day MMbbl/d in March 2017 making up about 48% of total U.S. oil production (9.1 MMbbl/d)

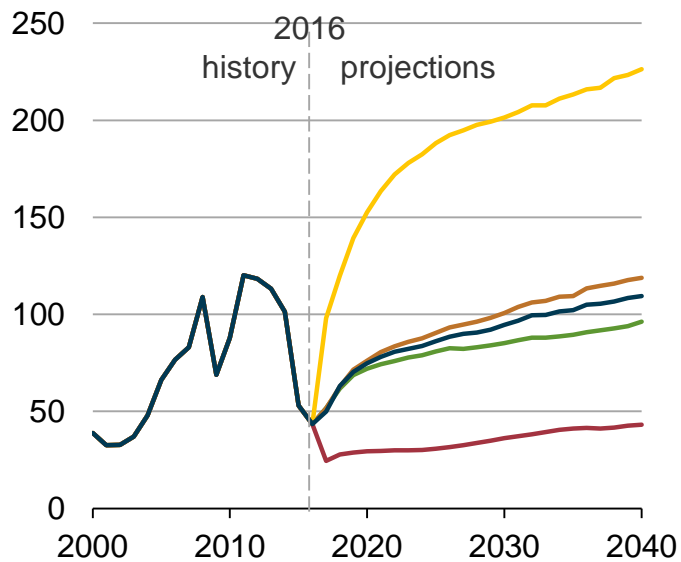


Source: U.S. Energy Information Administration and DrillingInfo

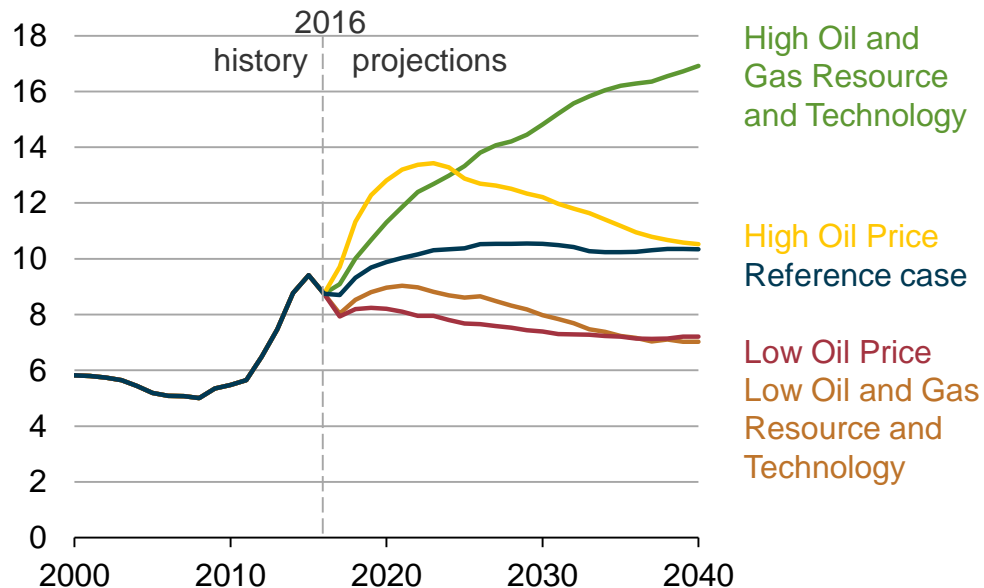


# Reference case oil prices and production increase from current levels. Price trajectories and production levels vary significantly across side cases.

North Sea Brent oil price  
2016 dollars per barrel

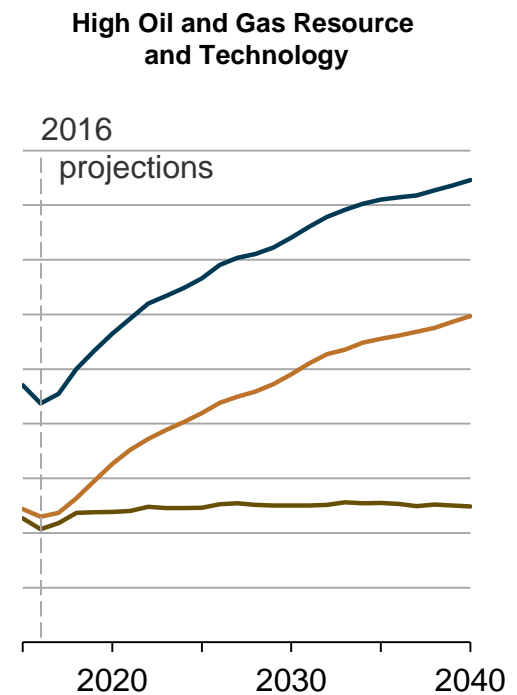
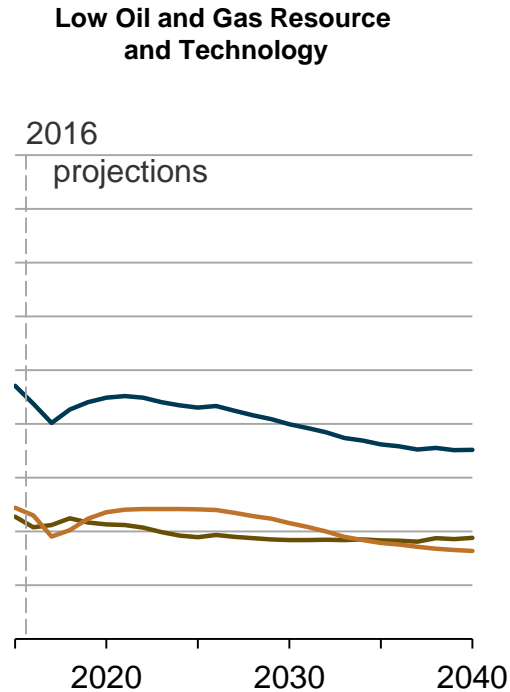
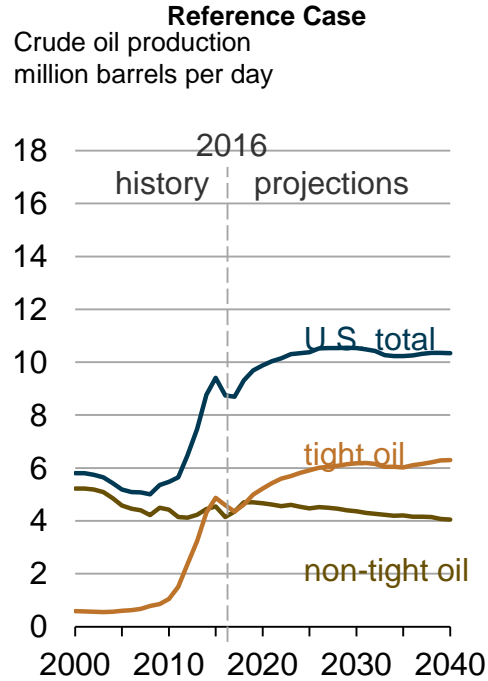


Crude oil production  
million barrels per day



Source: EIA, Annual Energy Outlook 2017

# Tight oil dominates U.S. production in the Reference case, but other types of oil production continue to yield significant volumes

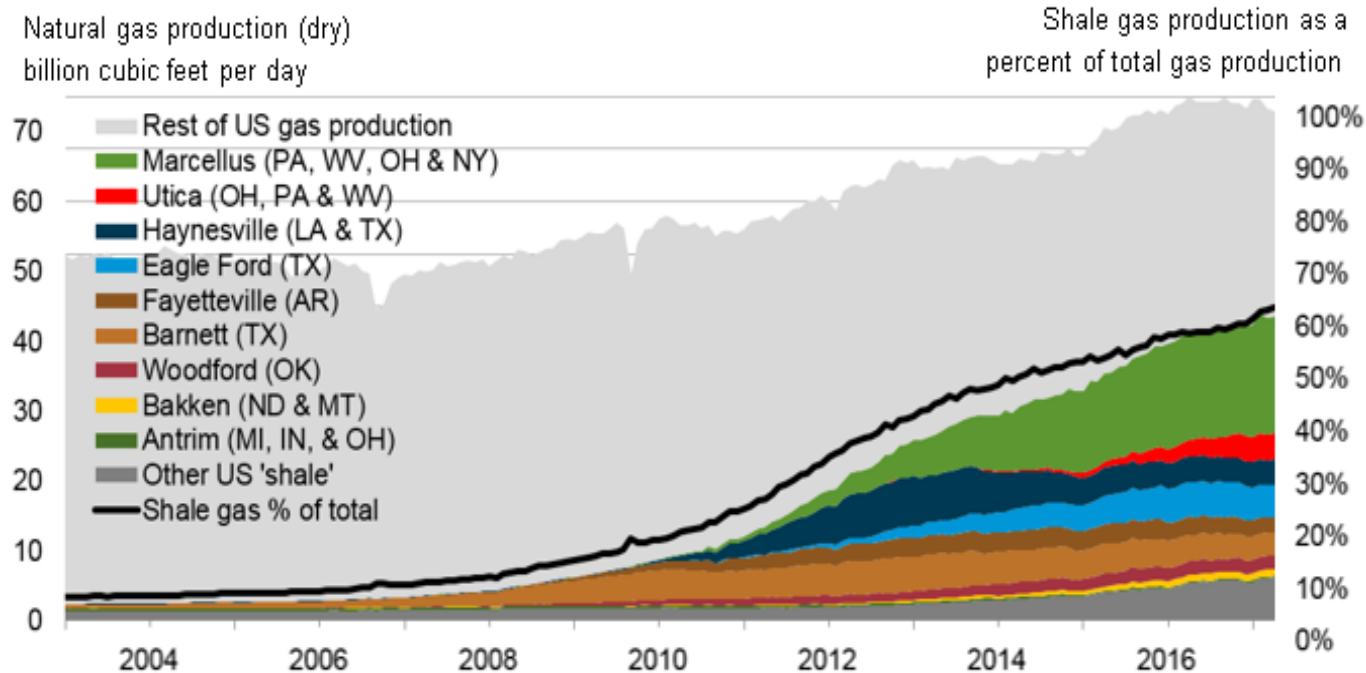


Source: EIA, Annual Energy Outlook 2017

# Natural gas

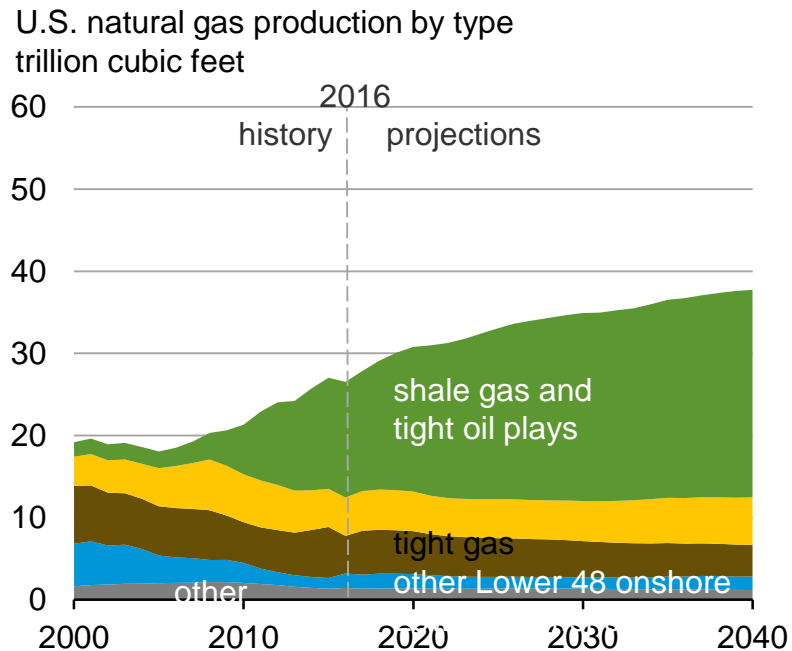
# Natural Gas

Estimated U.S. shale gas production was 44.3 Bcf/d in March 2017 making up about 62% of total U.S. dry gas production (71.6 Bcf/d)

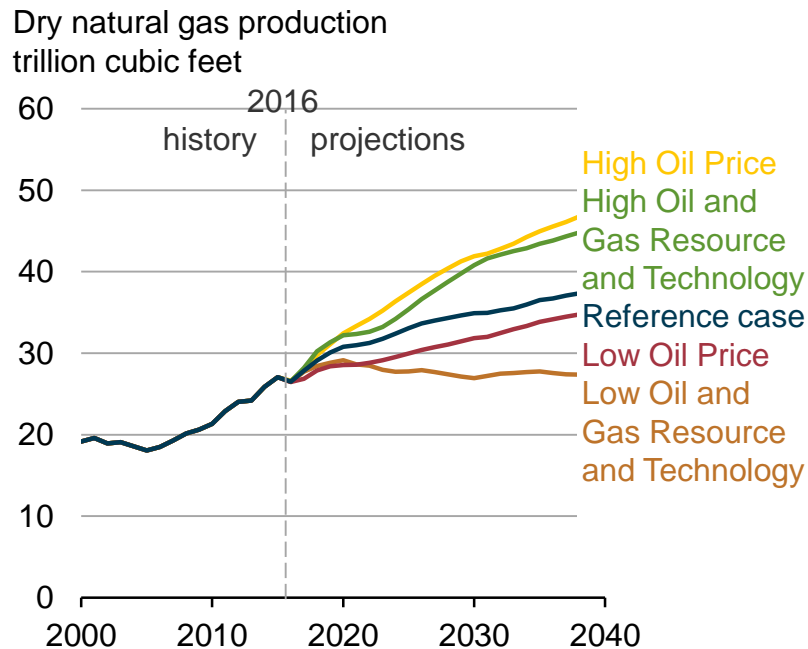


Source: U.S. Energy Information Administration and DrillingInfo

U.S. dry natural gas production is the result of continued development of shale gas and tight oil plays. Projections are sensitive to global energy prices, and resource and technology assumptions.



Source: EIA, Annual Energy Outlook 2017

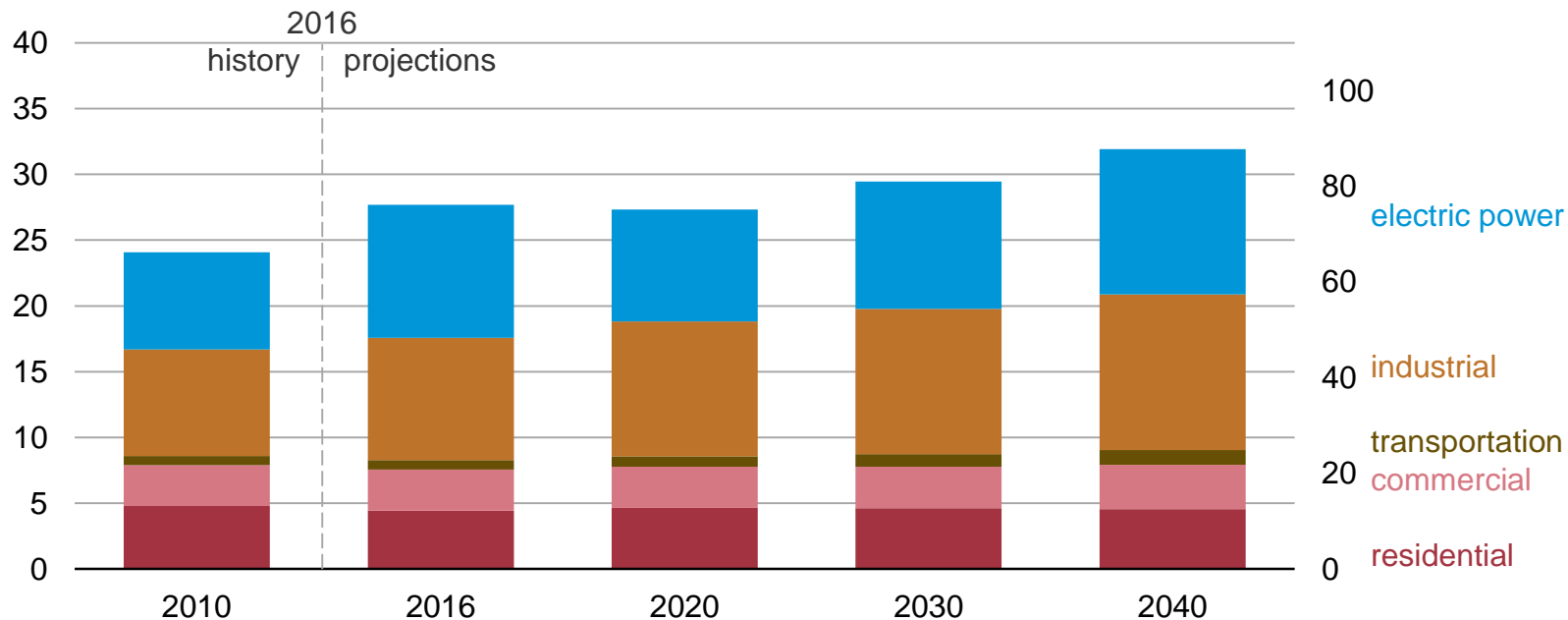


# Increasing demand from industrial and electric power markets drive rising domestic consumption of natural gas in the Reference case

Natural gas consumption by sector

trillion cubic feet

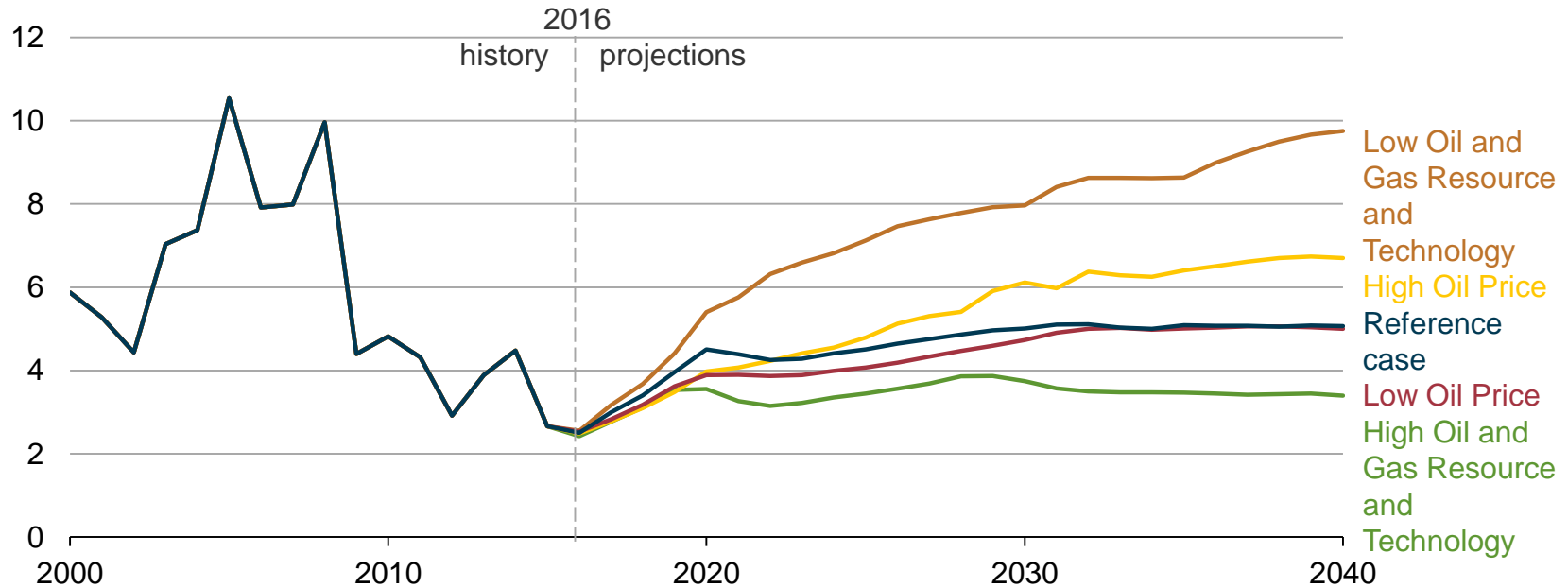
billion cubic feet per day



Source: EIA, Annual Energy Outlook 2017

# Future domestic natural gas prices depend on both domestic resource availability and world energy prices

Henry Hub natural gas price  
2016 dollars per million Btu



Source: EIA, Annual Energy Outlook 2017

# Key takeaways from AEO2017

- EIA's latest data show that U.S. crude oil production recovers from recent lows
  - ongoing development of tight oil resources
  - Crude oil production in the Permian is expected to lead the recovery in U.S. tight oil production
- With consumption flat to down, net crude oil and petroleum product imports decline across most cases
- Natural gas production increases despite relatively low and stable natural gas prices, supporting higher levels of domestic consumption and natural gas exports;
  - Collectively, shale gas production from the Marcellus and Utica plays is expected to be the driving force behind overall domestic natural gas production growth
- Increases in hydrocarbon production from low permeability reservoirs occurred mainly because of technology advances and improved efficiency
- Projections are sensitive to resource and technology assumptions



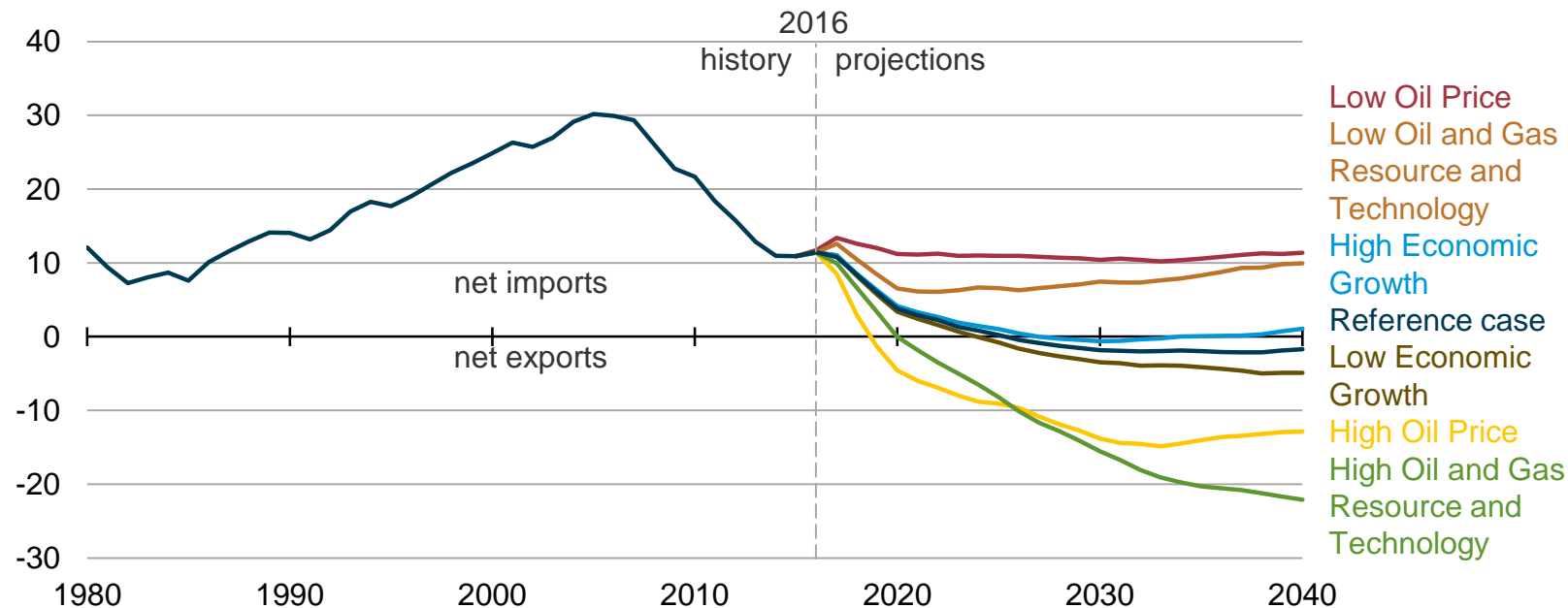
## Key takeaways from AEO2017, con'd

- The primary driver for new electricity generation capacity in the Reference case is the retirement of older, less efficient coal-fired units
  - even if the CPP is not implemented, low natural gas prices and the tax credits result in natural gas and renewables as the primary sources of new generation capacity;
- The United States remained the world's top producer of petroleum and natural gas hydrocarbons in 2016 for the fifth straight year despite production declines for both petroleum and natural gas relative to their 2015 levels
- The United States has been the world's top producer of natural gas since 2009, when U.S. natural gas production surpassed that of Russia, and it has been the world's top producer of petroleum hydrocarbons since 2013, when its production exceeded Saudi Arabia's
- Finally, with strong domestic production and relatively flat demand, the United States becomes a net energy exporter over the projection period in most cases

# With strong domestic production and relatively flat demand, the United States becomes a net energy exporter over the projection period in most cases

Net energy trade

quadrillion British thermal units



Source: EIA, Annual Energy Outlook 2017

# References

Monthly Crude Oil, Lease Condensate, and Natural Gas Production Report  
[http://www.eia.doe.gov/oil\\_gas/natural\\_gas/data\\_publications/eia914/eia914.html](http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/eia914/eia914.html)

Natural Gas Monthly [http://www.eia.doe.gov/oil\\_gas/natural\\_gas/data\\_publications/natural\\_gas\\_monthly/ngm.html](http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/natural_gas_monthly/ngm.html)

Petroleum Supply Monthly <http://www.eia.gov/petroleum/supply/monthly/>

Monthly Energy Review <http://www.eia.doe.gov/mer/>

Natural Gas Annual [http://www.eia.doe.gov/natural\\_gas/data\\_publications/natural\\_gas\\_annual/nga.html](http://www.eia.doe.gov/natural_gas/data_publications/natural_gas_annual/nga.html)

Petroleum Supply Annual <http://www.eia.gov/petroleum/supply/annual/volume1/>;

Annual Energy Outlook <https://www.eia.gov/outlooks/aeo/>

Short-Term Energy Outlook <http://www.eia.gov/forecasts/steo/>

EIA's mapping project <https://www.eia.gov/maps/maps.htm#field>

## Acknowledgement

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Thank you!

Questions?