

# **U.S. EIA Expects Future U.S. Tight Oil and Shale Gas Production to Depend on Resources, Technology, Markets\***

**Olga Popova<sup>1</sup>, Gary Long<sup>1</sup>, Jeffrey Little<sup>1</sup>, Neal Davis<sup>1</sup>, Steven Grape<sup>1</sup>, Elizabeth Panarelli<sup>1</sup>, Emily Geary<sup>1</sup>, and April Volke<sup>1</sup>**

Search and Discovery Article #80636 (2018)\*\*

Posted July 16, 2018

\*Adapted from oral presentation given at AAPG 2018 AAPG Annual Convention and Exhibition, Salt Lake City, Utah, May 20-23, 2018

\*\*Datapages © 2018 Serial rights given by author. For all other rights contact author directly.

<sup>1</sup>DOE EIA, Washington, DC, United States

([olga.popova@eia.gov](mailto:olga.popova@eia.gov))

## **Abstract**

Based on projections in the U.S. Energy Information Administration's AEO2017, U.S. tight oil production is expected to reach 7.1 million barrels per day (b/d), and shale gas production is expected to reach 79 billion cubic feet per day (Bcf/d) in 2040. These values reflect Reference case projections, while several side cases with different assumptions of oil prices, technological advances, and resource availability have different levels of tight oil and shale gas production. U.S. production of tight oil and shale gas has increased significantly from 2010 to 2016, driven by technological improvements that have reduced drilling costs and improved drilling efficiency in major shale plays, such as the Bakken, Marcellus, and Eagle Ford.

Production from tight oil in 2016 was 4.9 million barrels per day, or 52% of total U.S. crude oil production. As oil prices recover, oil production from tight formations is expected to increase. By 2019, Bakken oil production is projected to reach 1.3 million b/d, surpassing the Eagle Ford to become the largest tight oil-producing formation in the United States. Bakken production is projected to reach 2.3 million barrels per day by 2040, almost a third of the projected U.S. total tight oil production.

Natural gas production from shale gas plays in 2016 accounted for 41 billion cubic feet per day (Bcf/d), or 62% of total U.S. natural gas production. Natural gas production from shale gas plays is expected to increase through 2040 in the AEO2017 Reference case. The two Appalachian shale gas plays, the Marcellus and Utica, have factors favorable for production: shallower geologic formation depths and proximity to consuming markets. Both Appalachian shale gas plays have remained resilient to the low natural gas prices and are projected to continue to drive total U.S. production in the long term. Shale gas production in these plays is expected to reach more than 40 Bcf/d by 2040, providing just over half of U.S. total shale gas production.

Two oil price side cases illustrate the effect of higher or lower global crude oil prices on production from tight formations. By 2040, the global benchmark Brent crude oil spot price averages \$73/b in the Low Oil Price case, \$136/b in the Reference case, and \$230/b in the High Oil Price case.

### **Website Cited**

914 Report: <https://www.eia.gov/petroleum/production/> Website accessed July 2018.



# AAPG



## U.S. EIA Expects Future U.S. Tight Oil and Shale Gas Production to Depend on Resources, Technology, Markets

### Development of tight formations

*By Dr. O. Popova, G. Long, J. Little, Dr. N. Davis, S. Grape, E. Panarelli, E. Geary, A. Volke*



ACE 101: Bridging Fundamentals and Innovation

- EIA's data sources and processes
- U.S. historical oil and natural gas production
- EIA's energy forecasts

# Data integration

- EIA's Surveys
- Commercial Databases
- Oil and Gas play mapping

# EIA low permeability play mapping



EIA is also adding and updating geologic information and maps of the major plays with primary focus on low permeability oil and gas plays

# EIA low permeability play mapping, cont'd

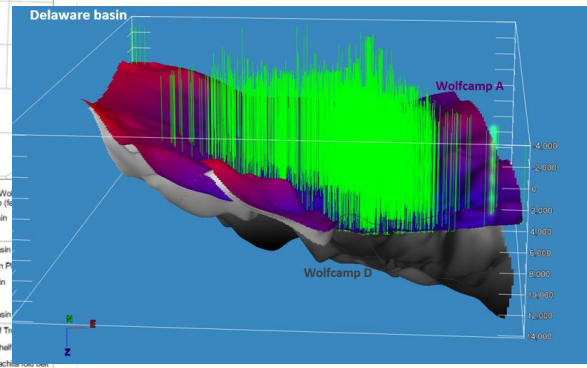
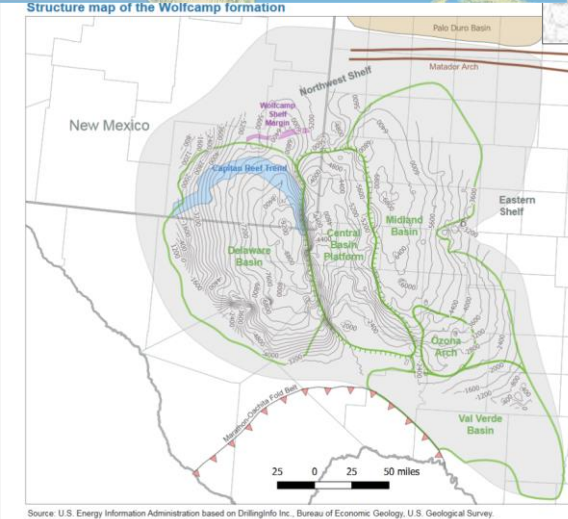
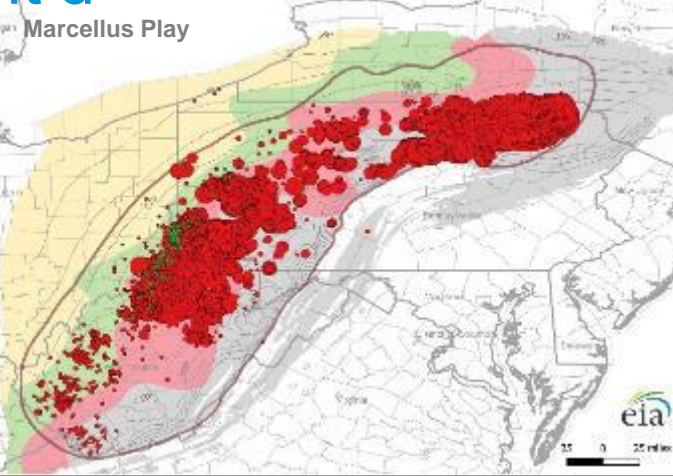
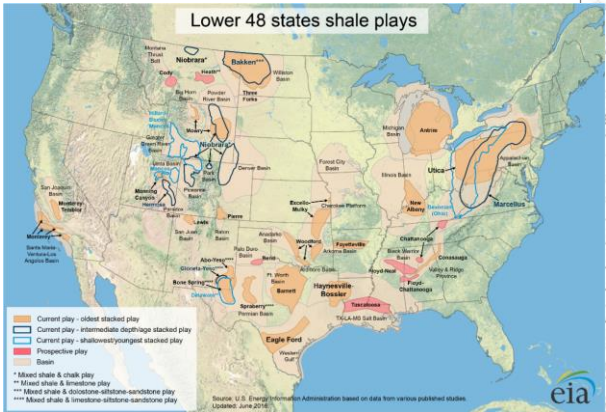
EIA constructed unconventional play map for the Lower 48 states,

- 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

- EIA started construction maps of stacked plays for the Permian basin. To that end there are published a number of the Wolfcamp play maps

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



# Data side: EIA-914 Report

- **15 states + GOM +Other States, about 375 operators**

## Information collected by this Report:

- Natural gas information (accounts for 90% of total U.S. production)
- Crude oil and lease condensate information (accounts for 90% of total U.S. production)
- Oil volumes by API gravity category
- Acquisitions and changes in ownership

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



# EIA-914 Survey Geographical coverage

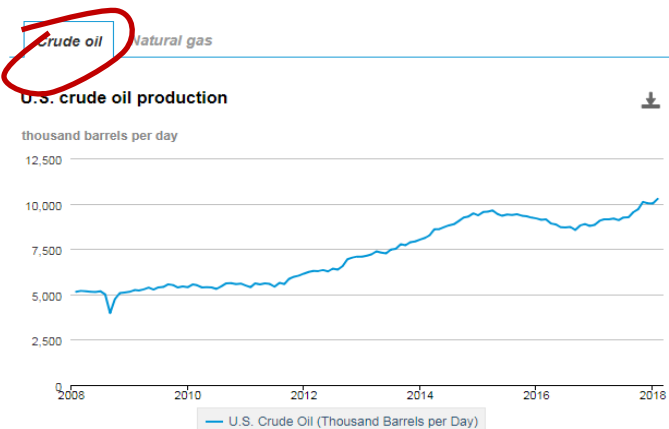
- The EIA-914 began collecting **natural gas** production data in 2005 from 5 states (**Louisiana, New Mexico, Oklahoma, Texas, and Wyoming** ), federal **GOM**, and other states (as a group). Oil production was not included (5+GOM)
- In 2015, EIA improved the EIA- 914 form to add more states: additional 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

# Publications: 914 report:

<https://www.eia.gov/petroleum/production/>

## Monthly Crude Oil and Natural Gas Production

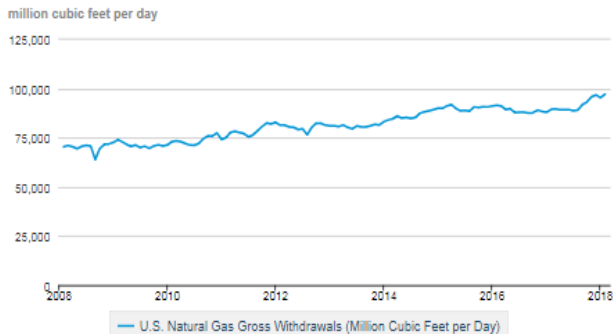
Release date: April 30, 2018 | Next release date: May 31, 2018



	Feb-17	Percent change
	9,058	13.3*
	20	-15.3*
	513	-0.1*
	0	36.3*

	Feb-17	Percent change			
Arkansas	14	14	2.0*	14	-1.5*
California	463	463	0.0	483	-4.2*
Colorado	425	434	-1.9*	292	45.8*
Federal Offshore Gulf of Mexico	1,721	1,632	5.5*	1,739	-1.0*
Federal Offshore Pacific	16	15	8.6*	16	4.4*
Florida	5	5	0.4*	5	3.5*
Idaho	0	0	0.0	0	-61.1*
Illinois	22	19	14.6*	24	-5.8*
Indiana	5	4	27.3*	5	-0.9*
Kansas	96	92	4.1*	100	-4.0*
Kentucky	4	2	116.7*	4	3.2*
Louisiana	130	121	7.1*	143	-9.3*
Michigan	15	16	-1.7*	14	6.8*
Mississippi	49	45	8.7*	50	-2.8*
Missouri	0	0	12.0*	0	-9.9*
Montana	56	56	-0.6*	59	-5.6*
Nebraska	5	6	-8.0*	6	-17.2*
Nevada	1	1	2.9*	1	0.0
New Mexico	588	542	8.4*	440	33.6*
New York	1	1	0.0	1	0.0
North Dakota	1,150	1,157	-0.6*	1,020	12.8*
Ohio	54	50	8.1*	52	2.4*

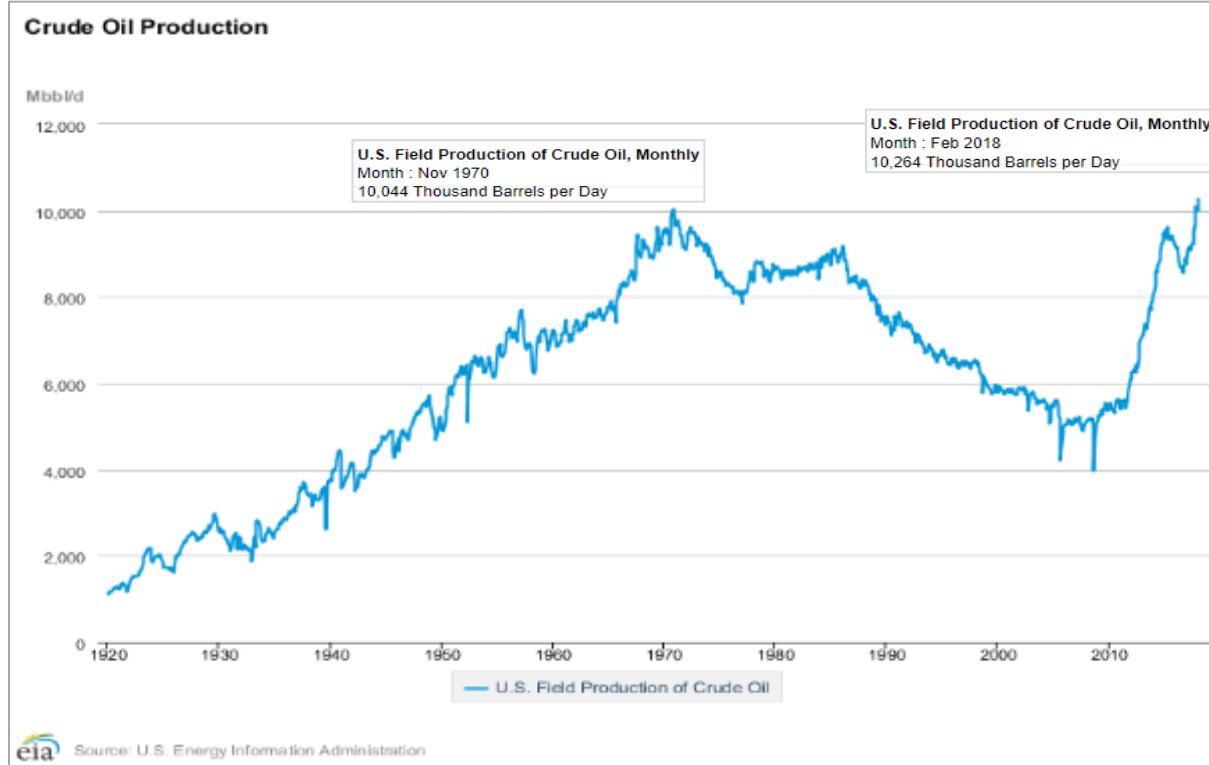
## U.S. natural gas production (gross withdrawals)



	Feb-17	Percent change
	89,419	8.7*
	1.8*	

	Feb-17	Percent change			
Alaska	9,593	9,573	0.2*	9,823	-2.3*
Arkansas	1,670	1,669	0.1*	2,014	-17.1*
California	543	542	0.2*	547	-0.7*
Colorado	4,878	4,869	0.2*	4,648	4.9*
Kansas	563	563	0.0	627	-10.3*
Louisiana	7,063	6,830	3.4*	5,157	37.0*
Montana	124	126	-2.1*	133	-8.8*
New Mexico	3,978	3,793	4.9*	3,482	14.3*
North Dakota	2,093	2,070	1.1*	1,714	22.1*
Ohio	6,110	5,911	3.4*	4,367	39.9*
Oklahoma	7,512	7,334	2.4*	6,399	17.4*
Pennsylvania	16,416	16,077	2.1*	14,983	9.6*
Texas	22,374	22,037	1.5*	21,206	5.5*
Utah	824	824	-0.1*	894	-7.9*
West Virginia	4,652	4,509	3.2*	4,013	15.9*
Wyoming	4,798	4,861	-1.3*	4,644	3.3*
Federal Offshore Gulf of Mexico	2,659	2,532	5.0*	3,276	-18.8*
Other States	1,345	1,311	2.7*	1,492	-9.8*

U.S. crude oil production reached 10.26 million bbl/d in February 2018, according to EIA's latest Petroleum Supply Monthly.

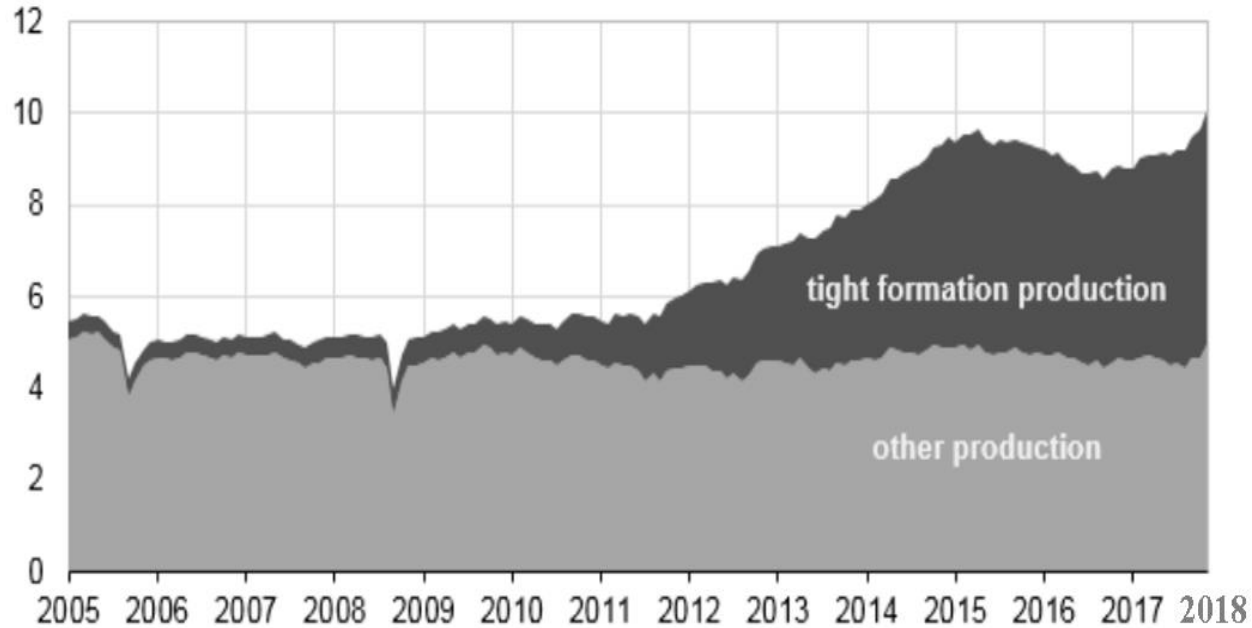


November 2017 production, as of 10,099, is the first time since 1970 that monthly U.S. production levels surpassed the November 1970 production as of 10.044 million bbl/d.

# U.S. crude oil production has increased significantly over the past decade, driven mainly by production from tight rock formations

## U.S. crude oil production (Jan 2005 – Feb 2018)

million barrels per day

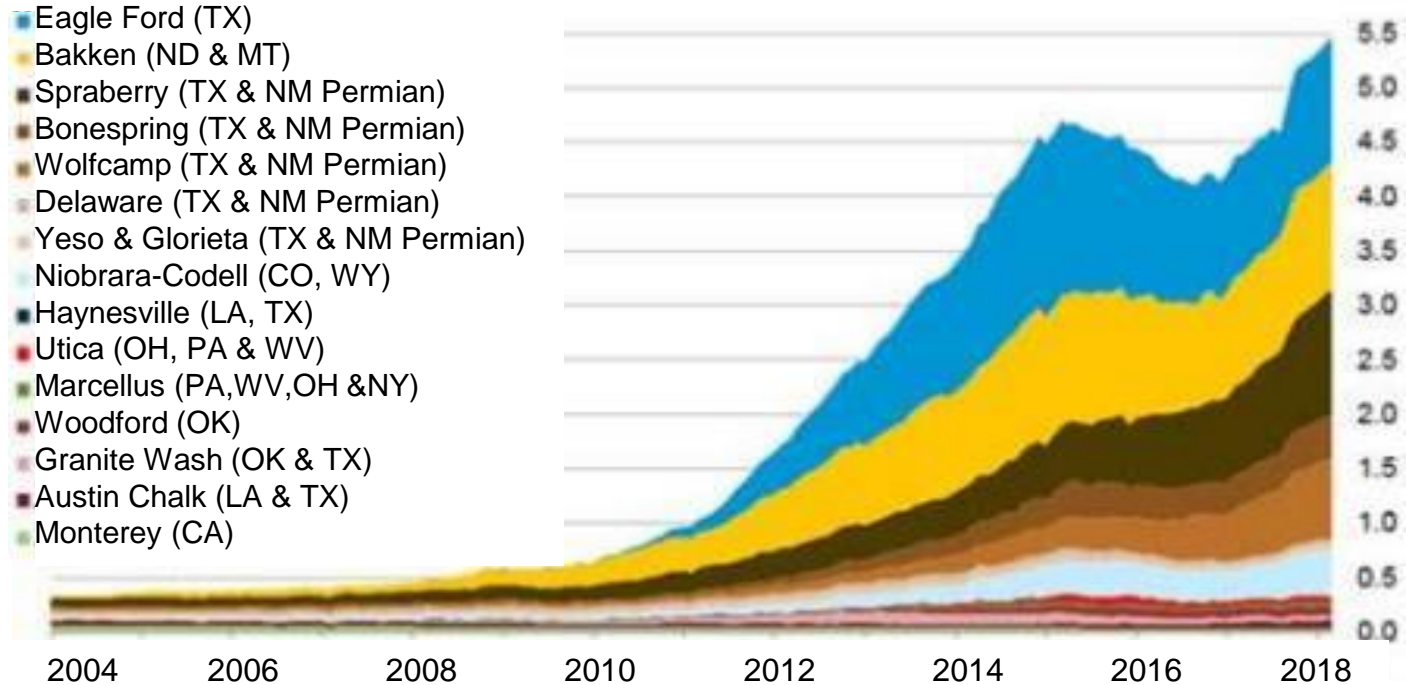


EIA estimates crude oil production from tight formations in February 2018 reached about 5.4 million bbl/d.

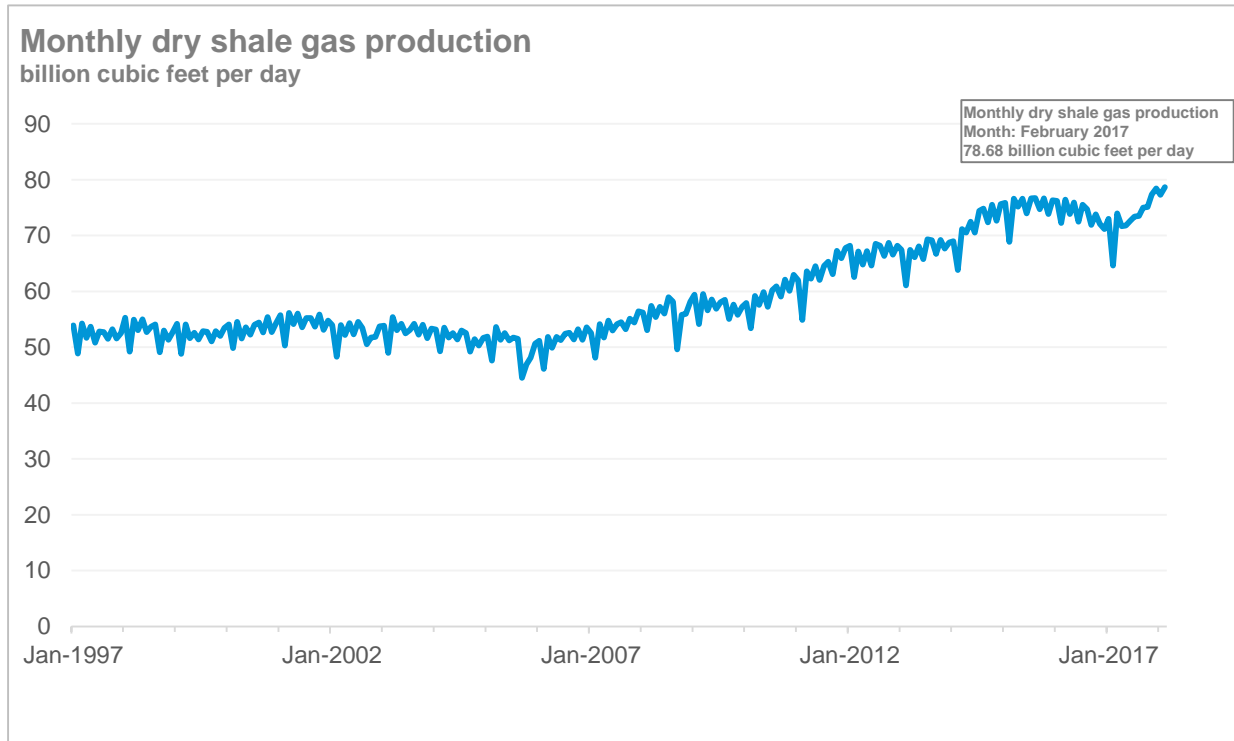
# Production from tight formations accounts for 52% of total U.S. crude oil production in February 2018

## Monthly tight oil production –selected plays

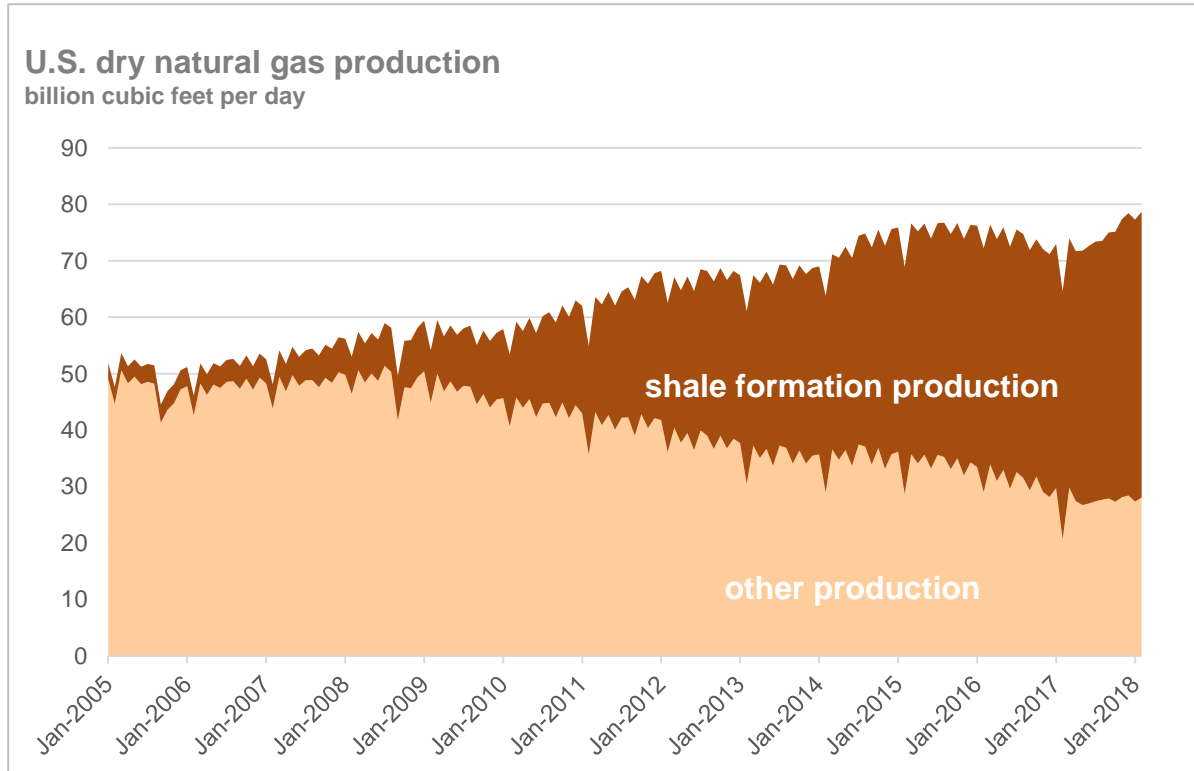
Million barrels per day



U.S. natural gas production reached about 79 billion cf/d in February 2018, according to EIA's latest Natural Gas Monthly.



# U.S. natural gas production has increased significantly over the past decade, driven mainly by production from shale formations

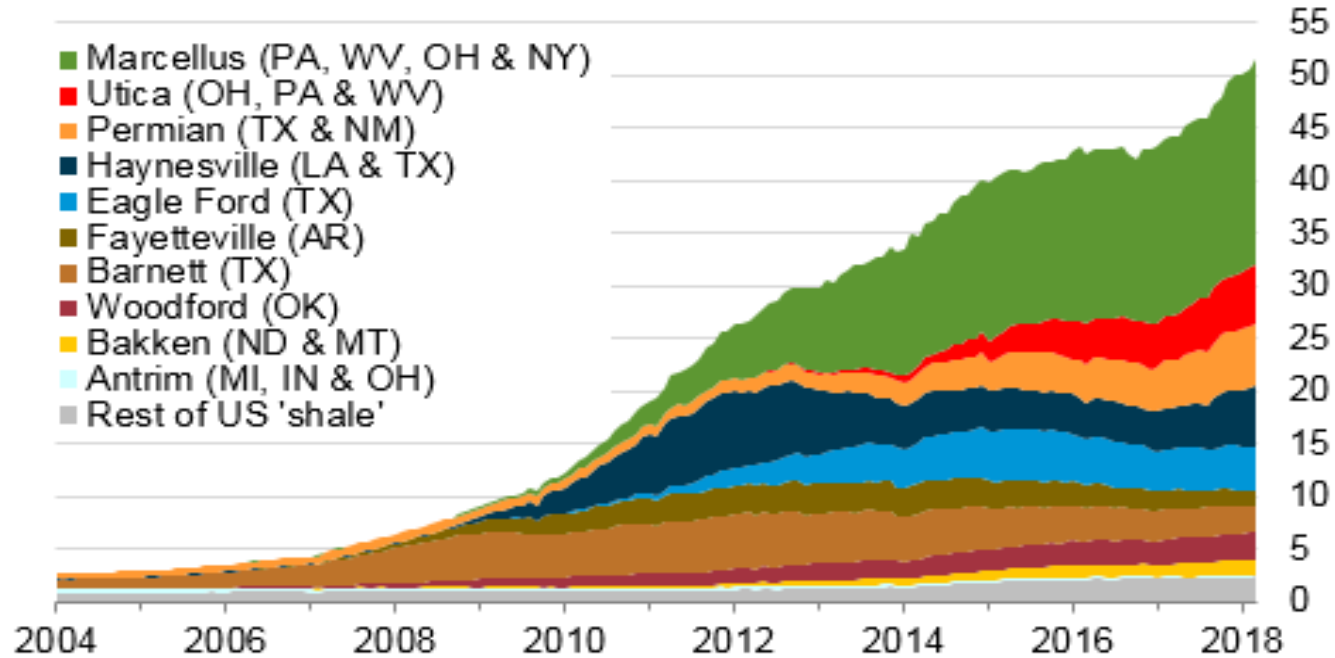


EIA estimates natural gas production from shale formations in February 2018 reached about 50.6 Bcf/d

# Production from shale formations accounted for 64% of total U.S. natural gas production in February 2018

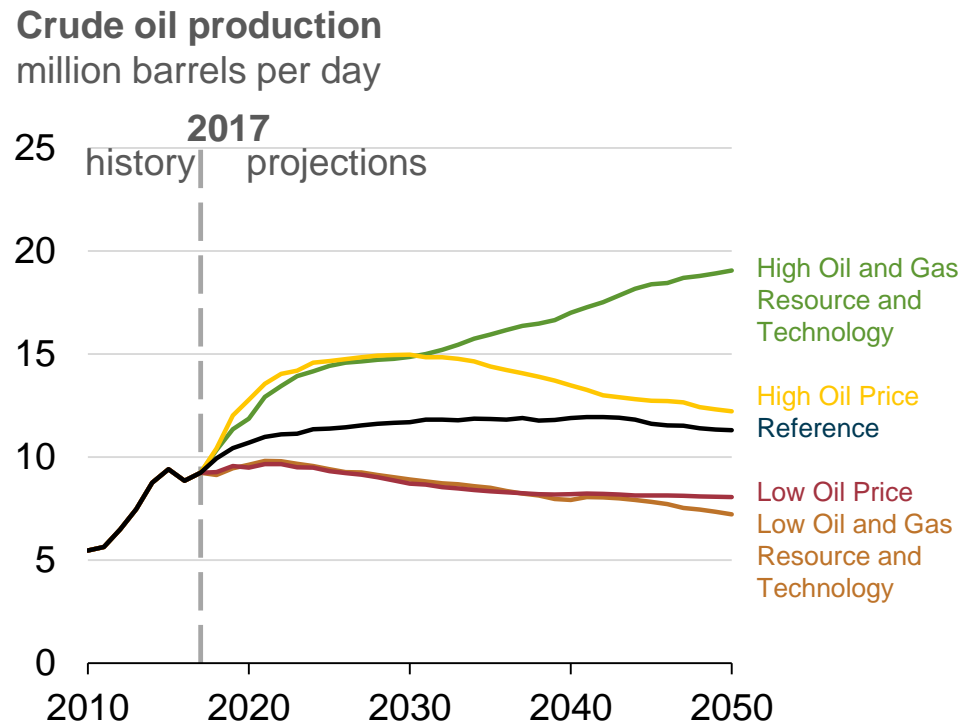
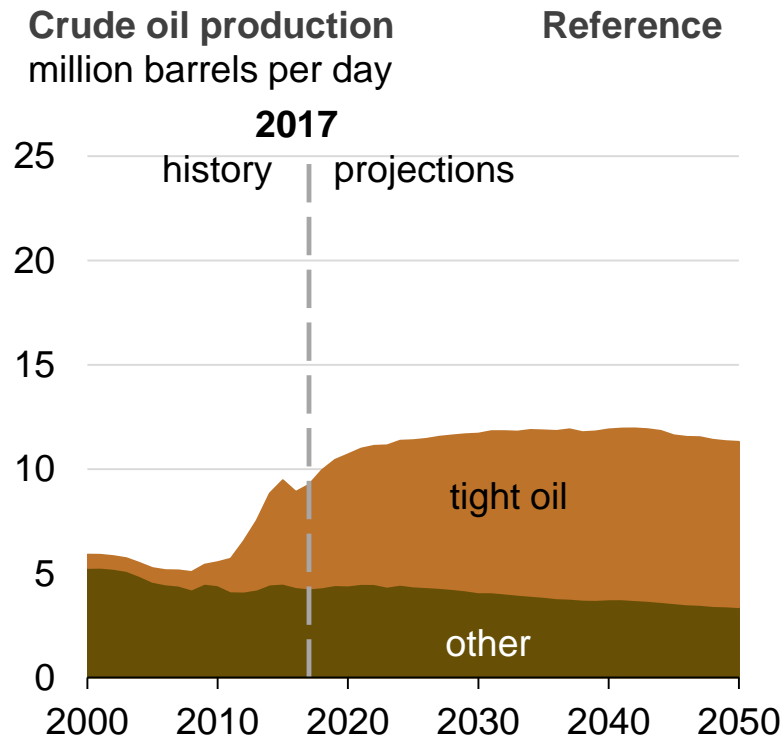
## Monthly dry shale gas production

billion cubic feet per day





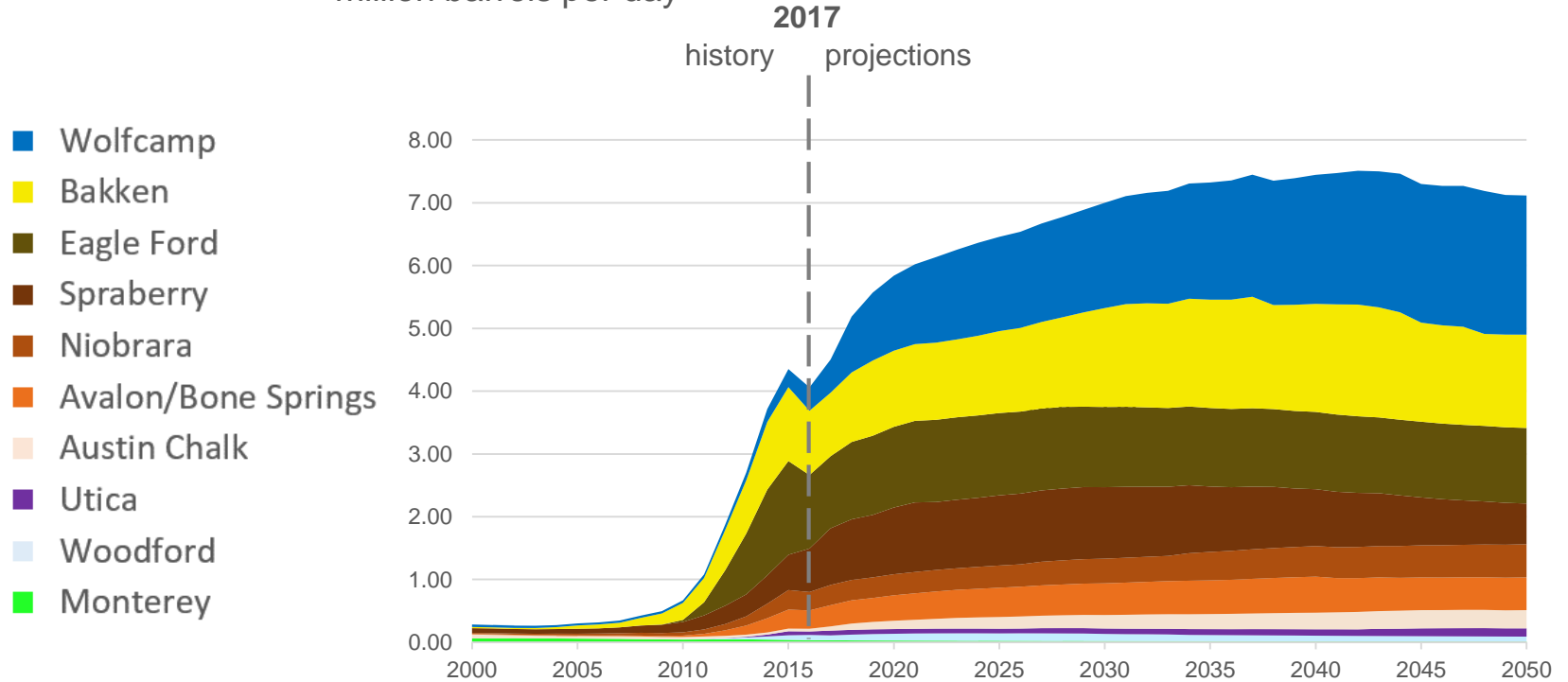
# According to Annual Energy Outlook (AEO) 2018 tight oil production remains the leading source of U.S. crude oil production from 2017 to 2050 in the Reference case -



- a result that is consistent across all side cases

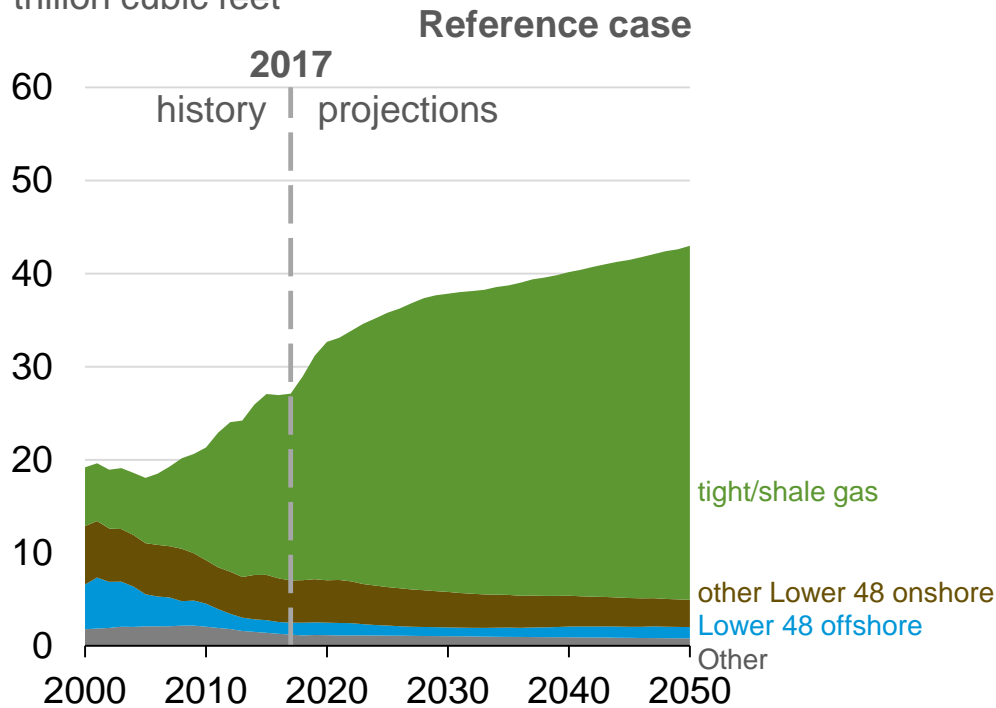
**Crude oil production**  
million barrels per day

**Reference case**



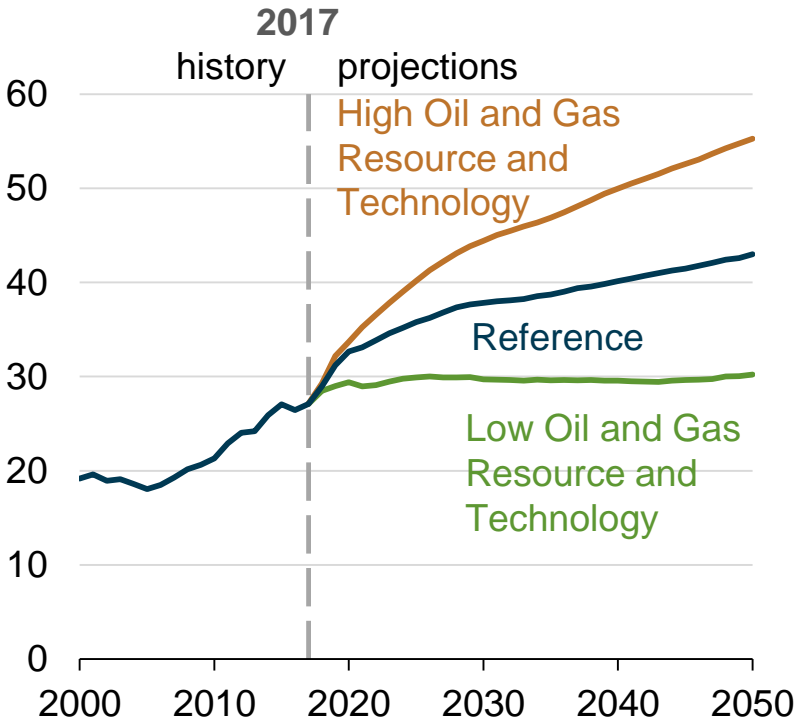
# Increased U.S. natural gas production is the result of continued development of shale gas and tight oil plays -

**Dry natural gas production by type**  
trillion cubic feet



Note: Other includes Alaska and coalbed methane

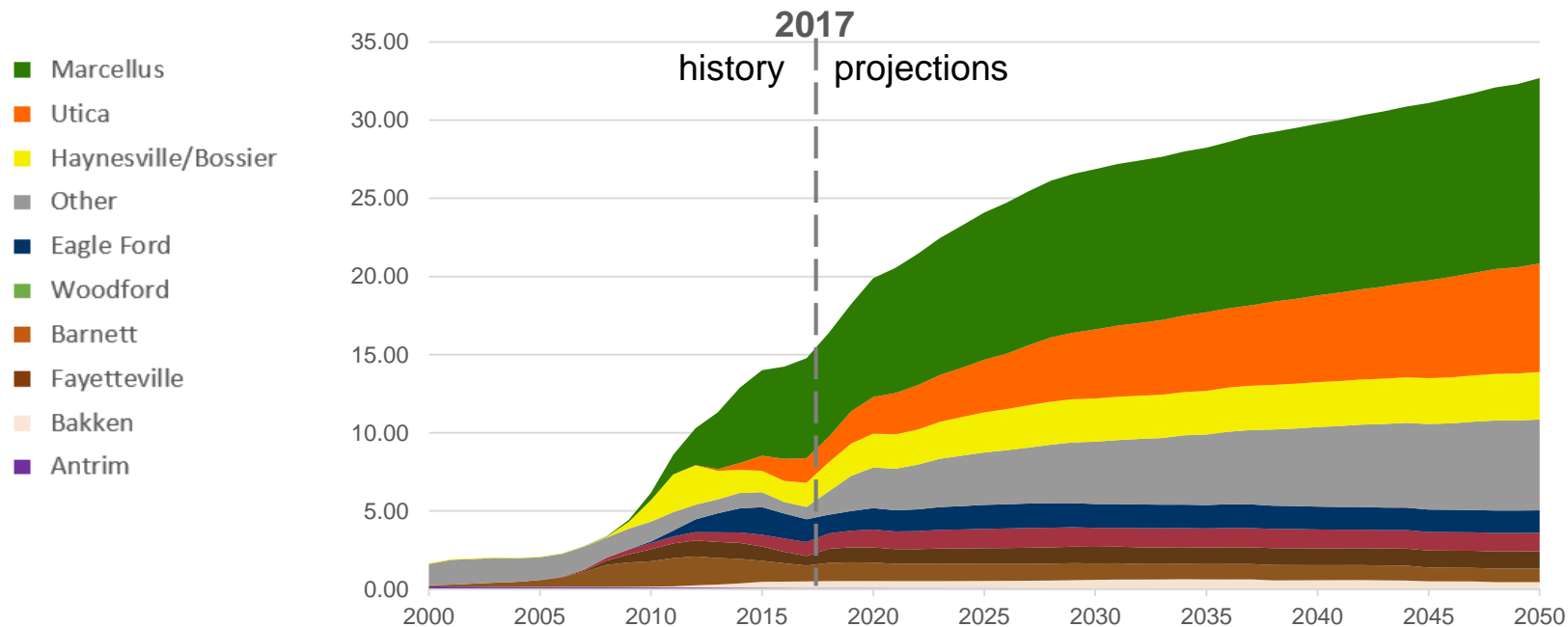
**Dry natural gas production**  
trillion cubic feet



- which account for more than three-quarters of natural gas production by 2050

Reference case

Dry natural gas production  
trillion cubic feet



# EIA's online publications

Drilling Productivity Report <https://www.eia.gov/petroleum/drilling/?src=home-b1>

Monthly Crude Oil, Lease Condensate, and Natural Gas Production Report  
<https://www.eia.gov/petroleum/production/>

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 <https://www.eia.gov/totalenergy/data/monthly/>

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

We thank our EIA's colleagues Jack Perrin, Jozef Lieskovsky, Dr. Margaret Coleman, Aloulou Faouzi, John Staub, Dr. Terry Yen, Danya Murali, Troy Cook, Dana Van-Wagener, Kenneth Platto, Jim O'Sullivan, Christopher Peterson, Barbara Marine-Volpe, Rob Merriam, Debra Coaxum, Shirley Neff, and Tom Leckey for their suggestions and expert opinion.

The authors also thank State Agencies for collaboration: Kristin Carter of PA Bureau of Topographic & Geologic Survey; Susan Pool, Phillip Dinterman, Mary Behling, Jessica Moore and Eric Lewis of WV Geological & Economic Survey; Ron Riley, and Dr. Mohammad Fakhari of OH State Geological Survey; James Leone of NY State Geological Survey, and Dr. Scott Tinker Dr. Svetlana Ikonnikova of the BEG, TX.

# Thank you!



ACE 101: Bridging Fundamentals and Innovation