AEO2018 Review & AEO2019 Plans

For

AEO2019 Oil and Gas Supply & Liquid Fuels Markets Working Group

May 30, 2018 | Washington, D.C.

By

James Preciado, Liquid Fuels Markets Team

Dana Van Wagener, Exploration and Production Team

Liquid Fuels Markets

Outline

- Brief background of the Liquid Fuels Market Module (LFMM) and International Energy Module (IEM)
- Evaluation and discussion of results from AEO2018
- Improvements for AEO2019

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Background on Liquid Fuels Market Module (LFMM) and International Energy Module (IEM)

- LFMM is a linear program that projects petroleum product prices and sources of liquid fuels supply for meeting petroleum product demand. The sources of supply include crude oil refined into petroleum products, imports of petroleum products, and non-petroleum liquids such as biofuels, coal-to-liquids, and gas-to-liquids.

- IEM is an economic model that simulates the interaction between U.S. and global petroleum markets. It uses assumptions of economic growth and expectations of future world crude oil and liquids production and consumption to compute Brent crude oil prices, provides a supply curve of world crude like liquids, and generates a worldwide oil supply/demand balance with regional detail.

Outline

- Brief background of the Liquid Fuels Market Module (LFMM) and International Energy Module (IEM)
- Evaluation and discussion of results from AEO2018
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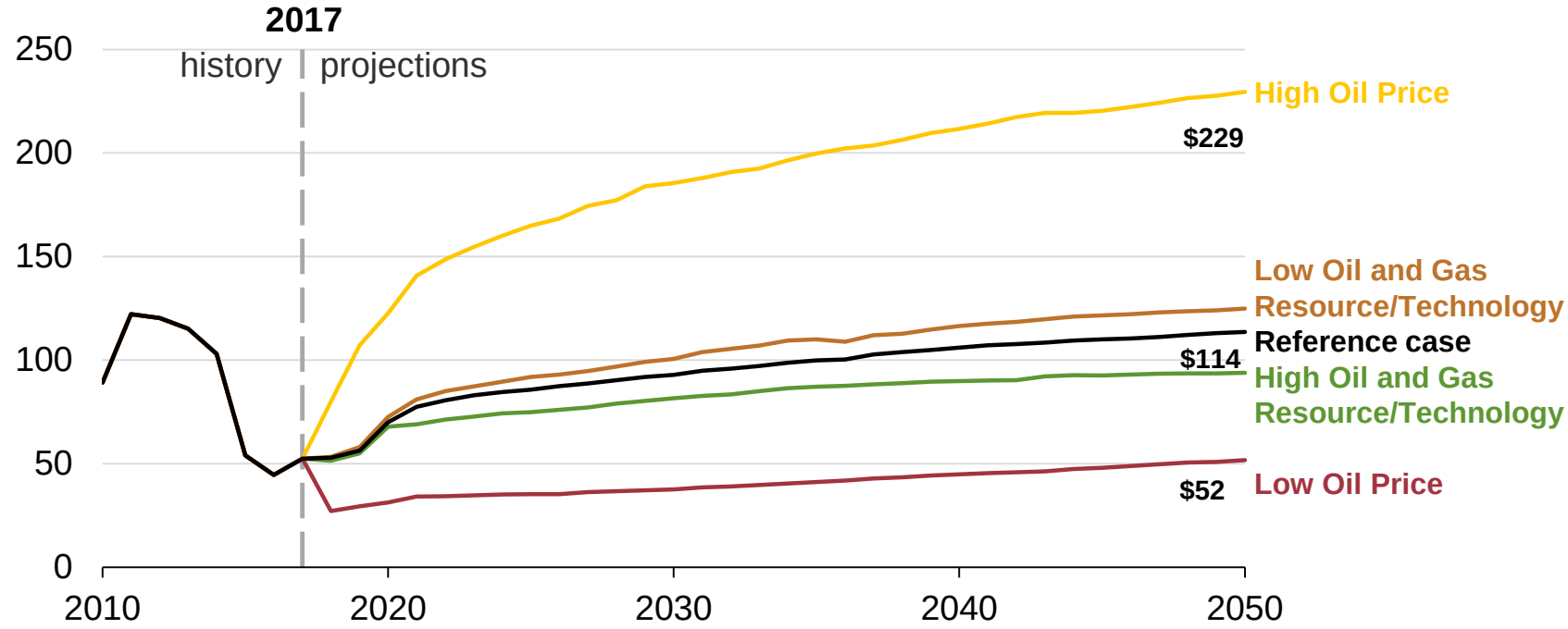
Oil prices continue to rise in the reference case projection

North Sea Brent oil price
2017 dollars per barrel

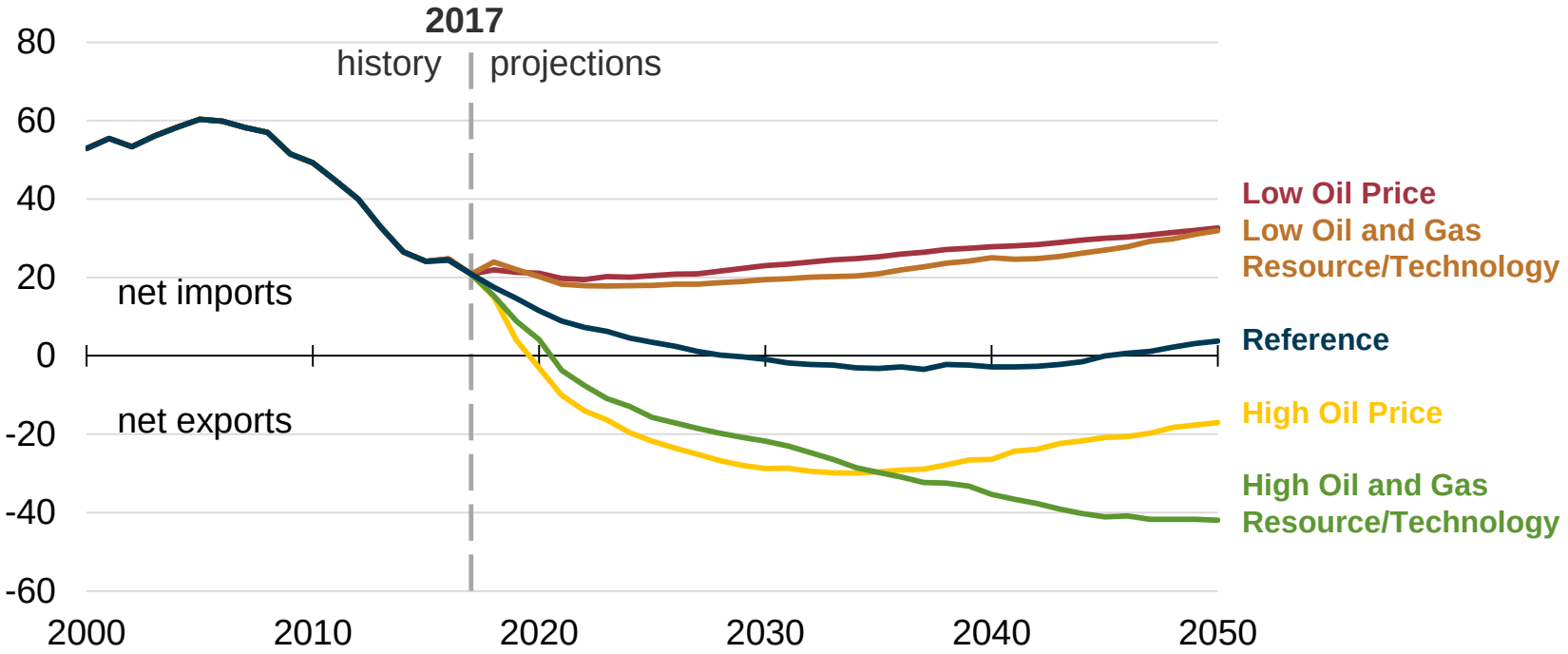


Source: U.S. Energy Information Administration, Annual Energy Outlook 2018

The United States becomes a net exporter of crude oil, petroleum products, and natural gas liquids in 2029

Petroleum net imports as a percentage of product supplied

Percent

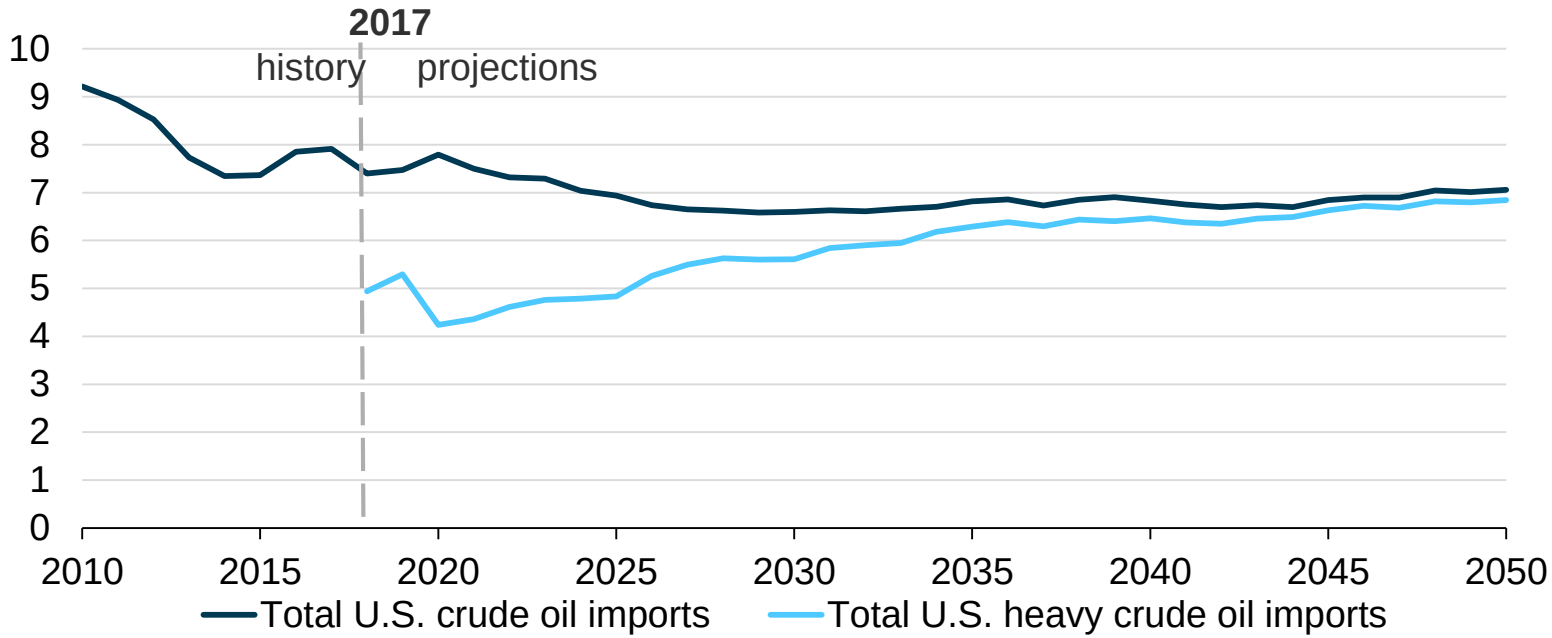


Source: U.S. Energy Information Administration, Annual Energy Outlook 2018

While total crude oil imports decline in the reference case, imports of heavy crude oil increase to balance the crude slate

Crude oil imports

Millions of barrels per day

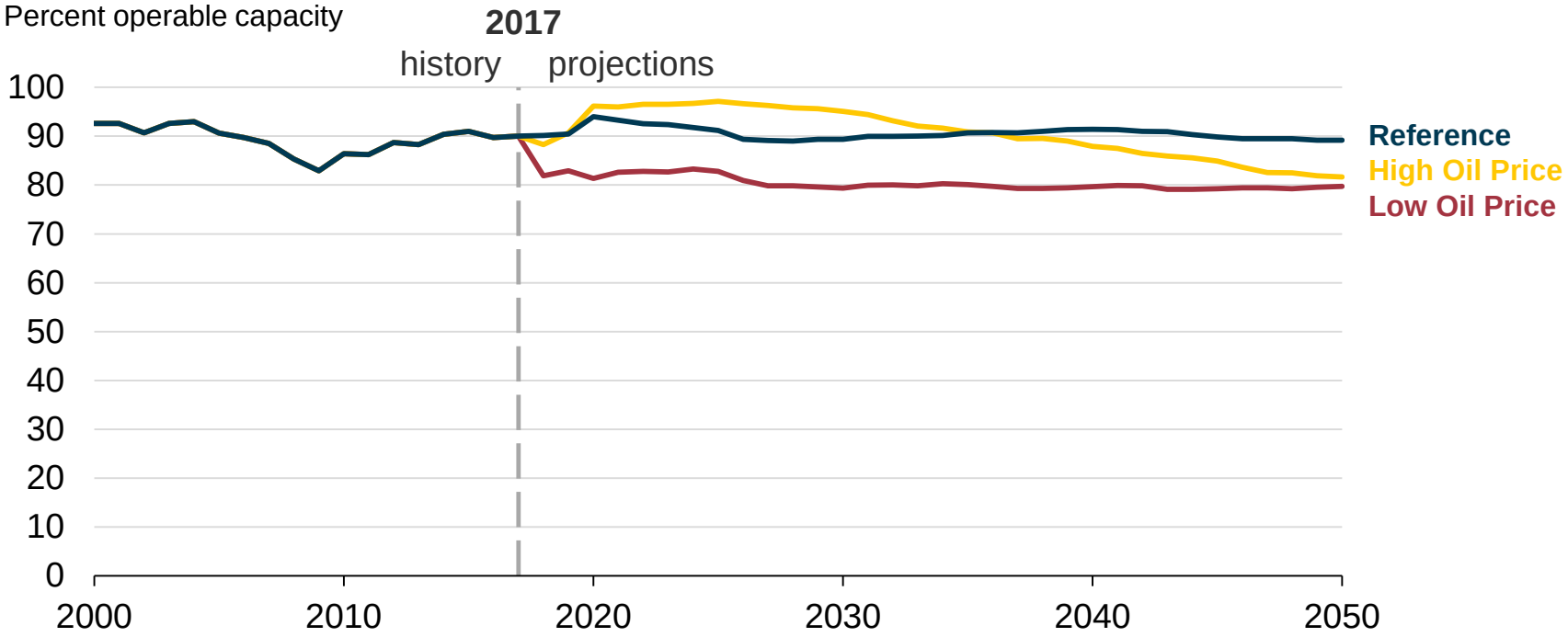


Source: U.S. Energy Information Administration, Annual Energy Outlook 2018 Reference case

Refinery utilization rises in 2020 in reaction to increased international demand for diesel, but returns to historical levels

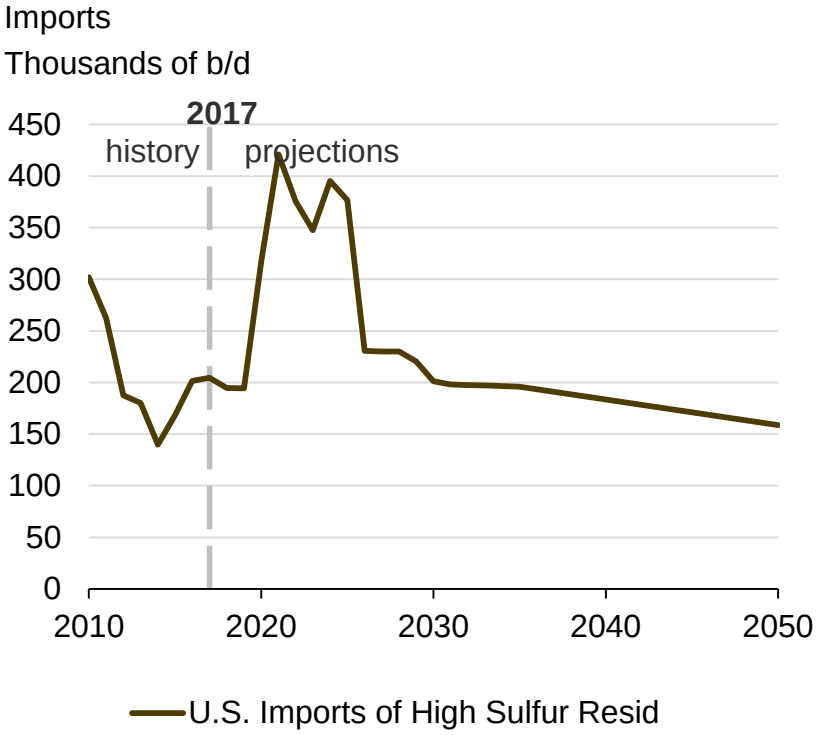
U.S. refinery utilization

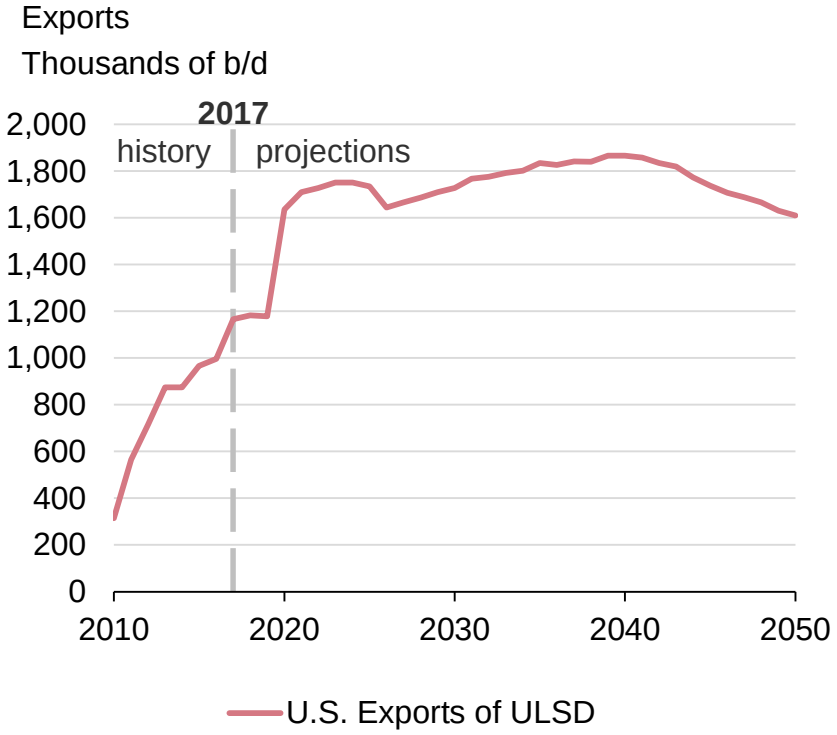
Percent operable capacity



Source: U.S. Energy Information Administration, Annual Energy Outlook 2018

Volumes of imports and exports of petroleum products shift as a result of the 2020 IMO regulation on sulfur content of marine fuel





Source: U.S. Energy Information Administration, Annual Energy Outlook 2018 Reference case

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AEO2019 Planned improvements

- Update transportation costs between regions as well as import and exports costs for crude oil and petroleum products
- Assess the ability of the West Coast refineries to process additional volumes of Alaskan crude oil production
- Further analyze the effects of IMO regulations on sulfur content for marine gasoil starting in 2020 on international crude oil and product markets
- Some “under the hood” process improvements for benchmarking to the STEO forecast

Oil and Gas Supply

Outline

- Evaluation and discussion of results from AEO2018
- Review of changes to the short-term outlook
- Current plans for AEO2019

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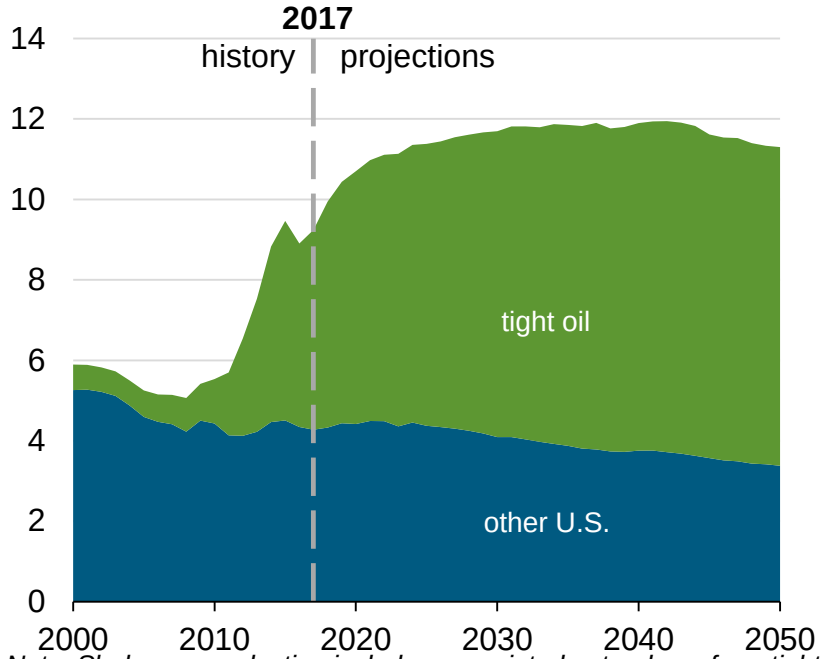
U.S. crude oil and natural gas production continues to be driven by growth in tight oil and shale gas supply

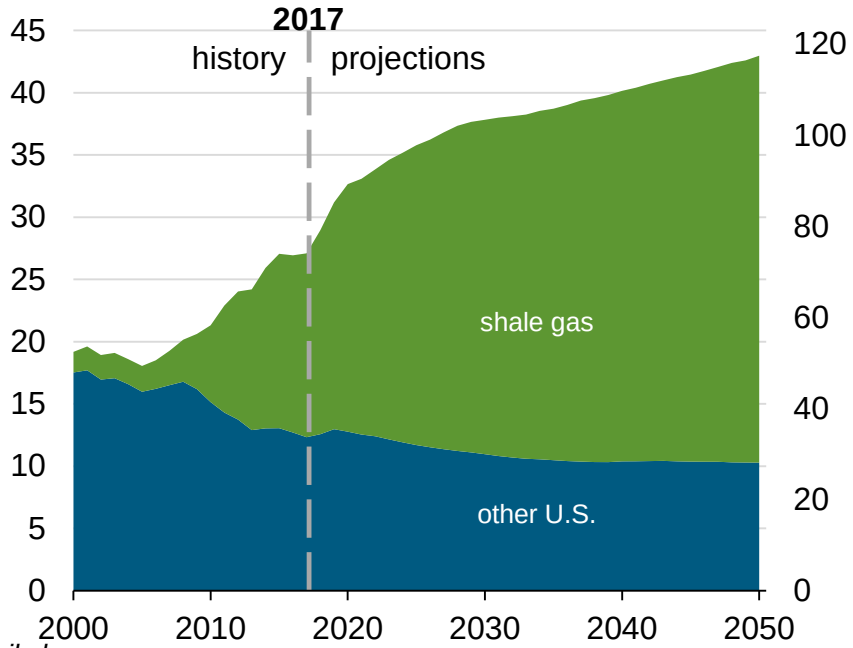
U.S. crude oil production

million barrels per day



U.S. dry natural gas production

trillion cubic feet billion cubic feet per day



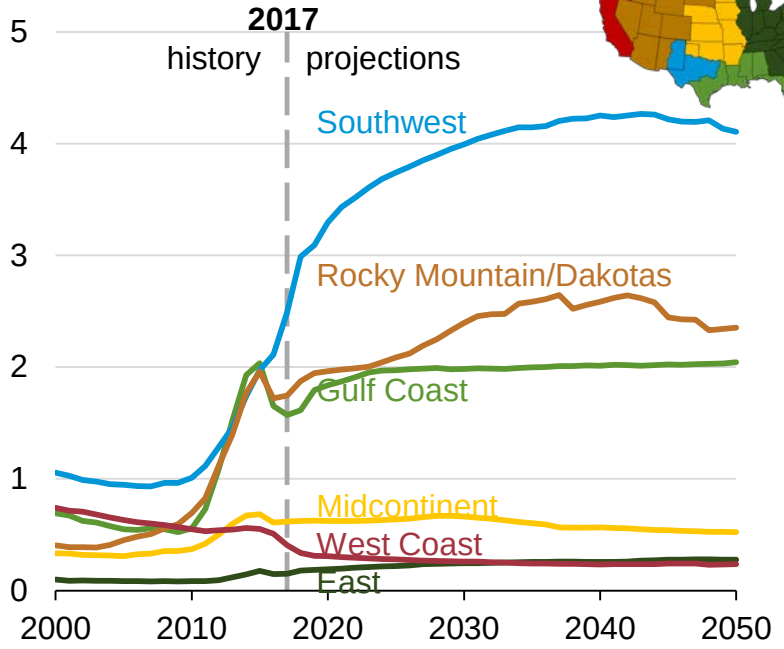
Note: Shale gas production includes associated natural gas from tight oil plays.

Source: U.S. Energy Information Administration, Annual Energy Outlook 2018 Reference case

The Southwest region leads growth in U.S. crude oil production and the East region leads growth in natural gas in the Reference case

Lower 48 onshore crude oil production by region

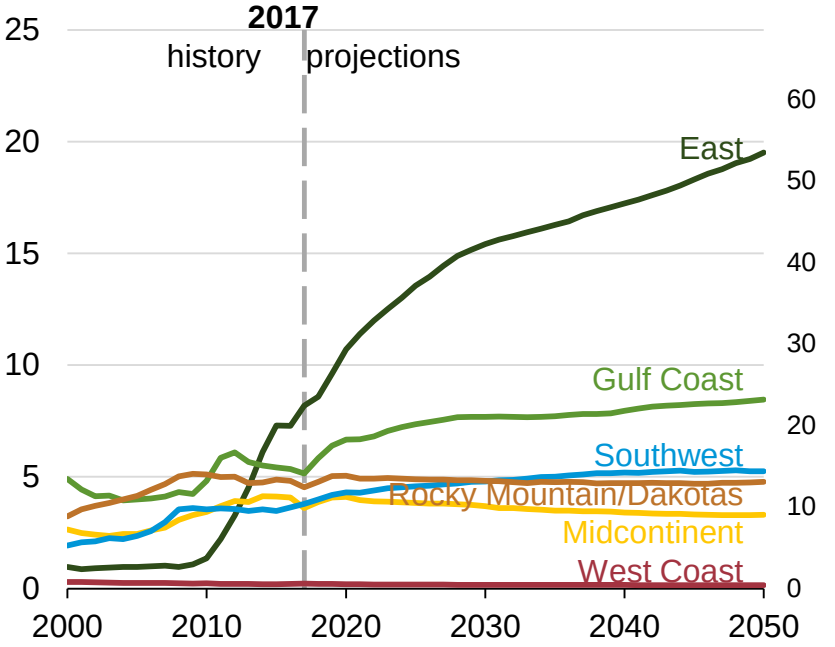
million barrels per day



Lower 48 onshore dry natural gas production by region

trillion cubic feet

billion cubic feet per day

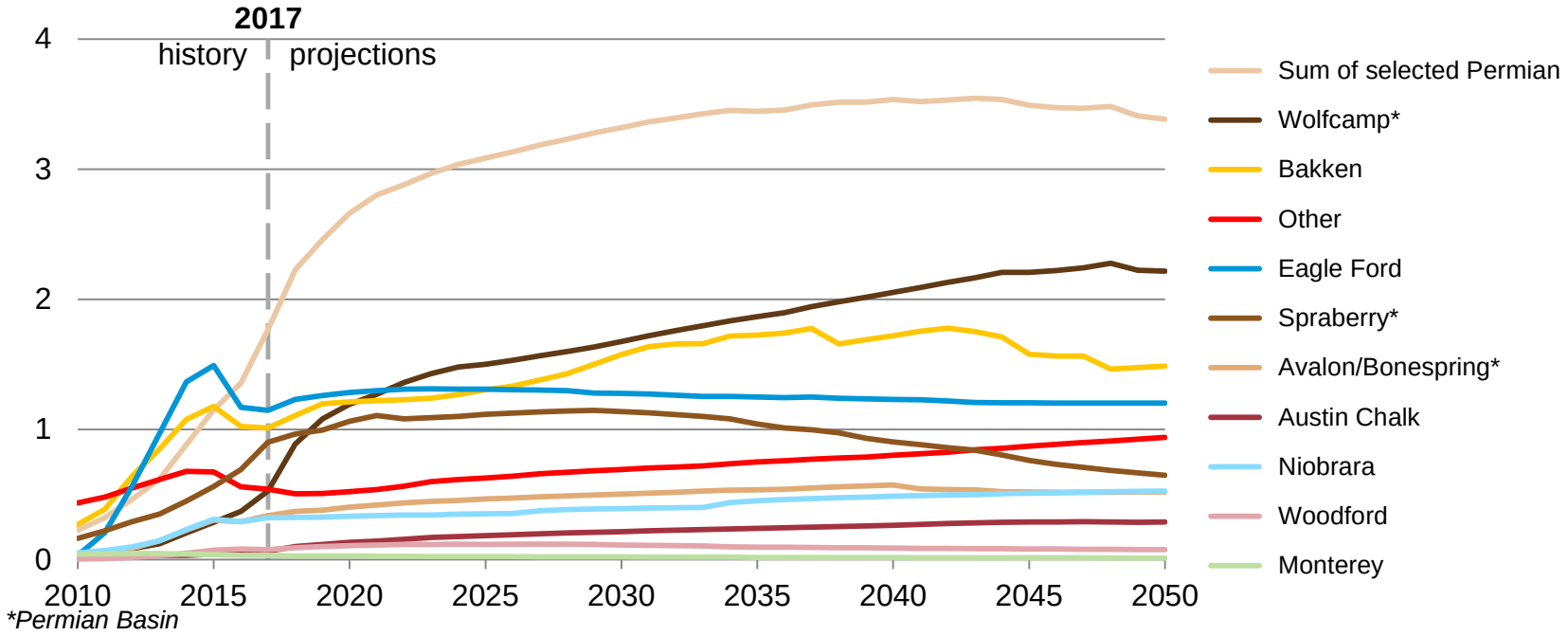


Source: U.S. Energy Information Administration, Annual Energy Outlook 2018 Reference case

Bakken and Wolfcamp lead growth in tight oil production

U.S. tight oil production

million barrels per day



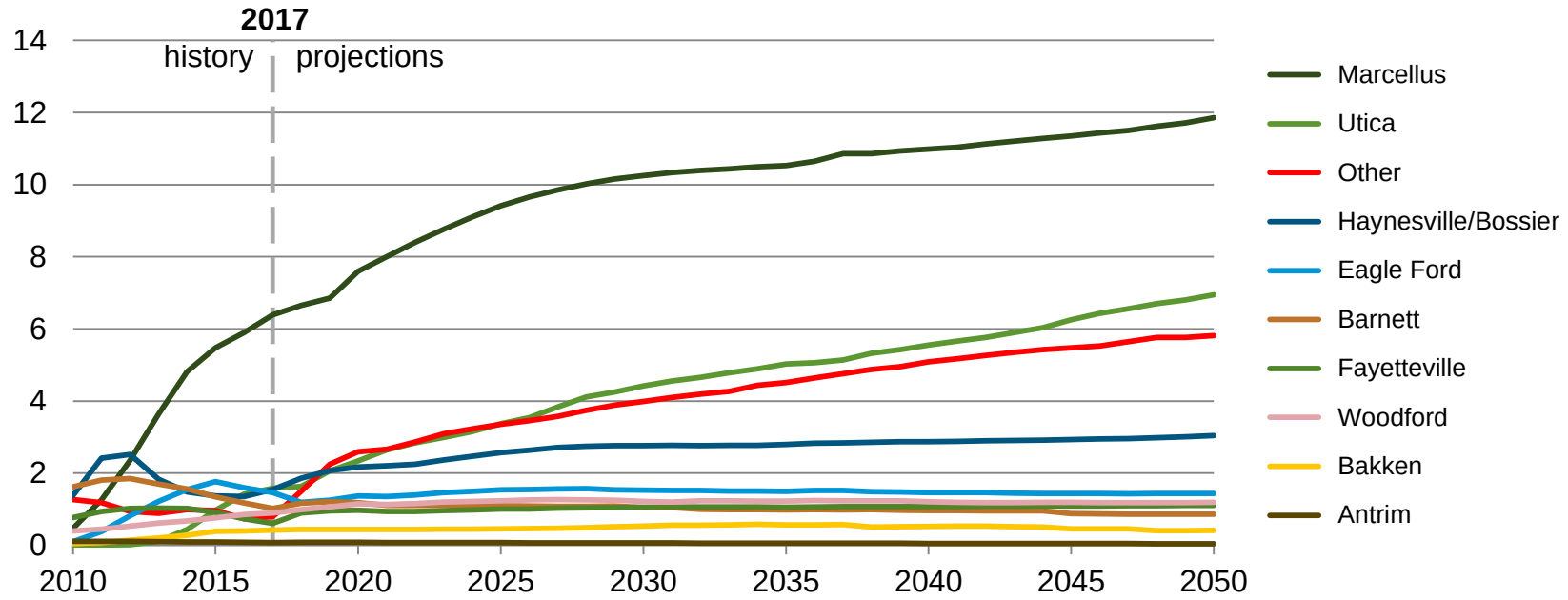
*Permian Basin

Source: U.S. Energy Information Administration, Annual Energy Outlook 2018 Reference case

Marcellus and Utica lead production of shale gas

U.S. dry shale gas production

trillion cubic feet



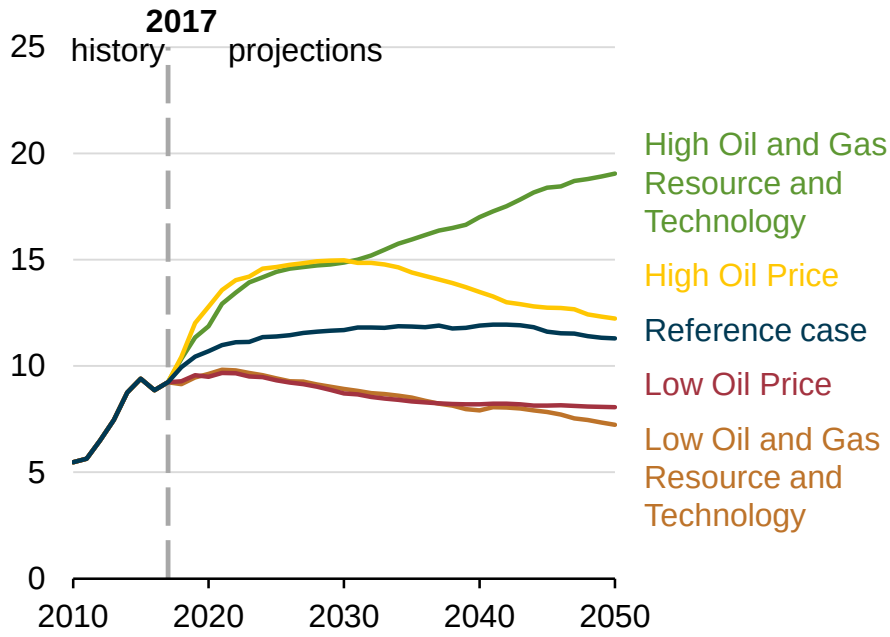
Note: Other includes natural gas production in tight oil plays.

Source: U.S. Energy Information Administration, Annual Energy Outlook 2018 Reference case

U.S. crude oil and natural gas production are sensitive to resource availability and technological improvements

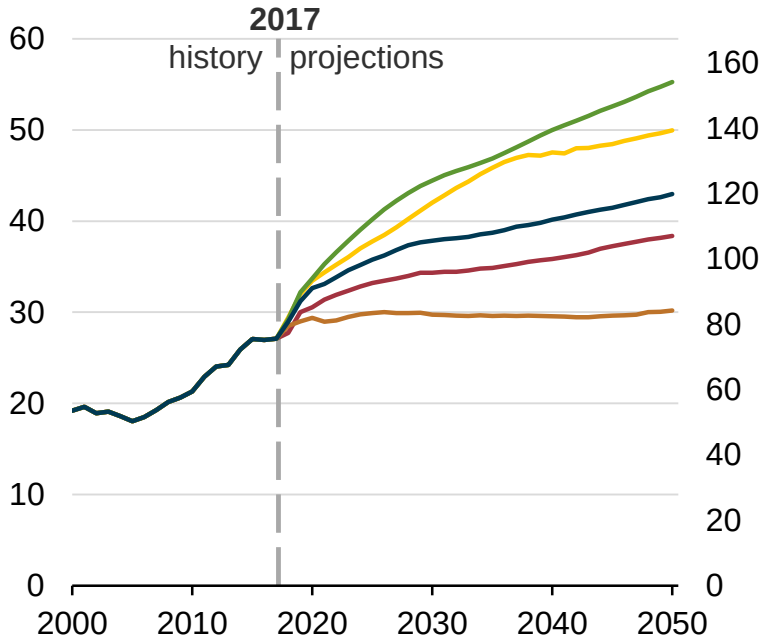
U.S. crude oil production

million barrels per day



U.S. dry natural gas production

trillion cubic feet per year billion cubic feet per day

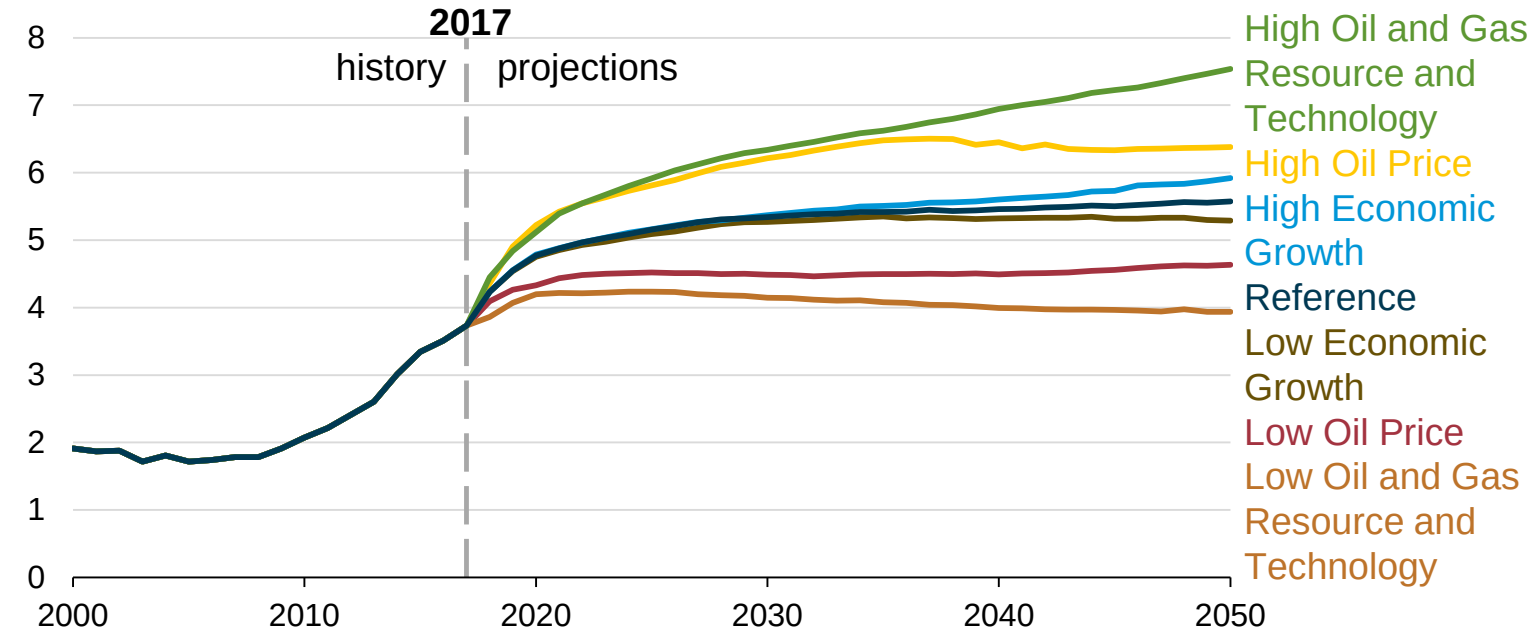


Source: U.S. Energy Information Administration, Annual Energy Outlook 2018

Natural gas plant liquids production increases from 2017 levels in all AEO2018 cases

U.S. natural gas plant liquids production

million barrels per day

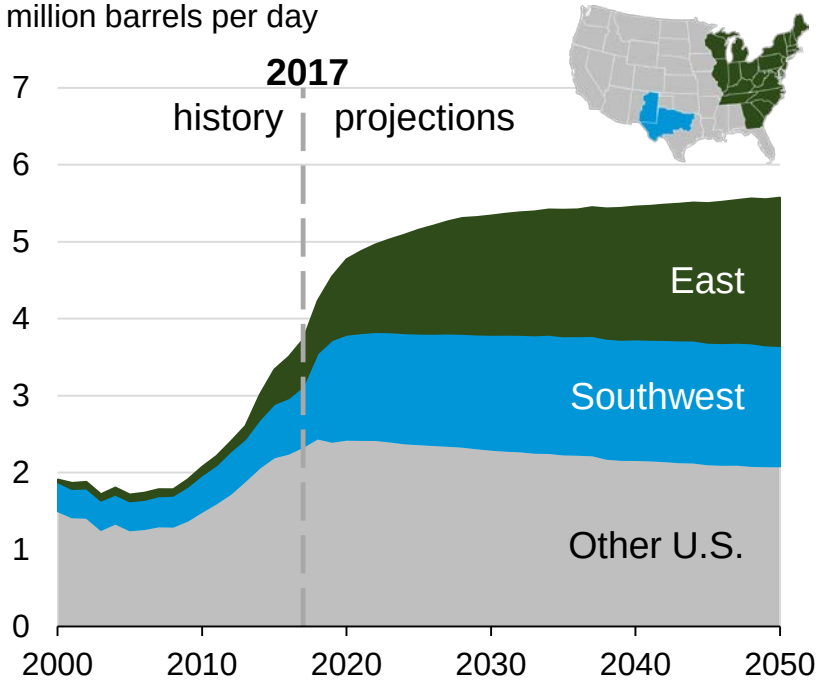


Source: U.S. Energy Information Administration, Annual Energy Outlook 2018

The East and Southwest regions lead the production of natural gas plant liquids in the Reference case

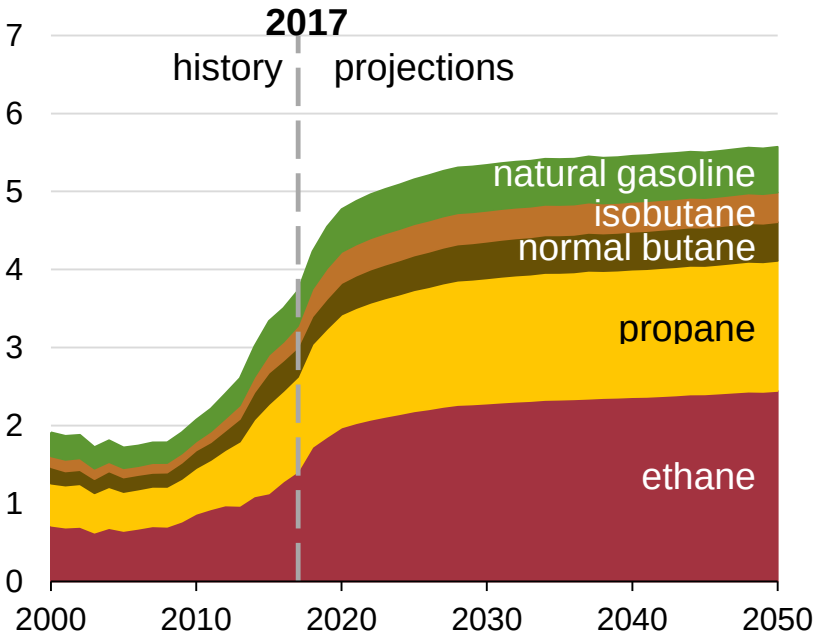
U.S. natural gas plant liquids production by region

million barrels per day



U.S. natural gas plant liquids production by fuel

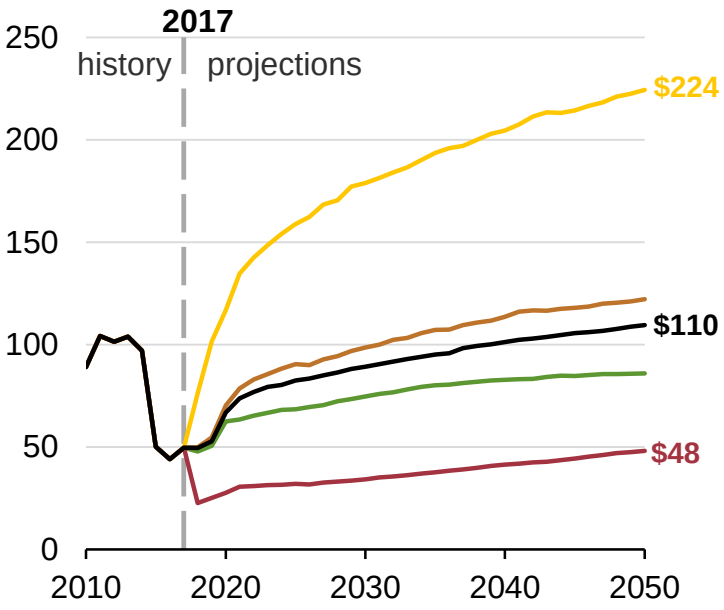
million barrels per day



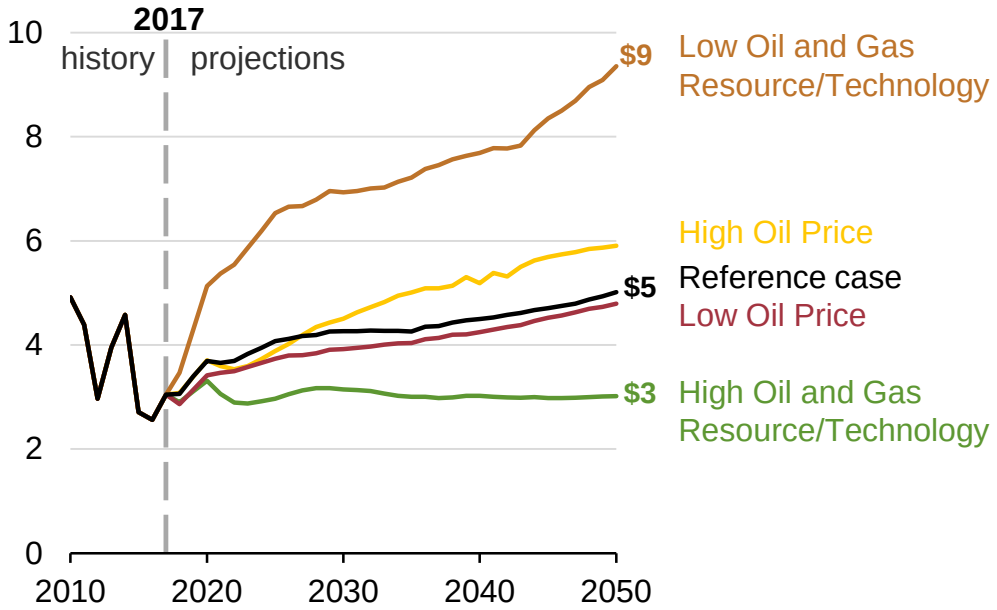
Source: U.S. Energy Information Administration, Annual Energy Outlook 2018

Crude oil price projections are sensitive to global conditions, while U.S. natural gas prices depend more on domestic resource assumptions

West Texas Intermediate oil price
2017 dollars per barrel



Henry Hub natural gas price
2017 dollars per million Btu



Source: U.S. Energy Information Administration, Annual Energy Outlook 2018

Key oil and natural gas supply assumptions, AEO2018

Technically recoverable resources (as of 1/1/2016)

	Crude oil (billion barrels)	Natural gas (trillion cubic feet)
Lower 48 onshore	194.1	1,907.1
East	4.6	707.1
Gulf Coast	37.8	423.9
Midcontinent	16.5	189.2
Southwest	80.9	238.7
Rocky Mountain/Dakotas	47.6	312.4
West Coast	6.6	35.8
Lower 48 offshore	54.4	279.6
Atlantic	3.3	31.7
Gulf of Mexico	44.6	238.3
Pacific	6.5	9.6
Alaska	36.1	275.6
Total U.S.	**284.6**	**2,462.3**

Annual average rate of technological improvement

Resource Type	Drilling Cost	Lease Equipment & Operating Cost	EUR Tier 1	EUR Tier 2	EUR Tier 2 drilling ramp-up period
Tight oil	-1.00%	-0.50%	1.00%	3.00%	6.00%
Tight gas	-1.00%	-0.50%	1.00%	3.00%	6.00%
Shale gas	-1.00%	-0.50%	1.00%	3.00%	6.00%
All other	-0.25%	-0.25%	0.25%	NA	NA

EUR = estimated ultimate recovery

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- Evaluation and discussion of results from AEO2018
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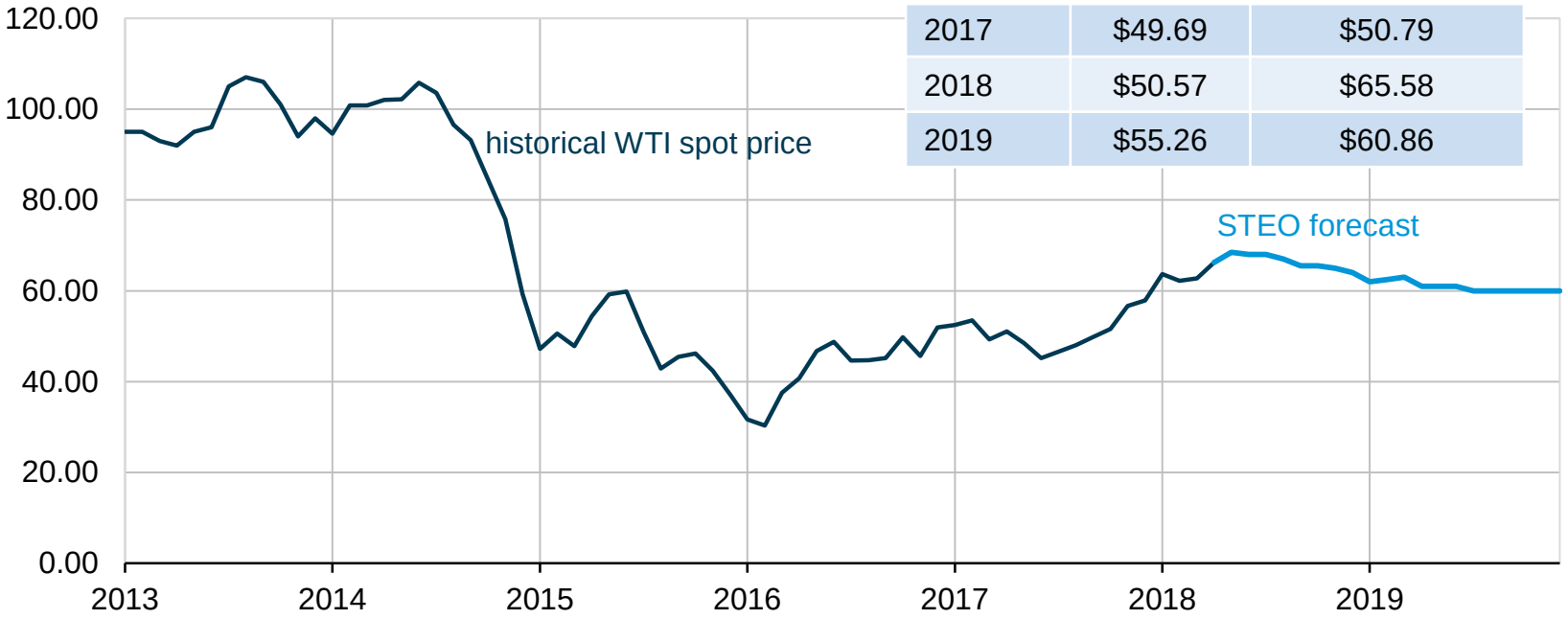
West Texas Intermediate oil prices are forecast to average over $60/barrel in both 2018 & 2019 in the latest Short-Term Energy Outlook

West Texas Intermediate oil price

dollars per barrel

Nominal $/barrel	AEO2018	May 2018 STEO
2017	$49.69	$50.79
2018	$50.57	$65.58
2019	$55.26	$60.86

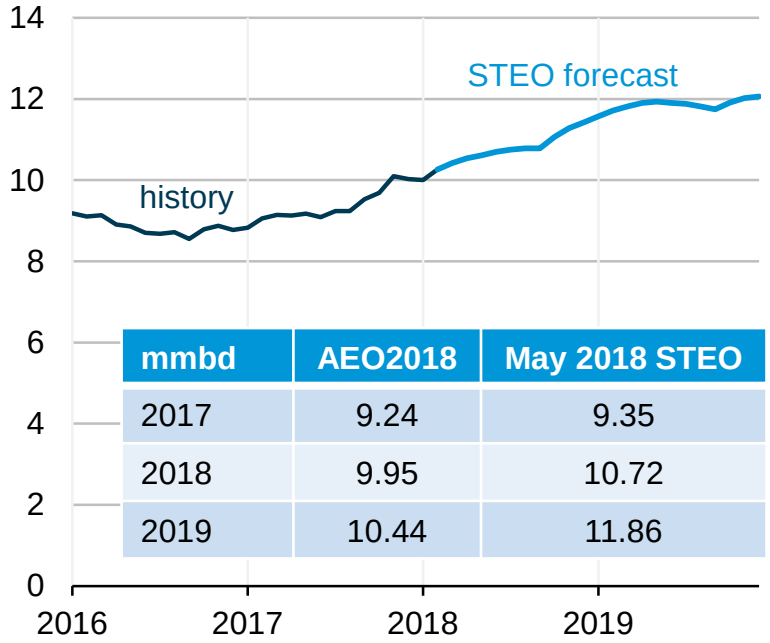


Source: EIA Short-Term Energy Outlook, May 2018

Higher prices drive crude oil production growth higher in the latest Short-Term Energy Outlook than in the AEO2018 Reference case

U.S. crude oil production

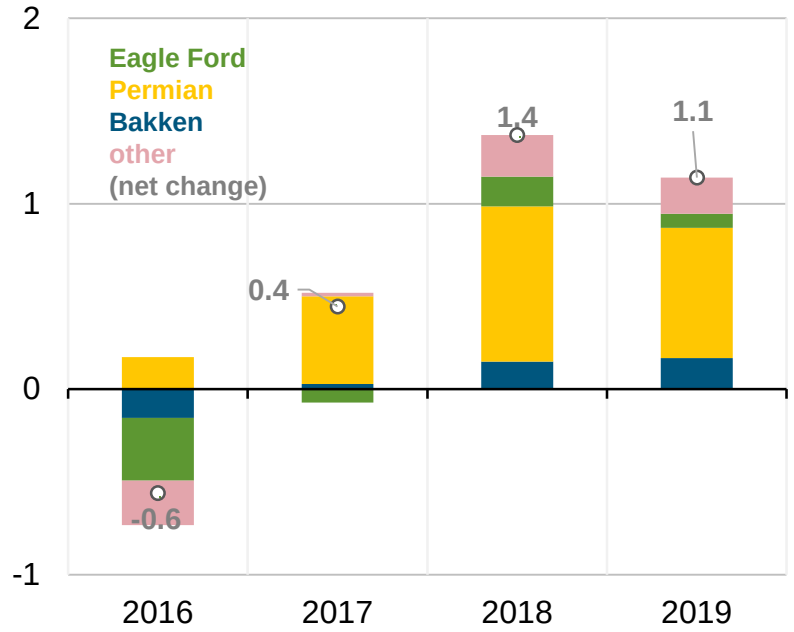
million barrels per day



mmbd	AEO2018	May 2018 STEO
2017	9.24	9.35
2018	9.95	10.72
2019	10.44	11.86

Components of annual change

million barrels per day

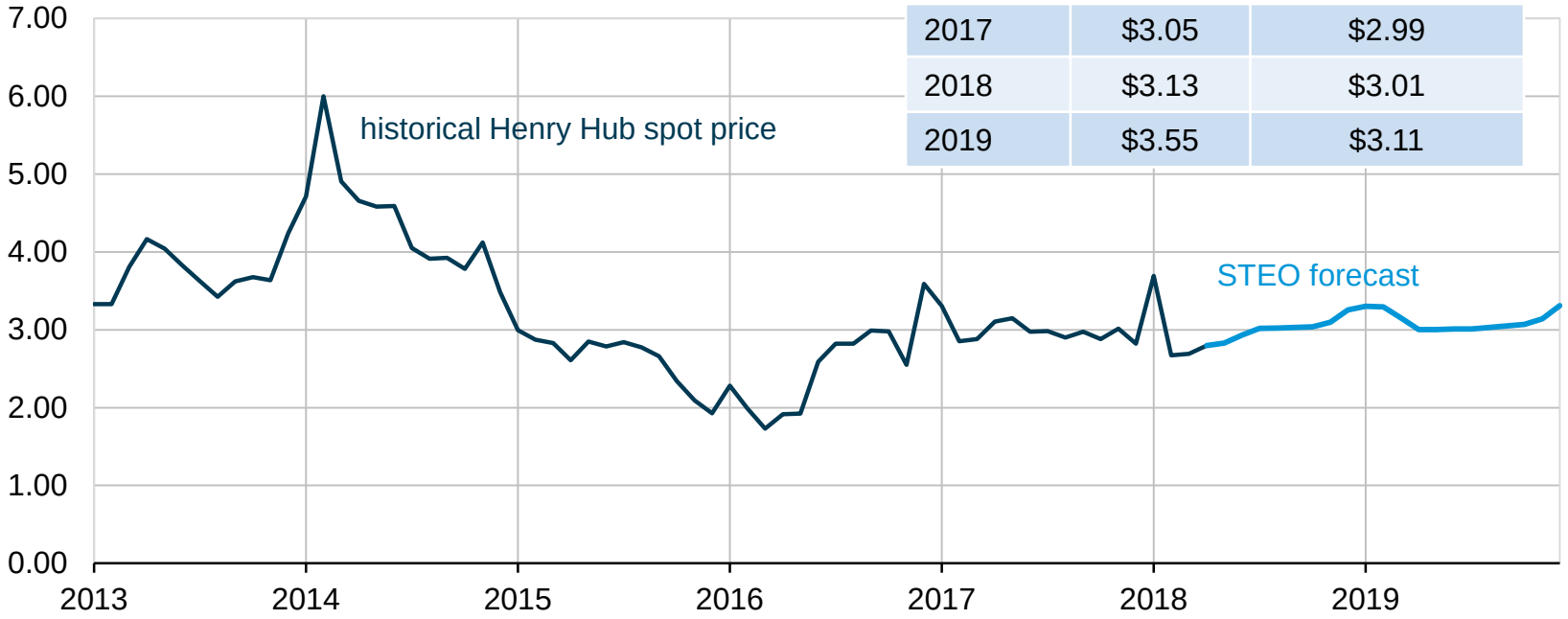


Source: EIA Short-Term Energy Outlook, May 2018

Henry Hub natural gas prices are forecast to average $3.01/MMBtu in 2018 and $3.11/MMBtu in 2019 in the latest Short-Term Energy Outlook

Henry Hub natural gas price

dollars per million British thermal units



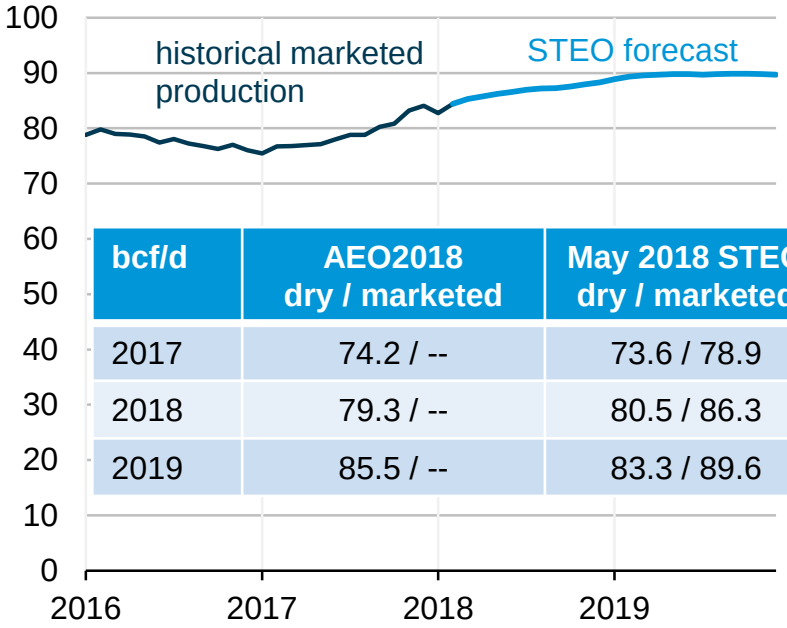
Nominal $/MMBtu	AEO2018	May 2018 STEO
2017	$3.05	$2.99
2018	$3.13	$3.01
2019	$3.55	$3.11

Source: EIA Short-Term Energy Outlook, May 2018, and Thomson Reuters

Marketed natural gas production is projected to grow by a record 7.4 Bcf/d on average in 2018 in the latest Short-Term Energy Outlook

U.S. marketed natural gas production

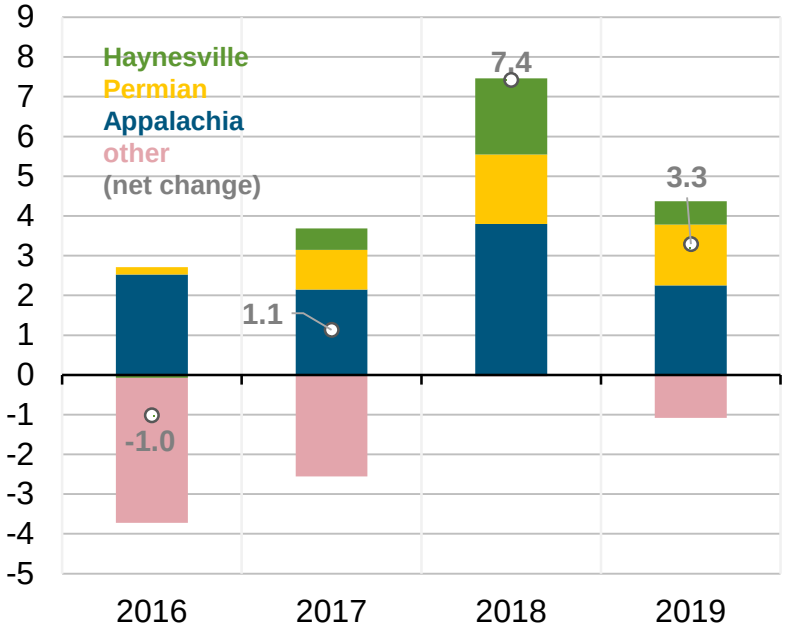
billion cubic feet per day



bcf/d	AEO2018 dry / marketed	May 2018 STEO dry / marketed
2017	74.2 / --	73.6 / 78.9
2018	79.3 / --	80.5 / 86.3
2019	85.5 / --	83.3 / 89.6

Components of annual change

billion cubic feet per day



Source: EIA Short-Term Energy Outlook, May 2018

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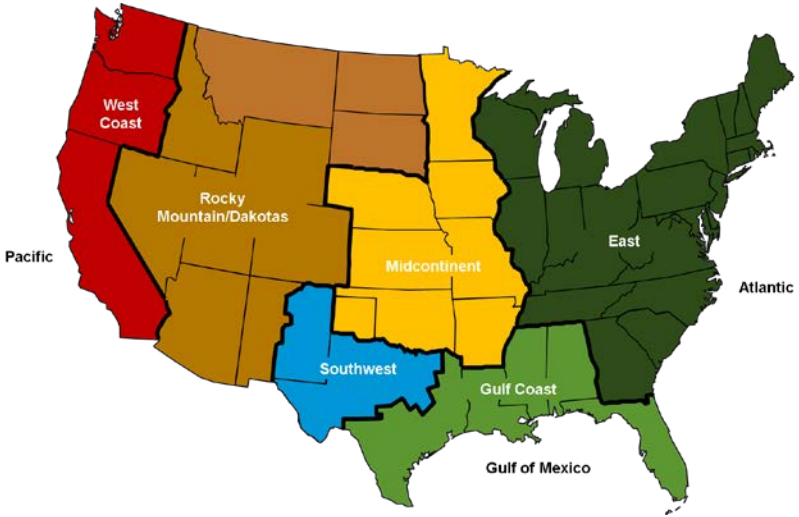
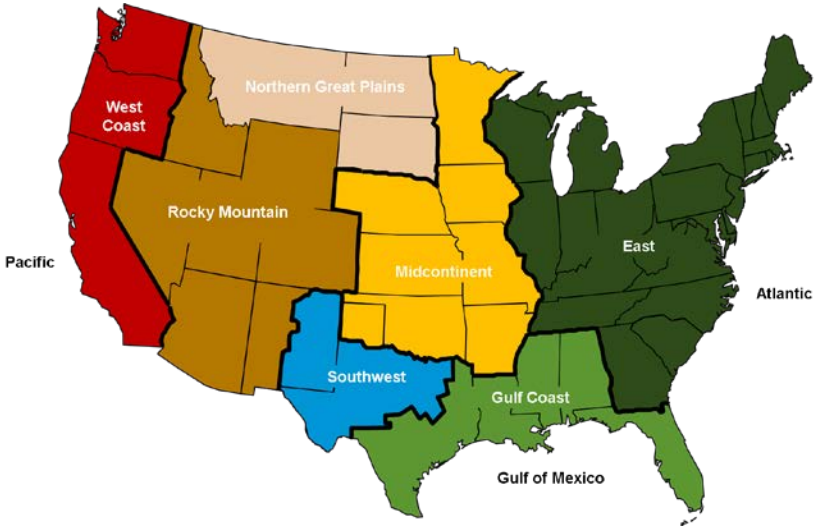
Add Northern Great Plains region to AEO2019 published regional crude oil and natural gas supply tables

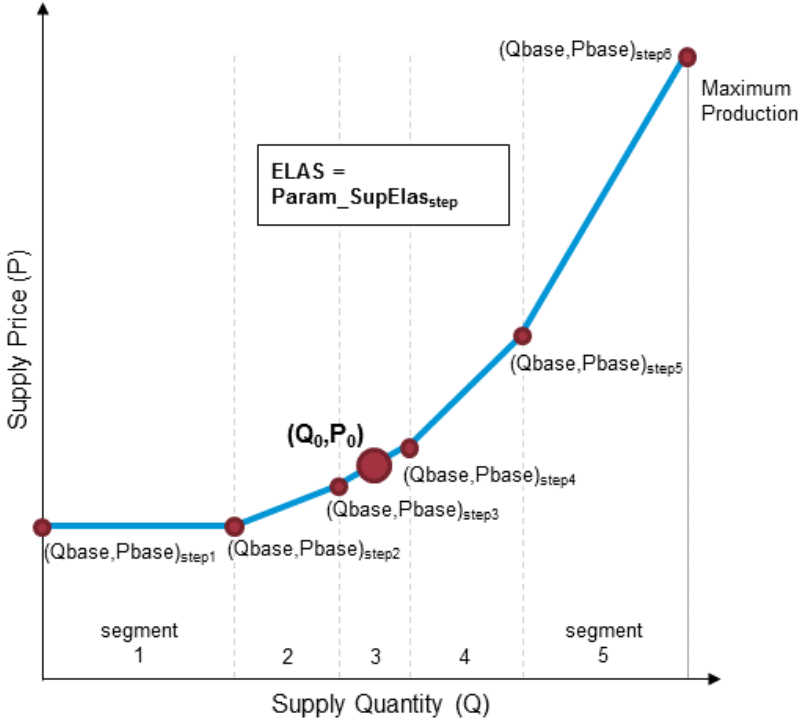
AEO2018 OGSM Lower 48 regions



AEO2019 OGSM Lower 48 regions



Expand short-term supply curve options

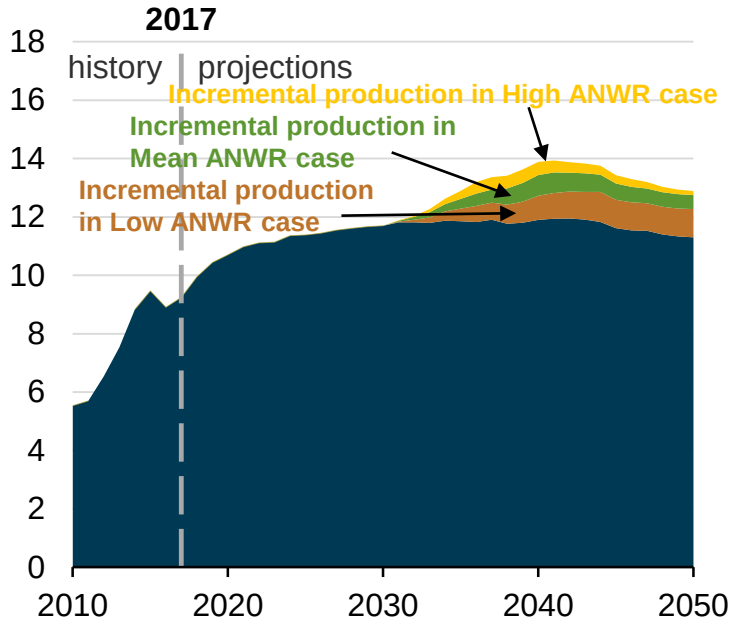


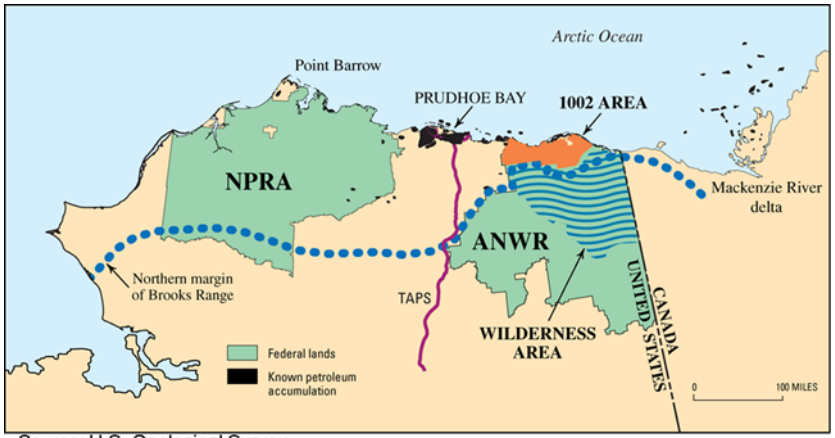
- Currently there is only one form, or set of parameters, to define the short term supply curve for all OGSM districts (84)
- Code already includes optionality for up to 3 different forms of the supply curve, as well as fixed supply
- Allow for different supply elasticities for different types of regions
  - Improve more granular results
  - Allows different types of nonassociated supply (i.e. offshore, Marcellus, western Canada) to respond to price differently

Include the coastal plain of the Arctic National Wildlife Refuge

U.S. crude oil production

million barrels per day





Source: U.S. Geological Survey.

Source: U.S. Energy Information Administration, Annual Energy Outlook 2018

Other AEO2019 updates

- Tight oil and shale gas
  - Estimated ultimate recovery
  - Lateral length
  - Well spacing
- NGPL assumptions for the DJ and Anadarko basins
- Lower 48 offshore and Alaska field declines and announced discoveries
- Current laws and regulations

We welcome feedback on our assumptions and documentation

- Working group meetings http://www.eia.gov/forecasts/aeo/workinggroup/
- The AEO Assumptions report http://www.eia.gov/forecasts/aeo/assumptions/
- NEMS Model Documentation
  - Oil and gas supply (OGSM) https://www.eia.gov/outlooks/aeo/nems/documentation/ogsm/pdf/m063(2017).pdf
  - Liquid Fuels Market Module (LFMM) https://www.eia.gov/outlooks/aeo/nems/documentation/lfmm/pdf/m059(2014).pdf
  - International Energy Module (IEM) https://www.eia.gov/outlooks/aeo/nems/documentation/international/pdf/m071(2016).pdf
- Working papers series http://www.eia.gov/workingpapers/

For more information

U.S. Energy Information Administration home page | www.eia.gov

Annual Energy Outlook | www.eia.gov/aeo

Short-Term Energy Outlook | www.eia.gov/steo

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

Today in Energy | www.eia.gov/todayinenergy

State Energy Profiles | www.eia.gov/state

Drilling Productivity Report | www.eia.gov/petroleum/drilling/

International Energy Portal | www.eia.gov/beta/international/?src=home-b1