

Assumptions and Expectations for *Annual Energy Outlook 2015:* Oil and Gas Working Group



AEO2015 Oil and Gas Supply Working Group Meeting

Office of Petroleum, Gas, and Biofuels Analysis

August 7, 2014 | Washington, DC

<http://www.eia.gov/forecasts/aeo/workinggroup/>

**WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES
DO NOT QUOTE OR CITE AS RESULTS ARE SUBJECT TO CHANGE**

Changes in release cycles for EIA's AEO and IEO

- To focus more resources on rapidly changing energy markets and how they might evolve over the next few years, the U.S. Energy Information Administration is revising the schedule and approach for production of the *International Energy Outlook (IEO)* and the *Annual Energy Outlook (AEO)*.
- Starting with *IEO2013*, which was released in July, 2013, EIA adopted a two-year production cycle for both the *IEO* and *AEO*.
- Under this approach, a full edition of the *IEO* and *AEO* will be produced in alternating years and an interim, shorter edition of each will be completed in the “off” years.

| | <u>2015</u> | <u>2016</u> |
|-------------------------------------|---|---|
| International Energy Outlook | Full Edition will be released in the spring 2015 | Shorter Edition will be released in mid 2016 , focusing on the liquids projection, which is used as part of the <i>AEO2016</i> . Summary tables and a short analysis will be included. |
| Annual Energy Outlook | Shorter Edition will be released in late 2014 and will only include the Reference, Low and High Economic Growth, and Low and High Oil Price, and High Resource cases. The shorter version will include tables for these cases and short discussions. | Full Edition will be released in spring 2016 , including analysis of energy issues and many alternative scenarios. |

We welcome feedback on our assumptions and documentation

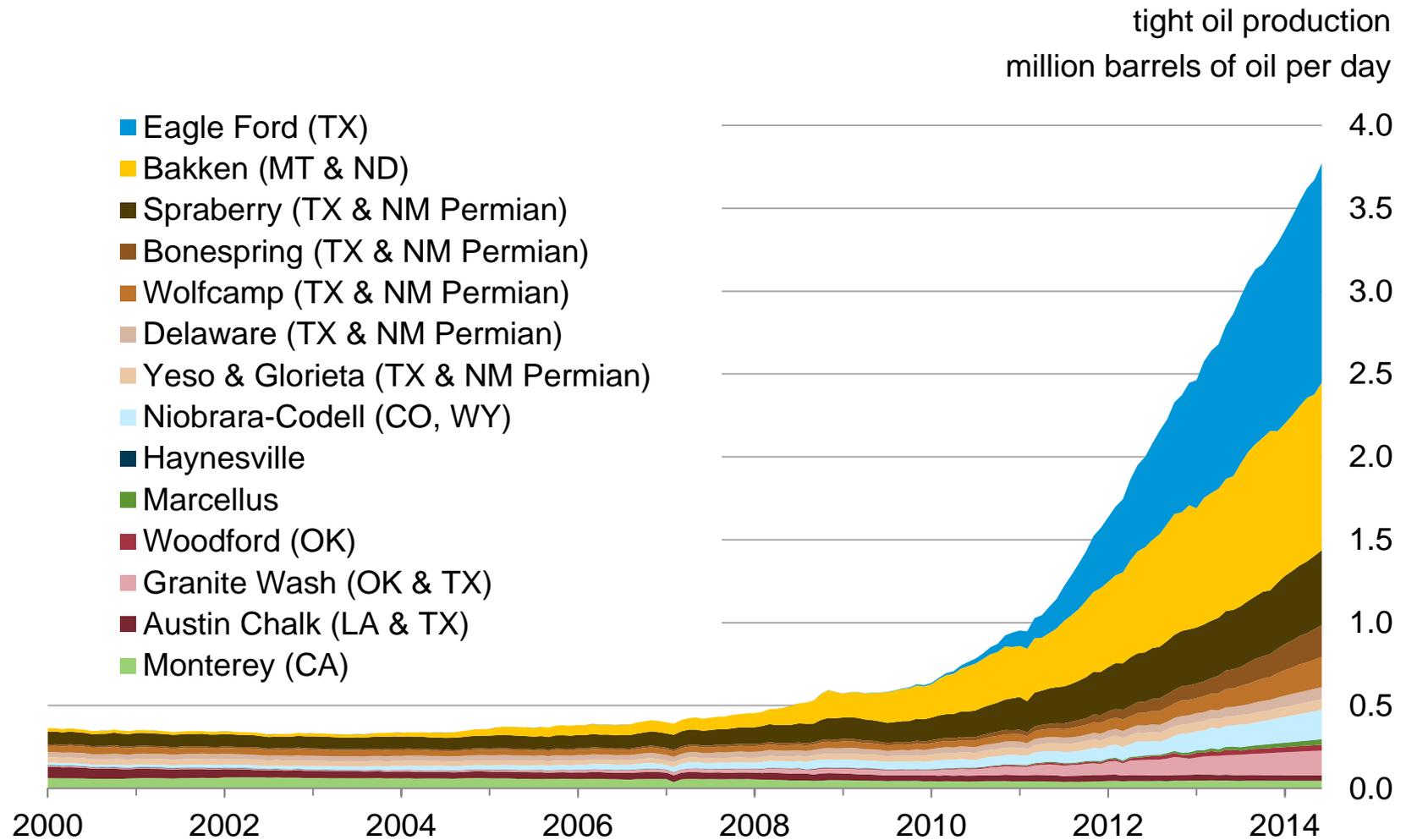
- The AEO Assumptions report
<http://www.eia.gov/forecasts/aeo/assumptions/>
- Appendix 2.C and Appendix 2.D in the AEO Documentation
[http://www.eia.gov/forecasts/aeo/nems/documentation/ogsm/pdf/m063\(2014\).pdf](http://www.eia.gov/forecasts/aeo/nems/documentation/ogsm/pdf/m063(2014).pdf)
- We have restarted our working papers series
<http://www.eia.gov/workingpapers/>
- And these working group meetings
<http://www.eia.gov/forecasts/aeo/workinggroup/>

Overview

- What has changed and what we've learned: DPR analysis
- Most of the focus is on
 - NGPL production and ethane rejection
 - Crude oil quality measured by API gravity
 - Offshore discoveries and project start-up timing
 - Exports as LNG and to Mexico
- New modeling innovation adds GIS based geologic dependency tools (prototype on the Marcellus play)
- World oil price outlooks based on updated resource and demand analysis

OGSM / Upstream

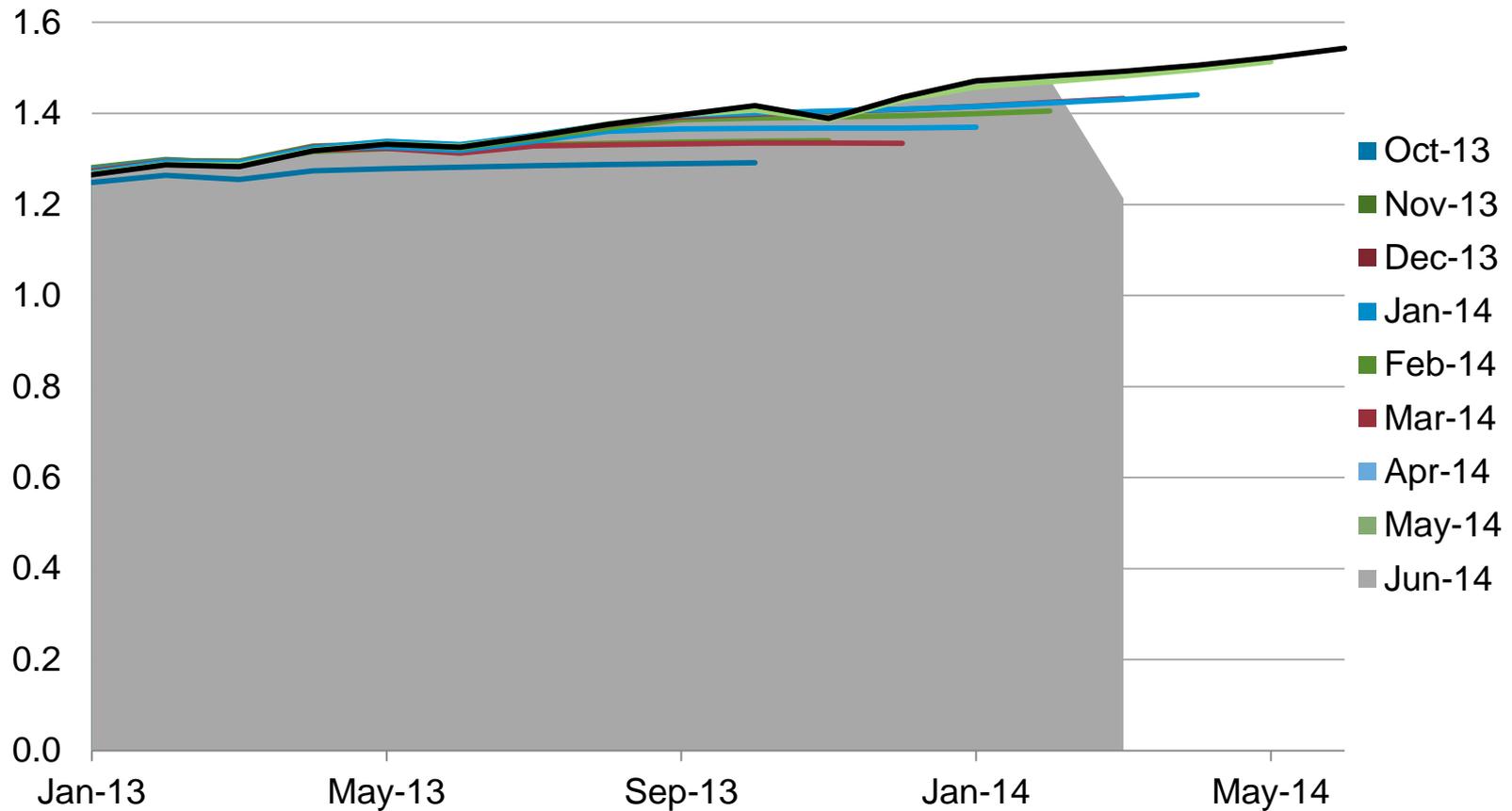
U.S. tight oil production – selected plays



Sources: EIA derived from state administrative data collected by DrillingInfo Inc. Data are through June 2014 and represent EIA's official tight oil estimates, but are not survey data. State abbreviations indicate primary state(s).

Data lags caused Permian drilling productivity to appear flat

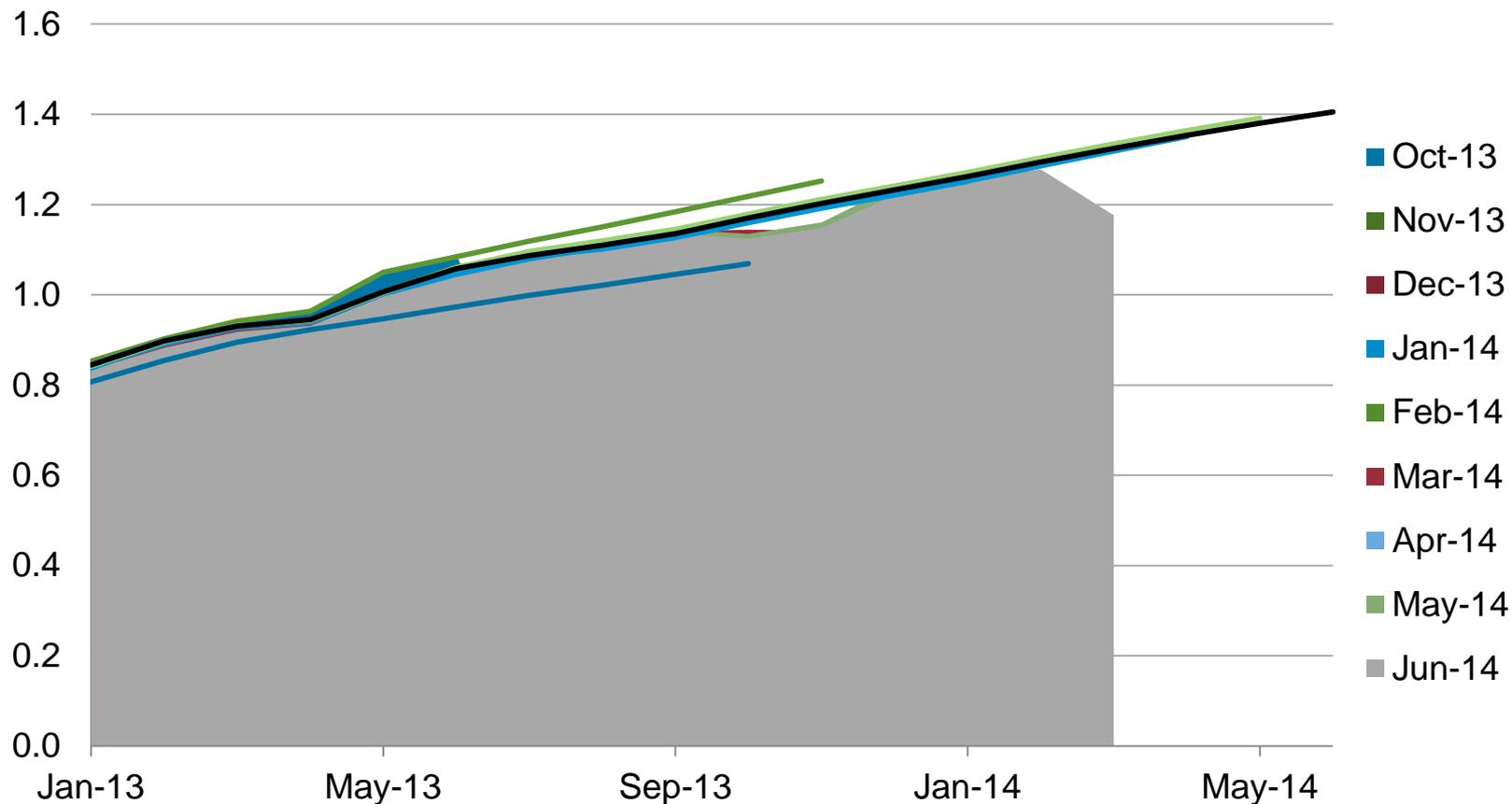
Permian region
million barrels per day



Source: EIA Drilling Productivity Report

Eagle Ford – Early changes to regional boundary caused errors, forecasts stabilized with steady drilling activity, incr. productivity

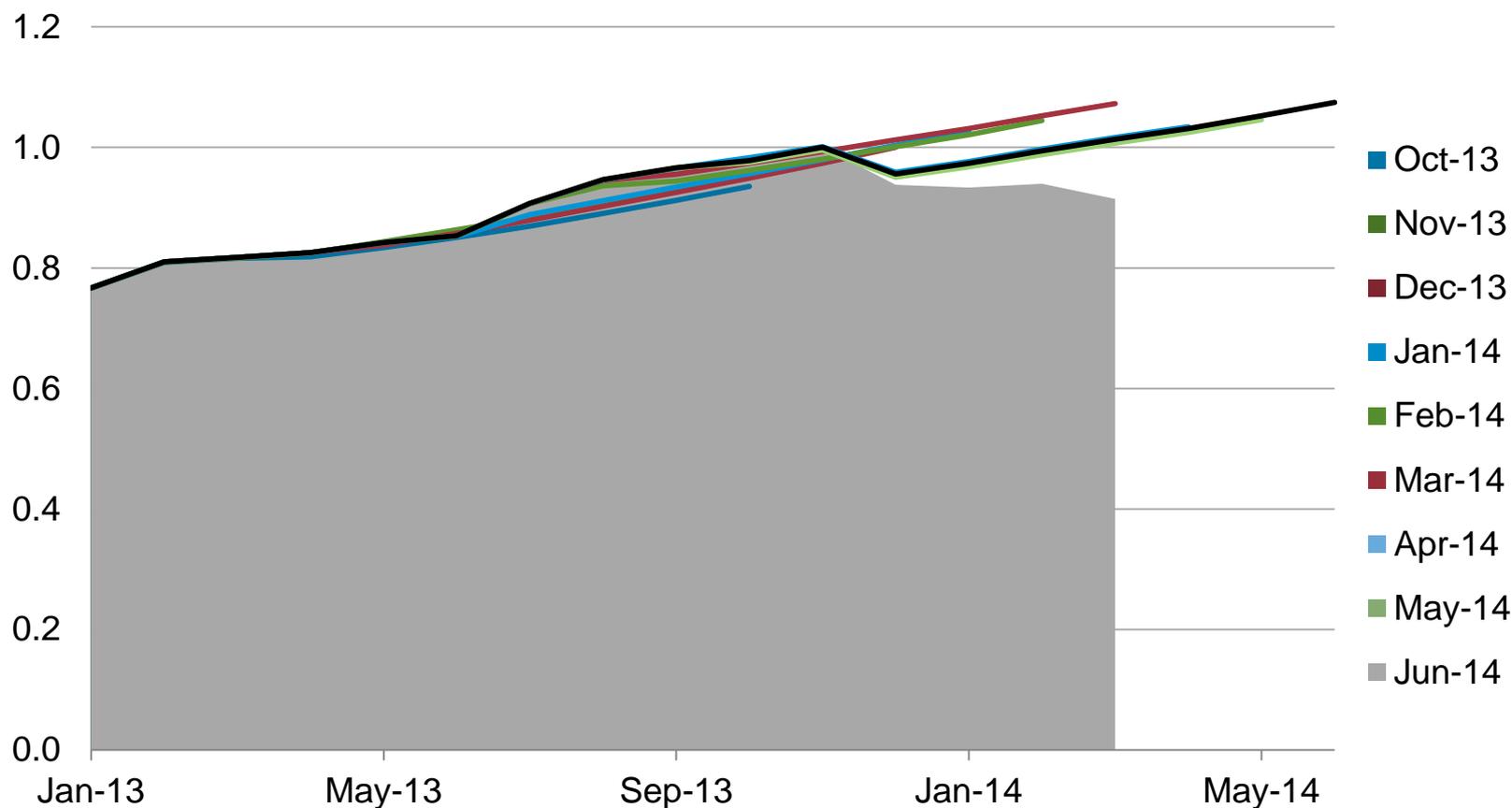
Eagle Ford region
million barrels per day



Source: EIA Drilling Productivity Report

Bakken – Changing completion techniques lead to mid-2013 growth, ‘event’ related decline in Dec. 2013, trends intact

Bakken region
million barrels per day



Source: EIA Drilling Productivity Report

NGPL

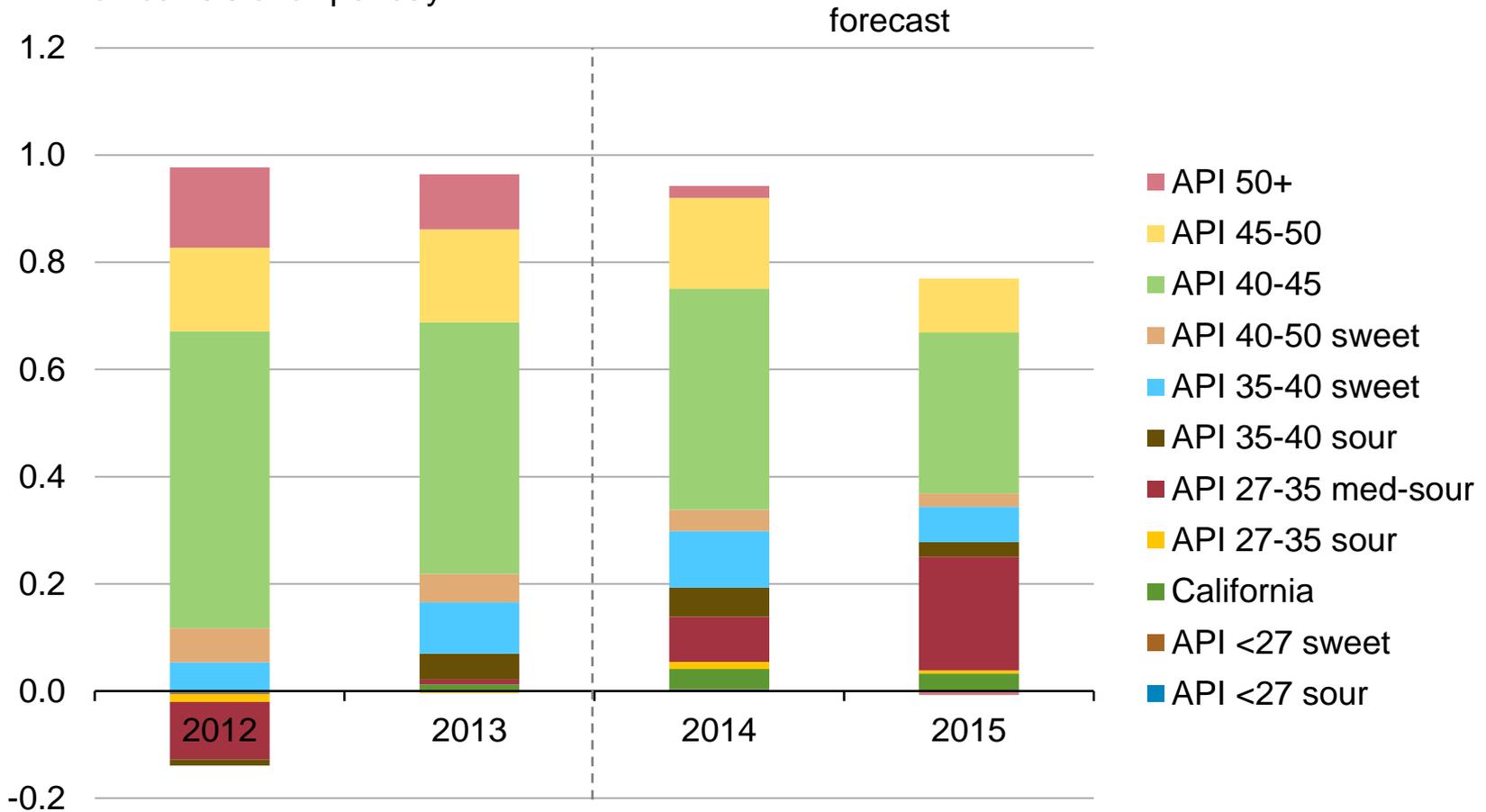
Improved representation of NGPLs significantly change NGPL production

- Refinement of NGPL factors for producing reservoirs in-progress
 - Updated NGPL factors are based on data from EIA-64, 757, and 816 surveys
- Reviewed and enhanced the algorithm associated with NGPL production
 - NGPLs were being underreported in the past
- These changes will significantly change levels of NGPL production

API gravity

More than 60% of EIA's production growth forecast for 2014 and 2015 consists of sweet grades with API gravity of 40+

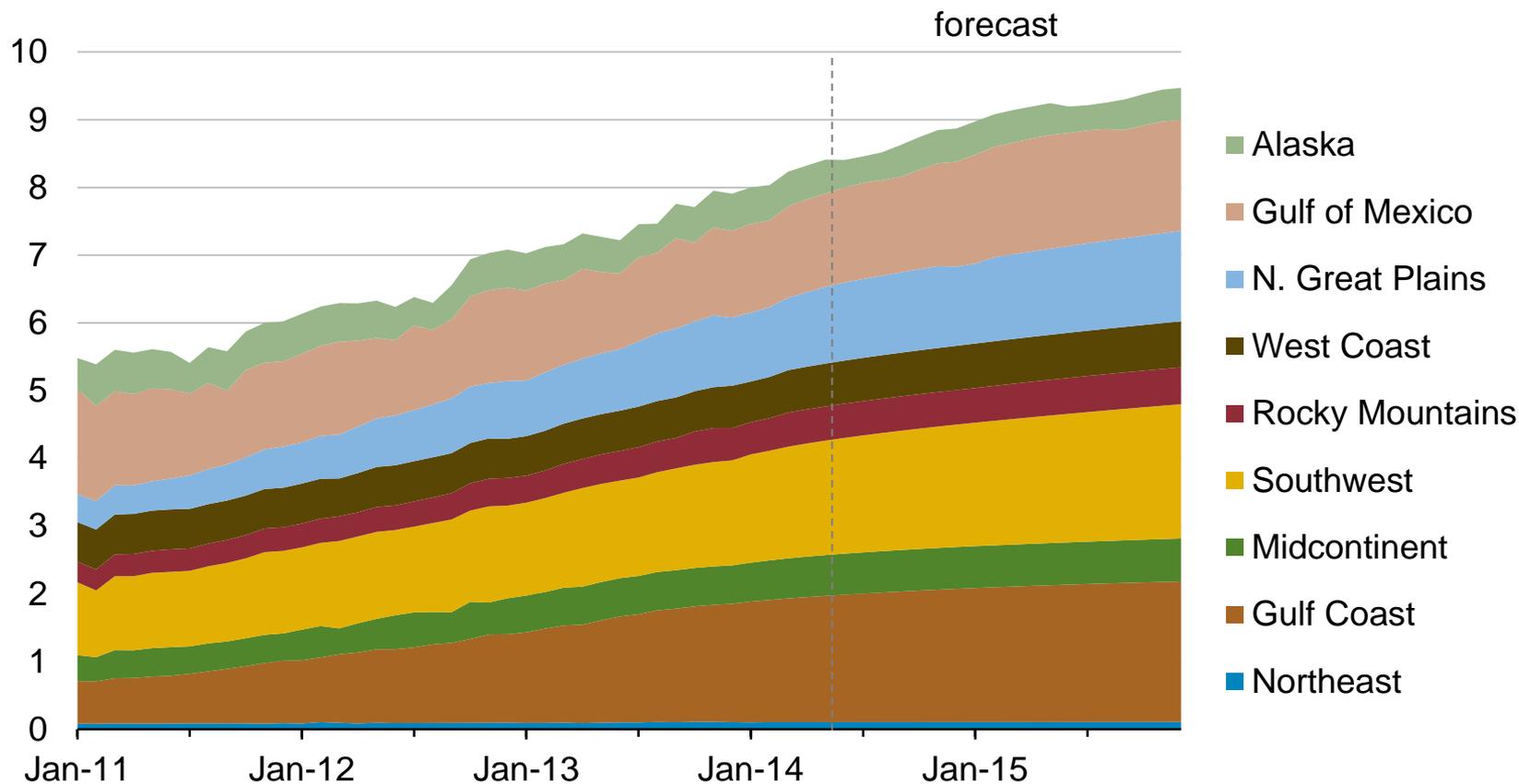
Annual change in U.S. crude oil production by type
million barrels of oil per day



Source: EIA, DrillingInfo, Colorado DNR, Texas RRC. <http://www.eia.gov/analysis/petroleum/crudetypes/>

EIA forecast that U.S. crude oil production will grow from an average of 7.4 million b/d in 2013 to 9.2 million b/d in 2015

U.S. crude oil production
million barrels of oil per day



Source: EIA, Short-Term Energy Outlook, May 2014

Lower 48 Offshore

Lower 48 offshore deepwater projects

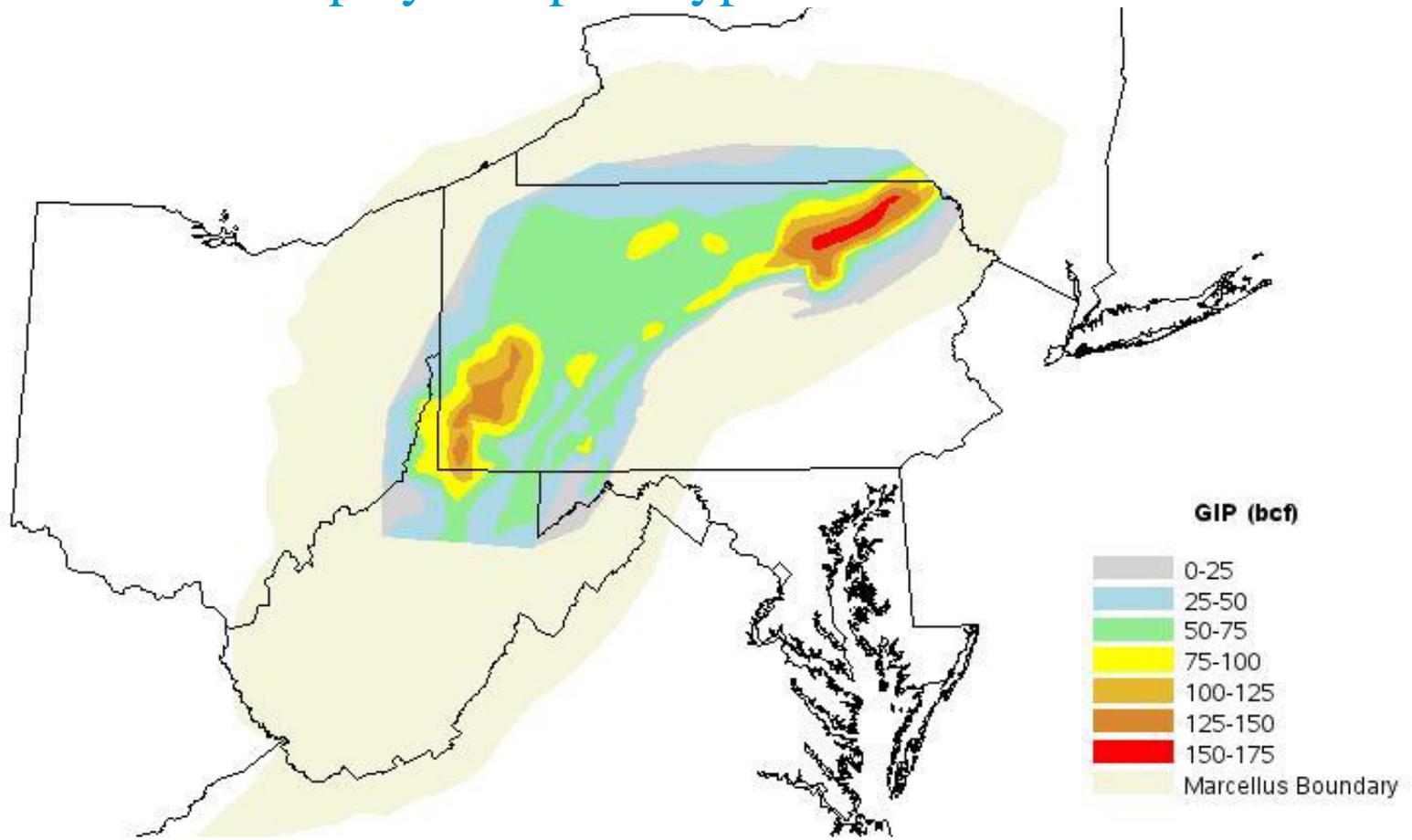
| BOEM Field name | Nickname | Water depth | Field Size (MMBoe) | Discovery Year | Start Year of Production |
|-----------------|-----------------------|-------------|--------------------|----------------|--------------------------|
| AC865 | GOTCHA' | 7844 | | 2006 | 2014 |
| DC004 | AXE' | 5831 | | 2010 | 2015 |
| DC048 | DALMATIAN' | 5876 | 89 | 2008 | 2015 |
| DC353 | 'VICKSBURG' | 7457 | 372 | 2009 | 2019 |
| GB427 | 'CARDAMOM' | 2720 | 182 | 2010 | 2015 |
| GB463 | BUSHWOOD' | 2700 | 89 | 2009 | 2015 |
| GB506 | DANNY II' | 2800 | 89 | 2012 | 2013 |
| GB515 | 'OZONA' | 3000 | 89 | 2008 | 2013 |
| GB605 | 'WINTER' | 3400 | 45 | 2009 | 2015 |
| GB782 | 'ENTRADA' | 4690 | 372 | 2000 | 2014 |
| GC432 | 'SAMURAI' | 3400 | 89 | 2009 | 2017 |
| GC468 | STAMPEDE-PONY' | 3497 | 372 | 2006 | 2015 |
| GC512 | STAMPEDE-KNOTTY HEAD' | 3557 | 372 | 2005 | 2014 |
| GC683 | CAESAR/TONGA' | 4457 | 45 | 2006 | 2013 |
| GC726 | 'WEST TONGA' | 4674 | 372 | 2007 | 2013 |
| GC859 | 'HEIDELBERG' | 5000 | 182 | 2009 | 2016 |
| KC102 | 'TIBER' | 4132 | 691 | 2009 | 2016 |
| KC292 | 'KASKIDA' | 5860 | 691 | 2006 | 2016 |
| KC736 | 'MOCCASIN' | 6759 | 372 | 2011 | 2018 |
| KC872 | 'BUCKSKIN' | 6920 | 182 | 2009 | 2018 |
| KC875 | 'LUCIUS' | 7168 | 182 | 2009 | 2014 |
| KC919 | 'HADRIAN NORTH' | 7000 | 372 | 2010 | 2020 |
| KC964 | 'HADRIAN SOUTH' | 7586 | 182 | 2009 | 2016 |
| LL370 | 'DIAMOND' | 9975 | 45 | 2008 | 2018 |
| LL400 | 'CHEYENNE EAST' | 9200 | | 2010 | 2013 |
| MC199 | 'MANDY' | 2478 | 182 | 2010 | 2013 |
| MC392 | 'APPOMATTOX' | 7217 | 691 | 2009 | 2019 |

Lower 48 offshore deepwater projects (cont.)

| BOEM Field name | Nickname | Water depth | Field Size (MMBoe) | Discovery Year | Start Year of Production |
|--------------------|------------------|----------------|-----------------------|-------------------|-----------------------------|
| MC519 | 'SANTIAGO' | 6526 | | 2011 | 2013 |
| MC562 | 'ISABELA' | 6535 | 45 | 2007 | 2013 |
| MC563 | 'SANTA CRUZ' | 6515 | | 2009 | 2013 |
| MC725 | TUBULAR BELLS' | 4334 | 89 | 2003 | 2014 |
| MC754 | 'ANDUIN WEST' | 2696 | 45 | 2008 | 2015 |
| MC762 | 'DEIMOS SOUTH' | 3122 | | 2010 | 2015 |
| MC771 | 'KODIAK' | 4986 | 182 | 2008 | 2016 |
| MC792 | 'WEST BOREAS' | 3112 | 182 | 2004 | 2016 |
| MC948 | 'FREEDOM ' | 6095 | | 2008 | 2014 |
| MC984 | 'VITO' | 4038 | 182 | 2009 | 2016 |
| SM217 | 'FLATROCK' | 10 | | 2007 | 2013 |
| SM230 | 'DAVY JONES' | 20 | | 2010 | 2013 |
| WR029 | 'BIG FOOT' | 5235 | 182 | 2005 | 2015 |
| WR052 | 'SHENANDOAH' | 5750 | 182 | 2009 | 2017 |
| WR508 | 'STONES' | 9556 | 89 | 2005 | 2017 |
| WR627 | 'JULIA' | 7087 | 89 | 2007 | 2016 |
| WR678 | 'ST. MALO' | 7036 | 372 | 2003 | 2014 |
| WR759 | 'JACK' | 6963 | 372 | 2004 | 2014 |
| WR848 | 'HAL' | 7657 | 45 | 2008 | 2019 |
| MC948 | GUNFLINT' | 6095 | 691 | 2008 | 2016 |
| MC806 | South Deimos' | 3117 | | 2010 | 2016 |
| MC029 | Cardona South | | | 2014 | 2015 |
| WC076 | Tomcat | | | 2014 | 2014 |
| MC026 | Amethyst | | | 2014 | 2014 |
| KC093 | Gila | 4900 | | 2013 | |
| MC782 | Dantzler | 6580 | | 2013 | |
| MC698 | Big Bend | | | 2012 | |
| AT063 | Telemark Phase 2 | | | | 2014 |
| | Troubadour | 7273 | | 2013 | |

Geologic dependencies and GIS

For AEO2014 we added county level EUR estimates, but there can be considerable variation across individual counties. AEO2015 debuts GIS based geologic dependences for EURs with the Marcellus play as a prototype.



Source: Range Resources, Marcellus extent and Range Resources gas in-place outlines

Adding geology improves EUR estimate quality, offers higher resolution. Cautionary tale: some apparent great EURs (Wyoming Co.) fizzle when look at extent of geology

| County | Average EUR | Average EUR weighted by GIP tier | County | Average EUR | Average EUR weighted by GIP tier |
|-----------|-------------|----------------------------------|--------------|-------------|----------------------------------|
| ALLEGHENY | 3.74 | 4.09 | SUSQUEHANNA | 6.14 | 4.92 |
| ARMSTRONG | 0.91 | 2.72 | TIOGA | 2.98 | 2.49 |
| BEAVER | 2.74 | 2.44 | UNION | 2.80 | 0.30 |
| BEDFORD | 1.16 | 0.85 | VENANGO | 0.83 | 2.49 |
| BLAIR | 1.34 | 1.23 | WARREN | 1.84 | 2.28 |
| BRADFORD | 5.70 | 3.94 | WASHINGTON | 2.45 | 3.69 |
| BUTLER | 1.74 | 2.72 | WAYNE | 7.49 | 1.34 |
| CAMBRIA | 1.46 | 2.43 | WESTMORELAND | 1.85 | 2.84 |
| CAMERON | 0.33 | 2.69 | WYOMING | 8.85 | 3.42 |

Resource and technology assumption changes from Reference to High Resource case

| Tight oil specific (L48) | High Resource case |
|---|--|
| New plays | ~57 billion barrels tight oil in plays not considered in the Reference case |
| Well spacing | 100% more wells/area (50% reduction in acre spacing) |
| Interference effects (diminishing returns) | IP rate increased 20%, but decline curve shifted to lower estimated ultimate recovery (EUR) to 80% of Reference once drill # of Ref case wells in county |
| Technology: production | Well EURs 50% larger 1% increase/year with no end date |

| Other resources | High Resource case |
|---------------------------------------|--|
| Offshore | 50% increase in undiscovered resources |
| Alaska: tight oil plays | Added 1.9 billion barrels |
| Alaska: undiscovered resources | 50% increase in undiscovered resources |

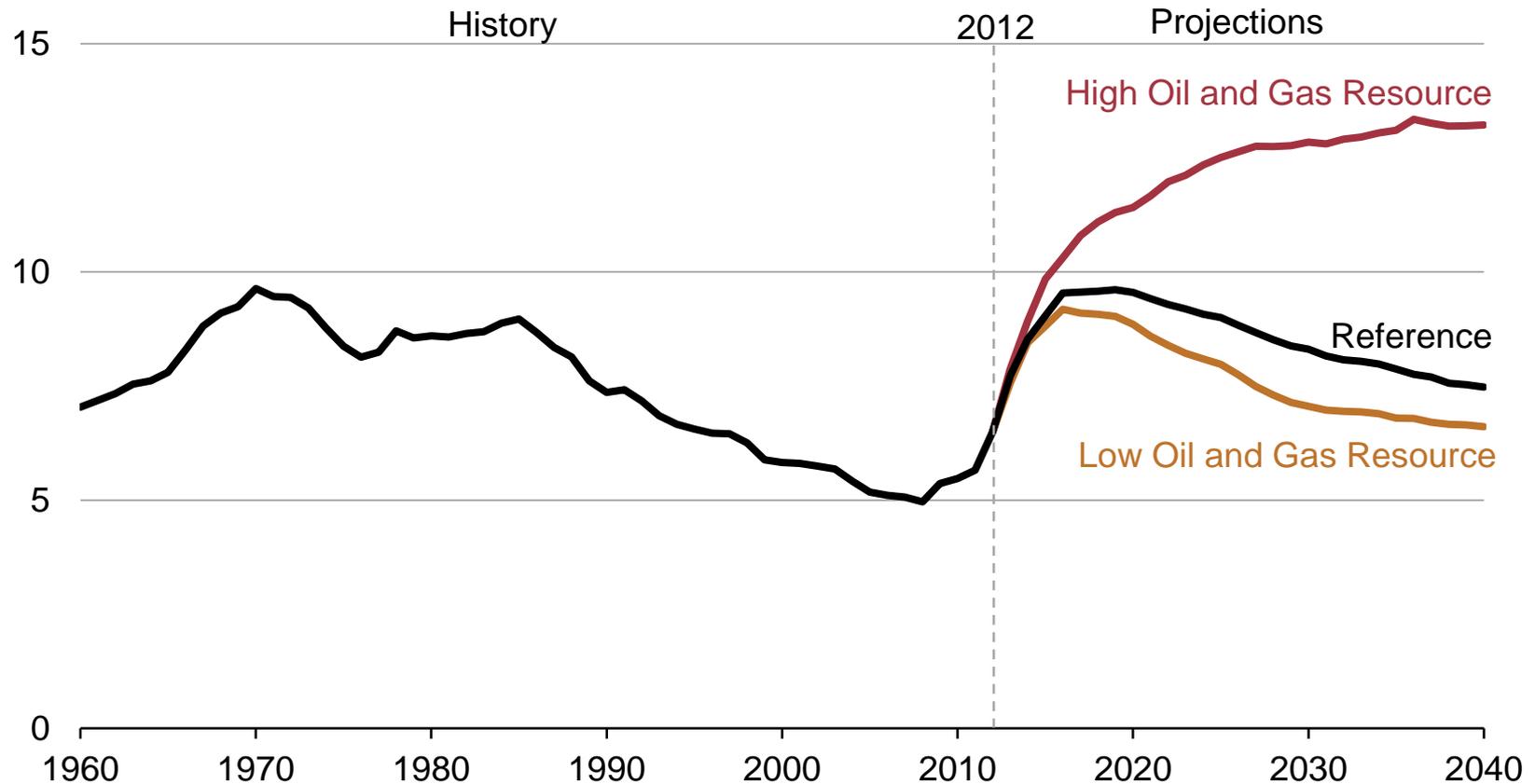
Development of Alaska North Slope shale oil production is not expected prior to 2040 because:

- low expected shale oil well recovery rates
- high drilling, completion, and infrastructure costs
- reduced wellhead oil prices
- natural gas and frack water disposal costs

Looking back at AEO2014 oil

U.S. crude oil production in three cases, 1960-2040

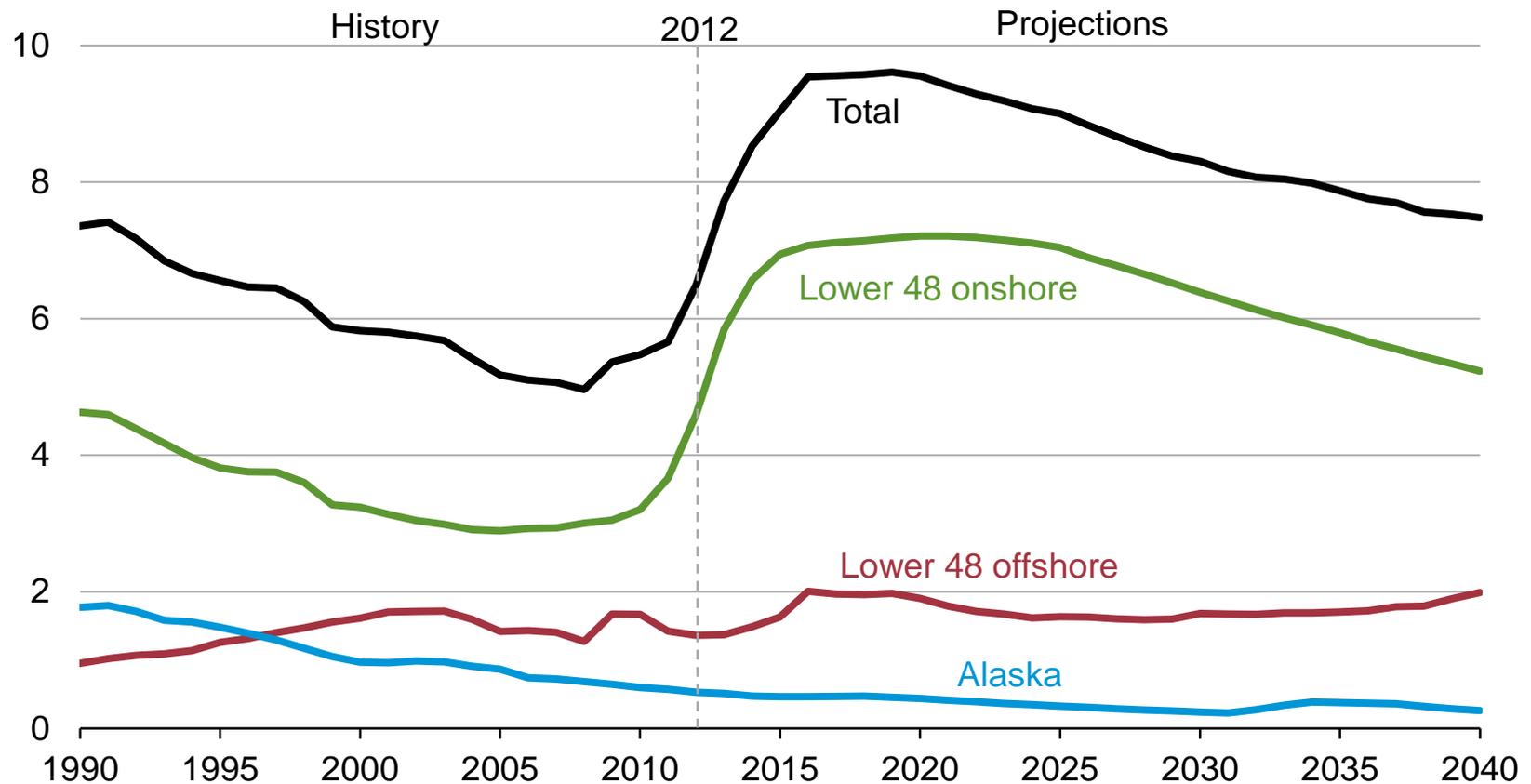
crude oil production
million barrels per day



Source: EIA, Annual Energy Outlook 2014

Domestic crude oil production by source in the Reference case, 1990-2040

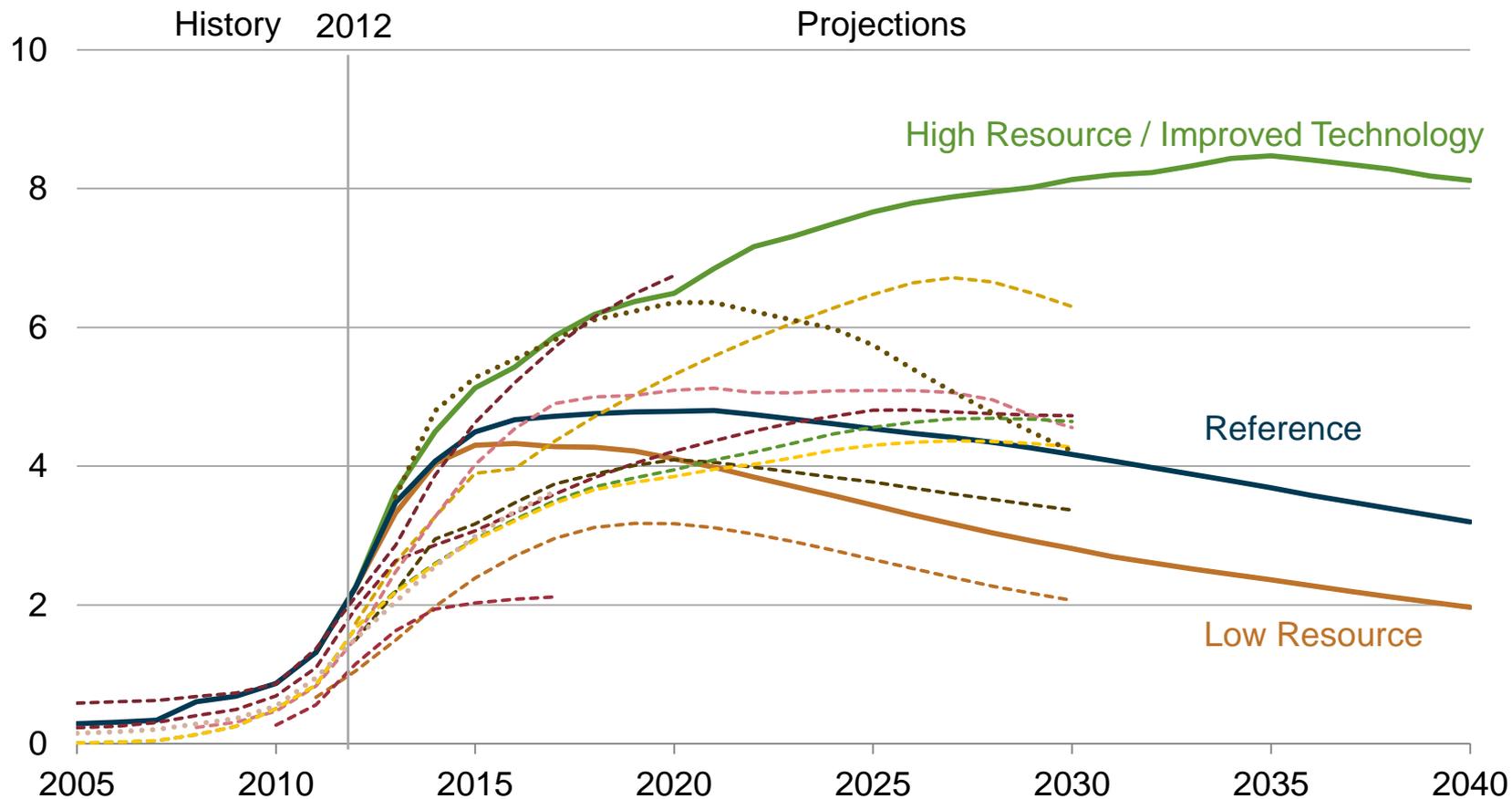
crude oil production
million barrels per day



Source: EIA, Annual Energy Outlook 2014

Projected tight oil production in EIA's three AEO2014 resource cases span the range of most other estimates

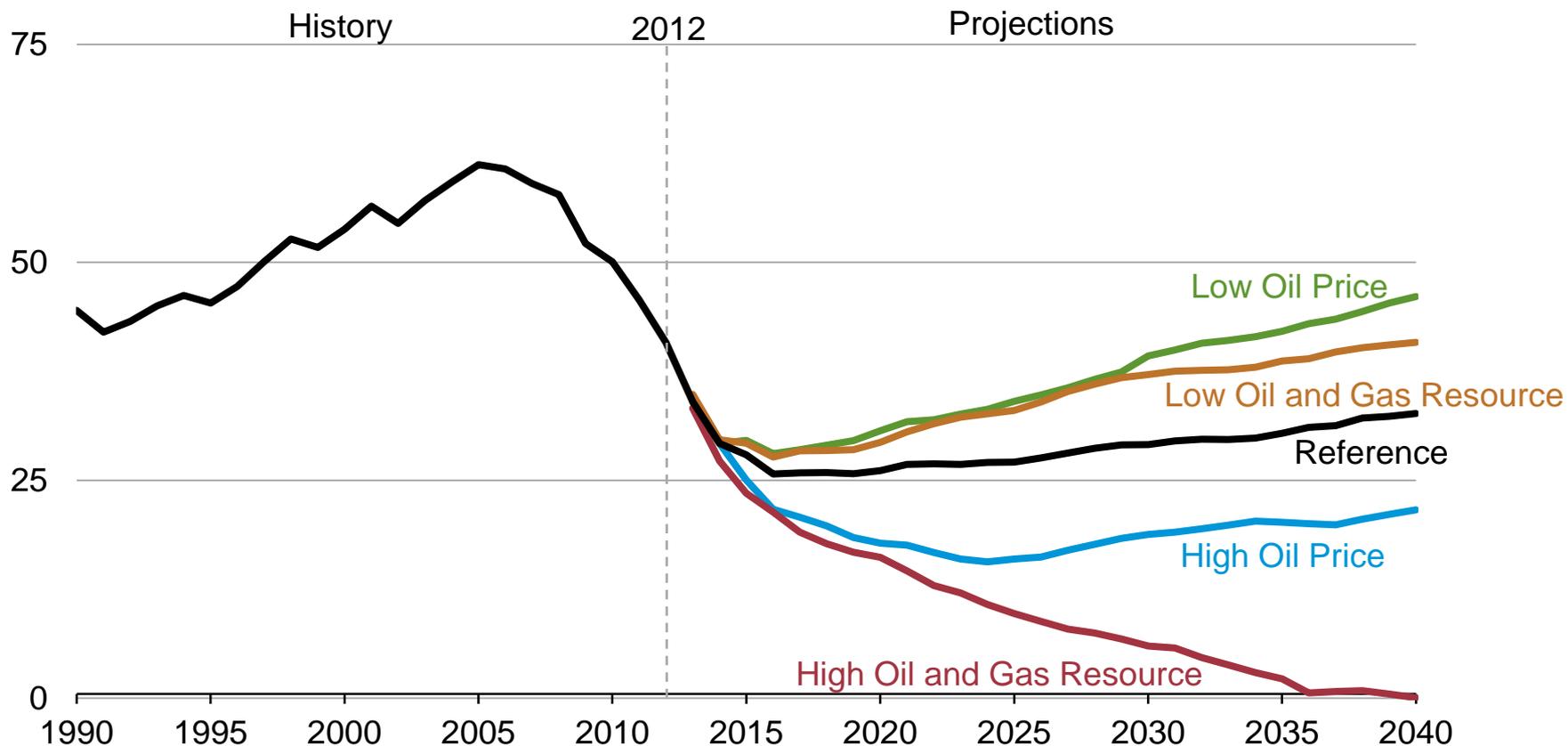
tight oil production
million barrels per day



Source: EIA, Annual Energy Outlook 2014, and external forecasts

Net import share of U.S. petroleum and other liquid fuels consumption in five cases, 1990-2040

net import share
percent



Source: EIA, Annual Energy Outlook 2014

Questions

- We plan to add additional detail to standard tables:
 - Drop AD gas, and add shale gas from tight oil plays (tables 14, 71, 72)
 - Split offshore oil and gas production by state and federal (tables 14, 71, 72)
 - Split Alaska onshore vs offshore (will require some assumptions on state lands vs federal)
 - Add tables of API gravity by region?
 - Other tables changes?

Table 14**Crude Oil Production** (million barrels per day)

| |
|--------------------------------------|
| United States Total |
| Lower 48 Onshore |
| Tight Oil 3/ |
| Carbon Dioxide Enhanced Oil Recovery |
| Other |
| Lower 48 Offshore |
| Federal |
| State |
| Alaska |
| Federal |
| State |

Natural Gas Plant Liquids Production

| |
|---------------------|
| United States Total |
| Lower 48 Onshore |
| Lower 48 Offshore |
| Alaska |

Natural Gas

Dry Production (trillion cubic feet) 4/

| |
|---------------------------------|
| United States Total |
| Lower 48 Onshore |
| Associated-Dissolved 5/ |
| Non-Associated |
| Tight Gas |
| Shale Gas (and Tight Oil plays) |
| Coalbed Methane |
| Other |
| Lower 48 Offshore |
| Associated-Dissolved 5/ |
| Non-Associated |
| Federal |
| State |
| Alaska |
| Federal |
| State |

Table 71

Lower 48 Total Crude Oil Production

| |
|------------------|
| Lower 48 Onshore |
| Northeast |
| Gulf Coast |
| Midcontinent |
| Southwest |
| Rocky Mountain |
| West Coast |

Lower 48 Offshore

| |
|-------------------------------|
| Gulf |
| Shallow (State) <200 meters |
| Shallow (Federal) <200 meters |
| Deep (Federal) |
| Pacific |
| State |
| Federal |
| Atlantic |
| State |
| Federal |

Table 72

Lower 48 Total Natural Gas Production

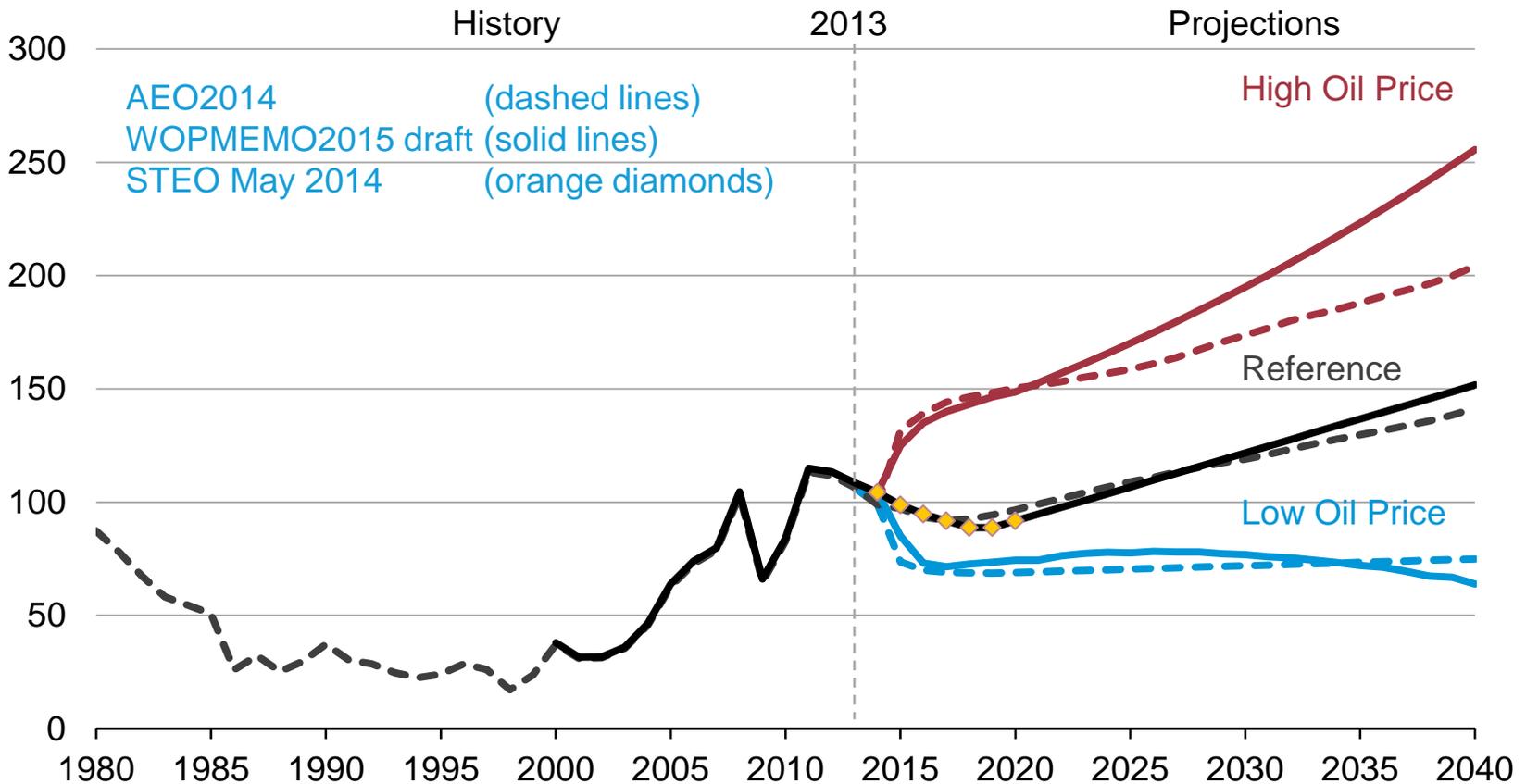
| |
|------------------|
| Lower 48 Onshore |
| Northeast |
| Gulf Coast |
| Midcontinent |
| Southwest |
| Rocky Mountain |
| West Coast |

Lower 48 Offshore

| |
|-------------------------------|
| Gulf |
| Shallow (State) <200 meters |
| Shallow (Federal) <200 meters |
| Deep (Federal) |
| Pacific |
| State |
| Federal |
| Atlantic |
| State |
| Federal |

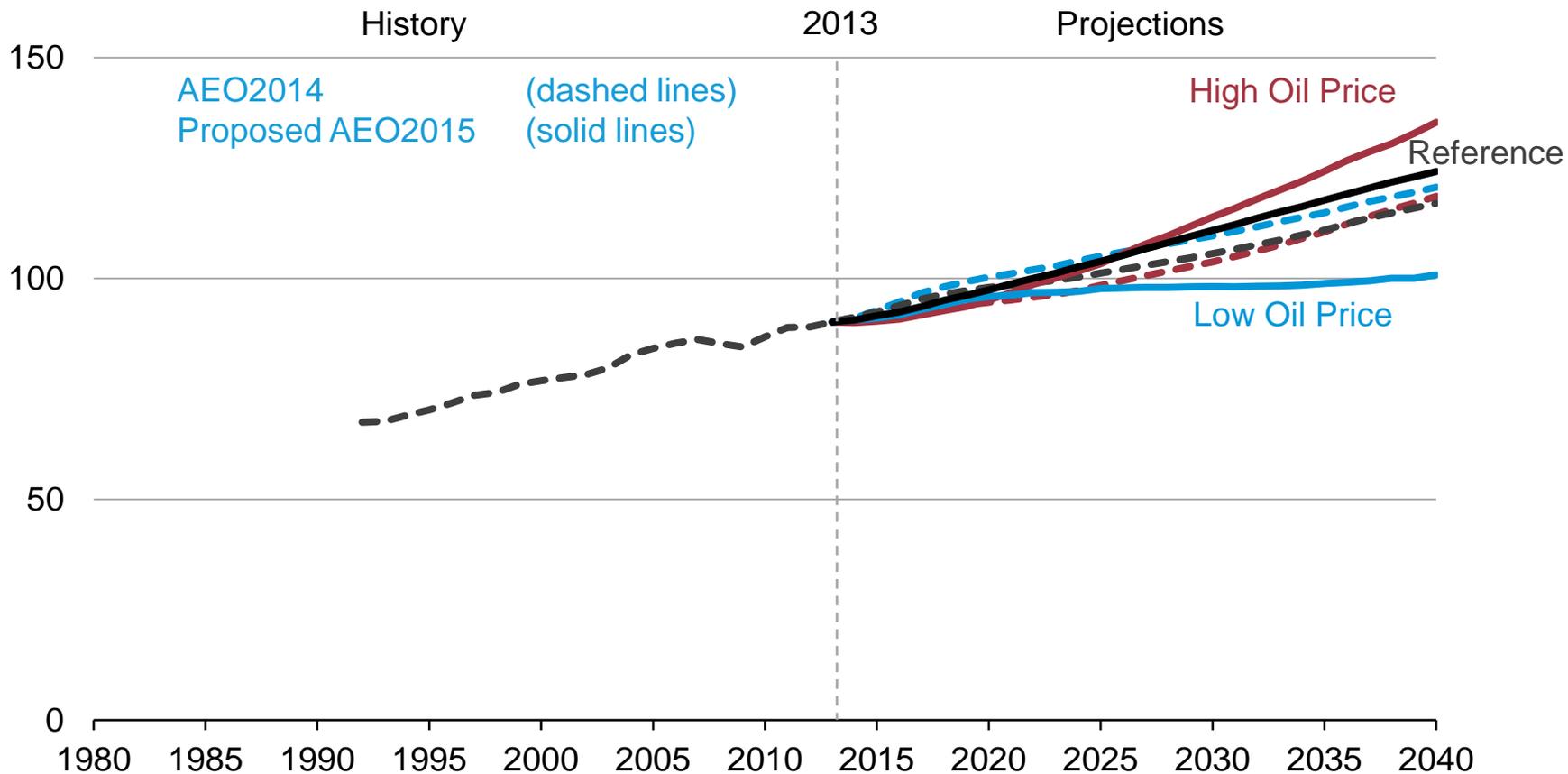
Oil price paths are higher than in AEO2014

Annual average spot price of Brent crude oil
2013 dollars per barrel (for the AEO2015 draft series)



Liquids volumes in proposed AEO2015 cases are wider relative to AEO2014 cases

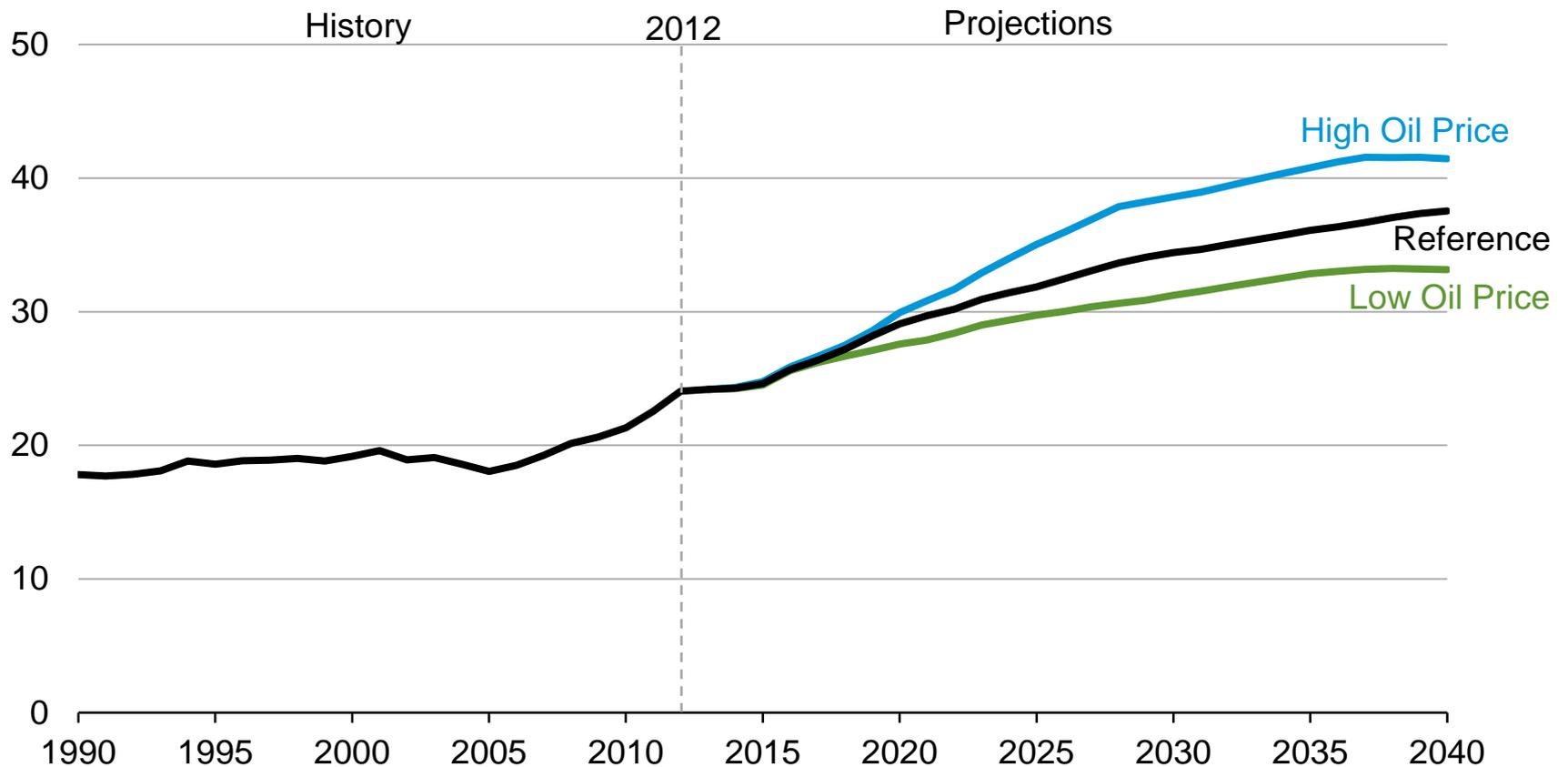
Annual world liquids demand
mmbd



Looking back at AEO2014 natural gas

U.S. natural gas production in three cases, 1990-2040

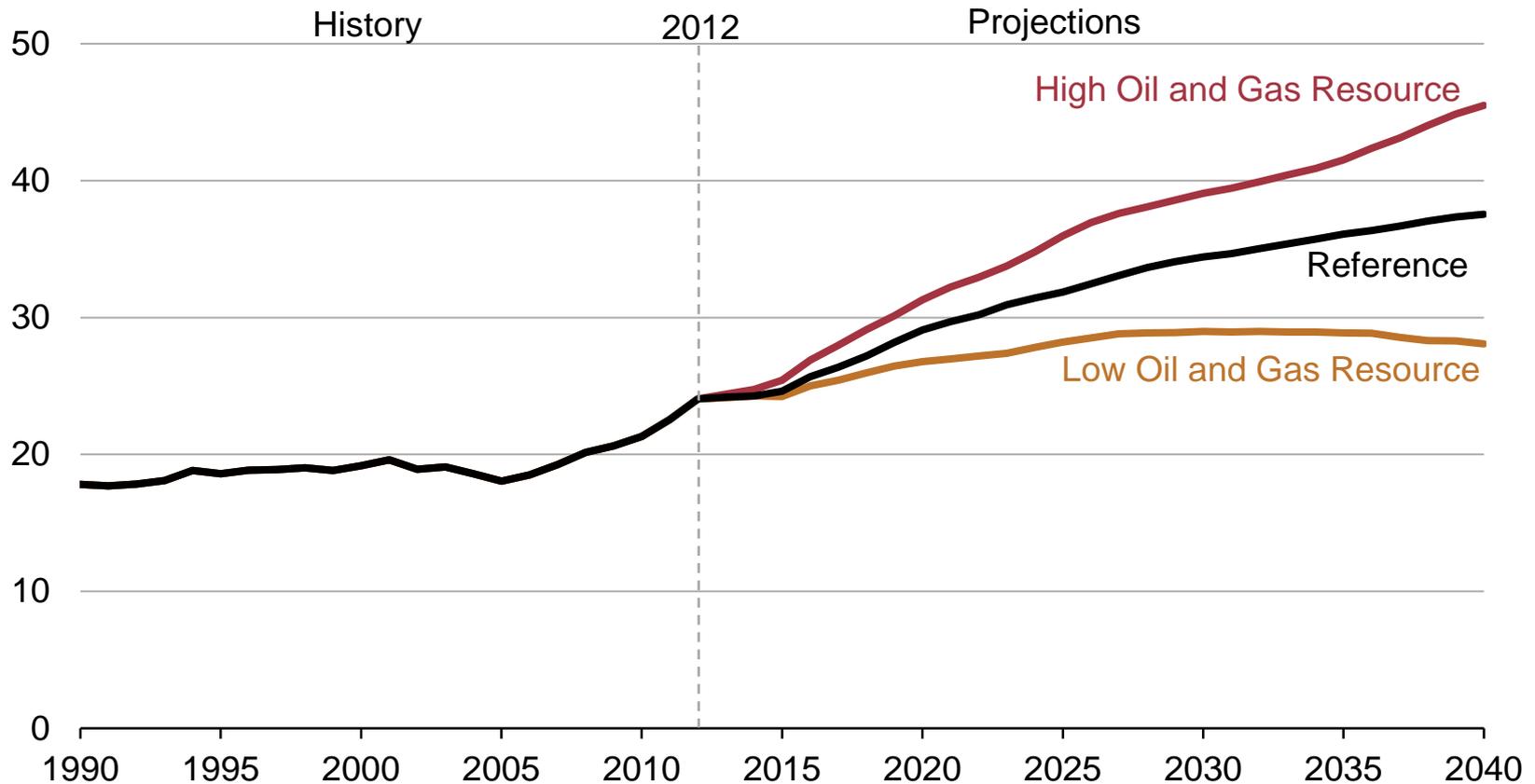
natural gas production
trillion cubic feet



Source: EIA, Annual Energy Outlook 2014

Total U.S. natural gas production in three cases, 1990-2040

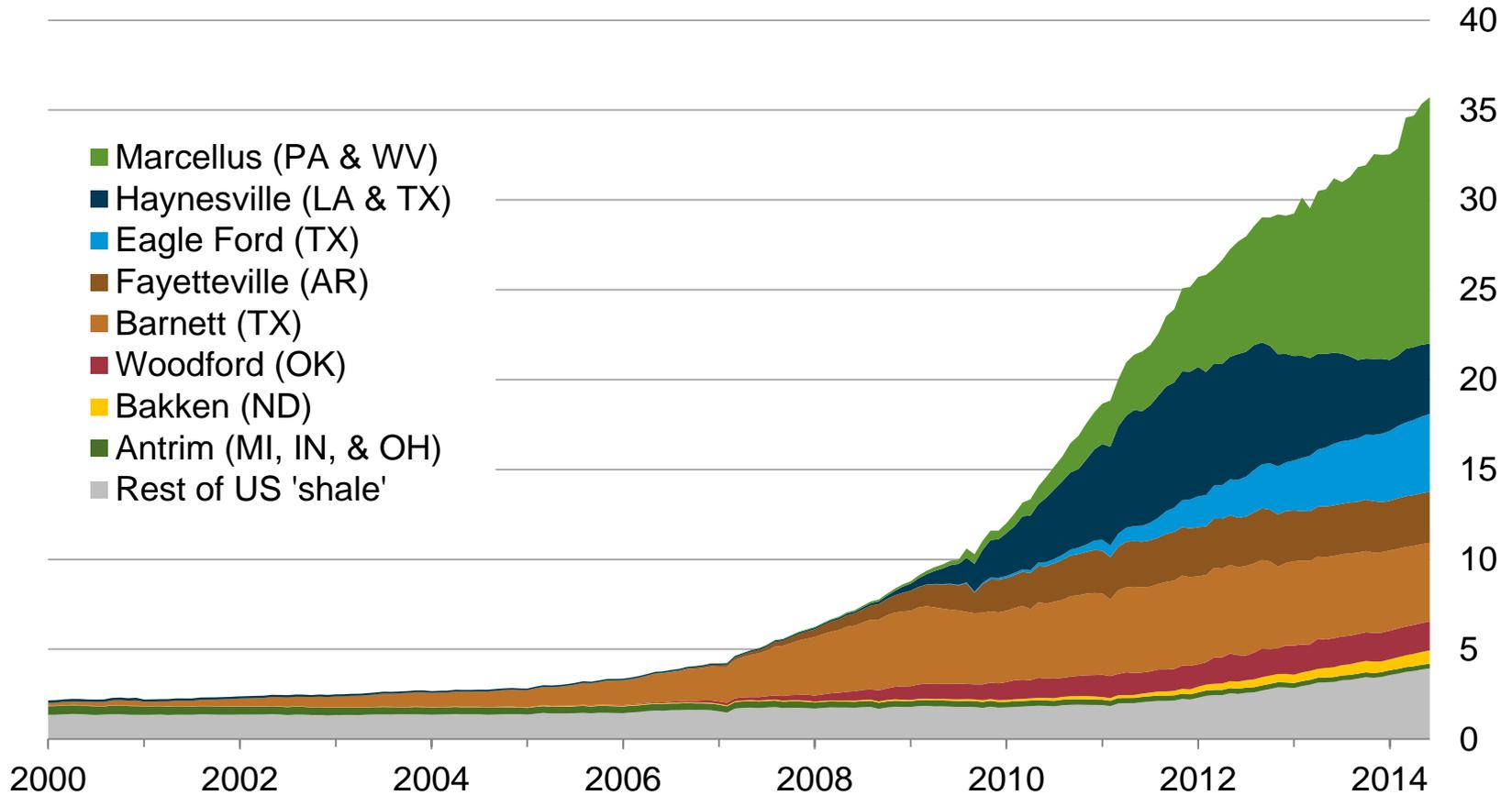
natural gas production
trillion cubic feet



Source: EIA, Annual Energy Outlook 2014

U.S. dry shale gas production

shale gas production (dry)
billion cubic feet per day



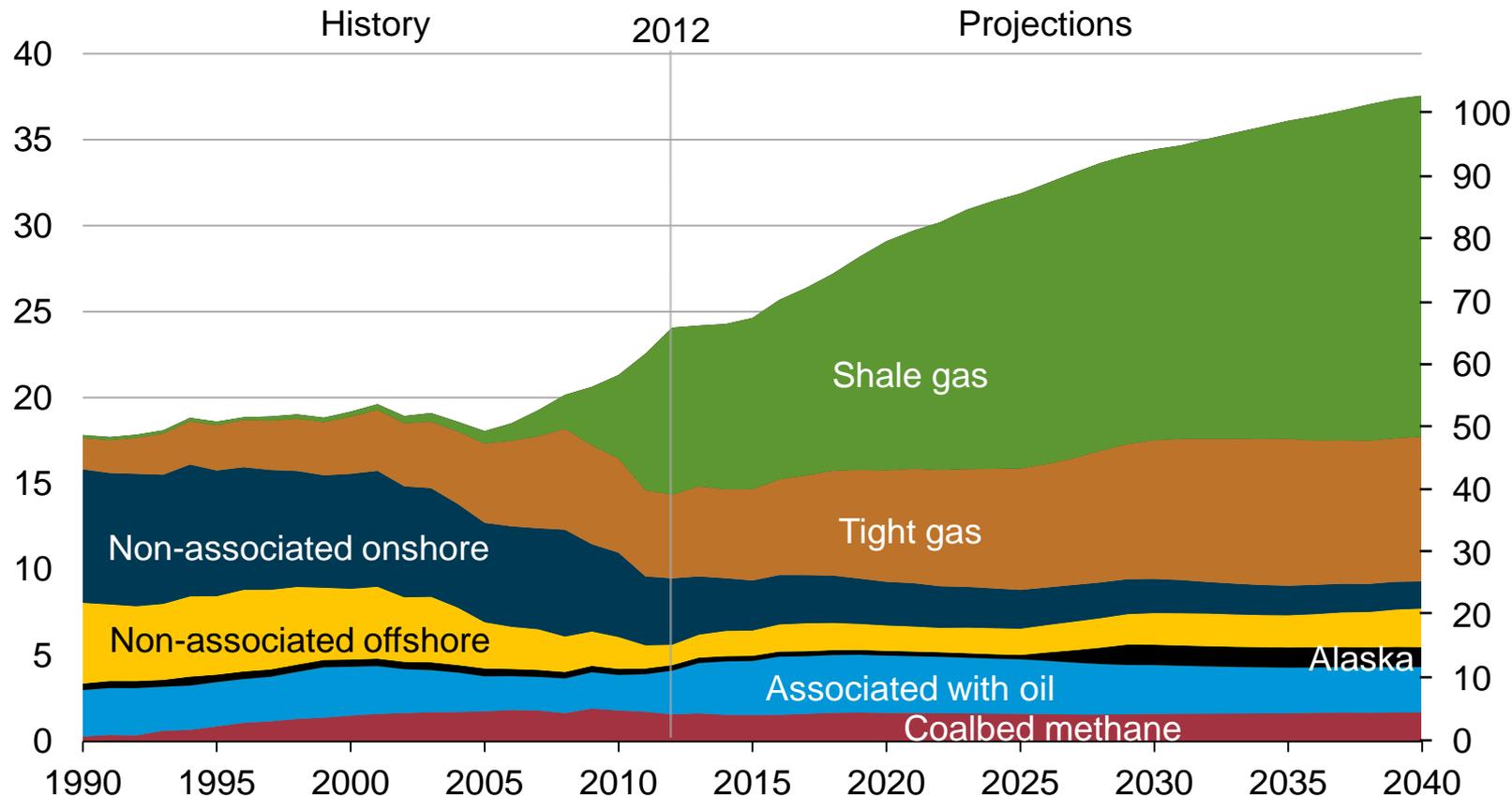
Sources: EIA derived from state administrative data collected by DrillingInfo Inc. Data are through June 2014 and represent EIA's official shale gas estimates, but are not survey data. State abbreviations indicate primary state(s).

Shale gas leads U.S. production growth

U.S. dry natural gas production

trillion cubic feet

billion cubic feet per day



Source: EIA, Annual Energy Outlook 2014

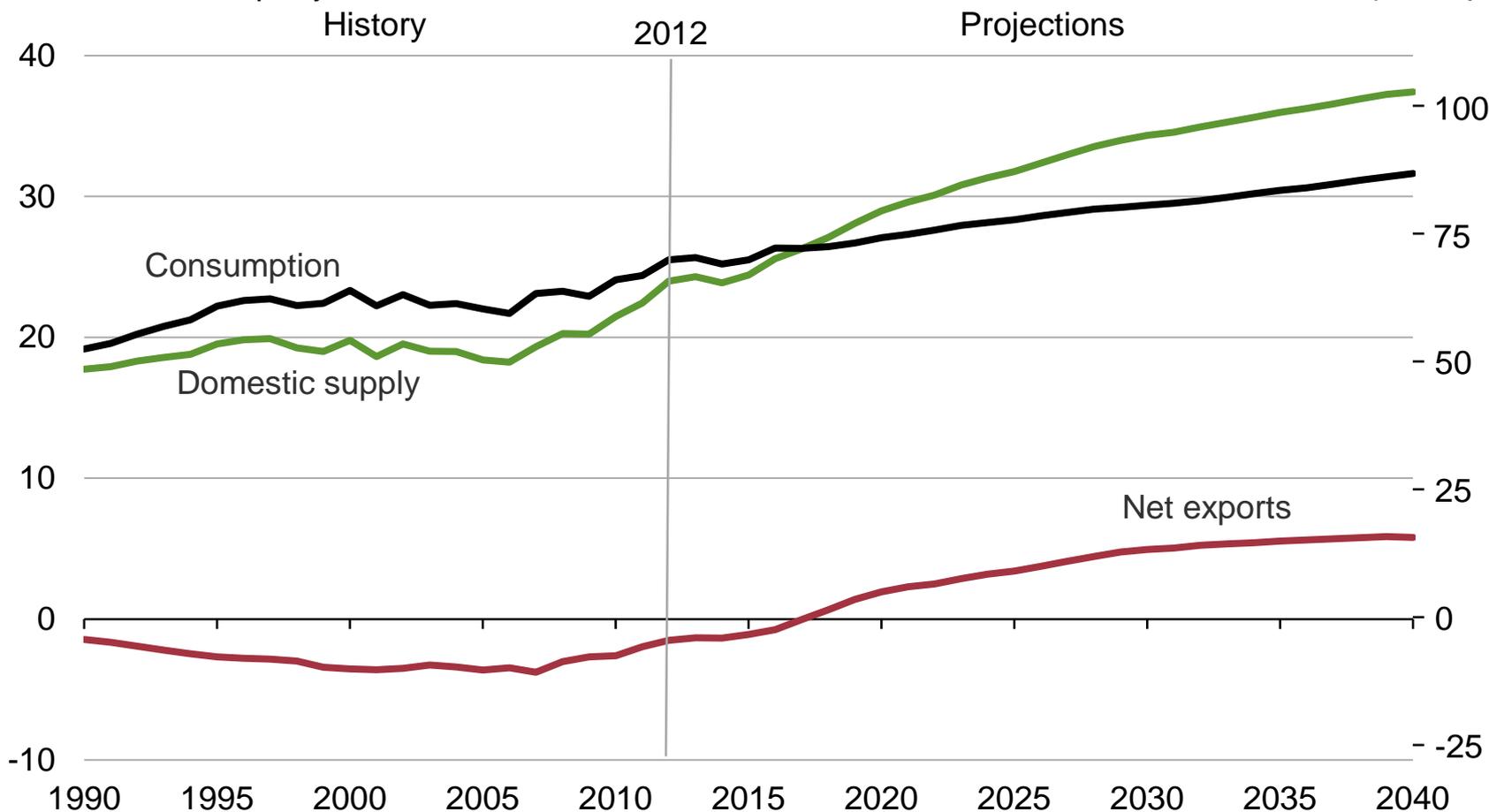
NGTDM

U.S. natural gas consumption, supply, net exports in AEO2014 Reference Case

U.S. dry natural gas

trillion cubic feet per year

billion cubic feet per day



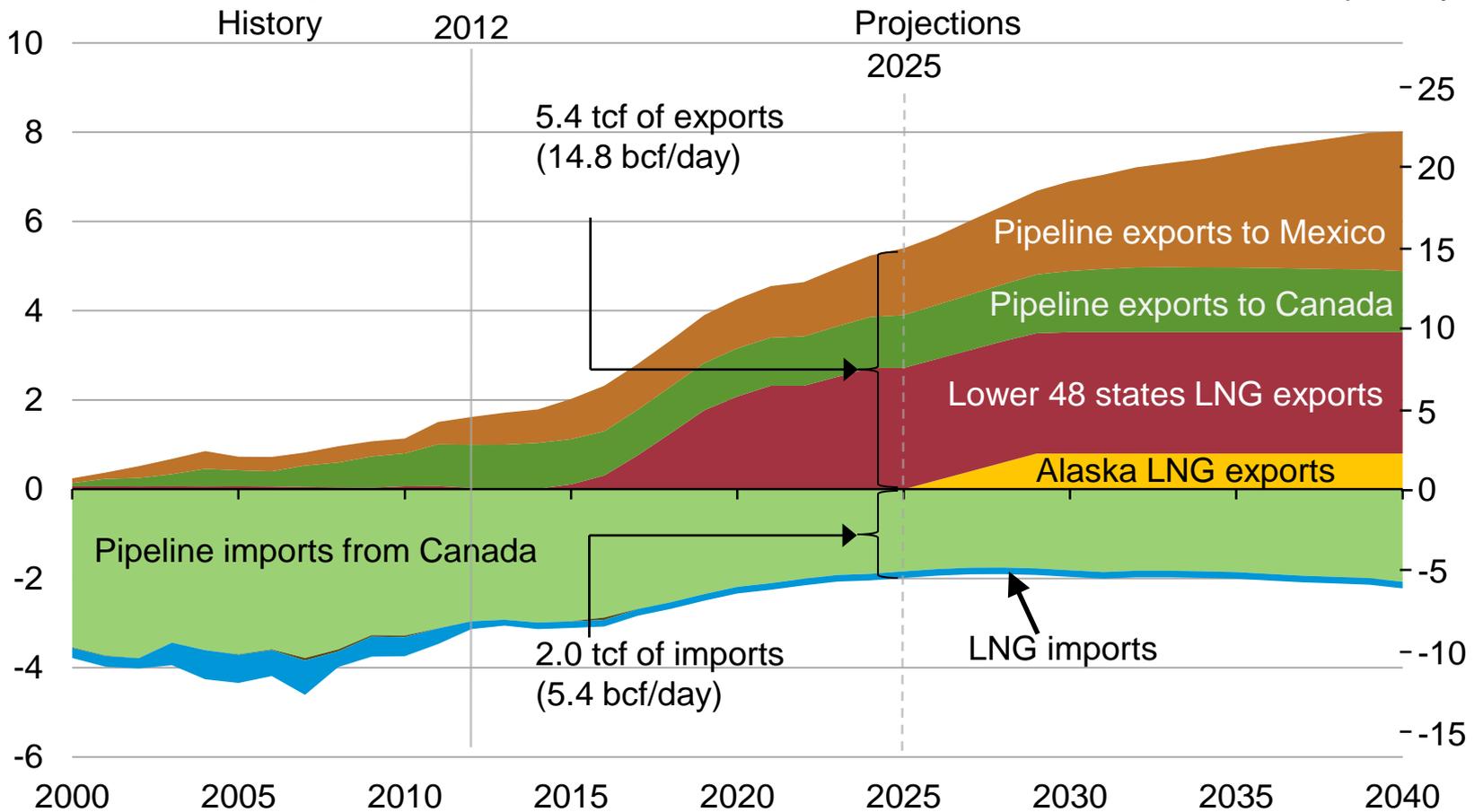
Source: EIA, Annual Energy Outlook 2014 Early Release

U.S. natural gas gross exports (and imports) AEO2014 Reference case

U.S. natural gas imports and exports

trillion cubic feet per year

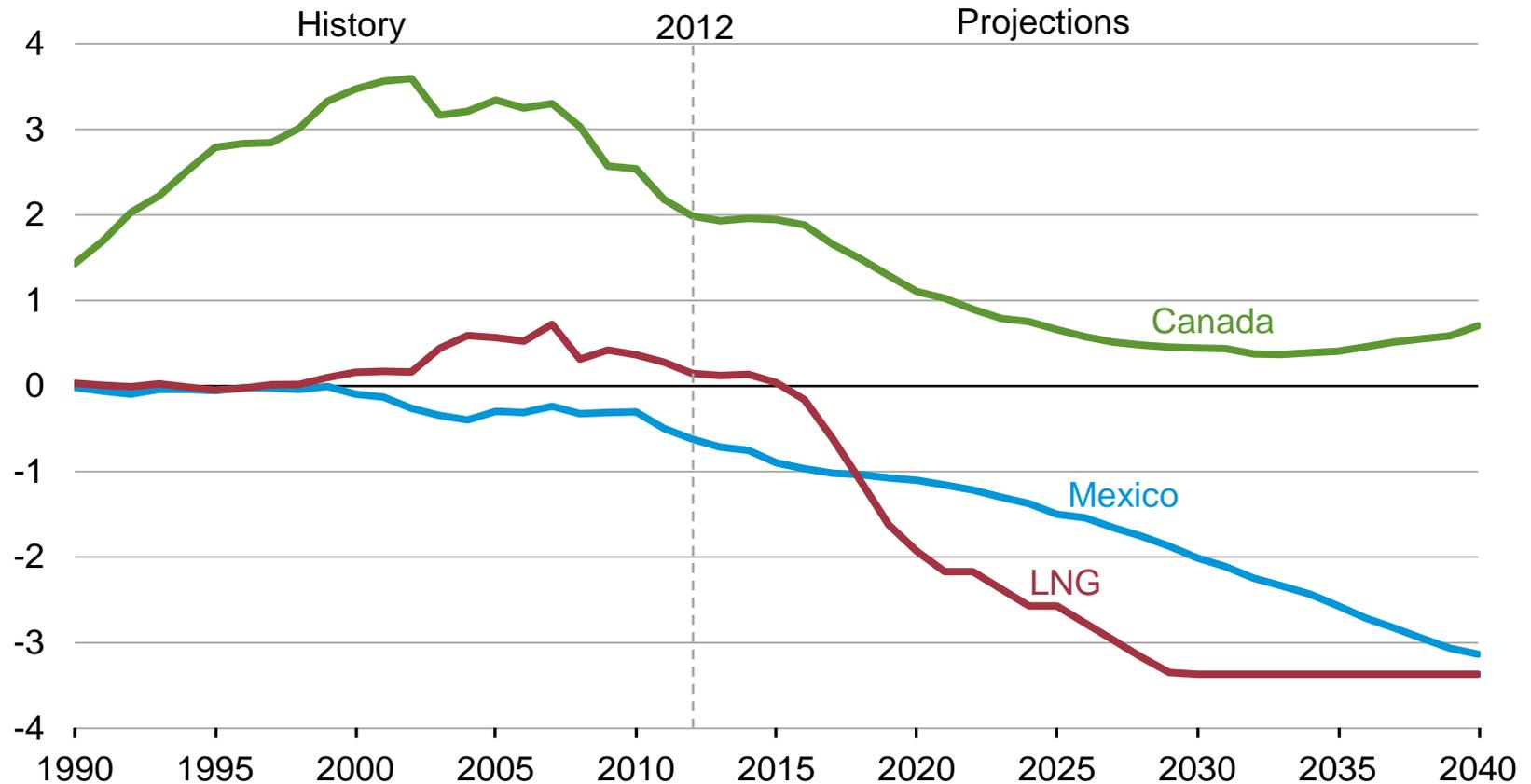
billion cubic feet per day



Source: EIA, Annual Energy Outlook 2014 Reference Case

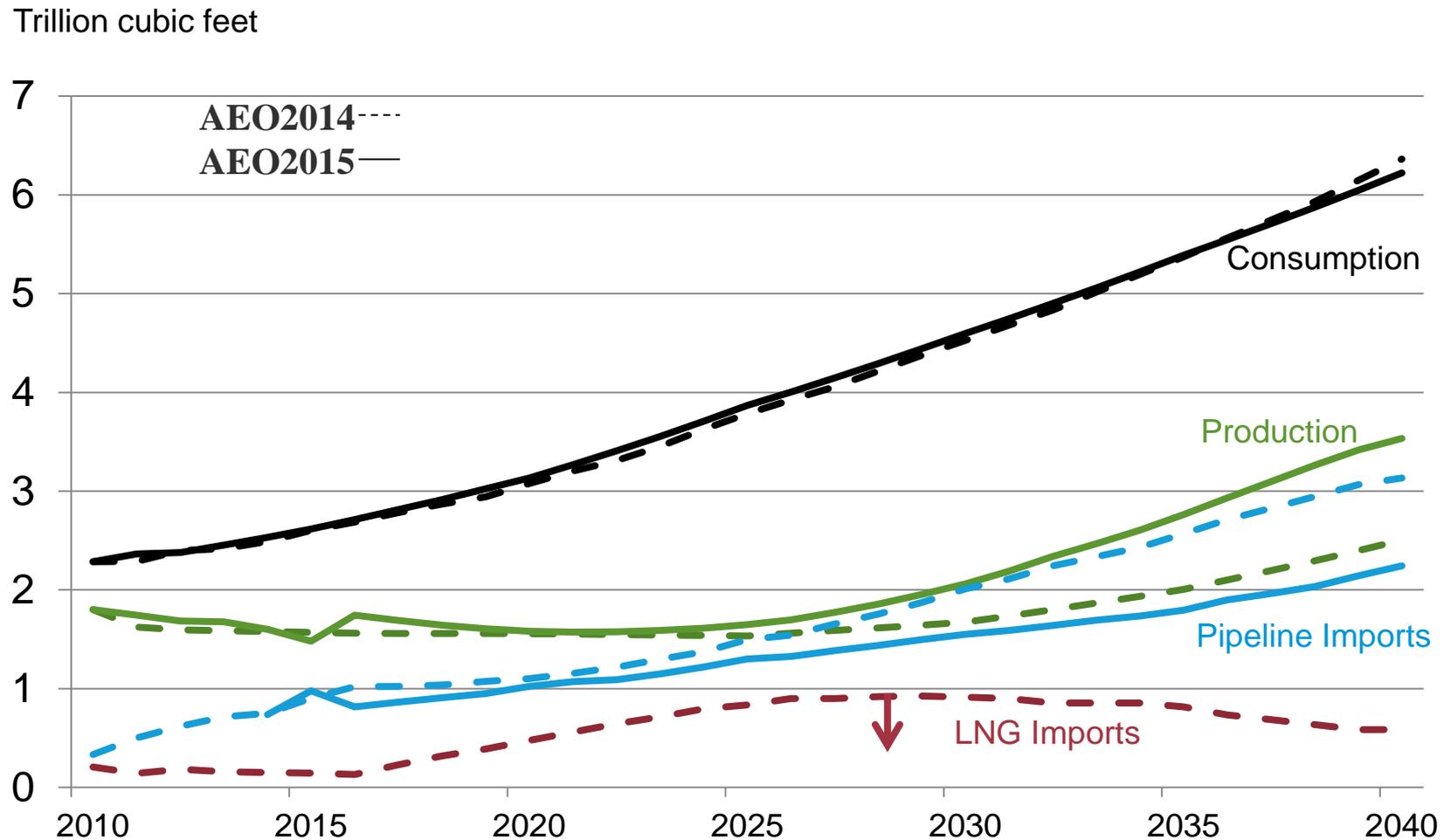
U.S. net imports of natural gas by source in the AEO2014 Reference case

natural gas net imports
trillion cubic feet



Source: EIA, Annual Energy Outlook 2014

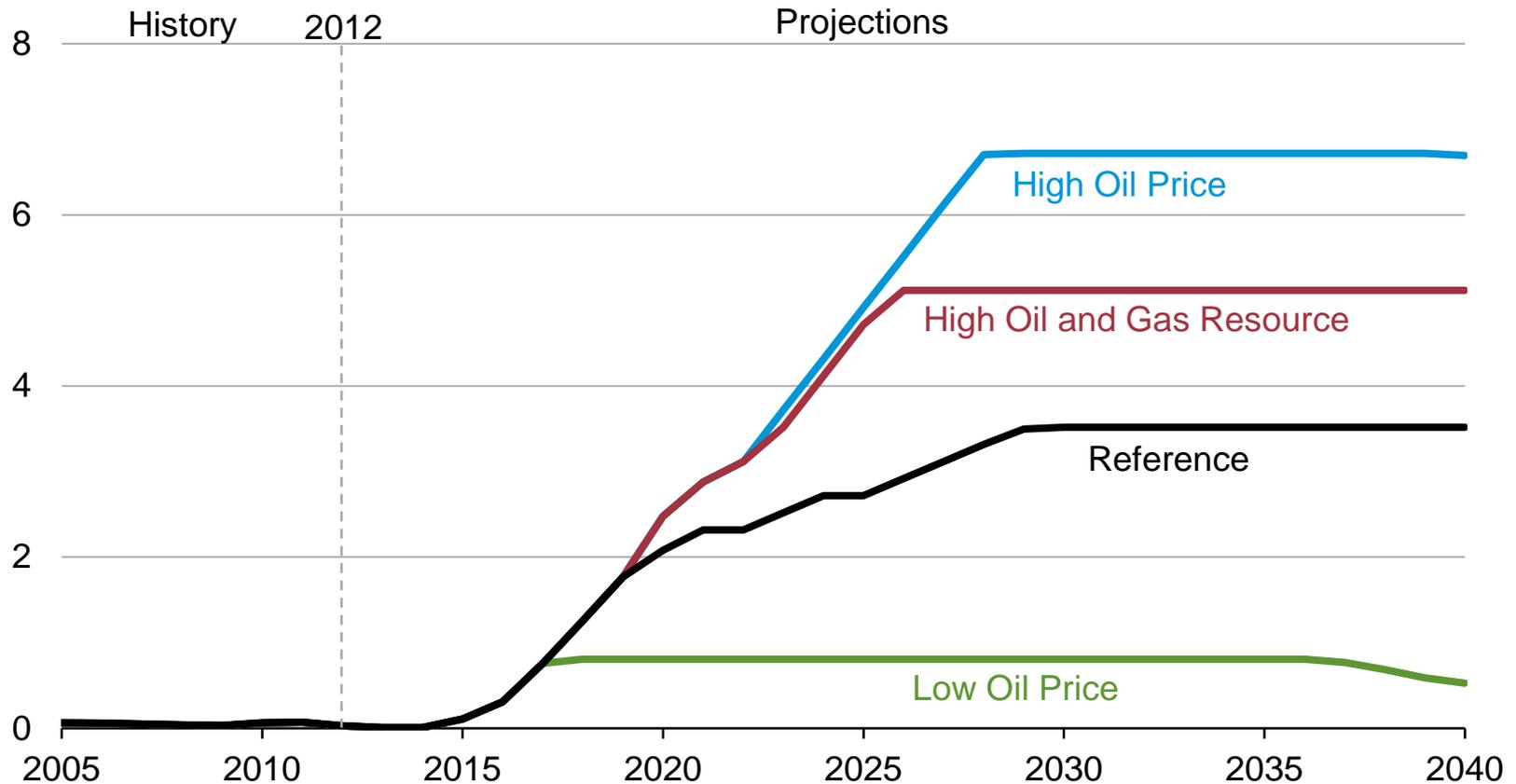
Mexico consumption, production, imports to Mexico, AEO2014 and AEO2015 (preliminary)



Source: Annual Energy Outlook 2014, preliminary AEO2015

U.S. exports of liquefied natural gas in four AEO2014 cases

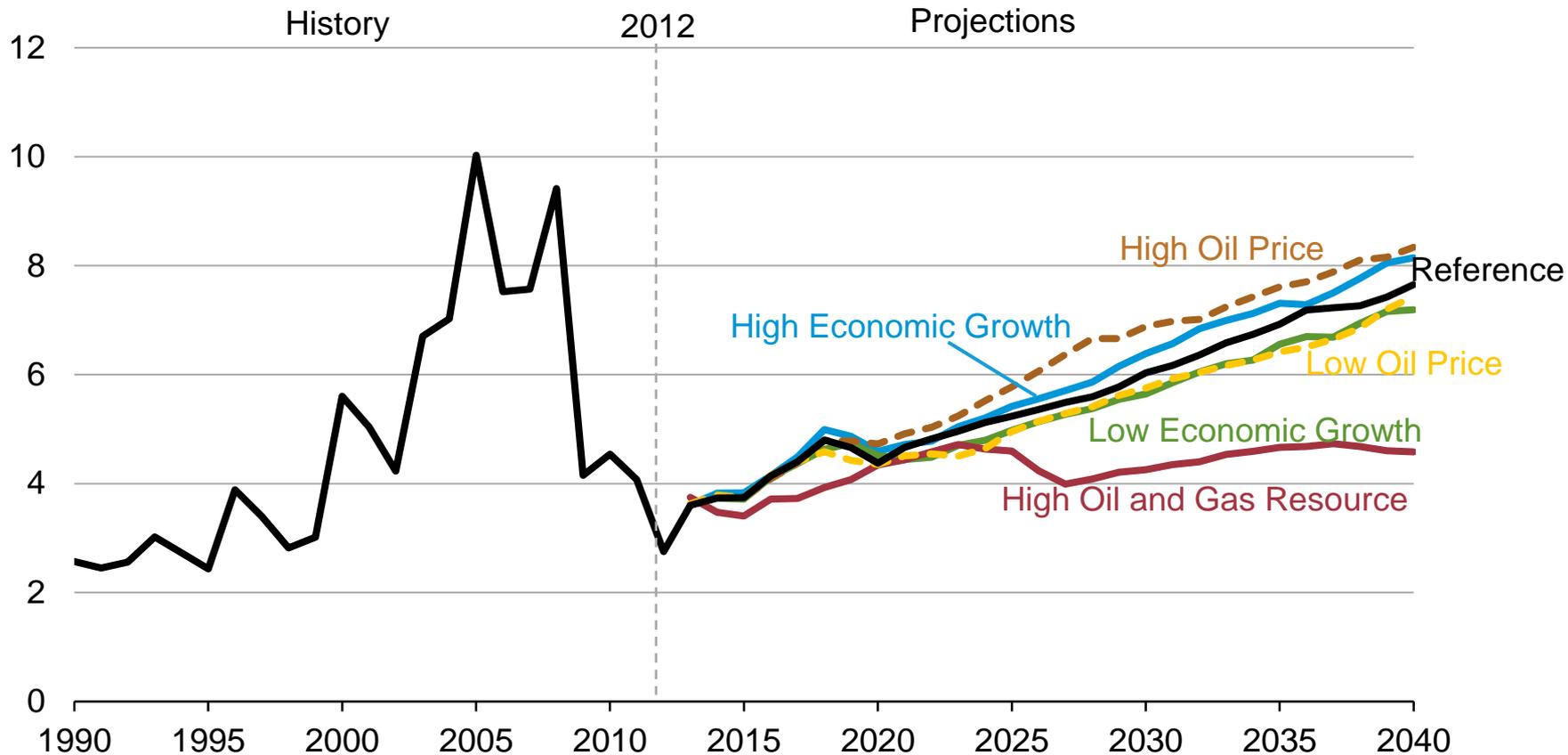
natural gas exports
trillion cubic feet



Source: EIA, Annual Energy Outlook 2014

Annual average Henry Hub spot prices for natural gas in six AEO2014 cases

natural gas spot prices
2012 dollars per million Btu



Source: EIA, Annual Energy Outlook 2014