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Effects of Removing Restrictions on U.S. Crude Oil Exports

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Preface

This report examines the implications of removing current restrictions on U.S. crude oil exports for the price of domestic and global marker crude oil streams, gasoline prices, domestic crude oil production, domestic refining activity, and trade in crude oil and petroleum products. The analysis, which builds on and extends previous studies and activities related to the implications of growing domestic crude production that the U.S. Energy Information Administration (EIA) has undertaken since May 2014, uses cases drawn from EIA's *Annual Energy Outlook 2015* (AEO2015) that incorporate a range of assumptions regarding domestic resource availability and world oil prices.

EIA studies and activities related to implications of increased crude oil production and possible relaxation or removal of crude oil export restrictions

Study/Activity	Publication Date
U.S. Crude Oil Production Forecast: Analysis of Crude Types	May 2014
Condensate Workshop	September 2014
What Drives U.S. Gasoline Prices?	October 2014
EIA's U.S. Crude Oil Import Tracking Tool: Selected Sample Applications	November 2014
Technical Options for Processing Additional Light Tight Oil Volumes within the United States	April 2015
Implications of Increasing Light Tight Oil Production for U.S. Refining	May 2015
U.S. Crude Oil Production to 2025: Updated Projection of Crude Types	May 2015
Effects of Removing Restrictions on U.S. Crude Oil Exports	*this study* (September 2015)

U.S. oil production has grown rapidly in recent years. Data reflecting combined U.S. production of crude oil and lease condensate show a rise from 5.6 million barrels per day (b/d) in 2011 to 8.7 million b/d in 2014. EIA's August 2015 *Short-Term Energy Outlook* forecasts U.S. crude oil production of 9.4 million b/d in 2015 and 9.0 million b/d in 2016, with the decrease in production between 2015 and 2016 reflecting recent and forecast changes in drilling activity following the sharp decline in oil prices since mid-2014. AEO2015 projects domestic production growth beyond 2016, although the pace and duration remain uncertain.

Recognizing that some options, such as like-for-like replacement of import streams, are inherently limited, the question of how the relaxation or removal of current limitations on crude exports might affect domestic and international markets for both crude oil and products continues to hold great interest for policymakers, industry, and the public.

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Executive Summary

Recent increases in domestic crude oil production and the prospect of continued supply growth have sparked discussion on the topic of how rising domestic crude oil volumes might be absorbed, including the possibility of removing or relaxing current restrictions on U.S. crude oil exports.

In response to requests from Congress[1] and the Administration, EIA developed several analyses that address these issues. Recent EIA reports have addressed gasoline price determinants (EIA, *What Drives U.S. Gasoline Prices?,* October 2014), changes in U.S. crude oil imports to accommodate increased domestic production (EIA, "Crude oil imports continue to decline," *This Week in Petroleum*, January 23, 2014), options for refinery capacity expansion (EIA, *Technical Options for Processing Additional Light Tight Oil Volumes within the United States*, April 2015), and refinery responses to higher, but fixed, levels of domestic crude oil production under both current crude oil export restrictions and with unrestricted crude oil exports (EIA, *Implications of Increasing Light Tight Oil Production for U.S. Refining*, May 2015). EIA also developed projections of domestic crude oil production by crude type through 2025 (EIA, *U.S. Crude Oil Production to 2025: Updated Projection of Crude Types*, May 2015), supplementing the overall production projection provided in the *Annual Energy Outlook 2015* (AEO2015) and updating a previous report issued in May 2014.

This report builds on these earlier efforts by applying EIA's energy models to directly compare cases over the next decade with and without the removal of current restrictions on crude oil exports. Four baseline cases using EIA's National Energy Modeling System are considered to reflect a range of outlooks for resources and technology as well as prices, which are key drivers of domestic crude oil production.

Current laws and regulations allow for unlimited exports of petroleum products, but require licensing of crude oil exports. Exports of crude oil to Canada for use there are presumptively granted licenses, as are exports of crude oil from Alaska's North Slope (ANS crude), re-exports of foreign-sourced crude, and certain exports from California. In addition, recent rulings by the U.S. Department of Commerce's Bureau of Industry and Security (BIS) have clarified that condensate processed through a distillation tower is classified as a petroleum product and is therefore exportable without a license.[2] For this analysis, EIA generally assumes that all streams with API gravity of 50 degrees and above (API 50+) would be eligible for processing and export under recent BIS guidance. Through the first five months of 2015, crude oil exports averaged 491,000 b/d. In addition, exports of processed condensate through the first five months of 2015 are estimated to have reached an average of 84,000 b/d.

[1] Requests from Congress include letters from Senators Murkowski and Landrieu (April 10, 2014) and Senators Cantwell and Wyden (February 3, 2014), which are provided in Appendix A. Questions on this matter have also been directed to Administrator Sieminski at several recent hearings.

[2] In addition, the Department of Commerce Bureau of Industry and Security is recently-reported to have approved one or more applications for the exchange of domestically produced light crude oil for heavy crude oil produced in Mexico (Reuters, "U.S. approves landmark crude oil export swaps with Mexico," August 14, 2015, http://www.reuters.com/article/2015/08/14/us-usa-oil-exports-exclusive-idUSKCN0QJ1RI20150814). This study does not consider this action or its impact on U.S. crude oil export and import volumes.

Although the current policies outlined above are characterized by some as a crude oil export ban, crude oil exports have been rising steadily in recent years (EIA, "Crude exports and re-exports continue to rise; some volumes sent to Europe and Asia," *Today in Energy*, October 31, 2014). Even with current restrictions, a further increase in crude exports, including additional flows to Canada and more exports of ANS crude, is possible. In this analysis, projections under current policies are compared to alternative cases that allow unrestricted exports of crude oil, paralleling the current treatment of petroleum product exports.

Key analysis results

The effects of eliminating restrictions on crude oil exports depend on the level of future domestic production, which itself depends on the characterization of resources and technology as well as future crude oil prices. Under current policies, projected domestic crude oil production (including lease condensate) in 2025 ranges from 9.5 million b/d in the Low Oil Price (LP) case to 13.6 million b/d in the High Oil and Gas Resource (HOGR) case, with production in other cases (the Reference case, and a case that combines HOGR with the LP case (HOGR/LP)) falling within this range (Table ES-1).

The discount of West Texas Intermediate (WTI) crude to North Sea Brent, the latter a key marker for waterborne light crudes, is expected to increase to more than $10/b in cases where current crude oil export policy is maintained and domestic production reaches or exceeds about 11.7 million b/d by 2025. Under current export policies, the Brent-WTI spread averages roughly $15/b over 2020-25 in the HOGR case, reflecting the price discount required to spur investment in additional processing capacity to convert incremental volumes of domestic crude oil into exportable petroleum products. In the Reference case, where production averages 10.4 million b/d over 2020-25, there is no need for a wider Brent-WTI spread to encourage more investment in domestic processing capacity additions. The average annual Brent-WTI spread remains close to $6/b in the Reference case whether or not restrictions on crude oil exports are removed, and unlike the HOGR case, projected total U.S. distillation capacity is the same whether current crude oil export restrictions are maintained or removed (Table ES-1). It should be noted that the $6/b–$8/b range for the Brent-WTI spread with unrestricted crude exports differs significantly from historic experience in which Brent and WTI typically traded close to parity. A Brent-WTI spread in the $6/b–$8/b range is consistent with the costs of moving WTI from Cushing, Oklahoma to overseas markets where it might compete with Brent. The historical situation of approximate parity reflected competition between Brent- and WTI-based crudes in the Gulf Coast and Cushing where Brent-based crudes have now been largely displaced.

In cases where the Brent-WTI spread grows beyond $6/b–$8/b, removal of current restrictions on crude oil exports would result in higher wellhead prices for domestic producers, who would then respond with additional production. This effect is evident in the HOGR and HOGR/LP cases, where projected levels of domestic production in 2025 in cases without export restrictions are, respectively, 3.5% (470,000 b/d) and 3.2% (380,000 b/d) higher than in corresponding cases that maintain current export policies. In contrast, in the Reference and LP cases, where projected annual average Brent-WTI spreads generally remain in the $6/b–$8/b range under current export restrictions, the removal of those restrictions does not increase wellhead prices or projected domestic crude oil production. In EIA's analysis, domestic production responds to the increase in domestic crude oil prices, if any, when crude

export restrictions are removed in each case. Any increase in domestic crude oil production that occurs because of the removal of restrictions on crude oil exports that is not offset by reduced production outside the United States would also represent an increase in global crude oil supplies, which in turn places downward pressure on global crude oil prices, as represented by Brent. To the extent that higher domestic production results in lower global crude prices, the increase in the absolute level of domestic crude prices will be smaller than the reduction in the Brent-WTI spread, which reflects both higher WTI prices and lower Brent prices.

Petroleum product prices in the United States, including gasoline prices, would be either unchanged or slightly reduced by the removal of current restrictions on crude oil exports. As shown in a previous EIA report (*What Drives U.S. Gasoline Prices?*, October 2014) petroleum product prices throughout the United States have a much stronger relationship to Brent prices than to WTI prices. In the high production cases considered in this study (HOGR and HOGR/LP), the elimination of current restrictions on crude oil exports narrows the Brent-WTI spread by raising the WTI price. As domestic producers respond to the higher WTI price with higher production, the global supply/demand balance becomes looser unless increased domestic production is fully offset by production cuts elsewhere. The looser balance implies lower Brent prices, which in turn results in lower petroleum product prices for U.S. consumers.

Combined net exports of crude oil and petroleum products from the United States are generally higher in cases with higher levels of U.S. crude oil production regardless of U.S. crude oil export policies. However, crude oil export policies materially affect the mix between crude and product exports, particularly in the HOGR and HOGR/LP cases, which have high levels of domestic production. The result regarding combined net exports of crude and petroleum products reflects a market in which domestic consumption of petroleum products is mainly driven by the economy, efficiency policies, and petroleum product prices and does not depend significantly on the level of U.S. crude oil production. Looking at the composition of trade, crude oil exports tend to represent a larger share of combined crude and product exports in cases where crude oil exports are unrestricted. Also, in cases where the level of domestic crude production increases with the removal of crude oil export restrictions, total combined crude and product exports are higher than in parallel cases with current crude export restrictions in place.

Refiner margins (measured as the spread between crude input costs and wholesale product prices), which tend to increase as the Brent-WTI spread widens, would be lower without current restrictions on crude oil exports than with them in high-production cases where export restrictions lead to a widening Brent-WTI spread. If domestic crude oil production reaches a level where current restrictions on crude oil exports result in a need for significant additional processing capacity to convert domestic crude into petroleum products that can be exported, the discount of domestic crude prices compared with global crudes such as Brent will widen to encourage investment in such capacity, notwithstanding the risk of future changes in crude oil export policy or market conditions. For owners of existing refinery capacity, a wider Brent-WTI spread will provide higher margins as refined product prices continue to move with global crude prices. In high-production cases, the removal of export restrictions limits growth of the Brent-WTI spread (Table ES-1), limiting growth in refining margins. However, even with

the removal of export restrictions, the projected Brent-WTI spread would still be higher than its average level in 2014. For upstream oil producer margins, the opposite prevails – in addition to an increase in production in cases where unrestricted crude oil exports result in higher domestic prices, production that would occur with or without a change in crude oil export policy is more profitable with domestic wellhead prices that are not held down by crude oil export restrictions.

Although unrestricted exports of U.S. crude oil would either leave global crude prices unchanged or result in a small price reduction compared to parallel cases that maintain current restrictions on crude oil exports, other factors affecting global supply and demand will largely determine whether global crude prices remain close to their current level, as in the Low Oil Price case, or rise along a path closer to the Reference case trajectory. While removing restrictions on U.S. crude oil exports either leaves global prices unchanged or lowers them modestly, global price drivers unrelated to U.S. crude oil export policy will affect growth in U.S. crude oil production and exports of crude oil and products whether or not current export restrictions are removed.

Caveats

The results of this study are sensitive to key assumptions used in the modeling as well as the structural features of EIA's model. Differences between the results obtained in this study and other analyses that address the same subject may result from differences in models or assumptions.

Characterization of current crude oil export policies. As noted above, current policies restrict, but do not ban, crude oil exports, and they are also assumed to allow exports of API 50+ material that is processed through a distillation tower. The use of a more restrictive characterization of current policies, which some other studies have applied, would likely show crude oil export restrictions to be binding at lower domestic production volumes and show larger effects from their removal for cases in this analysis in which they already have an impact on domestic production and crude export volumes.

Ability to back out existing crude oil imports. To date, import substitution has been a key part of the response to increased domestic crude oil production (EIA "U.S. crude oil production growth helps reduce Gulf Coast imports," *Today in Energy*, June 22, 2015). Between 2011 and 2014, U.S. light crude imports (35 API or greater) decreased by 1.0 million b/d, while imports of medium crude (27 API up to 35 API) decreased by 0.8 million b/d. Heavy crude imports (below 27 API) remained relatively flat in 2011 and 2012, but they have increased since 2013. Consistent with recent experience, the analysis assumes that import substitution or import shifting (for example, reducing imports of medium crudes and increasing imports of heavy crude for blending with light domestic streams) continues to be an option. However, import substitution must remain economic to continue. For example, refiners would be unlikely to back out heavy crude imports needed to keep their coking units fully charged, particularly since suppliers of such crudes may not be able to find alternative markets, and may therefore discount their prices. More severe limits on continued import substitution, up to and including the assumption in some studies that it is nearly impossible to back out any remaining imports, would result in domestic processing capacity to become constrained at somewhat lower levels of domestic crude oil production than in this analysis.

Additions of domestic processing capacity. After increasing significantly in 2012, U.S. crude processing capacity has been rising more slowly over the past few years. Nevertheless, several splitter and refinery

projects are currently underway. This report allows for additional expansion of domestic processing capacity in high production cases, although potential investors in such projects are assumed to require high and rapid return on their investment in new processing facilities, whose economic value could be adversely affected by future changes in crude oil export policy. More restrictive assumptions regarding barriers to incremental refining capacity investments, including an assumption in some studies that no new investment in U.S. processing capacity could occur given the risk of a subsequent change in crude oil export policy, could increase the challenge to increased domestic crude production under current crude export policies. The effects of more restrictive assumptions regarding investment in processing capacity would likely be most significant in cases that assume high resource availability (HOGR, HOGR/LP).

Global production response to incremental U.S. production. This study assumes a partial global offset to increases in U.S. crude oil production. A larger (e.g., full offset) or smaller (e.g., no offset) global production response would respectively increase or reduce the size of the projected increase in domestic crude prices and domestic production associated with the removal of export restrictions in the high resource (HOGR and HOGR/LP) cases, while respectively reducing or increasing the projected decline in crude and petroleum product prices at home and abroad.

Table ES-1. Summary results for U.S. petroleum markets with (res) and without (unr) crude oil export restrictions across EIA cases in 2025

				2025											
	History			Reference case			LP case			HOGR case			HOGR/LP case		
Selected results	**2013**	**2014**	**1q15**	**res**	**unr**	**dif**	**res**	**unr**	**dif**	**res**	**unr**	**dif**	**res**	**unr**	**dif**
Crude oil (million b/d)															
Total domestic crude production	7.46	8.71	9.48	10.28	10.28	0.00	9.46	9.47	0.00	13.63	14.10	0.47	11.69	12.07	0.38
Net crude imports	7.60	6.99	6.84	6.23	6.22	(0.01)	6.56	6.57	0.01	4.22	2.03	(2.19)	4.83	4.19	(0.64)
Crude imports	7.73	7.34	7.28	6.88	6.86	(0.02)	7.19	7.20	0.01	5.41	5.68	0.26	6.16	6.55	0.39
Crude exports	0.13	0.35	0.45	0.65	0.64	(0.01)	0.63	0.63	0.00	1.20	3.64	2.45	1.33	2.36	1.03
Non-crude petroleum and other liquids supply (million b/d)															
Net product imports	(1.36)	(1.95)	(1.89)	(3.33)	(3.32)	0.01	(2.07)	(2.08)	(0.01)	(5.40)	(3.63)	1.78	(3.12)	(2.88)	0.24
Product imports	2.13	1.88	2.12	2.39	2.39	0.00	2.99	2.98	(0.01)	2.24	2.25	0.02	2.83	2.82	0.00
Product exports	3.49	3.83	4.01	5.72	5.71	(0.01)	5.06	5.07	0.00	7.64	5.88	(1.76)	5.95	5.70	(0.24)
All other non-crude supply[1]	5.14	5.54	5.44	6.51	6.51	0.00	6.24	6.24	0.01	7.61	7.53	(0.07)	7.06	7.10	0.04
Total primary supply for domestic use[2]	18.83	19.30	19.87	19.69	19.70	0.00	20.19	20.19	0.00	20.05	20.04	(0.01)	20.46	20.48	0.02
Crude oil and petroleum product trade (million b/d)															
Net crude oil and petroleum product imports	6.24	5.04	4.95	2.90	2.90	0.00	4.49	4.48	(0.01)	(1.19)	(1.60)	(0.41)	1.71	1.31	(0.40)
Crude oil and petroleum product imports	9.86	9.22	9.40	9.27	9.25	(0.02)	10.18	10.18	0.00	7.65	7.93	0.28	8.99	9.38	0.39
Crude oil and petroleum product exports	3.62	4.18	4.45	6.37	6.35	(0.01)	5.69	5.70	0.00	8.84	9.53	0.69	7.28	8.06	0.79
Processing operations[3]															
Total distillation capacity (million b/cd)[4]	17.82	17.92	17.97	19.25	19.25	0.00	19.25	19.25	0.00	20.15	19.25	(0.90)	19.36	19.25	(0.11)
Total distillation unit inputs (million b/d)[5]	15.72	16.15	15.78	16.51	16.50	0.00	16.03	16.04	0.01	17.84	16.13	(1.71)	16.52	16.26	(0.26)

Table ES-1. Summary results for U.S. petroleum markets with (res) and without (unr) crude oil export restrictions across EIA cases in 2025 (cont.)

				2025											
	History			Reference case			LP case			HOGR case			HOGR/LP case		
Selected results	**2013**	**2014**	**1q15**	**res**	**unr**	**dif**	**res**	**unr**	**dif**	**res**	**unr**	**dif**	**res**	**unr**	**dif**
Crude oil prices (2013 $/b)[6]															
Brent spot	108.56	97.22	53.45	90.40	90.23	(0.18)	63.01	63.01	0.00	81.39	80.47	(0.92)	56.31	55.78	(0.54)
West Texas Intermediate spot	97.98	91.60	48.07	84.32	84.15	(0.17)	57.50	57.47	(0.03)	66.39	72.26	5.87	42.33	47.65	5.32
Brent-WTI spread	10.58	5.62	5.38	6.08	6.08	0.00	5.51	5.54	0.03	15.00	8.21	(6.79)	13.98	8.13	(5.85)
Average petroleum product prices (2013 $/gallon)[6]															
Motor gasoline (all sectors)[7]	3.58	3.38	2.34	2.91	2.90	0.00	2.37	2.37	0.00	2.66	2.65	(0.01)	2.20	2.19	(0.01)
Diesel (transportation sector)[8]	3.92	3.76	2.89	3.46	3.46	0.00	2.78	2.78	0.00	3.18	3.17	0.00	2.53	2.52	(0.01)

Sources: U.S. Energy Information Administration, *Petroleum Supply Monthly*, *Short-Term Energy Outlook*, *Refinery Capacity Report,* and Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System. Totals may not equal sum or difference of components due to independent rounding.

[1]All other non-crude supply includes refinery processing gain, product stock withdrawal, natural gas plant liquids, supply from renewable sources, liquids from gas, liquids from coal, and other supply.

[2]Historical values equal total petroleum product supplied (or U.S. petroleum product consumption) plus the average daily change in crude oil and petroleum product inventories.

[3]Includes both splitter and atmospheric distillation unit capacity and throughput.

[4] Equals total operable atmospheric crude oil distillation capacity as of January 1 of each calendar year.

[5]Historical volumes include unfinished oils, whereas projected volumes include only crude oil volumes.

[6]Historical prices calculated with historical values from the *Short-Term Energy Outlook*, adjusted to 2013 prices using the Consumer Price Index (all urban consumers).

[7]U.S. all grades retail price, including taxes.

[8]U.S. retail price, including taxes.

Introduction and Background

Recent increases in domestic crude oil production and the prospect of continued supply growth have sparked discussion on the topic of how rising domestic crude oil volumes might be absorbed, including the possibility of removing or relaxing current restrictions on U.S. crude oil exports. In response to requests from Congress[3] and the Administration, EIA developed several analyses that address these issues (Table 1).

Table 1. EIA studies and activities related to implications of increased crude oil production and possible relaxation or removal of crude oil export restrictions

Study/Activity	Publication Date
U.S. Crude Oil Production Forecast: Analysis of Crude Types	May 2014
Condensate Workshop	September 2014
What Drives U.S. Gasoline Prices?	October 2014
EIA's U.S. Crude Oil Import Tracking Tool: Selected Sample Applications	November 2014
Technical Options for Processing Additional Light Tight Oil Volumes within the United States	April 2015
Implications of Increasing Light Tight Oil Production for U.S. Refining	May 2015
U.S. Crude Oil Production to 2025: Updated Projection of Crude Types	May 2015
Effects of Removing Restrictions on U.S. Crude Oil Exports	*this study* (September 2015)

This report examines the effects of eliminating current restrictions on exports of domestically produced crude oil, drawing on cases from EIA's *Annual Energy Outlook 2015* (AEO2015). There are four cases that reflect different outlooks for future crude oil production and prices. Each of the four cases is run in a baseline version, reflecting current policies that restrict, but do not entirely ban, crude oil exports, and in an alternative version without any crude oil export restrictions. A summary of the baseline assumptions in each of these cases is shown below in Table 2.

[3] Requests from Congress include letters from Senators Murkowski and Landrieu (April 10, 2014) and Senators Cantwell and Wyden (February 3, 2014), which are provided in Appendix A. Questions on this matter have also been directed to Administrator Sieminski at several recent hearings.

Table 2. Comparison of baseline assumptions in the Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases

Case	Case overview
Reference	Assumes global crude oil prices continue to fall through 2015, before increasing to $75/b (all prices in 2013 dollars) in 2018; after 2018, growth in demand from non-OECD countries pushes the projected Brent price in 2025 to $90/b
Low Oil Price (LP)	Assumes lower world demand for petroleum products, higher OPEC upstream investment, and lower non-OPEC exploration and development costs; these factors hold the projected price for Brent crude oil in 2025 to $63/b, well below the level in the Reference case projection
High Oil and Gas Resource (HOGR)	Reflects more optimistic assumptions about domestic crude oil and natural gas supply prospects than the Reference case; these assumptions result in significantly higher domestic production, which reaches 13.6 million b/d in 2025 (versus 10.3 million b/d in the Reference case), and leads to the Brent crude oil price rising to $81/b by 2025 (versus $90/b in the Reference case)
High Oil and Gas Resource/ Low Oil Price (HOGR/LP)	Combines assumptions from the HOGR and LP cases; the projected price for Brent crude oil rises to $56/b in 2025; lower world oil prices also reduce the impact of more optimistic resource assumptions on domestic production, which reaches 11.7 million b/d in 2025, higher than production in the Reference case but lower than production in the HOGR case

Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

The implications of removing current restrictions on crude oil exports depend significantly on the amount of domestic crude production. The baseline cases considered in this report reflect widely varying perspectives regarding two key factors that drive domestic production: world oil prices and domestic crude oil supply potential. The world oil price trajectory reflects global supply and demand factors including world economic growth, decisions by major oil exporters, energy efficiency policies that affect oil demand, and geopolitical developments. AEO2015 includes the Reference and Low Oil Price (LP) cases, which span a wide range of future price outcomes. Domestic supply potential is characterized by the extent of the domestic hydrocarbon resource base and the pace of advances in production technology.

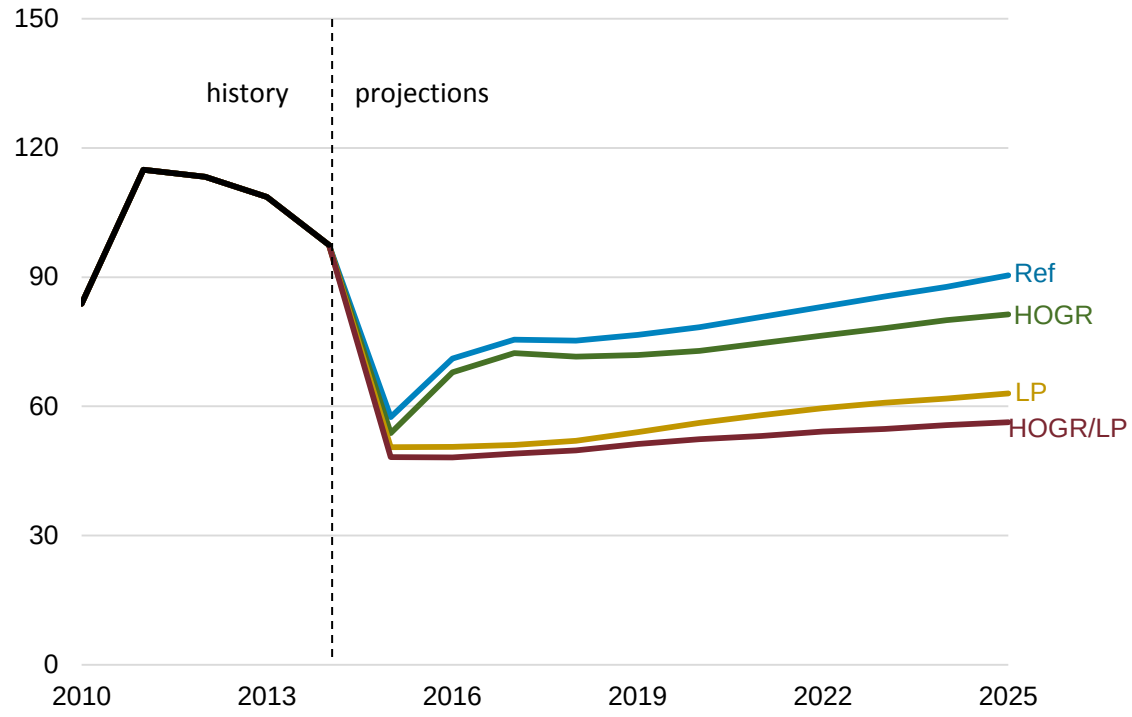
The Reference and High Oil and Gas Resource (HOGR) cases in AEO2015 reflect alternate views of domestic supply potential. The HOGR case uses Reference case global supply and demand conditions to

determine pricing in global crude oil markets, but it includes higher levels of U.S. production that reflect a combination of more abundant resources and better technology than assumed in the Reference case. Another case considered in this study, the High Oil and Gas Resource/Low Oil Price (HOGR/LP) case, combines HOGR case resource assumptions with assumptions regarding global supply and demand conditions from the LP case to determine pricing in global crude markets. The HOGR/LP case reflects a situation where resources and technology conditions support strong domestic production growth in a setting where low global crude prices have the opposite effect.

Oil price paths across the Reference, LP, HOGR, and HOGR/LP cases are shown in Figure 1. Domestic crude oil production levels for the same four baseline cases are shown in Figure 2. Domestic production responds to both oil prices and the domestic resource/technology characterization. The Reference and LP cases both use the Reference case domestic resource/technology assumptions, while the HOGR and HOGR/LP cases reflect more optimistic domestic resource/technology assumptions.

Figure 1. Brent crude oil price projections by case with current crude oil export restrictions, 2010-25

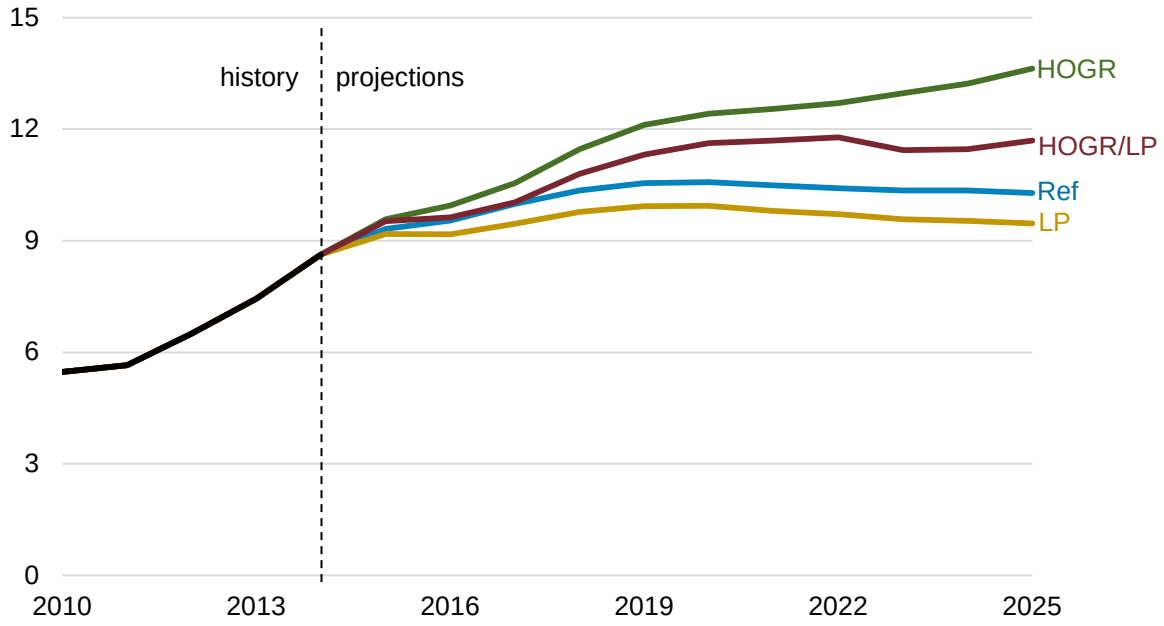
2013 dollars per barrel



Sources: U.S. Energy Information Administration, National Energy Modeling System Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Figure 2. Total U.S. crude oil production projections by case with current crude oil export restrictions, 2010-25

million barrels per day



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System. Includes production of lease condensate.

Export policy assumptions

Current policy allows for unrestricted exports of petroleum products, but requires licensing of crude oil exports. Exports of crude oil to Canada for use within that country are presumptively granted licenses, as are exports from Alaska's North Slope and certain heavy crude oil exports from California. In addition, recent rulings by the U.S. Department of Commerce's Bureau of Industry and Security (BIS) have classified condensate processed through a distillation tower as exportable without a license.[4]

For this analysis, EIA generally assumes that all crude oil streams with API gravity[5] of 50 degrees and above (API 50+) are eligible for processing and export under recent BIS guidance. However, to reflect uncertainty surrounding the interpretation of current BIS guidance, the report also considers the implications of a more restrictive interpretation of current policy that does not allow exports of API 50+ material to grow beyond the level of exports of processed condensate in the first quarter of 2015.

[4] In addition, BIS reportedly approved on August 14, 2015 applications for the exchange of domestically produced light crude oil for heavy crude oil produced in Mexico (Reuters, "U.S. approves landmark crude oil export swaps with Mexico", August 14, 2015, http://www.reuters.com/article/2015/08/14/us-usa-oil-exports-exclusive-idUSKCN0QJ1RI20150814). This study does not consider this action or its impact on U.S. crude oil export and import volumes.

[5] American Petroleum Institute measure of specific gravity of crude oil or condensate in degrees, an arbitrary scale expressing the gravity or density of liquid petroleum products. The measuring scale is calibrated in terms of degrees API; it is calculated as follows: Degrees API = (141.5 / specific gravity 60 deg.F/60 deg.F) - 131.5.

Options for accommodating increased crude oil production

There are three main pathways to accommodate increased domestic crude oil production without the need for significant investments in new processing capacity: (1) displacement of imported crude streams where economically justified; (2) increased crude runs through existing domestic processing capacity, yielding petroleum products that can be sold in domestic and global markets; (3) increased crude exports (including condensates) consistent with current restrictions.

In considering the pathway involving displacement of imported crudes, market conditions for particular grades of imported crude oil are an important factor. For example, given the profitability of coker operations in heavy conversion refineries and limited global markets for heavy crudes, heavy crudes from the Americas were assumed to compete favorably for access to U.S. coking capacity and remain sufficiently price-competitive with U.S. light crude. This view of the market for heavy crude oil results in high utilization rates for coking units located at U.S. refineries that do not vary significantly across analysis cases with different levels of domestic crude oil production.

Under conditions where domestic crude production would rise beyond a level that can be absorbed using the three pathways identified above, two additional options come into play: (1) adding new domestic distillation capacity to process additional volumes of crude oil into petroleum products that can be sold in either domestic or global markets; and (2) declining domestic crude prices that discourage production of crude oil. As a practical matter, these two options work together, because the lowering of domestic light crude prices compared with global crudes makes investment in additional processing capacity more economically attractive.

With current restrictions in place, domestic crude prices are expected to decline compared with global crude prices in cases where production rises beyond the volumes that can be accommodated using the three pathways that do not require new refinery investments. As the spread between global and domestic crude prices widens, which is represented by the difference between North Sea Brent (Brent) and West Texas Intermediate (WTI) prices, investment in new capacity to process additional crude becomes economically attractive because petroleum product prices are more closely tied to Brent than WTI prices, as shown in an EIA analysis of linkages between crude and product prices.[6]

A May 2015 report commissioned by EIA from Turner-Mason[7] suggests that a hydroskimming refinery, which consists of an atmospheric distillation unit (ADU) to distill light crude oil and a modest set of secondary processing units,[8,9] would be among the most attractive types of capacity to add for

[6] U.S. Energy Information Administration, *What Drives U.S. Gasoline Prices?*, October 2014, http://www.eia.gov/analysis/studies/gasoline/.

[7] U.S. Energy Information Administration, *Implications of Increasing Light Tight Oil Production for U.S. Refining*, May 2015, http://www.eia.gov/analysis/studies/petroleum/morelto/.

[8] It is assumed that a hydroskimmer refinery with a 100,000 barrel-per-stream-day (b/sd) ADU would include 20,000-b/sd heavy naphtha, light naphtha, kerosene, and diesel hydrotreater units, as well as a 20,000-b/sd heavy naphtha reformer unit, and a 5,000-b/sd gas processing unit.

[9] Barrels per stream day reflects the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude oil and product slate conditions with no allowance for downtime. For

processing additional light sweet crude oil. A hydroskimming refinery is a good match for light crude oil's distillation yield and would also be less expensive than a full cracking refinery. However, potential investors in new hydroskimming capacity would need to take account of policy risk as well as traditional market risks.[10] For example, the value of additional capacity, once built, could be materially reduced by the subsequent removal of restrictions on crude oil exports. The investment risk issue and its implications for the size of the Brent-WTI spread that might be required to encourage investment in new hydroskimming capacity were examined in a recent EIA report, *Technical Options for Processing Additional Light Tight Oil Volumes within the United States*, released in April 2015.

The alternative export policy scenario considered in this report assumes the removal of current restrictions on U.S. crude oil exports. With the ability to sell crude in the global market without restriction, the gap between global and domestic crude prices does not widen to a level sufficient to foster hydroskimmer investments even in cases where domestic crude oil production rises to 11.7 million b/d or more.

Caveats regarding the analysis

EIA recognizes that projections of energy markets over an extended period are highly uncertain and subject to many events that cannot be foreseen, such as supply disruptions, policy changes, and technological breakthroughs. This uncertainty is particularly true in projecting the effects of relaxing U.S. crude oil export restrictions because of the following factors:

- **Characterization of current crude oil export policy.** Characterizing the current crude oil export restrictions as allowing exports of API 50+ crude oil streams is an assumption that does not necessarily fully reflect current U.S. policy. The use of more restrictive current policies, which some other studies have applied, will result in restricted-exports scenarios with lower crude oil export and production volumes and will show larger effects from removing crude oil export restrictions.

- **Ability to back out existing crude oil imports.** To date, import substitution has been a key part of the response to increased domestic crude oil production.[11] Between 2011 and 2014, U.S. light crude oil imports (35 API gravity or greater) decreased by 1.0 million b/d, while imports of medium crude (27 API up to 35 API) decreased by 0.8 million b/d. Heavy crude imports (below 27 API) remained relatively flat, but they have increased since 2013. Consistent with recent experience, the analysis assumes that import substitution or import shifting (for example, reducing medium imports in favor of heavy imports for blending with light domestic streams)

more information, see U.S. Energy Information Administration, "U.S. refinery capacity reaches 18 million barrels per day," *Today in Energy*, June 25, 2015, http://www.eia.gov/todayinenergy/detail.cfm?id=21812.

[10] For a description of refinery types discussed in the paper, please see, U.S. Energy Information Administration, *Technical Options for Processing Additional Light Tight Oil Volumes within the United States*, April 2015, http://www.eia.gov/analysis/studies/petroleum/lto/, and U.S. Energy Information Administration, *Implications of Increasing Light Tight Oil Production for U.S. Refining*, May 2015, http://www.eia.gov/analysis/petroleum/crudetypes/pdf/crudetypes.pdf.

[11] U.S. Energy Information Administration, "U.S. crude oil production growth helps reduce Gulf Coast imports," *Today in Energy*, June 22, 2015, http://www.eia.gov/todayinenergy/detail.cfm?id=21752.

continues to be an available option. However, import substitution must remain economic to continue. For example, operators would be unlikely to back out heavy crude oil imports needed to keep their coking units fully charged, particularly since suppliers of such crudes may not be able to find alternative markets, and will therefore have to discount their prices as well. More severe limits on continued import substitution, up to and including the assumption in some studies that it is nearly impossible to back out any remaining imports, would result in domestic processing capacity becoming constrained at somewhat lower levels of domestic crude production than occur in this analysis.

- **Global crude oil market response**. When U.S. crude oil export restrictions are removed, resulting in higher levels of U.S. crude oil production and a narrower Brent-WTI price spread, this report assumes a response from overseas producers that is limited to the effect of lower Brent crude prices resulting from the greater availability of U.S. crude on world markets. If foreign production were to decrease in response to an increase in competing U.S. crude oil supply, there would likely be a somewhat greater positive effect on domestic production, but a smaller reduction in domestic product prices, from lifting U.S. crude oil export restrictions.

- **Modeling**. The National Energy Modeling System (NEMS) is not a world energy model and does not address the interaction among multiple international regions and the United States.

- **Aggregate versus individual company actions**. Individual company economic incentives to export crude oil will differ from the average industry incentives to export crude oil, and will depend on the individual sales options and logistical advantages they may have.

- **Price volatility and markets**. NEMS is an annual modeling system. As such, NEMS does not address the role of short-term price volatility that may affect both production and trade. NEMS also does not consider the effect of possible changes in the shape of the crude oil forward curve.[12]

Experience in accommodating increased domestic crude oil production since 2009

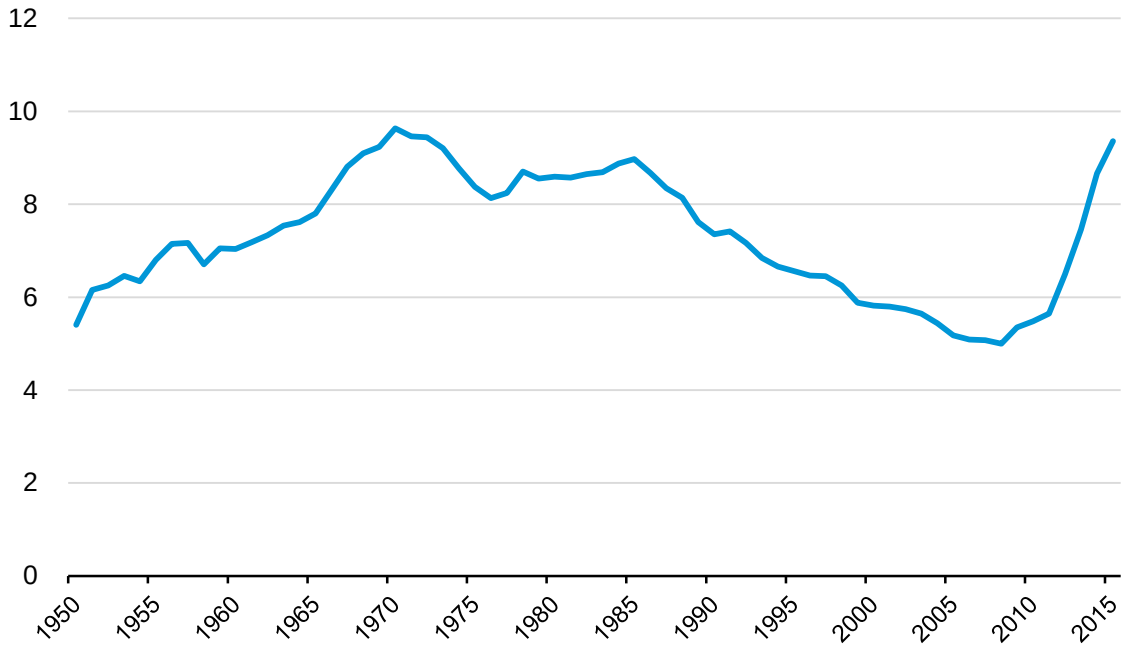
In 2009, after declining steadily since 1985 (with the exception of a 60,000 barrels per day (b/d) increase in 1991), crude oil production in the United States increased by 350,000 b/d to 5.4 million b/d. Since 2009, annual production has continued to rise, averaging 8.7 million b/d in 2014 and 9.5 million b/d in the first five months of 2015 (Figure 3).

[12] The shape of the forward curve can directly affect the economics of crude exports. With an upward-sloping (contango) forward curve, crude exports may be economic at a lower Brent-WTI spread at a given point in time; the opposite applies for downward-sloping forward curve, with the market in backwardation.

The experience in processing rapid domestic crude oil production growth in recent years illustrates some pathways that could play a role in accommodating future domestic production growth. Roughly 90% of all U.S. crude oil production growth from 2011 to 2014 consisted of light sweet crude oil with API gravity greater than 40 degrees and sulfur content less than 0.5% by weight.[13] The growth in production resulted primarily from the use of horizontal drilling in conjunction with multistage hydraulic fracturing to develop tight oil resources in areas including the Bakken, Eagle Ford, and Niobrara formations and the Permian Basin. EIA's monthly *Drilling Productivity Report* closely follows tight oil and shale gas production in these and other key regions.

Figure 3. Annual U.S. crude oil production, 1950-2015

million barrels per day



Source: U.S. Energy Information Administration, *Petroleum Supply Annual* and *Short-Term Energy Outlook*.
Note: 2015 crude oil production is a forecast from August 2015 *Short-Term Energy Outlook*.

Before 2010, domestically produced crude oil and crude oil imported into the Gulf Coast supplied the major crude oil trading and distribution hub at Cushing, Oklahoma, which also serves as the pricing location for the New York Mercantile Exchange light sweet crude oil futures contract. Northbound pipelines from the Gulf Coast and inland Texas moved both imported crude oil and domestic production, which was concentrated in Texas and the Federal Gulf of Mexico, to Cushing. This supply pattern defined the relationship between the price of Brent and WTI crude oil. The Brent-WTI spread moved in a range

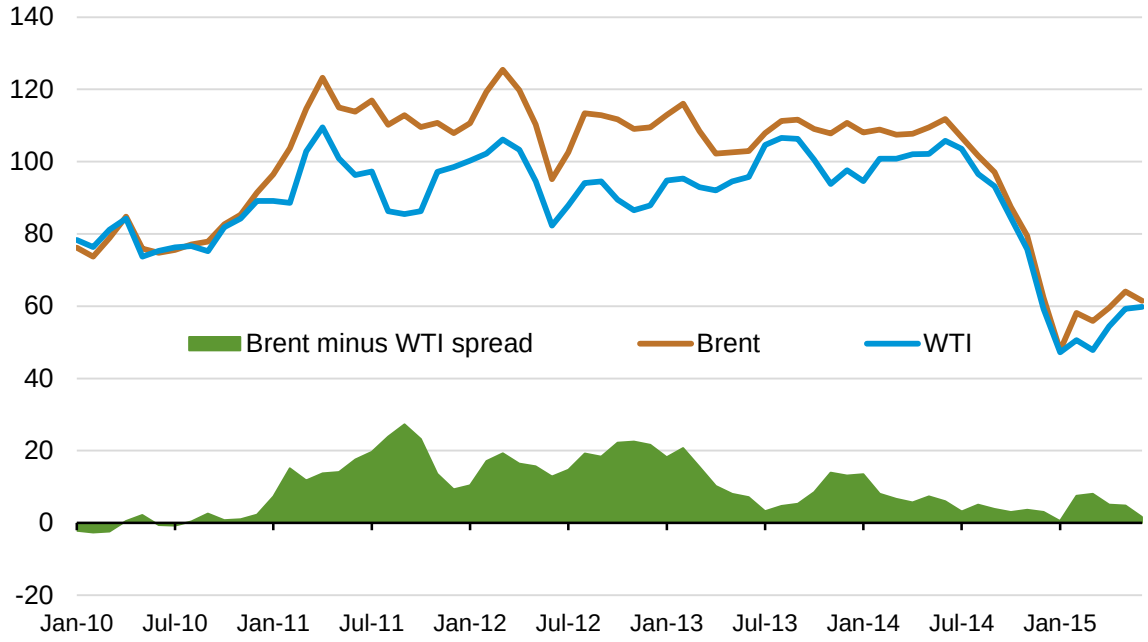
[13] EIA, *U.S. Crude Oil Production to 2025: Updated Projection of Crude Types*, May 2015, http://www.eia.gov/analysis/petroleum/crudetypes/pdf/crudetypes.pdf.

around zero as shifting market conditions affected crude oil supply/demand balances, with Brent priced at a slight discount to WTI on average.

The rapid growth of production from tight oil plays in the United States, as well as the development of oil sands in Canada, dramatically changed crude flows in the United States. By 2011, as increased flows of Canadian and U.S. crudes reached Cushing, the previous requirement for northward flows of Brent-linked crudes into Cushing was largely eliminated, and Cushing itself became glutted with crude supply. This situation created a requirement to ship crude oil from Cushing to the U.S. Gulf Coast, where roughly half of total U.S. refining capacity is located. Reflecting these new conditions, the Brent-WTI spread widened, averaging $16/b in 2011 and $18/b in 2012, with spreads of $20/b for limited periods in the second half of both years (Figure 4).

Figure 4. Monthly average Brent and WTI prices, January 2010 to June 2015

nominal dollars per barrel



Source: U.S. Energy Information Administration, based on Thomson Reuters.

The sustained large WTI discount to Brent encouraged additional infrastructure investment, including new and expanded pipeline capacity to move crude from Cushing to refining centers in the Gulf Coast, as well as crude-by-rail loading and unloading facilities to move crude oil from the new producing regions directly to refining centers on the Gulf Coast, East Coast, and West Coast. In 2014, almost 800,000 b/d of crude moved by rail between the five major regions for which EIA reports oil data, compared with just 13,000 b/d in 2010. Rail movements have averaged 776,000 b/d in the first five months of 2015. In 2014, 609,000 b/d of crude moved by pipeline from the Midwest (where the Cushing hub is located) to the Gulf Coast, compared with 136,000 b/d in 2010 and 52,000 b/d in 2009. The Brent-

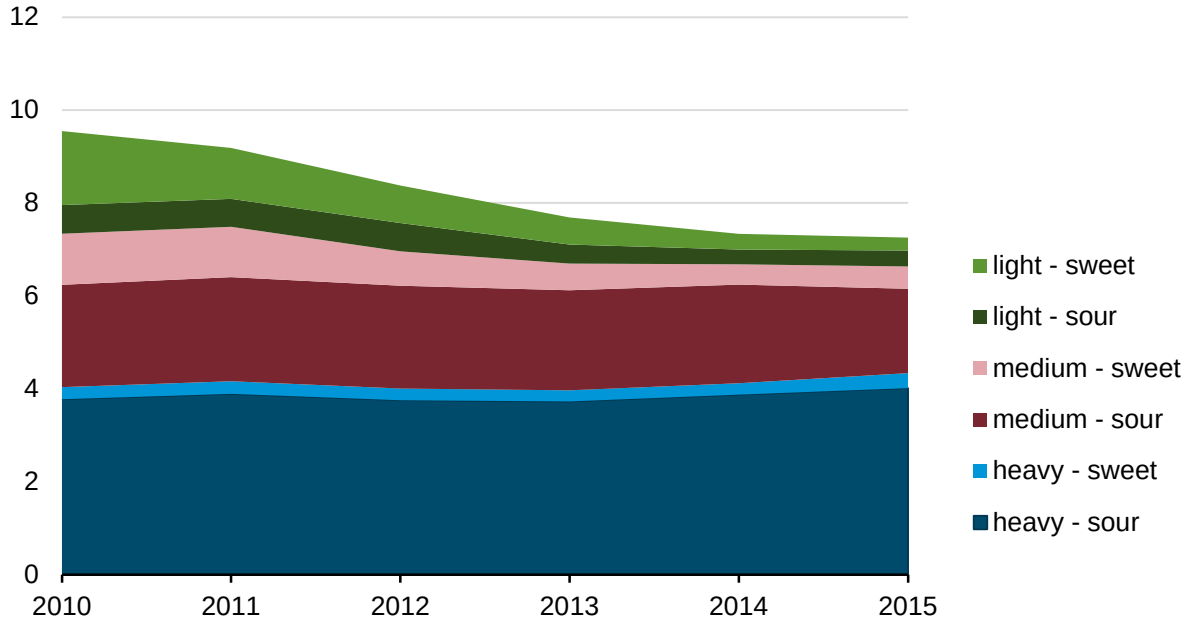
WTI spread remained positive throughout 2014 and the first eight months of 2015, but it is significantly lower than it was during 2011 and 2012.

Refiners adjusted the volume and mix of crude qualities processed (crude slates) to accommodate the increased flows of U.S. and Canadian production, only some of which provided a like-for-like replacement of the imported streams that were displaced by the new North American streams. As discussed in EIA's April 2015 report *Technical Options for Processing Additional Light Tight Oil Volumes Within the United States*,[14] U.S. refineries have accommodated much of the growth in U.S. crude production from 2010 to 2014 with two limited- or no-investment-cost options: displacing imports of crude oil (primarily light crude, but also medium crude) from countries other than Canada, and increasing refinery utilization rates.

Over this period, domestic crude production increased by 3.2 million b/d, crude imports fell by 1.9 million b/d (Figure 5), and refinery crude inputs increased by 1.1 million b/d.

Figure 5. Annual U.S. crude oil imports by type, 2010-15

million barrels per day



Source: U.S. Energy Information Administration, *Petroleum Supply Annual* and *Petroleum Supply Monthly*.
Note: 2015 crude oil imports value is a daily average from January through May from *Petroleum Supply Monthly*.

In 2010, total U.S. imports of light sweet crude oil averaged 1.6 million b/d, of which about 1.2 million b/d was sourced from Africa. By 2014, imports of light sweet crude oil into the United States had dropped to 338,000 b/d (of which only about 80,000 b/d was from countries in Africa). Through the first five months of 2015, imports of light sweet crude averaged 279,000 b/d, including 50,000 b/d coming

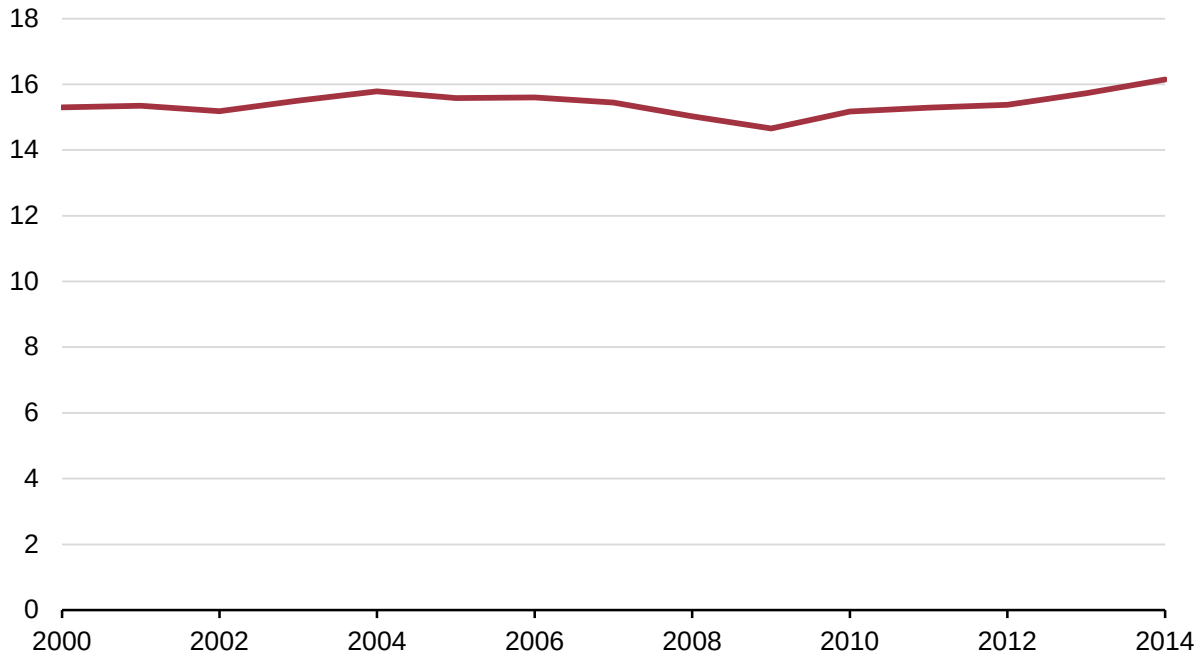
[14] http://www.eia.gov/analysis/studies/petroleum/lto/.

from Africa. Imports of light sour and medium sweet crude oil have also declined as refineries adjusted crude slates to balance increased inputs of light sweet crude oil produced in the United States. Adjustments to balance crude slates also partially explain the slight increase in heavy sour crude imports since 2010; however, heavy sour crude imports from Canada also increased to supply Midwest refineries that have added coker capacity.[15]

Gross inputs to U.S. refineries totaled a multi-decade high 16.1 million b/d in 2014, increasing 1.4 million b/d from 14.7 million b/d in 2009 (Figure 6). Through the first five months of 2015, gross inputs have continued to average 16.1 million b/d. The increase resulted from a combination of refinery capacity expansions, the return to service of previously idled refinery capacity, and increased utilization of overall capacity. Most of the increase in operating refinery capacity[16] is attributable to the expansion project at Motiva's Port Arthur, Texas, facility and the restart of the Trainer refinery in Pennsylvania. Utilization rates increased over this period[17] because of high refinery margins that resulted from high global petroleum product prices in combination with relatively lower crude oil and natural gas costs for U.S. refineries as compared to refineries outside the United States.

Figure 6. Annual U.S. refinery gross inputs, 2000-14

million barrels per day



Source: U.S. Energy Information Administration, *Petroleum Supply Annual*.

[15] EIA, "Midwest refineries boost capacity for heavy crude oil," *This Week in Petroleum*, March 27, 2013, http://www.eia.gov/petroleum/weekly/archive/2013/130327/twipprint.html.

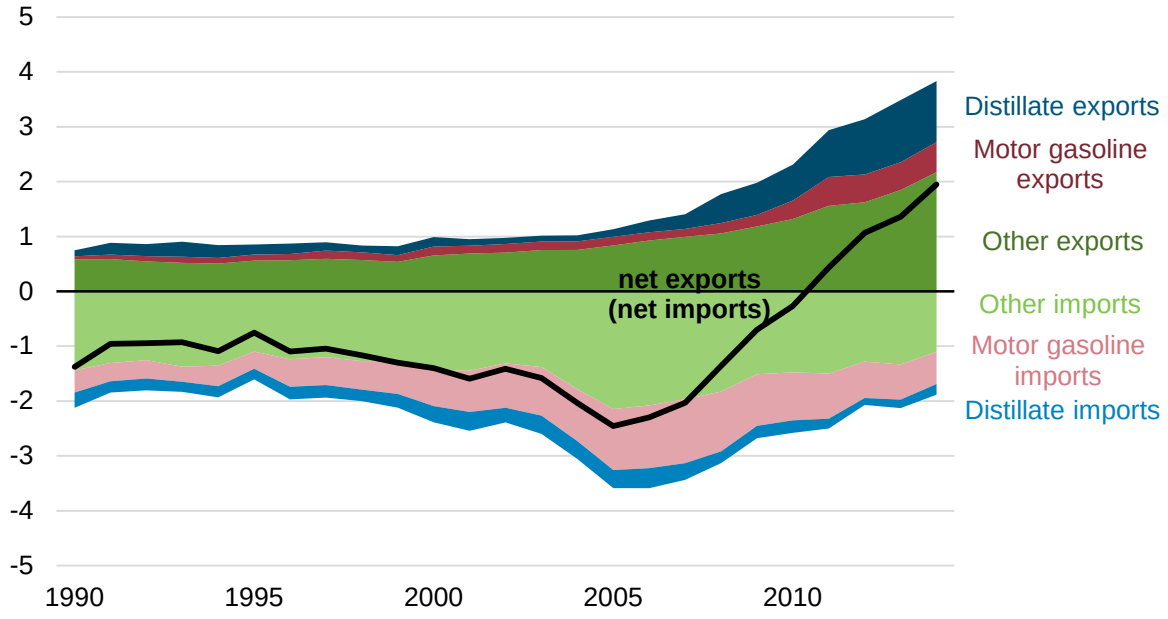
[16] EIA, "U.S. refinery capacity: Restarts and expansions increased capacity in 2012, with continuing changes in the first half of 2013," *This Week in Petroleum*, June 26, 2013, http://www.eia.gov/petroleum/weekly/archive/2013/130626/twipprint.html.

[17] EIA, "U.S. refineries run at record high throughputs," *This Week in Petroleum*, August 5, 2015, http://www.eia.gov/petroleum/weekly/archive/2015/150805/includes/analysis_print.cfm.

With U.S. demand for petroleum products slightly declining from 2010 through 2014, the increase in refinery production of gasoline, diesel, and other products from higher refinery inputs was exported to supply the global petroleum products market. These higher petroleum product exports, combined with lower product imports, shifted the United States from being a net petroleum product importer to a net product exporter in 2011. Gross product imports in 2011 were 2.5 million b/d and gross exports were 2.9 million b/d. From 2011 to 2014, this trend strengthened, as exports continued to increase and imports decreased. By 2014, U.S. net petroleum product exports had increased to 2.0 million b/d, compared with 0.4 million b/d in 2011. The increase in U.S. net product exports from 2011 to 2014 resulted from a decrease in gasoline imports, an increase in distillate exports, and both a decrease in imports and an increase in exports of other products (Figure 7). Through the first five months of 2015, U.S. net petroleum product exports have averaged 2.0 million b/d.

Figure 7. Annual U.S. petroleum product trade, 1990-2014

million barrels per day



Source: U.S. Energy Information Administration, *Petroleum Supply Annual.*

Most exports of petroleum products from the United States are from the Gulf Coast. Gulf Coast refineries are generally very competitive in the global market because of access to cost-advantaged crude oil and natural gas, significant upgrading capability, and proximity to demand centers in Latin America. Typically, about 90% of gasoline exports from the Gulf Coast are delivered within the Western Hemisphere. However, small volumes now routinely reach Africa and, less often, Asia. As discussed in an earlier EIA report, *What Drives U.S. Gasoline Prices* (October 2014),[18] gasoline exports to Asia typically

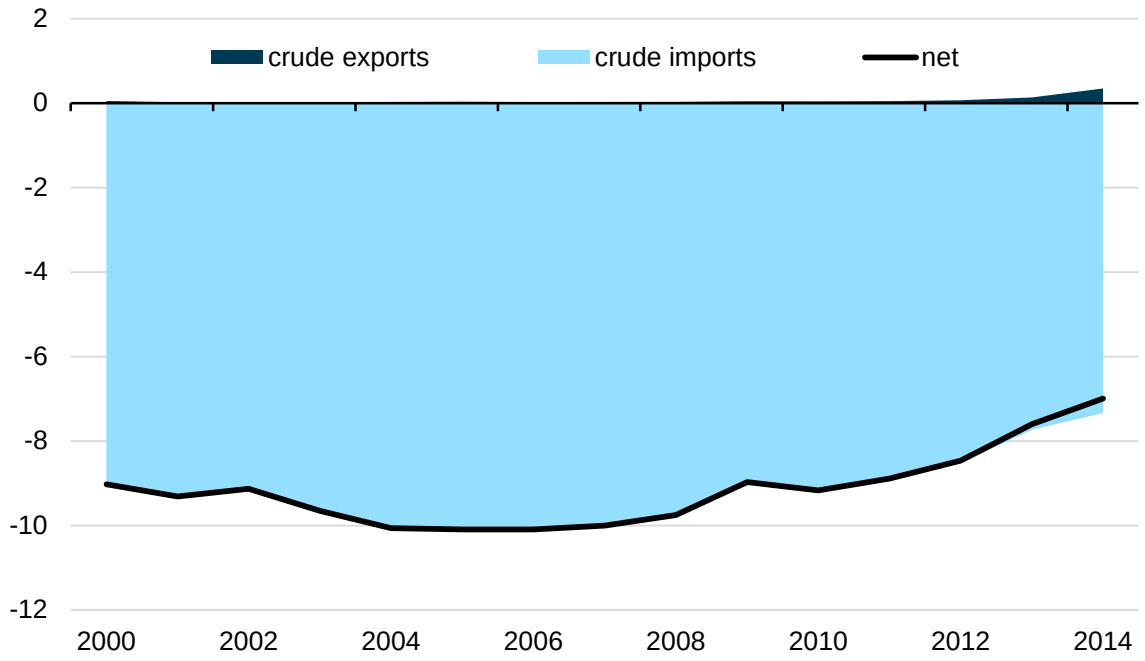
[18] U.S. Energy Information Administration, *What Drives U.S. Gasoline Prices?* October 30, 2014, http://www.eia.gov/analysis/studies/gasoline/.

peak in the winter months when U.S. demand is seasonally low. Gulf Coast distillate production is exported almost exclusively to the Atlantic Basin market, with about 50% delivered to Central America and South America, 35% to Europe, and 12% to North America, primarily Mexico.

Finally, notwithstanding existing restrictions on the export of U.S. crude oil production, increased crude oil exports have played some role in accommodating the increasing volumes of U.S. crude oil production (Figure 8). Notably, gross exports of crude oil to Canada increased from 46,000 b/d in 2011 to 324,000 b/d in 2014 and averaged 460,000 b/d through the first five months of 2015. Several shipments of ANS crude have also occurred recently.

Figure 8. Annual U.S. net crude oil imports, 2000-14

million barrels per day



Source: U.S. Energy Information Administration, *Petroleum Supply Annual.*

Although the Bureau of Industry and Security (BIS) considers condensate at the wellhead to be crude oil, in mid-2014 it responded to classification requests filed by market participants with rulings that condensate processed through a distillation tower is a refined petroleum product and therefore is not subject to the restricted licensing regime for crude oil exports. In December 2014, BIS published Frequently Asked Questions[19] related to the requirements for exporting crude oil and refined petroleum products. In the first five months of 2015, exports of processed condensate were estimated to average 84,000 b/d.

[19] U.S. Department of Commerce, Bureau of Industry Security. "FAQs – Crude Oil and Petroleum Products December 30, 2014," http://www.bis.doc.gov/index.php/licensing/embassy-faq?view=category&id=114#subcat171.

Results

Overview and organization

This report considers the effects of removing crude oil export restrictions in the context of four baseline cases. These cases encompass a wide range of outcomes with respect to crude oil and petroleum product prices, domestic crude oil production, trade flows for both crude oil and petroleum products, and domestic processing capacity levels and utilization patterns. Differences across the baseline cases highlight the wide range of future levels of oil prices and domestic crude oil production that may be realized whether or not current restrictions on crude oil exports are retained or removed (Figures 1 and 2).

Turning to the effects of removing restrictions on crude oil exports, the level of domestic production in each baseline case (Figure 2) is a key determinant of the differences, if any, between baseline outcomes and those that occur in a case that removes current crude oil export restrictions but otherwise uses the same assumptions.

In the Reference and Low Oil Price (LP) cases, which both use Reference case assumptions about resource and technology availability, domestic crude production rises modestly but does not exceed the capability of U.S. refiners to economically process domestic crude production after accounting for opportunities for further crude oil import substitution and the possibility of increased crude oil exports allowed under current restrictions. Under these conditions, the removal of export restrictions does not change domestic crude oil prices or production volumes.[20]

Domestic supply potential is significantly greater in cases that use more optimistic assumptions about resources and technology, as in the High Oil and Gas Resource (HOGR) and HOGR/Low Oil Price (HOGR/LP) cases. With higher domestic supply potential, the pathways identified in the previous paragraph are not capable of accommodating available domestic supply under current crude oil export restrictions. As a result, domestic crude prices fall compared with global crude prices, but domestic prices for petroleum products such as diesel and motor gasoline remain tied to the prices of crude oil and products in the global market. The increasing spread between domestic crude and product prices, which follows the widening of the Brent-WTI spread, encourages the addition of new domestic capacity to process additional volumes of crude oil into petroleum products that can be sold in both domestic and global markets. The wider Brent-WTI spread reflects a significant supply of domestic crude that is not easily accommodated through no- and low-cost pathways given current restrictions on crude exports.

Under these conditions, the absence of export restrictions on crude would change domestic crude prices, domestic crude production volumes, and trade flows. This results in a more favorable outcome for domestic crude producers (higher domestic crude prices and production volumes), and to a lesser extent, domestic consumers of gasoline and other petroleum products, who benefit from slightly lower

[20] The Brent-WTI spread is a direct indication of the profitability of light crude exports. The higher the Brent price and the lower the WTI price, the more profitable it is to export crude from U.S. ports.

petroleum product prices as additional domestic crude production volumes exert downward pressure on global crude oil prices. Domestic refiners, however, see lower processing margins as competition with overseas crude buyers for domestic production leads them to pay more for their crude inputs while product prices decline slightly.

The situation outlined above, and explored in more detail below, presents a challenge to policy makers. Given the range of cases considered in this analysis, most of which include rising price paths for both crude oil and petroleum products, even sectors or groups that would stand to benefit from the removal of crude oil export limitations, such as gasoline consumers, may see future price increases for reasons totally unrelated to decisions regarding the removal or retention of existing crude oil export restrictions. For example, should a removal of export restrictions on crude oil be followed by a rise in gasoline prices, it is unlikely that consumers would respond favorably to an argument that prices would have increased even more if crude oil export restrictions had remained in effect.

The subsections below present the results of the analysis, organized by topic rather than analysis case. The following topics are considered: Crude oil prices (prices and price spreads); petroleum product prices (mainly gasoline); domestic production; trade in crude oil and petroleum products (exports, imports, and net trade); and processing capacity, utilization, and refiner and producer revenues. Appendix B provides tables that summarize the analysis results for all cases for the years 2015, 2020, and 2025. Detailed tables for all model runs are available through EIA's AEO table browser application.

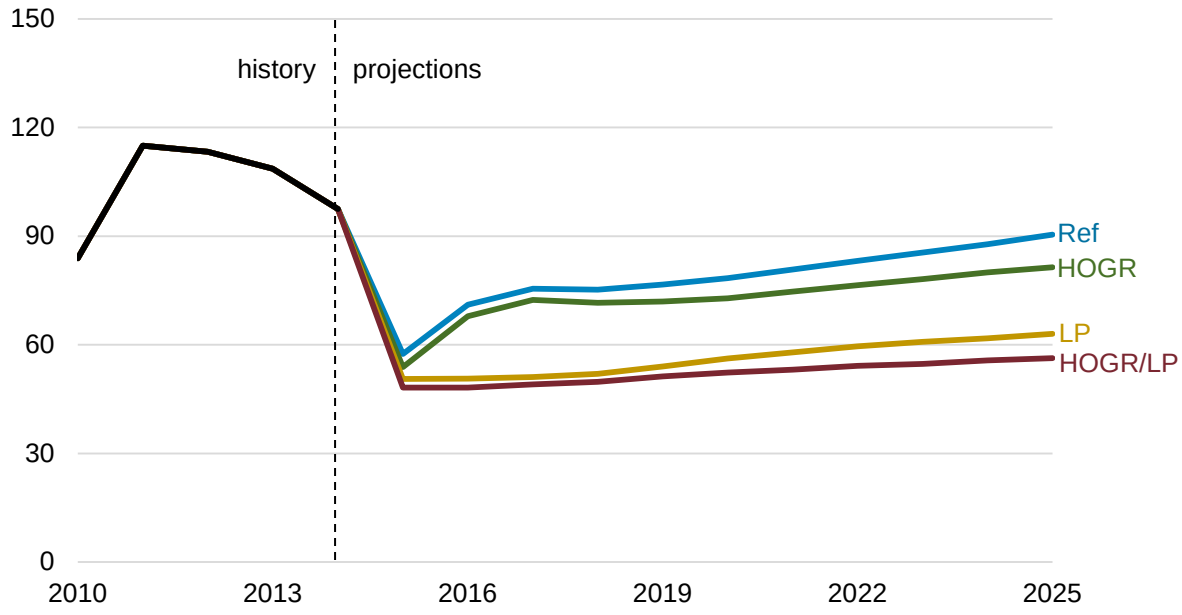
Crude oil prices

As previously noted, the price of Brent[21] and other global crude streams reflects global supply and demand factors including world economic growth, decisions by major oil exporters, energy efficiency policies that affect oil demand, and geopolitical developments, as well as the availability of U.S. crude oil resources. Assumptions about these factors, which vary across the baseline cases used in this report, have a major effect on both domestic and global crude oil prices (Figure 9a and Table 3). EIA's *Annual Energy Outlook 2015* (AEO2015) provides additional information regarding the specific demand and supply assumptions for each of the Reference, LP, and HOGR baseline cases shown in Figure 9a.

[21] Across all cases, the Brent spot price reflects the market price for light sweet crude oil free on board (FOB) at the Sullom Voe oil terminal in Scotland.

Figure 9a. Brent crude oil price projections by case with current crude oil export restrictions, 2010-25

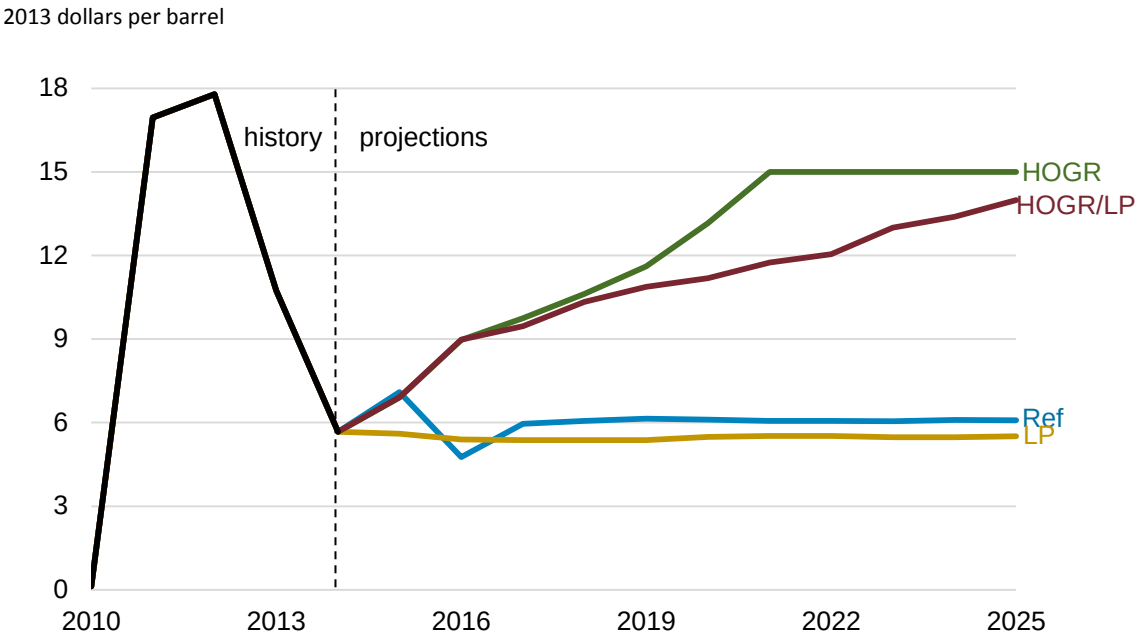
2013 dollars per barrel



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

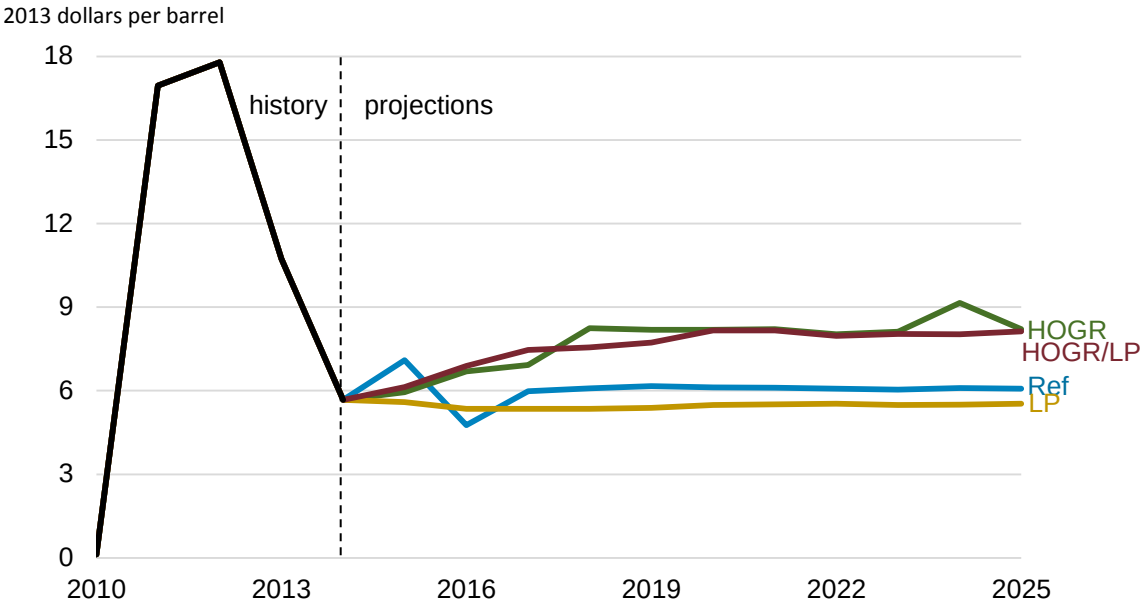
In cases with relatively modest growth in U.S. crude production, such as the Reference and LP cases, production is not high enough to require a reduction in domestic crude oil prices to lower domestic production and widen the Brent-WTI price spread to a point that encourages adding new domestic processing capacity. In such cases, the projected Brent-WTI spread remains within the $5/b–$6/b range in 2025 regardless of whether or not crude oil export restrictions are removed (Figures 9b and 9c). However, in baseline cases with high production growth, such as the HOGR and HOGR/LP cases, where domestic production reaches or exceeds 11.7 million b/d by 2025, the Brent-WTI price spread is projected to increase to about $14/b–$15/b with current policies restricting domestic crude oil exports in place (Figure 9b). Without export restrictions (Figure 9c), the Brent-WTI spread generally stays in the $6/b–$8/b range no matter how much domestic crude oil production increases, consistent with the costs of moving WTI from Cushing to overseas markets where it might compete with Brent. Significant differences arise only in the HOGR and HOGR/LP cases, where spreads would widen considerably under current export restrictions but generally remain in the $6/b–$8/b range without those restrictions.

Figure 9b. Brent-WTI crude oil price spread by case under current crude oil export restrictions, 2010-25



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Figure 9c. Brent-WTI crude oil price spread by case with the removal of current crude oil export restrictions, 2010-25

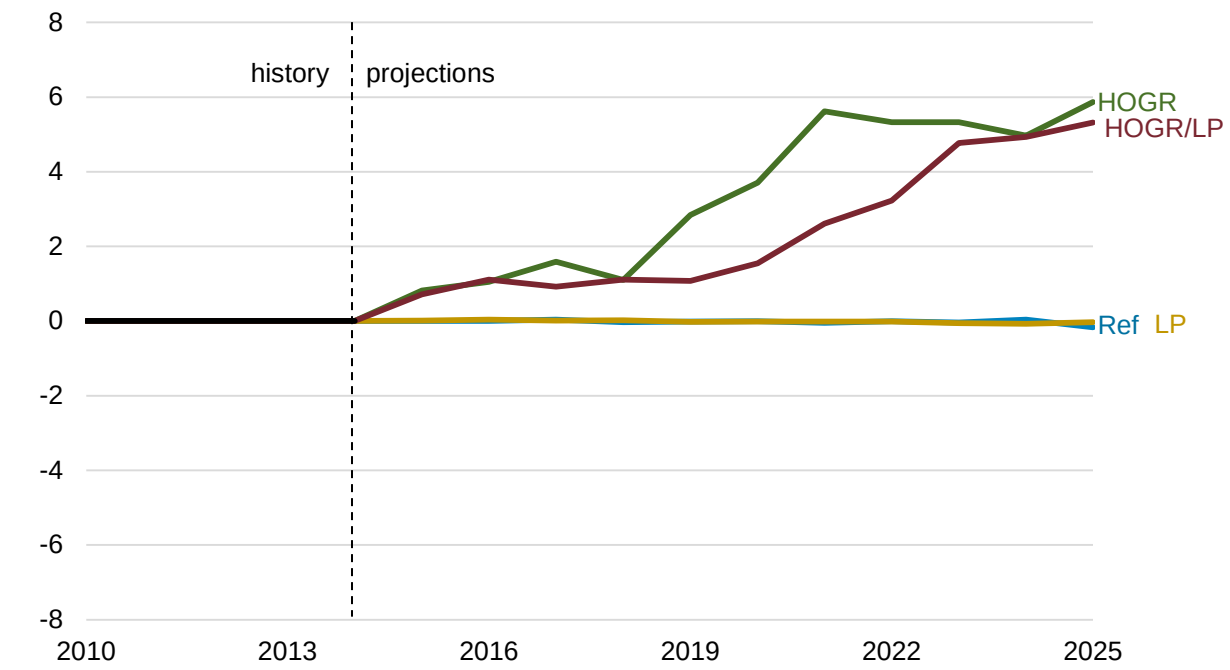


Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, without crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Export restrictions or the absence of export restrictions do not affect the absolute level of domestic (WTI) or global (Brent) prices in either the Reference or LP cases, where export restrictions are not a binding constraint. However, in high production cases (HOGR and HOGR/LP) projected domestic crude prices would be higher without export restrictions than with them (Figure 10a), while the reverse is true for projected global crude prices (Figure 10b). By contrast, many other oil price drivers tend to move domestic and global crude prices in the same direction. The difference in domestic crude prices with and without crude oil export restrictions in the high oil and gas resource cases tends to be larger in absolute terms than the difference in global crude prices, because the latter are tied to the overall percentage change in global production, which tends to be small.[22]

The estimated price effects presented in this analysis generally reflect an assumption that increases in U.S. crude oil production are partially offset by lower crude production outside the United States. The use of a *no offset* assumption would roughly double the projected reduction in global crude prices compared with those presented in this analysis, while a *full offset* assumption would result in no overall change to world crude production or global crude prices.

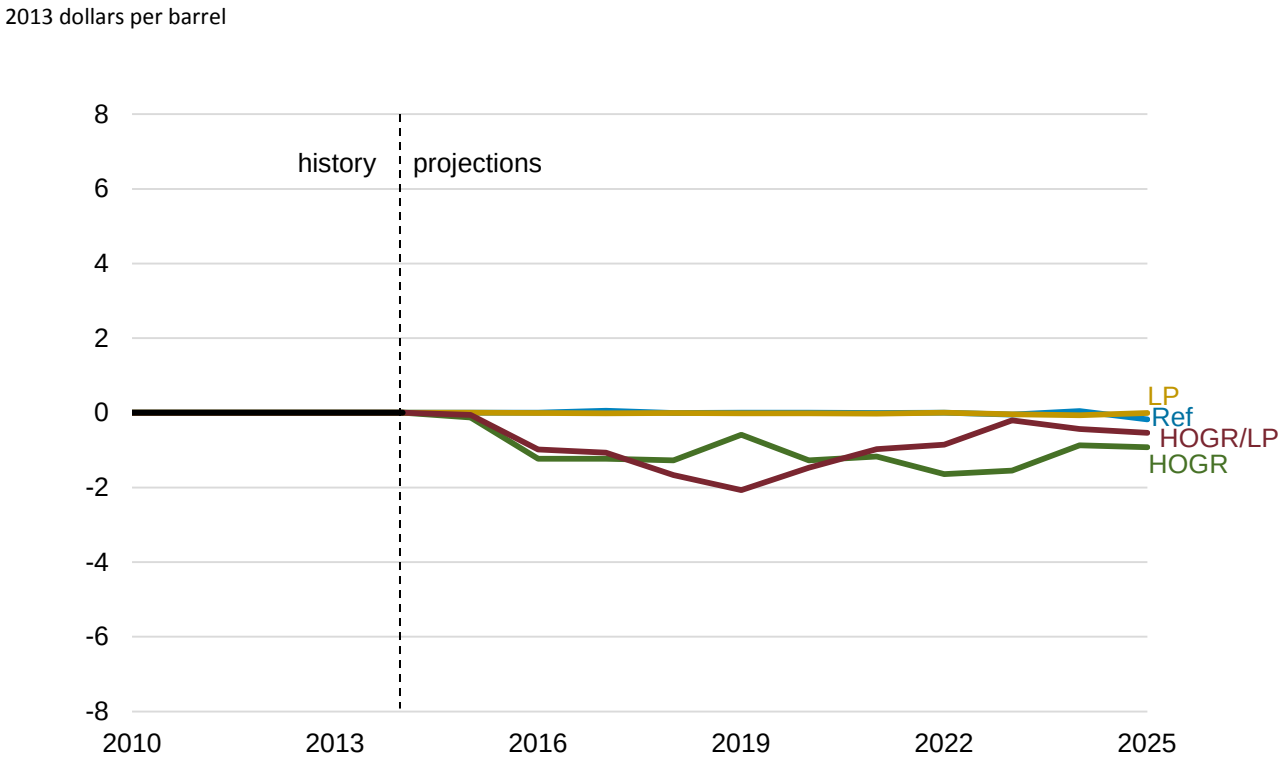
Figure 10a. Difference in West Texas Intermediate crude oil prices by case from removing current crude oil export restrictions, 2010-25



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

[22] For example, a 500,000 b/d increase in U.S. production in 2025 would represent roughly 0.5% of projected 2025 global production in the HOGR case.

Figure 10b. Difference in Brent crude oil prices by case from removing current crude oil export restrictions, 2010-25



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Given the interest of both policymakers and stakeholders in exploring the implications of relaxation or removal of existing policies restricting crude oil exports, many readers of this and other reports on this subject will naturally focus on comparisons between cases with and without these policies. Although policy decisions regarding crude oil export restrictions do affect crude oil prices in some cases, it is evident that those effects are modest in relation to the price differences that arise because of variation in other assumptions across the different baseline cases (Figures 9a and 10b, Table 3).

Table 3. Crude oil and petroleum product prices with (res) and without (unr) crude oil export restrictions in 2025 across cases

				2025											
	History			Reference case			LP case			HOGR case			HOGR/LP case		
Selected results	2013	2014	1q15	res	unr	dif	res	unr	dif	res	unr	dif	res	unr	dif
Crude oil prices (2013 $/b)[1]															
Brent spot	108.56	97.22	53.45	90.40	90.23	(0.18)	63.01	63.01	0.00	81.39	80.47	(0.92)	56.31	55.78	(0.54)
West Texas Intermediate spot	97.98	91.60	48.07	84.32	84.15	(0.17)	57.50	57.47	(0.03)	66.39	72.26	5.87	42.33	47.65	5.32
Brent-WTI spread	10.58	5.62	5.38	6.08	6.08	0.00	5.51	5.54	0.03	15.00	8.21	(6.79)	13.98	8.13	(5.85)
Average petroleum product prices (2013 $/gallon)[1]															
Motor gasoline (all sectors)[2]	3.58	3.38	2.34	2.91	2.90	0.00	2.37	2.37	0.00	2.66	2.65	(0.01)	2.20	2.19	(0.01)
Diesel (transportation sector)[3]	3.92	3.76	2.89	3.46	3.46	0.00	2.78	2.78	0.00	3.18	3.17	0.00	2.53	2.52	(0.01)

Sources: U.S. Energy Information Administration, *Petroleum Supply Monthly*, *Short-Term Energy Outlook*, and Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with (res) and without (unr) current crude oil export restrictions.

Note: Projections from National Energy Modeling System. Totals may not equal sum or difference of components due to independent rounding.

[1]Historical prices calculated with historical values from the *Short-Term Energy Outlook*, adjusted to 2013 prices using *Short-Term Energy Outlook* data for the Consumer Price Index (all urban consumers).

[2]U.S. all grades retail price, including taxes.

[3]U.S. retail price, including taxes.

Petroleum product prices

EIA research has found that Brent crude oil prices have historically had a stronger effect on the price of motor gasoline in the United States than the price of WTI, a pattern that has become more pronounced since U.S. crude production began growing in 2009 and put downward pressure on WTI prices compared with Brent.[23] The prices of motor gasoline and diesel fuel, which are freely traded, generally follow changes in the Brent price across the baseline cases in this analysis, with the highest prices in the Reference case and the lowest prices in the LP and HOGR/LP cases.

However, some differences between the gasoline and diesel responses to crude oil price changes reflect the assumptions that are used to develop the different baseline cases. For example, the LP and HOGR/LP cases reflect a combination of lower global demand and higher global supply for petroleum products. The downward shift in demand is driven primarily by assumptions regarding economic growth in developing economies, which in all EIA projections are the major growth markets for petroleum products. The product mix in developing countries is more heavily weighted toward diesel than it is in the traditional industrialized countries, which results in a disproportionate weakening of diesel demand and prices in cases where the projected growth rate is reduced.

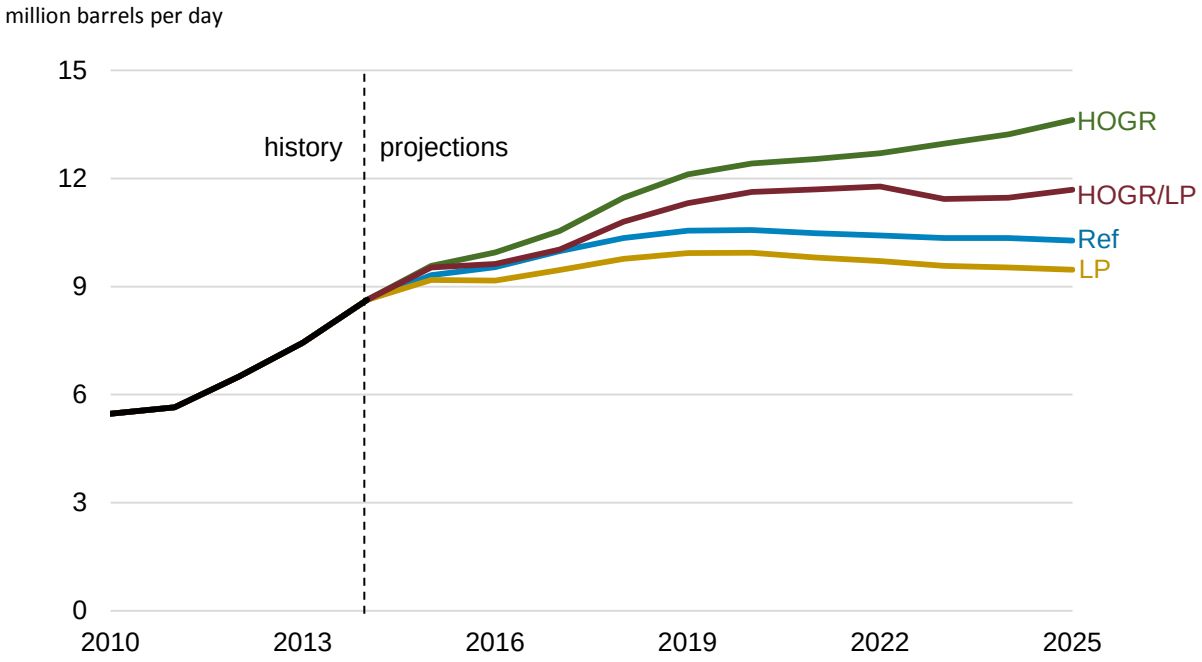
In a comparison of cases with and without current crude oil export restrictions, petroleum product prices in the United States, including gasoline prices, are either unchanged (Reference and LP cases) or slightly reduced (HOGR and HOGR/LP cases) without crude oil export restrictions. In the HOGR and HOGR/LP cases, the removal of crude oil export restrictions results in higher domestic crude prices, which leads to increased domestic production that adds to world crude supply and thereby reduces Brent crude prices and petroleum product prices (Table 3).

Domestic crude oil production

Across the four baseline cases considered in this report, crude oil production in the United States is primarily influenced by two factors: (1) availability and quality of resources and production technology, which determine the amount of crude oil production at each domestic crude price level; and (2) world oil prices, which depend on global supply and demand drivers. As previously noted, there is substantial variation in crude production across the four baseline cases considered in this report (Figure 11a).

[23] U.S. Energy Information Administration, *What Drives U.S. Gasoline Prices?* October 30, 2014 http://www.eia.gov/analysis/studies/gasoline/.

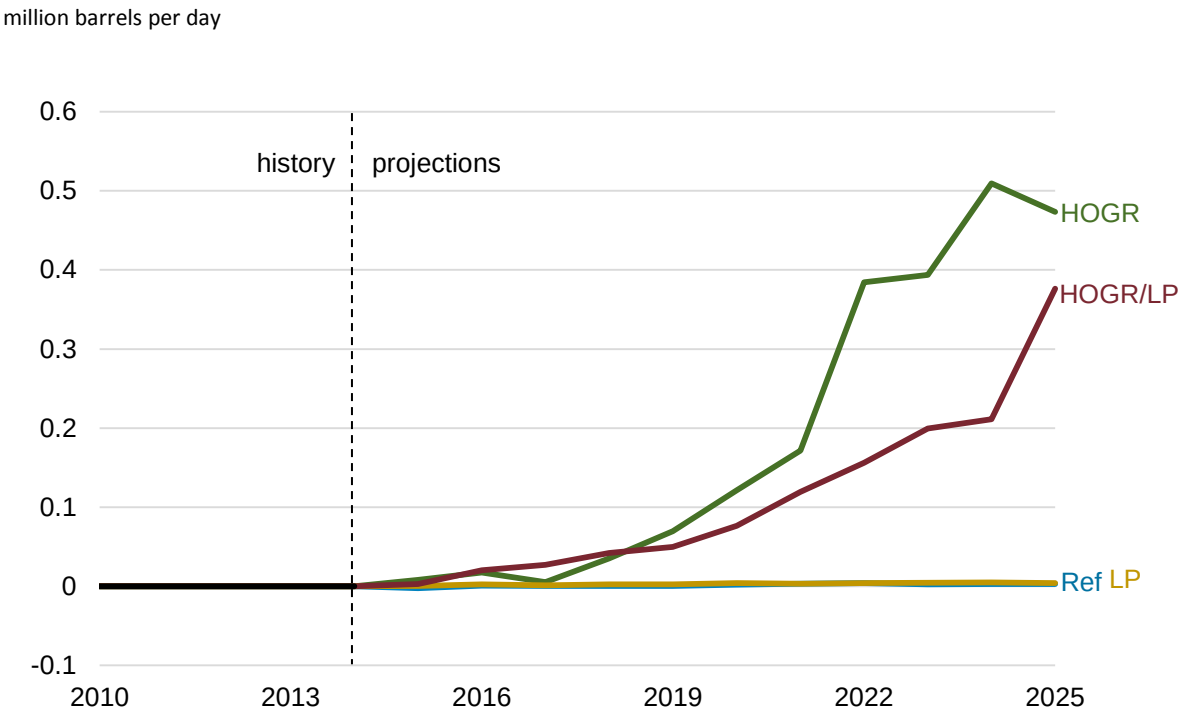
Figure 11a. Total U.S. crude oil production by case with current crude oil export restrictions, 2010-25



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System. Includes production of lease condensate.

Comparing cases with and without current crude oil export restrictions, the absence of crude oil export restrictions does not change projected domestic crude oil production over the next decade in the Reference and LP cases, but results in higher production and higher revenue to producers in the HOGR and HOGR/LP cases (Figure 11b). In the high oil and gas resource cases, the absence of export restrictions results in higher domestic crude prices, which leads to more domestic production. The HOGR case, which has the highest domestic crude production levels, shows the largest domestic production increase because of the removal of crude oil export restrictions. Production in 2025 totals 13.6 million b/d assuming current export restrictions, which is 470,000 b/d lower than the 14.1 million b/d of production without export restrictions. In the HOGR/LP case, where the WTI price with current export restrictions is about $42/b in 2025, about $24/b lower than in the HOGR case, domestic production in 2025 is roughly 2.0 million b/d lower than in the HOGR case, both with and without a removal of crude oil export restrictions. In the HOGR/LP case, domestic production in 2025 without current export restrictions is roughly 380,000 b/d higher than if current restrictions are maintained (11.7 million b/d with current export restrictions compared to 12.1 million b/d without export restrictions).

Figure 11b. Difference in domestic crude oil production by case from removing current crude oil export restrictions, 2010-25



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Producer revenue differences between variants of the HOGR and HOGR/LP cases with and without crude oil export restrictions reflect changes in the price received by domestic producers as well as the changes in the projected volumes of production noted above. A rough calculation using the change in WTI prices as a proxy for changes in the price for all domestic production streams suggests that gross revenue to producers from crude sales in the HOGR case when just accounting for price impacts would be about $29.7 billion higher in 2025 without crude oil export restrictions than it would be if those restrictions were maintained. The same calculation for the HOGR/LP case shows estimated gross revenue to producers in 2025 would be roughly $23.1 billion higher without crude oil export restrictions than if those restrictions were maintained. The similarity of the producer revenue effect of removing export restrictions in the HOGR and HOGR/LP cases highlights the dominant role of price changes rather than higher production volumes in driving increases in gross producer revenues. As noted below in the section on refining implications, refiner gross revenues net of crude input costs are lower in the HOGR and HOGR/LP cases without export restrictions than they would be if those restrictions were maintained.

The larger difference in domestic production because of the absence of export restrictions in the HOGR case than in the HOGR/LP case reflects the characterization of production activity in the Oil and Gas Supply Module of EIA's National Energy Modeling System. The more optimistic characterization of

resources and technology that is common to both the HOGR and HOGR/LP cases allows significant drilling activity in core areas to be profitable whether oil prices follow the Reference case path, as in HOGR, or the LP case path, as in HOGR/LP. In both the HOGR and HOGR/LP cases, the increased prices available to domestic producers in the absence of export restrictions encourage more drilling and production in core areas with high estimated ultimate recoveries. In the HOGR case, however, the absolute level of prices is high enough that the increased prices available to domestic producers in the absence of export restrictions also fosters additional drilling and production in noncore areas.

Petroleum trade and its components

The balance in the market for crude oil and petroleum products is summarized as:

Production – Consumption = Exports – Imports + Change in Inventory
= Net Exports + Change in Inventory

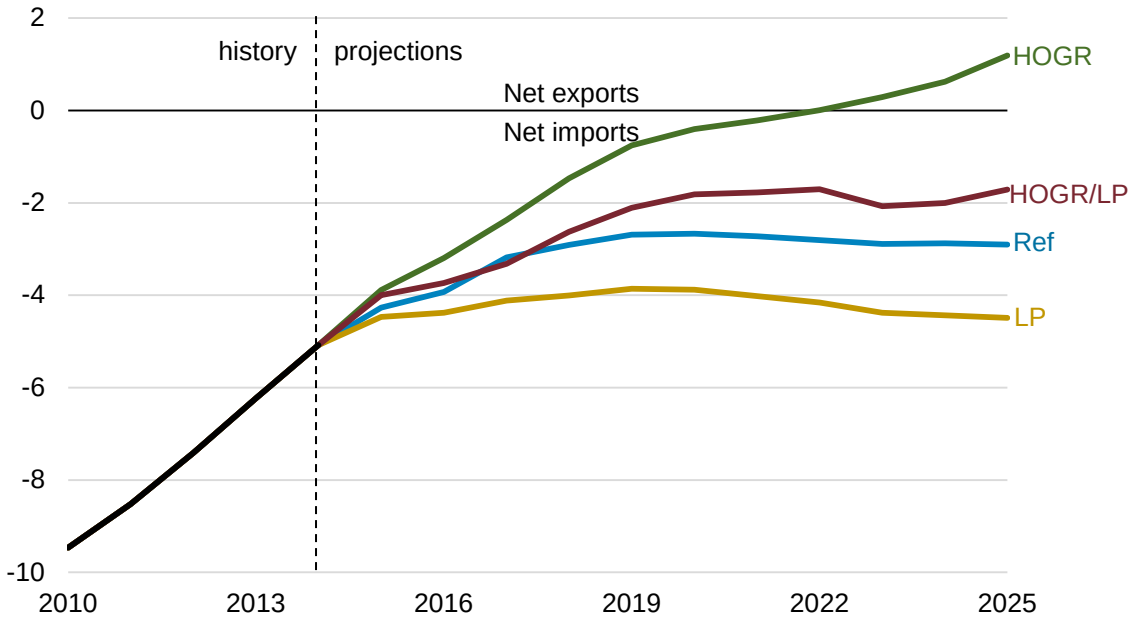
Although changes in crude oil and petroleum product inventories play a significant role over relatively short time periods, additions and withdrawals from inventories are roughly balanced over periods of a decade or more. For purposes of this long-term analysis, EIA therefore simplifies the relationship as:

Production – Consumption = Exports – Imports = Net Exports

With some combination of higher production and lower consumption in three of the four baseline cases considered in this analysis, U.S. net exports, equal to production minus consumption, are generally increasing. As already noted, domestic production varies widely across the four baseline cases. All cases show a rise in production from current levels over the next five years, with varying patterns thereafter. Turning to petroleum consumption, some cases show a slight rise and others a slight fall over time, mainly because of differences in assumptions about prices that, together with efficiency policies such as fuel economy standards and the level of economic activity, are the main drivers of petroleum product consumption. Petroleum consumption does not depend significantly on the level of U.S. crude oil production. As a result, combined net exports of crude oil and petroleum products from the United States are generally higher in cases with higher levels of U.S. crude oil production (Figures 11a and 12a). The HOGR case is the only case in which the United States becomes a combined net exporter of crude oil and petroleum products by 2025. This result occurs regardless of whether current crude oil export restrictions are removed.

Figure 12a. Combined U.S. crude oil and petroleum product net export projections by case with current crude oil export restrictions, 2010-25

million barrels per day

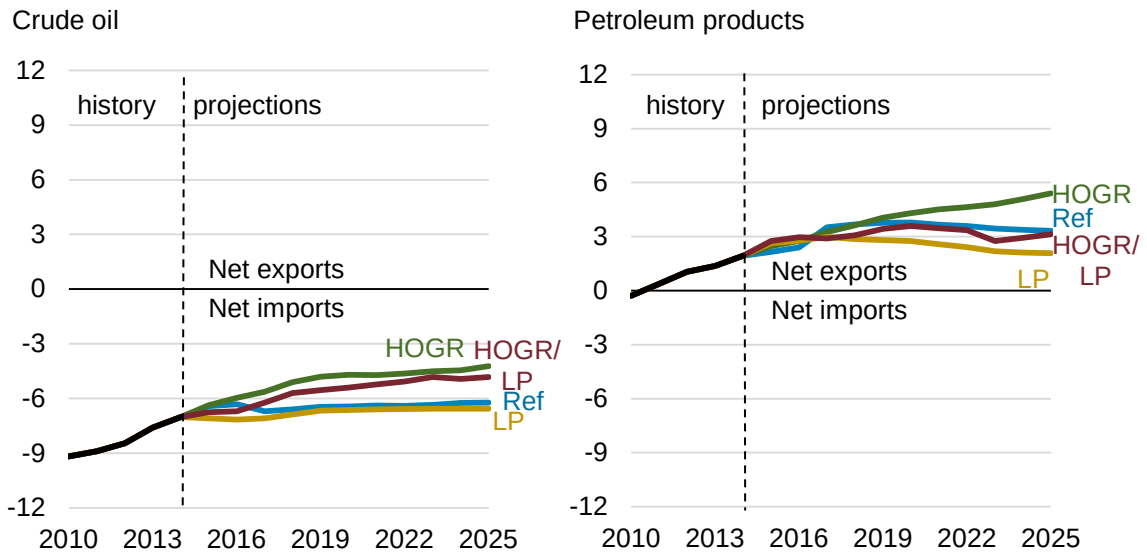


Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

There are important differences across cases in the composition of trade. Current policies restrict, but do not prohibit, exports of crude oil. Continued growth in domestic crude oil production supports some projected growth in crude oil exports (including processed condensate), even in the Reference and LP cases, which use Reference resource and technology assumptions. Projected crude oil net exports (Figure 12b1) are higher in cases with higher production levels, particularly the HOGR and HOGR/LP cases, but as current crude export restrictions become more binding, growth in net product exports (Figure 12b2) becomes the main channel for increasing net exports to maintain market balance in the HOGR and HOGR/LP cases (Figures 12c1 and 12c2) with current restrictions in place.

Figure 12b1/b2. U.S. crude oil and petroleum product net export projections by case with current crude oil export restrictions, 2010-25

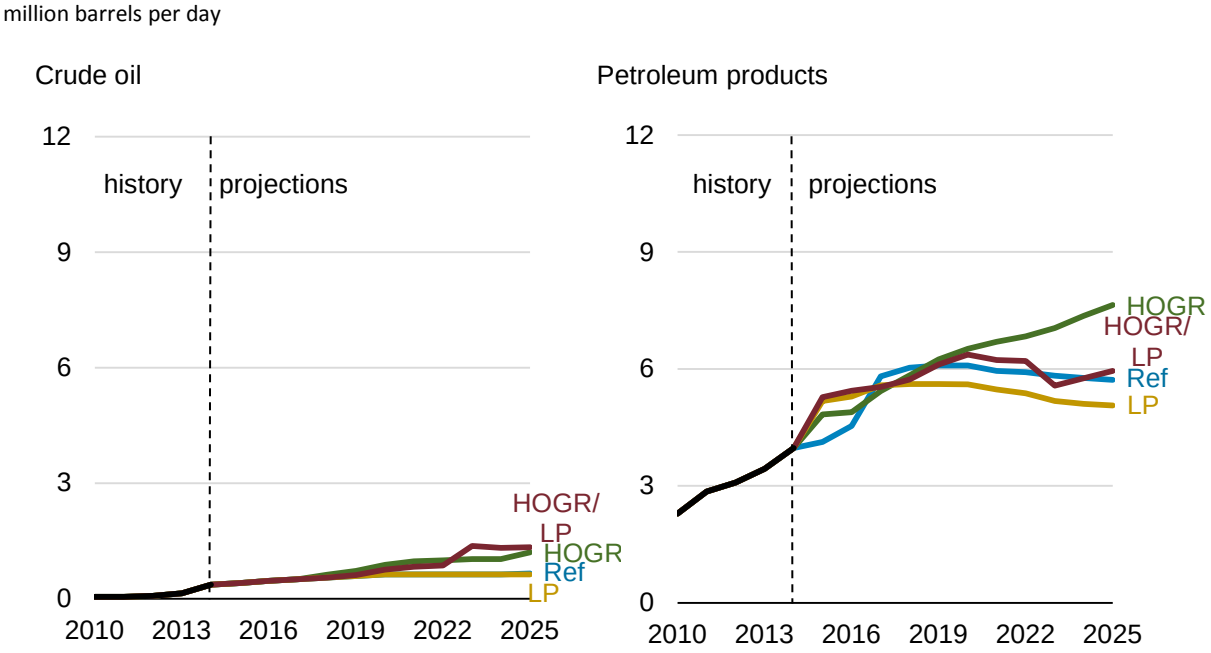
million barrels per day



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Looking at gross measures of exports and imports, gross exports of crude oil (Figure 12c1) and petroleum products (Figure 12c2) are higher in cases with higher projected domestic crude oil production with current export restrictions in place. The range across cases of projected petroleum product gross exports is significantly larger than the range of projected gross crude oil imports. This outcome reflects the role of current crude oil export restrictions, which limit crude oil exports but allow for unlimited petroleum product exports.

Figure 12c1/c2. U.S. crude oil and petroleum product gross export projections by case with current crude oil export restrictions, 2010-25

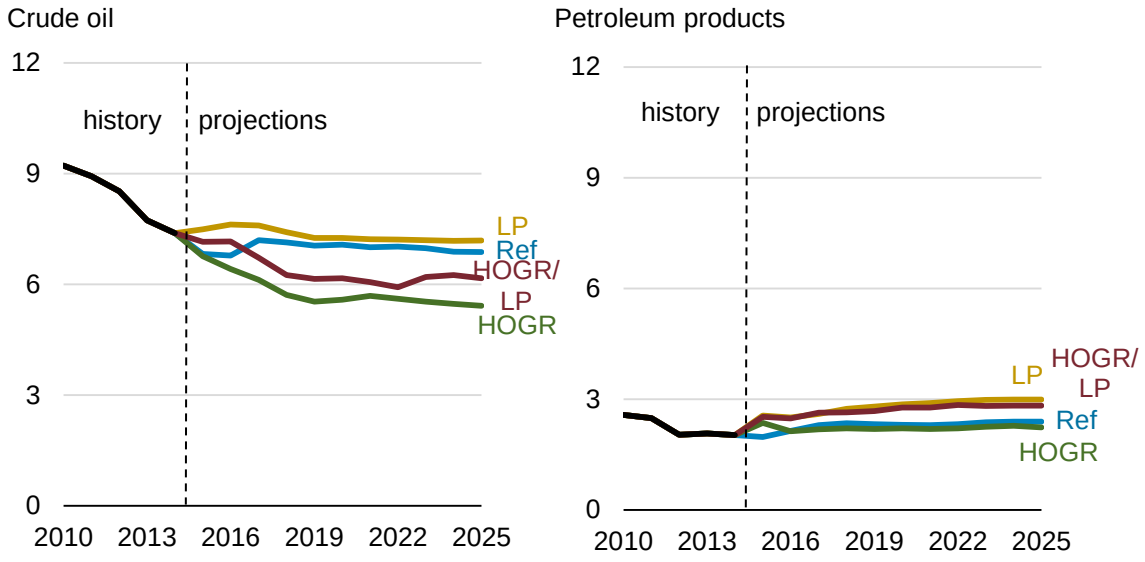


Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Looking at gross imports of crude oil (Figure 12d1) and petroleum products (Figure 12d2), there is a much larger range across cases in crude oil gross imports than in petroleum product gross imports. This also reflects the role of current crude oil export restrictions, which encourage additional substitution of domestic crude oil streams for imported crude oil in cases with high domestic crude oil production. For petroleum products, where exports are currently unrestricted, the level of prices rather than the level of domestic production is the key driver of variation in gross imports across cases. Lower prices encourage additional consumption of petroleum products throughout the country, including the East Coast which relies on petroleum product imports to meet a significant share of its overall product demand.

Figure 12d1/d2. U.S. crude oil and petroleum product gross import projections by case with current crude oil export restrictions, 2010-25

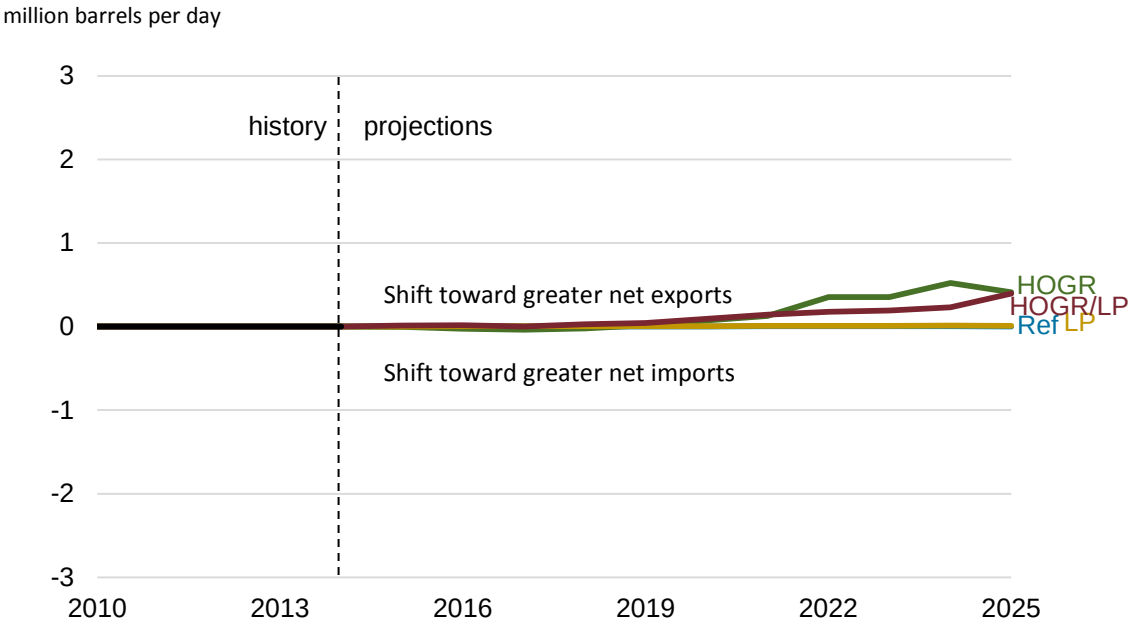
million barrels per day



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Comparing parallel cases with and without current crude export restrictions, the absence of crude oil export restrictions affects combined net trade in crude and products through its effect, if any, on domestic crude oil production. In the Reference and LP cases, where the absence of export restrictions does not change the level of domestic production, the absence of crude oil export restrictions does not affect combined U.S. crude oil and petroleum product net exports. In the HOGR and HOGR/LP cases, where projected domestic production is higher without export restrictions than if current export restrictions are maintained, the absence of export restrictions raises net combined crude and product exports (Figure 13a).

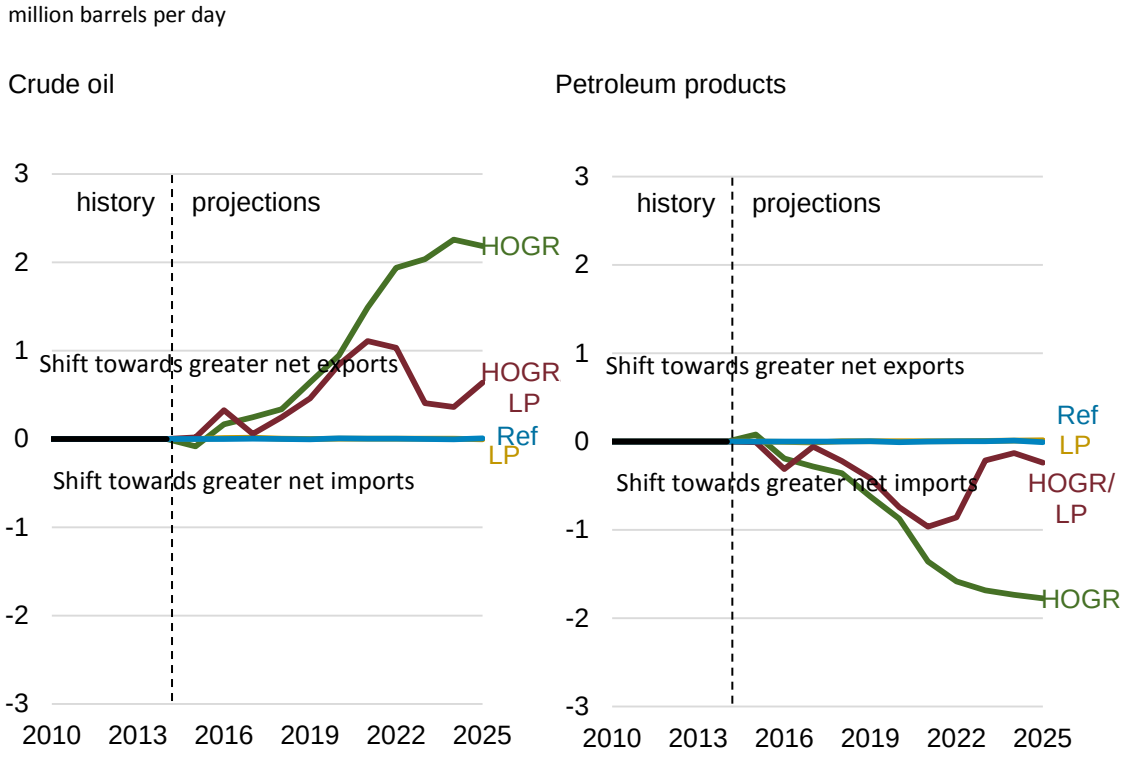
Figure 13a. Difference in combined U.S. crude oil and petroleum product net exports by case from removing current crude oil export restrictions, 2010-25



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Looking at net trade projections for separate crude oil and petroleum product components (Figures 13b1 and 13b2), the presence or absence of crude oil export restrictions does not affect projected net exports in either category in the Reference and LP cases. However, in the HOGR and HOGR/LP cases, where domestic crude oil production levels are higher, projected crude oil net exports are significantly higher without current export restrictions than with them in place. The reverse is true for petroleum product exports, reflecting the role of product exports as an (imperfect) alternative to crude exports in cases where crude oil production is high and current export restrictions are in place. With crude oil export restrictions in place in the HOGR and HOGR/LP cases, high production is largely accommodated by domestic processing of additional crude volumes, yielding refined products that can be exported freely. Without such restrictions, the volume of gross crude oil exports in 2025 in the HOGR and HOGR/LP cases are 2.4 million b/d and 1.0 million b/d higher, respectively, while product gross export volumes are substantially lower, by 1.8 million b/d and 0.2 million b/d respectively in that year.

Figure 13b1/b2. Difference in U.S. crude oil and petroleum product net exports by case from removing current crude oil export restrictions, 2010-25



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Capacity additions, throughput, and refiner and producer revenues

As previously noted, the combination of increased refinery utilization rates and growth in processing capacity has been one of the key pathways for accommodating the growth in U.S. crude production since 2009.[24] With continued domestic crude oil production growth and price-advantaged natural gas as both a fuel and feedstock for U.S. refineries, EIA expects that high utilization of domestic refineries will continue. Already-announced splitter investment plans and further investments to debottleneck existing refineries contribute to projected increases in total distillation capacity through 2020 across all four cases (Figure 14a). The need for domestic processing capacity beyond what is expected to be available based on currently planned splitter builds and continued debottlenecking depends on the level of domestic crude production, whether or not current restrictions on crude oil exports remain in place.

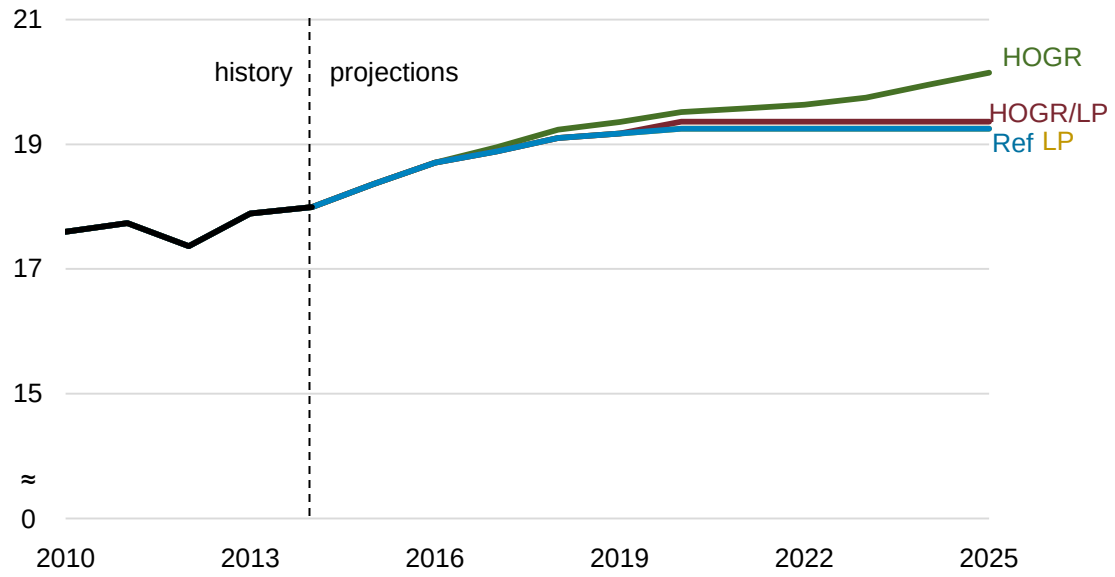
[24] See discussion in the section entitled "Experience in accommodating increased domestic crude oil production since 2009." Substitution of domestic crude for imported crudes, and, to a lesser extent, increased crude exports, have also played a role.

Refinery utilization rates are largely driven by domestic crack spreads, which, given the close relationship of the price of gasoline and other petroleum products to Brent crude prices, closely follow the Brent-WTI spread. Therefore, the Brent-WTI spread provides a general indication of the profitability for refiners from processing additional domestic production.

In the HOGR and HOGR/LP cases, there is robust growth in domestic crude oil production even with current export restrictions in place. As a result, the discount of domestic crude prices to global crudes such as Brent widens and encourages further capacity investments (Figure 14a), notwithstanding the risk of future changes in crude oil export policy or market conditions. The size of the discount required to motivate additional capacity investment is discussed in two recent EIA reports.[25] Total domestic refinery throughput also responds to the higher profitability of refining in the HOGR and HOGR/LP cases with current crude oil export restrictions in place (Figure 14b).

Figure 14a. Total U.S. crude oil distillation capacity projections by case with current crude oil export restrictions, 2010-25

million barrels per calendar day

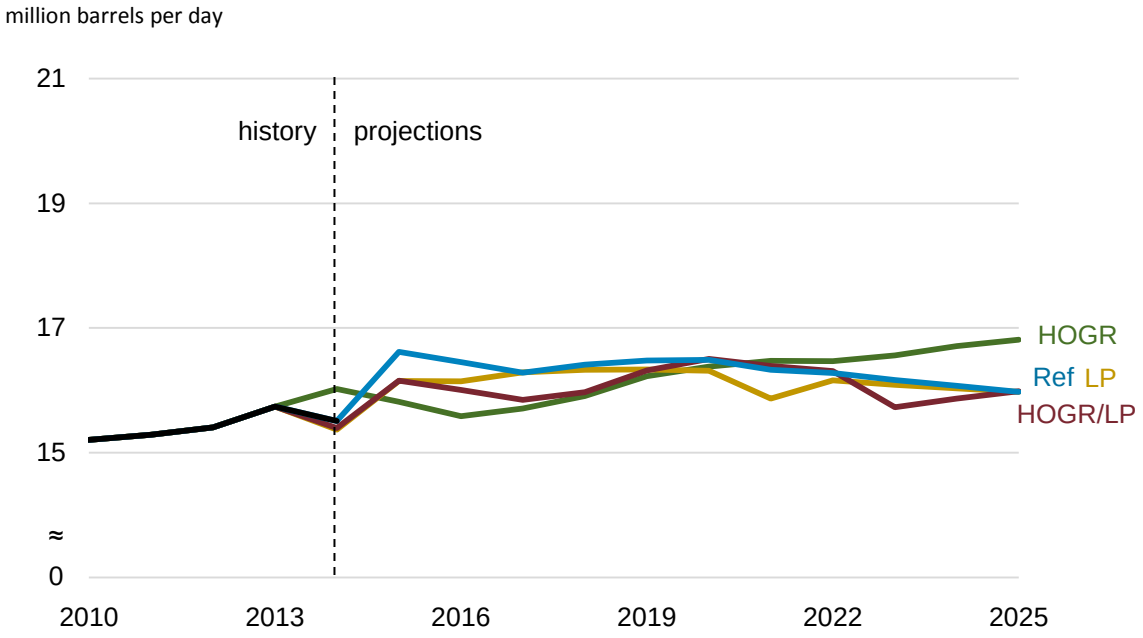


Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.

Note: Projections from National Energy Modeling System.

[25] U.S. Energy Information Administration, *Technical Options for Processing Additional Light Tight Oil Volumes within the United States*, April 2015, and U.S. Energy Information Administration, *Implications of Increasing Light Tight Oil Production for U.S. Refining*, May 2015. In the April 2015 report, EIA estimates the per-barrel amortized capital cost of a 100,000-b/d greenfield hydroskimmer at between $6.50/b and $7.00/b assuming an 18% required return on investment and a 10-year investment payback period. The per-barrel amortized cost would be nearly 50% lower under a low-risk scenario that would use a 12% required return and a 25-year investment payback period (p. 12). The market and policy risk issues that guide these assumptions are also discussed in the April 2015 report (pp. 5-6).

Figure 14b. Total U.S. crude oil distillation throughput projections by case with current crude oil export restrictions, 2010-25



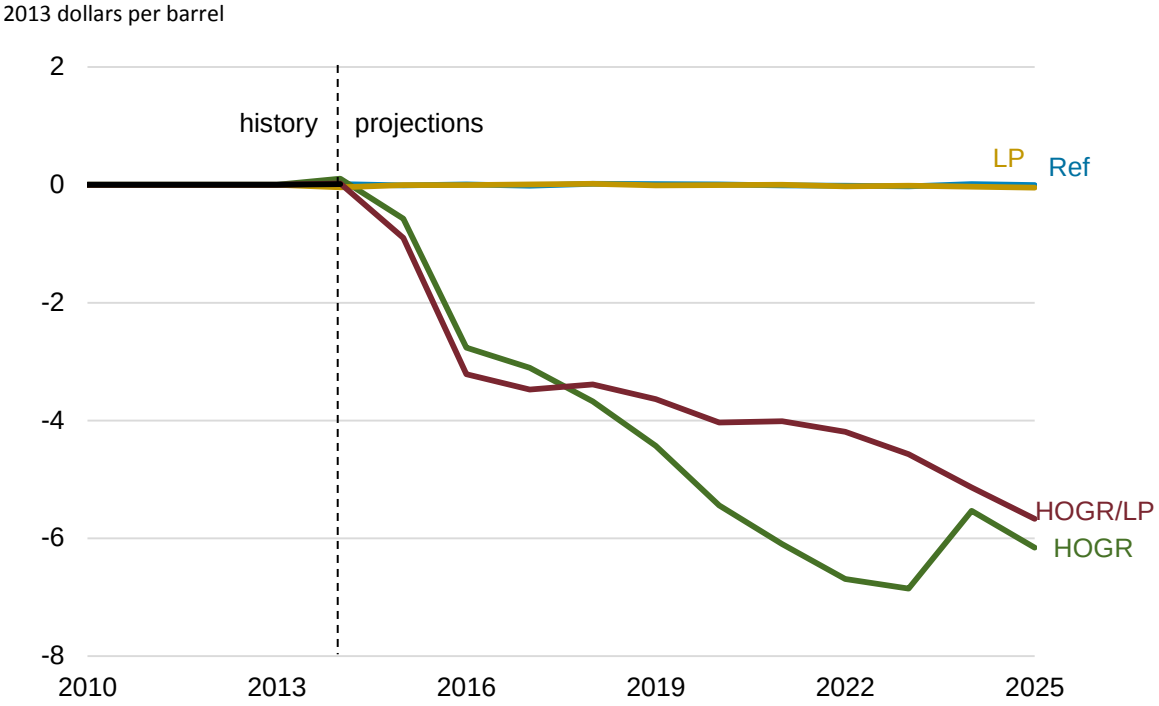
Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Comparing cases with and without current crude oil export restrictions, the absence of crude oil export restrictions affects domestic refinery capacity and utilization through its effects on refining margins. The absence of crude oil export restrictions matters most in cases with high resource assumptions (HOGR and HOGR/LP) where unrestricted crude oil exports generally preclude a widening of the Brent-WTI spread beyond $6/b–$8/b by providing an alternative to domestic processing of high production volumes. Without crude oil export restrictions in these cases, less domestic processing capacity is added, and both refinery throughout and refinery margins are lower compared to baseline cases that maintain current policies restricting crude oil exports (Figures 15a, 15b, and 51c).

Differences in refining margins and throughput with and without current export restrictions in the HOGR and HOGR/LP cases result in significant differences in gross revenue net of crude input cost from refining activity. A rough calculation suggests that refining sector gross profits (gross revenue net of crude costs) in the HOGR case are about $22.7 billion lower in 2025 without crude oil export restrictions than they would be if those restrictions were maintained. This outcome reflects the expectation that refinery margins would grow with increases in the Brent-WTI spread under current export restrictions in high-production cases. Without crude oil export restrictions, the Brent-WTI spread is limited by the export option, but still remains above its 2014 level. With or without current crude oil export restrictions, domestic refiners are also expected to maintain a significant advantage compared to

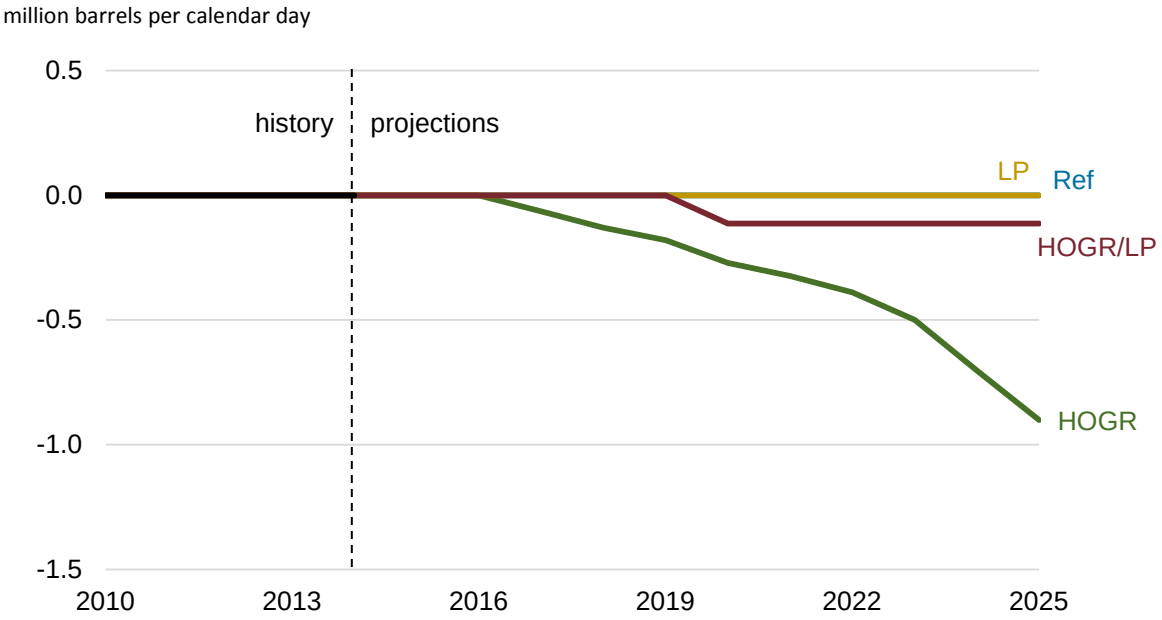
offshore refiners given the continued projected availability of low-cost domestic natural gas, which is used as both a fuel and feedstock by refiners.

Figure 15a. Difference in the average 3-2-1 crack spread at U.S. refineries by case from removing current crude oil export restrictions, 2010-25



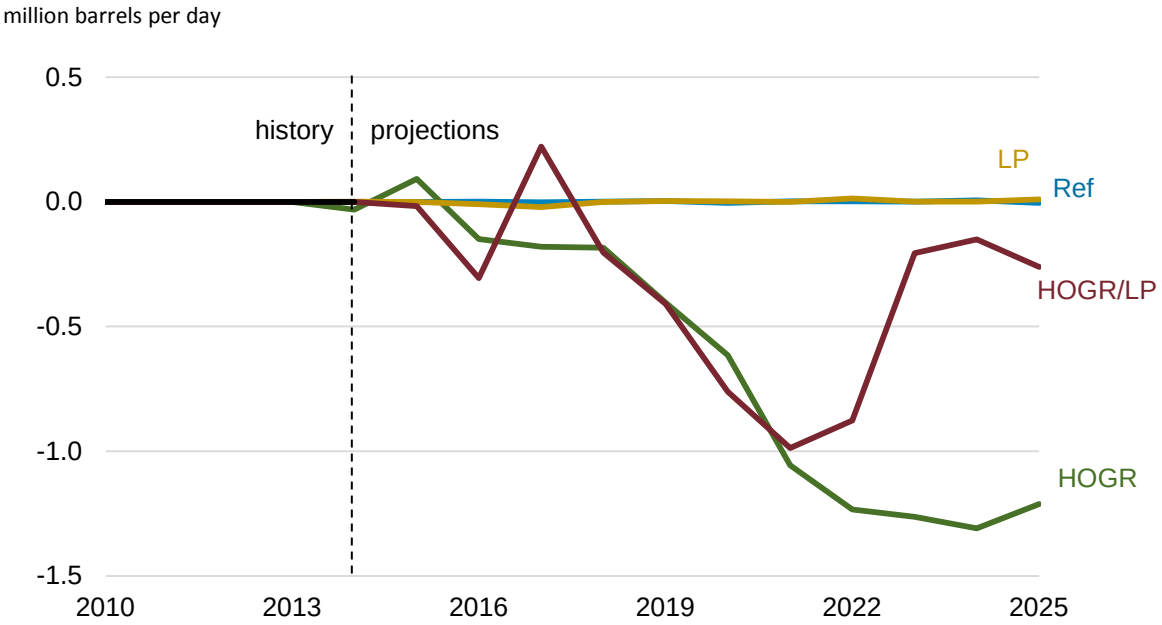
Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System. The crack spread is calculated using West Texas Intermediate Spot prices for crude oil feedstock prices and New York Harbor wholesale prices for gasoline and distillate fuel oil, for both historical data and projections.

Figure 15b. Difference in total U.S. crude oil distillation capacity by case from removing current crude oil export restrictions, 2010-25



Sources: U.S. Energy Information Administration, National Energy Modeling System Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Figure 15c. Difference in total U.S. crude oil distillation throughput by case from removing current crude oil export restrictions, 2010-25



Sources: U.S. Energy Information Administration, Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System.

Appendix A. Congressional Requests for Information on the Effects of Removing Restrictions on U.S. Crude Oil Exports

- February 3, 2014, Letter from Senators Cantwell and Wyden to EIA Administrator Adam Sieminski
- April 10, 2014, Letter from Senators Landrieu and Murkowski to EIA Administrator Adam Sieminski

MARIA CANTWELL
WASHINGTON

COMMITTEES:
COMMERCE, SCIENCE, AND TRANSPORTATION
ENERGY AND NATURAL RESOURCES
FINANCE
INDIAN AFFAIRS
SMALL BUSINESS

United States Senate

WASHINGTON, DC 20510–4705

February 3, 2014

Adam Sieminski
Administrator
Energy Information Administration
1000 Independence Avenue, SW
Washington, D.C. 20585

Dear Administrator Sieminski:

As you know, the Energy Policy and Conservation Act of 1975 prohibits the export of crude oil from the United States (with some exceptions for crude from Alaska and California, and crude destined for Canada). There is now a discussion underway about whether to overturn this ban to allow free export of U.S. oil.

We would like to understand how allowing unlimited export of American crude oil might affect:

- U.S. oil production, nationally and regionally;
- U.S. oil consumption, nationally and regionally;
- domestic supplies and prices, nationally and regionally, for both:
  - crude oil (paid by refiners), and
  - refined products (paid by consumers), and
- exports of refined products.

Furthermore, we would like EIA to identify the transit modes and routes that exported crude might be expected to travel.

We look forward to EIA's comprehensive analysis of this issue.

Sincerely,

Ron Wyden
United States Senator

Maria Cantwell
United States Senator

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United States Senate
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
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April 10, 2014

The Honorable Adam Sieminski
U.S. Energy Information Administration
1000 Independence Avenue, S.W.
Washington, DC 20585

Dear Administrator Sieminski:

You know better than most the true magnitude of the North American energy renaissance. Thanks in part to the efforts of the Energy Information Administration, we have watched with great interest as oil and gas production continues to break records.

While we are aware that the EIA has limited resources and numerous reporting requirements to the Congress, we would like to convey the interest of our Committee in the issue of crude oil exports, which are largely banned by statute. As you know, the possibility of lifting the ban – partially or completely – has emerged as a subject of critical concern here in the Congress.

Areas of interest include:

- Current and projected production of crude oil and condensate of varying grades;
- U.S. refining capacity and distribution, including the ability of U.S. refiners to process domestically produced crude oil and condensate of varying grades;
- The position and competitiveness of U.S. refiners in relation to global refining markets;
- The economic impact of continuing current policy in regard to exports on U.S. crude oil and condensate production as it relates to American consumers, upstream producers and the U.S. refining industry;
- The economic impact of changing current policy in regard to exports, specifically easing or lifting restrictions on exports, on U.S. crude oil and condensate production as it relates to American consumers, upstream producers and the U.S. refining industry; and
- Logistics associated with U.S. crude oil and condensate production, including rail capacity.

This is a complex puzzle that is best solved with dynamic and ongoing analysis of the full picture, rather than a static study of a snapshot in time. We look forward to your reply.

Sincerely,

Mary Landrieu
Chairwoman

Lisa Murkowski
Ranking Member

Appendix B. Supplemental Tables of Results

- Table B-1: Summary results for four cases with (res) and without (unr) current crude oil export restrictions in 2015
- Table B-2: Summary results for four cases with (res) and without (unr) current crude oil export restrictions in 2020
- Table B-3: Summary results for four cases with (res) and without (unr) current crude oil export restrictions in 2025

Note: The model runs used in this report were made using the National Energy Modeling System. The model run names that correspond to the specific cases in this report are listed below:

Reference Case (res):	refcx/d073015b
Reference Case (unr):	refallx/d073015a
LP Case (res):	lpcx/d073015a
LP Case (unr):	lpallx/d073015a
HOGR Case (res):	refhrcx/d073015a
HOGR Case (unr):	refhrallx/d073015a
HOGR/LP Case (res):	lphrcx/d073015a
HOGR/LP Case (unr):	lphrallx/d073015a

Table B-1. Summary results for four cases with (res) and without (unr) current crude oil export restrictions in 2015

				2015											
	History			Reference case			LP case			HOGR case			HOGR/LP case		
Selected results	2013	2014	1q15	res	unr	dif	res	unr	dif	res	unr	dif	res	unr	dif
Crude oil (million b/d)															
Total domestic crude production	7.46	8.71	9.48	9.32	9.32	0.00	9.18	9.18	0.00	9.58	9.59	0.01	9.53	9.53	0.00
Tight oil[1]	3.15	4.19	NA	4.78	4.78	0.00	4.64	4.64	0.00	5.10	5.11	0.01	4.97	4.98	0.01
CO2-EOR	NA	NA	NA	0.29	0.29	0.00	0.29	0.29	0.00	0.29	0.29	0.00	0.29	0.29	0.00
Lower 48 offshore[2]	NA	NA	NA	1.64	1.64	0.00	1.64	1.64	0.00	1.64	1.64	0.00	1.64	1.64	0.00
Other production[3]	4.31	4.53	NA	2.60	2.60	0.00	2.61	2.61	0.00	2.55	2.55	0.00	2.63	2.62	(0.01)
Net crude imports	7.60	6.99	6.84	6.42	6.42	0.00	7.09	7.09	0.00	6.36	6.45	0.08	6.75	6.73	(0.02)
Crude imports	7.73	7.34	7.28	6.82	6.82	0.00	7.49	7.49	0.00	6.76	6.85	0.08	7.15	7.13	(0.02)
Crude exports	0.13	0.35	0.45	0.40	0.40	0.00	0.40	0.40	0.00	0.40	0.40	0.00	0.40	0.40	0.00
Non-crude petroleum and other liquids supply (million b/d)															
Net product imports	(1.36)	(1.95)	(1.89)	(2.15)	(2.15)	0.00	(2.63)	(2.63)	0.00	(2.47)	(2.55)	(0.08)	(2.75)	(2.74)	0.01
Product imports	2.13	1.88	2.12	1.98	1.98	0.00	2.55	2.55	0.00	2.36	2.36	0.00	2.52	2.53	0.00
Product exports	3.49	3.83	4.01	4.12	4.12	0.00	5.18	5.18	0.00	4.83	4.91	0.08	5.28	5.27	(0.01)
All other non-crude supply[4]	5.14	5.54	5.44	5.43	5.43	0.00	5.46	5.46	0.00	5.67	5.66	(0.01)	5.60	5.61	0.00
Total primary supply for domestic use[5]	18.83	19.30	19.87	19.24	19.23	0.00	19.11	19.11	0.00	19.13	19.14	0.01	19.13	19.13	0.00
Crude oil and petroleum product trade (million b/d)															
Net crude oil and petroleum product imports	6.24	5.04	4.95	4.27	4.27	0.00	4.47	4.47	0.00	3.89	3.89	0.00	4.00	3.99	(0.01)
Crude oil and petroleum product imports	9.86	9.22	9.40	8.80	8.80	0.00	10.05	10.05	0.00	9.12	9.20	0.08	9.68	9.66	(0.02)
Crude oil and petroleum product exports	3.62	4.18	4.45	4.52	4.52	0.00	5.58	5.58	0.00	5.23	5.31	0.08	5.68	5.67	(0.01)
Crude oil prices (2013 $/b)[6]															
Brent spot	108.56	97.22	53.45	57.47	57.47	0.00	50.54	50.54	0.00	53.81	53.69	(0.13)	48.21	48.16	(0.06)
West Texas Intermediate spot	97.98	91.60	48.07	50.37	50.37	0.00	44.94	44.96	0.01	46.91	47.73	0.82	41.31	42.03	0.72
Brent-WTI spread	10.58	5.62	5.38	7.10	7.10	0.00	5.60	5.59	(0.01)	6.90	5.95	(0.95)	6.91	6.13	(0.78)
Average petroleum product prices (2013 $/gallon)[6]															
Motor gasoline (all sectors)[7]	3.58	3.38	2.34	2.31	2.31	0.00	2.19	2.19	0.00	2.27	2.28	0.01	2.16	2.15	0.00
Diesel (transportation sector)[8]	3.92	3.76	2.89	2.70	2.70	0.00	2.46	2.46	0.00	2.51	2.51	0.00	2.40	2.39	(0.01)

Table B-1. Summary results for four cases with (res) and without (unr) current crude oil export restrictions in 2015 (cont.)

				2015											
	History			Reference case			LP case			HOGR case			HOGR/LP case		
Selected results	2013	2014	1q15	res	unr	dif	res	unr	dif	res	unr	dif	res	unr	dif
Processing operations[9]															
Total distillation capacity (million b/cd)[10]	17.82	17.92	17.97	18.36	18.36	0.00	18.36	18.36	0.00	18.36	18.36	0.00	18.36	18.36	0.00
Total distillation unit inputs (million b/d)[11]	15.72	16.15	15.78	16.74	16.74	0.00	16.27	16.28	0.00	15.94	16.03	0.09	16.28	16.26	(0.02)
Total distillation capacity utilization rate (%)	88	90	88	91	91	0	89	89	0	87	87	1	89	89	0
Crude exports by gravity (million b/d) [12]															
Light exports	NA	NA	NA	0.36	0.36	0.00	0.36	0.36	0.00	0.36	0.36	0.00	0.36	0.36	0.00
Medium exports	NA	NA	NA	0.04	0.04	0.00	0.04	0.04	0.00	0.04	0.04	0.00	0.04	0.04	0.00
Heavy exports	NA	NA	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crude imports by gravity (million b/d) [12]															
Light imports	0.99	0.66	0.66	1.35	1.34	(0.01)	1.24	1.24	0.00	0.67	0.66	(0.01)	0.58	0.58	0.00
Medium imports	2.69	2.53	2.14	2.25	2.25	0.00	2.15	2.15	0.00	1.70	1.74	0.04	1.83	1.82	(0.01)
Heavy imports	4.01	4.15	4.48	4.22	4.23	0.01	4.11	4.11	0.00	4.39	4.44	0.05	4.75	4.73	(0.01)

Sources: U.S. Energy Information Administration, *Petroleum Supply Monthly*, *Short-Term Energy Outlook*, *Refinery Capacity Report*, and Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System. Totals may not equal or difference sum of components due to independent rounding. NA = Not Available.

[1]Historical totals reflect model results benched to EIA estimates calculated with state administrative data collected by DrillingInfo.
[2]Historical offshore values include Alaska offshore volumes and are thus not listed.
[3]Includes other Lower 48 onshore production and all Alaska production. Historical values also include carbon dioxide enhanced oil recovery and Lower 48 offshore production.
[4]All other non-crude supply includes refinery processing gain, product stock withdrawal, natural gas plant liquids, supply from renewable sources, liquids from gas, liquids from coal, and other supply.
[5]Historical values equal total petroleum product supplied (or U.S. petroleum product consumption) plus the average daily change in crude oil and petroleum product inventories.
[6]Historical prices calculated with historical values from the *Short-Term Energy Outlook*, adjusted to 2013 prices using the Consumer Price Index (all urban consumers).
[7]U.S. all grades retail price, including taxes.
[8]U.S. retail price, including taxes.
[9]Includes both splitter and atmospheric distillation unit capacity and throughput.
[10]Equals total operable atmospheric crude oil distillation capacity as of January 1 of each calendar year.
[11]Historical volumes include unfinished oils, whereas projected volumes include only crude oil volumes.
[12]Light crude oil includes crude oil with an API gravity of 35 or higher; medium crude oil includes crude oil with an API gravity of equal to or above 27 and less than 35; heavy crude oil includes crude oil with an API gravity of below 27.

Table B-2. Summary results for four cases with (res) and without (unr) current crude oil export restrictions in 2020

				2020											
	History			Reference case			LP case			HOGR case			HOGR/LP case		
Selected results	2013	2014	1q15	res	unr	dif	res	unr	dif	res	unr	dif	res	unr	dif
Crude oil (million b/d)															
Total domestic crude production	7.46	8.71	9.48	10.57	10.58	0.00	9.94	9.94	0.00	12.42	12.54	0.12	11.62	11.70	0.08
Tight oil[1]	3.15	4.19	NA	5.58	5.58	0.00	5.02	5.02	0.00	7.27	7.39	0.11	6.55	6.61	0.06
CO2-EOR	NA	NA	NA	0.35	0.35	0.00	0.33	0.33	0.00	0.31	0.31	0.00	0.30	0.31	0.01
Lower 48 offshore[2]	NA	NA	NA	2.15	2.15	0.00	2.13	2.13	0.00	2.30	2.30	0.00	2.28	2.28	0.00
Other production[3]	4.31	4.53	NA	2.50	2.50	0.00	2.46	2.46	0.00	2.53	2.54	0.00	2.49	2.50	0.01
Net crude imports	7.60	6.99	6.84	6.45	6.44	(0.01)	6.63	6.63	0.00	4.70	3.76	(0.95)	5.41	4.57	(0.84)
Crude imports	7.73	7.34	7.28	7.08	7.07	(0.01)	7.26	7.26	0.00	5.58	5.76	0.18	6.16	6.02	(0.15)
Crude exports	0.13	0.35	0.45	0.63	0.63	0.00	0.63	0.63	0.00	0.88	2.00	1.12	0.75	1.44	0.69
Non-crude petroleum and other liquids supply (million b/d)															
Net product imports	(1.36)	(1.95)	(1.89)	(3.78)	(3.77)	0.01	(2.75)	(2.75)	0.00	(4.30)	(3.43)	0.87	(3.60)	(2.85)	0.74
Product imports	2.13	1.88	2.12	2.31	2.31	0.00	2.86	2.86	0.00	2.21	2.18	(0.03)	2.77	2.74	(0.03)
Product exports	3.49	3.83	4.01	6.08	6.08	(0.01)	5.61	5.61	0.00	6.51	5.61	(0.90)	6.37	5.60	(0.78)
All other non-crude supply[4]	5.14	5.54	5.44	6.44	6.43	0.00	6.26	6.26	0.00	7.04	6.98	(0.06)	6.73	6.74	0.01
Total primary supply for domestic use[5]	18.83	19.30	19.87	19.68	19.68	0.00	20.07	20.07	0.00	19.86	19.85	(0.01)	20.17	20.16	0.00
Crude oil and petroleum product trade (million b/d)															
Net crude oil and petroleum product imports	6.24	5.04	4.95	2.67	2.67	0.00	3.88	3.88	(0.01)	0.40	0.33	(0.07)	1.81	1.72	(0.09)
Crude oil and petroleum product imports	9.86	9.22	9.40	9.38	9.38	0.00	10.12	10.11	0.00	7.80	7.94	0.15	8.94	8.76	(0.18)
Crude oil and petroleum product exports	3.62	4.18	4.45	6.71	6.71	(0.01)	6.24	6.24	0.00	7.39	7.61	0.22	7.12	7.04	(0.08)
Crude oil prices (2013 $/b)[6]															
Brent spot	108.56	97.22	53.45	78.39	78.39	0.00	56.20	56.18	(0.01)	72.87	71.60	(1.27)	52.36	50.89	(1.47)
West Texas Intermediate spot	97.98	91.60	48.07	72.28	72.27	0.00	50.71	50.70	(0.01)	59.71	63.41	3.71	41.17	42.72	1.55
Brent-WTI spread	10.58	5.62	5.38	6.11	6.11	0.01	5.49	5.49	0.00	13.16	8.18	(4.98)	11.18	8.16	(3.02)
Average petroleum product prices (2013 $/gallon)[6]															
Motor gasoline (all sectors)[7]	3.58	3.38	2.34	2.70	2.71	0.00	2.30	2.30	0.00	2.59	2.55	(0.03)	2.17	2.13	(0.04)
Diesel (transportation sector)[8]	3.92	3.76	2.89	3.15	3.15	0.00	2.60	2.60	0.00	2.94	2.90	(0.05)	2.46	2.39	(0.07)

Table B-2. Summary results for four cases with (res) and without (unr) current crude oil export restrictions in 2020 (cont.)

				2020											
	History			Reference case			LP case			HOGR case			HOGR/LP case		
Selected results	2013	2014	1q15	res	unr	dif	res	unr	dif	res	unr	dif	res	unr	dif
Processing operations[9]															
Total distillation capacity (million b/cd)[10]	17.82	17.92	17.97	19.25	19.25	0.00	19.25	19.25	0.00	19.52	19.25	(0.27)	19.36	19.25	(0.11)
Total distillation unit inputs (million b/d)[11]	15.72	16.15	15.78	17.02	17.01	0.00	16.57	16.57	0.00	17.12	16.30	(0.82)	17.03	16.27	(0.76)
Total distillation capacity utilization rate (%)	88	90	88	88	88	0	86	86	0	88	85	(3)	88	85	(3)
Crude exports by gravity (million b/d) [12]															
Light exports	NA	NA	NA	0.57	0.57	0.00	0.57	0.57	0.00	0.82	1.95	1.12	0.69	1.39	0.69
Medium exports	NA	NA	NA	0.06	0.06	0.00	0.06	0.06	0.00	0.06	0.06	0.00	0.06	0.06	0.00
Heavy exports	NA	NA	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crude imports by gravity (million b/d) [12]															
Light imports	0.99	0.66	0.66	0.91	0.91	0.00	1.21	1.21	0.00	0.11	0.04	(0.07)	0.22	0.16	(0.05)
Medium imports	2.69	2.53	2.14	1.61	1.61	0.00	1.59	1.59	0.00	0.79	0.81	0.03	0.92	0.92	0.00
Heavy imports	4.01	4.15	4.48	4.55	4.55	0.00	4.45	4.45	0.00	4.69	4.91	0.21	5.03	4.94	(0.09)

Sources: U.S. Energy Information Administration, *Petroleum Supply Monthly*, *Short-Term Energy Outlook*, *Refinery Capacity Report*, and Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.
Note: Projections from National Energy Modeling System. Totals may not equal sum or difference of components due to independent rounding. NA = Not Available.

[1]Historical totals reflect model results benched to EIA estimates calculated with state administrative data collected by DrillingInfo.
[2]Historical offshore values include Alaska offshore volumes and are thus not listed.
[3]Includes other Lower 48 onshore production and all Alaska production. Historical values also include carbon dioxide enhanced oil recovery and Lower 48 offshore production.
[4]All other non-crude supply includes refinery processing gain, product stock withdrawal, natural gas plant liquids, supply from renewable sources, liquids from gas, liquids from coal, and other supply.
[5]Historical values equal total petroleum product supplied (or U.S. petroleum product consumption) plus the average daily change in crude oil and petroleum product inventories.
[6]Historical prices calculated with historical values from the *Short-Term Energy Outlook*, adjusted to 2013 prices using the Consumer Price Index (all urban consumers).
[7]U.S. all grades retail price, including taxes.
[8]U.S. retail price, including taxes.
[9]Includes both splitter and atmospheric distillation unit capacity and throughput.
[10]Equals total operable atmospheric crude oil distillation capacity as of January 1 of each calendar year.
[11]Historical volumes include unfinished oils, whereas projected volumes include only crude oil volumes.
[12]Light crude oil includes crude oil with an API gravity of 35 or higher; medium crude oil includes crude oil with an API gravity of equal to or above 27 and less than 35; heavy crude oil includes crude oil with an API gravity of below 27.

Table B-3. Summary results for four cases with (res) and without (unr) current crude oil export restrictions in 2025

				2025											
	History			Reference case			LP case			HOGR case			HOGR/LP case		
Selected results	2013	2014	1q15	res	unr	dif	res	unr	dif	res	unr	dif	res	unr	dif
Crude oil (million b/d)															
Total domestic crude production	7.46	8.71	9.48	10.28	10.28	0.00	9.46	9.47	0.00	13.63	14.10	0.47	11.69	12.07	0.38
Tight oil[1]	3.15	4.19	NA	5.31	5.31	0.00	4.76	4.76	0.00	8.47	8.89	0.42	7.13	7.47	0.34
CO2-EOR	NA	NA	NA	0.47	0.47	0.00	0.37	0.38	0.00	0.37	0.38	0.02	0.33	0.34	0.01
Lower 48 offshore[2]	NA	NA	NA	1.95	1.95	0.00	1.87	1.87	0.00	2.20	2.22	0.01	2.05	2.05	0.00
Other production[3]	4.31	4.53	NA	2.55	2.55	0.00	2.46	2.46	0.00	2.59	2.61	0.02	2.18	2.21	0.03
Net crude imports	7.60	6.99	6.84	6.23	6.22	(0.01)	6.56	6.57	0.01	4.22	2.03	(2.19)	4.83	4.19	(0.64)
Crude imports	7.73	7.34	7.28	6.88	6.86	(0.02)	7.19	7.20	0.01	5.41	5.68	0.26	6.16	6.55	0.39
Crude exports	0.13	0.35	0.45	0.65	0.64	(0.01)	0.63	0.63	0.00	1.20	3.64	2.45	1.33	2.36	1.03
Non-crude petroleum and other liquids supply (million b/d)															
Net product imports	(1.36)	(1.95)	(1.89)	(3.33)	(3.32)	0.01	(2.07)	(2.08)	(0.01)	(5.40)	(3.63)	1.78	(3.12)	(2.88)	0.24
Product imports	2.13	1.88	2.12	2.39	2.39	0.00	2.99	2.98	(0.01)	2.24	2.25	0.02	2.83	2.82	0.00
Product exports	3.49	3.83	4.01	5.72	5.71	(0.01)	5.06	5.07	0.00	7.64	5.88	(1.76)	5.95	5.70	(0.24)
All other non-crude supply[4]	5.14	5.54	5.44	6.51	6.51	0.00	6.24	6.24	0.01	7.61	7.53	(0.07)	7.06	7.10	0.04
Total primary supply for domestic use[5]	18.83	19.30	19.87	19.69	19.70	0.00	20.19	20.19	0.00	20.05	20.04	(0.01)	20.46	20.48	0.02
Crude oil and petroleum product trade (million b/d)															
Net crude oil and petroleum product imports	6.24	5.04	4.95	2.90	2.90	0.00	4.49	4.48	(0.01)	(1.19)	(1.60)	(0.41)	1.71	1.31	(0.40)
Crude oil and petroleum product imports	9.86	9.22	9.40	9.27	9.25	(0.02)	10.18	10.18	0.00	7.65	7.93	0.28	8.99	9.38	0.39
Crude oil and petroleum product exports	3.62	4.18	4.45	6.37	6.35	(0.01)	5.69	5.70	0.00	8.84	9.53	0.69	7.28	8.06	0.79
Crude oil prices (2013 $/b)[6]															
Brent spot	108.56	97.22	53.45	90.40	90.23	(0.18)	63.01	63.01	0.00	81.39	80.47	(0.92)	56.31	55.78	(0.54)
West Texas Intermediate spot	97.98	91.60	48.07	84.32	84.15	(0.17)	57.50	57.47	(0.03)	66.39	72.26	5.87	42.33	47.65	5.32
Brent-WTI spread	10.58	5.62	5.38	6.08	6.08	0.00	5.51	5.54	0.03	15.00	8.21	(6.79)	13.98	8.13	(5.85)
Average petroleum product prices (2013 $/gallon)[6]															
Motor gasoline (all sectors)[7]	3.58	3.38	2.34	2.91	2.90	0.00	2.37	2.37	0.00	2.66	2.65	(0.01)	2.20	2.19	(0.01)
Diesel (transportation sector)[8]	3.92	3.76	2.89	3.46	3.46	0.00	2.78	2.78	0.00	3.18	3.17	0.00	2.53	2.52	(0.01)

Table B-3. Summary results for four cases with (res) and without (unr) current crude oil export restrictions in 2025 (cont.)

				2025											
	History			Reference case			LP case			HOGR case			HOGR/LP case		
Selected results	2013	2014	1q15	res	unr	dif	res	unr	dif	res	unr	dif	res	unr	dif
Processing operations[9]															
Total distillation capacity (million b/cd)[10]	17.82	17.92	17.97	19.25	19.25	0.00	19.25	19.25	0.00	20.15	19.25	(0.90)	19.36	19.25	(0.11)
Total distillation unit inputs (million b/d)[11]	15.72	16.15	15.78	16.51	16.50	0.00	16.03	16.04	0.01	17.84	16.13	(1.71)	16.52	16.26	(0.26)
Total distillation capacity utilization rate (%)	88	90	88	86	86	0	83	83	0	89	84	(5)	85	84	(1)
Crude exports by gravity (million b/d) [12]															
Light exports	NA	NA	NA	0.59	0.58	(0.01)	0.57	0.57	0.00	1.14	3.33	2.19	1.27	2.28	1.01
Medium exports	NA	NA	NA	0.06	0.06	0.00	0.06	0.06	0.00	0.06	0.31	0.25	0.06	0.08	0.02
Heavy exports	NA	NA	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crude imports by gravity (million b/d) [12]															
Light imports	0.99	0.66	0.66	0.82	0.83	0.00	1.21	1.21	0.00	0.07	0.05	(0.02)	0.28	0.17	(0.12)
Medium imports	2.69	2.53	2.14	1.41	1.41	0.00	1.45	1.45	0.00	0.51	0.48	(0.03)	0.59	0.64	0.04
Heavy imports	4.01	4.15	4.48	4.65	4.62	(0.02)	4.53	4.53	0.00	4.84	5.15	0.31	5.28	5.75	0.47

Sources: U.S. Energy Information Administration, *Petroleum Supply Monthly*, *Short-Term Energy Outlook*, *Refinery Capacity Report*, and Reference, Low Oil Price, High Oil and Gas Resource, and High Oil and Gas Resource/Low Oil Price cases, with and without current crude oil export restrictions.

Note: Projections from National Energy Modeling System. Totals may not equal sum or difference of components due to independent rounding. NA = Not Available.

[1]Historical totals reflect model results benched to EIA estimates calculated with state administrative data collected by DrillingInfo.

[2]Historical offshore values include Alaska offshore volumes and are thus not listed.

[3]Includes other Lower 48 onshore production and all Alaska production. Historical values also include carbon dioxide enhanced oil recovery and Lower 48 offshore production.

[4]All other non-crude supply includes refinery processing gain, product stock withdrawal, natural gas plant liquids, supply from renewable sources, liquids from gas, liquids from coal, and other supply.

[5]Historical values equal total petroleum product supplied (or U.S. petroleum product consumption) plus the average daily change in crude oil and petroleum product inventories.

[6]Historical prices calculated with historical values from the *Short-Term Energy Outlook*, adjusted to 2013 prices using the Consumer Price Index (all urban consumers).

[7]U.S. all grades retail price, including taxes.

[8]U.S. retail price, including taxes.

[9]Includes both splitter and atmospheric distillation unit capacity and throughput.

[10]Equals total operable atmospheric crude oil distillation capacity as of January 1 of each calendar year.

[11]Historical volumes include unfinished oils, whereas projected volumes include only crude oil volumes.

[12]Light crude oil includes crude oil with an API gravity of 35 or higher; medium crude oil includes crude oil with an API gravity of equal to or above 27 and less than 35; heavy crude oil includes crude oil with an API gravity of below 27.