



Report to the Ranking Member,
Committee on Energy and Natural
Resources, U.S. Senate

September 2014

CHANGING CRUDE OIL MARKETS

Allowing Exports
Could Reduce
Consumer Fuel
Prices, and the Size
of the Strategic
Reserves Should Be
Reexamined

GAO Highlights

Highlights of [GAO-14-807](#), a report to the Ranking Member, Committee on Energy and Natural Resources, U. S. Senate

Why GAO Did This Study

Almost 4 decades ago, in response to the Arab oil embargo and recession it triggered, Congress passed legislation restricting crude oil exports and establishing the SPR to release oil to the market during supply disruptions and protect the U.S. economy from damage. After decades of generally falling U.S. crude oil production, technological advances have contributed to increasing U.S. production. Meanwhile, net crude oil imports—imports minus exports—have declined from a peak of about 60 percent of consumption in 2005 to 30 percent in the first 5 months of 2014. According to Energy Information Administration forecasts, net imports are expected to remain well below 2005 levels into the future.

GAO was asked to provide information on the implications of removing crude oil export restrictions. This report examines what is known about (1) price implications of removing crude oil export restrictions; (2) other key potential implications; and (3) implications of recent changes in market conditions on the SPR. GAO reviewed four studies on crude oil exports, including two sponsored by industry, and summarized the literature and views of a nonprobability sample of stakeholders including academic, industry, and other experts.

What GAO Recommends

In view of changing market conditions and in tandem with activities to assess other aspects of the SPR, GAO recommends that the Secretary of Energy reexamine the size of the SPR. In commenting on a draft of this report, DOE concurred with GAO's recommendation.

View [GAO-14-807](#). For more information, contact Frank Rusco at (202) 512-3841 or ruscof@gao.gov.

September 2014

CHANGING CRUDE OIL MARKETS

Allowing Exports Could Reduce Consumer Fuel Prices, and the Size of the Strategic Reserves Should Be Reexamined

What GAO Found

The studies GAO reviewed and stakeholders interviewed suggest that removing crude oil export restrictions is likely to increase domestic crude oil prices but decrease consumer fuel prices. Prices for some U.S. crude oils are lower than international prices—for example, one benchmark U.S. crude oil averaged \$101 per barrel in 2014, while a comparable international crude oil averaged \$109. Studies estimate that U.S. crude oil prices would increase by about \$2 to \$8 per barrel—bringing them closer to international prices. At the same time, studies and some stakeholders suggest that U.S. prices for gasoline, diesel, and other consumer fuels follow international prices, so allowing crude oil exports would increase world supplies of crude oil, which is expected to reduce international prices and, subsequently, lower consumer fuel prices. Some stakeholders told GAO that there could be important regional differences in the price implications of removing crude oil export restrictions. Some stakeholders cautioned that estimates of the implications of removing export restrictions are uncertain due to several factors such as the extent of U.S. crude oil production increases, how readily U.S. refiners are able to absorb such increases, and how the global crude oil market responds to increasing U.S. production.

The studies GAO reviewed and stakeholders interviewed generally suggest that removing crude oil export restrictions may also have the following implications:

- **Crude oil production.** Removing export restrictions would increase domestic production—8 million barrels per day in April 2014—because of increasing domestic crude oil prices. Estimates range from an additional 130,000 to 3.3 million barrels per day on average from 2015 through 2035.
- **Environment.** Additional crude oil production may pose risks to the quality and quantity of surface groundwater sources; increase greenhouse gas and other emissions; and increase the risk of spills from crude oil transportation.
- **The economy.** Removing export restrictions is expected to increase the size of the economy, with implications for employment, investment, public revenue, and trade. For example, removing restrictions is expected to contribute to further declines in net crude oil imports, reducing the U.S. trade deficit.

Changing market conditions have implications for the size, location, and composition of Department of Energy's (DOE) Strategic Petroleum Reserve (SPR). In particular, increased domestic crude oil production and falling net imports may affect the ideal size of the SPR. Removing export restrictions is expected to contribute to additional decreases in net imports in the future. As a member of the International Energy Agency, the United States is required to maintain public and private reserves of at least 90 days of net imports but, as of May 2014, the SPR held reserves of 106 days—worth about \$73 billion—and private industry held reserves of 141 days. DOE has taken some steps to assess the implications of changing market conditions on the location and composition of the SPR but has not recently reexamined its size. GAO has found that agencies should reexamine their programs if conditions change. Without such a reexamination, DOE cannot be assured that the SPR is sized appropriately and risks holding excess crude oil that could be sold to fund other national priorities.

Contents

Letter		1
	Background	3
	Removing Crude Oil Export Restrictions Is Expected to Increase Domestic Crude Oil Prices and Could Decrease Consumer Fuel Prices	11
	Removing Crude Oil Export Restrictions Is Expected to Increase Domestic Production and Have Other Effects	19
	Changing Market Conditions Raise Questions about the Size, Location, and Composition of the SPR	25
	Conclusions	35
	Recommendation for Executive Action	35
	Agency Comments and Our Evaluation	35

Appendix I	Additional Information on Four Studies of the Implications of Removing Crude Oil Export Restrictions	37
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Appendix II	List of Stakeholders Interviewed	41
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Appendix III	Comments from the Department of Energy	42
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Appendix IV	GAO Contact and Staff Acknowledgments	44
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Related GAO Products		45
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Tables		
	Table 1: Crude Oil Price Implications of Removing Crude Oil Export Restrictions from Four Studies	15
	Table 2: Consumer Fuel Price Implications of Removing Crude Oil Export Restrictions from Four Studies	16
	Table 3: Description of Approach and Key Assumptions in Four Studies on the Implications of Removing Crude Oil Export Restrictions	38

Table 4: Summary of Price Implications of Removing Crude Oil Export Restrictions in Four Studies	39
Table 5: Summary of Other Implications of Removing Crude Oil Export Restrictions in Four Studies	40

Figures

Figure 1: Weekly West Texas Intermediate and Brent Crude Oil Prices, 2009-June 2014	7
Figure 2: U.S. Crude Oil Production and Energy Information Administration Forecast of Production by Crude Oil Type, 2011-2015	9
Figure 3: U.S. Net Petroleum Imports, Historical (1970-2013) and Energy Information Administration Forecasts	28
Figure 4: Heavier Crude Oil as a Percentage of Total U.S. Crude Oil Imports, 2008-2013	30
Figure 5: United States' Historic and Estimated Compliance with International Energy Agency Obligation to Hold Reserves	34

Abbreviations

API	American Petroleum Institute
BIS	Bureau of Industry and Security
DOE	Department of Energy
EIA	Energy Information Administration
EPCA	Energy Policy and Conservation Act of 1975
IEA	International Energy Agency
OPEC	Organization of the Petroleum Exporting Countries
RFF	Resources for the Future
SPR	Strategic Petroleum Reserve
WTI	West Texas Intermediate

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September 30, 2014

The Honorable Lisa Murkowski
Ranking Member
Committee on Energy and Natural Resources
United States Senate

Dear Senator Murkowski:

Almost 4 decades ago, Congress passed legislation restricting U.S. crude oil exports and establishing the Strategic Petroleum Reserve (SPR) in response to the Arab oil embargo and economic recession it triggered. In recent years, however, crude oil market conditions have changed, reversing decades-long trends in declining domestic crude oil production and increasing crude oil imports. Monthly crude oil production has increased by almost 68 percent from 2008 through April 2014, and increases in production in 2012 and 2013 were the largest annual increases since the beginning of U.S. commercial crude oil production in 1859, according to the Energy Information Administration (EIA).¹ With growing production, net crude oil imports—imports minus exports—have declined from a peak of about 60 percent of consumption in 2005 to about 30 percent in the first 5 months of 2014. In response, some members of Congress proposed legislation to remove crude oil export restrictions, while others argued that restrictions should remain in place and not be modified.² Recent congressional hearings stressed the need to understand how changing crude oil export restrictions could affect crude oil prices and the prices of consumer fuels refined from crude oil, such as gasoline and diesel.

At the same time, crude oil market changes may have implications for the SPR, the largest government-held emergency stockpile of crude oil in the world. The SPR holds 691 million barrels of crude oil in underground salt caverns along the Gulf Coast in Louisiana and Texas. In the event of a

¹EIA is a statistical agency within the Department of Energy that collects, analyzes, and disseminates independent information on energy issues.

²Proposed legislation includes H. R. 4349, the Crude Oil Export Act, which was referred to the House Foreign Affairs Committee, Subcommittee on Terrorism, Nonproliferation, and Trade on June 10, 2014.

crude oil supply disruption, the SPR relies on the existing commercial distribution and refining system to transport and process crude oil into usable products for sale to the public. Increasing crude oil production, shrinking crude oil imports, changing crude oil and fuel distribution patterns, and an evolving U.S. refining industry could have important implications for the SPR.

You asked us to provide information on the implications of removing crude oil export restrictions. This report examines what is known about: (1) the potential effect of removing crude oil export restrictions on prices of crude oil and consumer fuels; (2) other potential implications of removing crude oil export restrictions; and (3) implications for the SPR, if any, from recent changes in crude oil market conditions.

To conduct this work, we reviewed information, including studies by federal agencies, consultants, and academics, and summarized the results of interviews from a nonprobability sample of 17 stakeholders. We identified relevant information by conducting a literature search and obtaining suggestions from stakeholders we interviewed.³ We identified and summarized the results of four recent studies that estimate the potential implications of removing crude oil export restrictions. Two of these studies were sponsored by industry and conducted by consultants, another was sponsored by a research organization and conducted by consultants, and the fourth was conducted at a research organization.⁴ To assess the reasonableness of these studies, we conducted a high-level review of the assumptions and methods used, interviewed the studies' authors, and obtained views of other stakeholders. We determined that these studies were reasonable for describing what is known about the range of potential implications but identified several limitations, which we discuss later in this report. We did not identify any other publicly available

³Specifically, we searched sources including Proquest, PolicyFile, and Web of Science in April 2014.

⁴The four studies are: Resources for the Future (RFF), *Crude Behavior: How Lifting the Export Ban Reduces Gasoline Prices in the United States* (Washington, D.C.: Resources for the Future, February 2014, revised March 2014); ICF International and EnSys Energy (ICF International), *The Impacts of U.S. Crude Oil Exports on Domestic Crude Production, GDP, Employment, Trade, and Consumer Costs* (Washington, D.C.: ICF Resources, March 31, 2014); IHS, *US Crude Oil Export Decision: Assessing the impact of the export ban and free trade on the US economy* (Englewood, CO: IHS, 2014); and NERA Economic Consulting (NERA), *Economic Benefits of Lifting the Crude Oil Export Ban* (Washington, D.C.: NERA Economic Consulting, September 9, 2014).

primary studies of the implications of removing crude oil export restrictions. Stakeholders included representatives of companies and interest groups with a stake in the outcome of decisions regarding crude oil export restrictions, as well as academic, industry, and other experts. We selected stakeholders based on our literature review and recommendations from agency officials and others. We asked the same questions during each interview but also discussed individual stakeholders' perspectives, as appropriate. We summarized their views, noting areas of consensus and disagreement. We may not have identified all stakeholders with a view on this topic, but we sought to balance the group with the range of perspectives. The views of stakeholders we selected are not generalizable to all potential stakeholders, but they provide illustrative examples of the range of views. To assess the implications of recent trends on the SPR, we interviewed Department of Energy (DOE) officials and reviewed agency and other documents. Data in this report are primarily from EIA, the International Energy Agency (IEA), and Bloomberg.⁵ To assess the reliability of these data, we reviewed relevant documentation, interviewed EIA and Bloomberg officials, and compared the data with similar data published in other sources. We determined these data to be sufficiently reliable for the purposes of this report. Appendix I provides additional information on the four studies we reviewed, and appendix II lists the stakeholders we interviewed.

We conducted this performance audit from April 2014 to September 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

This section describes crude oil export restrictions, the SPR, and recent trends in U.S. crude oil production and the petroleum refining industry.

⁵Bloomberg is a provider of business and financial news, data, and analytics.

Crude Oil Export Restrictions

The export of domestically produced crude oil has generally been restricted since the 1970s. In particular, the Energy Policy and Conservation Act of 1975 (EPCA) led the Department of Commerce's Bureau of Industry and Security (BIS) to promulgate regulations which require crude oil exporters to obtain a license.⁶ These regulations provide that BIS will issue licenses for the following crude oil exports:

- exports from Alaska's Cook Inlet,
- exports to Canada for consumption or use therein,
- exports in connection with refining or exchange of SPR crude oil,
- exports of certain California crude oil up to 25,000 barrels per day,
- exports consistent with certain international energy supply agreements,
- exports consistent with findings made by the President under certain statutes, and
- exports of foreign origin crude oil that has not been commingled with crude oil of U.S. origin.

Other than for these exceptions, BIS considers export license applications for exchanges involving crude oil on a case-by-case basis, and BIS can approve them if it determines that the proposed export is consistent with the national interest and purposes of EPCA.⁷ In addition to BIS's export controls, other statutes control the export of domestically produced crude oil depending on where it was produced and how it is transported.⁸ In these cases, BIS can approve exports only if the President makes the necessary findings under applicable laws.⁹ Some of the authorized exceptions, outlined above, are the result of such Presidential findings.

⁶15 C.F.R. §754.2(a).

⁷15 C.F.R. §754.2(b)(2).

⁸For example, the Mineral Leasing Act of 1920 restricts exports of domestically produced crude oil transported by pipeline over certain rights-of-way (30 U.S.C. §185(u)); the Outer Continental Shelf Lands Act restricts exports of crude oil from the outer continental shelf (29 U.S.C. §1354); the Naval Petroleum Reserves Production Act restricts the export of crude oil produced from the Naval Petroleum Reserves (10 U.S.C. §7430) and Section 201 of Pub. L. No. 104-58, "Exports of Alaskan North Slope Oil," provides for exports of domestically produced crude oil transported by pipeline over rights-of-way granted pursuant to section 203 of the Trans-Alaska Pipeline Authorization Act (30 U.S.C. §185(s)).

⁹15 C.F.R. §754.2(c).

According to NERA, no other major oil producing country currently restricts crude oil exports.¹⁰

BIS approved about 30 to 40 licenses to export domestic crude oil per year from fiscal years 2008 through 2010. The number of BIS approved licenses increased to 103 in fiscal year 2013. Meanwhile, crude oil exports increased from less than 30 thousand barrels per day in 2008 to 396 thousand barrels per day in June 2014—the highest level of exports since 1957. Nearly all domestic crude oil exports have gone to Canada.

The SPR

To help protect the U.S. economy from damage caused by crude oil supply disruptions, Congress authorized the SPR in 1975. The SPR is owned by the federal government and operated by DOE. The SPR is authorized to hold up to 1 billion barrels of crude oil and has the capacity to store 727 million barrels of crude oil in salt caverns located at sites in Texas and Louisiana. According to DOE, the SPR held crude oil valued at almost \$73 billion dollars as of May, 2014. From fiscal year 2000 through 2013, the federal government spent about \$0.5 billion to purchase crude oil, and spent \$2.5 billion for operations and maintenance of the reserve.

The United States is a member of the IEA and has agreed, along with 28 other member nations, to maintain reserves of crude oil or petroleum products equaling 90 days of net imports and to release these reserves and reduce demand during oil supply disruptions.¹¹ The 90-day reserve requirement can be made up of government reserves, such as the SPR, and inventory reserves held by private industry.¹²

Under conditions prescribed by the Energy Policy and Conservation Act, as amended, the President and the Secretary of Energy have discretion to authorize the release of crude oil from the SPR to minimize significant

¹⁰NERA, *Economic Benefits of Lifting the Crude Oil Export Ban*, p.20.

¹¹The 29 member countries of the IEA are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

¹²Under the agreement, capacity to switch to nonpetroleum-based fuels and standby crude oil production capacity can also be used to meet the reserve requirement.

supply disruptions.¹³ In the event of a crude oil supply disruption, the SPR can supply the market by selling stored crude oil or trading crude oil in exchange for an equal quantity of crude oil plus an additional amount as a premium to be returned to the SPR in the future. When crude oil is released from the SPR, it flows through commercial pipelines or on waterborne vessels to refineries, where it is converted into gasoline and other petroleum products, and then transported to distribution centers for sale to the public.

Trends in U.S. Crude Oil Production and the Petroleum Refining Industry

Reversing a decades-long decline, U.S. crude oil production has increased in recent years. According to EIA data, U.S. production of crude oil reached its highest level in 1970 and generally declined through 2008, reaching a level of almost one-half of its peak. During this time, the United States increasingly relied on imported crude oil to meet growing domestic energy needs. However, recent improvements in technologies have allowed producers to extract crude oil from shale formations that were previously considered to be inaccessible because traditional techniques did not yield sufficient amounts for economically viable production. In particular, the application of horizontal drilling techniques and hydraulic fracturing—a process that injects a combination of water, sand, and chemical additives under high pressure to create and maintain fractures in underground rock formations that allow crude oil and natural gas to flow—have increased U.S. crude oil and natural gas production.¹⁴ Monthly domestic crude oil production has increased from an average of about 5 million barrels per day in 2008 to about 8.4 million barrels per day in April 2014, an increase of almost 68 percent.

As we previously found, the growth in U.S. crude oil production has lowered the cost of some domestic crude oils.¹⁵ For example, prices for West Texas Intermediate (WTI) crude oil—a domestic crude oil used as a

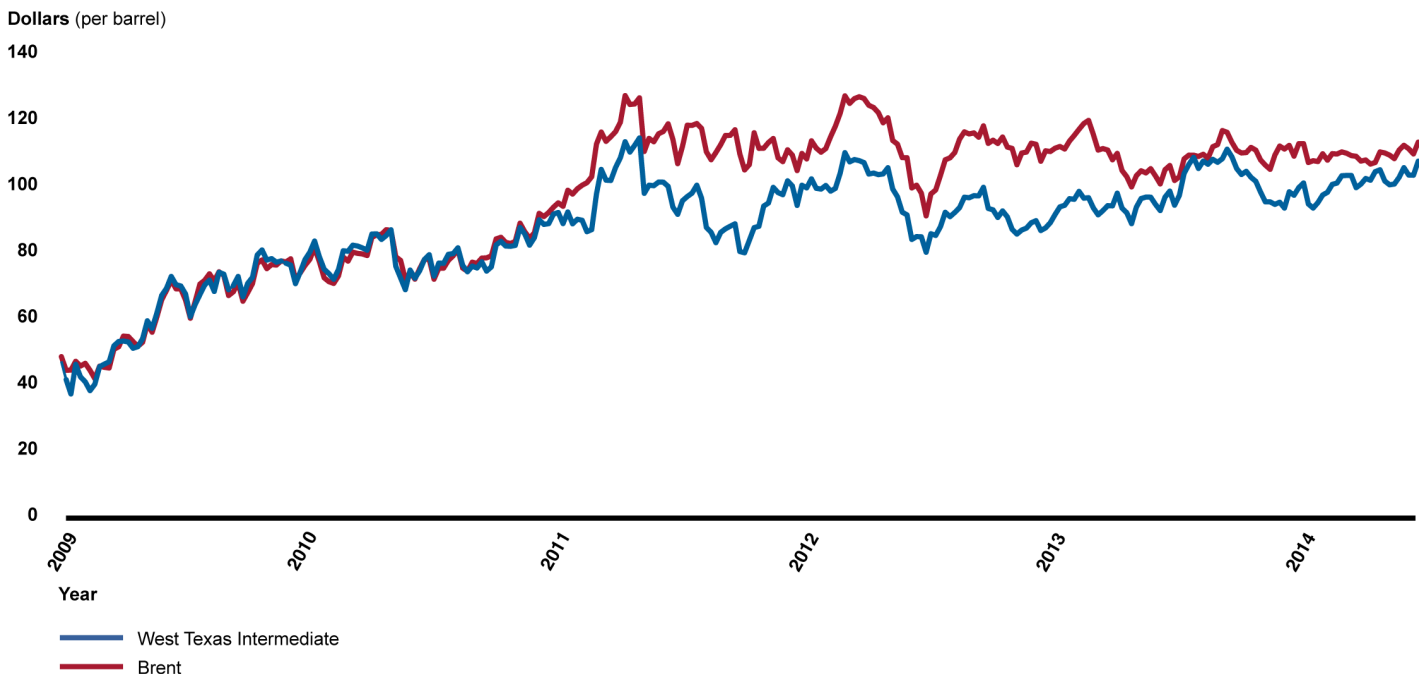
¹³Pub. L. No. 94-163, §161, 89 Stat. 888-889 (1975), codified as amended at 42 U.S.C. §6241. The statute provides for a drawdown of the reserve upon a finding by the President that there is a “severe energy supply interruption” as well as an event that is, or is likely to become, an energy supply shortage “of significant scope or duration” (42 U.S.C. §6241(d), (h)).

¹⁴For more information on these technologies, see: GAO, *Oil and Gas: Information on Shale Resources, Development, and Environmental and Public Health Risks*, [GAO-12-732](#) (Washington, D.C.: Sept. 5, 2012).

¹⁵GAO, *Petroleum Refining: Industry’s Outlook Depends on Market Changes and Key Environmental Regulations*, [GAO-14-249](#) (Washington, D.C.: Mar. 14, 2014).

benchmark for pricing—was historically about the same price as Brent, an international benchmark crude oil from the North Sea between Great Britain and the European continent.¹⁶ However, from 2011 through June 13, 2014, the price of WTI averaged \$14 per barrel lower than Brent (see fig. 1). In 2014, prices for these benchmark crude oils narrowed somewhat, and WTI averaged \$101 through June 13, 2014, while Brent averaged \$109. The development of U.S. crude oil production has created some challenges for crude oil transportation infrastructure because some production has been in areas with limited linkages to refining centers. According to EIA, these infrastructure constraints have contributed to discounted prices for some domestic crude oils.

Figure 1: Weekly West Texas Intermediate and Brent Crude Oil Prices, 2009-June 2014



Source: GAO analysis of Bloomberg data. | GAO-14-807

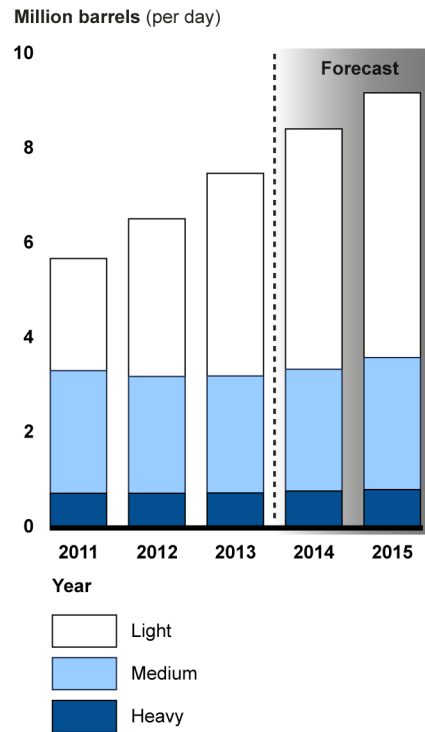
Note: West Texas Intermediate is a domestic crude oil used as a benchmark for pricing, and Brent is an international benchmark from the North Sea between Great Britain and the European continent.

¹⁶Because of the large number of grades of crude oils, buyers and sellers use benchmark crude oils as a reference in pricing crude oil. A benchmark crude oil is typically an abundantly produced and frequently traded crude oil. For example, crude oils produced in North and South America are typically priced in reference to WTI.

Much of the crude oil currently produced in the United States has characteristics that differ from historic domestic production. Crude oil is generally classified according to two parameters: density and sulfur content. Less dense crude oils are known as “light,” while denser crude oils are known as “heavy.” Crude oils with relatively low sulfur content are known as “sweet,” while crude oils with higher sulfur content are known as “sour.” As shown in figure 1, according to EIA, production of new domestic crude oil has tended to be light oils. Specifically, according to EIA estimates about all of the 1.8 million barrels per day growth in production between 2011 and 2013 consisted of lighter sweet crude oils.¹⁷ EIA also forecasts that lighter crude oils will make up a significant portion of production growth in 2014 and 2015—about 60 percent.

¹⁷The density, or gravity of a crude oil is specified using the American Petroleum Institute (API) gravity standard, which measures the weight of crude oil in relation to water, which has an API gravity of 10 degrees. For the purposes of this estimate, we considered light oils as those with an API gravity of 35 degrees or above. See: Energy Information Administration, *U.S. Crude Oil Production Forecast-Analysis of Crude Types* (Washington, D.C.: May 29, 2014).

Figure 2: U.S. Crude Oil Production and Energy Information Administration Forecast of Production by Crude Oil Type, 2011-2015



Source: GAO analysis of Energy Information Administration data. | GAO-14-807

Note: The density, or gravity, of a crude oil is specified using the American Petroleum Institute (API) gravity standard, which measures the weight of crude oil in relation to water, which has an API gravity of 10 degrees. Heavy crude oils include those with an API gravity of less than 27; medium includes crude oil with an API from 27 to 35; and light includes crude oil with API gravities of 35 and above.

Light crude oil differs from the crude oil that many U.S. refineries are designed to process. Refineries are configured to produce transportation fuels and other products (e.g., gasoline, diesel, jet fuel, and kerosene) from specific types of crude oil. Refineries use a distillation process that separates crude oil into different fractions, or interim products, based on their boiling points, which can then be further processed into final products. Many refineries in the United States are configured to refine heavier crude oils, and have therefore been able to take advantage of

historically lower prices of heavier crude oils.¹⁸ For example, in 2013, the average density of crude oil used at domestic refineries was 30.8 while nearly all of the increase in production in recent years has been lighter crude oil with a density of 35 or above.

According to EIA, additional production of light crude oil over the past several years has been absorbed into the market through several mechanisms, but the capacity of these mechanisms to absorb further increases in light crude oil production may be limited in the future as follows:

- **Reduced imports of similar grade crude oils:** According to EIA, additional production of light oil in the past several years has primarily been absorbed by reducing imports of similar grade crude oils. Light crude oil imports fell from 1.7 million barrels per day in 2011 to 1 million barrels per day in 2013. There may be dwindling amounts of light crude oil imports that can be reduced in the future, according to EIA.
- **Increased crude oil exports:** As discussed above, crude oil exports have increased recently, from less than 30 thousand barrels per day in 2008 to 396 thousand barrels per day in June 2014. Continued increases in crude oil exports will depend, in part, on the extent of any relaxation of current export restrictions, according to EIA.
- **Increased use of light crude oils at domestic refineries:** Domestic refineries have increased the average gravity of crude oils that they refine. The average API gravity of crude oil used in U.S. refineries increased from 30.2 degrees in 2008 to 30.8 degrees in 2013. Continued shifts to use additional lighter crude oils at domestic refineries can be enabled by investments to relieve constraints associated with refining lighter crude oils at refineries that were optimized to refine heavier crude oils.
- **Increased use of domestic refineries:** In recent years, domestic refineries have been run more intensively, allowing the use of more domestic crude oils. Utilization—a measure of how intensively refineries are used that is calculated by dividing total crude oil and other inputs used at refineries by the amount refineries can process under usual operating conditions—increased from 86 percent in 2011

¹⁸In general, heavier crude oils require more complex and expensive refineries to process the crude oil into usable products, but have been less expensive to purchase than lighter crude oils.

to 88 percent in 2013. There may be limits to further increases in utilization of refineries that are already running at high rates.

Removing Crude Oil Export Restrictions Is Expected to Increase Domestic Crude Oil Prices and Could Decrease Consumer Fuel Prices

The studies we reviewed and stakeholders we interviewed generally suggest some domestic crude oil prices would increase if crude oil export restrictions were removed, while consumer fuel prices could decrease, although the extent of consumer fuel price changes are uncertain and may vary by region.

Some Domestic Crude Oil Prices Are Expected to Increase

Studies we reviewed and most of the stakeholders we interviewed suggest that some domestic crude oil prices would increase if crude oil export restrictions were removed.¹⁹ As discussed above, increasing domestic crude oil production has resulted in lower prices of some domestic crude oils compared with international benchmark crude oils.²⁰ Three of the studies we reviewed also said that, absent changes in crude oil export restrictions, the expected growth in crude oil production may not be fully absorbed by domestic refineries or through exports (where allowed), contributing to even wider differences in prices between some

¹⁹Stakeholders we interviewed include representatives of companies and interest groups with a stake in the outcome of decisions regarding crude oil export restrictions, as well as academic, industry, and other experts.

²⁰Increasing U.S. crude oil production may also have affected some global oil prices. For example, in 2013 U.S. crude oil production grew more than the combined increase in the rest of the world, which contributed to relatively stable global crude oil prices in 2013, according to EIA. See: EIA, *Today in Energy: U.S. Crude Oil Production Growth Contributes to Global Oil Price Stability in 2013* (Washington, D.C.: Jan. 9, 2014).

domestic and international crude oils.²¹ By removing the export restrictions, these domestic crude oils could be sold at prices closer to international prices, reducing the price differential and aligning the price of domestic crude oil with international benchmarks.

While the studies we reviewed and most of the stakeholders we interviewed agree that domestic crude oil prices would increase if crude oil export restrictions were removed, stakeholders highlighted several factors that could affect the extent of price increases. The studies we reviewed made assumptions about these factors, and actual price implications of removing crude oil export restrictions may differ from those estimated in the studies depending on how export restrictions and market conditions evolve. Specifically, stakeholders raised the following three key uncertainties:

- **Extent of future increases in crude oil production.** As we recently found, forecasts anticipate increases in domestic crude oil production in the future, but the projections are uncertain and vary widely.²² Two of the studies and two stakeholders told us that, in the absence of exports, higher production of domestic light sweet crude oil would tend to increase the mismatch between such crude oils and the refining industry. In turn, one study indicated that a greater increase in production would increase the price effects of removing crude oil export restrictions. On the other hand, lower than anticipated production of such crude oil would lower potential price effects as the additional crude oil could more easily be absorbed domestically.
- **Extent to which crude oil production increases can be absorbed.** The domestic refining industry and exports to Canada have absorbed the increases in domestic crude oil production thus far, and one

²¹We summarize the results of four studies: Resources for the Future (RFF), *Crude Behavior: How Lifting the Export Ban Reduces Gasoline Prices in the United States* (Washington, D.C.: Resources for the Future, February 2014, revised March 2014); ICF International and EnSys Energy (ICF International), *The Impacts of U.S. Crude Oil Exports on Domestic Crude Production, GDP, Employment, Trade, and Consumer Costs* (Washington, D.C.: ICF Resources, March 31, 2014); IHS, *US Crude Oil Export Decision: Assessing the impact of the export ban and free trade on the US economy* (Englewood, CO: IHS, 2014); and NERA Economic Consulting (NERA), *Economic Benefits of Lifting the Crude Oil Export Ban* (Washington, D.C.: NERA Economic Consulting, September 9, 2014). For additional information on these studies, see appendix I.

²²Specifically, we reported on three forecasts, from the International Energy Agency (IEA), IHS Global, and EIA. See, [GAO-14-249](#).

stakeholder told us the domestic refining industry could provide sufficient capacity to absorb additional future crude oil production. This stakeholder said that refineries have the capacity to refine another 400,000 barrels a day of light crude oil, some of which is not being used because of infrastructure or logistics constraints. The industry is planning to develop or is in the process of developing the capacity to process an additional 500,000 barrels a day of light crude oil, according to this stakeholder. The current capacity that is not being utilized plus capacity that is planned or in development would constitute a total capacity to refine 900,000 barrels per day of light crude oil. To the extent that light crude oil production increases by less than this amount, the gap in prices between WTI and Brent could close in the future as increased crude oil supplies are absorbed.²³ This would reduce the extent to which domestic crude oil prices increase if crude oil export restrictions are removed. On the other hand, some stakeholders suggested that the U.S. refining industry will not be able to keep pace with increasing U.S. light crude oil production. For example, IHS stated that refinery investments to process additional light crude oil face significant risks in the form of potentially stranded investments if export restrictions were to change, and this could result in investments not being made as quickly as anticipated.

- **Extent to which export restrictions change.** Aspects of the export restrictions could be further defined or interpreted in ways that could change the pricing dynamics of domestic crude oil markets. Recently, two companies received clarification from the Department of Commerce that condensate—a type of light crude oil²⁴—that has been processed through a distillation tower is not considered crude oil and

²³For example, EIA estimates that light crude oil production may increase by 513,000 barrels per day in 2015. (See: EIA, *U.S. Crude Oil production Forecast-Analysis of Crude Types* (Washington, D.C.: May 29, 2014).

²⁴Specifically, the Department of Commerce's definition of crude oil includes condensates, which are light liquid hydrocarbons recovered primarily from natural gas wells.

so not subject to export restrictions.²⁵ One stakeholder stated that this may lead to more condensate exports than expected.²⁶

Within the context of these uncertainties, estimates of potential price effects vary in the four studies we reviewed, as shown in table 1. Specifically, estimates in these studies of the increase in domestic crude oil prices due to removing crude oil export restrictions range from about \$2 to \$8 per barrel.²⁷ For comparison, at the beginning of June 2014, WTI was \$103 per barrel, and these estimates represent 2 to 8 percent of that price. In addition, NERA found that removing export restrictions would have no measurable effect in a case that assumes a low future international oil price of \$70 per barrel in 2015 rising to less than \$75 by 2035. According to NERA, current production costs are close to these values, so that removing export restrictions would provide little incentive to produce more light crude oil.

²⁵Specifically, companies often process condensate through stabilization units to reduce their volatility and prepare the condensate for transport to markets. Some stabilization units include distillation towers. In March and May 2014, the Department of Commerce issued commodity classifications that determined that condensates processed through a crude oil distillation tower, as described by the two companies requesting clarification, did not meet the definition of crude oil in BIS's regulations and thus were not subject to the export prohibitions applicable to U.S. produced crude oil.

²⁶This clarification provided by the Department of Commerce occurred after the publication of the RFF, ICF International, and IHS studies and thus this was not taken into consideration in the studies. NERA also did not consider the potential effect of the clarification in its study.

²⁷Unless otherwise noted, dollar estimates in the rest of this report have been converted to 2014 year dollars. These are average price effects over the study time frames, and some cases in some studies project larger price effects in the near term that decline over time.

Table 1: Crude Oil Price Implications of Removing Crude Oil Export Restrictions from Four Studies

	Resources for the Future	ICF International	IHS	NERA
U.S. crude oil price	Midwest refiner acquisition costs increase \$6.68 per barrel ^a	WTI prices \$2.35 to \$4.19 per barrel higher on average from 2015-2035	\$7.89 per barrel higher on average from 2016-2030	Prices increase \$1.74 per barrel in the reference case and \$5.95 per barrel in the high case on average from 2015-2035. ^b

Sources: GAO analysis of Resources for the Future, ICF International, IHS, and NERA studies. | GAO-14-807

Note: Estimates are in 2014 year dollars.

^aRefiner acquisition costs are the costs of crude oil including transportation and other fees paid by the refiner. Such costs may be closely related to the prices of crude oil discussed in this report.

^bImplications refer to the difference between the reference case and its baseline with export restrictions in place, and the difference between the high oil and gas recovery case and its corresponding baseline. NERA also found that removing crude oil export restrictions would have no measurable effect in the low world oil price case.

Consumer Fuel Prices Could Decrease, but Effects May Vary by Region

The studies we reviewed and most of the stakeholders we interviewed suggest that consumer fuel prices, such as gasoline, diesel, and jet fuel, could decrease as a result of removing crude oil export restrictions. A decrease in consumer fuel prices could occur because they tend to follow international crude oil prices rather than domestic crude oil prices, according to the studies and most of the stakeholders. If domestic crude oil exports caused international crude oil prices to decrease, consumer fuel prices could decrease as well.²⁸ Table 2 shows that the estimates of the price effects on consumer fuels vary in the four studies we reviewed. Price estimates range from a decrease of 1.5 to 13 cents per gallon. These estimates represent 0.4 to 3.4 percent of the average U.S. retail gasoline price at the beginning of June 2014. In addition, NERA found that removing export restrictions has no measurable effect on consumer fuel prices in a case that assumes a low future world crude oil price.

²⁸RFF also estimates a decrease in consumer fuel prices but this decrease is as a result of increased refinery efficiency (even with an estimated slight increase in the international crude oil price).

Table 2: Consumer Fuel Price Implications of Removing Crude Oil Export Restrictions from Four Studies

	Resources for the Future	ICF International	IHS	NERA^a
U.S. Consumer Fuel Prices	Gasoline prices decline by 1.8 to 4.6 center per gallon on average	Petroleum product prices decline by 1.5 to 2.4 cents per gallon on average from 2015-2035	Gasoline prices decline by 9 to 13 cents per gallon on average from 2016-2030	Petroleum product prices decline by 3 cents per gallon on average from 2015-2035 in the reference case and 11 cents per gallon in the high case. Gasoline prices decline by 3 cents per gallon in the reference case and 10 cents per gallon in the high case.

Sources: GAO analysis of Resources for the Future, ICF International, IHS, and NERA studies. | GAO-14-807

Note: Dollar estimates are in 2014 year dollars.

^aImplications refer to the difference between the reference case and its baseline with export restrictions in place, and the difference between the high oil and gas recovery case and its corresponding baseline. NERA also found that removing crude oil export restrictions has no measurable effect in the world crude oil low price case.

Price Effects of Allowing Alaskan North Slope Crude Oil Exports

In 1995, Congress removed the restrictions on the export of Alaskan North Slope crude oil. From the time the restrictions were removed until 2004, about 2.7 percent of Alaskan North Slope crude oil was exported; however, no Alaskan North Slope crude oil has been exported since 2004. The experience of allowing Alaskan North Slope crude oil exports may illustrate some of the potential effects of removing crude oil export restrictions nationally. In 1999, we reviewed the effects of allowing Alaskan North Slope crude oil exports and concluded that:^a

- lifting the export ban raised the relative prices of Alaskan North Slope and comparable California crude oils by between \$0.98 and \$1.30 per barrel;^b
- some refiners' costs increased commensurate with the increase in crude oil prices; and
- consumer fuel prices for gasoline, diesel, and jet fuel did not increase.

The effect of removing the export restrictions for Alaskan North Slope oil is not completely understood due to data limitations and the difficulty of separating the effects of removing the export restrictions from other market changes that occurred at the same time.

Source: GAO. | GAO-14-807

^aGAO, Alaskan North Slope Oil: Limited Effects of Lifting Export Ban on Oil and Shipping Industries and Consumers, [GAO/RCED-99-191](#) (Washington, D.C., July 1, 1999).

^bThese estimates have not been adjusted for inflation.

The effect of removing crude oil export restrictions on domestic consumer fuel prices depends on several uncertain factors. First, it depends on the extent to which domestic versus international crude oil prices determine the domestic price of consumer fuels. Recent research examining the relationship between domestic crude oil and gasoline prices concluded that low domestic crude oil prices in the Midwest during 2011 did not result in lower gasoline prices in that region.²⁹ This research supports the assumption made in all of the studies we reviewed that to some extent higher prices of some domestic crude oils as a result of removing crude oil export restrictions would not be passed on to consumer fuel prices. However, some stakeholders told us that this may not always be the case and that more recent or detailed data could show that lower prices for some domestic crude oils have influenced consumer fuel prices.

Second, the extent to which domestic consumer fuel prices could decline also depends on how the global crude oil market responds to the domestic crude oil entering the market. In this regard, stakeholders highlighted several uncertainties. In particular, the response of the Organization of the Petroleum Exporting Countries (OPEC) could have a large influence on any international crude oil price changes. The projections in the RFF, IHS, and ICF International studies assumed that OPEC would not respond by attempting to counterbalance the effect of increased U.S. exports by reducing its countries' exports. However, OPEC could seek to maintain international crude oil prices by pulling crude oil from the global market. In this case, the international crude oil price would not be affected by removing export restrictions, and consumer fuel prices would not decline. On the other hand, OPEC could increase production to maintain its large market share, which would push international crude oil prices and consumer fuel prices downward. NERA examined two alternative OPEC response cases, and found that gasoline prices would not generally be affected if OPEC reduces production, and that consumer fuel prices would decrease further if OPEC maintains its production in the face of lower global crude oil prices. In addition, one stakeholder questioned whether international crude oil prices would be affected by U.S. crude oil exports. Given the size of the global crude oil market, this stakeholder suggested that U.S. exports would have little to no effect on international crude oil prices.

²⁹See Severin Borenstein and Ryan Kellogg, "The Incidence of an Oil Glut: Who Benefits from Cheap Crude Oil in the Midwest?" *The Energy Journal* 35, no. 1 (2014).

Third, two of the stakeholders we interviewed suggested that there could be important regional differences in consumer fuel price implications, and that prices could increase in some regions—particularly the Midwest and the Northeast—due to changing transportation costs and potential refinery closures. For example, two stakeholders told us that because of requirements to use more expensive U.S.-built, -owned, and -operated ships to move crude oil between U.S. ports, allowing exports could enable some domestic crude oil producers to ship U.S. crude oil for less cost to refineries in foreign countries.³⁰ Specifically, representatives of one refiner told us that, if exports restrictions were removed, they could ship oil to their refineries in Europe at a lower cost than delivering the same oil to a refinery on the U.S. East Coast. According to another stakeholder, this could negatively affect the ability of some domestic refineries to compete with foreign refineries. Additionally, because refineries are currently benefiting from low domestic crude oil prices, some studies and stakeholders noted that refinery margins could be reduced if removing export restrictions increased domestic crude oil prices. As a result, some refineries could face an increased risk of closure, especially those located in the Northeast. As EIA reported in 2012, refinery closures in the Northeast could be associated with higher consumer fuel prices and possibly higher price volatility.³¹ However, according to one stakeholder, domestic refiners still have a significant cost advantage in the form of less expensive natural gas, which is an important energy source for many refineries. For this and other reasons, one stakeholder told us they did not anticipate refinery closures as a result of removing export restrictions.

³⁰The Merchant Marine Act of 1920, also known as the Jones Act, in general, requires that any vessel (including barges) operating between two U.S. ports be U.S.-built, -owned, and -operated.

³¹EIA, *Potential Impacts of Reductions in Refinery Activity on Northeast Petroleum Product Markets* (Washington, D.C.: May 11, 2012).

Removing Crude Oil Export Restrictions Is Expected to Increase Domestic Production and Have Other Effects

The studies we reviewed and stakeholders we interviewed generally suggest that removing crude oil export restrictions would increase domestic crude oil production and may affect the environment and the economy.

Removing Export Restrictions Is Expected to Increase Domestic Production, but Projections Vary

Studies we reviewed and stakeholders we interviewed generally agree that removing crude oil export restrictions would increase domestic crude oil production. Monthly domestic crude oil production has increased by almost 68 percent since 2008—from an average of about 5 million barrels per day in 2008 to 8.3 million barrels per day in April 2014. Even with current crude oil export restrictions, given various scenarios, EIA projects that domestic production will continue to increase and could reach 9.6 million barrels per day by 2019.³² If export restrictions were removed, according to the four studies we reviewed, the increased prices of domestic crude oil are projected to lead to further increases in crude oil production. Projections of this increase varied in the studies we reviewed—from a low of an additional 130,000 barrels per day on average between 2015 and 2035, according to the ICF International study, to a high of an additional 3.3 million barrels per day on average

³²U.S. crude oil production grows from 2012 through 2019 in EIA's Reference scenario, peaking at more than 9.6 million barrels per day—about 3.1 million barrels per day above the 2012 total and close to the historical high of 9.6 million barrels per day in 1970. However, EIA projects declines in later years. EIA examined several alternative scenarios, including a High Oil and Gas Resource scenario, where growth in oil production continues for a longer period of time than projected in the Reference scenario. Domestic crude oil production increases to nearly 13 million barrels per day before 2035 in this scenario. EIA also examined a Low Oil and Gas Resource scenario reflecting uncertainty about tight oil and shale crude oil and natural gas resources, leading to lower domestic production than in the Reference scenario. In the latter, production reaches 9.1 million barrels per day in 2017 before falling to 6.6 million barrels per day in 2040 (Energy Information Administration. *Annual Energy Outlook 2014*. May 7, 2014. See: http://www.eia.gov/forecasts/aeo/MT_liquidfuels.cfm.)

between 2015 and 2035 in NERA's study.³³ This is equivalent to 1.5 percent to almost 40 percent of production in April 2014.

One stakeholder we spoke with told us that, although domestic demand for crude oil is not expected to change, production will rise as a result of increased international demand, primarily from Asia. For example, according to EIA, India was the fourth-largest consumer of crude oil and petroleum products in the world in 2013, and the country's dependence on imported crude oil continues to grow.³⁴ Another stakeholder stated that removing export restrictions could lead to increased local and regional opposition to crude oil production if the crude oil was primarily for export, which could affect domestic production.

Removing Export Restrictions Is Expected to Affect the Environment

Two of the studies we reviewed and most stakeholders we spoke with stated that the increased crude oil production that would result from removing the restrictions on crude oil exports may affect the environment. In September 2012, we found that crude oil development may pose certain inherent environmental and public health risks; however, the extent of the risk is unknown, in part, because the severity of adverse effects depend on various location- and process-specific factors, including the location of future shale oil and gas development and the rate at which it occurs, as well as geology, climate, business practices, and regulatory and enforcement activities.³⁵ The stakeholders who raised concerns identified the following risks related to crude oil production, about which GAO has reported in the past:

- **Water quality and quantity:** Increased crude oil production, particularly from shale, could affect the quality and quantity of surface and groundwater sources, but the magnitude of such effects is

³³In addition, RFF estimated that oil production in Canada and in the Midwest United States would gradually increase if the restrictions were lifted by about 84,000 barrels per day. RFF estimated production elsewhere in the United States and the rest of the world would increase by 54,000 barrels per day for a total increase in world production of 138,000 additional barrels per day. IHS projected an additional 1.2 to 2.3 million barrels per day of crude oil production from 2016- through 2030. (See app. I for additional information.)

³⁴U.S. Department of Energy. Energy Information Administration. Country Report: India. See: <http://www.eia.gov/countries/country-data.cfm?fips=IN>. June 26, 2014.

³⁵[GAO-12-732](#).

unknown. In October 2010, we found that water is needed for a number of oil shale development activities, including constructing facilities, drilling wells, generating electricity for operations, and reclamation of drill sites.³⁶ In 2012, we found that shale oil and gas development may pose a risk to surface water and groundwater because withdrawing water from streams, lakes, and aquifers for drilling and hydraulic fracturing could adversely affect water resources.³⁷ For example, we found that groundwater withdrawal could affect the amount of water available for other uses, including public and private water supplies. One of the stakeholders we interviewed suggested that water withdrawal is already an important consideration, particularly for areas experiencing drought. For example, the stakeholder noted that crude oil production and associated water usage already has implications for the Edwards Aquifer, a groundwater system serving the agricultural, industrial, recreational, and domestic needs of almost two million users in south central Texas. In addition, removing export restrictions may affect water quality. Another stakeholder told us that allowing crude oil exports would lead to more water pollution as a result of increased production through horizontal drilling.

- **Air quality:** Increased crude oil production may increase greenhouse gases and other air emissions because the use of consumer fuels would increase, and also because the crude oil production process often involves the direct release of pollutants into the atmosphere (venting) or burning fuels (flaring).³⁸ Two stakeholders told us that

³⁶We found, for example, that water is needed for five distinct groups of activities that occur during the life cycle of oil shale development: (1) extraction and retorting, (2) upgrading of shale oil, (3) reclamation, (4) power generation, and (5) population growth associated with oil shale development. We reviewed a set of studies that indicated that the expected total water needs for the entire life cycle of oil shale production ranged from about 1 barrel (or 42 gallons) to 12 barrels of water per barrel of oil produced from in situ (underground heating) operations, with an average of about 5 barrels, and from about 2 to 4 barrels of water per barrel of oil produced from mining operations with surface heating. See GAO, *Energy-Water Nexus: A Better and Coordinated Understanding of Water Resources Could Help Mitigate the Impacts of Potential Oil Shale Development*, [GAO-11-35](#) (Washington, D.C.: Oct. 29, 2010).

³⁷[GAO-12-732](#).

³⁸Burning natural gas is known as flaring, while releasing natural gas directly into the atmosphere is called venting. In 2004, we found that venting and flaring have adverse environmental effects and result in loss of a significant amount of energy. In areas where the primary purpose of drilling is to produce oil, producers flare or vent because no local market exists for the gas. See GAO, *Natural Gas Flaring and Venting: Opportunities to Improve Data and Reduce Emissions*, [GAO-04-809](#) (Washington, D.C.: July 14, 2004).

venting and flaring has escalated in North Dakota, in part because regulatory oversight and infrastructure have not kept pace with the recent surge in crude oil production in the state. In January 2014, the North Dakota Industrial Commission reported that nearly 30 percent of all natural gas produced in the state is flared. According to a 2013 report from Ceres, flaring in North Dakota in 2012 resulted in greenhouse gas emissions equivalent to adding 1 million cars to the road.³⁹ Another stakeholder told us that allowing crude oil exports would lead to more air pollution as a result of increased production through horizontal drilling and hydraulic fracturing. RFF estimated the potential environmental effect of removing export restrictions, estimating that increases in crude oil production and consumption would increase carbon dioxide emissions worldwide by almost 22 million metric tons per year.⁴⁰ By comparison, U.S. emissions from energy consumption totaled 5,393 million metric tons in 2013 according to EIA. NERA estimated that increased crude oil production and use of fossil fuels would increase greenhouse gas emissions by about 12 million metric tons of carbon dioxide equivalents per year on average from 2015 through 2035.⁴¹

- **Transportation challenges:** Increased crude oil production could exacerbate transportation challenges. In March 2014, we found that

³⁹Ceres, *Flaring Up: North Dakota Natural Gas Flaring More Than Doubles in Two Years* (July 2013). Ceres is a nonprofit organization.

⁴⁰According to the Environmental Protection Agency, carbon dioxide is the primary greenhouse gas emitted through human activities. Further, the main human activity that emits carbon dioxide is the combustion of fossil fuels (coal, natural gas, and oil) for energy and transportation.

⁴¹Carbon dioxide equivalents provide a common standard for measuring the warming potential of different greenhouse gases and are calculated by multiplying the emissions of the non-carbon dioxide gas by its global warming potential, a factor that measures its heat-trapping ability relative to that of carbon dioxide. The NERA study suggests that maintaining crude oil export restrictions could be a relatively costly means of constraining greenhouse gas emissions. The authors calculated that the cost per ton of avoided emissions using crude oil export restrictions range from about \$1,200 to \$1,400 per ton of carbon dioxide in one case, and about \$900 to \$1,000 per ton in another case (in 2013 dollars). The authors stated that these costs are higher than government estimates of the benefits of reducing carbon dioxide emissions—in 2013, an interagency working group estimated the benefits of avoided emissions ranged from \$37 to \$56 per metric ton of carbon dioxide from 2015 through 2035 (in 2007 dollars at a 3 percent discount rate). See: Interagency Working Group on the Social Cost of Carbon, United States Government, *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866* (Washington, D.C.: May 2013, revised November, 2013).

domestic and Canadian crude oil production has created some challenges for U.S. crude oil transportation infrastructure. Some of the growth in crude oil production has been in areas with limited transportation to refining centers.⁴² To address this challenge, refiners have relied on rail to transport crude oil. According to data from the Surface Transportation Board, rail moved about 236,000 carloads of crude oil in 2012, which is 24 times more than the roughly 9,700 carloads moved in 2008. As we recently found, as the movement of crude oil by rail has increased incidents such as spills and fires involving crude oil trains have also increased—from 8 incidents in 2008 to 119 incidents in 2013 according to Department of Transportation data.⁴³ Some stakeholders told us that removing export restrictions would increase the risk for crude oil spills by rail and other modes of transportation such as tankers. On the other hand, one stakeholder suggested that removing export restrictions could reduce the amount of crude oil transported by rail, in some instances, since the most economic way to export crude oil is by pipeline to a tanker. As a result, the number of rail accidents involving crude oil spills could decrease.

Removing Export Restrictions Is Expected to Affect the Economy

The studies we reviewed suggest that removing crude oil export restrictions would increase the size of the economy. Three of the studies project that removing export restrictions would lead to additional investment in crude oil production and increases in employment. This growth in the oil sector would—in turn—have additional positive effects in

⁴²[GAO-14-249](#).

⁴³Department of Transportation data show that the majority of the 2013 incidents were small; however, two incidents in 2013, in Aliceville, Alabama, and Casselton, North Dakota, resulted in large spills and greater damage. Significant incidents have continued to occur in 2014, including an April derailment and fire in Lynchburg, Virginia. The Department of Transportation Pipeline and Hazardous Materials Safety Administration's incident database can be searched at <https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/> (accessed June 12, 2014). GAO, *Oil and Gas Transportation: Department of Transportation Is Taking Actions to Address Rail Safety, but Additional Actions are Needed to Improve Pipeline Safety*, GAO-14-667 (Washington, D.C.: August 21, 2014).

the rest of the economy.⁴⁴ For example, NERA projects an average of 230,000 to 380,000 workers would be removed from unemployment through 2020 if export restrictions were eliminated in 2015.⁴⁵ These employment benefits largely disappear if export restrictions are not removed until 2020 because by then the economy will have returned to full employment. Potential implications for investment, public revenue, and trade are as follows:

- **Investments:** According to one of the studies we reviewed, removing export restrictions may lead to more investment in crude oil exploration and production, but this investment could be somewhat offset by less investment in the refining industry. As discussed previously, removing export restrictions is expected to increase domestic crude oil production. Private investment in drilling rigs, engineering services, and transportation and logistics facilities, for example, is needed to increase domestic crude oil production. According to IHS, this will directly benefit industries such as machinery, fabricated metals, steel, chemicals, and engineering services. At the same time, removing export restrictions may decrease investment in the refining industry because the industry would not need extensive additional investment to accommodate lighter crude oils. For example, one stakeholder told us that, under current export restrictions, refining additional light crude oils may require capital investment to remove processing constraints at refineries that are designed to process heavier crude oils. Officials from one refining company told us that they had invested a significant amount of capital to refine lighter oils. For example, the refinery installed two new distillation towers to process lighter crude oils at a cost of \$800 million. Such investments may not be necessary if export restrictions were removed.

⁴⁴Growth in one sector of the economy can result in economy-wide growth through follow-on effects. For example, researchers at the Federal Reserve Bank of Dallas found that oil development in the Eagle Ford region of South Texas has had profound effects on jobs, income, and spending in the region with effects beyond those in the oil sector alone. See: Gilmer, Robert W., Raúl Hernandez, and Keith Phillips, "Oil Boom in Eagle Ford Shale Brings New Wealth to South Texas," *Southwest Economy* (Federal Reserve Bank of Dallas: Second Quarter, 2012).

⁴⁵According to NERA, because of the increase in economic growth triggered by investment in more production capacity and infrastructure, there will be a corresponding acceleration of the rate at which the economy moves toward full employment.

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- **Public revenue:** Two of the studies we reviewed suggest that removing export restrictions would increase government revenues, although the estimates of the increase vary. One study estimated that total government revenue would increase by a combined \$1.4 trillion in additional revenue from 2016 through 2030 while another study estimated that U.S. federal, state, and local tax receipts combined with royalties from drilling on federal lands could increase by an annual average of \$3.9 to \$5.7 billion from 2015 through 2035.
 - **Trade:** According to the studies we reviewed, removing export restrictions would contribute to further declines in net petroleum (i.e., crude oil, consumer fuels, and other petroleum products) imports and reduce the U.S. trade deficit. Three of the studies we reviewed estimated the effect of removing export restrictions on net petroleum imports, with ICF projecting a decline in net imports of about 100,000 to 300,000 barrels per day; IHS projecting a decline, but not providing a specific estimate; and NERA projecting a decline of about 0.6 to 3.2 million barrels per day. Further, according to one study, removing export restrictions could also improve the U.S. trade balance because the light sweet crude oils are usually priced higher than heavy, sour crude oils. One study estimated that removing export restrictions could improve the trade balance (narrow the U.S. trade deficit) by \$8 to \$15 billion per year on average from 2015 through 2035. Another study estimated that removing crude oil export restrictions would improve the trade balance by \$72 to \$101 billion per year from 2016 through 2030.

Changing Market Conditions Raise Questions about the Size, Location, and Composition of the SPR

Changing market conditions—most importantly the significant increase in domestic production of crude oil from shale—have implications for the role of the SPR, including its appropriate size, location, and composition. DOE has taken some steps to reexamine the location and composition of the SPR in light of these changes, but has not recently reexamined its size.

Changing Crude Oil Market Conditions Affect the SPR

Recent and expected changes in crude oil markets have important implications for the role of the SPR, including its size, location, and composition. DOE has recognized that recent increases in domestic crude oil production and correlating reductions in crude oil imports have changed how crude oil is transported around the United States, and that these changes carry potential implications for the operation and maintenance of the SPR. As discussed above, removing crude oil export

restrictions would be expected to increase domestic crude oil production and contribute to further declines in net imports. Our review of DOE documents, prior GAO work, and discussions with stakeholders highlight three primary implications for the SPR.

Size: Increased domestic crude oil production and falling net petroleum imports may affect the ideal size of the SPR—how much the SPR should hold to optimize the benefits of protecting the economy from damage with the costs of holding the reserves. One measure of the economy’s vulnerability to oil supply disruptions is to assess net petroleum imports—imports minus exports. Net petroleum imports have declined from a peak of 60 percent of consumption in 2005 to about 30 percent in the first half of 2014. In 2006, net imports were expected to increase in the future, increasing the country’s reliance on foreign crude oil. However, imports have declined and, according to EIA’s most recent forecast, are expected to remain well below 2005 import levels into the future. (See fig. 3.) As discussed above, removing crude oil export restrictions would be expected to contribute to additional decreases in net petroleum imports in the future.

To the extent that changes in net imports reflect changes in vulnerability, these and other changes in the economy may have reduced the nation’s vulnerability to supply disruptions. For example, a recent report by the President’s Council of Economic Advisers suggests that decreased domestic petroleum demand, increased domestic crude oil production, more fuel efficient vehicles, and increased use of biofuels, have each contributed to reducing the vulnerability of the nation’s economy to international crude oil supply disruptions.⁴⁶ Although international crude oil supply and price volatility remains a risk, the report suggests that additional reductions in net petroleum imports could reduce those risks in the future. In addition, the SPR currently holds oil in excess of international obligations. As a member of the IEA, the United States is required to maintain reserves of crude oil or petroleum products equaling at least 90 days of net imports, which it does with a combination of public and private reserves. According to IEA, as of May 2014, the SPR held 106 days of net imports, and private reserves held an additional 141 days of imports for a total of 247 days—well above the 90 days required by the

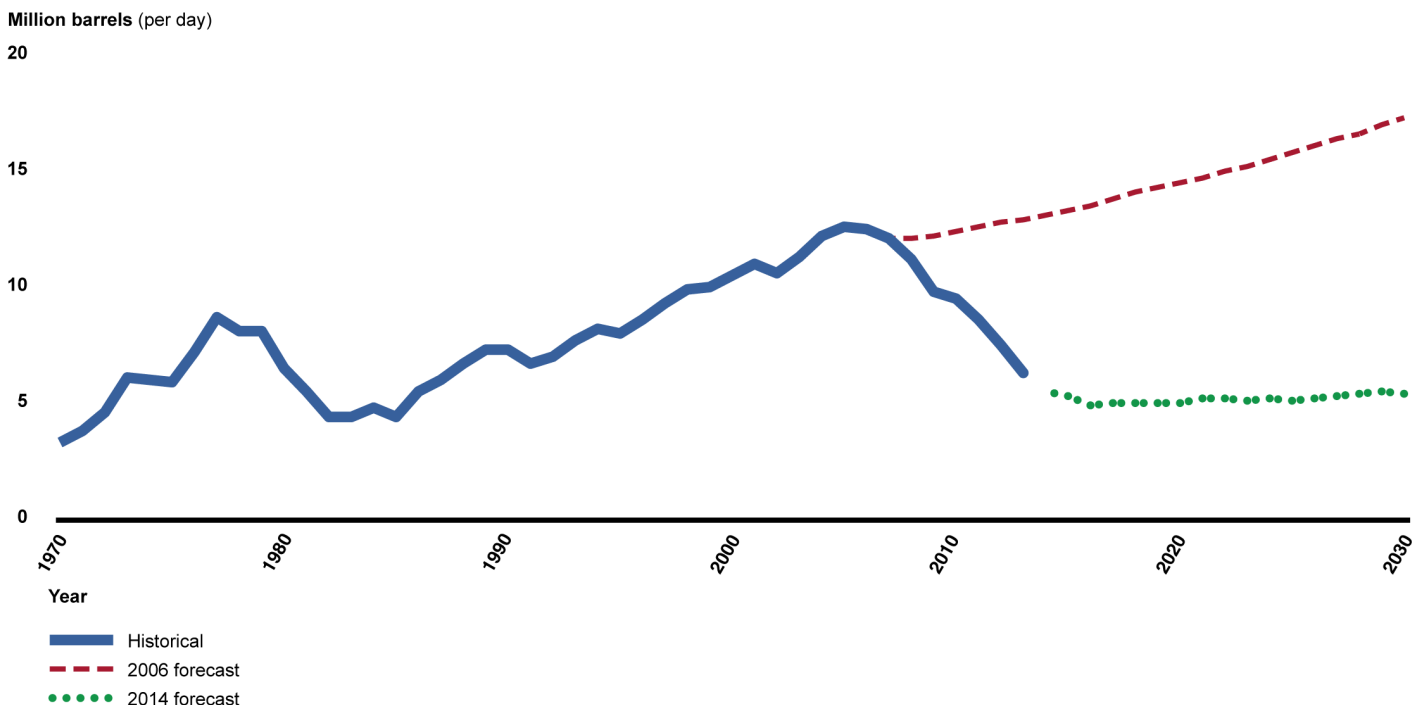
⁴⁶President’s Council of Economic Advisers, *The All-of-the-Above Energy Strategy as a Path to Sustainable Economic Growth*. Executive Office of the President. May 2014.

IEA.⁴⁷ In light of these factors, some of the stakeholders we interviewed raised questions about whether such a large SPR is needed in the future. For example, one stakeholder indicated that SPR crude oil is surplus and no longer needed to protect the economy. However, other stakeholders highlighted the importance of maintaining the SPR. For example, one stakeholder said that the SPR should be maintained at the current level, and another said that the SPR serves an important “energy insurance” service. DOE officials and one other stakeholder highlighted that, in addition to net imports, there are other factors that may affect the appropriate size of the SPR.⁴⁸

⁴⁷According to IEA, all reserves held by industry count towards meeting a country’s IEA reserve commitment. Most member governments require certain companies, such as importers, refiners, product suppliers or wholesalers, to hold a minimum number of days of reserves. However, 9 countries, including the United States, do not place such a requirement on industry. According to DOE officials, commercial entities set their reserves based on the economic principle of inventory minimization and require a large portion of the reserves they hold to keep their logistical systems moving. These reserves may therefore not be available to address a supply disruption in the same way as mandated industry reserves or public reserves.

⁴⁸DOE officials cited several studies to show the diversity of views in this regard, and noted that most of the literature on the effect of supply disruptions on the economy does not focus on net imports, and that this is an area of active research. According to DOE, the literature shows that the United States is still vulnerable to oil price shocks as these can cause dislocations within key economic sectors. As part of this review, we did not assess the validity of the studies. For example, see: J.D. Hamilton, “Causes and Consequences of the Oil Shock of 2007-08,” *Brookings Papers on Economic Activity*, Spring 2009: 215-261; L. Kilian, “The Economic Effects of Energy Price Shocks,” *Journal of Economic Literature* 46, no.4(2008): 871-909.

Figure 3: U.S. Net Petroleum Imports, Historical (1970-2013) and Energy Information Administration Forecasts



Sources: GAO analysis of Energy Information Administration data and forecasts. | GAO-14-807

Note: Forecast data are the 2006 and 2014 Annual Energy Outlook reference scenarios.

Location: According to DOE, changes in how crude oil is transported throughout the United States and in the existing infrastructure surrounding SPR facilities have implications for the location of the SPR. Crude oil in the SPR is stored along the Gulf Coast, where it can take advantage of being in close proximity to a major refining center, as well as distribution points for tankers, barges, and pipelines that can carry crude oil from the SPR to refineries in other regions of the country. Most of the system of crude oil pipelines in the United States was constructed in the 1950s, 1960s, and 1970s to accommodate the needs of the refining sector and demand centers at the time. According to DOE officials, the existing infrastructure was designed primarily to move crude oil from the southern United States to the North. The SPR has historically been able to rely on this distribution system to reach a large portion of the nation's refining capacity. But, with increases in crude oil production in the Northern U.S. and imports of crude oil from Canada, the distribution system has changed to increase crude oil flows south to the Gulf Coast. Such changes include new pipeline construction and expansions, flow reversals in existing pipelines, and increased utilization of terminals and

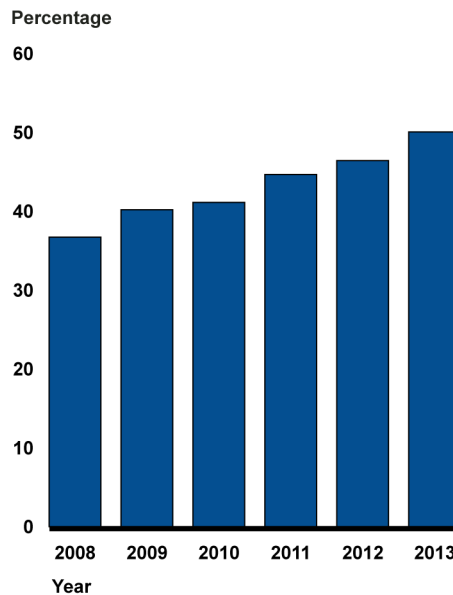
marine facilities. Such changes may make it more difficult to move crude oil from the SPR to refineries in certain regions of the United States, such as the Midwest, where almost 20 percent of the nation's refining capacity is located, according to EIA data. Some stakeholders raised questions about the location of the SPR. One stakeholder also suggested that holding SPR crude oil in the western United States may better ensure access to crude oil in the case of a disruption, since the West has no pipeline connectivity to the Gulf Coast. According to DOE, recent changes to crude oil distribution in the United States could have significant implications for the operation and maintenance of the SPR.

Composition: In 2006, we reported that the type of crude oil in the SPR was not compatible with all U.S. refineries. We reported that some U.S. refineries processed crude oils heavier than those stored in the SPR. We found that in the event of a disruption in the supply of heavy crude oil, refineries configured to use heavy crude oil would not be able to efficiently refine crude oil from the SPR and would likely reduce production of some petroleum products. As we reported, in such instances, prices for heavy crude oil products could increase, reducing the SPR's effectiveness to limit economic damage.⁴⁹ Refinery officials we spoke with noted that the SPR should contain heavier crude oils that domestic refineries could refine in the event of a supply disruption. Since our 2006 report, domestic production of light sweet crude oil has increased. According to EIA, roughly 96 percent of the 1.8 million-barrel per day growth in production from 2011 to 2013 consisted of light sweet grades with API gravity of 40 or above. As a result, imports of light crude oils have declined, and U.S. reliance on imported heavy crude oil has increased from 37 percent of total imports in 2008 to 50 percent of total imports in 2013, as shown in figure 4. However, DOE officials raised concerns about the prospect of storing additional heavy crude oil in the SPR. According to DOE officials and a 2010 report by DOE, storing heavy crude oil in the SPR would limit the SPR's ability to respond to nonheavy crude oil disruptions, such as a loss of Middle East medium sour crude oils. In addition, storing more heavy crude would require infrastructure

⁴⁹GAO, *Strategic Petroleum Reserve: Available Oil Can Provide Significant Benefits, but Many Factors Should Influence Future Decisions about Fill, Use, and Expansion*, [GAO-06-872](#) (Washington, D.C.: Aug. 24, 2006).

improvements.⁵⁰ At the same time, DOE officials also stated that, based on recent conversations with refinery officials, no U.S. refineries would have difficulty using SPR crude oils. Another issue raised by some stakeholders we interviewed is that the SPR holds primarily crude oil, and some stakeholders told us that holding additional consumer fuels could be beneficial.⁵¹ Many recent economic risks associated with supply disruptions have originated from the refining and distribution sectors rather than crude oil supplies.

Figure 4: Heavier Crude Oil as a Percentage of Total U.S. Crude Oil Imports, 2008-2013



Source: GAO analysis of Energy Information Administration data. | GAO-14-807

Note: The weight of a crude oil is specified using the American Petroleum Institute (API) gravity standard, which measures the weight of crude oil in relation to water. Data in this figure are imports of crude oils with 25 or lower API gravity as a share of total crude oil imports.

⁵⁰For example, according to DOE, storing heavier crude oil in the SPR would require upgrading the Sun Terminal, a tanker delivery location, to handle the heavier crude oil; building an additional pipeline from one of four storage sites to maintain current drawdown rates; and performing other site improvements. U.S. Department of Energy. Office of the Deputy Assistant Secretary for Petroleum Reserves. *Strategic Petroleum Reserve: Updated Crude Compatibility Study*. April 2010.

⁵¹DOE also operates the Northeast Home Heating Oil Reserve, which stores 1 million barrels of diesel fuel in Massachusetts and Connecticut.

DOE Has Taken Steps to Reexamine Some Aspects of the SPR but Has Not Recently Reexamined Its Size

DOE has taken some steps to assess the appropriate location and composition of the SPR in view of changing market conditions, but has not recently re-examined its size. We previously found that federal programs should be re-examined if there have been significant changes in the country or the world that relate to the reason for initiating the program.⁵² In that report, we identified a set of reexamination criteria that, when taken together, illustrate the issues that can be addressed through a systematic reexamination process. We found that many federal programs and policies were designed decades ago to respond to trends and challenges that existed at the time of their creation. Given fiscal constraints that we are likely to face for years to come, reexamination may be essential to addressing newly emergent needs without unduly burdening future generations of taxpayers. DOE has taken some steps to reexamine how recent changing market conditions could affect the location and composition of the SPR as follows:

- In March 2014, DOE conducted a test sale of SPR crude oil to evaluate the SPR's ability to draw down and distribute SPR crude oil through multiple pipeline and terminal delivery points within one of its distribution systems.⁵³ DOE officials told us they were reviewing the results of the test sale including data on the movement of crude oil through the system.
- DOE officials also told us they are working to establish a Northeast Regional Refined Petroleum Product Reserve in New York Harbor and New England to store refined consumer fuels. Although the northeast reserve will not store crude oil, it will be considered part of the SPR and hold 1 million barrels of gasoline at a cost of \$200 million.
- DOE officials told us that they are conducting a regional fuel resiliency study that will provide insights into whether there is a need for additional regional product reserves and, if so, where these reserves

⁵²21st Century Challenges: Reexamining the Base of the Federal Government, [GAO-05-325SP](#) (Washington, D.C.: Feb. 1, 2005).

⁵³According to DOE, the SPR's oil storage facilities are grouped into three geographical distribution systems in the Gulf Coast: Seaway, Texoma, and Capline. Each system has access to one or more major refining centers, interstate crude oil pipelines, and marine terminals for crude oil distribution.

should be located and the capacity.⁵⁴ We did not assess this effort because the study was ongoing at the time of our review.

- DOE finalized an assessment in 2010 of the compatibility of crude oil stored in the SPR with the U.S. petroleum refining industry. DOE decided against storing heavy crude oil in the SPR at the time, but committed to revisiting the option of storing heavy crude oil in the future.⁵⁵

However, DOE has not recently reexamined the appropriate size of the SPR. DOE last issued a strategic plan for the SPR in May 2004. The plan outlined the mission, goals, and near-term and long-term objectives for the SPR.⁵⁶ In 2006, we recommended that the Secretary of Energy reexamine the appropriate size of the SPR. In 2007, while DOE was planning to expand the SPR to its authorized size of 1 billion barrels, the Administration reevaluated the need for an SPR expansion and decided that the current level was adequate. In responding to our recommendation, DOE stated that its reexamination had taken the form of more “actionable items,” including not requesting expansion-funding in its 2011 budget and canceling and redirecting prior year’s expansion funding to general operations of the SPR. Officials from DOE’s Office of Petroleum Reserves told us that the last time they conducted a comprehensive re-examination of the size of the SPR was in 2005. At that time, DOE’s comprehensive study examined the costs and benefits of alternative SPR sizes.⁵⁷ Officials told us that they have not conducted a

⁵⁴This study is being undertaken as part of DOE’s Quadrennial Energy Review. According to DOE, the Quadrennial Energy Review will provide a multiyear road map that outlines federal energy policy objectives, legislative proposals to Congress, executive actions, and resource requirements. The first installment of the review will focus on transmission, storage, and distribution infrastructure that links energy supplies, including crude oil, to intermediate users.

⁵⁵U.S. Department of Energy. Office of the Deputy Assistant Secretary for Petroleum Reserves. *Strategic Petroleum Reserve: Updated Crude Compatibility Study*. April 2010.

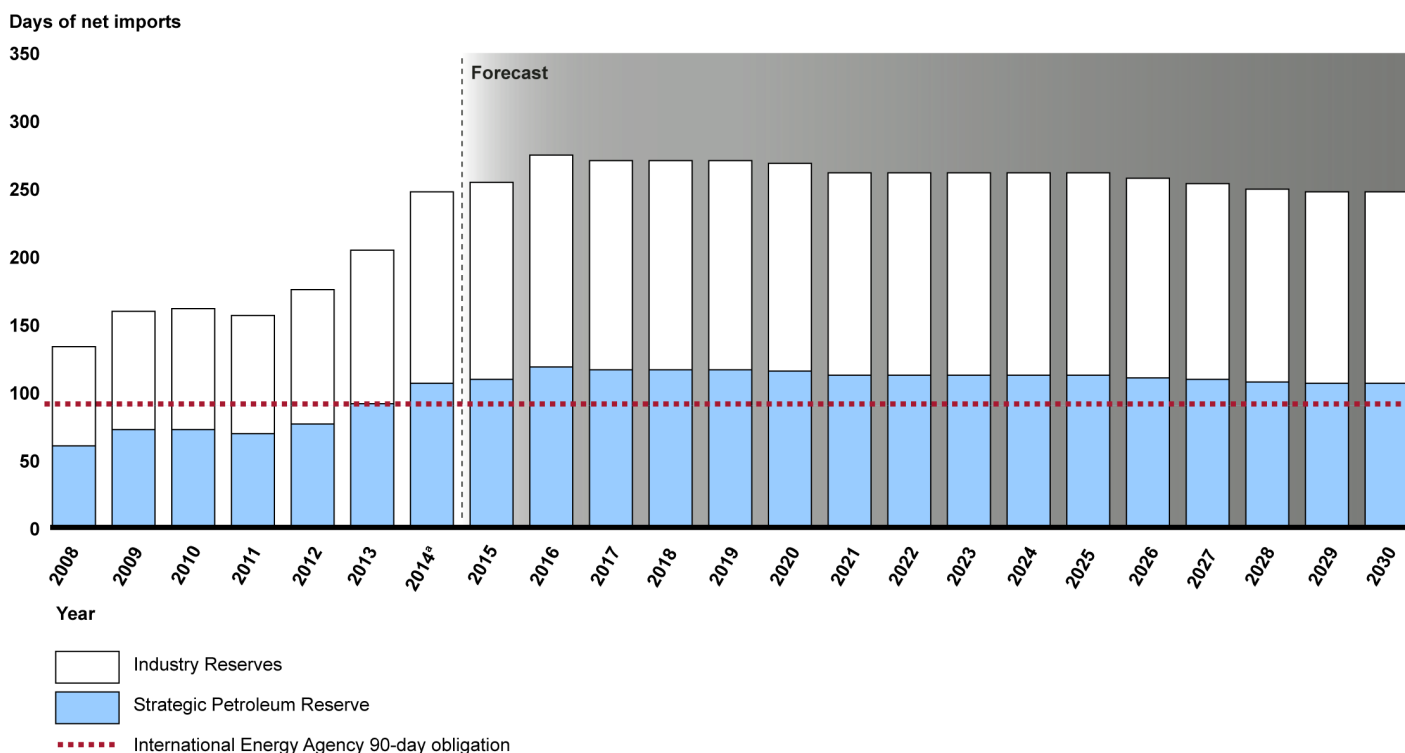
⁵⁶U.S. Department of Energy. Office of Fossil Energy. *Strategic Petroleum Reserve (SPR) Strategic Plan*. May 19, 2004.

⁵⁷The report evaluates the net economic benefits of enhancing the SPR size and drawdown capability. DOE assessed alternative SPR sizes and drawdown capabilities using a numerical simulation model, considering the benefits and costs of oil stockpiling. The evaluation included the SPR’s ability to reduce economic losses and oil import costs during oil shocks, and it subtracted the costs of building, filling, and operating the reserve. See: Paul Leiby and David Bowman. *Economic Benefits of Expanded Strategic Petroleum Reserve Size or Drawdown Capability*. Final Report, Oak Ridge National Laboratory. ORNL/TM-2006/5. Dec. 31, 2005.

comprehensive reexamination since 2005 because the SPR only recently met the IEA requirement to maintain 90 days of imports. However, the IEA requirement is for total reserves, including those held by the government and private reserves. As shown in figure 5, such reserves in the United States are currently in excess of the nation's international obligations and, in some scenarios, are expected to be in excess in the future. In July 2014, DOE's Office of Inspector General recommended that the Office of Fossil Energy perform a long-range strategic review of the SPR to ensure it is best configured to respond to the current and future needs of the United States.⁵⁸ DOE concurred with the recommendation. DOE stated that it expected to determine the appropriate course of action by August 2014, and according to DOE, it has initiated a process to conduct such a review.

⁵⁸According to DOE officials, this review should take into consideration what the near-term and long-term role of the reserve should be relative to U.S. energy and economic security goals and objectives and International Energy Program requirements; what the optimal configuration and capabilities (e.g., composition, volume, location of petroleum products, infrastructure requirements, distribution capability, and performance criteria) of the Reserve should be; the resources required to attain and maintain the Reserve's long-term sustainability (to ensure alignment with optimal configuration and capabilities); and whether existing legal authorities that govern the policies, configuration, and capabilities of the Reserve are adequate to ensure the Reserve can meet both current and future U.S. energy and economic security goals and objectives. U.S. Department of Energy. Office of Inspector General. Office of Audits and Inspections. *The Strategic Petroleum Reserve's Drawdown Readiness*. DOE/IG-0916. July 2014.

Figure 5: United States' Historic and Estimated Compliance with International Energy Agency Obligation to Hold Reserves



Sources: GAO analysis of International Energy Agency data and Energy Information Administration forecasts. | GAO-14-807

Note: Data for 2015 and later are based on May 2014 reserve levels reported by the International Energy Agency and forecast changes in net imports from the Energy Information Administration's (EIA) reference case forecast. EIA's forecast includes several cases, highlighting uncertainty about future conditions which are not depicted in this figure.

^aAs of May 2014.

The SPR currently holds oil valued at over \$73 billion, and without a current reexamination of the SPR's size, DOE cannot be assured that the SPR is sized appropriately. The SPR may therefore be at risk of holding excess crude oil. In addition, DOE officials told us that SPR infrastructure is aging and will need to be replaced soon. Conducting a reexamination of the size of the SPR could also help inform DOE's decisions about how or whether to replace existing infrastructure. If DOE were to assess the appropriate size of the SPR and find that it held excess crude oil, the excess oil could be sold to fund other national priorities. For example, in 1996, SPR crude oil was sold to reduce the federal budget deficit and

offset other appropriations. If, for example, DOE found that 90 days of imports was an appropriate size for the SPR, it could sell crude oil worth about \$10 billion.⁵⁹

Conclusions

Increasing domestic crude oil production, and declines in consumption and crude oil imports have profoundly affected U.S. crude oil markets over the last decade. These changes can have important implications for national energy policies and programs. The SPR is a significant national asset, and it is important for federal agencies tasked with overseeing such assets to examine how, if at all, changing conditions affect their programs. DOE has recently taken several steps to reexamine various aspects of the SPR in light of these changes, including its location and composition; however, DOE's most recent comprehensive examination of the appropriate size of the SPR was conducted in 2005 when the general expectation was that the country would increasingly rely on foreign crude oil. At about that time, however, it began to become clear that this was not to be the case. Removing export restrictions would be expected to lead to further decreases in net imports that would further affect the role of the SPR. Without a reexamination of the SPR that considers whether a smaller or larger SPR is in the national interest in light of current and expected future changes in market conditions, DOE cannot be assured that the SPR is holding an appropriate amount of crude oil in the SPR, and its ability to make appropriate decisions regarding maintenance of the SPR could be compromised.

Recommendation for Executive Action

In view of recent changes in market conditions and in tandem with DOE's ongoing activities to assess the content, connectivity, and other aspects of the SPR, we recommend that the Secretary of Energy undertake a comprehensive reexamination of the appropriate size of the SPR in light of current and expected future market conditions.

Agency Comments and Our Evaluation

We provided a draft of this report to DOE and Commerce for their review and comment. The agencies provided technical comments, which we incorporated as appropriate. In its written comments, reproduced in

⁵⁹Calculated based on DOE's assessment of the weighted average price of crude oil held in the SPR as of May 28, 2014.

appendix III, DOE concurred in principle with our recommendation. However, DOE stated that conducting a study of only the size of the SPR would be too narrow in scope and would not address other issues relevant to the SPR carrying out its mission of providing energy security to the United States. DOE stated that a broader, long-range review of the SPR is needed. We agree that such a review would be beneficial. We do not recommend that DOE undertake an isolated reexamination of the size of the SPR, but that such a reexamination be conducted in tandem with DOE's other activities to assess the SPR and we clarified our recommendation accordingly.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the appropriate congressional committees, the Secretaries of Energy and Commerce, and other interested parties. In addition, the report will be available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or ruscof@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix IV.



Sincerely yours,
Frank Rusco
Director, Natural Resources and Environment

Appendix I: Additional Information on Four Studies of the Implications of Removing Crude Oil Export Restrictions

We identified four studies that examined the price and other implications of removing crude oil export restrictions. These four studies are as follows:

- Resources for the Future (RFF). *Crude Behavior: How Lifting the Export Ban Reduces Gasoline Prices in the United States*. Washington, D.C.: Resources for the Future, February 2014, revised March 2014.
- ICF International and EnSys Energy (ICF International). *The Impacts of U.S. Crude Oil Exports on Domestic Crude Production, GDP, Employment, Trade, and Consumer Costs*. Washington, D.C.: ICF Resources, March 31, 2014.
- IHS. *US Crude Oil Export Decision: Assessing the impact of the export ban and free trade on the US economy*. Englewood, Colorado: IHS, 2014.
- NERA Economic Consulting (NERA). *Economic Benefits of Lifting the Crude Oil Export Ban*. Washington, D.C.: NERA Economic Consulting, September 9, 2014.

Table 3 describes these studies and several key assumptions, Table 4 summarizes their findings regarding prices, and Table 5 summarizes their findings regarding other implications of removing crude oil export restrictions.

**Appendix I: Additional Information on Four
Studies of the Implications of Removing Crude
Oil Export Restrictions**

Table 3: Description of Approach and Key Assumptions in Four Studies on the Implications of Removing Crude Oil Export Restrictions

	Resources for the Future	ICF International	IHS	NERA
Sponsor	Resources for the Future	American Petroleum Institute	Several oil companies.	The Brookings Institution
Description of approach	Using a small static simulation model calibrated to world oil market conditions for 2012, assessed long-run implications of removing export restrictions assuming crude oil prices change to reflect only crude oil qualities.	Used a detailed integrated U.S. and global refining and logistics model together with a detailed assessment of crude oil production and supply and demand changes. Modeled a complete lifting of export restrictions in 2015 and two cases with different assumptions about how hard it will be to accommodate increases in crude oil production. ^a	A bottom up study of crude oil production, refining, and international markets. Examined two outlooks for U.S. crude oil production—a base case based on known production areas and limited technological improvements; and a more optimistic case that includes additional production areas and technological improvements.	Used a partial equilibrium model of the petroleum industry to estimate crude oil production, refining, consumption, and trade effects; and a computable general equilibrium model of the U.S. economy to assess economic effects. Modeled eighteen cases including a reference case and a high oil and gas resources case. ^b
Time period covered in analysis	Modeled long run adjustment, not specific years.	2015-2035	2016-2030	2015-2035
Detailed modeling of crude oil production?	No	Yes	Yes	No
Detailed modeling of refineries?	No	Yes	Yes	Yes
Transportation network model?	No	Yes	Yes	Yes
Crude oil production response from OPEC and other producers	Assumed long run world crude oil supply elasticity of 0.4 based on literature. No significant OPEC response modeled.	Assumed world supply response derived from EIA Annual Energy Outlook sensitivity cases. OPEC production would decline by 50,000 barrels per day from 2015 through 2035 without export restrictions.	We were unable to determine IHS' assumption regarding the crude oil production response of other nations.	Examined three cases of OPEC responses: 1) OPEC competes in the market; 2) OPEC maintains crude oil exports and 3) OPEC cuts crude oil exports to maintain crude oil price.

Sources: GAO analysis of Resources for the Future, ICF International, IHS, and NERA studies | GAO-14-807.

^aICF assessed two cases; a low case that assumed relatively rapid accommodation of light crude oil, and a high case that assumed slower adaptations to changing crude oil production than were assumed in the low case. In the high case, the resulting differences in prices between domestic and international crude oils would remain wide for a longer period of time.

^bNERA's reference case assumes U.S. crude oil production peaks in the early part of the next decade and declines thereafter, while the "high oil and gas resources" case represents a more optimistic and sustained view of future production. NERA examined a total of 18 cases with alternative assumptions about (1) future U.S. crude oil production, (2) the international crude oil market, (3) the status, timing, and scope of export restrictions; and (4) OPEC's response to changes in U.S. export restrictions.

**Appendix I: Additional Information on Four
Studies of the Implications of Removing Crude
Oil Export Restrictions**

Table 4: Summary of Price Implications of Removing Crude Oil Export Restrictions in Four Studies

	Resources for the Future	ICF International	IHS	NERA^a
U.S. Crude Oil Price	Midwest refiner acquisition costs increase \$6.68 per barrel.	West Texas Intermediate prices increase \$2.35 to \$4.19 per barrel on average.	\$7.89 per barrel increase on average.	Prices increase \$1.74 per barrel in the reference case and \$5.95 per barrel in the high case, on average.
International Crude Oil Prices	Prices increase outside the Midwest by \$0.15 per barrel.	Price of Brent declines by \$0.37 to \$0.79 per barrel on average.	Brent average price declines by \$3.24-5.41.	International average crude oil prices decline by \$1.31 per barrel in the reference case and \$6.23 per barrel in the high case.
U.S. Consumer Fuel Prices	Gasoline prices decline by 1.8 to 4.6 cents per gallon on average.	Petroleum product prices decline by 1.5 to 2.4 cents per gallon on average.	Gasoline prices decline by 9 to 13 cents per gallon on average.	Petroleum product prices decline by 3 cents per gallon in the reference case and 11 cents per gallon in the high case. Gasoline prices decline by 3 cents per gallon in the reference case and 10 cents per gallon in the high case.

Sources: GAO analysis of Resources for the Future, ICF International, IHS, and NERA studies | GAO-14-807.

Note: Price implications in this table are for the period covered in each study. For Resources for the Future, this is the long run price implication; for ICF International and NERA, it is the average from 2015 through 2035; and for IHS, it is the average from 2016 through 2030. Estimates are in 2014 year dollars.

^aResults refer to the difference between the reference case and its baseline with export restrictions in place, and the difference between the high oil and gas recovery case and its corresponding baseline. NERA also found that removing crude oil export restrictions has no measurable effect in the world oil low price case.

**Appendix I: Additional Information on Four
Studies of the Implications of Removing Crude
Oil Export Restrictions**

Table 5: Summary of Other Implications of Removing Crude Oil Export Restrictions in Four Studies

	Resources For the Future	ICF International	IHS	NERA^a
Domestic Crude Oil Production	Canada and the Midwest: increase by 84,000 barrels per day (bpd). Rest of the World: increase by 54,000 bpd. Total world production will increase by 138,000 bpd.	Increases 130,000 bpd on average in the low scenario (10.6 to 10.7 million bpd) and 300,000 bpd in the high scenario (10.4 to 10.7 million bpd).	Increase of 1.2 million bpd in the low case (9.5 to 10.7 million bpd) to 2.3 million bpd in the high case (11 to 13.3 million bpd).	Increase of 0.7 million bpd, on average, in the reference case and 3.3 million bpd in the high case.
Oil Industry Investments	Not addressed.	Additional \$16 to \$73 billion in additional crude oil production related investment between 2015 and 2020, and a decline in refining investment of \$5 to \$7 billion from 2015-2035.	Net cumulative investment increases by \$806 billion to \$1.1 trillion from 2016-2030.	Increases by \$1.08 billion per year on average in the reference case and \$26.81 billion per year in the high case from 2015 through 2035. ^b
Environmental Implications	Carbon dioxide emissions would increase by 22 million metric tons per year.	Not addressed.	Not addressed.	Greenhouse gas emissions increase by 12 million metric tons of carbon dioxide equivalents per year.
Trade Implications	Would improve trade balance, though not estimated.	Volumes: Decline in net crude oil imports of 26,000-200,000 bpd and decline in net petroleum product imports of nearly 93,000 bpd. Balance of trade: Increases by \$8 to \$15 billion.	Volumes: Project a decline in net imports, specific amount not provided. Balance of trade: Increases net petroleum trade by \$72-\$101 billion per year.	Volumes: Decline in net crude oil and petroleum product imports of 0.63 million bpd in the reference case and 3.15 million bpd in the high case.

Sources: GAO analysis of Resources for the Future, ICF International, IHS, and NERA studies. | GAO-14-807

Notes: Implications in this table are for the period covered in each study. For Resources for the Future, this is in the long run; for ICF International and NERA, it is the average from 2015 through 2035; and for IHS, it is the average from 2016 through 2030. Estimates are in 2014 year dollars.

^aResults refer to the difference between the reference case and its baseline with export restrictions in place, and the difference between the high oil and gas recovery case and its corresponding baseline. NERA also found that removing crude oil export restrictions has no measurable effect in the world oil low price case.

^bIncludes investment in oil extraction, industrial, and manufacturing sectors.

Appendix II: List of Stakeholders Interviewed

This appendix lists the stakeholders we interviewed. Stakeholders included representatives of companies and interest groups with a stake in the outcome of decisions regarding crude oil export restrictions, as well as academic, industry, and other experts.

1. American Fuel & Petrochemical Manufacturers
2. American Petroleum Institute
3. American Automobile Association
4. Jason Bordoff, Columbia School of International and Public Affairs
5. Severin Borenstein, University of California, Berkeley
6. Stephen Brown, Resources for the Future and University of Nevada-Las Vegas
7. Citigroup
8. Deborah Gordon, Carnegie Endowment for International Peace
9. Hillard Huntington, Stanford University
10. IHS
11. ICF International and EnSys Energy
12. Kenneth Medlock, Rice University
13. NERA Economic Consulting
14. Lorne Stockman, Oil Change International
15. Philip Verleger, PKVerleger LLC
16. Dan Weiss, Center for American Progress
17. Valero Energy Corporation

Appendix III: Comments from the Department of Energy



Department of Energy
Washington, DC 20585

SEP 17 2014

Mr. Frank W. Rusco
Director
Natural Resources and Environment
U.S. Government Accountability Office
Washington, DC 20548

Dear Mr. Rusco:

The Department of Energy (DOE) appreciates the opportunity to review and provide comments on the Government Accountability Office's (GAO-14-807) draft report on "*Changing Crude Oil Markets - Allowing Exports Has Price and Other Implications, and the Size of the Strategic Reserves Should Be Re-Examined.*" We offer the following comments, in response to the recommendation provided in the report:

GAO Recommendation for Executive Action:

We are making one recommendation in this report.

"In view of recent changes in market conditions and in tandem with DOE's ongoing activities to assess the content and connectivity of the SPR to markets, we recommend that the Secretary of Energy undertake a comprehensive re-examination of the appropriate size of the SPR in light of current and expected future market conditions."

Agency Comments to GAO Recommendation:

DOE concurs in principle with the GAO recommendation to undertake a comprehensive re-examination of the appropriate size of the Strategic Petroleum Reserve (SPR), in light of current and expected future market conditions. However, DOE believes conducting a size study only is too narrow in scope, and by itself, would fail to investigate and address other issues and factors relevant to the SPR carrying out its mission of providing energy security to the United States, by reducing the impact of disruptions in supplies of petroleum products, and to carry out the obligations of the United States under the International Energy Program.

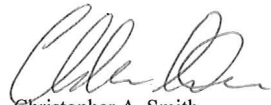
DOE believes that a broader, long-range strategic review of the SPR needs to be accomplished and has initiated the process to conduct this review. This review will take into consideration what the near-term and long-term role of the SPR should be relative to U.S. energy and economic security goals and objectives, and International Energy Program requirements; what the optimal configuration and capabilities (e.g. composition/volume/location of petroleum products, infrastructure requirements, distribution capability, and performance criteria) of the SPR should be; the financial and management-related resources required to attain and maintain the SPR's long-term sustainability (to ensure alignment with optimal configuration and capabilities); and whether existing legal authorities that govern the policies, configuration, and



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capabilities of the SPR are adequate to ensure the SPR can meet both current and future U.S.
energy and economic security goals and objectives.

Sincerely,



Christopher A. Smith
Principal Deputy Assistant Secretary
Office of Fossil Energy

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact:

Frank Rusco, (202) 512-3841 or ruscof@gao.gov

Staff

Acknowledgments:

In addition to the individual named above, Christine Kehr (Assistant Director), Philip Farah, Quindi Franco, Cindy Gilbert, Taylor Kauffman, Celia Rosario Mendive, Alison O'Neill, and Barbara Timmerman made key contributions to this report.

Related GAO Products

Petroleum Refining: Industry's Outlook Depends on Market Changes and Key Environmental Regulations. [GAO-14-249](#). Washington, D.C.: March 14, 2014.

Oil and Gas: Information on Shale Resources, Development, and Environmental and Public Health Risks. [GAO-12-732](#). Washington, D.C.: September 5, 2012.

Energy Markets: Estimates of the Effects of Mergers and Market Concentration on Wholesale Gasoline Prices. [GAO-09-659](#). Washington, D.C.: June 12, 2009.

Strategic Petroleum Reserve: Issues Regarding the Inclusion of Refined Petroleum Products as Part of the Strategic Petroleum Reserve. [GAO-09-695T](#). Washington, D.C.: May 12, 2009.

Energy Markets: Refinery Outages Can Impact Petroleum Product Prices, but No Federal Requirements to Report Outages Exist. [GAO-09-87](#). Washington, D.C.: October 7, 2008.

Energy Markets: Increasing Globalization of Petroleum Products Markets, Tightening Refining Demand and Supply Balance, and Other Trends Have Implications for U.S. Energy Supply, Prices, and Price Volatility. [GAO-08-14](#). Washington, D.C.: December 20, 2007.

Strategic Petroleum Reserve: Available Oil Can Provide Significant Benefits, but Many Factors Should Influence Future Decisions about Fill, Use, and Expansion. [GAO-06-872](#). Washington, D.C.: August 24, 2006.

Motor Fuels: Understanding the Factors That Influence the Retail Price of Gasoline. [GAO-05-525SP](#). Washington, D.C.: May 2, 2005.

Alaskan North Slope Oil: Limited Effects of Lifting Export Ban on Oil and Shipping Industries and Consumers. [GAO/RCED-99-191](#). Washington, D.C.: July 1, 1999.

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