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U.S. Energy Information  
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# Liquid Fuels and Natural Gas in the Americas

January 2014



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## Executive summary

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This report examines the major energy trends and developments of the past decade in the Americas, focusing on liquid fuels and natural gas—particularly, reserves and resources, production, consumption, trade, and investment. The Americas, which include North America, Central America, the Caribbean, and South America, account for a significant portion of global supply, demand, and trade of both liquid fuels and natural gas. Liquid fuels include all petroleum and petroleum products, natural gas liquids, biofuels, and liquids derived from other hydrocarbon sources.

At the outset of 2013, the Americas region accounted for one-third of proved worldwide reserves of crude oil, at 536 billion barrels, and one-tenth of proved natural gas reserves, at 688 trillion cubic feet (Tcf), as well as immense recoverable resources of oil and gas including reservoir resources, tight oil, and shale gas.

In 2012, the Americas produced 29% of the world's liquid fuels supply, at almost 26 million barrels per day (bbl/d), and consumed one-third of the world's liquid fuels, at nearly 30 million bbl/d. Combined, the countries in the region imported and exported substantial volumes of both crude oil and refined petroleum products, accounting for 25% of global crude imports, 9% of global crude exports, and 22% of global petroleum product imports and exports. The countries in the Americas imported 4 million bbl/d and exported 3 million bbl/d of refined petroleum products in 2012, much of which was exported from the United States.

For much of the past decade, the United States has been a major crude oil, petroleum product, and natural gas trading partner with other countries in the Americas. From 2003 to 2012, the United States imported about 5 million bbl/d of crude oil from other countries in the region—primarily from Canada, Mexico, and Venezuela. However, the quantities and shares of imports from those countries are shifting. With U.S. crude oil production continuing to increase, domestic production has displaced some imports of crude oil, including those from Latin America, defined as Mexico plus Central America, the Caribbean, and South America.

The United States has been a major petroleum product supplier to the Americas for the past decade, and its significance as a product supplier has grown considerably in recent years. In 2003, the United States exported 0.6 million bbl/d of petroleum products to other countries in the Americas, primarily Mexico and Canada. In 2012, U.S. exports to the countries in the region totaled 2.0 million bbl/d, still primarily to Mexico and Canada but increasingly to other countries, most notably Brazil and Chile. As a result, the United States recently became a net exporter of petroleum products.

Refined product trade in the Americas has changed as demand in Latin America (the Americas excluding the United States and Canada), including demand for cleaner, low-sulfur products, has grown faster than local refinery capacity. U.S. refineries on the Gulf Coast, where some of the most sophisticated and economic refining capacity in the world is concentrated, have been well positioned to provide additional supply to meet this growing demand.

In 2012, the Americas produced and consumed about 31% of the world's natural gas, both at 37 Tcf, while accounting for 20% of global natural gas trade in both imports and exports, both at 6 Tcf. More

than 80% of both natural gas imports and exports in the Americas were transported via pipeline to neighboring countries, while the remainder was traded within the region as liquefied natural gas (LNG). The U.S. Energy Information Administration (EIA) expects natural gas exports from the Americas to increase further as natural gas supply, particularly in the United States, continues to rise as shale gas production increases. Additional LNG terminals and the ongoing Panama Canal expansion, which will allow passage of larger LNG tankers, will further boost LNG exports in the Americas region.

Recognizing the abundance of hydrocarbon resources in the Americas and the availability of technical capabilities to produce them, companies within and outside of the region have invested heavily in developing and producing liquid fuels and natural gas. Both international oil companies (IOCs) and state-owned oil companies in the Americas have made the most substantial investments, followed by companies based in Europe and in Asia and Oceania.

Foreign investment in the region has been concentrated in those countries with legal and regulatory structures open to foreign involvement. Countries with the most open structures like Canada, Brazil, Colombia, and the United States have attracted significantly more investment than others in the region. Mexico, which recently adopted new energy reforms that allow some types of foreign private investment in the energy sector, looks to join their ranks.

Asian investment in the region has risen dramatically in the past five years, in particular, investment by China's national oil companies to secure both crude oil supplies and physical assets, such as refineries, especially in those countries considered to have more restrictive foreign investment laws and regulations.

The Americas region holds an abundance of existing proven reserves, as well as the promise of abundant resources of both oil and natural gas. While the Americas have accounted for a considerable portion of the global markets in liquid fuels and natural gas and have attracted sizeable investments, the region has the potential for further expansion and development.



## Introduction

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This report examines the major energy trends and developments of the past decade in North America, Central America, the Caribbean, and South America, collectively referred to as “the Americas.” The report focuses on liquid fuels and natural gas—particularly, reserves and resources, production, consumption, trade, and investment—given their scale and significance to the region.

Liquid fuels include all petroleum and petroleum products, natural gas liquids, biofuels, and liquids derived from other hydrocarbon sources. Natural gas is the gaseous mixture of hydrocarbon compounds. Dry natural gas (also known as consumer-grade natural gas) is the gas that remains after the liquefiable hydrocarbon portion and any nonhydrocarbon gases have been removed. The term “natural gas” is often used interchangeably with “dry natural gas.”

While the report considers the region as a whole and its relationships with Africa, Asia and Oceania, Eurasia, Europe, and the Middle East, it also discusses the principal energy-producing and consuming countries individually, based on energy statistics available the past decade.

The growing importance of Asia to the Americas is also discussed. While the United States is the leading trading partner for liquid fuels in the major markets of the region, countries of the Americas are sending increasing volumes of liquid fuels to China and India in the past decade. In most cases, China and India are the two top export destinations outside the Americas for the region’s crude oil. The report also looks at Asia’s, particularly China’s, considerable investments in oil and natural gas assets in the Americas.

This report is structured to be concise. In the following chapters, the first bolded statement under each header is considered the primary message of the section. Bullet points following the header provide supporting information and describe important related trends and developments, generally based on a decade of the best and most current data available to EIA, which most often ends in 2012 but in some cases may end as early as 2010.

The report is divided into four sections. The first section looks at the Americas in a global context. The second section covers liquid hydrocarbon production and consumption and provides statistics and information on proved oil reserves, undiscovered reservoir oil resources, and tight oil resources; trade within the Americas and also imports and exports to and from the Americas; and crude oil exports from the Americas to China and India.

The third section discusses natural gas, including proved natural gas reserves, undiscovered reservoir resources, and shale gas resources; dry natural gas production and consumption; and global trade in dry natural gas to and from the Americas, with a focus on LNG.

The fourth and last section examines global investment in the region’s energy sector, highlights Asia’s investment in the region’s LNG assets, as well as China’s growing presence in its oil sector, and details the laws and regulations of the major producing countries in the Americas region.

Unless otherwise noted, EIA is the source for data cited in the report and monetary figures are in nominal U.S. dollars (not adjusted for inflation). Because data tables include only major contributors in the Americas region, the totals shown may not equal sums of the components shown. Charts and other graphics in this report are current as of October 2013, and are supplemented with data tables in Appendix A.

## The Americas in context

The Americas, which include North America, Central America, the Caribbean, and South America (Figure 1), cover 30% of the world's land area, approximately 15 million square miles, and have long been a major source of raw materials and other commodities for the world market. In turn, those markets have been a source of wealth for the Americas. In 2012, inhabitants of the Americas constituted 13% (960 million) of the world population but created more than 30% (\$22 trillion) of the world's gross domestic product (GDP), real GDP in purchasing power parity. In this report, Latin America is defined as Mexico plus Central America, the Caribbean, and South America.

Figure 1. The Americas



Economic growth and wealth creation from energy development have varied across the region, as different political and economic regimes have come into power or declined. In the past decade, while global GDP increased by 39%, collective GDP in the Americas grew by 24%. Notably, collective Latin America and the Caribbean GDP grew 51% in the same period. While a complex set of factors drive the different growth rates for countries in the region, relatively strong growth in the energy sector has been key to economic growth in a number of oil and gas producing countries.

Recent population growth in the region is close to global average trends. From 2003 to 2012, world population increased by 11%, and total population in the Americas grew by 10%, with increases of 8% in North America and 11% in Central and South America and the Caribbean. In 2010, primary energy production in the Americas totaled 132 quadrillion British thermal units (Btu), equal to 26% of global production and well above the global average on a per capita basis. With primary energy consumption in the Americas totaling 145 quadrillion Btu in 2010—equal to 28% of global consumption and thus exceeding per capita production—the region was a net importer of energy.

Population and economic growth are leading to increasing demand for oil and natural gas in many countries in the region. Some countries, like Brazil, Columbia, Peru, Canada, and the United States, have robust and growing energy sectors with advances in technology and practice enabling expanded development of tight oil and shale gas in the United States, oil sands in Canada, and deep water presalt resources in Brazil. In other countries, including Peru and Columbia, political and economic changes have opened energy sectors to international investors, resulting in dramatic growth in production. In others, including Mexico, Venezuela, Argentina, and Bolivia, policies unrelated to environmental considerations have restrained growth, although in Mexico, the recent election of a new president has been followed by legislation to open the petroleum sector to private investment for the first time since the sector was nationalized in the 1930s.

The expansion of the Panama Canal scheduled for 2015 will double its transit capacity and allow larger ships, including a majority of world's liquefied natural gas (LNG) tankers, to move through the canal. The relaxation of the longstanding capacity constraint on trans-Isthmus waterborne shipments should foster expansion of energy trade between the producers on the Atlantic side of the canal and oil- and gas-hungry markets on the Pacific, including China, Japan, and South Korea.

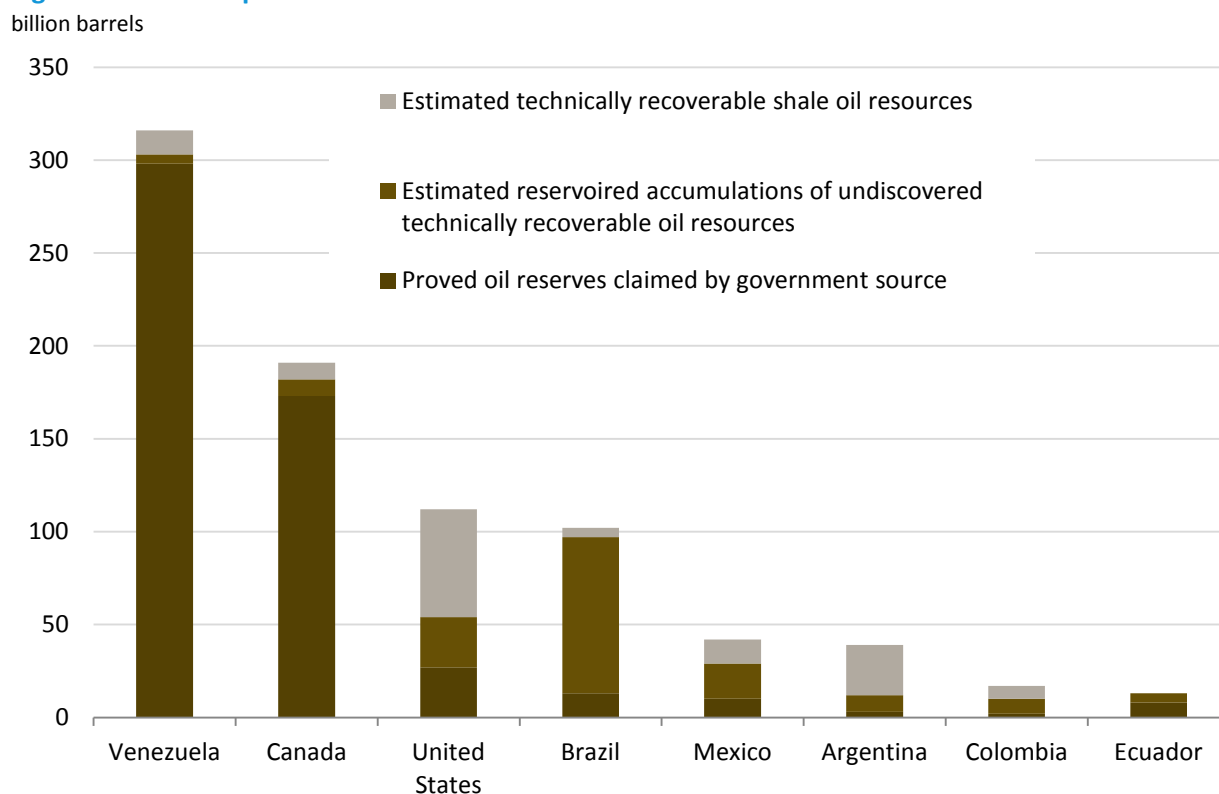
## Liquid fuels

### Proved reserves and recoverable resources

As of late 2013, the Americas held nearly one-third of reported global proved oil reserves (536 billion barrels), about 40% of estimated global reservoirized accumulations<sup>1</sup> of undiscovered oil resources (236 billion barrels), and substantial shale oil resources (140 billion barrels).<sup>2</sup>

- According to the *Oil and Gas Journal* (OGJ), the world has 1.6 trillion barrels of proved oil reserves, of which nearly one-third, or 536 billion barrels, is in the Americas. The Middle East has the largest regional share of world reserves at 799 billion barrels.<sup>3</sup>
- Venezuela claims the world's largest proved oil reserves with nearly 298 billion barrels, or 18% of the global total. Saudi Arabia which reports 265 billion barrels of proved oil reserves and Canada with 173 billion barrels are second and third on OGJ's list.
- According to the U.S. Geological Survey (USGS), the Americas region contains an estimated mean total<sup>4</sup> of 236 billion barrels of reservoirized accumulations of undiscovered technically recoverable oil resources, or 40% of global reservoirized resources, surpassing any other region.<sup>5</sup>
- South America and the Caribbean have approximately 126 billion barrels of reservoirized oil resources, approximately 44% of which is offshore Brazil.
- The Americas are also estimated to hold approximately 140 billion barrels of technically recoverable shale oil resources, with sizeable deposits located in Argentina, Canada, Mexico, the United States, and Venezuela (Figure 2).<sup>6</sup>

**Figure 2. Americas proved oil reserves and recoverable oil resources**



Sources: U.S. Energy Information Administration and Advanced Resources International, Inc., *EIA/ARI World Shale Gas and Shale Oil Resource Assessment*; *Oil and Gas Journal*; U.S. Geological Survey.

## Crude oil production

### Crude oil

**In 2012, the Americas produced nearly 19 million bbl/d of crude oil—approximately 25% of world crude oil supply and second only to the Middle East with 32% of global supply.**

- In the past decade, total production of crude oil in the Americas has increased by 9% and accounted for about 25% of world production. Production in the Americas fell to 23% of world production at its lowest point in 2008.
- The increase in the region’s production over the past decade is attributable to production growth in the United States, Canada, Brazil, and Colombia, which offset production declines in Mexico, Venezuela, and Argentina (Table 1).
- Production in Colombia increased by 74% in the past decade, following the institution of policies that encourage foreign investment in its oil sector. Production in the United States has increased by 27% as a result of increases in the production of tight oil.
- In 2012, the three top producers in the Americas were the United States, Canada, and Mexico, which together produced 12 million bbl/d, or 65% of the region’s total production.
- Venezuela and Brazil each produced more than 2 million bbl/d, and Colombia produced 944 thousand bbl/d.

**Table 1. Americas crude oil production by major country and 2012 world rank**

thousand barrels per day

Country (World Rank)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
United States (3rd globally)	5,644	5,435	5,186	5,089	5,077	5,000	5,353	5,479	5,652	6,486
Canada (6th)	2,306	2,398	2,367	2,525	2,628	2,579	2,579	2,741	2,901	3,138
Mexico (10th)	3,459	3,476	3,423	3,345	3,143	2,839	2,646	2,621	2,600	2,593
Venezuela (12th)	2,335	2,557	2,565	2,511	2,490	2,464	2,319	2,216	2,300	2,300
Brazil (13th)	1,496	1,477	1,634	1,723	1,748	1,812	1,950	2,055	2,105	2,061
Colombia (20th)	541	529	526	531	531	588	671	786	914	944
Argentina (27th)	783	733	704	696	679	661	651	626	581	551
<b>Total Americas</b>	<b>17,320</b>	<b>17,478</b>	<b>17,293</b>	<b>17,315</b>	<b>17,141</b>	<b>16,770</b>	<b>16,954</b>	<b>17,306</b>	<b>17,842</b>	<b>18,855</b>
<b>Total World</b>	<b>69,363</b>	<b>72,462</b>	<b>73,644</b>	<b>73,269</b>	<b>72,873</b>	<b>73,698</b>	<b>72,306</b>	<b>74,067</b>	<b>74,141</b>	<b>75,606</b>

Source: U.S. Energy Information Administration.

### Tight oil

#### U.S. and Canada tight oil production

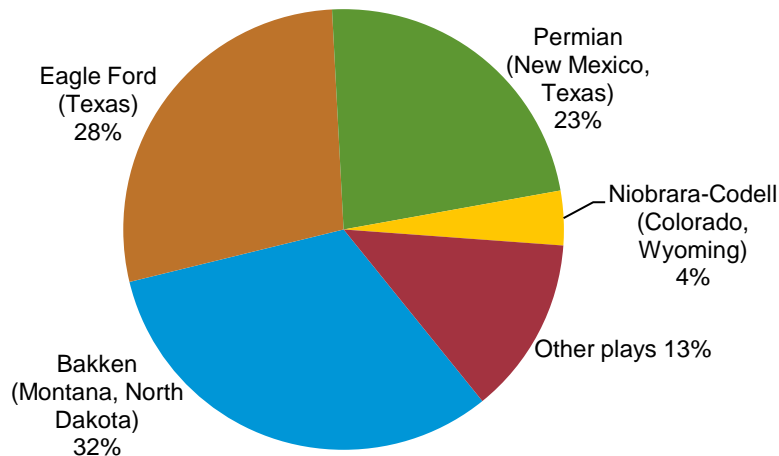
**Increasing production of tight oil is the single largest development for oil supply in the Americas. In the United States, tight oil production accounted for 30% of total crude oil production in 2012 and an estimated 36% in 2013. Currently, only the United States and Canada produce commercial quantities of tight oil.**

- The term “tight oil” refers to a variety of geologies, including shales, chalks, and tight sands, that contain oil. These geologies share low permeability, which means the ability to increase permeability with hydraulic fracturing and horizontal drilling.

- Tight oil production in the United States has increased to more than 2.7 million bbl/d in 2013 and accounted for 36% of total crude oil production. It is the single largest development for oil supply in the Americas.
- The U.S. portion of the Bakken play in North Dakota and Montana was the largest producing tight oil play in the United States in 2012 (Figure 3). Much of Bakken production growth can be attributed to advantageous geology that includes a layer of more easily fractured dolomite sandwiched between two shale layers.
- U.S. Bakken production grew from an about 120,000 bbl/d in 2008 to an estimated 1 million bbl/d in 2013. The Eagle Ford play in Texas produced 843,000 bbl/d in March 2013, having increased from 29,000 bbl/d in March 2010.
- Canada’s tight oil production averaged 292,000 bbl/d in 2012, or 8% of the country’s total oil production.

**Figure 3. Tight oil production in the United States by play, 2012**

percent of total



Source: U.S. Energy Information Administration; Drilling Information.

### *Other tight oil potential in the Americas*

**Given the variations in geology and above-ground conditions, the extent to which tight oil resources will be economically recoverable outside the United States and Canada is unclear.**

- The success of tight oil resource development depends on conditions both above ground and below ground. The above-ground advantages in the United States and Canada such as transportation infrastructure and private mineral ownership may not exist elsewhere. Exploration and production companies also must make substantial investments and commit to long-term drilling programs to determine the best extraction methods for different formations and to drill economic, commercial wells.
- A report by EIA and Advanced Resources International (ARI), released in June 2013, identified other liquids-rich prospective shale formations in the Americas, such as Vaca Muerta in Argentina, Eagle Ford in Mexico, Ponta Grossa in Brazil, and La Luna/Capachu shared by Colombia and Venezuela.
- As of July 2013, among the countries in the Americas with identified shale formations, Argentina and Mexico had taken the lead in evaluating production potential.
- The production of shale resources outside the United States will depend on production costs in the various formations and the market value of crude oil.

- Production costs depend on drilling costs, volumes produced per well, and the fiscal regime, including taxes and royalties, surrounding resource extraction. Even modest variations in costs can determine whether a resource is economically attractive or unprofitable.

#### **Argentina**

- The EIA/ARI report estimates Argentina's technically recoverable shale oil resources at 27 billion barrels, the second largest shale oil resource in the Americas after the United States.
- A number of major international energy companies are actively exploring the potential of Argentina's shale resources. As of June 2013, more than 50 test wells had been drilled in Los Molles and especially in Vaca Muerta in the Neuquen Basin.

#### **Mexico**

- The Eagle Ford shale play extends across Texas and the Burgos Basin in Mexico. The Mexican national oil company (NOC), Petroleos Mexicanos (PEMEX), has drilled at least six shale wells in Eagle Ford which did not yield economic production volumes. The first well was completed in early 2011, while the subsequent five wells were drilled in 2012.
- PEMEX's first shale exploration wells have been costly at \$20 to \$25 million per well compared to \$6 to \$9 million per well in Texas, and have modest initial oil flow rates. PEMEX plans to drill up to 75 shale exploration wells in the Burgos Basin through 2015. As more wells are drilled, cost reductions and better implementation of completion technology may improve to the point where commercial production is viable.

## **Crude oil trade**

### *Crude oil imports and exports*

**For much of the past decade, the United States has been the top export destination for crude oil produced in Venezuela, Mexico, Canada, and Brazil. Crude oil from those countries accounted for nearly 53% of total imports of crude oil into the United States in 2012. China was one of the top three destinations for crude oil exported from Canada, Colombia, Brazil, and Venezuela in 2012.<sup>7</sup>**

- In 2012, the countries of the Americas accounted for 25% of global crude oil imports, importing nearly 11 million bbl/d from all sources, 56% of this was within the Americas. The region was second behind Asia and Oceania, which accounted for 46% of global crude oil imports.
- About 80%, or 8.5 million bbl/d, of the crude oil imported into the Americas was imported into the United States. Imports into the region accounted for only 5% of world crude oil imports.
- In 2012, the countries of the Americas exported 8 million bbl/d of crude oil, 73% of which went to other countries in the region, accounting for 19% of global crude oil exports. The largest exporters were Venezuela, Mexico, Canada, and Brazil, which made up 77% of the region's total exports.

### *U.S. imports*

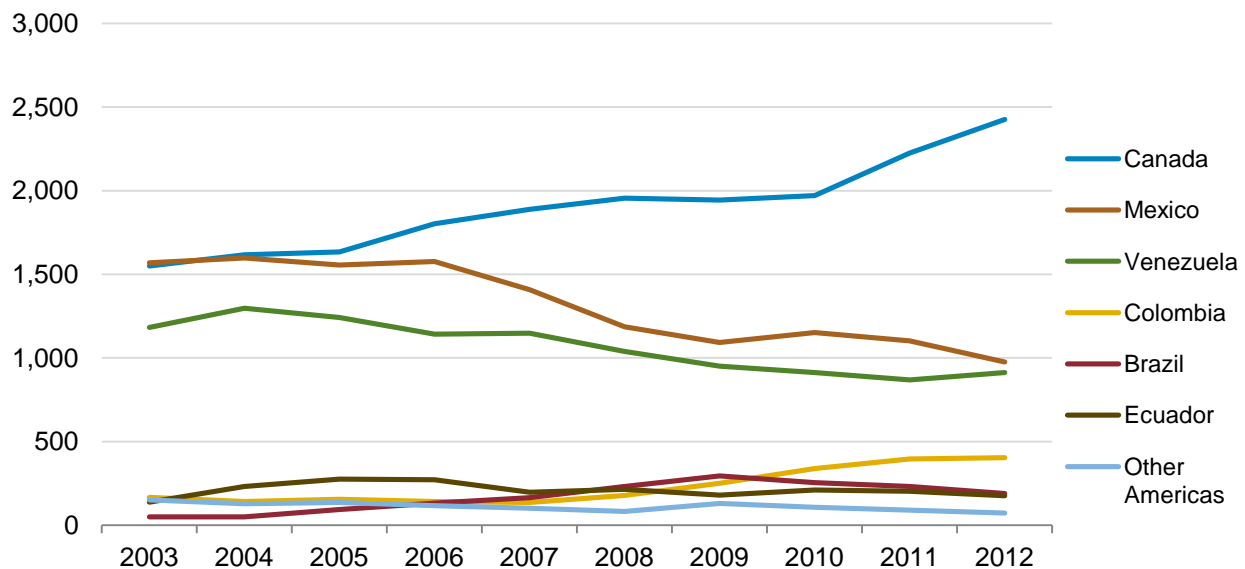
**Canada, Mexico, and Venezuela are important sources of crude oil for the United States (Figure 4). Imports from Canada grew 57% in the past decade and has been the largest source of U.S. crude oil imports at 2.4 million bbl/d in 2012. Mexico and Venezuela, while declining, remain important, in part as a result of joint ventures between their NOCs and U.S. refineries.**

- In 2012, U.S. crude oil imports totaled 8.5 million bbl/d. In 2011, the United States imported less than 9 million bbl/d for the first time since 1999 and has been importing less overall from its Latin American partners.
- In 2012, 60% of U.S. crude oil imports came from other countries in the Americas. From 2003 to 2008, such imports averaged only 50% of total U.S. imports.

- A number of U.S. refineries are joint ventures between NOCs in the Americas and private companies, including:
  - The Deer Park, Texas, refinery (327,000 bbl/d), which has operated as a joint venture between Shell Oil Company and PMI Norteamerica SA (a subsidiary of PEMEX, Mexico’s NOC) since 1993.
  - Citgo Petroleum, which owns three U.S. refineries and is owned by Petroleos de Venezuela, S.A. (PdVSA), the NOC of Venezuela. PdVSA, purchased 50% of Citgo in 1986 and the remaining 50% in 1990.
  - The Chalmette, Louisiana, refinery (192,500 bbl/d), which is a joint venture between ExxonMobil (50%) and PdVSA (50%).

**Figure 4. U.S. crude oil imports from major countries in the Americas, 2012**

thousand barrels per day



Source: U.S. Energy Information Administration.

### *China and India crude oil trade with the Americas*

**Venezuela was the top exporter from the Americas to China and India in 2012. Venezuela shipped about 306,000 bbl/d of crude oil to China and 349,000 bbl/d to India. Venezuela also exported 95,000 bbl/d of oil products to China in 2012.<sup>8</sup>**

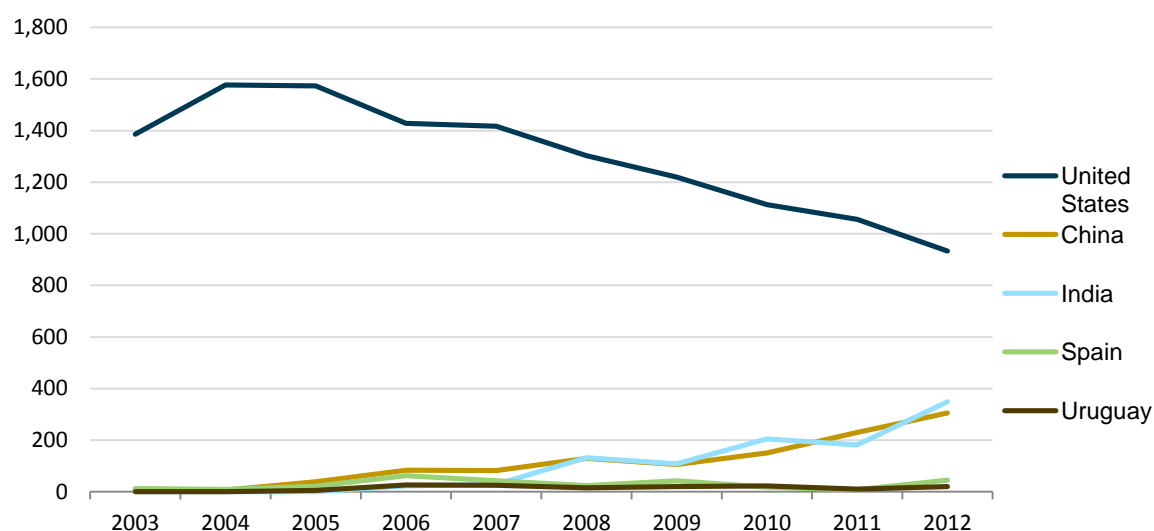
- China and India were among the largest importers of crude oil in the world in 2012. Over the past decade, both countries have imported increasing quantities of crude oil from the Americas (Table 2).
- In 2012, the Middle East provided 50% of China’s crude oil imports and over 60% of India’s.
- In 2012, 10% of the crude oil shipped to China came from the Americas, an increase from 7% in 2008. Crude oil supplies from the Americas could increase as China ramps up its ownership interest in oil-producing properties in the region.
- The Americas—primarily Venezuela, Brazil, and Mexico—are a rising source of crude oil for India. Crude oil imports to India from the Americas were 16% of India’s total crude oil imports in 2012, up from 7% in 2008.
- Since 2009, Venezuela’s crude oil exports to China have almost tripled. China’s massive loans-for-oil deal to help develop Venezuela’s oil production, combined with recent upgrades of refining capacity in China, has facilitated imports of Venezuela’s heavy, sour crude oil (Figure 5).



- Venezuelan crude oil exports to India increased in the past five years to almost 350,000 bbl/d in 2012, from 130,000 bbl/d in 2008, as a result of greater investment in and development of the vast Orinoco oil reserves.
- Brazil was the second largest exporter from the Americas to both China and India in 2012. A loan-for-oil pact stipulated that Petrobras would supply Sinopec, a Chinese NOC, with 200,000 bbl/d until 2019, contingent on further progress of its reserves. Indian companies, like the Chinese National Oil Companies, are seeking investment opportunities in Brazil.
- The Chinese NOCs Sinopec and Chinese National Offshore Oil Corporation (CNOOC) have invested in Canadian oil sands through acquisition of ownership interests in upstream companies operating in the oil sands in Alberta.

**Figure 5. Venezuela crude oil exports by destination**

thousand barrels per day



Source: U.S. Energy Information Administration; Global Trade Services.

**Table 2. Crude oil exports from major countries in the Americas to China and India and 2012 world rank**

thousand barrels per day

	2008	2009	2010	2011	2012
<b>Exports to China by Origin Country</b>					
Venezuela (7th largest to China)	129	105	151	230	306
Brazil (12th)	60	81	161	134	121
Colombia (16th)	23	25	40	45	58
Argentina (20th)	15	14	23	9	24
<b>Total Americas</b>	<b>256</b>	<b>272</b>	<b>421</b>	<b>475</b>	<b>563</b>
<b>Exports to India by Origin Country</b>					
Venezuela (4th largest to India)	132	108	205	182	349
Brazil (10th)	3	41	48	63	96
Mexico (11th)	38	35	19	42	75
Colombia (14th)	0	13	28	20	35
<b>Total Americas</b>	<b>183</b>	<b>213</b>	<b>314</b>	<b>316</b>	<b>582</b>

Source: U.S. Energy Information Administration; Global Trade Information Services.

## Petroleum products and biofuels

### *Petroleum products consumption, including biofuels*

In 2012, the world's largest regional consumer of petroleum products was the Americas, at one-third of the global total (30 million bbl/d). More than 62% of total Americas production was consumed in the United States. Consumption in the Americas outside the United States was 11 million bbl/d (Table 3).

- Since 2007, total petroleum product consumption in the Americas has fallen by more than 4%, but outside the United States, consumption has increased by 8%.
- Over the past decade, growth in liquid fuel consumption in the Americas has been most rapid in Brazil, where consumption has increased by nearly 37%.
- Although petroleum product consumption in the United States is declining, in 2012 the United States is still the largest refined product consumption market in the world, at nearly 19 million bbl/d, followed by China at more than 10 million bbl/d.
- Gasoline was the most widely consumed refined product in the Americas, at 14 million bbl/d in 2012. U.S consumption was 9 million bbl/d, and in Mexico and Canada consumption was nearly 1 million bbl/d. Gasoline consumption in the Americas has fallen since 2007; however, outside the United States it has grown by 400,000 bbl/d, with 50% of the growth in gasoline consumption in Brazil.
- In 2012, distillate fuel oil was the second most consumed product in the region, at 9 million bbl/d. A total of 4 million bbl/d was consumed in the United States, 1 million bbl/d in Brazil, and 0.5 million bbl/d in Canada.
- Overall, distillate fuel consumption in the Americas has been flat since 2007. However, outside the United States it has grown by almost 11%.

**Table 3. Americas petroleum product consumption by major country and 2012 world rank**

thousand barrels per day

Country (World Rank)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
United States (1st globally)	20,034	20,731	20,802	20,687	20,680	19,498	18,771	19,180	18,949	18,555
Brazil (7th)	2,056	2,123	2,206	2,287	2,355	2,205	2,481	2,622	2,722	2,807
Canada (10th)	2,191	2,282	2,315	2,229	2,283	2,225	2,163	2,265	2,266	2,287
Mexico (11th)	2,016	2,069	2,117	2,123	2,173	2,161	2,071	2,080	2,113	2,145
Venezuela (23rd)	541	553	583	631	691	862	675	718	751	777
Argentina (26th)	450	472	483	535	587	582	589	620	678	699
<b>Total Americas</b>	<b>29,457</b>	<b>30,486</b>	<b>30,760</b>	<b>30,786</b>	<b>31,134</b>	<b>29,907</b>	<b>29,120</b>	<b>29,865</b>	<b>29,907</b>	<b>29,760</b>
<b>Total World</b>	<b>79,712</b>	<b>82,573</b>	<b>84,077</b>	<b>85,141</b>	<b>85,908</b>	<b>84,565</b>	<b>84,813</b>	<b>87,446</b>	<b>88,662</b>	<b>89,275</b>

Source: U.S. Energy Information Administration.

### *Production of refined petroleum products*

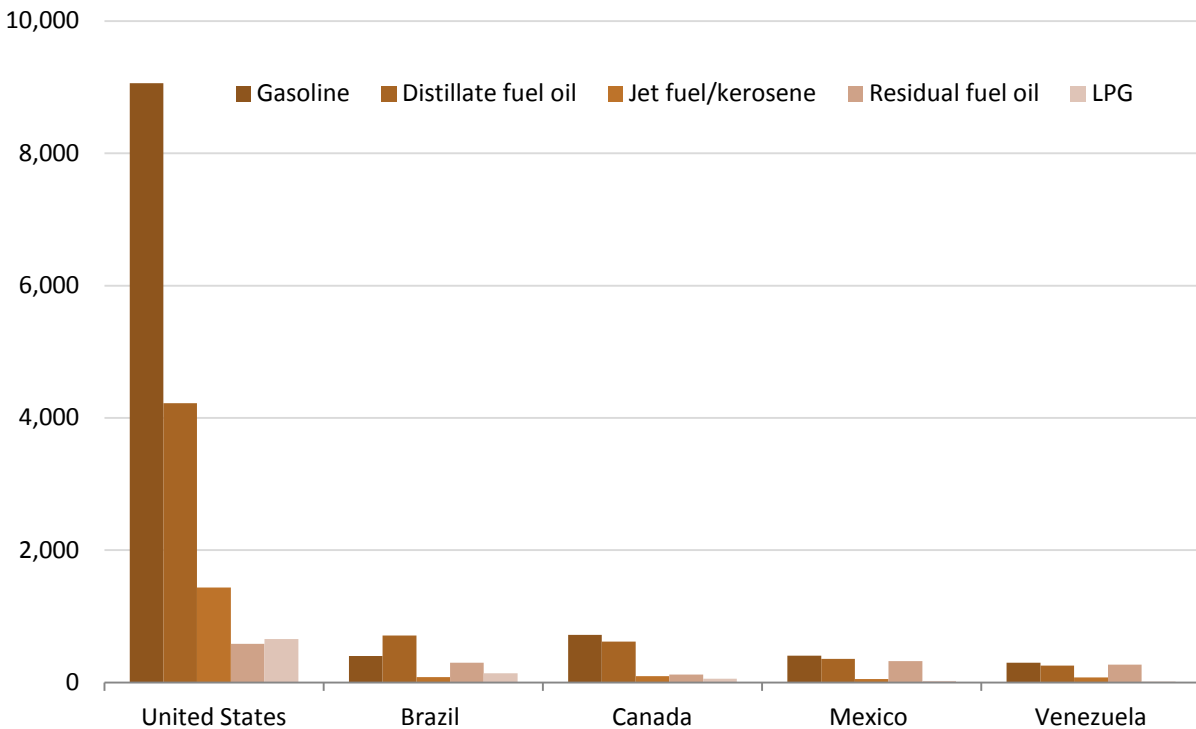
The Americas are the number one producer of refined petroleum products in the world, having produced 28 million bbl/d in 2010 (Figure 6). Within the region and globally, the United States is the leading producer in all the major product categories.

- In 2010, the Americas produced the following:
  - Motor gasoline: 11 million bbl/d (41% of total refined product production)

- Distillate: 7 million bbl/d (25% of total refined product production)
- Residual fuel oil: 2 million bbl/d (8% of total refined product production)
- Jet fuel : 2 million bbl/d (7% of total refined product production)
- Liquefied petroleum gases (LPG): 1 million bbl/d (nearly 4% of total refined product production).
- The United States produced 18 million bbl/d of refined products, or 66% of production in the Americas. Of the refined product produced in the United States, nearly half (9 million bbl/d) was gasoline, 23% (4 million bbl/d) was distillate fuel oil, and 8% (1 million bbl/d) was jet fuel.
- The United States produces much more gasoline relative to distillate fuel in comparison with other countries in the Americas, reflecting the dominance of gasoline in U.S. consumption. Other countries tend to produce a more balanced mix of gasoline and distillate.
- After the United States, the next largest producers of refined products in the Americas are Brazil and Canada, both of which produced 2 million bbl/d in 2010, primarily motor gasoline and distillate.
- Given the heavy characteristics of crude oil produced in Mexico and Venezuela and the refinery specifications in those countries, their refineries produce, on average, a higher proportion of residual fuel oil.
- Over the past decade, both China and India imported oil products, primarily petroleum coke, from the United States. In 2012, China imported 85,000 bbl/d of product, more than 80% of which was petroleum coke, and India imported 36,000 bbl/d, the bulk of which was petroleum coke.

**Figure 6. Production of refined petroleum products in the Americas, 2010**

thousand barrels per day



Source: U.S. Energy Information Administration.

## Refinery capacity

The Americas had a total crude oil distillation capacity of 27.7 million bbl/d, about 32% of total global capacity, as of the end of 2013 (Table 4). This capacity is concentrated in the United States (Figure 8).<sup>9</sup>

- The United States had crude distillation capacity of 17.8 million bbl/d, 20% of global capacity, and 64% of the Americas capacity. Many U.S. refineries are complex and have considerable upgrading capacity, including coking, hydrocracking, and hydrotreating.
- Latin America, including the Caribbean, had crude oil distillation capacity of 7.9 million bbl/d as of January 1, 2014, 29% of total capacity in the Americas, and 9% of global capacity. Among the Latin American countries, Brazil had the most refining capacity at more than 1.9 million bbl/d.
- Refining capacity in Latin America has failed to keep pace with the growth in petroleum product demand that has resulted as economies have expanded. The increase in Latin American product demand is being supplied by imports, primarily from the United States (Table 4).
- Several Latin American nations have passed legislation to lower sulfur content in gasoline (Figure 7) and distillate fuel,<sup>10</sup> and refinery upgrades that will enable meeting these specifications are planned to be completed in the next several years. Until the refinery upgrades are completed, many of these countries are importing low-sulfur fuels from the United States. However, it is not yet clear that planned upgrades will allow production of sufficient fuel to meet the region's rapidly growing demand.
- Global growth of distillate fuel demand has supported refinery margins throughout the world and has encouraged investment in U.S. refineries to maximize high-value distillate output.
- Additional investments are also expected to improve capability to process the increased volume of lighter crudes and condensates coming from tight oil plays like the Eagle Ford.

**Table 4. Refining capacity in the Americas by major country as of January 1, 2014**

thousand barrels per day

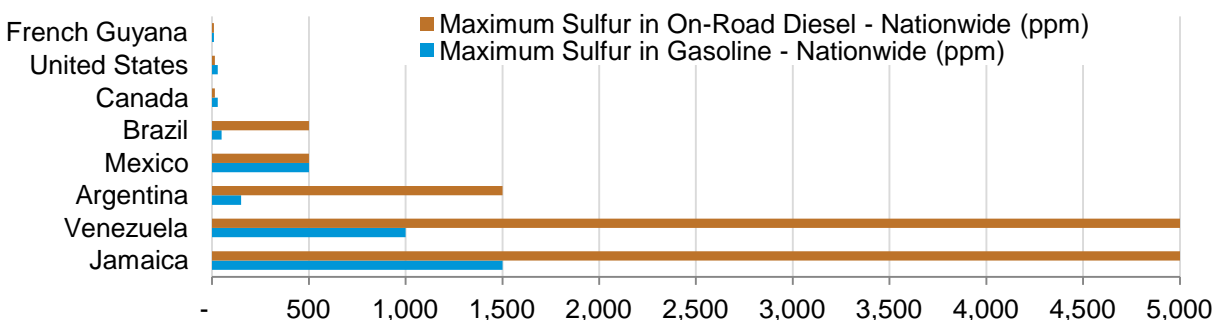
Country	Number of refineries	Distillation capacity	Coking capacity	Hydrocracking	Hydrotreating
United States	142	17,818	2,596	1,887	15,174 <sup>a</sup>
Canada	17	1,957	59	206	1,390
Brazil	13	1,917	115	0	284
Mexico	6	1,540	191	0	926
Venezuela	5	1,282	145	0	390
<b>Total Americas</b>	<b>230</b>	<b>27,675</b>	<b>3,266</b>	<b>2,225</b>	<b>19,179</b>
<b>Total World</b>	<b>664</b>	<b>87,753</b>	<b>4,683</b>	<b>5,741</b>	<b>45,819</b>

<sup>a</sup>This number has been converted from barrels per stream-day to barrels per day.

Source: U.S. Energy Information Administration; *Oil & Gas Journal*.

**Figure 7. Maximum nationwide sulfur limits for gasoline and on-road diesel**

parts per million (ppm)



Source: Hart Energy Research and Consulting.

Figure 8. Top 100 refineries in the Americas by crude distillation capacity, selected major refinery by country



Source: U.S. Energy Information Administration; IHS, EDIN; *Oil and Gas Journal*.

## Refined petroleum products trade

Refined product trade in the Americas has changed as Latin American product demand has grown faster than local refinery production capacity, changing refined product flows, at least temporarily reshaping refined product trade in the Americas. U.S. refiners have been well-positioned to take advantage of the rapidly growing demand and delayed refinery investment in Latin America (Figure 9).

### *Petroleum product imports and exports*

According to preliminary 2012 data, the countries in the Americas imported more than 4 million bbl/d globally, 66% of which came from within the Americas, and exported more than 3 million bbl/d globally, 86% of which went to other countries in the Americas, of petroleum products. The United States was the largest petroleum product importer in the world at 2 million bbl/d and the second largest exporter of products after Russia, at more than 3 million bbl/d.

- Other major petroleum product importers in the Americas include Brazil at 575,000 bbl/d, followed by Mexico at 567,000 bbl/d in 2012.
- Exports from the United States accounted for more than 60% of total exports into the countries of the region in 2012. A decade ago exports accounted for less than 25%. Venezuela is the only other major exporter at 355,000 bbl/d, a sizeable decline from 719,000 bbl/d a decade ago.<sup>11</sup>
- The United States exported products primarily into the Americas region, to Mexico, Canada, Brazil, and Chile. Exports to those four countries comprised 40% of total U.S. exports in 2012.

### *U.S. imports*

The largest categories of U.S. product imports are motor gasoline blending components, residual fuel oil, and unfinished oils. Most of the gasoline and unfinished oils imported into the United States originate in Europe, Russia. A substantial amount also comes from Canada (Table 5). Most of the residual fuel oil and the distillate imports come from within the Americas, primarily from Canada.

- In 2012, the United States imported 2 million bbl/d of refined petroleum products and other liquids. The largest categories of imports were motor gasoline blending components at 663,000 bbl/d and unfinished oils at about 600,000 bbl/d. Most gasoline imports came into the East Coast and most unfinished oil imports came into the Gulf Coast, where refining is concentrated.

**Table 5. U.S. petroleum product imports from the Americas by major country, by major product and 2012 world rank**

thousand barrels per day

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>Country (World Rank)</b>										
Canada (1st globally)	523	522	548	551	566	536	536	565	504	521
Mexico (7th)	55	66	106	129	124	115	118	132	105	60
Venezuela (11th)	193	258	288	277	212	149	111	76	83	47
<b>Total Americas</b>	<b>1,356</b>	<b>1,453</b>	<b>1,716</b>	<b>1,664</b>	<b>1,562</b>	<b>1,380</b>	<b>1,228</b>	<b>1,147</b>	<b>1,105</b>	<b>811</b>
<b>Total World</b>	<b>2,599</b>	<b>3,057</b>	<b>3,588</b>	<b>3,589</b>	<b>3,437</b>	<b>3,132</b>	<b>2,678</b>	<b>2,580</b>	<b>2,501</b>	<b>2,071</b>
<b>Product</b>										
Motor Gasoline	449	410	434	378	399	375	354	353	321	201
Residual Fuel Oil	227	272	342	252	217	212	202	238	225	167
Distillate Fuel Oil	261	273	270	265	227	180	198	193	162	108
<b>Total Products</b>	<b>2,599</b>	<b>3,057</b>	<b>3,588</b>	<b>3,589</b>	<b>3,437</b>	<b>3,132</b>	<b>2,678</b>	<b>2,580</b>	<b>2,501</b>	<b>2,071</b>

Note: Motor gasoline includes both finished motor gasoline and motor gasoline blending components.

Source: U.S. Energy Information Administration.

Figure 9. U.S. crude oil and petroleum products trade, 2012



Note: Thickness of lines corresponds to relative trade volume.  
 Source: U.S. Energy Information Administration.

## U.S. exports

The United States recently became a net exporter of petroleum products. The majority of product exports are from the U.S. Gulf Coast, where some of the most sophisticated refining capacity in the world is concentrated. More than 60% of the gasoline and distillate exported from the United States in 2012 was delivered to other countries in the Americas (Table 6).

- In 2012, the United States exported more than 3 million bbl/d of petroleum products, including just over 1 million bbl/d of distillate fuel, 500,000 bbl/d of motor gasoline, 380,000 bbl/d of residual fuel, and 500,000 bbl/d of petroleum coke.
- Motor gasoline and distillate, exported primarily to Mexico, are driving the growth in U.S. petroleum product exports. Mexico's consumption of refined petroleum products rose 6% over the past 10 years, while Mexican refining capacity did not change. Since 2003, U.S. exports of petroleum products to Mexico, chiefly motor gasoline and diesel fuel, have more than doubled.

**Table 6. U.S. petroleum product exports to the Americas by major country and major product**

thousand barrels per day

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>Country (World Rank)</b>										
Mexico (1st globally)	228	209	268	255	279	333	322	448	570	565
Canada (2nd)	128	133	150	134	162	235	179	192	305	349
Brazil (4th)	27	27	39	42	46	54	55	123	157	166
Chile (5th)	10	23	40	27	53	83	78	75	126	148
Panama (6th)	43	38	37	42	51	52	66	86	102	126
Venezuela (11th)	12	7	14	27	21	27	26	20	32	85
<b>Total Americas</b>	<b>620</b>	<b>591</b>	<b>734</b>	<b>746</b>	<b>858</b>	<b>1,072</b>	<b>1,085</b>	<b>1,429</b>	<b>1,747</b>	<b>1,979</b>
<b>Total World</b>	<b>1,014</b>	<b>1,021</b>	<b>1,133</b>	<b>1,292</b>	<b>1,405</b>	<b>1,773</b>	<b>1,980</b>	<b>2,311</b>	<b>2,939</b>	<b>3,137</b>
<b>Product</b>										
Distillate	83	67	118	136	177	301	289	435	484	632
Motor Gasoline	143	148	152	139	135	179	208	327	489	466
Residual Fuel Oil	155	145	177	149	195	195	202	181	201	185
Propane	31	27	36	41	41	51	62	91	103	131
Coke	98	91	100	115	126	133	102	137	141	128
Pentanes Plus	3	2	7	11	13	34	39	32	43	113
<b>Total Products</b>	<b>1,014</b>	<b>1,021</b>	<b>1,133</b>	<b>1,292</b>	<b>1,405</b>	<b>1,773</b>	<b>1,980</b>	<b>2,311</b>	<b>2,939</b>	<b>3,137</b>

Note: Motor gasoline includes both finished motor gasoline and motor gasoline blending components.

Source: U.S. Energy Information Administration.

## Biofuels production

The United States has been the world's largest producer of biofuels since surpassing Brazil in 2006.

- Brazil and the United States made up nearly three-fourths of global biofuels output in 2011.
- In the past decade, the Americas' biofuels production quadrupled to 1.5 million bbl/d.
- Despite large production growth, the Americas share of world biofuels production declined from 90% in 2002 to 80% in 2011.
- Overall, the Americas produced more ethanol than biodiesel, but in Argentina and Colombia the reverse was true.



## Biofuels consumption

**Biofuels consumption in the Americas more than quadrupled between 2002 and 2011, growing from 0.3 million bbl/d to over 1.3 million bbl/d in 2011.**

- Most biofuels produced in the Americas are consumed in the Americas. The United States and Brazil account for 70% of the world's total consumption of biofuels (Table 7).
- From 2002 to 2011, biofuels production in the Americas exceeded consumption in every year since 2002 (Table 8), suggesting that the Americas export biofuels to other regions of the world.
- In the Americas in the past decade, Canada is the only major biofuels producer whose consumption exceeds production. Argentina consumes the smallest fraction of its own production (35% in 2011).

**Table 7. Americas biofuels production and consumption by major country and 2011 world rank**

thousand barrels per day

Country (World Rank)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Production</b>										
United States (1st globally)	140	184	223	261	335	457	650	747	890	972
Brazil (2nd)	217	249	252	276	307	396	486	478	527	438
Argentina (5th)	0	0	0	0	1	4	14	24	38	50
Canada (7th)	4	4	4	5	5	15	17	22	26	33
<b>Total Americas</b>	<b>366</b>	<b>443</b>	<b>484</b>	<b>550</b>	<b>671</b>	<b>899</b>	<b>1,200</b>	<b>1,303</b>	<b>1,505</b>	<b>1,524</b>
<b>Total World</b>	<b>403</b>	<b>499</b>	<b>555</b>	<b>656</b>	<b>841</b>	<b>1,103</b>	<b>1,477</b>	<b>1,635</b>	<b>1,865</b>	<b>1,897</b>
<b>Consumption</b>										
United States (1st globally)	136	185	233	271	375	473	650	741	856	899
Brazil (2nd)	160	144	177	182	195	268	356	420	424	377
Canada (5th)	5	5	5	6	5	22	26	28	34	47
Argentina (11th)	0	0	0	0	0	0	0	1	12	18
<b>Total Americas</b>	<b>302</b>	<b>335</b>	<b>416</b>	<b>461</b>	<b>582</b>	<b>770</b>	<b>1,041</b>	<b>1,207</b>	<b>1,346</b>	<b>1,369</b>
<b>Total World</b>	<b>336</b>	<b>387</b>	<b>486</b>	<b>562</b>	<b>747</b>	<b>991</b>	<b>1,350</b>	<b>1,585</b>	<b>1,772</b>	<b>1,820</b>

Source: U.S. Energy Information Administration.

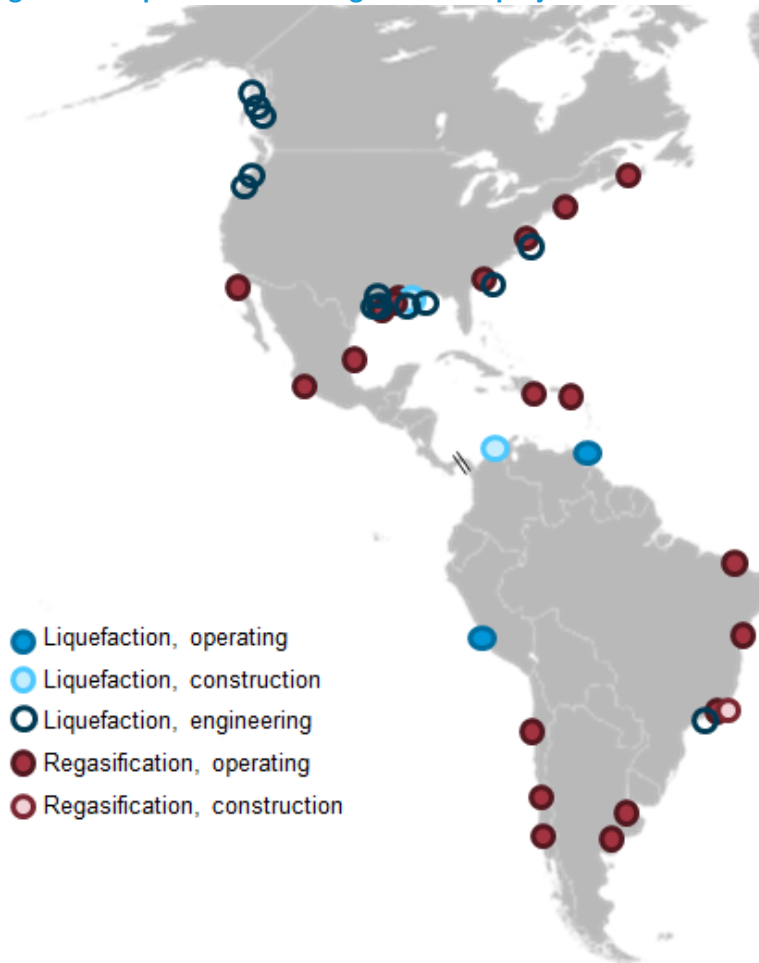
## Panama Canal and pipeline

**The Panama Canal and the Trans-Panama Pipeline are not currently used for significant volumes of petroleum trade. Vessel size restrictions make transporting petroleum through the canal costly. However, the Panama Canal expansion project will open the canal route to Aframax tankers and 80% of the current global LNG carrier fleet. Petroleum and LNG trade to and from the region will likely increase.**

- Because the Panama Canal is currently only 110 feet wide at its narrowest point (Culebra Cut) the canal can only accommodate tankers up to 80,000 deadweight tons (dwt), about 950 feet in length, 106 feet wide, and with a draft of not more than 39.5 feet. These tankers are often referred to as Panamax-class vessels and are generally the second smallest class of oil tankers. Crude oil typically moves on much larger vessels, which can carry up to 550,000 dwt.
- Panama is engaged in a project to expand the Canal that will accommodate the next class of tankers, a fully loaded Aframax tanker, up to 120,000 dwt.<sup>12</sup> According to the Panama Canal Authority, only a fifth of the canal traffic in 2011 was petroleum tanker traffic. Upon project completion in 2015, EIA expects oil tanker traffic to increase through the Canal.

- The Trans-Panama Pipeline (TPP) is an oil pipeline that traverses Panama from the port of Chiriqui Grande on the Caribbean to the port of Charco Azul on the Pacific and now flows east to west. It was built in 1982 to ship Alaska North Slope crude to refineries in the U.S. Gulf Coast and the Caribbean without circumnavigating South America. In 2009, the flow was reversed to move crude oil produced in Africa and the Middle East to U.S. west coast refineries.<sup>13</sup>
- Currently, no LNG trade is conducted through the canal. However, the expanded canal will be able to accommodate more than 80% of the world's current LNG carrier fleet.<sup>14</sup>
- Peru and Trinidad and Tobago operate the only two major LNG liquefaction facilities in the Americas at a combined 2.6 billion cubic feet per day (Bcf/d). By 2019, liquefaction capacity is expected to increase 8-fold. Most of the projects are in the United States, heavily concentrated in the U.S. Gulf Coast. As of late 2013, there were 35 LNG export projects in the various stages of approval. (Figure 10).
- EIA anticipates increased LNG trade between countries in the Americas but also from the Americas to Asia, the largest LNG import market, through the Panama Canal will increase, with growing natural gas production in the Americas, particularly from U.S. shale gas production.

**Figure 10. Liquefaction and regasification projects in the Americas**



Note: The Kenai LNG export facility in Alaska is not included in this map. The Kenai facility's LNG export permit expired on March 31, 2013. On December 11, 2013, the facility applied for an export permit to resume LNG exports with a total export level of 40 billion cubic feet over a two-year time frame.

Source: U.S. Energy Information Administration; IHS EDIN

## Natural gas

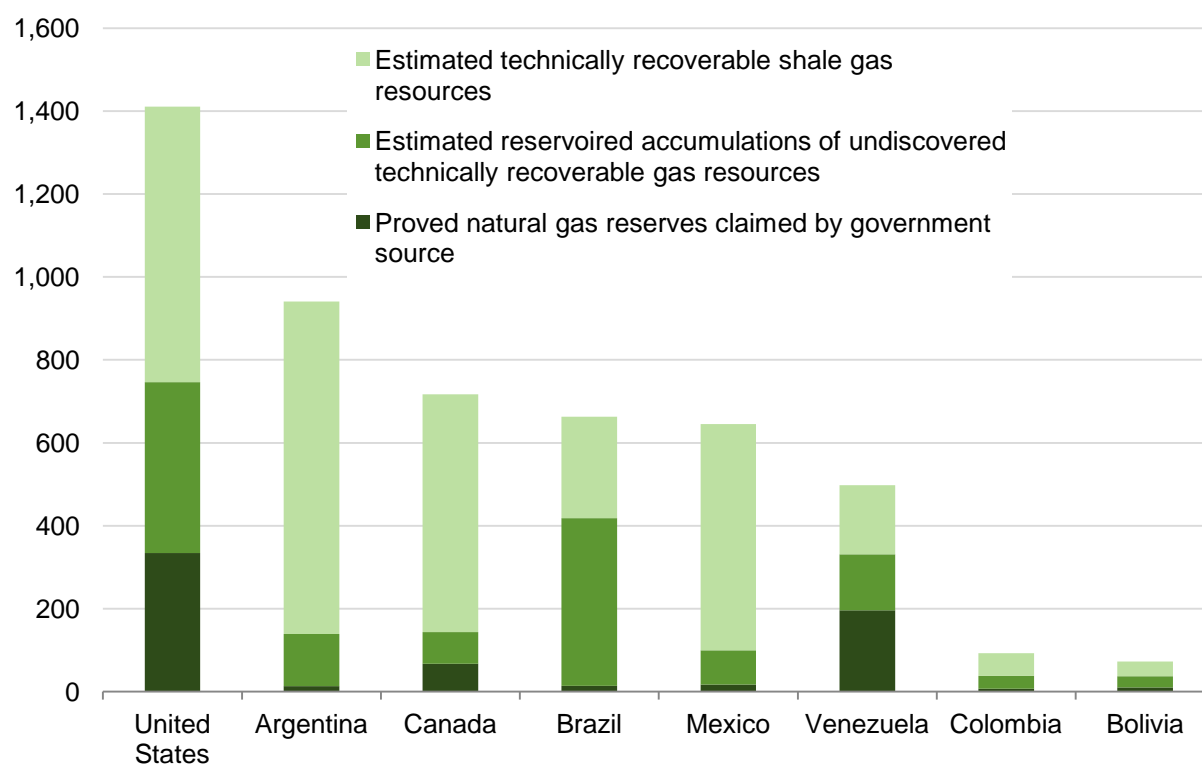
### Proved reserves and recoverable resources

The Americas held one-tenth of global natural gas proved reserves (693 Tcf), more than 20% of global reservoirized accumulations of undiscovered gas resources<sup>15</sup> (1,252 Tcf), and sizeable shale gas resources (3,213 Tcf).<sup>16</sup>

- The world has 7,024 Tcf of proved natural gas reserves, about one-tenth (693 Tcf) of which is in the Americas. The Middle East has the largest share of world reserves at 2,827 Tcf, followed by Eurasia at 2,189 Tcf.<sup>17</sup>
- Russia and Iran have the world's largest proved natural gas reserves at more than 1,000 Tcf each. In the Americas, the United States and Venezuela hold the largest proved natural gas reserves, at 334 Tcf and 196 Tcf, respectively.
- According to the USGS, the Americas hold an estimated mean total<sup>18</sup> of more than 1,252 Tcf in reservoirized accumulations of undiscovered technically recoverable gas resources (Figure 11), representing just over 20% of the world total. The United States and Brazil lead the region with more than 400 Tcf each of reservoirized accumulations of undiscovered technically recoverable gas resources.<sup>19</sup>
- Argentina, the United States, Canada, Mexico, and Brazil are among the top 10 countries with technically recoverable shale gas resources. In 2013, the Americas held an estimated total of 3,213 Tcf of technically recoverable shale gas resources.<sup>20</sup>

**Figure 11. Americas natural gas reserves and resources, 2012**

trillion cubic feet



Source: U.S. Energy Information Administration and Advanced Resources International, Inc., *EIA/ARI World Shale Gas and Shale Oil Resource Assessment*; *Oil and Gas Journal*; U.S. Geological Survey.

## Production

### *Dry natural gas*

**The United States is the world's largest producer of dry natural gas, producing roughly 20% of the world total in 2012. A significant portion of U.S. production comes from shale, which accounted for about 40% of U.S. dry natural gas production in 2012.**

- In 2012, the Americas produced 37 Tcf of dry natural gas (Table 8), which accounted for approximately 31% of the world's total dry natural gas production.
- North America accounts for the majority of dry natural gas production in the Americas, producing 84% of the region's total in 2012.
- Outside of North America, the region's top two producers are Trinidad and Tobago and Argentina, which together account for roughly 22% of total non-U.S. Americas production.
- South America's dry natural gas production is a small percentage of total production in the Americas but has, with some exceptions, been increasing over the past decade. For example, Peru's production increased by 2,100% from 2003 to 2012.
- Despite recent production gains in South America, the continent is at risk of a decline in dry natural gas production because of maturing fields and a lack of continued investment.

**Table 8. Dry natural gas production by country and 2012 world rank**

trillion cubic feet

Country (World Rank)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
United States (1st globally)	19.0	18.6	18.0	18.5	19.3	20.2	20.6	21.3	22.9	24.1
Canada (4th)	6.5	6.5	6.6	6.5	6.4	6.0	5.6	5.4	5.2	5.5
Mexico (18th)	1.4	1.3	1.3	1.7	1.7	1.7	1.7	1.8	1.8	1.7
Trinidad and Tobago (21st)	0.9	1.0	1.1	1.3	1.4	1.4	1.4	1.5	1.4	1.5
Argentina (23rd)	1.4	1.6	1.6	1.6	1.6	1.6	1.5	1.4	1.4	1.3
Venezuela (27th)	0.9	1.0	0.8	0.9	0.7	0.7	0.7	0.9	0.9	0.8
Peru (38th)	0.02	0.03	0.06	0.06	0.1	0.1	0.1	0.3	0.4	0.4
<b>Total Americas</b>	<b>31.0</b>	<b>30.9</b>	<b>30.6</b>	<b>31.9</b>	<b>32.4</b>	<b>33.1</b>	<b>33.0</b>	<b>34.0</b>	<b>35.5</b>	<b>37.1</b>
<b>Total World</b>	<b>93.4</b>	<b>95.6</b>	<b>98.4</b>	<b>102.0</b>	<b>104.0</b>	<b>107.7</b>	<b>105.2</b>	<b>112.0</b>	<b>116.0</b>	<b>118.4</b>

Source: U.S. Energy Information Administration.

### *Shale gas*

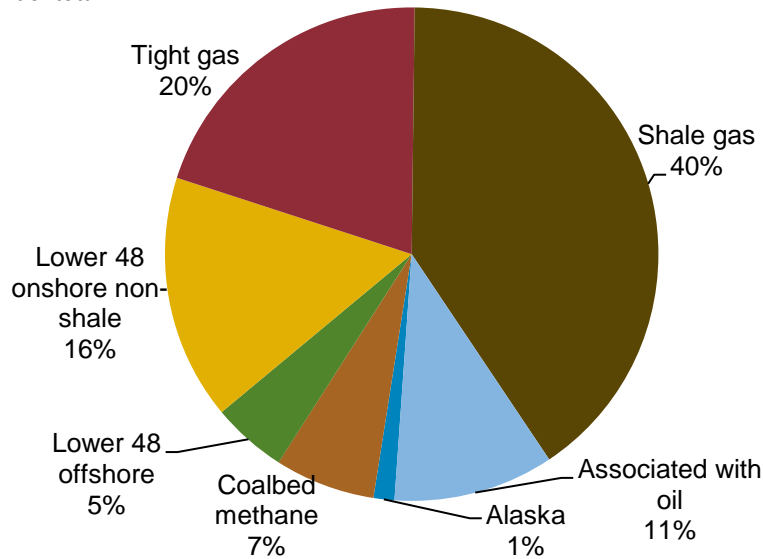
**Argentina has the largest estimated shale gas resource in the Americas. Currently, only the United States and Canada produce commercial quantities of shale gas.**

- U.S. dry shale gas production averaged 27.4 Bcf/d in 2012, which represented about 40% of total U.S. dry natural gas production, greater than any single share in the United States (Figure 12). Estimates for 2013 show that shale gas production accounted for 44% of total U.S. dry natural gas production. Canada's shale gas production averaged 0.3 Bcf/d in 2012, which was 2% of its total dry natural gas production.
- Canada's National Energy Board projects that Canadian shale gas production will reach 4 Bcf/d and represent 22% of the country's total dry natural gas production in 2035.
- A report by EIA and Advanced Resources International, released in June 2013, estimates Argentina's technically recoverable shale gas resources at 802 Tcf, the largest shale gas resource in the Americas. A number of major international energy companies are actively exploring the potential of Argentina's shale resources.

- At the end of 2012, Mexico’s PEMEX announced that it had made a major shale gas discovery in northeastern Mexico, and that it plans to drill 20 to 25 shale gas wells in 2013. Based on information from Mexico’s Ministry of Energy and PEMEX, shale gas production could reach 4.2 Bcf/d by 2035.

**Figure 12. U.S. natural gas production by source, 2012**

percent of total



Source: U.S. Energy Information Administration.

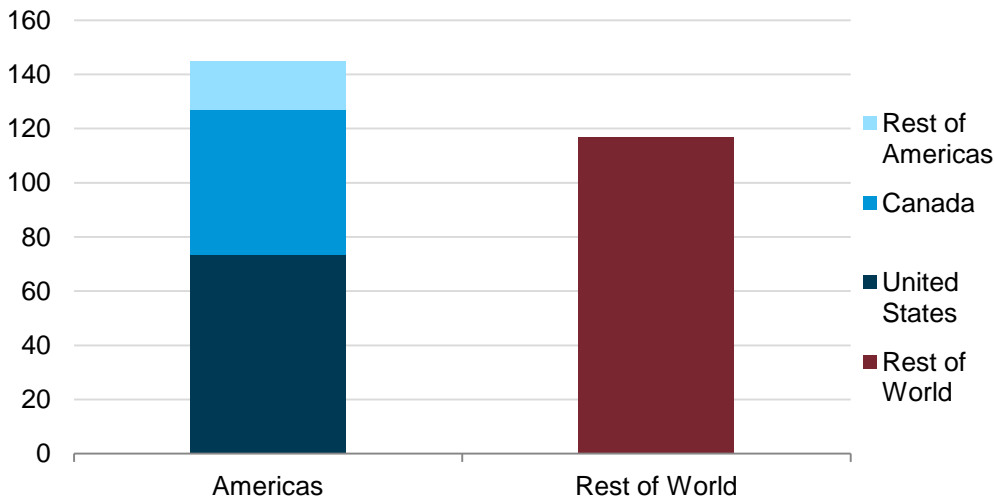
### Natural gas processing

**The United States and Canada are by far the largest processors of natural gas in the Americas, with capacity greater than those of all of the countries in the region.**

- As of January 1, 2013, the Americas had the capacity to process 148.8 billion cubic feet per day (Bcf/d) of natural gas (Figure 13), accounting for 56% of world gas processing capacity (265.7 Bcf/d).

**Figure 13. Natural gas processing capacity, Americas and rest of the world, January 1, 2013**

billion cubic feet per day



Source: U.S. Energy Information Administration; *Oil and Gas Journal*.

- The capacity for natural gas production that occurs in the rest of the Americas is small compared to the United States (capacity of 77.5 Bcf/d) and Canada (capacity of 53.3 Bcf/d). Within the United States, Alaska, Louisiana, and Texas accounted for 58% of U.S. capacity. In Canada, Alberta maintained capacity of more than double that of any other province.
- Most of the remaining capacity in the Americas is located in three countries: Argentina, Mexico, and Venezuela.
- Venezuela had the largest natural gas plant throughput in the Americas after the United States and Canada, at 3.6 Bcf/d in 2012. It was followed by Argentina at 3.1 Bcf/d and Mexico at 2.7 Bcf/d.

## Consumption

### *Dry natural gas*

**In 2012, the Americas consumed a total of 37 Tcf, about 31% of global consumption. Over the past decade, consumption increased significantly in South America, particularly in Argentina, Brazil, Colombia, and Peru, growing by more than 40%.**

- Consumption of dry natural gas is increasing throughout the Americas. With domestic demand increasing, many countries in the region hope to expand production to help decrease dependence on imports.
- The top three producers of dry natural gas in the Americas (Table 8) are also the top three consumers: the United States, Canada, and Mexico (Table 9). The United States is the world's largest consumer of dry natural gas, accounting for 21% of the world's total dry natural gas consumption in 2012.
- Over the past decade, consumption of dry natural gas increased by 51% in Central and South America. Of the major consumers, Venezuela increased consumption by 0.8% over the period and Brazil increased by over 100%. Notably, Peru saw consumption increase by more than 2,000% from 2003 to 2012.

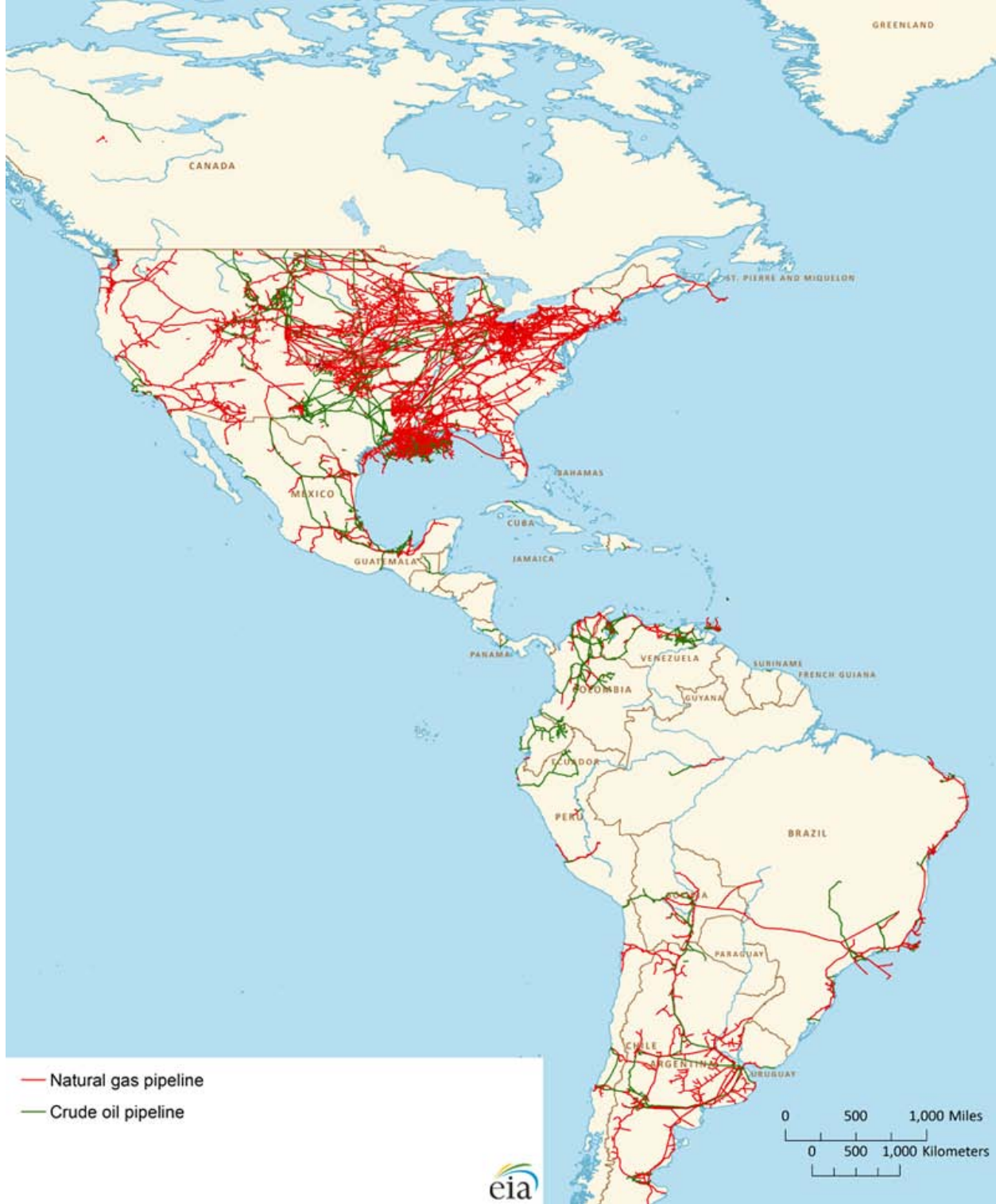
**Table 9. Dry natural gas consumption in the Americas by major country and 2012 world rank**

trillion cubic feet

Country (World Rank)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
United States (1st globally)	22.3	22.4	22	21.7	23.1	23.3	22.9	24.1	24.4	25.5
Canada (7th)	3.4	3.3	3.4	3.3	3.1	3	3.1	2.9	3.2	3.6
Mexico (11th)	1.6	1.7	1.7	2.2	2	2.1	2.1	2.3	2.4	2.4
Argentina (20th)	1.2	1.3	1.4	1.5	1.6	1.6	1.5	1.5	1.6	1.6
Brazil (30th)	0.5	0.6	0.7	0.7	0.7	0.8	0.7	0.9	0.9	1.0
Venezuela (31st)	0.9	1.0	0.8	0.9	0.7	0.8	0.7	1.0	1.0	0.9
Peru (43rd)	0.02	0.03	0.06	0.06	0.09	0.13	0.12	0.19	0.2	0.4
<b>Total Americas</b>	<b>31</b>	<b>31.5</b>	<b>31.3</b>	<b>31.7</b>	<b>32.6</b>	<b>33.1</b>	<b>32.5</b>	<b>34.4</b>	<b>35.1</b>	<b>37.1</b>
<b>Total World</b>	<b>94.1</b>	<b>97.3</b>	<b>100</b>	<b>102.7</b>	<b>105.9</b>	<b>109.2</b>	<b>105.3</b>	<b>113.3</b>	<b>118.7</b>	<b>120.5</b>

Source: U.S. Energy Information Administration.

Figure 14. Oil and natural gas pipeline infrastructure in the Americas, 2012



Notes: Representation of international boundaries and names is not authoritative. For the United States, only interstate natural gas and crude oil transmission pipelines are shown. Pipeline data for Canada not available.

Source: U.S. Energy Information Administration; IHS, EDIN.

## Natural gas trade

In 2012, over two-thirds of world natural gas trade was via pipeline between neighboring countries, with Europe accounting for over 40% of global pipeline trade and the Americas accounting for over 20%. The remaining traded natural gas was liquefied natural gas (LNG), with exports to Asia accounting for nearly 50% of global LNG trade.<sup>21</sup>

### Total natural gas imports

The vast majority of U.S. natural gas imports, almost 90% in 2012, arrived via pipeline from Canada. From 2007 to 2012, annual U.S. imports declined by nearly 1.5 Tcf, or almost 32%.<sup>22</sup>

- The United States, Canada, and Mexico accounted for about 82% of the Americas' imports in 2012.
- Excluding the United States, which increased domestic shale gas production, there has been a significant rise of imports across the region, especially by Canada, Mexico, Argentina, and Brazil.

### LNG imports

The United States is the second largest importer, after Argentina, of liquefied natural gas (LNG) in the Americas, although a large share of current U.S. LNG imports is eventually re-exported.

- The sharp decline in U.S. imports from 2011 to 2012 (Table 10) was the result of increased domestic production and pricing that made Asia a more attractive market for LNG exporters.
- Intra-regional trade accounted for more than 60% of all LNG trade volumes in the Americas in 2012.<sup>23</sup> LNG imports to countries in the Americas from outside the region came primarily from the Middle East, which was the source of 58% of the region's imports in 2012.<sup>24</sup>
- Both Argentina and Brazil have additional LNG regasification facilities under construction. Chile, Ecuador, El Salvador, Jamaica, and Uruguay are planning to construct facilities.

**Table 10. Total natural gas and LNG imports in the Americas by major country and 2012 world rank**

trillion cubic feet

Imports	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>Total Natural Gas (World Rank)</b>										
United States (2nd globally)	3.9	4.3	4.3	4.2	4.6	4.0	3.8	3.7	3.5	3.1
Canada (13th)	0.3	0.4	0.3	0.3	0.5	0.6	0.7	0.8	1.1	1.1
Mexico (17th)	0.3	0.4	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.8
Brazil (25th)	0.2	0.3	0.3	0.3	0.4	0.4	0.3	0.4	0.4	0.5
<b>Total Americas</b>	<b>5.1</b>	<b>5.6</b>	<b>5.6</b>	<b>5.5</b>	<b>6.1</b>	<b>5.6</b>	<b>5.5</b>	<b>5.9</b>	<b>6.1</b>	<b>6.1</b>
<b>Total World</b>	<b>27.1</b>	<b>29.1</b>	<b>30.9</b>	<b>32.7</b>	<b>34.2</b>	<b>35.5</b>	<b>32.6</b>	<b>35.7</b>	<b>37.5</b>	<b>40.8</b>
<b>LNG</b>										
Argentina	0.0	0.0	0.0	0.0	0.0	0.02	0.03	0.06	0.02	0.2
United States	0.5	0.7	0.6	0.6	0.8	0.4	0.5	0.4	0.4	0.2
Mexico	0.0	0.0	0.0	0.05	0.1	0.1	0.1	0.2	0.1	0.2
Chile	0.0	0.0	0.0	0.0	0.0	0.0	0.02	0.1	0.1	0.1
<b>Total Americas</b>	<b>0.5</b>	<b>0.7</b>	<b>0.7</b>	<b>0.7</b>	<b>0.9</b>	<b>0.5</b>	<b>0.7</b>	<b>1.0</b>	<b>0.8</b>	<b>0.9</b>
<b>Total World</b>	<b>5.9</b>	<b>6.4</b>	<b>6.8</b>	<b>7.6</b>	<b>8.3</b>	<b>8.0</b>	<b>8.6</b>	<b>10.5</b>	<b>11.7</b>	<b>11.6</b>

Source: U.S. Energy Information Administration; BP; International Energy Agency.



### Total natural gas exports

Argentina, Bolivia, Canada, Columbia, and Mexico export natural gas solely through pipelines to neighboring countries, while Peru and Trinidad and Tobago export only LNG. In 2012, most U.S. natural gas exports were via pipeline, with just under 2% exported as LNG.

- In 2012, the top exporters of natural gas in the Americas were Canada, the United States, and Trinidad and Tobago (Table 11). Increase in total exports of the past five years in the region were driven by growth in exports of LNG.
- Argentina, once the top exporter in South America, has seen a dramatic decline over the past decade because of lower domestic production as a result of natural decline, low levels of investment, and increased domestic consumption.

### LNG exports

About 38% of LNG exports from the Americas go to markets outside the region, primarily to Europe.<sup>25</sup> 20% of LNG exports from the Americas went to European markets in 2012.

- Trinidad and Tobago is the largest exporter of LNG in the Americas, accounting for nearly 88% of the region's exports since 2003.
- The U.S. Sabine Pass LNG export facility, currently under construction, will have two LNG trains with a combined capacity of 0.4 Tcf. The Sabine Pass import terminal facility opened in 2008. In addition, the United States has a number of LNG projects awaiting approval from the federal government.
- Bolivia, Brazil, Canada, and Peru also are planning to build LNG export facilities, but construction has yet to begin on any of their proposed facilities.

**Table 11. Total natural gas and LNG exports in the Americas by major country and 2012 world rank**

trillion cubic feet

Exports	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>Total Natural Gas (World Rank)</b>										
Canada (5th globally)	3.6	3.7	3.8	3.6	3.8	3.6	3.3	3.3	3.1	3.1
United States (9th)	0.7	0.9	0.7	0.7	0.8	1.0	1.1	1.1	1.5	1.6
Trinidad and Tobago (15th)	0.4	0.5	0.5	0.6	0.7	0.6	0.7	0.7	0.7	0.7
Bolivia (17th)	0.2	0.3	0.4	0.4	0.4	0.4	0.3	0.4	0.5	0.5
<b>Total Americas</b>	<b>5.1</b>	<b>5.6</b>	<b>5.6</b>	<b>5.5</b>	<b>5.8</b>	<b>5.7</b>	<b>5.5</b>	<b>5.7</b>	<b>6.0</b>	<b>6.0</b>
<b>Total World</b>	<b>26.4</b>	<b>28.1</b>	<b>29.9</b>	<b>31.7</b>	<b>33.1</b>	<b>34.3</b>	<b>32.0</b>	<b>36.2</b>	<b>36.6</b>	<b>39.3</b>
<b>LNG</b>										
Trinidad and Tobago	0.4	0.5	0.5	0.6	0.7	0.6	0.7	0.7	0.7	0.7
Peru	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.1	0.2
United States	0.06	0.06	0.07	0.06	0.05	0.05	0.03	0.06	0.07	0.03
<b>Total Americas</b>	<b>0.5</b>	<b>0.5</b>	<b>0.6</b>	<b>0.6</b>	<b>0.7</b>	<b>0.7</b>	<b>0.7</b>	<b>0.8</b>	<b>0.9</b>	<b>0.9</b>
<b>Total World</b>	<b>5.9</b>	<b>6.4</b>	<b>6.8</b>	<b>7.6</b>	<b>8.3</b>	<b>8.0</b>	<b>8.7</b>	<b>10.5</b>	<b>11.7</b>	<b>11.6</b>

Source: U.S. Energy Information Administration; BP; International Energy Agency.

## Investment

### Overview of foreign investment in Americas energy production

Companies based in the Americas, Europe, and East Asia are the biggest investors in oil and natural gas assets in the Americas, based on the number of those companies owning shares of licenses with hydrocarbon production. The top five destinations for foreign companies based on number of assets with foreign ownership are Colombia, Canada, Brazil, the United States, and Argentina.

- The countries with the greatest number of foreign companies owning shares of hydrocarbon assets are Colombia, Canada, Brazil, and the United States (Table 12). With the exception of Brazil, where foreign companies on average own only 42% of oil and natural gas leases, in the other countries foreign companies own the majority of the assets.
- In contrast, foreign companies on average have only a 35% share of oil and gas leases in Venezuela and Mexico, where national oil companies maintain a controlling share of the producing fields.<sup>26</sup> For Mexico, this is expected to change with its recent adoption of a more foreign investor-friendly energy reform legislation.
- Investment and operating costs have been rising in the Americas. According to EIA's analysis of Evaluate Energy data, energy-related capital expenditures in the Americas grew by 4% per year from 2003 to 2012. In the same period, costs for finding and developing oil and natural gas reserves, such as property acquisition costs and exploration and development expenditures, grew by 12% per year. The United States and Canada receive the majority of the Americas' foreign investment in terms of capital expenditure and operating costs.<sup>27</sup>
- The primary driver of foreign direct investment (FDI) growth in Latin America is oil and gas extraction. According to a United Nations report, the region's mining and hydrocarbon industries received 13% of total FDI in 2012 and have accounted for most of the growth in FDI since 2011.<sup>28</sup>
- In the past five years, Asian investment in the Americas region, particularly in LNG and oil assets, has increased dramatically. Since 2009, China's expenditures for acquisition of oil and gas assets in the Americas have been about \$59 billion.<sup>29</sup>

**Table 12. Number of foreign companies owning shares of oil and natural gas licenses in the Americas, by country and investor region, 2012**

Country	Americas	Europe	China	Other Asia & Oceania	Eurasia	Africa	Middle East	Total
Colombia	62	16	4	8		1		91
Canada	36	9	2	9		1	3	60
Brazil	14	15	3	9	1	3	1	46
United States	13	11	2	14	1	5		46
Argentina	24	9	3	3	1		1	41
Peru	21	8	1	10				40
Venezuela	13	7	3	8	5		1	37
Trinidad and Tobago	10	8	2	2	1			23
Bolivia	7	5	1		1			14
Ecuador	7	2	3	1				13
Mexico	2	1		1				4
Other Americas	52	34	1	12	3	1	1	104
<b>Total Americas</b>	<b>261</b>	<b>125</b>	<b>25</b>	<b>77</b>	<b>13</b>	<b>11</b>	<b>7</b>	<b>519</b>

Note: "Foreign Company" refers to a company headquartered in a country outside where it is investing.

Source: U.S. Energy Information Administration; Rystad Energy.

## Mexico's Energy Reform

**In December 2013, in an effort to address the declines of its domestic oil production, Mexico's federal authorities approved the constitutional amendments that would overturn the 1938 expropriation of the energy sector, ending PEMEX's 75-year monopoly and allowing for greater foreign investment.**

- Mexico's oil and gas reserves and resources are located primarily onshore near or offshore in the Gulf of Mexico. The country's proximity to the U.S. refineries in the Gulf Coast and their low costs of production relative to others in the region make it potentially attractive to U.S. companies in both upstream and downstream activities, including companies specializing in developing deep water resources in the Gulf of Mexico and shale plays such as Texas's Eagle Ford Basin which extends well into Mexico.
- The new legislation (further discussion can be found in the *Laws and regulations* section):
  - Creates four oil and gas exploration and production contract models: service contracts (similar to those already in place), production-sharing, profit-sharing, and licenses. Under the licensing model, foreign companies can "book" reserves for accounting purposes, but noting that the government still owns them.
  - Gives PEMEX first refusal on its resources in a "round zero" given that it can provide financial and technical plans that the resources can be productive within three years.
  - Gives regulatory authority over the oil and gas sectors to Energy Regulatory Commission (CRE), Secretaria de Energia de México (SENER), National Hydrocarbon Commission (CNH), and the new National Agency of Industrial Safety and Environmental Protection.
  - Keeps PEMEX as state-owned but with more administrative and budgetary autonomy and will compete for bids with other firms on new projects.
  - Establishes the Mexican Petroleum Fund to manage contract payments and oil revenue.
- In 2014, Mexico's Congress will need to detail and implement the energy reforms, including the fiscal regime and contract terms for the various models, which will be crucial in determining if foreign firms will invest. Although this is not the first time that Mexico has initiated energy reforms, this round of reforms goes deeper than ones previous.

## Brazil's pre-salt layer

**After discovery of potentially immense amounts of hydrocarbon resources in exceptionally deep water under thick layers of rock and salt, Brazil instituted a new regulatory framework governing investment in the pre-salt layer in 2010. The legislation allows only production-sharing agreements in the pre-salt layer and that Petrobras be the sole operator of each agreement and hold a minimum 30% stake in all projects.**

- Estimates vary for total pre-salt resources. Some analysts place the total extent of presalt recoverable oil and gas reserves at more than 50 billion barrels of oil equivalent. For context, in January 2014, Brazil held proved oil reserves of more than 13 billion barrels.
- Production of moderate quantities of oil and gas from pre-salt began in 2009. In October 2013, Brazil concluded its first pre-salt licensing round for the rights to Libra field, estimated to contain recoverable reserves of 8-12 billion barrels.
- Although Brazil expected a lot more participation, eleven companies registered in the auction. Five of these companies joined together to submit the only bid: Petrobras, Royal Dutch Shell, Total, and Chinese national oil companies China National Petroleum Corporation and China National Offshore Oil Corporation.

## Asia's natural gas investment in the Americas

The future prospect of North American LNG exports sourced from abundant natural gas production in Canada and the United States has encouraged several Asian companies to enter into supply contracts with prospective LNG export terminals (Figure 15).

- Currently, Asia imports very little LNG from the Americas. Trinidad and Tobago, Peru, Brazil, and the United States are the only countries in the Americas that exported LNG in 2012, and most of the volumes exported to Asia were in the form of spot cargos. The long-standing U.S. export contract to Japan from its Kenai LNG facility in Alaska expired in early 2013, with no plans for a contract renewal.<sup>30</sup>
- Japan is the largest LNG importer in the world, accounting for more than one-third of global LNG sales in 2012. South Korea is the second largest. China and India may rapidly increase LNG imports from emerging gas exporters through their investments in LNG assets.
- Many Asian companies have signed LNG agreements to purchase LNG from North American export terminals once liquefaction facilities become operational (Table 13). South Korea's KOGAS, the largest gas-importing company in the world, signed a supply purchase agreement with Cheniere for gas from the Sabine Pass liquefaction terminal on the U.S. Gulf Coast for 170 Bcf for 20 years. The contract involves a Henry Hub-linked price, marking a shift for many Asian buyers in the long-term oil-linked pricing structure for natural gas.<sup>31</sup>
- Asia's LNG imports have traditionally been indexed to international oil-linked prices, which have been higher than hub-based gas prices in North America for the past several years. Several Japanese utilities have entered into supply purchase and tolling agreements with U.S. liquefaction facilities such as Cameron LNG, Freeport LNG, and Sabine Pass. Other contracts involve Asian companies purchasing deals from the general portfolios of large LNG suppliers such as GDF Suez, Shell, and Repsol.
- KOGAS and some Japanese utilities have moved downstream, owning assets in regasification plants as well. Mexico's Manzanillo LNG receiving terminal is owned and operated by the consortium of Samsung (37.5%), Mitsui (37.5%), and KOGAS (25%). KOGAS also signed a deal with Mexico's PEMEX to supply its Lázaro Cardenas receiving terminal.<sup>32</sup>

**Table 13. Selected Asian investment in liquefaction terminals in the Americas**

Liquefaction Terminal	Asian Stakeholders	Status	Comments
Atlantic LNG (Trinidad)	China Investment Corporation (CIC) (China)	Existing	CIC acquired GDF Suez's (France) 10% stake in Train 1 in 2012.
Peru LNG	SK Energy (South Korea) 20% Marubeni (Japan) 10%	Existing	Operated by Hunt Oil; 200 Bcf/year capacity; Sales contract to Mexico's Manzanillo regasification terminal
Sabine Pass LNG (United States)	None	Under construction	Train 3: KOGAS (South Korea) 168 Bcf/year; Train 4: GAIL (India) 168 Bcf/year
Cameron LNG (United States)	Mitsubishi (Japan) 16.6% Mitsui (Japan) 16.6%	Planned; FERC review in process; Expected online 2017	648 Bcf/y, 3-train facility. Operated by Sempra Energy; Tolling agreements with Mitsubishi, Mitsui, and GDF Suez
LNG Canada	KOGAS (South Korea) 20% CNPC (China) 20% Mitsubishi (Japan) 20%	Planned; Environmental review in process; Expected online 2020	Operated by Shell; 1,156 Bcf/y, 4-train facility in Western Canada. Sales purchase agreements pending
Pacific Northwest LNG (Canada)	Petronas (Malaysia) 90% JAPEX (Japan) 10%	Planned; Environmental review in process; Expected online 2018	576 Bcf/y, 2-train facility, Petronas in discussion with other companies to sell off part of its project share

Source: FACTS Global Energy; PFC Energy; Reuters; Rigzone.

## China's investment in the Americas

### *Loans for resources agreements*

China has entered into several loans-for-oil-and-gas agreements, over \$110 billion globally, with countries that have large budget deficits or lack sufficient capital for energy infrastructure and development of their hydrocarbon reserves. In exchange, these countries commit to repay the loans from China with long-term crude oil or natural gas shipments at set prices and allow market access through exploration and production contracts. In the Americas, China entered into loan-for-oil agreements with Venezuela, Ecuador, Brazil, and Bolivia.

- Venezuela has secured nearly \$40 billion in loan-for-oil agreements with China (Table 14), including two \$4 billion deals negotiated in 2013. PdVSA and CNPC plan to increase production at the Orinoco Heavy Oil Basin through a joint venture (Petrolera Sinovensa). Per the agreement, Venezuela is scheduled to send 600,000 bbl/d of crude oil to China until 2020. Based on China's trade data, Venezuela has fallen short of that amount, but the country's crude oil exports to China have ramped up markedly over the past four years, including more than 300,000 bbl/d in 2012.<sup>33</sup>
- China has become the leading source of loans for Ecuador since 2008 and signed a \$2 billion loan deal in 2011 in exchange for 130 million barrels of crude oil and 18 million barrels of fuel oil over six years. Another \$2 billion loan agreement followed at the end of 2012.<sup>34</sup>

**Table 14. China's loan-for-oil-and-gas deals in the Americas**

Country	Loan Amount	Comments
Bolivia	\$2 Billion	Signed in 2009; Natural gas networks and infrastructure development.
Brazil	\$10 Billion	Signed in 2009; Petrobras to supply Unipec (China) with 150,000-200,000 bbl/d until 2018.
Ecuador	\$7 Billion	Since 2009, four separate agreements explicitly backed by oil sales. Latest deal is December 2012, includes crude oil sales to 2018 and fuel oil to 2020.
Venezuela	~\$40 Billion	Several deals made since 2009.

Sources: FACTS Global Energy; PFC Energy; Reuters; Rigzone.

### *Upstream investment*

In addition to loan-for-oil-and-gas agreements, China has been engaged in direct acquisitions of assets. China's major NOCs, China National Petroleum Corporation (CNPC), China Petrochemical Corporation (Sinopec), and China National Offshore Oil Corporation (CNOOC), as well as Sinochem and a few independent Chinese companies, continue to acquire oil and gas assets in the Americas, with an estimated \$59 billion invested, or about two-thirds of their total direct acquisition investments since 2009.

- In 2011, China's overseas equity crude production reached about 1.4 million bbl/d, including 175,000 bbl/d from the Americas. In the region, China holds upstream oil and gas investments in Argentina, Brazil, Bolivia, Canada, Colombia, Cuba, Ecuador, Peru, the United States, and Venezuela.<sup>35</sup>
- The majority of the recent deals in the Americas focus on Brazil's deep water offshore, Canadian oil sands, and North American shale oil and gas (Table 15 and Figure 15). These ventures are part of Chinese companies' aims to acquire know-how for their own domestic shale and deep water reserves and to become more competitive globally.

- **Argentina:** Sinopec acquired all of Occidental Petroleum’s mature onshore fields in Argentina in 2010. CNOOC purchased half of Bidas Energy Holdings, which owns a 40% stake in Pan American Energy, the second largest oil and gas producer in Argentina.
- **Brazil:** Sinopec and Sinochem are the most active Chinese companies in Brazil thus far. Sinopec’s two key investments in Brazil amount to \$12.3 billion: purchases of 40% of Repsol’s subsidiary in Brazil, giving it equity in the prolific pre-salt Santos Basin; and 30% equity in Galp Energia’s Brazilian division.
- **Canada:** China’s investments in Canada have centered on exploration and development of oil sands. CNOOC’s \$17.9 billion purchase of Canada’s Nexen in 2012 marked the largest purchase of Americas energy assets by any Chinese firm to date. A majority of Nexen’s resources are in Canada, largely in the Alberta oil sands. It also has assets in the U.S. Gulf of Mexico and Colombia.<sup>36</sup> CNPC was the first Chinese NOC to obtain an entire Canadian oil sands project through its acquisition of Athabasca’s MacKay River and Dover oil sands projects, which are expected to be online in 2014.
- **United States:** CNOOC added U.S. oil and gas upstream assets to its portfolio in 2010 by buying onshore shale oil and gas production shares from Chesapeake Energy. Sinopec has followed suit with purchases of onshore shale gas acreage in 2012. Through its purchase of Nexen, CNOOC acquired a 20% stake in three blocks in the U.S. Gulf of Mexico.
- **Venezuela:** Venezuela’s vast oil reserves in the Orinoco Belt have attracted billions in loans from China. CNPC and Sinopec have been China’s key players in exploration and production joint ventures with PdVSA.

**Table 15. Key upstream acquisition investments by Chinese companies in the Americas, 2010-2013**

Country	Company	Asset	Investment (billion)
Argentina	Sinopec	100% Occidental	\$2.5
Argentina	CNOOC	Bidas Energy Holdings (50% stake)	\$3.1
Brazil	Sinopec	40% Repsol-YPF of Brazil	\$7.1
Brazil	Sinopec	30% Galp Energia (Portugal)/deep water	\$5.2
Brazil	Sinochem	40% Peregrino field from Statoil (Norway)	\$3.1
Canada/Colombia/U.S.	CNOOC	100% Nexen/Canadian oil sands and global assets	\$19.4
Canada	CNOOC	100% OPTI	\$2.1
Canada	Sinopec	Daylight Energy	\$2.8
Canada	CNPC	100% Athabasca/ MacKay River, Dover oil sands	\$2.5
Canada	CNPC	20% Shell’s Groundbirch shale gas assets	\$1.4
Canada	CNPC	49.9% stake in JV with Encana shale gas	\$2.2
United States	Sinopec	Chesapeake	\$1
United States	Sinopec	Devon/shale gas	\$2.2
United States	CNOOC	Chesapeake/shale oil and gas in Eagle Ford and Niobrara	\$2.4
Venezuela	CNPC	Junin-4 Project (Orinoco Heavy Oil Belt)	Part of \$40 billion investment
Venezuela	Sinopec	Junin-1 and 8 Projects (Orinoco Heavy Oil Belt)	Part of \$40 billion investment

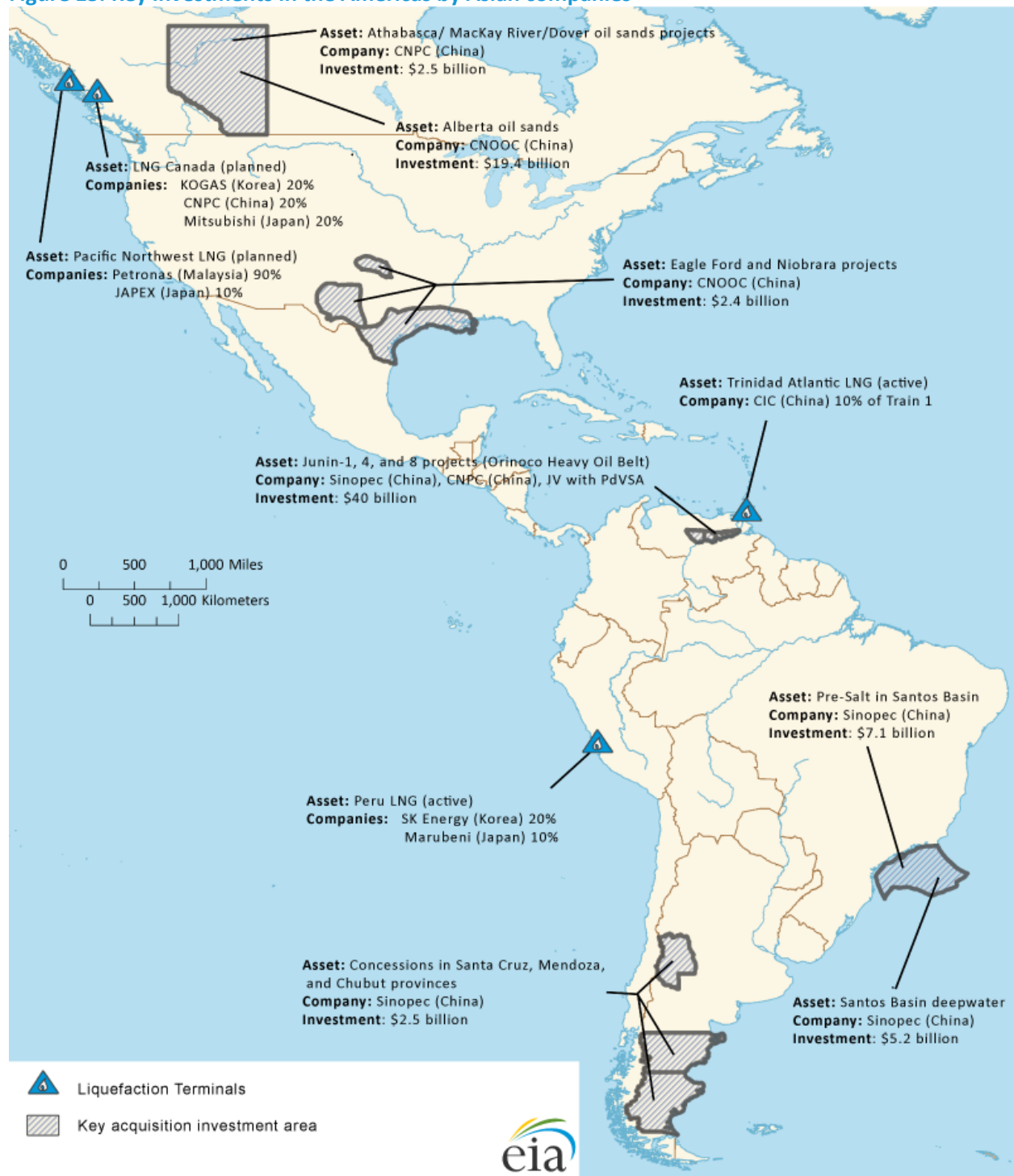
Sources: FACTS Global Energy; PFC Energy; Reuters; and Rigzone.

### *Downstream investment*

**Chinese companies recently began expanding investments in the downstream oil sector of the Americas to create more global opportunities for energy trading, storage, and greater vertical integration of upstream and downstream assets.**

- CNPC signed a deal in mid-2013 to purchase a 30% stake in Ecuador's 300,000 bbl/d Pacifico refinery expected to be online by 2017.
- CNPC and PdVSA are part of a joint venture (CNPC 60%, PdVSA 40%) to construct a 400,000 bbl/d refinery in Guangdong, China. Construction of the \$9 billion refinery began in 2012 and is expected to come online by 2017. Sinopec is involved in the construction of the 200,000 bbl/d Cabruta refinery in Venezuela. Both refineries are designed to process the heavy, sour Venezuelan crude oil, which gives China the opportunity to import more crude oil from Venezuela.
- In 2010, CNPC signed a deal to lead the \$6 billion refinery expansion project in Cuba. PdVSA, partial owner of the project, is backing the project through oil revenues.
- Sinopec recently signed a letter of intent with Petrobras of Brazil to develop the 300,000 bbl/d Premium I refinery in that country.
- China's largest bank, the Industrial and Commercial Bank of China, is in discussions regarding a potential investment in the planned Kitimat refinery project in Western Canada.

Figure 15. Key investments in the Americas by Asian companies





## Laws and regulations governing investment of the major liquid fuels producers

The major countries in the Americas producing liquid fuels govern foreign investment in their oil sectors with varying degrees of complexity and openness. Opportunities for investment exist in their oil sectors (Table 16).

### *United States*

**Any person or group can incorporate a domestic company and all entities incorporated in the United States are treated the same. A review by the Committee on Foreign Investment in the United States (CFIUS) is required in the case of a transaction that could result in control of any critical infrastructure that could impair the national security.**

- Executive Order 11858 (b), May 7, 1975, 40 F.R. 20263: Established the Committee on Foreign Investment in the United States (CFIUS), which is an interagency committee that serves the President in overseeing the national security implications of foreign investment to buy U.S. assets.<sup>37</sup>
- 30 U.S.C. §22: All valuable mineral deposits in lands belonging to the United States that are open to exploration and purchase may be purchased by United States citizens and by those who have declared their intention to become United States citizens.<sup>38</sup>
- 30 U.S.C. §181: Deposits of coal, phosphate, sodium, potassium, oil, oil shale, gilsonite, or gas and lands containing these deposits owned by the United States, including within national forests and in incorporated cities, towns, villages, and national parks and monuments, shall be subject to disposition in the approved manner to United States citizens, associations of United States citizens, or any corporation organized under United States, state, or territorial laws. Citizens of another country whose laws, customs, or regulations deny similar privileges to citizens or corporations of the United States shall not by stock ownership, stock holding, or stock control own any interest in any lease concerning these mineral lands.<sup>39</sup>
- 43 U.S.C. §§1331 *et seq.*: The leasing of oil, natural gas, and other mineral deposits is allowed in the submerged lands of the Continental Shelf.
- 30 C.F.R. §256.35: Regulations require that only United States citizens, resident aliens, domestic corporations, or associations of one or more of these groups may obtain these leases.

### *Canada*

**With the exception of reviews of investments from state-owned enterprises totaling \$330 million or greater, Canada's oil sector is open to foreign investment.**

- National Energy Board (NEB) Act, 1959: established the NEB to regulate the oil industry.
- Canada Petroleum Resources Act, 1985: gives federal government authority to lease land in "frontier lands" and attach restrictions for environmental reasons.<sup>40</sup>
- Foreign companies operating in Canada are subject to taxes on profits from oil production:
  - General corporate tax rate: 38%, 28% for companies that pay provincial income tax.
  - Provincial corporate income tax: Alberta 10%, British Columbia 11%, Saskatchewan 12%, Newfoundland 18%, Northwest Territories 11.5%.
  - Royalty rates and exploration periods vary among the different provinces.
- Investment Canada Act, 1985: Investment Canada oversees foreign investment in the oil sector and reviews investments exceeding \$330 million from state-owned enterprises.<sup>41</sup>

## Mexico<sup>42</sup>

**Prior to the enactment of constitutional changes by Mexico's federal authorities in December 2013, Mexican law prohibited foreign ownership of its resources and allowed private sector involvement only through service contracts. Mexico's energy reform legislation would allow the government to maintain sovereignty over hydrocarbon resources, but grant greater private investment through production-sharing, profit-sharing, and licensing mechanisms.**

- *Expropriation and creation of PEMEX, 1938: removed and banned foreign oil companies from operating in Mexico, created PEMEX and bestowed upon it exclusive rights to exploration, production, refining, and commercialization of oil.*
- *Foreign Investment Law, 1993:*
  - *Retail sales of gasoline and liquid petroleum gas reserved for Mexican nationals.*
  - *Petroleum and other hydrocarbons and basic petrochemicals reserved for the state.*
- *Public Works Law, 2000: permits private-sector deals in equipment and services for exploration and production, such as noncommercial scientific and technology agreements.*
- *Ordinary Duty on Hydrocarbons, 2006: applied to gross revenue from crude oil production less deductions for exploration expense, capital investments, and operating costs:*
  - *Extraction Tax: 71.5% applied to crude oil less certain permitted deductions; deduction cost must not exceed \$6.50 per barrel of crude oil equivalent (boe).*
  - *Duty: ranges between 1% and 10%, applied to the value of extracted crude oil when the average export price of crude oil exceeds \$22 per barrel, 10% when price is above \$31.*
- *Energy Reform Package, 2008: established the National Hydrocarbons Commission (CNH) to regulate the exploration and extraction of hydrocarbons; transportation and storage of newly produced hydrocarbons also created:*
  - *New special fiscal regime: applies to exploration and production of oil in Chicontepec and deep waters in the Gulf of Mexico: 15% extraction tax; special duty of 30% on value of crude from production below 240 million boe, 36% above 240.*
  - *Regulations of the PEMEX Law, published 2009: allows PEMEX to contract private companies for both upstream and downstream activities, to include drilling, servicing, and upgrading refineries.<sup>43</sup>*
- *Article 27 of the Constitution, 2009: bars the award of upstream concessions, licenses, or leases to private companies.<sup>44</sup>*
- *Amendments to Constitutional Articles 25, 27, and 28 and supporting Transitory Articles, 2013:*
  - *Article 25 allows for laws that will establish guidelines related to the administration, organization, functioning, procedures of contracting and other legal acts concerning the planning and control of the exploration and extraction of petroleum and other hydrocarbons.*
  - *Article 27 affirms that the hydrocarbons in the subsoil belong to the State. However, with the purpose of obtaining income that contributes to the long-term development of the State, exploration and production of hydrocarbons are allowed through agreements with PEMEX or through contracts with private entities.*
  - *Article 28 establishes the Mexican Fund of Petroleum Stabilization and Development and empowers the executive branch with regulatory bodies to oversee the energy sector.*
  - *Transitory Article 4 stipulates that Congress will create a legal framework for the contract models: service, profit-sharing, production-sharing, and license. Transitory Articles 7 and 9 will further establish local content requirements and transparency clauses to be added to the contract framework.*

- Transitory Article 5 allows private entities to report subsoil hydrocarbons for accounting and financial purposes but also noting that they are owned by the State.
- Transitory Article 6 gives PEMEX the ability to retain its assets provided it can show financial and technical plans that the resources can be productive within three years.
- Transitory Article 10, 12, and 13 enable Congress to create legislation to prescribe and empower regulatory bodies.
- Transitory Article 14 details the functions of the Mexican Fund of Petroleum Stabilization and Development.

## **Brazil**

**Brazil allows open private investment in its oil sector with the exception of resources found in the pre-salt layer. The law requires Petrobras to be the operator and hold a minimum 30% stake in all pre-salt exploration and production.**

- Constitution, amended 1995: opened the oil industry to private participation.
- Petroleum Law No. 9,478, 1997: created a regulatory body, National Petroleum Agency (ANP), for the oil sector; removed barriers restricting private sector participation in the oil sector:
  - Following the 1997 Petroleum Law, *concession contracts (CC)* were given by ANP annually in competitive bidding rounds.
  - Private participation was allowed; bids could be made alone, in partnership with Petrobras, or as a member of a consortium.
- Pre-Salt Legislation, 2010: spotlights areas located in the pre-salt layer and other areas of strategic interest to the government; legislation reform package includes the creation of:
  - A parallel licensing regime to award *production-sharing contracts (PSCs)* for 35 years; Petrobras, the operator, would have a minimum stake of 30%.
  - Pre-sal Petroleo S.A. to supervise the regions not yet under concession and energy trading in the area, as well as administer PSCs.
  - Federal Social Fund to hold funds from sales.
  - Royalty on pre-salt blocks not yet awarded under PSCs is set to increase to 15%.
- Oil export transactions are exempt from state and federal VAT and social contribution taxes.<sup>45</sup>

## **Venezuela**

**Venezuela oil exploration and production is restricted to its NOC PdVSA and allows for private participation up to 49% in new upstream oil projects.**

- Constitution, 1999: reserves oil exploration and production for the state through Petroleos de Venezuela S.A. (PdVSA); prohibits the sale of PdVSA; allows private sector involvement if in national interest.
- Organic Hydrocarbons Law, 2001: renationalized Venezuela's oil and replaced old operating agreements with mixed company agreements, where PdVSA is the majority stakeholder, and:
  - Restricted private-sector participation to 49% in new upstream oil projects.
  - Demands 30% royalty on production and 50% income tax.
  - Allows up to 100% private-sector participation in downstream ventures.
  - For companies operating in the Orinoco Belt, tax adjustments were made in May 2006: 33% extraction tax replaced the 16.67% royalty and 0.1% export tax.
- Carabobo Licensing, 2009: permits mixed companies to deduct capital costs from the development of primary hydrocarbons over 10 years and deduct carryover net operating losses.
- Organic Law for the Development of Petrochemical Activities, 2009: allows joint ventures with state-owned Pequiven but limits private sector to 50% stake in form of mixed companies.

- Organic Law Preserving for the State Goods and Services Connected to Primary Hydrocarbons Activities, 2009: government able to nationalize specific activities (e.g., gas and water re-injection, marine transport, etc.) considered essential to PdVSA; 60 service companies and 11 rigs were taken over in 2009-2010.
- Oil Windfall Tax Law, 2013: applies oil-profit taxes based on price per barrel; tax rates are:
  - 20% for sales of crude oil at prices that exceed \$55 per barrel.
  - 95% of the increased profits when prices exceed \$110 per barrel.
  - Exemptions for: new projects in the Orinoco belt; additional volume, beyond amount in development plan, produced from existing fields; exports under the Petrocaribe and international financial accords; and oil intended for domestic consumption.<sup>46</sup>

## *Colombia*

### **Colombia opened its oil sector to foreign participation in 2003 and is further incentivizing foreign investment into the oil sector.**

- To further attract foreign investment, the Colombian government has:
  - Reduced Ecopetrol’s share on fields of less than 60 million barrels from 50% to 30%.
  - Adopted accelerated environmental licensing; sliding royalty varying on size of field.
- Decree Law 1760, 2003: created the National Hydrocarbons Agency (ANH), responsible for managing oil royalties, contracts, and reserves; allows private companies to hold 100% stake in new projects; Ecopetrol must compete like any other company.
- Law 963, 2005: promoting “legal stability;” the law requires investment for a period of 3 and 20 years, minimum of \$1.2 million investment, and a fee based on the investment.
- The government partially (10%) privatized Ecopetrol to fund upstream activities.<sup>47</sup>

## *Argentina*

### **Liberalized in the 1990s, Argentina began enacting protective measures in response to its financial crisis in the early 2000s. In addition to the protective measures, the state introduced incentives to attract investments from private firms.**

- Amendments to the 1976 Foreign Investment Law, 1989 and 1993: allows foreigners to have up to 100% ownership in property and businesses.
- The Hydrocarbons Law, 1967: established to regulate the industry.
- Privatization Law, 1992: allowed for the privatization of YPF, Argentina’s national oil and gas company.
- Creation of the national oil company, Enarsa, in 2004 enabled the government to benefit from hydrocarbons exploration (i.e., fiscal incentives were offered if private companies were willing to partner with Enarsa).
- A 2006 amendment to the Hydrocarbons Law of 1967 granted provincial governments subsoil rights over oil and gas reserves in their territories as well as the right to award contracts for upstream activities. Provinces also have control of reserves in up to 12 miles off their coast.
- Petroleum Plus, 2008: offered tax credits/breaks to oil companies.
- Law to Protect Glaciers, 2010: limits exploration and production activities that could adversely impact Argentine glaciers.
- In March 2011, the Argentine government approved a bill that will place sanctions on companies operating in Argentina and the disputed Falkland Islands.
- Repatriation of Earnings from Exports of Hydrocarbons, 2011: requires 100% repatriation of any export-generated foreign currency.<sup>48</sup>

## Ecuador

### Recent law prohibits companies from booking reserves. Investing companies must now engage in service contracts or modified production-sharing contracts.

- Law Reforming the Petroleum Sector, 1993: amending the Hydrocarbons Law of 1978, this new law allows private participation in oil exploration and infrastructure activities.
- The Hydrocarbons Law, Reformed 2006: increased state's share of windfall oil profits to 50%.
- The Fundamental Law for Economic Transformation of Ecuador, 2000: allows companies that build and operate pipelines to maintain ownership of them.
- Windfall Oil Tax Decree, 2007: under a service-contract model, the state takes 70% share of excess oil revenue.
- 20<sup>th</sup> Constitution, 2008: contains a number of articles pertaining to the oil sector; they are:
  - Article 57: indigenous communities have the right to participate in the use of natural resources on their lands.
  - Article 261: state has exclusive rights over energy resources.
  - Article 313: state is in charge of administering, regulating, and controlling strategic sectors (i.e., E&P, transports, refining).
  - Article 339: having defined energy as a strategic sector, foreign investment is subject to local laws and oriented to the needs and priorities of the government's National Development Plan.
  - Article 408: state has absolute ownership of non-renewable natural resources.
  - The Hydrocarbons Law, Reformed 2010: modified the production-sharing model in place; companies can no longer book reserves and are now paid a fixed fee per barrel produced.<sup>49</sup>

**Table 16. Laws and regulations in the oil sector of selected major producers in the Americas**

Country	Primary Regulatory Body	National Oil Company	Government Stake (%)	Restrictions on Upstream Investment	Restrictions on Downstream Investment
United States	Department of Interior; states	None	n/a	Possibly subject to CFIUS	Possibly subject to CFIUS
Canada	National Energy Board	None	n/a	Review investments greater than \$330M of state-owned companies	Review investments greater than \$330M of state-owned companies
Mexico	National Hydrocarbon Commission	PEMEX	100	None, but pending further legislation	None, but pending further legislation
Brazil	National Petroleum Agency	Petrobras	63.6	Limited to less than 70% stake in pre-salt layer	None
Venezuela	Ministry of Petroleum and Mining	PdVSA	100	Reserved for PdVSA	Reserved for PdVSA
Colombia	National Hydrocarbons Agency	Ecopetrol	90	None	None
Argentina	Secretariat of Energy	Enarsa and Repsol YPF	65 in Enarsa, 51 in YPF	Export taxes, dividend repatriation first 5 years; E&P activities in disputed waters	Export taxes, dividend repatriation first 5 years; Activities in disputed waters
Ecuador	Hydrocarbons Regulation and Control Agency	CEPE	100	Limited to service contracts, tariff per barrel produced	Limited to service contracts, tariff per barrel produced

Sources: U.S. Energy Information Administration; IHS Energy; Reuters.

## Laws and regulations governing investment of the major natural gas producers

The major producing countries of natural gas in the Americas govern foreign investment into their gas sector with varying degrees of complexity and openness. Opportunities for investment exist in these countries' natural gas sector (Table 17).

### *United States*

See United States under Laws and regulations governing investment of the major liquid fuels producers.

### *Canada*

See Canada under Laws and regulations governing investment of the major liquid fuels producers.

### *Venezuela*

Venezuela allows foreign participation in its gas sector but reserves the right to acquire 35% equity, in addition to the royalties and taxes, once the project is commercially viable.

- Gaseous Hydrocarbon Law, 1999: allows 100% private participation in upstream nonassociated gas production; PdVSA can acquire 35% equity once it is commercially viable.
- Government requires: 20% royalty, 34% income tax.<sup>50</sup>

### *Mexico*<sup>51</sup>

Prior to the enactment of constitutional changes by Mexico's federal authorities in December 2013, Mexican law prohibited foreign ownership of its resources and allowed private sector involvement only through service contracts. Mexico's energy reform legislation would allow the government to maintain sovereignty over hydrocarbon resources, but grant greater private investment through production-sharing, profit-sharing, and licensing mechanisms.

- *Regulatory Law of Article 27 in the Constitution, amended 1995: permits private sector in the storage, distribution, and transportation of gas; only PEMEX allowed to explore and produce.*<sup>52</sup>
- *Financed Public Works Contracts: attract foreign investment in non-associated gas fields:*
  - Private companies bear the cost of a project and are paid for services rendered.
  - Services include field engineering, drilling, construction, and geological modeling.
- *Permit Regime: employed by regulators to ensure industrial uniformity in domestic projects:*
  - Required for activities including constructing pipelines, transportation, and storage.
  - Transportation permits are obtained through bidding; both transportation and storage permits are issued with no exclusivity. Capacity limits and defined routes are provided.
- *Ordinary Duty on Hydrocarbons, 2006: applied to gross revenue from gas production less deductions for exploration expense, capital investments, and operating costs:*
  - *Extraction Tax: 71.5% applied to gas less certain permitted deductions; deduction cost must not exceed \$2.70 per thousand cubic feet of non-associated gas.*
  - *Duty: ranges between 1 and 10%, applied to the value of extracted gas when the average export price of crude oil exceeds \$22 per barrel; 10% above \$31.*
- *Energy Reform Package, 2008: established the CNH to regulate exploration and extraction of hydrocarbon and transportation and storage of newly produced hydrocarbons. Also created:*
  - *New special fiscal regime: applies to exploration and production of gas in Chicontepec and deep waters in the Gulf of Mexico: 15% extraction tax; special duty of 30% on value of gas from production below 240 million boe, 36% above 240 boe.*<sup>53</sup>
- Amendments to Constitutional Articles 25, 27, and 28 and supporting Transitory Articles, 2013:

- Article 25 allows for laws that will establish guidelines related to the administration, organization, functioning, procedures of contracting and other legal acts concerning the planning and control of the exploration and extraction of petroleum and other hydrocarbons.
- Article 27 affirms that the hydrocarbons in the subsoil belong to the State. However, with the purpose of obtaining income that contributes to the long-term development of the State, exploration and production of hydrocarbons are allowed through agreements with PEMEX or through contracts with private entities.
- Article 28 establishes the Mexican Fund of Petroleum Stabilization and Development and empowers the executive branch with regulatory bodies to oversee the energy sector.
- Transitory Article 4 stipulates that Congress will create a legal framework for the contract models: service, profit-sharing, production-sharing, and license. Transitory Articles 7 and 9 will further establish local content requirements and transparency clauses to be added to the contract framework.
- Transitory Article 5 allows private entities to report subsoil hydrocarbons for accounting and financial purposes but also noting that they are owned by the State.
- Transitory Article 6 gives PEMEX the right to first refusal on its assets provided it can show financial and technical plans to be productive within three years.
- Transitory Article 10, 12, and 13 enable Congress to create legislation to prescribe and empower regulatory bodies.
- Transitory Article 14 details the functions of the Mexican Fund of Petroleum Stabilization and Development.

### *Argentina*

**Liberalized in the 1990s, Argentina began enacting protective measures in response to its financial crisis in the early 2000s. In addition to the protective measures, the state introduced incentives to investment from attract private firms.**

- Foreign Investment Law, 1993: allows foreign firms to own and invest in nearly all businesses.
- Privatization Law, 1992: allows leading energy company YPF to be sold.
- Public Emergency Law 25,561, 2002: puts 20% tax on liquefied petroleum gas exports.
- Gas and Petroleum Plus Program, 2008: firms can use international prices for domestic market.
- Decree 1722, 2011: requires the repatriation of all export-generated foreign currency.
- Decree 929, 2013: after investment for five years, allowed to export 20% of production without paying export taxes and exempt from dividend repatriation.<sup>54</sup>

### *Trinidad and Tobago*

**The state maintains a wholly owned gas company but competes with other international firms in a largely open and competitive environment.**

- Petroleum Act, 1969: the Ministry of Energy and Energy Affairs to manage contracts and licenses.
- Petroleum Profits Tax, 1974: tax of about 50% of profits from activities such as gas processing, separation of liquids from gas; royalties are determined by project.
- Other taxes include: Green Fund Levy, a petroleum impost, and an unemployment levy.
- Foreign Investment Act, 1990: removed exchange controls and profit repatriation regulations; allowed investment treaties with the United Kingdom, United States, Canada, Spain, and France.<sup>55</sup>

## Colombia

### Colombia aims to become natural gas exporter and is incentivizing foreign investment into the gas sector to accomplish its mission.

- Law 963, 2005: promoting “legal stability”, the law requires investment for a period of 3 and 20 years, minimum of \$1.2 million investment, and a fee based on the investment.
- The government privatized Ecogas, Ecopetrol’s gas subsidiary.
- Ministry of Mines and Energy Decree 2100, 2011: aims to make Colombia self-sufficient in terms of natural gas by expanding upstream activities, promoting exports, and securing domestic supply without breaking current contracts.
- Decree No. 4923, 2011: to attract investment, the government decreed a 40% discount on royalties from nonconventional gas.
- According to the 2012 E&P contract model, upstream activities are subject to:
  - 80% royalty, applied to conventional hydrocarbons for onshore and shallow water offshore gas fields.
  - 60% royalty, applied to conventional hydrocarbons for deep water (i.e., over 1,000 feet) offshore fields.
  - Economic rights (i.e., duties) on high prices, payable for gas exports from the fifth year of production when the U.S. Gulf Coast Henry Hub index is higher than the reference price set in the contract.
  - Effective income tax: 38.5%; \$0.88–\$5.24 per hectare surface fee.<sup>56</sup>

## Brazil

See Brazil under Laws and regulations governing investment of the major liquid fuels producers.

**Table 17. Laws and regulations in the natural gas sectors of selected major producers in the Americas**

Country	Primary Regulatory Body	National Gas Company	Government Stake (%)	Restrictions Upstream Investment	Restrictions Downstream Investment
United States	Department of Interior; states	None	n/a	Possibly subject to CFIUS	Possibly subject to CFIUS
Canada	National Energy Board	None	n/a	Review investments greater than \$330M of state-owned companies	Review investments greater than \$330M of state-owned companies
Venezuela	Ministry of Petroleum and Mining	PdVSA	100	100% participation allowed; own up to 65% of equity once commercially viable	None
Mexico	National Hydrocarbon Commission	PEMEX	100	None but pending further legislation	None but pending further legislation
Argentina	Secretariat of Energy	Enarsa, Repsol-YPF	65 in Enarsa, 51 in YPF	Export taxes, dividend repatriation first 5 years	Export taxes, dividend repatriation first 5 years
Trinidad and Tobago	Ministry of Energy and Energy Affairs	National Gas Co. of Trinidad and Tobago	100	None	None
Colombia	Energy and Gas Regulatory Commission	Ecopetrol	90	None	None
Brazil	National Petroleum Agency	Petrobras	63.6	Limited to less than 70% stake in pre-salt layer	None

Sources: U.S. Energy Information Administration; IHS Energy; Reuters.



## Appendixes

### Appendix A. Supplement to charts and graphics

**Table A1. Americas proved oil reserves and recoverable oil resources**

billion barrels

Country	Proved Oil Reserves 2013 <sup>a</sup>	Estimated Reservoired Accumulations of Undiscovered Technically Recoverable Oil Resources, 2012 <sup>b</sup>	Estimated Technically Recoverable Shale Oil Resources, 2013
Venezuela	298	5	13
Canada	173	9	9
United States <sup>c</sup>	27	27	58
Brazil	13	84	5
Mexico	10	19	13
Ecuador	8	5	NA
Argentina	3	9	27
Colombia	2	8	7
<b>Total Americas</b>	<b>536</b>	<b>236</b>	<b>140</b>
<b>Total World<sup>d</sup></b>	<b>1,645</b>	<b>592</b>	<b>345</b>

<sup>a</sup>Proved reserves represent the volumes of oil and natural gas that could be produced with reasonable certainty with the existing equipment and existing operating conditions.

<sup>b</sup>Technically recoverable resources represent the volumes of oil and natural gas that could be produced with current technology, regardless of oil and natural gas prices and production costs. Estimates are mean totals and do not include natural gas liquids. Some country estimates include resources found in basins shared with another country, which may mean some basins are counted twice.

<sup>c</sup>Estimates for the United States are as of December 31, 2011.

<sup>d</sup>Certain countries with potentially productive shales were not included in the EIA/ARI report.

NA = data not available.

Sources: U.S. Energy Information Administration; *Oil and Gas Journal*; U.S. Geological Survey; and *EIA/ARI World Shale Gas and Shale Oil Resource Assessment*.

**Table A2. Tight oil production by play in the United States**

thousand barrels per day

Selected Plays	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bakken (ND, MT)	9	23	47	59	71	120	176	270	380	638
Eagle Ford (TX)	0	0	0	0	0	2	2	29	186	551
Permian (TX, NM)	71	72	78	81	93	167	186	236	321	493
Niobrara-Codell (CO)	22	26	29	33	36	45	48	53	67	80
Other plays	187	182	181	184	194	206	212	240	311	221
<b>Total</b>	<b>289</b>	<b>303</b>	<b>335</b>	<b>357</b>	<b>394</b>	<b>540</b>	<b>624</b>	<b>828</b>	<b>1,265</b>	<b>1,983</b>

Source: U.S. Energy Information Administration; Drilling Information.

**Table A3. U.S. crude oil imports from other major countries in the Americas and 2012 world rank**

thousand barrels per day

Country (World Rank)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Canada (1st globally)	1,549	1,616	1,633	1,802	1,888	1,956	1,943	1,970	2,225	2,425
Mexico (3rd)	1,569	1,598	1,556	1,577	1,409	1,187	1,092	1,152	1,102	975
Venezuela (4th)	1,183	1,297	1,241	1,142	1,148	1,039	951	912	868	912
Colombia (7th)	166	142	156	141	137	178	251	338	397	403
Brazil (10th)	50	51	94	133	165	231	295	255	232	189
Ecuador (11th)	139	232	276	272	198	214	181	210	203	177
<b>Total Americas</b>	<b>4,807</b>	<b>5,064</b>	<b>5,092</b>	<b>5,185</b>	<b>5,046</b>	<b>4,888</b>	<b>4,844</b>	<b>4,945</b>	<b>5,117</b>	<b>5,154</b>
<b>Total World</b>	<b>9,665</b>	<b>10,088</b>	<b>10,126</b>	<b>10,118</b>	<b>10,031</b>	<b>9,783</b>	<b>9,013</b>	<b>9,213</b>	<b>8,935</b>	<b>8,527</b>

Source: U.S. Energy Information Administration.

**Table A 4. Production of refined petroleum products in the Americas by country and 2010 world rank**

thousand barrels per day

Country (World Rank)	Distillate Fuel		Jet	Residual Fuel	LPG	Total Products
	Gasoline	Oil	Fuel/Kerosene	Oil		
United States (1st globally)	9,059	4,223	1,437	585	659	18,452
Brazil (8th)	399	712	80	298	139	2,108
Canada (9th)	719	618	97	121	59	2,016
Mexico (15th)	408	360	51	323	25	1,364
Venezuela (19th)	299	257	76	272	16	1,110
<b>Total Americas</b>	<b>11,478</b>	<b>6,858</b>	<b>1,921</b>	<b>2,102</b>	<b>993</b>	<b>27,771</b>
<b>Total World</b>	<b>22,299</b>	<b>25,446</b>	<b>6,728</b>	<b>9,805</b>	<b>3,858</b>	<b>83,799</b>

Source: U.S. Energy Information Administration.

**Table A5. Americas natural gas reserves and resources**

trillion cubic feet

<b>Country</b>	<b>Proved Natural Gas Reserves, 2013<sup>a</sup></b>	<b>Estimated Reservoired Accumulations of Undiscovered Technically Recoverable Gas Resources, 2012<sup>b</sup></b>	<b>Estimated Technically Recoverable Shale Gas Resources, 2013</b>
United States <sup>c</sup>	334	412	665
Venezuela	196	135	167
Canada	67	77	573
Mexico	17	83	545
Brazil	14	404	245
Argentina	13	126	802
Bolivia	10	27	36
Colombia	7	31	55
<b>Total Americas</b>	<b>693</b>	<b>1,252</b>	<b>3,212</b>
<b>Total World<sup>d</sup></b>	<b>7,024</b>	<b>6,017</b>	<b>7,298</b>

<sup>a</sup>Proved reserves represent the volumes of oil and natural gas that could be produced with reasonable certainty with the existing equipment and existing operating conditions.

<sup>b</sup>Technically recoverable resources represent the volumes of oil and natural gas that could be produced with current technology, regardless of oil and natural gas prices and production costs. Estimates are mean totals and do not include natural gas liquids. Some country estimates include resources found in basins shared with another country, which may mean some basins are counted twice.

<sup>c</sup>Estimates for the United States are for December 31, 2011.

<sup>d</sup>Certain countries with potentially productive shales were not included in the EIA/ARI report.

Sources: U.S. Energy Information Administration, *Oil and Gas Journal*, U.S. Geological Survey, *EIA/ARI World Shale Gas and Shale Oil Resource Assessment*.

## Appendix B. EIA world regions and their countries and territories

### ***North America***

Bermuda  
Mexico  
Greenland  
Canada  
Saint Pierre and Miquelon  
United States

### ***Central and South America***

Antarctica  
Antigua and Barbuda  
Argentina  
Aruba  
Bahamas, The  
Barbados  
Belize  
Bolivia  
Brazil  
Cayman Islands  
Chile  
Colombia  
Costa Rica  
Cuba  
Dominica  
Dominican Republic  
Ecuador  
El Salvador  
Falkland Islands  
(Islas Malvinas)  
French Guiana  
Grenada  
Guadeloupe  
Guatemala  
Guyana  
Haiti  
Honduras  
Jamaica  
Martinique  
Montserrat  
Netherlands Antilles

Nicaragua  
Panama  
Paraguay  
Peru  
Puerto Rico  
Saint Kitts and Nevis  
Saint Lucia  
Saint Vincent/Grenadines  
Suriname  
Trinidad and Tobago  
Turks and Caicos Islands  
Uruguay  
Venezuela  
Virgin Islands, U.S.  
Virgin Islands, British

### ***Africa***

Algeria  
Angola  
Benin  
Botswana  
Burkina Faso  
Burundi  
Cameroon  
Cape Verde  
Central African Republic  
Chad  
Comoros  
Congo (Brazzaville)  
Congo (Kinshasa)  
Côte d'Ivoire (IvoryCoast)  
Djibouti  
Egypt  
Equatorial Guinea  
Eritrea  
Ethiopia  
Gabon  
Gambia, The  
Ghana  
Guinea  
Guinea-Bissau  
Kenya

Lesotho  
Liberia  
Libya  
Madagascar  
Malawi  
Mali  
Mauritania  
Mauritius  
Morocco  
Mozambique  
Namibia  
Niger  
Nigeria  
Reunion  
Rwanda  
Saint Helena  
São Tomé and Príncipe  
Senegal  
Seychelles  
Sierra Leone  
Somalia  
South Africa  
Sudan and South Sudan  
Swaziland  
Tanzania  
Togo  
Tunisia  
Uganda  
Western Sahara  
Zambia  
Zimbabwe

### ***Asia and Oceania***

Afghanistan  
American Samoa  
Australia  
Bangladesh  
Bhutan  
Brunei  
Burma (Myanmar)  
Cambodia  
China

Cook Islands  
Fiji  
French Polynesia  
Guam  
Hong Kong  
India  
Indonesia  
Japan  
Kiribati  
Korea, North  
Korea, South  
Laos  
Macau  
Malaysia  
Maldives  
Mongolia  
Nauru  
Nepal  
New Caledonia  
New Zealand  
Niue  
Pakistan  
Papua New Guinea  
Philippines  
Samoa  
Singapore  
Solomon Islands  
Sri Lanka  
Taiwan  
Thailand  
Timor-Leste (East Timor)  
Tonga  
U.S. Pacific Islands  
Vanuatu  
Vietnam  
Wake Island

### ***Eurasia***

Armenia  
Azerbaijan  
Belarus  
Estonia  
Georgia  
Kazakhstan  
Kyrgyzstan  
Latvia  
Lithuania  
Moldova  
Russia  
Tajikistan  
Turkmenistan  
Ukraine  
Uzbekistan

### ***Europe***

Albania  
Austria  
Belgium  
Bosnia and Herzegovina  
Bulgaria  
Croatia  
Cyprus  
Czech Republic  
Denmark  
Faroe Islands  
Finland  
France  
Germany  
Gibraltar  
Greece  
Hungary  
Iceland

Ireland  
Italy  
Luxembourg  
Macedonia  
Malta  
Montenegro  
Netherlands  
Norway  
Poland  
Portugal  
Romania  
Serbia  
Slovakia  
Slovenia  
Spain  
Sweden  
Switzerland  
Turkey  
United Kingdom

### ***Middle East***

Bahrain  
Iran  
Iraq  
Israel  
Jordan  
Kuwait  
Lebanon  
Oman  
Palestinian Territories  
Qatar  
Saudi Arabia  
Syria  
United Arab Emirates  
Yemen

## Appendix C. Selected trade agreements within the Americas

### *U.S. trade agreements with the Americas*

**The United States is engaged in six Free Trade Agreements (FTAs) and Trade Promotion Agreements (TPAs) in the Americas. The agreements have opened foreign markets to U.S. companies and offer a more favorable environment for U.S. investment. However, these agreements usually exclude investment in the partner countries' domestic hydrocarbon sectors.**

#### North American Free Trade Agreement (NAFTA)

- In 2010, mineral fuel (which includes petroleum, coal, and natural gas) and oil was the third largest export and accounted for \$27 billion in export revenue. Mineral fuel and oil imports totaled \$116 billion and was the largest import category.

#### Dominican Republic-Central America Free Trade Agreement (CAFTA-DR)

- In 2009, U.S. total (two-way) goods trade under CAFTA-DR was \$39 billion. The United States exported \$3 billion of mineral fuel to CAFTA-DR countries in 2009.

#### Chile Free Trade Agreement

- Top U.S. exports to Chile in 2010 were machinery, mineral fuel, and oil.

#### Colombia Trade Promotion Agreement

- In 2011, U.S exports of petroleum equaled nearly \$3 billion. Oil and natural gas imports from Colombia were \$10 billion.

#### Panama Trade Promotion Agreement

- U.S. firms gained improved access to Panama's service market, which includes energy services.

#### Peru Trade Promotion Agreement

- Under the TPA, tariffs will be phased out by 2019. Principal U.S. exports to Peru include petroleum and oil products.

### *Venezuela's energy alliance: Petrocaribe*

**In 2005, Venezuela established Petrocaribe to provide preferential oil purchase agreements with 14 Caribbean nations. Venezuela extended the agreement to Central America, increasing to 18 total countries and expanded in scope to energy security and economic cooperation.**

- Through the Petrocaribe agreement, Venezuela discounts between 5% and 50% on the purchase price, depending on the market value of oil, and provides financing at 1% interest for up to 25 years.
- Between the signing of the agreement and the first quarter of 2009, total supply of oil and oil products in the framework was roughly 90 million barrels.
- The agreement has also prompted joint investments, worth \$552 million, between Venezuela and member states for the development of oil and gas infrastructure. Examples:
  - St. Vincent and the Grenadines: Petroleum Liquefied Gas (PLG) Filling Plant
  - Cuba: Fuel Storage and Distribution Plant, Camilo Cienfuegos Refinery
  - Nicaragua, Haiti, Antigua and Barbuda, and Dominica: Power generation projects.
- In addition, leaders of Petrocaribe hope to use their alliance to establish new, strategic partnerships with economies including China and Russia.

## Glossary

Listed below are selected terms from the U.S. Energy Information Administration's Glossary. The complete glossary can be found on the EIA web site at <http://www.eia.gov/tools/glossary/>.

**Barrel:** A unit of volume equal to 42 U.S. gallons.

**Barrels per (calendar) day:** The amount of input that a distillation facility can process under usual operating conditions. The amount is expressed in terms of capacity during a 24-hour period and reduces the maximum processing capability of all units at the facility under continuous operation (see barrels per stream day) to account for the following limitations that may delay, interrupt, or slow down production. 1. The capability of downstream processing units to absorb the output of crude oil processing facilities of a given refinery. No reduction is necessary for intermediate streams that are distributed to other than downstream facilities as part of a refinery's normal operation; 2. The types and grades of inputs to be processed; 3. The types and grades of products expected to be manufactured; 4. The environmental constraints associated with refinery operations; 5. The reduction of capacity for scheduled downtime because of such conditions as routine inspection, maintenance, repairs, and turnaround; and 6. The reduction of capacity for unscheduled downtime because of such conditions as mechanical problems, repairs, and slowdowns.

**Barrels per stream day:** The maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime.

**Biodiesel:** A fuel typically made from soybean, canola, or other vegetable oils; animal fats; and recycled grease. It can serve as a substitute for petroleum-derived diesel or distillate fuel. For EIA reporting, it is a fuel composed of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100, and meeting the requirements of ASTM (American Society for Testing materials) D 6751.

**Biofuels:** Liquid fuels and blending components produced from biomass feedstocks, used primarily for transportation.

**Bitumen:** A naturally occurring viscous mixture, mainly of hydrocarbons heavier than pentane, that may contain sulphur compounds and that, in its natural occurring viscous state, is not recoverable at a commercial rate through a well.

**BOE:** Barrels of Oil Equivalent (used internationally)

**Catalytic converter:** A device containing a catalyst for converting automobile exhaust into mostly harmless products.

**Catalytic cracking:** The refining process of breaking down the larger, heavier, and more complex hydrocarbon molecules into simpler and lighter molecules. Catalytic cracking is accomplished by the use of a catalytic agent and is an effective process for increasing the yield of gasoline from crude oil. Catalytic cracking processes fresh feeds and recycled feeds.

**Catalytic hydrocracking:** A refining process that uses hydrogen and catalysts with relatively low temperatures and high pressures for converting middle boiling or residual material to high octane gasoline, reformer charge stock, jet fuel, and/or high grade fuel oil. The process uses one or more catalysts, depending on product output, and can handle high sulfur feed stocks without prior desulfurization.

**Catalytic hydrotreating:** A refining process for treating petroleum fractions from atmospheric or vacuum distillation units (e.g., naphthas, middle distillates, reformer feeds, residual fuel oil, and heavy gas oil) and other petroleum (e.g., cat cracked naphtha, coker naphtha, gas oil, etc.) in the presence of catalysts and substantial quantities of hydrogen. Hydrotreating includes desulfurization, removal of substances (e.g., nitrogen compounds) that deactivate catalysts, conversion of olefins to paraffins to reduce gum formation in gasoline, and other processes to upgrade the quality of the fractions.

**Catalytic reforming:** A refining process using controlled heat and pressure with catalysts to rearrange certain hydrocarbon molecules, thereby converting paraffinic and naphthenic type hydrocarbons (e.g., low octane gasoline boiling range fractions) into petrochemical feedstocks and higher octane stocks suitable for blending into finished gasoline. Catalytic reforming is reported in two categories:

- **Low Pressure.** A processing unit operating at less than 225 pounds per square inch gauge (PSIG) measured at the outlet separator.
- **High pressure.** A processing unit operating at either equal to or greater than 225 pounds per square inch gauge (PSIG) measured at the outlet separator.

**Crude oil:** A mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Depending upon the characteristics of the crude stream, it may also include 1. Small amounts of hydrocarbons that exist in gaseous phase in natural underground reservoirs but are liquid at atmospheric pressure after being recovered from oil well (casing head) gas in lease separators and are subsequently comingled with the crude stream without being separately measured. Lease condensate recovered as a liquid from natural gas wells in lease or field separation facilities and later mixed into the crude stream is also included; 2. Small amounts of nonhydrocarbons produced with the oil, such as sulfur and various metals; 3. Drip gases, and liquid hydrocarbons produced from tar sands, oil sands, gilsonite, and oil shale.

**Crude oil production:** The volume of crude oil produced from oil reservoirs during given periods of time. The amount of such production for a given period is measured as volumes delivered from lease storage tanks (i.e., the point of custody transfer) to pipelines, trucks, or other media for transport to refineries or terminals with adjustments for 1. net differences between opening and closing lease inventories, and 2. basic sediment and water (BSW).

**Deadweight tons:** The lifting capacity of a ship expressed in long tons (2,240 lbs.), including cargo, commodities, and crew.

**Distillate fuel oil:** A general classification for one of the petroleum fractions produced in conventional distillation operations. It includes diesel fuels and fuel oils. Products known as No. 1, No. 2, and No. 4 diesel fuel are used in on-highway diesel engines, such as those in trucks and automobiles, as well as off-highway engines, such as those in railroad locomotives and agricultural machinery. Products known as No. 1, No. 2, and No. 4 fuel oils are used primarily for space heating and electric power generation.



**Distillation unit (atmospheric):** The primary distillation unit that processes crude oil (including mixtures of other hydrocarbons) at approximately atmospheric conditions. It includes a pipe still for vaporizing the crude oil and a fractionation tower for separating the vaporized hydrocarbon components in the crude oil into fractions with different boiling ranges. This is done by continuously vaporizing and condensing the components to separate higher boiling point material. The selected boiling ranges are set by the processing scheme, the properties of the crude oil, and the product specifications.

**Dry natural gas:** Natural gas that remains after: 1) the liquefiable hydrocarbon portion has been removed from the gas stream (i.e., gas after lease, field, and/or plant separation); and 2) any volumes of nonhydrocarbon gases have been removed where they occur in sufficient quantity to render the gas unmarketable. Note: Dry natural gas is also known as consumer-grade natural gas. The parameters for measurement are cubic feet at 60 degrees Fahrenheit and 14.73 pounds per square inch absolute.

**Dry natural gas production:** The process of producing consumer-grade natural gas. Natural gas withdrawn from reservoirs is reduced by volumes used at the production (lease) site and by processing losses. Volumes used at the production site include 1. the volume returned to reservoirs in cycling, repressuring of oil reservoirs, and conservation operations; and 2. gas vented and flared. Processing losses include 1. nonhydrocarbon gases (e.g., water vapor, carbon dioxide, helium, hydrogen sulfide, and nitrogen) removed from the gas stream; and 2. gas converted to liquid form, such as lease condensate and plant liquids. Volumes of dry gas withdrawn from gas storage reservoirs are not considered part of production. Dry natural gas production equals marketed production less extraction loss.

**Gas processing unit:** A facility designed to recover natural gas liquids from a stream of natural gas that may or may not have passed through lease separators and/or field separation facilities. Another function of natural gas processing plants is to control the quality of the processed natural gas stream. Cycling plants are considered natural gas processing plants.

**Heavy gas oil:** Petroleum distillates with an approximate boiling range from 651 degrees Fahrenheit to 1,000 degrees Fahrenheit.

**Henry Hub:** A pipeline hub on the Louisiana Gulf coast. It is the delivery point for the natural gas futures contract on the New York Mercantile Exchange (NYMEX).

**Hydrocarbon:** An organic chemical compound of hydrogen and carbon in the gaseous, liquid, or solid phase. The molecular structure of hydrocarbon compounds varies from the simplest (methane, a constituent of natural gas) to the very heavy and very complex.

**Lease condensate:** A mixture consisting primarily of hydrocarbons heavier than pentanes that is recovered as a liquid from natural gas in lease separation facilities. This category excludes natural gas plant liquids, such as butane and propane, which are recovered at downstream natural gas processing plants or facilities.

**Liquid fuels:** All petroleum including crude oil and products of petroleum refining, natural gas liquids, biofuels, and liquids derived from other hydrocarbon sources (including coal to liquids and gas to liquids). Not included are liquefied natural gas (LNG) and liquid hydrogen.

**Motor gasoline (finished):** A complex mixture of relatively volatile hydrocarbons with or without small quantities of additives, blended to form a fuel suitable for use in spark-ignition engines. Motor gasoline,

as defined in ASTM Specification D 4814 or Federal Specification VV-G-1690C, is characterized as having a boiling range of 122 to 158 degrees Fahrenheit at the 10 percent recovery point to 365 to 374 degrees Fahrenheit at the 90% recovery point. Motor Gasoline includes conventional gasoline; all types of oxygenated gasoline, including gasohol; and reformulated gasoline, but excludes aviation gasoline. Note: Volumetric data on blending components, such as oxygenates, are not counted in data on finished motor gasoline until the blending components are blended into the gasoline.

**Motor gasoline blending components:** Naphthas (e.g., straight-run gasoline, alkylate, reformate, benzene, toluene, xylene) used for blending or compounding into finished motor gasoline. These components include reformulated gasoline blend stock for oxygenate blending (RBOB) but exclude oxygenates (alcohols, ethers), butane, and pentanes plus. Note: Oxygenates are reported as individual components and are included in the total for other hydrocarbons, hydrogens, and oxygenates.

**Natural gas:** A gaseous mixture of hydrocarbon compounds, the primary one being methane.

**Natural gas marketed production:** Gross withdrawals of natural gas from production reservoirs, less gas used for reservoir repressuring, nonhydrocarbon gases removed in treating and processing operations, and quantities vented and flared.

**Operable refineries:** Refineries that were in one of the following three categories at the beginning of a given year in operation; not in operation and not under active repair, but capable of being placed into operation within 30 days; or not in operation, but under active repair that could be completed within 90 days.

**Petroleum:** A broadly defined class of liquid hydrocarbon mixtures. Included are crude oil, lease condensate, unfinished oils, refined products obtained from the processing of crude oil, and natural gas plant liquids. Note: Volumes of finished petroleum products include non-hydrocarbon compounds, such as additives and detergents, after they have been blended into the products.

**Petroleum Administration for Defense District (PADD):** A geographic aggregation of the 50 States and the District of Columbia into five Districts, with PADD 1 further split into three subdistricts. The PADDs include the states listed below:

- PADD 1 (East Coast):
- PADD 1A (New England): Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.
- PADD 1B (Central Atlantic): Delaware, District of Columbia, Maryland, New Jersey, New York, and Pennsylvania.
- PADD 1C (Lower Atlantic): Florida, Georgia, North Carolina, South Carolina, Virginia, and West Virginia.
- PADD 2 (Midwest): Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, and Wisconsin.
- PADD 3 (Gulf Coast): Alabama, Arkansas, Louisiana, Mississippi, New Mexico, and Texas.
- PADD 4 (Rocky Mountain): Colorado, Idaho, Montana, Utah, and Wyoming.
- PADD 5 (West Coast): Alaska, Arizona, California, Hawaii, Nevada, Oregon, and Washington.

**Petroleum coke, marketable:** Those grades of coke produced in delayed or fluid cokers that may be recovered as relatively pure carbon. Marketable petroleum coke may be sold as is or further purified by calcining.

**Petroleum products:** Petroleum products are obtained from the processing of crude oil (including lease condensate), natural gas, and other hydrocarbon compounds. Petroleum products include unfinished oils, liquefied petroleum gases, pentanes plus, aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, petrochemical feedstocks, special naphthas, lubricants, waxes, petroleum coke, asphalt, road oil, still gas, and miscellaneous products.

**Petroleum refinery:** An installation that manufactures finished petroleum products from crude oil, unfinished oils, natural gas liquids, other hydrocarbons, and alcohol.

**Processing plant:** A surface installation designed to separate and recover natural gas liquids from a stream of produced natural gas through the processes of condensation, absorption, adsorption, refrigeration, or other methods and to control the quality of natural gas marketed and/or returned to oil or gas reservoirs for pressure maintenance, repressuring, or cycling.

**Proved energy reserves:** Estimated quantities of energy sources that analysis of geologic and engineering data demonstrates with reasonable certainty are recoverable under existing economic and operating conditions. The location, quantity, and grade of the energy source are usually considered to be well established in such reserves. Note: This term is equivalent to "Measured Reserves" as defined in the resource/reserve classification contained in the U.S. Geological Survey Circular 831, 1980. Measured and indicated reserves, when combined, constitute demonstrated reserves.

**Refined petroleum products:** Refined petroleum products include, but are not limited to, gasolines, kerosene, distillates (including No. 2 fuel oil), liquefied petroleum gas, asphalt, lubricating oils, diesel fuels, and residual fuels.

**Refinery production:** Petroleum products produced at a refinery or blending plant. Published production of these products equals refinery production minus refinery input. Negative production will occur when the amount of a product produced during the month is less than the amount that is reprocessed (input) or reclassified to become another product during the same month. Refinery production of unfinished oils and motor and aviation gasoline blending components appear on a net basis under refinery input.

**Residual fuel oil:** A general classification for the heavier oils, known as No. 5 and No. 6 fuel oils, that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations. It conforms to ASTM Specifications D 396 and D 975 and Federal Specification VV-F-815C. No. 5, a residual fuel oil of medium viscosity, is also known as Navy Special and is defined in Military Specification MIL-F-859E, including Amendment 2 (NATO Symbol F-770). It is used in steam-powered vessels in government service and inshore powerplants. No. 6 fuel oil includes Bunker C fuel oil and is used for the production of electric power, space heating, vessel bunkering, and various industrial purposes.

**Shale Gas:** Natural gas produced from wells that are open to shale formations. Shale is a fine-grained, sedimentary rock composed of mud from flakes of clay minerals and tiny fragments (silt-sized particles) of other materials. The shale acts as both the source and the reservoir for the natural gas.

**Unconventional oil and natural gas production:** An umbrella term for oil and natural gas that is produced by means that do not meet the criteria for conventional production. See Conventional oil and natural gas production. Note: What has qualified as "unconventional" at any particular time is a complex

interactive function of resource characteristics, the available exploration and production technologies, the current economic environment, and the scale, frequency, and duration of production from the resource. Perceptions of these factors inevitably change over time, and they often differ among users of the term. For these reasons, the scope of this term will be expressly stated in any EIA publication that uses it.

**Unfinished oils:** All oils requiring further processing, except those requiring only mechanical blending. Unfinished oils are produced by partial refining of crude oil and include naphthas and lighter oils, kerosene and light gas oils, heavy gas oils, and residuum.

## Endnotes

<sup>1</sup>“Reservoired accumulations” of natural gas and oil involve gases and liquids that have migrated out of a source rock and become trapped by structural (e.g., cap rock) or stratigraphic (e.g., faults) geologic features and traditionally have been referred to as “conventional.” “Reservoired accumulations” is EIA terminology. USGS refers to these resources as “undiscovered technically recoverable conventional resources.”

<sup>2</sup>Proved reserves represent the volumes of oil and natural gas that could be produced with reasonable certainty with the existing equipment and existing operating conditions. Technically recoverable resources represent the volumes of oil and natural gas that could be produced with current technology, regardless of oil and natural gas prices and production costs. Estimates are mean totals and do not include natural gas liquids. Some country estimates include resources found in basins shared with another country, which may mean some basins are counted twice. Estimates for the United States are for December 31, 2011. Certain countries with potentially productive shales were not included in the EIA/ARI report.

<sup>3</sup>*Oil and Gas Journal*, “Worldwide Look at Reserves” (January 1, 2014). U.S. figures from U.S. Energy Information Administration.

<sup>4</sup>Mean totals represent the estimate of the available amount after calculations of 95%, 50%, and 5% probability estimates. U.S. Geological Survey, *An Estimate of Undiscovered Conventional Oil and Gas Resources of the World, 2012* (March 2012), <http://pubs.usgs.gov/fs/2012/3042/fs2012-3042.pdf>.

<sup>5</sup>U.S. Geological Survey, *An Estimate of Undiscovered Conventional Oil and Gas Resources of the World, 2012* (March 2012), <http://pubs.usgs.gov/fs/2012/3042/fs2012-3042.pdf>.

<sup>6</sup>U.S. Energy Information Administration and Advanced Resources International, Inc., *EIA/ARI World Shale Gas and Shale Oil Resource Assessment* (June 2013), [http://www.adv-res.com/pdf/A\\_EIA\\_ARI\\_2013%20World%20Shale%20Gas%20and%20Shale%20Oil%20Resource%20Assessment.pdf](http://www.adv-res.com/pdf/A_EIA_ARI_2013%20World%20Shale%20Gas%20and%20Shale%20Oil%20Resource%20Assessment.pdf).

<sup>7</sup>Global Trade Information System, *Global Trade Atlas*, 2013.

<sup>8</sup>*Ibid.*

<sup>9</sup>*Oil and Gas Journal*, “2012 Worldwide Refining Survey” (December 3, 2012) (non-U.S. only).

<sup>10</sup>Hart: International Fuel Quality Center, Latin America & the Caribbean: Mexico, Central America, Caribbean Face Fuel Quality Hurdles (November 1, 2013).

<sup>11</sup>*Ibid.*

<sup>12</sup>Panama Canal Authority, *Expansion Program* (2013).

<sup>13</sup>U.S. Energy Information Administration, *World Oil Transit Chokepoints* (August 22, 2012).

<sup>14</sup>Federal Maritime Commission, “Commissioner Doyle’s Keynote Address to the Eno Center for Transportation’s Forum on the Panama Canal” (September 19, 2013).

<sup>15</sup>“Reservoired accumulations” of natural gas and oil involve gases and liquids that have migrated out of a source rock and become trapped by structural (e.g., cap rock) or stratigraphic (e.g., faults) geologic features and traditionally have been referred to as “conventional.” “Reservoired accumulations” is EIA terminology. USGS refers to these resources as “undiscovered technically recoverable conventional resources.”

<sup>16</sup>Proved reserves represent the volumes of oil and natural gas that could be produced with reasonable certainty with the existing equipment and existing operating conditions. Technically recoverable resources represent the volumes of oil and natural gas that could be produced with current technology, regardless of oil and natural gas prices and production costs. Estimates are mean totals and do not include natural gas liquids. Some country estimates include resources found in basins shared with another country, which may mean some basins are counted twice. Estimates for the United States are for December 31, 2011. Certain countries with potentially productive shales were not included in the EIA/ARI report.

<sup>17</sup>*Oil and Gas Journal*, “Worldwide Look at Reserves” (January 1, 2014). U.S. figures from U.S. Energy Information Administration.

<sup>18</sup>Mean totals represent the estimate of the available amount after calculations of 95%, 50%, and 5% probability estimates. U.S. Geological Survey, *An Estimate of Undiscovered Conventional Oil and Gas Resources of the World, 2012* (March 2012), <http://pubs.usgs.gov/fs/2012/3042/fs2012-3042.pdf>.

<sup>19</sup>U.S. Geological Survey, *An Estimate of Undiscovered Conventional Oil and Gas Resources of the World, 2012* (March 2012), <http://pubs.usgs.gov/fs/2012/3042/fs2012-3042.pdf>.

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- <sup>42</sup>The laws and regulations detailed in italics are subject to modification once secondary legislation is passed by Congress.
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