



# Country Analysis Brief: Mexico

Last Updated: December 8, 2016

## Overview

**Mexico is a major producer of petroleum and other liquids and is among the largest sources of U.S. oil imports.**

Mexico is one of the largest producers of petroleum and other liquids in the world. Mexico is also the fourth-largest producer in the Americas after the United States, Canada, and Brazil, and an important partner in U.S. energy trade. In 2015, Mexico accounted for 688,000 barrels per day (b/d), or 9%, of U.S. crude oil imports.

Mexico's oil production has steadily decreased since 2005 as a result of natural production declines from Cantarell and other large offshore fields. In August 2014 in an effort to address the declines of its domestic oil production, the Mexican government enacted [constitutional reforms](#) that ended the 75-year monopoly of Petroleos Mexicanos (PEMEX), the state-owned oil company.

Figure 1. Map of Mexico

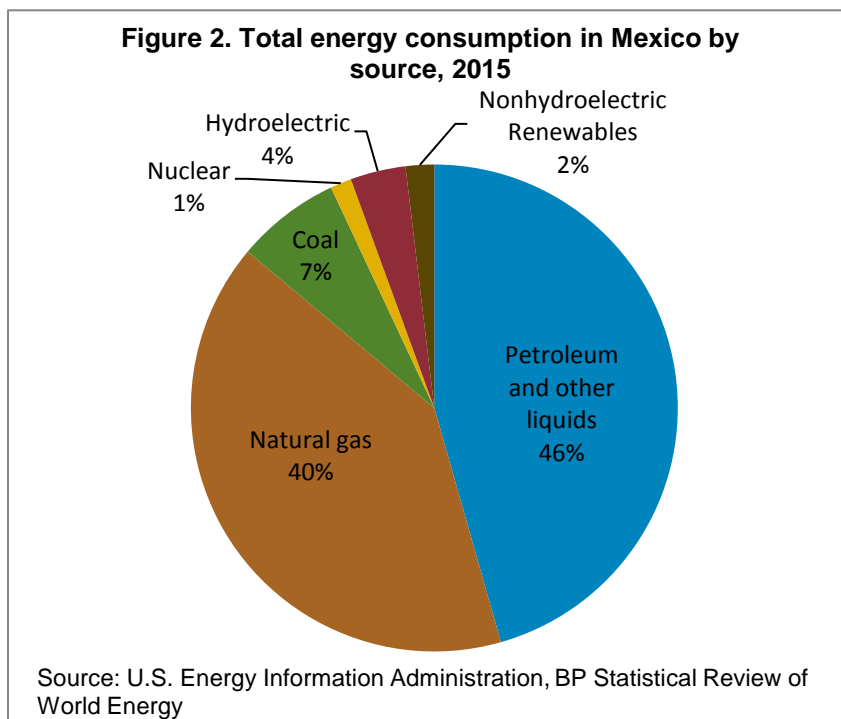


Source: CIA World Factbook

The role of the petroleum sector as a component of Mexico's economy has decreased significantly in recent years as a result of tax reform, the drop in oil prices, and diversification of the Mexican economy.<sup>1</sup> The oil sector generated only 6% of the country's export earnings in 2015, down from about 30% in 2009, according to Mexico's central bank.<sup>2</sup> The 2015 federal budget was based on Mexican crude oil being

valued at \$79 per barrel (/b), although Mexican Maya crude oil averaged about \$46/b in 2015.<sup>3</sup> However, Mexico regularly hedges a price for their oil production, and in 2015 the country secured a price of \$76.40/b, thus earning a windfall profit of \$6.4 billion.<sup>4</sup> The price for 2016 oil exports was hedged at \$49/b and the 2017 price at \$42/b, while the proposed 2017 federal budget will assume crude oil prices to average \$35/b in 2017.<sup>5</sup>

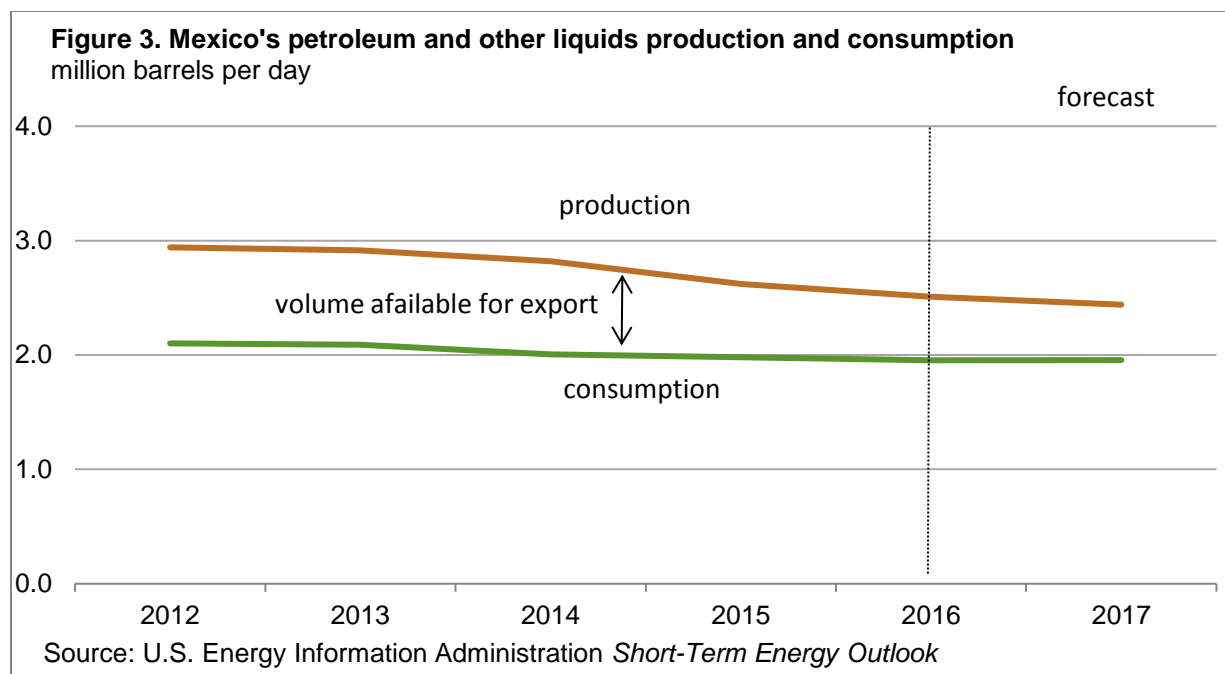
Mexico's total energy consumption in 2015 (Figure 2) consisted mostly of petroleum (46%), followed by natural gas (40%). Natural gas is increasingly replacing oil in electric power generation. Projected increases in natural gas consumption are resulting in plans to many new pipelines to import natural gas from the United States. All other fuel types contribute relatively small amounts to Mexico's overall energy mix, although the country also has set goals for increased renewable energy generation capacity.



## Petroleum and other liquids

***Mexico's oil production has declined over the past decade, as has the country's position as a net oil exporter to the United States.***

Mexico produced an average of 2.6 million barrels per day (b/d) of petroleum and other liquids in 2015 (Figure 3). Crude oil accounted for 2.3 million b/d, or 86%, of total output, with the remainder attributed to lease condensate, natural gas liquids, and refinery processing gain. Mexico's total oil production had declined substantially, falling 32% from its peak in 2004. Notably, crude oil production in 2015 was at its lowest level since 1981 and has continued to decline in 2016. Mexico is a significant crude oil exporter, the third largest in the Americas, but the country is a net importer of refined petroleum products. The United States is the destination for most of Mexico's crude oil exports and the source of most of its refined product imports.



## Sector organization and reforms

Mexico nationalized its oil sector in 1938, and PEMEX was created as the sole oil operator in the country. PEMEX is the largest company in Mexico and one of the largest oil companies in the world. Mexico's energy sector is regulated by the Secretaría de Energía (SENER). The Comisión Nacional de Hidrocarburos (CNH) serves as the governing body for exploration and production of hydrocarbons.

After years of declining production, Mexico instituted significant energy reforms. In December 2013, the Mexican government enacted constitutional reforms ending PEMEX's monopoly on the oil and natural gas sector and opening the industry to greater foreign investment. The reforms allow for new contract models for exploration and production including: licenses, production-sharing, profit-sharing, and service contracts. Previously, foreign firms were only allowed to participate in service contracts where companies were paid for services and were not allowed shares or profits derived from the hydrocarbon resources.

PEMEX remains state-owned, but is being given more budgetary and administrative autonomy and will have to compete for bids with other firms on new projects. As stipulated by the reforms, PEMEX was allowed first refusal on developing Mexican resources before private companies began bidding. This phase was known as Round Zero and resulted in PEMEX being awarded the right to develop 83% of Mexico's proved and probable oil reserves and 21% of total prospective resources.<sup>6</sup> The reforms also call for expanding the regulatory authorities of SENER and CNH, and for creating a new environmental protection agency, the Agencia de Seguridad, Energía y Ambiente (ASEA).

In 2015, the Mexican government held the three auction phases as part of Round One, offering onshore and offshore blocks for exploration and production to private investors. Low crude oil prices and the auction rules led to disappointing results in the first auction.<sup>7</sup> Subsequent phases of Round One were more successful after auction rules were adjusted to promote more bidding on the offerings. The fourth auction phase of Round One will occur in December 2016 and includes the lucrative deepwater blocks, which are expected to draw more attention from the major international oil companies. Round Two of auctions commenced in July 2016, offering 15 shallow water blocks in the Gulf of Mexico, followed by 12 onshore blocks.<sup>8</sup> Bids for phase one of Round Two are due in March 2017.

## Reserves

According to the *Oil & Gas Journal* (OGJ), Mexico had 9.7 billion barrels of proved oil reserves as of the end of 2015.<sup>9</sup> Most reserves consist of heavy crude oil varieties, with the largest concentration occurring offshore of the southern part of the country, particularly the Campeche Basin. There are also sizable reserves in onshore basins in the northern parts of Mexico.

## Exploration and production

Most of Mexico's oil production occurs off the eastern coast of the Bay of Campeche in the Gulf of Mexico, near the states of Veracruz, Tabasco, and Campeche (Figure 4). The two main production centers in the area are Cantarell and Ku-Maloob-Zaap (KMZ). In total, approximately 1.7 million b/d—or three-quarters—of Mexico's crude oil is produced offshore in the Bay of Campeche. Because of the concentration of Mexico's oil production offshore, tropical storms or hurricanes passing through the area can disrupt oil operations.

**Figure 4. Mexico's oil and natural gas fields**



Source: Bentek Energy, a unit of Platts

## Offshore

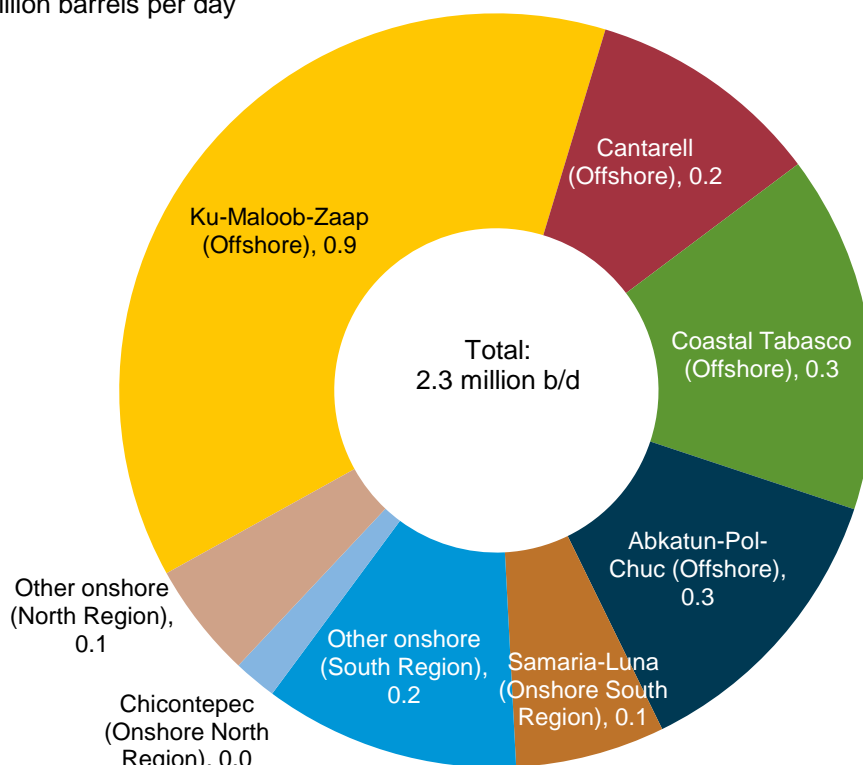
Nearly half of Mexico's oil production comes from two offshore fields in the northeastern region of the Bay of Campeche—Ku-Maloob-Zaap (KMZ) and Cantarell (Figure 5). Another important source of oil production is southwest in the same bay, offshore the state of Tabasco. Most of the oil produced at KMZ and Cantarell is heavy and marketed as Maya blend (API specific gravity of 21 to 22 degrees), while the oil produced offshore Tabasco is a lighter grade.

Cantarell was once one of the largest oil fields in the world, but its output has been declining significantly for a decade. Production at Cantarell began in 1979 but stagnated as a result of falling reservoir pressure. In 1997, PEMEX developed a plan to reverse the field's decline by injecting nitrogen into the reservoir to

maintain pressure, which was successful for a few years. However, production rapidly declined beginning in 2005—initially at extremely rapid rates, and more gradually in recent years. In 2015, Cantarell produced an average of 228,000 b/d of crude oil. This level was about 90% below the peak production level of 2.1 million b/d reached in 2004 and 29% lower than the year before.<sup>10</sup> As production at the field declined, so has its relative contribution to Mexico’s oil sector. Cantarell accounted for just 9% of Mexico’s total crude oil production in 2015, compared with 63% in 2004.<sup>11</sup>

KMZ, which is adjacent to Cantarell, has emerged as Mexico’s most prolific oil field. Crude oil production nearly tripled between 2004 and 2013, when it reached 864,000 b/d. PEMEX used a nitrogen reinjection program similar to the one used at Cantarell. PEMEX hopes to increase output over the next few years, in part through the development of the anticipated Ayatsil field coming online in 2019. However, views differ about whether the KMZ complex has already reached peak production.

**Figure 5. Mexican crude oil production by field, 2015**  
million barrels per day



Source: Comisión Nacional de Hidrocarburos

Mexico’s other offshore oil production center is in the southwest in the Bay of Campeche, near the state of Tabasco. In that bay, the Abkatun-Pol-Chuc and Litoral de Tabasco projects, each consisting of several small fields, accounted for a combined average 633,000 b/d of oil production in 2015.<sup>12</sup> The production trajectories of the two oil field complexes differ considerably. Output from Litoral de Tabasco has increased from less than 200,000 b/d in 2008 to 363,000 b/d in May 2016, offsetting some of the declines at Cantarell. Litoral de Tabasco also includes the promising Tsimin and Xux discoveries. Production from Abkatun-Pol-Chuc, on the other hand, has declined considerably from peak levels achieved in the mid-1990s, when output exceeded 700,000 b/d. Production from Abkatun-Pol-Chuc in 2015 averaged less than 300,000 b/d.<sup>13</sup>

In July 2016, SENER announced a tender for a private company to operate a joint-venture with PEMEX to develop the Trion light oil field. The agreement, also known as a farm out, represents the first time PEMEX has offered a production share to private companies.<sup>14</sup>

Mexico is believed to possess considerable hydrocarbon resources in the deepwater Gulf of Mexico that have not yet been developed. PEMEX has been drilling deepwater exploratory wells since 2006, making its first significant find in the Perdido Fold Belt, near the U.S. maritime border, in August 2012. In February 2012, the United States and Mexico signed a Transboundary Hydrocarbon Agreement concerning the development of oil and natural gas reservoirs that extend across their maritime border.<sup>15</sup> The agreement established a cooperative process and legal framework for safely managing and jointly developing transboundary reserves, and ended the moratorium on exploration and production in the transboundary area.

## **Onshore**

Onshore fields account for roughly 25% of Mexico's total crude oil production. Most of this production is of light or extra-light crude oil from the southern part of the country. The largest oilfield in the south of Mexico is Samaria-Luna, which produced about 145,000 b/d in 2015.<sup>16</sup>

The most notable onshore prospect in the north is the Aceite Terciario del Golfo (ATG) project, better known as Chicontepec, which is located northeast of Mexico City. At one point, Chicontepec was expected to produce nearly 1 million b/d, however, the production averaged only 42,000 b/d in 2015, a decline from the peak of 69,000 b/d in 2012.<sup>17</sup> PEMEX was once heavily invested in Chicontepec and promoted it as a potentially significant source of future production. However, after the energy reforms were implemented, PEMEX allowed some of its Chicontepec interests to be included with the bid auction rounds, rather than committing to develop the ATG alone.<sup>18</sup>

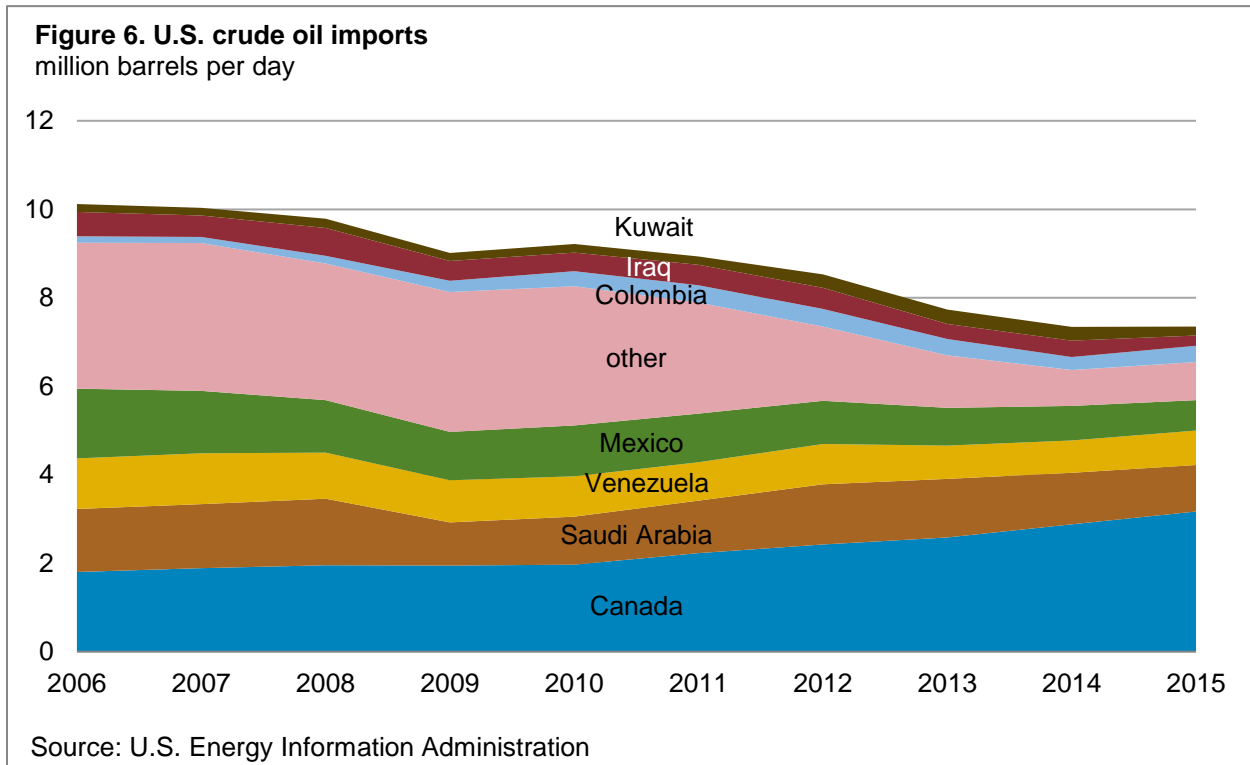
Mexico has significant shale resources in the Burgos basin near the northern border with the United States, which is similar in geology to the Eagle Ford shale in south Texas. Mexico ranks 8<sup>th</sup> in the world in [shale oil reserves](#), with 13.1 billion barrels of technically recoverable resources.<sup>19</sup>

## **Trade**

### **Crude oil exports**

Mexican authorities reported that the country exported 1.17 million b/d of crude oil in 2015, a figure that continues to decline.<sup>20</sup> The United States received approximately 59% of Mexico's crude oil exports, which arrived by tanker.<sup>21</sup> Most Mexican crude oil exports to the United States are Maya blend. Mexico retains most of the output from its lighter crude streams (Isthmus and Olmeca) for domestic consumption. The United States is likely to attract the bulk of Mexico's oil exports because of the proximity of the two countries and the operation of sophisticated U.S. Gulf Coast refineries capable of processing heavier Maya crudes.

Mexico is typically among the top exporters of crude oil to the United States (Figure 6). In 2015, the United States imported 688,000 b/d of crude oil from Mexico, behind Canada, Saudi Arabia, and Venezuela. Mexico's crude oil exports to the United States rose steadily through the 1980s and 1990s, and peaked in 2004 at 1.6 million b/d. U.S. crude oil imports from Mexico have generally declined since 2006, reflecting Mexico's steady drop in crude oil production and rising domestic fuel demand, along with dramatic increases in U.S. production in recent years.

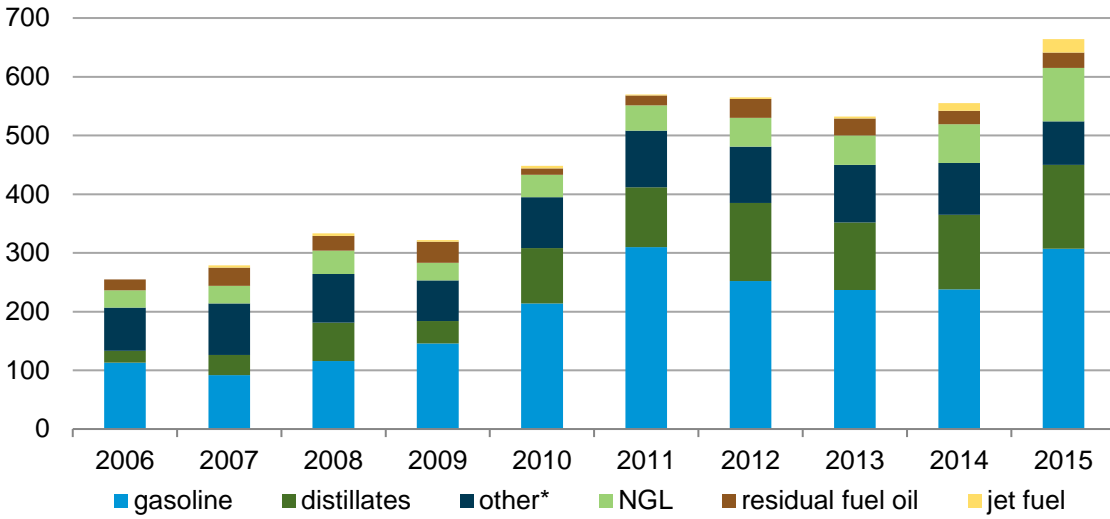


### Refined petroleum product trade

Despite its status as a large crude oil exporter, Mexico is a net importer of refined petroleum products. According to PEMEX, Mexico imported 740,000 b/d of refined petroleum products in 2015, of which 58% was gasoline, and most of the remainder was diesel and liquefied petroleum gases (LPG).<sup>22</sup> Mexico was the destination for 50% of U.S. exports of motor gasoline in 2015 (Figure 7).<sup>23</sup>

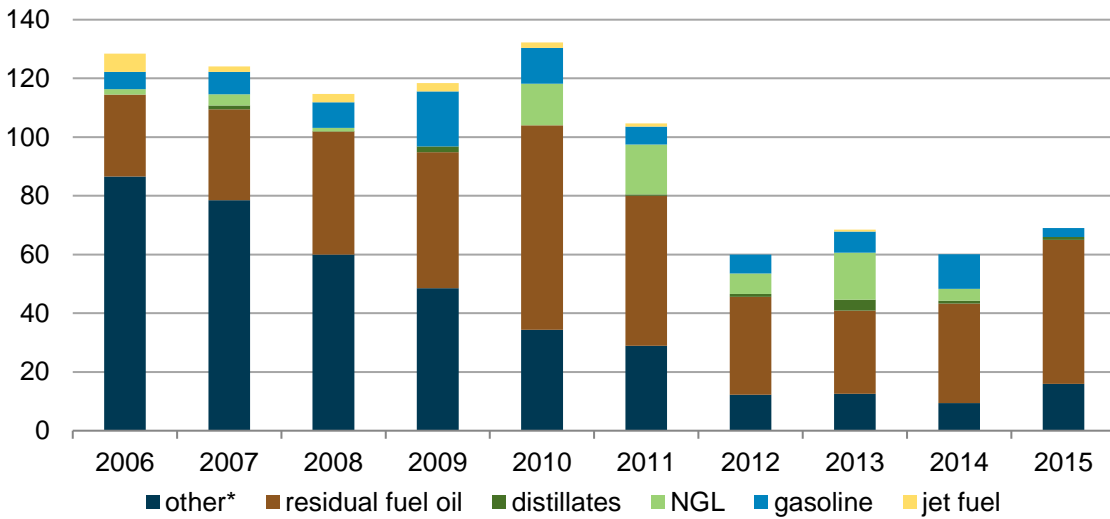
In 2015, Mexico exported 195,000 b/d of refined petroleum products.<sup>24</sup> The United States imported 70,000 b/d of that export total, most of which was residual fuel oil, naphtha, and pentanes plus (Figure 8). As with crude oil, U.S. imports of refined petroleum products from Mexico have declined in recent years, from a high of 132,000 b/d in 2010.

**Figure 7. U.S. annual exports of petroleum products to Mexico**  
thousand barrels per day



Source: U.S. Energy Information Administration  
\*Other includes unfinished oils, petroleum coke, asphalt, and lubricants

**Figure 8. U.S. annual imports of petroleum products from Mexico**  
thousand barrels per day



Source: U.S. Energy Information Administration  
\*Other includes unfinished oils and petrochemical feedstocks



## Pipelines and Export Terminals

PEMEX operates an extensive petroleum pipeline network in Mexico that connects major production centers with domestic refineries and export terminals (Figure 9). According to PEMEX, this network consists of pipelines spanning more than 3,000 miles, with the largest concentration occurring in southern Mexico.

Theft of oil from Mexican pipelines often results in environmental damage or occasional explosions. According to PEMEX, there were 4,125 illegal fuel taps in 2014, an increase of 44% from the previous year.<sup>25</sup> Sinaloa and Veracruz have been cited as the states most affected by theft in recent years.<sup>26</sup>

Most of its exports are shipped by tanker from three export terminals on the Gulf Coast in the southern part of the country: Cayo Arcas, Dos Bocas, and the Pajaritos terminal at the port of Coatzacoalcos. Another export terminal is on the Pacific Coast at Salina Cruz.

**Figure 9. Mexico – Downstream petroleum infrastructure map**



## Downstream

Mexico's total oil consumption remained relatively steady over the past decade, averaging about 1.7 million b/d in 2015. According to Mexican government data, gasoline accounted for roughly 46% of the country's petroleum product sales in 2015, and diesel accounted for another 23%.<sup>27</sup>

Mexico's six refineries, all operated by PEMEX, had a total refining capacity of 1.54 million b/d as of the end of 2015.<sup>28</sup> According to PEMEX, refinery output was 1.27 million b/d in 2015, a 9% decline from 2014.<sup>29</sup> PEMEX also controls 50% of the 334,000 b/d Deer Park refinery in Texas.

Mexico hopes to reduce its imports of refined products by improving domestic refining capacity and the output quality. In February 2012, PEMEX awarded a contract for the design of a new refinery at Tula, but in December 2014 the company opted for a \$4.6 billion expansion of the existing facility. Gasoline and diesel production will increase from 140,000 b/d to 300,000 b/d at Tula when it is completed in 2018.<sup>30</sup>

Despite this and other expansions, analysts contend that Mexico does not have a natural competitive advantage in refining, given the country's close proximity to a sophisticated U.S. refining center. Some analysts feel that it would be more productive to apply PEMEX's limited capital to the upstream sector.

## Natural gas

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***Mexico is a net importer of natural gas, mostly via pipeline from the United States, and its natural gas demand is rising because of expanding power generation capacity.***

Mexico has considerable natural gas resources, but its production is modest relative to other North American countries (see [Liquid Fuels and Natural Gas in the Americas](#)). The development of Mexico's shale gas resources is proceeding slowly, while consumption is projected to increase 31% from 2015 to 2029.<sup>31</sup> Mexico's import needs are rising as domestic production stagnates and as demand increases, particularly in the electricity sector. Consequently, Mexico will rely on increased pipeline imports of natural gas from the United States and liquefied natural gas (LNG) imports from other countries.

## Reserves

According to the *Oil & Gas Journal*, Mexico had 15.3 trillion cubic feet (Tcf) of proved natural gas reserves at the end of 2015.<sup>32</sup> Although the southern region of the country contains the largest share of proved reserves, the Burgos region in the north has the potential to be the center of growth in future reserves. This region contains 343 Tcf of technically recoverable shale gas resources.<sup>33</sup> Mexico's shale gas resources could support increased natural gas reserves and production. According to [EIA's assessment of world shale gas resources](#), Mexico has an estimated 545 Tcf of technically recoverable shale gas resources—the sixth largest of any country examined in the study. The figure of technically recoverable shale gas resources is far smaller than the total resource base because of the geologic complexity and discontinuity of Mexico's onshore shale zone. While most of Mexico's shale gas resources are in the northeast and east-central regions of the country, the Burgos Basin, which accounts for most of Mexico's technically recoverable shale gas resources, is considered to be Mexico's most promising prospect for natural gas production in the future.

## Sector organization

Before the energy reforms of 2013, PEMEX retained a monopoly on natural gas exploration, but the government allowed private participation in nonassociated gas exploration and production. The Mexican government opened the downstream natural gas sector to private operators in 1995, although no single company may participate in more than one downstream function (transportation, storage, or distribution). The Comisión Reguladora de Energía (CRE) was created to monitor the sector.

The newly enacted energy reforms allow for greater outside investment in exploration, production, and other activities in the natural gas sector. The reforms allow for new exploration and production contract models: licenses, production-sharing, profit-sharing, and service contracts. PEMEX will remain state-owned, but it will be given more budgetary and administrative autonomy and will have to compete for bids with other firms on new projects. The reforms also call for expanding the regulatory authorities of SENER and CNH, and for creating a new environmental protection agency, the Agencia de Seguridad, Energía y Ambiente (ASEA).

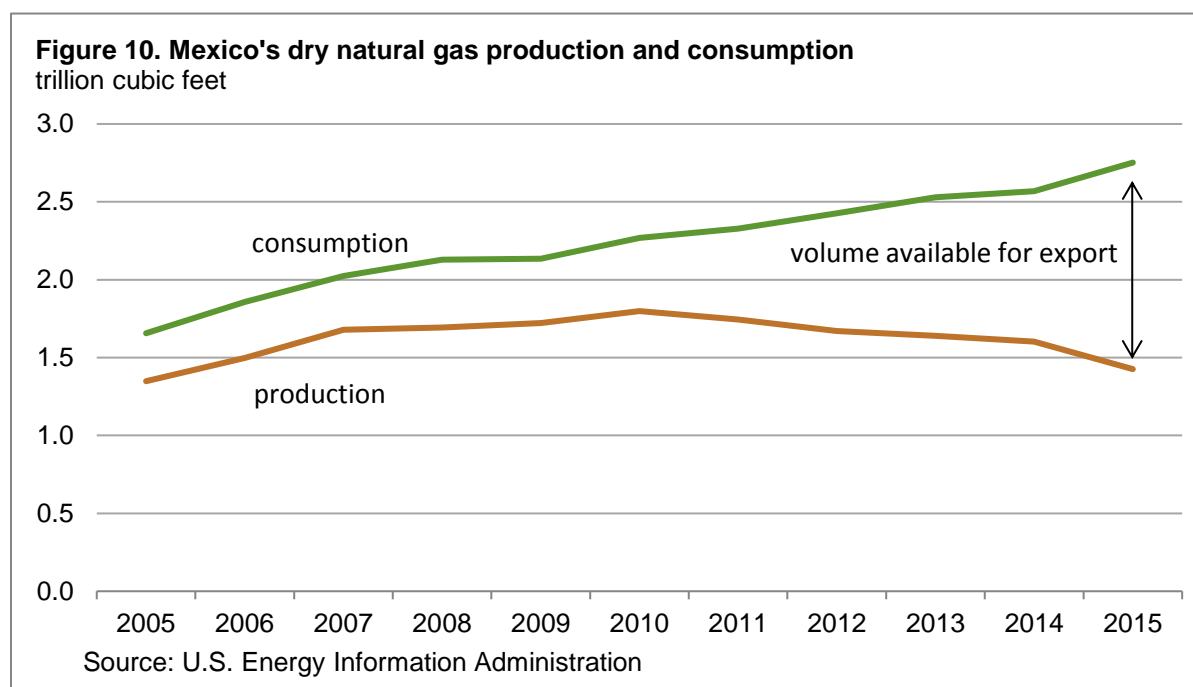
As the energy reforms were implemented, Round Zero was held where PEMEX was allowed to submit bids to retain resources before offering them in public auction. PEMEX was awarded 100% of their bids, representing 83% of Mexico's overall reserves.<sup>34</sup>

## Exploration and production

Mexico produced an estimated 1.4 Tcf of dry natural gas in 2015, a modest decline from the year before (Figure 10). Part of the decline is in response to the higher price of crude oil relative to the price of natural gas, which encouraged PEMEX to favor development of oil.

PEMEX reports that natural gas flaring in the first half of 2016 averaged 562 million cubic feet per day.<sup>35</sup> PEMEX and government agencies have prioritized a reduction in natural gas flaring for economic and environmental reasons. Efforts to improve the ability to capture, process, and transport associated natural gas production, particularly at Cantarell, have been effective, and natural gas utilization rates have recently increased.

The geographic distribution of Mexico's marketed natural gas production is slightly different and more dispersed than it is for oil. According to statistics from PEMEX, nearly three-quarters of Mexico's natural gas production is from associated oil fields.<sup>36</sup> Unlike in the oil sector, the onshore (Samaria-Luna) and offshore fields of Tabasco yield more natural gas than Cantarell or KMZ. More than two-thirds of the country's nonassociated natural gas production occurs in the Burgos Basin in the northern part of the country. Most of the remaining production is from nonassociated fields in Veracruz.

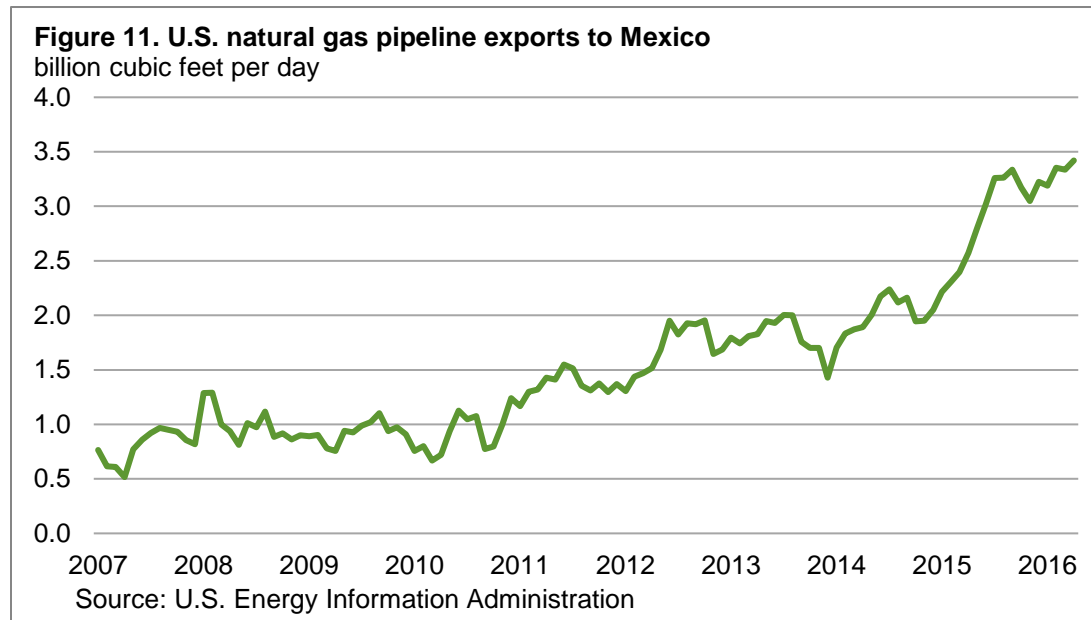


Mexico has taken preliminary steps to explore for and produce shale gas, but the country lags the United States considerably in terms of the development of its shale gas and tight oil potential. PEMEX produced its first shale gas in early 2011 from an exploratory well in northern Mexico. Later that year, the government announced a discovery in the same region, which could significantly increase the country's proved natural gas reserves. PEMEX announced in early 2014 that it planned on drilling 10 shale test wells, bringing Mexico's total to 175, a small figure compared with the more than 27,000 wells drilled across the border in Texas in 2014.<sup>37</sup> Although PEMEX has allocated a small share of its budget to shale gas development, the sector is unlikely to grow rapidly without improvement in PEMEX's financial situation, technical abilities, and terms for investors. However, new rules set by the energy reforms could allow entry of foreign firms to develop Mexico's shale gas resources.

## Trade

### Pipeline imports from the United States

Mexico is a net importer of natural gas, with most imports arriving via pipeline from the United States (Figure 11). In 2015, Mexico imported an average of 2.9 billion cubic feet per day (Bcf/d) of natural gas from the United States, an increase of more than 200% from 2010.<sup>38</sup> In April 2016, monthly imports from the United States set another record when they reached 3.4 Bcf/d, following the upward trend in recent years. U.S. natural gas exports to Mexico accounted for 59% of total U.S. natural gas exports in 2015 and were approximately 81% of Mexico's natural gas imports in 2015.



Mexico is constructing dozens of new natural gas-fired power plants across the country to meet increasing electricity demand. To fuel these new power plants, many natural gas pipelines are being constructed to import larger amounts of natural gas from the United States. Projects to increase natural gas pipeline capacity are underway across the northern part of Mexico, with capacity expected to exceed 7 Bcf/d by 2020.<sup>39</sup>

### Liquefied Natural Gas

Because of pipeline constraints, Mexico has to meet some of its natural gas demand with liquefied natural gas (LNG). The country imported 251 Bcf of LNG in 2015.<sup>40</sup> LNG imports were 24% of total natural gas imports in 2015, a steep decline from 46% in 2014.<sup>41</sup> With pipeline capacity expansions underway, LNG imports are expected to continue declining because cheaper natural gas from the United States via pipeline will displace more expensive LNG imports and could possibly lead to LNG exports from Mexico.

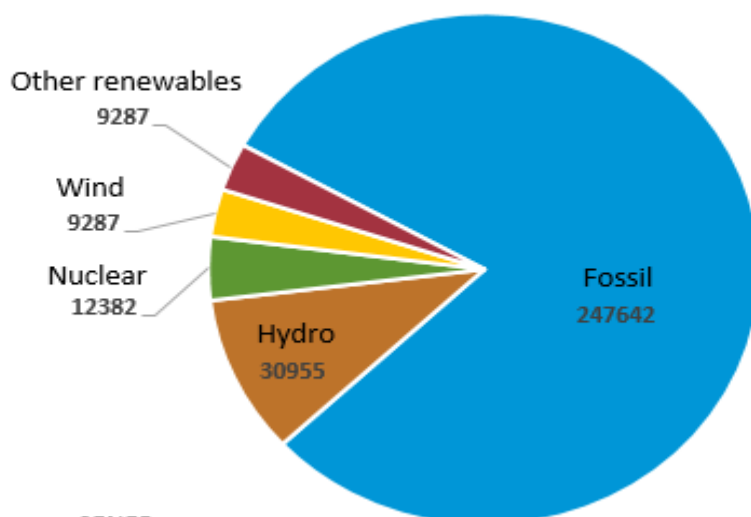
## Electricity

**Mexico is investing in new power plants to increase electricity generation capacity and to transition to natural gas as the main fuel source.**

According to SENER, Mexico had 68 gigawatts (GW) of installed generation capacity in 2015.<sup>42</sup> The country generated an estimated 310 billion kilowatt-hours (kWh) of electric power in 2015, an increase of 21% from a decade ago.<sup>43</sup> Power plants using fossil fuels provided 72% of Mexico's electricity capacity and 80% of Mexico's electricity generation (Figure 12) in 2015.

In 2013 the [National Energy Strategy](#) outlined by SENER and the [Works and Investment Program of the Electricity Sector \(POISE\)](#) set up by Comision Federal de Electricidad (CFE) set a goal to generate 35% of electricity from nonfossil sources by 2024.<sup>44</sup> During the 2016 American Leaders Summit, which consists of the U.S., Canada, and Mexico, all parties agreed on a goal of 50% nonfossil electricity generation across North America by 2025.<sup>45</sup> According SENER, nonfossil electricity generation accounted for 20% of Mexico's electricity supply in 2015.<sup>46</sup>

**Figure 12. Mexico's electricity generation by fuel source, 2015**  
billion kilowatt-hours



Source: SENER

The electricity trade began in 1905 between remote border towns in the United States and Mexico. Privately-owned utilities on both sides of the border helped meet one another's electricity demand with a few cross-border, low-voltage lines.<sup>47</sup> Over the years, both countries developed highly regulated and structured electricity sectors, and major and minor cross-border transmission lines were constructed. For a variety of technical and market reasons, U.S.-Mexico electricity trade has remained small compared to the electricity trade between the U.S. and Canada.<sup>48</sup> Existing electrical interconnections between Mexico and the United States are relatively limited in capacity and are operationally constrained by nonsynchronous cross-border ties, except in the Southern California-Baja California region where new renewable energy projects are coming online and supplying power across the border.<sup>49</sup>

Mexico has been a modest exporter of electricity to the United States since 1990. In 2014, Mexico exported 7.1 billion kWh to the United States, or 11% of total electricity imports.<sup>50</sup> Electricity sales from Mexico to the United States could increase as the U.S. Department of Energy issued a Presidential Permit in 2012 for construction of a transmission line across the U.S.-Mexico border. The transmission line began commercial use in 2015 and has supplied electricity from Baja California to the southern California market.<sup>51</sup> Mexico also exports smaller amounts of electricity to Belize and Guatemala.

## Sector Organization

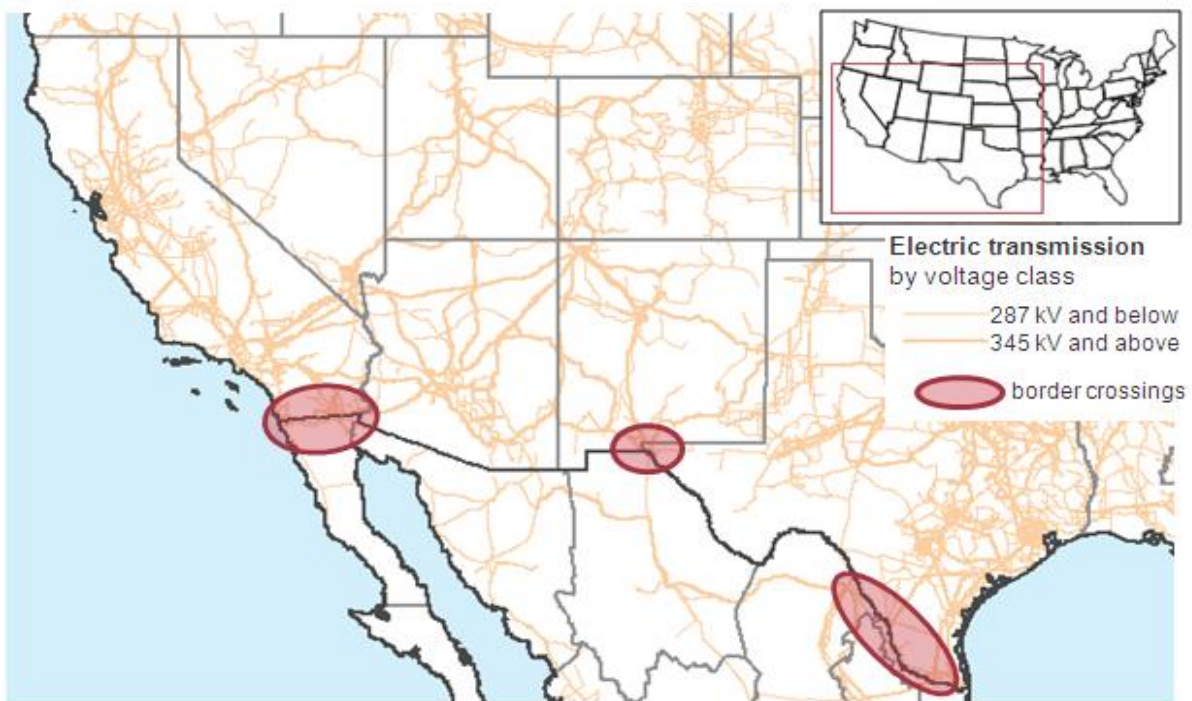
As a result of the recent energy reforms, Mexico is [transforming its electricity sector](#). The state-owned Comisión Federal de Electricidad (CFE) is still the dominant player in the generation sector, controlling most of the country's installed generating capacity. After CFE absorbed Luz y Fuerza del Centro in 2009, CFE became the only supplier of retail electricity, although private companies may sell into the wholesale market. The Comisión Reguladora de Energía (CRE) has principal regulatory oversight of the electricity sector, and the Centro Nacional de Control de Energía (CENACE) serves as the grid operator.

The Public Electricity Service Act of 1975 established exclusive federal responsibility over the electricity industry through CFE, but amendments to Mexican law in 1992 partially opened electricity generation to the private sector. Private participation in electricity generation is permitted in certain categories, including construction and operation of private plants for self-supply, cogeneration, small production (under 30 MW), and import/export. Any company seeking to establish private electricity generating capacity or to begin importing and/or exporting electric power must obtain a permit from CRE. As of 2015, independent generators—Productores Independientes de Energía (PIE)—held about 13 GW of generation capacity, or 24% of total capacity, consisting mostly of combined-cycle, natural gas-fired turbines.<sup>52</sup>

In March 2016, Mexico held the first long-term auction for the development of new electricity generation. Eleven companies were awarded contracts to develop a total of 2.8 gigawatts of new solar and wind generation capacity.<sup>53</sup> The second electric power auction resulted in 23 companies being awarded contracts to develop 2.9 GW of electricity. The results were announced on September 28, 2016.<sup>54</sup>

Mexico's national transmission grid, which is operated by CFE, includes more than 35,906 miles of mostly high- and medium-voltage lines, which cross along three main areas along the U.S.-Mexico border (Figure 13).<sup>55</sup>

**Figure 13** Electric transmission crosses U.S.-Mexico border in only a few areas



Source: U.S. Energy Information Administration

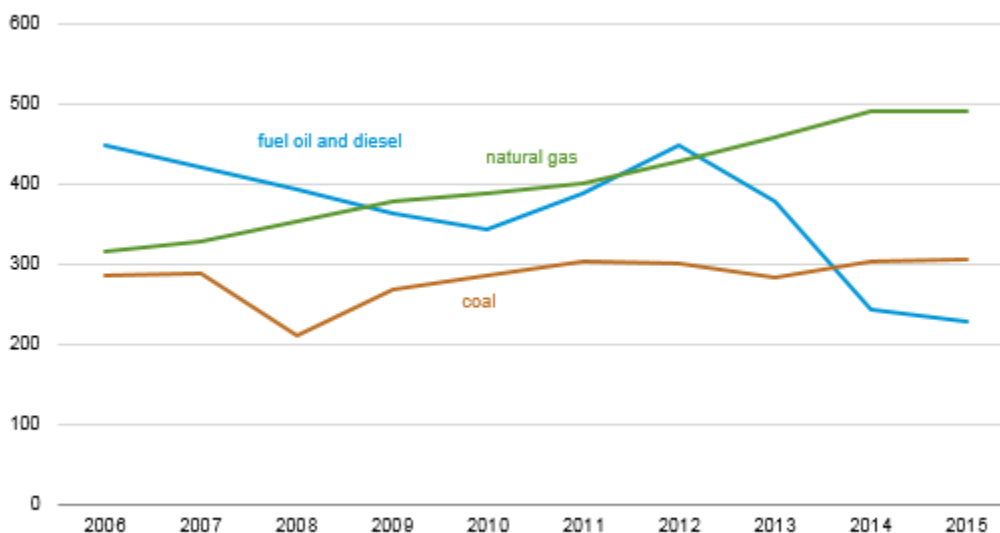


## Fossil Fuels

Power plants using fossil fuels provide most of Mexico's electricity generation. Although petroleum products were the leading fuels in Mexico's electric generation mix, natural gas used for electricity generation has risen rapidly in the past decade as price and availability have made it a more economic fuel source.

Coal consumption in Mexico has leveled out as natural gas consumption increases (Figure 14). Coal represents only 7% of total electricity generation.<sup>56</sup> Mexico is a net importer of coal, supplying about 80% of its coal demand domestically.

Figure 14. Mexico's consumption of fossil fuels for electricity generation  
trillion Btu



Source: Comisión Federal de Electricidad, U.S. Energy Information Administration

## Nuclear

Mexico has one nuclear power plant, Laguna Verde, in Veracruz. The Laguna Verde power plant, which includes two CFE-operated boiling water reactors with a combined generating capacity of 1,510 MW, accounted for 4% of Mexico's total electricity generation in 2015.<sup>57</sup> Current operation licenses for the reactors expire in 2020 and 2025, but they are expected to receive extensions.<sup>58</sup> There are plans to expand Mexico's nuclear generation capacity by building additional plants; three nuclear power plants are planned and scheduled for operation by 2026, 2027, and 2028.<sup>59</sup>

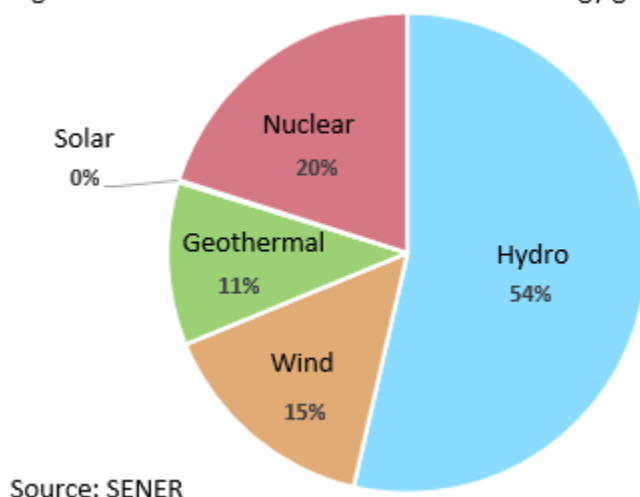
## Renewables

Mexico had 16,406 MW of total renewable energy installed capacity as of 2015, predominantly in hydroelectric, wind, and geothermal capacity.<sup>60</sup> Mexico invested \$4 billion in the renewable energy sector in 2015, more than double the amount invested in 2014.<sup>61</sup>

The largest source of renewable power generation is hydroelectric power (Figure 15). Mexico had 12,489 MW of hydroelectric capacity in 2015, which accounted for 18% of the country's total installed electrical capacity.<sup>62</sup> Hydroelectricity supplied about 10% of Mexico's total electricity generation in 2015.<sup>63</sup> The largest hydroelectric plant in the country is the 2,400 MW Manuel Moreno Torres, at the Chicoasén dam in Chiapas. In the same river basin as the Chicoasén dam, the Malpaso and Angostura dams have capacities of 1,080 MW and 900 MW of power, respectively.<sup>64</sup> Another major hydroelectric project, the 750-megawatt La Yesca facility, was completed in November 2012. These larger hydroelectric projects are supplemented by smaller hydroelectric facilities (categorized as lower than 30 MW each) that are being developed by both CFE and

the private sector. In 2015, there were 3,000 MW of hydroelectric projects under development, which demonstrates the continuing importance of hydroelectricity in Mexico.<sup>65</sup>

Figure 15. Mexican renewable and nuclear energy generation, 2015



Nonhydro renewables such as wind, geothermal, and solar PV, represented 5% of Mexico's electricity generation in 2015.<sup>66</sup> According to SENER, Mexico has 926 MW of geothermal capacity, making the country fifth in terms of global geothermal capacity.<sup>67</sup> The largest of these geothermal plants is the 720 MW Cerro Prieto Geothermal field in Baja California, the key component of Mexican geothermal generation.<sup>68</sup> In 2015, Azufres III phase 1 became operational with a capacity of 53 MW. Phase 2 at the Azufres III site will add another 25 MW in capacity by June 2018. The Los Humeros III plant is expected to come online in November 2016 and add 25 MW of capacity.<sup>69</sup>

Solar power has received significant attention in northern Mexico, where the first large-scale solar power project, Aura Solar I, began operations in 2013 with a capacity of 39 MW.<sup>70</sup> Other solar projects have broken ground, and more proposals are being considered as the cost to generate power using solar begins to compete with natural gas. The electric power auction held in March 2016 awarded contracts for 12 new solar parks.<sup>71</sup>

Several wind projects are in development in Mexico's Baja California and in southern Mexico to boost Mexico's wind generation capacity from 3 GW in 2015 to 15 GW by 2022.<sup>72</sup> Approximately 90% of the current wind generation capacity is located in Oaxaca, where the Isthmus of Tehuantepec has especially favorable wind resources and has been a focus of government efforts to increase wind capacity.<sup>73</sup> From 2010 to 2013, the Oaxaca region experienced a near 667% increase in wind generation capacity with the additions of five major projects (Oaxaca I, II, III, and IV, and La Venta III), bringing Oaxaca's wind generation capacity to 1,751 MW.<sup>74</sup> Continuing the momentum, the Oaxaca region expects an additional 2.5 GW to be operational between 2017 and 2018.<sup>75</sup> In Baja California, Semptra U.S. Gas & Power is developing the 156 MW Energía Sierra Juárez 1 (ESJ) wind farm. Electricity from the wind farm will be exported to the United States on a new transmission line, powering an estimated 65,000 homes in San Diego County, California.<sup>76</sup> ESJ became commercially operational in 2015 with a potential total capacity of more than 1.2 GW.<sup>77</sup> With these developments, Mexico is poised to become one of the world's fastest-growing wind energy producers.



## Notes

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- Data presented in the text are the most recent available as of August 29, 2016.
- Data are EIA estimates unless otherwise noted.

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<sup>3</sup> New York Times, "[With Oil Revenue Dropping, Mexico Announces Budget Cuts](#)," Jan. 30, 2015.

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<sup>6</sup> [PEMEX](#)

<sup>7</sup> Wall Street Journal, "[Mexico begins new round of oil auctions with shallow-water blocks](#)," July 19, 2016.

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<sup>9</sup> Oil & Gas Journal, Worldwide Look at Reserves and Production, January 1, 2016

<sup>10</sup> CNH, [Reported de incadores de extraccion](#)

<sup>11</sup> Ibid

<sup>12</sup> Ibid

<sup>13</sup> CNH, [Produccion historica de petroleo manual por campo](#)

<sup>14</sup> BN Americas, "Mexico launches Trion deepwater tender" July 27, 2016.

<sup>15</sup> [U.S. Department of the Interior](#)

<sup>16</sup> CNH, [Reported de incadores de extraccion](#)

<sup>17</sup> Ibid

<sup>18</sup> [Oil & Gas Mexico](#)

<sup>19</sup> [EIA](#)

<sup>20</sup> [PEMEX](#)

<sup>21</sup> [EIA](#)

<sup>22</sup> [PEMEX](#)

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<sup>24</sup> [PEMEX](#)

<sup>25</sup> PEMEX, [Sustainability Report 2014](#), page 55.

<sup>26</sup> Houston Chronicle, "[To combat fuel theft, Pemex reduces gasoline and diesel pipeline shipments](#)" February 17, 2015.

<sup>27</sup> [PEMEX](#)

<sup>28</sup> *Oil & Gas Journal*, Worldwide Refining Survey 2015

<sup>29</sup> [PEMEX](#)

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<sup>31</sup> SENER, Natura Gas Prospectus 2015.

<sup>32</sup> Oil & Gas Journal, Worldwide Look at Reserves and Production, January 1, 2016

<sup>33</sup> EIA, [Shale Gas Assesment](#), Attachment A-1,

<sup>34</sup> Oil & Gas Mexico, "[An Overview of Round Zero Results & Round One Content](#)"

<sup>35</sup> PEMEX, [Quarterly Reports](#)

<sup>36</sup> Ibid

<sup>37</sup> [Railroad Commission of Texas](#)

<sup>38</sup> [EIA](#)

<sup>39</sup> Barclays, Bentek

<sup>40</sup> [BP Statistical Review of World Energy 2016](#)

<sup>41</sup> Ibid

<sup>42</sup> SENER, "[Programa de Desarrollo del Sistema Electrico Nacional](#)" parte 1 pg 27

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- <sup>43</sup> SENER, "[Programa de Desarrollo del Sistema Eléctrico Nacional](#)" parte 1 pg 30 and SENER, "[Perspectiva del Sector Eléctrico 2007-2016](#)" pg 81
- <sup>44</sup> [Ibid](#)
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- <sup>64</sup> [International Hydropower Association](#)
- <sup>65</sup> [Mexico Energy & Sustainability Review: 2015, page 136.](#)
- <sup>66</sup> SENER, "[Programa de Desarrollo del Sistema Eléctrico Nacional](#)" parte 1 pg 31
- <sup>67</sup> SENER, "[Programa de Desarrollo del Sistema Eléctrico Nacional](#)" parte 1 pg 28 and Geothermal Energy Association, "[2016 Annual U.S. & Global Geothermal Power Production Report](#)" pg 10
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- <sup>74</sup> [AMDEE](#)
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