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U.S. Energy Information
Administration

Country Analysis Brief: South Korea

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Overview

South Korea relies on imports to meet about 98% of its fossil fuel consumption as a result of insufficient domestic resources. The country is one of the world's leading energy importers.

South Korea was the world's ninth-largest energy consumer in 2015, according to estimates from the *BP Statistical Review of World Energy 2016*.¹ Because South Korea lacks domestic energy reserves, it is one of the top energy importers in the world and relies on imports for about 98% of its fossil fuel consumption. South Korea ranks among the world's top five importers of liquefied natural gas, coal, crude oil, and refined products.² South Korea has no international oil or natural gas pipelines and relies exclusively on tanker shipments of LNG and crude oil.

Despite its lack of domestic energy resources, South Korea is home to some of the largest and most advanced oil refineries in the world. In an effort to improve the nation's energy security, oil and natural gas companies are aggressively seeking overseas exploration and production opportunities.

Figure 1. Map of South Korea



Source: U.S. Department of State

South Korea's highly developed economy drives its energy consumption, and economic growth is fueled by exports, most notably exports of electronics and semiconductors. The country also comprises one of the world's top shipbuilding industries. Real gross domestic product (GDP) grew to 3.3% in 2014, up from 2.9% in 2013. However, GDP growth dropped to 2.6% in 2015 as demand in the country's export markets weakened.³

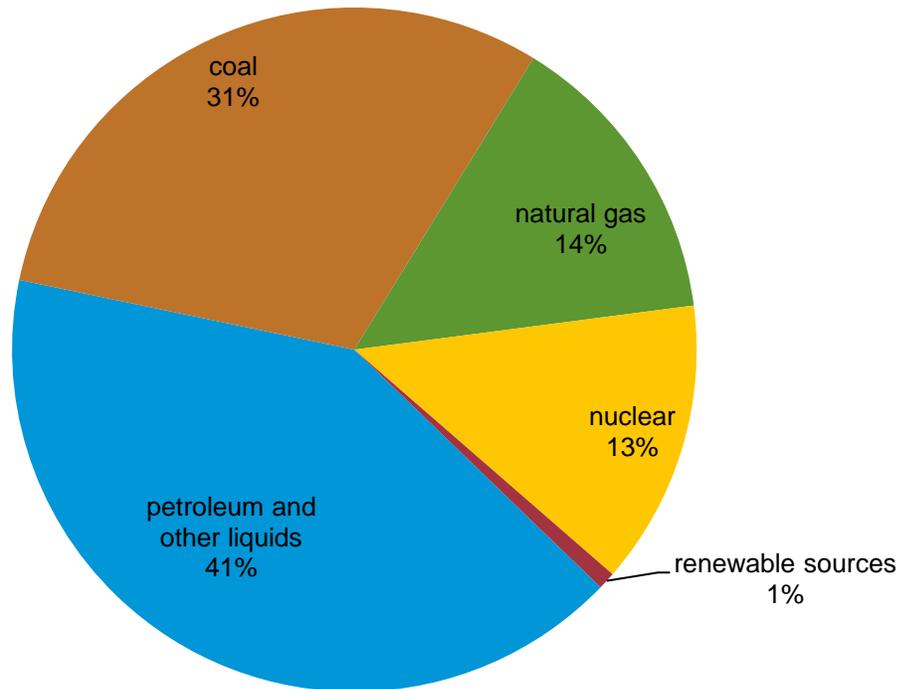
South Korea's economic growth following the 2008 global financial crisis was relatively resilient compared to weaker growth of the economies in other developed countries. However, South Korea's economy is heavily dependent on export markets, particularly within Asia, which have experienced a slowdown in the past few years. Also, the country's aging population is expected to dampen domestic demand for energy and the overall economic landscape.⁴

Although petroleum and other liquids, including biofuels, accounted for the largest portion (41%) of South Korea's primary energy consumption in 2015, its share has been declining since the mid-1990s, when it reached a peak of 66%.⁵ This trend is attributed to the steady increase in natural gas, coal, and nuclear energy consumption, which has reduced oil use in the power sector and the industrial sector. Higher vehicle efficiencies have also reduced oil consumption (Figure 2).

Following Japan's Fukushima disaster and South Korea's problems with false safety certifications of nuclear parts in late 2012, the government scaled back its long-term reliance on nuclear power in the electricity portfolio from its first plan in 2008 to the most recent plan unveiled in early 2014.⁶ South Korea is attempting to balance its fuel portfolio to meet higher energy consumption, to moderate its nuclear power generation, to reduce greenhouse gas emissions, and to offset some fossil fuel imports.

As part of this effort, the government is also promoting greater demand-side management, energy efficiency measures, and use of renewable energy.

Figure 2. South Korea total primary energy consumption by fuel type, 2015



Note: Petroleum and other liquids includes biofuels (ethanol and biodiesel)

Source: *BP Statistical Review of World Energy 2016*



Petroleum and other liquids

South Korea has a large oil refining sector, but the country relies almost entirely on crude oil imports to supply its refineries.

Overview

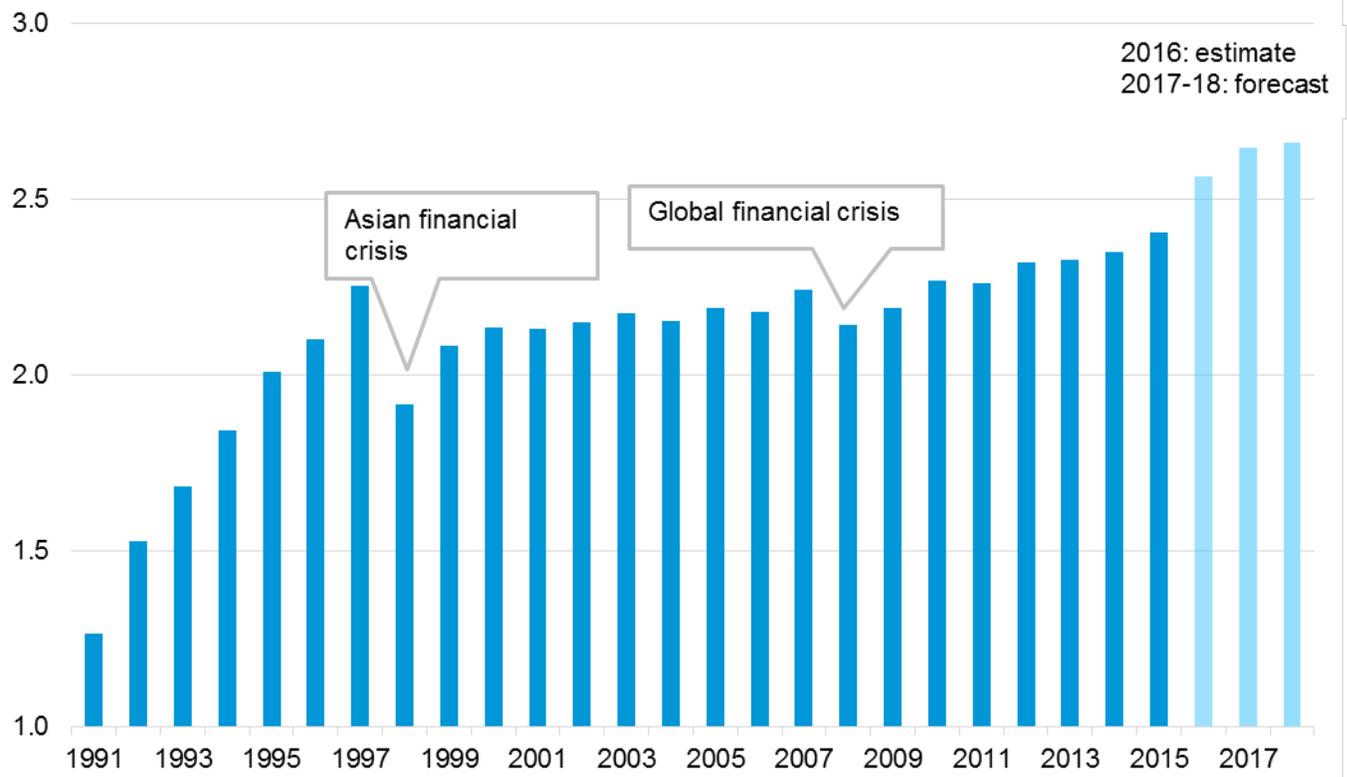
South Korea consumed 2.4 million barrels per day (b/d) of petroleum and other liquids in 2015, making it the 8th largest consumer in the world (Figure 3). Preliminary data shows that South Korean oil demand rose by nearly 160,000 b/d in 2016 as a result of support from lower oil prices in the transportation sector and greater use of liquefied petroleum gas and naphtha in the petrochemical sector. According to the Korea National Oil Company (KNOC), South Korea has a small amount of domestic oil reserves, but the country relies almost entirely on crude oil imports to meet its demand. Most of South Korea's total petroleum and other liquids production of 79,000 b/d is from refinery processing gains, non-conventional liquids, and biofuels production.

According to the *Oil & Gas Journal* (OGJ), 3 of the 10 largest crude oil refineries in the world are located in South Korea, making it one of Asia's largest petroleum product exporters.⁷ According to Facts Global

Energy (FGE), South Korea exported about 1.3 million b/d of refined oil products in 2015, mostly in the form of middle distillates such as gasoil, gasoline, and jet fuel. Oil product imports, about 0.9 million b/d in 2015, were primarily naphtha and LPG.⁸ Because of increased demand in Asia during the past decade, South Korea's exports of refined products have grown rapidly. The future growth rate of oil product exports will depend on demand from regional trading partners, which has been weak over the past few years, and on rising competition from new Asian and Middle Eastern refineries.

Figure 3. South Korea's petroleum and other liquids consumption, 1991-2018

million barrels per day



Source: U.S. Energy Information Administration, *Short-Term Energy Outlook*, January 2017

South Korea's oil consumption level has fluctuated with its economic growth, oil prices, and the status of its export markets. Oil consumption grew at a rapid pace with economic growth in the 1990s, but then it fell following the Asian Financial Crisis of 1997. Oil consumption then rose steadily until 2007, but it dipped during the global economic downturn in 2008. Oil demand gradually rose from 2008 to 2015, and reports indicate that fuel oil demand is up some months in 2016 because of a hotter-than-normal summer and a temporary closure of some nuclear facilities in September.⁹

Naphtha, which is used for the country's sizeable petrochemical and industrial sectors, accounts for about 42% of total oil product demand and is a primary driver of domestic demand growth.¹⁰ South Korea also uses liquefied petroleum gas (LPG) for its petrochemical industry. LPG demand, which accounted for 10% of petroleum product demand in 2015, is projected to increase in the next few years following the addition of two large propane dehydrogenation (PDH) plants in 2015 and 2016.¹¹

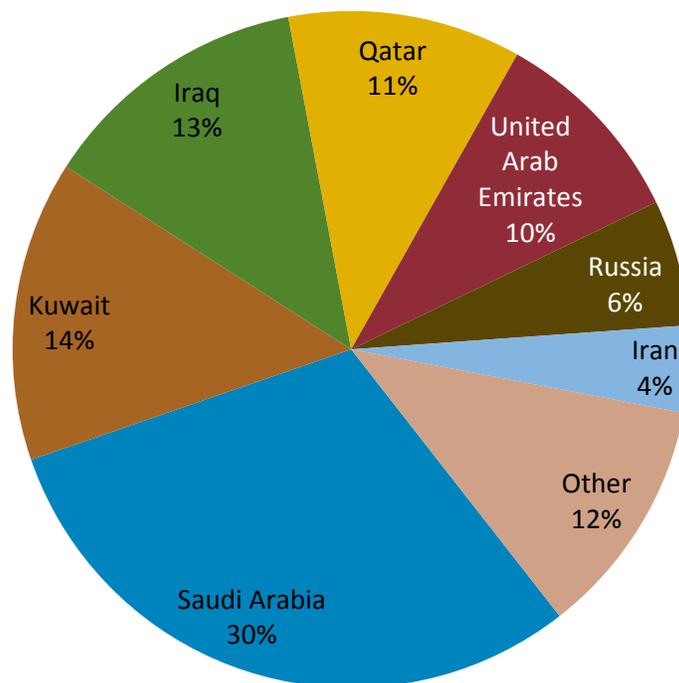
Lower oil prices in 2015 and 2016 have spurred growth in transportation fuels, but South Korea's oil demand growth outside of the petrochemical sector is limited in the long term because of the country's

declining population growth and aging demographics, greater energy efficiency measures, and competition from other fuels such as natural gas, coal, and nuclear power.

In 2015, South Korea imported nearly 2.8 million b/d of crude oil and condensate, making it the fifth-largest importer in the world. South Korea is highly dependent on the Middle East for its oil supply, and the region accounted for more than 83% of South Korea's 2015 crude oil imports. Saudi Arabia was the leading supplier and the source of 30% of South Korea's imports, followed by Kuwait at 14% of total crude oil imports (Figure 4).¹²

South Korea reduced its share of crude oil imports from Iran from 10% in 2011 to 4% by 2015 to comply with sanctions imposed by the United States and Europe. The sanctions that resulted from Iran's disputed nuclear program severely limited Iran's sale of crude oil and condensate on the international market. Russia and other Middle Eastern suppliers, such as Iraq, Qatar, and the United Arab Emirates, made up for South Korea's lost imports from Iran through 2015. When Western sanctions were lifted on Iranian oil exports and its financial sector in January 2016, South Korea began increasing shipments of crude oil and condensate from Iran.¹³ According to estimated data, the amount of Iranian crude oil and condensate entering South Korea during the first 11 months of 2016 was more than double the volumes in the same period of 2015.¹⁴

Figure 4. South Korea crude oil imports by source, 2015



Sources: United Nations/World Trade Organization International Trade Center, Korea Customs and Trade Development Institution

Sector organization

The Korea National Oil Corporation (KNOC) is a state-owned oil company and the largest entity in South Korea's upstream oil and natural gas sector. Through acquisitions of overseas companies and investments with major international and national oil companies, KNOC produced 137,000 b/d of oil and about 190 billion cubic feet of natural gas in 2015 in its overseas operations.¹⁵

Korea's downstream sector includes several large international oil companies including SK Energy, the nation's largest international oil company (IOC). SK Energy is the largest marketer of petroleum products, followed by GS Caltex, S-Oil, and Hyundai Oilbank. These companies have historically focused on refining, but some have put increasing emphasis on crude oil extraction projects in other countries. SK Energy also owns the largest stake in the Daehan Oil Pipeline Corporation (DOPCO), which exclusively owns and manages South Korea's oil pipelines, although most of the country's oil is distributed by tankers or trucks.

To compensate for the lack of domestic oil reserves and to secure more crude oil supplies, South Korea's state-owned and private oil companies engage in many overseas exploration and production (E&P) projects. The Korea Petroleum Association (KPA) started the Korea-Oil Producing Nations Exchange (KOPEX) in 2006 to maintain good relations with oil-producing countries and to offer technology training to producing countries in the downstream sector. In addition, the South Korean government has provided financial support for the country's upstream companies to win bids overseas on E&P projects through the Special Accounts for Energy and Resources (SAER), administered by KNOC.

To reduce South Korea's dependency on foreign energy imports, the Ministry of Trade, Industry and Energy (MOTIE) set self-sufficiency targets for South Korean energy companies based on their domestic and overseas production levels each year since 2008. Almost none of South Korea's overseas production has been shipped back to South Korea. South Korea received its first crude oil delivery of overseas production at the end of 2013. The NOC has accumulated massive debt in the past decade because it purchased several unprofitable assets in a high oil price environment, and the government reversed its energy policy.

Since early 2013, South Korea's energy policy has moved away from self-sufficiency targets to reduce the debt-to-equity ratios (total debt to total assets) of the key energy companies such as KNOC, KOGAS, and KEPCO. KNOC's debt-to-equity ratio has climbed sharply in recent years to 453% in 2015 from 168% in 2012. The government plans to divest some of KNOC's global oil assets based on profitability and to set a debt-to-equity ratio of 177% by 2017.¹⁶

Exploration and production

South Korea has only one commercially producing field among its basins under exploration (Ulleung Basin, Yellow Basin, and Jeju Basin). Discovered in 1998, Donghae-1, Block 6-1, in the Ulleung Basin, has total proved reserves of 3.2 million barrels of ultra-light crude oil (condensates).¹⁷ Natural gas and associated condensate production from Donghae-1 began in 2004. On average, KNOC has produced less than 1,000 b/d of ultra-light crude oil (condensates) from the Donghae-1 natural gas field, representing a negligible portion of its 2.4 million b/d total petroleum consumption.¹⁸

Figure 5. KNOC's domestic exploration blocks



Source: Korea National Oil Corporation

Although new discoveries might improve domestic oil prospects, overseas exploration and production play an essential role in South Korea's oil industry. The South Korean government has encouraged private E&P overseas through tax benefits and through the extension of credit lines to IOCs by the Korea Export-Import Bank. South Korea has also provided diplomatic aid in overseas negotiations. As of December 2015, KNOC has invested in 16 producing blocks and 8 fields under exploration in several countries.¹⁹

Figure 6. KNOC's global exploration projects



Source: Korea National Oil Corporation

Downstream and refining

According to OGI, South Korea had about 3 million b/d of crude oil distillation refining capacity at the end of 2016 and ranked sixth largest for refining capacity in the world (Table 1). The country's three largest refineries are owned by SK Energy, GS Caltex, and S-Oil Corporation (partially owned by Saudi Aramco).

Table 1. South Korea's Oil Refineries as of December 2016

Owner	Location	Capacity (barrels/day)
SK Energy	Ulsan	840,000
GS Caltex Corporation	Yeosu	785,000
S-Oil Corporation	Onsan	669,000
Hyundai Oil Refinery Company	Daesan	390,000
SK Energy	Inchon	275,000
Total Refining Capacity		2,959,000

Source: *Oil & Gas Journal*

Korean refineries are increasingly producing light, clean oil products as a result of refinery upgrades in recent years. The high degree of sophistication of South Korean refineries results in high capacity utilization. As a result, South Korea is expected to remain a leading refiner in Asia, with significant exports to other Asian countries. Recently, South Korean refiners have faced the headwinds of slower demand in export markets in recent years, although lower oil prices boosted refining margins in 2015.

In 2014, several major South Korean refiners commissioned three condensate splitters, which are refinery units that convert condensate oil into naphtha for petrochemical use. Hyundai Oilbank and Lotte Chemical commissioned another 110,000 b/d splitter in September 2016, which brings South Korea's total condensate splitting capacity to about 485,000 b/d.²⁰ Most of the condensate imports are from Qatar. South Korea's refiners have expressed interest in importing more condensate from the United States and Iran and have boosted imports from Iran in 2016.²¹

Petroleum and other liquids storage

To reduce volatility from oil supply disruptions and price fluctuations, South Korea holds strategic and commercial oil reserves. As part of the strategic reserves, KNOC held 94 million barrels of strategic crude oil and petroleum products inventories, plus international joint stockpiles, at nine storage facilities with 146 million barrels of capacity as of mid-2016. Other companies such as SK Energy, GS Caltex, S-Oil, and Hyundai Oilbank also hold stocks for industrial operations, according to the International Energy Agency.²²

In response to South Korea's diversification of its energy portfolio over the past few decades, oil companies not only upgraded refining facilities and increased upstream investment, but they also began investing in oil storage and alternative energy projects. As part of South Korea's efforts to become a major liquids storage and trading hub in northeastern Asia, KNOC, through joint ventures with other firms, is building the country's first three commercial oil storage facilities, which will hold a total capacity of 36.6 million barrels. The first facility, located in Yeosu in the southwestern region, came online in 2013, with 8.2 million barrels of capacity. The other two planned facilities will be built in Ulsan in the southeastern region of South Korea and will come online by 2025.²³

Natural gas

South Korea is the second-largest importer of liquefied natural gas in the world behind Japan.

South Korea relies on imports to satisfy almost all of its natural gas demand, which has nearly doubled over the past decade. Domestic natural gas production is negligible and accounts for less than 1% of total consumption. South Korea does not have any international natural gas pipeline connections and must import all gas via LNG tankers. As a result, although South Korea is not among the top natural gas-consuming nations, it is the second-largest importer of LNG in the world after Japan.

Consumption

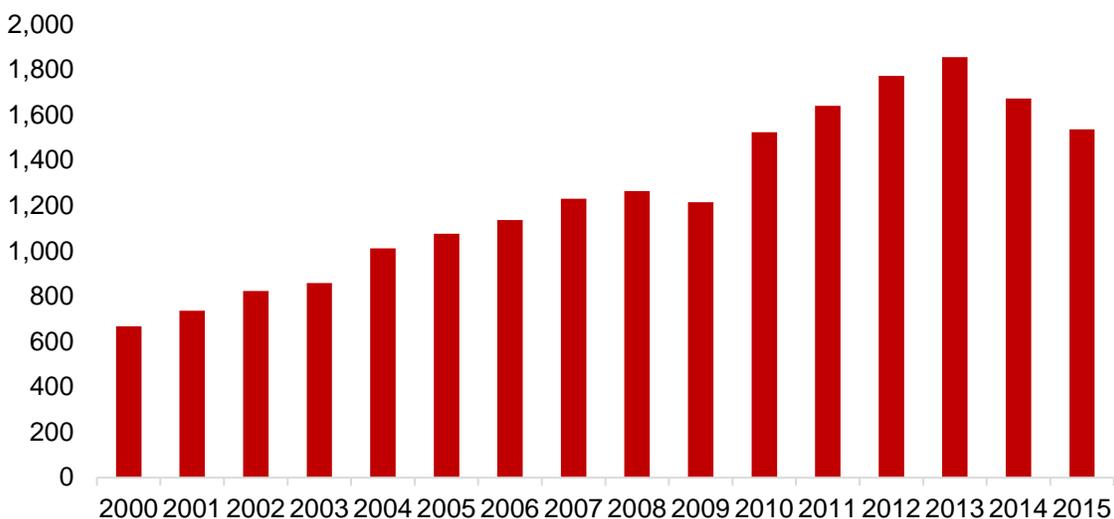
South Korea consumed an estimated 1.6 trillion cubic feet (Tcf) of dry natural gas in 2015, more than double the amount in 2000 (Figure 7). The city gas network, serving residential, commercial, and industrial consumers, accounted for about half of the natural gas sales in 2015, while power generation

companies made up much of the remaining share. For the past decade, power generation has required a growing share of South Korea's natural gas supply.²⁴

Strong natural gas consumption growth between 2009 and 2013 was driven by electricity demand and economic growth. Natural gas consumption then fell by 17% between 2013 and 2015. Power generators turned to more coal and nuclear power starting in 2014. Nuclear facilities returned to service following a shutdown in 2012 because of safety problems, and global coal prices plummeted and became less expensive than imported natural gas. Industries chose to use less-expensive coal instead of natural gas. Despite recent lower demand, natural gas remains a key source of cleaner fossil energy for the country.

Figure 7. South Korea's natural gas consumption, 2000-15

billion cubic feet



Source: U.S. Energy Information Administration, International Energy Agency

Sector organization

Korea Gas Corporation (KOGAS) dominates South Korea's wholesale natural gas sector, and the company is the largest single LNG importer in the world. In spite of recent efforts by the government to liberalize the LNG import market and allow other local importers to resell their LNG cargoes, KOGAS maintains an effective monopoly over the purchase, import, and wholesale distribution of natural gas. Currently, other companies are allowed to import LNG only if they use the gas for their own purposes and if the price does not exceed KOGAS' long-term contract prices. The government intends to deregulate this sector by 2025 and to allow private companies to import and resell LNG, and essentially compete with KOGAS.²⁵ In addition to operating three of Korea's five LNG receiving terminals, KOGAS owns and operates the national pipeline network.²⁶

The South Korean central government is the largest KOGAS shareholder with 26.15% direct equity, a 20.47% share through the state-owned Korean Electric Power Company (KEPCO), and 7.94% from local governments. The remaining shares are privately owned.²⁷ South Korea has more than 30 private distribution companies, and each company has monopoly control in its region. These local companies

purchase wholesale natural gas from KOGAS at a government-approved price, and sell the gas to end-users.²⁸

In the upstream sector, KOGAS has focused primarily on overseas LNG liquefaction projects, while the KNOC has handled most exploration and production-related activities. However, KOGAS seeks new opportunities for growth, and its focus on overseas upstream activities has increased. As part of the effort to develop into a global integrated energy company and to secure more LNG from its own supplies, KOGAS has participated in E&P projects around the world and has invested in foreign gas companies with LNG supply. As of mid-2016, KOGAS held investments in 26 projects, including exploration, production, LNG assets, and downstream facilities, in 13 countries.²⁹

Recently, KNOC and KOGAS have announced intentions to divest certain assets as a result of mounting debt levels, cost overruns from several overseas projects, and pressure from the Korean government to reduce expenditures. The government has called for KOGAS to reduce its debt-to-equity ratio to 274% by 2017 from 322% in 2015. In response, KOGAS divested some of its oil and natural gas projects.³⁰

Exploration and production

South Korea produced only 7 Bcf of natural gas in 2015, down from a high of 19 Bcf in 2010. This production was from the Donghae-1 natural gas field in the Ulleung Basin.³¹ KNOC plans to continue production operations of the field until 2019, when the project will be converted into an offshore storage facility. KNOC and Woodside Energy (Australia) are jointly exploring deepwater blocks of the offshore Ulleung Basin and began drilling in 2012.³²

Liquefied natural gas

South Korea ranks as the second-largest global importer of LNG after Japan. In 2015, South Korea imported more than 1.6 Tcf of LNG, dropping from a high of nearly 2 Tcf in 2013.³³ Preliminary data indicate that imports fell by nearly 3% in the first half of 2016 compared with the same period in 2015.³⁴

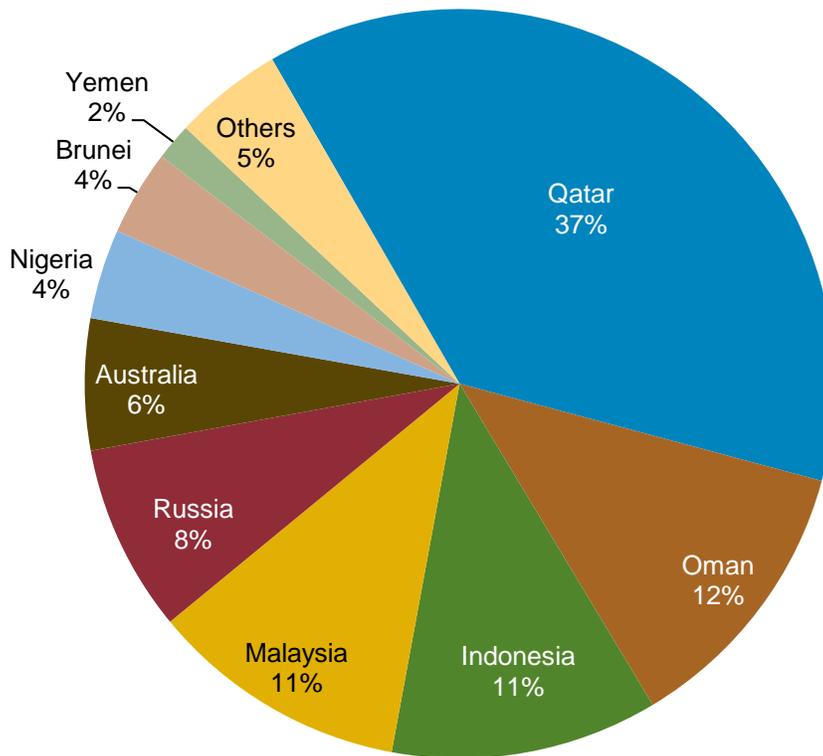
South Korea currently has five LNG regasification facilities with a total capacity of 4.7 Tcf per year and an average estimated 34% utilization rate. KOGAS operates four of these facilities (Pyongtaek, Incheon, Tong-Yeong, and Samcheok), accounting for about 98% of current capacity. The Samcheok terminal, located on the northwest coast, is KOGAS's smallest terminal and was added in 2014.

Pohang Iron and Steel Corporation (POSCO) and K-Power jointly own the only privately owned regasification facility in South Korea, located on the southern coast in Gwangyang. A second privately owned regasification facility at Boryeong, located in the northwestern region, is under construction by a joint venture between GS Energy Corporation and SK E&S Company. The facility is scheduled to begin commercial operations by the first quarter of 2017 and to add about 145 Bcf to capacity.³⁵ Both of these private terminals have very small capacities compared with the capacity owned by KOGAS.

KOGAS purchases most of its LNG through long-term supply contracts, and the company uses spot cargos primarily to correct small market imbalances. Almost three-fourths of 2015 LNG imports came from Qatar, Indonesia, Malaysia, and Oman (Figure 8). Indonesia was South Korea's first source of LNG and supplied more than half of South Korea's LNG imports before 2000. As South Korea diversified its LNG imports to secure more sources of gas to meet its growing demand, Indonesia lost some market share to other countries including Qatar, Oman, Nigeria, and Russia.

Several South Korean firms own shares in liquefaction projects in the Middle East, Australia, Indonesia, and Canada and signed long-term purchase agreements for LNG coming online from new liquefaction projects in Australia, the United States, and Canada by 2022. KOGAS and SK Energy have flexible destination contracts with the Sabine Pass and Freeport liquefaction terminals in the Gulf Coast of the United States starting in 2017, which allows the companies to resell volumes in the open market.³⁶ KOGAS also owns shares in upstream exploration and production assets in natural gas fields around the world including Canada, Iraq, and Southeast Asia.³⁷

Figure 8. South Korea LNG imports by source, 2015



Source: IHS Energy

Note: Others include Algeria, Equatorial Guinea, Trinidad and Tobago, and re-exports.

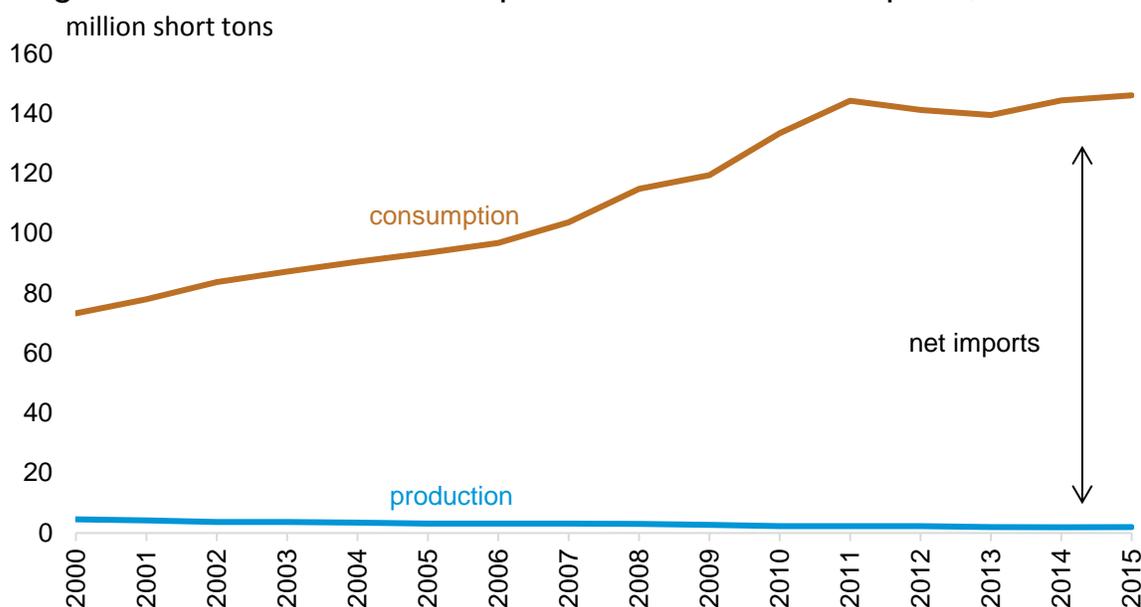


Coal

Rising coal consumption in South Korea and negligible domestic production resulted in the country having to rely heavily on coal imports over the past several years. In 2015, South Korea was the fourth-largest global coal importer.

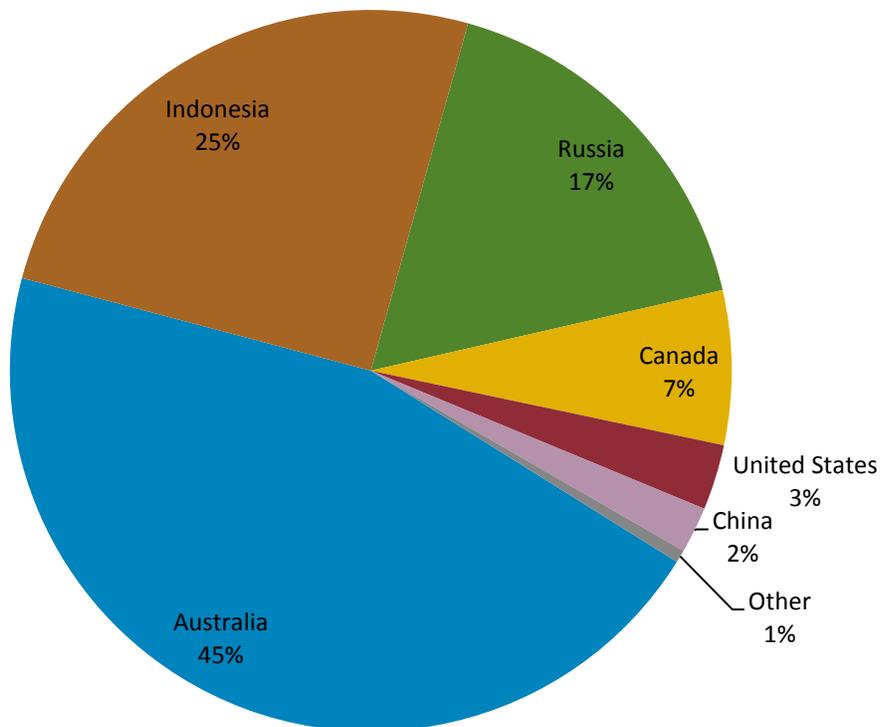
South Korea produced an estimated 1.9 million short tons (MMst) of coal from its anthracite reserves, which was a fraction of its estimated primary coal consumption of 146 MMst in 2015 (Figure 9).³⁸ Because of this wide supply and demand gap, South Korea is the fourth-largest importer of coal in the world, following China, India, and Japan. Imports have risen substantially in the past few years, from 131 MMst in 2010 to 149 MMst in 2015 as a result of the forced shutdowns of some nuclear plants in late 2012 because of safety issues. Australia and Indonesia account for the majority of South Korea's coal imports. Russia and Canada are other notable sources (Figure 10).³⁹ Coal consumption in South Korea increased by 56% between 2005 and 2015, driven primarily by growing demand from the electric power sector. The electric power sector accounted for more than 60% of the country's coal consumption, while the industrial sector (primarily steel and cement) contributed to most of the remaining coal demand in 2015, according to KEEL.⁴⁰

Figure 9. South Korea's coal production and consumption, 2000-15



Source: U.S. Energy Information Administration,

Figure 10. South Korea, coal imports by source, 2015



Source: United Nations/World Trade Organization, International Trade Center

Electricity

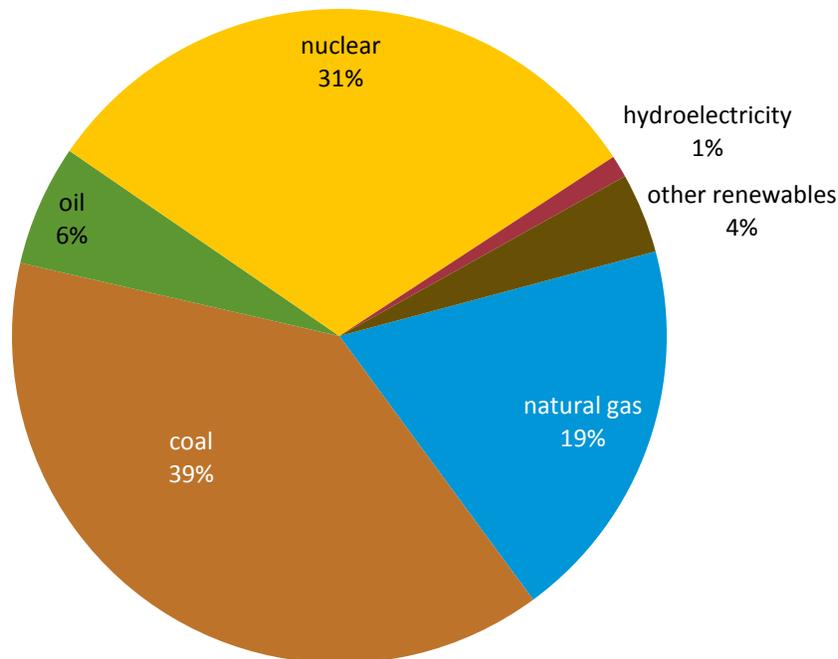
Fossil fuel sources account for nearly two-thirds of South Korea's electricity generation, while the share of nuclear power is almost one-third.

South Korea generated more than 528 terawatt-hours (TWh) of gross electricity in 2015, according to KEEI estimates. South Korea's power generation has increased by an average of 4% annually since 2005. Although in the past two years, generation growth rates have hovered around 1%, and in the first half of 2016, average electricity generation fell below the level in the same 2015 timeframe.⁴¹ This significant deceleration is attributed to weaker economic demand and export growth, more temperate weather, and demand side management.

In its latest power supply plan published in 2015, the South Korean government lowered its anticipated electricity demand growth to 2.2% annually to 2029. The government intends to cut its greenhouse gas emissions through energy conservation measures and through the use of cleaner energy from nuclear and renewable energy sources.⁴²

Fossil fuels generated about 64% of South Korea’s electricity generation in 2015, while 31% came from nuclear power, and 5% came from renewable sources, including hydroelectricity (Figure 11).⁴³ Coal-fired power, which is a baseload source, is the dominant fossil fuel used to generate electricity, and natural gas the second largest. Oil products generate very small amounts of power. Although fossil fuel-fired capacity is now dominant in South Korea, nuclear power is also a baseload power source, and South Korea plans to increase capacity from this fuel in the long term. In 2015, about 55% of electricity consumption was from industries, 25% from commercial and service enterprises, 13% from the residential sector, and 6% from other sectors such as transportation and agriculture, according to KEEL.⁴⁴

Figure 11. South Korea electricity generation by type, 2015



Source: KEPCO Annual Report 2016

Sector organization

The state-owned Korea Electric Power Corporation (KEPCO) controls all aspects of electricity generation, retail sales, transmission, and distribution. In 2001, KEPCO’s generation assets were spun off into six separate subsidiary power generation companies. Although the initial restructuring included plans to subsequently divest KEPCO of these generation companies (excluding the Korea Hydro & Nuclear Power Company), KEPCO still owns each of the subsidiaries. KEPCO also owns majority shares of KEPCO Engineering and Construction, Korea Nuclear Fuel, Korea Plant Service and Engineering, and Korea Electric Power Data Network. In 2016, the South Korean government proposed a partial privatization of KEPCO and plans to invite more competition from the private sector in power generation and distribution. The timeframe for the proposed restructuring has yet to be determined.⁴⁵

The Korea Electric Power Exchange (KPX), also established in 2001 as part of the electricity sector reform efforts, serves as the system operator and coordinates the wholesale electric power market. KEPCO continues to act as the electricity retailer, and it controls transmission and distribution.

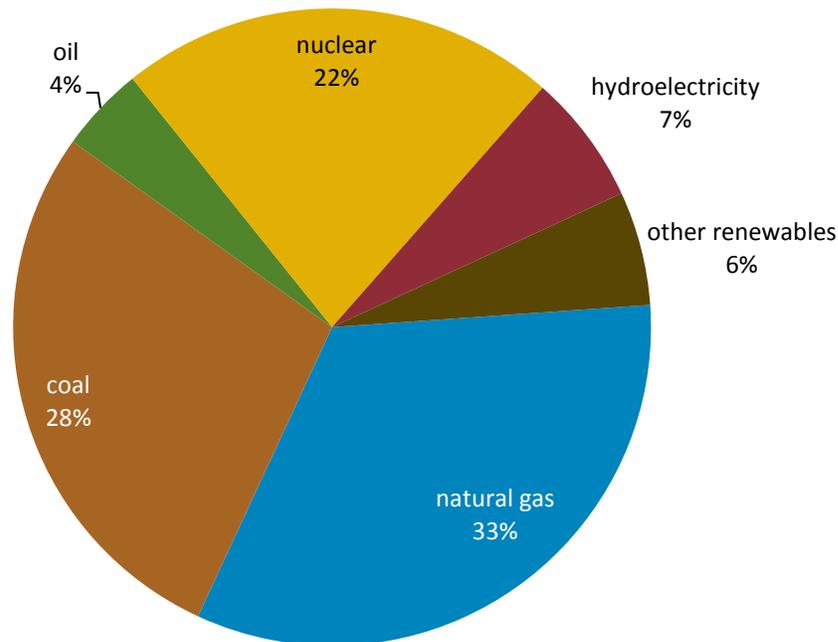
KPX regulates the cost-based bidding-pool market and determines prices sold between electricity generators and the KEPCO grid. An electricity tariff pricing system, designed to protect low-income residents and industrial consumers, historically has not reflected the true costs of generation and distribution, and the pricing system has not provided incentives to conserve electricity. MOTIE must approve all changes in end-use electricity prices. Retail consumer prices remain far below electricity prices in other economically developed countries, which has contributed to high overall electricity demand and power shortages during peak seasons over the past several years.⁴⁶ Although, MOTIE has raised prices at various points over the past few years to reduce demand.⁴⁷

According to KEEI, reserve ratios—the ratio of peak capacity to peak electricity demand—fell below 10% on an annual basis between 2007 and 2013, resulting in major blackouts in 2011.⁴⁸ These low margins were the result of delays in installed capacity additions, low electricity prices, high peak demand during certain years as a result of weather, and insufficient investment in renewable energy and energy efficiency projects until recently. In 2014, the reserve ratio increased to more than 11% because power consumption eased, more natural gas-fired, coal-fired, and renewable plant capacity came online, and nuclear facilities affected by the safety problems in 2012 returned to service.

Generation structure

Most of South Korea's installed generation capacity is fossil fuel-based, although nuclear power plays a significant role in the power sector. Baseload generation is primarily made up of coal and nuclear power, while peak demand is generally met by the country's LNG imports. According to KEPCO, South Korea's generating capacity at the end of 2015 was 98 gigawatts (GW), consisting primarily of natural gas (33%), coal (28%), and nuclear generation (22%).⁴⁹ In 2015, capacity rose from 93 GW in 2014 as coal, combined-cycle, and nuclear plants were added. Oil, hydroelectricity, and other renewables made up smaller shares (Figure 11).⁵⁰ South Korea intends to reduce its greenhouse gas emission levels by 37% from business-as-usual projected levels (projections of emission levels absent any carbon price scheme) by 2030.⁵¹ As part of this effort, the government is promoting more nuclear power plant development, cleaner burning coal-fired plants compared to the older and less efficient units, and greater development of renewable energy.⁵²

Figure 12. South Korea installed electricity generating capacity by type, 2015



Source: KEPCO Annual Report 2016

Fossil fuels account for a majority of the country's installed capacity, of which coal and natural gas power plants consisted of 60 GW in 2015, or about 61% of the total capacity, according to KEPCO.⁵³ South Korea plans to close 10 older coal-fired power plants by 2025 and not incorporate any new builds in its next electricity plan, which is consistent with the country's goal to incorporate cleaner sources of fuel into the generation portfolio. However, the previous power plan includes 20 new coal-fired power plants scheduled to enter service by 2022, Coal is likely to compete with LNG use in the power sector, despite the current low LNG prices.⁵⁴ Natural gas-fired power plants are also expected to contribute more to electricity generation with at least 2 GW of capacity additions entering service by 2020.⁵⁵ Currently, natural gas competes with less-expensive coal and nuclear sources of power. South Korea is weighing environmental, economic, and nuclear safety concerns and is trying to balance its power generation portfolio accordingly. The country's future slate of fuel for power will depend on fuel costs, the government's nuclear capacity designs, and the level of investment for clean energy technology.⁵⁶

Nuclear generation accounts for nearly one-third of South Korea's electricity generation and about 22% of installed generating capacity.⁵⁷ As of late 2016, South Korea ranked sixth-highest for nuclear generation capacity in the world and was surpassed by China in the past year.⁵⁸ The country's first nuclear power plant was completed almost four decades ago, and since then, South Korea has directed significant resources towards developing its nuclear power industry. South Korea imports all of the uranium needed to fuel its nuclear power plants and does not reprocess or enrich uranium as a result of a 30-year nuclear cooperation agreement with the United States. The countries extended this

agreement for 20 years in June 2015, although the new terms did not lift the restrictions on South Korea to produce its own nuclear fuel.⁵⁹

Korea Hydro & Nuclear Power Company currently operates South Korea's four nuclear power stations, which have 25 individual reactors with a power generation capacity of 23 GW. The latest reactor came online in early 2016, and the country has added 5.3 GW of capacity at new plants since 2010.⁶⁰ Eleven additional reactors are scheduled for completion by 2029, and three reactors with 4 GW of capacity are already under construction and scheduled to come online by 2019. Meanwhile, four of the country's oldest reactors are scheduled to close by 2025, unless the government extends their licenses.⁶¹

In late 2012, South Korea experienced several incidents of falsified certificates for components of some of its existing nuclear power plants, adding to the industry's distress following neighboring Japan's Fukushima nuclear disaster in 2011. The South Korean government shut down four reactors temporarily, and another six were offline for maintenance, which removed up to 40% of the nuclear capacity from service until the government inspected all reactors. Nuclear power generation fell by 10% from 155 TWh in 2011 to 139 TWh in 2013 before rebounding to 165 TWh in 2015.⁶² The country's current long-term energy plan, released in 2014, lowered the share of nuclear capacity to 29% of total generating capacity by 2035, from the previous goal of 41% by 2030, in response to anti-nuclear sentiment following the Fukushima incident in 2011. However, South Korea still plans for nuclear power to play a significant role in the electricity sector over the next few decades.

Nuclear generation utilization rates in South Korea are typically greater than 90%, some of the highest in the world, and the fuel serves as a baseload source for power generation. In 2013 and 2014, capacity factors were below 90% because a few nuclear facilities were closed for safety reasons in late 2012.⁶³

A renewable portfolio standard for South Korea replaced the previous feed-in tariff system in 2012 and require South Korea's major electric utilities to gradually increase the renewable energy share in their power generation portfolios to an average of 10% by 2024.⁶⁴ Renewable sources (primarily solar, wind, biomass, and waste) remain a small share of South Korea's electricity generation (5% in 2015), although there is robust growth in generation from renewable energy, apart from hydropower.⁶⁵

Notes

- Data presented in the text are the most recent available as of January 18, 2017.
- Data are EIA estimates unless otherwise noted.

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