Independent Statistics & Analysis
U.S. Energy Information Administration

Background Reference: South Korea

Last Updated: October 2020

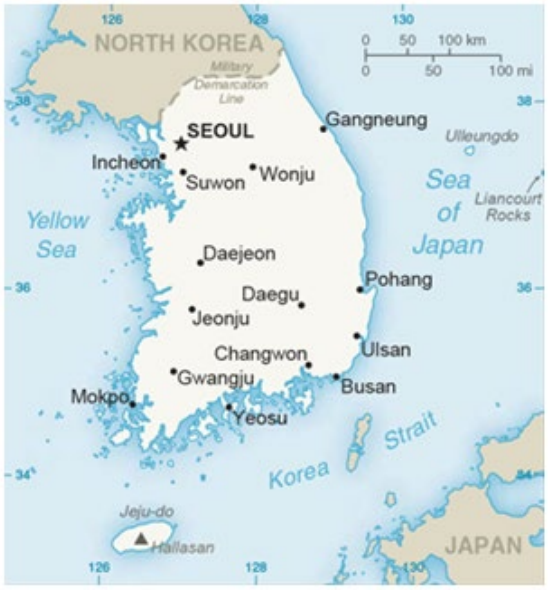
Overview

South Korea is one of the world's leading energy importers because of its insufficient domestic resources.

Despite its lack of domestic energy resources, South Korea is home to some of the largest and most advanced oil refineries in the world, and it exports a significant amount of refined fuel for transportation use.

South Korea's government scaled back long-term plans to rely on nuclear power in its most recent power plan, the *8th Basic Plan for Long-term Electricity Supply and Demand*, released at the end of 2017 and in its draft plan of the *9th Basic Plan for Long-term Electricity Supply and Demand*.[1] The plan reflects growing safety and health concerns following Japan's Fukushima nuclear disaster, South Korea's problems with false safety certifications of nuclear parts in late 2012, and several earthquakes that occurred during 2016 and 2017, all of which have potentially endangered the structural integrity of existing nuclear power plants. However, the government recognized that nuclear is still a vital source of power supply.[2] This plan also attempts to reduce greenhouse gas emissions and fine dust particle pollution by reducing overall coal use in electricity, replacing nuclear and coal-fired generation with natural gas and renewable energy, and promoting greater demand-side management and energy efficiency measures.

Figure 1. Map of South Korea



eia Source: U.S. Department of State

Petroleum and other liquids

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.

South Korea's downstream oil and natural gas sector includes several large international oil companies (IOCs) such as SK Energy, the nation's largest 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 companies have increasingly emphasized 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 tankers and trucks distribute most of the country's oil.

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 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 reliance on foreign energy imports, the Ministry of Trade, Industry and Energy (MOTIE) established self-sufficiency targets in oil and natural gas for South Korea's energy companies

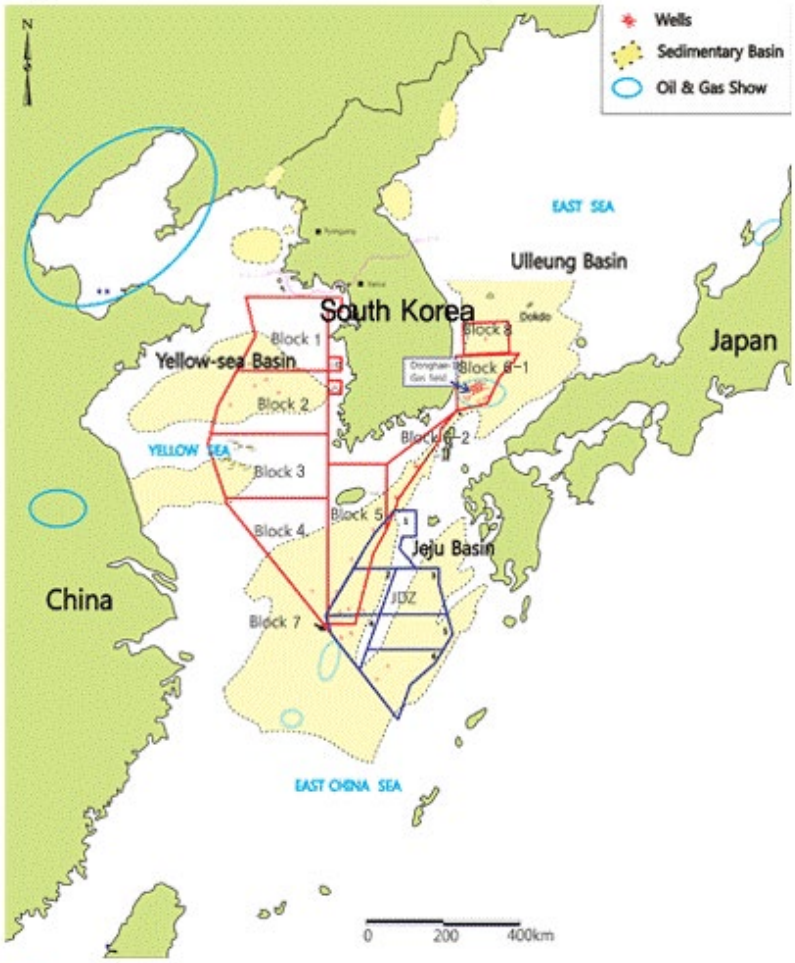
based on their domestic and overseas production levels each year starting in 2008. These targets represented the percentage of the country's oil and natural gas consumption to be met by overseas production by companies based in South Korea, although very little of South Korea's overseas production has been shipped back to South Korea. KNOC accumulated massive debt because the company purchased several unprofitable assets in a high oil price environment, and the government has reversed this energy policy.

Since early 2013, South Korea's energy policy has moved away from self-sufficiency targets to reduction of debt-to-equity ratios (total debt to total assets) of the key energy companies such as KNOC, Korea Gas Corporation (KOGAS), and Korea Electric Power Corporation (KEPCO). KNOC's debt-to-equity ratio climbed sharply to 529% in 2016 from 168% in 2012.[3] The government is considering restructuring KNOC and KOGAS, among other state-owned firms, to reduce debt and management inefficiencies.[4]

Exploration and production

South Korea has only one commercially producing oil field in its three domestic basins under exploration—Ulleung Basin, Yellow Sea Basin, and Jeju Basin (Figure 2). On average, since 2005, KNOC has produced less than 1,000 barrels per day (b/d) of ultra-light grade crude oil (condensates) from the Donghae-1 natural gas field, representing a negligible portion of its total petroleum consumption.[5]

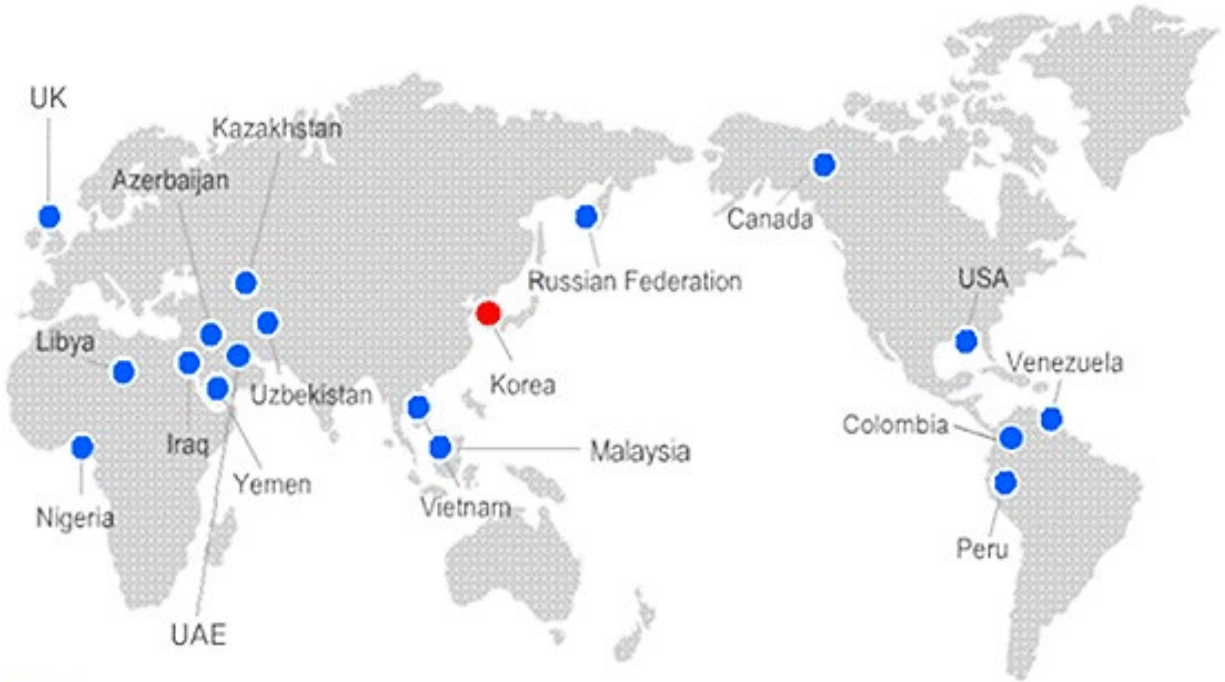
Figure 2. KNOC's domestic exploration blocks



eia Source: Korea National Oil Corporation

Although new discoveries might improve domestic oil prospects, overseas E&P play an essential role in South Korea's oil industry (Figure 3). South Korea's government has encouraged private E&P overseas through tax benefits, and the Export-Import Bank of Korea has extended credit lines to IOCs. South Korea has also provided diplomatic aid in overseas negotiations.

Figure 3. KNOC's global exploration projects



eia Source: Korea National Oil Corporation

Consumption

Oil used for feedstocks in the petrochemicals industry, particularly naptha, accounts for a significant portion of South Korea's oil demand. Naphtha use is likely to continue expanding in South Korea as a result of adding capacity at ethylene plants and rising demand for plastics in Asia. Oil consumption outside the petrochemical sector is limited in the long term because of the country's declining population growth and aging demographics; increasing energy efficiency measures; and competing fuels, such as natural gas, coal, and nuclear power.

Refining

South Korea has some of the most advanced oil refineries in the world, and its companies have investments in overseas oil and natural gas assets. 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.[6]

SK Energy, GS Caltex, and S-Oil Corporation (partially owned by Saudi Aramco) each own one of South Korea's three largest refineries. Demand growth for oil products has improved in South Korea's export and domestic markets during the past two years and has boosted the country's refining margins.[7]

South Korea's refineries have been producing more light oil products and middle distillates—such as diesel, gasoline, and jet fuel—as a result of refinery upgrades in recent years. Other upgrades include adding desulfurizing units to produce cleaner-burning oil. The high degree of sophistication of South

Korea's refineries results in high capacity utilization. As a result, South Korea will likely remain a leading refiner in Asia, with significant exports to other Asian countries.

Since 2014, South Korea's refiners have commissioned several condensate splitters, which are refineries that convert only condensate oil (ultra-light grade crude oil) into products such as naphtha for petrochemical use. Hyundai Oilbank and Lotte Chemical commissioned a 121,000-b/d splitter in late 2016.[8]

Petroleum and other liquids storage

To protect against oil supply disruptions and price fluctuations, South Korea holds strategic and commercial oil reserves for both crude oil and petroleum products. In addition to domestic storage facilities, additional inventories are also stored as international stockpiles under agreements between South Korea and other governments. The international joint stockpiling mechanism provides a way to lease out the strategic reserve capacity, although South Korea can use these reserves in emergencies.

In addition, 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) has been building the country's first three commercial terminals for crude oil and petroleum products at Yeosu and Ulsan, which will hold a total capacity of 36.6 million barrels. The first facility, located in Yeosu in the southwestern region of the country, came online in 2013, with 8.2 million barrels of capacity. The other two facilities are being constructed in two phases in Ulsan in the southeastern region of South Korea and will bring 28.4 million barrels of capacity online by 2026.[9]

Natural gas

South Korea relies on imports to satisfy almost all of its natural gas demand, which has nearly doubled during the past decade. Domestic natural gas production is minimal and accounts for less than 1% of total consumption.

Natural gas sector organization

The Korea Gas Corporation (KOGAS) dominates South Korea's wholesale natural gas sector, and the company is the largest single liquefied natural gas (LNG) importer in the world. In addition to operating four of Korea's six LNG-receiving terminals, KOGAS owns and operates the national pipeline network.[10] Although the government has plans to liberalize the LNG import market by allowing other local importers to resell their LNG cargoes, KOGAS maintains an effective monopoly over the purchase, import, and wholesale distribution of natural gas. Currently, private companies are allowed to import LNG only if they use the natural gas for their own purposes and if the price does not exceed KOGAS's long-term contract prices. In 2016, the government announced plans to deregulate this sector by 2025 and to allow private companies to import and resell LNG, essentially allowing them to compete with KOGAS.[11]

South Korea's central government is the largest KOGAS shareholder, with 26.15% direct equity. The state-owned Korea Electric Power Company (KEPCO) has the second-largest share at 20.47%, and local governments hold 7.93% of the shares. The remaining shares are privately owned.[12] 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 then sell the natural gas to end users.[13]

In the upstream sector, KOGAS has primarily focused on overseas LNG-liquefaction projects, and KNOC has handled most E&P-related activities. However, as KOGAS seeks new opportunities for growth, its focus on overseas upstream activities has increased. As part of the effort to develop into a globally 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 natural gas companies with LNG supply.

KOGAS's equity purchases of upstream and downstream projects overseas in the past decade and cost overruns from some of these projects have increased the company's debt levels. At the end of 2018, KOGAS's debt-to-equity ratio remained high at 367%. In response to the government's pressure in the past to reduce its debt-to-equity ratio, KOGAS has divested some stakes in its natural gas projects overseas.[14]

Several firms in South Korea own shares in liquefaction projects in the Middle East, Australia, Indonesia, and Canada, and they also signed long-term purchase agreements for LNG coming online from new liquefaction projects in Australia and the United States. KOGAS and SK Energy hold flexible destination contracts, which allow the companies to resell volumes in the open market, with the Sabine Pass and Freeport liquefaction terminal projects in the Gulf Coast of the United States. Sabine Pass began operations in 2017, and Freeport LNG came online in 2019.[15] KOGAS also owns shares in upstream E&P assets in natural gas fields around the world, including Canada, Iraq, and Southeast Asia.[16]

Exploration and production

South Korea's natural gas production is from the Donghae-1 and Donghae-2 natural gas fields in the Ulleung Basin.[17]

KNOC and Woodside Energy (Australia) are jointly exploring deepwater blocks of the offshore Ulleung Basin, and they began drilling in 2012.[18]

Consumption

Between 2009 and 2013, electricity demand and economic growth increased natural gas consumption. However, between 2013 and 2015, natural gas consumption fell by 16%. Several factors contributed to this decline. Power generators increased the use of coal and nuclear power starting in 2014 as a result of nuclear facilities that returned to service after a safety-related shutdown in 2012; the subsequent decrease in global coal prices to lower than the price of imported natural gas; and the cost competitiveness of burning coal versus natural gas.

South Korea's government recently unveiled its long-term natural gas plan through 2031, which affirms the growth of natural gas through the forecast period, albeit at a much slower pace (less than 1% annually) than the average rate during the past decade.

Natural gas in the power sector will compete with lower cost coal-fired generation facilities and new coal- and nuclear-based capacity under construction that will come online in the next few years. Natural gas remains a key source of lower-emitting fossil energy for the country, and over the long run, key

factors determining natural gas demand growth will be LNG market prices, deregulation of the LNG market in South Korea, and government policy.

Liquefied natural gas

Indonesia was South Korea's first source of LNG, and it supplied more than half of South Korea's LNG imports before 2000. As South Korea diversified its LNG imports to secure more sources of natural gas to meet its growing demand, Indonesia lost market share to other countries including Qatar, Oman, Nigeria, Russia, and Australia.

South Korea currently has seven LNG-regasification facilities with a peak capacity of 6.1 trillion cubic feet (Tcf) per year and an average estimated utilization rate of 31%. KOGAS operates five of these facilities (Pyongtaek, Incheon, Tong-Yeong, Samcheok, and a new small-scale terminal on Jeju Island), which account for most of the current capacity. The other two terminals are privately owned. The Gwangyang regasification facility, located along the southern coast, came online in 2005, and the Boryeong, located in the northwestern region, came online at the beginning of 2017.[19]

Both of these privately owned terminals have very small capacities compared with the capacity owned by KOGAS. However, these private operators have been key contributors to the rise in Korea's LNG imports in 2017. Because of KOGAS's monopoly power and high LNG-resale prices, private industries have a greater incentive to invest in regasification capacity and purchase less expensive LNG on the global market.[20]

South Korea has a large natural gas storage capacity at its LNG terminals, and the country held about 19% of the world's LNG storage, or 440 billion cubic feet (Bcf), of LNG in 2019.[21] KOGAS is building more LNG storage terminals at a proposed LNG terminal by 2031 in response to the country's expected reliance on natural gas in the long term.[22]

Electricity

Fossil fuel sources account for more than two-thirds of South Korea's electricity generation, and the nuclear power share accounts for almost one-quarter. Renewable energy will grow based on government incentives and power plan targets.

In the *8th Basic Plan for Long-term Electricity Supply and Demand*, published at the end of 2017, South Korea's government lowered its anticipated electricity demand growth to slightly more than 1% annually through 2030. The government intends to cut its greenhouse gas emissions and reduce fine dust particle pollution through energy conservation measures and the use of cleaner energy from natural gas, nuclear, and renewable energy sources.[23] The country's new power plan calls for shares of coal and nuclear to decrease to 36% and 24%, respectively. South Korea's government expects these shares to be offset by renewable energy sources rising to a 20% share and natural gas staying at a 19% share in 2030.[24]

Electricity sector organization

The state-owned Korea Electric Power Corporation (KEPCO) is the primary electricity producer in South Korea and dominates the country's retail sales, transmission, and distribution. In 2001, KEPCO's

generation assets were split into six 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.

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. Several independent power producers, such as Posco, SK, and GS, can sell electricity into the KPX. KEPCO continues to act as the electricity retailer, and it controls transmission and distribution.[25]

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 lower than electricity prices in other economically developed countries, which has contributed to high overall electricity demand and power shortages during peak seasons, particularly before 2013.[26]

Generation

South Korea's power generation growth has remained lower than 3% per year since 2012 after averaging about 5% per year during the previous decade.[27] This significant deceleration, especially through 2015, is attributed to weaker economic demand and export growth and demand side management measures. Since 2015, generation growth has marginally accelerated.

South Korea's reserve margins—the difference between peak capacity and peak electricity demand—were lower than 10% on an annual basis between 2007 and 2013, resulting in major blackouts in 2011.[28] 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. Since 2014, the reserve ratio increased 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. The speed of incremental capacity additions has increased since 2014, and several more generation facilities are expected to come online in the next few years. In its latest electricity plan, South Korea projects that reserve margins will reach 22% by 2030.[29]

Capacity

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 composed of coal and nuclear power, but peak demand is generally met by natural gas-fired power.

Electric generation capacity rose in 2016 as coal, natural gas, renewable energy, and nuclear units were added. South Korea intends to reduce its greenhouse gas emission levels by 26% from business-as-usual projected levels (projections of emission levels absent any carbon price scheme) and to cut its fine dust

pollution levels by 62% by 2030.[30] To meet these goals, the government is promoting the development of renewable energy and natural gas-fired plants and phasing out of older, less efficient coal-fired plants.[31]

South Korea plans to retire ten coal-fired power plants older than 30 years by 2022 and to suspend any proposed coal-fired projects either not under construction or not at least 10% complete, which is consistent with the country's goal to incorporate cleaner sources of fuel into the generation portfolio.[32]

The government intends for natural gas-fired power plants to replace retired coal-fired facilities and some of the coal-fired power projects that have been suspended as a result of the latest electricity plan.[33] Historically, natural gas competed with less-expensive coal and nuclear sources of power, and prices for much of the natural gas sold within the country, particularly by KOGAS, were higher than international spot LNG prices. In 2019, South Korea implemented a new tax policy that favors natural gas over coal for power generation.[34] 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 tax policies and regulations that favor one fuel over another, and the level of investment for clean energy technology.

The country's first nuclear power plant was completed almost four decades ago, and since then, South Korea has directed significant resources toward developing its nuclear power industry. Korea Hydro & Nuclear Power Company, which currently operates South Korea's four nuclear power stations, has 25 reactors with a net power generation capacity of 23 GW.[35] South Korea imports all of the uranium it needs 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 for producing its own nuclear fuel.[36]

Although South Korea has historically relied on nuclear power for a significant portion of its generation, public sentiment has turned negative following Japan's Fukushima disaster in 2011 and several incidents of falsified certificates for components of some of South Korea's existing nuclear power plants in 2012.

A renewable portfolio standard for South Korea replaced the previous feed-in tariff system in 2012 and requires 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.[37] Renewable sources (primarily solar, wind, biomass, and waste) remain a small share of South Korea's electricity generation, although these fuel sources have rapidly increased.[38] South Korea's latest power plan targets the share of power generation from renewable energy to rise to 20% by 2030, mostly by developing wind and solar capacity.[39]

Coal

Although South Korea intends to reduce its reliance on coal for power in the longer term, coal is likely to continue playing a large role in South Korea's energy demand during the next few years. Several coal-fired facilities are already under construction and will come online by 2024, and coal continues to remain more economical than natural gas and renewable energy, despite the current coal tax.

Notes

- In response to stakeholder feedback, the U.S. Energy Information Administration (EIA) has revised the format of the Country Analysis Briefs. As of December 2018, updated briefs are available in two complementary formats: the Country Analysis Executive Summary provides an overview of recent developments in a country's energy sector, and the Background Reference provides historical context. Archived versions will remain available in the original format.
- Data presented in the text are the most recent available as of October 2020.
- Data are EIA estimates unless otherwise noted.

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