REPUBLIC OF KOREA

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**Republic of Korea**

**Key Oil Data**

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<tbody>
<tr>
<td>Production (kbb/d)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>13.0</td>
<td>9.8</td>
<td>14.2</td>
<td>19.0</td>
<td>20.9</td>
</tr>
<tr>
<td>Demand (kbb/d)</td>
<td>553.7</td>
<td>1,046.3</td>
<td>2,007.7</td>
<td>2,135.3</td>
<td>2,191.3</td>
<td>2,142.3</td>
<td>2,185.0</td>
<td>2,248.6</td>
</tr>
<tr>
<td>Motor gasoline</td>
<td>19.0</td>
<td>64.9</td>
<td>163.9</td>
<td>170.5</td>
<td>162.9</td>
<td>172.0</td>
<td>179.8</td>
<td>180.9</td>
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<tr>
<td>Gas/diesel oil</td>
<td>149.6</td>
<td>279.1</td>
<td>481.2</td>
<td>379.1</td>
<td>413.9</td>
<td>389.3</td>
<td>391.5</td>
<td>399.2</td>
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<tr>
<td>Residual fuel oil</td>
<td>212.2</td>
<td>332.1</td>
<td>558.6</td>
<td>487.2</td>
<td>433.7</td>
<td>331.7</td>
<td>313.2</td>
<td>306.3</td>
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<tr>
<td>Others</td>
<td>170.9</td>
<td>371.1</td>
<td>804.1</td>
<td>1,046.4</td>
<td>1,160.9</td>
<td>1,250.3</td>
<td>1,310.5</td>
<td>1,364.2</td>
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<tr>
<td>Net imports (kbb/d)</td>
<td>553.7</td>
<td>1,046.3</td>
<td>2,007.7</td>
<td>2,135.3</td>
<td>2,191.3</td>
<td>2,142.3</td>
<td>2,185.0</td>
<td>2,248.6</td>
</tr>
<tr>
<td>Import dependency</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>99.4%</td>
<td>99.6%</td>
<td>99.3%</td>
<td>99.1%</td>
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<tr>
<td>Refining capacity (kbb/d)</td>
<td>776.6</td>
<td>867.1</td>
<td>1,170.1</td>
<td>2,540.2</td>
<td>2,577.2</td>
<td>2,577.2</td>
<td>2,607.1</td>
<td>2,790.1</td>
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<tr>
<td>Oil in TPES</td>
<td>48.5%</td>
<td>53.4%</td>
<td>63.0%</td>
<td>53.3%</td>
<td>44.0%</td>
<td>39.5%</td>
<td>40.0%</td>
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**End-Month Total Oil Stock Levels**

- Range 2005 - 2009
- 2009
- 2010

**Key Natural Gas Data**

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<tbody>
<tr>
<td>Production (mcm/y)</td>
<td>-</td>
<td>3,042</td>
<td>9,265</td>
<td>18,932</td>
<td>30,477</td>
<td>36,631</td>
<td>34,413</td>
<td>42,694</td>
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<tr>
<td>Demand (mcm/y)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>642</td>
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<tr>
<td>Transformation</td>
<td>2,274</td>
<td>4,653</td>
<td>6,407</td>
<td>12,362</td>
<td>15,964</td>
<td>13,834</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Industry</td>
<td>81</td>
<td>594</td>
<td>3,207</td>
<td>4,652</td>
<td>6,113</td>
<td>6,286</td>
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<td>Residential</td>
<td>519</td>
<td>2,808</td>
<td>6,853</td>
<td>9,546</td>
<td>9,205</td>
<td>9,227</td>
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<td>Others</td>
<td>108</td>
<td>1,010</td>
<td>2,465</td>
<td>4,117</td>
<td>4,552</td>
<td>5,066</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Net imports (mcm/y)</td>
<td>3,042</td>
<td>9,265</td>
<td>18,932</td>
<td>29,985</td>
<td>36,614</td>
<td>33,912</td>
<td>42,152</td>
<td>-</td>
</tr>
<tr>
<td>Import dependency</td>
<td>0.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>98.4%</td>
<td>99.4%</td>
<td>96.5%</td>
<td>98.7%</td>
</tr>
<tr>
<td>Natural Gas in TPES</td>
<td>0.0%</td>
<td>2.9%</td>
<td>5.7%</td>
<td>9.2%</td>
<td>12.0%</td>
<td>14.0%</td>
<td>13.5%</td>
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*Based on monthly data submissions to the IEA.

**End-Month Natural Gas Stock Levels**

1. Primary oil stocks on national territory; these exclude utility stocks and including pipeline and antipip stockcels where known.
2. Stocks held on national territory, as reported to the IEA in monthly data submissions.
OVERVIEW

Oil has been the dominant energy source in Korea, accounting for roughly 40% of the country’s total primary energy supply (TPES) in 2008. The share of natural gas in the country’s TPES steadily increased from 3% in 1990 to 9% in 2000 and 14% in 2008. In 2010, the IEA forecasted that the share of oil in the TPES will gradually decrease from 40% in 2008 to 35% in 2020 and 31% in 2035, while the share of natural gas will remain flat.

Korea has very little indigenous oil production, which averaged at 21 kb/d in 2010. Korea’s oil demand increased from 2.14 mb/d in 2000 to 2.25 mb/d in 2010, with an annual average growth rate of 0.5%. Korea is a big consumer of naphtha mainly for the petrochemical industry. Korea’s oil imports in 2010 were 3.14 mb/d, consisting of 2.37 mb/d of crude oil. Korea is highly dependent on the Middle East, which accounted for some 82% of the total crude oil imports in 2010. Korea exported 919 kb/d of oil products in 2010. One-third of the product exports went to the OECD (mainly to US and Japan), while the remainder was destined for non-OECD countries, such as China, Singapore and Indonesia. Korea is a net exporter of oil products.

Diversification of energy fuel sources (energy mix), diversification of import sources of crude oil and LNG, further build-up of SPR (government stocks), expansion of storage capacity for oil and gas, and promotion of domestic and overseas E&P activities have been the main pillars in the energy security policy of Korea. The use of emergency oil stocks is central to Korea’s emergency response policy, which can be complemented by demand restraint measures. During an emergency, the Minister responsible for energy will make the political decision to participate in an IEA collective action and on the emergency response measures, including oil stock release. Korea meets its stockholding obligation to the IEA by holding government stocks and by placing a minimum stockholding obligation on industry. The national oil company KNOC manages the state-owned oil emergency reserves. Korea has been compliant with its 90-day obligation of the IEA since it joined the IEA in March 2002.

Domestic gas production is negligible. Korea produced some 0.5 BCM of natural gas in 2010, which covered merely 1.3% of the total domestic consumption. Gas demand has steadily increased since the first LNG shipments arrived in 1986. Gas demand reached 42.7 BCM (117 mcm/d) in 2010. The Administration forecasts that gas demand in Korea will increase from 42.7 BCM per year (117 mcm/d) in 2010 to 46.4 BCM (127 mcm/d) in 2024. Natural gas is the third biggest source of fuel for electricity generation. All of the gas imports are in the form of LNG.

Diversification of supply sources, ensuring LNG supply on the basis of long-term contracts, and securing sufficient supply of gas for high seasonal demand are the key elements of Korea’s overall gas security policy. Korea does not have government gas stocks or mandatory industry stocks. An emergency response plan is in place for the event of a gas supply disruption. The Plan foresees the emergency response measures in phases including demand restraint and fuel switching.
1. Energy Outlook

Oil has been the dominant energy source in Korea, accounting for some 40% of the country’s total primary energy supply (TPES) in 2009. Coal remains the second biggest energy source in Korea, whose share the country’s TPES stood at 28% in 2009. The share of natural gas in Korea’s TPES steadily increased from 3% in 1990 to 9% in 2000 and 14% in 2009.

The World Energy Outlook (WEO) 2010 of the IEA forecasts that Korea’s TPES will grow from 227 Mtoe in 2008 to 264 Mtoe in 2020 and 271 Mtoe in 2035. The share of oil in the TPES is projected to gradually decrease to 35% in 2020 and 31% in 2035, while the share of natural gas will remain flat during the projection period.

According to the draft Second National Energy Fundamental Plan of Korea, the Administration has a target for oil to make up no more than 31% of the primary energy consumption by 2030.
2. Oil

2.1 Market Features and Key Issues

Korea does not have significant proven reserves of crude oil, and the country has very little indigenous crude oil production. Korea’s crude oil (condensate) production in 2010 averaged at merely 1.1 kb/d, which covered less than 0.1% of the country’s total oil demand.

Korea National Oil Corporation (KNOC) is the only producer of condensate in Korea. KNOC has drilled 43 wells in the continental shelf to explore possible oil and gas reserves since the early 1980s, and finally discovered a commercially viable gas field called Donghae-1, which is located about 60 km southeast of Ulsan. The Donghae-1 offshore field began commercial production of gas and condensate in 2004. A significant increase of domestic oil production is not expected in Korea.

Oil Consumption, by Product

Source: Monthly Oil Statistics, IEA

Korea’s oil demand has remained relatively flat during the last decade, which stood at about 2.25 mb/d in 2010. The industry sector accounted for some 42% of the total oil consumption in Korea in 2010, while the transport and transformation/energy sectors represented 32% and 18% of the total, respectively. In terms of oil demand by product, demand for diesel and motor gasoline increased by 38% and 11%, respectively, between 2000 and 2010. Demand for naphtha and LPG/ethane rose by 46% and 25%, respectively, during the same period, while demand for residual fuel dropped by 37%.

Korea is a big consumer of naphtha, which is mainly used in the petrochemical industry. Demand for naphtha stood at 914 kb/d in 2010, accounting for about 41% of the total oil demand.

According to the New Policies Scenario of the IEA/WEO 2010, Korea’s total oil demand is forecast to gradually decrease to 2.04 mb/d in 2015, 1.97 mb/d in 2020 and 1.79 mb/d in 2035.
**Imports/exports and import dependency**

Korea’s oil imports in 2010 were some 3.2 mb/d, consisting of about 2.4 mb/d crude oil, 5 kb/d NGLs and feedstock, and some 0.8 mb/d refined products. Concerning crude import sources, Korea is highly dependent on the Middle East, which accounted for more than 80% of the total crude oil imports in 2010. By country, Saudi Arabia (32% of the total) was the biggest supply source of crude oil in 2010, followed by Kuwait (13%), UAE (12%), Iran (9%), Qatar (7%), Iraq (7%) and Russia (6%). Roughly 70% of the imports are based on commercial long-term contracts. To stimulate diversification of crude supply sources, the Administration offers subsidies of up to 90% of the additional transport costs for imports from countries outside the Middle East. However, no crude oil has been imported under this subsidy scheme since 2004.

In 2010, roughly 56% of the refined product imports came from OPEC countries, mainly from UAE, Saudi Arabia, Kuwait and Qatar, while some 14% of refined products were imported from India.

Korea exported some 920 kb/d of oil products in 2010. Around one-third of the product exports went to OECD, mainly to Japan (12%) and US (11%), while the remainder was destined for non-OECD, such as China (27%), Singapore (12%) and Indonesia (11%). Korea is a net exporter of oil products.

**Oil Company Operations**

KNOC is a key player in the domestic and overseas oil exploration and production (E&P) projects. At the end of February 2011, KNOC was engaged in 191 E&P projects in 25 countries. KNOC is involved in production projects in countries including Canada, China, Indonesia, Peru, Venezuela, Vietnam and the United Kingdom. At the end of 2010, KNOC’s overseas oil output stood at about 180 kb/d, while KNOC’s oil and gas reserves totaled some 1.13 billion barrels of oil equivalent.

Korea’s refining industry is dominated by four major oil companies; they are SK Innovation, GS Caltex, S-Oil and Hyundai Oilbank. Saudi Aramco is the controlling shareholder of S-Oil.

Daehan Oil Pipeline Corporation (DOPCO) is the major oil pipeline company in Korea. DOPCO is in charge of the operation of nationwide oil pipeline systems which connect refineries to major cities, airports and storage facilities. The aforementioned four Korean refiners, SK Innovation (43%), GS Caltex (27%), S-Oil (9%) and Hyundai Oilbank (6%), and the Korean government (12%) are main shareholders of DOPCO.

The retail market in Korea is dominated by the said four Korean refiners. At the end of 2009, there were 13,231 fuel stations in Korea, about 95% of which were owned by these refiners.
2.2 Oil Supply Infrastructure

Refining

There are five refineries in Korea, with a total crude distillation capacity of around 2.94 mb/d. SK Innovation has two refineries, one in Ulsan (840 kb/d) and another in Inchoen (275 kb/d). The other refineries are held by GS Caltex in Yeosu (850 kb/d), by S-Oil in Onsan (580 kb/d) and by Hyundai Oilbank in Daesan (390 kb/d).

In 2010, the five refineries processed around 904 million barrels of crude oil (including NGL and feedstocks), which indicates that the overall capacity utilization rate was about 85%. In the same year, the composition of production from these refineries was motor gasoline (12%), gas/diesel oil (29%), other middle distillates (16%), residual fuel oil (13%), LPG (4%) and naphtha (18%).

Korea had a naphtha deficit of around 450 kb/d in 2010, and some 50% of the total diesel consumption was met by imports. Korea also encountered an LPG deficit of some 190 kb/d in 2010, and the import dependency of LPG stood at about 70%.

The Administration does not have a specific plan to diminish the deficits of these products, leaving the procurement of these products to the open market.

Ports and Pipelines

The domestic transport of petroleum products is mainly undertaken by oil tankers, rail tank cars, tank trucks and pipelines. Among these transport means, tank trucks play the most important role in transporting petroleum products from oil depots or oil terminals to service stations and large consumers, such as factories. Coastal oil tankers are also used for transportation, since Korea is surrounded by seas on three perimeters and all the domestic oil refineries are located near the nation’s coastal areas.

Korea does not have any cross-border oil pipelines for exports or imports. There are six oil product pipelines in Korea, with a total length of 1,104 km. These six pipelines are operated by DOPCO.

The DOPCO pipeline system connects refineries with major cities, airports, military bases and SPR storage facilities. The utilisation rate of the pipelines was estimated to be approximately 64% in 2010. The pipelines are reversible, and it would take about 3 days to change directions of pipeline delivery. Though restrictions do not exist on the access of the pipeline network of DOPCO, companies other than shareholders of DOPCO do not make commercial use of it.

There are 8 main oil port terminals in Korea, where crude oils are imported. These oil terminals, owned by KNOC and the four big refiners, have a total crude import capacity of some 12.3 mb/d.
There are 7 oil port terminals which are used for imports and exports of oil products. The total importing and exporting capacity of these terminals is some 20 mb/d.

The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.
Stockholding Obligation and Storage Capacity

Based on the IEA’s methodology for calculating emergency reserves, Korea’s daily net imports for 2010 were about 764 kb. To meet the 90-day commitment, about 64-80 million barrels of oil stocks are required, which is equivalent to 10.1-12.6 million cubic metres of oil storage capacity.

The Administration started a 30-year project of securing storage facilities for petroleum in 1980, which was completed in May 2010. At the end of 2010, Korea possessed a total storage capacity of 286 million barrels (45.5 million cubic meters), which was composed of 146 mb of KNOC’s facilities used for government stocks and international joint oil stockpiling, and 140 mb used for industry operation and mandatory industry stocks.

Korea held 87.2 mb of government stocks at the end of 2010, which indicates that some 60% of the total government storage capacity was utilised to store public stocks. Domestic refiners and other companies may rent storage facilities of KNOC by concluding a lease agreement. The term of such lease agreements is usually less than six months. There are 9 government storage sites across the country. 87% of this capacity is for crude oil, while the remainder is for oil products. About 73% of government storage capacity exists in the form of underground storage facilities, while 27% is in above-ground tanks.

Roughly 44% of the total industry storage capacity was owned by SK Innovation at the end of 2010. The remaining portions were held by GS Caltex (30%), S-Oil (15%), Hyundai Oilbank (9%) and DOPCO (2%).
2.3 Decision-making Structure for Oil Emergencies

The President of Korea acts as the head of national crisis management, including responding to oil supply disruptions. In practice, the Ministry of Knowledge & Economy (MKE) is the main and leading governmental body responsible for dealing with oil supply disruptions, and it will closely consult with other relevant governmental entities, such as the Ministry of Foreign Affairs and Trade, the Ministry of Strategy and Finance, and the Central Disaster Relief Centre, as well as with domestic industry.

The Energy and Resource Policy Division and the Petroleum Division of MKE function as core body of Korea’s National Emergency Strategy Organisation (NESO). In case a domestic or global oil supply disruption occurs the Petroleum Supply and Demand Committee and the Energy Emergency Response Centre are set up in MKE. The Petroleum Supply and Demand Committee is headed by the minister of MKE and is composed of vice-ministers of related ministries and senior executives of relevant companies. This Committee is expected to establish a response plan and to make crucial decisions on response actions.

The Energy Emergency Response Centre is led by Head of Office of Energy and Resources of MKE, and is comprised of Director Generals and Directors of MKE as well as vice presidents of KNOC, KOGAS, KEPCO, executives of refiners and the president of Korea Energy Economics Institute (KEEI). This Centre is in charge of implementing emergency response measures in the response plan, and of monitoring the supply/demand balance of oil. During a global supply disruption, the Minister of MKE will make the political decision to participate in an IEA collective action and on emergency response measures, including oil stock release.

Korea has participated in IEA’s Emergency Response Exercises in Paris. Domestically, MKE conducts a few simulation exercises every year in order to practice and test emergency response policies and procedures for possible fires at refineries and storage facilities, a war with North Korea and general oil supply disruptions. MKE has not published a comprehensive handbook that outlines the Korean legislations, organisational structures, decision-making process, and emergency response measures and procedures to be employed during an oil supply disruption.

The Petroleum and Petroleum-Alternative Business Act and the Energy Act provide MKE with the statutory power to deal with emergency measures during oil supply disruptions. The Petroleum and Petroleum-Alternative Business Act obliges major oil refiners, oil marketers and oil importers to maintain emergency oil stocks at the level which MKE requires. The Korea National Oil Corporation Act requires KNOC to maintain national stockpiling on behalf of the Korean government. The Petroleum and Petroleum-Alternative Business Act, the Energy Act and the Energy Use Rationalisation Act authorise the Minister of MKE to make an energy demand and supply plan in case of an energy crisis and to decide on emergency response measures, including oil release, reduction of the level of private compulsory oil stocks and demand restraint.
2.4 Stocks

Stockholding Structure

Korea meets its stockholding obligation to the IEA by holding government stocks and by placing a minimum stockholding obligation on industry. The Petroleum and Petroleum-Alternative Fuel Business Act and the Korea National Oil Corporation Act form the legal basis for Korea’s stockholding regime. Under these acts, KNOC manages the state-owned oil emergency reserves.

Crude refiners are obliged to hold at least 40 days of stocks, in either crude or products (excluding naphtha), based on a 12-month average of their previous year’s sales. The country’s total domestic sales averaged about 1 MB/d in 2010. KNOC is responsible for monitoring quantities, qualities and locations of industry stocks, as well as for collecting data from industry. KNOC is authorised to visit commercial storage facilities to verify physical stock levels. The government has a legal authority to penalise non-compliant companies.

Furthermore, product importers, LPG importers and petrochemical companies are required to hold at least 30 days of stocks, based on their domestic sales.

Since 1999, KNOC has promoted the International Joint Stockpile (IJS) Project, inviting and storing crude oil for companies of oil-producing countries. Under the IJS, KNOC rents out storage space to foreign firms for a fee, but the IJS also gives Korea first rights to purchase crude oil in case of an oil emergency. Stocks held under this scheme are not counted towards Korea’s meeting its 90 day commitment.

Crude or Products

Government stocks in Korea at the end of April 2011 stood at about 87 mb, accounting for slightly over half of the country’s total stocks. 87% of the government stocks were held in the form of crude oil, while the remainders were in middle distillates (8%), motor gasoline (1%) and other products (4%).

Industry stocks in Korea amounted to some 86 mb at the end of April 2011. About 55% of the total industry stocks were stored as crude oil, while the shares of middle distillates, motor gasoline and fuel oil in the total industry stocks were 17%, 5% and 11%, respectively. Obligatory industry stocks may be commingled with operational and commercial stocks.

Location and Availability

Korea has no bilateral agreements to hold stocks on foreign territory. Emergency oil stocks are held entirely on the national territory of Korea. Korea held some 173 mb of oil stocks at the end...
of April 2011, equating to 197 days of 2010 net-imports. Some 70% of the total stocks were held in the form of crude oil.

Domestic refiners generally hold around 60-80 days of industry stocks for their operational and commercial purposes as well as for complying with the domestic stockholding requirement. A domestic ticket market does not exist in Korea.

It is estimated that some 40 mb of crude stocks were held in KNOC’s storage facilities under the scheme of International Joint Stockpile in December 2010. Statoil, Sonatrach, Total, Trafigura, Shell, Unipec, Chinaoil, Glencore, Vitol and JP Morgan have participated in the IJS project.

**Monitoring and Non-compliance**

Korea has been compliant with its 90-day obligation of the IEA since it joined the IEA in March 2002.

Korea’s oil stocks in terms of days of net imports have consistently been above 160 days since January 2009, hitting the country’s historical record of 201 days in September 2010. Government stock levels in days of net imports have been above the IEA 90-day commitment since December 2009.

**Stock Drawdown and Timeframe**

The Petroleum and Petroleum-Alternative Fuel Business Act authorises the Minister of MKE to decide on the drawdown of government stocks and reduction of stockholding obligation on industry.

Upon receiving the stock release order from MKE, KNOC would release government oil stocks to Korea’s four refining companies in the form of loans. In principle, the amount allocated to each refiner is to be based upon its respective market share. It generally takes KNOC one week to deliver oil stocks to the refiners. Korea’s government stocks are not legally allowed to be leased to oil companies and traders other than the domestic four refiners. Domestic refiners may resell government stocks to third parties if product stocks are leased by KNOC, but they are prohibited from reselling government crude stocks. It is believed that MKE and KNOC could ensure the release of government stocks by monitoring the refiners’ oil import levels thought the Petroleum Demand and Supply Information System (PEDSIS).

The period for replenishment of oil stocks would be determined based on the oil market situation. In the case of the IEA Collective Action in 2005, a one year re-stocking period was given to the domestic refiners. The pricing scheme for the lease of government stocks would be based on international oil prices, the Korean economic situation and other relevant factors, including market interest rates.

It is not envisaged that government stocks would be made available to the oil industry through other release mechanisms, such as a tender bidding process.

During a crisis, Korea would be able to drawdown government stocks on a certain scale during the first five weeks. For the first week following the government decision on stock release, the drawdown would be at a maximum rate of some 5.2 mb/d, which is more than double that of the domestic oil demand in 2010. The maximum drawdown rates would fall to 3.4 mb/d and 1.7 mb/d during the second and third week, respectively. For the fifth week, the maximum drawdown would further drop to 0.5 mb/d.
In the case of the release of obligatory industry stocks, the minister of MKE can take the initiative to lower the minimum stockholding obligation on industry. The minister has to bring his proposal forward to the National Assembly for approval, which usually takes more than 20 days. The MKE minister will notify the new minimum stockholding obligation on industry through a public announcement. The Administration has never lowered the stockholding obligation on industry to respond to oil supply disruptions. It is expected that MKE and KNOC would be able to know the amount of the industry stocks that were released to the markets by monitoring the decrease in oil stocks through the PEDSIS.

There is a flexibility mechanism in Korea, called a short-term loan, which allows the government to loan small amounts of government stocks to domestic private companies for short-time periods in case of temporary supply disruptions. KNOC can lease such oil stocks within one week to private entities, which will be required to reimburse the same amount and type of oil with an agreed interest rate at a later stage. Korea’s refiners utilised this short-term loan arrangement with KNOC 8 times during the last three decades.

As for the stock release under the International Joint Stockpile Project, foreign companies are required to deliver the crude oil to KNOC within 90 days after KNOC exercises the pre-emptive right to buy crude stocks, according to the emergency purchase clause of the contract signed between the two parties. KNOC has never exercised the right to purchase crude oil under this scheme during oil emergencies.

**Financing and Stockholding Costs**

Concerning the initial set-up/capital costs of government stocks, the construction of government stockpiling facilities has been funded by the central government budget. Costs to purchase the oil for government stocks have been funded by the central government budget and KNOC’s internal revenue. About 94 percent of Korea’s government stocks have been funded by government.

Operational costs of government stocks are financed from the central government budget or KNOC’s revenue. The average operational (maintenance) costs for government stocks in 2009 were 0.35 USD per barrel for crude and 2.4 USD for refined products. In terms of stockholding costs by type of facility, the operational costs averaged some 1.2 USD per barrel for government stocks held in above-ground storage tanks while 0.29 USD per barrel for stocks in underground rock caverns.

The Korean government does not provide financial support for building compulsory industry stocks. All refiners and importers must self-fund the operational costs of meeting emergency requirements. These costs are passed on to consumers. In 2009, the operational (maintenance) costs for industry stocks averaged about 1 USD per barrel, for both crude oil and refined products.
3. Other Measures

3.1 Demand Restraint

Oil consumption in Korea is primarily in the industry and transport sectors, which represented 41% (dominantly naphtha) and 32% of all oil use in 2009, respectively. Transformation, commercial/agriculture and Residential sectors accounted for 18%, 6% and 3% of the 2009 total, respectively.

![Oil Consumption by Sector](chart)

Source: Oil Information, IEA

The Petroleum and Petroleum-Alternative Fuel Business Act and the Energy Use Rationalisation Act form the legal basis for oil demand restraint measures. The Minister of MKE would make a decision on demand restraint measures flexibly, according to the degree of gravity of an oil supply disruption.

Measures are expected to be introduced, according to the alert levels in a color code system when demand and/or supply side disruptions occur. Demand restraint is regarded as a secondary emergency response measure which would complement the release of oil stocks in a severe or prolonged oil supply disruption.

Korea’s demand restraint measures would range from light-handed measures to medium-handed and heavy-handed. Demand restraint measures under the color code system on the demand side are summarised in the table below. In Korea, the public sector plays a leading role in energy savings. Major demand restraint measures cover not only the transport sector, but also residential and industry sectors. Violators will be given a seven-day grace period but will then be fined up to some 2,800 USD for breaking the regulations.

Under the color code system on the supply side, it is foreseen that voluntary demand restraint measures will be implemented. If the energy alert level is raised from yellow to orange, mandatory demand restraint measures are expected to be introduced in the public sector. In case the energy alert level reaches red, mandatory demand restraint measures will be taken both in the public and in the private sectors.

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1 Total Consumption (including refinery consumption), does not include international marine bunkers.
The Administration has not conducted comprehensive assessments on the expected volumetric savings of demand restraint measures in the relevant sectors.

The Prime Minister’s Office and the MKE create and manage inspection units to monitor the implementation of demand restraint measures. The Prime Minister’s Office can establish a joint inspection unit with central government departments and public entities in the energy sector (such as the Korea Energy Management Corporation (KEMCO), which conducts spot inspections for the public sector and publish the inspection results. The MKE can set up a joint inspection unit with local governments and public entities in the energy sector. The MKE is in charge of monitoring the private sector, and is authorised to impose fines on individuals and entities that do not comply with mandatory demand restraint measures.

### 3.2 Fuel Switching

Short-term fuel switching from oil to other fuels is not regarded as an emergency response measure in Korea. Therefore fuel switching capacity in the transformation sector is very limited. Coal and nuclear are the major fuels for power generation in Korea, while the share of oil as fuel for power generation in Korea was merely 4.4% in 2009. Only 5% of total oil consumption was used for power generation in 2009.

Units 3 and 4 of the Pyeongtaek Power Plant, with a total generation capacity of 700MW, are the only oil-fired power plant units that have fuel switching potential from oil to LNG. The volume of oil that can be saved at these units through fuel switching is estimated to be...
negligible. No data is available concerning the fuel switching capacity from oil to other fuels in sectors other than the transformation sector.

The Administration does not have a specific policy or legislation to promote short-term fuel switching in an emergency.

3.3 Others

Due to the small amount of indigenous oil production and lack of spare crude oil production capacity, surge production of oil is not considered as an emergency response measure in Korea. There is no legislation to promote or implement surge production in an emergency.

4. Natural Gas

4.1 Market Features and Key Issues

Gas production and import dependency

According to CEDIGAZ’s “Natural gas in the world, 2010 Edition”, Korea was estimated to possess merely 2 BCM of proven reserves of natural gas at the end of 2009.

Domestic gas production is negligible. Korea produced some 0.5 BCM of natural gas in 2010, which covered merely 1.3 % of total domestic consumption. The Donghae-1 gas field is the only domestic gas field in production. KNOC started commercial production from this offshore gas field in July 2004, and the production operation will end around 2018, when the gas field will be converted into a storage facility.

Due to the very small indigenous gas production, almost all of the gas demand in Korea is met by imports. All of the gas imports are in the form of LNG. Korea’s total natural gas imports in 2010 amounted to some 44 BCM (119 MCM/d). Korea Gas Corporation (KOGAS) is the largest LNG import company in the world, whose share in Korea’s total gas imports was 95% in 2010.

KOGAS has diversified its supply sources. In 2010 roughly 43% of the total gas (LNG) imports came from the Middle East, while Asia Pacific, Russia and Africa accounted for some 37%, 9% and 9% of the total gas imports, respectively. By country, Qatar was the biggest gas supplier, representing 23% of the total imports in 2010. Indonesia (17%), Malaysia (15%), Oman (14%), Russia (9%) and Yemen (5%) are other key gas supply sources for Korea.

KOGAS imports 80-90% of LNG though mid-to-long term contracts. Due to the heavy seasonality in gas demand, some long term contracts allocate more volumes in winter, but seasonality and other variables are also covered by imports through spot markets.
Gas demand

Gas demand has steadily increased since the first LNG shipments arrived in 1986. Korea’s gas demand increased from 18.9 BCM (52 mcm/d) in 2000 to 42.7 BCM (117 mcm/d) in 2010, with an annual average growth rate of some 6%. In 2009, the transformation sector represented about 40% of the country’s total gas consumption, while residential and industry sectors represented 27% and 18%, respectively.

Gas demand in Korea peaks in winter when gas consumption significantly increases for heating and cooking. Daily peak gas demand in 2010 stood at some 218 mcm/d, which occurred in January.

### Natural Gas Consumption, by Sector

![Graph showing natural gas consumption by sector]

Source: Natural Gas Information, IEA

According to the 10th Long-term Natural Gas Demand and Supply Plan, which was released by the MKE in December 2010, gas demand in Korea is projected to increase from 35.3 BCM per year (97 mcm/d) in 2009 to 46.4 BCM (127 mcm/d) in 2024, with an annual average growth rate of 1.8%. Gas demand for the city gas sector is forecast to grow at an annual average rate of 2.3% during the projection period. On the other hand, gas demand for power generation is anticipated to pose a lower annual average rise of 1.1% during the same period, since nuclear and renewable energies are expected to play a greater role as fuel for power generation.

In Korea, coal is the principal fuel for electricity generation, accounting for 46% of the total in 2009. The share of natural gas as fuel for electricity generation gradually rose from 10% in 2000 to 15% in 2009, while that of nuclear fell from 38% to 32% during the same period.

### Gas Companies

KOGAS imports almost all the gas that is needed in the country, and it has grown to become the world’s largest LNG importer. KOGAS is listed on the Korean Stock Exchange, but the major shareholders are government entities, such as central government (26.9%), Korea Electric Power Corporation (KEPCO) (24.5%), local governments (9.6%) and Treasury (6.1%). As a public enterprise, KOGAS highly dominates the Korean wholesale market for gas in all its aspects, including LNG imports, transmission network, storage and sales activities.
Concerning the retail market for gas, 30 private city gas companies are granted with exclusive retail sales rights within their respective regions.

MKE is the regulator of the natural gas industry in Korea. MKE regulates KOGAS’ wholesale of gas with detailed rate of return/cost of service regulation. Local governments regulate the local distribution companies’ retail business. Since 2006, the Administration has made efforts to reform the gas market in Korea. For example, an Open-Access Policy has been put in place to give direct importers improved access to the KOGAS’ transmission network and LNG facilities. However, third party access to the transmission network, storage facilities and LNG terminals which KOGAS owns and operates is still limited.

4.2 Natural gas supply infrastructure

Ports, LNG Terminals and Pipelines

There are four LNG terminals in operation in Korea. Three out of the four LNG terminals are owned and operated by KOGAS. Besides KOGAS, the privately-owned Pohang Iron and Steel Company (Posco) operates a LNG terminal in Gwangyang, to support power plants of Posco and K-Power.

The four terminals are able to handle and supply to the Korean national gas transmission system about 118 BCM per year (324 mcm/d) of natural gas, which is some 180% higher than the level of average gas demand in Korea.

KOGAS’ 4th LNG terminal in Samcheok, with a regasification capacity of 2.3 BCM of natural gas per year, is scheduled to be completed by 2015. Five storage tanks, with a total storage capacity of 1.3 mcm of LNG (800 mcm of natural gas), will be built at this LNG terminal. Third party access to the gas storage facilities, transmission network and LNG terminals owned by KOGAS is quite limited.

Korea does not have any cross-border gas pipelines. The nationwide trunk lines, with a total length of 2,853 km, are owned and operated by KOGAS. KOGAS has a plan to further expand the nationwide pipeline grid, and the total length of the pipeline network will increase to 4,251 km by 2024.

In September 2008, KOGAS and Gazprom signed a memorandum of understanding on Russia supplying 10 BCM of natural gas per year for 30 years to South Korea via North Korea. North Korea had not given its consent to the construction of an international gas pipeline that runs through its national territory, until a bilateral summit in August 2011, where President Medvedev of Russia and Kim Jung-II of North Korea agreed on developing a gas pipeline to South Korea. It is uncertain however, whether and when the planned pipeline project will materialise. South Korea and Russia have an alternative plan in place, one that involves shipping natural gas in the form of LNG from Vladivostok, if they are unable to build the pipeline through North Korea.
The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.
Storage

There are no underground storage facilities in Korea. Almost all natural gas storage facilities in Korea are in the form of storage tanks of LNG and their ancillary facilities. At the end of June 2011, Korea had 52 tanks at 4 LNG terminals, with a total storage capacity of 7.2 million cubic meters of LNG (equivalent to some 4.4 BCM of natural gas). The total storage capacity is theoretically able to cover about 38 days of average gas demand in 2010 and 20 days of peak gas demand in the same year. KOGAS owns roughly 97% of the country’s total storage capacity at 3 LNG terminals in Incheon, Pyeongtaek and Tongyeong, while the remainder is held by Posco at its LNG terminal in Gwangyang. The maximum withdrawal rate of the three KOGAS storage facilities is about 610 MCM/d of natural gas, which is almost three times bigger than Korea’s peak gas demand in 2010.

There are no storage facilities outside of Korea, which are accessible to its supply network. The 10th Long-term Natural Gas Demand and Supply Plan envisages that the gas storage capacity will expand from 4.4 BCM to 9.4 BCM in 2017. Under this plan, the Donghae gas field is expected to be converted to a storage facility with a capacity of some 2.3 BCM of natural gas in 2017.

4.3 Emergency Policy for Natural Gas

Diversification of supply sources, ensuring LNG supply on the basis of long-term contracts, expansion of storage capacity and securing sufficient supply of gas for high seasonal demand are the key elements of Korea’s overall gas security policy.

Korea does not have government gas stocks or mandatory industry stocks. However, KOGAS has internal criteria to hold gas stocks. KOGAS holds two types of stocks; “Minimum stocks” and “Safety stocks”. While the former is used to enable storage facilities to operate under normal conditions, the latter is required to successfully handle any discrepancy between demand and supply, which would arise from unexpected market changes, including sudden gas supply disruptions.

There is no clear legal basis for emergency planning and managing crisis situations that affect the natural gas system in Korea. KOGAS is in charge of Korea’s overall domestic supply of natural gas except for large scale companies which import LNG for their own usage. KOGAS, as the Transmission System Operator of Natural Gas in Korea, plays a major role in emergency planning and managing crisis situations that affect the national natural gas system, in consultation with the gas division of MKE.

An emergency response plan is in place for the event of a gas supply disruption. The Plan envisages that the following emergency response measures will be taken in phases.

In the initial stage of a gas emergency, when a shortage of gas supply is anticipated (Phase I), KOGAS will secure additional volumes of LNG on a commercial basis, through securing spot cargoes, cargo swaps and cargo rescheduling. KOGAS has signed Master Agreements with its major gas suppliers for the supply of LNG in such circumstances. KOGAS has also developed regional cooperation for gas emergency response with some Japanese LNG importers, through swapping of LNG cargos.
In case the gas shortfall problem in Phase I cannot be solved, MKE will discuss the situation with major gas users and urge them to reduce gas demand for power generation (Phase II). Subsequently, fuel switching at power plants from gas to other fuels such as fuel oil will be implemented.

If the measures taken in Phase I and II do not restore the state of Korea’s natural gas security, according to Article 24 of the City Gas Business Act, the minister of MKE may decide on the phased reduction of gas supply to power generators or city gas companies (Phase III). Interruptible contracts do not exist in Korea.

**Gas Stocks and Drawdown**

While the “Minimum stocks” level usually remains at 0.3 million LNG tons (some 250 MCM of natural gas), the “Safety stocks” level varies from 0.7 million LNG tons (some 585 MCM of natural gas) in summer to 1.1 million LNG tons (some 920 MCM of natural gas) in winter, depending on the gas demand.

The maximum withdrawal rates of the three storage facilities of KOGAS stand at some 610 MCM/d of natural gas, which is almost three times bigger than the peak demand in 2010. Gas stock levels in terms of days of forward demand ranged between 10 and 20 days in 2010.

**Surge Production**

Surge production of natural gas is not regarded as an effective response measure in a gas crisis, due to the negligible indigenous gas production in Korea.

**Fuel Switching**

In principle, fuel switching in the power generation sector is practically possible. However, gas-fired power plants in metropolitan areas, such as Seoul and Gyeonggi province, are not allowed to conduct fuel switching, due to environmental restrictions.

Gas-fired power producers are not required to hold a certain amount of back up fuel reserves. In practice, about 21 kb of fuel oil is stored as back-up fuel on site.

Fuel switching capacity from gas to oil is estimated to be about 2.6 mcm/d of natural gas, which is equivalent to some 2.2% of the average gas demand in 2010. In order to implement the fuel switching from gas into oil, some 14 kb/d of fuel oil (bunker-c) would be required.

The Korean Administration does not have a policy or legal authority to promote fuel switching from natural gas into other fuels during a gas supply disruption.
The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 28 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency’s aims include the following objectives:

- Secure member countries’ access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

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The European Commission also participates in the work of the IEA.