Korean Gas Market and Demand Outlook

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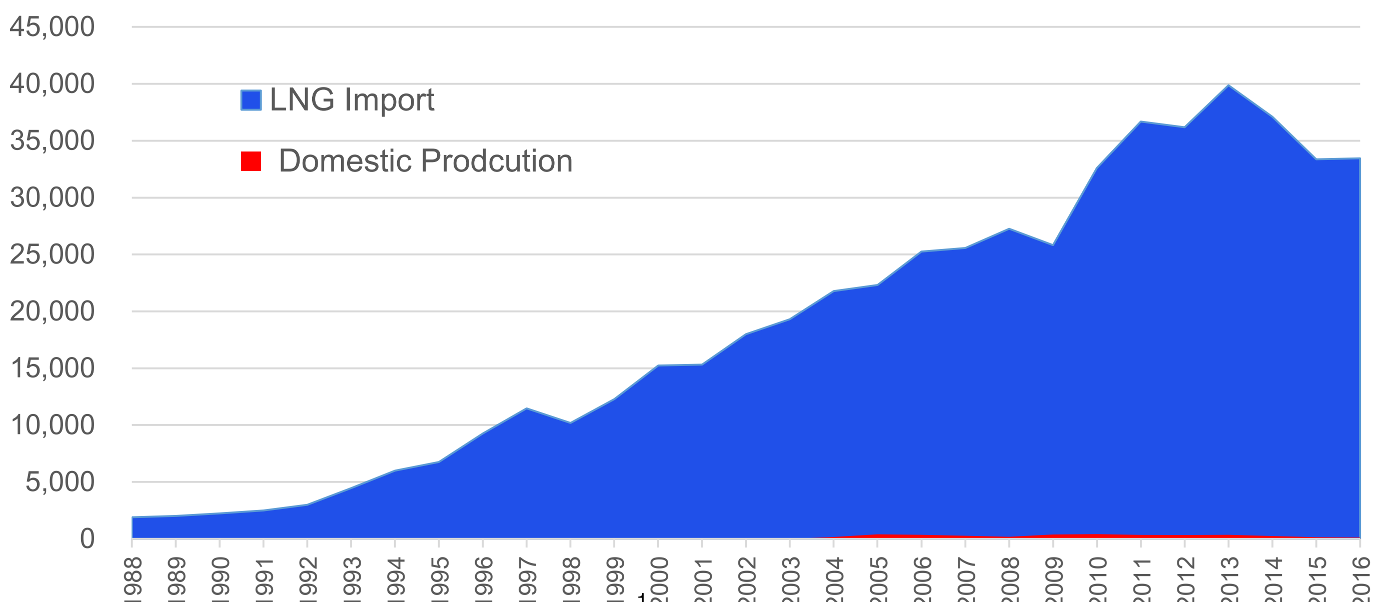
Natural Gas Supply in Korea

- LNG was introduced as one of the major sources of energy in Korea after the oil shock to diversify the energy supply mix and to secure the stable supply of energy.
  - Almost all of the natural gas used in Korea are imported from foreign countries in the form of LNG.
  - Korea has a domestic production of natural gas in an offshore field, but it's volume is negligible.

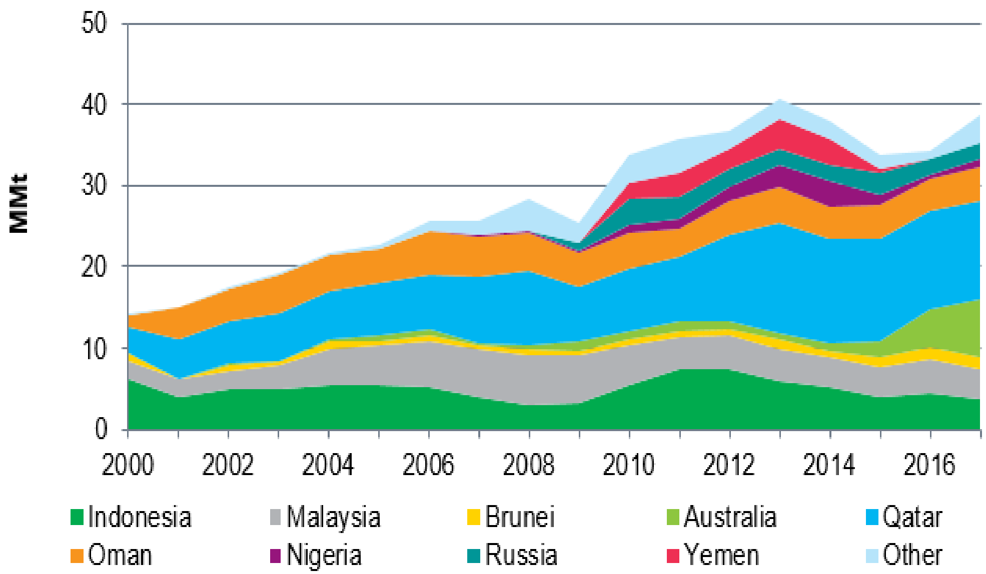
Natural Gas Supply in Korea (1988-2016)



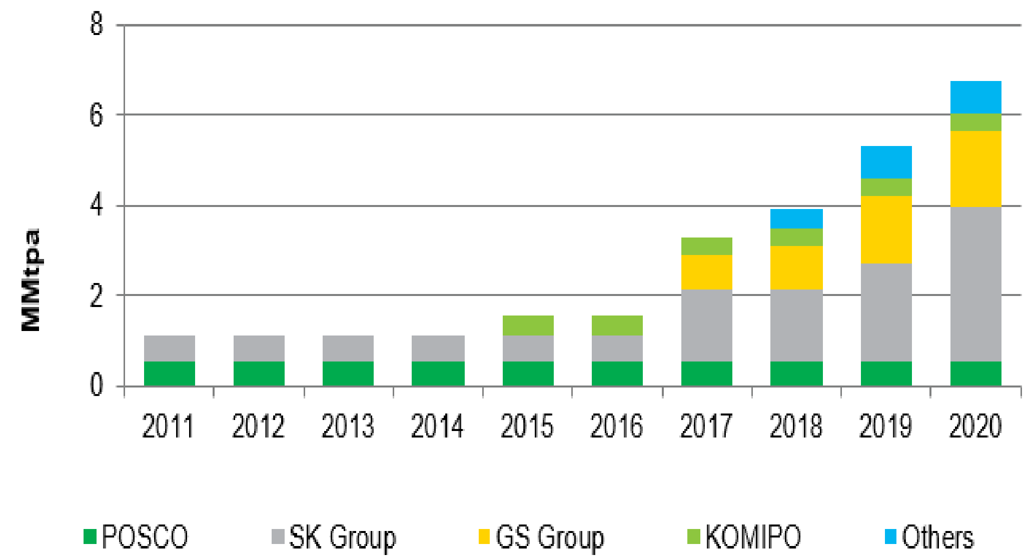
LNG imports

- Korea imported 38.9 MMt of LNG in 2017, 13.4% higher than in 2016 (34 MMt).
- South Korea imported 13% of the global LNG traded in 2017, down from 17.0% in 2013 (Japan: 28.8%, China: 13.5% in 2017).
- LNG imports from non-KOGAS buyers have increased greatly since March 2017

LNG imports by source (2000-2017)



Direct importer's LNG term contracts



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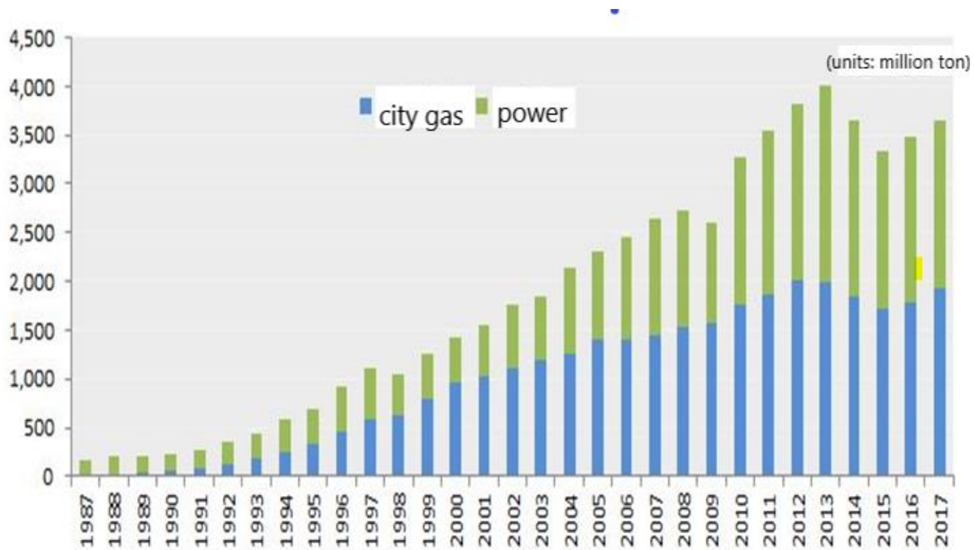
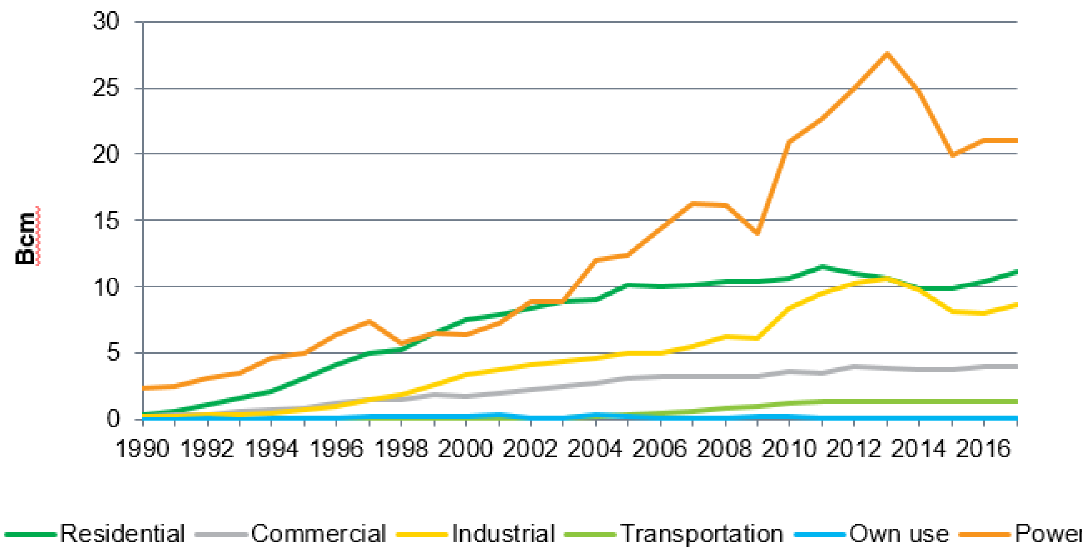
Natural Gas Demand in Korea

- Domestic natural gas demand grew at a CAGR of 11.0% from 1.61 MMt in 1987 to 36.81 MMt in 2017 after the commencement of supply in 1986.
- Power generation is by far the largest sector for natural gas consumption in Korea: 50% (‘13) → 43% (‘17)

Historical Natural Gas Demand (1987-2017)



Gas demand by use (1990-2017)



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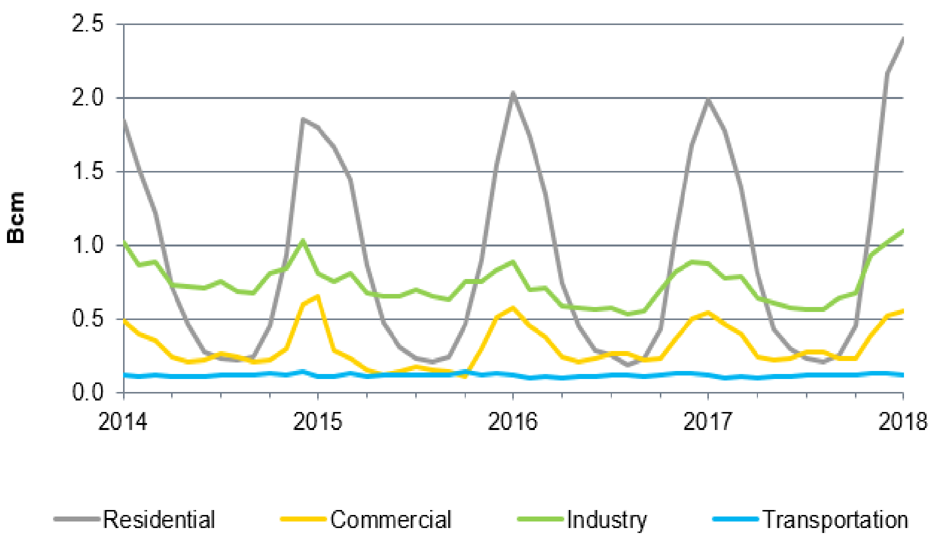
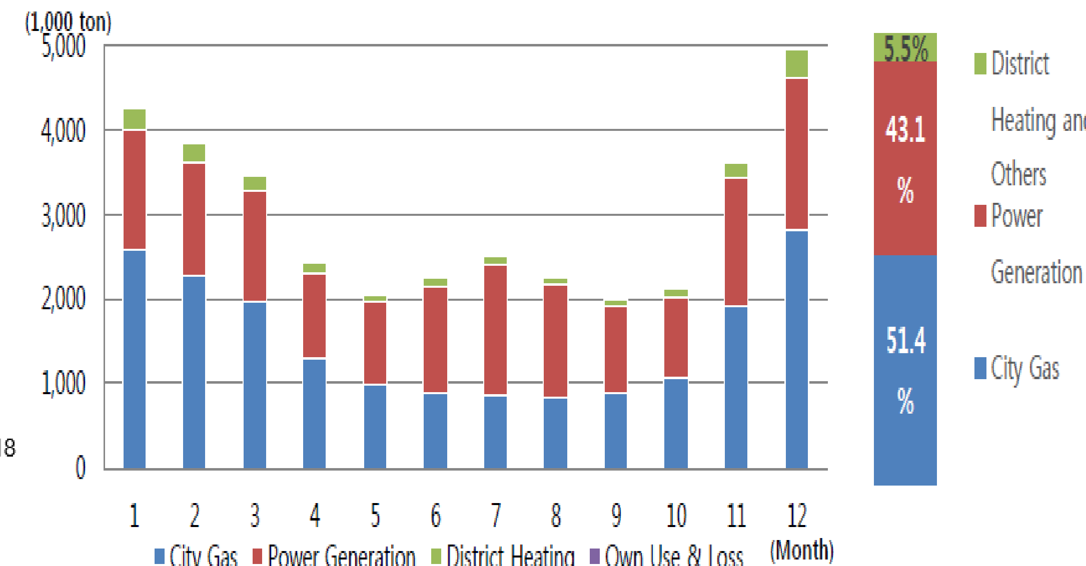
Natural Gas Demand in Korea

- Residential heating demand in winter mainly causes high seasonality of gas demand.
- The industrial and commercial sectors also experience seasonal patterns although less pronounced.
- Gas demand in power experienced a strong uptick during the peak heating months in 2017/18 (December and January).

Monthly gas demand (2014-2017)



Gas demand by use(2017)



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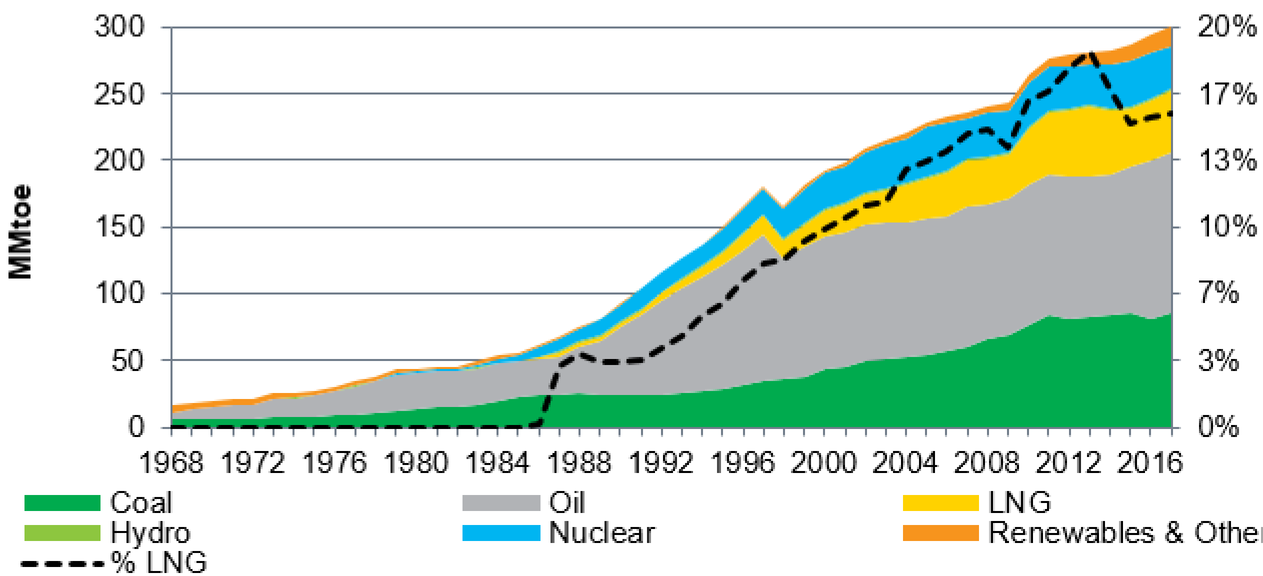
Gas in the Energy Mix

- LNG plays a relatively small role in the energy mix.
- The share of LNG: 19.0% ('13) → 15.2% ('15) → 15.7% ('17)
- The share of LNG has climbed over the past two years owing to demand growth in both power and city gas sectors

Primary Energy Demand and the Share of LNG (1968-2017)



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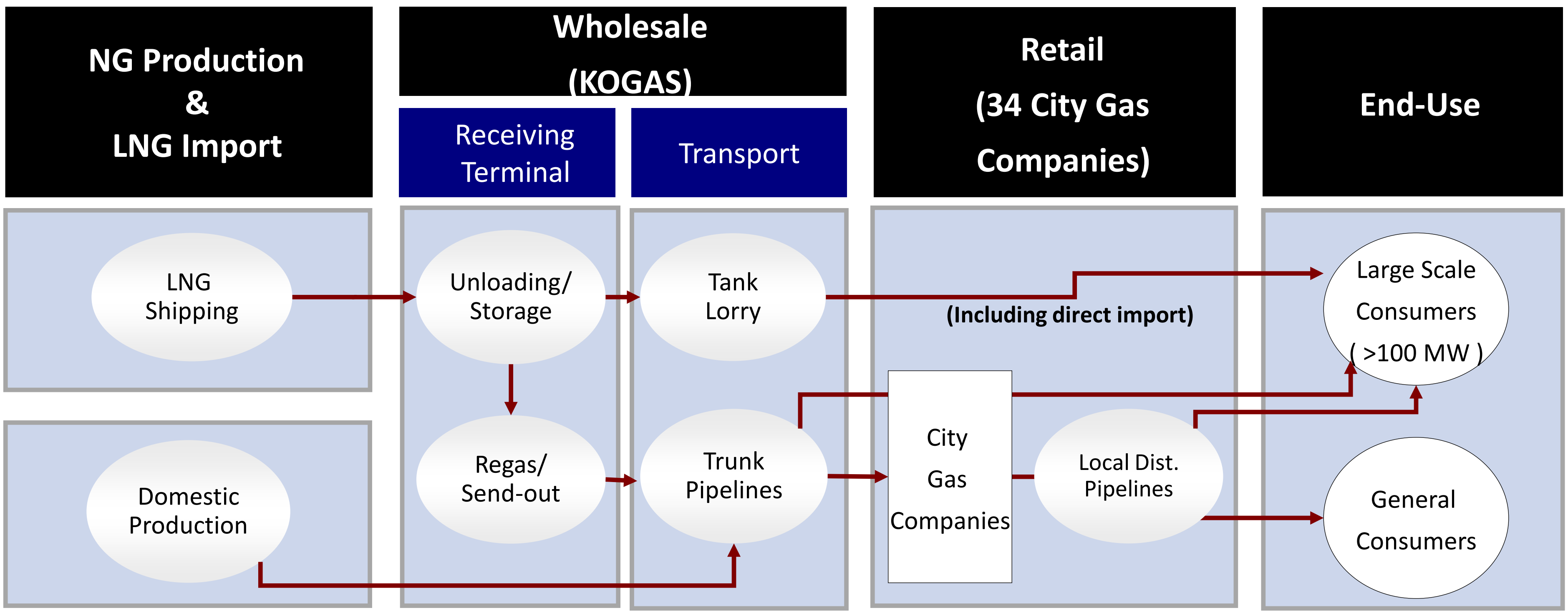
Korean Gas Market and Industry

- KOGAS has a de-facto monopoly over Korea's LNG import, storage and transportation and monopoly in the wholesale business.
- KOGAS imports almost 95% of the LNG demand in the wholesale sector and it provides gas to large-scale consumers (like power generation company) and city gas companies.
  - Large-scale consumers are those who have their own power plants larger than 100 MW and are eligible for a direct contract with KOGAS which is a wholesaler not a retailer.
- Large-scale consumers such as power producers and manufacturer are also allowed to import LNG for their own use ("Direct importing").
  - However LNG imported by direct importers can not be sold to other domestic costumers since KOGAS is the sole wholesaler according to the law.
- 34 city gas companies, who have exclusive selling rights in each region of the Korea, purchases all natural gas for manufacturing city gas from KOGAS.

Korean Gas Market and Industry

Korean Natural Gas Market Structure



- KOGAS imports more than 90% of total demand
- Several direct importers are allowed to import LNG for their own use.

- KOGAS: de-facto monopoly
- Third Party Access to facilities: trunk pipeline, terminals

- 34 City Gas Companies : regional monopoly in the local distribution and sales to the end customers

- Direct Import: power companies & large industrial consumers

Gas Pricing in Korea

- **LNG import prices are mostly linked with the oil prices.**
  - **Average LNG import price rose in the recently with the international oil price rise.**
  - **LNG from the U.S. is attracting direct importers since it is priced based on the Henry hub gas price and it is free from the destination clause.**
- **Wholesale gas price paid to KOGAS by the city gas companies**
  - **Wholesale gas price is set by the cost pass through mechanism, in which total cost is compensated by reasonable return.**
  - **Total cost is composed of the raw material cost and wholesale supply cost.**

Wholesale Gas Pricing in Korea

Wholesale gas price = Raw Material Cost + Wholesale Supply Cost + Return

Raw Material Cost:
- LNG Importing Cost
- Shipping Cost
- Insurance premium
- Taxes & Duties

Wholesale Supply Cost:
- Direct and Indirect costs relating to production and supply of natural gas
  - Depreciation
  - Admin Expenses
  - Labor cost

Return:
- Reasonable Opportunity Cost on assets contributed to the natural gas wholesale business

Gas Pricing in Korea

- **Retail gas price payed to city gas companies by the end customers**
  - **The retail gas prices are made up of the KOGAS wholesale gas price and the supply cost, which varies by region and city gas company.**
  - **The retail gas supply costs is approved by a local government every year.**
  - **Detailed guideline to calculate and set retail price is determined by the MOTIE (Ministry of Trade, Industry and Energy)**

Retail Gas Pricing in Korea

Retail gas price = Wholesale Gas Price + City gas supply cost + Return

Wholesale Gas Price
- Representing 85-90% of the retail price

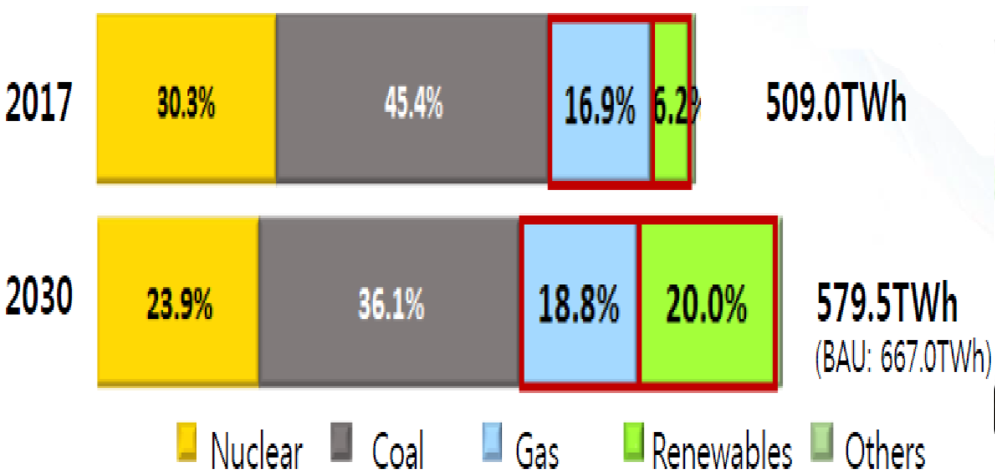
City gas supply cost
- Costs for city gas manufacturing and distribution except for wholesale gas purchase cost
  - Depreciation
  - Admin Expenses
  - Labor cost

Return
- Reasonable Opportunity Cost on assets contributed to the natural gas retail business

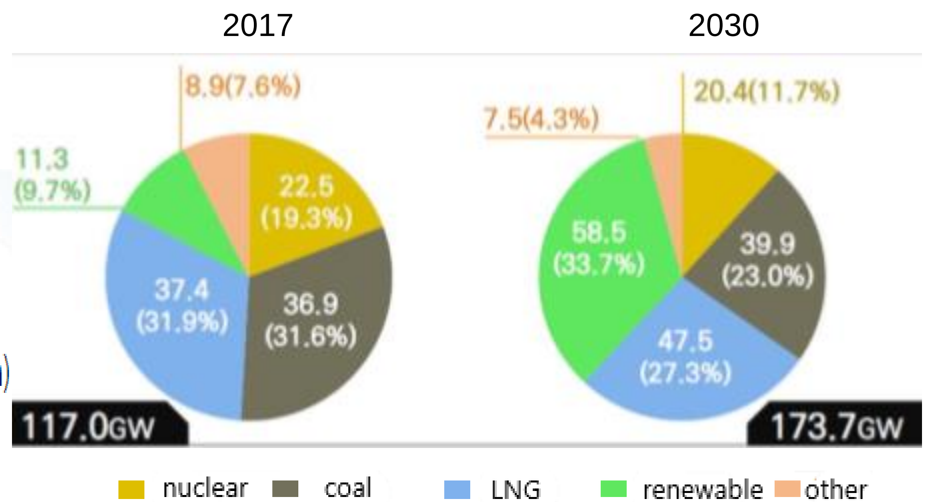
Energy Transition and Role of the Gas

- **Korean government is pursuing a reshape of the long-term energy landscape**
- **The new energy policy focuses on reducing the dependence on nuclear and coal in the power sector, while it intends to increase the use of natural gas and renewable sources in power mix.**
  - **Gas fired power plants capacity will increase to 47.5 GW by 2030 from the current 37.4 GW**
  - **The share of the LNG power generation in the total generation will increase to 18.8% from the current 16.9%**

Power Generation by fuel (2017 vs. 2030 outlook)

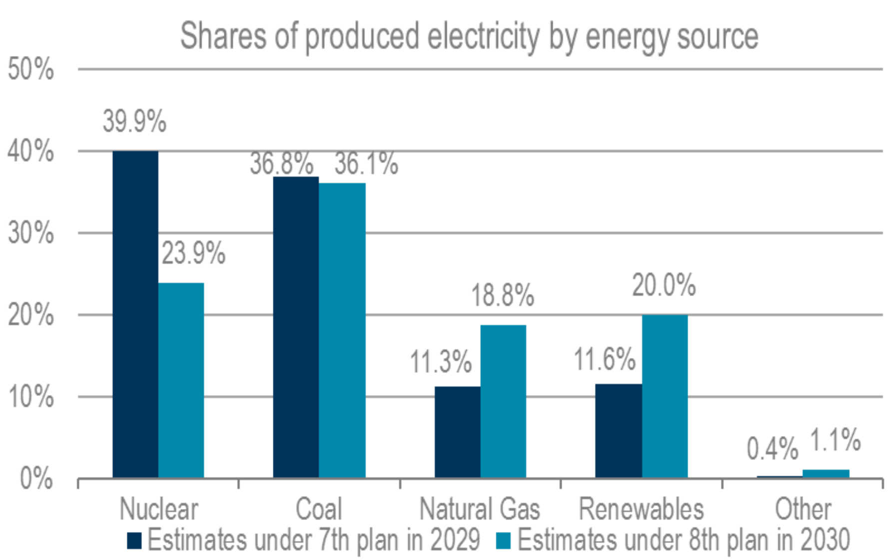


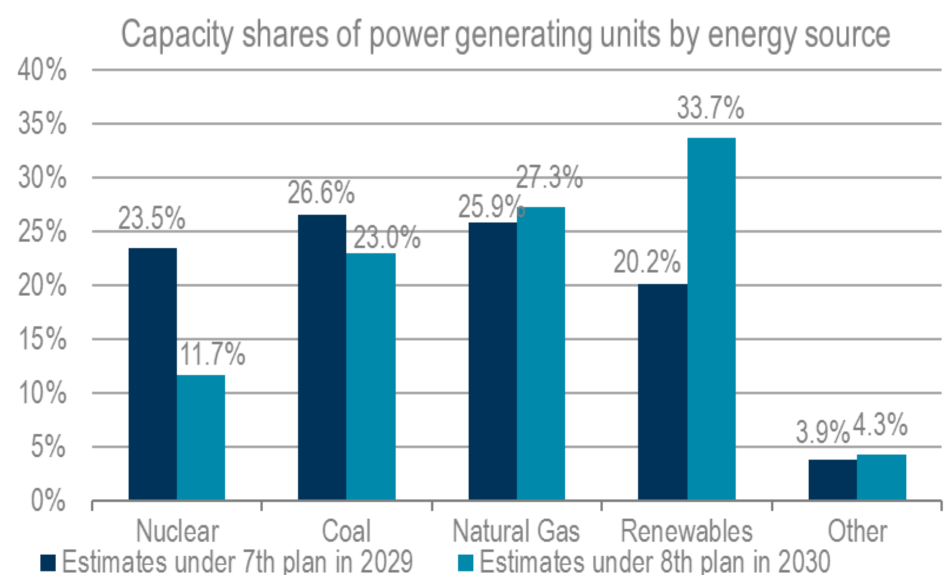
Capacity by fuel (2017 vs. 2030 outlook)



8th Basic Plan for Long-term Electricity Supply and Demand

- The 8th Basic Plan for Long-term Electricity Supply and Demand reflects the new government's intention to reduce its reliance on coal and nuclear in the future energy mix.
- According to this plan, renewable energy will receive government support to meet the increased target of a 20% share of generation by 2030.
- LNG is also likely to benefit as a lower-emission fuel source and by replacing lost generation from coal-fired power plants during periods of suspension.



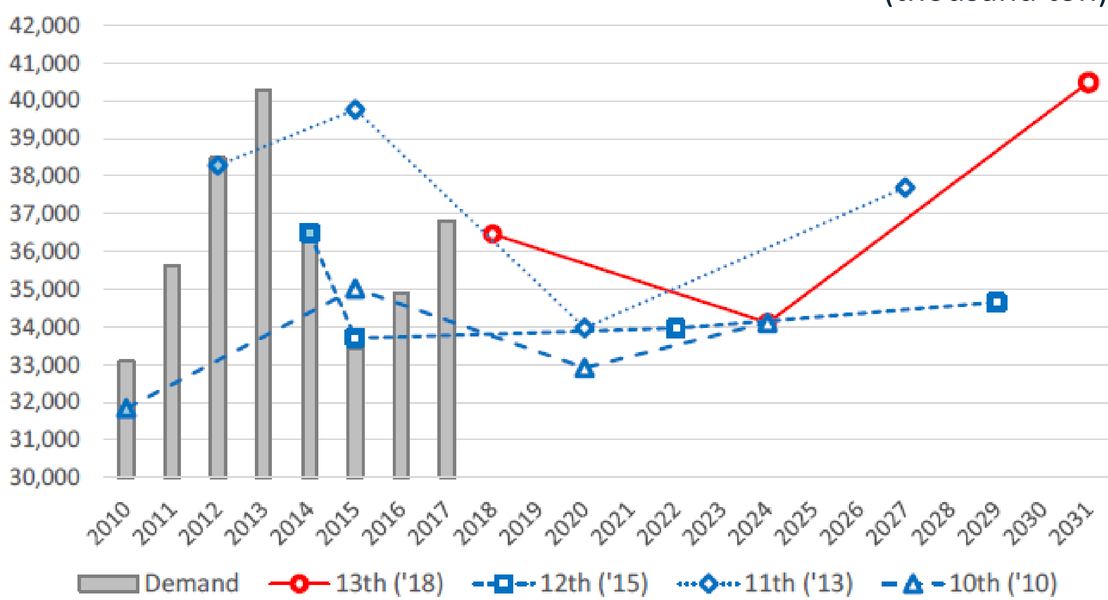


Natural Gas Demand Outlook (13th Plan)

- The biennially updated national plan for natural gas supply and demand (13th plan) was released in Apr. 2018
- The overall gas demand to fall to 34.1 MMt in 2024 before rebounding to 40.5 MMt in 2031, with an average annual growth rate of 0.81% from 2018 to 2031.
  - 36.5 MMt ('18) → 40.5 MMt ('31) with +0.81%/yr
  - 12th Plan: 34.7 MMt in 2029 with -0.34%/yr ('14-'29)

Gas demand outlook by 13th plan (2018-2031)

(thousand ton)

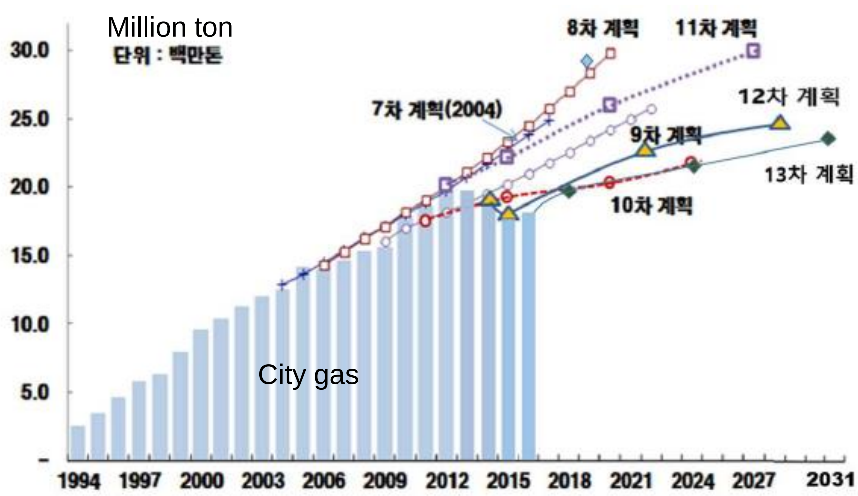


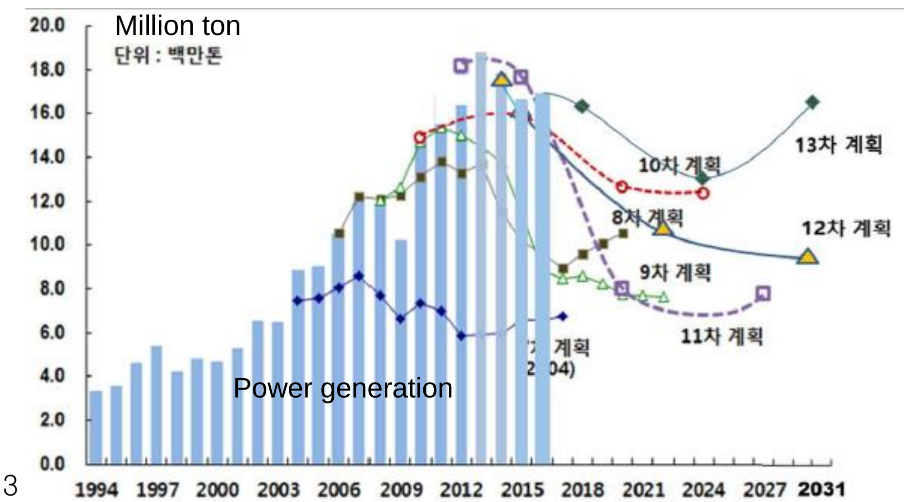
Natural Gas Demand Outlook (13th Plan)

- City gas demand is forecast to have the strongest growth throughout the next 15 years with an average annual growth rate of 1.24%.
- Gas demand in power generation is forecast to fall to 2024 by an annual average of 4.0 %, before increasing post-2025 by an average of 4.1% per year.

Gas demand outlook by 13th plan (2018-2031)

USE	SECTOR	2018	2024	2031	AAGR
City Gas	Residential/Others	11,850	12,310	13,290	0.89%
	Industry	8,090	8,860	10,110	1.73%
	subtotal	19,940	21,170	23,400	1.24%
Power Generation		16,520	12,940	17,090	0.26%
Total		36,460	34,110	40,490	0.81%





LNG import policy (13th Plan)

- The 13th plan announces LNG import policy directions emphasizing (i) supply security, (ii) diversification of import source, and (iii) preparation against sudden changes of global LNG market
- **Secure stable supply of natural gas to support the energy transition policy**
  - Procure the natural gas preemptively to meet the future generation target mix
  - Foster cooperation with other LNG importing countries to earn more flexible terms of the importing long-term contracts
- **Diversity the source of the LNG import**
  - Optimize the LNG import portfolio, taking both costs and stability into account
  - Diversify the LNG pricing index and mechanisms to lessen the vulnerability of price fluctuation
- **Strenghten capacity against the uncertainty of the global natural gas market**
  - Diversify the long-term contract-oriented import portfolio by adding more mid-term, short-term and spot contracts
  - Improve the flexibility of domestic gas supply by managing oversea assets owned by KOGAS, which are free to sell to the other market consumers

Management of Gas Supply & Demand (13th Plan)

- The 13th plan also announces policy directions regarding gas supply & demand management:
- Improve management system for stable gas supply
  - Organize 'natural gas supply-demand council' participating the representatives from MOTIE, KOGAS, direct importers in order to cooperate gas supply and infrastructure management.
- Strengthen capacity of gas supply & demand management in winter
  - Operate 'organization for stable gas supply & demand in winter' participating the representatives from MOTIE, KOGAS, KPX, local retailers, and other experts
  - Strengthen inter-government or inter-companies cooperation for stable supply management with cargo swap or sharing facilities by strengthening cooperation among Korea, Japan, and China
- Strengthen measures for gas supply management
  - Adopt 'fuel-switching contract' to temporarily replace city gas with LPG and compensate for loss to consumers
  - Strengthen monitoring gas supply management of direct importers, and revise the rules to manage gas supply by direct importers, when needed by national gas supply management

Thank you