Technology Collaboration Programme on Heat Pumping Technologies (HPT TCP)

Annex 42

Heat Pumps in Smart Grids

Market overview: Country report for South Korea

Appendix to the Final report

Operating Agent: The Netherlands

2017

Report no. HPT-AN42-2f

Market overview

Country report for SOUTH KOREA

Report compiled by

KIER

ABSTRACT
This appendix provides the detailed summary report discussing the market overview for South Korea.

Table of contents

List of figures

1 Executive Summary

South Korea energy market context – challenges & opportunities for heat pumps

- **The South Korea faces an increasing need to reduce peak demand and balance supply & demand – creating an opportunity and challenge for heat pumps.**
  Korea has been experienced electricity shortage problems in recent years because of rapid increase of industrial sector demand and cooling/heating demand due to relatively low electricity price. Electricity reserve rate fell to 3.8% in 2012 and Korea experienced blackout in 2011. The need to reduce peak demand through the use of flexible demand side resources such as heat pumps will be critical for the future security of supply in the South Korea. However, in Korea, the heat pumps are considered as an electric heater, so consumers as well as even policy makers have a resistance in acceptance of the electric driven heat pumps.
- **There are currently cumulative electricity tariffs without time-period dependent tariffs for residential sector, therefore it blocks demand-side flexibility.**
  In the commercial buildings and industrial sector, seasonal and time-period dependent electricity tariffs exist. However, in residential sector, total amount of electricity consumption is only parameter to determine household's electricity fare. The maximum electricity price level is 11 times larger than the minimum price level, so consumers tend to do not accept electric driven heat pump due to expectation of rapid increase of their electricity fare. To reduce electricity peak demand using demand-side flexibility devices, new electricity tariffs for residential would be needed.

The South Korea heat pump market development – small market share of heat pump

- **The South Korea heat pump market share is competitively low due to Korean floor heating culture by hot water supply from boiler.**
  Korean prefer air-to-air room air conditioner as a cooling and gas boiler as a heating. Korean do not like air heating method, so heat pump market share is low. However, advancement of cognition and governmental policy induces growth of the heat pump market. In recent, multi-type heat pump systems are been installed in large size buildings such as commercial and public buildings such as schools.

Challenges for heat pumps which need to be overcome to realise the potential – and capture the flexibility

- **The characteristics of the South Korea building stock are not ideal for heat pumps, or for providing heat pump flexibility**
  Newly built houses with gas boilers, a high-rise apartment house style, about half portion of house is lease or monthly rental, which blocks penetration of heat pumps.
- **Gas is a formidable challenge in the South Korea.**
  The gas network extends to >90% of dwellings in metropolitan cities which most population lives in and >72% in national average. In addition to easy connection with gas supply, cultural preference for gas boilers and aggressive promotions from gas boiler companies and low cognition of heat pump lead consumers to choose gas boilers.
- **Customer barriers need to be overcome to realise the South Korea heat pump market opportunity.**
  Low energy prices make customers more sensitive to the initial cost than to the running cost. Due to Korea's preference for floor heating, boilers are typically installed in houses for domestic hot water production. Since boilers are far cheaper than water-heating heat pumps, the payback time of a heat pump is longer than in other countries. In addition, heat pumps are usually regarded as appliances, in the same way as are air conditioners. This makes it more difficult for the concept of payback to be considered by customers.
- **Electric heating mat is competitor in Korea heating market.**
  Due to extremely low electricity price, an electric heating mat is competitor in residential heating market. The electric heating mat which price is less than $200 is cheaper than a heat pump or an air conditioner which price is about $2,000. Therefore, people uses an electric heating mat regardless of low energy efficiency of it.

2 Overview of the South Korea Energy Sector

2.1 Overview of main challenges in the South Korea [1]

South Korea faces some significant challenges in the energy sector. **Korea has been experienced electricity shortage problems in recent years because of rapid increase of industrial sector demand and cooling/heating demand due to relatively low electricity price.** Electricity consumption of industrial sector increases with average ratio of 6.4% during 2008-2012, therefore total electricity peak demand increases rapidly. In addition, relative electricity price decrease compared to other energy type induced increase of the direct electric heating (electric mat), so heating demand occupied 25% of total electricity peak demand as shown in Table 1.

Table 1 – Proportion of heating load in electricity peak demand (%).

2005-2006	*2006-2007*	*2007-2008*	*2008-2009*	*2009-2010*	*2010-2011*
18.6	19.8	22.0	22.6	24.1	25.4

Source: Ministry of Trade, Industry & Energy, 2nd National Energy Master Plan 01/2014.

Nationwide worries about safety of nuclear power plant increase due to accident of Fukusima nuclear plant in Japan. Therefore, South Korea faces challenges in the making of energy mix. In this circumstance, Korea has no diverse choices for stable supply of electricity. **Inevitably, coal-fired power plants have to be constructed and operated continuously in the near future which have a high carbon dioxide emission. Therefore, diverse efforts have to be carried out to meet the target of reduction of greenhouse effect gas emissions (30% reduction compared to BAU by 2020).**

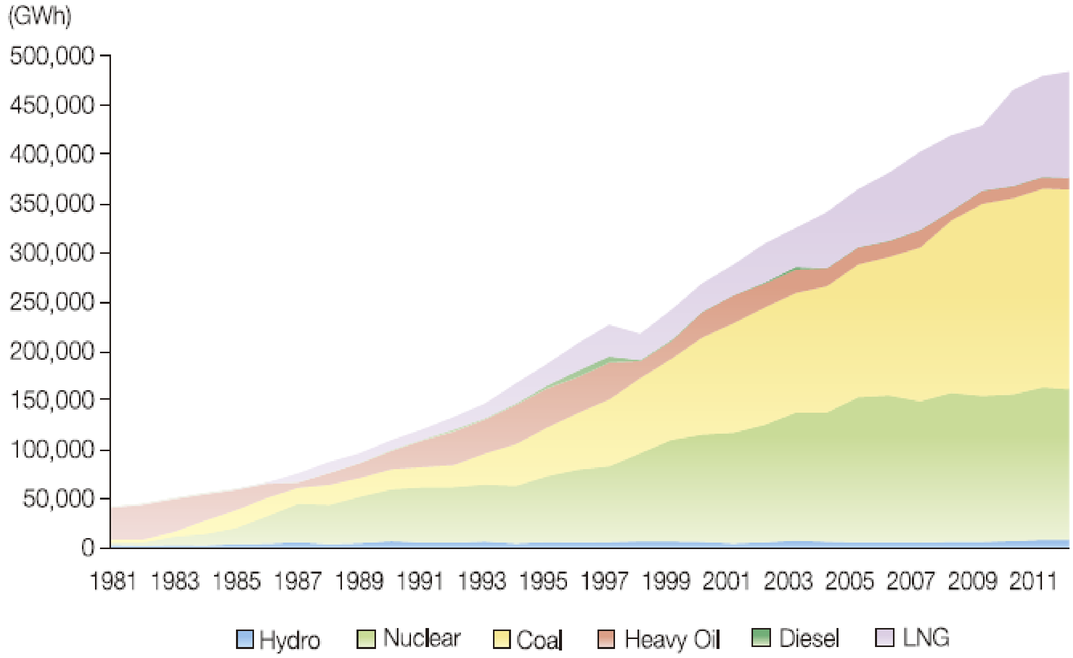
In addition, **due to social conflict induced from construction of the ultra-high voltage transmission system,** central oriented electric power supply system faces its limits in Korea.

The propagation renewables are relatively slow compared to other OECD countries. As IEA definition, only 1.5% of total electricity was generated by renewables in 2011. Korean government set a target that renewables supply 5.2% in the primary energy supply by 2020 and 11% by 2035.

2.2 South Korea electricity generation

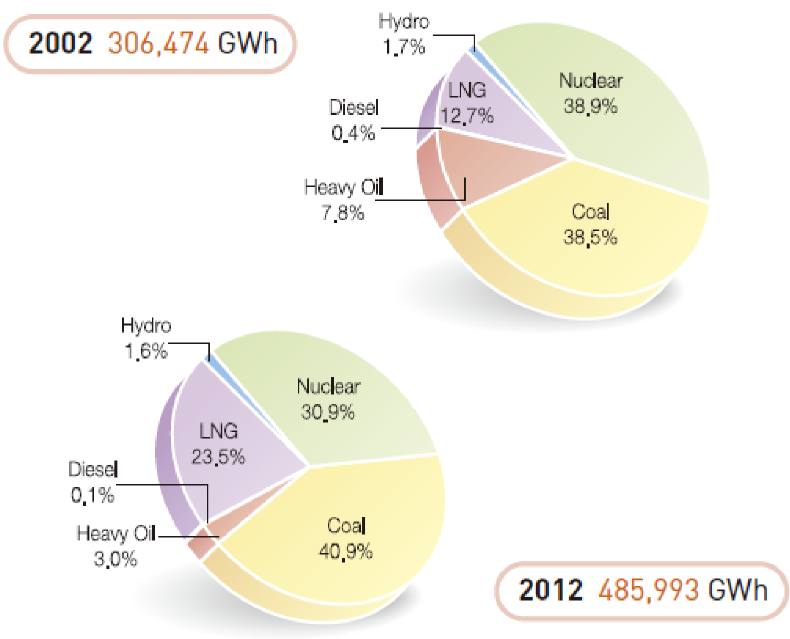
The South Korea's electricity supply is dominated by coal and nuclear. Continuously, the share of LNG is inclining due to increase of gas combined cycle facilities as shown in Figure 1 and Figure 2.

Figure 1 – Electricity supplied, 1981 – 2012, by fuel (in GWh)



Source: Korea Energy Economics Institute, 2013 Energy Info. Korea 12/2013, Section 2

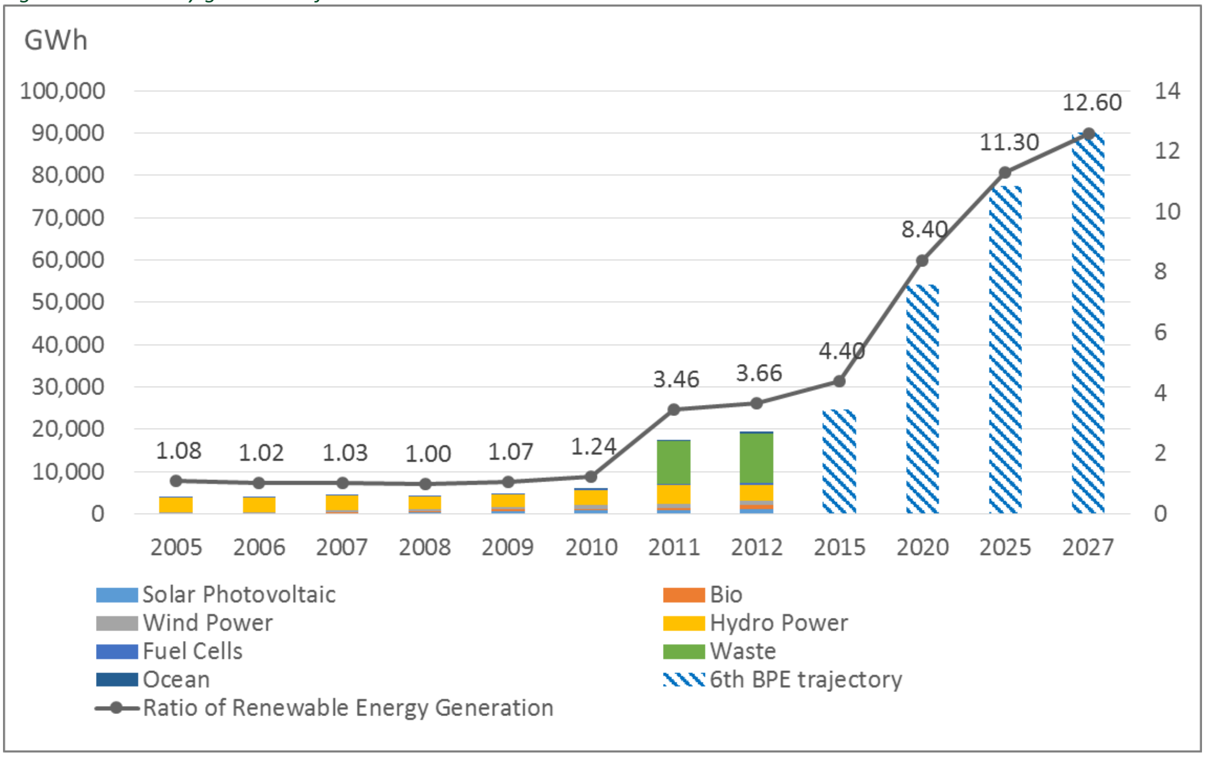
Figure 2 – Electricity supplied in 2002 vs. 2012, by fuel (in %)



Source: Korea Energy Economics Institute, 2013 Energy Info. Korea 12/2013, Section 2.

In Korea, there are difference in the definition of renewables compared to IEA, the share of renewables in the electricity mix has been rising consistently as shown in Figure 3. In 2012 it reached a share of 3.6% in the electricity supplied (1.5% in 2011 as a IEA definition, *from Energy Policies of IEA Countries-Korea 2012 Review*). Generation from renewable sources is dominated by waste energy, reaching a share of 60% in the overall generation of renewable electricity. Solar PV and Wind power has a share of 5.7% and 4.7% in the overall generation of renewable electricity.

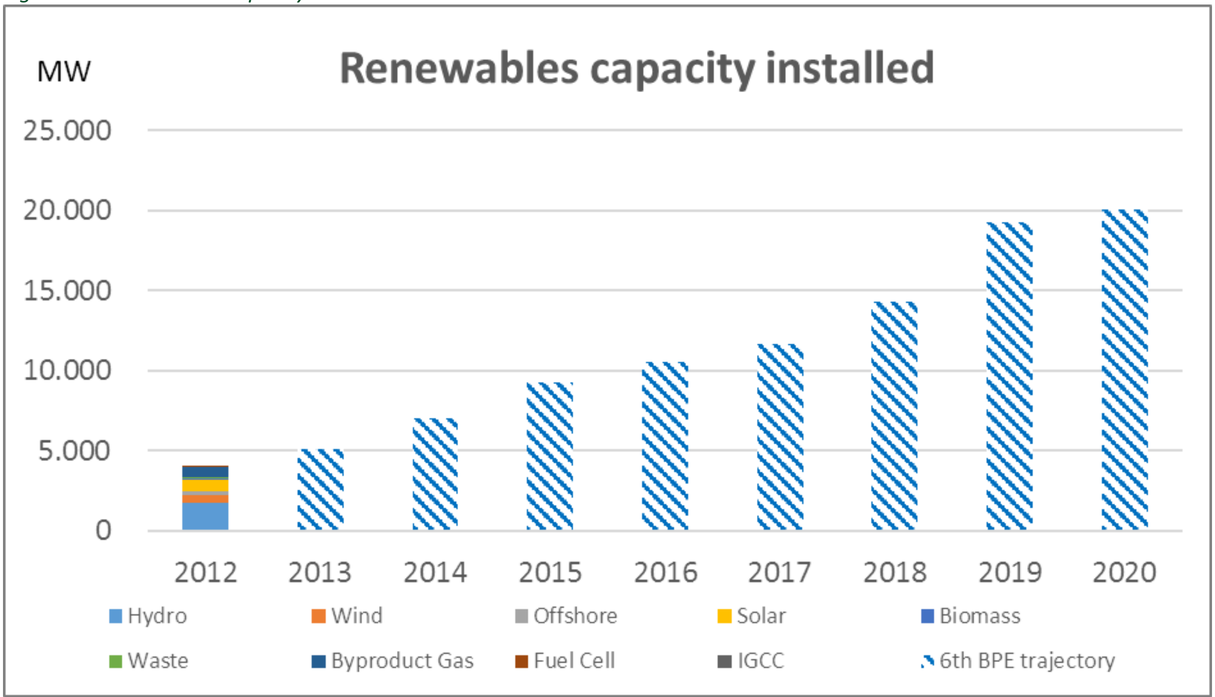
Figure 3 – Electricity generation from renewables.



Sources: Korea Energy Management COrporatoin, Statistics of New & Renewables 2012, 12/2013; Ministry of Trade, Industry & Energy, The 6th Basic Plan for Long-term Electricity Supply and Demand [2013-2027], 02/2013.

In Figure 4, the South Korea’s renewable energy generation capacity currently reaches 4.08 GW. According to “The 6th Basic Plan for Long-term Electricity Supply and Demand (BPE) [2013-2027] made by Ministry of Trade, Industry & Energy”, it is expected to reach a total installed capacity of approximately 20.07 GW in 2020, with the bulk of the added capacity coming from on- and offshore wind farms and PVs. **This will increase the volatility of supply in the South Korea electricity grid and therefore require new ways to deal with situations like over- or undersupply through demand side response technologies.**

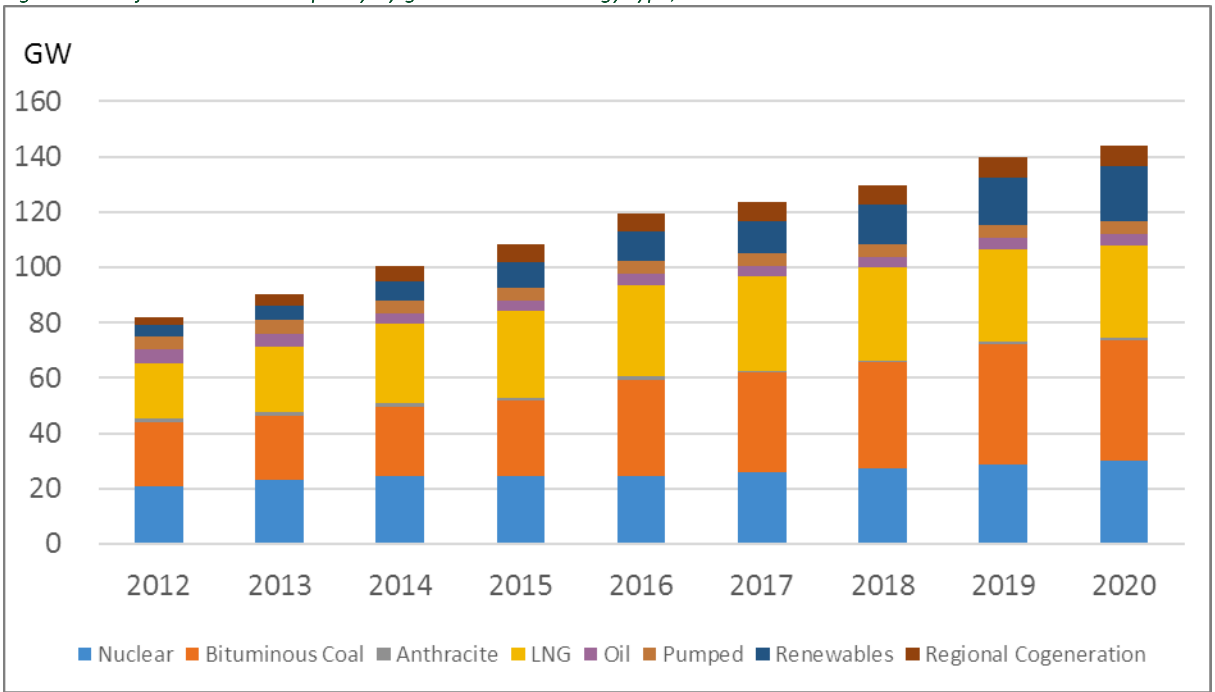
Figure 4 – Renewables capacity installed.



Source: Ministry of Trade, Industry & Energy, The 6th Basic Plan for Long-term Electricity Supply and Demand [2013-2027], 02/2013.

The South Korea total generation capacity currently reaches 82 GW. The 6th BPE expects a continuous increase in installed capacity to approximately 144 GW by 2020, which is almost double capacity of 2012 as shown in Figure 5.

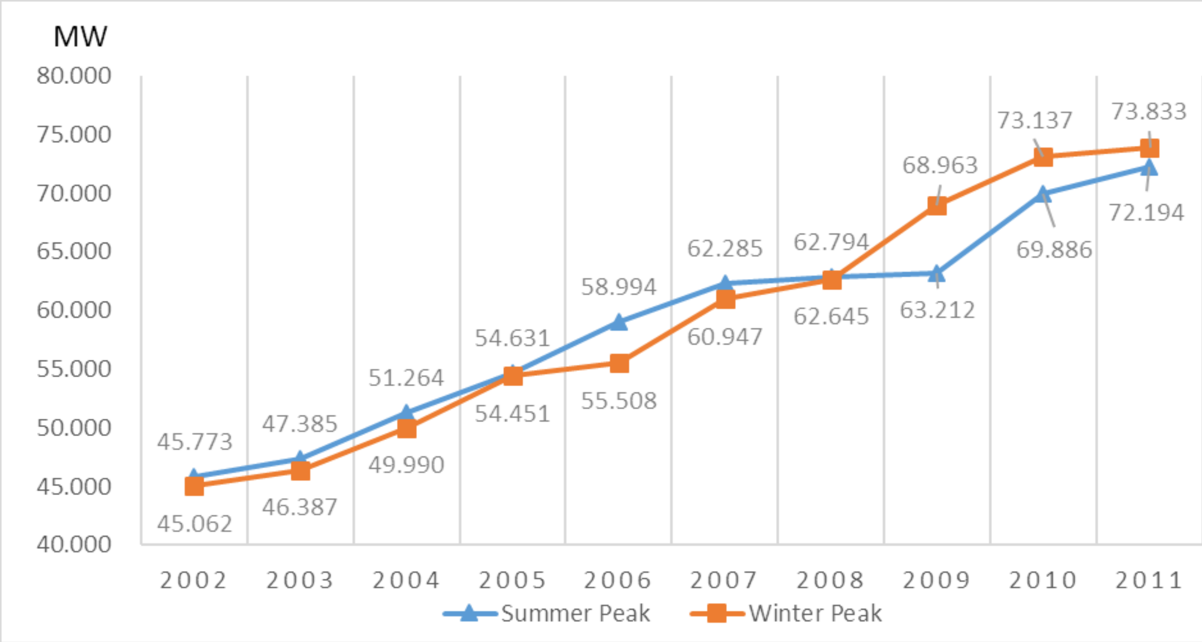
Figure 5 – Projected installed capacity by generation technology type, 2012 – 2020.



Source: Ministry of Trade, Industry & Energy, The 6th Basic Plan for Long-term Electricity Supply and Demand [2013-2027], 02/2013.

In Figure 5, major changes in the generation mix are not expected because Korea must install additional mature types of power plant such as coal-fired and nuclear to meet rapid increase of electricity demand.

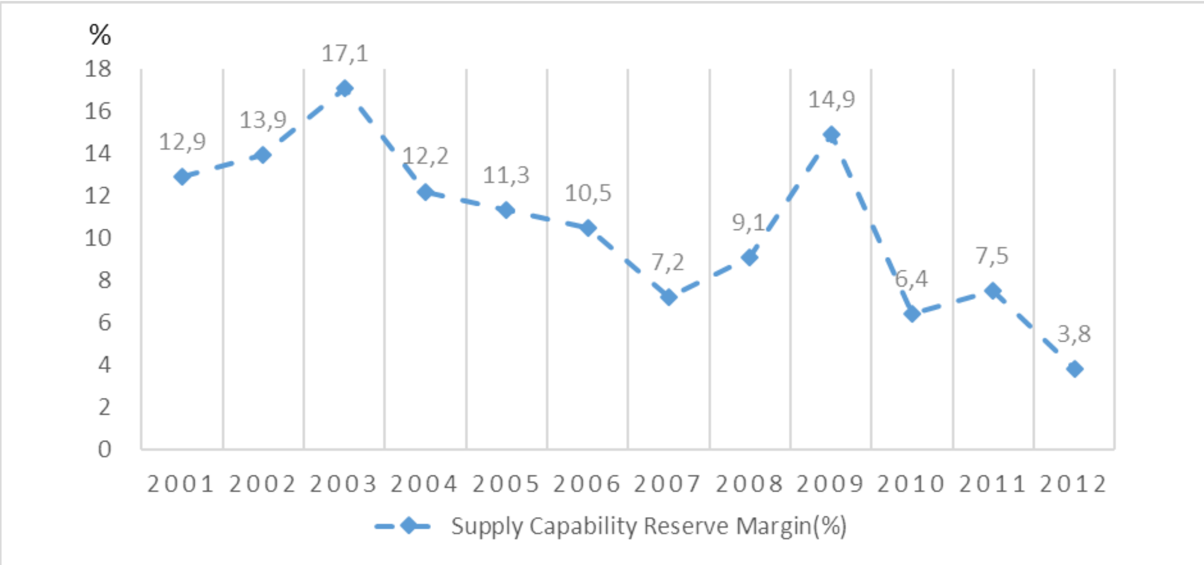
Figure 6 – Yearly summer/winter peak demand.



Source: *Ministry of Trade, Industry & Energy, The 6th Basic Plan for Long-term Electricity Supply and Demand [2013-2027], 02/2013.*

In Korea, peak demand has increased rapidly during past decade and used to occur in summer, but since 2009 it is occurring in winter as shown in Figure 6.

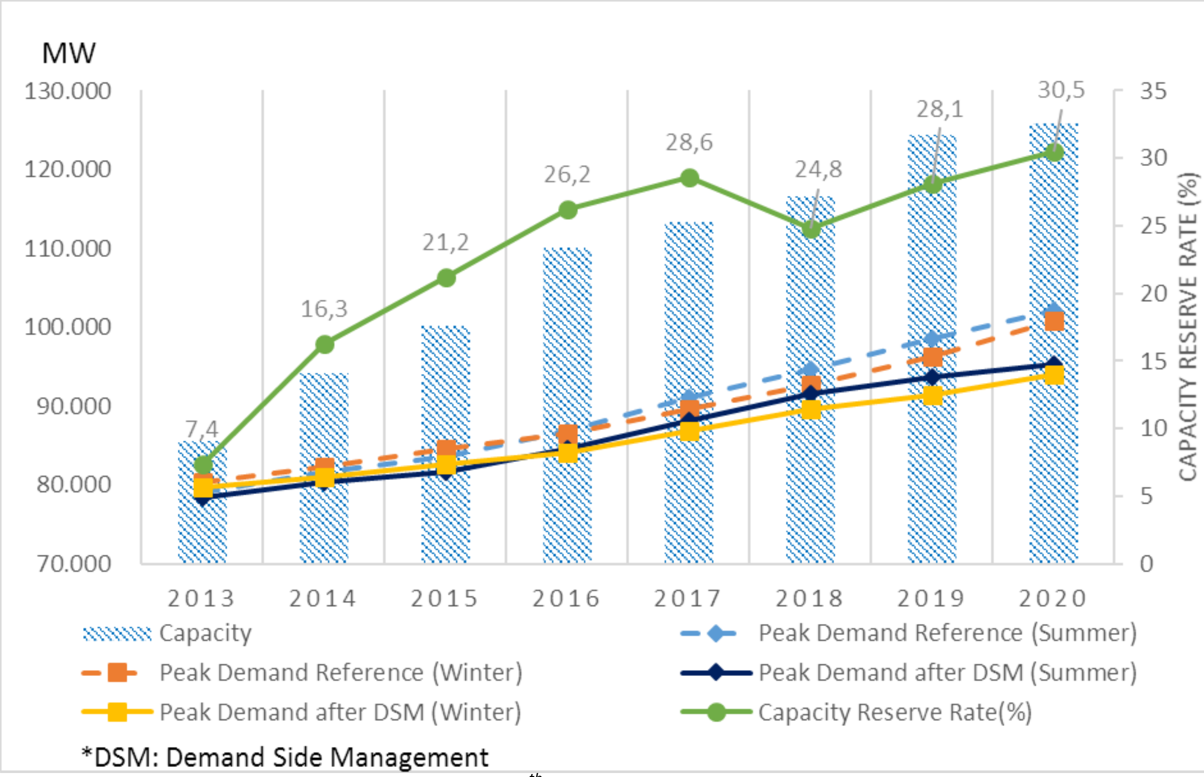
Figure 7 – Supply capacity reserve margin by year.



Source: *Ministry of Trade, Industry & Energy, The 6th Basic Plan for Long-term Electricity Supply and Demand [2013-2027], 02/2013.*

Since 2010, actual demand was more than 5,000MW higher compared to 3rd BPE (2006 to 2020). 3rd BPE predicted 67,120MW of demand for 2012, but in reality, it was 74,291MW, an error of 7,171MW. Therefore, reserve rate fell to 3.8% in 2012 due to unexpected rise in demand, insufficient demand side management (DSM), delay or cancellation of power plant projects, reinforcement of nuclear plant safety standard and rise of generator trip. Due to deteriorating balance since 2010, short-term demand curtailment has been carried out (3,666MW in 2012) and Korean people experienced severe electricity shortage.

Figure 8 – Electricity supply and demand outlook by year.



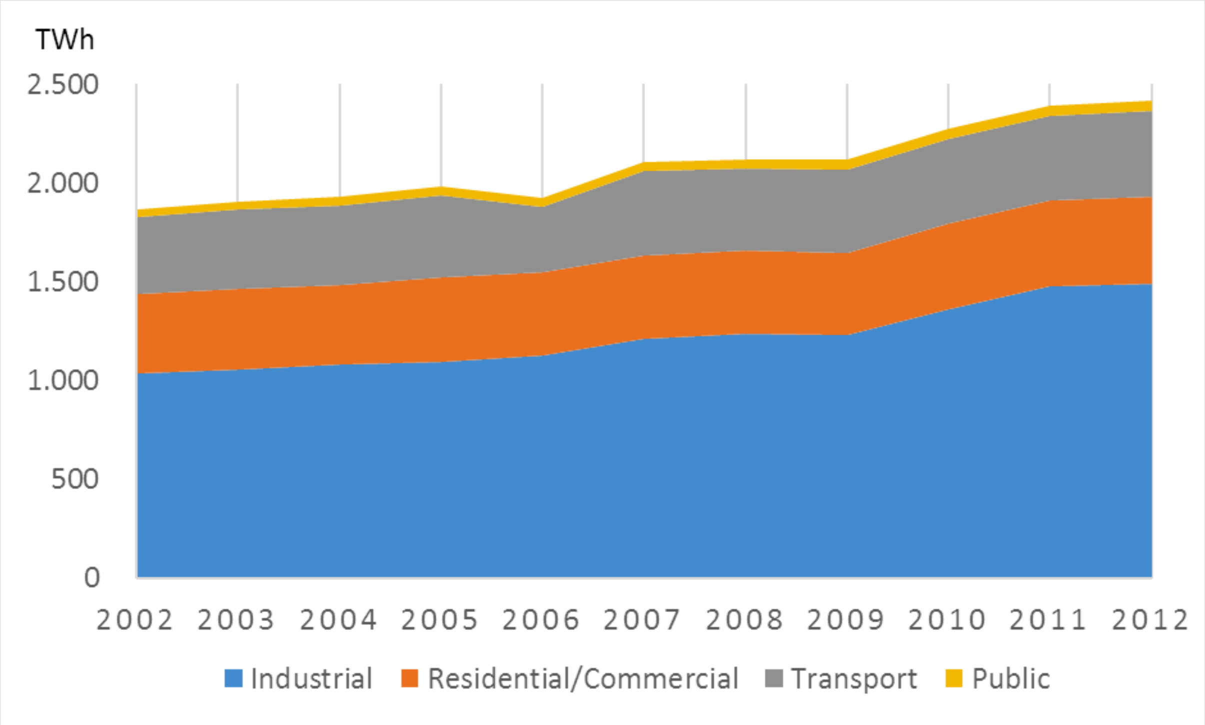
Source: *Ministry of Trade, Industry & Energy, The 6th Basic Plan for Long-term Electricity Supply and Demand [2013-2027], 02/2013.*

To overcome electricity shortage, in 6th BPE which was conducted in 2013, Korea made a master plan for stable electricity supply. The peak demand is expected as 102,205 MW(summer) and 100,809 MW(winter) in 2020 due to economic and population growth (this is a reference case). After demand side management (DSM), peak demand is expected as 95,316 MW(summer) and 94,014 MW(winter) in 2020. With continuous installation of power plants, the capacity reserve rate will reach 30.5% in 2020. To achieve this plan, **reducing peak demand through the use of flexible demand side resources such as heat pumps is therefore critical as well as increasing supply capacity for the future security of supply in the South Korea.**

2.3 South Korea Energy Demand

The South Korea's final energy demand is currently around 2,420 TWh per year, 18.2% of which is consumed by the residential/commercial sector:

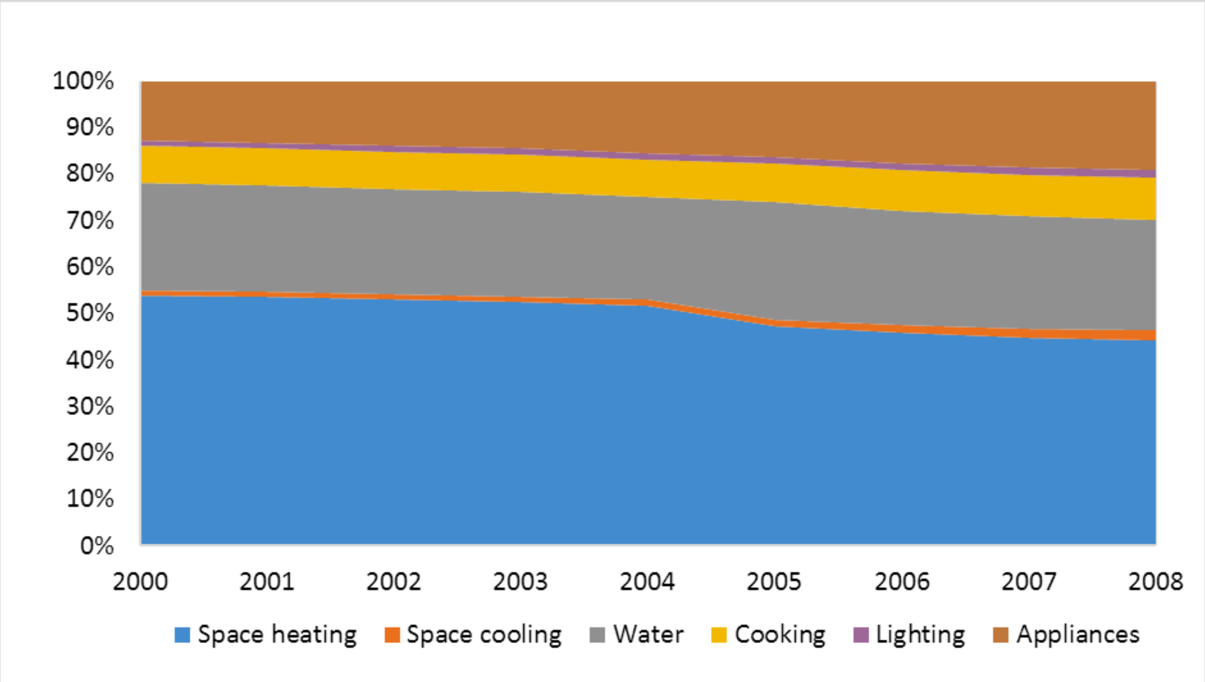
Figure 9 – South Korea final energy consumption by sector.



Source: Korea Energy Economics Institute, 2013 Energy Info. Korea 12/2013.

The most important use of energy in the domestic sector is for space and water heating purposes, representing over 70-80% of the energy consumed in this sector every year between 2000 and 2008 (see Figure 10). Overall consumption of energy in the domestic sector has not changed appreciably during past decade – as seen in Figure 9.

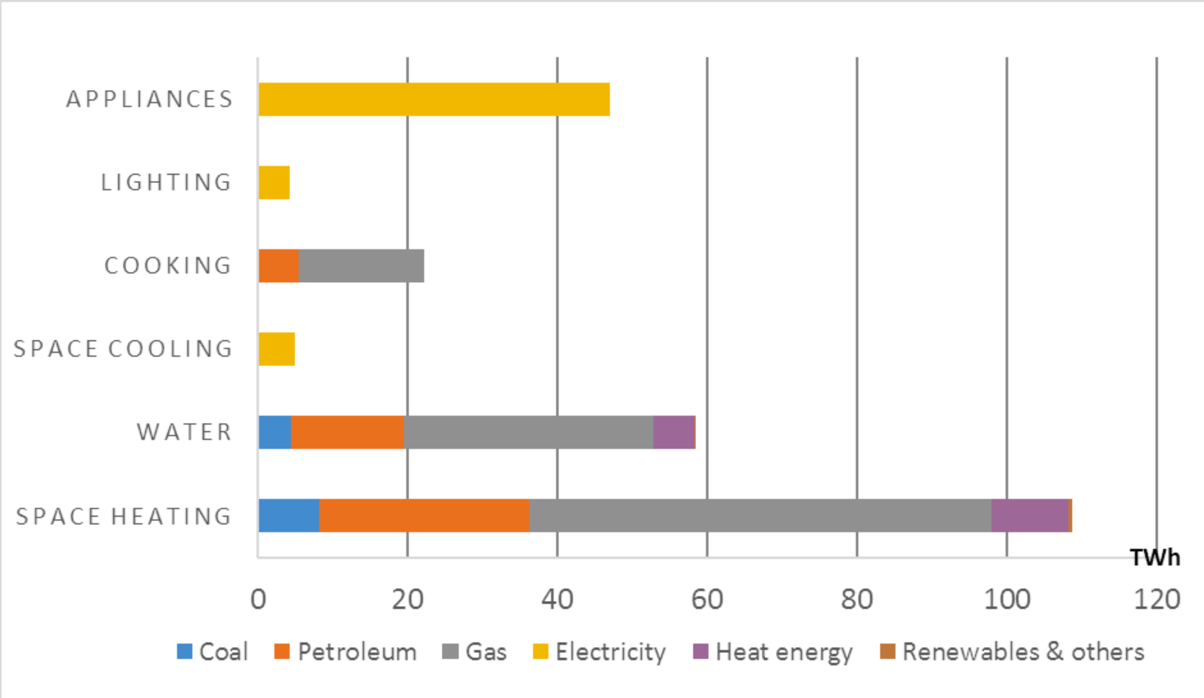
Figure 10 – Energy consumption of South Korea households by end use.



Source: Korea Energy Economics Institute, Energy consumption of residential sector, 12/2010.

Gas is by far the most important energy carrier in the use of energy by South Korea households, accounting for 45.5% of the total energy demand. This is followed by the use of electricity, which accounts for 22.9% of the energy consumed.

Figure 11 – Energy consumption of South Korea households in 2008, by end use and fuel.



Source: Korea Energy Economics Institute, Energy consumption of residential sector, 12/2010.

2.4 South Korea Energy Infrastructure [2]

The South Korea energy infrastructure will require heavy investment in the upcoming years in order to cope with an increased peak demand, uptake of renewable generation and the widespread deployment of new demand side technologies like heat pumps and electric vehicles.

2.4.1 The South Korea Electricity Grid

Transmission Grid: Korea Electric Power Corporation (KEPCO) owns and operates the national power grid and all distribution networks. The transmission network is approximately 31,250 km long, including 835 km of 765 kV lines, 8,653 km of 345 kV lines and 21,530 km of 154 kV and below lines. Transmission lines tend to run from the north-western and south-eastern coastal regions, where much of the generating capacity is located, to major urban and industrial centres in the north-west while submarine high-voltage direct current (HVDC) cables connect the island of Jeju in the south to the mainland. Compared to networks in many other IEA countries, it is a young transmission network, with relatively low system losses; its transmission and distribution loss factor is less than 5%, lower than the OECD's average of 6.7%, helped by the addition in 2002 of the 765 kV transmission system. KEPCO is devising an HVDC transmission line construction plan to prepare for the construction of a large-scale offshore wind farm, to be located on the west coast, in line with the government's new and renewable energy promotion policies. The national power grid is an isolated system; there are no cross-border transmission lines but there are a number of proposals to connect the grid with that of Russia or Japan. It is expected that the biggest obstacle for any possible interconnection with Russia will be Korea's relationship with North Korea.

Distribution Grid: KEPCO also maintains Korea's distribution network, which is approximately 435,549 km long. Korea is divided into 14 electricity supply zones. Community energy suppliers are responsible for the supply of electricity in certain areas. A community energy supplier is a government-licensed power producer who, for purposes of distributed power generation, possesses CCGT plants (using LNG) and distribution facilities in a certain area, generates power and heat, and supplies customers within that area.

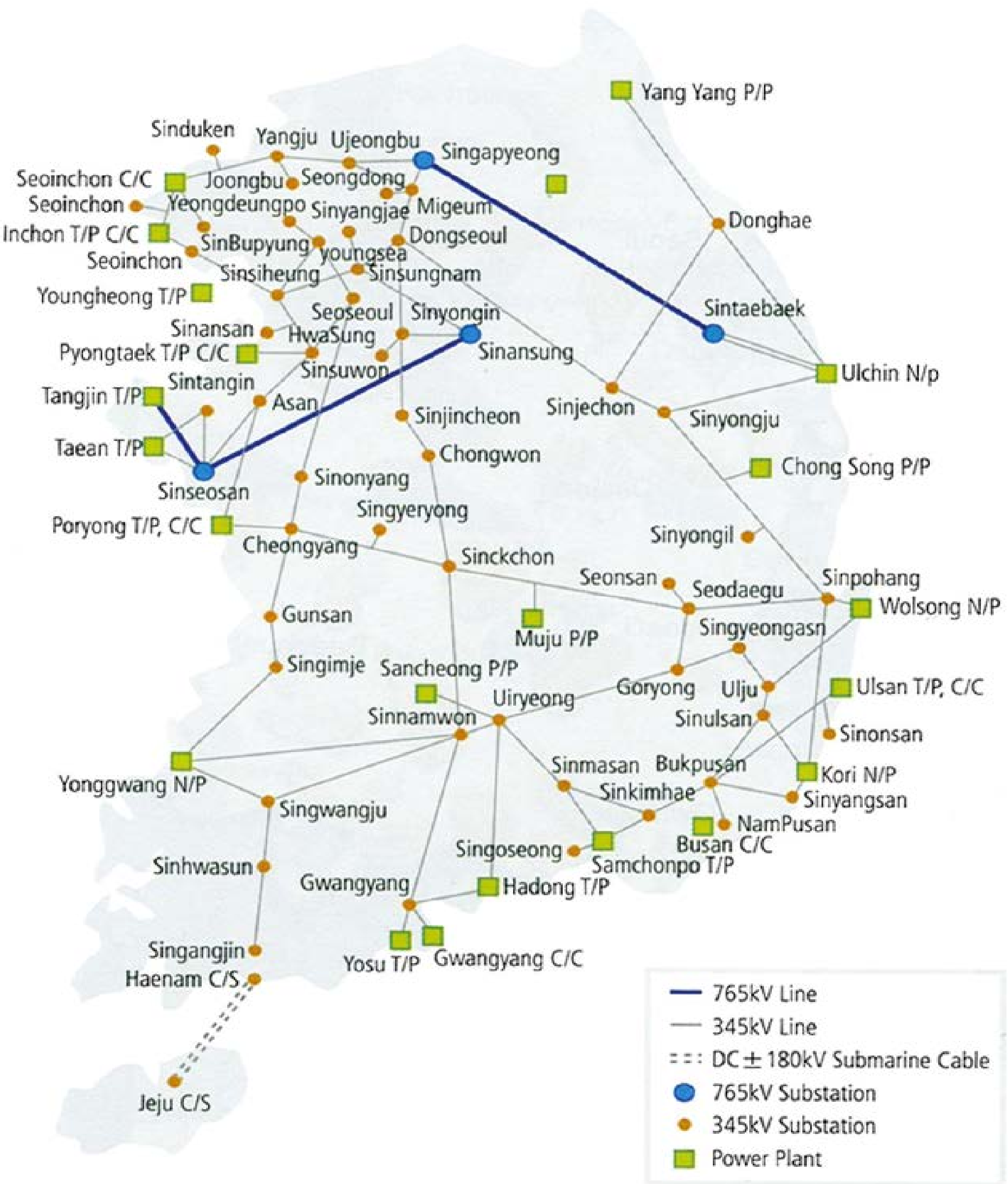
Smart Grid: In 2009, Korea's Presidential Committee on Green Growth presented a roadmap of smart grid, the government is developing its smart grid project in five areas:

- Smart power grid;

- Smart consumer response and smart home appliances;
- Smart transportation;
- Smart renewable; and
- Smart electricity service.

The Smart grid project will be implemented in three phases by 2030. The first stage is the construction and operation of the Smart Grid Test-Bed to test relevant technologies. In this regard, the government launched a USD 65million government-funded pilot programme on Jeju Island in partnership with industry. The pilot consists of a fully integrated smart grid system for 6,000 households, wind farms and four distribution lines. From 2013, Jeju test-bed was completed and developed technologies and tested systems will be applied to electricity networks at city level until 2020. The third and final stage is the establishment of a nationwide smart grid.

Figure 12 – South Korea electricity transmission network.



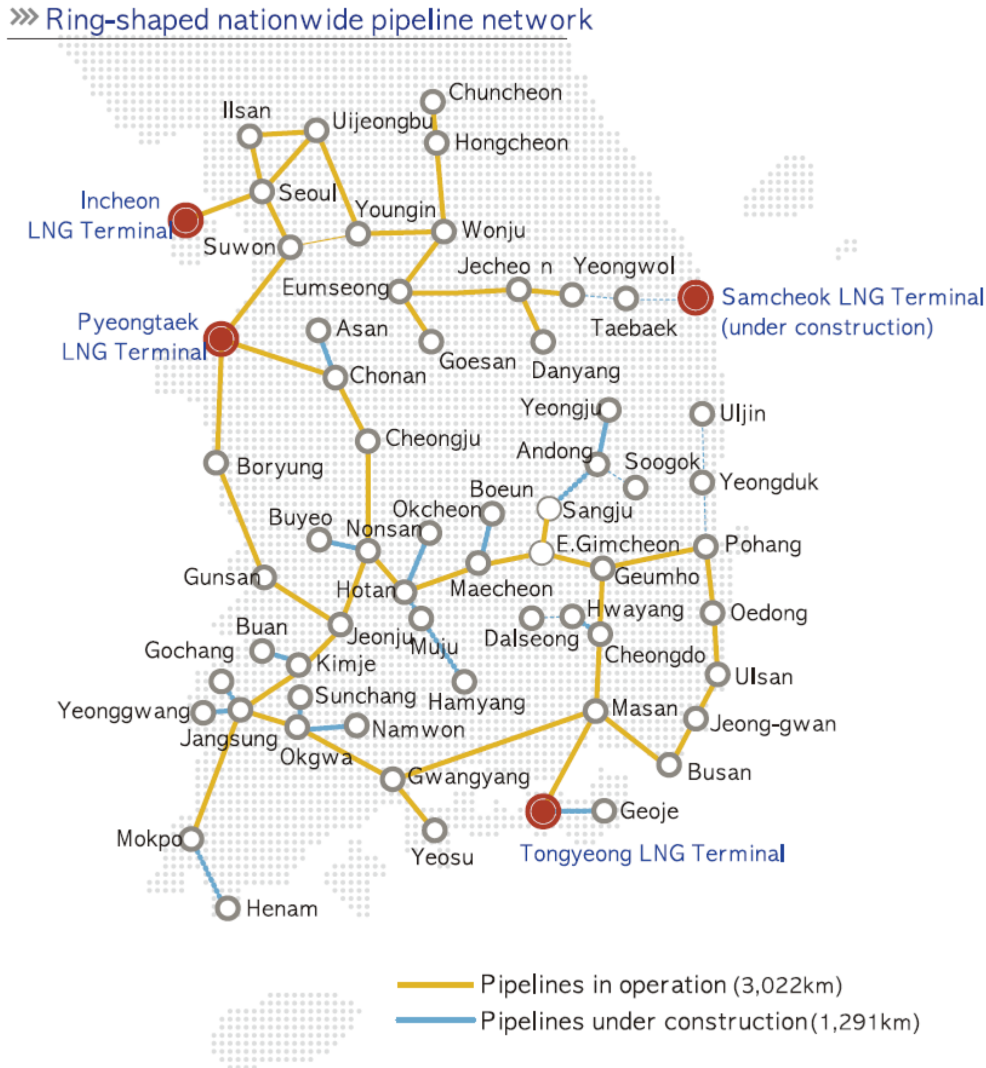
Source: Korea Energy Economics Institute, 2013 Energy Info. Korea 12/2013.

2.4.2 The South Korea Gas Grid

The Korean natural gas industry is dominated by KOGAS; it owns three of the four LNG import facilities (with another under construction), the transmission system, almost all storage capacity and is the sole wholesaler of gas. There are 30 city gas companies that are responsible for supply to industrial, residential and commercial consumers. Fourteen power companies, with the exception of POSCO (a steel producer) and SK E&S (formerly K-Power) purchase their gas from KOGAS. The largest of these is Korea Electric Power Corporation (KEPCO): in 2011, it purchased 69% of all gas consumed by the power sector.

Almost every household in metro cities can use natural gas. The penetration rate of residential sector in 2011 is 92.3% for Seoul and 72.2% for national average.

Figure 13 – The South Korea gas transmission network.



Source: Korea Energy Economics Institute, 2013 Energy Info. Korea 12/2013.

2.4.3 District Heating Networks in the South Korea

District heating networks are not very common in the South Korea. About 2 million households which is 11% of total household (18 million in 2012) in Korea are supplied. The major company is Korea District Heat Corporation (KDHC) which supply district heat energy to 1,212,000 households, representing 60% of the nation's total.

Figure 14 – The South Korea district heat locations.

Source: *Korea District Heating Corporation, http://www.kdhc.co.kr (2014).*

The largest district heating scheme in the South Korea is located in Seoul and its neighbourhood. The main heat source is combined heat and power plant. The total heat supply in 2012 is 0.66 Mtoe.

2.5 South Korea Energy Policy

South Korea government announced 2nd National Energy Master Plan on January 2014. The major targets are:

- A renewables target of 5.2% in the primary energy supply by 2020 and 11% by 2035. The major increasing sources are PV and Wind energy.
- Distributed power plants (Microgrid with Renewables, Regional energy) will supply above 15% of total electricity generation by 2035.
- Demand reduction of 13% in the total energy demand and 15% in the electricity demand by 2035. To achieve targets, demand side management using a ICT (Information Communication Technology)-based smart grid including ESS (Energy Storage System) will be conducted. Also, tax and tariff system will be changed.
- Reduction of carbon dioxide emission by 30% below business-as-usual (BAU) levels by 2020.

Renewables Portfolio Standard (RPS): A Renewable Portfolio Standard (RPS) was introduced in 2012 and replaces FIT (Feed-in Tariffs for new and renewables electricity[1]). The RPS forces power producers to supply a certain amount of their total power generation portfolio from new and renewable sources. The standards apply to generators with more than 500 MW of capacity. [2]
Renewables Heat Obligation (RHO) (plan): The South Korea government prepares RHO to promote heat energy from renewables such as solar thermal, geothermal and biomass. The RHO forces new buildings have a certain ratio of heat supply of their total heat energy consumption from new and renewable sources. Government expects RHO will be started in 2016.

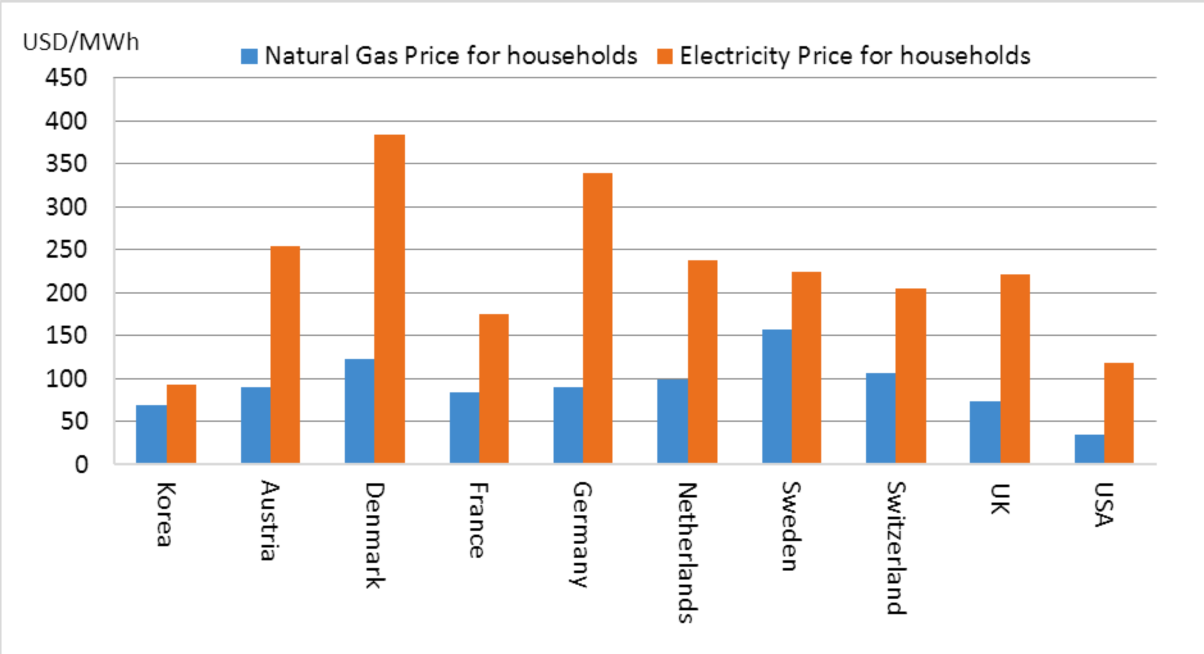
[1] The government compensated producers for the differences between the costs of electricity generated from new and renewable sources and fossil-fuel thermal generation to promote the production and use of renewable sources

2.6 Energy Prices, Tariffs & Structures

Energy prices in the South Korea are comparatively low.

Natural Gas for households	69.2 USD / MWh
Electricity for households (average tariff)	93.1 USD / MWh

Figure 15 – Gas and electricity prices for households in selected OECD nations.



Source: IEA, 2013 Key World Energy STATISTICS, 2013.

Figure 15 shows gas and electricity prices for households in selected OECD nations. In special, **electricity price of Korea is the lowest** through all nations. Denmark's electricity price is four times larger than Korea's price and other nations' electricity price are about two times larger than that of Korea.

Korea has complex electricity tariff system as shown in Table 2. For the purpose of uses, six categories have different tariffs. The industrial price is lower than the residential and commercial prices due to energy price policy for growth of industries.

In 'General' and 'Industrial' category, seasonal and time-period grade tariff systems are imposed. However, **in residential, there is no peak-different tariff system, only six stage progressive tariffs are imposed** for the purpose of energy savings and protection of low-income households. The residential electricity tariff consists of demand charge (base charge) for household and energy charge(running charge) for the amount of consumption, and also divided into two sub-systems as a high (above 3,300V) and low voltage(220 and 380V). Table 3 shows low-voltage residential electricity tariff. The maximum tariff is 11.7 times larger than the minimum tariff.

Table 2 – South Korea electricity tariff system (nov. 2013).

Category	*Applicability*	*Tariff system*	*Price (KRW/kWh)*
Residential	Residential Under 3kW contract	6 stage progressive	127.02
General	Commercial, Public	Seasonal grade Time-period grade(above 300kW)	121.98
Educational	Schools, Museums, etc.	Seasonal grade Time-period grade(above 1,000kW)	115.99
Industrial	Mining, Manufacturing, etc.	Seasonal grade Time-period grade(above 300kW)	100.70
Agricultural	Agriculture, Fishery, etc.	Single tariff (low voltage) Seasonal(high voltage)	45.51

Category	*Applicability*	*Tariff system*	*Price (KRW/kWh)*
Street lighting	Lighting	Single tariff	107.33
Average			106.33

Source: Korea Electric Power COmpany, ***http://www.kepco.co.kr****.*

If a household uses 300 kWh of low-voltage electricity, using values in Table 3,
Electricity tariff = 1,600 + (60.7 x 100) + (125.9 x 100) + (187.9 x 100) = 39,050 KRW, and with additional 10% of VAT and 3.7% of funding for electricity industry, then final tariff is 44,390 KRW.

Table 3 – Residential progressive electricity tariff for low voltage (nov. 2013).

Demand charge	*KRW/household*	*Energy charge*	*KRW/kWh*
1-100 kWh	410	1-100 kWh	60.7
101-200 kWh	910	101-200 kWh	125.9
201-300 kWh	1,600	201-300 kWh	187.9
301-400 kWh	3,850	301-400 kWh	280.6
401-500 kWh	7,300	401-500 kWh	417.7
501 kWh -	12,940	501 kWh -	709.5

Source: Korea Electric Power Company, ***http://www.kepco.co.kr****.*

3 Analysis of the South Korea housing stock & heating market

3.1 Overview of main challenges in the South Korea

The characteristics of the South Korea building stock create one of the main challenges with regards to the use of heat pumps

- The high average ratio of rental building stock means there is comparatively low initiatives for use of new energy saving facilities.
- Many peoples live in the newly built high-rise apartments and condominiums, it means there is low initiatives for replacement to the heat pump system from present gas boiler system.

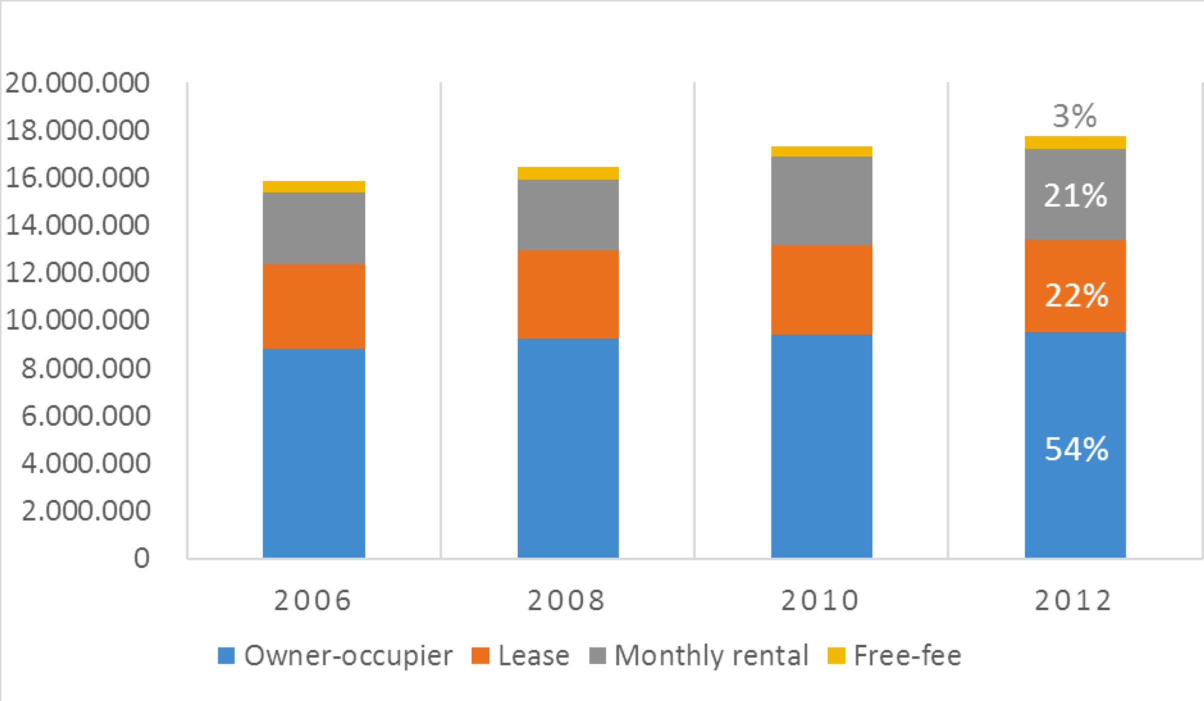
The availability of relatively low cost gas and gas boilers and Korean preference creates a strong challenge for heat pumps – limiting the potential heat pump market size.
The characteristics of South Korea buildings, combined with the overall small share of heat pumps in the South Korea heating market, significantly reduce the amount of demand response flexibility that heat pumps could provide in the South Korea.

3.2 South Korea Housing Stock Characteristics

3.2.1 Customer types

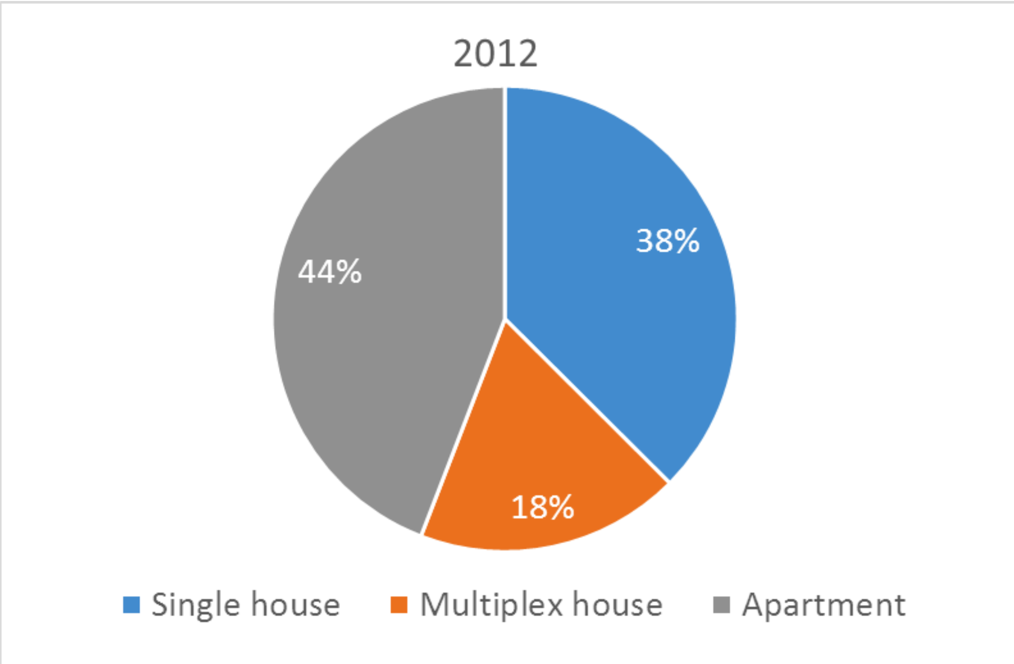
In 2012 the dwelling stock in South Korea comprised ~17.73 million dwellings. **The dwelling stock consists of owner-occupied and rental with similar ratio.** In Korea, lease on a deposit money basis is 22% and monthly rental is 21% of total housing.
In addition, 44% of household type is apartment and 18 % is multiplex house therefore many people **have no choice to choose their heating system**. Also, most people live in high-rise apartment and condominium in the metropolitan city, so they prefer installation of room air conditioner (RAC) which has a benefit in installation size.
The major energy consumption of Korean household is gas. In recent, most housing which is built is apartment, therefore supply of district heat increases.
In single houses, still oil boilers are used so it seems that there is some possibility of replacement to the heat pump, however, Korean people have a resistance for acceptance of the heat pump due to preference of heating type and installation cost.

Figure 16 – Breakdown of South Korea housing stock.



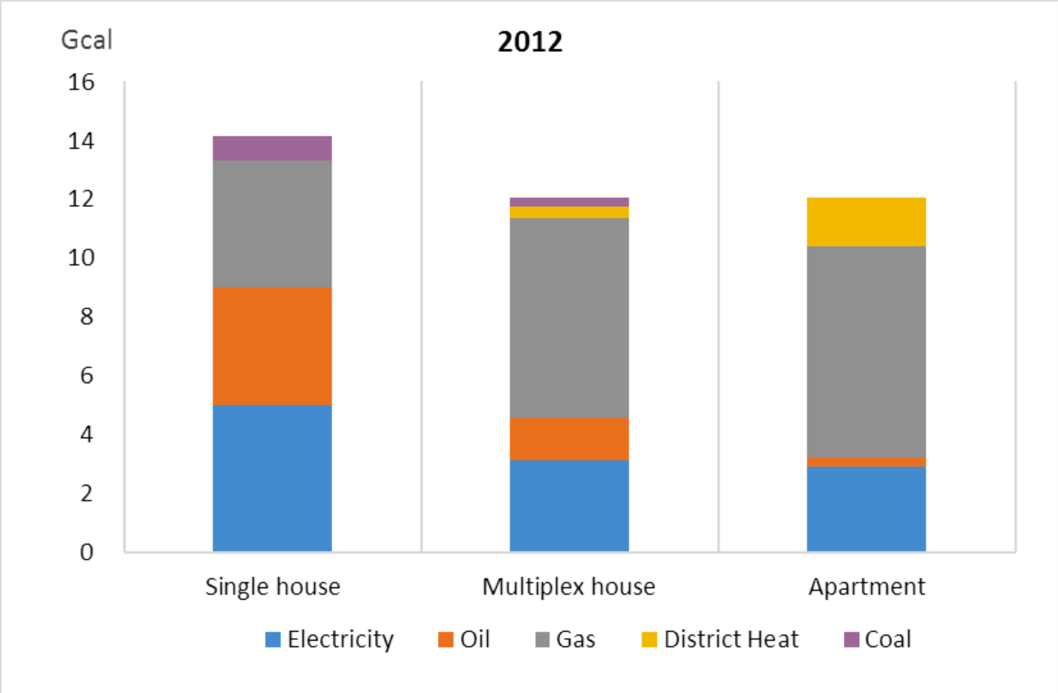
Source: Korean Statistical Information Service, ***http://www.kosis.kr****.*

Figure 17 – Housing type of South Korea in 2012.



Source: Korean Statistical Information Service, ***http://www.kosis.kr****.*

Figure 18 – Energy consumption vs. house type (2012).

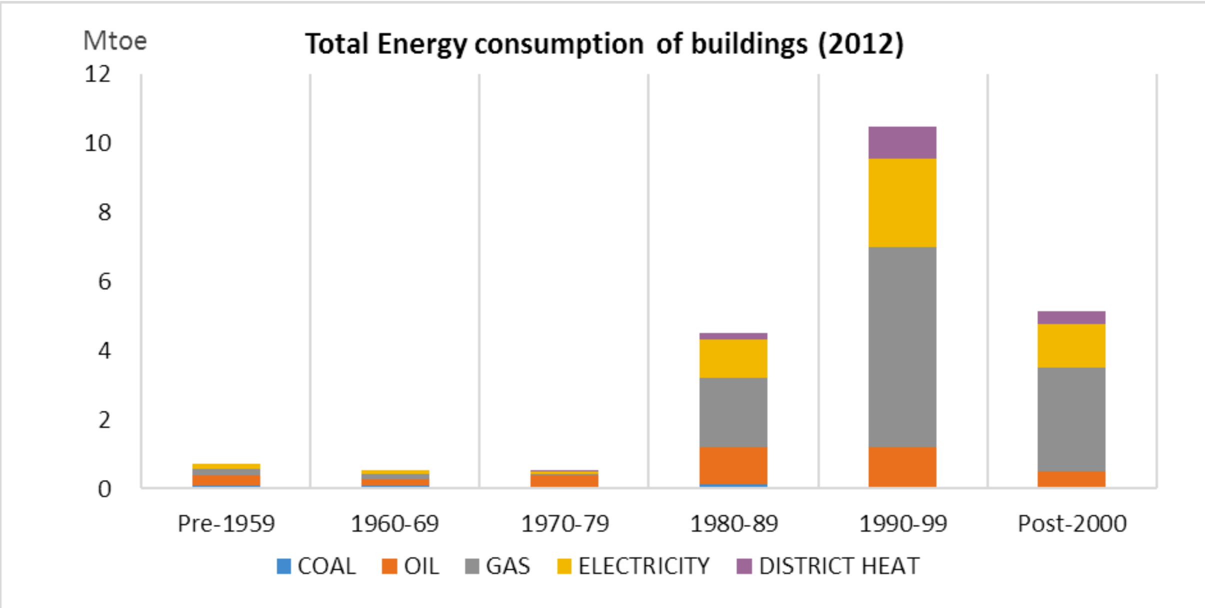


Source: Korean Statistical Information Service, ***http://www.kosis.kr****.*

3.2.2 Age of the building stock

After Korean War in 1950-53, from 1980s, Korea has been grown up very fast**.** Most of building are newly built compared to EU countries such as UK that 50% of dwellings have been built before 1965. As show in Figure 19, most energy consumption is shown in buildings built in 1990-99 which means most of builidings were built in this decade.

Figure 19 – Total energy consumption of buildings by age (2012).



Source: Korean Statistical Information Service, ***http://www.kosis.kr****.*

3.2.3 Thermal Performance

The thermal efficiency of buildings in the South Korea is rated via the Building Certification System conducted by Korea Energy Management Corporation (KEMCO). For domestic and Non-Domestic buildings, 10 stage grade is evaluated by yearly primary energy consumption by square meter (kWh/m^2.year) from Sep. 2013 as shown in Table 4.

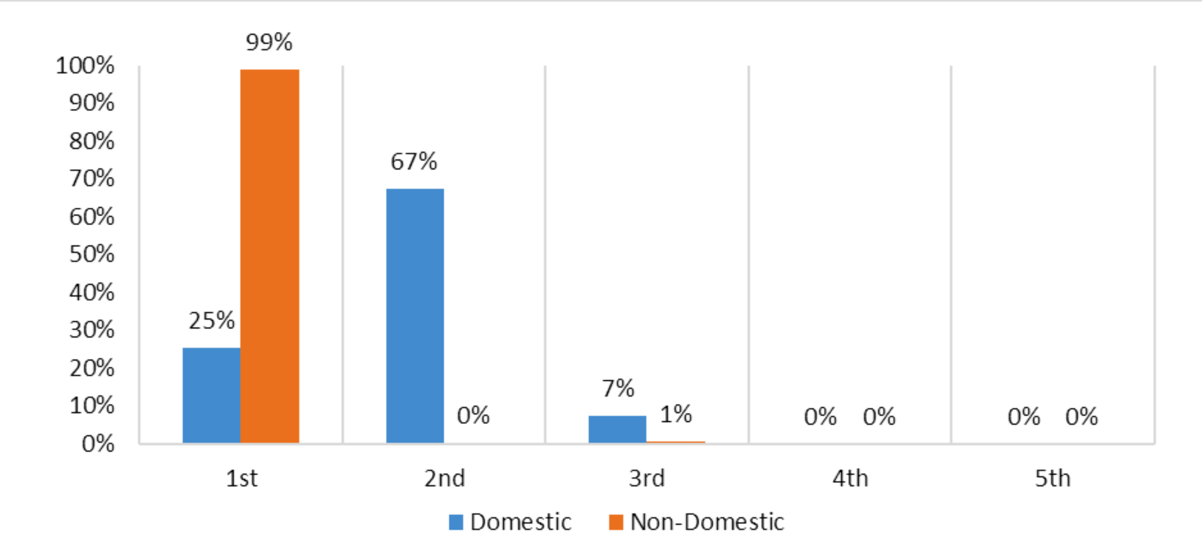
Table 4 – Building certification system (from 9/2013).

grade	Domestic (kWh/m2.year)	Non-Domestic (kWh/m2.year)
1+++	~ 60	~ 80
1++	60 - 90	80 - 140
1+	90 - 120	140 - 200
1	120 - 150	200 - 260
2	150 - 190	260 - 320
3	190 - 230	320 - 380
4	230 - 270	380 - 450
5	270 - 320	450 - 520
6	320 - 370	520 - 610
7	370 - 420	610 - 700

*Source: Korea Energy Management Corporation (KEMCO), **http://www.kemco.or.kr**.*

Before Sep. 2013, 5 stage grade system was conducted and only newly built buildings were evaluated, therefore most buildings were evaluated above 2nd grade as shown in Figure 20. Government will progressively evaluate all present buildings to manage building energy status.

Figure 20 – Energy performance of new buildings in South Korea (in 5-grade system before September 2013).

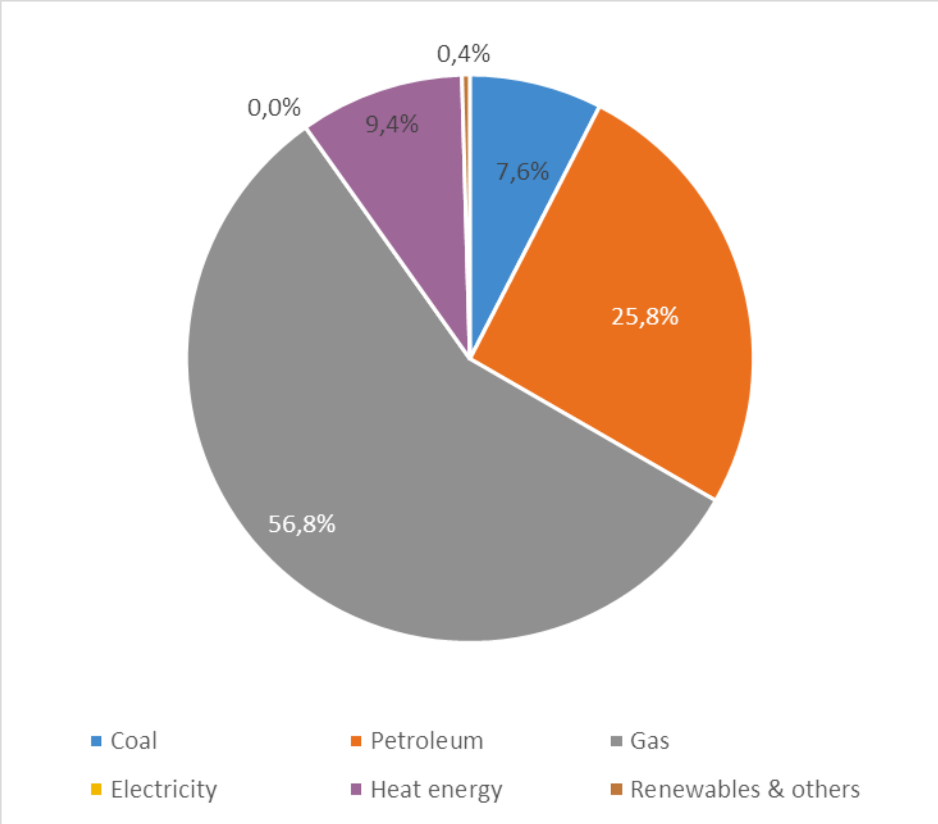


Source: Korea Energy Management Corporation (KEMCO) 2013.

3.3 Trends in the Heating Market and Customer Preferences

The South Korea heating system stock is dominated by gas and oil boilers, which account for 57% and 26% of the energy consumption in 2008. In recent years, the condensing gas boilers replace oil boilers with aggressive advertisement of companies and cognition of high energy saving device, therefore most installed heating system is a gas boiler. In addition, Korean people prefer floor heating called as 'Ondol' combined with a gas boilers. A room air conditioner for cooling and a gas boiler for heating is typical heating system in Korea households. Korea is the 2nd largest gas boiler production country after UK. People are not familiar with heat pump. **This is currently the greatest barrier to the uptake of heat pumps in the South Korea**.

Figure 21 – Energy consumption of South Korea household heating (2008), by fuel.



Source: Korea Energy Economics Institute, Energy consumption of residential sector, 12/2010.

Figure 22 – Heating style in Korean house.

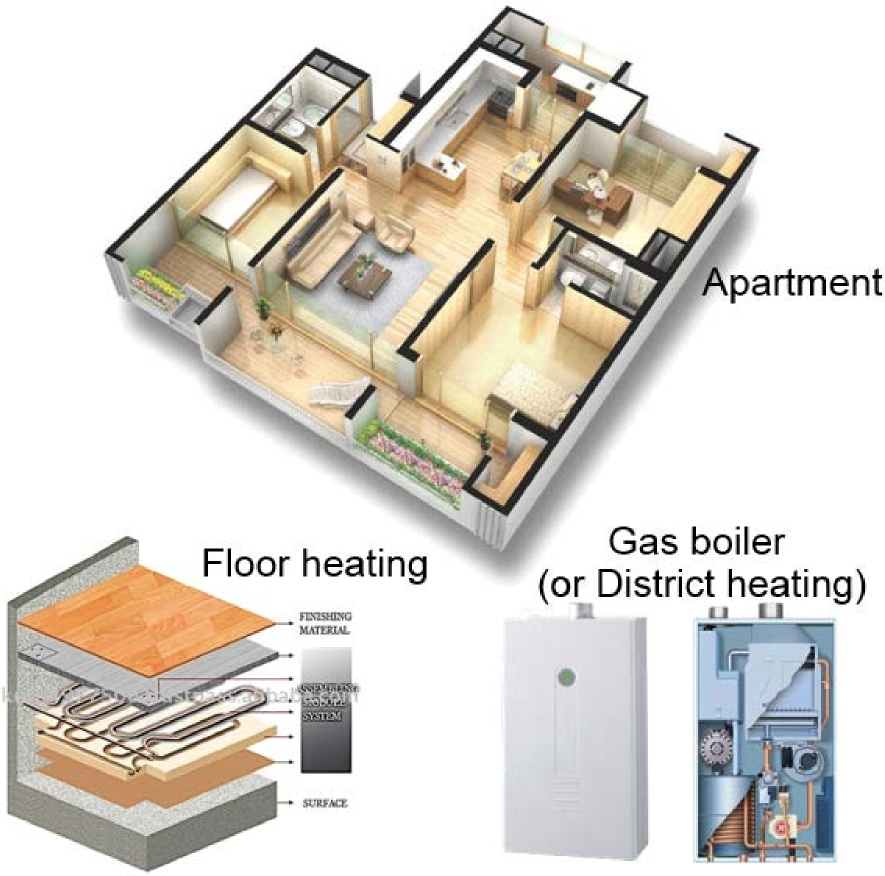
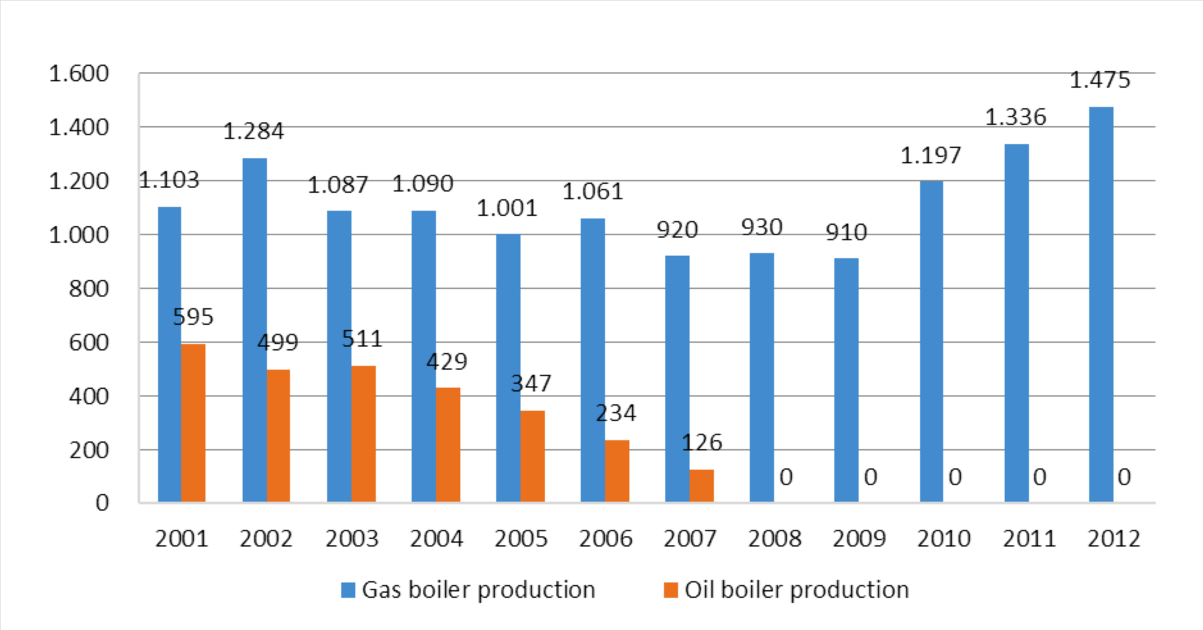


Figure 23 – Gas and oil boiler production in South Korea (x1000).



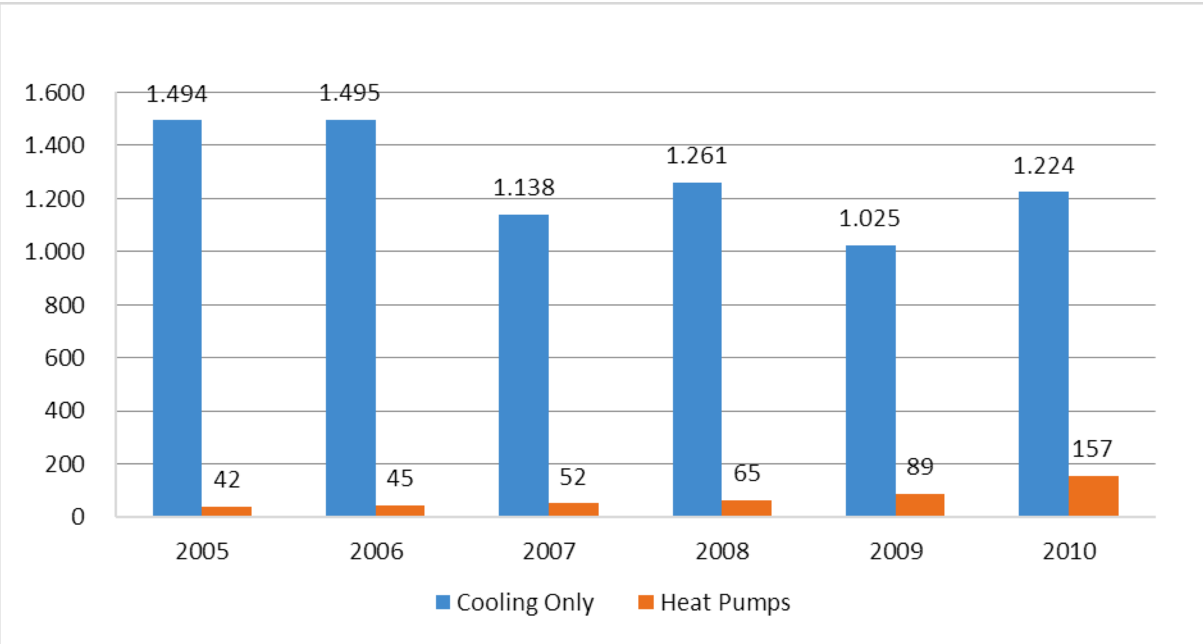
Source: Korean Statistical Information Service, ***http://www.kosis.kr****.*

4 Analysis of the South Korea domestic heat pump market

4.1 Installed Heat Pump Capacity

Due to its high energy-saving potential, the global heat pump market has grown rapidly in recent years. Korea strives on efforts to spread the utilization of heat pump systems, but still lags in market development. Figure 24 shows the shipments of residential cooling-only air conditioners and heat pumps. As of 2010, compared to the 1.224 million cooling-only units, only 0.157 million heat pumps were sold for other applications, amounting to an 11 % market share. Various market features have contributed to the low share of heat pumps.

Figure 24 – Shipment of residential air-to-air heat pumps and cooling-only air conditioners in South Korea (x1000).

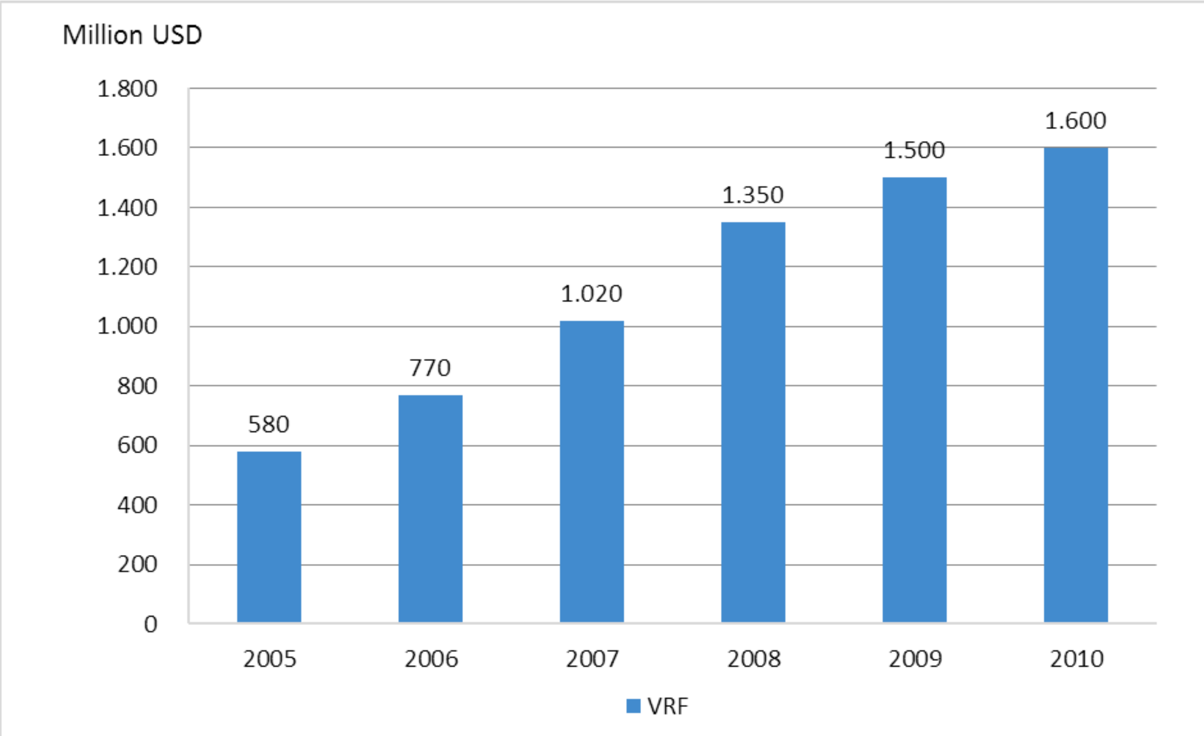


Source: Korea Energy Management Corporation (KEMCO) 2011.

4.2 Trends in the Heat Pump Market

Although South Korea is the 4th HVAC production country, HP market share is only 10%.
Most population lives in a high-rise apartment and a condominium in the metropolitan cities, so a room air conditioner is preferred due to its small installation space.
People has a resistance in acceptance of the heat pumps because technology level of HP doesn't meet consumer's needs. This is opposite phenomenon compared to Japan and China.
Almost all houses use floor heating which uses hot water circulation supplied by a boiler due to Korean traditional culture of floor heating called as 'Ondol (warm stone)'
A market of VRF (Variable Refrigerant Flow) which is a representative of compression heat pump system has been increased rapidly as shown in Figure 25.

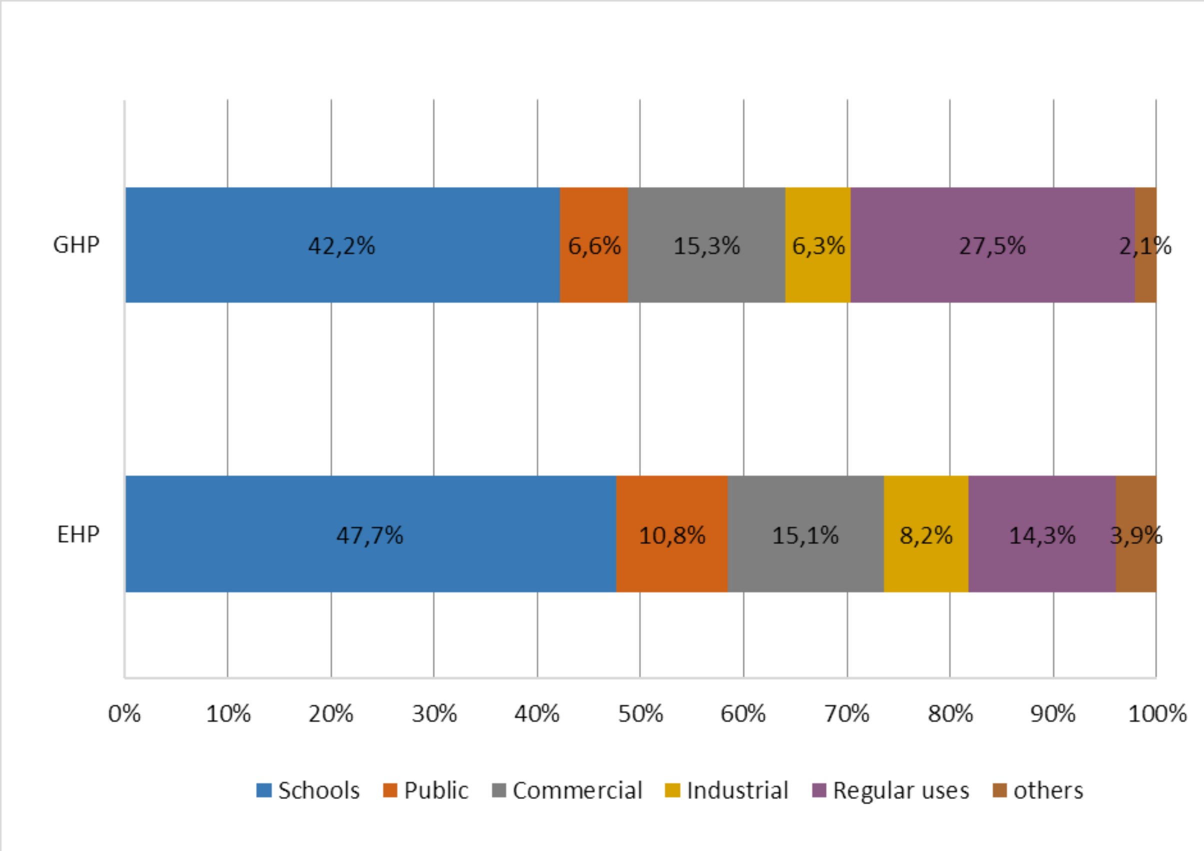
Figure 25 – VRF sales in South Korea.



Source: *Korea institute of Energy Technology Evaluation and Planning (KETEP), Green Energy Strategy Roadmap: Heat Pump 2011.*

Samsung and LG have a market share of 90% of total VRF market in Korea. Toshiba-Carrier(Japan-USA), Daikin-Korea(Japan) and Media CAC(China) started their businesses in Korean market.
Market share of heat pump is expected to increase due to advancement of developing technology, environmental issues, increase of fuel prices and diversification of energy sources and applications (such as 24hours convenience stores, wholesale marts which have regular load of HVAC)
Korea HP market is expected to grow up in high-rise buildings and commercial buildings, and also expected to be formed in residential sector as an alternative for a boiler.
Penetration rate of a multi-type heat pump system (two-way operation system for heating and cooling) increases, so the heat storage heat pump systems have to be developed and supplied in the market to control increase of peak electricity demand.
Since 2007, a multi-air conditioner has been introduced for medium and large size buildings and market expands as an individual HVAC system which is changed from a central HVAC system.
In 2009, multi-type heat pump is dominated in public facilities including schools and commercial sector as a 74% of total sales.

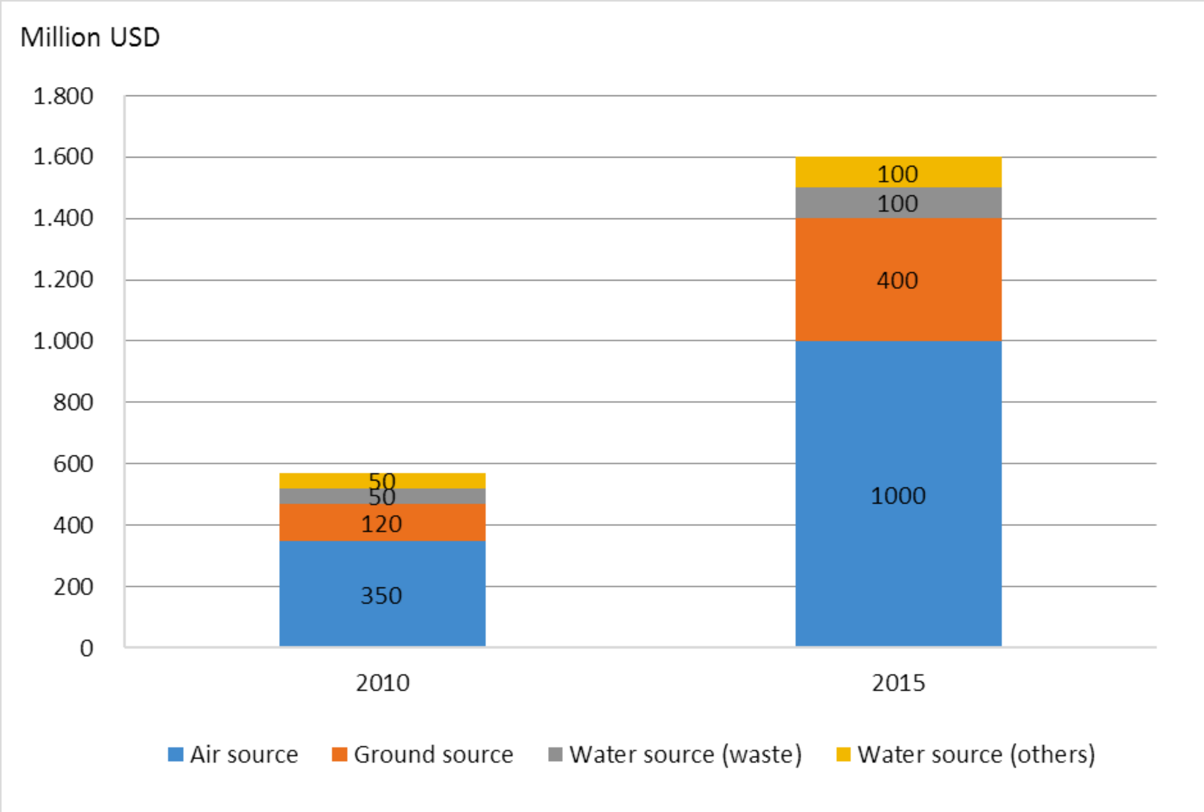
Figure 26 – Heat pump market in South Korea by use (2009).



Source: Korea institute of Energy Technology Evaluation and Planning (KETEP), Green Energy Strategy Roadmap: Heat Pump 2011.

The heat pump market in the South Korea is today dominated by air-to-air heat pumps, and market is expected to be grown up to 1,600 million USD size.

Figure 27 – Heat pump market expectation for South Korea.



Source: Korea institute of Energy Technology Evaluation and Planning (KETEP), Green Energy Strategy Roadmap: Heat Pump 2011.

4.3 Market Drivers

Low electricity price

Korea has the lowest electricity price as shown in Figure 15. The price of electricity for domestic consumers is, for example, only 42 % of that paid by UK domestic consumers. Therefore, electric heat pump (EHP) is competitive heating system in Korea market. However, due to progressive electricity tariff system for residential uses, more sophisticated evaluation of energy price against gas boiler has to be done.

Domestic RHO

The most important market driver for heat pumps in the South Korea will be the Renewable Heat Obligation for domestic installations, which is expected to be introduced in 2016. The RHO forces new buildings have a certain ratio of heat supply of their total heat energy consumption from new and renewable sources. Then ground source heat pump and waste heat source heat pump market will be increased.

Government efforts

The Korean government supports measures to improve energy efficiency and the use of new renewable energy sources because it considers heat pumps as key players to achieve its goal of Green Growth with Low CO2. On the government's road map to Green Energy, heat pumps were selected as one of the 15 green energy sectors to increase energy efficiency. KETEP (Korea Institute Energy Technology Evaluation and Planning) selected four heat pump systems in its Green Energy Strategy Road Map 2011, and has supported their technical development, which it hopes will create a new heat pump market in Korea.

4.4 Market Barriers

4.4.1 Heat pumps are not preferable against gas boilers in South Korea

From the former report on Korea market, two unique features of the Korean market are mentioned: high penetration of natural gas, and low energy prices. In 2010, the nationwide penetration rate of natural gas in the residential sector was 72.2 %. The Seoul Special City, which is the capital and largest metropolis of Korea, had a 92.3 % penetration rate. Other major cities also have penetration rates approaching 90 %. These high numbers reflect the fact that almost every resident in the city uses natural gas, either for heating or cooling with boilers, rather than heat pumps, taking by far the largest share.

Korea has the lowest energy prices as shown in Figure 15. Low energy prices make customers more sensitive to the initial cost than to the running cost. Due to Korea's preference for floor heating, boilers are typically installed in houses for domestic hot water production. Since boilers are far cheaper than water-heating heat pumps, the payback time of a heat pump is longer than in other countries. In addition, heat pumps are usually regarded as appliances, in the same way as are air conditioners. This makes it more difficult for the concept of payback to be considered by customers.

In addition, due to extremely low electricity price, an electric heating mat is competitor in residential heating market. The electric heating mat which price is less than $200 is cheaper than a heat pump or an air conditioner which price is about $2,000. Therefore, people uses an electric heating mat regardless of low energy efficiency of it.

4.4.2 Increase of peak electricity demand

Korea experiences severe electric shortage in 2013 due to rapid increase of electricity demand and unexpected stops of large power plants, so all people were under severe pressure to reduce consumption of electricity. People turned off all possible power switches, in these circumstances, EHPs which use electricity were considered as a high energy consuming devices so EHPs were turned off. Over several years, it is expected that Korea will experience electricity shortage before completion of maintenance of stopped power plant and construction of new power plants. Therefore, EHPs will be a burden to peak electricity demand.

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