Policies for a Sustainable Energy System – South Korea

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Innehåll

Sammanfattning

I rapporten ”Policies for a Sustainable Energy System” beskriver vi det rådande energiläget i Sydkorea, liksom strategierna och policies för landets framtida energisystem.

Med sitt stora beroende av importerat bränsle söker Sydkorea nu en långsiktig och stabil lösning på sin energisituation. I den nya Nationella Energiplanen för 2013–2035 sker ett viktigt paradigmskifte då fokus riktas mot efterfrågan istället för produktion av energi. Den viktigaste åtgärden för att driva utvecklingen är att överge de subventionerade elpriserna och istället låta marknaden styra och jämna ut toppar och dalar i efterfrågan, och på så vis undvika strömavbrott. De tekniska insatserna för att främja energieffektivitet rör framförallt energilagringssystem (ESS) och ”smarta” IKT-lösningar. Det är helt i linje med nya president Parks vision om en ”kreativ ekonomi” som tar fasta på Sydkoreas starka och avancerade industri inom internet- och telekom. Olika förslag finns för att implementera energieffektiva lösningar hos energikonsumenter inom såväl industri, kommersiella fastigheter som hos privatpersoner.

Högre elpriser kommer att kompenseras i industrin genom subventioner av ESS och energihanteringssystem. För låginkomsthushåll kommer så kallade energicheckar att delas ut.

Paradigmskiftet blir synligt i målsättningar kring framtida energimix. Målet för andelen kärnkraft har minskats från 41 procent i tidigare plan till runt 25 procent i den nya planen. Andelen förnybar energi ska ökas från blygsamma 1 procent till 11 procent 2035, och decentraliserad energiproduktion bli vanligare. Målet att minska miljö- och klimatpåverkan omnämns i policyn men väger i praktiken lätt när insatsernas prioriteras i jämförelse med energisäkerheten och ekonomi.

Det är framförallt ekonomiska styrmedel som används för att genomföra förändringarna, exempelvis gröna certifikat och utsläppsrätter. Även subventioner används i stor utsträckning för att främja ny teknologi och implementering av intelligent infrastruktur för energieffektivisering.

Summary

In the report "Policies for a Sustainable Energy System" we describe the current energy state for South Korea and the strategies and goals for the country´s energy system.

Being heavily dependent on imported fuel, South Korea is looking for long-term safe and secure energy situation. In the new Basic Energy Plan for 2013–2035, the important paradigm shift is to change attention towards demand instead of supply. An important measure is to obey the subsidised energy price in South Korea, and move towards market regulated price. By introducing supply–demand price fluctuation, accompanied with implementing Energy Storage Systems (ESS), it will be possible to even out peaks and avoid blackouts.

The demand approach is aligned with the "creative economy" vision from president Park, and will take advantage of South Korea´s advanced ICT industry in appliances to support energy management at energy consumers in industry, commercial buildings and at private house holds. To compensate the poorer part of the population for the price increase, energy vouchers will be introduced from 2015. Also industries will be compensated for the higher prices by subsidies of ESS.

The paradigm shift is manifested in some changes in energy mix. The proportion of nuclear energy is reduced from 41 per cent in previous plan to about 25 per cent in the new plan. Furthermore, the introduction of renewable energy and decentralised energy will be promoted. The goal is to have 11 per cent renewable energy in 2035, which is a substantial increase from today´s low levels of about 1 per cent wind and solar power.

The country has dedicated targets for reducing it´s CO_2 emissions in the Basic Energy Plan, but environmental and climate concerns are not top priority.

It is mainly economic and market driven instruments used for driving change, such as Renewable Portfolio Standard and Emission Trade Schemes. Subsidies are also used to a large extent to promote new technology and implementation of intelligent infrastructure for energy efficiency.

1 Background

In this chapter, we describe the current state of the energy situation in South Korea, regarding actual status for energy systems. We also give a brief recap of the energy strategies from recent years.

1.1 A review of the energy landscape in South Korea

1.1.1 Energy intensive country depending on imported fuel

South Korea is a country scarce of finite resources such as fossil fuels and minerals. It is almost entirely depending on imported energy and has one of the highest energy consumption in the OECD. Currently, Korea is importing 97 per cent of its energy, which equals high costs and also a dependency on other countries. Korea's total primary energy supply is dominated by oil and coal and to a lesser extent by nuclear energy and natural gas. It is the fifth largest oil importer in the world, Asia's third largest crude oil importer after China and Japan, and Korea Gas Corporation (KOGAS) is the largest single buyer of LNG in the world.

The energy intensity is high in South Korea, nearly 30 per cent higher than OECD average (0.19 TOE per 1 000 USD vs 0.15 for OECD[1]). The high energy consumption is partly explained by heavy and energy intense industries, such as steel, petroleum refineries and ship industry. At the same time, the government has in practice subsidized the energy price, giving little incentives to energy efficiency measures. Furthermore, due to the subsidies for electricity it is favourable for industry to use electricity as a source of energy, increasing demand and reducing efficiency in energy transformation. Currently, electrical energy occupies 20 per cent of the final energy consumption.

1.1.2 High performing power grid with limitations

The electric power system in Korea has evolved very rapidly. During the last 40 years, generation capacity has been increased from 400MW to 80,000MW and the quality of electricity service has also improved dramatically. Annual power outage duration is less than 15 minutes which is shortest in the world. Due to highly automated and renovated facilities, transmission and distribution losses are less than 4 per cent, which is also the lowest in the world. Although Korean electric power network shows one of the best performances in the world, it also has its own inherent limits as:

- Korean power system is isolated. Excessive generation facilities are required due to restricted power trading.
- Conventional power system facilities such as transmission lines and large generators are too densely constructed in small territory.
- Due to keen response to environmental problem of Korean people, it became harder and harder to find the sites for generation and transmission facilities.
- Due to low and flat electricity price for industrial load, demand management during the peak load period is difficult.

[1] IEA. 2012.

The power reserve in 2012 was 3.8 per cent – a level beneath 4 per cent is considered dangerous. The government now aims to raise the power reserve to 21.2 per cent until 2015.[2] The demand for electricity combined with shortages in supply has caused a series of blackouts of electricity shortage, and both the public and the government are concerned about improving the energy security. A paradigm shift towards focus on demand rather than supply is currently taking place, as will be described in the next section.

1.1.3 Smarter grids

The Smart Grid Project in Korea was initiated by the *Low Carbon Green Growth Policy* and the final target of this project is to develop the world's first nationwide Smart Grid System. As a new growth engine, the project is focused on not only the technical development but also the market creation. Moreover, various activities to enter the over-sea market have been planned. As the top level control tower, the Presidential Committee on Green Growth coordinates and evaluates the Smart Grid policies of various ministries. Among the ministries, Ministry of Trade, Industry and Energy (MOTIE) is the major authority corresponding to the Smart Grid Project and supervises organizations such as the Korea Smart Grid Institute, the Korea Smart Grid Association, and Korea Institute of Energy Technology Evaluation and Planning. The Korea Smart Grid Institute and Korea Smart Grid Association manage cooperation among private, public, academic, and government sectors. The government established the National Smart Grid Road Map of Korea in January 2010. The Smart Grid Promotion Act was legislated in May 2011 to overcome the limits of conventional law and to promote Smart Grid activities. In accordance with the act, the First Five Year Master Plan for Smart Grid, which is the detail action plan for 2012 to 2016 of the National Smart Grid Road Map of Korea, was established in July 2012. According to these plans, implementation technologies of Smart Grid are classified into five major areas considering creation of new business models such as: Smart Power Grid, Smart Consumer, Smart Transportation, Smart Renewable, and Smart Electricity Service.

1.1.4 Nuclear and renewable energy as alternatives

The government has previous promoted an expansion of nuclear power as a way to reduce CO_2-emissions and mitigate climate changes. However, after the accident in Fukushima the public opinion shifted towards a reduction of nuclear power. In addition to this, South Korea has shut down two nuclear power reactors and delaying the start of another two after its inspectors discovered that the reactors used components whose safety certificates had been fabricated. An anonymous whistle-blower led government investigators to uncover the latest problem, in which control cables that had failed to pass a safety test were given fake certificates and supplied to four reactors, according to the Nuclear Safety and Security Commission.

In 2012, the share of renewables was 2.4 per cent. This figure includes waste as energy source - the share of renewable sources other than waste was 0.78 per cent of total.[3] As for

[2] The Korea Herald, 22nd May 2013."Gov't to remove electricity subsidies for companies next year". http://english.yonhapnews.co.kr/business/2013/05/22/37/0501000000AEN20130522004900320F.HTML [2013-12-03]

[3] Korea Energy Economics Institute (KEEI).

now, Korea is one of the countries in OECD that have the lowest contribution of renewable energy in their energy mix.[4]

1.1.5 Energy Sustainability Index

Every year, World Energy Council (WEC) publishes an Energy Sustainability Index ranking, which considers countries' energy security, energy equity and environmental sustainability. In the ranking for 2013, Republic of Korea is on the 64th place out of 129 countries. There are also rankings for each category; rank 49 on energy equity, 85 on environmental sustainability and 103 on energy security.[5]

1.2 Previous Governmental Strategies

Energy and environmental policies in South Korea focus on low-carbon and green growth and on creating a momentum for economic growth by means of green technology and clean energy. In 2008, *Low Carbon, Green Growth* was proclaimed by President Lee Myung-bak as a national vision to guide the nation's long-term development. In 2009, the Presidential Committee of Green Growth presented the ambitious target for reduction of greenhouse gas emissions to 30 per cent in year 2030.[6] The Green Energy Strategy Roadmap is a part of this strategy. It includes strategic plans for market penetration of new technologies, international cooperation, human resources development and education, and collaboration with the private sector. 15 technologies have been chosen as focus areas for development and there are specific roadmaps for each of these.

In 2009, the *Act on low carbon, green growth* was established. The act addresses climate change mitigation, energy policies and sustainable development. It intends to bring together different ministries or governmental agencies in the sector. The three main objectives for the National Strategy of Green Growth are to:

- Effectively deal with climate change and help attain energy independence,
- Create new engines of economic growth,
- Improve quality of life in Korea.

[4] IEA. (2012). Energy Policies of IEA Countries- the Republic of Korea 2012 Review. IEA

[5] World Energy Council, 2013. "World Energy Trilemma: 2013 Energy Sustainability Index" http://www.worldenergy.org/wp-content/uploads/2013/09/2013-Energy-Sustainability-Index-VOL-2.pdf [2013-12-04]

[6] IEA. 2012.

2 Energy policy priorities at present and in the future

This section describes the overall governmental priorities related to energy policy and strategy moving forward. In particular, the highlights of the anticipated National Energy Basic Plan are revealed. It is followed by a number of associated policies on renewables, electric grid, energy tax reforms as well as demand management. Finally, the energy strategies for a number of different energy sources are described.

2.1 Overall priorities for future energy policy and strategy

In October this year, WEC was held in Daegu in Korea and President Park, who took office in January this year, held the keynote address. According to her, the most significant challenge for energy today is the *Energy Trilemma*; the trade-offs between energy security, social equity and environmental sustainability. This is also the general opinion of WEC. She believes that cooperation between countries is needed in order to response to this challenge, especially in Asia since there are some countries that are large producers of energy and some who imports almost everything. She suggests that cooperation can be done in terms of jointly transports, for example for shale gas from North America, and she proposes that this will be done through legal frameworks, e.g. Energy Charter Treaty. Moreover, President Park promoted to step away from traditional energy economic model to a *creative economy* (which she also promotes strongly in Korea), which means energy conservation and environmental protection by use of ICT and new technologies. Creative Economy is a model combining creative ideas, science, technology and IT to achieve growth. It includes the use of by ESS, Energy Management Systems (EMS), smart grids, LEDs and low-emission vehicles. According to President Park, energy efficiency would help cut the country's energy consumption by 1 GWh of electricity. In addition, it would create a 21.5 billion SEK (3.5 trillion KWN) industry and 15,000 new jobs.

2.2 Energy direction in National Energy Basic Plan

2.2.1 National Energy Basic Plan

The National Energy Basic Plan is the paramount energy plan in South Korea and it provides principles and directions for the plans for each energy source and sector. A new version of the plan is supposed to be announced every fifth year by MOTIE, and in the end of this year, the second version will be launched. The second plan will apply for 2013–2035 and the tasks of it are to:

- Derive a reasonable energy mix
- Securing stable energy supply and demand
- Improving efficiency of energy consumption
- Fostering acceptability by citizens participation

Below is an outline of the second plan:

Table 1 Overview of The National Energy Basic Plan

Policy goals (Visions)	2nd National Basic Energy Plan
Proportion of nuclear in 2035	22-29 per cent
Changing to demand management policy	Reduction in power demand more than 15 per cent in 2035
Building distributed power systems	Providing distributed power more than 15 per cent in 2035
Improving sustainability (eg. Environmental safety)	Obligation of greenhouse gas reduction technology in thermal plant. Reduction of more than 20 per cent in 2035
Enhancing Energy Security	40 per cent resource development rate, 11 per cent renewable energy in 2035
Policy implementation with the nation	Introducing energy voucher system from 2015

To achieve these policy goals, a number of policy initiatives have been drafted:

- Demand Side Management by Energy Price Changes
- Distributed Generation by Combined Heat and Power (CHP), District Energy, New and Renewable Energy (NRE), ESS etc.
- Greenhouse gas emission reduction by Ultra-Supercritical Technology (USC) and Carbon Capture Storage (CCS)
- Strengthening Energy Safety Standard for Nuclear Power Plants
- Energy Security by Oversea Energy Development and NRE
- Proper Social Conflict Management in Energy Infrastructure Construction and Site Selection Process
- Energy Voucher Program for Energy Poverty

There are notable changes from the first version. The maybe most important is that there will be a shift of focus from supply management to demand management. Because of the energy shortages, this plan focuses more on energy security, rather than green growth and reducing oil dependency. However, it does include environmental protection, e.g. reducing greenhouse gases from the power section. Moreover, there will be an increased focus on people participation; South Korea is a small country with a large population, which means that it is hard to find spots for new power plants and transmission lines where nobody lives. There are often protests when something new is going to be built, which of course aggravates the processes. Also the procedure for accepting the plan has changed so that it engages more actors. In addition, the nuclear share will change from 41 per cent to 21–29 per cent, meanwhile the goal for renewables will be unmodified at 11 per cent.

There is also a change in procedure to develop the plan. For the first time, the government has used a private–public joint working group of experts and stakeholders to make a draft for the plan. Previously, governmental bodies have made the draft. The draft is object to public hearings and finalised by the experts before it is reviewed by national committees on energy and green growth and decided by the cabinet.

2.2.2 6th National Electric Power Supply Plan

The Electric Power Supply Plan is announced every second year to cover for the coming 15 years. The most current plan is the *6th National Electric Power Supply Plan* covering the years 2013–2027. An important issue in the current plan is to minimize the construction of new power generation facilities by utilizing active demand management. The first core task of the plan is to minimize the demand prediction error to ensure power reserve, and the second is the demand management. To accomplish these, the plan proposed the diffusion of the Smart Grid and the improvement of electricity price system. For improving the electricity price system, this plan suggests the following three tasks:

- The electricity price should be increased to a proper level.
- Various electricity price systems, which reflect fuel cost, will be introduced.
- Demand management system utilizing the real time electricity price will be expanded.

Advanced Metering Infrastructure (AMI) will be supplied to all customers by 2020 and ESS will be expanded to disperse peak demand. By actively utilizing the demand management, the plan predicted that the peak demand will be reduced by 15 per cent and power consumption will be reduced by 12 per cent. Furthermore, the share of renewable power is expected to rise to 20.2 per cent of total generation in 2027 according to the 6th National Electric Power Supply Plan. In addition to this, an increased dependency on thermal plant is proposed. This plan did not state anything on the share of nuclear, but rather left this to the National Energy Basic Plan (see above). Finally, MOTIE will increase the total electricity generation capacity with 20–30 kW until 2027. This means a total capacity of 130 million kW. The electricity demand target is set at 111 million kW for the same year – leaving the rate of reserves at 22 per cent. To achieve this MOTIE will develop different types of measures to curb electricity demand.[7]

2.2.3 New and Renewable Energy Plan

In December 2008, *The 3rd Basic Plan for Technology Development, Application and Deployment of New and Renewable Energy* was established. This is published every fifth year, so the next is soon to be announced. However, according to persons involved in writing the new plan, no changes in target for renewable energy are expected since the 3rd plan was "very optimistic". This is also in agreement with content of the Basic Plan described above. The plan states the mid- and long-term targets for NRE development, application and deployment and provides basic strategies and action plans to achieve them. There are three fundamentals for the plan:

- To classify renewable energy sources into a deployment focused group (wind, bioenergy, waste and geothermal) and a R&D focused group (PV, hydrogen and fuel cells)
- To respond to climate change and the depletion of fossil fuels
- To provide mid- and long-term NRE deployment plans

[7] Korea Institute of Energy Technology Evaluation and Planning: "6th basic plan f long-term electricity supply demand". 8 Feb 2013.
http://ketep.re.kr/english/activities/view.jsp?str_page=3&bbs_sid=8549&bbs_cd=energy&flag=1
[2013-12-02]

The aims of the plan are to create a new growth engine for Korea through facilitating the NRE industry and to increase the share of NRE in the primary energy supply. In the business–as–usual (BAU) scenario, the share is expected to be 3.6 per cent in 2015, 4.2 per cent in 2020 and 5.7 per cent in 2030. With the new plan it is expected to be 4.3 per cent, 6.1 per cent and 11.0 per cent for the same years. Below is a map for how the establishment of a sustainable energy system based on sustainable energy systems will look like, according to the 3rd plan:[8] [9]

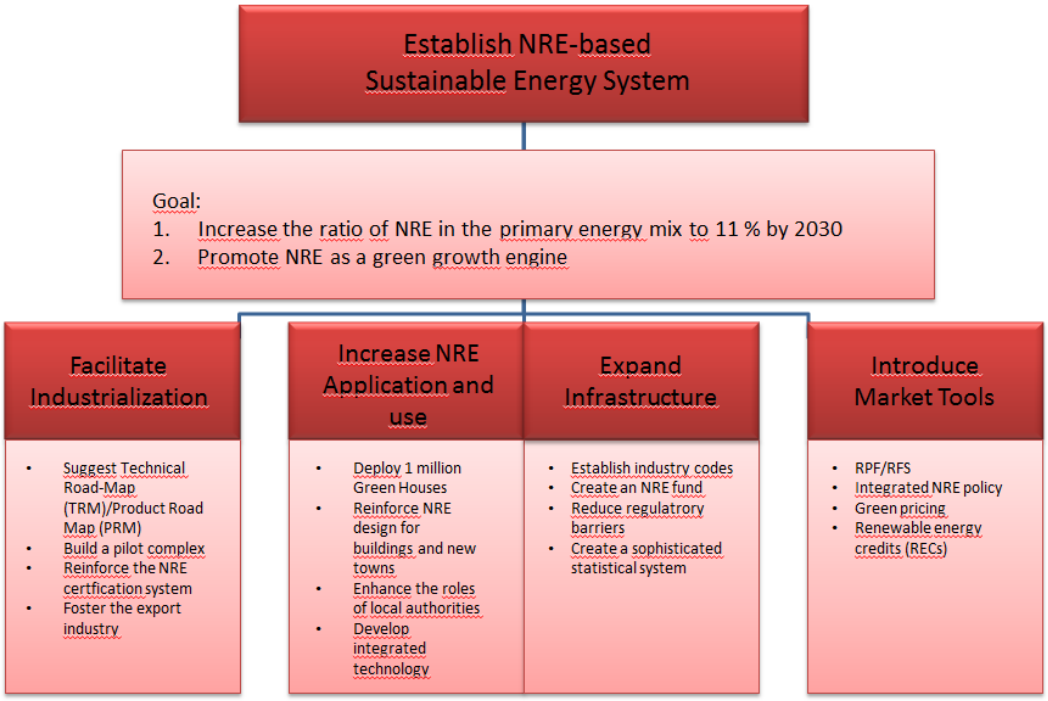

Figure 1 Map of The 3rd Basic Plan for Technology Development, Application and Deployment of New and Renewable Energy

2.2.4 Price and tax changes

On November 19 2013, MOTIE announced the decision to raise electricity prices, since they "require a sustained adjustment", according to an official. The proposed hike is the highest since 1998, and it took effect already two days later. It means that commercial users and households will have a combined raise of 5.4 percent. Also, the prices will alter between different hours during the day, with increased prices during peak hours and reduced during lower-demand periods. The government aims to increase the use of certain energy sources, like natural gas and kerosene. Therefore, a new taxed will be introduced for coal, 0.19 SEK/kg (30 KRW/kg), meanwhile the current taxes on LNG and kerosene will be cut by 30 per cent. These new tax incentives will be implemented in July next year, after necessary legislative revisions.[10]

[8] "Korea Energy Management Corporation. Annual Report 2012."
[9] It is likely that the structure remains in the new plan although figures are altered.
[10] The Nikkei, 25 Nov 2013."Changing tack: South Korea OKs higher electricity prices". http://asia.nikkei.com/Politics-Economy/Policy-Politics/Changing-tack,-South-Korea-OKs-higher-electricity-prices [2013-11-25]

2.3 Future key sources of energy in South Korea

2.3.1 Energy Efficiency and Demand Management

Energy efficiency is identified as a key area for South Korea. At the Cabinet Council meeting in May 2013, it was stated that: *"There are ways to improve energy efficiency or prevent waste with technology and to conserve energy by informing how much one consumes energy in real time using IT such as smart grid, please research on such ways actively".*[11] Korea Energy Management Corporation (KEMCO) one of the organizations that works with energy efficiency and the Figure 2 on the next page shows how the organization will work with energy efficiency and what tools they intend to use.

Some of these tools are described more in depth below:

Energy saving in buildings

- Building Certification System: Objective information on the energy performance of buildings, e.g. energy consumption and CO_2-emissions. The aim is to promote investments in energy saving technologies and improve energy saving.
- Energy-saving Design Criteria: The property owner must complete an energy-saving worksheet to obtain a building permit.

Energy Audit: Companies with an annual energy consumption larger than 2 000 TOE (ton of oil equivalent) must submit energy audit reports to KEMCO. However, firms with a consumption of less than 10 000 TOE of energy per annum will have a discount on the energy audit fees charged by the government. The audits were introduced because of the drastic increase of energy consumption, which naturally is related to an increase in the energy that needs to be imported. The audits are also an attempt from the government to mitigate climate change by reducing greenhouse gases.

Energy Efficiency Program: MOTIE and KEMCO are operating three different energy efficiency programs:

- The Energy Efficiency Standards and Labeling Program
- High Efficiency Appliance Certification System
- e-Standby Program

The aim is to cut greenhouse gases by using energy efficient products and to create a demand for these – which will encourage manufacturers to develop more energy efficient products.[12]

From these examples, the conclusion is that the underlying incentives for energy efficiency are paramount to prevent an increase of energy consumption. In addition, the climate change is also a concern and the initiatives aims to raise awareness among the consumers, promote energy efficient products and to cut the emissions of greenhouse gases.

[11] Quote from Prof. Moon
[12] KEMCO: "Introduction to the business", 2009.
http://www.kemco.or.kr/new_eng/pg02/pg02010100.asp [2013-11-18]

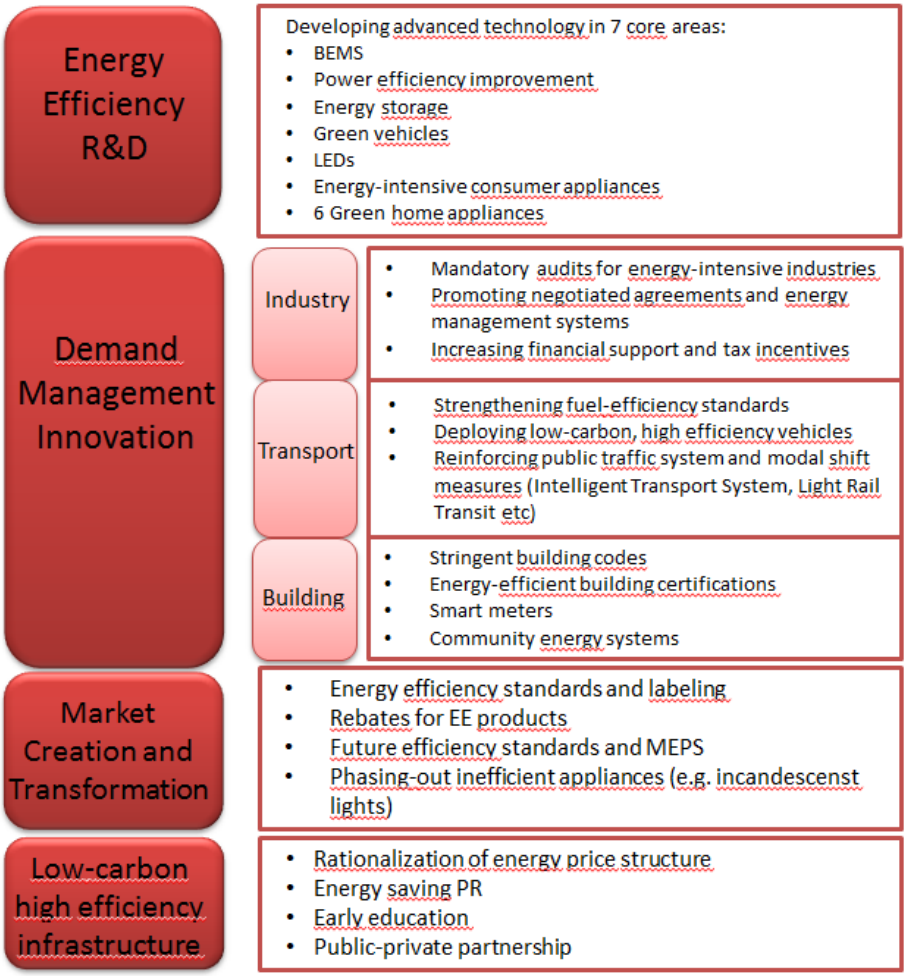

Figure 2 Overview of Korea Energy Management Corporation (KEMCO) energy efficiency strategy.

2.3.2 Demand Management; Smart grid and Energy Storage

The government have decided to focus on *demand management*, since the social cost of supplying power has increased. The demand management is also seen as an opportunity to create new markets, e.g. for energy efficiency products, and thereby also new job opportunities. The demand management is to a large extent based on the usage of ICT and dependent on the reforms of the electricity pricing system.

The nationwide *Smart Grid* will be developed through following stages, where the first one was accomplished this year:

- Smart Grid Test-bed: 2010–2013
- 7 Smart Grid Hub Cities: 2013–2016
- Wide Area Smart Grid: until 2020
- Nationwide Smart Grid: until 2030

A total of 162.5 billion SEK (26 trillion KWN) will be invested to develop the nationwide Smart Grid until 2030. Among them, 21 million SEK (3.3 billion KWN) will be invested in the years 2013–2016. In order to develop and verify the Smart Grid technology, various

projects are on progress. Among the projects, the Jeju Smart Grid Test-Bed Project and the Korea Micro Energy Grid Project, are almost completed. Recently, many government organizations recognized the importance of Smart Grid in the future and made a plan about the Smart Grid. Ministry of Strategy and Finance declared to develop the Smart Grid earlier than the National Smart Grid Road Map to bring up the Smart Grid as a new growth engine. Also, early development of the Smart Grid is planned in the 6th National Electric Power Supply Plan. In addition, the Presidential Committee on the Green Growth suggested the Smart Grid Project to be continued as a Mega Project in the new government. Reflecting the opinion of the committee, the new president pledged to develop the Smart Grid and to reform electricity pricing system. Consequently, the supporting to the Smart Grid Project will be continued in the new government.

Energy Storage Systems work as batteries and are highly prioritized by the South Korean government. The expectation is that ESS will lead to an increased share of renewables, since the energy storage enables stable operation in the grid system even if there are natural fluctuations in the generation. The government plans to install 500 kWh of ESS and Korea Electric Power Corporation (KEPCO) plans to install an additional 1000 kWh. Already today Korea has the technology for ESS – the three leading companies in the world for ESS-technology are South Korean; LG, Samsung and SK. However, for the ESS to become successful, two points are critical according to experts in Korea. Firstly, it needs to be incorporated into the Renewable Portfolio Standard (RPS) system so that it becomes compulsory for companies to implement it in their work. Secondly, the ESS must become classified as emergency generators. To encourage the use of ESS, MOTIE offers various financial incentives, especially for small-and mid-sized companies to install the systems.[13]

2.3.3 Nuclear energy

After the Fukushima accident in Japan, the government is facing challenges of nuclear safety, economic feasibility, environmental sustainability and social equity.[14] As can be found in the National Energy Basic Plan (see sec. 2.2.1), the plan is to decrease the share of nuclear power from 41 per cent to 22–29 per cent. However, last year nuclear power accounted for 26.4 per cent, which means that this will not be a big change in practice – but it is a turning point for the nuclear policies.[15] This year, the operation rate of the nuclear power plants has been the lowest in 25 years, due to the suspension when faulty parts were found and because of maintenance work. The first ten months of 2013, the operation rate was 75.2 per cent, compared to 82.3 per cent for the same period last year.[16]

2.3.4 Fossil fuels; coal, oil and gas

For **oil**, the strategy is to compile reserves to ease any disruption in supply and increase the number of stockpiling facilities for commercial use.[17] There are also a number of measures in order to improve energy security. The oil is imported, and therefore an increased part of

[13]The Korea Herald, 18 Aug 2013 "Gov't to prioritize reducing power demand". http://www.koreaherald.com/view.php?ud=20130818000194 [2013-12-02]
[14] Institute français des relations internationals (Ifri). "The economic opportunities and constraints of Green Growth – The case of South Korea". 2012.
[15] Korea Joongang Daily, 14 Oct 2013. "Gov't to back off nuclear energy". http://koreajoongangdaily.joins.com/news/article/article.aspx?aid=2978783 [2013-12-03]
[16] The Korea Herald, 8th Dec 2013. "Operation rate of S. Korean nuke power plants dips to 25-year lo". http://www.koreaherald.com/view.php?ud=20131208000144 [2013-12-09]
[17] Ministry of Trade, Industry and Energy. "Energy Strategies: Manage the National Energy Supply". http://www.mke.go.kr/language/eng/policy/Epolicies.jsp [2013-12-03]

the contracts should be of long-term type. In 2007, 62 per cent of the contracts where long-term, and the aim is 85 per cent for year 2030. The co-operation with oil-producing countries should be increased and an additional strategic petroleum reserves should be purchased. In connection to this, a North East Asia oil hub should be established. In addition, the refinery updates should be expanded and development and diffusion of alternative oil fuels should be promoted.[18]

The government promotes mid- and long-term *LNG* import contracts and to increase contract flexibility, as well as diversify the import sources. The domestic infrastructure should be extended with a forth LNG receiving terminal and expansion of the gas transmission grid so that households can be supplied.[19] In addition, the government should promote the use of LPG as fuel for compact and hybrid vehicles.[20]

Carbon Capture and Storage is mentioned in the new policy as means to achieve climate targets. According to the new National Basic Energy Plan, the emissions of CO_2 should be reduced by more than 20 per cent from BAU-level by 2035. The CCS-technology is considered as an important technology to reach this goal. It was expected that the technology would be incorporated in new fossil-fuel-fired plants within the years 2013–2017. In the *Roadmap of green energy strategy 2011* (for 2011–2030) there were planned pilot projects of 100 MW capture-transport-storage processes that would start in 2020. The aim was also that the technology would be commercialized by then. However, the situation today looks a bit different. The largest challenge for the CCS systems seem to be the storage part, both technically and in terms of physical storage space in Korea. There are some R&D-projects around the technology, e.g. Korea Institute of Energy Technology Evaluation and Planning's (KETEP) Energy Efficiency Program, but nothing has been implemented. In addition, some experts say that if CCS would be introduced the energy price for fossil fueled power plants would double, because of the expensive technique.

2.3.5 Renewable energy

Koreas total primary energy supply consists of less than 1 per cent of energy generated from biofuels and waste. Very small amount of hydro, wind and solar energies and heat also contribute to its total primary energy supply. The dominating types of renewables in South Korea are wind and solar power. There is also a 500 kW tidal power plant in operation.

Bio-fuels are very rare in South Korea since it is a country with little utilisation of renewable resources. It is not allowed to cut the trees in the country – so to be able to produce biofuel the material needs to be imported. Even so, there are R&D-projects on biofuels, e.g. the Clean Energy Research Centre under Korea Institute of Science and Technology (KIST). The government is also promoting bio-fuels: financial support is available for the development of wood pellet manufacturing facilities. As of 2010, 13 facilities have been supported by the government and five other facilities have been supported by private-sector investments to increase demand for wood pellets, including distribution of small wood pellet boilers have to agricultural and mountainous villages since 2009 and horticultural greenhouse heaters have also been deployed since 2010.

[18] IEA. (2012).
[19] Ibid.
[20] Ministry of Trade, Industry and Energy. "Energy Strategies: Manage the National Energy Supply".

Furthermore, there is an official recommendation to blend fossil diesel by 2 per cent biodiesel.[21] This recommendation is believed to become a legal requirement, and maybe also increase, during 2014.

2.4 Ecology and climate considerations in energy policy and strategy

The energy and environmental policies in Korea focus on low-carbon and green growth and on creating a momentum for economic growth by means of green technology and clean energy. One of the goals for the new version of the National Basic Energy Plan is about *Improving sustainability*. However, according to some sources, this is the least prioritized goal by the government – mainly because it is not an important matter for the people in Korea.

MOTIE has a strategy for mitigating the climate changes – *Combat Climate Change*. This includes the following tasks:

- Increase clean and renewable energy while reducing reliance on fossil fuels
- Improve energy efficiency and promote conservation
- Establish a carbon market and promote a voluntary agreement to reduce greenhouse gas emissions
- Provide support for research and development pertaining green technologies.[22]

[21] Interview with KEMCO; Biofuel Policy Watch, 5th March 2013. "Biodiesel Nes: 5 March 2013" http://biofuelpolicywatch.wordpress.com/2013/03/03/biodiesel-news-march-5-2013/ [2013-12-09]
[22] Ministry of Trade, Industry and Energy. "Energy Strategies: Manage the National Energy Supply".

3 Challenges ahead and important crossroads

In this chapter we try to summarise the challenges that the government will face during the implementation of the energy strategy. There is no particular order in how these challenges are presented or should or will be prioritised. On the contrary, you could argue that it is a challenge in itself to manage so many different aspects by the decision makers. In the light of the identified challenges, some important decisions have to be made. Important decisions are listed in section 3.2.

3.1 Challenges in implementing the energy strategy

3.1.1 Pricing mechanisms

To abandon the subsidies for electricity is the main challenge, according to all of the interviewed experts. South Korea has supported its industry and households with cheap electricity as part of a strategy. The change will be stepwise and soft in order to avoid protests. For the industry, other support measures such as subsidies for ESS and EMS systems will be offered, and for energy vouchers will be implemented for the poor households. The step towards market oriented pricing is necessary to enable efficient energy use and energy security, but might be painful and jeopardize industrial competitiveness at a first glance. The challenge for the government and its agencies is to overcome the first strong resistance and promote the opportunities the smarter energy use can bring to the new and growing industry of South Korea.

3.1.2 Public opinion

Currently, Korea is importing 97 per cent of its energy, which equals high costs and also a dependency on other countries. Moreover, the country is densely populated, which means that it is hard to find locations for new power plants and transmission lines. The reasons for this are lack of empty land and protests from the people when energy facilities are built close to their homes. The government has previous promoted an expansion of nuclear power as a way to reduce CO_2-emissions and mitigate climate changes. However, the public opinion is now against nuclear power, as mentioned earlier, mostly of security and corruption reasons. As was mentioned in the strategies above, the government are now aiming to include the public earlier in the decision process.

3.1.3 Increasing renewables

Korea is determined to increase the part of renewable power to increase energy security and reduce climate impact. However, starting from very low levels there are several challenges to reach the goal of 11 per cent for 2035. Besides technology and grid related aspects, there is the fact that South Korea is densely populated with limited areas to install wind power plants and solar power facilities. Furthermore, energy infrastructure development is also subject to protests from the affected inhabitants. The governmental policy about “Proper Social Conflict Management in Energy Infrastructure Construction and Site Selection Process” is added in the new National Basic Energy Plan to deal with the issue.

The physical limitations are also behind the speculations about grid connections for electricity and gas with China and Russia. However, such infrastructure has probably to

involve North Korea. Discussions are said to be on-going between Russia and North Korea and Russia and South Korea, respectively, but so far no proposal exist. Time will tell how the energy issues will influence the geopolitical situation in the region, and vice versa.

3.2 Critical decisions regarding implementation of future energy system

The probably most important decision for the government *is* ***reorganization of the price system***. For a long time, the electricity price has been subsidized in order to support the industries and thereby the growth of the nation. This means that there is no incentive for energy conservation for the industries, so the electricity consumption is very high. Obviously, the industries are against an increase of price and they have a very strong influence. This summer, the government paid ten big companies (nine steel and one cement) 400 million USD to save energy during two weeks, in order to be able to handle the peak-demand. One of the energy experts in the Green Growth Committee is expressing a concern that if the government would continue to subsidize the prices – these companies could expand their business and it would increase the cost for the government even more, even if it would be better to support other, less energy-intensive, industries. Connected to this issue is *the shift from supply management to demand management*, which includes electricity prices, but also technology and policies. This means that instead of increasing the input of energy by building and importing more – the output will be decreased. This will be done by energy conservation the use of energy which currently is very intensive and in many cases excessive – the electric power consumption per person is higher than that of Japan, France and UK, whose GDP's per person are about double of Korea.

Another important issue is how to handle the *sustainable power mix*; considering economy, capacity, environmental, and system condition. As for now, there is a low percentage of renewables and a high dependency on other countries. There is also an aim to obtain an energy supply in *harmony with the environment*, meaning a reduction of emissions of greenhouse gases. This is an especially difficult issue according to obtain, and currently this is not an issue prioritized either by the government or the public. Moreover, the *transparency of the capacity* within the energy industry must be improved. This should be done by improving the energy ecosystem and by managing conflict actively. Finally, the new energy strategies should *create growth* by activating new industries within renewable energy and smart grids.[23]

[23] Prof. Moon.

4 Governance and policy instruments

This section is about the principles and instruments used to implement the energy strategy. In section 4.1, we have tried to capture some of the underlying principles for governance by the Korean government, tightly linked to history and culture. This is based on responses in interviews as well as our own observations. In the consecutive section, the actual tools and instruments are described.

4.1 Underlying principles for governance

4.1.1 Slow steps to secure stable energy supply

The energy security is utterly important for South Korea and the electricity shortages pose a major threat to the country's sustained economic growth. Therefore, the strategies and policies deal with this issue; by energy efficiency, demand management and improvements to create a stable energy supply. The changes are planned and implemented in a step-wise and controlled fashion, with great care for both industry and inhabitants. The drastic manoeuvres e. g. for nuclear power in Japan and Germany are seen as deterrent examples of how South Korea does not want to drive change within the energy sector.

4.1.2 Technology and growth

In the strategies, the increased share of renewables is closely connected to the creation of new markets, and thereby growth and jobs. For example, the smart grid aims to improve the energy situation in Korea – but a part of it is to export the technologies and collaborate with other countries. In the energy efficiency campaigns the aim is to raise the awareness among the people and also to create a demand on energy efficient products – which will encourage the domestic industries to create such products. As energy efficiency is an issue to most of the world – quality products of this type are likely to be exported. Also for the energy storage, Korea has the three leading companies for this technology in the world. Since more and more countries want to increase the share of renewables, these products have export potential.

4.1.3 Reduce greenhouse gases

Although it is not top priority in practice, the reduction of greenhouse gases are frequently mentioned in the policies; both as one of the main goals for the National Energy Basic Plan and as a sub-target for the energy efficiency campaigns. The Emission Target Scheme (under 4.2.1) is partly introduced as an international commitment to reduce the countries emissions.

4.2 Policy instruments to implement the basic energy plan

4.2.1 Renewable Portfolio Standard

Until 2011, South Korea had a feed–in–tariff (FIT) system but it was replaced by a RPS in 2012. The abandon of the FIT was made out of economic reasons, according to an unofficial statement. The RPS is now the key instrument for renewable energy development the country and the purpose of the implementation is to reach the new and renewable energy target of 11 per cent in the energy mix in 2035. According to the RPS,

power utilities that generate more than 5000 MW (14 generators in 2010[24]) must generate at least 2.0 per cent renewables in 2012. This will be extended to 10 per cent in 2022. However, solar PVs are placed in a special quota, and this will continue until 2016.[25] The qualified types of energy sources for the RPS includes: solar, bio, wind, hydro, fuel cell, gasification or liquefaction of coal technology, ocean, waste, geothermal and hydrogen energy. The key design features of the RPS in South Korea are:

- Generators under the obligation have to meet their target and submit the Renewable Energy Certificate (REC). There are three different ways for a company to get the REC, either by the company generating the energy from their own renewable facilities, by purchasing long-term contracts with other renewable developers or via the REC market.
- There is a fee for non-compliance, but this cannot be greater than 150 per cent of the REC price.
- The REC is verified by KEMCO
- Generators are required to purchase 50 per cent of solar REC from third party solar power developers, a so called carve-out program.
- Different types of technologies are assigned different weight values, in order to promote some energy sources. Some examples are found in the Table 2 below.

Table 2 Wieghts of different energy sources in the Korean RPS

Weight value	Energy sources
0.7 – 1.5*	PV
1.0	Hydro, inland wind power, bioenergy, tidal power with seawall
1.5	Wood fired generation, off-shore wind power (within 5 km)
2.0	Offshore wind (outside 5 km), tidal power without seawall, fuel cells

**Depending on if it is attached on existing buildings and construction, land and what type of land. The cases where existing buildings and constructions are used have the highest weight value.*

When the government shifted from FIT to RPS, there were concerns that this system would not, contrary to the FIT, promote decentralized energy options.

Furthermore, a *Renewable Fuel Scheme* is under discussion in order to promote renewable energy mix for the transportation sector. The scheme will call for renewable fuel to be blended into transportation fuel in increasing amounts each year. The policy is under public hearing and planned to be implemented in 2014.[26]

4.2.2 Emission Trading Scheme

In 2015, South Korea will implement an Emission Trading Scheme (ETS). The country's aim is to reduce greenhouse gases with 30 per cent from BAU until 2035, and according to International Energy Agency (IEA) the ETS will be a comprehensive and economically

[24] Institute français des relations internationals, 2012.
[25] Interview with KEEI.
[26] Today Energy. (2013, June 10). Today Energy (in Korean). Retrieved from http://www.todayenergy.kr/news/articleView.html?idxno=75094

efficient way to reach this goal.[27] A Target Management System, which covers 68 per cent of the total national emission, was implemented in 2012 to set a cap on large emitters and oblige them to reduce their target emission, as a precursor to implementation of ETS. In May 2012, the proposal for ETS passed the National Assembly and the scheme is on its way for implementation in January 2015, and it will then become the first nation-wide, cap–and–trade scheme to be implemented in Asia.

4.2.3 Subsidies

The government has been promoting a *regional deployment subsidy program* designed to support various projects carried out by local governments. This program, which started in 1996, supported both new and renewable energy and energy-saving schemes until 2005. The two areas were separated in 2005 in accordance with the Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy. The subsidy for installing new and renewable energy systems, such as PV and wind power, supports up to 50 per cent of the investment outlay. Another subsidy program is the *One million green homes*, which facilitates the installation of new and renewable energy facilities in residential sites. It emerged from the previous program *100 000 Solar-roof program*.

4.2.4 Carbon tax

According to our sources, there is currently a discussion in South Korea on an introduction of carbon taxes, but nothing is yet decided.

4.2.5 Regulations

Since April 2011, energy supply for new buildings and recently extended or reconstructed buildings, that exceed 3 000 square meters, must include at least 10per cent new and renewable energy. The obligation ratio will be increased gradually from 10per cent in 2011 to 20per cent in 2020, and, since 2012, the obligation applies to buildings over 1 000 square meters.

[27] IEA. (2012).

5 Abbreviations

ESS – Energy Storage Systems

ICT – Information and Communication Technology

OECD – The Organisation for Economic Co-operation and Development

KOGAS – Korea Gas Corporation

MOTIE – Ministry of Trade, Industry and Energy

WEC – World Energy Council

EMS – Energy Management Systems

NRE – New and Renewable Energy

LED – Light Emitting Diodes

USC – Ultra-Supercritical Technology

CCS – Carbon Capture and Storage

AMI – Advanced Metering Infrastructure

BAU – Business–as–usual

KEMCO – Korea Energy Management Corporation

TOE – Tonnes of oil equivalent

KEPCO – Korea Electric Power Corporation

RPS – Renewable Portfolio Standard

KETEP – Korea Institute of Energy Technology Evaluation and Planning

KIST – Korea Institute of Science and Technology

FIT – Feed–in–tariff

REC – Renewable Energy Certificate

ETS – Emission Trading Scheme

IEA – International Energy Agency