UK TRADE & INVESTMENT

# Low Carbon Opportunities in the Republic of Korea

## Report by UK Trade & Investment

# Contents

# Foreword

## LOW CARBON OPPORTUNITIES IN KOREA
## Foreword by HM Ambassador Scott Wightman

HE Scott Wightman, Her Britannic Majesty's Ambassador to the Republic of Korea

There are great low carbon opportunities for British business in South Korea.

South Korea has the 12th largest economy in the world and the fourth largest in Asia. GDP growth in 2012 is expected to be in the region of 3.5%, and GDP per capita is just over $30,000 (PPP – Purchasing Power Parity). South Korea is home to global companies such as Samsung, Hyundai and LG. They are now turning to low carbon and green growth as the next drivers for their businesses at home and overseas.

The South Korean Government is leading the way in the Asia Pacific region with an ambitious low carbon strategy. In July 2009, the Government committed to spending 2% of GDP annually on the low carbon economy. The Presidential Committee for Green Growth has set a target of a 30% reduction in carbon emissions by 2020. British business can help South Korea meet these ambitious targets.

This report seeks to match UK strengths to South Korean needs in the low carbon and green growth sectors. The UK is a global leader in green buildings and design, as well as in retrofitting and building materials. BRE sets the standard for green building certification with its BREEAM certificate. And the UK leads the way in new and renewable energies with strengths in offshore wind as well as wave and tidal power. There are also good synergies in our respective approaches to smart grids. Opportunities abound for exports of products & expertise, commercial and technical collaboration and sourcing of competitively priced, advanced parts and components.

There has never been a better time to do business in South Korea. The EU-Korea Free Trade Agreement is now in place. It will eliminate 97% of tariffs within three years – some have already been scrapped. Many of those tariff reductions are in the low carbon sector.

This report compliments our "South Korea – Open for Business" report, published in March 2011. You can find a copy at **www.ukti.gov.uk**. Once you identify an opportunity, or if you want more information about the market, please contact a member of the UKTI team, either in the UK or in Seoul. You can find contact details in this report.

South Korea is leading the way in green growth in the Asia Pacific. It is one of the most exciting markets in the world. We look forward to seeing you and helping you to grow your business here.

**Seoul**
**February 2012**

# Executive Summary

Both the United Kingdom and the Republic of Korea are pursuing Low Carbon, Green Growth strategies. However, the focus of the policies and objectives of the two countries exhibit some differences.

The UK is clearly committed to achieving Low Carbon targets. A detailed, year by year timeline of carbon reduction targets and specific plans on how to achieve them has been laid out and progress towards those targets is being carefully tracked. Growth is a by-product that the UK government hopes will be generated by pursuing carbon reduction policies. UK has a wide array of strengths but most notably in the areas of green buildings, construction and deployment of off shore wind power systems, environmental impact assessments, wind assessments and connection to the grid.

Korea also has targets but is primarily focused on economic growth and low carbon activities are defined as a "new growth engine". Policies and objectives are defined in terms of anticipated employment generation and potential for exports. The commercial viability of new technologies and energy conservation products are at the forefront of Korean policies. The government is hoping to create a sustainable business model that utilises market forces to drive green developments. A reduction in Korea's carbon footprint is a welcome addition to its green growth policy. Carbon reduction targets certainly exist but the link between the targets and the low carbon activities is less strong than in the UK. Korea has a wide array of strengths but most notably in building materials, hardware for wind power and ICT components for smart grids.

This analysis of low carbon, green growth opportunities is divided into 2 parts: Green Building Design and Materials, and New and Renewable Energy (including Smart Grid). Due to the differences in the approach to green building in Korea, the opportunities in Green Buildings have been slow to evolve. UK green building policies take a systematic approach looking at the whole spectrum of contributors to carbon emissions: building design, building materials, materials manufacturing processes, transportation, demolition, recycling and reuse. Korea is focused almost exclusively on reducing energy consumption through energy saving materials (primarily insulation), active energy reduction systems at the expense of passive solutions. Unfortunately, Korea's electricity costs are relatively low in minimising commercial motivation to save energy.

New and Renewable Energy (NRE) offers much more potential for cooperation. Both countries are actively working to increase power generation from new and renewable sources, both face the need to develop a grid that can handle diversified power inputs and two way flow with the UK focusing on system design and management while Korea is focused on developing ICT devices to monitor and regulate power flow.

More than 30 specific low carbon, green growth opportunities are presented in this report. General country information, tips on doing business in Korea and key contacts are also provided to assist UK companies interested in capitalizing on these opportunities.

# Summary of Opportunities

| Sector 1: Green Building Design | |
|---|---|
| Description | Integrated Green Building Design |
| UK Provider | BRE, Architects and Consulting companies |
| Summary | Korea lacks a comprehensive green building design model and would benefit from a customised BREEAM based model adapted to global sourcing. |
| Description | Educate Decision Makers about UK Green building strengths |
| UK Provider | BRE, Consulting companies and UK government |
| Summary | Korean decision makers are most familiar with US practices and standards. An education effort / familiarisation trip would "put the UK on the map". |
| Description | High rise Passive Design & Technologies |
| UK Provider | Architects, and Companies in the Low Carbon supply chain |
| Summary | Korean construction (residential & commercial) is dominated by high rise structures. Passive energy & zero carbon concepts applicable to high rise buildings are needed. |
| Description | Regulatory Advice |
| UK Provider | UK government and Consulting Companies |
| Summary | Korean regulators need to develop integrated, consistent and practical initiatives for promoting low carbon technologies. |
| Description | Retrofit / Remodelling of old building stock |
| UK Provider | Architects, consultants |
| Summary | Korea has set ambitious targets for remodelling 500,000 old buildings to achieve low carbon targets. UK is experienced with this activity. |

| Sector 2: Green Building Materials | |
|---|---|
| Description | Green Building Material Technologies |
| UK Provider | Suppliers of construction materials |
| Summary | Korean equipment suppliers are focused on insulation and reduction of energy loss. Technologies supporting 'green' materials, recyclable materials, and reduced production costs would enhance competitiveness. |
| Description | Effective (but high priced) Construction Materials |
| UK Provider | Suppliers of construction equipment |
| Summary | Proven technologies with significant carbon reduction properties that are expensive but with proven rapid payback could succeed. |

| | |
|---|---|
| Description | Energy Savings Consulting |
| UK Provider | ESCOs (energy service companies) & materials producers |
| Summary | There is considerable demand for multiple energy saving technologies: conservation, infrastructure, micro power generation, risk management. |
| Description | Energy Efficient Materials |
| UK Provider | Materials producers |
| Summary | Licenses for manufacture of energy efficient (insulated) materials. |

| Sector 3: Waste to Energy | |
|---|---|
| Description | Waste to energy technology |
| UK Provider | Engineering companies |
| Summary | Advanced technologies for efficient conversion of waste to energy. |
| Description | Attractive design of waste to energy facilities |
| UK Provider | Architects |
| Summary | Designs to make waste to energy facilities attractive minimizing public resistance (NIMBY). |
| Description | Waste to fertiliser |
| UK Provider | Engineering companies |
| Summary | Fertilizer generated by food waste is relatively expensive and perceived to be low quality. Technologies for low cost manufacture and for enhancing quality would both be well received. |
| Description | Waste to Bio-mass / Bio-gas |
| UK Provider | Engineering companies |
| Summary | Converting waste to gas can be highly profitable. |

| Sector 4: Solar | |
|---|---|
| Description | Solar Technology |
| UK Provider | Engineering companies |
| Summary | Korean firms are efficient manufacturers of modules but are dependent on foreign technology. |
| Description | Joint Development of overseas solar projects |
| UK Provider | Engineering companies, solar systems suppliers |
| Summary | Korean companies would like partners to penetrate overseas markets. |
| Description | Sourcing of low cost solar modules |
| UK Provider | Solar systems suppliers |
| Summary | Korean manufacturers of solar panels are globally price competitive. |
| Description | Joint development of domestic solar projects |
| UK Provider | Engineering companies, solar systems suppliers |
| Summary | The Korean solar power market will be driven by sales to the GENCOs who must achieve NRE targets. Local content will be required. The focus will be on roof tops and other eco-friendly installations, a UK strength. |

| Sector 5: Wind | |
|---|---|
| Description | Joint development of offshore wind farms |
| UK Provider | Engineering companies, wind power installation companies |
| Summary | Korean firms are new to wind power but are eager to participate in off shore projects. They have advanced production capabilities and have a long history with off-shore capabilities (vessels, production platforms). |
| Description | Parts & Service Supply (including Wind Mill Blades) |
| UK Provider | Equipment suppliers & installation companies |
| Summary | The UK's ambitious off-shore wind program will generate substantial demand for turbines, parts and installation services. |
| Description | Installation of off shore farms |
| UK Provider | Engineering companies, wind power installation firms, Korean investors |
| Summary | Korea needs to develop references for off shore wind installation and are likely to adopt a loss-leader approach to achieve them. |
| Description | Certification |
| UK Provider | Certification companies (Lloyds) |
| Summary | Korean wind mill turbine manufacturers are developing new systems that require certification. |
| Description | Grid connection |
| UK Provider | Engineering companies |
| Summary | Korea is new to the industry and therefore has no experience connecting off shore wind to the grid. |
| Description | Training for design, installation, operation and maintenance |
| UK Provider | Engineering companies, training companies |
| Summary | New to the industry, Korea needs to rapidly build up its human resources. |
| Description | Test Bed Development in Korea |
| UK Provider | Engineering companies, consultants |
| Summary | The Korean government is implementing several 'test beds' to provide references for local manufacturers' capabilities in a commercial setting. UK engineers could assist to design, monitor and document the performance of various systems on the test bed. |
| Description | Wind quality analysis |
| UK Provider | Engineering companies, consultants |
| Summary | Currently, Korean skills for documenting wind quality in test beds are weak. |
| Description | Small wind |
| UK Provider | Engineers, system suppliers |
| Summary | "Small Wind" suppliers in Korea are SMEs that lack technology and credibility. However the government is encouraging micro energy generation. UK companies with proven systems could be highly successful partnering with Korean firms through licensing or joint ventures. |
| Description | Supply chain |
| UK Provider | Korean investors into the UK |
| Summary | Korean firms could tap the UK supply chain for wind power parts. |

| Sector 6: Wave | |
|---|---|
| Description | **Durable wave generation equipment** |
| UK Provider | Engineering companies, generator suppliers |
| Summary | Wave power generators face severe environmental conditions. This sector is still pre-commercial so an early entrant could capture the market. |
| Description | **Technology to capture low energy density, low height waves** |
| UK Provider | Engineering companies |
| Summary | Waves have low density (12 ~ 13 KW) and are on average only 1.5 to 2 meters high. Custom technologies are required to capture this energy. |
| Description | **Waterproofing of underwater connections** |
| UK Provider | Engineering companies, cable suppliers |
| Summary | Off-shore wind generators have components that need to be effectively protected against water and corrosion. |

| Sector 7: Tidal Power | |
|---|---|
| Description | **Joint R&D** |
| UK Provider | Educational institutions, R&D centres, Engineering companies |
| Summary | Tidal power development is largely 'pre-commercial' and involves considerable research & field study so knowledge could be shared. |
| Description | **Tidal turbine development** |
| UK Provider | Engineering companies, turbine manufacturers |
| Summary | Turbines must be customized for tidal systems to achieve maximum efficiency. |
| Description | **Joint construction** |
| UK Provider | Construction companies |
| Summary | Korean construction firms are competent builders with global experience. They could be good partners for projects around the world. |

| Sector 8: Smart Grid | |
|---|---|
| Description | **Sourcing of parts** |
| UK Provider | Systems integrators |
| Summary | Korean manufacturing is high quality and price competitive. Particularly parts involving ICT could be sourced from Korea. |
| Description | **Innovative Business Model** |
| UK Provider | Engineering companies, systems integrators, consultants |
| Summary | Korea has embraced the smart grid but is still struggling to capture variable supply and demand into a rational commercial model. |
| Description | **Jeju Test Bed** |
| UK Provider | Engineering companies, research organizations |
| Summary | UK companies could benefit from participation in Korea's pilot smart grid project in Jeju gaining experience and developing important relationships. |

# How to Use This Report

Opportunities: Over 30 specific opportunities were identified during the course of this project. They are summarised in the first section of this report called “Opportunities”. Each opportunity in the summary is hyperlinked to the opportunity in the text.

Basic facts about Korea and selected ‘tips’ for doing business in Korea are presented on pages 11 and 12.

The report begins with an overview of Korea’s Green Growth strategy and is subdivided into two sections: Part 1 discusses Green Buildings and Green Materials. Part 2 examines renewable energy divided into 6 sectors including the ‘smart grid’ sector.

- Waste to Energy
- Solar energy
- Wind power
- Wave power
- Tidal power
- Smart Grid

The discussion of each sector is divided into 6 subjects:

- Overview
- Korean Government plans
- Private sector plans
- UK strengths
- Opportunities
- Contacts in the industry (in Korea)
- Appendices (To facilitate ‘readability’, large tables have been appended to the end of the discussion of each subject. Not all subjects have appendices.)

When you find an opportunity that looks interesting, contact information is provided under ‘contacts’. The section ‘Key Contacts at UKTI’ (page 10) provides contacts for UK government resources that can assist UK and Korean companies to capitalise on low carbon green growth opportunities in the UK and Korea.

**NOTES:**

- Exchange rates are converted at the rate at the end of each calendar year.
- Korean names are presented in Korean order with Family name followed by Given names.

# Key Contacts at UK Trade & Investment

UK Trade & Investment (UKTI) is the government department that helps UK based companies succeed in the global economy and assists overseas companies to bring their high quality investment to the UK. Companies seeking to capitalize on opportunities in Korea are encouraged to coordinate their efforts with the knowledgeable experts at the UKTI in Korea.

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IRC
Guiding the way

**IRC Limited:** Research and preparation of this report was prepared exclusively for the UKTI by IRC Limited. IRC is a business development consultancy that has been assisting Western firms to successfully enter and succeed in the Korean market for three decades. IRC has endeavoured to capture this diverse, comprehensive and detailed subject to the maximum possible extent within the constraints of time and budget available for this project. We hope that it has been helpful for readers. We thank the UKTI and various Korean organisations for their support but take full responsibility for the inadequacies of the report. To learn more about IRC, visit **www.ircltd.com** or **write to irc@ircltd.com**.

# Basic Facts & Statistics on South Korea (2010)

| | |
|---|---|
| **Geography** | |
| Location | • Southern half of the Korean peninsula (between China & Japan) |
| Area | • 100,072 square kilometres (2,413 km of coastline) |
| **Industries & Resources** | |
| Industries | • Electronics, Telecommunications, Automobile production, Chemicals, Shipbuilding, Steel |
| Natural Resources | • South Korea's natural resources are limited but do include: Coal, Tungsten, Graphite, Molybdenum, Lead |
| Agricultural Products | • Rice, Root crops, Barley, Vegetables, Fruit, Cattle, Pigs, Chickens, Milk, Eggs, Fish |
| **Economy** | |
| Inflation Rate | • 3.5% |
| GDP | • £631 billion (6.1% real growth rate at the end of 2011) |
| GDP by Sector | • Agriculture: 3%<br>• Industry: 31%<br>• Services: 67% |
| Income per Capita | • £13,419 ($20,759) – PPP $29,997 (IMF, 2010) |
| Consumption Expenditure Structure | • Food & Beverages: 15%<br>• Transportation & Communication: 18%<br>• Education, Culture & Recreation: 19%<br>• Clothing & Footwear: 6%<br>• Medical Care: 7%<br>• Furniture & Utensils: 4%<br>• Housing, Fuel, Electricity and Water Charges: 10%<br>• Dining & Lodging: 13%<br>• Others: 9% |
| Exports | • £298.4 Billion |
| Export Commodities | • Semiconductors, Wireless telecommunications equipment, Motor vehicles, Computers, Steel, Ships, Petrochemicals |
| Export Markets | • China 25%, US 11%, Japan 6%, HK 5%, UK 1% |
| Imports | • £267 Billion |
| Import Commodities | • Machinery, Electronics & electronic equipment, Steel, Transport equipment, Organic chemicals, Plastics |
| Import Partners | • China 17%, Japan 15%, US 10%, Saudi Arabia 6%, Australia 5%, Germany 3%, UK 1% |
| **People** | |
| Population | • 48,874,539 |
| Labour Force | • 24,620,000 |
| Labour Force by Occupation | • Agriculture: 7.3%<br>• Industry: 24.3%<br>• Services: 68.4% |
| Unemployment Rate | • 3.7% |

# Tips for Doing Business in Korea

Koreans are experienced with international business. However, UK companies that accommodate cultural peculiarities will find interaction easier and more effective.

**Communication:** While many Koreans are comfortable communicating in English, many talented and capable Koreans are not. Accommodate your language to your audience. Speak in clear, basic English. Do not rely solely on verbal communication but reiterate your messages in writing.

Cultural differences also influence communication. Traditional culture favours harmony rather than confrontation often causing Westerners to understand silence as acceptance. Negative questions are understood differently and 'yes/no' questions are unreliable. Ask questions from several directions to verify that the message has been successfully communicated. Your counterpart is unlikely to request clarification even if understanding is not complete.

When making presentations, minimise words and maximise graphs, charts and visuals that can communicate across languages and cultures.

Korea is a country where things can happy extremely quickly. Same day response is the norm. A week without communication is interpreted as lack of interest and/or termination of a project.

**Names & Personal Address:** Korean names are written Surname, and then Given Name. Often in communication with Westerners, the order is reversed to accommodate our culture. Initials and Anglicized names are sometimes used to facilitate communication with Westerners. While this is very considerate and convenient for Westerners, fellow Koreans often will not be aware of the Anglicized name so may not know who is being discussed. Titles are very important among Koreans and are used when addressing individuals. The most common address in Korean is surname and title, for example "Director Lee".

**Caution with Numbers:** Simple things like numbers can lead to a break down in business relations. Korean counting indicates the units of time that a condition existed. As a result, the practice is to start counting at 1 (you are 1 year old when you are born, an overnight trip is a 2 day trip). Large numbers are confusing as Northeast Asia counts in groups of 4 digits (10,000, 100,000,000) rather than in thousands. This makes converting large numbers between English and Korean quite challenging. To a Korean, 5 million is 500 ten thousands. When clarity is critical, write out the entire number with all its digits or use specific dates and times for starting and ending. Avoid culture bound references to time such as Easter which will not be familiar to Koreans. Likewise, Koreans may refer to events in the lunar calendar (Lunar New Year, Chuseok) that will be unfamiliar to Westerners. Seek clarification when you are unsure.

**Hierarchy:** All Korean relationships are hierarchical. The individual in the 'superior' position is treated with respect while the 'junior' is subservient (to the point of rudeness by Western values). Age, position in the company, education, and marital status all determine one's 'rank' in society. Westerners are often surprised that they are asked very specific and even personal questions when they first meet a Korean. Your counterpart is trying to determine where you fit in the hierarchy. Your 'rank' can have a major impact on who is willing to meet you and the nature of the dialogue (relative position). (Titles are hierarchical rather than functional in Korean companies.) Know your counterpart and how he fits within his organization.

**Relationships:** EVERYTHING depends on personal relationships. One can 'borrow' relationships and introductions are very helpful but successful business requires one to build ones' own relationships. Devote time getting to know your counterparts both professionally and personally. Work on developing your relationships just as you would your professional skills. Mix business with pleasure. Develop, sustain and grow your personal network.

**Gifts:** The culture of gift giving persists in Korea, particularly for formal meetings and meetings between very senior people. Also, when travelling overseas, taking a gift for your host (and reciprocating) is not uncommon. For working level business meetings, gifts are rare. However, hosting meals is expected.

**Eating:** Eating is important in Korea. An important component of building relationships and 'bonding', it is rare for a meeting that ends near mealtime not to result in an invitation by the 'host'. It is common for the host to pay for the meal. Sharing the cost of the meal (in a business setting) is unheard of in Korea – be prepared to invite your guest. Seminars and workshops always include a meal – usually hosted by the event sponsor.

**Drinking:** Health consciousness has blissfully supplanted heavy drinking with golf and other pursuits but eating and drinking remain important parts of relationship building, particularly among the over 50 age group. Drinking is serious not casual. While it is not common to drink at lunch, often beer or wine will be served to accommodate 'Western' habits. Serious drinking is done at night and is often a drawn out affair demonstrating prowess and stamina. Be careful. Often, key commercial information is revealed at the very end of a drinking session so one needs to be alert enough to catch the message.

**Meetings:** Meetings have a predictable format. It is useful to know who will participate before the meeting – in particular, it is important to know whom you have already met!! The senior person enters the meeting first and seating is arranged hierarchically. Business cards are exchanged before sitting down and several minutes of small talk follow. Receive the business cards with two hands (or at least the right hand) and study it carefully; place it face up on the table in front of you during the meeting. Treat cards with respect; they represent your counterparts' 'face', provide important clues as to their importance and are a key tool for managing relationships. You will always be offered 'Tea' (which can also be coffee, juice, water or something else); it is awkward to refuse so better to accept even if not consumed. Wait until these rituals have been completed to commence business discussions. Allow your counterpart plenty of time to express his opinion; avoid dominating the conversation but try to listen and understand what your counterpart is thinking. This is particularly true if your counterpart is weak at English.

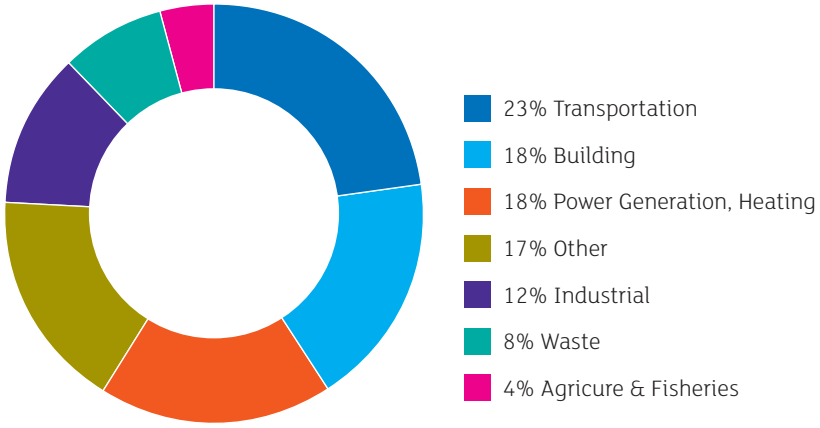
# Overview of Korea's Low Carbon Strategy

Korea's national strategy and 5-year plan for green growth that was announced in July 2009 represents a major attempt to fundamentally transform the country's growth paradigm from "quantitative growth" to low carbon, "qualitative growth". The green growth strategy contains encouraging policy goals and targets to tackle climate change and enhance energy security, create new engines of growth through investment in environmental sectors, and develop ecological infrastructure.

The Presidential Committee on Green Growth (PCGG): PCGG was established under the direct supervision of President Lee, Myung-bak to implement the national vision of low-carbon green growth that he presented in an address on August 15, 2008.

The overall carbon target announced by the PCGG was a 30% reduction compared to BAU (Business As Usual) estimated carbon emissions by 2020.

**Carbon Emissions Reduction Target by 2020**




**Source:** PCGG "2020, Low Carbon, Green Growth Roadmap"

**Carbon Emissions Target by Sector, Industry by 2020** Units: Million CO2e, %

| Sector | Industry | Carbon Emission in 2007 | Target | | |
|---|---|---|---|---|---|
| | | | 2020 BAU | Reduction Target (Volume) | Reduction Target (%) |
| Industry | Oil refining | 12.8 | 17.1 | 1.28 | 7.5 |
| | Mining | 1.0 | 0.68 | 0.027 | 3.9 |
| | Steel | 86.0 | 121.35 | 7.88 | 6.5 |
| | Cement | 42.2 | 41.48 | 3.53 | 8.5 |
| | Petrochemical | 50.7 | 63.47 | 4.77 | 7.5 |
| | Paper/Timber | 8.7 | 7.73 | 0.55 | 7.1 |
| | Fabric/Leather | 11.9 | 9.81 | 0.61 | 6.3 |
| | Glass/Ceramic | 4.5 | 5.50 | 0.22 | 4.0 |
| | Nonferrous metals | 5.4 | 5.02 | 0.21 | 4.1 |
| | Machinery | 10.2 | 13.10 | 0.99 | 7.6 |
| | Electricity & Electronics – Energy | 9.7 | 12.09 | 0.96 | 7.9 |
| | Electricity & Electronics – Non energy | 18.0 | 29.25 | 24.55 | 83.9 |
| | Electronic display device | 6.3 | 71.65 | 28.32 | 39.5 |
| | Semiconductor | 8.4 | 14.53 | 4.03 | 27.7 |
| | Automotive – Energy | 6.7 | 8.72 | 0.68 | 7.8 |
| | Automotive – Non energy | 2.9 | 3.62 | 3.25 | 90.0 |
| | Shipbuilding | 1.8 | 3.79 | 0.25 | 6.7 |
| | Other manufacturing | 17.6 | 16.91 | 0.29 | 1.7 |
| | Food and drink | 6.8 | 6.16 | 0.31 | 5.0 |
| | Construction | 2.5 | 3.22 | 0.23 | 7.1 |
| | Sub-total | 314.1 | 455.18 | 82.94 | 18.2 |
| Transportation | Transportation | 87.7 | 107.25 | 36.82 | 34.3 |
| Building | Residential | 70.5 | 87.44 | 23.62 | 27.0 |
| | Commercial | 67.6 | 91.52 | 24.44 | 26.7 |
| | Sub-total | 138.1 | 178.96 | 48.06 | 26.9 |
| Others-public | Others-public | 16.2 | 18.85 | 4.70 | 25.0 |
| Agriculture, Fishery | Agriculture, Fishery | 30.0 | 29.10 | 1.52 | 5.2 |
| Waste | Waste | 17.1 | 13.83 | 1.71 | 12.3 |
| **Total** | | **610** | **813** | **243.9** | **30.0** |

**Source:** PCGG "2020, Low Carbon, Green Growth Roadmap"

* Fluorinated refrigerants and abstergent in Electricity & Electronics and Automotive sectors is classified as non-energy to align with current Korean regulation structure.

# PART 1:
# GREEN BUILDING DESIGN AND MATERIALS

# Sector 1: Green Building Design

## 1.1. Overview

Korean low carbon regulations and standards are focused on active solutions including improved materials and application of New and Renewable Energy with little application of passive energy saving solutions.

Korean industry has strong capabilities in many different solutions (particularly energy efficient insulation solutions) for achieving low carbon targets but integration skills to look at buildings as a whole and select the best solutions are still in need of development. A characteristic of the construction industry that remains an obstacle to introduction of low carbon solutions is insufficient coordination involving the architect, builder, owner and operator of buildings.

Government regulations and policies for promoting low carbon solutions appear to be strongly influenced by political imperatives. The government wishes to demonstrate that it is sensitive to environmental issues so often generating a quick result has higher priority than developing enduring solutions.

Korea is trying to develop its own energy modelling for integration and design called Eco2 (similar to EQuest, Energy Phase 2).

The government has tried to promote its own standard (GBC) but it cannot yet compete with LEED or BREEAM. The focus has largely been on energy cost saving and operational cost saving through insulation rather than a systematic or comprehensive process from design and materials to demolition and recycling.

The UK government has also invested £55,000 to assist the Green Building Council to bring BREEAM to Korea.

BRE is working with the Korean Green Building Association, government regulators, academics, industry and consumer groups on a UK funded project to enhance the Korean Green Building Code. It is hoped this will create a common technology platform allowing UK and Korean participants to exchange research and technologies.

## 1.2.
## Government Plans and Initiatives for the Green Building Sector

Construction / buildings are a major contributor to Korea's carbon emissions (second only to transportation). Korea announced a greenhouse gas (GHG) reduction target for the building sector of 27% by 2020 (vis Business as Usual – BAU). The target includes strengthening energy efficiency standards to reduce emissions by 30% by 2012, 70% by 2017 and achieving zero-energy housing by 2025.

**Annual Carbon Emission Reduction Targets in the Construction Sector** Unit: %, Comparison to BAU

| Year | 2012 | 2013 | 2015 | 2020 |
|---|---|---|---|---|
| Residential | 1.8% | 5.0% | 8.9% | 27.0% |
| Commercial | 1.9% | 4.4% | 8.8% | 26.7% |

**Source:** PCGG "2020, Low Carbon, Green Growth Roadmap"

The Ministry of Land, Transport and Maritime Affairs (MLTM) announced its roadmap to achieve the carbon reduction target in construction & housing sector in June 2011 in their (The Presidential Committee on Green Growth) PCGG report. Even before this report, the government had introduced insulation standards and created a green building certificate but as they were voluntary, they had little impact in the industry.

The MLTM roadmap for achieving carbon reduction targets includes building construction, maintenance and remodelling. Existing regulations for green buildings are becoming stricter in terms of standards, incentives and penalties to bring practical change in carbon reduction. The roadmap is expected to shift Green building design regulations from a 'prescriptive' standard to an overall performance standard.

### 1.2.1.
### Green Building Construction

- Construction permits will require stricter Energy efficiency (zero energy by 2025)
  - 2012: 30% energy reduction compared to the 2009 level
  - 2017: 70% energy reduction compared to the 2009 level
  - 2025: Zero energy
- Energy Consumption Cap: Effective from 1 July, 2011, commercial buildings over 10,000 m² must be designed to achieve the energy consumption standard. However, the standard has not been defined as yet. The Seoul City standard is 345 kwh m² or less. The MLTM is expected to fix its own standard after closely monitoring / evaluating the energy consumption of large scale buildings. This requirement will be extended to all commercial buildings by 2020. Designs that do not achieve the targets will not be issued a building permit.

**NOTE:** Clearly, without an objective standard, enforcement is difficult.

- Green Home Model Town: The government has created two small 'towns' to demonstrate low energy building solutions.
  - Yongin: 52 green homes (houses)
    - > NRE applications (solar photovoltaic and solar heat)
    - > Target: 70% energy saving compared to average energy consumption of house in Korea
  - Segok: 200 green homes (Condos with 3 ~ 4 units)
    - > High insulation performance materials, passive technology and new & renewable energy facilities
    - > Target: 60% energy saving in comparison to average energy consumption of an apartment in Korea
- One Million Green Homes Project (Includes all kinds of residential buildings): This project is designed to encourage builders of residential structures to install new and renewable energy. A subsidy is available for up to 50% of the cost of installing the system. Please refer to the Appendix on page 21 for details about the One Million Green Homes Project.
  - Credibility of the One Million Green Homes Project: The target of one million dwelling units seems to be a symbolic rather than a finite target. There is no annual target within the 1 million. The target includes green homes constructed since 2004 (prior to the launch of the project). The green homes need not generate all their energy from renewable sources. Furthermore, any home that installs renewable energy facilities can apply for and receive subsidies for the installation costs regardless of overall energy efficiency. (In fact, new homes can qualify by installing NRE even if they consume more energy than existing homes.) The budget per home seems quite low. Assuming approximately 30,000 homes were built in 2011, the 89 billion won budget would approximate 30 million won (£15,000) per home. Please refer to the appendix on page 21 for the track record of One Million Green Homes Project to date.

- Current status of green construction design of Korea: A green building uses little or no external energy. Green building design achieves this goal by designing and positioning buildings to capture 'passive energy': sunshine, ground temperature, and air flow resources.
  - Application of passive building design (design requiring little or no external energy sources for heating and cooling) is still very rare in Korea. Project consultants were able to identify only 2 examples of buildings that have received international recognition. A "Passive House Certification in Residential Buildings" was awarded to the following projects by the Passive House Institute in Germany:
    > The seniors' community centre at the Vivaldi Apartment Complex in Incheon constructed by Halla Engineering & Construction in 2010
    > e+Green Home constructed by Kolon Engineering in 2011
  - No non-residential buildings have achieved passive energy certification.
  - While Passive House designs will eventually help achieve reductions in carbon emissions, as a first step, they are designed to create a viable business model to help commercialise the industry.

The Korea Passive House Institute (KPHI) was established in June 2011. KPHI will take the lead in developing "Passive House" standards through discussion with industry, university and government. KPHI is cooperating with the Passive House Institute (PHI) of Germany to train and provide technical information to passive design experts and related industry. A description of the 'basic features' of a passive house are presented in the Appendix on page 22.

### 1.2.2. Maintenance of Green Buildings

- Green Building Certification: The government introduced the Green Building Certification (the Korean equivalent of LEED or BREEAM) in 2002. However, the details of GBC are still being developed. GBC is not reliable and several more years will be required for general acceptance. A further challenge is that several different agencies are developing their own certification direction and policies and coordination among them is poor. The GBC will offer incentives as follows:
  - 20% ~ 50% reduction of Environmental Improvement Tax
  - 5% ~ 15% reduction of Acquisition / Registration Tax

Although the Green Building Certification system was implemented in 2002 there is as yet no market for trading certificates – the only benefit available today is using the 'eco-friendly' image when marketing the building. This system needs to be developed further for it to gain in credibility.

- Others Certifications: Currently, there are many different green building certifications such as the Building Energy Efficiency Ranking Certification, Eco-Friendly Building Certification, Housing Performance Ranking, Building Energy Saving Design Standard and Eco-friendly House Performance and Construction Design Standard generated by the Ministry of Land, Transportation and Maritime Affairs (MLTM), Ministry of Knowledge Economy (MKE) and Ministry of Environment (MEV).

- MLTM is combining all the regulations of green building into three categories focused respectively on construction (Green Building Certification), energy (Building Energy Efficiency Rank Certification) and city (Green City Certification. The MLTM intends to 'brand' the three certifications as a tool to build public confidence.
  - Building Energy Efficiency Ranking Certification: Owners of buildings exceeding 1,000 m² can generate tax incentives and earn tradable certificates by installing renewable energy sources. Owners can apply for certificates that are awarded on the basis of the percentage of their own consumption they generate from renewable sources. Please refer to the Appendix on page 22 for details about the Building Energy Efficiency Ranking certification system.
  - Energy Efficiency Information: From 2012, all sales or rentals of buildings must document energy efficiency. This is expected to influence prices as incentive to owners of green buildings.

### 1.2.3. Remodelling of Buildings

To encourage improvements in energy efficiency, the government is making available low interest loans to owners who upgrade the insulation of their homes. This plan targets:

- Remodelling / Improvement of Public Rental Housing: 280,000 old public rental housing 15 years or over, to be completed by 2016.
- Remodelling of Private or Public Buildings: 200,000 units (30% of total old buildings) by 2020 (houses and apartments)
- Improvement of Private Housings: Loans of up to 14 million won (£10,000) are available at 3% per year for 3 years for all units that are 10 years old or more.

### 1.2.4. Other projects

- Ten Grand Green Projects: The government has mandated that public buildings (divided into 10 categories) utilise NRE in order to stimulate the industry. This has been translated into the Ten Grand Green Projects as presented in the Appendix on page 23.
- Credibility of the 10 Grand Green Projects: While this initiative is short on specifics (particularly targets), the government mandate for government facilities to adopt NRE technologies is likely to be implemented. The major challenge will be budget. If the government is squeezed due to economic fluctuations, projects may be postponed or targets lowered.

### 1.3.
### Private Industry Plans for Green Building Design

The government's green building plans are still being developed and refined and do not yet define a reliable framework to stimulate private industry investment. Some construction companies are taking advantage of the green building incentives to help finance their activities but only a few construction companies are proactively conducting research & development for passive design. In fact, the main players in the construction industry are the builders who have little or no incentive to reduce construction costs or equipment costs. The following projects have been announced in the media.

- KOLON Engineering built a passive house called e-Green Home at their R&D centre in Yongin and received "passive house" certification from the Passive House Institute of Germany in October 2011. KOLON announced it would continue developing passive house technology for both residential and non-residential buildings and develop an "Energy Zero House" by 2020.
- Halla Engineering & Construction received a "Passive House Certification in Residential Buildings" from the Passive House Institute in 2010 for a seniors' community centre in Incheon. Halla announced it would continue developing energy saving technologies such as passive, high efficiency of materials and energy saving systems and develop an "Energy Zero House" by 2025.
- GS Engineering & Construction, the third largest engineering and construction company in Korea announced a "Green Partnership" with its subcontractors in recognition of the importance of green technology in the construction industry and the impact of climate change on the construction and civil engineering industries. The "Green Partnership" is part of GS's goal of becoming a Global Top-tier Construction Company under its Vision 2015" plan announced in 2008. Funded with 200 million KRW (£112,000), 50% supported by the Ministry of Environment, GS has established a 3-year program working with 10 major sub-contractors to develop: green management systems, energy efficiency improvements, reducing carbon materials, green procurement systems, green certification, publishing green reports, green building certification and training green experts.
- Top Architects & Associates, a leader in green construction design, is focusing on passive house design to embrace the green construction environment. Top offers consulting services to construction companies and building owners to obtain BREEAM or LEED certification based on its experience in green design. Top also plans to contribute to promoting and popularising the Korean "Green Building Certification" program to increase public confidence. Top believes that green construction should adapt to the local environment rather than uniformly applying global standards.
- The SK Chemical Ecolab building at the Pangyo Technovalley in Bundang achieved 'platinum' level LEED certification with 55 points, the highest ranking in Korea. Heerim Architects and Planners designed the building with the support of EAN Technology (a LEED consulting company) and was constructed by SK E&C.

### 1.4.
### UK Company Strengths in the Green Building Design Sector

The UK has considerable expertise in design and especially, design integration. In the UK, design (architecture), materials sourcing, construction and operations are integrated and considered at the design stage.

Building Research Establishment (BRE) developed BREEAM – an environmental assessment method and rating system for sustainable building design, construction and operation. Already, 110,000 buildings are BREEAM certified and over half a million registered for certification. BREEAM has attracted a lot of attention in Korea.

The UK is using the 2012 Olympics to showcase environmental friendly building practices and technologies such as:

- Reduced water use by 57% through reduction and substitution
- Zero waste to landfill targets for building demolition

With a large stock of existing buildings, the UK has developed technology to retrofit existing buildings for heat retention and passive cooling.

The British Government has created the Modern Built Environment Knowledge Transfer Network with the mission to stimulate innovation and implementation in low carbon construction. UK expertise is recognised and is being applied by developers and governments not only in the UK but also in the Middle East and China.

UK Support of Green Policies:

- The UK offers "thought leadership" in policies on: emission reduction commitments and environmental financial transactions
- Imperial College in London's Grantham Institute converts climate related research into world impact.
- Met Office Hadley Centre is a leader in climate modelling. The organisation provided basic research for the Stern Review on the Economics of Climate Change and contributed to the IPCC Fourth Assessment Report.
- The Tyndall Centre for Climate Change Research coordinates the ADAM Project that supports EU policy development for future energy strategies.
- Carbon Trust is leader in carbon products – carbon foot-printing, carbon management and 'carbon' risk.

**Industry Examples of UK Capabilities**
Chinese developer VANKE is working with BRE to create a master plan for a 450,000 m² 'Green Building Park' in Beijing designed with materials, products and technologies for sustainable homes.

Beijing airport incorporated British know how when it integrated public transport systems into the new airport. It also applied energy saving concepts such as south facing skylights to capture early morning sun for maximum heat gain.

Arup, a global firm of designers, engineers, planners and consultants creates innovative and sustainable buildings, transport systems and civil engineering projects. Arup provides energy strategy development, and carbon emissions modelling. Arup was appointed by Dubai developer Nakheel to carry out a low carbon strategy for the Dubai Waterfront. Arup was selected to construct the Doha Showcase 2018 World Cup Stadium with solar power technology to control high temperatures resulting in a carbon neutral facility. In another project, Arup will study the greenhouse gas emissions of the city master plan of Beijing.

Foster + Partners was selected by Abu Dhabi to design Masdar City, the first carbon neutral and zero waste community in the country. Each building is designed to solve a specific environmental problem.

Modcell Ltd. is an innovative UK company that designs and constructs large-scale, carbon-negative buildings through the use of straw bale pre-fabricated panels.

David Lock Associates in Milton Keynes will cooperate with the Wuhan Planning and Design Institute on an urban design project.

NorthgateArinso in Hemel Hempstead will be measuring the carbon footprint of Wuxi, China.

The Green Investment Bank capitalised at £3 billion was created by the UK Government to leverage private finance and invest in £15 billion green infrastructure by 2014 ~ 2015. The Low Carbon Bond Group was created by six London financial services firms committed to funding the debt requirements of the low carbon sector.

The UK Low Carbon Cities Program was adopted by Nanchang China to create the first, complete carbon emission baseline assessment in China on which to base its low-carbon development goals.

## 1.5. Opportunities in Green Building Design

- An Integrated Approach to Green Building Design: There is a strong need in Korea for a comprehensive approach to green building design. BREEAM could be used to drive building design through the whole process from the planning and design phase and help to establish a suitable business model in the low carbon construction industry. It is well established and proven and would contribute significantly to public confidence in the industry. Korea is developing a Green Building Certification (GBC) system. Rather than "re-inventing the wheel", modelling GBC on BREEAM (even with modifications) could rapidly accelerate Korea towards being a leader in green building construction.
- Demonstrate Flexibility & Sourcing Neutrality of BREEAM: Industry insiders have a preference for BREEAM over LEED as it is perceived to be more flexible. (LEED is believed to favour 'made in USA' materials.) For BREEAM to be readily accepted in Korea, government and industry must have confidence that it is geographically neutral in its sourcing recommendations.
- Familiarise Decision Makers with BREEAM: Senior government officials and private industry executives are more familiar with US standards. For BREEAM to be widely accepted, industry leaders must have a good understanding and acceptance of BREEAM. The UK government should generate opportunities for Korean leaders to visit the UK and be exposed to the benefits of BREEAM to encourage its acceptance.
- Multi Dwelling Passive Designs: BREEAM and zero carbon designs have been focused on single family dwellings and low rise buildings whereas Korea's construction industry is dominated by high rise apartments and commercial buildings. Designs for utilising passive systems to achieve low carbon and zero carbon high rise buildings would be of tremendous benefit to Korea and would give the UK a unique foothold into the Korean market.
- Regulatory Advice: Korean government organisations often issue plans and targets in isolation. The government itself would benefit from advice on developing and implementing a consistent roadmap.
- Retrofit / Remodelling Advice: The UK has a long history of redevelopment of big cities. As Korea's building stock ages, the UK experience could have pertinent applicability in Korea.

## 1.6. Points of Contact

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## 1.7. Appendix for Sector 1: Green Building Design

**Outline of the One Million Green Homes Project**

| | |
|---|---|
| Name of programme | One Million Green Homes Project |
| Eligible technologies | Solar thermal, PV, geothermal, biomass, fuel cell and small wind |
| Maximum subsidy | 50% of the cost of the system |
| Requirements for installation | The system installer must be certified by the Korean Energy Management Corporation (KEMCO). |
| Finance provider | Korean New and Renewable Energy Centre (KNREC)<br>**www.knrec.or.kr** |
| Total funds | • 89.0 Billion KRW in 2011 (£50 million)<br>- 50.0 Billion KRW for Solar voltaic (£ 28.5 million)<br>- 15.0 Billion KRW for Solar heat (£ 8.5 million)<br>- 12.0 Billion KRW for Geothermal (£ 6.8 million)<br>- 0.5 Billion KRW for Small wind (£ 0.28 million)<br>- 11.5 Billion KRW for Fuel cell (£ 6.5 million)<br>• The total budget will be determined each year. |
| Funding source | Public funds |
| Effective date | 1 January 2009 ~ 31 December 2020 |
| Contact | Koran Energy Management Corporation<br>Yongin City, Gyeonggi-Do,<br>South Korea<br>Tel: +82 3 1260 4114<br>Email: kemco@kemco.or.kr<br>**www.kemco.or.kr** |

**Source:** Global Solar Thermal Energy Council, Ministry of Knowledge Economy, Renewable Energy Center

**Track record of One Million Green Homes Project to date** Unit: Number of Houses

| Year | 2004 | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|---|
| Target | | | | | 17,400 (2004 ~ 2007) |
| Total | 310 | 907 | 5,964 | 7,467 | 14,648 |
| Solar Panels | 310 | 907 | 5,964 | 7,317 | 14,498 |
| Solar Heat | - | - | - | 150 | 150 |
| Geo-thermal | - | - | - | - | - |
| Small Wind | - | - | - | - | - |

| Year | 2008 | 2009 | 2010 | 2011 | 2012 | Total | 2013 - 2020 |
|---|---|---|---|---|---|---|---|
| Target | | | | | 94,150 (2008 ~ 2012) | | 913,000 |
| Total | 10,021 | 18,840 | 28,898 | 13,393 | - | 71,152 | - |
| Solar Panels | 9,142 | 14,895 | 26,360 | 11,961 | - | 62,358 | - |
| Solar Heat | 879 | 3,653 | 1,097 | 736 | - | 6,365 | - |
| Geo-thermal | - | 292 | 1,428 | 696 | - | 2,416 | - |
| Small Wind | - | - | 13 | - | - | 13 | - |

**Source:** Korea Energy Management Corporation, NRE Center

**PHI defined "Basic features" of a Passive House**

| | |
|---|---|
| Compact form and good insulation | All components of the exterior shell of the house are insulated to achieve a U-factor that does not exceed 0.15 W/(m²K) (0.026 Btu/h/ft²/°F). |
| Southern orientation and shade considerations | Passive use of solar energy is a significant factor in passive house design. |
| Energy-efficient window glazing and frames | Windows (glazing and frames, combined) should have U-factors not exceeding 0.80 W/(m²K) (0.14 Btu/h/ft²/°F), with solar heat-gain coefficients around 50%. |
| Building envelope air-tightness | Air leakage through unsealed joints must be less than 0.6 times the house volume per hour. |
| Passive preheating of fresh air | Fresh air should be brought into the house through underground ducts that exchange heat with the soil. This preheats fresh air to a temperature above 5°C (41°F), even on cold winter days. |
| Highly efficient exhaust air heat recovery using an air-to-air heat exchanger | Most of the perceptible heat in the exhaust air is transferred to the incoming fresh air (heat recovery rate over 80%). |
| Hot water supply using regenerative energy sources | Solar collectors or heat pumps provide energy for hot water. |
| Energy-saving household appliances | Low energy refrigerators, stoves, freezers, lamps, washers, dryers, etc. are indispensable in a passive house. |

**Building Energy Efficiency Certification Process**

| | |
|---|---|
| Applicant | Building owner |
| Authorization Body | Korea Institute of Construction Technology, Korea Institute of Energy Research |
| Application | • Preliminary certificate: A preliminary certificate is awarded prior to construction based on the building design.<br>• Main certificate is based on performance (ratio of NRE to total) during building operation) |
| NRE Ratio (%) | (NRE consumption / Total energy consumption) |
| Level 1 | Above 20% |
| Level 2 | More than 15%, less than or equal to 20% |
| Level 3 | More than 10%, less than or equal to 15% |
| Level 4 | More than 5%, less than or equal to 10% |
| Level 5 | More than 3%, less than or equal to 5% |
| Incentives | Renewable Energy Certificate can be traded on the market<br>Tax incentives and relaxed construction regulations (TBD) |
| Timing Plan | 2011: Demonstration period |
| | 2013: Apartments larger than a certain scale (TBD) |
| | 2015: Small houses and apartments |
| | 2020: All buildings |

**Source:** New & Renewable Energy Center

**Ten Grand Green Projects**

| 10 Targets | Location for NRE Facilities | Recommended power |
|---|---|---|
| Green Post Offices | Regional Communications Offices, 2,746 Post offices | Solar photovoltaic and heat, Geothermal |
| Green Ports | 28 trade ports and attached terminal complexes | Solar photovoltaic, Offshore wind |
| Green Schools | 11,080 school buildings | Solar photovoltaic and heat, Geothermal |
| Green Islands | 132 islands that have independent power systems | Wind, Bio, Geothermal |
| Green Logistics | Large scale logistics facilities | Solar photovoltaic and heat, Geothermal |
| Green Industrial Complexes | National Industrial Complexes (40), General industrial Complexes (347), Agricultural Complexes (396), Urban High-tech Complexes (6) | Fuel cell, Bio, Waste |
| Green Highways | Expressway Rest Areas (167), Korea Expressway Corporation buildings & facilities | Solar photovoltaic and heat, Geothermal |
| Green Army | Military facilities | Solar photovoltaic, Bio Geothermal |
| Green Factories | Factories | Fuel cell, Waste, Geothermal |
| Green Power | KEPCO, Power companies | Solar photovoltaic, Wind, Bio |

**Source:** MKE "New & renewable Energy Growth Strategy" 2010 October

# Sector 2:
# Low Carbon Materials

## 2.1.
## Overview

- The Korean government is focusing its "low carbon materials" efforts on developing materials, parts and equipment that will be internationally competitive 'export drivers' more than on reducing Korea's carbon emissions.
- The Korean construction market is limited. The era of rapid growth and massive building projects has passed. Construction companies are looking for new business models. Thus, the government is seeking export markets, especially in Southeast Asia, to achieve economies of scale. Government and private initiatives are focusing more on improving insulation of construction materials than systematically approaching the low carbon process.
- The government is encouraging private companies to produce more effective building products as a means to reduce energy consumption.
- As yet, there is very little attention on the energy (carbon) used to produce, transport or dispose of construction materials.
- The infrastructure for supplying low carbon materials is not in place. There is limited supply and limited demand. Construction companies operate on tight budgets and are reluctant to incorporate any materials that are more expensive than their normal ones.
- Local architects are reluctant to adopt innovative materials out of concern that they will be blamed should there be any problems with the products.

**Annual Carbon Emission Reduction Targets in Production of Construction Materials**

Unit: %, Comparison to BAU

| Industry | 2012 | 2013 | 2015 | 2020 |
|---|---|---|---|---|
| Steel | 0.1 | 0.2 | 2.1 | 6.5 |
| Cement | 0.3 | 0.5 | 3.0 | 8.5 |
| Paper/Timber | 0.4 | 0.5 | 2.4 | 7.1 |
| Glass/Ceramic | 0.4 | 0.5 | 0.7 | 4.0 |
| Construction | 0.2 | 0.5 | 3.2 | 7.1 |

**Source:** PCGG "2020, Low Carbon, Green Growth Roadmap"

## 2.2.
## Government Plans and Initiatives for Low Carbon Materials

### 2.2.1.
### Industry

The government announced a target of reducing industrial carbon emissions by 8 million tons in 2012 (606 million BAU to 598 million tons of CO2in 2012) 598,000,000 tons). The 10 biggest companies among 458 companies targeted for carbon reduction are as follows;

1. **POSCO (Steel producer): 963,000 tons**
2. Samsung Electronics: 429,000 tons
3. LG Display (Flat panel maker): 327,000 tons
4. **Hyundai Steel: 192,000 tons**
5. Samsung Mobile Display (Flat panel maker): 129,000 tons
6. **Ssangyong Cement: 126,000 tons**
7. **LG Chemical (Petrochemicals): 104,000 tons**
8. **S-Oil (Petrochemicals): 96,000 tons**
9. **SK Energy (Petrochemicals): 85,000 tons**
10. **Tong Yang Cement & Energy (Cement): 80,000 tons**

7 of the 10 (highlighted in bold) produce construction materials.

### 2.2.2. Reduction in Carbon Emissions during Production of Construction Products

Energy Efficiency Labels and Standards: The Korea Energy Management Corporation (KEMCO) has ranked 24 items for energy efficiency. While not focused specifically on construction materials, some are related to buildings and construction. Windows and doors will be added to the list from 2012.

- Items related to construction equipment
  - air-conditioners,
  - chillers / heaters,
  - electric fans,
  - air cleaners,
  - incandescent light bulbs,
  - fluorescent lights,
  - three phase induction motors,
  - gas fired boiler for family use,
  - water chiller / heaters,
  - gas water heaters
- Items unrelated to construction
  - cars
  - refrigerators,
  - freezers,
  - Kimchi refrigerators,
  - washing machines,
  - dish washers,
  - dish dryers,
  - electric rice cookers,
  - vacuum cleaners,
  - ballast stabilizer for fluorescent lights,
  - lamp containing stabilizers,
  - adaptors/chargers,
  - commercial refrigerators,
- Credibility: While Energy Efficiency labels are a positive step (sale of poor performing products will be banned), the applicable materials are limited. Furthermore, the rating applies to energy consumption during operations rather than CO2 emission reduction.

### 2.2.3. Promoting the LED industry

The Korea Energy Management Corporation (KEMCO) has budgeted 1.3 trillion KRW (£737 million) to convert 20% of the lights in public buildings and schools to LED by 2012. The primary motivation is to promote the LED industry but it will have an impact on reducing Korea's carbon emissions. (Source: Korea.kr, Invest Korea Journal March-April 2009 p.10)

### 2.3. Private Industry Plans for Low Carbon Materials

- In October 2010, the Korea Housing Association signed the "Construction material standard agreement" with seven construction companies and six major construction material manufacturers to respond to the government's "Low Carbon Green Growth" policy. The agreement was designed to support the government's initiative as well as to reduce construction costs and time through standardisation of construction materials.
  - Builders – Hyundai E&C, Samsung E&C, GS E&C, Daewoo E&C, Daelim, Hyundai Development, Hanwha E&C,
  - Construction material manufacturers – KCC, LG Hausys, Eagon, Hanwha L&C, SY Steel and Dongbang Novoferm.
- LG Hausys has been proactively promoting the government's system of charging for disposal of construction waste. The goal is to save resources and promote recycling. LG Hausys has signed a voluntary agreement with the Ministry of Environment for recycling profiles (windows & doors) and flooring materials.
- LG Hausys formed a joint venture with Interpane of Germany (HausysInterpane) in September 2009 to strengthen the functional glass business by introducing German technology. LG Hausys is building a factory that will have production capacity of 10,000,000SQMLow-E glass per year.
- KCC, one of the biggest construction material makers in Korea is trying to achieve ISO 14001 Environmental Management System for all its factories. KCC is upgrading the insulation efficacy of its products to reduce building energy consumption.
- Credibility: There is little evidence that private industry is concerned about reducing the carbon impact of building materials.
  - Standards for doors and windows have resisted implementation for decades, primarily because:
    - > The standard practice is to produce windows and doors at the job site rather than utilising standard products.
    - > Even construction doors and windows produced in factories are customised to the specific requirements of their customer.
  - Private companies are focusing on improving the insulating capacity rather than improving the efficiency of production or recycling after demolition. For example
    - > Relatively recyclable aluminium window frames are being replaced by less recyclable PVC because PVC has better insulation capacity.
    - > Glass is being coated to manage sunshine even though uncoated glass is easier to recycle.

## 2.4. UK Company Strengths in Low Carbon Building Materials Sector

- The UK has developed building materials that utilise natural resources or recycled materials resulting in much lower production or recycling costs even if the materials are less efficient in terms of insulation.
  - Limetechnology developed a range of building materials that use lime as an alternative to cement and petro-chemicals.
  - UK companies have developed Hempcrete and Strawbonds building materials manufactured from renewable raw materials.
  - RockTron has developed a means to recycle 100% of ash from coal-fired power plants into minerals for construction, automotive and aerospace applications. RockTron will be the first to establish this type of facility in North America.
  - WRAP, an independent NGO supported the development of a 300g bottle design for the lightest screw cap bottle in the world (greater than 25% reduction).
  - Axion Polymers provides certified recycled plastic polymer raw materials for application in a diverse range of plastic goods.
  - Digital Surface Research developed SolaVeil windows for retrofitting. Glazing can reduce building energy consumption by up to 70%.

## 2.5. Opportunities in Low Carbon Building Materials

- Building Material Technologies: Korean companies would benefit from licensing technologies for manufacture of new building materials made from organic or recycled / recyclable resources. These materials must not be significantly more expensive than their alternatives to be accepted in the market.
- High Priced but Cost Effective Materials: Selling higher priced products is always challenging. If UK companies can present convincing data demonstrating that more expensive construction materials can generate energy savings that have a short payback period, Korean manufacturers and construction companies could be very interested.
- Energy Savings Consulting: ESCOs (energy service companies) that can advise on a range of comprehensive energy solutions including design and implementation of energy savings projects, energy conservation, energy infrastructure outsourcing, power generation and energy supply, and risk management could sell their services to Korean construction companies and materials producers.
- Energy Efficient Materials: Korean companies are overly focused on energy saving materials. Companies that can offer materials or license the manufacture of such materials would be likely to find a market in Korea.

## 2.6. Points of Contact

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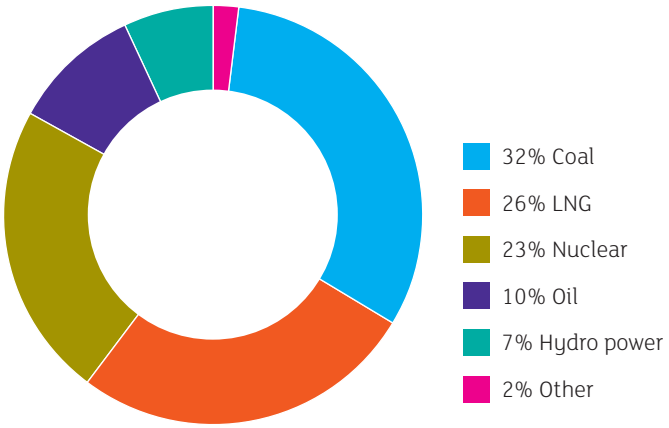
# PART 2:
# NEW AND RENEWABLE ENERGY (NRE)

In 2010, Korea produced 474,660GWh of electricity. This was generated primarily by Coal but also by nuclear, oil & gas, hydro and NRE. NRE accounted for only about 2.6% of total electricity generation in 2010.

**NOTE:** sources are inconsistent on the amount of electricity generated by NRE. KEPCO's data has been used whenever available.

**Korea's Electricity Generation Capacity by Type (2010)**




**Source:** KEPCO

Unit: MW

| Year | | 1980 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Hydro | | 1,157 | 5,485 | 5,492 | 5,505 | 5,515 | 5,525 |
| Thermal | Coal (Domestic) | 750 | 1,125 | 1,125 | 1,125 | 1,125 | 1,125 |
| | Coal (Bituminous) | - | 17,340 | 19,340 | 22,580 | 23,080 | 23,080 |
| | Oil | 6,897 | 6,172 | 6,808 | 6,867 | 7,048 | 7,467 |
| | Gas | - | 17,436 | 17,436 | 17,969 | 17,850 | 19,417 |
| Nuclear | | 587 | 17,716 | 17,716 | 17,716 | 17,716 | 17,716 |
| Alternative | | - | 240 | 351 | 728 | 1,136 | 1,749 |
| **Total** | | **9,391** | **65,514** | **68,268** | **72,491** | **73,470** | **76,078** |

**Source:** KEPCO

The Korean government, like many other governments, has committed to increasing the ratio of energy generated by NRE to 6% by 2020 and 11% by 2030.

# Definition of New & Renewable Energy by the Korean Government

The Korean government defines NRE to include the following technologies:

- Solar photovoltaic
- Solar heat
- Wind power
- Fuel cell
- Hydrogen energy
- Biomass energy
- Waste to energy
- Coal gasification, liquefaction
- Geothermal
- Small hydro-power (less than 10,000 kw)
- Ocean energy (tidal, wave and thermal difference generation)

**Government plan and achievement of NRE ratio to total energy supply**

| Year | 2008 | 2009 | 2010 | 2015 | 2020 | 2030 |
|---|---|---|---|---|---|---|
| Target | 2.48% | 2.80% | 2.98% | 4.33% | 6.08% | 11.0% |
| Achievement | 2.43% | 2.50% | 2.61% | - | - | - |
| Ratio of achievement to the target | 98% | 89% | 88% | - | - | - |

**Source:** Statistics Korea Compiled by IRC

The gap between NRE generation and target NRE generation is deteriorating. A 2011 parliamentary inspection of the administration revealed that between 2004 and 2009, the administration has spent only 61% of the budget it had targeted for NRE.

The inspection also revealed the target achievement rate of NRE in 2010 as follows:

- Solar heat: 73%
- Solar photovoltaic: 120%
- Wind power: 80%
- Biomass: 75%
- Small hydro: 82%
- Geothermal: 78%
- Waste to energy: 90%
- Total: 90%

The inspection further revealed an imbalance in budget allocation. The budget plan called for 40% of the total budget to be spent on generating electricity including solar photovoltaic, wind power, small hydro and fuel cells, with the balance and the rest of the 60% allocated to the heat sector including solar heat, biomass, waste to energy, geothermal and others. However in practice, 80% of the budget was spent on electricity and only 20% on heat.

# Government Policy

**General Subsidy Programmes (since 1994)**
The Korea government subsidises 50% of the installation costs of NRE systems (both electricity and heat generation) to encourage NRE deployment and to reduce the end user's cost burden.

**Local NRE Deployment Programme (since 1996)**
Local governments implement eco-friendly NRE deployment programmes suitable to the local situation for public buildings and social service facilities as well as private homes in remote areas. Central government supports regional governments up to 50% of total cost.

**Mandatory use for public buildings (since 2004)**
New construction, expansion and remodelling of public buildings with a floor area exceeding 3,000 square meters must allocate at least 5% of their total construction expenses to the installation of NRE systems.

Implementation: The government and public organisations invested 778 billion KRW (£ 440 million) while private organizations invested 3,879 Billion KRW (£ 2.2 billion) for production and R&D in new & renewable energy in 2010.

**Renewable Portfolio Standards (RPS, from 2012)**
The major power generation companies are obliged to generate a certain portion of their total energy from new and renewable sources. These companies include: Korea Hydro & Nuclear Power Co., Ltd., Korea District Heating Corp., Korea South-East Power Co., Ltd., Korea Midland Power Co., Ltd., Korea Western Power Co., Ltd., Korea Southern Power Co., Ltd., Korea East-West Power Co., Ltd., K-Water, POSCO Power, K-Power, GS EPS, GS Power and MPC Yulchon Generation.

**Required NRE Generation Obligation:** Ratio of NRE to Non NRE

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 2.0% | 2.5% | 3.0% | 3.5% | 4.0% | 5.0% | 6.0% | 7.0% | 8.0% | 9.0% | 10.0% |

**Weighted value:** In order to influence the types of NRE, for purposes of calculating the RPS, the following weights are assigned. Thus, one KW of photovoltaic installed in a land based farm is equivalent to .7 KW while 1 KW of photovoltaic installed on a roof is equivalent to 1.5 KW.

| | Weighted Value | Type | Land type | Capacity |
|---|---|---|---|---|
| Photovoltaic | 0.7 | On Fields, Paddies, Orchards, Farm, Forest | | |
| | 1.0 | On other types of land and greater than 30 kw | | |
| | 1.2 | On other types of land and greater <= 30 kw | | |
| | 1.5 | On existing facilities such as building roofs | | |
| Others | 0.25 | Coal gasification, liquefaction | | |
| | 0.5 | Waste, landfill gas | | |
| | 1.0 | Hydraulic power, Wind farms on land, PDF power generation, waste gasification generation, tidal power with sea wall | | |
| | 1.5 | Tree biomass generation, Offshore wind farms (within 5km of grid) | | |
| | 2.0 | Offshore wind farms (More than 5 km from grid), tidal power without a sea wall, fuel cell | | |

# Sector 3: Renewable Energy – Waste to Energy

### 3.1. Overview

Waste to energy strategies are focused primarily on disposing of waste rather than creating energy. It is increasingly difficult to dispose of waste in landfills due to a shortage of land and objections of local residents. Furthermore, disposing of food waste by dumping it into the sea will be prohibited from 2013. Thus, alternatives must be developed.

Waste is converted into fertiliser and fuel. The fertiliser from food waste is perceived to be of low quality so farmers refuse to apply it even when it is provided free of charge. Therefore, the focus has shifted to creating fuel from waste. Waste can be incinerated directly to create energy or can be used to create fuel; either methane or other gasses extracted from landfills or RDF (refuse derived fuel – large pellets for burning). Local citizens remain opposed to locating waste treatment facilities in their communities as it is perceived to reduce land values (due to odour and inconvenience).

### 3.2. Government Plans for Waste to Energy

The Ministry of Environment has announced plans for the construction of Waste and Biomass to Energy facilities and allocated 3 trillion KRW (£1.7 billion) over the period of 2009 to 2020. The Facilities, Quantity of Waste and Budget Allocated for Waste to Energy are presented in the Appendix on page 33.

### 3.3. Private Industry Plans for Waste to Energy

- Korea Midland Power, one of the 13 major GENCOs will build a cogeneration plant using Refuse Derived Fuel (RDF) that will generate 9.8 MW of electricity. The plant is also expected to generate 75tons of heat/hour which will be sold to 9 petrochemical factories near the power plant. Total revenue from the plant is expected to be 26.5 billion KRW (£ 15 million) per year. The cogeneration plant will burn only RDF.

**Source:** Maeil Business Daily "RDF Power Plant at January 2012" 26 April 2011

- SK Innovation, an energy development and petrochemical company is already saving 75,000 kl of bunker C-oil and has reduced 112,000 tons of CO2 per year by recycling steam and waste heat from its factories. SK Innovation is developing commercial manufacturing technology for "CO2 plastic" which is plastic made from the CO2 captured at factories.
- Kumho Petrochemical is focusing on recycling industrial waste to reduce its carbon footprint. Kumho Petrochemical developed technology utilising waste tyres as fuel for cogeneration plants. Based on the technology, Kumho Petrochemical is trying to establish a waste resource recycling network with neighbouring companies in an industrial park to provide industrial waste, waste heat and by-products to each other.

## 3.4. UK Company Strengths in Waste to Energy

The UK has developed new technologies for shredding and mixing waste with combustible materials to facilitate incineration of municipal waste without pre-sorting.

**Industry Examples of UK Capabilities**

ENER-G Natural Power collects and captures methane from landfills and organic waste. The company bores into landfills, extracts the gasses and converts them into electricity. ENER-G employs anaerobic digestion (AD) to generate energy from sewerage & food waste. The firm also collects and converts natural methane emissions from abandoned coal mines. All three of these technologies have application in Korea.

Adnams brewery uses technology to reduce environmental impact:

- Recovers 100% of heat from brew to heat the next batch.
- Uses only 3.1 litres of water to produce 1 litre of beer compared to industry average of 8:1.
- Developed a light weight bottle (500 ml bottle reduced from 445 g to 299 g).
- Built a passively cooled distribution centre using: 'hemcrete' walls (lime & hemp), green roof, rainwater catchments and glulam wood beams.
- Uses solar collector gas boiler (reduced gas use by 58% and electricity by 67%).

Closed Loop Recycling converts 35,000 tons of PET and HDPE waste each year and turns it into food-grade packaging.

Balcas converts surplus raw materials from timber suppliers into bio-fuel pellets (called Brites).

## 3.5. Opportunities for Waste to Energy

- Technical Expertise for Waste to Energy: Korean waste to energy technology is only about 60% the level of global technology (Seoul Economic Daily "Establish Recycling Society" 13 September 2011). The UK has clearly demonstrated expertise in this area that could be applicable.
- Attractive Design of Waste to Energy Facilities: Korea suffers from NIMBY opposition from citizens. Designs for waste to energy facilities that would be attractive and minimize objection from local residents would be very welcome. UK engineers and architects able to make these facilities into parks or recreation areas would make a significant contribution.
- Technology for Efficient Conversion of Food Waste to Fertiliser: Converting food waste to fertiliser is a very low margin business. If the UK can deliver technologies to implement this process effectively and at low cost, there would certainly be interest.
- Enhancement of Fertiliser made from Waste: Local farmers shun fertiliser made from food waste. Technologies to improve the quality of this type of fertilizer would probably have a market.
- Waste to Bio-Mass / Bio-gas: Technology for converting waste bio-mass to bio-gas would likely be attractive.

## 3.6. Points of Contact

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## 3.7.
## Appendix for Waste to Energy

### Facilities

| Year | 2009 | 2010 - 2013 | 2014 - 2020 |
|---|---|---|---|
| **Combustible waste to energy** (units: facilities – tons of energy production per day) | | | |
| Refuse Derived Fuel (RDF) Manufacturing facilities | 1 (80) | 20 (5,455) | 29 (7,855) |
| Furnace for combustible waste | | 6 (2,180) | 10 (2,830) |
| Facility for converting construction waste to fuel | | 1 (500) | 3 (4,000) |
| **Organic waste to energy** | | | |
| Organic waste to fuel facilities | 2 (360) | 21 including 17 (3,168) gasification of food waste, livestock manure & sewage sludge | 28 bio gasification facilities (5,638)<br>4 sewage sludge facilities (2,770) |
| **Other** | | | |
| Heat generated by incinerators (Gcal / Year) | 43 (6.4 Million) | 17 (410,000) | 24 (430,333) |
| Collection of landfill gas (Million $m^3$ / Year) | - | 25 (92) | - |

### Quantity (by 2013)

| | | Total | Landfill sites | Energy town* | Stand-alone Facilities |
|---|---|---|---|---|---|
| Combustible waste to fuel (Thousand tons / Year) | RDF | 1,636 (100%) | 360 (22.0%) | 1,035 (63.3%) | 241 (14.7%) |
| | Other solid fuels | 130 (100%) | 130 (100%) | - | - |
| Organic waste to fuel (Thousand tons / Year) | Bio gas | 1,045 (100%) | 264 (25.3%) | 409 (39.1%) | 372 (35.6%) |
| | Solid fuel | 831 (100%) | 690 (83.0%) | 117 (14.1%) | 24 (2.9%) |
| Capturing waste heat (Thousand Gcal / Year) | - | 411 (100%) | - | - | 411 (100%) |
| Landfill gas (Thousand $m^3$ / Year) | Generation | 68,429 (100%) | - | 7,128 (10.4%) | 61,301 (89.6%) |
| | Refinement | 23,760 (100%) | 14,256 (60%) | - | 9,504 (40%) |

* Energy Town is a model complex with sustainable recycling with waste to energy facilities. The Ministry of Environment is the main authority for the project.

**Allocated budget:** 3 Trillion KRW (£1.7 billion, by 2020)

| Billion KRW | Total | Sub-total | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 - 2020 |
|---|---|---|---|---|---|---|---|---|
| Total | 2,986 | 2,168 | 160 | 466 | 598 | 483 | 462 | 818 |
| Combustible | 1,917 | 1,306 | 70 | 194 | 349 | 325 | 367 | 611 |
| Organic | 974 | 782 | 75 | 263 | 230 | 140 | 73 | 192 |
| Incineration heat | 53 | 383 | 4 | 3 | 9 | 9 | 14 | 15 |
| Landfill gas | 42 | 418 | 11 | 5 | 9 | 8 | 9 | 0 |

**Source:** Ministry for Food, Agriculture, Forestry and Fisheries "Implementation Plan of Waste and Biomass to Energy".

# Sector 4:
# Renewable Energy – Solar

### 4.1.
### Overview

- Solar energy is the most developed of NRE technologies. The Korean government has historically provided the greatest support for the solar photovoltaic industry more than other new & renewable energy technologies.
- The global solar energy market has become highly competitive. Module makers seem to be the most competitive.
- The primary market in Korea for solar power is the major GENCOs who are obliged to install 190 MW each to meet RPS targets. GENCOs will only consider turn key projects with 20 year performance guarantees effectively limiting their suppliers to large companies.
- A major obstacle to development of the local market is the unpredictability of electricity prices under the RPS system.
- Currently, the local market is not attractive due to limited government subsidies so Korean firms are focusing on overseas markets.
- Korean government programs are aimed at helping private Korean companies become competitive in the global solar industry (more than achieving carbon targets).
- The solar power generation industry in Korea is driven by price per nominal capacity while performance (generation) is relatively unimportant. Focus is on price competitiveness. Lack of focus on performance allows weak players to survive.
- Early solar farms (up to 2009) were established on mountains and fields resulting in reduced vegetation. This has been widely criticised as being 'non-Green'. Subsequently, the government has discouraged installation of solar farms on mountains and in 'natural areas' by reducing the subsidies while simultaneously increasing the subsidies for solar panels on roofs by 50%. (The 'weight' for power generation subsidies for mountains was reduced from 1.0 to 0.7 while the 'weight' of panels installed on roofs of building was increased from 1.0 to 1.5.)
- Strengths of Korean Companies in the Solar Industry
  - Korean semiconductor and display manufacturers utilise technology similar to the manufacturing of photovoltaic cells.
  - Korea is strong at auxiliary parts such as distribution boards, wires and IT.

### 4.2.
### Government Plans for Solar Power

The government has set a target of achieving 15% market share in the global Solar Power market by 2015. By component, targets for global market share are as follows:

Units: Market share of global market

| Year | 2009 | 2012 | 2015 |
|---|---|---|---|
| Poly silicon | 14% | 18% | 18% |
| Ingot / Wafer | 7% | 12% | 12% |
| Cell | 4% | 8% | 15% |
| Module | 4% | 9% | 15% |

**RPS – Solar**

- The Korean government has set minimum solar energy generation targets for the GENCOs as follows (separately from RPS for general NRE)

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Obligation (GWh) | 263 | 552 | 867 | 1,209 | 1,577 | 1,557 | 1,577 | 1,557 | 1,577 |

- Companies that fail to achieve this level of generation will be obliged to pay a fine equivalent to 150% of the average price of NRE certification.

### 4.3.
### Private Industry Plans for Solar Power

- Many solar power suppliers are feeling management pressure to grow their business and export to overseas markets to survive.
- Given the challenging business environment, local developers are relying on affiliated companies for opportunities.
  - GS Neotek, an affiliate of the GS Group, depends heavily on GS Caltex projects. GS Caltex announced that they would install solar panels on the roofs of their gas stations. At the end of 2010, solar panels on GS Caltex gas stations were generating around 300 ~ 500 KW per year.
  - POSCO Plantec plans to wait until the focus on price subsides and the market returns to normal. In the interim, they are focusing on overseas markets such as Indonesia.
  - KEPID is focusing on new business such as ESCO rather than solar energy.
- Ssangyong Cement is reviewing their plan to establish a solar farm at its exhausted mine at Youngwol-Gun in Gangwon-Do. Ssangyong Cement favours installing a solar farm because it is easier to build deep in the mountains where there are no residents and it offers a better return than alternative remediation projects. (Mine owners in Korea are required to 'restore' the site after the mine is exhausted.)
- Korea Southern Power plans to develop the largest capacity solar farm in Asia (65 MW) on the roofs of the Busan New Port warehouses by 2016. They started in 2011 with a pilot 120 KW project on the roofs of container freight stations to determine the most efficient technology for the site. (Korea Southern Power is one of the 13 power generation companies that is obliged to produce new & renewable energy.)

### 4.4.
### UK Company Strengths in the Solar Power Sector

Solar power is a minor source of renewable energy in the United Kingdom. In April 2010, the UK instituted a feed-in tariff, offering at least 36p per kW·h. In its first year, 77.8 MW of photovoltaic capacity was installed – three times as much as in the previous year, but still only representing 0.1% of total electricity production. As of August 2011, about 200 megawatts (MW) of solar photovoltaic capacity has been installed in the UK, capable of producing about 200 gigawatt hours (GW·h) per year. Effective 12 December 2011, the UK's FIT on installations up to 4Kw have been halved leading to a sudden drop in new orders for solar systems.

UK solar technology excels at roof-top systems with very few ground based systems installed in the country. Latest technology is integrating PV into building materials, eg. adding solar film to roof tiles. Efficiencies of 20% ~ 24% have been achieved in the UK.

**UK strengths are as follows:**

- Well-developed financial system to back up solar business in the UK.
- Massive potential in the UK for domestic, commercial and public sector applications for solar power.
  - Derry Newman, chief executive of Solarcentury, argues that the UK's "famously overcast weather" does not make it an unsuitable place for solar power, as solar panels work on daylight, not necessarily direct sunlight.
  - Well-developed low carbon systems such as "BREEAM" generate demand for new and renewable energy.
- The world's largest PV manufacturer, Sharp Solar, has a facility in Llay near Wrexham in Wales.
- G42i is building (2007) the world's first commercial scale dye sensitized TiO2 module plant.

**Industry Examples of UK Capabilities:**

Sharp Corporation has a long history of involvement in the solar power industry, beginning research and development into solar energy in 1959 and commencing the mass-production of solar cells in 1963.

Sharp sees massive potential in the UK for domestic, commercial and public sector applications for solar power, which was one of the main reasons why it chose North Wales as the site for its European manufacturing base. Officially opened in July 2004, the Wrexham facility assembles monocrystalline and polycrystalline solar modules for residential and commercial installations.

Commercial projects completed via Sharp's authorised distributor, Solarcentury, have included supplying PV panels as part of a complete solar power generation system on a new Tesco petrol station in Nottinghamshire and a large social housing project owned by the Peabody Trust in King Cross, London and the CIS Tower in Manchester.

### 4.5.
### Opportunities in the Solar Power Sector

- Sales of Technology: Korean firms are highly dependent on foreign patents suggesting a good market for technical licenses.
- Joint Development of Solar Projects in Asia: Korean solar companies are eager to work with foreign players to obtain financial stability, technology and access to foreign markets. UK companies looking for partners in Asia would likely find Korean firms receptive to cooperation.
- Production Base: Korean companies sell modules for 1,300 KRW / WP while the global price is more than double at 2,900 KRW / WP. This suggests that Korea could be a competitive production base for sale of modules to neighbouring countries.
- Joint Sales to Korean GENCOs: Foreign companies who want to supply solar voltaic projects to the GENCOs must establish local production. Because the market is driven by the GENCOs who will only accept turn key projects with long guarantees, established UK companies could partner with smaller local players by lending credibility to the consortium.

### 4.6.
### Points of Contact

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# Sector 5: Renewable Energy – Wind

## 5.1. Overview

- Wind power is likely to offer the greatest number and scale of opportunities for UK companies in Korea.
- Korea's wind power development is driven by shipbuilding (heavy industry) firms such as Samsung, Hyundai, Daewoo and STX which are considered to be reliable. They all have outstanding engineering and manufacturing capabilities requiring similar disciplines so they will have no difficulty producing the systems. Falling profitability of their core shipbuilding businesses may however make capital funding a challenge. They have all pledged to support the government's offshore wind farm projects. There are very few public objections to off shore wind projects.
- Currently, the shipbuilders are in the process of obtaining certification for their components and systems from relevant bodies.
- One of the main drivers for the heavy industry companies' development of windmills is the desire for diversification in the face of a downturn in the shipbuilding industry. If the industry picks up again or if another alternative is identified, the focus on windmills may possibly wane causing some of the players to withdraw from the industry.
- The Government is providing support by providing test beds for construction of offshore wind farms.
- The key challenges to Korea's windmill and wind farm development plans are commercial / competitive. The Korean players are entering the field much later than their European counterparts and need to close a large technical gap very quickly. Korean suppliers have no sales references / track record to demonstrate their capabilities to customers so the first few sales could be very difficult (hence the government's 'test bed' projects).
- Onshore wind: Korea is very mountainous providing many opportunities for on-shore wind power. However, the locations are far from population centres. Companies wishing to install on-shore windmills often encounter opposition from local residents.
- Small wind, in contrast to off-shore wind, is dominated by SMEs. Poor performance, frequent malfunction, and inadequate (unresponsive) maintenance have tarnished the image of small wind in Korea. Performance has seldom achieved commitments resulting in investor disillusionment and customer opposition.

## 5.2.
## Government Plans for Wind Power

- Offshore Wind farm Roadmap:
  - Vision: Korea intends to become one of the Top 3 countries in the windmill industry
  - Timeline:
    - > Technology development: 5 MW offshore windmill by 2012
    - > Test trial: Construct 100 MW (20 X 5MW) test offshore windmill farms off the west and south coast of Korea by investing 400 billion KRW (£ 227 million) by 2013
    - > Demonstration: To construct 400 MW demonstration offshore windmill farm by 2015 investing 1,600 billion KRW (£900 million)
    - > Development: To construct 2,000 MW commercial offshore wind farm by 2019 investing 8,193 billion KRW (£ 4.6 billion)
  - System: Joint investment by central government, regional governments and private companies. KEPCO will be responsible for the grid connection recovering its investment through sale of electricity.
- Onshore Test trial Wind Farm:
  - Youngheung: South East Power will build a 30 MW wind farm at Youngheung Thermal Power Site on Youngheung Island near Incheon.
  - Saemangeum: Jeonbuk province will invest 75 billion won (£42.7 million) to build a 40MW wind farm near the Saemangeum reclamation area by 2014.

**Source:** Energy & Environment News "South East Power Co. to complete the largest windmill farm in Youngheung" MKE "New & renewable Energy Growth Strategy" October 2010, Green Growth Korea.

## 5.3. Private Industry Plans for Wind Power

- Offshore Wind Development Plans:
  - The major heavy industry (shipbuilding) companies are developing turbines for offshore wind mills as follows:
    - > Hyundai Heavy Industries: 5MW by 2011.
    - > Samsung Heavy Industries: 5 ~ 7 MW by 2012.
    - > STX Heavy Industries: 7~8 MW by 2012.
    - > Doosan Heavy Industries: Completed 3 MW turbine.
    - > DSME: announced a 7 MW turbine.
- Onshore Wind farm Plans:
  - The Samsung Group signed a 7.6 trillion KRW (£4.3 billion) MOU with the government to build a "Green Energy General Industrial Complex" in Saemangeum that includes windmill, solar cell and fuel cell manufacturing facilities between 2021 and 2025.
- Windmill Development Plans:
  - STX Heavy Industries plans to have its STX 93 windmill certified by the end of 2011 and will develop a 2MW low speed windmill in 2012. It will begin development of an offshore windmill by 2015.
  - Unison was the first company in Korea to install windmills (Vestas systems). Currently, they produce a 750 KW, gearless windmill. They are now developing a 2 MW model and will develop 5 a MW windmill by 2014.
- Wind Farms:
  - Halla Windpower: Halla Windpower plans to construct a 100 MW offshore wind farm with Korea Midland Power, POSCO Power and Korea District Heating Corp. east of Jeju Island by 2014.
  - STX Heavy Industries will participate in the government's offshore wind farm project from its inception and Unison will join in 2014.

## 5.4. UK Company Strengths in Wind Power

The UK is currently in the "3rd Round" of wind power deployment. The lessons learned during the first two rounds have generated valuable expertise that will help achieve maximum effectiveness and efficiency in future deployment. For example, the Scroby Sands project, designed for a 20 year life, required replacement of 100% of its generators and most gearboxes involving 1500 service visits in just 3 years. UK has developed know how in the areas of integrity, monitoring, fatigue valuation, design, etc.

UK expertise includes construction and deployment, connection to grid, environmental impact assessments and wind assessments.

UK companies are developing vertical wind turbines with alternative rotors (locating generators at ground level significantly reducing risk as well as installation and maintenance costs).

North Sea oil & gas expertise has been utilised to develop new solutions for harsh offshore conditions: drive-trains, power systems, composites, subsea cables, anchoring platforms, vibration and stress analysis, environmental impact for off shore wind farms.

UK has 14 OSW farms with capacity of >1.5 GW and plans to have 65 GW installed by 2020.

**Industry Examples of UK Capabilities:**

"Small Wind" – 22 'small wind' manufacturers (out of 255 globally) including the 3rd largest in the world combine to make the UK a successful exporter of small wind turbines.

NAREC (New and Renewable Energy Centre in Blyth in the north of England) is the UK's largest centre for developing, testing and commercialising wind energy. The centre specialises in developing the next generation of offshore wind technology including a facility for testing wind turbine blades up to 100 meters long. NAREC is seeking business for its offshore wind test bed from Korean turbine manufacturers who are seeking international certification.

SgurrEnergy is providing engineering advice to the US's most advanced offshore wind farm development – the Cape Wind Project.

SeaEnergy Renewables will cooperatively develop and market turbine jacket substructures, towers and access systems with a Chinese state owned company.

## 5.5. Opportunities for Wind Power

- Technical Cooperation in Developing Offshore Wind Farms: Korean heavy industry companies are late entrants in the development of windmills while the UK has a long history of experience. At the same time, Korean companies have strong offshore capabilities due to their background in shipbuilding and off-shore oil & gas vessel production. UK companies willing to share their technology could have a good opportunity to co-develop off shore wind projects. On a cautionary note, there is a strong Korean preference for developing local knowhow and independently taking full control of technology.
- Parts & Services Supply: The UK is currently and will continue to be in the near future the largest market for off-shore wind farms. Round 3 off-shore wind power targets installations greater than 15 meters. This will trigger needs for larger new turbines and new installation methods. To meet its ambitious off-shore wind power deployment targets, the UK will need to boost its supply chain which could present opportunities for Korean manufacturers. (Existing turbine manufacturers combined with new entrants will make the sector highly competitive.) Participation in Round 3: If Korean wind generation system suppliers wish to participate in the 3rd Round UK offshore wind initiative, it will be essential to establish operations in the UK to win business.
- Wind mill blades in Korea: Korea currently has only one supplier of wind mill blades – KM. The market would be strengthened by competing suppliers.
- Partnering for Installation of Offshore Wind Farms: Korean windmills need to establish a proven track record through successful operation of test beds. As a leader in offshore wind farm development, Korean firms could benefit from cooperating with UK companies for installation in the North Sea.
- Certification: Korean windmill turbine manufacturers are in the initial stage of development and will require certification from globally recognised firms such as GL, DEWI OCC and DNV.
- Grid Connection: The UK is strong in grid connection, a skill that in not part of the core competence of Korean heavy industry companies.
- Training: Korea will need to train manpower to manufacture, install, operate and maintain off shore wind farms. UK organisations able to provide this training could capitalize on the massive investment in this industry in Korea.
- Consulting on "Test Bed" deployment: The Korean government is planning several 'test beds' to provide Korean suppliers with practical references for off-shore wind farms. UK experts could take part in the project by advising / consulting with government authorities and private companies. Carefully recording appropriate parameters of performance data for off-shore wind farms will be needed.
- Consulting on Wind quality analysis: Particularly in low wind speed environments like Korea, wind quality analysis is particularly important.
- Small Wind: Small wind turbines are produced only by small sized companies with questionable reliability and credibility. They have not been well received due to poor performance, frequent malfunction, and inadequate (unresponsive) maintenance. Performance has seldom achieved the promised levels resulting in investor disillusionment and opposition. UK companies who can strengthen this sector would have a significant opportunity.
- Supply Chain: The UK has an outstanding supply chain for parts, components and systems for wind power. Korean companies could tap into this supply chain by setting up a production facility or a buying office in the UK.

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# Sector 6:
# Renewable Energy – Wave

### 6.1.
### Overview

Wind power is likely to offer the greatest Korean scientists are experimenting with several different wave energy technologies. All research is still in the initial, pre-commercial stage. Koreans have registered more than 200 patents related to wave power technologies. There is general acknowledgement that UK is strong in this sector.

The waves in Korea average only 1.5 to 2 meters (compared with global average of 3 to 4 meters and maximum of 7 to 8 meters). Wave 'power' is also weak with the most powerful waves (near Jeju) reaching 12 ~ 13 KW compared to 30 ~ 40 KW in the North Sea.

Some wave power generation technologies generate concern due to their impact on shipping channels but generally, the environmental concerns are limited.

### 6.2.
### Government Plans for Wave Power

The Ministry of Land, Transport and Maritime Affairs has allocated a budget of 33.2 Billion KRW (£18.8 million) for wave power R&D through 2020 allocated across 4 alternative technologies (so the research budget for each technology is very limited).

- The Korea Ocean Research & Development Institute (KORDI), a government institute, successfully carried out its 1st test operation of a 150 W facility near Jeju Island in 2006 and is preparing for its 2nd test operation, a 500 KW facility (10.5 Billion KRW, £6 million) facility at another location in Jeju.
- Naval Operation Base in Jeju: By far the biggest investment in wave power is the 1.6 trillion KRW (£900 million) plan to build two 100kw "caisson breakwater" wave power facilities in Jeju between 2012 and 2021.

**Credibility of Government Initiatives:**

- Government support of developing wave power is relatively weak compared to investment in others alternatives such as solar, wind, geothermal or tidal power.
- There is some public criticism against the government for failure to play a leading role in wave power in spite of many ideas, experiments and prototypes.
- There is little (or negative) public awareness of the potential for wave power but there is no public debate regarding environmental issues.

**Bird's Eye View of Naval Operation Base in Jeju**
**Source:** Photo News

### 6.3.
### Private Industry Plans for Wave Power

Most of the activities in Wave power are taking place at universities and research organisations. However, two projects have been identified during this project:

- Samcheok Green Power Complex Generation Park is a 5.9 trillion KRW (£3.3 billion) thermal power plant project being carried out in Gangwon Province by Korea Southern Power. The project will utilise a combination of wave power, CCS, offshore wind power and will generate 1000 MW by the end of 2015.
- Taekyung Industry Co., Ltd signed an MOU with Kyungnam University in July 2010 to carry out a demonstration study of an oil pressure wave power facility.

### 6.4.
### UK Company Strengths in Wave Power

The UK boasts:

- 25% of the world's wave and tidal patents
- 23% of world's wave technology
- 24 universities focused on marine energy

**Industry Examples of UK Capabilities:**

- NAREC is the world's only independent company involved in all aspects of marine technology.
- Wave Hub is an electrical hub on the seabed 16 KM from coast of Cornwall. It is linked to the grid network by a 25 KM undersea cable (weighing 1300 tons and carrying 11kV).
- US based Ocean Power Technologies is developing and testing its innovative Power Buoy wave energy device 33 nautical miles from Invergordon, Scotland.

### 6.5.
### Opportunities for Wave Power

- Durability: Wave energy generators are subject to severe environmental conditions and are often lost or destroyed. An experimental wave power generator near Pohang was damaged soon after installation. The UK has experience in severe sea conditions. There should be opportunities for consulting on developing durable systems.
- Generator Development: Researchers are working on several technologies for capturing wave energy. However, they will require new types of generators to convert the wave energy into electricity.
- Energy density: Given that Korean waves generate only 12~13 KW (compared to 30 ~ 40 KW in the North Sea), Korea will require unique technology to capitalise on weaker waves.
- Wave size: Given that Korean waves average only 1.5 to 2 meters (global average is 3 to 4 meters) Korea will require unique technology to capture energy from smaller waves.
- Water proofing: Wave driven generators will be located in severe, wet locations. The piston has air in it and needs to keep the air so it needs to be water proof. Electrical connections also need to be water proof.

### 6.6.
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# Sector 7: Renewable Energy – Tidal

## 7.1. Overview

Tidal power is attractive due to the relatively large scale and the predictability of tidal movements and the reliability of the power that can be generated. The large scale civil engineering involved in tidal power also generates appeal due to job creation and economic stimulus. The major disadvantage of tidal power is the negative impact on the costal ecology.

### Tidal power

- Sihwa Lake tidal power plant was completed and began operating in 2011. Sihwa Lake was initially intended to provide fresh water to farms around the lake. However, the project failed and the water became severely polluted. The initial plan was abandoned in 1998 and the lake was restored to sea water in 2001. It was converted to a tidal power generation project which was completed in 2011.
- While the Sihwa Lake tidal power plant faced limited challenges (as it was built utilising an existing seawall) the other four plans, Asan bay, Ganghwa Island, Garorim bay and Incheon bay are facing strong opposition from environmentalists, civic groups and political parties.

### Tidal currents

- Korea first tidal current power plant was established by KORDI at Uldolmok in 2011. The agreement was that Korea East-West Power would take over operations upon completion but KEWP has refused to purchase the facility and it has been suspended. KEWP claims that operating the facility would cost more than the value of the power generated.
- The Ministry of Knowledge Economy excluded tidal current power from the RPS weighted value list suggesting that the government does not plan to provide support for tidal current power. Rather, according to industry insiders, the Korean government is focusing on tidal power which provides better economics and generates a larger economic impact compared to tidal current power.
- UK expertise in building and operating tidal power plants is not recognised in Korea.

## 7.2. Government Plans for Tidal Power

The Ministry of Land, Transport and Maritime Affairs has allocated 27.9 Billion KRW (£15.8 million) for R&D into tidal power and 49.5 billion KRW (£28 million) for tidal current power from 2001 to 2020.

A MLTM insider suggested that the MKE should increase the weighting awarded to tidal current facilities in the RPS system. He added that the "Uldolmok tidal current project was technically successful but that commercialisation and expansion of the facility depended entirely on government support for the project.

### 7.3.
### Private Industry Plans for Tidal Power

There are 5 major tidal power projects as follows. Most are designed to capture water during rising tide and release it during falling tide to generate electricity.

| | Capacity | Subject | Type | Fund (Bil. KRW) | Period |
|---|---|---|---|---|---|
| Asan Bay | 200 MW | Korea Midland Power | Ebb | 783 | NA |
| Ganghwa Island | 81 MW | KHNP, GSE&C | Ebb | NA | NA |
| Garorim Bay | 520 MW | K-Water | Ebb | 1,022 | 2011~2014 (Not sure) |
| Incheon Bay | 1,320 MW | East West Power, Daewoo Engineering | Ebb | 3,900 | 2012~2017 (Not sure) |
| Sihwa-Lake | 254 MW | Korea Western Power, POSCO | Flood | 355 | Completed (2003 ~ 2011) |

- Tidal power generation has been facing major opposition from environmental groups such as the Korea Foundation for Environmental Movements and the National Council for Cancelling Tidal Power Generation as well as some politicians. These groups claim that tidal power should not be considered a new & renewable energy due to its negative impact on the eco-system.
- The government has expressed its intent to proceed with tidal power plants but the planned construction of the Garolim Bay Tidal Power Plant in Chungnam province had to be delayed due to strong opposition from civic and political groups.

### 7.4.
### UK Company Strengths in the Tidal Power Sector

- The UK boasts 27% of world's tidal developments.
- High tides in Scotland are a good environment for tidal power development and deployment.
- UK off-shore oil & gas skills are applicable to installation of tidal current systems due to similarities of environment.
- A Delta Stream tidal energy harnessing device was created at the Low Carbon Innovation Centre at the University of East Anglia.
- An array of 10 tidal turbines, the first and largest in the world, will be installed on the seabed in the channel between the islands of Islay and Jura on the west coast of Scotland producing 10 MW of electricity.
- One Korean expert interviewed for this project recognised UK superior turbine design and control technology but felt that grid connection technology was weak.
- Strathclyde University in the UK has been working with Inha University and commercial partners on the dynamics of tidal flow and the operational parameters impacting on tidal device performance. This research is being used by tidal farm developers in Korea to position turbines in new tidal projects.

### 7.5.
### Opportunities for Tidal Power

- Cooperative Technical Development: Tidal systems are still in the 'pre-commercial' stage. KORDI is responsible for researching the feasibility of tidal power including selecting the location, capacity, generation type and other technical research. UK groups interested in tidal power should partner with KORDI for cooperation in the Korean market.
- Developing Tidal Turbines: Doosan and Hitachi have the required technology to design turbines for tidal power applications. However, the turbines (low-head bulb type) are imported from China because manufacturing them is labour intensive. Other parts and designs are from Austria. UK companies that can assist Korean firms to build turbines for tidal applications would have opportunities in Korea.
- Cooperative Construction: Korean construction companies are competent builders and have sufficient know how to build tidal power plants.

### 7.6.
### Points of Contact

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# Sector 8: Smart Grid

## 8.1. Overview

The traditional electric grid was relatively simple, designed to transmit electricity in one direction from a small number of large power generation plants to a large number of distribution points where it is transformed to required voltage levels for industrial, commercial and domestic consumers. In a 'low carbon, renewable energy' environment, the grid must be more flexible and controllable to accommodate a large number of small scale, intermittent and fluctuating power sources, changing patterns of demand (e.g. charging electric vehicles) and electricity flowing in both directions. The Korean Government is very enthusiastic about implementing a smart grid system in Korea because;

- Government considers smart grid is the sector that Korea can make the best use of its IT and electric technology.
- Smart grid can generate new service industries such as energy management services, energy storage services, electric vehicle charging services, virtual power plant's and so on.
- Smart grid can generate new manufacturing business such as IT, communication technology, control technology, software, battery, advanced metering infrastructure (AMI), electricity convert system and other new & renewable energy equipment.

The Korean government is preparing a "5 Year Basic Plan for Smart Grid" that will be announced at the beginning of 2012. The 5 Year Basic Plan for Smart Grid is likely to include regulations for new businesses, financial support for households to replace old household appliances with 'smart' appliances and introduce variable electricity rated linked to real-time supply and demand.

Korea is developing a test bed in Jeju province called the Roadmap to Smart Grid which will be utilised to develop a nationwide system.

The Korean government sees the smart grid system as a tool for energy security.

Korea's smart grid is principally focused on ICT and the new services a smart grid can provide. The driver is the export of smart home appliances and smart meters.

Korea's power distribution relies on highly efficient, high voltage transmission. As a result, there is lower interest in smart power distribution.

## 8.2. Government Plans for Smart Grid

The Korean government is investing in smart grid demonstration projects leveraging the country's ICT strengths to become the leader in smart grid technologies such as smart meters (AMI – advanced metering infrastructure), Demand Response (DR) technologies, Real Time Pricing (RTP), Energy Management Systems (EMS), energy storage infrastructure (including sensors), electric vehicles and home gateways. The comprehensive 'Roadmap' for Smart Grid is presented in the Appendix on page 47.

## 8.3. Private Industry Plans for Smart Grid

Big companies such as POSCOICT, KEPCO, KT, SK Telecom, LG Industrial Systems (LG U+) are actively participating in the government's smart grid project. For a comprehensive overview of private industry participation in the Jeju Smart Grid Test-bed Project, please refer to the Appendix on page 49.

## 8.4.
## UK Strengths in Smart Grid

There are many consortia and initiatives in the UK addressing the smart grid and issues of a rapidly expanding, decentralised power grid with local and micro generation. The UK has implemented many grid access technologies over the first two rounds of wind power development. The emphasis of micro photovoltaic systems on rooftops has also provided experience in feeding into the grid. The UK leads Europe in smart grid applications.

UK key strengths are in:

- Smart meters
- Design of smart grids
- Regulatory / legal framework related to smart grids
- Advanced transmission monitoring control
- Communication infrastructure
- Advanced distribution network components
- Distribution automation
- Cyber security

## 8.5.
## Opportunities for Smart Grid

Manufacturing: Korean companies would make good partners and suppliers for parts and components for the smart grid. They can produce high quality parts for a reasonable price with rapid delivery. Particularly products that include an ICT component would be attractive such as components for:

- Smart grid apps and infrastructure
- Smart grip operations
- Smart grid communications and network services
- Smart meter design and manufacture
- Meter installation & maintenance
- Smart meter communication network services
- DCC applications and infrastructure
- DCC operations
- HAN device design & manufacture
- IHD design and manufacture

Innovative Business Model: The traditional Korean electricity market is vertical and integrated by sole electricity provider, KEPCO. Korea needs to change the market structure to respond to variable needs by implementing a Smart Grid. UK technology companies could support the redesign of delivery and pricing to match supply and demand by taking a system wide approach to the problem.

Jeju Test Bed: There are opportunities to share test bed data and possibly participate in Korea test bed consortia (the Jeju test bed is one of the largest projects of its kind in the world) although up until now Korean test beds have involved mostly Korean companies.

### Opportunities for Korean companies in the UK

Access to Europe: UK is relatively advanced in Europe and could provide a platform for penetrating the European market. In particular, UK is advanced in Smart Grid and Smart Metering.

The UK's transmission networks are in need of upgrade in areas such as:

- cables
- substation equipment
- offshore platforms
- pylon construction
- underground tunnel construction
- control systems
- sensors
- data management systems related services
- low voltage transformers
- communication equipment and installation services

## 8.6.
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## 8.7.
## Appendix for Sector 8: Smart Grid

Roadmap for Smart Grid

| Implementation by Phase | First Stage (2010 ~ 2012) "Construction and operation of the Smart Grid Test-bed for technical validation" | Second Stage (2012 ~ 2020) "Expansion into metropolitan areas" (Intelligent consumers) | Third Stage (2021 ~ 2030) "Completion of a nationwide power grid" (Intelligent power grid) |
|---|---|---|---|
| Smart Power Grid | • Real-time power grid monitoring<br>• Digital power transmission<br>• Operate optimal distribution system | • Predict failure risk in power grid<br>• Connect the power grid with that of other countries<br>• Connect the power delivery system with distributed generation and power storage devices | • Self-recovery of power grids<br>• Operate an integrated energy Smart grid |
| Smart Consumer | • Power management of intelligent homes<br>• Various choices for consumers including rates | • Smart power management of buildings / factories<br>• Encourage consumer power generation | • Zero energy homes and buildings |
| Smart Transportation | • Build & test electric vehicle charging facilities<br>• Operate electric vehicles as a pilot project | • Expand electric vehicle charging facilities across the nation<br>• Effective maintenance and management of electric vehicles | • Make the presence of charging facilities commonly available<br>• Diversify charging methods<br>• Utilise portable power storage devices |
| Smart Renewable | • Operate microgrids by connecting distributed generation, power storage devices and electric vehicles<br>• Expanded utilisation of power storage devices and distributed generation | • Optimal operation of the power system with microgrids<br>• Expand the application of power storage devices | • Make renewable energy universally available |
| Smart Electricity Service | • Consumers' choice of electricity rates<br>• Consumers' selling of renewable energy | • Promote transactions of electrical power derivatives<br>• Implement real-time pricing system nationwide<br>• Emergence of voluntary market participants | • Promote various types of electrical power transactions<br>• Promote convergence for the market of electricity-based sectors<br>• Lead the power market in Northeast Asia |

**Authority: Ministry of Knowledge Economy**

**Objectives by stages**

- 2012: test bed system in one city
- 2020: wide area system across a large metropolitan area
- 2030: Establish smart grid system in nationwide

**Fund**

- Total: 27.5 Trillion KRW (£15.7 billion)
  - Source:
    - > Private: 24.8 Trillion KRW (£14.1 billion)
    - > Public: 2.7 Trillion KRW (£1.5 billion)
  - Purpose
    - > R&D: 7 Trillion KRW (£4 billion)
    - > nfrastructure: 20.5 Trillion KRW (£11.7 billion)

**Five strategic Objectives**

- Smart power grid:
  - Creating open electricity networks linking suppliers and consumers with varying demand profiles while facilitating new business models
  - Insure reliable, high-quality power supply by establishing systems to forecast grid failure and facilitate automatic recovery
- Smart place:
  - Rationalising energy consumption creating a comprehensive and interactive energy management system based on Automatic Metering Infrastructure (AMI)
  - Adopting smart meters and AMI to reduce peak loads by increasing the use of 'smart electronics' that respond to changes in electricity rates to manage demand load.
- Smart Transportation
  - Establishing charging infrastructure across the nation in cooperation with electric vehicle makers
  - Establishing a "Vehicle to Grid" system in which electric vehicles are charged when electricity rates are low and sell power back to the grid when the rates are high
- Smart Renewables
  - Building infrastructure that can stably connect renewable energy sources (which usually generate power intermittently and have poor power control) to the existing grid
  - Making energy self-sufficient Green Homes, Zero Energy Buildings and Green Villages
- Smart Electric Services
  - Establishing diverse energy pricing schemes to provide consumers with a wide-range of options
  - Providing a variety of value-added electricity services through the application of ICT and to set up a real-time electricity trading system in which electricity and the derivatives are exchanged

**Jeju Smart Grid Test bed**

- Objectives
  - To build the world's largest comprehensive test bed to test the output of R&D and demonstrate new smart grid technology
  - To lay the groundwork for commercialising and exporting smart grid technologies, while strengthening Korea's position as a smart grid leader

**Source:** Korea Smart Grid Institute, Korea Smart Grid Association

**Consortia for Jeju Smart Grid Test-bed Project**

| Strategic Area | Leading Company | Participating companies |
|---|---|---|
| Smart Place | SK Telecom | 28 companies including Iljin Electric, Samsung Electronics, EN Technologies, LH and Hyundai Heavy Industries |
| | KT | 15 companies including Hyosung, Samsung SDI, Omni System, Digital Ocean and KETI |
| | LG Electronics | 13 companies including LG Chem, GSE&C, LG U+, M.A.T., Omnipas and PSTEC |
| | KEPCO | 37 companies including LS Cable, Namjun, Nexus, Nuri Telecom, Taihan Electric Wire and Songam |
| Smart Transportation | KEPCO | 21 companies including KEPCOKDN, LS Industrial Systems, Lotte Data Communication, PNE Solution and Sejin Electron |
| | SK Energy | 14 companies including Byucksan Power, EN Technologies, KODI-S, CT&T and Renault Samsung |
| | GS Caltex | 7 companies including KT, Nexcon Technology |
| Smart Renewable | KEPCO | 16 companies including Hyosung, Kokam, Nexcon Technology, SUDO Electric and KOSPO |
| | Hyundai Heavy Industries | 6 companies including SK Telecom, SK Energy and KERI |
| | POSCOICT | 6 companies including LG Chem, Daekyung Engineering and KIER |
| Smart Electricity Service | KPX | 7 companies including LG Industrial Systems, KERI, Bitek Information & Communication and Wooam |
| Smart Power Grid | KEPCO | 13 companies including KPX, Wooam, LS Industrial Systems, KEPCOKDN and Byucksan Power |

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