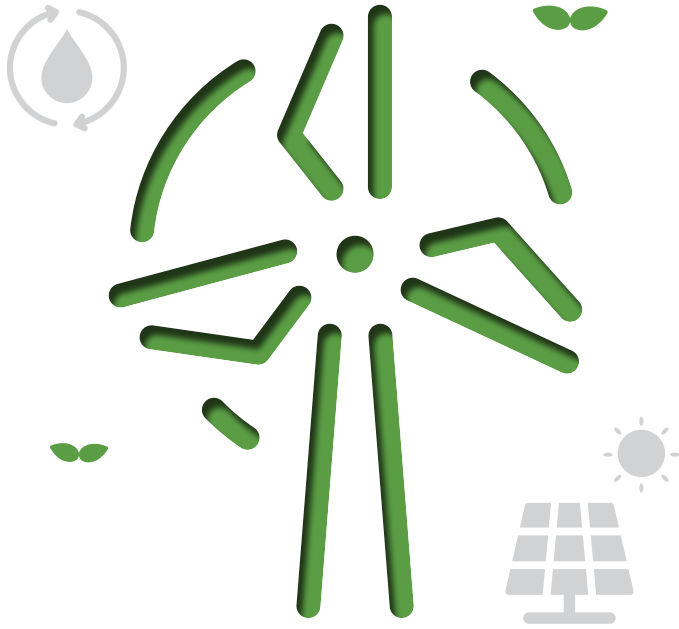
KOTRA자료 17-066

INVEST KOREA

INVESTMENT
OPPORTUNITIES
IN KOREA

NEW & RENEWABLE ENERGY



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Most figures in this report are converted from KRW into USD based on yearly average exchange rates. But growth rates (e.g. CAGR and YoY growth rate) are calculated based on KRW to prevent any distortion caused by changes in exchange rates.

Global Link to Success, **Invest KOREA**

INVESTMENT OPPORTUNITIES IN KOREA

NEW & RENEWABLE ENERGY

01 INDUSTRY OVERVIEW

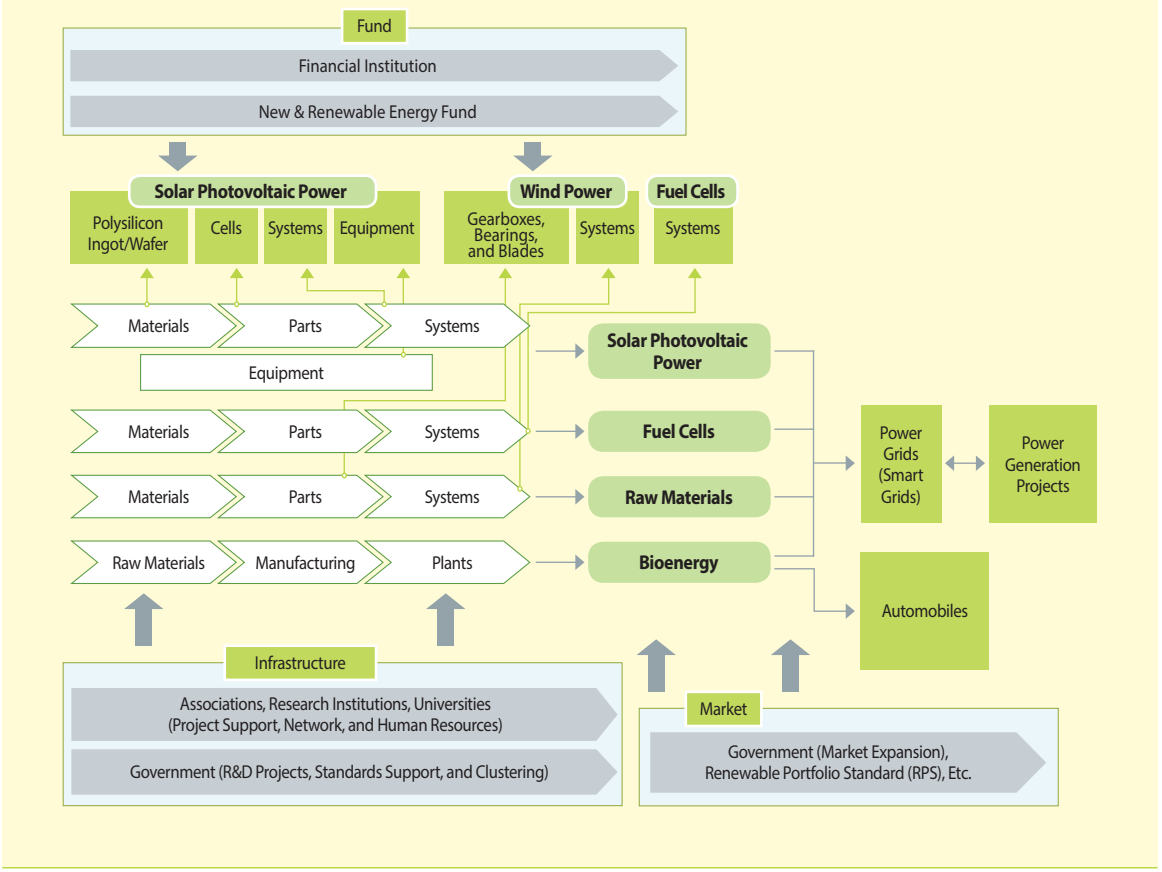
Definition of the Industry

Definition and Industrial Ecosystem

The new and renewable energy industry is comprised of 11 categories, largely divided into new energy and renewable energy.

- New energy includes three items: hydrogen, fuel cells, and the gasification of coal and heavy residual oil. Renewable energy includes photovoltaics (solar heat), bio, wind power, hydraulic power, marine, waste, and thermal heat.

Concept Map of the Ecosystem of the New & Renewable Energy Industry



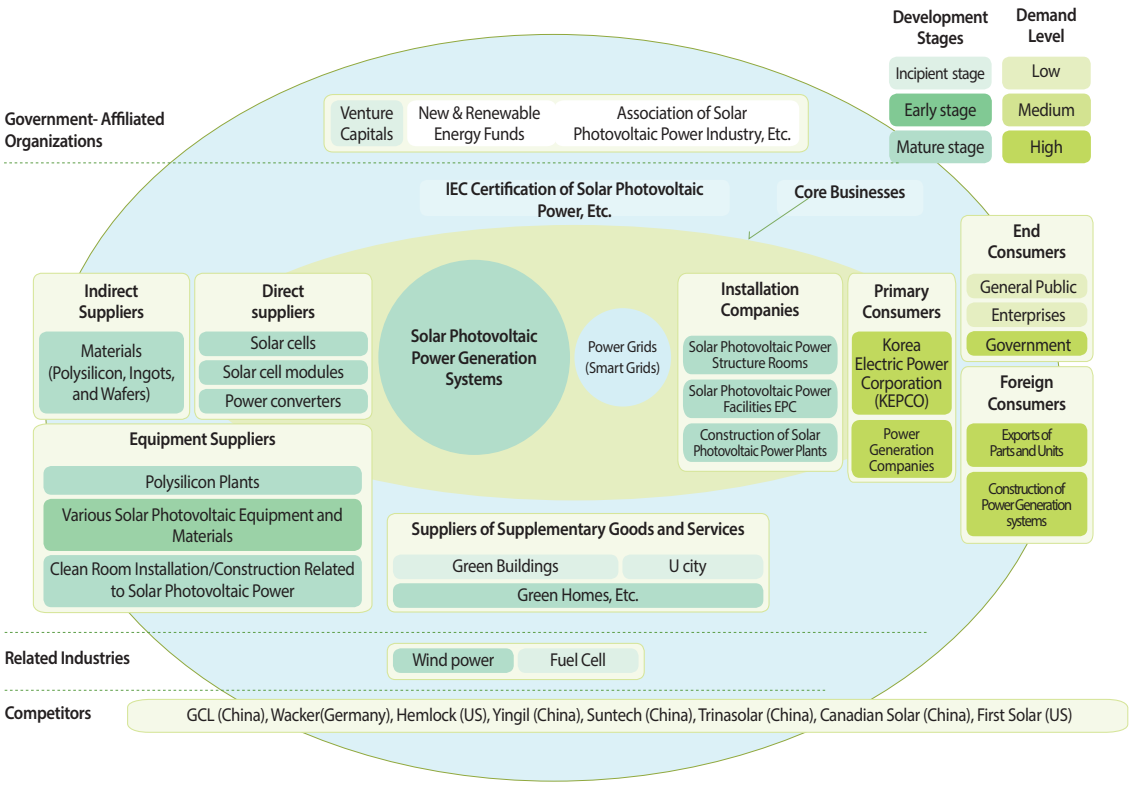
Source: Research on New Growth Engines and Ways to Promote Them, 2010, Korea Institute for Industrial Economics and Trade (2010)

Solar Photovoltaic Power, Wind Power, and Fuel Cells

For photovoltaics, the core business area is a photovoltaic power system. The structure of the system connects a system operator and a domestic demand group, which consists of direct consumers including the Korea Electric Power Corporation and indirect consumers, including the public, through power grids.

- This system forms a business ecosystem, in a broad sense, where there is an overseas consumer group for the export of each parts and materials unit and system; suppliers of related equipment for demand purposes; green buildings for complementary goods and relevant industries; and certificate authorities including the International Electrotechnical Commision (IEC).

The Value Chains and Ecosystem of the Photovoltaic Business

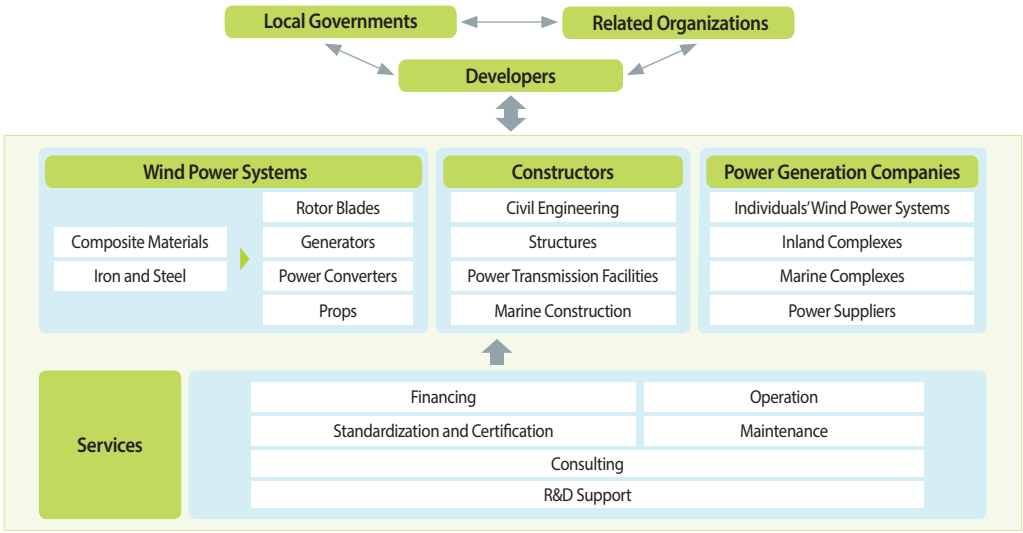


Source: Research on the Promotion of the Industrial Ecosystem of New Growth Engines, Dec. 2011, Korea Institute for Industrial Economics and Trade (2011)

The wind power industry is related to the construction industry that builds the wind power system and development projects.

- It has a business ecosystem where private developers, local governments and government institutions order projects with the support of external service providers that handle the industry's financial, authentication, consulting, research and development (R&D) affairs, operation and maintenance.

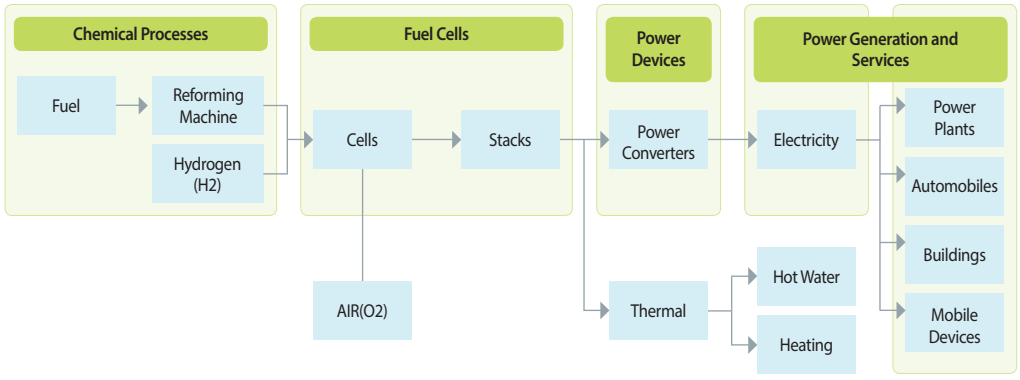
Value Chains and Ecosystem of the Wind Power Industry



Source: Approaches to the Creation of an Industrial Ecosystem for the Co-survival and Development of Large/Small/Medium Enterprises in the New & Renewable Energy Industry, Apr. 2012, Korea Institute for Industrial Economics and Trade

In the case of fuel cells, heat and electricity are produced through a fuel battery system composed of cells and stacks. The heat is supplied to consumers as energy for hot water and air/floor heating and electricity is supplied to power generation plants, automobiles, buildings and mobile devices.

Structure of the Value Chain of the Fuel Cell Business



Source: Approaches to the Creation of an Industrial Ecosystem for the Co-survival and Development of Large/Small/Medium Enterprises in the New & Renewable Energy Industry, Apr. 2012, Korea Institute for Industrial Economics and Trade (2012)

Status of the Industry

Global Demand

Recently, global demand for new & renewable energy has shrunk a little due to unfavorable situations, such as the curtailment of subsidies in many of the EU market leaders that are suffering economic recessions.

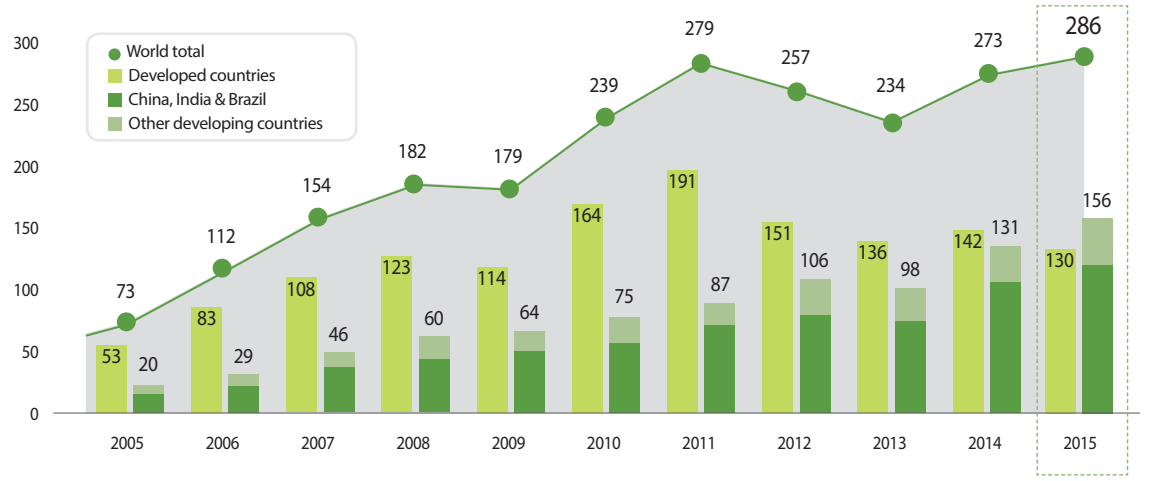
- The significant decline in costs for photovoltaic modules, etc., has sparked a downward adjustment in the amount of support.
- As seen in the example of Australia, there are local governments that are not favorable to the new & renewable energy business.
- As proven by the example of the EU and the United States, local governments that are in financial trouble are trying to constrain their overall government budgets. This results in the scaling down of related support.

The shale gas reform in the United States continues to drop global oil prices, which has negative effects on the possibility of a demand hike.

Despite low oil prices, however, the amount of global investment in the new and renewable energy industry stood at USD 286 billion in 2015. Its global production also increased by 20% YoY in 2015, showing signs of recovery.

Global Trends in Renewable Energy Investment (2005–2015)

(USD billion)



Source: REN21, Renewables, Global Status Report (2015), 2016

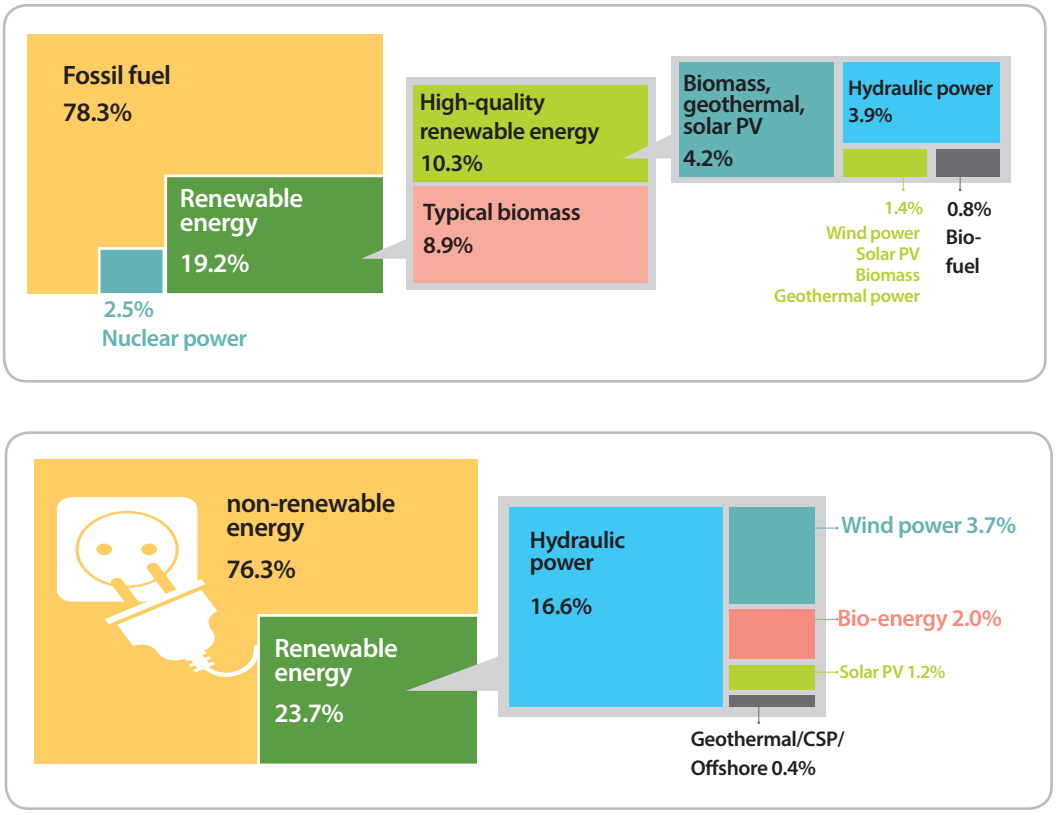
Global Supply

Chinese corporations are taking up nearly 70% of the intermediate market, including cells and modules, based on their larger capacities and lower costs. This is partly because of lower access barriers in almost all processes, except for some of the materials and parts.

In contrast, players in the advanced world are bellying up one after another, which is accelerating price competition in the global supply market rather than competition for technologies. Meanwhile, trade barriers, including anti-dumping duties, are fueling the increase of costs that mostly result from the overseas relocation of factories.

China and advanced countries seem to be engaged in a trade war. Europe and the US are imposing anti-dumping and countervailing tariffs against China, for fear that the country dominates the global market with its cost competitiveness and large-scale supply capabilities supported by the government.

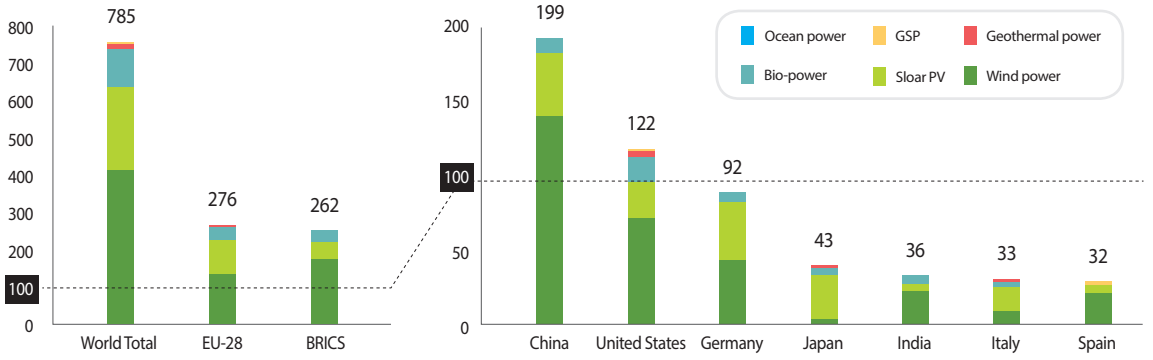
Share of New & Renewable, and Primary Energy in Power Generation



Source: REN21, Renewables, Global Status Report (2015), 2016.

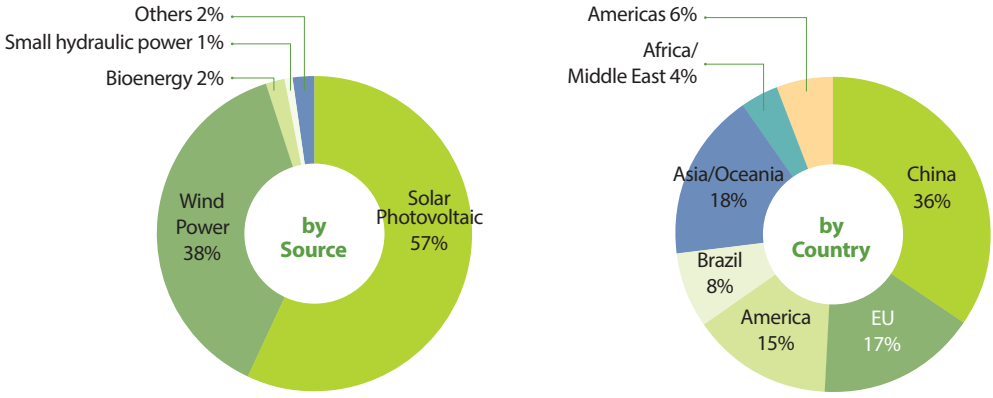
Renewable Power Capacities in World, EU-28, BRICS, and Top Seven Countries (2015)

(GW)



Source: REN21, Renewables, Global Status Report (2015), 2016

Investment Proportion in New & Renewable Energy by Source and Country (2015)



Source: REN21, Renewables, Global Status Report (2015), 2016

Status of the Korean New & Renewable Industry

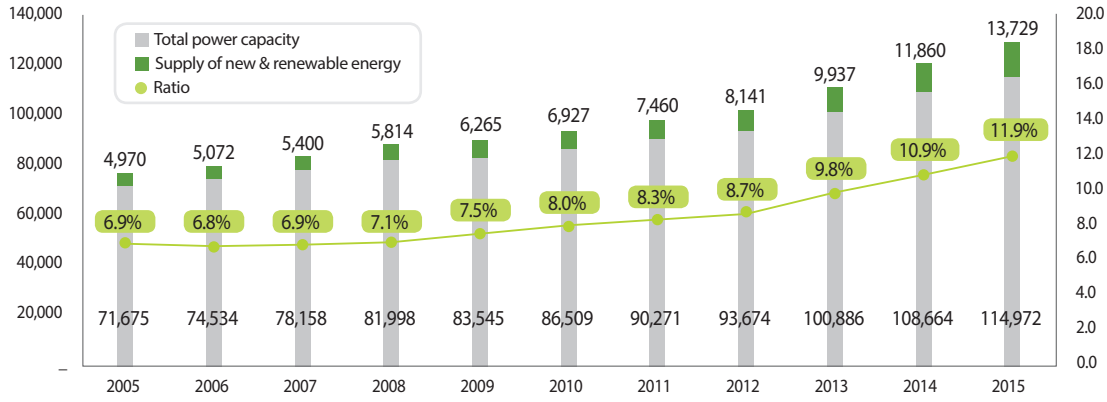
Trends in Supply

The total supply of Korea's new and renewable energy recorded 13,729MW in 2015, showing a 98.2% increase from 6,927 MW in 2010.

- The ratio of new and renewable energy's power capacity to the country's entire power generation increased by 3.9%p from 8.0% in 2010 to 11.9% in 2015.

The Supply of New & Renewable Energy Compared to Total Power Capacity

(MW, %)



Source: Korea Energy Agency (KEA) (2016), 2015 Supply of New and Renewable Energy, (Nov. 2016)

Trends of Providers

From 2004 to 2015, the number of new and renewable providers in Korea increased by 9.7 times; employment by 22.5 times, sales by 79 times, export by 64 times, and investment by 12.5 times.

- Korea's new and renewable industry has primarily been developed with the growth of photovoltaics and wind power. Photovoltaics and wind power now accounts for 34% of the industry's employment, 74% of investment, 80% of sales and 97% of exports.

However, the global new & renewable energy industry is going through a restructuring process due to global economic contraction and oversupply, which has, in turn, significantly withered Korea's new & renewable energy industry.

Major Indicators of Korea's New & Renewable Energy Industry

(no. of enterprises, employees, USD million)

Classification	2004	2005	2010	2011	2012	2013	2014	2015	CAGR (2004–2015)
Number of Enterprises	49.0	59.0	209.0	225.0	200.0	245.0	485.0	473.0	25.8%
Number of Employees	716.0	1,317.0	13,149.0	14,563.0	11,836.0	11,962.0	15,707.0	16,131.0	36.2%
Sales Revenue	138.2	277.8	8,241.6	9,995.7	5,133.0	6,453.4	8,924.9	9,815.1	53.1%
Export	61.8	146.3	4,226.7	5,096.7	2,057.2	2,236.2	2,839.3	3,537.1	45.9%
Investment	61.8	146.3	3,804.0	4,895.8	1,099.6	1,810.2	770.2	692.0	25.8%

Source: New & renewable energy Center of Korea Energy Agency (KEA), The Statistics of the new & renewable energy Industry (Annually)

The proportion of photovoltaics in the entire new & renewable energy industry has increased significantly since 2007. Furthermore, a large number of SMEs have joined related businesses to contribute to the creation of an ecosystem for each value chain.

Competitiveness of the Industry

The overall technical level of Korea's new & renewable energy industry is 81.7% on average, which is about 10%p less compared to that of the advanced countries, including the EU, the United States and Japan. However, it is about 5%p higher than that of China.

- In the eleven areas, the technical capacity of Korea's new & renewable energy industry is generally 10-17%p points behind that of the advanced countries and 1-7%p ahead of that of China.

For each energy source, the technological capacity in photovoltaics, hydraulic and bio is close to that of advanced countries, but is substantially behind in wind power and thermal heat.

- As for the top technologies in the eleven new & renewable energy sources, Europe has ten of them and Japan has one in the fuel cell area.

Technical Capacity of New & Renewable Energy Industry by Major Countries

(%)

Category	US	Japan	Europe	China	Korea
Photovoltaics	92.2	93.1	95.7	81.2	85.1
Wind power	91	90.3	96.1	77.2	80
Hydrogen	93.7	92	94.4	77.6	80.8
Fuel Cells	92.5	92.8	92.3	71.4	78.7
Coal Liquidation/Gasification	92.5	90	94.1	80.3	80.4
Hydraulic power	93.1	93.6	96.8	82.1	84.7
Marine	91.8	90.1	94.4	76.6	81.1
Bio	92.6	91.9	95.9	80.4	83.9
Geothermal	92.6	91.9	95.1	77.5	78.3
Solar Thermal	92.1	90.6	96.2	79.7	82
Waste	89.9	92.5	96.2	76.9	82.4
All New & Renewable Energy	92	91.8	95.1	77.8	81.7

Source: Plans for the analysis and expansion of tech achievements of new & renewable energy, June 2013, Korea Energy Economics Institute (2013)

The localization rate of new & renewable energy in Korea is 76.9% and 68.4% in terms of technologies and markets, respectively. The localization rate of photovoltaics and bio is high but very low in fuel cells.

- The gap between the localization rate for technologies and markets in hydraulic, wind, fuel cell, thermal heat and waste energy is wide. In this regard, Korea's technological prowess is secure but market competitiveness is insufficient.

Tech Localization Rate of Each New & Renewable Energy Type in Korea

(%)

Category	Tech level [A]	Market [B]	Average [C]	A-B
Photovoltaics	79.4	71.8	75.6	7.5
Wind power	75.9	66.4	71.2	9.5
Hydrogen	76.2	68.8	72.5	7.3
Fuel Cells	73.4	63.7	68.6	9.7
Coal Liquidation/Gasification	75	68.4	71.7	6.6
Hydraulic power	80.5	68.4	74.5	12.1
Marine	75.6	70.4	73	5.2
Bio	78.7	70.6	74.7	8
Geothermal	75	65.2	70.1	9.7
Solar Thermal	77.6	70	73.8	7.6
Waste	78.3	68.7	73.5	9.5
All New & Renewable Energy	76.9	68.4	72.6	8.5

Source: Plans for the analysis and expansion of tech achievements of new & renewable energy, June 2013, Korea Energy Economics Institute (2013)

Korea's domestic dissemination rate of new & renewable energy is low, which may lead to future growth opportunities.

- As of 2014, the share of photovoltaics and wind power was 0.7%, lower than those of Denmark (42.8%), Germany (15.0%), and the US (4.9%).
- Korea is at a budding stage in the following areas; the deployment of new energy technologies such as Energy Storage System(ESS) in manufacturing facilities like smart factories, the establishment of basic infrastructure like Advanced Metering Infrastructure (AMI), and the creation of new ICT-convergence businesses.

Although Korea has only a few examples of foreign market entry through cooperation with companies that have track records, the country has accumulated experience with its demonstration projects including Jeju Smart Grid Demonstration Project and Gapado Self-Sufficient Energy Island Project

Prospect for the Industry

Korea's new & renewable energy industry is now mainly led by photovoltaics, replacing wind power that had been driving the industry's growth until the late 2000s. However, the solarvoltaics segment is likely to go through the second round of restructuring process worldwide, after the first one led by China in the late 2000s induced by the global financial crisis.

According to the Export–Import Bank of Korea, despite the recent upward trend in the global photovoltaics (PV) industry, concerns are rising over the second round of restructuring process caused by heightened competition in facilities expansion.

- This is because PV enterprises are planning to begin full-fledged operations by the second half of 2016.

In particular, Chinese solar photovoltaic power companies are expected to aggressively expand their facilities.

- As for the first restructuring process in the early 2010s, PV companies from advanced countries (mainly Europe), were the ones who lost ground in the market. However, the second restructuring process, which will take place after 2017, is likely to threaten the survival of Asian companies such as those from China, Taiwan, and Korea.

Chinese SMEs are likely to be subject to the restructuring process, with their low factory utilization rate of less than 70%.

Meanwhile, the global photovoltaics installment in 2017 is expected to be 64GW, down 11% from 72GW in 2016.

- In particular, the global polysilicon production already reached 480,000 tons in the first half of 2016, which is 80,000-ton over the global demand. In the midst of the slowdown of the global PV market, China's expanded production of polysilicon to increase its domestic share will exacerbate the oversupply issue.

As for Korean PV companies, OCI and Hanhwa Chemical Corp. seemed to recover from their recent sluggish businesses, thanks to the increased selling price of polysilicon in the second half of 2016. However, the two companies fell short of the break-even point, because the selling price recently dropped to under USD 15 per kilogram.

- The decline in the demand for the two firms may aggravate the overall management conditions faced by domestic polysilicon manufacturers.
- Accordingly, these two companies need to boost their performances in areas other than PV (e.g. OCI: petrochemical and carbon material products, Hanhwa Chemical Corp: chemical) to offset the limited progress in the PV segment.

Korea's wind power industry will be revitalized, as the government plans to fully implement the Southwest Offshore Wind Power Project in 2017.

- The purpose of the project is to install offshore wind power complex (demonstration complex 60MW, pilot complex 400MW, proliferation complex 2,000MW) across Wido Island, Buan and Anmado Island, Yeongkwang by 2022, to significantly improve track records and industrial competitiveness.

Development Plan for Southwest Offshore Wind Power Project

Classification	Verification Complex	Pilot Complex	Expanded Complex
Purpose	To build an offshore test bed	To secure a track record	To develop large-scale complexes
Scale	60 MW (3 MW × 20 units)	400 MW (5 MW × 80 units)	2,000 MW (5 MW × 400 units)
Period	–2018	2018–2020	2020–2022
Construction Cost	KRW 425.6 billion	Approximately KRW 2 trillion	-
Supervisor	Korea Offshore Wind Power	Korea Offshore Wind Power	Private enterprises, KEPCO, power generation companies

Source: Korea Offshore Wind Power

02 LOCATIONAL COMPETITIVENESS

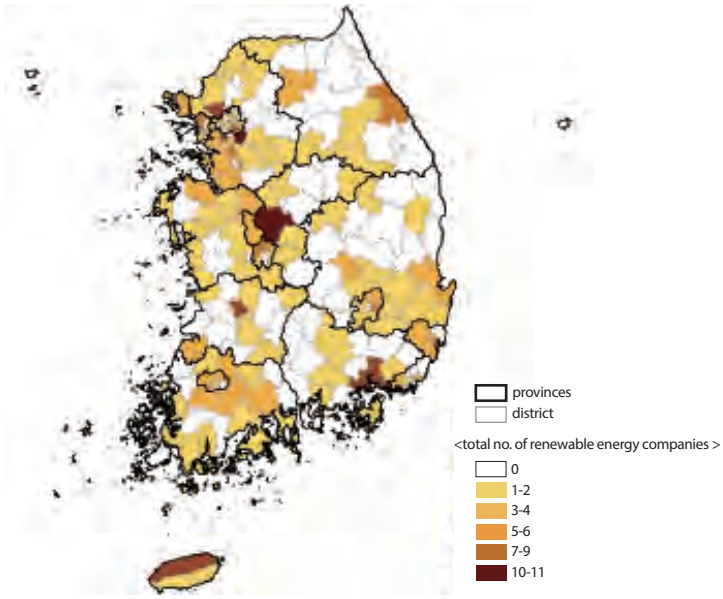
Locational Status

Distribution of New & Renewable Enterprises

In Korea, new and renewable energy clusters have been formed around the capital area Chungcheong-do (Cheongju-Cheonan-Sejong), Jeollanam-do (Gwangju), Jeoallabuk-do (Jeonju), Busan and Gyeongsangnam-do, Gyeongsangbuk-do (Daegu-Ulsan) and Jeju.

The government's policy support to foster specialized industries has led to the formation of new & renewable energy clusters in most regions, except for the capital area which was not a subject to the central government's support.

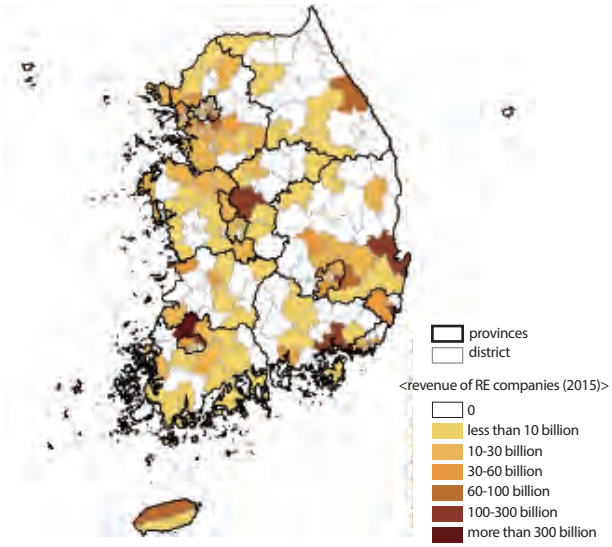
Distribution of Enterprises in the New & Renewable Energy Industry



Concentration of Sales

The sales of new and renewable energy industries are also concentrated in the capital area, Chungcheong-do (Cheongju-Cheonan-Sejong), Jeollanam-do(Gwangju), Jeollabuk-do (Jeonju), Busan and Gyeongsangnam-do, Gyeongsangbuk-do(Daegu-Ulsan-Pohang) and Jeju.

Sales Status of New & Renewable Energy Industries (2015)



Distribution of photovoltaics enterprises by value chain

Korean solar photovoltaic power companies have an imbalanced structure in each value chain. For example, some large companies have global competitiveness in polysilicon (a photovoltaic material).

Distribution of PV Enterprises by Value Chain (Apr. 2016)

(polysillicon-ton, others-MW)

Region	Polysilicon	Ingots	Wafers	Cells	Modules
Captial area (1)					30 (1)
Incheon (1)					20 (1)
Kwangju (2)				45 (1)	100 (1)
Daejon (4)		1,000 (1)	500 (1)		370 (2)
Gyeonggi-do (2)		150 (1)	130 (1)		
Chungcheongbuk-do (8)				2,520 (3)	2,720 (5)
Chungcheongnam-do (2)					230 (2)
Jeollabuk-do (4)	52,000 (1)	1,750 (1)	1,750 (1)		600 (1)
Jeollanam-do (3)	25,000 (2)				80 (1)
Gyeongsangbuk-do (7)				1,180 (2)	1,290 (5)
Ulsan (1)	13,000 (1)				
Gyeongsangnam-do (0)					
Total (35)	90,000 (4)	2,900 (3)	2,380 (3)	3,745 (6)	5,440 (19)

Source: Jeonghwa Kang (2016), Trends of the Solar Photovoltaic Industry in 3Q 2016, The Overseas Economics Research Center, Export–Import Bank of Korea (Oct. 14, 2016)
Note : ( ) refers no. of enterprise. Multiple producers exist.

Locational Conditions and Benefits

Regional Specialized Industries

Under the Regional Industry Promotion Plan, the government has designated specialized industries for each region, which are subdivided into focus industries and cooperation industries.

- In particular, the government has designated new & renewable energy projects for focus and cooperation industries in Daegu, Gwangju, Ulsan, Chungcheongbuk-do, Chungcheongnam-do, Jeollanam-do and Gyeongsangbuk-do.

Designation of the Focus and Cooperation Industries by City/Region

Region (No. of Industries)	Key Industries (63)					Industries of cooperation likely (16)		
Busan (11)	Intelligent machinery and parts	Super-precision convergence parts	Mold heat treatment	Bio-health	Digital contents	Shipbuilding and marine plants	Automotive parts	Functional high-tech textile
Daegu (11)	Precision forming	**Smart dispersed energy system**	Material-based bio-health	Medical devices	Smart knowledge service	Automotive convergence parts	Intelligent machinery	Functional high-tech textile
Daejon (11)	Wireless communication convergence	Medi-bio	Robot automation	Intellectual property services	Metal finishing	Functional chemical materials	Photoelectronics convergence	Intelligent machinery
Kwangju (11)	Smart home appliances	Biomedical materials and parts	Composite molding	Design	Super-precision manufacturing/ processing systems	Ecofriendly automobiles	**Materials/parts for energy conversion/ storage**	Photoelectronics convergence
Ulsan (11)	Ecofriendly gasoline automobiles/ parts	Precision chemistry	Shipbuilding equipment/ materials	**Energy parts**	Environment	Automotive convergence parts	Nano-convergence parts	Shipbuilding and marine plants
Sejong (4)	Automotive parts	Biomaterials				Machinery parts		
Gang won-do (9)	Wellness food	Ceramic new materials	Sport knowledge services			Bioactive materials	Medical devices	LOHAS health care
Chung cheong buk-do (10)	Semiconductors	Biomedicine	Electrics/ electronics parts	**Solar photovoltaic**	Power-based machinery/ parts	Cosmetics and beauty	Secondary battery	Medical devices
Chung cheong nam-do (11)	Automotive parts	Printing electronics	Animal/plant medicine	Digital contents	Display	**Secondary battery**	Machinery parts	Functional chemical materials
Jeolla buk-do (11)	Machinery parts	Functional health food	Marine facilities/ equipment/ materials	Forming of light materials	Composite textile materials	Ecofriendly automobiles	Materials/parts for energy conversion/ storage	Bioactive materials

Region (No. of Industries)	Key Industries (63)					Industries of cooperation likely (16)		
Jeolla nam-do (10)	Metal materials finishing	Petrochemical-based high-molecular materials	Biofood	**Energy facilities**		Bioactive materials	Shipbuilding and marine plants	Nano-convergence parts
Gyeong sang buk-do (11)	Mobile convergence	Digital devices/parts	**Energy materials/ parts**	Forming and finishing	Functional biomaterials	Automotive convergence parts	Intelligent machinery	Functional high-tech textile
Gyeong sang nam-do (11)	Intelligent manufacturing machinery	Machinery materials/ parts	Aviation	Wind power parts	Antiaging bio technologies	Shipbuilding and marine plants	Nano-convergence parts	Automotive parts
Jeju (9)	Water applications	Tourism digital contents	Clean healthy food	Wind power and automotive services		LOHAS health care	Cosmetics and beauty	

Note: The categories indicated in bold are specialized industries related to new & renewable energy

New & Renewable Energy Clusters in Korea

In Korea, new and renewable energy clusters have been formed around the regions of Daegu/Gyeongsangbuk-do, Chungcheongbuk-do and Jeollabuk-do.

Daegu/Gyeonsangbuk-do Cluster

In 2011, Gyeongsangbuk-do was selected through public offerings as a proper region for two of six projects planned by the central government (three for photovoltaics, two for wind power and one for fuel batteries). The province completed the establishment of a new & renewable energy test bed by the end of June, 2014.

- Responsibilities for these test bed projects are divided between the Gumi Electronics & Information Technology Research Institute (GEITRI) and Pohang University of Science and Technology (POSTECH).
- The test beds in Gumi help 240 photovoltaic manufacturers in Daegu/Gyeongsangbuk-do nurture personalized professionals and support the R&D of SMEs to develop new parts and commercialize their products.
- The test bed for fuel cells that has been set up in POSTECH's new & renewable energy lab supports qualified enterprises regarding the analysis of hydraulic fuel cell performance and product commercialization. The world's largest fuel cell plant to be built at POSCO Energy and a number of original technologies pertained by POSTECH will help the nation become more competitive in the global market.

Chungcheongbuk-do Cluster

"Chungbuk Innovation City" in Chuncheongbuk-do is going to have a photovoltaic R&D cluster that will act as an outpost to promote the nation's photovoltaics industry.

- In the cluster, a photovoltaics tech support center on an area that is approximately 4,900 ㎡ will be responsible for photovoltaics-related research and technology development, certification testing and manpower training.
- A building-energy tech support center on about 3,400 ㎡ will handle the certification and estimation of buildings/structures and construction materials related to photovoltaics.

Jeollabuk-do Cluster

The cluster in Jeollabuk-do aims to lead Korea's new & renewable energy industry by establishing a power generation hub for photovoltaics, wind power and fuel cells.

- An 355 m^2 size of renewable energy complex is in Buan, which is the only comprehensive complex in Korea.
- In Jeollabuk-do cluster, OCI, Nexolon, Solarpark Korea, Hyundai Heavy Industries and Quartz Tech occupy all part of the photovoltaics sector; Hyundai Heavy Industries and DACC-Aerospace, which are part of the wind power sector; and Propower in the fuel cell sector.
- Furthermore, Buan has the Korea Testing Laboratory, which is responsible for demonstrations and performance testing for photovoltaics, a materials development center within Chonbuk National University responsible for the R&D of photovoltaic sources, a nano IC center under the Korea Electronics Technology Institute and the Jeonju Center of Korea Basic Science Institute, which is dedicated to the R&D of next-generation solar cell materials.
- For the wind power sector, Buan has the Korea Institute of Machinery & Materials, a performance rating institution for wind power blades and speed boosters, the Korea Institute of Energy Research and a hydraulic fuel cell performance assessment and R&D organization.
- Meanwhile, Jeollabuk-do plans to attract photovoltaics-related companies and research institutions to the Saemangeum Solar Power Cluster (area: 2.237 million m^2); the world famous photovoltaics specialist OCI will invest KRW 10 trillion in a 1.55 million m^2 site.

The Jeollabuk-do Wind Power Industrial Cluster will build a 20MW capacity monitoring block (with an investment of KRW 82.7 billion) at a pilot complex for wind power generation in Saemanguem and plans to invest about KRW 10 trillion in a 2.5GW-class maritime wind power generation complex that is to be introduced along Wido Island to Anmado Island in Yeonggwang.

- A new & renewable energy project site in Saemangeum, on a 20.3 km^2 site, will, as its first step, accommodate a 4.3 km^2 research and test center as well as a 4 km^2 pilot bio crop complex.
- In the second step, a photovoltaic generation complex and bio crop harvest complex (11.5 km^2) will be built there.
- In particular, the Composite Green Energy Industrial Complex, in which Samsung is scheduled to invest, will receive a total investment of KRW 120 trillion from 2021 to 2040 to accommodate solar cell, wind power generation, bio fuel, fuel cell and R&D centers.

03 GOVERNMENT POLICIES AND RELATED REGULATIONS

Government Policies and Incentives

The Fourth New & Renewable Energy Development Framework (Sept. 2014)

With the goal of replacing 11% of the primary energy supplied with new & renewable energy by 2035, the Korean government finalized The Fourth New & Renewable Energy Development Framework in September of 2014.

- For the annual objectives for proportions in major periods, the government aims to fulfill the goal toward 11% by 2035. It will do so by gradually upgrading the proportion from 3.2% in 2012 to 3.6% in 2014, 5% in 2020, 7.7% in 2025 and 9.7% in 2030.
- According to the schedule, the year-on-year supply increase of new & renewable energy from 2014-2035 may reach 6.2%, which is a relatively high increase given the goal of a 0.7% supply increase for the primary energy group.

In addition, the government plans to reduce the amount of waste energy, which accounts for 2/3 of the entire new & renewable energy supply, and intends to focus on promoting the supply of photovoltaics and wind power energy.

Goals for Proportion to the Supply by New & Renewable Energy Sources

(%)

Category	2012	2014	2025	2035	CAGR (2012-2035)
Solar Thermal	0.3	0.5	3.7	7.9	21.2
Photovoltaics	2.7	4.9	12.9	14.1	11.7
Wind Power	2.2	2.6	15.6	18.2	16.5
Bio	15.2	13.3	19	18	7.7
Hydraulic power	9.3	9.7	4.1	2.9	0.3
Geothermal heat	0.7	0.9	4.4	8.5	18
Maritime	1.1	1.1	1.6	1.3	6.7
Waste	68.4	67	38.8	29.2	2

Source: Ministry of Trade, Industry and Energy (2014)

The plan aims to replace 11% of the primary energy supplied with new & renewable energy by 2035 and to expand the share of solar photovoltaic power and wind power to 72%.

As such, the government plans to implement their policies by focusing on the creation of a business ecosystem for the new & renewable energy market, which will shift from government-oriented to public-private partnership.

- On top of this, the Korean government will be committed to inviting the private sector to make voluntary investments by finding appropriate business model types for the effective supply of new & renewable energy, designing market-friendly systems, suggesting profitable business models and promoting deregulation.

<Action Plan>

01 Improve the economic efficiency of new & renewable energy projects.

- Increase long-term fixed contracts on the basis of competition.
- Enhance the economic efficiency of PVs installed in schools and households.

02 Expand the locations for new & renewable energy facilities.

- Loosen regulatory measures on the environment and site selection.
- Engage community members.
- Expand the community-engagement models such as rural PV projects.

03 Establish infrastructure for new & renewable energy.

- Create early connection to power systems.
- Resolve grievances of new & renewable energy business with no less than 1MW capacity in connecting power systems.

04 Create future-oriented energy systems.

- Reshape the scope of new & renewable energy and the Renewable Enegy Certificates (REC) system to meet global standards.
- Increase R&D and investment in the new & renewable sector, focusing on solar photovoltaic power and wind power.

Source: Ministry of Trade, Industry and Energy

Subsidies, loans, and feed-in tariffs are also provided as parts of the governmental support to create and expand the new and renewable energy market.

- In particular, focused support is being made in the technical and human resource development of the three core strategic categories (solar photovoltaic power, wind power, and hydrogen fuel cells).

R&D Support and Subsidies for Domestic New & Renewable Energy Industries (2003–2015)

(KRW billion)

Subsidy	2003	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	CAGR (2003–2015)
Total	118	288.1	422.6	784.4	774.1	808.4	1,003.00	5,998.20	851.2	802.7	772.6	17
R&D	37	94.1	132.6	208.8	219.4	252.8	267.7	277.3	272	249.3	234.2	16.6
Subsidy and Loan	75.4	186.2	263	449	315.4	292	340.8	325.1	233.2	217.4	219.2	9.3
Feed-in Tariffs (FIT)	5.7	7.8	27	126.7	239.2	263.6	395	395	346	336	319.2	39.9

Source: Korea Energy Agency (KEA)

Details of Revised Support Policies

The National Assembly of Korea is in deliberation of the amendment of the Electric Utility Act to allow new private enterprises, including "energy prosumers" and electric vehicle chargers, to sell electricity.

- In January 2016, a consultative body for energy regulatory reform was formed to seek several ways to engage the private sector in the electricity market.

Renewable Energy Certificates (REC) weighted values were modified in March 2015 to expand investments in new & renewable energy. The weighted values for tidal power, geothermal power, and Energy Storage System (ESS) facilities (linked with wind power) were newly added.

- In the recent modification, variable weighted values were adopted for the energy sources that require a considerable amount of initial investment, such as offshore wind power, tidal power, and geothermal power.

Rec Weighted Values in Revised Policy

(REC weight)

Category	Existing	Revised		
	Fixed	Stage 1	Stage 2	Stage 3
Geothermal	-	2.5 (for 5 years)	2.0 (for 10 years)	1.0 (later on)
Offshore Wind (Exceeding 5 km)	2	2.5 (for 5 years)	2.0 (for 10 years)	1.0 (later on)
Tidal Power (No Breakwater)	2	2.5 (for 10 years)	2.0 (for 20 years)	1.0 (later on)

With regard to solar photovoltaic power, the existing categorization based on land categories was abolished. Instead, differentiated weighted values are adopted depending on the installation types and scales, based on the principle of market.

REC Weighted Values by Installation Scale

(REC weight)

Installation Type	Small Scale (– 100 MW)	Medium Scale (100–3 MW)	Large Scale (3 MW –)
Land	1.2	x	x
Buildings	1.5	1.5	x
Waters	1.5	1.5	1.5

The mandatory ratio of new & renewable energy installation is expanded for public organizations.

- Newly constructed, expanded or modified public buildings with a total area no smaller than 1,000 m^2 are under the obligation of having a certain share of new & renewable energy installation.

- Increased: installable energy sources (wood pallets added).
- Renewed: correction coefficients of energy sources by usage.
- Ratio of obligatory installation: 18% (2016) → 21% (2017) (3%p ↑)

Mandatory Supply Ratio of New & Renewable Energy by year

(%)

Classification	2016	2017	2018	2019	after 2020
Mandatory Ratio	18	21	24	27	30

To vitalize housing support projects, the government provides subsidies for residential installation of new & renewable energy such as solar photovoltaic (including thermal) power, geothermal power, small-scale wind power, and fuel cells.

Subsidy for Residential Installation of New & Renewable Energy

Category	Existing (2016)	Revised (2017)
Limited application based on electric power consumption	Limited application based on the average electric power consumption (450 kWh per month)	Abolition of limitation
Amount of subsidy for solar photovoltaic power	Differentiated subsidies for installation capacity	The stage of installation capacity is subdivided into six levels, depending on the average monthly electric power consumption of applicants, to provide differentiated subsidies.

The annual obligatory supply ratio under the renewable energy portfolio system (RPS) system will increase by 0.5% starting 2018 to reach the target in 2023, one year earlier than scheduled.

Annual Mandatory Supply Ratio of RPS

(%)

Classification	2016	2017	2018	2019	2020	2021	2022	2023	after 2024
Existing	3.5	4	4.5	5	6	7	8	9	10
Revised	3.5	4	5	6	7	8	9	10	10

The competitive bidding system for long-term fixed-price contracts will be improved as follows.

Changes in Long-term, fixed-price Contracts

Classification	Existing (2016)	Revised (2017)
Energy Source	Solar photovoltaic	Solar photovoltaic (gradually expanded to non-solar photovoltaic)
Subject	Small scale (- 3 MW) (Preferential selection for no less than 50%: for less than 100 kW)	Unlimited (Preferential selection for no less than 50%: for less than 100 kW)
Bidding Cycle	Twice a year	Twice a year (one more if necessary)
Bidding Type	REC bidding	Bidding based on SMP + REC
REC Contract	REC 12-year fixed contract at the bid-winning price	Long-term (20-year) fixed contract at the bid-winning price
Selected Capacity	400 MW (2016)	More or less 500 MW (The proper level will be adjusted after ex-ante demand surveys)
Determination of Selection Price	Lowest-bid winning type	Same as the left
Others		Preferential treatment of power plants that engage residents such as farmers

Incentives are expanded for the new & renewable energy projects that engage residents.

- For new & renewable resident-participating energy projects, REC weight values are given (maximum 20%), to encourage the participation of residents.

Incentives in Resident-participating Energy Projects

Category	Details
Participation Type	Residents shall invest a certain portion of the entire project cost.
Applicable Projects	• Solar photovoltaic power generation projects with the capacity of no less than 1MW and wind power of not less than 3MW - Medium and large-scale projects are the major targets, since they are more difficult to gain approval from residents; but the criteria for wind power plant is 3MW, in consideration of the installation scale.
Applicable residents	• Those who are registered as residents who live in Eup, Myeon, or Dong* within 1km of the power plant for the period of 1 year or more - Offshore wind power plants: residents who live near the electricity facilities such as substation or who live in islands near the power plants * Administrative division of Korea: Eup(towns), Myeon(townships), Dong(neighborhoods)
Number of participating residents	• The minimum number is 5, and per capita investment amount shall be no more than 30% of the total amount of residents' investment. - In case of verifying renewable energy portfolio system(RPS) facilities, evidential documents such as shareholder lists are required.
Preferential treatment	• Preferential weight values are given when the group meets a criteria in terms of the share of owner's equity and total project cost. - Additional weighted value of 0.1 is given if the resident–participation ratio is 10% and the share of the total project cost is 2%. - Additional weighted value of 0.2 is given if the resident–participation ratio is 20% and the share of the total project cost is 4%.

The following policies are newly established to support the overseas market entry of new & renewable energy enterprises.

- Financial support for small and medium-sized enterprises (KRW 10 billion in 2015); Support for demonstration projects to explore areas proper for overseas market entry (KRW 400 million in 2015); Organizations for a feasibility study of foreign market entry project changed to new & renewable energy Center of the Korea Energy Agency from Korea new & renewable energy Association.

To vitalize solar photovoltaic power rental businesses (in which rental businesses install power generation facilities at houses and gain returns from the rental fees and Renewable Energy Point), the scope of applicable businesses and capacity is expanded.

- Applicable projects: (Existing) stand-alone houses → (changed) stand-alone houses, neighborhood living facilities, and apartment buildings
- Installation capacity: (Existing) 3KW → (changed) 3–10KW

Regulations Applicable to Renewable Energy Investment

Support and Regulatory Measures for Power Generation Businesses

Power generation businesses are eligible for the following support policies related to the dissemination of new & renewable energy, including the renewable energy portfolio system (RPS).

- RPS, new & renewable energy housing support project (one million green homes), new & renewable energy building (general dissemination) support project, new & renewable energy local support project, new & renewable energy convergence support program, solar photovoltaic power rental project, new & renewable energy financial support system, and obligatory installation of new & renewable energy facilities in public organizations

Power generation businesses are subject to the new & renewable energy facilities certification system and the renewable fuels standard (RFS) system.

In particular, power generation businesses that utilize major new & renewable energy such as solar photovoltaic power and wind power, are inevitably affected by the regulations under the Forestry Act, the Agricultural Land Act, and the Urban Planning Act.

Support and Regulatory Measures for New & Renewable Energy Materials/ Parts/System Manufacturers (Including Installation)

New & renewable energy materials/parts/system manufacturers will be indirectly benefited from the various support policies of the central government listed above.

In addition, if the entities are designated as the focus, cooperation, or grassroots industries of cities and provinces under the plans for promoting local industries, they can receive site support as well as financial and institutional assistance from the central and local government.

Others

In May 2014, the Guidelines on the Operation of the Foreign-Invested Regions Concerning Energy Facilities were revised, allowing foreign-invested enterprises to install solar photovoltaic power generation facilities in foreign-invested regions.

- Accordingly, applicable enterprises can save energy costs and improve the utilization rate of new & renewable energy.

04 COST

Cost and Employment

Cost Items

In the new & renewable energy industries, power generation companies and new & renewable energy materials/parts/system manufacturers (including installation) have different cost items.

However, the cost of new & renewable energy materials/parts/system (including installation) is the most important item for power generation companies. One of the major price indicators in the new & renewable energy industry is the power generation cost of each energy source.

Global Power Generation Unit Cost and Prices of Major Parts and Systems

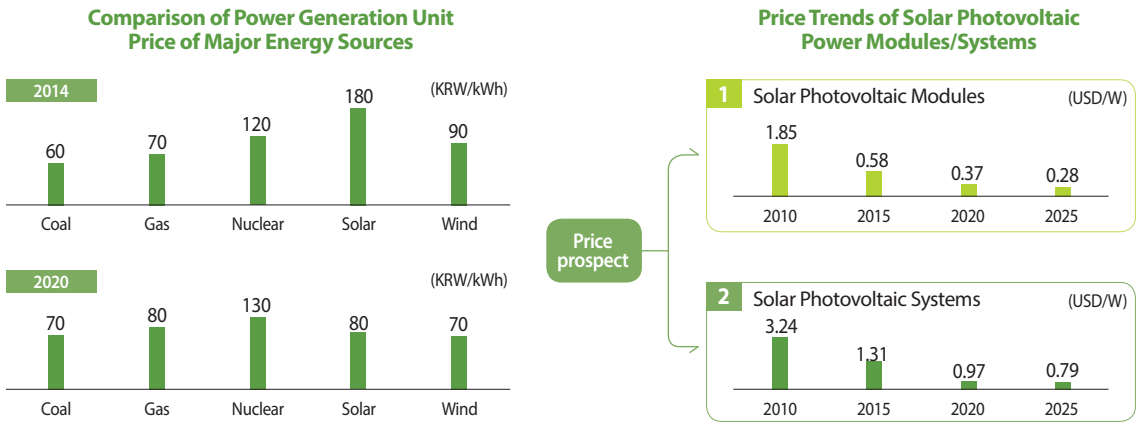
According to the Export–Import Bank of Korea, the global power generation unit cost (KRW/kWh) of solar photovoltaic power and wind power has not yet reached grid parity. However, the unit cost of wind power generation is expected to match that of coal power, and the unit cost of solar photovoltaic power generation to match that of gas thermal power in 2020.

- As of 2014: coal (60) < gas (70) < wind power (90) < nuclear (120) < solar (180)
- 2020 forecast: coal (70) = wind power (70) < gas (80) = solar (80) < nuclear (130)

With regard to the global unit price (USD/W) of solar photovoltaic modules and systems, it is expected that the current unit price of PV modules of 0.58 is likely to rapidly decrease to 0.37 in 2020 and 0.28 in 2025.

- Accordingly, the global unit price (USD/W) of solar photovoltaic systems is expected to decline from the current 1.31 to 0.97 in 2020 and 0.79 in 2025.

Comparison of Power Generation Unit Price of Major Energy Sources & Price Trends of Solar Photovoltaic Power Modules/Systems



Source: Jeonghwa Kang (2016), Trends of the Solar Photovoltaic Industry in 3Q 2016, The Overseas Economics Research Center, Export–Import Bank of Korea, (Oct. 14, 2016)

Profitability

System Marginal Price (SMP) of Photovoltaics in Korea

As Korea adopted the renewable energy portfolio system (RPS) instead of the feed-in tariffs (FIT) system in 2013, system marginal price (SMP) has become the most important indicator of the profitability of new & renewable energy.

In 2016, the profitability of photovoltaics in Korea remained stable thanks to high REC prices, despite falling SMP.

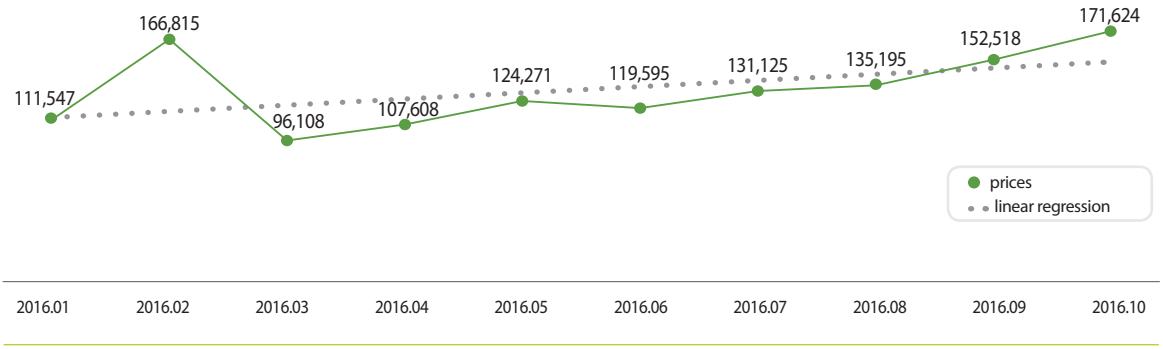
- The price of electricity generated by solar photovoltaic power is determined by the combination of SMP and renewable energy certificate (REC) price under the RPS system.

The REC price started to rise in the second half of 2015. The integration of PV and non-PV REC markets in 2016 has increased the demand for REC.

Figure 13 below shows the trend of REC price from January to October 2016. The blue line shows the trends in transaction prices, while the orange line indicates the overall trajectory. In October 2016, the average price exceeded the KRW 171,000 mark, the highest since the market integration.

Trends in REC Transactions

(KRW)



Source: Energiance (http://energiance.com/?p=7008)

Trends in REC Price for Solar Photovoltaic Power in Korea

(KRW)

Classification	2011	2012		2013		2014		2015	2016
	1/2Q	1/2Q	3/4Q	1/2Q	3/4Q	1/2Q	3/4Q	1/2Q	3/4Q
Averge price	219,977	156,634	158,660	136,095	128,539	112,591	70,707	73,275	86,477
Bidding Competition	5:1	7:1	2.5:1	4.4:1	4.9:1	4.2:1	11.2:1	6.7:1	5:1

Source: Korea Photovoltaic Industry Association (KOPIA)

05 SUCCESS CASES OF FOREIGN INVESTMENT

The Korean government announced its plan to promote green growth and green industries in 2008 and implemented various policies in 2009 to attract foreign investment .

- Korea's new & renewable energy industries have strong growth potential with its competitiveness in human resources and R&D capabilities.

Progress has been made in attracting R&D enterprises and PV materials manufacturers, as well as expanding installation facilities through cooperation with global wind power firms.

Wind Power Generation Complex at Taeki Mountain, Gangwon-do

In April 2005, the Gangwon-do Government, in cooperation with Hoengseong-gun and Pyeongchang-gun, signed an MOU with POSCO Engineering and Construction and Eurus Energy, the largest wind power operator in Japan in April 2005.

The complex is located in a 53,000 m^2 land around the ridge of Taeki Mountain, covering Dunnae-myeon, Heongsung-gun to Bongpyong-myeon, Pyeongchang-gun. The complex is home to a total of twenty-2MW wind power generators (9 in Heongsung-gun and 11 in Pyeongchang-gun).

- The total capacity of the facilities is 40 MW/h and the total annual power generation volume is 98,300MW, which can cover 92% of (30,000) of all households (33,000) in Heongsung-gun and Pyeongchang-gun. Each wind power generator installed in the complex has a tower height of 78m, blade length of 40m, and gross weight of 250t.

The operation of the complex can reduce carbon emissions by 60,000 ton and secure carbon emission rights (CER) worth approximately KRW 2 billion. If the annual average operation rate of the wind power generators is 26%, the complex is expected to create electricity sales of KRW 9 billion to KRW 11 billion annually.

The complex is the first investment case in which KRW 42.5 billion (USD 40 million), or half the total investment cost (KRW 85 billion), was induced from foreign investment.

- The success factors of the project include sufficient wind resources, the local government's strong determination for investments, and a proper consortium.

Joint Investment by Samsung Fine Chemical and MEMC

Samsung Fine Chemical and MEMC jointly established SMP Corporation and built a polysilicon plant based on the fluidized bed reactor (FBR) process.

- The FBR process is a new cost-saving technology that can produce high-purity polysilicon with less electricity power consumption and operation cost compared to the existing Siemens method.

In March 2014, Samsung Fine Chemical sold 35% of the SMP Corporation's equity to Sun Edison. Then, Samsung invested part of the sales price in buying the SSL's equity, an affiliate of Sun Edison.

SMP built a plant that can produce about 10,000t annually in its Ulsan premises and held its completion ceremony in the first half of 2014. It began a full-scale production in the second half of the year.

The investment project became successful thanks to the strong determination of a company with large capital and the engagement of an advanced company with up-to-date technologies, all of which was in line with the government's policy drive for green growth. In particular, tax reduction policies for the adoption of new technologies played a crucial role in inducing investments.

Solvay R&D Center at EWHA Womans University

Solvay opened its Headquarters of Global Business Unit Special Chemicals on the EWHA University Campus in Seoul. The facitilies was completed in December 2013 and has been operated since May 2014. The Development and Technology (RDT) Center is also located in the EWHA campus.

- The 6,600 m^2 wide center is its fourth R&D center in Asia.

Solvay invested a total of EUR 13 million in the construction of the RDT Center, and EUR 3.8 million in the 5 year collaborative research fellowship with EWHA Women's University.

- Solvay acquired Plextronics, a US company, to accelerate its OLED display development, and the lab in charge will be located in the EWHA center. The company will also conduct research on the materials of lithium ion batteries.

Solvay decided to invest in Korea to enjoy business opportunities created in the country's well-established business ecosystem. The RDT Center will be mainly focused on high-growth markets such as photovoltaic cells and lithium ion batteries.

American Thin-Film Solar Cell Company Made Investments in Gwangju

In July 2013, Gwangju and SoloPower Korea Corp. started the construction of a factory and a research center on Copper Indium Gallium Selenide (CIGS) thin-film solar cells.

- US SoloPower made investment worth USD 250 million (KRW 275 billion) in Korea, including its cash investment worth USD 125 million in factory facilities.

The production factory is located on the 39,600 m^2 land in Woljeon Foreigner Investment Zone in Gwangju . The facilties are likely to create a total of 308 jobs including 278 production workers and 30 researchers.

Mokpo University Signed a Business Agreement with China's Goldwind

On October 28, 2016, the Leaders in Industry-university Cooperation (LINC) Project Group of Mokpo National University signed a joint business agreement with Goldwind Korea, the Korean branch of the world's greatest

wind power operator Goldwind to enhance industry–academy cooperation and foster human resources in specialized areas.

- Goldwind has the biggest market share in the global wind turbine market. It has constructed over 23,000 units of wind turbine across the world with turbine capacity of 30GW. The company established the Korean branch in 2015.

With the business agreement, the two entities will seek cooperation in a variety of areas including nurturing human resources specializing in wind power, holding consultative bodies for industry-academia cooperation, and exchanging industry and academic trends.

Korea's GS Power and China's CNPV Joint Solar Photovoltaic Power Generation Facilities at Saemangeum Seawall

As the first economic cooperation case since the Korea–China FTA, Korea's GS Power and China's solar photovoltaic cell company CNPV signed an agreement in July 2015 to build solar photovoltaic power generation facilities at Saemangeum Seawall.

- They started investment worth KRW 320 billion in the construction process in the third quarter of 2015.
- The facilities are expected to be 165,000 m^2 large and can be expanded further depending on the consultation between the two companies.

06 RELATED COMPANIES AND ASSOCIATIONS

List of Related Companies and Associations

List of Related Companies

Solar Photovoltaic Power

Solar Photovoltaic (Category)	Company	Major Item	Website	Location
Metal silicon	Neo Plant Co., Ltd.	Metal silicon	neoplant.co.kr	Yeongdeungpo-gu, Seoul
	Korea Metal Silicon	Metal silicon	www.korms.kr	Yeongwol-gun, Gangwon-do
	OCI Specialty Corp.	Metal silicon, ingots, and wafers	www.ocis.co.kr	Cheonan-si, Chungcheongnam-do
Polysilicon	OCI Corp.	Polysilicon	www.oci.co.kr	Jung-gu, Seoul
	KCC	Polysilicon	www.kccworld.co.kr	Seocho-gu, Seoul
	LG International Corp.	Polysilicon, ingots, wafers, batteries, and modules	www.lgicorp.com	Yeongdeungpo-gu, Seoul
	Lotte Fine Chemical Corp.	Polysilicon	www.lottefinechem.com	Nam-gu, Ulsan
	Sentrosum Photo Voltaic	Polysilicon, equipment, materials, and parts		Suwon-si, Gyeonggi-do
Ingots and Wafers	Nexolon	Ingots and wafers	www.nexolon.com	Iksan-si, Jeollabuk-do
	SEMI-MATERIALS	Ingots, wafers, and equipment	www.semimaterials.com	Seongnam-si, Gyeonggi-do
	LG International Corp.	Polysilicon, ingots, wafers, batteries, and modules	www.lgicorp.com	Yeongdeungpo-gu, Seoul
	SKC Solmix	Ingots and wafers	www.skcsolmics.com	Pyongtaek-si, Gyeonggi-do
	TopSun Co., Ltd.	Ingots, wafers, modules, and installation/construction	www.topsun.kr	Jangseong-gun, Jeollanam-do
	Hansol Technics Corp.	Ingots, wafers, modules, and installation/construction	www.hansoltechnics.com	Jung-gu, Seoul
	Osung LST	Ingots and wafers	www.osunglst.com	Asan-si, Chungcheongnam-do
	OCI Specialty Corp.	Metal silicon, ingots, and wafers	www.ocis.co.kr	Cheonan-si, Chungcheongnam-do
	Woongjin Energy Co., Ltd.	Ingots, wafers, and installation/construction	www.woongjinenergy.com	Yuseong-gu, Daejon
Batteries	Shinsung Solar Energy Co., Ltd.	Batteries, modules, and installation/construction	www.shinsung.co.kr	Seongnam-si, Gyeonggi-do
	Hyundai Heavy Industries Corp.	Batteries, modules, and installation/construction	www.hhi.co.kr	Dong-gu, Ulsan
	Hanwha Chemical	Batteries	hcc.hanwha.co.kr	Jung-gu, Seoul
	LG International Corp.	Polysilicon, ingots, wafers, batteries, and modules	www.lgicorp.com	Yeongdeungpo-gu, Seoul

Solar Photovoltaic (Category)	Company	Major Item	Website	Location
Modules	Shinsung Solar Energy Co., Ltd.	Batteries, modules, and installation/ construction	www.shinsung.co.kr	Seongnam-si, Gyeonggi-do
	Hyundai Heavy Industries Corp.	Batteries, modules, and installation/ construction	www.hhi.co.kr	Dong-gu, Ulsan
	S-Energy Co., Ltd.	Modules	www.s-energy.com	Seongnam-si, Gyeonggi-do
	SE Network Corp.	Modules, and installation/ construction	www.se-networks.com	Gangnam-gu, Seoul
	LS Industrial Systems Corp.	Modules, and installation/ construction	www.lsis.com	Anyang-si, Gyeonggi-do
	LG International Corp.	Polysilicon, ingots, wafers, batteries, and modules	www.lgicorp.com	Yeongdeungpo-gu, Seoul
	JSPV	Modules	www.jspv.co.kr	Asan-si, Chungcheongnam-do
	Hanwha QCELLS Korea	Modules, and installation/ construction	www.hanwha.co.kr	Jung-gu, Seoul
	SDN	Modules, installation/construction, and power generation	www.sdn-i.com	Seongnam-si, Gyeonggi-do
	Solar Park Korea Co., Ltd.	Modules, and equipment	solarpark-korea.com	Wanju-gun, Jeollabuk-do
	NGU Solar & Global Co., Ltd.	Modules, and installation/ construction		Ulju-gun, Ulsan
	TopSun Co., Ltd.	Ingots, wafers, modules, and installation/construction	www.topsun.kr	Jangseong-gun, Jeollanam-do
	Hansol Technics Corp.	Ingots, wafers, modules, and installation/construction	www.hansoltechnics.com	Jung-gu, Seoul
	T & Solar	Modules	www.tsolar.co.kr	Bonghwa-gun, Gyeongsangbuk-do
Inverters	Hanyang Power Corp.	Inverters, and installation/ construction	www.hypower.co.kr	Paju-si, Gyeonggi-do
	Dass Tech Co., Ltd.	Inverters	www.dasstech.com	Cheongju-si, Chungcheongbuk-do
	KACO New Energy Corp.	Inverters	www.kaco-newenergy.kr	Seongnam-si, Gyeonggi-do
	Hex Power System Corp.	Inverters	www.hex.co.kr	Guro-gu, Seoul
Equipment	Semimaterials	Ingots, wafers, and equipment	www.semimaterials.com	Seongnam-si, Gyeonggi-do
	SolarPark Korea Co., Ltd.	Modules, and equipment	solarpark-korea.com	Wanju-gun, Jeollabuk-do
	HANKOOK Technology Corp.	Equipment, installation/construction, and power generation	www.myht.co.kr	Seocho-gu, Seoul
	Fortix Co., Ltd.	Equipment	www.fortix.kr	Seo-gu, Incheon
	Sentrosum Photo Voltaic	Poly silicon, equipment, materials, and parts		Suwon-si, Gyeonggi-do
	Durasonic Co., Ltd.	Equipment	durasonic.com	Pyongtaek-si, Gyeonggi-do
	Jeis Holdings Co., Ltd.	Equipment	www.jeisholdings.com	Ansan-si, Gyeonggi-do
	TCK Co., Ltd.	Equipment	www.tck.co.kr	Anseong-si, Gyeonggi-do
	DKSH Corp.	Equipment	www.dksh.com	Gangnam-gu, Seoul
	SJ Inno Tech	Equipment	www.sjinnotech.com	Dalseo-gu, Daegu
	EO Technics Co., Ltd.	Equipment	www.eotechnics.com	Anyang-si, Gyeonggi-do
	HANMI Semiconductor Co., Ltd.	Equipment	www.hanmisemi.com	Seo-gu, Incheon
	SFA Co., Ltd.	Equipment	www.sfa.co.kr	Hwaseong-si, Gyeonggi-do
	Paru Co., Ltd.	Equipment, installation/construction, and power generation	www.paru.co.kr	Suncheon-si, Jeollanam-do

Wind Power

Company	Major Item	Website	Location
Anytek Sys. Co., Ltd.	Wind power	www.anytek.com	Geumcheon-gu, Seoul
Kyung Nam Precision Co.	Wind power	www.knpco.kr	Sasang-gu, Busan
Daeshin Wind Power Corp.	Wind power	daeshinwp.com	Gangseo-gu, Seoul
Gyeongju Wind Power Generation Corp.	Wind power		Gyeongju-si, Gyeongsangbuk-do
Daekwang Industries Co., Ltd.	Wind power	www.dkic.co.kr	Gyeongju-si, Gyeongsangbuk-do
Yeongdeok Wind Power Generation Corp.	Wind power	www.yowip.co.kr	Yeongdeok-gun, Gyeongsangbuk-do
Hanjin Industry Co., Ltd.	Wind power	www.hanjinind.co.kr	Yangsan-si, Gyeongsangnam-do
KM Co., Ltd.	Wind power	kmbiz.co.kr	Wanju-gun, Jeollabuk-do
Dongguk S&C Co., Ltd.	Wind power	www.dongkuksnc.co.kr	Pohang-si, Gyeongsangbuk-do
Samhyun Engineering Co., Ltd.	Wind power	www.samhyun-eng.com	Haman-gun, Gyeongsangnam-do
KR Co., Ltd.	Wind power	www.krroad.co.kr	Yeongdeungpo-gu, Seoul
Unison Corp.	Wind power	www.unison.co.kr	Seocho-gu, Seoul
DaeMyoung GEC Corp.	Wind power and small hydraulic power	www.dmgec.com	Seocho-gu, Seoul
POSCO-Daewoo Co., Ltd.	Solar photovoltaic, bioenergy, wind power, small hydraulic power, hydrogen/fuel cells, and geothermal power	www.posco-daewoo.com	Jung-gu, Seoul
POSM Corp.	Solar photovoltaic, bioenergy, wind power, small hydraulic power, and waste-to-energy	www.posm.co.kr	Gwangyang-si, Jeollanam-do
Energy ENC Co., Ltd.	Solar photovoltaic, bioenergy, wind power, small hydraulic power, and offshore power	www.energyenc.com	Seocho-gu, Seoul
LG CNS Co., Ltd.	Solar photovoltaic, bioenergy, wind power, and waste-to-energy	www.lgcns.co.kr	Yeongdeungpo-gu, Seoul
Hankuk Plant Service	Solar photovoltaic, bioenergy, wind power, waste-to-energy, and geothermal power	www.hps.co.kr	Seongnam-si, Gyeonggi-do
Asian Power & Energy Corp.	Solar photovoltaic, wind power, and small hydraulic power	www.apecorp.org	Seocho-gu, Seoul
Futura Energia Co., Ltd.	Solar photovoltaic, wind power, and small hydraulic power		Gangnam-gu, Seoul
Korea Electricity Engineering & Consulting Co., Ltd.	Solar photovoltaic, wind power, small hydraulic power, hydrogen/fuel cells, and geothermal power	www.kelec.kr	Anyang-si, Gyeonggi-do
IM Co., Ltd.	Solar photovoltaic, wind power, and hydrogen/fuel cells	www.im2006.com	Wanju-gun, Jeollabuk-do

Company	Major Item	Website	Location
Edison Tech Co., Ltd.	Solar photovoltaic, wind power, and hydrogen/fuel cells	www.edisontech.co.kr	Seongdong-gu, Seoul
Hyundai Heavy Industries Corp.	Solar photovoltaic, wind power, hydrogen/fuel cells, gasification of coal and intermediate petroleum residuum	www.hhi.co.kr	Dong-gu, Ulsan
LG CNS Co., Ltd.	Solar photovoltaic, wind power, hydrogen/fuel cells, and geothermal power	www.lgcns.co.kr	Yeongdeungpo-gu, Seoul
Kimpo Electric Power Co., Ltd.	Solar photovoltaic, wind power, and geothermal power	www.kpepco.com	Gimpo-si, Gyeonggi-do
Haneolnuri Co., Ltd.	Solar photovoltaic, wind power, and geothermal power		Danyang-gun, Chungcheongbuk-do
Seokwang Engineering Service Group	Solar photovoltaic, wind power, and geothermal power	www.skesgroup.com	Goyang-si, Gyeonggi-do
NMS Co., Ltd.	Solar photovoltaic, wind power, and geothermal power	www.nms21.net	Hwaseong-si, Gyeonggi-do
Jawon Medical Co., Ltd.	Solar photovoltaic, wind power, and geothermal power	www.gnrinc.kr	Kwangsan-gu, Gwangju
M&M 21 Co., Ltd.	Solar photovoltaic, wind power, and waste-to-energy		Wonju-si, Gangwon-do
Yushin Electric Power Co., Ltd.	Solar photovoltaic, wind power, waste-to-energy, and geothermal power		Suseong-gu, Daegu
KT Co., Ltd.	Solar thermal, solar photovoltaic, bioenergy, wind power, small hydraulic power, hydrogen/fuel cells, and geothermal power	www.kt.com	Seongnam-si, Gyeonggi-do
Jungdo Enertech Co., Ltd.	Solar thermal, solar photovoltaic, bioenergy, wind power, small hydraulic power, hydrogen/fuel cells, and geothermal power	jungdo-energy.com	Cheonan-si, Chungcheongnam-do
Samyang E&P Corp.	Solar thermal, solar photovoltaic, bioenergy, wind power, small hydraulic power, hydrogen/fuel cells, and geothermal power		Chuncheon-si, Gangwon-do
Unitech Co., Ltd.	Solar thermal, solar photovoltaic, bioenergy, wind power, small hydraulic power, hydrogen/fuel cells, offshore power, and geothermal power	www.unitech99.co.kr	Gwangyang-si, Jeollanam-do
ENE Co., Ltd.	Solar thermal, solar photovoltaic, bioenergy, wind power, small hydraulic power, waste-to-energy, and geothermal power	www.ene21.co.kr	Jeonju-si, Jeollabuk-do
Gyeongnam Technopark Foundation	Solar thermal, solar photovoltaic, bioenergy, wind power, and hydrogen/fuel cells	www.gntp.co.kr	Changwon-si, Gyeongsangnam-do
Samyang Eco-Energy Co., Ltd.	Solar thermal, solar photovoltaic, bioenergy, wind power, hydrogen/fuel cells, waste-to-energy, and geothermal power	www.ecosy.co.kr	Jongno-gu, Seoul
KT Engcore Co., Ltd.	Solar thermal, solar photovoltaic, bioenergy, wind power, hydrogen/fuel cells, waste-to-energy, and geothermal power	www.ktengcore.com	Seongnam-si, Gyeonggi-do
Korea District Heating Engineering Co., Ltd.	Solar thermal, solar photovoltaic, bioenergy, wind power, hydrogen/fuel cells, waste-to-energy, and geothermal power	www.kdhec.com	Seongnam-si, Gyeonggi-do
Onnuri Solar Energy Co., Ltd.	Solar thermal, solar photovoltaic, bioenergy, wind power, and geothermal power	www.knsun.co.kr	Yangju-si, Gyeonggi-do
HLB Life Science Corp.	Solar thermal, solar photovoltaic, bioenergy, wind power, and geothermal power	www.hlb-ls.com	Guro-gu, Seoul

ESS

Company	Major Item	Website	Location
Gaga Electric Power (Sunkang Group)	ESS, electric automobile charging systems, and smart grid	www.sunkang.re.kr	Naju-si, Jeollanam-do
Kangwha ENC	Electric construction, IT construction, and new & renewable energy	www.kwenc.co.kr	Haenam-gun, Jeollanam-do
Green Information and Communications	Automotive electrical S/W, and embedded systems	www.greenia.co.kr	Seongnam-si, Gyeonggi-do
Keumwon Electric & Solar Tech	Electric construction and solar photovoltaic power construction		Naju-si, Jeollanam-do
Nuri Telecom	Energy IoT services and electric power IoT	www.nuritelecom.co.kr	Seocho-gu, Seoul
Daekyung Engineering	Tester manufacturing, tension/compression, and fatigue testers	www.dktester.com	Bucheon-si, Gyeonggi-do
Daeyung	Electric construction and IT construction	www.dy21.co.kr	Nam-gu, Kwangju
Ruby	Fourth-generation battery management system	www.rubycoltd.com	Uiwang-si, Gyeonggi-do
Misum	Battery packs, BMS, and cyclers	www.misum.co.kr	Dongan-gu, Anyang-si
Samsung SDI	Display and lithium-ion batteries	www.samsungsdi.co.kr	Yongin-si, Gyeonggi-do
Seoltech	Permanent magnet synchronous generators, inverters, and micro-grids	www.seoltech.com	Dalseo-gu, Daegu-si
Sebang Electrics, Co., Ltd.	UPS, ESS	www.globalups.co.kr	Shiheung-si, Gyeonggi-do
Sunkang SG	New & Renewable energy, and solar photovoltaic power generation	www.sunkang.re.kr	Naju-si, Jeollanam-do
Sebang Battery	Secondary batteries, and ESS	www.gbattery.com	Gangnam-gu, Seoul
LG Chemical	Petrochemistry, information/electronics materials, and secondary batteries (lithium-ion)	www.lgchem.com	Yeongdeungpo-gu, Seoul

List of Related Associations

Association	Website	Main Roles
Korea Energy Agency New Renewable Energy Center	http://www.knrec.or.kr/knrec/index.asp	Professional institution that provides expertise and efficient support for the development, dissemination, and industrialization of new & renewable energy
Korea New Renewable Energy Association	http://www.knrea.or.kr/	Industrial association that protects the common interest and ensures the common development of new & renewable energy industries
Korea Photovoltaic Industry Association	http://www.kopia.asia/	Industrial association that protects the common interest and ensures the common development of solar photovoltaic industries
Korea Wind Energy Industry Association	http://www.kweia.or.kr/	Industrial association that protects the common interest and ensures the common development of wind power industries
Korea Hydrogen Industry Association	http://www.h2.or.kr/	Industrial association that protects the common interest and ensures the common development of hydrogen & fuel cell industries
Korea Bio-energy Association	http://www.kbea.or.kr/	Industrial association that protects the common interest and ensures the common development of bioenergy industries
Korea Institute of Energy Technology Evaluation and Planning	http://www.ketep.re.kr	Institution that supports R&D on energy including new & renewable energy

Relations with Other Industries

Related to Photovoltaics

Category	Association	Major Item	Website	Location
Installation/ Construction	Shinsung Solar Energy Co., Ltd.	Batteries, modules, and installation/ construction	www.shinsung.co.kr	Seongnam-si, Gyeonggi-do
	Hyundai Heavy Industries Corp.	Batteries, modules, and installation/ construction	www.hhi.co.kr	Dong-gu, Ulsan
	KC Cottrell	Installation/construction	www.kc-cottrell.com	Mapo-gu, Seoul
	Eagon Window	Installation/construction	www.eagon.com	Nam-gu, Incheon
	Woosin Solar Tech Corp.	Installation/construction	www.woosinsolar.com	Buk-gu, Daegu
	LG CNS	Installation/construction, etc.	www.lgcns.co.kr	Yeongdeungpo-gu, Seoul
	Hanyang Power Corp.	Inverters and installation/construction	www.hypower.co.kr	Paju-si, Gyeonggi-do
	Korea Engineering Consultants Corp.	Installation/construction and power generation	www.kecc.co.kr	Kangdong-gu, Seoul
	SE Network Corp.	Modules, and installation/construction	se-networks.com	Gangnam-gu, Seoul
	Edison Tech Co., Ltd.	Installation/construction, power generation, etc.	edisontech.co.kr	Seongdong-gu, Seoul
	LS Industrial Systems Corp.	Modules, and installation/construction	kr.lsis.biz	Anyang-si, Gyeonggi-do
	I-Solar Energy Corp.	Installation/construction	www.isolar.kr	Goyang-si, Gyeonggi-do
	Solar Energy & System	Installation/construction, power generation, etc.	www.solarens.kr	Changwon-si, Gyeongsangnam-do
	COSPI Corp.	Installation/construction	www.cospi.co.kr	Gangnam-gu, Seoul
	Hanwha QCELLS Korea	Modules and installation/construction	www.hanwha.co.kr	Jung-gu, Seoul
	SDN	Modules, installation/construction, and power generation	www.sdn-i.net	Seongnam-si, Gyeonggi-do
	Onnuri Solar Energy	Installation/construction, etc.	www.knsun.co.kr	Yangju-si, Gyeonggi-do
	HANKOOK Technology Corp.	Equipment, installation/construction, and power generation	www.myht.co.kr	Seocho-gu, Seoul

Category	Association	Major Item	Website	Location
Installation/ Construction	NGU Solar & Global Co., Ltd.	Modules, and installation/construction	www.ngusolar.com	Ulju-gun, Ulsan
	Topsun Co., Ltd.	Ingots, wafers, modules, and installation/construction	www.topsun.kr	Jangseong-gun, Jeollanam-do
	Hansol Technics Corp.	Ingots, wafers, modules, and installation/construction	www.hansoltechnics.com	Jung-gu, Seoul
	Etec E&C	Installation/construction	www.etecenc.com	Seocho-gu, Seoul
	KD Power	Installation/construction	www.kdpower.co.kr	Chuncheon-si, Gangwon-do
	Hanvit DNS	Installation/construction	www.hanvitdns.com	Gangseo-gu, Seoul
	Paru Co., Ltd.	Equipment, installation/construction, and power generation	www.paru.co.kr	Suncheon-si, Jeollanam-do
	Woongjin Energy Co., Ltd.	Ingots, wafers, and installation/construction	www.woongjinenergy.com	Yuseong-gu, Daejon
	Shingsung E&G Co., Ltd.	Installation/construction	www.shinsung-eng.co.kr	Seongnam-si, Gyeonggi-do
Others	KC Solar Energy	Others	kc-solarenergy.com	Mapo-gu, Seoul
	LG CNS	Installation/construction, etc.	www.lgcns.co.kr	Yeongdeungpo-gu, Seoul
	Edison Tech Co., Ltd.	Installation/construction, power generation, etc.	edisontech.co.kr	Seongdong-gu, Seoul
	Gogang Aluminum Co., Ltd.	Others	www.gg-al.co.kr:446	Ulju-gun, Ulsan
	KEPCO	Others	www.kepco.co.kr	Naju-si, Jeollanam-do
	Solar E&S	Installation/construction, power generation, etc.	www.solarens.kr	Changwon-si, Gyeongsangnam-do
	Onnuri Solar Energy	Installation/construction, etc.	www.knsun.co.kr	Yangju-si, Gyeonggi-do
	Lotte Aluminum Corp.	Others	www.lotteal.co.kr	Geumcheon-gu, Seoul
	Dongbu INC	Others	www.dongbuinc.co.kr	Gangnam-gu, Seoul
	Ubisen Co., Ltd.	Others	www.ubisen.co.kr	Suwon-si, Gyeonggi-do
	Paru Co., Ltd.	Equipment, installation/construction, and power generation	www.paru.co.kr	Suncheon-si, Jeollanam-do
	Hileben Co., Ltd.	Others	www.hileben.com	Seongnam-si, Gyeonggi-do

Power Generation Companies (Photovoltaics)

	Association	Major Item	Website	Location
Power Generation	Korea Engineering Consultants Corp.	Installation/construction, and power generation	www.kecc.co.k	Kangdong-gu, Seoul
	S-Energy Co., Ltd.	Power generation	www.s-energy.com	Seongnam-si, Gyeonggi-do
	Edison Tech Co., Ltd.	Installation/construction, power generation, etc.	edisontech.co.kr	Seongdong-gu, Seoul
	POSCO Energy Corp.	Power generation	www.poscoenergy.com	Gangnam-gu, Seoul
	Solar E&S	Installation/construction, power generation, etc.	www.solarens.kr	Changwon-si, Gyeongsangnam-do
	Korea Midland Power Co., Ltd.	Power generation	www.komipo.co.kr	Boryung-si, Chungcheongnam-do
	Korea Hydro & Nuclear Power Corporation	Power generation	www.khnp.co.kr	Gyeongju-si, Gyeongsangbuk-do
	SDN	Modules, installation/construction, and power generation	www.sdn-i.net	Seongnam-si, Gyeonggi-do
	LST Energy Co., Ltd.	Materials, parts, and power generation	www.lstkorea.kr	Seongdong-gu, Seoul
	HANKOOK Technology Corp.	Equipment, installation/ construction, and power generation	www.myht.co.kr	Seocho-gu, Seoul
	Paru Co., Ltd.	Equipment, installation/ construction, and power generation	www.paru.co.kr	Suncheon-si, Jeollanam-do

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Headquarters

Address 13, Heolleung-ro, Seocho-gu, Seoul, Republic of Korea
Tel (82-2) 1600-7119 **Fax** (82-2) 3460-7920
E-mail ikonline@kotra.or.kr
Homepage www.investkorea.org

NORTH AMERICA

New York, USA
Tel (212) 826-0900
E-mail kotrany@hotmail.com

Los Angeles, USA
Tel (323) 954-9500
E-mail info@kotrala.com

Chicago, USA
Tel (312) 644-4323
E-mail info@kotrachicago.com

Dallas, USA
Tel (972) 243-9300
E-mail info@kotradallas.com

Washington D.C., USA
Tel (202) 857-7919
E-mail washington@kotra.or.kr

Silicon Valley, USA
Tel (408) 432-5000
E-mail info@kotrasv.org

Detroit, USA
Tel (248) 619-1601
E-mail detroit@kotradtt.org

Vancouver, Canada
Tel (604) 683-1820
E-mail ktc@kotrayvr.com

Toronto, Canada
Tel (416) 368-3399
E-mail info@kotra.ca

EUROPE

Frankfurt, Germany
Tel (49-69) 2429-920/9
E-mail frankfurt@kotra.or.kr

Hamburg, Germany
Tel (49-40) 3405-740
E-mail info@kotra.de

Munich, Germany
Tel (49-89) 2424-2630
E-mail munich@kotra.or.kr

Paris, France
Tel (33-1) 5535-8888
E-mail paris@kotra.or.kr

London, U.K.
Tel (44-20) 7520-5300
E-mail kotra@kotra.co.uk

Brussels, Belgium
Tel (32-2) 205-0089
E-mail kotrabru@kotra.or.kr

Milan, Italy
Tel (39-02) 79-5813
E-mail kotramil@kotra.it

Zurich, Switzerland
Tel (41-44) 202-1232
E-mail ktc@kotra.ch

Stockholm, Sweden
Tel (46-8) 30-8090
E-mail stockholm@kotra.nu

Copenhagen, Denmark
Tel (45) 3347-7221
E-mail info@kotra.dk

Amsterdam, Netherlands
Tel (31-20) 754-6903
E-mail info@koreatradecenter.nl

Vienna, Austria
Tel (43-1) 586-3876
E-mail kotravie@kotra.at

Madrid, Spain
Tel (34-91) 556-6241
E-mail madridktc@kotra.or.kr

ASIA & OCEANIA

Singapore
Tel (65) 6426-7200
E-mail kotrasin@singnet.com.sg

Sydney, Australia
Tel (61-2) 9264-5199
E-mail info@kotra.org.au

Melbourne, Australia
Tel (61-3) 9860-0500
E-mail info@kotramelbourne.org.au

Tokyo, Japan
Tel (81-3) 3214-6951
E-mail kotratky@kotra.or.jp

Osaka, Japan
Tel (81-6) 6262-3831
E-mail osaktc@kotra.or.jp

Nagoya, Japan
Tel (81-52) 561-3936
E-mail nagoya@kotra.or.jp

Fukuoka, Japan
Tel (81-92) 473-2005
E-mail fukuoka@kotra.or.jp

Beijing, China
Tel (86-10) 6410-6162
E-mail pekktc@kotra.or.kr

Shanghai, China
Tel (86-21) 5108-8771/2
E-mail shanghai@kotra.or.kr

Guangzhou, China
Tel (86-20) 2208-1600
E-mail canton@kotra.or.kr

Qingdao, China
Tel (86-532) 8388-7931/4
E-mail qdkbc@kotra.or.kr

Hong Kong, China
Tel (852) 2545-9500
E-mail kotra5@kotra.org.hk

Taipei, Taiwan
Tel (886-2) 2725-2324
E-mail kotra.tpe@msa.hinet.net

MIDDLE EAST

Dubai, United Arab Emirates
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Korea Trade-Investment Promotion Agency

INVEST KOREA
www.investkorea.org
13, Heolleung-ro, Seocho-gu, Seoul, Republic of Korea (137-749)
Tel (82-2)1600-7119 **Fax** (82-2)3460-7920

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