

Chapter 21

Republic of Korea

1.0 Introduction

In 2007, the first domestically produced 750-kW and 1.5-MW turbines were introduced to the Korean market, while the 2- to 3-MW turbines were still under development and scheduled for field testing over the next two years. So far, progress in the Korean wind market has been a little behind schedule. At the end of 2007, the cumulative installed capacity was 193 MW (Table 1). Even though there is a national campaign with incentive programs for new and renewable energy sources, the added installation capacity of only 18 MW of wind in 2007 indicates the presence of some difficulties and barriers. These barriers include complex terrain at onshore sites and serious public acceptance issues.

The Korean wind generation capacity target of 2,250 MW by 2012 is a very ambitious goal. The local electric generating power companies that have been split from the Korea Electric Power Corporation (KEPCO) entered the wind farm market by making an agreement with the government to diversify their generating sources and include new and renewable sources. The Korean government will set the new policy by implementing the RPS and providing strong support for R, D&D into offshore sites. This is expected to accelerate growth in the future. The official data used in the following tables and this report were provided by the New and Renewable Energy Center under the Korea Energy Management Corporation (KEMCO).

2.0 Progress Toward National Objectives

At the end of 2007, there were 127 wind turbines operating in Korea. According to the 2003 government installation target as set in The Second Basic Plan for New & Renewable Energy Technology Development and Dissemination,

an additional 2,057 MW of wind energy capacity is needed from 2007 to 2012 in order to reach the target. In the plan, the portion of offshore capacity is 675 MW or 30% of the total 2,250 MW by 2012.

3.0 Benefits to National Economy

3.1 Market characteristics

The second National Energy Basic Plan states that the share of new and renewable energy of primary energy consumption will be 3% in 2006 and 5% in 2011 respectively. For the electricity supply target, wind generation is expected to provide the largest contribution (up to 25% or 5.2 TWh) of the total generation 20.5 TWh by new and renewable sources in 2011. To achieve this goal, the government is providing attractive incentive programs such as the 15-year guaranteed feed-in tariff, tax incentives, and subsidies for the local wind market. Encouraged by the strong government support of R&D programs, several big companies have been participating in wind turbine development projects including component localization. In 2007, as a result of government support in previous years, 750-kW and 1.5-MW wind turbines have been successfully tested and certified by GL and DEWI-OCC respectively.

The Korean wind farm business is still behind schedule and has been slow so far for several reasons. These reasons include the complex system for approval of developments caused by the conflict among existing laws, public acceptance issues, and difficulty in getting permits for grid connection. Also sites are limited because of mountainous onshore characteristics. Coping with all these barriers, more than 550 MW of capacity is currently under development (scheduled through 2009) according to construction permit statistics at the end of 2007.

Table 1 Key Statistics 2007: Korea

Total installed wind generation	193 MW
New wind generation installed	18 MW
Total electrical output from wind	399 GWh
Wind generation as % of national electric demand	0.1%
Target:	2,250 MW by 2012

Table 2 Total Installed Wind Capacity in Korea								
Year	~2001	2002	2003	2004	2005	2006	2007	Total
Capacity (MW)	7.9	4.7	5.4	50	30	77	18	193
Electrical Output (GWh)	32	15	21	48	130	239	399	884

The onshore wind map feasibility study performed by the Korea Institute of Energy Research (KIER) estimates the potential for wind farm development at up to 7.8 GW. In addition to this onshore possibility, the government is supporting an offshore wind map study to determine the expansion potential and take advantage of being a peninsula country. However, offshore wind construction might be challenging due to deep-sea foundation issues, concerns over coastal fishery rights, military radar issues, and environmental issues.

3.2 Industrial development and operational experience

The Korean wind industry is still in its development stage, having only recently gained experience with wind energy – developing turbines and components, constructing wind projects, and operating wind farms. One major private developer in Korea, Unison, operates the two biggest wind farms accounting for 138.6 MW. Unison installed imported wind turbines from VESTAS and contracted for O&M with this foreign manufacturer. Unfortunately, Unison experienced a long-term shut down of several wind turbines during commissioning because defective parts had to be re-imported and delivered to the project. This kind of problem is one reason why local manufacturers and developers are accelerating their efforts to supply the local market and building up in-house technical expertise.

The Korean market was initially formed by companies such as Unison, Hajin, Doosan Heavy Industries, and Hyosung Heavy Industries. The formation of the industrial value-chain or supply-chain for the wind business has been based on the existing infrastructure of utility companies, major ship building heavy industries, and their components sub-contractors. Taewong, Pyongsan metal, and Hyunjin materials hold the biggest share of the world market for hot forging metal parts such as main shafts, tower flanges, and bearing rings. They are

exporting major wind turbine components to Vestas, Enercon, Gamesa, GE Wind, and others. About a half of the world's market for wind turbine towers is also covered by the Korean companies Unison and Dongkuk S&C. Recently, new players such as Hyundai Heavy Industries, Samsung Heavy Industries, and STX engine are entering the market in Korea, with megawatt-scale wind turbines.

4.0 National Incentive Programs

According to the Korean Second Basic Plan, except for energy from wastes, wind energy will supply the biggest portion (9.8%) of the final target for new and renewable sources. In order to achieve this goal, the feed-in tariff system is the most important of the government's incentive policies. Wind generation is eligible for a 15-year feed-in tariff of 107.29 Won/kWh that is scheduled to be reduced by 2% every year after October 2009.

The government also provides subsidies up to 70% to local governments if demonstration projects or stand-alone small wind installations are less than 10 kW. For the installation of a new and renewable facility, 1/10 of the cost is deductible from income or corporation tax for the year. Also, an import tariff rate reduction is applied for stand-alone or grid-connected wind generators and blades. The government also compensates any loss to commercial banks up to a certain portion when long-term project financing to renewable energy construction is offered at lower than commercial rates. A single renewable construction facility can make a proposal to KEMCO for a maximum of 20 million USD that is payable over ten years following an initial five-year grace period.

5.0 R, D&D Activities

A strategic approach called Selection and Concentration has resulted in the selection of PV, wind power, and hydrogen/fuel cell technologies as cost-effective investments. The national goal is for wind technology to be raised

from the current 60–70% level compared to the developed European countries up to about 90% by 2011.

The government's annual budget for wind R, D&D in 2007 was 17.8 million USD, and has been aimed at localizing the manufacturing of MW-size wind turbine systems and their components. Recent government research has been carried out to develop 2-MW onshore and 3-MW offshore turbine models. The research program is also running a 4-MW offshore demonstration project that will be realized in 2009.

This significant government funding has helped establish a wind generator manufacturing industry that can compete with foreign players. Unison developed a 750-kW gearless permanent-magnet generator turbine and Hyosung developed a geared doubly-fed induction generator. Hanjin took a further step by introducing a 1.5-MW wind turbine to the local market. Unison also has developed a geared 2-MW turbine adopting the permanent-magnet generator (Figure 1), while Hyosung devoted itself to a 2-MW geared doubly-fed induction generator wind turbine (Figure 2). Both 2-MW prototypes will be type tested during 2008. Doosan Heavy Industries & Construction, a giant EPC company in power and desalination plants, has been developing a 3-MW offshore model and is scheduled

to fabricate the prototype by mid 2009. This type class Ia turbine adopts an integrated light-weight three-stage gearbox to reduce top head mass. It is equipped with a permanent-magnet generator. The mass production of this turbine is expected during 2010 after successful field testing.

To satisfy recent requests from the wind industry for increased research infrastructure and education programs, the government launched several sponsored programs. The Wind Turbine Technology Research Center aims to develop core technology and infrastructure with industries while training field engineers and technicians. The National Wind Research Laboratory and the Graduate School for Wind Energy are dedicated to research-oriented education programs for the next five years under an initial contract.

6.0 The Next Term

During the next few years, the government is willing to support the installation of domestically manufactured 750-kW and MW-class wind generators as demonstration projects. This support should help local manufactures to install their turbines more widely in several places. Government R, D&D support will also be focused on speeding up the localization of



Figure 1 The Prototype of Unison's 2-MW PMSG wind turbine, U88.



Figure 2 The Hyosung's HS90 2-MW wind turbine.

important turbine components like gearboxes, pitch and yaw systems, and bearings.

The Wind R, D&D Strategy for 2030 published by KEMCO in November 2007, was based on a survey of major developers. The long-term projection for installed wind generating capacity was estimated at about 2,000 MW by 2012, 8,000 MW by 2020, and 14,000 MW by 2030. These numbers comply with the government target of 2,250 MW by 2012.

However, all the barriers mentioned above tend to slow down developing and planning onshore wind farms, which is forcing the Korean government also to set up new incentive programs to stimulate offshore possibility.

Authors: Jong-Deuk Ahn, Korean Energy Management Corporation and Chinwha Chung, Pohang Wind Energy Research Center, Republic of Korea.