Fuel Cells: Highly-Efficient, Decentralized Energy Systems

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Introduction

Fuel cells are electrochemical devices that generate electricity through a chemical reaction between oxygen and hydrogen. Since they generate low levels of noise, less than 1% of the gases they emit are harmful, and yet they are highly energy-efficient, fuel cells are touted as a viable alternative to fossil fuels. In addition, fuel cell facilities do not require a lot of space, increasing their attractiveness as the most suitable energy source in large cities such as Seoul.

National Attention to Fuel Cell Technology & Adoption

Investing in Development of Fuel Cell Technology

Korea has invested heavily in the development of fuel cell technology. The first efforts began back in 1985 when Korea imported the main body of a 5.9kW capacity phosphoric acid fuel cell from Japan for testing. Soon, the nation began developing a 2kW-phosphoric acid fuel cell power generator as part of the nation's 6-Year Development Plan in 1987. Korea began researching polymer fuel cells in 1996 and developing a 6kW fuel cell stack and system for residential application in 2001.

Basis for Fuel Cell Deployment

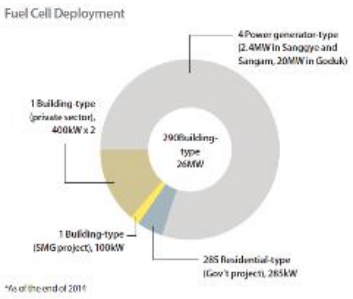
Another milestone was set in 2002 when the private sector succeeded in developing a highly efficient and more compact 1-3kW FC-CHP (fuel cell and combined heat & power) system. The system was further developed and applications for vehicles, homes, power generation, and compact and mobile power sources were made available. This outstanding progress helped form a growing market for fuel cells in Korea.

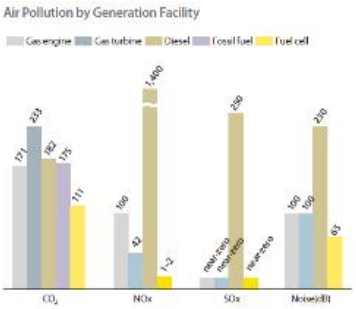
In 2008, the Korean government announced the ambitious 1 Million Green Home Project to mark the 60th anniversary of the establishment of modern Korea. The project aims to have as many as 1 million households in the nation generate energy through renewable energy sources. As a result of vigorous efforts to realize this project, 19,224 households across the country produced 10,157 TOE of energy in 2009 from fuel cells and other renewable energy sources.

Expansion of Fuel Cell Deployment

The government supported to expand fuel cells in the form of Feed-in Tariffs (FIT) from 2006 to 2011.

Renewable Portfolio Standard (RPS), since 2012, has helped with the wide adoption of fuel cells in Korea. As of the end of 2014, there were 22 fuel cell power plants with total generating capacity of 154 MW.





Seoul at the Forefront of Fuel Cell Deployment

In line with the central government's green initiative, the Seoul Metropolitan Government (SMG) announced in April 2007 the Seoul Eco-Friendly Energy Declaration. In it, the SMG pledged its commitment to conserving energy, energy efficiency, renewable energy and appropriate response to climate change. Specific targets in the Declaration include increasing the city's renewable energy share of power generation to 2% by 2010, 10% by 2020, and 20% by 2030, with 700 MW of power to be from fuel cell technology.

Seoul Increases Power Generation from Renewable Energy Sources

Seoul constructed a 2.4MW fuel cell power generation plant in Sanggye in December 2009, and another plant with the same capacity in Sangam in November 2010, followed by a 100kW plant in Children's Grand Park in Gwangjin-gu in February 2012. The SMG's new Guidelines on Calculation of Energy Generated from Renewable Energy Facilities set in July 2013 provides an institutional framework for requiring new residential and commercial buildings of over 500 m² to have installed generators using renewable energy, such as geothermal, PV and fuel cell.

Leveraging Private Sector Capital

The SMG has utilized the central government-initiated RPS as part of the city's One Less Nuclear Power Plant initiative since April 2012. With this, it is making use of idle land such as near water reuse centers and subway train garage space while focusing on leveraging private capital to get the most possible benefit.
To this end, a 19.8MW fuel cell power plant was constructed in October 2014 using idle land in Goduk and another 20MW fuel cell power plant will be constructed at World Cup Park's waste management facility by the first half of 2015.

In addition, a 30MW fuel cell power plant is to be constructed at a water reuse center in Magok, which will be the largest fuel cell park of its kind in the city. The facility is expected to produce 236 GWh per year,

enough to meet the electricity needs of 65,000 households. It should also be able to produce 120,000 Gcal of heat, enough to provide district heating to 10,000 homes.

Expanding the Use of Fuel Cells for Large Buildings

The SMG began requiring that a minimum 6% of energy used for all large new buildings in Seoul be from renewable sources. In 2014, this was increased to 12%, facilitating the widespread adoption of fuel cells from 1 to hundreds of kW in buildings. The minimum requirement will be increased again to 15% by 2015 and 18% by 2018.

Seoul's Renewable Energy Target

Through the use of more fuel cells, the SMG seeks to have renewable energy sources generate enough power to meet the needs of 420,000 households by 2020. Towards this, the second phase of the One Less Nuclear Power Plant initiative began in April 2014, under which a decentralized system of fuel cell facilities will be built with the capacity to generate 195MW.

When construction of the power plants in Goduk, Noeul and Seonam are completed as planned, the total capacity of fuel cell generation in Seoul will be 75MW. This should enable the city to increase its energy self-sufficiency rate from the current 0.7% to 1.2%, a nearly two-fold jump. This accounts for power generation of 590 GWh, enough to meet the electricity needs of 160,000 households as well as 300,000 Gcal of heat for 30,000 households.

The SMG is committed to extensive research on potential fuel cell deployment in energy-inefficient buildings and those located around district energy pipelines while commissioning other research on future directions and other potential for this new form of energy. This focus on research should help with expanding the basis for wider use of fuel cells and formulation of a roadmap to achieve its goals in the long term.