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Review

Climate technology promotion in the Republic of Korea

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Abstract

The implementation of climate technologies and their commercialization ultimately depends on the success of their research and development (R&D) projects. In the Republic of Korea (ROK), twenty-seven climate technologies were selected to boost the greening of existing industries and to develop new green industries to promote a sustainable climate technology development strategy. Rechargeable battery technology, carbon capture and storage (CCS) technology, smart grids, and sewage treatment are all research areas expected to have tangible outcomes in the forthcoming years. As such, they were included in a comprehensive R&D plan for climate technology advancement, which places an emphasis on climate technology development and commercialization strategy. In this study, the R&D plan of the ROK is reviewed by examining its six core climate technology programs: solar cells, fuel cells, bioenergy, rechargeable battery technology, information technology (IT) applications for the power sector, and CCS technology in detail. The climate policy in the ROK aims to find new economic growth engines and to develop new business opportunities while actively participating in international efforts to combat climate change.

Keywords: R&D plan and strategy; Climate technology; The Republic of Korea

1. Introduction

Sustainable development means balancing economic growth and environmental protection while considering social inclusiveness. The needs of the current generation must be met without sacrificing those of the future generation. To mitigate greenhouse gas (GHG) emissions, current strategies involve selecting low-carbon options, increasing renewable energy sources, and promoting the research and development (R&D) of climate technologies. Climate technology refers to technologies that can save energy and resources by actively mitigating GHG emissions and air pollutants. Energy efficiency improvement technology, clean technology, resource recycling, environmentally-friendly technology, and fusion-related technology are various types of climate technologies. The green industry is defined as economic activities that contribute to improving the quality of the environment and energy efficiency. At the 11th Meeting of the National Science and Technology Advisory Council on Climate Change Core Technology Development Strategy, chaired by President Park Geun-hye, the Korean government decided to focus on six key technologies in three areas to combat climate change. According to the United Nations Framework Convention on Climate Change (UNFCCC), the highest global increase GHG emissions between 1990 and 2011 came from Republic of Korea (ROK), due to its high dependence on fossil fuels.

The commercialization of climate technologies will ultimately depend on their R&D success. Hence, twenty-seven climate technologies were selected for improvement because of their potential to "green" existing industries and to develop new green industries. For example, tangible improvements in rechargeable battery technology, carbon capture and storage

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(CCS) technology, smart grids, and sewage treatment are expected in the forthcoming years. Thus, these technologies were included in a comprehensive R&D plan for climate technology (NSTC, 2009), which has an emphasis on climate technology development and commercialization strategy (PCGG, 2009).

Section 2 reviews the climate technology R&D plan and strategies of the ROK by examining the six core climate technology programs in detail. In Section 3, the overall policy direction for the climate technology R&D plans is outlined. In Section 4, the paper is concluded with a discussion of policy implications.

2. Review of R&D programs on climate technology

The current Korean government's climate policy is to overcome the decline in economic growth by shrinking the middle-class and deepening economic polarization. This will be accomplished through the promotion of creative economic strategies that will integrate the Information & Communication Technology (ICT) into the environmental and energy sectors. An emphasis will be placed on the concept of inclusive green growth: seeking harmonious societal growth through social integration and equity, as well as enhanced environmental protection. In 2014, the second 5-year Green Growth Plan was established, in which the roadmap for the systematic implementation of GHG emission reduction, a domestic-emissions trading system, an energy management system, the expansion of carbon sinks and renewable energy as well as a sustainable energy system are well explained (GTC, 2014).

In July 2014, the Korean government chose three key areas, containing six core climate technologies, from which to address the issues of climate change. Three technologies, solar cells, fuel cells, and bioenergy were selected to replace fossil fuel energy production (PACST, 2014). In addition, the development of rechargeable battery technology and IT applications for the power sector were promoted for efficient energy production and consumption. Last, CCS technology is to be employed for the direct reduction of GHG emissions.

Each of the six core technology area has a specific target to achieve by 2020. For example, the cost of solar cell module production is expected to be reduced by 35%. Then, the current generation of solar cells is to be replaced with silicon solar cells. In the case of fuel cell, the commercial battery is expected to have an increased efficiency of 120%, as well as a halved manufacturing cost. For bioenergy, the goal is to reduce the production cost of microalgae biodiesel from 3300 KRW L^{-1} to 1000 KRW L^{-1}. An additional 3000-ton capacity for bioenergy production, including the construction of demonstration plants, should be implemented by 2017. The target for small and medium rechargeable batteries is to achieve a localization of core materials and the enhancement performance. The application of IT technology in the power generation sector is expected to promote energy management system (EMS) for residential and commercial buildings, as well as factories. The price competitiveness for CCS technologies is expected to decrease from US$150 per ton CO_2 to US$30−50 per ton CO_2 in 2020 (EMM, 2015).

The R&D strategy for solar cells technology is to replace the silicon solar cell market, to secure price competitiveness, and to create new markets for the next-generation of solar cells. Investments in the silicon solar cell technology will secure the market competitiveness. The use of silicon semiconductors will reduce the thickness of the wafers, ultimately reducing the production cost by 35%. Increasing the power production efficiency has also been targeted, and will be brought about by manufacturing high-purity silicon. Furthermore, price competitiveness in the market enhanced by reducing the production cost; the cost of raw materials can be reduced through highly efficient production. Non-silicon-based flexible solar cells will replace the existing market and create a new market. The development of next-generation solar cells will be transparent and lightweight and also function as core materials for larger-scale solar cells (GTC, 2014).

The R&D strategy for fuel cells is to become the world's leading fuel cell developer in the transportation fuel cell market. Core materials, such as the electrolytic membrane, the catalyst, and carbon fibers, are to be developed by 2020. By developing production technology for these key components, the cost of production is expected to be reduced by 50%, compared with that for 2013. This production cost reduction will allow for the creation of competitive domestic small and medium enterprises (SME), as well as create jobs in the automotive and shipping industries. Another area for development is high efficiency fuel cell technology, which will be used to reduce thermal power generation. High efficiency batteries created from molten carbonate (MCFC) and solid oxide cells (SOFC), as well as next-generation high-capacity batteries that will improve the efficiency of fuel cell power generation, particularly with respect to thermal power generation via hydrogen mass production and storage capacity, are required (GTC, 2014).

The R&D strategy for bioenergy is to develop a stable supply of raw materials to reduce oil consumption. This stable supply will arise from the development of microalgae extraction technology, in particular, the development of a catalyst to increase the mass production conversion rate. The R&D strategy for alternative biofuels has been based on domestic petrochemical technologies, in partnership with the domestic petrochemical industry, and will substitute overseas bio-resources, leading to a world-class bioenergy country (GTC, 2014).

The R&D strategy for rechargeable battery development is to create rechargeable batteries for phones that have advanced capabilities and a localization of key components and materials. This in turn will induce innovation and global competitiveness within the area of eco-friendly cars. The clear target for the technological development in this area is to substitute approximately 40% of the imported parts and materials with domestic components. The development and commercialization of a large-capacity rechargeable battery is to back-up the power supply. The new rechargeable battery technology will

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