



Korea's Green Transition (1): High Volume, Low Impact Innovation?

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As global demands for addressing the climate crisis and building a sustainable economy intensify, the importance of climate technologies is becoming prominent in the transition to a carbon neutral economy where net carbon emissions are 'zero'. Climate technologies are technologies that reduce greenhouse gases and adapt to climate change while generating economic returns, serving as a key element supporting the transition to carbon neutrality. Climate technology innovation provides opportunities to minimize economic contraction and create new growth engines during the transition.

Table 1. Classification of Climate Tech

	Content	Representative Technology Fields	Examples
Energy Supply Tech	- Supply of low-carbon energy	▶ Renewable Energy	- High-efficiency solar cells - Floating offshore wind system
Enabling Tech	- Storage and transport of low-carbon energy - Storage and transport of low-carbon energy	▶ Secondary Batteries ▶ Hydrogen Fuel ▶ CCUS	- Secondary battery modules and systems - Hydrogen storage and transportation - Direct air capture
Enabling Tech	- Transition to low-carbon energy and raw materials - Improvement of energy consumption efficiency - Climate change adaptation	▶ Electric Vehicles (EVs) ▶ Chemical and Oil Refining Production Process ▶ Steel and Mineral (Cement) Production Process ▶ Information and Communication Technology (ICT)	- Electric drive motors for large trucks - Eco-friendly biomaterials - Hydrogen reduction steel-making - Low-power semiconductors

Note: 1) Selected considering the government's 「100 Core Technologies for Carbon Neutrality」 (May 2023), Korea's core technology fields, and the necessity of technology development (use in major export industries, core promising technologies, etc.). For detailed information on all climate technology fields, refer to IEA (2020).

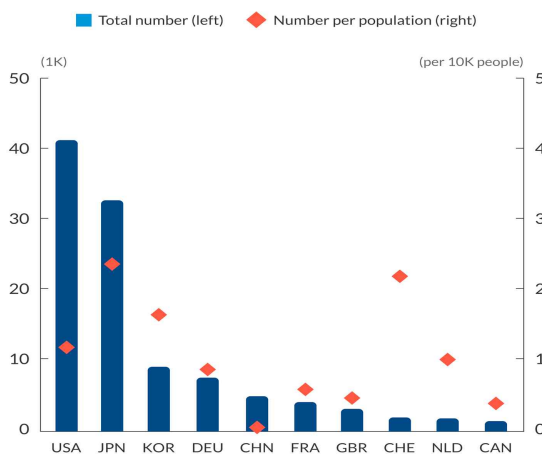
Source: Reorganized from IEA (2021b)

[Key Finding 1] Korea Ranked Third Globally in Climate Tech Innovation by Patent Counts

Comparing major countries' climate technology innovation performance based on patent application numbers, Korea showed quantitatively favorable results. Analysis of patents registered with the U.S. Patent and Trademark Office shows that Korea's climate technology patent applications ranked third globally between 2011-21, placing it among the world's top tier. Even after adjusting for population size, Korea recorded 1.6 patents per 10,000 people, ranking fourth globally after Luxembourg (3.0), Japan (2.3), and Switzerland (2.2). Furthermore, while the United States and Japan have shown stagnation or decline since the early to mid-2010s, Korea has continued to increase steadily until recently.

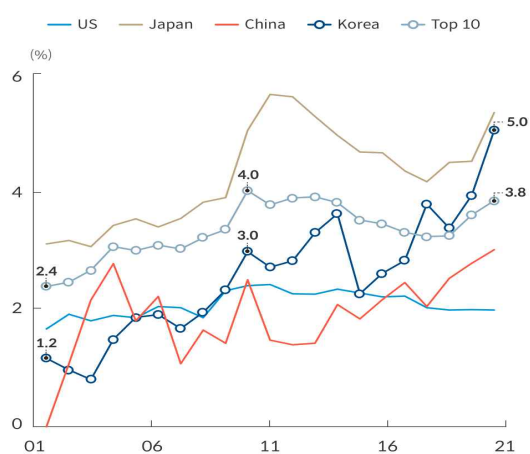
Korea's innovation performance in the climate technology sector has been increasing at a faster pace compared to other technological fields, reflecting the global trend of intensified responses to the climate crisis. Analyzing the share of climate technologies within total patent applications by country, the average for the top 10 leading countries rose from 2.4% in 2001 to 4.0% in 2010 but slightly declined to 3.8% in 2021. In contrast, Korea's share steadily increased from 1.2% in 2001 to 3.0% in 2011, reaching 5.0% in 2021.

Figure 1. 2011–2021 Total Number of Patent Applications in Climate Tech



Note: 1) Based on Patents Registered with the USPTO
 2) Country labels are ISO alpha-3 codes
 Source: USPTO, OECD STI Micro-data Lab, Own Calculations

Figure 2. Share of Climate Tech Patents in Total Patent Applications by Country



Note: 1) Based on Patents Registered with the USPTO
 Source: USPTO, OECD STI Micro-data Lab, Own Calculations

[Key Finding 2] Climate Tech Innovation Highly Concentrated in Few Companies and Technologies

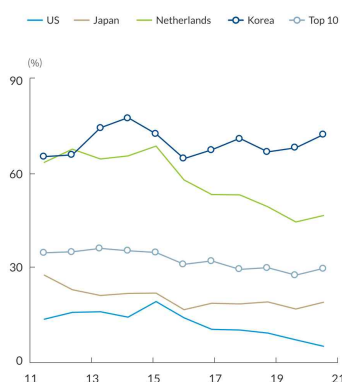
The top four companies in Korea accounted for 72.1% of climate tech patent applications (as of 2021), significantly exceeding the average of 29.7% among the top 10 leading countries.

Korea's climate tech innovation also exhibited striking concentration patterns across technological fields. Analysis of climate tech patent applications by technology field from 2011-21 shows that renewable energy (7%) dominated in energy supply technologies, secondary batteries

(44%) in enabling technologies, and electric vehicles (7%) and information and communication technology (ICT, 7%) in end-use technologies.

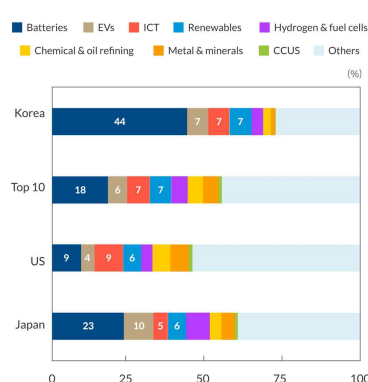
Notably, Korea shows significantly low innovation performance in both carbon-intensive core export industries and promising climate tech fields that require active innovation promotion. The refinery, chemical, and steel industries accounted for 8.2%, 7.2%, and 5.6% of export customs clearance respectively in 2023, establishing themselves as key export industries following semiconductors (15.6%) and automobiles (11.2%). However, these are carbon-intensive industries that contributed 10.6%, 23.2%, and 35.5% respectively to total industrial greenhouse gas emissions as of 2022. Nevertheless, Korea remains at relatively low levels in terms of global patent application shares for carbon reduction technologies in chemical, refinery, and steel industries, as well as in Carbon Capture, Utilization, and Storage (CCUS) technologies.

Figure 3. Top Four Firms' Share of Climate Tech Patents by Country



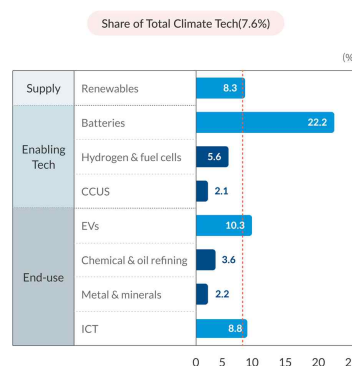
Note: 1) Based on Patents Registered with the USPTO
Source: USPTO, OECD STI Micro-data Lab, Own Calculations

Figure 4. echnology Share of Climate Tech Patent Applications (2011–2021)



Note: 1) Based on Patents Registered with the USPTO
2) CCUS refers to Carbon Capture, Utilization, and Storage technology
Source: USPTO, OECD STI Micro-data Lab, Own Calculations

Figure 5. Global Share of Korea's Climate Tech Patent Applications by Key Technology Fields (2011–2021)



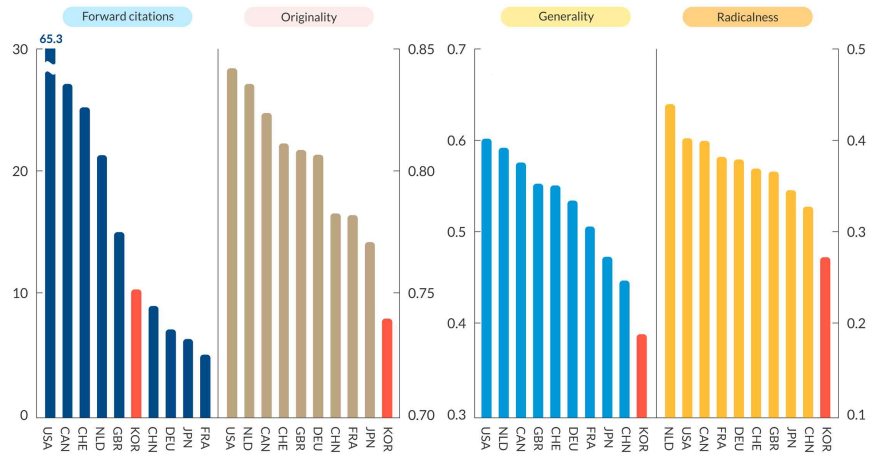
Note: 1) Based on Patents Registered with the USPTO
2) CCUS refers to Carbon Capture, Utilization, and Storage technology
Source: USPTO, OECD STI Micro-data Lab, Own Calculations

[Key Finding 3] Climate Tech Innovation Quality Remains Inadequate

Comparative analysis of climate technology patent quality across countries from 2011-21 shows that Korea exhibits significant deficiencies in subsequent impact (forward citations per patent), originality, and generality.

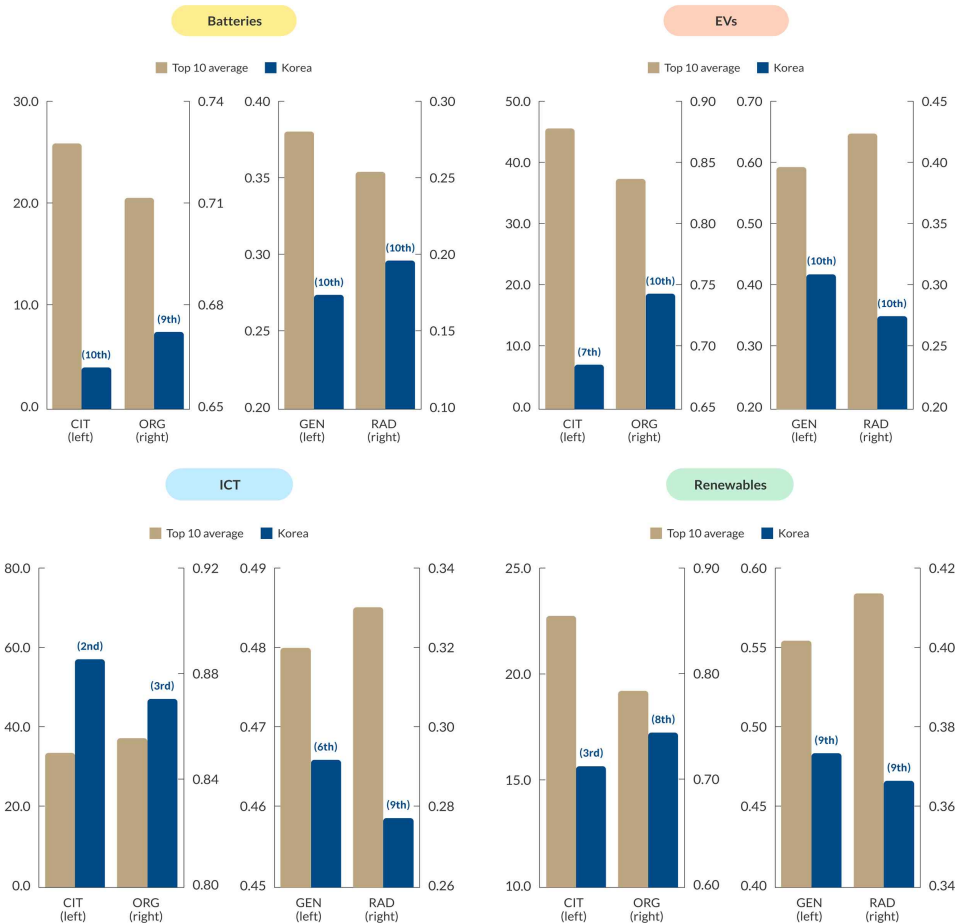
Even in Korea's core technology areas such as secondary batteries, electric vehicles, and renewable energy, most qualitative patent evaluation indicators remained in the lower ranks among the top 10 leading countries (countries with the highest number of patent applications), showing significantly inadequate qualitative competitiveness compared to quantitative performance. These findings suggest that Korea's climate technology innovation has focused primarily on incremental innovations aimed at defending market share or countering competitors, rather than pursuing disruptive innovations that create new products or markets.

Figure 6. Qualitative Indices of Climate Tech Innovations by Top 10 Leading Countries (2011–2021)



Notes: 1) Based on patents registered with the USPTO
 2) Country labels are ISO alpha-3 codes
 3) Top 10 countries by the number of climate tech patent applications
 4) The number of citations per patent within 5 years
 Source: USPTO OECD STI Micro-data Lab, own calculations

Figure 7. Qualitative Indices of Major Climate Technology Sectors (2011–2021)



Notes: 1) Based on patents registered with the USPTO
 2) CIT, ORG, GEN and RAD indicate forward citations per patent, originality, generality, and radicalness, respectively.
 3) The numbers in parentheses indicate Korea's ranking among the top 10 leading countries by the number of patent applications in each technology field.
 4) Citations mean number of citations per patent (within 5 years)
 Source: USPTO, OECD STI Micro-data Lab, own calculations