A comparison of green energy technology index by country

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Overview

Global issues are related to energy such as fossil energy depletion and global warming. Also, according to the OECD environmental Outlook to 2050, it is expected that the world population will have increased to 9 billion people and world energy consumption will have increased by over 80 percent by 2050 with the world economy growth. So, energy issues for the sustainable development need to be addressed. Therefore, the importance of green energy technology is increasing. With that in mind, this research aims to measure technological competitiveness index on green energy technology by countries. In this research, energy technology competitiveness analysis was conducted by patent analysis index about solar cell, fuel cell and CCS. Also, expert survey was conducted on ways to strengthen competitiveness. A patent is considered an important measure in gauging technological innovation (OECD, 1994). Patents include detailed technological information and various bibliography information, so many studies have been performed utilizing patents. Likewise, many studies identifying technology development trend, or measuring technological competitiveness were conducted using patents, and this research will also use patent analysis method to compare technology competitiveness in phovoltaic, fuel cell, and CCS fields.

Methods

WIPS was used as data for patent analysis, and patents that were registered and disclosed in the U.S. for the past 10 years (2001~2010). Patents were extracted by searching key words by technologies, and the same patents as application technology among extracted patent data were removed with noise reduction. Among many indexes in patent analysis, CPP[1], PII[2], PFS[3] and PSI[4] were used for comparison by nations (Korean Intellectual Property Office, 2005) in this research. CPP uses citation information of patents to show how much patents affect technology development.[5]

n_t is the number of patent, and Ci is the number of forward citation of each patent. PII is key index to estimate the quality of the patent. PII is an indicator for evaluating patents' quality, and calculated by using CPP value. And PII uses CPP to show how much patents are important.

$$PII_i = \frac{CPP_a}{CPP_t} \qquad (1)$$

The PII_i is PII value of i country. CPP_t is the average number of forward citation in the technology sector. And CPP_a is the average number of forward citation in a certain country. PSI may be used to TS index. PSI considers the quality and quantity of patents, and is calculated by multiplying PII by the number of patents.

$$PSI_i = PII_i \times N_i \qquad (2)$$

The PSI_i is PSI value of i country. PIIi is the value of PII in a certain country. And Ni is the total number of patent in certain country. Finally using information on the nations where patents were registered, PFS shows the importance of the patentse in terms of commerce, and security of market.[6]

[1] Cites per Patent
[2] Patent Imact Index
[3] Patent Family Size
[4] Patent Strength Index
[5] CPP is the average number of citations in certain country's patents.
[6] PFS is the average number of registered country in certain country's patents.

With above patent analysis indexes, this research compares the competitiveness of green energy technology by nations. Also, through expert survey by technologies, the cause of difference in technological competitiveness among nations and plans for enhancing the technological competitiveness were examined, providing suggestions.

Results

The result of photovoltaic field analysis showed that the U.S. topped the list with 4.633 in CPP, while Korea was 0.845, lower than the U.S., Japan, Austrailia, Germany, and Canada. As for FPS, the U.S. was the highest (19.008), and Austrailia(13.500), Germany(9.833), England(9.000) were in the higher rank. Korea (4.792) was higher than China, but much lower than other advanced nations. As for PSI, the U.S. scored the top(334.255), Japan was 63.718. Korea was 8.239, lagging far behind the U.S. and Japan. The result of fuel cell field analysis showed that China has the highest CPP(4.100), the U.S., 1.923, Canada, 1.922. Korea was 4.368. PSI, which considers the quality and quantity of patents, were the highest in the U.S.(734.579), Japan(209.679) and Korea(42.313) were in the higher rank. The result of CCS analysis suggested that the U.S. (3.430) ranked the highest, followed by Korea(1.950), France(1.629), and Canada(1.370). The U.S., also topped in PFS with 12.330, and England and Japan were in the higher ranks. On the other hand, Korea was at the bottom of the list. As for PSI, the U.S., overwhelmed other nations with 646.895, France, 23.433, and Japan, 10.557. Korea was 5.993, lower than Germany, but higher than England. After analyzing patents in 3 technology sectors, it is shown that Korea's technological competitiveness is generally low. Korea ranked in the middle to the bottom in the case of PSI, which considers the quality and quantity of patents, implying efforts to reinforce technological competitiveness should be made.

The reasons behind the differences in technological competitiveness were examined through the expert survey. In the photovoltaic sector, the main reasons for the differences were lack of R&D personnel and insufficient R&D base. Experts answered that R&D budget should be increased to resolve the problems. In the fuel cell sector, major reasons were lack of R&D fund and efforts to commercialize technologies. R&D budget increase was suggested as a solution. As for CCS, insufficient policy measures by the government and lack of efforts to commercialize technologies were counted as main causes. R&D investment increase and nurturing experts were proposed as solutions.

Conclusions

This research examined technological competitiveness of patents that are registered to or opened in the U.S. for the past 10 years. The result shows that Korea's technological competitiveness is still low. As for PSI, Korea was 8.239 in PV. The result of fuel cell field analysis showed that Korea was 42.313. Finally The result of CCS analysis suggested that Korea was 5.993. To strengthen green energy competitiveness, R&D budget should be actively increased and policies for nurturing experts should be established.

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