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Estimation of Greenhouse Gas (GHG) Reductions from Solar Cell Technology Using Bottom-up Approach and Scenario Analysis in South Korea

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Abstract : Solar cell is one of the main technologies to reduce greenhouse gas (GHG). Thereby, accurate estimation of greenhouse gas reduction by solar cell technology is crucial to consider strategic applications of the solar cell. The bottom-up approach using operating data such as operation time and efficiency is one of the methodologies to improve the accuracy of the estimation. In this study, alternative GHG reductions from solar cell technology were estimated by a bottom-up approach to indirect emission source (scope 2) in Korea, 2015. In addition, the scenario-based analysis was conducted to assess the effect of technological change with respect to efficiency improvement and rate of operation. In order to estimate GHG reductions from solar cell activities in operating condition levels, methodologies were derived from 2006 IPCC guidelines for national greenhouse gas inventories and guidelines for local government greenhouse inventories published in Korea, 2016. Indirect emission factors for electricity were obtained from Korea Power Exchange (KPX) in 2011. As a result, the annual alternative GHG reductions were estimated as 21,504 tonCO2eq, and the annual average value was 1,536 tonCO2eq per each solar cell technology. Those results of estimation showed to be 91% levels versus design of capacity. Estimation of individual greenhouse gases (GHGs) showed that the largest gas was carbon dioxide (CO2), of which up to 99% of the total individual greenhouse gases. The annual average GHG reductions from solar cell per year and unit installed capacity (MW) were estimated as 556 tonCO2eq/yr•MW. Scenario analysis of efficiency improvement by 5%, 10%, 15% increased as much as approximately 30, 61, 91%, respectively, and rate of operation as 100% increased 4% of the annual GHG reductions.

Keywords : bottom-up approach, greenhouse gas (GHG), reduction, scenario, solar cell
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