Carbon footprint analysis of electricity production from hard coal taking into account CO2 removal technology

Summary

The main purpose of this study was to analyze the amount of greenhouse gases emitted into the environment generated during the fuel and electricity production, including the entire chain of technological operations of the Carbon Capture and Storage as well as Carbon Capture and Utilization processes. An original method of carbon footprint calculation of electricity production which takes into account CO2 removal technology is presented in the dissertation. Carbon footprint analyses were carried out for three cases: conventional coal-fired power plant, coal gasification plant (SNG gas production) and coal gasification plant (electricity production). The calculations considered the process of hard coal extraction and production of other materials used in the production of the electricity, the process of transporting materials to the power plant (via conveyor belt, road transport and rail transport) and the process of electricity production. In addition, each of the above installations was equipped with CCS and CCU technology. Overall, nine analyses of the amount of greenhouse gases emitted into the environment generated throughout the entire electricity production cycle. The final part of this dissertation contains the results of public awareness research on CO_2 CCS removal technology.

Based on the results of analysis it can be concluded that the main thesis of this work was proven i.e. CCS and CCU technologies are not “zero-emission”. CCU technology generates the lowest amount of greenhouse gases when considering all phases of the process. Both CCU and CCS do not reduce completely carbon emission but remove carbon dioxide only during the process of energy generation. Emission from other processes remain at the same levels. Two major source of emission can be identified: material production and electricity generation. Emissions from transport to power plant is negligible. Proposed calculation methodology show that carbon footprint of 1 GJ energy generation in conventional power plant is equal to 3 100 kg/GJ whereas typical values calculated by the National Centre for Emissions Management gives a value of 94 kg/GJ.