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Towards the Paris Agreement – negative emission and what Korea can contribute

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Energy from fossil fuel comprises more than 80% of the total energy consumption in Korea. While aiming at ambitious renewable energy targets, Korea is also investigating the option of carbon capture and storage (CCS) – especially applied to emissions from the conversion of coal to energy. Two CCS pilot plants linked to existing coal plants are in the pipeline – one in the Gangwon Province (north east Korea) and another one in Chungnam Province (in the west of Korea). The final target is the capturing of one million tons of CO_2 per year. The best storage options for CO_2 have been identified offshore Korea, with the Ulleung Basin, off the east coast of Korea, considered to feature the greatest potential. Kunsan Basin, off the west coast, is considered another optional site.
The objective of this study is to analyze Koreas's negative emissions potential through BECCS (bioenergy combined with CCS) created under the assumption that the two CCS pilot plants were retrofit for cofiring biomass from sustainable domestic forest management and coal. Various scenarios include inter-alia additional green field plants for BECCS. In a first step, national and global biophysical forest models (e.g. G4M) are applied to estimate sustainable biomass availability. In a second step, the results from these forest models are used as input data to the engineering model BeWhere. This techno-engineering model optimizes scaling and location of greenfield heat and power plants (CHP) and related feedstock and CO_2 transport logistics. The geographically explicit locations and capacities obtained for forest-based bioenergy plants are then overlaid with a geological suitability map for in-situ carbon storage which can be further combined with off-shore storage options. From this, a theoretical potential for BECCS in Korea is derived. Results indicate that, given the abundant forest cover in South Korea, there is substantial potential for bioenergy production, which could contribute not only to substituting emissions from fossil fuels but also to meeting the targets of the country's commitments under any climate change mitigation agreement. However, the BECCS potential varies with the assumptions underlying the different scenarios. Largest potentials can be identified in a combination of retrofitted coal plants with greenfield bioenergy plants favoring off-shore CO_2 storage over on-shore in-situ storage. The technical assessment is used to support a policy discussion on the suitability of BECCS as a mitigation tool in Korea.