SUSTAINABLE BECCS PATHWAYS EVALUATED BY AN INTEGRATED ASSESSMENT MODEL

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Negative emissions technologies, particularly Bioenergy with Carbon Capture and Storage (BECCS), are key components of mitigation strategies in future socio-economic scenarios that aim to keep mean global temperature rise below 2°C above pre-industrial, which would require net negative carbon emissions in the end of the 21st century (IPCC, 2013; Fuss et al., 2014). Also, in the context of Paris agreement from COP21, which denotes “a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century”, RD&D of the negative emissions technologies in this decade has a crucial role for the early deployment of them. Because of the requirement of potentially extensive use for land and water for producing the bioenergy feedstock to get the anticipated level of negative emissions, researches on how to develop sustainable scenarios of BECCS is crucial.

Here, we present BECCS deployment scenarios that consider interaction of economically viable flow of bioenergy system including power generation and conversion to liquid and gaseous fuels for transportation and heat, their carbon balances, biophysical limit of bioenergy productivity, and food security. In the modelling process, detailed bioenergy representations, i.e. various feedstock and conversion technologies with and without CCS, are implemented in an integrated assessment (IA) model GRAPE (Global Relationship Assessment to Protect the Environment). Also, to overcome a general discrepancy about assumed future agricultural yield between 'top-down' IA models and 'bottom-up' estimates, which would crucially affect the land-use pattern, we applied yields change of food and energy crops consistent with process-based biophysical crop models in consideration of changing climate conditions. Using the framework, economically viable strategy for implementing sustainable bioenergy and BECCS flow are evaluated in the emission scenarios targeting to keep global average temperature rise below 2°C and/or 1.5°C above pre-industrial.