

Global and Regional Potential for Biomass Energy with Carbon Capture and Storage

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ABSTRACT

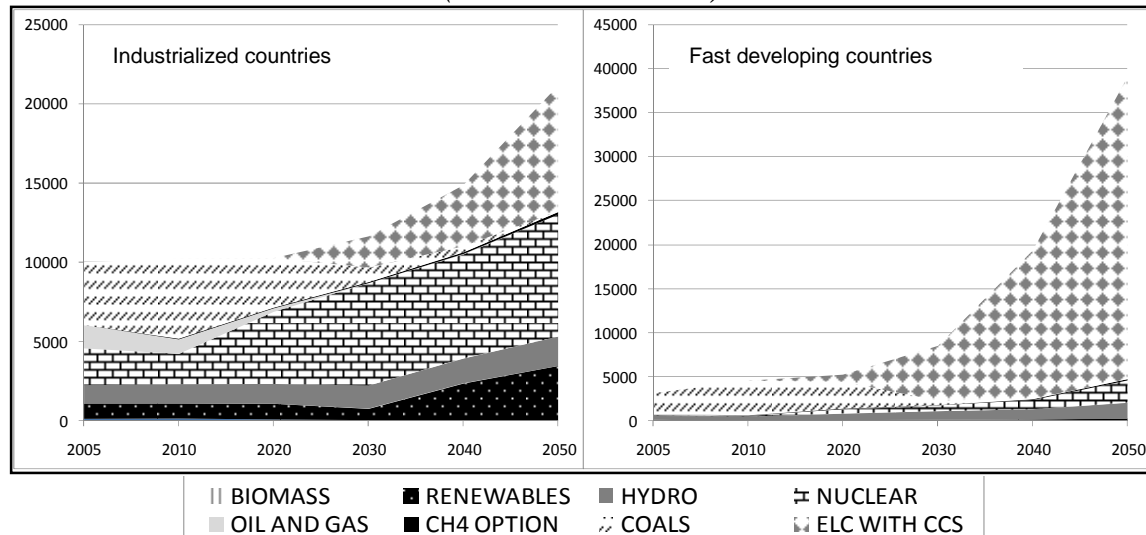
Among technological options to mitigate greenhouse gas (GHG) emissions, Biomass Energy with Carbon Capture and Storage technology (BECCS) is gaining increasing attention. This option offers a unique opportunity for a net removal of atmospheric CO₂ while it fulfills energy needs [1]. Considering that carbon from biomass is neutral (because it is included in the natural carbon cycle), BECCS can lead to “negative emissions”, given sustainable biomass harvesting practice and the permanent geological storage of CO₂. A growing body of literature using bottom-up energy models shows that BECCS has an important role to play in the future energy mix [2] [3] [4]. Most of those studies focus on BECCS global potential whereas it is of interest to understand where this mitigation will be deployed. This key issue will strongly depends on regions’ biomass resources and storage sites endowment. The aim of this study is to assess the global and regional potential of BECCS up to 2050 and to compare it to the deployment of CCS in the power generation.

This analysis is conducted with the global multiregional TIAM-FR optimization model (the French versions of the TIMES Integrated Assessment Model) developed under the Energy Technology Systems Analysis Programme (ETSAP) of IEA [5]. It is a technology-rich, bottom-up energy system model. It depicts the world energy system with a detailed description of different energy forms, resources, processes/technologies and end-uses in 15 regions. The main outputs of the model are future investments and activities of technologies for each time period. Furthermore, the structure of the energy system is given as an output, i.e. type and capacity of the energy technologies, energy consumption by fuel, emissions, energy trade flows between regions, transport capacities, a detailed energy system costs, and marginal costs of environmental measures as GHG reduction targets.

To analyze possible alternative development paths of the system we investigated a global environmental scenario with distinct constraints on the deployment of CCS and BECCS technologies. It consists in reducing world CO₂ emissions by 85% by 2050 compared to 2000 (objective consistent with the IPCC recommendations to keep temperature increase below 2°C).

The first result highlights the distinctive deployment of CCS (included BECCS) technologies according to industrialized and fast developing countries. The response to the climate constraint appears also specific if we focus on the situation of developing countries with a higher share of hydro on the power mix but an also important place of CCS investments.

Electricity production (TWh) for industrialized and fast developing countries in the global 85% scenario (without CCS constraint)



Power generation by bio plant with CCS in 2050 represents 26% in USA and 21% in Western Europe of the electricity production with CCS, against 4.6% in China where CCS deployment concern more coal plant (83%) and co-firing plant (12%). The development of bio plant with CCS knows an important increase in developing regions as Africa, Central and South America and Asian developing countries.

More than 90% of world CO₂ emissions are stored in deep saline aquifers, especially in China. In industrialized countries, others types of sites are used as enhanced coalbed methane recovery or depleted oil field. But whatever the region, it will be necessary to discuss the plausibility of sequestration potential as the plausibility of biomass expansion.

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