Bio-energy and carbon capture and storage (BECCS) in low-emission scenarios

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Background

An increasingly active debate in the scientific community revolves around the possibility that using **bio-energy in combination with carbon capture and storage** (BECCS) could put CO_2 emissions into negative territory. In the face of increasing pressures to reach and maintain low levels of stabilization, BECCS actually turns out to be a substantial ingredient in any **low emission mitigation portfolio**. However, many obstacles and uncertainties remain both in the **techno-economic** and **biophysical** dimension and in terms of **public perception** and **incentivization**. In this joint IEA-IIASA research, we zoom into both opportunities and difficulties of BECCS and offer insights for certain key countries such as **Indonesia**.

Research Questions

- What are the main challenges for BECCS adoption and what are the opportunities?
- How can we provide incentives for BECCS?
- Can we offer insights into BECCS potentials in specific countries such as Indonesia?

BECCS Challenges & Opportunities

BECCS experts workshop at IIASA in November 2011:

Factors perceived as main obstacles to a large-scale diffusion of BECCS named by the experts:

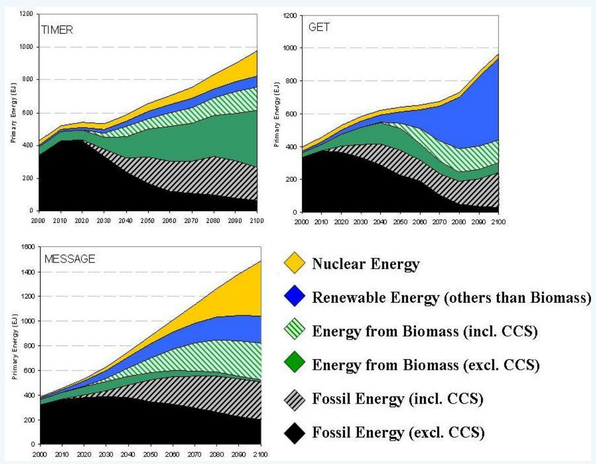
(1) Biomass availability (regional vs. central)
(2) Amounts
(3) Costs of both capture and storage
(4) Availability of storage capacity
(5) Accountancy issues GHG calculations
(6) Lack of awareness of policy-makers

Policies suggested to overcome these obstacles:

Create price advantage for non-food competing biomass ○ Decrease fossil fuel subsidies while supporting subsidies for sustainable bioenergy production on marginal land ○ Reducing barriers to a global biomass market
Support for demonstration projects ○ Subsidies and other incentive mechanisms ○ Stimulate capacity building, facilitating demo's (removing bureaucrat hurdles, tax incentives, etc.) ○ Risk guarantees
Full scale commercial projects ○ Promote carbon market ○ Portfolio standardsand clarifying (% BECCS) ○ Enhance international cooperation
Explore international funding mechanisms ○ CDM ○ NAMAS ○ REDD+
Storage capacity: IEA harmonization of assessment requirements and methodologies
Accountancy issues: standardize international GHG mechanisms
Sustainability reporting should be mandatory
Bridging the science-policy gap through stakeholder engagement

BECCS as a mitigation tool: open issues

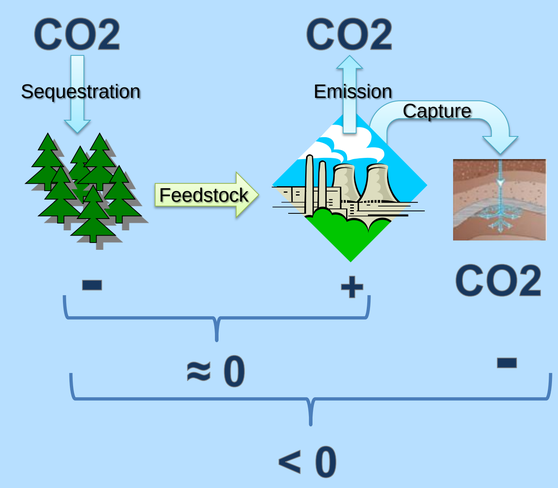
- Overshooting
- Climate science assumptions
- Timing issues
- Lifecycle emissions across the supply chain
- Incentive mechanisms
- Funding and costs
- Impact on health, the environment & public acceptance
- The role of BECCS in different technology contexts: a portfolio view
- Economic considerations: Enhanced Oil Recovery? Abatement alternatives?



Adapted from Azar C., K. Lindgren, M. Obersteiner, K. Riahi, D.P. Vuuren, K.M.G.J. Elzen, K. Möllersten, and E.D. Larson, "The feasibility of low CO2 concentration targets and the role of bio-energy with carbon capture and storage (BECCS)," Climatic Change, vol. 100, 2010, pp. 195-202.

What is BECCS

The BECCS concept revolves around using biomass to produce bio-energy, then capturing and diverting the CO_2 produced during combustion/processing into a long-term geological storage facility. Injection of CO_2 in suitable geological reservoirs, which could lead to permanent storage of CO_2, is the most mature of a variety of storage methods including both onshore and offshore, or conversion into solid materials through mineralization, biomass cultivation among other processes. A number of pilot capture and storage projects are already in operation e.g. in Canada, the US and Scandinavia.



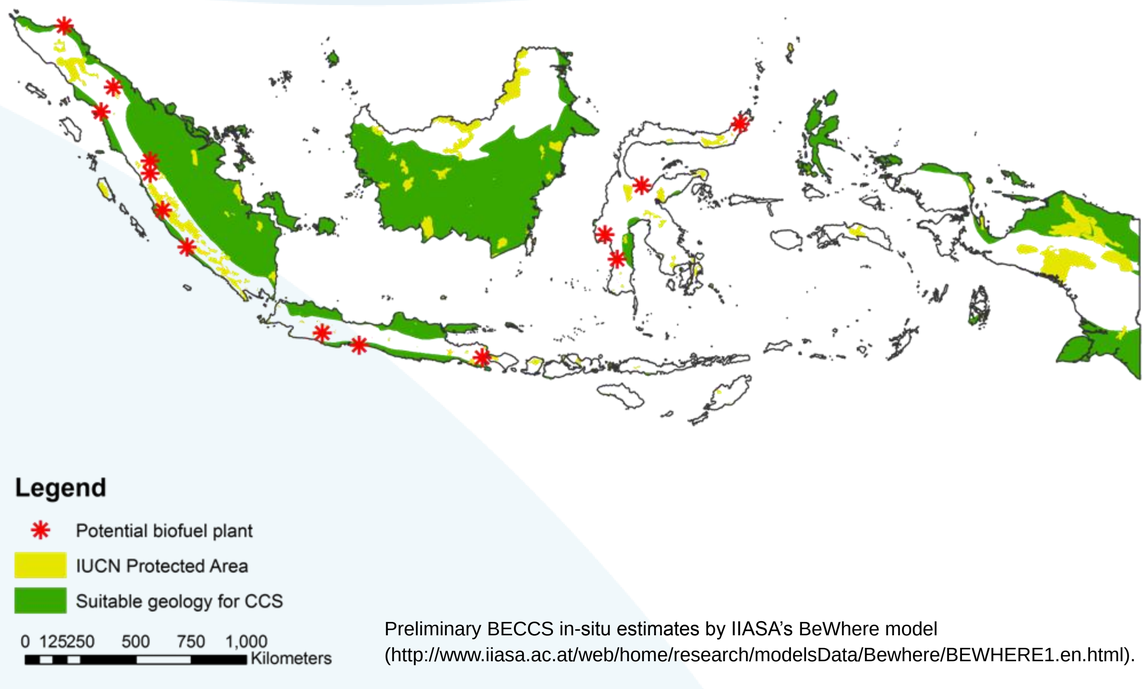
A combination of bio-energy technologies together with CCS could therefore decrease costs and increase attainability of low stabilization levels, producing a "negative emissions" situation and thus achieving a double dividend: CO_2 fixation by photosynthesis (i.e. bio-energy under certain criteria, is considered to be carbon neutral) plus capture and storage of CO_2 from biomass combustion (negative emissions). To quote the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), BECCS is "a potential rapid-response prevention strategy for abrupt climate change."

Case Study: BECCS in Indonesia

Indonesia has seen a large expansion in **biofuel production** over recent years (IEA, 2011). It also features two more characteristics, which makes it attractive for BECCS. Indonesia has **large offshore sequestration sites**. Government studies examine the role of **CCS in EOR and EGR** activities (Lemigas, UK, Shell 2008) in conjunction with significant industrial bioenergy plantations.

Based on current policy Indonesia's energy mix is largely reliant on oil (43%), coal (34.5%) and gas (18.5%) with less than 5% in non-fossil energy. With an annual growth of energy consumption of 7%, and more than 30% of households still to be electrified amid limited national resources, **bioenergy** may play a significant role in Indonesia's carbon mitigation scheme and energy security, as the government aims to **reduce Indonesia's dependence on fossil fuels**.

Preliminary results (see map below) delineate the technical potential for BECCS Indonesia. However, at the 2012 BECCS workshop in Jakarta co-organized with the Republic of Indonesia's Ministry of Energy and Mineral Resources (KESDM), the President's Delivery Unit for Monitoring and Oversight (UKP4), the School of Business & Management at Bandung Institute of Technology (SBMITB), IEA and IIASA, the need for **integrated analysis with focus on socio-economic and ecological co-benefits** such as rural development and implications for conservation of biodiversity came strongly forward. Further research will also explore synergies with efforts to **reduce deforestation** and support for **sustainable forest management**.



Preliminary BECCS in-situ estimates by IIASA's BeWhere model (http://www.iiasa.ac.at/web/home/research/modelsData/Bewhere/BEWHERE1.en.html).