Negative Emissions Potential for BECCS

Results from the Laxenburg Workshop
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Workshop on Bio-energy & CCS (BECCS): Options for Brazil
13 June 2013
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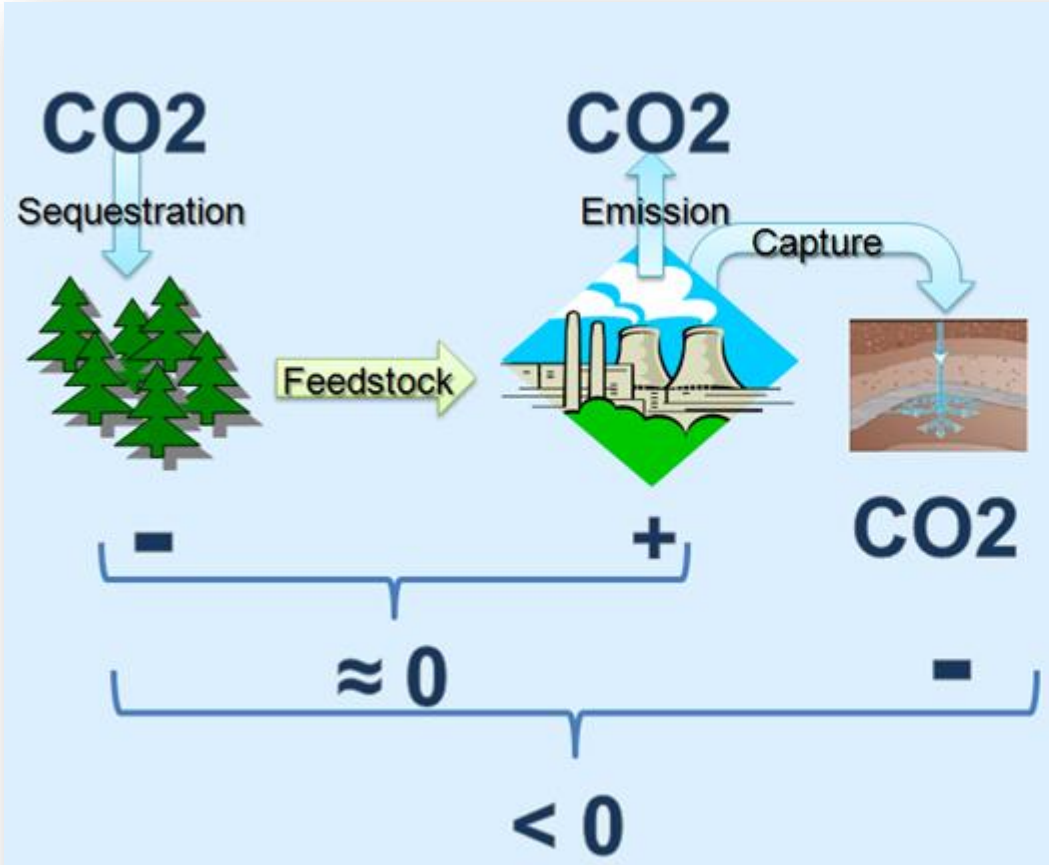
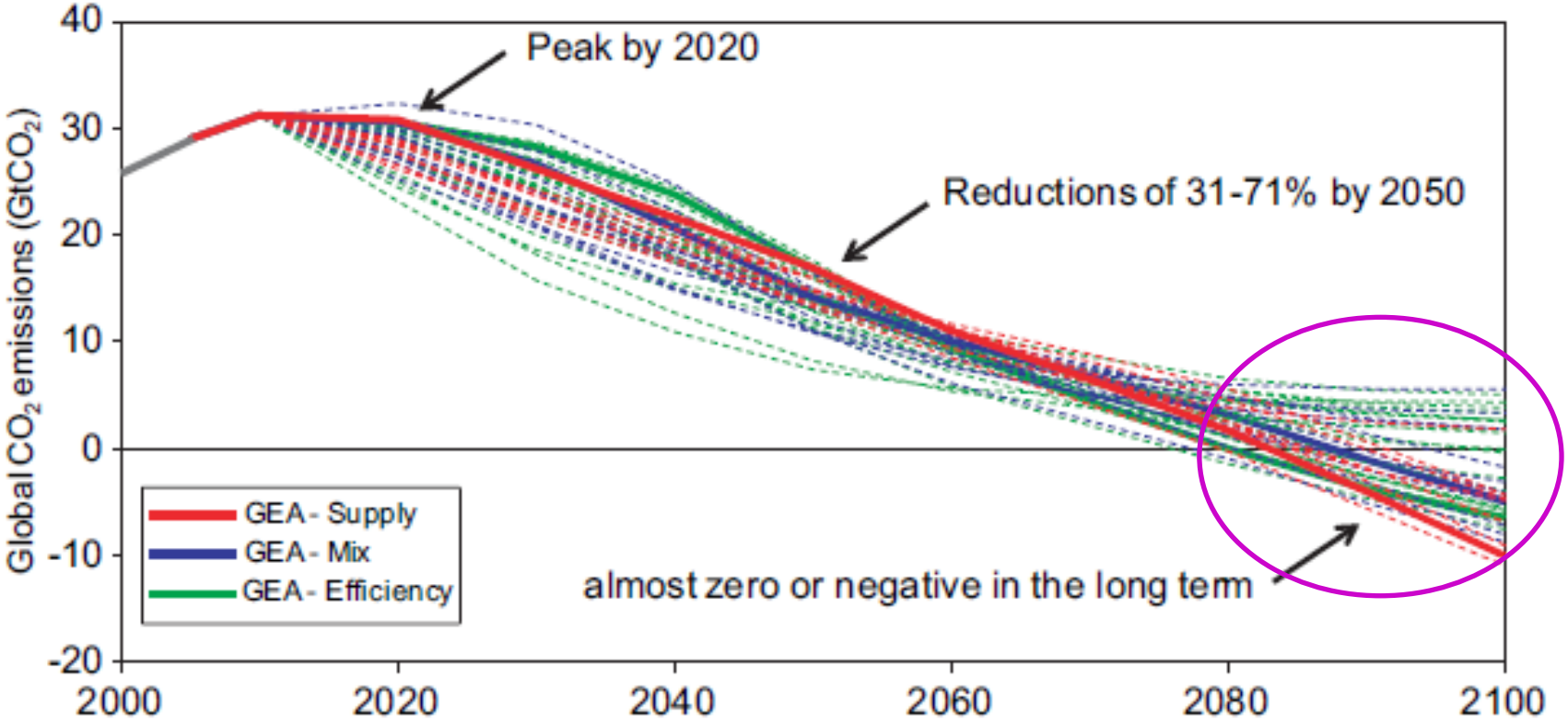
The BECCS Concept



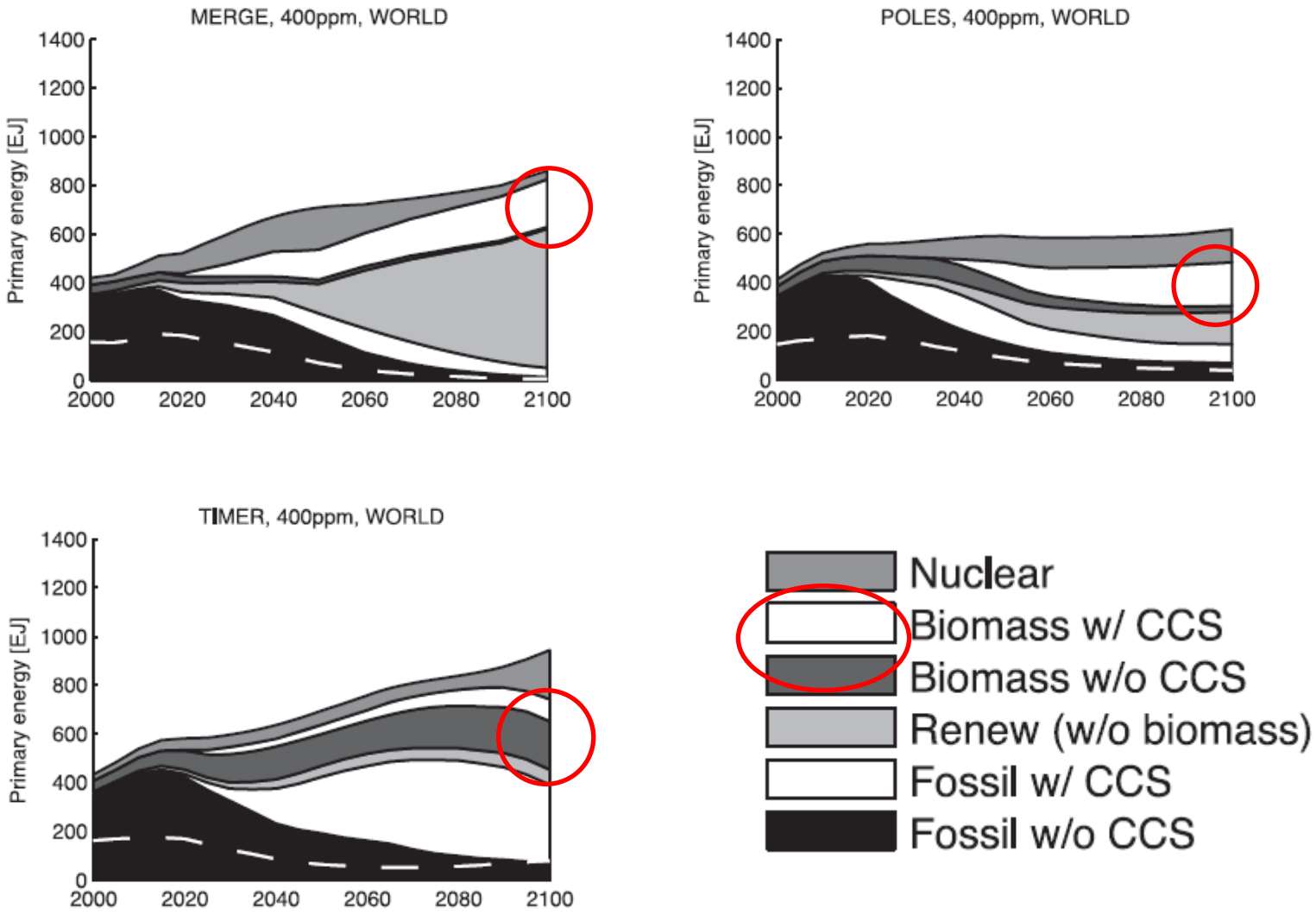
- BECCS uses biomass to produce bio-energy
- Then captures CO_2 produced during combustion/ processing into long-term geological storage facility
- This could decrease costs and increase attainability of low stabilization levels through "negative emissions" situation

Negative emissions to reach 2°C



Source: Global Energy Assessment, Chapter 17, Fig. 17.37, 2012

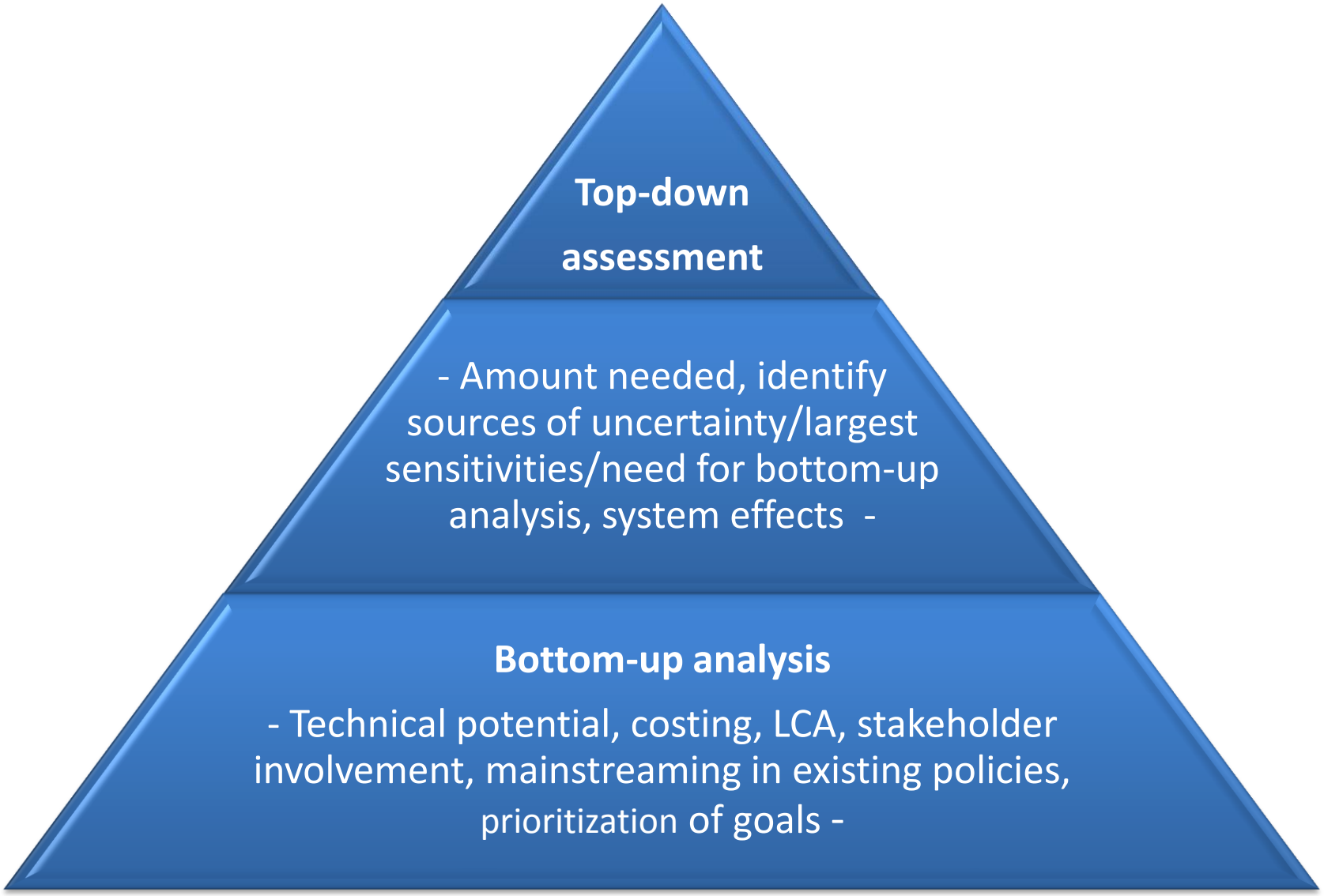
BECCS in low-stabilization energy mix



Source: Adapted from Edenhofer et al. (The Energy Journal 2010)

Research Questions

1. When will BECCS become commercially available?
2. Biomass availability (sustainability)
3. Uncertainty about **future** biomass potentials
3. CCS costs and availability of secure storage capacity
4. Accountancy issues, lifecycle GHG emissions
6. Lack of awareness
7. Public acceptance (NIMBY, BECCS vs fossil CCS, energy security)


Top-down
assessment
- Amount needed, identify sources of uncertainty/largest sensitivities/need for bottom-up analysis, system effects -
Bottom-up analysis
- Technical potential, costing, LCA, stakeholder involvement, mainstreaming in existing policies, prioritization of goals -

Motivation behind Workshop Series

- Uncertainties and system effects largely disregarded so far by top-down analysis
- Integrated analysis to capture system and knock-on effects for bioenergy potentials
- Complementarity with other policies / funding & incentives
- Co-benefits beyond mitigation need to be valued
- Modeling in the existing socio-economic & policy context $\Rightarrow$ collaboration with local stakeholders

Workshop Series

- Link with IEA and country stakeholders
  - Experts workshop, Laxenburg 2011
  - Indonesia workshop, Jakarta 2012
  - Brazil workshop, Sao Paulo 2013
- Bioenergy in socio-economic, political and environmental country-specific context with option for CCS.
  - Incentives and funding
  - Co-benefits

2011 Workshop Objectives

1. Review status quo of BECCS knowledge and identify gaps
2. Discuss policy context, possible incentive schemes and situation in case countries
3. Prioritize future research agendas

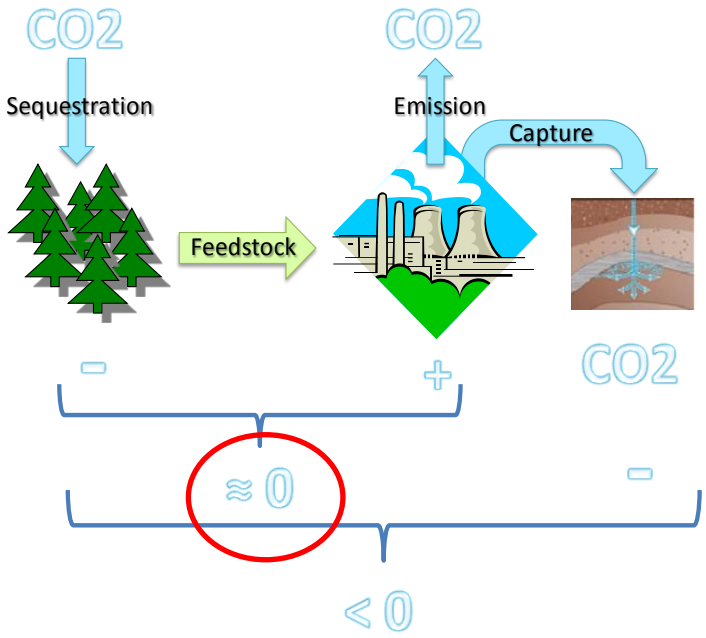
Obstacles to BECCS diffusion

1. Biomass availability (local, regional, global)
2. Uncertainty about future biomass potentials

   - How much biomass can be sustainably used for bioenergy production?
   - Competition for land? Other policies?
   - How will biomass potentials look like under climate change (temperature, precipitation, etc)?

Obstacles to BECCS diffusion

3. CCS costs
4. Uncertain availability of secure storage capacity
5. Accountancy issues & GHG calculations



Obstacles to BECCS diffusion

6. Lack of awareness
7. Public acceptance

   - Not in my backyard effect (NL, Switzerland)
   - BECCS vs. fossil CCS
   - Impact of uncertainty

Open BECCS issues: outcomes of the expert debate

- Overshooting, timing issues
- Climate science assumptions
- Lifecycle emissions
- 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 (EOR? Abatement alternatives?)

Modeling approach to BECCS

- Caveat: BECCS might be an attractive option to reach low ppm levels, BUT uncertainties and system effects are largely disregarded so far.
- Important factors: economies of scale, technological learning, discount rates
- Integrated analysis to capture system and knock-on effects for bioenergy potentials.
- Systems view also at higher level: interplay with other technologies needs to be addressed

Regional focus areas identified in 2011

- Sweden (neighbors with storage potential, sustainable forest management)
- USA (EOR, geol. storage potential)
- **Indonesia** (biomass, policy, bioenergy, offshore storage)
- **Brazil** (biomass, biofuels)
- Canada (EOR, EMP)
- China (biofuel demand, CCS)
- Japan

Appendix

Identified research priorities

1. Bioenergy from biomass production + CO2 capture	
Research needs	**Key questions**
A. biomass with CO2 capture affects the efficiency of power plants? Is there an additional energy penalty? Incremental penetration of biomass displacing coal	Traditional coal technology vs. gasification (pre combustion)
B. Given the different conversion technologies how can we proceed to implement BECCS (gasification, co-firing, fermentation)?	What are the technological and economic aspects of each technology?
C. Demonstration pilot projects	Small scale biomass based projects vs. collection of various large scale projects
D. Effect of flue gas composition in the CC unit	

Research priorities cont'd

2. Environmental aspects (sustainability land use change)	
Research needs	**Key questions**
E. The Whole Picture – A 360 Degree View including Life cycle assessments (LCA). Necessity of including BECCS in LCAs and LCCs From a BECCS specific Framework	Which biomass feedstock in combination with CCS is qualified when we apply certain sustainability criteria?
F. Consideration of environmental externalities and aspects	What are the impacts on water consumption? – Residues, ashes, closing cycles? – Other air pollutants
G. Depending on the technology route some impacts are amplified, we need diverse pilot projects to understand the outcomes.	What is the difference in terms of public perception between BECCS and CCS? - Include multiple perspectives of stakeholders; different sorts of organizations

Research priorities cont'd

3. Logistics of production (geography, transport, storage, etc)	
Research needs	**Key questions**
H. Transport of the gas and (pipeline?) corrosion	What is the flue gas composition in terms of CO2, condensable gases, moisture?
I. Availability, timing	When is the reservoir available – it is better to keep a constant flow over the year when the CO2 is available – e.g. seasonal production in fermentation
J. Identify mismatches between expected CCS potential and storage availability	What are the implications of different BECCS location options (closer to cities, ag. regions, forests)?
K. Data availability: storage location, maps, global coverage, how deep, number and location of wells (access points)	
L. Centralized vs. decentralized BECCS (production to storage)	