

Biomass with carbon capture and storage (BECCS or Bio-CCS)

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Bio-CCS – 10 years ago



IPCC's SRCCS 2005

- Merely described Bio-CCS as „CCS in which feedstock is biomass“
- Acknowledged negative emissions potential if sustainable harvesting
- Cost estimate 22-110 \$/tCO₂
- Conclusion: Bio-CCS at small scale and high costs

IPCC's AR4 2007

- Information spread out and not very coherent
- Global bioenergy potential 100-300 EJ/yr (total range 50-1000)
- No numbers for Bio-CCS potential and costs

Bio-CCS – 10 years ago



IEA Bioenergy

IEA Bioenergy (set up in 1978)

- Biomass gasification
- Liquid biofuels
- Biomass co-firing
- Biogas production and utilisation
- Availability and sustainability of biomass feedstocks

Only small number of small-scale Bio-CCS projects starting to come online:

- Russel EOR project: first negative emissions delivery at small scale (7.7 ktCO₂) [completed 2005]
- Arkalon: CO₂ from EtOH plant for EOR, 0.1-0.3 MtCO₂/yr [operating since 2009]



Bio-CCS – now



EBTP/ZEP Bio-CCS Joint Task Force 2011

IPCC's SRREN 2011

- First time bioenergy got dedicated chapter

Lots of organisations working on bioenergy (e.g. in UK: SUPERGEN, ETI, E4Tech)

IEAGHG reports on Bio-CCS potential and accounting

IPCC's AR5 2014

- Relies on SRREN for biomass related discussion
- Highlights Bio-CCS as one of the few technologies to remove historic CO₂ emissions from the atmosphere
- Considers competing land use and impacts of sourcing biomass (dedicated appendix)
- Update: „agreement“ on 100 EJ/yr bioenergy potential
- Global Bio-CCS potential: 10 GtCO₂/yr (total range 0-20)
- No info on LCOE of Bio-CCS, citing other reviews' ballpark range of 60-250 \$/tCO₂
- In general: downward revision of potentials and upward revision of costs
- Overall impact of LUC remains unclear
- Biomass options with low life-cycle emissions already exist (e.g. miscanthus, SRCs, SRF, sugarcane, residues)

Bio-CCS – now



Many studies conclude: Bio-CCS, incl. its CCS components, technically feasible as of today (TRL 3-7) [except microalgal biomass]

Perceived „double benefit“: heat/power + negative emissions

5 operating Bio-CCS projects 0.1-1 MtCO₂/yr (all EtOH, 3 for EOR, 4 in US, 1 rather Bio-CCU), several more underway

GHG accounting: only 2006 IPCC GLs, CDM/JI, Ca LCFS and EU RED/FQD cover Bio-CCS

Plenty of research on public perception of CCS but very limited and contradictory on Bio-CCS

- Bio-CCS generally has lower profile than Fossil-CCS

Main drivers/barriers for Bio-CCS:

- CO₂/NG price, infrastructure/clusters, sustainable feedstocks, public perception

Bio-CCS – now

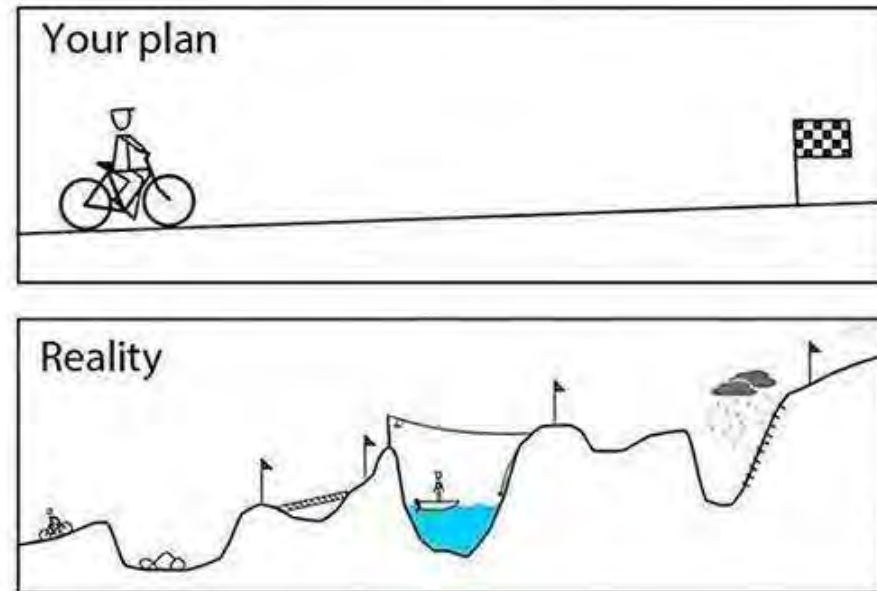


- IBDP (Illinois Basin Decatur Project)
 - CO₂ source is ADM's corn ethanol plant (350 Mgal/yr)
 - Captured ~ 0.3 MtCO₂/yr over more than 3 years (total 1.1 MtCO₂)
 - Stored in Mount Simon sandstone
 - 3-year post-injection monitoring
- IL-ICCS (Illinois Industrial CCS Project)
 - Will capture 1.1 MtCO₂/yr over 5 years
 - Expected to be operational in 2016
 - Draw level with Fossil-CCS demo scale

Bio-CCS – the future



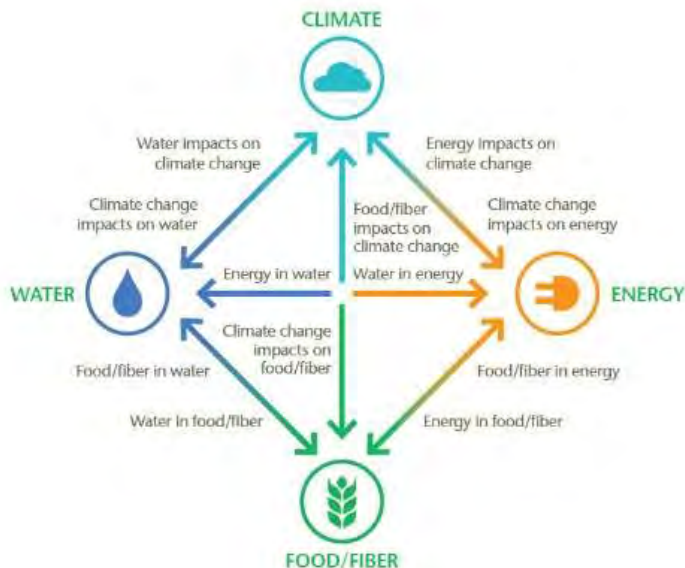
- More research on some gasification technologies necessary
- Verification for high amounts of co-firing >30% re pre-treatment and boiler modifications
- Bio-CCS scale-up issues
- Overcome uncertainty and lack of standard methodology for estimating bioenergy potentials and costs
- Inclusion of NETs/Bio-CCS in more policies and accounting frameworks
- Clarify circumstances of double benefit (zero-carbon energy + negative emissions permits)
- Approaches to prevent carbon leakage
- Open question/debate: Does Bio-CCS need more support than other NETs/Fossil-CCS?
- Need to explore other financial instruments than the CDM
- More research on impacts of Bio-CCS on global trade and commodity markets



Bio-CCS – the future



- Address the whole food-water-energy-climate nexus of Bio-CCS, integrated approaches
- Water and carbon intensity of Bio-CCS systems
- Address LUC issues, esp. iLUC (incl. measurement/quantification) and carbon debts
- Opportunities to free land for bioenergy production
- Monitoring systems for land management activities need improvement
- Investigating competition for land, feedstock and storage resources
- Supply chain optimisation for non-forest biomass
- Identify more “sweet spots” for Bio-CCS
- Clarification of Bio-CCS public perception and impact of CCS perception on Bio-CCS, public outreach efforts, building up trust



Bio-CCS – the future



So: Is Bio-CCS a good or bad thing?

My main conclusions:

- Will be very case-specific
- Bio-CCS no silver bullet or complimentary ticket but deserves our fullest attention as we are running out of time and options





Thank you, any questions?

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Registration opens 6th April 2016
Draft technical programme 1st June 2016
Early bird registration closes 13th July 2016



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