



# **Biomass and CCS**

## **IEAGHG Activities**

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IEA GHG R&D Programme

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# IEAGHG R&D Programme



- A collaborative research programme founded in 1991 as an IEA Implementing Agreement financed by its members
- Aim: Provide definitive information on the role that technology can play in reducing greenhouse gas emissions.
- Producing information that is:
  - Objective, trustworthy, independent
  - Policy relevant but NOT policy prescriptive
  - Reviewed by external Expert Reviewers
- Focuses on Carbon Dioxide Capture and Storage (CCS)
- **Activities:** Studies and reports (>120); International Research Networks : Wells, Risk, Monitoring, Modelling, Oxy, Capture, Solid Looping, Social Research; Communications (GHGT conferences, IJGGC, etc); facilitating demonstration activities; peer reviews.
- Collaborate with IEA, Global CCS Institute, CSLF, ZEP, IPAC, CO2GEONET, UNFCCC



**Techno-economic assessment  
of capture**

**Regulation and Incentives**

**Global Potential**

# Why Biomass and CCS - the net carbon balance



Positive



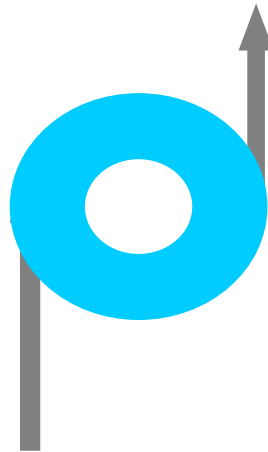
Fossil fuels

Less positive



Fossil fuels  
with CCS

Neutral to  
slightly  
positive



Renewable  
energy

Neutral to  
slightly  
positive



Bio-energy

Neutral to  
negative



Bio-energy  
with CCS

# Need for Biomass CCS



- Deployment of current emissions reduction technologies may not be enough for climate stabilisation - future emission scenarios (IPCC 4<sup>th</sup> AR) may require negative emissions
- Only one technology option large-scale and near-market – biomass and CCS
- Highlighted in GHGT9 conclusions, and starting to be recognised, but no assessment of realistic potential, issues, limitations etc.
- Implications uncertain, possibly large, not reflected in climate policy (Rhodes & Keith 2008) – due to lack of information
- IEA CCS Roadmap
- **IEAGHG Study with ECOFYS – assessment of global potential, and issues**



**TECHNO-ECONOMIC  
EVALUATION OF POST  
COMBUSTION CAPTURE ON  
BIOMASS POWER PLANT**

# Techno-Economic Evaluation of Biomass Power Plant with Post Combustion Capture



- IEAGHG Report 2009/9 , Foster Wheeler Italy
- Scope - PF and CFBC – dedicated and co-fired, EU context
- Findings
  - Efficiency drops significantly for dedicated
  - Capital cost increases 63%-126% (highest for dedicated - due to capture plant and flue gas cleaning)
  - COE increases 50%-100% (highest for dedicated)
  - Requires ETS price 48-76 Euro tCO<sub>2</sub>



# **Biomass CCS Economic Incentives using Carbon Markets**



# Carbon markets



- EU ETS – EUAs
- JI – ERUs
- CDM – CERs
- IPCC GHG Guidelines - AAUs

# Carbon markets



- EU ETS Directive 2009
- Art 10a – free allocation can be given to biomass CCS, but not to any electricity production
- Industrial operations OK? use of benchmarks
- Annex 1.1 – 100% biomass combustion not covered by Directive
- Article 24a – EUAs can be given to activities reducing GHGs outside ETS, given not in respect of emissions. Needs host gov to apply.
- Creates uncertainty, needs clarification

# Carbon markets



- JI-ERUs
- Bilateral offset projects in co-operation with host gov'n – allocates from AAUs and converts AAUs to ERUs for project – can work for biomass CCS
- Domestic offsets??

# Carbon markets



- CDM – CERs
- CERs allocated for emissions reductions below baseline – can work for biomass CCS, BUT CCS not yet recognised for CDM.
- Copenhagen CMP5 – invites new methodologies for net reduction technologies
- Sustainable development

# Carbon markets



- IPCC GHG Guidelines (2006)
- CCS Chapter 5.3 – “Negative emissions may arise.....if CO<sub>2</sub> generated by biomass combustion is captured. This is a correct procedure and negative emissions should be reported as such.”
- However in practice – limitations, uncertainty, lack of being tested



# Global Potential



# Global Potential for Biomass and CCS

- ECOFYS, NL (Joris Koornneef et al)
- Report Draft out for peer review
- Scope
  - Full biomass chain and CCS chain
  - Technical, realisable and economic potential
  - 2030 and 2050
  - Dedicated and co-firing
- Initial findings: -

# Conclusions



- Technical potential BE-CCS options is large in 2050
  - Up to -10 Gt in power sector (33% of global electricity demand), **or**;
  - Up to -5 Gt in bio-fuel sector (31% of global fuel demand)
  - Biomass potential is limiting factor
- Realisable potential BE-CCS options is smaller in 2050
  - Up to almost -3 Gt (biomass share ~10% of global electricity demand)
    - Co-firing installed capacity + CCS retrofit is largest
  - Biofuels up to -1 Gt (5% of global fuel demand = conservative estimate)



# Conclusions



- Economic potential with CO<sub>2</sub> price of 50 €/ton
  - Up to -3 Gt in both power and bio-fuel sector
- Early BE-CCS opportunities with bio-ethanol most likely exist in US and Brazil

# Policy, Incentives, Regulation?



- Policy, regulations, incentives developed generally without Biomass CCS in mind
- Policy makers need to decide.....
- To decide – need to be
  - 1<sup>st</sup> - aware
  - 2<sup>nd</sup> – informed

ALSTOM

B&W  
power generation group

BG GROUP



CEZ GROUP



CIAB

VATTENFALL



ConocoPhillips



TOTAL



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Enel  
L'ENERGIA CHE TI ASCOLTA.



Statoil



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EPRI

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REPSOL YPF

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