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Biofuels: the Relationship with Greenhouse Gases in Agriculture and Forestry

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Transport Biofuels Research in Austria
2nd National IEA Bioenergy T39 Workshop
Wien, 9 September, 2008

JOANNEUM RESEARCH
Graz, Austria

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Introduction

- What is Task-38 doing?
- When is energy from biomass CO2 neutral?
- What are the direct and indirect GHG emissions from biofuel production?
- How do biofuels impact agriculture and land use?
- Carbon sequestration and protection or biofuel production?
- Conclusions

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Objectives of Task 38

- Develop, demonstrate and apply standard methodology for GHG balances
- Increase understanding of GHG benefits of bioenergy and carbon sequestration
- Address policy relevant issues on GHG mitigation
- Promote international exchange of ideas, models and scientific results
- Aid decision makers in selecting mitigation strategies that optimize GHG benefits

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Task 38
Participating Countries 2008

Australia:
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United States:
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Task 38 Key Activities

- **Standard Methodology for GHG Balances of Biomass/Bioenergy Systems**
  - ➔ Methodological toolbox on IEA Bioenergy Task38 website
- **Case Studies**
- **Publications, Papers, Brochures, Presentations**
  - ➔ Frequently Asked Questions: Bioenergy, carbon sinks and global climate change
  - ➔ Special Issue of the Journal 'Mitigation and Adaptation Strategies for Climate Change' on: "Efficient use of Biomass for Mitigating Climate Change"
  - ➔ Optimizing the Greenhouse Gas Benefits of Bioenergy Systems
- **Organisation of Workshops**
  - ➔ Transportation biofuels: For greenhouse gas mitigation, energy security or other reasons? Salzburg, Austria, February 5 - 6, 2008
- **Cooperation**
  - ➔ Worldbank, FAO, IPCC, IEA, UNFCCC, EFI, COST E21 & E31

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Case Studies (1)

- **Australia**
  - ➔ GHG balance of a co-firing system of biomass and a wood fired conversion facility, both based on conventional hardwood plantation forestry
  - ➔ Char as a soil amendment
- **Austria**
  - ➔ Maize to biogas for electricity and heat
- **Canada**
  - ➔ GHG impacts of pellet production from woody biomass in BC, Canada, and transporting them to Europe, USA and Canada substituting fossil fuels.
  - ➔ GHG balance of a small pyrolysis plant using both sawmill residues and thinnings from a juvenile spacing program to produce bio-Oil, used either in a pulp mill limekiln or for export of biofuel
- **Croatia**
  - ➔ Assessment of the GHG emissions-reduction potential of biodiesel production in the context of Joint Implementation
- **Finland and Sweden**
  - ➔ GHG balances of bioenergy and carbon sequestration projects with links between increased use of construction wood and the use of biomass-fired cogeneration plants, replacing fossil fuels

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Case Studies (2)

- **Ireland**
  - ➔ GHG balance of peat use for energy
  - ➔ GHG benefits of using municipal solid waste as a fuel in a thermal treatment plant in Ireland
- **Netherlands**
  - ➔ Import of wood pellets from Canada and of palm kernel shells from Malaysia to Netherlands for green energy production
- **New Zealand**
  - ➔ Assessment of the GHG balance of a bioenergy cogeneration plant based on the use of sawmill residues
- **United Kingdom**
  - ➔ GHG balances of miscanthus fuelled biomass projects
- **United States**
  - ➔ GHG emission reduction potential associated with anaerobic digestion plant of organic wastes, California

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Hot Topics and Current Focus

- **Energy from Biomass - CO_2 Neutral**
- **Implications for National Inventories**
  - ➔ JI und CDM
- **Direct and Indirect GHG emissions from land-use change (EC RES-D)**
- **Other Impacts**
  - ➔ Albedo change
- **Land Use Optimization**

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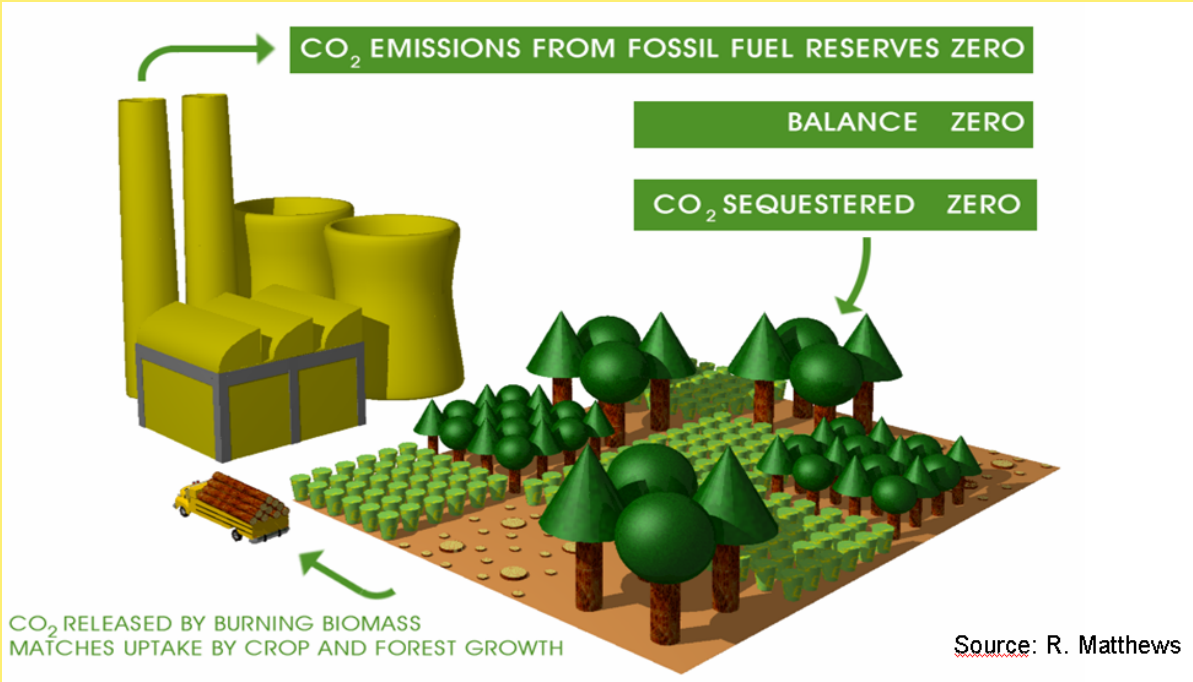
When is energy from biomass CO_2 neutral?

- **When biomass is sustainably produced**
- **Annex-I Parties**
  - ➔ Loss of biomass is captured in LULUCF sector
    - Deforestation only
  - ➔ CO_2 neutral in the energy sector



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When is energy from biomass CO_2 neutral?

- **Non Annex-I Parties**
  - ➔ No change in land-use, or the land-use changes are from cropland or grassland to forest; and
  - ➔ No systematic decrease in carbon stocks; and
  - ➔ In compliance with all national and regional forestry, agriculture and environmental regulations.
  - ➔ Use of forest or agriculture resides is considered CO_2 neutral if their use does not cause a decrease in carbon stocks.

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When is energy from biomass CO_2 neutral?

- **There are losses or gains of carbon stocks during the transitional period after a change in land-use**
  - ➔ Analogous to the emissions (or removals) for the construction of a power plant or factory
  - ➔ All carbon pools must be considered
    - Above-ground and below-ground living biomass
    - Litter, dead wood and soil
  - ➔ Transition period depends on rotation length of crop, climate
  - ➔ Examples
    - ↑ ↑ forest to cropland (deforestation) causes losses of all five carbon pools
    - ↑ grassland to cropland causes losses of soil organic carbon
    - ↑ natural forest to managed forest can cause losses of all five pools
    - ↓ grassland to forest (reforestation) can cause increases in all five carbon pools

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What are the direct and indirect GHG emissions from biofuel production?

- **Direct emissions**
  - ➔ Use of fossil fuels during cultivation and harvesting
  - ➔ Use of natural and synthetic fertilizers
  - ➔ Vegetation clearing during site preparation
  - ➔ Transitional period losses of carbon stocks if there is a land-use change
  - ➔ Use of fossil fuels during transportation, conversion of biomass and distribution of product
- **Indirect emissions**
  - ➔ Use of fossil fuels during transportation, conversion of biomass and distribution of product
  - ➔ Upstream emissions during the production of fossil fuels and synthetic fertilizers
  - ➔ Loss of carbon stocks due to displacement of land-use activities
- **CDM Methodological Panel Tool ignores displacement of land-use**

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How do biofuels impact agriculture and land use?

- **Prices of all agricultural produce are related to energy prices**
  - ➔ Input costs increase as energy prices increase
- **Value of biofuel crops are related to energy prices**
  - ➔ Increase faster than increases in input costs
  - ➔ Conversion of existing agriculture land will occur
- **Value of all agricultural produce will increase as biofuel prices increase**
  - ➔ Decrease production means increase prices; or
  - ➔ Decrease production of feedstock means increase in inputs costs
- **Increased agricultural prices will provide incentives to increase land-use change to agriculture**
  - ➔ Deforestation for grassland or cropland
  - ➔ Conversion of grassland to cropland

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How do biofuels impact agriculture and land use?

- **Project specific estimation**
  - ➔ Direct land-use change quantifiable
  - ➔ Indirect land-use change difficult to assess
    - Can estimate maximum potential negative impact
- **Solutions**
  - ➔ Limit projects to using agriculture or forest residuals
    - Improve efficiency of biomass utilization by cascading use
  - ➔ Limit projects to sites without competing land-use
    - "Waste" lands – Jatropha
    - Non-productive, set aside, marginal land
    - Forest land – 2nd generation biofuels
- **Regional approaches to indirect emissions**
  - ➔ Discount benefits based on national deforestation or other land use conversion rates
  - ➔ Require Party to adopt binding national targets for deforestation rates as a pre-condition for the creation of CERs from biofuel projects

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How do biofuels impact agriculture and land use?

- **The focus should be more than just greenhouse gas emissions**
  - ➔ Hydrology
  - ➔ Biodiversity
  - ➔ Recreation
  - ➔ Socio-economic factors
  - ➔ Albedo
    - Surface darkening is equivalent to greenhouse gas emission

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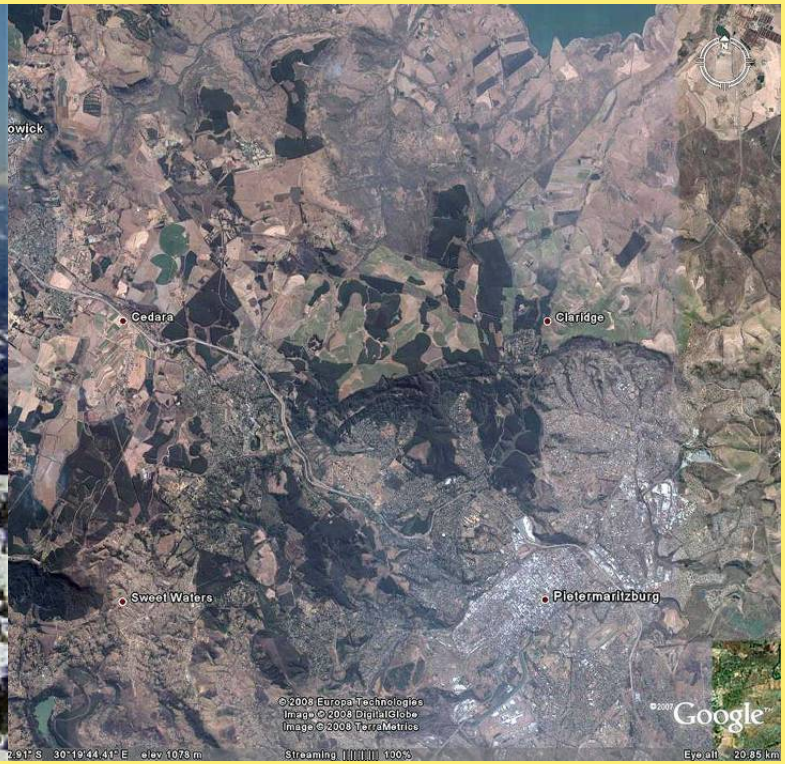
Does albedo change contribute to net equivalent greenhouse gas emissions?

Coniferous forests in regions with snow

Irrigation and forests in regions with drought

Spruce and Pine
Lachtal, Austria



Eucalyptus and irrigated agriculture,
Pietermaritzburg, South Africa

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Carbon sequestration and protection or biofuel production?

- **Sequestration and protection are limited due to carbon saturation**
  - ➔ An equilibrium is reached with time after which no more carbon is sequestered
- **Using biofuel displaces fossil fuel**
  - ➔ Biomass is renewable
- **Biofuel production is a better mitigation option if**
  - ➔ Initial carbon stocks are low (sequestration)
  - ➔ Growth rates are high
  - ➔ Biomass is used efficiently
  - ➔ A low efficiency, carbon intensive system is displaced
  - ➔ A long-term view is adopted

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Conclusions

- Energy from biomass can be CO_2 neutral
- Emissions (or removals) from transformation in all pools must be considered
- Direct emissions can be quantified
- Indirect emissions are difficult to estimate and can be large
- Impacts of biofuel production are more than greenhouse gas emission reductions
- Biofuel is a good mitigation option in the appropriate conditions and with efficient use

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Thank you for your attention

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www.ieabioenergy-task38.org