Potential future developments of international bioenergy trade

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Abstract

Introduction

Global bioenergy use is expected to undergo major changes in the coming years and decades. Biomass demand and supply, the types of feedstock used, fuels and technologies, policies, sustainability requirements and certification procedures etc. will develop differently in various regions around the world. This will have a strong impact on global supply and demand patterns as well as bioenergy trade on a local and global level.

The core objective of this paper is to give an outlook for bioenergy trade in the form of different consistent storylines for the time steps 2020, 2030 and 2050 in order to provide insight into "possible futures" of bioenergy trade and discuss implications and challenges related to different developments. These storylines will be described in a qualitative way. As far as available quantitative scenario data will be added.

This leads to the following sub-objectives:

(1) Investigate to which extent various global energy models and scenarios take into account bioenergy trade,
(2) Identify the implications of different global bioenergy scenarios on bioenergy trade (I.e.: Which bioenergy trade volumes would be required to fill the gap between regional biomass supply and demand in different scenarios?) and
(3) summarize the range of results into 3–5 storylines of future international bioenergy trade.

The results of this paper include a comparison of representative scenario results of wide known global energy models with respect to bioenergy trade. They show the range of global bioenergy trade. The storylines will describe the main drivers and barriers in different settings of bioenergy trade. This allows to derive conclusions regarding the perspectives, challenges and key implications of possible future pathways of bioenergy trade.

Concept and methodology

The work presented in this paper consists of the following steps:

- Identification of important global energy models taking into account international bioenergy trade
- Comparative analysis of global model based scenarios of (bio)energy systems and related trade flows
- Identification and discussion of key drivers of bioenergy trade
- Summarizing the results in form of illustrative storylines of bioenergy trade
- Deriving conclusions

Figure 1 shows an overview of selected papers, models and studies. From an overall of 28 studies we selected three models that we will take into account for a comparative analysis of scenario results.

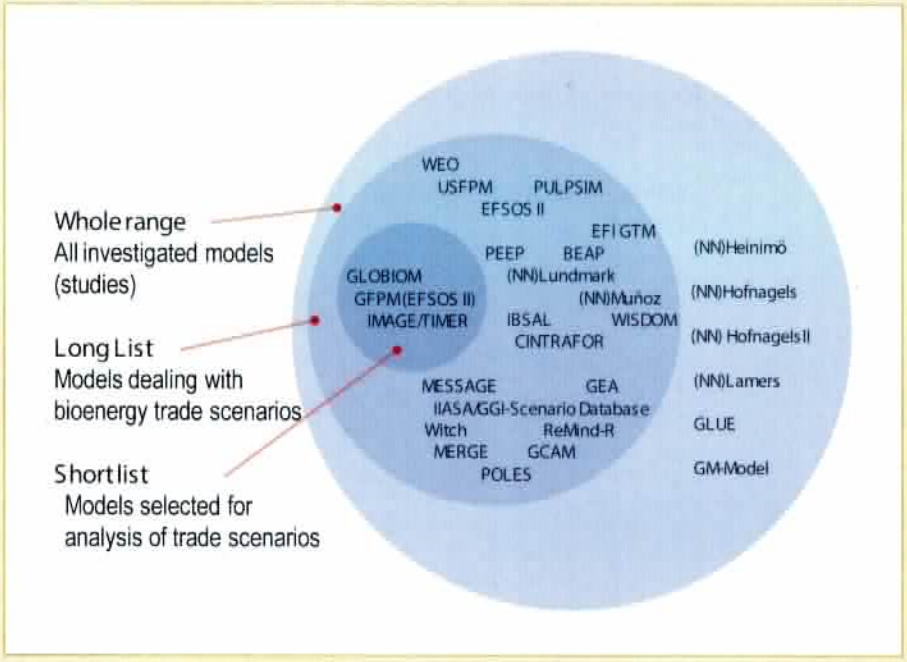

Fig.1: Overview of investigated models, papers and studies

3. Acknowledgements

This paper has been elaborated in the frame of IEA Bioenergy Task 40.

4. References

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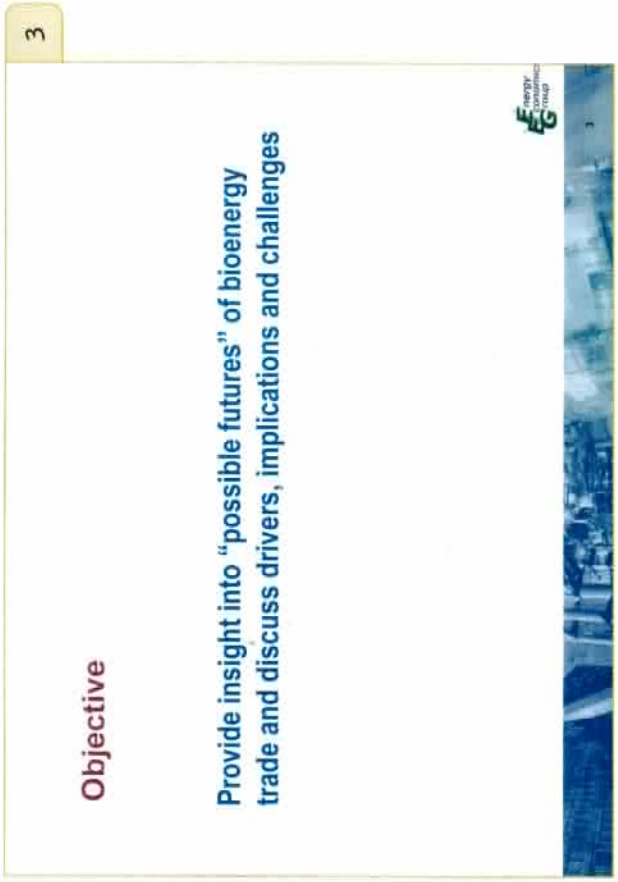

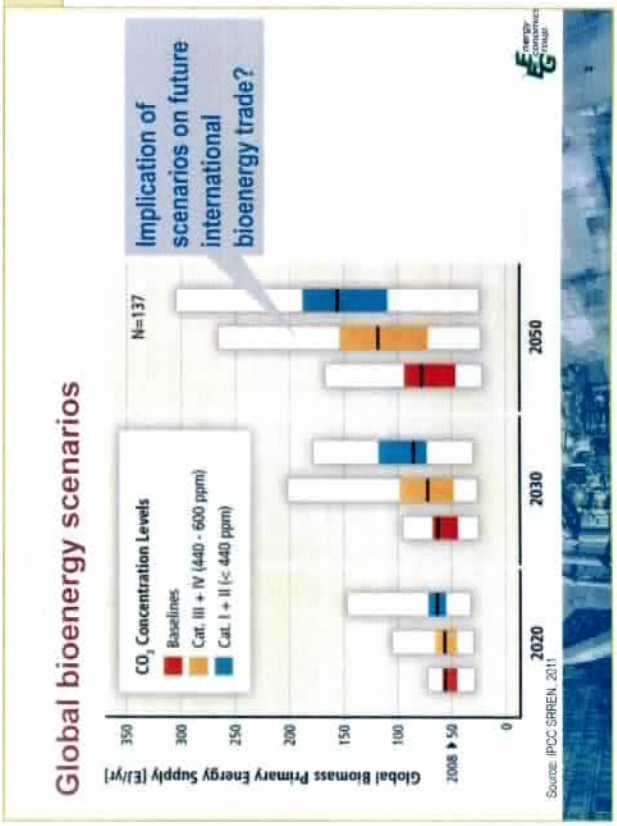

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Comparison of models and scenarios

- ✓ Screening of existing models and studies
  - 28 models have been screened in total
  - Preselection of models
  - Request (small questionaire) to selected modeling groups
- ✓ Selection of models for further investigation: GFPM, IMAGE/TIMER
- ✓ Three biomass fractions to be covered:
  - solid biomass
    - based on residues and waste
    - based on primary energy products
  - liquid biomass distinction of three fractions
- ✓ Regional aggregation level: 20 world regions

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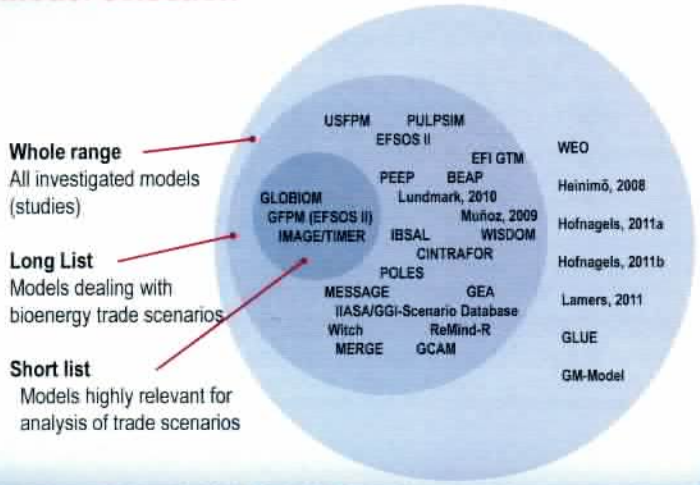
Model selection



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Models I – GFPM (EFSOS II)

Short Description: Partial Equilibrium Model

Coverage Biomass Trade: Global - Trade between country and world market rather than between individual countries

Assumptions regarding trade:
- equilibrium calculation determine the direction of change of trade flow
- Institutional and other constraints limit the adjustment that can take place in any given year.
- Effect of tariffs change the cost of transportation.

Sectoral Coverage: Limited to the forest and forest biomass sectors
- covers 14 principal categories of forest products

Regional Aggregation: 180 countries,
- 50 from Africa, 35 from North Central and South America, 50 from Asia and Oceania, and 45 from Europe and former USSR

Scenario Time Frame Up to 2060

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Models II – IMAGE/TIMER

Short Description: Systems dynamic Integrated assessment model

Coverage Biomass Trade: Yes

Assumptions regarding trade: Bilateral trade available
- n regions, n markets. Each region imports from wherever offers the lowest price
- Imports have transport costs, plus a factor determining how "open" they are to that region (i.e. indicating OECD countries or closed economies)

Sectoral Coverage: Traditional biomass (no trade), modern solid biofuel, liquid biofuel

Regional Aggregation global 26 regions

Scenario Time Frame: up tp 2100

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Selected drivers

- **Regional balancing of supply and demand**
  - Barriers and drivers of bioenergy demand (in current supply and demand regions): oil price, policies, technological learning, ...
  - Barriers and drivers of bioenergy supply
  - Regional development of bio-based industry
- **Barriers and drivers of bioenergy trade**
  - Logistics
  - Trade policies
  - Sustainability requirements
  - ...
- **Technological change**
  - Traditional biomass => modern biomass
  - Change in resource base

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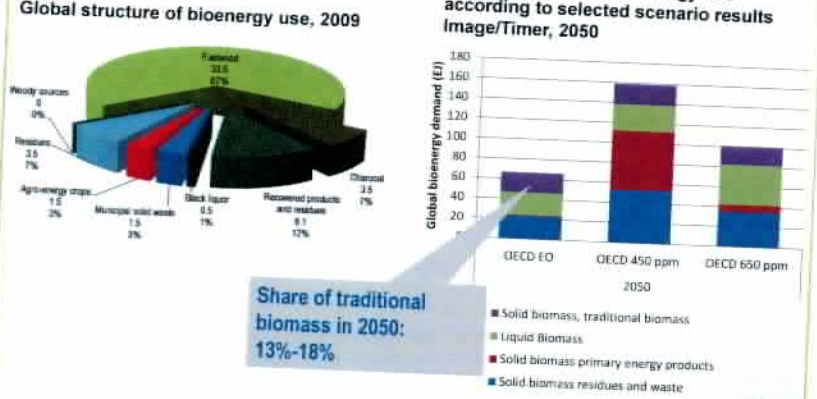
Shift from traditional to modern biomass



Source: estimation according to FAO 2010

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Conclusions (1)

- **Quantities of produced biomass are rising in all investigated scenarios.**
- **All investigated scenarios show a strong increase in total internationally traded biomass (in a range of 20-90 fold increase from 2010 to 2050).**
- **The scenarios indicate a considerable dependency of global bioenergy use on international trade. Bioenergy use decreases significantly with higher trade barriers.**
- **The development of international bioenergy trade will be driven strongly by**
  - Climate policies
  - Regional differences of policies
  - Technological change and thus shift in the biomass resource base
  - Overall global energy demand, GDP, population, ...

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Conclusions (2)

- **Only a few number of global energy models explicitely simulate international bioenergy trade.**
- **Nevertheless, all global energy scenarios need to make an assumption on the future development of bioenergy trade. Mostly, this is only implicitely the case and is not clearly documented.**
- **A further investigation and integration of international bioenergy trade, barriers and drivers into existing modeling frameworks is highly needed.**