

Global land use change and greenhouse gas emissions due to recent European biofuel policies

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1. Biofuel policies in the EU

RED
Renewable
Energy Directive
(2009/28/CE)

+

COM 595
Proposal in October
2012, but still under
debate

+

Antidumping
duties on
biofuel imports

35% less GHG than
fossil fuels, including
GHG from **Direct Land**
Use Change (LUC)

10% renewable energy
consumption in the transport
sector by 2020

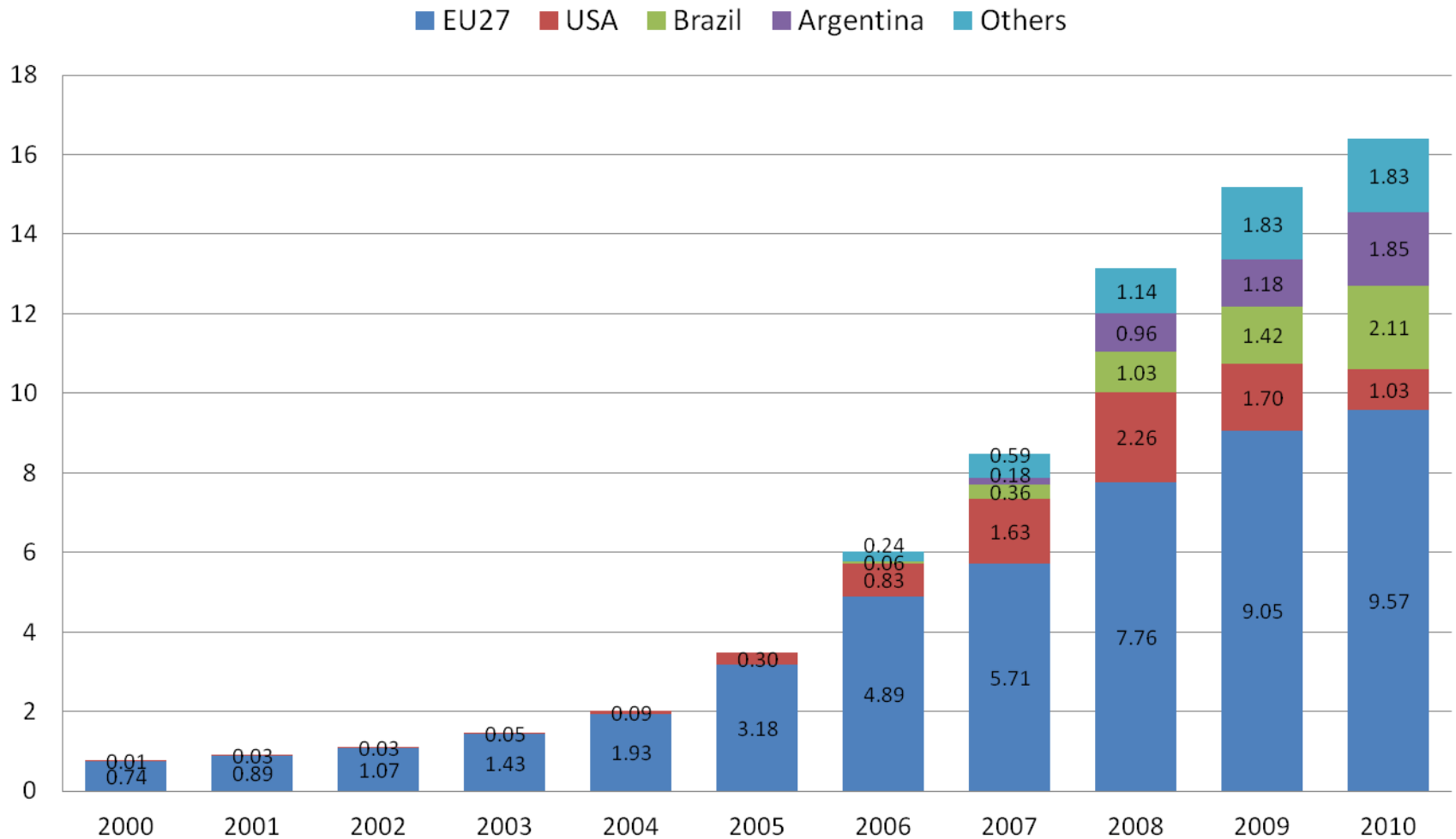
Report **Indirect LUC**
emissions (IFPRI estimates)

Cap on **first generation**
biofuels (FGBs): 6-7%

Biodiesel from the US
(Regulations 193/2009
and 444/2011)

Biodiesel from
Argentina and
Indonesia
(Regulation
490/2013)

Biodiesel consumption (Mtones)



Source: Ecofys-UFOP 2011



2. Objective

To analyze the global effects of these different policies recently proposed by the EC to stimulate the domestic biodiesel production while reducing GHG emissions.

One single experiment simulating the new cap on FGBs and the existing anti-dumping measures on biodiesel from Argentina, Indonesia and the US.

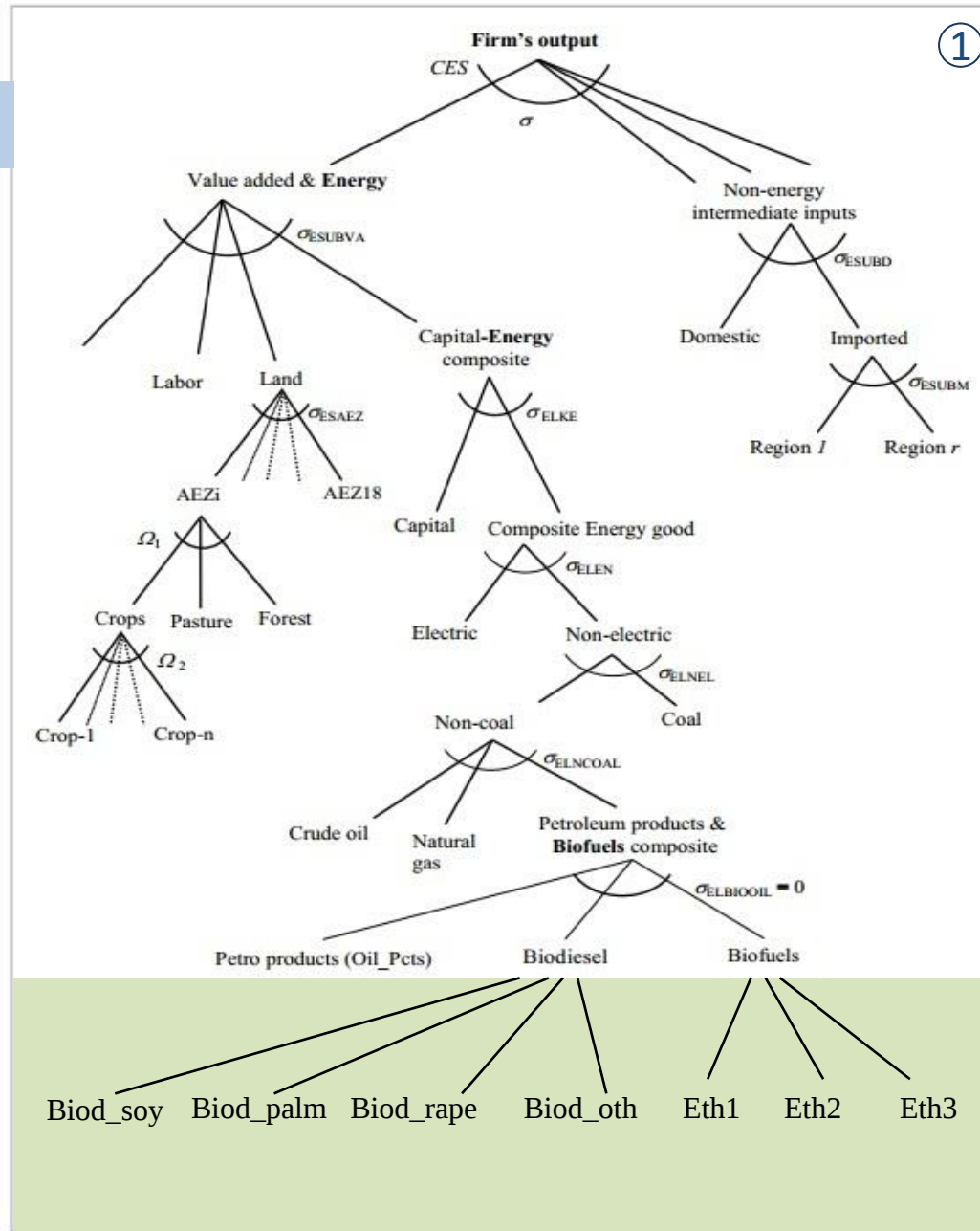


3. The model: GTAP-BIO

- ❑ The latest version of the **GTAP-BIO** (Birur et al., 2008; Golub and Hertel, 2012)
- ❑ Based on the **GTAP-E model** (Burniaux and Truong, 2002).
- ❑ Potential for **biofuels to substitute for petroleum products** (Taheripour et al., 2007)
- ❑ **Land Use module** to model competition for land across uses, within 18 AEZ, coupled with **CO₂ emission factors**
- ❑ **Intensive margin**: increase in yields as a response of higher prices of agricultural commodities (yield elasticity)
- ❑ **Extensive margin**: decrease in yields as less productive land (*cropland pasture*) must be brought into production to produce biofuel commodities
- ❑ **Biodiesel imports into the EU, as well as production and consumption** in the regions concerned have been updated (2009 levels) by using the **Altertax closure** (Malcolm, 1998)

GTAP-BIO:

19 regions,
42 industries,
48 commodities



① ② ③ ④ ⑤ ⑥ ⑦



4. Shock statements

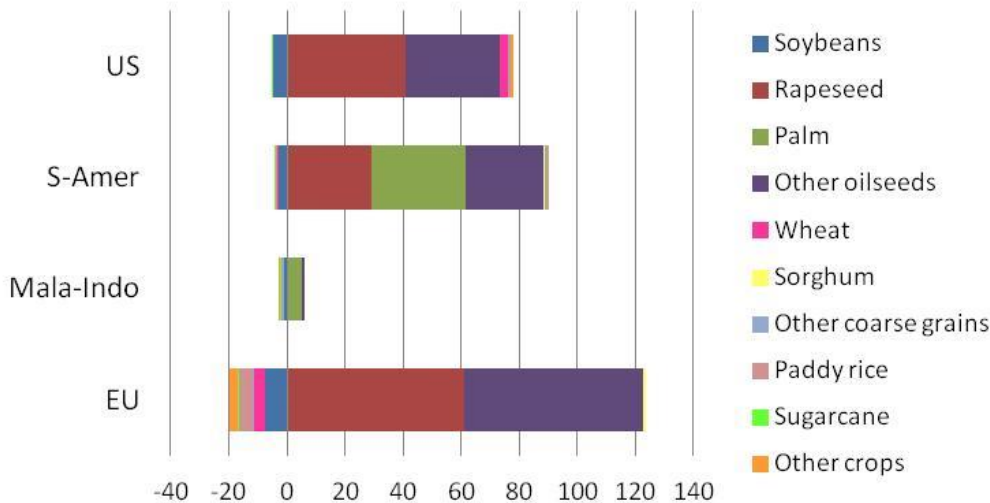
- ❑shock qp("biod_rape","EU27") = 685.0%
- ❑shock qp("biod_palm","EU27") = 119.6%
- ❑shock qp("biod_soy","EU27") = 45.12%
- ❑shock qp("biod_oth","EU27") = 7,327.8%
- ❑shock tms("biod_palm","Mala-Indo","EU27") = 18.9%
- ❑shock tms("biod_soy","S-Amer","EU27") = 24.6%
- ❑shock tms("biod_soy","USA","EU27") = 10.8%



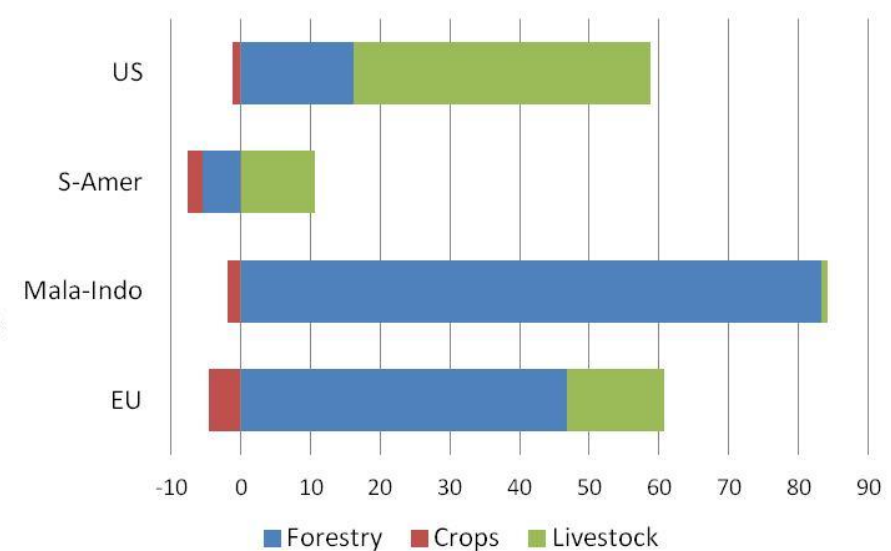
5. Results

- ❑ Biodiesel imports expand, despite the tariffs: **24.9% for S-Amer**, **34.2% for Mala-Indo** and **93.2% for the US**
- ❑ The increase for US imports is the highest, because tms is the lowest and US takes part of the S-Amer market share
- ❑ Mala-Indo is barely affected by the tariff, 100% of the market share
- ❑ Domestic biodiesel production increases, too: **Biod_oth (16,313.8%)**, **Biod_palm (852.9%)**, **Biod_rape (685.0%)** and **Biod_soy (36.4%)**
- ❑ Sharp increase in firms demand for:
 - ❑ **Vegetable oils** (both imported and domestic, but 100% imported palm oil)
 - ❑ **Oilseeds for crushing** (higher demand for imported soybean and for domestic rapeseed and other oilseeds)
- ❑ Production of oilseeds also expands in the EU and in exporting countries: **LUC and subsequent GHG emissions**

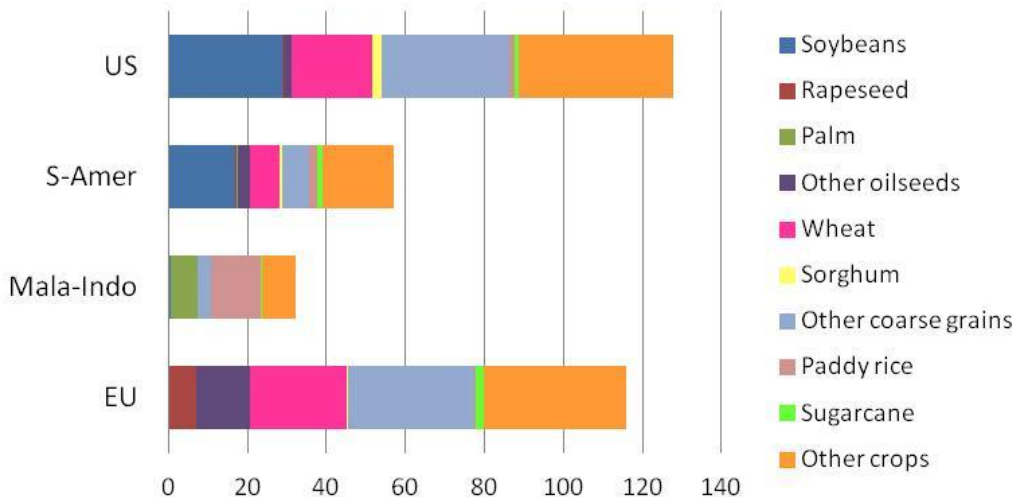
Changes in oilseeds production (%)



Overall GHG emissions from LUC

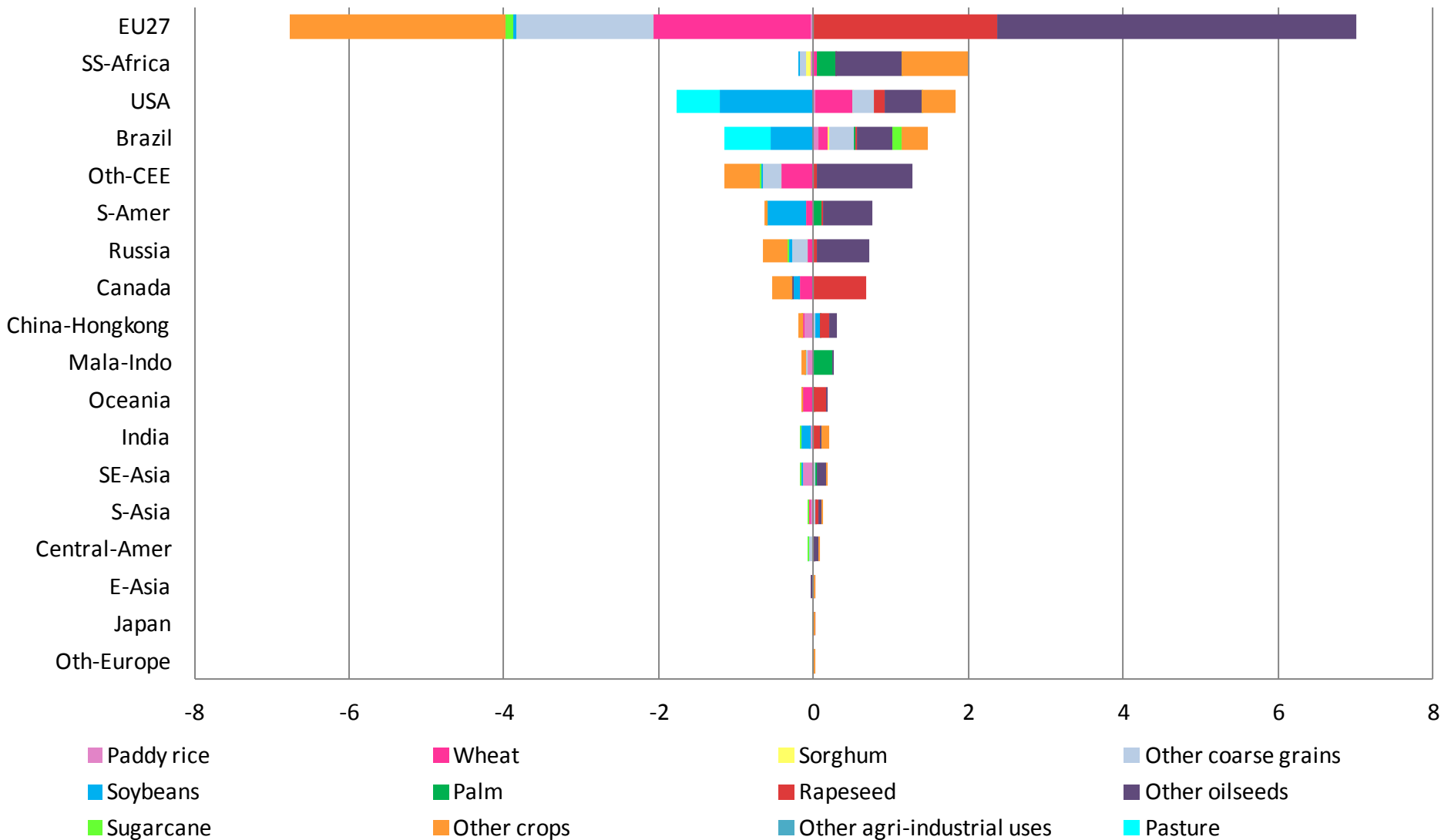


Total cropland extension after the shock (Mha)



-The highest emissions in Mala-Indo from deforestation, also in the EU
 - In the US and S-Amer oilseeds expansion takes place mainly at the expense of livestock activities
 - Crop transformation causes overall carbon uptake

Change in cropland extension by region due to the shock (Mha)





6. Conclusions

- ❑ Recent European biofuel policies are a **great incentive for the biodiesel sector in the EU**
- ❑ The **EU market is filled with imported biodiesel but also with domestic product** (mainly rapeseed biodiesel and biodiesel from other feedstock)
- ❑ **EU continues depending on biodiesel imports** from the leading exporting countries (the US, S-Amer and Mala-Indo) but mainly on biodiesel feedstock imports
- ❑ Other countries are thus affected through **interactions in the global market of vegetable oils and oilseeds** (e.g. Brazil, India, China or Canada) but also interactions among other agricultural markets (e.g. SS-Africa) → **ILUC**
- ❑ **CGE models are recommended** to analyze the global consequences of biofuel policies due to their global dimension



7. Recommendations

- ☐ Considering **other biodiesel exporting countries** would improve the reliability of the analysis
- ☐ It has been assumed that *Biod_oth* corresponds entirely to advanced biodiesel, but it may also include biodiesel from other oilseeds such as sunflower
- ☐ Disaggregating any other crop-based biodiesel from an **advanced biodiesel commodity** would lead to much lower GHG emissions worldwide, since they are supposed to emit **0 g CO₂/MJ**
- ☐ **Vegetable oil diversification** for biodiesel production is recommended for the EU energy security
- ☐ Addressing LUC is not temporary but... **what would happen if there was an ILUC threshold for other agricultural commodities apart from biofuels?**



8. References

- Birur, D., Hertel, T., Tyner, W. E. (2008). Impact of biofuel production on world agricultural markets: a computable general equilibrium analysis. GTAP Working Papers no. 53. *Center for Global Trade Analysis, Purdue University. West Lafayette (USA).*
- Burniaux, J. M., Truong, T. P. (2002). GTAP-E: an energy-environmental version of the GTAP model. GTAP Technical Papers no. 18. *Center for Global Trade Analysis, Purdue University. West Lafayette (USA).*
- Golub, A. A., Hertel, T. (2012). Modeling land-use change impacts of biofuels in the GTAP-BIO framework. *Climate Change Economics*, 3(03).
- Malcolm, G. (1998). Adjusting tax rates in the GTAP data base. GTAP Technical Paper no. 15. *Center for Global Trade Analysis, Purdue University. West Lafayette (USA).*
- Taheripour, F., Birur, D. K., Hertel, T. W., Tyner, W. E. (2007). Introducing liquid biofuels into the GTAP database. GTAP Research Memorandum no. 11. *Center for Global Trade Analysis, Purdue University. West Lafayette (USA).*

**Thank you for your
attention:
Questions?**