Role of biomass in the energy system - linkages between the energy and the agricultural in the EU until 2050

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Introduction

• Biofuels and bioenergy in general might be one important GHG emission reduction option in the energy system.

• Potential supply and price of biomass has an impact on future energy demand.

• Demand for biomass for energy production has an impact on agricultural markets.

• Relationship between agricultural and energy prices is expected to strengthen further.
Scenario assumptions

- Energy prices from WEO 2012
- Abolition of all EU biofuel mandates from 2015 on
- Limitation of area available for woody biomass to 30% of agricultural area

3 Scenarios with different greenhousegas reduction targets:

- **ETS75** restricted on the ETS sector
- Overall sectors GHG emission reduction targets **C75** (75% till 2050) and **C80**
Bioenergy potential in selected European countries

Source: de Witt et al. 2008, RES 2020; Bentsen 2012
Dependency of the energy system and the agriculture market

Additional price for energy crops

\[ P^* \]  
\[ Q^* \]  
Equilibrium price  
Equilibrium quantity

Demand of energy crops from the energy system

Agriculture  
Energy system

Price  
Quantity
# Product Mapping – Data harmonization

<table>
<thead>
<tr>
<th>TIMES PanEU</th>
<th>ESIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oilseeds</td>
<td>Rapeseed, Sunflower, Soybeans</td>
</tr>
<tr>
<td>Starchy Crops</td>
<td>Corn, Wheat, Triticale, Rye, Barley, Grass, Silage maize,</td>
</tr>
<tr>
<td>Sugar Crops</td>
<td>White sugar</td>
</tr>
<tr>
<td>Woody Crops</td>
<td>Area (woody crops not explicitly modeled in ESIM)</td>
</tr>
</tbody>
</table>

Source: own compilation
TIMES PanEU

- Technology oriented bottom-up partial equilibrium model
- 30 region model (EU 28, No, CH)
- Energy system model
  - SUPPLY: reserves, resources, exploration and conversion Country specific renewable potential and availability (onshore wind, offshore wind, ocean, geothermal, biomass, biogas, hydro)
  - Electricity: public electricity plants, CHP plants and heating plants
  - Residential and Commercial: End use technologies (space heating, water heating, space cooling and others)
  - Industry: Energy intensive industry (Iron and steel, aluminium copper ammonia and chlorine, cement, glass, lime, pulp and paper), food, other industries, autoproducer and boilers
  - Transport: Different transport modes (cars, buses, motorcycles, trucks, passenger trains, freight trains), aviation and navigation
- Country specific differences for characterisation of new conversion and end-use technologies
- Time horizon 2010 - 2050
- GHG: CO2, CH4, N2O, SF6 /Others pollutants: SO2, NOx, CO, NMVOC, PM2.5, PM10
European Simulation Model (ESIM)

- Comparative static partial equilibrium multi-country model for the agricultural sector
- Isoelastic supply functions (separate for yield and area) and demand functions
- 32 regions (EU Member States; USA, Croatia, Turkey, Western Balkans, RoW)
- Product coverage:
  - 15 crops
  - 21 processed products
  - 6 animal products
  - Pasture, set-aside
Primary energy consumption in the EU28

- Natural gas
- Oil
- Lignite
- Coal
- Nuclear
- Hydro, wind, solar, Ocean
- Other renewables
- Waste (non-renewable)
- Share of bioenergy
Bioenergy consumption in the EU28 by application

Consumption in [PJ]

- Residential sector
- Commercial sector
- Agriculture
- Industry
- Electricity/Heat production
- Others
- Hydrogenation of oil seeds
- Biodiesel production
- Ethanol production (1.Gen.)
- Ethanol production (2.Gen.)
- FT-Diesel production
- Methanol production
- DME production
- Hydrogen Production
- Biogas production

Years:
- 2010
- 2020
- 2030
- 2040
- 2050
Energy crops demand in the EU28

- Starchy crops
- Sugar crops
- Rape seed
- Woody crops

Energy crop production in [PJ]

- 2010
- ETS75
- C75
- C80
- 2020
- 2030
- 2040
- 2050
- C80
Comparison of real price index for starchy and woody crops in the EU28 (2006 = 100)
Comparison of the price index for energy crops and energy carrier in the EU28 (2010 = 100)
Net exports of selected products in the EU28 in 2050 in kt
Conclusions

• The chosen GHG mitigation scenarios, which do not take into account direct and indirect land use effects as well as emissions from higher production intensity in agriculture, result in:
  • Strong price effects
  • Enormous net trade effects
• Price changes for biomass effect demand from the energy sector
• A convergence after 3 to 4 iterations can be observed within the model coupling.
• Further work focus on detail modelling of bioenergy in both models (biogas, Lignocelluloses,…).
Thank you for your attention!