Modelling Energy Community LULUCF emissions/removals with GLOBIOM-G4M

Key assumptions and draft results on land use, land use change, and forestry

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Modelling suite for the draft Reference scenario
GLOBIOM – quick facts

- **Global Biosphere Optimization Model**
  - Developed by IIASA's BNR-Program
- **Partial equilibrium model**
  - Agriculture, forestry, and bioenergy sectors
  - Global coverage, World Regions, EU+Energy Community Countries
  - Bilateral trade flows
- **Bottom-up approach**
  - Detailed spatial resolution
  - Explicit description of production technologies by grid cell
- **Land use and land use change**
  - 6 different land use types
- **Linear programming approach**
  - Maximization of consumer and producer surplus
  - Optimization constraints
- **Base year**: 2000
- **Time step**: 10 years

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**Population, GDP, consumer preferences**

**Market & Trade: EU + World → Prices**

**Land Cover**

- Cropland
- Grassland
- Short rotation plantations
- Managed forest
- Natural forest
- Other natural land

**Crop model**

- EPIC
- RUMINANT (Digestibility model)
- BIOENERGY Processing
- G4M (Global Forest model)

**Production**

- Feed intake
- Animal production
- GHG emissions
- Feedstock
- MI biofuel
- MI bioelectric
- Coproducts
- Harvestable wood
- Harvesting costs

**Land use**

- 6 different land use types

**Base year**: 2000

**Time step**: 10 years
Linkage between GLOBIOM and G4M

Models

G4M
- Harvest potentials
- Carbon stocks
- Harvesting costs

GLOBIOM
- Harvest quantities
- Wood price
- Land use prices

Results

Afforestation / deforestation development
- Emissions and removal for forests
- Marginal Abatement Cost Curve

Harvest quantities
- Development of forest-based industries
- Emissions/removals/areas from CM, GM, HWP
G4M – The Global Forestry Model

- The Global Forestry Model (G4M) is a **geographically explicit economic forest sector model** (full foresight).

- The model provides global coverage and is spatially explicit.

- Estimates the impact of forestry activities (afforestation, deforestation and forest management) on harvestable biomass and forest carbon stocks.

- Historical trends as well as driver developments (wood prices, land productivity & rents, carbon price) are used.
G4M – The Global Forestry Model

The model is linked with GLOBIOM to provide spatial explicit information concerning:

• Change in **forest area** (e.g. afforestation, deforestation) as driven by the value of forest and alternative land use

• Change in **forest management** (e.g. rotation periods, thinning intensity) driven by increasing/decreasing demand of wood (for material and energy purposes)

• The **impact of management activities** on forest carbon stocks, increment, age structure development, harvest assortment, etc.

• **Carbon sequestration** and forest related emissions/removals (e.g. biomass, soil, dead organic matter)
Reference scenario drivers

Macro-economic (GEM-E3)
- Population growth
- GDP growth

Bioenergy (PRIMES)
- Conventional crops
- Lignocellulosic crops
- Forest biomass & residues

Other key drivers
- Technological change
- Consumer preferences
- Policies
- ROW developments

GLOBIOM-G4M projections
- Model calibration to FAOSTAT for activity data
- Offset calibration to country feedback/UNFCCC
- Difference between FAOSTAT cropland and sum of crops interpreted as abandoned land
Data

- UNFCCC data were not available for all countries/categories
- Complemented with country feedback
- If no data available → model results without offset calibration
- Few categories remain empty (e.g. GM can be sink or source in different countries, difficult to assume emission factors)

- Afforestation and deforestation rates*: UNFCCC > National data > FAO-FRA > global watch
- Forest area*: State of Europe's Forest Report > FAO FRA

* With few deviations
Area developments (EC-9)
Results – Forest sector removals (EC-9)

- Historical increase in roundwood harvests continues less strong after 2020
- Wood use for energy rather stable, material use expanding
Forest sink – EC-9 countries

- Forest management is the main driver of the LULUCF sink
- Difference to UNFCCC/Country data due to missing data for some countries, which have been filled with model results
- Decreasing sink goes back to higher harvesting of managed forests, only slightly compensated by afforestation
Results – afforestation and deforestation (EC-9)

- Annual afforestation rate declines and stabilizes at lower level after 2015. Slight decline after 2035.
- Deforestation rates are low and declining.
- Rather stable net forest area growth over time.
- Afforestation category (emissions) covers 20 years according to UNFCCC accounting.
- Accumulated Afforestation shows the trajectory without shifting emissions after 20 years into forest management category.
Projected cropland emissions slightly increase over time

CM not matching well historical trends

CM emissions mainly from Ukraine

No explicit SOC module in the model

Other categories rather small
Total LULUCF sink (EC-9)

- Cropland emissions increase slowly, grasslands remain a small source
- LULUCF dominated by forest management sink which is projected to decrease
- Net LULUCF sink declines to about 23 MtCO$_2$/y by 2030 (decrease by ~50% compared to 2005), thereafter much less dramatic
- Pattern is not the same for all countries
Thank you!