

# ECOFYS



sustainable energy for everyone

## Modelling ILUC of biofuels with the GLOBIOM model

**Stakeholder meeting**

14/11/2013

# Meeting agenda

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- > Introduction, project description, project context
- > Description of the GLOBIOM model (IIASA)
- > Which elements of ILUC modelling are important and should be taken into account
- > Providing information to improve the consistency of our modelling exercise
- > Conclusions

# Project description

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- > Ecofys, IIASA and E4tech quantify ILUC emissions of conventional and advanced biofuels consumed in the EU
- > Assignment by DG ENER, European Commission, other DGs involved
- > GLOBIOM partial equilibrium model, developed by IIASA
- > Study results available by early 2015
- > Transparent process, stakeholders requested to provide input
- > All documentation on GLOBIOM published on project website [www.globiom-iluc.eu](http://www.globiom-iluc.eu)

# Project timeline

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- > September ` 13: brief description of GLOBIOM sent to stakeholders, invitation to provide input via [ILUC@ecofys.com](mailto:ILUC@ecofys.com)
- > October: detailed description of GLOBIOM and comparison with MIRAGE-BioF circulated
- > November: stakeholder meetings
- > January: list of changes to GLOBIOM and draft *baseline en policy* scenario`s
- > Dialogue with Advisory Committee
- > 1st half 2014: IIASA amends GLOBIOM model
- > 2nd half 2014: modelling ILUC emissions

# Project context

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- > Project separate from current policy discussion
- > Outcomes may be used by policy makers, e.g. for discussion on post-2020 biofuels policy
- > Project aims to include stakeholders

# ILUC modelling with GLOBIOM

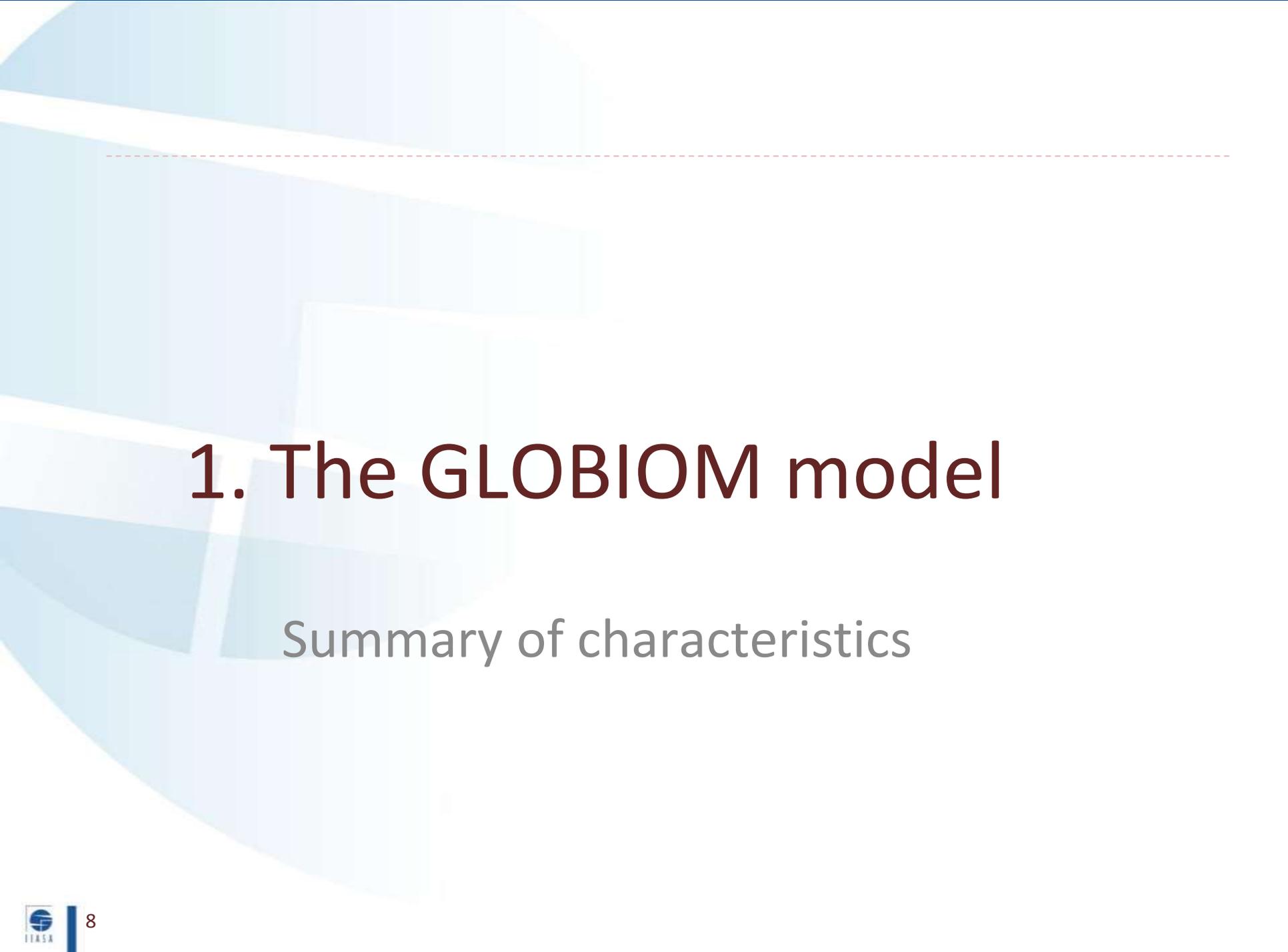
Hugo Valin, Petr Havlik, Nicklas Forsell, Stefan Frank,  
Aline Mosnier, Michael Obersteiner et al.

In partnership with Ecofys and E4Tech

# Outline

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1. The GLOBIOM model: Summary of characteristics
2. Our approach in modelling ILUC
3. How stakeholders can help us to improve



# 1. The GLOBIOM model

Summary of characteristics

# GLOBIOM context

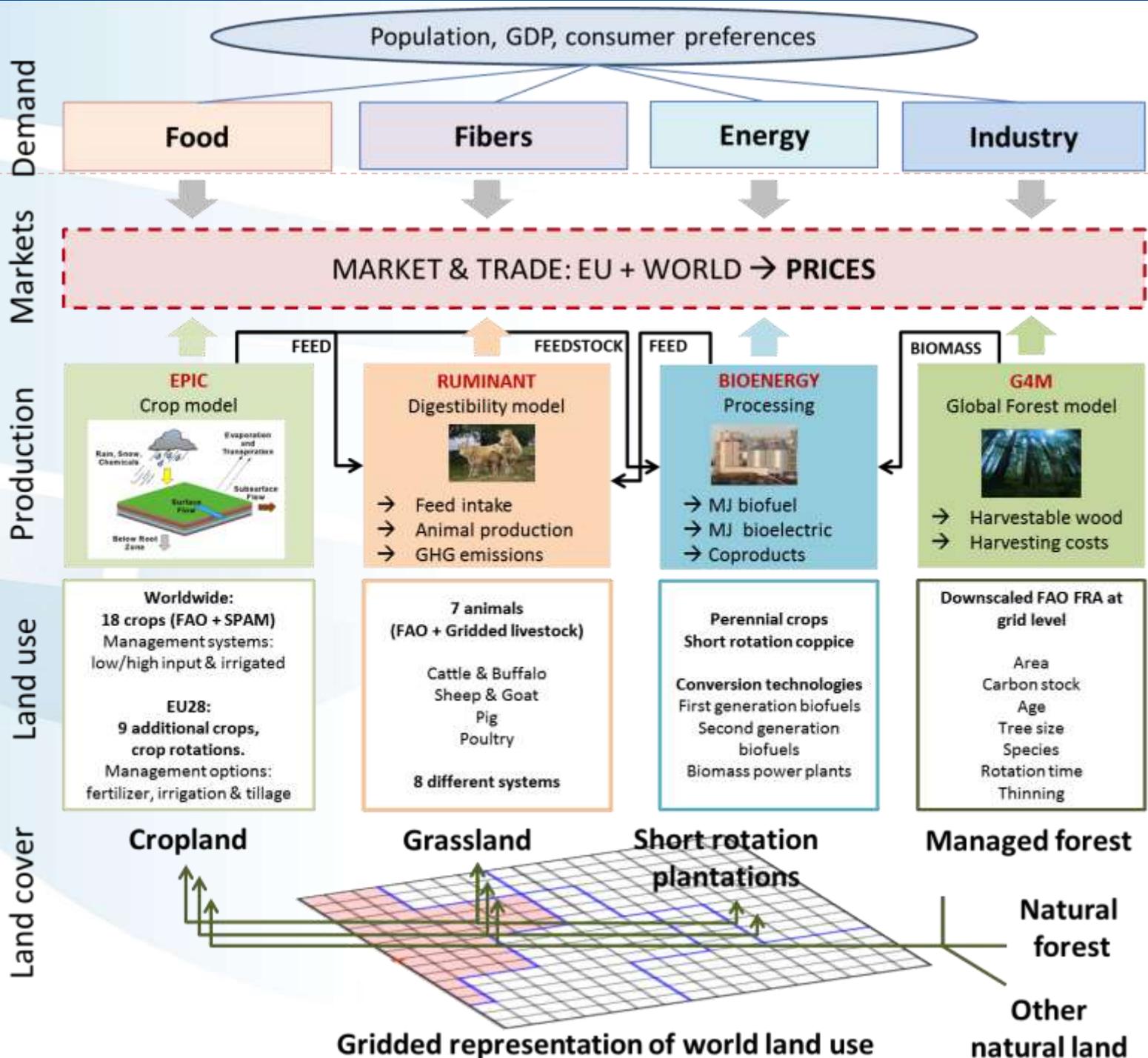
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- ▶ GLOBIOM will be used for this ILUC assessment exercise
  - ▶ Developed at IIASA since 2007
  - ▶ By a team of now 10 researchers with different backgrounds (economists, crop modellers, forest experts)
- ▶ Team experienced with the ILUC debate (several papers)
- ▶ Access to wide range of disciplines of relevance within IIASA
  - ▶ Agronomists, remote sensing, carbon accounting experts...
  - ▶ Access to large international network of researchers
- ▶ Significant involvement on land use change projects
  - ▶ Reduction of Emissions from Deforestation and Degradation (REDD)
  - ▶ Agricultural prospective
  - ▶ Climate change impact, adaptation and mitigation
  - ▶ Bioenergy
  - ▶ Collaborations with Brazil and Congo Basin

# Model structure

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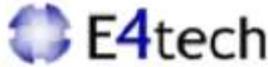
- ▶ Global scale model based on grid cell resolution (50 x 50 km)
- ▶ Partial equilibrium
  - ▶ agricultural, wood and bioenergy markets
  - ▶ for 28 Member states + 25 world regions
  - ▶ bilateral trade flows based on spatial equilibrium approach
- ▶ Linear programming approach
  - ▶ Maximisation of consumer + producer (incl. trade costs) surplus
  - ▶ Non linear expansion costs
  - ▶ Optimisation constraints
- ▶ Base year 2000
- ▶ Time-step: 10 years, typical time-horizon 2020/2050
- ▶ Setting tested in several assessments exercises (Havlik et al., 2011; Frank et al., 2012; Mosnier et al., 2013)



# GLOBIOM-EU version

	World non EU	EU
<b>Economic markets</b>	25 regions	28 Member States
<b>Land cover</b>	Global Land Cover 2000	CORINE Land Cover
<b>Lowest grid level</b>	10 x 10 km	1 x 1 km
<b>Running resolution</b>	< 2 x 2 degrees	< NUTS2 regions
<b>Agricultural accounts</b>	FAOSTAT SUA	EUROSTAT
<b>Crops</b>	EPIC: 18 crops, 3 management systems	EPIC + CropRota: 25 crops, 2 fertilizer, 2 irrigation, 3 tillage levels
<b>Livestock</b>	ILRI/FAO: 8 management systems for ruminant, 2 for monogastrics	ILRI/FAO: 8 management systems for ruminant, 2 for monogastrics Harmonisation with CAPRI
<b>Forestry</b>	FRA 2010 (FAO)	FRA 2010 (FAO)

# Differences with MIRAGE-BioF



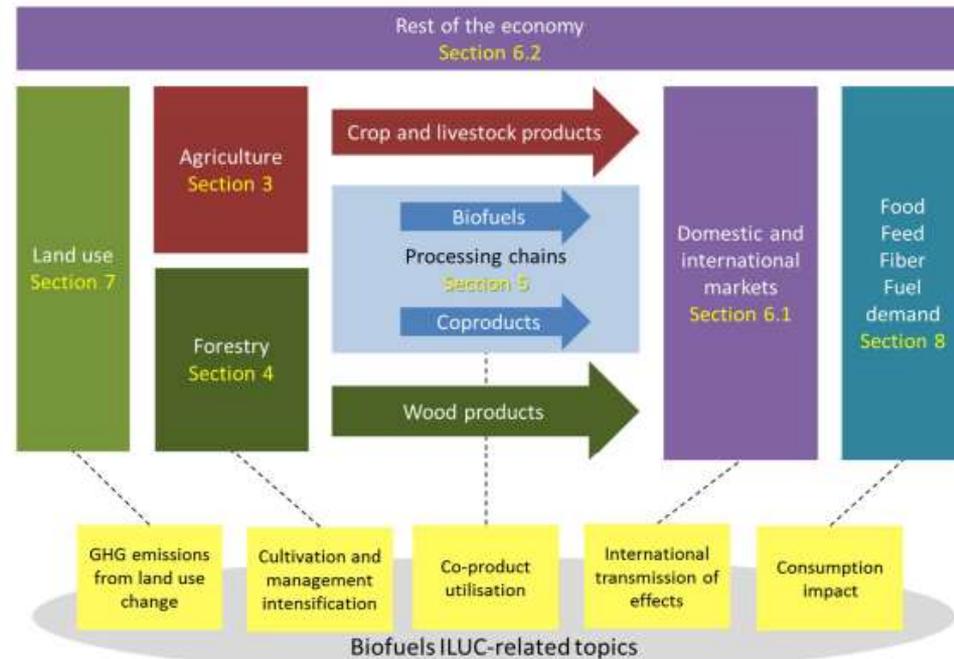
EC project ENER/C1/428-2012 - LOT 2  
Assessing the land use impact of EU biofuels policy

## Description of the GLOBIOM (IIASA) model and comparison with the MIRAGE-BioF (IFPRI) model

Hugo Valin, Petr Havlík, Niklas Forsell, Stefan Frank, Aline Mosnier (IIASA)  
Daan Peters, Carlo Hamelinck, Matthias Spöttle (Ecofys)  
Maarten van den Berg (E4tech)

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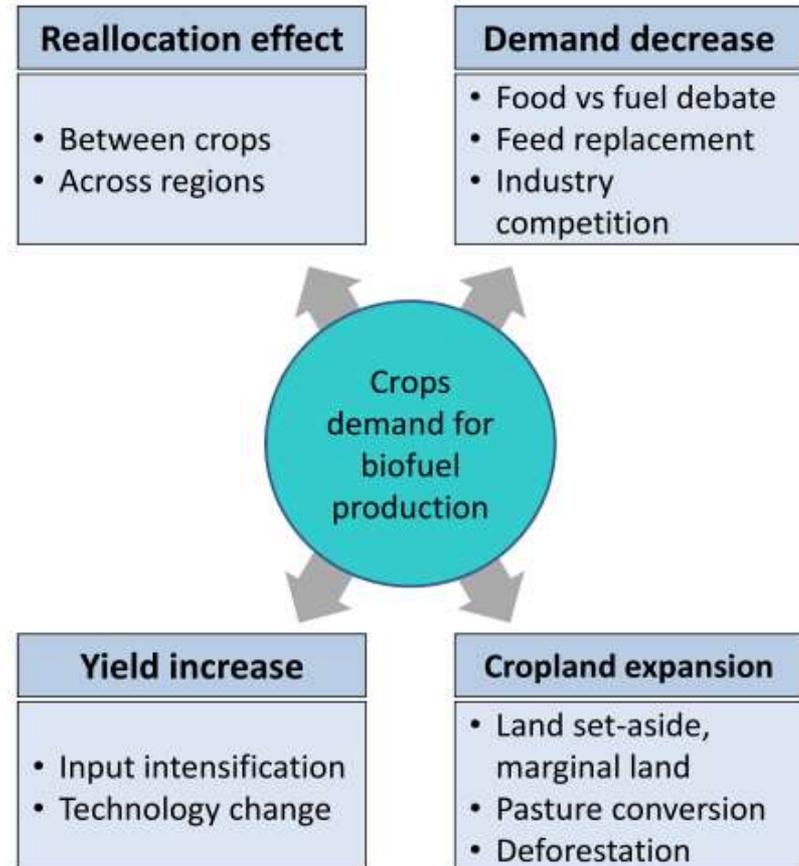
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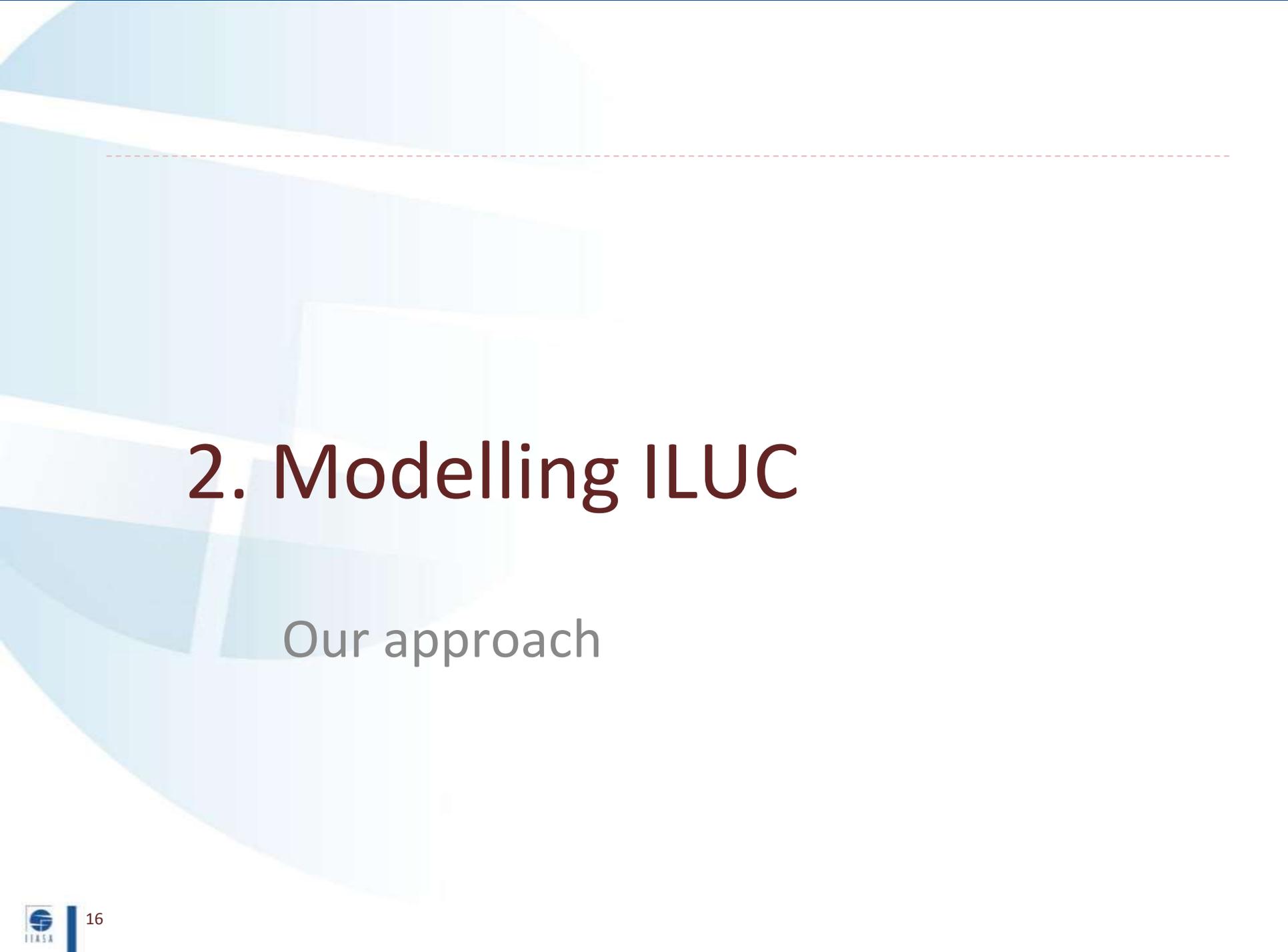


	<b>GLOBIOM (2013)</b>	<b>MIRAGE-BioF (2011)</b>
<b>Model framework</b>	Bottom-up, starts from land and technology	Top-down, starts from macroeconomic accounts
<b>Sector coverage</b>	Agriculture (incl. livestock), forestry and bioenergy (Partial equilibrium)	All economic sectors with agriculture disaggregated (General equilibrium)
<b>Regional coverage</b>	Global (28 EU Member states + 25 regions)	Global (1 EU region + 10 world regions)
<b>Resolution on production side</b>	Detailed grid-cell level (>10,000 units worldwide)	Regional level, land split into up to 18 agro-ecological zones
<b>Time frame</b>	2000-2030 (ten year time step)	2004-2020 (one year time step)
<b>Market data source</b>	EUROSTAT and FAOSTAT	GTAP economic accounts, harmonised with FAOSTAT
<b>Factor of production explicitly modelled</b>	More detailed on natural resources (land, water)	More detailed on economic resources (labour, capital, land)
<b>Land use change mechanisms</b>	Geographically explicit. Grid-cells with suitability, protected areas, conversion costs.	Not geographically explicit Substitution of land use at regional and agro-ecological zone level.
<b>Representation of technology</b>	Detailed biophysical model estimates from biophysical models. Literature reviews for biofuel processing	Input-output coefficient from GTAP or national statistics at regional level. Literature reviews for biofuel processing
<b>Demand side representation</b>	On consumer per region and per good, only reacting to price	One agent per region, adjusting its consumption between goods depending on prices and level of income
<b>GHG accounting</b>	12 sources of GHG emissions: crop, livestock, land use change, soil organic carbon. Peatland based on IPCC default emission factors.	Only land use change emissions. Deforestation and soil organic carbon from default IPCC emissions factors. Peatland revised upward from IPCC emission factor

# ILUC modelling features

- ▶ Detailed representation of land
  - ▶ associated uses (and non-uses)
  - ▶ carbon stocks
- ▶ Yield endogenous response
  - ▶ Intensification (change in systems)
  - ▶ Irrigation
  - ▶ Intra-regional reallocation
- ▶ Endogenous demand response
- ▶ Bilateral trade
- ▶ Marginal yield values from biophysical model





# 2. Modelling ILUC

Our approach

# Our approach to the study

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- ▶ Using the current state of literature
- ▶ Consultation with stakeholders and experts to refine and adapt the model to the ILUC question
  - ▶ Land use change drivers
  - ▶ Competition of uses
  - ▶ Technical and economic constraints
- ▶ Information and transparency on assumptions and results
  - ▶ Dedicated website: [www.globiom-iluc.eu](http://www.globiom-iluc.eu)
  - ▶ Model documentation
  - ▶ Downloadable results
  - ▶ Email address for questions and comments: [ILUC@ecofys.com](mailto:ILUC@ecofys.com)
- ▶ Scientific research
  - ▶ Accepting uncertainty
  - ▶ Acknowledging knowledge gaps

# Simulating LUC: Baseline and scenario

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1. Defining the baseline 2010-2030
  - ▶ Drivers (macro/future demand, productivity, technology)
  - ▶ Policies for EU and Rest of the world
    - ▶ Bioenergy
    - ▶ Agriculture and trade
    - ▶ Protected areas
2. Reference values
  - ▶ EU and rest of the world land use change
  - ▶ GHG emissions from agriculture and land use change
3. Applying a shock in demand for biofuels
  - ▶ Increase in 1 feedstock with 1 technology
  - ▶ Increase in all feedstocks with predefined portfolio of technologies
  - ▶ Increase in all feedstocks with cost-efficiency scenario

# Simulating LUC: Impacts

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## 4. Analysing policy impacts

- ▶ Additional demand drives prices up for biofuel feedstocks

Different effects:

- ▶ Increase in production
  - ▶ Increase in harvested area
  - ▶ Increase in yields (intensification, reallocation within regions)
  - ▶ In Europe but also in the rest of the world through trade
- ▶ Changes in demand for food, feed and industrial products
  - ▶ Buffers production side effects
  - ▶ Food security issues
  - ▶ Cheaper and more abundant feed for livestock through co-products

# Simulating LUC: Sensitivity and comparison

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5. Accounting GHG emissions from land use change (and others?)
6. Sensitivity analysis
  - ▶ Technical coefficients
  - ▶ Economic parameters on supply, demand and trade
  - ▶ Emission factors
7. Decomposition of effects
  - ▶ Net displacement factor (NDF, Plevin et al., 2010)
  - ▶ Contribution of demand, expansion, and yield response
8. Comparison with literature
  - ▶ IFPRI-MIRAGE
  - ▶ Other models



# 3. Role of stakeholders

How you can help us improve the tools?

# What information can help us

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- ▶ Reality checks
- ▶ Feedstocks supply constraints
  - ▶ Technical
  - ▶ Economic
  - ▶ Natural resources
- ▶ GHG sources and carbon stocks
- ▶ Drivers of land use change
- ▶ Market leakages
- ▶ Competition of uses for product and co-products
- ▶ Any information on current developments deemed of interest
  - ▶ Dataset
  - ▶ Reports
  - ▶ Peer-reviewed literature

# Conclusion

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- ▶ This modelling exercise is not a new assessment but an additional assessment
- ▶ Wish to model ILUC as consistently as possible
  - ▶ Stakeholder inputs can help us with this
- ▶ New models may bring new results but land use change is still likely to happen
- ▶ What will not change:
  - ▶ Results are feedstock specific
  - ▶ Uncertainty analysis will remain a major aspect
  - ▶ Models are not predictive tools but a simplified representation of a complex reality