Proposal for ILUC modelling baseline and scenarios

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Ecofys, IIASA and E4tech are undertaking a study for the European Commission on the indirect land use change impact of conventional and advanced biofuels consumed in the EU. This assessment will be based on the GLOBIOM partial equilibrium model, developed at IIASA. This document presents a proposal by the project consortium on key aspects of the study: the proposed baseline and main baseline assumptions, chosen feedstock scenarios, alternative scenarios and sensitivity analyses. This proposal will be discussed with the scientific advisory committee of the project, with the European Commission and with a wide group of interested stakeholders. Based on these discussions a final decision on the modelling baseline and scenarios is expected to be made in March 2014.

First of all, a **baseline** will be set up to take into account the evolution of main macro-economic indicators and policies. This baseline will serve as a reference for the study. A proposal for its main parameter assumptions is presented in Table 1. However, the range of plausible futures is wide and possible alternative developments will also be considered in two ways:

1) A sensitivity analysis will be performed on model parameters. This will highlight different developments of the model variables, for a same baseline. For instance, changing the elasticity of endogenous yield response can lead, for the same future food consumption patterns, to different land use changes;
2) Some alternative policy scenarios can be tested, reflecting effects of more or less deforestation and other land use related policies.

The baseline will be compared with several policy **scenarios**. Suggested scenarios are listed in Table 3. First, some feedstock-specific scenarios will be explored; looking at the effect of increasing the incorporation level of one biofuel feedstock only (the proposed list of **feedstocks** is presented in Table 2). In addition, some scenarios will look at different possible developments of the EU biofuel policy and test alternative assumptions. There is a large recognition of the sensitivity of land use change impacts to behavioural parameters in economic models. For that reason, **sensitivity analyses** will be performed to explore uncertainty ranges around the results of these scenarios. This will be performed through Monte-Carlo simulations, i.e. the GLOBIOM model will be run a large number of times, drawing random values of parameters in a plausible distribution, to produce an estimate of the results distribution. The parameters that will be at the core of the sensitivity analysis are presented in Table 4.

Any comments or remarks on this document can be sent by early March 2014 to iluc@ecofys.com.

Other documents from the project are retrievable on the project website: www.globiom-iluc.eu

Table 1. Main baseline indicator assumptions

Variable	Assumption	Source
Macroeconomics		
Population	SSP2 *The Shared Socio-economic Pathways (SSP) are consistent and harmonised prospective scenarios developed and widely used by the scientific community in the framework of research on climate change. The SSP2 scenario, called "Middle of the Road" assumes mostly prolongation of currently observed trends. World population in this scenario reaches 9.3 billion by 2050.*	SSP Database IIASA https://secure.iiasa.ac.at/web-apps/ene/SspDb/dsd?Action=htmlpage&page=about
GDP	SSP2 *The same scenario as above is used, which ensures consistency of GDP projections with population assumptions. In SSP2, the trend of fast growth in emerging regions continues. The world GDP per capita increases from USD 6,700 on average in 2005 to USD 16,000 in 2050. China's and India's GDP per capita are multiplied by more than ten in this period.*	SSP Database IIASA https://secure.iiasa.ac.at/web-apps/ene/SspDb/dsd?Action=htmlpage&page=about
Energy		
Energy prices	World Energy Outlook 2013 and EU Roadmap Reference scenario 2050 *Price of crude oil is assumed to slightly increase by 2030 to reach a level of USD 121 per barrel in real terms versus USD 109 in 2012.For the EU, imported gas prices increase from 65 USD in 2012 to 80 USD in 2030, whereas coal price is considered stable around 30 USD per barrel oil equivalent.*	World Energy Outlook 2013 www.worldenergyoutlook.org EU Energy Transport and GHG Emissions Reference scenario 2013 Trends to 2050 http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf
Fuel demand in EU transport	EU Roadmap Reference scenario 2050 *Total demand for transportation fuel Is expected to decrease by about 10% between 2010 and 2030, whereas the share of diesel in car conventional fuels is shifted from 67% to 81% in 2030.*	EU Energy Transport and GHG Emissions Reference scenario 2013 Trends to 2050 http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf
Biofuel 1G Rest of the world	AGMIP 1G scenario (except for EU) *This scenario has been developed by a consortium of modelers working on global agricultural scenarios. The first generation biofuels assumptions follow the current commitments of the following countries:* *- USA: Implementation of the 36 billion gallon mandate by 2022; 15 billion gallon from corn ethanol already in 2020 and 5 billion gallon from advanced non cellulosic biofuels (50% biodiesel and 50% sugar cane based).* *- Brazil: 25% of ethanol incorporation and stable incorporation of biodiesel; transportation fuel increase according to Petrobras business plan 2012-2016* *- Argentina: Incorporation of 10% of biodiesel in diesel fuel by 2020; Ethanol remains little used.*	Lotze-Campen et al., 2014 http://dx.doi.org/10.1111/agec.12092

	- China: Stable ethanol incorporation rate; increase of 8% per year of fuel transport demand; biodiesel remains little used. *- Canada: Incorporation of 5% of ethanol in gasoline by 2020; biodiesel remains little used (B2 mostly - not reported here).*	
Biofuel 2G Rest of the world	US mandate projection according to US EIA AC advise to use another source than RFS targets to have a more realist 2G target for the US..	RFS2, US EPA or IEA
Solid biomass	IIASA or PRIMES *Bioelectricity generation increase from 0.9 to 1.3 EJ/yr at the global level. Traditional use of biomass decrease in developing countries and stops by 2030, except in Africa where it is halved and stops in 2050.*	Global Energy Assessment database www.iiasa.ac.at/web-apps/ene/geadb
Biofuels EU 1G	3.3% conventional biofuels as in IFPRI 2011 baseline for 2020 modelling (2030 tbd)	
Biofuels EU 2G	Zero, as in IFPRI 2011 baseline	
Agriculture		
Crop yield	Historical projections based on 10 to 15 years regression	Historic yield projections. Source: FAOSTAT
Livestock productivity	ANIMAL CHANGE *Livestock feed conversion efficiencies increase in developing regions by up to 50-70% by 2050 for SSP2 but grow only slowly in Europe (below 5% increase).*	ANIMAL CHANGE Projections www.iiasa.ac.at/web/home/research/researchPrograms/EcosystemsServicesandManagement/D2.2_AnimalChange.pdf
Diet patterns	FAO *Consumption per capita increases across the world from an average of 2,772 kcal/cap/day in 2005/2007 to 2,960 kcal/cap/day in 2030. Diet structure evolves with increase in meat consumption per capita in developing regions. In developed regions some slight substitution occurs from bovine meat towards pig and poultry meat consumption. Milk consumption share also increases in diet.*	Alexandratos and Bruisma, 2012 www.fao.org/docrep/016/ap106e/ap106e.pdf
Technical change processing	Fixed (assumptions to be updated)	
Common Agricultural Policy	- Status quo on direct payment after CAP reform 2014-2020 - set aside level 7,8%, remains constant after introduction of greening in 2015 - no subsidy on energy crop	
Trade policies	Status quo on trade policy except: - recent WTO accession (China 2001, Russia 2012) - US-EU: Transatlantic Trade and Investments Partnership (TIPP), if signed - Free Trade Area of the Americas (changing biofuel trade patterns) - WTO Doha 2013	World Trade Organization www.wto.org MAcMap tariffs database www.cepii.fr

Land use		
Land protection	Protected areas from WDPA *The World Database on Protected Areas (WDPA) is the most comprehensive global dataset on terrestrial and marine protected areas. It is a joint project between the United Nations Environment Programme (UNEP) and the International Union for Conservation of Nature (IUCN), maintained at the UNEP World Conservation Monitoring Centre.*	World database on protected areas www.wdpa.org
Deforestation policy	Status quo after 2010 *Effect of policies put in place during the 2000s will be considered to the extent that their effects have been visible. Reference period for deforestation will be 2005-2010.*	Forest Assessment Report 2010 www.fao.org/forestry/fra/fra2010

Table 2. List of feedstocks for the scenario modelling

nr	Conventional	nr	Advanced
1.	Wheat (Ethanol)	1.	Wheat straw (Ethanol, butanol)
2.	Maize (Ethanol)	2.	Short rotation plantations (Ethanol, methanol, FT biodiesel, Bio DME)
3.	Rye (Ethanol)	3.	Forestry residues (Ethanol, methanol, FT biodiesel, Bio DME)
4.	Sugar beet (Ethanol)	4.	Grassy crops (e.g. miscanthus) (Ethanol)
5.	Sugar cane (Ethanol)	5.	Silage maize (Biogas)
6.	Rapeseed (Biodiesel, HVO)	6.	
7.	Soybean (Biodiesel, HVO)	7.	
8.	Sunflower (Biodiesel, HVO)	8.	
9.	Palm oil (Biodiesel, HVO)	9.	

Table 3. List of suggested scenarios

Scenario		Nr of scenarios	Sensitivity Analysis
	Baseline		
A0	Baseline to 2030: see Table 1.	1	MC
	Central scenarios		
A	**"Marginal feedstock":** A0 + or B (tbd) 1% incorporation of 1 feedstock	14	MC
A1	**"Marginal feedstock groups":** as A but with crop groups (ILUC proposal)		
B	**"EU biofuel mix in 2020":** A0 + biofuel consumption forecasts from National Renewable Energy Action Plans (+ 2030 tbd)	1	MC
B1	**"EU biofuel mix in 2020 with 5% cap":** B + cap at **5%** of conventional biofuels (+ 2030 tbd)	1	No
	Possible additional policy scenario		
C	**"Biofuels + increased marginal land access in EU"**: Scenario B + incentivised land expansion into EU abandoned land	1	No
D1	**"Biofuels + increased REDD efforts":** A0 and scenario B (tbd) + REDD type policy reducing deforestation	1	No
D2	**"Biofuels + less effort on deforestation":** Scenario B + decreased land conversion cost due to institutional framework more favourable to land exploitation.	1	No
TOTAL		**20**	

Sensitivity analysis design

As described in the introduction, sensitivity analyses will be performed using a Monte-Carlo approach. The number of runs per scenario will be fine-tuned in the course of the project (if possible, 1,000 per scenario)[1]. Parameters to be targeted by the Monte-Carlo are:

1. Demand elasticities
2. Intensification costs for yield response
3. Land conversion costs
4. Trade costs
5. Co-product substitution rates
6. Substitution of vegetable oil

Distribution on these parameters will be assessed through literature surveys.

[1] FAPRI has already performed Monte-Carlo analysis with a number of 500 runs.