iLUC – risks, remedies and regulations

The role of good governance for a sustainable development

International Palm Oil Sustainability Conference 2012
Putrajaya, Malaysia

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and
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Technical University Darmstadt

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iLUC – risks, remedies and regulations

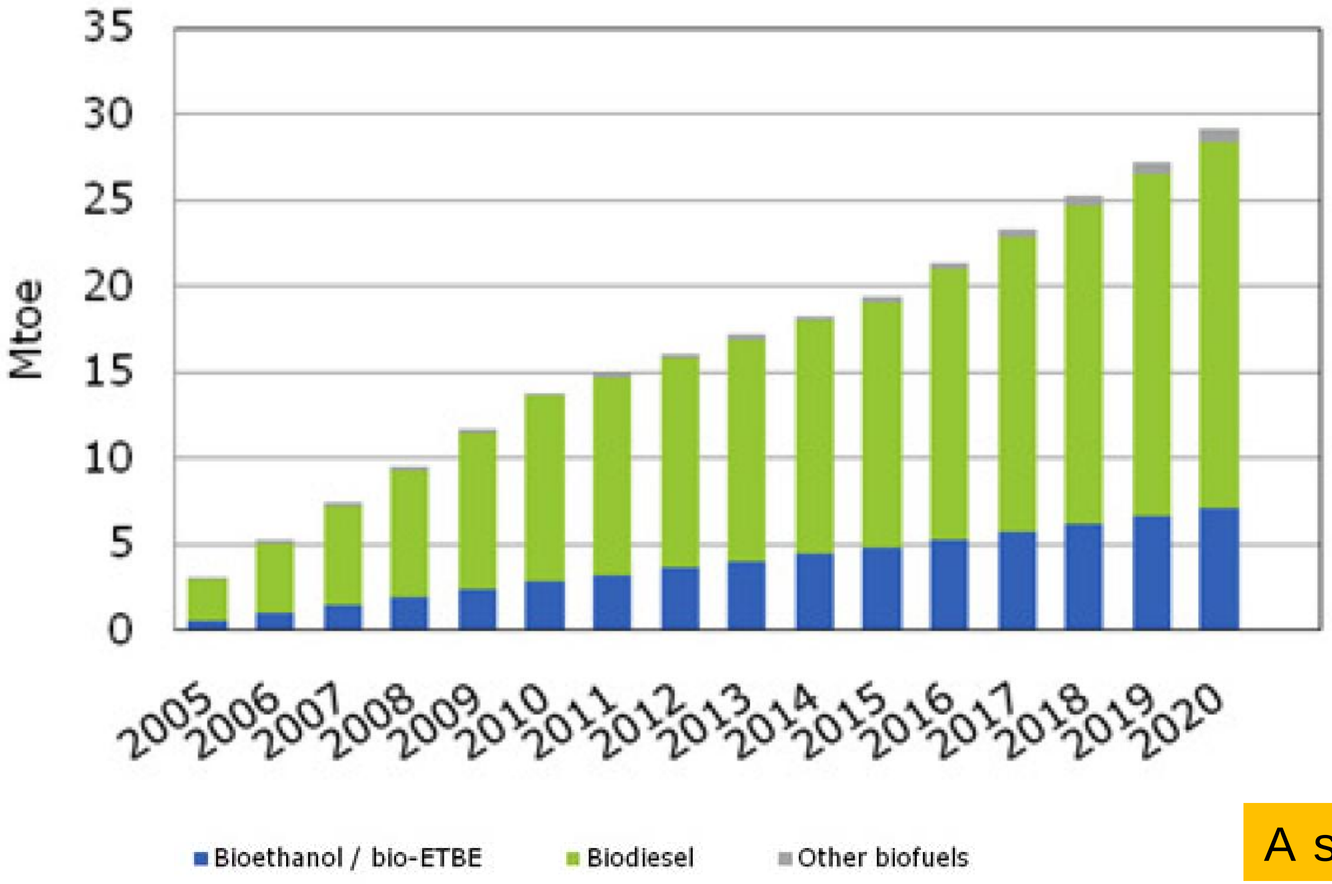
Structure of the presentation

1. The „climate“ in Europe
2. iLUC associated risks
3. Calculating „indirect Land Use Change“ (iLUC)
   3.1 Agro-econometric models
   3.2 Cause effect relationships
4. Biofuel regulation EU
5. iLUC controversy within the European regulatory bodies
6. RFS2 USA
7. California Air Resource Board (CARB)
8. Personal point of view
   7.1 Regional approach
   7.2 Foster „Good Governance“

8. Summary

9. If there is time: an UNEP-video about REDD

1. The „climate" in Europe



Biofuel demand in the EU following the members' „National Renewable Energy Action Plans".

A success story ?

Ecofys 2012

2. iLUC associated risks

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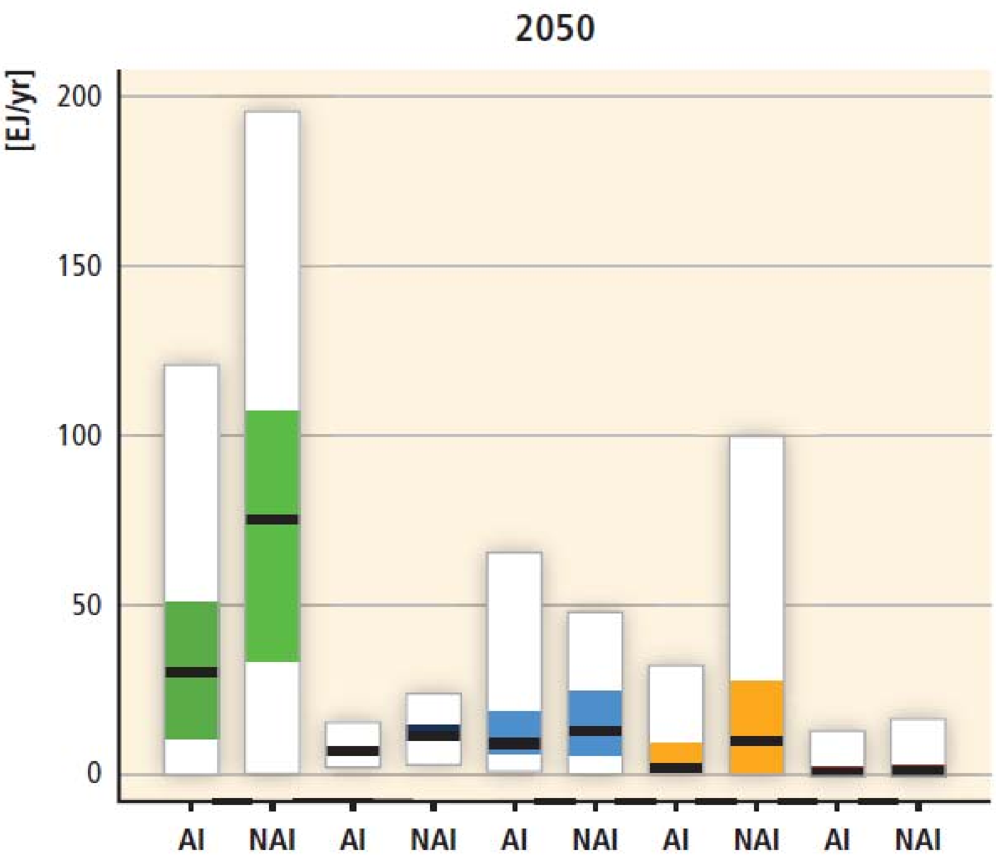
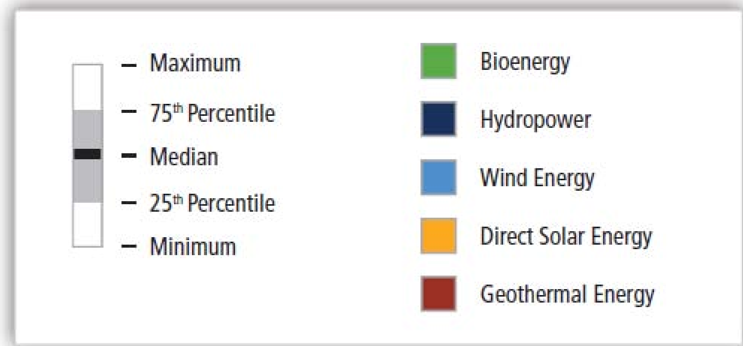


Biomass is the most important pillar to reach the goal



AI = Annex 1 States
(industrialized countries)

NAI = Non Annex 1 States

Result of the analysis of 164 climate change scenarios: Global RE primary energy supply (direct equivalent) by source

http://srren.ipcc-wg3.de/report/IPCC_SRREN_TS.pdf

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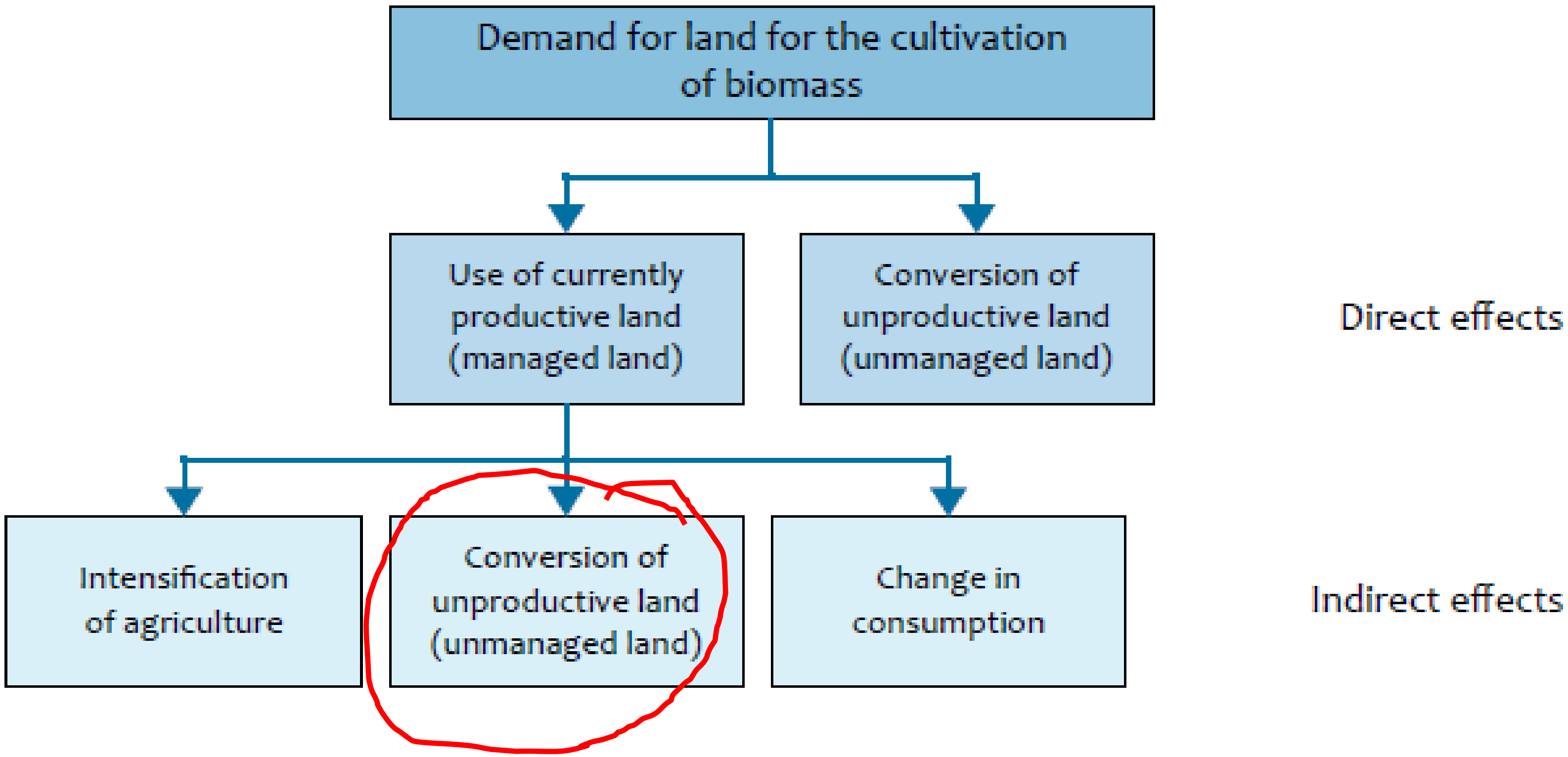
2. iLUC associated risks



Prins A. G. et al. 2010

2. iLUC associated risks

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A European NGO‘s point of view

Peter and Jane A Short Film about Biofuels - YouTube.flv

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3. Calculating „indirect Land Use Change“ (iLUC)

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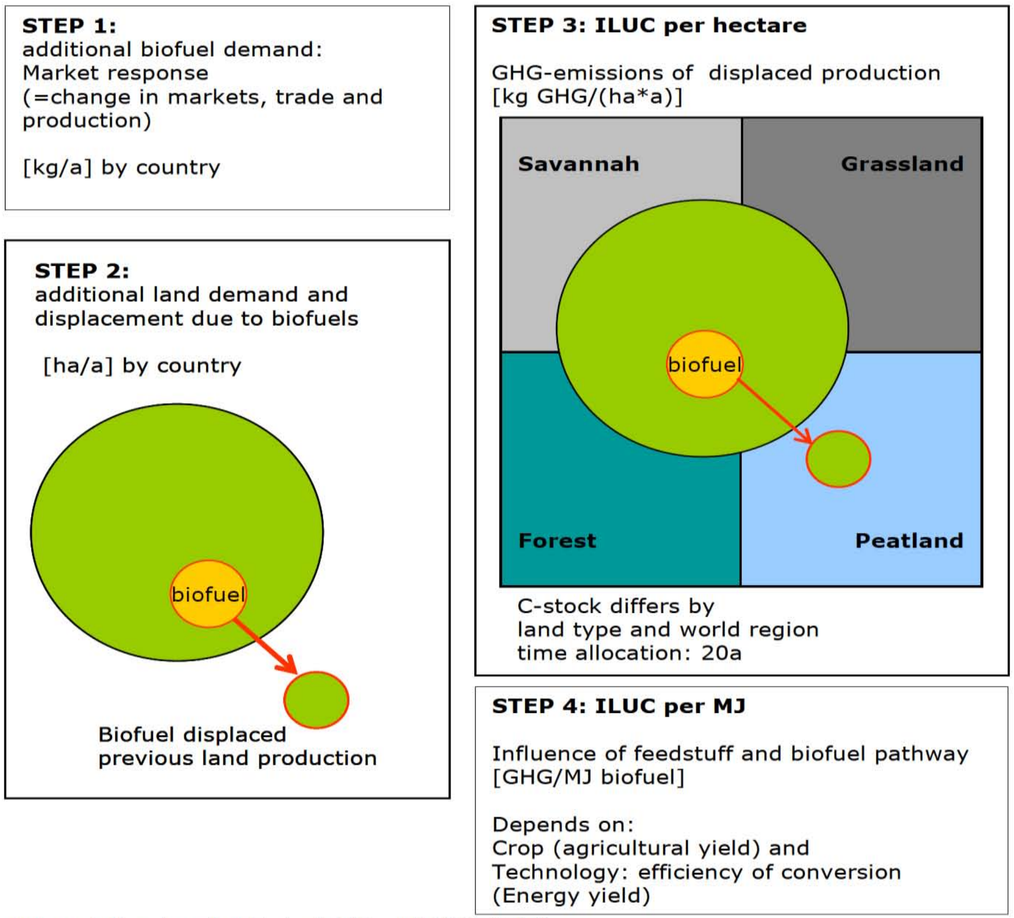

Source: Authors based on Ecofys (2010), and OEKO (2010)

Structure of modeling iLUC:

Models in use:

- Agro-econometric models
- Cause effect analysis
- Simple spreadsheets

http://www.mvo.nl/Portals/0/duurzaamheid/biobrandstoffen/nieuws/2011/03/EP%20rapport.pdf

3. Calculating „indirect Land Use Change" (iLUC)

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Carbon stock (in vegetation and soil) for different land uses, in Mg C/ha

Land use	Carbon stock	Land use	Carbon stock
Rain Forest, **Default**	300 Mg C/ha	Grassland, **Default**	100 Mg C/ha
Rain Forest, Asia, soil = 0	205 Mg C/ha	Bushland, Africa	90 Mg C/ha
Rain Forest, Asia, Peatland	970 Mg C/ha	Woody Cerrado, South America	75 Mg C/ha
Rain Forest, Amazon	265 Mg C/ha	Grassy Cerrado, South America	65 Mg C/ha
		Savanna wet	130 Mg C/ha
Forest, **Default**	150 Mg C/ha	Grassland tropical	75 Mg C/ha
Forest North America	140 Mg C/ha	Grassland temperate	70 Mg C/ha
Forest Europe	130 Mg C/ha	Pasture temperate, minimal	40 Mg C/ha
Plantage	110–130 Mg C/ha		
Wetland	100 Mg C/ha	Cropland annual harvest, **Default**	55 Mg C/ha
		Cropland annual harvest, soil = 40	45 Mg C/ha
		Cropland annual harvest, minimal	30 Mg C/ha

3.1 Agro-econometric models

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There is direct (dLUC) and indirect (iLUC) Land Use Change (LUC):

- Direct LUC: You can observe, visit and regulate.
- Indirect LUC: You can't …
- Indirect LUC can happen within a country, between two countries, between more than two countries, within one year or over a longer time period.
- Indirect LUC can be „caught" with the help of agro-econometric model calculations.
- Unfortunately the models show very different results.
- One solution to the problem: look for the „best" model and use this results.
- EPA and DG Climate use this approach.

3.1 Agro-econometric models

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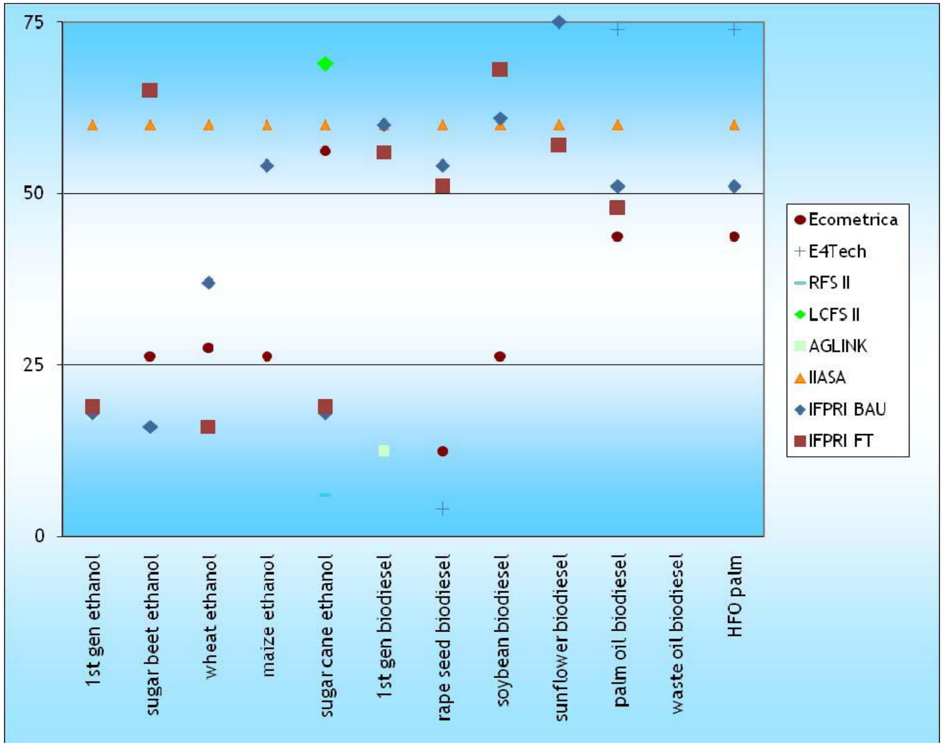
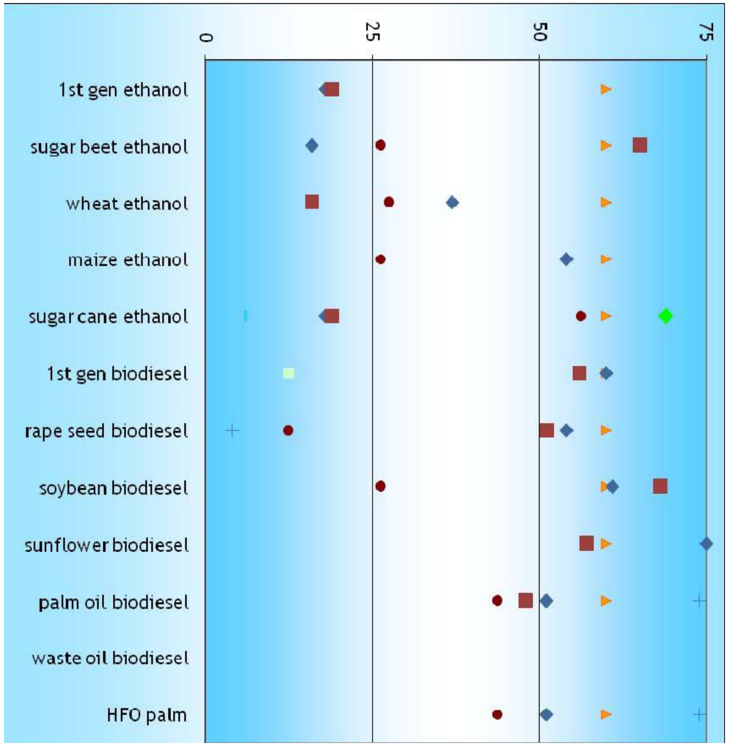
Model calculations show significant scattering





iLUC by biofuels using different calculation models (g CO_{2eq}/MJ)

http://www.ce.nl/publicatie/biofuels%3A_indirect_land_use_change_and_climate_impact/1068

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3.2 Cause effect relationships (E4tech)

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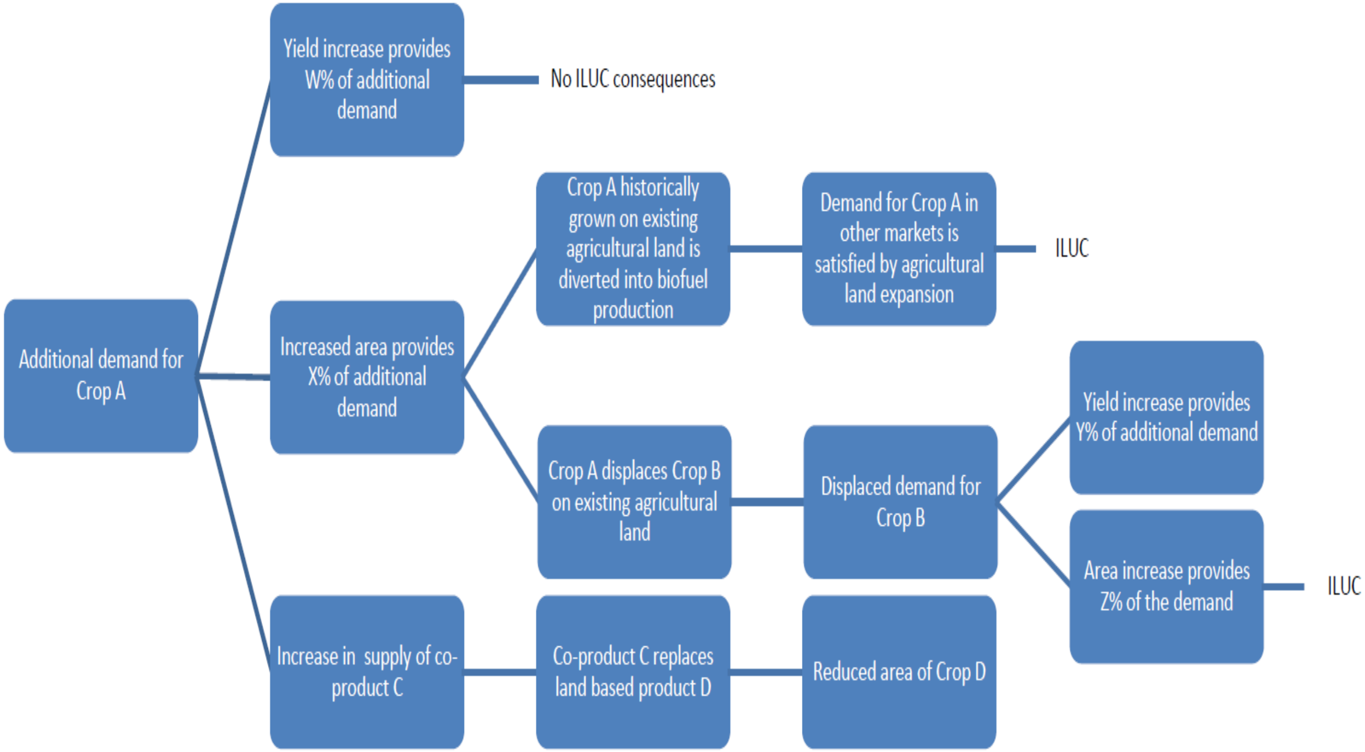

The analytical relationship is discussed with local and regional experts: **expert judgement.**

E4tech 2010

3.2 Cause effect relationships (E4tech)

Scenario	1	2	3	4	5	6	7	8	9	10
16% yield increase attributed to palm biofuel demand	✓	X	X	X	X	X	X	X	X	X
No palm yield increase attributed to palm biofuel demand	X	✓	✓	✓	✓	✓	✓	✓	✓	✓
Historical deforestation	✓	✓	✓	✓	X	X	X	✓	✓	✓
10 % deforestation	X	X	X	X	✓	✓	✓	X	X	X
No peat land expanded onto	X	✓	X	X	✓	X	X	✓	X	X
5% peat land expanded onto	X	X	✓	X	X	✓	X	X	✓	X
33% peat land expanded onto	✓	X	X	✓	X	X	✓	X	X	✓
Single plantation lifetime	✓	✓	✓	✓	✓	✓	✓	X	X	X
Continuous plantings	X	X	X	X	X	X	X	✓	✓	✓

Work with policy scenarios

E4tech 2010

3.2 Cause effect relationships (E4tech)

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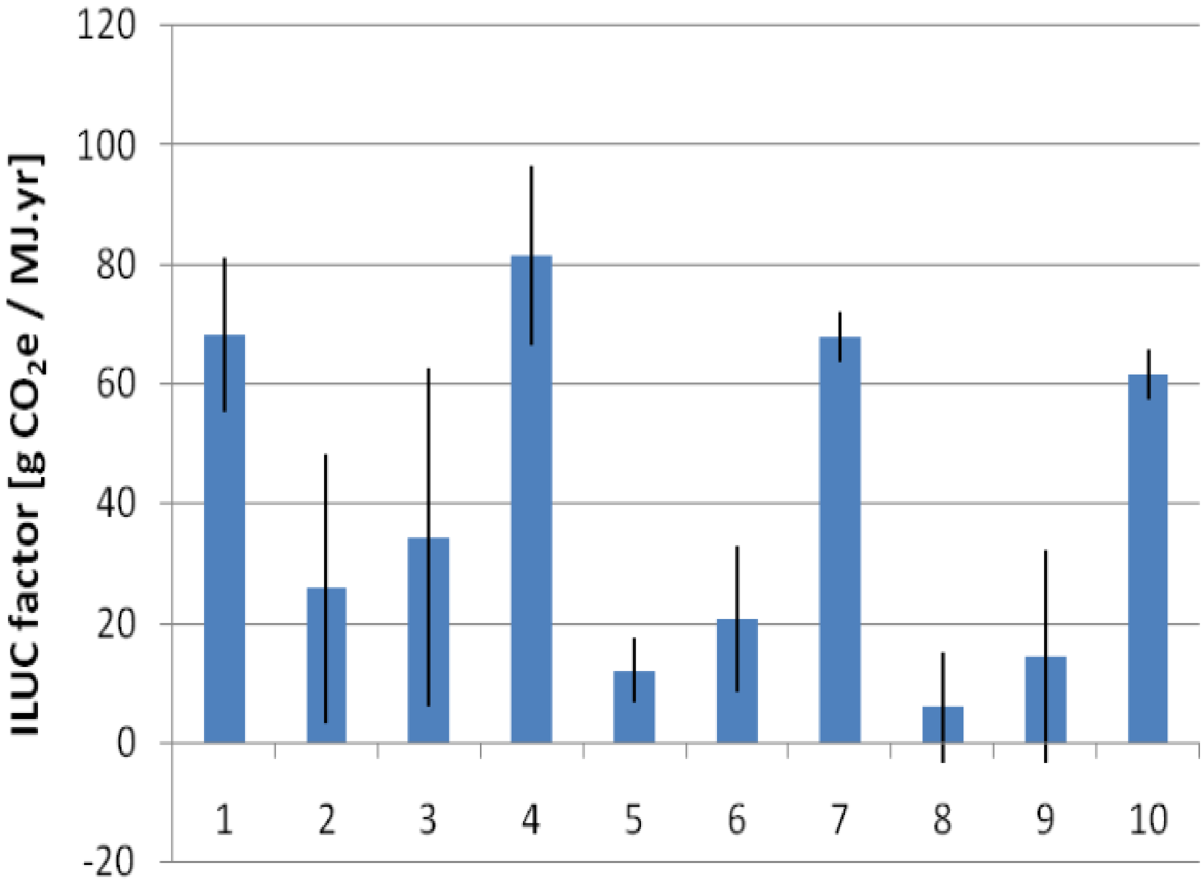

Policy scenarios define the results for iLUC !

E4tech 2010

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4. Biofuel regulation EU

The EU-goals

The EU's overall energy and climate policy target: consumption of renewable energy **to 20% by 2020.**

And for the Transportation Sector:

2. Member States shall require suppliers to reduce as gradually as possible life cycle greenhouse gas emissions per unit of energy from fuel and energy supplied by up to 10 % by 31 December 2020, compared with the fuel baseline standard referred to in paragraph 5(b). This reduction shall consist of:

4. European Fuel Quality Directive (FQD) and the Renewable Energy Directive (RED)

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$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr} - e_{ee}$$

where

E	=	total emissions from the use of the fuel;
e_{ec}	=	emissions from the extraction or cultivation of raw materials;
e_l	=	annualised emissions from carbon stock changes caused by land use change;
e_p	=	emissions from processing;
e_{td}	=	emissions from transport and distribution;
e_u	=	emissions from the fuel in use;
e_{sca}	=	emission savings from soil carbon accumulation via improved agricultural management;
e_{ccs}	=	emission savings from carbon capture and geological storage;
e_{ccr}	=	emission savings from carbon capture and replacement; and
e_{ee}	=	emission savings from excess electricity from cogeneration.

Indirect LUC-effects are not included in the formula above.

Emissions from the fuel in use, e_u, shall be taken to be zero for biofuels.

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5. iLUC controversy within the European regulatory bodies

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And iLUC ?

The EU Commission has developed **four options** for consideration of fighting the iLUC phenomenon:

1. No activity (watch and wait)
2. Increase the required minimum greenhouse gas savings of RED/FQD, (e.g. DG Energy: 35 % to 65 %)
3. Introduction of additional sustainability requirements for individual biofuels in the RED,
4. Introduction of a factor for considering iLUC in the calculation formula of the greenhouse gas savings (DG Climate, see below)

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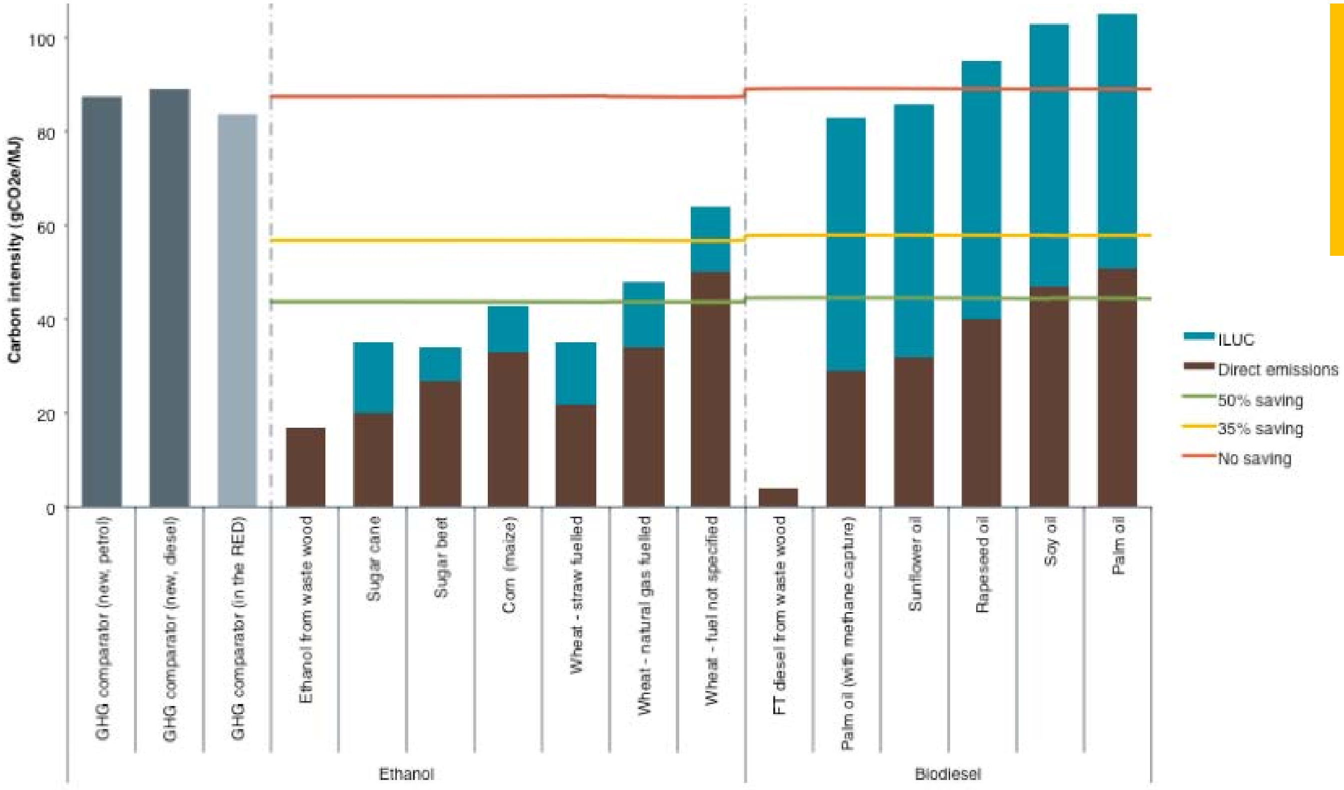
5. iLUC controversy within the European regulatory bodies

Perhaps one of today's best agri-econometric model

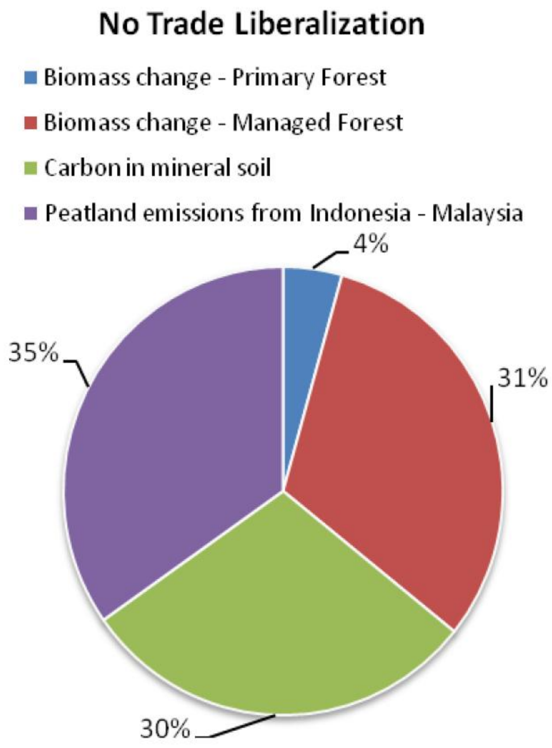


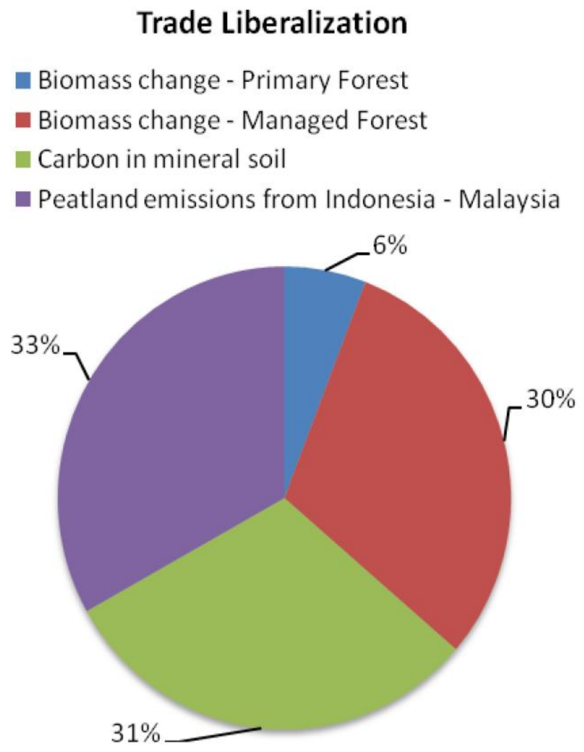
Biodiesel from oil seeds does not meet the 35 % savings

iLUC here stands for LUC

http://www.theicct.org/2011/10/new-ifpri-mirage-iluc-study-released-by-european-commission/

5. iLUC controversy within the European regulatory bodies





Causes for iLUC

http://www.theicct.org/2011/10/new-ifpri-mirage-iluc-study-released-by-european-commission/

5. iLUC controversy within the European regulatory bodies

The actual status ?

Decision still pending

6. Renewable Fuel Standard (RFS2) USA

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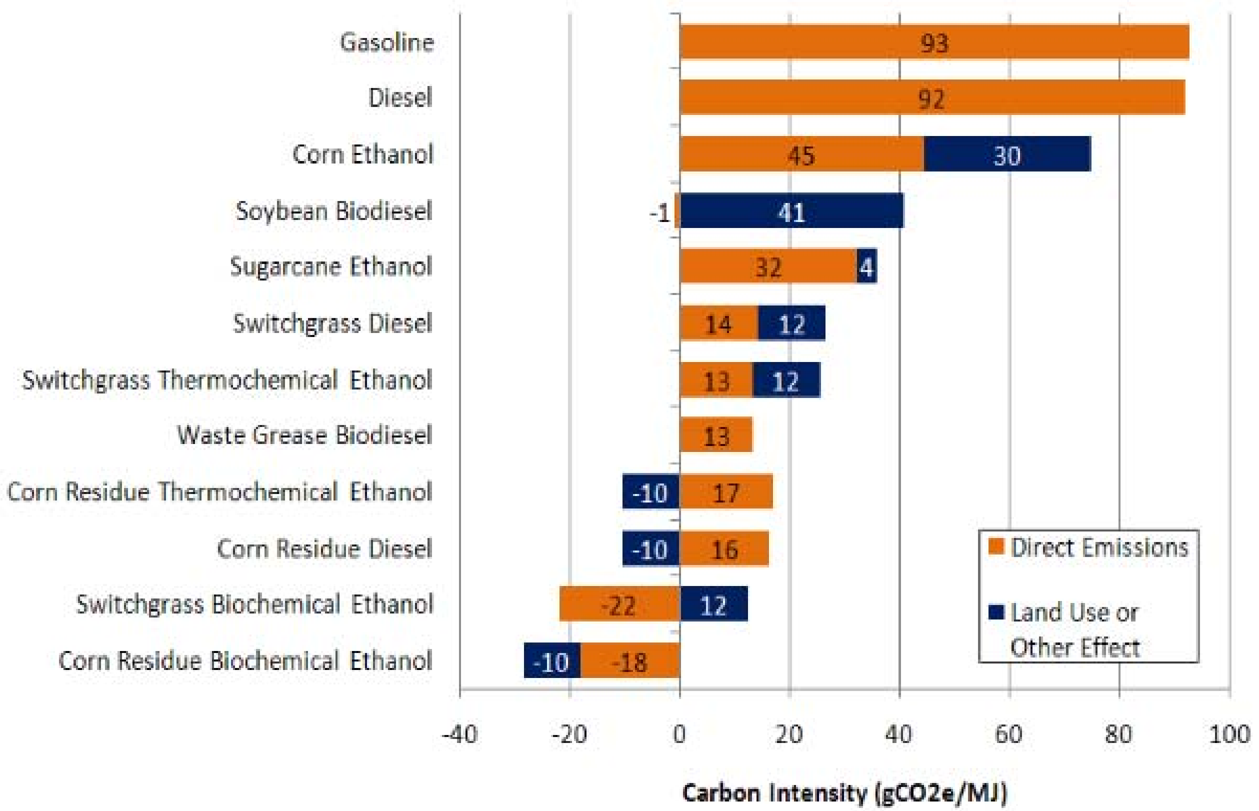
Fuel	% reduction from displaced gasoline/diesel (2005 baseline)	Definition
Renewable fuel	20%	Fuel produced from renewable biomass and that is used to replace or reduce the quantity of fossil fuel present in a transportation fuel.**
Advanced biofuel	50%*	Renewable fuel other than ethanol derived from corn starch.
Biomass-based diesel	50%	Includes both biodiesel (mono-alkyl esters) and non-ester renewable diesel (including cellulosic diesel). It includes any diesel fuel made from biomass feedstocks. However, EISA included three restrictions. EISA requires that such fuel be made from renewable biomass. The statutory definition of "biomass-based diesel" excludes renewable fuel derived from co-processing biomass with a petroleum feedstock.
Cellulosic biofuel	60%	Renewable fuel derived from any cellulose, hemicelluloses, or lignin each of which must originate from renewable biomass.

EPA

6. Renewable Fuel Standard (RFS2) USA



http://www.c2es.org/docUploads/figure2_0.png

6. Renewable Fuel Standard (RFS2) USA

EPA United States Environmental Protection Agency

Palm Oil Lifecycle GHG Analysis Results

- EPA's analysis shows that biodiesel and renewable diesel produced from palm oil do not meet the minimum 20% lifecycle GHG reduction threshold needed to qualify as renewable fuel under the RFS program.
- EPA's RFS rulemaking would not restrict the import of palm oil to the U.S. – it would only determine if palm oil qualifies for credit as a transportation fuel under the RFS program.

Lifecyle GHG Emissions Summary (kgCO2e/mmBtu)			
Emissions Category	2005 Diesel Baseline	Palm Oil Biodiesel	Palm Oil Renewable Diesel
Net Agriculture (w/o land use change)	-	5	5
Land Use Change	-	46	47
Fuel Production	18	25	31
Fuel and Feedstock Transport	-	4	4
Tailpipe Emissions	79	1	1
Net Emissions	**97**	**81**	**87**
% Reduction Relative to Baseline		**-17%**	**-11%**

EPA, Bali 2012

6. Renewable Fuel Standard (RFS2) USA

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Malaysian Palm Oil Industry

Number	Scenario	Net reductlon relative to fossil fuel (%)	
		Palm oil biodiesel	Palm oil renewable diesel
1	Palm oil NODA study	17	11
2	Lower C stock in forest/mixed	38	32
3	Lower C stock, lower peat emission	52	47
4	Lower C stock, lower peat emission, not including palm kernel	53	47
5	Lower C stock, lower peat emission, not including palm kernel, methane capture	79	74
6	Lower C stock, lower peat emission, not including palm kernel, no methane capture, C sequestration	75	70
7	Lower C stock, lower peat emission, not including palm kernel, methane capture, C sequestration	101	96

What is the difference:

1. Modeling,
2. Uncertainties about scientific data,
3. What are the future policy scenarios in the countries (governance)?

MPOC 2012

7. California Air Resources Board (CARB)

Revisions to CARB´s iLUC values through the Low Carbon Fuel Standard (LCFS) Expert Workgroup

CARB´s recommendation: improve and update GTAP model

"The Global Trade Analysis Project (GTAP) model has a global scope, is publicly available, and has a long history of use in modeling complex international economic effects. Therefore, **CARB staff determined that the GTAP is the most suitable model for estimating the land use change impacts** of the crop based biofuels that will be regulated under the LCFS."
(Low Carbon Fuel Standard 2011 Program Review Report)

http://www.arb.ca.gov/fuels/lcfs/workgroups/advisorypanel/20111208_LCFS%20program%20review%20report_final.pdf

7. California Air Resources Board (CARB)

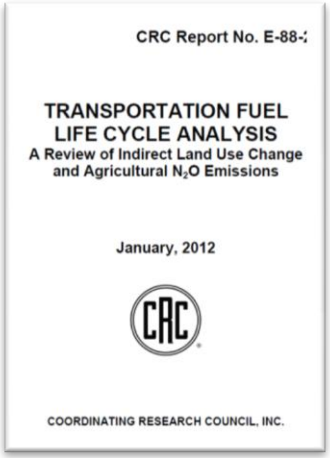
Table 2-13: LUC and CI results from CARB's LCFS.

Fuel Pathway	Volume modeled (billion gallons)	Total LUC (million ha)	ILUC- CI ($g\ CO_{2,eq}\ MJ^{-1}$)
Corn Ethanol [77]	13.25	3.89	30
Sugarcane Ethanol [77]	2	1.09	46
Soy Biodiesel [83]	0.995	0.94	66

6 REFERENCES

77. California EPA Air Resources Board Stationary Source Division; Staff Report: Initial Statement of Reasons Proposed Regulation to Implement the Low Carbon Fuel Standard Volume 1. 2009.

83. California Air Resources Board; Attachment 2: Land Use Change Effects for Soy Biodiesel and Renewable Diesel. 2010.


CRC Report No. E-88-2

TRANSPORTATION FUEL LIFE CYCLE ANALYSIS

A Review of Indirect Land Use Change and Agricultural N_2O Emissions

January, 2012

COORDINATING RESEARCH COUNCIL, INC.

http://www.crcao.com/reports/recentstudies2012/E-88-2/CRC%20E-88-2%20Final%20Report.pdf

8. Personal point of view

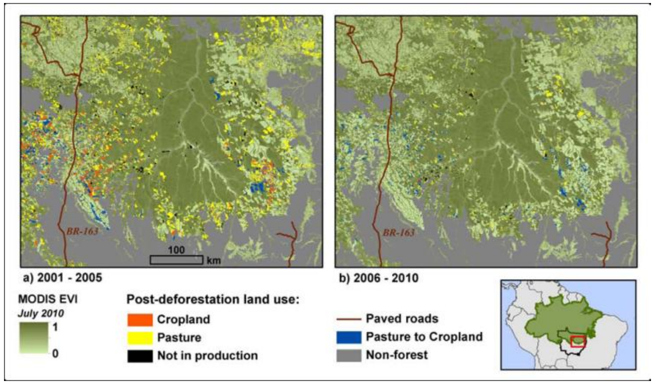
Regional approach

Around 75% of the entire iLUC provoked from the EU biofuel goals will be caused by Indonesia/Malaysia and Brazil (JRC*).

Cause effect relationship, using ex ante-approaches**, real land uses of the past would be used to determine the generated real Land Use Change (LUC) in **countries** (not globally).

Support **Good Governance** !!

Remote Monitoring would help to validate.



Marcia N. Macedo et al.: Sustainable Science 2011

* JRC 2011: Estimate of GHG emissions from global land use change scenarios

** Lahl 2010: http://bzl-gmbh.de/de/sites/default/files/iLUC_Studie_Lahl_engl.pdf

9. Summary

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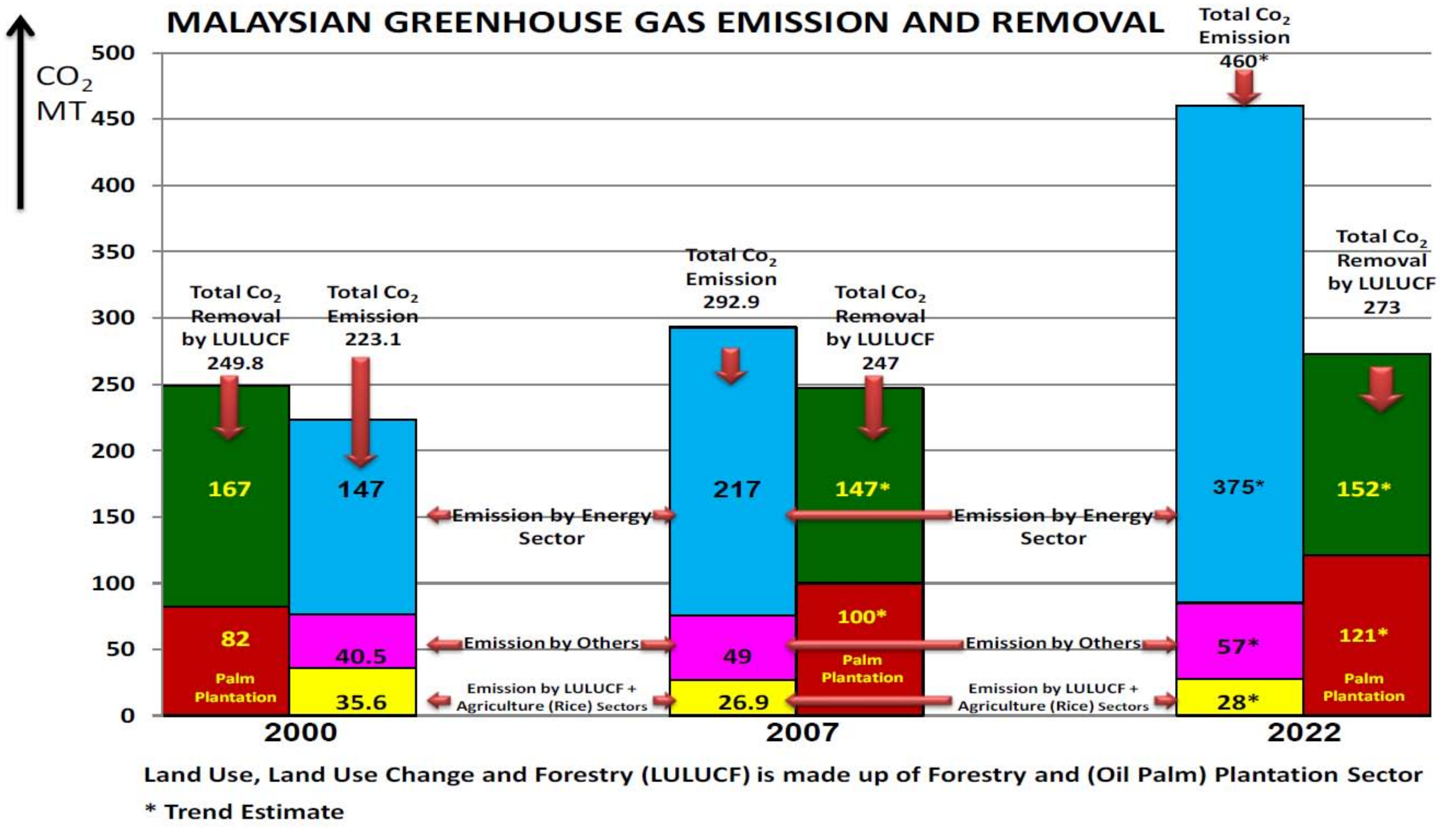
http://blog.cifor.org/wp-content/uploads/2012/02/palm-oil2-300x225.jpg

1. LUC or iLUC is a real and serious problem.
2. It is a specific problem in some countries.
3. The problem is not "exclusively" associated with biofuels!
4. A rising demand for biomass is likely to intensify LUC / iLUC in these countries.
5. Fighting climate change needs biomass.
6. Thus, LUC / iLUC should be controlled/supervised by appropriate and efficient instruments.
7. Appropriate instruments are those that start on a regional cause of the problem: You should address the land use policy in the relevant countries.
8. Global iLUC factors control "perversely". Countries fighting/solving iLUC or having a negative GHG-balance should have a positive incentive for their **Good Governance**.
9. REDD is part of the solution

Backup

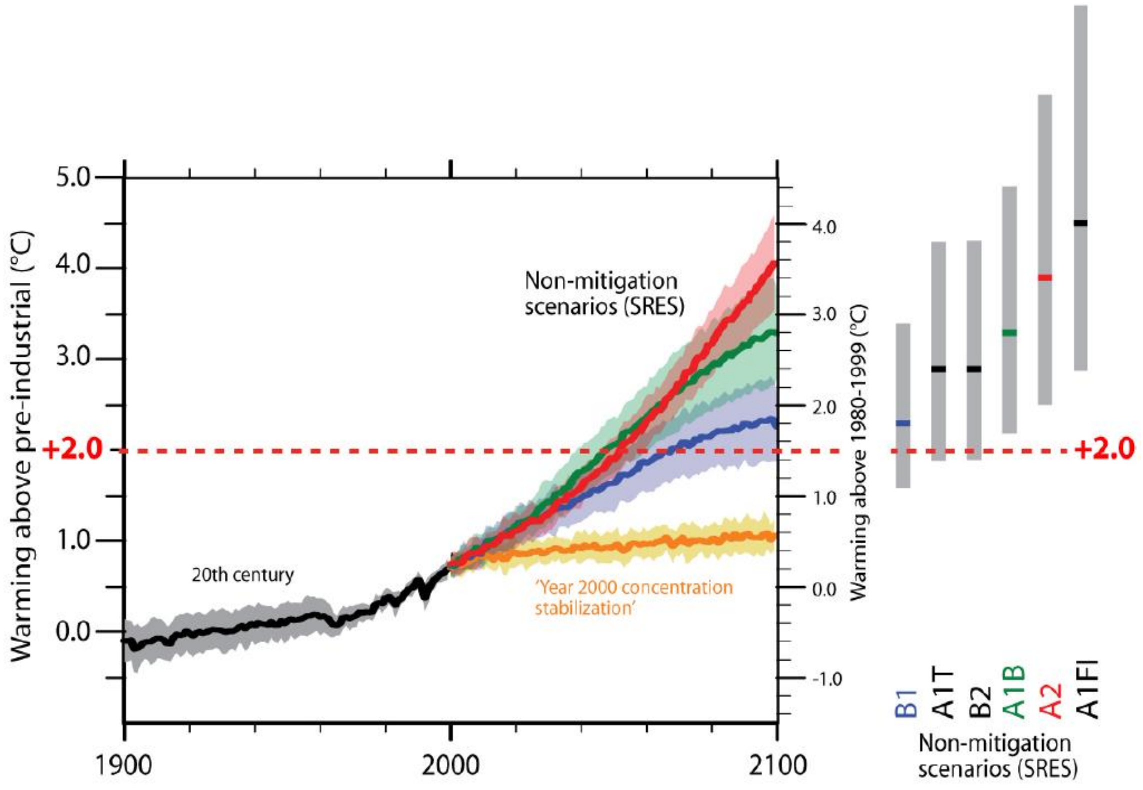
For answering questions that may arise

6. Renewable Fuel Standard (RFS2) USA



Basiron 2010

2. iLUC associated risks



The +2.0 degree goal is the landmark for climate protection

Different Climate Protection Scenarios (IPCC)

3.1 Agro-econometric models

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Status 2009

Model	General features		Bio-energy chain		Endogenous ...			Emissions from ILUC		References
Name	Type	Sectors	Types of bio-fuel crops	By-products	Expansion	Intensification	Consumption change	Emissions from fertiliser use	CO_2 land conversion	
DART	GE	All	WT, MA, OS, VO, SC, SB	No	No	Yes	Yes	No	No	Kretschmer et al., 2008
EPPA	GE	All	not specified, 2nd generation	No	No	No	Yes	No	No	Reilly and Paltsev, 2009
GTAP	GE	All	WT, MA, SC	Yes	Yes	Yes	Yes	Yes	partly	Lee, 2005; Taheripour, 2008; Hertel et al., 2008; Birur et al., 2008.
GTEM	GE	All	2nd generation	n/a	No	No	Yes	No	No	De Vries, 2009
LEITAP	GE	All	VO, WT, MA, SC, SB, 2nd generation	Yes	Yes	Yes	Yes	No (but Yes via IMAGE)	No (but Yes via IMAGE)	Eickhout et al., 2009
MIRAGE	GE	All	bioethanol and biodiesel	Yes	Yes	Yes	Yes	No	partly	Valin et al., 2009; Al-Riffai, 2010
AGLINK /COSIMO	PE	Agriculture	VO, WT, MA, SC, SB, 2nd generation	Yes	Yes	Yes	Yes	No[2]	No[2]	OECD, 2008; De Vries, 2009
CAPRI	PE	Agriculture	WT, MA, OC, OS, VO, SB	Yes	No[1]	Yes	Yes	Included in DNDC-Europe	No	Britz et al., 2007; Leip et al., 2008.
FAPRI	PE	Agriculture	bioethanol, biodiesel	Yes	Yes	Yes	Yes	Yes	Yes	Searchinger et al., 2008; Fabiosa et al., 2009; Dumortier and Hayes, 2009; Dumortier et al., 2009
GLOBIOM	PE	Agriculture Forestry	1st generation, 2nd generation	Yes	Yes	Yes	Yes	Yes	Yes	De Vries, 2009; Havlik et al., 2010
IMPACT	PE	Agriculture	SC, SB, MA, WT, OC	No	Yes	Yes	Yes	No	No	Pers. Com. S. Msangi, 2009; De Vries, 2009
G4M	Allocation, coupled to GLOBIOM	n/a	not explicit	n/a	Yes	n/a	n/a	No	Yes	De Vries, 2009
GCAM	IAM & PE	Energy, Agriculture, GHG emissions	2nd generation	No	Yes	No	Yes	No	Yes	Wise et al., 2009; Brenkert et al., 2003
IMAGE	IAM, coupled to any GE or PE[3]	n/a	WT, MA, OS, SC, 2nd generation	n/a	Yes	n/a	n/a	Yes	Yes	Leemans and Van den Born, 1994; Eickhout et al., 2009

WT = wheat, MA = maize, OC = other cereals, OS = oil seeds, VO = vegetable oil, SC = sugar cane, SB = sugar beet

1) The total agricultural area is fixed within CAPRI. Crop area can be expanded on fallow land.

2) A separate model, SAPIM (no global coverage), has been developed that deals with fertiliser emissions. CO_2 from land conversion can be calculated outside the model.

3) The LEITAP model has often been used to model economic drivers for the IMAGE model

More than a dozen models.

The models have different scopes, are in ongoing development and are not comparable.

Prins A. G. et al 2010

4. Biofuel regulation EU

Directive 2009/28/EC:

„4. Biofuels and bioliquids taken into account for the purposes referred to in points (a), (b) and (c) of paragraph 1 **shall not be made from raw material obtained from land with high carbon stock,** namely land that had one of the following statuses in January 2008 and no longer has that status:

(a) wetlands, namely land that is covered with or saturated by water permanently or for a significant part of the year;

(b) continuously forested areas, namely land spanning more than one hectare with trees higher than five metres and a canopy cover of more than 30 %, or trees able to reach those thresholds in situ;

(c) land spanning more than one hectare with trees higher than five metres and a canopy cover of between 10 % and 30 %, or trees able to reach those thresholds in situ, unless evidence is provided that the carbon stock of the area before and after conversion is such that, when the methodology laid down in part C of Annex V is applied, the conditions laid down in paragraph 2 of this Article would be fulfilled. The provisions of this paragraph shall not apply if, at the time the raw material was obtained, the land had the same status as it had in January 2008.“

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:de:PDF

3. Calculating „indirect Land Use Change“ (iLUC)

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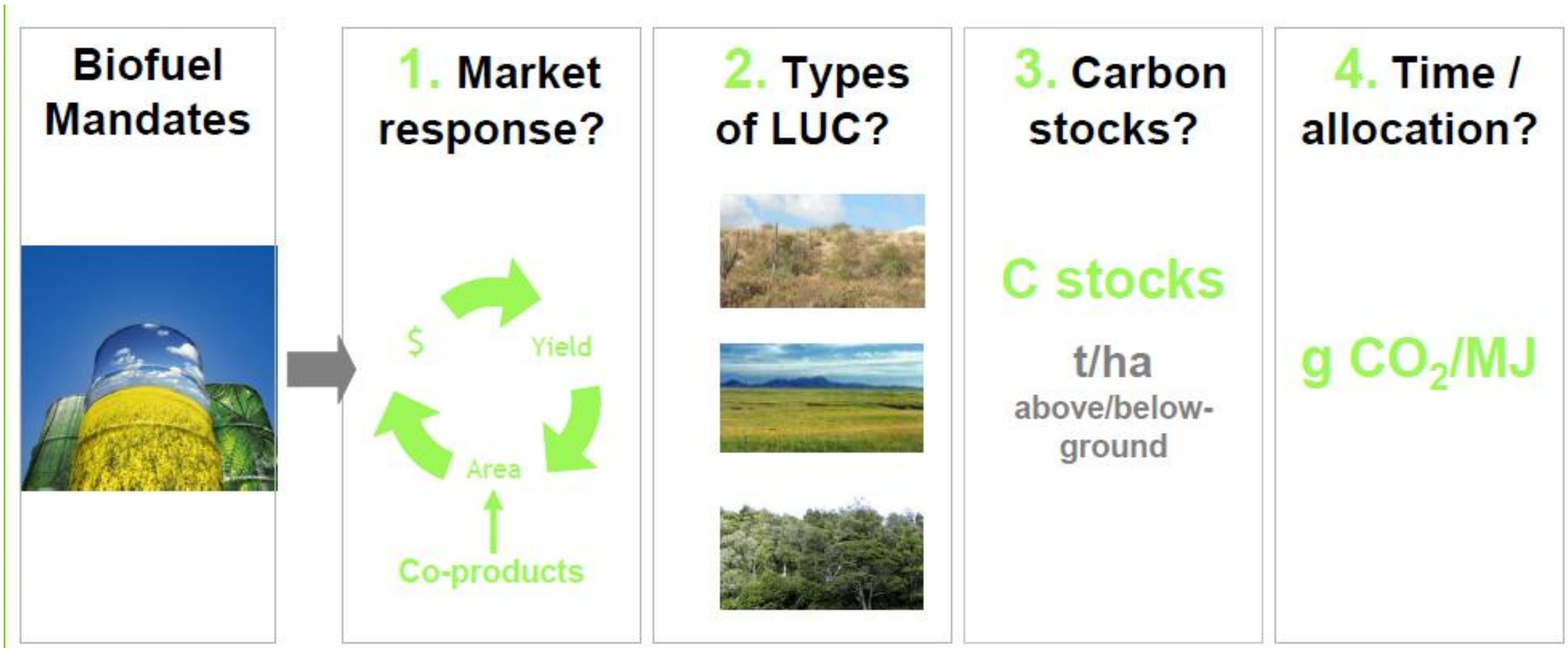

nach Präsentation B. Dehue (Ecofys) bei GBEP ILUC Workshops, Mai 2009 in NYC

Source U. Fritsche 2011

5. iLUC controversy within the European regulatory bodies

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EU member states are required to source 10% of transport energy from renewable sources, mainly biofuels, by 2020. FQD requires fuel suppliers to reduce emissions from the production of transport fuel by 6% by 2020.

Internally proposed iLUC-factor from DG Climate: Oil seeds 55 g/MJ, Ethanol: 15 g/MJ.

Consequences: Market „phase out" for oil seeds

The data propose iLUC-incorporating CO_2/MJ values for biofuels as follows:
Palm Oil - 105g
Soybean – 103g
Rapeseed – 95g
Sunflower – 86g
Palm Oil with methane capture – 83g
Wheat (process fuel not specified) – 64g
Wheat (as process fuel natural gas used in CHP) – 47g
Corn (Maize) – 43g
Sugar Cane – 36g
Sugar Beet – 34g
Wheat (straw as process fuel in CHP plants) – 35g
2G Ethanol (land-using) – 32g
2G Biodiesel (land-using) – 21g
2G Ethanol (non-land using) – 9g
2G Biodiesel (non-land using) – 9g

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The European Parliament

Option 3: Regional approach / additional criteria

... calls therefore on the Commission to pursue the issue of iLUC a broader approach and to promote adequate protection of the environment in those third countries at bilateral and multilateral levels, which are affected by land use changes

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Palm Oil might be underrated

[21] Palm production in South East Asia represents 25 percent of net total cropland expansion in our simulation. We assume that 30 percent of palm extension is done on peatlands. Emissions from peatlands have been adjusted upwards compared to the previous report (from 19 to 55 t CO2eq/ha yr). However, uncertainty remains. Recent research (Page, S. E., Morrison, R., Malins, C., Hooijer, A., Rieley, J. O. & Jauhiainen, J. 2011 suggests that it could even be higher, at around 86 t CO2eq/ha/yr with emissions annalised over 50 years after conversion. Annualizing over 20 years will lead to a value of 106 t CO2eq/ha/yr. In this case the LUC results reported for oilseeds will increase significantly. For example for palm oil, the central average estimated indirect land use change emissions could increase to 84.6 grCO2/MJ.

The European Commission

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Option 4 is favored especially by "DG-Climate" and others.

Option 4 contains two central problems:

1. A problem of scientifical correctness of the prediction of the global iLUC effect of EU biofuels policy. This forecast can only be made via model calculation. These model calculations are so uncertain that a legalization would entail high risks. Parts of the Commission seem to want to solve this legal problem by finding the best of all models.
2. An iLUC-factor will produce more iLUC.

IWAR

The European Commission

Option 2 is favored especially by “DG-Energy” and others.

Option 2 contains two central problems:

1. What will be the quantitative required minimum greenhouse gas savings decided by the Commission and which kind of biofuels can meet this standard in the future?
2. No measures against iLUC in relevant countries like Brazil or Indonesia.

European Parliament resolution of 15 March 2012 on a Roadmap for moving to a competitive low carbon economy in 2050 (2011/2095(INI))

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„*The European Parliament*,

44. Calls, therefore, on the Commission **to follow a broader approach on the issue of iLUC** and to promote adequate protection of the environment **in third countries affected by land use change bilaterally and multilaterally** in order to take account of the greenhouse gas emissions attributable to changes in land use patterns; this could be achieved through the **introduction of additional sustainability requirements** on certain categories of biofuels imported from third countries; ...“

P7_TA-PROV(2012)0086

Competitive low carbon economy in 2050

European Parliament resolution of 15 March 2012 on a Roadmap for moving to a competitive low carbon economy in 2050 (2011/2095(INI))

The European Parliament,

– having regard to the Commission Communication 'A Roadmap for moving to a competitive low carbon economy in 2050' (COM(2011)0112) and the accompanying working documents (SEC(2011)0288) and (SEC(2011)0289),

– having regard to the Commission Communication 'Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage' (COM(2010)0265) and the accompanying document (SEC(2010)0650),

– having regard to the proposals to recast (COM(2011)0656) and amend the Markets in Financial Instruments Directive (MiFID) (COM(2011)0652) and the Market Abuse Directive (MAD) (COM(2011)0651) with regard to emission allowances under the EU's ETS,

– having regard to the conclusions of the European Council meeting of 23 October 2011,

– having regard to the EU climate and energy package,

– having regard to Article 9 TFEU (the 'social clause'),

– having regard to Rule 48 of its Rules of Procedure,

– having regard to the report of the Committee on the Environment, Public Health and Food Safety and the opinions of the Committee on Industry, Research and Energy and the Committee on Agriculture and Rural Development (A7-0033/2012),

A. Whereas some 90 parties to the United Nations Framework Convention on Climate Change, including emerging economies, which are collectively responsible for more than 80 % of global emissions, have made unilateral declarations of quantified economy-wide emission reduction objectives, albeit not legally binding;

B. whereas the European Parliament and the European Council have declared their ambition to secure an 80 to 95 % level of reduction in greenhouse gas emissions by 2050;

C. whereas the European Union must agree specific targets for emission reductions to provide the basis and framework for the necessary legislative acts and other measures;

D. whereas the Roadmap demonstrates that the current 20 % climate target, of which more than half could be achieved through non-domestic offsets, is not on a cost-effective pathway towards a 80 % reduction in 2050 as compared to 1990; whereas 80 % is on the low end of the 80-95 % range which the IPCC considered necessary for industrialised countries, and which the European Council adopted as the EU target for 2050;

Regional models are available

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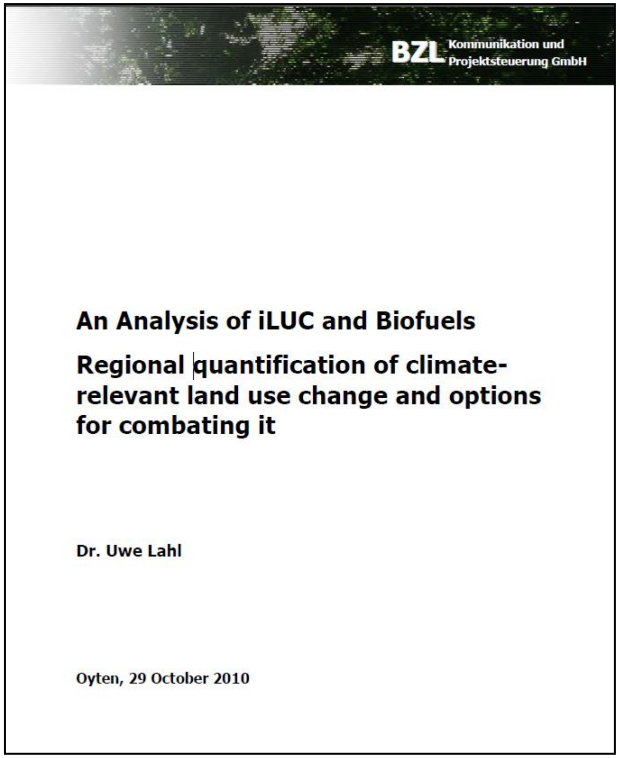
Case B	Large tropical country, 35% of the land is tropical forest	Relevant input figures (GE = grain unit)	ILUC in g CO_{2eq}/MJ
B 1	Worst case bioethanol: In the reference year 0.17% of rainforest is converted. Livestock farming is replaced by sugar cane cultivation. Bioethanol production is a major reason for this.	LUC^R = 714 000 ha CS^{RF} = 265 Mg C CS^{GLtrop} = 75 Mg C ΔAgr = 150 million Mg GE ΔAgr_{fuel} = 29 million Mg GE $Agr_{fuel, energy}$ = 4.23 E+11 MJ	159
B 2	Bioethanol: In the reference year 0.17% of rainforest is converted. Livestock farming is replaced by sugar cane cultivation. Bioethanol production is not a major reason for this.	LUC^R = 714 000 ha CS^{RF} = 265 Mg C CS^{GLtrop} = 75 Mg C ΔAgr = 150 million Mg GE ΔAgr_{fuel} = 3.5 million Mg GE $Agr_{fuel, energy}$ = 3.76 E+11 MJ	22
B 3	Soybean oil diesel fuel: In the reference year 0.17% rainforest is converted to grassland. Pasture is replaced by soybean cultivation. Soybean oil-diesel shows no big increase.	LUC^R = 714 000 ha CS^{RF} = 265 Mg C CS^{GLtrop} = 75 Mg C ΔAgr = 150 million Mg GE ΔAgr_{fuel} = 3.1 million Mg GE $Agr_{fuel, energy}$ = 2.81 E+10 MJ	44
B 4	Soybean oil diesel fuel: In the reference year 0.17% rainforest is converted to grassland. Pasture is replaced by soybean cultivation. Soybean oil-diesel shows a large increase.	LUC^R = 714 000 ha CS^{RF} = 265 Mg C CS^{GLtrop} = 75 Mg C ΔAgr = 150 million Mg GE ΔAgr_{fuel} = 78 million Mg GE $Agr_{fuel, energy}$ = 7.98 E+11 MJ	39
B 5	Worst case soybean oil diesel fuel: In the reference year 0.60% rainforest is converted to grassland. Pasture is replaced by soybean cultivation. Soybean oil-diesel shows a large increase.	LUC^R = 2 520 000 ha CS^{RF} = 265 Mg C CS^{Sa} = 75 Mg C ΔAgr = 150 million Mg GE ΔAgr_{fuel} = 78 million Mg GE $Agr_{fuel, energy}$ = 7.98 E+11 MJ	136


BZL Kommunikation und Projektsteuerung GmbH

An Analysis of iLUC and Biofuels

Regional quantification of climate-relevant land use change and options for combating it

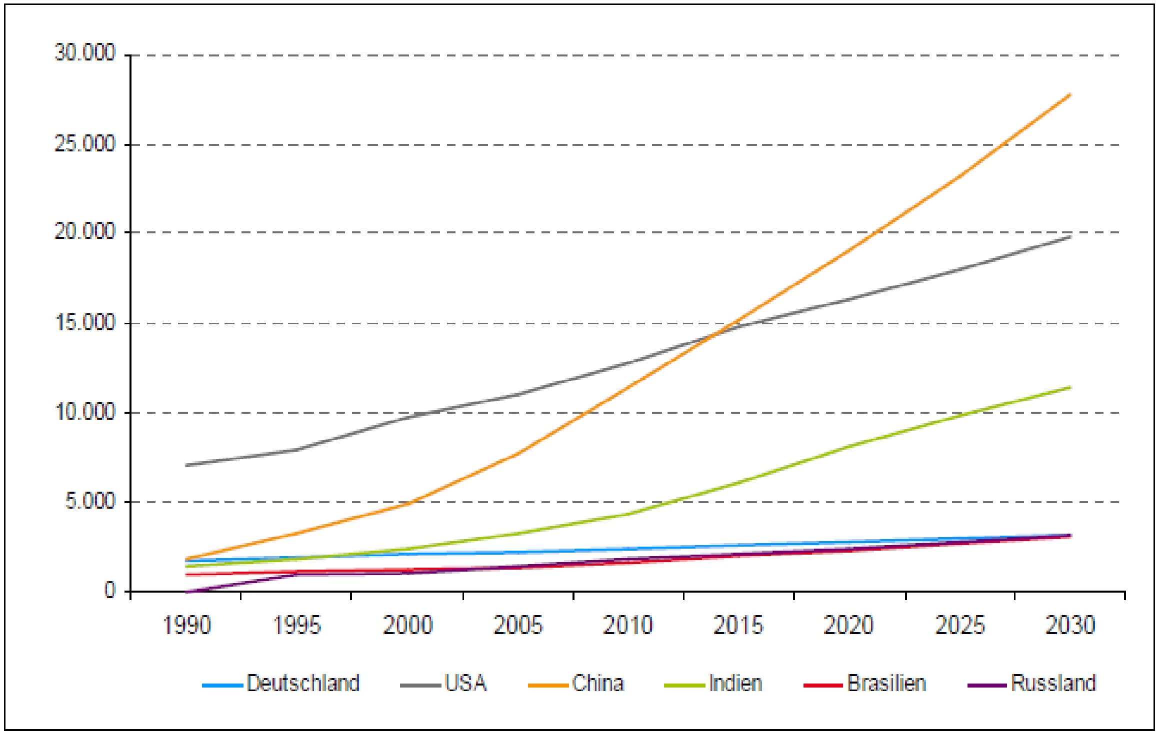
Dr. Uwe Lahl

Oyten, 29 October 2010

http://www.bzl.info/de/sites/default/files/iLUC_Studie_Lahl_engl.pdf

The problem: Growth

GDP in selected countries in the reference scenario in billion U.S. dollars in 2000 (Purchasing power parities)




gws
prognos

Projektnummer 21/05:
„Ökonomische Kriterien zur Bewertung alternativer Verhandlungslösungen für eine Weiterentwicklung des Klimaregimes nach 2012"

im Auftrag des Bundesministeriums für Wirtschaft und Technologie

Endbericht

GWS mbH:
Christian Lutz (Projektleitung)
Ariane Jungnitz
Bernd Meyer

Prognos AG:
Almut Kirchner
Christian Michelsen

Osnabrück, Basel im Oktober 2007

Gesellschaft für Wirtschaftliche Strukturforschung mbH (GWS)
Heinrichstraße 4
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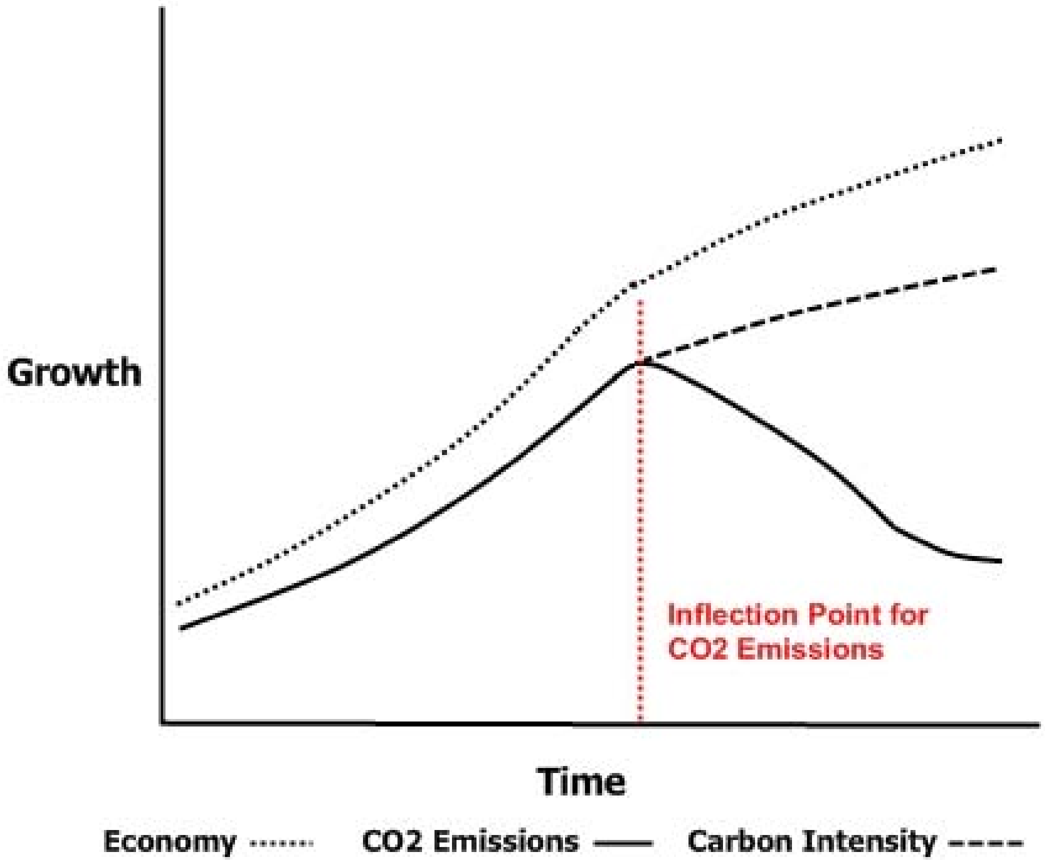
http://www.gws-os.de

Quelle: IMF, OECD, United Nations (2005); ab 2004 Modellrechnung mit GINFORS.

http://www.bmwi.de/BMWi/Redaktion/PDF/G/gws-prognos-studie-klima-endbericht,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf

Solution: Decoupling growth and GHG-emissions



http://peakwatch.typepad.com/.a/6a00d83452403c69e2012876cb6b5d970c-pi

Decoupling: Growth and resource uses

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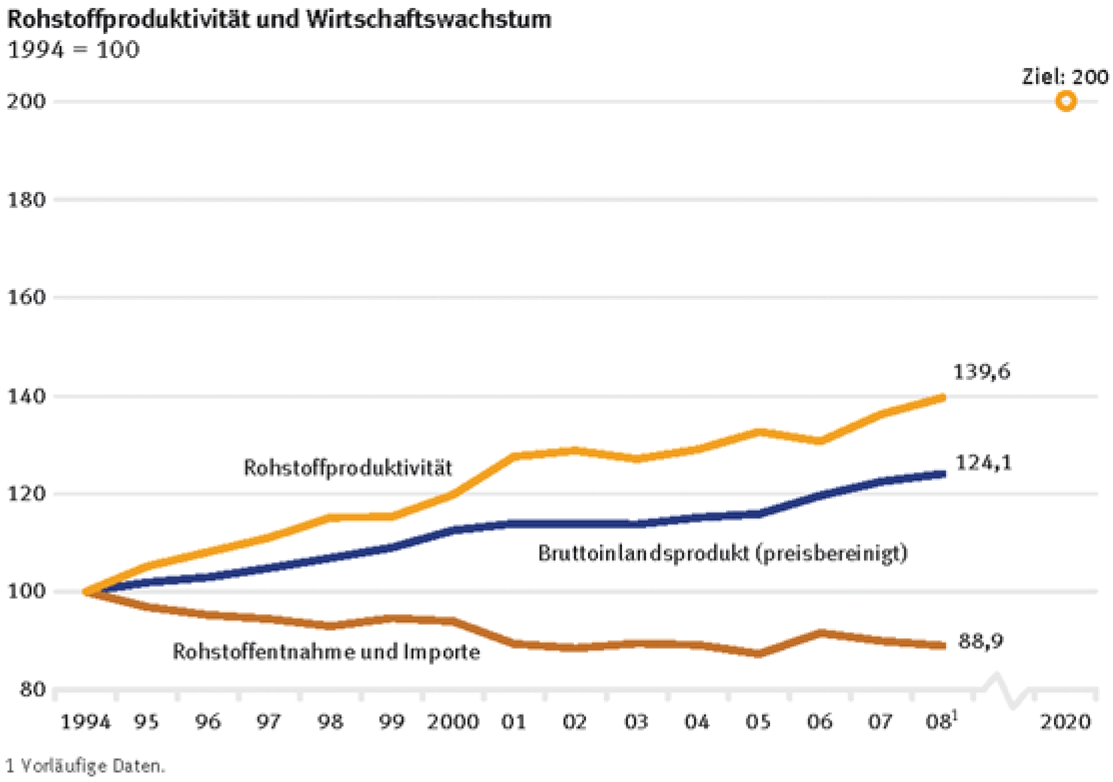
Resource productivity and economic growth



http://www.umweltschulen.de/images/image7007.gif

Decoupling: Growth and waste generation

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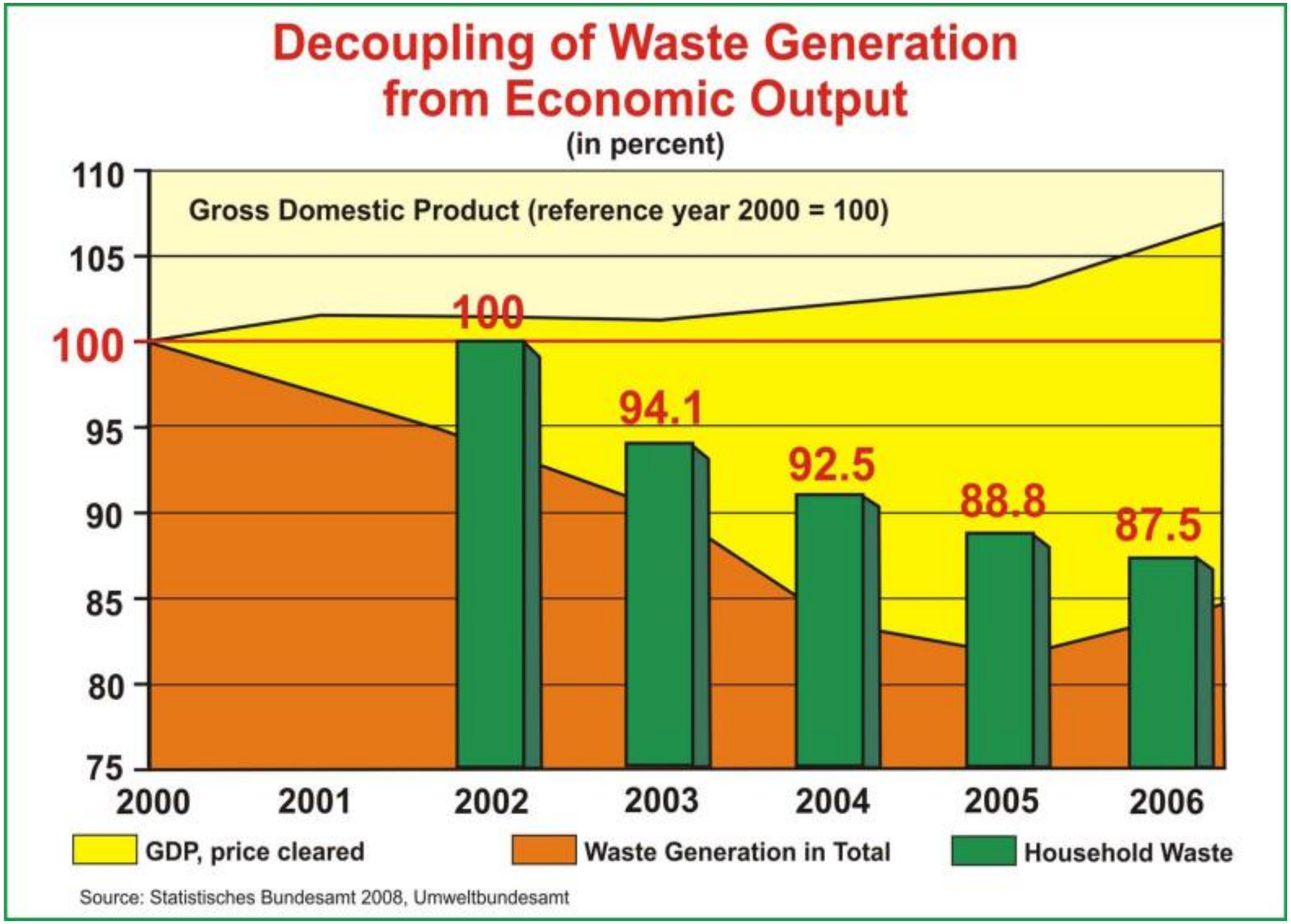

BMU 2010

Decoupling: Growth and land use?

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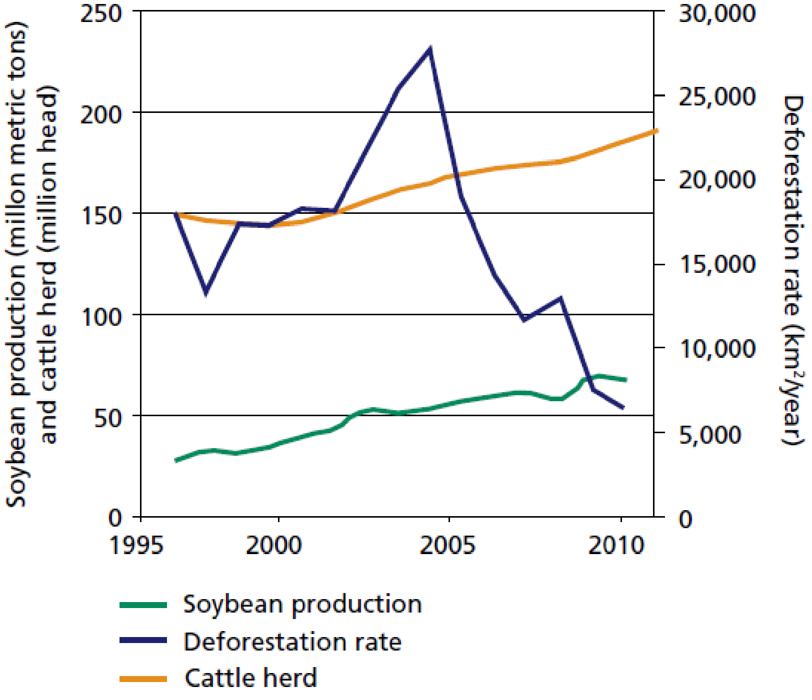
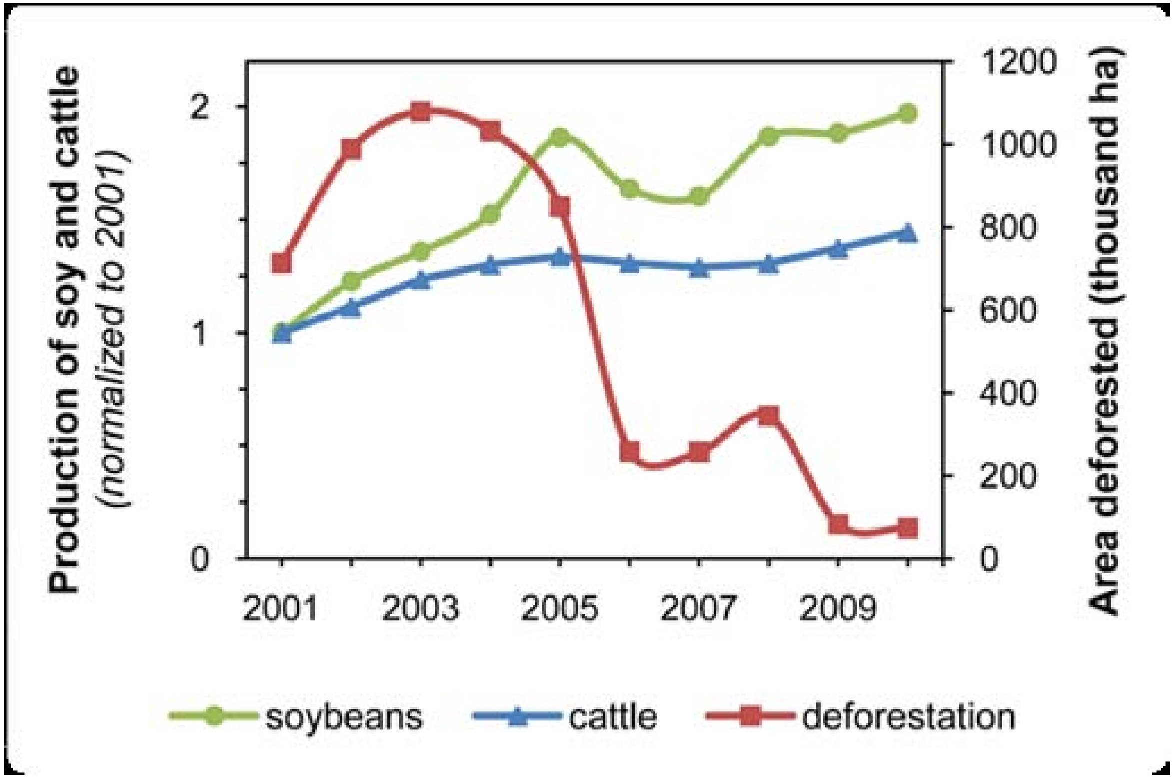


An increase in agricultural production does not necessarily lead to LUC!

IWAR

Decoupling



A current study from Brazil

Deforestation in Mato Grosso (13), tons of soy produced (22), and number of heads of cattle produced (19) from 2001-2010. Production was normalized to 2001. Production increases correspond to an area increase of 3 million ha for cropland (soy) and 10 million ha for pasture (assuming one head of cattle per ha). Marcia N. Macedo et al.: Sustainable Science 2011

Decoupling

Decoupling is the basis of environmental policy in Germany, the EU and globally.

Thesis: Without the power of persuasion and the fantasy that **decoupling** is possible, the modern environmental policy would not have been so successful.

Of course you have also learnt that **decoupling** is difficult to achieve.
But there are positive examples that it can succeed.

Development of the global vegetable oil production

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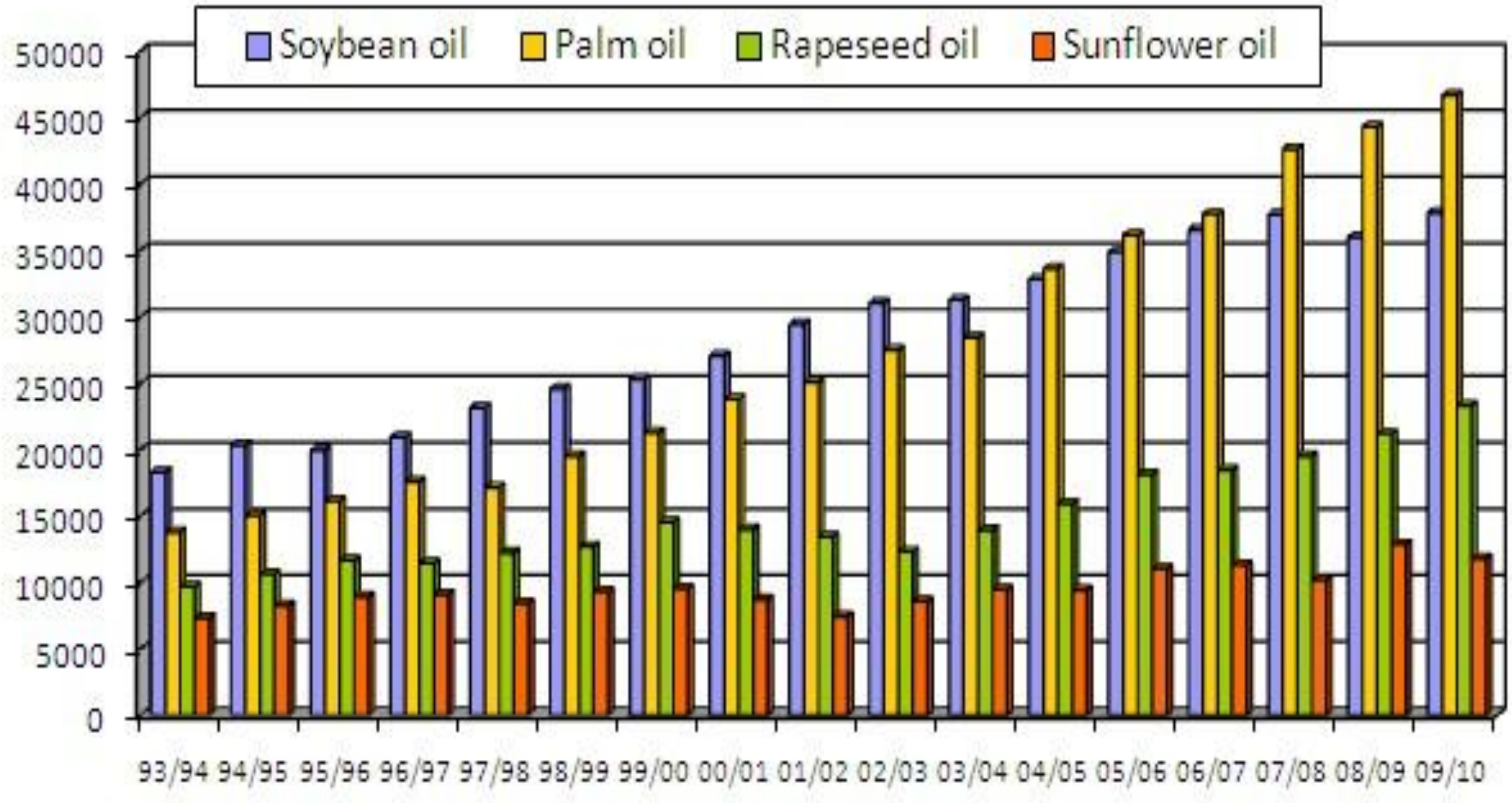


http://www.fediol.eu/web/world%20production%20data/1011306087/list1187970075/f1.html

IFPRI-study findings

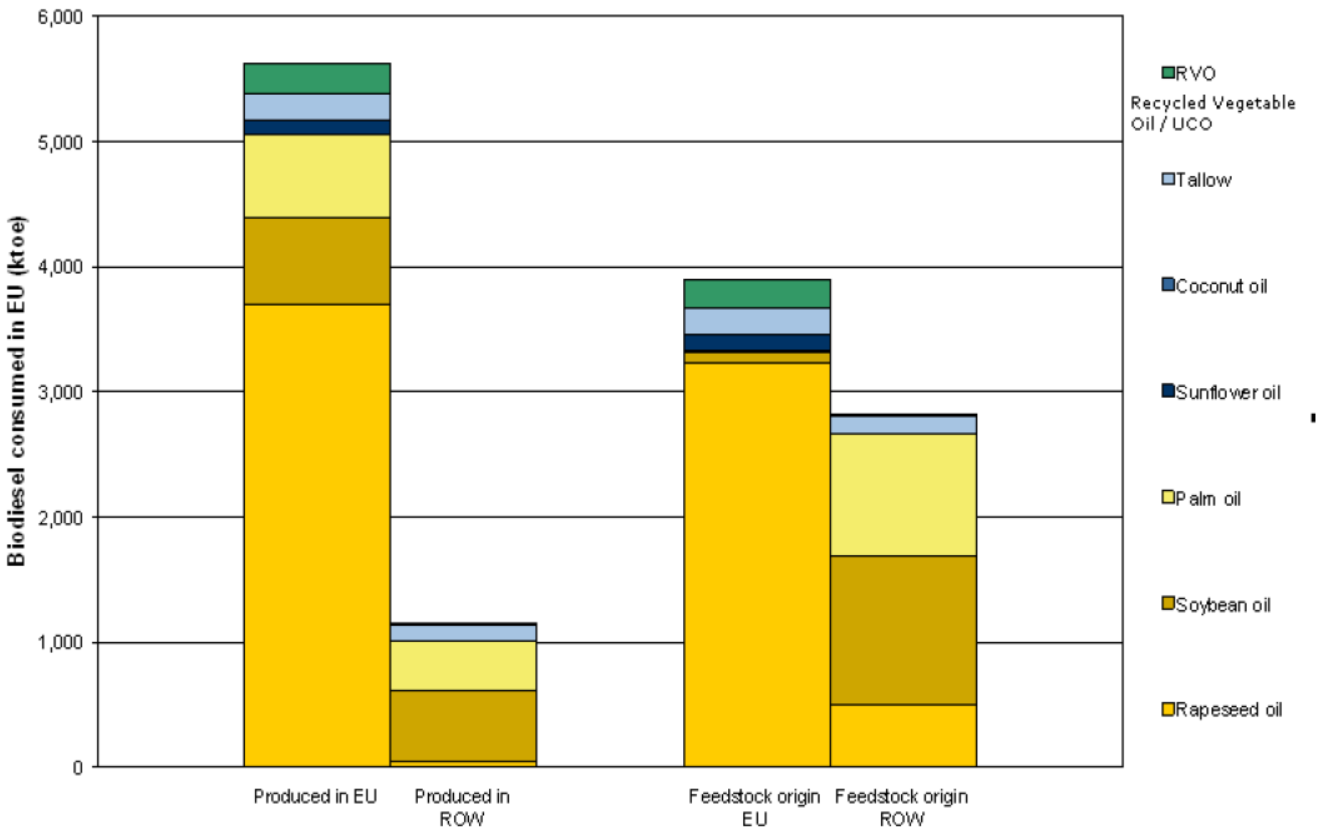
- iLUC is a serious concern, but significant uncertainties remain
  - Included as a list of 25 sources of uncertainty
- Overall iLUC is estimated to eliminate around 70% the direct savings offered by biofuels, leaving biofuels with 17% savings
  - i.e. Biofuels still save emissions compared to fossil fuels <u>even if iLUC is included</u>*
- Large differences in estimated iLUC between sugars, cereals and vegetable oils

*No indirect emissions of fossil fuels included

Some of the listed uncertainties

- Crop yields in the baseline and in scenarios
  - How does yield reacts to price?
  - Yield on new land?
- Substitution among vegetable oils
  - To what extent can substitution take place?
- The livestock sector/availability of pasture
  - Will intensification take place?
- Land governance
- Emissions from palm oil planted on peatland
- Global agricultural policies towards 2020

Feedstock for Europe



Biodiesel feedstock used in the EU 2008

Ecofys 2012

More Indirect Effects

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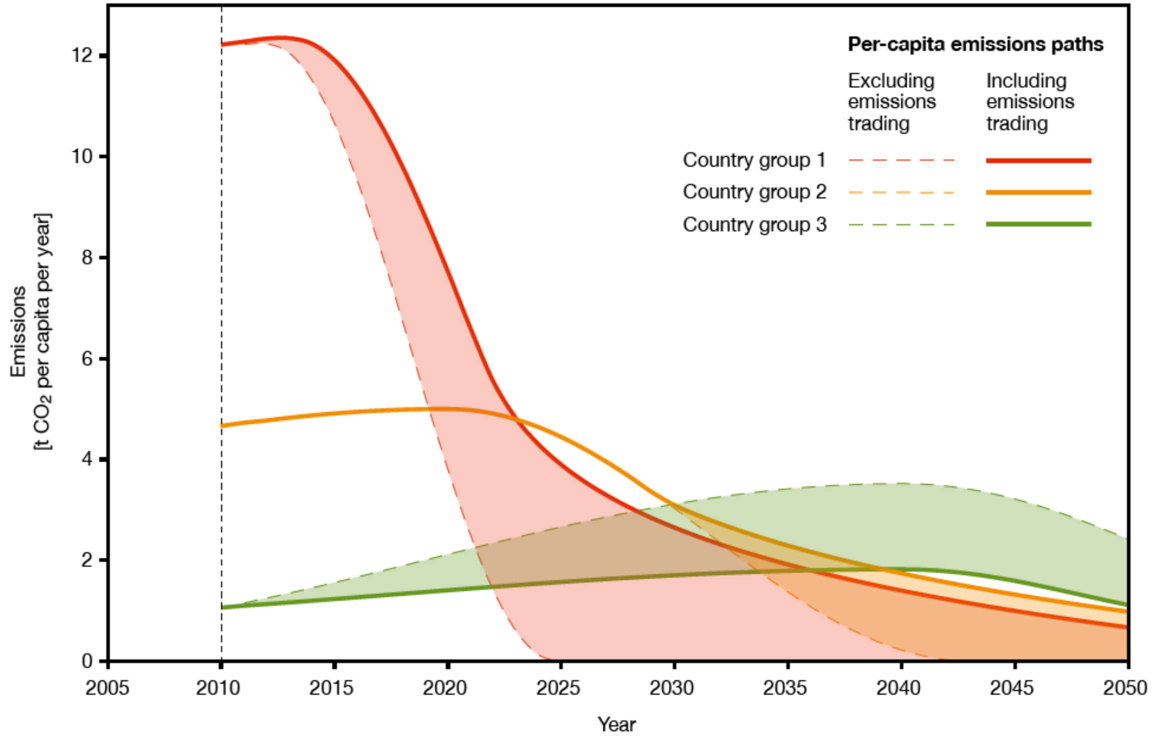
Indirect effect	Impact on GHG emissions	Impact on biodiversity *
a. Indirect land-use change (ILUC): conversion of land	Loss of carbon from vegetation and soils can be substantial, sometimes of the same order of magnitude as direct reductions	Immediate loss of natural area, more infrastructural barriers
b. Intensification of agricultural production	Emissions from nitrogen fertiliser use, very sensitive to management practices (worst case emissions equal to ILUC emissions);	Emissions of nitrogen compounds and pesticides affect terrestrial and aquatic life
c. Substitution of traditional feed-stocks with by-products	Can reduce potential ILUC emission, considerably	Can reduce indirect land-use change and loss in natural area, considerably
d. Excess in production of animal feed	Effects unclear, both positive and negative; effects mainly via the land-use system	Effects unclear, both positive and negative; effects mainly via the land-use system
e. Impact on oil prices (leading to lower oil prices and higher oil consumption)	The indirect emissions can be in the order of 10-40% the emissions of the fossil fuels	Increase in environmental pressure of many economic activities
f. Impact of climate change on agricultural production	Regional differences: positive and negative effects on yields	Regional differences: positive and negative effects mainly via the land-use and water systems

* the consequential effect of GHG emissions on biodiversity is relevant too, but not explicitly mentioned in this column. (i.e. climate change will impact biodiversity in the long term).

Ros J. P. M. et al 2010

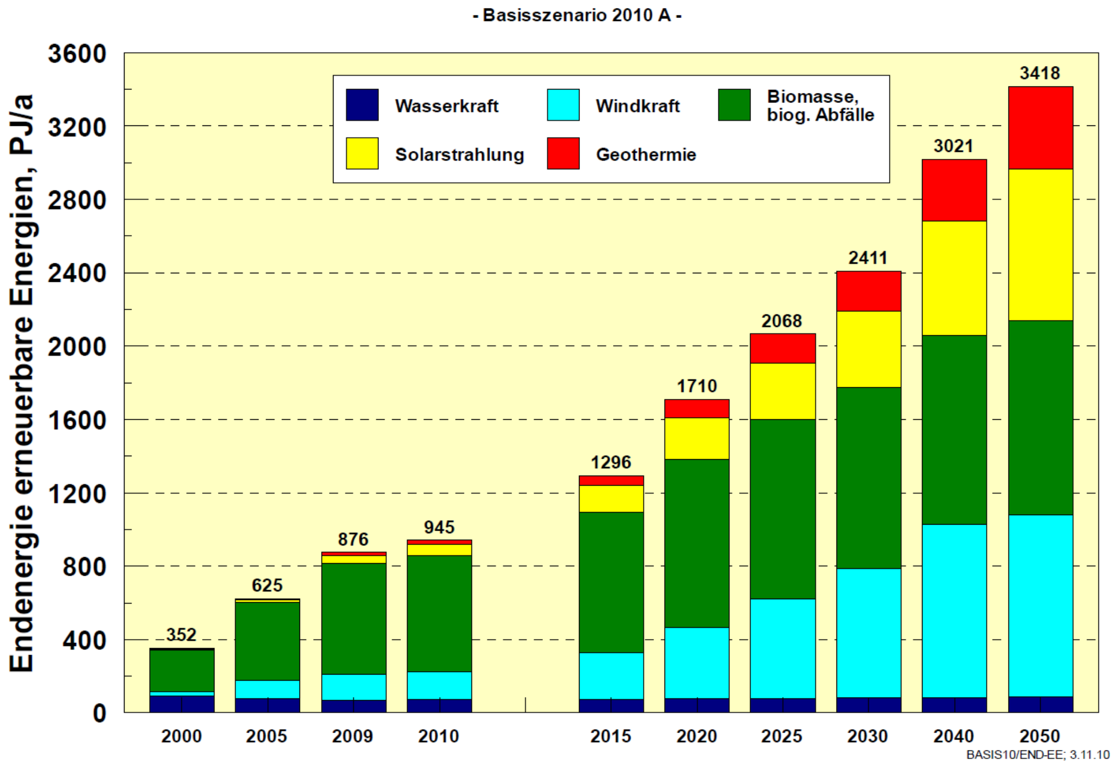
2. iLUC associated risks



All country groups have to engage

Burden sharing among countries (IPCC)

2. iLUC associated risks



For example Germany

Risk: iLUC leads to high emissions of greenhouse gases

Scenario for Germany (by the Ministry of Environment)

7. California Air Resources Board (CARB)

Table 2-20: Comparison of 30-year ILUC results (IFPRI is for 20 years) from different studies. Units are g $CO_{2,eq}$ MJ^{-1} fuel.

	Searchinger	EPA International (FAPRI)	EPA Domestic (FASOM)	CARB	Tyner	IFPRI
Corn Ethanol	106	30	-4	30	18	54
Soy biodiesel	340	40	-8	62		75
Sugarcane Ethanol		4[A]	1[A]	46		18
Rapeseed Biodiesel						53
Complete Policy with blend of fuel types						17

http://www.crcao.com/reports/recentstudies2012/E-88-2/CRC%20E-88-2%20Final%20Report.pdf

7. California Air Resources Board (CARB)

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LCFS Expert Workgroup: Wide range of different opinions- e.g. subgroup „Uncertainty“ (Perspective 1):

„Is it possible that such economic models are inappropriate to estimate bioenergy policy effects on first-time land conversion? The models assume rational, profit-making behavior, compliance with laws, private ownership of property etc. First time conversion is generally characterized by public lands (FAO 2010: nearly all remaining tropical forests are public property), illegal behavior, extensive unmanaged but previously disturbed areas (far more land has already been cleared than what is actively used or needed for cultivation), insecurity, and other factors that are explicitly excluded from the economic models and the assumptions employed thus far to estimate iLUC.”

http://www.arb.ca.gov/fuels/lcfs/workgroups/ewg/010511-final-rpt-uncertainty.pdf

7. California Air Resources Board (CARB)

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- **Revisions to CARB´s iLUC values through Purdue University (update GTAP model)**

- Interim report of Wallace E. Tyner (Purdue University) "CALCULATION OF INDIRECT LAND USE CHANGE (iLUC) VALUES FOR LOW CARBON FUEL STANDARD (LCFS) FUEL PATHWAYS" for California Air Resources Board (CARB) – October 2011
- Tyner´s interim report covers four groups of sensitivity analyses:
  - Sensitivity of land cover changes with respect to changes in the food demand induced by higher food prices due to biofuel production
  - Sensitivity of land cover changes with respect to yield-to-price elasticity
  - Sensitivity of land cover changes with respect to land transformation elasticity among crops within cropland cover
  - Sensitivity of land cover changes with respect to endogenous productivity change for cropland pasture

7. California Air Resources Board (CARB)

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Update GTAP model: Interim report of Wallace E. Tyner (Purdue University)

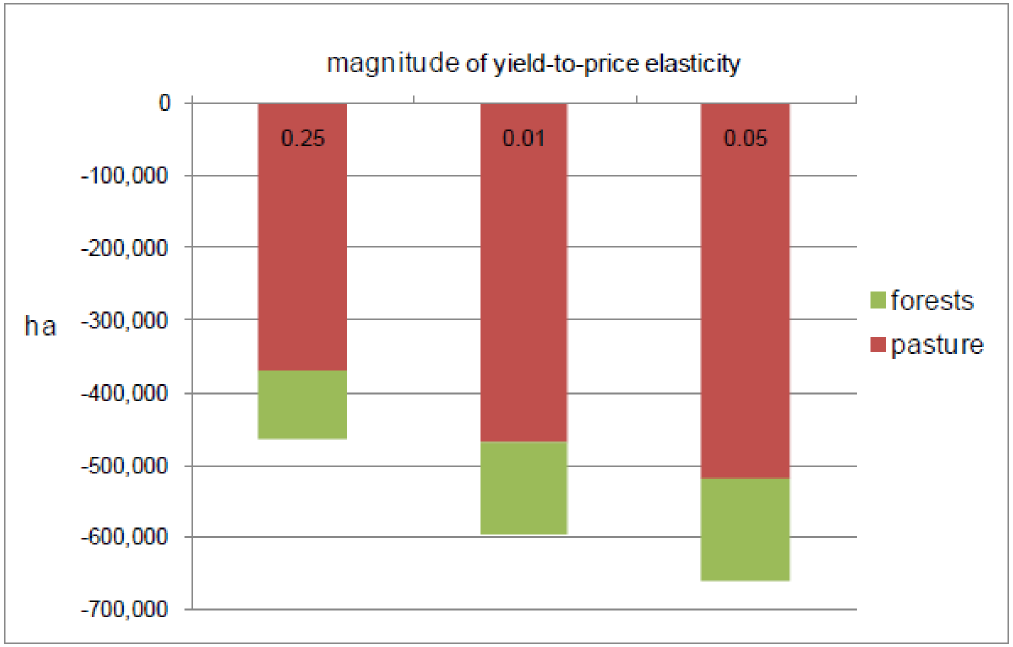

Figure 8. Summary of the sensitivity of land cover changes due to expansion of Brazilian sugarcane ethanol with respect to yield-to-price elasticity, ha

7. California Air Resources Board (CARB)

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Update GTAP model: Interim report of Wallace E. Tyner (Purdue University)

Table 8. Comparison with Previous Estimates of Land Cover Change (ha/1000 gal. biofuel)

Biofuel	CARB 2009	Purdue 2010	Current Results	Results with CP
US corn ethanol	0.29	0.13 – 0.22	0.18	0.31
US soy biodiesel	0.63	0.94[a]	0.33	0.64
Brazilian sugarcane	0.55	-	0.16	0.39

[a] Preliminary Purdue result provided to CARB in January 2010

The last column in the Table provides the land needed per 1000 gallons of biofuel including in the land base the cropland pasture converted to other crops. In the past, cropland pasture has been considered as part of cropland (and is modeled that way in GTAP), so "conversion" of cropland pasture was not counted in emissions calculations.

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8. Personal point of view

Therefore iLUC should not be regulated via global factors on the basis of agro-economic models, but **regionally and problem-oriented** by regarding each relevant country **individually on the basis of cause effect relationships**.

This approach would also be administratively realizable, since not even a dozen countries around the world are known to be relevant for biofuel production.

Biomass from LUC countries does not contribute to climate protection. This biomass cannot be rated as a fulfillment of climate protection goals.

7. California Air Resources Board (CARB)

Revisions to CARB´s iLUC values through the Low Carbon Fuel Standard (LCFS) Expert Workgroup

- The Expert Workgroup was established in February 2010 with 30 members
- 8 Expert Workgroup Meetings between February 26 and November 2010.
- The meetings were open to the public and broadcast electronically via either webcast or webinar. Meeting minutes and documents presented or discussed at these meetings: http://www.arb.ca.gov/fuels/lcfs/workgroups/ewg/expertworkgroup.htm
- 9 subgroups: Elasticity Values subgroup, Land Cover Types subgroup, Emission Factors subgroup, Co-Product Credits subgroup, Time Accounting subgroup, Food Consumption subgroup, Uncertainty in LUC Estimates subgroup, Indirect Effects of Other Fuels subgroup, Comparative and Alternative Modeling Approaches subgroup

6. Renewable Fuel Standard (RFS2) USA

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EPA United States Environmental Protection Agency

Lifecycle GHG Analysis of Palm Oil Biofuels

- The release of EPA's assessment provides the public an opportunity to comment on our analysis.
- To calculate lifecycle GHG emissions related to palm oil-based biodiesel and renewable diesel, EPA utilized the models developed for the final RFS2 rule.
  - Our analysis incorporates new data from Indonesia and Malaysia, where most of the palm oil is grown.
    - Data on palm oil yields, agricultural inputs, methane capture at palm oil mills, protected conservation areas, soil types, elevation, palm oil mill locations, etc.
- EPA used the same approach to estimate global land use change GHG emissions from using palm oil as a biofuel feedstock as we have used to analyze other biofuel pathways.
- EPA's analysis highlights key factors which contribute to the lifecycle emissions for palm oil-based biofuels
  - Palm oil production produces wastewater effluent that decomposes and creates methane, a GHG with high global warming potential.
  - Projected expansion of oil palm plantations onto land with carbon-rich peat soils which would lead to significant releases of GHGs to the atmosphere.

EPA, Bali 2012

What a definition ?

modeled carbon intensity. ILUC is best defined as "human induced" land use change on a global basis. There continues to