

Prospects for Developing Sustainable Bioenergy Markets and Trade.

IEA Bioenergy ExCo workshop (part of Bioenergy Australia), Twin Waters - Australia, 23th November 2011

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IPCC publishes Special Report on Renewable Energy Sources and Climate Change Mitigation

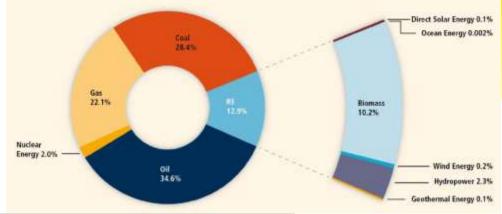
Potsdam, 11 May 2011 - By 2050, a maximum of 77 percent of the world's energy supply could be provided from renewable energy sources. The share of renewable energy in the future global energy mix differs substantially among scientific scenarios....A comprehensive review by the IPCC outlines the large potential of renewable energy sources to mitigate emissions of greenhouse gases and anthropogenic climate change. Special Report on Renewable Energy Sources and Climate Change Mitigation' (SRREN) has been approved by government representatives for IPCC member countries at the **11th Session of Working Group III** in Abu Dhabi, United Arab Emirates.



oordinating Lead Authors Meeting with PCC WGIII cochairs and TSU – Potsdam, Jan. 2011



Biomass & bioenergy flows according to IEA + other refs (2008)

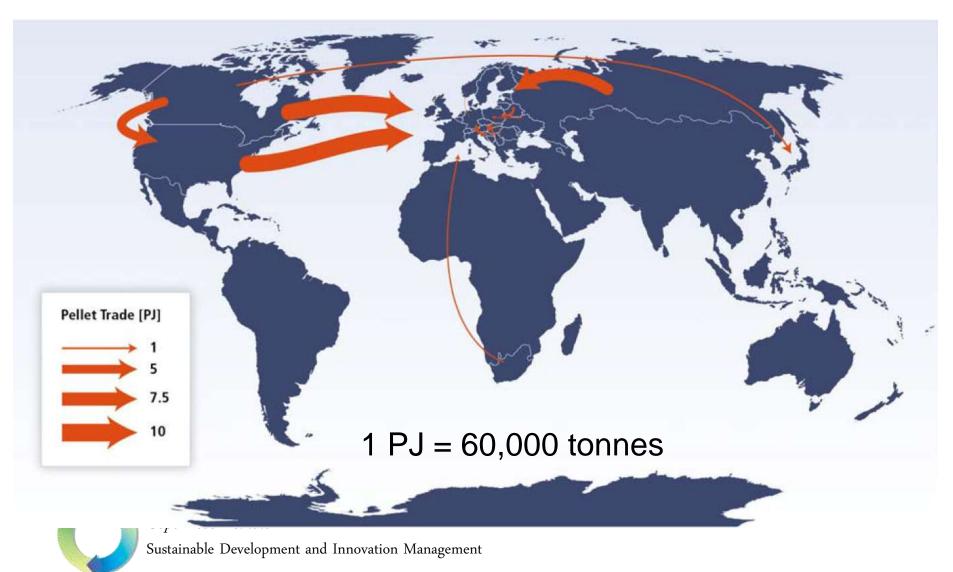


Туре	Primary Energy, EJ/y	~Average Efficiency, %	Secondary Energy Carrier, EJ/y	
Traditional Biomass				
Accounted by IEA, 2010	30.7*	10 to 20	3 to 6	
Unaccounted - informal sectors	6 to 12		0.6 to 2.4	
Total Traditional Biomass	37-42		3.6 to 8.4	
Modern Biomass (IEA, 2010)				
Power sector : Electricity (0.82 EJ*), Heat, and CHP from biomass, MSW (0.58 EJ*), biogas	5.2	60	3.1	
Residential and Others : Total residential heat (33.7 EJ*) minus IEA traditional biomass; biogas heating, public/commercial buildings heating	4.1*	60 to 80	2.4-3.2	
Road Transport Fuels (ethanol, biodiesel, ETBE)	3.1	65	1.9*	[IPCC-
Total Modern Bioenergy (as accounted by IEA , 11.4 EJ for values*)	12.4	<u>60-65</u>	7.4 to 8.3	SRREN, 20

Note: (*) Direct data from 2010 IEA Energy Balances Statistics for 2008. Others derive from combinations of data across biomass sources and sectors of the IEA publication.



Global wood pellet trade 2009

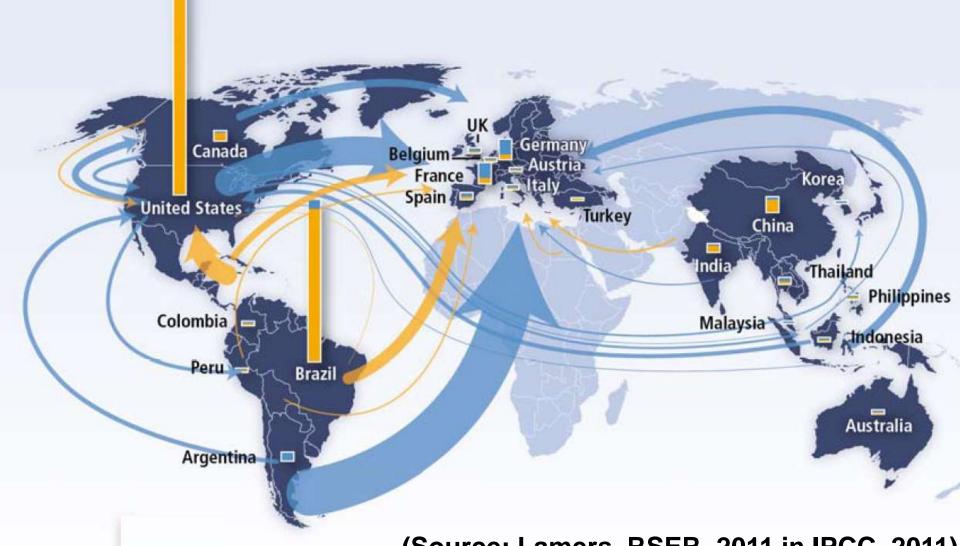


(Source: Sikkema et al., Bio FPR 2011 in IPCC, 2011)



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Global biofuels production and main international trade 2009



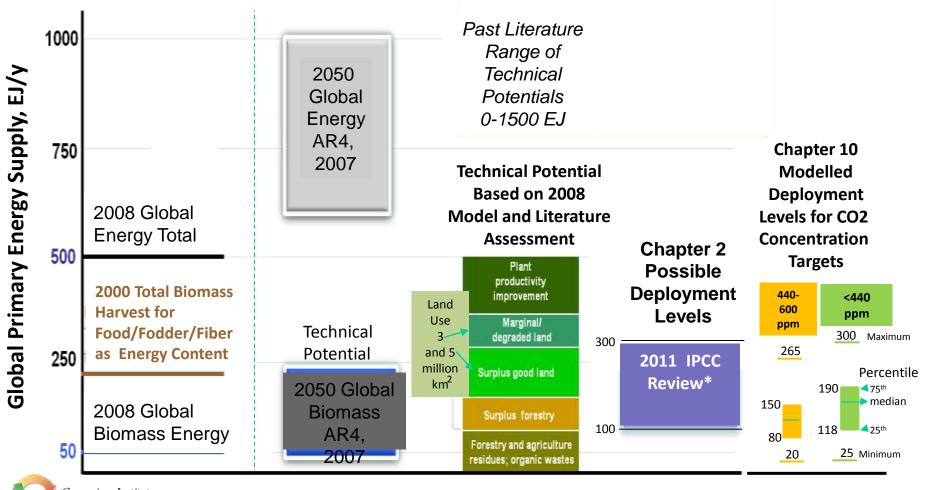
Global production and trade of the major biomass commodities (2008)

	Bioethanol	Biodiesel	Wood pellets
Mton in 2008			
Global production	52.9	10.6	11.5
Global net trade	3.72 (*)	2.92	Approx. 4
Main exporters	Brazil	US, Argentina, Indonesia Malaysia	Canada,USA, Baltic countries, Finland, Russia
Main importers	USA, Japan, EU	EU	Belgium, Netherlands, Sweden, Italy

(^{\$)} An estimated 75% of the traded bioethanol is used as transport fuel.

[Heinimö & Junginger, Biomass & Bioenergy, 2009]

2050 Bioenergy Potentials & Deployment Levels



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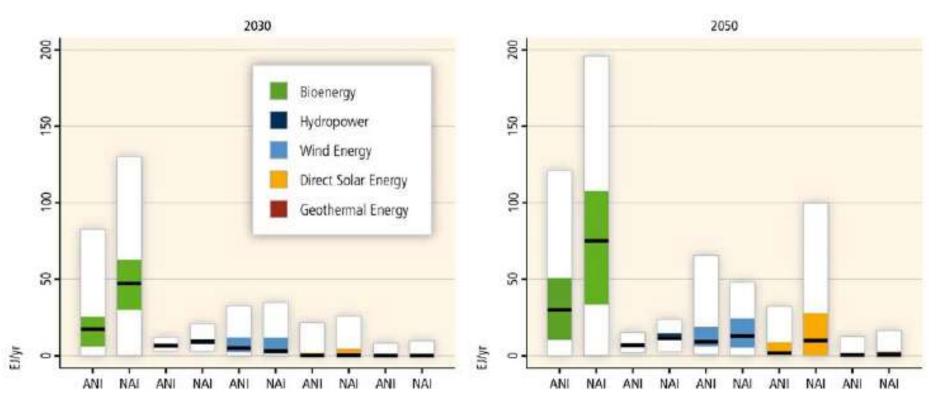
2050 Projections

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[IPCC-SRREN, 2011]

Global RE supply by source in Annex I (ANI) and Non-Annex I (NAI) countries in 164 long-term scenarios (2030 and 2050).



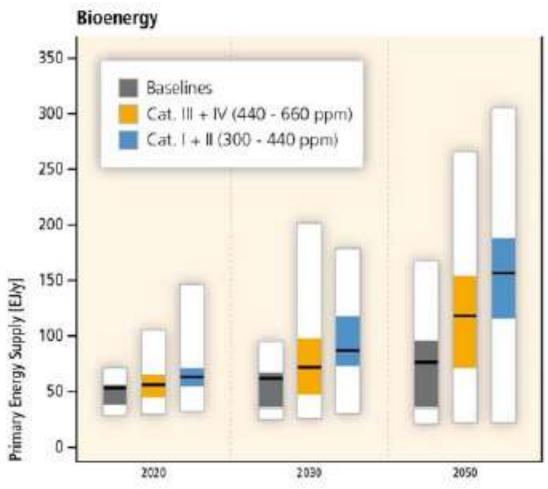


<u>Thick black line</u> = median, <u>Coloured box</u> = 25th-75th percentile, <u>Whiskers</u> = total range across all reviewed scenarios.

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[IPCC-SRREN, 2011]

Global primary energy supply of biomass in 164 long-term scenarios in 2020, 2030 and 2050, grouped by different categories of atmospheric CO2 concentration level in 2100



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[IPCC-SRREN, 2011]

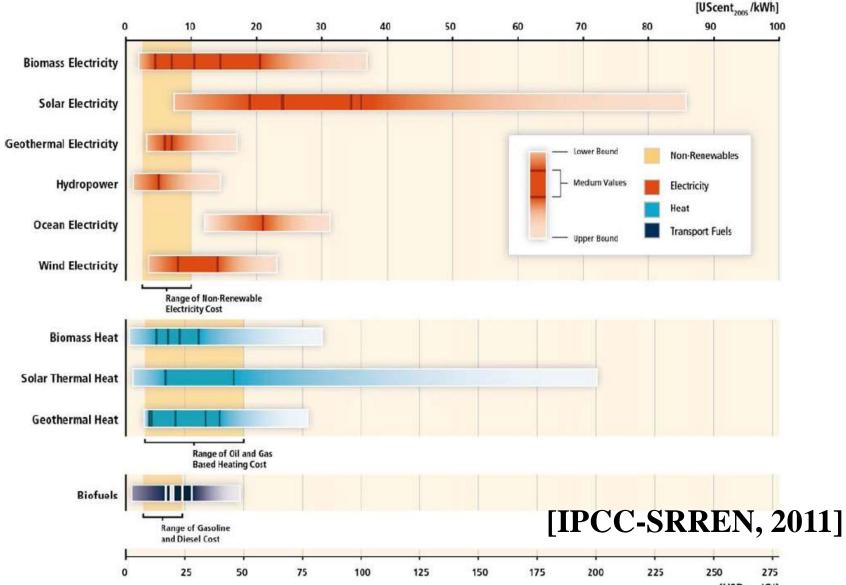
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Range of LCOE for selected commercially available RE technologies compared to recent non-RE costs.

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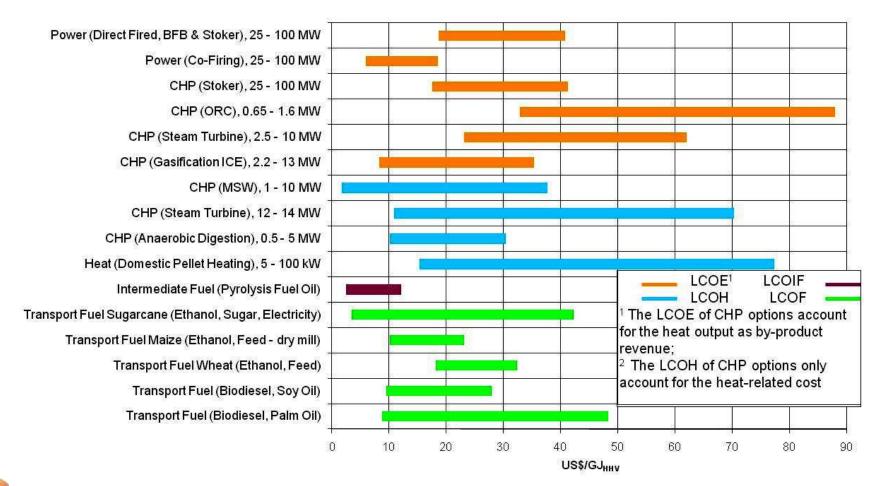




[USD₂₀₀₅/GJ]



Cost ranges various current bioenergy systems.



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[IPCC-SRREN, 2011]





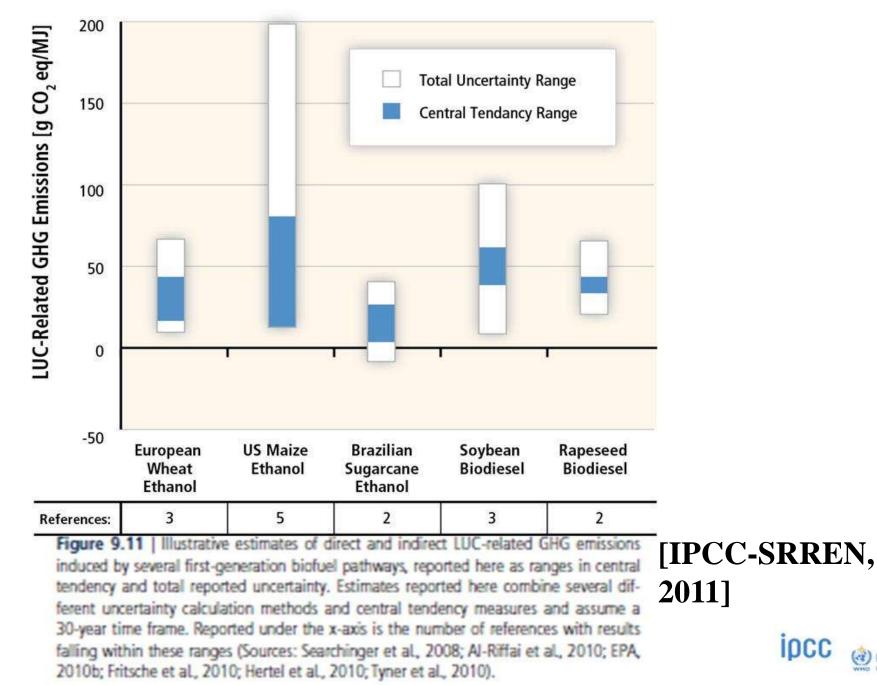
Projected production costs estimated for selected *developing* technologies

Select Bioenergy Technology	Energy Sector (Electricity, Thermal, Transport)*	2020-2030 Projected Production Costs US\$(2005)/GJ	
Integrated Gasification Combined Cycle (IGCC) ^{1.}	Electricity and/or Transport	12.8-19.1 (4.6-6.9 cents/kWh)	
Renewable diesel & jet fuel	Transport and electricity	15-30	
Lignocellulose sugar-based biofuels ²		6-30	
Lignocellulose syngas-based biofuels ³	Transport	12 -25	
Lignocellulose pyrolysis-based biofuels ⁴		14-24 (blendstock)	
Gaseous biofuels ⁵	Thermal and Transport	6-12	
Aquatic plant derived fuels, chemicals	Transport	30-140	

¹Feed cost \$3.1/GJ, IGCC (future) 30-300 MW, 20 yr life, 10% Discount Rate; ²ethanol, butanols, microbial hydrocarbons and microbial hydrocarbons from sugar or starch crops; ³ syndiesel, methanol and gasoline, etc.; syngas fermentation routes to ethanol; ⁴ biomass pyrolysis (or other thermal treatment) and catalytic upgrading to gasoline and diesel blendstocks or to jet fuels; ⁵ synfuel to SNG, methane, dimethylether, hydrogen from biomass thermochemical and anaerobic digestion (larger scale)

[**IPCC-SRREN**, 2011]

Direct and indirect land use GHG emissions – Take II (Chapter 9)



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Status iLUC (an opinion)

- Diverging outcomes; more sophisticated approaches; from 0.8 to later analyses: 0.3 -> 0.2.
- More detailed regional studies: depends highly (Fully...) on rate of improvement in agricultural and livestock management.
- CGE: extrapolates past developments, very sensitive to input data, poor in tackling technological change...

iLUC is a **reactive** concept while we actually want to be **proactive** in avoiding it altogether...

 defining ilUC factors has received most attention versus very limited focus on mitigation of iLUC [Faaij, 2011]

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Confrontation of bottom-up vs. top down

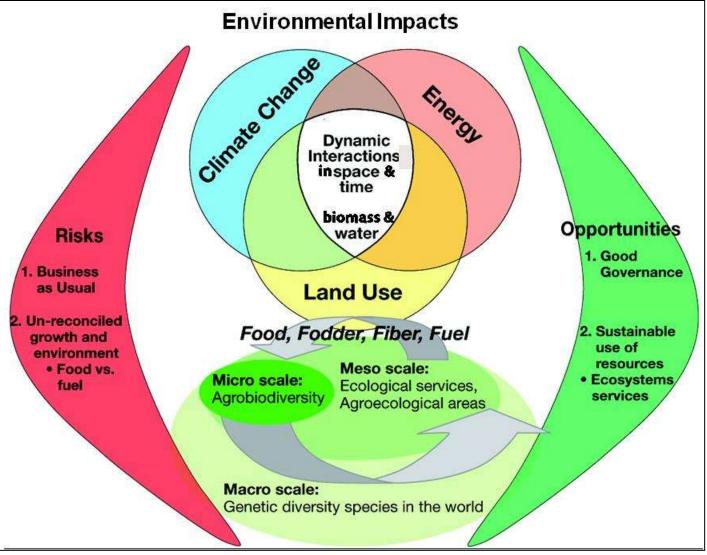
Key steps iLUC modelling efforts:

- CGE; historic data basis
- Model shock, short term, BAU, current technology.
- Quantify LUC
- Quantify GHG implications (carbon stocks)

Bottom-up insights:

- Coverage of BBE options, advancements in agriculture, verify changes (land, production)
- Gradual, sustainability driven, longer term, technological change (BBE, Agriculture)
- LUC depends on zoning, productivity, socio-economic drivers
 - Governing of forest, agriculture, identification of "best" lands.

Driving forces, dimensions, scales...



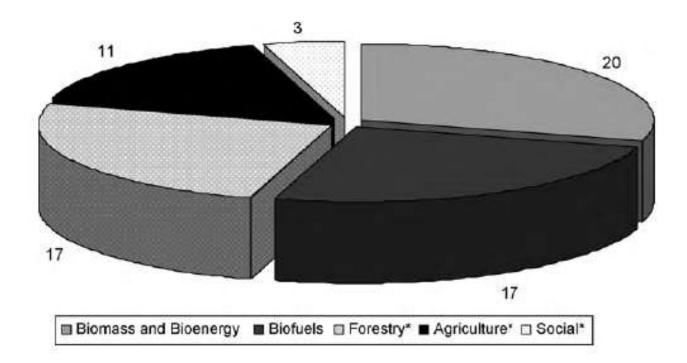
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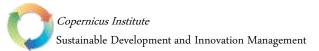
[IPCC-SRREN, 2011]

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Initiatives and certification systems on biomass and bioenergy certification (substantially more systems exist)

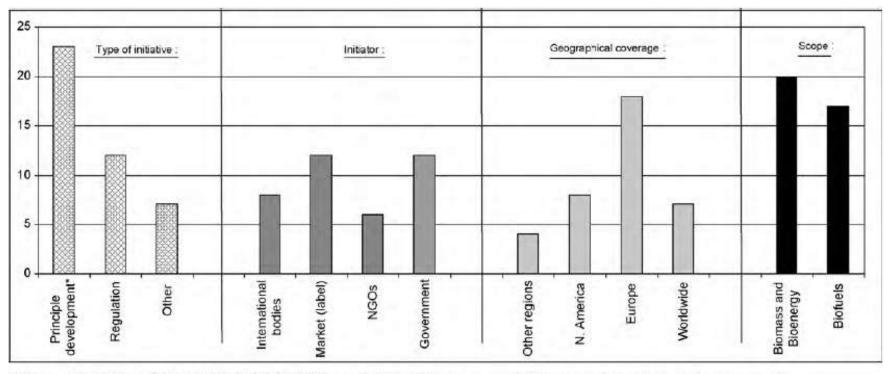




[van Dam et al., RSER, 2010]



Key characteristics of initiatives and systems on biomass and bioenergy certification



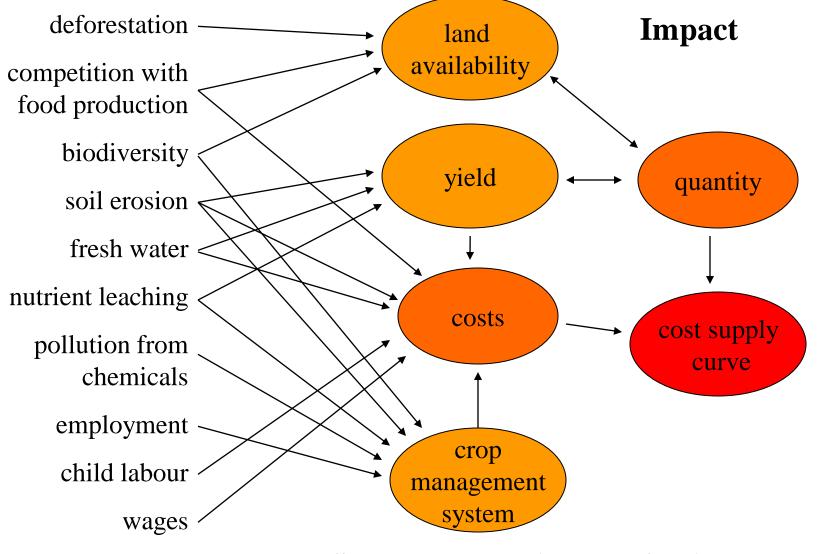
* Several initiatives (NTA 8080, UK-RTFO) focus their initiatives on regulation as well as principle development.

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[van Dam et al., RSER, 2010]

Operationalisation of sustainability criteria Criteria



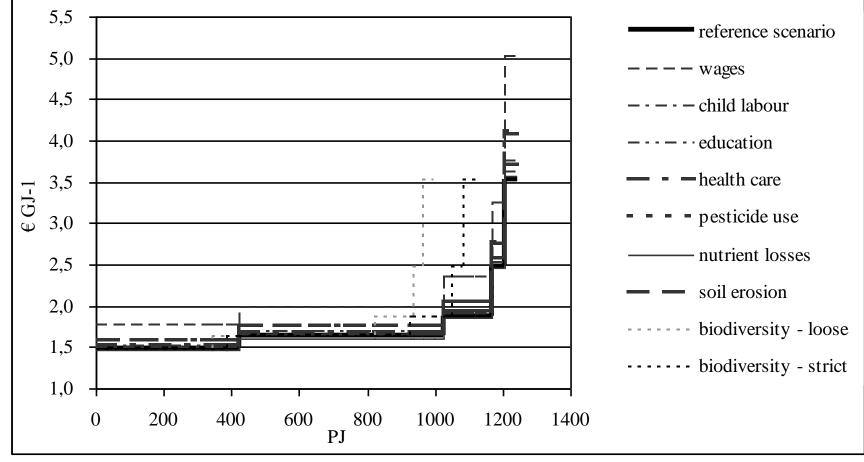


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[Smeets et al., Biomass & Bioenergy, 2010]



Cost supply curve Brazil with sustainability demands

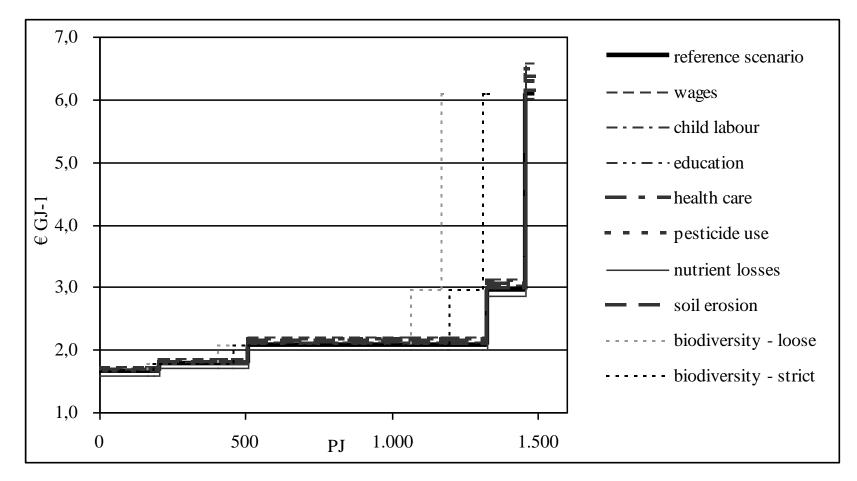


[Biomass & Bioenergy, Smeets et al., 2010]

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Cost supply curve Ukraine with sustainability demands



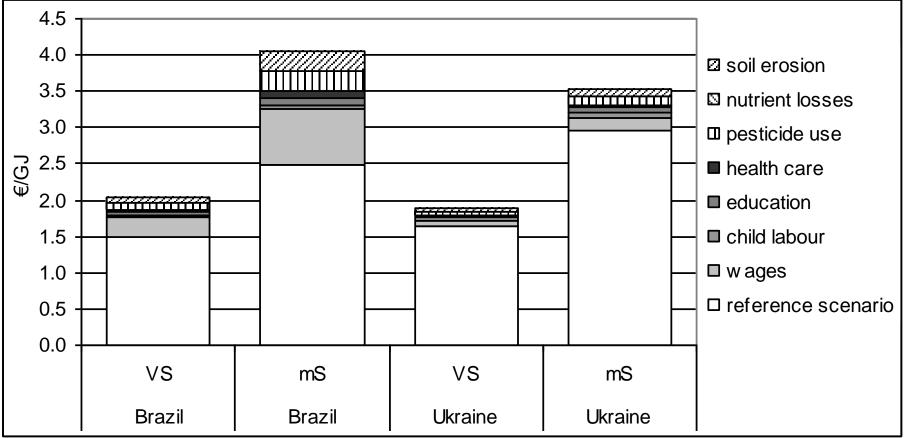
[Biomass & Bioenergy, Smeets et al., 2010]

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Indicative cost impacts of applying

sustainability criteria...



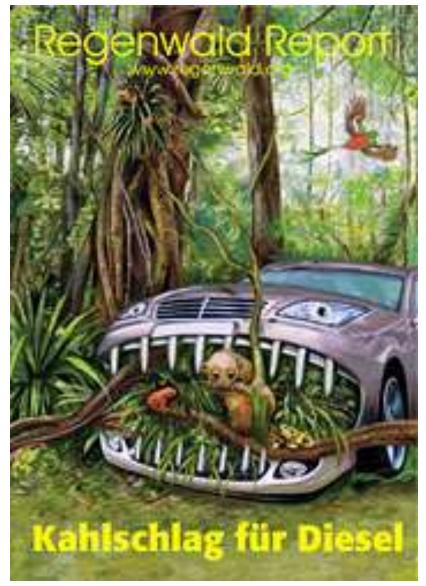
[Biomass & Bioenergy, Smeets et al., 20010]

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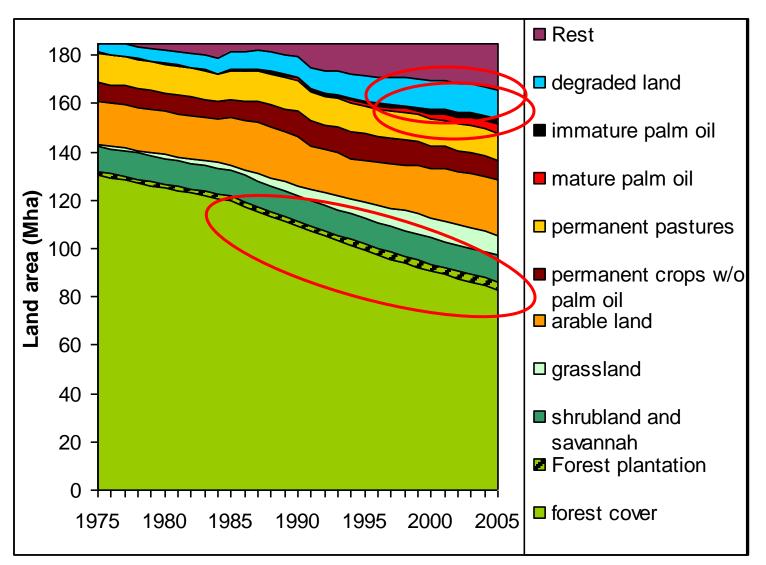
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The oil for ape scandal How palm oil is threatening the orang-utan

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LUC in Indonesia



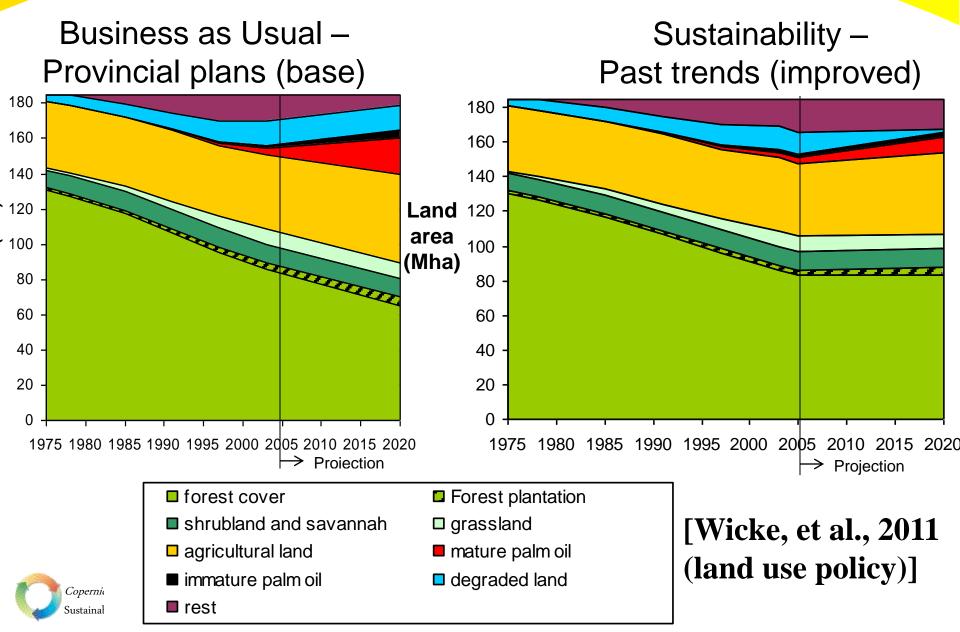
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[Wicke, et al., 2011, Land use policy]

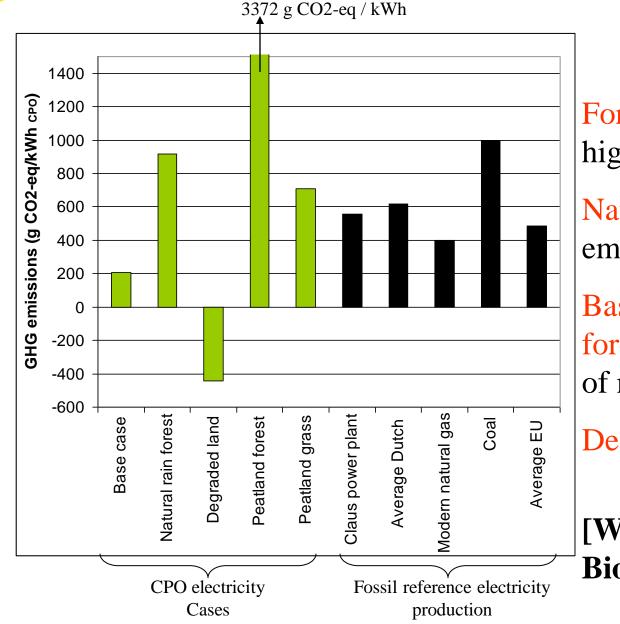
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LUC until 2020 Indonesia





GHG Balances and land conversion issues



Forested peatland: extremely high emissions Natural rainforest: high emissions Base case - Logged over forest: emissions about half of modern natural gas power

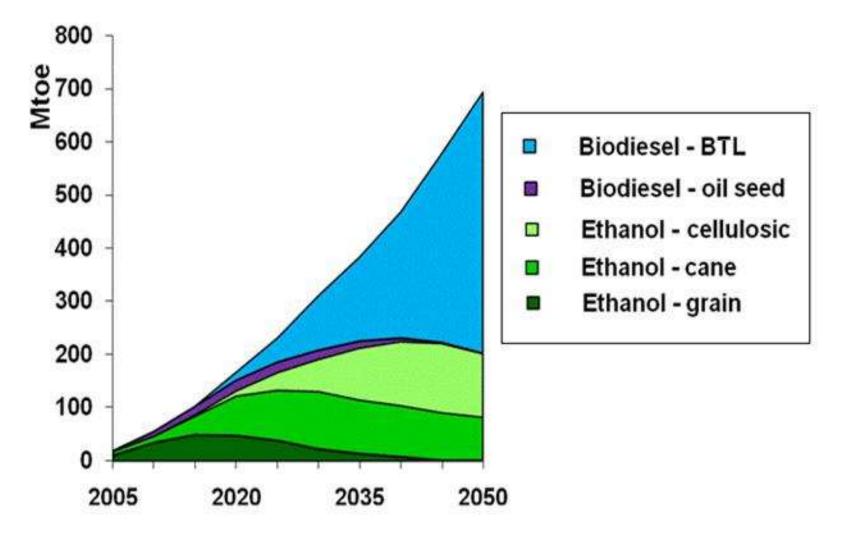
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Degraded land: CO2 uptake

[Wicke, et al., Biomass & Bioenergy, 2008



The IEA on biofuels...

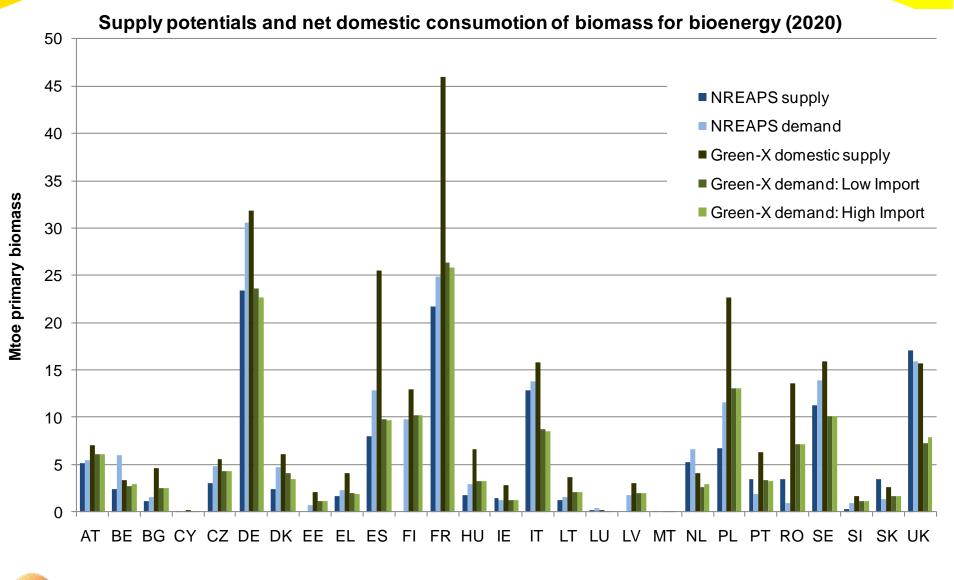


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IEA-ETP, 2008

Biomass supply and demand in 2020





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[Hoefnagels et al, UU/Task 40, 2011]

Simulated Biomass trade flows 2020

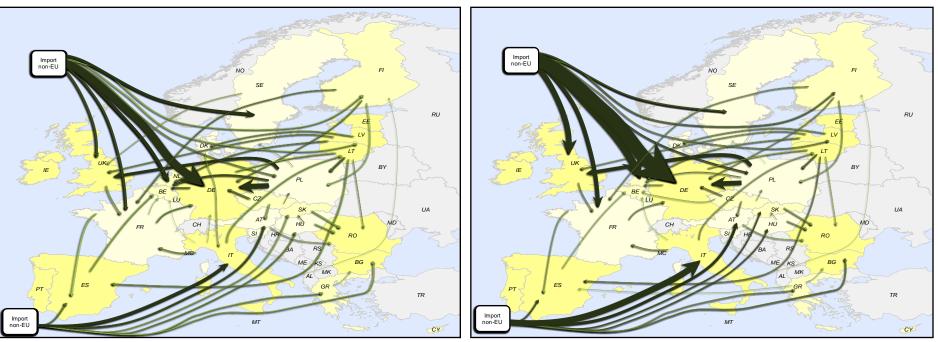


	2009	2015		2020	
	(pellets)	Low Import	High Import	Low Import	High Import
Total trade (Mtoe)	1.6	5.4	6.2	12.6	17.4
Total trade (Mt wood pellet					
eq.)*	3.8	12	14	29	40
Of which Intra-EU	55%	38%	32%	52%	32%
Of which Inter-EU	45%	62%	68%	48%	68%

*) Mt eq. = million metric tonne pellet equivalent (18 MJ/kg)

Low Import scenario

High Import scenario





[Hoefnagels et al, UU/Task 40, 2011]

Material/Economic

(A1) 300 EJ/Poor Governance

Key Preconditions

- High Energy Demand Results in High Energy Prices and Drive Strong Biomass Demand.
- Limited Oversight on Biomass Production and Use, Largely Driven by Market Demand.
- · Fully Liberalized Markets for Bioenergy as Well as in Agriculture as a Whole.
- Strong Technology Development Leading to Increased Demand for Biochemicals and Advanced Transport Fuels from Biomass.

Key impacts

- · Production Emphasis is on Higher Quality Land, Converted Postures, etc.
- Biomass Produced and Used in Large Scale Operations, Limiting Small Faimers' Benefits.
- Large Scale Global Trade and Conversion Capacity Developed in Major Seaports.
- Competition with Conventional Agriculture for the Better Quality Land, Driving Up Food Prices and Increasing Pressure on Forest Resources.
- GHG Benefits Overall but Sub-Optimal Due to Significant iLUC Effects.

(A2) 100 EJ/Poor Governance

Key Preconditions

- High Fossil Fuel Prices Expected Due to High Demand and Limited Innovation. Which Pushes Demand for Biofuels Use From an Energy Security Perspective.
 Increased Biomass Demand Directly Affects Food Markets.
 - eased biomass pernand precity enects rood markets.

Key Impacts

- Increased Biomass Demand Partly Covered by Residues and Wastes, Partly by Annual Crops.
- Additional Crop Demand Leads to Significant LUC Effects and Biodiversity Impacts.
- · Overall Increased Food Prices Linked to High Oil Prices.
- Limited Net GHG Benefits.
- Sub-Optimal Socio-Economic Benefits.

2050 Bioenergy Storylines

(B1) 300 El/Good Governance

Key Preconditions

- Well Working Sustainability Frameworks and Strong Policies are Implemented.
- · Well Developed Bioenergy Markets.
- Progressive Technology Development, e.g. Biorefineries, New Generation Biofuels and Multiple Products, Successful Use of Degraded lands.

Globally Oriented

- Developing Countries Succeed in Transitioning to Higher Efficiency Technologies and Implement Biorefineries at Scales Compatible with Available Resources.
- Satellite Processing Emerges.

Key Impacts

- 35% Biomass from Residues and Waster, 25% from Marginal/Degraded Landa and 40% from Arable and Pastare Lands (3 and 1 Million km/, Respectively).
- Moderate Energy Price (Notably Oil) Due to Strong Increase of Biomass and Biofuels Supply.
- Food and Fuel Conflicts Largely Avoided Due to Strong Land-Use Planning and Alignment of Bioenergy Production Capacity with Efficiency Increases in Agriculture and Livesbock Management.
- Soll Quality and Soll Carbon Improve and Negative Biodiversity Impacts are Minimised Using Diverse and Mixed Cropping Systems.

(B2) 100 EJ/Good Governance

Key Preconditions

 Focus on Smaller Scale Technologies, Utilization of Residues, Waste Streams and Smaller Scale Cropping Schemes (e.g., Jathropha) and a Large Array of Specific Cropping Schemes.

Regionally Oriented

- International Trade is Constrained and Trade Barriers Remain.
- Strong National Policy Frameworks Control Bioenergy Deployment, Put Priority on Food and Optimize Biomass Production and Use for Specific Regional Conditions.

Key Impacts

- Biomass Comes From Residues, Organic Wastes and Cultivation on More Marginal Lands.
- Smaller Scale Bioenergy Applications Developed Specially and Used Locally. Substantial Benefits Provided for Rural Economies in Terms of Employment and Diversified Energy Sources Providing Services.
- · Food, Land-Use and Nature Conservation Conflicts are Largely Avoided.
- Significant GHG Mitigation Benefits are Constrained by Limited Bioenergy Deployment.
- Transport Sector Still Uses a High Share of Mineral Oil to Cover Energy Needs.

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Opposing sketches for the scenario preconditions technological challenges, and impacts for bioenergy deployment on long term following **Typical IPCC SRES.**

Environment/Social

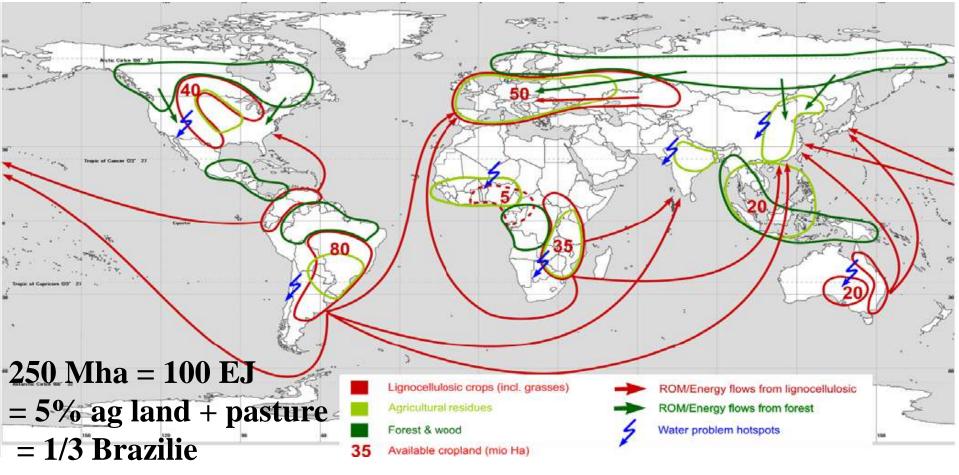
[IPCC-SRREN, 2011]

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A future vision on global bioenergy markets (2050...)



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[GIRACT FFF Scenario project; Faaij, 2008]

Final remarks



- Bioenergy trade has rapidly become more important in total biomass supplies (for pellets in particular).
- Plays major role in balancing out fluctuations in demand (policy!) & supply (variable at large).
- Markets still immature; ethanol closest to commodity trading.
- Rapid growth very likely to continue; in particular ('advanced'') pellets (torrefaction); cultivated wood is becoming more important.
- More markets for lignocellulosic biomass emerge: 2nd gen biofuels, biochemicals...
- Only a future when done sustainably...
- ...while at the same time RE and GHG mitigation targets cannot be met without large scale bioenergy deployment



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Thanks for your attention

For more information, see:

www.bioenergytrade.org

- Detailed activities
- Background information
- Results
- Events
- Subscribe to the newsletter (2x per year).

And:

- Sciencedirect/Scopus
- http://srren.ipcc-wg3.de/report

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