Biomass Global; Facts, Chances & Risks

Tagung Bioenergie; Gemeinsam Visionen Schaffen.

Ittingen - Switzerland, 24th September 2010

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Problems of bioenergy today

- GHG balances not OK
- Endless subsidies needed.
- Land and water constrain bioenergy to marginal levels.
- Increases food prices and not good for farmers.
- Other alternatives (solar, efficiency, hydrogen) are better and *really* sustainable.
- **Main issue: Indirect Land Use Change (iLUC)**

Agricultural land use; the baseline!

1. We need a lot more food (especially protein).
2. We don't have (a lot) more (agricultural) land.
3. Agriculture and livestock main threat for biodiversity (today…), main consumer of water, main emitter of GHG's.
4. Agriculture and poverty interlinked: 70% of the world's poor in rural setting;
5. Agricultural productivity is low on large parts of the globe.
6. Such agricultural practices often unsustainable as such.
7. Poverty (and lack of investment) key driver for unsustainable land use (erosion, forest loss).
8. **Bioenergy can provide the money and investment to the rural regions by capturing oil money (besides CO2).**

Contributors to land use change…

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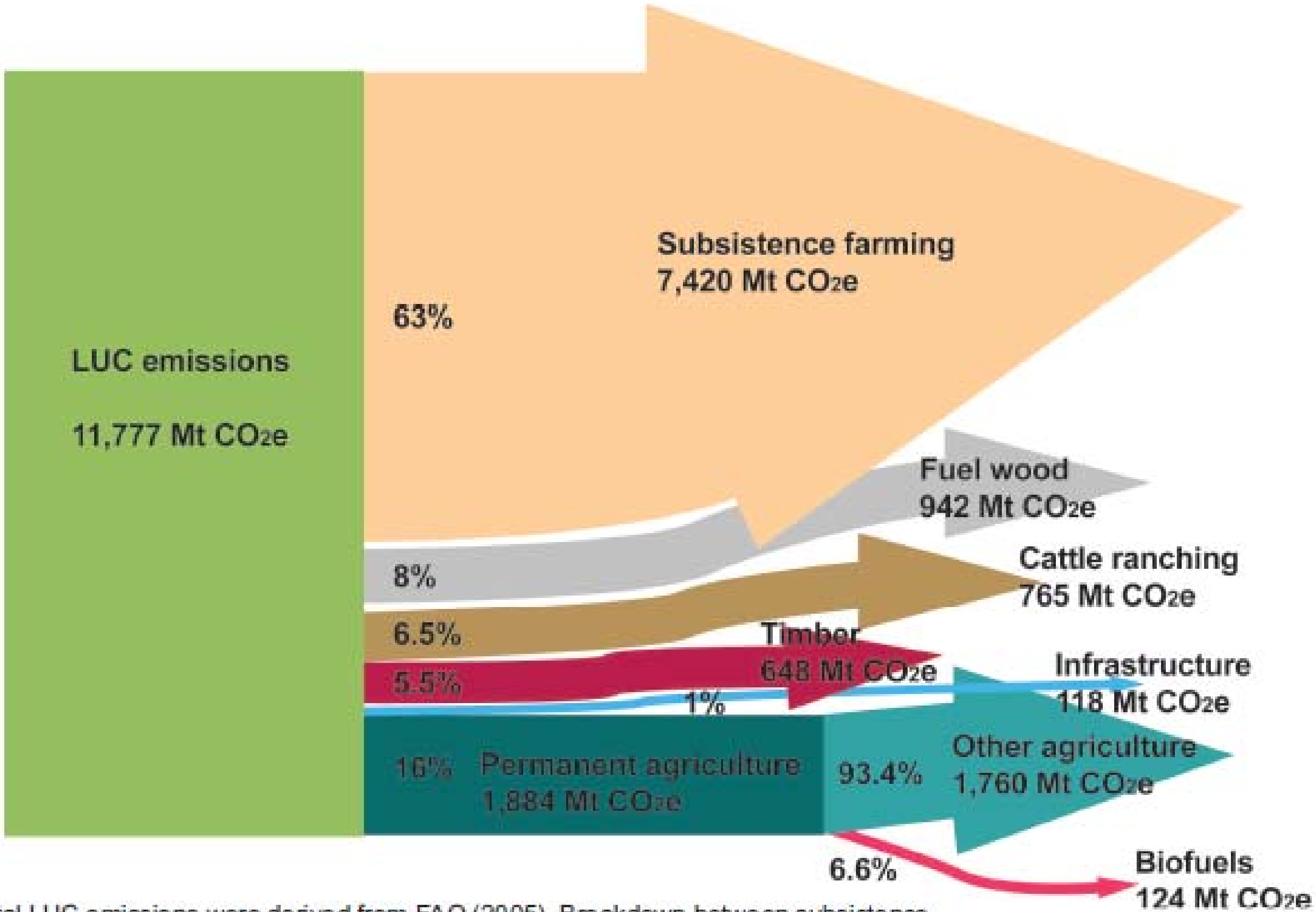
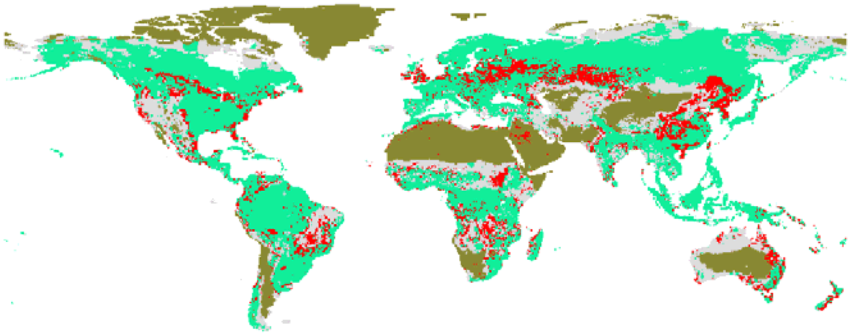
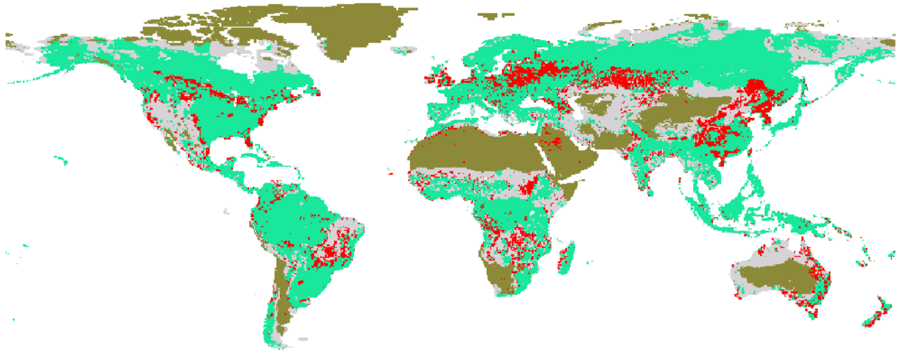


Total LUC emissions were derived from FAO (2005). Breakdown between subsistence farming, fuel wood, cattle ranching, timber and permanent agriculture were taken from FAO (1980). The contribution of biofuels was based on the proportion of commercial agricultural output allocated to biofuels over the period 2000 - 2005.

B1 2050

A1 2050



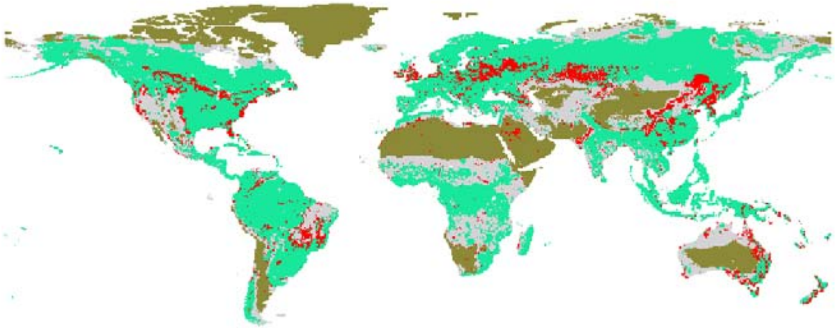


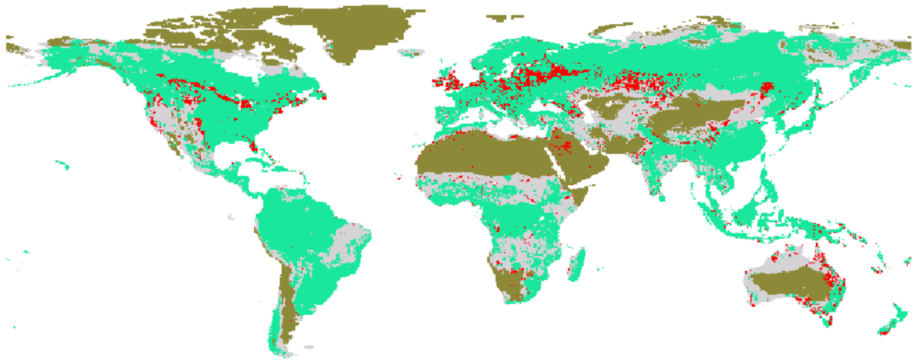
Integrated assessment modelling results (IMAGE)

Source: Hoogwijk, Faaij 2005

B2 2050

A2 2050





Limitations in degraded land, protected areas and water

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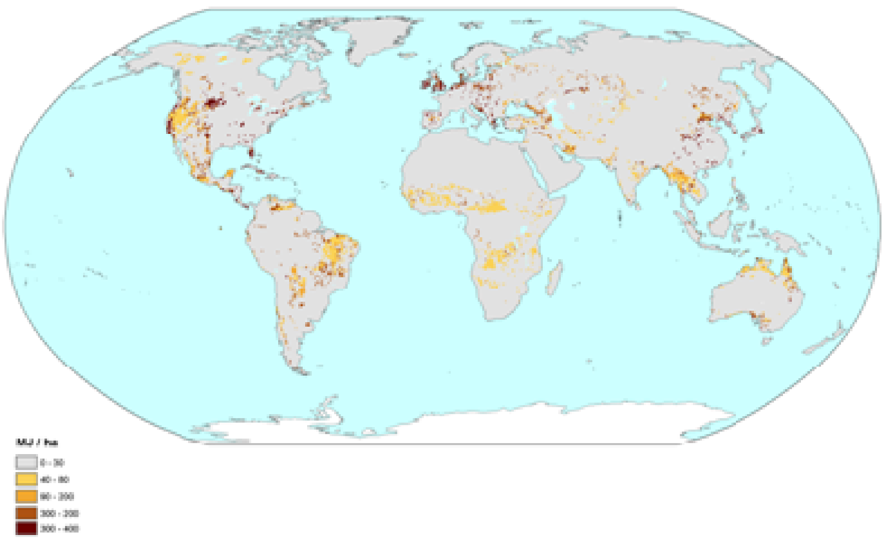
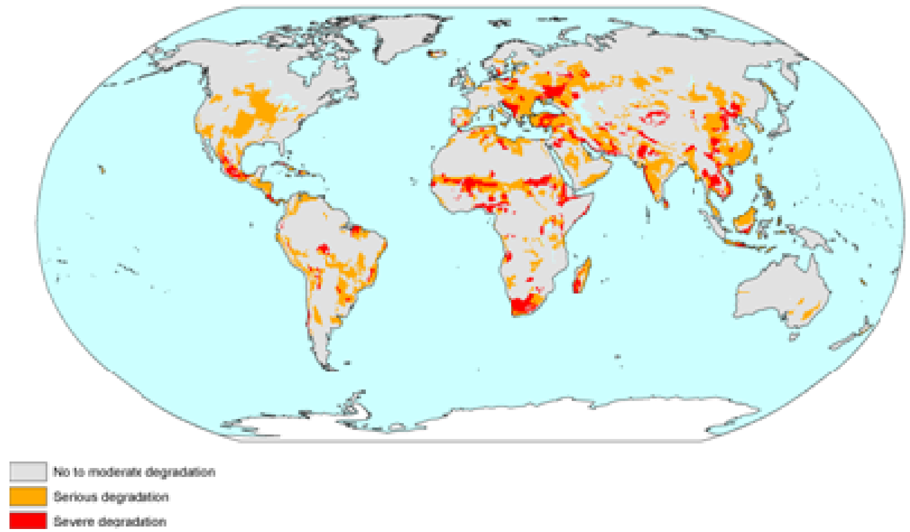
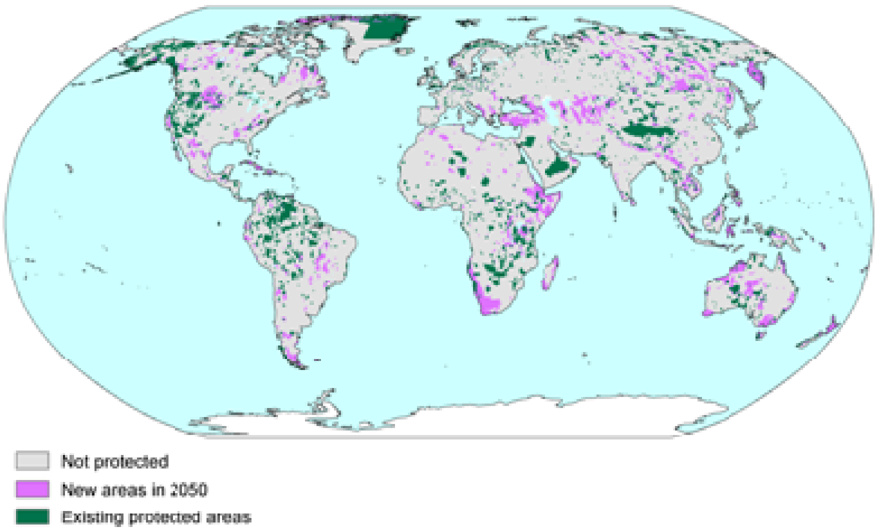
Potential for Woody Biomass 2050



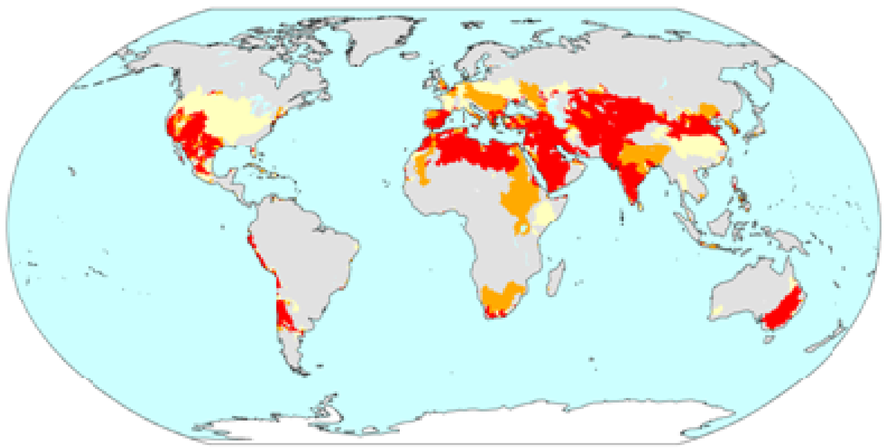
Land degradation risk 2050



Protected areas 2050

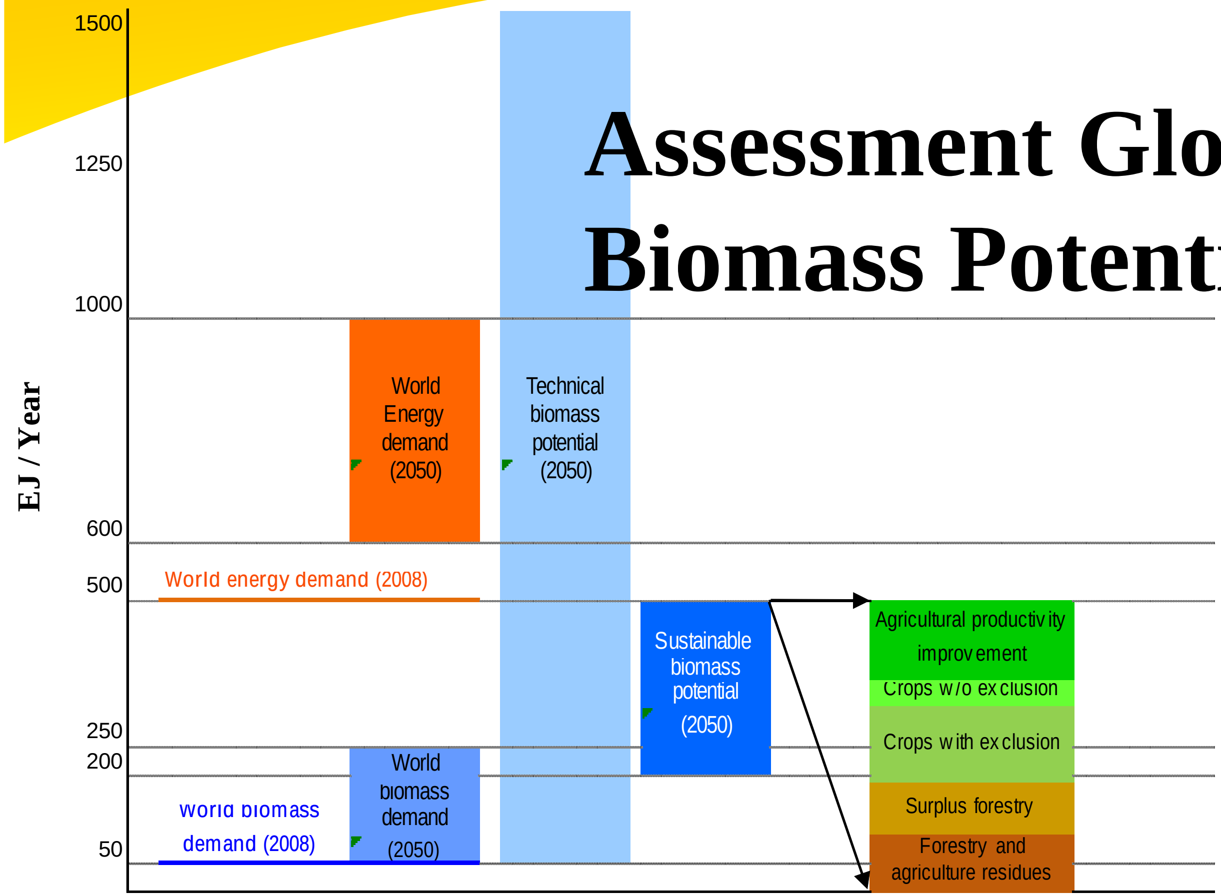


Watershortage 2050



Dornburg et al., 2008

Assessment Global *Sustainable* Biomass Potentials 2050…



Current world energy demand (500 EJ/year)

Current world biomass use (50 EJ/year)

Total world primary energy demand in 2050 in World Energy Assessment (600 - 1000 EJ/year)

Modelled biomass demand in 2050 as found in literature studies. (50 - 250 EJ/year)

Technical potential for biomass production in 2050 as found in literature studies. (50 - 1500 EJ/year).

Sustainable biomass potential in 2050 (200-500 EJ/year). *Sustainable biomass potentials consist of: (i) residues from agriculture and forestry; (ii) surplus forest material (net annual increment minus current harvest); (iii) energy crops, excluding areas with moderately degraded soils and/or moderate water scarcity; (iv) additional energy crops grown in areas with moderately degraded soils and/or moderate water scarcity and (v) additional potential when agricultural productivity increases faster than historic trends thereby producing more food from the same land area.*

100-300 EJ achievable… = 1/3 global demand 2050

[*Bioenergy Revisited*: Dornburg et al., Energy & Environmental Science, 2010]

Key factors affecting biomass potentials

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Issue/effect	Importance
Supply potential of biomass	
Improvement agricultural management	***
Choice of crops	***
Food demands and human diet	***
Use of degraded land	***
Competition for water	***
Use of agricultural/forestry by-products	**
Protected area expansion	**
Water use efficiency	**
Climate change	**
Alternative protein chains	**
Demand for biomaterials	*
Demand potential of biomass	
Bio-energy demand versus supply	**
Cost of biomass supply	**
Learning in energy conversion	**
Market mechanism food-feed-fuel	**

[*Bioenergy Revisited*: Dornburg et al. Energy & Environmental Science, 2010]

Yield projections Europe

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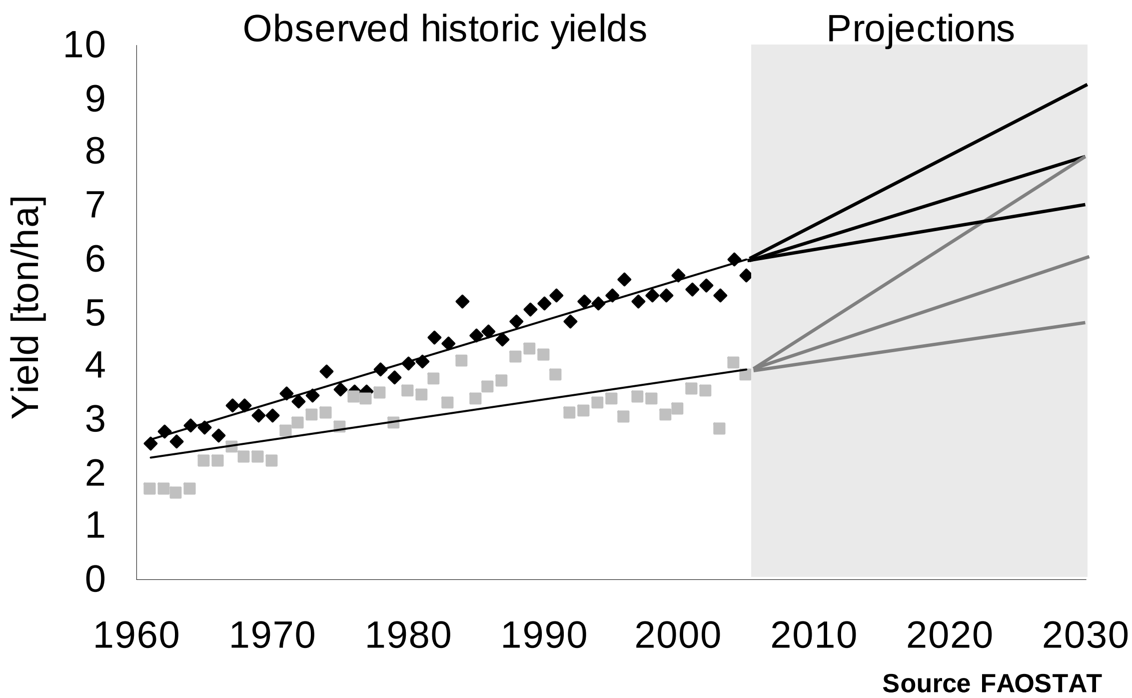
- Observed yield
  - CEEC and WEC
- Linear extrapolation of historic trends
  - Widening yield gap
- Applied scenarios
  - Low, baseline and high



[Wit & Faaij, 2010]

Results - spatial production potential

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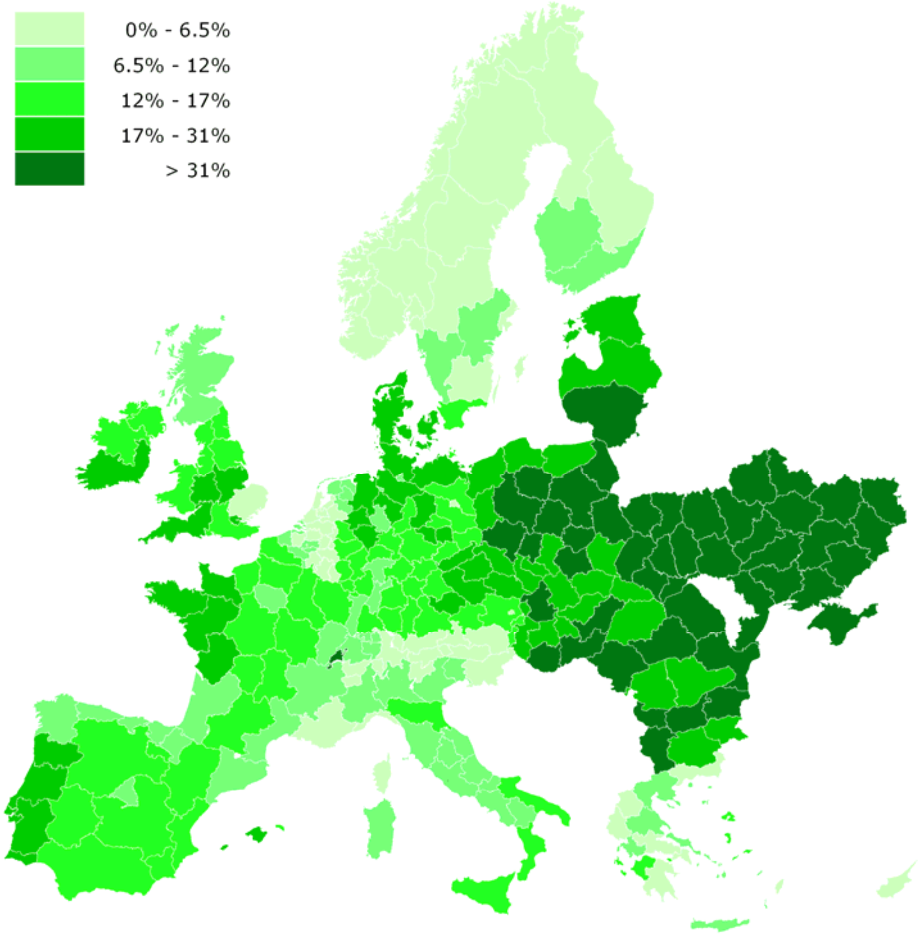
Arable land available for dedicated bio-energy crops divided by the total land

Potential		**Countries**
Low potential	< 6,5%	NL, BE, LU, AT, CH, NO, SE and FI
Moderate potential	6,5% - 17%	FR, ES, PT, GE, UK, DK, IE, IT and GR
High potential	> 17%	PL, LT, LV, HU, SL, SK, CZ, EST, RO, BU and UKR



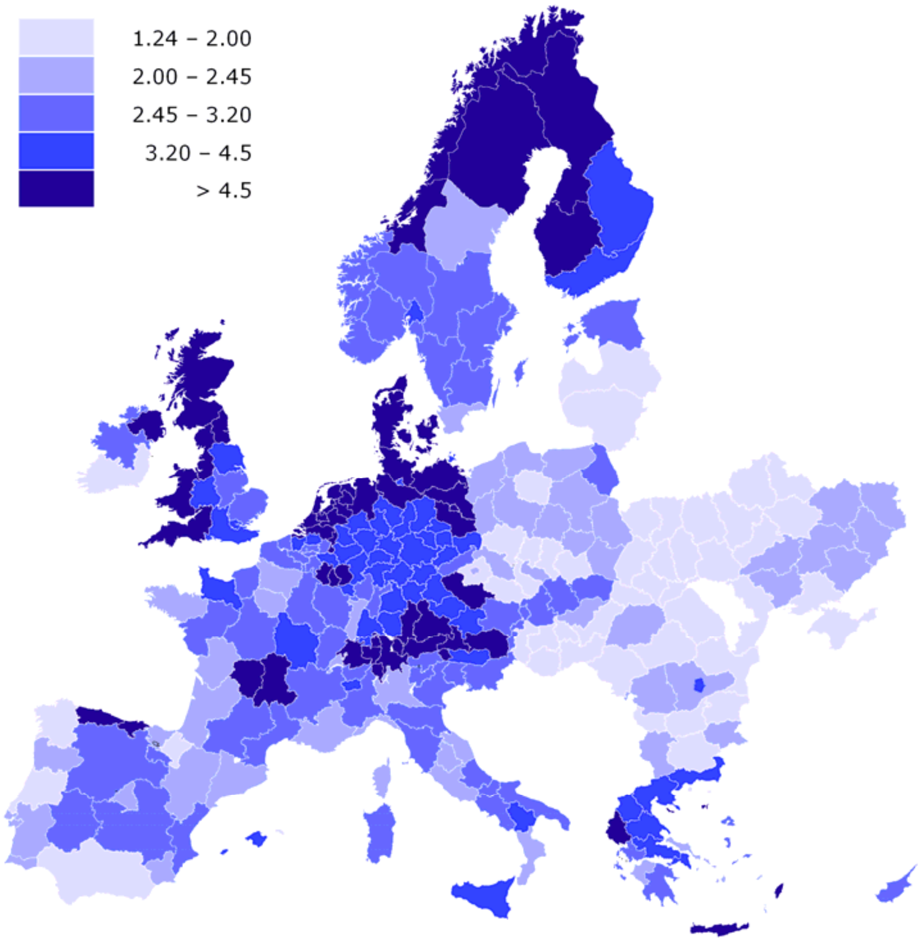
[Wit & Faaij, Biomass & Bioenergy, 2010]

Results - spatial cost distribution

Production cost (€ GJ^{-1}) for

Grassy crops

Potential		Countries
Low Cost	< 2,00	PL, PT, CZ, LT, LV, UK, RO, BU, HU, SL, SK, EST, UKR
Moderate Cost	2,00 – 3,20	FR, ES, GE, IT, SE, FI, NO, IE
High Cost	> 3,20	NL, BE, LU, UK, GR, DK, CH, AT



[Wit & Faaij, Biomass & Bioenergy, 2010]

Bandwidth EU-27+ Biomass Supplies 2030+.

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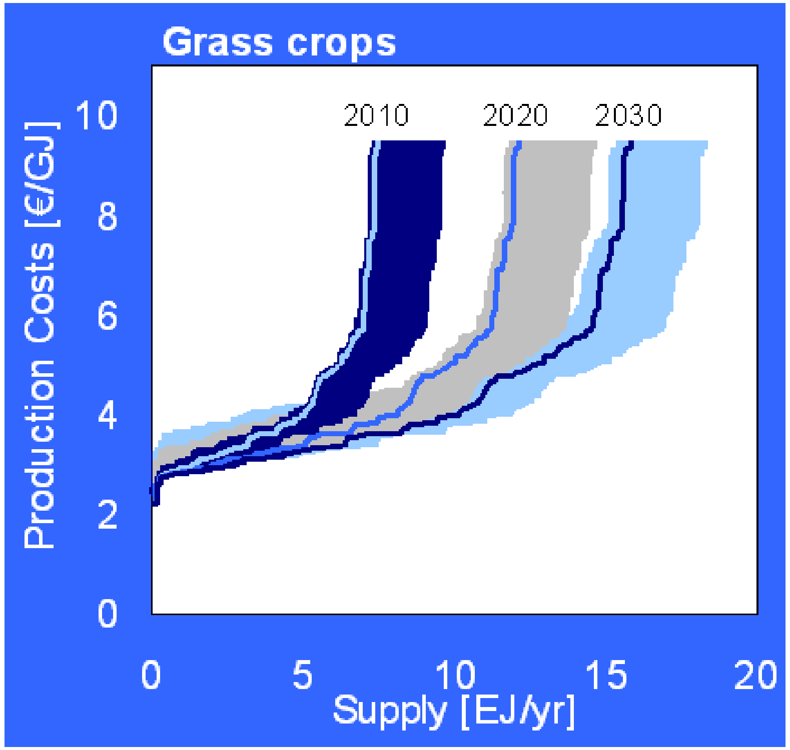

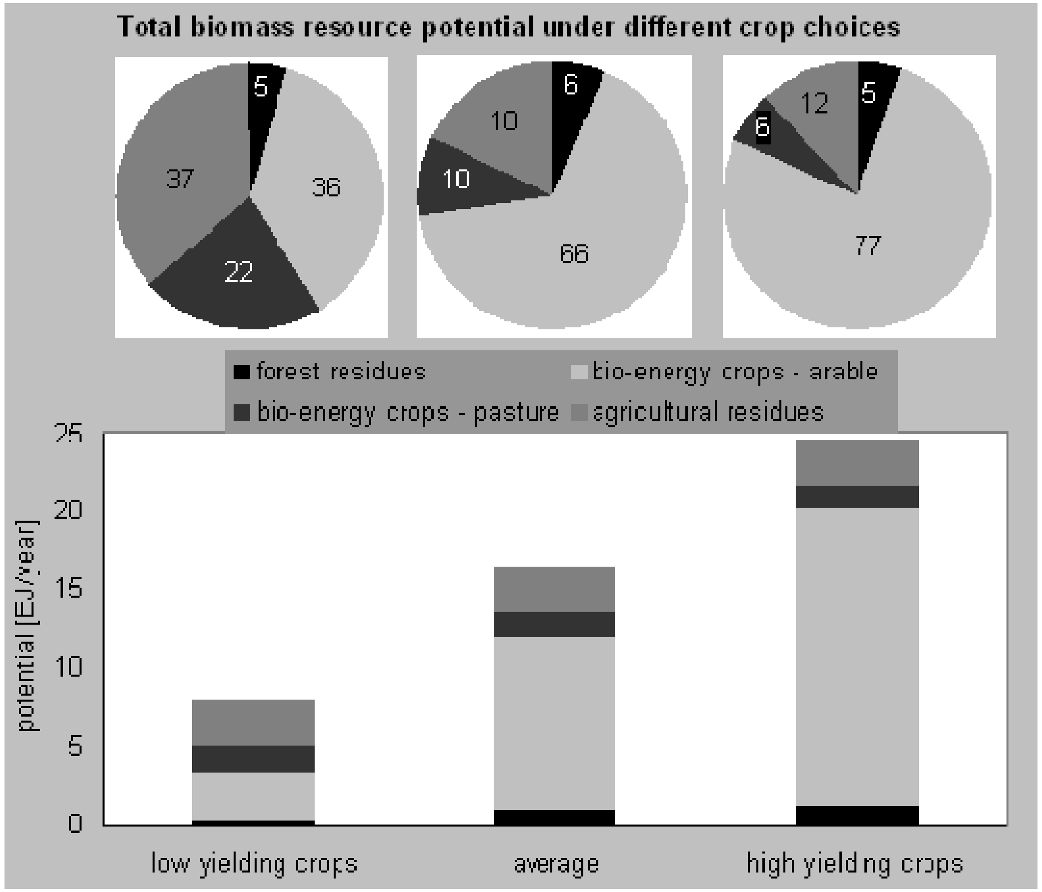

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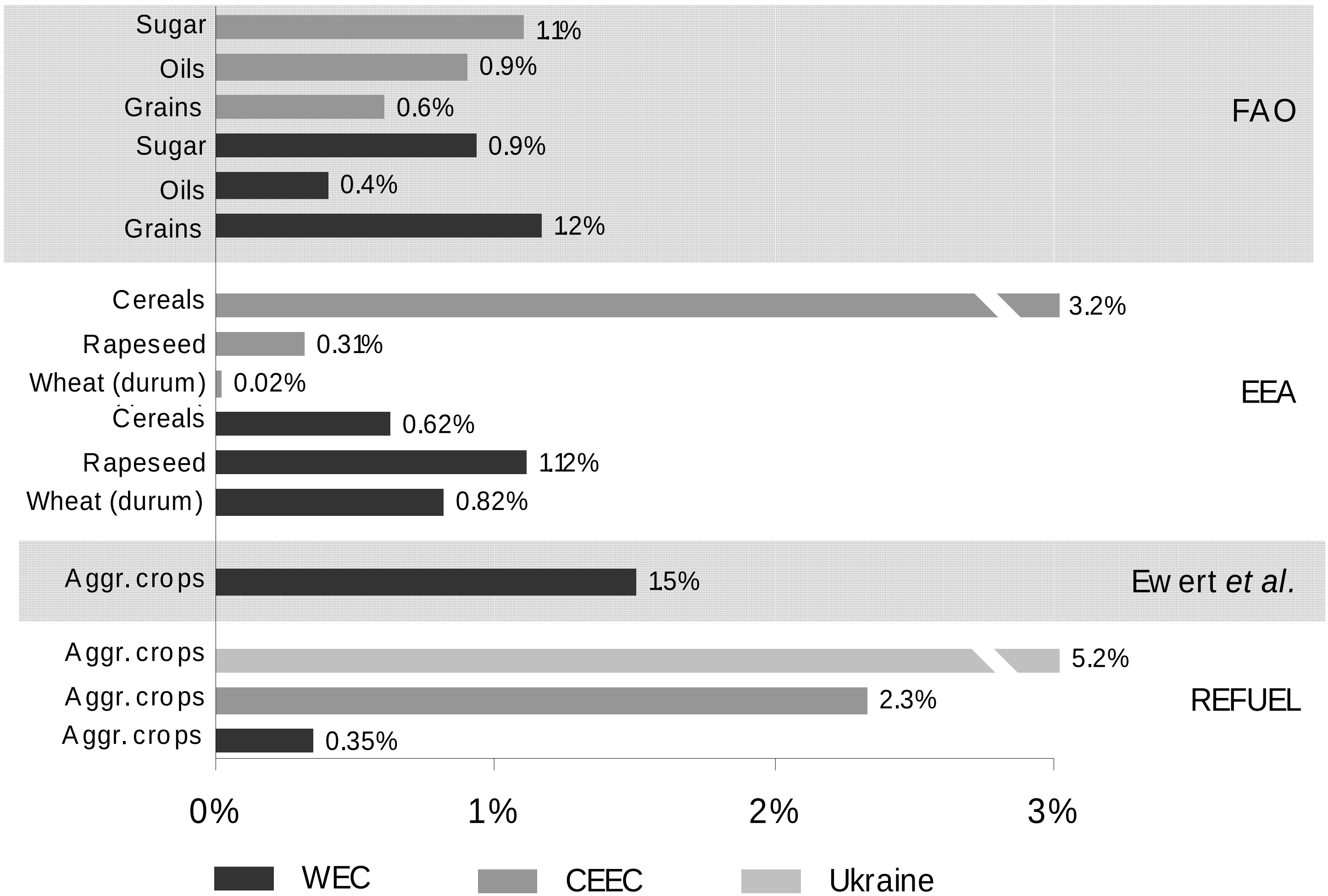
[Wit & Faaij, Biomass & Bioenergy, 2010]

Average annual yield growth rate projections for Europe for the period 2000-30 for four studies



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De Wit, et al., (forthcoming) 2010

Absolute productivity increases and relative growth rates for the period 1961-2007 and per decade.

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		Absolute 1961-2007 kg ha^{-1} y^{-2} kg animal^{-1} y^{-1}	Relative **1961-2007**	'61-'69	'70-'79 % y^{-1}	'80-'89	'90-'99	'00-'07
France	Wheat	104	**3.6**	5.2	2.5	2.5	1.6	-0.9
	Rapeseed	40	**2.5**	1.4	0.3	-0.3	2.1	1.2
	Sugarbeet	1024	**3.1**	3.6	0.2	2.4	1.0	2.8
	Cattle	2.8	**1.6**	0.5	1.2	0.9	-0.1	0.9
Netherlands	Wheat	110	**2.7**	0.7	3.8	1.4	0.5	-0.6
	Rapeseed	25	**1.0**	-0.6	-1.8	-0.1	0.6	0.2
	Sugarbeet	489	**1.2**	2.6	0.1	1.4	-1.9	2.5
	Cattle	1.1	**0.6**	0.7	0.9	2.1	-0.9	-1.0
Poland	Wheat	39	**1.8**	3.6	2.3	4.1	-0.6	1.6
	Rapeseed	21	**1.4**	1.7	0.4	-0.4	-0.6	4.0
	Sugarbeet	319	**1.2**	3.5	-0.5	2.6	1.0	3.7
	Cattle	2.5	**2.7**	3.6	6.1	4.9	0.6	10.1
Ukraine *(USSR)* [a]	Wheat	*n.a*	*n.a*	5.1	1.0	3.6	-4.5	-0.2
	Rapeseed	*n.a*	*n.a*	3.5	-2.7	-0.4	-7.4	9.4
	Sugarbeet	*n.a*	*n.a*	9.0	0.3	5.0	-3.2	11.3
	Cattle	*n.a*	*n.a*	6.3	2.1	2.1	-4.9	1.2

De Wit, et al., (forthcoming) 2010

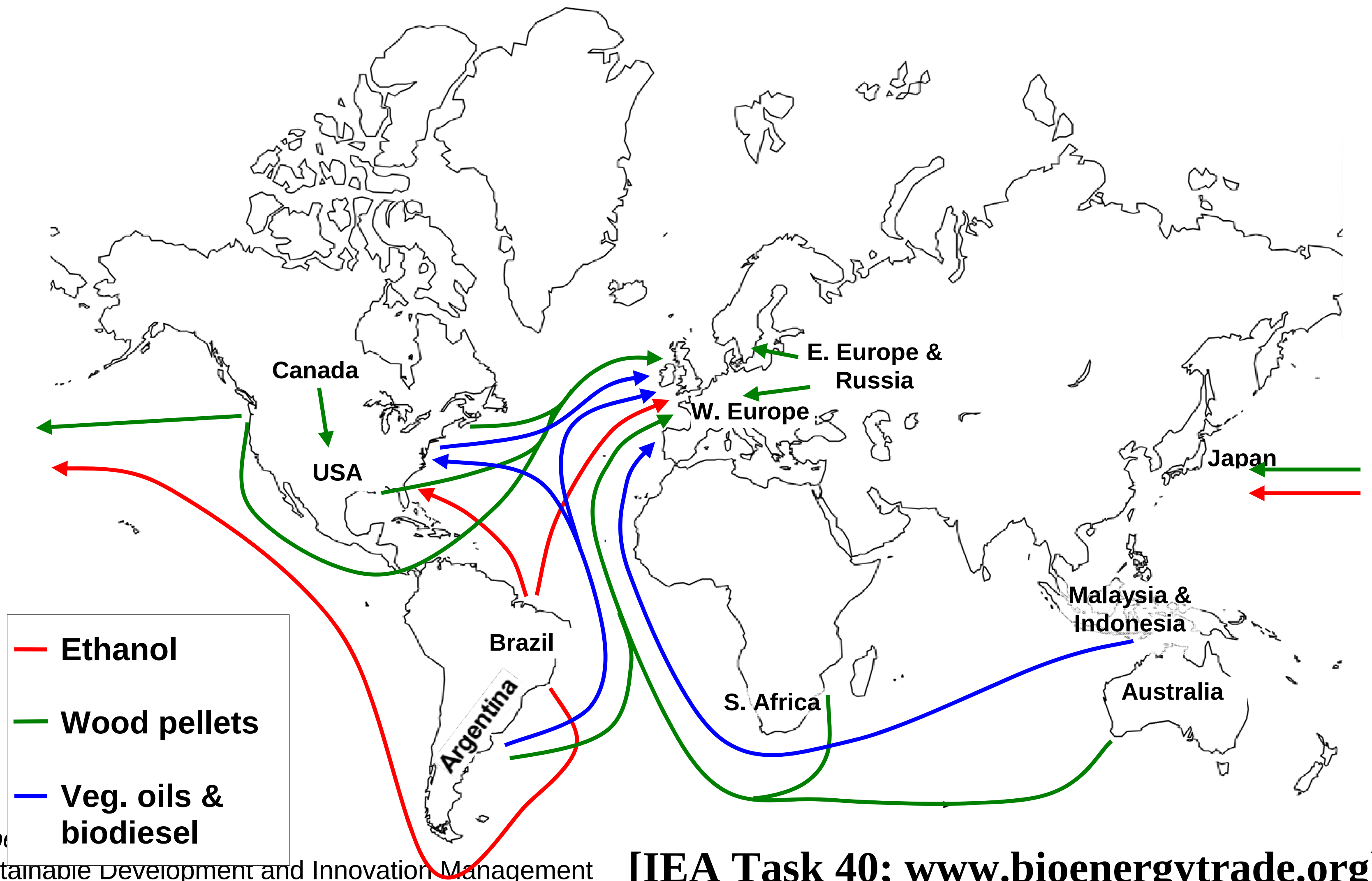
Selected remarks on yields

- Yield growth projections in WEC at 0.5-1.5% / yr, are modest when compared to historic developments between 1961-2007, but seems high compared to developments in the last two decades. Declining growth rates in the latter period, explained by an expansion in organic farming, set-aside obligations and a decoupling of production support. REFUEL projections (0.4% y-1) for the WEC seem conservative in this respect.

- Projected growth rates for the CEEC around 1% / yr – as projected by FAO (0.9% / yr) and EEA (1.2% / yr) – seem modest when compared to average growth figures between 1961 and 2007, even more so when compared to growth rates prior to 1990 and past 2000.

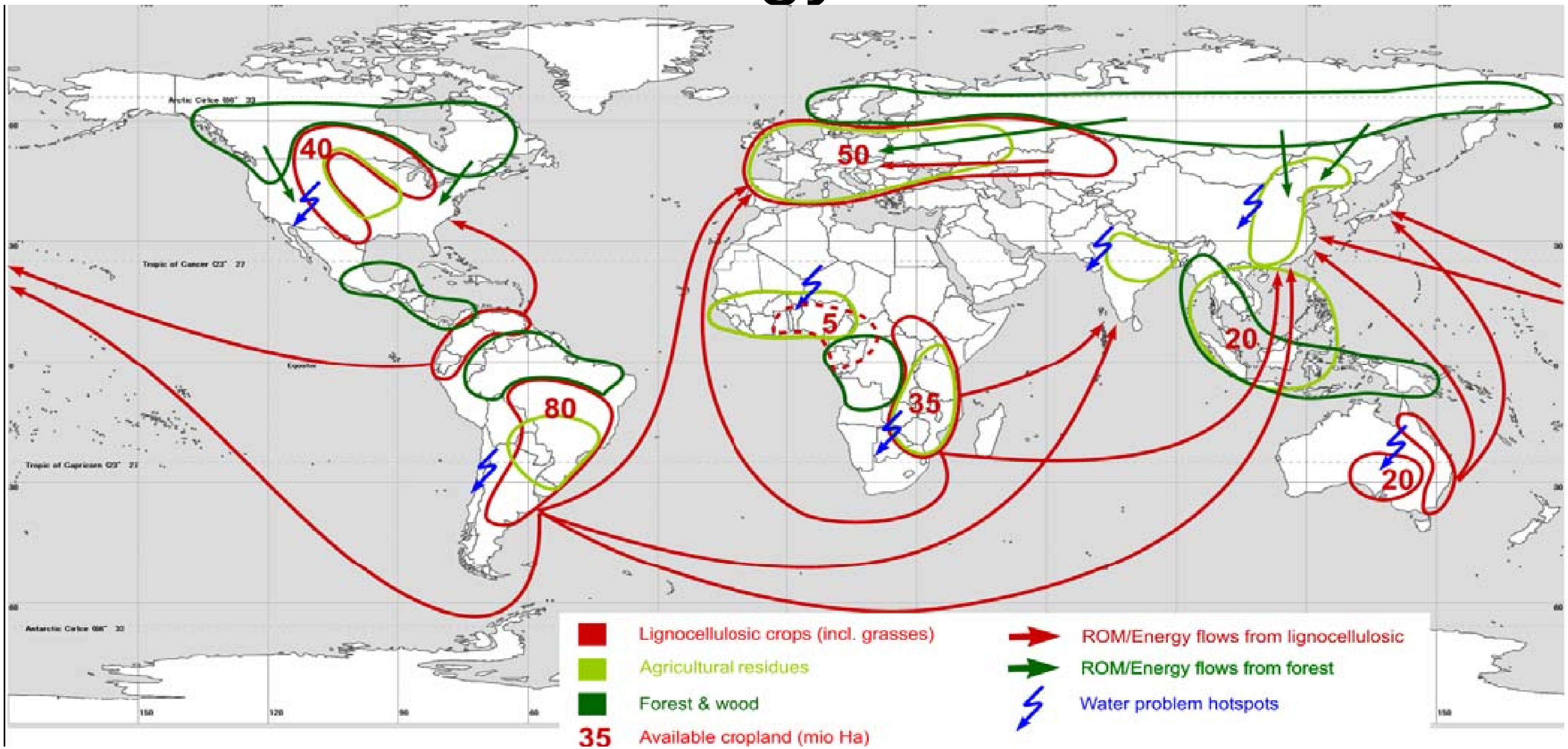
De Wit, et al., (forthcoming) 2010

Bioenergy is global business



[IEA Task 40; www.bioenergytrade.org]

A future vision on global bioenergy…



[GIRACT FFF Scenario project; Faaij, 2008]

Good news on criteria frameworks and frontline of debate:

- Debate has come to it’s senses a bit.
- Recognition that iLUC for biofuels alone is inconsistent: it is about management of land use.
- Spillover effect from biofuels (< 1% of land for food) to agriculture & livestock; COOL!!!.
- More attention for synergies (e.g.: Committee Corbey, Netherlands, 2010, GSB initiative, 2010)

Overview and comparison of initiatives to guarantee sustainability of bioenergy

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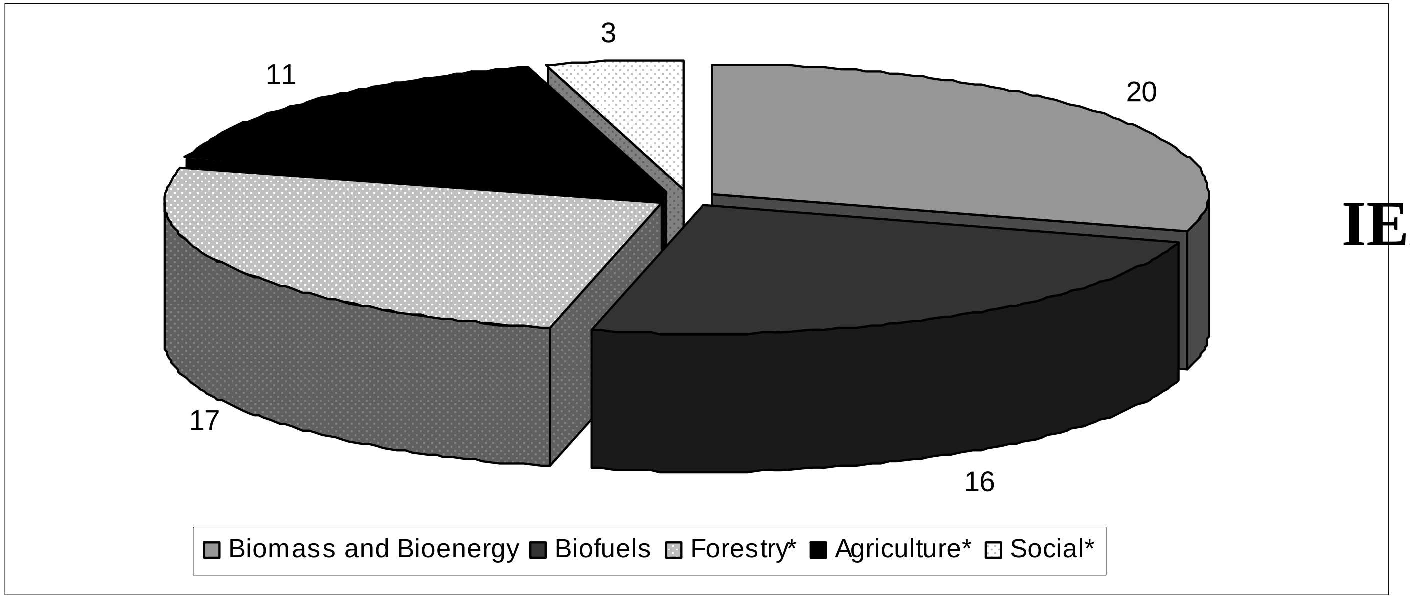
Preliminary results: 67 initiatives (regulation + systems) included

- **All relevant for (some) sustainability issues and/or**
- **Various parts of the bioenergy value chain**

Overview of amount of initiatives and certification systems included in review on biomass and bioenergy certification (*substantially more systems exist).



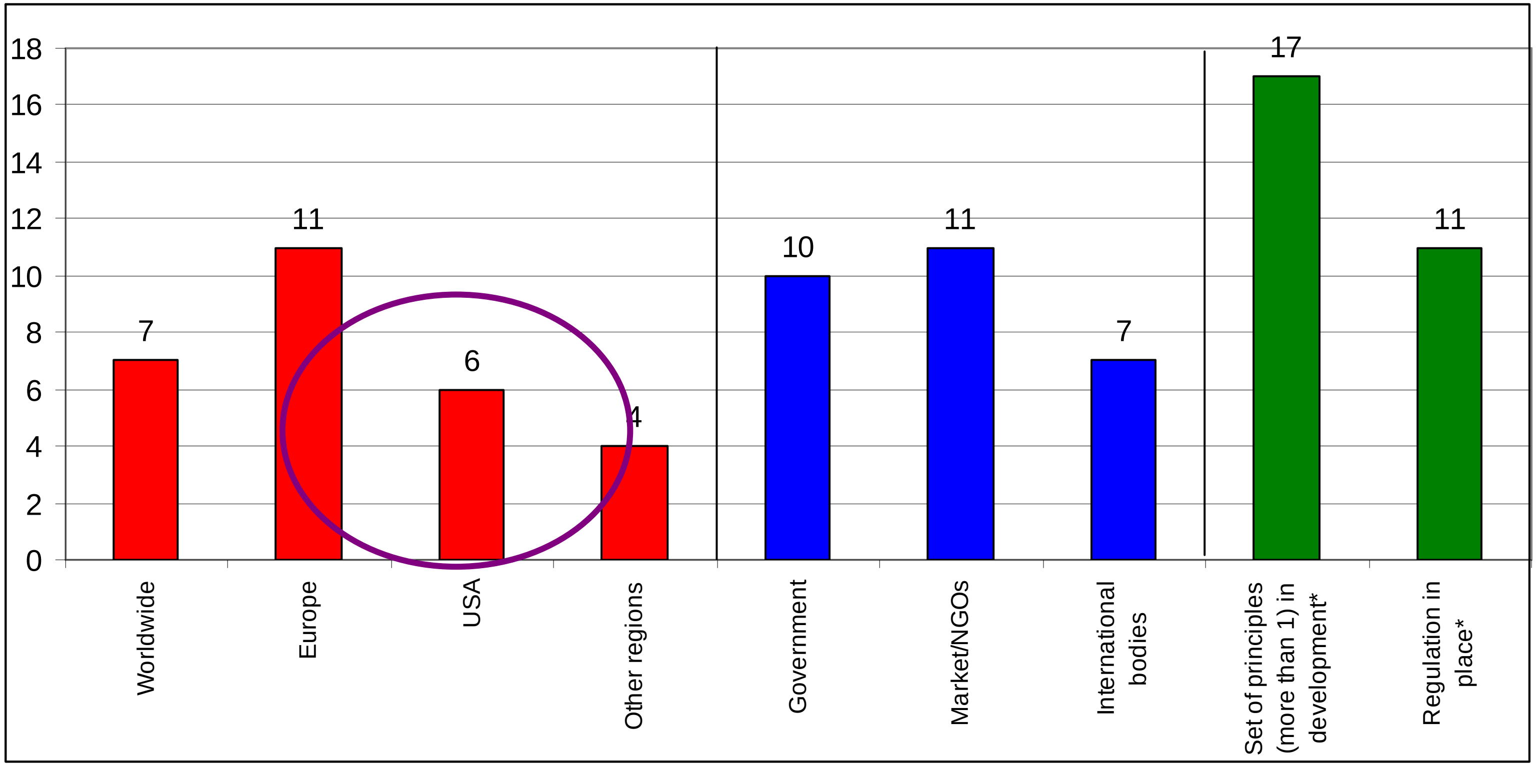
IEA Task 40

Dam et al., Renewable & Sustainable Energy Reviews, 2010

overview and comparison of sustainability certification schemes (2)

- **28 initiatives cover the sustainability of biofuels**
- **From which 17 are developing principles**

IEA Task 40



Dam et al., Renewable & Sustainable Energy Reviews, 2010

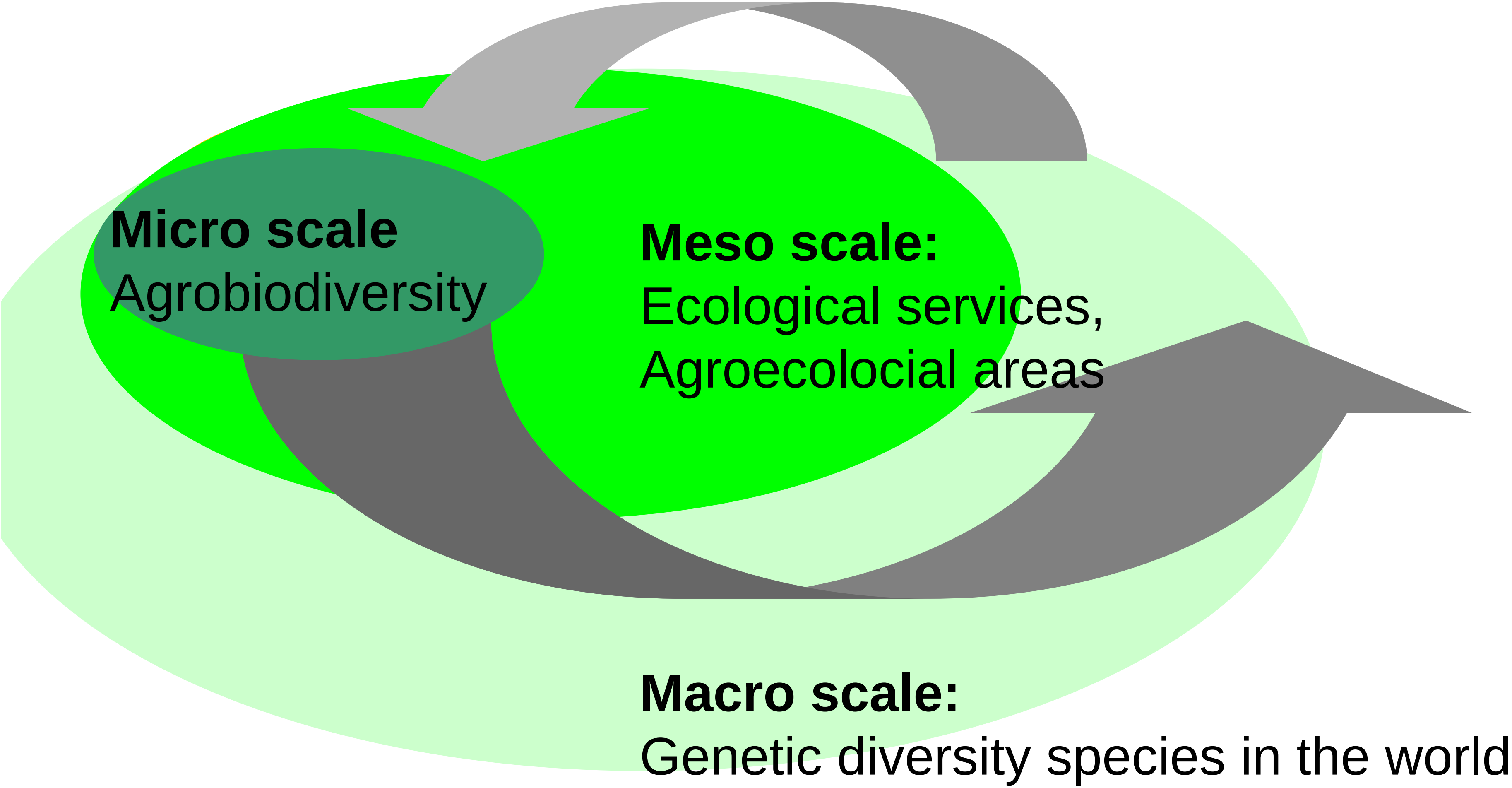
The bad news on frameworks:

- The overview of 67 initiatives shows that concerns in various parts of the world are focused on food security and on the socio-economic impacts of bioenergy production. Strikingly, these concerns are generally not included in the existing initiatives.
- The overview shows a strong proliferation of standards and, consequently, the risk for confusion in the market, abuse and "shopping" of standards.

Dam et al., Renewable & Sustainable Energy Reviews, 2010

Macro-meso-micro level

<u>Examples are: Impacts of </u>Biodiversity, water, socio-economic impacts…



Dam et al., Renewable & Sustainable Energy Reviews, 2010

Negative vision, ahead of IPCC- SRREN…

Low biomass scenario		
Largely follows A2 SRES scenario conditions, assuming limited policies, slow technological progress in both the energy sector and agriculture, profound differences in development remain between OECD and DC's.	High fossil fuel prices expected due to high demand and limited innovation, which pushes demand for biofuels for energy security perspective Increased biomass demand directly affects food markets	Increased biomass demand partly covered by residues and wastes, partly by annual crops. Total contribution of bioenergy about 100 EJ before 2050. Additional crop demand leads to significant iLUC effects and impacts on biodiversity. Overall increased food prices linked to high oil prices. Limited net GHG benefits. Socio-economic benefits sub-optimal.

[IPCC-SRREN, forthcoming 2011]

Positive vision (ahead of IPCC - SRREN…)

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Storyline	Key preconditions	Key impacts
High biomass scenario		
Largely follows A1/B1 SRES scenario conditions,	Assumes: well working sustainability frameworks and strong policies well developed bioenergy markets progressive technology development (biorefineries, new generation biofuels, successful deployment of degraded lands.	Energy price (notably oil) development is moderated due to strong increase supply of biomass and biofuels. Some 300 EJ of bioenergy delivered before 2050; 35% residues and wastes, 25% from marginal/degraded lands (500 Mha), 40% from arable and pasture lands 300 Mha). Conflicts between food and fuel largely avoided due to strong land-use planning and aligning of bioenergy production capacity with efficiency increases in agriculture and livestock management. Positive impacts with respect to soil quality and soil carbon, negative biodiversity impacts minimised due to diverse and mixed cropping systems.

[IPCC-SRREN, forthcoming 2011]

Some simple statements:

- Well possible to mess up the bioenergy option.
- But biobased economy needs to deliver to meet fundamental targets (climate, energy security, rural development, soils,…); biggest RE option, only real alternative for oil.
- And it is one of the few big ones that *can* be deployed with major economic benefits ("*it's an economic mess out there, stupid*").
- Skipping options is unacceptable strategy (popular with NGO's though).

Am I optimistic?

- This is not about ***optimism***, it is about ***necessity***; ***bioenergy is fully interlinked*** with rural development; (re)storing soil (C) and smart farming are essentials anyway; but nobody is paying!
- Climate change and energy security **cannot do without** bioenergy; 2^{nd} gen biofuels likely gamechanger as well as bio-CCS…
- Hard work ahead for science, policy and the market. Would be nice if they work together really.
- Get rid of iLUC; it is only a ***reactive*** concept while we should be ***pro-active*** via proper policies and analyses.
- Stable markets, stable markets, stable markets -> clear policy (carbon pricing, clear, long term targets, steady RDD&D efforts).

Thanks for your attention

For more information, see e.g:

www.bioenergytrade.org

And sciencedirect/scopus