

Sustainability criteria for bioenergy products derived from forest biomass

**2nd Symposium on forest biomass and processing residues for energy production, Q-WEB, April 22-23, 2008
Gatineau, Canada**

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Presentation overview

0. Global biomass potentials and trade – the bigger picture
1. Ratio and development of sustainability criteria for (woody) biomass for energy in Europe – relevance for Canada
2. The current situation: sustainability criteria for the production, trade and use of solid woody biomass
 - Co-firing of wood pellets in the Netherlands
 - Co-firing in wood pellets Belgium
3. Outlook: Sustainability criteria for liquid biofuels for transport (from lignocellulosic material)



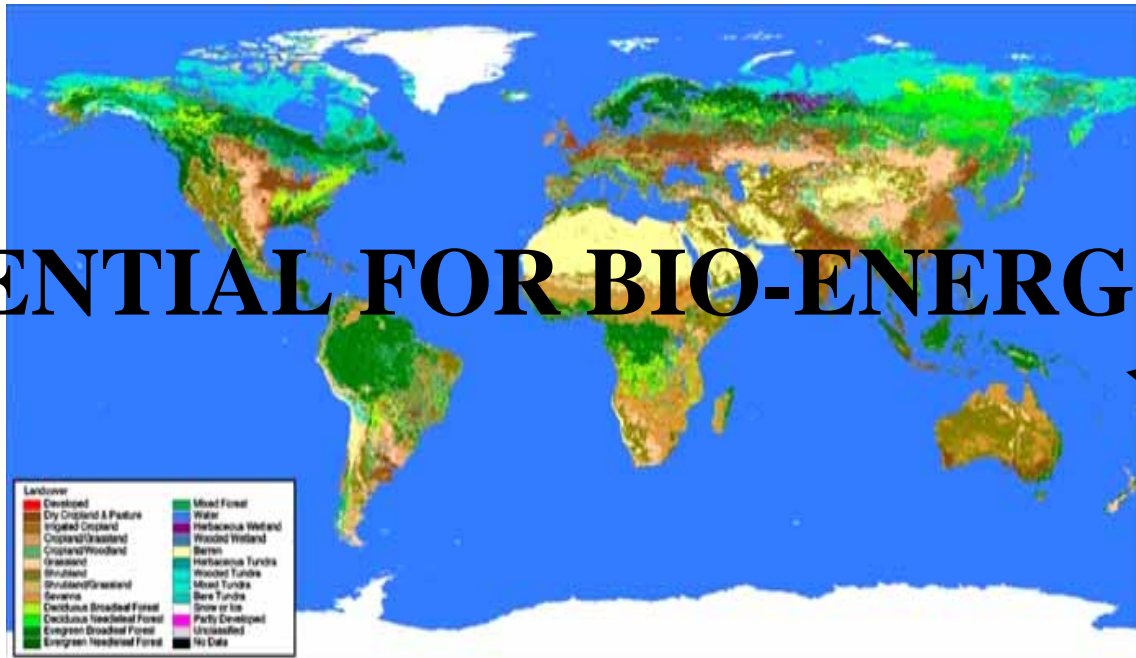
population

energy consumption

trade

biotechnology

future land use patterns



POTENTIAL FOR BIO-ENERGY?

GDP

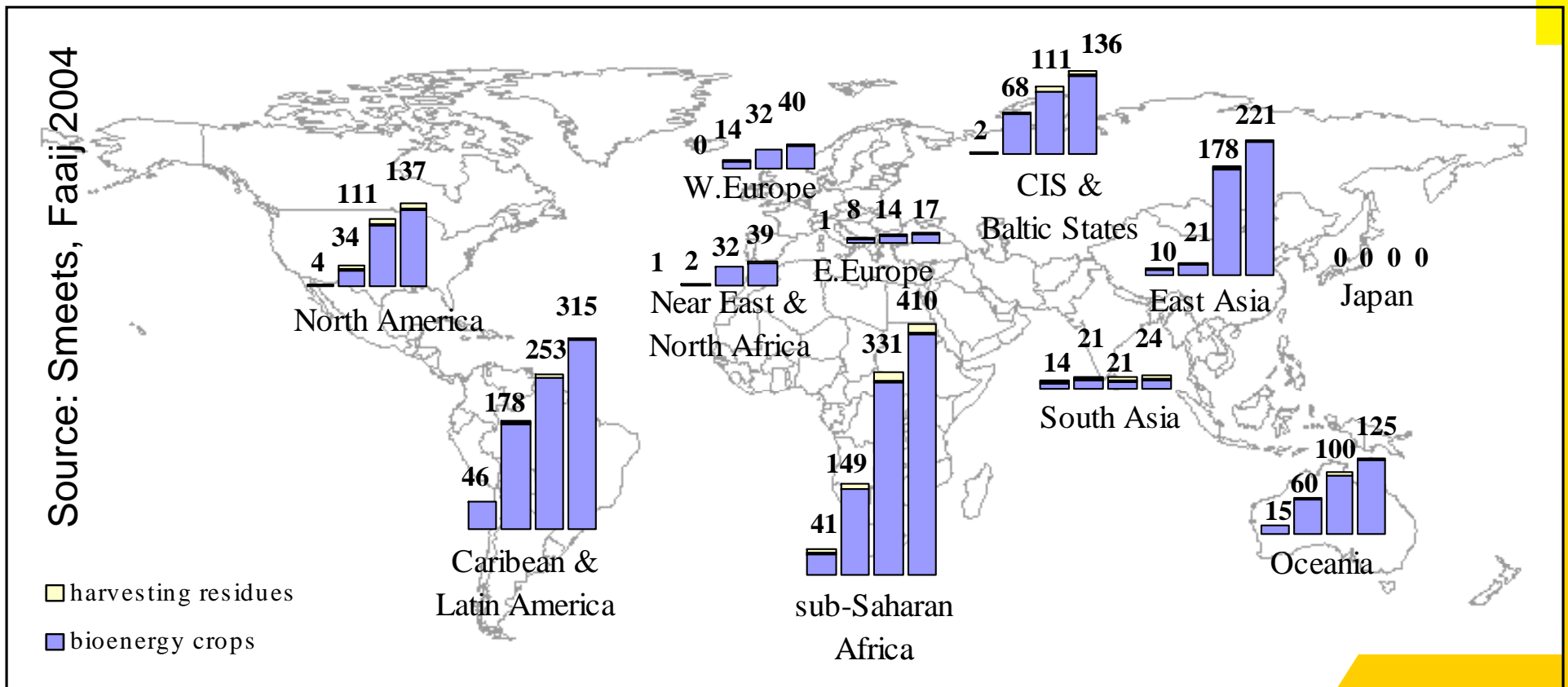
agricultural system
irrigation, breeding,
mechanization,
chemicals

land productivity

agricultural policy

Bioenergy production potential in 2050 in EJ for different levels of change in agricultural management

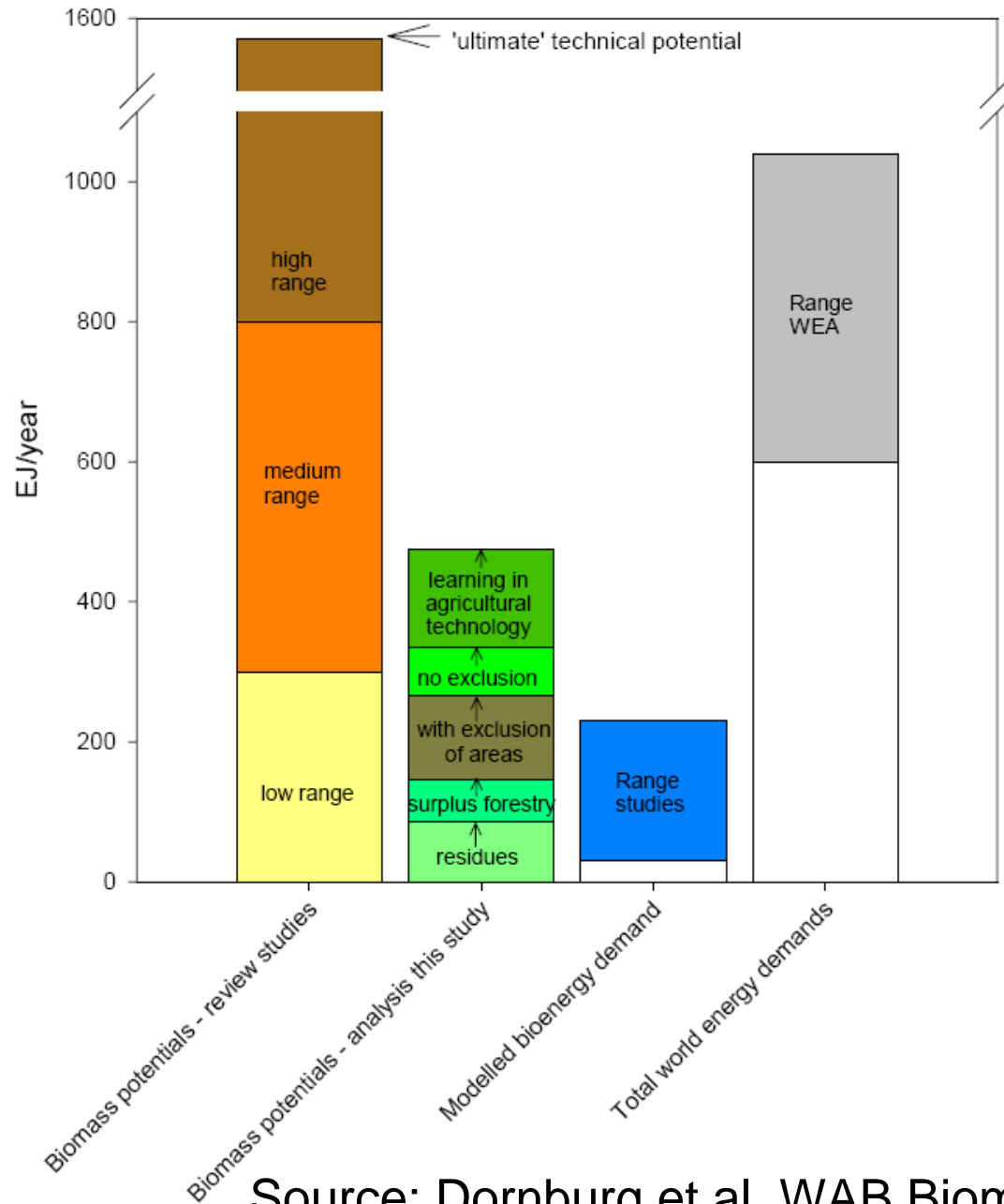
Global energy use 2007: 480 EJ, estimated energy use 2050 : 1200 EJ



Overall picture 2050

Biomass category	Main assumptions and remarks	Potential bio-energy supply up to 2050.
Agricultural land	Potential land surplus: 0-4 Gha (more average: 1-2 Gha).	0 – 700 EJ (average: 100 – 300 EJ)
Marginal lands.	On a global scale a maximum land surface of 1.7 Gha could be involved.	(0) 60 – 150 EJ
Residues agriculture	Estimates from various studies	15 – 70 EJ
Forest residues	Low value: figure for sustainable forest management. High value: technical potential. Figures include processing residues.	(0) 30 - 150 EJ
Dung	Use of dried dung. Low estimate based on global current use. High estimate: technical potential.	(0) 5 – 55 EJ
Organic wastes	Figures include the organic fraction of MSW and waste wood. Higher values possible by more intensive use of bio-materials.	5 – 50 (+) EJ
Total	Most pessimistic scenario: no land available for energy farming; only utilisation of residues. Most optimistic scenario: intensive agriculture concentrated on the better quality soils.	40 – 1100 EJ (250 - 500 EJ)



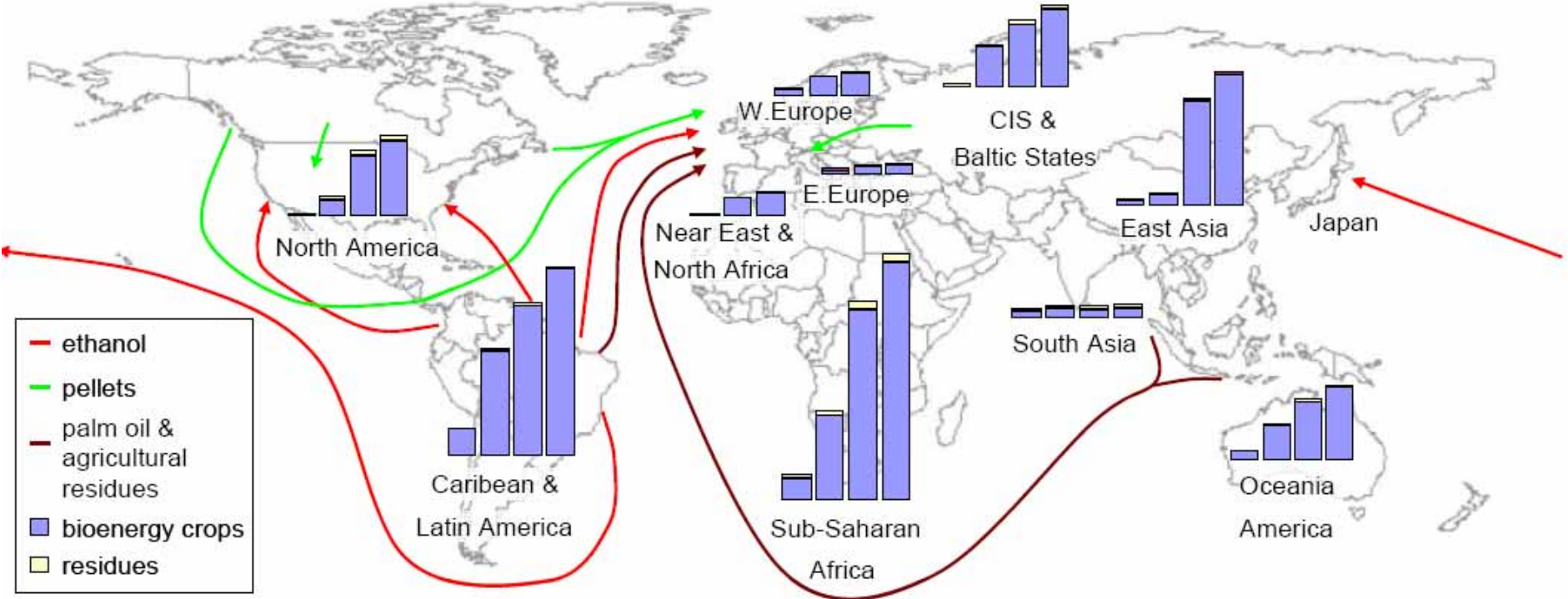


Biomass potentials by 2050

Source: Dornburg et al, WAB Biomass assessment, 2008



Bioenergy trade –going global



Source: adapted from IEA (2007); more info on trade:

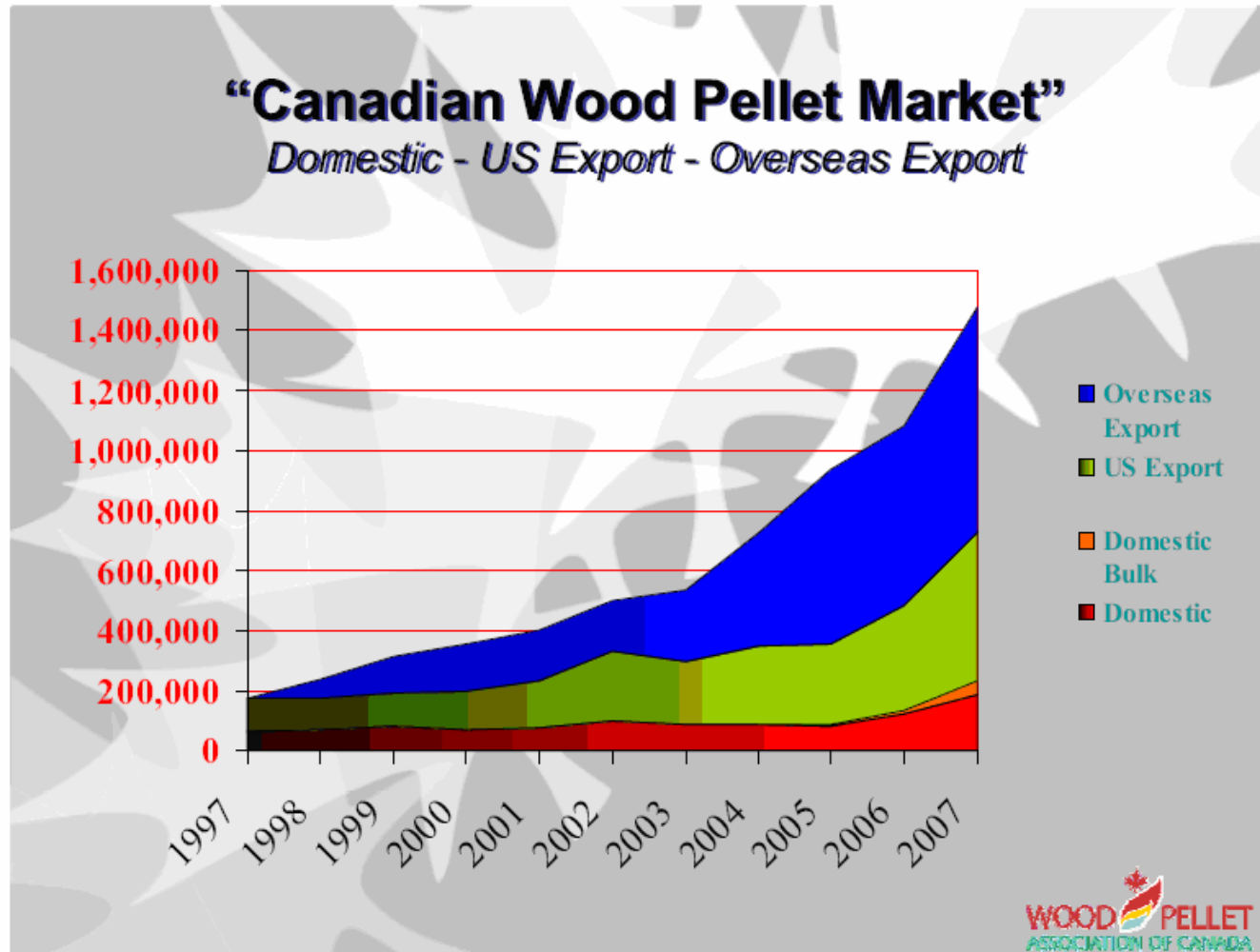
IEA Bioenergy Task 40 - Sustainable International Bioenergy Trade

Why sustainability criteria?

1. Biomass use for energy went from residues to energy crops and from local to global use
=> CO₂ neutral character of biomass no-longer self-evident
 2. Use of (food) crops for energy purposes (especially transportation fuels) has been subject to heavy criticism because of competition with food, additional necessity of land (and thus claimed deforestation of the rain forest), loss of biodiversity, environmental impacts, social impacts
- => Call for additional measures to ensure sustainable production and use of biomass by, NGO's policy makers but also by industrial parties



Wood pellet exports from Canada

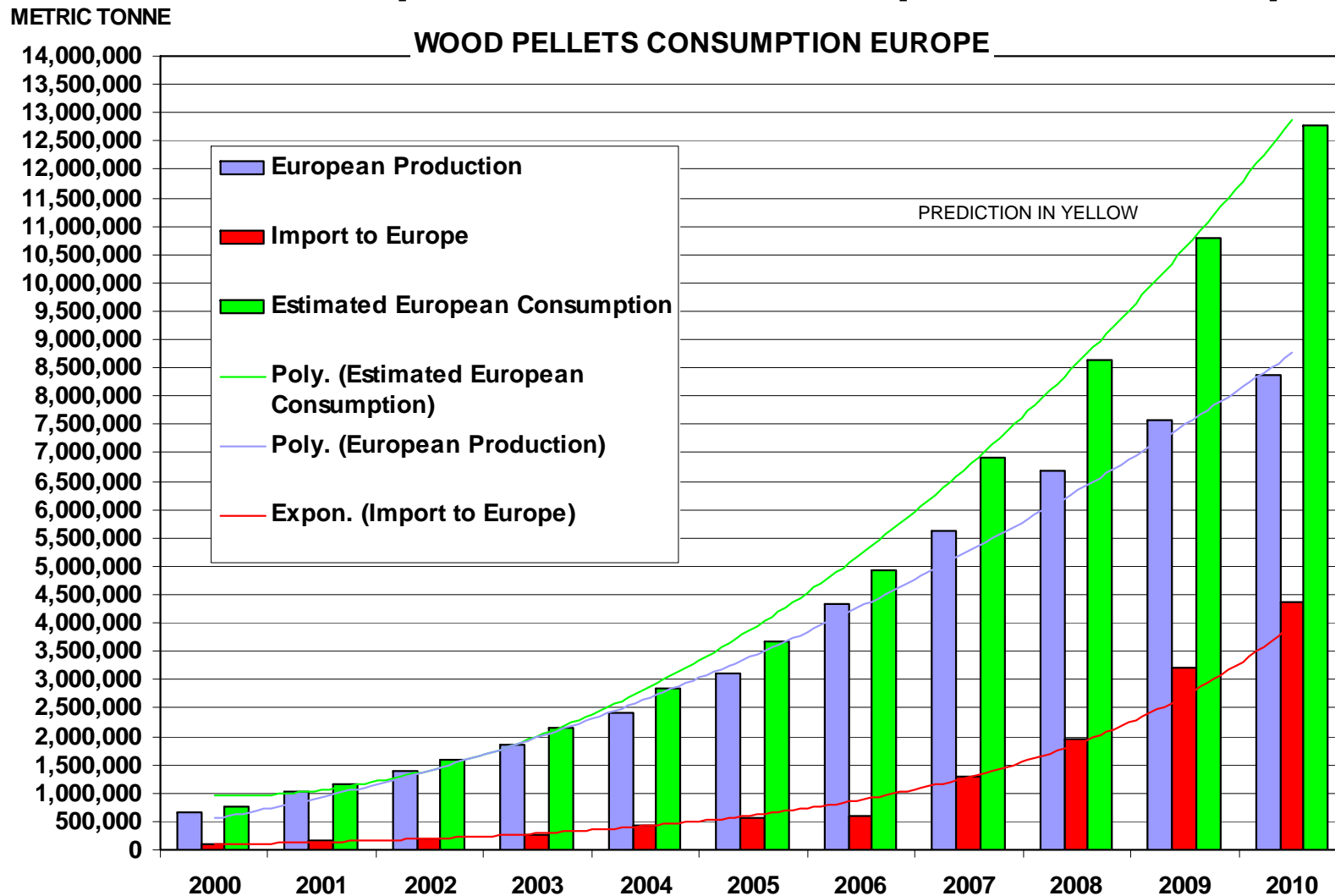


Total prod.:
1.5 Mtons in
2007

Exports to:
Sweden,
Netherlands,
Belgium...

Production &
Exports
expected to
double in 5
years

Wood pellet consumption Europe



Source: S. Melin, Wood Pellets Association Canada, August 2006



Wood pellet imports in Europe

Total Canadian exports to Europe ca. 600 ktonnes in 2006
(@ 120 €/tonne CIF ARA -> ca. 140 million Can\$ market volume)

Country	Total imports in 2006 (ktonnes)	Imports from Canada (ktonnes)
Sweden	445	130
Belgium	600 (2005) >600? (2006)	substantial
Netherlands	455	substantial

Sources: J. Swaan, IEA task 40 country reports, www.bioenergytrade.org



Sustainability criteria for bioenergy

Developments in the Netherlands

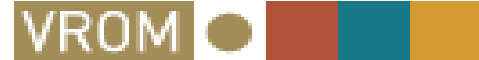
- Establishment of a project group 'Sustainable production of biomass' beginning of 2006
- *Assignment:* Formulation of testable criteria which can be applied in policy instruments for biofuels and electricity production
- Consultation of stakeholders to ensure public support
- Specific working groups for further development of indicators



Main stakeholders involved



Ministerie van Economische Zaken



Ministerie van
Buitenlandse Zaken



Natuur
en
Milieu



Rabobank



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Sustainable Development Mark Innovation Center SenterNovem



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Points of departure

Set of criteria is a universal framework:

- Universal, generic framework of criteria, applicable to all biomass and countries
- No discrimination between biomass produced in the Netherlands and imported biomass
- Connection with international initiatives and WTO regulations
- Exception for residual flows with a negligible economic value



Points of departure (2)

- Set of criteria is manageable, verifiable and enforceable:
- Certification of biomass is needed
- Testing must be manageable. Only necessary information will be asked for
- Minimum requirements for 2007, including incentives for higher future performances
- Testable indicators lacking? Reporting proposed



Selection of themes

- Greenhouse gas balance
- Competition with food, local energy supply, medicines and construction materials
- Biodiversity
- Environment
- Economic prosperity
- Well-being



Criteria and Indicators (1)

THEME	CRITERIA	INDICATORS & REPORTS
Greenhouse gas emissions	Net reduction over the chain, fossil reference	Reduction > 30% biofuels > 70% electricity
Competition food and local biomass applications	No threatening of food supply	Price information Information on land use
Biodiversity	No deterioration of protected areas or valuable ecosystems	No biomass production in protected areas Reporting obligation on a management plan for active protection local ecosystem



Criteria and Indicators (2)

THEME

CRITERIA

INDICATORS & REPORTS

Environment

Soil, water and air quality are maintained or improved

a.o. Application of Best Practices, no use of water not renewable sources

Economic Prosperity

Biomass production contributes to local and national prosperity

Report based on GRI indicators

Well being

Working conditions of workers and local population

a.o. comply with Social Accountability 8000

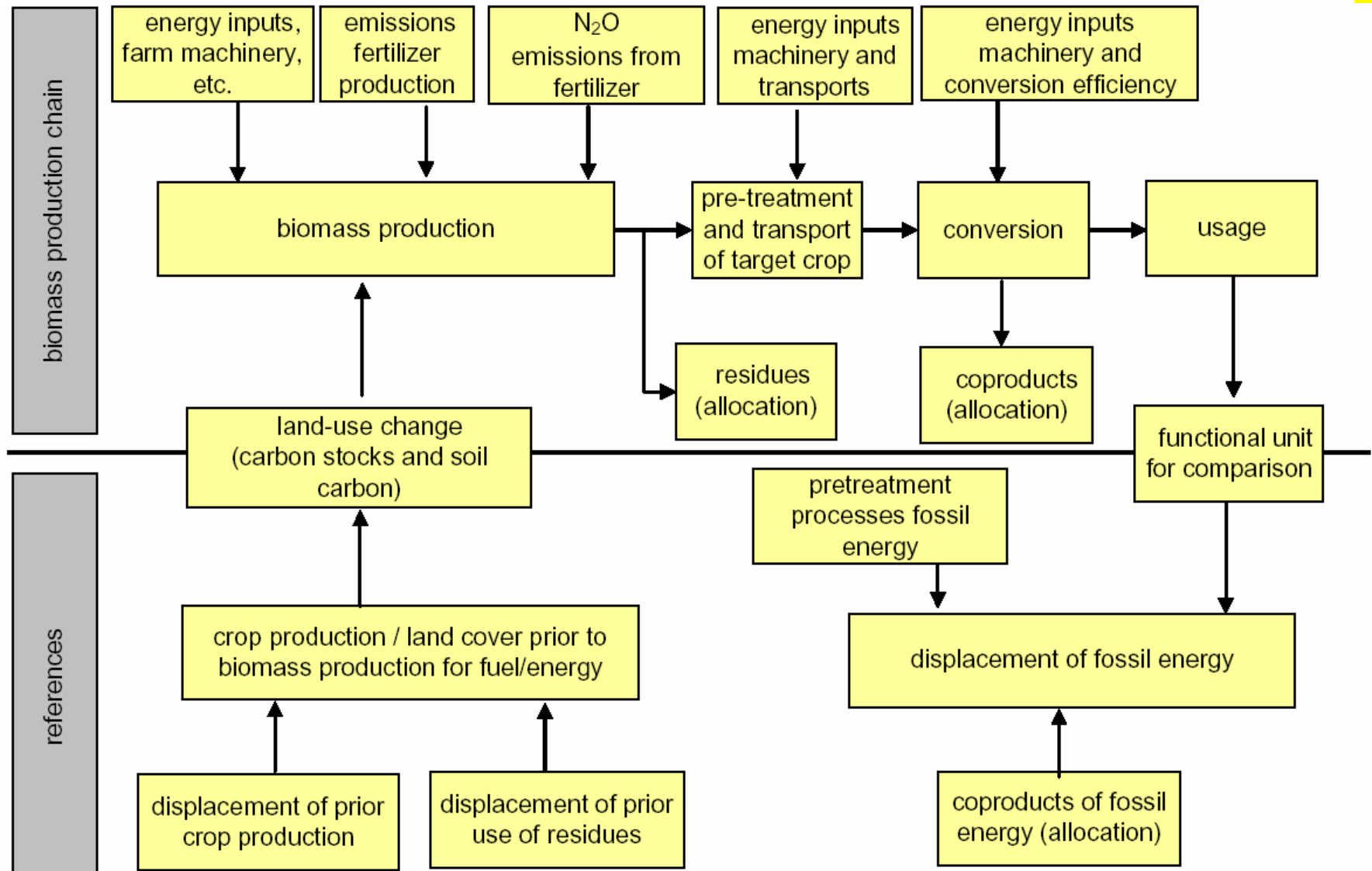


Minimum criteria

- Comply with present international obligations and local jurisdiction, in addition to other specific indicators. Obligatory reports when indicators are lacking.
- 2011: Indicators are developed on the basis of the obligatory reports of the first period.

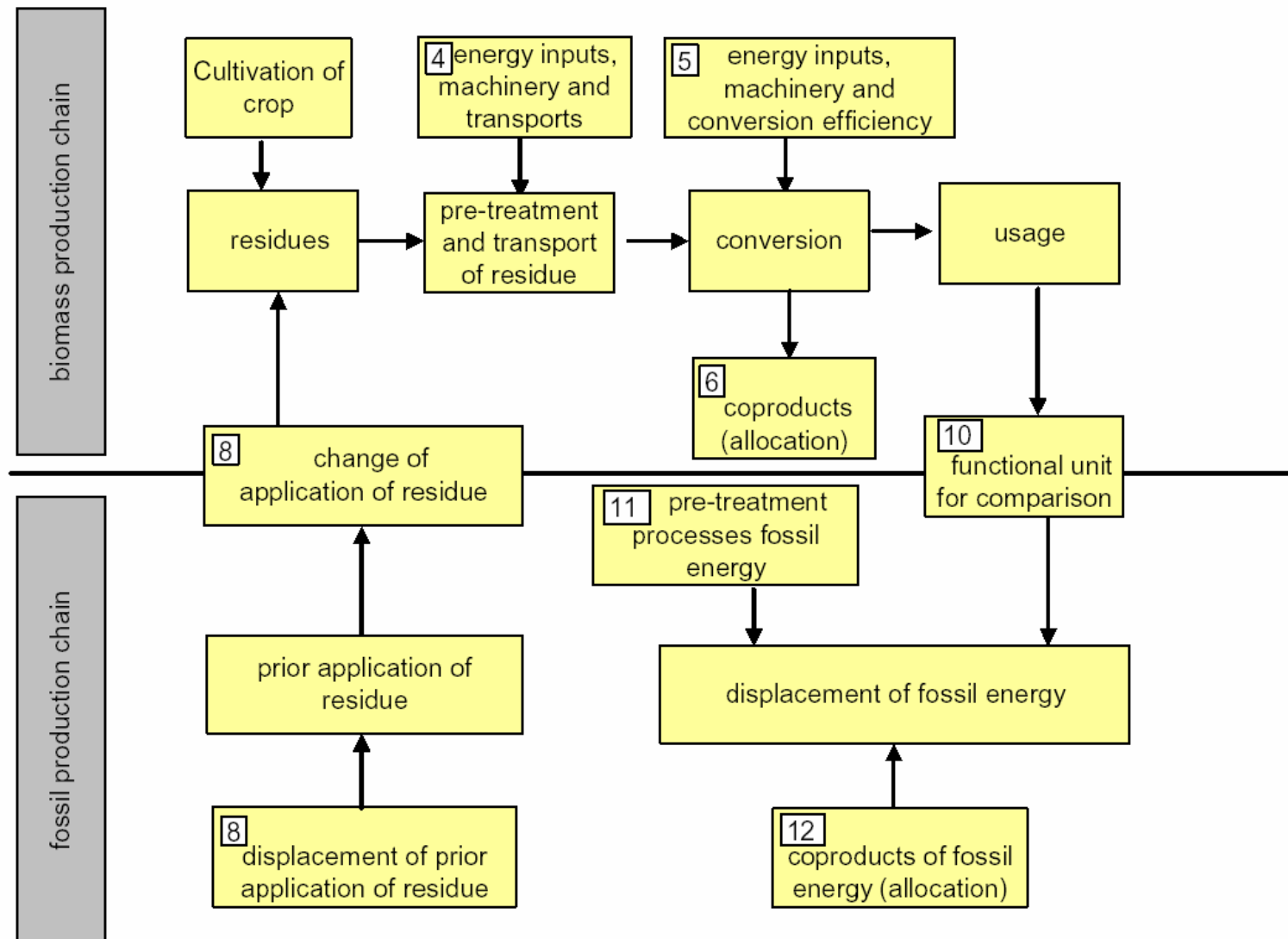


Greenhouse balance calc. methodology for energy crops



Source: The greenhouse gas calculation methodology for biomass-based electricity, heat and fuels, SenterNovem, 2007

Greenhouse balance calc. methodology for residues



Source: The greenhouse gas calculation methodology for biomass-based electricity, heat and fuels, SenterNovem, 2007

Compatibility with other certification systems

- Aim of framework to keep as much as possible in line with existing systems
- comparison between these the certification systems involved and the Dutch testing framework can lead to a declaration of equivalence.
- GHG so far included in none of the existing certification systems, always additional test required



Compatibility with other certification systems

CRAMER CRITERIA	SAN/RA:	RSPO	RTRS Basel	EUREPGAP	FSC:	SA 8000	IFOAM
1 Greenhouse gas balance							
1a Net emission reduction compared with fossil reference, inclusive of application, is at least 30%. Here a strong differentiation of policy instruments is assumed, in which for instance a better performance would lead to more financial support.	N	N	N	N	N	N	N
2. Competition with food, local power supply, medicines and building materials							
2a Insight into the availability of biomass for food, local energy supply, building materials or medicines.	N	N	N	N	N	N	N
3.1 Biodiversity The installation of biomass production units will not be at the expense of protected or vulnerable biodiversity							
3a No deterioration due to biomass production of biodiversity in protected areas.	Y	Y	Y	N	Y	N	Y
3b No deterioration of biodiversity by biomass production in other areas with high biodiversity value or vulnerability.	Y	Y	Y	N	Y	N	N
3c No installation of biomass production units in regions where biodiversity has recently been decreased due to conversion.	N	Y	Y	N	Y	N	P
3.2 Biodiversity: The management of biomass production units will contribute towards the conservation or strengthening of biodiversity							
3.2a Concrete contribution towards the maintenance or recovery of biodiversity at or around biomass production units in natural	P	N	P	P	Y	N	P
4. Prosperity							
4A Insight into possible negative effects on the regional and national economy.	P	P	P	N	P	N	N
5 Social well-being No negative effects on the well-being of the employees and local population, taking into account:							
5a Working conditions of employees	Y	P	Y	P	P	Y	P
5b Human Rights	Y	P	P	N	P	Y	P
5c Property rights and rights of use	P	Y	Y	N	Y	N	P
5d Insight into the social circumstances of local population	Y	Y	Y	N	Y	P	N
5e Integrity	N	N	N	N	N	N	N
6.1 Environment: In the production and processing of biomass, the soil, and the soil quality must be retained or even improved.							
6.1 a In the production and processing of biomass best practices must be applied to retain or improve the soil and soil quality.	Y	Y	Y	P	P	N	Y
6.1 b In the production of biomass crop residues are used for multiple purposes	P	P	N	N	N	N	P
6.2 Environment: In the production and processing of biomass ground and surface water must not be depleted and the water quality must be maintained or improved.							
6.2 a In the production and processing of biomass best practices must be applied to restrict the use of water and to retain or improve ground and surface water quality.	Y	Y	Y	P	P	N	P
6.2.b In the production and processing of biomass no use must be made of water from non-renewable sources.	Y	Y	Y	P	N	N	Y
7. Legislation: Biomass production will take place in accordance with relevant national laws and regulations and international treaties.							
7a No violation of national laws and regulations that are applicable to biomass production and the production area.	Y	Y	Y	Y	Y	Y	N
7b No infringement of relevant international treaties	Y	Y	P	N	Y	Y	P

Compatibility with other certification systems

A number of forestry production standards have been identified:

- Forest Stewardship Council (FSC)
- Programme for the Endorsement of Forest Certification Schemes (PEFC)
- Canadian Standard Association (CSA)
- Sustainable Forestry Initiative (SFI)
- Malaysian Timber Certification Council (MTCC)
- American Tree Farm System (ATFS)
- Green Gold Label system forest source criteria (GGLS5)

But so far, none have been declared equivalent of (parts of) the Cramer framework...

Industry certification activities

- Essent is by far the largest wood pellet consumer in the Netherlands -> Initiator of the Green Gold Label -> fully independent board within a few months
- Green Gold Label quality system (GGL) aims at a track and trace system for biomass from (by-) products from the power plant (and its green power it produces) back to the sustainable source.
- Mixing or contamination with non-intrinsic or environmentally harmful materials is prohibited.
- Approved Forest Management Certification Systems: are FSC, PEFC, SFI, CSA-SFM, FFCS



Criteria at Macro-level

- Indirect effects, e.g. prices of land and food, GHG emission due to induced land-use changes (e.g. deforestation), loss of biodiversity etc. cannot be linked to a single plantation
- Monitoring of (indirect) land use change is needed, at macro-level
- Primary responsibility of Dutch government, (preferably coordinated in EU context) to start the dialogue with producing countries, aiming at responsible land-use planning



Status & follow-up activities 2008+

- Framework report published in February 2007 and presented to the Dutch government
- Concerns regarding conflicting social criteria with WTO rules
- Publication of EC draft directive for biofuels for transport
- Currently: sustainability reporting obligation mandatory to receive feed-in tariff of € 62/MWh_e (ca. 100 Can\$/MWh_e) for solid woody biomass for co-firing
- Pilot projects of international sustainable supply chains in coming years
- Research to further underpin indicators
- Supporting the private sector in starting the certification



process

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Sustainability criteria for bioenergy

Developments in Belgium (Flanders and Wallonia)

Flanders :

- obligation $3,75\% \times 50\text{TWh} = 1,875 \text{ TWh}$,
1GC=125 €
- green certificates granted according to energy balance of supply chain and reference
NGCC

$$\#GC = \text{net } MWh_{el} - \text{electricity use} - \text{fossil } MWh_p * 55\%$$

Source: Y. Ryckmans, Laborelec/Electrabel, March 2008



Wallonia:

- obligation 7,00% x 23,5 TWh=1,65 TWh, 1GC=100€
- green certificates granted according to proven sustainability,

CO₂ balance of supply chain and reference NGCC

- All fuels have reference CO₂ emission according to LCA

▪ Natural gas	= 251	kg CO ₂ /MWh _p
▪ Coal	= 396	kg CO ₂ /MWh _p
▪ Wood pellets	= 55	kg CO ₂ /MWh _p

$$\# GC = \left(1 - \frac{55}{251} * \frac{55\%}{34\%} = 0,65 \right) * MWh_{el}$$

Source: Y. Ryckmans, Laborelec/Electrabel, March 2008



Evolution of legislation in Flanders from June 2007

- The acceptance of each additional supplier requests the results of the certification procedure of Laborelec: **certification documents must be issued before first use**
- **From May 2007 on primary energy for transport is subtracted at 55% from the net green power instead of 100%**
- For new projects, green certificates are only granted for wood that is not used by classical wood industry (woodboard, paper) in Flanders **but short rotation wood (cycle < 8 years) is always accepted**
- After heavy discussions:
 - a power level limitation at 20 MW_{el} has **not** been set up
 - energy from biomass used for drying is **not** subtracted from net green power
 - energy from CO₂-neutral fuels (bio-diesel) is subtracted at reduced level

Source: Y. Ryckmans, Laborelec/Electrabel, March 2008



Evolution of legislation in Wallonia

- Cogeneration brings additional green certificates: up to doubled
- Certification documents must be issued before first use
- Independent report on regional forest management is requested
- No limitation on firing wood but for cultivated wood specific CO₂ factor is expected to be higher
- Real data by supplier should be considered with calculated CO₂ factor for the specific supply chain: this is still not decided and arbitrary CO₂ coefficients are applied (like 55 kg CO₂/MWh_p for imported wood pellets), except if the calculation leads to a worse result
- a power level limitation at 20 MW_{el} for new biomass project has been introduced (grant limited to the first slice of 20 MW)
- energy from biomass used for drying does not lead to a penalty (but use of peat lead to a penalty)



Laborelec Sustainability Certification

Procedure : designed by Laborelec & SGS

1) S1: Supplier Declaration

- concerns origin of raw material, technical specs and energy use
- signed by supplier
- checked on site by inspection company

2) S2: International Transport Declaration

- number of days of sea and distance
- energy use of sea/river vessels

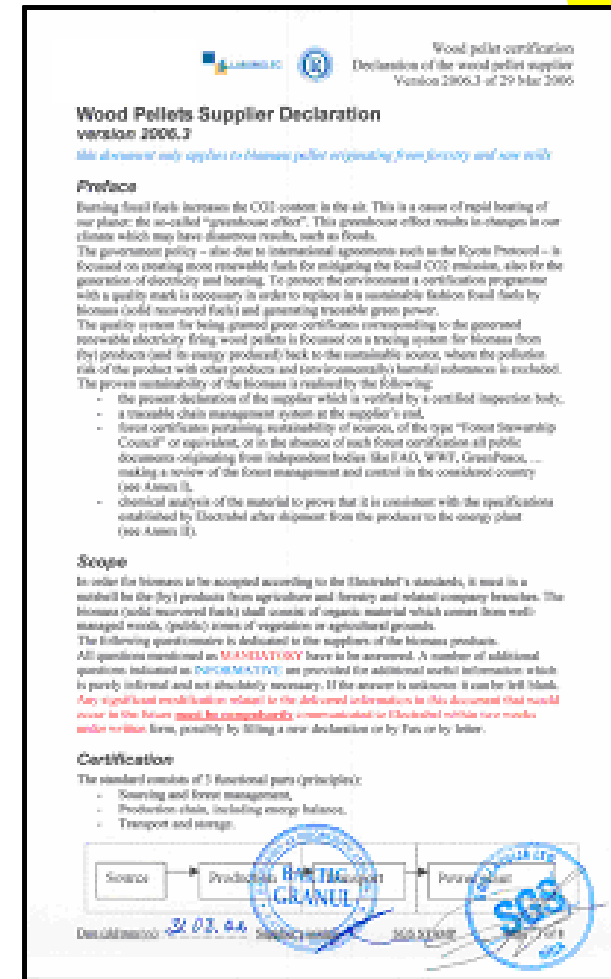
3) S3: Overview of energy balance

4) Inspectorate prepares an audit report:

Verified by 

S4:

- list of critical points to check
- suggested methodologies for evaluation of internal energy use



S1: Traceability and origin of raw material

□ Origin of raw material:

- **country, region of origin**
 - **forests or agriculture**
 - **intermediate industry**
- legislation & policy

□ Status of raw material:

- **primary product**
 - **secondary product (saw dust, fatty acids)**
 - **biomass-waste (coffee ground, sewage sludge)**
- influences permit
- determines starting point for energy balance

In the case of woody biomass:

- Residues originating from saw mills
 - saw dust
 - shavings
 - others, specify
- Sanitary cuttings of forests
 - hard wood
 - soft wood
- Treated wood (with traces of paint, varnish, preservatives, MDF, woodboards, etc.)
- Timber wood
- Woody short rotation coppices¹
- Others, specify

Average percentage of bark in mass:%

In the case of non woody agricultural resources:

- Energy crops (plants grown only for energy purposes)
 - Cereals primary products (wheat, maize, etc.)
 - Cereals by-products (like wheatbran)
 - Other (non-cereal) agricultural residues (cassava, olive cake, rice husk, coffee husk, grape powder, etc.)
 - Vegetal oils
 - refined
 - crude
 - by-product (like fatty acids)
 - Dry Distillated Grain & Solubs (secondary products bio-ethanol production)
 - Others, specify
-



S1: Energy use for production

<p>MANDATORY: ELECTRICITY Give the best estimation and origin of the total electricity consumption of the production plant per metric ton of delivered biomass</p> <p>E = kWh/ton⁽¹⁾</p>	<input type="checkbox"/> from network <input type="checkbox"/> cogeneration plant <input type="checkbox"/> wind farm <input type="checkbox"/> other (specify)	_____ % _____ % _____ % _____ % _____ %
<p>MANDATORY: FOSSIL PRIMARY ENERGY Best estimation of fossil primary energy consumption of the production plant per metric ton of delivered biomass (for drying, cooling, ...).</p> <p>TOTAL FOSSIL :PF= kWh/ton</p>	<input type="checkbox"/> natural gas firing <input type="checkbox"/> industrial gas firing <input type="checkbox"/> diesel oil firing <input type="checkbox"/> propane firing <input type="checkbox"/> <u>waste heat fossil boiler</u> <input type="checkbox"/>	_____ , _ kWh/ton ⁽²⁾ _____ , _ kWh/ton ⁽²⁾ _____ , _ kWh/ton ⁽²⁾ _____ , _ kWh/ton ⁽²⁾ _____ , _ kWh/ton ⁽²⁾ _____ , _ kWh/ton ⁽²⁾
<p>MANDATORY: NON FOSSIL PRIMARY ENERGY Best estimation of non fossil primary energy consumption of the production plant per metric ton of delivered biomass (for drying, cooling, ...).</p> <p>TOTAL NON FOSSIL :PB= kWh/ton⁽²⁾</p>	<input type="checkbox"/> biomass <u>pellets</u> firing <input type="checkbox"/> biomass <u>residues</u> firing <input type="checkbox"/> <u>waste heat biomass boiler</u> <input type="checkbox"/> other (specify)	_____ , _ kWh/ton ⁽²⁾ _____ , _ kWh/ton ⁽²⁾ _____ , _ kWh/ton ⁽²⁾ _____ , _ kWh/ton ⁽²⁾

⁽¹⁾estimation can be made according to yearly consumption of the plant in kWh divided by the plant capacity in tons of delivered biomass per year.

⁽²⁾estimation can be made according to yearly consumed mass of fuel, multiplied by specific average low heating value and divided by the plant capacity in tons of biomass per year.



S3: Energy use of biomass supply

Transport of raw material:	<ul style="list-style-type: none">– Avg. distance– Max. distance
Pelleting:	<ul style="list-style-type: none">– Electricity/ton pellets
Drying:	<ul style="list-style-type: none">– Fossil/ton pellets– Biomass/ton pellets
Transport of pellets:	<ul style="list-style-type: none">– Distance to harbour– Truck or train
Sea/River transport:	<ul style="list-style-type: none">– Capacity in tons– Distance in miles– Number of days of sea– Consumption/sea day
Flatboat from ARAG:	<ul style="list-style-type: none">– Avg. diesel use



Typical GHG performances of Canadian wood pellets transported to Belgium

<i>Process:</i>	<i>Energy use</i>	<i>kg CO₂ / MWh_p pellets</i>
Drying:	– Fossil/ton pellets – Biomass/ton pellets	Biomass -> 0
Pelleting:	– Electricity	4.6-9.3
Transport of pellets:	– Distance to harbour: 700 km, train	5.7
Sea transport:	– Distance to Belgium: 16,000 km	15
Flatboat from ARAG:	–Avg. fuel oil use	1.7
Total		27-31.7

Compare to reference nr of 55 Kg CO₂ / MWh_p pellets

Experience of evaluating energy balance

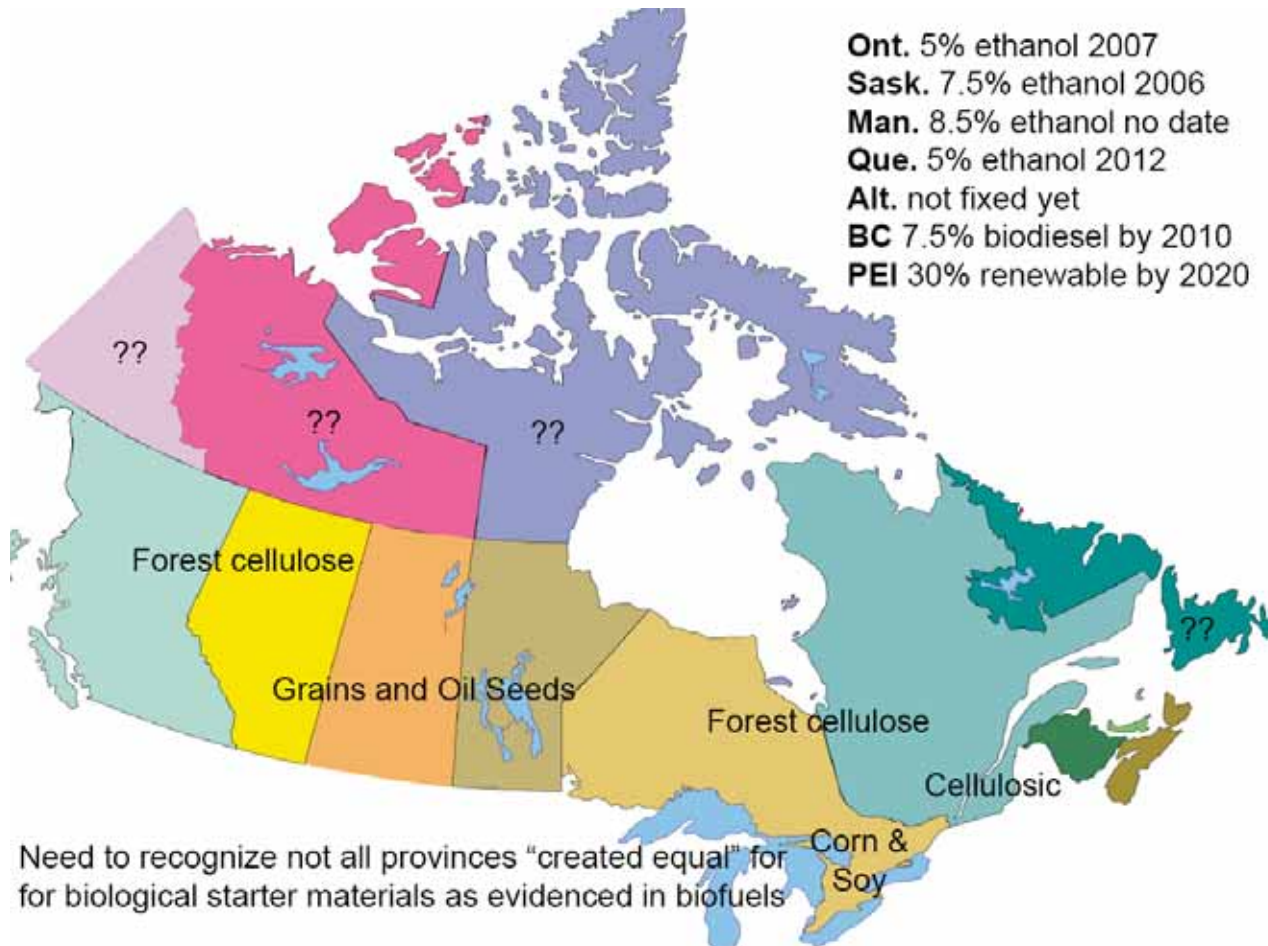
- Evaluating energy use of pellet plant is not obvious and can vary according to reference used:
 - Electricity: from installed power or from invoices ?
 - Thermal energy for drying: varies with moisture content
- Evaluating energy use for local transport is not obvious, trucks have different sizes, are modern or old, ...
- Evaluating energy use by sea vessels is not obvious, vessels are modern or old, use different types of fuels, ...
- Transport scheme can change in time as well as vehicles used

Source: Y. Ryckmans, Laborelec/Electrabel, March 2008



Future outlook: Liquid biofuels

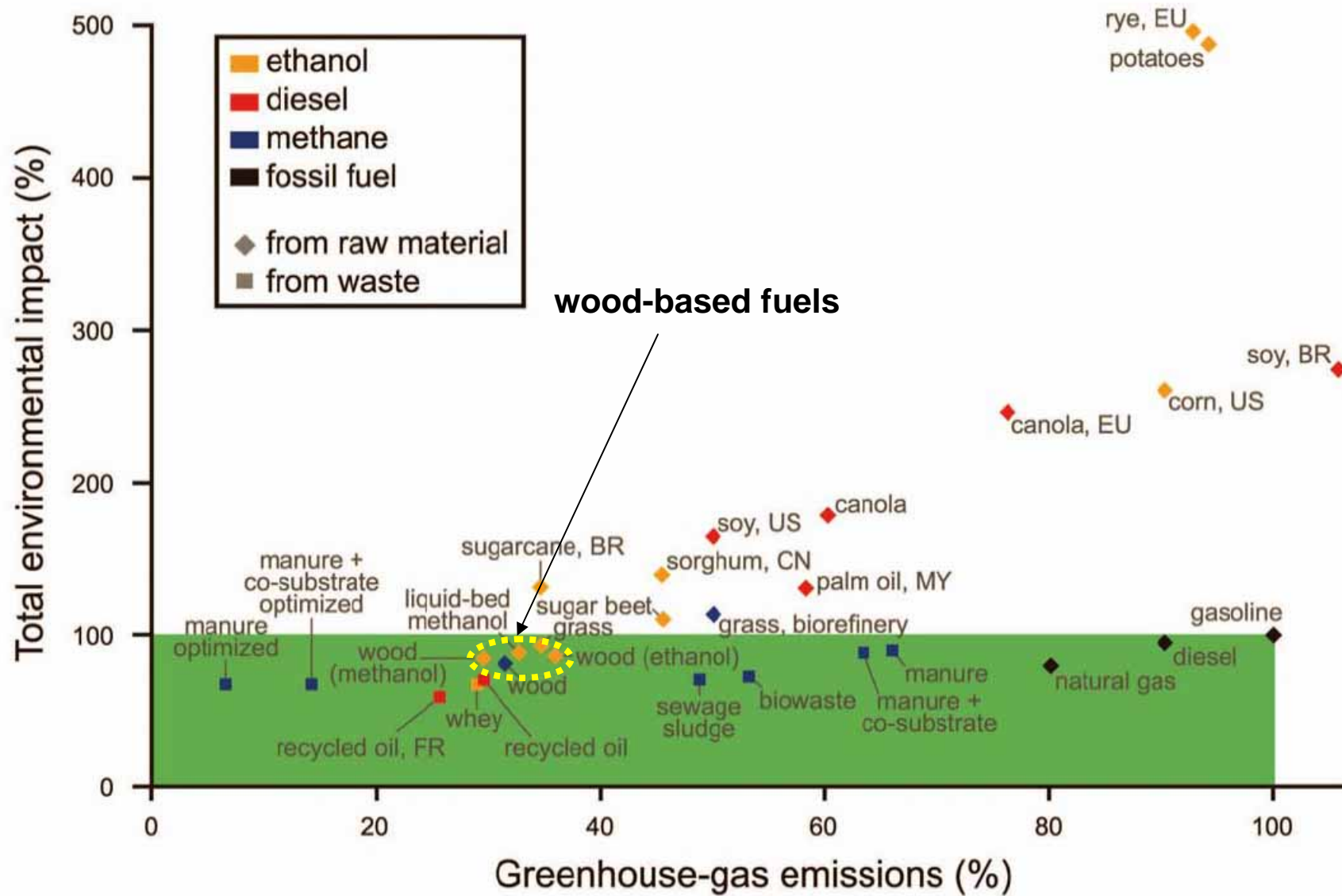
Feedstock and policy targets for biofuels in Canada



Need to recognize not all provinces "created equal" for biological starter materials as evidenced in biofuels

Source: Terry McIntyre, Environment Canada

GHG emissions & env. impact of liquid biofuels

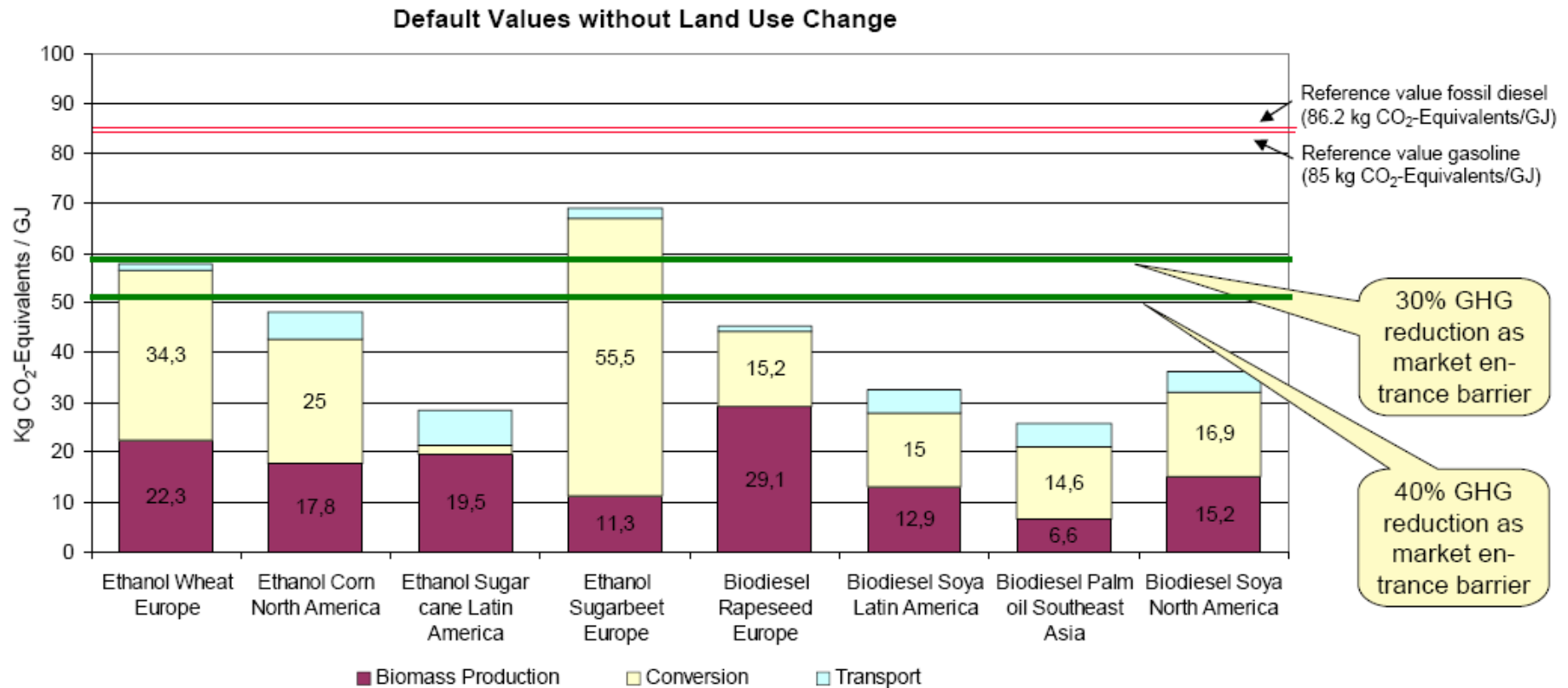


Sustainability criteria for liquid biofuels in Europe

- The recent public sustainability discussion focuses almost solely on the use of biofuels for transportation
- The UK has implemented the Renewable Transportation Fuel Obligation (RTFO) -> reporting obligation
- Germany has implemented a 'sustainability decree' for biofuels



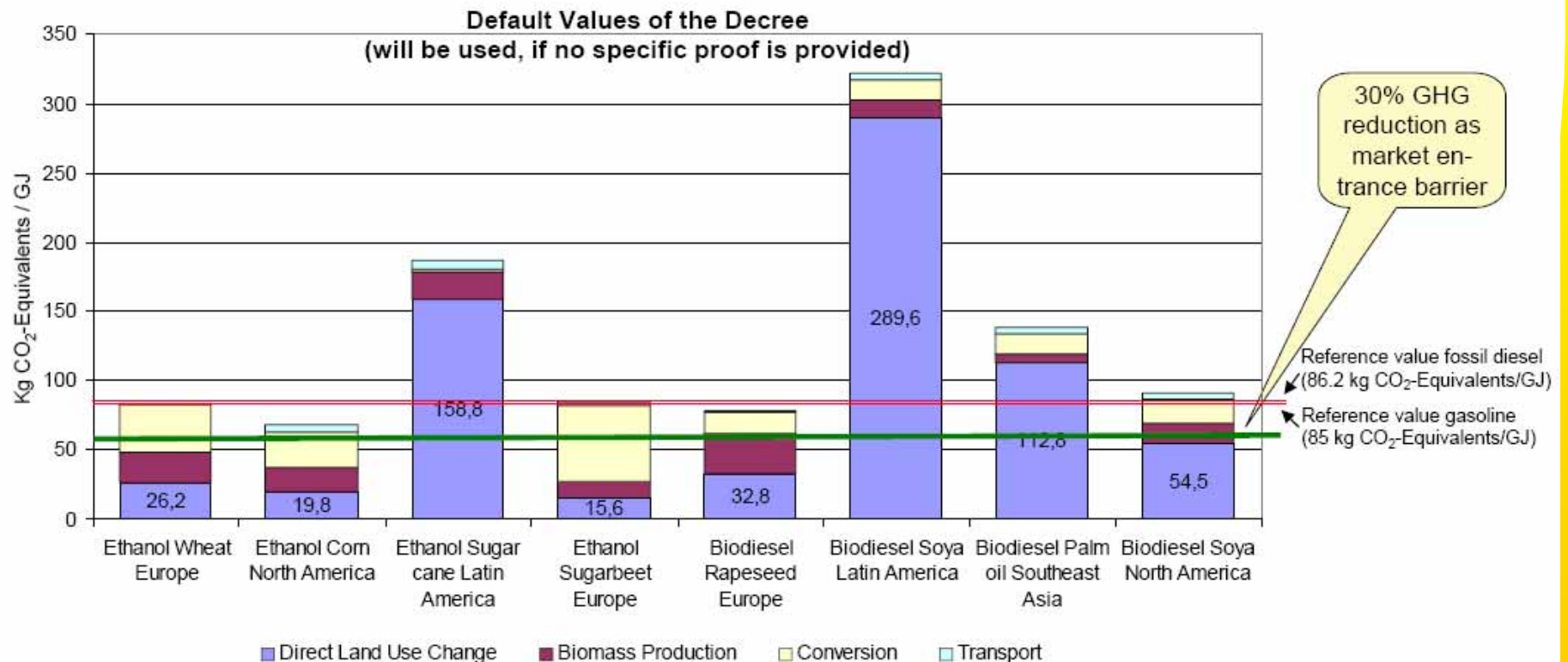
German GHG emission reduction requirements without land-use changes



Source: J. Henke, Meo, March 2008

German GHG emission reduction requirements with land-use changes

The default values quoted in the Sustainability Decree are not sufficient to achieve the minimum GHG savings set (30%, 40% from 2011 onwards). Therefore, a specific proof has to be provided by the biofuels producers



Future outlook: sustainability criteria for liquid biofuels

- In Jan. 2008, the European Commission published a draft directive on the promotion of the use of RES, including SC for biofuels:
- “the greenhouse gas emission saving from the use of biofuels ...shall be at least **35%**”
- “**not** to be made from raw material obtained from land with recognised **high biodiversity value**” ... including “forest undisturbed by significant human activity, that is to say, forest where there has been no known significant human intervention“
- “**not** be made from raw material obtained from land with **high carbon stock**” ... including ” continuously forested areas, that is to say land spanning more than 1 hectare with trees higher than 5 metres and a canopy cover of more than 30%, or trees able to reach these thresholds in situ;”



Current developments in Canada:

- Extensive review of existing environmental life cycle analysis studies on various biofuels by Environment Canada
- Establish environmental baseline data for all facets of targeted biomass to biofuel life-cycles and fossil fuel alternatives they are replacing
- Validate data under representative Canadian conditions
- Potential for combining EC /AAFC BIMAT data to determine optimal determine optimal “number”, siting location, sustainability, and productivity for biofuels and biorefinery production facilities across Canada utilizing Prairie Provinces as a “microcosm”
- Development of standards, incl. independent certification by accredited bodies and product traceability / supply chain control on the mid-term (?)

Source: Terry McIntyre, Environment Canada



Summary and conclusion

For the short-term wood pellet trade:

- Use of residues has to meet less (strict) requirements than energy crops
- (Canadian) wood pellets lead to significant ($\geq 85\%$) GHG emission reductions when co-fired with coal
- Existing forestry certification systems likely meet (large parts of) environmental, social & biodiversity criteria for the Dutch and Belgian systems
- Detailed documentation of (energy inputs in) the logistic chain required

Summary and conclusion

For the long-term liquid biofuel production:

- GHG balances of 2nd generation biofuels from lignocellulosic feedstocks generally are favorable compared to the current 1st generation fuels, 35% GHG emission reduction likely to be achieved
- Especially for lignocellulosic biomass grown in areas where food crops are not viable, there is no competition with (land for) food
- Land-use changes may yield additional credits in case of afforestation

General conclusions

- Global trade is not a show-stopper *if biomass is produced sustainably and transported efficiently*
- With the exception of sugarcane, food crops will unlikely be the feedstock for liquid transportation fuels – perennial lignocellulosic crops hold the promise for a sustainable biomass the future – also for electricity and heat production
- Canada has the potential to contribute significantly to this potential



Thank you for your attention!
Merci pour votre attention!

More information at:

IEA bioenergy Task 40, www.bioenergytrade.org
-> full overview paper on development of biomass
sustainability criteria and certification systems and
much more on international bioenergy trade

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