

# Methodological Issues Regarding Indirect Biofuels Trade

## Development of Meaningful Statistics for Sustainable Bioenergy Trade - Workshop

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## (Bio-) Terminology

### **Biomass**

Refers to the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances) and forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste.

### **Biofuel (=biomass fuel)**

Fuel produced directly or indirectly from biomass. The fuel may have undergone mechanical, chemical or biological processing or conversion or it may have had a previous use. Biofuel refers to solid, gaseous and liquid biomass-derived fuels.

*(In several papers, biofuels mean only liquid biofuels used in road transport sector)*

### **Bioenergy**

Bioenergy refers to energy derived from biofuel.

*The above definitions are used in this presentation.*

## Challenges for determining biofuels import and export

- When the definition of biofuel is considered, biomass becomes biofuel when it is purchased for energy use or, on some cases, when it is consumed in energy production.
- Simplest procedure to define the status of international biofuels trade is to consider only products which are traded directly for energy purposes (fuel ethanol, wood pellets...).
- However, the actual trade and streams of biomass that are closely related to the energy use of biomass are larger.

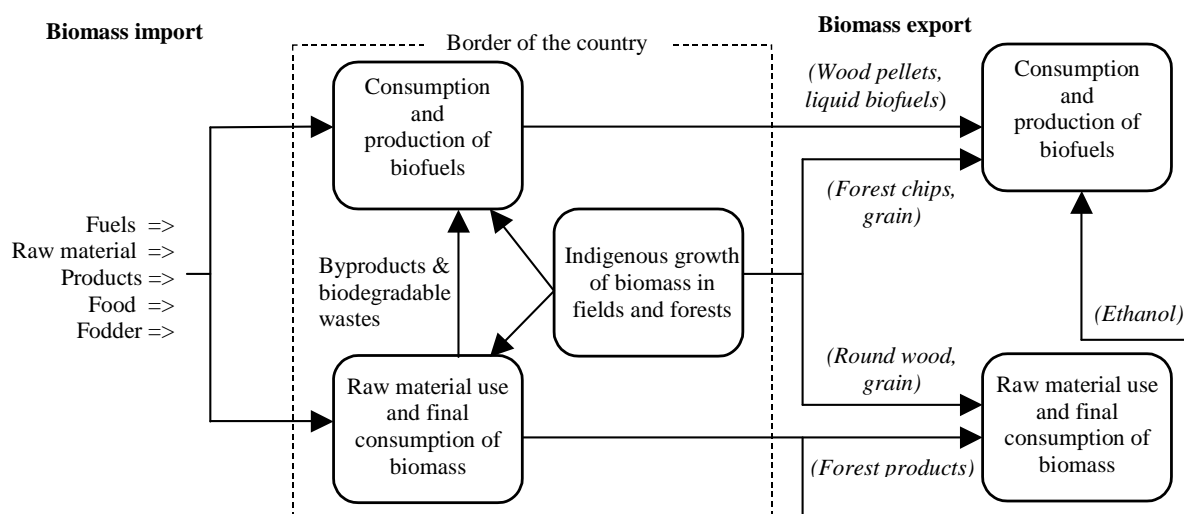
# Global biomass trade

Type of biomass	Volume of international trade, (in Mt)	International trade / total production
<b>BIOFUELS</b>		
• Ethanol	3.5	~10%
• Biodiesel	<0.5	~10%
• Fuel wood	4	~0%
• Charcoal	1	<5%
• Wood pellets	1	~25%
<b>INDUSTRIAL WOOD AND FOREST PRODUCTS</b>		
• Industrial round wood	100	<10%
• Sawn timber	60	~30%
• Paper and paperboard	110	~30%
<b>AGRICULTURAL PRODUCTS</b>		
• Wheat	118	~20%
• Maize	83	~10%
• Rice	28	~5%
• Palm oil	23	~60%
• Barley	22	~15%
• Oats	3	~10%

- Trade of biomass for energy purposes “biofuels” is much smaller than the trade of for other purposes.
- Biomass is mostly consumed locally excepting few exceptions (forest products, palm oil & wood pellets).

Figures presented in a table above are indicative, main source: FAOSTAT/year 2004

## An illustration of biomass streams within a country and between countries



Products presented in brackets represent examples of products

Streams of biomass-raw, processed or within products-together with their various end use purposes constitute a complex field.

## Challenges for determining biofuels import and export

- The examination of the status of international biofuels trade will become complex if it included all biomass streams, until the carbon they contain is oxidised into CO<sub>2</sub>.
- The biomass streams within the following products are difficult to monitor:
  - Forest products (paper, paperboard, sawn timber, wood-based panels)
  - Food and fodder
  - Raw wood (=raw material for forest industry)



## Challenges for determining biofuels import and export

- It is rather easy to determine the calorimetric values or dry tons of the above mentioned products in the state when they cross the border of a country.
- To what extent the bioenergy production of a country is based on imported biomass or to what extent the above mentioned (e.g. forest products) products end up in energy production?



## Challenges for determining biofuels import and export

Difficulties related to forest products, food, fodder and raw wood:

- Fibres of paper and board are often recycled and exported several times during their lifetime.
- Organic waste includes fractions that have grown outside the country, and it is difficult to determine the exact amount of foreign based matter in this fraction.
- The lifetimes of the products vary a great deal, and only a part of the products end up in energy in the same year they have been imported.
- Only a part of these products finally end up in energy production; the rest is oxidised without energy recovery.

## Case study – International biofuels trade in Finland

Targets:

- To determine the status of international biofuels trade more accurately than earlier studies
- To find out how much biomass is imported and exported related to energy purposes in Finland
- To explore what extend bioenergy produced in the country is based on foreign biomass

## Case study - Finland

For simplifying the investigation the following streams were excluded:

- Forest products (including recycled paper)
- Food and fodder
- Municipal waste

### The consumption of biofuels in Finland in 2004

Biofuel/consumption	[PJ]	[%]
Black liquor	157.1	39.2%
Industrial wood residues <sup>(a)</sup>	77.6	19.3%
Other wood industry byproducts and waste products <sup>(b)</sup>	4.3	1.1%
Firewood	45.3	11.3%
Forest chips	18.9	4.7%
Recovered wood	2.3	0.6%
Wood pellets & briquettes <sup>(c)</sup>	0.5	0.1%
Recovered fuels <sup>(d)</sup>	3.8	1.0%
Biogas	1.1	0.3%
Bioliqum fuel in traffic, ethanol	0.2	0.0%
Fuel peat	88.8	22.2%
Other bioenergy <sup>(e)</sup>	0.8	0.2%
In total	401	100%

<sup>(a)</sup> Includes bark, sawdust and other dusts and wood residue chips.

<sup>(b)</sup> Includes among others burnt tall oil and birch oil, methanol, fibrous sludge and paper.

<sup>(c)</sup> Includes only pellets and briquettes in energy consumption. The total consumption of wood pellets was 0.8 PJ in 2004 [14].

<sup>(d)</sup> Includes the biodegradable part of recovered and waste fuels.

<sup>(e)</sup> Includes plant-derived and animal derived products (e.g. field biomass ) and liquid biofuels.

Source: Statistics Finland

## Case study - Finland

The study covered:

- Biofuels (products that are traded for energy production, e.g. fuel ethanol, wood pellets, firewood)
- Raw materials that are traded for manufacturing of biofuels (e.g. ethanol for ETBE manufacturing)
- Raw wood (wood matter that is used in the manufacturing of forest products)

## Indirect import and export of biofuels

The forest industry imports wood primarily to be used as raw material. Nevertheless, during the manufacturing processes of the primary products a remarkable part of the raw wood ends up in energy production or is converted into byproducts that are utilised in energy production.

The biofuel purchase and use of this kind is called in this study **indirect import of biofuels**, and corresponding export is called **indirect export of biofuels**.



## International biofuels trade- the information available from the Finnish statistics

Summary of the most interesting features of the Finnish statistics relevant to investigating international streams of biofuels

Name and compiler of statistics	Most important features in the definition of international biofuels trade
The Foreign Trade Statistics (The National Board of Customs)	<ul style="list-style-type: none"><li>• Contain all foreign trade (export and import) classified under almost 10,000 product codes according to the EU's combined nomenclature (CN)</li><li>• Record inter alia the value and quantity or amount of products</li><li>• Detailed classification for round wood according to wood species</li><li>• Do not differentiate products according to their end use purposes</li><li>• Some CN codes include several products</li></ul>
Energy Statistics (Statistics Finland)	<ul style="list-style-type: none"><li>• Contain e.g. information on the production and consumption of energy, imports and exports of energy products</li><li>• Contain figures on the export of wood pellets and energy peat</li><li>• Include the direct and indirect import of wood fuels</li></ul>
Forestry Statistics (Finnish Forest Research Institute)	<ul style="list-style-type: none"><li>• Consist of various comprehensive statistics on forestry including e.g. statistics on wood use in the forest industry and in energy production</li><li>• Contain detailed information on the use of domestic and imported wood as raw material in different branches of the forest industry</li></ul>

## Imported and exported biomass streams in Finland in 2004

Product	CN code(s)	Import		Export	
		Volume [1,000 t]	Price <sup>(b)</sup> [€/t]	Volume [1,000 t]	Price <sup>(c)</sup> [€/t]
Round wood	(a)	12,016	45.2	475	81.9
Chips	44012100, 44012200	1,459	53.4	111	58.8
Sawdust of wood	44013010	39	17.3	1	227.3
Wood waste and scrap	44013090	146	21.9	164	89.9
Fuel wood	44011000	110	17.6	4	108.9
Tall oil	38030010, 38030090, 38070090	58	192.9	121	238.4
Peat	27030000	47	28.7	116	88.0
Ethanol	22070000	23	529.2	0	-
MTBE,ETBE,...	29091900	109	371.9	8	606.9
In Total	-	14,007	-	1,000	-

<sup>(a)</sup> 44032031, 44032039, 44032011, 44032019, 44032091, 44032099, 44039951, 44039959, 44034100...44039910 and 44039995.

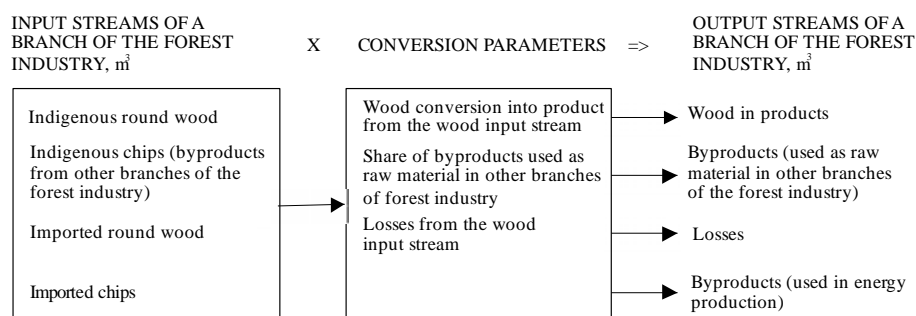
<sup>(b)</sup> CIF price (cost, insurance and freight).

<sup>(c)</sup> FOB price (free on board).

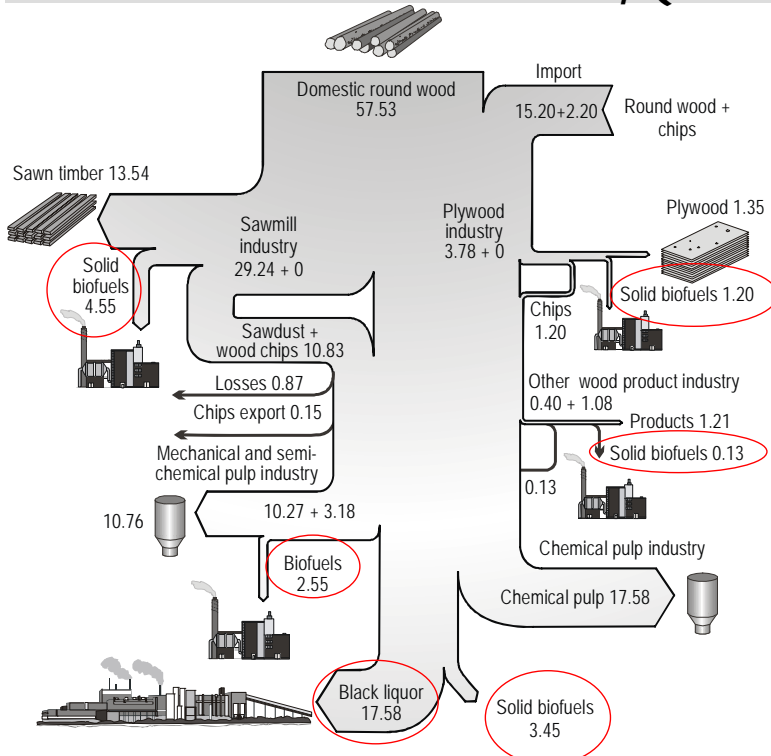
Source: EUROSTAT/Trade statistics

## Wood streams in the forest industry

The investigation of wood streams in the forest industry sheds light on the status of the indirect import of wood fuels. For that purpose, an Excel based spreadsheet model was composed. By means of the model, wood streams that end up in energy production, raw material use and final products were calculated for the branches of the forest industry. The model takes into account the differences between the branches in the efficiency of wood conversion into products.



# Wood streams in the Finnish forest industry in 2004, (million m<sup>3</sup>)



Streams compiled by using the model, round wood includes bark.

⇒ 39% from the total raw wood volume was converted into biofuels (black liquor and solid biofuels)

⇒ 45% (7.7 Mm<sup>3</sup>) from imported raw wood ended up in energy production

## Indirect import of biofuels in the Finnish energy statistics

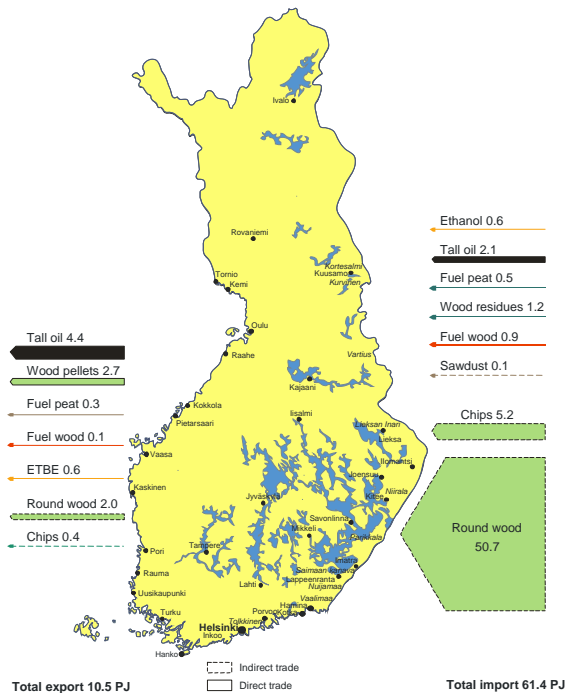
Energy Statistics  
Yearbook 2007

Energy Balance Sheet 2006\* (TJ)

	Hiili Coal	Raaka- öljy ja kaasu- kond. Crude oil and NGL	Öljy- tuotteet Petroleum products	Maa- kaasu Natural gas	Ydin- energia Nuclear energy	Vesivoima ml. tuuli- voima Hydro power incl. wind power	Energia- turve Peat fuel	Puu <sup>1)</sup> ja kierrätys- ainheet Wood <sup>1)</sup> and recovered fuels	Sähkö Electricity	Kauko- lämpö ja lämpö- pumput District heat and heat pumps	Yhteensä Total
TJ	1	2	3	4	5	6	7	8	9	10	11
Primaärienergian tuotanto kotimaassa – Indigenous production .....	-	-	-	-	240 040	41 277	132 381	226 874	-	8 630	649 201
Kierrätysöljy – Recycled oil	-	-	1 118	-	-	-	-	-	-	-	1 118
Tuonti – Imports .....	189 743	509 406	211 368	162 684	-	-	-	72 850 <sup>1)</sup>	50 823	-	1 196 873
Vienti – Exports .....	-73	-	-234 844	-	-	-	-256	-3 261	-9 781	-	-248 214
Ulkomaan merenkululiikenne – International marine bunkers .....	-	-	-23 202	-	-	-	-	-	-	-	-23 202
Varastomuutokset – Stock changes .....	29 243	-7 354	-35 782	-	-	-	-38 525	-	-	-	-52 418
Primaärienergian kokonaishankinta – Total primary energy supply .....	218 913	502 052	-81 342	162 684	240 040	41 277	93 600	296 463	41 042	8 630	1 523 359

<sup>1)</sup> Import of wood fuels includes direct (firewood and wood residues) and indirect imports (proportion of the imported raw timber consumed by the forestry industry used for energy). The data are based on calculations made with the model developed at the Lappeenranta University of Technology for describing wood flows in the forest industry. Source: Lappeenranta University of Technology/Jussi Heinimö.

## Biofuels import and export streams in Finland in 2004



	Import	Export
<b>Direct trade</b>	<b>5.4</b>	<b>8.2</b>
Wood pellets		
Fuel peat including peat pellets		
Fuel wood		
Wood residues		
Tall oil		
Ethanol		
ETBE		
<b>Indirect trade</b>	<b>56.0</b>	<b>2.4</b>
Round wood		
Chips		
Sawdust		
<b>Total</b>	<b>61.4</b>	<b>10.6</b>

## Global biofuels trade – an overview

**Estimate on the scope of international trade of biofuels in 2004, (EJ). Tall oil, ETBE and wastes excluded. (EJ = 10<sup>18</sup>J)**



<b>Indirect trade</b>	<b>0.54</b>
Industrial round wood <sup>(a)</sup>	0.41
Wood chips and particles <sup>(b)</sup>	0.13
<b>Direct trade</b>	<b>0.22</b>
Ethanol <sup>(c)</sup>	0.09
Biodiesel <sup>(d)</sup>	0.02
Fuel wood <sup>(e)</sup>	0.03
Charcoal <sup>(f)</sup>	0.02
Wood pellets <sup>(g)</sup>	0.02
Palm oil <sup>(h)</sup>	0.04
<b>In total</b>	<b>0.76</b>



Foto: Vapo

(a) Round wood in FAO's statistics is without bark, so 10% bark was added. Other assumptions: average density 0.8 t/m<sup>3</sup>, 45% average conversion into biofuels, calorific value 9.4 GJ/t.

(b) Assumptions: average density 0.8 t/m<sup>3</sup>, 45% average conversion into biofuels and 9.4 GJ/t calorific value.

(c) Assumed calorific value 27 GJ/m<sup>3</sup>.

(d) Assumed calorific value 37 GJ/t.

(e) Assumed density and calorific value 0.7 t/m<sup>3</sup> and 13 GJ/t.

(f) Assumed calorific value 22 GJ/t.

(g) Assumed calorific value 17.5 GJ/t

(h) According to Indexmundi the global industrial use of palm oil was 6.8 Mt in 2004. Palm oil use for energy purposes (for power generation and biodiesel production) was estimated at 1 Mt, which approximately equals the volume of the industrial use of palm oil in the EU-25 indicated by Indexmundi. The calorific value of palm oil was assumed at 37 GJ/t.

## Future challenges for the monitoring of international biofuels trade

- The major challenges for the monitoring will be related to liquid biofuels (road transport sector)
  - The import of raw or pre-processed biomass to be used as raw material of liquid biofuels will be increased (vegetable oils, pyrolysis oil, torrefied wood)
  - The trading of fuels blends that include bio-components will be increased (e.g. E85, mixtures of bio- and fossil diesel, ETBE)
  - In the case of refined biofuels the tracking of origin becomes easily complex or even impossible (e.g. forest chips vs. synthetic diesel made from various raw materials in a large-scale bio-refinery)

### More information:

- Heinimö, J. "Methodological Aspects on International Biofuels Trade: - International Streams and Trade of Solid and Liquid Biofuels in Finland" *Biomass & Bioenergy, Special Issue on International Bioenergy Trade, Accepted 2 January 2008.*

- Heinimö, J. & Junginger, M. "Production and Trading of Biomass for Energy: An overview of the Global Status" *15th European Biomass Conference & Exhibition, From Research to Market Deployment 7-11 May 2007, Berlin, Germany.*