CRITICAL ANALYSIS OF THE GHG CALCULATION METHODOLOGY OF THE EUROPEAN RENEWABLE ENERGY DIRECTIVE FOR THE CASE OF PALM OIL IN INDONESIA

Dr. Heinz Stichnothe,
Thuenen Institute of Agricultural Technology

Agenda

- European Renewable Energy Directive (EU-RED)
- Calculation methodology
- Assumptions
- Reality check
- Results
- Conclusions
- Acknowledgement

DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of the use of energy from renewable sources

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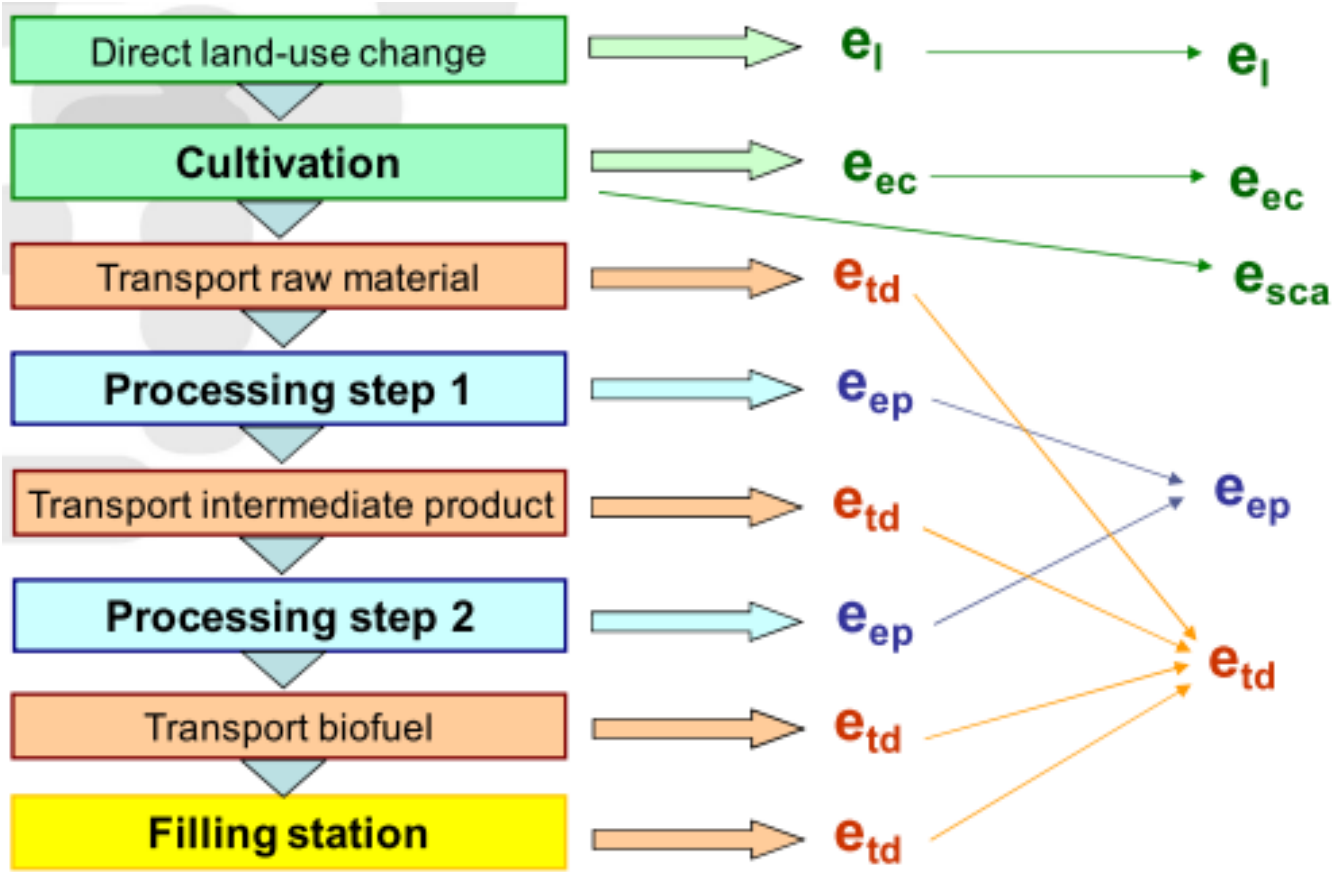
Aims: 20% share of renewable energy,
10% share of renewable energy in transport by 2020

Sustainability criteria:

- GHG savings at least 35% (50% from 2017)
- Raw material not taken from land (after 2008)
  - with high biodiversity value
  - with high carbon stock
  - Designated for nature protection, endangered species.
- Compliance with ILO conventions

Detailed calculation methodology and default values in Annex V

Calculation methodology



GHG-savings [%] = $(GHG_{fossil} - GHG_{biofuel})*100/GHG_{fossil}$, (with 83.6 g CO_{2eq}/MJ)

Assumptions - default values

- Two management options – with and without methane capture
- EFB/compost returned to the plantation, but…
- CPO and CPKO is converted to biodiesel
- Biodiesel production in Europe

Default values:

- Fertilisers, PPA, diesel, yield
- OER 22.5%
- Transport distance
- Storage

www.biograce.net

EU-RED (Annex V)

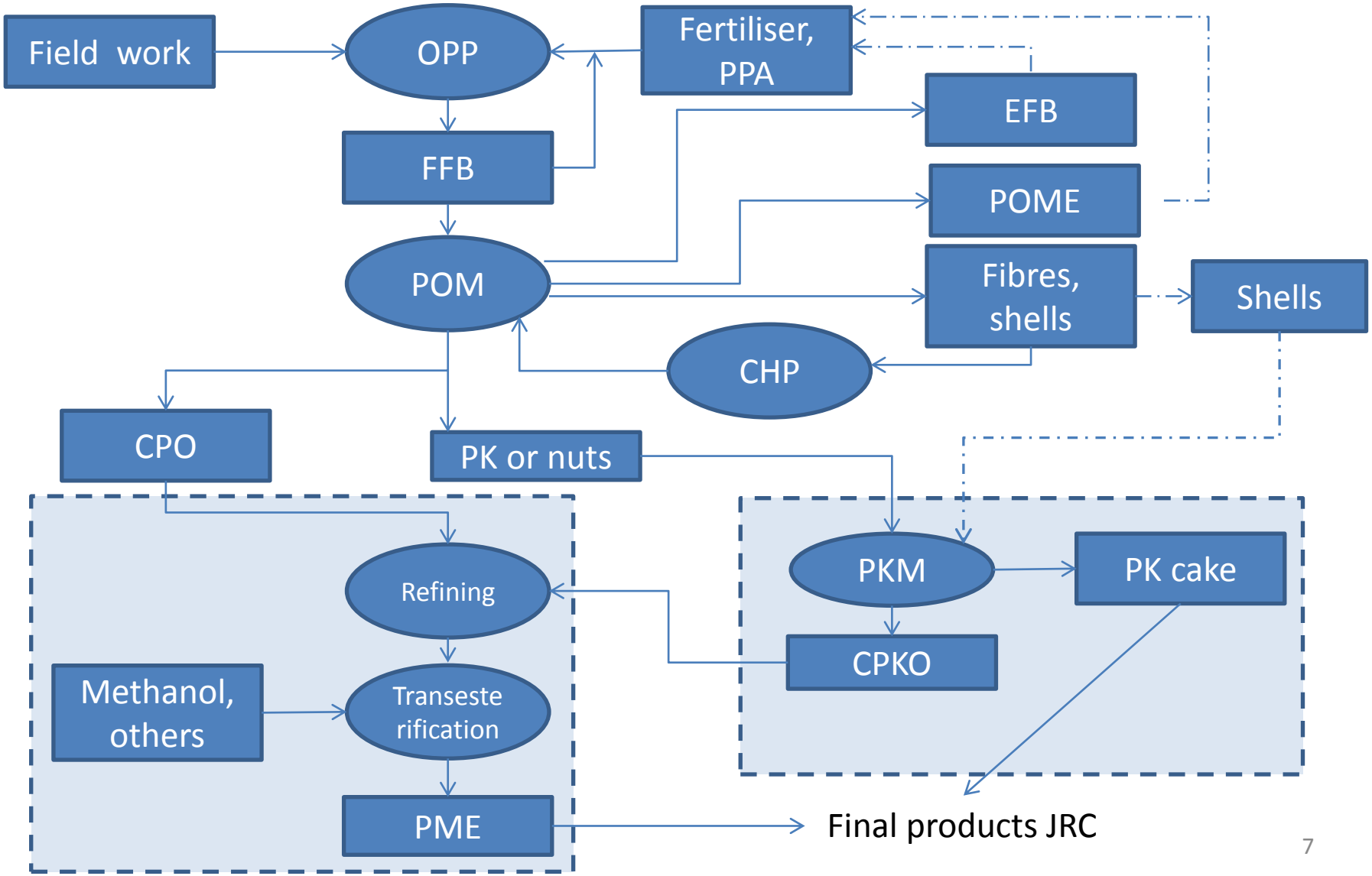
(6) **Emissions from** the extraction or cultivation of raw materials, shall include emissions from the extraction or **cultivation process itself**; from the collection of raw materials; from waste and leakages; and from the production of chemicals or products used in extraction or cultivation….

(11) **Emissions from** processing e.g. shall include emissions from the processing itself; from **waste and leakages**; and from the production of chemicals or products used in processing.

(17) Where a fuel production process produces, in combination, the fuel for which emissions are being calculated and one or more other products (co-products), **greenhouse gas emissions shall be divided between the fuel or its intermediate product and the co-products in proportion to their energy content** (determined by lower heating value in the case of co-products other than electricity).

(18) (third paragraph)
Wastes, agricultural crop residues, including straw, bagasse, husks, cobs and **nut shells,** and residues from processing, including crude glycerine (glycerine that is not refined), **shall be considered to have zero life-cycle greenhouse gas emissions** up to the process of collection of those materials.

PO-biodiesel - simplified



Life cycle of oil palms – system boundary?

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Seeding 3 month

Nursery 9 month

Immatured palms 3 yr

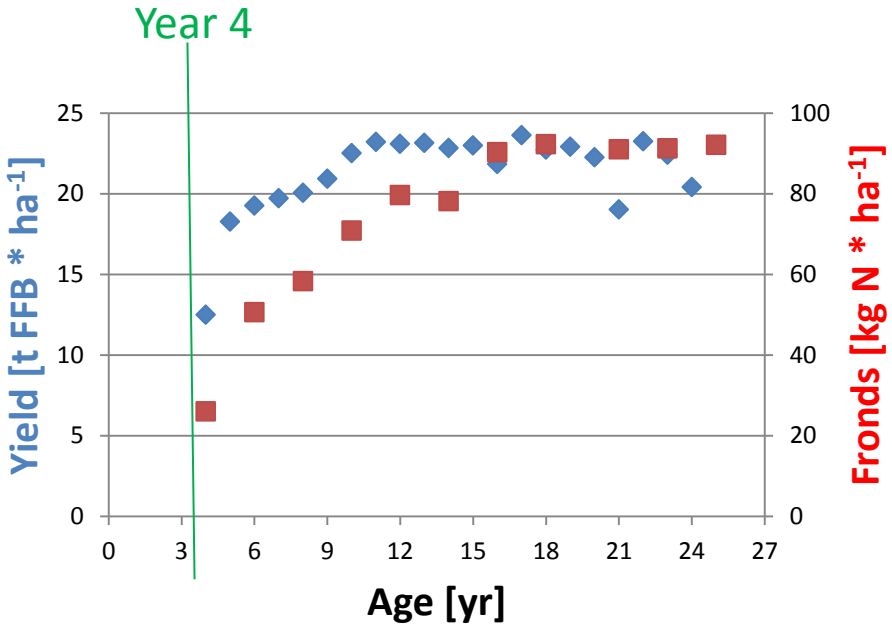
Matured palms 5- 23 yr

Post matured palms 23-26

EoL

EFB-Management

Fronds



Measured: N-content in fronds

Assumed: 24 pruned fronds per palm

132 palms per ha

Nitrous oxide emissions

IPCC, 2006, Vol.4

TABLE 11.1
DEFAULT EMISSION FACTORS TO ESTIMATE DIRECT N_2O EMISSIONS FROM MANAGED SOILS

Emission factor	Default value	Uncertainty range
EF_1 for N additions from mineral fertilisers, organic amendments and crop residues, and N mineralised from mineral soil as a result of loss of soil carbon [kg N_2O–N (kg N)$^{-1}$]	0.01	0.003 - 0.03

		Mineral N-fertiliser	EFB	N-recycling fronds	N- irrigation POME
Input	[kg N*ha^{-1}]	127	13	75 (100)	10
JRC	[kg N*ha^{-1}]	127	0.4	0	0

JRC approx. 127.5 kg N * ha^{-1} ; but with N_{org} it would be 225 kg N * ha^{-1}

	[kg N * ha^{-1}]	[kg N_2O*ha^{-1}]	[kg CO_{2eq}*ha^{-1}]
JRC	127.5	2.7	809
incl. N_{org}	225.0	4.8	1,427

Fugitive methane loss

- JRC open ponds: 1,222 kg CO_{2eq}/t CPO
  covered ponds: 0

- IPCC 2006, Vol. 5, Anaerobic digestion
  0 - 10% losses
- FNR. (2009) Biogas-Messprogramm II.
  best practise 1.25%, poor practise 9% losses (measured data Germany)
- Flesch et al. Biomass and Bioenergy, 2011
  average fugitive emission rate 3% (modern biodigester in Canada)
- Small CDM Projects: manure biogas systems
  5-10% losses
- *US-EPA on off-set methodology*
  5-10% losses (covered lagoons)

Co-product or waste

CPO:
Allocation factor: 0.83

CPO:
Allocation factor: 0.75

CPO: (36 MJ/kg), 230 kg/t FFB

Shells: 18 MJ/kg (waste), 55 kg/ t FFB

Kernels: **24**-28 MJ/kg (co-product), 75 kg/t FFB

Nuts: **22** – 24 MJ/kg (co-product), 120 kg

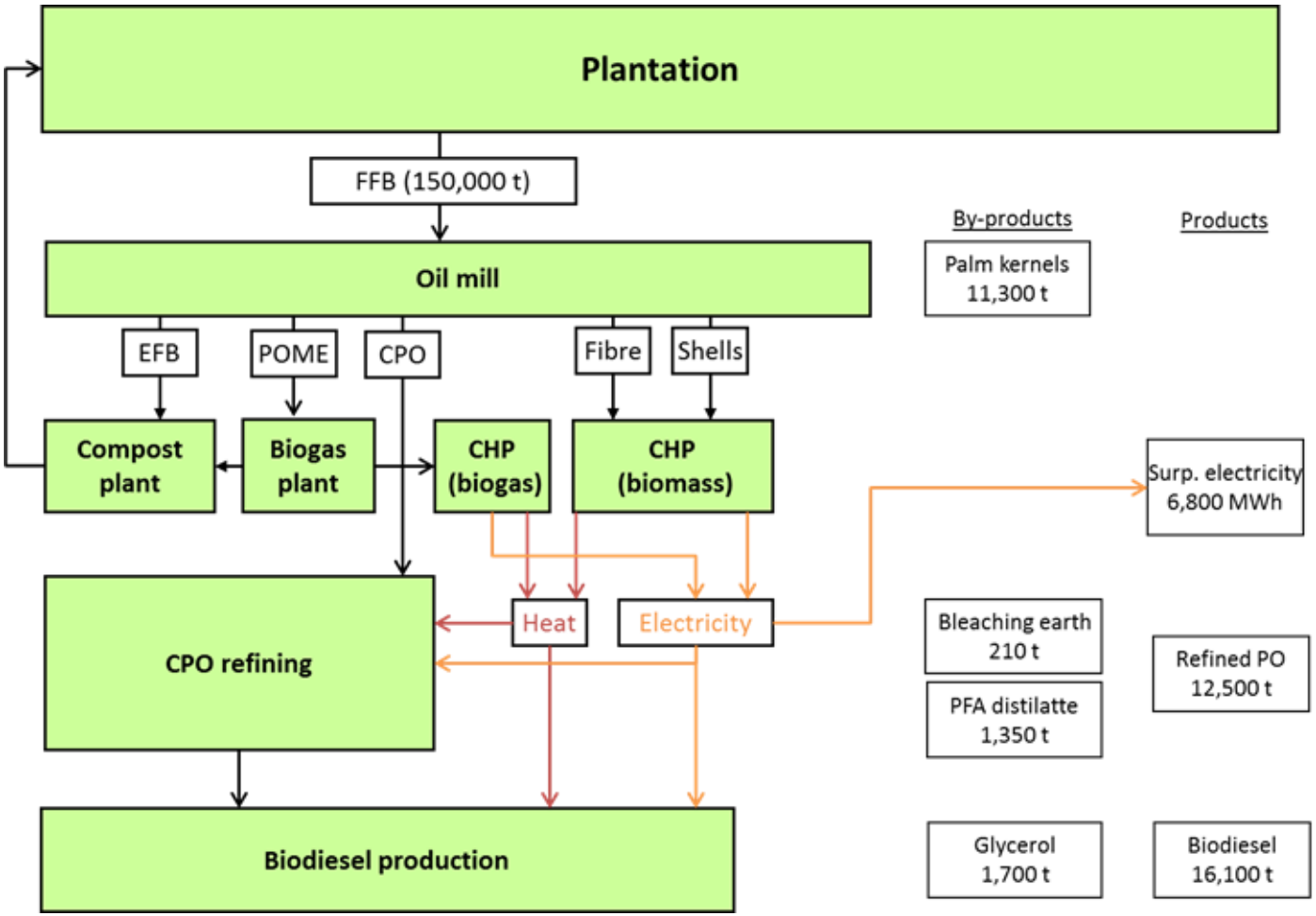
Comparison of important values

	JRC/Biograce	Literature values	
Allocation factor (at oil mill)	0.95	0.75 - 0.83	
FFB yield (t FFB/(ha*a))	19	10 - 30	average 14
OER [%]	23.7	16.5 - 26	
EFB compost [kg N /ha]	**6** - 8	**12** -18	
Fronds [kg N/ha]	0	**75** - 100	If equal to annual crops as perennial crop
Direct N_2O emissions due to organic N [kg N_2O-N/ha]	0.06	**0.9** – 1.2	
Indirect N_2O-Emissions due to organic N [kg N_2O-N/ha]	0.024	0.38	
Field emissions due to organic N [kg CO_{2eq} / ha]	25	379	
Down-stream emissions from co-composting [kg CO_{2eq}/ha]	0	296	
Fugitive methane emissions [kg CO_{2eq}/t FFB]	0	4.7	

Conclusions

- Strange assumptions e.g. CPKO, EFB, no fugitive emissions
- Faulty system boundary (?),
- Methodologically not sound (organic nitrogen)
- Overestimation of GHG savings
- Good management practices not encouraged
  Update of default values for palm oil is urgently needed!!
- Residue management is crucial for sustainable PO production
- Integrated system approach, e.g. heat demanding processes and simulteously use of by-products to add value

Outlook - Energy optimised system



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Questions?

Further information:

Stichnothe H, Schuchardt F, Rahutomo S (2014) European renewable energy directive: Critical analysis of important default values and methods for calculating greenhouse gas (GHG) emissions of palm oil biodiesel. The International Journal of Life Cycle Assessment:1-11. doi:10.1007/s11367-014-0738-x

Contact:

Thuenen Institute of Agricultural Technology
Bundesallee 50
38016 Braunschweig, Germany

Email: Heinz.Stichnothe@ti.bund.de