3rd Palm Oil Summit - Yield Improvement & Carbon Management, 18 - 19 Jul 2011, Bali

Detailed LCA of Palm Oil in Malaysia

- comparing different practices in United Plantations and with European rapeseed oil

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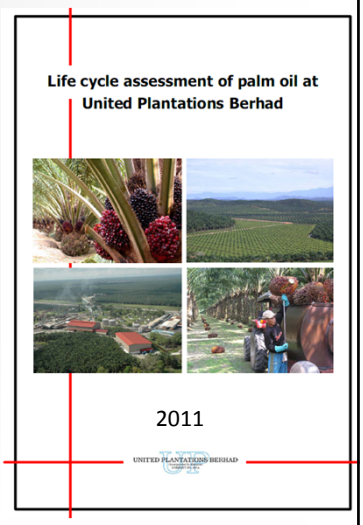
Presentation

- Methods and data
- Indirect land use change (ILUC)
- Product system and material flows
- Results: United Plantations Berhad
- Results: Comparison with average Malaysian palm oil and European rapeseed oil



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Methods and data

- **Life cycle assessment:** compliant with ISO 14040 and 14044
- **Purpose:** Document and follow performance of United Plantations palm oil over time, identify improvement options, compare with other suppliers
- **Functional unit:** 1 kg refined (NBD) vegetable oil for food purposes

- **Data:**
  - Foreground data:
    - Palm oil system: Detailed data collection at United Plantations Berhad, PhD thesis, people.plan.aau.dk/~jannick/research.htm, data exchanges with MPOB
    - Rapeseed oil system: PhD thesis, people.plan.aau.dk/~jannick/research.htm
    - Field emissions: Detailed nutrient balances and IPCC 2006 methodology
  - Background data:
    - Statistics, literature and ecoinvent LCI database, www.ecoinvent.org
- **Impacts:** Focus on GHG-emissions

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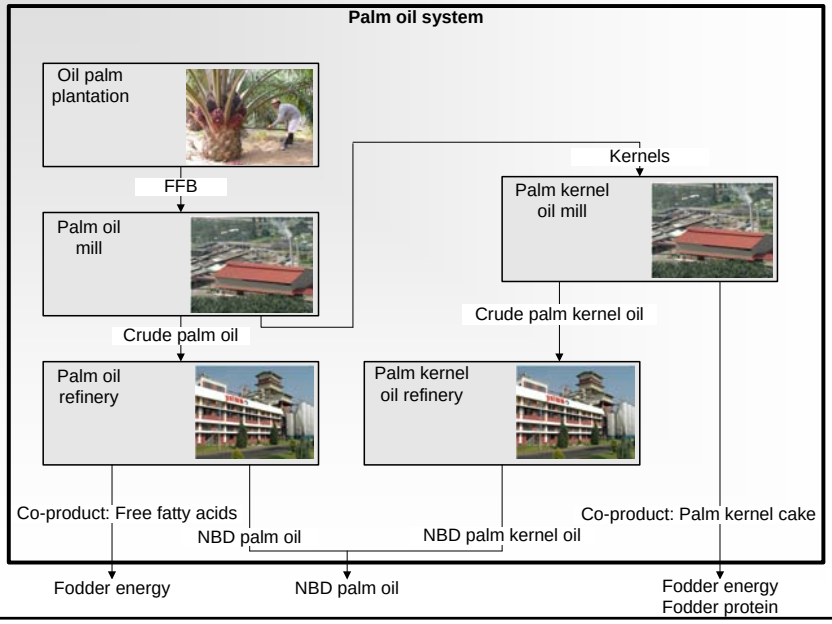
Methods: System boundary - Cradle to gate



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Inclusion of indirect land use changes (ILUC)

- Land = capacity for cultivation of biomass
- Market for land “land tenure” is global
- Use of land is measured in units of potential net primary production (NPP_0)

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United Plantations Berhad (unitedplantations.com)
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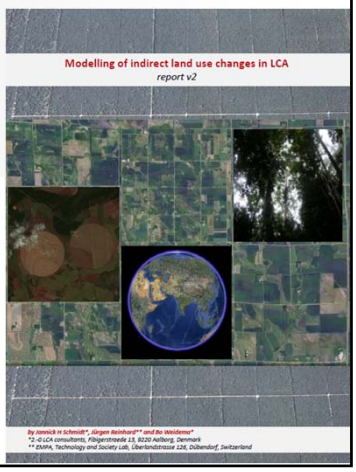


Inclusion of indirect land use changes (ILUC)

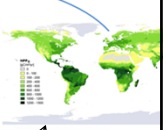
- GHG-emissions from transformation: Changes in carbon stock
- GHG-emissions from intensification: Additional fertiliser (Schmidt 2008: System delimitation in agricultural consequential LCA - Outline of methodology and illustrative case study of wheat)

Land tenure LCA process

Output	Flow	Unit
Land tenure, NPP_0 as kg C	a	kg NPP_0
Inputs		
Land already in use	b	kg NPP_0
Expansion	c	kg NPP_0
Intensification	d	kg NPP_0
Crop displacement	e	kg NPP_0

Wheat LCA process (1 ha yr)

Output	Flow	Unit
Wheat	7200	kg
Inputs		
Traction, burning diesel	4921	MJ
N-Fertiliser, as N	161	kg
Land tenure, NPP_0 as kg C	7000	kg
Emissions		
N_2O	4.3	kg



- 1 ha yr Malaysia: 13.9 t CO2-eq.
- 1 ha yr Brazil: 12.6 t CO2-eq.
- 1 ha yr Central EU: 8.8 t CO2-eq.
- 1 ha yr Canada 6.3 t CO2-eq.

Haberl H, Heinz Erb K, Krausmann F, Gaube V, Bondeau A, Plutzar C, Gingrich S, Lucht W and Fischer-Kowalski M (2007), Quantifying and mapping the human appropriation of net primary production in earths terrestrial ecosystems. PNAS, vol. 104, no. 31, pp 12942–12947

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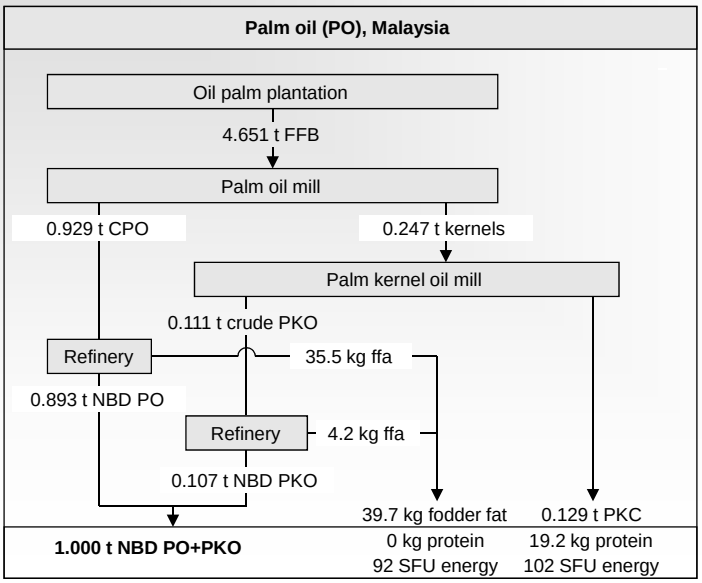
Product system and material flows



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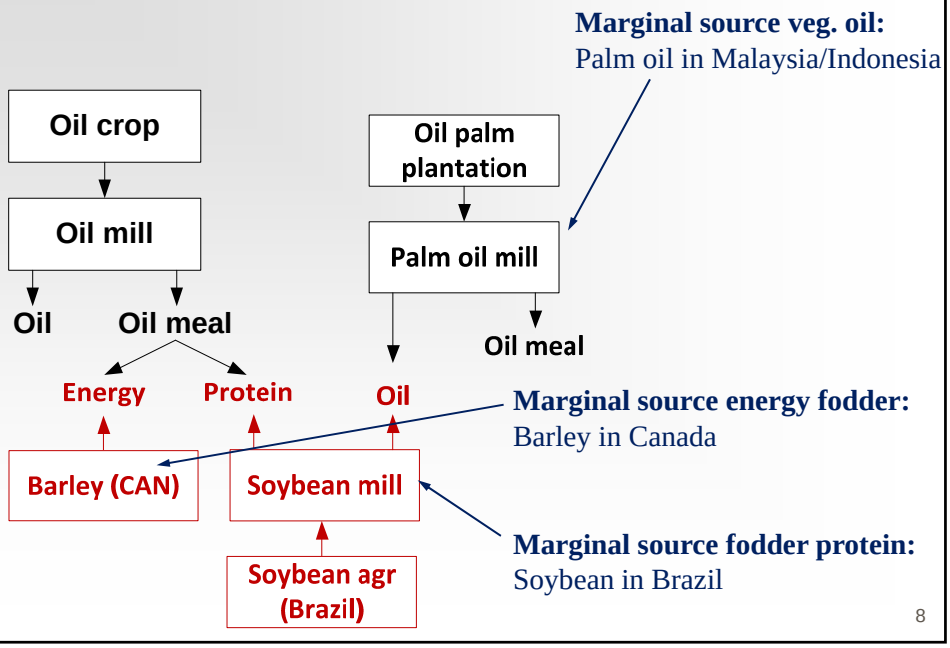
Product system: Modelling of by-products



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Results: United Plantations Berhad 2010

Life cycle stage	Specification	GHG-emission (kg CO2-eq./kg NBD oil	
		Contribution	Total
ILUC	Deforestation	0.31	
	Intensification	2.44	
	Total		**2.75**
Oil palm plantation	Field emissions, N2O	0.53	
	CO2 from peat oxidation	0.57	
	Fertiliser inputs	0.21	
	Fossil fuels and other	0.05	
	Total		**1.36**
Palm oil mill	CH4 from POME	0.95	
	By-products: exp biogas, steam, shells, elec	-0.20	
	Fossil fuels and other	0.04	
	Total		**0.79**
Palm kernel oil mill	By-products: Palm kernel oil meal	-0.31	
	Fossil fuels and other	0.04	
	Total		**-0.26**
Refining of palm oil	**Total**	0.11	**0.11**
Refining of palm kernel oil	**Total**	0.01	**0.01**
Total		**4.75**	**4.75**

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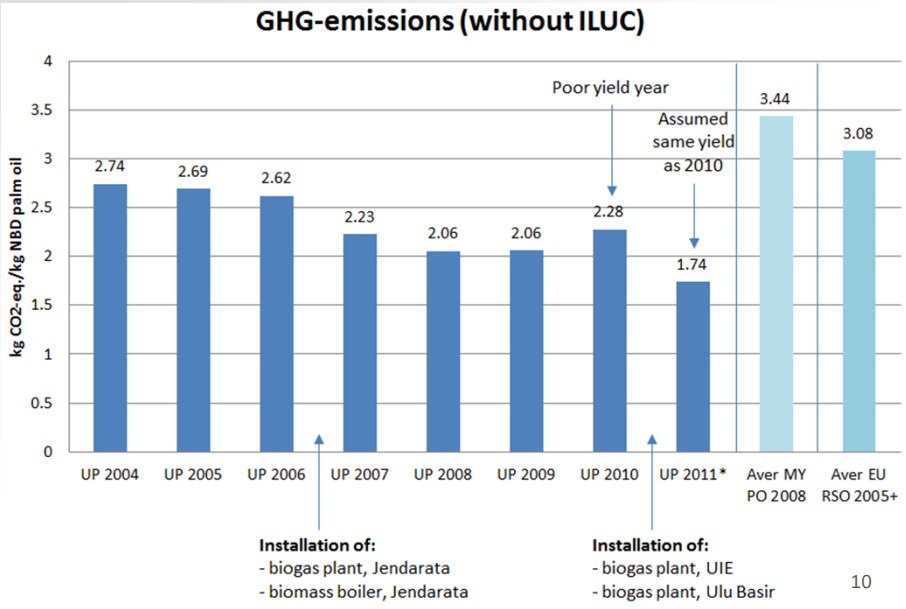
Results: United Plantations time series compared with aver. MY palm oil and rapeseed oil



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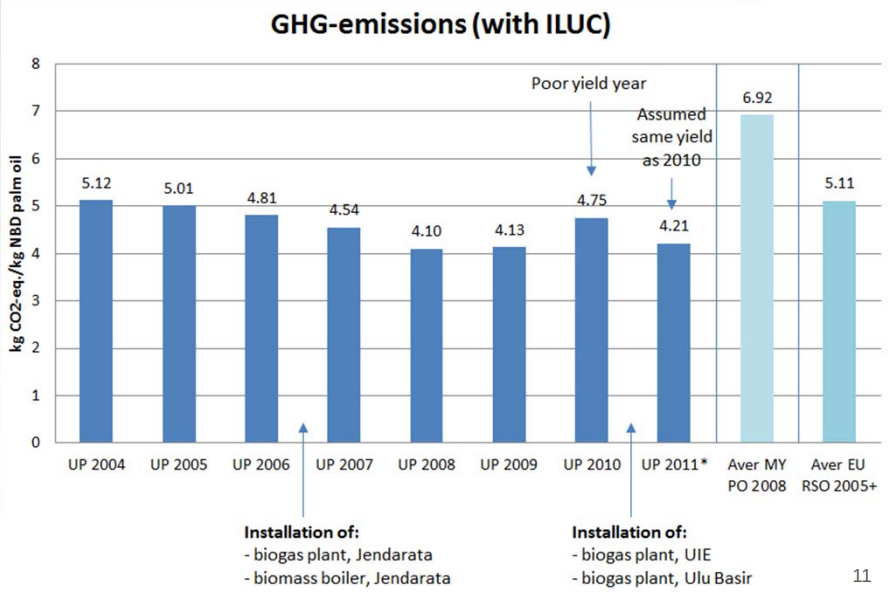

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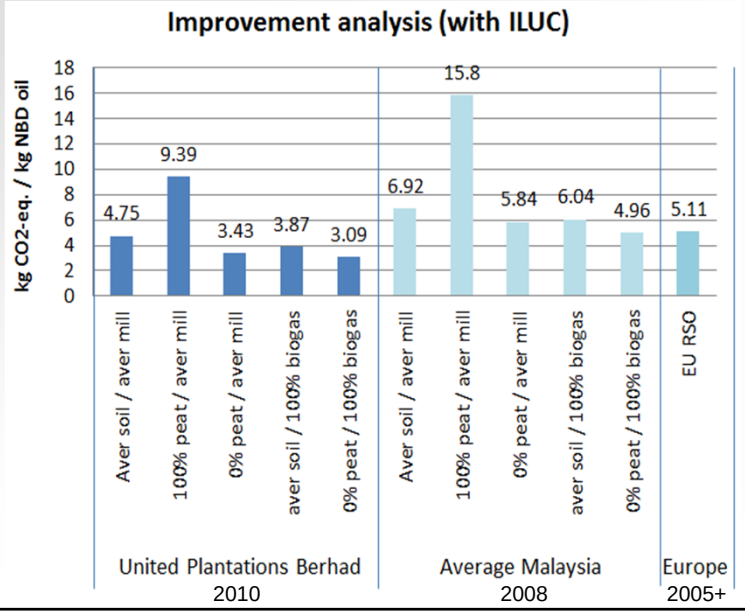
Results: Improvement options



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Conclusion

- **United Plantations Berhad 2010**
  - 2.28 (4.75 with ILUC) kg CO2-eq. per kg NBD palm oil
  - Most significant GHG-emissions:
    ILUC, field emissions (N_2O and CO_2) and POME treatment (CH_4)
- **Comparison**
  - UP performs significantly better than aver. MY palm oil and rapeseed oil
  - Rapeseed oil performs better than aver. MY palm oil
- **Improvement options**
  - UP has shown significant reductions from 2004-2011
  - UP has still unexploited improvement options
  - Malaysian palm oil is associated with same/higher potential as UP
  - No significant improvement options identified for rapeseed oil

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