

Life cycle assessment of palm oil

- investigating nature conservation and other
GHG mitigation options

By: Jannick H. Schmidt

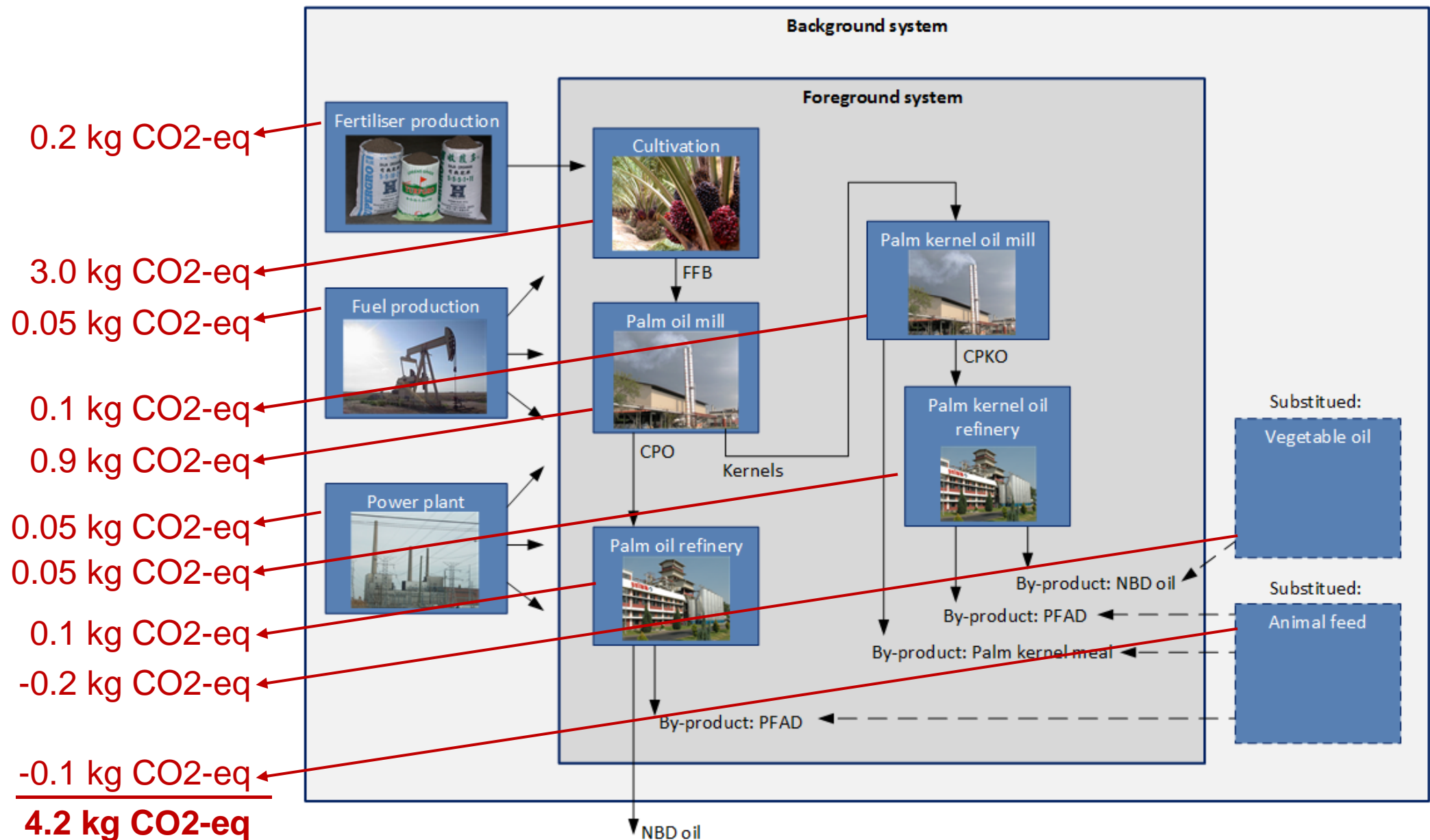
Background

- **Food production is associated with high impacts on the environment**
 - Agriculture and forestry: 24% of global GHG emissions
- **Many mitigation options in palm oil production**
 - Biogas capture in POME treatment
 - Nature conservation
 - Utilization of by-products:
 - Energy from shell, fibre and EFB
 - Nutrient value of POME and EFB
 - Various good practices: Yields, nutrient cycles, water management in peat soils, integrated pest management, OER
- **Important to consistently quantify mitigation options**
 - Life cycle assessment (LCA)
 - Land use changes and mitigation hereof are significant
 - Land use change and mitigation often omitted from LCA

Objectives

- **Investigate mitigation options**
 - Benchmark industry averages of vegetable oils
 - Investigate mitigation options for palm oil production:
 - Biogas capture
 - Nature conservation
 - Exemplify reduction potentials for good performer:
United Plantations Berhad
- **Presenting a method to account for land use changes in LCA**
 - iLUC method
 - Mitigation of iLUC by nature conservation

Life cycle assessment (LCA)



Indirect land use changes (iLUC)



Land for displaced crops?



Somewhere else – at the frontier

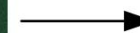
e.g. Brazil



Direct land use changes (**dLUC**)



Indirect land use changes (**iLUC**)

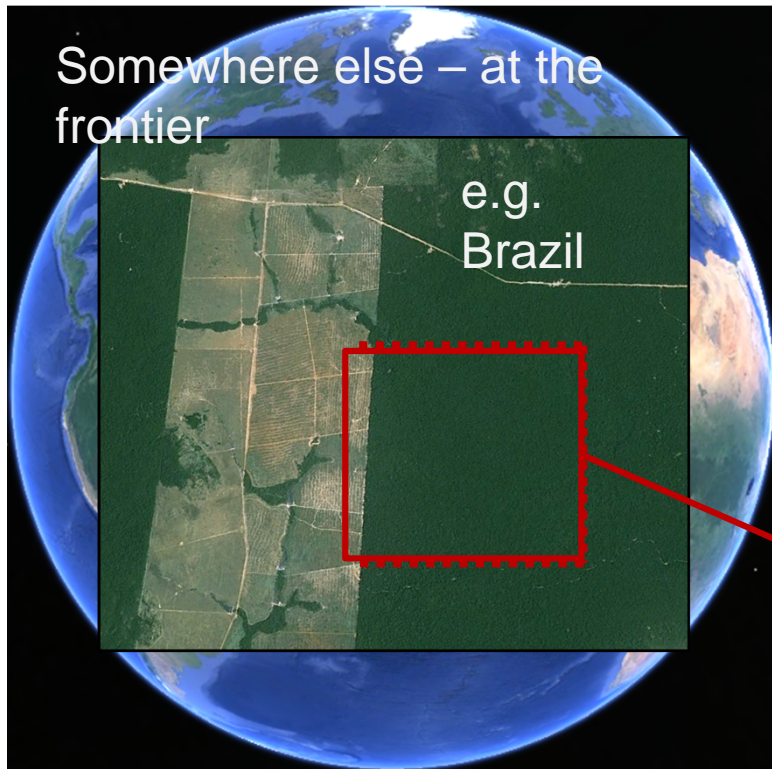
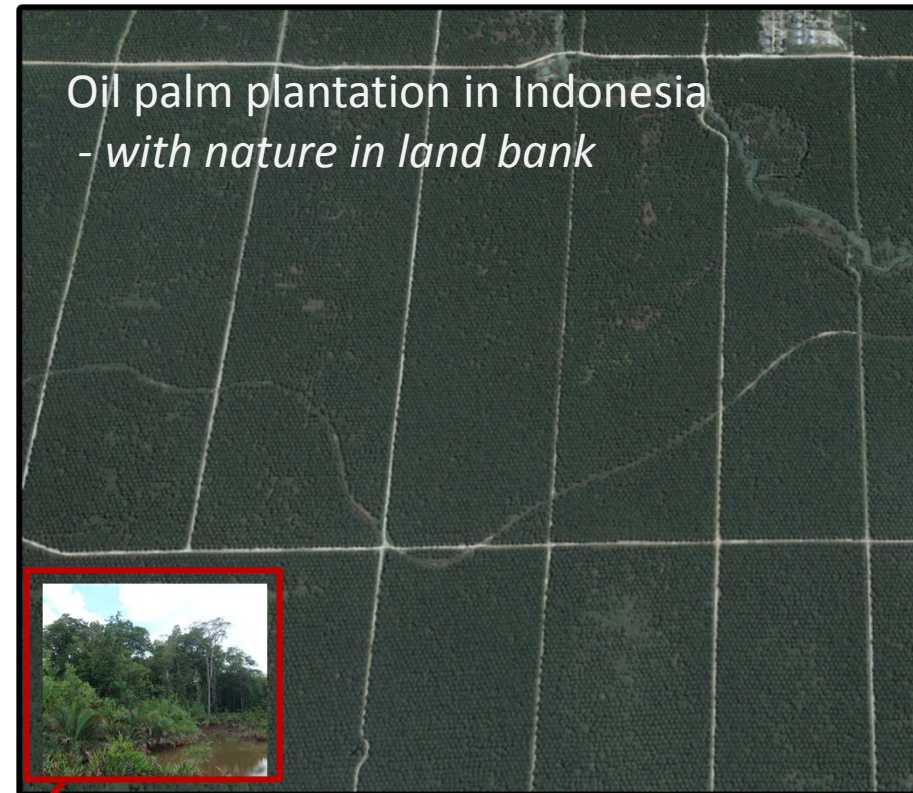


Nature conservation

Effect of 1 ha Nature conservation

The choice:

- Cultivate oil palm, or
- Nature conservation



Avoided direct land use changes (**-dLUC**)



Indirect land use changes (**iLUC**)



Net effect

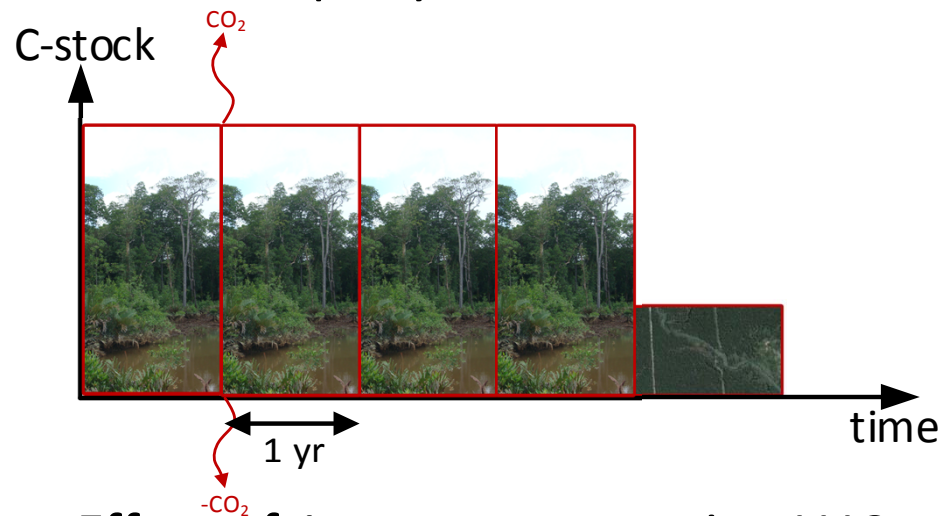
Nature conservation

Emissions from LUC

- $\text{CO}_2 \text{ emissions} = 44/12 \times (C_{\text{stock,before}} - C_{\text{stock,after}})$

Temporal effects of emissions

- Conservation areas may be lost
- \Rightarrow effect per year

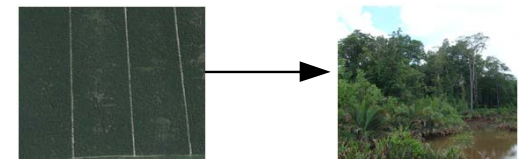


- Effect of 1 year = postponing LUC
- Net $\text{CO}_2 = 0$
- $\text{GWP}_{100} = >0$

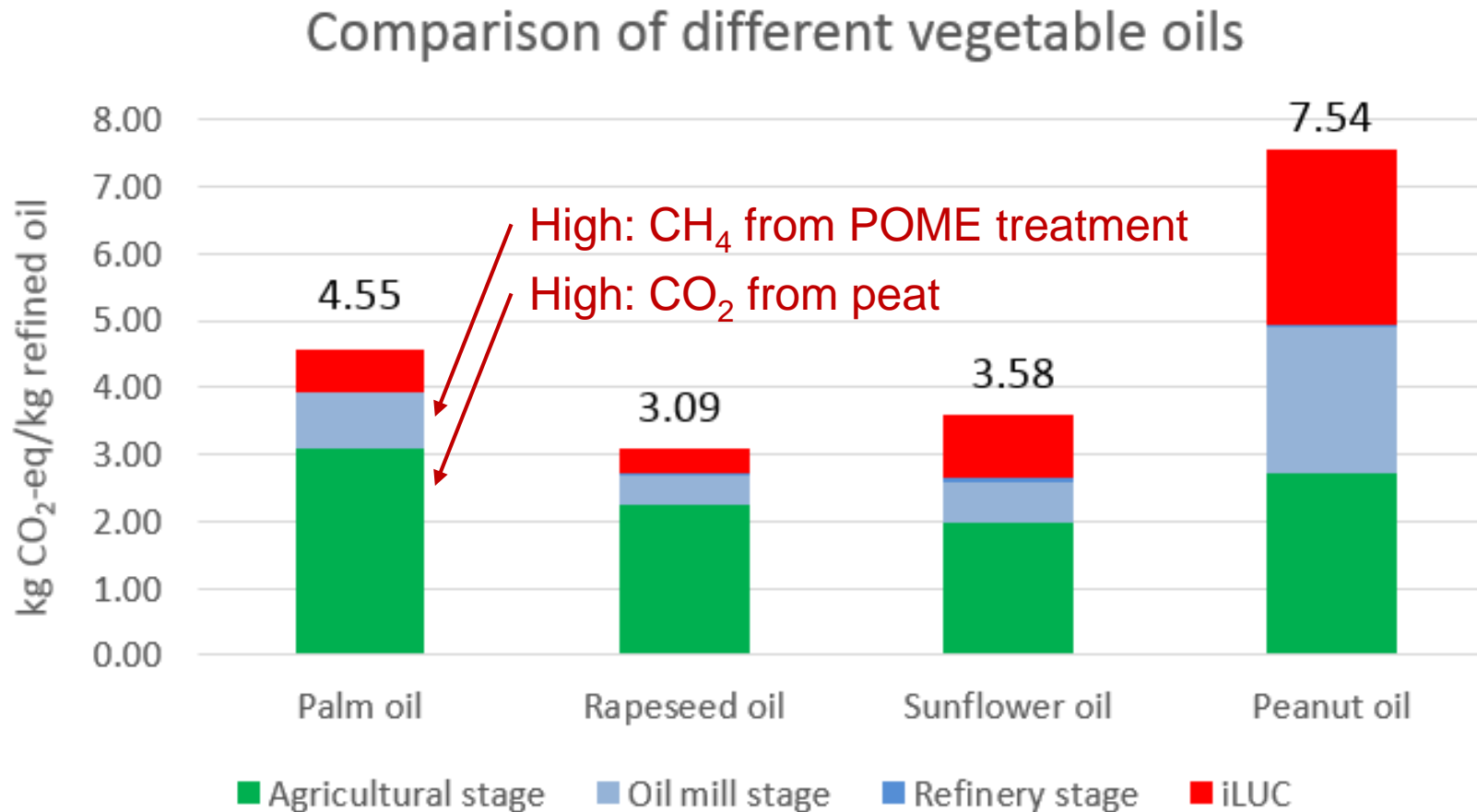
(See Schmidt et al. 2015)



Avoided direct land
use changes (**dLUC**)



Results: Different vegetable oils



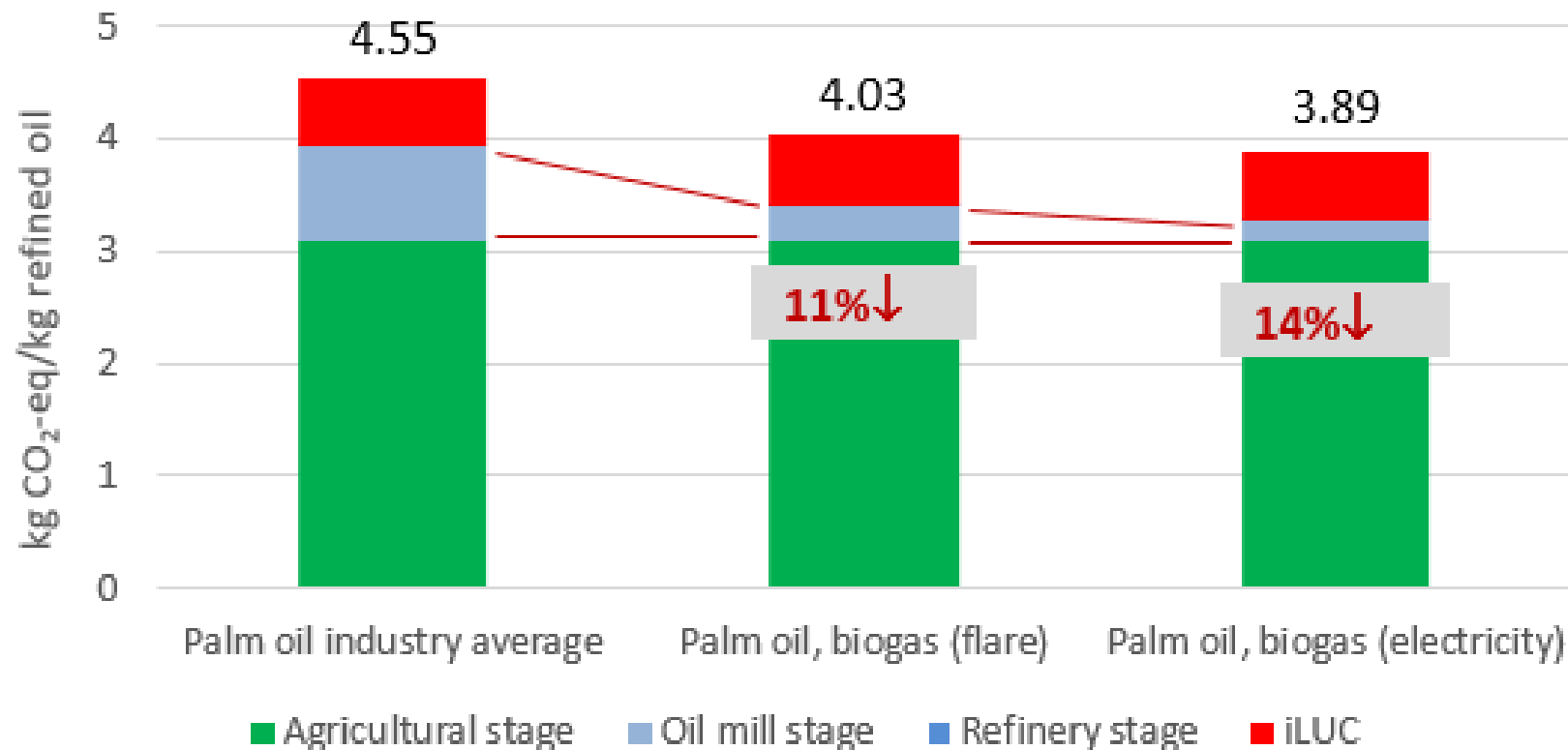
Palm oil industry average:

- 18% on peat
- 5% POME treated with biogas capture

Schmidt J.H. (2015) Life cycle assessment of five vegetable oils. Journal of Cleaner Production 87:130-138

Results: Mitigation with biogas capture

Mitigation with biogas capture



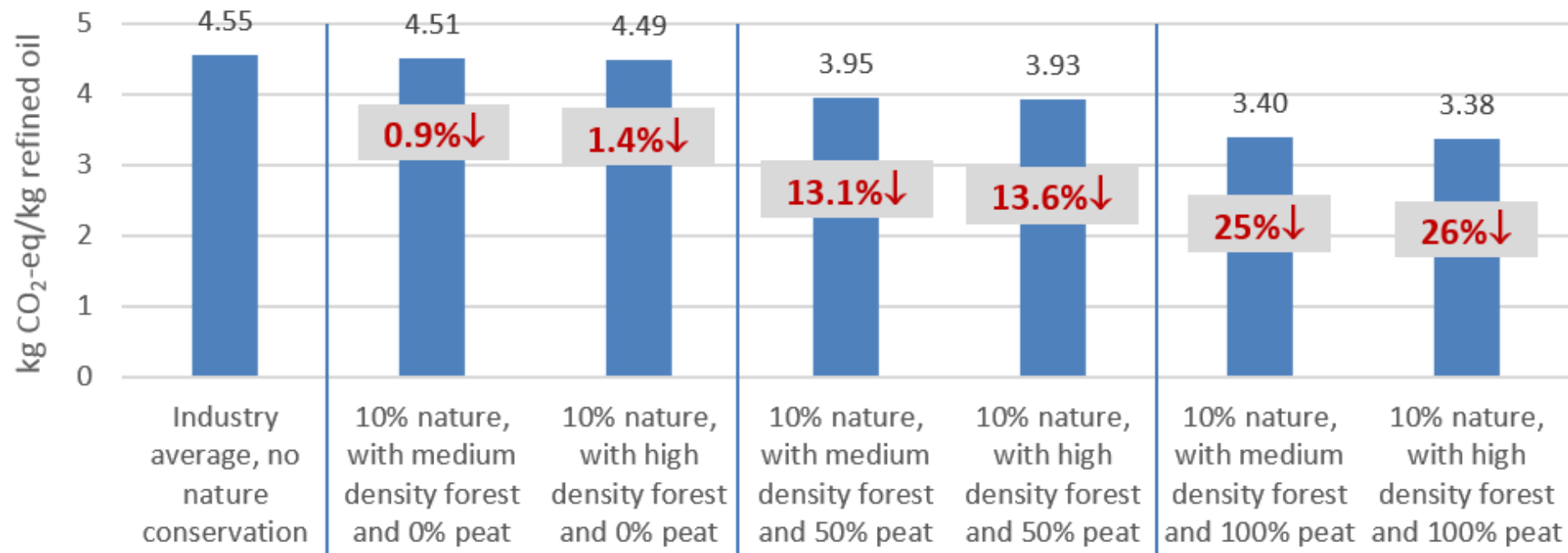
Schmidt J.H. (2015) Life cycle assessment of five vegetable oils. Journal of Cleaner Production 87:130-138

Schmidt J.H. (2015) Life cycle assessment of Palm Oil at United plantations Berhad 2014. Results for 2004-2013 Summary report. United Plantations Berhad, Teluk Intan, Malaysia.

http://www.unitedplantations.com/PDF/United%20Plantations%20LCA%20summary%20report_2014.pdf

Results: Mitigation with nature conservation

Mitigation with nature conservation



10% of land bank set-aside for nature conservation

Forest density: High and medium density forest

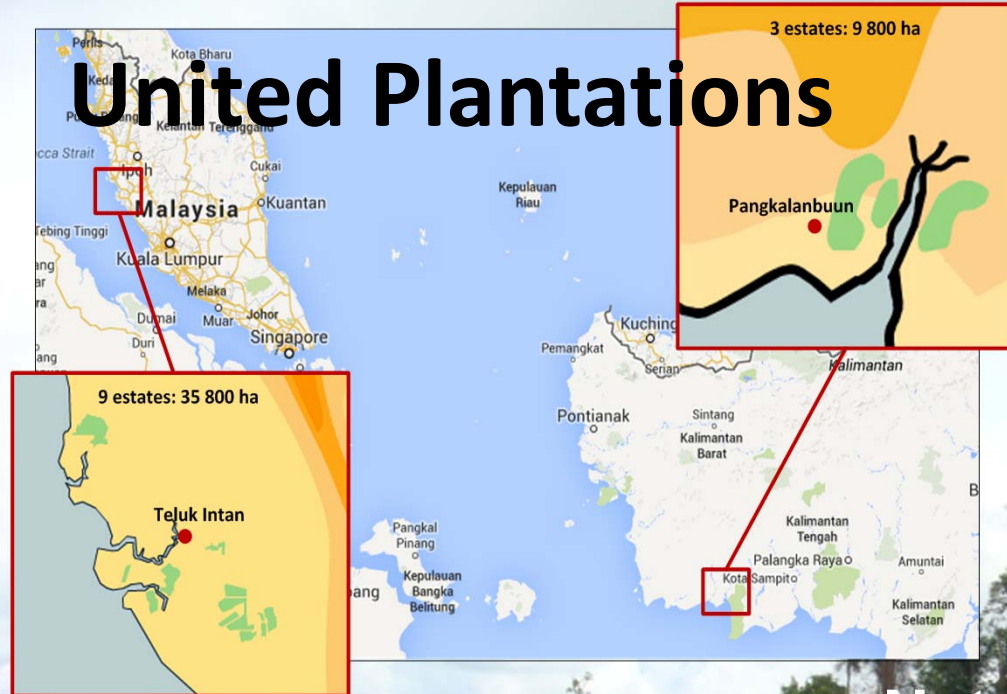
Peat: Different shares of peat soil in set-aside land: 0%, 50% and 100%

Golden Agri-Resources, SMART (2012) High Carbon Stock Forest Study Report - Defining and identifying high carbon stock forest areas for possible conservation. Golden Agri-Resources and SMART.

Schmidt J.H. (2015) Life cycle assessment of five vegetable oils. Journal of Cleaner Production 87:130-138

Schmidt J.H. (2015) Nature conservation in Life Cycle Assessment – new method and case study with the palm oil industry. Extended abstract for presentation at the SETAC2015, Barcelona 3-7 May 2015. <http://lca-net.com/p/1818>

United Plantations



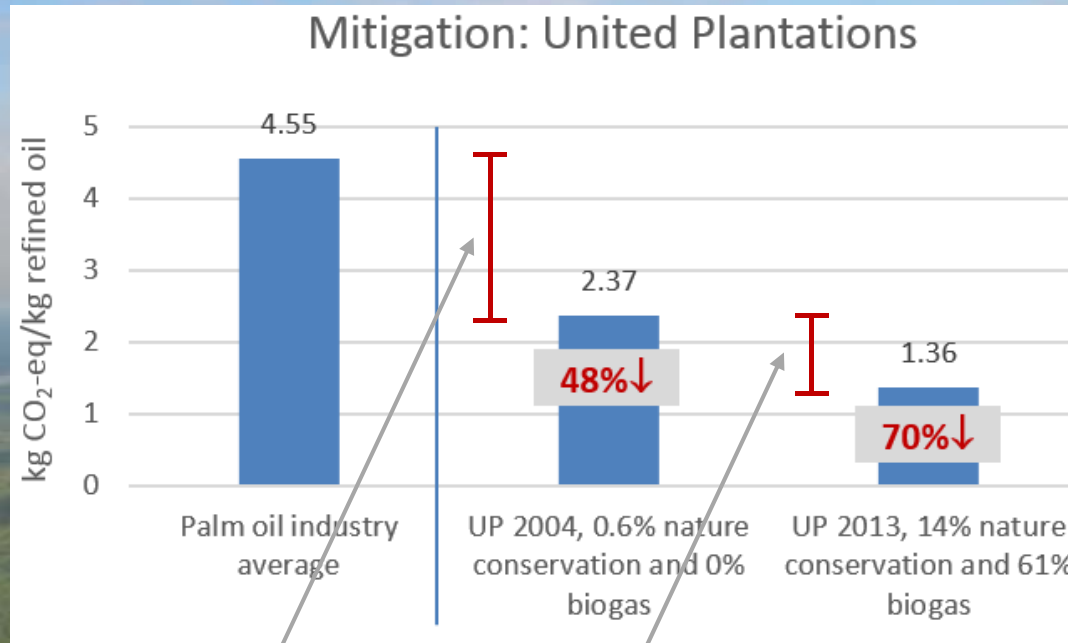
Nature conservation area
(*Peat swamp secondary forest, >50 yr*)

Oil palm plantation

Land bank	Mineral soil ha	Peat soil ha	Total ha
Oil palm plantation	40,500	5,100	45,600
Nature conservation	5,200	3,000	8,200
Total land bank			53,800

Picture: Jannick H Schmidt, United plantations, Runtu Estate

Results: Mitigation – good performer: United Plantations



Key data	United Plantations		Industry average Malaysia and Indonesia
	Malaysia	Indonesia	
Cultivation stage			
FFB yield (mature)	24.3	20.0	18.9
Share of land that is peat	12%	6%	18%
Share of land bank set-aside as nature conservation	1%	39%	0%
Palm oil mill stage			
Oil extraction rate (OER)	22.0%	24.4%	20.3%
Share of POME treated with biogas capture	65%	46%	5%

Yield
Peat share & management
Oil extraction rate

Biogas capture
Nature conservation



Schmidt J.H. (2016) Life cycle assessment of Palm Oil at United plantations Berhad 2016. Results for 2004-2015 Summary report. United Plantations Berhad, Teluk Intan, Malaysia.

Pictures: United Plantations Berhad

Conclusions

- **Palm oil compared to other oils**
Palm oil not the best performing
... But more mitigation options for palm
- **Mitigation options**
 - Biogas capture: 11-14% reduction
 - Nature conservation: 1-26% reduction (with 10% set-aside)
 - United Plantations: 70% reduction
 - Palm oil has the potential for being the best performing oil
- **Approach**
 - New approach for iLUC and mitigation by nature conservation
 - Can be used on
 - Industry averages
 - Individual palm oil producers
 - Certified palm oil
 - New land development: Can be compared with global iLUC baseline

Acknowledgements

United Plantations

- **United Plantations Berhad** (unitedplantations.com)

Members of the 2.-0 LCA iLUC initiative

- **Aalborg University, Department of Planning and Development, AAU** (plan.aau.dk)
- **Aarhus University, Department of Agroecology - Agricultural Systems and Sustainability** (scitech.au.dk)
- **Arla Foods** (arla.com)
- **Concito** (concito.dk)
- **CSIRO** (csiro.au)
- **DuPont Nutrition and Health** (dupont.com)
- **DONG Energy** (dong.dk)
- **ecoinvent** (ecoinvent.org)
- **Mahidol University, Department of Civil and Environmental Engineering** (http://www.eg.mahidol.ac.th/)
- **IFP Energies nouvelles** (http://www.ifpen.fr/)
- **Miljögiraff** (miljogiraff.se)
- **National Agricultural Research Center, Japan** (naro.affrc.go.jp)
- **Niras** (niras.dk)
- **NSW Department of Primary Industries** (http://www.dpi.nsw.gov.au/)
- **PRé Consultants** (https://www.pre-sustainability.com/)
- **Round Table on Sustainable Palm Oil, RSPO** (rspo.org)
- **Sustainability Consortium** (sustainabilityconsortium.org)
- **Swedish University of Agriculture Sciences, SLU** (slu.se)
- **TetraPak** (tetrapak.com)
- **Unilever** (unilever.com)
- **United Plantations Berhad** (unitedplantations.com)
- **University of Copenhagen, The Faculty of Life Sciences, LIFE** (life.ku.dk)

More information: the 2.-0 LCA iLUC initiative: <http://lca-net.com/clubs/iluc/>

