バイオマス産業社会ネットワーク拡大研究会2017
持続可能なバイオマス発電燃料の調達
と持続可能性基準

「パーム油のCO_2排出係数と持続可能性」

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JAPAN TROPICAL FOREST ACTION NETWORK
熱帯林行動ネットワーク

アウトライン

- パーム油の温室効果ガス排出量推計
  →操業による排出増
  →土地利用変化＝森林転換によるストック量の減少による排出量の増加
  →泥炭湿地林利用による排出増
- 間接的土地利用変化(ILUC)の考慮
- パーム油の様々な問題と持続可能性

直接的排出への影響

- 1a. 輸送、機械利用のための化石燃料
- 1b. 肥料利用
- 1c.副産物の工場での燃料利用
- 1d.廃棄物からの排出

- 2a.他の土地利用からの転換による排出
- 2b.アブラヤシによる吸収
- 2c.泥炭地からの排出

RSPO委託調査報告2009

Table 2.5 GHG emissions from palm oil production, including emissions from carbon stock changes (all emissions on a kg CO_2-eq/ha and kg CO_2-eq/tonne CPO basis).

GHG emission factor	Emissions per ha *(kgCO_2-eq/ha* annum)*	Emissions per tonne CPO*(kg CO_2-eq/tonne CPO)*	Note
1.Operations			
1a. fossil fuel use transport & machinery	+180 to + 404	+45 to + 125	-
1b. fertilizer use	+1,500 to +2,000	+ 250 to + 470	-
1c. fuel of mill & utilization of mill by-products	0	0	-
1d. POME	+2,500 to +4,000	+ 625 to + 1,467	-
Total operations	*+4,180 to +6,225*	*+920 to + 2,007*	-
2.Emissions from carbon stock change			
2a. 25 year discounted GHG emission from conversion of grass land/forest	+1,700 to + 25,000	+425 to +7,813	Based on a carbon stock change of 11.5 – 171 tonnes C/ha, which is discounted over 25 years and expressed as CO_2
2b. Annual carbon sequestration by oil palms	- 7,660	-1,915 to -2,393	Henson [22]
2c. Emissions from oil palm on peat	+18,000 to + 73,000	+4,500 to +22,813	-
Total emissions related to carbon stock change	*+12,040 to +90,340*	*+3,010 to + 28,233*	-
Total	*+16,220 to 96,565*	*+3,930 to +30,240*	-

Note: a positive sign indicates a net GHG emission

パーム油の排出係数は石炭より高い

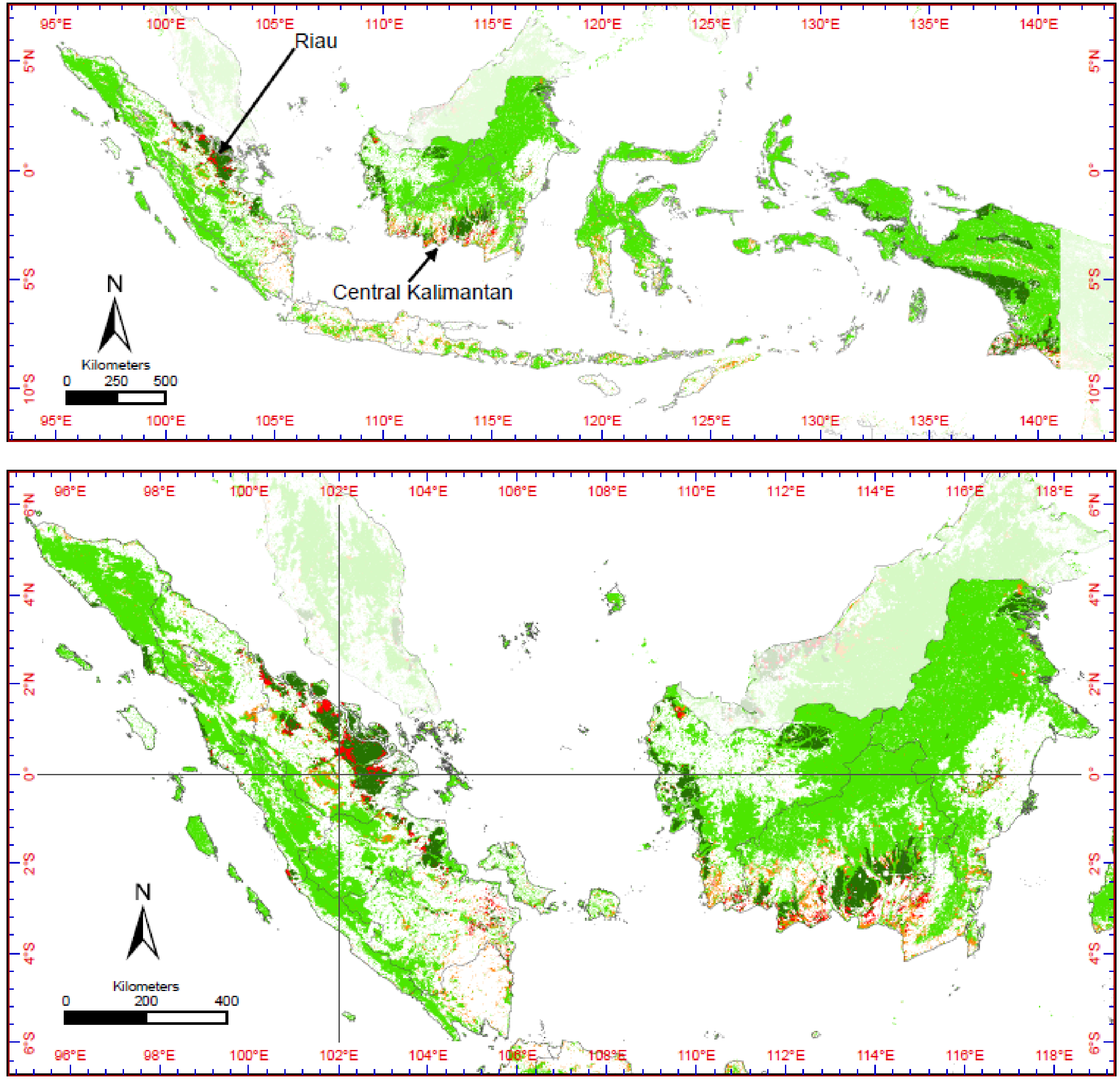
- RSPOによる委託調査による推計値
- パーム油原油の重量ベースでのCO2排出係数は、3.9～30と推計。
- 一般炭：2.33　原料炭：2.61
- 　　操業でのCO2排出量:　920-　2,007kg/ton
  炭素貯蔵変化の排出量:　3,010-28,233kg/ton
  合計：　3,930-30,240kg/ton

- Brinkmann Consultancy, "*Greenhouse Gas Emissions from Palm Oil Production: Literature review and proposals from the RSPO Working Group on Greenhouse Gases*", *2009, page24* http://www.rspo.org/files/project/GreenHouse.Gas.Working.Group/Report-GHG-October2009.pdf

泥炭湿地林:「水の森」

- 「『水の森』は低湿地に成立する生態系です。そこは絶えず水に満たされ、樹木などが枯死し堆積しても、微生物分解が抑制されるために、有機物が多量に堆積してゆきます。」「熱帯雨林のなかでもひときわ湿潤な生態です。」 by 大崎満、岩熊敏夫 編『ボルネオ』（岩波書店 2008）

インドネシア
泥炭地



- Forest on peatland remaining 2007
- Forest on non peatland remaining 2007
- Forest on peatland lost 2000-2007
- Forest on non peatland lost 2000-2007

泥炭地開発によるGHG発生

- 熱帯泥炭地の熱帯林の下に眠る泥炭層には、世界の化石燃料の消費量の100年分にも相当する炭素が貯蔵され、熱帯泥炭地は「地球の火薬庫」と呼ばれています。

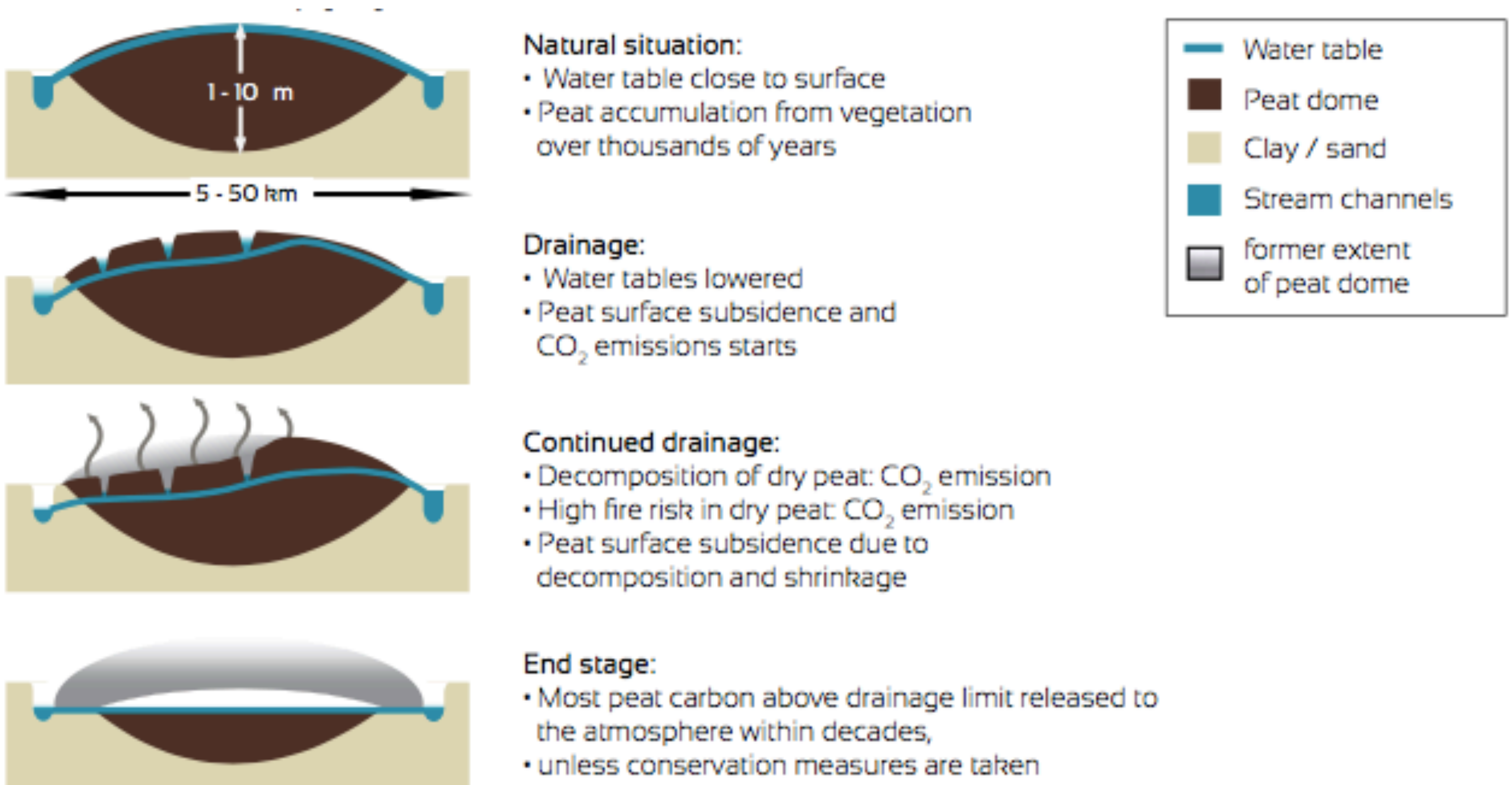


Figure 2. Drainage for palm cultivation results in peat decomposition [25]

Rainforest Foundation Noway and Cerulogy “For peat’s sake: Understanding of palm oil biodiesel consumption” by Dr.Chris Malins (May 2017)より

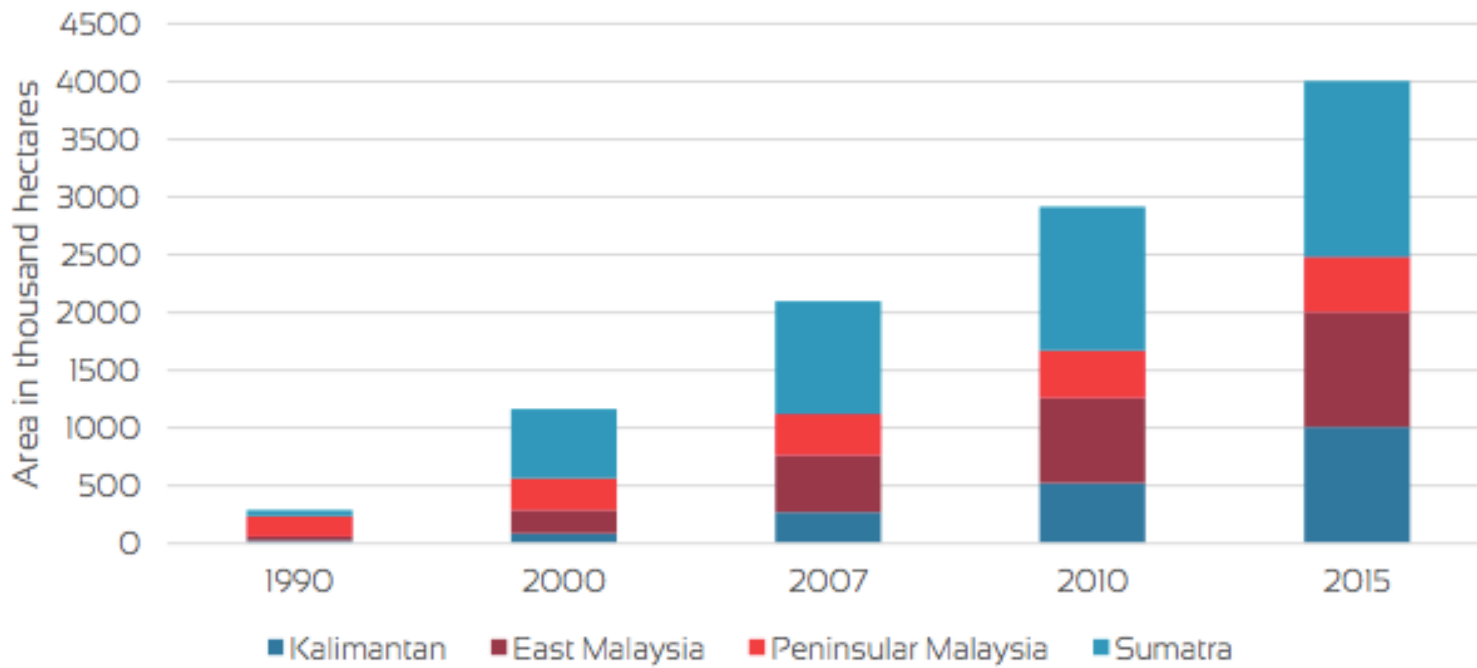
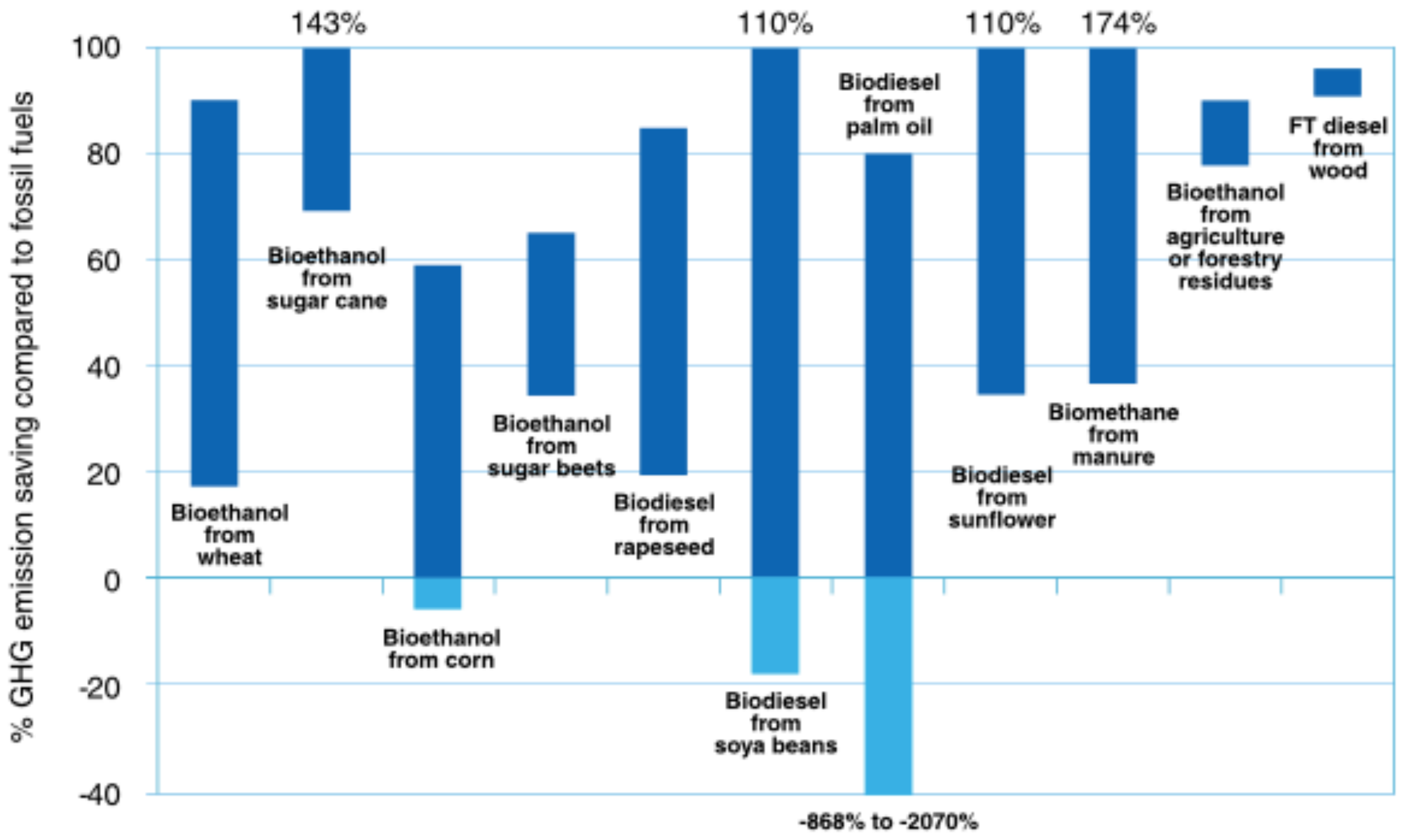


Figure 3. Area of oil palm plantations on peatland, 1990 – 2015 [33]

UNEPの調査(2009)Assessing Biofuels

Figure 4.3: Greenhouse gas savings of biofuels compared to fossil fuels



Sources: own compilation based on data from Menichetti/Otto 2008 for bioethanol and biodiesel, IFEU (2007) for sugar cane ethanol, and Liska et al. (2009) for corn ethanol; RFA 2008 for biomethane, bioethanol from residues and FT diesel

間接的土地利用変化(ILUC)の考慮

- <直接的土地利用変化:Direct Land Use Change(DLUC)>
- バイオマス原料の生産拡大のための新規農地開発による土地利用変化: 別の用途だったものが、原料生産のために転換される場合
- <間接的土地利用変化:Indirect Land Use Change(ILUC)>
- 既存の農地がバイオマス原料の生産拡大に利用されることで、食用や餌などの既存の生産が他の地域で新規農地開発を余儀無くされて起きる土地利用変化

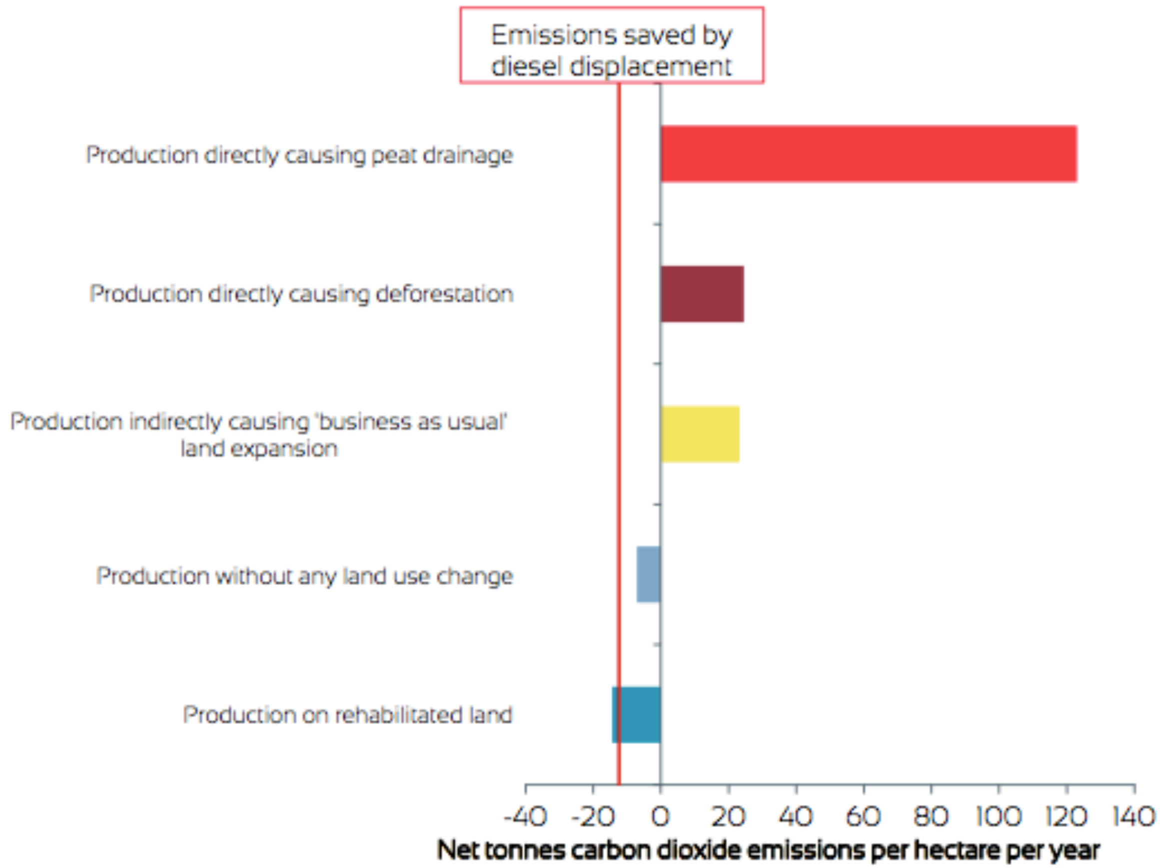


Figure 4. Comparison of emissions consequences for five different palm oil production cases

Note: Palm oil production is assumed to be accompanied by methane capture for these calculations.

研究報告のまとめ(Rainforest Foundation Norway)

Table 1. Summary of indirect land use change results for palm oil biodiesel, including overview of assumptions on peat conversion

Study	Peat emissions factor (tCO_2e/ha/yr)	Fraction of expansion on peat	Land use change emissions[1] (gCO_2e/MJ)
GLOBIOM [12]	61	~33%[2]	231
IFPRI MIRAGE (2011) [11]	55	30%	54
IFPRI MIRAGE (2010) [10]	19	~19%[3]	50
CARB [37]	95	50%	83
US EPA [38]	95	11.5%	58
US EPA (adjusted)[4]	95	33%	102

Notes on table: [1] *In Europe, the accounting convention is to divide emissions over 20 years. In the United States, the convention is to divide emissions over 30 years. Here, the outcomes of US studies have been adjusted (author's calculation) to reflect the EU accounting convention. This is done by adding 50% to all land use change emissions except peat emissions (because peat emissions are ongoing, the average annual emissions are only marginally affected by the accounting period chosen);* [2] *32% mean for Indonesia, 34% mean for Malaysia;* [3] *27% for Indonesia, 10% for Malaysia;* [4] *Several issues in the initial EPA analysis have been identified by the International Council on Clean Transportation [56]. The 'adjusted' case for EPA gives a recalculated ILUC result (author's calculation) to reflect European time accounting, 33% location of new palm plantations on peatland and more reasonable palm oil yield assumptions.*

化石燃料ディーゼルとパーム油バイオディーゼルの比較

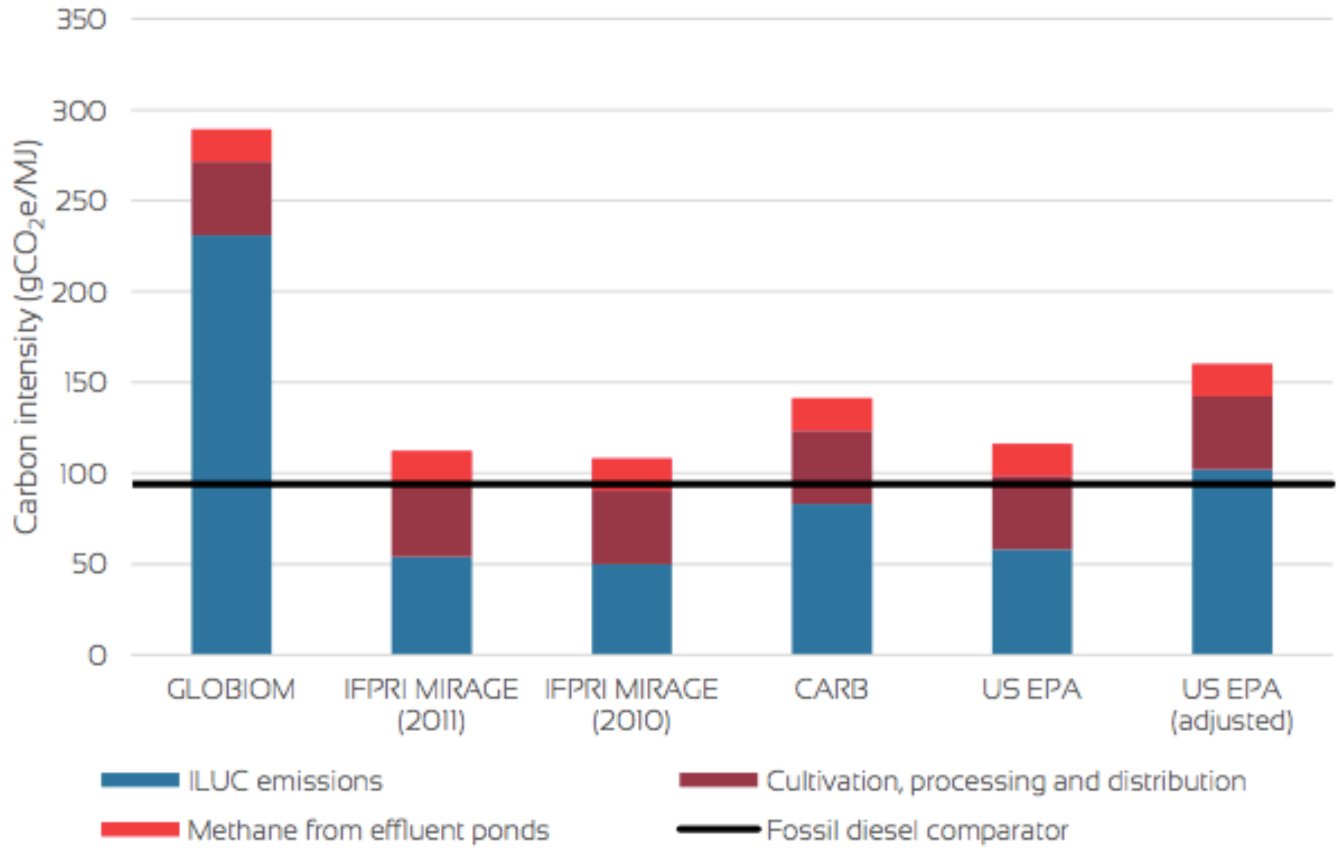


Figure 1. Lifecycle carbon intensity of palm oil biodiesel compared to fossil diesel

Note: Direct emissions from RED II proposal Annex V [1], ILUC estimates as labelled and detailed in the main text below.

GLOBIOM：EUの委託調査(2015)

The land use change impact of biofuels consumed in the EU

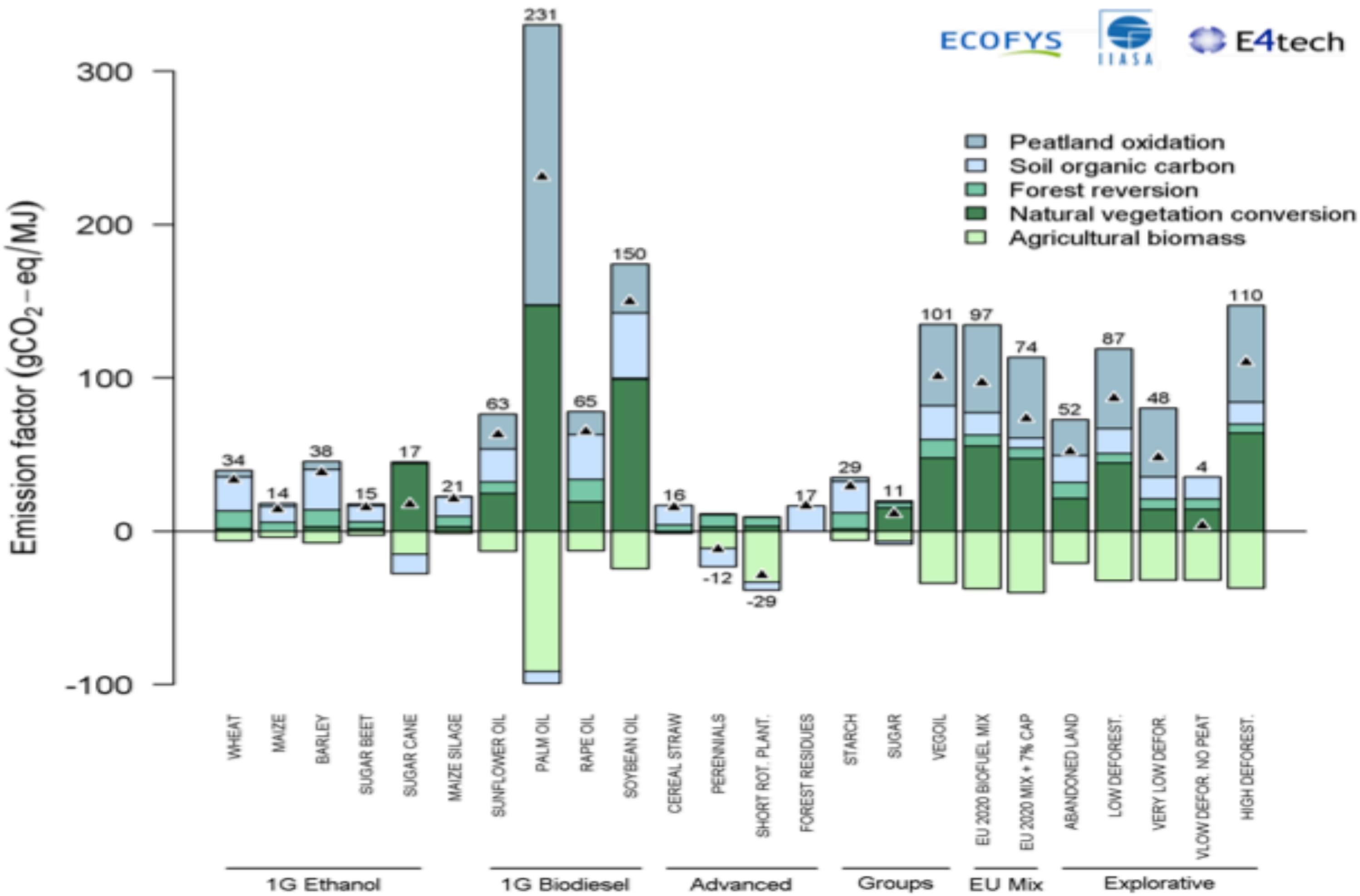
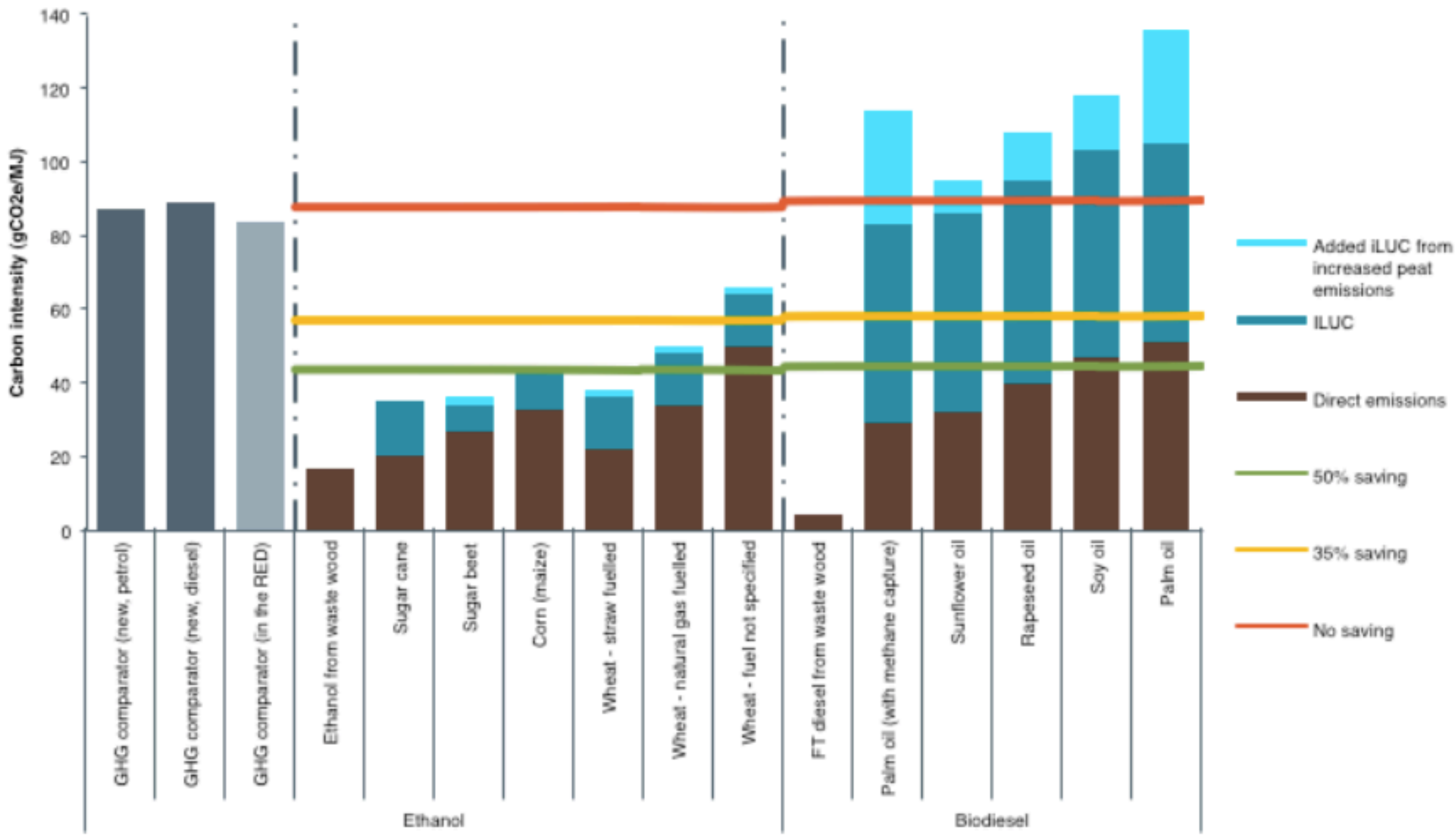


Figure 2: Overview of modelling results: LUC emissions per scenario. Source: GLOBIOM

IFPRI: International Food Policy Research Institute(2011)

Figure 1. Emissions from different biofuel pathways based on the 'typical' direct emissions specified in the Renewable Energy and Fuel Quality Directives and the new IFPRI MIRAGE iLUC factors



パーム油の様々な問題と持続可能性

- 気候変動リスク：パリ条約目標達成？
- 生物多様性喪失リスク：SDGs達成？
- 強制労働、児童労働、労働権、
- 土地権侵害リスク：指導原則達成？

- 汚職・違法開発への関与リスク
- 規制強化のリスク
- 投資引き上げのリスク

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  www.plantation-watch.org
- パーム油調達ガイド
  http://palmoilguide.info

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