

# **Life Cycle Assessment of Malaysian Palm Oil** *– improvement options and comparison with European rapeseed oil*

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# Presentation

- Methods and data
- Product system and material flows
- Results: Average Malaysian Palm oil
- Results: Improvement options
- Results: Comparison with European rapeseed oil

## Life cycle assessment of palm oil at United Plantations Berhad



UNITED PLANTATIONS BERHAD  
UNIP

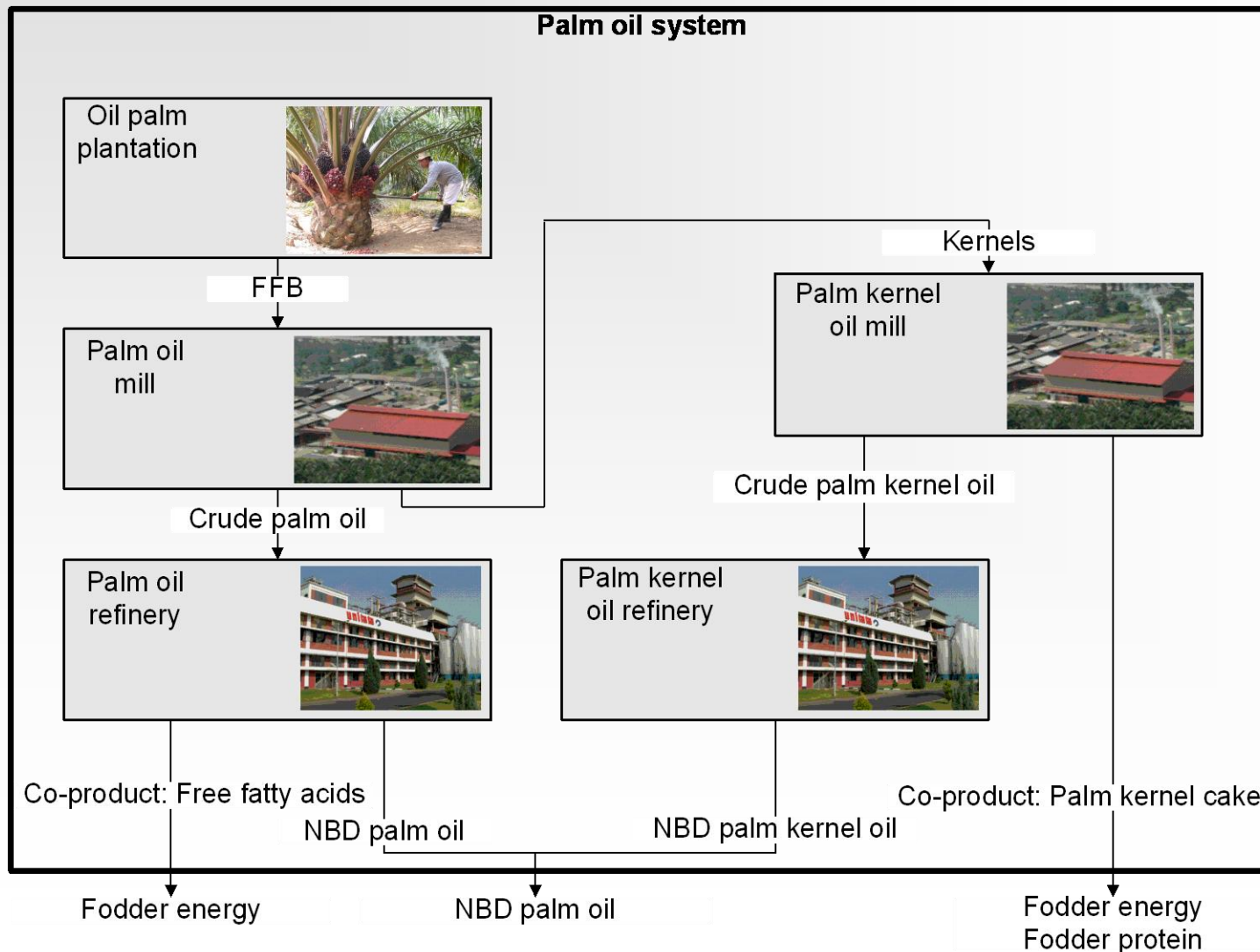
# Methods

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- **Life cycle assessment:** compliant with ISO 14040 and 14044
- **Functional unit:** 1 t refined (NBD) vegetable oil for food purposes
- **Data:**
  - Foreground data:
    - Palm oil system: Detailed data collection at United Plantations Berhad
    - Rapeseed oil system: PhD thesis, [people.plan.aau.dk/~jannick/research.htm](http://people.plan.aau.dk/~jannick/research.htm)
    - Field emissions: Detailed nutrient balances and IPCC emission factors
  - Background data:
    - Statistics, literature and Ecoinvent LCI database, [www.ecoinvent.ch](http://www.ecoinvent.ch)
- **Impacts:** Focus on GHG-emissions



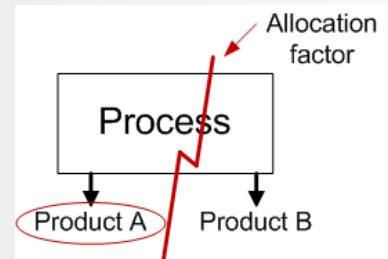
# Methods: System boundary - Cradle to gate



# Methods: Consequential modelling

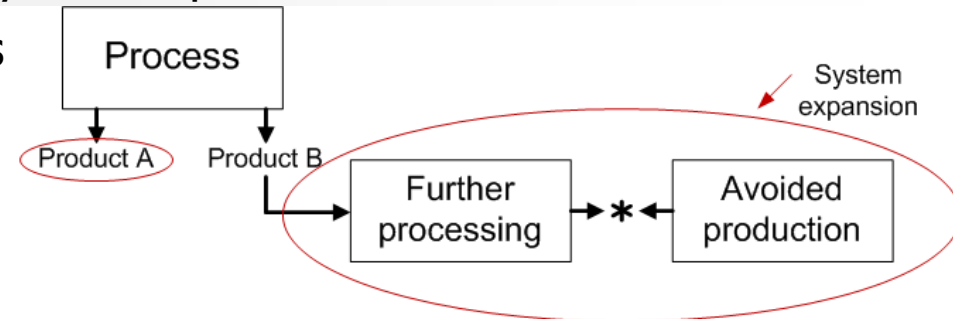
## ▪ **Attributional:**

- Co-products: Allocation factor
- Processes: Market average



## ▪ **Consequential:**

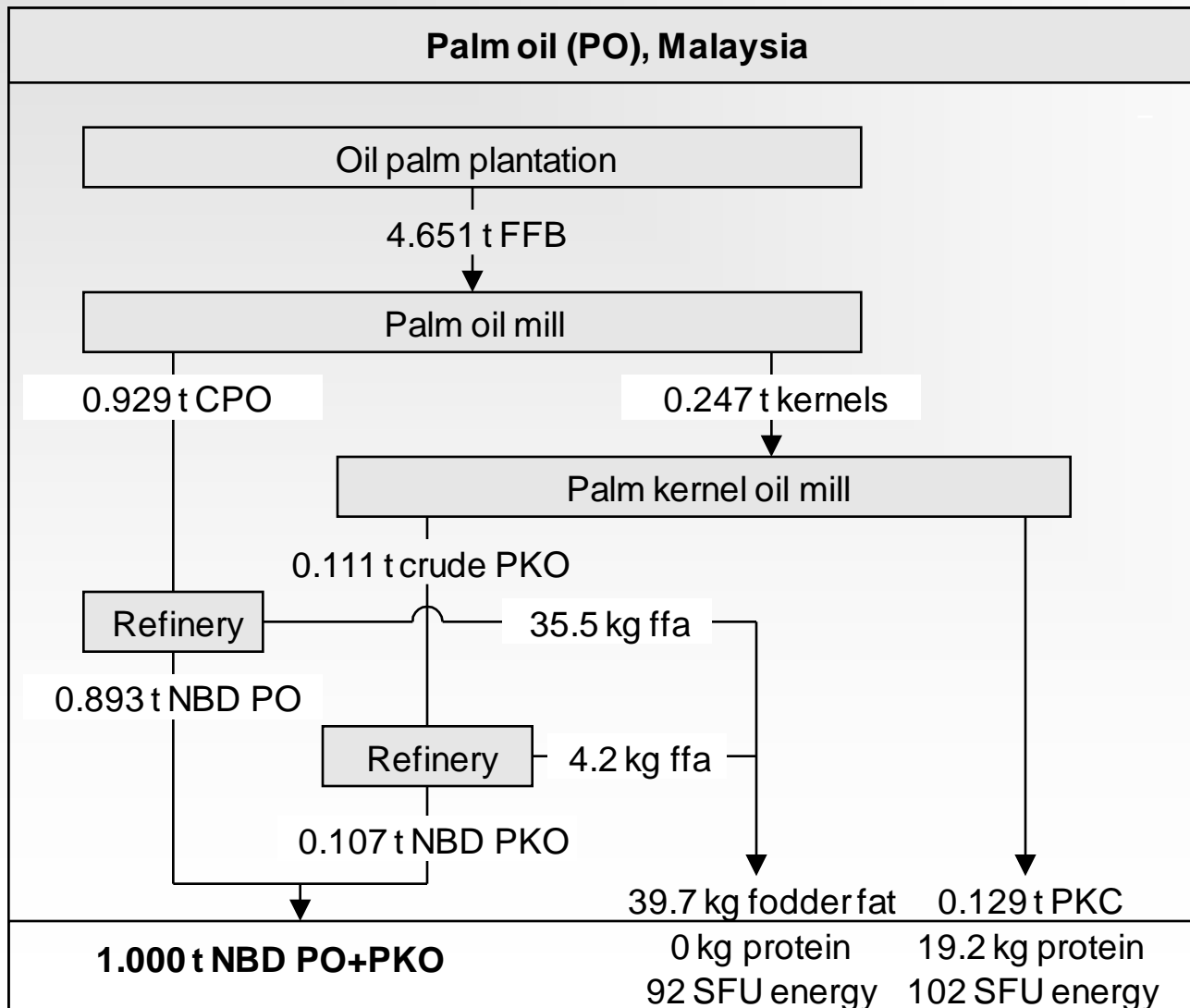
- Co-products: Allocation avoided by system expansion
- Processes: Actual affected processes



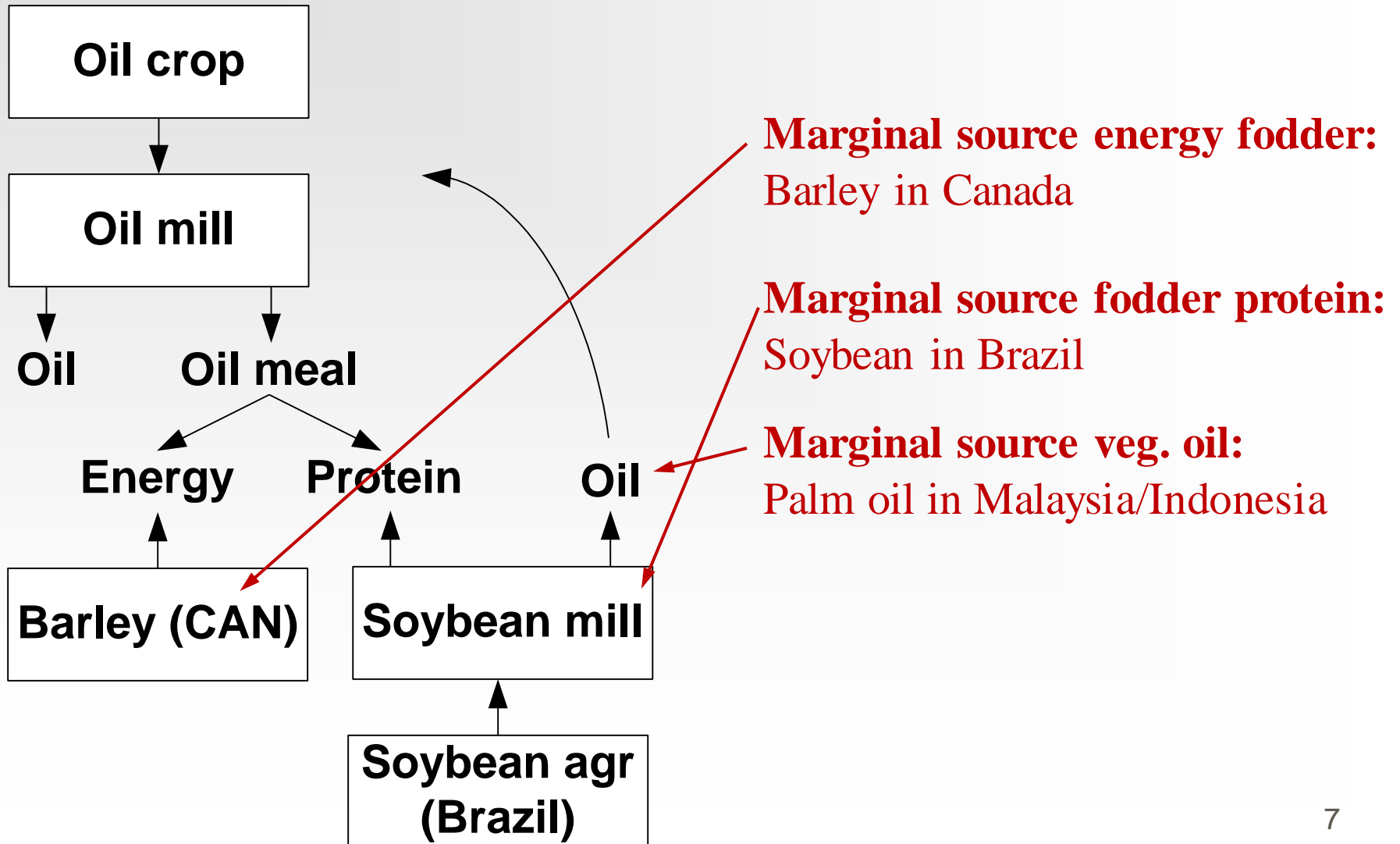
## ▪ **Why consequential?**

- Allocation ignores processing and product substitutions caused by co-products
- Market average includes processes which can not be affected
- Therefore attributional modelling may lead to misleading results

# Product system and material flows



# Product system: By-products and system expansion

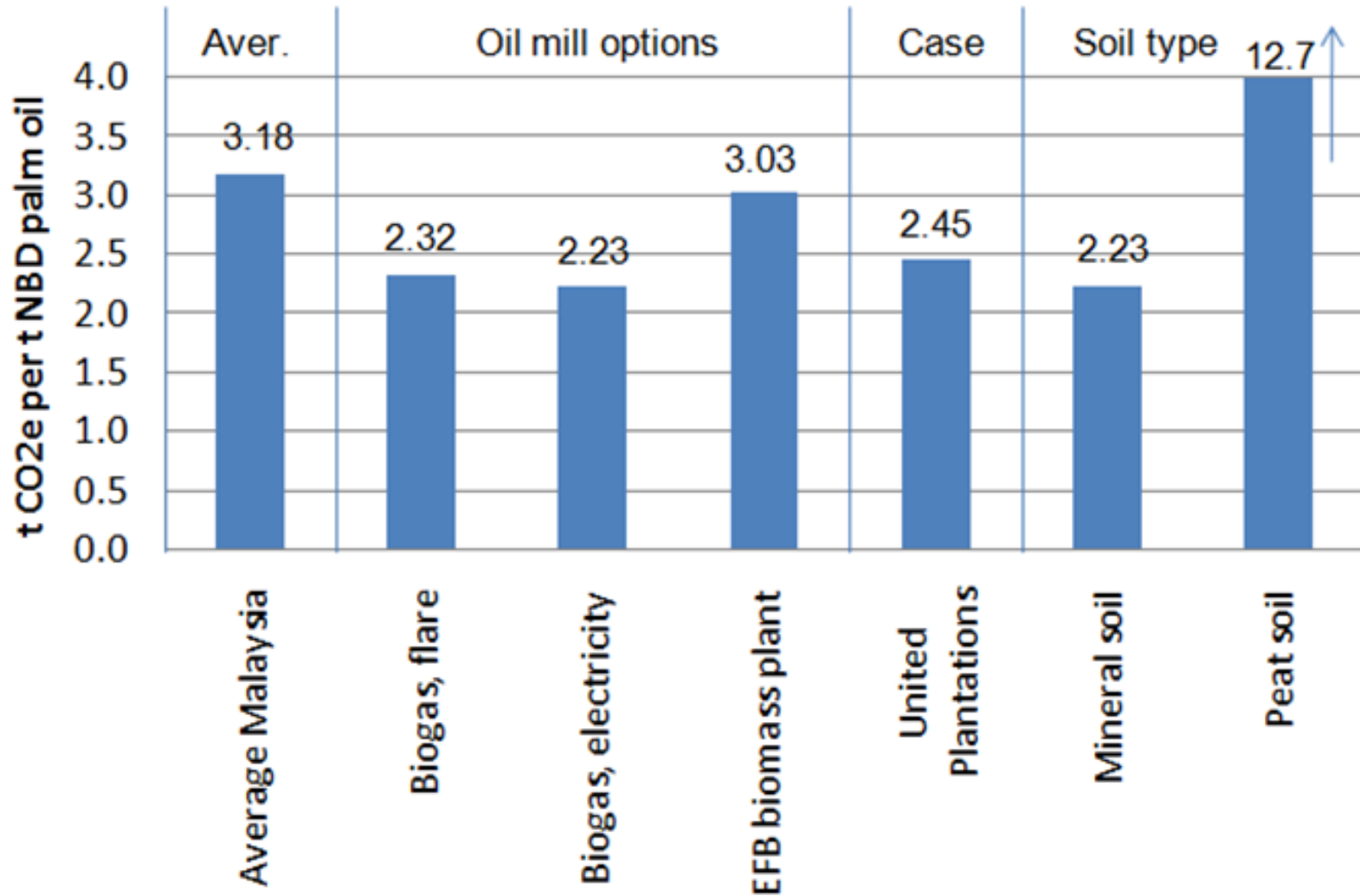


# Results: Average Malaysian Palm oil

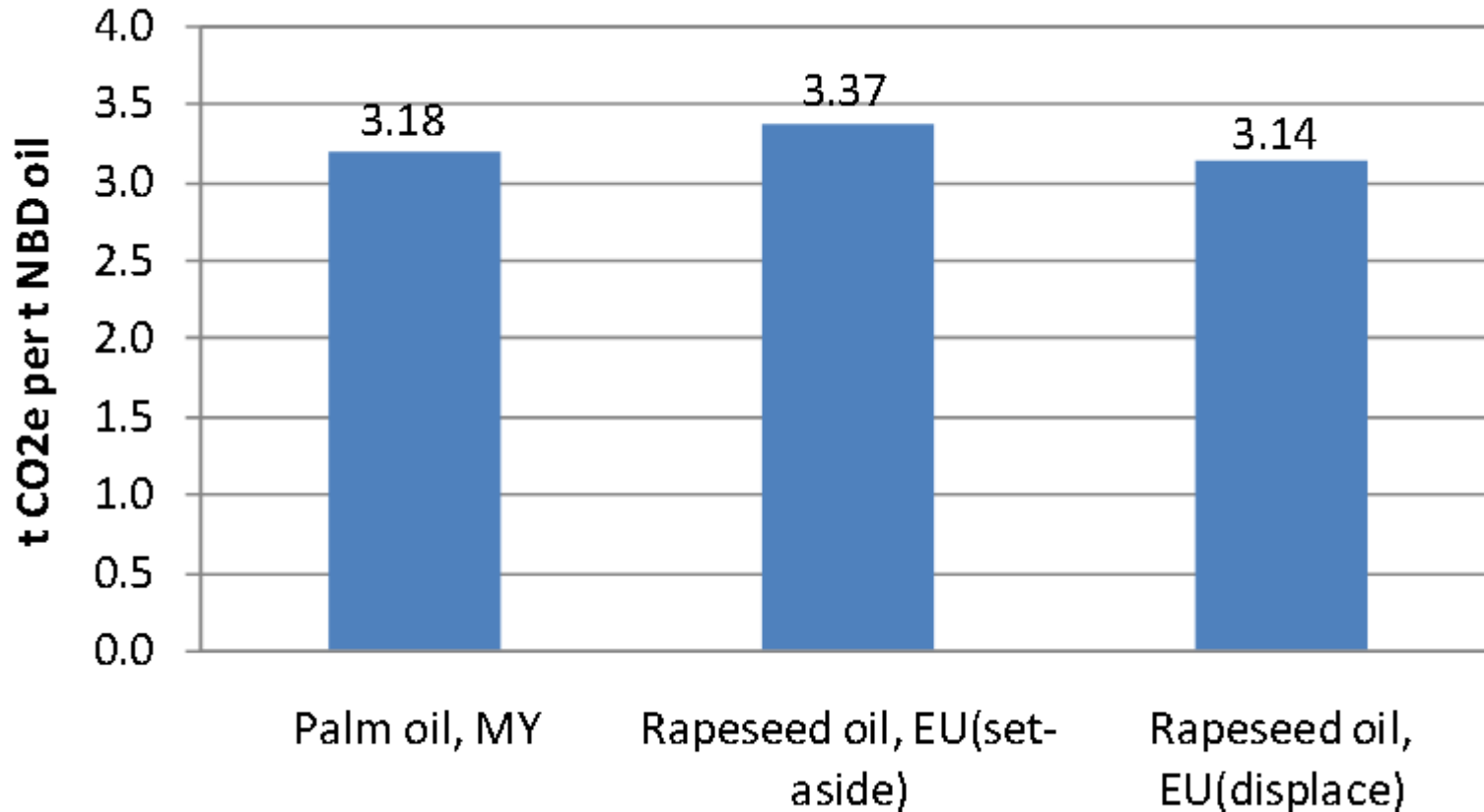
Life cycle stage	Specification	GHG-emission (t CO <sub>2</sub> e/t NBD oil)	
		Contribution	Total
Oil Palm Plantation	Field emissions	1.92	
	Fertiliser input	0.32	
	Other	0.082	
	<b>Total</b>		<b>2.32</b>
Palm Oil Mill Stage (palm and palm kernel oil)	POME emissions (CH <sub>4</sub> )	0.932	
	POME appl. on land	-0.064	
	EFB appl. on land	-0.024	
	Electricity sold to grid	-0.018	
	Palm kernel oil mill	0.035	
	Other	0.050	
	<b>Total</b>		<b>0.911</b>
Palm Oil Refinery Stage (palm and palm kernel oil)	<b>Total</b>		<b>0.084</b>
System Expansion	Soybean system	0.0014	
	Barley system	-0.143	
	<b>Total</b>		<b>-0.142</b>
<b>Total</b>			<b>3.18</b>



# Results: Improvement options



# Results: Comparison with European rapeseed oil



# Conclusion

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- **Average Malaysian Palm Oil**

- 3.18 t CO<sub>2</sub>e per t NBD palm oil
- Most significant GHG-emissions:  
Field emissions (N<sub>2</sub>O and CO<sub>2</sub>) and POME treatment (CH<sub>4</sub>)

- **Improvement options at UP**

- Biogas electricity generation/flare: -30% / -27%
- Biomass plant -5%
- Avoiding peat cultivation -30%
- All combined -65%

- **Comparison with European rapeseed oil**

- Palm oil from Malaysia from 6% less to 1% more GHG-emissions