Substitution in vegetable oil markets

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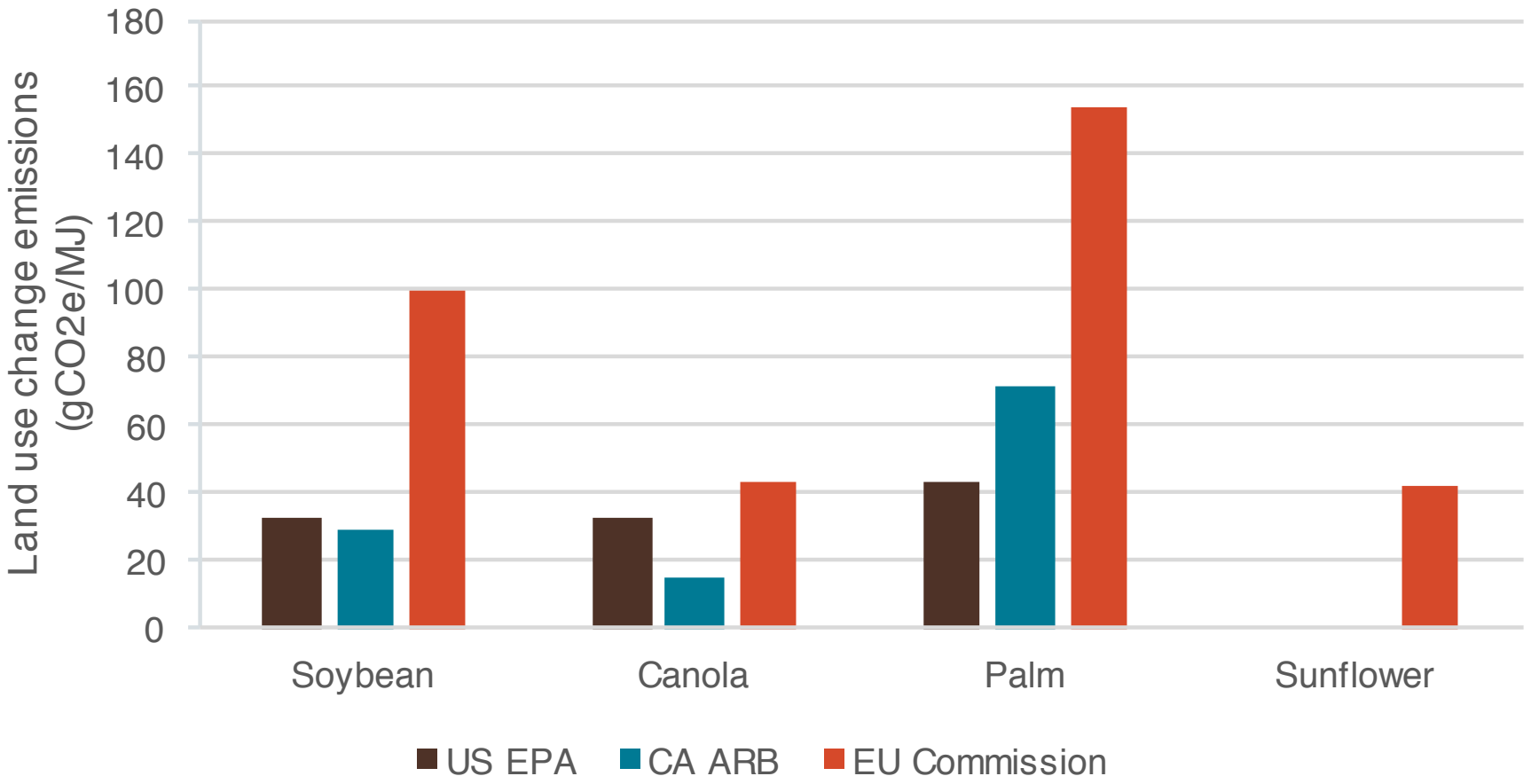
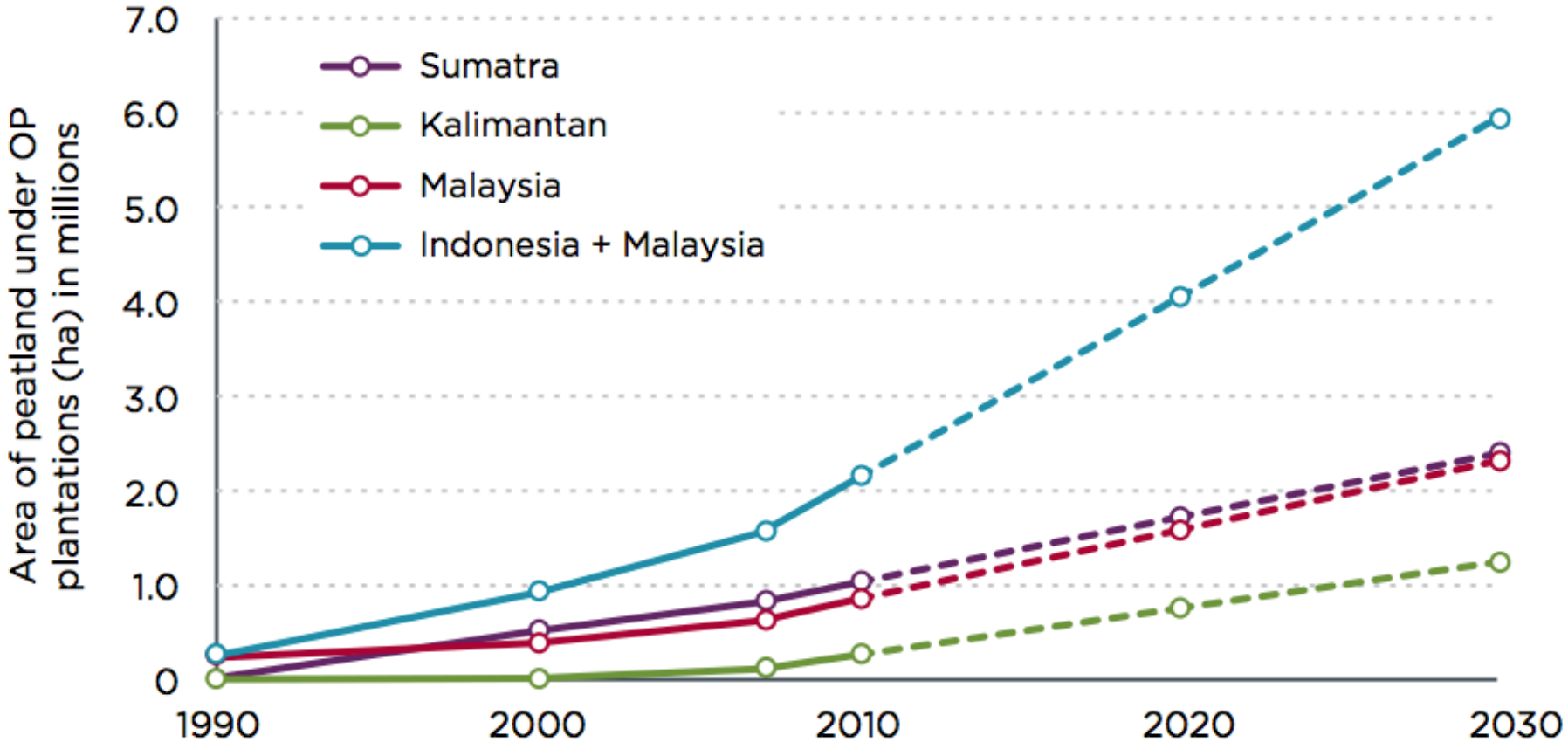
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Land use change impacts of vegetable oils



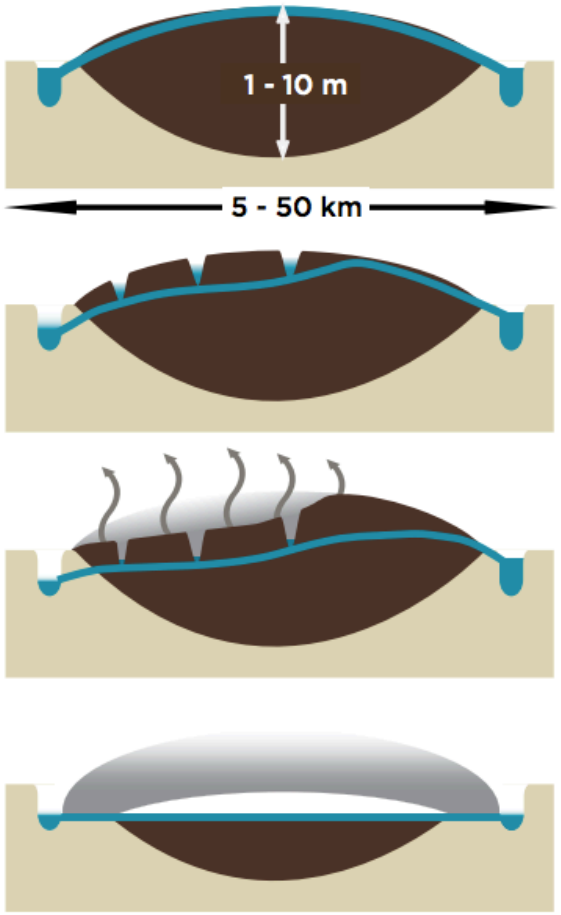
Land use change emissions only are shown. This figure does not include direct fuel processing and transport emissions or other agricultural changes. All results shown with 30 year ammortization.

1/3 new palm plantations on drained peat soils



Miettinen et al., 2012

Peat drainage results in massive CO2 loss



Natural situation:
- Water table close to surface
- Peat accumulation from vegetation over thousands of years

Drainage:
- Water tables lowered
- Peat surface subsidence and CO_2 emission starts

Continued drainage:
- Decomposition of dry peat: CO_2 emission
- High fire risk in dry peat: CO_2 emission
- Peat surface subsidence due to decomposition and shrinkage

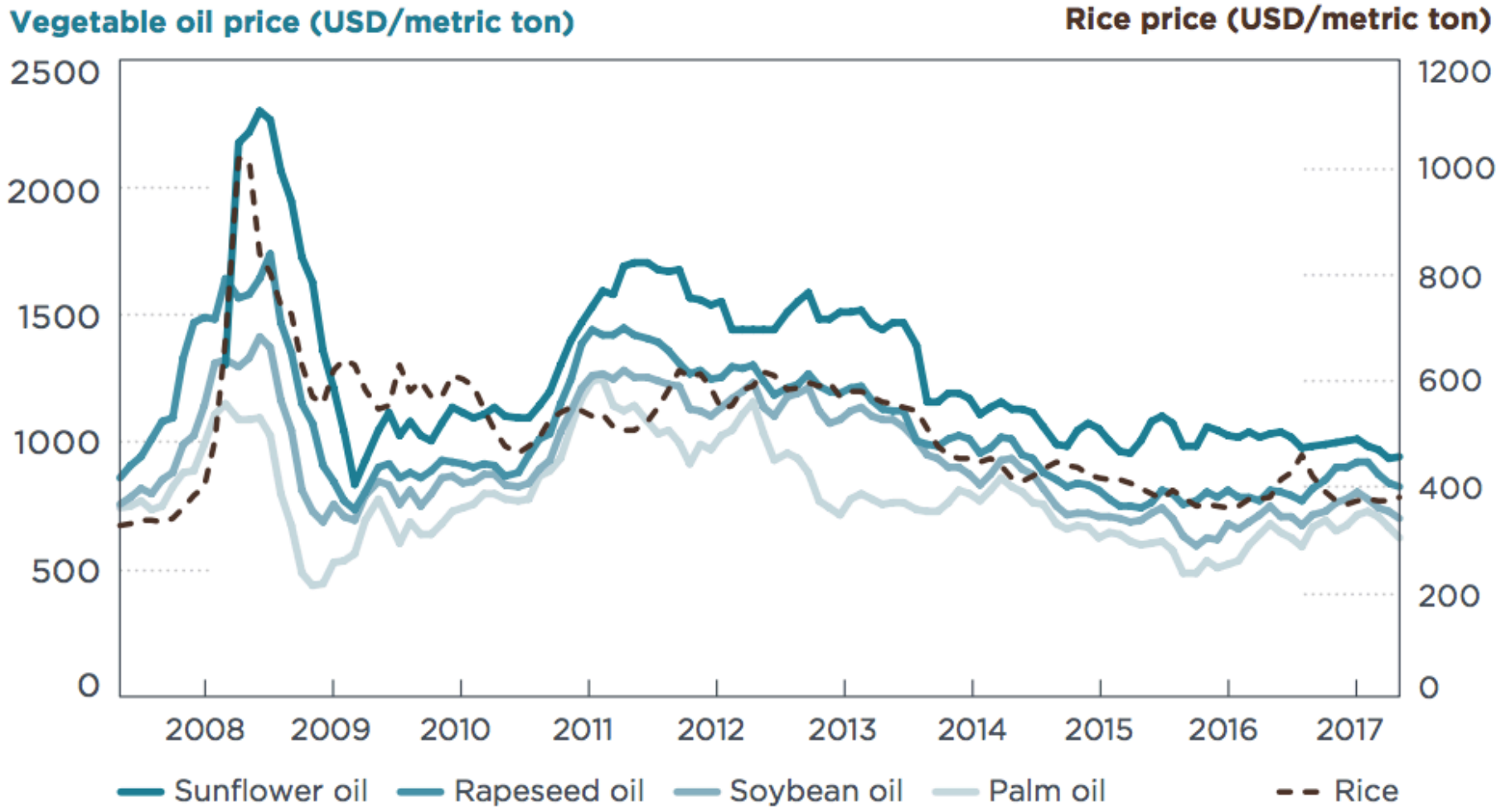
End stage:
- Most peat carbon above drainage limit released to the atmosphere within decades,
- unless conservation / mitigation measures are taken

Water table
Peat dome
Clay / sand
Stream channels
former extent of peat dome

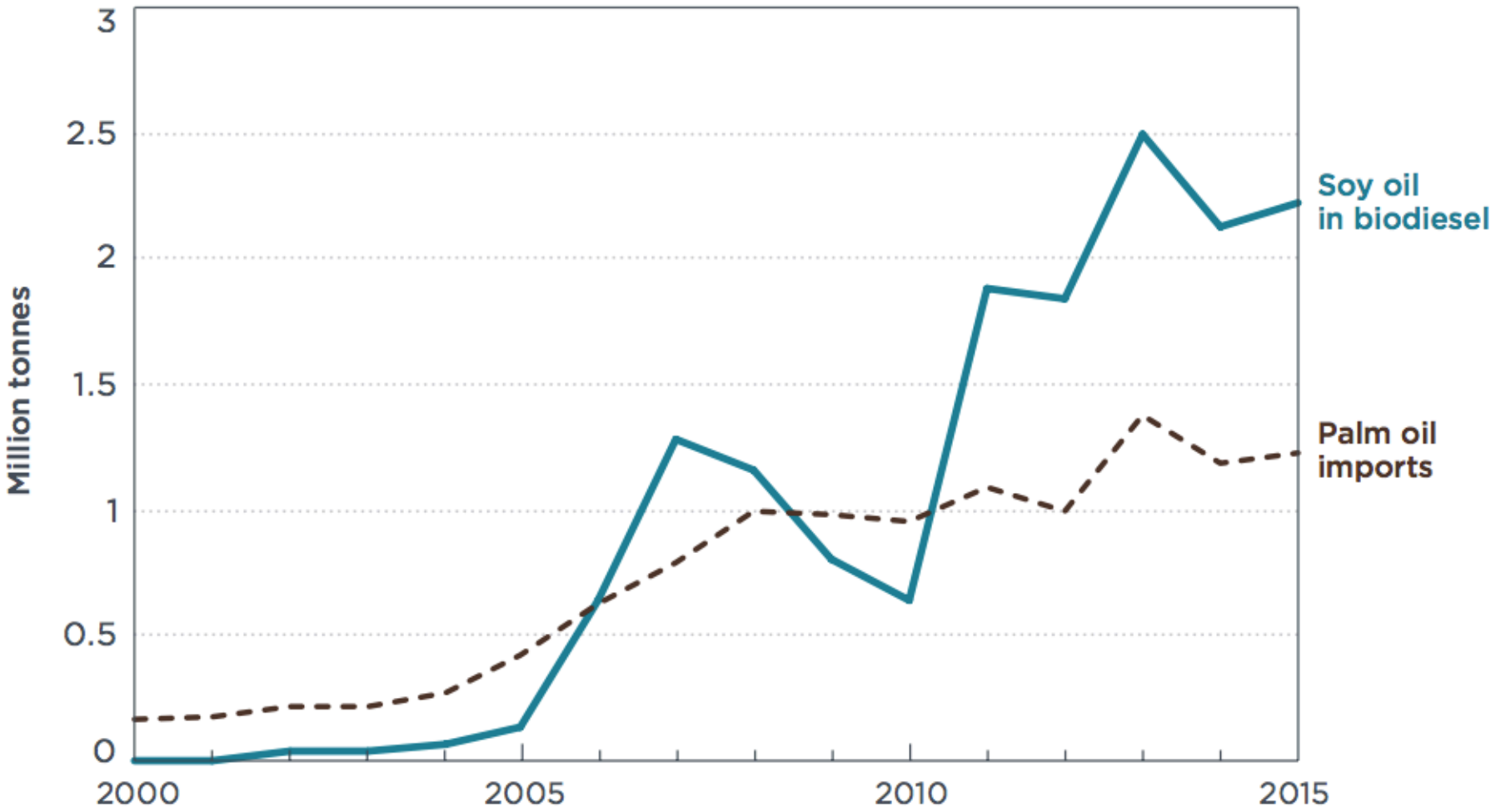
Page et al., 2011

Vegetable oils are similar in many uses

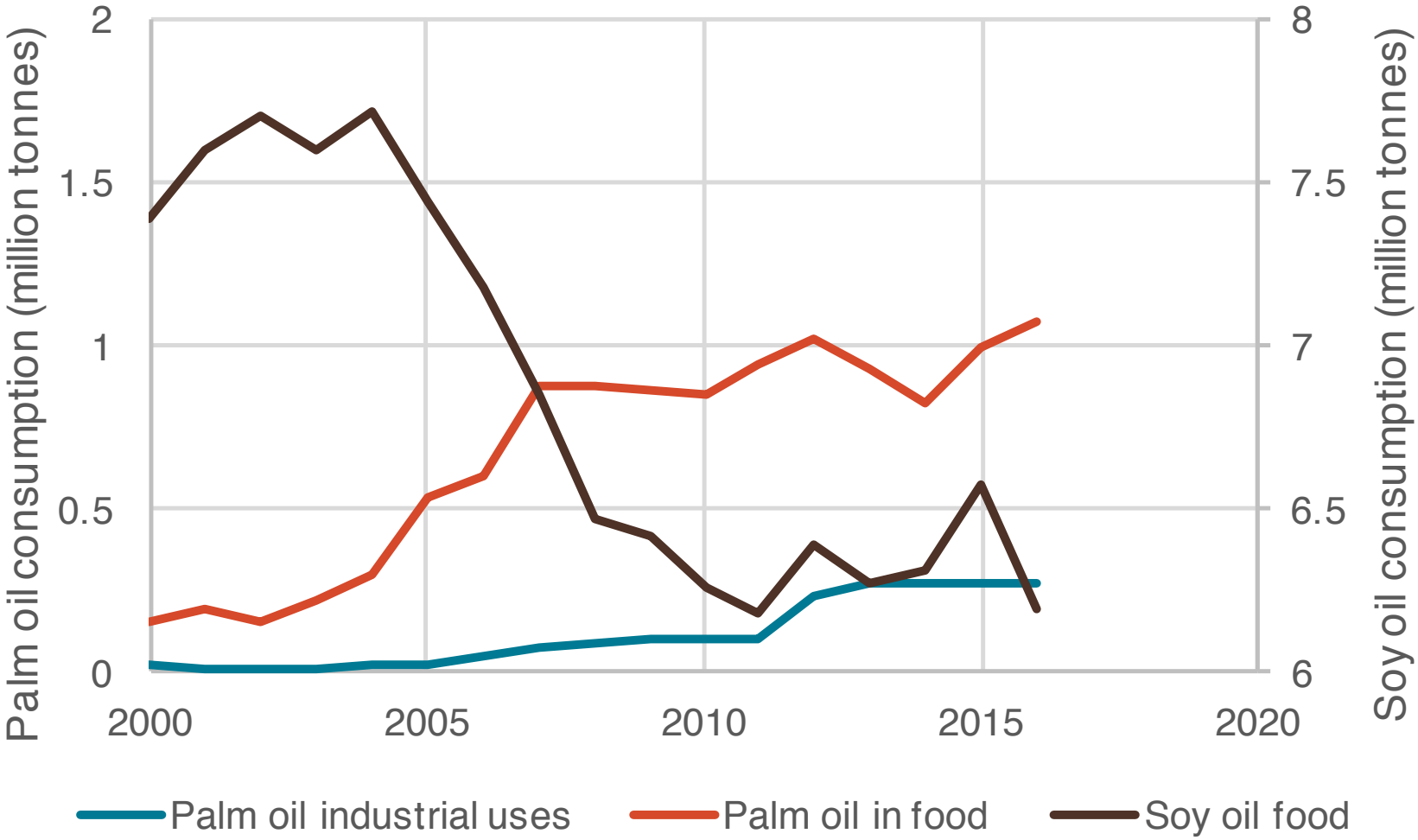
Vegetable oil markets linked



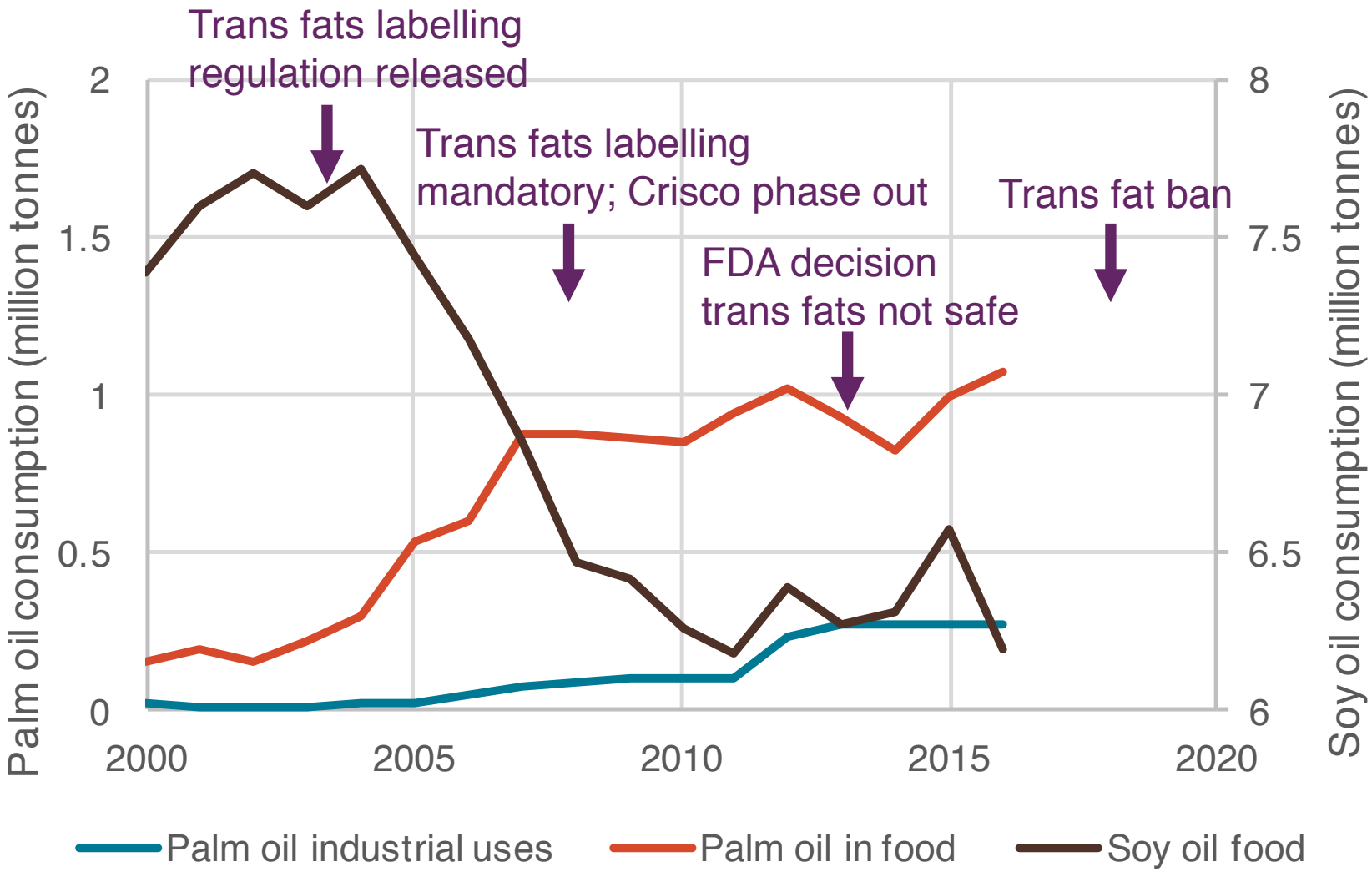
US: palm oil increase tracks soy oil use



Changes in US non-biodiesel oil consumption



Trans fats phase out



Palm oil is similar to hydrogenated soy and canola

Ingredients

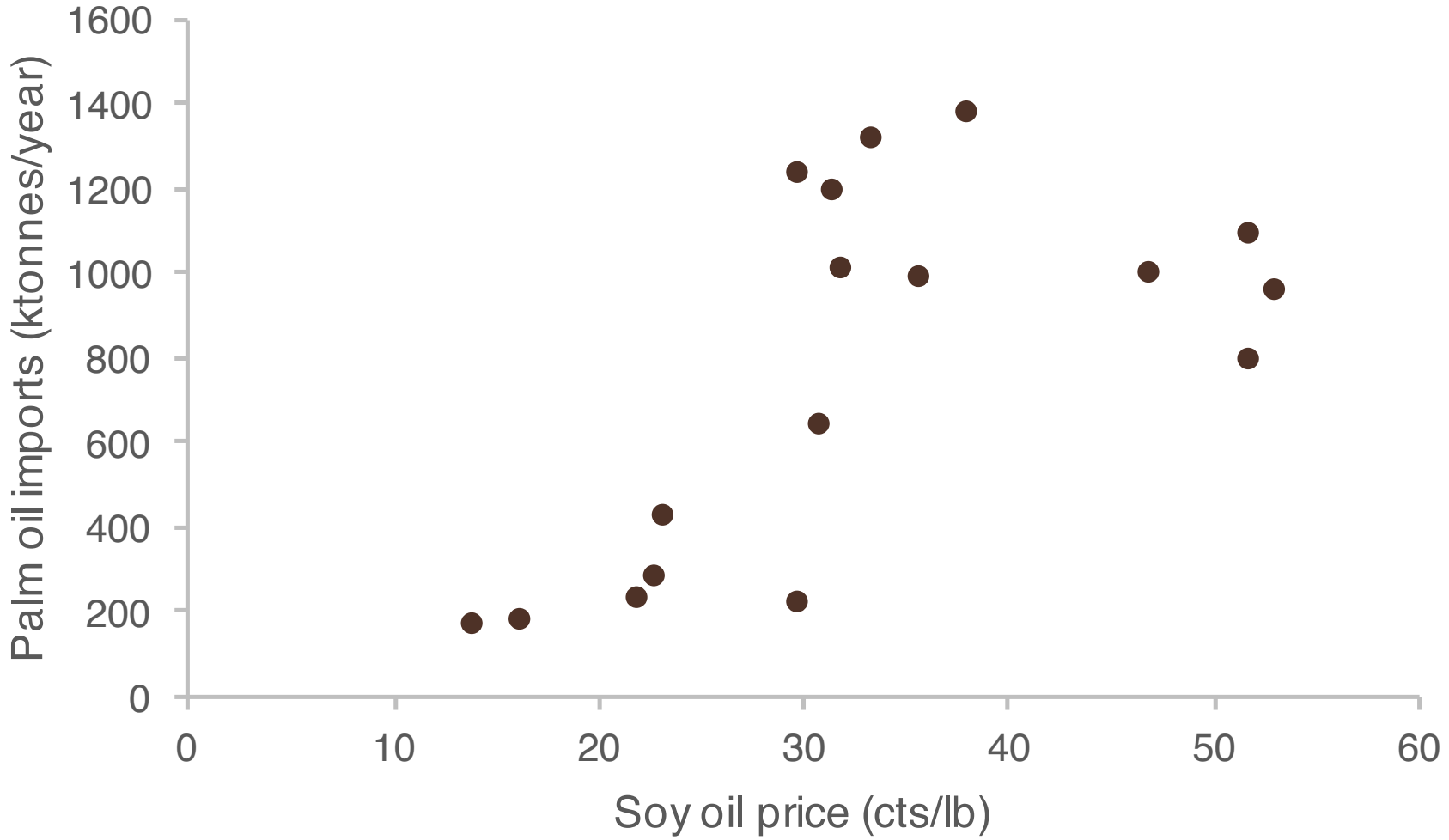
Soybean Oil, Fully Hydrogenated Palm Oil, Palm Oil, Mono And Diglycerides, TBHQ And Citric Acid (Antioxidants).

Nutrition information from Crisco's website

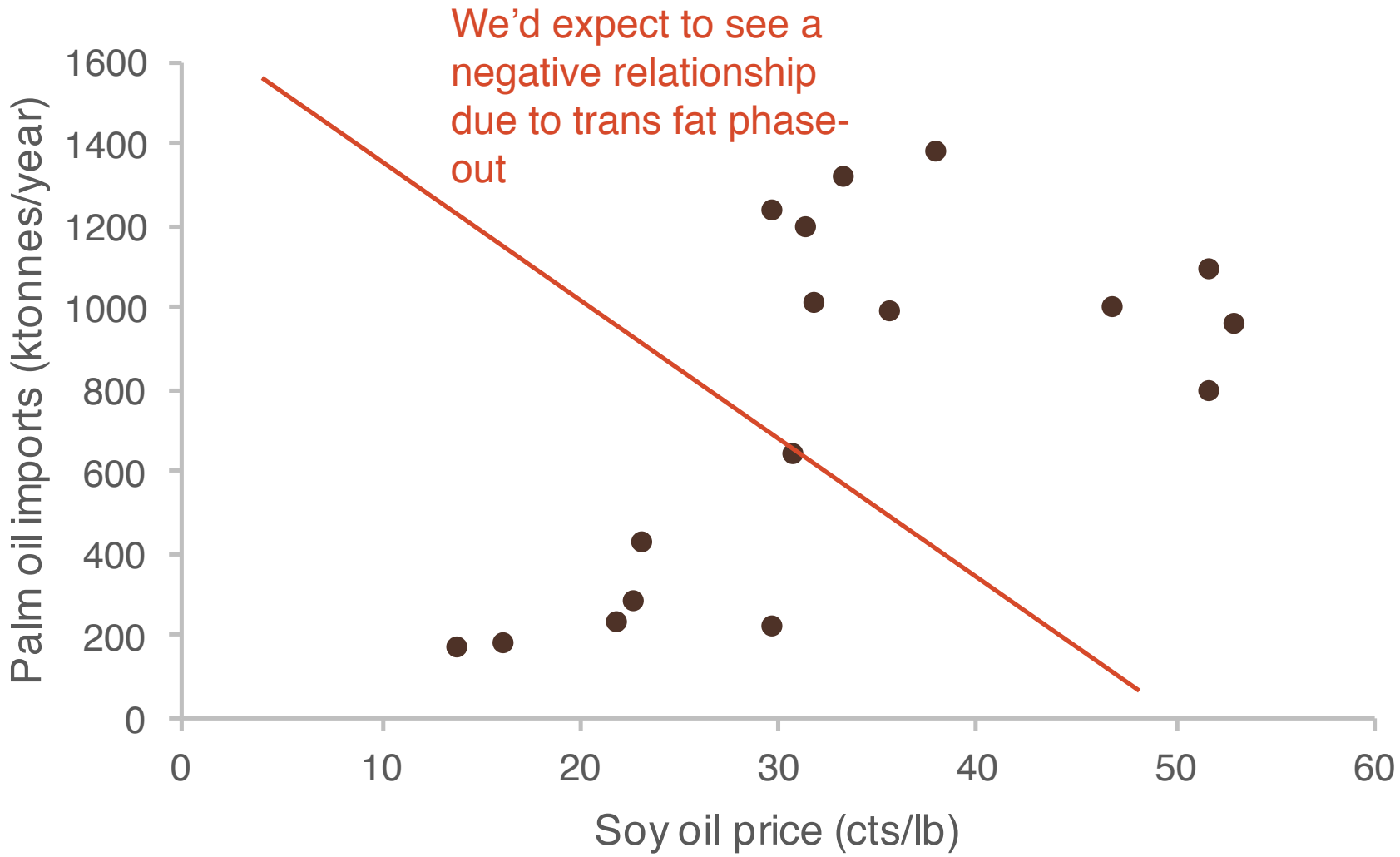
Multiple solutions to avoiding trans fats

- Palm oil, coconut oil
- Mixture of fully hydrogenated and non-hydrogenated soybean oil
- Partially hydrogenated soybean oil with high pressure process to reduce trans fats below labelling limit

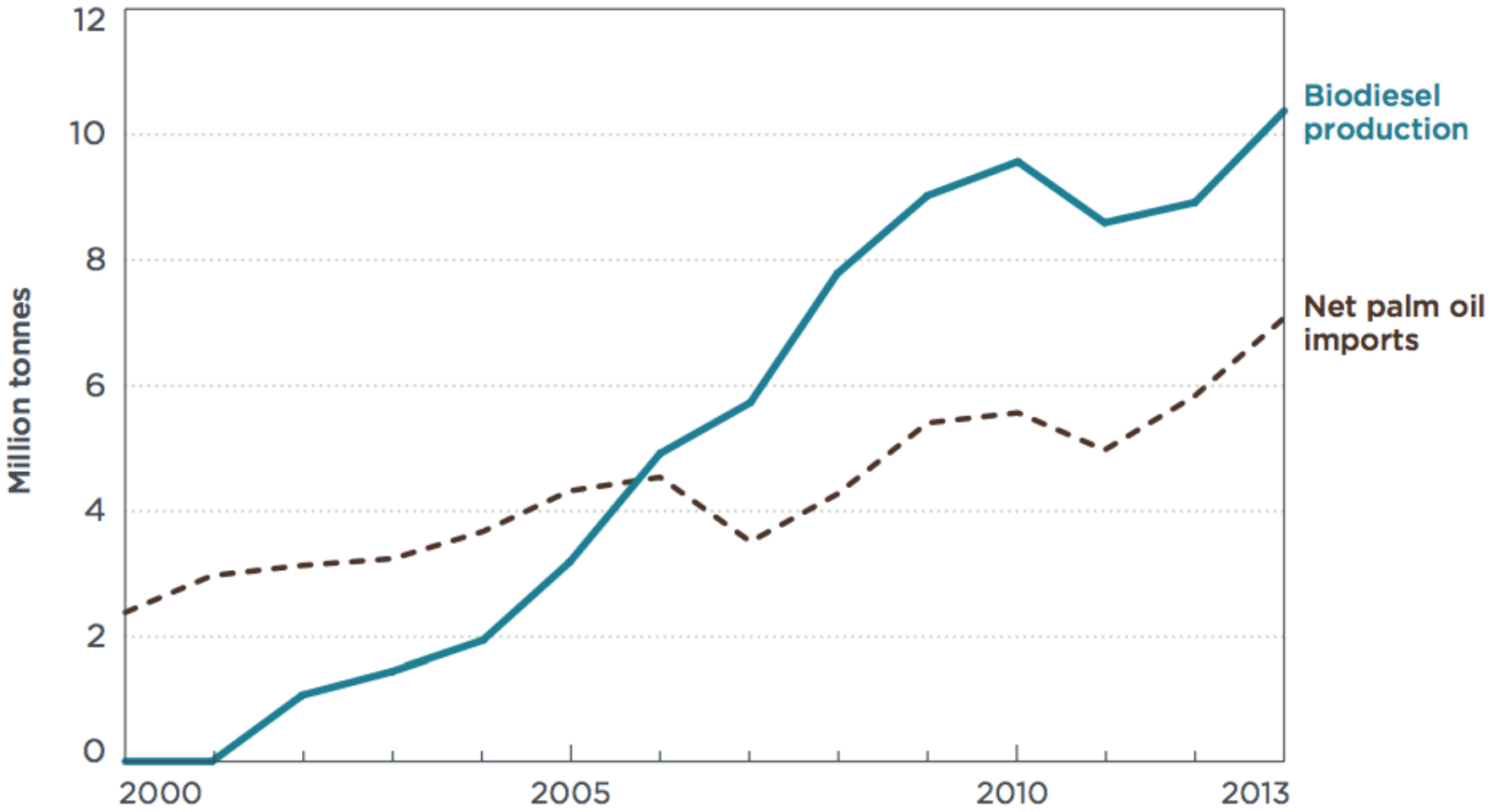
US palm oil imports vs. soy oil price 2000-2016



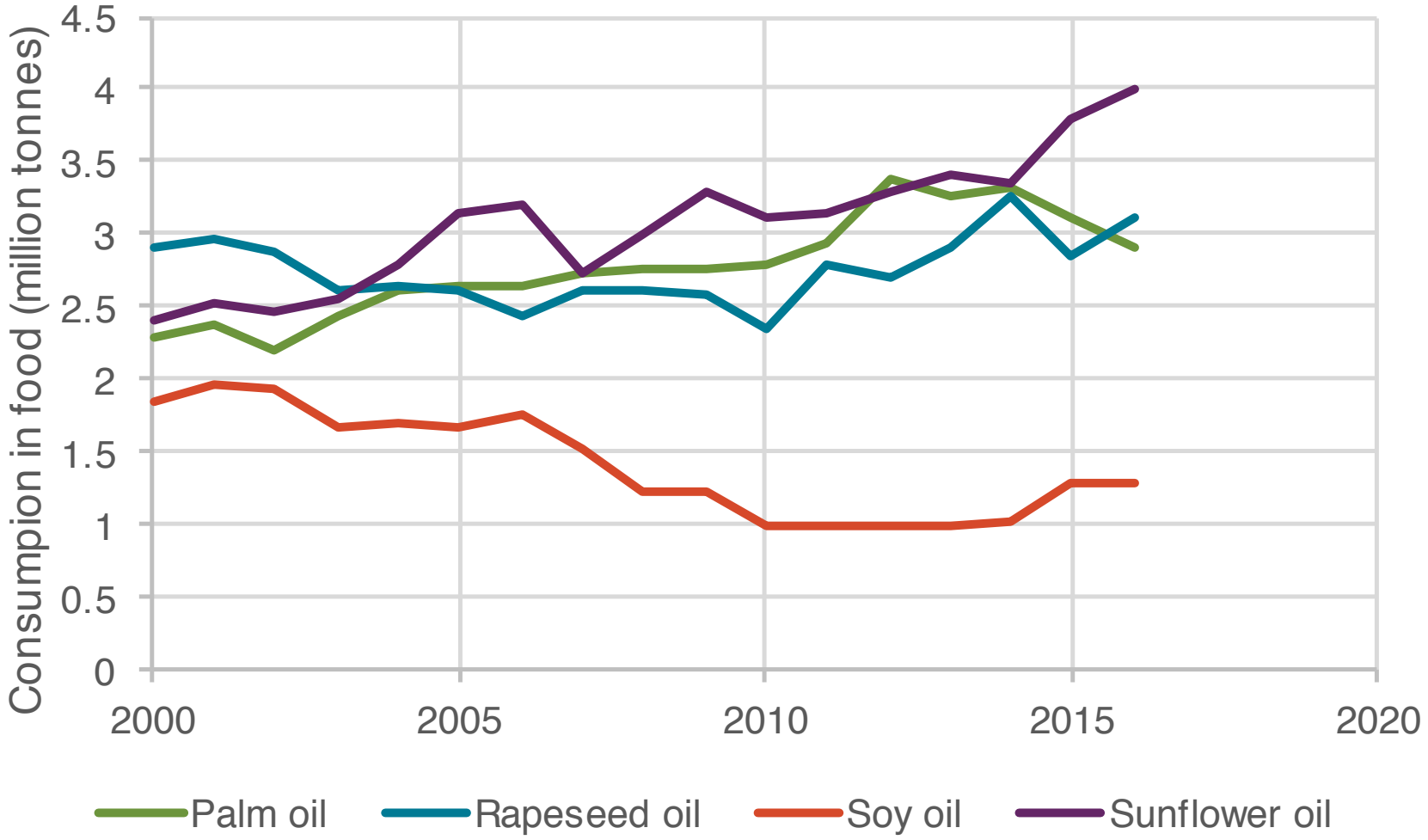
US palm oil imports vs. soy oil price 2000-2016



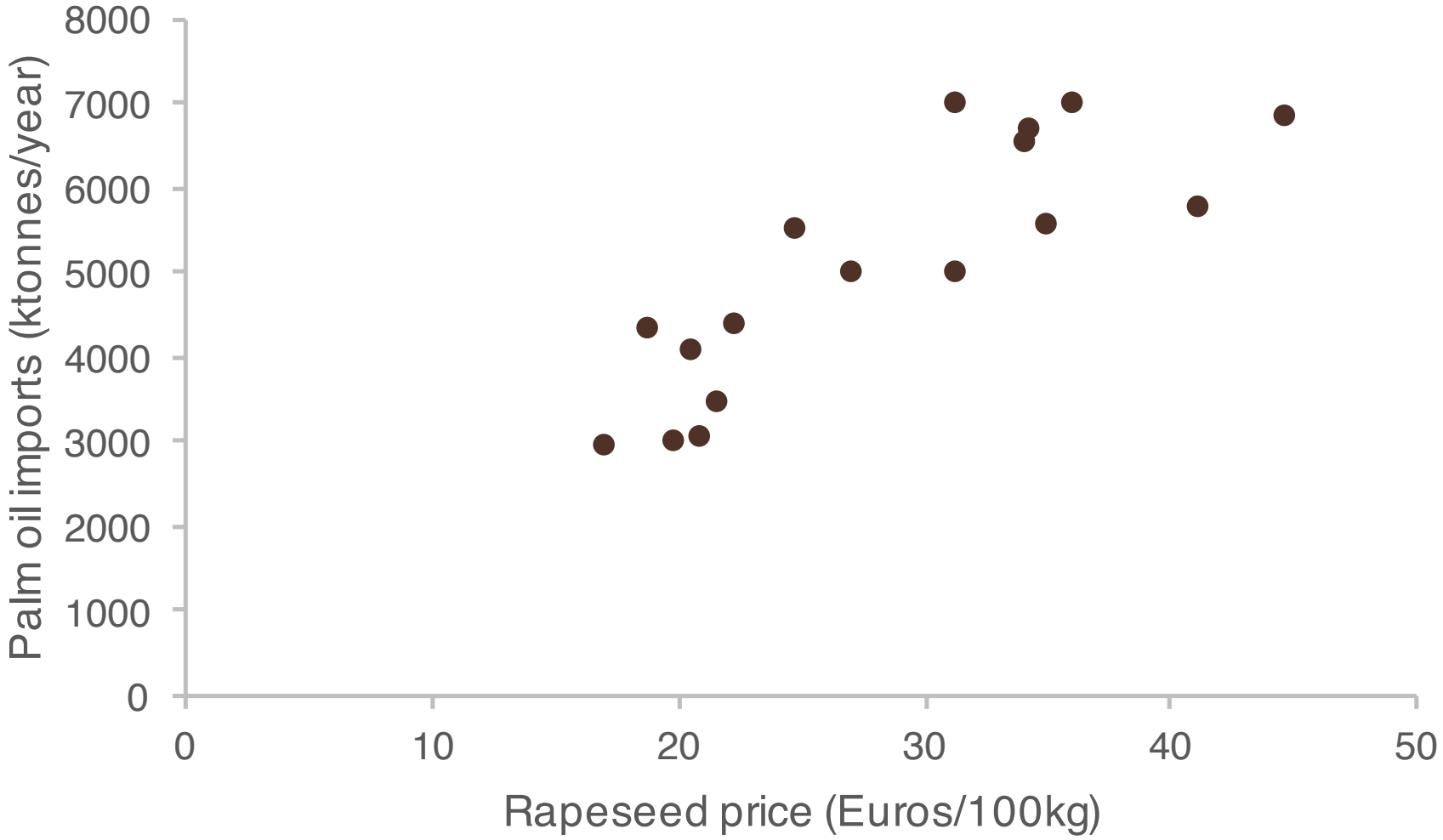
EU: palm oil imports rise with biofuel mandate



Changes in food consumption in the EU



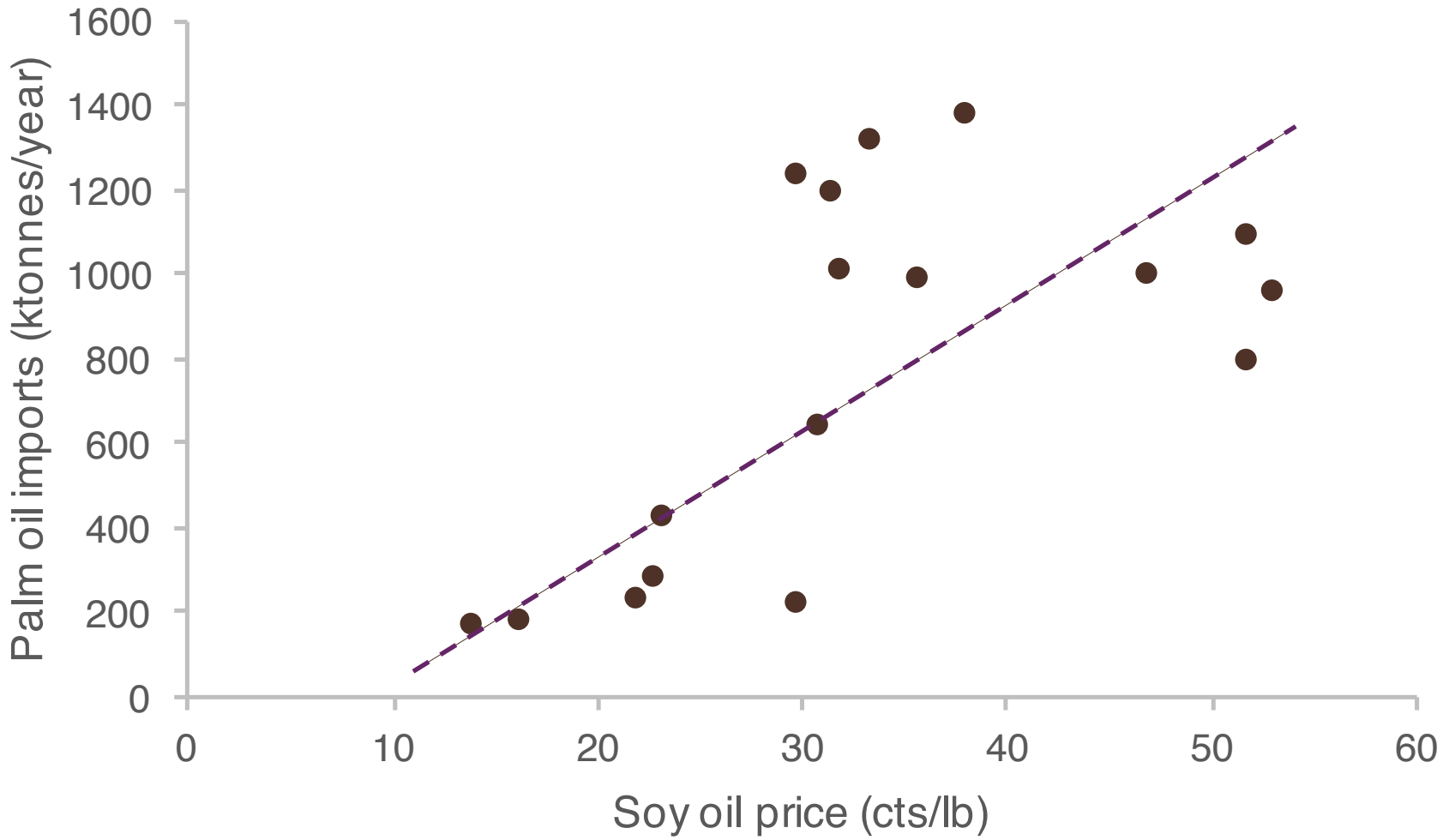
EU palm oil imports vs. rapeseed price 2000-2016



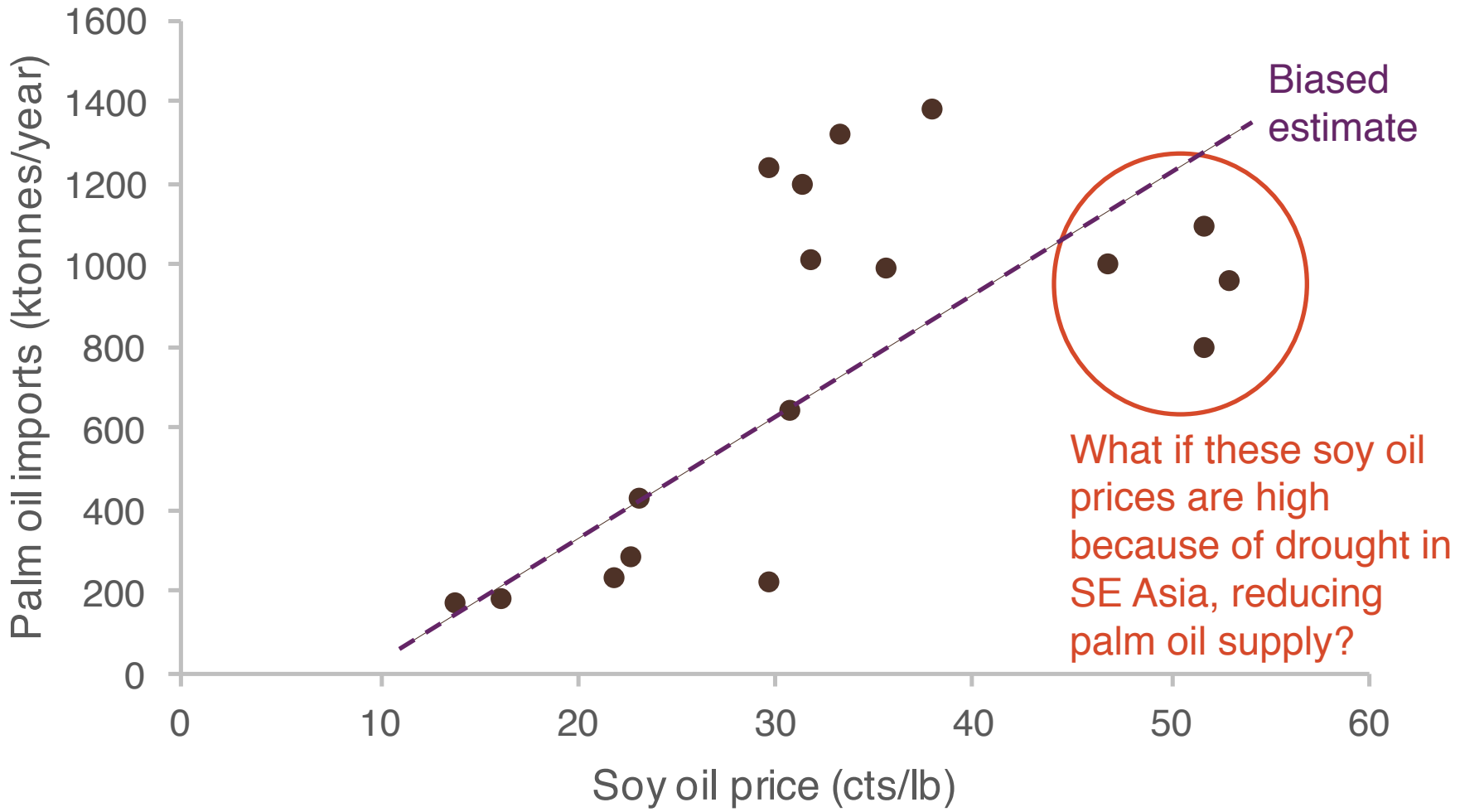
Santeramo (2017)

- ICCT commissioned economists at University of Foggia, Italy
- Estimate own-price and cross-price elasticities for vegetable oils in EU, US
- Regression analysis using instrumental variables (IVs)

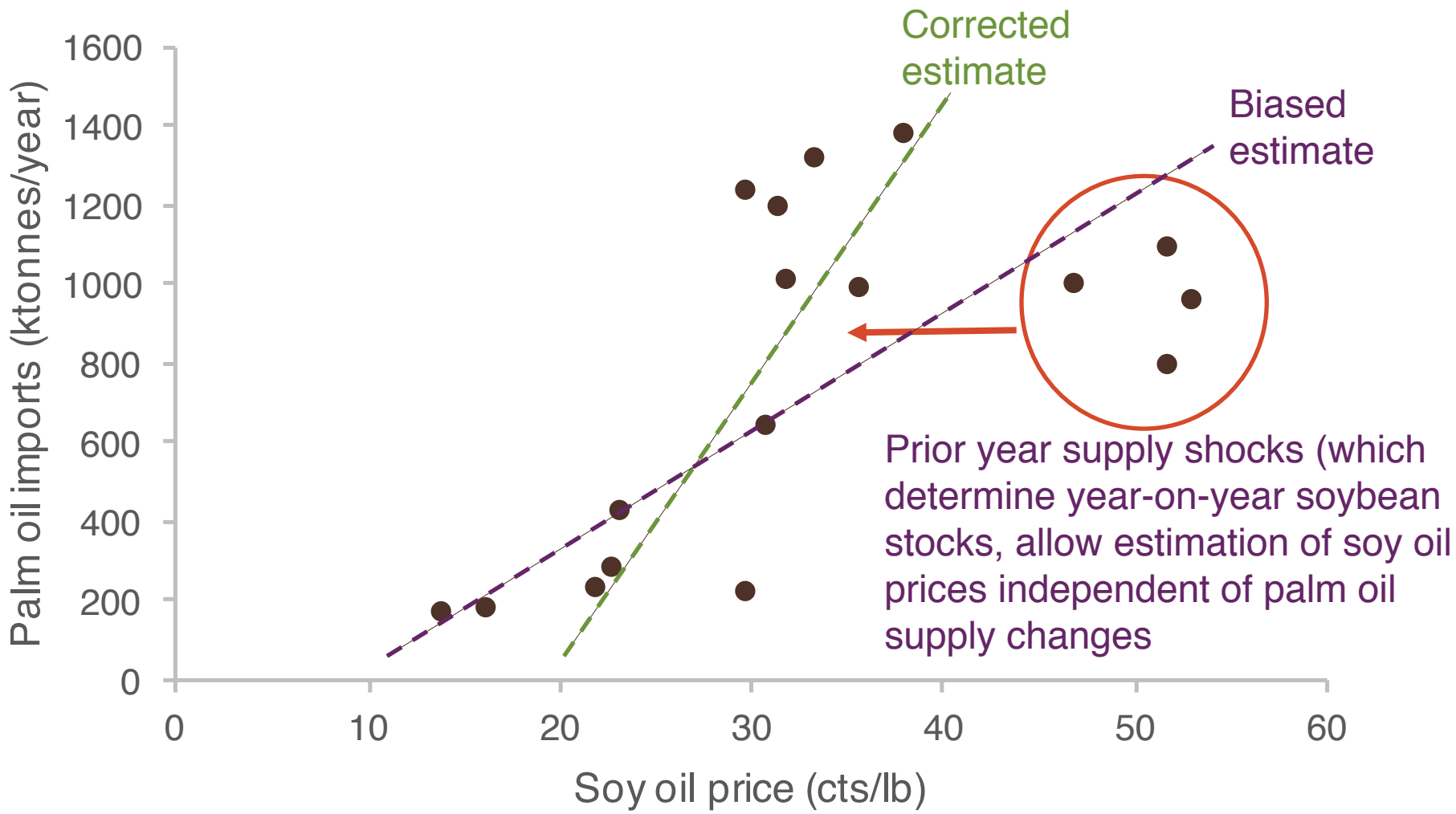
Instrumental variables enable more accurate estimation of elasticity value



Demand affects supply, but supply also affects demand: difficult to disentangle



IVs allow us to predict demand independently of supply, then estimate supply response



Using instrumental variables also allows us to tease apart cause and effect

- How do we know palm oil increase is due to soy oil prices and not because of some third factor (e.g. global population increase) increased demand for both?

	Scenario 1: no substitution	Scenario 2: substitution
Cause	Global population increase, people eating both more soy oil and more palm oil	Changes in soy oil price drive changes in palm oil imports through substitution
Instrumental variable	Past soybean production affects soy oil price through stock changes but not palm oil supply	Past soybean production affects palm oil supply indirectly through soy oil supply
Result of analysis	Weak or no correlation	Significant correlation

Results for United States

		SUPPLIED QUANTITY		
		Soy oil	**Canola oil**	**Palm oil**
ESTIMATED PRICE	**Soy oil**	0.356*** (0.122)	0.471 (0.372)	3.157*** (0.654)
	Canola oil	0.120 (0.076)	1.1814*** (0.233)	0.923 (0.714)
	Palm oil			1.040*** (0.409)

Results for United States

Soy oil price has weak effect on soy oil production

Soy oil price drives palm oil imports

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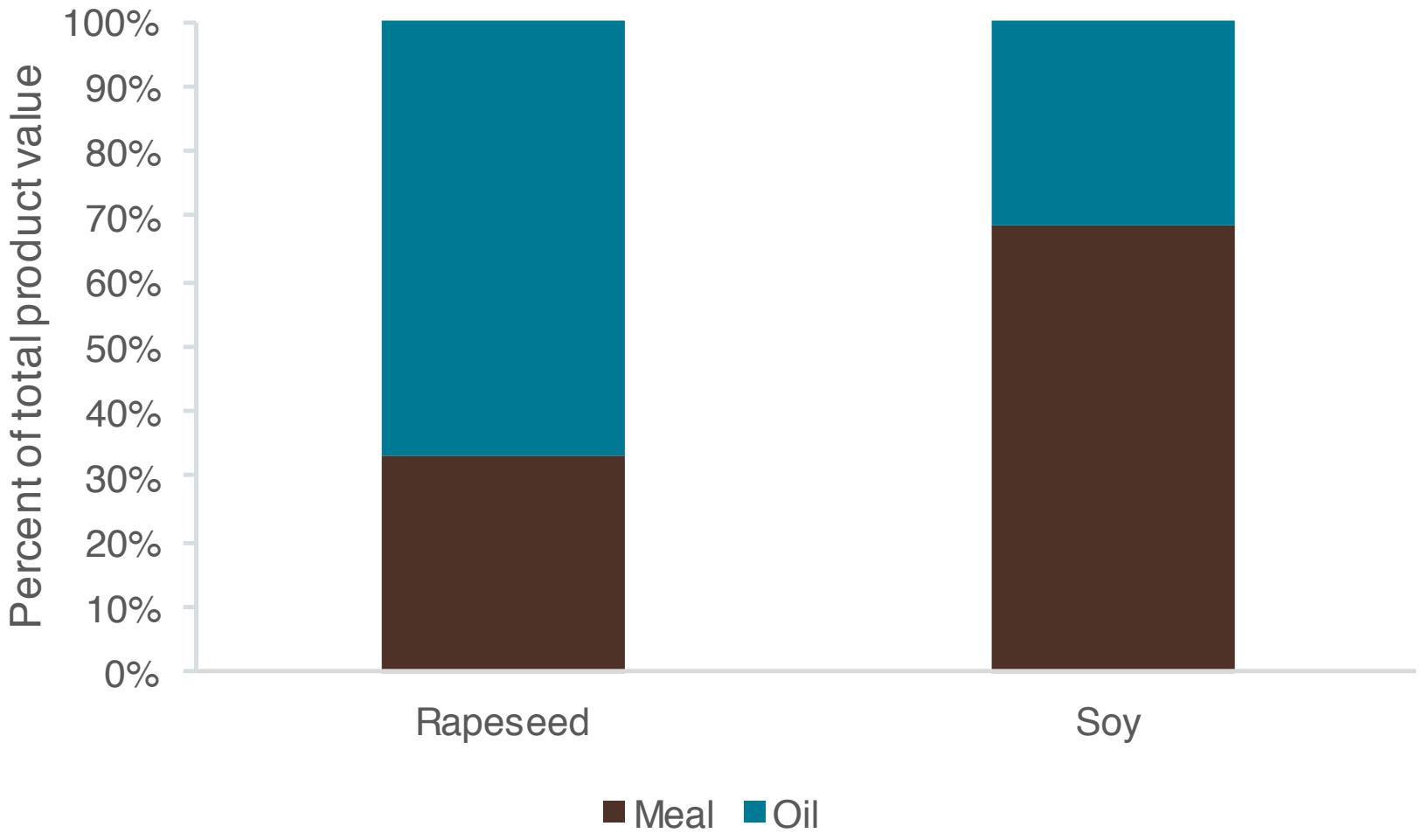
Composition of oilseeds on value basis



Results for European Union

		SUPPLIED QUANTITY			
		Soy oil	**Rapeseed (canola) oil**	**Palm oil**	**Sunflower oil**
ESTIMATED PRICE	**Soy oil**	-4.960*** (2.307)	-3.869* (2.032)	-1.947 (1.569)	-0.236 (1.313)
	Rapeseed (canola) oil	0.624 (0.679)	4.055*** (0.593)	3.015*** (0.569)	0.931* (0.488)
	Palm oil			0.698 (0.472)	
	Sunflower oil			0.305 (0.425)	-0.145 (0.331)

Results for European Union

Rapeseed oil price does drive rapeseed expansion

Rapeseed oil price drives palm oil imports

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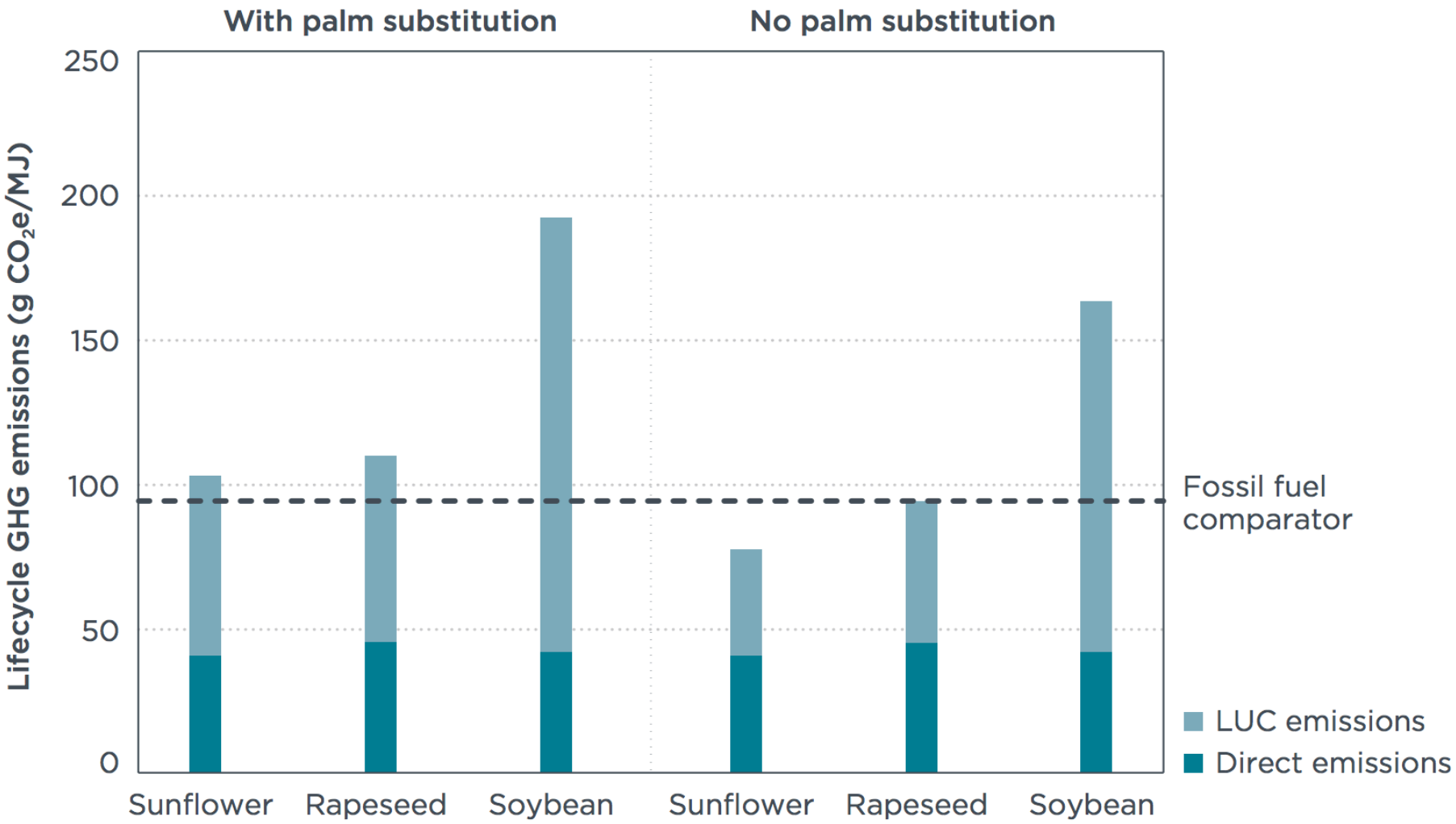
Effect of palm substitution in Valin et al. (2015)



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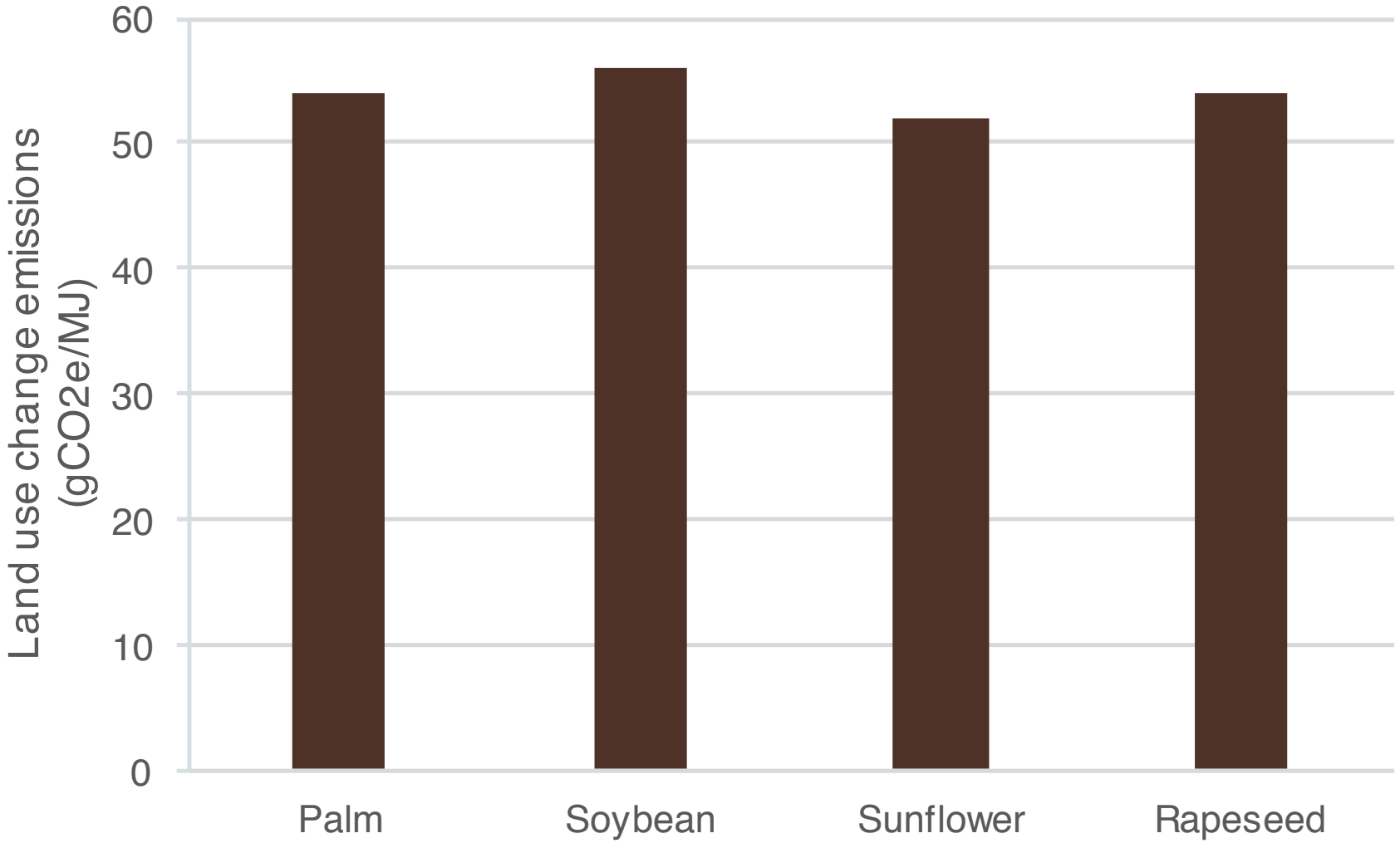
"No palm substitution" LUC emissions estimated from results in Valin et al. (2015)

Effect of palm substitution in Laborde (2011)



Conclusions

- Vegetable oil substitution is an important parameter in ILUC modeling
- Vegetable oils can be substituted in many uses
- Trans fats trends do not explain the rise in palm oil
- Instrumental variable analysis allows us to estimate significant and relatively high elasticities of palm oil supply to soy oil price in the US and rapeseed oil price in the EU
- Higher soy and rapeseed biodiesel demand will likely increase palm oil supply and exacerbate tropical deforestation and peat drainage

Thanks!

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