Comparative waterfootprint profile of vegetable oils for biodiesel production

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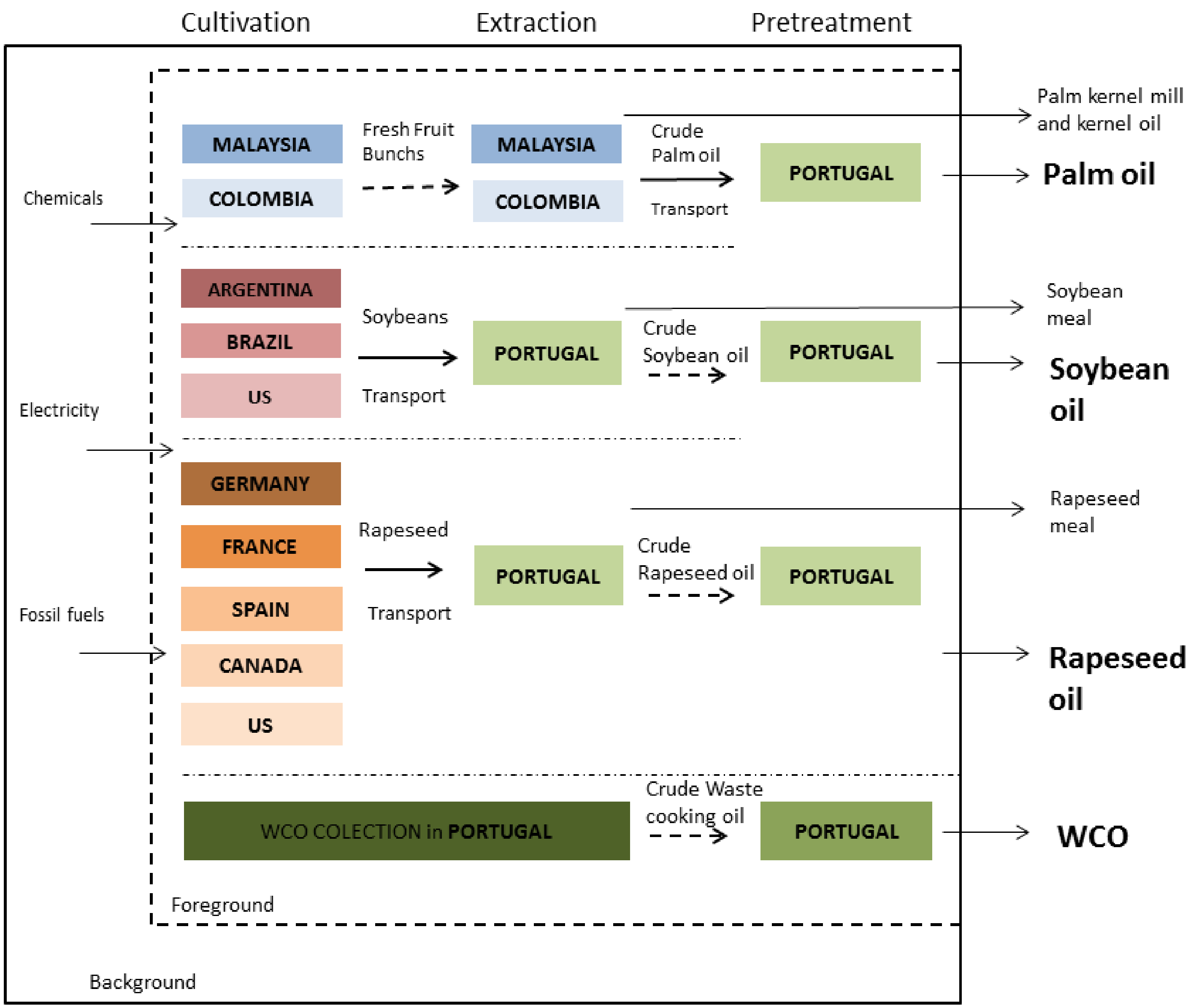
1. GOAL AND SCOPE

- **Waterfootprint profile (water consumption and water degradability) assessment** of **four different vegetable oils used for biodiesel production** following the ISO 14046 guidelines
- Compare two methods to assess water consumption: **WSI** (Pfister et al. 2009; Pfister & Ridoutt 2013)) and **AWARE** (Boulay et al. 2015)
- Comparison of 4 alternative feedstocks for biodiesel: **rapeseed, soybean, palm and waste cooking oil** (Functional unit: 1 kg of oil)
- **Addressing cultivation in different countries**
- The results will be used by a biodiesel producer to support decision planning on the selection of "oil blends" for biodiesel production

System Boundaries



1. GOAL AND SCOPE

Impact categories

- Water comsumption (Pfister 2009, Aware 2015) → **Water consumption**
- Eutrophication (Recipe)
- Acidification (Impact 2002 +)
- Ecotoxicity (Usetox)
- Human toxicity (Usetox)

→ **Water degradability**

Multifunctionality

- Energy allocation (Renewable Energy Directive approach)

General assumptions

- No infraestructures
- No specific agricultural activities/ general process for diesel agricultural machinary
- Transportation of chemicals and materials not included
- Transportation Seeds/beans/oil /WCO collection included

2. LIFE-CYCLE INVENTORY

<table>
<tr><th>STAGE</th><th>DATA SOURCE</th></tr>
<tr><td>CULTIVATION</td><td>(1) Pfister, S., Bayer, P., 2014. Monthly water stress: spatially and temporally explicit consumptive water footprint of global crop production. J. Clean. Prod. 73, 52–62

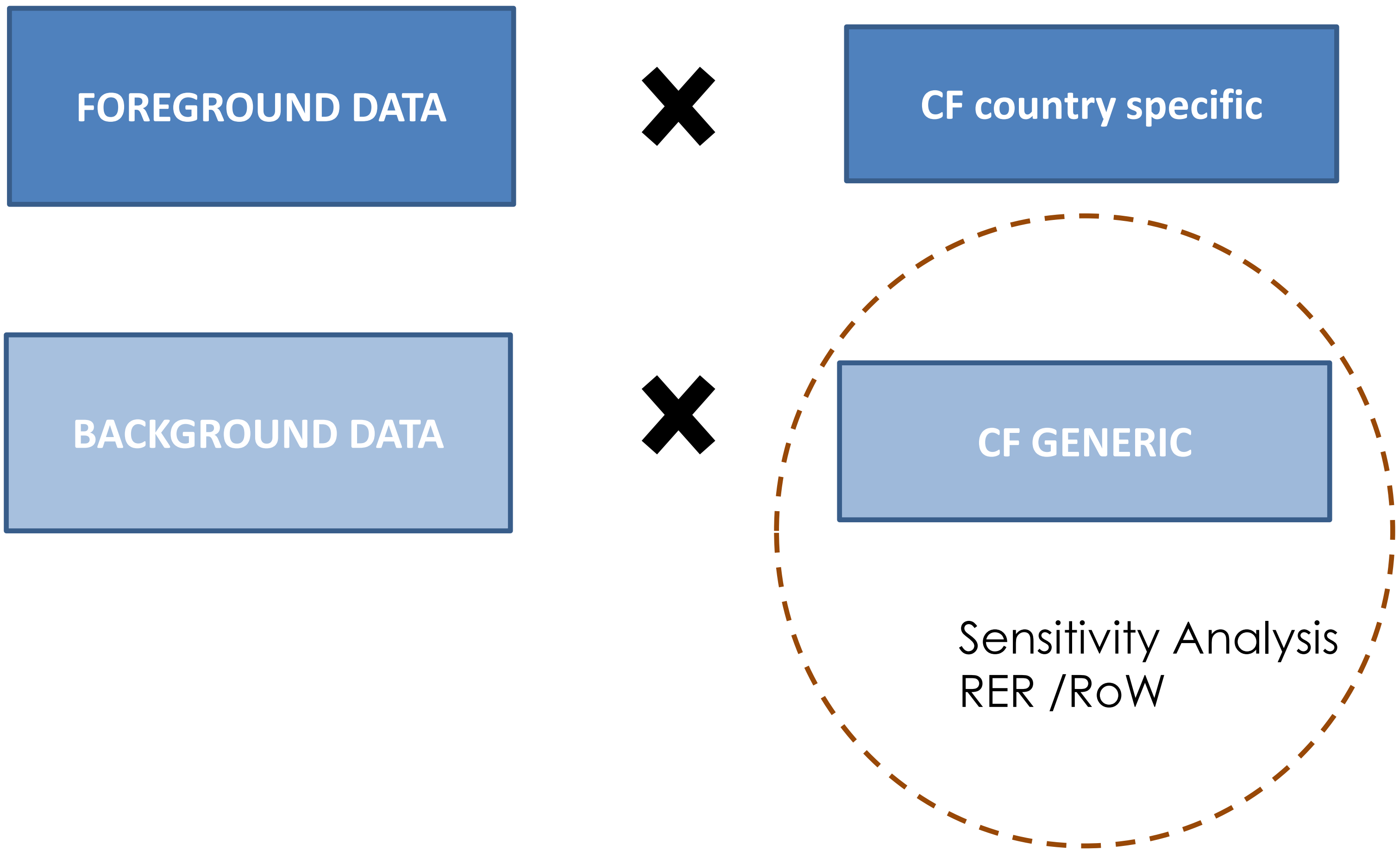
(2) Malça, J., Coelho, A., Freire, F., 2013. Environmental Life-Cycle Assessment of Rapeseed-Based Biodiesel: Alternative Cultivation Systems and Locations. Appl. Energy.

(3) Castanheira, É.G., Acevedo, H., Freire, F., 2014. Greenhouse gas intensity of palm oil produced in Colombia addressing alternative land use change and fertilization scenarios. Appl. Energy 114, 958–967

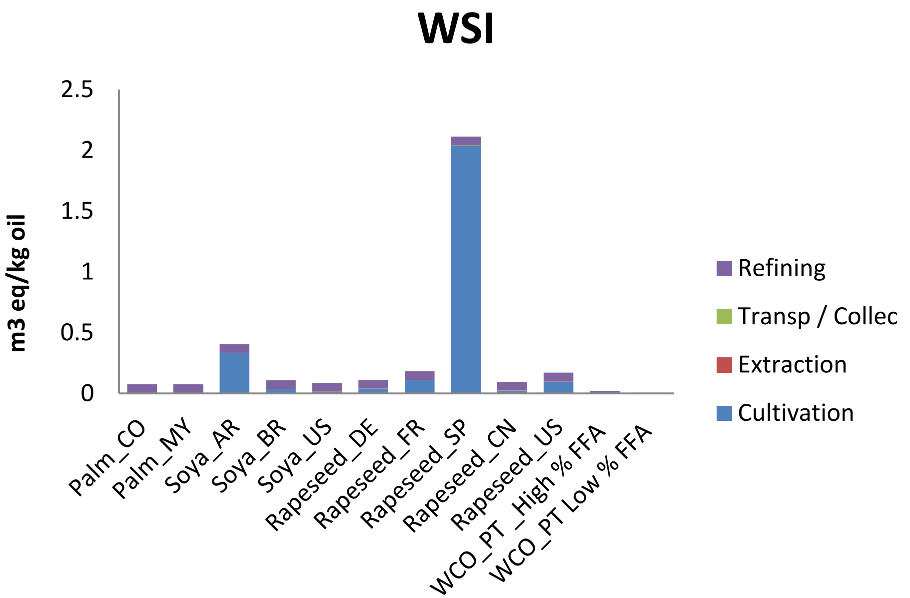
(4) Castanheira, É.G., Freire, F., 2013. Greenhouse gas assessment of soybean production: Implications of land use change and different cultivation systems. J. Clean. Prod. 54, 49–60

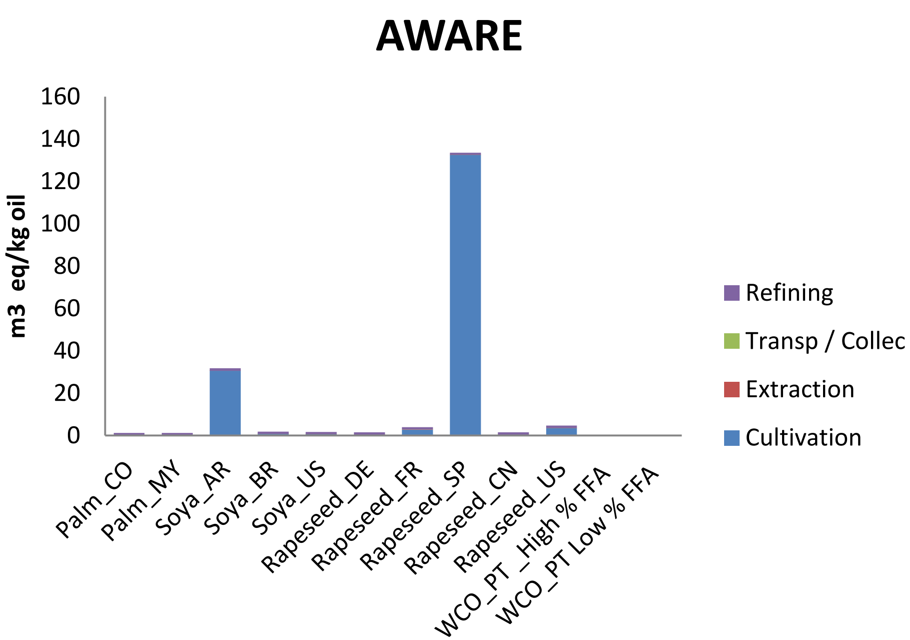
(5) Castanheira, É.G., Grisoli, R., Coelho, S., Anderi da Silva, G., Freire, F., 2015. Life-cycle assessment of soybean-based biodiesel in Europe: comparing grain, oil and biodiesel import from Brazil. J. Clean. Prod. 102, 188–201.

(6) Ecoinvent database</td></tr>
<tr><td>EXTRACTION</td><td rowspan="2">(2) (3) (4) (5) (6)</td></tr>
<tr><td>TRANSPORTATION</td></tr>
<tr><td>WCO COLLECTION</td><td>(7) Caldeira C., Queirós J., Freire F., 2015. Biodiesel from Waste Cooking Oils in Portugal: alternative collection systems. Waste and Biomass Valorization 6, 771–779.</td></tr>
<tr><td>PRE-TREATMENT</td><td>(2) (3) (4) (5) (6) (7)</td></tr>
</table>

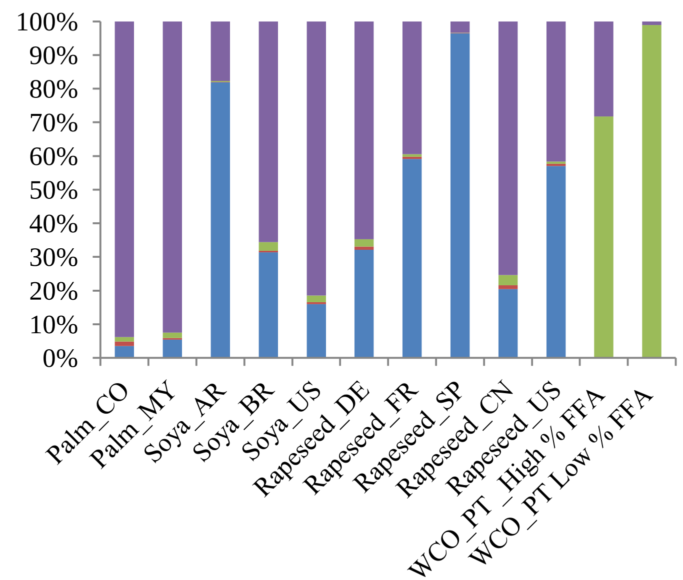

FOREGROUND DATA
CF country specific
BACKGROUND DATA
CF GENERIC
Sensitivity Analysis
RER /RoW

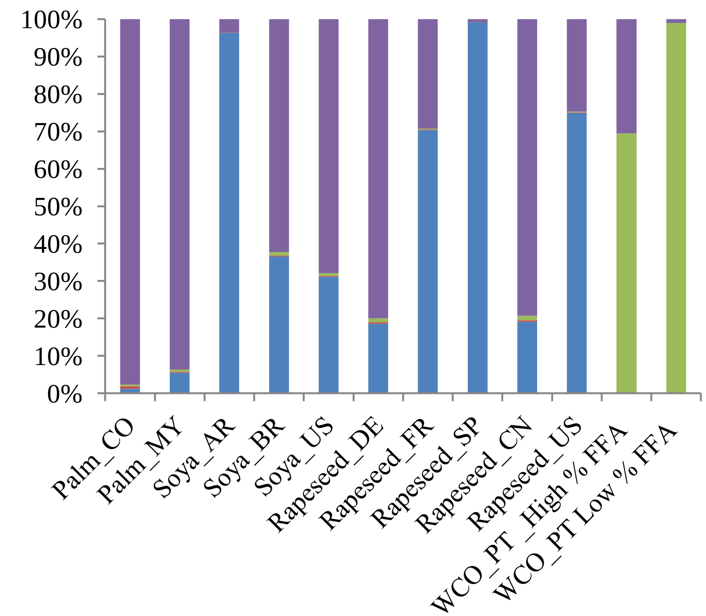
3. IMPACT ASSESSMENT – WATER SCARCITY





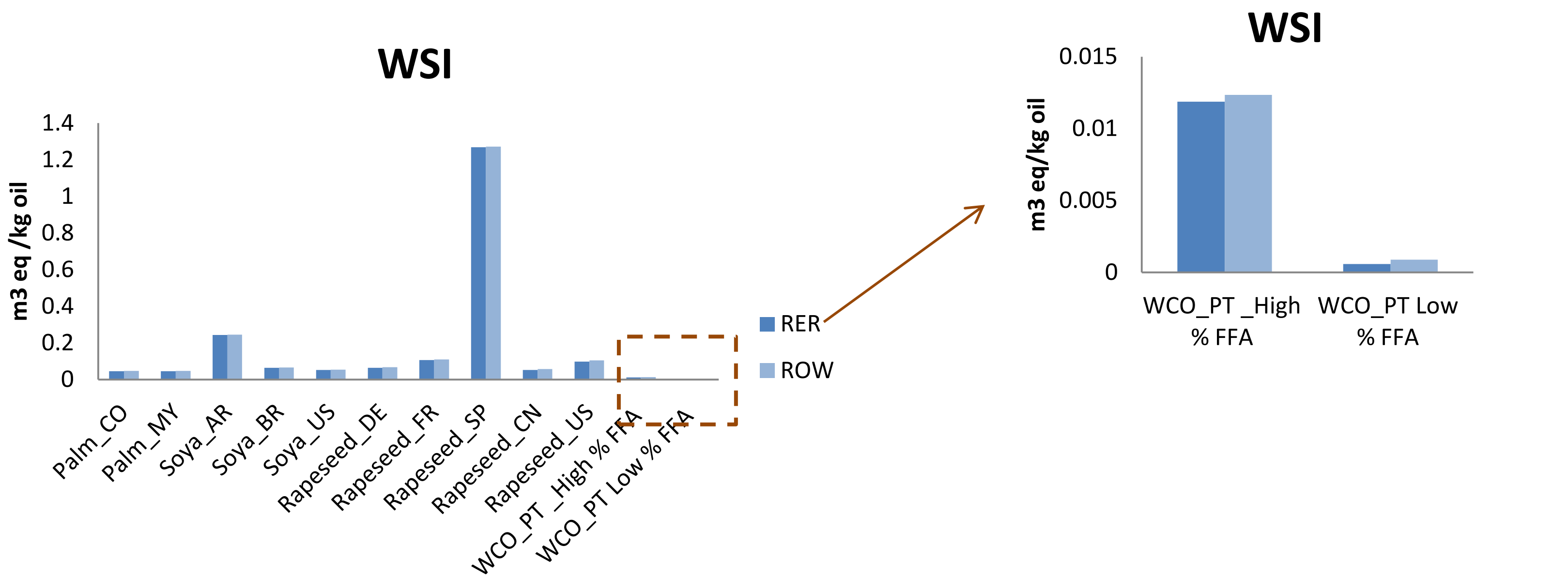
LC STAGE CONTRIBUITION

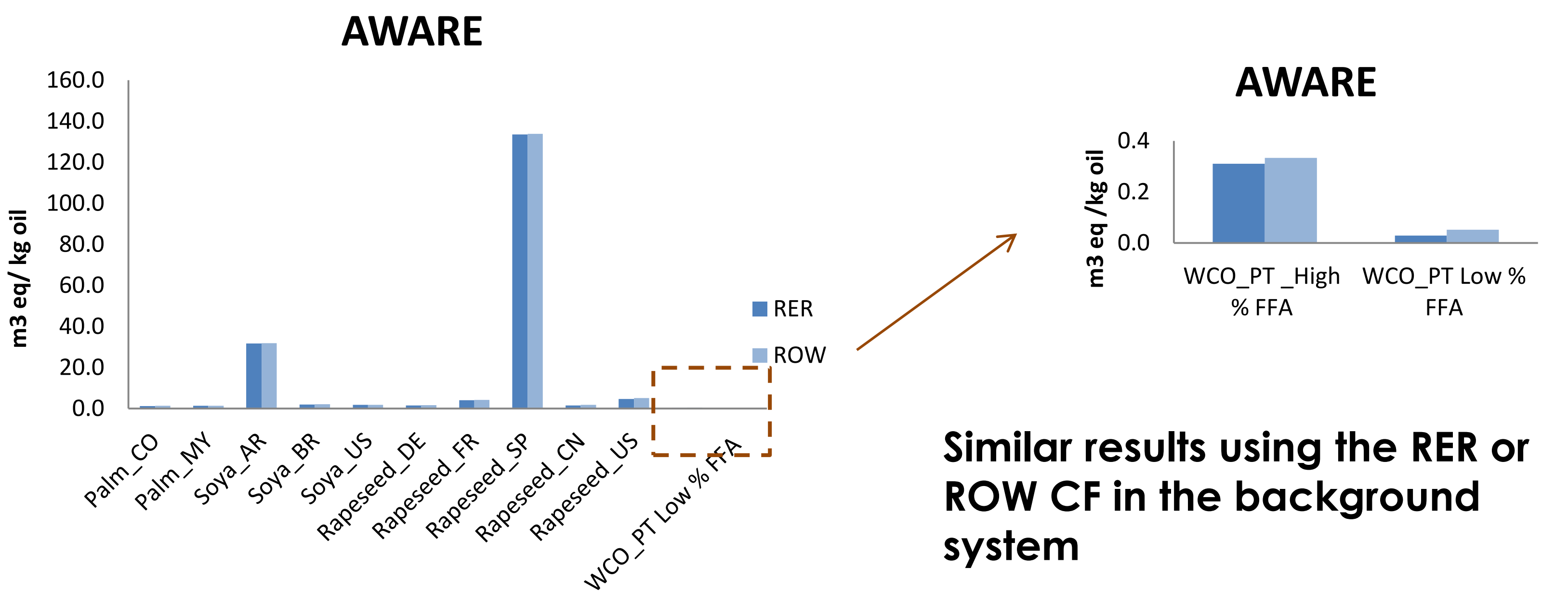




3. IMPACT ASSESSMENT – WATER SCARCITY

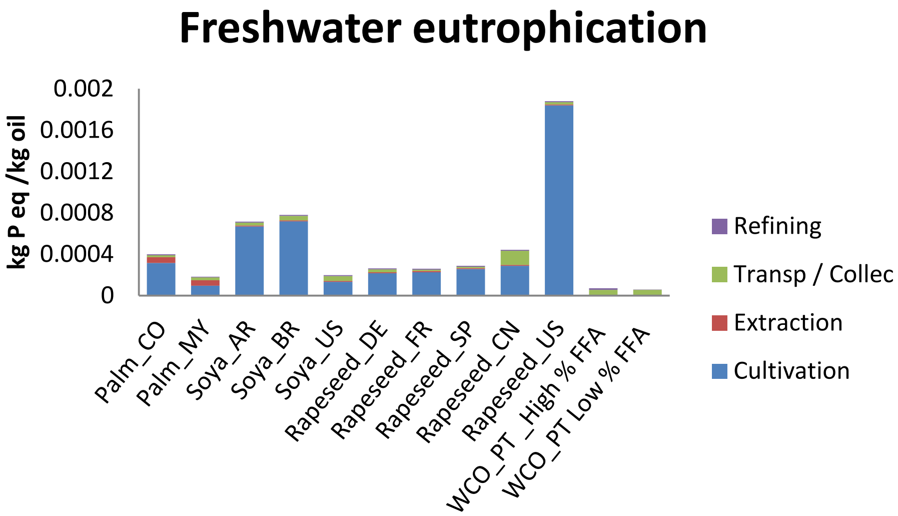
Sensitivity analysis on the background CF – RER or RoW

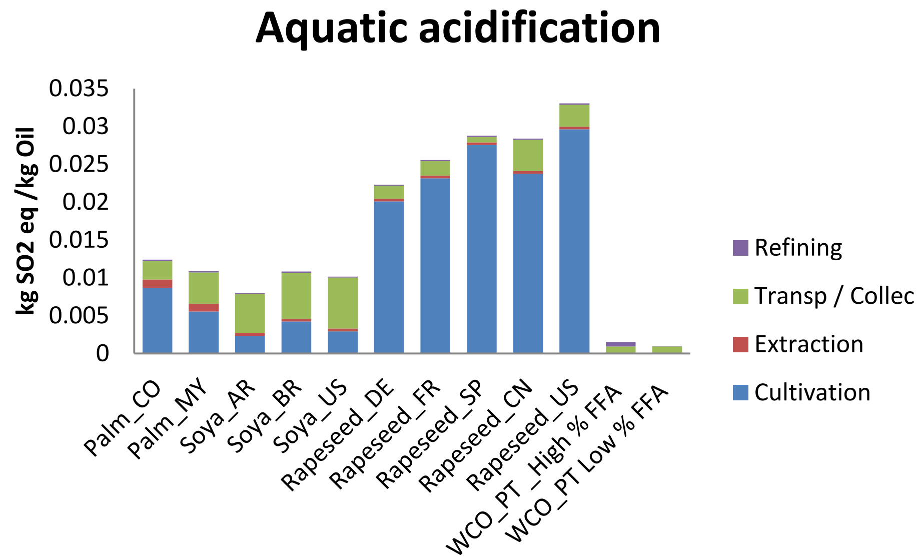


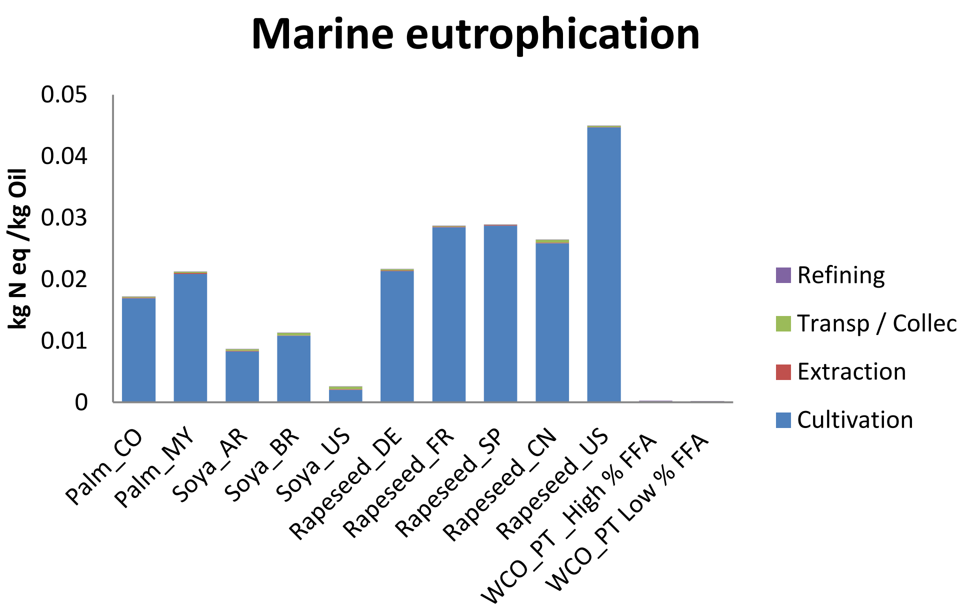


Similar results using the RER or ROW CF in the background system

Eutrophication and Acidification







Virgin Oils
Cultivation stage

WCO
Collection

4. FEEDSTOCKS WITH HIGHER IMPACTS

		Feedstocks with higher impacts		
WATER CONSUMPTION	**WSI/AWARE**	Rapeseed_SP	Soya_AR	Rapeseed_FR
WATER QUALITY RELATED IMPACTS	**Freshwater eutrophication**	Rapeseed_US	Soya_Br	Soya_AR
	Marine eutrophication	Rapeseed_US	Rapeseed_FR	Rapeseed_SP
	Aquatic Acidification	Rapeseed_US	Rapeseed_SP	Rapeseed_CN

Cultivation | **Cultivation**

- Impacts in water quality of the cultivation stage are due to the fertilizers use (Phosphates – FE; Ammonia and Nitrates, Nitrogen fertilizers – ME; Ammonia and Ammonium nitrate – AA)

5. MAIN CONCLUSIONS

- Both methods (WSI and AWARE) used to address water scarcity provide the same conclusions
- The higher water scarcity impact was calculated for Rapeseed _Sp
- The higher water degradability impacts was calculated for Rapeseed_US
- Cultivation is the stage that contibutes the most to water scarcity and water degradability

THANK YOU!

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