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Agroscope Reckenholz-Tänikon Research Station ART

ecoinvent V3: New and updated agricultural data



Swiss Centre
For Life Cycle
Inventories

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Overview

- Introduction
- Updated datasets in the LCI biofuel project
 - N emissions
 - LUC
- New datasets in the LCI biofuel project
- New datasets in the catch crops for biogas project
- External data supply
- Outlook



New and updated datasets for agriculture

- Fruit and vegetables → presented by Franziska Stössel
- 178 updated crop inventories (N emissions, LUC)
- 5 new biofuel inventories Switzerland and Germany
- 6 new biofuel inventories overseas
- 1 update soybean production, US (external data supplied)

ecoinvent Version 2.0

What was covered in agriculture?

Production branches	Buildings	Machinery	Work processes	Inputs	Products CH	Products Europe	Products America	Products Asia
Arable crops	relevant	relevant	relevant	relevant	relevant	partly	partly	partly
Fodder crops	relevant	relevant	relevant	relevant	partly			
Horticulture (Field)	relevant	partly	partly	relevant				
Horticulture (Greenhouse)		partly	partly	relevant				
Fruit growing	partly	partly	partly	relevant				
Vineyards	partly	partly	partly	relevant				
Cattle production	relevant	relevant	relevant	relevant				
Pig production	relevant	relevant	relevant	relevant				
Poultry production		partly	partly	relevant				
Sheep production		partly	partly	relevant			partly	

 relevant datasets available
 partly available
 not available



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Crops and countries

Crops	
barley	potato
cotton	protein peas
faba beans	ramie
fodder beets	rape seed
grain maize	rice
grass	rye
grass silage	silage maize
green manure	soy beans
hay	sugar beets
hemp	sugar cane
jute	sunflower
kenaf	sweet sorghum
oil palm	wheat

Countries
Brazil
Cameroon
China
Europe
France
Germany
Global
India
Malaysia
Philippines
Scandinavia
Spain
Switzerland
Thailand
USA

Cereals
Oil crops
Protein crops
Fibre crops
Grass



Biofuel projects

Background and motivation

- Datasets from 2 projects presented here:
 1. Harmonisation of extension of biofuel life cycle inventories and LCAs
 2. Life cycle assessment of catch crop growing for biogas production
 - The environmental impact of biofuels from agricultural biomass is dominated by the agricultural phase
 - The emission of greenhouse gases is a key criterion for the evaluation of biofuels
 - Dynamic context
 - New emission models and factors for nitrous oxide (N_2O), ammonia (NH_3) and nitrate (NO_3)
 - New methods and better data on land use change
 - Emerging sources of biomass like Jatropha, Miscanthus, Salix
- An update, harmonisation and extension of the data for the assessment of biofuels is required

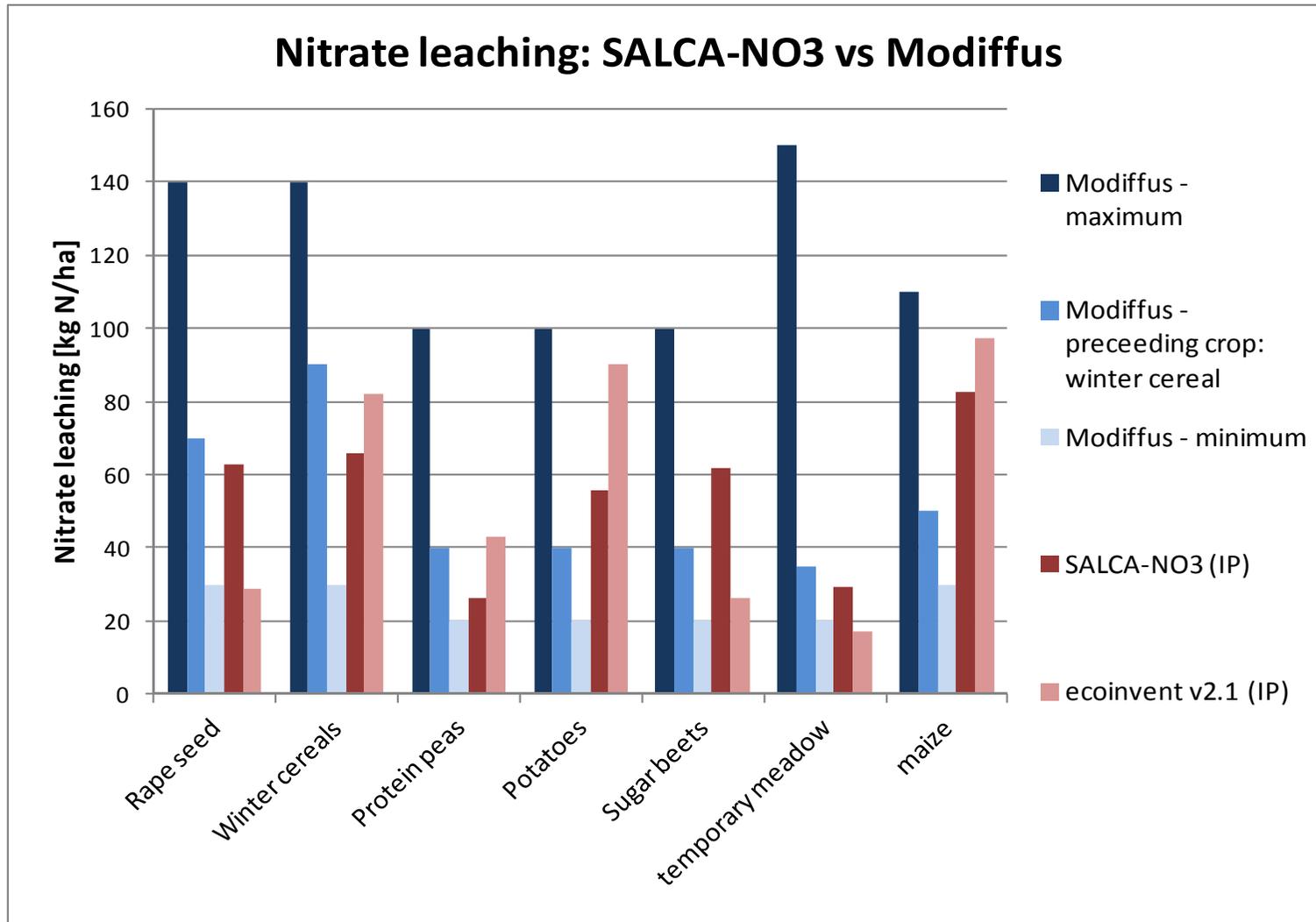


Biofuel LCIs: Harmonised and updated nitrogen emission models

N compound	Applied	Emission model used
Ammonia (NH ₃)	Global	AGRAMMON
Nitrate (NO ₃)	Europe	SALCA-NO3
	Non-European countries	SQCB / de Willigen (2000)
Nitrous oxide (N ₂ O)	Global	IPCC 2006, Tier 1

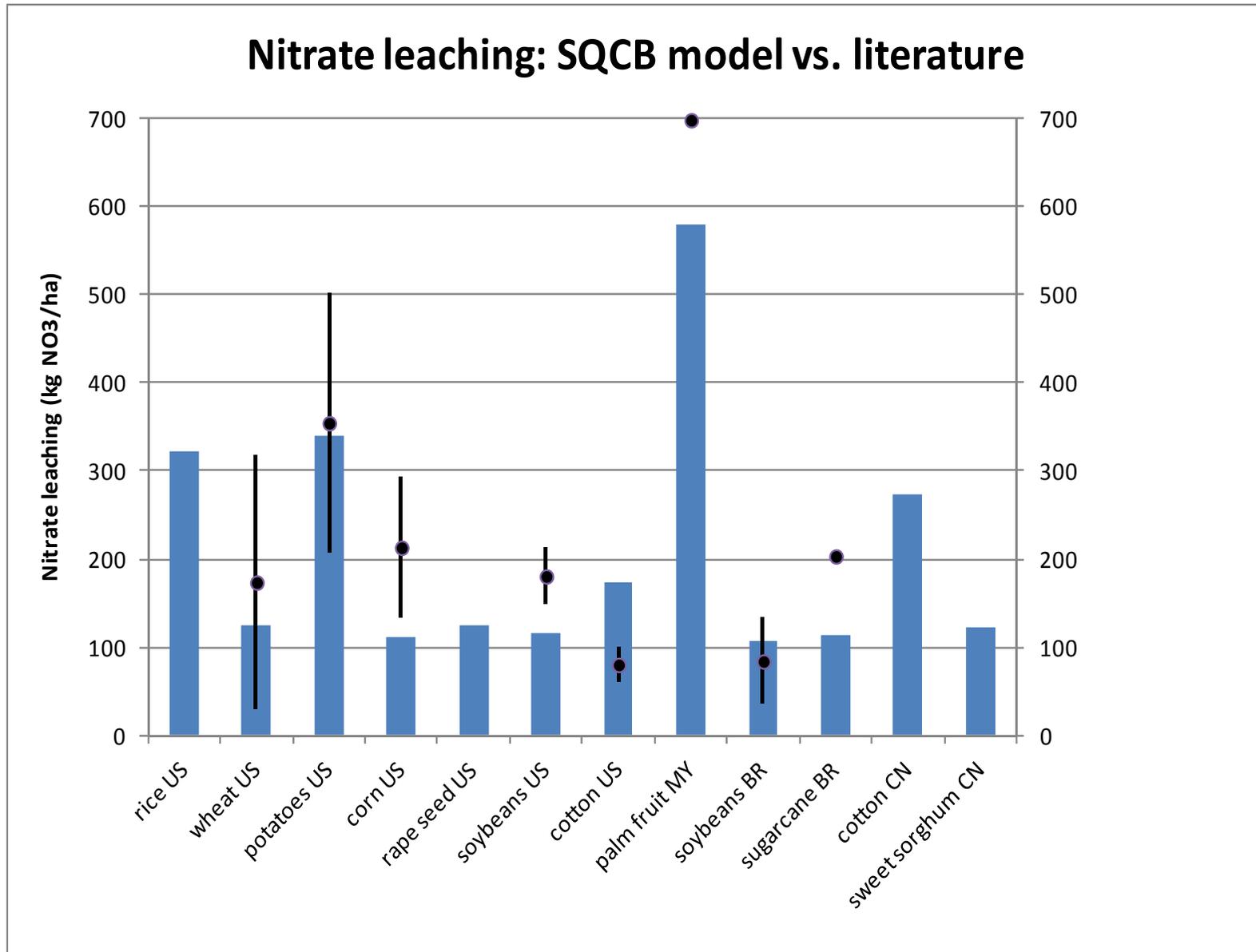


Validation of nitrate leaching for Swiss crops



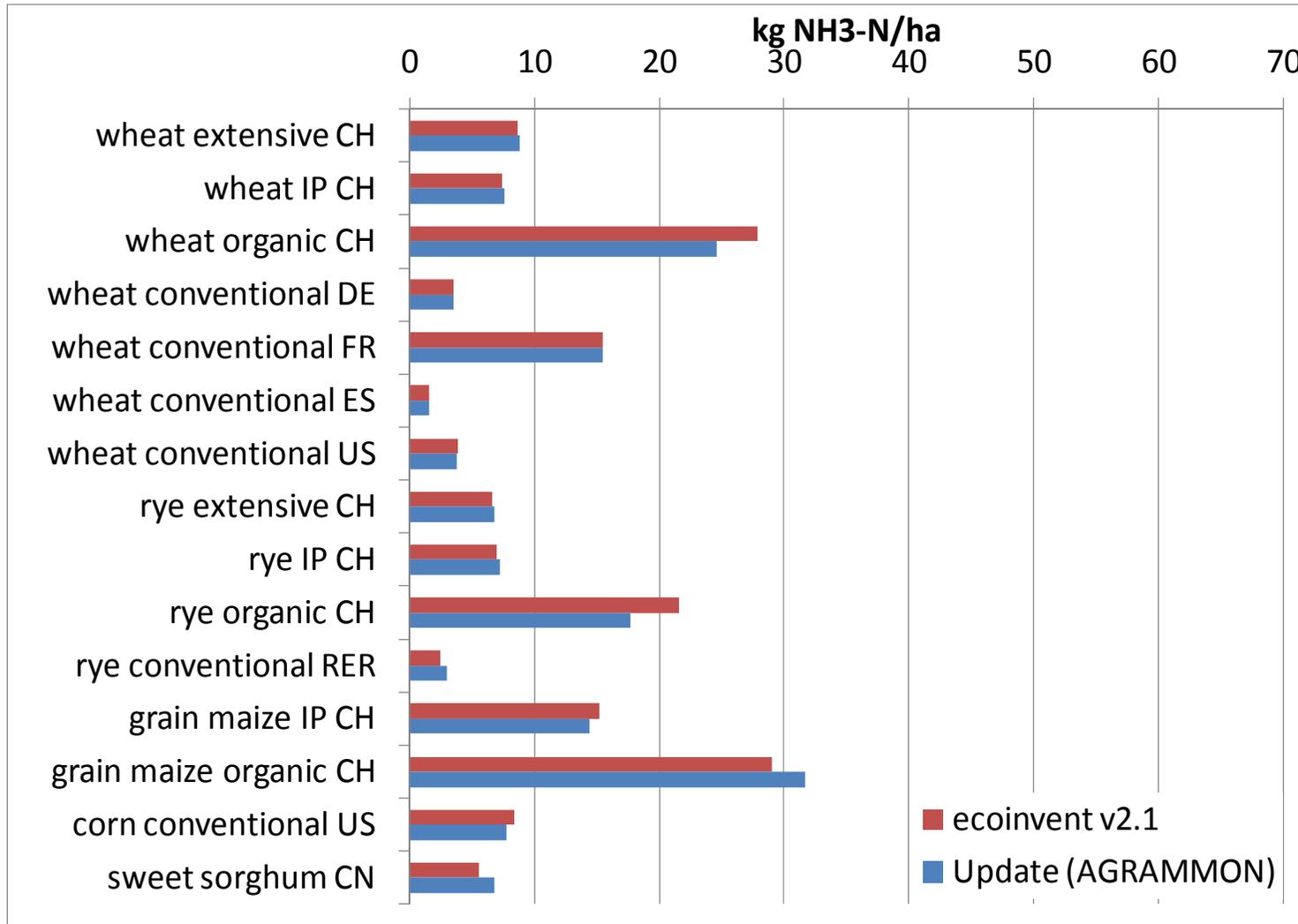


Validation of nitrate leaching for non-European crops



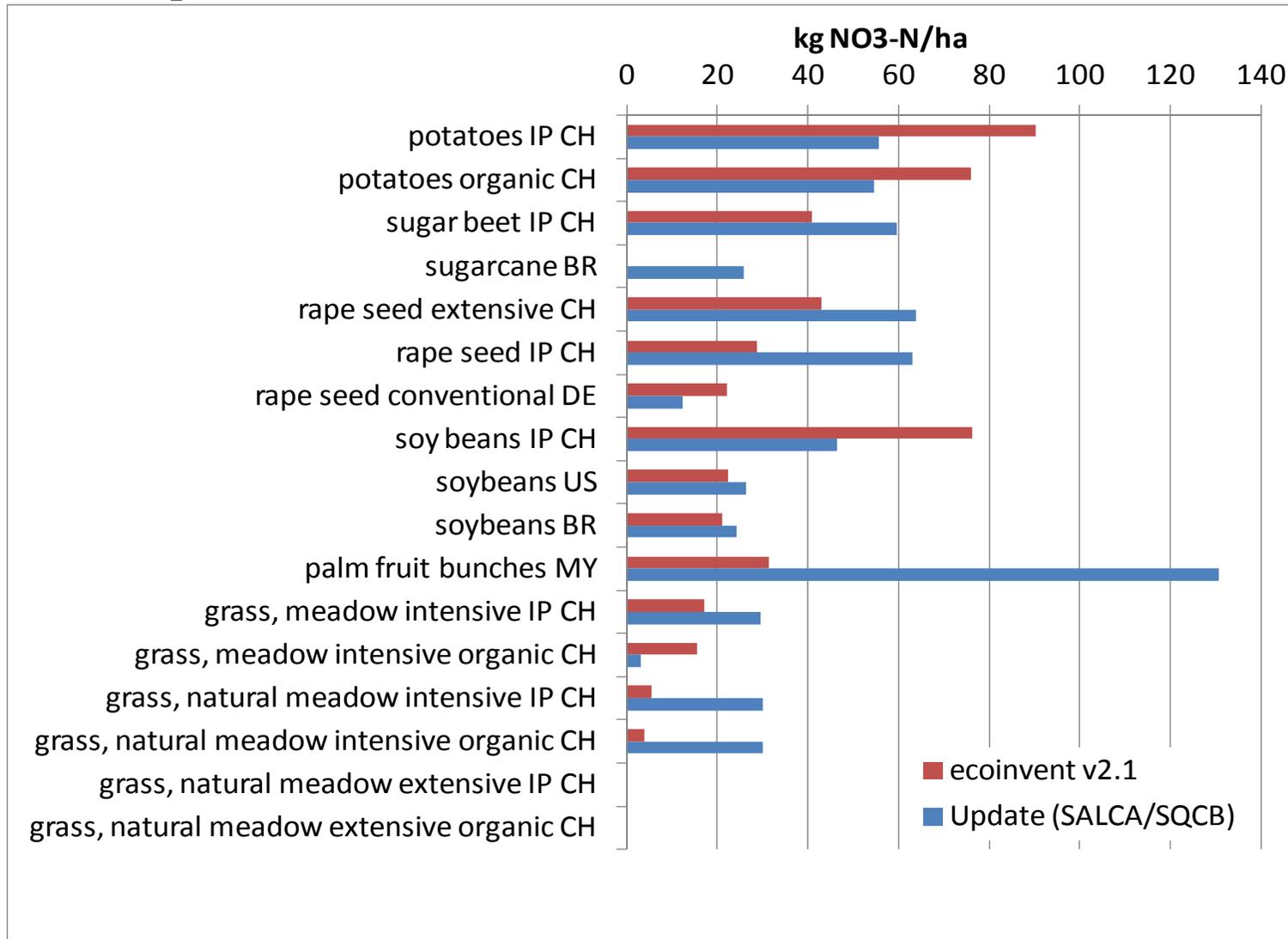


Ammonia emissions: cereals comparison of ecoinvent V2 and V3



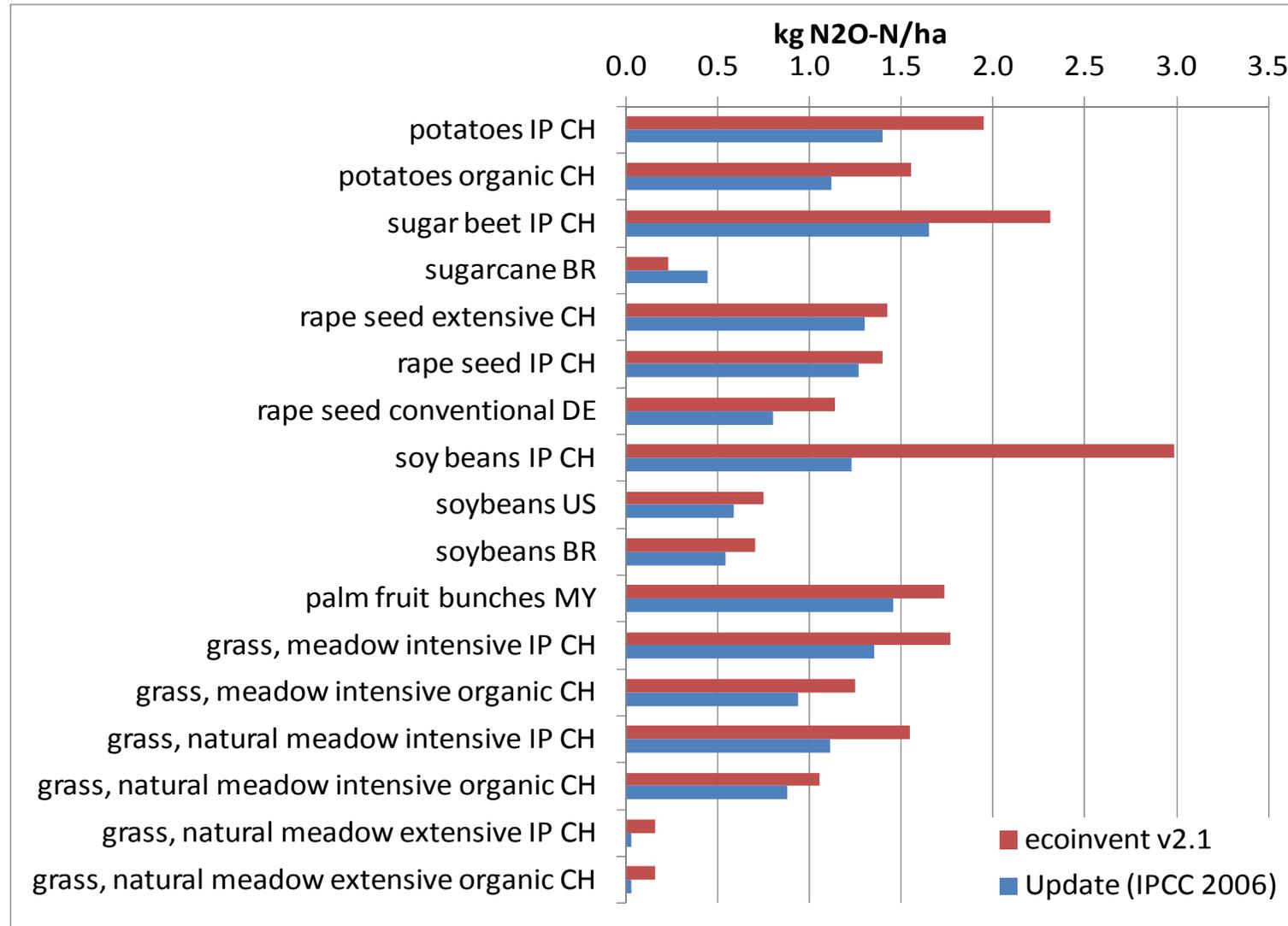


Nitrate leaching: other crops comparison of ecoinvent V2 and V3





Nitrous oxide emissions: other crops comparison of ecoinvent V2 and V3





Biofuel LCIs: N emissions: relative changes between ecoinvent V2 and V3

	kg NH ₃ -N/ha	kg NO ₃ -N/ha	kg N ₂ O-N/ha
ecoinvent v2.1	13.69	40.28	1.38
ecoinvent v3	13.04	45.70	1.01
Relative change	-4.8%	+13.4%	-26.4%

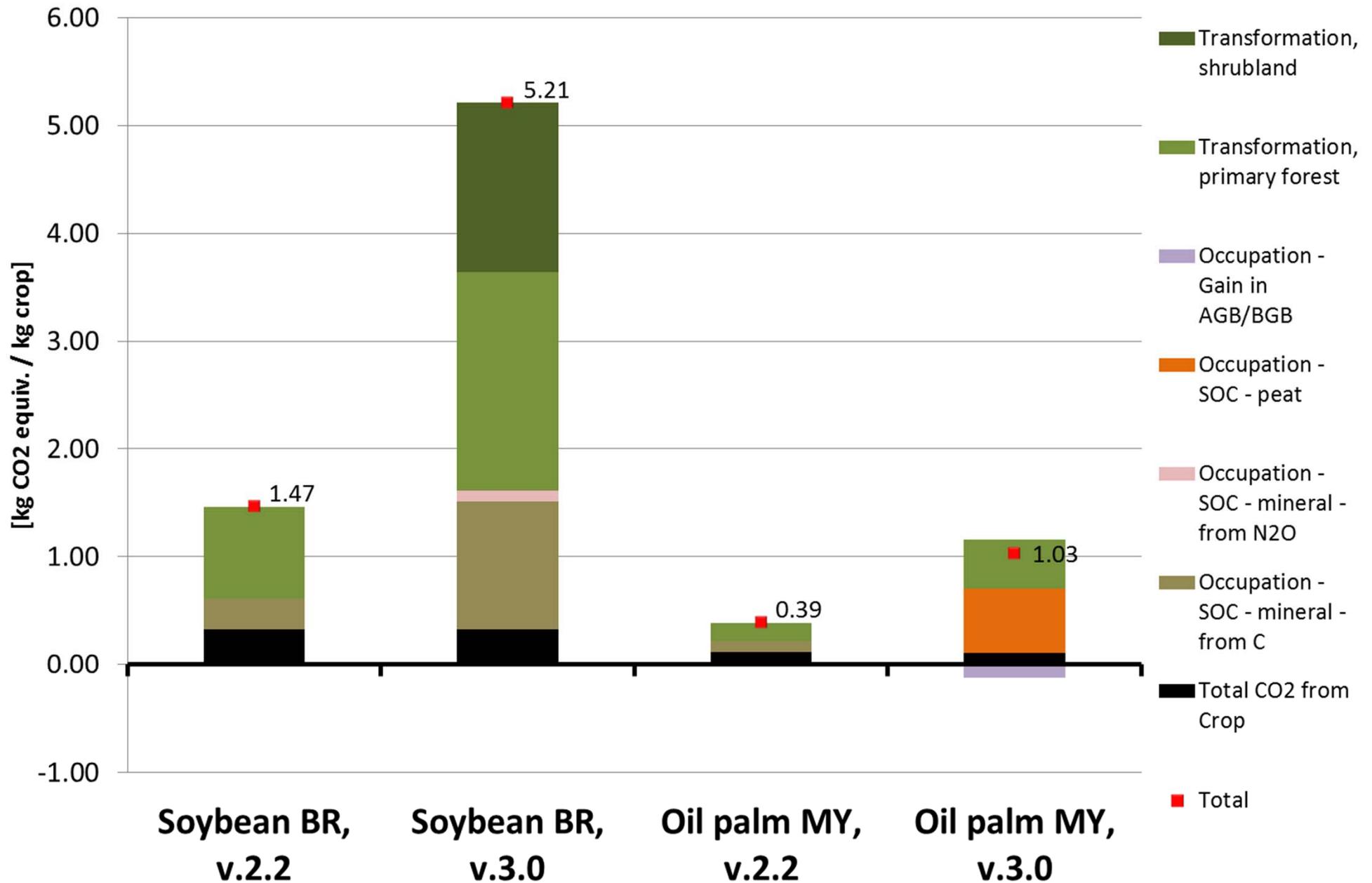


Biofuel LCIs: Update LUC inventories

- Goal: update of the emission from direct LUC for all relevant crop activities:
 - Soybean, Brazil (BR)
 - Sugarcane, BR
 - Palm fruit bunches, Malaysia (MY)
- Consistent consideration of all carbon pools (IPCC 2006)
 - Above Ground Biomass (AGB)
 - Below Ground Biomass (BGB)
 - Dead Organic Matter (DOM)
 - Soil Organic Carbon (SOC)



Biofuel LCIs: Overview: LUC Results





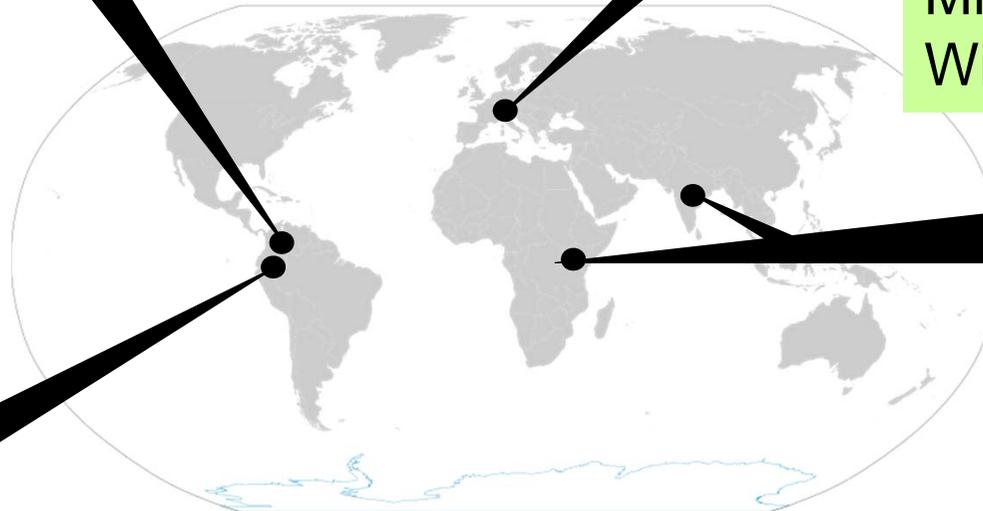
New biofuel crop inventories



Sugar cane
Colombia



Alfalfa-grass
mixture, CH
Miscanthus, DE
Willow, DE



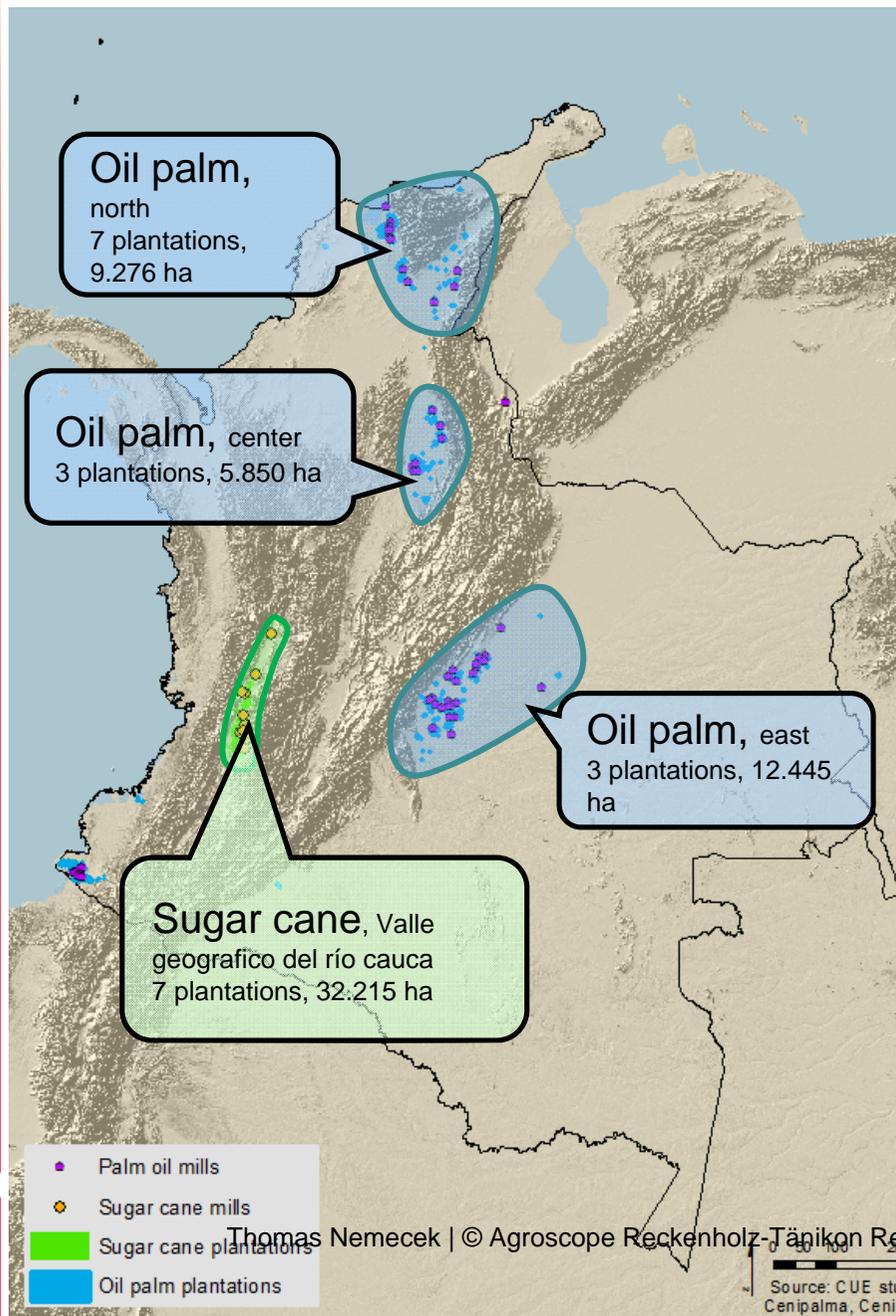
Jatropha
India
East-Africa



Oil palm
Colombia



New biofuel inventory - Colombia



Sugar cane cultivation

National average data from field visits (20% of total SC area) validated and completed with literature data / expert interviews

Oil palm cultivation

National average data from field visits (26% of total palm area) validated and completed with literature data / expert interviews



New biofuel inventory - Jatropha



Hedge/fence (East Africa):

- Grown since more than 60 years
- Protection of crops/livestock, soil conservation
- Average data from 9 Sites in Et, Ke, Tz
- No crop management



Small-scale plantation (East Africa):

- Since a few years
- Additional income source, risk distribution
- Average data from 9 Sites in Et, Ke, Tz
- Little crop management



Large-scale plantation (India):

- Since a few years
- Data from field trials in Hyderabad, India
- Extensive management (little organic fertilizer / rain fed)
- Intensive management (min. fertilizer / pesticides / irrigation)



New biofuel inventory – Processing

Oil expeller & filtration system



straight jatropha oil

Transesterification unit

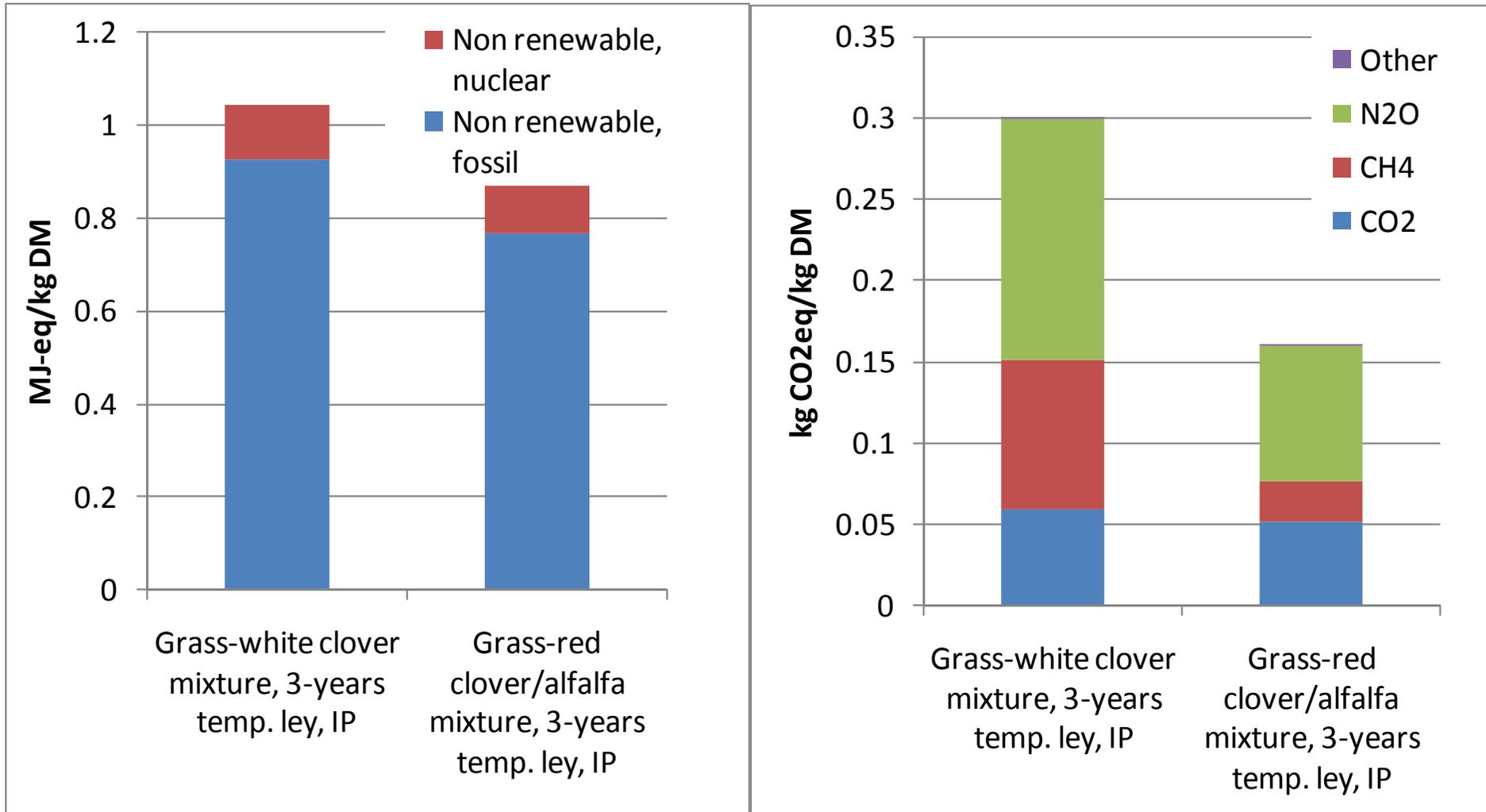


Jatropha methylester



Alfalfa/Red clover-grass mixture

Reduced energy and GHG emissions





Catch crops for biogas

Green manure:

mustard (*Sinapis alba*)

phacelia (*Phacelia tanacetifolia*)

Autumnal catch crops

mustard, phacelia

sunflower

SM 101: oat-vetches-mixture

SM 106: grass-clover-mixture

Overwintering catch crops

SM 200, SM 210: grass-clover-mixtures

Italian Ryegrass





Variants of catch crops

Yield variability for each crop according to sowing date, fertilisation intensity and harvest frequency, but no yield differences were assumed between different fertiliser types

- Fertilisation levels: (0), 20-80 kg N
- Fertiliser type: mineral fertiliser, cattle slurry
- Harvest: 1-3 times (grass-clover-mixtures)



Datasets for catch crops

Data sets for catch crops
catch crop growing, mustard, August-October, organic fertiliser 20 kg N
catch crop growing, mustard, August-October, organic fertiliser 60 kg N
catch crop growing, mustard, September-October, organic fertiliser 20 kg N
catch crop growing, mustard, September-October, organic fertiliser 60 kg N
catch crop growing, phacelia, August-October, organic fertiliser 40 kg N
catch crop growing, phacelia, August-October, organic fertiliser 60 kg N
catch crop growing, phacelia, September-October, organic fertiliser 40 kg N
catch crop growing, phacelia, September-October, organic fertiliser 60 kg N
catch crop growing, ryegrass-Egyptian&Persian clover-mixture, August-October, organic fertiliser 30 kg N, one cut
catch crop growing, ryegrass-Egyptian&Persian clover-mixture, August-October, organic fertiliser 30 kg N, two cuts
catch crop growing, ryegrass-Egyptian&Persian clover-mixture, August-October, organic fertiliser 60 kg N, two cuts
catch crop growing, oats-vetches-peas-mixture, August-October, organic fertiliser 30 kg N
catch crop growing, sunflower, August-October, organic fertiliser 20 kg N
catch crop growing, sunflower, August-October, organic fertiliser 30 kg N
catch crop growing, Italian ryegrass-red clover-mixture, September-April, organic fertiliser 40 kg N, one cut
catch crop growing, Italian ryegrass-red clover-mixture, September-April, organic fertiliser 60 kg N, one cut
catch crop growing, Italian ryegrass-red clover-mixture, August-April, organic fertiliser 60 kg N, three cuts
catch crop growing, Italian ryegrass-red clover-mixture, August-April, organic fertiliser 80 kg N, three cuts
catch crop growing, ryegrass-red&Egyptian clover-mixture, September-April, organic fertiliser 40 kg N, one cut
catch crop growing, ryegrass-red&Egyptian clover-mixture, September-April, organic fertiliser 60 kg N, one cut
catch crop growing, ryegrass-red&Egyptian clover-mixture, August-April, organic fertiliser 60 kg N, three cuts
catch crop growing, ryegrass-red&Egyptian clover-mixture, August-April, organic fertiliser 80 kg N, three cuts
catch crop growing, ryegrass, September-April, organic fertiliser 40 kg N, one cut
catch crop growing, ryegrass, September-April, organic fertiliser 60 kg N, one cut
catch crop growing, ryegrass, August-April, organic fertiliser 60 kg N, three cuts
catch crop growing, ryegrass, August-April, organic fertiliser 80 kg N, three cuts



Datasets soybeans, US, 2007

- Author: Anne Creig, Four Elements Consulting, LLC
- Based on: Omni Tech International & Four Elements Consulting, 2010: Life Cycle Impact of Soybean Production and Soy Industrial (report for the United Soybean Board)

Life Cycle Impact of Soybean Production and Soy Industrial Products

Released February 2010



Prepared for
The United Soybean Board

By
Omni Tech International



Outlook

- Revision of fertiliser modelling
- Further parametrisation of emission models
- Animal products
- Food sector
- Larger geographical coverage
- More data suppliers