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science for global insight

Joint meeting IRG-GRA & CIRCASA
CIAT, Recta Cali, February 2, 2019

Model based scenarios in support of climate mitigation strategies development

Stefan Frank, Aline Mosnier, **Petr Havlík,** M. Gusti, J. Balkovič, N. Forsell, R. Skalský, and many others

EUROPEAN
COMMISSION

Brussels, 22.1.2014
SWD(2014) 15 final

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions

A policy framework for climate and energy in the period from 2020 up to 2030

{COM(2014) 15 final}
{SWD(2014) 16 final}

EN

EUROPEAN COMMISSION

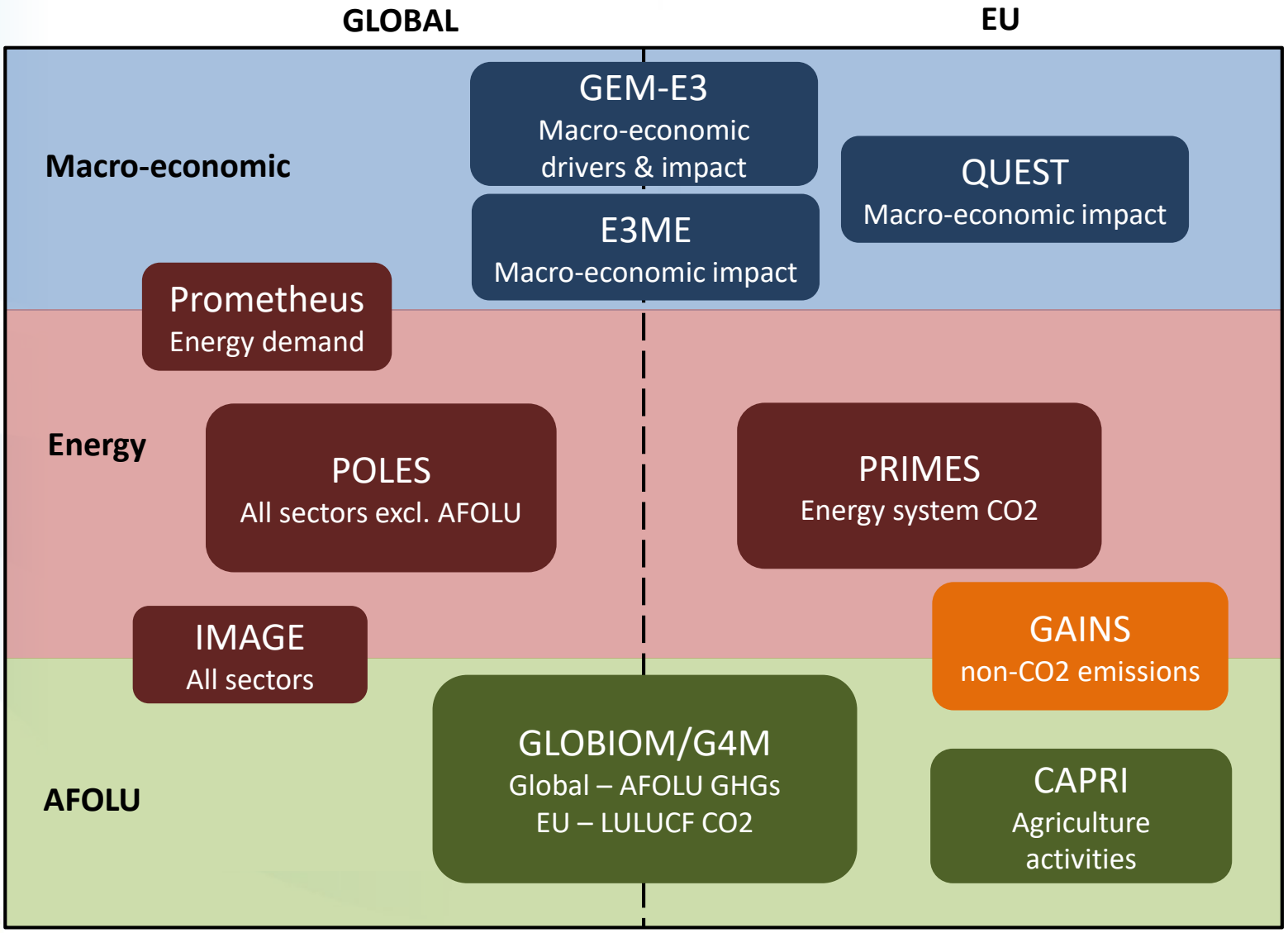
Brussels, 28 November 2018

IN-DEPTH ANALYSIS IN SUPPORT OF THE COMMISSION COMMUNICATION COM(2018) 773

A Clean Planet for all
A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy

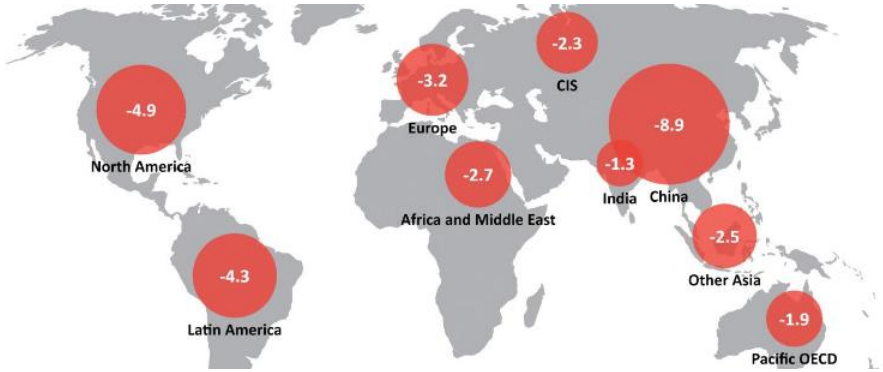
EN

EU – Climate modeling framework



From global targets to national commitments

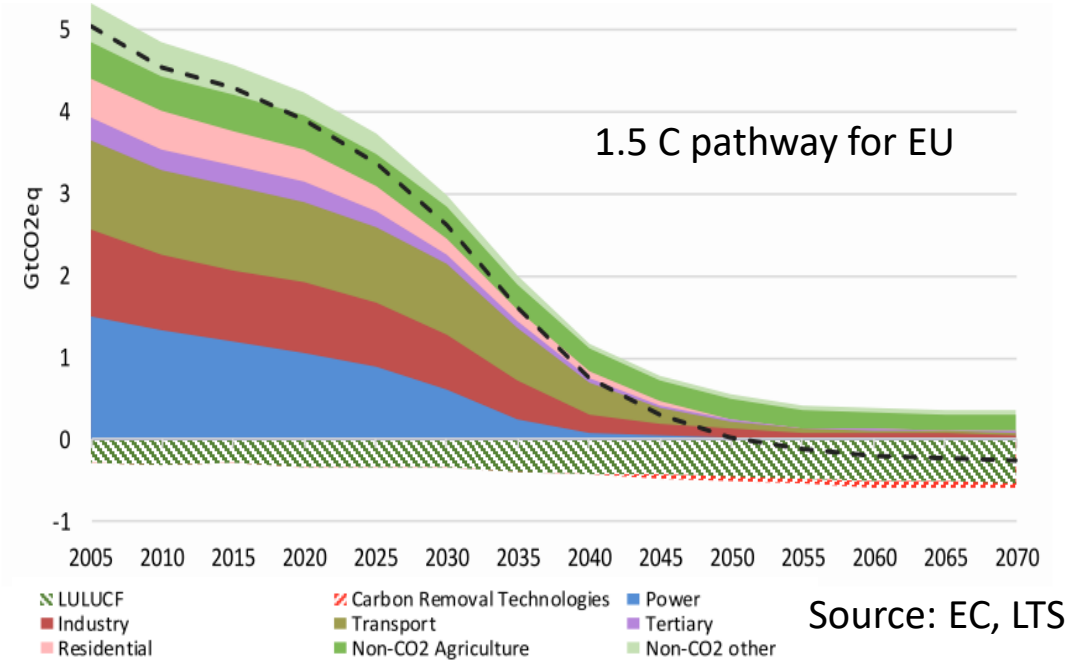
Global models develop consistent climate stabilization pathways



GHG emissions variation over 2015–2050 by world region ($GtCO_2$-eq), in the central 2°C scenario

Source: POLES-JRC 2018.

Detailed regional model quantify EU pathway consistent with global target



Source: EC, LTS

GLOBIOM

Population, GDP, consumer preferences

Demand

Food | Fibers | Energy | Industry

Markets

MARKET & TRADE: EU + WORLD → **PRICES**

Seafood

MARKET, TRADE, PRICES

TBD
Fish model

→ **Feed supply, intake**
→ **Fish processing**
→ **GHG emissions**

Worldwide:
11 species groups

Capture/aquaculture
Freshwater/marine
Small-/large-scale
Fishmeal and fish oil
5 feed crops

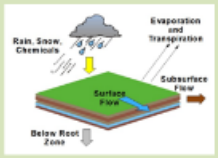
Water surface

FAO Fishing Areas / 0.5° Grid

FEED

Production

EPIC
Crop model



FEED | **FEEDSTOCK** | **FEED** | **BIOMASS**

RUMINANT
Digestibility model

→ Feed intake
→ Animal production
→ GHG emissions

BIOENERGY
Processing

→ MJ biofuel
→ MJ bioelectric
→ Coproducts

G4M
Global Forest model

→ Harvestable wood
→ Harvesting costs

Land use

Worldwide:
18 crops (FAO + SPAM)
Management systems:
low/high input & irrigated

EU28:
9 additional crops,
crop rotations.
Management options:
fertilizer, irrigation & tillage

7 animals
(FAO + Gridded livestock)

Cattle & Buffalo
Sheep & Goat
Pig
Poultry

8 different systems

Perennial crops
Short rotation coppice

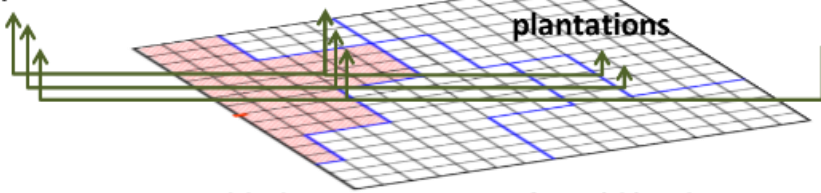
Conversion technologies
First generation biofuels
Second generation biofuels
Biomass power plants

Downscaled FAO FRA at grid level

Area
Carbon stock
Age
Tree size
Species
Rotation time
Thinning

Land cover

Cropland | **Grassland** | **Short rotation plantations** | **Managed forest**



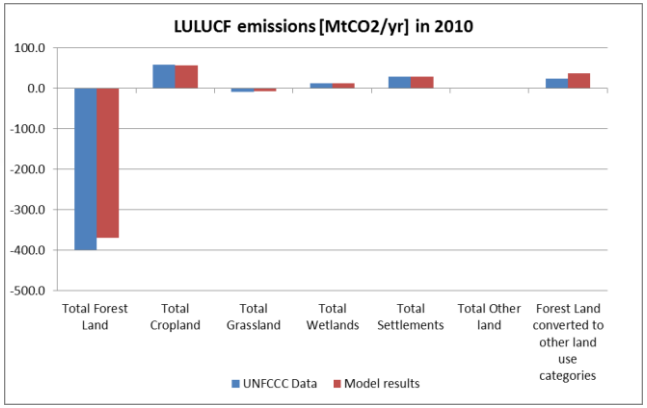
Natural forest

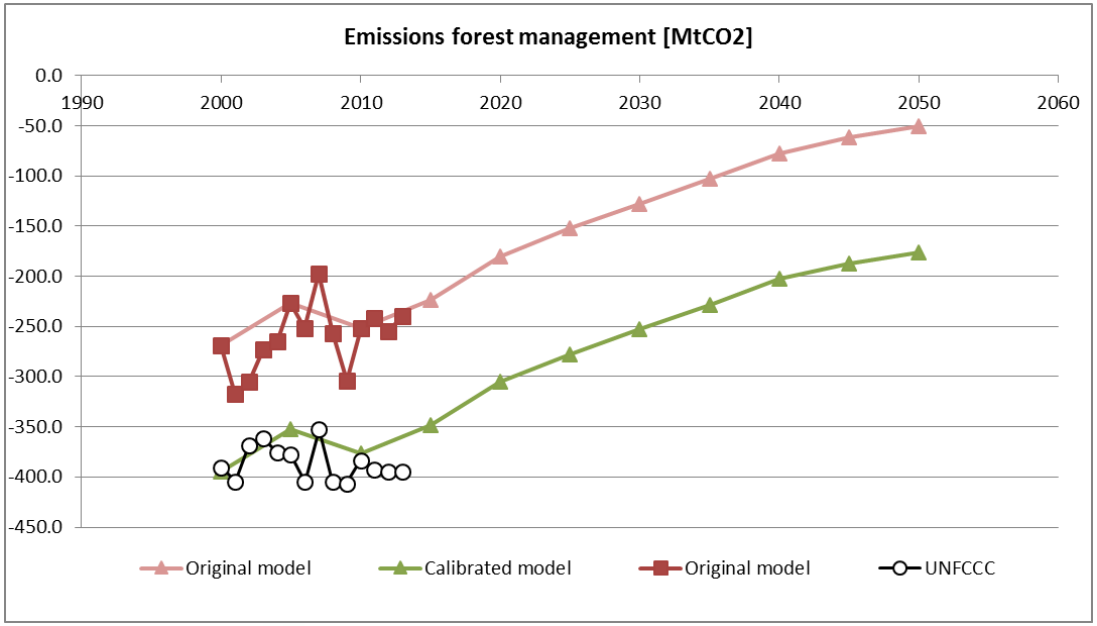
Other natural land

Gridded representation of world land use

From global targets to national commitments

Calibration with national GHG inventories and other statistics to ensure consistency in projections





Technical non-CO2 mitigation options based on US EPA database

Different crop and livestock technologies

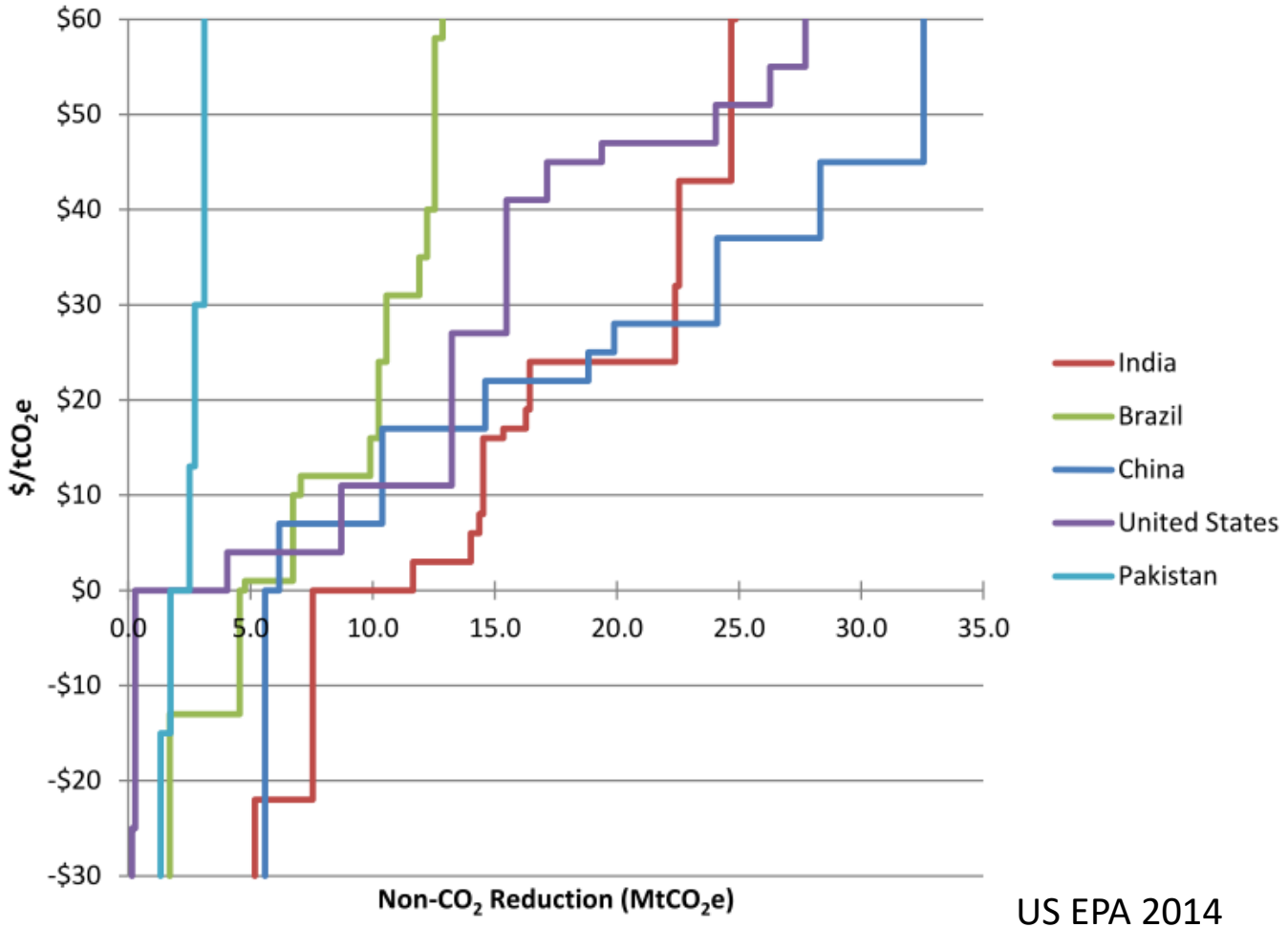
- CH4 and N2O emission reduction achieved by technology
- Related impacts on productivities
- Costing:
  - +Capital/investment costs
  - +Operating and maintenance costs
    - +Labor
    - +Fertilizers
    - +Energy
    - +Other inputs
    - - Other revenues e.g. from biogas production etc.
  - +Inertia constraint on adoption rates (quadratic cost function)

Technical non-CO2 options based on EPA database

Diffe

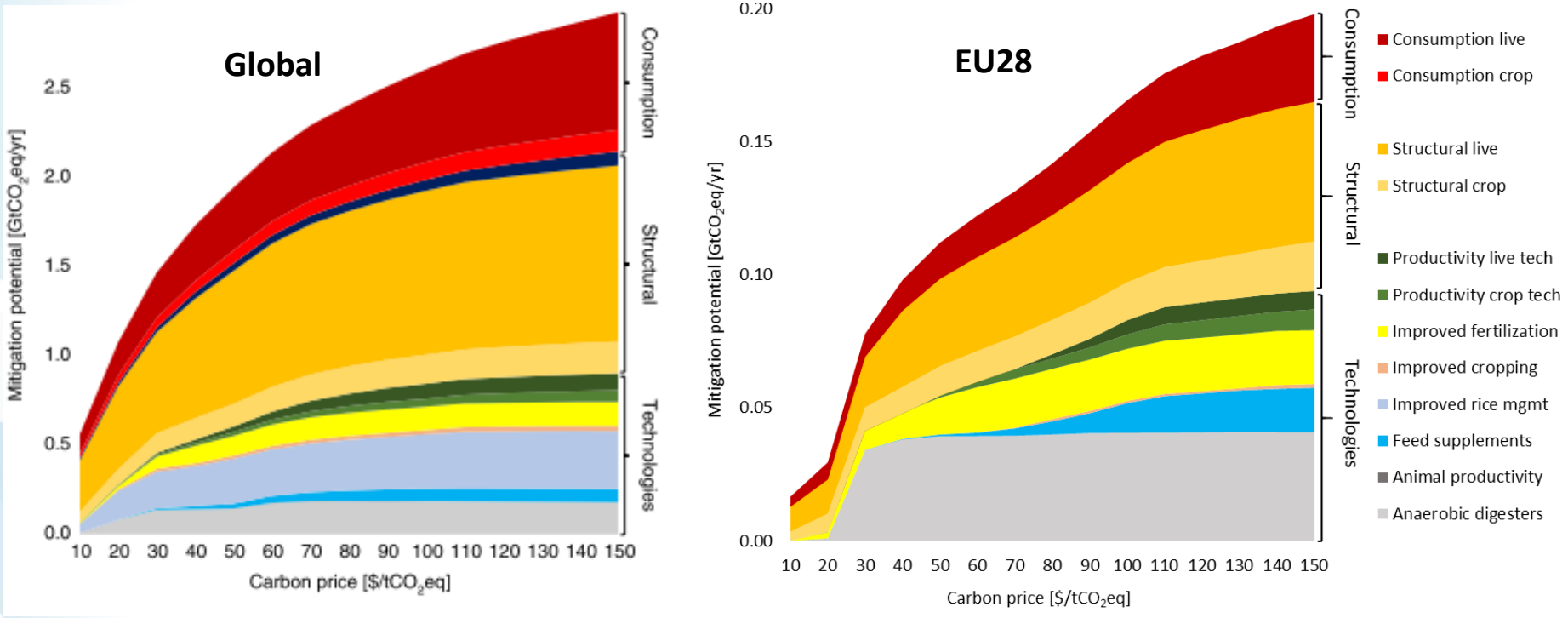
- C
- R
- C

Figure 3-5: Marginal Abatement Cost Curve for Top 5 Emitters in 2030 (Baseline Production Case)



US EPA 2014

Non-CO2 mitigation in GLOBIOM



Supply side options:

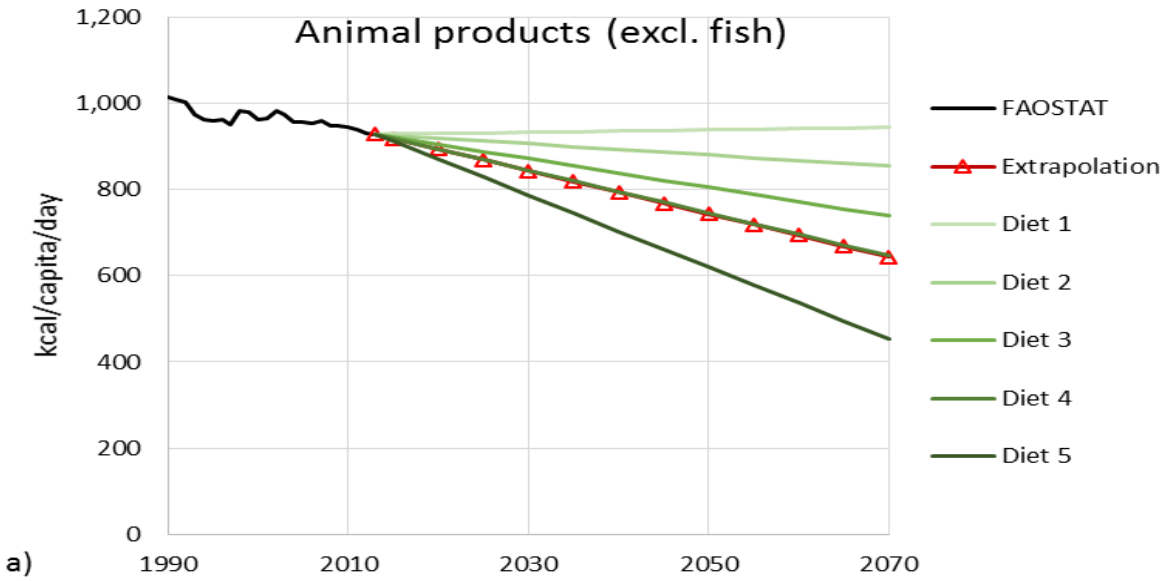
Technologies: Technical options based on EPA (2015)

Structural change: Transition in production systems (Havlik et al. 2014)

Lifestyle changes in EU LTS

- Several diet options tested
- LTS finally relied on Diet4
- Sensitivity around international trade response

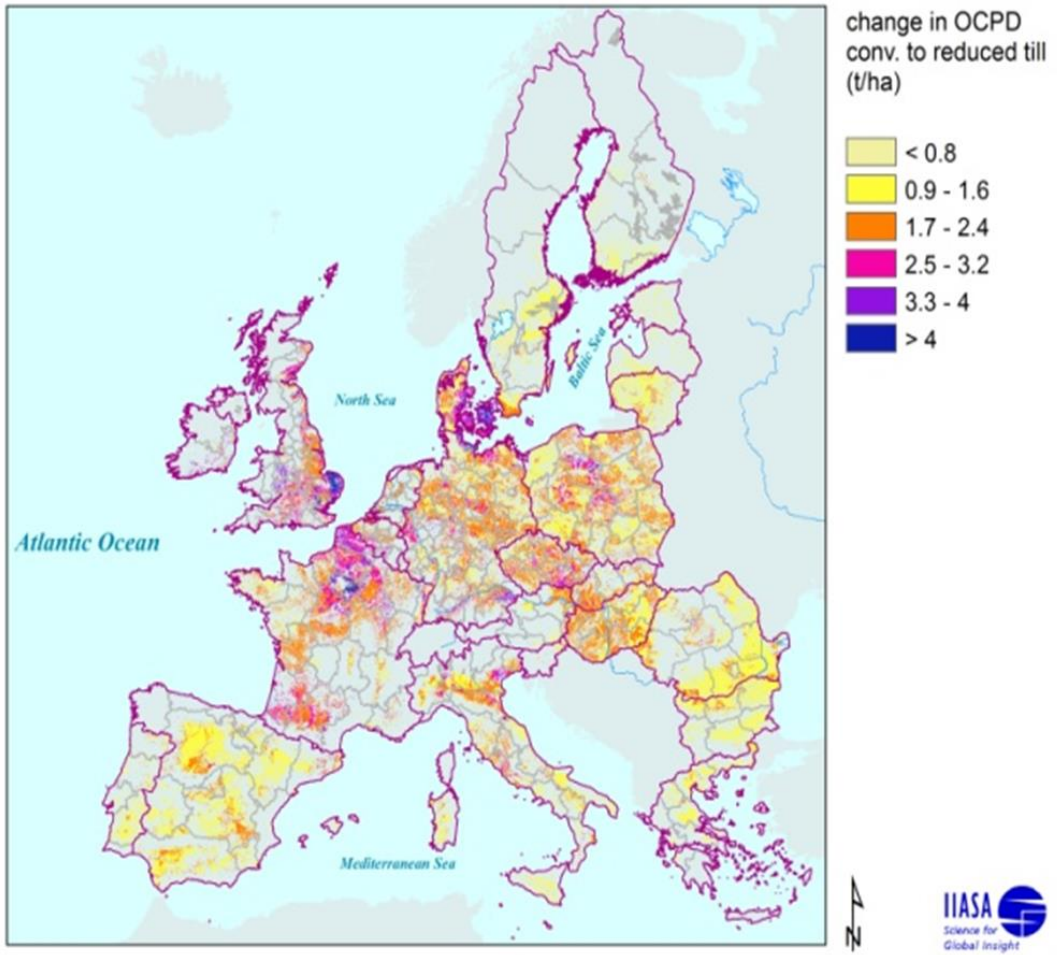
	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Bovine meat	-50%	-50%	-50%	-50%	-50%
Sheep and goat meat	-50%	-50%	-50%	-50%	-50%
Milk	2010	2010	-50%	-50%	-50%
Pig meat	BAU	2010	BAU	2010	-50%
Poultry meat	BAU	2010	BAU	2010	-50%
Eggs	BAU	2010	BAU	2010	-50%



a)

Soil Organic Carbon: EPIC

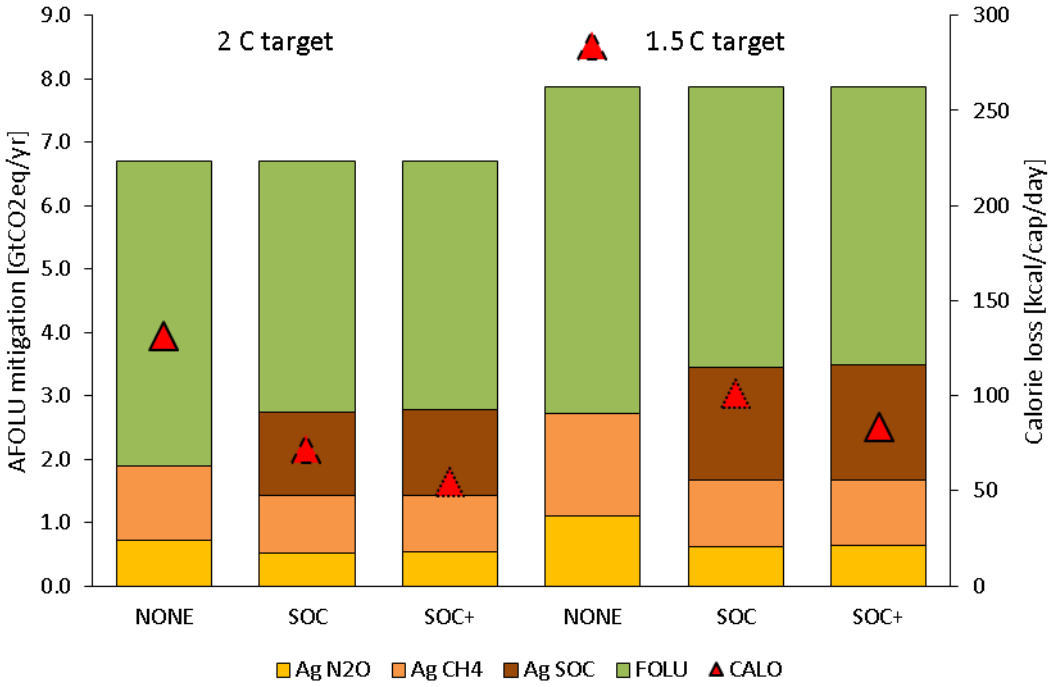
- Average annual change in the total SOC content in 0-30 cm ploughing layer (OCPD in t/ha) when converted from conventional to reduced tillage



Source: Balkovič et al.

Soil organic carbon and food trade-offs

- Land based mitigation without considering soil organic carbon would lead to a rise in undernourishment of 40 to 170 million people in 2050
- While including the SOC into the mitigation portfolio would limit the additional number of undernourished to to 10 - 40 million people



Source: Frank et al. ERL (2017)

Nature, 29 July 2010

THE GLOBAL FARM

With its plentiful sun, water and land, Brazil is quickly surpassing other countries in food production and exports. But can it continue to make agricultural gains without destroying the Amazon?

Who are the stakeholders?

High-level meeting about Brazil's iNDC