OECD ◀◀● OCDE

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Modelling global biofuel impacts

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Approach, results and issues

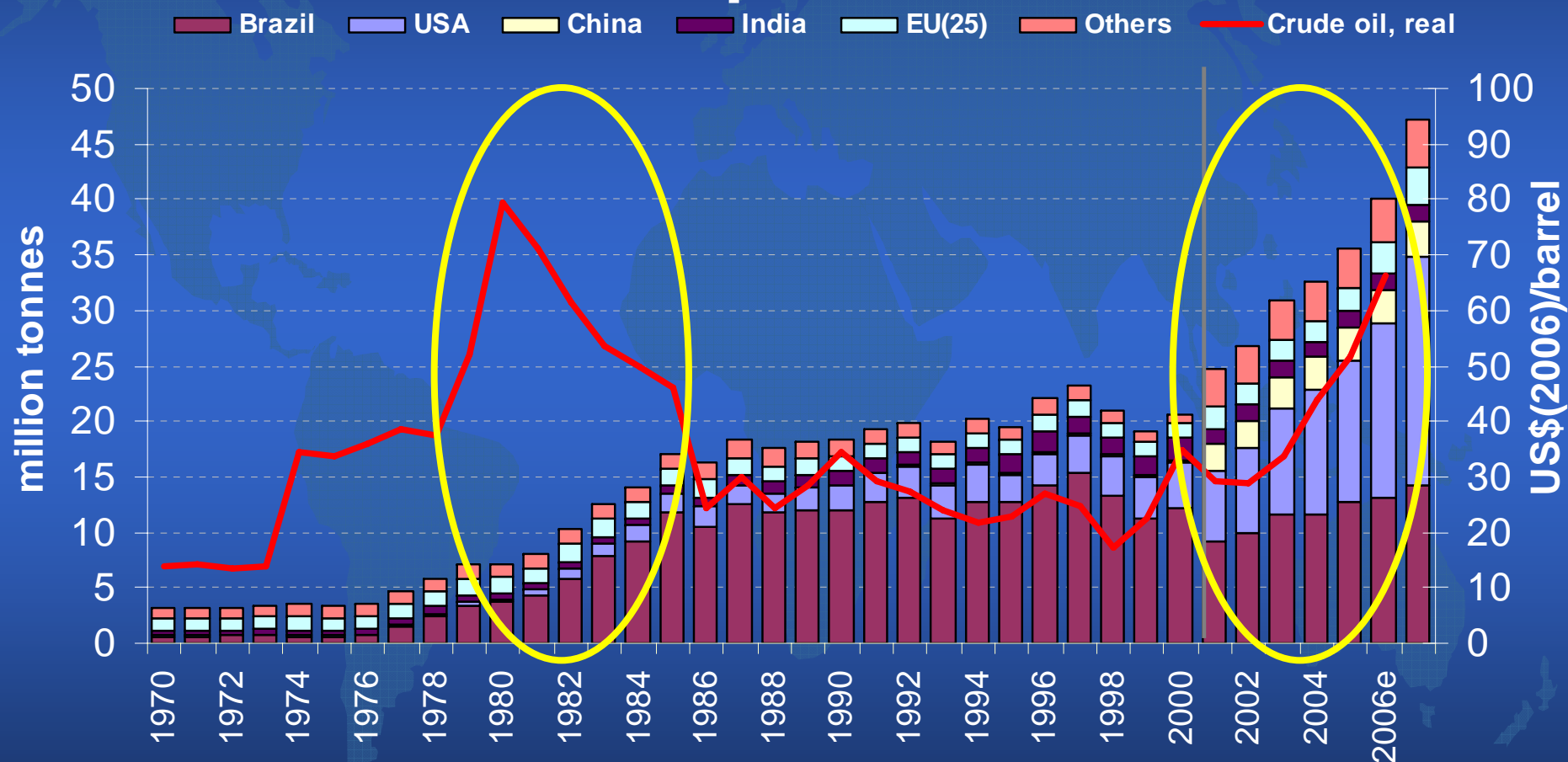Martin von Lampe

Directorate for Trade and Agriculture

Farm Foundation and ERS Workshop
Global Biofuel Developments: Modeling the Effects on Agriculture
Washington, D.C., 27/28 Febuary, 2007

Changing interests in biofuels: Ethanol production and crude oil price

Legend: Brazil · USA · China · India · EU(25) · Others · Crude oil, real

Source: FAOSTAT (non-food only)

Source: F.O. Licht's

Directorate for Trade and Agriculture

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Why do we model biofuels?

- Strong policy engagement in biofuels, other bioenergy

- Knowledge base still fairly weak
  - Contribution to objectives
    - environment, energy, farm income
  - Unintended side-effects
    - market distortions, environment, costs

➔ OECD work in its initial phase only

Main problems in biofuel modelling

- Link between crude oil and fossil fuel prices
  - and finally biofuel prices
- Cost and profitability assessment
  - Responsiveness of biofuel industry
- Two fuels, various feedstocks (particularly EU)
  - contribution of each feedstock type
- Link to agricultural markets
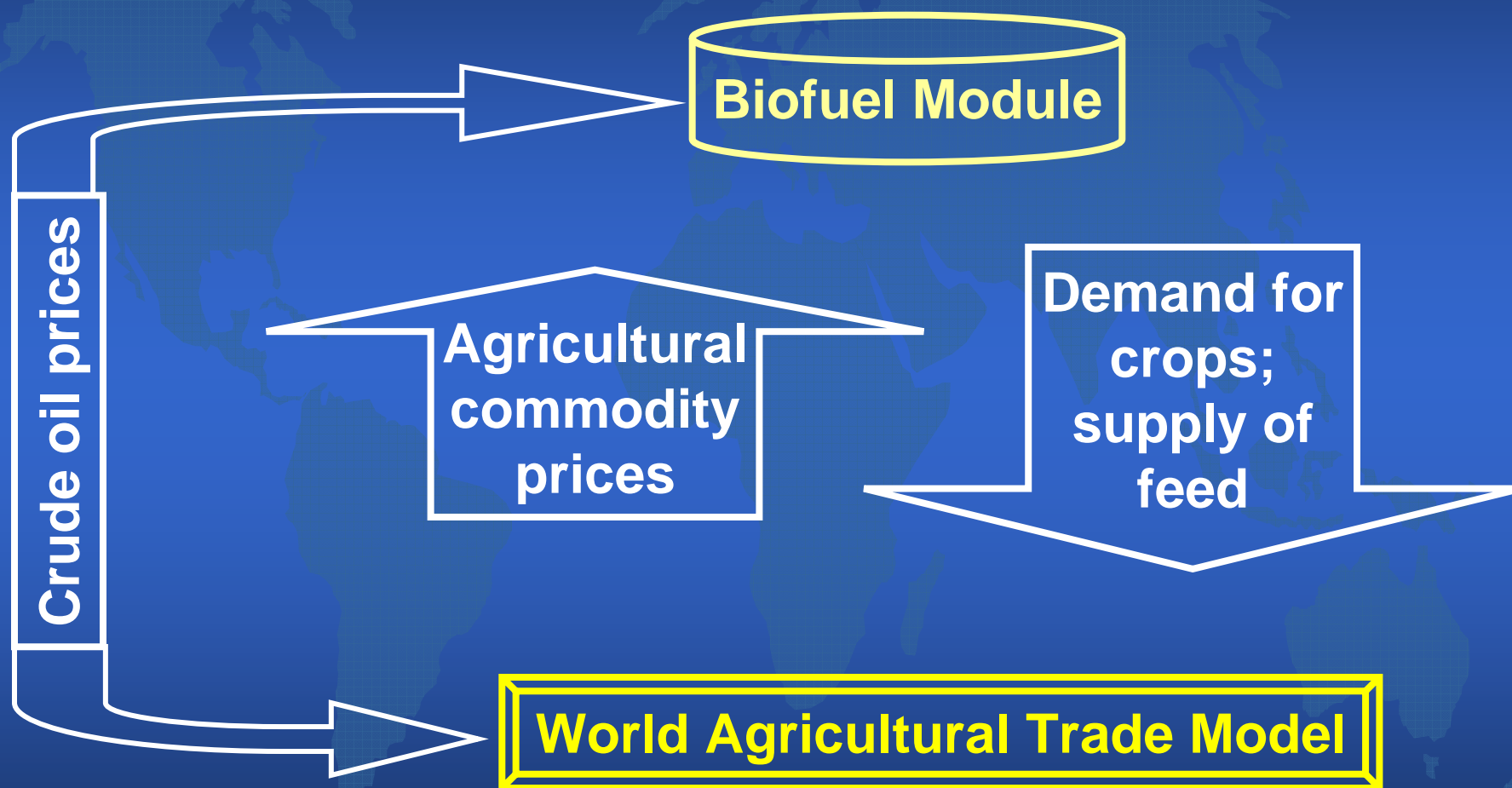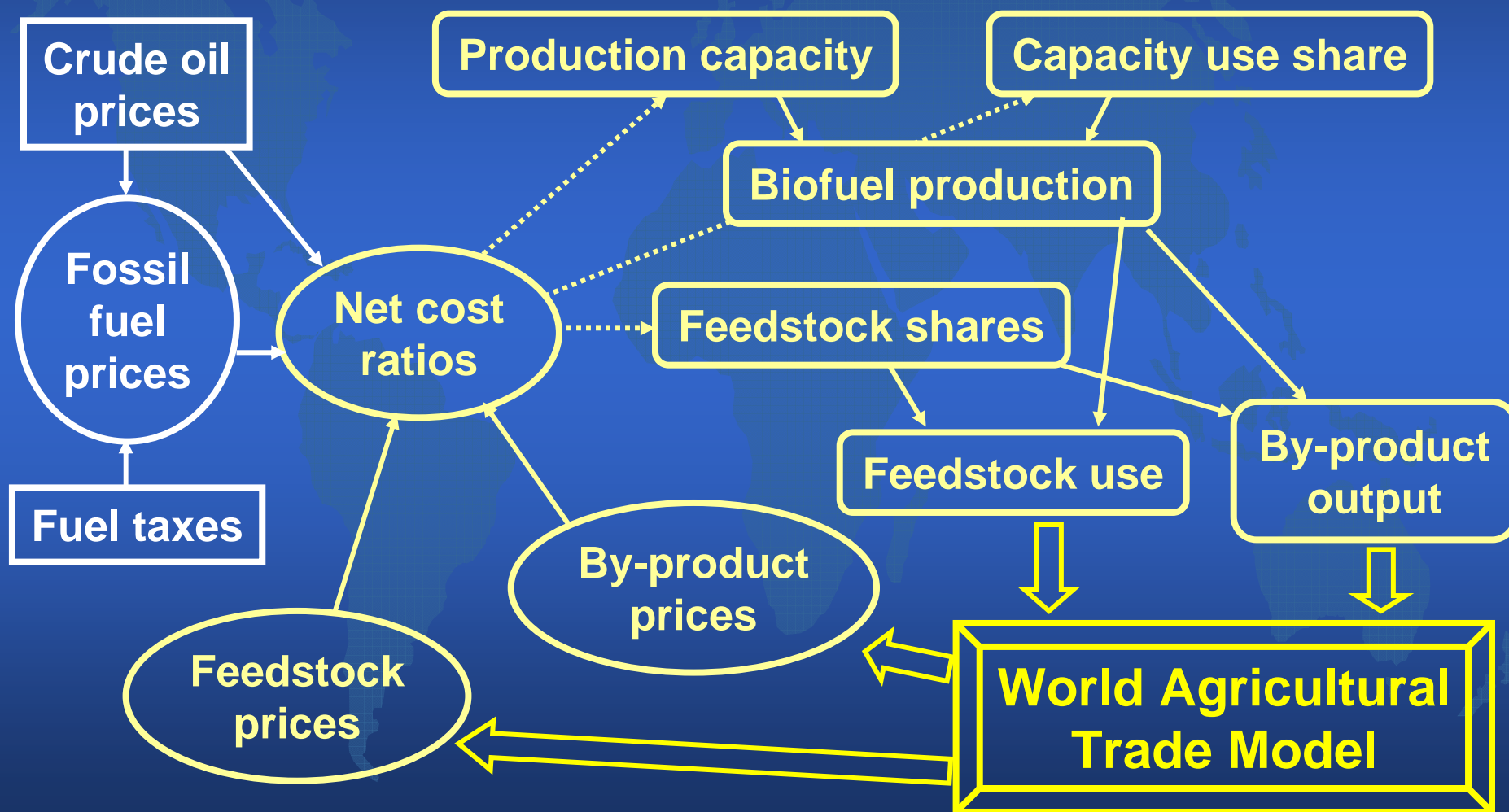- (Link of crude oil prices to agric. production costs)

Modelling scheme (1)

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┌─────────────────────────┐         ┌─────────────────────────┐
│   OECD Aglink Model     │         │   FAO Cosimo Model      │
└─────────────────────────┘         └─────────────────────────┘
              ↘                         ↙
        ┌───────────────────────────────────────────┐
        │    World Agricultural Trade Model         │
        │         All relevant regions,             │
        │        most commodities covere            │
        └───────────────────────────────────────────┘
                          ↑
                ┌─────────────────────────┐
                │   World Sugar Model     │
                └─────────────────────────┘
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Modelling scheme (2)

Biofuel Module

Crude oil prices

Agricultural commodity prices

Demand for crops; supply of feed

World Agricultural Trade Model

The Biofuel Module
Main variables and linkages

Key modelling issues (1)
Profitability of biofuel production

Net production costs of biofuels

$$NC_{r,t}^{i,j} = \alpha_{r,t}^{i,j} * PP_{r,t}^{i}$$

$$+ \beta 0_{r,t}^{i,j} + \beta_{r,t}^{i,j} * XP_{t}^{OIL} * XR_{r,t}$$

$$+ \gamma_{r,t}^{i,j}$$

$$- \delta_{r,t}^{i,j,EF} * PP_{r,t}^{CG} - \delta_{r,t}^{i,j,PF} * PP_{r,t}^{OM} - \delta_{r,t}^{i,j,OBP}$$

Fossil fuel prices

$$CP_{r,t}^{j'} = a_{r,t}^{j'} + b_{r,t}^{j'} * XP_{t}^{OIL} * XR_{r,t} + TAX_{r,t}^{j'}$$

Net cost ratio

$$CRT_{r,t}^{j} = \frac{NC_{r,t}^{j} / \lambda^{j,j'}}{CP_{r,t}^{j'}}$$

→ **Perfect substitution of fuels**

Key modelling issues (2)

Biofuel production capacity development

$$\ln\left(QPC_{r,t}^{j}\right) = QPC_{r,t-1}^{j} + \chi_{r}^{j} + \phi_{r}^{j} * \ln\left(\left(CRT_{r,t-1}^{j} + CRT_{r,t-2}^{j} + CRT_{r,t-3}^{j}\right)/3\right) + \ln\left(R.QPC_{r,t}^{j}\right)$$

Biofuel production capacity use

$$QPS_{r,t}^{j} = QPSL_{r,t}^{j} + \frac{1 - QPSL_{r,t}^{j}}{1 + LOGA_{r}^{j} * e^{\left(LOGB_{r}^{j} * \left(CRT_{r,t}^{j} - 1\right)\right)}}$$

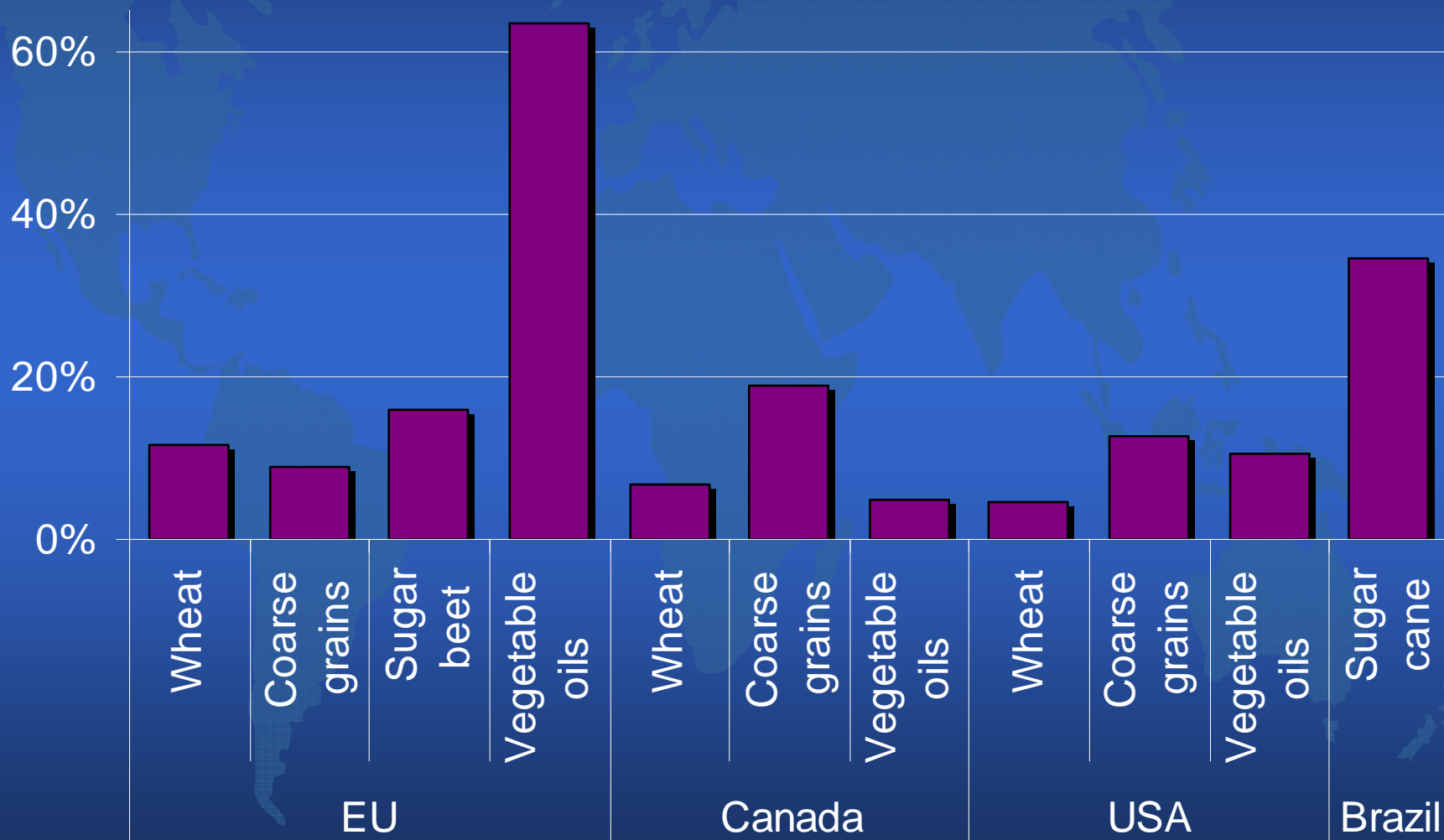# Market impacts
Some results from first study

- Constant biofuels scenario
    - Base of comparison
- Policy-target scenario
- High oil price scenario 60 US$ (instead of 46 – 34 US$)
    - Higher production costs in agriculture
    - Increased biofuel production due to higher fuel prices

Demand growth for biofuels
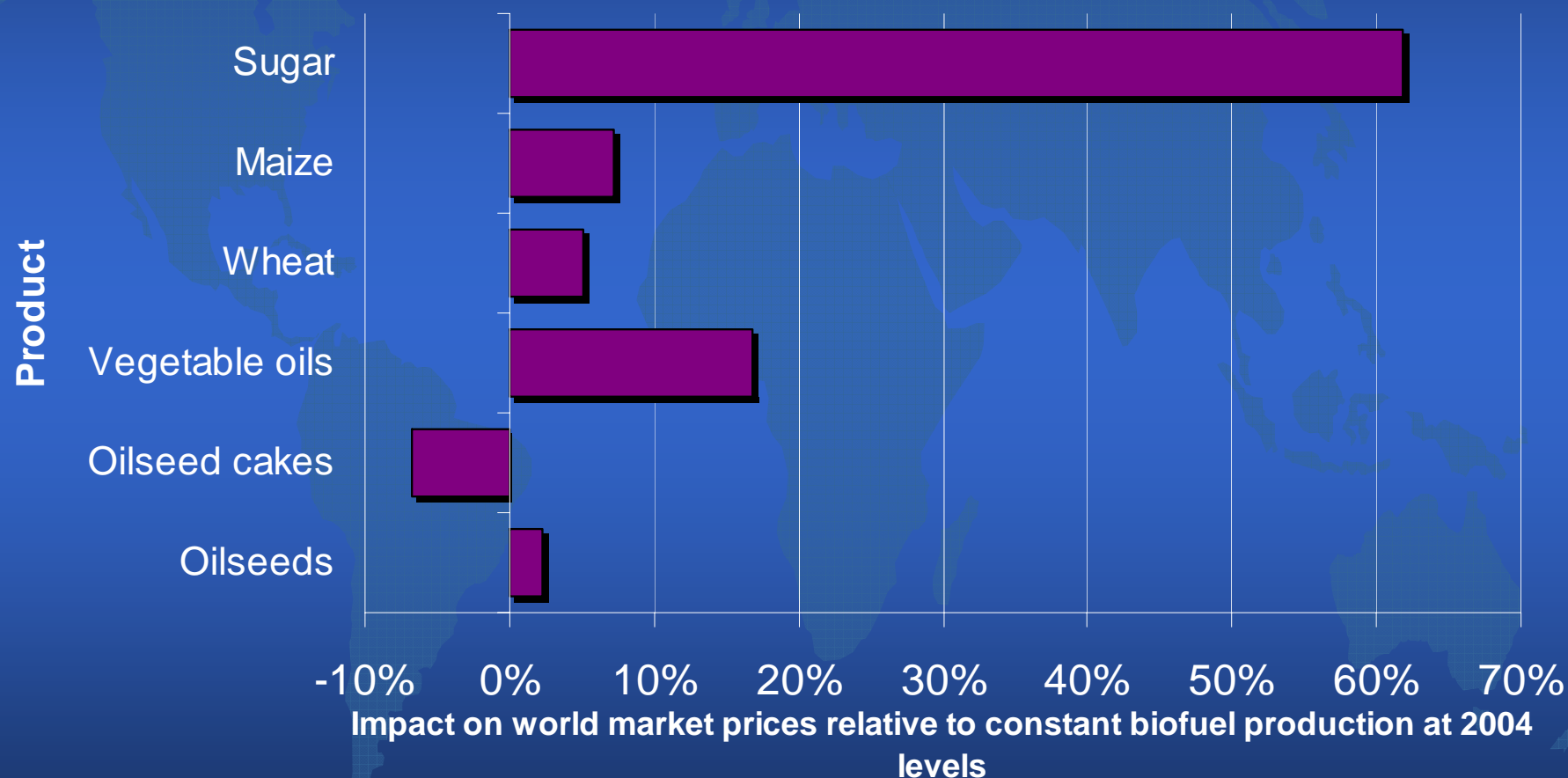## 2004 to 2014, in % of total consumption in 2004

Biofuel-driven demand growth (vertical axis)

Y-axis: 0%, 20%, 40%, 60%

EU: Wheat, Coarse grains, Sugar beet, Vegetable oils

Canada: Wheat, Coarse grains, Vegetable oils

USA: Wheat, Coarse grains, Vegetable oils

Brazil: Sugar cane

**Country / product**

High oil price scenario
Principal results

- High crude oil prices have important effects on agricultural markets
  - Higher production costs reduce global crop supply by 1-3% in the medium term
  - Higher biofuel production stimulates crop demand
  - Higher world crop prices: up 12-17% compared to lower oil prices
  - Dominated by ag production cost changes?

High oil price scenario
2014 world price impact of higher crude oil prices relative to policy target scenario
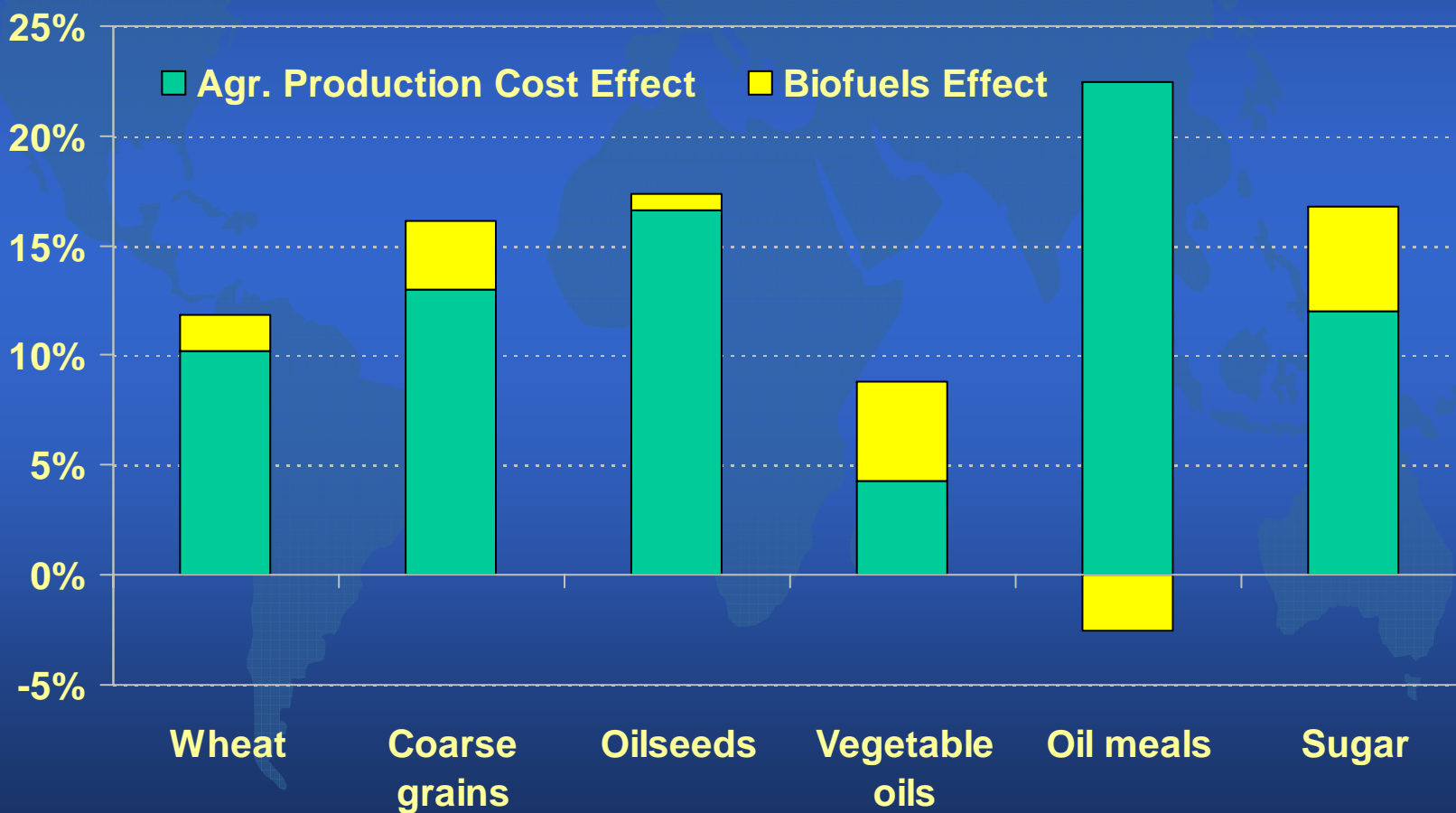
Concluding remarks:
What needs to be improved?

- Data! Data!! Data!!!
- Regional representation
- Representation of support policies
- Responsiveness of biofuel industries
- Responsiveness of biofuel demand
- Next-generation biofuels
- Other forms of bioenergy

Thank you!

www.oecd.org/tad

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