EU Biofuel Policy and Effects on Production and Trade

First Modeling Results with ESIM and GTAP

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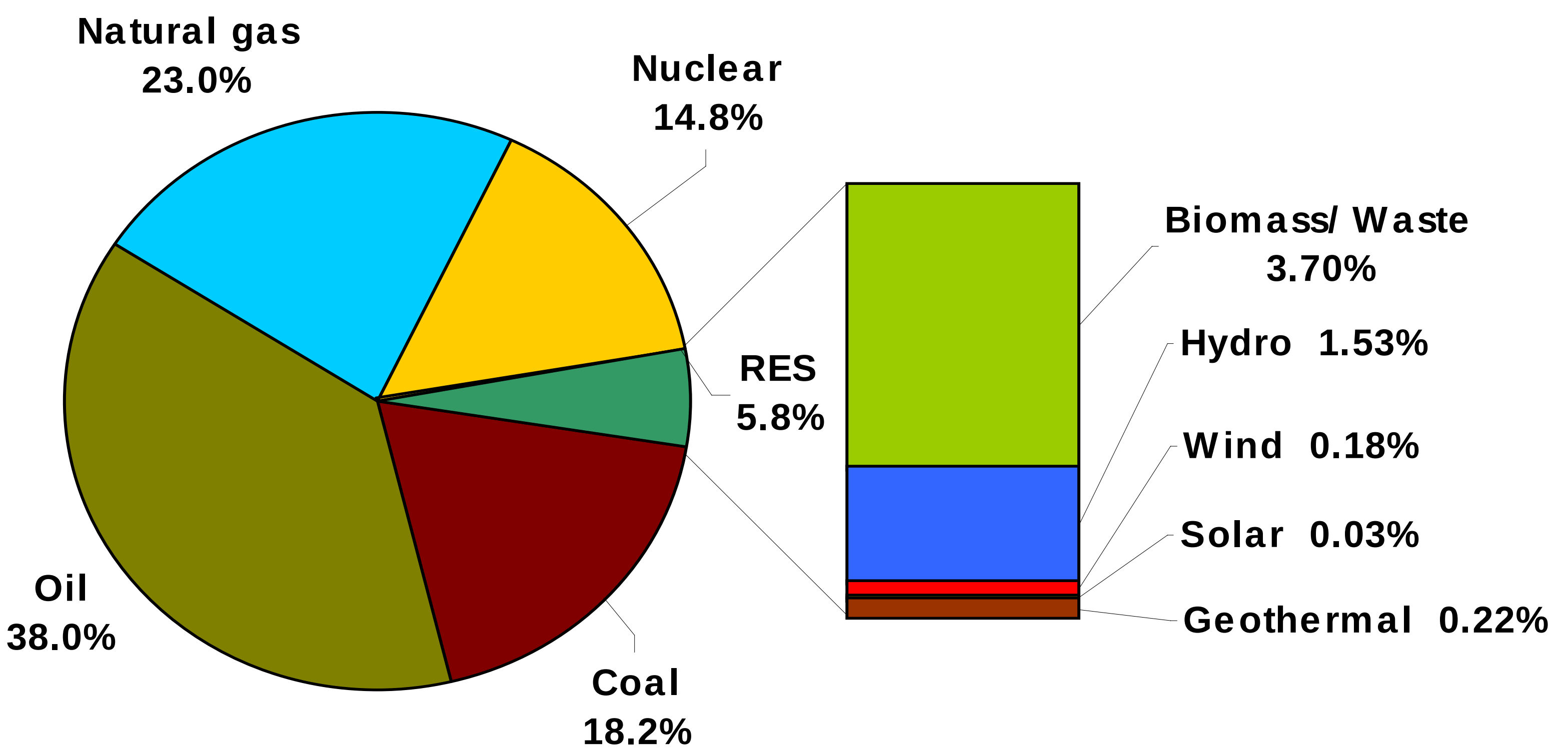
Outline of Presentation

1) Current Market Situation
2) Political Perspective
3) Modeling Biofuels in ESIM
   3.1) Approach
   3.2) Preliminary Results
4) Modeling Biofuels in LEITAP
   4.1) Approach
   4.2) Preliminary Results

4) Conclusions and Outlook

1) Current Market Situation

Figure: EU-25 Gross Energy Consumption - 2002



Source: Eurostat.

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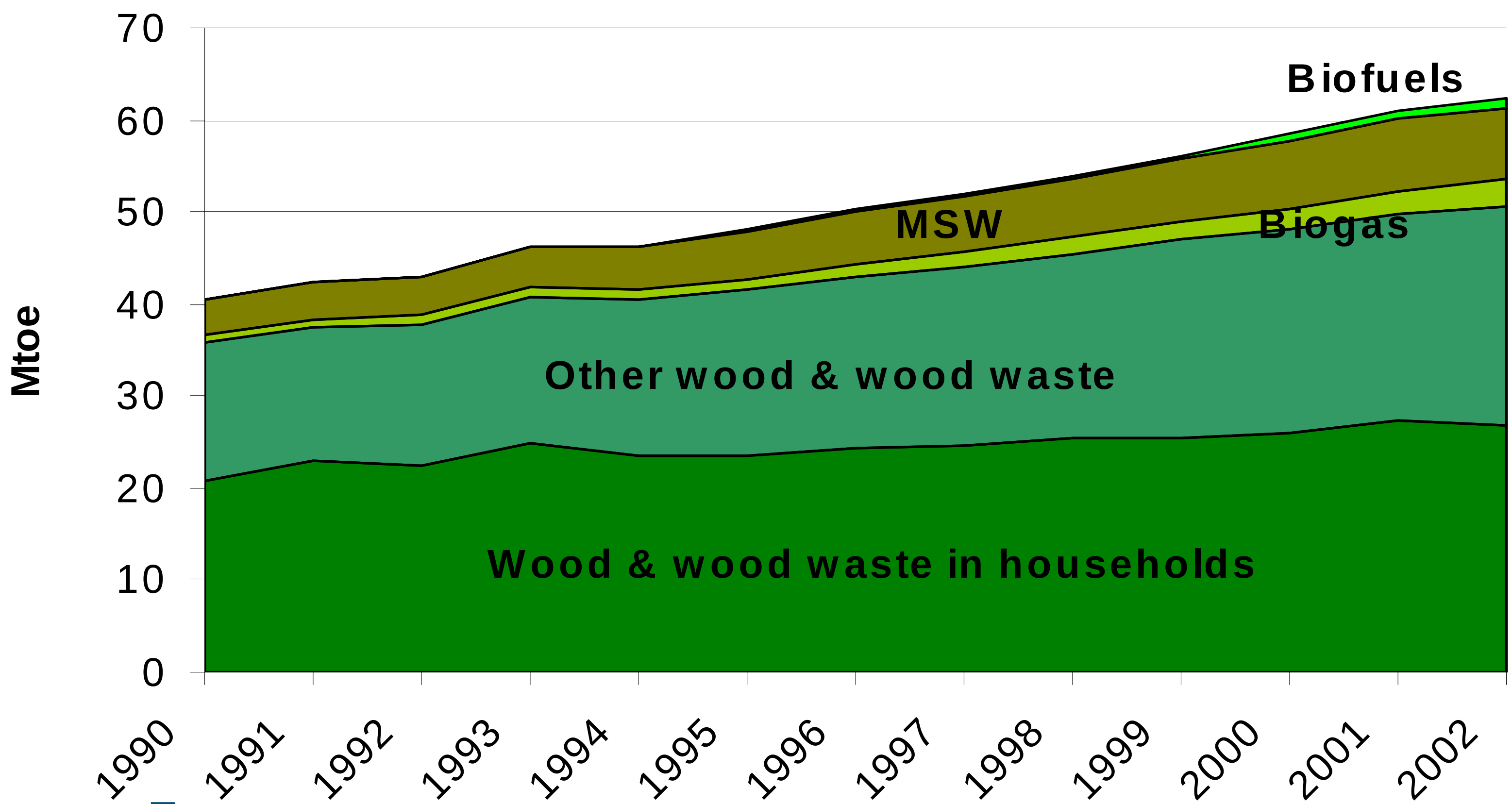
1) Current Market Situation

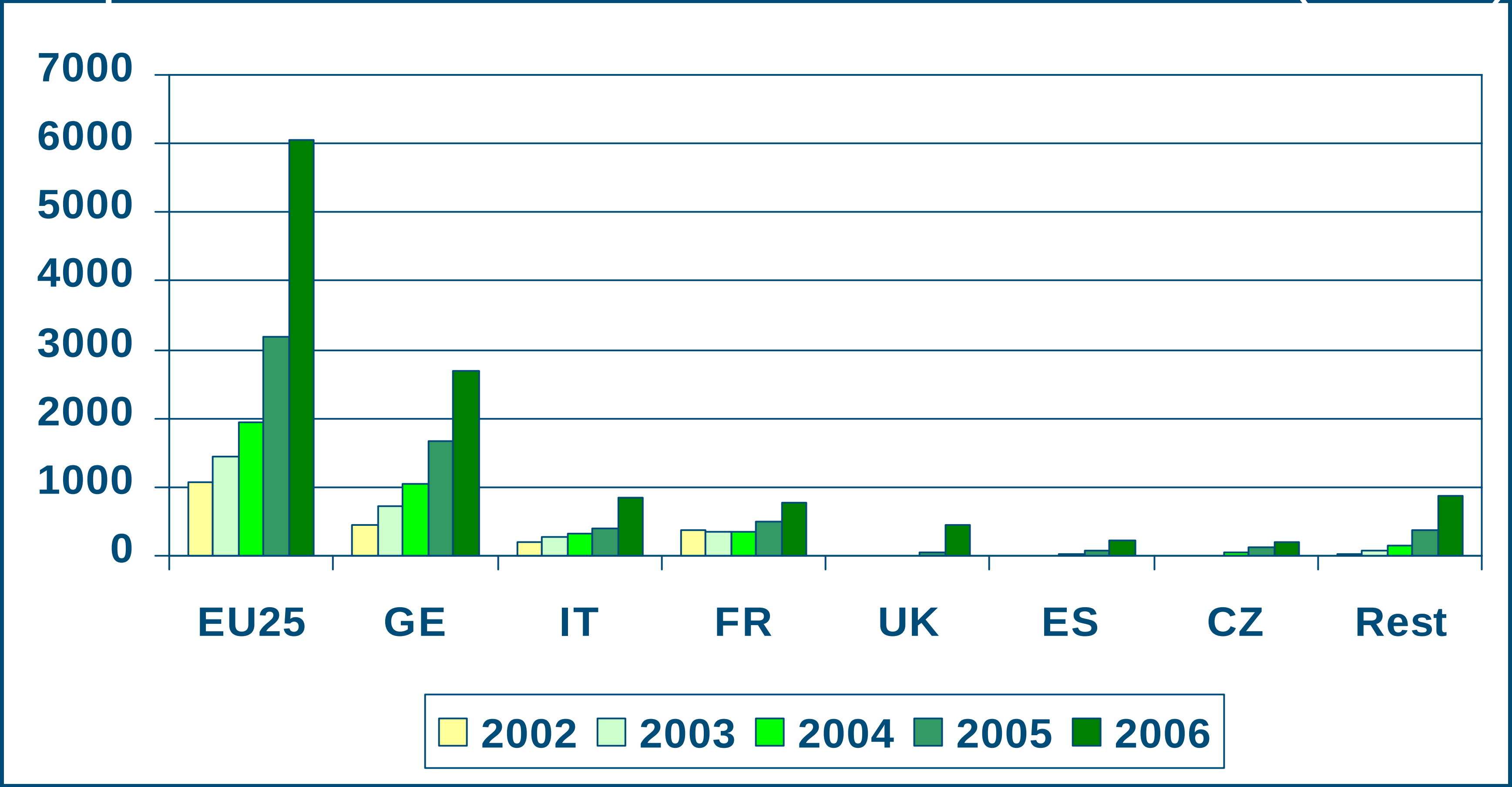
Graph: EU-25 Use of Biomass for Energy (2002)



Source: Eurostat.

1) Current Market Situation

Graph: Biodiesel Production in the EU, 2005 (1000 t)



Source: Data based on F.O. Licht

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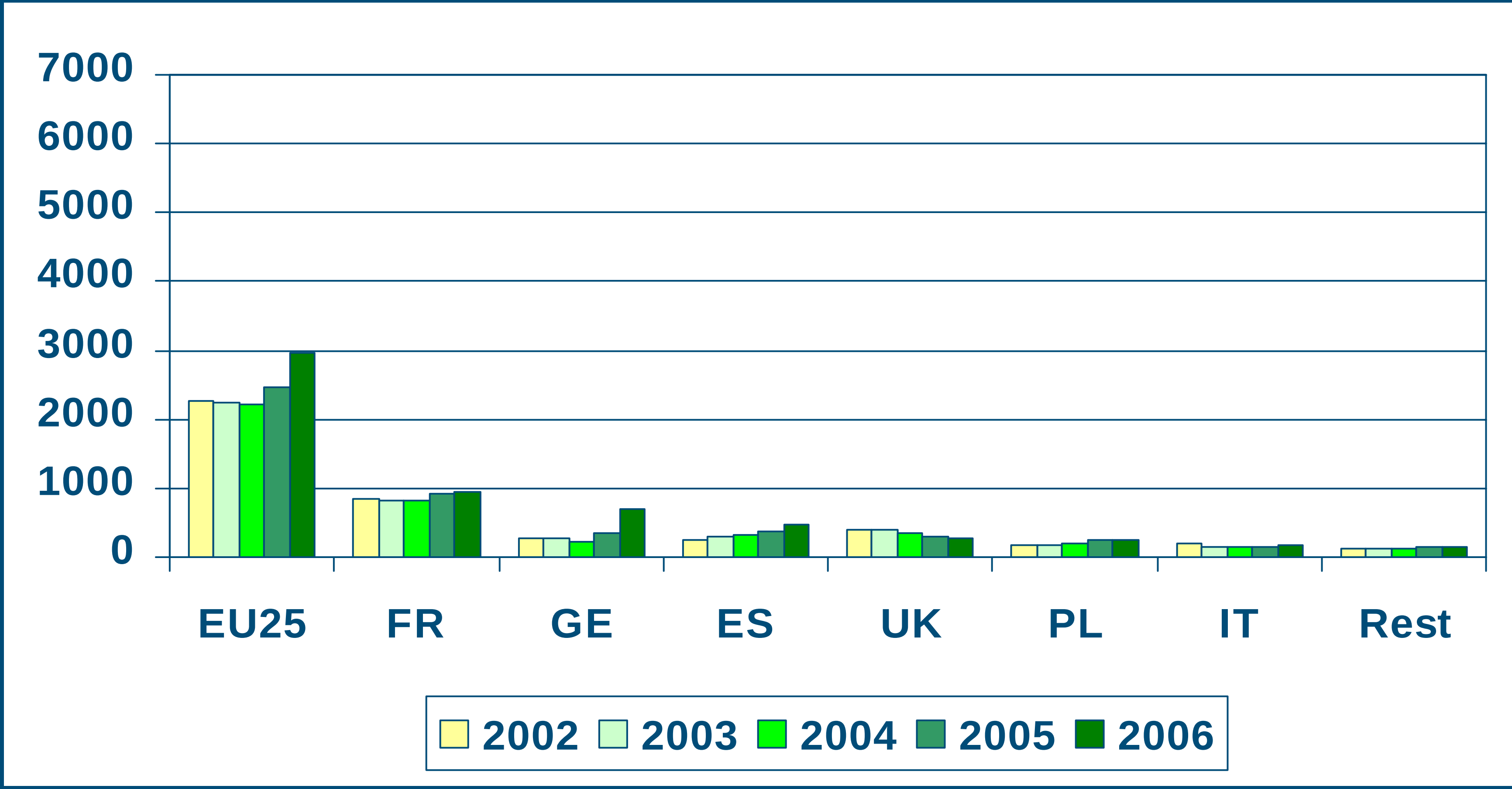
1) Current Market Situation

Graph: Bioethanol Production in the EU, 2005 (1000 t)



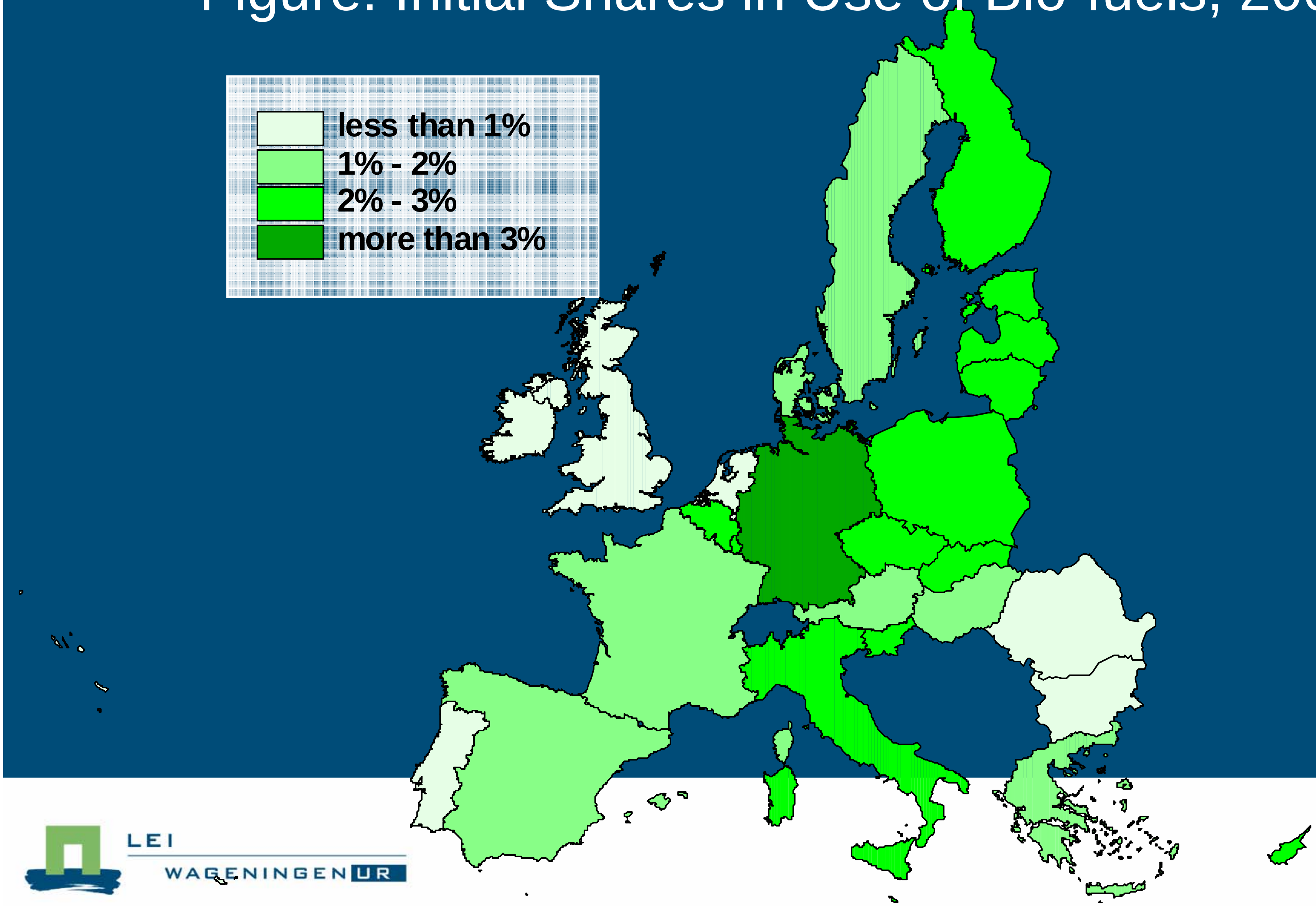
Source: Data based on F.O. Licht

2) Political Perspective

- EU biofuel directive: 5.75% of EU fuel supply by the end of 2010
- 24 mio t biofuels to replace about 18.6 mio t of fossil fuels (due to lower energy content)
- European Commission estimates
  - 16-18 mio ha needed if all biofuels feed stocks grown in EU
  - Which is about 17% of total arable area: 103.6 mio ha
- Area reserve:
  - About 2.8 mio ha obligatory set aside not yet grown with biofuel crops
  - 3 mio ha arable land currently not used

2) Political Perspective

Figure: Initial Shares in Use of Bio-fuels, 2006



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3.1) Modeling Biofuels in ESIM: Approach

- European Simulation Model (ESIM)
  - Recursive dynamic partial equilibrium model
  - 28 regions (EU-15, EU-10, Bulgaria, Romania, Turkey, the US and RoW)
  - Projection period 2003-2020
  - Commodity coverage:
    - 20 crops, 6 animal products, pasture and voluntary set aside
  - Processing activities:
    - milk processing:
    - oilseed processing:
      - seed $\Rightarrow$ oil (food or bio-diesel) and cake

3.1) Modeling Biofuels in ESIM: Approach

- Coverage
  - Oilseeds for biodiesel
  - Cereals and sugar for ethanol
- Production of biofuel crops: two calibrated area allocation functions for each biofuel crop
  - On set-aside area: f(input prices, direct payments, output prices for crops used for biofuel production)
  - On non-set-aside area: f(input prices, direct payments, output prices for all other crops, special energy crop premium)

3.1) Modeling Biofuels in ESIM: Approach

- Production of biofuels:
  - bioethanol and biodiesel production each dependent on i) bioethanol/biodiesel price, ii) weighted prices of energy crops/oils
  - Shares of feedstocks in bioethanol production/oils in biodiesel production
    - CES specification based on energy crop prices (minus price of related feed output)
    - CES specification based on oil prices
  - Demand quantities for energy crops
    - respective fuel produced * share of respective crop/technical extraction factor

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3.1) Modeling Biofuels in ESIM: Approach

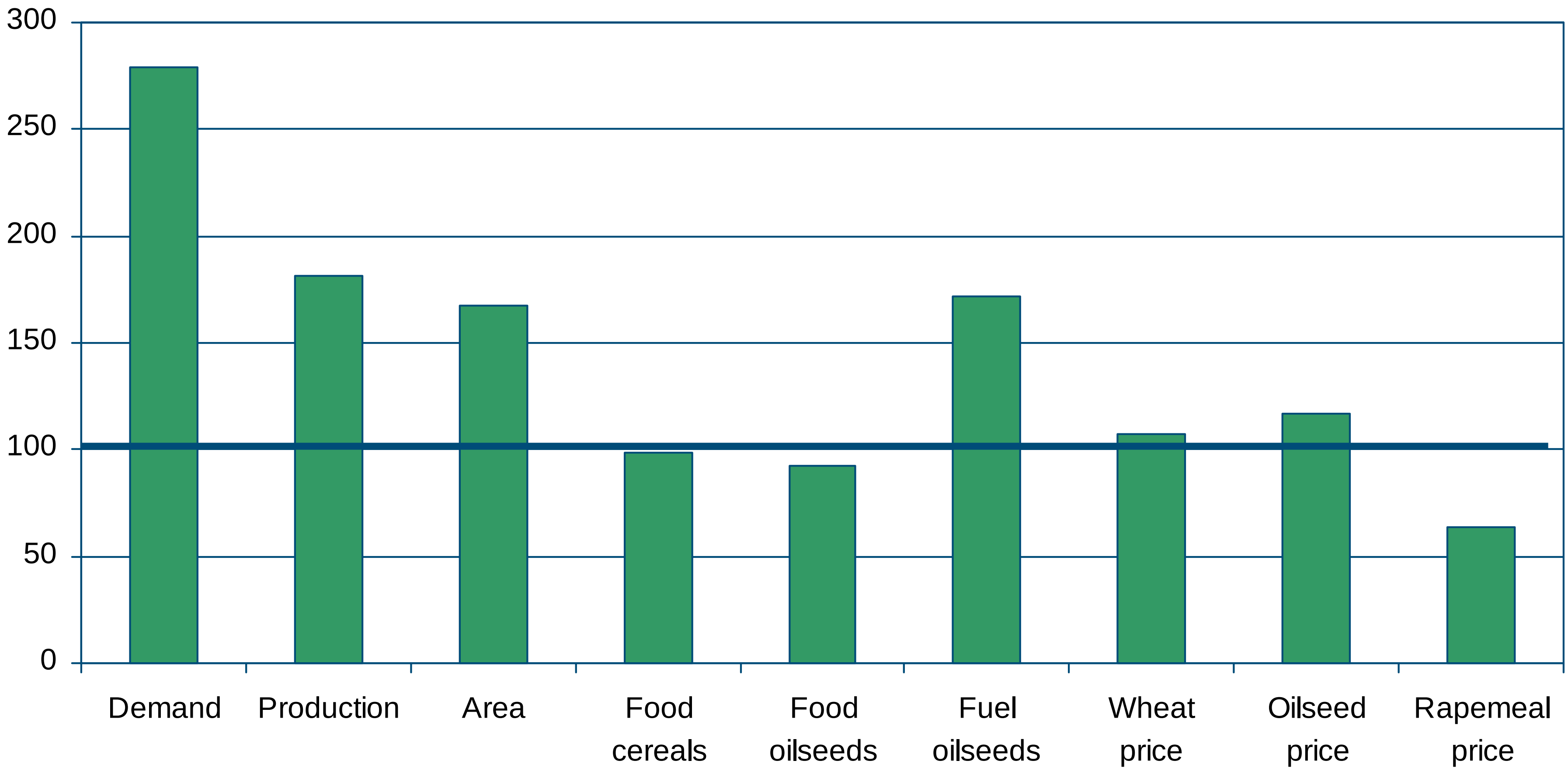
- Processing activities also produce by-products
  - Bioethanol: Cereal gluten feed
  - Biodiesel: Oilcake from oilseed processing
- Biodiesel/bioethanol price
  - Function of crude oil price, tax rates for fuels from mineral oils, tax rates for biofuels, tariffs

3.1) Modeling Biofuels in ESIM: Approach

- Policies
  - The special premium of 45 €/ha (non-set-aside only)
  - Tax rates for fossil fuels biofuels
  - Compulsory blending as a minimum restriction on biofuel production quantity
  - Changes in compulsory set aside rate
    - Shift of all crop supply functions (less than 100% effect to reflect low productivity of set-aside area)
    - Shifters calculated as a mix reflecting i) area shares of biofuel crops on set-aside area, ii) area shares on non-set-aside area

3.2) Modeling Biofuels in ESIM: Preliminary Results

Graph: Effects of Biofuel Directive in 2010 (baseline = 100)



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4.1) Modeling Biofuels in LEITAP: Approach

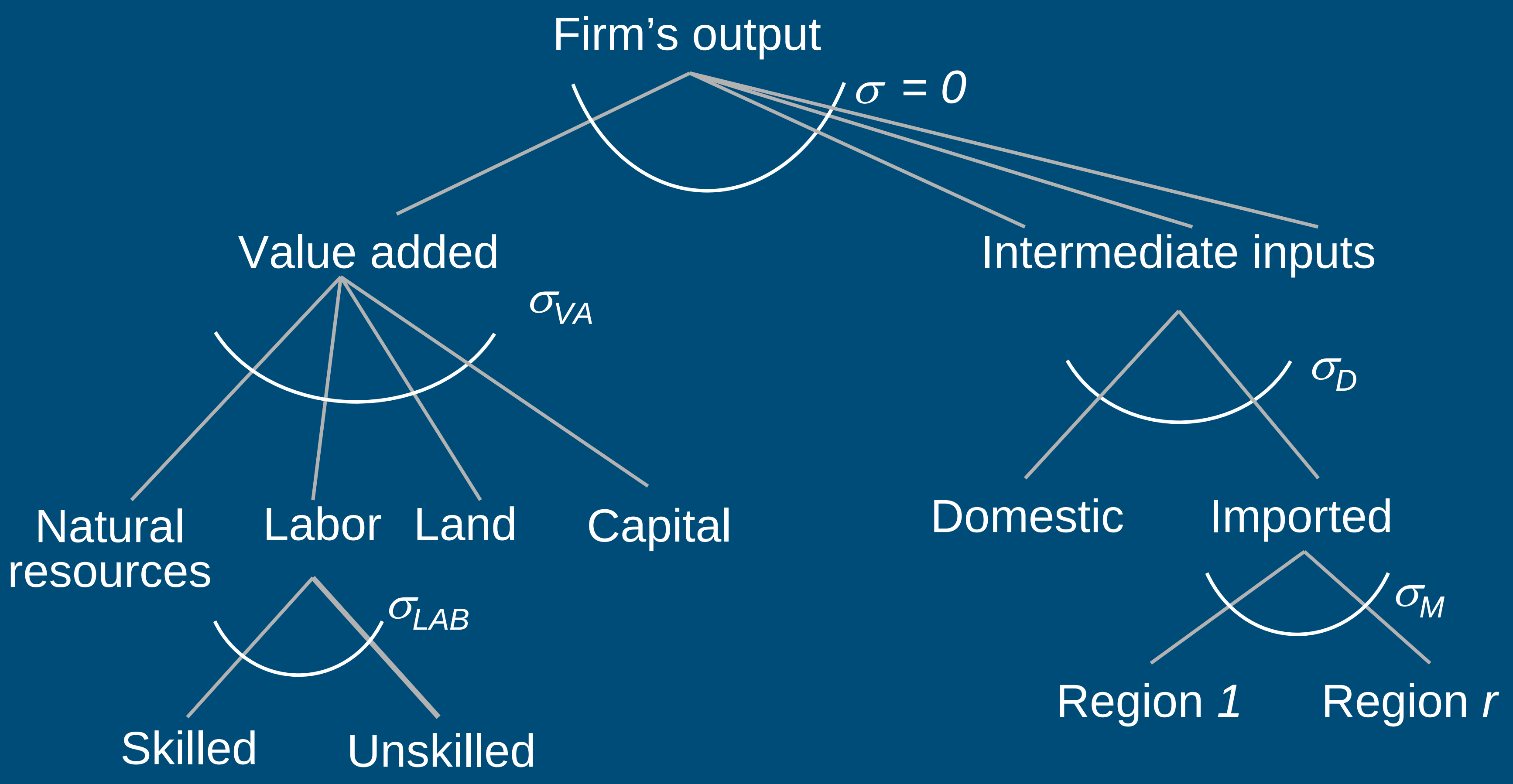
- LEITAP: elaborate GTAP version
  - Segmentation of factor markets
  - Agricultural policies (e.g. endogenous production quota)
  - Land allocation structure (PEM from OECD)
  - Land supply curve
  - Linkage with IMAGE (biophysical model) to improve treatment of yields and feed conversion rates based on feed diet

4.1) Modeling Biofuels in LEITAP: Approach

- Energy in Standard GTAP
  - GTAP has a ‘top-down’ structure for energy production / consumption
  - No energy substitution in production
  - Some limited scope for energy substitution in consumption
- In LEITAP similar approach as in GTAP-E (Burniaux and Truong, 2002)
  - Introduction of energy substitution in production
  - Allows for energy and capital to be either substitutes or complements

4.1) Modeling Biofuels in LEITAP: Approach

Figure: Standard GTAP: Production Structure



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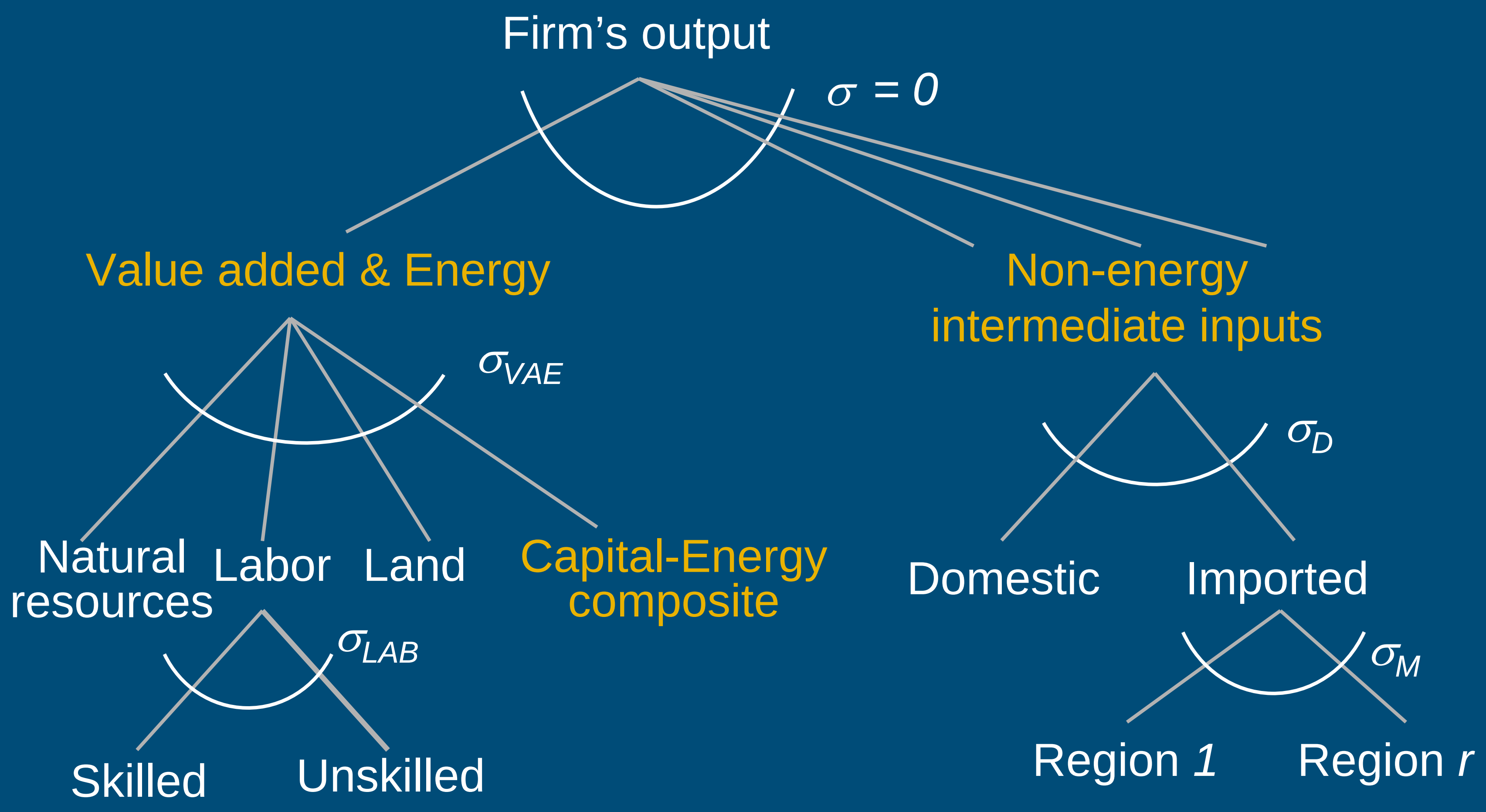
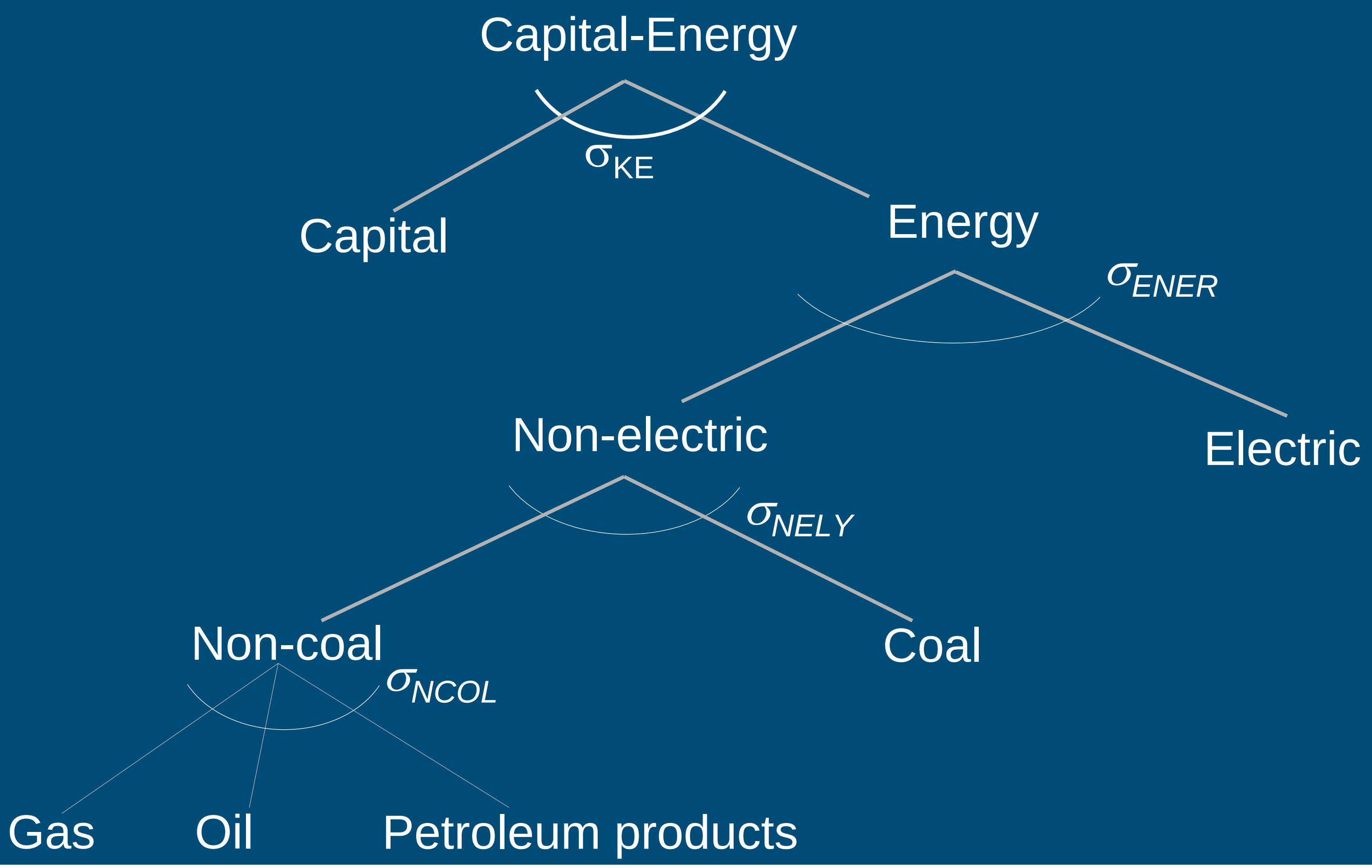
4.1) Modeling Biofuels in LEITAP: Approach

Figure: GTAP-E Production Structure



4.1) Modeling Biofuels in LEITAP: Approach

Figure: GTAP-E: Capital-Energy Composite



4.1) Modeling Biofuels in LEITAP: Approach

Where is the Bio-fuel?

- Non-coal (σ_{NCOL})
  - Fuel (σ_{PETRO})
    - Diesel & gasoline (σ_{DIES})
      - Veget. oil
      - Oil
      - Petroleum products
    - Ethanol (σ_{ETHAN})
      - Sugar
      - Grain
      - Forestry
  - Gas

4.1) Modeling Biofuels in LEITAP: Approach

- Implementation of policies
  - Blending obligations
    - Substitution of bio-fuel with crude oil
    - Implemented as shifters at the level of petroleum activity
  - Taxes/subsidies
    - Tax exemptions at final use
    - Premium per ha at the raw commodity level
  - Trade policy measures
    - Not relevant for oilseeds, oils and biodiesel
    - Relevant for sugar, cereals and ethanol (AVE > 100%)
  - Use of set-aside land for biofuel production

4.1) Modeling Biofuels in LEITAP: Approach

- Implementation of the biofuel directive: huge problems in the data
  - How much do the Member States contribute in the initial situation?
  - What kind of feed-stocks are used to produce bio-fuels?
    - Are these feed-stocks imported or domestically produced?
  - Is future development driven by capacity constraints or by limited demand?

4.1) Modeling Biofuels in LEITAP: Approach

- Implementation of the biofuel directive:
  - How should the bio-fuel directive implemented in a CGE model?
    - No fixing of share (5.75%) of total fuel demand possible
      - Price incentive (subsidy or tax exempt) to use bio fuels
      - Shifters in technology (adjusting input coefficients of biofuels in the aggregate fuel production)

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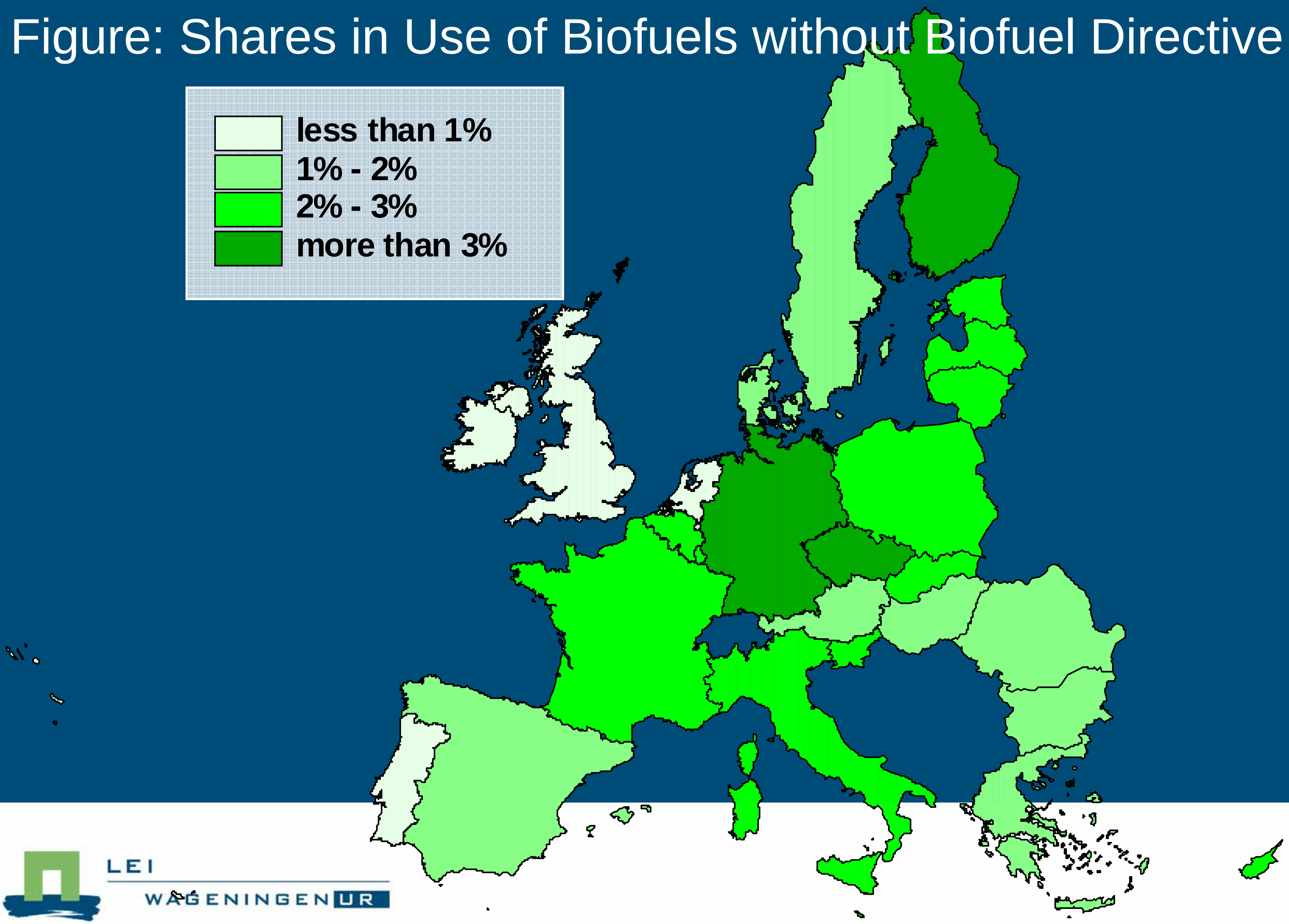
4.2) Modeling Biofuels in LEITAP: Preliminary Results

Figure: Shares in Use of Biofuels without Biofuel Directive (2010)



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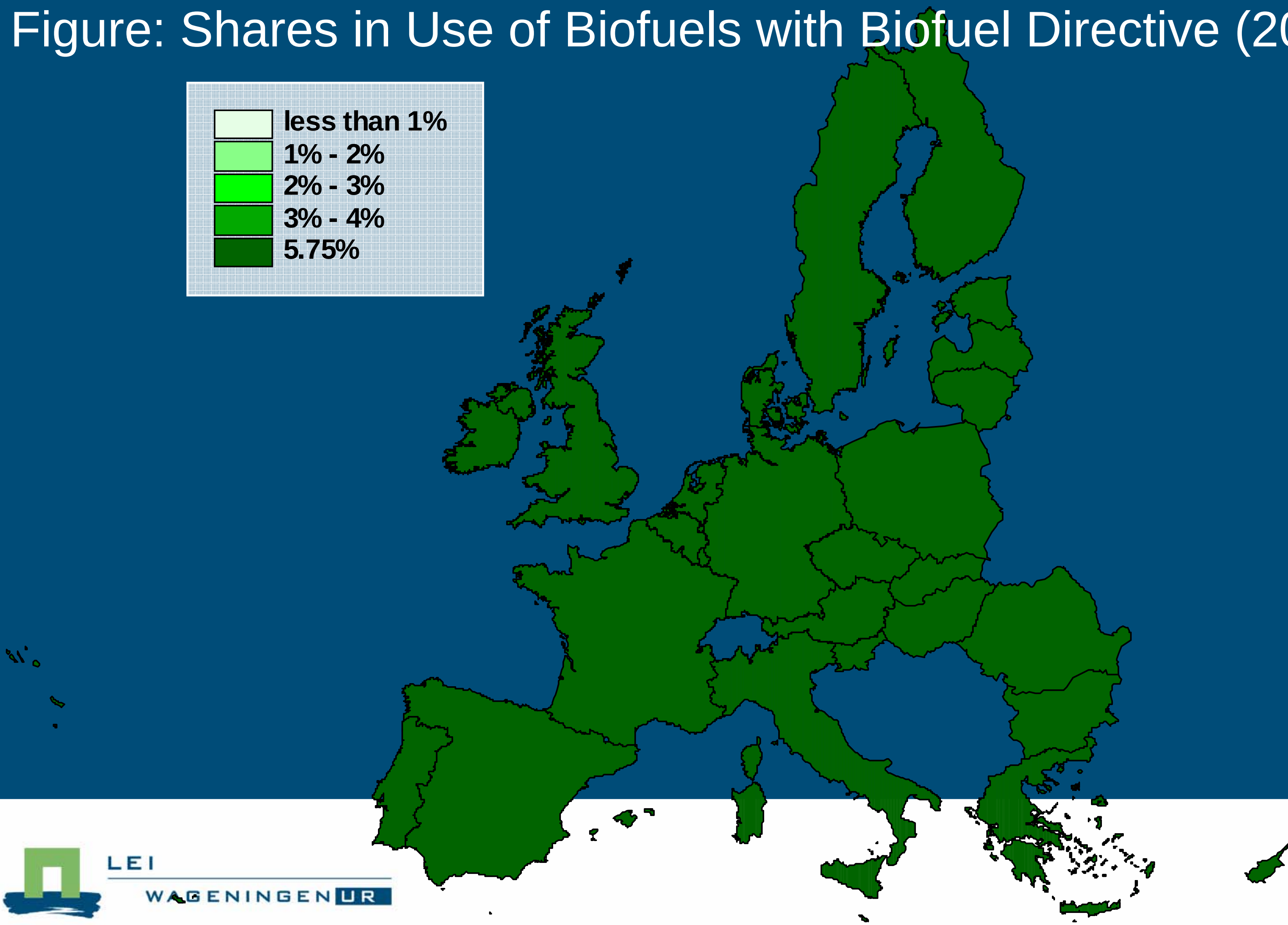
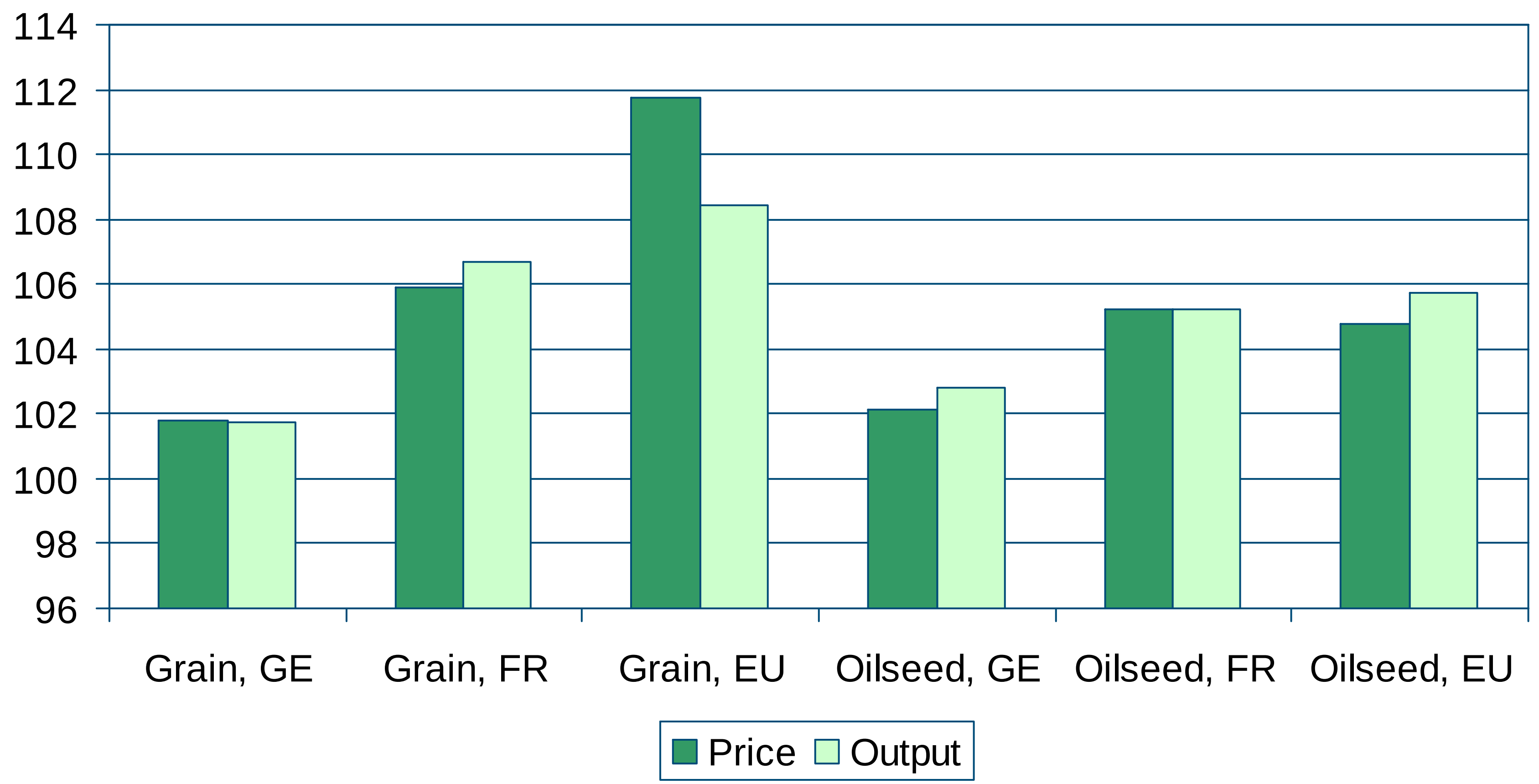
4.2) Modeling Biofuels in LEITAP: Preliminary Results

Figure: Shares in Use of Biofuels with Biofuel Directive (2010)



4.2) Modeling Biofuels in LEITAP: Preliminary Results

Graph: Impact of Biofuel Directive on Production and Price (Baseline = 100)



5) Conclusions and Outlook

- Future EU biofuel policy is likely to have a significant impact on agricultural prices
- Simulation model projections for the EU should include an explicit formulation of EU biofuel policies
- EU price effects of the biofuel directive depend on formulation of price mechanism
  - Armington bilateral trade:
    - Heterogeneous price increases due to heterogeneous demand shifts in different member states
    - Especially high in countries with a low biofuel production today
  - This is different in net trade models

5) Conclusions and Outlook

- CGE/PE modelling?
  - As long as crude oil is the main basis of fuel production, GE effects of biofuel policies in the EU-15 are likely to be small
  - But biofuel policies may heavily affect the price level for agricultural products
    - GE effects relevant in member states with a large agricultural sector (EU-10)

5) Conclusions and Outlook

- Outlook
  - Finalize biofuels in ESIM
    - Special challenge: proper depiction of effects of changes in obligatory set aside area
    - How does the decline of biofuel crops on set-aside area translate into biofuel crops on non-set-aside area?
  - Include other "biofuels": biogas
  - Include results from energy models for scenario specification and validation of dynamics (investment cycles in the energy sector)
  - Causal tracing - sensitivity analysis
    - e.g. higher rates of technical progress
  - Use recent production and trade data in the LEITAP data base