EU Biofuel Policy and Effects on Production and Trade
First Modeling Results with ESIM and GTAP

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Outline of Presentation

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2) Political Perspective
3) Modeling Biofuels in ESIM
   - 3.1) Approach
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4) Modeling Biofuels in LEITAP
   - 4.1) Approach
   - 4.2) Preliminary Results
4) Conclusions and Outlook

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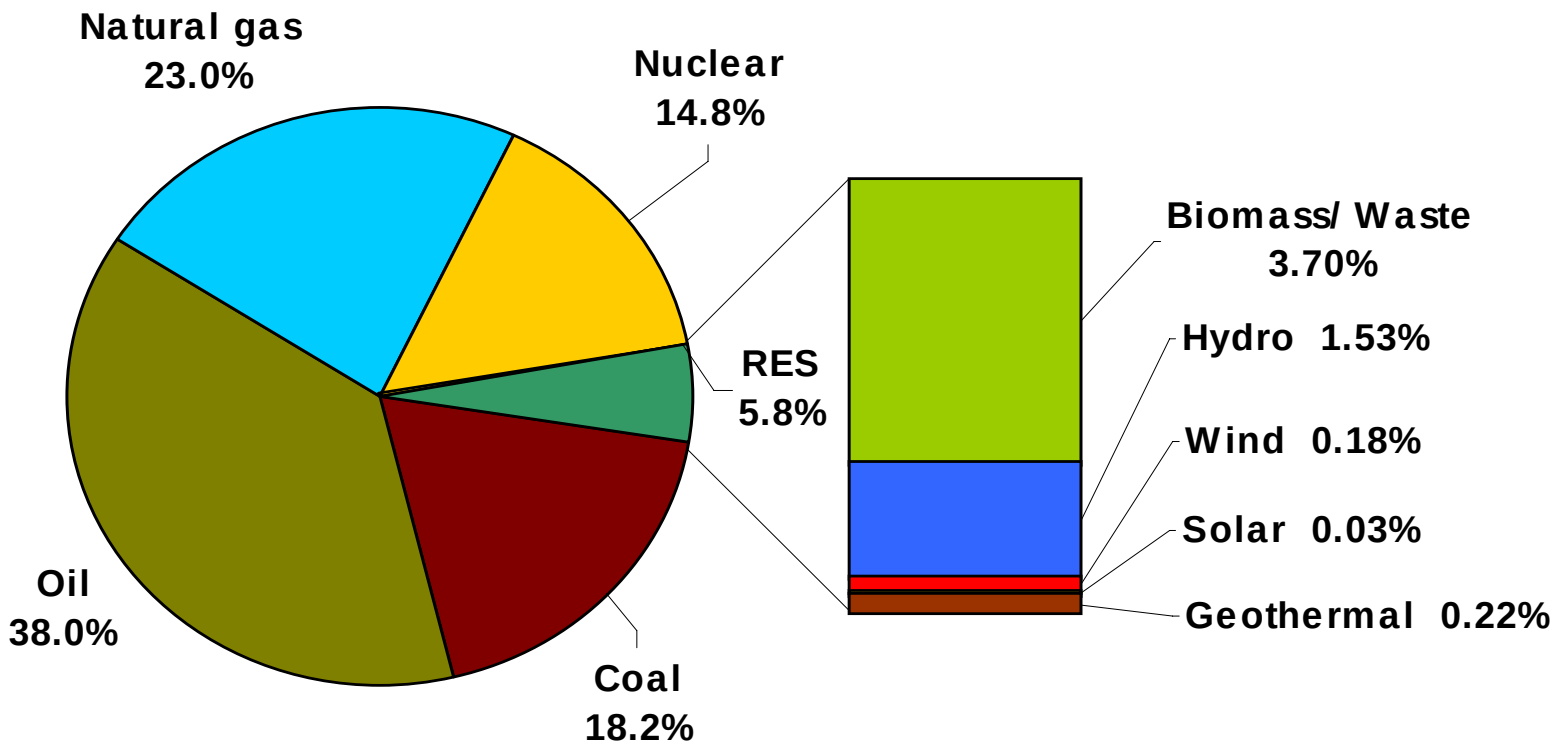
1) Current Market Situation

Figure: EU-25 Gross Energy Consumption - 2002



Source: Eurostat.

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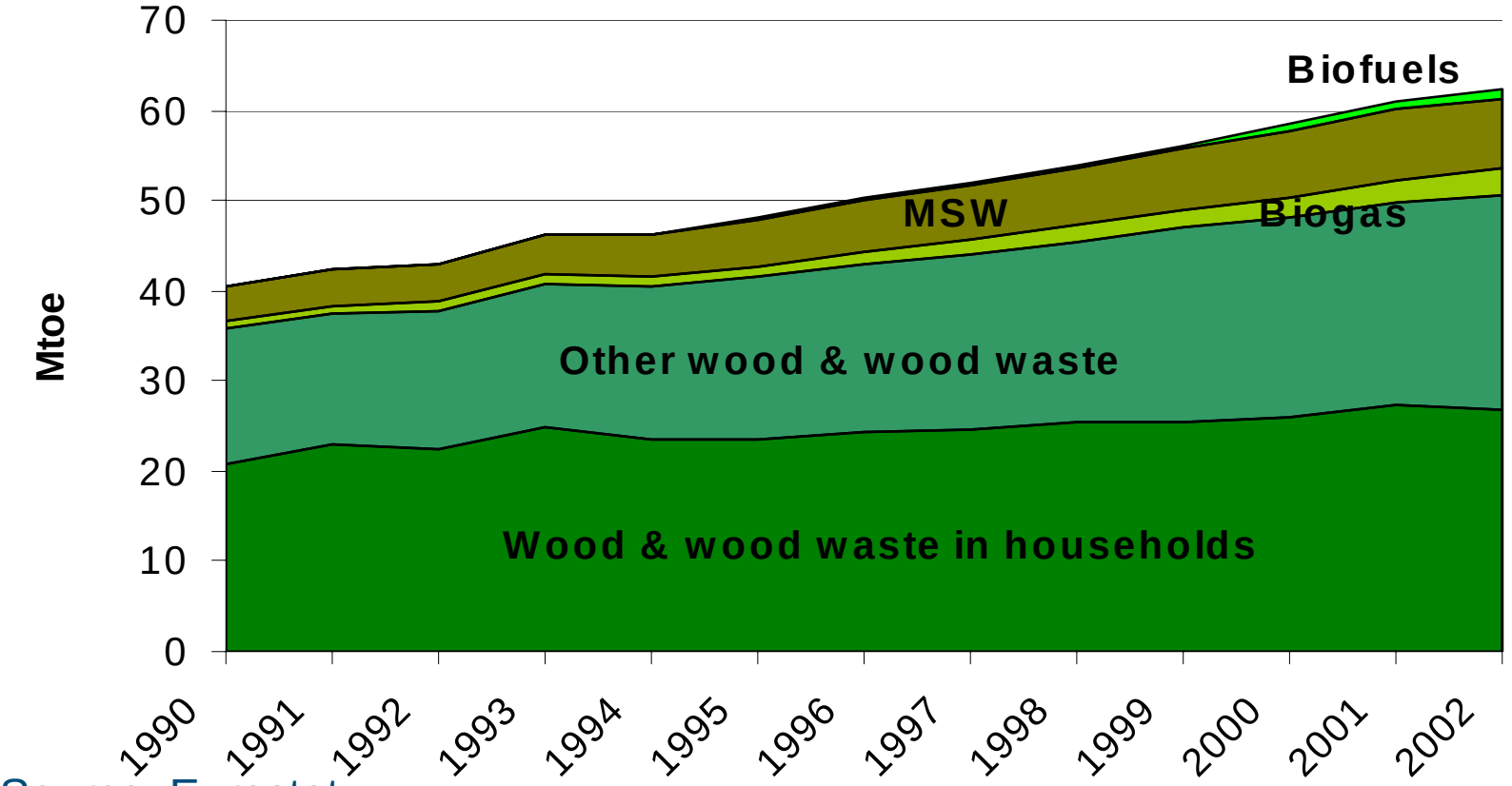
1) Current Market Situation

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



Source: Eurostat.

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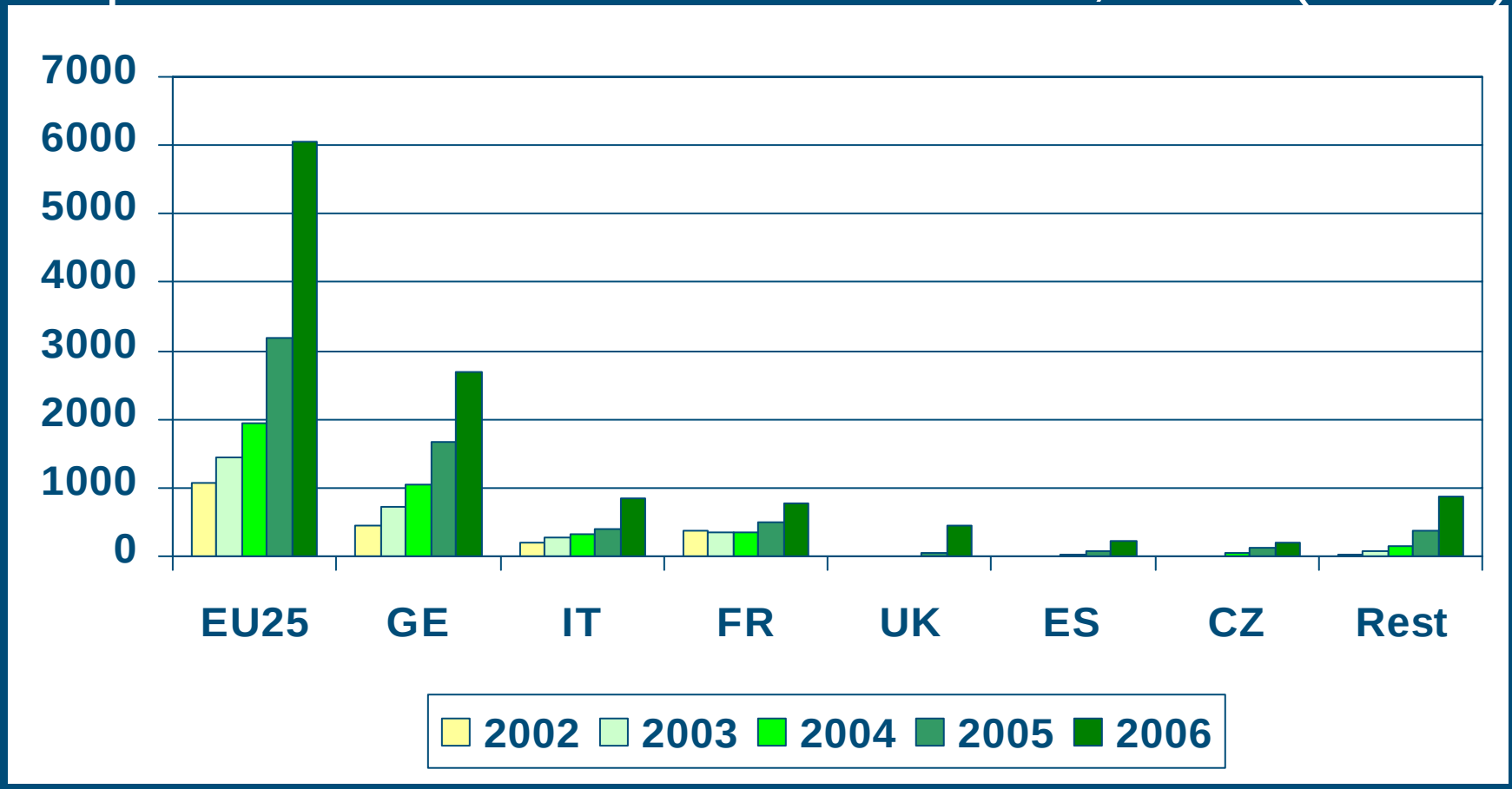
1) Current Market Situation

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



Source: Data based on F.O. Licht

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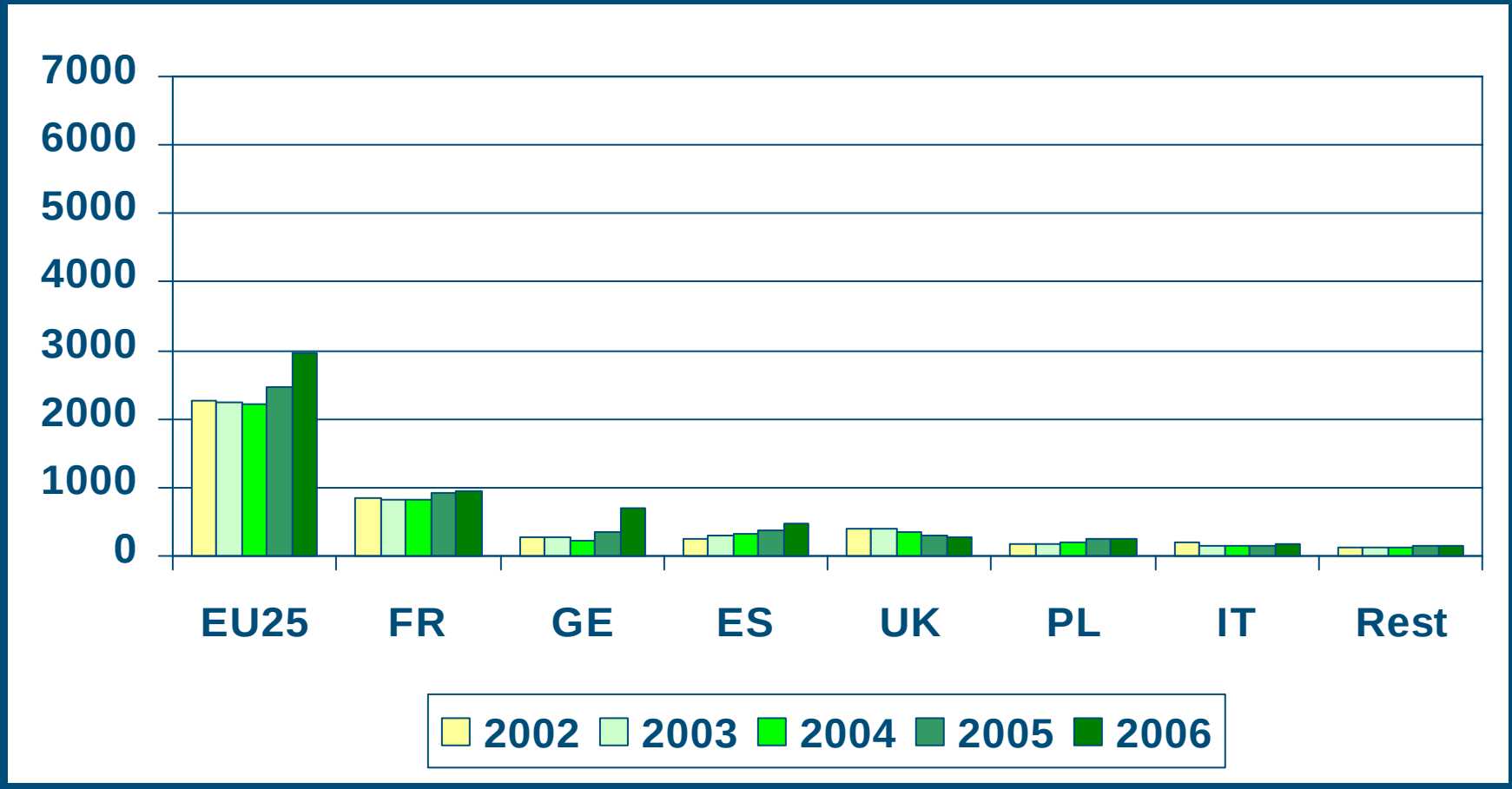
1) Current Market Situation

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



Source: Data based on F.O. Licht

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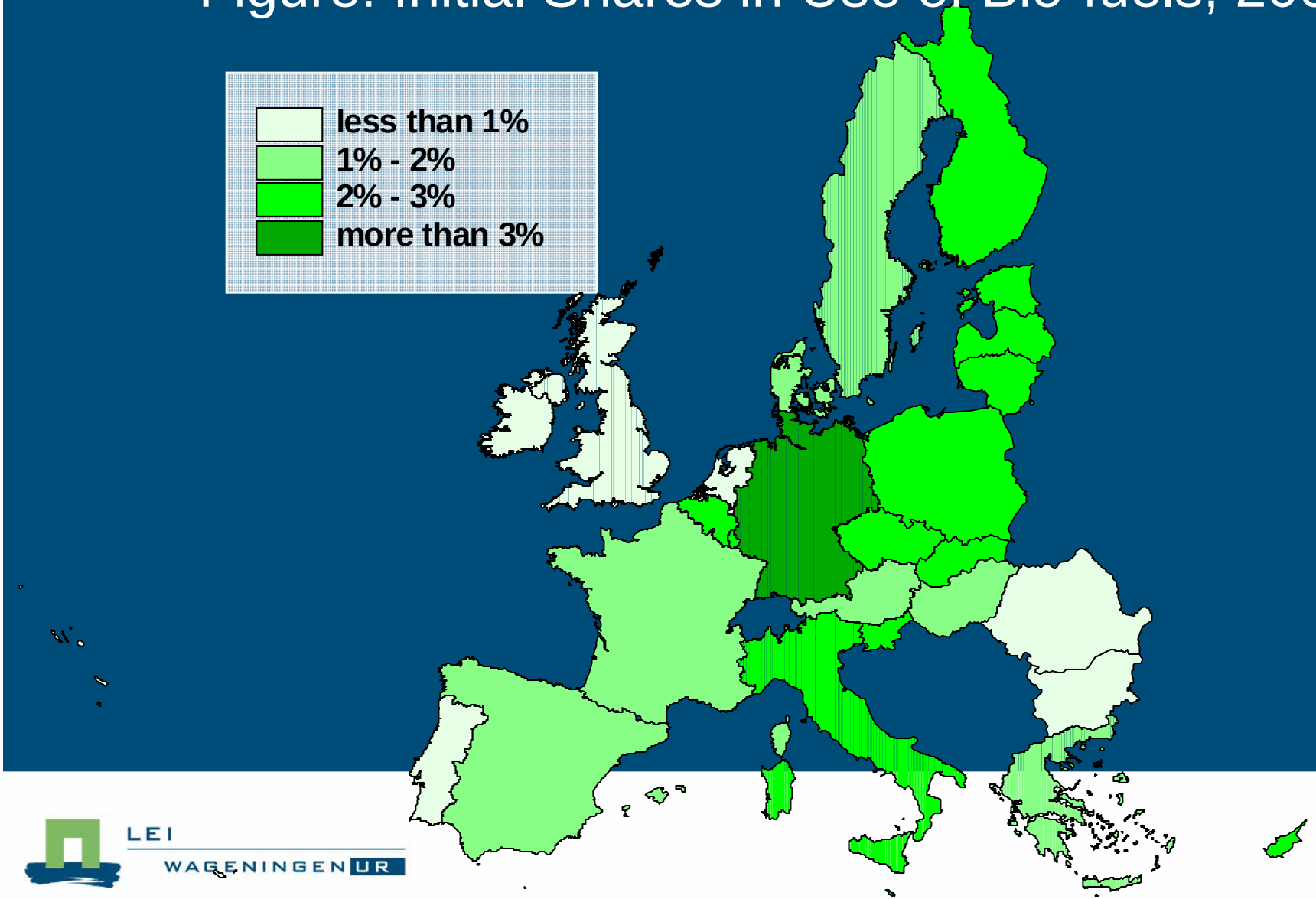
2) Political Perspective

- 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

3.1) Modeling Biofuels in ESIM: Approach

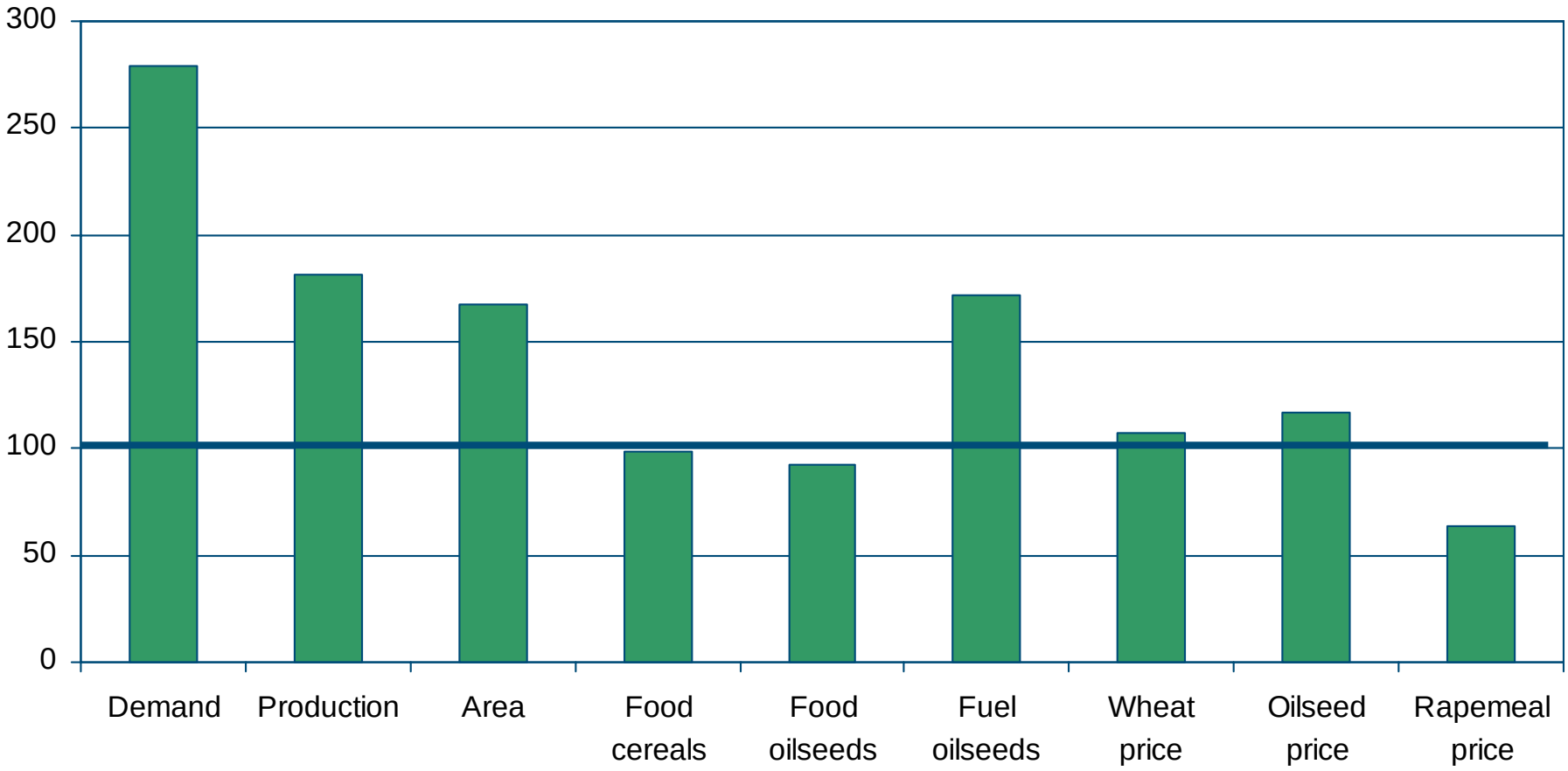
- Processing activities also produce by-products
  - Bioethanol: Cereal gluten feed
  - Biodiesel: Oilcake from oilseed processing
- Biodiesel/bioethanol price
  - Function of crude oil price, tax rates for fuels from mineral oils, tax rates for biofuels, tariffs

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

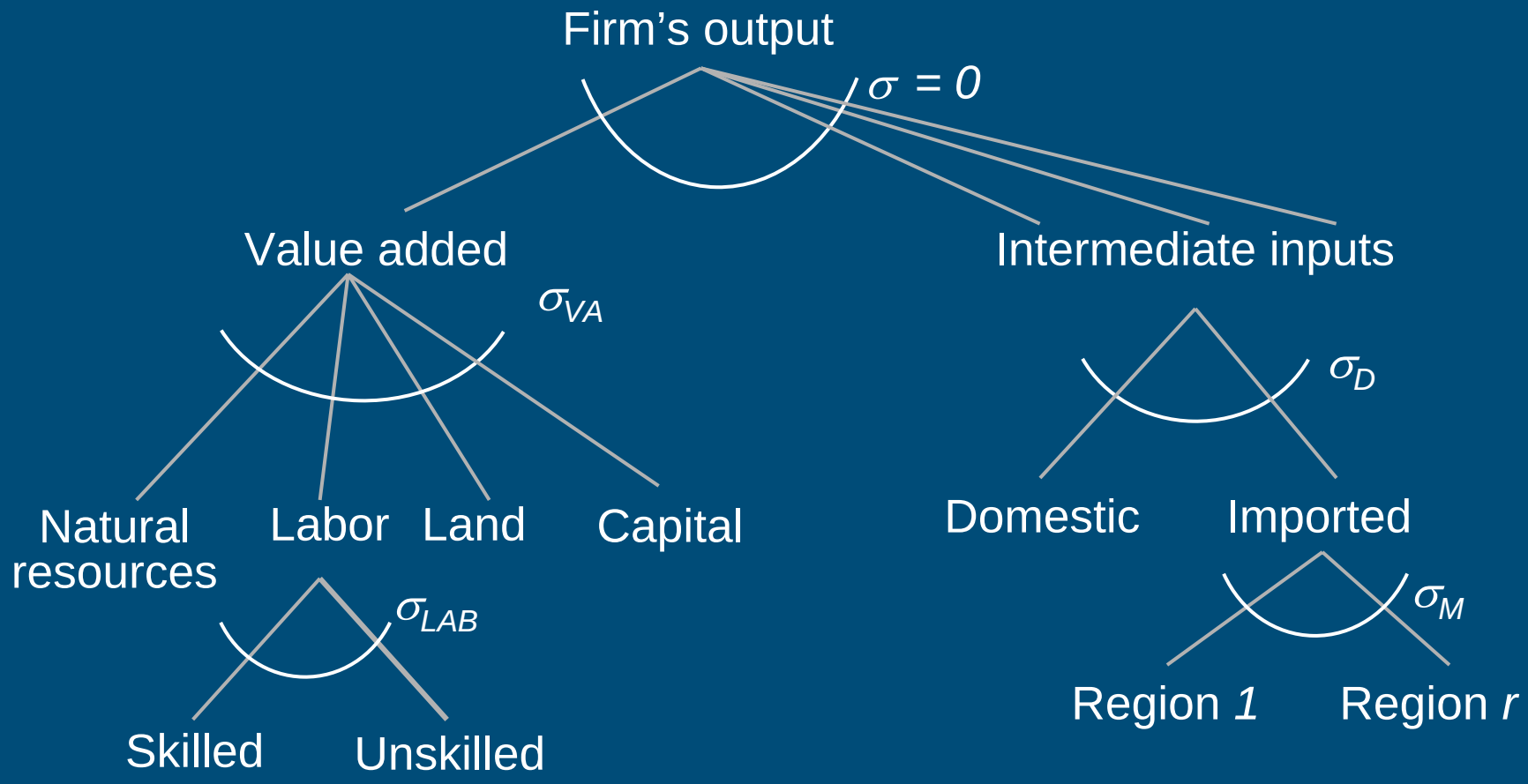
- LEITAP: elaborate GTAP version
  - Segmentation of factor markets
  - Agricultural policies (e.g. endogenous production quota)
  - Land allocation structure (PEM from OECD)
  - Land supply curve
  - Linkage with IMAGE (biophysical model) to improve treatment of yields and feed conversion rates based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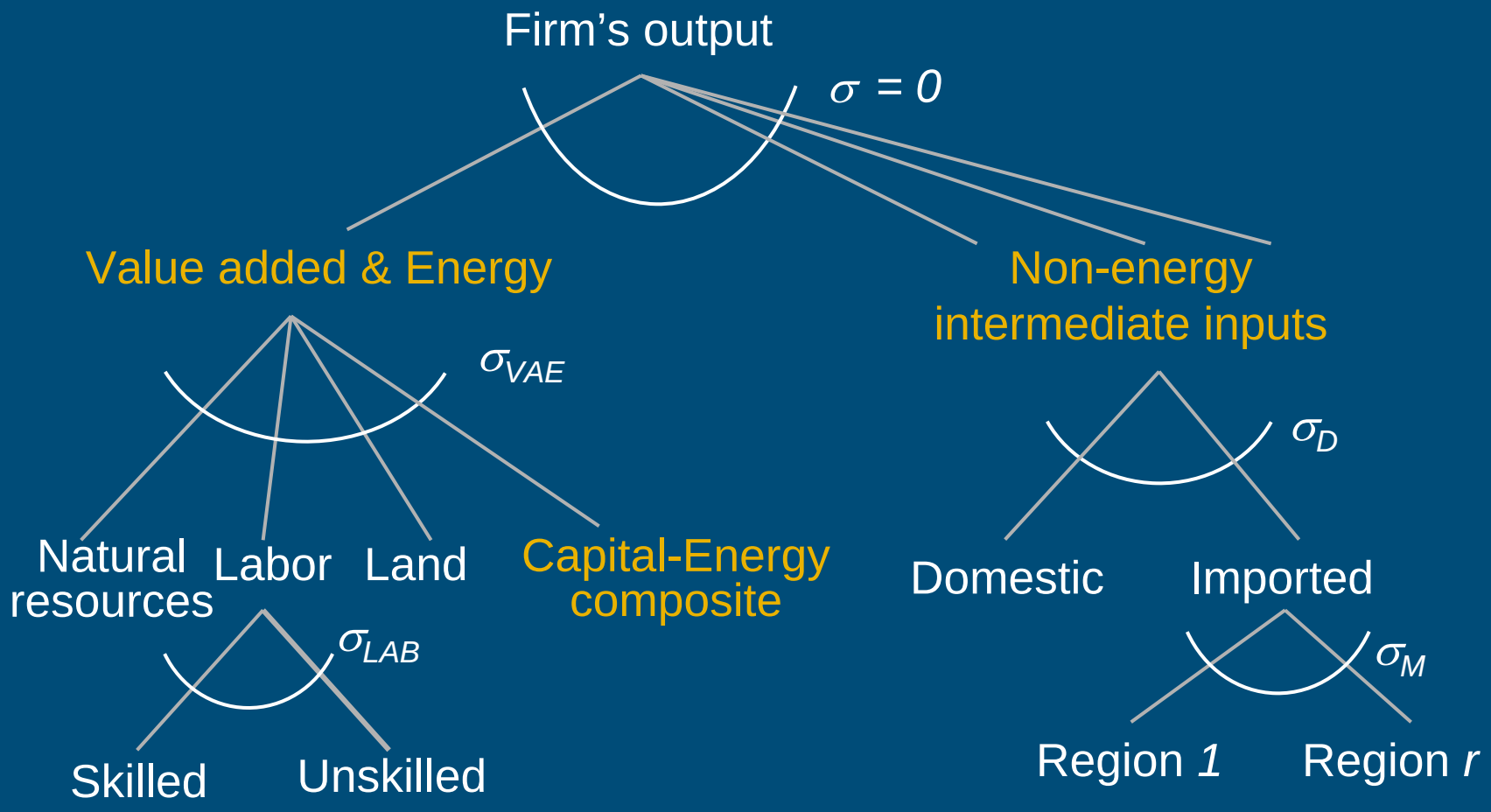
4.1) Modeling Biofuels in LEITAP: Approach

Figure: GTAP-E Production Structure



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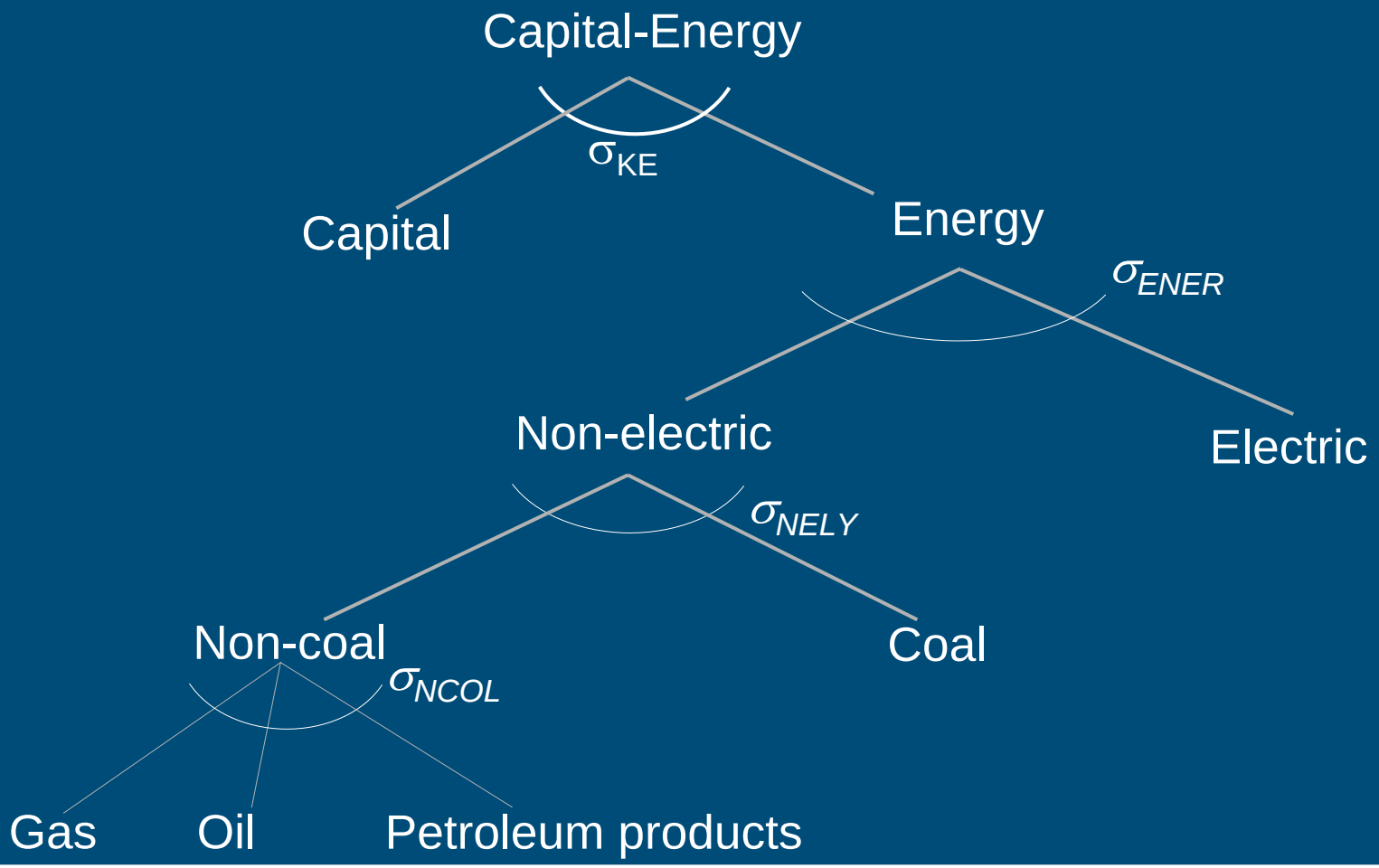
4.1) Modeling Biofuels in LEITAP: Approach

Figure: GTAP-E: Capital-Energy Composite



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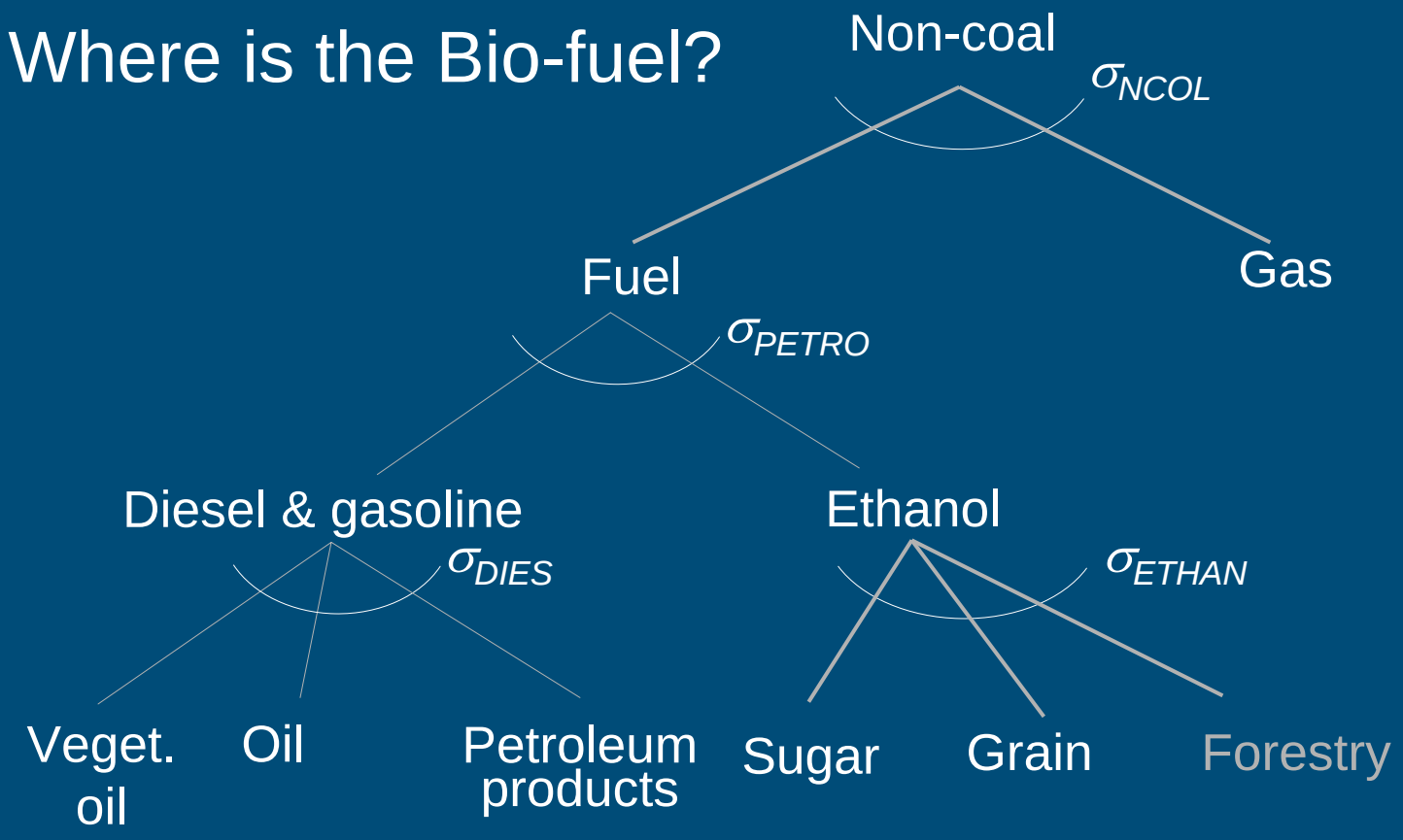
4.1) Modeling Biofuels in LEITAP: Approach

Where is the Bio-fuel?



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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

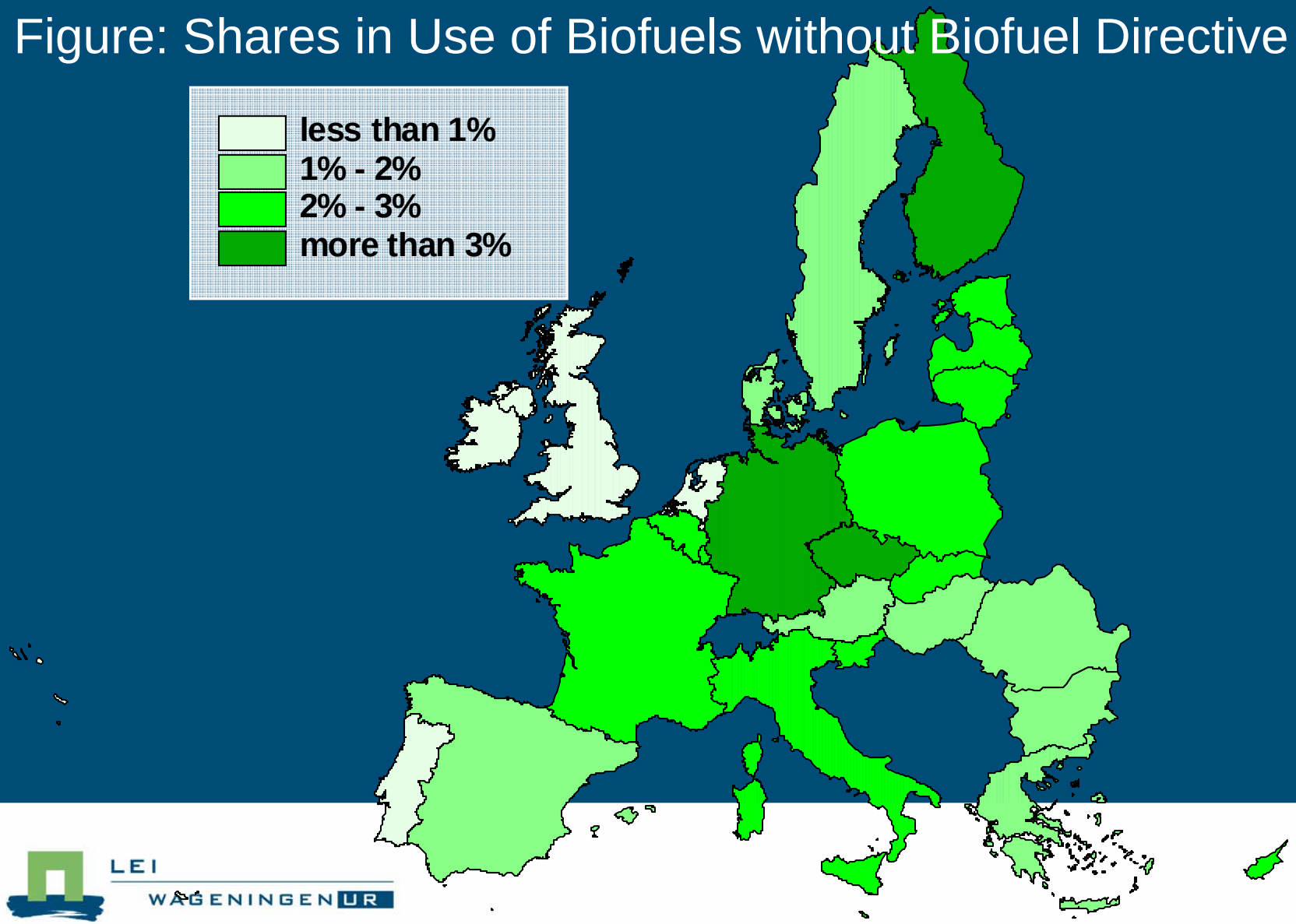
- Implementation of the biofuel directive: huge problems in the data
  - How much do the Member States contribute in the initial situation?
  - What kind of feed-stocks are used to produce bio-fuels?
    - Are these feed-stocks imported or domestically produced?
  - Is future development driven by capacity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

4.2) Modeling Biofuels in LEITAP: Preliminary Results

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



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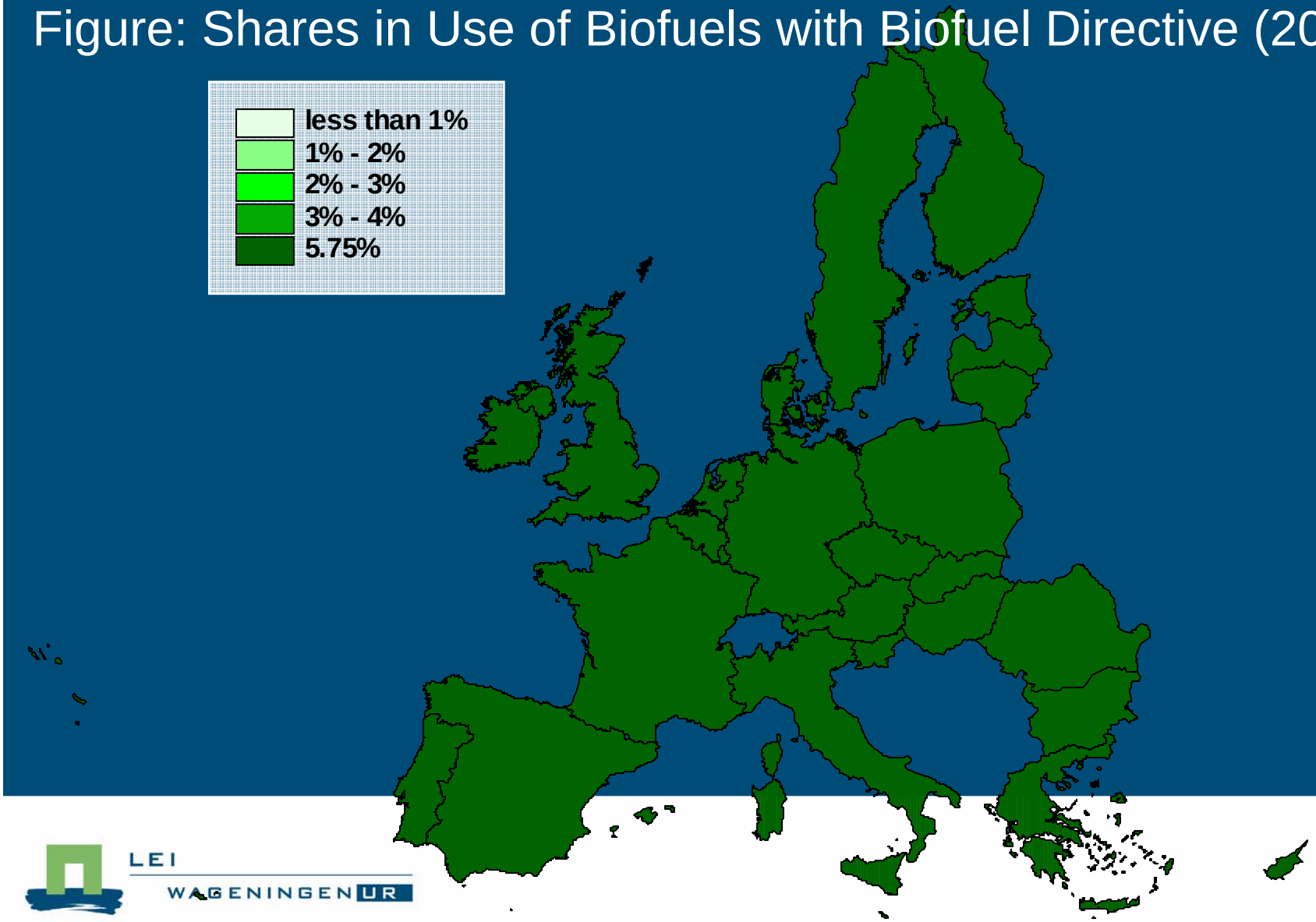
4.2) Modeling Biofuels in LEITAP: Preliminary Results

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



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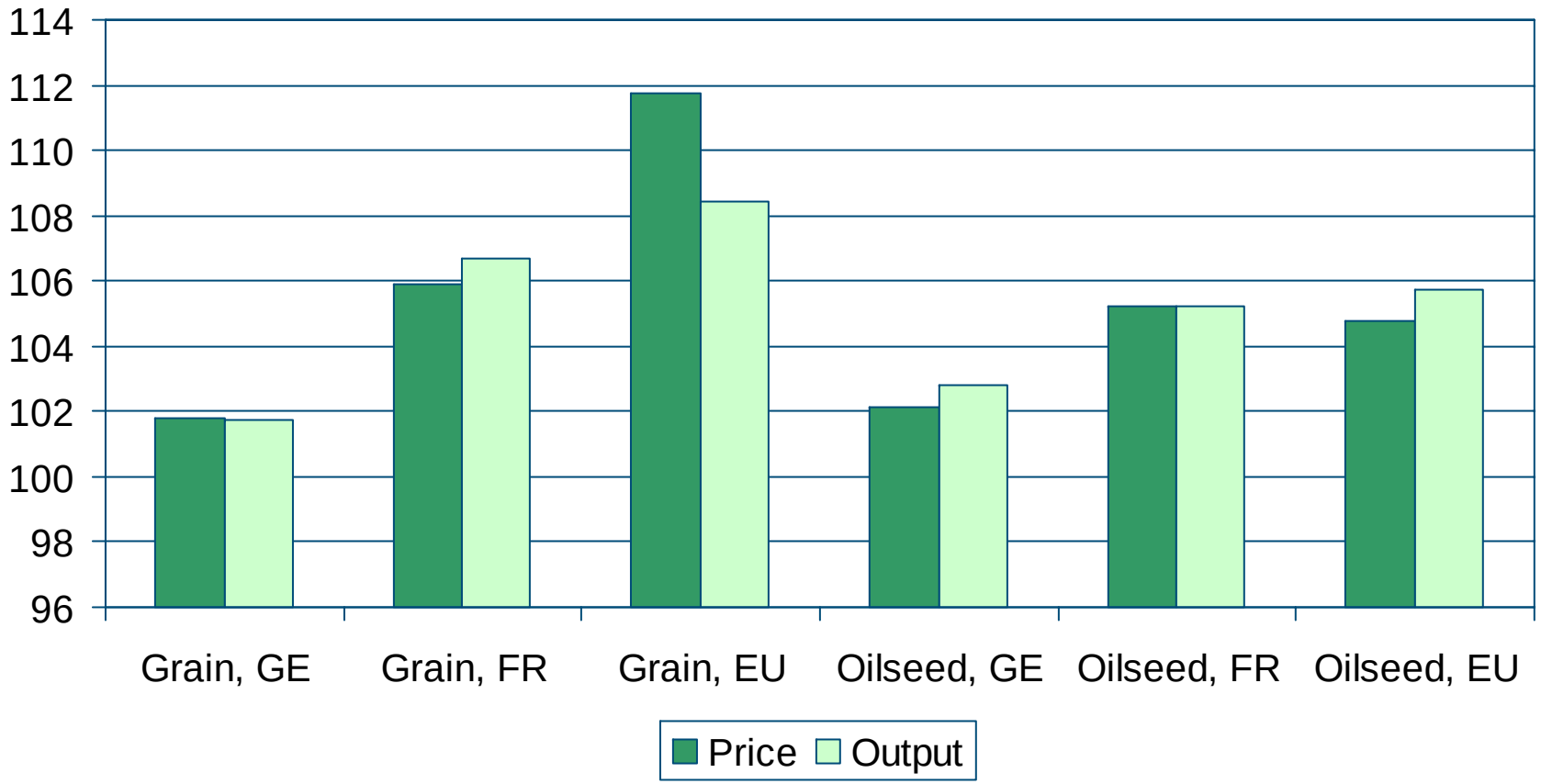
4.2) Modeling Biofuels in LEITAP: Preliminary Results

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



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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