Implementation of the GTAP greenhouse gas emission database in a General Economy model for climate change and biobased economy research

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Introduction

- Objective: economy wide and world wide impact assessment of climate change related mitigation and adaptation measures
- focus on GHG emissions (CO2, N2O, CH4, carbon storage emissions)
- World wide and economy wide approach, not only agriculture
- Focus on bio-based economy
- Different applications are foreseen e.g. to analyse the macro-economic impact on the biobased economy in the Netherlands
- Still under development.

Content of the presentation

- GTAP GHG emissions database per sector and total in the EU and some selected member states
- MAGNET
    - General overview
    - Biobased sectors
- Illustrative example of results
- Discussion and conclusions

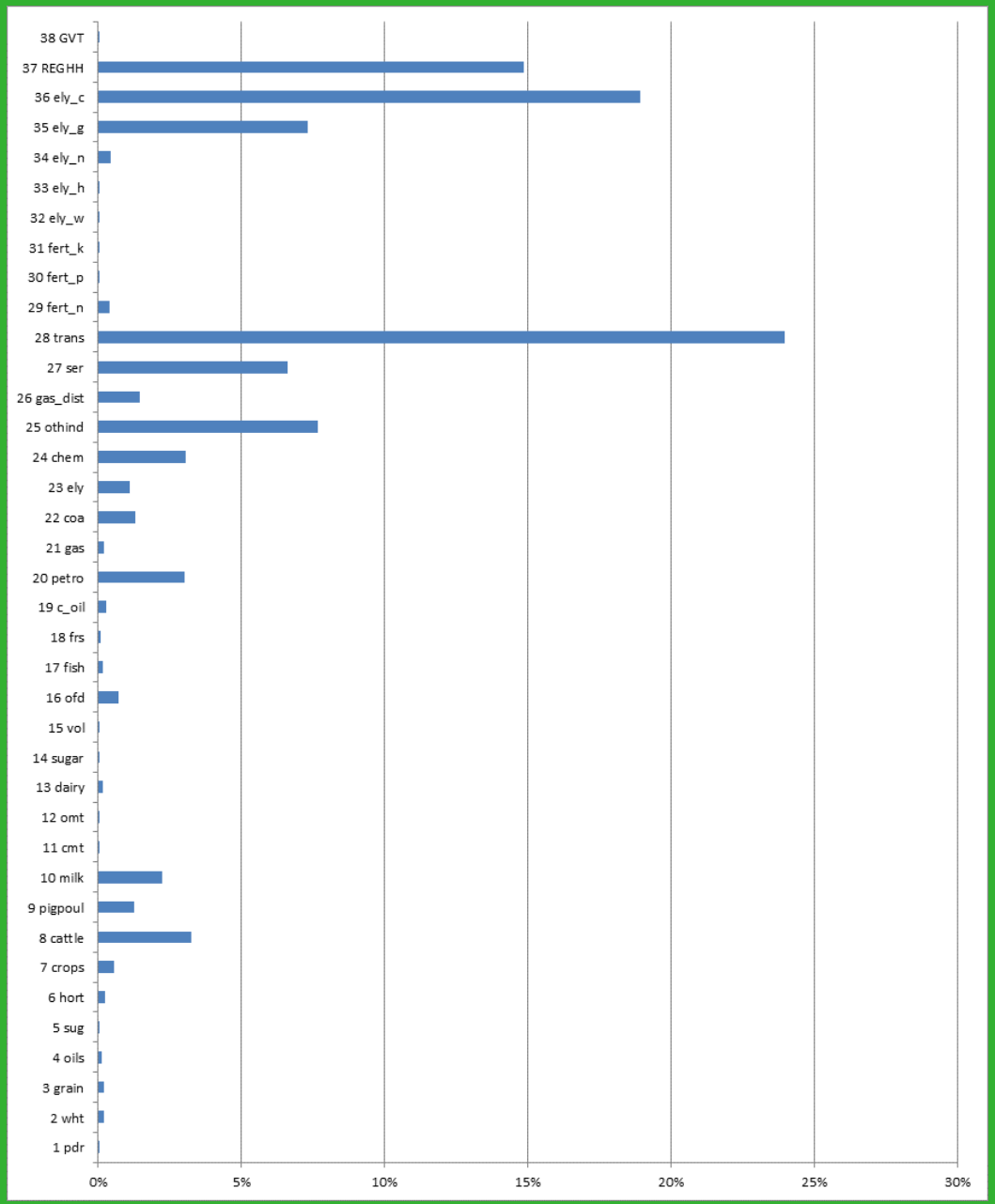
Greenhouse gas (GHG) emissions data for climate change economic analysis in the GTAP database: background

- CO2 and non-CO2 emissions
- GHG emissions for each of the 128 GTAP regions, 57 economic sectors and the regional household
- Mapping to fossil fuel sources (CO2) and emission drivers or inputs e.g. land use, fertilizer, capital (non-CO2)
- This allows for input substitution to manage emissions and maintain production at the same time.

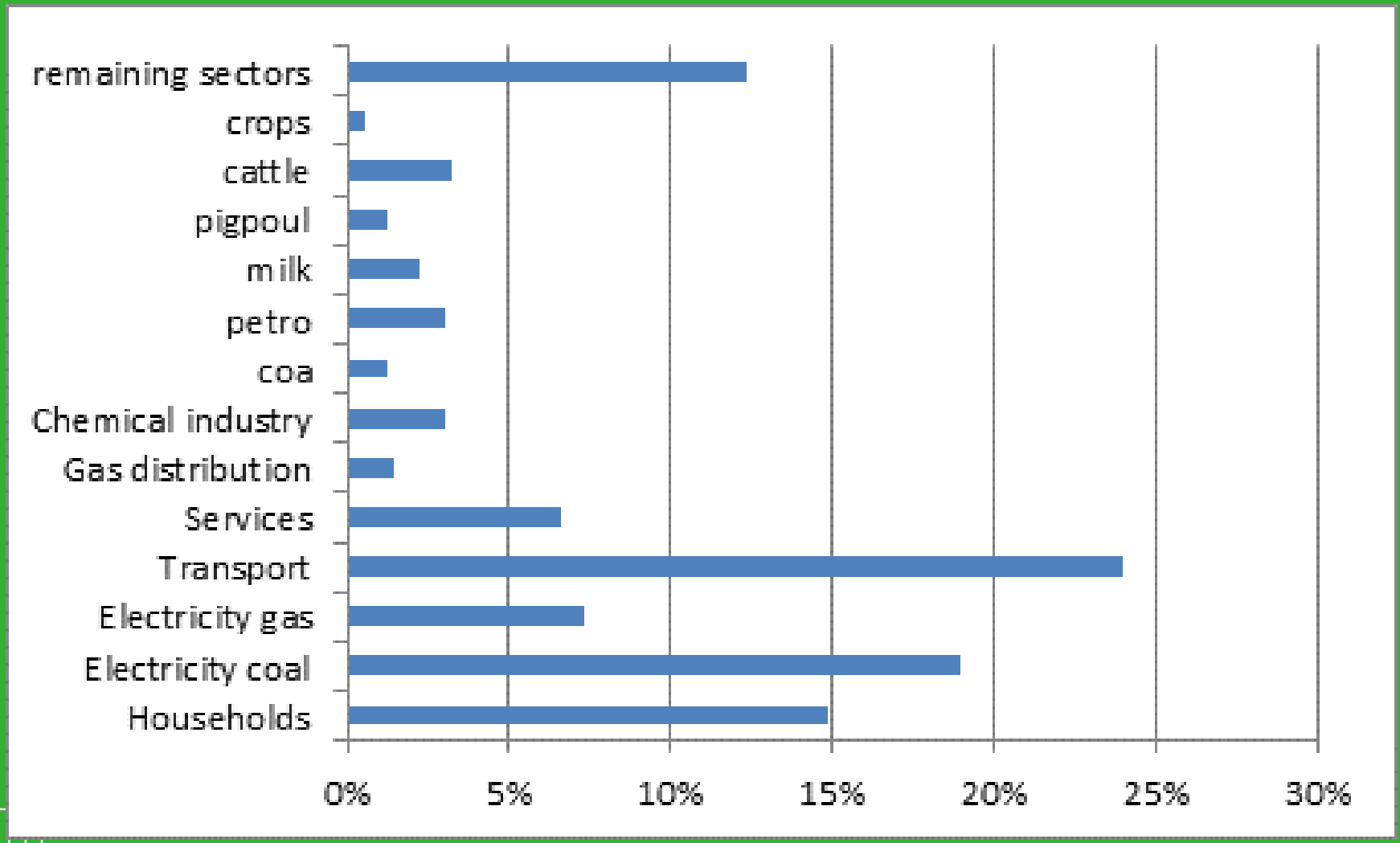
2007 Total GHG emissions in the EU. Comparison between EEA and GTAP database (Mio ton of CO2 equivalent)

	EEA	GTAP database
Agriculture	490	484
Total economie	5614	5942
share agriculture	8.7%	8.1%

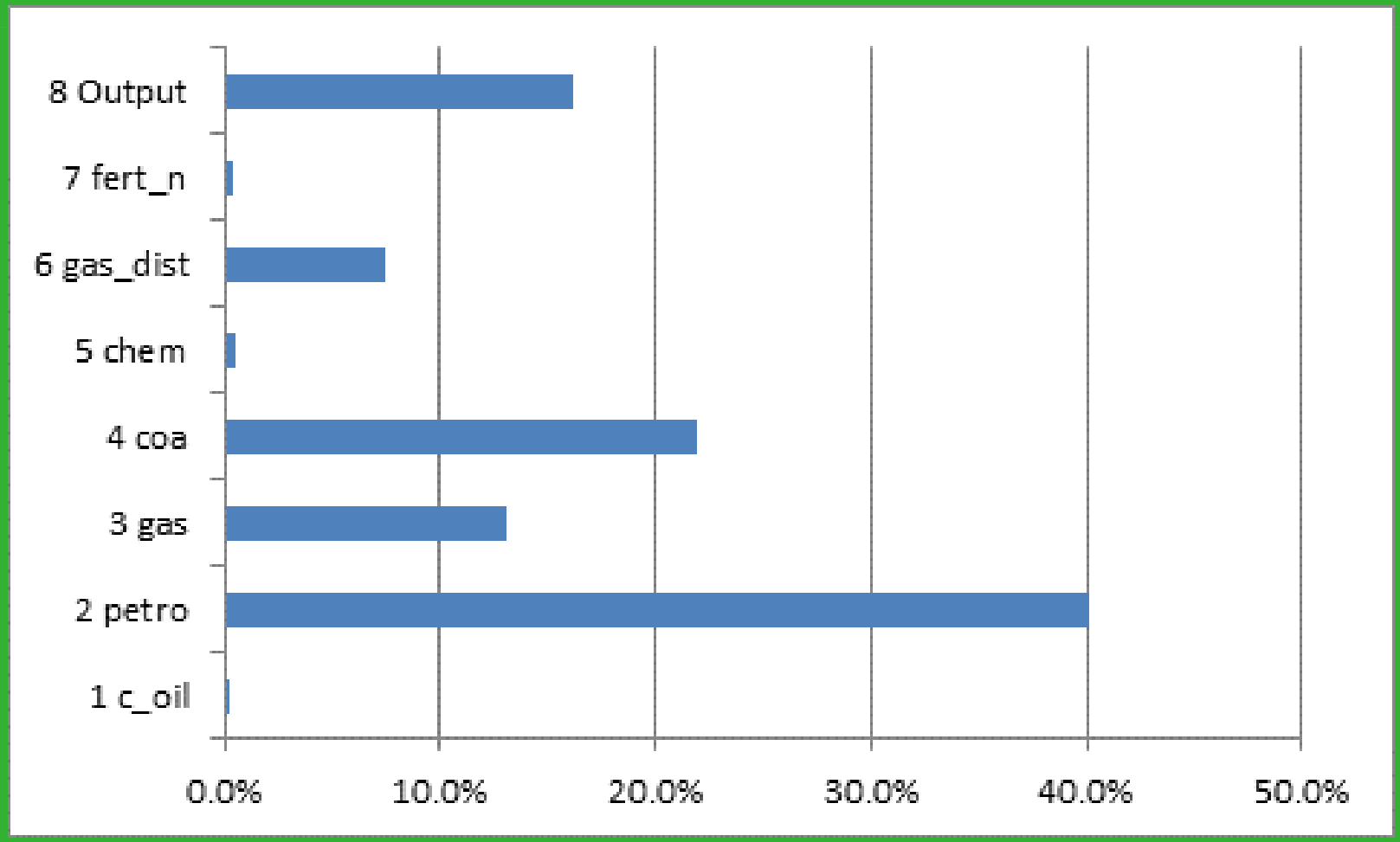
2007 EU GHG emissions per MAGNET sector (% share in total emission)



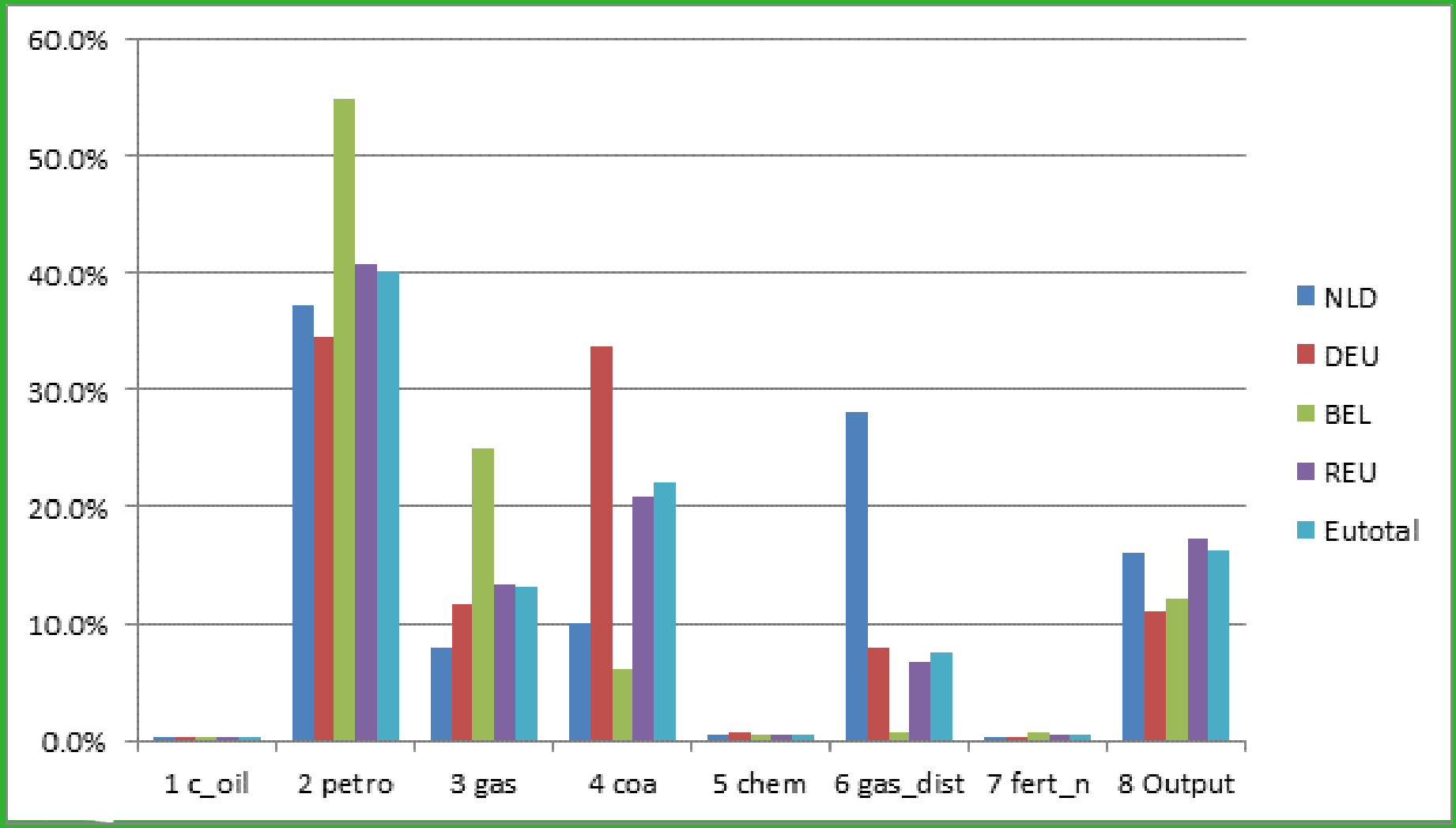
2007 EU GHG emissions per selected and aggregated MAGNET sector (% share in total emission)



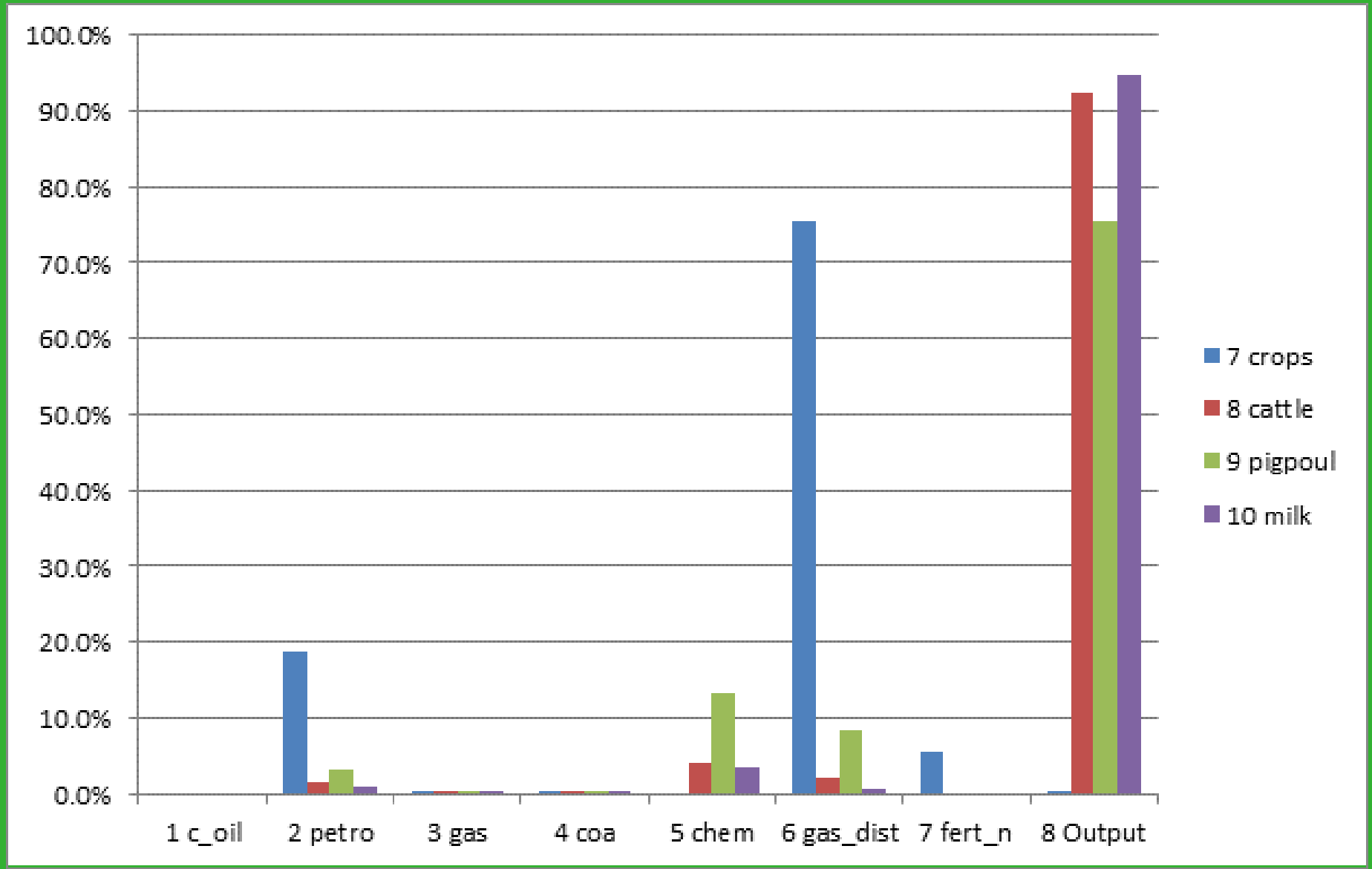
2007 EU GHG emissions by source (% share in total emission)



2007 GHG emissions by source in some selected EU Member States, rest of EU and total EU (% share in total emission)



2007 GHG emissions by source in some selected sectors in the Netherlands (% share in total emission)



MAGNET (Modular Applied GeNeral Equilibrium Tool)

- global general equilibrium model
- tool for quantitative analysis in the area of agricultural policies, international trade policies and bio-economy policies (including bioelectricity, first and 2nd generation biofuels and biochemicals policies)
- focus on impacts of policies on land use, agricultural prices, nutrition and household food security and GHG emissions
- own consortium of: LEI Wageningen UR, Institute for Prospective Technological Studies (IPTS), which is an institute of the European Commission's Joint Research Centre (JRC) and the Thünen-Institute (TI).
- website:http://www3.lei.wur.nl/magnet/Default.aspx

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From biomass supply.....

- **Biomass supply and trade of biomass**
  - *Residues (res)*
  - *Plantations (plan)*
  - *Pellets (pel)*

	a_res	a_plan	a_pel
m_intmr est,d_int mrest	x	x	x
d_res			x
d_plan			x

… to second generation biofuel and bio-electricity demand (columns)

- **Fuel:** two production of second generation biofuels are included in MAGNET using two technologies:
  - *2nd generation biofuel – thermal pathway fuels (ft_fuel)*
  - *2nd generation biofuel – biochemical pathway fuels (eth)*
- **Electricity:** The electricity sector in MAGNET will be split in six sectors among which:
  - *Electricity biomass (bioe)*

From biomass supply (rows) to second generation biofuel and bio-electricity demand (columns)

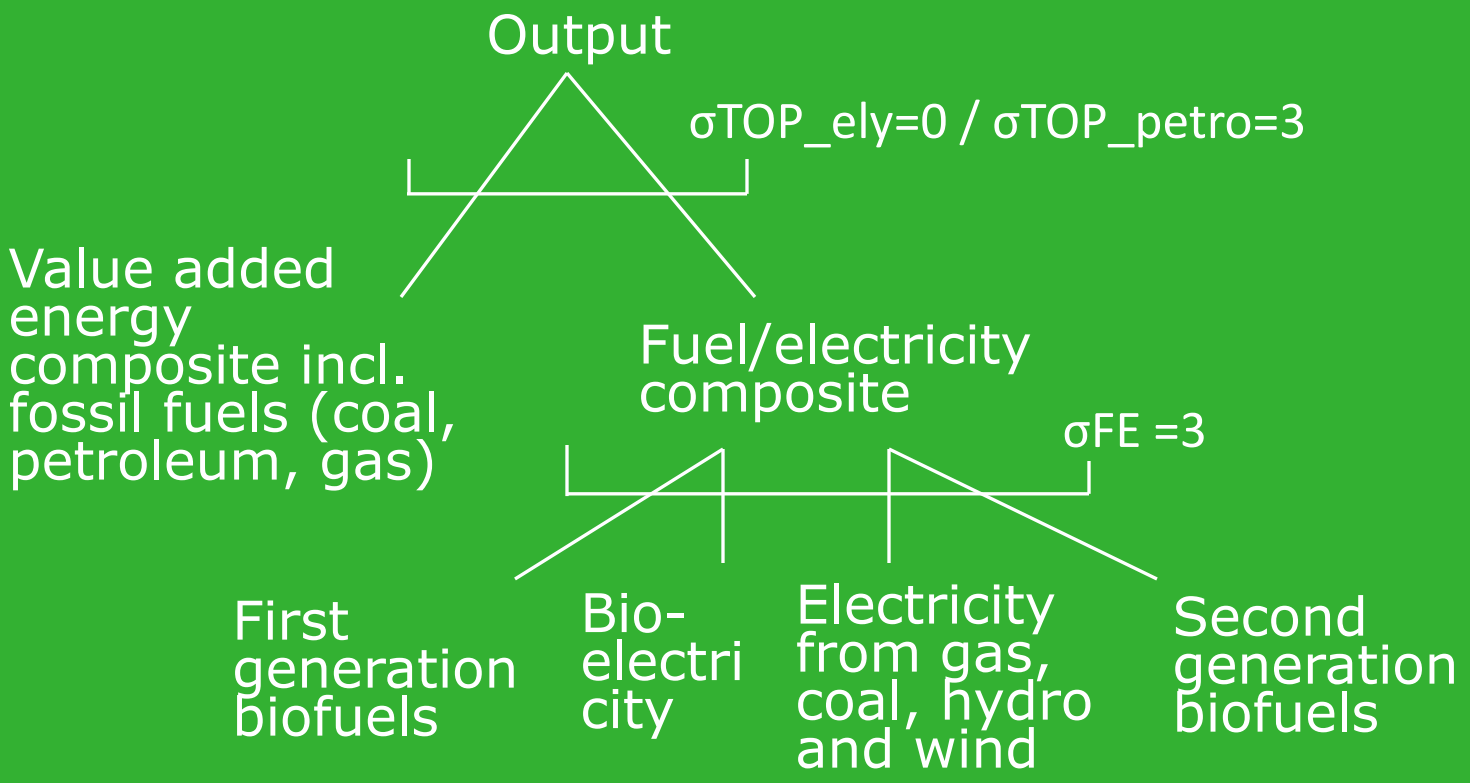
	a_bioe	a_ftfuel	a_eth	ww
m_res				
m_plan				
m_pel	x	x	x	
d_res	x	x	x	
d_plan	x	x	x	
d_pel				x

Production structure of electricity and petrol sector (I)

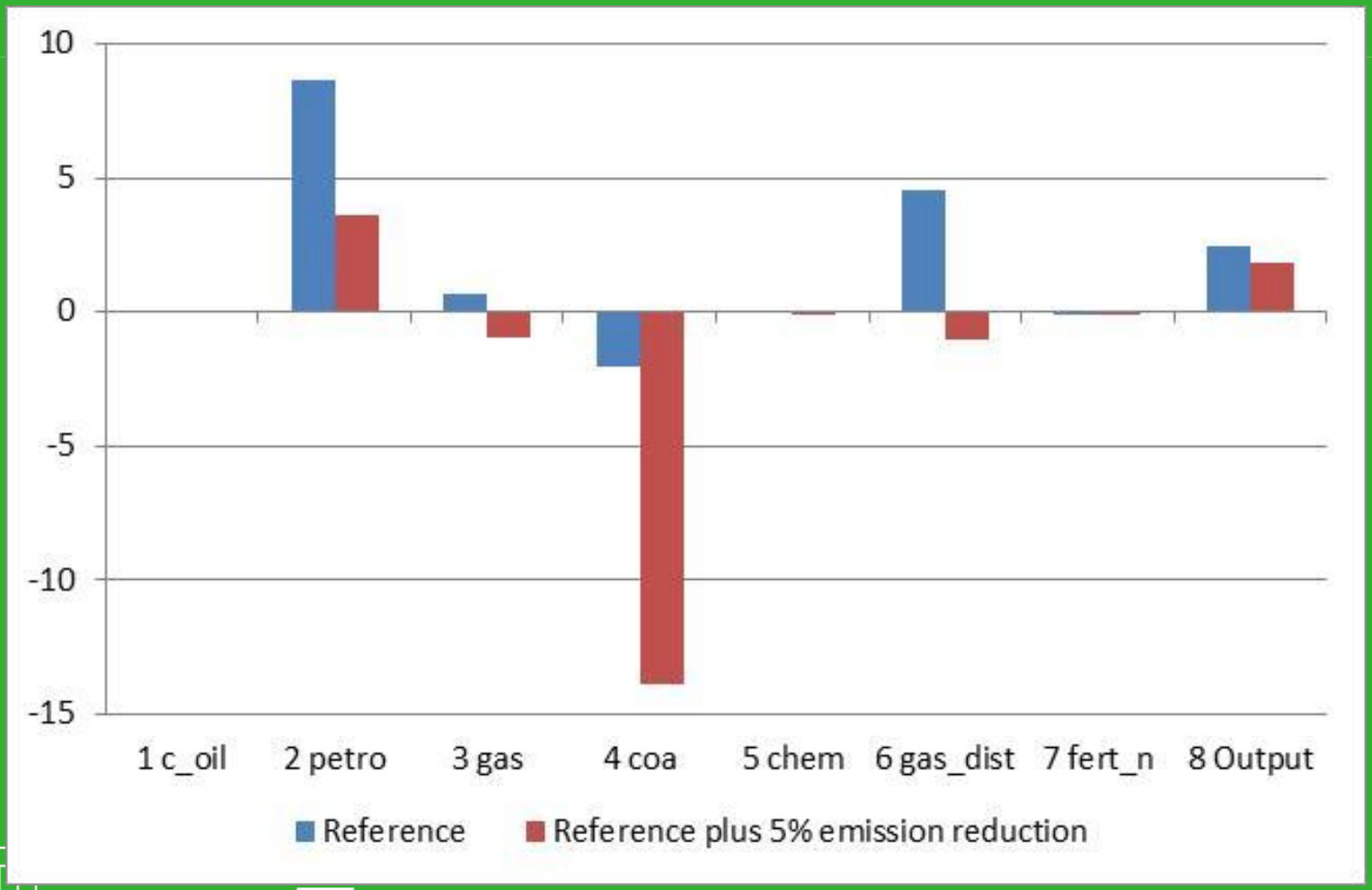
- Input demand in petro and electricity sector in the Netherlands, selected sectors, mio US dollar in 2007

	petro			ely
22 c_oil	25608		38 bioe	192
27 gas	2778		55 ely_w	242
24 biod	206		57 ely_n	278
25 biog	23		58 ely_g	4137
39 ftfuel	2		59 ely_c	1862
40 eth	2			

Production structure of electricity and petrol sector (II)



Illustrative scenario result: Change in GHG emission by source in the Netherlands due to 5% total GHG emission reduction obligation (mio ton of CO2 equivalent)



Quantity changes in input composition in petrol and electricity sector in the Netherlands (percentages compared to reference)

- Electricity sector: increase in electricity from biomass and wind, decrease in electricity from gas and coal
- Petrol sector: increase in input from first and second generation biofuels, decrease in input from gas and conventional oil and in

	petro			ely
22 c_oil	-5		38 bioe	111
27 gas	-5		55 ely_w	127
24 biod	23		57 ely_n	170
25 biog	17		58 ely_g	-12
39 ftfuel	831		59 ely_c	-64
40 eth	833			

Change in output quantity in selected sectors in the Netherlands (percentages)

- Increase in arable production for first generation biofuels
- Increase in biomass production for second generation biofuels
- Decrease in livestock production

7 wht	5		39 trans	-3
10 sug	2		40 plan	6
13 cattle	-8		41 res	88
14 pigpou	-1		42 pel	-18
15 milk	-1		43 bioe	111
29 biod	24		44 ftfuel	606
30 biog	14		45 eth	768
31 ddgs	14		46 fert_n	-25

Discussion and conclusion

- Data and empirical validation of coefficients
- Level of regional and sectoral aggregation
- Market structure (perfect competition assumption)
- Lack of alternative production technologies
- More?

- But it provides usefull insights into economy wide effects, taking into account competition for scarce resources.

Thank you for your attention

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