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Human health-related externalities in energy system modelling

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Human health-related externalities in energy system modelling

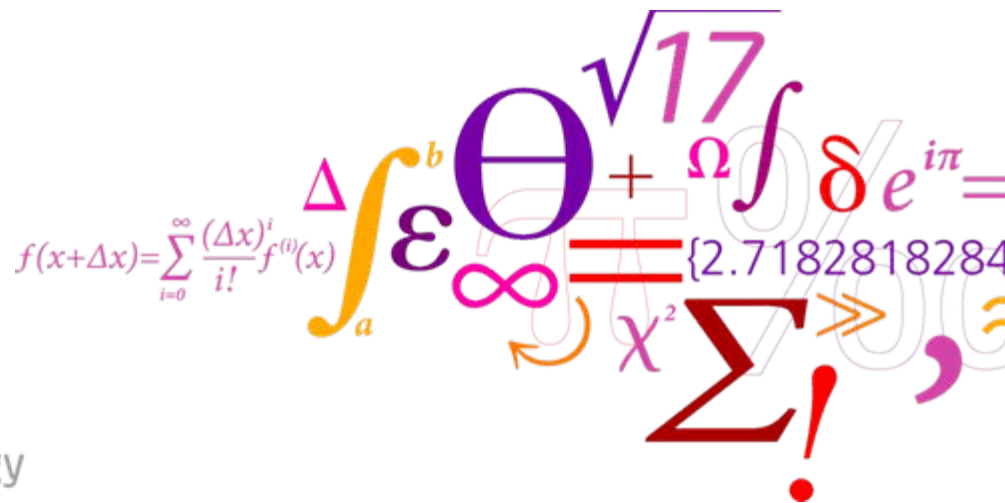
The 5th Dubrovnik conference on sustainable development of energy, water and environmental systems

September 29-October 3 2009, Dubrovnik, Croatia

Erika Zvingilaite

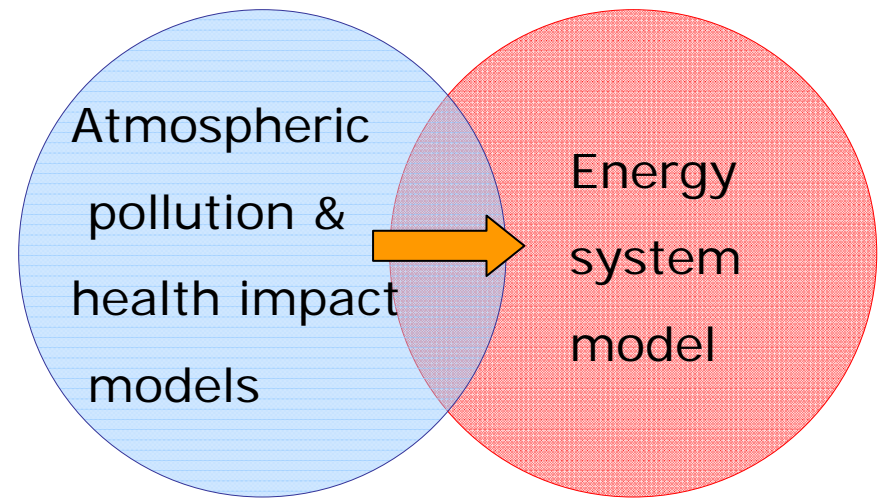
PhD Student

System Analysis Division



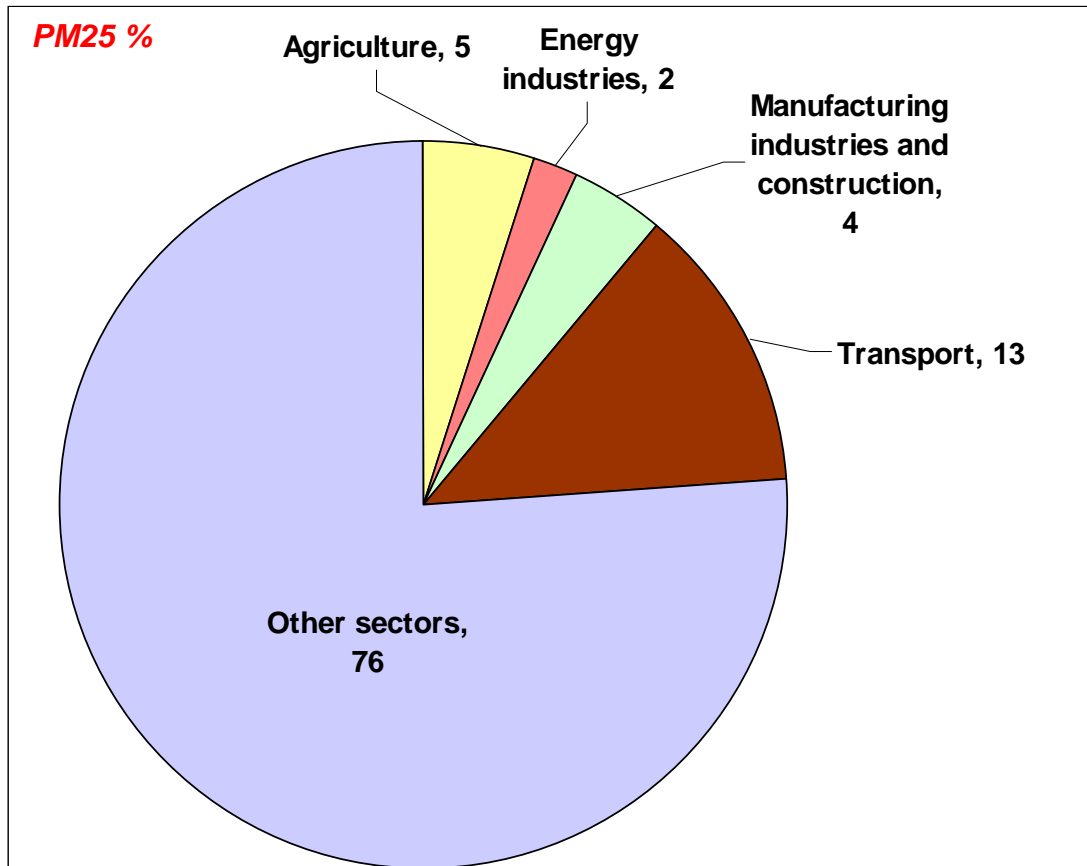
Introduction - motivation

- Air pollution cause health effects
- Including into energy planning
- Co-benefits local and global
- Gap between air pollution & health impact assessment and energy models
- Adapting energy models

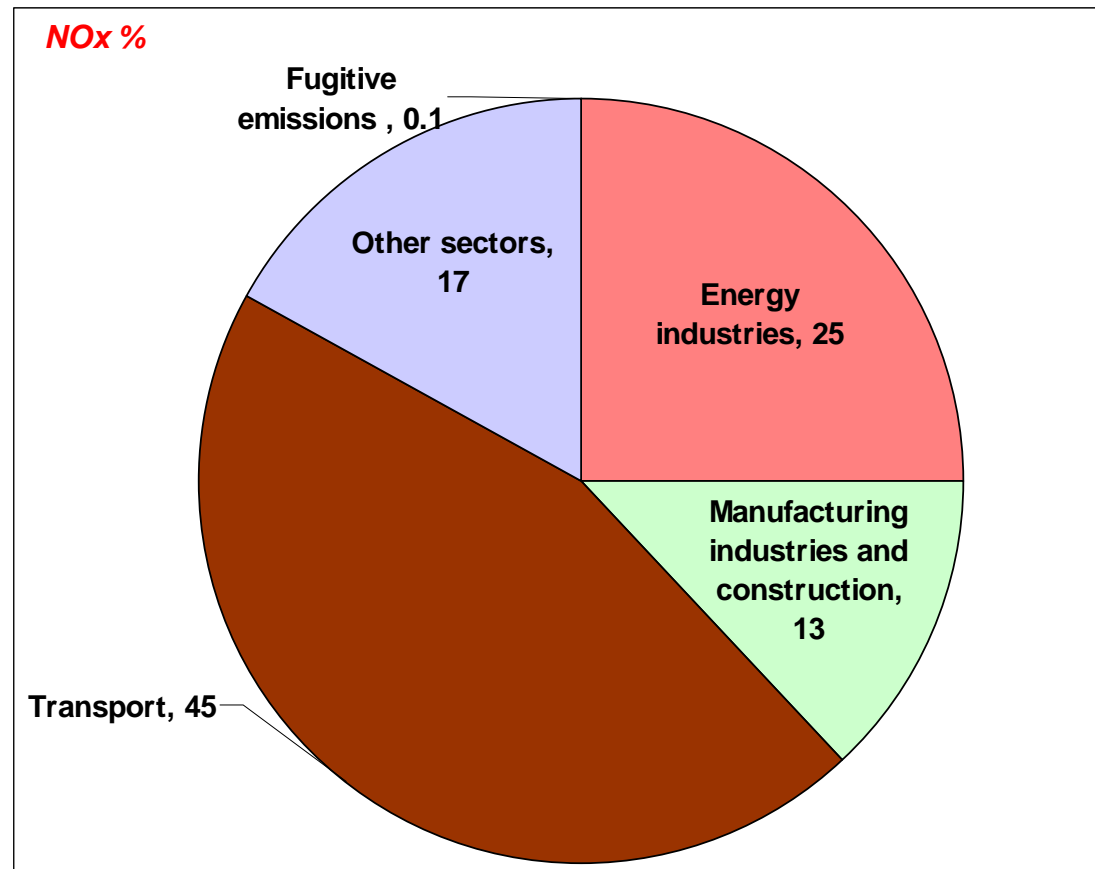


Outline

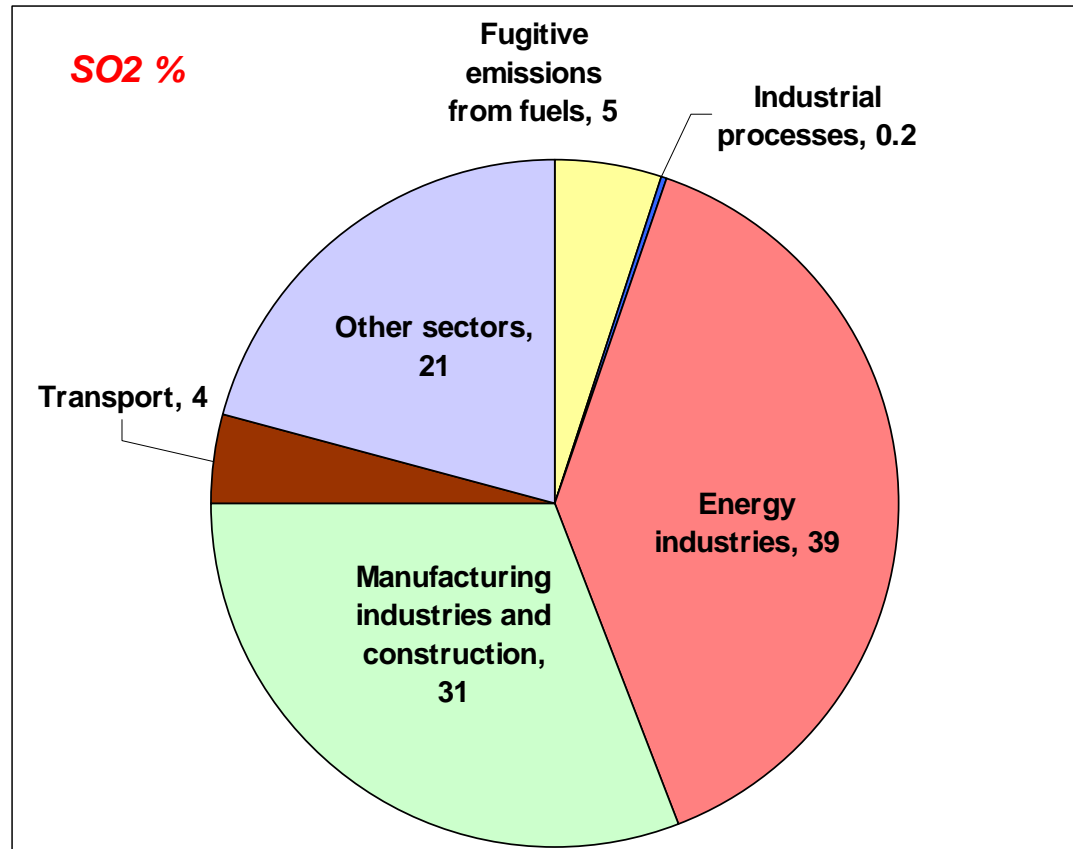
- BACKGROUND:
 - Sector contribution
 - Example of three plants
- THE MODEL AND SCENARIOS
- RESULTS
- CONCLUSIONS



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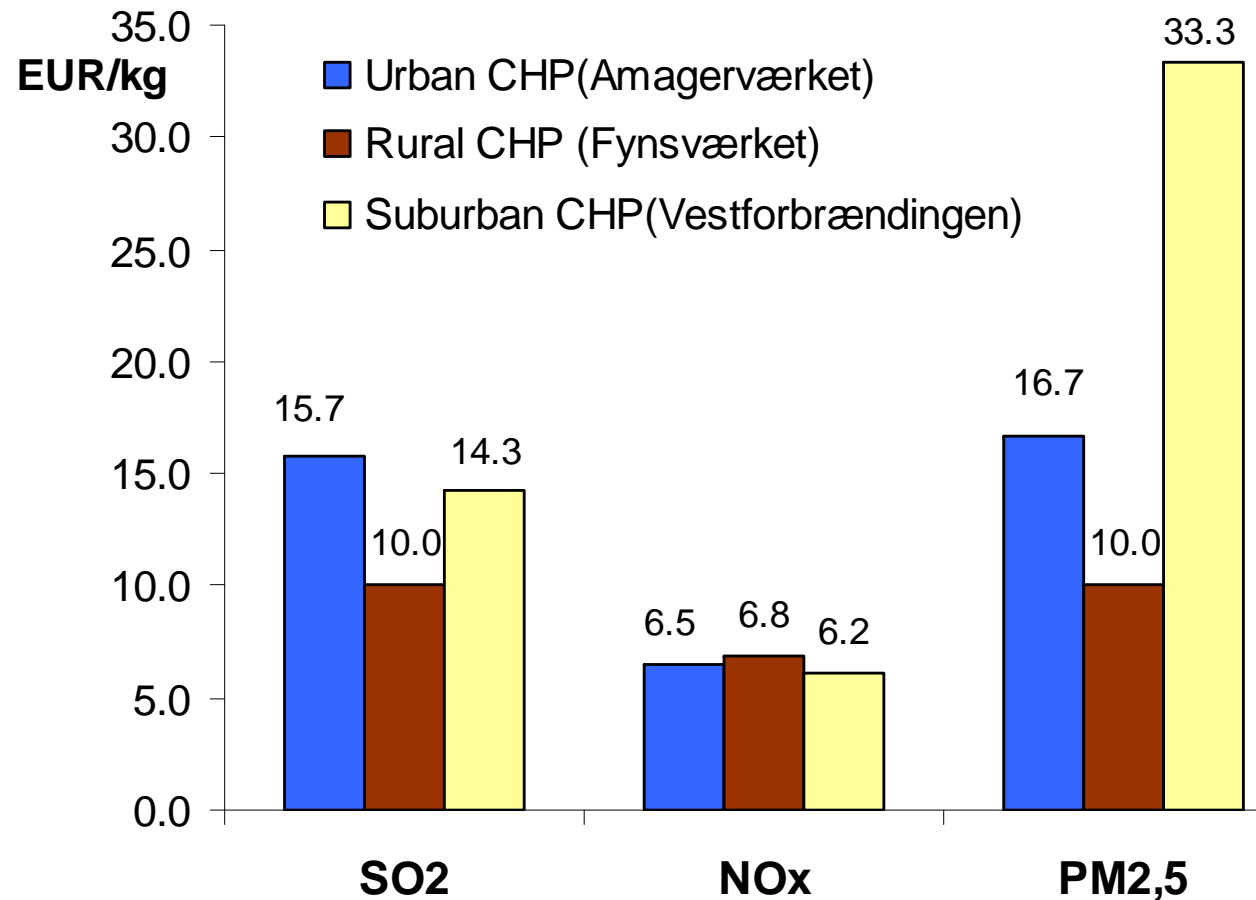
Health related externalities and energy production

– Location

- Meteorology
- Population

– Stack height

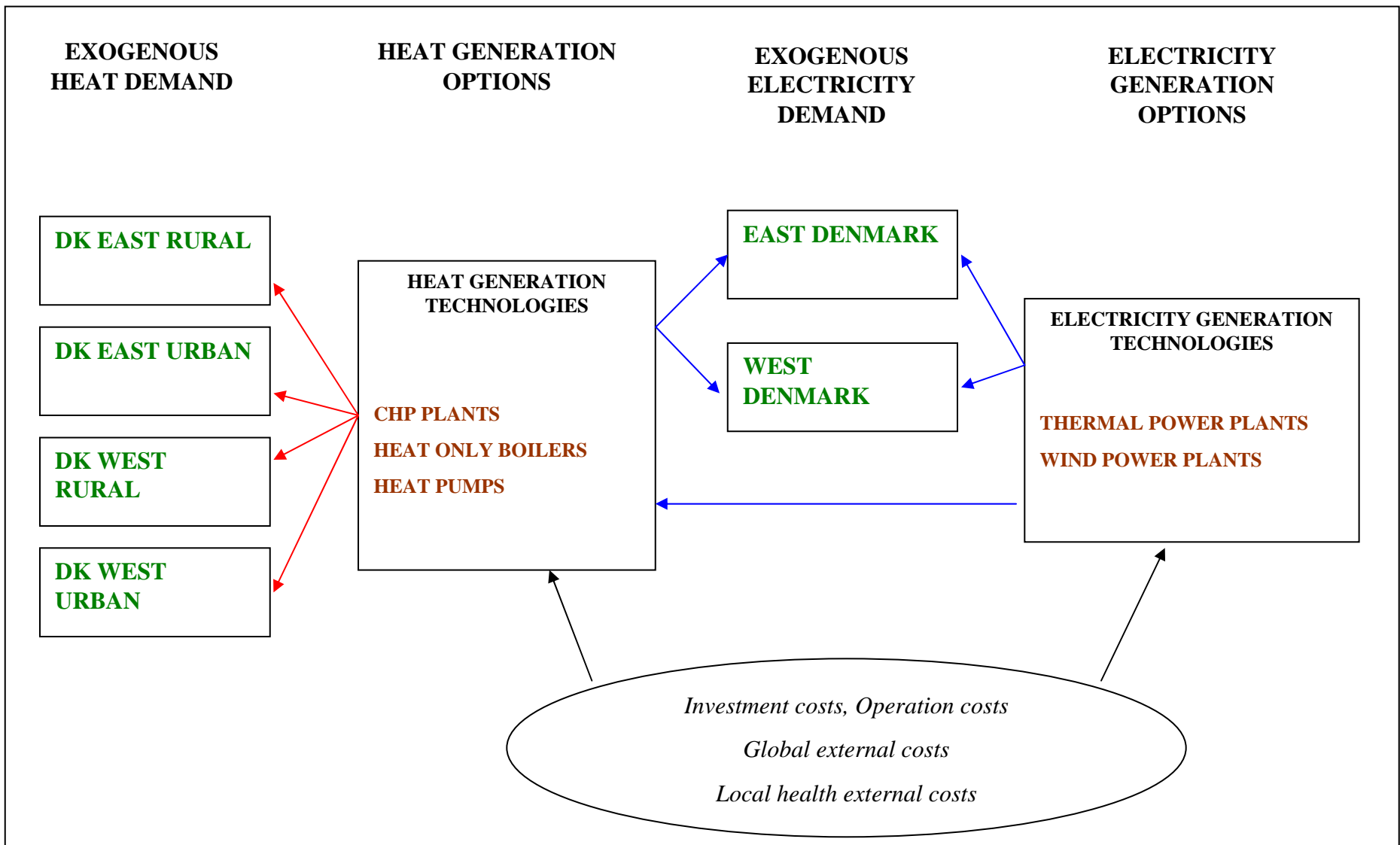
- Plant size



based on Andersen et al., 2008

The model - Balmorel

– a linear optimisation model of heat and power sectors (Denmark)



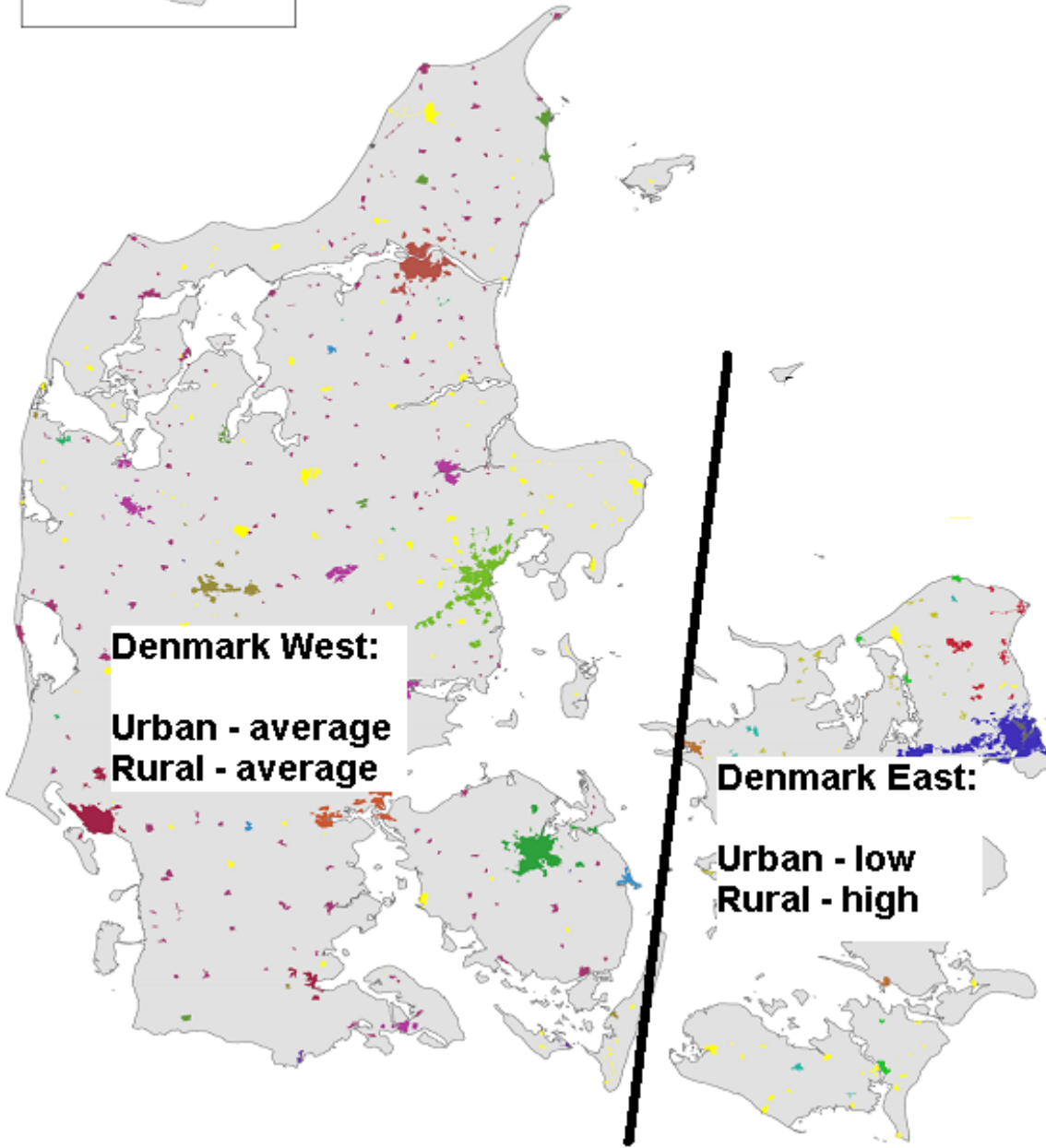
Scenarios – 2005, 2015, 2030



<i>Scenario</i>	<i>Description</i>
No Externalities	<u>No health externalities</u> – only an external cost of CO ₂ - 15 EUR/t
Uniform cost	The single <u>average local externality cost</u> in addition to CO ₂ cost
Different area cost	<u>Different local area externality costs</u> in addition to CO ₂ cost

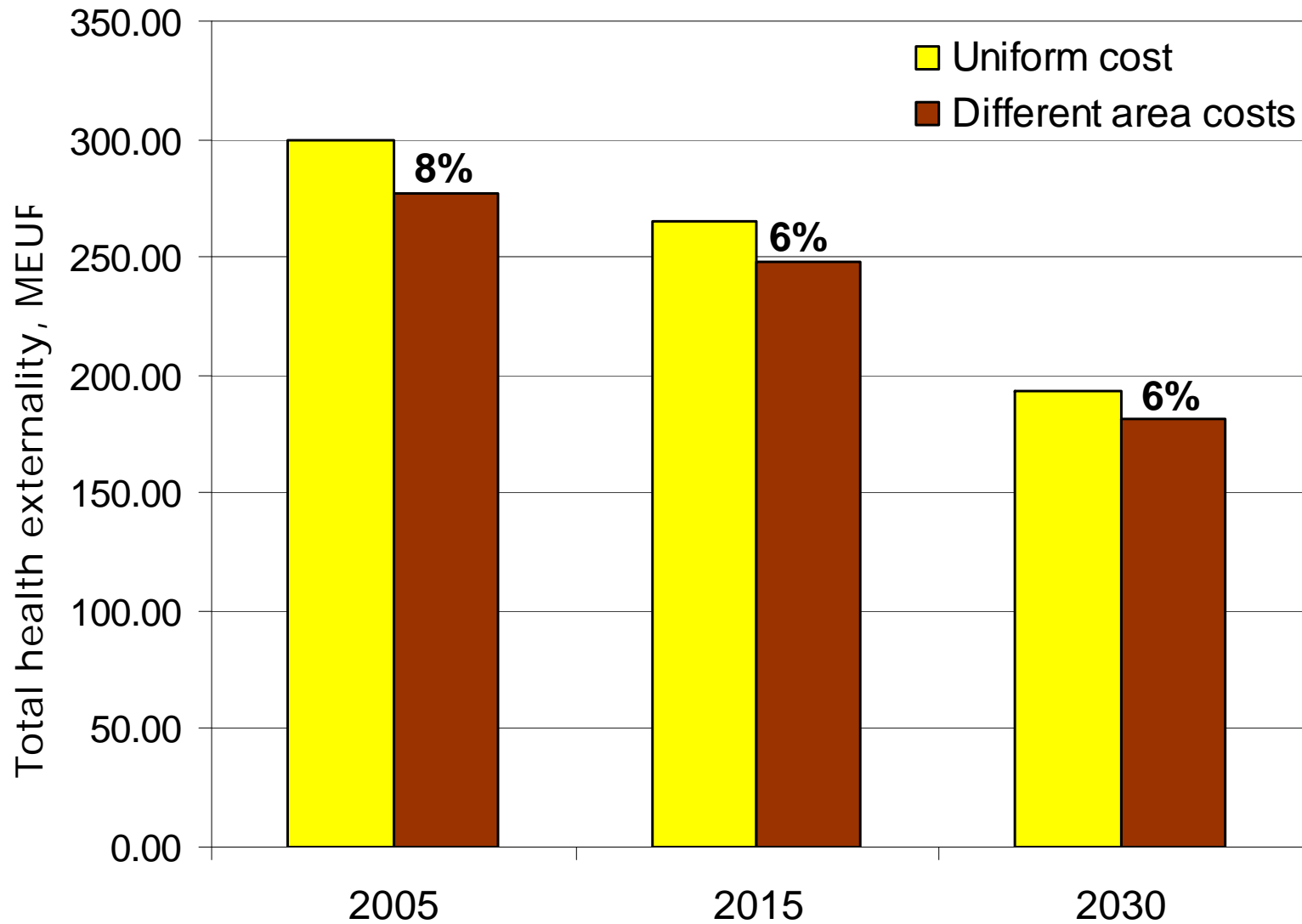
Health related external costs included in the model

	SO2 Cost, EUR/t	NOx cost, EUR/t	PM2,5 Cost EUR/t
Average cost	9100	5870	10900
High cost	13542	10483	18533
Low cost	5962	2533	7595

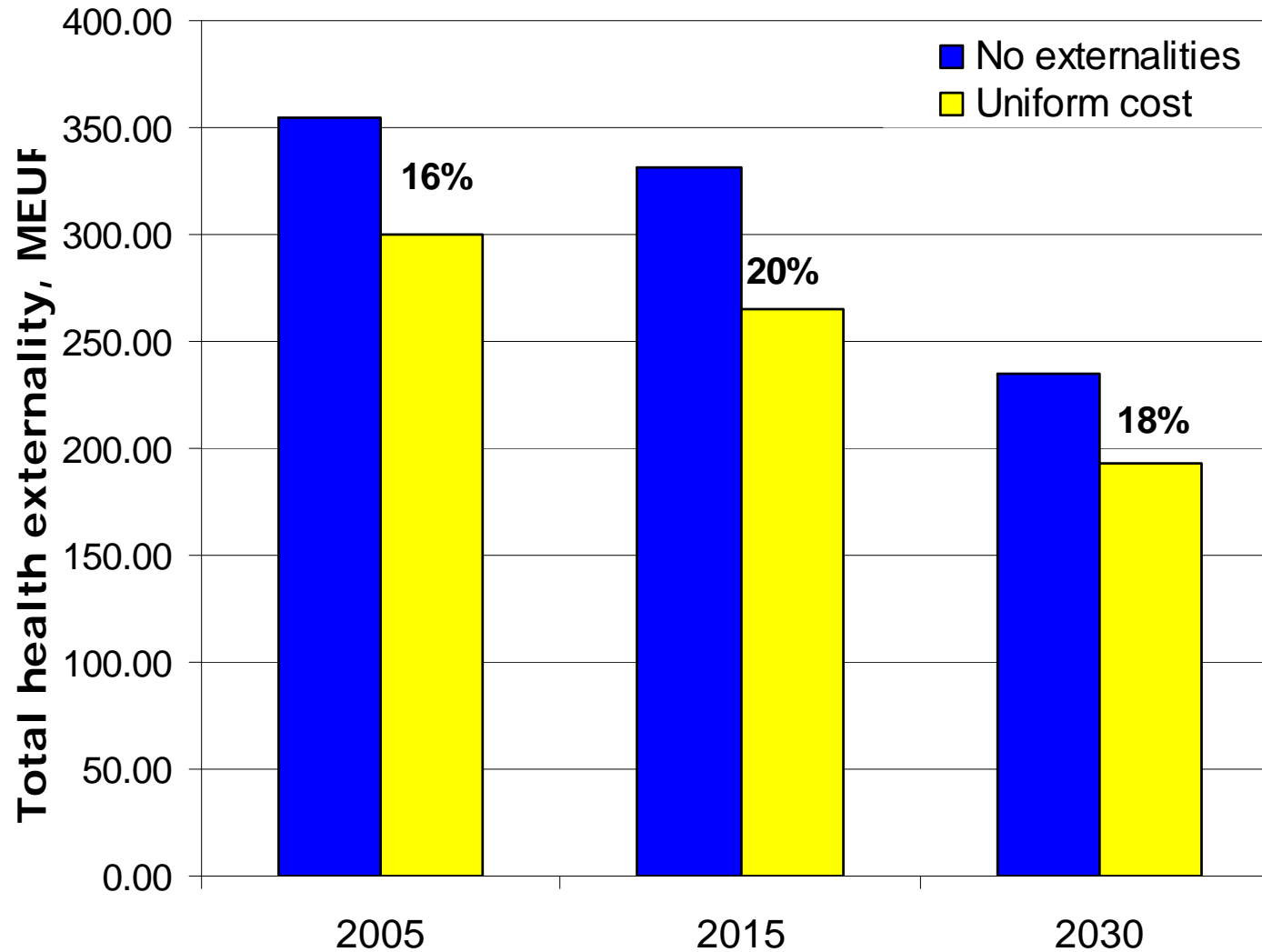


adopted from Bernd Möller,
Aalborg University 2008

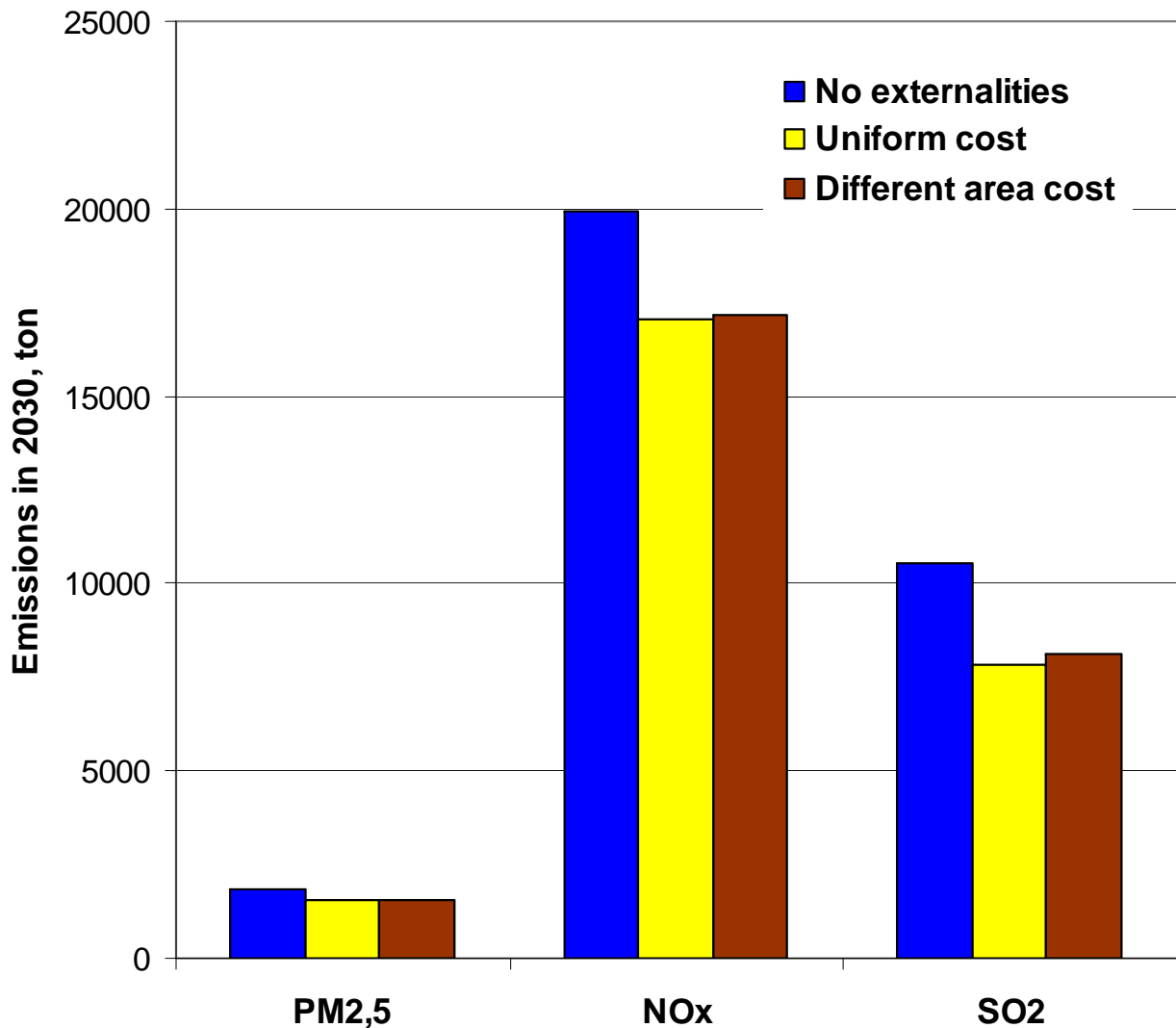
Results I – The external costs



Results I – The external costs



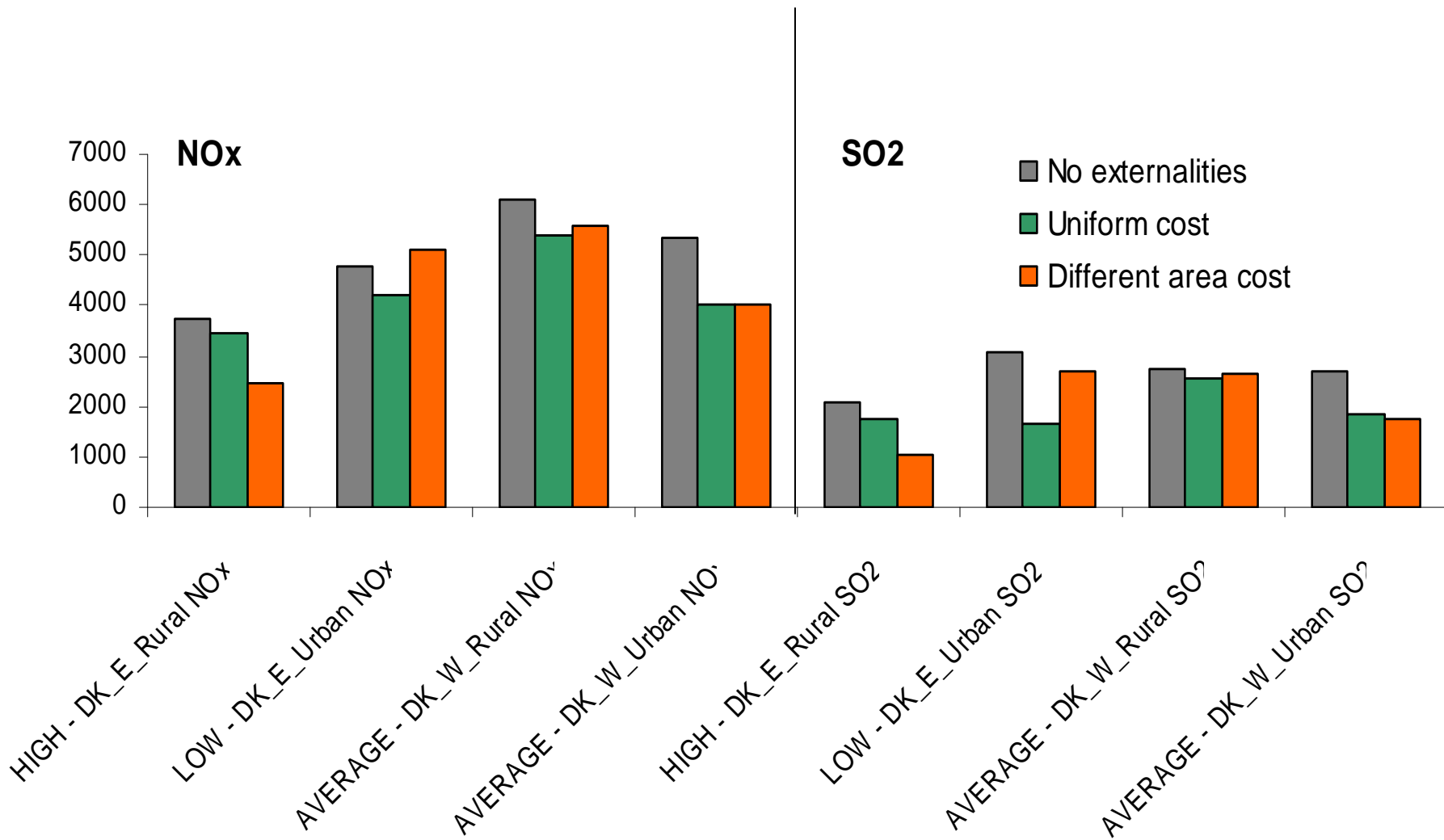
Results II – pollution emissions in areas



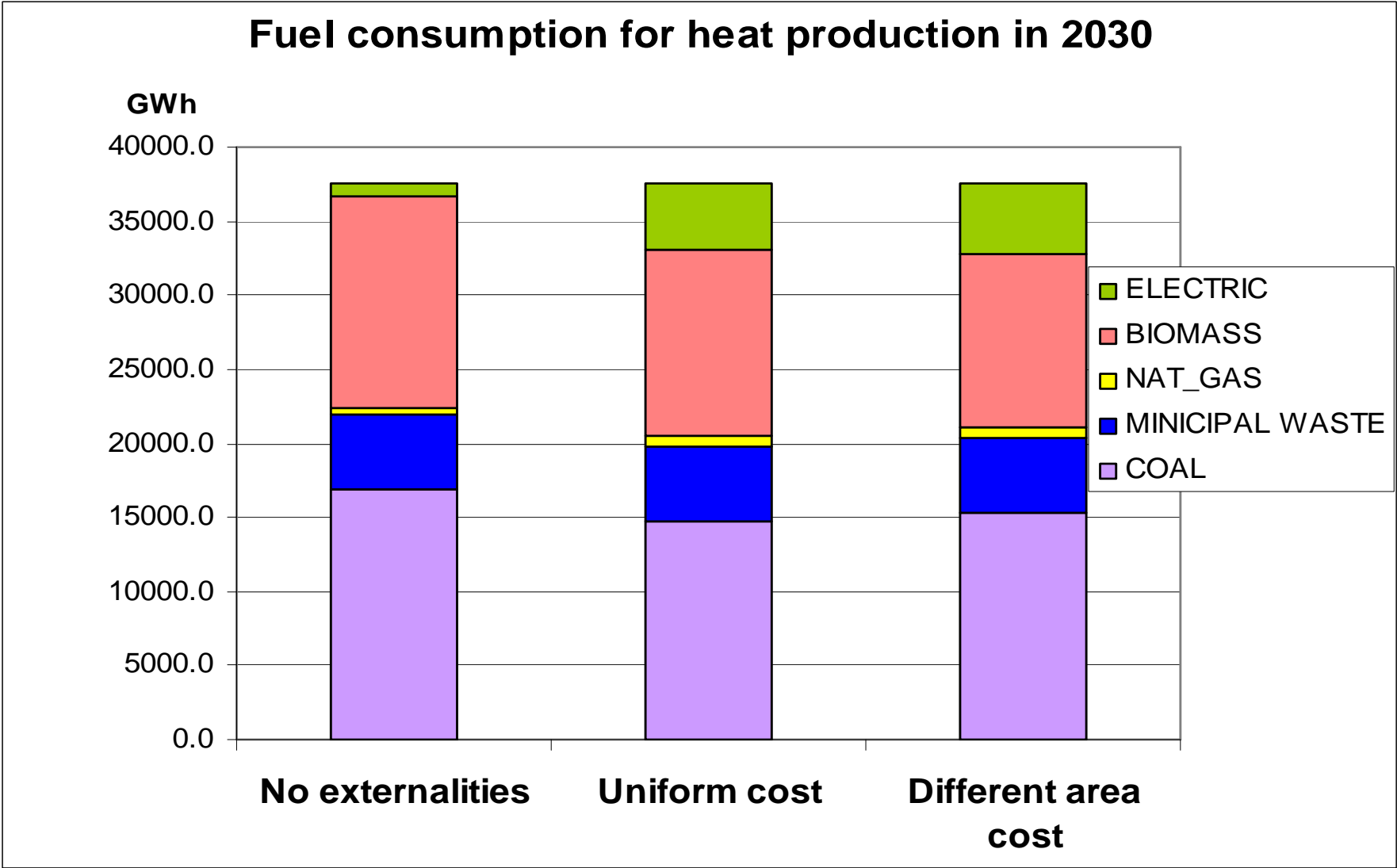
Results II – pollution emissions in areas



Emissions in 2030, ton

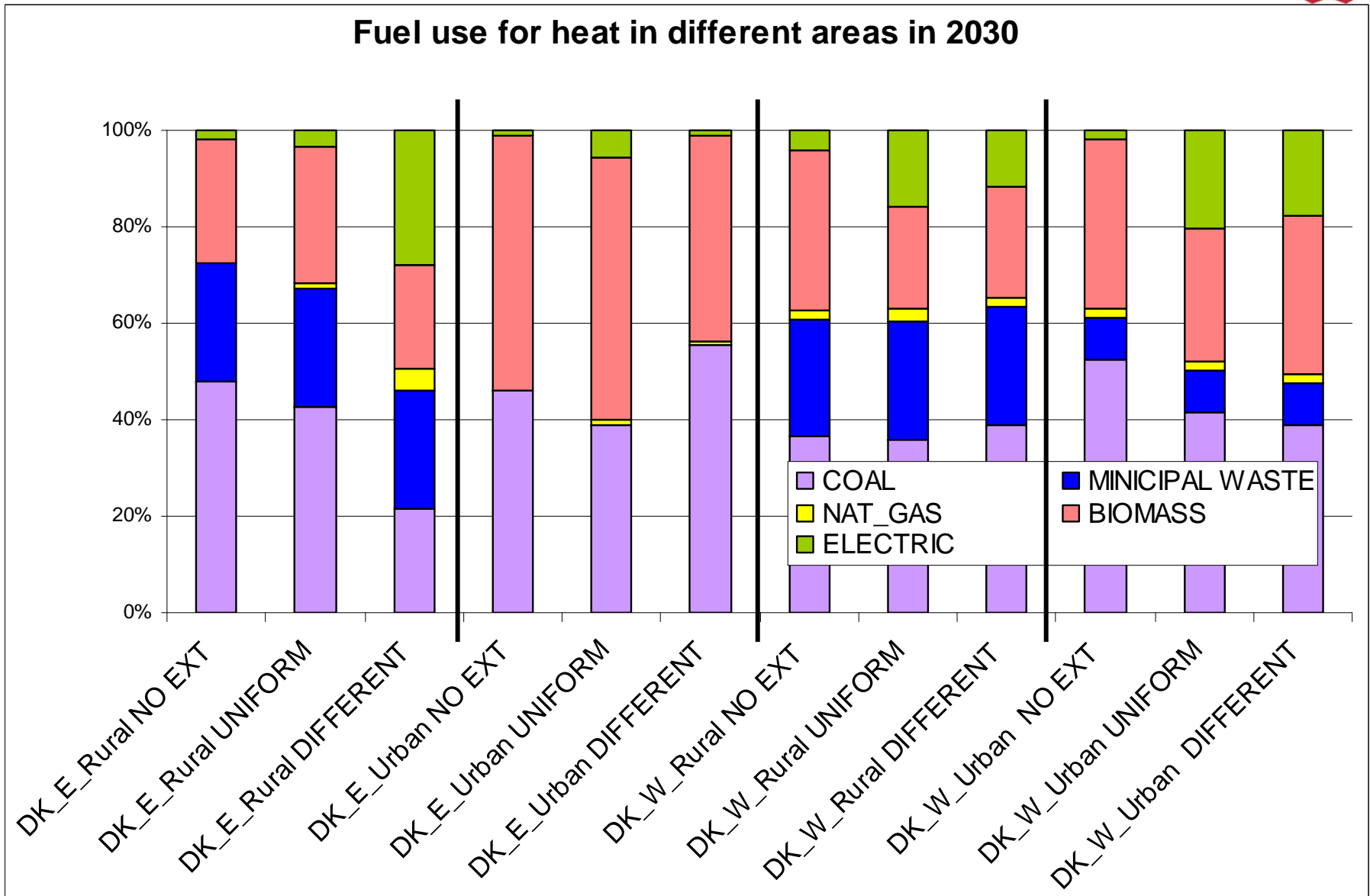


Results III – fuels used for heat production

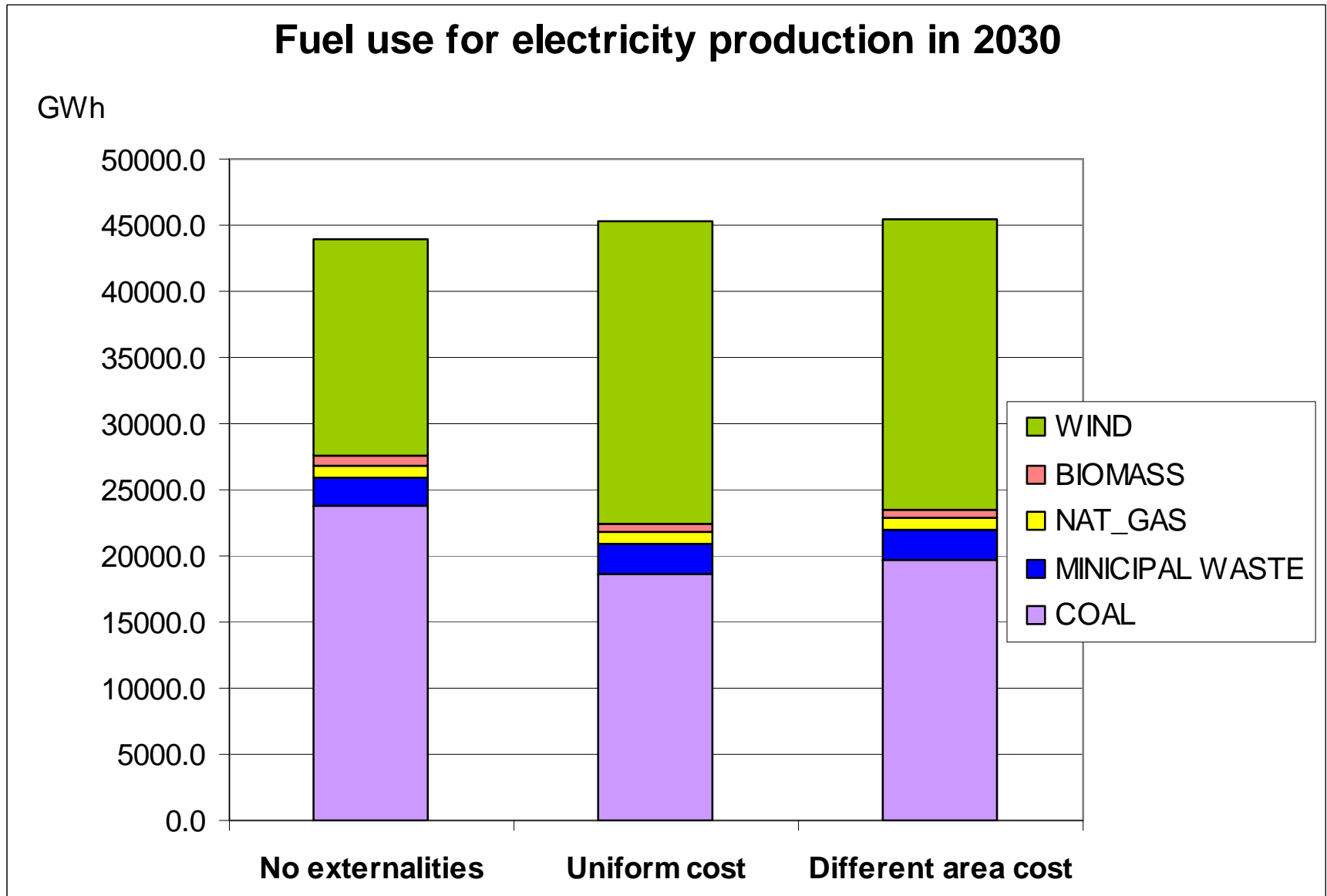


Results III – fuels used for heat production

Fuel use for heat in different areas in 2030

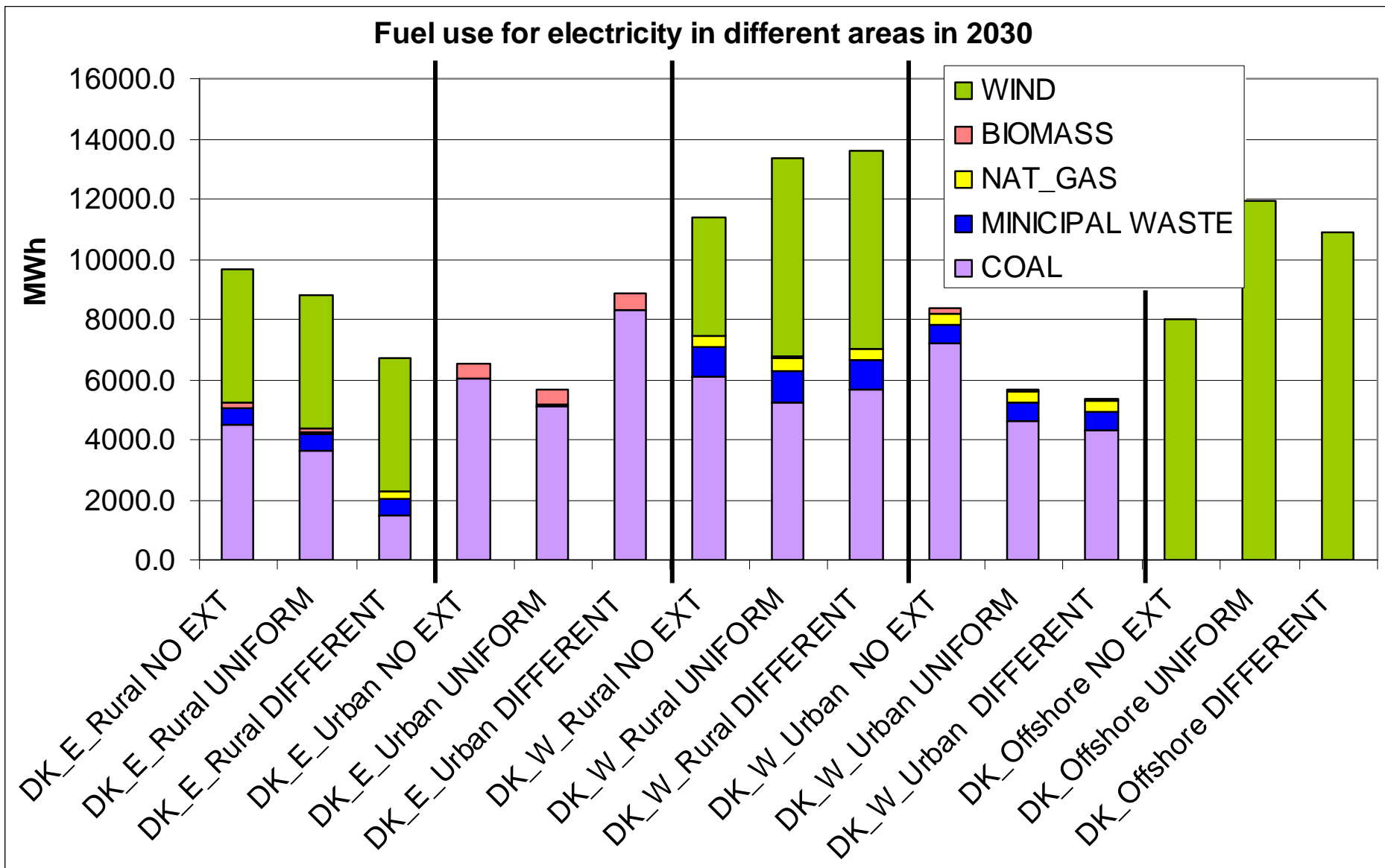


Results IV – fuels used for electricity production



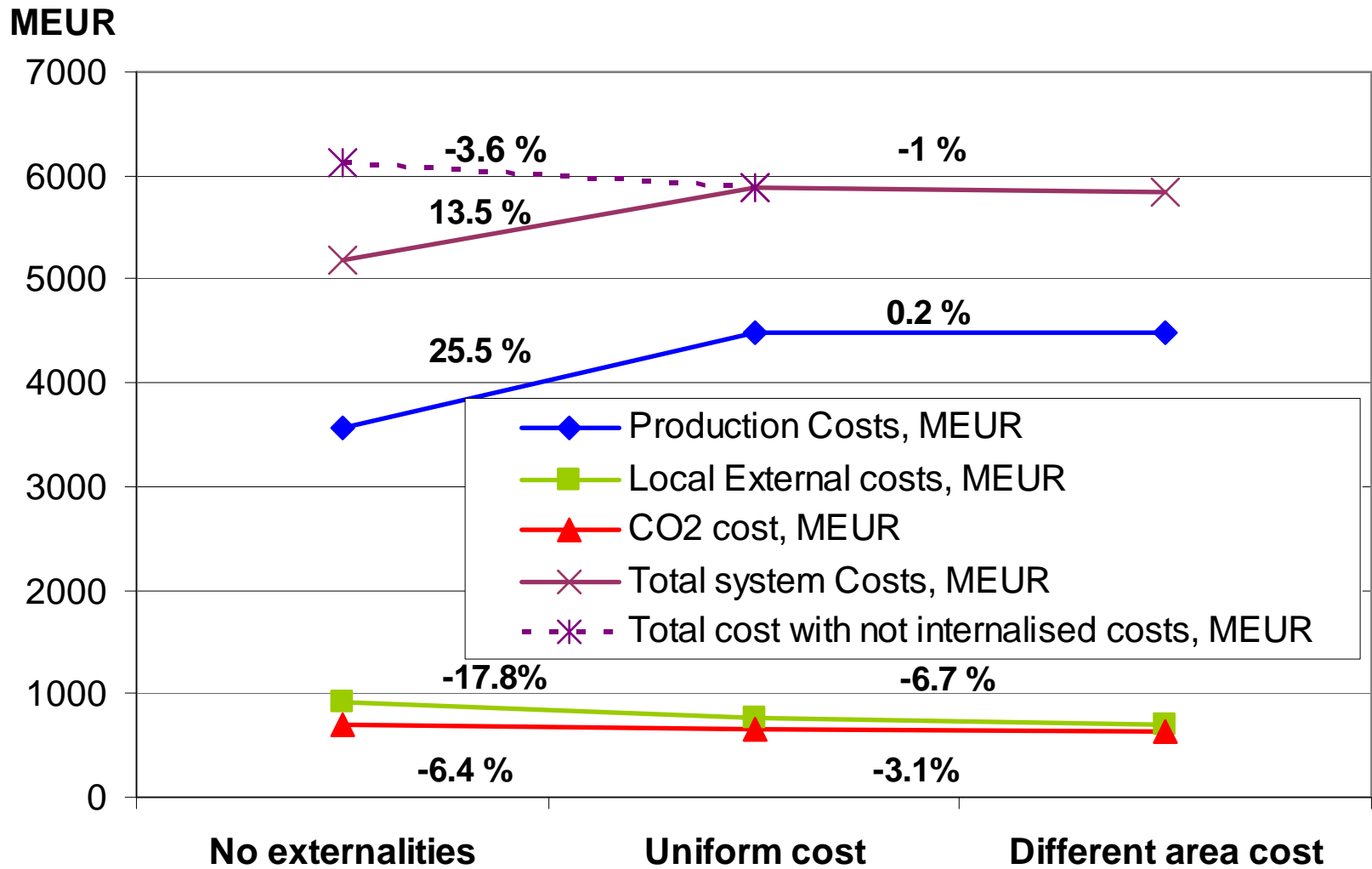
Results IV – fuels used for electricity production

Fuel use for electricity in different areas in 2030



Results IV – System costs

Cumulative undiscounted system costs



Conclusions



- Internalising local externalities leads to around 18% decrease in local external cost of the system
- Considering different local area costs leads to further reduction in local external cost by around 7%
- Reflecting
 - Technology
 - Goals
 - Location
- Identify areas with different health costs of air pollution:
 - atmospheric pollution modelling
 - health impact assessment modelling

Thank you for attention!

The presented study is a part of the research of the Centre for Energy, Environment and Health, financed by The Danish Strategic Research Program on Sustainable Energy under contract no 2104-06-0027.

For more information visit www.ceeh.dk

