

# ExternE Applications

*The newest results for the New EU MS*

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**MAXIMA WORKSHOP 01**  
**Krakow, 28 February – 1 March, 2005**



# CONTENT

1. External applications in NMS's  
...overview of the methods, tools and applications
2. External costs calculation for energy generation in NMS's (plus non-energy in brief)  
... countries, and technology coverage
3. Policy options/instruments and future steps



# METHODS BEING APPLIED

- several applications based on „**top-down**“ **approach** ...are out of our focus here
- EU-15 estimates **transferred to NMS**
  - directly (several national R&D projects)
  - or by using BeTa database
- **ExternE methodology** (since 2002)
  - externality is a site-, technology-, time-specific
  - „bottom-up“ approach
  - „impact-pathway analysis“
  - life cycle assessment
  - neoclassical economics (monetary valuation)
  - supplemented by „top-down“ approaches (eutrophisation...) or specific approaches such as standard price method (ecosystems)



# NATIONAL IMPLEMENTATIONS

## **ExternE: National Implementation**

- only EU-15/EEA covered up to 2002

## **ExternE: Extension of geographical coverage** (focused on energy sector)

- **ExternE-Pol** (2002-2004 FP5 EC) - “Externalities of Energy: Extension of accounting framework and Policy Applications”
- **IP NEEDS** (2004-2008 FP6 EC) – „*New Energy Externalities Developments for Sustainability*“

## **ExternE: Extension of sector coverage** (focused on NMS's)

- **SusTools** (2003-2004 FP5 EC) - „Tools for sustainability: Development and application of an integrated framework“
  - municipal waste & N-fertilisers
- **MethodEx** (2004-2008 FP6 EC) – „*Methods and data on environmental and health externalities: harmonising and sharing of operational estimates*“
  - waste treatment, industry & agriculture



# EXTERNE NMS APPLICATIONS

	ENERGY	TRANS	WASTE	INDSTRY	AGRI
BULGARIA	NEEDS		Sus-Tools		
CROATIA	Y				
CZECH REP	Ext-Pol NEEDS	Ext-Pol	Sus-Tools MethodEx	MethodEx	Sus-Tools MethodEx
ESTONIA	NEEDS				
HUNGARY	Ext-Pol NEEDS				MethodEx
POLAND	Ext-Pol NEEDS		Sus-Tools		MethodEx
SLOVAKIA	Ext-Pol NEEDS				



# DAMAGES ASSESSED

## Pollutant/burden

- Particulate matters
- SO<sub>2</sub>, NO<sub>x</sub>
- CO<sub>2</sub>
- O<sub>3</sub>



## Impact category

- Human health
  - morbidity
  - mortality
- Building materials
- Crops
- Climate change



# DAMAGES NOT ASSESSED

## Pollutant/burden

- Heavy metals
- CO, VOC
- Noise
- Odour
- focused on ***the process***



## Impact category

- Forests
- Natural ecosystems
- Visibility
- Cultural heritage

- estimation of up-stream externalities based on EcoInvent database  
(developed by PSI) not on original national data

- down-stream externalities not covered



# DATA & ASSUMPTIONS

focused on energy sector

- **technology & emission data** mostly based on regular official statistical surveys of
  - energy offices, resp. energy regulatory offices
  - hydro-meteorological institutes (no for Hungary)
  - and provided by companies/utilities (e.g. ČEZ)
- **monetary values**
  - VSL/VOLY and cost-of-illness (as estimated for the EU-15)
- impacts due to **global warming**
  - based on  $MAC = 19 \text{ €} / \text{CO}_2\text{-eq.}$  (NewExt & EC 2004)





# SOFTWARE TOOLS

- **Uniform World Model** (by Rabl & Spadaro)
  - applied for Hun, Pol, CZ in 2003
- **EcoSense software** 2.0, 4.0., and 4.1 (by IER)
  - applied for Hun, Pol, CZ in 2004
  - planned to be update and applied in IP NEEDS
- **RiskPol model** version 1.5.1 (by Rabl & Spadaro)
  - applied for an estimation of local impacts and transport externalities in CZ

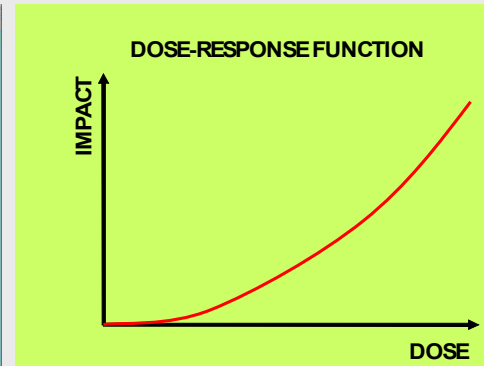
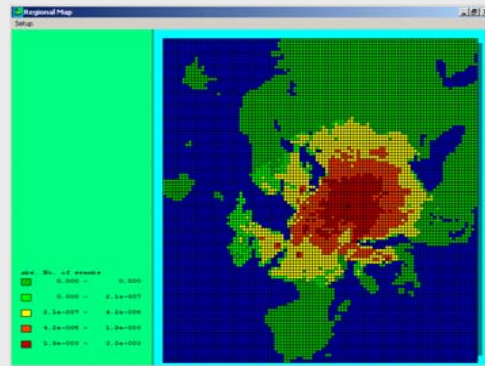


# **EXTERNAL COSTS OF ELECTRICITY GENERATION**

**Results for the  
Czech Republic,  
Hungary and  
Poland**

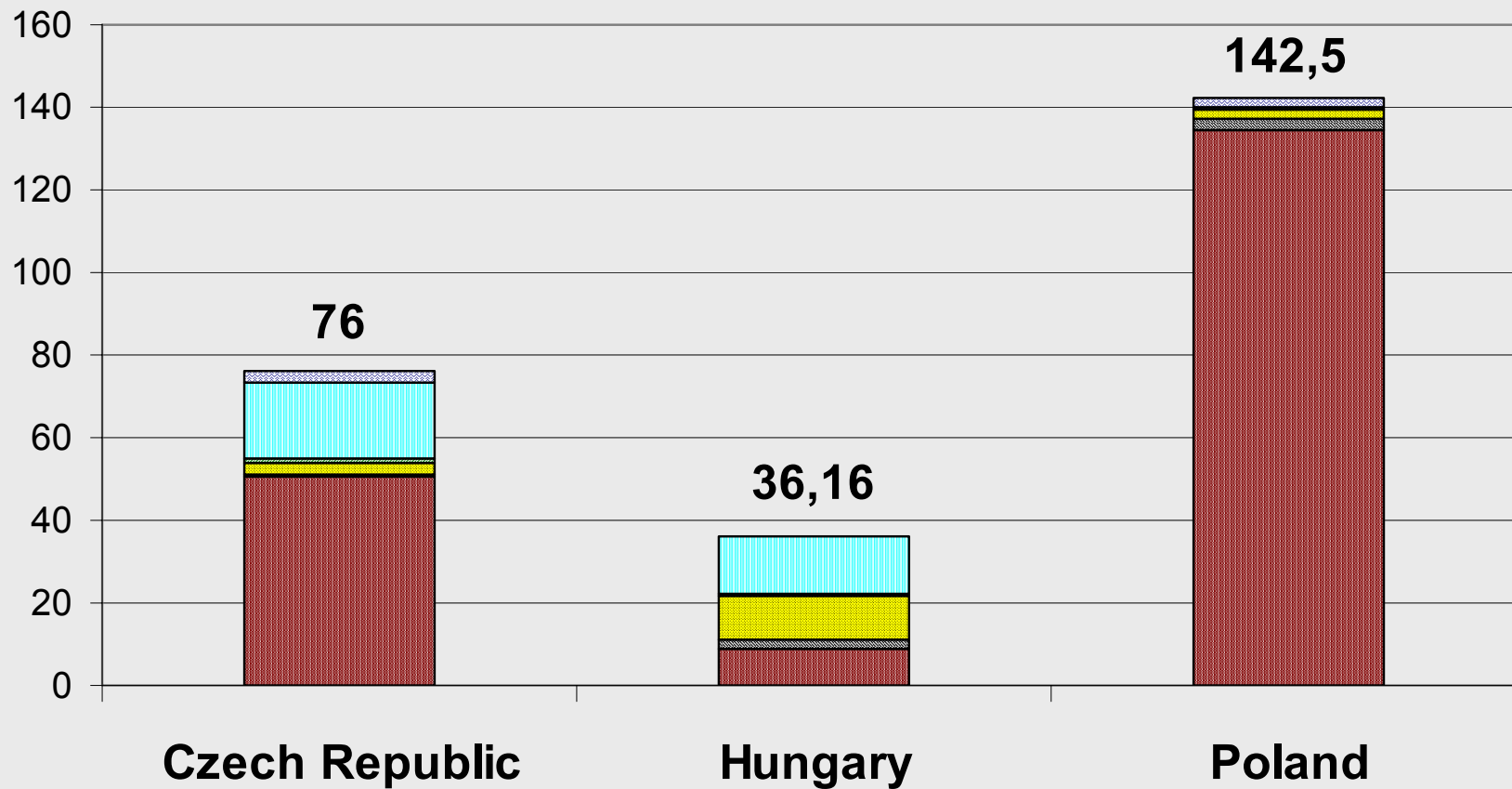


# IMPACT PATHWAY ANALYSIS



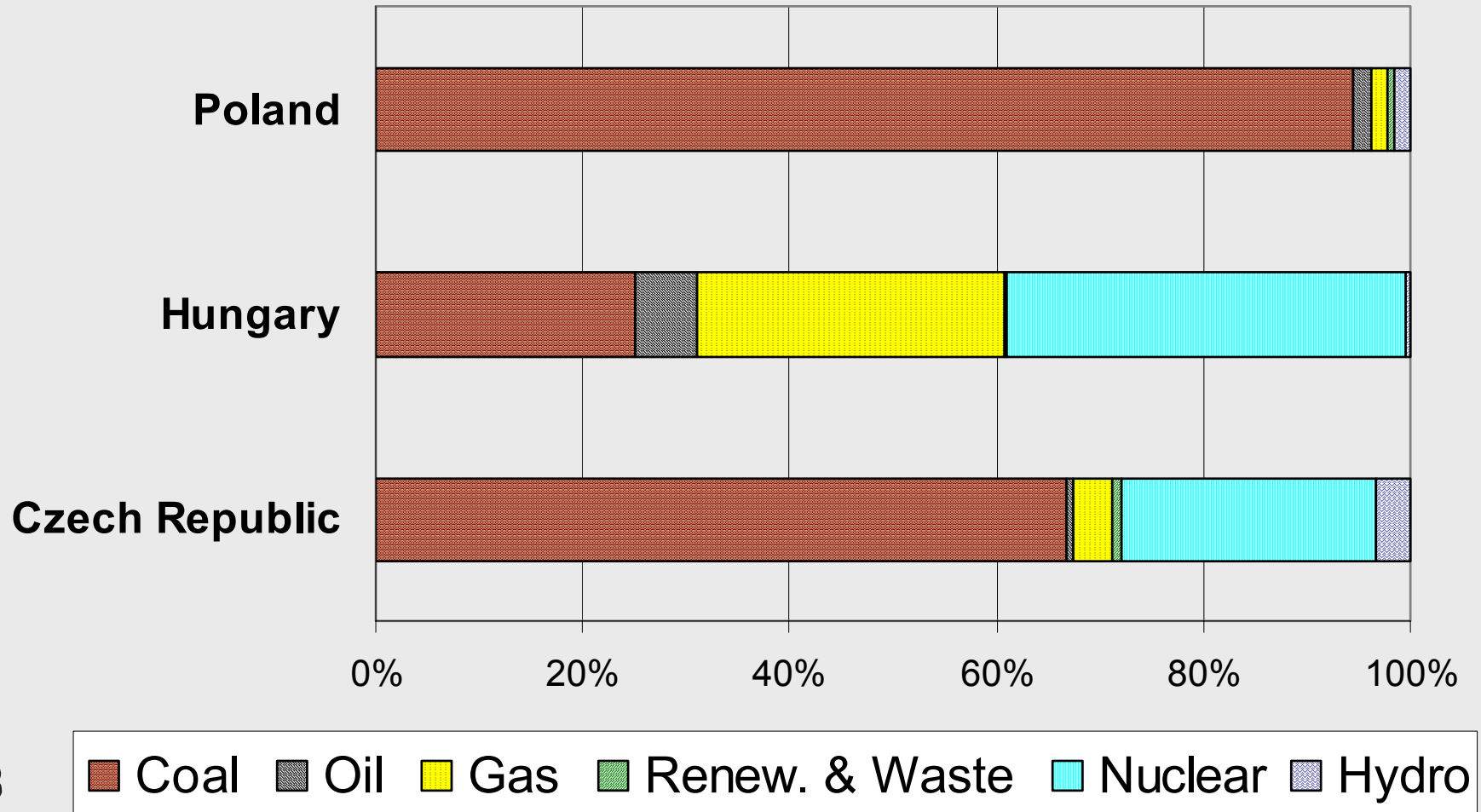
**LCA:** mining, transport and preparation of fuel, operation of power plant

# ELECTRICITY GENERATION BY SOURCE (2002), TWh



Coal Oil Gas Renew. & Waste Nuclear Hydro

# ELECTRICITY GENERATION BY SOURCE (2002)



# SELECTION OF FUEL CYCLE

## CZECH REPUBLIC

- hard coal, brown coal, lignite CHP and brown coal CHP

## HUNGARY

- hard coal, brown coal and natural gas

## POLAND

- hard coal and brown coal



# CZECH REFERENCE POWER PLANT

Characteristics	Reference power plant			
	brown coal	hard coal	lignit CHP	brown coal CHP
Fuel	brown coal	hard coal	lignit CHP	brown coal CHP
Plant type	Dry-bottom boiler, FGD, DENOX and dedusting	Dry-bottom boiler, FGD, DENOX and dedusting	Fluidized bed, FGD, DENOX and dedusting	Fluidized bed, FGD, DENOX and dedusting
Installed capacity [MW]	1000	800	105	352
Local environment	rural	urban	rural	rural
Stack height [m]	200	250	100	140
Energy production per year, netto[GWh]	7 000	2000	300	1200

# HUNGARIAN REFERENCE POWER PLANT

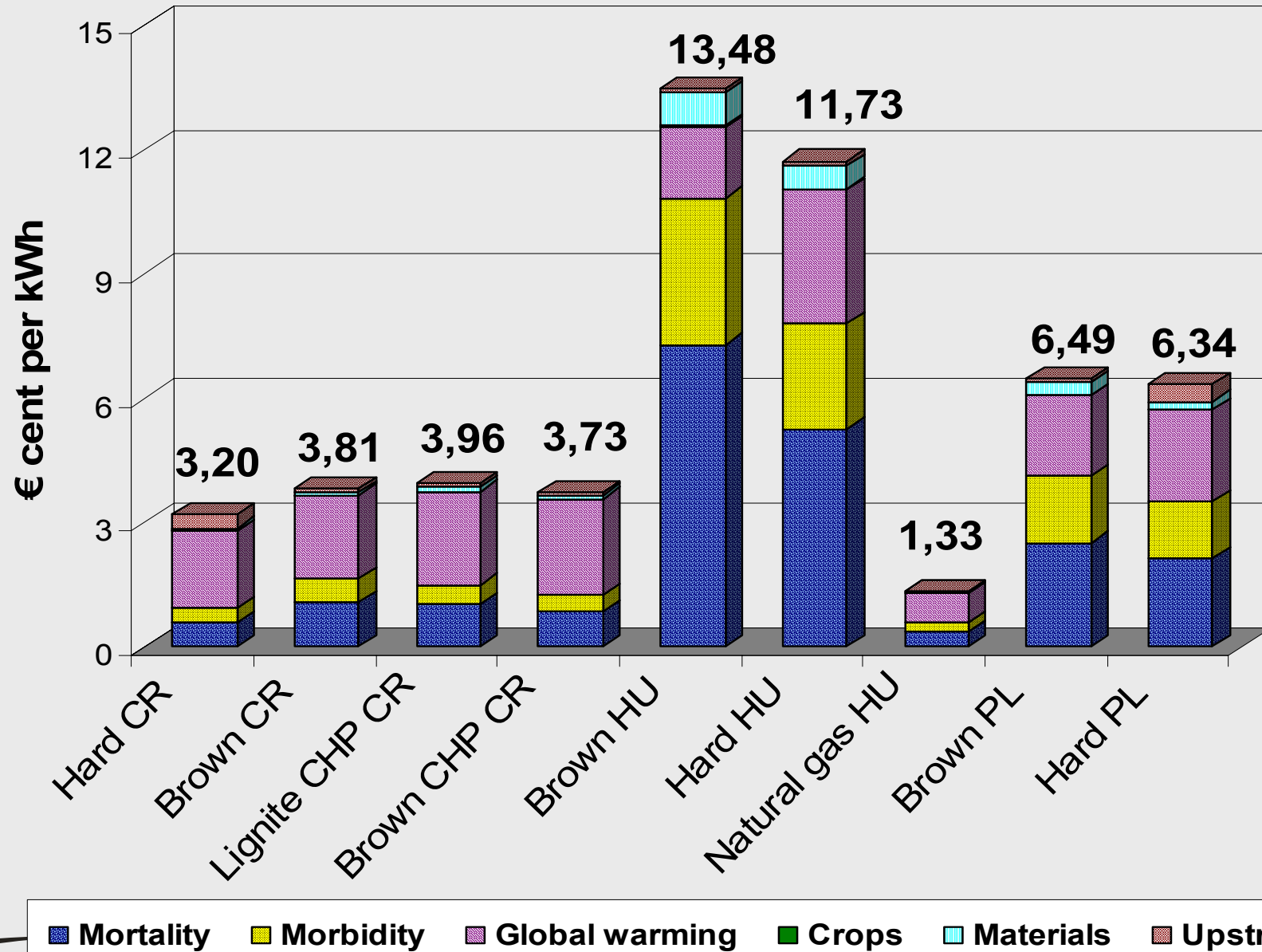
Characteristics	Reference power plant		
	hard coal	brown coal	natural gas
Fuel	hard coal	brown coal	natural gas
Plant type	DENOX and dedusting	DENOX and dedusting	dual-fired boilers, DENOX and dedusting
Installed capacity [MW]	190	145	860
Local environment	rural	rural	rural
Stack height [m]	100	122	250
Energy production per year, netto[GWh]	500	500	2500



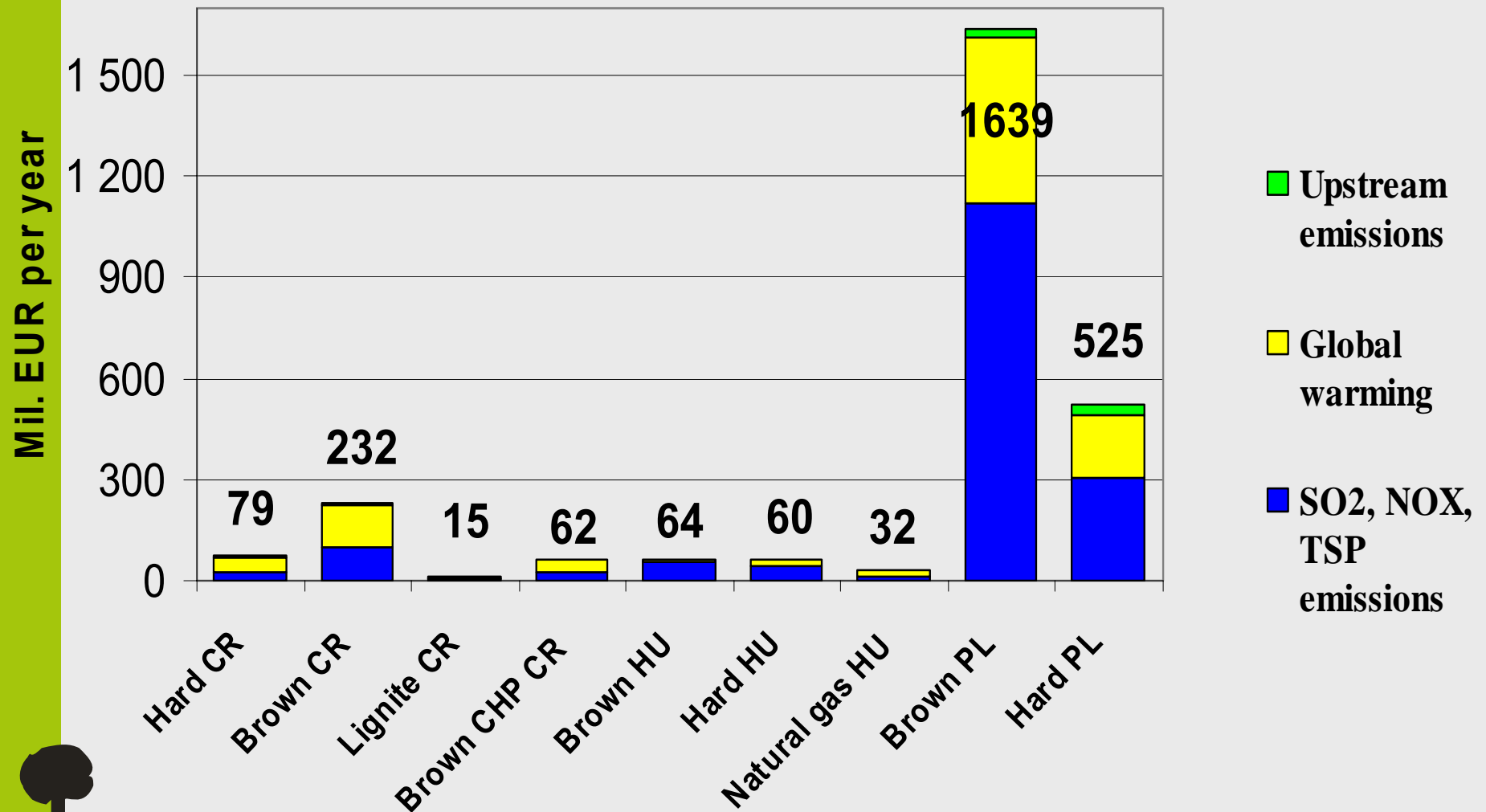
# POLISH REFERENCE POWER PLANT

<b>Characteristics</b>	<b>Reference power plant</b>	
Fuel	hard coal	brown coal
Plant type	Pulverized plant with FGD, DENOX and dedusting	Pulverized plant with FGD, DENOX and dedusting
Installed capacity [MW]	2820	4410
Local environment	rural	rural
Stack height [m]	200	300
Energy production per year, netto[GWh]	8000	25000

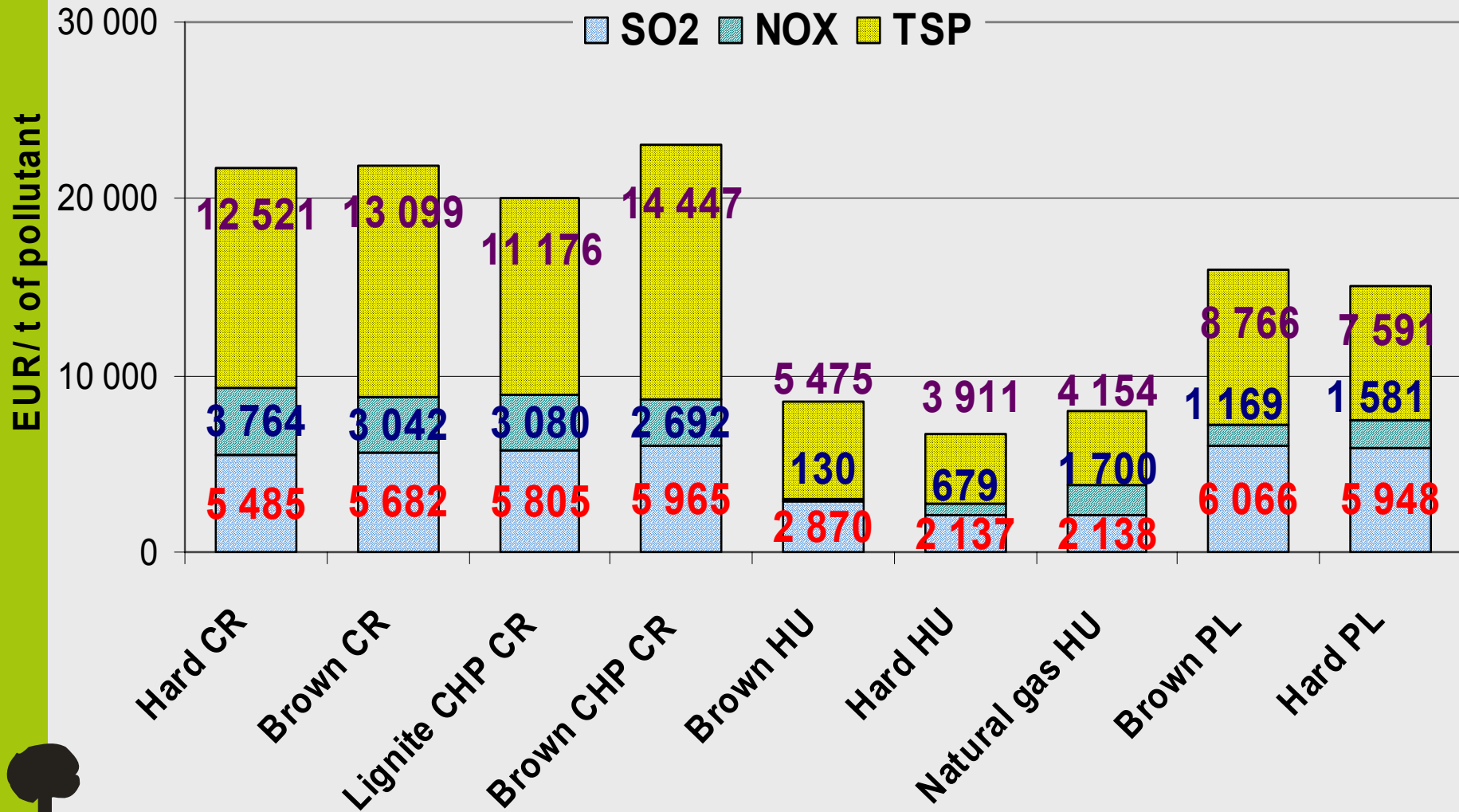
# EXTERNAL COSTS in €/kWh (2002)



# TOTAL EXTERNALITIES in mio. € in 2002

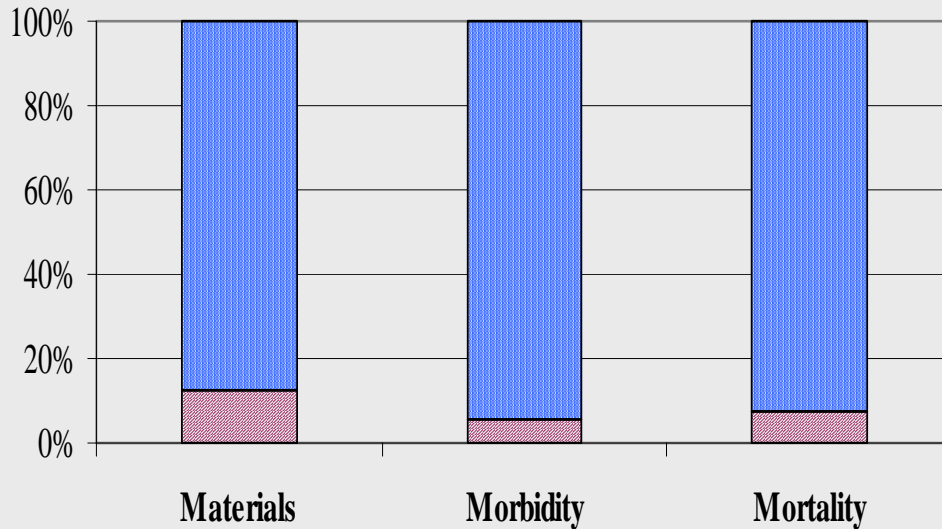


# DAMAGES BY POLLUTANT (2002)



# SPATIAL ALLOCATION OF EXTERNALITIES

## PM, SO<sub>2</sub>, NO<sub>x</sub>: Czech Republic vs. rest of the world



■ Hard coal CR ■ Hard coal All countries



■ Brown coal CHP CR ■ Brown coal CHP All countries



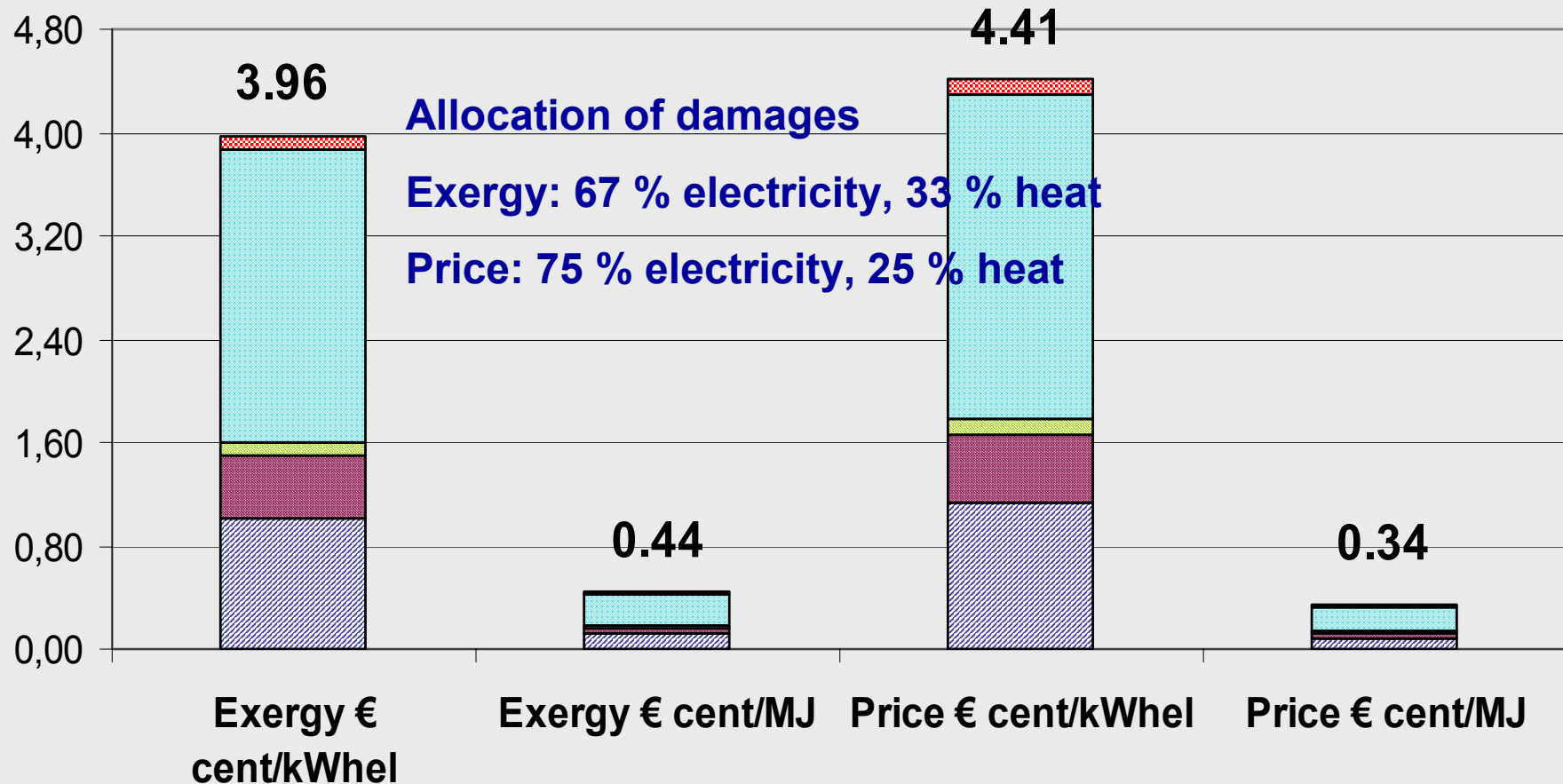
# PAY ATTENTION FOR CHP in CEEC

Combined heat and electricity production, Czech Rep. (2001)

	TWh	%	
<b>Electricity generated</b>	<b>74,23</b>		
Electricity plants	54,31	73,2	
CHP plants	19,92	26,8	
	PJ	%	TWh
<b>Heat generated</b>	<b>149,09</b>		<b>41,41</b>
CHP plants	111,80	75,0	31,06
Heat plants	37,29	25,0	10,36

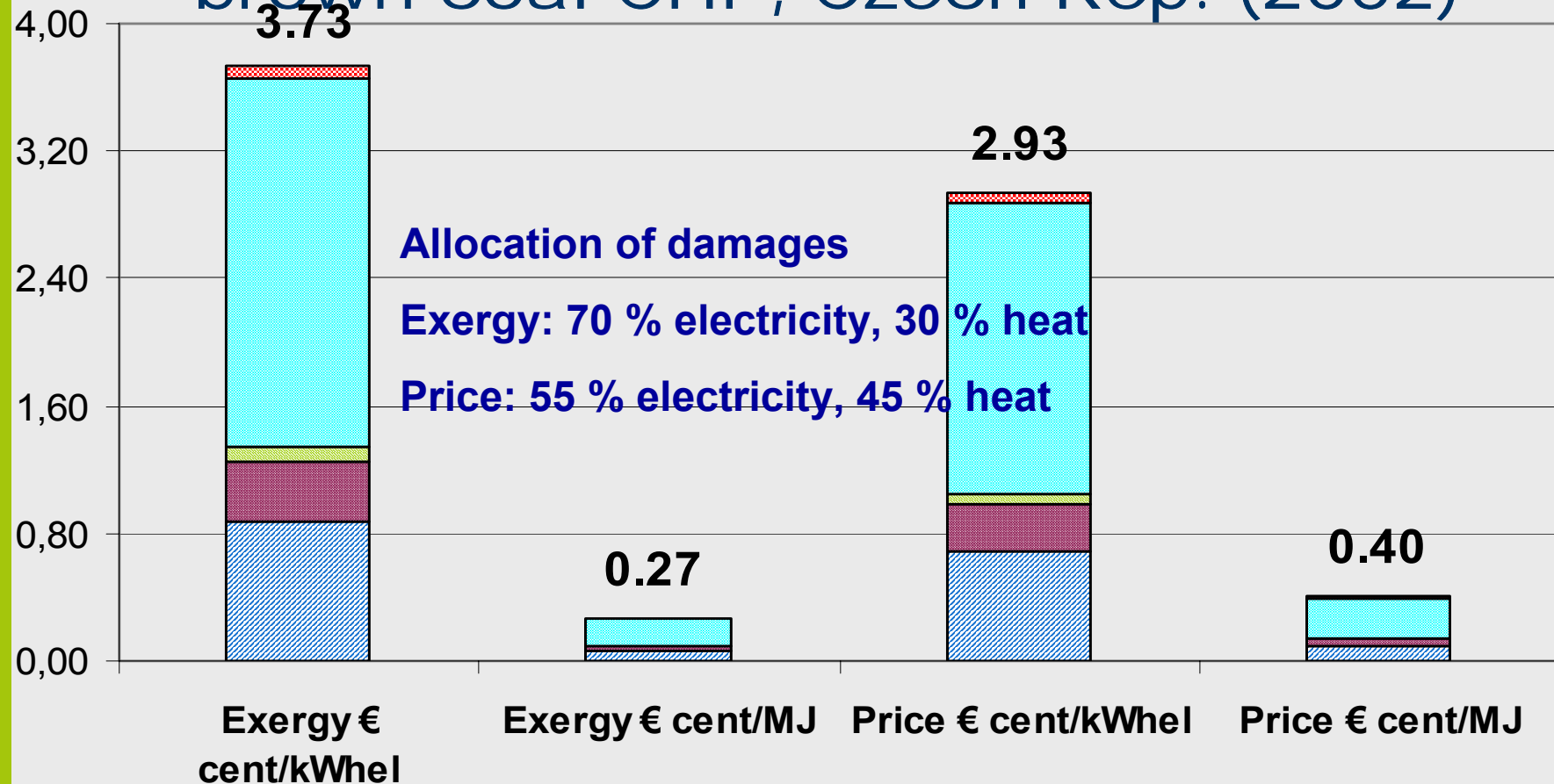
# ALLOCATION OF EXTERNAL COSTS between ELECTRICITY and HEAT

## lignit CHP, Czech Rep. (2002)



Mortality
  Morbidity
  Crops
  Materials
  Global warming
  Upstream

# ALLOCATION OF EXTERNAL COSTS between ELECTRICITY and HEAT brown coal CHP, Czech Rep. (2002)



Mortality
  Morbidity
  Crops
  Materials
  Global warming
  Upstream



# LOCAL MODELLING

## Czech Republic (2002)

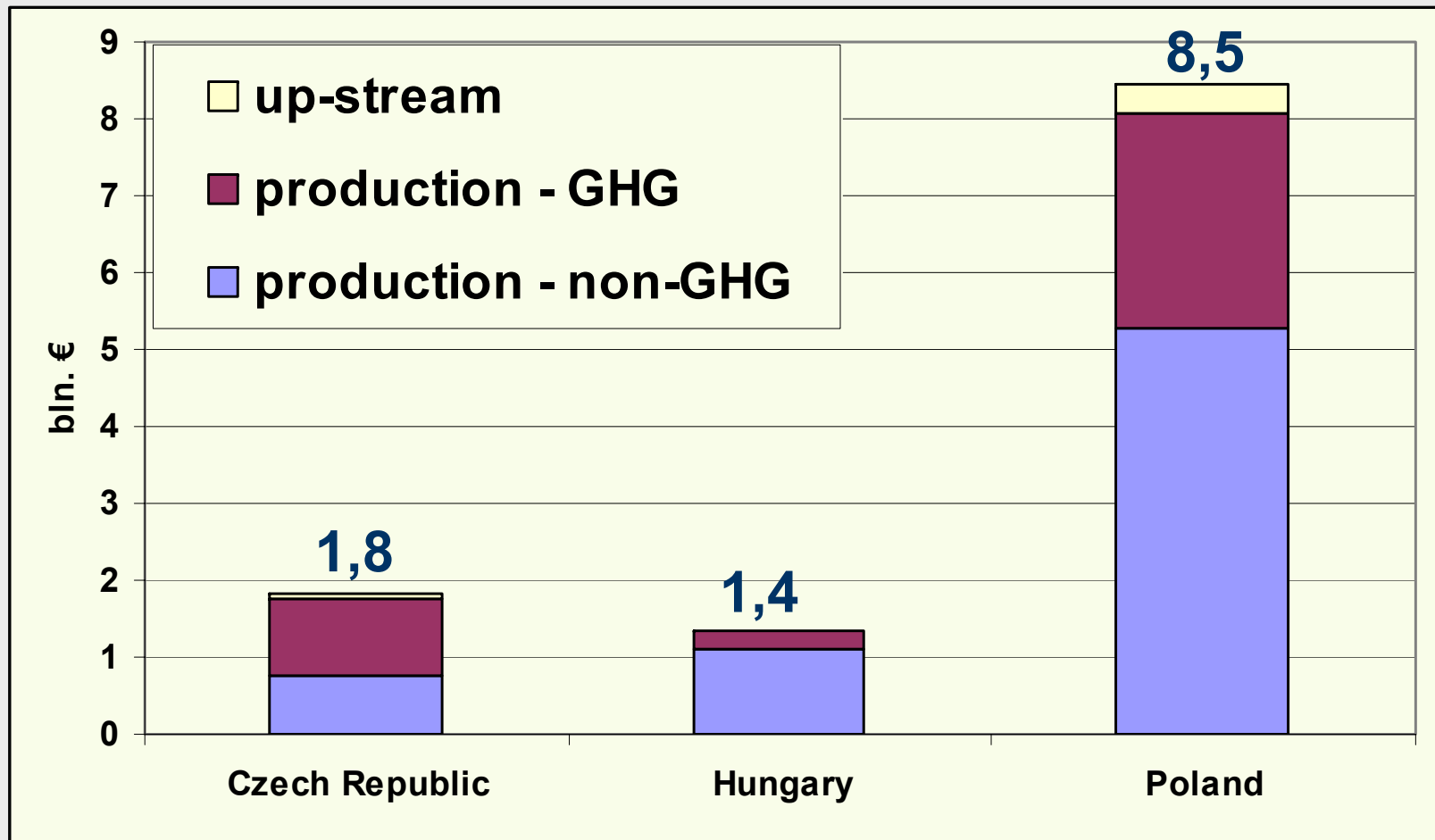
- RiskPoll v. 1.51, QUERI model
- estimation algorithm: best
- hourly meteo data from Automatic imission stations (AIM)
- reference power plant, brown coal
- local impact due to PM10, SO2 is **3.9 %**



# SUMMARY

## Aggregated external costs in 2002

**only coal and gas power plants concerned**



# SUMMARY

External costs per capita and GDP

**only coal and gas power plants concerned**

	CR	HU	PL
<b>Externalities per capita, <i>in €</i></b>	178 €	133 €	219 €
<b>Externalities per GDP, in %</b>	2.5 %	2.0 %	4.8 %

# SUMMARY RESULTS

- due to FGD the externalities for energy generation for the **Czech Republic** are comparable with EU-15 (e.g. Germany) and lower than average of (*EU-15+Visegrad that equals to 4.7 €/kWh for coal*)
- externalities for **Poland** are two times higher than for the Czech power plants (6.5 €/kWh) but still comparable with Spain, Belgium and France
- externality for **Hungary** are very high (two to three times higher than an average) due to old technologies without FGD (in 2002), but FGD has been installed and switch to natural gas supported last years

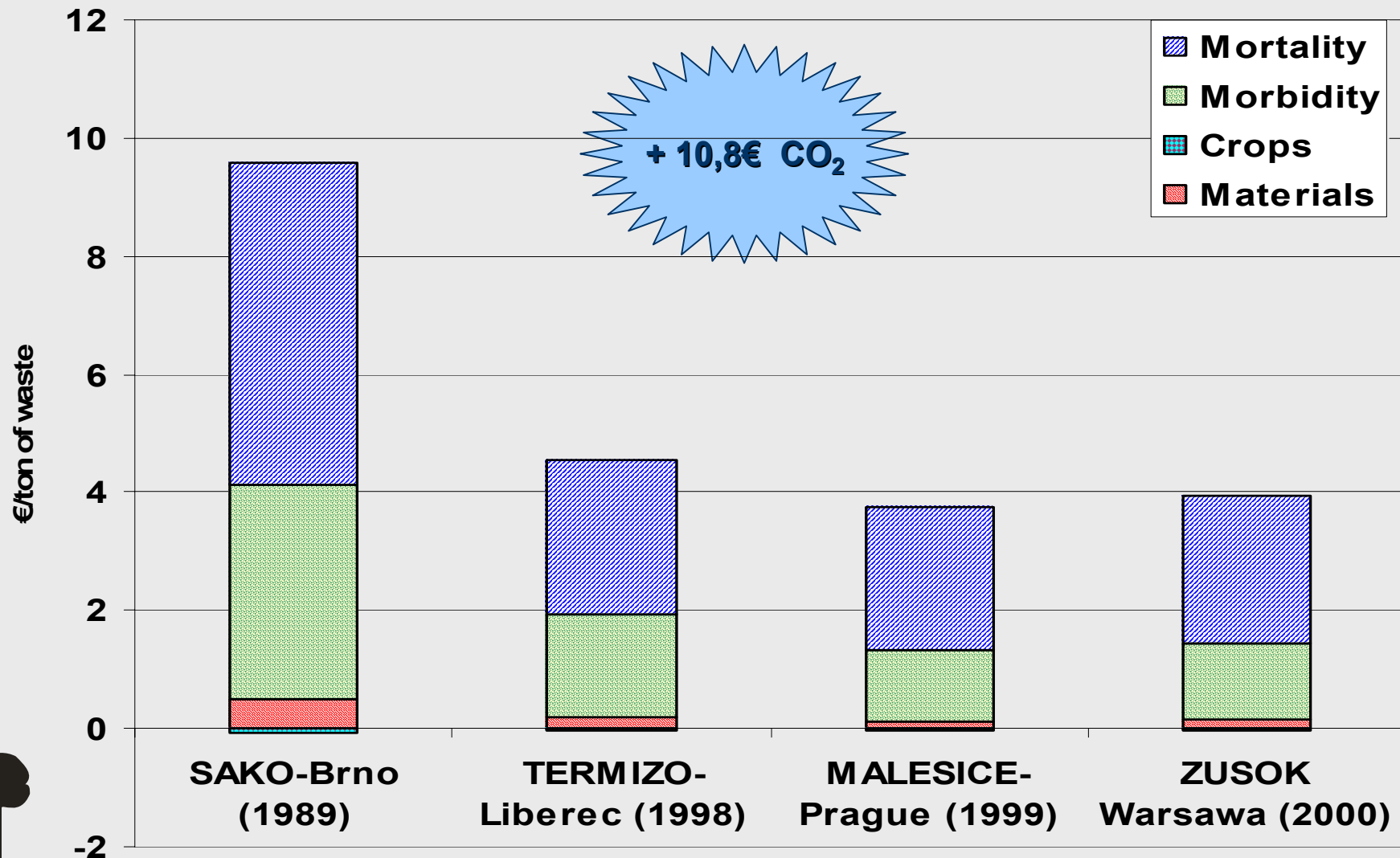


# NON-ENERGY APPLICATIONS



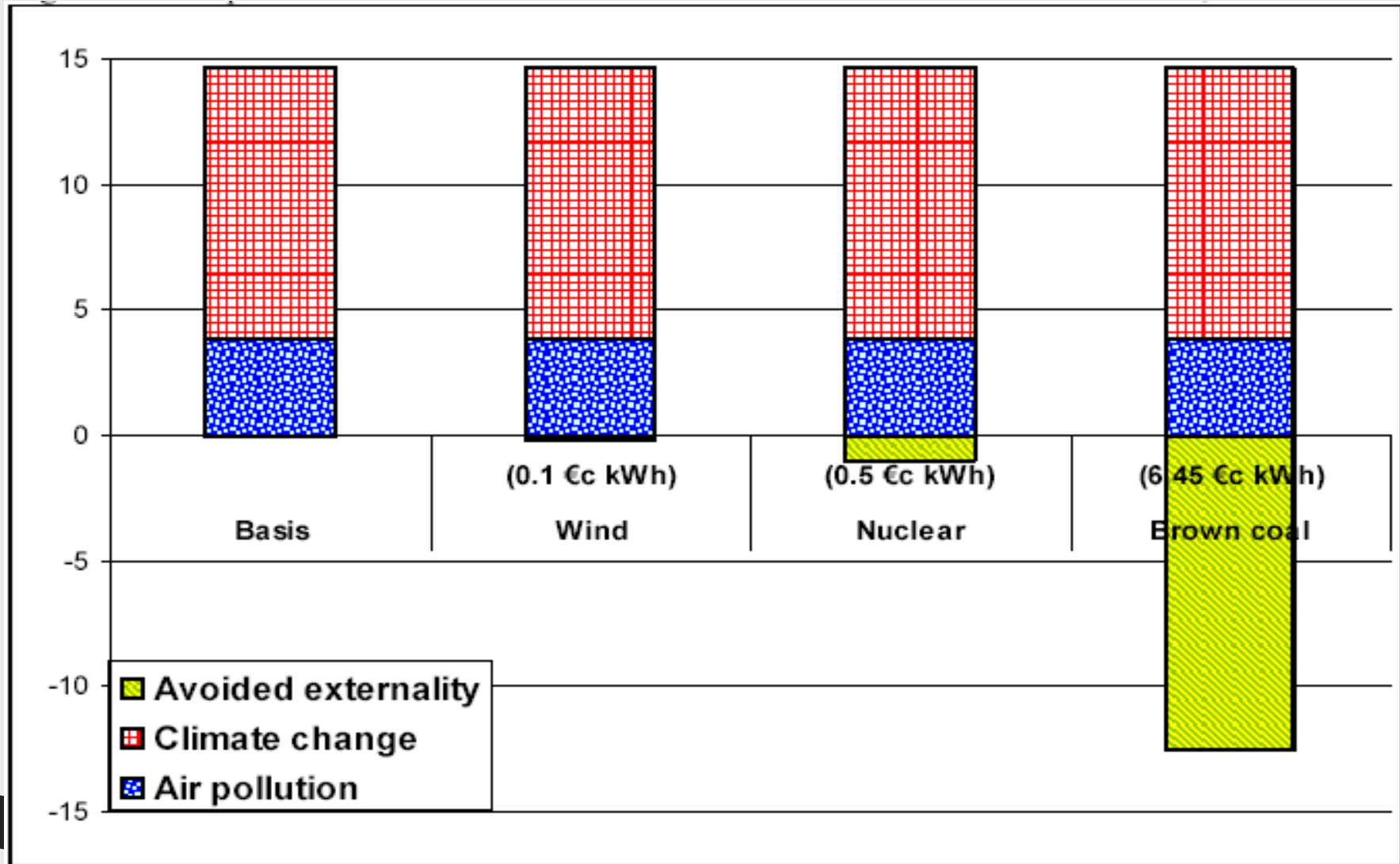
# WASTE EXTERNALITIES

## Municipal solid waste incinerators (CZ&Pol)



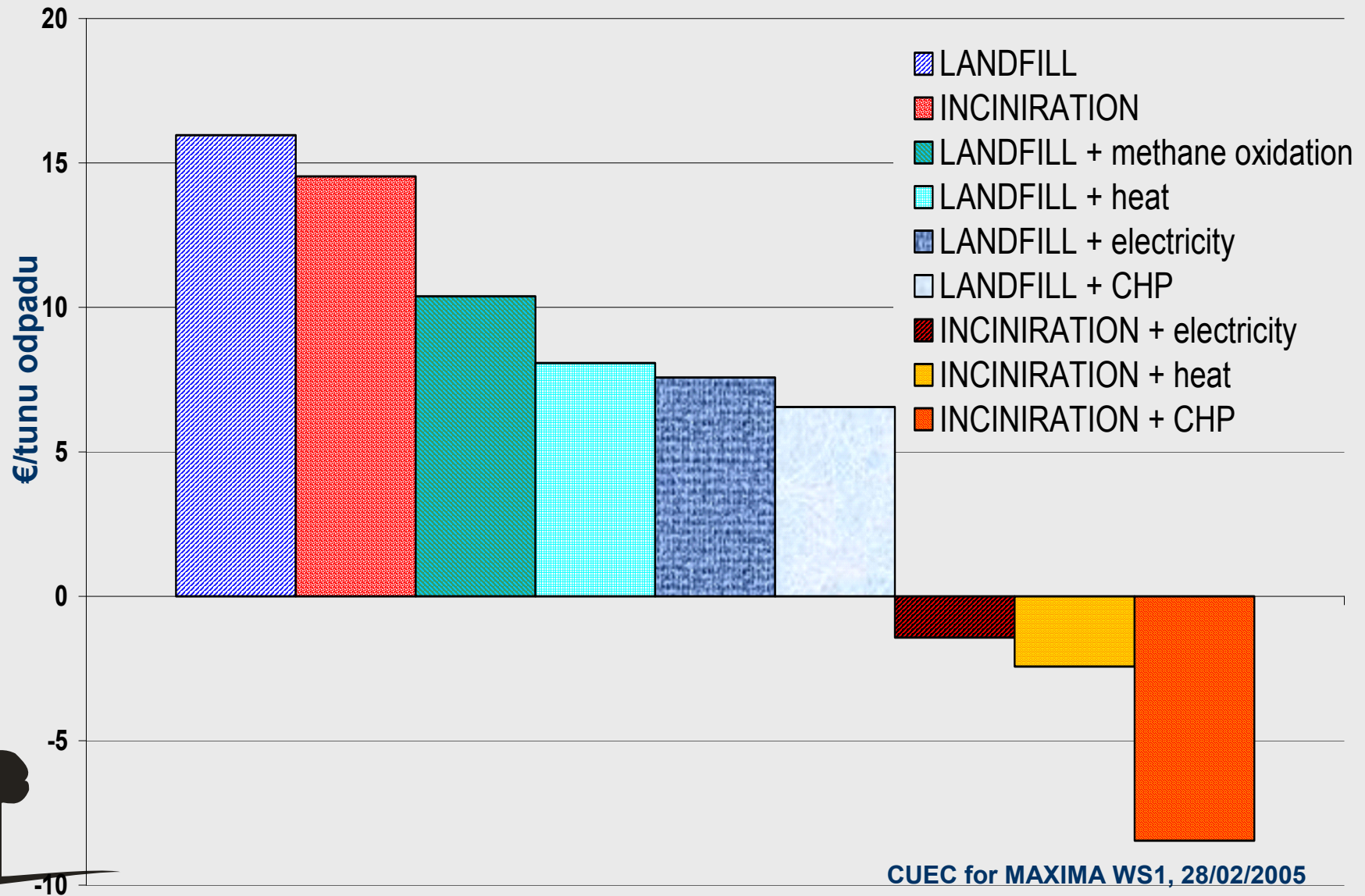
# „AVOIDED EXTERNALITIES“

Externality calculated for ZUKOS waste incinerator



# COMPARISON OF WASTE TREATMENT OPTIONS

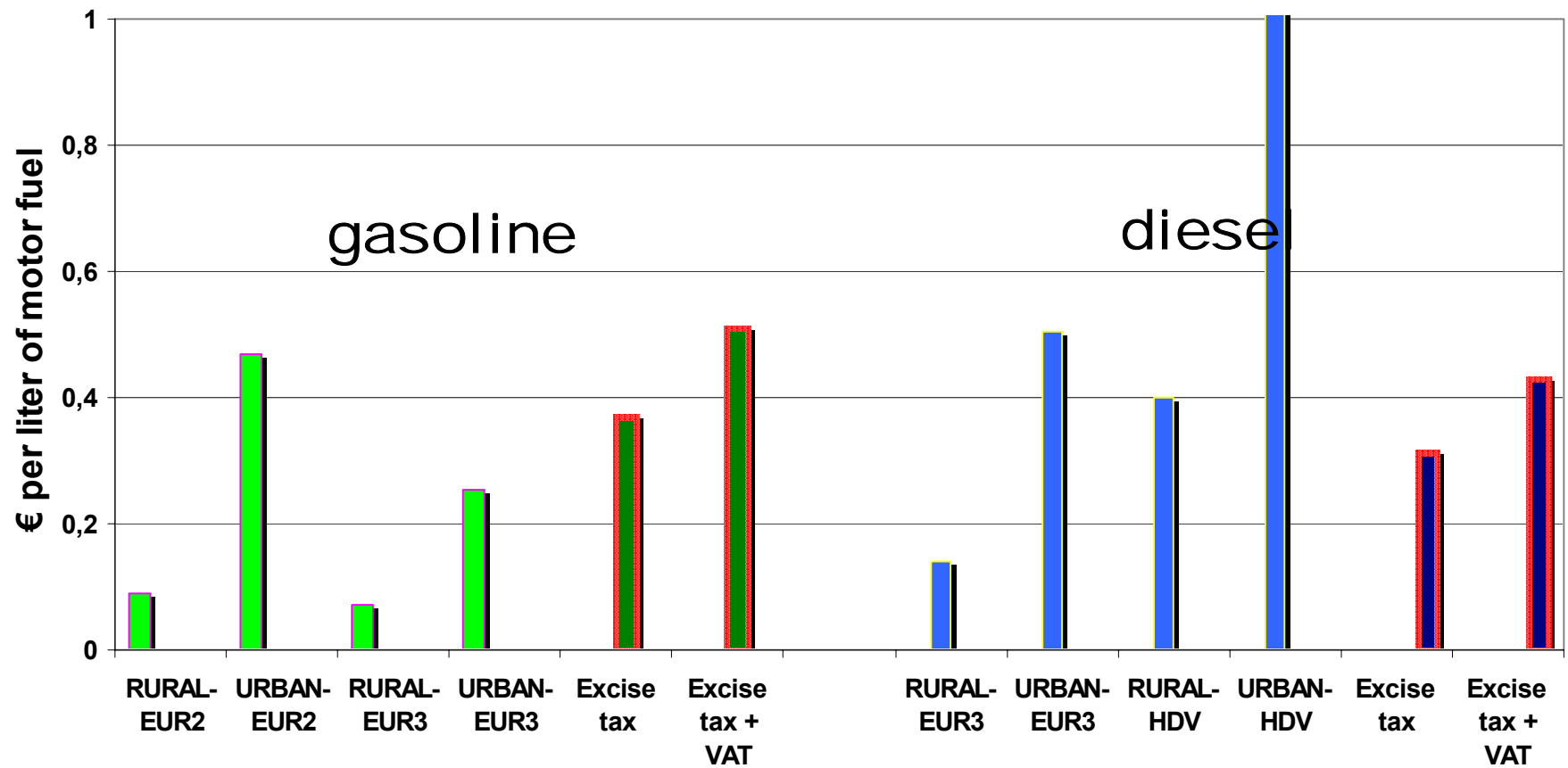
*...energy utilisation matters...*





# TRANSPORT EXTERNALITIES

Externalities and taxes per liter of motor fuel,  
Czech Republic (2004)



# EXTERNALITIES FOR N-FERTILISER PRODUCTION AND USE

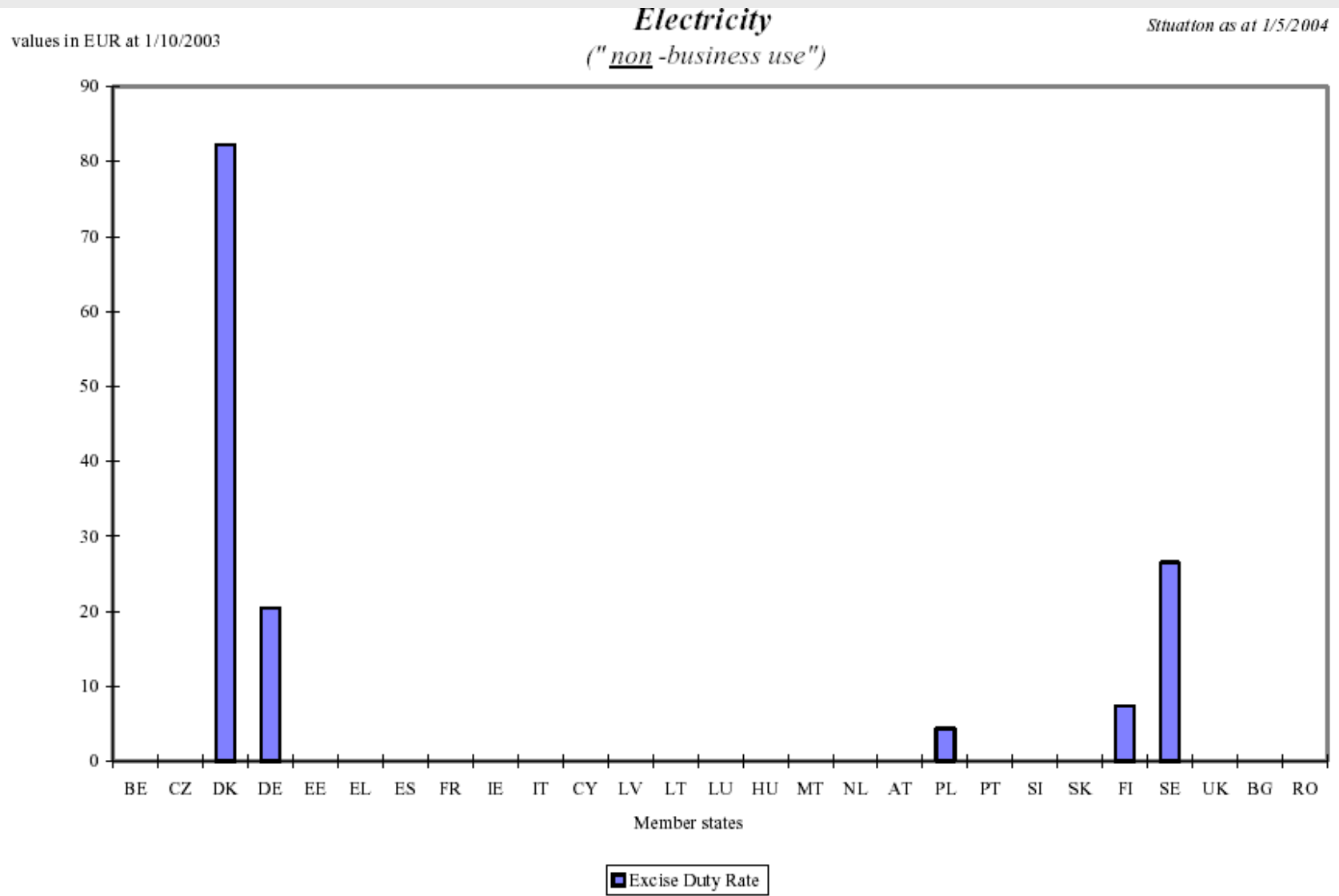
	BULGARIA	CZECH REPUBLIC
<i>N-fertiliser production</i>		
<b>Factory</b>	<b>NEOHIM</b>	<b>LOVOCHEMIE</b>
Air pollution	3.99	3.35
Climate change	13.30	1.80
Bought electricity	0.80	1.12
Sold electricity	-	-0.78
<b>Total</b>	<b>18.10 €/kg<sub>N</sub></b>	<b>5.50 €/kg<sub>N</sub></b>
<i>N-fertiliser application</i>		
Climate change	<b>11.6 €/kg<sub>N</sub></b>	<b>11.6 €/kg<sub>N</sub></b>
<i>Fuel consumption due to N-fertiliser application</i>		
proxy for overall externalities	-	3.50 €/kg <sub>N</sub>
<i>Eutrophication (as estimated by Ari Rabl in WP4 SusTools)</i>		
	cc. 13.0 €/kg <sub>N</sub>	cc. 13.0 €/kg <sub>N</sub>
<i>Health (nitrate mortality)</i>		
		negligible*
<i>Total externality per 1 kg of N-fertiliser</i>		
<b>TOTAL</b>	<b>29.6 €/kg<sub>N</sub></b> <b>43 €/kg<sub>N</sub> (incl. eutrophication)</b>	<b>17.10 €/kg<sub>N</sub></b> <b>30 €/kg<sub>N</sub> (incl. eutrophication)</b>



# POLICY INSTRUMENTS FOR INTERNALISATION in CEEC

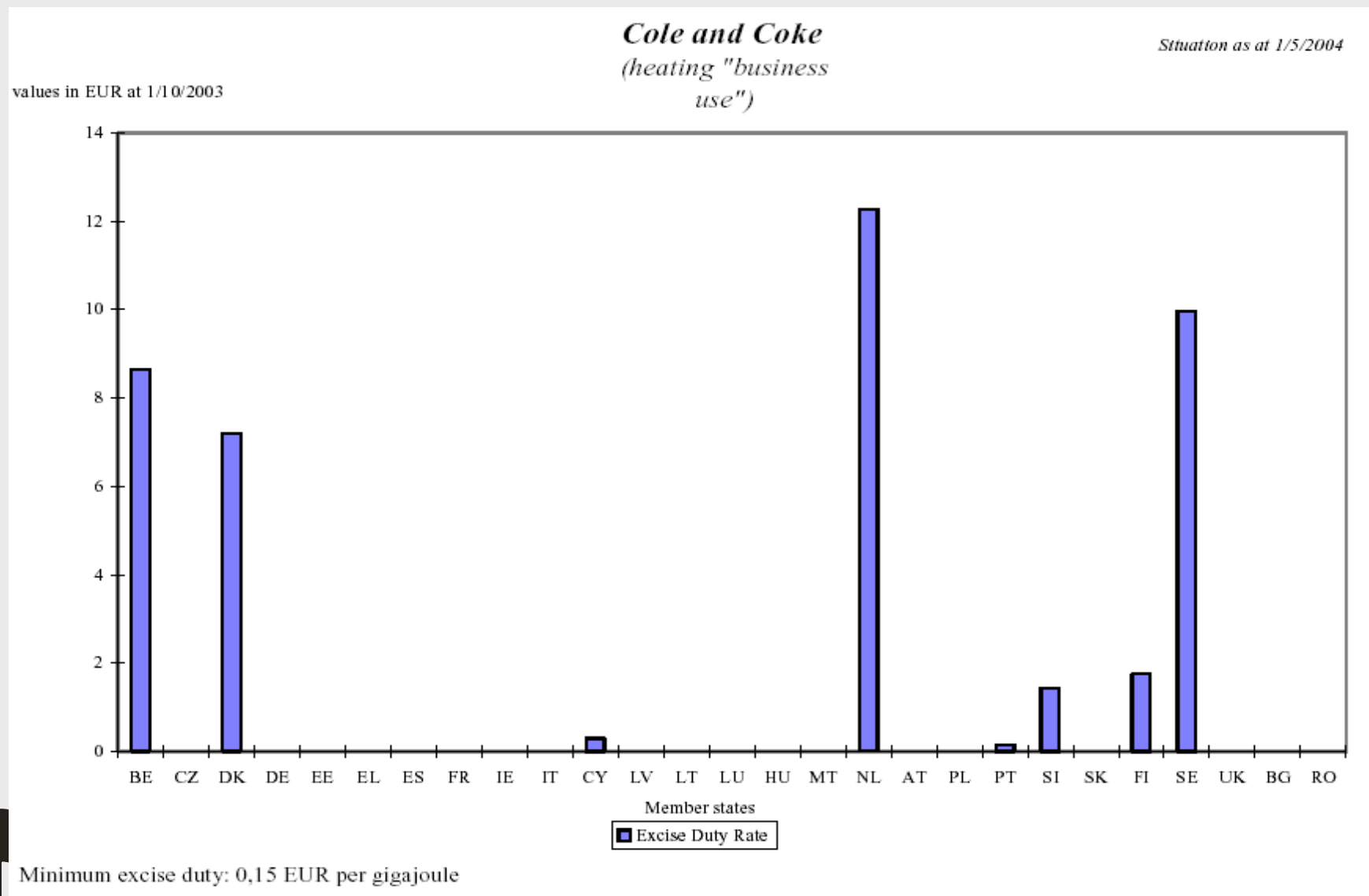
- **command-and-control instruments** are widely relevant
  - standards and limits set out by national laws
  - performance standards required by IPPC & LCP Directives
- **subsidy policy** is mostly used as the main economic instrument in CEEC (public funds, tax rebates/relieves, feed-in-tariffs,...)
- **emission trading**
  - emission ceilings in NAP's for 1st period are pretty far to be strict and effective (even higher than current emission in the Czech Rep.)
- **emission charges**
  - widely implemented in CEEC, however with no effective rate
  - Poland (cc. 80€/t), Czech Rep. (cc. 30 €/t of pollutant)
- **energy taxes**
  - so far only in Slovenia (CO<sub>2</sub>)
  - new taxes are foreseen due to the implementation of 96/2003/EC Directive (however a transitional period for the implementation was provided to almost all of them)
- **environmental tax reform**
  - change in relative prices of production factors (by tax shift, increase relative share of indirect taxation)

# TAXATION ON ELECTRICITY (EU-25)

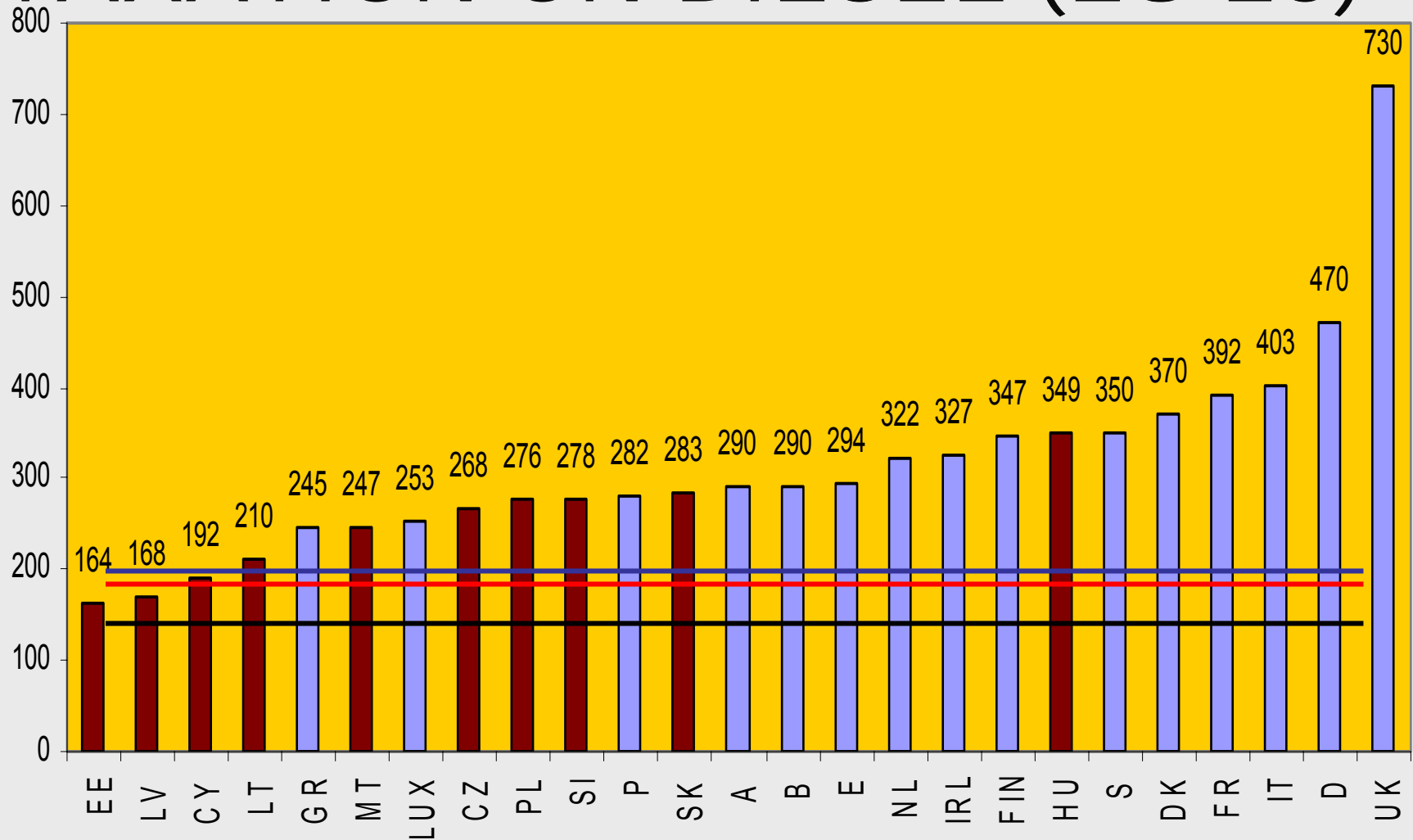


Minimum excise duty: 1,0 EUR per MWh

# TAXATION ON COAL (EU-25)



# TAXATION ON DIESEL (EU-25)



- new min. rate from 2010: 330 €
- min. rate since 01/2003: 302 €
- min. rate set out in 1993: 245 €

- New Member States 05/2004
- EU-15

• rates as in July 2003

# POLICY QUESTIONS

- what is the preference of social planner ? Are the local (national) impacts (e.g. caused by particulates preferred then the regional/global ones (e.g. due to climate change)?
- how the local (national) impacts should be valued if price level significantly differs ?
- what is the uncertainty associated to transfer of values from richer countries to less rich ones ?



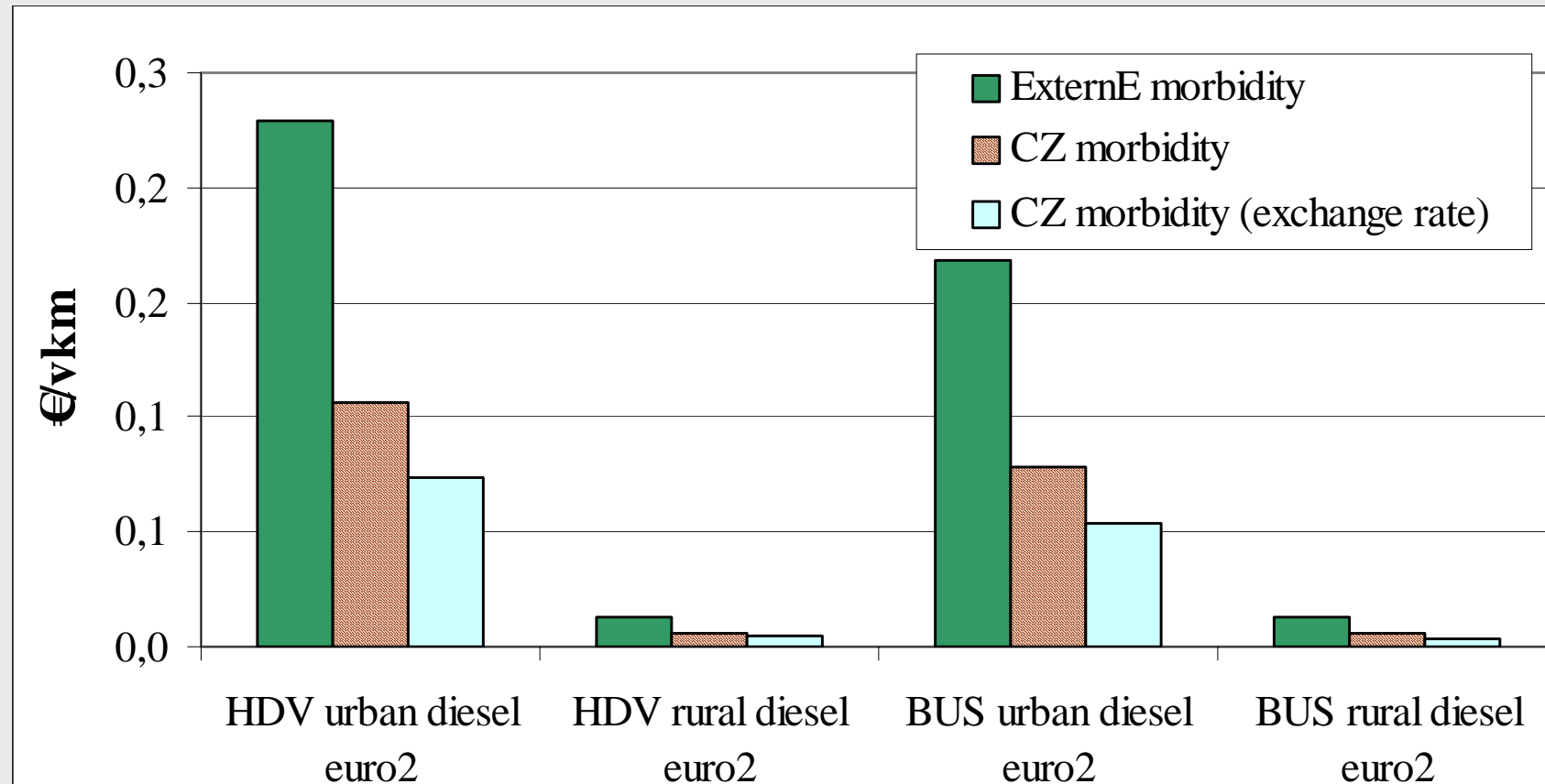
# HEALTH IMPACTS VALUATION

## *SENSITIVE ANALYSIS*

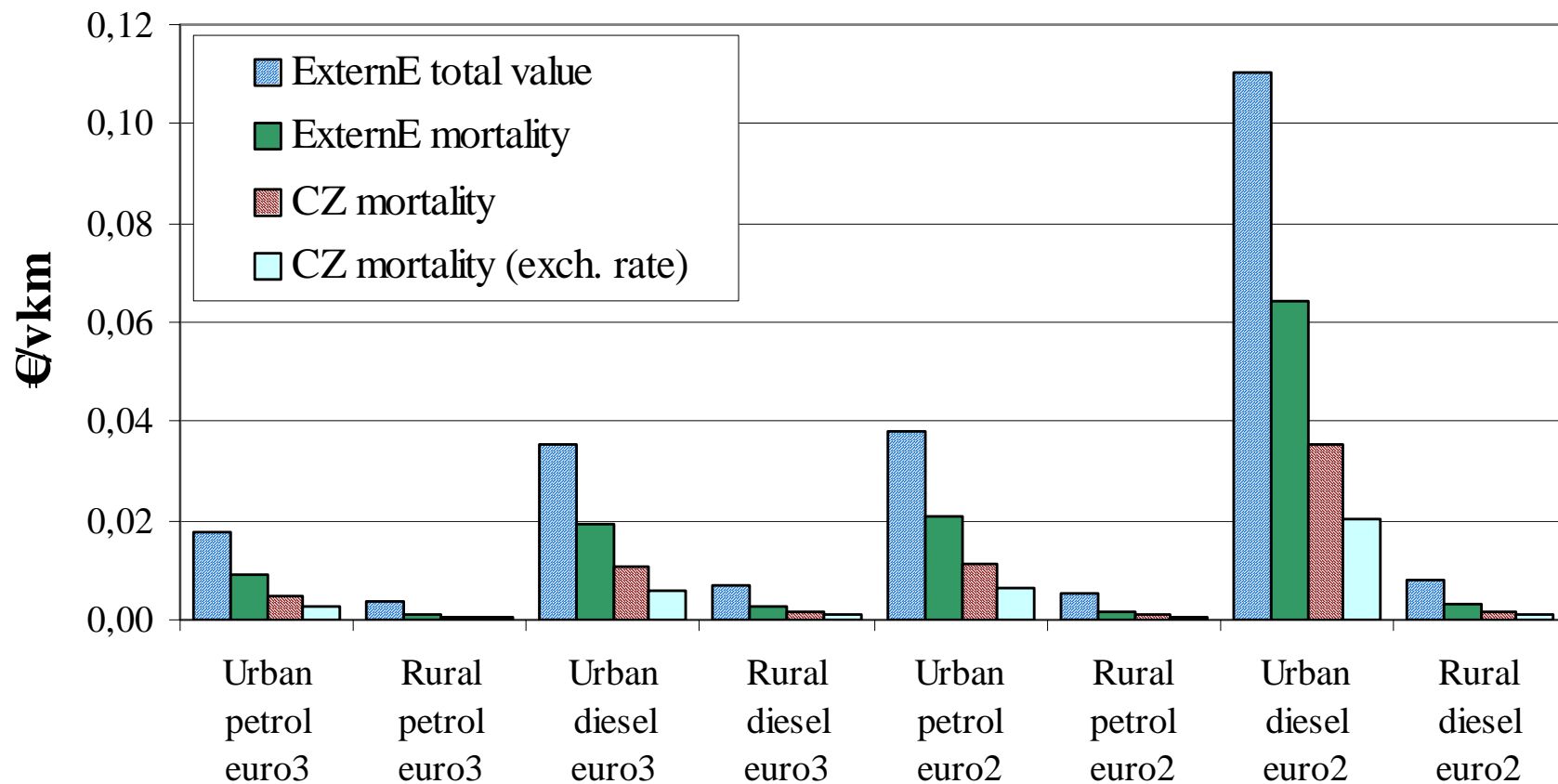
	€ <sub>2000</sub> ExternE	Values for the CZ	
		€ <sub>2000</sub> CZ-val.	€ <sub>2000</sub> GDP ratio exch.rate
Chronic bronchitis (CVM)	169 330	-	54 186
Days with minor restricted activity	45	11	14
Days with restricted activity	110	54	35
Use of bronchodilator	40	-	13
Cough	45	11	14
Hospital admission (respiratory diseases)	4 320	360	1 382
Days with respiratory symptoms	45	11	14
Acute YOLL (3% d.r.)	75 000	41 250	24 000
Chronic YOLL (3% d.r.)	50 000	27 500	16 000



# SENSITIVITY ANALYSIS for MORBIDITY



# SENSITIVITY ANALYSIS for MORTALITY



# FUTURE STEPS

- **calculation of external costs in energy sector**
  - IP NEEDS for 6 CEEC and 3 MPC at three levels (to be decided):
    - micro-scale --- technology assessment
    - CBA --- total costs and welfare of policy measures
    - macro-scale --- green accounting and SD/welfare indicators
    - internalisation strategies
  - National funded projects
    - renewables, nuclear (in Czech Rep.)
- **monetary values related with health impacts for CEEC**
  - mortality (NEEDS, cCASHh, VERHI,...)
  - morbidity effects based on cost-of-illness as well as on CVM
- **new impacts assessed**
  - e.g. forestry, land use
- need for **testing transferability** of CRFs and monetary values

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