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ExternE

‚ExternE : Methodology and Results‘

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www.ExternE .info

External Costs Definition

An external cost arises, when the social or economic activities of one group of persons have an impact on another group and when that impact is not fully accounted, or compensated for, by the first group.

Aim of the ExternE methodology: = helps to take into account all externalities in a consistent way when making decisions

- *Investment decisions*
- *Technology assessment (subsidies, research support)*
- *Consumer decisions (e.g. by adjusting prices)*
- *Cost-benefit analyses, esp. for environmental and health regulation*
- *Green accounting*

Basic principles

1) Assessment or weighting of effects should as far as possible be carried out using quantitative figures and functions

   ->ensures transparency and reproducibility

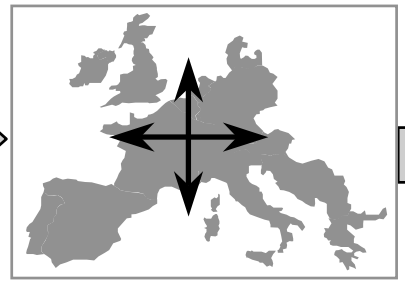
2) Assessment of effects/damage (e.g. health risk), not of pressures (e.g. emissions of pollutants)

-> relation between pressure and effect is in general non-linear and
->effects depend on time and site of activity
-> -> *Bottom-up approach needed for the complex pathways: the 'impact pathway approach'*

Impact Pathway Approach – Part 1

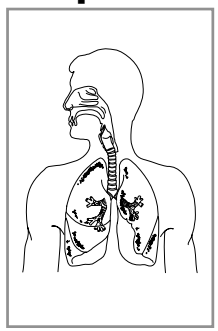
Pollutant/Noise Emission

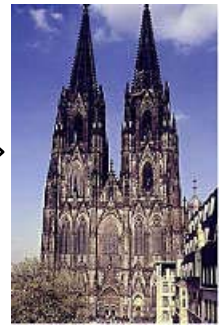
Transport and Chemical Transformation; Noise Propagation



Calculation is made twice: with and without project!

Differences of Physical Impacts





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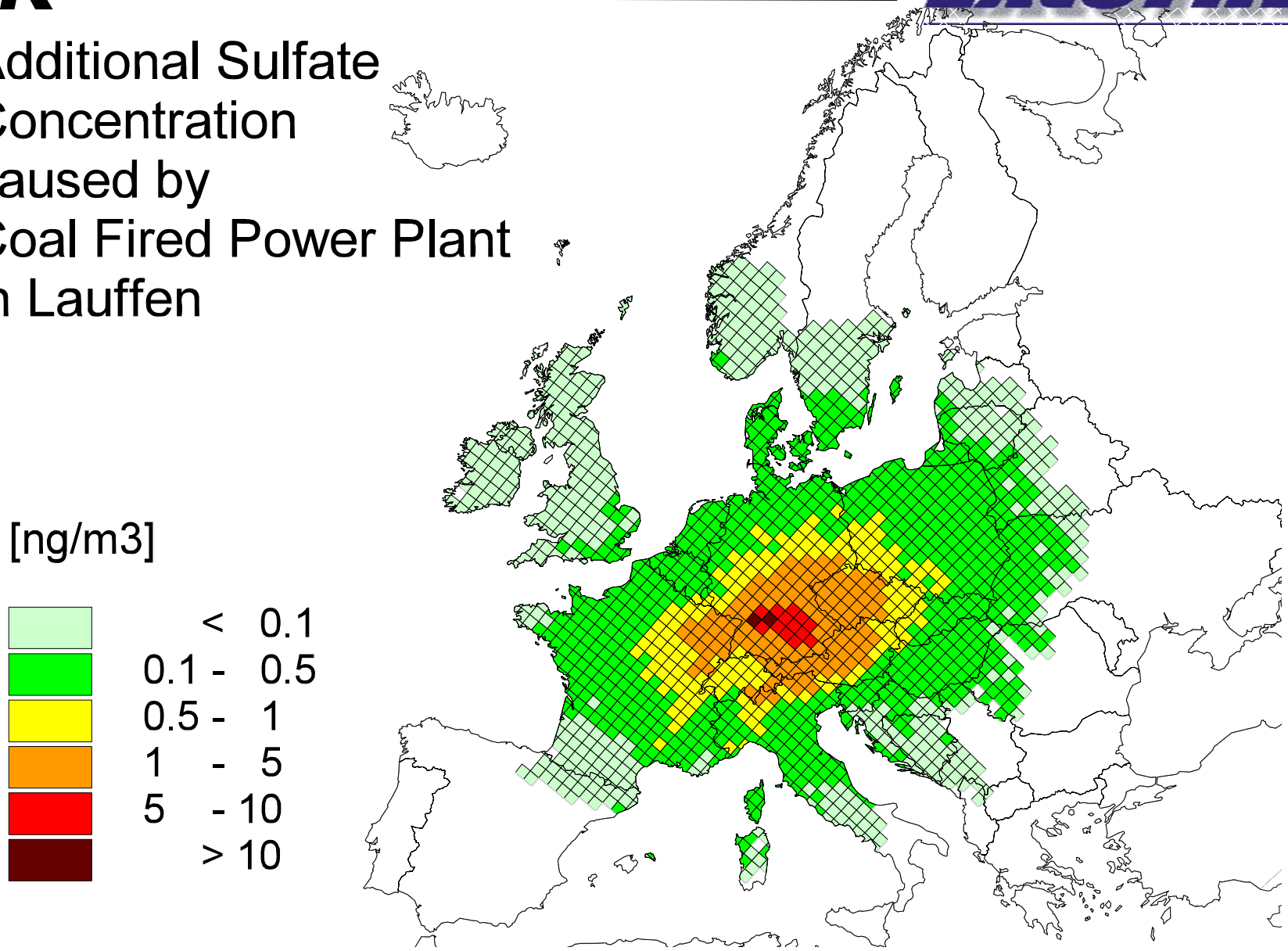
Additional Sulfate Concentration caused by Coal Fired Power Plant in Lauffen



Quantification of Impacts and Costs

Exposure Response Function:

Additional Years of Life Lost

$$= 3.9 \cdot 10^{-5} \cdot \Delta Sulfate \cdot Population$$

Quantified number of additional Years of Life Lost due to one year operation : 103

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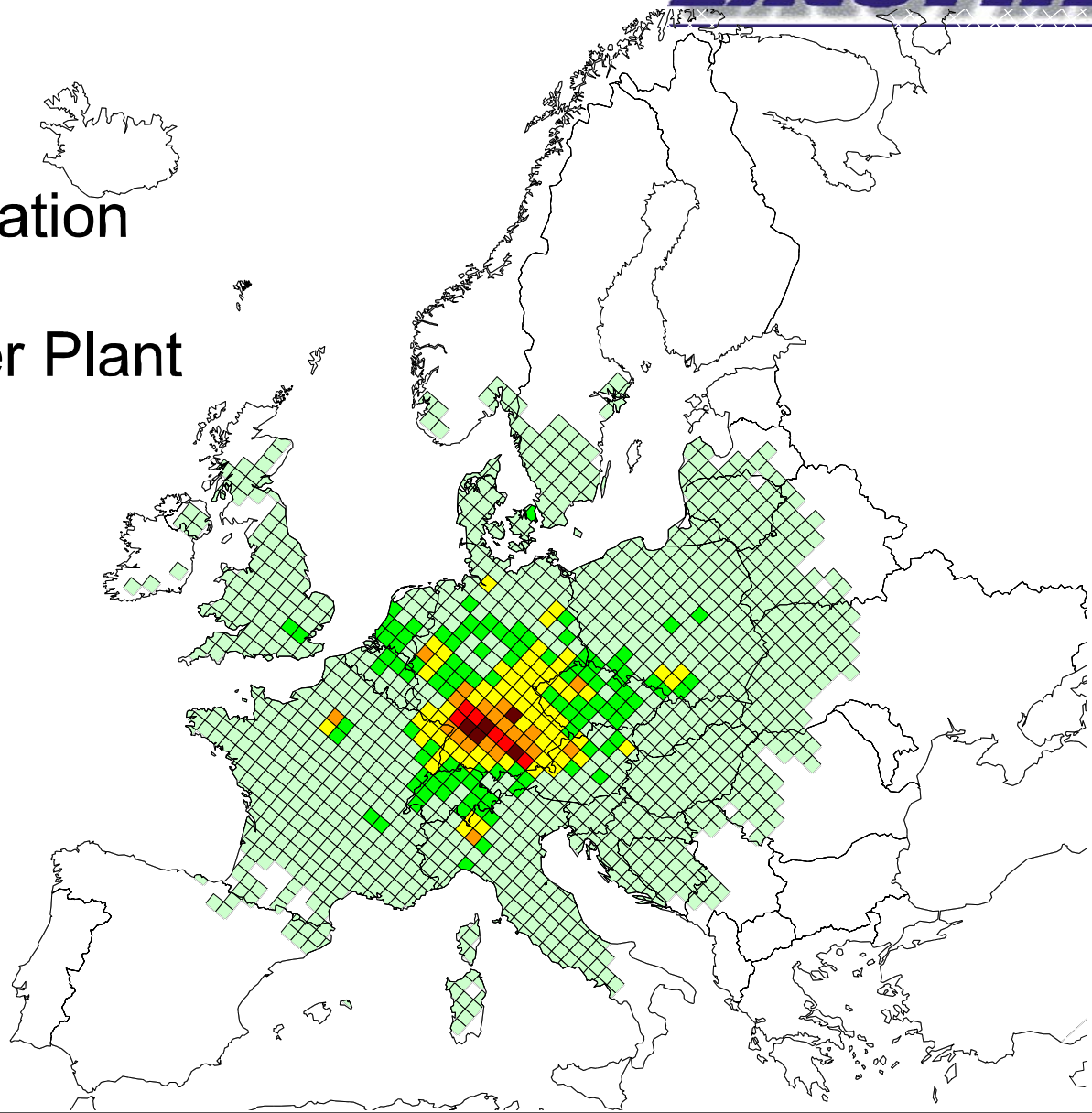
ExternE

Life Time Lost caused by Sulfate concentration due to Coal Fired Power Plant in Lauffen



Impacts included (I)

Impact Cat.	Pollutant / Burden	Effects
Human Health mortality	PM_{10}	Reduction in life expectancy due to short and long time exposure
	SO_2, O_3	Reduction in life expectancy due to short time exposure
	Benzene, BaP, 1,3-butad., Diesel part.	Reduction in life expectancy due to long time exposure
	Noise	Reduction in life expectancy due to long time exposure
	Accident risk	Fatality risk from traffic and workplace accidents
Human Health morbidity	PM_{10}, O_3, SO_2	Respiratory hospital admissions
	PM_{10}, O_3	Restricted activity days
	PM_{10}, CO	Congestive heart failure
	Benzene, BaP, 1,3-butad., Diesel part.	Cancer risk (non-fatal)
	PM_{10}	Cerebrovascular hospital admissions, cases of chronic bronchitis, cases of chronic cough in children, cough in asthmatics, lower respiratory symptoms
	O_3	Asthma attacks, symptom days
	Noise	Myocardial infarction, angina pectoris, hypertension, sleep disturbance
	Accident risk	Risk of injuries from traffic and workplace accidents

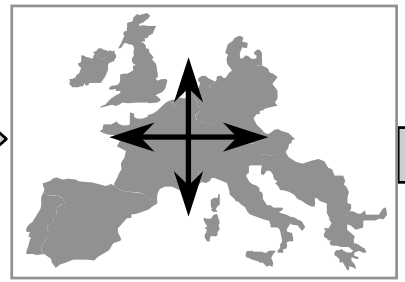
Impacts included (II)

Impact Category	Pollutant / Burden	Effects
Building Material	SO_2, Acid deposition	Ageing of galvanised steel, limestone, mortar, sand-stone, paint, rendering, and zinc for utilitarian buildings
	Combustion particles	Soiling of buildings
Crops	SO_2	Yield change for wheat, barley, rye, oats, potato, sugar beet
	O_3	Yield change for wheat, barley, rye, oats, potato, rice, tobacco, sunflower seed
	Acid deposition	Increased need for liming
	N, S	Fertilising effects
Global Warming	CO_2, CH_4, N_2O	World-wide effects on mortality, morbidity, coastal impacts, agriculture, energy demand, and economic impacts due to temperature change and sea level rise
Amenity losses	Noise	Amenity losses due to noise exposure
Ecosystems	SO_2, NO_x, NH_3	Eutrophication, Acidification

Impact Pathway Approach – Part 1

Pollutant/Noise Emission

Transport and Chemical Transformation; Noise Propagation



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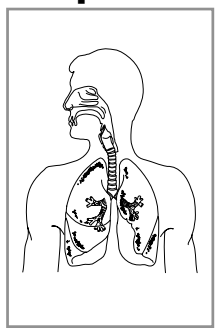

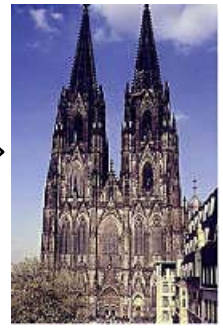

Basic Approach of ExternE

Assessment of impacts is based on the (measured) preferences of the affected well-informed population

This implies:

- **Available information should be explained before measuring preferences**

Basic Approach

Preferences are expressed in, i. e. effects are transformed into monetary units ($€_{2005}$)

->allows transfer of values, units are conceivable, direct use of results in CBA and for internalising via taxes possible

-> however: 'utility points' would give the same results

Impact Pathway Approach

Pollutant/Noise Emission

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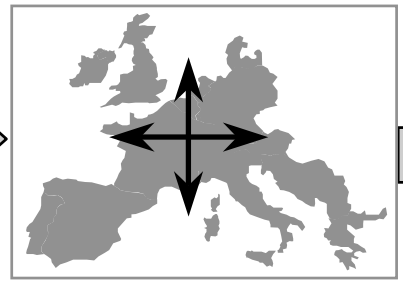

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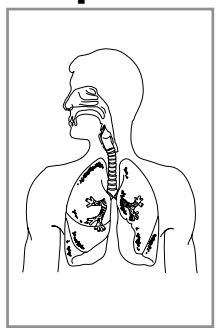

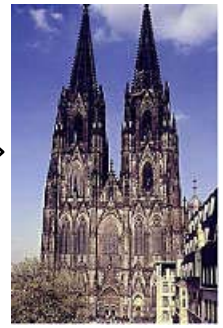

Monetary Valuation

Valuation methods for non-market goods

Revealed Preference (RP)
behaviour (shown in the past)

Stated Preference (SP)
surveys

Indirect valuation

assesses costs or efforts that can be linked to the non-market good

- **Hedonic Price Method**
- **Averting Behavior Method**
- **Travel Cost Method**
- **Contingent Behavior Method**
- **Past behaviour of public decision makers**

Direct valuation

- **Contingent Valuation Method (CVM)**
- **Attribute Based Choice Modeling (ABCM)**
- **Participatory approaches**
- **Surveys for preferences of public decision makers**

Monetary Valuation

Health end-point	Recommended central unit values in € price year 2000
Value of a prevented Fatality	1,000,000
Year of Life Lost	50,000 / year lost
Hospital admissions	2,000 / admission
Emergency Room Visit for respiratory illness	670 / visit
General Practicioner visits:	
Asthma	53 / consultation
Lower respiratory symptoms	75 / consultation
Respiratory symptoms in asthmatics:	
Adults	130 / event
Children	280 / event
Respiratory medication use – adults and children	1 / day
Restricted activity days	130 / day
Cough day	38 / day
Symptom day	38 / day
Work loss day	82 / day
Minor restricted activity day	38 / day
Chronic bronchitis	190,000 / case

Quantification of Impacts and Costs

Exposure Response Function:

Additional Years of Life Lost

$$= 3.9 \cdot 10^{-5} \cdot \Delta Sulfate \cdot Population$$

Quantified number of additional Years of Life Lost due to one year operation : 103

Monetary value

50 000 $Euro_{2000}$ per Year of Life Lost

Damage costs per year:

5.1 Million $Euro_{2000}$

Some exemplary results of applying the ExternE tools:

The results of the ExternE research are the functions and tools that can be applied to answer individual questions!

Results of applying the tools depend on scenario, site, time and technology!

Some exemplary results of applying the ExternE tools:

Possibly important effects that are not (yet) included:

Visual intrusion

Biodiversity losses (eutrophication and acidification), however new method developed within the NEEDS project

Biodiversity loss (local, however included in Environmental Impact Study)

Risk of nuclear proliferation and terrorism

Risk aversion resp. treatment of Damocles risks

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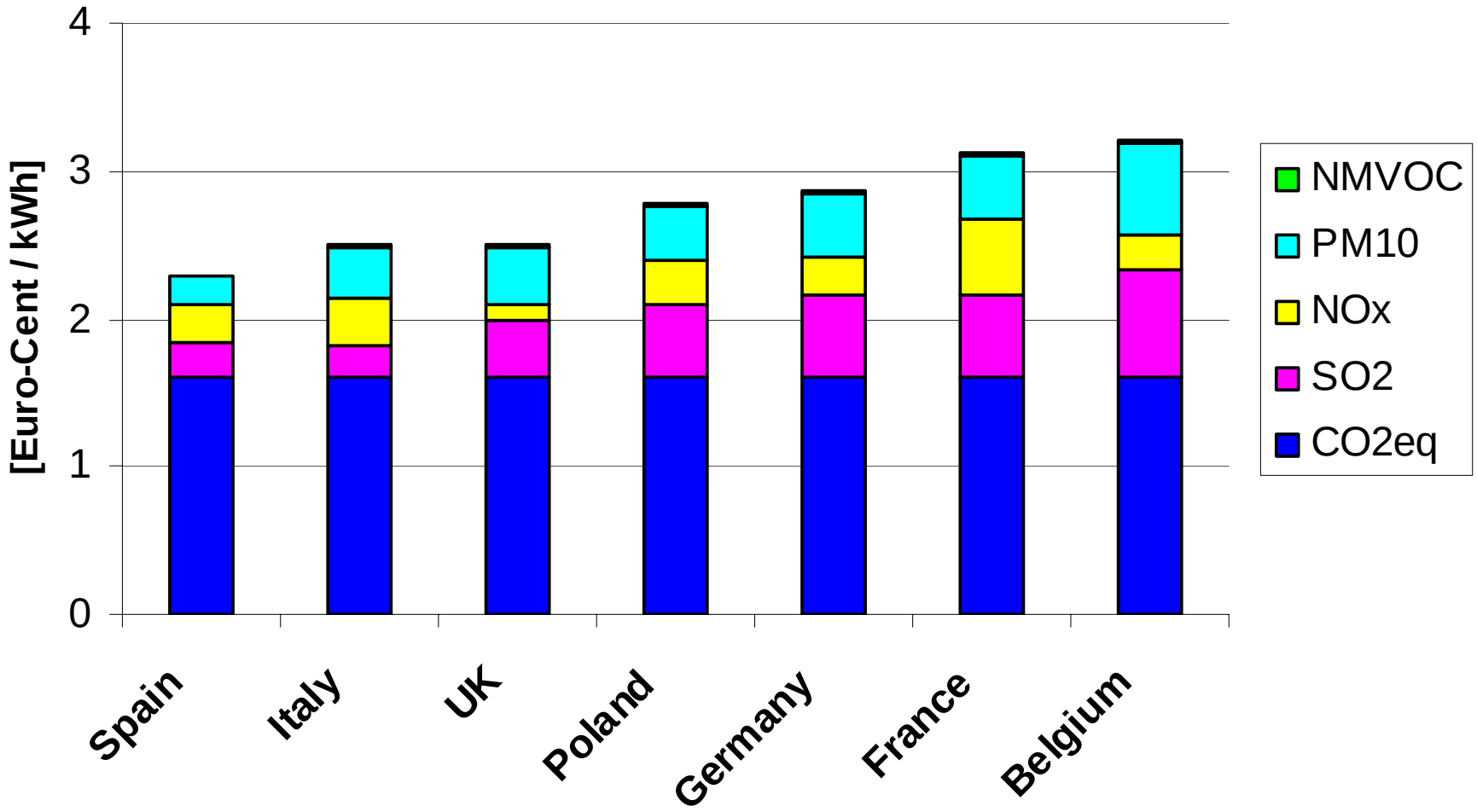
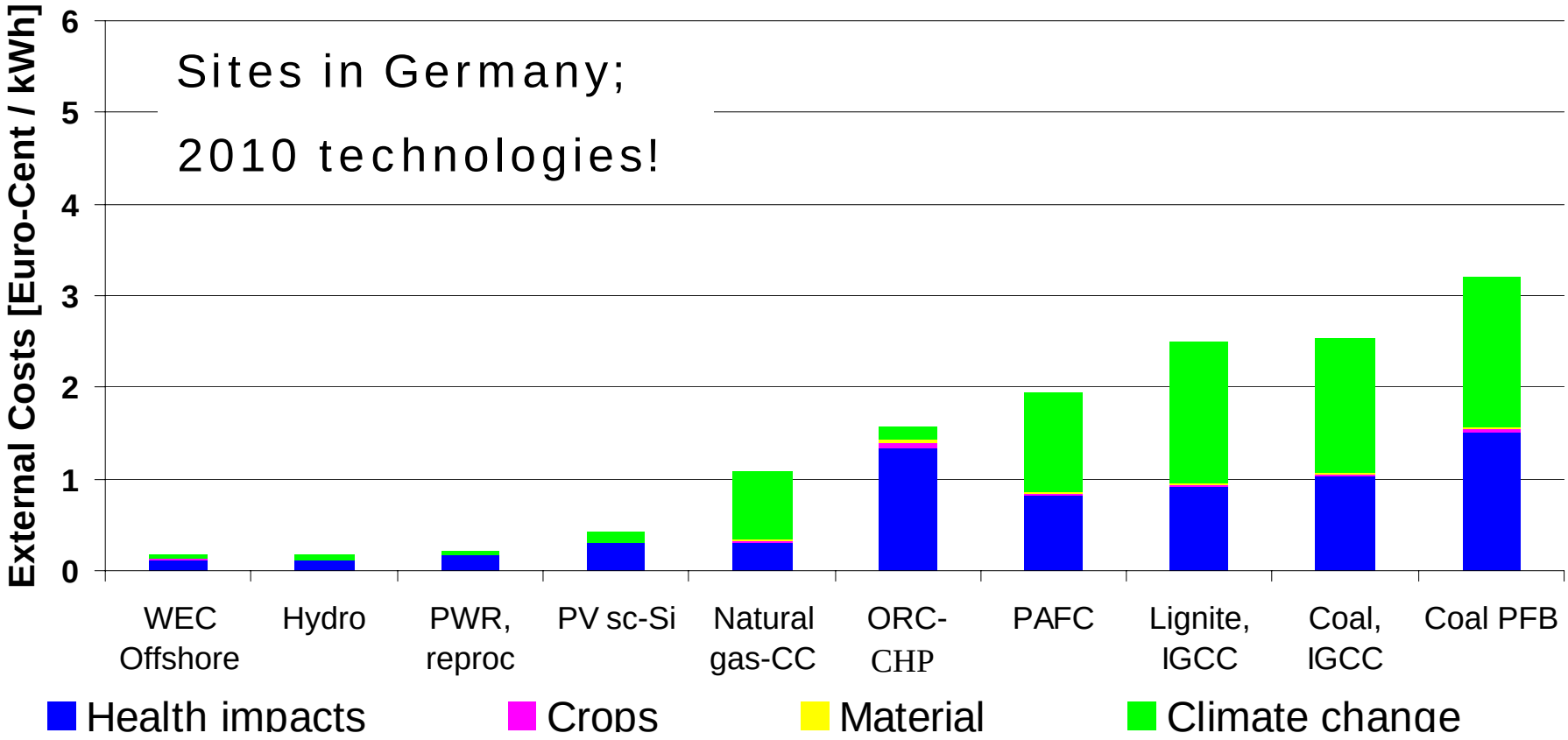
Quantified External Costs [Euro-Cent / kWh] of a Coal Fired Power Station (steam turbine)



External Costs of Power Stations [Euro-Cent / kWh]

19 Euro/t CO2, Nitrates = 0.5 PM10, $YOLL_{chronic}$ = 50.000 Euro



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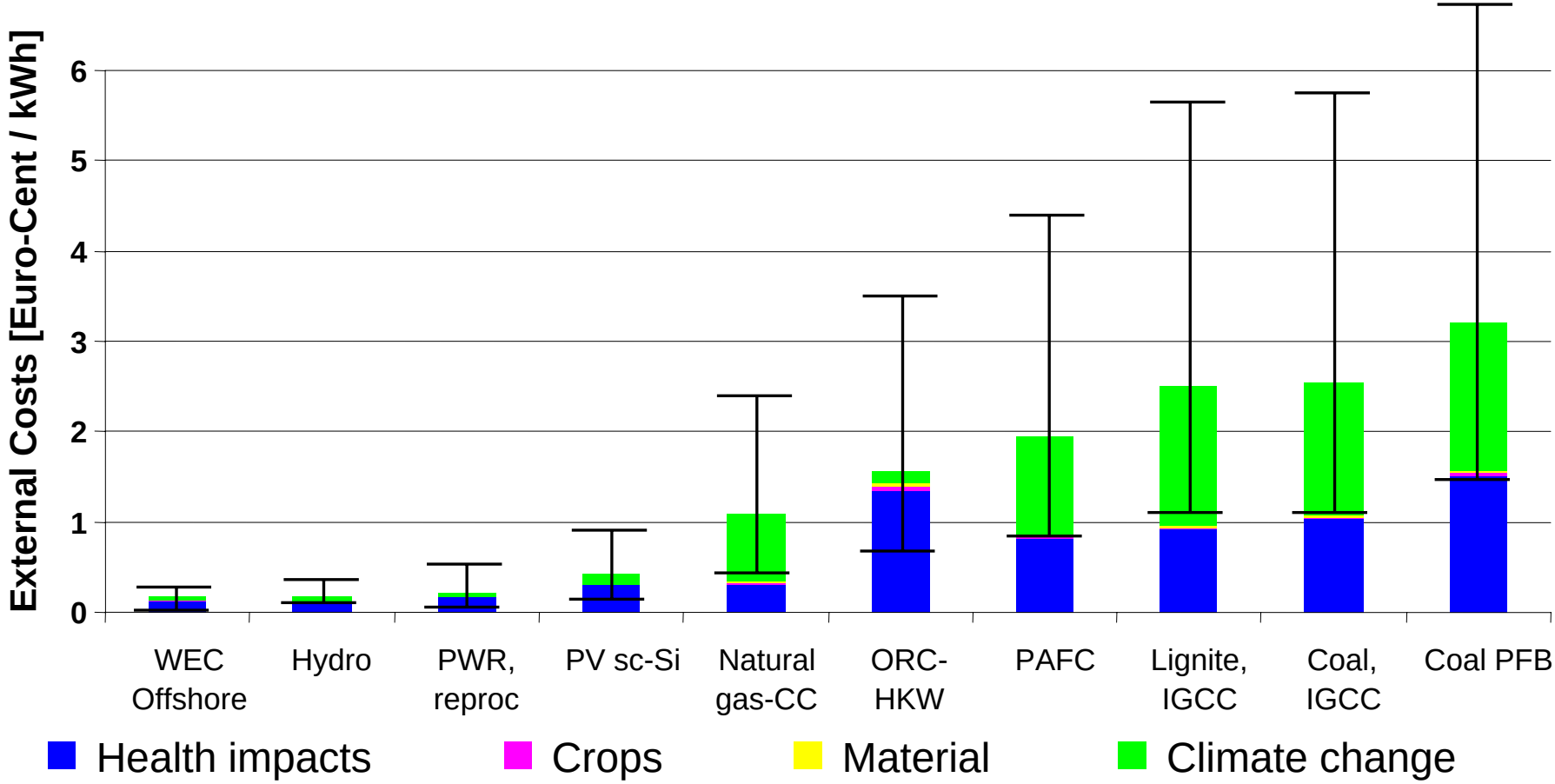
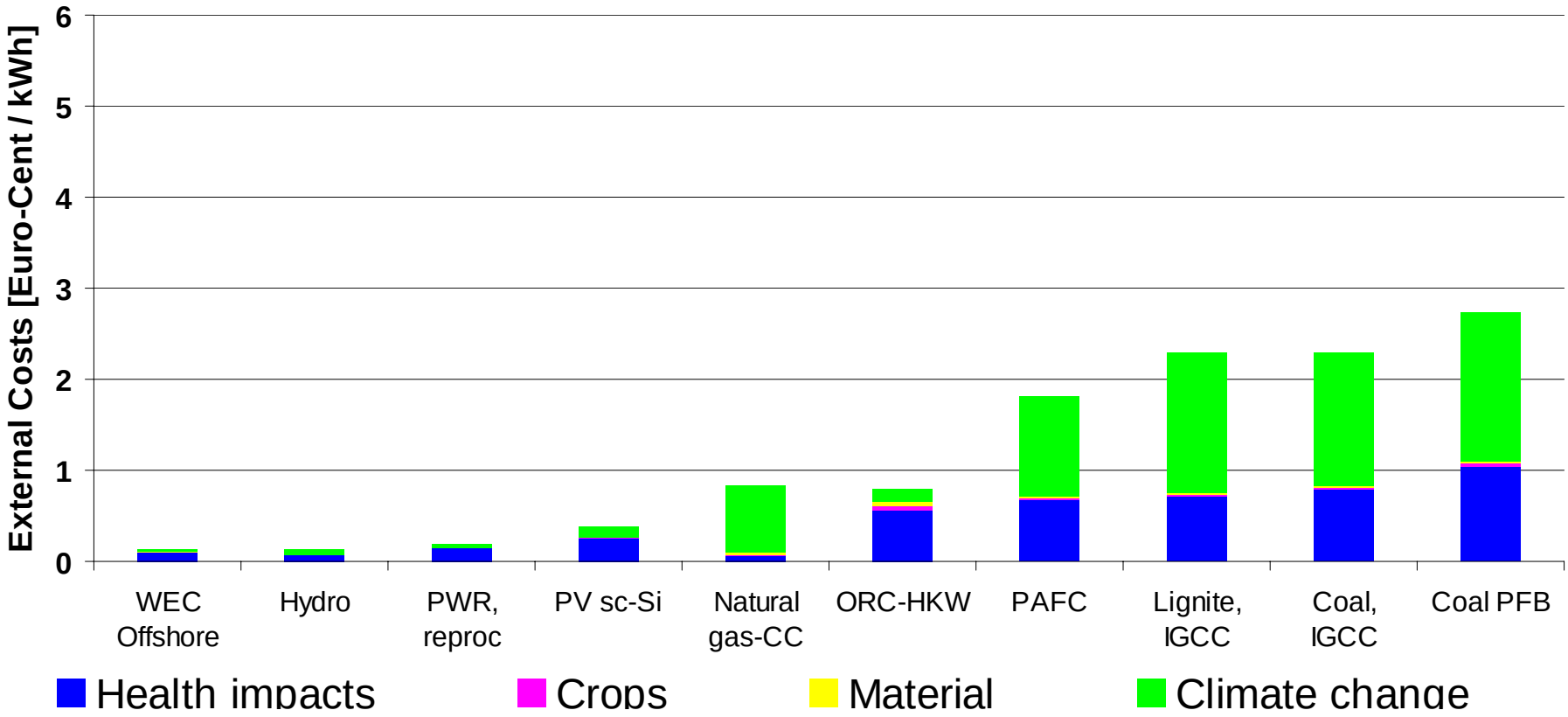


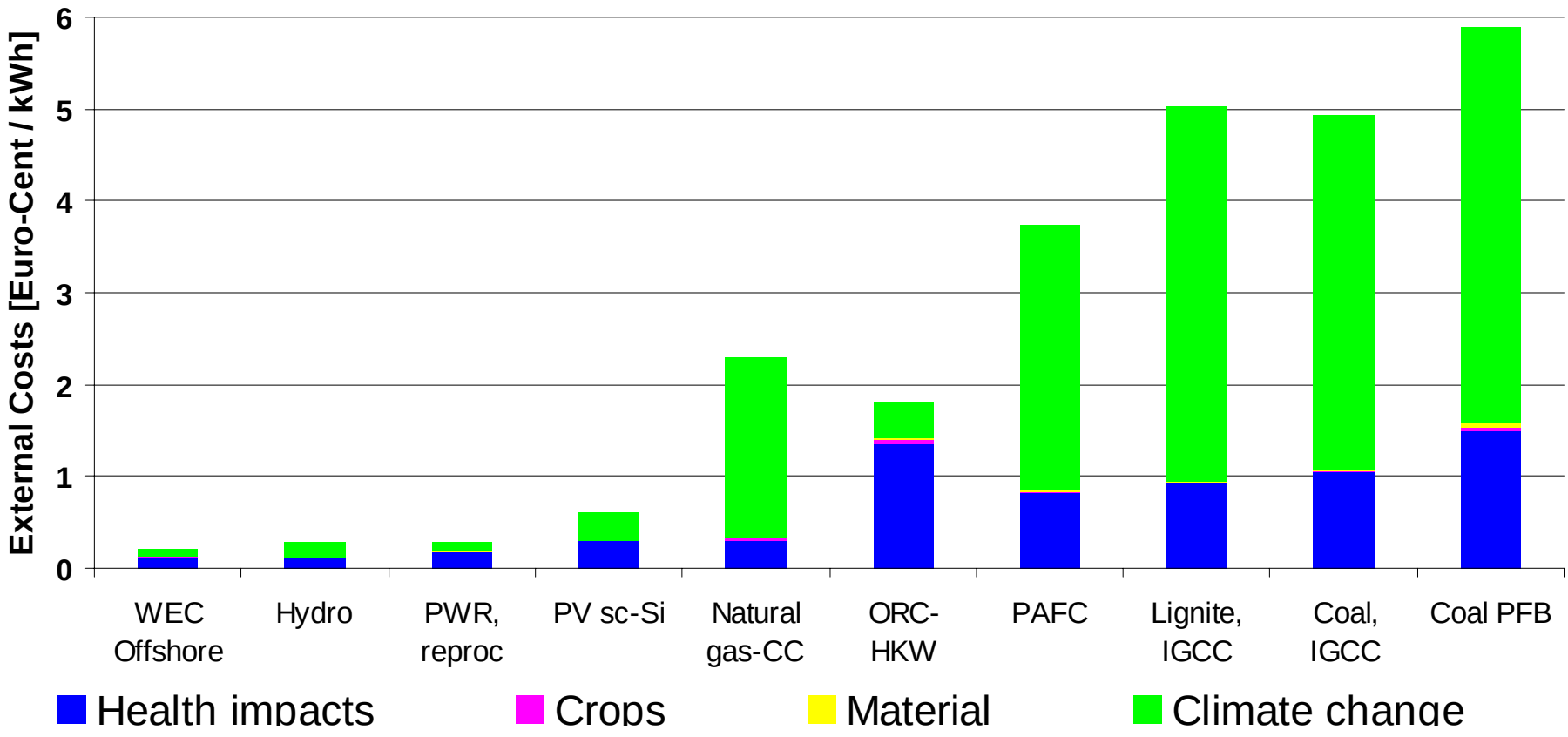
External Costs of Power Stations [Euro-Cent / kWh]

Sc: Nitrates have no impact to human health



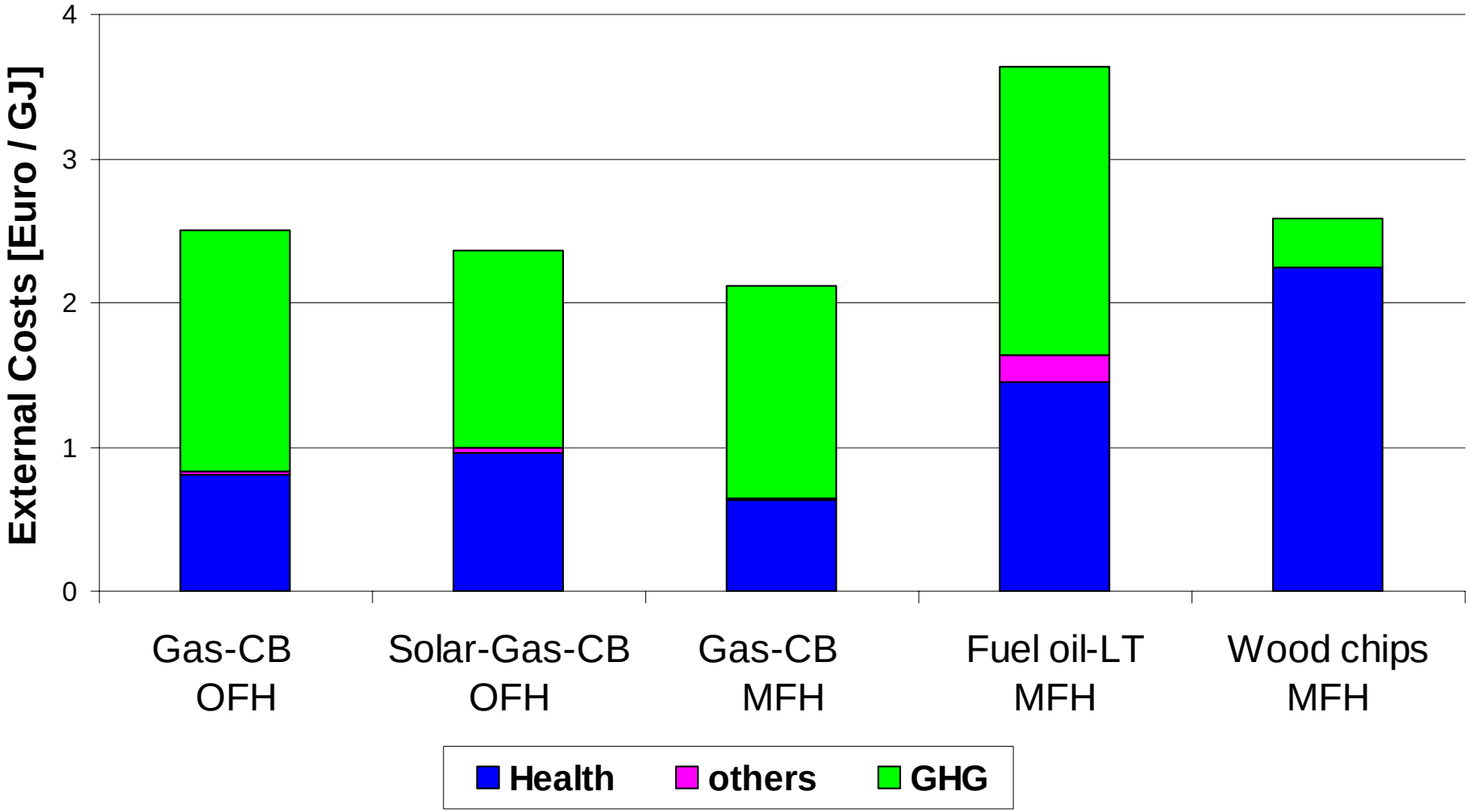
External Costs of Power Stations [Euro-Cent / kWh]

Sc: 50 Euro/t CO2



Quantification of Externalities of Heat Supply

CB = condensing boiler, MFH = multi family house, OFM = one family house



Human Health Effects due to Electricity Production in the EU25 Countries

Substance	Years of Life Lost	Damage Costs (Million Euro$_{2000}$)
PM 10 (primary and secondary)	474 000	35 300
03 and SO2	11 000	430
Total (rounded)	**480 000**	**36 000**

Summary

- **The ExternE methodology estimates effects of technologies for energy conversion and assesses them based on preferences of the affected population for a large number of impact pathways.**
- **The methodology is already widely used for decision aid in the fields of energy conversion, transport and environmental protection.**
- **Gaps and uncertainties exist, however will be more and more reduced due to ongoing research (e.g. on pathways involving toxic substances, heavy metals, biodiversity, water and soil contamination…)**
- **More information on the ExternE website:**

  www.ExternE.info