7th Framework Programme

Polish-German Energy Brokerage Event

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Scientific Multidisciplinary "think-tank“

Assessment of Environmental Damages of Different Technologies

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Presentation Outline

1. What is the department IER – TFU ?
2. What kind of collaboration are we looking for - What can IER offer?
3. What are and How to calculate external costs?
   → Impact Pathway Approach (IPA)
   implemented in EcoSenseWeb computer tool
4. EcoSenseWeb computer tool
5. External costs [Euro-Cent per kWh]
6. Summary

Department of Technology Assessment and Environment (TFU)

The department TFU is particularly concerned with following subjects:

- **Assessment of external costs, especially for energy and transport systems**
- **Determination of strategies to achieve an efficient protection of the environment and human health based on the concept of welfare optimisation and sustainable development**
- **Sustainable use of non renewable resources**
- **Generation of emission inventories for air pollutants**
- **Identification of efficient air pollution control strategies**
- **Analysis and assessment of ecopolitical instruments.**

Collaboration in FP7

We like to contribute to a project where potential improvements of technologies or changes of policies have to be evaluated with regard to environmental performance.

For example, possible trade-offs or synergies in change of emissions of classical pollutants (SO2, NOx, PPM, etc), other pollutants and pressures, and greenhouse gases can be evaluated.

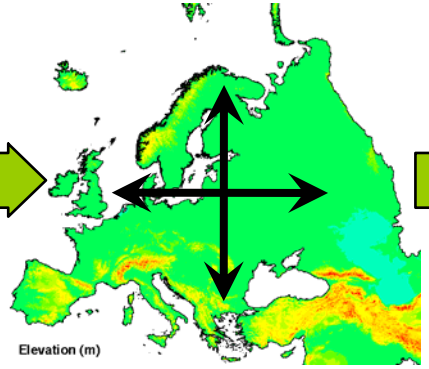
Environmental characteristics can be summarized to external costs. These can be applied in cost-benefit analysis.

The need of proving the environmental performance is stated in several Topics and especially in Topic ENERGY 2009.9.2.1.

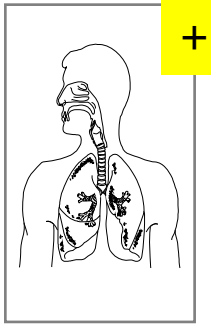
External costs - Impact Pathway Approach (IPA)

Emissions

Transport and Chemical Transformation



Impacts



+ Human health

Monetary Evaluation

+ Building materials

+ Climate Change

+ Crops

+ Ecosystem

Online Computer Tool for Calculating Damages According to the IPA

http://EcoSenseWeb.ier.uni-stuttgart.de

EcoSenseWeb

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OVERVIEW | STRUCTURE | EXAMPLE | I/O DATA | HOW TO GET

OVERVIEW

EcoSenseWeb is an integrated atmospheric dispersion and exposure assessment model which implements the Impact Pathway Approach developed within ExternE . It was designed for the analysis of single point sources (electricity and heat production) in Europe but it can also be used for analysis of multi emission sources in certain regions. EcoSense was developed to support the assessment of priority impacts resulting from the exposure to airborne pollutants, namely impacts on human health, crops, building materials and ecosystems. The current version of EcoSenseWeb, covers the emission of 'classical' pollutants SO2, NOx, primary particulates, NMVOC, NH3, as well as some of the most important heavy metals. It includes also damage assessment due to emission of greenhouse gases. Impacts of 'classical' pollutants are calculated on different spatial scales, i.e. local (50 km around the emission source), regional (Europe-wide) and (northern) hemispheric scale.
The version EcoSenseWeb has a web-based user interface and was developed within the European Commission projects NEEDS and CASES.

The EcoSenseWeb and the calculation of external costs follow as far as possible the so called Impact Pathway Approach (IPA). The IPA, a bottom-up approach, is depicted in Figure 1. The IPA starts with the emission of a pollutant at the location of the source into the environment; models its dispersion and chemical transformation in the different environmental media; identifies the exposure of the receptors and calculates the related impacts which then are aggregated to external costs.

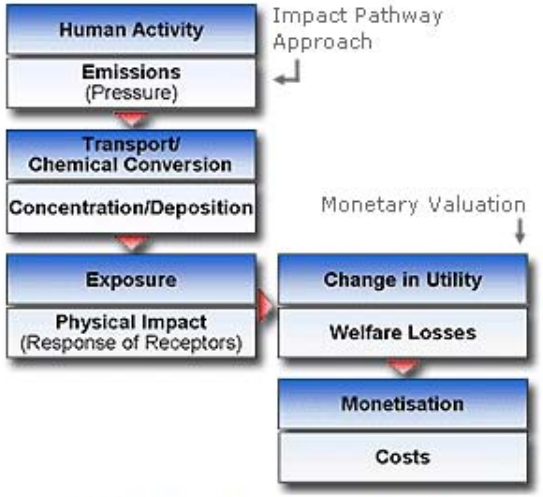


Fig. 1: Impact Pathway Approach.

From dust, SO_2, NH_3, NO_x & NMVOC emission to air via dispersion and chemical transformation to delta ! concentration and deposition of:

Fine primary particles with diameter below 2.5 µm and up to 10 µm
Secondary **I**norganic **A**erosols (SIA) - ammonium nitrate and sulphate particles
Dry and wet deposition of oxidized and reduced nitrogen and of sulphur
Ozone (SOMO35: sum over means of 35 ppb)

Further substances also included:
Greenhouse gases, POPs, dioxins, radionuclides and heavy metals.

Quantification of Impacts and Costs

relation between pressure and impact

Concentration Response Function (CRF):

Example: Additional **Y**ears **o**f **L**ife **L**ost due to fine dust

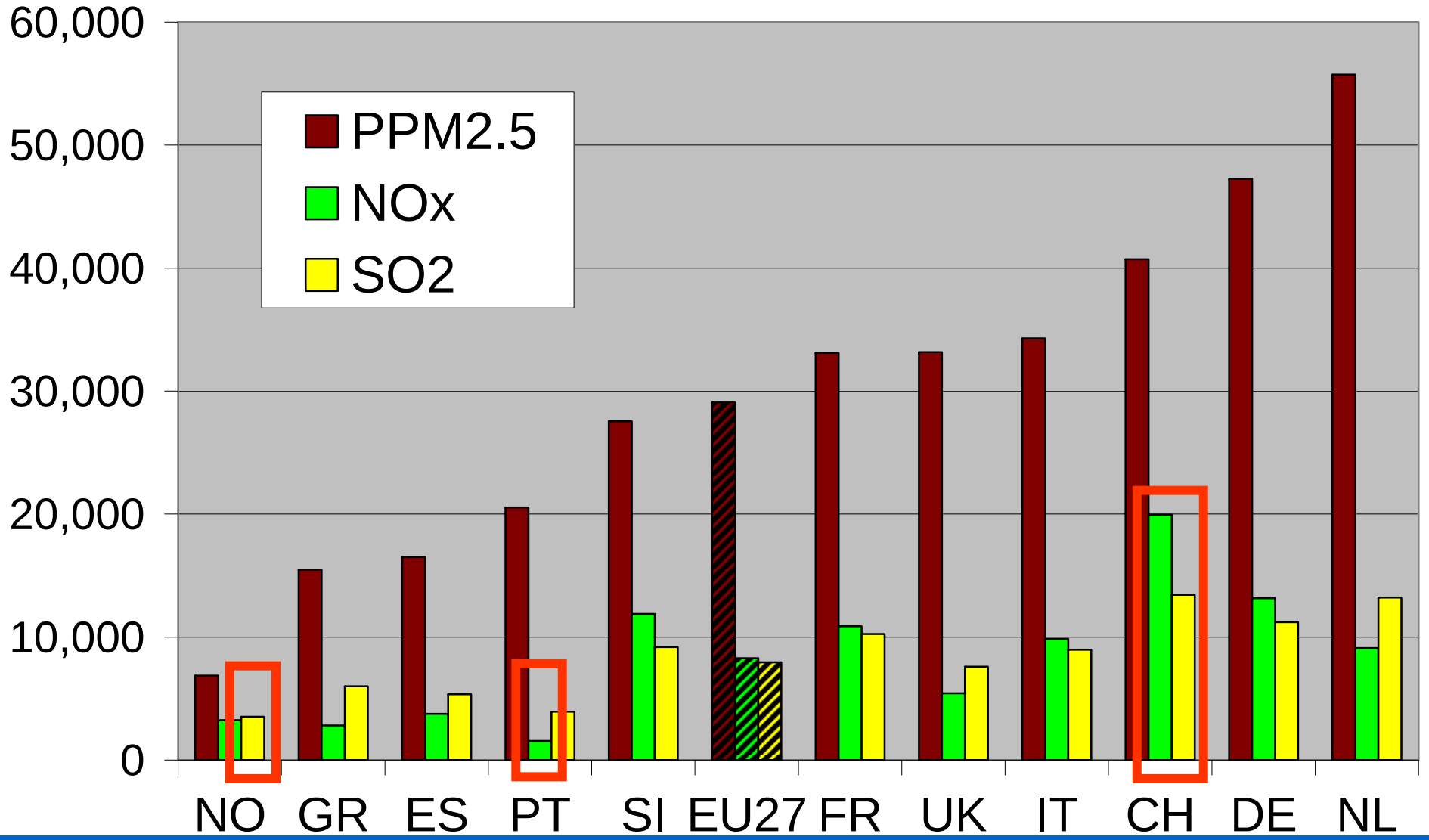
$$= 6.5 \cdot 10^{-5} \cdot \Delta\text{conc. PPM2.5} \cdot \textit{Population}$$

Emission of fine dust PPM2.5 emitted in Europe leads to a range of ca. 0.01 to 15 life years lost per tonne.

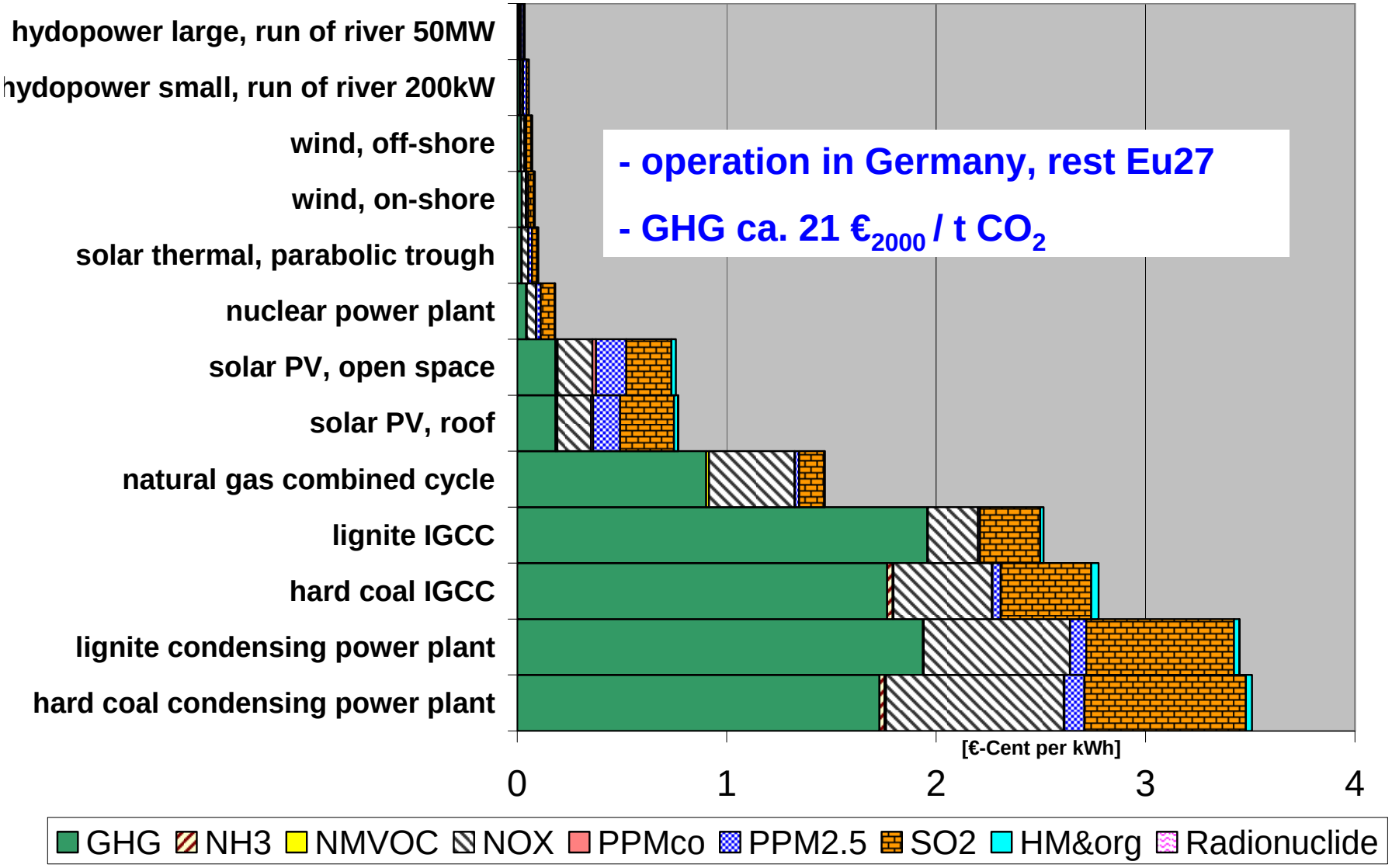
Quantification of Damage – Willingness to pay to avoid risk of…

Health end-points	Euro per case / per YOLL
Increased mortality risk (infants)	3,000,000
New cases of chronic bronchitis	200,000
Increased mortality risk - YOLLacute	60,000
Life expectancy reduction - YOLLchronic	40,000
Respiratory hospital admissions	2,000
Cardiac hospital admissions	2,000
Work loss days (WLD)	295
netto Restricted activity days (netRADs)	130
Minor restricted activity days (MRAD)	38
Lower respiratory symptoms	38
LRS excluding cough	38
Cough days	38
Medication use / bronchodilator use	1

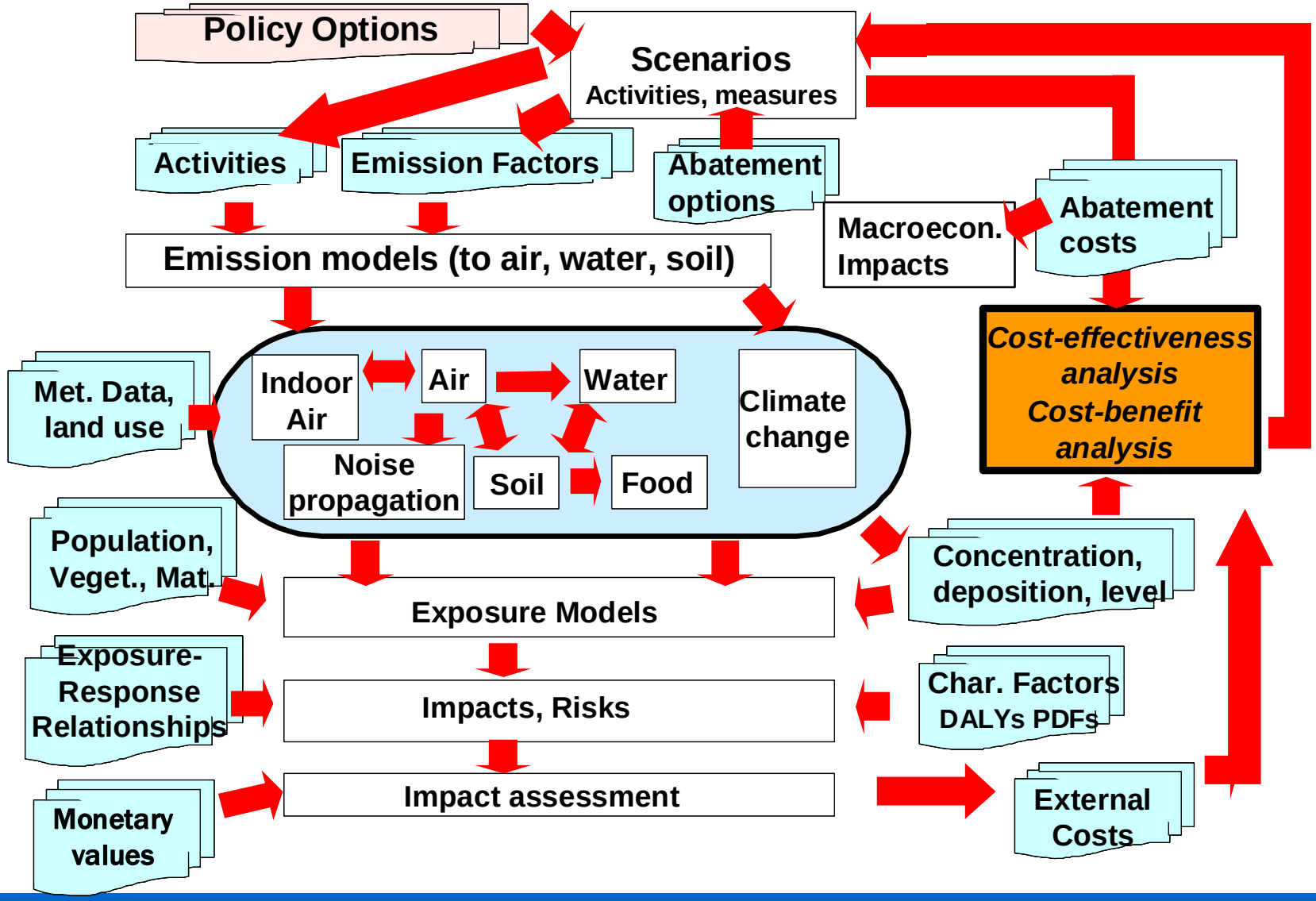
Example: “average” External Costs [Euro per tonne]



Example: Total External Costs [Euro-Cent$_{2000}$ per kWh$_{el}$] at present



IER Integrated Assessment System



Summary

- The methodology can estimate impacts of different technology
- Impacts are weighted based on preferences of the effected population for a large number of impacts
- Uncertainties have been quantified as ca. factor of 1/3 to * 3
- Gaps and uncertainties will be more and more reduced due to ongoing research (e.g. on dispersion models, pathways involving further toxic substances, heavy metals, biodiversity, water and soil contamination…)
- External costs have to be taken into account to support decisions on future technology mix, together with other features like internal costs, supply security, availability and potentials, etc. etc.
- The methodology is already widely used for decision aid in the fields of energy conversion, transport and environmental legislation.
- **More information**
  ExternE: www.ExternE.info
  EcoSenseWeb: http://EcoSenseWeb.ier.uni-stuttgart.de

Thank you for Your Attention !