RAPIDC
Regional Air Pollution In Developing Countries

SEI STOCKHOLM ENVIRONMENT INSTITUTE

Economic aspects

Presentation
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Malé Declaration: Workshop on
Air Quality and Health Impacts

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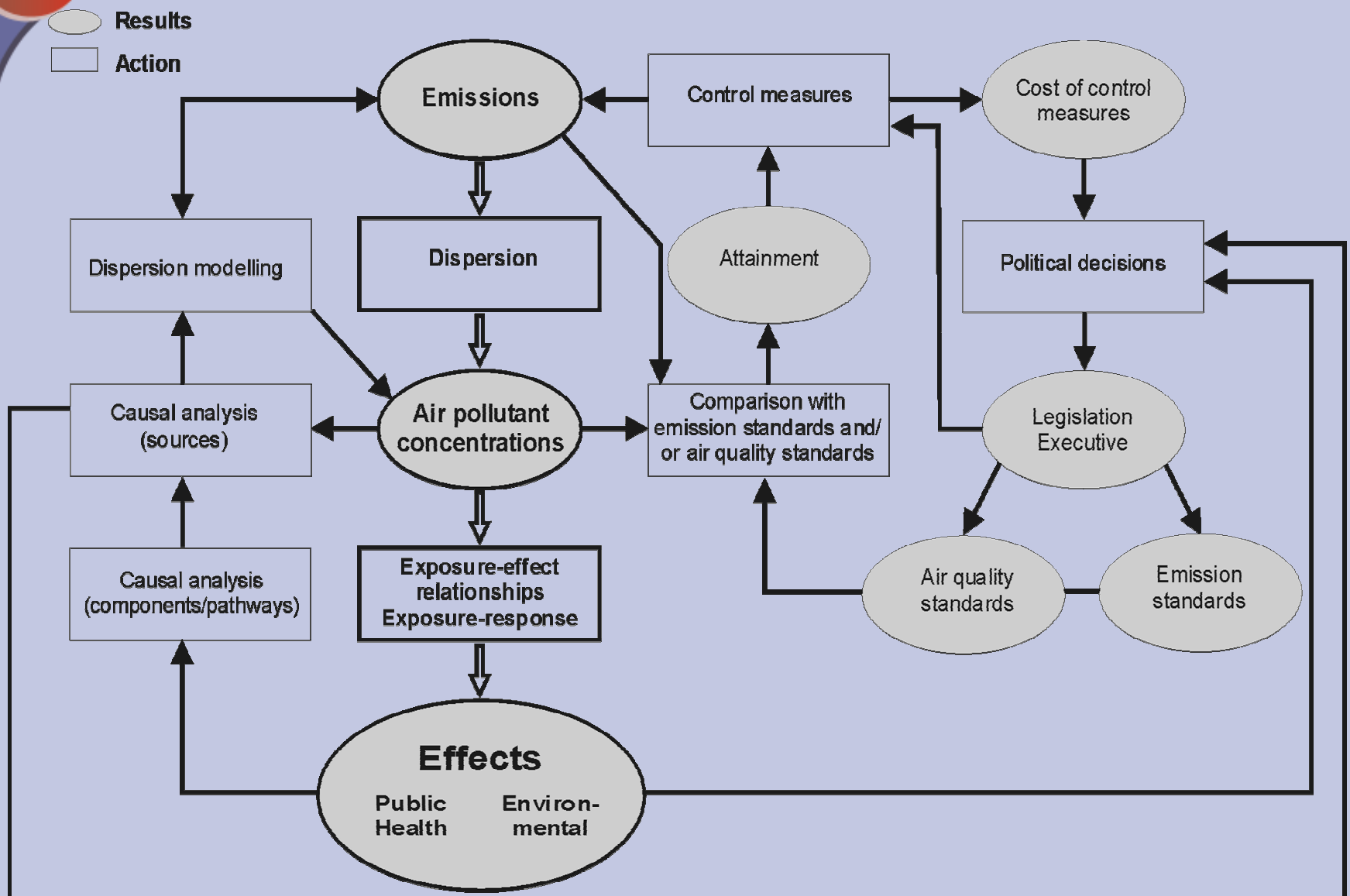
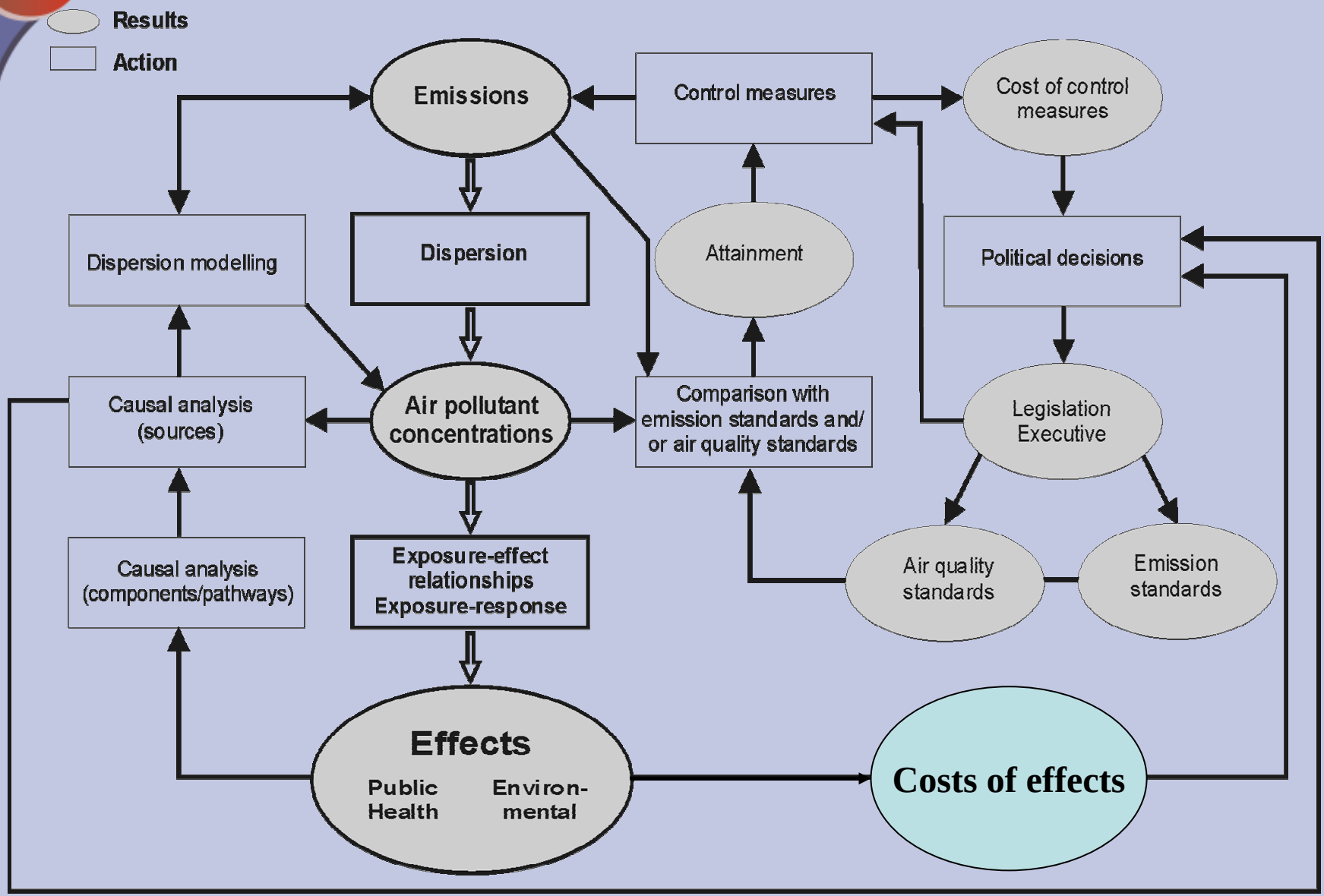
Learning objectives

Understanding

- **The role of cost effectiveness / cost-benefit analysis**



Air pollution management model



Air pollution management model

Air quality management

Air pollutant concentrations
Air quality guidelines and standards
Exposure and health effects
Costs of health effects
Emissions
Costs of controls

Control action is devised if air quality standards are not met. Cost benefit analysis compares the benefits of avoided health and environmental impacts with the costs of action.

Development of AQM action using cost-benefit analysis

Approaches for decisions on control measures:

1. **Basing purely on health, cultural, environmental impacts with little weight to economic efficiency.**
   Objective: To reduce the risk of adverse effects to a socially acceptable level.
2. **Basing on a formal cost-benefit or cost-effectiveness analysis.**
   Objective: To identify the action that achieves greatest net economic benefit, or is the most economically efficient.

Decisions should account for both extremes:
Process involving stakeholders that assures social equity to all

Understanding by stakeholders of the scientific and economic consequences

Techniques for comparing costs and benefits

Cost-effectiveness analysis (CEA):

Only costs of action are considered.

The benefits are described in terms of reduced concentrations, reduced emissions, avoided cases of illness, avoided cases of premature deaths, avoided days of labor lost, decreased hospital admissions, avoided crop loss, avoided damage to ecosystems, ...

Cost-benefit analysis (CBA):

Costs and benefits (avoided adverse effects) of implemented action are compared using a monetary measure.

Steps in cost-benefit analysis

Identification and cost analysis of action (emission abatement strategies and tactics)

Assessment of air quality and population exposure, with and without the action

Identification of benefit categories (health effects, material damage, damage to ecosystems)

Comparison of effects to target objects with and without action

Comparison of estimated costs and benefits

Sensitivity and uncertainty analysis

Abatement measures needed

Abatement measures to reduce emissions are known

Direct measures at the source are measurable in monetary terms

Indirect measures such as alternative traffic plans or change of behaviour may not be monetised

Secondary pollutants must be included (even if not regulated)

Costs of investment, operation and maintenance

Unforeseen effects, technical innovations, indirect costs

Area representativeness

Air quality assessment requirements

Provision of information about expected air quality both with and without implementation of control measures. Typically, the assessment will be based on air quality monitoring data and dispersion modeling.

Types of data requested:

Measured concentrations for relevant averaging times and site classification

Emission data from all significant sources with sufficient spatial and temporal resolution

Meteorological and topographical data relevant to dispersion of emissions

Comparison of benefits with and without control action

Combination of information on exposure-response relationships with that of air quality assessment, application of the combined information to the population at risk.

Additional data needed:

Specification of the population at risk

Prevalence of the different health effects in the population at risk

Comparison of estimated costs and benefits

CBA should provide a benefit/cost ratio based on monetised costs and benefits, accompanied by a description of the non-monetised items that also should be considered.

The results of comparing costs and benefits in two areas which are different and vary substantially may differ significantly

Action taken to reduce one pollutant may increase or decrease the concentration of other pollutants. These additional effects should be considered as well as pollutant interactions which may lead to double counting of costs or benefits.

Cost of an environmental policy action may vary according to the scale and level of decision making, e.g. transfer costs (taxes, subsidies aimed at redistribution of costs). Benefits may also be transferable between population groups.

Sensitivity analysis

Sensitivity analysis provides valuable insight into the properties and assumptions underlying the results of a CBA.
Sensitivity methods include comparison with other studies, recalculation of the whole chain of CBA using other assumptions, or ranges of values around a central value, e.g. a range for the value of statistical life.

Sensitivity analysis has to be carefully designed and requires considerable resources.

Due to different levels of knowledge on the costs of control action and those of health effects there is a tendency to under-estimate the cost of health effects.

Uncertainty analysis

- Choice of categories of benefits
- Difficulty and inaccuracy of monetary values
- Well-being not measurable in monetary terms
- Dose-response relationships
- Dose-response relationships are not necessarily transferable
- Linearity assumption for dose relationships might overestimate pollution effects
- Extrapolations in the “response per 1 µg m^{-3}” to “response per 10 µg m^{-3}“ using a simple multiplicative factor might be misleading
- Same indicators may not be representing the same ambient air quality at two different locations
- Disregarding what population is being referred to might lead to erroneous results

Challenge and value of CBA

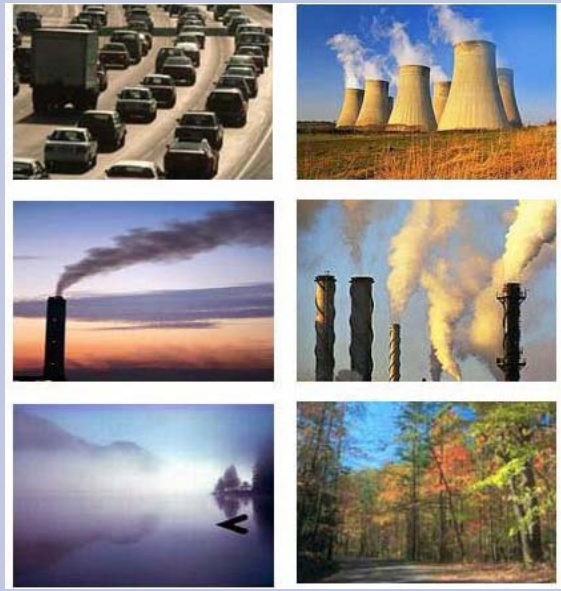
CBA difficult to perform but:

CBA provides information of value in the decision making process by organizing quantitative information (monetary costs) and qualitative (non-monetary costs) information of the positive and negative consequences of an action.

A recent example:

AEAT/ED51014/Baseline Scenarios. Issue 5

CAFE CBA: Baseline Analysis 2000 to 2020



April 2005

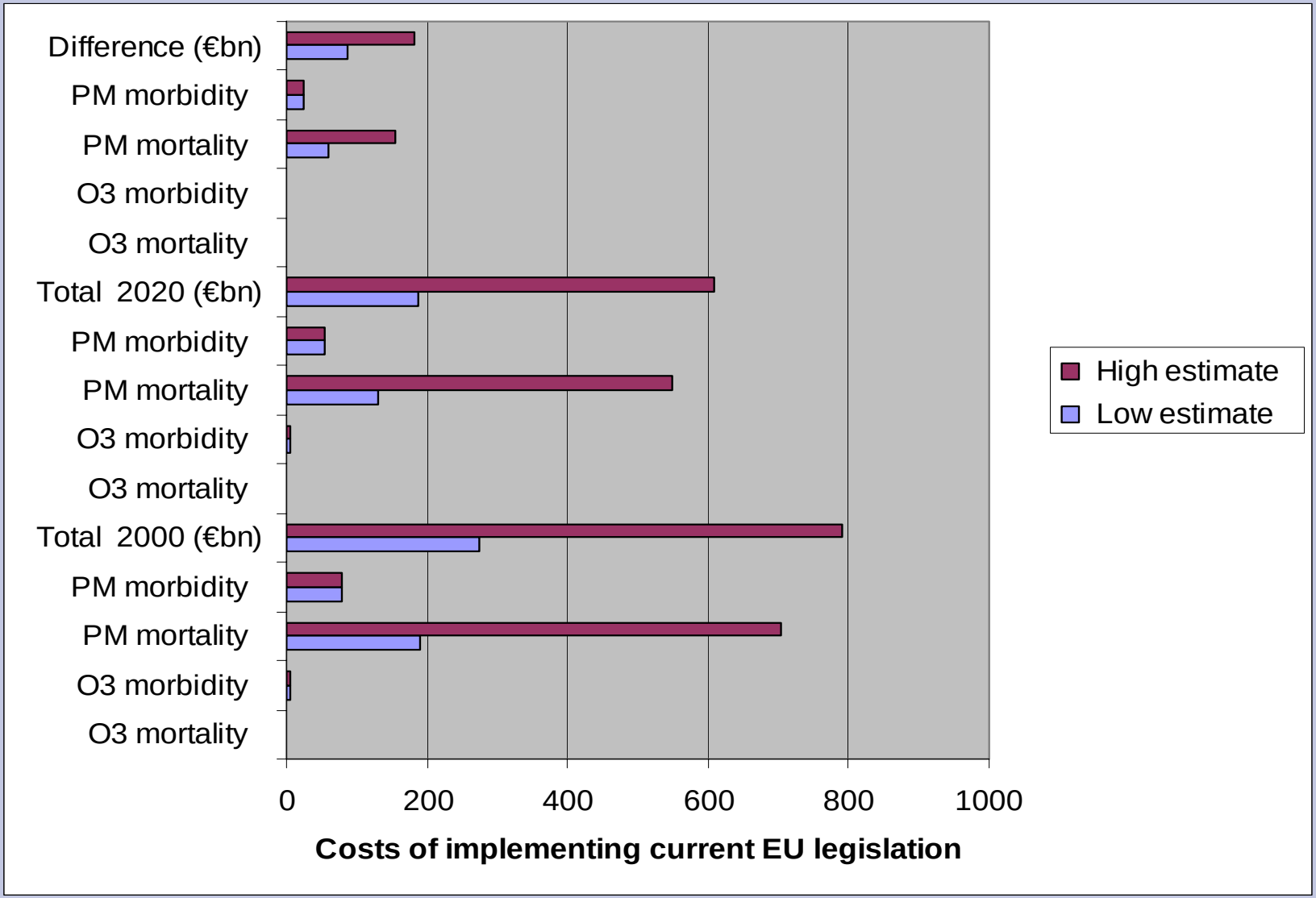
Service Contract for Carrying out Cost-Benefit Analysis of Air Quality Related Issues, in particular in the Clean Air for Europe (CAFE) Programme

Direct and indirect impacts addressed in the CAFÉ CBA

	PM2.5	SO2	NOx	VOCs	NH3
Direct impacts					
Tropospheric ozone formation, leading to effects on health, crops, materials and ecosystems					
Health impacts from primary pollutants and secondary pollutants (ozone and aerosols)					
Ecosystem acidification					
Ecosystem eutrophication					
Damage to building and other materials					
Indirect impacts					
Changes in greenhouse gas emissions as a result of measures employed to control CAFE pollutants					
Wider social and economic effects from impacts and the measures recommended for their control					

Core Health Analysis in CAFÉ CBA

End point	End point output	Pollutant
Acute Mortality	Premature deaths	O3
Respiratory hospital admissions	Cases	O3
Minor Restricted Activity Days (MRADs)	Days	O3
Respiratory medication Use (Children)	Days	O3
Respiratory medication Use (Adults)	Days	O3
Cough and LRS (children)	Days	O3
Chronic mortality *	Life years lost OR Premature deaths	PM
Infant mortality	Premature deaths	PM
Chronic bronchitis	Cases	PM
Respiratory hospital admissions	Cases	PM
Cardiac hospital admissions	Cases	PM
Restricted activity days (RADs)	Days	PM
Respiratory medication Use (children)	Days	PM
Respiratory medication Use (adults)	Days	PM
LRS (including cough) among children	Days	PM
LRS among adults with chronic symptoms	Days	PM


Difference (€bn)
PM morbidity
PM mortality
O3 morbidity
O3 mortality
Total 2020 (€bn)
PM morbidity
PM mortality
O3 morbidity
O3 mortality
Total 2000 (€bn)
PM morbidity
PM mortality
O3 morbidity
O3 mortality
0
200
400
600
800
1000
High estimate
Low estimate
Costs of implementing current EU legislation

Concluding remarks

CBA is a highly interdisciplinary task.

CBA, when appropriately used, is a legitimate and useful way to provide information for risk managers making decisions that will affect health and the environment.

CBA should not be used as the sole and overriding determinant of those decisions.

Information about costs and benefits that cannot be monetised must be explicitly considered along with information about risks and social and cultural concerns.

Peer review should play a critical role in evaluation of the quality of a CBA and the technical information underlying it.