CAFE CBA






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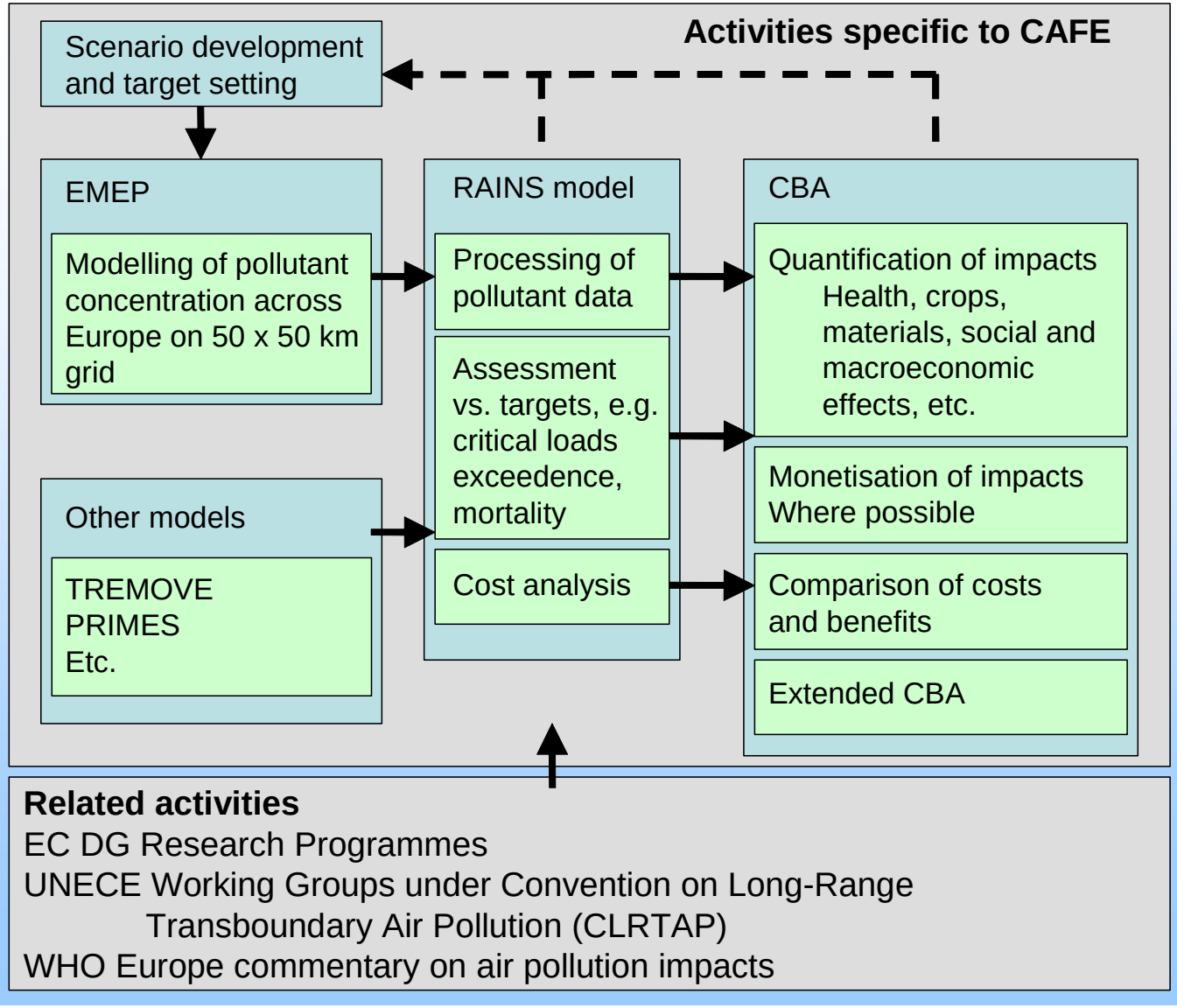
What is CAFE?

- CAFE = Clean Air For Europe Programme
- Currently developing ‘Thematic Strategy on Air Pollution’
  - Revised National Emission Ceilings Directive
  - PM2.5 standard
  - Revised Large Combustion Plant Directive
  - Etc.

CAFE analytical framework



Roles of the different models

- PRIMES: Energy sector modelling, forecasting
- TREMOVE: Transport sector modelling, forecasting
- EMEP: Dispersion modelling, pollutant chemistry
- RAINS: Cost-effectiveness analysis, optimisation of emission strategies against pre-defined targets
- CAFE-CBA/ALPHA2: Quantification of benefits and comparison with costs (cost-benefit analysis)

Cost-effectiveness analysis vs. cost-benefit analysis

- Cost effectiveness analysis
  - What is the most efficient way to meet targets for human health improvement, ecological protection, etc.
  - Does NOT say if it is worth reaching targets
- Cost-benefit analysis
  - Comparison of costs and benefits – is it worth reaching targets?

Development of CAFE-CBA methodology

- Rooted in ExternE and benefit quantifications for original NEC and Ozone Directives and the Gothenburg Protocol
- Subject to intensive discussions with stakeholders (Member States, WHO, Industry, NGOs etc.) and formal peer review
- Presented in 3 volumes:
  - 1. Overview (finalised)
  - 2. Health Impact Assessment and Valuation (finalised)
  - 3. Uncertainty Assessment (in preparation)

CAFE-CBA methodology

- Some important differences to ExternE methods
  - Particularly for chronic mortality impacts (No differentiation by type of particle, risk factor used, quantification of number of deaths, valuation)
  - 35 ppb cut point for ozone – health assessment
  - ‘Extended CBA’
- CAFE has made some advances that will come into ExternE…
- …but in other places, adopts a more conservative approach to quantification than developed by ExternE

Why the differences between CAFE and ExternE?

- CAFE-CBA
  - Applied analysis, needs to reflect consensus of experts
- ExternE
  - Research, needs to ask and investigate important questions
- Both have their merits.
- Differences in method are important, but can have limited effect on the outcome of analysis

Suggested use of ExternE and CAFE methods and assumptions

	Core	Sensitivity
Research analysis	ExternE	CAFE-CBA
Policy analysis	CAFE-CBA	ExternE

Illustrative Results

Baseline scenarios (where we in 2000, where will we be in 2020?)

Baseline Health Impacts – EU25

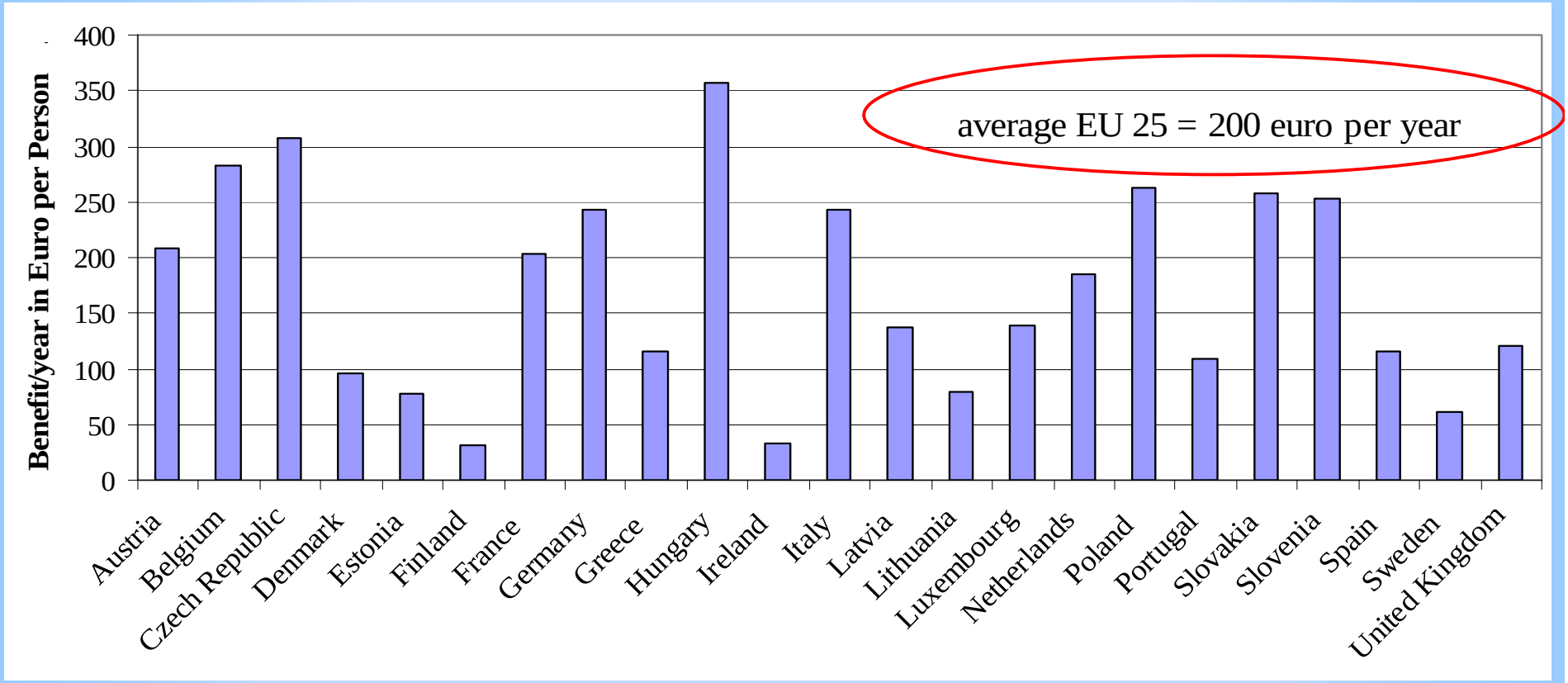
End point		Baseline in 2000	Current leg. 2020 (w/Climate Policy)	Difference 2020 and 2000
Acute Mortality	O_3	21 400	20 700	745
Respiratory hospital admissions	O_3	14 000	20 000	-6 000
Minor Restricted Activity Days	O_3	53 924 000	42 227 000	11 697 000
Respiratory medication Use (Children)	O_3	21 413 000	12 897 000	8 516 000
Respiratory medication Use (Adults)	O_3	8 837 000	8 136 000	701 000
Cough and LRS (children)	O_3	108 056 000	64 955 000	43 101 000
Chronic mortality *	PM	3 001 000	1 900 000	1 101 000
Chronic mortality *	PM	288 300	208 000	80 100
Infant mortality	PM	562	271	292
Chronic bronchitis	PM	135 700	98 400	37 300
Respiratory hospital admissions	PM	51 400	32 600	18 900
Cardiac hospital admissions	PM	31 700	20 100	11 600
Restricted activity days (RADs)	PM	288 292 000	170 955 700	117 337 000
Respiratory medication Use (children)	PM	3 510 000	1 548 700	1 961 000
Respiratory medication Use (adults)	PM	22 990 000	16 055 000	6 935 000
LRS among children	PM	160 349 000	68 819 000	91 529 000
LRS in adults with chronic symptoms	PM	236 498 000	159 724 000	76 774 000

Summary – Health Valuation – EU25

	2000 (€bn)		2020 (€bn)		Difference (€bn)	
	Low estimate	**High estimate**	**Low estimate**	**High estimate**	**Low estimate**	**High estimate**
O_3 mortality	1.1	2.5	1.1	2.4	0.0	0.1
O_3 morbidity	6.3	6.3	4.2	4.2	2.1	2.1
PM mortality	157.7	582.3	99.7	420.1	58.0	162.2
PM morbidity	77.9	77.9	49.3	49.3	28.6	28.6
Total	**243.0**	**669.0**	**154.3**	**476.0**	**88.7**	**193.0**

- The impact (the benefit) of implementing current legislation up to 2020 is valued at between €89 billion to €193 billion

Health Benefits (Euro per Person)
Policies from 2000 to 2020 by Member State
Low Estimate



(YOLL – VOLY median)

High estimate gives a value of 430 Euro per person per year

Further work

- Currently working to add in:
  - Damage to materials
  - Ozone effects on crops
  - Macroeconomic effects (using GEM-E3)
- Remaining unquantified effects being dealt with using ‘Extended CBA’
- Uncertainty analysis (mainly on benefits, but some consideration to cost-side uncertainty)

Analysis of Policy Scenarios

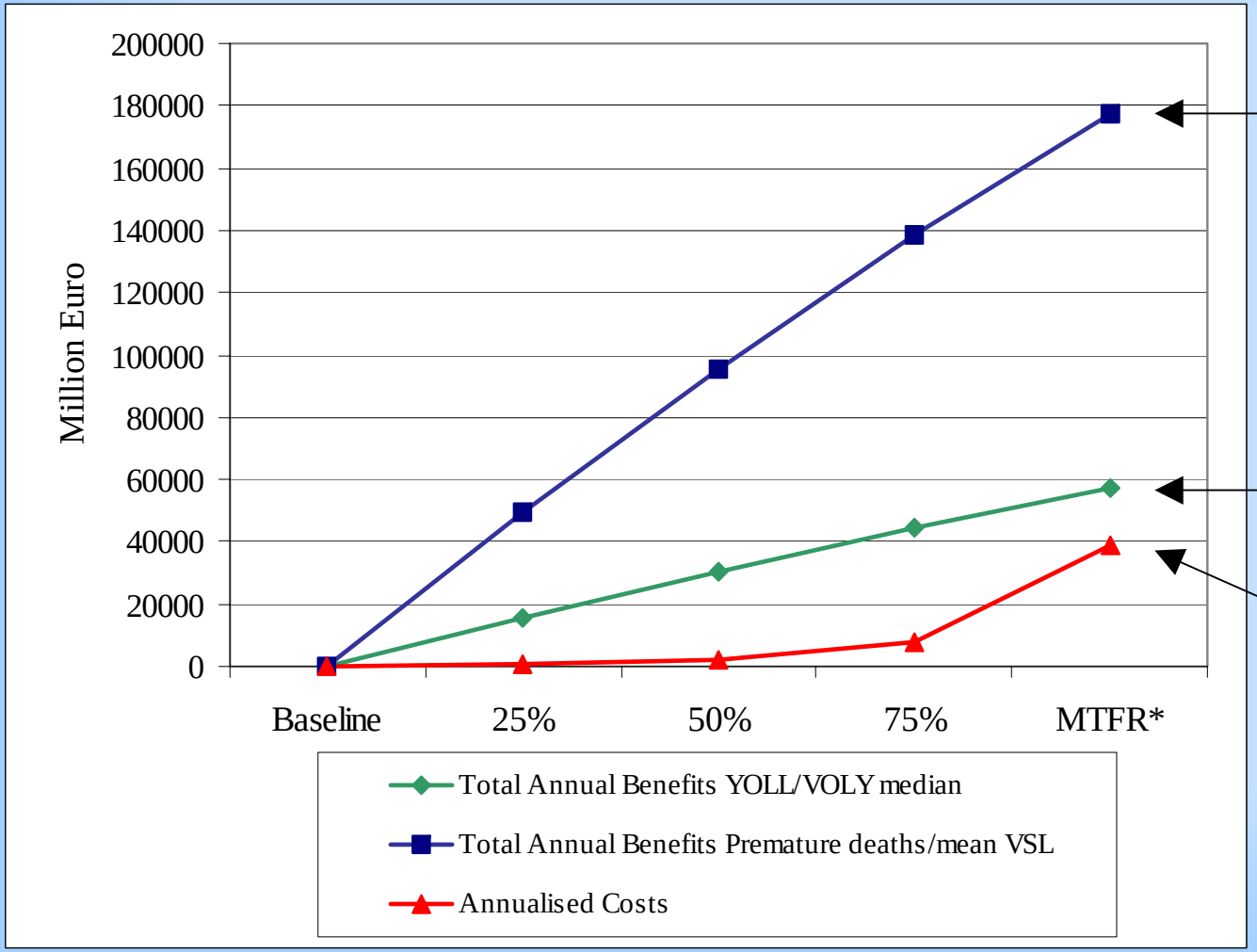
Preliminary results

Gap Closure relative to MTFR for PM exposure

Baseline 2020 - CLE Climate Policy (CP)

- Maximum Technical Feasible Reduction (MTFR) from measures included in the RAINS model represents 100% gap closure
  - 'MTFR' used here does not include Euro V/VI standards, abatement from shipping, some retrofit options, etc.
- Also investigated 25%, 50%, 75% gap closure for PM exposure

Summary – Annual Health Benefits EU25

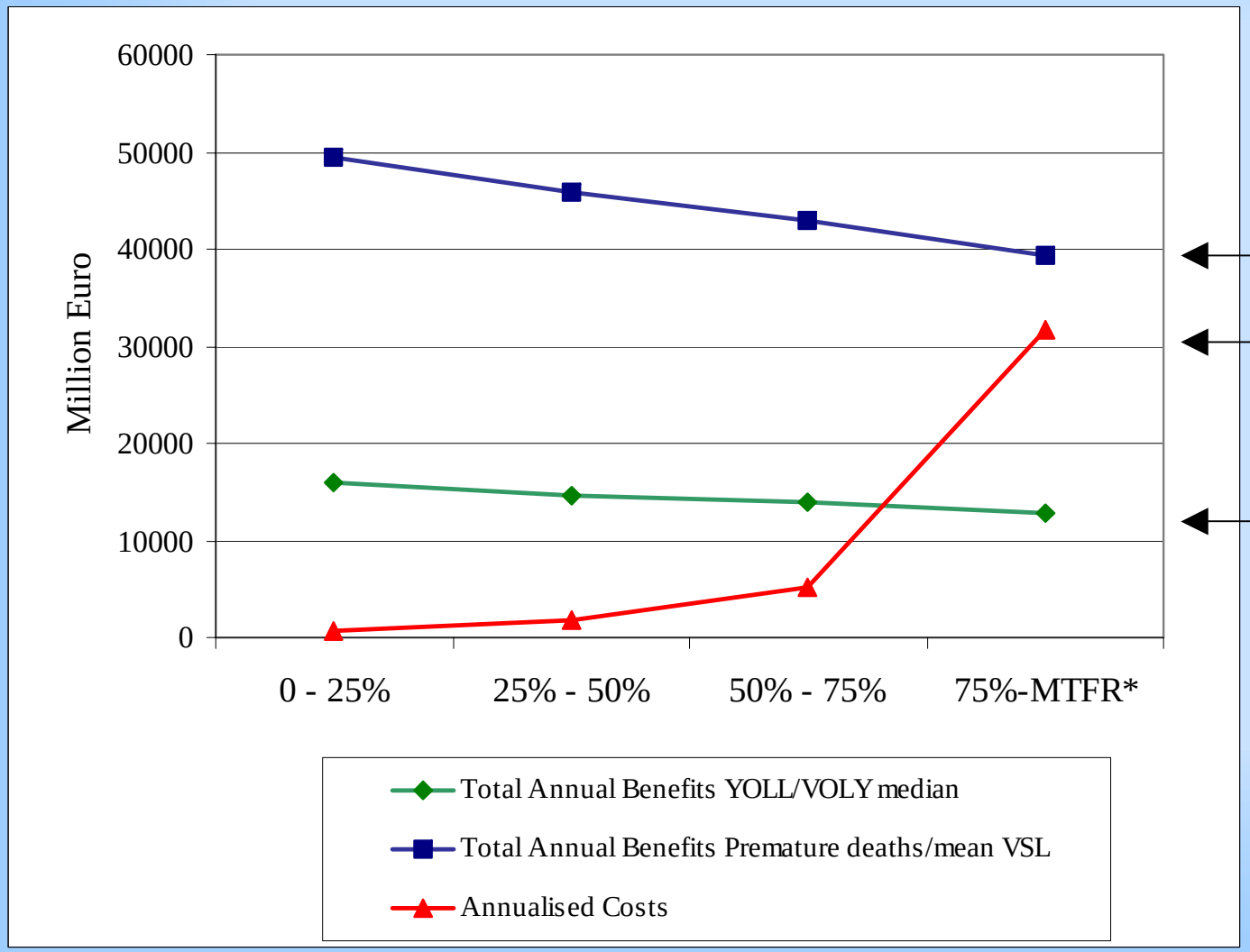


High estimate
€ 178 billion

Low estimate
€ 57 billion

Costs
€39 billion

Incremental Annual Health Benefits EU25



Incremental Health Valuation – EU25

Summary EU25 Health Valuation (Million) – benefits low & high estimate

	Baseline to 25% Gap Closure	25 to 50% Gap Closure	50 to 75% Gap Closure	75% to MTFR exc Euro 5/6
Incremental Annual Benefits	15870 to 49487	14668 to 45861	13841 to 42840	12697 to 39348
Incremental Annualised Costs	617	1825	5087	31594
Incremental Benefit:Cost Ratio	26 to 80	8 to 25	3 to 8	0.4 to 1.2

Need to consider additional benefits, effects of uncertainty

Extended CBA

- Importance of unquantified effects
  - Benefits < costs
    - Are unquantified effects likely to contribute enough for benefits to exceed costs?
  - Benefits > costs
    - Are unquantified effects likely to add significantly to confidence that benefits > costs?
    - Are unquantified effects likely to change the ratio of benefits : costs significantly?

Extended - CBA – initial ratings

Effect	Preliminary rating
Health	
Ozone: chronic effects on mortality and morbidity	★★
SO_2: chronic effects on morbidity	★
Direct effects of VOCs	★
Social impacts of air pollution on health	★★
Altruistic effects	★★
Materials	
Effects on cultural assets	★★

Extended - CBA – initial ratings

Effect	Preliminary rating
Groundwater quality and supply of drinking water	
Effects of acidification	★
Visibility	
Change in amenity	★
Crops	
Indirect air pollution effects on livestock	★
Visible injury following ozone exposure	★
Interactions between pollutants, with pests and pathogens, climate...	★★

Extended - CBA – initial ratings

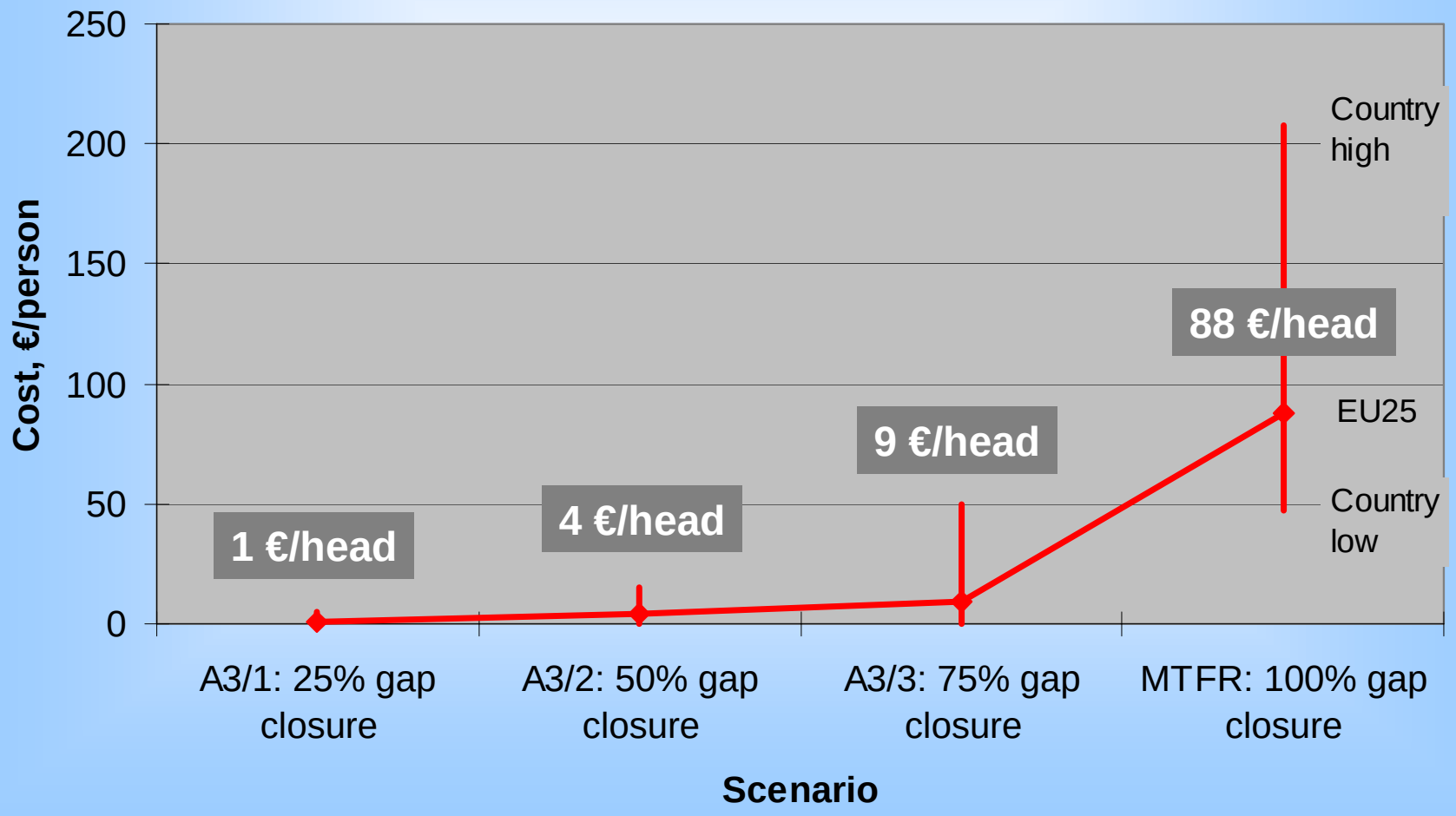
Effect	Preliminary rating
Forests	
Effects of O_3, acidification and eutrophication	★★★
Freshwaters	
Acidification and loss of invertebrates, fish, etc.	★★★
Other ecosystems	
Effects of O_3, acidification and eutrophication on biodiversity	★★★

Given the size of costs…

- How might the value of unquantified effects compare?
  - Cultural heritage
  - Ecosystems

IIASA results, annual cost (€) per head

Scenario A3: Reduction in acidification



Effect of other uncertainties

- Expected that uncertainty in estimates of specific impacts and associated costs is higher than uncertainty in assessment of the costs of specific abatement measures
- !!!BUT!!!
  - Inherent biases seem to exist in the analysis
  - Several biases push abatement costs to overestimation
  - Several biases push benefits to underestimation
  - True excess of benefit over cost may be larger than shown here

Conclusions on scenario runs

- Quantified benefits look likely to exceed costs by a significant margin, certainly up to ~75% gap closure.
- Pattern of declining benefit to cost ratio as move towards MTFR
- Sharp decrease in benefit to cost ratio above 75% for most Member States
- A more disaggregated view is needed to investigate marginality, relative merits of abating different pollutants, etc.
- Sensitivity to method for PM mortality valuation is limited, even when all other impacts are omitted