Implementations of HRAPIE recommendations for CBA of air policies

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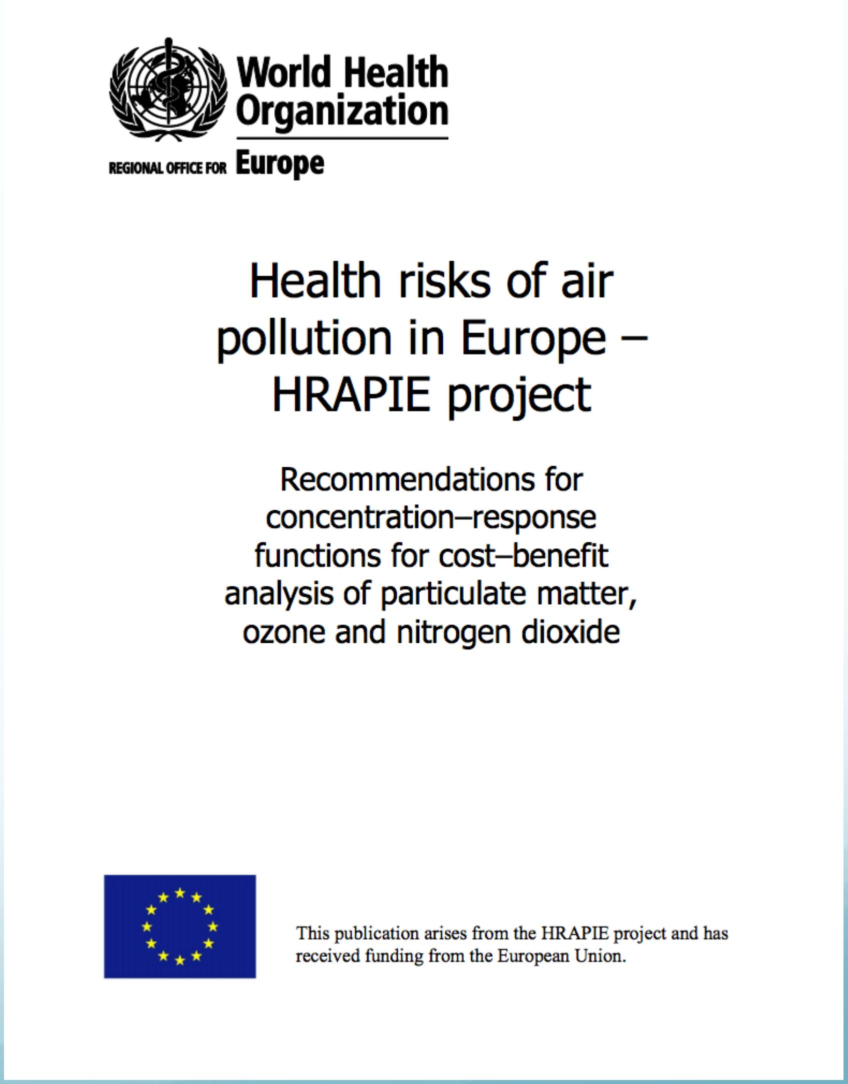
HRAPIE

- Health Risks of Air Pollution in Europe
- Led by WHO-Europe
- Informed analysis of the review of the Thematic Strategy on Air Pollution and the Clean Air Policy Package
- http://www.euro.who.int/__data/assets/pdf_file/0006/238956/Health-risks-of-air-pollution-in-Europe-HRAPIE-project,-Recommendations-for-concentrationresponse-functions-for-costbenefit-analysis-of-particulate-matter,-ozone-and-nitrogen-dioxide.pdf?ua=1



World Health Organization
REGIONAL OFFICE FOR Europe

Health risks of air pollution in Europe – HRAPIE project

Recommendations for concentration–response functions for cost–benefit analysis of particulate matter, ozone and nitrogen dioxide

This publication arises from the HRAPIE project and has received funding from the European Union.

This presentation

- Reports on use of the HRAPIE recommendations for analysis of…
- …the EU's Clean Air Policy Package within the ALPHA-Riskpoll model…
- …and other applications

- Considers outstanding questions
- Looks at possible further additions to the analysis

What has not changed ?

- Mortality functions for chronic PM and acute ozone
  - Effects used in health optimisation by IIASA
- Valuations for mortality
- No (policy relevant) threshold for $PM_{2.5}$
- Use of SOMO35 for ozone
- Non-inclusion of chronic ozone impacts

- Collectively, these assumptions dominate the health impact assessment for the CBA

Why was there no change for these effects ?

- Mortality response functions: New epidemiology studies largely confirm the old studies for application in Europe
- New valuations for mortality
  - Suggestion that new valuations would increase damage estimates, but the European Commission's position is unchanged since CAFE
- No policy relevant threshold for $PM_{2.5}$
  - Crouse (2012) study from Canada and others
- Some new insights on ozone cut-point
  - Suggestion to use SOMO10 as well as SOMO35
  - But no data on SOMO10 at time of the policy analysis

- Collectively, these assumptions dominate the health impact assessment for the CBA

What has changed in HRAPIE?

- Update of morbidity functions
  - Some effects added
    - Bronchitis in children (PM), cardiac hospital admissions (ozone)…
  - Some effects no longer included
    - Respiratory medication use, upper and lower respiratory symptoms…
  - Some effects included with expanded scope
    - RADs, mRADs applied to all ages
- (Inclusion of functions for NO_2)
  - Mortality (acute and chronic)
  - Morbidity (respiratory hospital admissions, bronchitis)

NO_2 functions

- Mortality
  - Acute with no threshold
  - Chronic with 20ug.m^{-3} threshold annual mean
- Morbidity
  - Respiratory hospital admissions (no threshold)
  - Bronchitis in children
- Are we describing exposure in a way that matches with the epidemiology studies ?
- Should same threshold apply to all effects ?
- Addition across pollutants ?

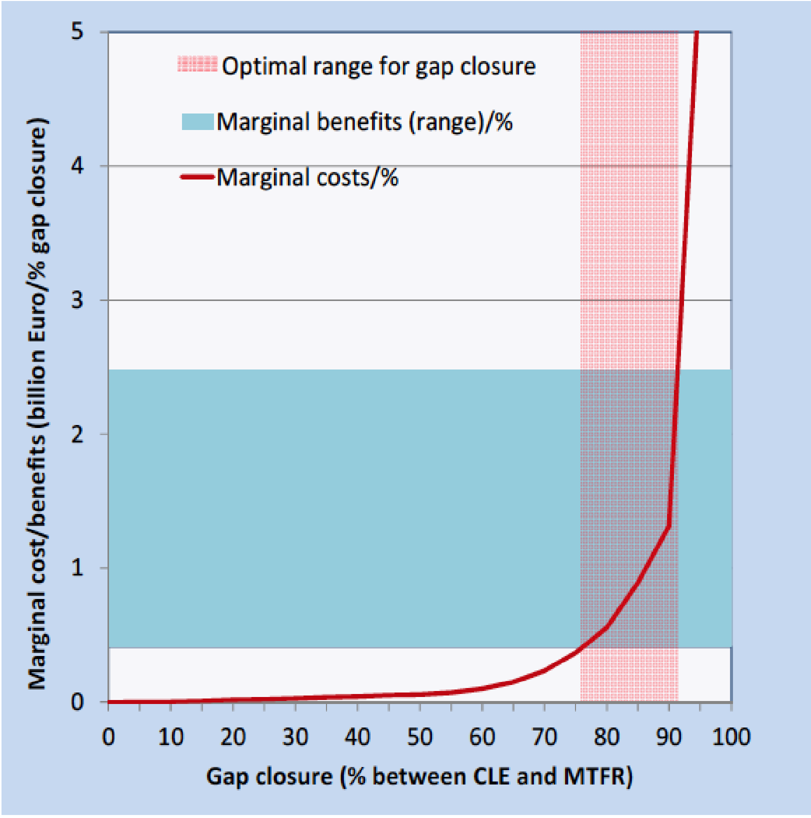
Effect of changes on outcome of the EU Clean Air Policy Package

- Reduction in monetised health damage by 5% for effects included in the analysis (vs CAFE) for most conservative position (median VOLY)
- Very little effect on overall conclusions (next slide)
- However:
  - Updating the function set leads to greater confidence in estimates
  - Excludes some HRAPIE recommendations
    - NO_2 effects
    - Use of SOMO10 metric (sensitivity, factor 4 increase ?)

- CBA report available at:
- http://ec.europa.eu/environment/air/pdf/review/TSAP%20CBA%20corresponding%20to%20IIASA11%20v2.pdf

Process for identifying ambition level

- Shows marginal cost and benefit in Euro per % gap closure
- Range for marginal benefits considered only mortality
- Linear, no threshold position leads to constant marginal benefits
- Range shows effect of alternative assumptions on mortality valuation



EU Clean Air Policy Package scenarios

- Mapping scenarios to “gap” closure
  - “gap” = distance between current legislation (CLE) and Maximum Technically Feasible Reduction (MTFR) scenario

Table 1. Policy scenarios considered in this report for 2025 and 2030.

			Gap closure		
Year	**Scenario**	**IA Option Label**	**Mortality**	**Ozone**	**Eutrophication**
2025	CLE	1	0%		
2025	B1	6A	25%		
2025	B2	6B	50%		
2025	B6		70%		
2025	B3	6C	75%		
2025	B4	6C*	75%	46%	80%
2025	MTFR	6D	100%		
2030	CLE		0%		
2030	B7	Commission proposal	67%		
2030	MTFR		100%		

CBA CAPP results for 2025

Table 2. Net health benefits of the scenarios for 2025, €M/year - EU28.

Net benefits, EU28	CLE - B1	B1 - B2	B2 - B6	B6 - B3	B3 - B4	B4 - MTFR
Costs	222	979	2,138	1,289	51	42,327
Net benefits						
Total with median VOLY	14,176	13,344	9,482	1,609	-42	-27,579
Total with mean VOLY	28,987	28,056	21,444	4,559	-35	-12,638
Total with median VSL	25,864	25,513	18,794	4,044	-58	-15,907
Total with mean VSL	48,994	49,070	37,340	8,762	-72	7,277

CBA CAPP results for 2030

Table 3. Net health benefits of the scenarios for 2030, €M/year - EU28.

Net benefits, EU28	CLE - B7	B7 - MTFR
Costs	3,334	47,347
Net benefits		
Total with median VOLY	35,140	-28,063
Total with mean VOLY	74,437	-8,606
Total with median VSL	70,012	-11,059
Total with mean VSL	135,371	21,002

Relative magnitude of mortality and morbidity effects

Table 1. Benefits from moving from the CLE to the MTFR scenario, EU28, €million/year, 2005 prices.

Endpoint	CLE – MTFR, 2025	CLE – MTFR, 2030
Particulate matter		
Chronic Mortality (All ages) median VOLY	42,605	41,623
Infant Mortality (0-1yr) median VSL	198	185
Morbidity	16,187	16,388
Ozone		
Acute Mortality (All ages) median VOLY	161	160
Morbidity	595	599
Total health benefits		
Mortality only (median VOLY, median VSL for infant mortality)	42,424	41,968
Mortality and morbidity (median VOLY, median VSL for infant mortality)	57,996	57,759
Range	57,966 – 198,377	57,759 – 207,054

Different outputs

- Total health damage
- Healthcare costs
- Direct costs to employers of lost work days

Valuation of healthcare costs

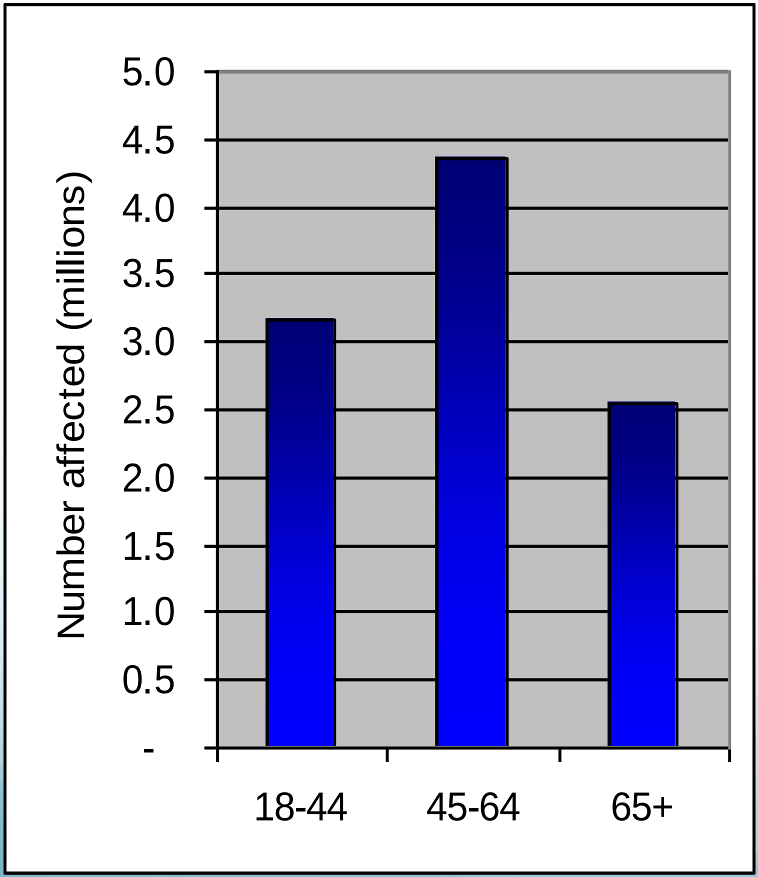
- Reviewed all effects
- Excluded those without additional healthcare costs
  - Mortality
  - (minor) restricted activity days
- Factored in healthcare costs from WHO and various studies from recent literature
- Dominated by effects of chronic bronchitis

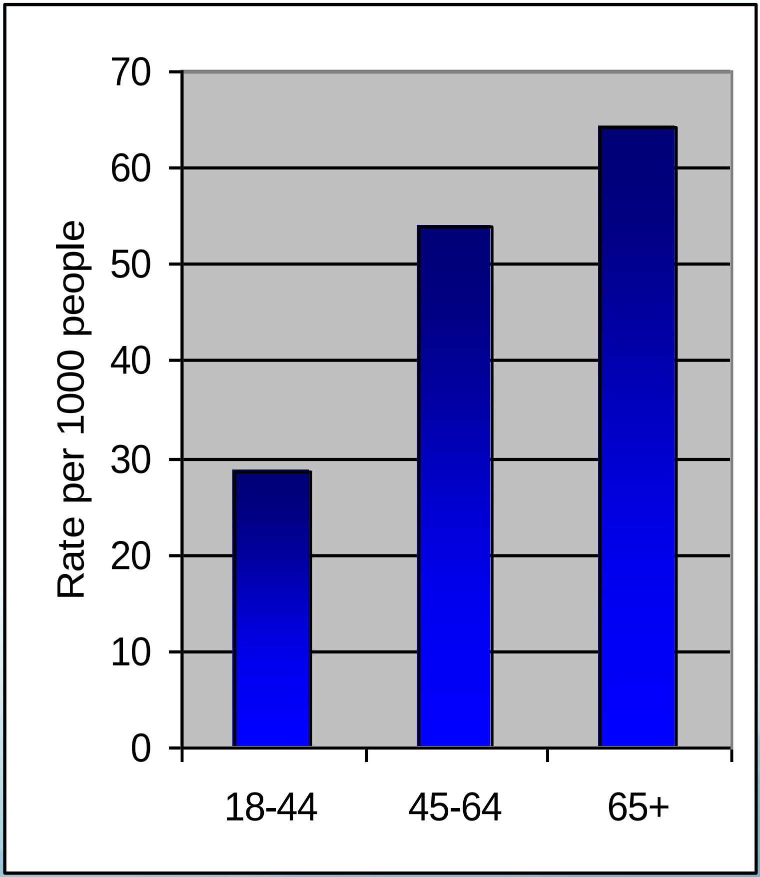
Valuation of healthcare costs

IMPACTS		CLE	B7	MTFR
Respiratory hospital admissions (>64)	O_3	17	16	14
Cardiovascular hospital admissions (>64)	O_3	20	19	17
Chronic Bronchitis (adults)	PM	2,679	2,171	1,922
Bronchitis in children aged 6 to 12	PM	33	27	24
Respiratory Hospital Admissions (All ages)	PM	101	82	72
Cardiac Hospital Admissions (>18 years)	PM	77	63	55
Asthma symptom days (children 5-19yr)	PM	8	6	6
Effects assumed to have negligible healthcare costs	Acute mortality (NO_2, O_3) Minor restricted activity days (O_3)			
Unquantified effects that ***may*** have significant healthcare costs	Chronic morbidity (in addition to chronic bronchitis) (NO_2, O_3 and $PM_{2.5}$) Infant morbidity ($PM_{2.5}$) Restricted activity days ($PM_{2.5}$) Child bronchitis (NO_2) Respiratory hospital admissions (NO_2)			
Total where quantified		2,935	2,384	2,110

Chronic bronchitis – incidence and persistence

- American Lung Association data





Valuation of lost workdays

- Focus on direct costs to employers
- CBI survey on absenteeism

- Excluded effects
  - Presenteeism
  - Indirect costs

- Alternative approach: GDP/workday

Costs to employers of lost workdays, 2030 (€million)

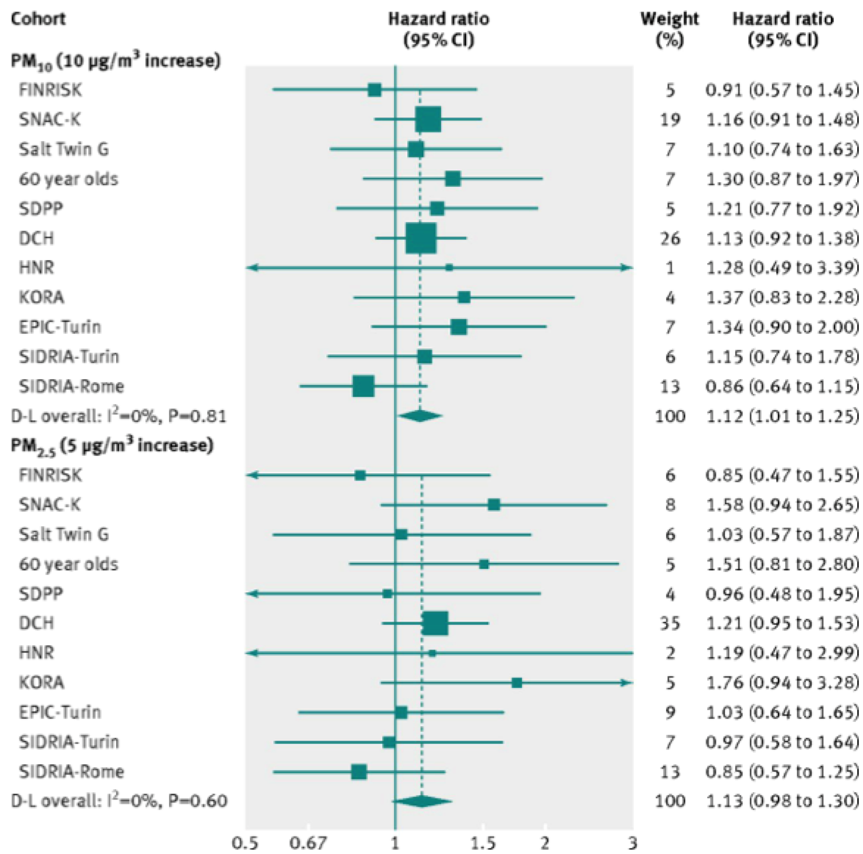
EU28 2030	CLE	B7	MTFR
Lost working days (million)	76	62	55
Value of lost working days	9,893	8,019	7,096

Omitted effects ?

- NO_2: all effects
- Ozone and chronic mortality
- NO_2 and ozone – issue of double counting for chronic mortality impacts ? Does the same apply to morbidity impacts ?
- Low birth weight (Dadvand et al, 2013) potentially linked to later productivity in the workforce (Isen et al, 2014)
- Changes in lung function
- Restriction of some impacts to a subset of the population
- Effects of other air pollutants
- Chronic effects on morbidity beyond those identified for quantification

Long term exposure to ambient air pollution and incidence of acute coronary events: prospective cohort study and meta-analysis in 11 European cohorts from the ESCAPE Project

Hazard ratios of incident coronary events per 10 μg/m3 PM10 and 5 μg/m3 PM2.5.



Cesaroni G et al. BMJ 2014;348:bmj.f7412

BMJ

Long term exposure to ambient air pollution and incidence of acute coronary events: prospective cohort study and meta-analysis in 11 European cohorts from the ESCAPE Project

- Results 5157 participants experienced incident events. A 5 μg/m^3 increase in annual mean $PM_{2.5}$ associated with a 13% increased risk of coronary events, and a 10 μg/m^3 increase in annual mean PM_{10} associated with a 12% increased risk of coronary events.
- Positive associations detected below current annual European limit value of 25 μg/m^3 for $PM_{2.5}$ and below 40 μg/m^3 for PM_{10}. Positive but non-significant associations found with other pollutants.
- Conclusions Long term exposure to particulate matter is associated with incidence of coronary events, and this association persists at levels of exposure below the current European limit values.

Uncertainty

- Standard approach
  - Look for the most important uncertainties
- Scientifically accurate, but misleading
  - Does not emphasise what we are confident about

IPCC scheme for defining certainties and uncertainties

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties

IPCC Cross-Working Group Meeting on Consistent Treatment of Uncertainties
Jasper Ridge, CA, USA
6-7 July 2010

Table 1. Likelihood Scale

Term*	Likelihood of the Outcome
Virtually certain	99-100% probability
Very likely	90-100% probability
Likely	66-100% probability
About as likely as not	33 to 66% probability
Unlikely	0-33% probability
Very unlikely	0-10% probability
Exceptionally unlikely	0-1% probability

- http://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf

Idea expanded on discussion from earlier workshop

Certainties ('Virtually certain' or 'Extremely unlikely to be incorrect')

1. Fine particles cause lung cancer (IARC **Group 1**: "The agent (mixture) is carcinogenic to humans.")
2. Aside from lung cancer, $PM_{2.5}$ increases rates of mortality and morbidity through effects on the respiratory system and the circulatory system
3. There is no threshold for effects of fine particles on the health of the population
4. Given the lack of threshold, statutory air quality limits do not fully protect health, but simply limit the total number of people affected
5. Ozone increases rates of mortality and morbidity through effects on the respiratory system and the circulatory system
6. …

High confidence ('Very likely', 90-100% probability of being correct)

1. $PM_{2.5}$ risk factors for European application within band of ……
2. …

Case study in Tuzla, Bosnia and Herzegovina

- http://www.ekologija.ba/userfiles/file/Health%20Impacts%20of%20Coal%20Fired%20Power%20Generation%20in%20Tuzla.pdf

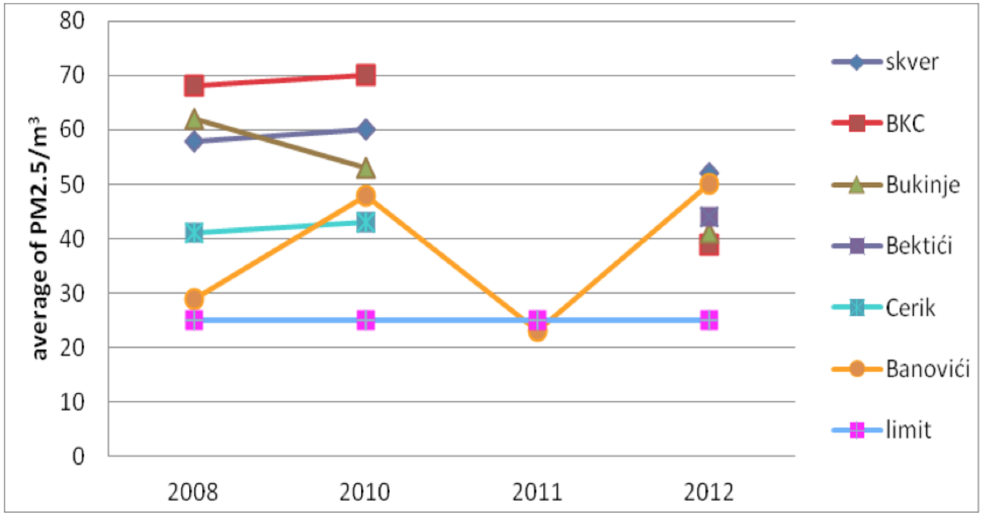
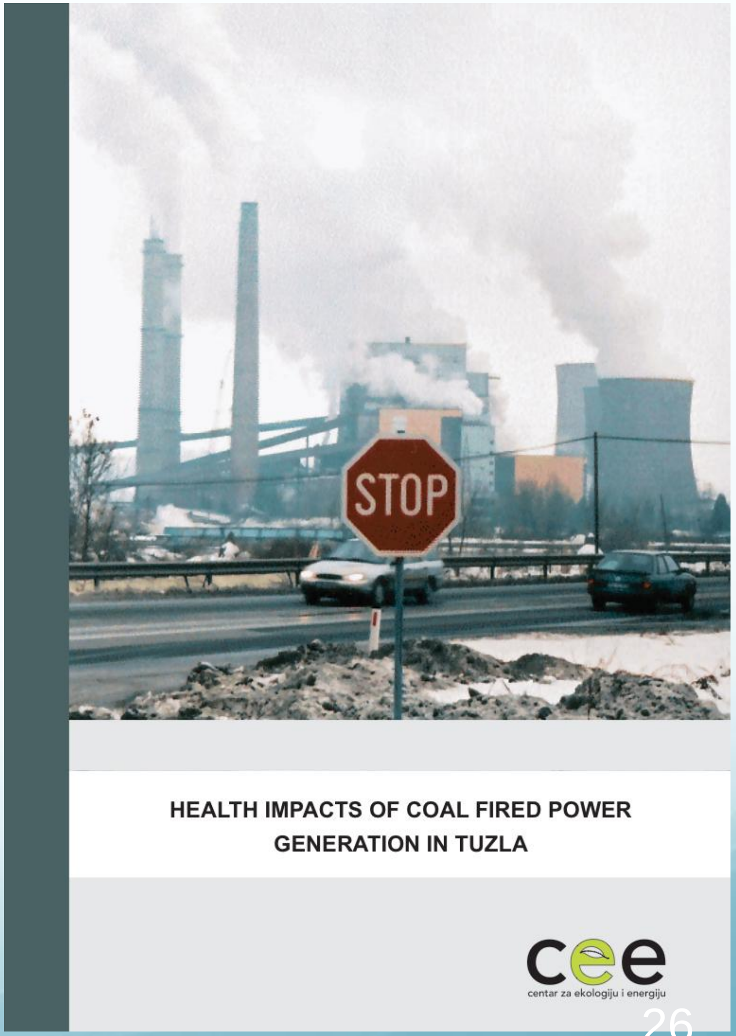


Figure 3. *Mean $PM_{2.5}$ $\mu g/m^3$ per year for the air quality monitoring stations in Tuzla and Banovići from 2008 to 2012.*



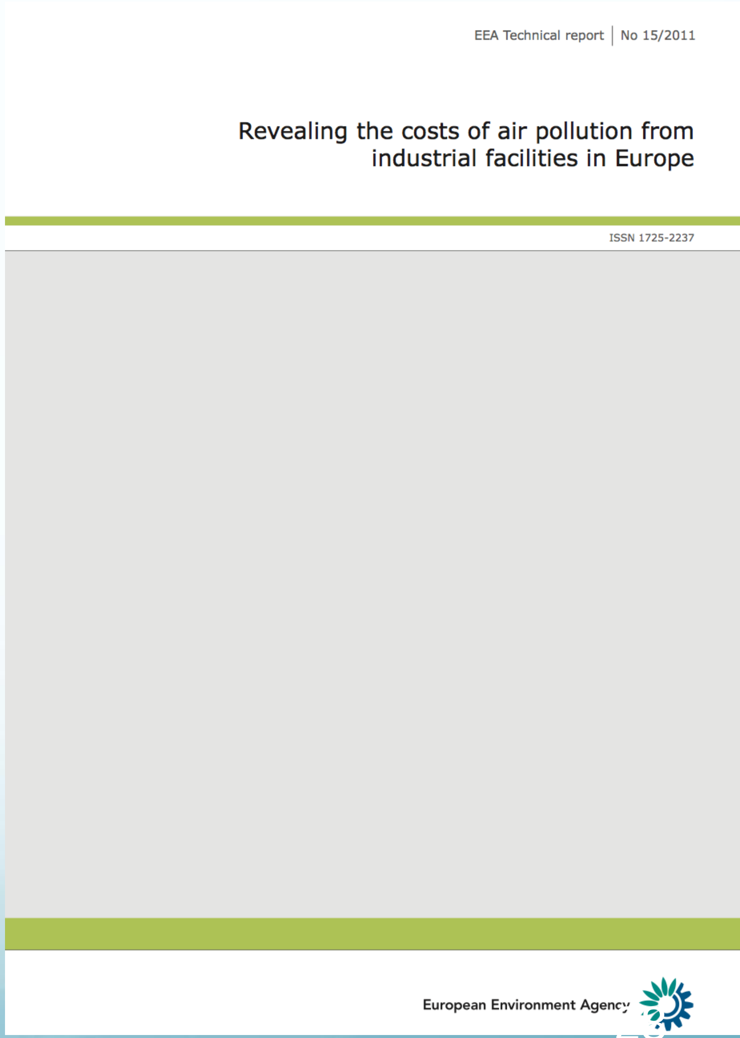
Illustrative results

Table i) *Annual impacts associated with $PM_{2.5}$ concentrations in the Tuzla region*

Tuzla and Banovići		Impact
Chronic Mortality (All ages) LYL median VOLY	Life years lost	2,875
Infant Mortality (0-1yr) median VSL	Deaths	3
Chronic Bronchitis (27yr +)	Cases	187
Bronchitis in children aged 6 to 12	Added cases	361
Respiratory Hospital Admissions (All ages)	Cases	113
Cardiac Hospital Admissions (>18 years)	Cases	81
Restricted Activity Days (all ages)	Days	272,914
Asthma symptom days (children 5-19yr)	Days	5,355
Lost working days (15-64 years)	Days	69,924

Analysis for European Environment Agency

- Application of damage per tonne estimates to all plant reporting to the E-PRTR (European Pollutant Release and Transfer Register)


EEA Technical report | No 15/2011

Revealing the costs of air pollution from industrial facilities in Europe

ISSN 1725-2237

European Environment Agency

Illustrative results

Map 3.1 Location of the 191 E-PRTR facilities that contributed 50 % of the total damage costs estimated for 2009

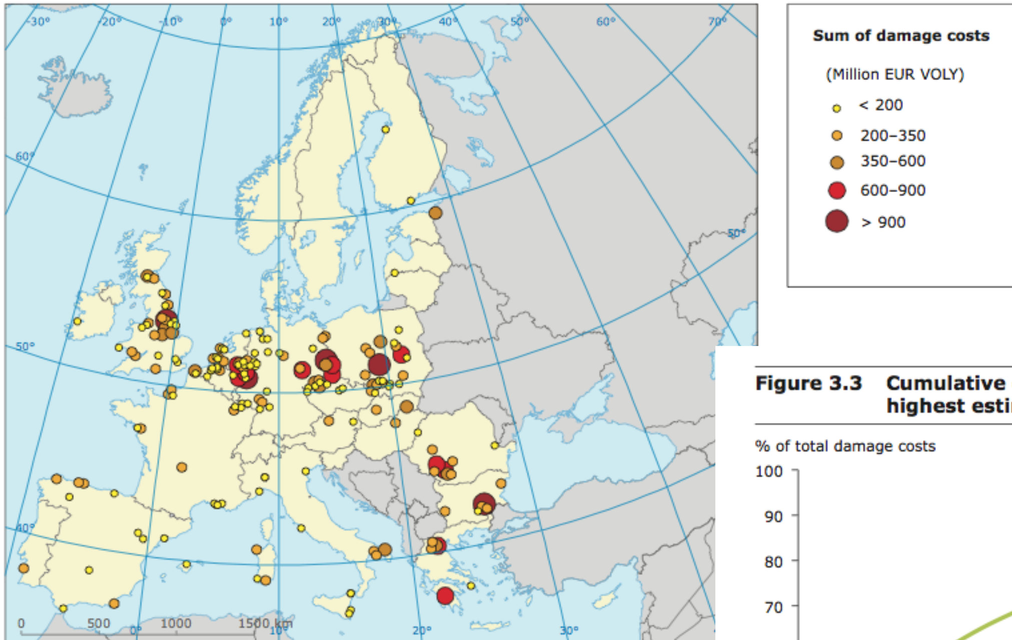
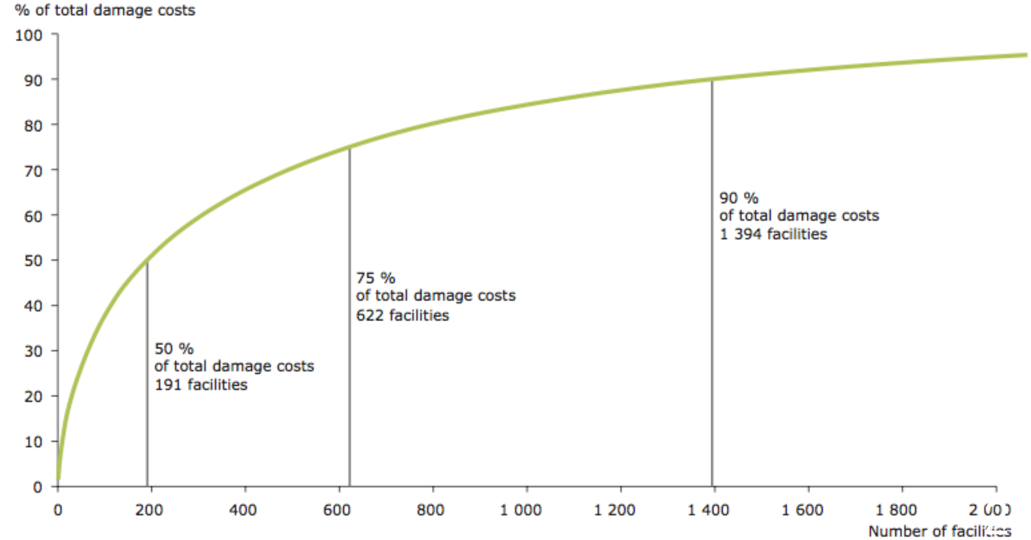


Figure 3.3 Cumulative distribution of damage costs for the 2 000 E-PRTR facilities with the highest estimated damage costs (including CO_2)



Conclusions

- Quantified health damage little different between CAFE and Clean Air Policy Package (HRAPIE) assessment framework
- Some potentially significant impacts omitted from the analysis
- Large healthcare costs
- Large costs of lost working days
- Potential for more effects to be added in
- Application spreading (EEA, individual countries and regions…)