Assessing the Health Impacts of Air Pollution in Asia

19 Feb. Tokyo

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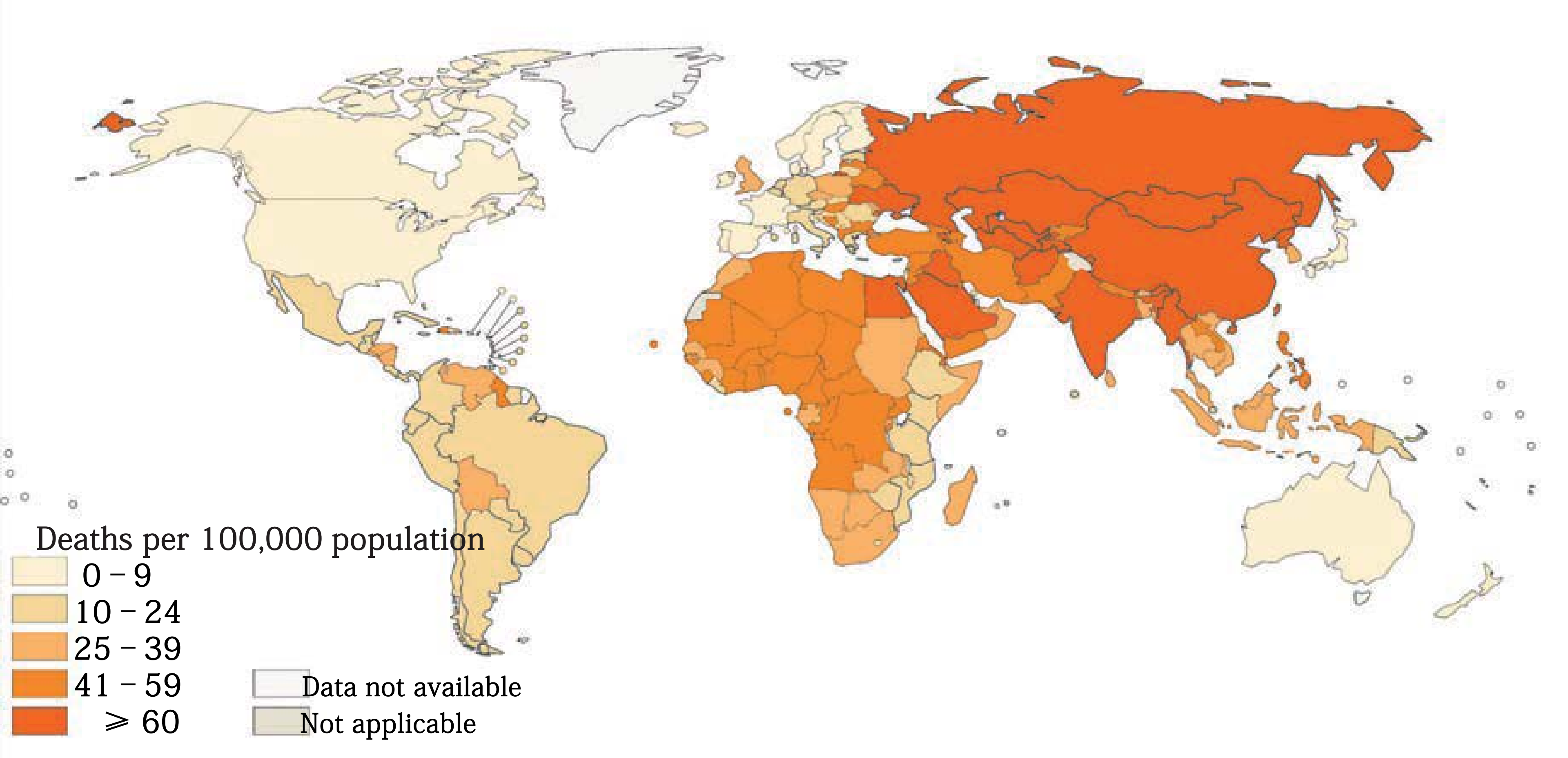
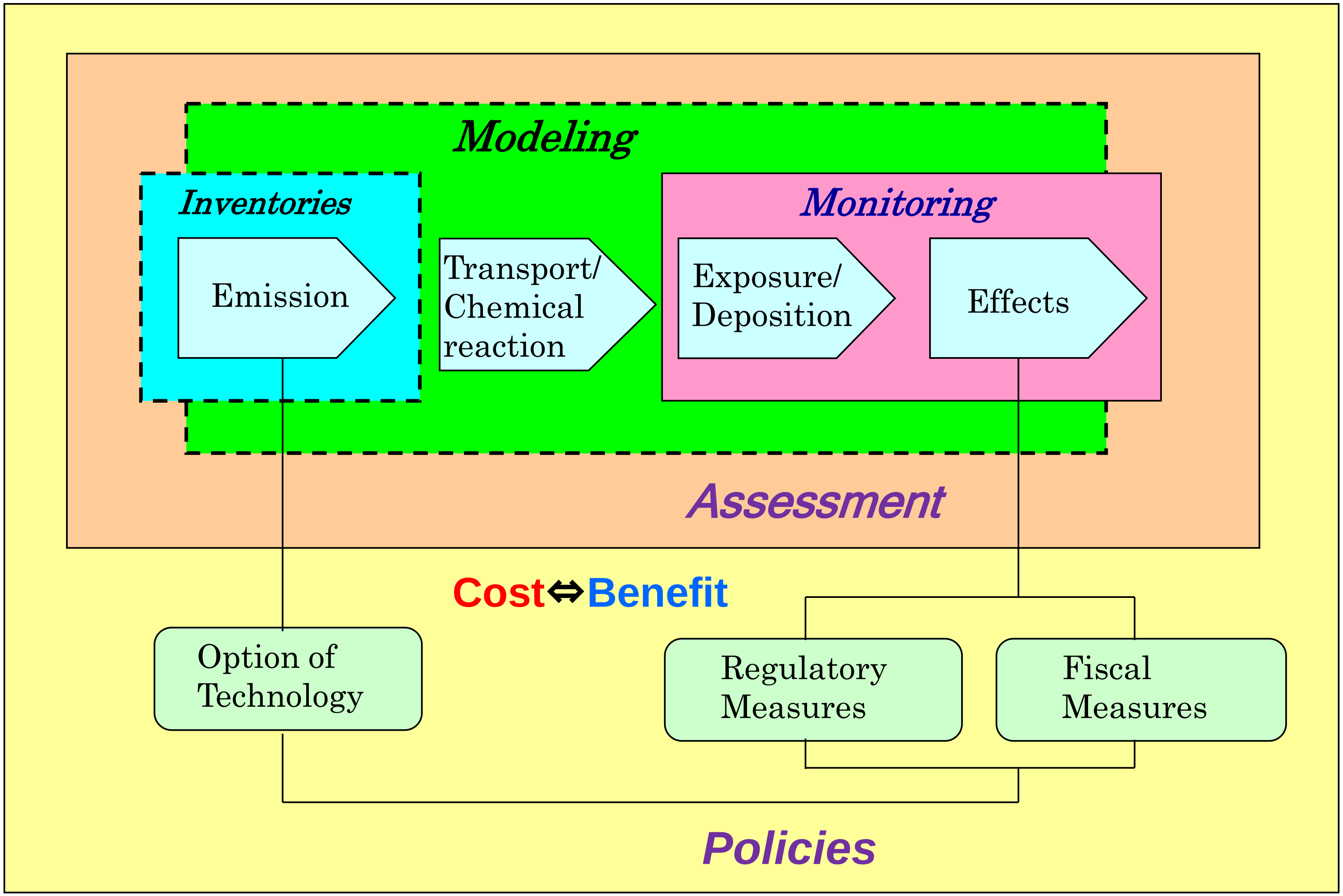
Age-standardized deaths per 100,000 people associated with air pollution, by country, 2012



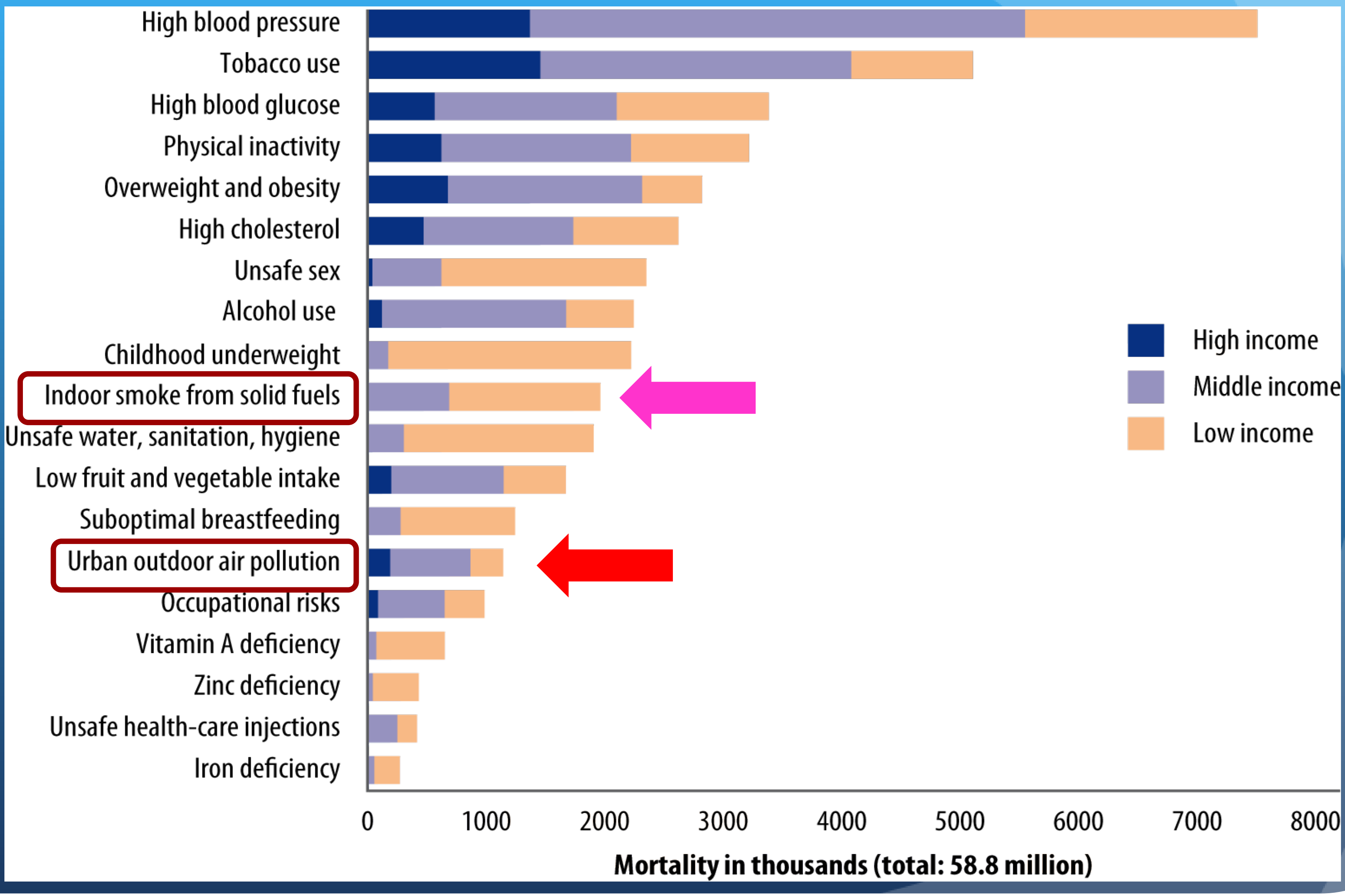
Source:Science-Based Solution(adapted from WHO 2016)

An integrated approach to air quality management



Source: ACAP

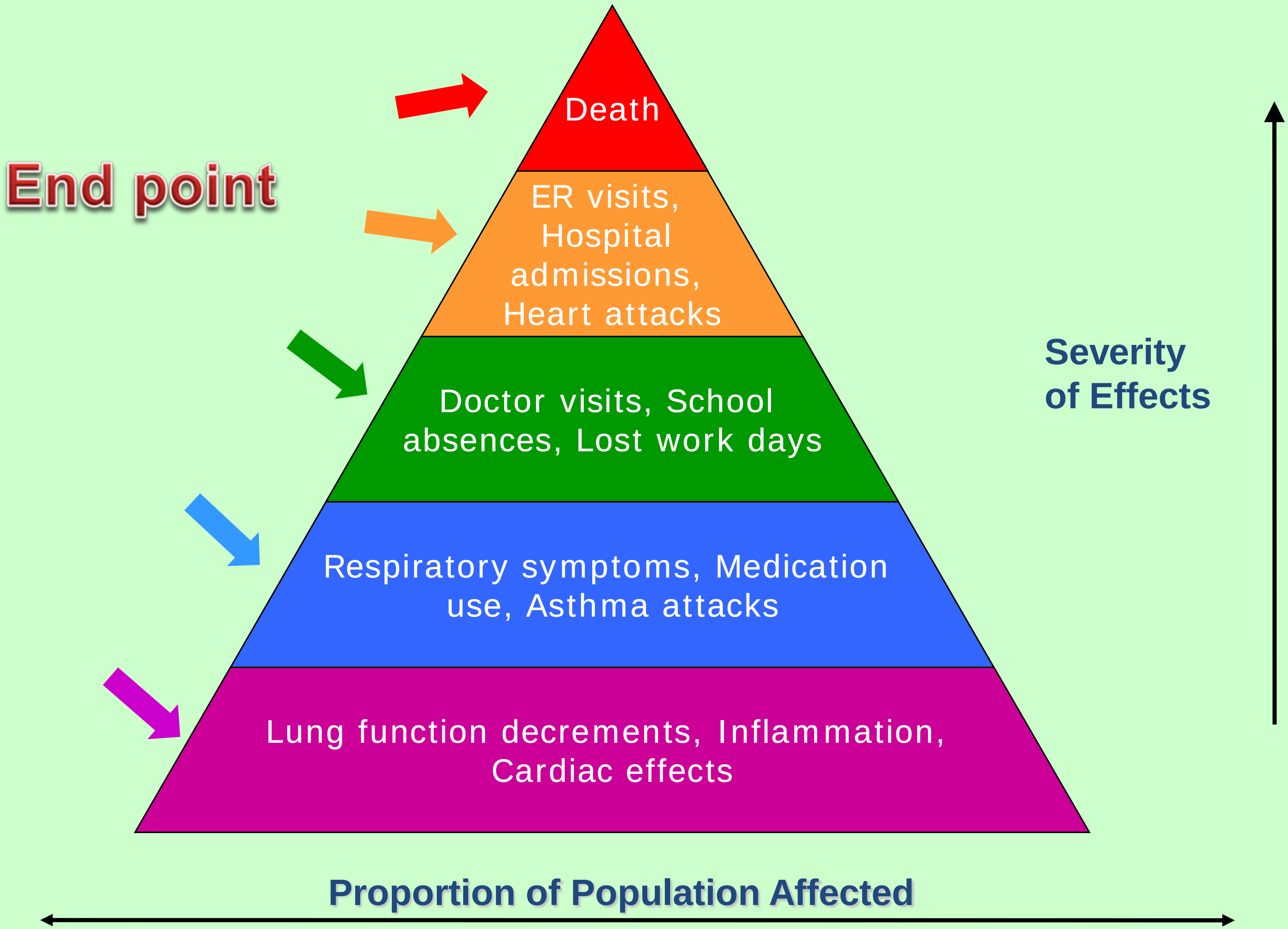
Deaths attributed to 19 leading factors, by country income level, 2004 (WHO, 2004)



Environmental Standard in Japan, USA, EU and WHO:PM (μg/m³)

Year	Japan		USA:NAAQS (primary)		EU:Air Quality Standards		WHO:Air Quality Guideline	
	SPM	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5
1971			75:annual mean 260:24-hour mean (TSP)					
1973	100: daily mean 200: 1-hour mean							
1980					150:annual mean 300:24-hour mean (SP)			
1987			50:annual mean 150:24-hour mean					
1997				15:annual mean 65:24-hour mean				
1999					40:annual mean 50:24-hour mean			
2005							20:annual mean 50:24-hour mean	10:annual mean 25:24-hour mean
2006			150:24-hour mean	15:annual mean 35:24-hour mean				
2009		15:annual mean 35:daily mean						
2010						25annual mean		
2012				12:annual mean 35:24-hour mean				

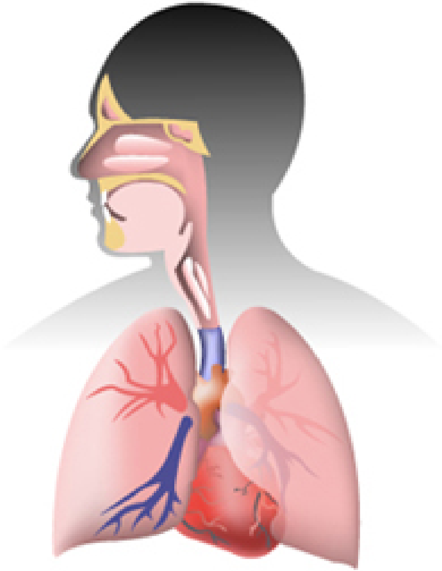
Health Impacts: "Pyramid of Effects"



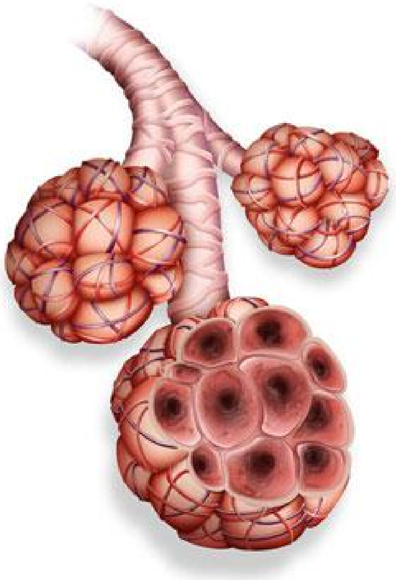
(Source: WHO, revised by Yamashita)

Particulate Matter

- Course particle (> PM_{10}) is deposited on upper part of air way
- Fine particle (≤ PM_{10}) penetrates in deep part of lung



Ozonn



・Ozone is a powerful oxidant that can irritate the airways.

・Ozone can cause the muscles in the airways to constrict, trapping air in the alveoli. This leads to wheezing and shortness of breath.

(source：USEPA)

Epidemiological studies

ozone

RR: 1.003(8h mean/5ppb), 95% CI: 1.001-1.004

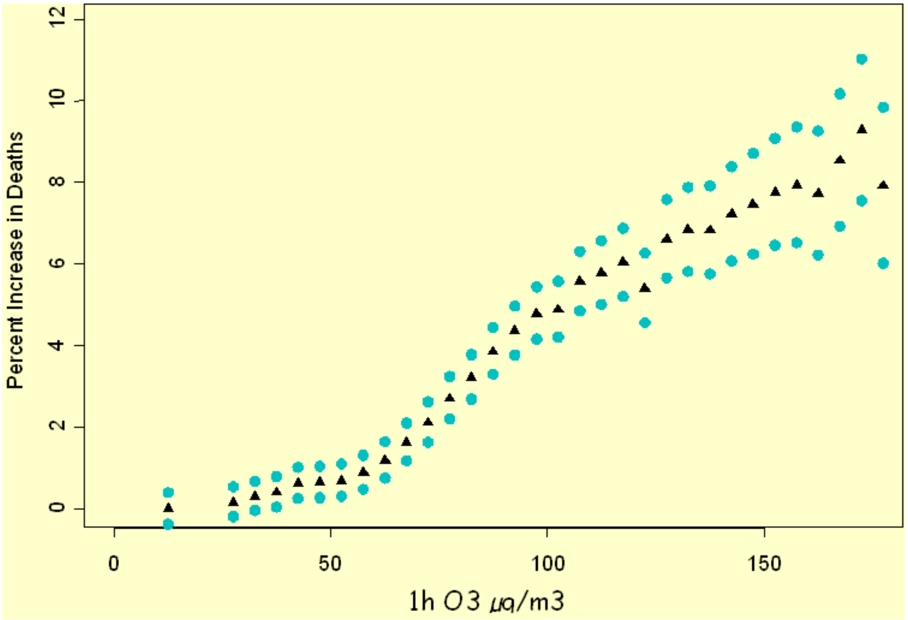
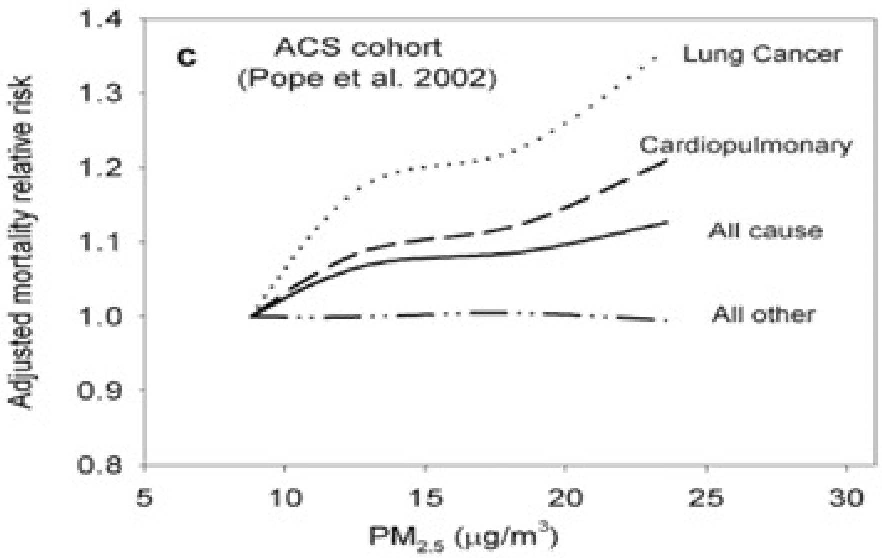


Figure 2.2. Dose-response of ozone (1-hour maximum daily mean) and daily number of deaths (average of lags 0 and 1) during the summer season. Data from 23 European cities of APHEA2 study. (Gyparis et al, 2004)

Concentration of ozone and mortality(WHO, 2008 modified by Yamashita)

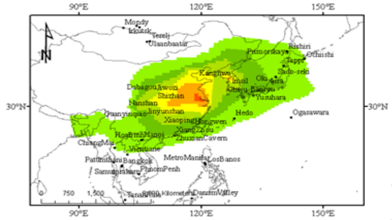
PM2.5

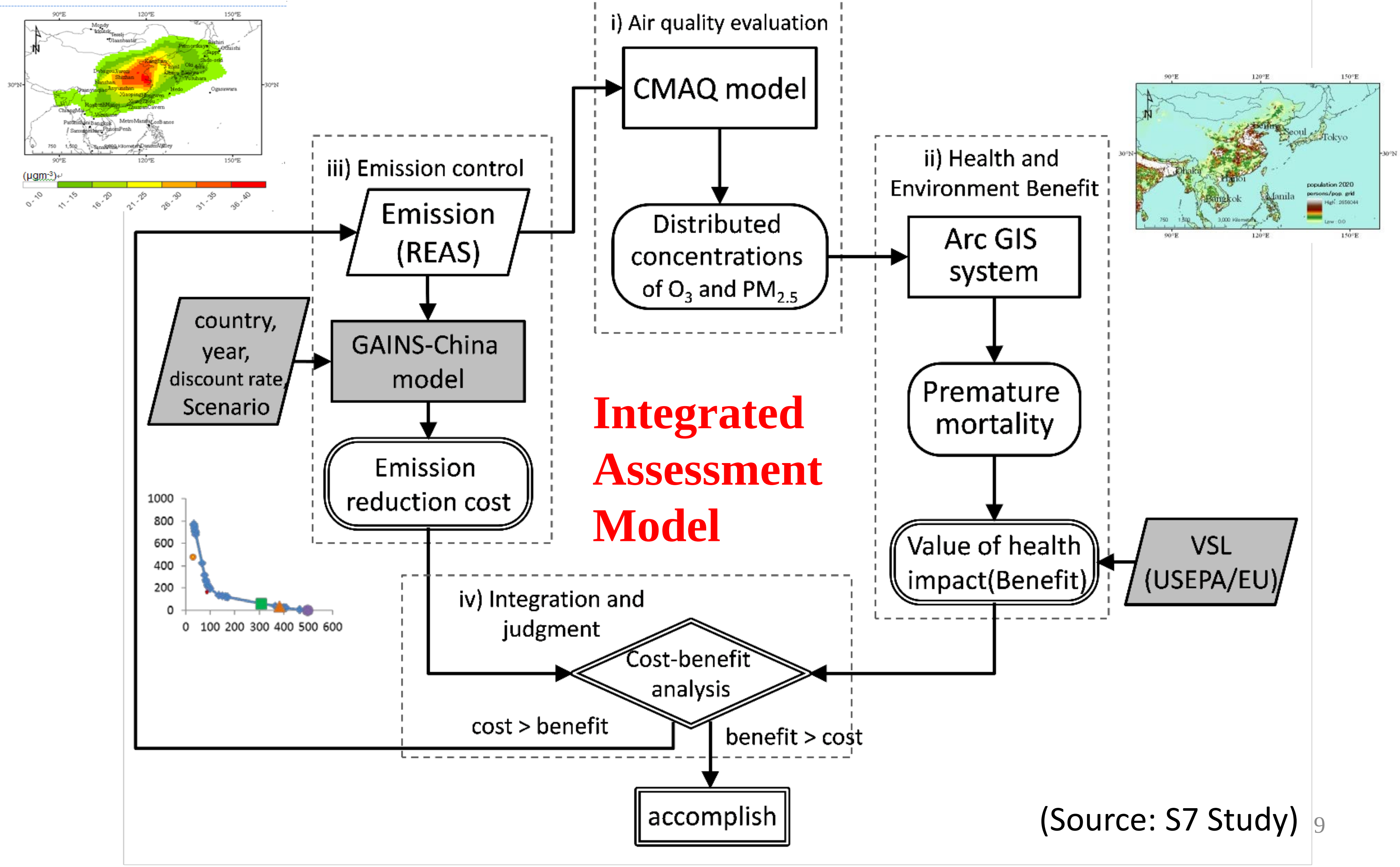
RR: 1.04(annual mean/10μg/m³), 95% CI: 1.01-1.08



Concentration of PM2.5 and relative risk(Pope and Dockery, 2006 modified by Yamashita)

Flowchart of cost and benefit estimation

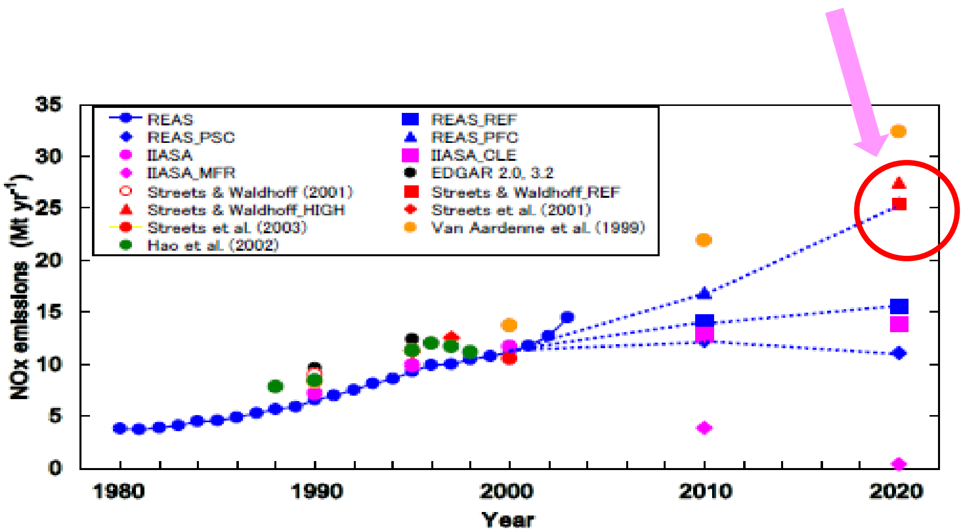




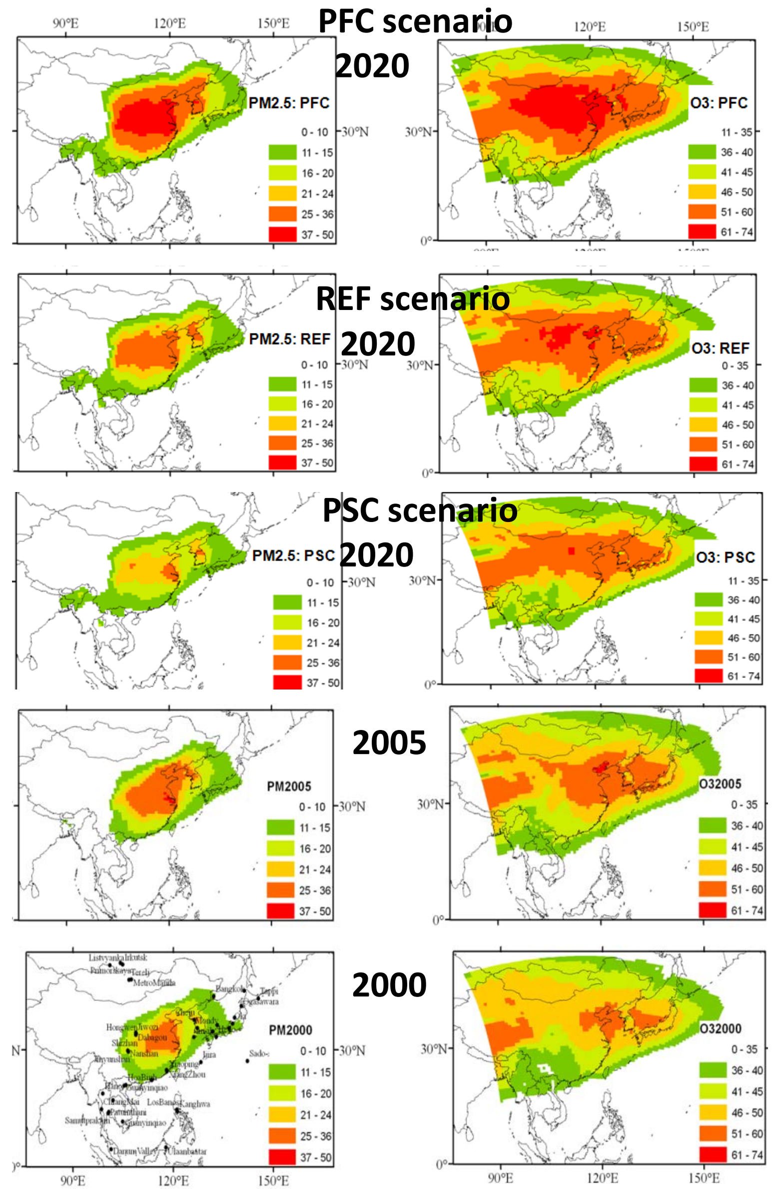
(Source: S7 Study)

CMAQ(regional chemical transport model)/REAS(emission inventory) [an example of study]

PFC scenario



(Source: Ohara)



CMAQ(Community Multi-scale Air Quality Model):

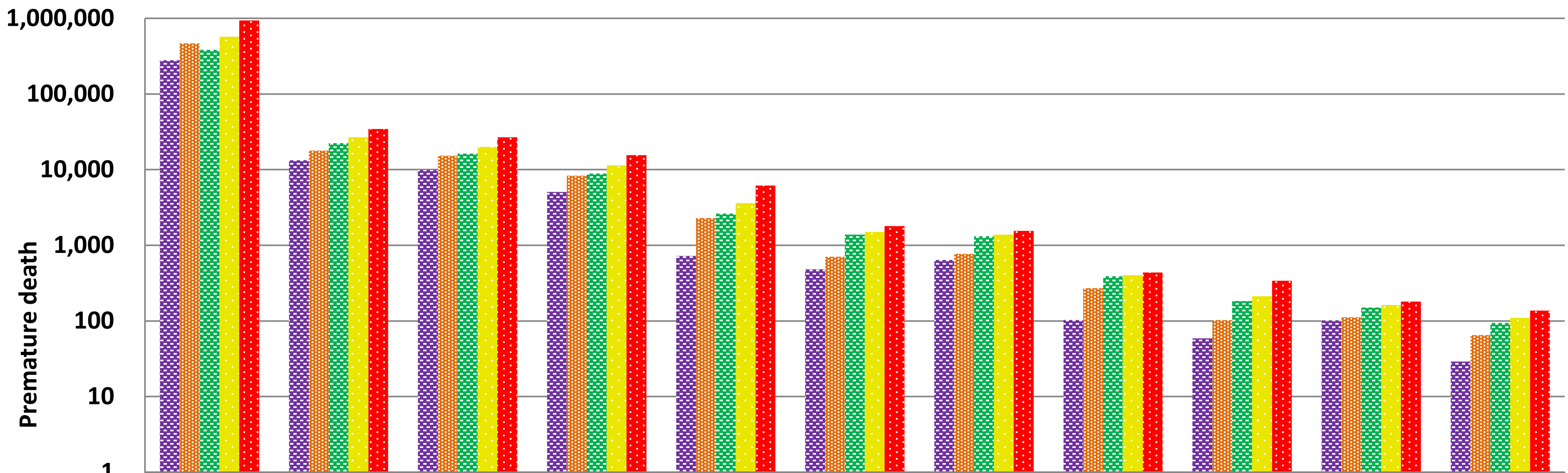
- domain: **6,240 × 5,440 (km)**
- grid: **80 km × 80 km x 150 m(hight)**

3 scenarios of REAS (ver.1.1)(China, 2020)

1. **PFC: Policy Failure Case**
2. **REF: Reference Case**
3. **PSC: Policy Successful Case**

(Source: S7 study)

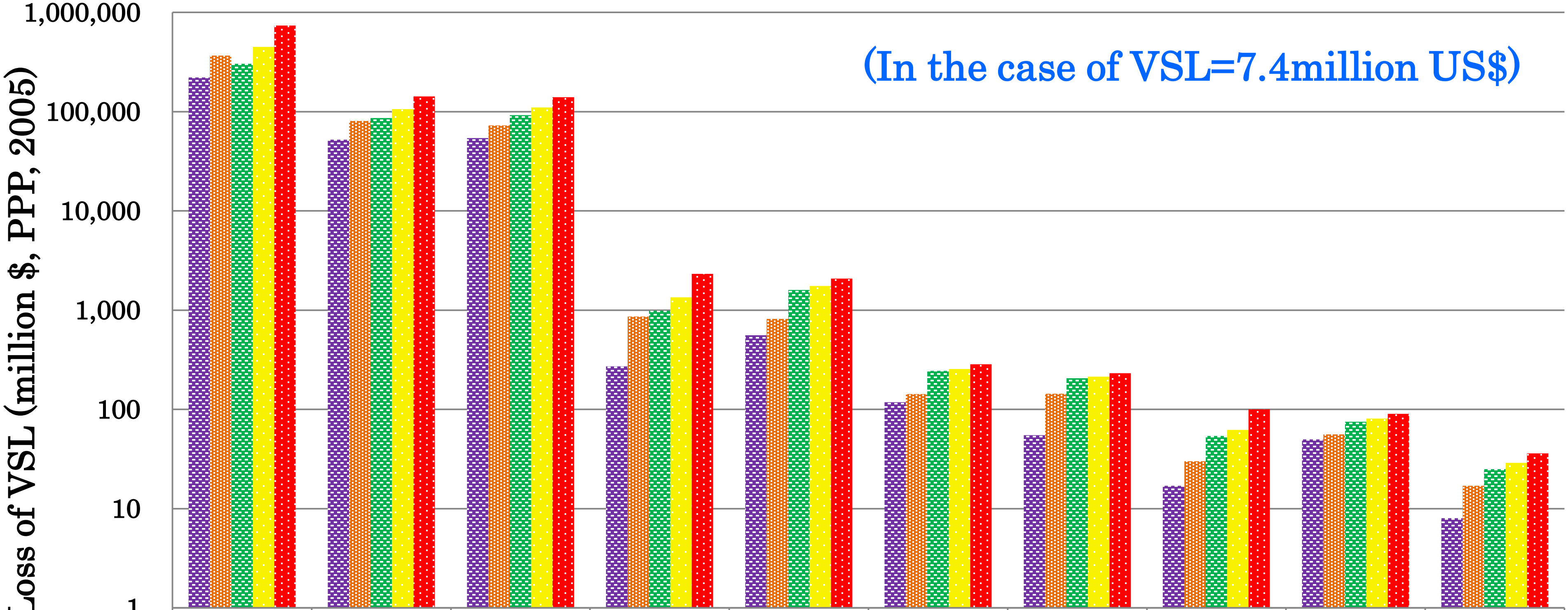
Estimated premature mortality of countries in East Asia - effect by $PM_{2.5}$ and ozone -



	China	R. of Korea	Japan	DPR of Korea	Vietnam	Thailand	Myanmar	Philippine s	Lao	Mongolia	cambodia
2000	281,000	13,300	9,890	5,070	722	480	638	103	59	101	29
2005	467,000	17,800	15,300	8,350	2,290	704	773	271	102	112	65
2020 (PSC)	384,000	22,500	16,300	8,880	2,630	1,380	1,320	389	183	151	94
2020 (REF)	571,000	26,800	20,000	11,400	3,600	1,500	1,380	403	213	162	110
2020 (PFC)	935,000	34,400	26,900	15,500	6,170	1,790	1,550	437	340	180	137

(Source:S7 study)

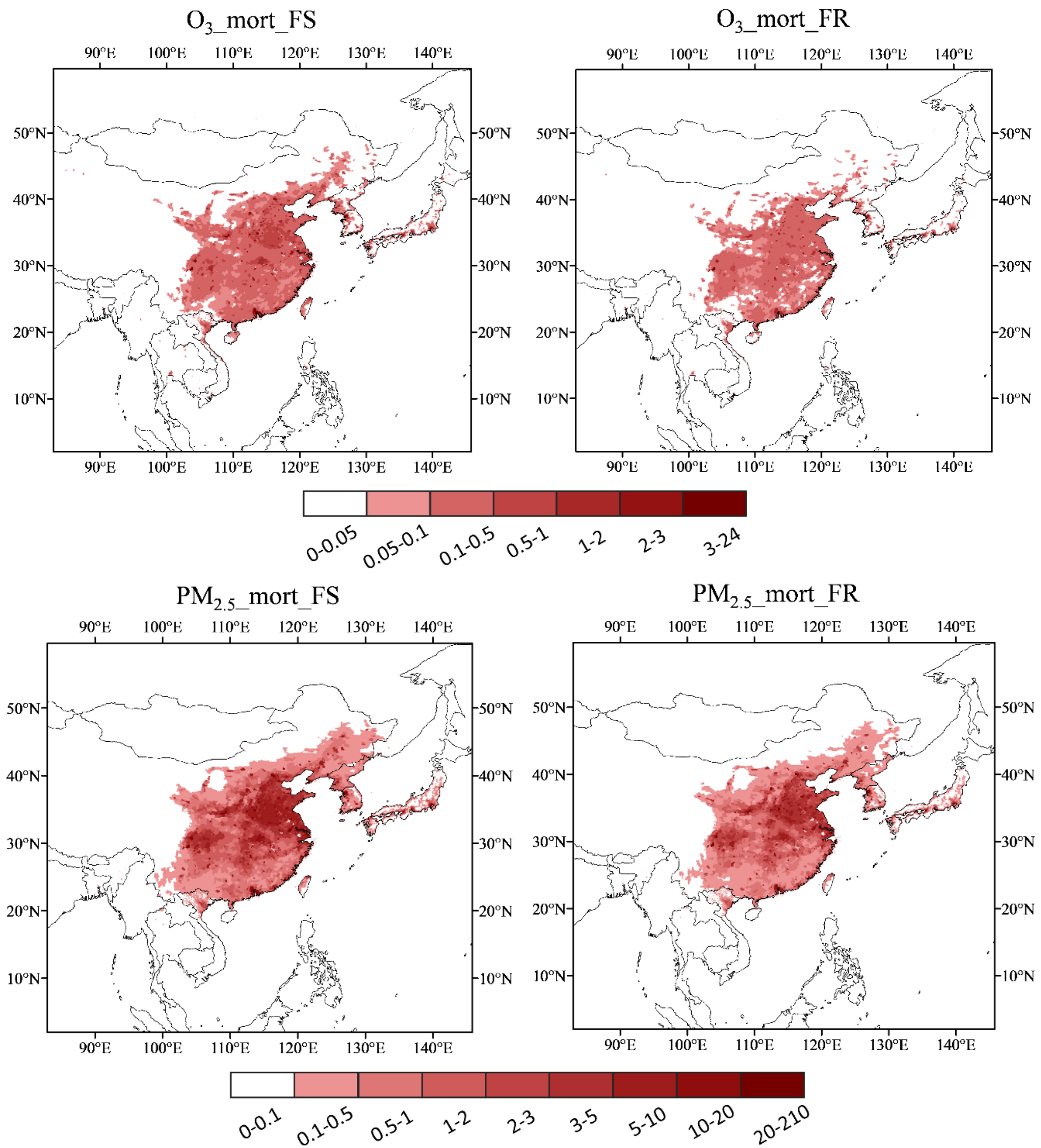
Loss of Value of Statistical Life (VSL) of premature mortality by exposure of $PM_{2.5}$ and ozone



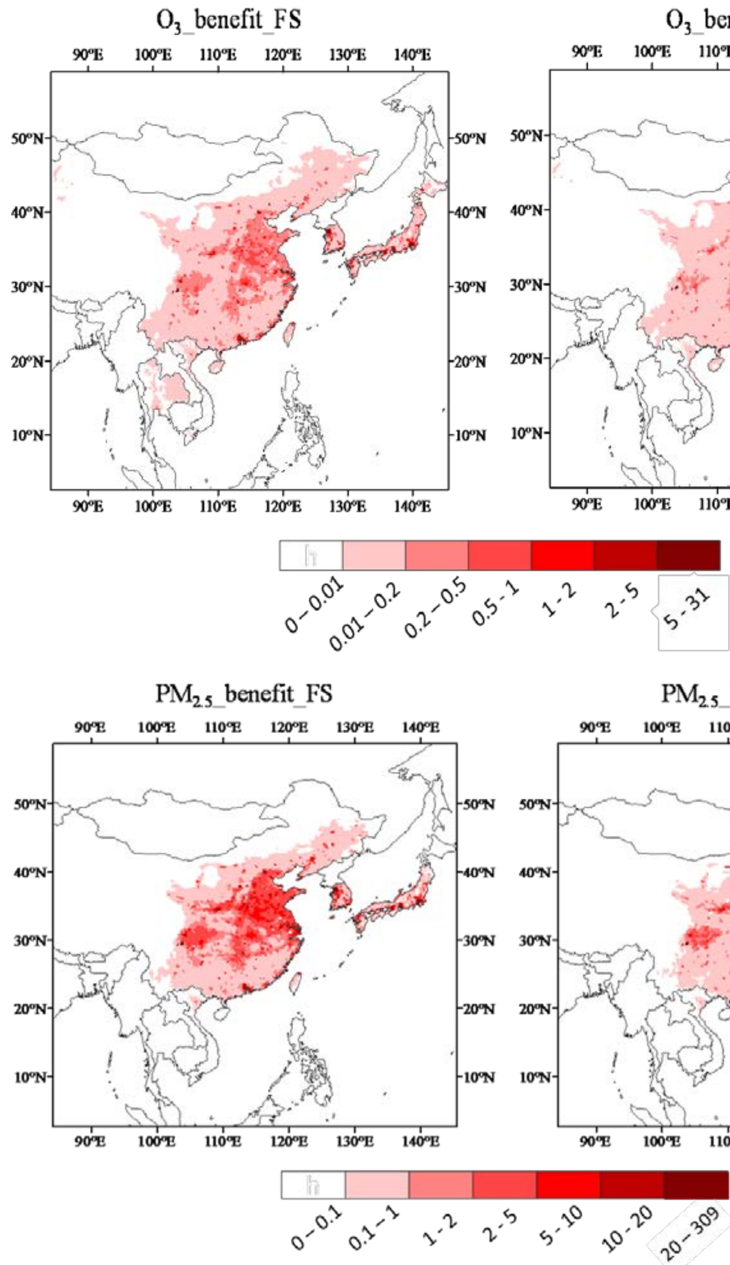
	China	Japan	R. of Korea	Vietnam	Thailand	Myanmar	Philippines	Lao	Mongolia	Cambodia
2000	221,000	52,300	54,100	271	557	118	55	17	50	8
2005	368,000	80,800	72,700	861	817	143	144	30	56	17
2020(PSC)	303,000	86,200	92,000	986	1,600	245	206	54	75	25
2020(REF)	450,000	106,000	110,000	1,350	1,750	256	214	62	81	29
2020(PFC)	737,000	142,000	140,000	2,320	2,080	285	232	100	90	36

(Source:S7 study)

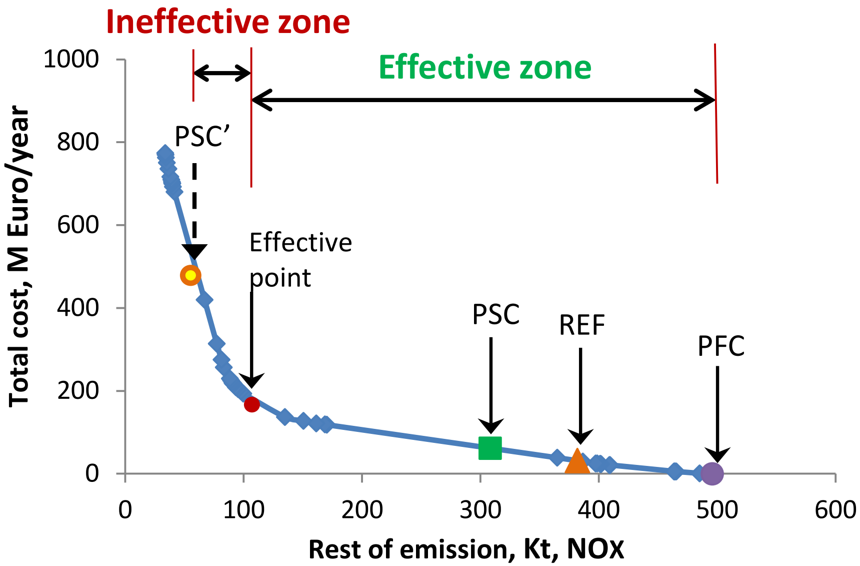
Distribution of lives saved in East Asia for Case FS and Case FR



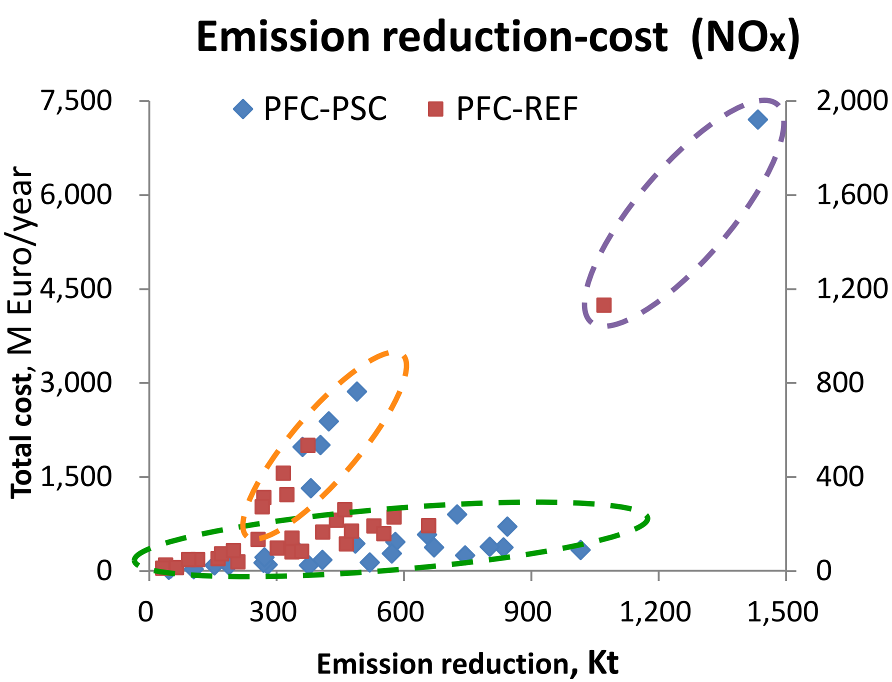
Distribution of annual accumulation of benefits of life saving in Case FS and Case FR, based on adjusted VSL (unit: million int.$, 2005)

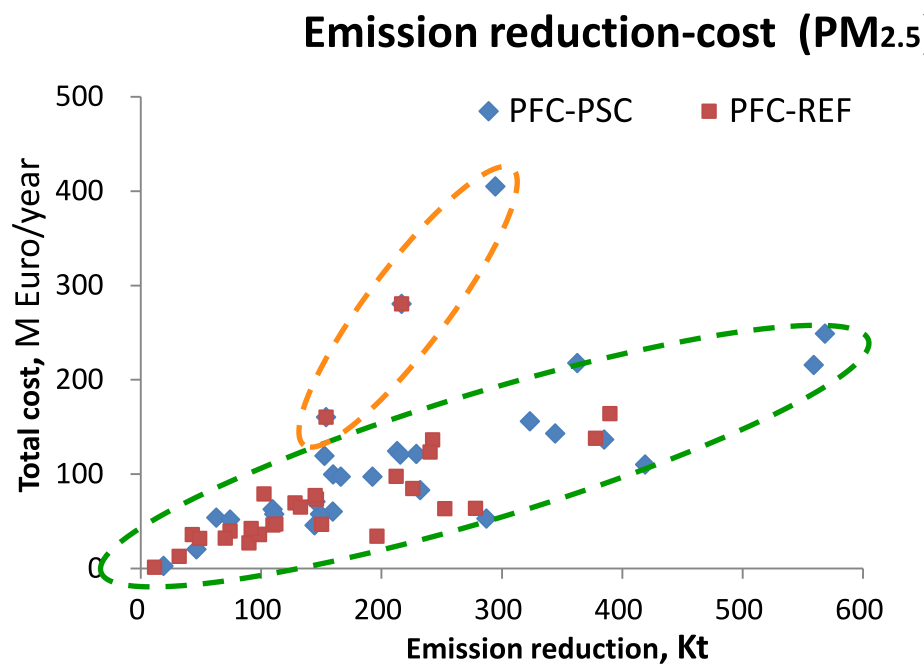


Cost-benefit analysis of emission reduction



- point -29 cities and provinces(China)(except Chongqing and Tibet)
- Green circle – effective zone
- Orange and purple circle – ineffective zone

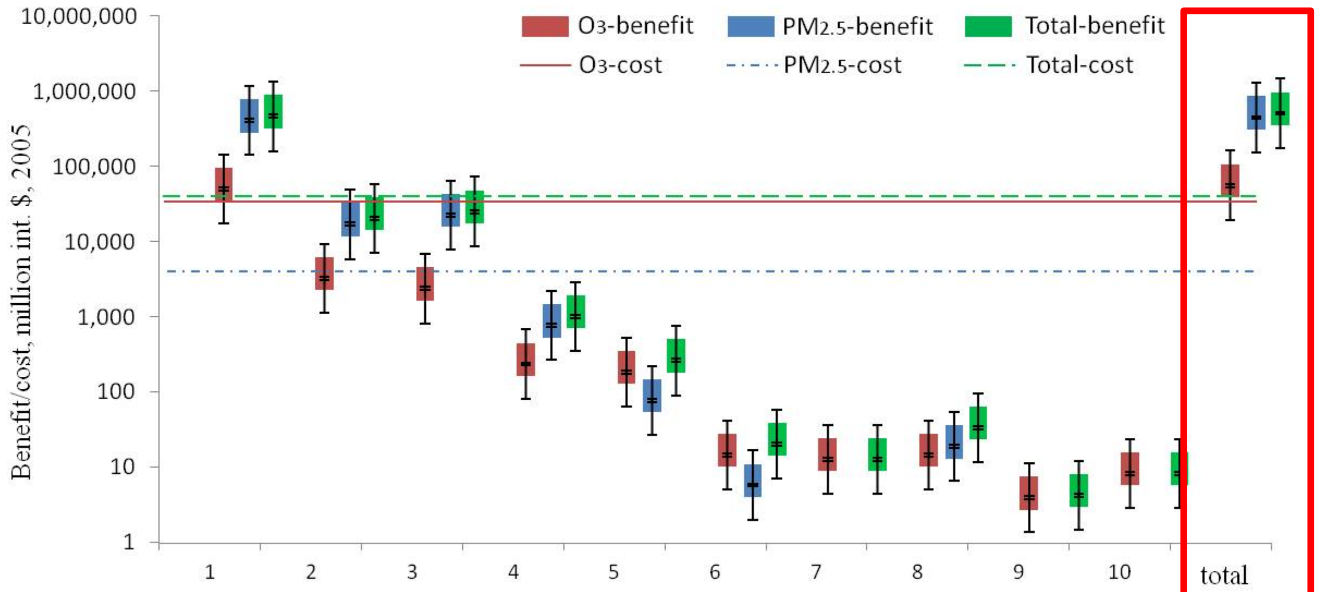




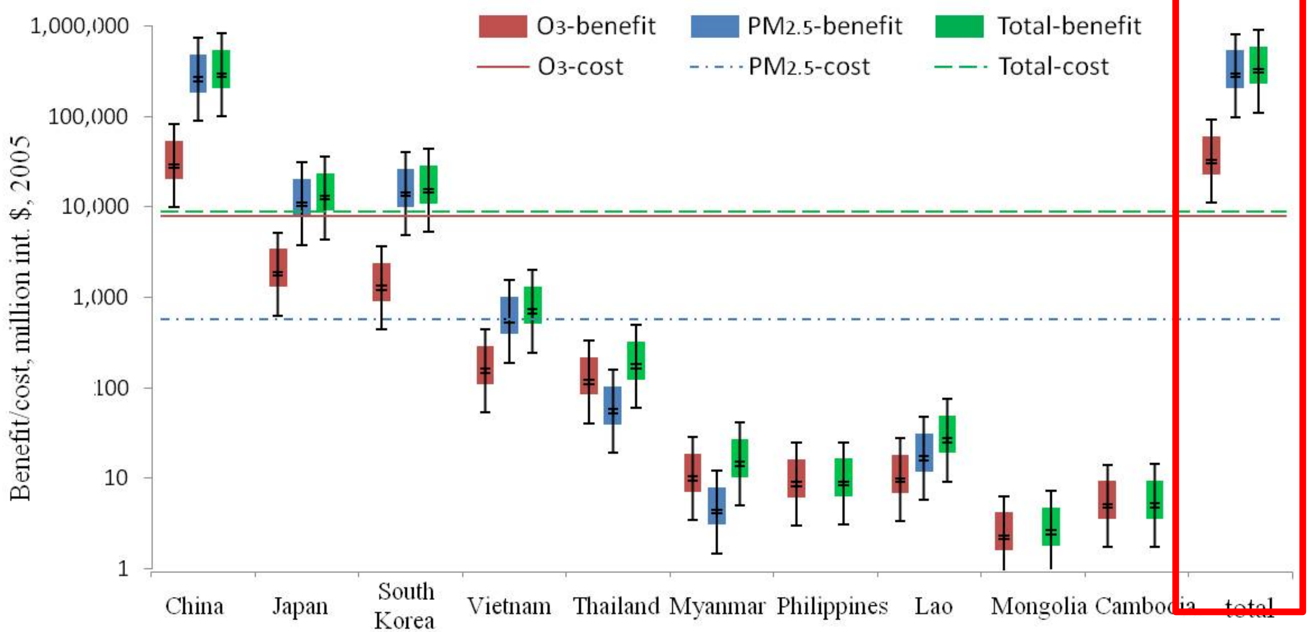
Source:S7-3-3

Cost and benefit in FS case and FR case in 2020

FS case



FR case



case	benefit/cost	
	FS	FR
ozone	1.1-3.0	2.7-7.4
$PM_{2.5}$	82-220	370-1,010
total	9.0-25	25-68

benefit > cost

※VSL (max:3.0, min: 1.1 (million int. $)) is transformed into each country value

(source: S7 study)

Thank you for your attention!