Four Discussion Pieces on Setting Air Quality Guidelines*

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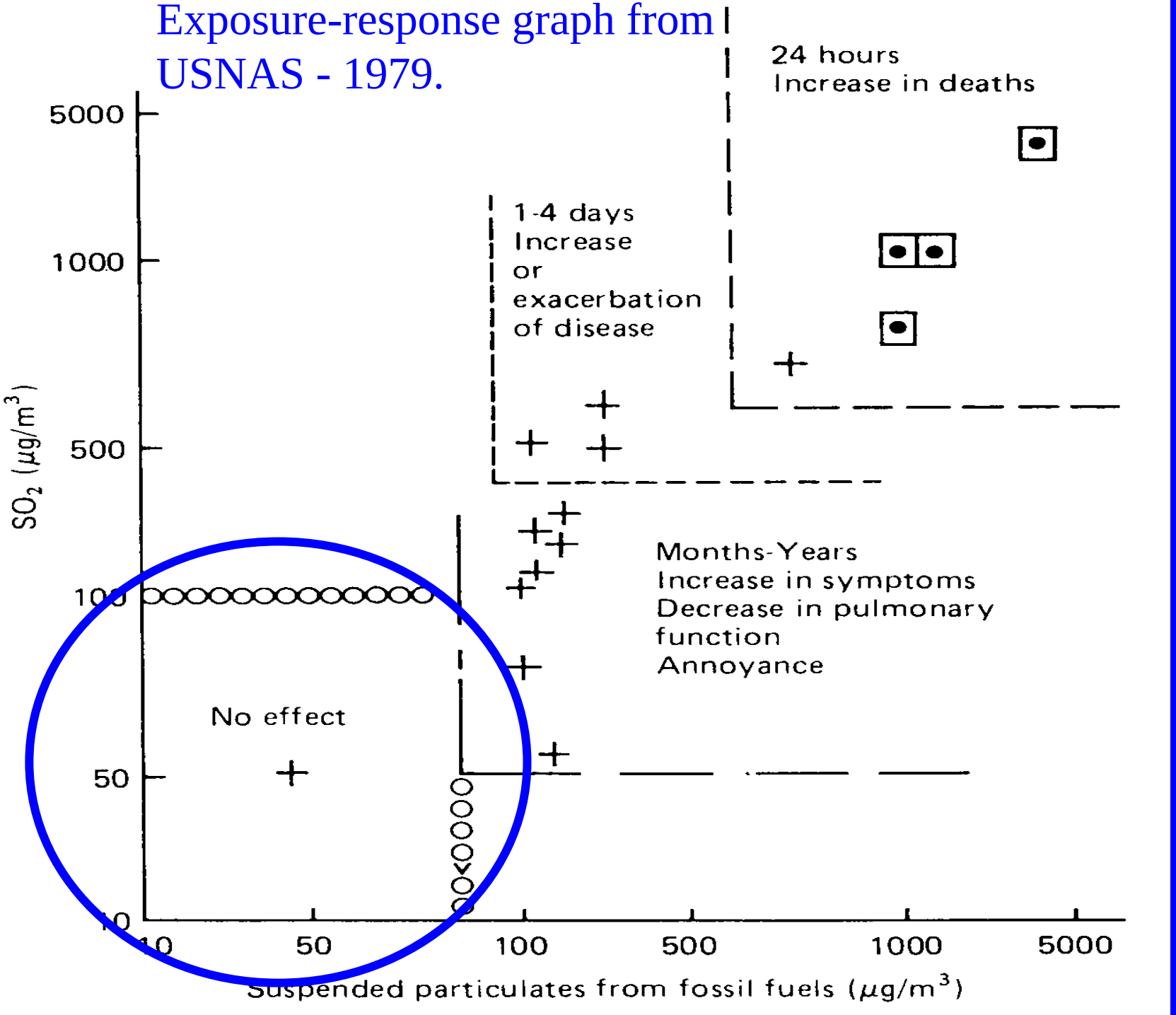
*Based on discussion pieces prepared for the WHO Air Quality Guidelines Expert Committee Meeting, October 2005, Bonn

Four Easy Pieces

- **#1 How Can AQGs be Specified for a Pollutant that has No Threshold for Health Effects?**
- **#2 Should there be Different AQGs for Indoors and Outdoors?**
- **#3 Arguments for Expanding AQGs beyond Exposure Concentration Metrics: The Example of Biomass Smoke**
- **#4 Institutionalizing the Global AQG System: Lessons from ICRP**

#1 How Can AQGs be Specified for a Pollutant that has No Threshold for Health Effects? The Euro-x model

Exposure-response graph from USNAS - 1979.



WHO 2000 AQGs

Health Topics
Environmental Health

WHO Ambient Air Quality Guidelines

Compound	Guideline Value	Averaging Time
Ozone	120 micrograms/cubic metre (0.06 parts per million)	8 hours
Nitrogen dioxide	200 micrograms/cubic metre (0.11 ppm) 40 to 50 micrograms/cubic metre (0.021 to 0.026 ppm)	1 hour annual
Sulfur dioxide	500 microgrms/cubic metre (0.175 ppm) 125 micrograms/cubic metro (0044 ppm) 50 microgrms per cubicmetre (0.017 ppm)	0 min 24 hours
Particulate matter	[a]	
Carbon monoxide	100 milligrams/cubic metre (90 ppm)[b] 60 mg/cubic metre (50ppm) 30mg/cubic metre (25 ppm) 10mg/cubic metre (10 ppm)	15 min 30 min 1 hour 8 hours
Lead [c]	0.5 to 1.0 micrograms/cubic metre	Annual

- No guideline values were set for particulate matter because there is no evident threshold for effects on morbidity and mortality.

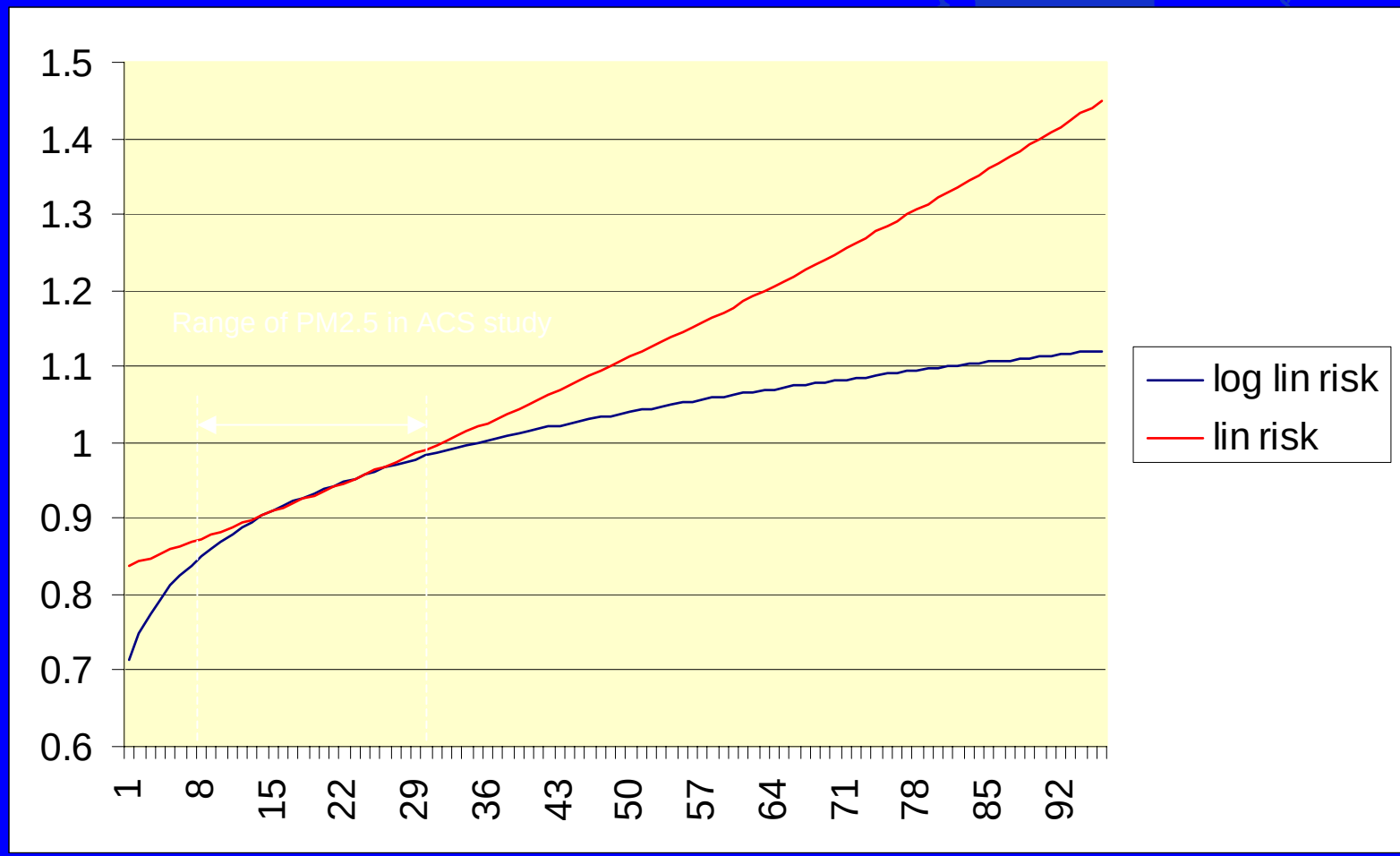
Exposure-Response Support for 2000 AQGs

Table 26. Summary of relative risk estimates for effects of long-term exposure to particulate matter on the morbidity and mortality associated with a 10 μg/m³ increase in the concentration of $PM_{2.5}$ or PM_{10}

Endpoint	Relative risk for $PM_{2.5}$ (95% confidence interval)	Relative risk for PM_{10} (95% confidence interval)
Death *(2)*	1.14 (1.04–1.24)	1.10 (1.03–1.18)
Death *(3)*	1.07 (1.04–1.11)	
Bronchitis *(4)*	1.34 (0.94–1.99)	1.29 (0.96–1.83)
Percentage change in FEV_1, children *(5)*[a]	−1.9% (−3.1% to −0.6%)	−1.2% (−2.3% to −0.1%)
Percentage change in FEV_1, adults *(6)*		−1.0% (not available)

[a] For $PM_{2.1}$ rather than $PM_{2.5}$.

Hazard functions for cardiopulmonary deaths ACS Study 1982-1998



Euro-x Auto Emissions Standards

http://www.euractiv.com/Article?tcmuri=tcm:29-133325-16&type=LinksDossier

Emissions Standard	Particulate matters (PM)/(mg/km)	-	Oxides of nitrogen (NOx) (g/km)	-	Hydrocarbons (HC) (g/km)	-	Carbon monoxide (CO)(g/km)
-	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel
Euro 2 (1996)	80-100	-	-	-	-	-	0.7/0.9
Euro 3 (2000)	50	-	0.5	0.15	-	0.2	0.56
Euro 4 (2005)	25	-	0.25	0.08	-	0.1	0.3
Euro 5* (2010)	5	5	0.2	0.06	-	0.075	-

*Not yet firm

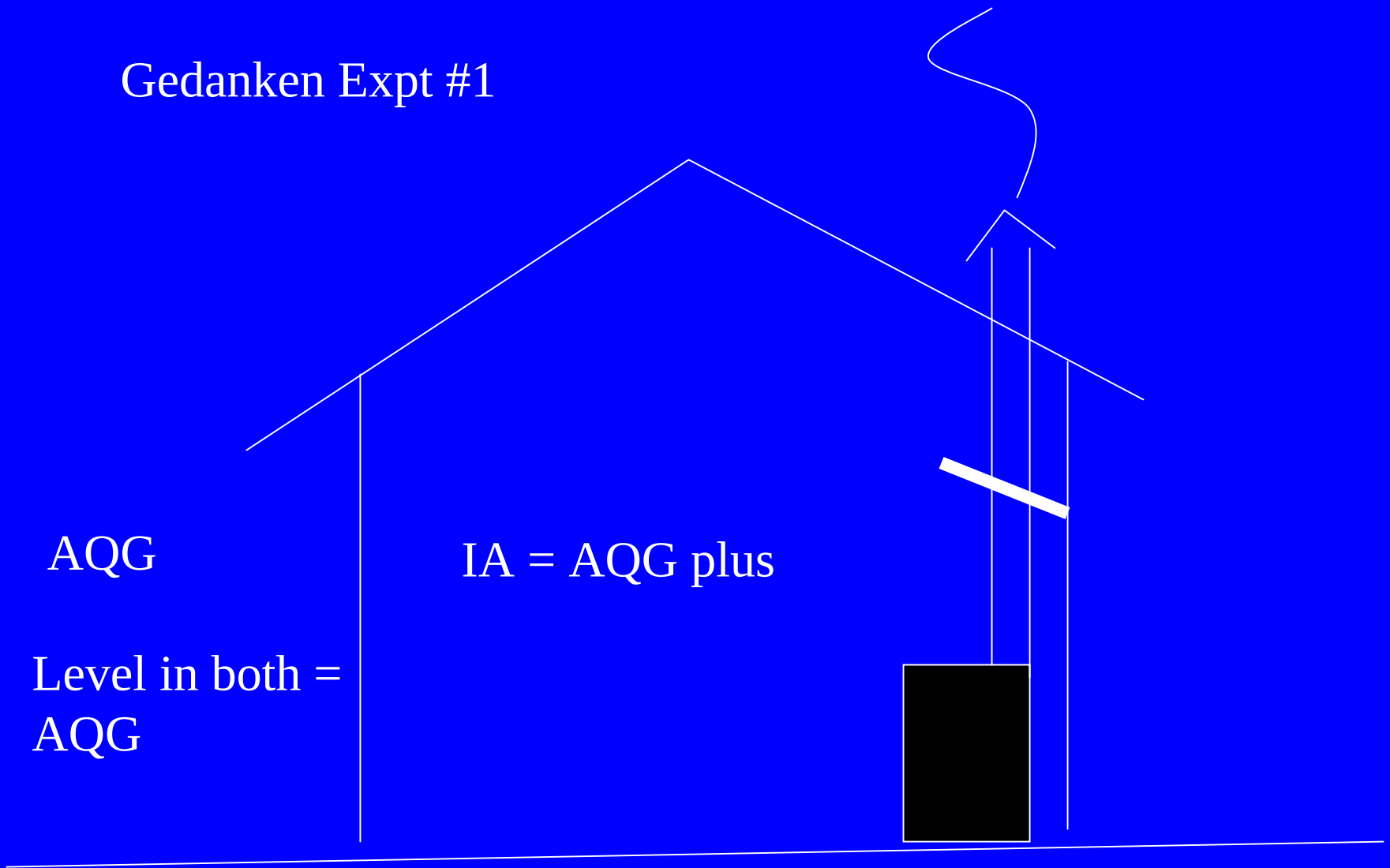
WHO AQG: Global update 2005: Particulate matter - annual mean

Annual mean level	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	Basis for the selected level
WHO interim target-1 (IT-1)	70	35	Levels associated with about 15% higher long-term mortality than at AQG
WHO interim target-2 (IT-2)	50	25	Risk of premature mortality decreased by approximately 6% (2-11%) compared to WHO-IT1
WHO interim target-3 (IT-3)	30	15	Mortality risk reduced by approximately 6% [2-11%] compared to WHO-IT2 levels.
WHO Air quality guidelines (AQG)	**20**	**10**	Lowest levels at which total, CP and LCA mortality have been shown to increase (Pope et al., 2002). The use of $PM_{2.5}$ guideline is preferred.

WORLD HEALTH ORGANIZATION
EUROPE

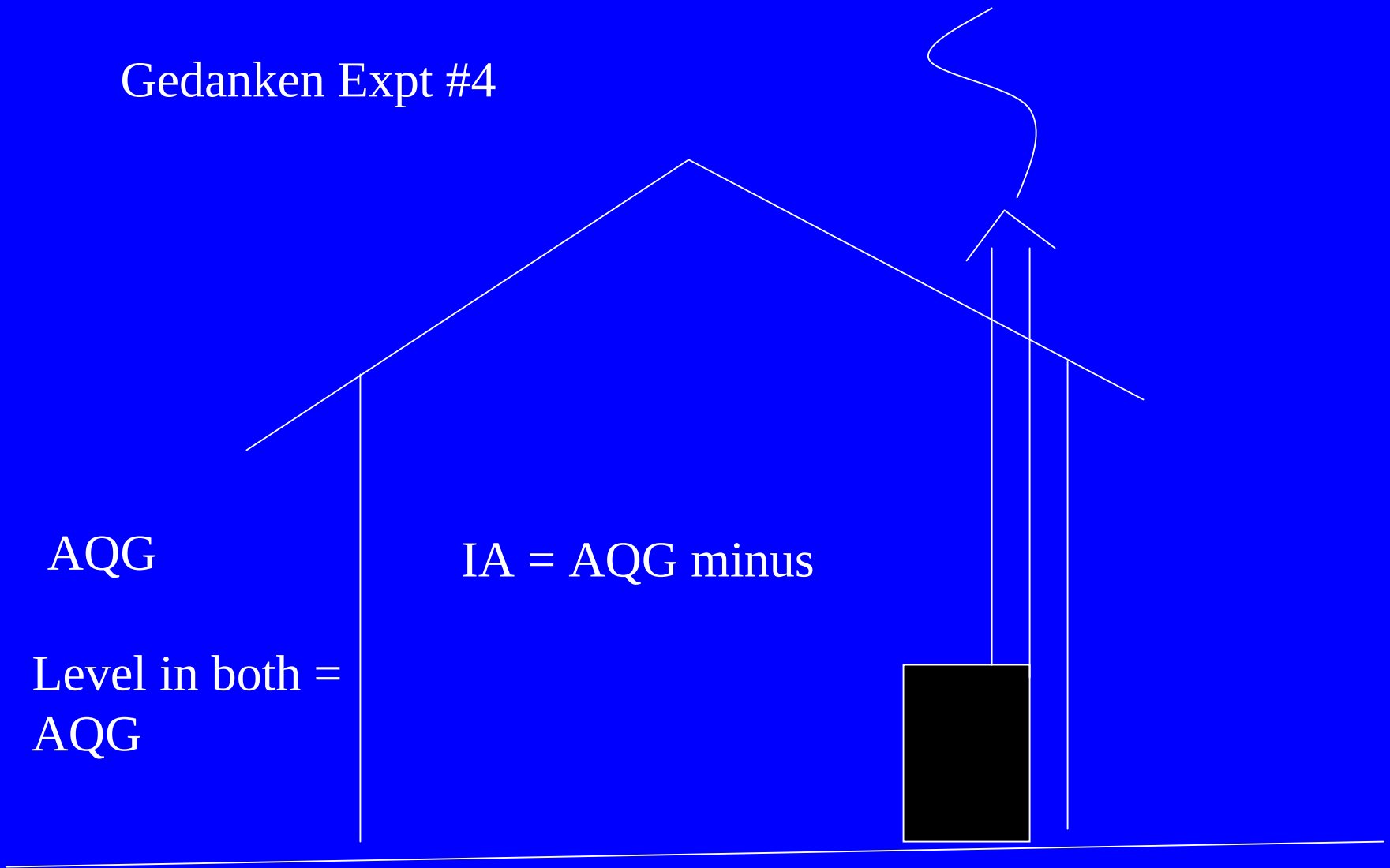
#2 Should there be Different AQGs for Indoors and Outdoors?

Gedanken Expt #1



A chimney would be a bad thing

Gedanken Expt #4



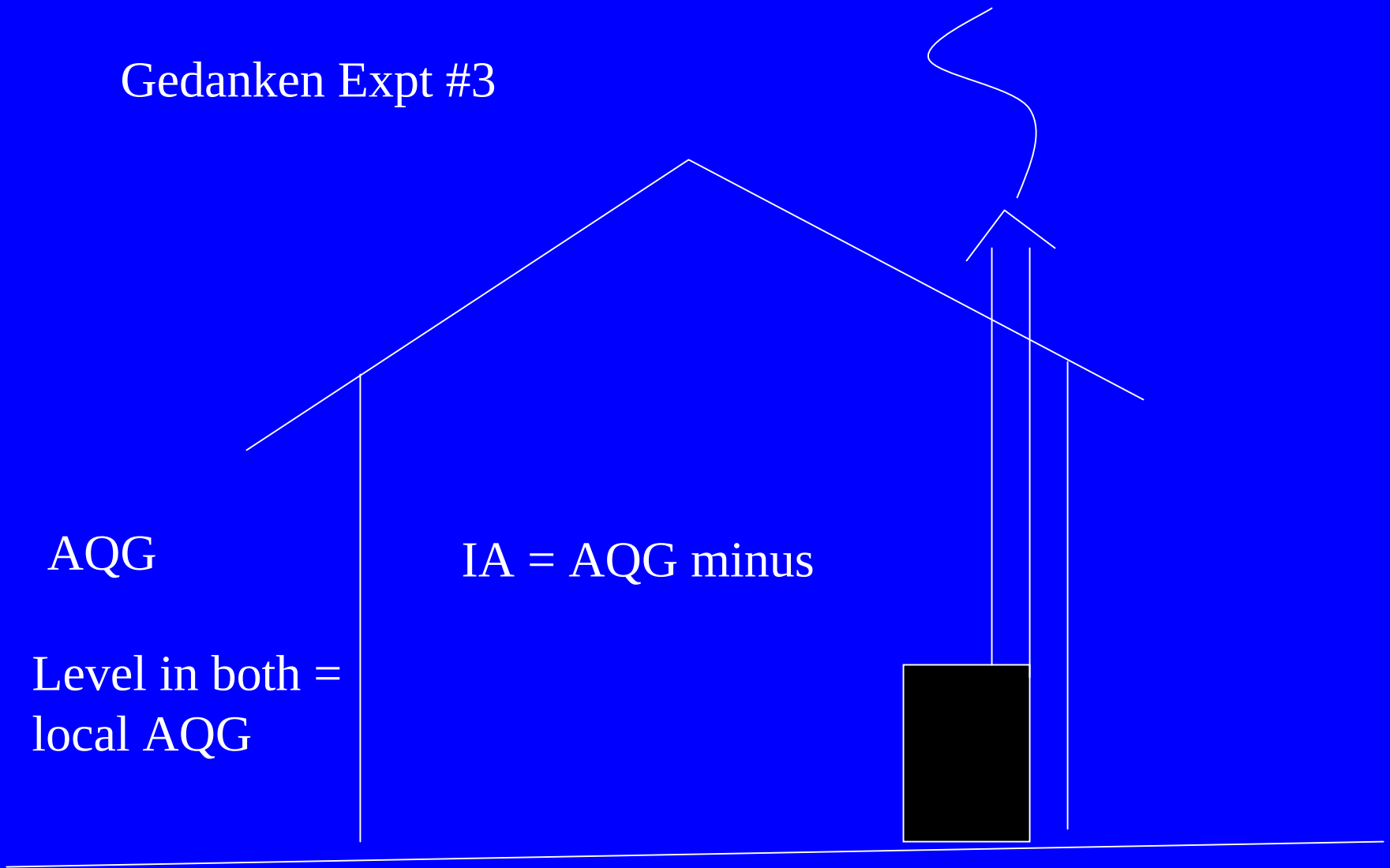
AQG

IA = AQG minus

Level in both = AQG

People should leave their houses even though pollution outdoors is the same

Gedanken Expt #3



AQG

IA = AQG minus

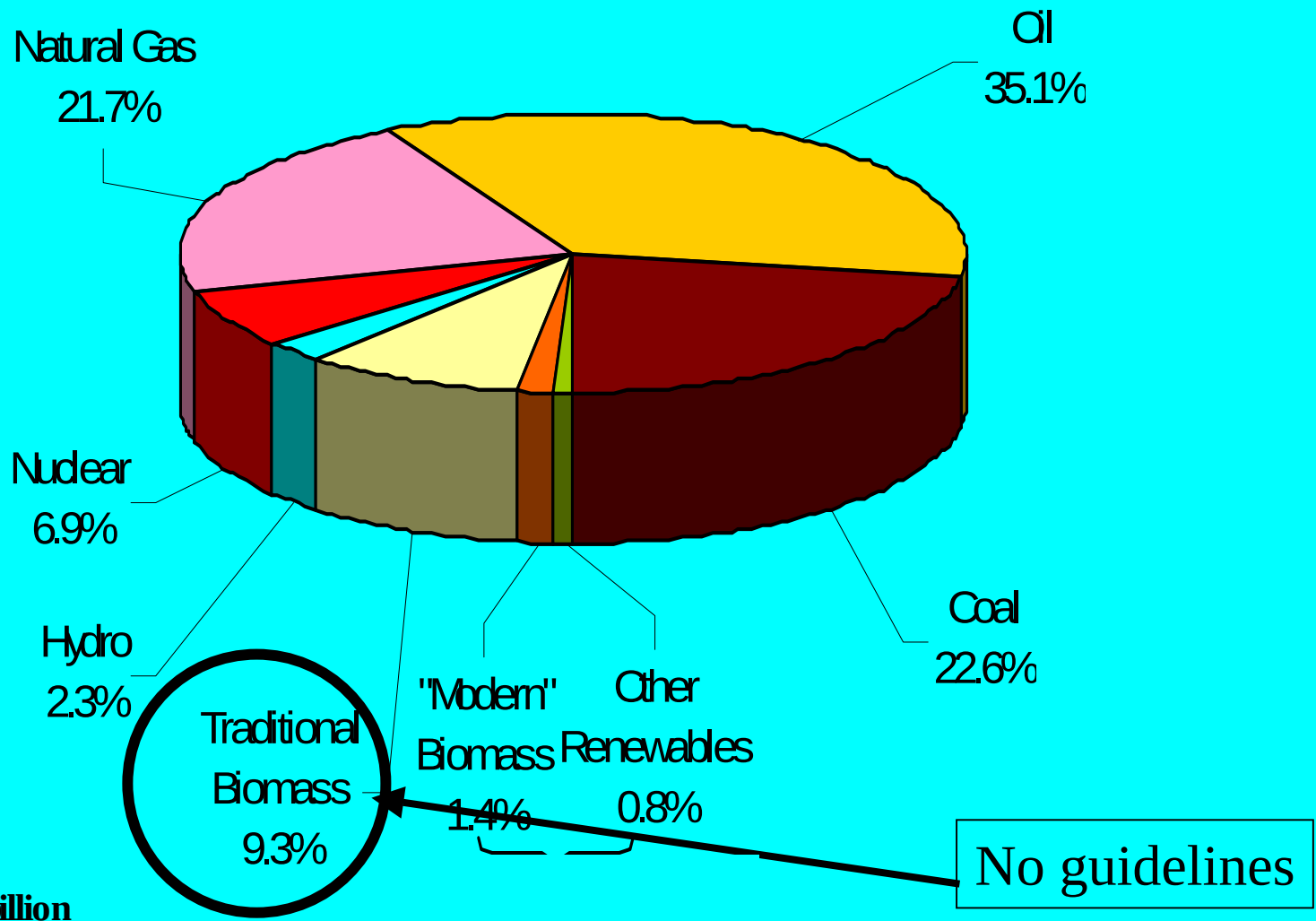
Level in both = local AQG

Opening window is ok from the outside, but not from the inside

“consensual pretense of undifferentiated PM”

#3 Arguments for Expanding AQGs beyond Exposure Concentration Metrics: The Example of Biomass Smoke

World Energy – 2001

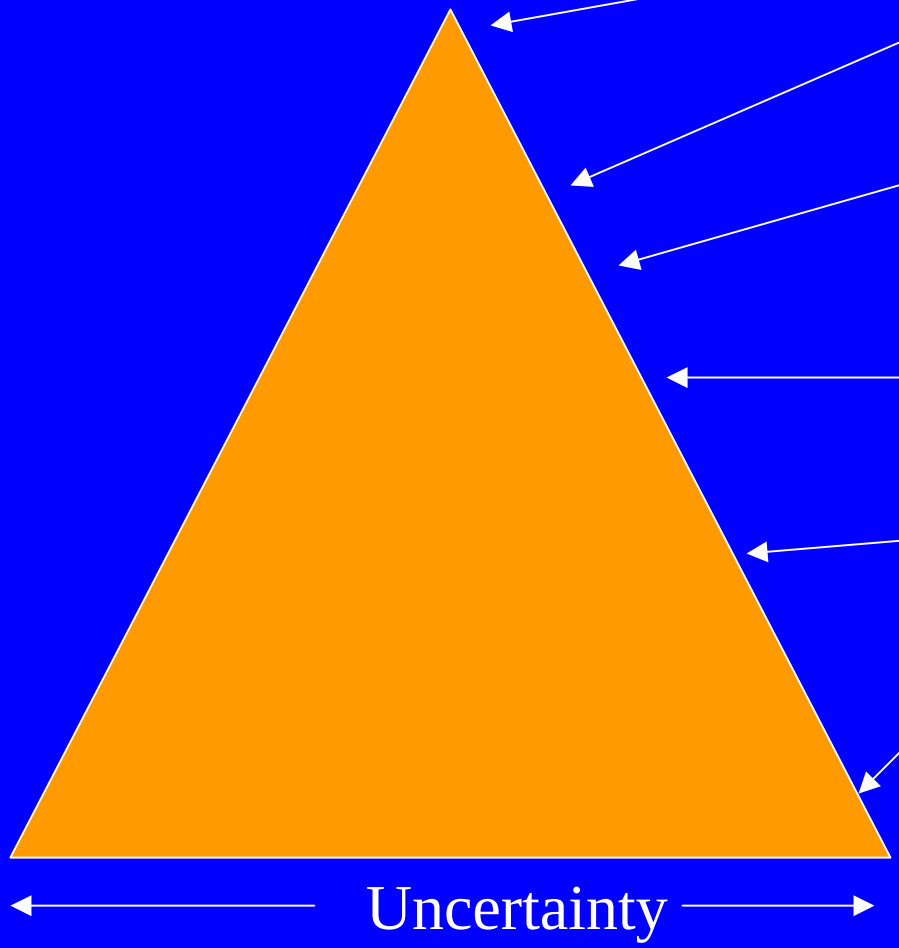


Population: 6.102 billion
Total energy use: 10.2 Gtoe
Per capita energy consumption: 1.67 toe

World Energy Assessment, 2004


Ventilation
Solid Fuel
KR. Smith

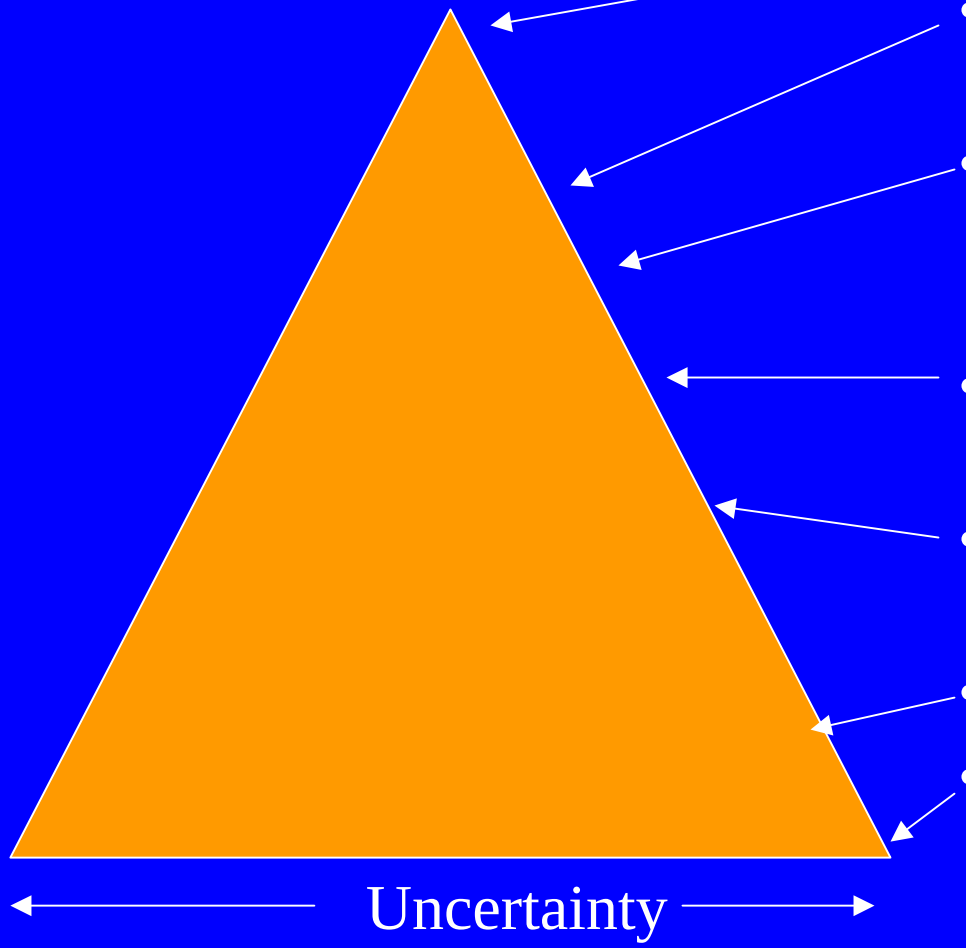
Pyramid of Exposure Assessment Outdoor Air Pollution



- Biomarkers
- Continuous personal monitoring
- Microenvironmental monitoring with time-activity data
- Multiple microenvironment monitoring
- Single microenvironment monitoring
- Secondary information

Cost

Pyramid of Exposure Assessment Indoor Air Pollution



- Biomarkers
- Continuous personal monitoring
- Microenvironmental monitoring with time-activity data
- Multiple microenvironment monitoring
- Single microenvironment monitoring
- **HH Questionnaires**
- Secondary information

Cost

Analog to Water and Sanitation

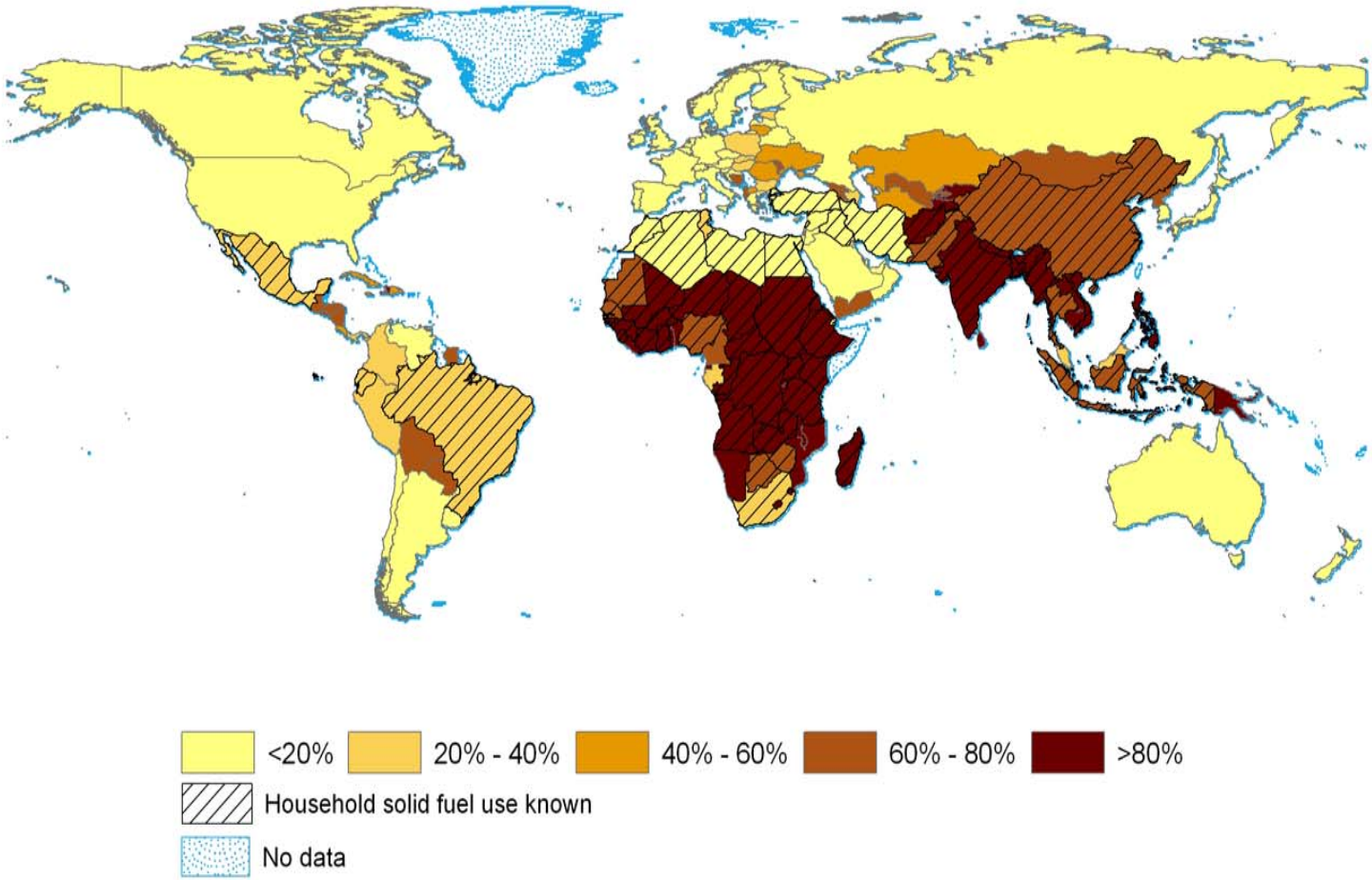
- Access to clean water
- Access to sanitation
- Access to clean fuels
- Access to ventilation

Survey based – no measurements

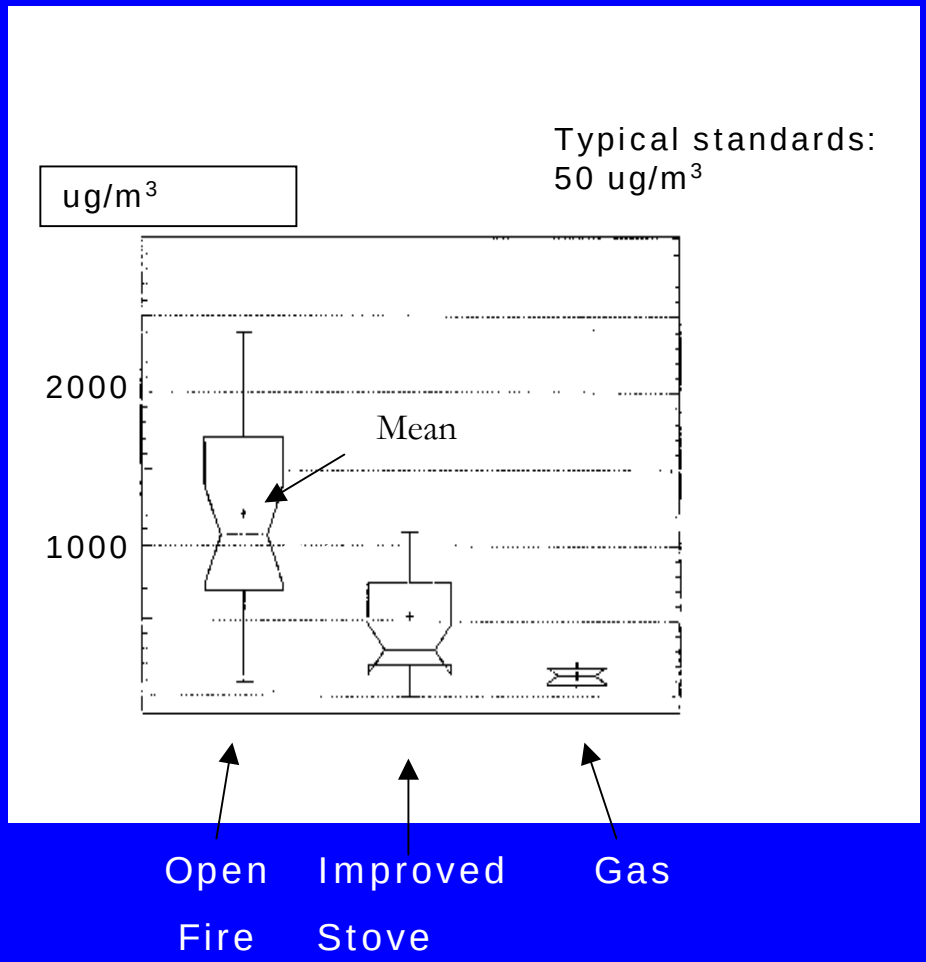
Technology based – no judgment on how well technology works

All of these air and water metrics are commonly used for epidemiological studies with excellent results

National Household Solid Fuel Use, 2000

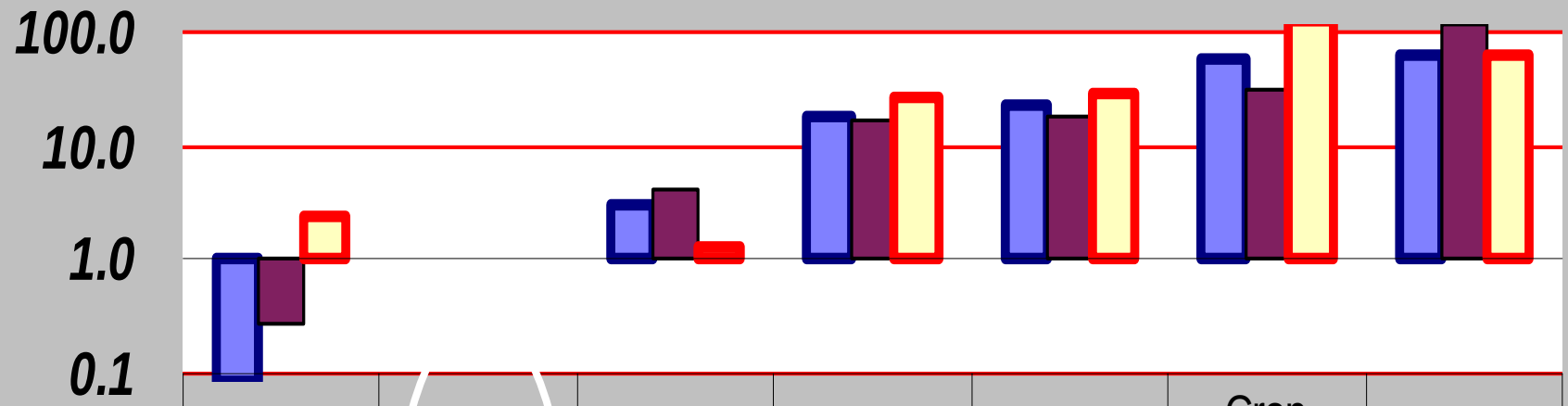


Indoor PM_{10} Levels



- Highland Guatemala
- PM_{10}
- Kitchen
- 24 hours
- Open woodstove
- Improved woodstove with chimney
- LPG stove

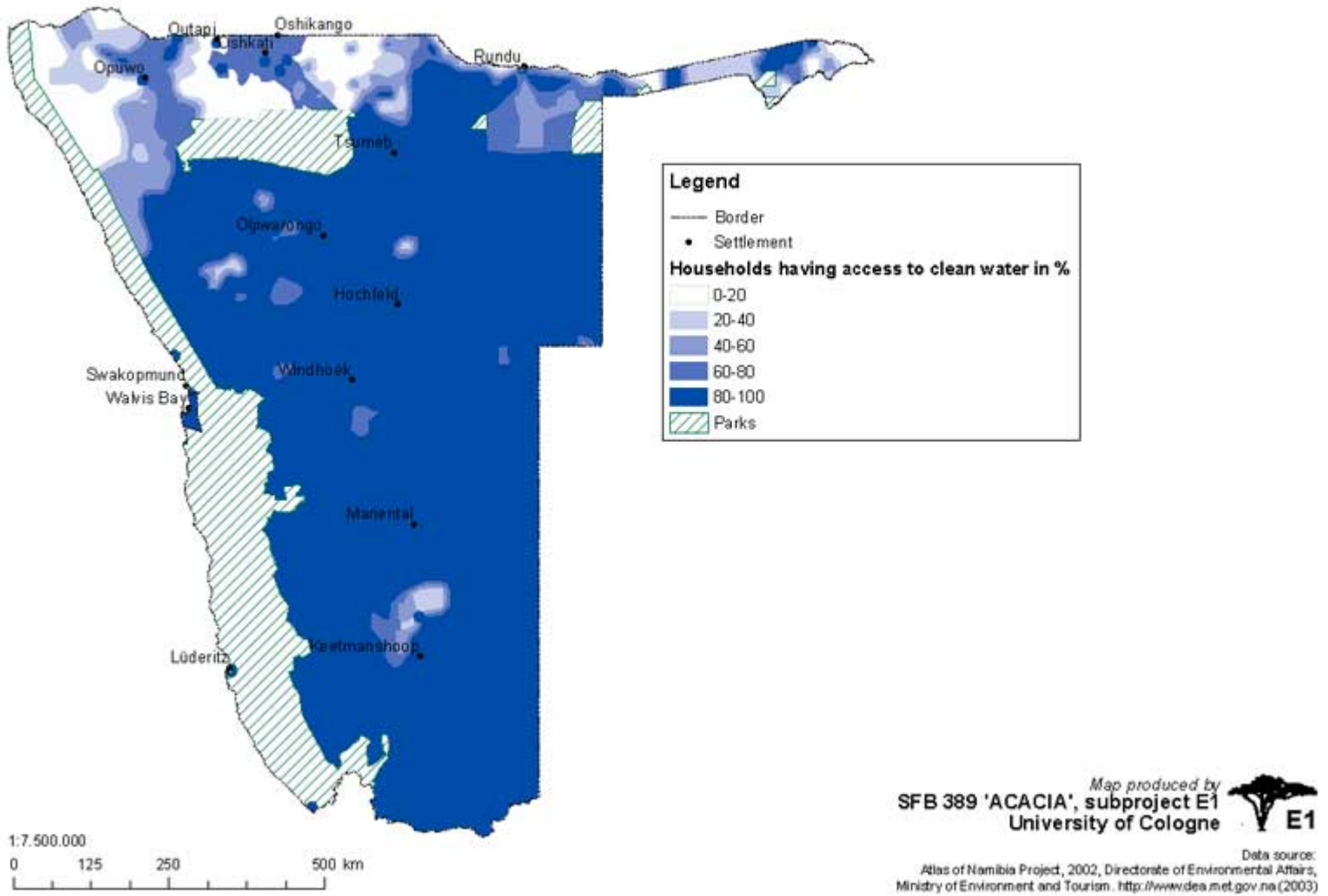
The Energy Ladder: Relative Pollutant Emissions Per Meal



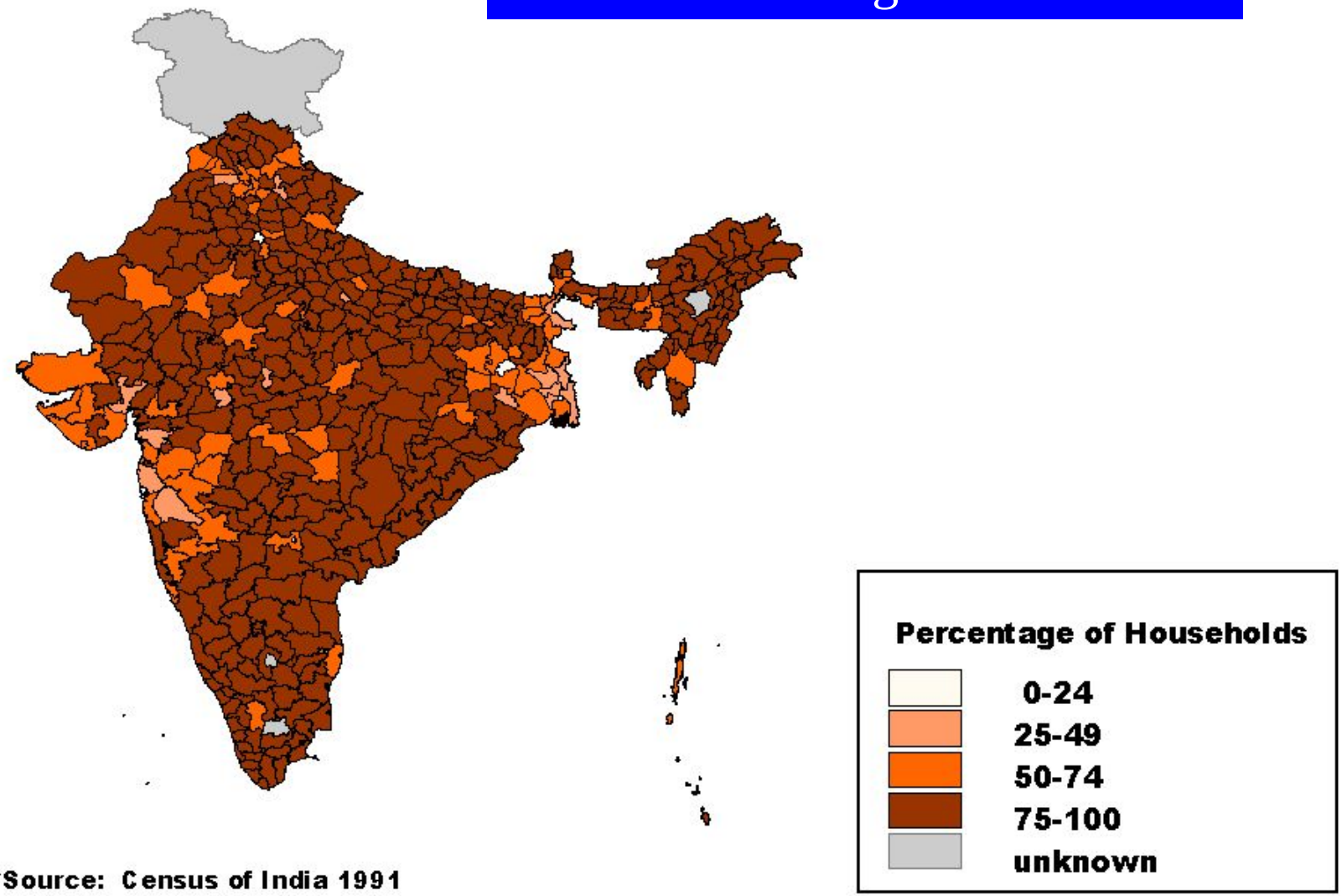
	Biogas	LPG	Kerosene	Wood	Roots	Crop Residues	Dung
CO	0.1	1.0	3	19	22	60	64
Hydrocarbons	0.3	1.0	4.2	17	18	32	115
PM	2.5	1.0	1.3	26	30	124	63

CO Hydrocarbons PM

Access to clean water in Namibia



Households Using Biomass Fuels

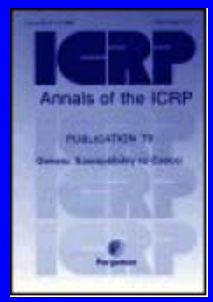


*Source: Census of India 1991


Solid-fuel Cooking in Rural China
Wood
Coal
Straw

#4 Institutionalizing the Global AQG System: Lessons from ICRP

ICRP INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION



Mission: The International Commission on Radiological Protection is an independent Registered Charity, established to advance for the public benefit the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionizing radiation.

Global Health Effects of Combustion Particles: Premature Deaths Per Year

- Large city outdoor air pollution: ~800,000
- Small city and rural outdoor air pollution: ?
- Household use of solid fuels: ~1,600,000
- Environmental tobacco smoke: ~300,000
- Occupational exposures: ~250,000
- Total ~ 3 million per year
  - With smoking: ~8 million
- Compare with global totals for
  - Poor water/sanitation: 2 million
  - HIV: 3 million
  - All cancer: 7 million
  - Malnutrition: 4 million

放影研 RERF

Radiation Effects Research Foundation

財団法人 放射線影響研究所

The Japanese-United States research organization focused on the study of health effects of radiation in survivors of the atomic bombings in Hiroshima and Nagasaki

広島と長崎の原爆被爆者における放射線の
健康影響について調査研究を行う
日米共同研究機関

お知らせ What's New

Hiroshima Laboratory
広島研究所

Nagasaki Laboratory
長崎研究所

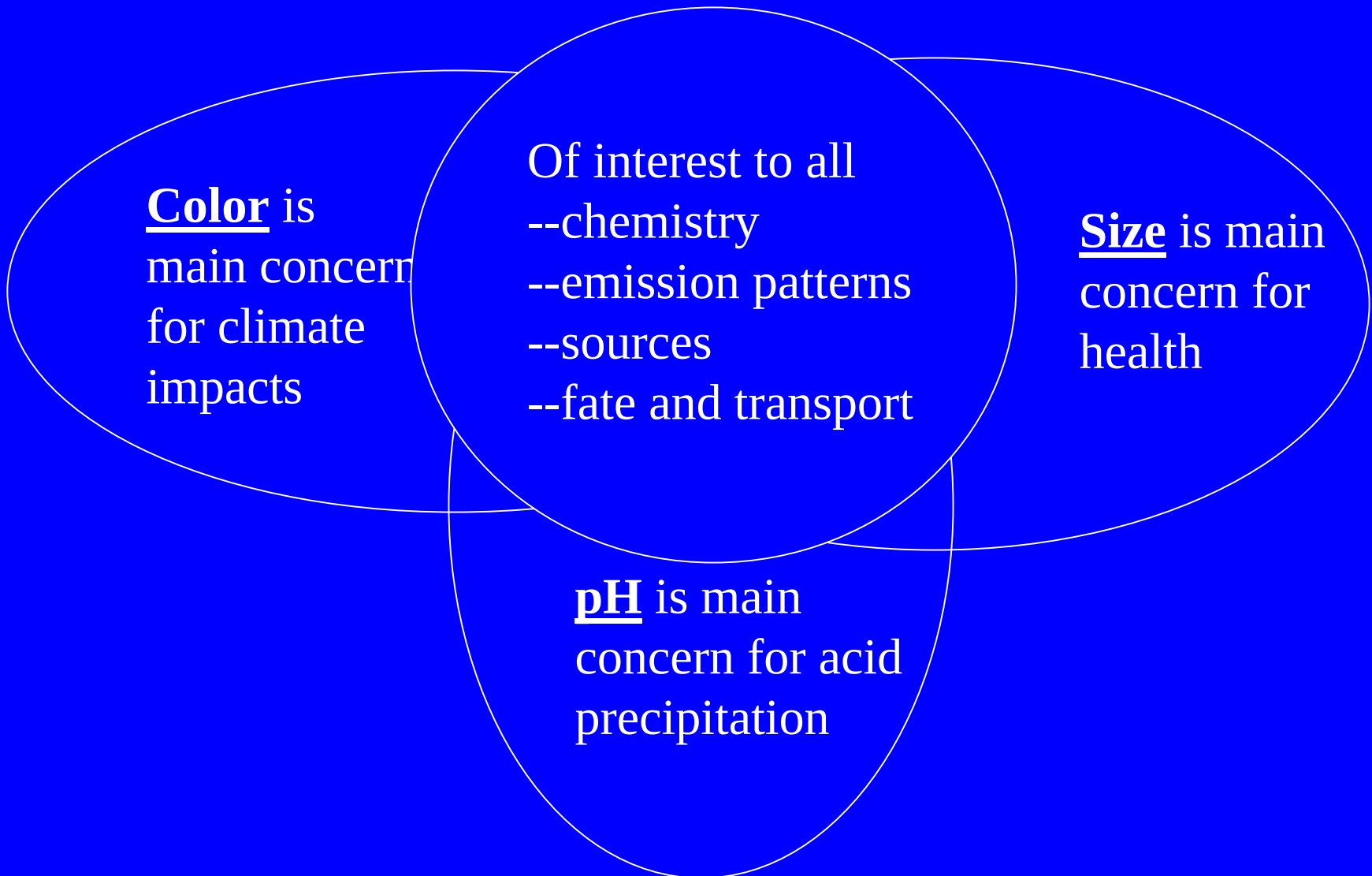
Radiation Effects Research Foundation (RERF)

- –Set up in Hiroshima after WWII
- –100s of millions of dollars spent
- –Internationally funded
- –Highly credible science is done, although the subject is politically charged.
- –Still most important source of information on radiation health effects
- –Total excess deaths found in the two cities in 60 years ~500

Why Not A Particle Effects Research Foundation?

- Large problem worldwide in developed and developing countries
- Important effects on health
- Important effects on climate
- Important effects on ecosystems
- Many important scientific uncertainties in emissions, transformation, and impacts
- Sources linked to human economic activity at every level of development
- Much work to be done to find viable interventions because of engineering, economic, and policy difficulties and uncertainties
- About 500 deaths every 2 hours!

Of Special Interest
Airborne Particles from Combustion



Thank you