Working Party on Health and Environment, Luxembourg , May 23rd 2006

APHEIS

Air Pollution and Health: A European Information System

Monitoring the impact of Air Pollution on Public Health in 26 European cities

P. PIRARD on behalf of Sylvia MEDINA coordinator of the APHEIS group

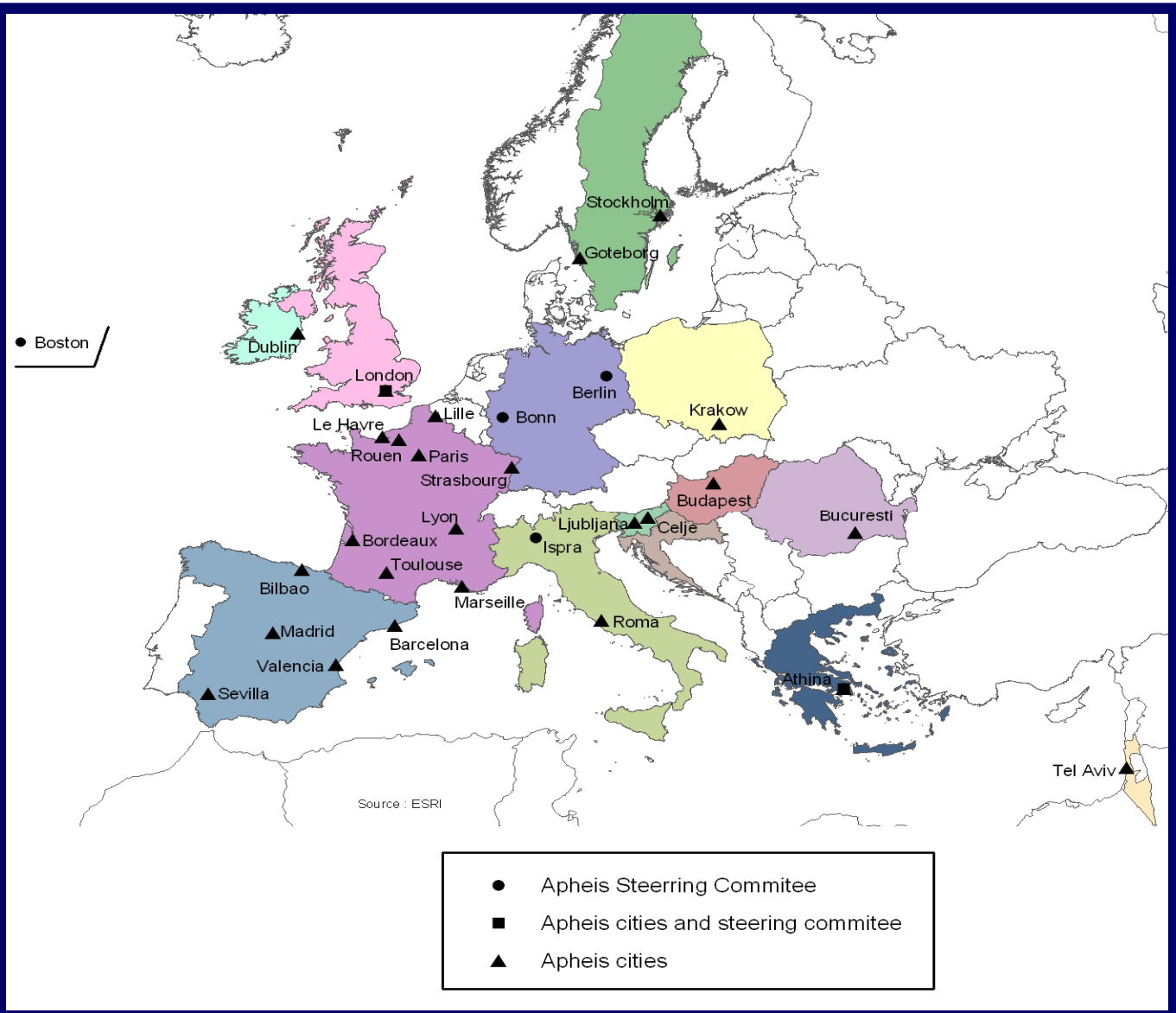
What is Apheis ?

- **European public health surveillance** system to monitor the effects of air pollution (AP) on public health (PH)
- **Objective**: translates epidemiological findings into decision-making tools and provide reliable, up-to-date and easy-to-use information on the effects of AP on PH
- **Target audiences**: policy-makers, environment and health professionals, NGOs, the general public

How Apheis meets the information needs of its key audiences

- Create a Europe-wide PH surveillance network on the effects of AP on health
- Perform health-impact assessments (HIAs) on short- and long-term effects of AP over time
- Deliver periodic reports on the impact of AP on PH at the city and European levels simultaneously
- Develop communications tools for its different target audiences

The Apheis Network



The Apheis Network

APHEIS Coordination Centre

Paris and Barcelona

Advisory groups
Exposure assessment
Epidemiology
Statistics
Public health
Health impact assessment

APHEIS Participating Centre

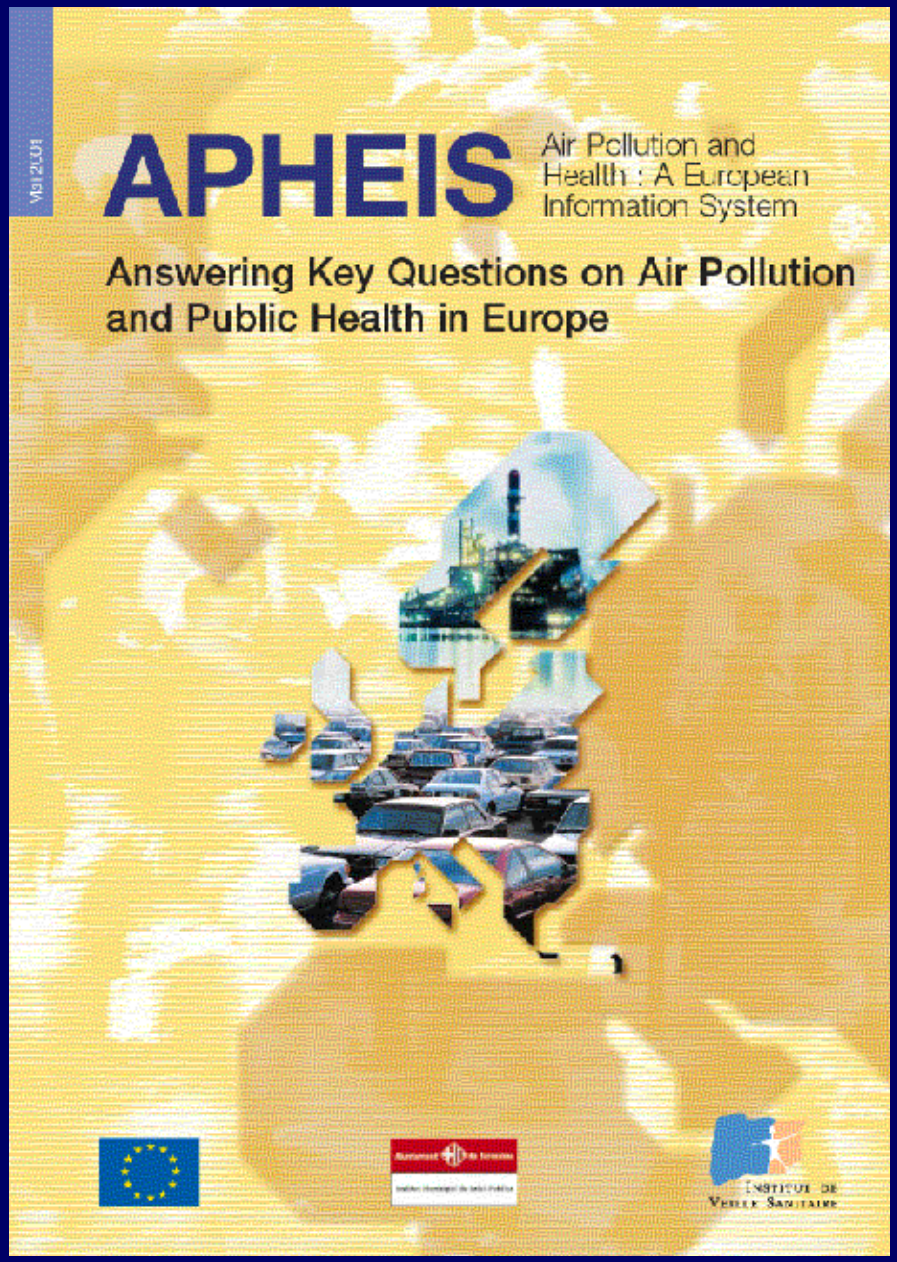
Local/regional coordinator

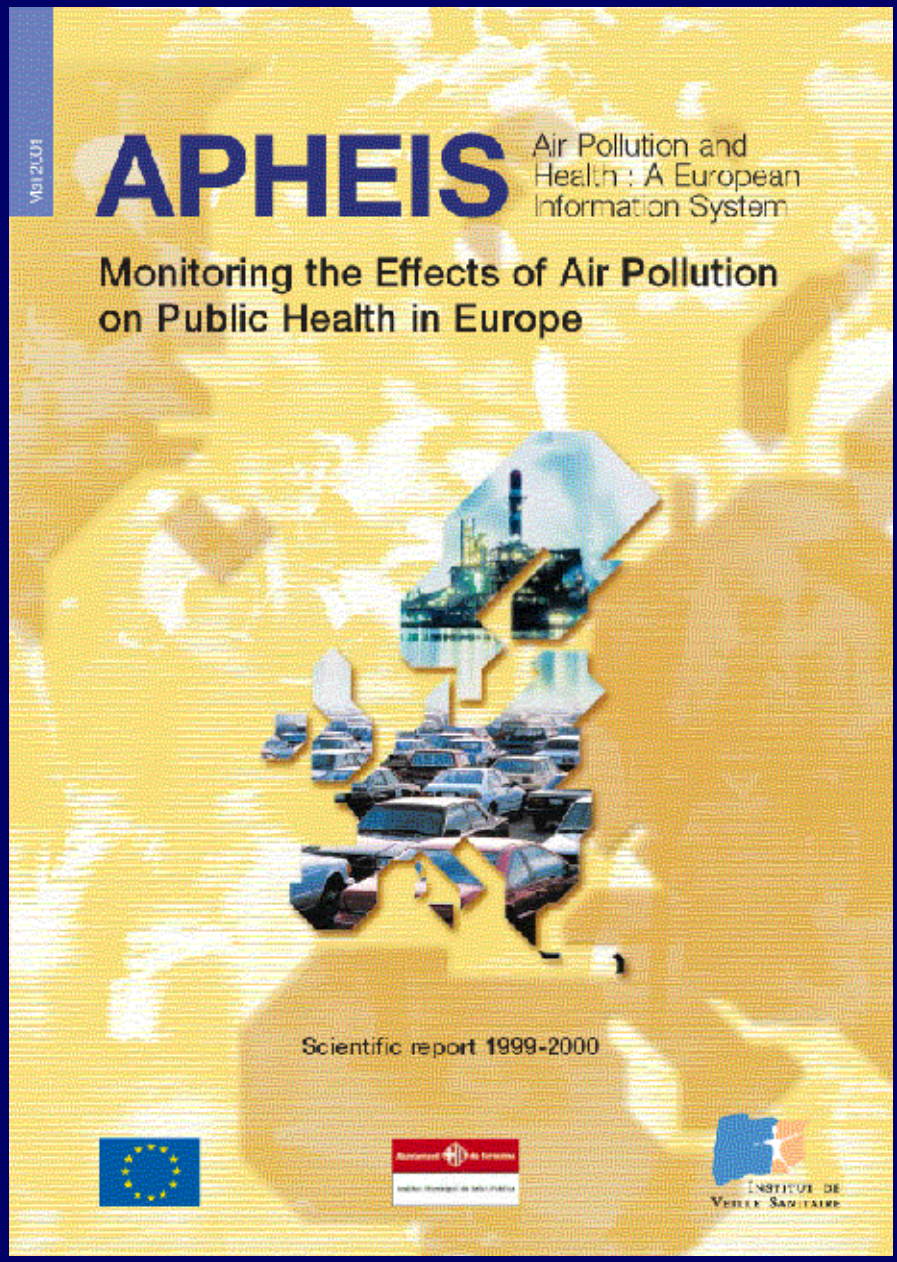
Technical committee
Exposure assessment
Epidemiology
Statistics
Public Health
Health Impact Assessment

City committee
NEHAPs
Local/national authorities
Medical/environmental sciences
Citizens

Actions, steps and results during the first year

- Created five advisory groups: public health; health-impact assessment; epidemiology; exposure assessment; statistics
- Drafted guidelines for designing and implementing the surveillance system, and for developing a standardised protocol for data collection and analysis for HIA
- Review of capacities for HIA in institutions of participating cities


APHEIS
Air Pollution and Health : A European Information System
Answering Key Questions on Air Pollution and Public Health in Europe
Institut de Veille Sanitaire


APHEIS
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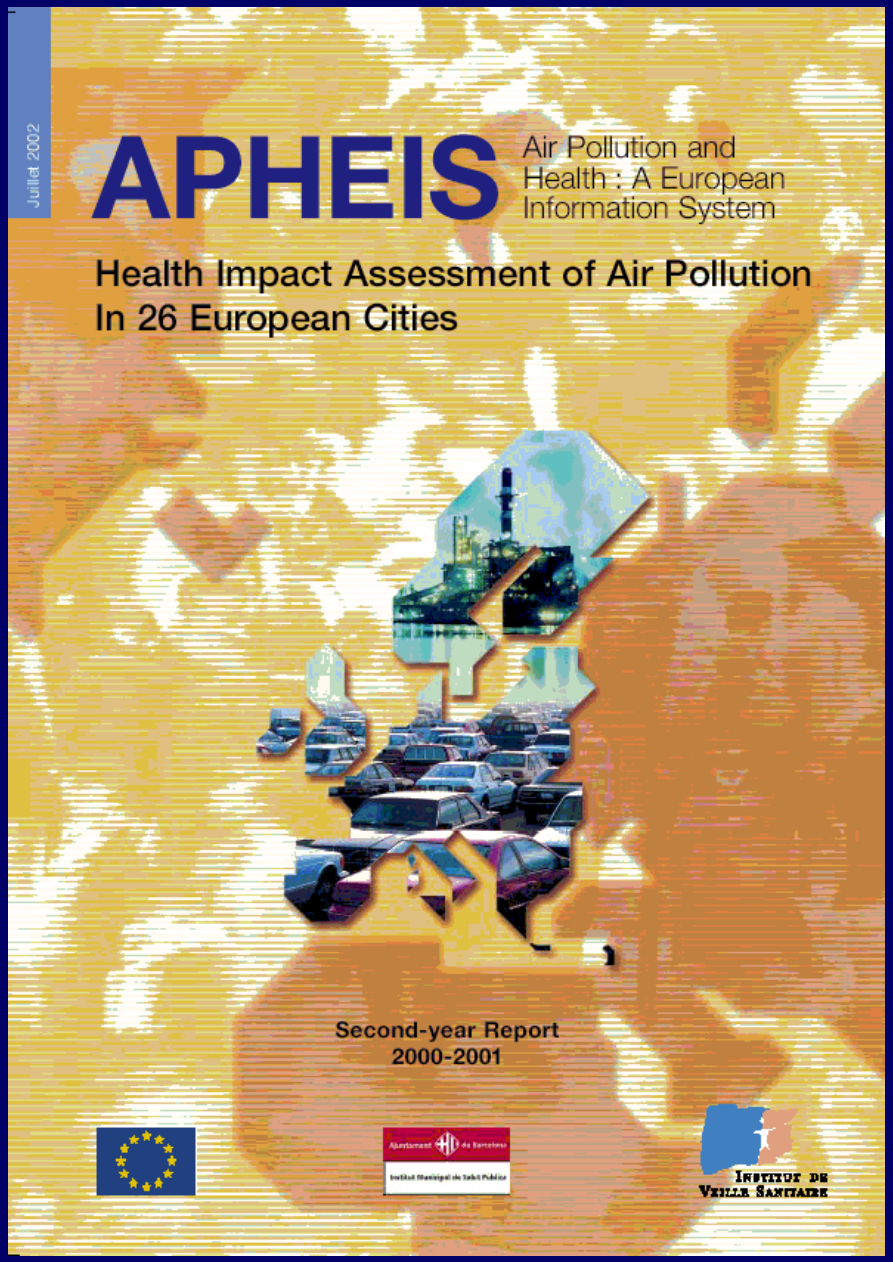
Monitoring the Effects of Air Pollution on Public Health in Europe
Scientific report 1999-2000
Institut de Veille Sanitaire

Actions, steps and results during the **second year**

- Implement or adapt organisational models designed during first year
- Collect and analyse data for health-impact assessment
- Prepare different health-impact scenarios
- Prepare HIA report in standardised format (HIA in 26 cities)



* Our first HIA provided a conservative and detailed picture of the impact of air pollution on health in 26 European cities, and showed that air pollution continues to threaten public health in Europe.

* Even very small and achievable reductions in air pollution levels have an impact on public health

  - All other things being equal, reducing long-term exposure to PM_{10} by just 5 $\mu g/m^3$ would have 'prevented' more than 5 000 premature deaths annually

EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

Apheis: public health impact of PM_{10} in 19 European cities

S Medina, A Plasencia, F Ballester, H G Mücke, J Schwartz, on behalf of the Apheis group

J Epidemiol Community Health 2004;58:831–836. doi: 10.1136/jech.2003.016386

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Study objective: Apheis is a public health surveillance system that aims to provide European, national, regional, and local decision makers, environmental health professionals, and the general public with up to date and easy to use information on air pollution and public health. This study presents the health impact assessment done in 19 cities of Western and Eastern European countries.

Design: Apheis developed guidelines for gathering and analysing data on air pollution and the impact on public health. Apheis has analysed the acute and chronic effects of fine particles on premature mortality using the estimates developed by Aphea2 study and two American cohort studies. This health impact assessment was performed for different scenarios on the health benefits of reducing levels of particles less than 10 μm in size (PM_{10}).

Main results: PM_{10} concentrations were measured in 19 cities (range: 14–73 μg/m^3). The population covered in this health impact assessment includes nearly 22 million inhabitants. The age standardised mortality rates (per 100 000 people) range from 456 in Toulouse to 1127 in Bucharest. Reducing long term exposure to PM_{10} concentrations by 5 μg/m^3 would have "prevented" between 3300 and 7700 early deaths annually, 500 to 1000 of which are associated with short term exposure.

Conclusions: Apheis shows that current levels of air pollution in urban Europe have a non-negligible impact on public health, and that preventive measures could reduce this impact, even in cities with low levels of air pollution.

The international literature shows that air pollution continues to threaten public health despite tighter emission standards, closer monitoring of air pollution, and decreasing levels of certain types of air pollutants. In Europe, multicentre studies[1–4] have shown the adverse health effects

protocol for HIAs of air pollution in Europe[5 6] allowing for comparability across all participating cities.

We went through the five main steps in HIA[5 6] city by city and then comparatively. *Exposure*: PM_{10} was measured in the 19 cities at 104 monitoring stations. PM_{10} was studied using

Actions, steps and results during the third year

- **To fulfill our mission of making our learnings available to the broadest possible audiences, and to evaluate the usefulness of our work on HIA among those who need to know:**

- Explore and understand in terms of content and form how best to meet the information needs of policy makers concerned with the impact of air pollution on public health

- Develop tool templates/generic tools that centres can use

Actions, steps and results during the third year

- **To keep our HIA as accurate and up-to-date as possible**:

  - Produce new exposure-response functions on short-term effects of AP

  - Calculate years of life lost or reduction in life expectancy, in addition to the attributable number of deaths based on long-term effects of AP

Apheis 3

Short-term scenarios

	Health indicator	ICD		Tool	RR (95% IC) For 10 µg/m^3 increase	Scenarios	References
Attributable cases		**ICD9**	**ICD10**			**Daily mean**	
ST HIA for all Apheis cities							
Black smoke	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	PSAS-9 Excel spreadsheet	1.006 (1.004 - 1.009)	Reduction to 50 µg/m^3	WHO, 2004
	All ages, cardiovascular mortality	390-459	I00-I99		1.004 (1.002 - 1.007)		WHO, 2004
	All ages, respiratory mortality	460-519	J00-J99		1.006 (0.998 - 1.015)		WHO, 2004
	All ages, cardiac hospital admissions	390-429	I00-I52		1.011 (1.004 - 1.019)	Reduction to 20 µg/m^3	APHEIS 3, 2004
	All ages, respiratory hospital admissions	460-519	J00-J99		1.0030 (0.9985 -1.0075)	Reduction by 5 µg/m^3	APHEIS 3, 2004
PM_{10} very short-term	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	PSAS-9 Excel spreadsheet	1.006 (1.004 - 1.008)	Reduction to 50 µg/m^3	WHO, 2004
	All ages, cardiovascular mortality	390-459	I00-I99		1.009 (1.005 - 1.013)		WHO, 2004
	All ages, respiratory mortality	460-519	J00-J99		1.013 (1.005 - 1.021)		WHO, 2004
	All ages, cardiac hospital admissions	390-429	I00-I52		1.006 (1.003 - 1.009)	Reduction to 20 µg/m^3	APHEIS 3, 2004
	All ages, respiratory hospital admissions	460-519	J00-J99		1.0114 (1.0062 - 1.0167)	Reduction by 5 µg/m^3	APHEIS 3, 2004
PM_{10} cumulative short-term (40 days)	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	PSAS-9 Excel spreadsheet	1.01227 (1.0081 - 1.0164)	Reduction to 50 µg/m^3	A. Zanobetti et al, 2002
	All ages, cardiovascular mortality	390-459	I00-I99		1.01969 (1.0139 - 1.0255)	Reduction to 20 µg/m^3	A. Zanobetti et al, 2003
	All ages, respiratory mortality	460-519	J00-J99		1.04206 (1.0109 - 1.0742)	Reduction by 5 µg/m^3	A. Zanobetti et al, 2003
Complementary ST HIA for some Apheis cities							
PM_{10} with shrunken estimates	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	PSAS-9 Excel spreadsheet	RRs calculated from betas & se of Apheis shrunken estimates for each city	Reduction to 50 µg/m^3 Reduction to 20 µg/m^3 Reduction by 5 µg/m^3	Apheis 3, 2004

Apheis 3

Long-term scenarios

Summary LONG-TERM HIA							
	Mortality indicator	ICD 9	ICD10	Tool	RR (95% IC) For 10 µg/m^3 increase	Scenarios	Cities
LT HIA for all-cities report							
Attributable cases						Annual mean	
PM10	All causes	< 800	A00-Q99	InVS Excel	Apheis 2 1,043 (1,026-1,061)	Reduction to 40 µg/m3 Reduction to 20 µg/m3 Reduction by 5 µg/m3	All cities with PM10
PM2,5	Total Cardiopulmonary LCA	0-999 401-440 and 460-519 162	A00-T98 I10-I70 and J00-J99 C33-C34	InVS Excel	Average Pope, 2002 1.06 (1.02-1.11) 1.09 (1.03-1.16) 1.14 (1.04-1.23)	Reduction to 20 µg/m3 Reduction to 15 µg/m3 Reduction by 3,5 µg/m3	All cities with PM2,5 and converted from PM10
YoLL						Annual mean	
PM2,5	Total Cardiopulmonary LCA	0-999 401-440 and 460-519 162	A00-T98 I10-I70 and J00-J99 C33-C34	AirQ	Average Pope, 2002 1.06 (1.02-1.11) 1.09 (1.03-1.16) 1.14 (1.04-1.23)	Reduction to 20 µg/m3 Reduction to 15 µg/m3 Reduction by 3,5 µg/m3	All cities with PM2,5 and converted from PM10

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Health Impact Assessment

A few examples of findings

Exposure indicators

for Health Impact Assessment

in Apheis

Table A: APHEIS-3 - PM monitoring information

City	Popul. (Mio.)	Year
Athens	3.0	2001
Bilbao	0.7	2002
Bordeaux	0.6	2000
Celje	0.05	2000
Cracow	0.7	2000
Gothenburg	0.5	2000
Le Havre	0.2	2000
Lille	1.1	2001
Ljubljana	0.3	2000
London	6.9	2001
Lyon	0.8	2000
Madrid	2.9	2000
Marseille	0.8	2000
Paris	6.2	2000
Rome	2.2	2001
Rouen	0.4	2001
Sevilla	0.5	2000
Stockholm	1.2	2000
Strasbourg	0.5	2002
Tel Aviv	1.1	1998
Toulouse	0.7	2000
Sum	**31.4**	

Table A: APHEIS-3 - PM monitoring information (2/5)

City	Popul. (Mio.)	Year	PM 10	PM 10 HIA
Athens	3.0	2001	8	6
Bilbao	0.7	2002	5	4
Bordeaux	0.6	2000	7	4
Celje	0.05	2000	1	1
Cracow	0.7	2000	5	4
Gothenburg	0.5	2000	4	1
Le Havre	0.2	2000	3	2
Lille	1.1	2001	7	6
Ljubljana	0.3	2000	2	2
London	6.9	2001	11	1
Lyon	0.8	2000	5	2
Madrid	2.9	2000	25	23
Marseille	0.8	2000	4	3
Paris	6.2	2000	7	7
Rome	2.2	2001	4	2
Rouen	0.4	2001	2	2
Sevilla	0.5	2000	10	6
Stockholm	1.2	2000	4	1
Strasbourg	0.5	2002	5	3
Tel Aviv	1.1	1998	2	2
Toulouse	0.7	2000	3	2
Sum	**31.4**		**128**	**84 66%**

Table A: APHEIS-3 - PM monitoring information (3/5)

City	Popul. (Mio.)	Year	PM 10	PM 10 HIA	PM2.5	PM2.5 HIA
Athens	3.0	2001	8	6		
Bilbao	0.7	2002	5	4		
Bordeaux	0.6	2000	7	4		
Celje	0.05	2000	1	1		
Cracow	0.7	2000	5	4		
Gothenburg	0.5	2000	4	1	1	1
Le Havre	0.2	2000	3	2	2	2
Lille	1.1	2001	7	6	2	2
Ljubljana	0.3	2000	2	2		
London	6.9	2001	11	1	2	1
Lyon	0.8	2000	5	2	2	0
Madrid	2.9	2000	25	23		
Marseille	0.8	2000	4	3	2	2
Paris	6.2	2000	7	7	1	0
Rome	2.2	2001	4	2		
Rouen	0.4	2001	2	2	2	2
Sevilla	0.5	2000	10	6		
Stockholm	1.2	2000	4	1	3	1
Strasbourg	0.5	2002	5	3	3	2
Tel Aviv	1.1	1998	2	2		
Toulouse	0.7	2000	3	2	2	2
Sum	**31.4**		**128**	**84 66%**	**22**	**15 68%**

Table A: APHEIS-3 - PM monitoring information (4/5)

City	Popul. (Mio.)	Year	PM 10	PM 10 HIA	PM2.5	PM2.5 HIA	Method
Athens	3.0	2001	8	6			ß-attenuation
Bilbao	0.7	2002	5	4			ß-radiation absorption
Bordeaux	0.6	2000	7	4			TEOM
Celje	0.05	2000	1	1			TEOM (50°C)
Cracow	0.7	2000	5	4			ß-gauge-monitor
Gothenburg	0.5	2000	4	1	1	1	TEOM (50°C)
Le Havre	0.2	2000	3	2	2	2	TEOM (50°C)
Lille	1.1	2001	7	6	2	2	TEOM (50°C)
Ljubljana	0.3	2000	2	2			TEOM (50°C)
London	6.9	2001	11	1	2	1	TEOM
Lyon	0.8	2000	5	2	2	0	TEOM
Madrid	2.9	2000	25	23			TEOM
Marseille	0.8	2000	4	3	2	2	TEOM (50°C)
Paris	6.2	2000	7	7	1	0	TEOM
Rome	2.2	2001	4	2			ß-gauge monitor
Rouen	0.4	2001	2	2	2	2	TEOM (50°C)
Sevilla	0.5	2000	10	6			ß-radiation-attenuation
Stockholm	1.2	2000	4	1	3	1	TEOM (50°C)
Strasbourg	0.5	2002	5	3	3	2	TEOM (50°C)
Tel Aviv	1.1	1998	2	2			TEOM
Toulouse	0.7	2000	3	2	2	2	TEOM (50°C)
Sum	**31.4**		**128**	**84**	**22**	**15**	

Table A: APHEIS-3 - PM monitoring information (5/5)

City	Popul. (Mio.)	Year	PM 10	PM 10 HIA	PM2.5	PM2.5 HIA	Method	Operated by
Athens	3.0	2001	8	6			ß-attenuation	MoE
Bilbao	0.7	2002	5	4			ß-radiation absorption	Reg. Env. Dept.
Bordeaux	0.6	2000	7	4			TEOM	Reg. AQNet/AIRAQ
Celje	0.05	2000	1	1			TEOM (50°C)	Nat. Env. Agency
Cracow	0.7	2000	5	4			ß-gauge-monitor	Loc. Env. Prot. Inspect.
Gothenburg	0.5	2000	4	1	1	1	TEOM (50°C)	Loc. Env. Office
Le Havre	0.2	2000	3	2	2	2	TEOM (50°C)	Reg. AQNet/AIRNORMAND
Lille	1.1	2001	7	6	2	2	TEOM (50°C)	Reg. AQNet/AREMA
Ljubljana	0.3	2000	2	2			TEOM (50°C)	Nat. Env. Agency
London	6.9	2001	11	1	2	1	TEOM	Loc. AQ Authority
Lyon	0.8	2000	5	2	2	0	TEOM	Reg AQNet/COPARLY
Madrid	2.9	2000	25	23			TEOM	Loc. AQNet/City Council
Marseille	0.8	2000	4	3	2	2	TEOM (50°C)	Reg. AQNet/AIRMARAIX
Paris	6.2	2000	7	7	1	0	TEOM	Reg. AQNet/AIRPARIF
Rome	2.2	2001	4	2			ß-gauge monitor	Reg. Env. Dept.
Rouen	0.4	2001	2	2	2	2	TEOM (50°C)	Reg. AQNet/AIRNORMAND
Sevilla	0.5	2000	10	6			ß-radiation-attenuation	Reg. Env. Dept.
Stockholm	1.2	2000	4	1	3	1	TEOM (50°C)	Loc. E&H Dept.
Strasbourg	0.5	2002	5	3	3	2	TEOM (50°C)	Reg. AQNet/ASPA
Tel Aviv	1.1	1998	2	2			TEOM	MoE
Toulouse	0.7	2000	3	2	2	2	TEOM (50°C)	Reg. AQNet/ORAMIP
Sum	**31.4**		**128**	**84**	**22**	**15**		

Table B: Classification types of exposure (HIA) relevant air monitoring stations

Type	PM_{10}	$PM_{2.5}$	Sum
Traffic	**28**	**2**	**30**
Kerbside	-	-	
Building line	-	-	
Commercial	**4**	**2**	**6**
Urban residential	**44**	**11**	**55**
Sub-urban	**6**	-	**6**
Rural	-	-	
Industrial	-	-	
Others (e.g. public gardens)	**2**	-	**2**
TOTAL	**84**	**15**	**99**

Table C: Use of correction and conversion factors for PM_{10} and $PM_{2.5}$

cities	PM_{10} measurement data corrected?			Conversion factor
	no	yes	factor	-$PM_{2.5}$ calculated from PM_{10}-
Athens	x			0.3 to 0.63[+]
Bilbao		x	1.2 [#]	0.7
Bordeaux		x	1[s] ; 1.3[w]	0.67
Celje		x	1.3[§]	0.7
Cracow		x	1.3 [§]	0.8
Göteborg		x	1.3	0.66
Le Havre		x	1[s]; 1.22[w]	0.7
Lille		x	1.18[s]; 1.27[w]	0.66
Ljubljana		x	1.3[§]	0.7
London		x	1.3	ö
Lyon		x	1.22[w]	0.7
Madrid		x	1.0 [#]	0.51
Marseille		x	1[s]; 1.13[w]	0.65
Paris		x	1[s]; 1.37[w]	0.7
Rome		x	1.3	0.7
Rouen		x	1[s]; 1.22[w]	0.7
Sevilla		x	1.13	0.7
Stockholm		x	1.2 [#]	0.65
Strasbourg		x	1[s]; 1.21[w]	0.7
Tel Aviv		x	1.3	0.5
Toulouse		x	1[s]; 1.2[w]	0.65

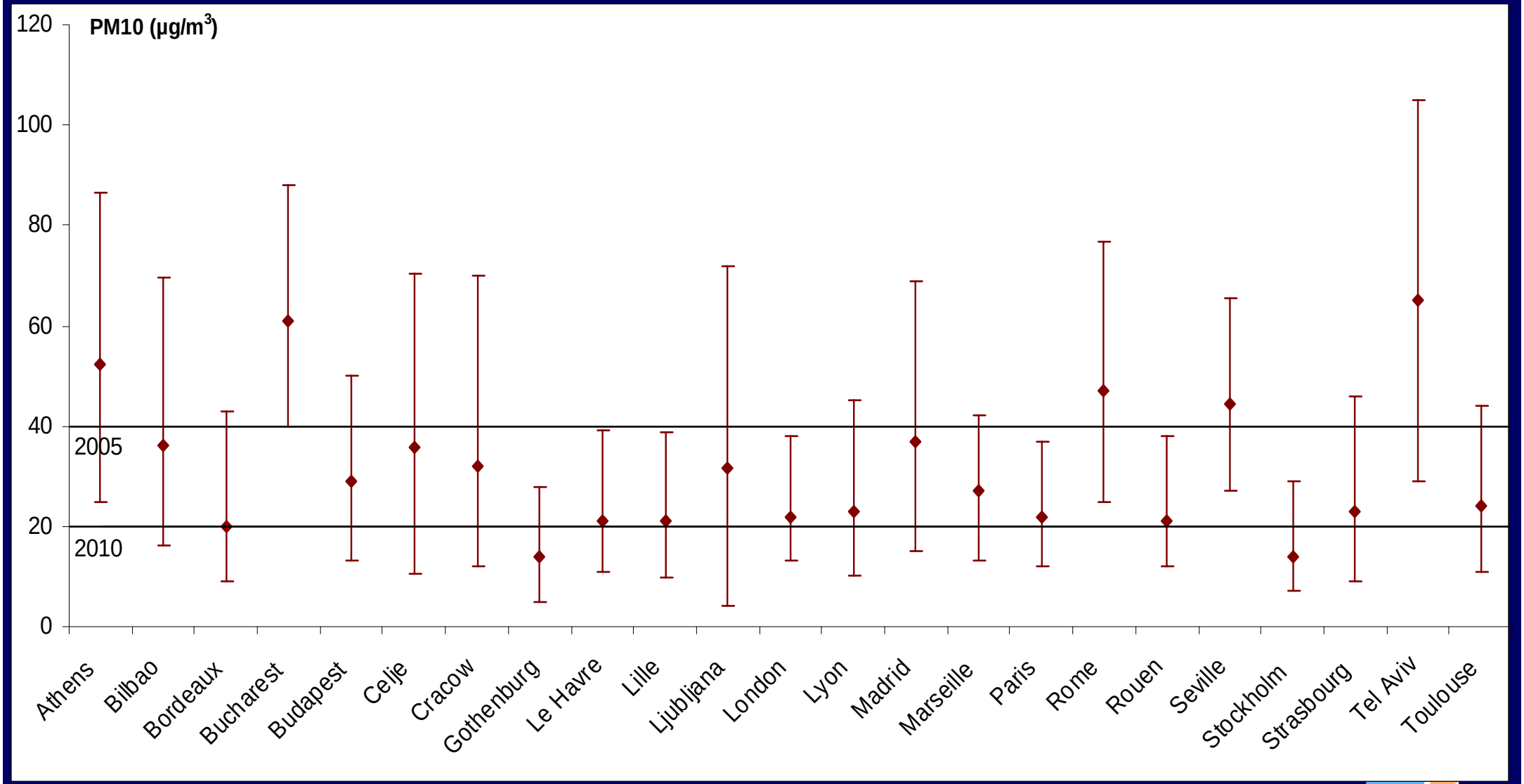
Barcelona, Bucharest, Budapest, Dublin and Valencia are not considered inhere, because they do not calculate HIA for PM_{10}

Measured PM_{10}, $PM_{2.5}$ and BS levels ($\mu g/m^3$) in 26 Apheis cities.

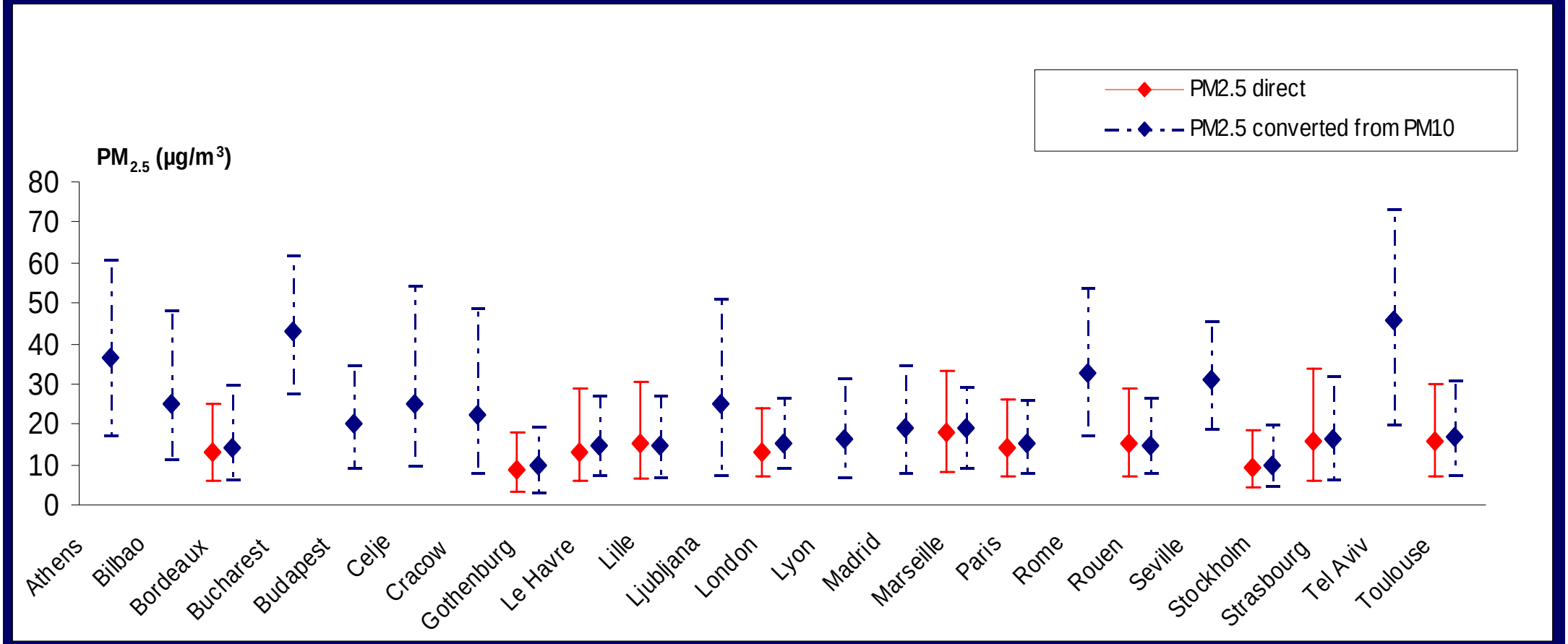
City	Year	PM_{10}				$PM_{2.5}$				BS			
		Mean	SD[1]	P5[2]	P95[3]	Mean	SD	P5	P95	Mean	SD	P5	P95
Athens	2001	52	19	25	87					77	37	28	147
Barcelona	2000									32	13	11	59
Bilbao	2002	36	17	16	69					13	6	6	25
Bordeaux	2000/2002[4]	20	10	9	43	13	6	6	25	11	11	3	33
Bucharest[5]	2000	61	20	40	88								
Budapest[5]	2000	29	12	13	50								
Celje	2000	36	20	11	70					14	16	1	47
Cracow	2000	32	18	12	70					31	28	8	94
Dublin	2000									9	5	3	18
Gothenburg	2000	14	7	5	27	9	5	3	18				
Le Havre	2000/2002[4]	21	8	11	39	13	8	6	29	7	7	2	19
Lille	2001	21	12	10	39	16	11	7	31	10	4	6	18
Ljubljana	2000	32	24	4	72					15	17	3	44
London	2001	22	8	13	38	13	6	7	24	9	6	3	21
Lyon	2000/2001[4]	23	12	10	45					48	21	20	87
Madrid	2000	37	17	15	69								
Marseille	2000/2002[4]	27	10	13	42	18	8	8	33	18	13	5	43
Paris	2000	22	9	12	37	14	7	7	26	16	11	6	34
Rome	2001	47	17	25	77								
Rouen	2001/2002[4]	21	9	12	38	15	8	7	29	8	7	3	24
Seville	2000	44	12	27	65								
Stockholm	2000	14	7	7	29	9	4	5	18				
Strasbourg	2002	23	12	9	46	16	10	6	34				
Tel Aviv	1998	65	119	29	105								
Toulouse	2000	24	10	11	44	16	7	7	30				
Valencia	2000									20	11	8	40

1. SD: Standard deviation
2. P5: 5th percentile of the distribution of the pollutant
3. P95: 95th percentile of the distribution of the pollutant
4. For Bordeaux, year 2000 for PM_{10} and year 2002 for $PM_{2.5}$ and BS; for Le Havre and Marseille, year 2000 for PM_{10} and BS and year 2002 for $PM_{2.5}$; for Lyon, year 2000 for PM_{10} and year 2001 for BS; for Rouen, year 2001 for BS and PM_{10} and year 2002 for $PM_{2.5}$
5. PM_{10} converted from TSP

Annual mean levels and 5th and 95th percentiles of the distribution of measured PM_{10}



Annual mean levels, 5th and 95th percentiles of the distribution of $PM_{2.5}$ measured and converted from PM_{10}

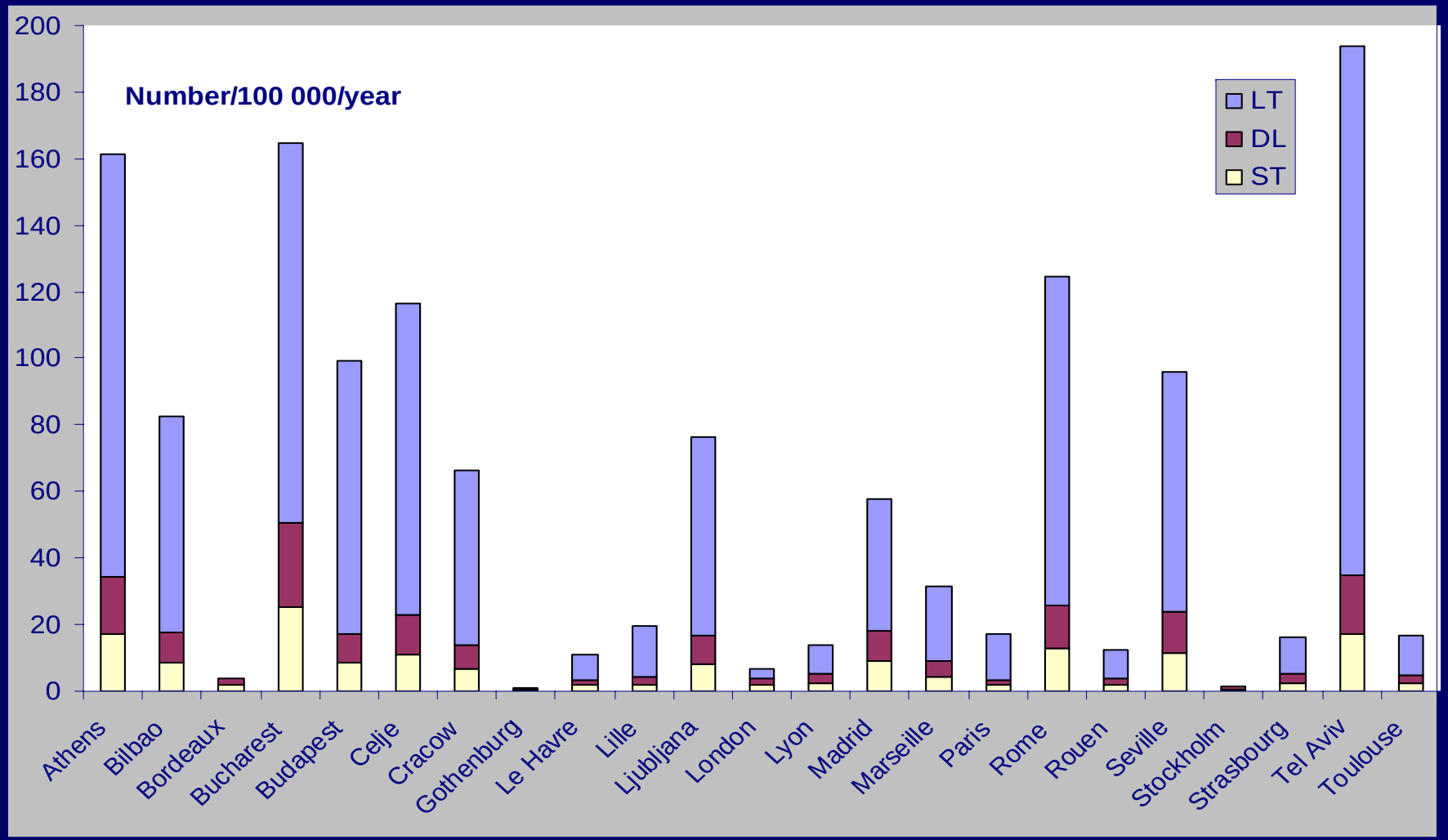


Reductions of PM_{10} levels

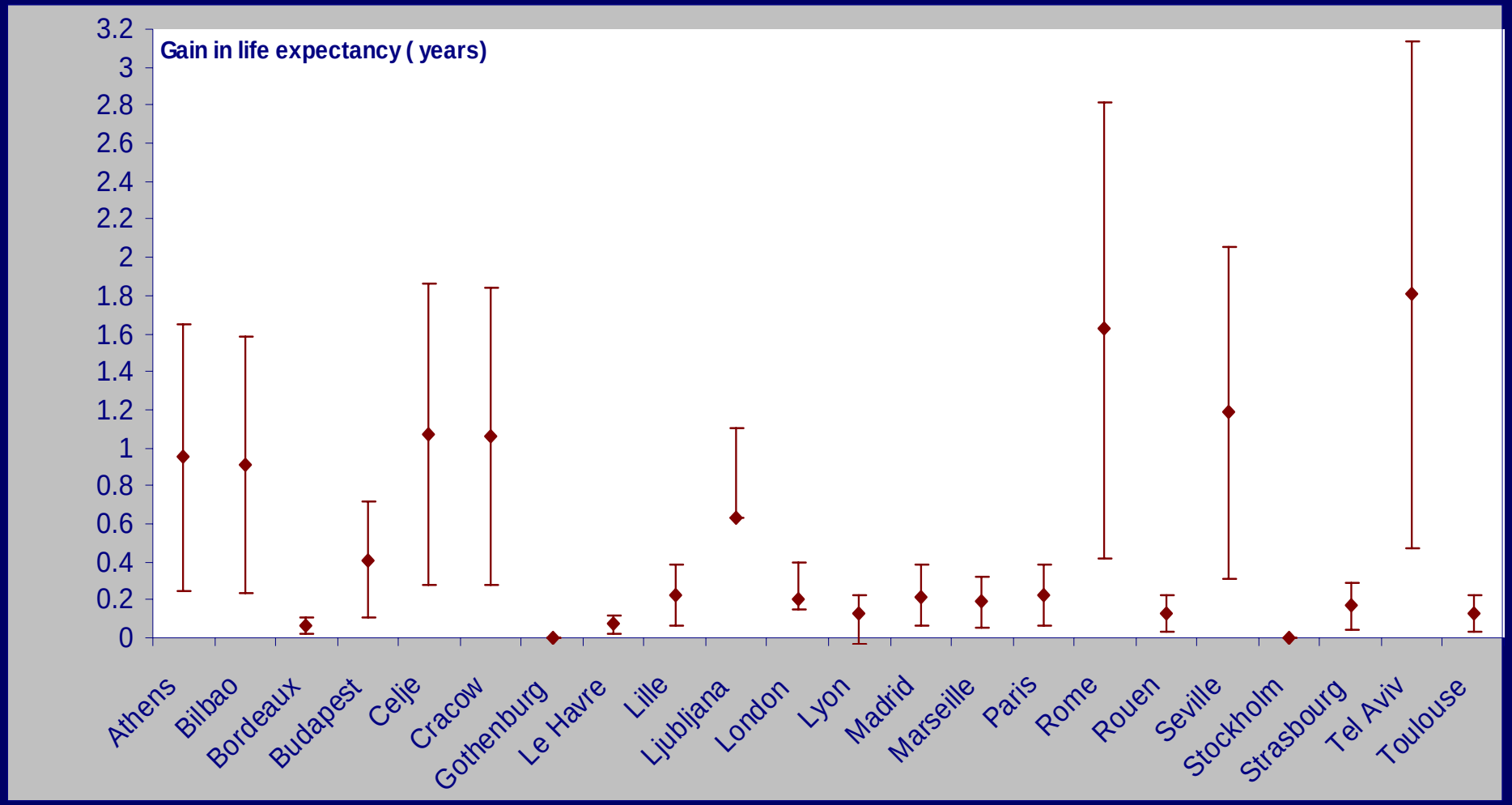
↓ of PM_{10} annual mean **to 20 µg/m³** (EC LV for 2010) in each city would prevent **21 828** premature deaths annually

↓ of PM_{10} annual mean **by 5 µg/m³** in each city would prevent **6 143** premature deaths annually

$PM_{10:}$ Short term (ST), cumulative short-term (DL), long term (LT) health impact on all causes mortality (ICD 9 < 800). Reductions to 20 µg/m³. Number of deaths per 100 000 inhabitants.



Expected Gain in Life Expectancy at 30 years old if annual $PM_{2.5}$ levels were reduced to 15 µg/m³



CAFE legislation process at the EC
Setting limit values for $PM_{2.5}$: 20 *vs* 15 µg/m³

- Our HIA revealed that reducing $PM_{2.5}$ levels **to 15 µg/m³** produces a **benefit** in terms of both total and cause-specific mortality that is over **30% greater** than for a reduction to 20 µg/m³
- However, because a significant health impact can be expected **even below 15 µg/m³**, we advise reducing air pollution to levels lower than 15 µg/m³:

➢ All other things being equal, the HIA estimated that 6 355 premature deaths, including 4 199 cardiopulmonary deaths and 743 lung-cancer deaths, could be prevented annually if long-term exposure to $PM_{2.5}$ levels were reduced by 3.5 µg/m³ in each city

Learnings from Apheis

- The **APHEIS** findings add one more brick in the wall of evidence that air pollution continues to threaten public health in Europe
- Main source of air pollution in Apheis cities: **traffic**
- A **bottom-up network** very successful to help simultaneously local and European decision-making

Learnings from Apheis

- The Apheis programme fosters ongoing **cross-fertilization** between multiple disciplines and regions to:
  - ↗ create skilled, local teams
  - ↗ enrich know-how and the quality of its findings
  - ↗ and explore important HIA methodological issues
- Using this approach, Apheis has established a good basis for comparing methods and findings between cities

Learnings from Apheis

- Today Apheis is a **highly active network** of environmental and health professionals in Europe:

- Various local and national authorities have identified this network as able over time to provide sound scientific advice on health risks related to air pollution

- Cities not involved in the Apheis programme have expressed a desire to join the Apheis network

Apheis today and tomorrow

- Contribution of the Apheis network to the **ENHIS project**
- **Thirty one cities** on HIA of outdoor air pollution **in 2005-2006**
- MoU between the **Apheis network** and JRC (meeting in June in Ispra to decide on the workplan and future call for proposals and fundings)

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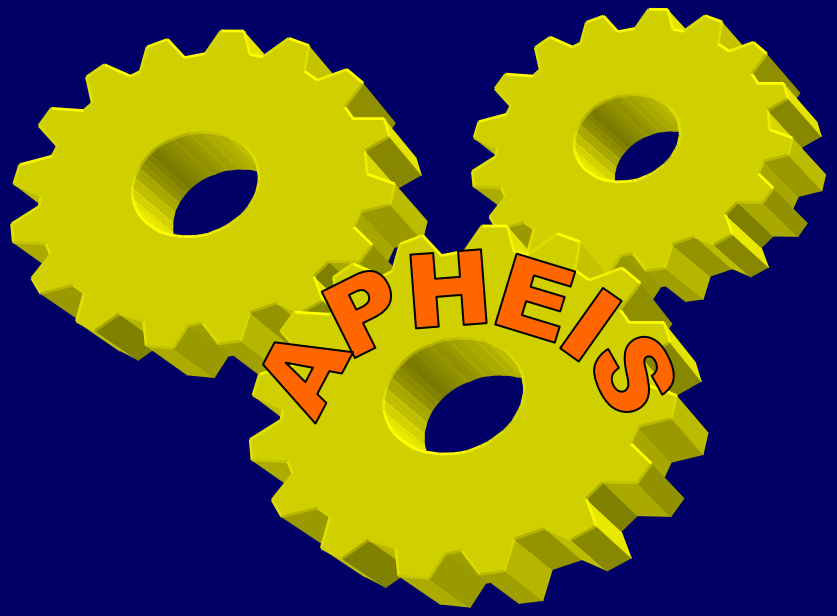
KNOWLEDGE



ACTION

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