Resultados del proyecto AIRUSE LIFE+

X. Querol[1], F. Amato[1], A. Karanasiou[1], A. Alastuey[1], F. Lucarelli[2], S. Nava[2], G. Calzolai[2], R. Udisti[2], S. Becagli[2], R. Traversi[2], M. Severi[2], S. Borselli[2], C. Alves[3], C. Pio[3], T. Nunes[3], L. Tarelho[3], M. Duarte[3], M. Cerqueira[3], E. Vicente[3], D. Custódio[3], H. Pinto[3], E. Montfort[4], I.Celades[4], V. Sanfelix[4], R. Harrison[5], C. Holman[5], K. Eleftheriadis[6], L. Diapouli[6], V.L. Gianelle[7], C. Colombi[7]

1 idaea CSIC Consejo Superior de Investigaciones Científicas
2 Università degli Studi Firenze Dipartimento di Fisica e Astronomia
3 universidade de aveiro
4 AICE jtc Universitat Jaume I
5 University of Birmingham
6 Demokritos National Centre for Scientific Research
7 ARPA Lombardia Agenzia Regionale per la Protezione dell'Ambiente Settore Monitoraggi Ambientali

Cuacos de Yuste, 23-24/04/2015

Jornadas Técnicas de Gestores de Calidad del Aire

AIRUSE

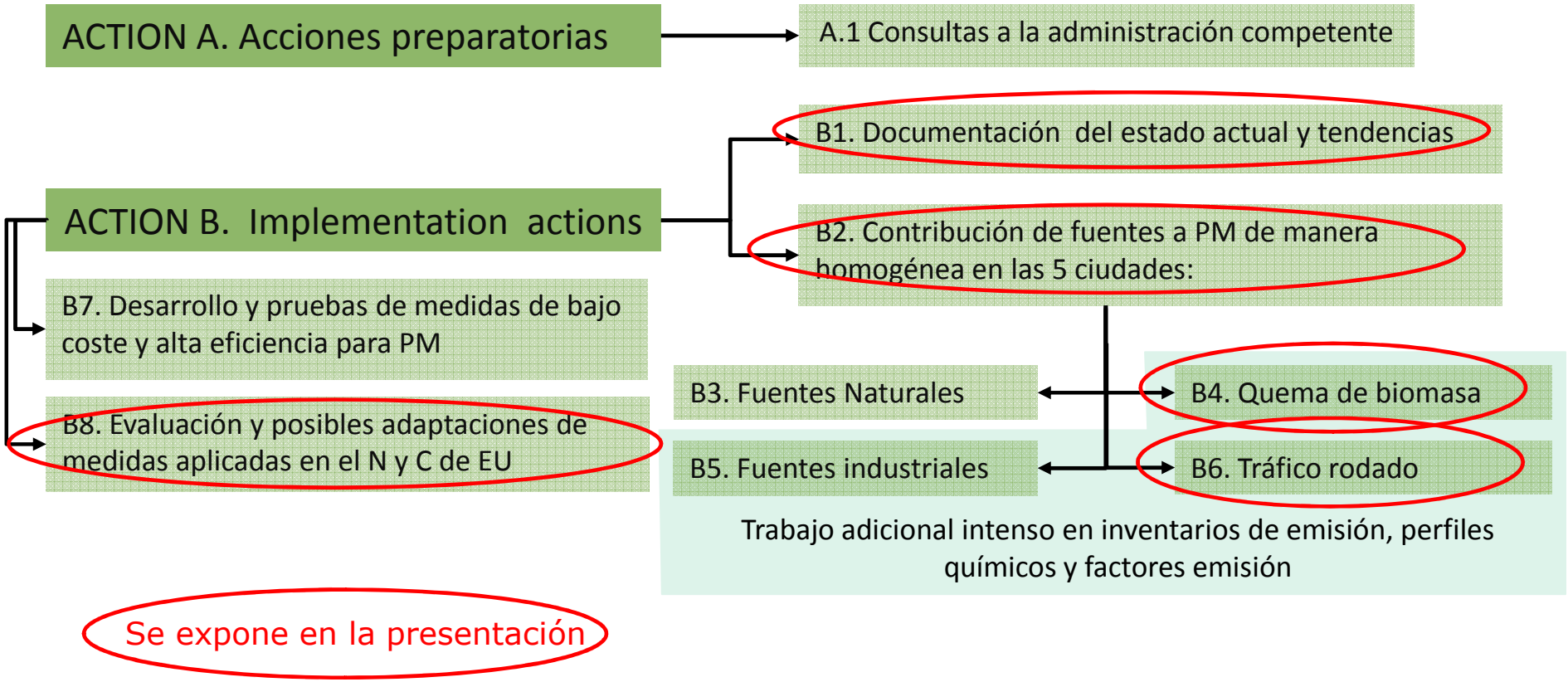
OBJETIVOS

- Identificar similitudes y diferencias en contribución de fuentes a PM en el S-EU (**5 ciudades)**
- Una vez identificadas fuentes clave de PM10 and PM2.5 el objetivo estratégico de AIRUSE es **el desarrollo, pruebas y propuestas de medidas específicas y no específicas para entornos urbanos del S-EU que permitan alcanzar los valores guía y límite OMS-UE**

Medidas de PM específicas

- Lavado y aspiración vías de tráfico y aplicación supresores de polvo de rodadura y polvo africano
- Reducción de emisiones de quema de biomasa
- Reducción de emisiones canalizadas y fugitivas del sector industrial
- Evaluar estrategias de otra regiones europeas (ZBE, vehículos eco-eficientes, etiquetados, buques, biomasa)

ESTRUCTURA: ACCIONES Y TAREAS



ESTRUCTURA: SOCIOS Y COORDINACIÓN

idaea CSIC
Consejo Superior de Investigaciones Científicas

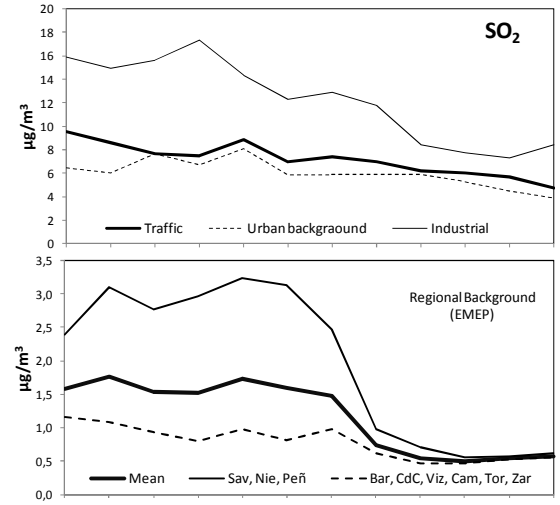
Coordinador
Project Manager
Spain

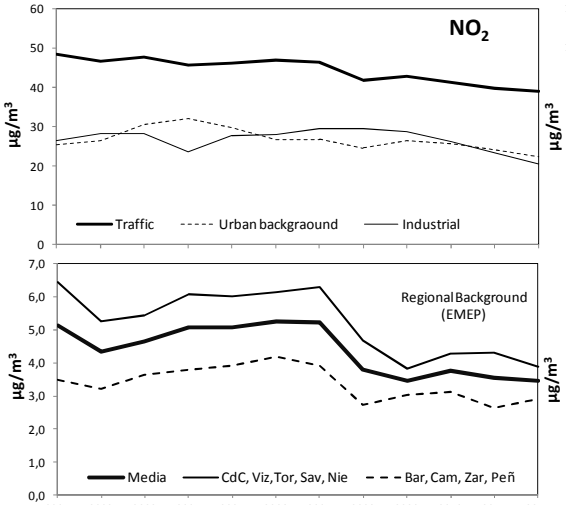
Socios

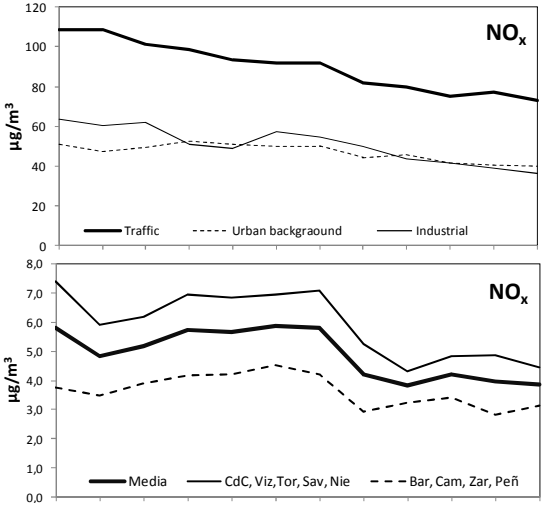
Leader B5 D5	Leader B8	Leader B3 D2	Leader B2	Leader B4	Milan
Spain	UK	Greece	Italy	Portugal	Italy

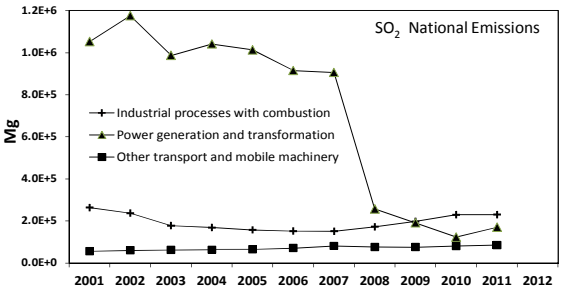
AIRUSE

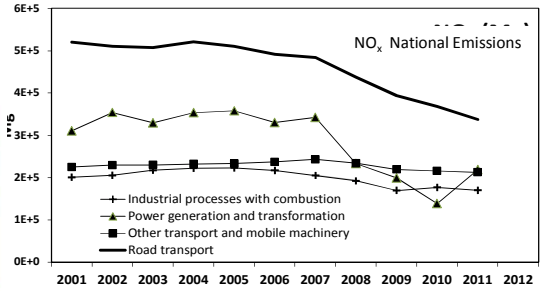
B1: TENDENCIAS 2001-2012 CALIDAD AIRE EN ESPAÑA





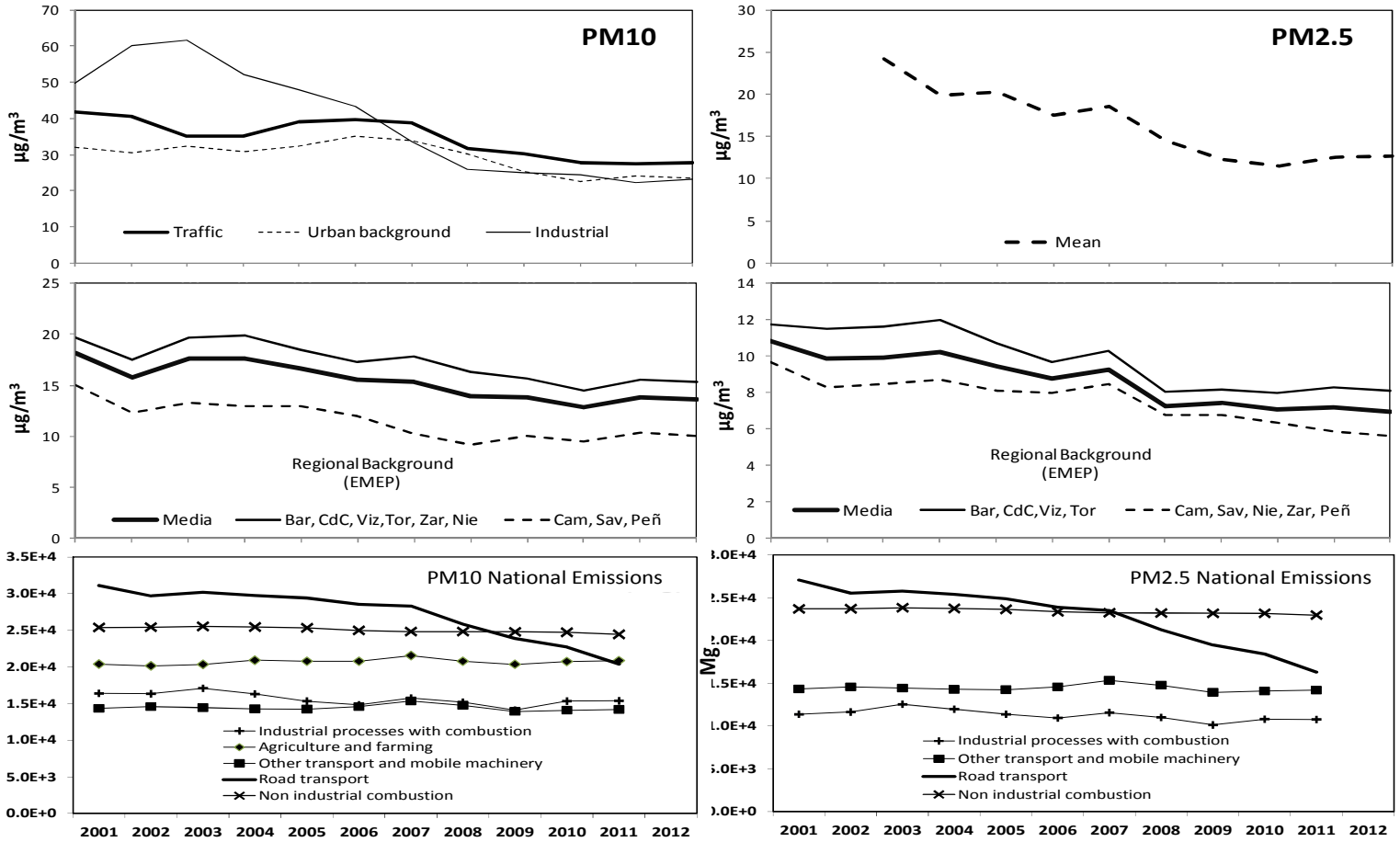






Querol et al., 2014. Science of Total Environment

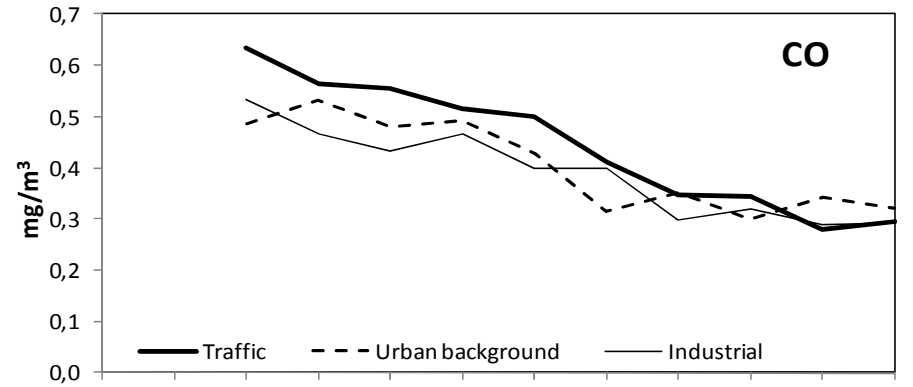
B1: TENDENCIAS 2001-2012 CALIDAD AIRE EN ESPAÑA

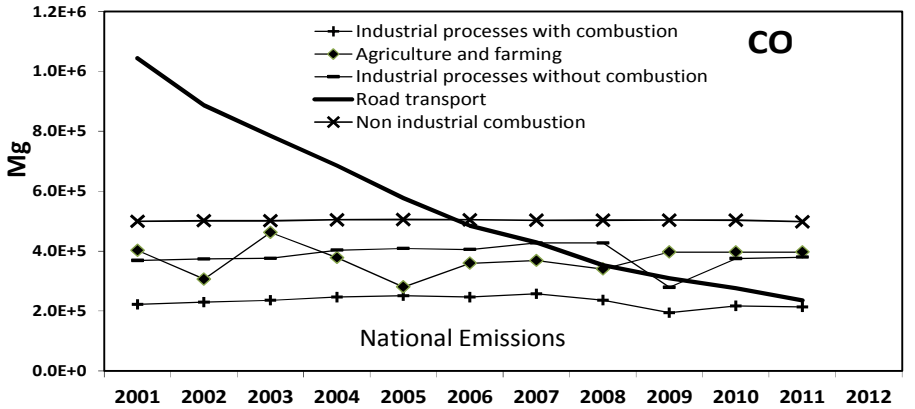


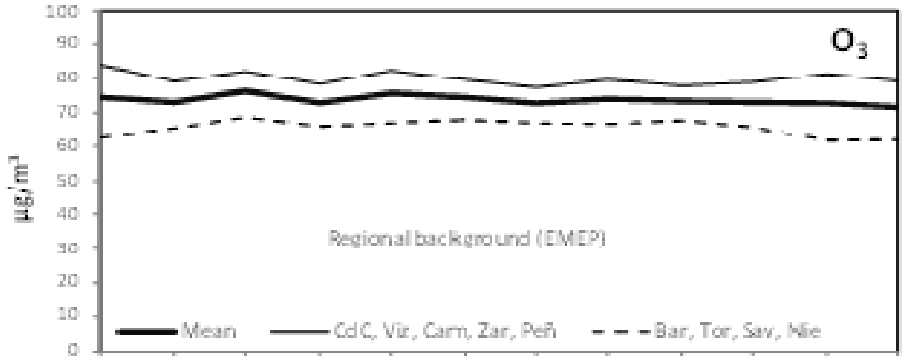
Querol et al., 2014. Science of Total Environment

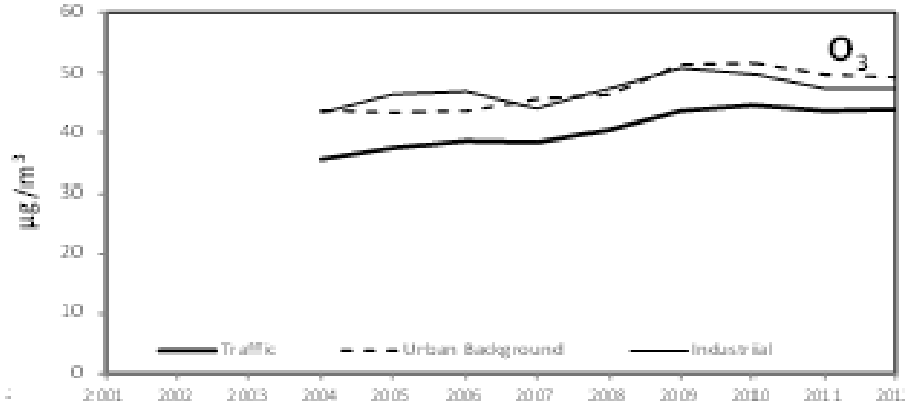
AIRUSE

B1: TENDENCIAS 2001-2012 CALIDAD AIRE EN ESPAÑA









Querol et al., 2014. Science of Total Environment

B2. CONTRIBUCIÓN DE FUENTES 2013 PM10 & PM2.5

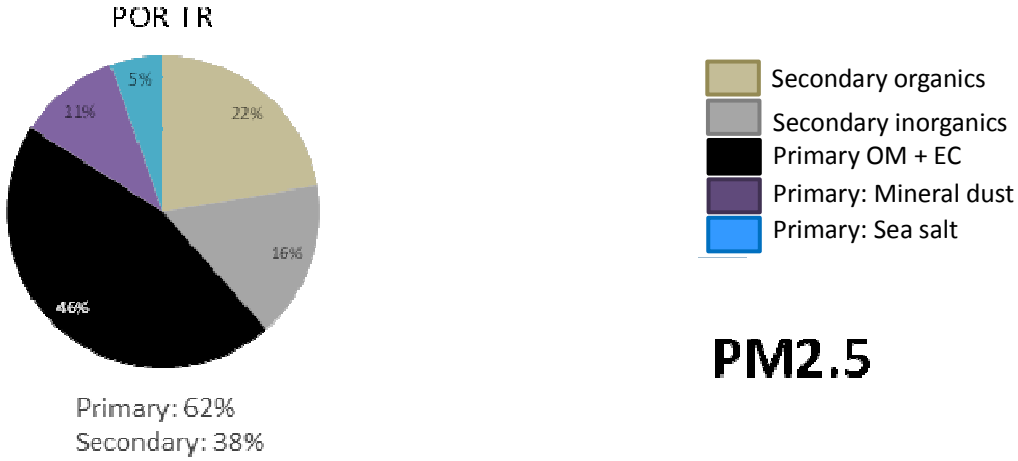
Long term measurements			BCN-UB	FI-UB	MLN-UB	POR-TR	ATH-SUB
Daily	PM10	**Mass**	**122**	**226**	**379**	**123**	197
		Elements	122	226	241§	123*	197‡
		Ions	122	226	337	123	197
		ECOC	122	226	348	123	197
		CC	122	226	89	123	197
		Levoglucosan			324		243
	PM2.5	**Mass**	**126**	**243**	**378**	**126**	243
		Elements	126	243	361§	126	243
		Ions	126	243	374	126	243
		ECOC	126	243	370	126	243
		Levoglucosan	126	243	356	126	888
Hourly	PM2.5-10	Elements	716	504		504	888
	PM2.5	Elements	714	504		504	197

*intercomparison between PIXE and ICP on Teflon filters
‡intercomparison between Teflon (PIXE) and quartz (ICP) filters
§ intercomparison between PIXE and XRF on Teflon and MCE filters

PIXE
ICP
SUNSET
XRF
Infrared
IC
GC

1047 PM10 samples
1116 PM2.5 samples

B2. CONTRIBUCIÓN DE FUENTES 2013 PM10 & PM2.5



PM10 (media anual)	**PM10** (días de superación)
1. **Road Traffic** is the main source contributing to PM10: **31-38%** (ATH 23%)	**36-45%** (ATH 15%)
1.1. Vehicle exhaust + traffic related NO_3^- are the main causes: **21-29%** (ATH 15%)	**30-34%** (ATH 6%)
1.2. Non-exhaust vehicle emissions are also relevant: **8-11%**	**18-29%** (ATH 3%, POR 6%)
2. **Regional OC and/or SO_4^{2-}** dominated pollution: **20-26%** (POR-**TR** 10%)	BCN **19%,** 2-6%
3**. Local dust** : **10-19%**	POR **27%,** 1-4%
4. **Biomass burning** very relevant in POR & FI (**14-16%**), less in ATH (**7%**) and negligible in BCN	POR & FI (**25-30%**), ATH 1%, negligible in BCN
5. **Industry** BCN **11%, 4-5%,** ATH <1%	BCN **17%,** <1-3%
6. **Non traffic-NO_3^- 6-8%** (2% POR)	BCN & FI 7-9% (1-2% POR & ATH)
7. **Shipping 4%** in coastal sites	3-4% in coastal sites
8. **African dust** ATH **14%,** 1-4%	ATH **52%,** 1%
9. **Sea salt** POR **13%, 4-8%**	ATH **7%,** 1-3%
10. **Anthropogenic dust** (Local dust + Non exhaust) reaches **19-25%**	**11-33%**, ATH 4%

PM2.5 (media anual)	**PM2.5** (días de superación PM10)
1. **Road Traffic** is the main source contributing to PM2.5: **28-39%** (ATH **22%**)	**32-42%** (ATH 11%)
1.1. Vehicle exhaust + traffic related NO_3^- are the main causes: **25-34%** (ATH 17%)	**31-40%** (ATH 10%)
1.2. Non-exhaust vehicle emissions are also relevant: **5-9%** (BCN&FI 1-2%)	1-7%
2. **Regional OC and/or SO_4^{2-}** dominated pollution: **19-37%** (POR **13%**)	BCN & MLN **11-22%,** 2-6%
3**. Local dust**: POR **16%, 2-6%**	POR **22%,** 1-2%
4. **Biomass burning** very relevant in MLN, FI & POR (**18-21%**), less in ATH (**10%**) and negligible in BCN	POR, FI & MLN (**26-33%**), <2%
5. **Industry 5-12%**, ATH <1%	BCN **18%,** <1-3%
6. **Non traffic-NO_3^- 3-6%** (POR **1%**)	BCN, FI & MLN **6-9%** (1-3% POR & ATH)
7. **Shipping 5-7%** in coastal sites	**6-10%** in coastal sites
8. **African dust:** ATH **6%,** <1%	ATH **45%,** 1%
9. **Sea salt** POR **5%,** <1-3%,	<1%-1%
10. **Anthropogenic dust** (Local dust + Non exhaust) reaches **10-21%**, BCN **7%**, FI **4%**	**POR 15, 3-9%**

AIRUSE

B4. QUEMA DE BIOMASA

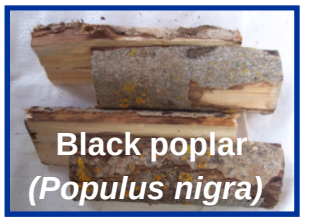
Contribution of biomass burning to PM_{10} and $PM_{2.5}$, % (µg m^{-3}) in AIRUSE cities

PM_{10}	POR-TR	BCN-UB	FI-UB	MLN-UB	ATH-SUB
Contributions to the annual mean	**14%(5)**	<2%(<0.5)	**16%(3)**	--%(--)	7%(1.4)
Contributions to the mean of days > 50 µg/m^3 PM_{10} (BCN > 40 µg/m^3)	**25%(16)**	<2%(<0.5)	**30%(22)**	--%(--)	1%(0.6)

$PM_{2.5}$	POR-TR	BCN-UB	FI-UB	MLN-UB	ATH-SUB
Contributions to the annual mean	**18%(5)**	<3%(<0.5)	**21%(3)**	**21%(6)**	10%(1.2)
Contributions to the mean of days >50 (40 BCN) µg PM_{10}/m^3 (>35 µg/m^3 $PM_{2.5}$ MLN)	**33%(22)**	<3%(<0.5)	**33%(23)**	**26%(14)**	2%(0.5)

B4. QUEMA DE BIOMASA

Biomass fuels: Based on forest inventories and information provided by the AIRUSE partners, wood species widely used as biofuels in residential combustion in Southern European



agro-fuels

Biomass burning appliances

1

Traditional brick fireplace

2

Traditional cast iron wood stove

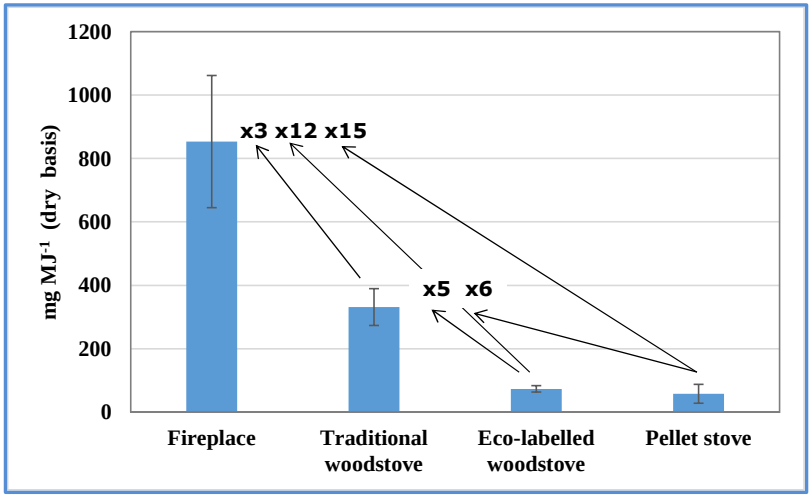
3

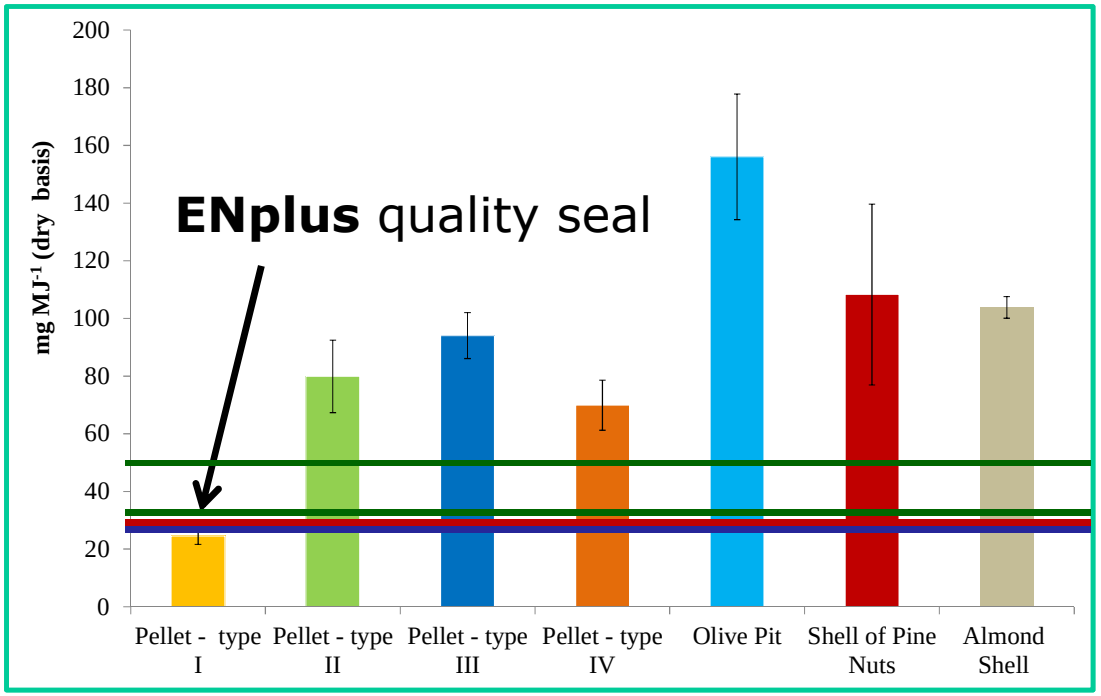
Eco-labelled chimney-type wood stove

4

Pellet stove

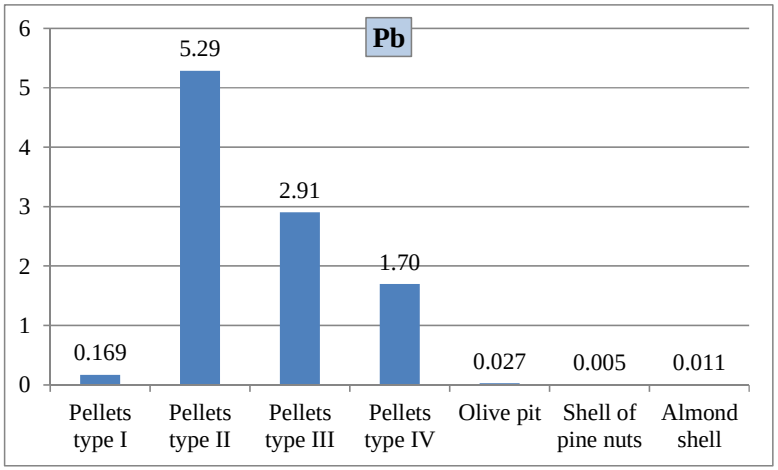
PM emission factors

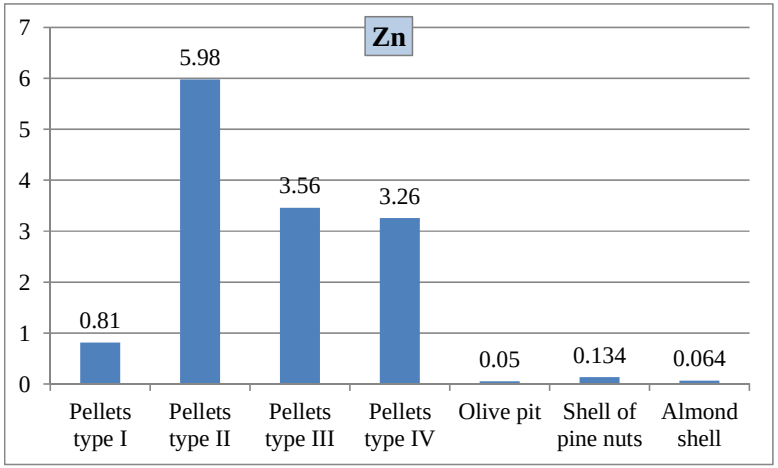


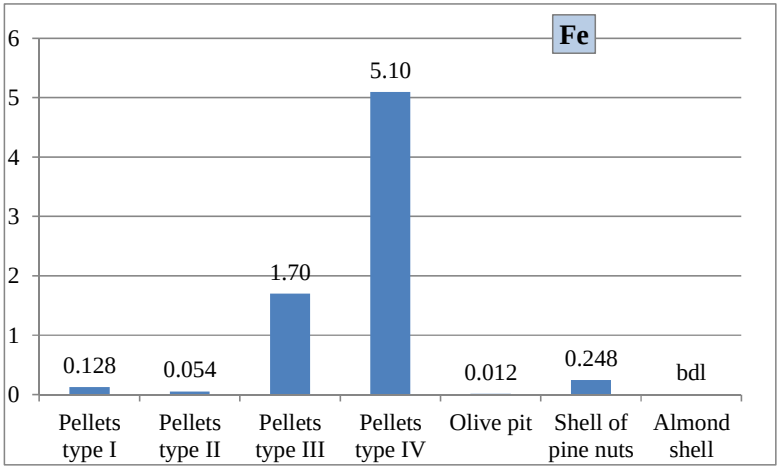


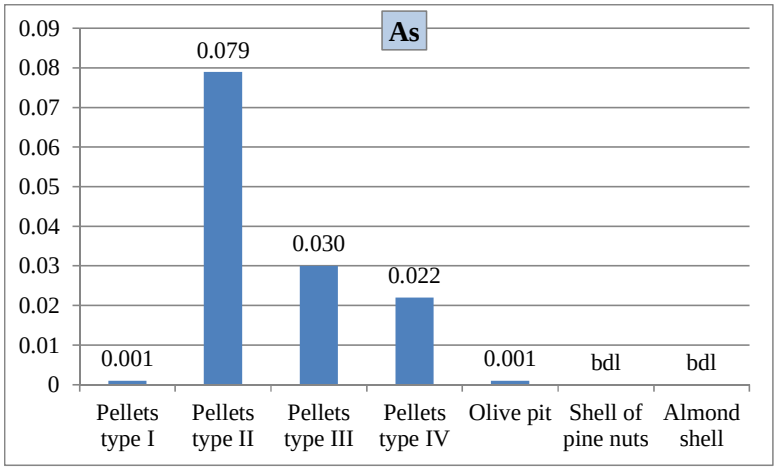
50 mg MJ^{-1} in Denmark & Switzerland
35 mg MJ^{-1} wood fuels & 25 mg MJ^{-1} for pellets in Austria
27 mg MJ^{-1} in Germany

B4. QUEMA DE BIOMASA









Standards need to be established in the EU for elemental composition of commercial wood pellets and chips to avoid the inclusion of extraneous materials. Only Germany has standards containing extensive trace element limits.

B4. QUEMA DE BIOMASA

PM2.5 & BaP emission factors

FIREPLACE							
	Softwood		Hardwood		Briquettes		
g $PM_{2.5}$ kg^{-1} biofuel	7.02		16.9		13.8		
µg BaP kg^{-1} biofuel	260		475		31.4		
TRADITIONAL WOODSTOVE							
	Softwood		Hardwood		Briquettes		
g $PM_{2.5}$ kg^{-1} biofuel	3.64		13.5		9.02		
µg BaP kg^{-1} biofuel	46.7		322		85.3		
ECO-LABELLED STOVE							
	Softwood		Hardwood		Briquettes		
g PM_{10} kg^{-1} biofuel	1.12		2.06		---		
µg BaP kg^{-1} biofuel	1543		146		---		
PELLET STOVE							
	Pellets I	Pellets II	Pellets III	Pellets IV	Olive pit	Shell of pine nuts	Almond shell
g PM_{10} kg^{-1} biofuel	0.49	1.51	1.77	1.35	3.12	2.19	2.07
µg BaP kg^{-1} biofuel	4.43	nd	nd	4.61	nd	17.2	9.19

Es necesario certificar no solo el tipo de caldera, sino:
el tipo de pellet y su transporte y almacenamiento

B8: ESTRATEGIAS Y ACTUACIONES DEL N Y CENTRO DE LA UE: EVALUACIÓN Y ADAPTACIÓN

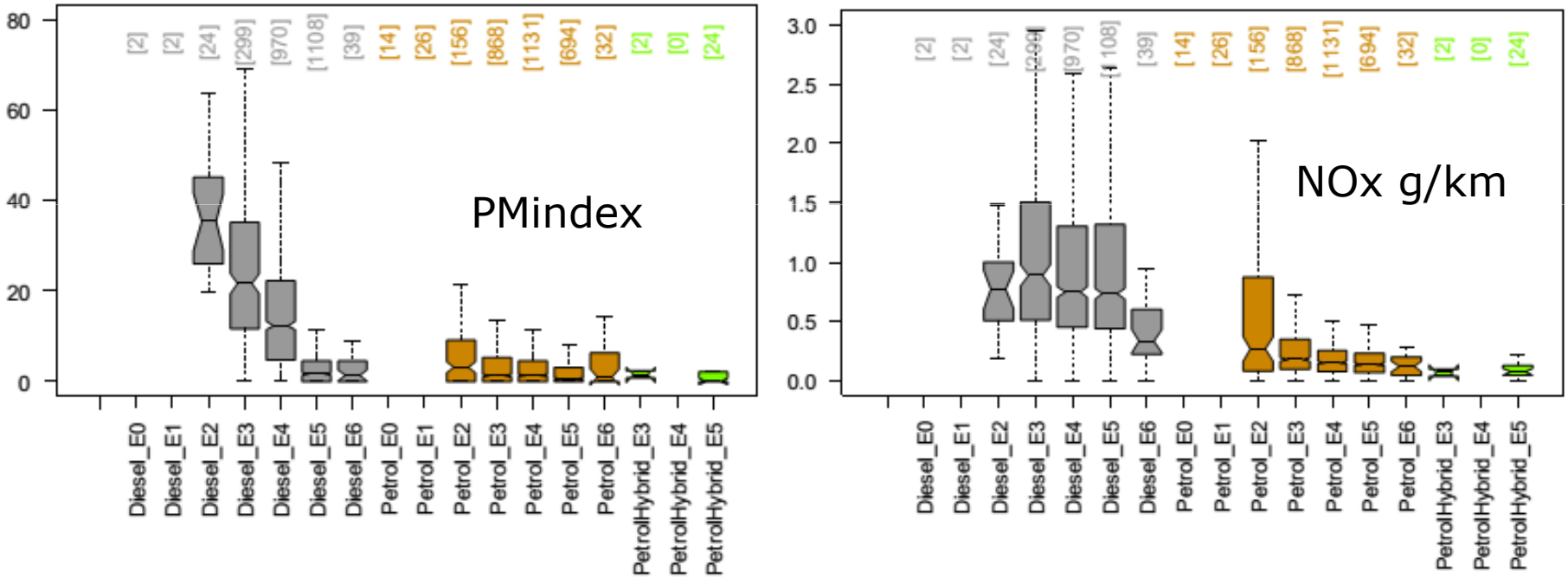
10 reports on evaluation efficiency of specific measures

1. Street cleaning – **draft completed**
2. Dust suppressants – **draft completed**
3. Low Emission Zones - **draft completed**
4. Discourage diesel cars – **draft completed**
5. Encourage use of EVs, HEVs and gas vehicles – **draft completed**
6. Eco-efficient car labels – **draft completed**
7. Traffic NOx abatement measures
8. Shipping
9. Biomass burning - agricultural and domestic sectors
10. Air quality/climate change synergies/interferences

B8: ESTRATEGIAS Y ACTUACIONES DEL N Y CENTRO DE LA UE: EVALUACIÓN Y ADAPTACIÓN

Diesel car PM Emissions

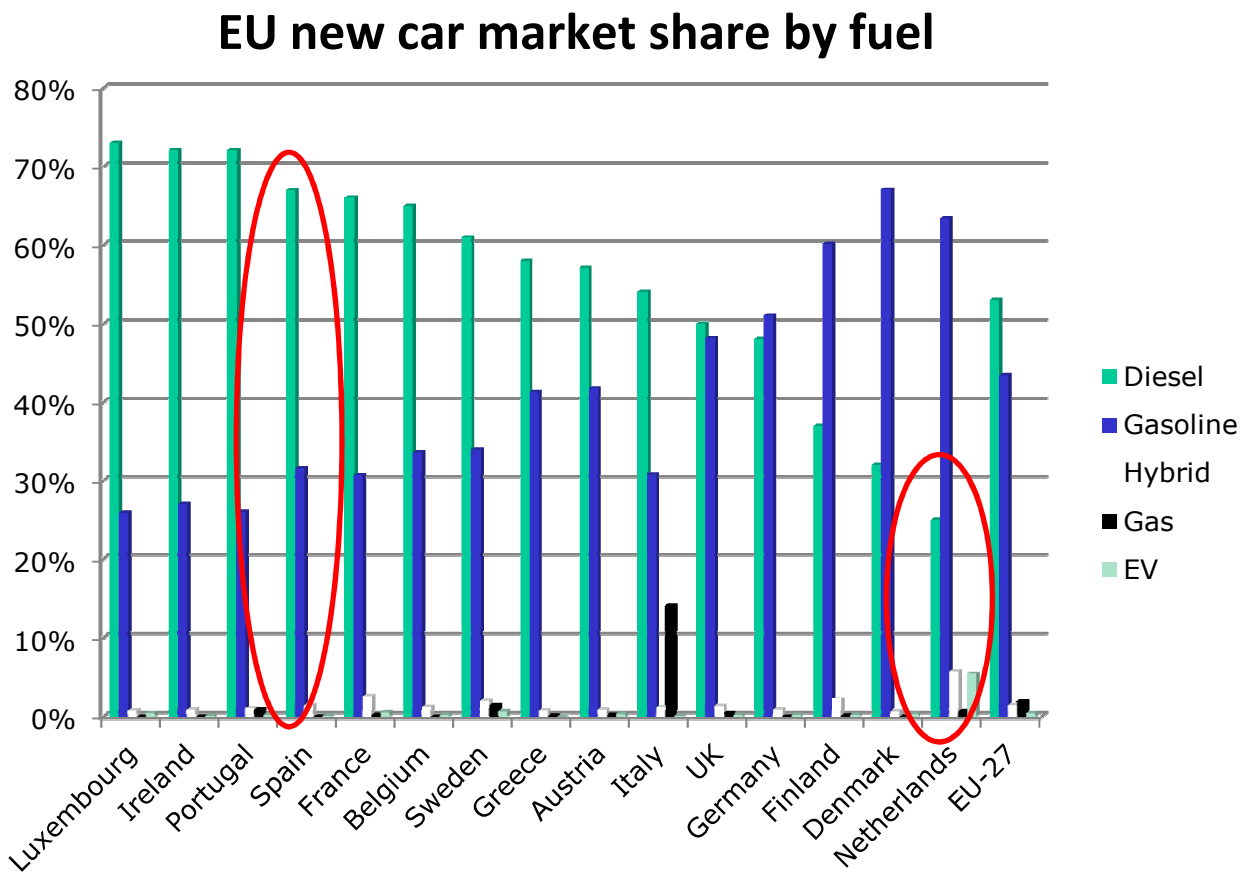
Remote Sensing of Vehicle Emissions (Leeds autumn/winter 2014)
Source: James Tate, University of Leeds, 2015



- **Average Euro 6 NOx seven times the type approval limit (ICCT, 2014)**
- **Some Euro VI buses continue to have high in-use NOx emissions, depending on exhaust T (Carslaw et al, 2014)**

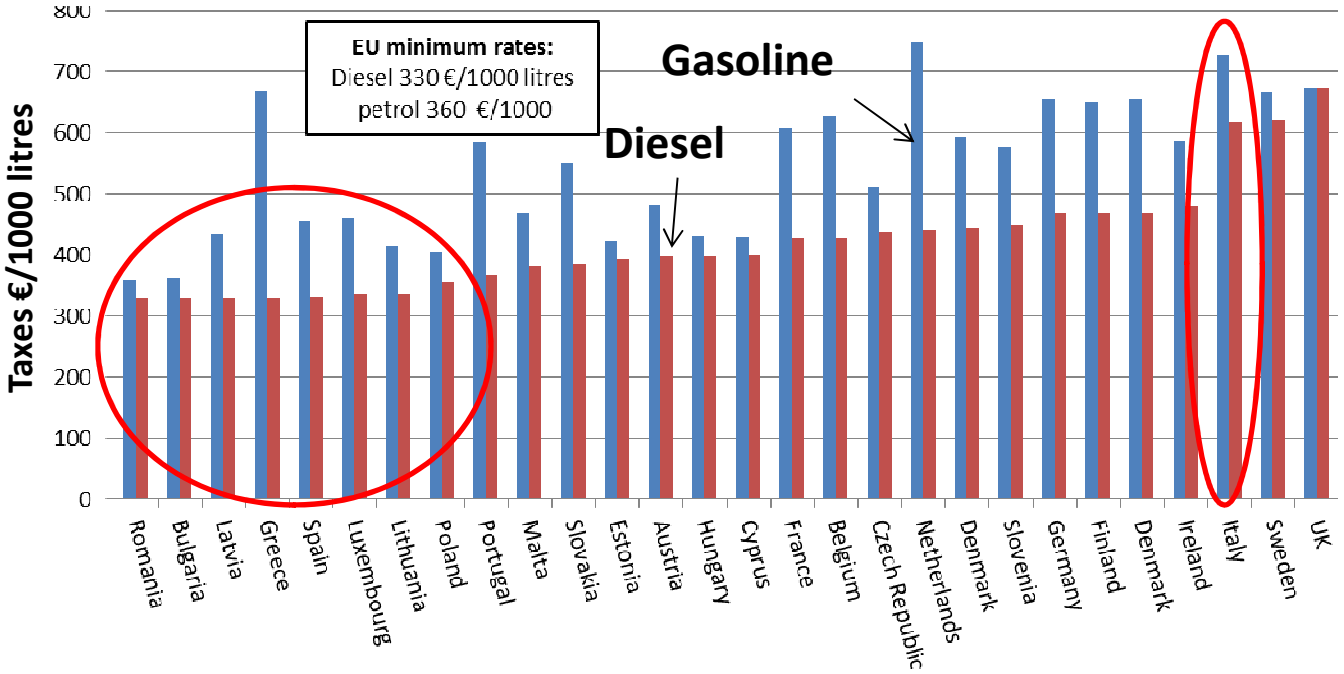
B8: ESTRATEGIAS Y ACTUACIONES DEL N Y CENTRO DE LA UE: EVALUACIÓN Y ADAPTACIÓN

EU Diesel market share increased from 36% (2001) to 55% (2013)



Source: ICCT, 2014

Diesel and gasoline fuel duty



Efficacy of LEZs

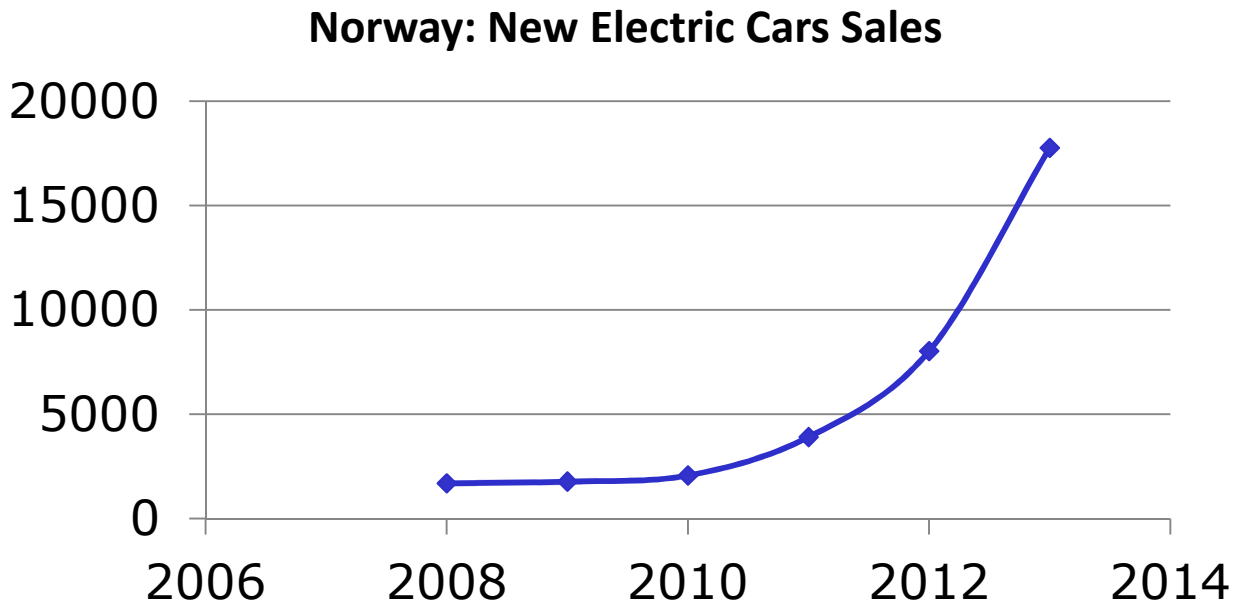
- Difficult to determine
- Confounding factors e.g. weather, other policy measures, recession
- Little evidence of impact on PM_{10} and NO_2 concentrations outside Germany
- EC/BC reduced

Efficacy of German LEZs

- $PM_{10} \leq 7\% \downarrow$
- Munich (LEZ + HDV ban) PM_{10} ca.13%↓ and NO_2 ≤10%↓
- But not all robust studies
- Early phases studied

- LEZs apply to cars as well as HDVs
- Generally more stringent than elsewhere

Electric car market in Norway



Norway 5.8%; Netherlands 5.4%; EU-28 0.4% (2013)

Norway electric car market

- Long term fiscal incentives from 1990s
- Incentives added sequentially until the market responded.
- The price difference between BEV and petrol car can be €1,000.

- Exempt from
  - vehicle registration tax
  - road tolls
  - VAT (normally 25%)
- Bus lane access
- BEVs -reduced annual tax
- Reduced rates on the main coastal ferries

Vehicle eco-label

Recommendations

- Mandatory EU wide scheme
- NOx, PM and CO_2 emissions, with no weighting
- Apply to new & used vehicles
- To take account of real-world emissions
- 'Well to tank' to enable ICEs and EVs to be compared
- Based on domestic appliances label (A to G rating) with running costs.
- Updated on annual basis by allocating a fixed percentage of models to each band.
- Long term public education is required to support the eco-label

CONSIDERACIONES FINALES

Informes individuales en www.airuse.eu

1. Contribución de fuentes a PM
2. Condiciones de lavado y aspiración polvo rodadura
3. Uso de supresores de polvo
4. Uso de organo nanopolimeros
5. Quema de biomasa
6. Emisiones industriales
7. Medidas del norte y centro de Europa (10 informes)
8. Fuentes naturales

Déjenos su dirección postal y le remitiremos los informes

AGRADECIMIENTOS

LIFE+ AIRUSE

Spain	**MAGRAMA, GenCat, Barcelona and Madrid City Councils**
Italy	**ARPA-Lombardia, Regione Lombardia, Regional Government of Tuscany, ARPA Toscana**
Portugal	**Porto City Council, North Regional Coord. & DeveloP. Comm. (CCDR-N)**
Greece	**Ministry of Environment, Energy and Climate Change**

¡GRACIAS POR SU ATENCIÓN!

xavier.querol@idaea.csic.es

GRACIAS A MARTÍN BASTOS POR ORGANIZAR LAS JORNADAS Y POR SU CONTRIBUCIÓN A LA MEJORA DE CALIDAD DEL AIRE, SU SABER HACER Y SU CALIDAD HUMANA

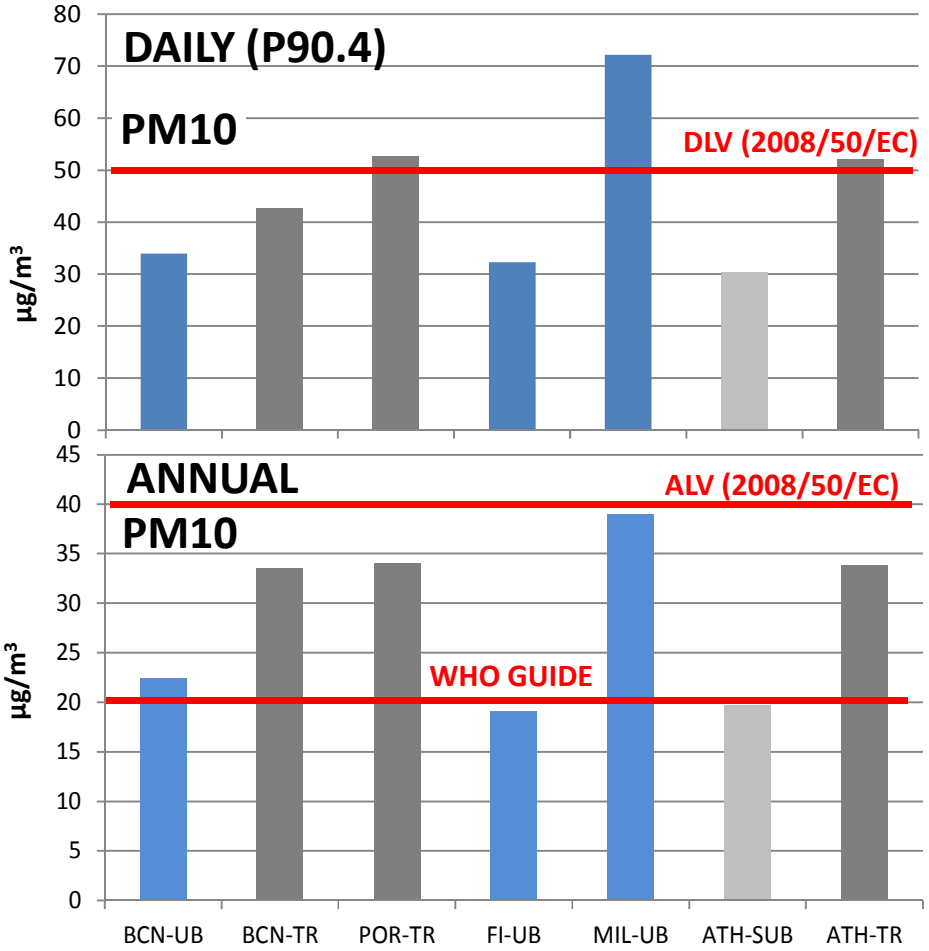
IN MEMORIAM DE MIGUEL LAVADO

LEZs

Country	Number of LEZs	Applicable vehicles	National Framework/ legislation
Austria	3	HGVs	Yes
Czech Republic	1	HGVs	-
Denmark	6	Vehicles > 3.5 tonnes	Yes
France	1	HGVs	No
Germany	>70	All except motorcycles	Yes
Hungary	1	HGVs	No
Italy	>130	Various	No
Netherlands	14	HGVs	Yes
Portugal	1	Cars & HGVs	No
Sweden	8	Vehicles > 3.5 tonne	Yes
UK	2	Various	No

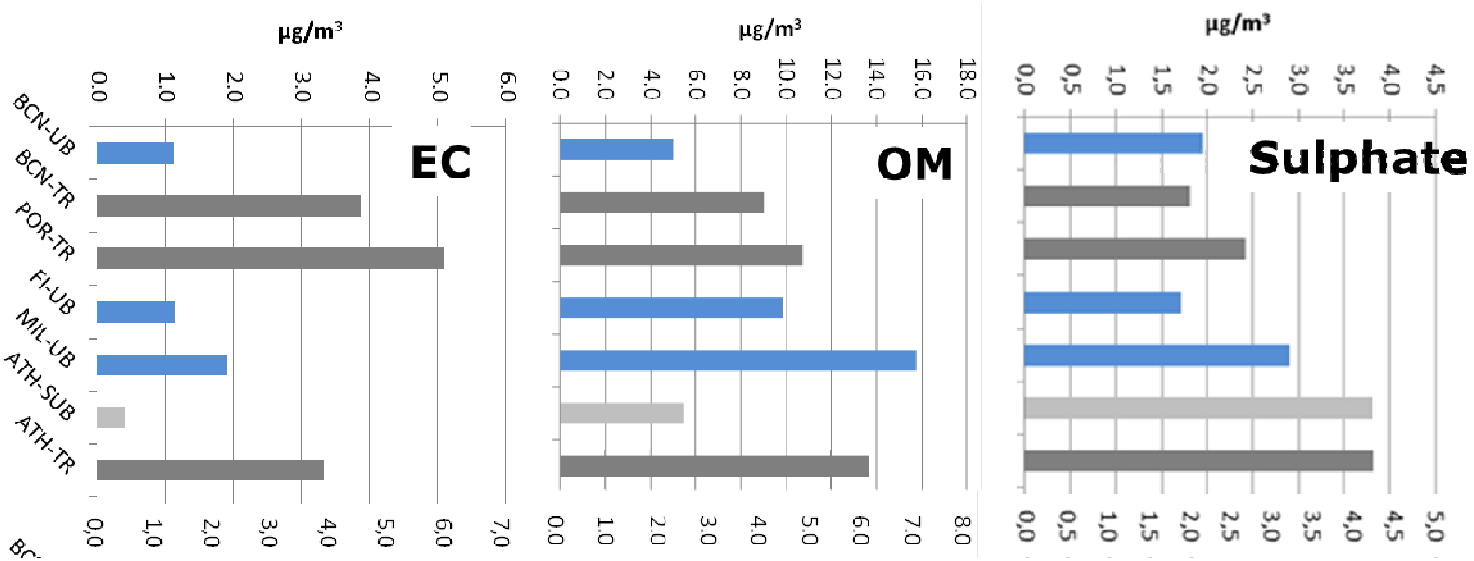
At mid 2014

B2. CONTRIBUCIÓN DE FUENTES 2013 PM10 & PM2.5

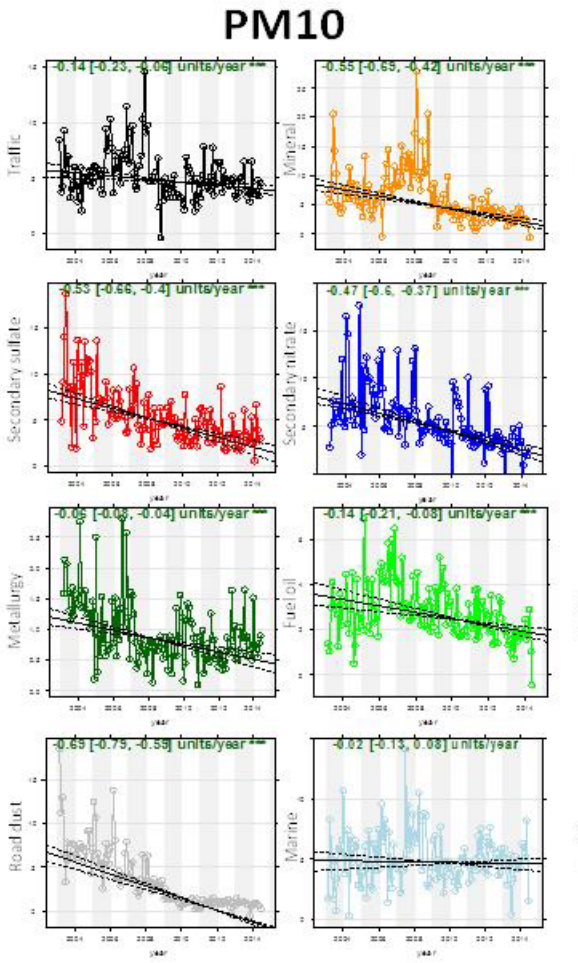


B2. HARMONIZED 2013 PM10 & PM2.5 SOURCE APPORTIONMENT

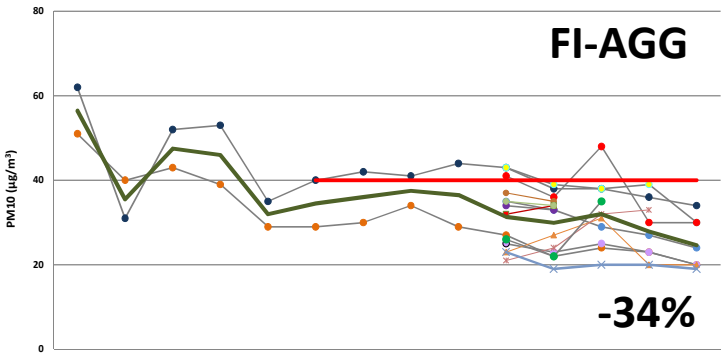
Example PM10

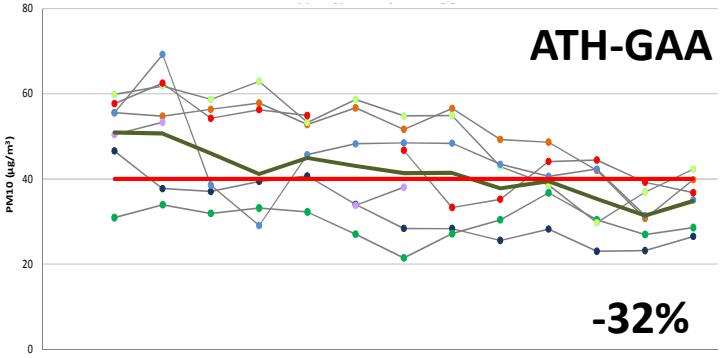


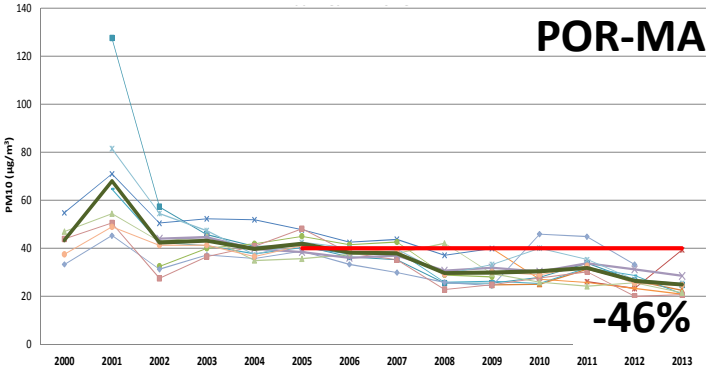
B1: BARCELONA TENDENCIAS 2004-2014 PM10 Y PM2.5 CONTRIBUCIÓN FUENTES

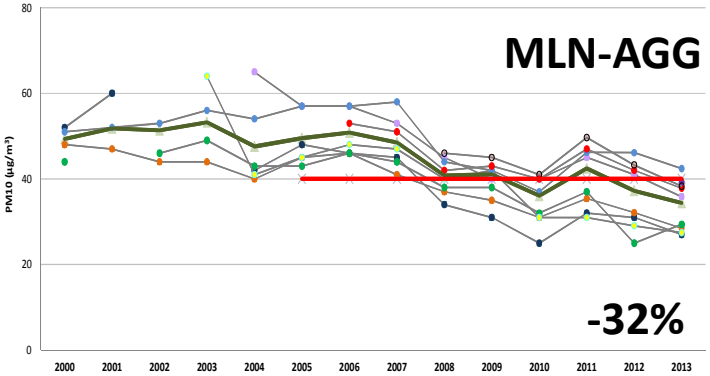


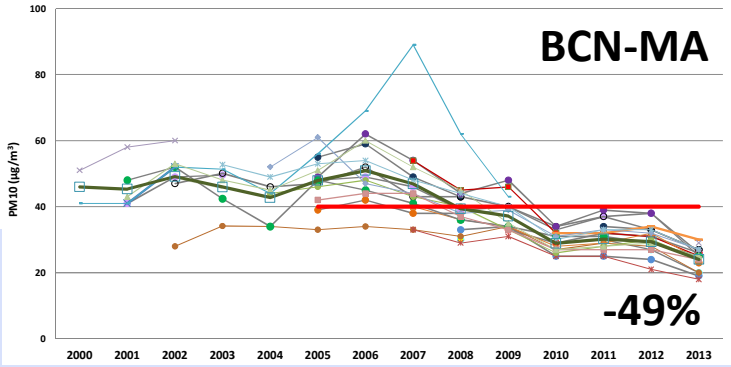
B1: 5 CIUDADES TENDENCIAS 2001-2013 PM10 ANUAL



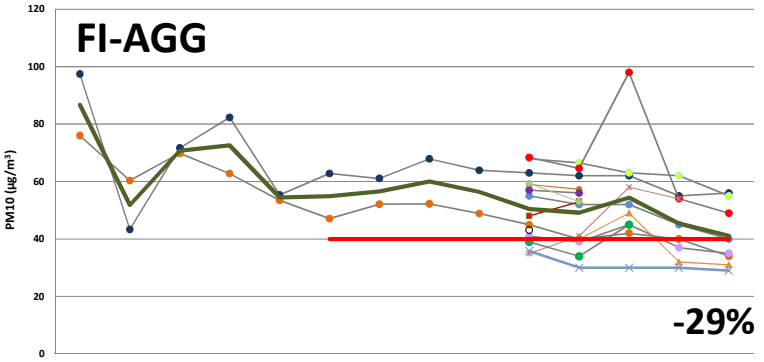


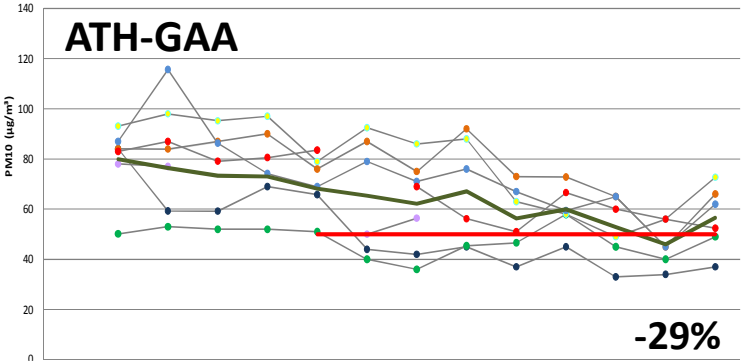


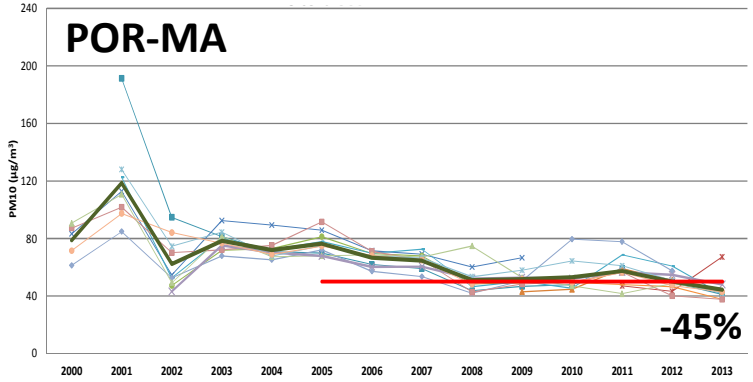


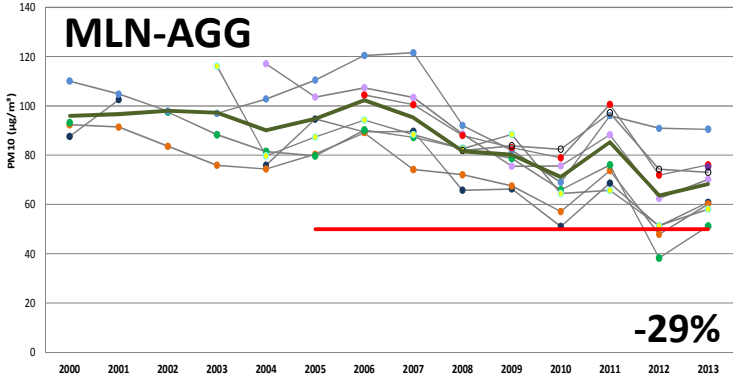


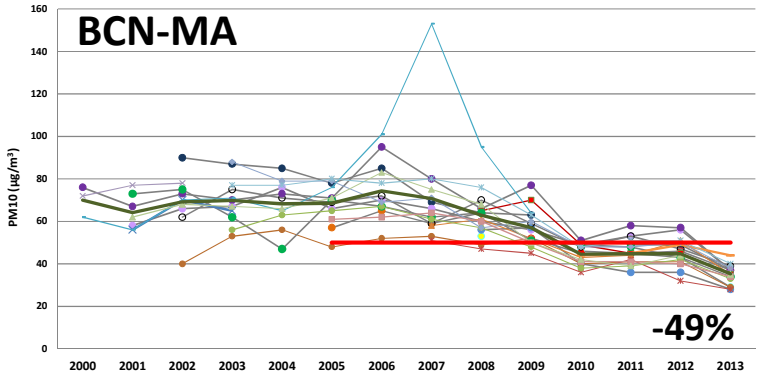
B1: 5 CIUDADES TENDENCIAS 2001-2013 PM10 DIARIO



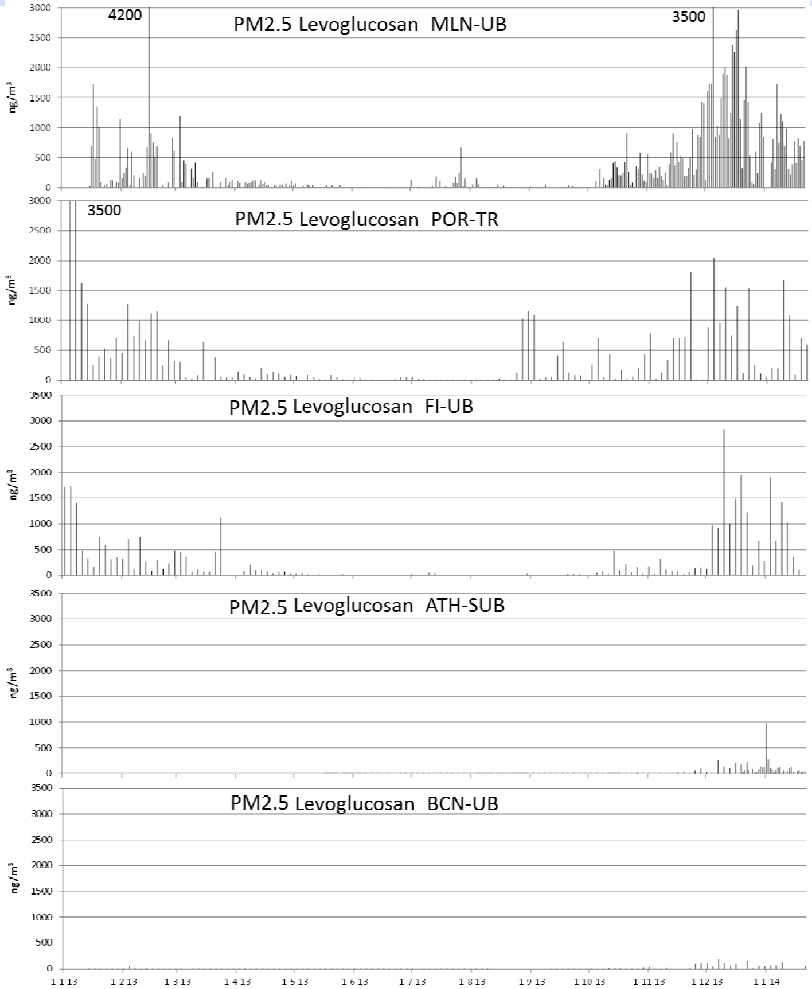


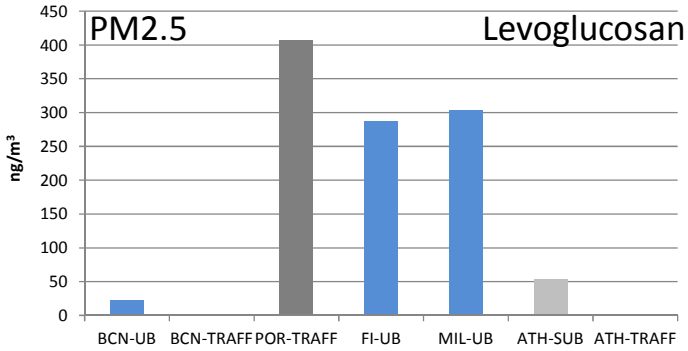


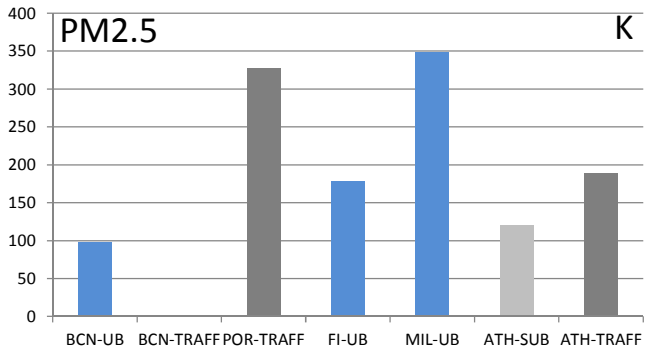




B2. CONTRIBUCIÓN DE FUENTES 2013 PM10 & PM2.5







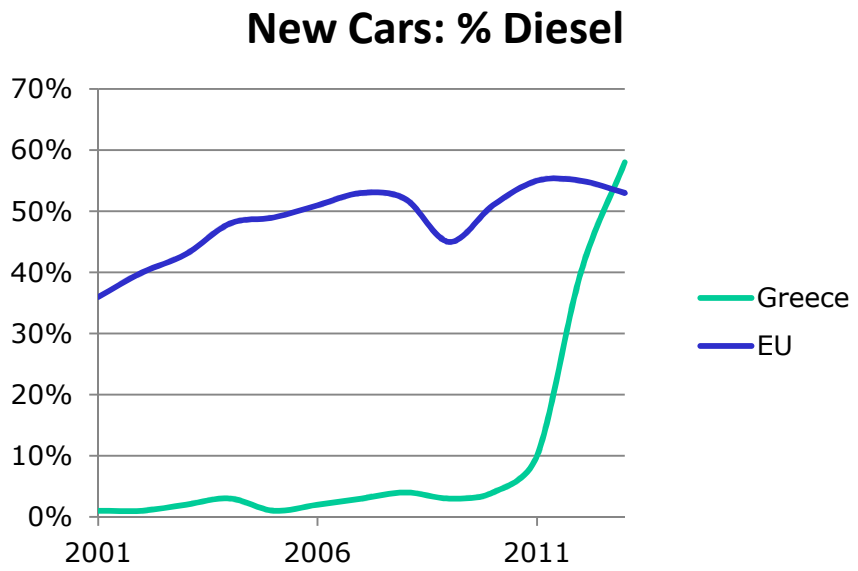
Banning Diesel cars

Greece

•1991 until 2011 – diesel cars banned in Athens and Thessaloniki

•Diesel 20% cheaper than gasoline

•Rapid increase in diesel car sales since ban lifted



London

•2014: Attempts to ban diesel cars from London LEZ dropped due to public opposition

Paris

•2015: Mayor announces ban on diesel cars – LEZ