The air quality impact of energy saving measures in the major cities signatories of the Covenant of Mayors

Fabio Monforti-Ferrario
Albana Kona
Emanuela Peduzzi
Denise Pernigotti
Enrico Pisoni

The European Commission's science and knowledge service

Joint Research Centre

European Commission

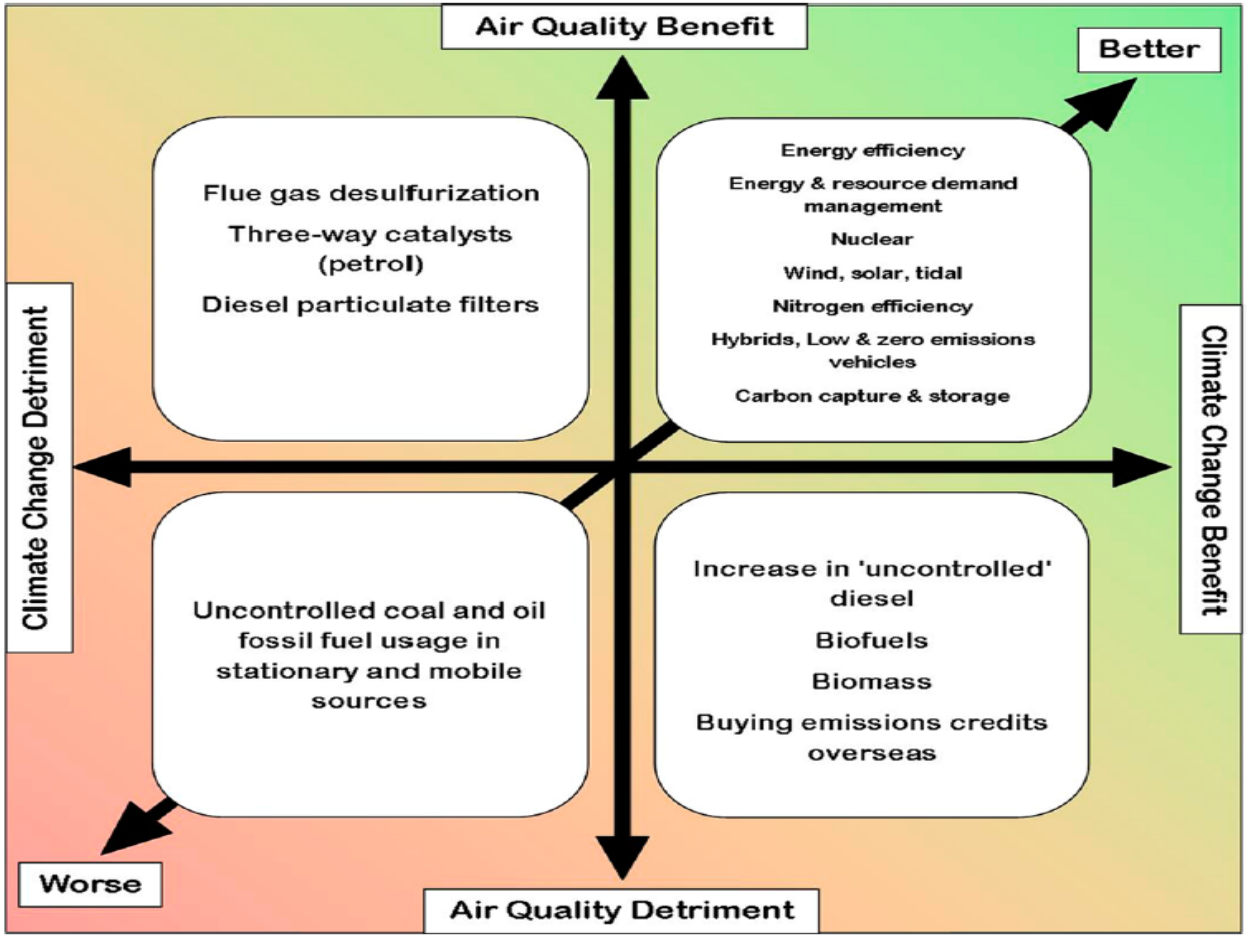
Scope

The Covenant of Mayors is the world's largest movement for local climate and energy actions.

Is it possible to quantify the co-benefits for air quality for such a wide initiative?

Outline

- Climate mitigation and air quality benefits
- Covenant of Mayors
- Tools and indicators
- Results & discussion
- Conclusions



Climate change benefit (CCB)

≠

Air Quality Benefit (AQB)

 (von Schneidemesser and Monks ,2013)

European Commission

Covenant of Mayors initiative

- 54 Countries
- 7 755 signatories
- 252 million citizens

The CoM – signatories commitments

Signatory cities pledge action to support implementation of the EU greenhouse gas-reduction targets of **20% by 2020** and/or **40% by 2030** and the adoption of a joint approach to tackling mitigation and adaptation to climate change and have to prepare and implement a **Sustainable Energy Action Plan (SEAP)** (now SECAP – Sustainable Energy and Climate Action Plan) including:

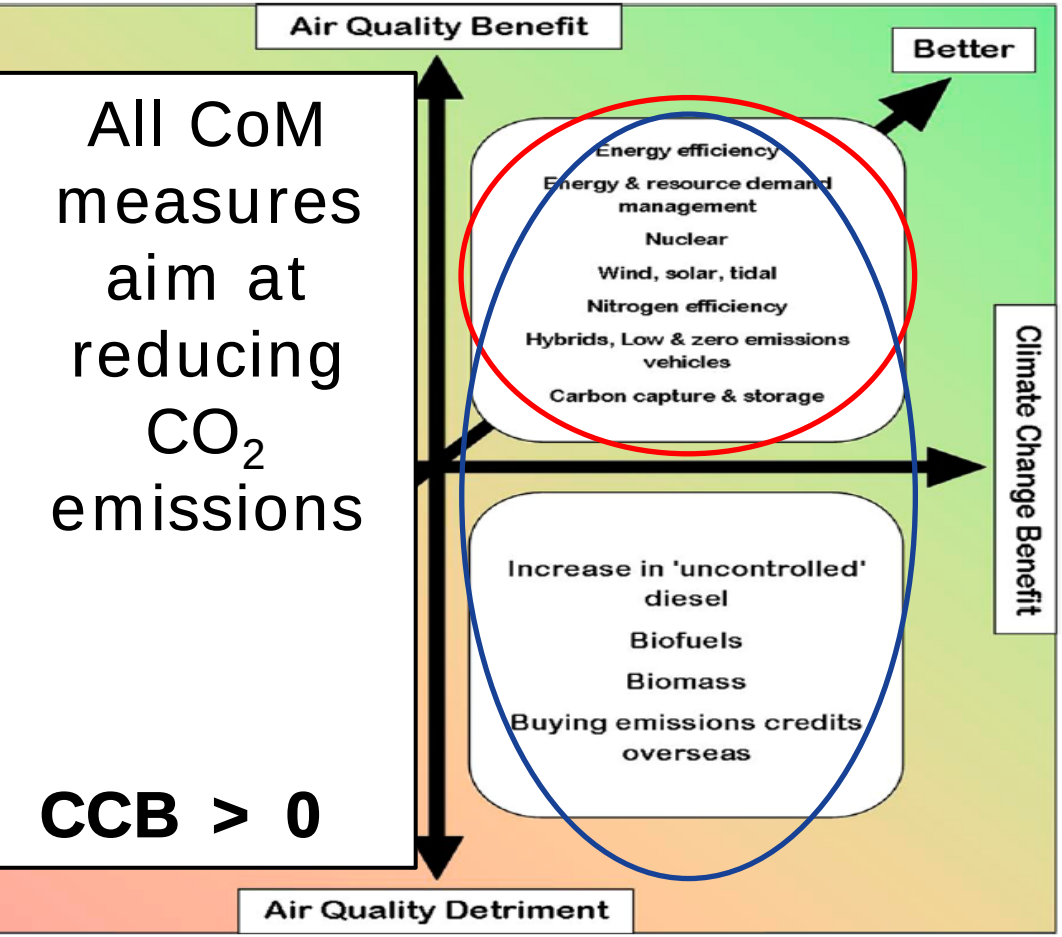
- the **list of measures planned** and their estimated impact

- **a Baseline Emission Inventory** (GHG!!)

The CoM measures

Three main types of measures:

- **Energy Saving** measures (ES)
- **Renewable Energy Production** measures (REP)
- **Mixed measures** (MIX)



Energy Saving (ES)

Renewable Energy Production (REP)

Mixed (MIX)

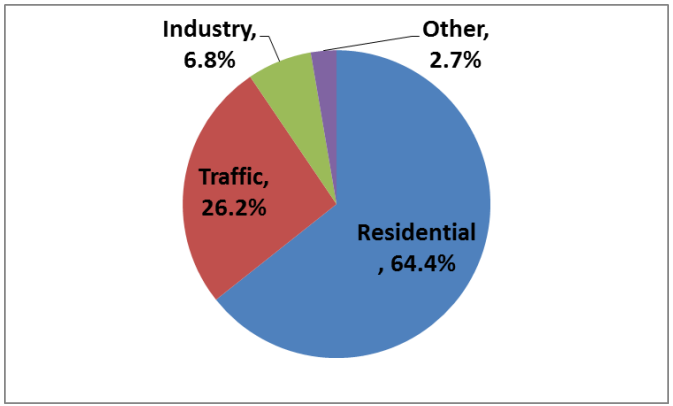
This work focuses on ES measures only

European Commission

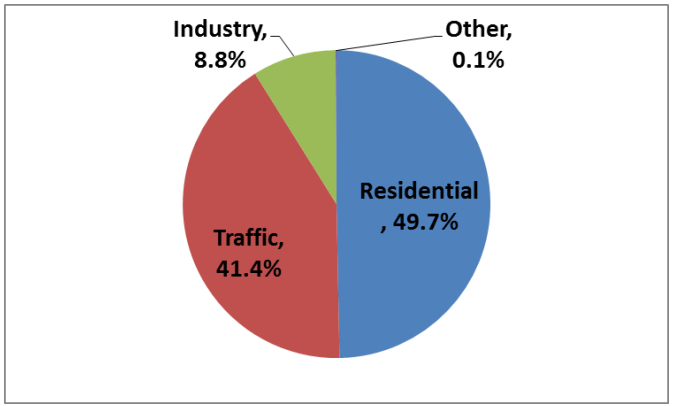
Dataset selection

Criteria: largest cities + full data availability for both AQ and CC

2713 measures in **146 cities** spread over **23 countries**



Shares of measures by sector



Shares of energy saved by sectors

Pop: 54 125 000 ES: 60 TWh/y

European Commission

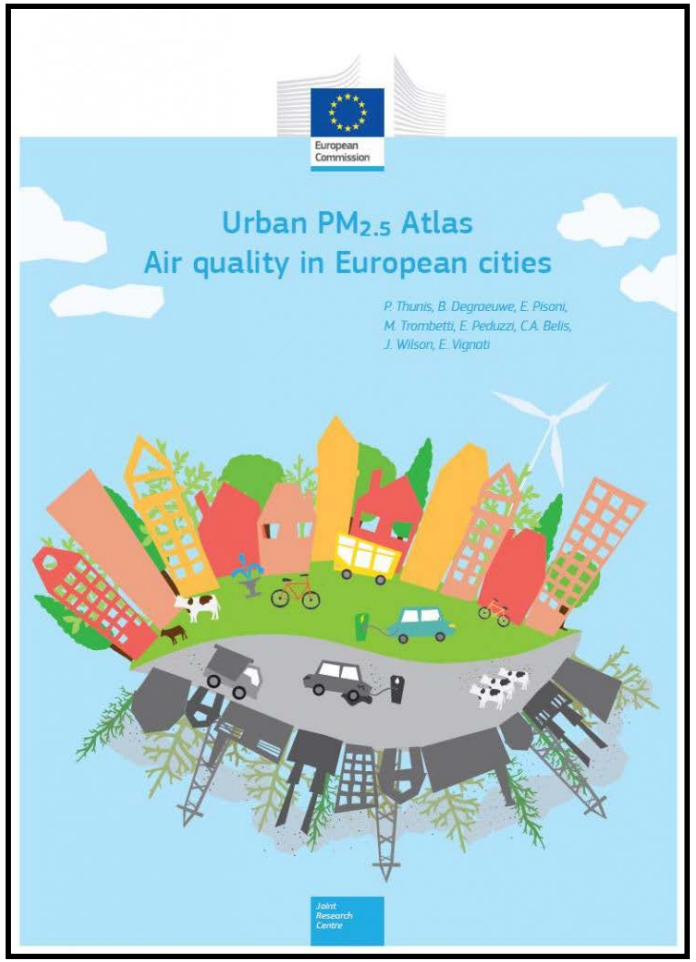
Indicators: Climate Change Benefit (CCB)

$$CCB = (EM_{SAV}/EM_{TOT,X})$$

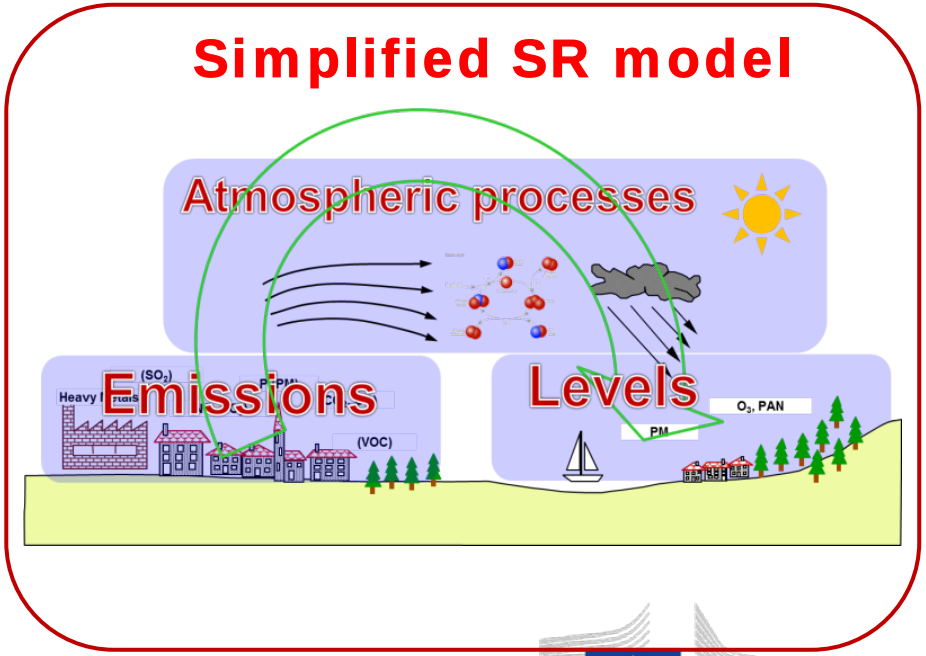
EM_{SAV} = Emissions saved by the measure

EM_{TOT} = Total CO_2 Emissions in city X

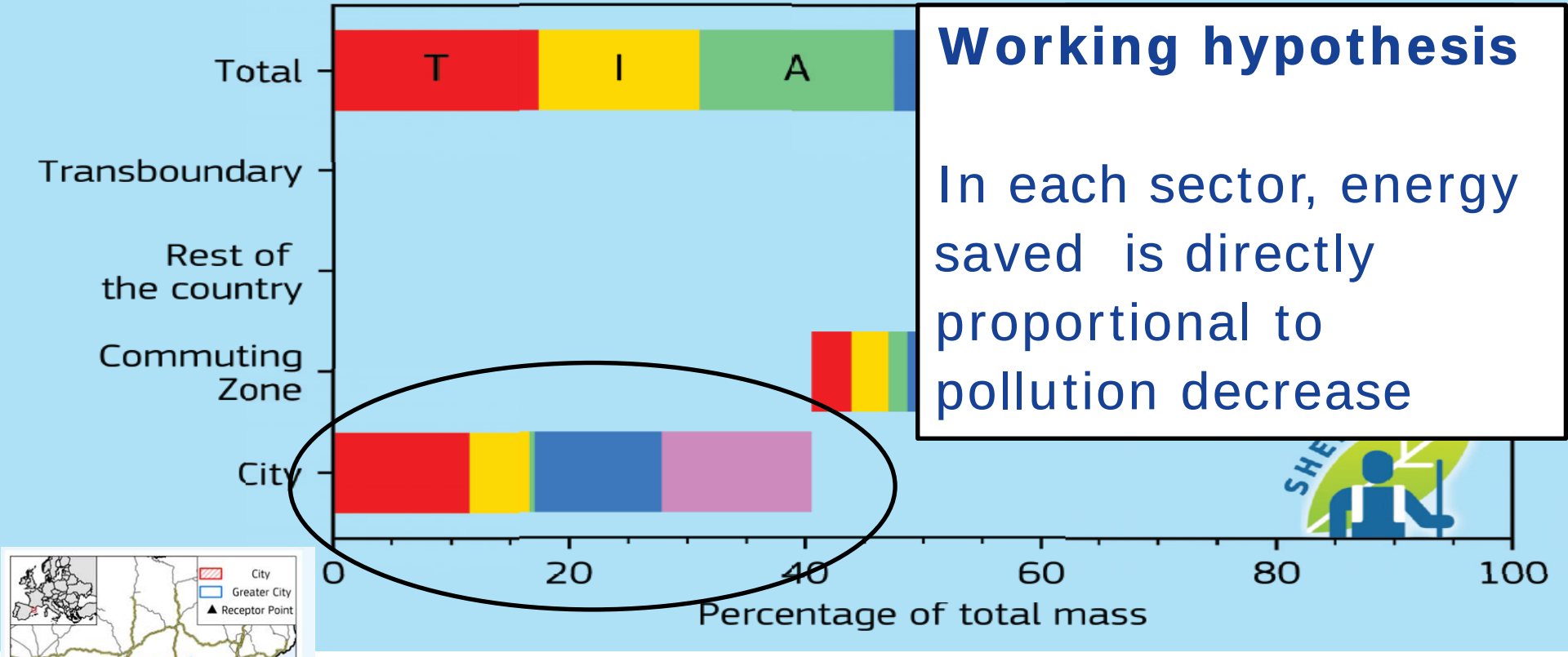
$0 < CCB < 1$



Screening for High Emission Reduction Potentials on Air quality

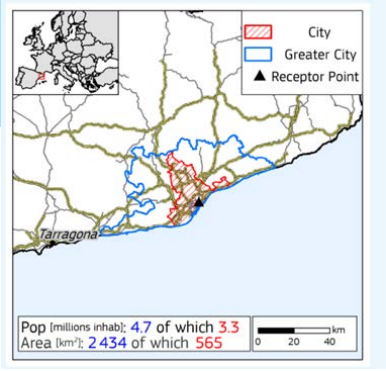


European Commission



Working hypothesis

In each sector, energy saved is directly proportional to pollution decrease



Harmonized methodology across investigated cities.

European Commission

Indicators: Air Quality Benefit (AQB)

$$AQB = (E_{SAV}/E_{SEC,X})(SI_{SEC,X}/SI_{TOT,X})$$

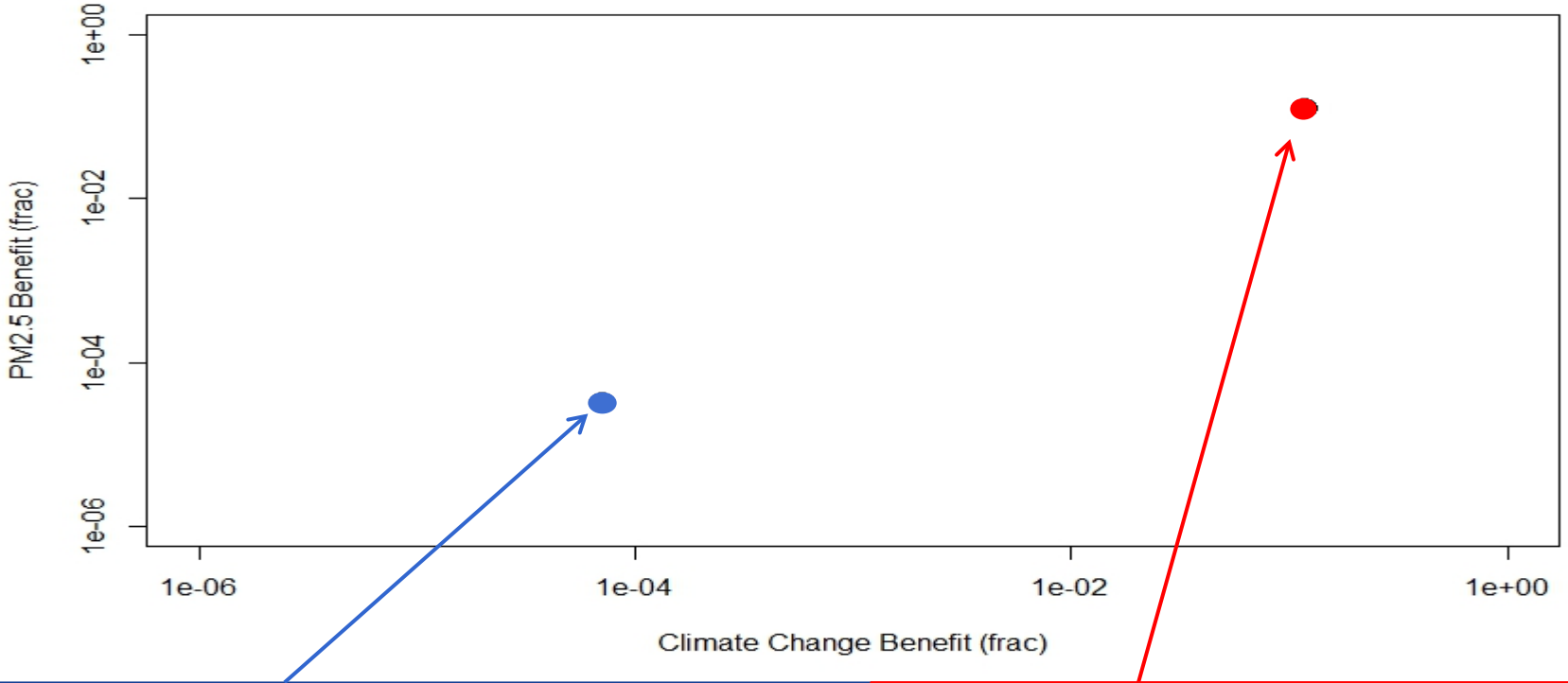
E_{SAV} = Energy saved by the measure, applied in city X to sector SEC
E_{SEC} = Energy consumption in the city X in the sector SEC

SI_{SEC} = Impact on the AQ levels of city X of the **local** emissions of SEC
SI_{TOT} = Impacts on the AQ levels of city X of the **local** emissions from all sectors

$$0 < AQB < 1$$

Fractional decrease of the pollutant concentration originated by the local sources

Examples of measures in Barcelona

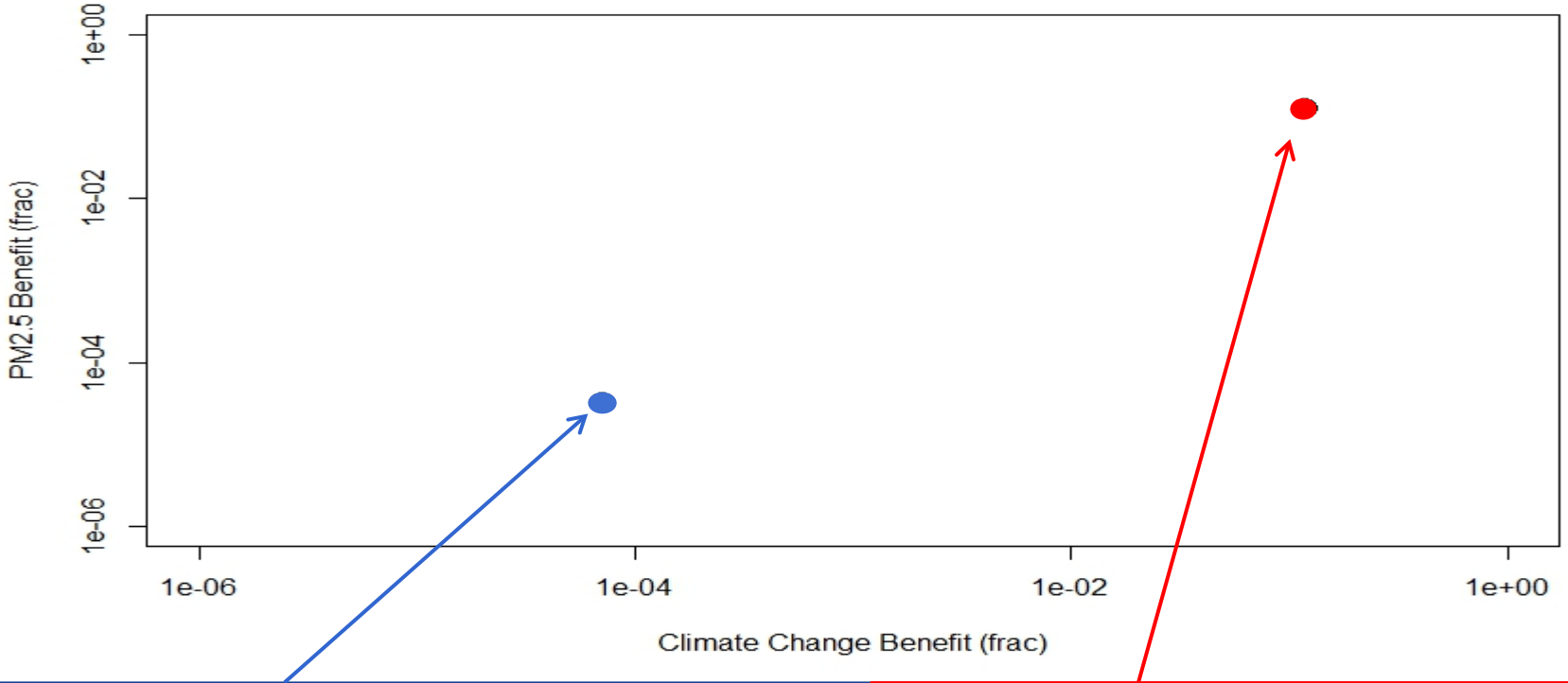


Promote the installation of solar thermal systems in sports centres

Implementation of Barcelona Urban Mobility Plan

European Commission

Examples of measures in Barcelona

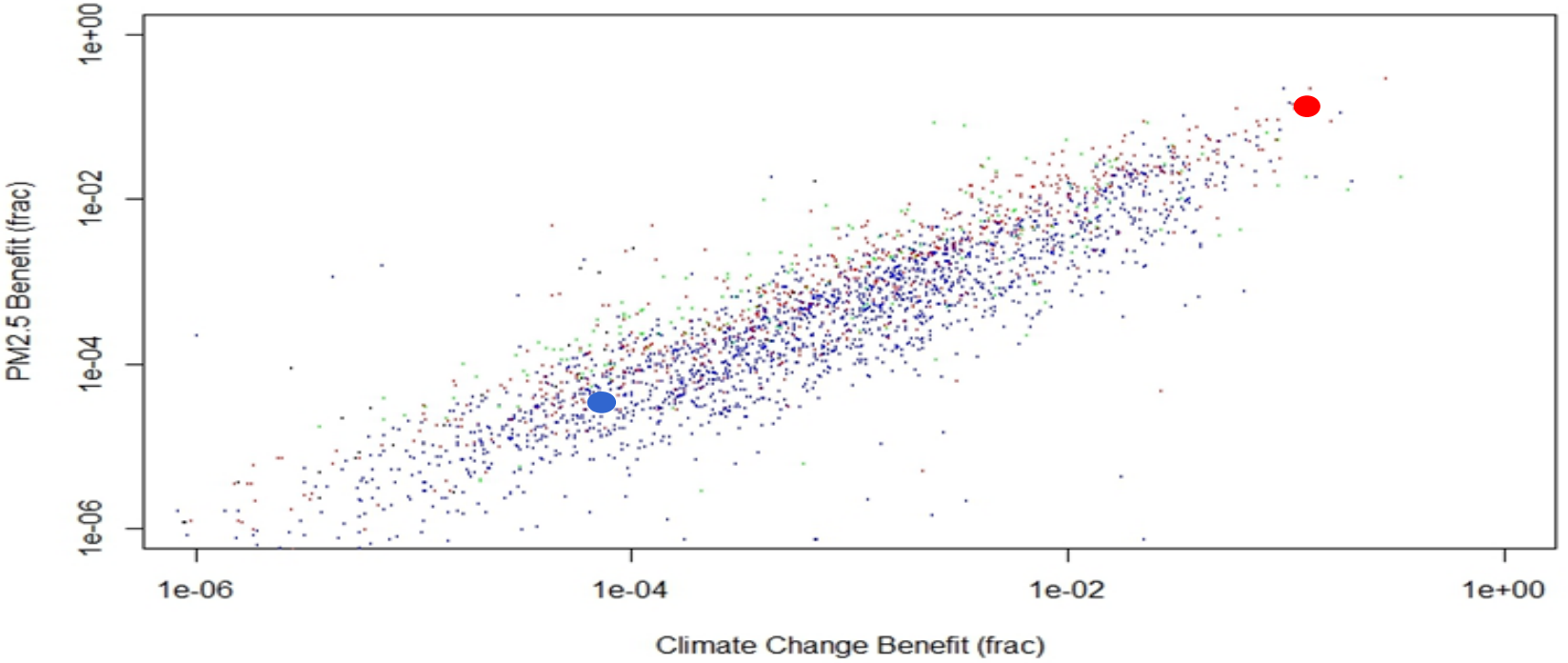


CCB = 0.007 %
AQB = 0.003 %

CCB = 11.9 %
AQB = 12.4 %

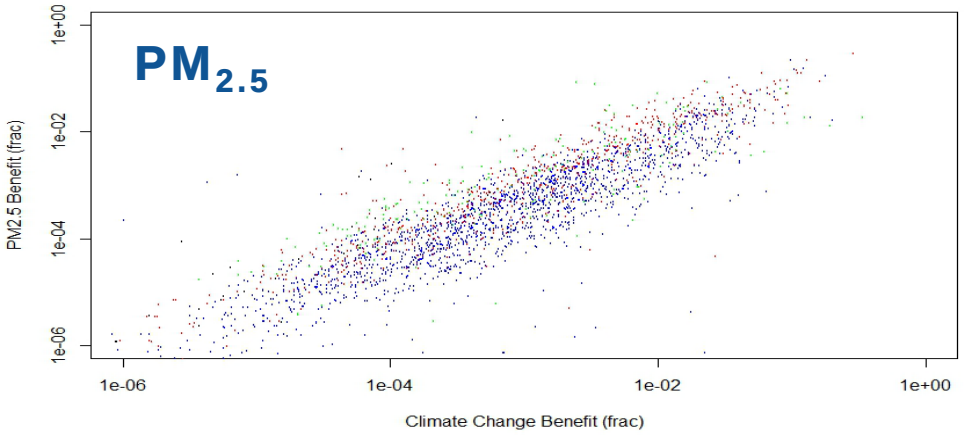
European Commission

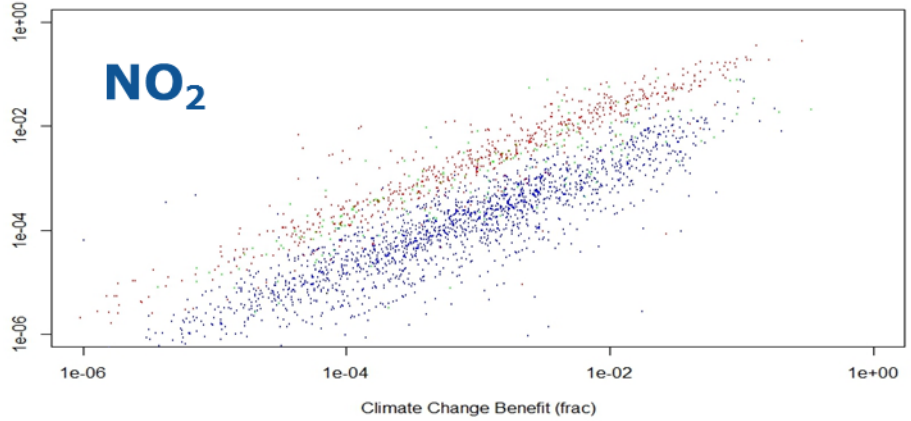
AQB vs CCB - all selected measures



European Commission

AQB vs CCB - sectors and pollutants

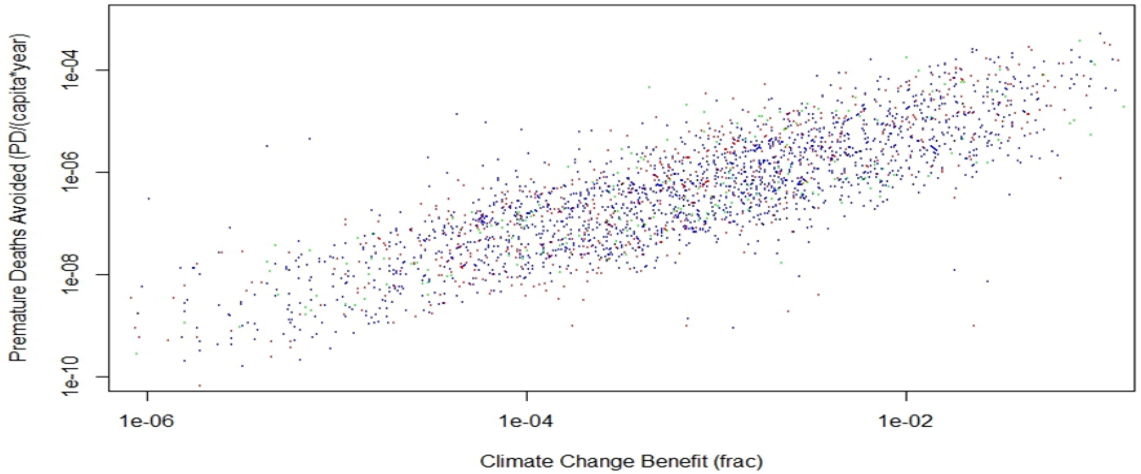




For the same climate benefit, traffic measures produce a **higher** $PM_{2.5}$ benefit than measures targeting residential sector

For the same climate benefit, traffic measures produce a **much higher** NO_2 benefit than measures targeting residential sector

Premature Deaths avoided vs. CC benefit – $PM_{2.5}$



	Avoided Premature Deaths	Years of Life Saved
All sectors	**6569**	**68476**
Traffic	**3280**	**34192**
Buildings	**2591**	**27003**
Industry	**673**	**7000**

Total PD avoided : 6569/y

Of which:
2591/y from "Residential" measures

3280 /y from "Traffic" measures

Pop: 54 125 000

European Commission

Conclusions

- We have provided a first **quantitative** evaluation of the Air Quality co-benefits of a subset of the measures planned in the CoM.

- A main result of this study is the demonstration **of existence of co-benefits**: for the cities and the measures involved, the presence of relevant co-benefits has been demonstrated in a robust way.

- Moreover, statistical analysis has also shown that **co-benefits depend on the sector targeted and the pollutant considered** and has provided a first quantification.

Environment International 118 (2018) 222–234

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

The impact on air quality of energy saving measures in the major cities signatories of the Covenant of Mayors initiative

Fabio Monforti-Ferrario*, Albana Kona, Emanuela Peduzzi, Denise Pernigotti, Enrico Pisoni

European Commission, Joint Research Centre, Via E. Fermi 2749, TP 450, I-21027 Ispra, VA, Italy

ARTICLE INFO

Handling Editor: Xavier Querol

Keywords:
Covenant of Mayors
Air quality
Urban air pollution
Energy saving
Health impact

ABSTRACT

This study is a first attempt to evaluate how the major efforts made by several European cities in the frame of the Covenant of Mayors (CoM) initiative can impact the air pollution levels in the participating cities. CoM is by no mean one of the major cities initiatives aimed at mitigating climate change, supporting local authorities in the implementation of their climate action plans. Energy savings measures reported in the CoM cities' action plans have been analysed from the air quality perspective in order to find quantitative relations in the way local authorities deal with mitigation and how these practices are expected to have consequences on the air quality at urban level and finally positively impacting the citizens' health.

Commission

Outlook

- Extend the analysis to include other kinds of measures.
- Focusing on “key actions” for more details
- Investigate the influence of other variables (e.g, city size, climate areas, pollutants levels)
- Discuss findings with stakeholders

European Commission

Stay in touch

EU Science Hub: ***ec.europa.eu/jrc***

Twitter: ***@EU_ScienceHub***

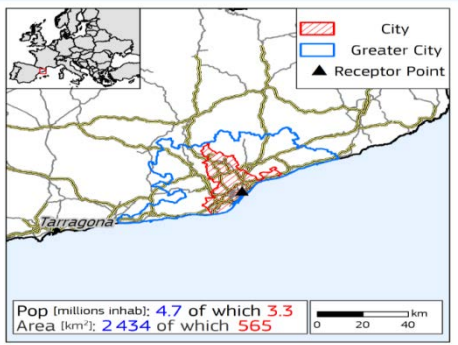
Facebook: ***EU Science Hub - Joint Research Centre***

LinkedIn: ***Joint Research Centre***

YouTube: ***EU Science Hub***

European Commission

Example – a SMALL measure in Barcelona – CCB



COM3: Promote the installation of solar thermal systems in sports centres

$$CCB = (EM_{SAV}/EM_{TOT,X})$$

EM_{SAV} = 226 tCO2-eq/y

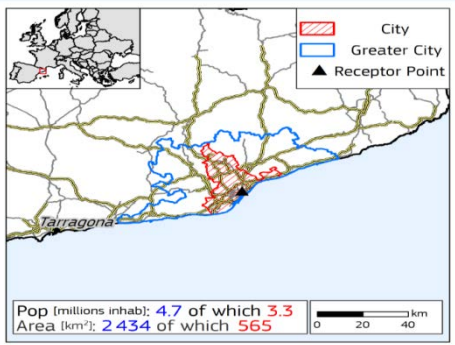
EM_{TOT} = 3211928 tCO2-eq/y

Covenant of Mayors

CCB = 0.007%

European Commission

Example – a measure in Barcelona – AQB



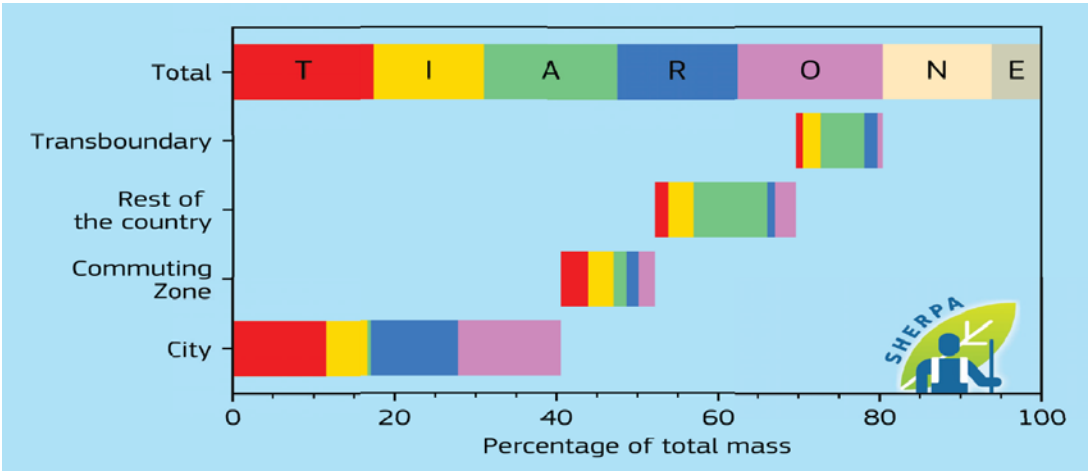
COM3: Promote the installation of solar thermal systems in sports centers

$$AQB = (E_{SAV}/E_{SEC,X})(SI_{SEC,X}/SI_{TOT,X})$$

E_{SAV} = 1120 MWh/y

E_{SEC} = 9.78 x 10^7 MWh/y

Covenant of Mayors



SI_{SEC} = 8.34

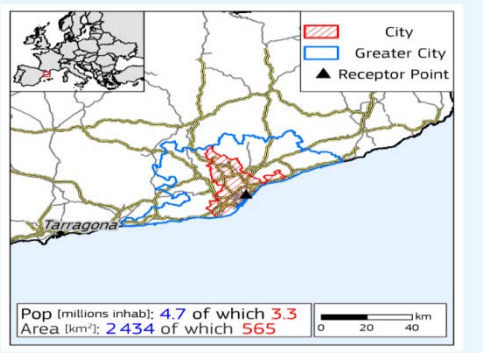
SI_{TOT} = 29.5

SHERPA

AQB = 0.0032 %

European Commission

Example – a LARGE measure in Barcelona – CCB



Implementation of Barcelona Urban Mobility Plan

$$CCB = (EM_{SAV}/EM_{TOT,X})$$

EM_{SAV} = 383439 tCO2-eq/y

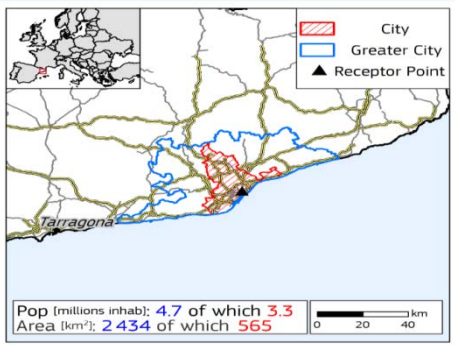
EM_{TOT} = 3211928 tCO2-eq/y

Covenant of Mayors

CCB = 11.9 %

European Commission

Example – a LARGE measure in Barcelona – AQB



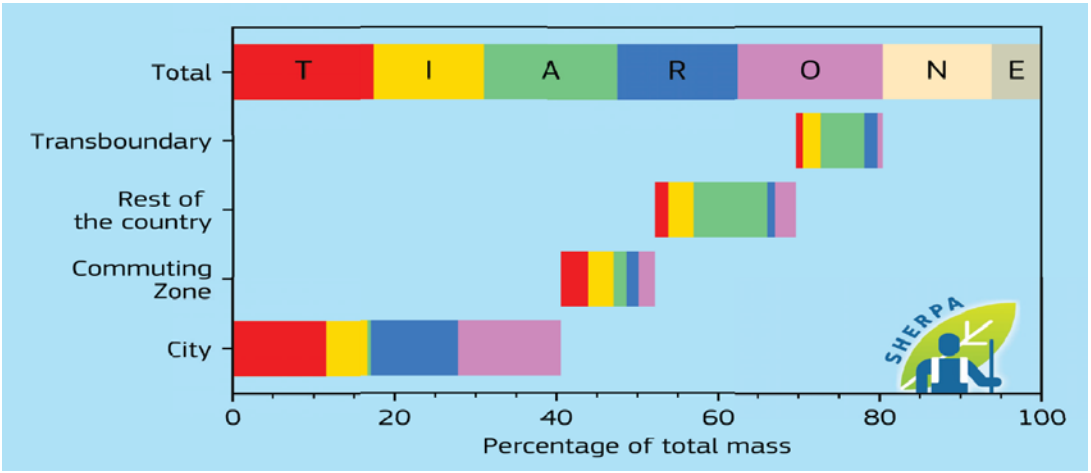
Implementation of Barcelona Urban Mobility Plan

$$AQB = (E_{SAV}/E_{SEC,X})(SI_{SEC,X}/SI_{TOT,X})$$

$E_{SAV} = 1.48 \times 10^7$ MWh/y

$E_{SEC} = 4.09 \times 10^7$ MWh/y

Covenant of Mayors



$SI_{SEC} = 10.1$

$SI_{TOT} = 29.5$

SHERPA

AQB = 12.4%

European Commission