Air quality and climate: two sides of the same coin

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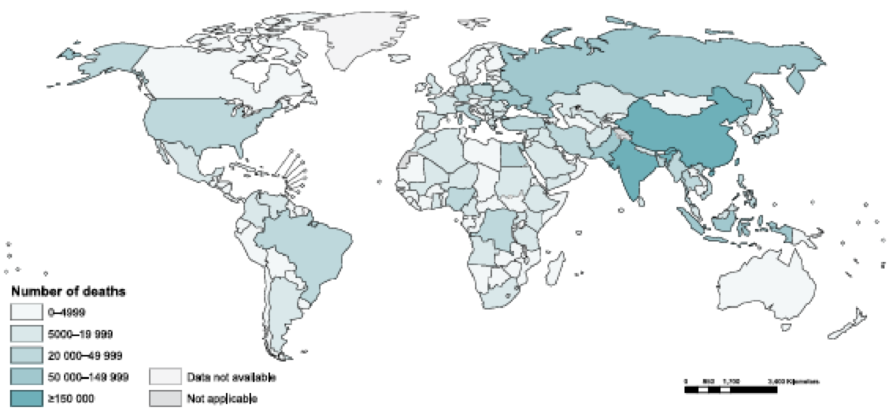
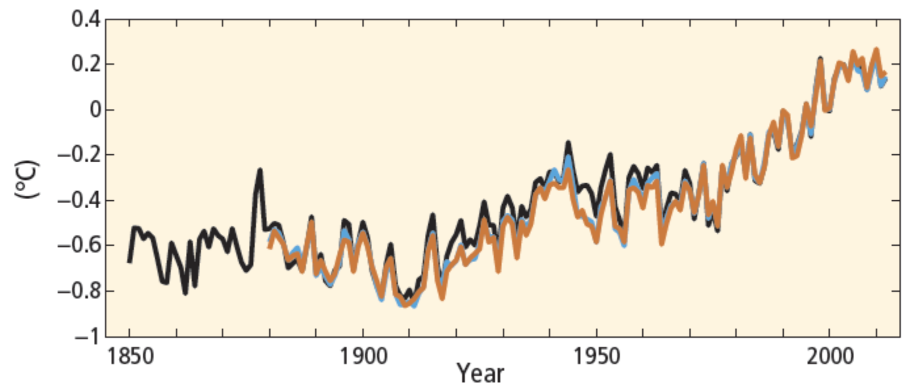
Air quality and climate

Air quality and climate change are two important environmental emergencies that our society is confronting with

Atmospheric pollution is the second risk factor at the global level, leading to 3.5 millions premature deaths per year

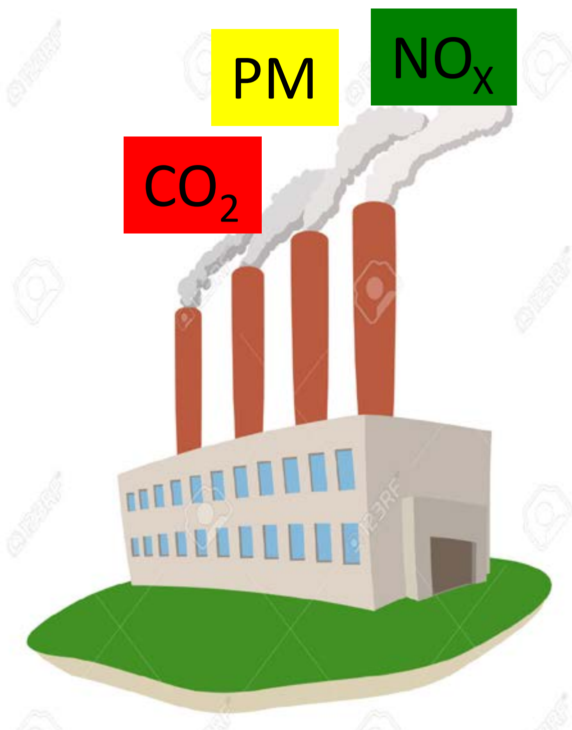


The 5th IPCC *Assessment Report* has stated that “warming of the climate system is unequivocal and, since the 1950s, many of the observed changes are unprecedented over decades to millennia”



Anthropogenic emissions

All anthropogenic activities (energy production, transportation, industry, agriculture, waste management) are responsible for the emission of gaseous and particulate pollutants that modify atmospheric composition

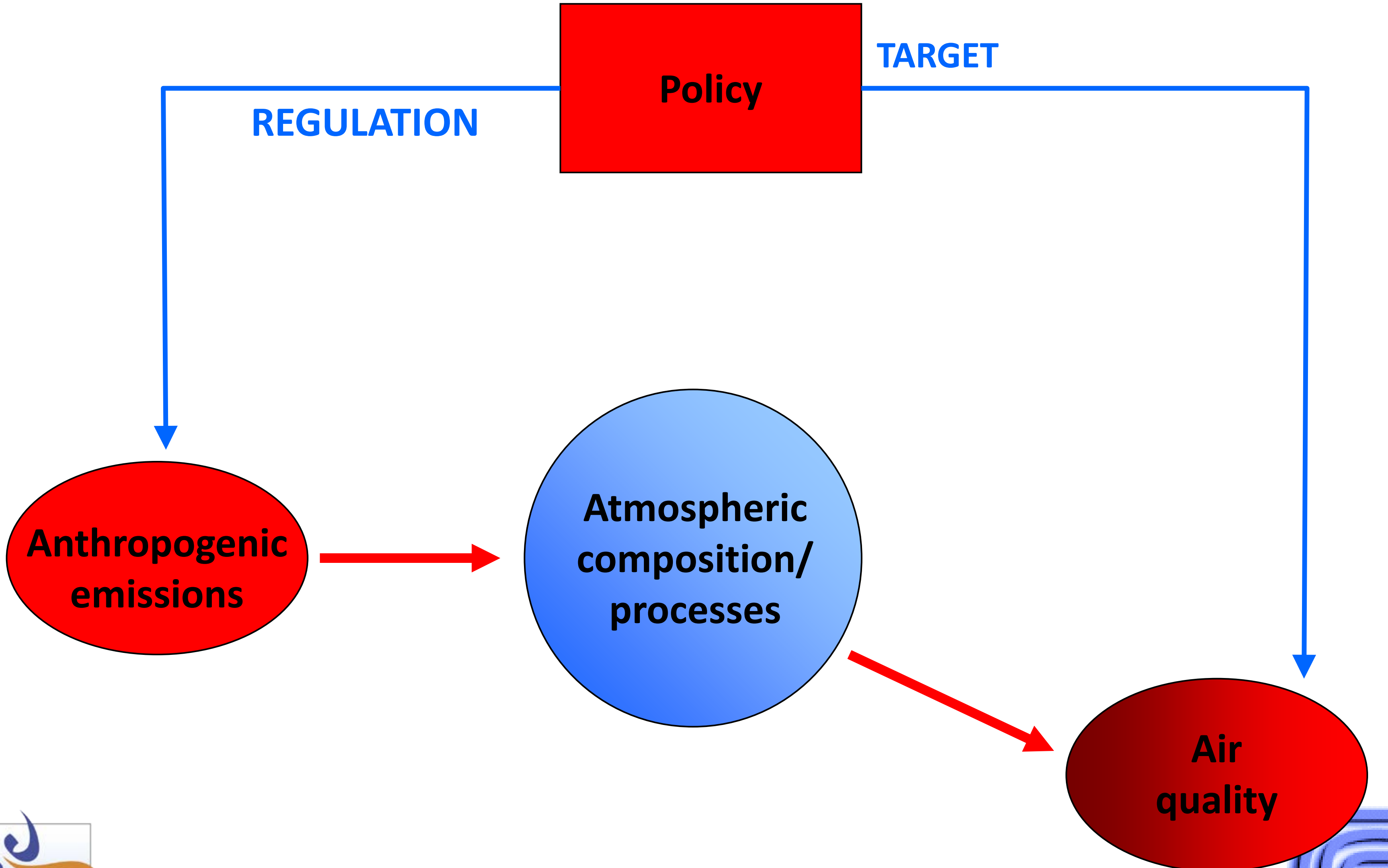


The same source injects into the atmosphere both climate forcers and pollutants that are detrimental for human health and the ecosystems

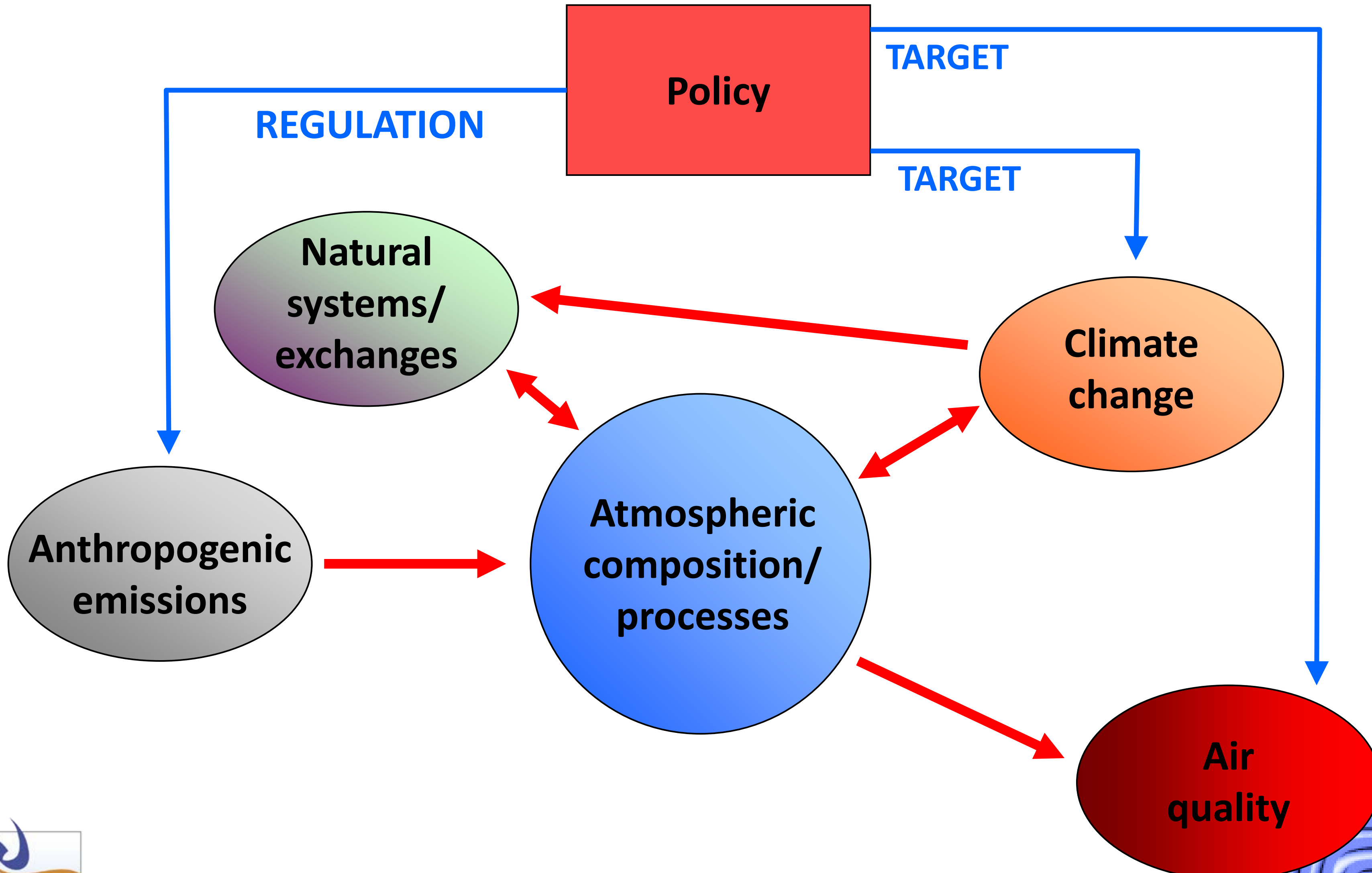
Emission abatement

- It is not possible to unequivocally separate the anthropogenic emissions in two distinct categories: atmospheric pollutants and climate-active species
- Several species affect both air quality and climate
- Still, these two environmental challenges are viewed as separate issues, which are dealt with by different science communities and within different policy frameworks

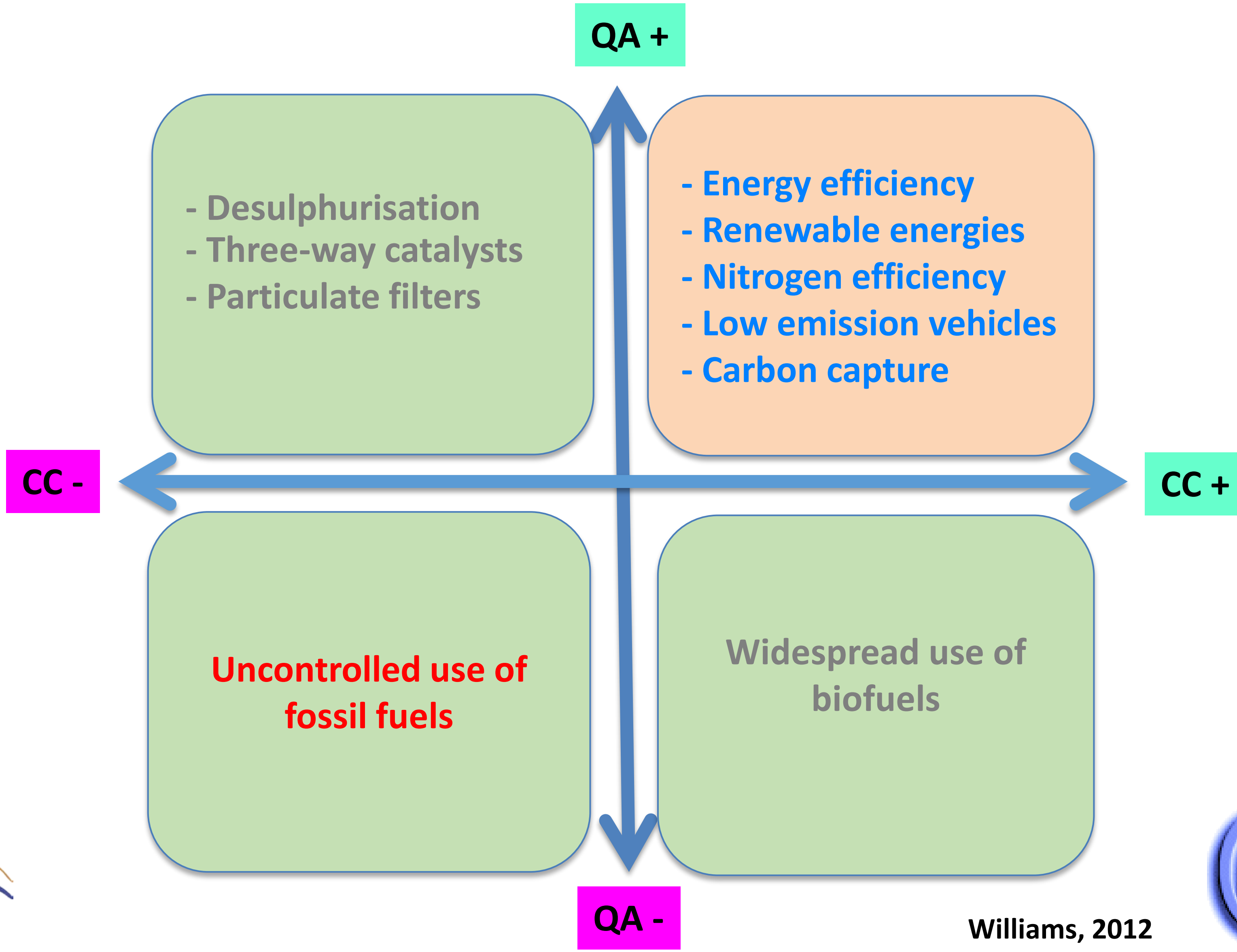
Air quality policy design



Air quality and climate policy



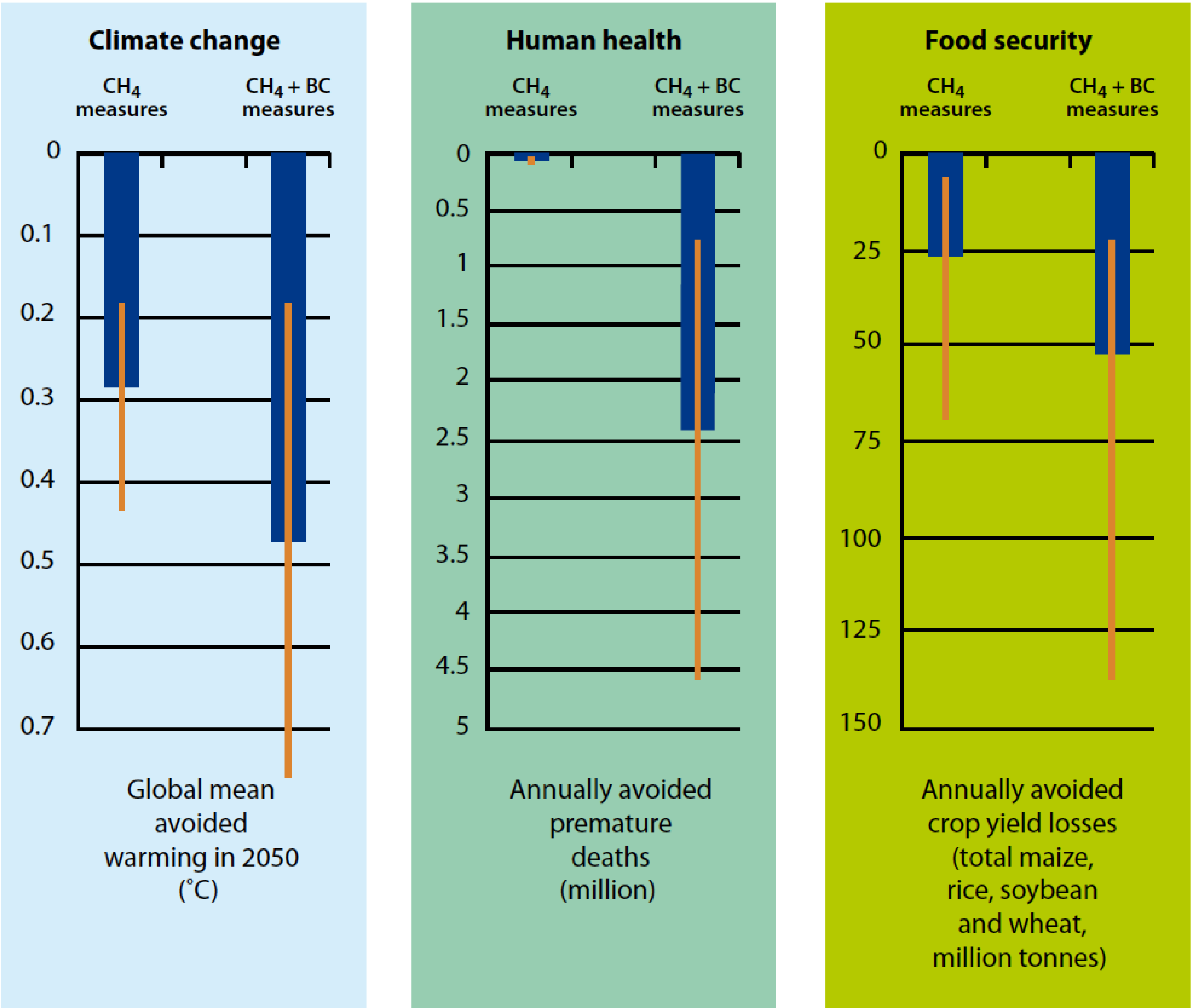
Win-win or win-lose policies?



Williams, 2012

UNEP-WMO Report

Integrated Assessment of Black Carbon and Tropospheric Ozone



Lifetime of atmospheric pollutants

- The efficiency of the removal processes through precipitation, dry deposition or chemical reaction determines the atmospheric lifetime of the atmospheric pollutants
- The lifetime defines whether a specific pollutant is important at the local, regional or global scale

Effects of atmospheric pollutants

	Compound	Lifetime	Health effects	Ecosystem effects	Climate effects
Long-lived compounds	Carbon dioxide (CO_2)	centuries	NO		warming
	Nitrous oxide (N_2O)	120 years	NO	NO	warming
	CFC and HFC	years to centuries	NO	NO	warming
	Methane (CH_4)	8 years			warming
Short-lived compounds	Carbon monoxide (CO)	2 months			warming
	Ozone (O_3)	1 month			warming
	Sulphur dioxide (SO_2)	1 week			cooling
	Nitrogen oxides (NO_X)	1 week			cooling
	Ammonia (NH_3)	1 week			cooling
	Black carbon (BC)	1 week			warming
	Volatile organics (VOC)	highly variable			warming

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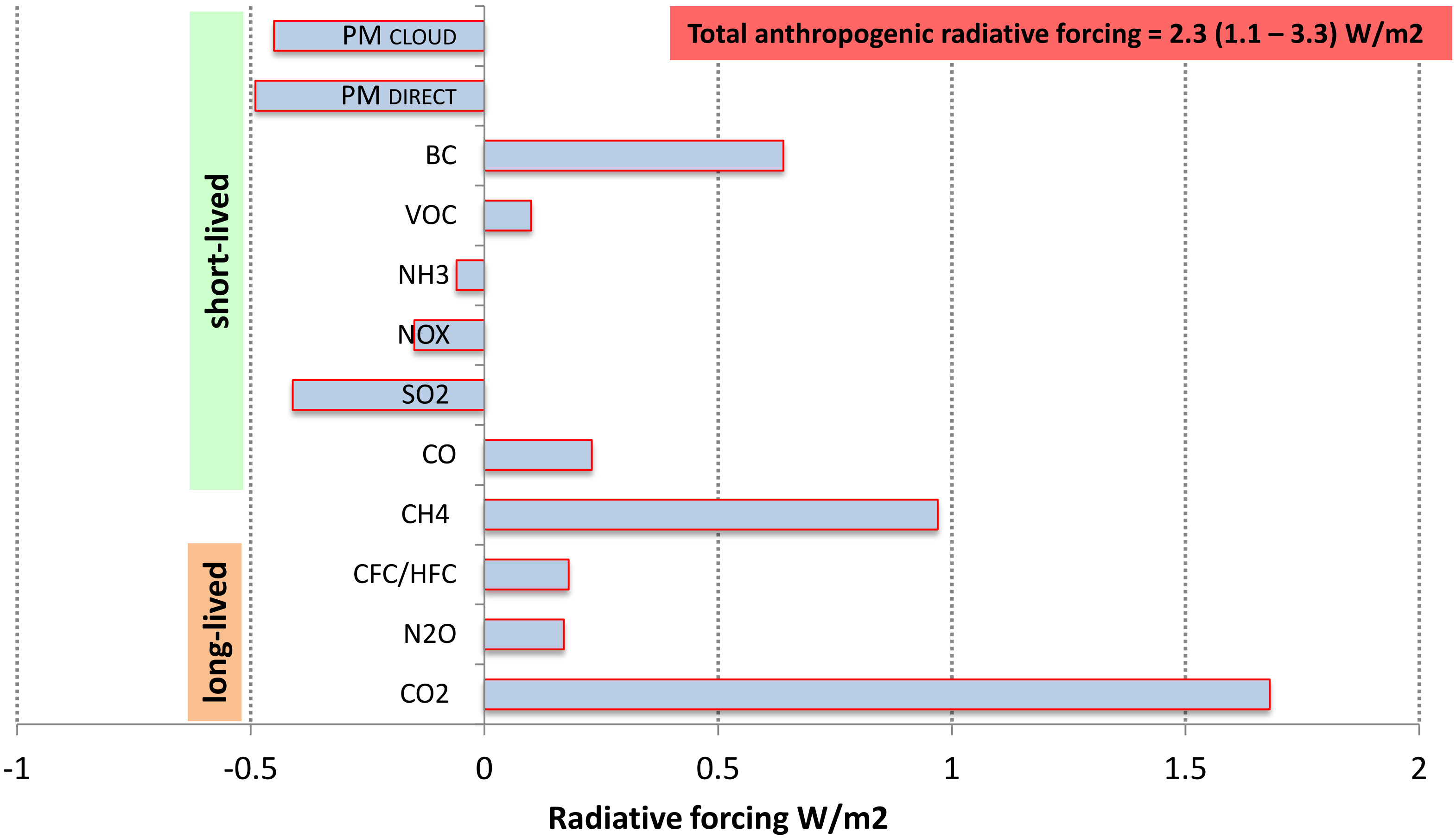
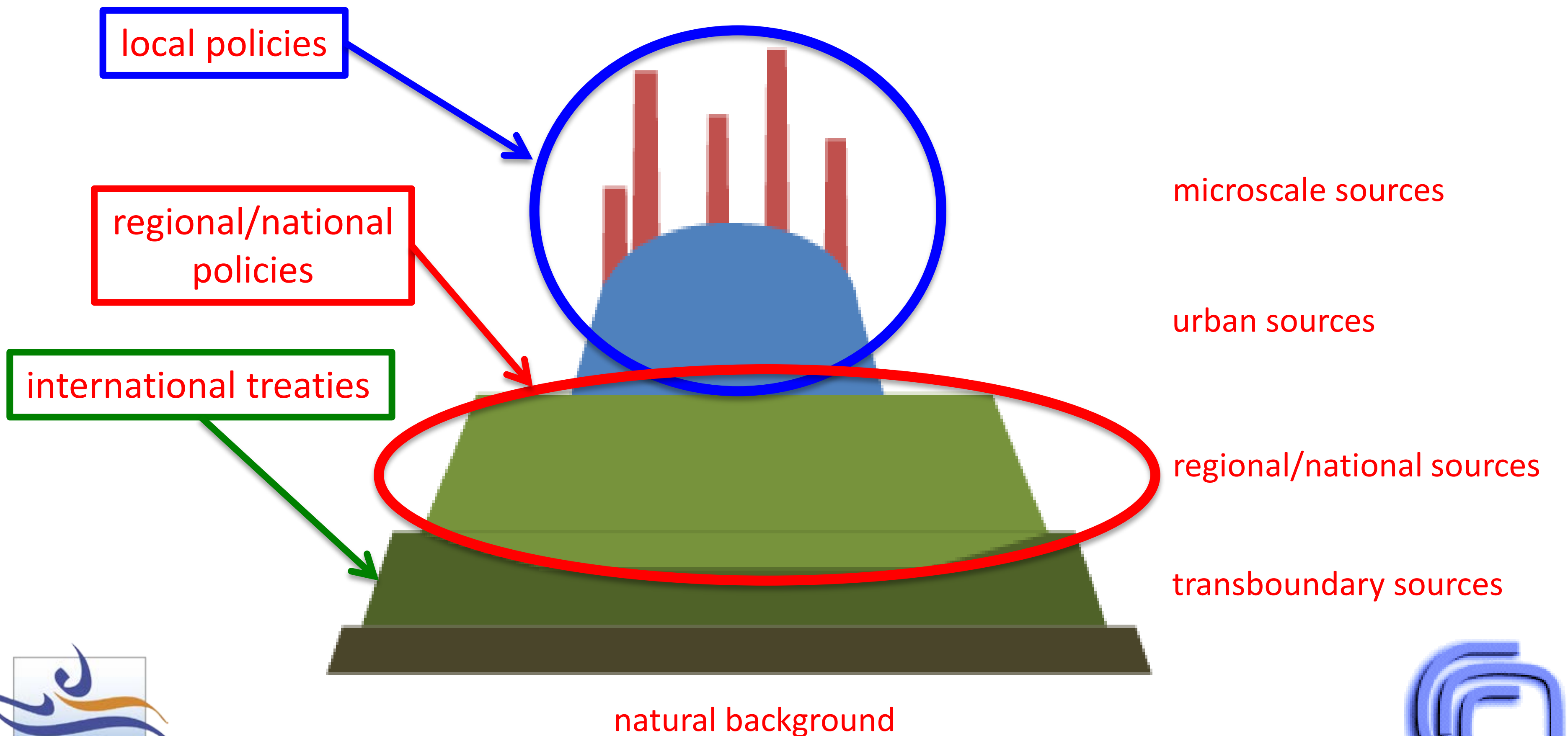
Anthropogenic radiative forcing



Integration of different decision levels

atmospheric pollutant concentrations



(adapted from Lenschow et al., 2001)

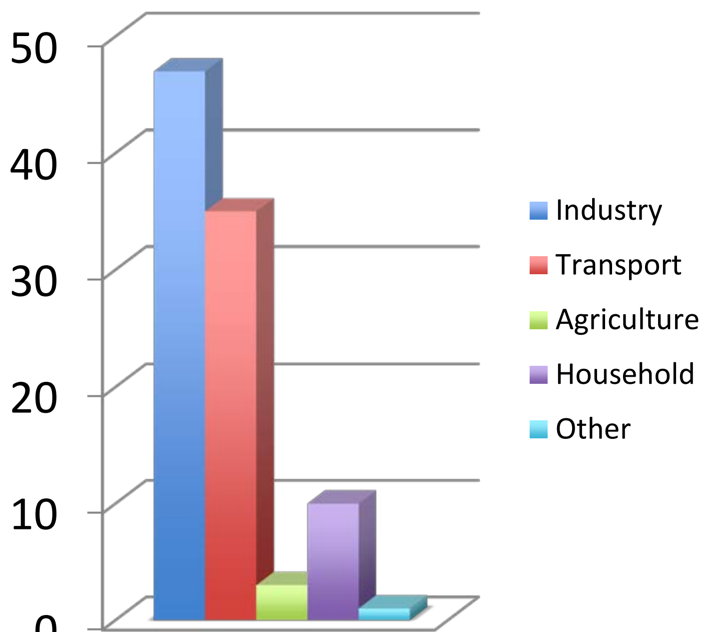
Technological/behavioural measures

- Emission abatement strategies are usually intended in terms of technological measures
- Equally important are the behavioural measures for which the citizen active involvement is key (commuting habits, waste disposal, dietary habits, etc.)

Social acceptability

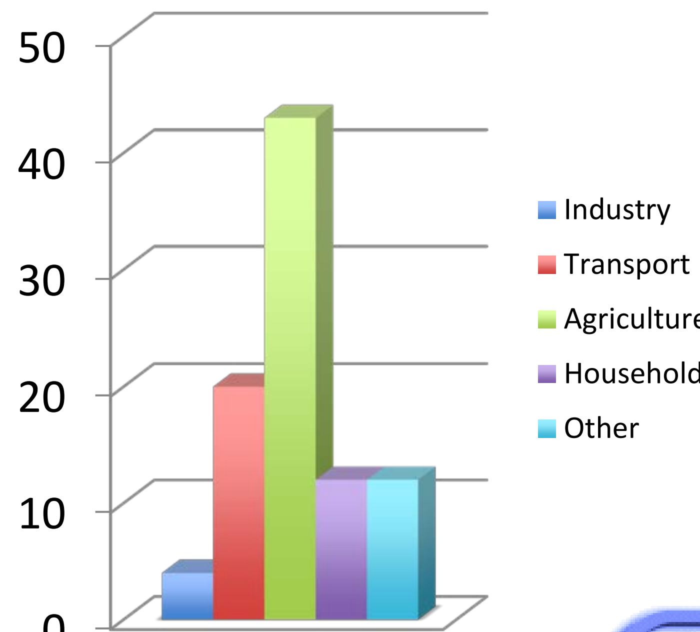
- Social acceptability is key for the implementation of any environmental policy
- This implies a correct information for the citizens

Perception of PM sources



Cohort of 2300 people from 4 Italian cities (SEFIRA project)

Actual PM sources (IIASA, 2014)



In conclusion...

- Many emission reduction policies provide the opportunity of simultaneously improve air quality and mitigate global warming (*win-win policy options*)
- There are however also mitigation options that may provide benefits to one aspect, while worsening the situation in the other (*win-lose policy options*)
- An integrated approach is therefore needed to evaluate the air quality-climate policies
- Social acceptability is key to any environmental policy option and a correct information for citizens is therefore required
- Involvement of social sciences is important for this
- Integrated policy options that take into account the feedbacks between air quality and climate constitute the best environmental policy strategies in terms of both social and economic costs

IPCC AR6

Chapter 6: Short-lived climate forcers

- Key emissions: global overview, natural, anthropogenic, historical and scenarios
- Observed and reconstructed concentrations and radiative forcing
- Direct and indirect - aerosol forcing
- Implications for greenhouse gas lifetimes
- Implications of different socio - economic and emission pathways, including urbanisation, for radiative forcing
- Connections to air quality and atmospheric composition

Expert meeting on SLCF
Geneva, 28-31 May 2018

- Review existing work to estimate emissions of SLCF considering suitability for the IPCC to develop methodological guidance;
- Consider which SLCF(s) should be prioritized in the possible future work to develop inventory methodology;
- Consider how the inventory methodology on SLCF would relate to the existing inventory methodology on GHG;
- Review existing methodological work to quantify the global radiative direct and indirect effects of SLCF;
- Identify gaps in scientific understanding on estimates of direct and indirect climate effects of SLCF on radiative forcing and climate response, including implications on clouds.

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