Operational Procedure for Emission Reduction Assessment

The challenge of defining optimal air quality policies at regional and local level

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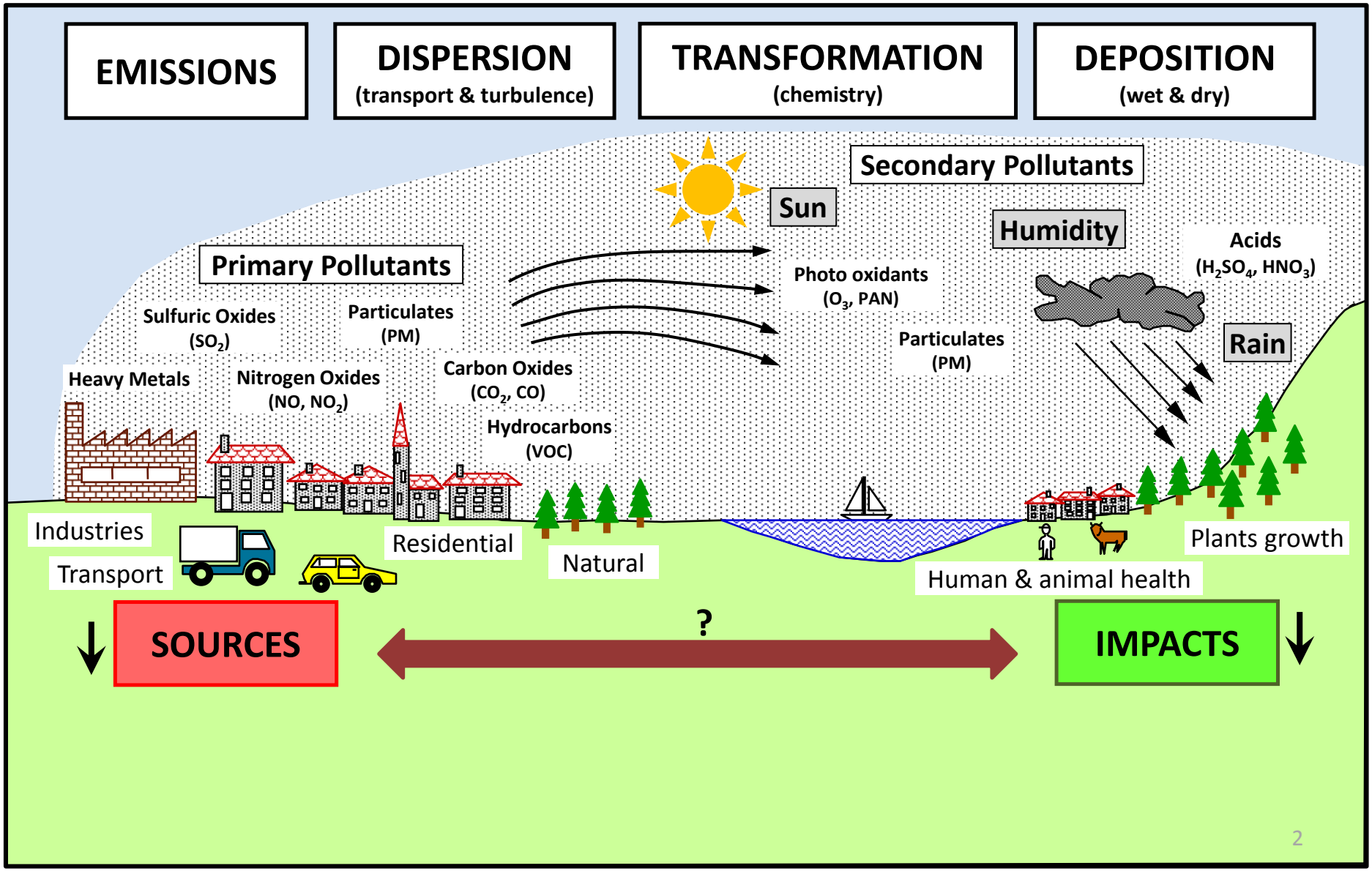
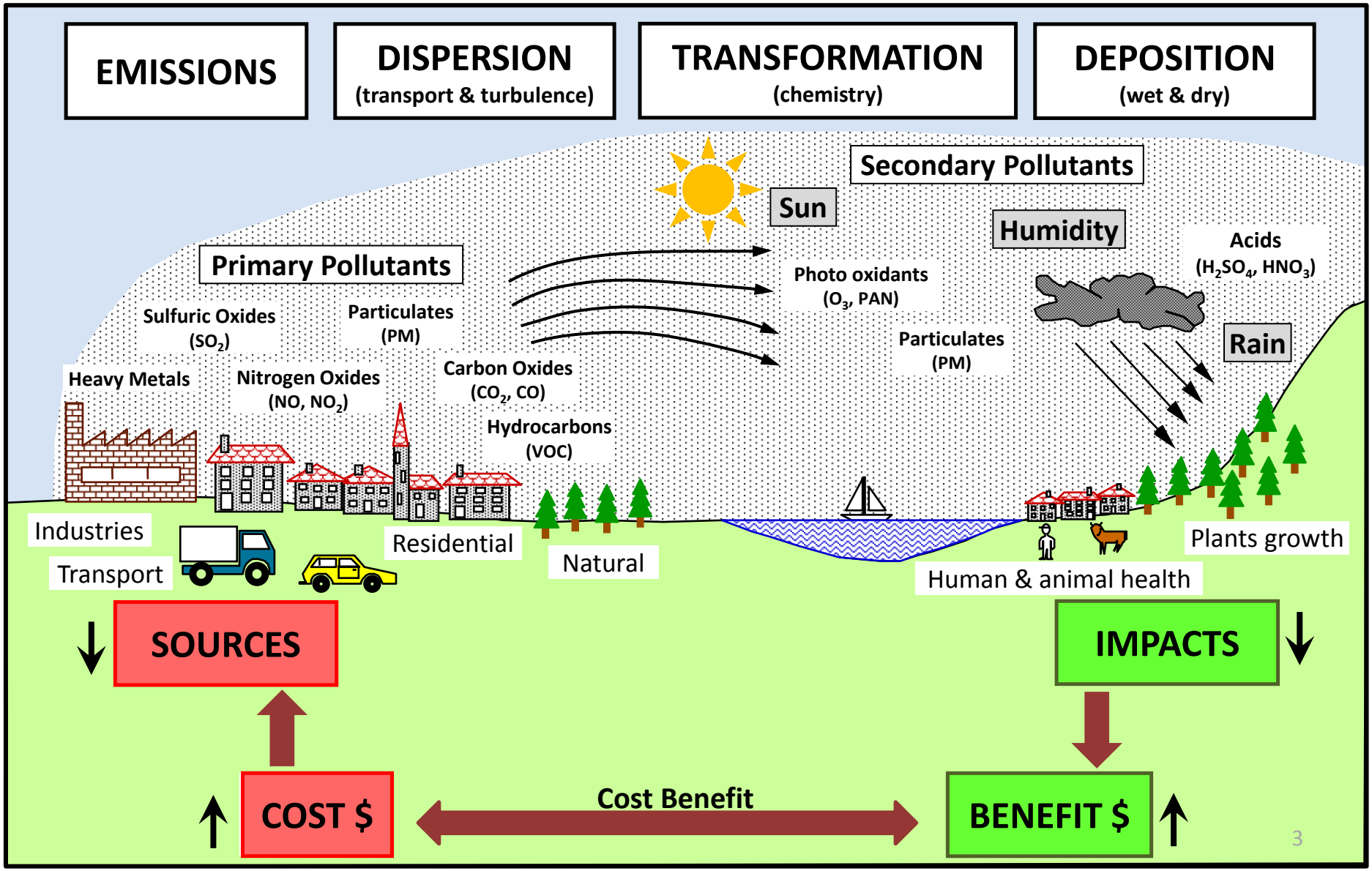
Air Quality Managment

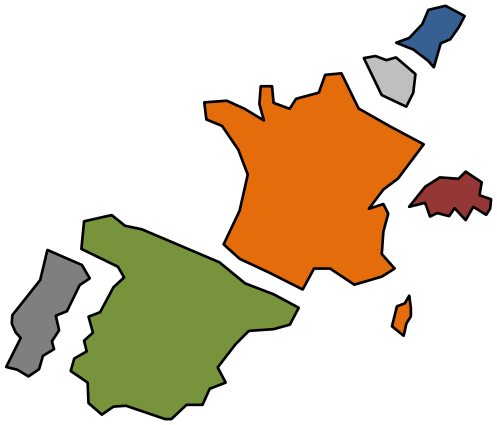


Cost & Benefit

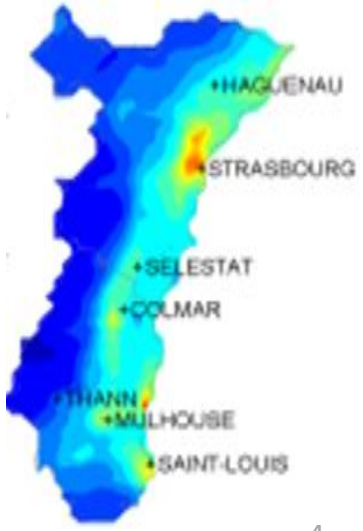


Integrated Assessment Models

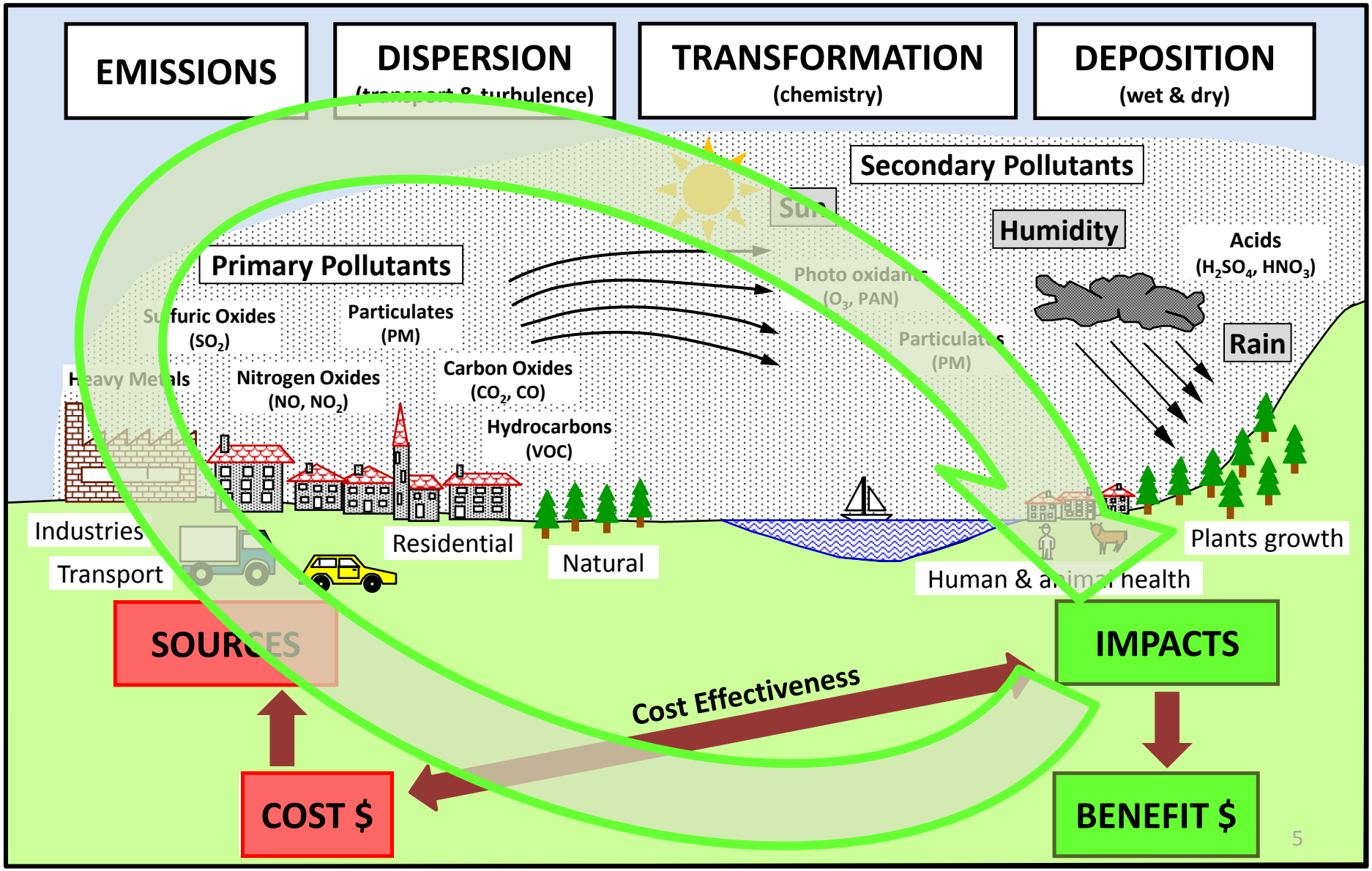
- **GAINS** (Greenhouse Gas and Air Pollution Interactions and Synergies) have been developed by IIASA (International Institute for Applied Systems Analysis) in order to estimate the best abatement strategies **for different countries**.



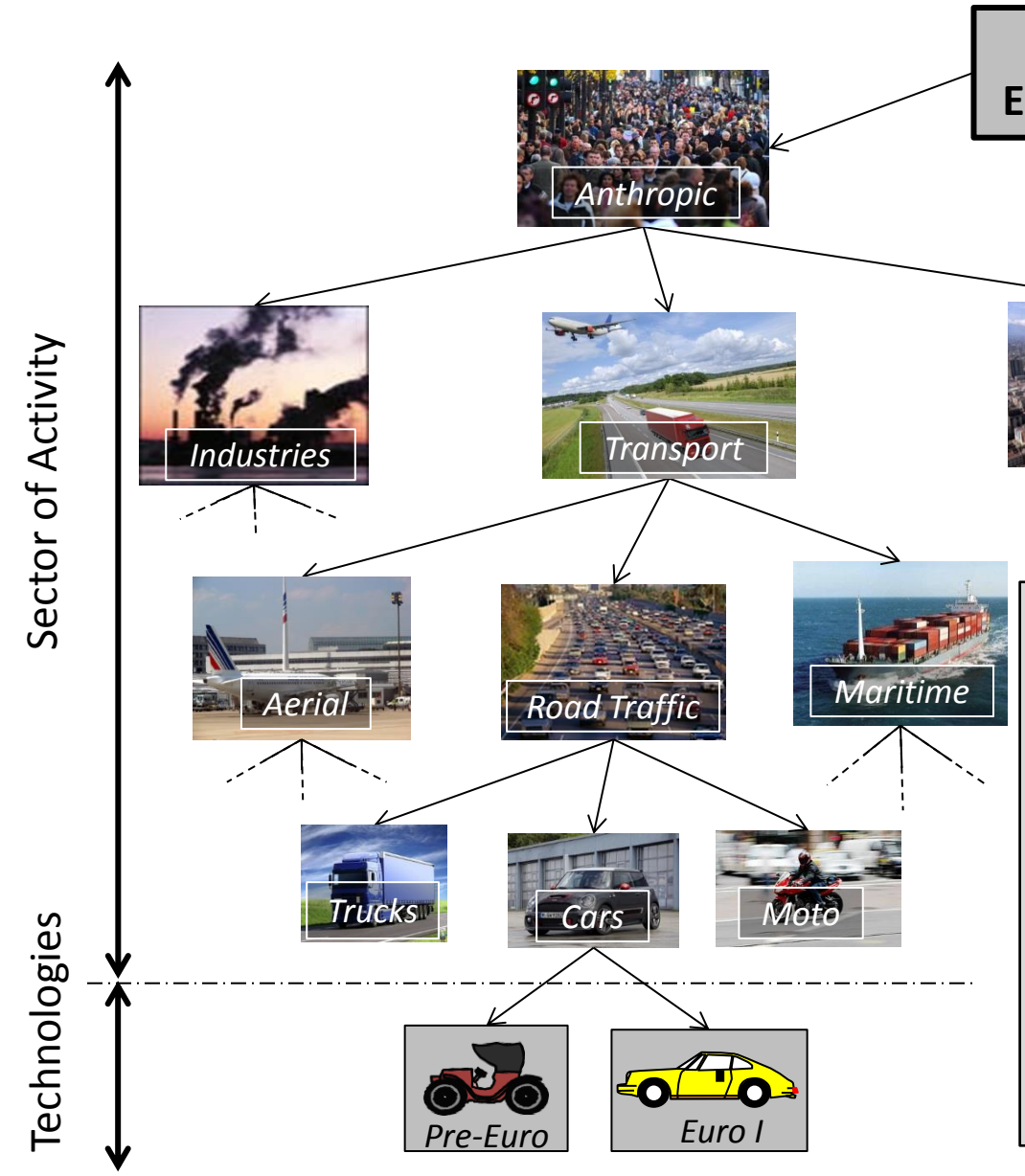
- **RIAT+** (Regional Integrated Assessment Tool) have been developed in the framework of the OPERA project in order to estimate the best abatement strategies **for small regions or cities**.



Cost Effectiveness



Emission Segregation



For a technology (t) in a sector of activity (s)and a pollutant (p):

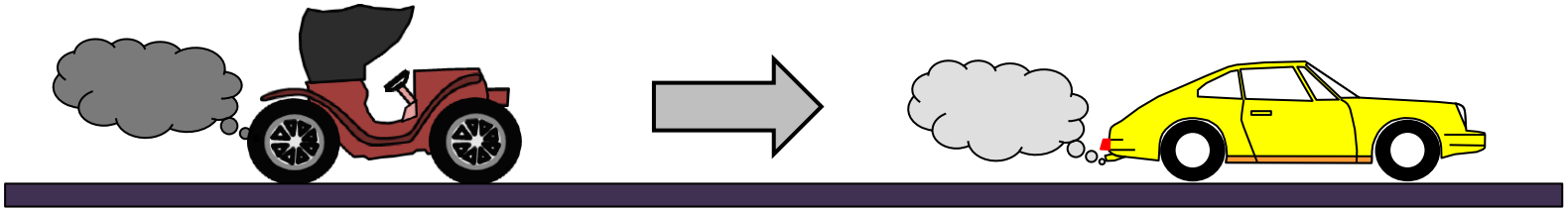
Emission [ktones/year] = Emission factor [ktonnes/PetaJoules/year] × Activity [PetaJoules/year]

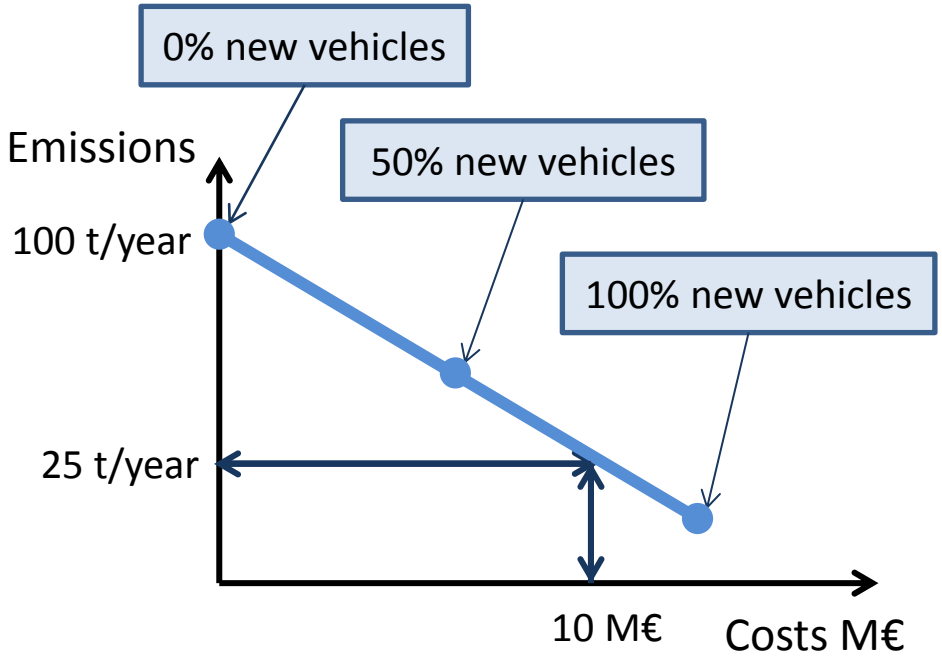
$$E_{p,t,s} = e_{p,t} \times A_s$$

Cost [M€/year] = Unit cost [M€/PetaJoules/year] × Activity [PetaJoules/year]

$$C_{t,s} = c_t \times A_s$$

Application Rate





When a new technology (t) replace an old technology (0) in a sector of activity (s):

Cost *[M€/year]*

$$C_{s,t} = \alpha_t . c_t . A_s$$

Application rate *of the new technology* t

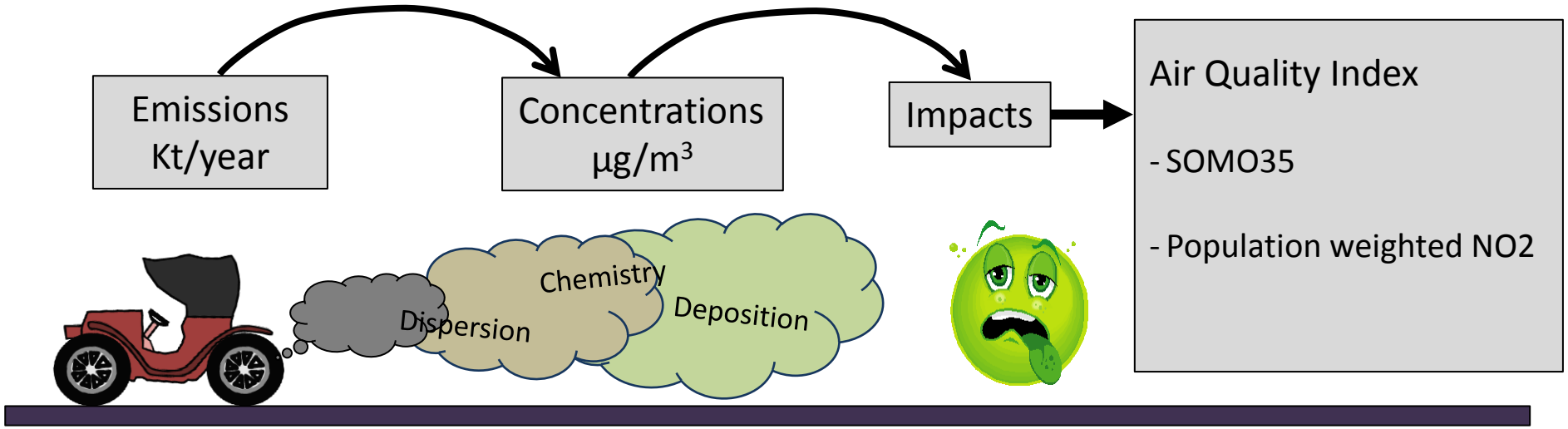
$$E_{p,s,t} = \alpha_t . e_{p,t} . A_s + (1 - \alpha_t) e_{p,0} . A_s$$

Emission *[ktonnes/year]*

Emissions factor of the new technology

Emission factor of the old technology

Source Receptor Relationship

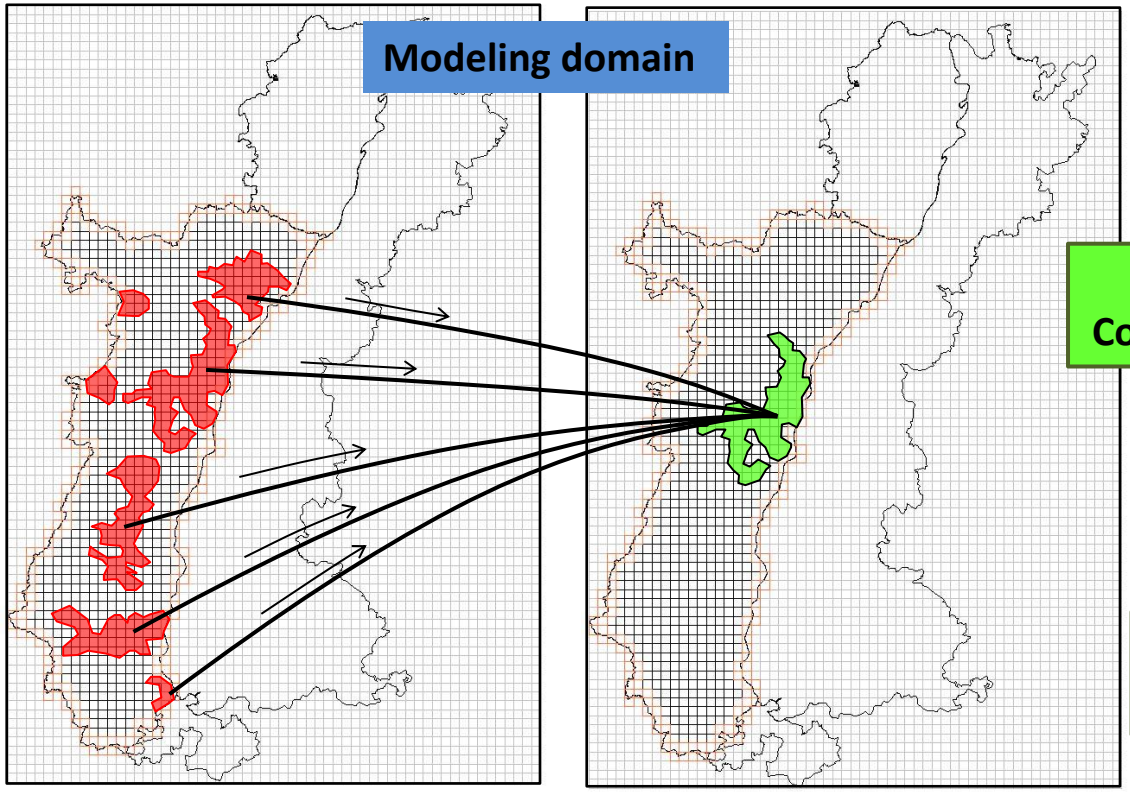


Source

Receptor

$$AQI = fct(E_1, E_2, \ldots)$$

Source Receptor Relationship



Source/Receptor relationship = relation between the AQI and any kind of emission reduction (i.e. any kind of application rates).

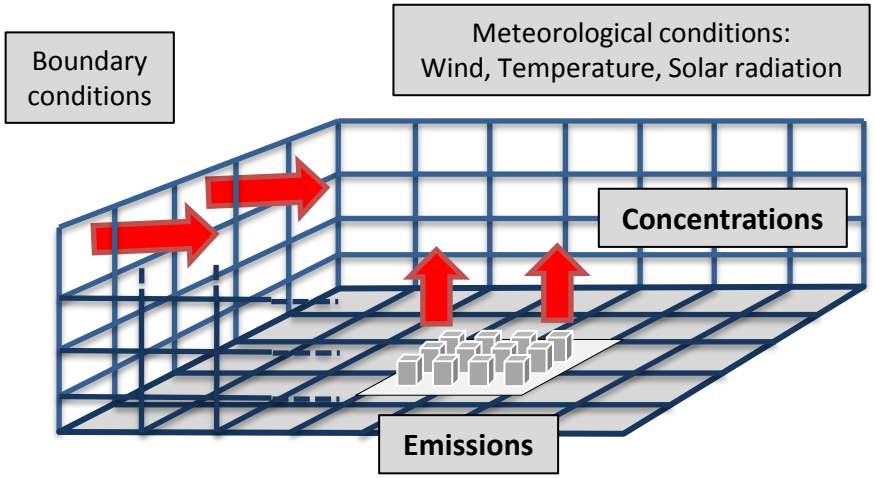
$$AQI(x, y) = fct\left(E_1, E_2, \ldots\right)$$

AQI in each cell of the receptor domain

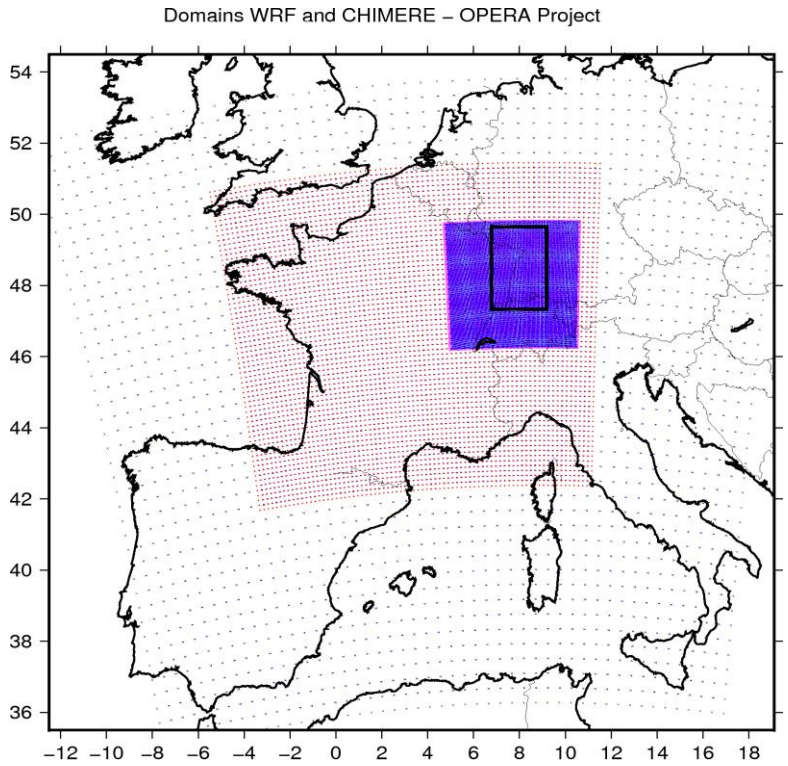
Emissions of all the precursors in the source domain

Source Receptor Relationship

Mesoscale models



Model domain

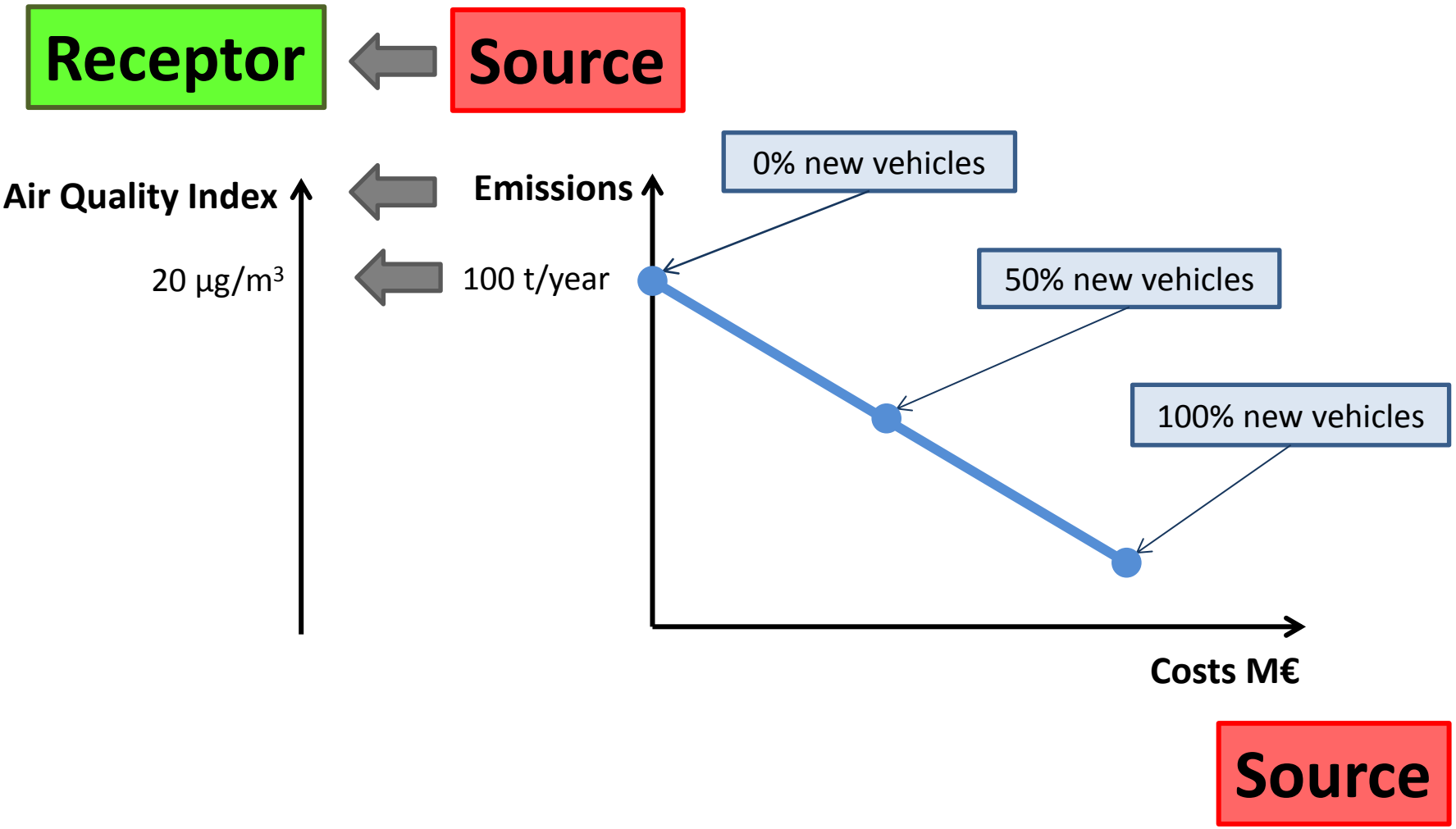


Meteorological and Chemical Transport models are used to simulate the effect of emission reduction on concentrations and then on Air Quality Indexes.

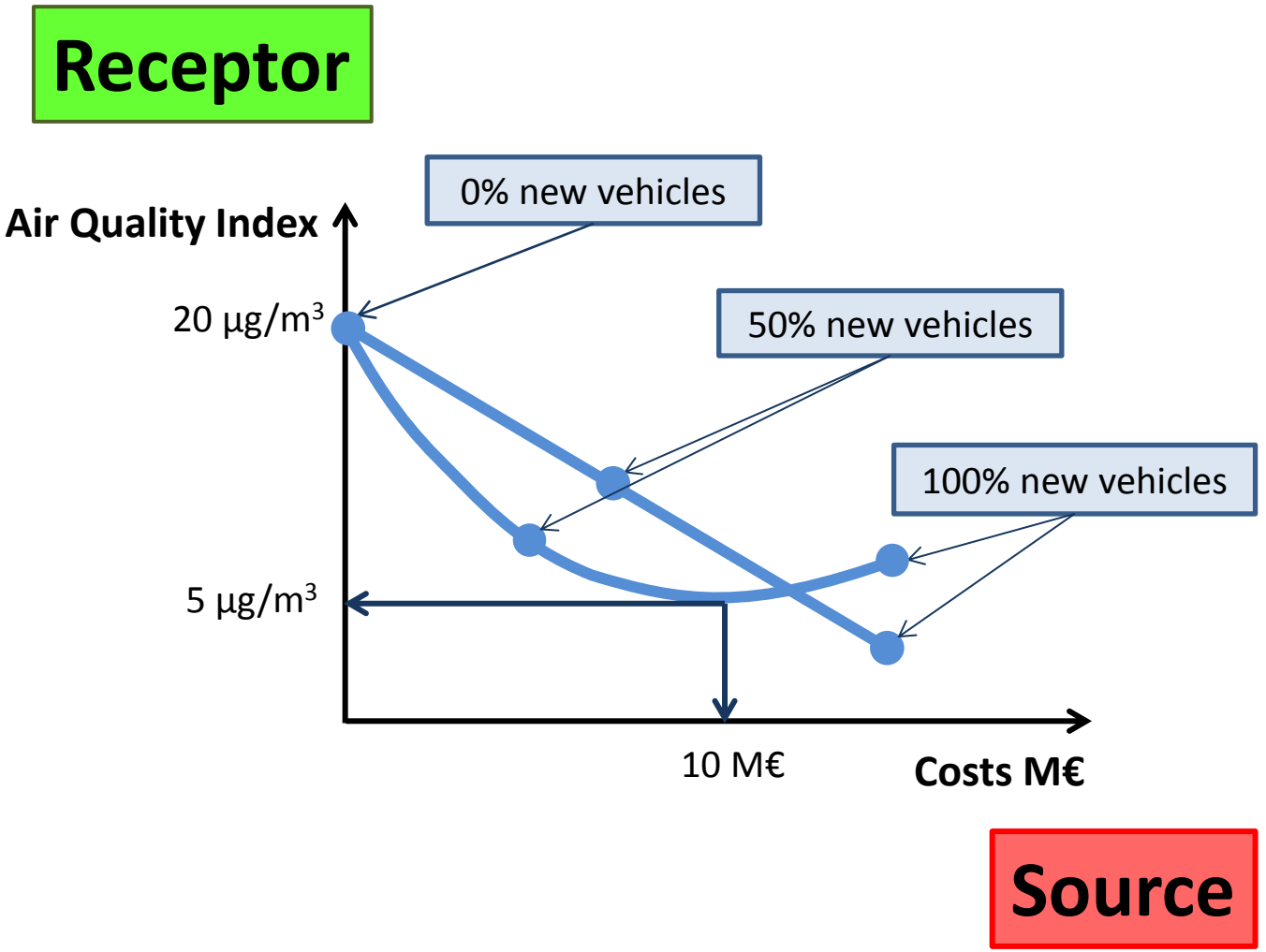
A limited number of scenarios (22) are performed reducing successively all the precursors of 3 different percentage.

The results of the different scenarios are used by a neural network to calculate the Source/Receptor relationship (=relation between the AQI and any kind of emission reduction).

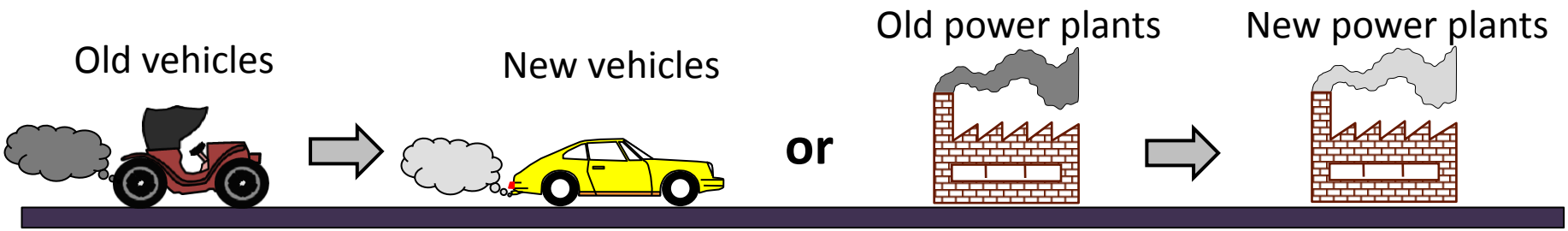
Source Receptor Relationship

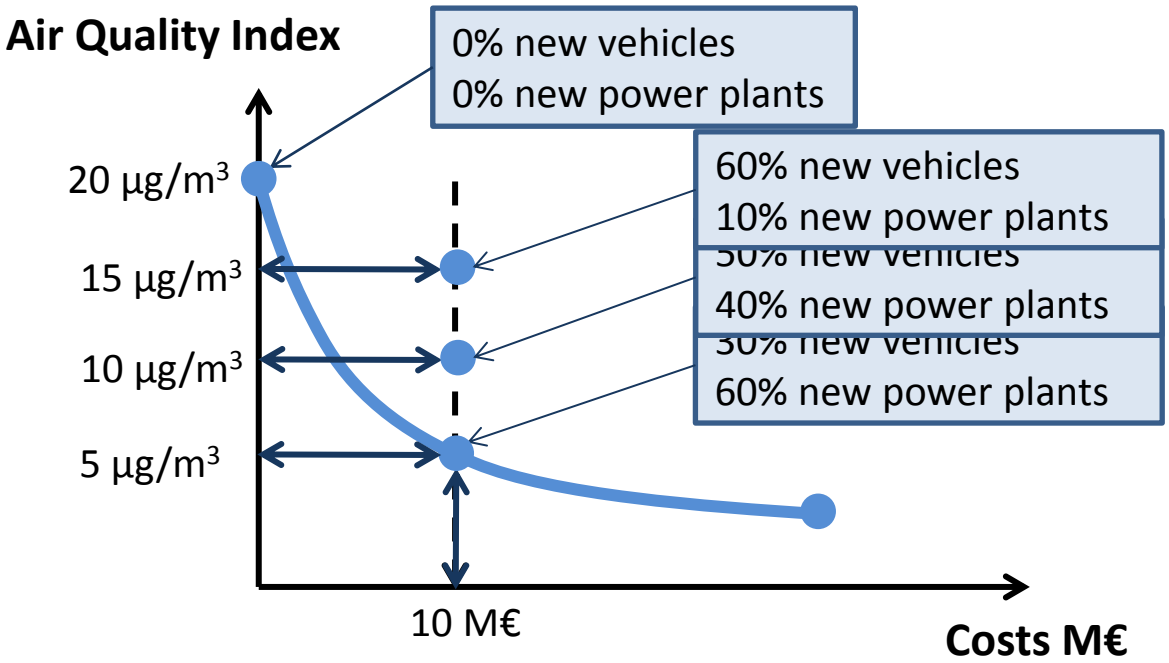


Source Receptor Relationship



Optimization





Optimization: Find the set of Application Rates which minimize the Air Quality Index for a given cost.

Total Cost *[M€]*

$$C = \alpha_1.c_1.A_1 + \alpha_2.c_2.A_2 + \ldots$$

Application rates *for the different technologies*

$$\min\left[AQI(\alpha_1, \alpha_2, \ldots \alpha_t)\right]$$

AQI *for a pollutant q*

Abatement Measures

Optimization: Find the best application rates of 3000 different technologies.

legislation

reinforcement

Air Quality Index

CLE: Current Legislation

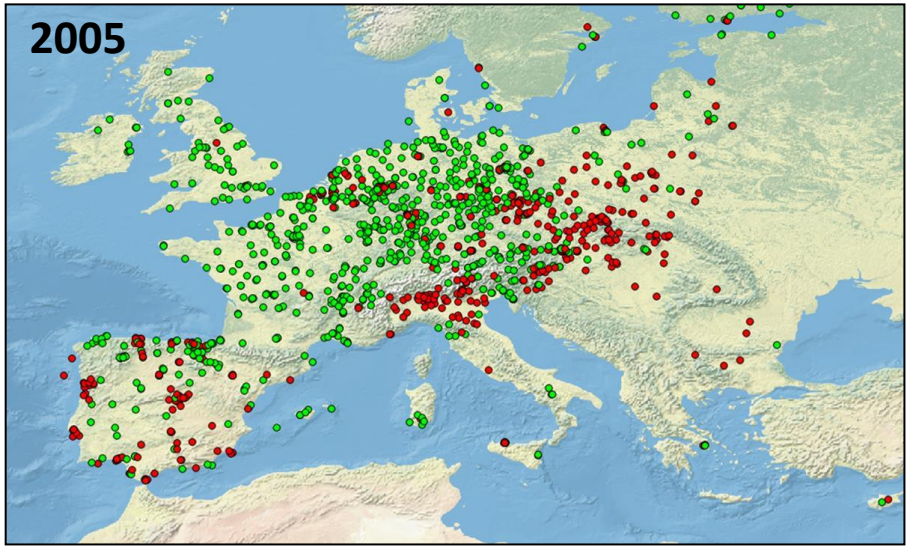
Global technical measures

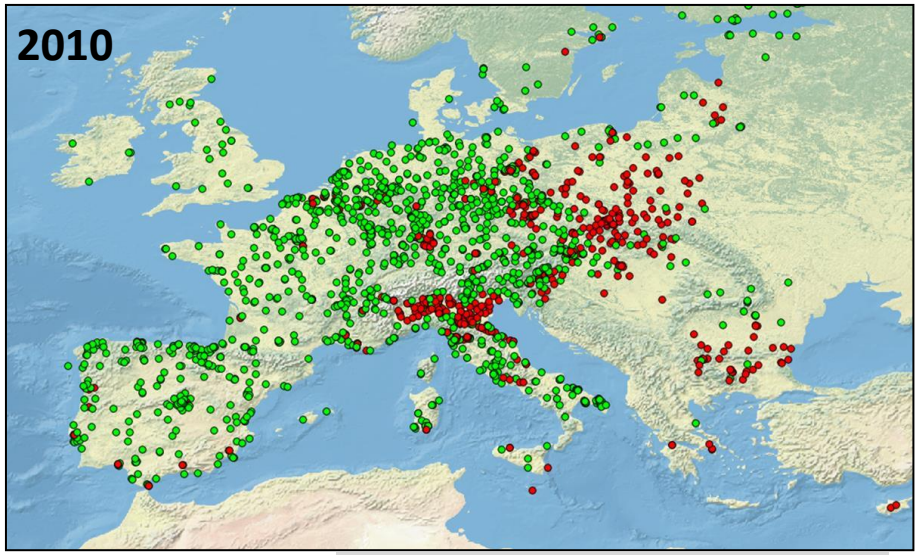
Cost over CLE [M€]

Global & Local Measures

Compliance with 24h PM Exceedance Limit (>50):

Situation Urban Background Stations



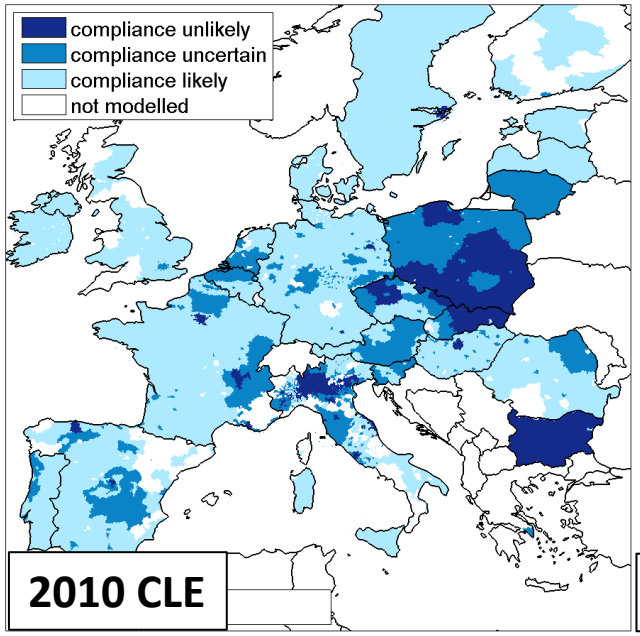


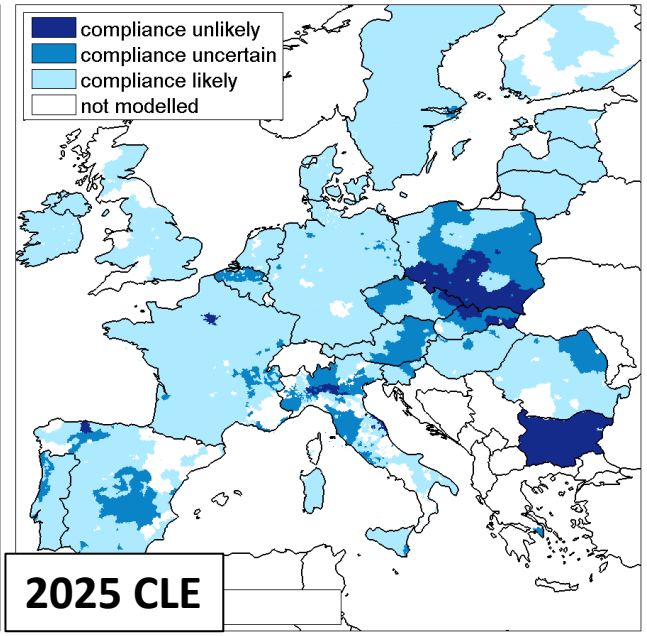
Green = Stations in Compliance
Red = Stations not in Compliance

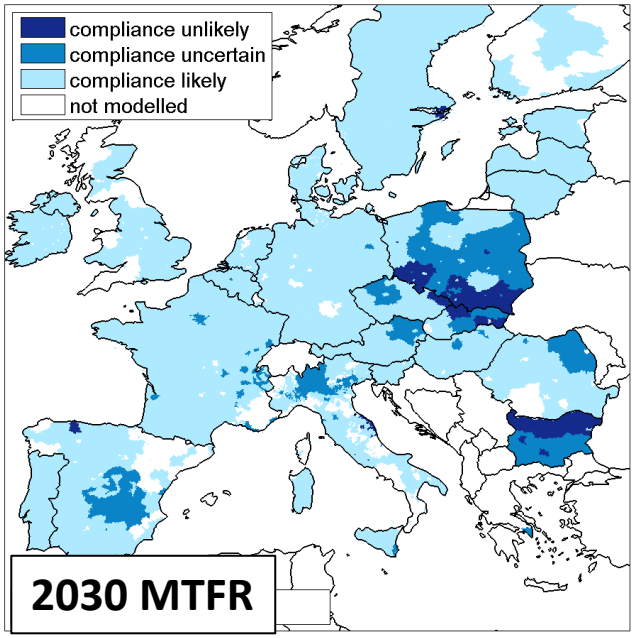
Global & Local Measures

Compliance with 24H PM10 Exceedance Limit

IIASA GAINS Perspective







Abatement Measures

Optimization: Find the best application rates of 3000 different technologies.

legislation

reinforcement

Air Quality Index

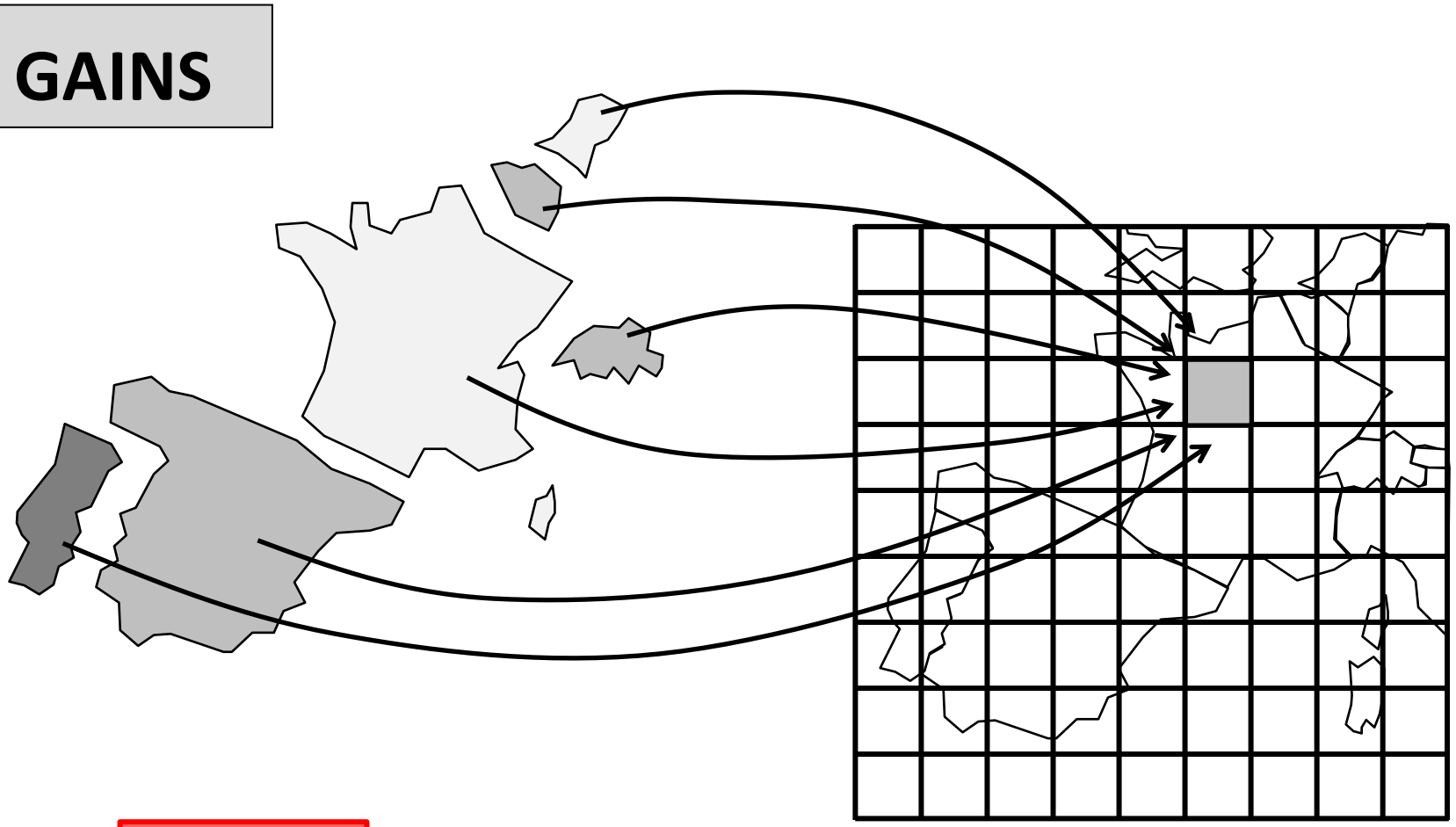
CLE: Current Legislation

Global technical measures

Global + Local technical measures

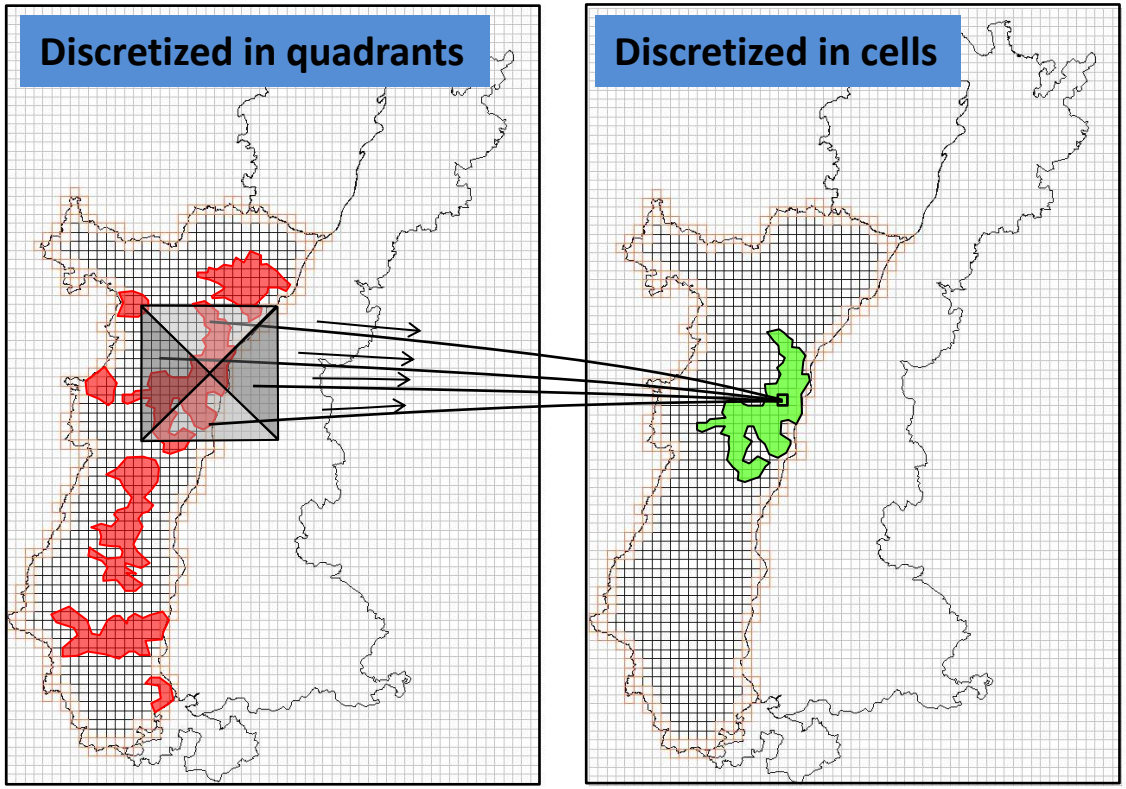
Cost over CLE [M€]

Adapted S/R Relationship



Adapted S/R Relationship

RIAT



Source

Receptor

Non Technical Measures

Optimization: Find the best application rates of 3000 different technologies.

legislation

reinforcement

Air Quality Index

CLE: Current Legislation

Global technical measures

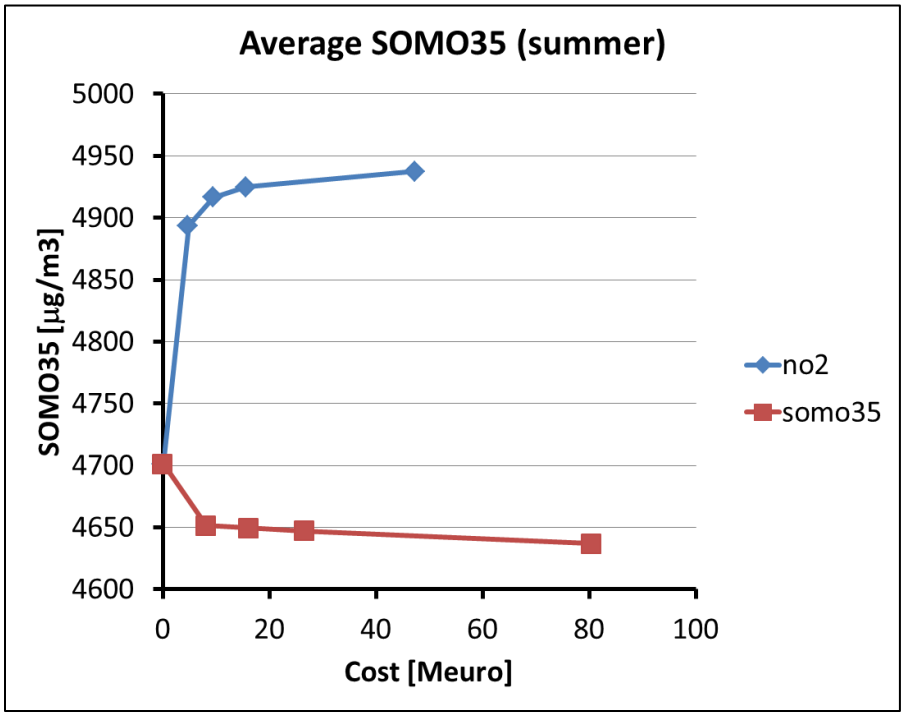
Global + Local technical measures

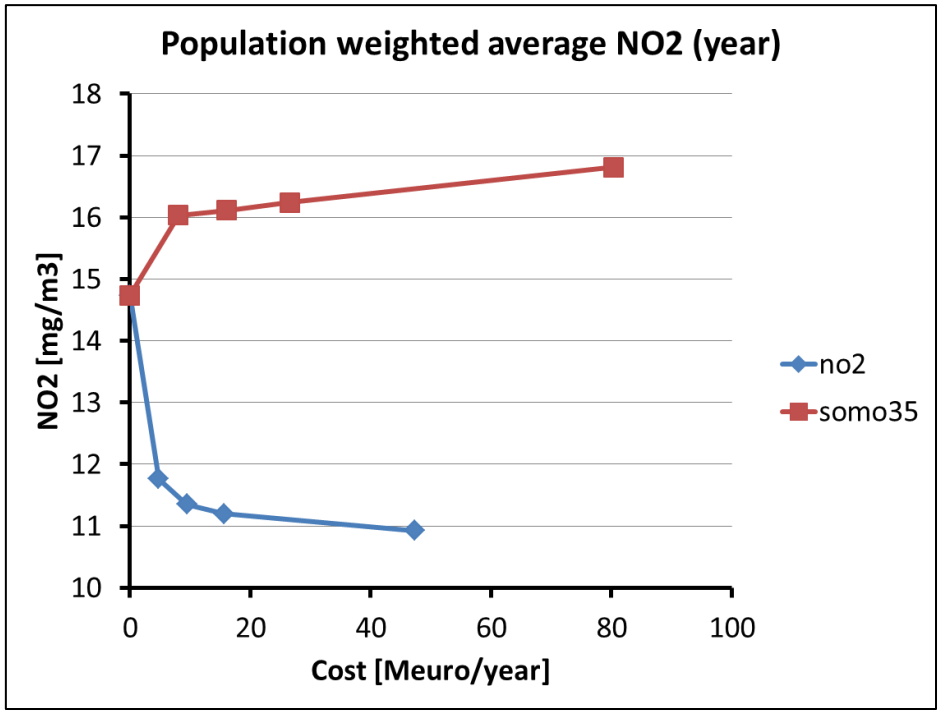
All measures

Cost over CLE [M€]

Multi-objectives

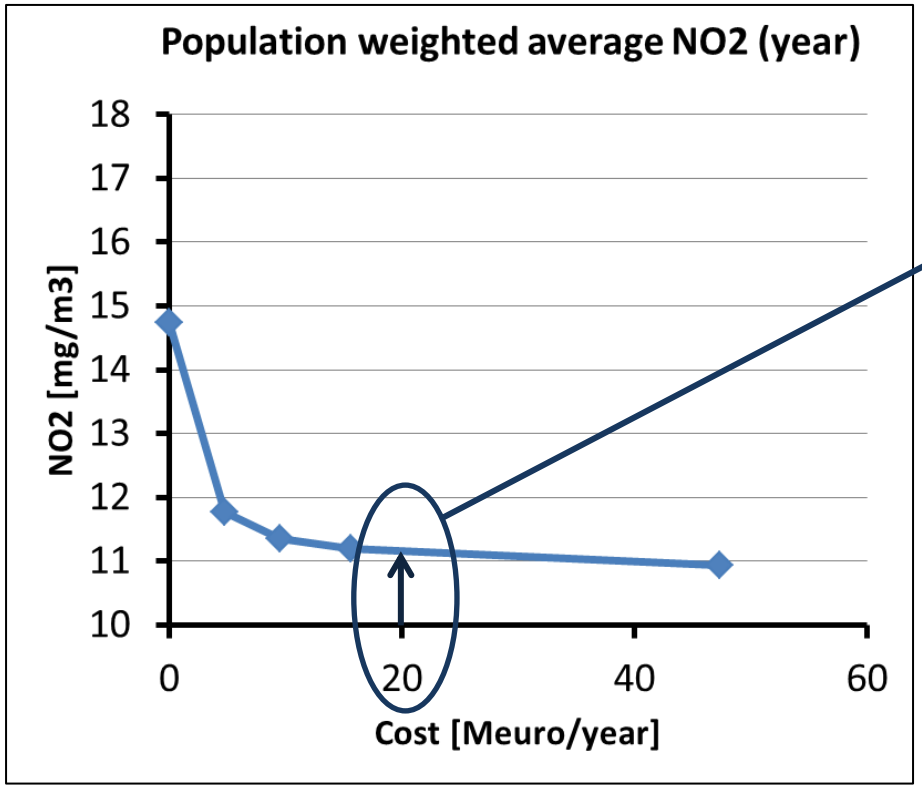
O_3 & NO_2 over Alsace

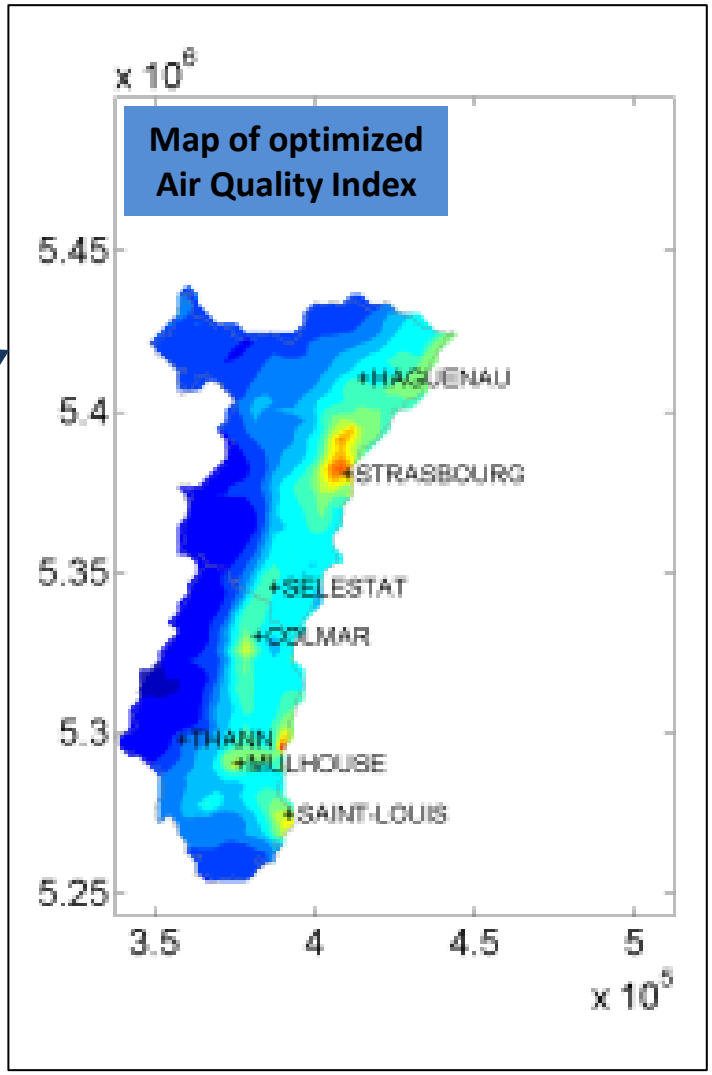




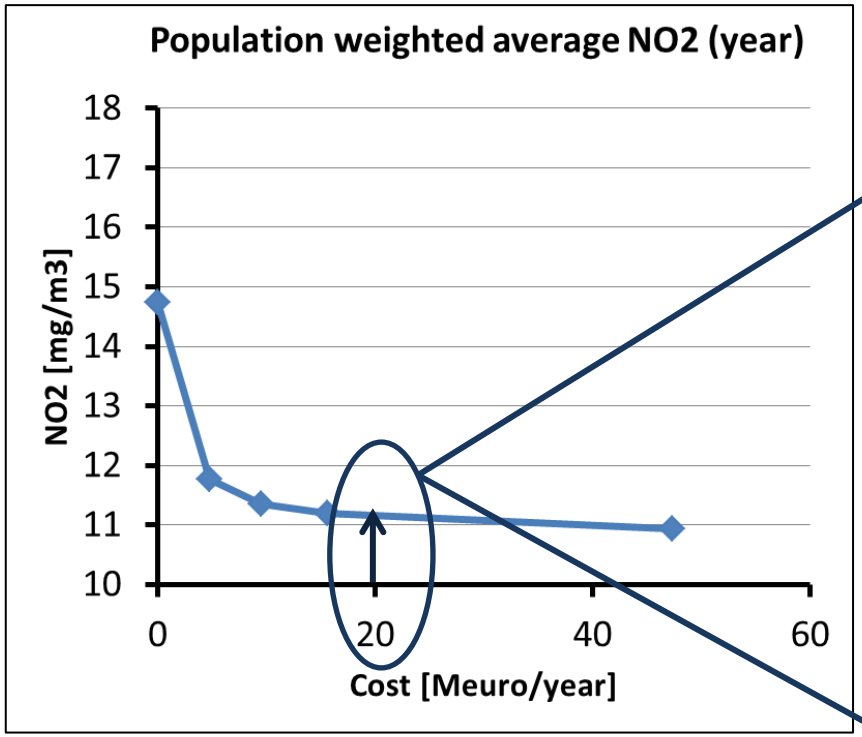

Thank you!

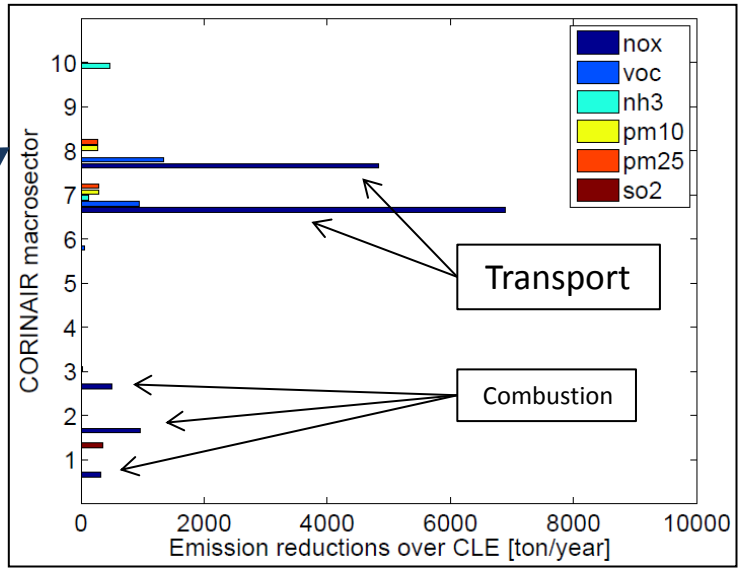
NO_2 over Alsace

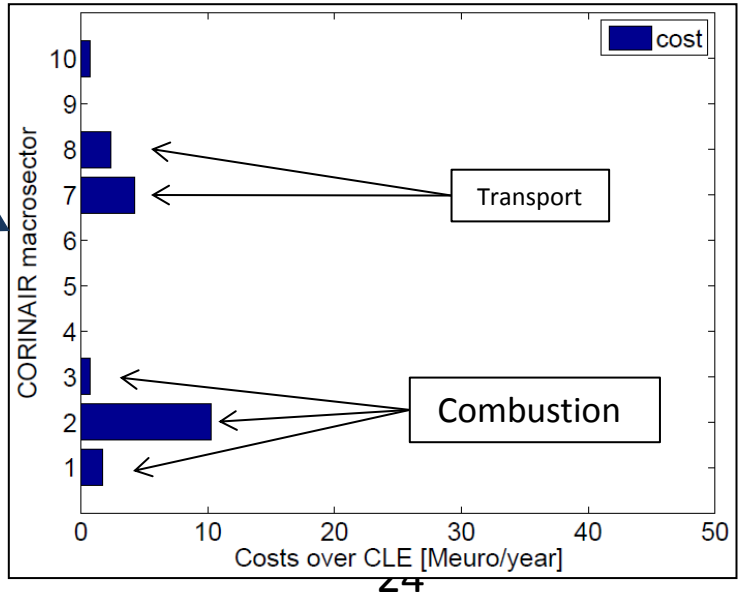




NO_2 over Alsace



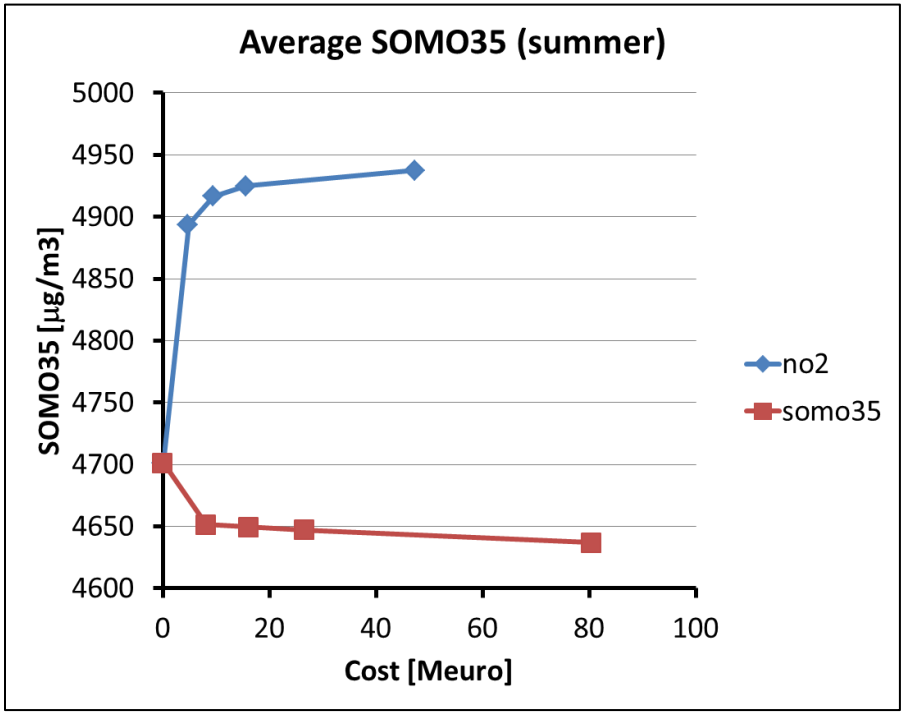


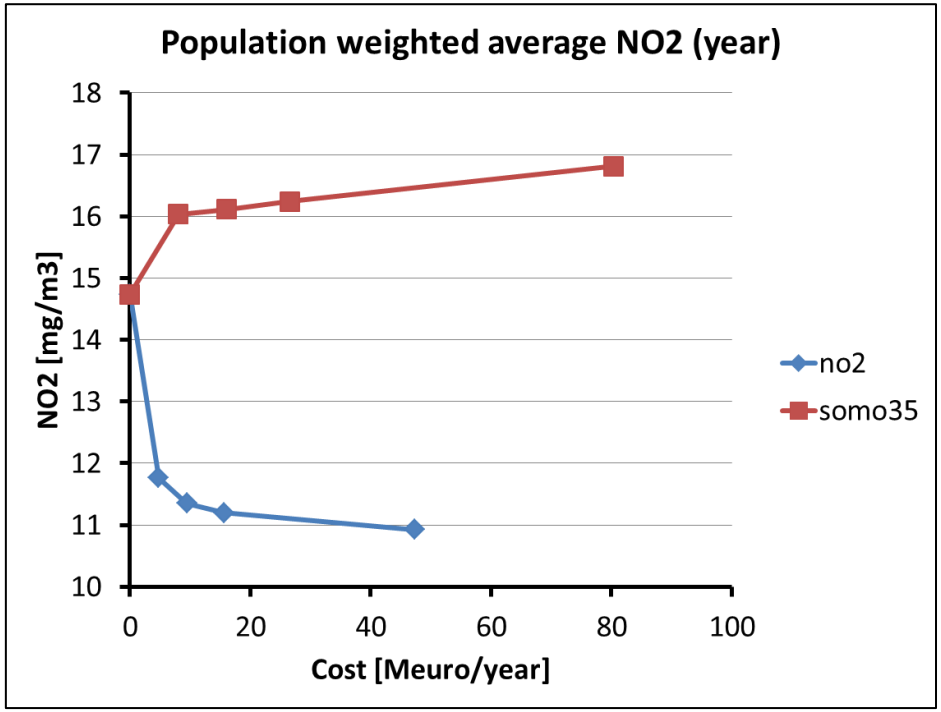


CORINAIR macrosectors:

1: Combustion in energy and transformation industries
2: Non-industrial combustion plants
3: Combustion in manufacturing industry
4: Production processes
5: Extraction & distribution of fossil fuels and geothermal energy
6: Solvent and other product use
7: Road transport
8: Other mobile sources and machinery
9: Waste treatment and disposal
10: Agriculture
11: Other sources and sinks

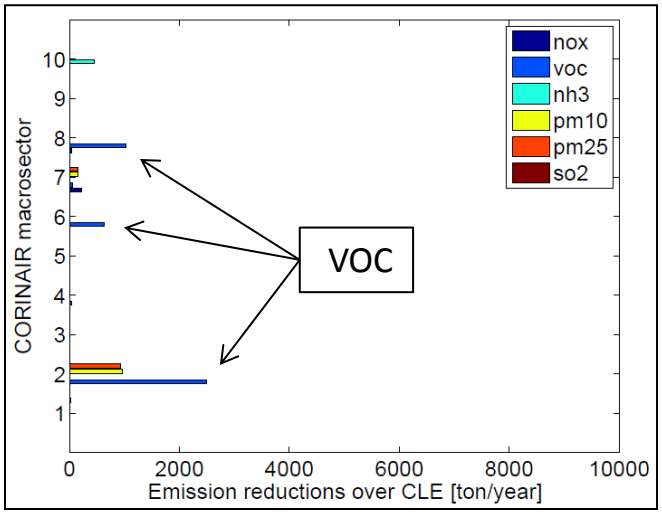
O_3 & NO_2 over Alsace



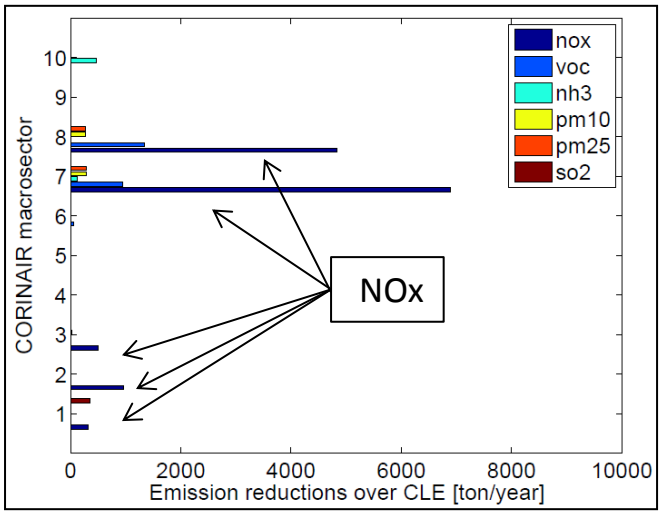


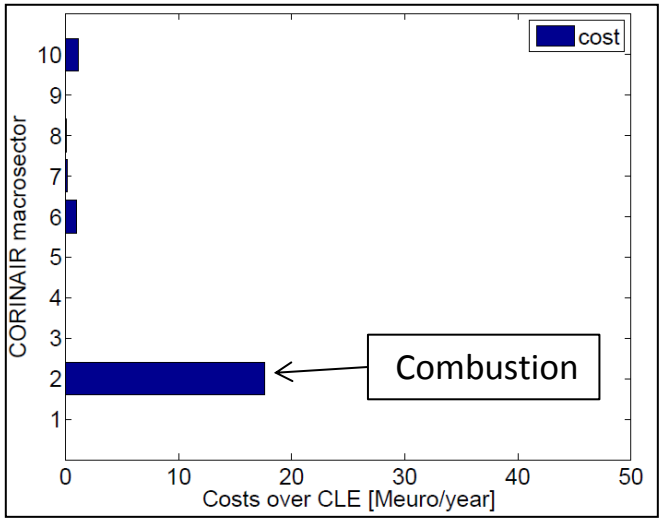
O_3 & NO_2 over Alsace

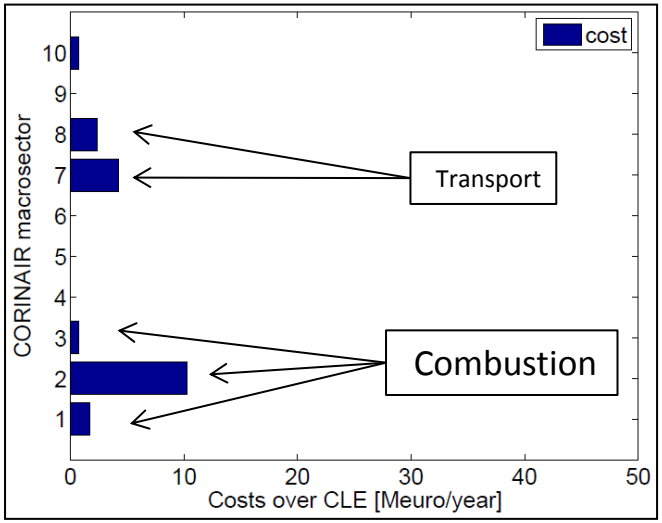
SOMO35



Population weighted averageNO2







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O_3 & NO_2 over Alsace

Weighted Air Quality Index