Emilia Romagna air quality plan and RIAT+

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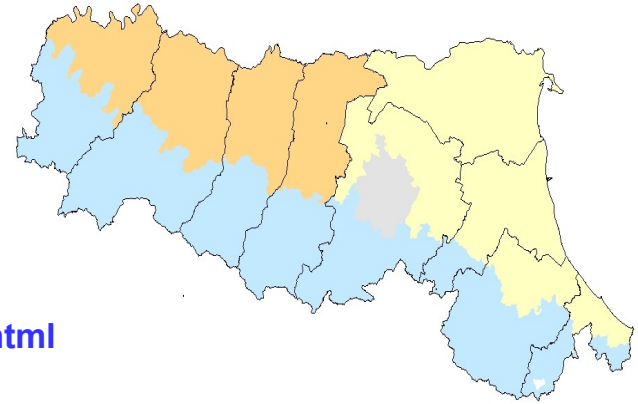
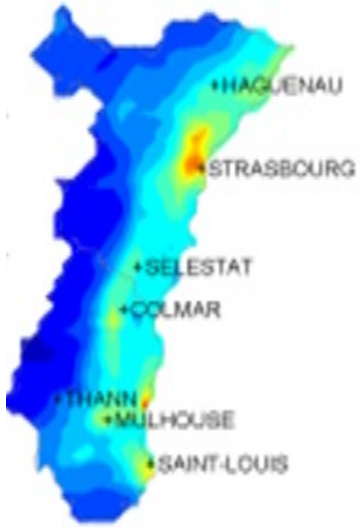
Challenges and questions

- What are the reduction emissions that we have to reach in order to comply EU limit?
- Which is the best way to do this?

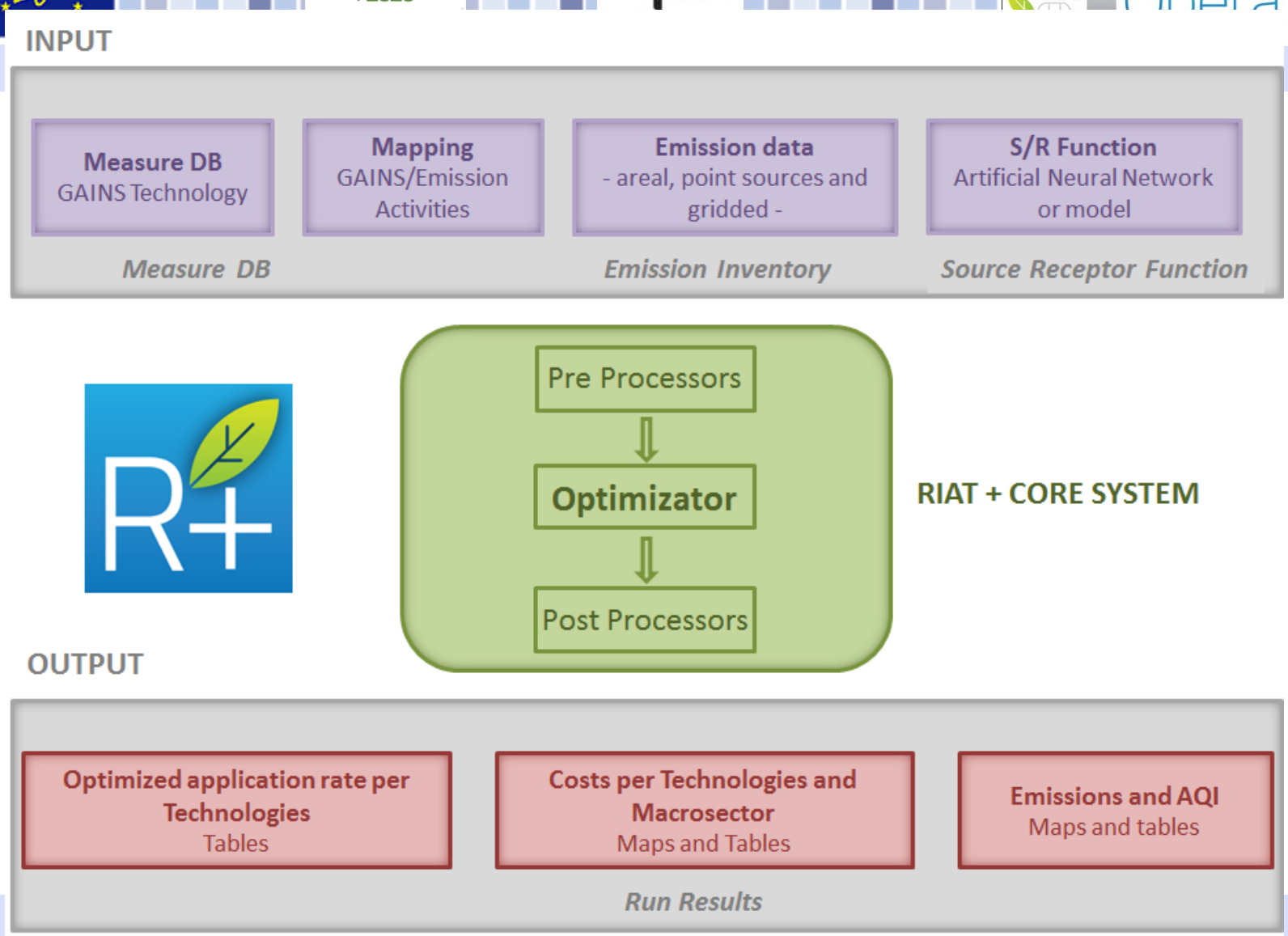
Integrated Assessment Models

- **RIAT+** (Regional Integrated Assessment Tool) have been developed in the framework of the LIFE OPERA project to to support regional/local authorities in the definition, application and evaluation of air quality plans policies, devoted to the reduction of population exposure to PM10,PM25, NO2,O3





http://www.riatplus.eu/html/eng/home.html

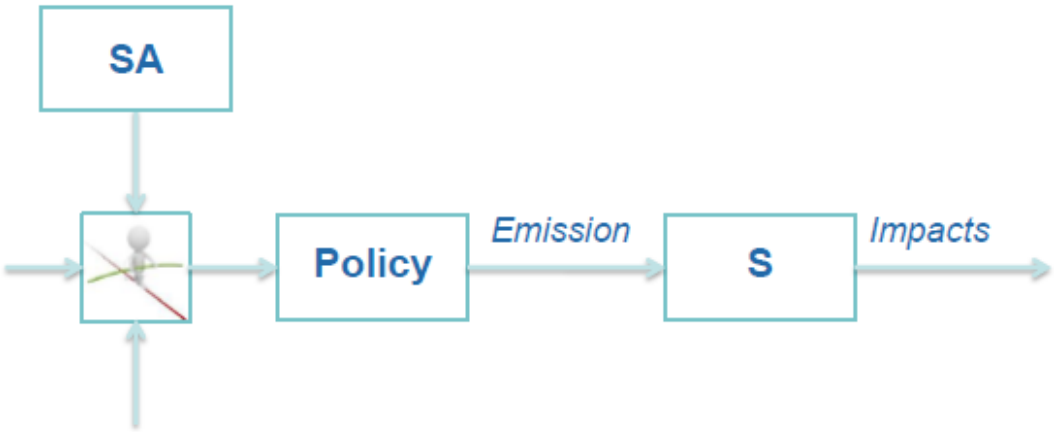

INPUT
Measure DB
GAINS Technology
Mapping
GAINS/Emission Activities
Emission data
- areal, point sources and gridded -
S/R Function
Artificial Neural Network or model
Measure DB
Emission Inventory
Source Receptor Function
Pre Processors
Optimizator
Post Processors
RIAT + CORE SYSTEM
OUTPUT
Optimized application rate per Technologies
Tables
Costs per Technologies and Macrosector
Maps and Tables
Emissions and AQI
Maps and tables
Run Results

Easy Way
Hard Way
Scenario analysis:
assesses the impacts of proposed actions
Optimization approach:
identifies emission reduction measures maximizing the environmental benefits and minimizing costs

Scenario analysis

In RIAT+ scenario analysis is possible in two ways:

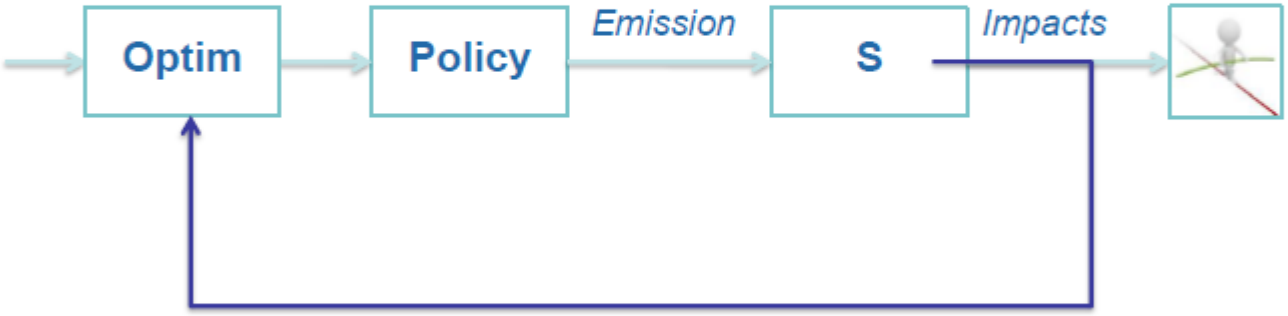
1. Emission (macrosector) level – *aggregated approach*
2. Technology level – *detailed approach*



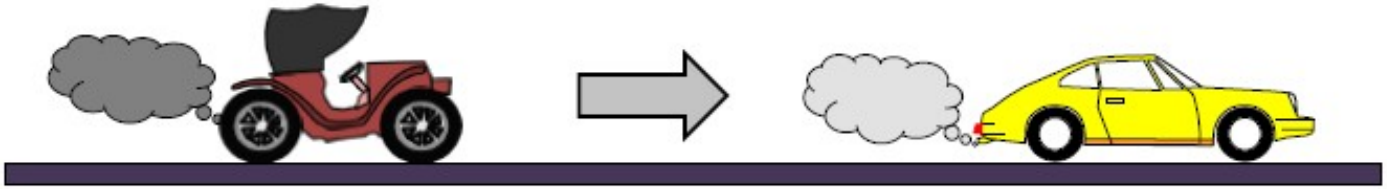
Optimization analysis

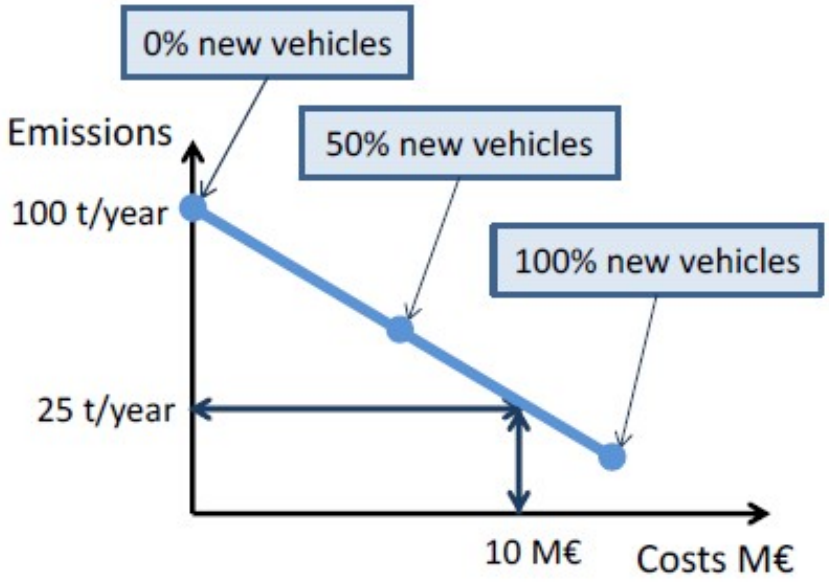
In RIAT+ optimization analysis is possible in two ways:

1. Cost-effectiveness – *best technologies at a fixed cost*
2. Multi-objective – *best technologies at varying costs*



Emissions and technology





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

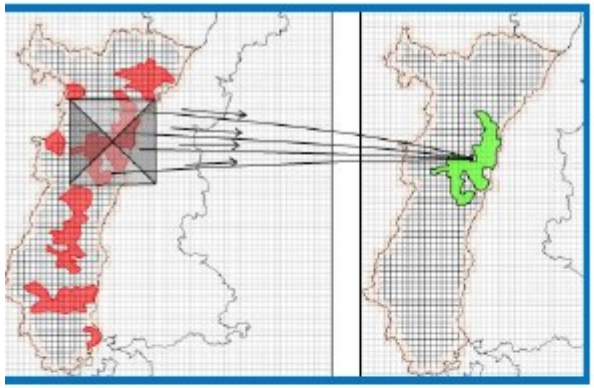
$$E_{p,s,t} = \alpha_t . e_{p,t} . A_s + (1 - \alpha_t) e_{p,0} . A_s$$

Emission [ktonnes/year]

Emissions factor of the new technology

Emission factor of the old technology

Source Receptor Relationship

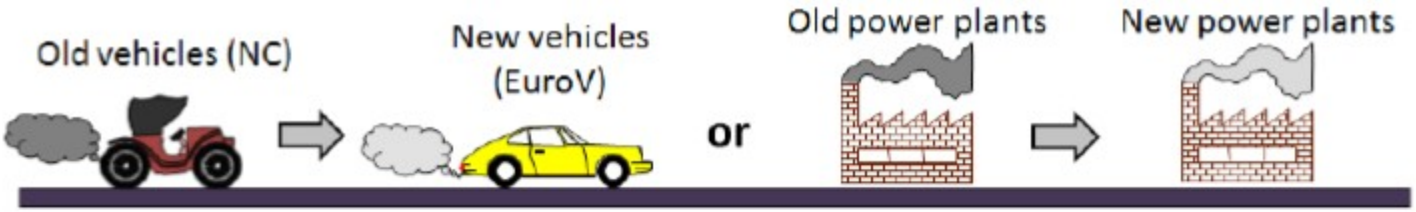


$AQI(x,y) = F_{S/R}$ (quadrant Emissions)
4 quadrants emissions (point/areal) for 6 precursors

	AREAL AND POINT EMISSIONS				
SCENARIOS	NOX	VOC	NH3	PM	SO2
0	B	B	B	B	B
1	L	L	L	L	L
2	H	H	H	H	H
3	H	L	L	L	L
4	L	H	L	L	L
5	L	L	H	L	L
6	L	L	L	H	L
7	L	L	L	L	H
8	H	H	L	L	L
9	H	L	H	H	H
10	H	L	H	L	L
11	H	L	H	L	H

CTM training scenarios:
B = CLE + 15%
H = MFR - 15%

Optimization



Multi-objective approach

$$\min_x J(x) = \min_x \left[AQI(x) \quad C(x) \right]$$

$$x \in X$$

Cost-effective approach

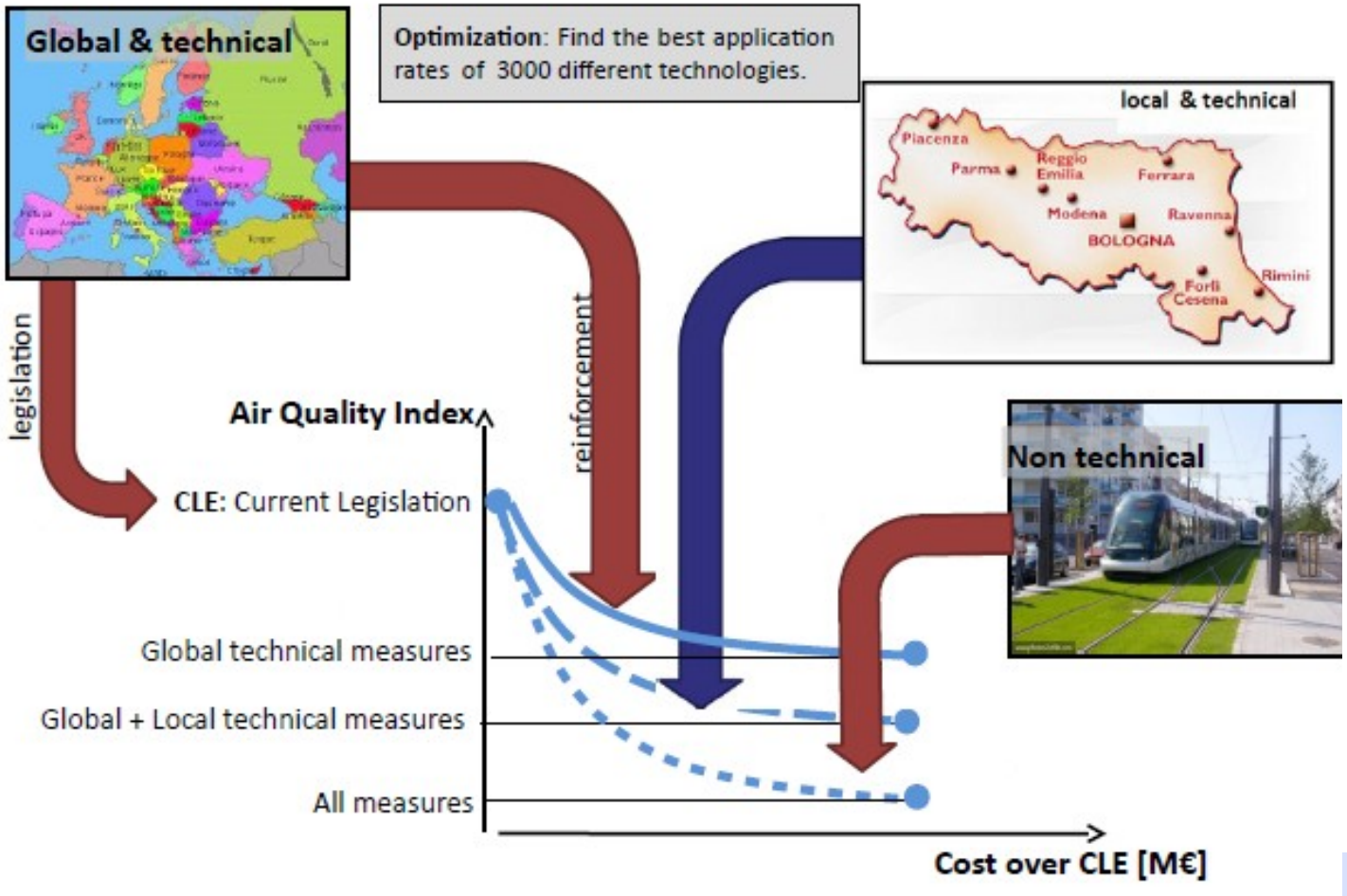
$$\min_x AQI(x)$$

$$C(x) \leq L$$

Control variables (application rates):

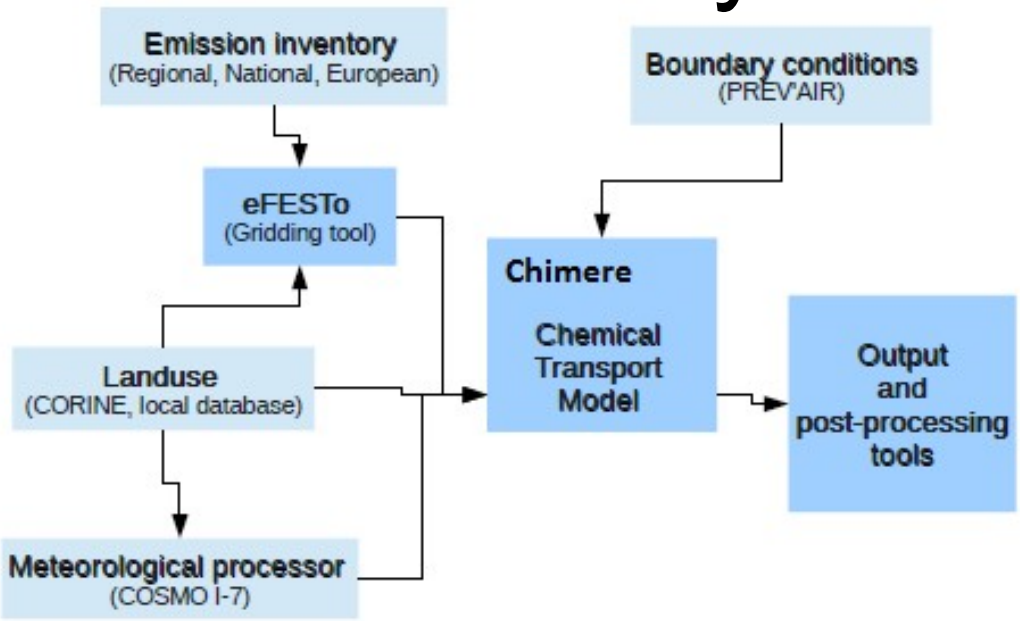
- Technical measures
- Non technical measures

The most effective measure

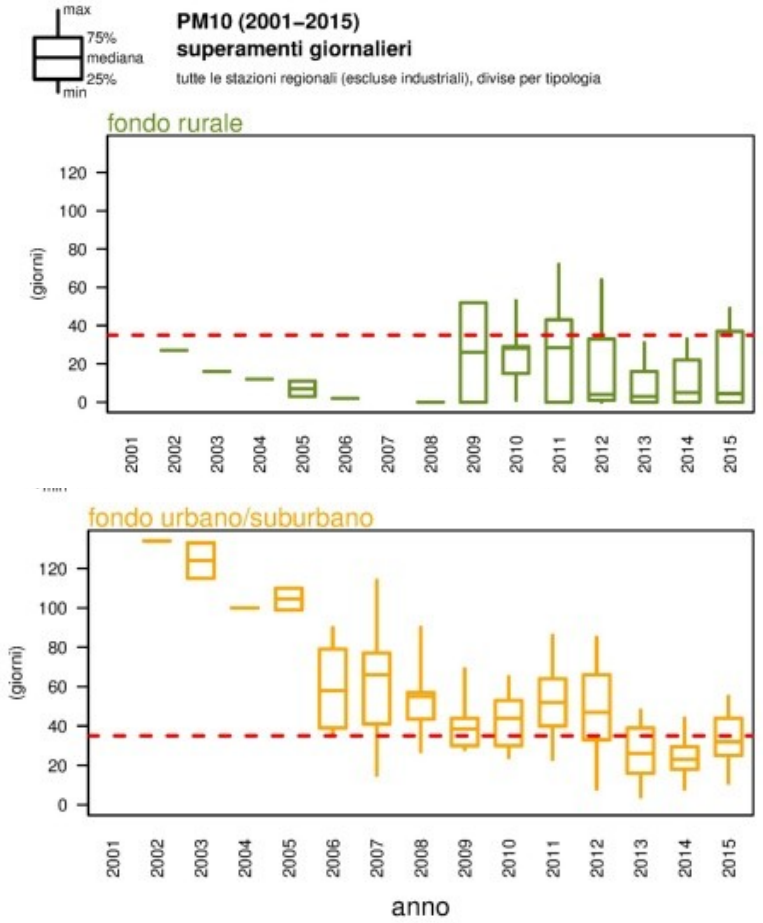


The Emilia-Romagna AQ plan: PAIR2020

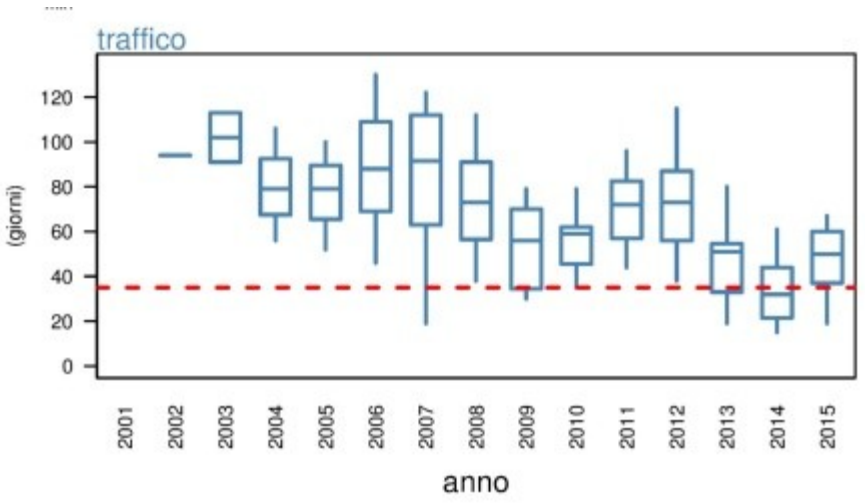
NINFA Air Quality Modeling System



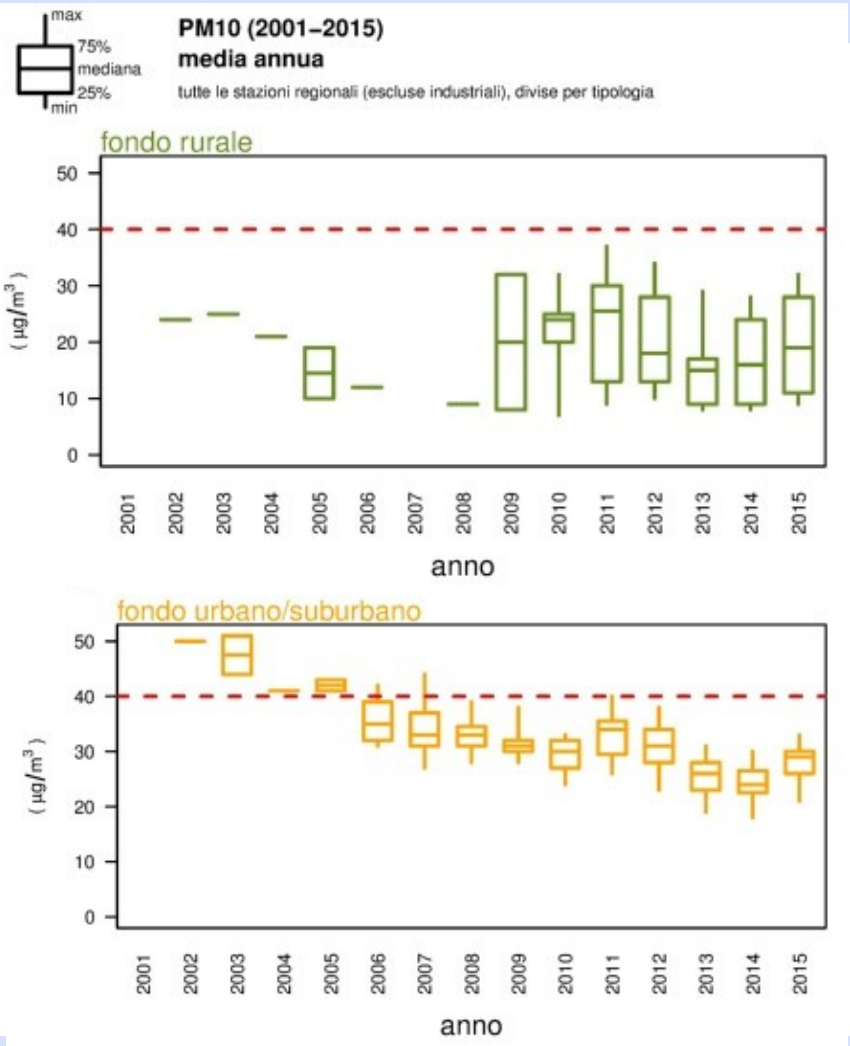
NINFA has been used to to prepare simulations for S/R model, simulate basecase,CLE2020, as well as target and PAIR2020 emissions scenarios

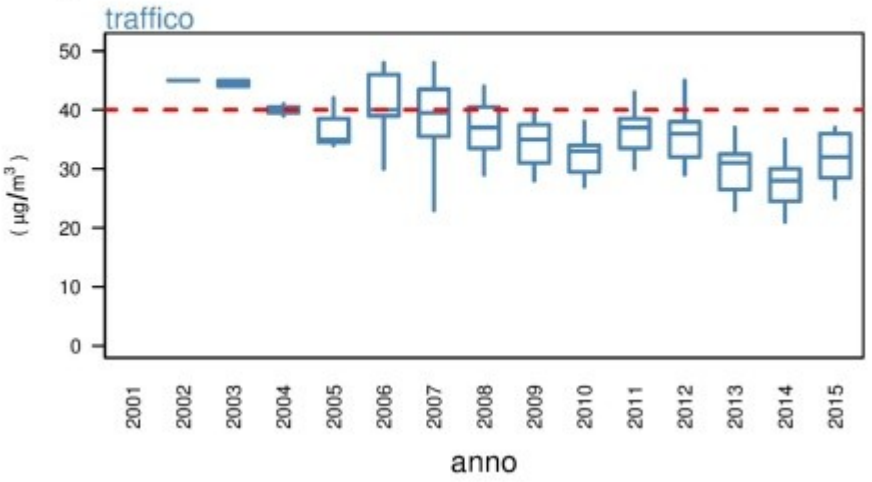


PM10 Number of exceedances of daily values

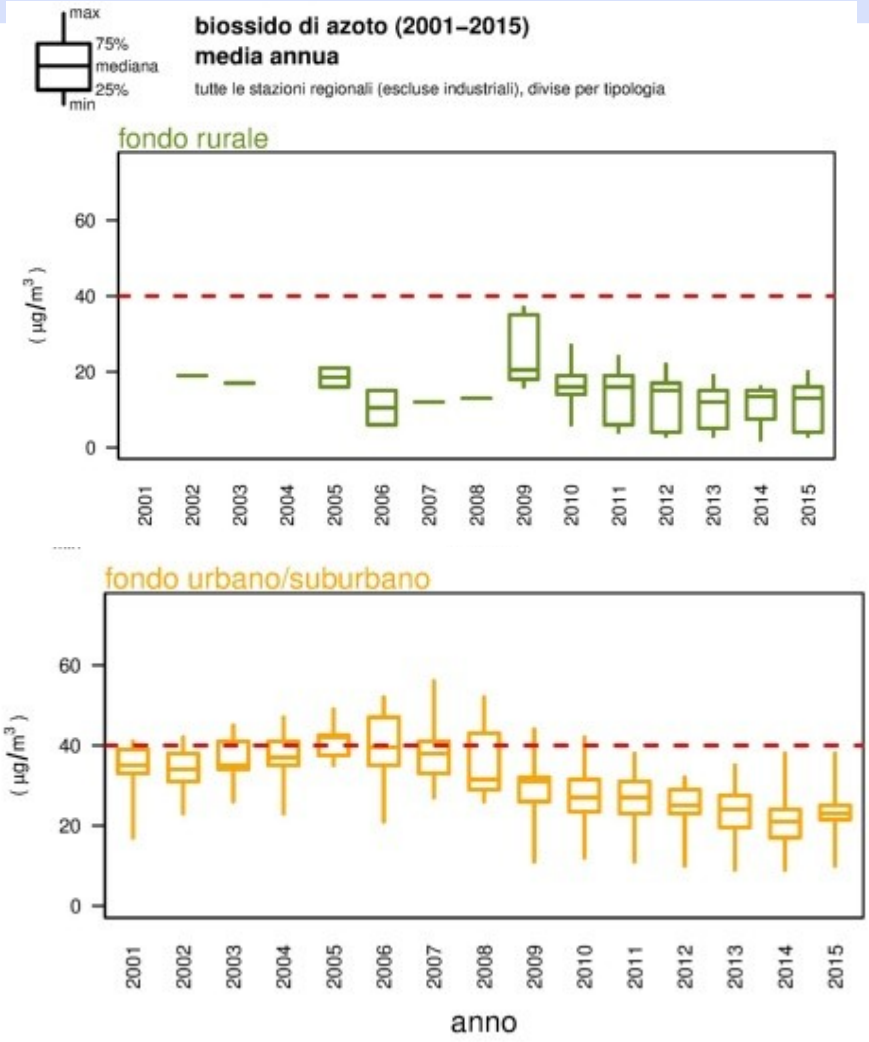


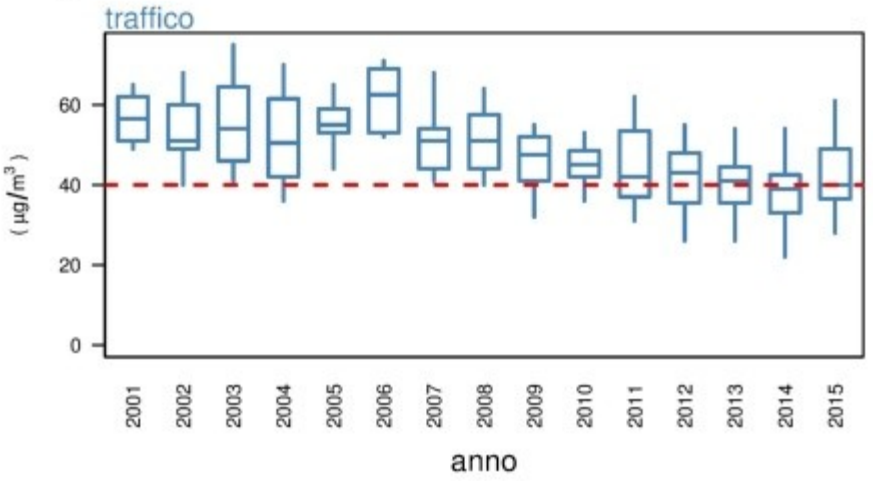
PM10 yearly average





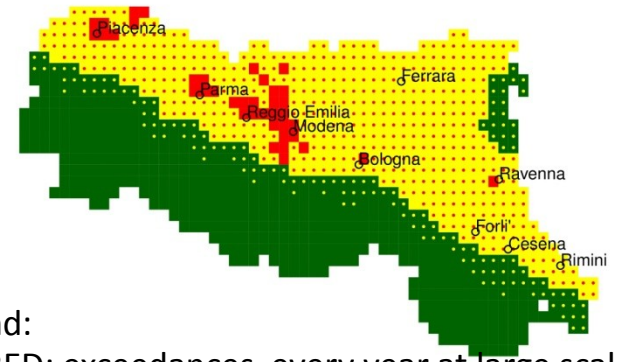
NO_2 yearly average





PM10 daily mean: actual and trend scenario

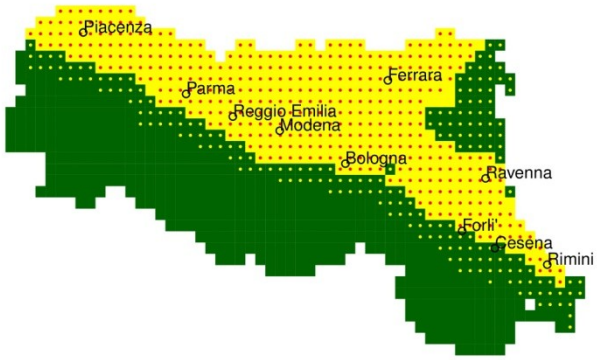
Base case(2010)



Legend:

- RED: exceedances every year at large scale
- YELLOW with RED spots: local exceedances every year
- GREEN with YELLOW spots: local exceedances in "bad" year
- GREEN : no exceedances

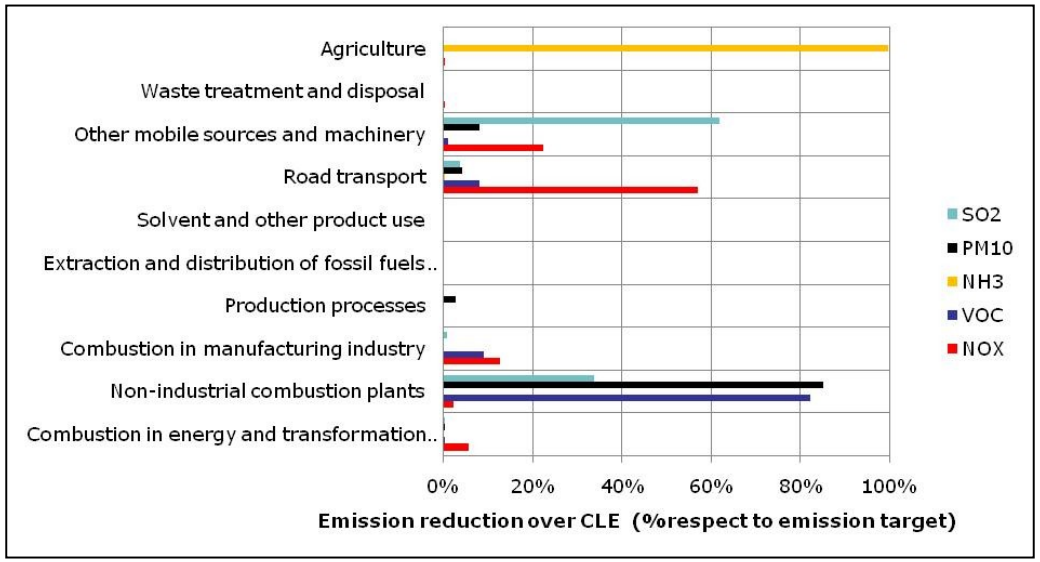
CLE 2020 (GAINS-I SEN-v2013 + Regional Domestic, Traffic, Energy)

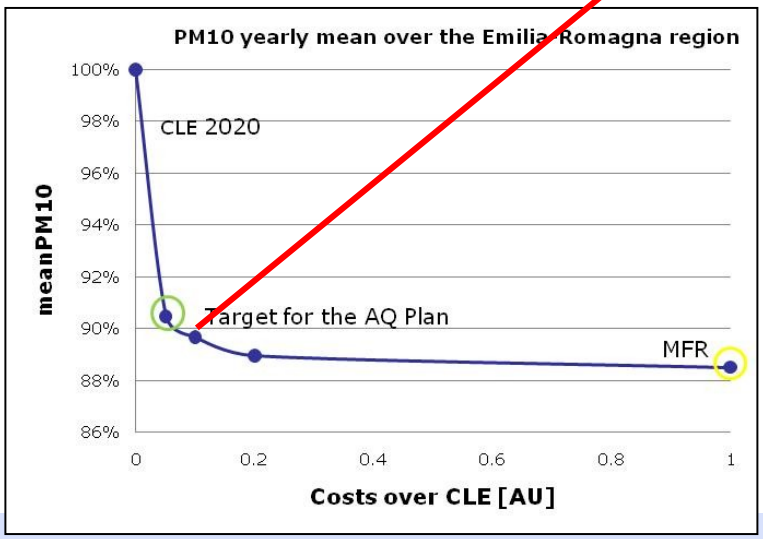


Maps are corrected for the effect of the interannual variability due to meteorology and subgrid variability

RIAT+ output from E-R PAIR2020

Emilia-Romagna A.Q. action plan: measures per macro-sector for the target scenario (RIAT+ output)



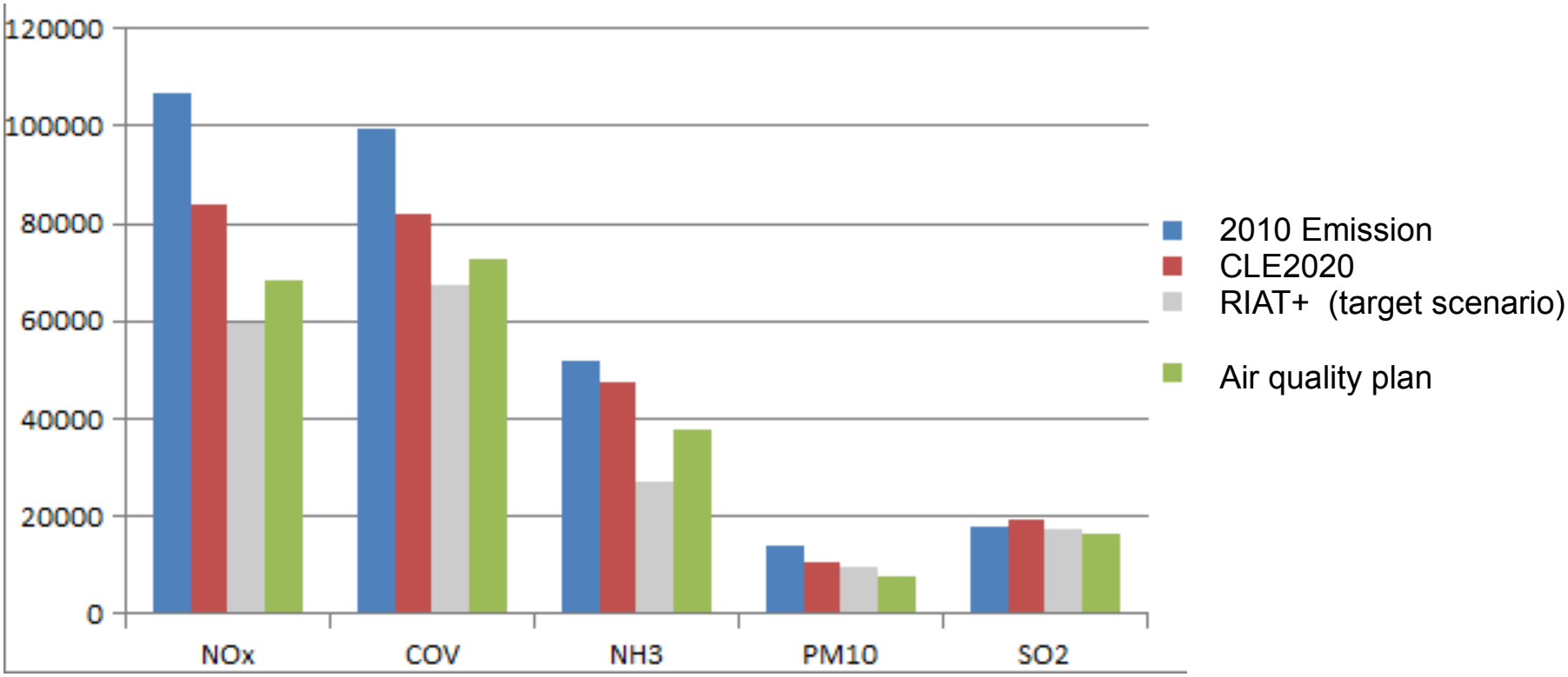


Emilia-Romagna A.Q. action plan: identification of the target scenario by the cost-effectiveness analysis (RIAT+)

Emissions reduction target

% EMISSIONS REDUCTION 2020	COV	NH3	NOx	PM10	SO2
Target scenario respect to the 2010 emissions	-32%	-48%	-44%	-30%	-2%
CLE 2020 trend scenario respect to the 2010 emissions	-17%	-9%	-24%	-24%	+9%
Target scenario respect to the CLE 2020 emissions	-18%	-43%	-26%	-8%	-10%

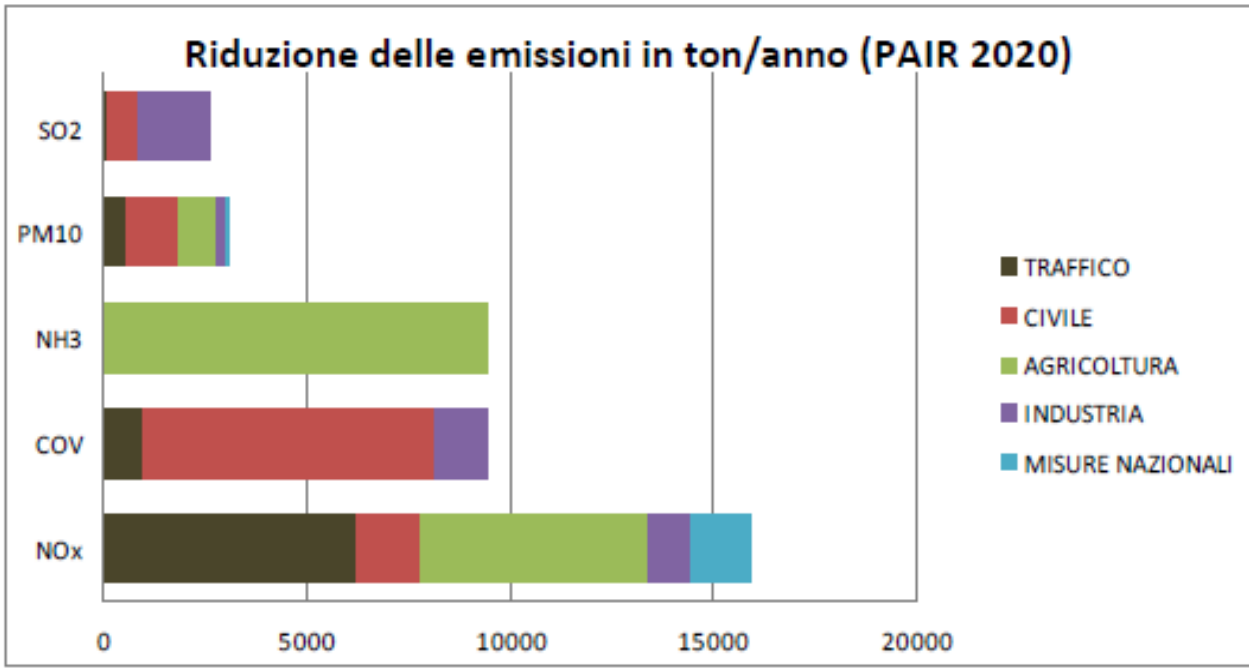
Total emissions for each scenario Emilia-Romagna domain (tons)



PAIR2020:measures

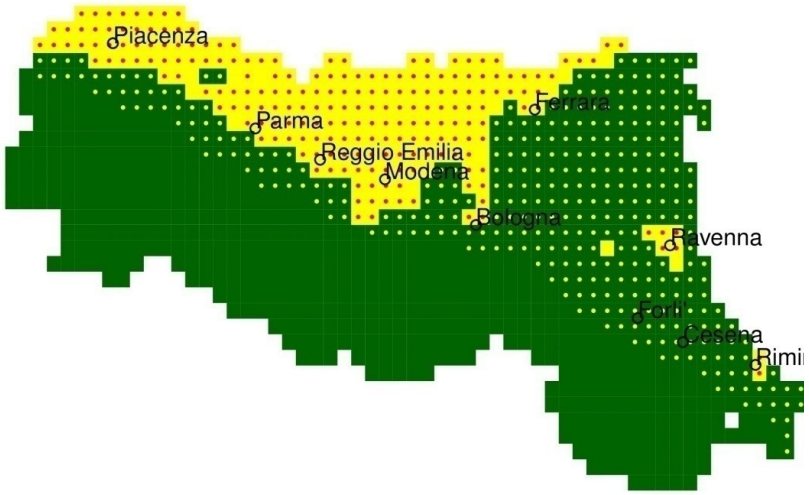
Industry	Traffic
Building insulation	Stop "old" vehicles (i.e. EURO2 gasoline, EURO3 diesel)
Efficiencies in industrial process	Increase Local public transport, pedestrian areas, cycling line,LEZ, etc
Substitution of burning oil with diesel fuel	Encourage fleet renewal
Domestic	Bus replacement (< EURO3)
Building insulation ad high efficiencies boilers	Encourage reduction of private car in small urban area and in around cities
Reducing use of fireplaces	Encourage sustainable logistics in the cities
Substitution of diesel fuel with natural gas	Ecodriving
Increase efficiency of heating	**Agriculture**
National measure	Agriculture: animal house adaption to reduce NH3
Speed reduction in motorway and other measure to be defined	Agriculture urea free fertilizer
	Encourage tractor fleet renewal

PAIR2020:emissions reduction

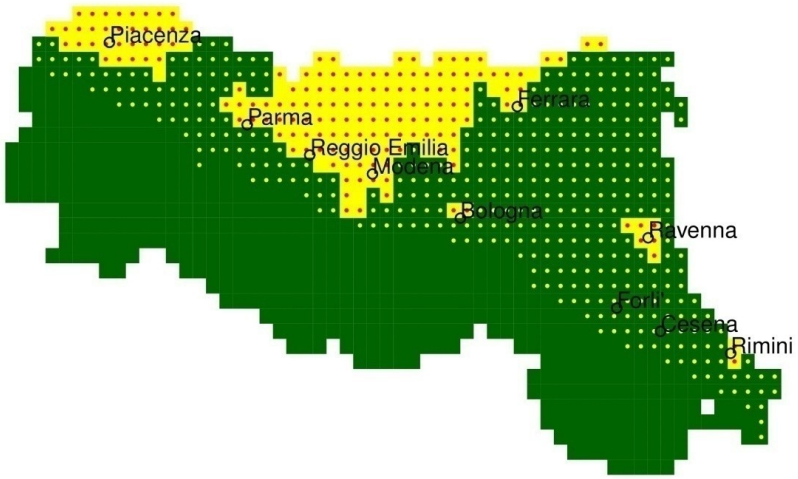


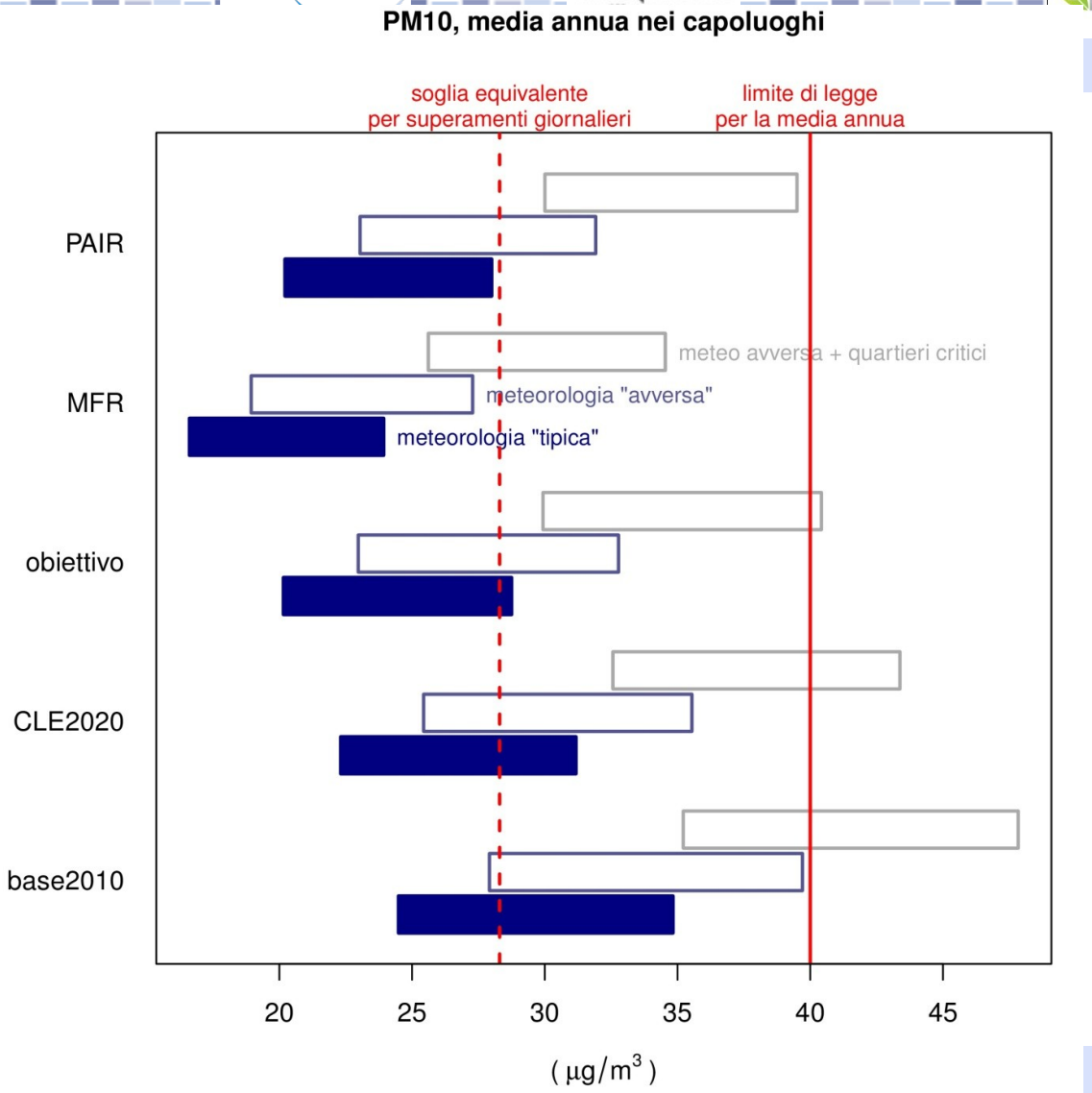
PM10 daily mean: trend scenario

Target scenario (RIAT+)



PAIR2020




PM10, media annua nei capoluoghi
soglia equivalente
per superamenti giornalieri
limite di legge
per la media annua
PAIR
MFR
obiettivo
CLE2020
base2010
meteo avversa + quartieri critici
meteorologia "avversa"
meteorologia "tipica"
20
25
30
35
40
45
(µg/m3)

Conclusions

The RIAT+ tool implemented in Emilia-Romagna help ARPAE and local government to define the Regional Air quality action and most effective actions.

Despite significant reductions, the plan does not guarantee the compilance on the number of exceedances of the daily value for PM10 and average annual No2 everywhere. Additional actions are needed at the municipal level

Help us to increase awareness of the importance of action in sectors traditionally not considered in air quality action plan such as agriculture

But this is not the end …..

At the end of March kick off meeting of PREPAIR (Po Regions Engaged to Policies of AIR) , LIFE15 IPE/IT/000013

PREPAIR project

Implement actions in the territory of the Po Valley and Slovenia in order to improve air quality and comply with Dir. 2008/50/EC.

The general objectives are:

- Implement measures included in the Air Quality Plans (AQPs) and in the Po Valley Agreement,
- Increase know-how and reinforce capacity building within public authorities and private operators;
- Strengthen coordination among Po Basin and Slovenia authorities in the field of air quality;
- Establish a permanent networking structure that involves the environmental agencies
- Produce homogeneous assessment reports on the effectiveness of PREPAIR concrete actions on air quality
- Assess the effectiveness and resources needed for measures to improve air quality
- Create a community that recognises the risks for human health and for the environment posed by air pollution
- Create a network of national, regional and local governments, research centres and other stakeholders.