

The OPERA logo, featuring a stylized house, car, and factory with green leaves, and the word "Opera" in a blue font.

Operational Procedure for Emission Reduction Assessment

# OPERA AND EMILIA-ROMAGNA AIR QUALITY PLAN

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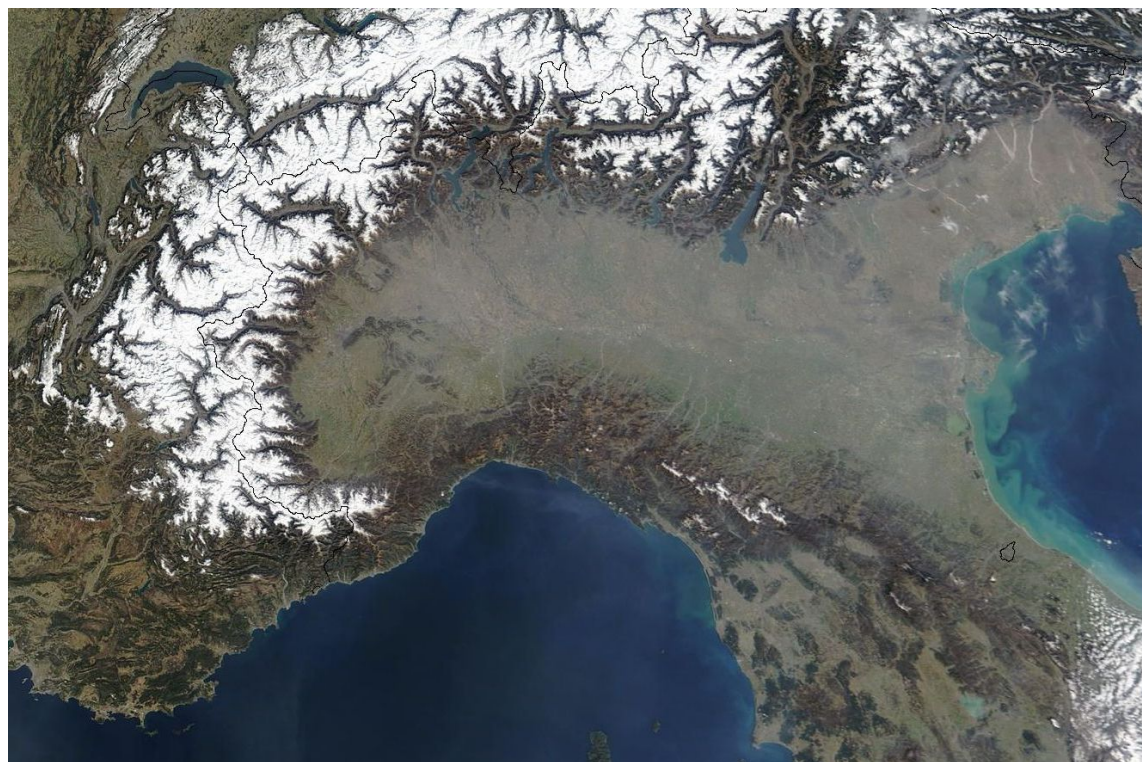




# Contents

Directive 2008/50/EC, *ANNEX XV*

- ➔ *General information (zones, climate)*
- ➔ *Nature and assessment of pollution*
- ➔ *Origin of pollution and factors responsible for the exceedance*
- ➔ *possible measures for the improvement of air quality*







# Zones and agglomerate

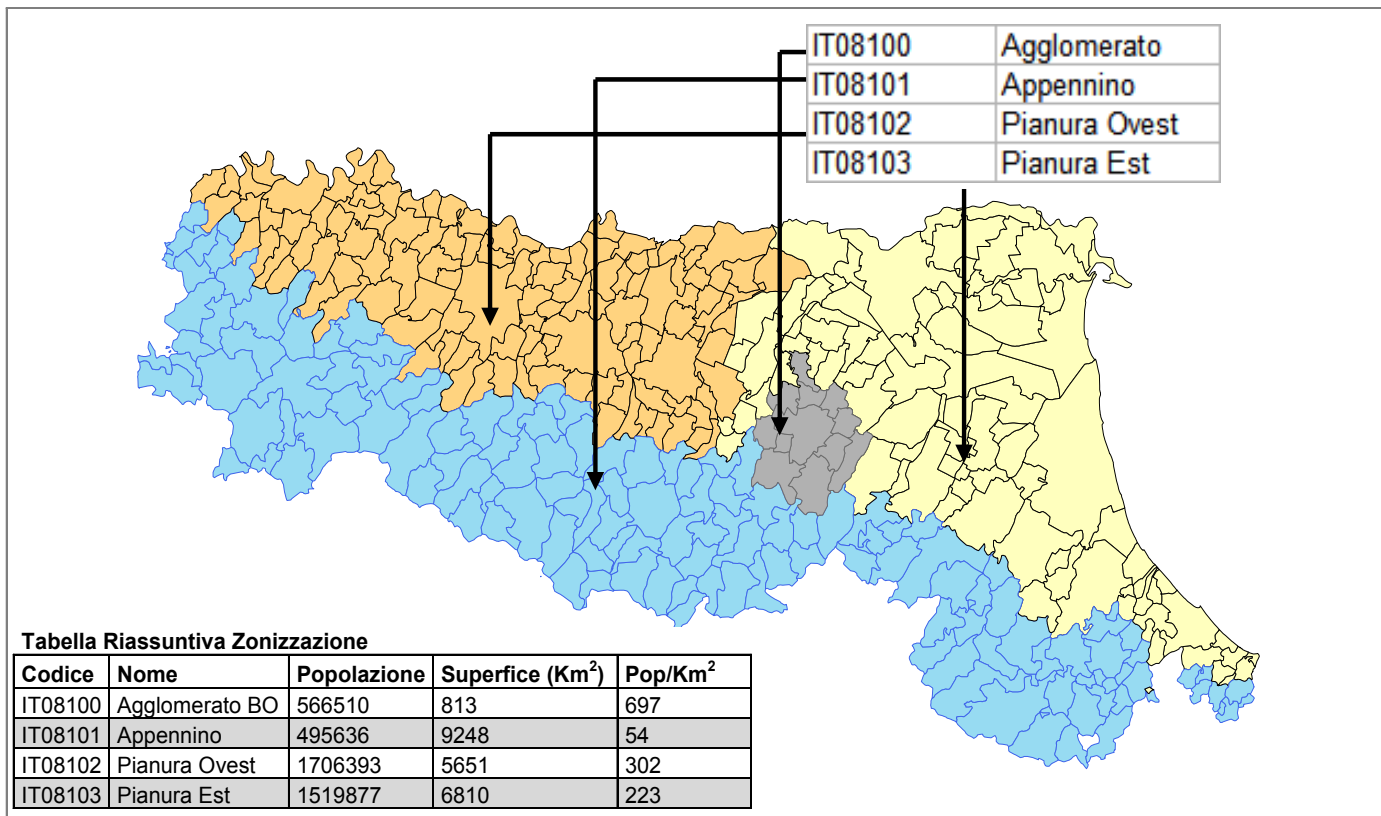


Figura 3 - Zonizzazione Emilia-Romagna



# NATURE AND ASSESSMENT OF POLLUTION





## Air Quality in Emilia-Romagna: exceedances situations

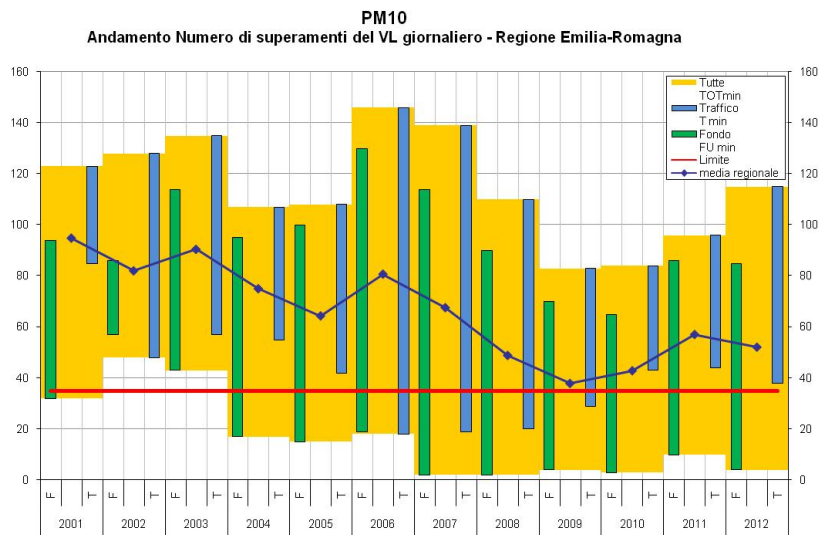
- The daily Limit Value (LV) for PM10 was exceeded every year since the enforcement of the EU directive (2005). Slow, but statistically significant, decreasing trend for the PM10 annual mean during the 2001 – 2012 period.
- Since 2010, local exceedances of the annual LV for NOX, mainly in the traffic stations. Decreasing trend.
- The LV for health and vegetation protection for ozone are systematically exceeded. Stationary trend.
- The annual LV for PM2.5 (obligation from 2015) can be exceeded during adverse meteorological years
- The inter annual variability of the concentration is strongly dependent from meteorological conditions. Evidences of an increase of the meteorological variability due to climate change (2 extreme years occurred during the last 5 years).

### References:

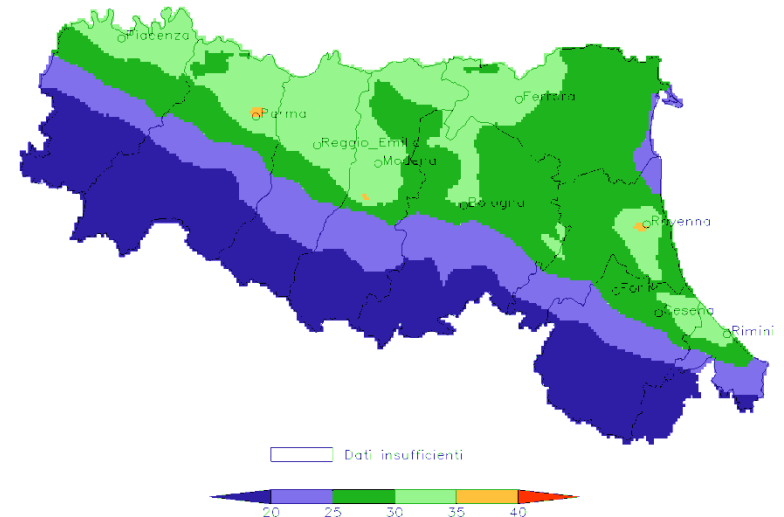
<http://ambiente.regione.emilia-romagna.it>

La terza edizione del "Report regionale della qualità dell'aria" [www.arpa.emr.it](http://www.arpa.emr.it)

# PM10, daily and annual mean



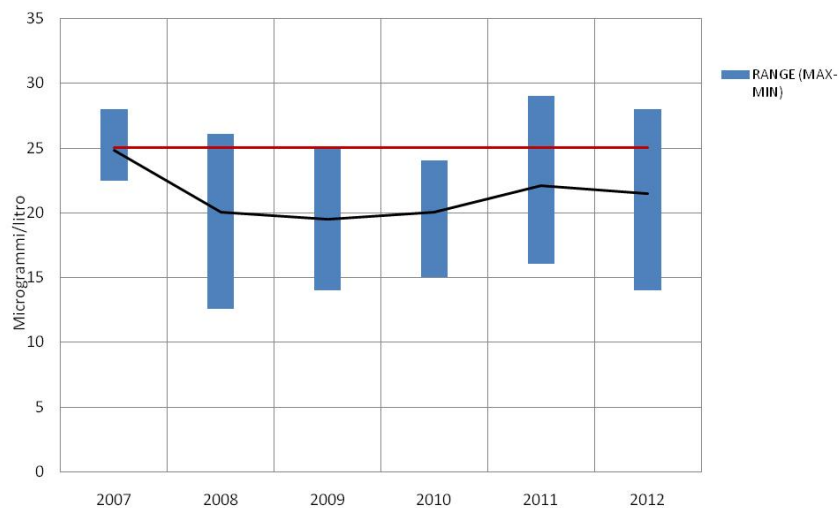
PM10 di fondo: stima della concentrazione media [ $\mu\text{g}/\text{m}^3$ ]  
nel periodo 01JAN2012-31DEC2012 (dati validi 350)  
lontano da emissioni dirette (parchi, zone pedonali, aree rurali)



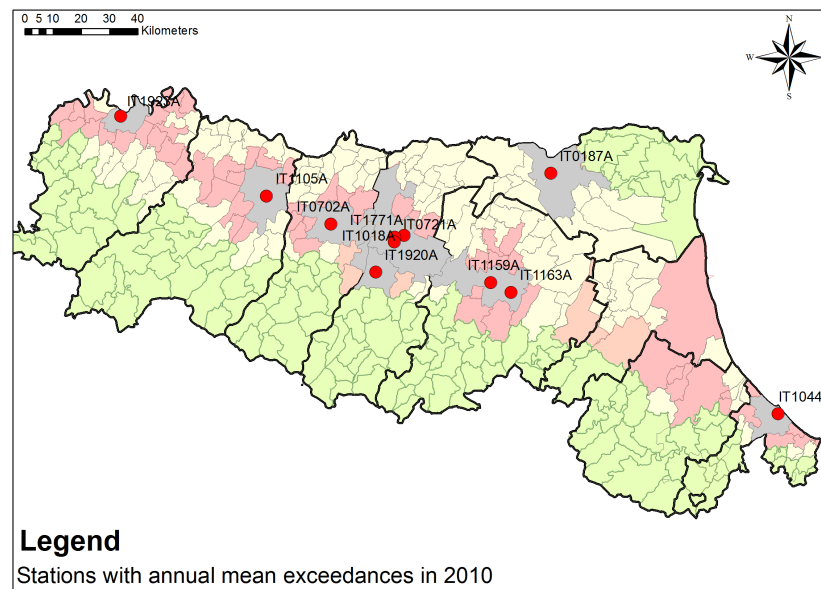




# PM2.5 and NO2



**Nel 2012, 3 stazioni superiori al limite**  
**Nel 2011, 2 stazioni superiori al limite**  
**Nel 2009 e 2010 tutte le stazioni inferiori al limite**



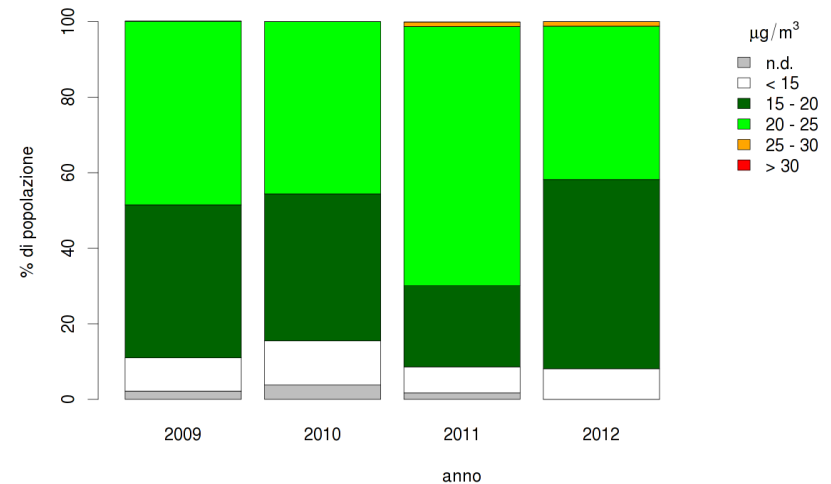
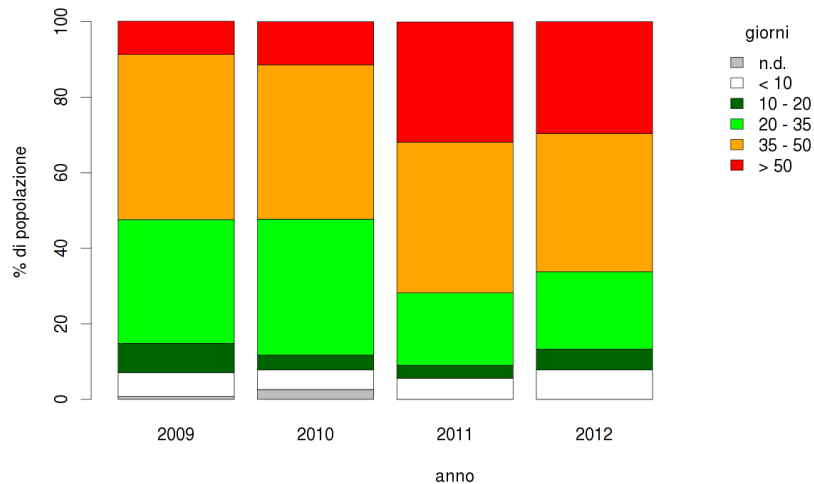
Fonte: richiesta di deroga al rispetto dei valori limite per NO2, ai sensi dell'art. 22 della Direttiva 2008/50/CE (presentata il 2 settembre 2011, concessa fino a 1 gen 2013 o 2014)



# Population exposure: PM10 and PM2.5

2011 e 2012: 70 % esposta a PM10 > VL giornaliero

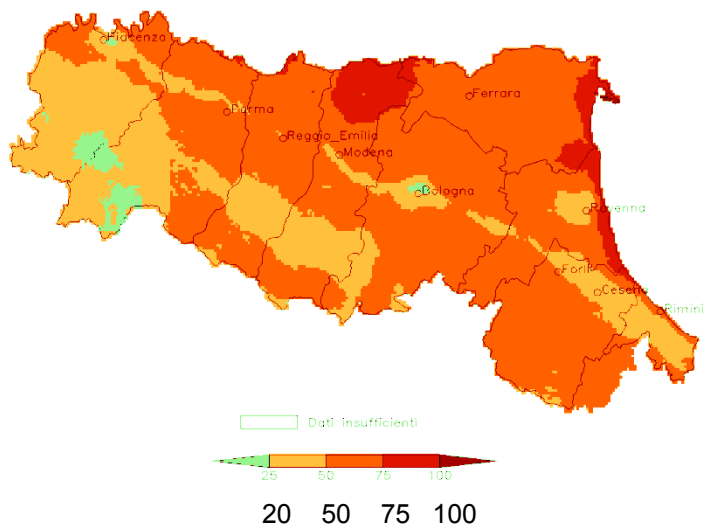
2011 e 2012: una parte della popolazione (2-3 %) esposta a PM2.5 > VO annuale





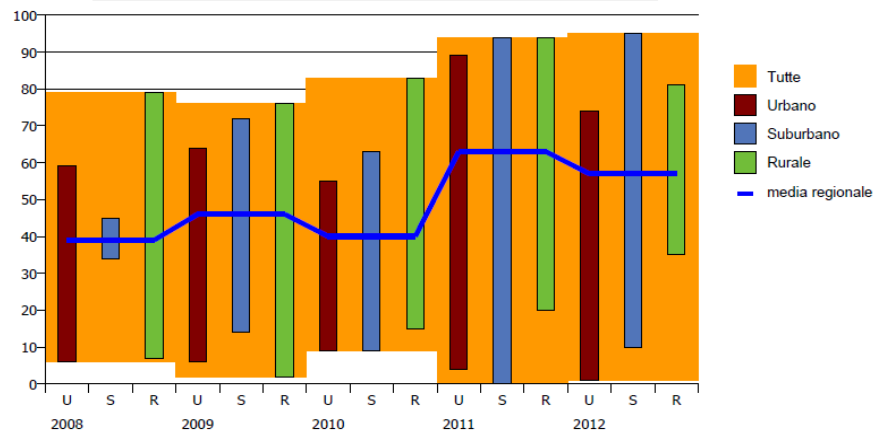
# Ozone

ozono: stima del numero di superamenti del massimo giornaliero della media mobile su 8h (soglia  $120 \mu\text{g}/\text{m}^3$ ) nel periodo 01JAN2012-31DEC2012



Anno 2012: Distribuzione territoriale regionale della stima del numero di superamenti dell'obiettivo per la protezione della salute umana

Andamento numero superamenti del valore limite per la protezione della salute umana (120) - Regione Emilia-Romagna

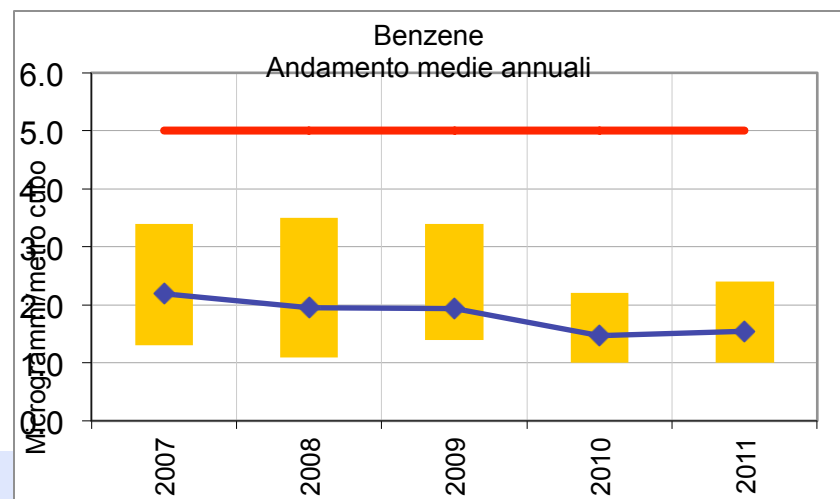
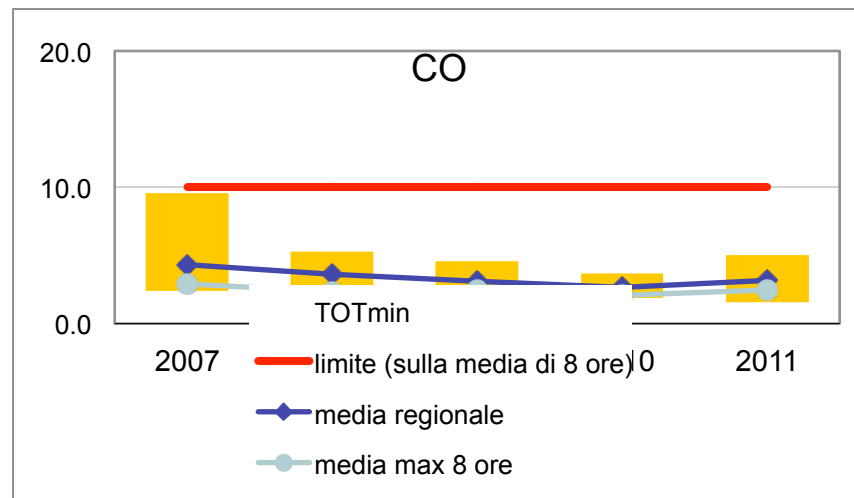
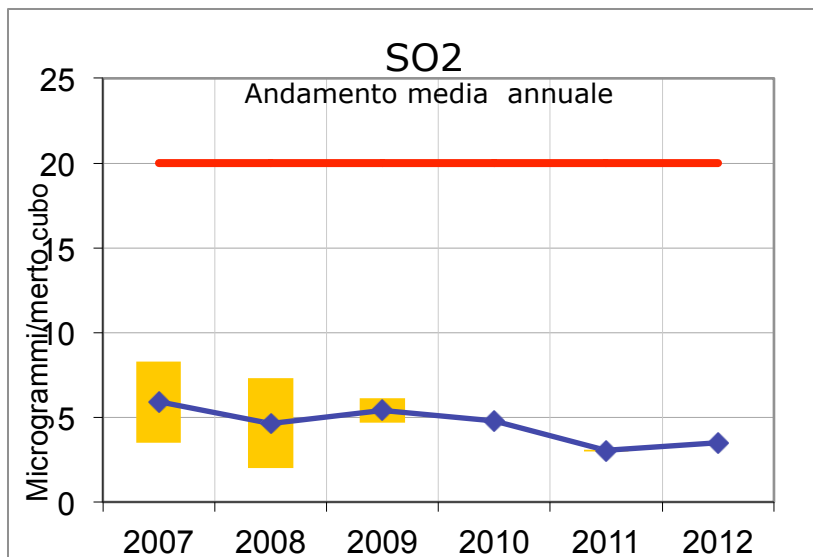


**Andamento del numero di superamenti del valore obiettivo per la protezione della salute umana \* (120  $\mu\text{g}/\text{m}^3$ ) – Regione Emilia-Romagna**

\* Massimo giornaliero della media mobile su 8 ore da non superare più di 25 volte in un anno



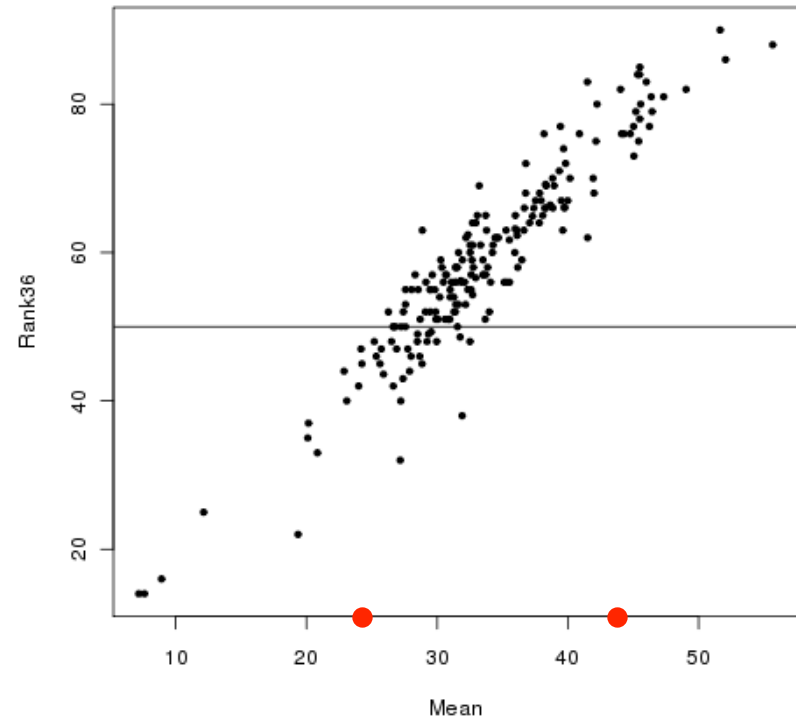
# SO<sub>2</sub>, CO, benzene





## The equivalent limit value (ELV) for PM10

- The annual ELV is set to 28 (instead of 40) microg/m<sup>3</sup>.
- we suppose that the respect of the ELV for PM10 will guarantee the respect of the annual LV for PM2.5 and NO<sub>2</sub> (except for hot spots)





# ***ORIGIN OF POLLUTION AND FACTORS RESPONSIBLE FOR THE EXCEEDANCE***





# Origin of pollution in Emilia-Romagna

- ➔ The large scale background concentration of PM<sub>10</sub> exceed the LV in some zones:
  - To comply with the LV a large scale action plan is needed.
  - The additional emergency and local actions act at local level on hot spots
- ➔ The 60-65 % of PM is secondary
  - The action plan should reduce the emissions of pollutants responsible for secondary PM pollution (VOCs, NH<sub>3</sub>, SO<sub>x</sub>, ...)

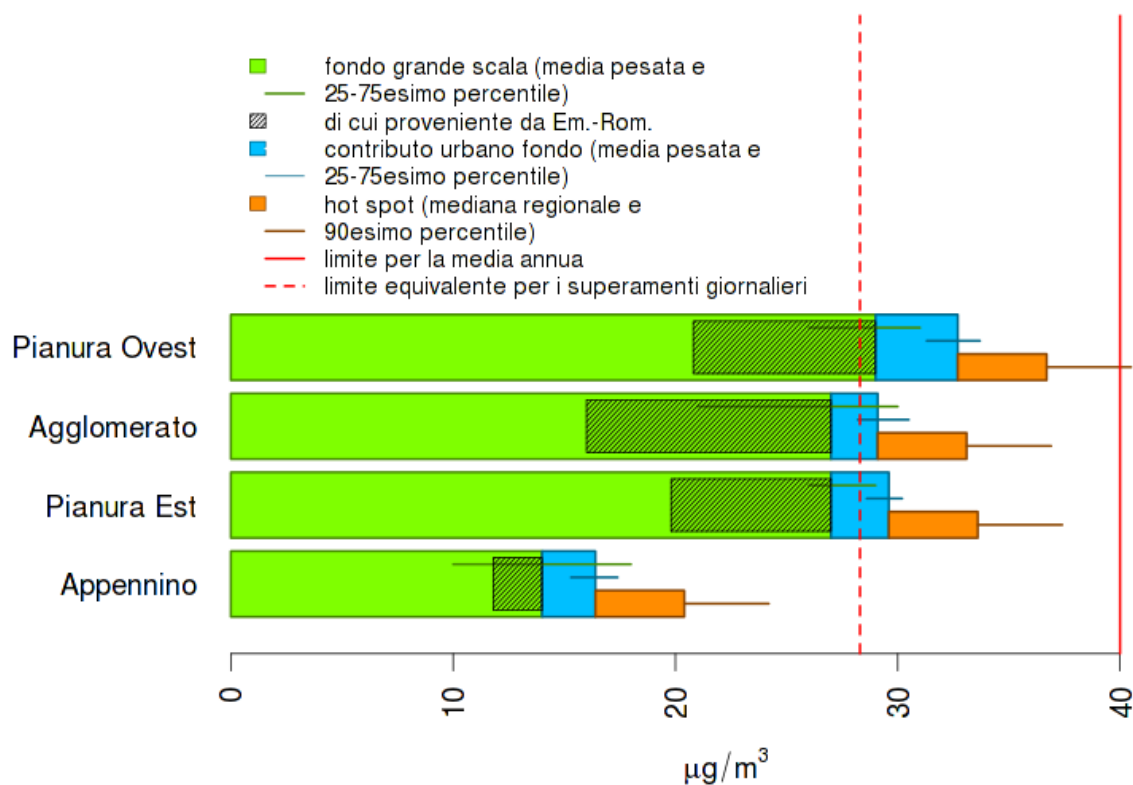


# PM10 source apportionment in Emilia - Romagna

Fraction of PM10	Geographic area (zonizzazione Dl.vo 155)			
	Appennino	Pianura Est	Agglomerato	Pianura Ovest
natural	23 %	18%	16 %	14%
total anthropogenic	<b>77 %</b>	<b>82 %</b>	<b>84 %</b>	<b>86 %</b>
of which:				
Primary anthropogenic	14%	21%	25%	22%
Secondary anthropogenic	63%	61%	59%	64%

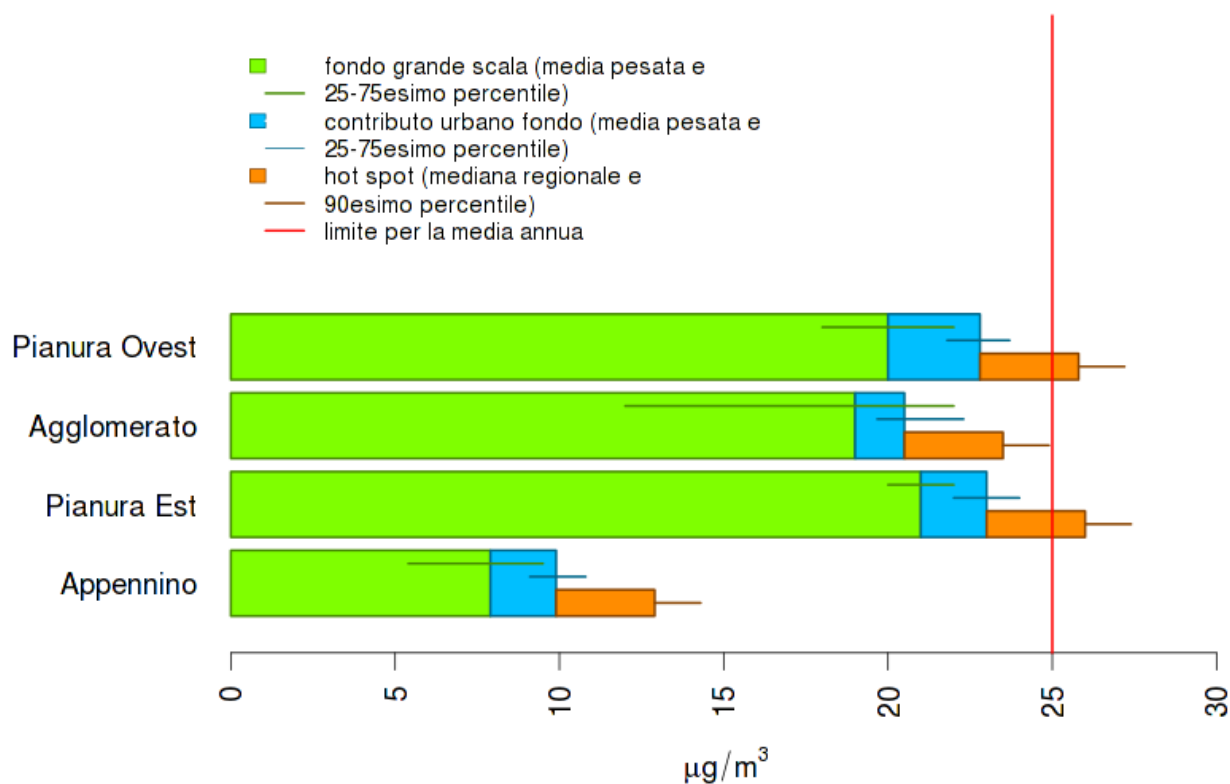


# Origin of pollution PM10



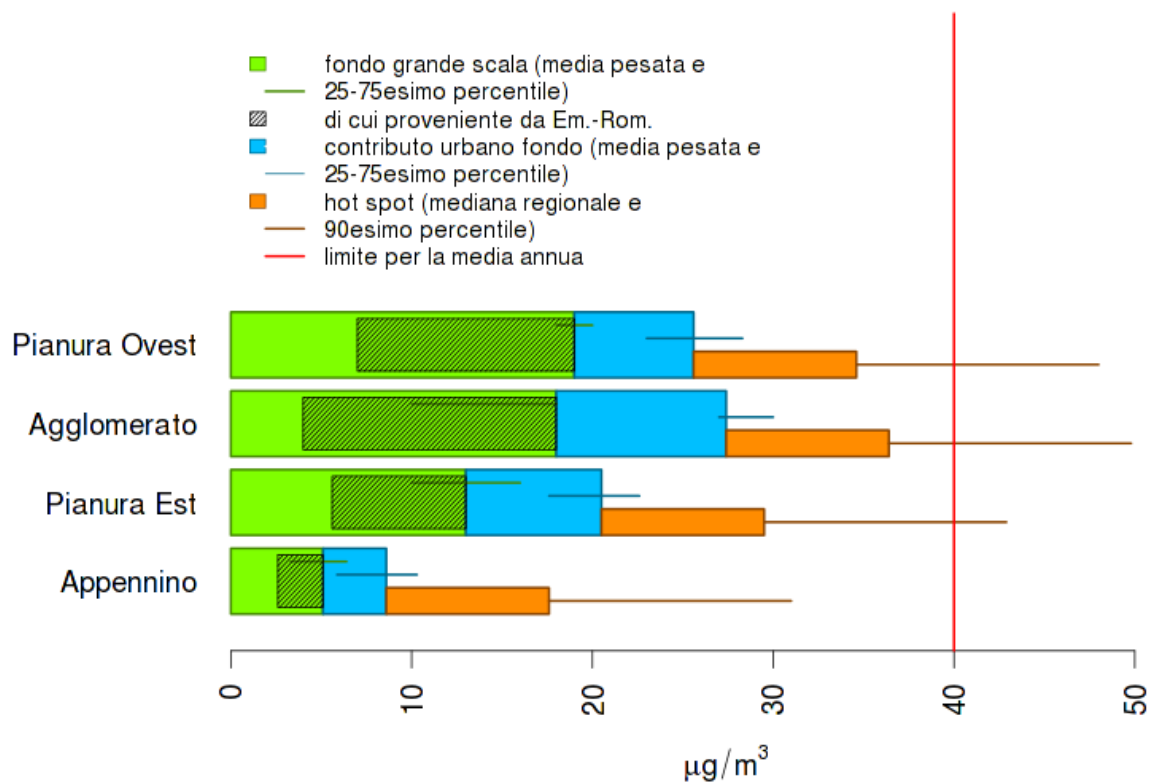


# Origin of pollution PM2.5





# Origin of pollution NO2



# The trend scenario

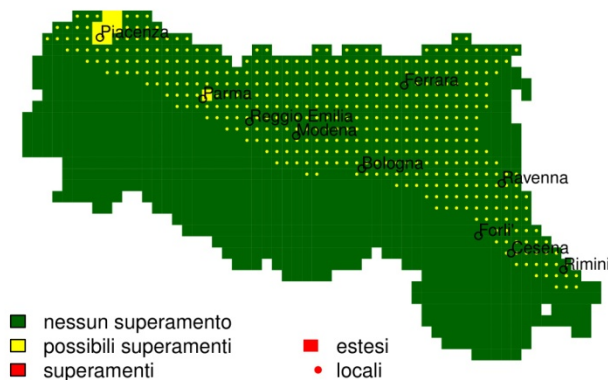
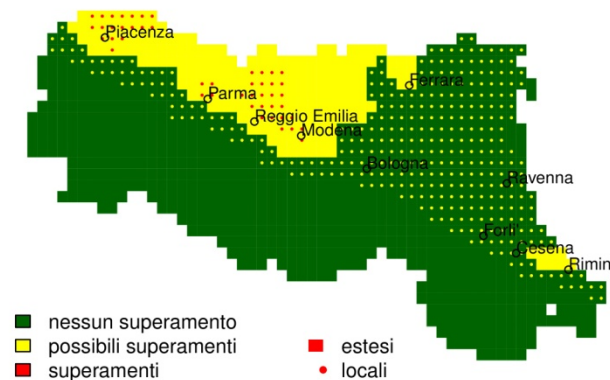
- ➔ The ELV will be exceeded in the CLE 2020 scenario: a regional AQ plan is needed.
- CLE 2020:
  - National Strategy for Energy (SEN 2013, approved by Decreto interministeriale 8/3/2013)
  - Regional Transport Plan (PRIT)
  - Regional Energy Plan (PER)
  - Regional rules (n. 1, 28 ottobre 2011) for the storage and application of liquid and slurry effluents from agriculture (disposizioni in materia di utilizzazione organica degli effluenti di allevamenti e delle acque reflue di aziende agricole).



# PM10 annual mean: actual and trend scenario

**Base case(2010)**

**CLE 2020 (GAINS-I SEN-v2013 + RER  
civile, traffico, energia)**

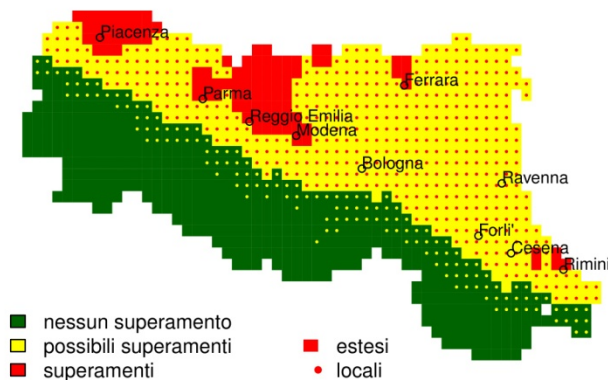
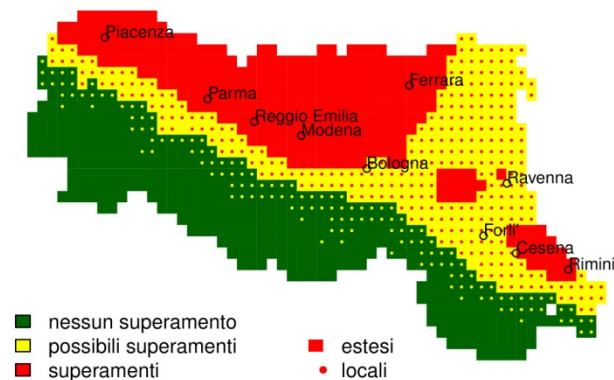


Maps are corrected for the effect of the interannual variability  
due to meteorology and subgrid variability

# PM10 daily mean: actual and trend scenario

## Base case(2010)

CLE 2020 (GAINS-I SEN-v2013 + RER  
civile, traffico, energia)



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

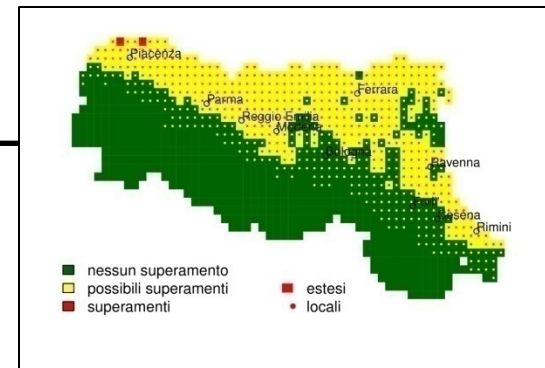
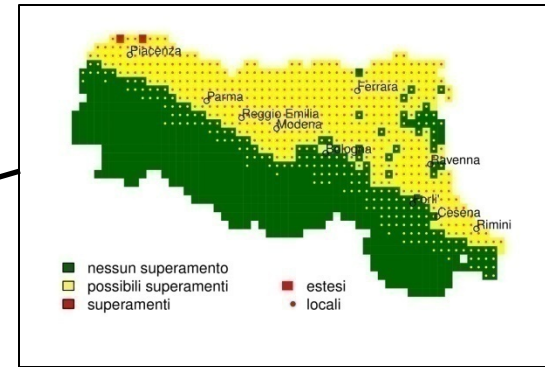
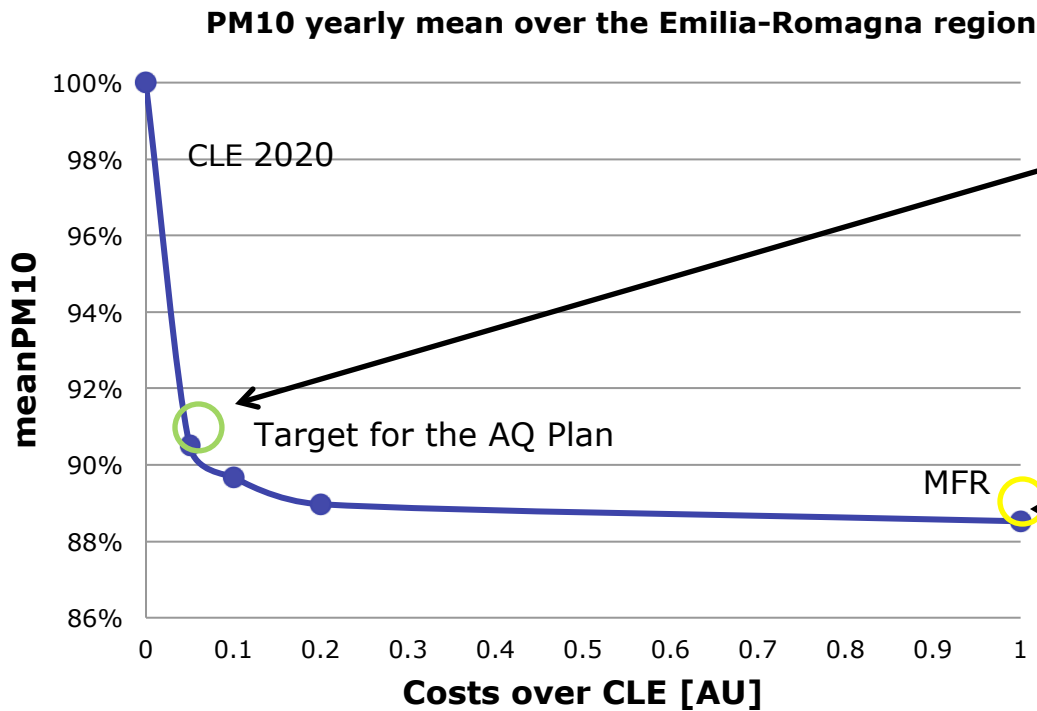


## The target scenario for the AQ plan

- The costs – effectiveness analysis is applied to set the total emission reduction target at regional level for the AQ plan (PAIR)



# Costs – effectiveness (Pareto curve)





# Emissions reduction target

<b>% EMISSIONS REDUCTION 2020</b>	<b>COV</b>	<b>NH3</b>	<b>NOx</b>	<b>PM10</b>	<b>SO2</b>
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%



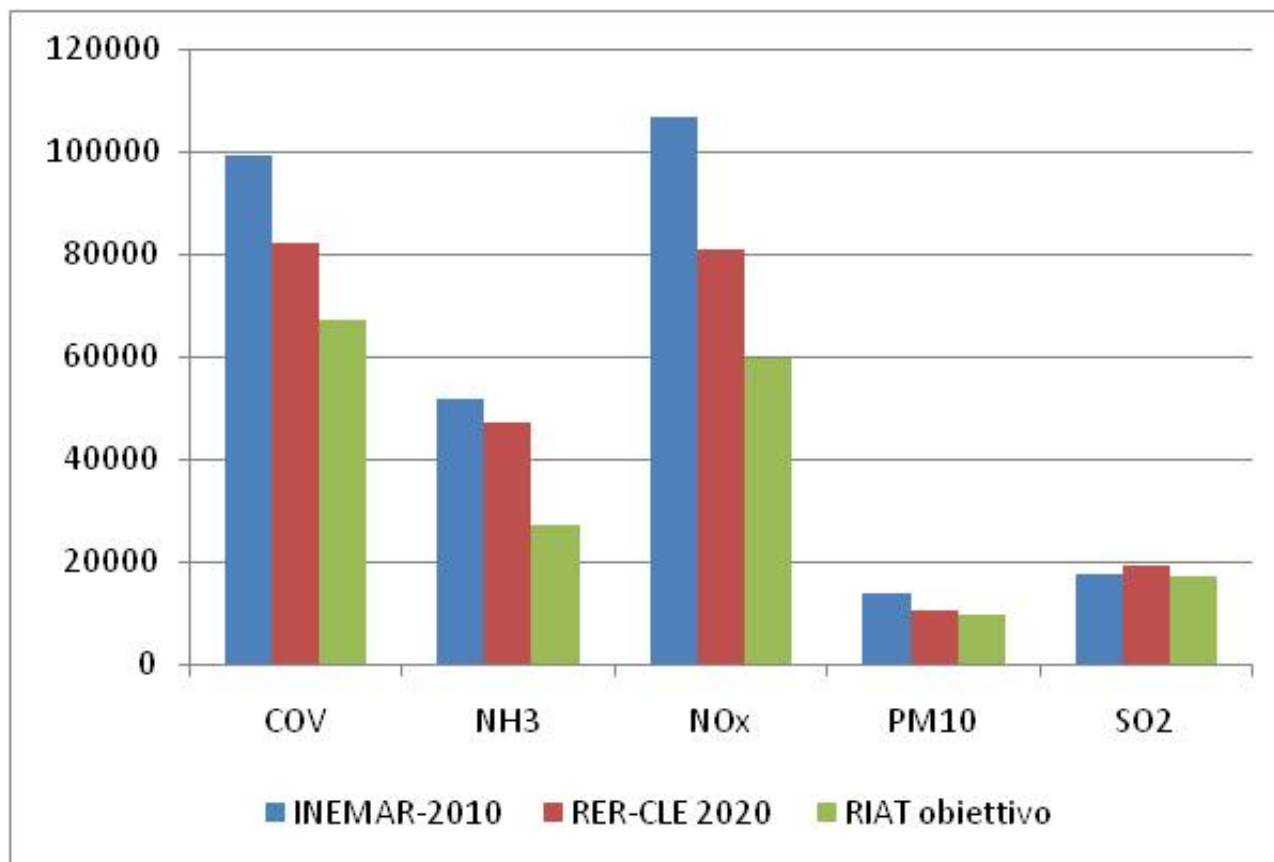
# Obiettivi di riduzione:

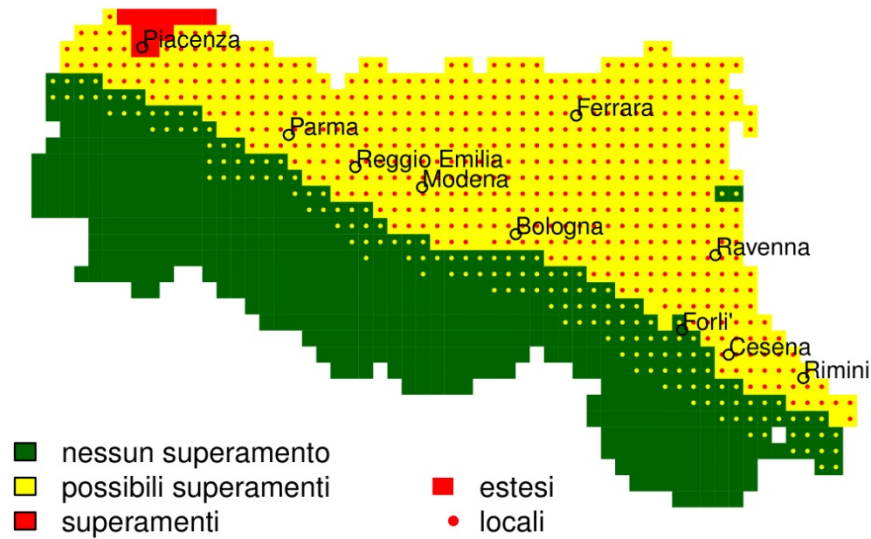
Emissioni (ton)		2010	2020
PM10	attuali	13637	
	scenario no piano		10324
	scenario obiettivo di piano		9531
NOx	attuali	106745	
	scenario no piano		80997
	scenario obiettivo di piano		59589
NH3	attuali	51522	
	scenario no piano		47085
	scenario obiettivo di piano		26929
COV	attuali	99000	
	scenario no piano		81895
	scenario obiettivo di piano		67257
SO2	attuali	17498	
	scenario no piano		19038
	scenario obiettivo di piano		17067

- per ottenere il pieno rispetto del valore limite giornaliero di PM10 si rendono necessarie ulteriori azioni per la riduzione delle emissioni inquinanti rispetto a quelle previste dallo scenario energetico nazionale al 2020 (SEN 2020), previste dalla legislazione corrente e dai piani regionali attualmente in vigore (CLE 2020).



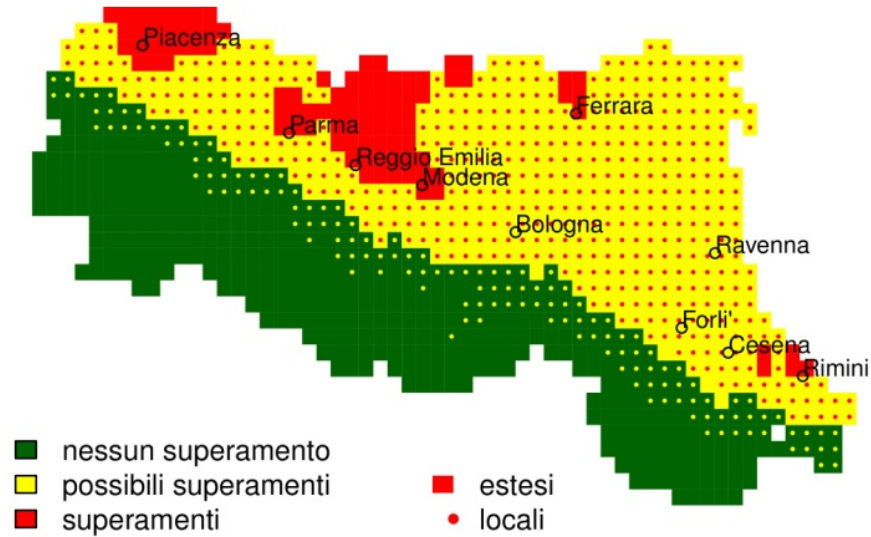
# Total emissions for each scenario over Emilia-Romagna (tons)





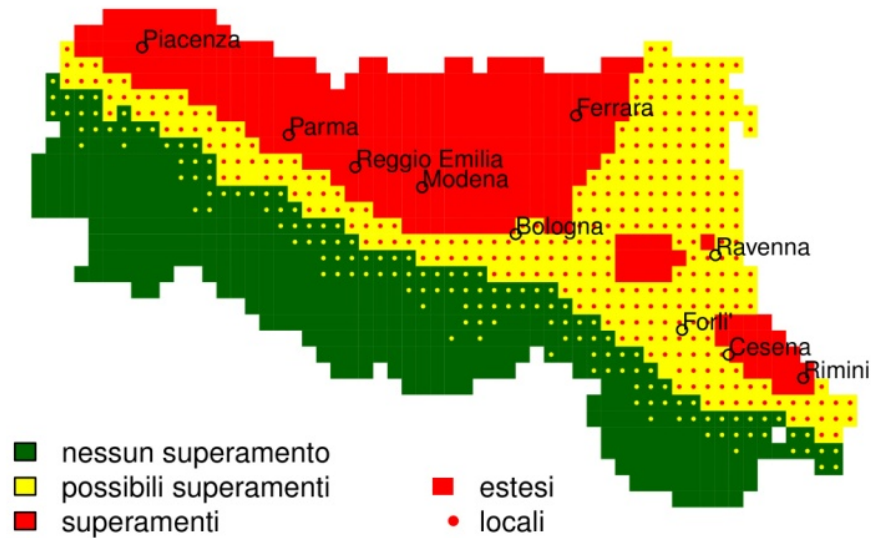
## Target scenario

PM10 exceedances of the daily mean



## CLE 2020 scenario

PM10 exceedances of the daily mean

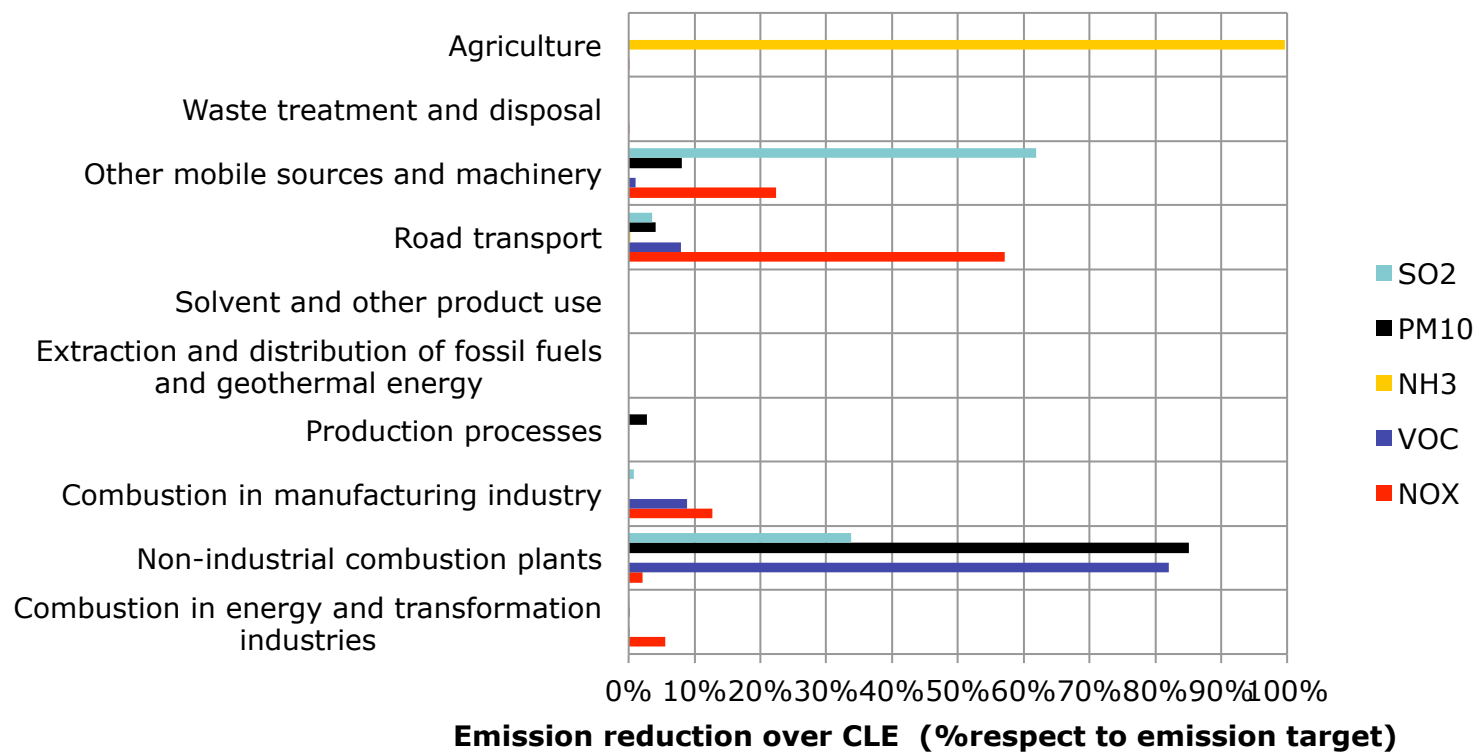


## Base case scenario (2010)

PM10 exceedances of the daily mean

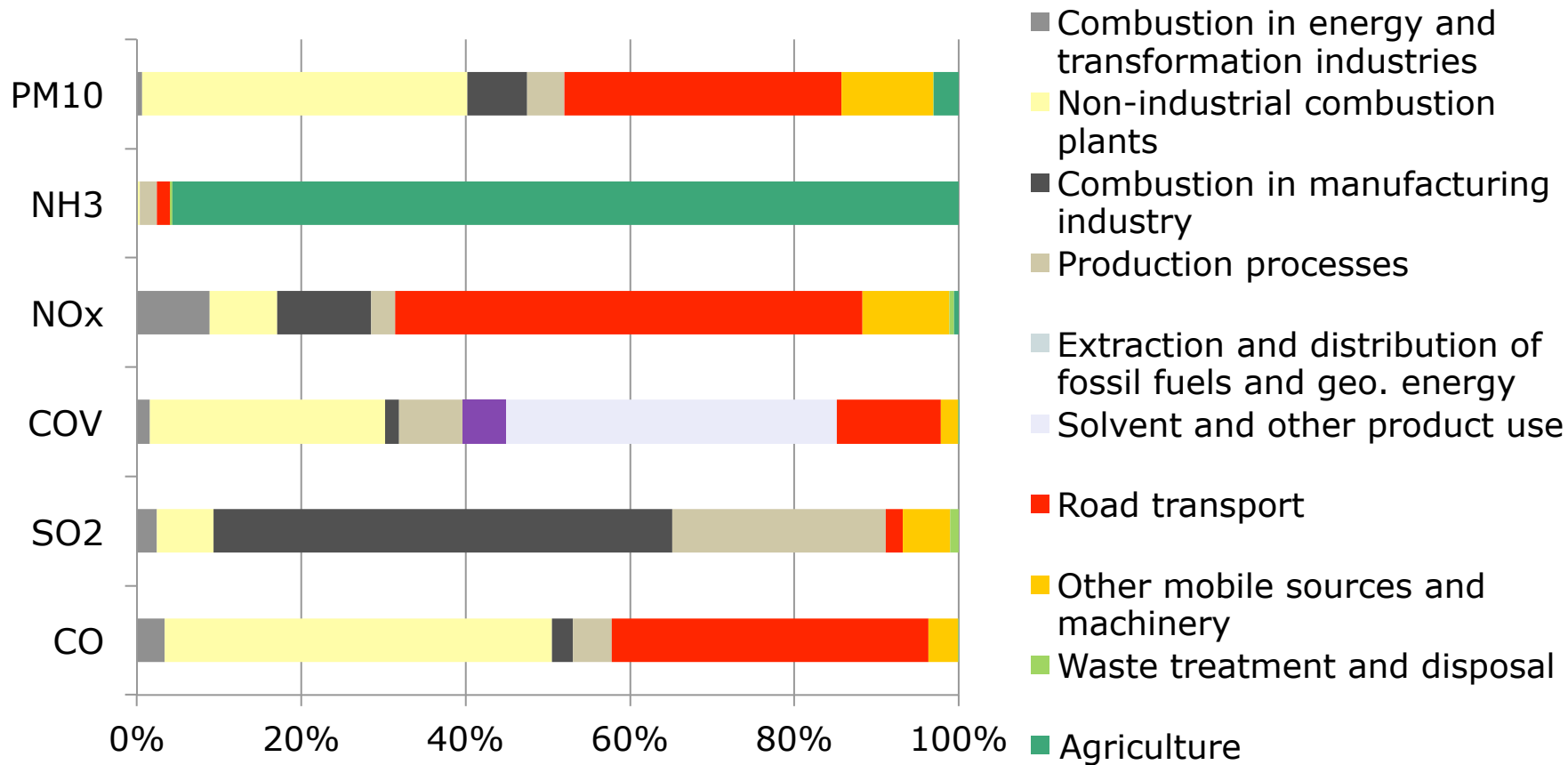


# RIAT+: measures per macrosector for the target scenario



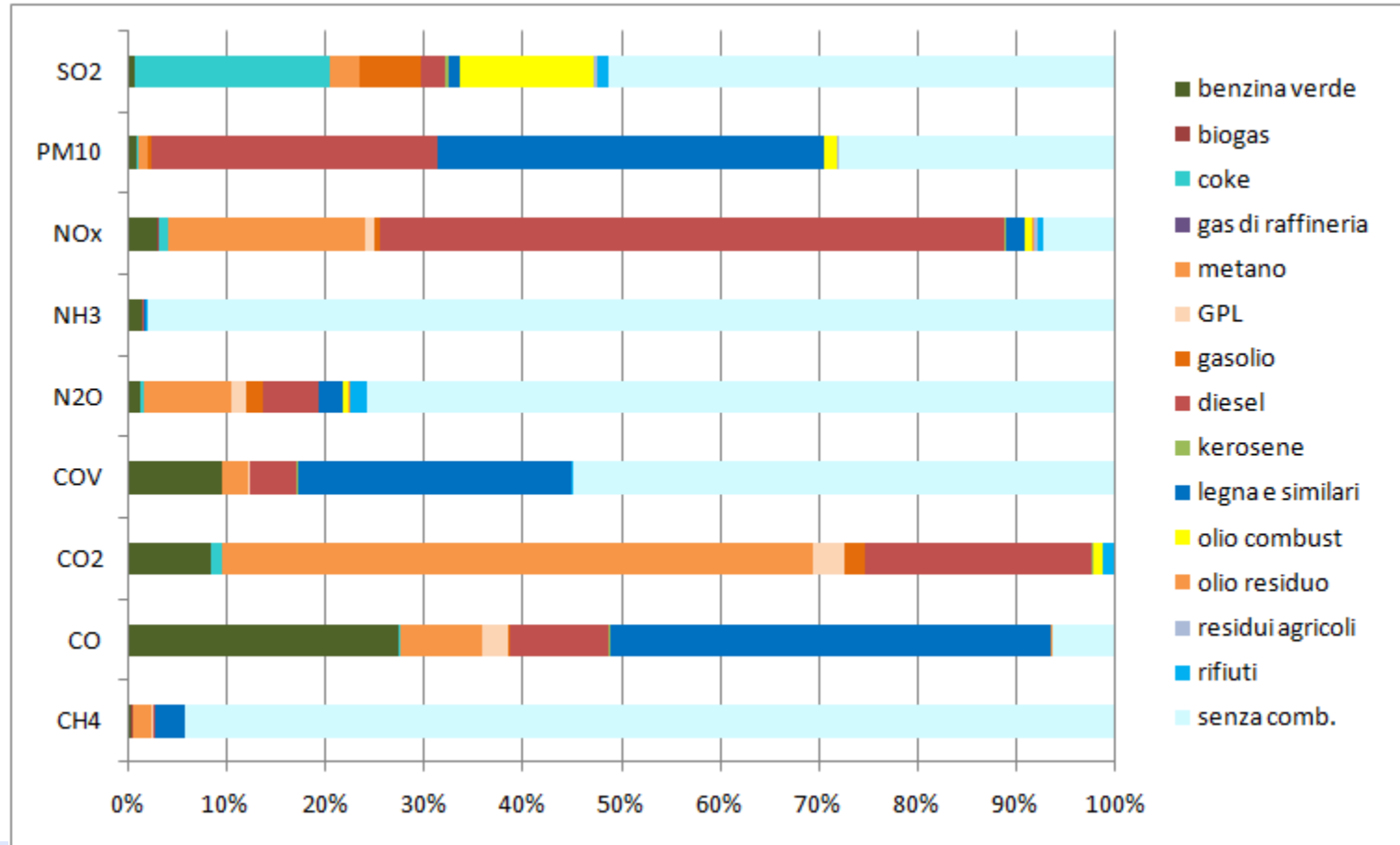


# Emissions per macrosector





# Emissions by fuel type





## Ex. 1 Main actions to reduce NH3 emissions

action	emission reduction (NH3 tons)	% respecto to emission reduction target
<b>Agriculture: Livestock - dairy cattle</b>		
Dairy cows - liquid (slurry) systems		
<b>Combination of LNF_CS_LNA</b>	<b>3318.8</b>	<b>14%</b>
<b>Combination of LNF_SA_LNA</b>	<b>949.3</b>	<b>4%</b>
<b>Agriculture: Livestock - other cattle</b>		
Other cattle - solid systems		
<b>Low ammonia application; high efficiency</b>	<b>1711.3</b>	<b>7%</b>
<b>Agriculture: Livestock - pigs</b>		
Pigs - liquid (slurry) systems		
<b>Combination of LNF_BF_CS_LNA</b>	<b>4613.9</b>	<b>20%</b>
<b>Agriculture: Livestock - poultry</b>		
Laying hens		
<b>Combination of LNF_BF_CS_LNA</b>	<b>652.1</b>	<b>3%</b>
Other poultry		
<b>Combination of LNF_SA_LNA</b>	<b>1842</b>	<b>8%</b>
<b>Fertilizer use - urea</b>		
No fuel use		
<b>Urea substitution</b>	<b>9846.5</b>	<b>43%</b>

LNF low nitrogen feed  
 CS Covered outdoor storage of manure; mean efficiency  
 LNA low ammonia application mean efficiency  
 BF bio filtration  
 SA animal house adaption



## Ex. 2 main actions to reduce NOx emissions

- 1 - Road transport and other mobile
- 2- Industry
- 3 - Energy

action (road transport)	emission reduction (NOx tons)	% respecto to emission reduction target
Heavy duty vehicles - trucks	2705.2	38%
Light duty vehicles: cars and small buses with 4-stroke engines - Highway	143.7	2%
Light duty vehicles: cars and small buses with 4-stroke engines - Urban	76.8	1%
Light duty vehicles: cars and small buses with 4-stroke engines - Extraurban	563	8%
Light duty vehicles: light commercial trucks with 4-stroke engines	522.5	7%
Motorcycles with 4-stroke engines	14.9	0.2%
Motorcycles, mopeds and cars with 2-stroke engines	6.8	0.1%



# Domestic sector (NTM)

	Removal efficiency NO <sub>x</sub>	Maximum Application rate	Domestic NO <sub>x</sub> Emission Reduction
Buildings insulation	<b>8.8</b>	<b>64</b>	<b>6%</b>
Heat Pump	<b>68.0</b>	<b>32</b>	<b>22%</b>
High efficiency Boilers	<b>21.6</b>	<b>64</b>	<b>14%</b>
Thermostatic valves	<b>10.8</b>	<b>64</b>	<b>7%</b>
Solar Heating	<b>11.6</b>	<b>35</b>	<b>4%</b>

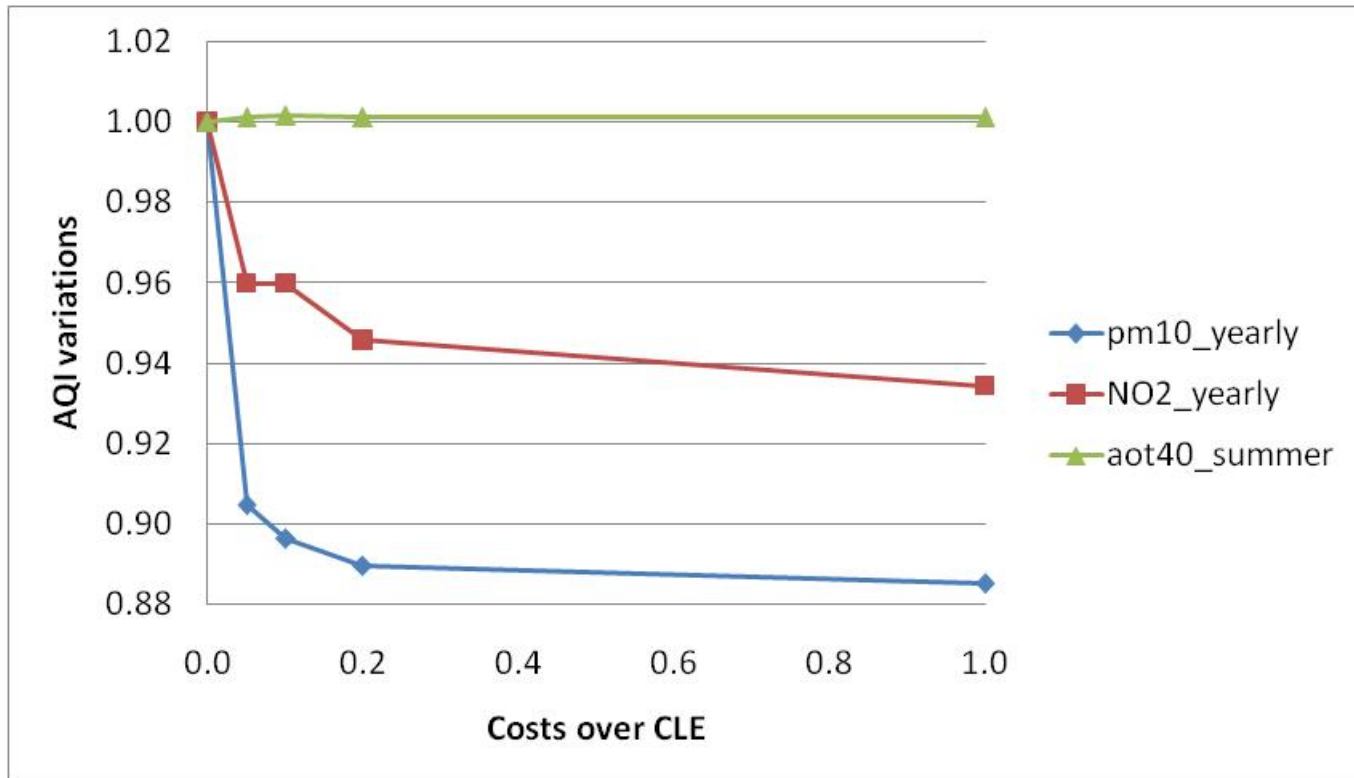
# Goal: comply with the LVs for PM10, NO2 and O3 throughout the whole country

## Next steps and ongoing activities

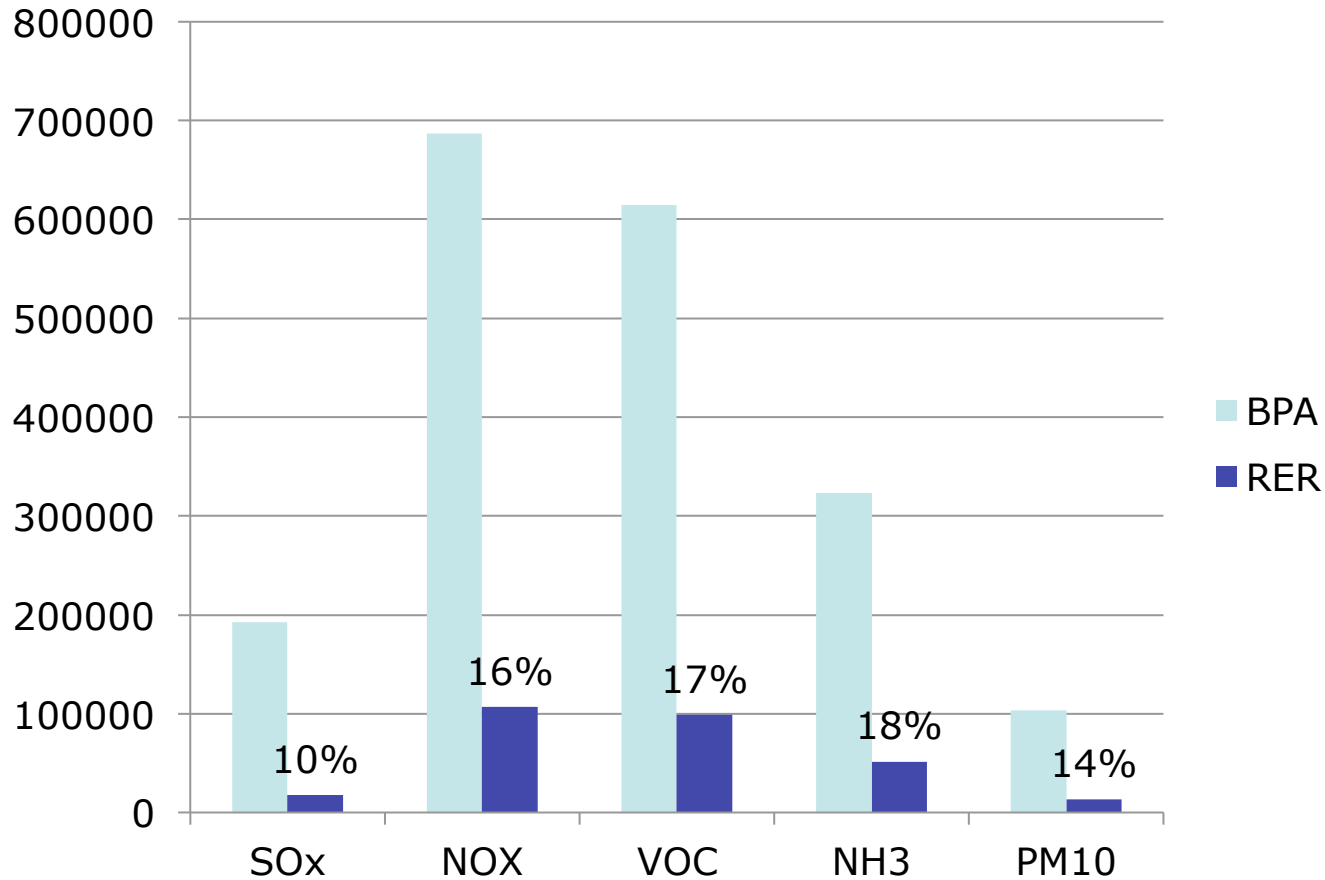
- Defining the details of the abatement actions and projects for the AQ plan;
- Include and harmonize into the scenario the details of the other related action plans (energy, agriculture, transport, waste, etc.)
- Include the plans by neighbouring regions
- Assessment of the AQ plan scenario (from the screening to the simulation by the CTM)
- Assessment of the local exceedance situations for NO2 by high resolutions models.

## Some critical items

- Some abatement actions cannot be enforced by the regional and local authorities (ex. trucks)
- The “cross border” transport of pollutants is very important;
- O3 will be critical also in the plane scenario
- The PM10 daily mean will be critical during extreme meteorological conditions;

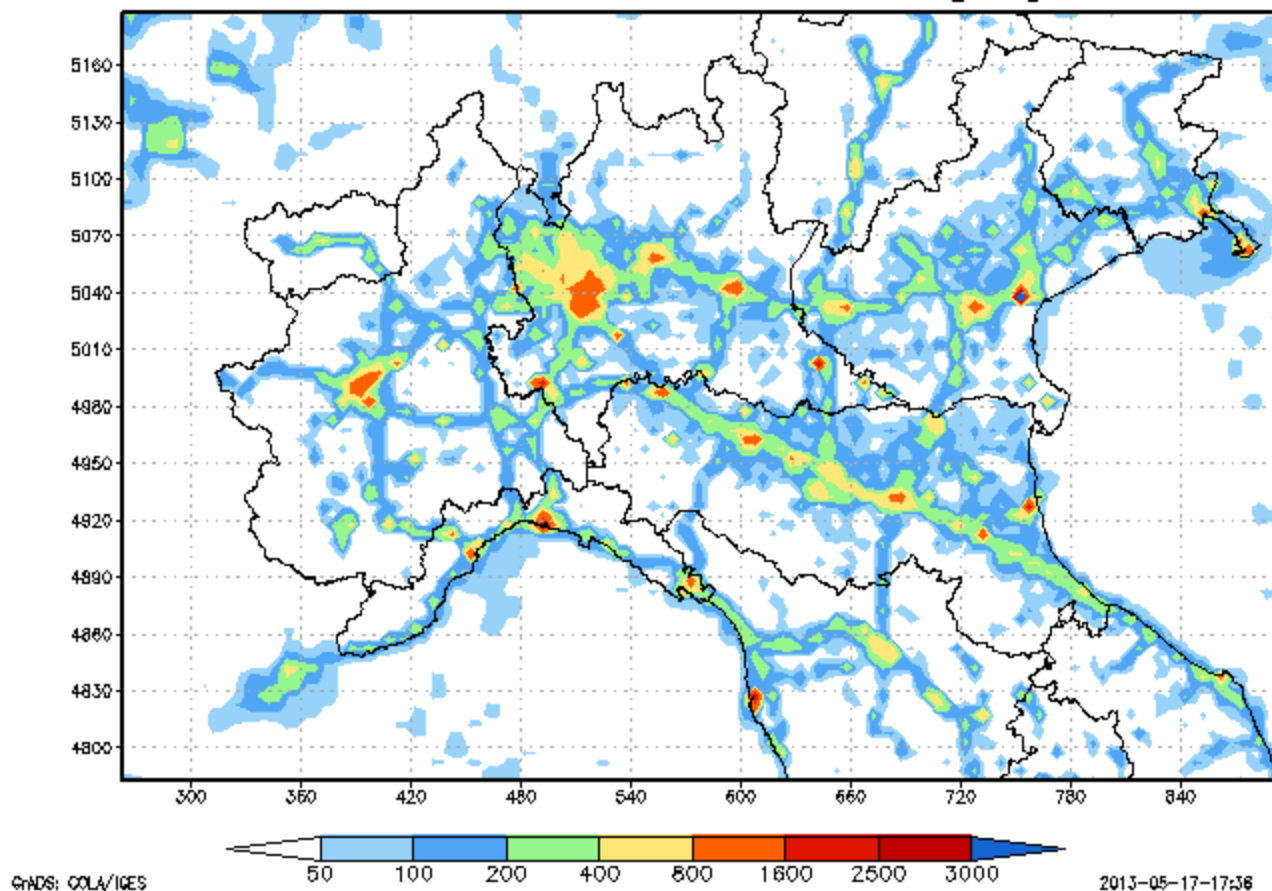


# Emissions (tons) ER vs BPA





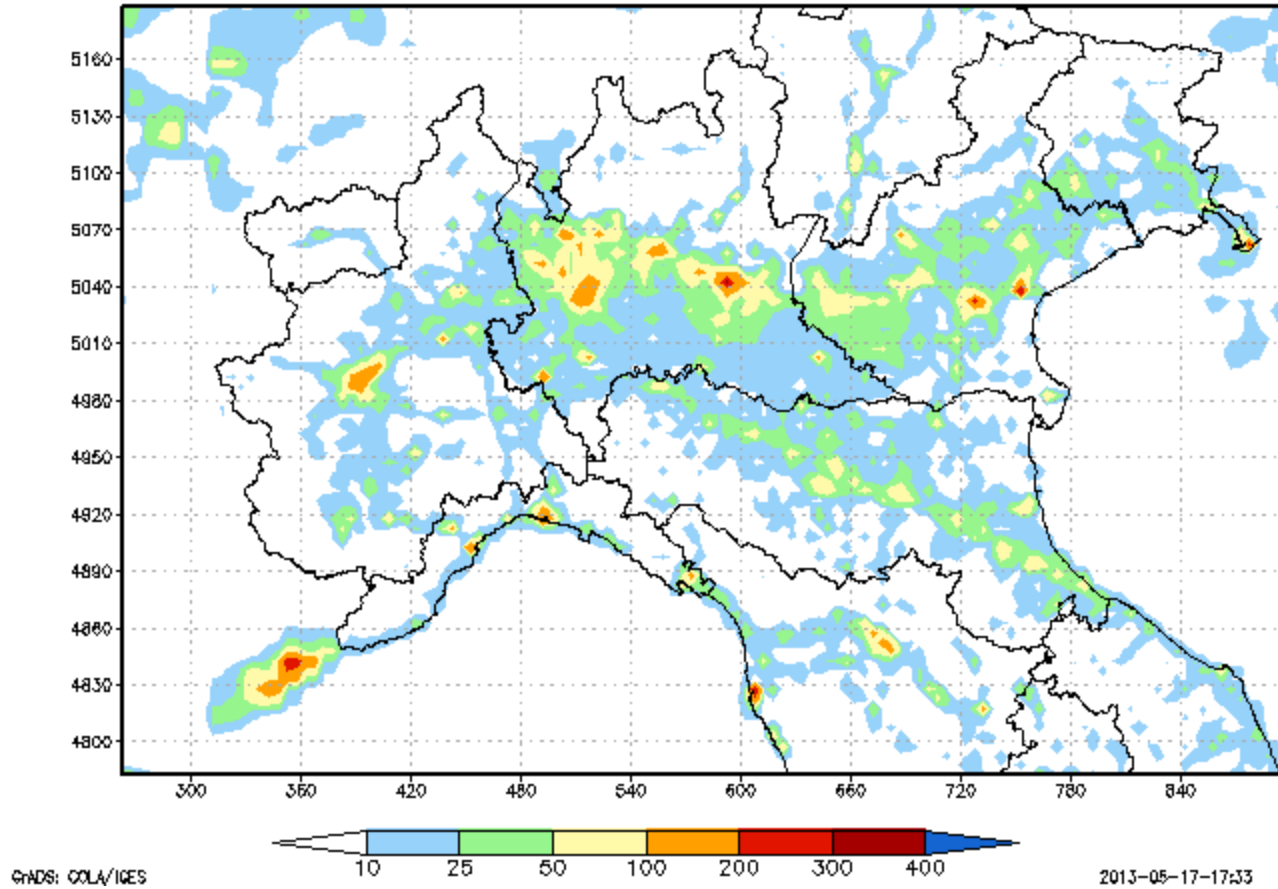
### Scenario 2010: Emissioni NOx [ton]





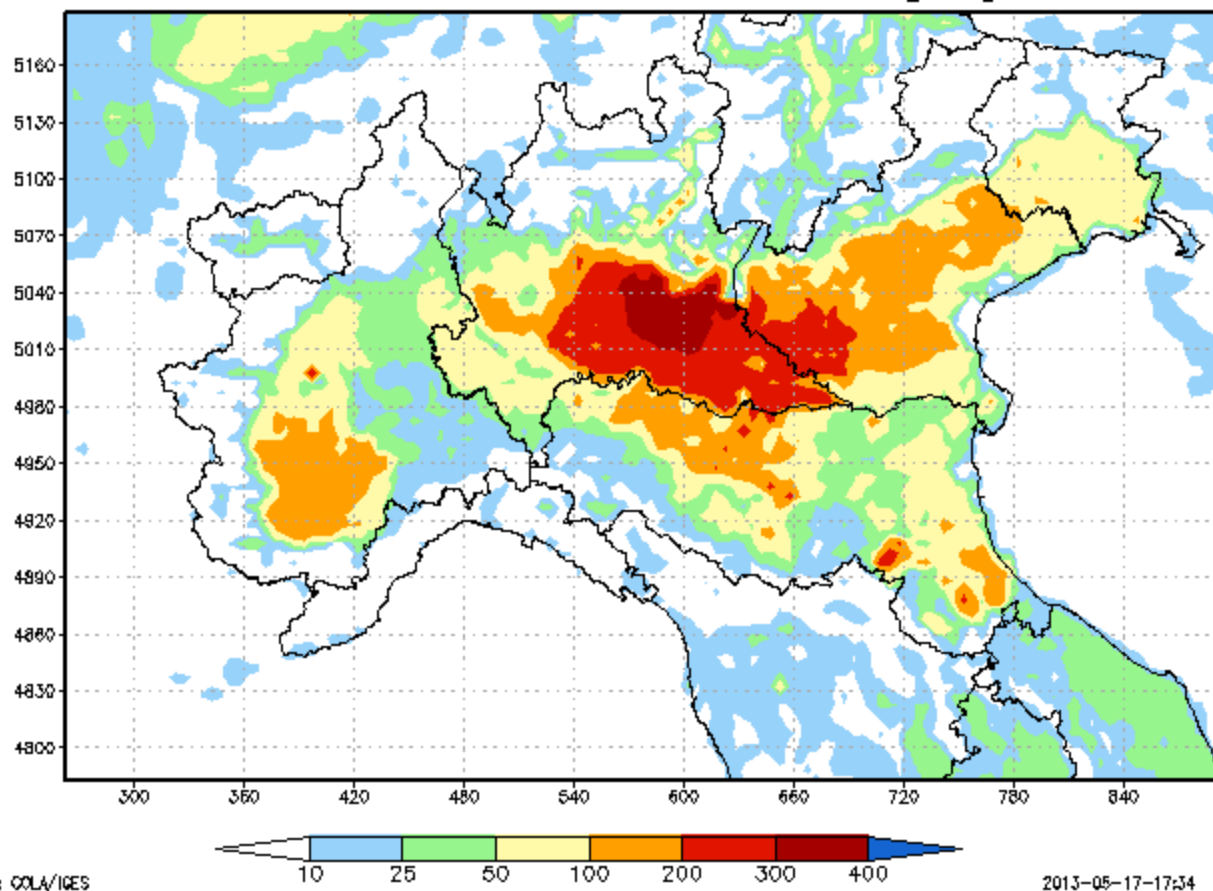


### Scenario 2010: Emissioni PM10 [ton]





### Scenario 2010: Emissioni NH<sub>3</sub> [ton]





# Conclusions

- ➔ The RIAT+ tool implemented on Emilia-Romagna provide a wide set of information and data that support the analysis of the pollution factors responsible for the exceedance and of the possible measures for the improvement of air quality:
  - costs – effectiveness analysis is used to set the emission reduction target for the AQ plan;
  - the action database help to define and evaluate the most effective actions;
  - the source-receptor model is used for a fast screening of the effects on air quality of the selected set of actions;
  - the emissions output help to prepare the input data for the detailed evaluation of the selected scenario by the CTM (NINFA)
- ➔ The results of the S-R model were validated and improved by a post processing tool for the unbiasing of the PM10 evaluation; costs need to be validated.