National and regional emissions projections in Europe: methodology, tools and case studies

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EU air quality directives

- in the last year new European Union (EU) air quality directives have been introduced
- the Directives requires Member States to divide their territory into *zones* related to air quality standards
- the directives requires Member States to adopt plan and programs inside zones when air quality standards are not respected

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EU NEC Directive

- **sets upper limits for each Member State for the total emissions in 2010 of four pollutants (sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia)**
- **a proposal to amend the NEC Directive is still under preparation and should set emission ceilings to be respected by 2020 for the four already regulated substances and for the primary emissions of $PM_{2.5}$ as well**

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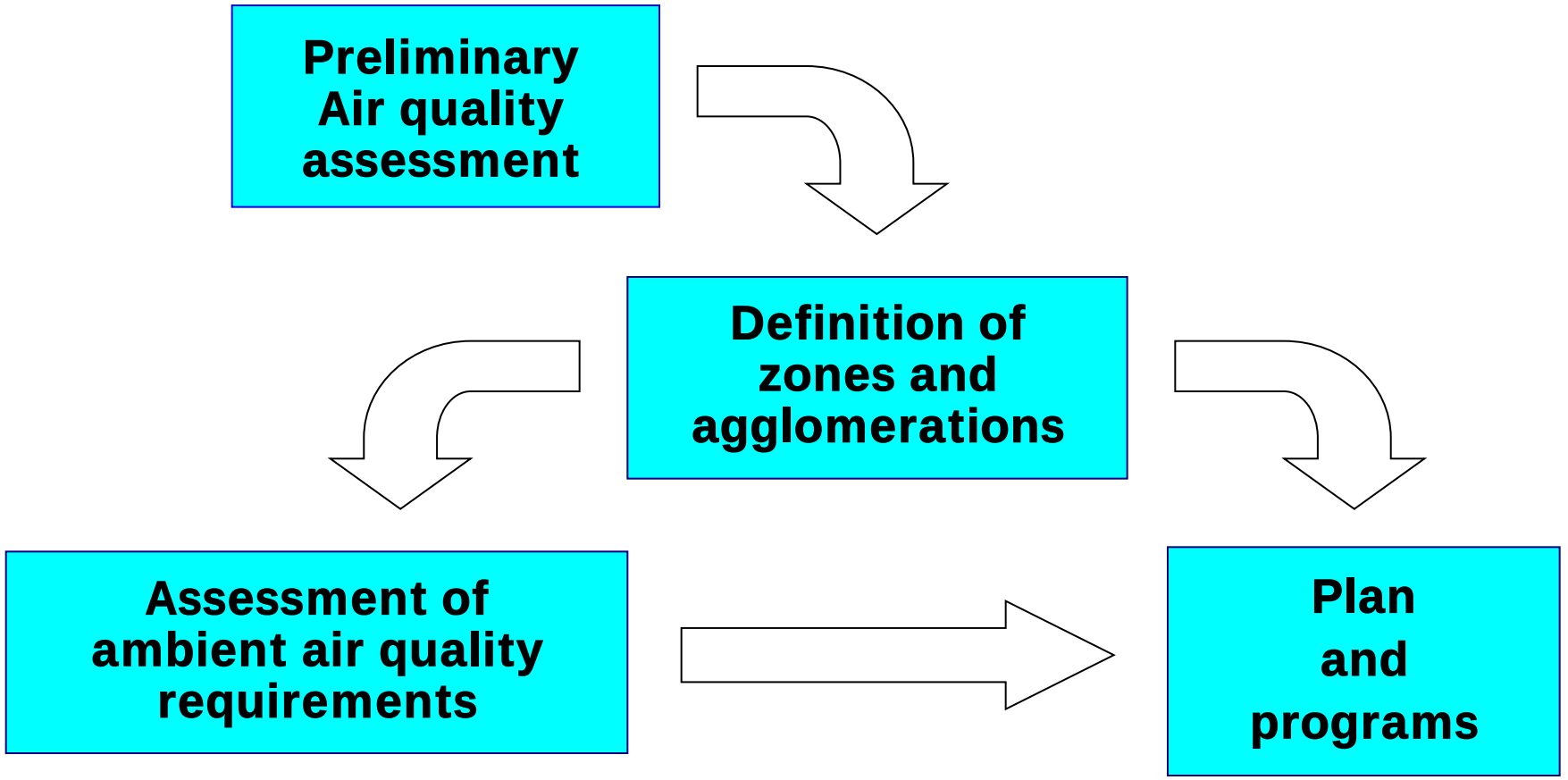
EU legislation procedure



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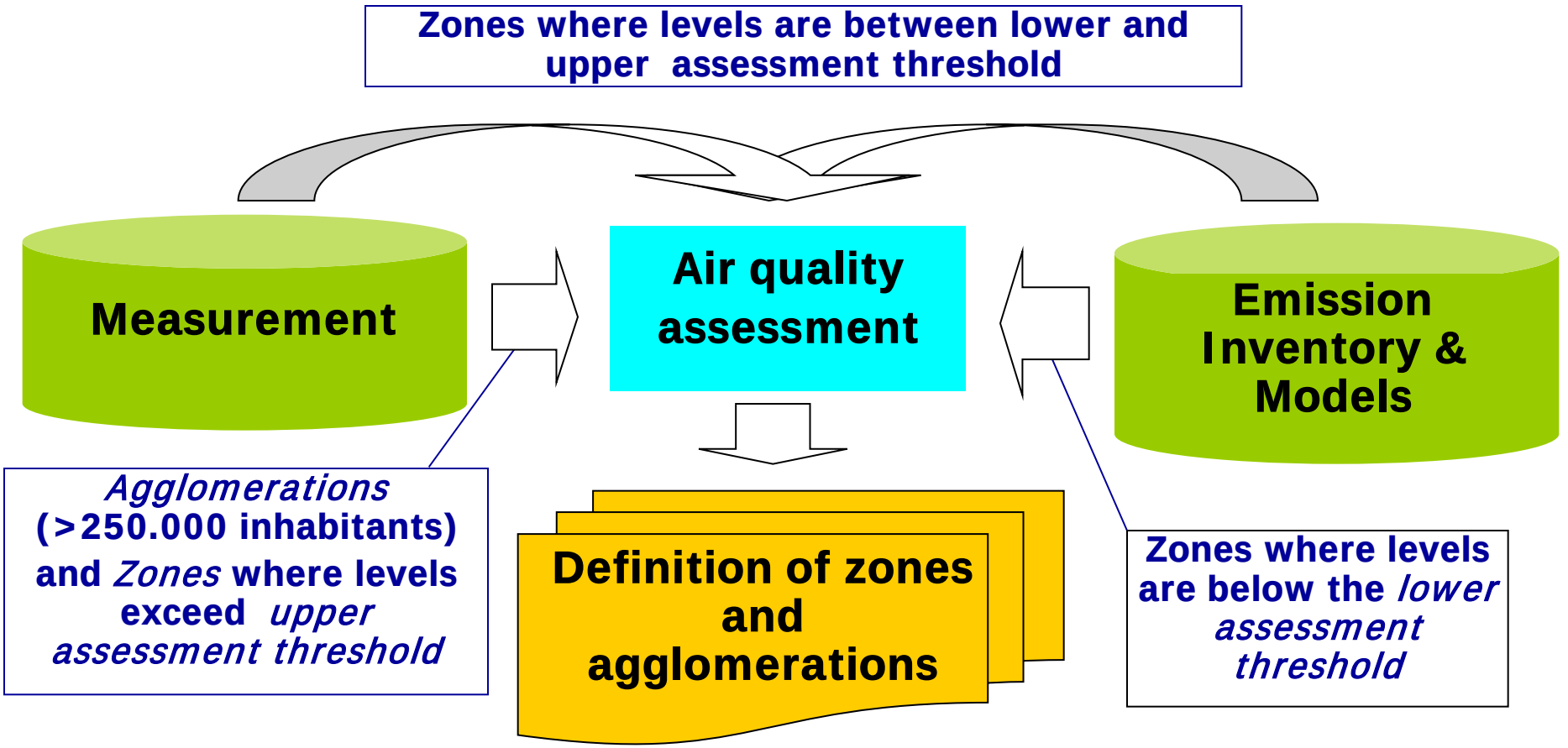
Assessment of ambient air quality



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Plan and programs

zones and agglomerations in which the levels of one or more pollutants are:

higher than the limit value

plan or programme

below the limit values

attaining the limit value within the specific time limit

- **maintain the levels of pollutants below the limit values**
- **preserve the best ambient air quality, compatible with sustainable development**

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Regional, National & EC planning

Measures at EC scale

National Plans

Local effects of measures at EC or national scale

Measures at national scale

Specific measures inside zones

Regional Plans

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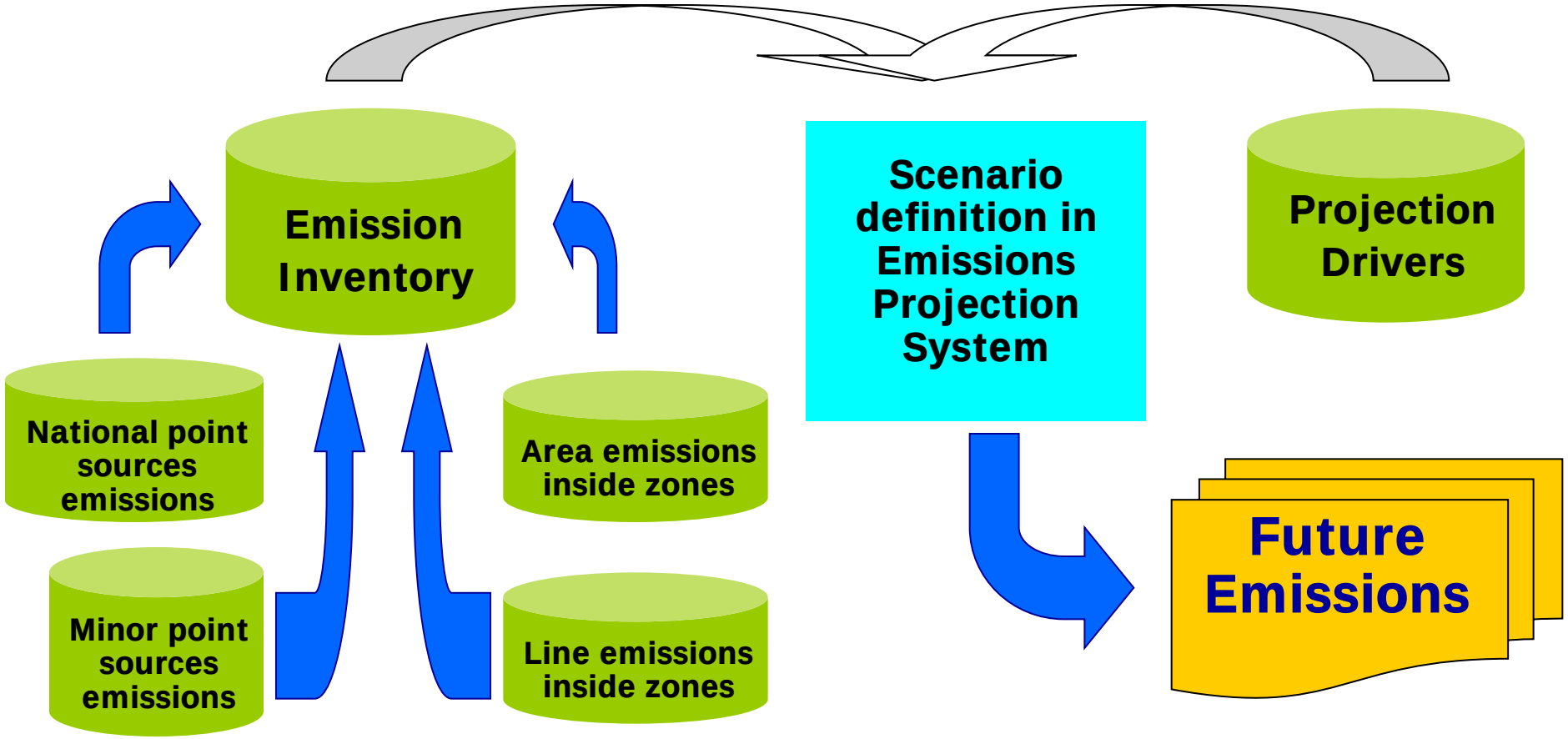
Emissions inventory and projections



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Emission inventory

- **SNAP classification of Activities**
- **main air pollutants (NO_x, SO_x, NMVOC, CO, PM_{10}, $PM_{2.5}$, NH_3), heavy metals, benzene, polycyclic aromatic hydrocarbons, other aromatics, dioxin, greenhouse gases (CO_2, CH_4, N_2O)**
- **Sources:**
  - **Point (stationary sources whose emissions exceed fixed thresholds, (i.e. NO_x 100 tons for national and 5 tons for local)**
  - **Line/nodal sources: the main roads, railways, and waterways, ports, airports, landfills, storage areas (totals for the national one by one in local one)**
  - **Area sources: all other sources (totals for national district level in local)**

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Emissions estimation

- stacks emissions from point sources are calculated using hourly gas flow, working hours and average concentration of pollutant
- Area and line emissions are estimated using data obtained by direct surveys, statistical information and knowledge of the sources and through the software *E²Gov Emissions*
- EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009, US EPA AP42 and 2006 IPCC Guidelines for National Greenhouse Gas Inventories were applied

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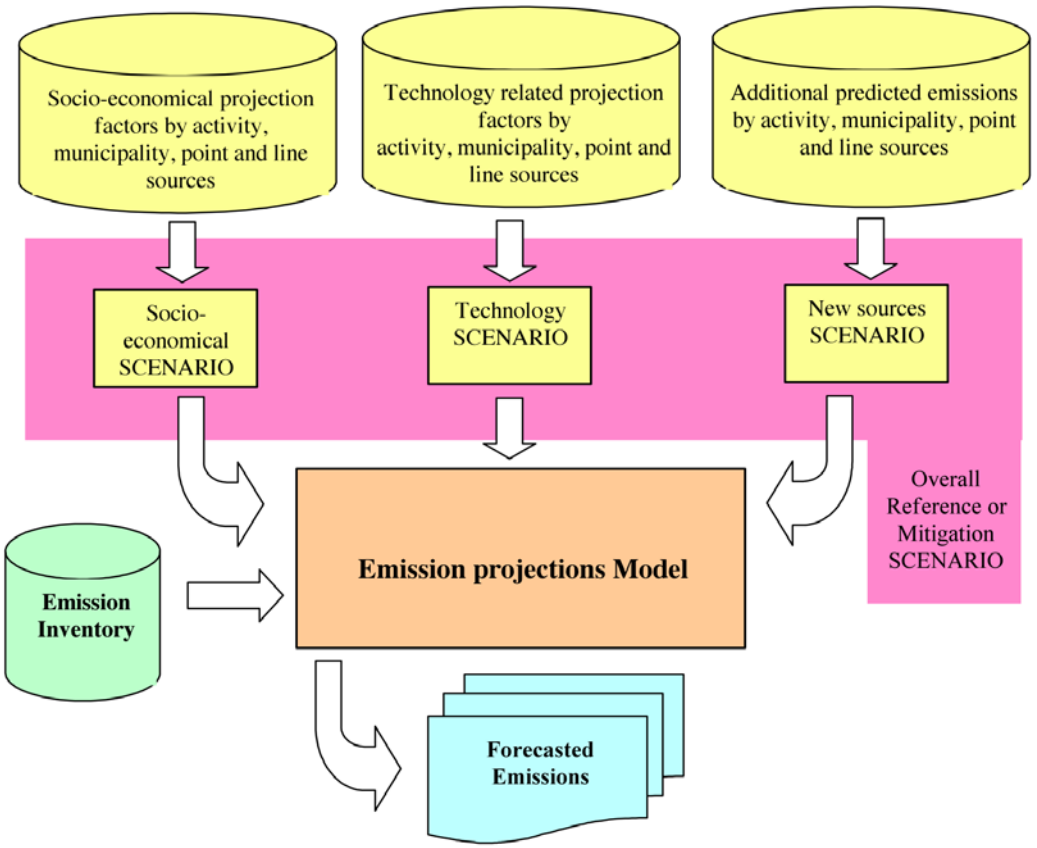
Emissions projections model



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Emissions projection formula

Emissions E_{ijkn} of pollutant j from at year k, in zone (or plant or line) n, for the activity i are evaluated as:

$$E_{ijkn} = E_{ij0} \cdot a_{ik} \cdot f_{ijk} \cdot a^{z}_{jkn} \cdot f^{z}_{ijkn} + E^{z}_{ijkn}$$

E_{ij0z} emissions at base year

a_{ik} driver for global activity indicators projection

f_{ijk} driver for global emission factors projection

a_{zjkn} driver for zone (or plant or line) activity indicators projection

f_{zijkn} driver for zone (or plant or line) emission factors projection

E_{zijkn} additional emissions for new absolute contribution (new activities in some zones, new plants or lines)

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Projection drivers: activity

$$a_{ik} = V_{ik} / V_{i0}$$

V_{i0} (V_{ik}) activity levels at base (at future) year

examples:

- **population, gross domestic product**
- **agricultural production, waste production**
- **number of road vehicles, number of takeoff/landing**
- **tons of freight transported by road and sea**
- **specific reduction of miles in zone by traffic limitation**
- **specific reduction of miles in zone by fuel limitation**
- **specific modification of single Point and Line sources activities**

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Projection drivers: technology (EFs)

$$f_{ijk} = V_{ijk} / V_{ij0}$$

V_{ij0} (V_{ijk}) parameters which affect emission at base year (at future year)

examples:

- sulphur content of fuels
- new regulation limits on emissions from point sources and mobile sources
- solvent content of products (paints, inks, glues, etc.)
- application of Best Available Technologies/Practices – BATs/BAPs at regional or single sources level

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Scenarios definition

- **activity scenarios** defined associating to selected activities, specific activity drivers at regional, zone, line and units of point source level
- **technology scenarios** defined associating to selected activities and pollutants, specific technology drivers at regional, zone, line and units of point source level
- **emissions scenarios** obtained as combination of activity, technology and point sources scenarios

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BAU and plan scenario

- Reference or Business as Usual (BAU) Scenario will consider socio-economical and technology trends and all already planned and approved measures
- Plan scenario will include all proposed measures for air quality improvement, often counterbalancing Reference BAU Scenario trends that will produce an emission raise
- the forecasted emissions can then be used also as an input to computer-based dispersion models in order to find out direct impact of the measures on air quality

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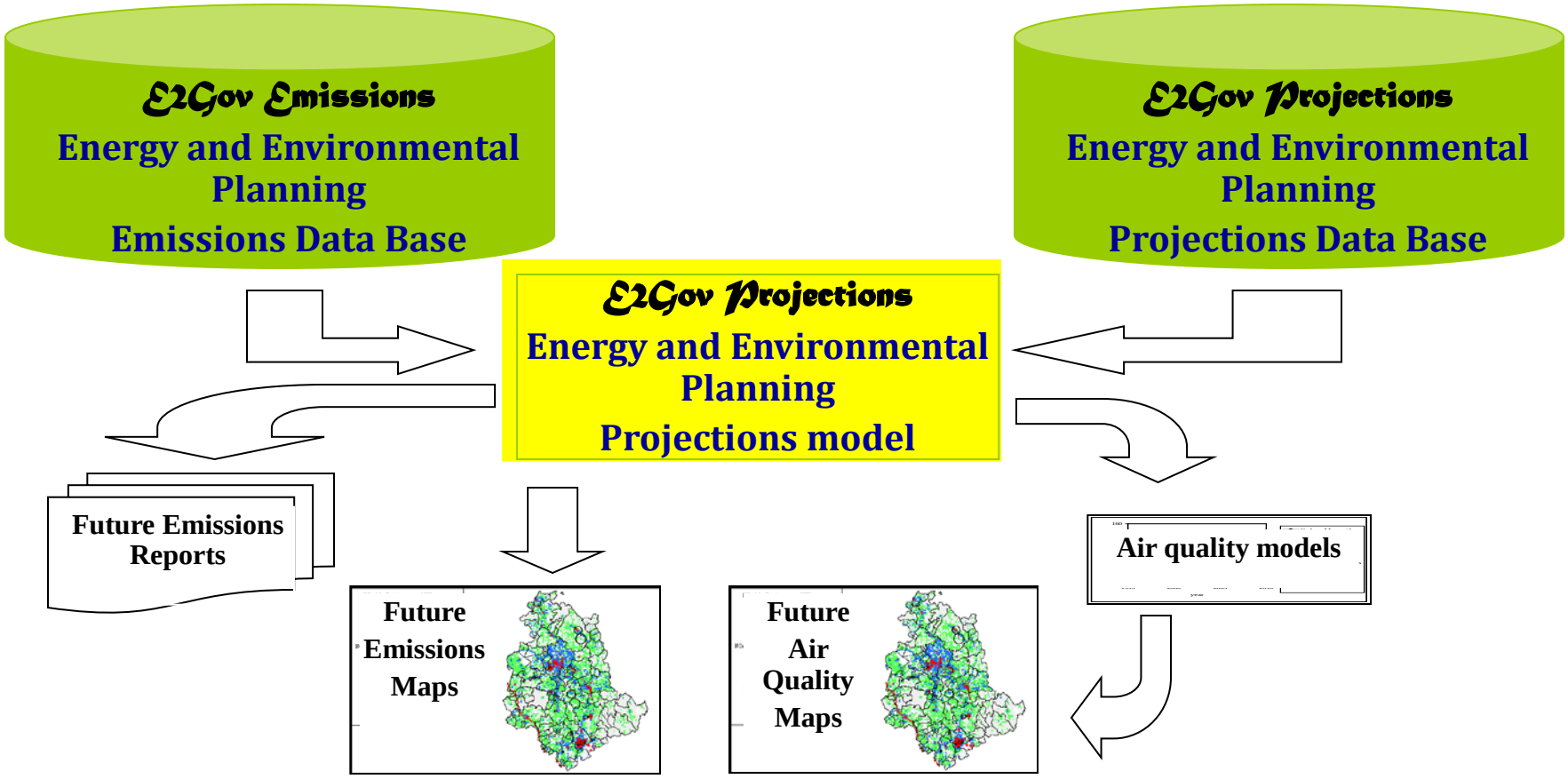
E²Gov Projections model



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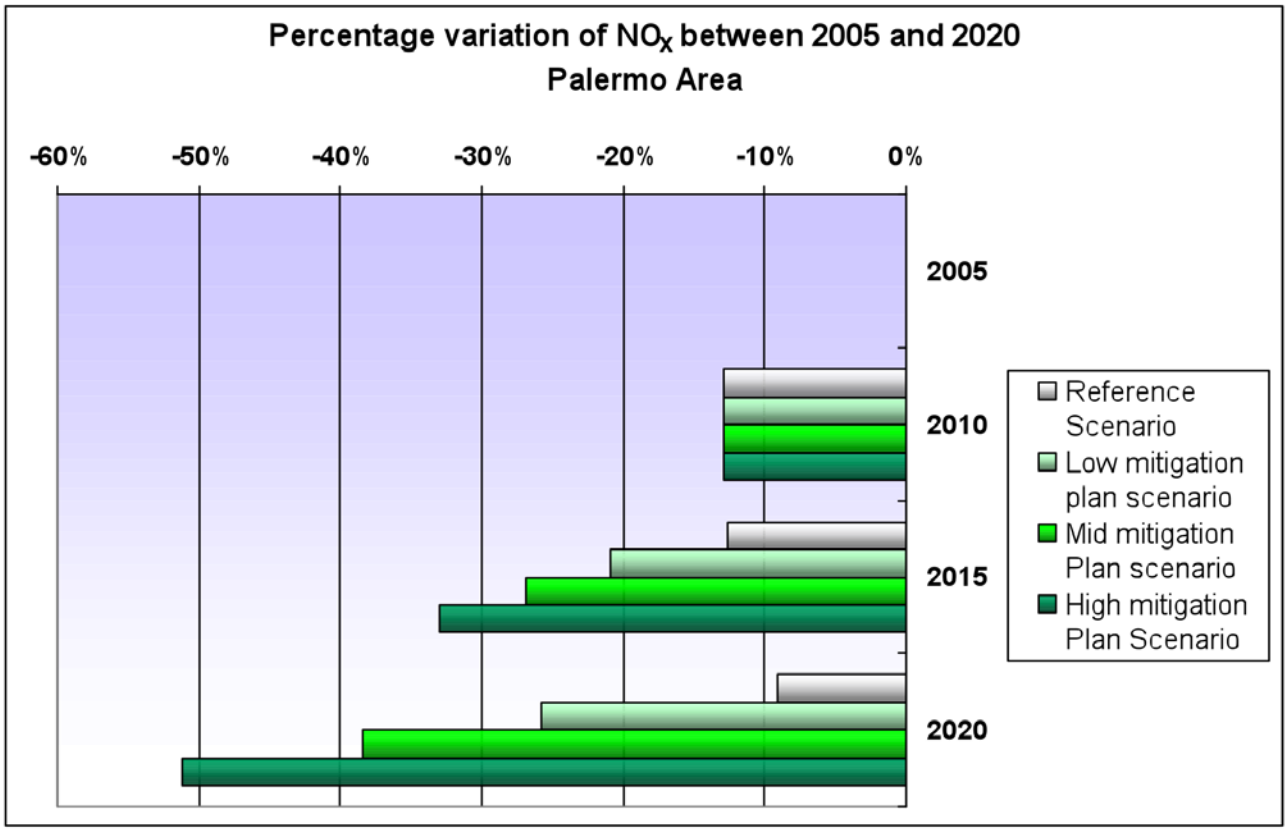
Regional case studies in Italy (1)



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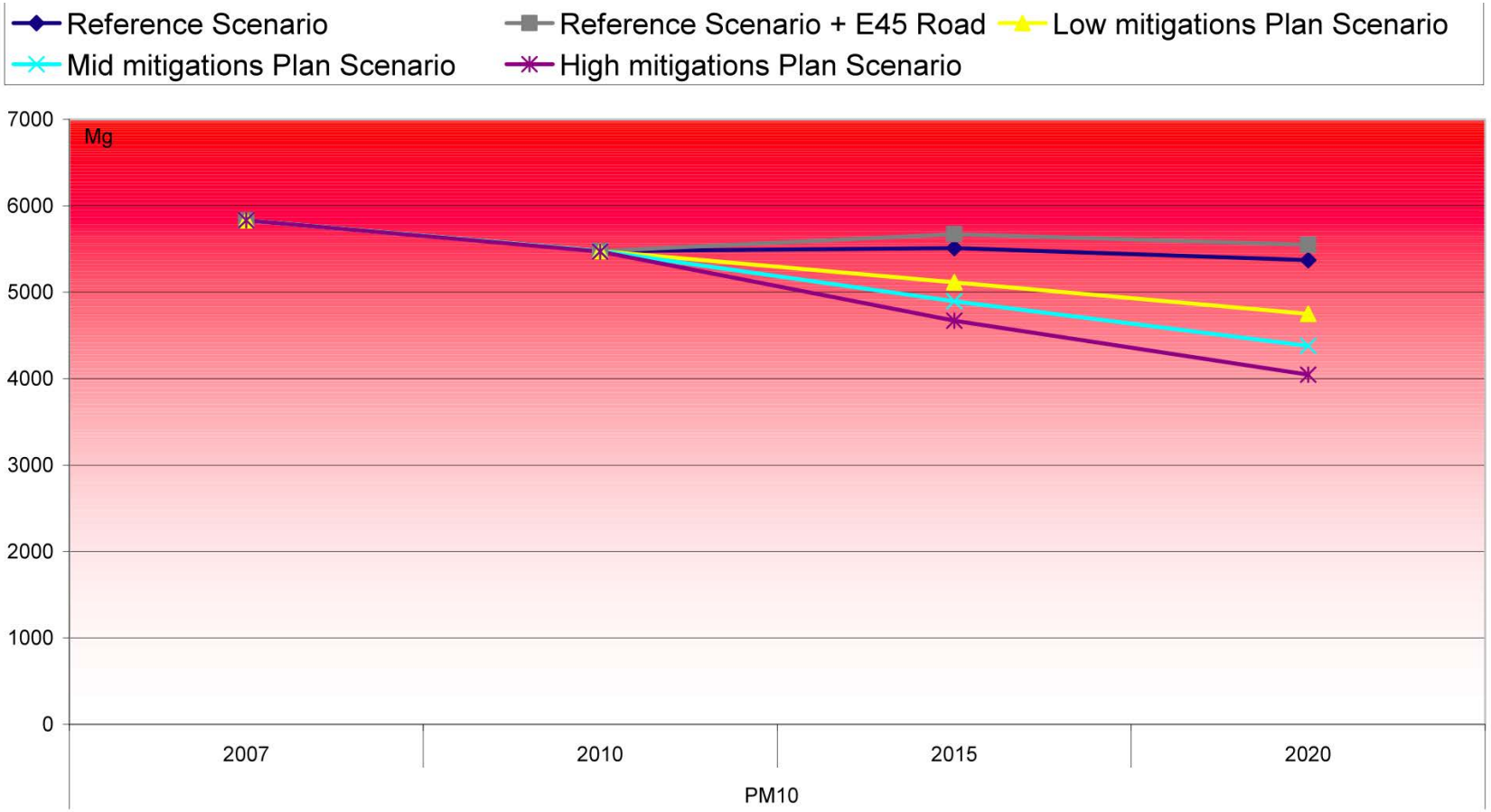
Regional case studies in Italy (2)



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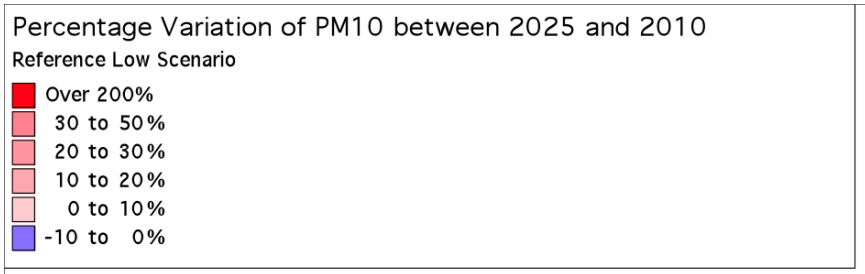

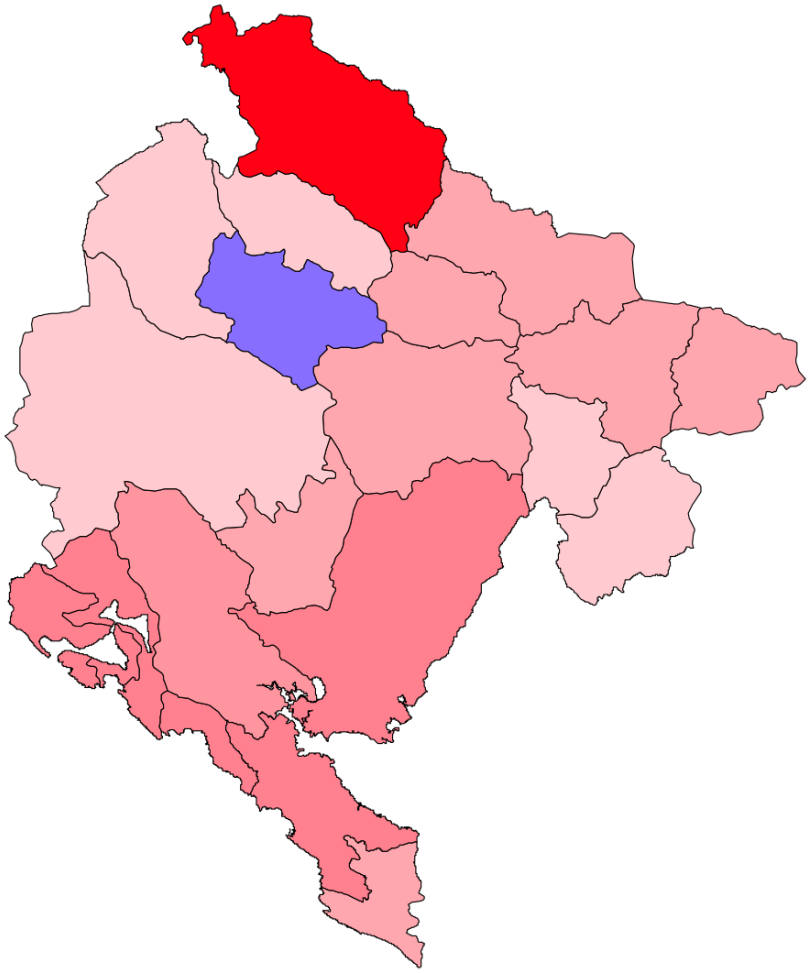

National case study (Montenegro)

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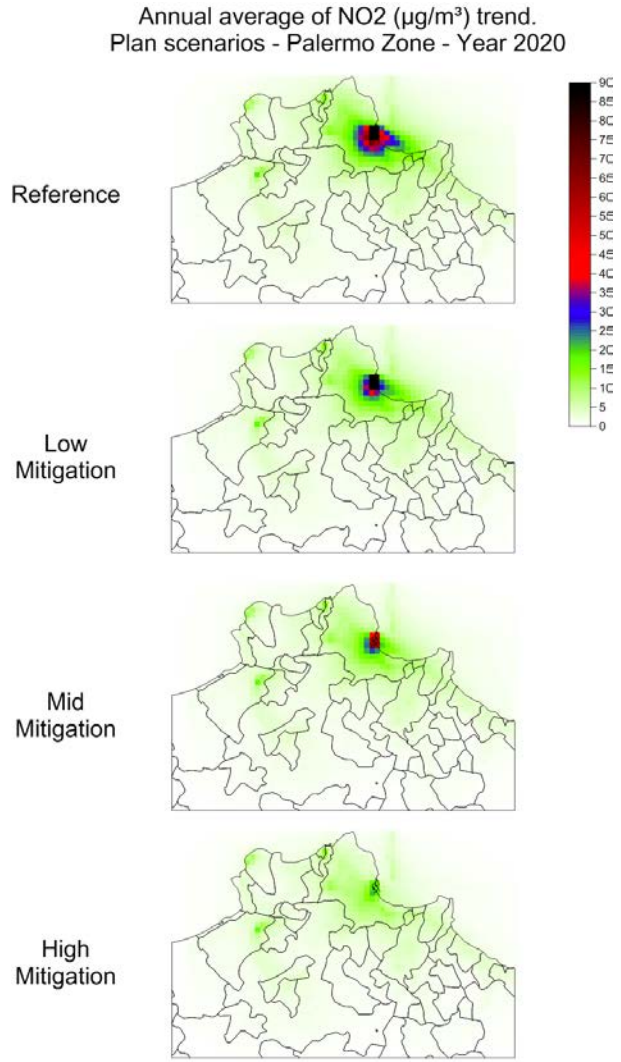

Use of emissions projections in air quality models

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Conclusion

- Additional methodologies and tools are introduced to obtain emissions projection in different scenarios
- *E²Gov Projection* model is a complete tool for this kind of issue
- Application of the model in the last years in Europe made possible national and local planning that improved the overall air quality

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