



**20th Joint EIONET & UNECE
Task Force on Emission Inventories & Projections Meeting
Thessaloniki, 13th-15th May 2019**

**Tools, method and case studies in
emissions projections for
regional and local air quality plans**

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Carlo Trozzi – Tools, method and case studies in emissions projections for regional and local air quality plans

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Topics

- **National vs Regional & City Projections**
- **National Scenario definitions (GB)**
- **Regional Air quality planning**
- **E2Plan - Tool for regional/local AQP & CF**
- **Emissions projections methodology**
- **Regional Air Quality Plan case study**
- **ClairCity H2020 project city-level projections**
- **Conclusion**

National vs Regional & City Projections



➤ *National projections*

Used to assess progress towards targets (as for UNFCCC Paris Agreement and EU NECD Directive 2016/2284) and as an input to global and continental air quality models

➤ *Regional projections*

Used as an input to air quality models to evaluate future compliance of zone and agglomerate air quality standard (as for Directive 2008/50/EC); ➡ include national

➤ *City level projections*

Used as an input to air quality models to evaluate future hot spots compliance of air quality (as for Air Quality Directive 2008/50/EC; ➡ include national & regional

National Scenario definitions (GB)

➤ ***Without measures (WOM) or (BAU)***

excludes all policies and measures implemented, adopted or planned after the year chosen as the starting point for this projection (*Para 26 - UNFCCC, 2016*)

➤ ***With existing measures (WEM)***

encompass currently implemented and adopted policies and measures (*Para 26 - UNFCCC, 2016*)

➤ ***With additional measures (WAM)***

encompass planned policies and measures* (*Para 26 - UNFCCC, 2016*); where:

* options under discussion and having a realistic chance of being adopted and implemented in future (*Para 11, UNFCCC, 2016*)

National Projections Methodology

National projected emissions for a selected **pollutant** (j) in a future **year** (k) related to a specific **activity&fuel &technology** (i) are estimated starting from the base year (0) emissions and using specific **projections factors** (drivers) of **activity** level (a_{ik}) due to activity measures m and specific drivers for **emission factors** (f_{ijk}) due to emissions technology measures n:

$$E_{ijk} = E_{ij0} \prod_m \prod_n a_{ikm} f_{ijkn}$$

(notation is equivalent to GB formulae)

The formula take into account:

- average national variations in activity levels (for example energy saving and/or fuel ban and/or fuels switch in domestic sector)
- average national variations in emission factors (for example new euro standard and/or exhaust filter control)

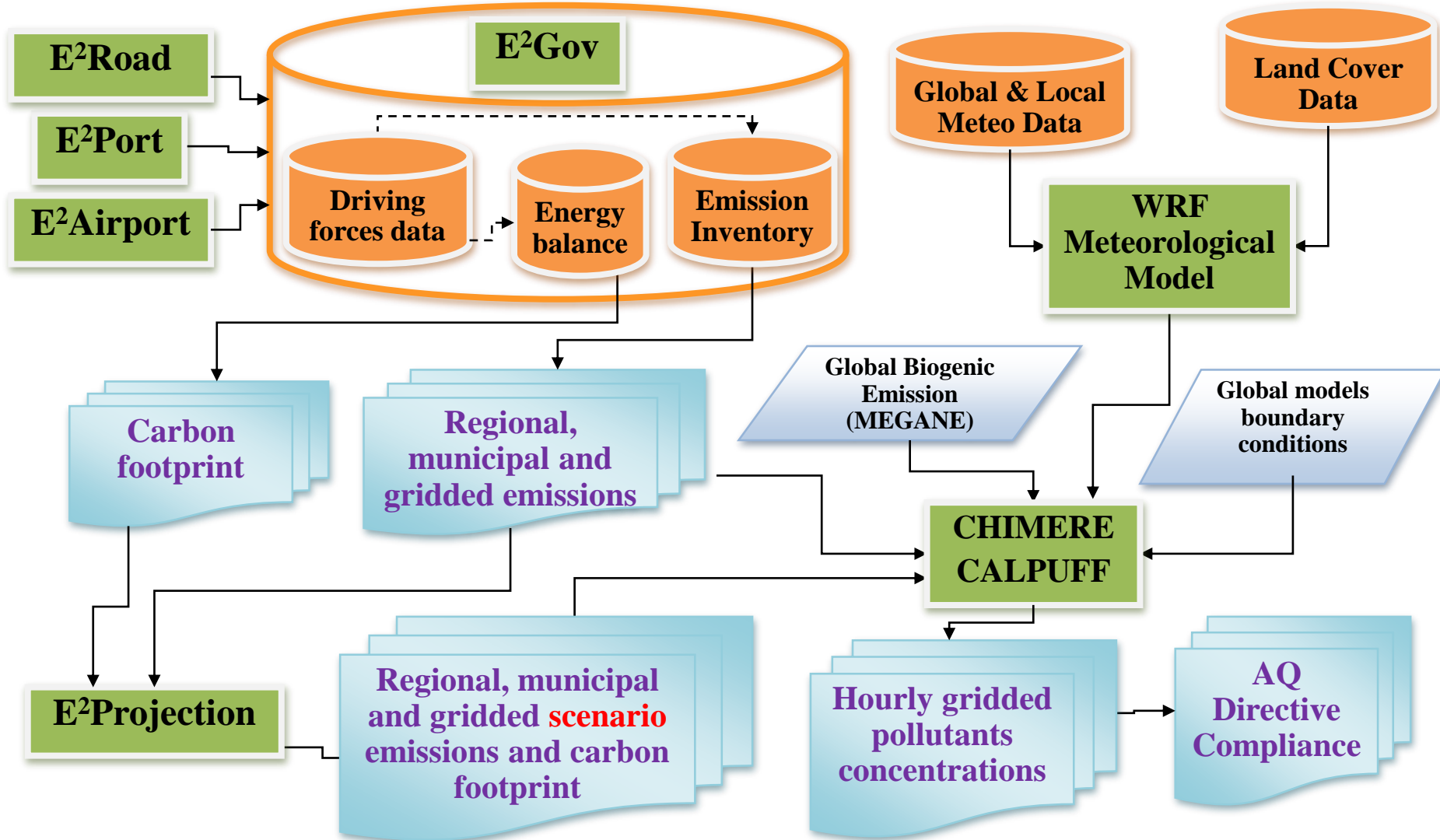
EU air quality directives

- in the last years European Union **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**
- **Italy** legislation **delegates** air quality planning activities to the **regions**

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E²Plan - Tool for regional/local AQP & CF



Regional and local emissions inventories

- **Sources:**
 - **Structure**, sources that is possible and useful geolocate and evaluated by direct census and emission factors:
 - **Point** - stationary sources whose emissions exceed fixed thresholds (i.e. 5 tons/year of NO_x or PM₁₀, SO_x, NMVOC)
 - **Line** - the main roads, railways, seaways, canalways
 - **Area** - the main ports, airports, landfills, storage areas
 - **Diffuse (statistic)** sources not included in the previous classes estimated at municipal or sub-municipal level by statistical or direct census data and emission factors
- This level of detail is necessary to evaluate the effect of specific measures on air quality at a local dimension and to define air quality management plans with specific source oriented and spatially oriented measures

Regional/local scenarios definition

- **activity scenarios** defined associating to selected activities, specific activity drivers at national, regional, zone, line, area and units of point source level
- **technology scenarios** defined associating to selected activities and pollutants, specific technology drivers at national, regional, zone, line, area and units of point source level
- **new sources scenarios** defined introducing new specific source (new plant, new road, ...) or source category (for example new fuel)
- **emissions scenarios** obtained as combination of activity, technology and new sources scenarios

Regional/local Projections: diffuse sources

Projected emissions for a selected pollutant (j) in a future year (k) and in a single territorial unit (e. g. LSOA, Buurt, municipality, ...) (u) related to a specific activity&fuel&technology (i) are estimated starting from the base year (0) emissions and using specific projections factors (drivers) of activity level (a_{ikum}) due to activity measures m and specific drivers for emission factors (f_{ijkun}) due to emissions technology measures n:

$$E^d_{ijuk} = E^d_{iju0} \Pi_m \Pi_n a_{ikm} f_{ijkn} a^d_{iukm} f^d_{ijkun}$$

The formula take into account:

- activities measures at national, regional and local (for example “gas free” or “wood ban” or “diesel ban” or “car ban”) level;
- measures about emission factors at national, regional and local (for example “Pre-Euro 4 car ban” in main urban areas)

Regional/local Projections: structures

Projected emissions for a selected pollutant (j) in a future year (k) and for a single structure (e. g. plant, road, port, ...) (p) related to a specific activity & fuel & technology (i) are estimated starting from the base year (0) emissions and using specific projections factors (drivers) of activity level ($a_{i(p)km}$) due to activity measures m and specific drivers for emission factors ($f_{ij(p)kn}$) due to emissions technology measures n:

$$E^p_{ijpk} = E^p_{ijp0} \prod_m \prod_n a_{ikm} f_{ijkn} a^p_{ipkm} f^p_{ijpkn} + E^p_{ijkp}$$

The formula take into account:

- specific regional and local measures about activities (for example “gas free” or “wood ban” or “diesel ban” or “car ban” and about emission factors (for example “Pre-Euro 4 car ban”

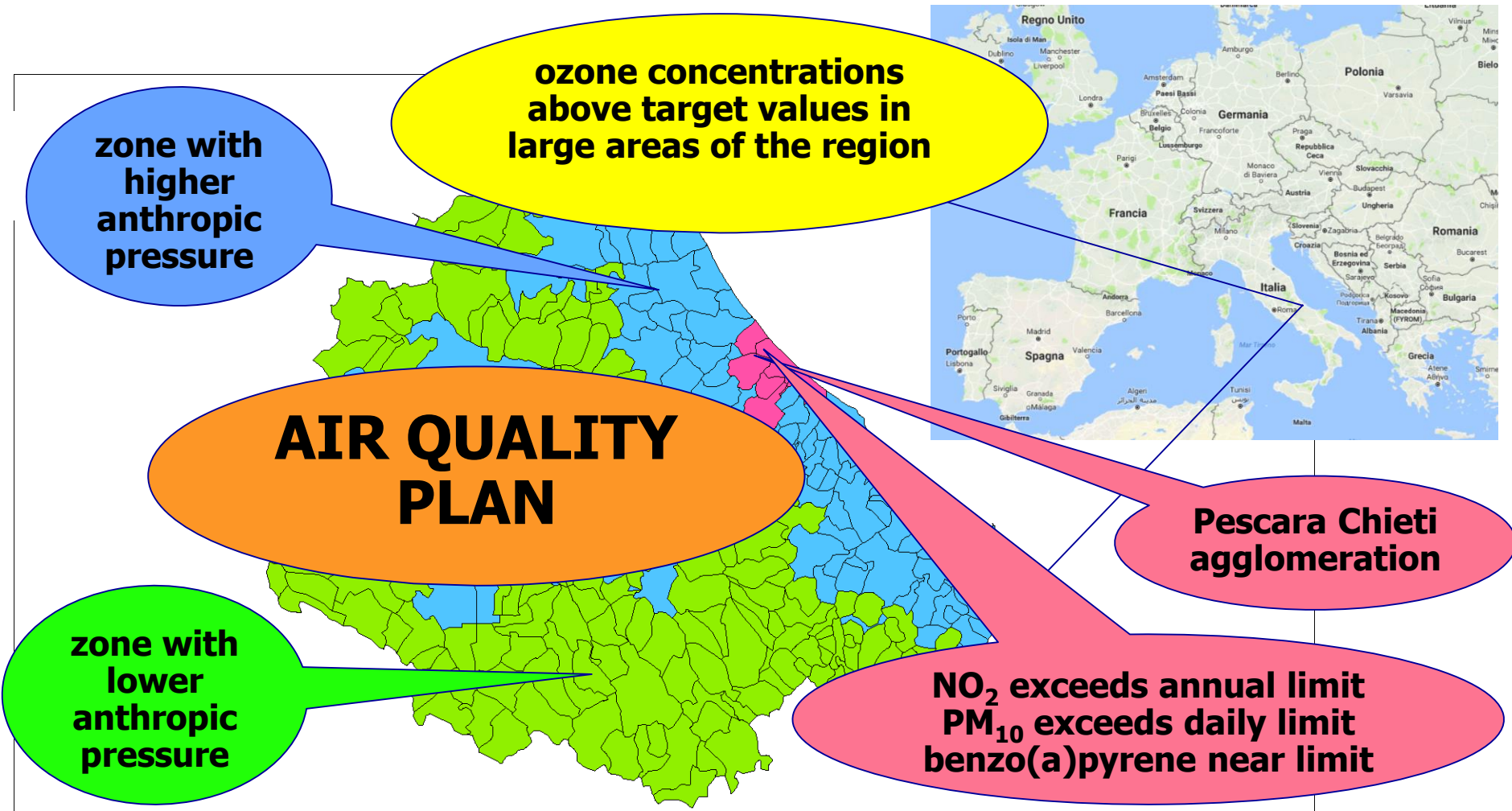
Scenario definition in regional/local plan

- **Baseline:** the current situation (i.e. 2016 data);
- **WEM:** future situation without any policy actions beyond what is already decided including:
 - **national** measures defined in the 'with measures' (adopted measures) NECD or energy/GHG strategies projection;
 - **regional** measures adopted in regional air quality plans;
 - all the other measures already adopted at **city level** by local planning actions;
- **Plan Scenarios:** added policy interventions to the WEM, same time horizon; including:
 - **national or regional** planned measures in the 'with additional measures' in NECD or regional plans, where available;
 - all the other planned measures defined at **city level** by local planning actions or during the project
 - eventual "**hot spot**" measures (single plant, road, port)

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Abruzzo Region air quality planning case study



Abruzzo Region Air quality Management planning activities

- **multiyear emission inventory (by source for main sources and at municipal and 1km x 1km scale for other sources)**
- **specific road traffic, airport, port, vegetation emissions models**
- **emission projection model implemented with inventory base year and projections at 5, 10, 15 years in different scenario**
- **air quality models applications (CHIMERE & CALPUFF) in different scenario**

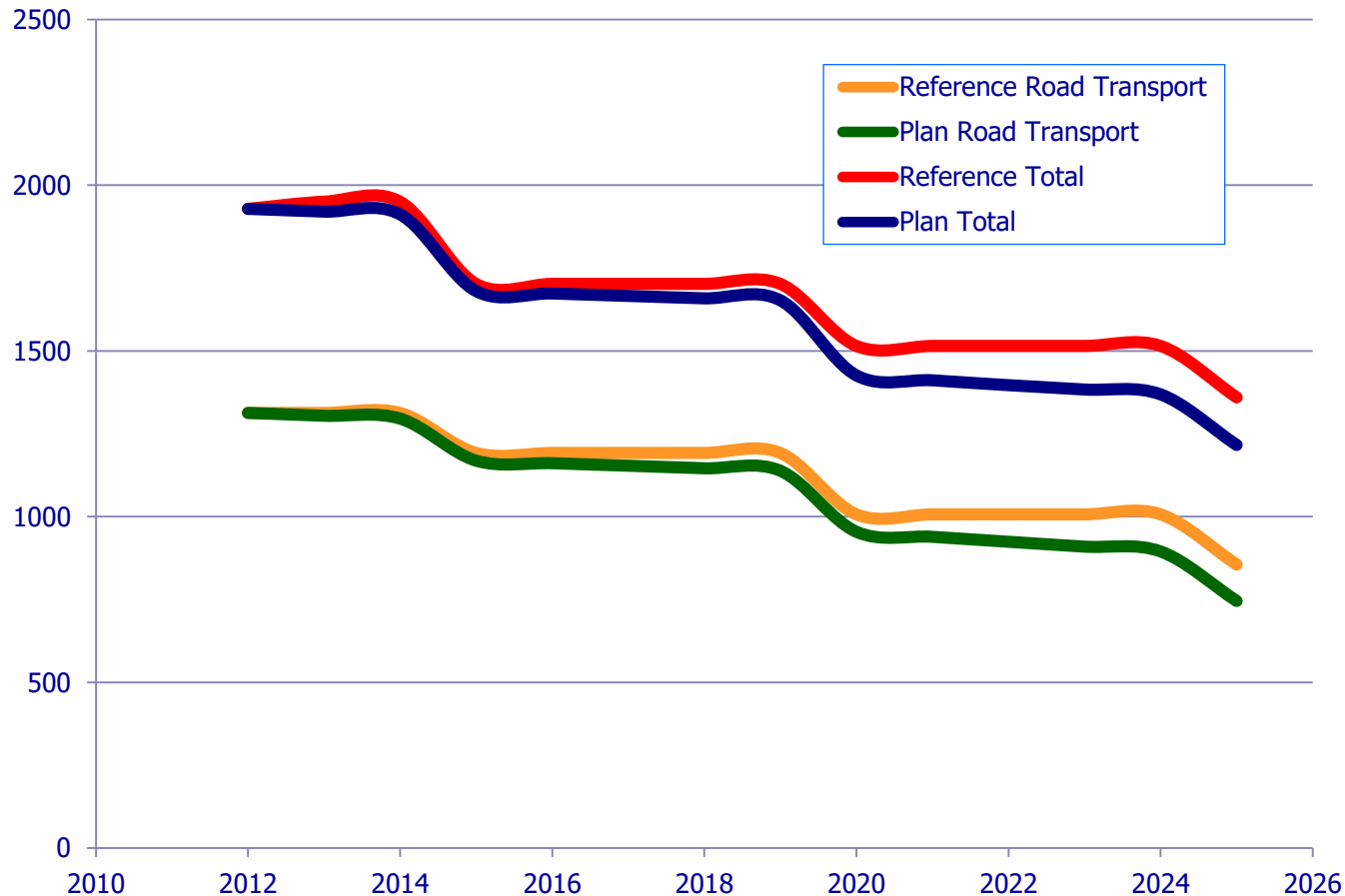
BAU and plan scenario

- **Reference or Business as Usual (BAU) Scenario has considered socio-economical and technology trends and all already planned and approved measures**
- **Plan scenario include general national and regional measures and the following specific measures for the agglomeration Pescara – Chieti :**
 - **Reduction of urban and suburban traffic (-4% by 2020 and 10% by 2025)**
 - **Support for replacing existing stoves and fireplaces with advanced stoves and fireplaces or pellet stoves (target of 10% of installations replaced by 2025)**
 - **Reduction of the emissions of nitrogen oxides of selected industrial combustion plants in the area**

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NO_x agglomerate scenarios emissions (Mg)



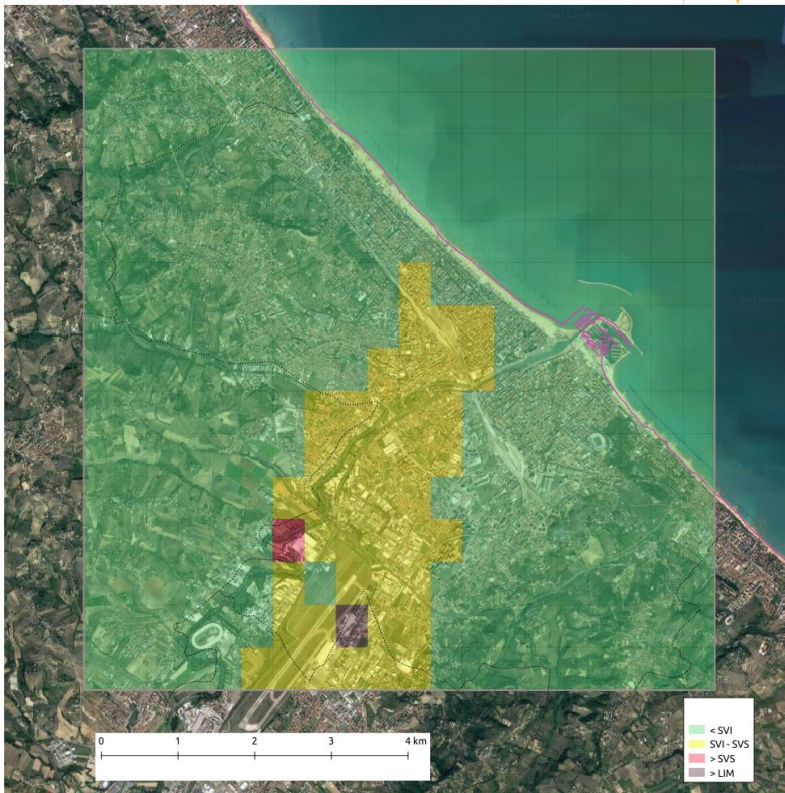
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Future air quality modeling results

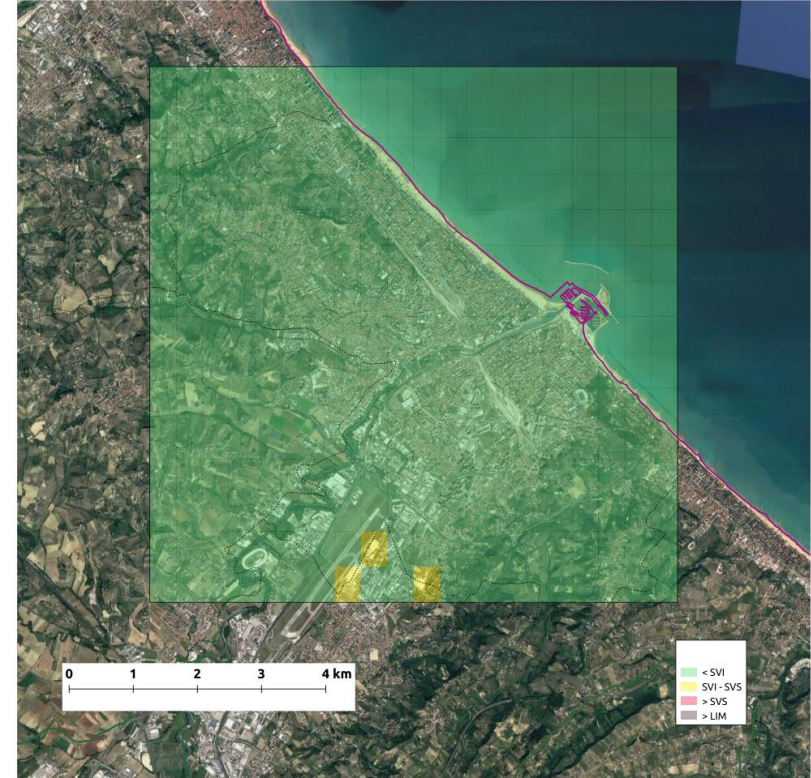
BAU scenario 2025

NO₂ Annual mean ($\mu\text{g}/\text{m}^3$)



Plan scenario 2025

NO₂ Annual mean ($\mu\text{g}/\text{m}^3$)



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ClairCity Horizon 2020 Ongoing Project



- **ClairCity is aimed at creating a major shift in public understanding towards the causes of poor air quality, inviting citizens to give their opinions on air pollution and carbon reduction to shape the cities of the future**
- **ClairCity will apportion air pollution emissions and concentrations, carbon footprints and health outcomes by city citizens' behaviour and day-to-day activities in order to make these challenges relevant to how people chose to live, behave and interact within their city environment**
- **ClairCity uses six pilot cities/regions: Amsterdam, Aveiro, Bristol, Genoa, Ljublijana, Sosnowiec**

Amsterdam Claircity case study spatial domain and LSOA subdivision



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Amsterdam industrial, residential and commercial (IRC) sector BAU scenario

Amsterdam: Socio-economic drivers used to project emissions in industrial, residential and commercial sector

Code	Name	Domain
AMS_BAS_CFF	Amsterdam 7NC WAM: Commercial - Fossil fuels	All Buurts
AMS_BAS_RFF	Amsterdam 7NC WAM: Residential - Fossil fuels	All MSOAs
AMS_BAU_CFF	Amsterdam NEC: Residential & Commercial - Fossil fuels	All MSOAs
AMS_HOUSE	Amsterdam Private Households Growth	All MSOAs

Amsterdam: Technological drivers used to project emissions in industrial, residential and commercial sector

Code	Name	Domain
AMS_NEC_B_PM	AMS NEC Building PM	All Buurts
AMS_NEC_I_PM	AMS NEC Industry PM	All Buurts
AMS_NEC_I_NOx	AMS NEC Industry NOx	All Buurts
AMS_NEC_B_NOx	AMS NEC Building NOx	All Buurts

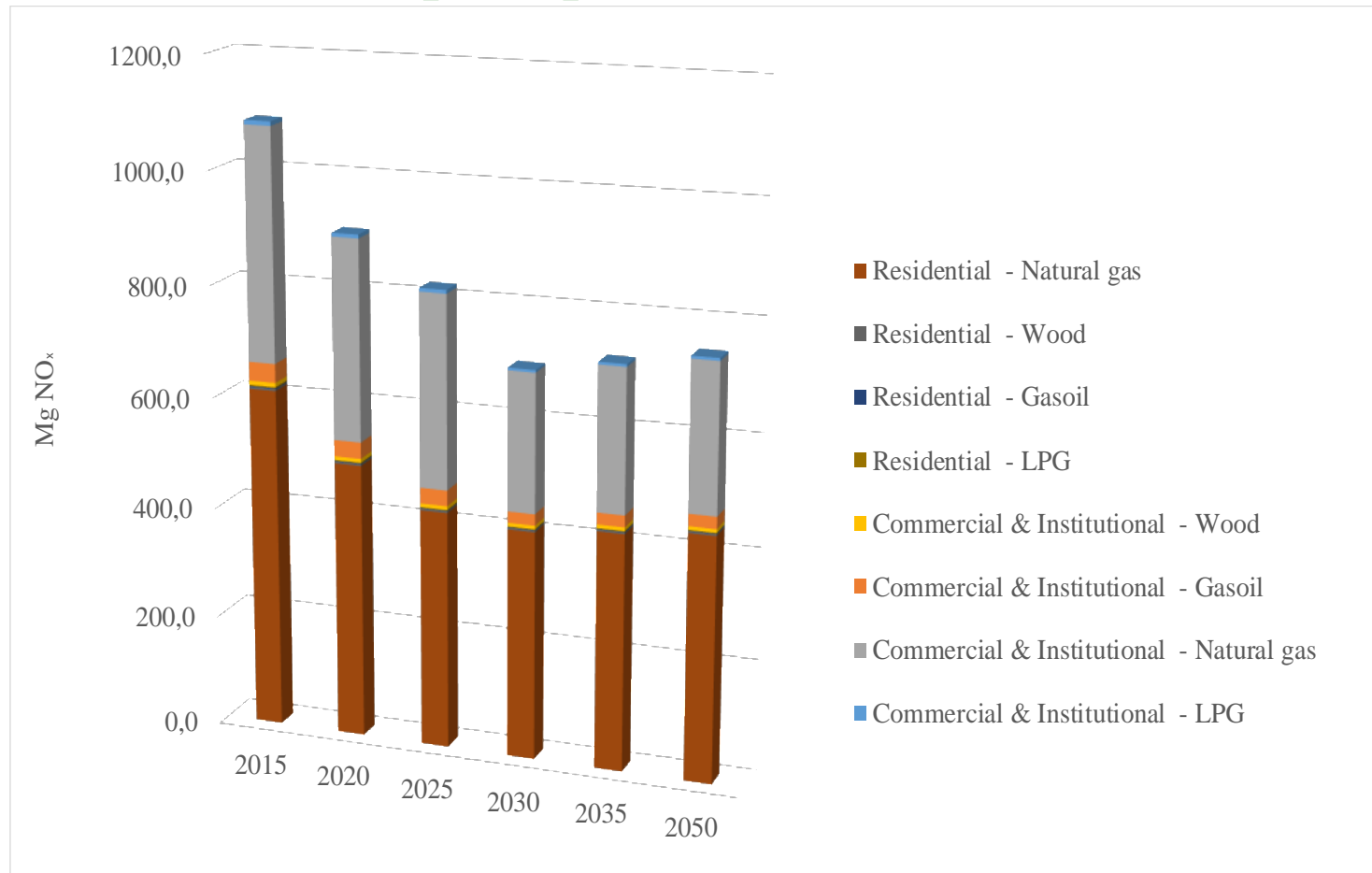
Amsterdam: point sources drivers used to project emissions for point sources

Code	Name	Domain
AMS_Coal	AMS Coal ban	Nuon Hemweg Coal unit

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Amsterdam residential and commercial (RC) sector BAU scenario



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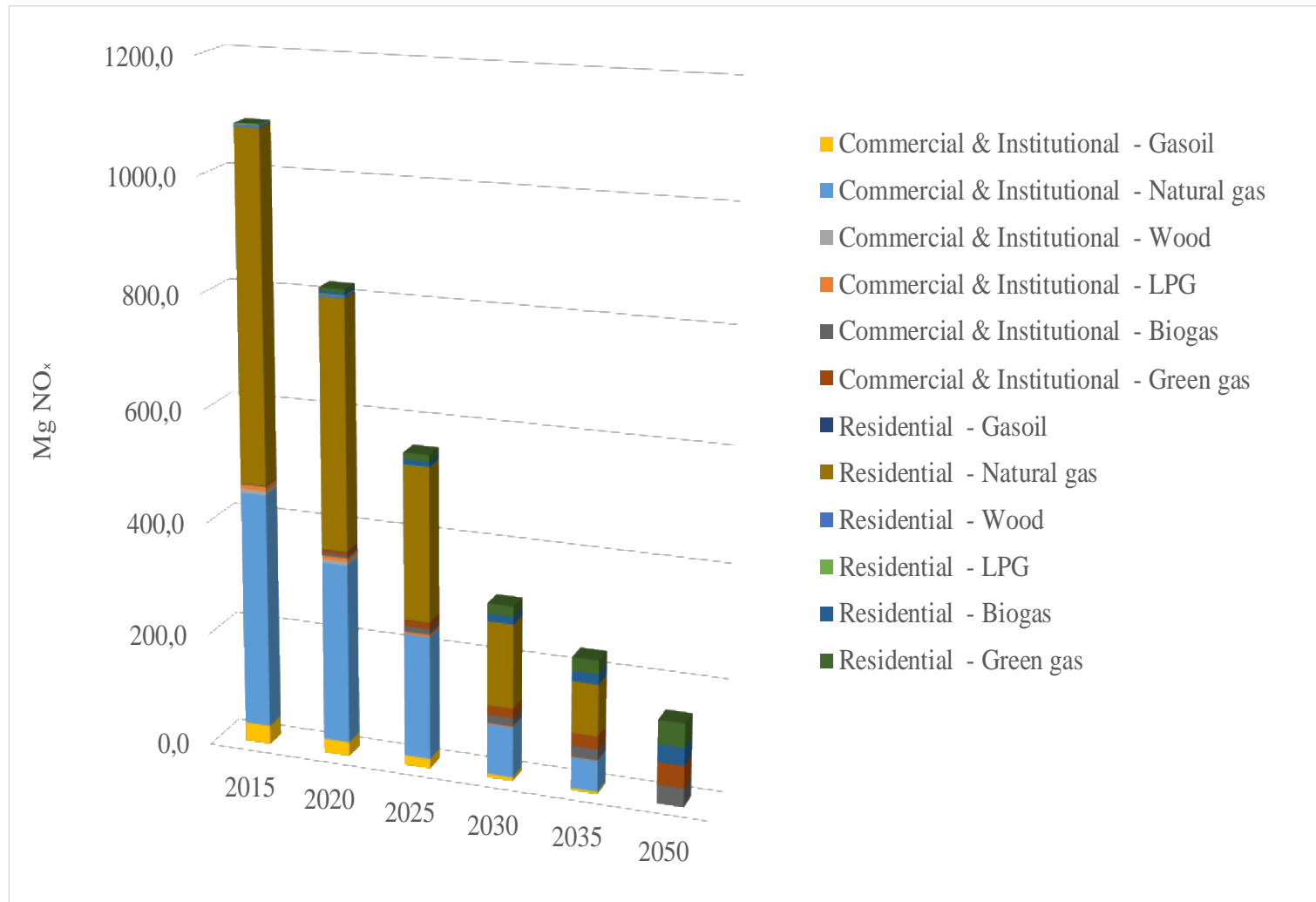
Amsterdam RC Policy scenario

Code	Description
AMS_LblBC	Amsterdam house label B&C
AMS_Wood	Amsterdam ban wood stoves and fireplaces
AMS_SunMand	Amsterdam Solar Panel mandatory
AMS_GFMand40	Amsterdam Gas free mandatory in 2040
AMS_GFM40	Amsterdam Gas Free Mandatory in 2040 Natgas
AMS_GFM40Bg	Amsterdam Gas free mandatory 2040 Biogas
AMS_GFM40Gg	Amsterdam Gas free mandatory 2040 Greengas

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Amsterdam RC sector Policy Scenario



Conclusions

- Different levels of planning require an integrated model for projections
- Air quality planning need the integration of national, regional, city level and hot spot modelling
- A specific integrated tool *E²Plan* is presented to manage emission inventory on different territorial domains and to model projections
- Integrated air quality models (such as Chimere or Calpuff) give the instrument to evaluate the effect of measures on air quality

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THANK YOU FOR THE ATTENTION

QUESTIONS?