

# Ammonia emission estimates from manure management in Northern Italy at different resolution: farms, municipality and national level

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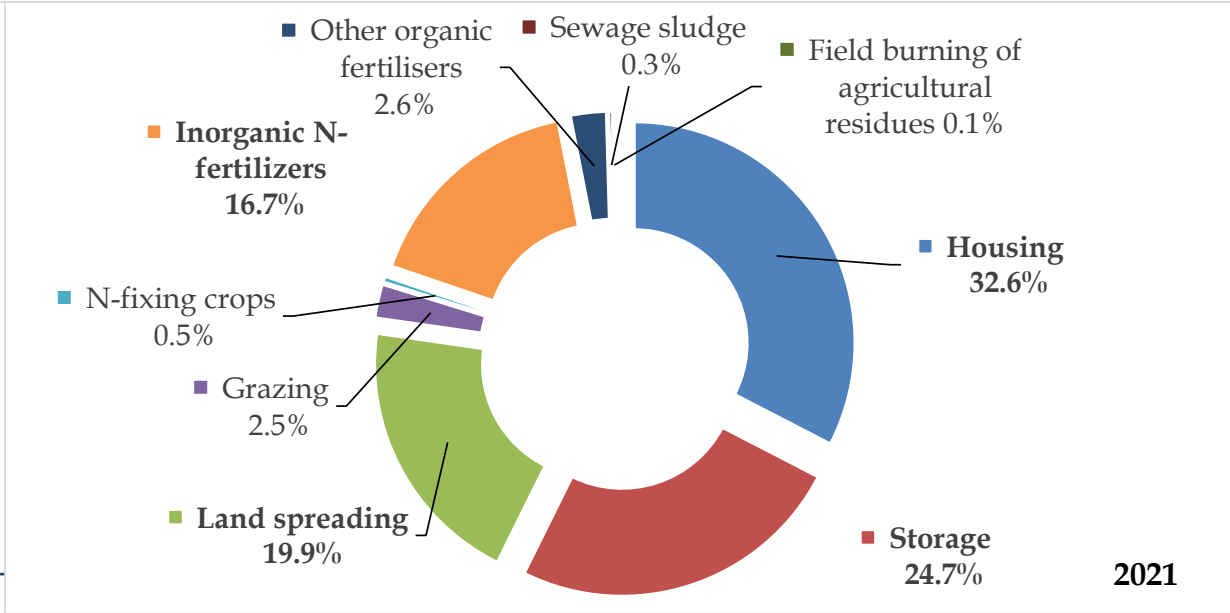
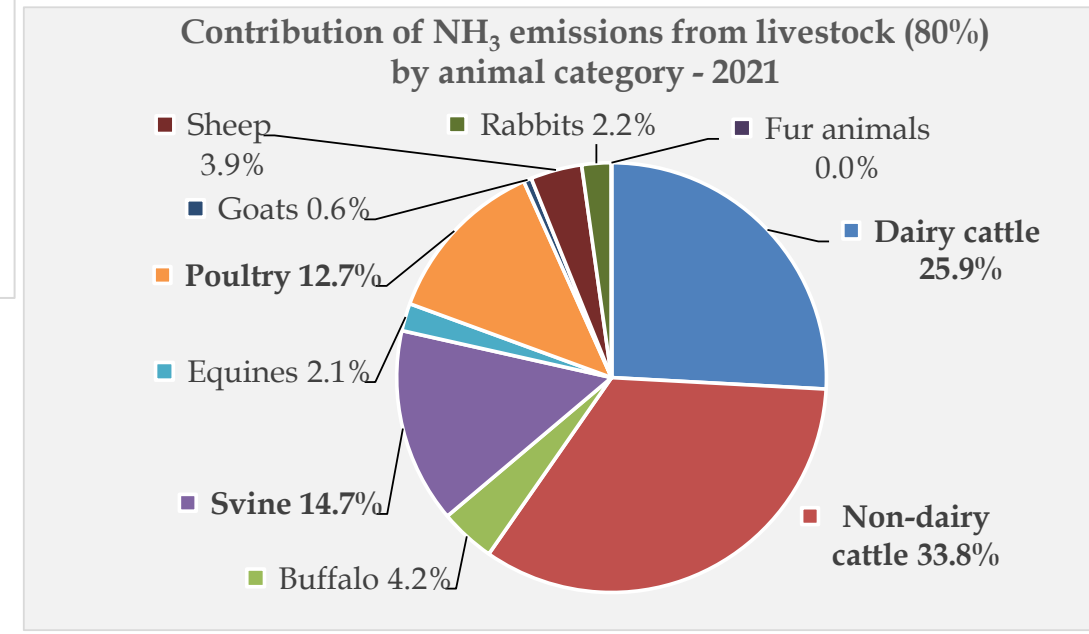
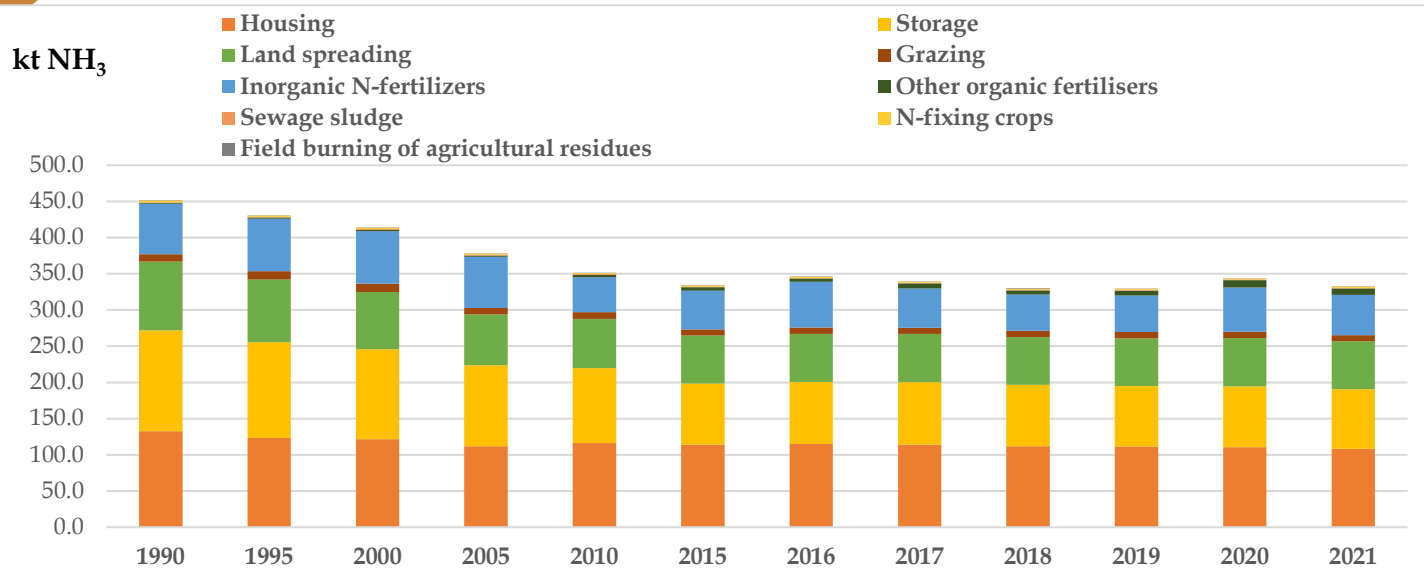
ISPRA - Institute for Environmental Protection and Research Environmental Assessment  
Control and Sustainability Department Emissions  
Prevention of Atmospheric Impacts and Climate Change Area  
Air Emission Inventory Unit  
Italy

# Summary

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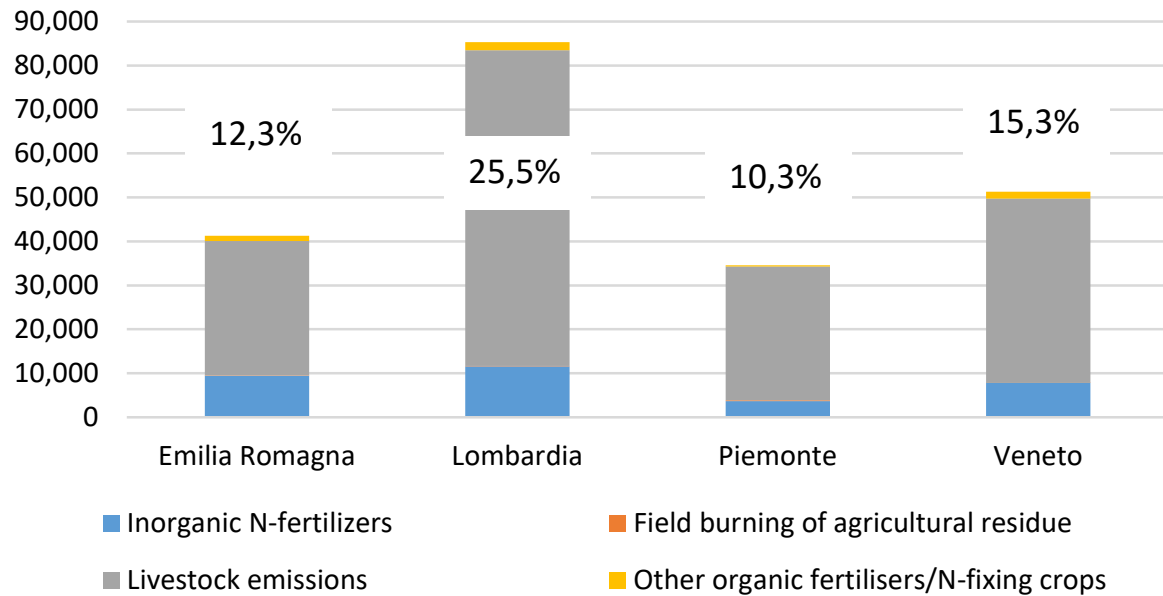
- Ammonia emissions in agriculture at national level (Italian national, regional and provincial)
- Local emission inventories and composite map of NH<sub>3</sub> (Northern Italy Municipality and grid)
- Local variability of activity indicators in Italy
- Time series of ammonia emissions
- Ammonia emissions estimates at the farm

# Ammonia emissions in agriculture at national level

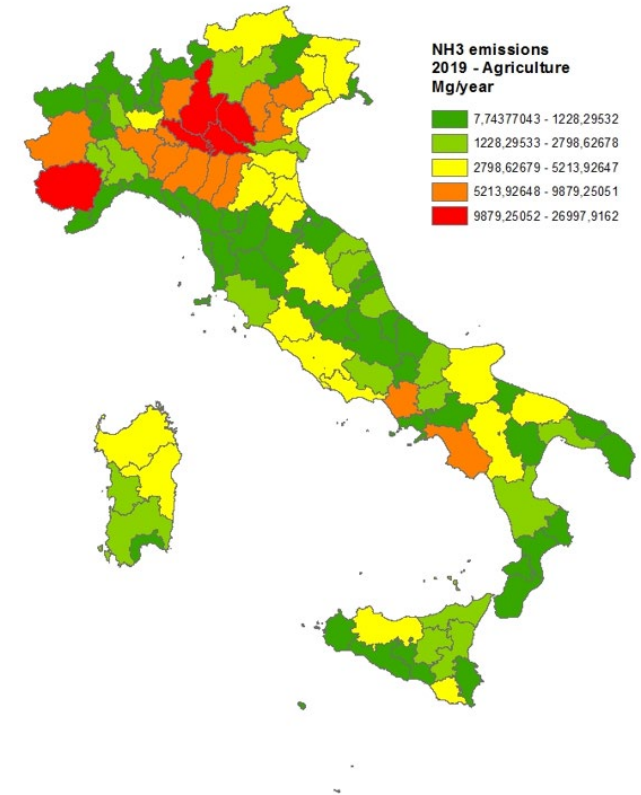
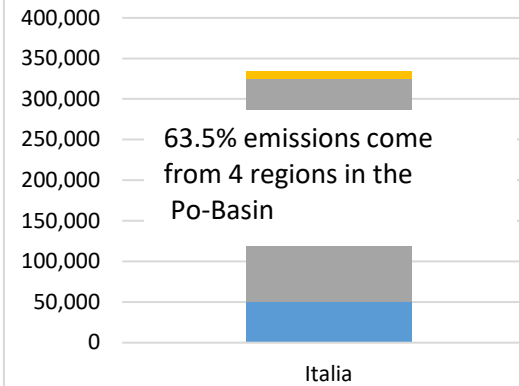


# Disaggregation of national ammonia emissions in agriculture at provincial/regional level

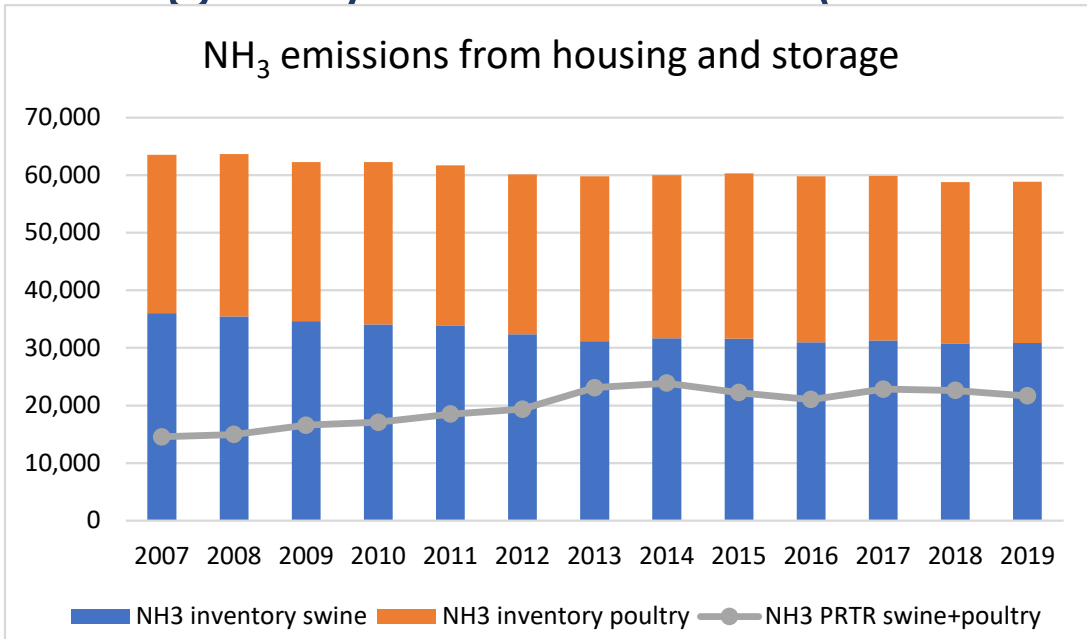
emissions of NH<sub>3</sub> (tons) - 2019



emissions of NH<sub>3</sub> (tons) - 2019



# NH<sub>3</sub> swine and poultry data from emissions inventory and registry data PRTR (Pollutant Release and Transfer Register)



Farm declaration thresholds for PRTR register:

40000 places poultry

2000 places production pigs over 30 kg

750 places sows

annual emissions greater than 10 t NH<sub>3</sub>

About 900 farms in 2019 and account for 37% of national swine and poultry emissions from housing and storage

Classi di LSU (Livestock unit)	Cattle heads (2020)	Swine heads (2013)	Poultry LSU (2020)
Less than 5 LSU	71,150	23,420	10,660
From 5 to 9.9 LSU	117,590	20,560	2,470
From 10 to 14.9 LSU	133,070	25,580	1,980
From 15 to 19.9 LSU	136,130	18,890	1,980
From 20 to 49.9 LSU	769,270	173,000	14,050
From 50 to 99.9 LSU	904,740	178,850	38,580
From 100 to 499.9 LSU	2,552,500	1,436,370	453,240
500 LSU or over	1,316,250	6,721,800	1,174,980
	64% in the class of 100 LSU and above (100 LSU~100 heads)	78% in the class of 500 and above (500 LSU~2000 heads)	70% in the class of 500 and above (500 LSU~50000 heads)



# Emission dataset in LIFE PREPAIR

Development of a common pollutant emission dataset on the Po-basin and Slovenia (domain of 135000 Km<sup>2</sup> and population of 28 million inhabitants):

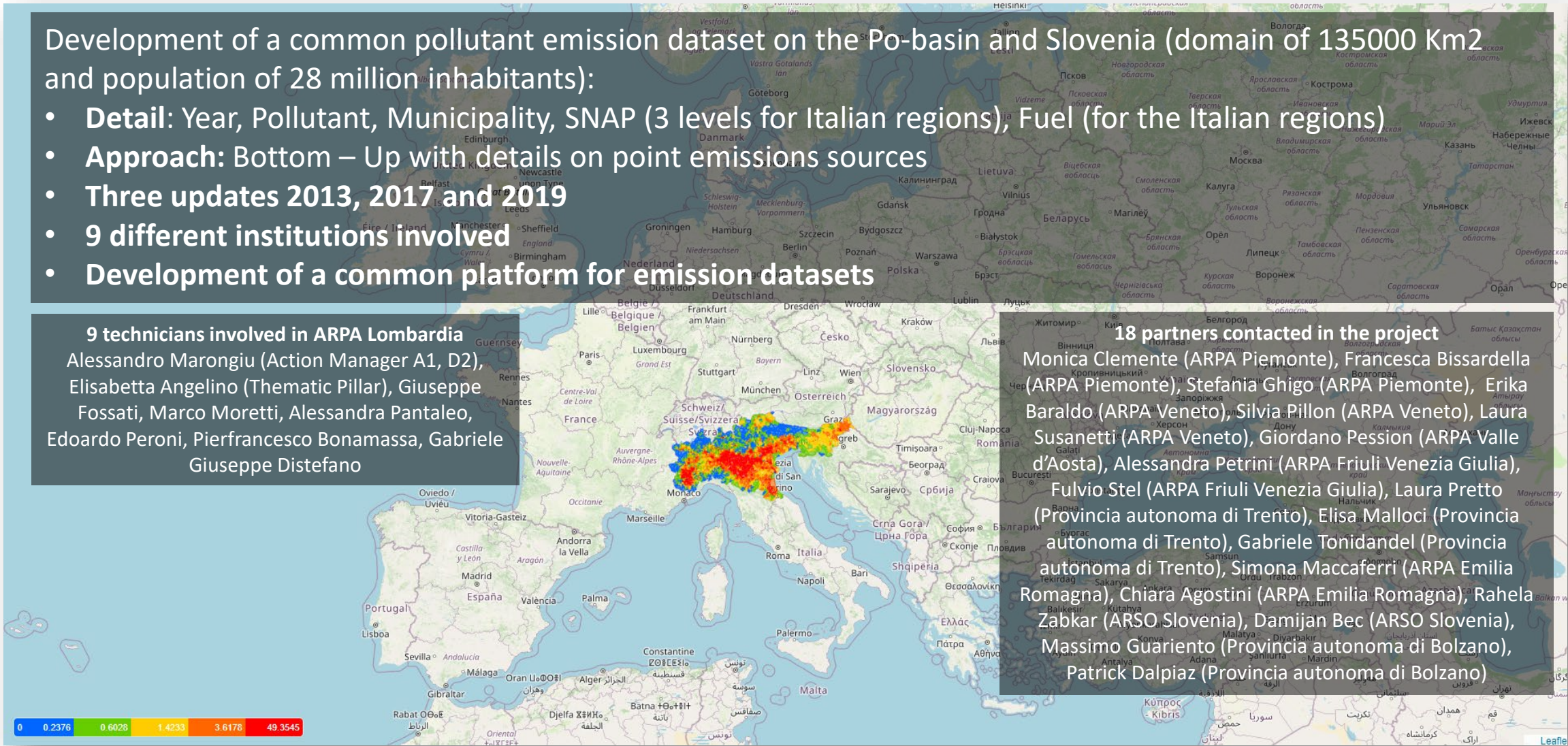
- **Detail:** Year, Pollutant, Municipality, SNAP (3 levels for Italian regions), Fuel (for the Italian regions)
- **Approach:** Bottom – Up with details on point emissions sources
- **Three updates 2013, 2017 and 2019**
- **9 different institutions involved**
- **Development of a common platform for emission datasets**

## 9 technicians involved in ARPA Lombardia

Alessandro Marongiu (Action Manager A1, D2),  
Elisabetta Angelino (Thematic Pillar), Giuseppe Fossati, Marco Moretti, Alessandra Pantaleo, Edoardo Peroni, Pierfrancesco Bonamassa, Gabriele Giuseppe Distefano

## 18 partners contacted in the project

Monica Clemente (ARPA Piemonte), Francesca Bissardella (ARPA Piemonte), Stefania Ghigo (ARPA Piemonte), Erika Baraldo (ARPA Veneto), Silvia Pillon (ARPA Veneto), Laura Susanetti (ARPA Veneto), Giordano Pession (ARPA Valle d'Aosta), Alessandra Petrini (ARPA Friuli Venezia Giulia), Fulvio Stel (ARPA Friuli Venezia Giulia), Laura Pretto (Provincia autonoma di Trento), Elisa Malloci (Provincia autonoma di Trento), Gabriele Tonidandel (Provincia autonoma di Trento), Simona Maccaferri (ARPA Emilia Romagna), Chiara Agostini (ARPA Emilia Romagna), Rahela Zabkar (ARSO Slovenia), Damijan Bec (ARSO Slovenia), Massimo Guariento (Provincia autonoma di Bolzano), Patrick Dalpiaz (Provincia autonoma di Bolzano)





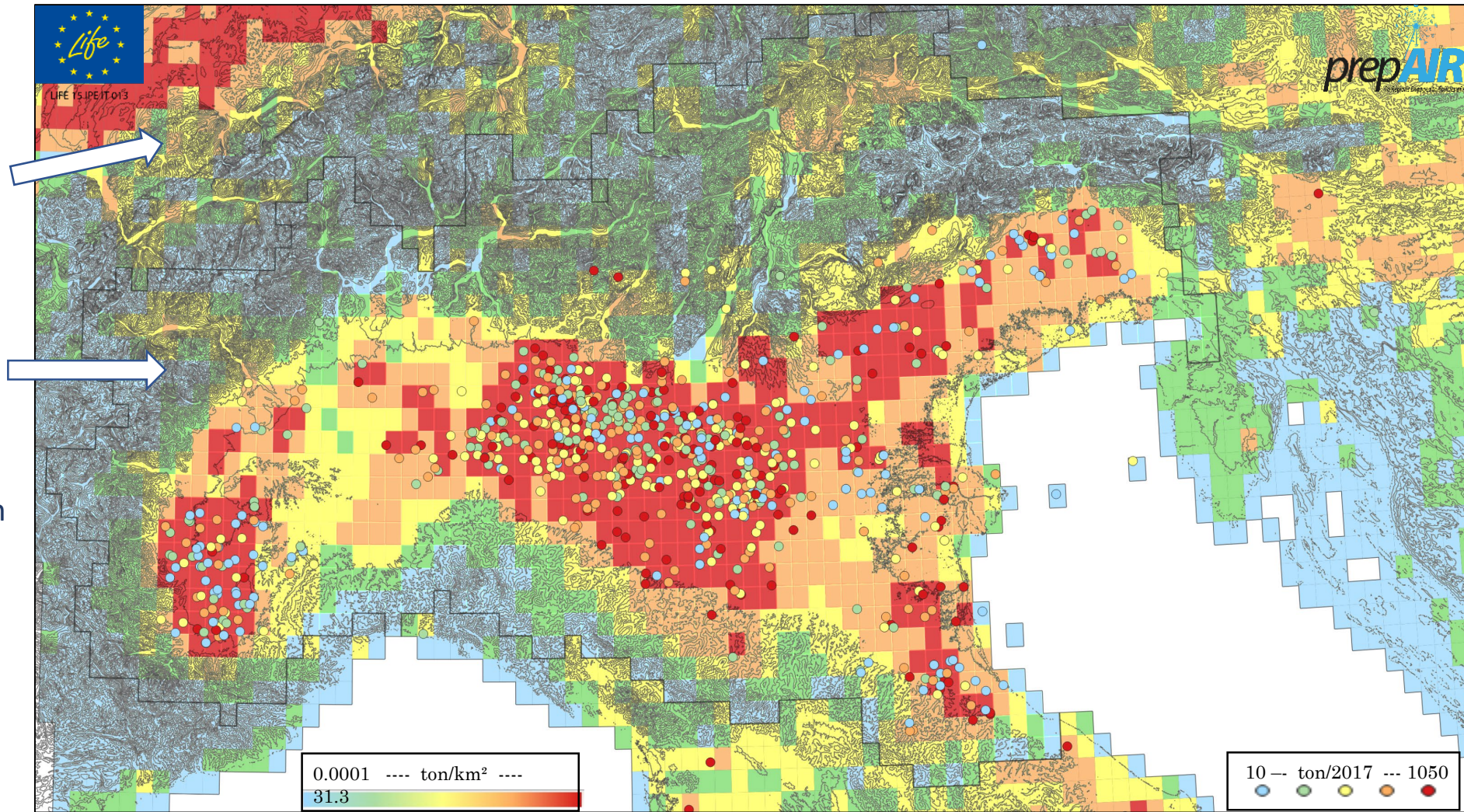
# Emission mapping of NH<sub>3</sub> in Northern Italy

**Composite map** from emission data (2017) from different sources:

- data in the outline represent those coming from [ceip.at/the-emep-grid](https://ceip.at/the-emep-grid);
- representation of the data from “**LIFE PREPAIR**”\* project within **black outlines**;

both are expressed as the emission density (ton of ammonia per km<sup>2</sup>).

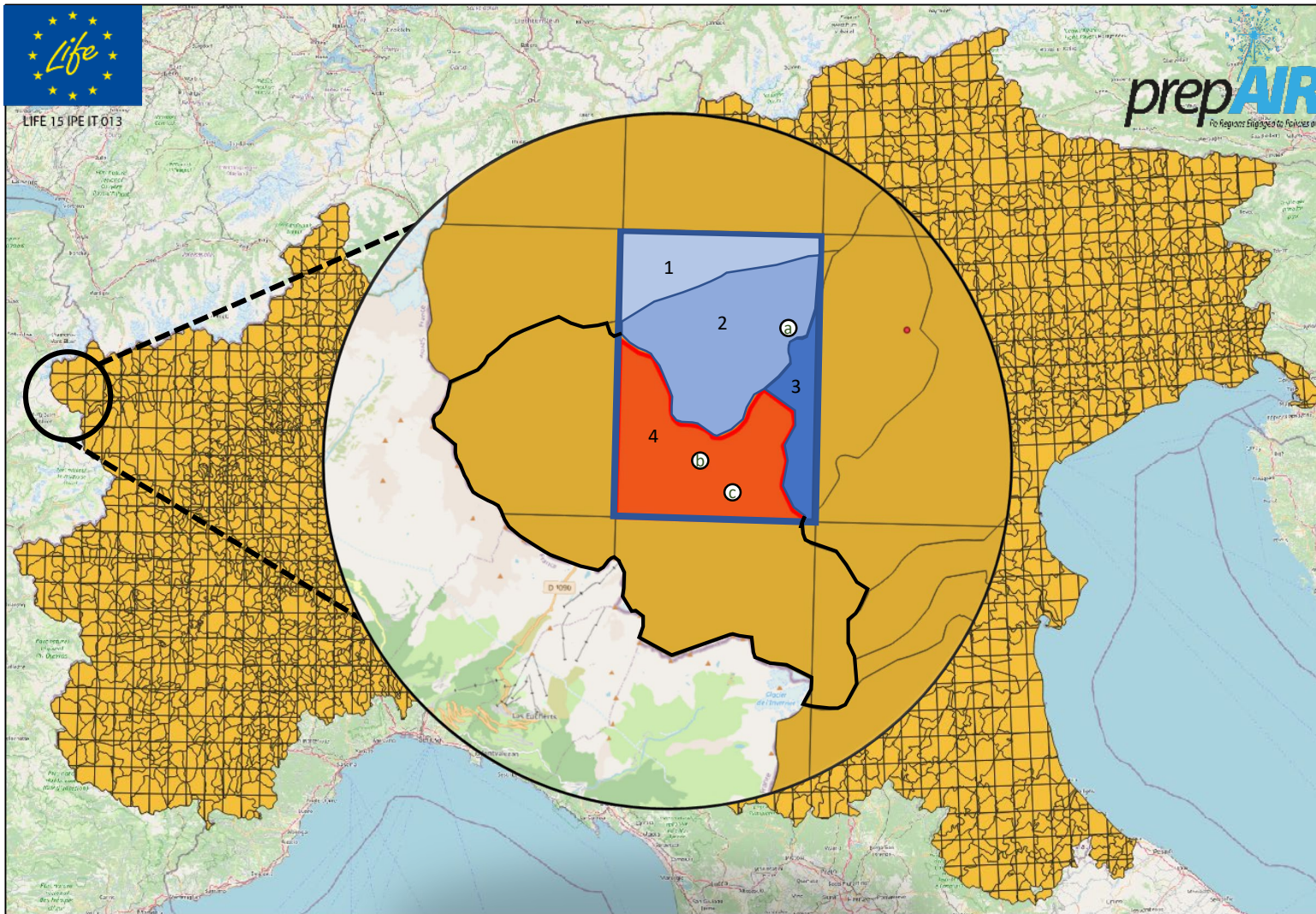
- 945-point emission sources in Italy from 10 tonnes of NH<sub>3</sub> from intensive rearing of poultry or swine reported in E-PRTR database v.18 ([industry.eea.europa.eu](https://industry.eea.europa.eu)).



\*<https://www.scirp.org/journal/paperinformation.aspx?paperid=119885>



# Map comparison methodologies



From intersection between map of prepAIR municipal areas and the EMEP grid it's possible calculate the portion of municipal area reported in the prepAIR project which is located within the EMEP-cell.

Assuming that the relative diffuse emission of each municipality is proportional to its area within the cell, we calculated the total diffuse emission as the sum of each relative municipal emission within the EMEP-cell.

The total emission of cell ( $E_c$ ):

$$E_c = \sum_{m=1,2,..}^n \frac{E_{diffuse\ m} \times A_{C \cap m}}{A_m} + \sum_{p=a,b,..}^h E_{punctual}$$

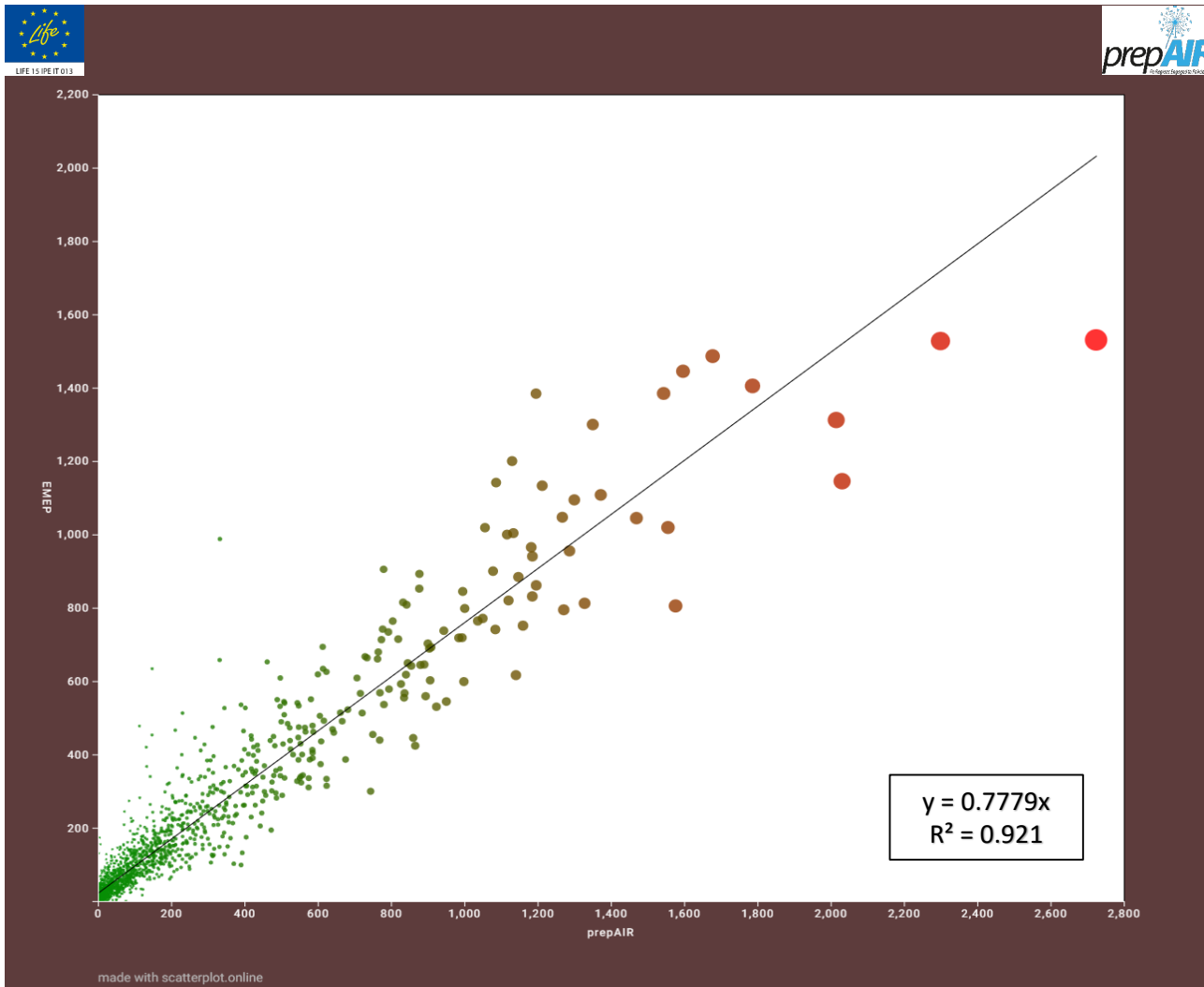
Where:

$A_m$  = total municipal area

$A_{C \cap m}$  = municipal area within cell



# Map comparison LIFE PREPAIR vs EMEP grid



The comparison between the value reported in EMEP and that obtained from the prepAIR emission estimation methodology has the purpose of verifying and comparing emission inventories at European, national and regional level.

Each point of the scatter plot represents the ammonia emitted in tons in 2017 for each cell according to PREPAIR and EMEP estimates. 1735 cells representing the Po basin were compared.

# Local emission inventories and composite map of NH<sub>3</sub>

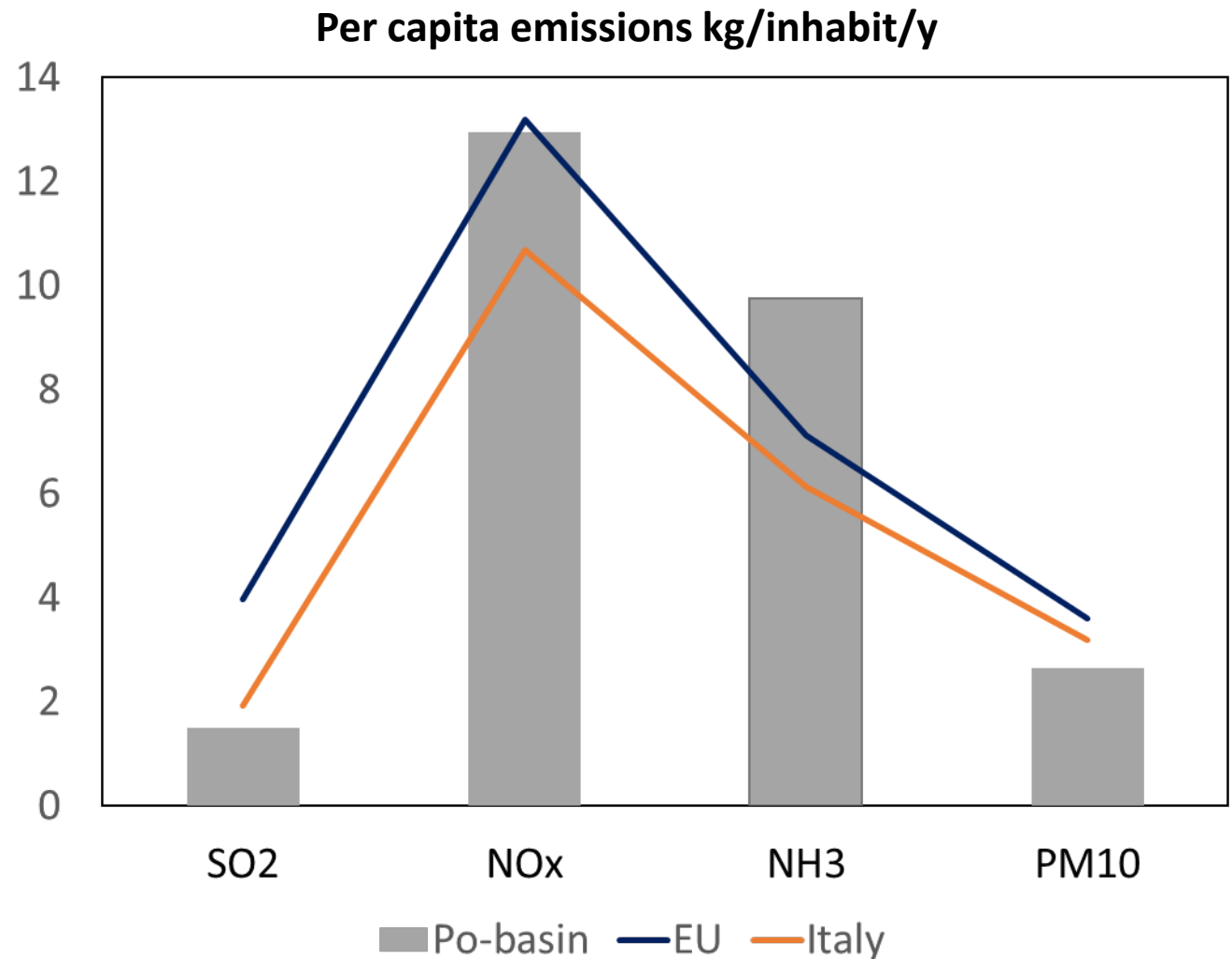
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- **Italian Regions and autonomous provinces** have different functions in the monitoring and management of air quality and must compile and update an **emission inventory** every two or three years on their own territory.
- The **EEA-EMEP Guidebook is the main technical reference** in updating the emission inventories ([www.eea.europa.eu](http://www.eea.europa.eu)) both at National and Local levels and plays a fundamental role in the comparability of the estimates.
- The Italian local emission inventories are generally compiled at a **municipal detail** and implement the SNAP source classification. This high spatial resolution can allow to better describe the emission pressure on the domain, but sometimes can lead to greater difficulties ensuring consistent time series due to lacks, gaps and changes in local information availability.
- The **composite map of NH<sub>3</sub> shows a good comparability**, without relevant gaps and discontinuities and confirm the common technical base between different regions and top-down national inventory; due to the use of same methodological reference (the EEA-EMEP Guidebook) and, in many cases, the same modelling system (INEMAR database).
- Same emission factors of the Italian Emission Inventory, activity indicators at municipal detail (veterinary authority, local administrations).

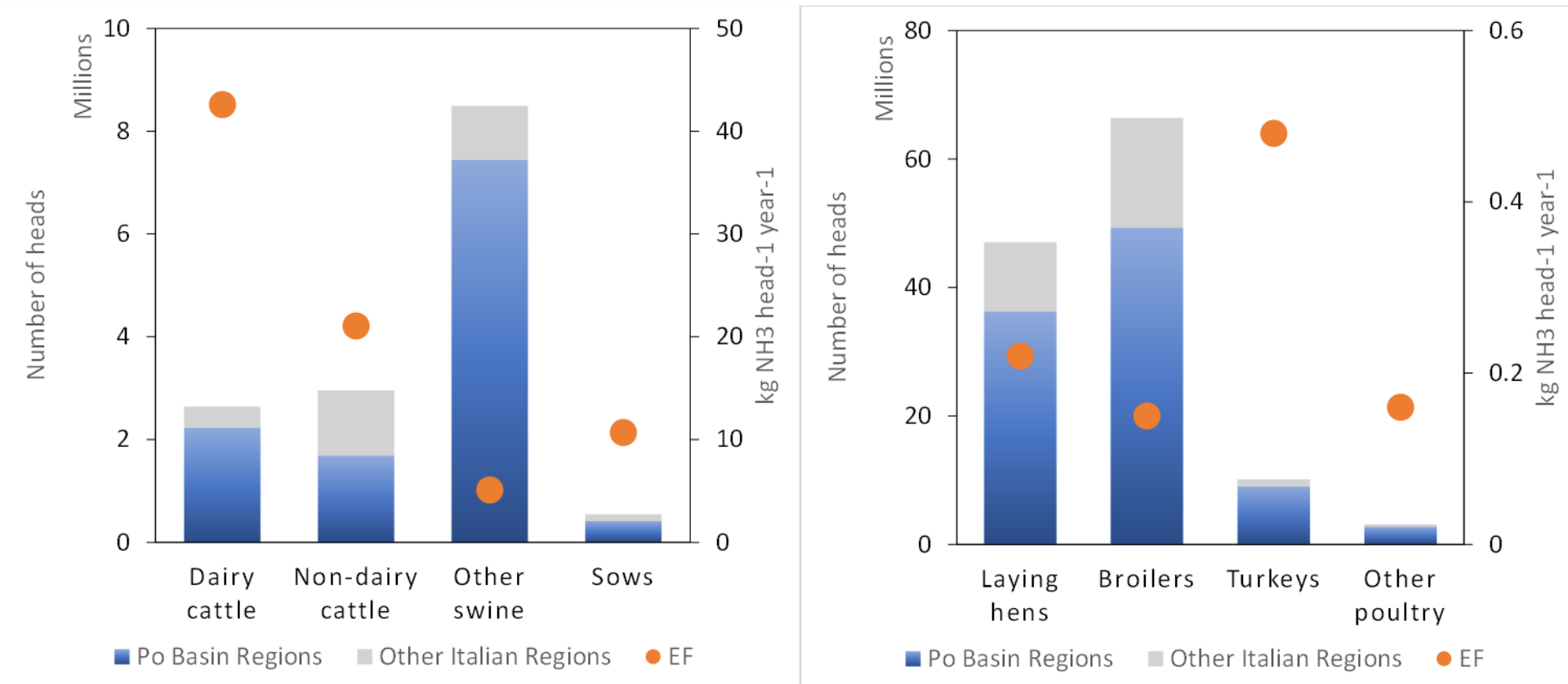


# Ammonia in Northern Italy

The role in the Po-basin of the NH<sub>3</sub> emissions in the formation of secondary particulate matter by chemical reactions is focused by different studies. According to the emission estimates in PREPAIR for Northern Italy, the use of mineral fertilizers contributes for 15% to emissions of NH<sub>3</sub>. The larger contribution on total emissions is due to livestock (81%) encompassing housing, storage and spreading.



# Local variability of activity indicators in Italy

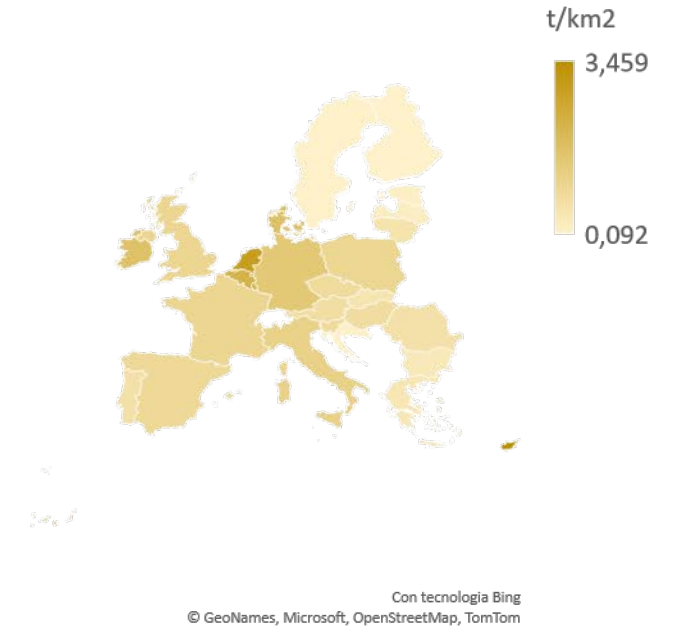
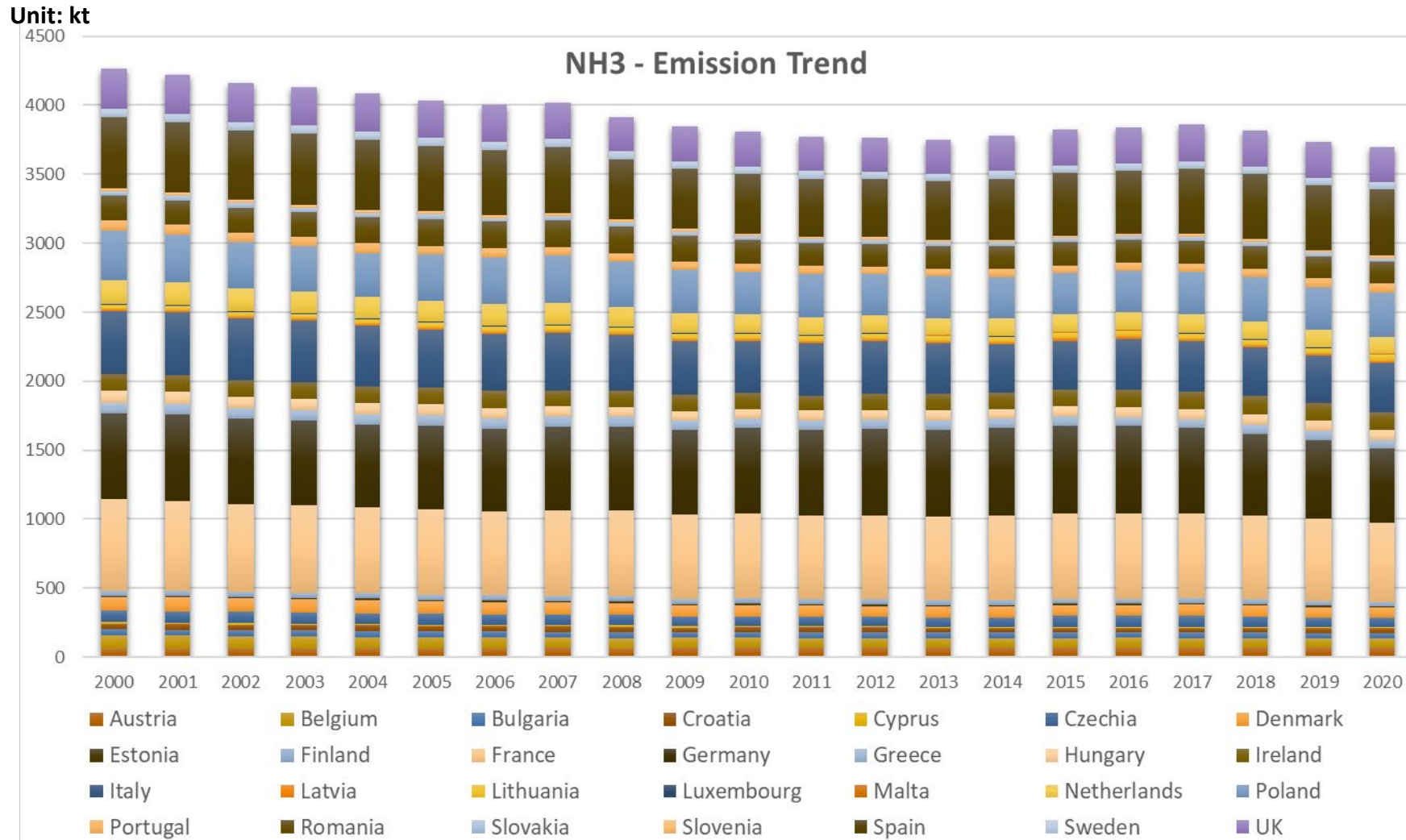


Data reported by Veterinary Authority show that the most (about of 80%) of cattle, swine and poultry are bred in the regions of Po valley. This analysis explains the relative higher emission density of the Po valley area compared to Italy and EU.

Elaboration on: [https://www.vetinfo.it/j6\\_statistiche/#/report-pbi/41](https://www.vetinfo.it/j6_statistiche/#/report-pbi/41) and Italian IIR 2023

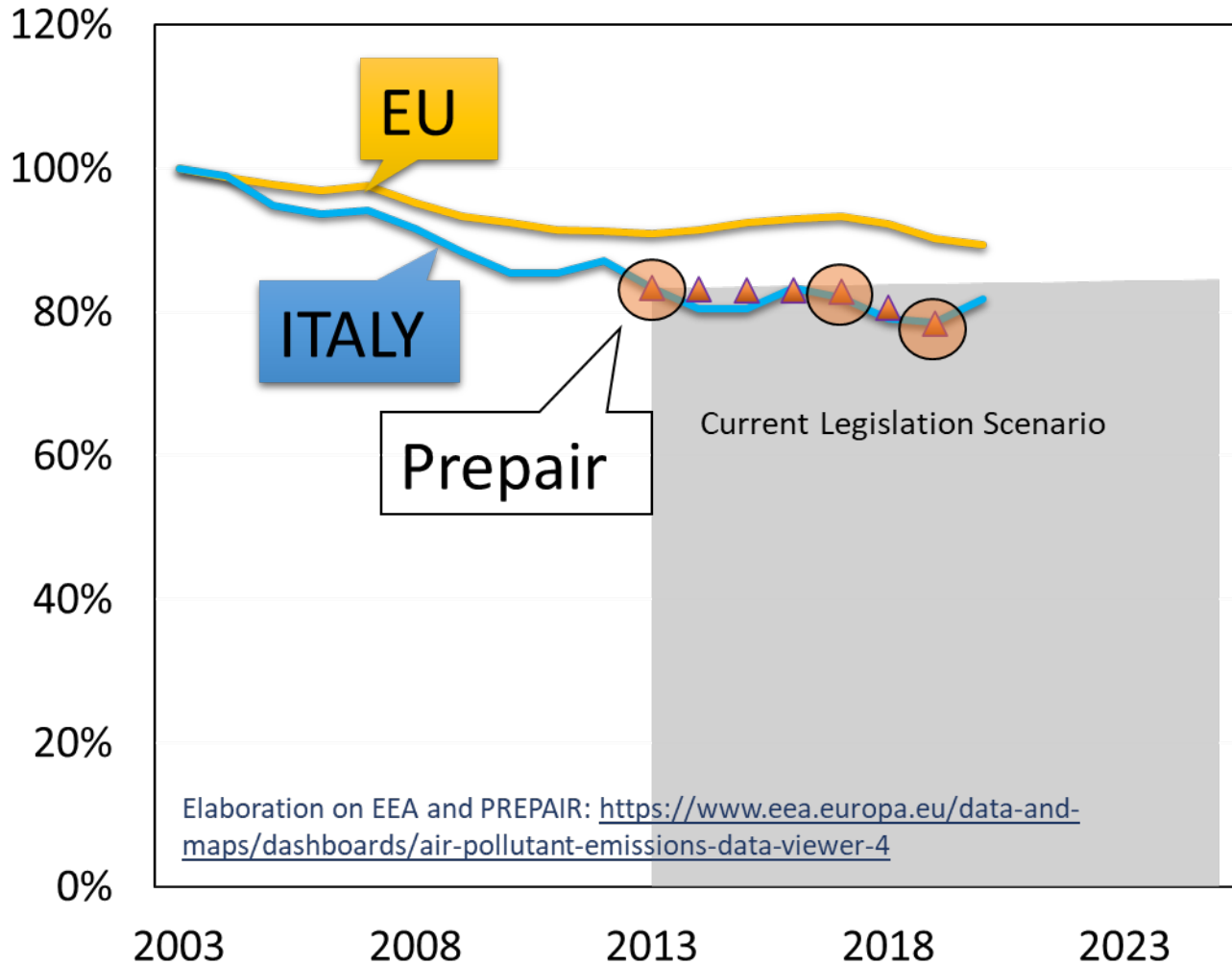


# Time series of ammonia emissions



Elaboration from EEA: <https://www.eea.europa.eu/data-and-maps/dashboards/air-pollutant-emissions-data-viewer-4> and from NAEI: <https://naei.beis.gov.uk/data/data-selector?view=air-pollutants>

# Time series of ammonia emissions

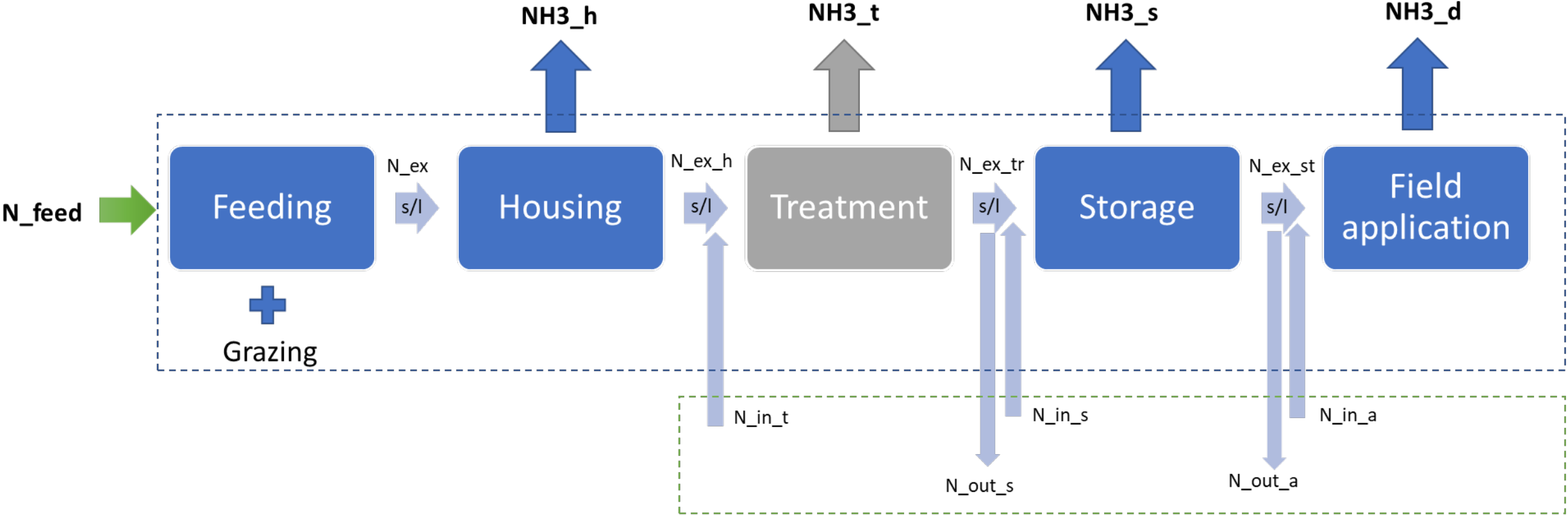


The NEC Directive sets 2020 and 2030 emission reduction commitments and Member States report air pollutant emission inventories to assess progress in reducing air pollution and to verify their compliance with commitments.

Regional Air Quality Intervention Plans are planning and programming tool in the field of air quality, aimed at reducing emissions into the atmosphere to protect health and the environment. NH<sub>3</sub> is a precursor of particulate matter and can be subjected to specific reduction measures needing: harmonization of national and regional emission trend, evaluation of local effect of the measures.



# Mass balance of nitrogen and ammonia emissions



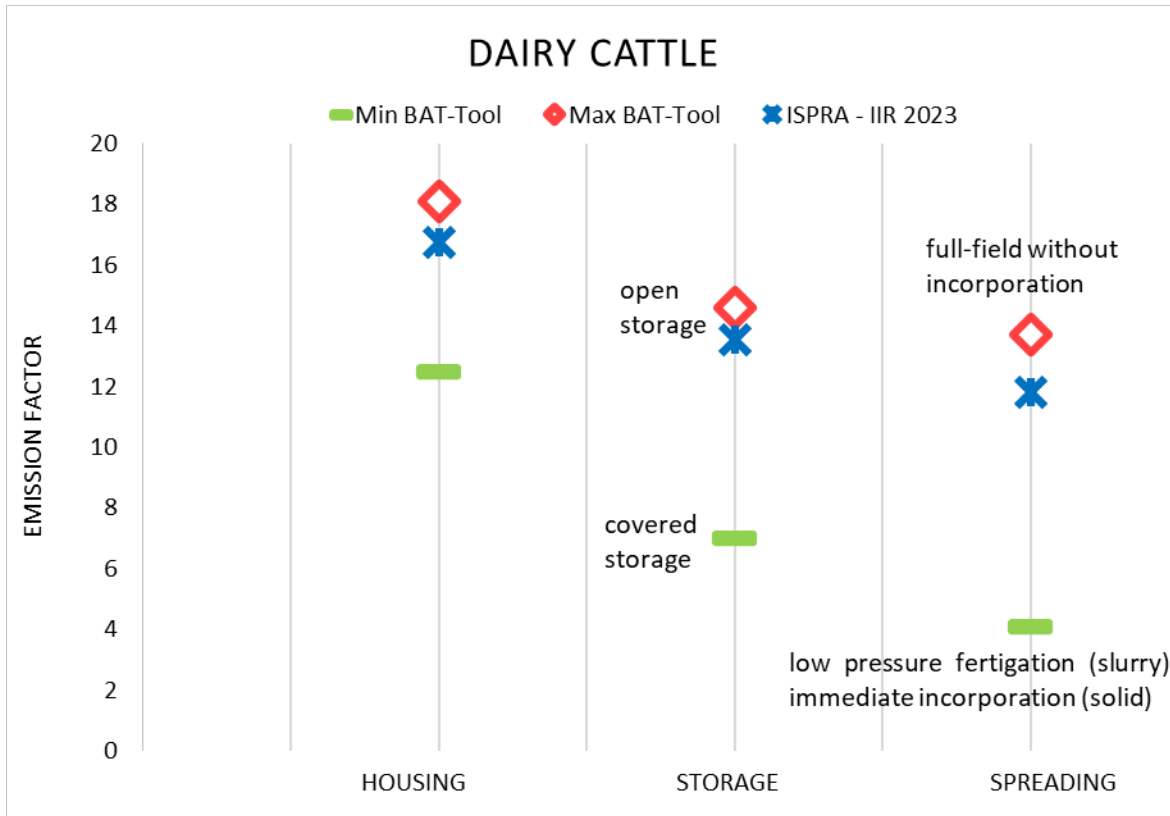
Applied to a single Farm or small district

- BAT-Tool estimates NH<sub>3</sub> emissions at farm and territorial scale using a nitrogen flux approach, with reference to IED Directive (directive 2010/75/UE).
- The methodology refers to single farm/district and is possible to indicate the **import of effluents and biomass** (useful in particular in the case of biogas plants). The quantity (in kg of nitrogen/year) of imported effluents and biomass, the type (liquid or solid) and at what stage they enter the emission chain (possible choices: upstream of treatment, upstream of storage, upstream of distribution) are required.
- The Treatments section is not mandatory. If there are **treatments in the company**, the % of effluents that are subject to treatment must be indicated and the type of treatment (or combinations of treatments) must be chosen from the drop-down menu. If only a part of the effluent is subject to treatment, 100% complement is automatically considered not to be subject to treatment.
- A **sensitivity study of the BAT-Tool** was carried out using a decision tree where **for each phase the best and worst technologies** were chosen from the point of view of NH<sub>3</sub> emissions into the atmosphere.
- The total annual emissions estimated by BAT-Tool have been **compared** to the number of animals reared by defining **Implied Emission Factors**
- The variability of this parameter was compared with the emission factors used in INEMAR and the Implied Emission Factors published by ISPRA as part of the national inventory.

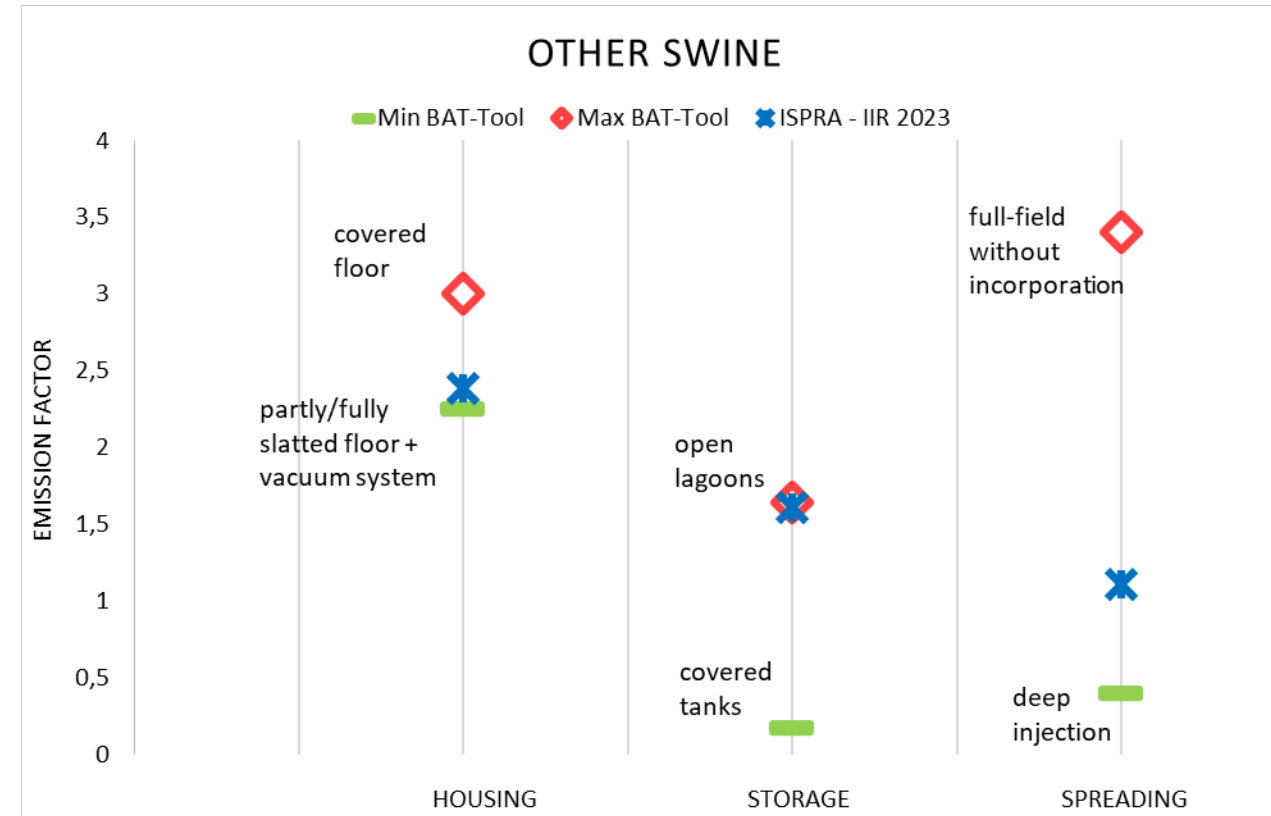
# Ammonia emissions estimate from farms (Cattle and Swine)

Stage by stage (Housing, Manure Storage, Field - applied Manure) NH<sub>3</sub> emissions estimated by BAT-Tool plus have been related to the number of animals, resulting in «Implied Emission Factors»; therefore, they have been compared with Implied Emission Factors published by ISPRA in the Italian Informative Inventory Report 2023.

Unit: kg NH<sub>3</sub>/head/year



Unit: kg NH<sub>3</sub>/head/year

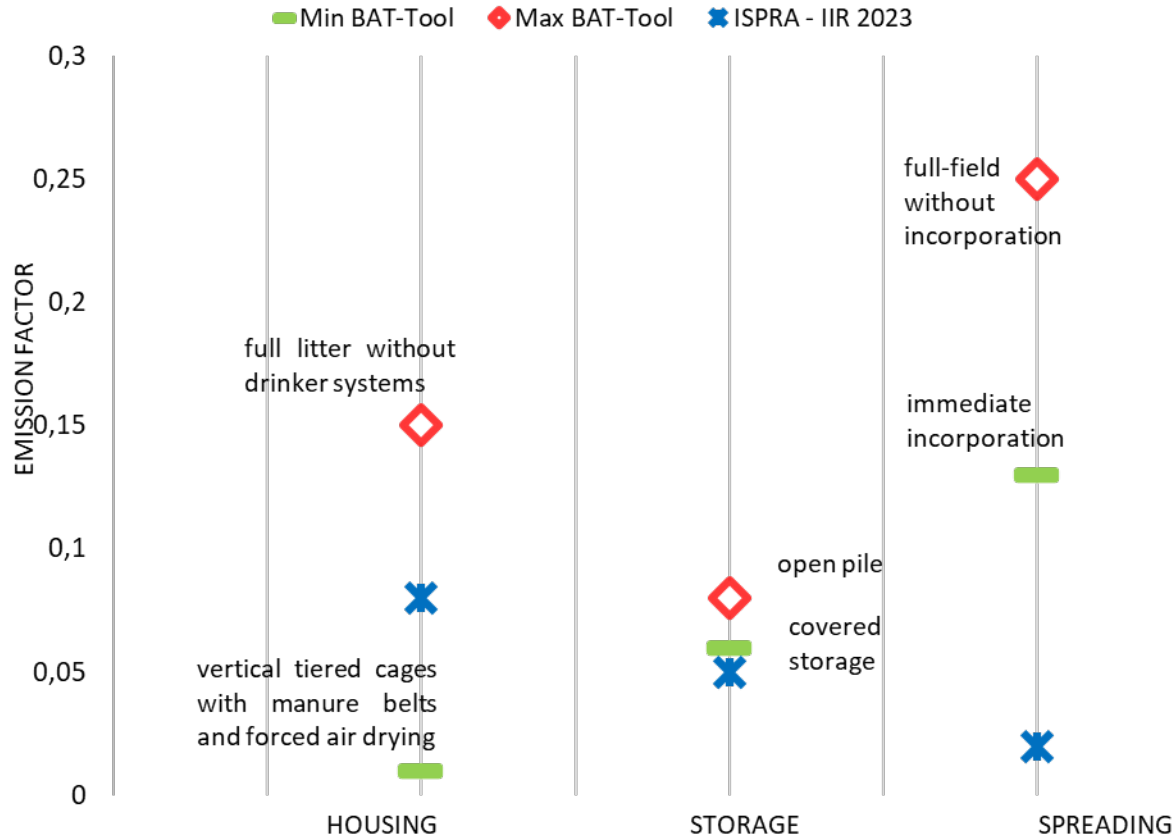




# Ammonia emissions estimate from farms (Poultry)

Unit: kg NH<sub>3</sub>/head/year

## BROILERS



Unit: kg NH<sub>3</sub>/head/year

## LAYING HENS

