



UNIVERSITÀ
DEGLI STUDI
DI BRESCIA



Co-benefits of changing diet. A modelling assessment at the regional scale integrating social acceptability, environmental and health impacts

Volta, M.^a, Turrini, E.^a, Carnevale, C.^a, Valeri, E.^b, Gatta, V.^c, Polidori, P.^d, Maione, M.^e

^aDepartment of Mechanical and Industrial Engineering, University of Brescia, Brescia, Italy

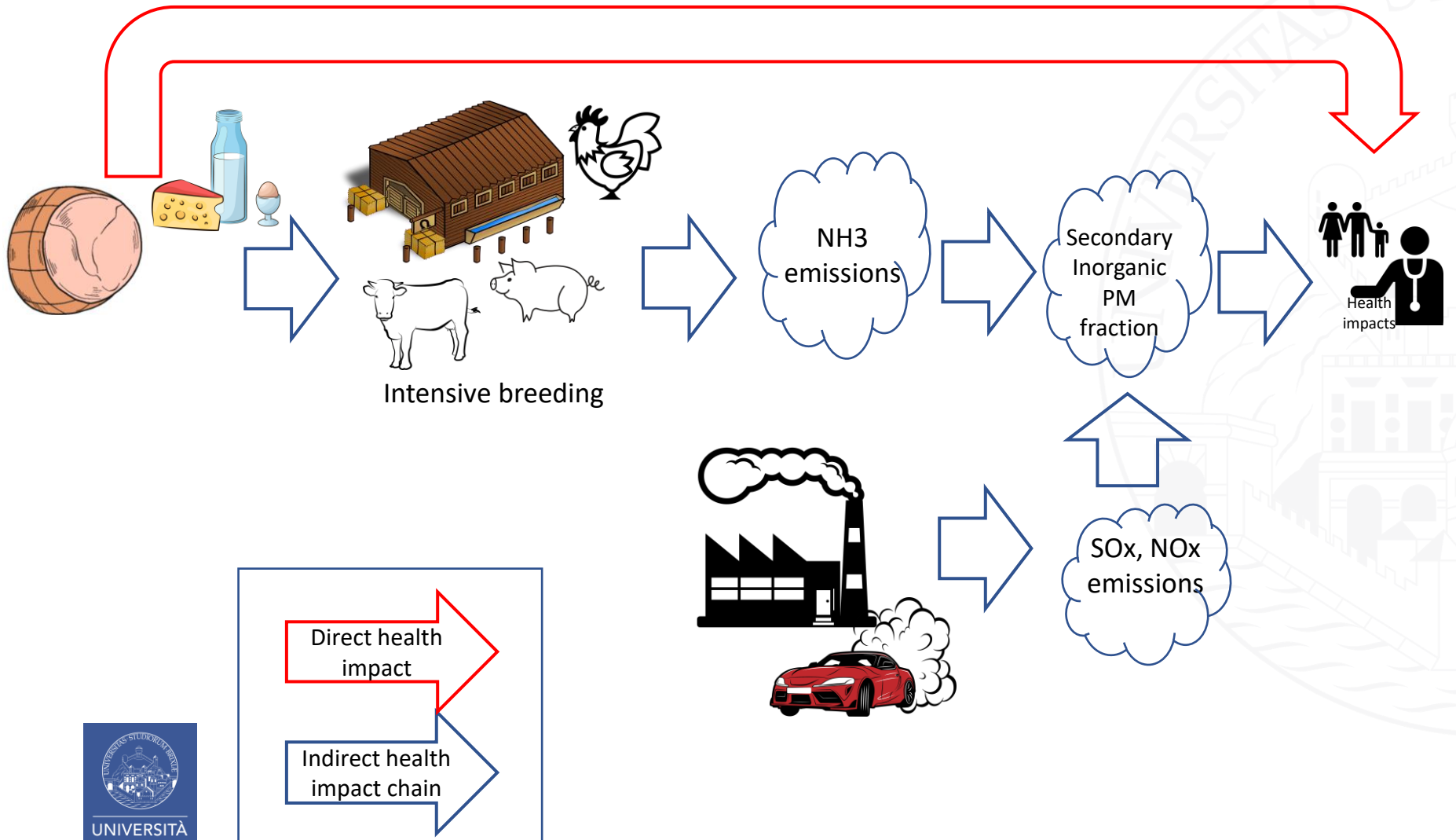
^bEuropean Commission, Joint Research Centre, Energy, Transport and Climate Directorate, Seville, Spain

^cDepartment of Political Sciences, Roma Tre University, Rome, Italy

^dDepartment of Law, University of Urbino, Urbino, Italy

^eDepartment of Pure and Applied Science, University of Urbino, Urbino, Italy

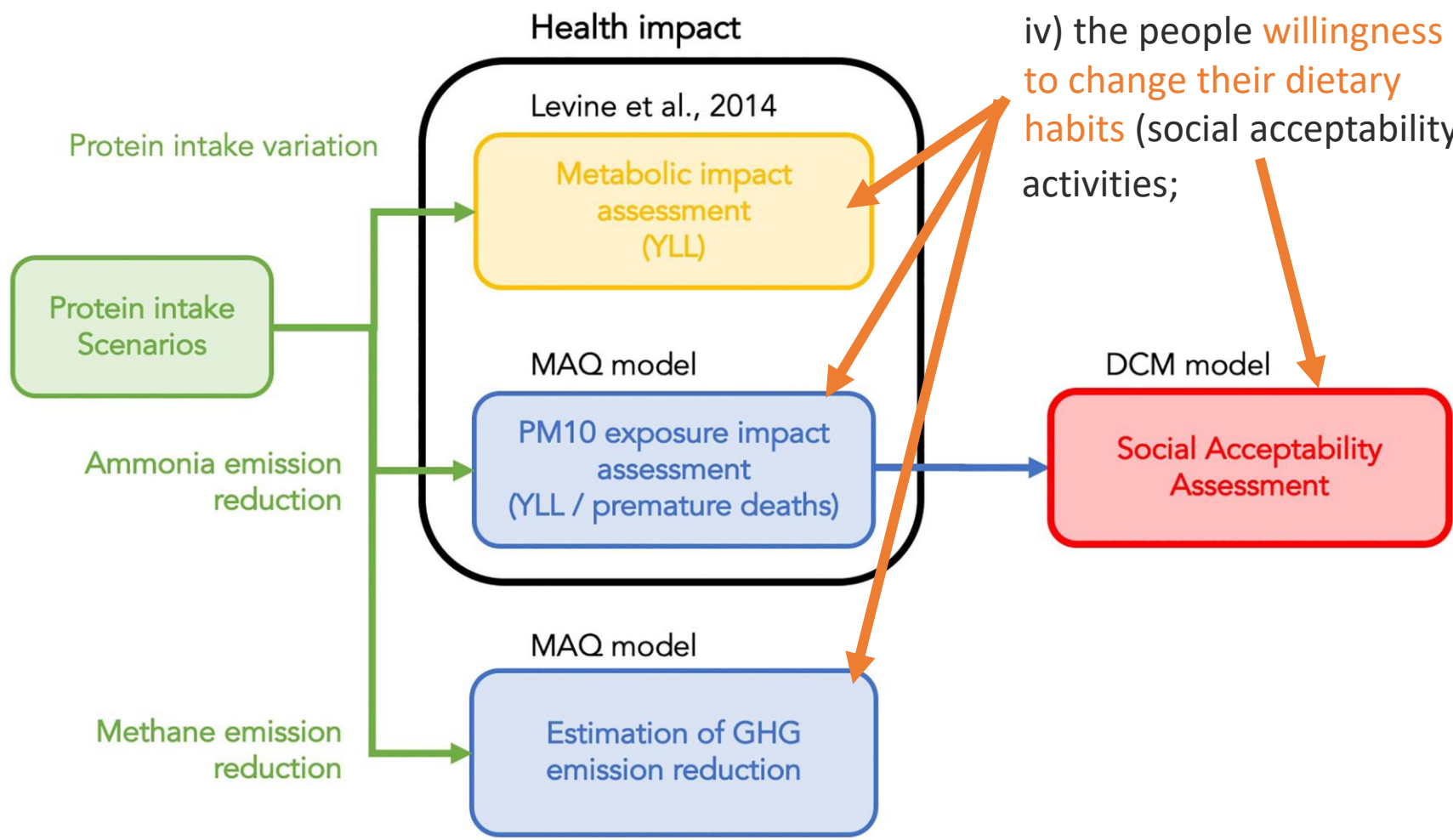
Introduction



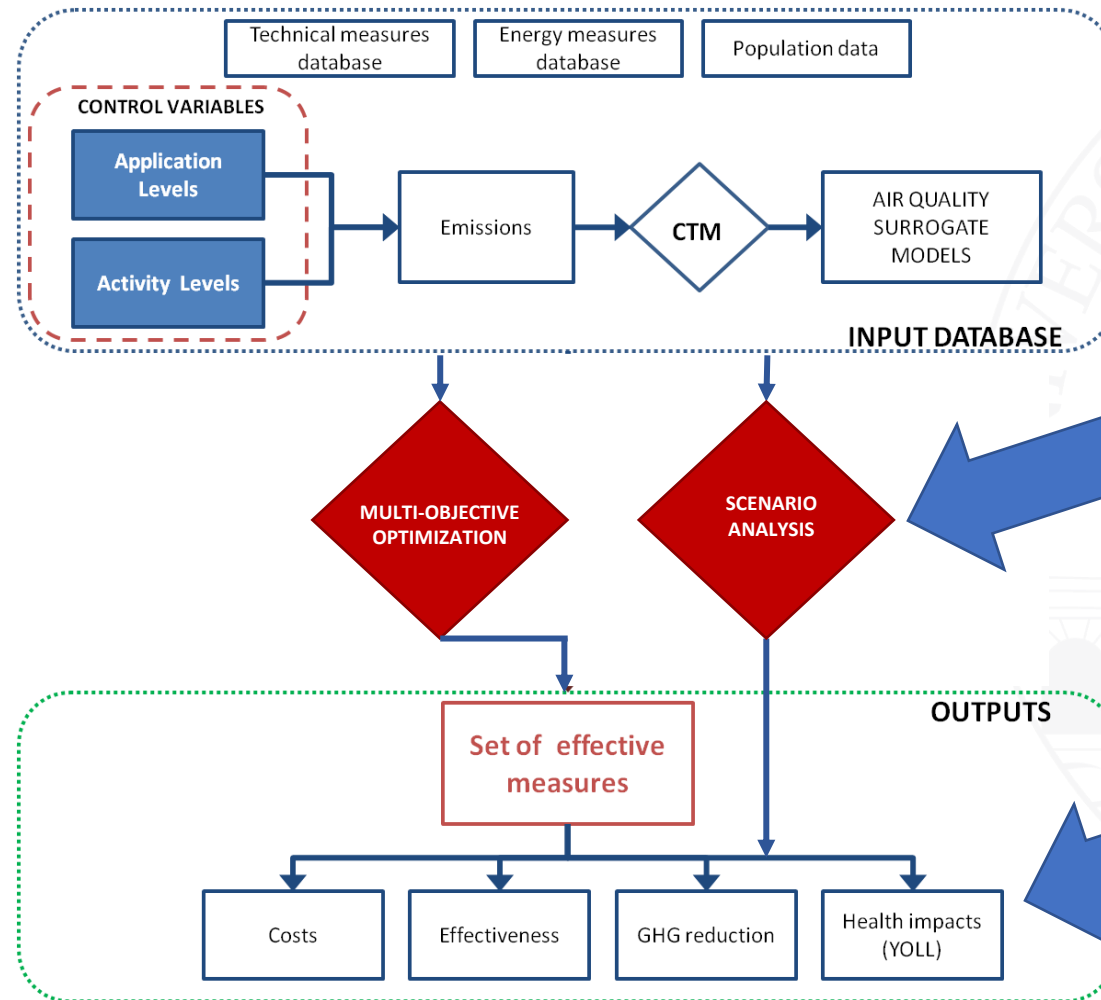
Modelling scheme

INTEGRATED ASSESSMENT of:

iv) the people **willingness to change their dietary habits** (social acceptability) activities;



MAQ system



DCM model

Analysing and predicting how people's choices are influenced by:

- personal characteristics and
- measures' drivers.

Based on the microeconomic approach of consumer behaviour based on the utility maximization under a budget constraint.

They imply the **design and implementation of a field survey** including the experimental design definition, the questionnaire setting and administration, data collection and sampling strategy, the model analysis and interpretation, as well as some internal and external validity



- M. Ben-Akiva, S.R. Lerman Discrete Choice Analysis: Theory and Application to Travel Demand MIT Press, Cambridge (1985)
- Ben-Akiva, M. D., McFadden, K., Train, J., Walker, C., Bhat, M., Bierlaire, D., Bolduc, Z., Boersch-Supan, D., Browns D., Gopinath, A., Karlstrom, and M. A. Munizaga, 2002. Hybrid choice models: progress and challenges. Mark. Lett., 13(3), 163–175.

Metabolic model

The reduction in YLL due to lower protein intake has been computed according to [Levine et al. \(2014\)](#)

According to the study:

A diet with

more than **10% of caloric intake from animal protein**

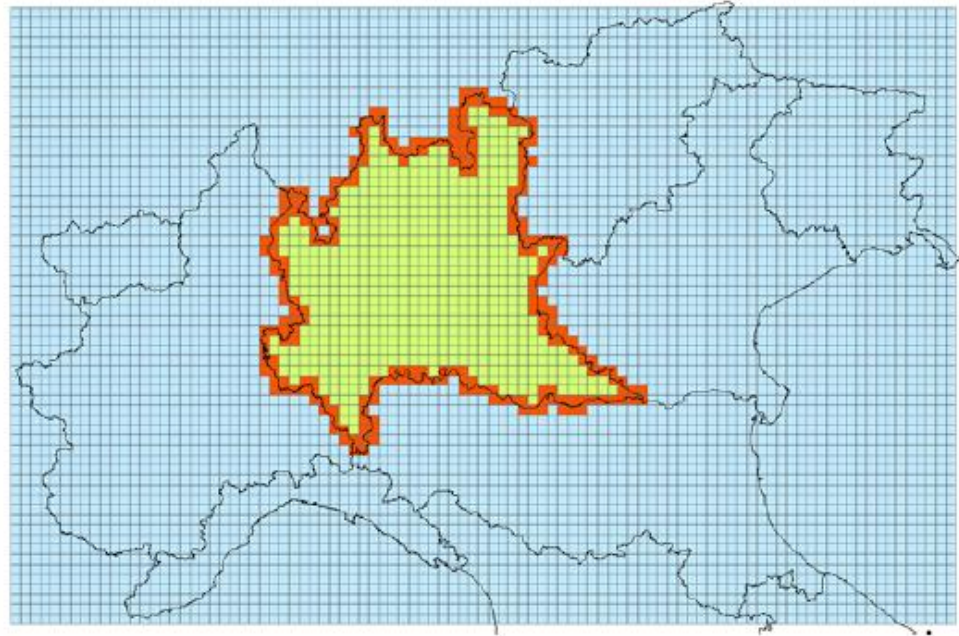
results in a

30% increase in mortality for individuals **between the ages of 50 and 65 (HR=1.3)**

CASE STUDY

Lombardia Region

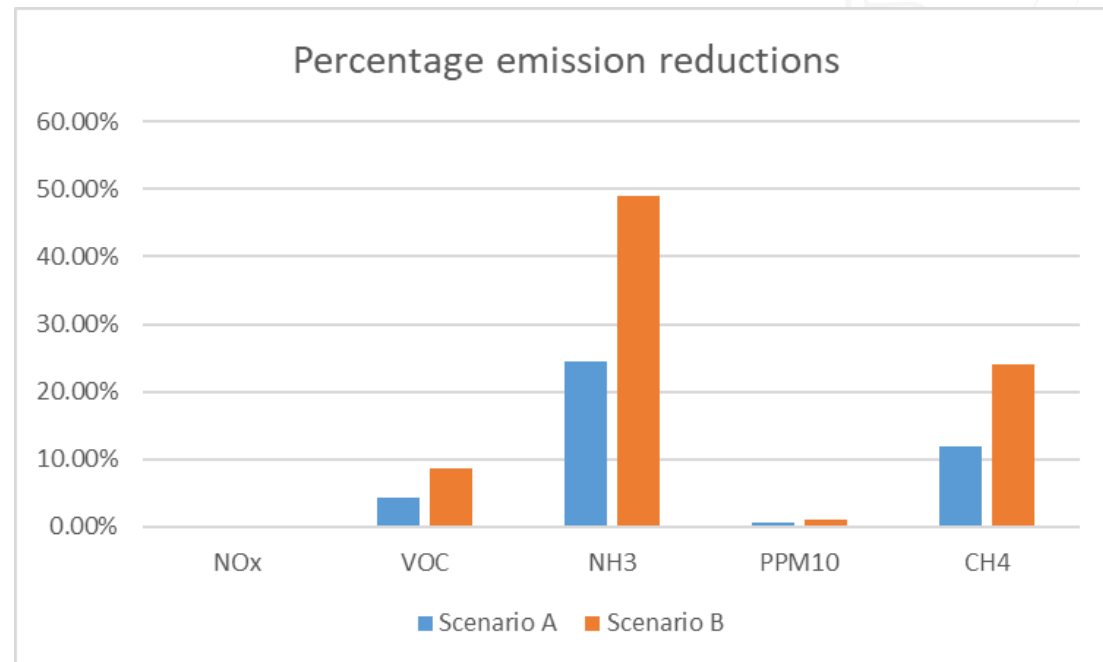
95x62 cells of 6x6 Km²



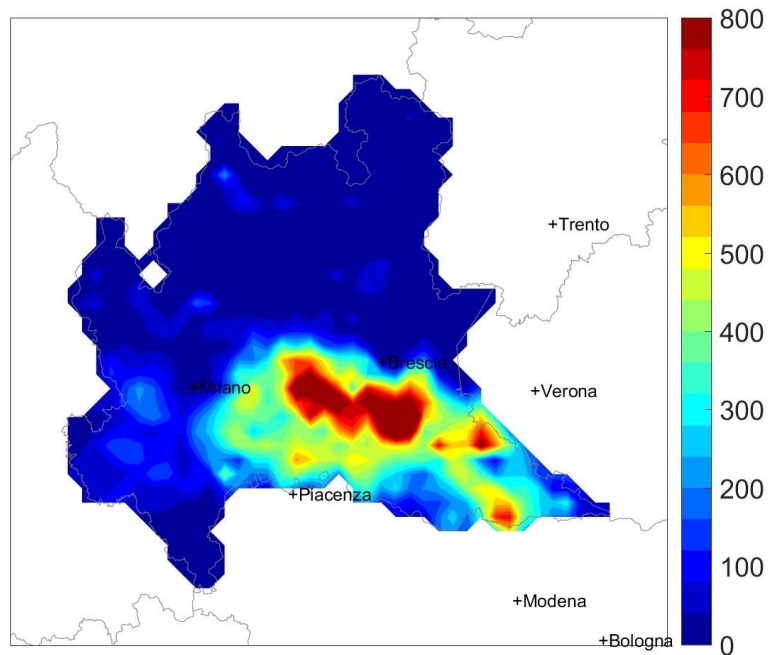
- PM10 exceeds limits
- Densely populated and industrialized
- Presence of intensive farming in the central/southern part of the domain

Protein reduction scenarios

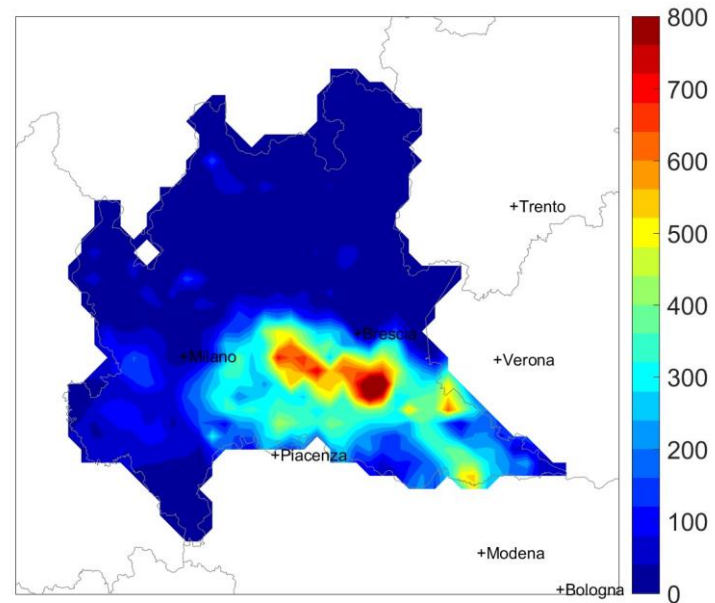
- **base case:** corresponding to the Current Legislation (CLE) scenario expected by the European Legislation for the year 2020;
- **Scenario A:** a 25% reduction of the breeding activities over the domain;
- **Scenario B:** a 50% reduction of the breeding activities over the domain.



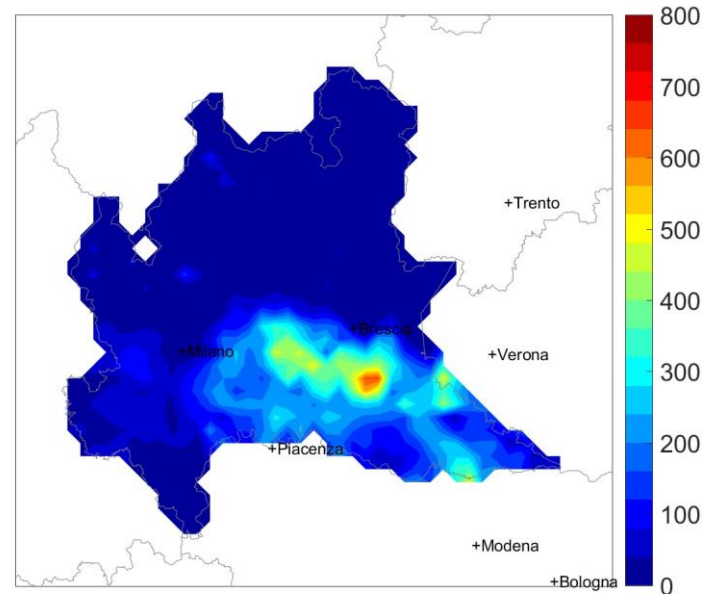
NH₃ emissions [t/year]



CLE 2020

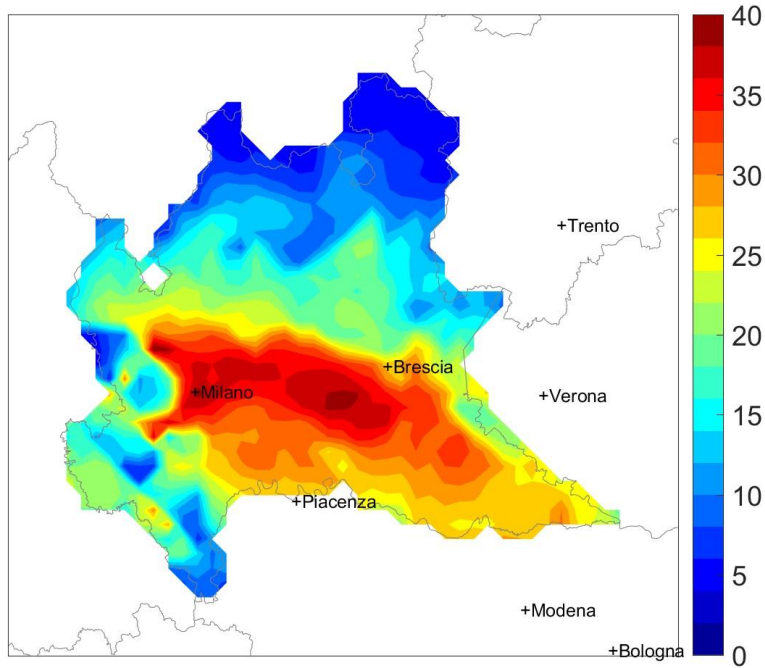


Scenario A

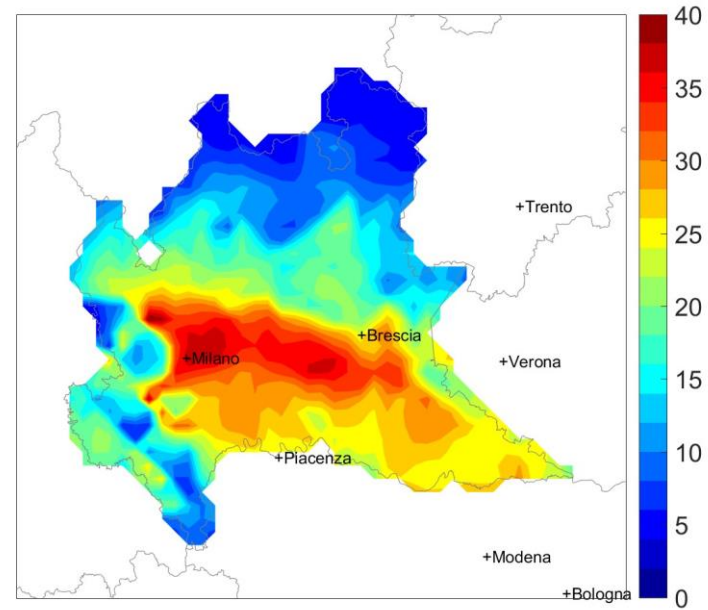


Scenario B

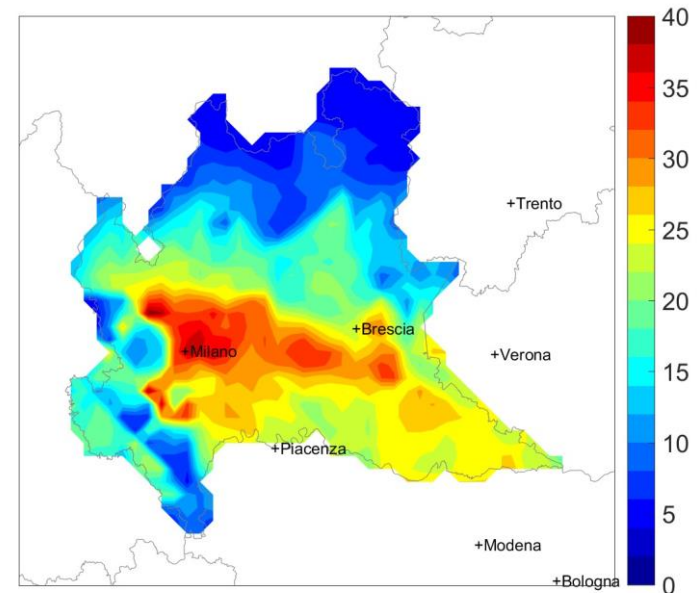
PM₁₀ concentrations [μg/m³]



CLE 2020



Scenario A



Scenario B

Max PM10 reduction [μg/m ³]	
Scenario A	5.34
Scenario B	10.04

Health impact assessment

	Long term PM₁₀ exposure (on total population)		Metabolic effects (on 50-65 years old people reducing protein consumption)	
	Total avoided YLL per year [years]	Total avoided premature deaths per year [-]	Total avoided YLL per year [years]	Total avoided premature deaths per year [-]
Scenario A	3622	724	9212	815
Scenario B	7477	1495		

Social acceptability

DCM identified **3 clusters** :

- **Cluster 1**: highly sensitive to the cost of a policy measure. **Not interested in policies implying a decrease in meat and dairy products consumption** even if this would be compensated by a reduction in premature deaths
- **Cluster 2**: might change her/his dietary habits only after **compensation**, (reduction of premature deaths) and are favourable to the “polluters pay more” principle.
- **Cluster 3**: highly e positively **sensitive to a dietary change**, also if this would imply higher costs

Social acceptability

Percentage of animal protein consumption

	Base scenario	Scenario A	Scenario B
Cluster 1	43%	43%	43%
Cluster 2	29%	25%	22%
Cluster 3	28%	7%	-15%
Total animal protein consumption	100%	75%	50%

Conclusions

- **Significant but not decisive health benefit** due to lower **PM₁₀ population exposure** and a **metabolic health benefit** of the **same order of magnitude**.
- Co-benefits for **CH₄ emissions reduction**.
- In principle a 25% reduction of protein consumption is socially accepted.
- **End-of-pipe and energy measures** are needed in order to reduce **NH₃ and CH₄ emissions from the breeding activities**



UNIVERSITÀ
DEGLI STUDI
DI BRESCIA



SEFIRA IS A EU FP7 COORDINATION ACTION ON
Socio Economic Implications
For Individual Responses to
Air Pollution policies in EU +27

EU FP7 SEFIRA project (603941)



Appraisal project

EU FP7 APPRAISAL project (308395)

Thank you for your attention

email: enrico.turrini@unibs.it



M. Volta, E. Turrini, C. Carnevale, E. Valeri, V. Gatta, P. Polidori, M. Maione, Co-benefits of changing diet. A modelling assessment at the regional scale integrating social acceptability, environmental and health impacts, *Science of The Total Environment*, Volume 756, 2021, 143708, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2020.143708>.