Life cycle assessment of pig rearing with wet acid scrubber for ammonia emissions reduction

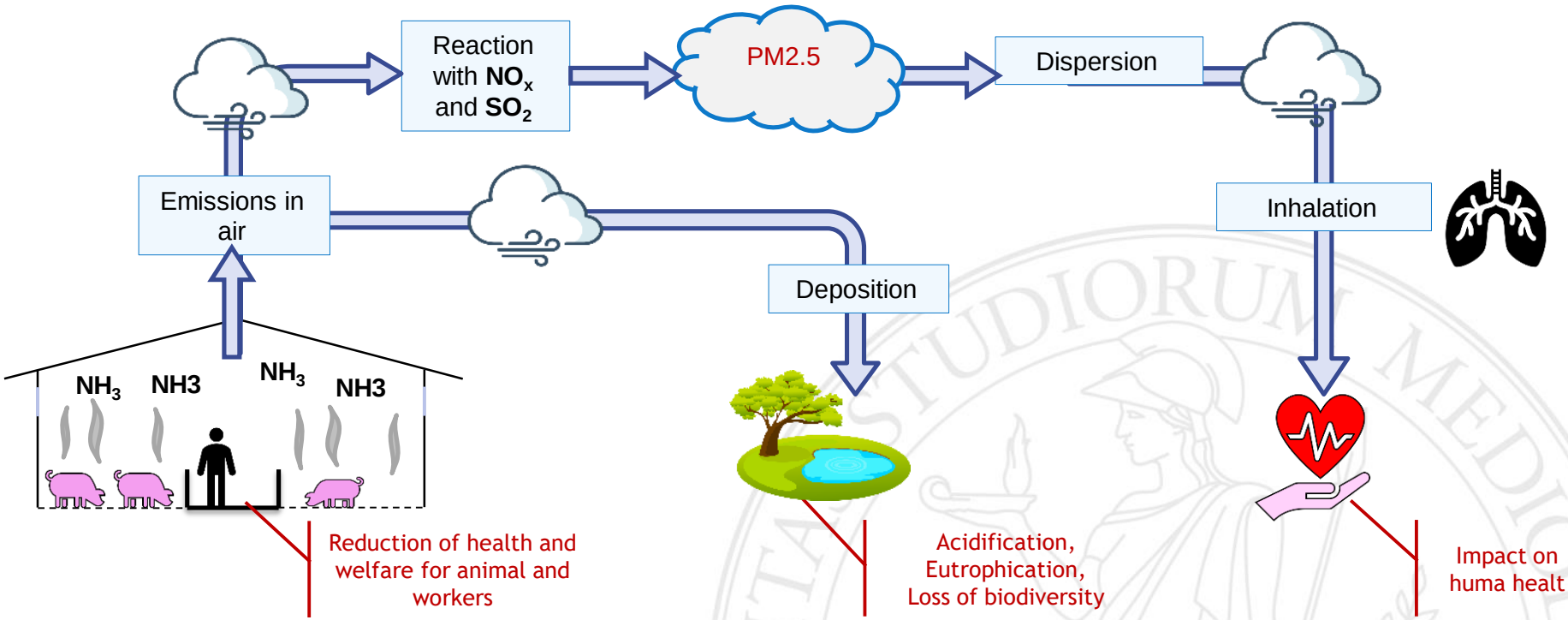
Bacenetti Jacopo, Conti Cecilia, Costantini Michele, & Guarino Marcella

Department of Environmental Science and Policy (ESP)

University of Milan

jacopo.bacenetti@unimi.it

Agriculture is responsible of about 95% of ammonia emission…
Pig rearing systems is one of the main emission source due to emission during rearing and manure management



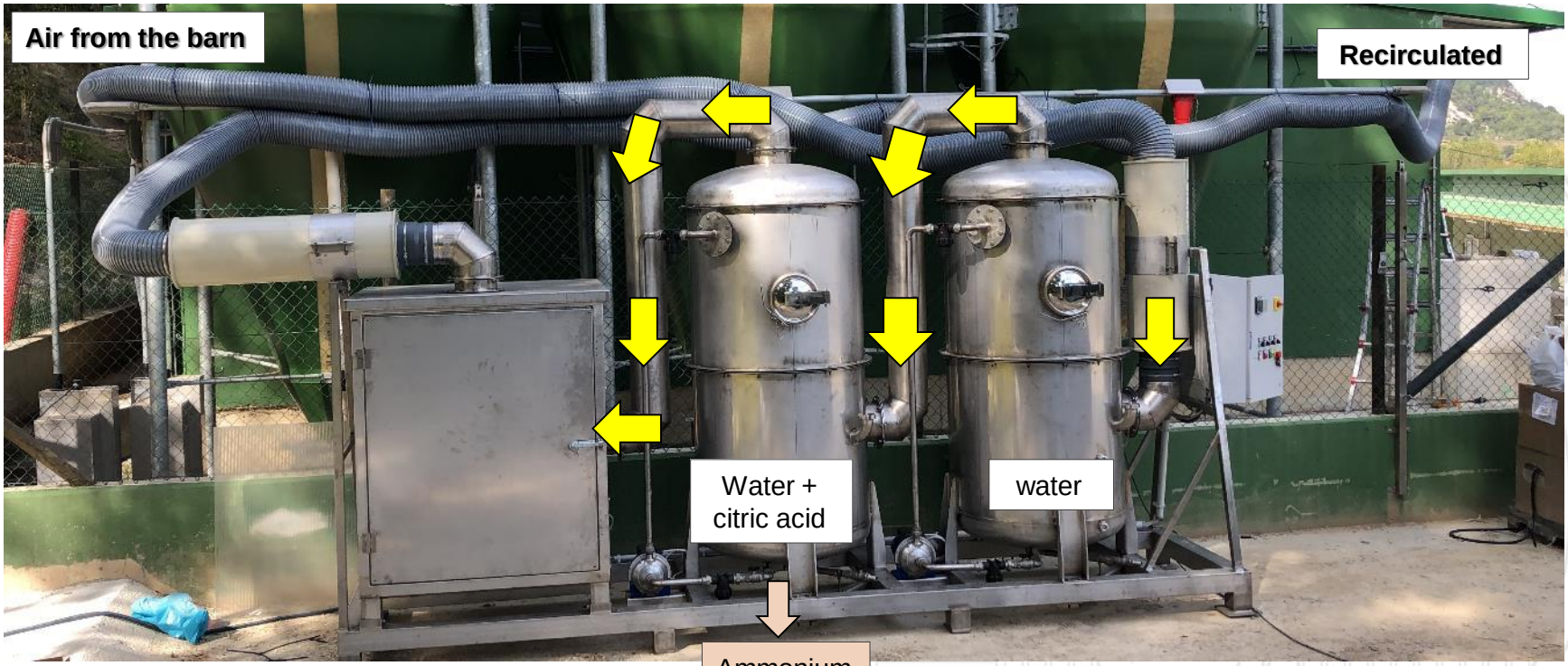
→ Different mitigation strategies were tested. Among these, for the reduction of the emission inside the pig barns the scrubbers is one of the most effective

Life-MEGA

Context → EU pig system

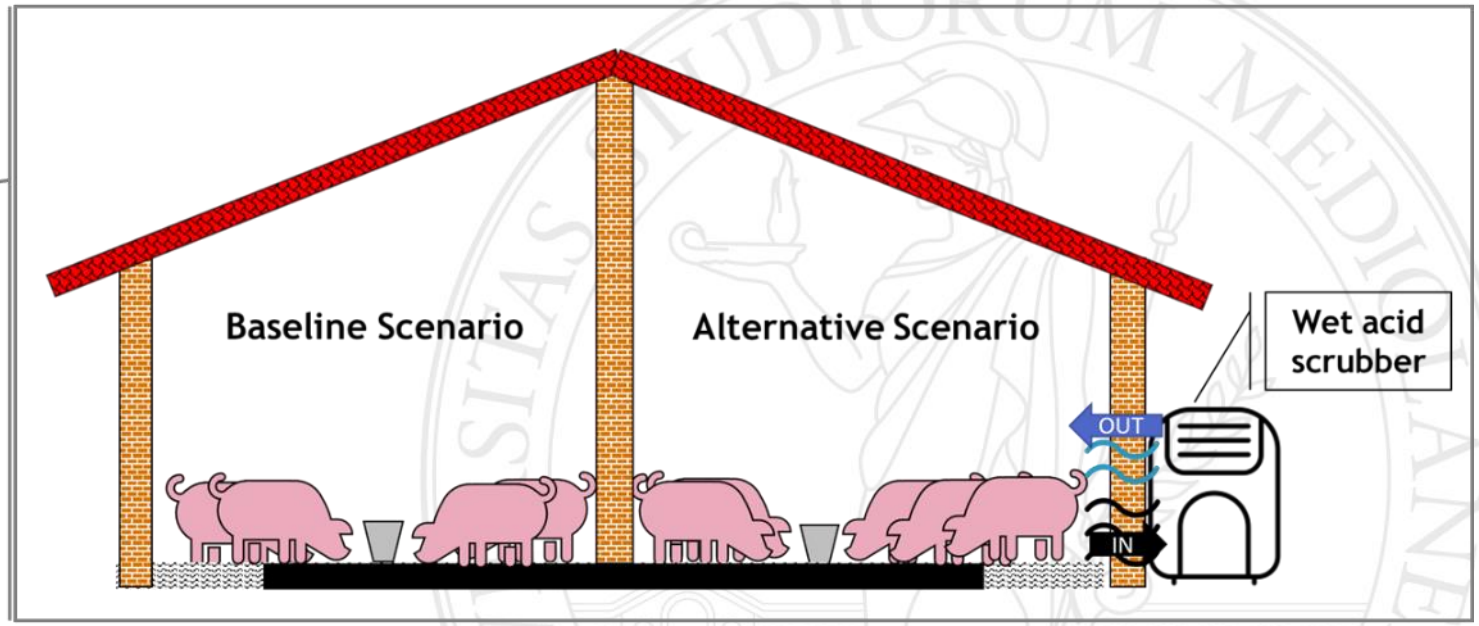
Aim → The Life MEGA project aims at developing and testing “smart” scrubber for ammonia, particulate and odor in pig barns

Where → Lombardy (naturally ventilated pig facilities) and Catalunia (mechanically ventilated)



To assess, using the **Life Cycle Assessment** (LCA) approach, the effects of wet acid scrubber on the environmental impact of pig meat production in pig barns naturally ventilated.

Are there environmental benefits? Some tradeoffs among environmental impacts can be identified?



LCA

Defined by specific ISO standards, is the most widely accepted method to evaluate the environmental effects related to a production process. It considers the **whole life cycle** of the products from the extraction of raw materials to the management of the produced wastes

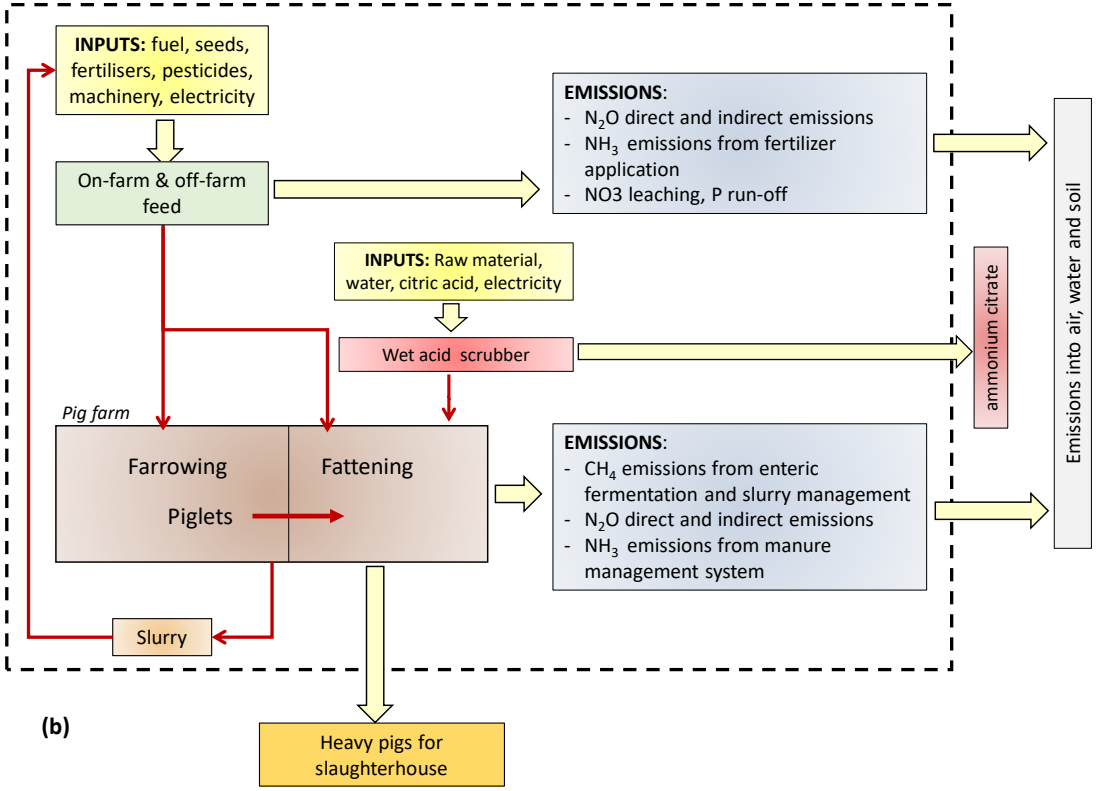
OUTPUT OF A LCA STUDY:

The environmental labels such as Carbon footprint & Water footprint are assessed by applying LCA

- **TO QUANTIY THE IMPACT & TO IDENTIFY** the environmental hotspots (processes mainly responsible of the impact)
- **TO COMPARE** different products or different production processes providing the same function

→ **The farm**: It is an intensive farrowing to finishing farm, which means that it produces piglets and raises them to market weight

→ Function unit: **1 kg of live weight** (LV), animal ready for the slaughterhouse
→ System boundary: «cradle-to-farm gate»
→ Baseline and alternative scenario



Scrubber (manufacturing + mantainance) and energy water and citric acid

Inventory Data Collection (LCI)

Primary data (farm surveys, farmer interviews)

- Rearing systems → feed, energy consumption, productivity, FCR
- scrubber → manufacturer and preliminary measurements

Secondary data:

- Emissions of GHG→ Guidelines IPCC
- Ammonia → Guidelines EEA

Dati Background:

Ecoinvent Database v.3

Inventory (LCI) in aggregated in **potential environmental impact (LCIA)**

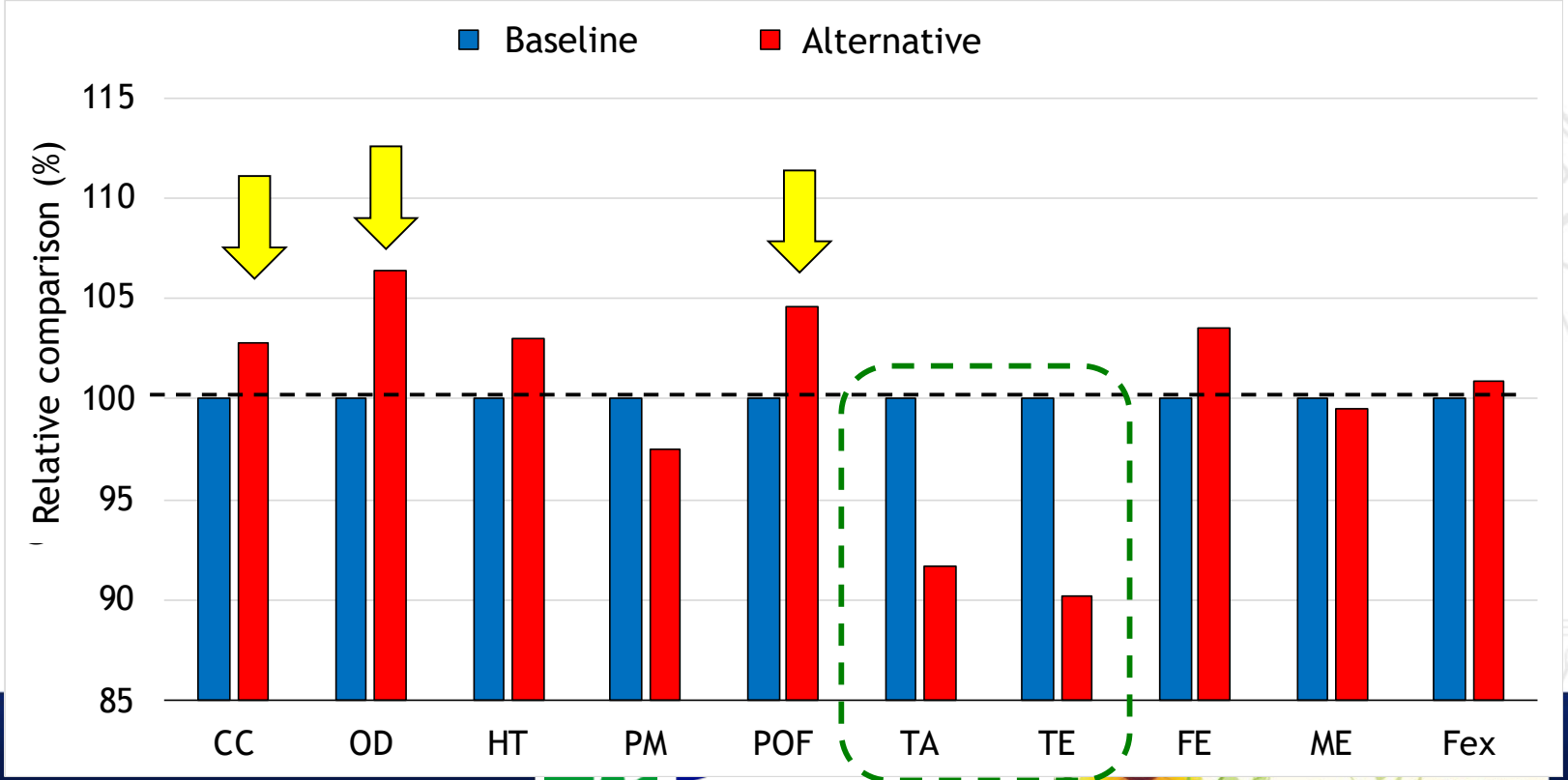
INDICATORI DI IMPATTO

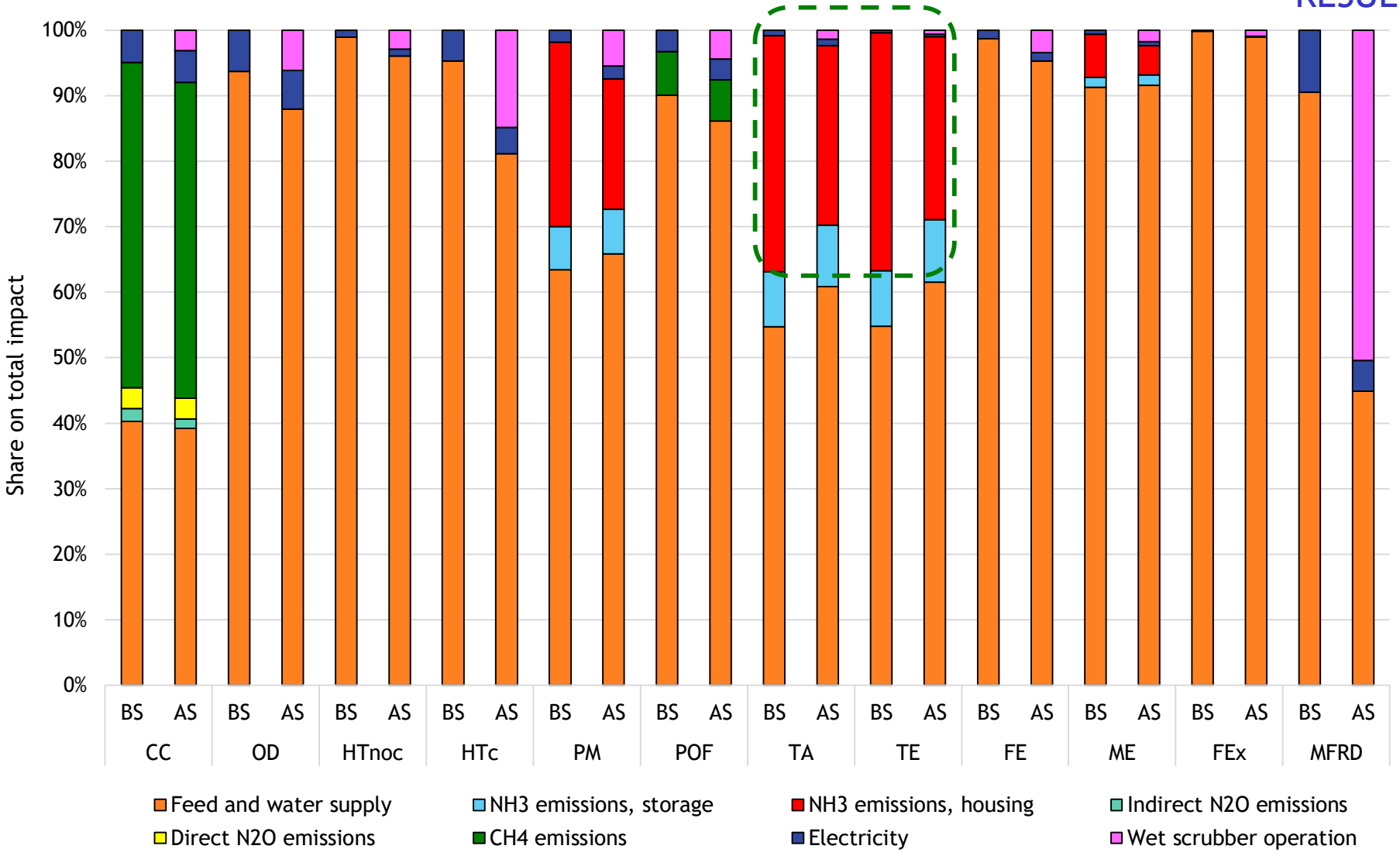
1. climate change (CC),
2. ozone depletion (OD),
3. human toxicity (HT),
4. photochemical oxidant formation (POF),
5. terrestrial acidification (TA),
6. freshwater eutrophication (FE),
7. terrestrial eutrophication (TE),
8. marine eutrophication (ME),
9. freshwater ecotoxicity (FEx),

Absolute results for 1 kg of live weight

RESULTS

Impact category	Unit of measure	BS	AS	Δ (%)
Climate change – CC	kg CO_2 eq	3.55	3.65	2.9
Ozone depletion – OD	kg CFC-11 eq · 10^{-7}	3.12	3.32	6.5
Human toxicity – HT	CTUh · 10^{-7}	7.08	7.29	3.0
Particulate matter formation – PM	kg $PM_{2.5}$ eq · 10^{-3}	3.28	3.20	-2.4
Photochemical ozone formation – POF	kg NMVOC eq · 10^{-2}	1.08	1.13	4.7
Acidification – TA	molc H+ eq	0.12	0.11	-8.5
Terrestrial eutrophication – TE	molc N eq	0.51	0.46	-9.3
Freshwater eutrophication – FE	kg P eq · 10^{-4}	4.49	4.65	3.5
Marine eutrophication – ME	kg N eq · 10^{-2}	1.93	1.92	-0.2
Freshwater ecotoxicity - Fex	CTUe	23.74	23.95	0.9





Climate change – CC, Ozone depletion – OD, Human toxicity – HT, Particulate matter formation – PM, Photochemical ozone formation – POF, Acidification – TA, Terrestrial eutrophication – TE, Freshwater eutrophication – FE, Marine eutrophication – ME, Freshwater ecotoxicity – Fex, Mineral fossil & renewable resource depletion - MFRD

- The wet acid scrubber can have a positive effect for all the impact categories deeply affected by ammonia emissions.
- On the other side, there are some tradeoffs. The consumption of electricity and citric acid scrubber as well as the manufacturing of the scrubber involve an impact increase for other environmental effects
- The installation of ***smart control unit*** for the automatic control of the scrubber (depending on the ammonia concentration) we are reducing the consumption of citric acid and electricity without reducing the abatement efficiency
- Valorisation of the ammonium citrate to substitute mineral fertilizers

THANK YOU FOR YOUR ATTENTION

For more info https://lifemega.unimi.it/

Life-MEGA

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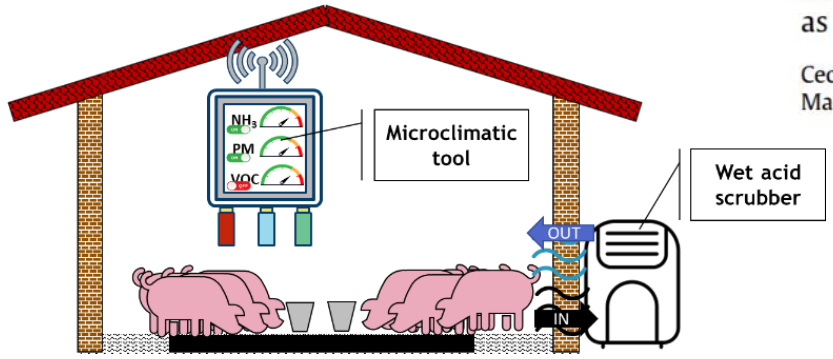

Environmental impact of pig production affected by wet acid scrubber as mitigation technology

Cecilia Conti[a], Michele Costantini[a,*], Alessandra Fusi[a], Alessandro Manzardo[b], Marcella Guarino[a], Jacopo Bacenetti[a]