Are emission control policies and technologies sufficient to mitigate harm of poor air quality?

https://www.safera.com/fine-particles-pm25-are-significant-health-risk/
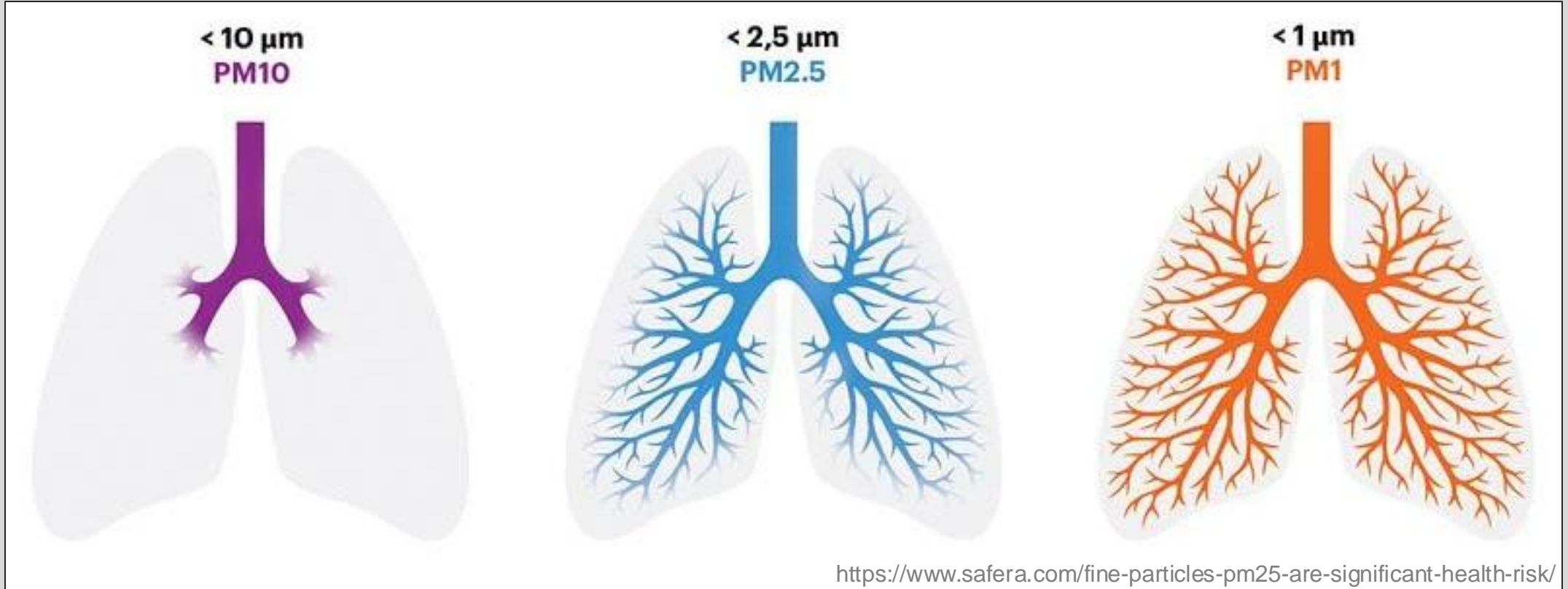
Royal Society Bilateral Meeting   **Eloise A Marais**   **25 September 2024**

UK Trends in Air Pollutant Precursor Emissions
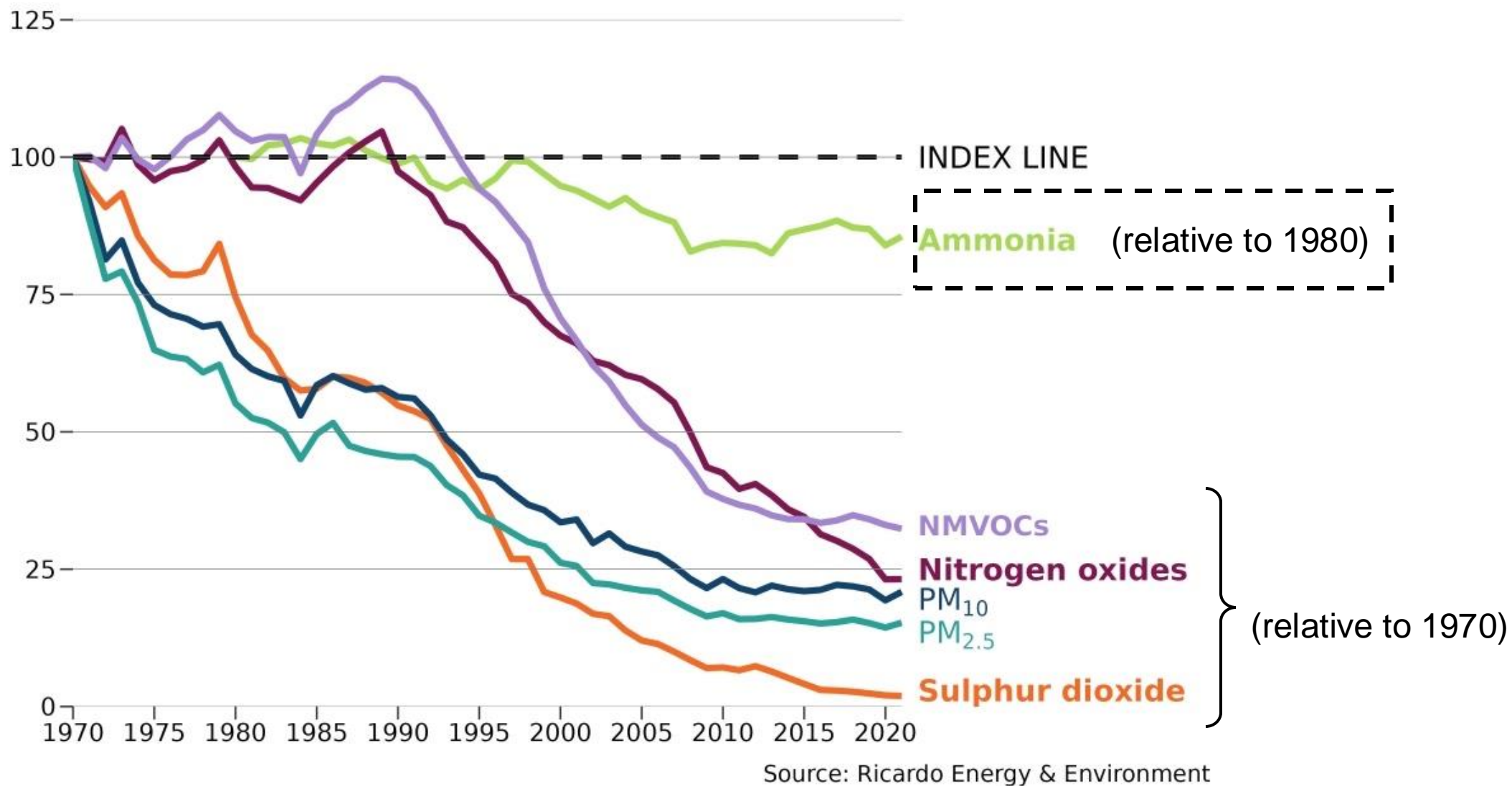

Source: Ricardo Energy & Environment

Image source: https://www.gov.uk/government/statistics/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-summary

Ammonia (NH_3) stagnant in comparison to all other precursor emissions
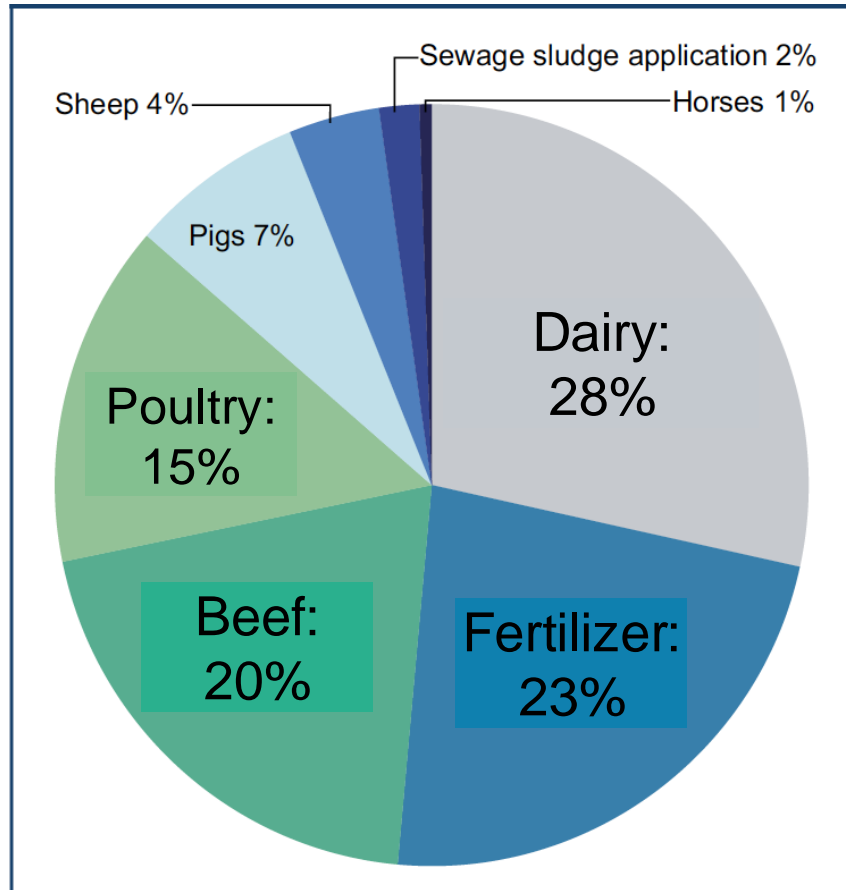
Agriculture a Large Source of Ammonia (NH_3)

~80% nitrogen (N) wasted due to inefficient use
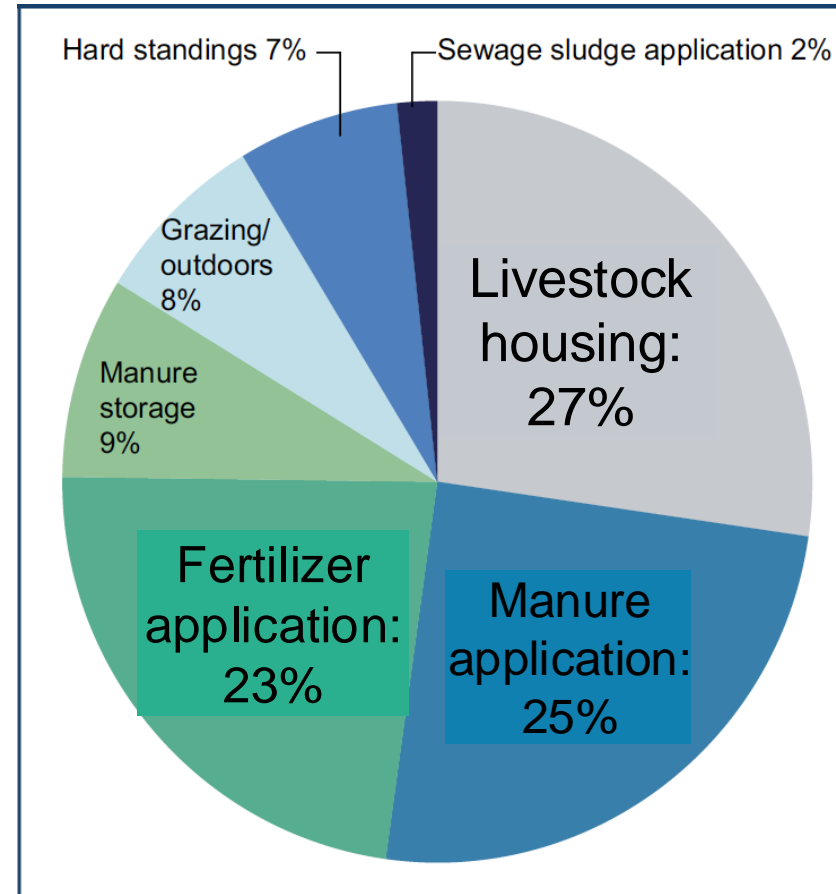
200 million tonnes costing USD 200 billion

Farming Practices that Releasing NH$_3$

UK NH$_3$ Emissions by activity and category
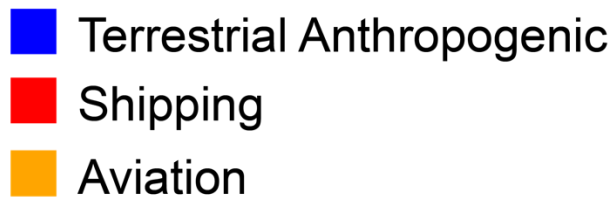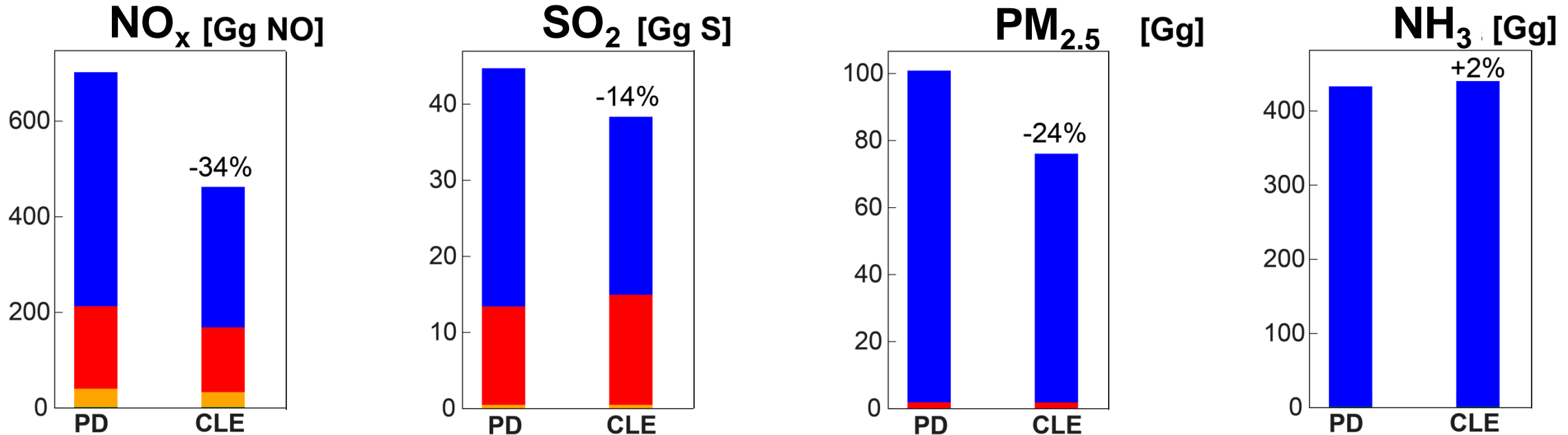

by farming activity

by management category

[UK Clean Air Strategy, 2019]

Emission Control Options for the UK

Legislated emissions targets (**CLE**)

Emissions for present-day or PD (**2019**) and future (**2030**) for legislation (**CLE**)

NO$_x$ [Gg NO]   **SO$_2$ [Gg S]**   **PM$_{2.5}$ [Gg]**   **NH$_3$ [Gg]**

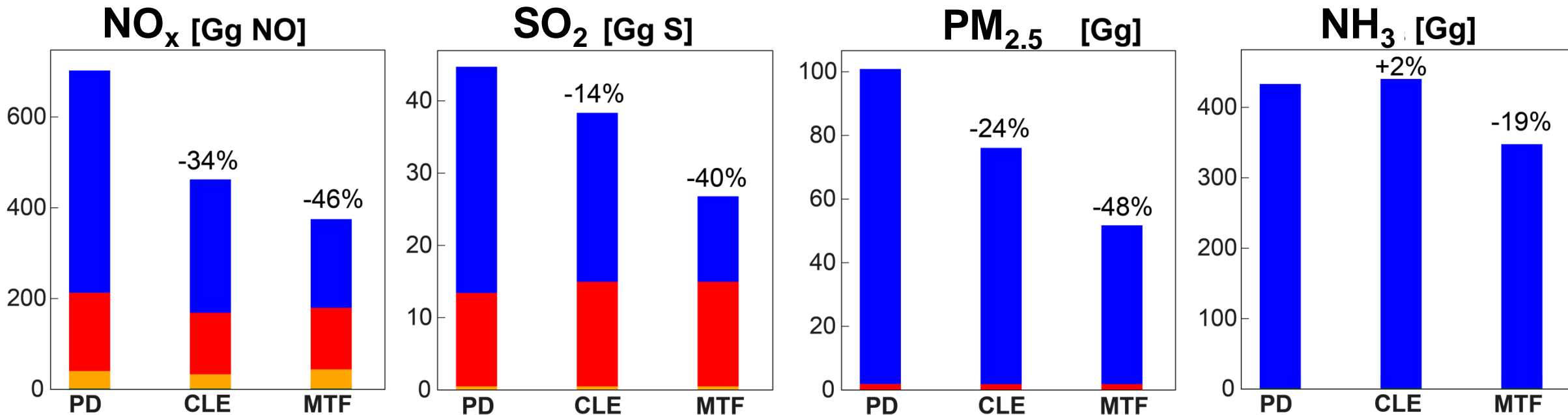- ■ Terrestrial Anthropogenic
- ■ Shipping
- ■ Aviation

Projections from **ECLIPSE v6b** for all but aviation (from **IPCC**)

NH$_3$ emissions increase, as controls insufficient to curtail increases from growth in demand

Emission Control Options for the UK

Adoption of best best, readily available technology (MTF)

Emissions for present-day (**2019**) and future (**2030**) for legislation (**CLE**) vs best-available technology (**MTF**)

NO$_x$ [Gg NO]

-34%
-46%

SO$_2$ [Gg S]

-14%
-40%

PM$_{2.5}$ [Gg]

-24%
-48%

NH$_3$ [Gg]

+2%
-19%

■ Terrestrial Anthropogenic
■ Shipping
■ Aviation

Projections from **ECLIPSE v6b** for all but aviation (from **IPCC**)

Best technology decreases all precursors except ammonia (NH$_3$) by 40-48%

NH$_3$ controls limited to suggested rather than enforced measures

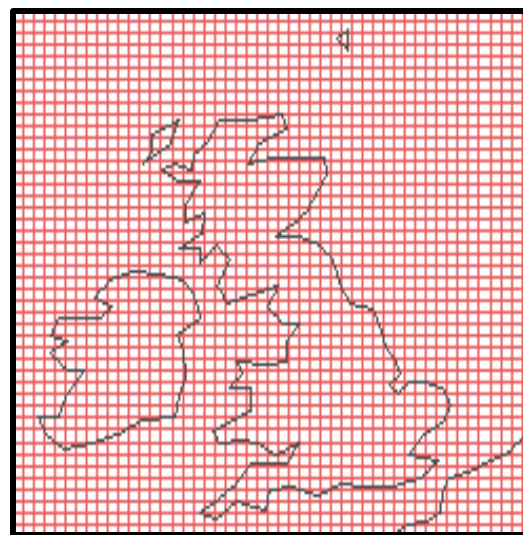# Influence of Emission Controls on fine particle (PM$_{2.5}$) pollution

Emissions

GE❂S-Chem

Nested over the UK at 0.25° x 0.3125°

Gas- and aerosol-phase chemistry, transport, wet+dry deposition

Future:
scale 2019 emissions with projections
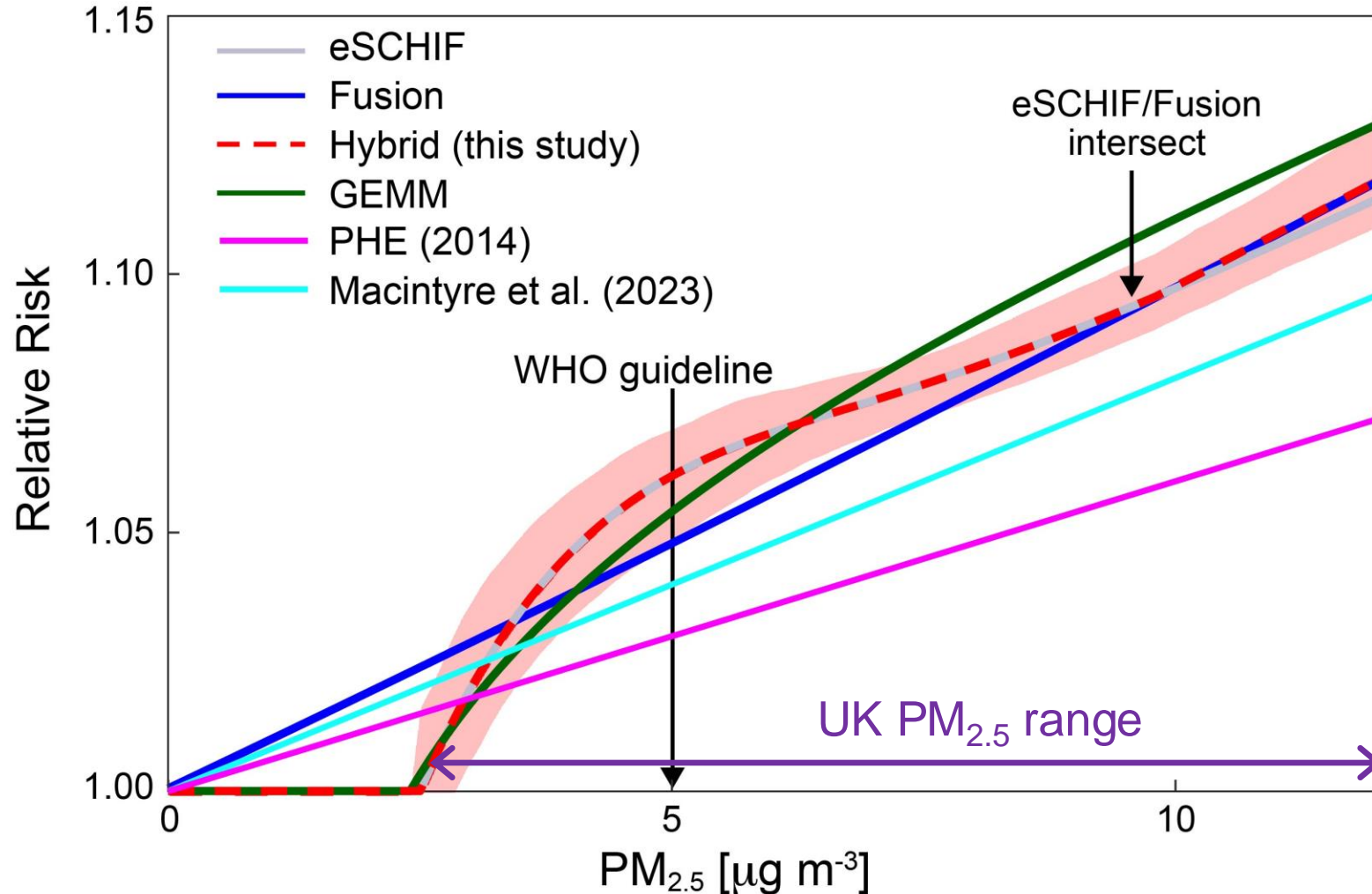
NASA GEOS-FP Meteorology

2019

Future ambient PM$_{2.5}$ concentrations

Relating long-term PM$_{2.5}$ exposure to adverse health outcomes

Hybrid curve combines Fusion and CanCHEC

Approach motivated by Weichenthal et al. (2022)

PHE (2014):
Public Health England report

MacIntyre et al. (2023):
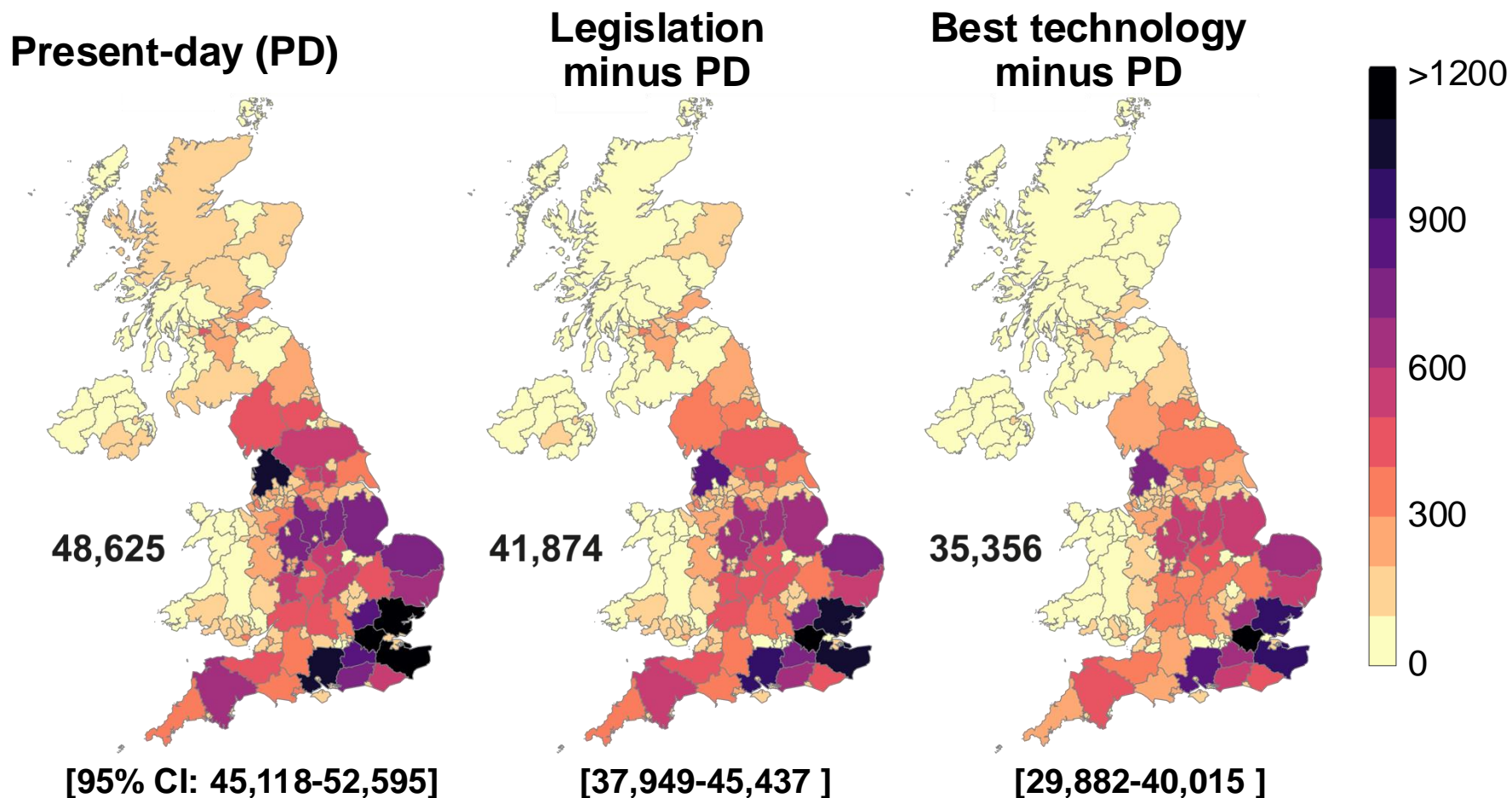doi:10.1016/j.envint.2023.107862

GEMM:
Global Exposure Mortality Model

Hybrid:
eSCHIF at 2.5-9.8 µg m^{-3} and
Fusion beyond 9.8 µg m^{-3}

85% of UK grids use eSCHIF in the present day; 100% in future for both scenarios. None are < 2.5 µg m^{-3}

Adult premature mortality from long-term exposure to PM$_{2.5}$

Values for all 184 administrative areas in the UK (115 in England, 32 in Scotland, 22 in Wales, 11 in N. Ireland)

Present-day (PD)

48,625

[95% CI: 45,118-52,595]

Legislation minus PD

41,874

[37,949-45,437]

Best technology minus PD

35,356

[29,882-40,015]

6,751 avoided early deaths with legislated controls, double that (13,269) with best available technology

Burden of disease estimates greater than past UK-focused studies and similar to those obtained with GEMM curve