

The science of super-pollutants:

Super Pollutants and their Fast-Acting Solutions for Climate, Health, and the Economy

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DELIVERING CLEAN AIR FOR CLIMATE AND HEALTH

- CAF launched in 2019 with support and backing from a number of foundations
- We have launched a broad and inclusive clean air movement that advocates for climate-friendly solutions
- CAF and our grantees have achieved early wins including:
 - ✓ More than \$200m in funding for the movement
 - ✓ Ambitious government action
 - ✓ The first ever business coalition for clean air

Breathe Cities: **284 Mt**

CO₂e emissions avoided by 2030*

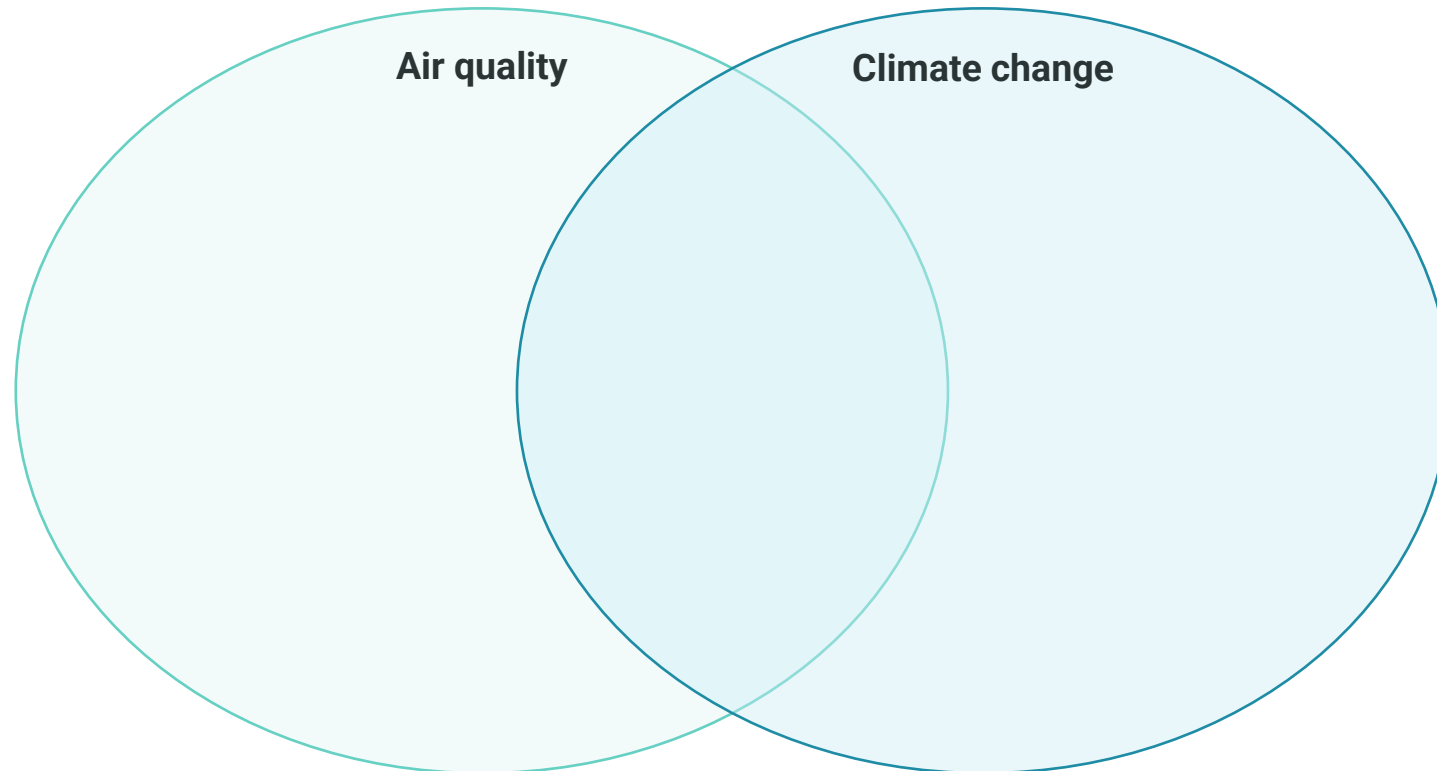
Super Pollutants: **35%**

emissions reduction of black carbon by 2030 from a 2010 baseline

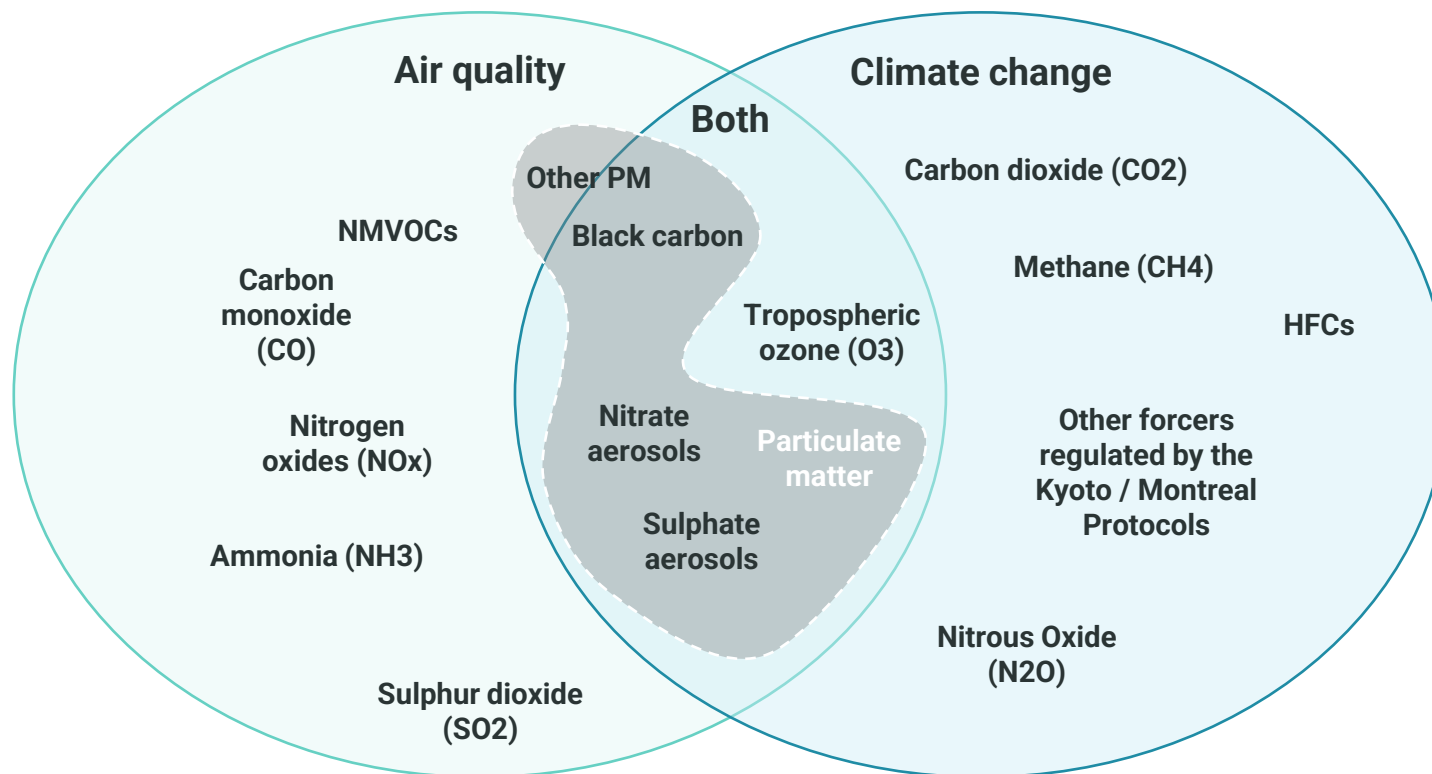
*Estimates produced via simplified modelling and not including aerosols in CO₂e

SHARED POLLUTANTS

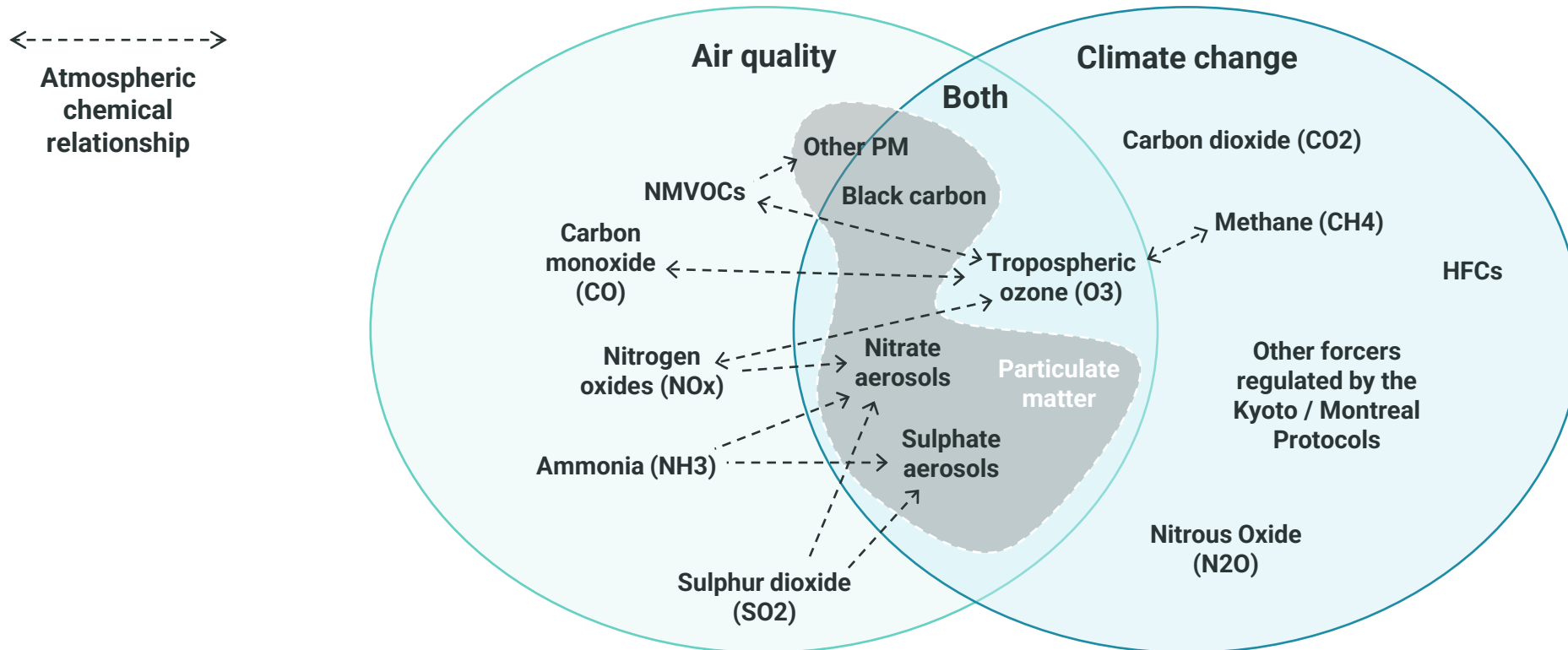
CLEAN
AIR
FUND



SHARED POLLUTANTS



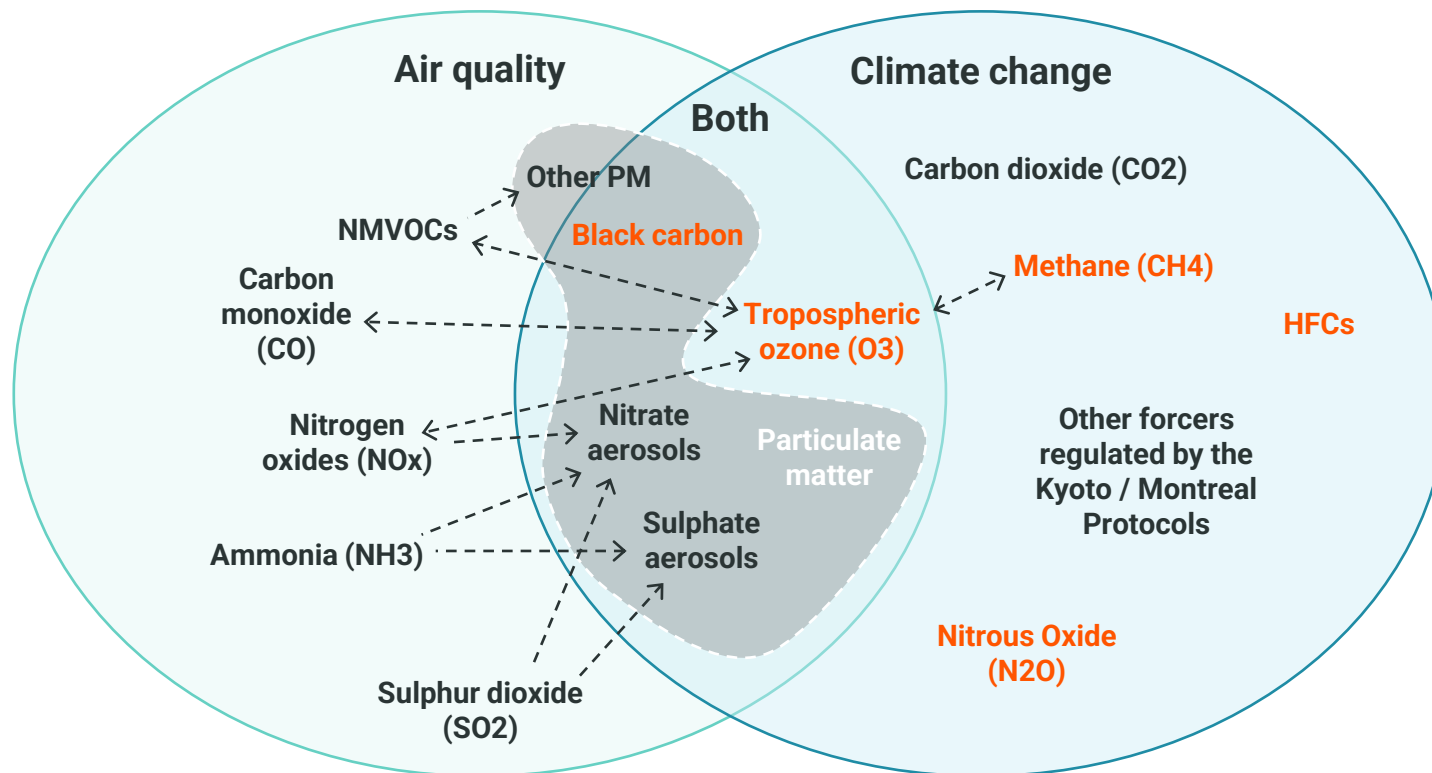
SHARED POLLUTANTS



SHARED POLLUTANTS

↔
Atmospheric
chemical
relationship

- Super pollutants:
- Methane
 - Black carbon
 - Tropospheric ozone
 - HFCs
 - Nitrous oxide

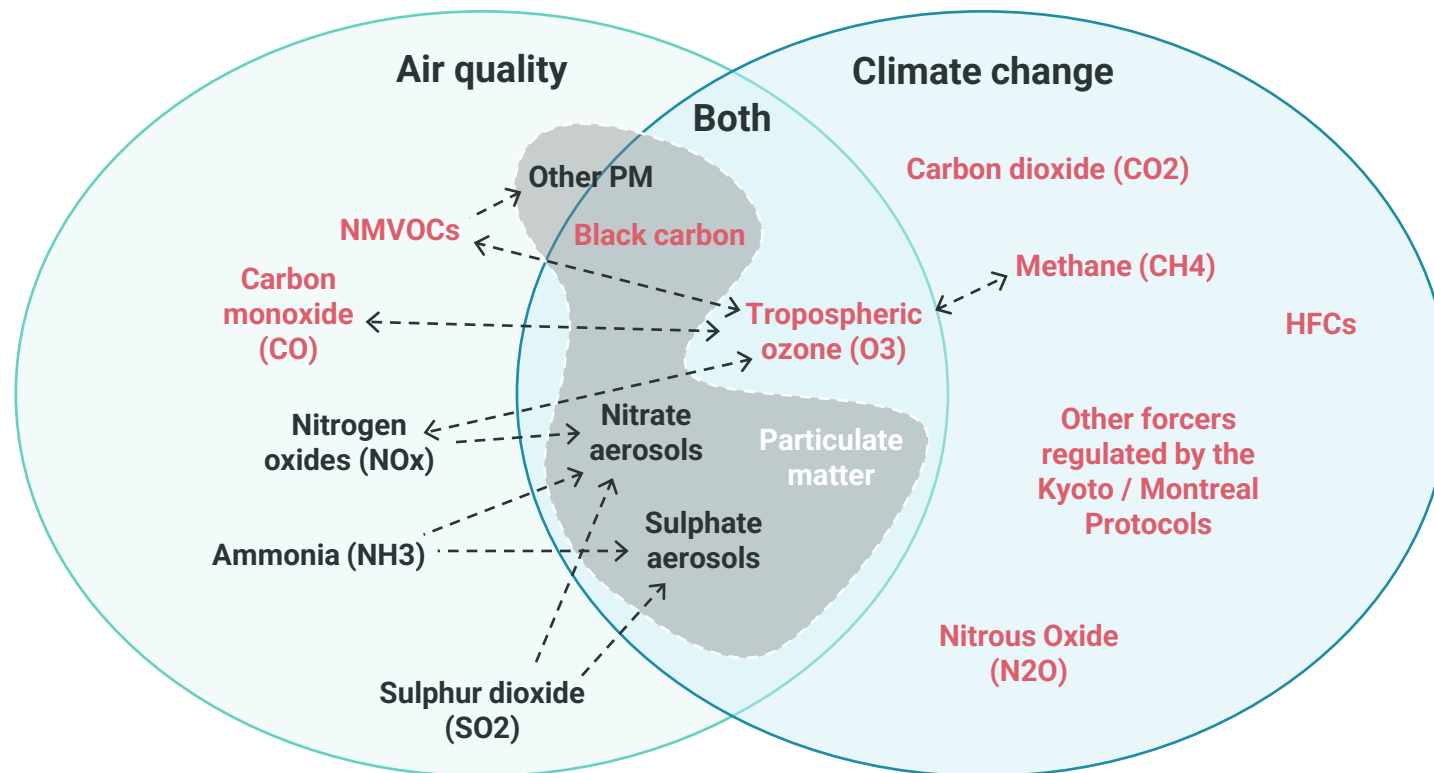


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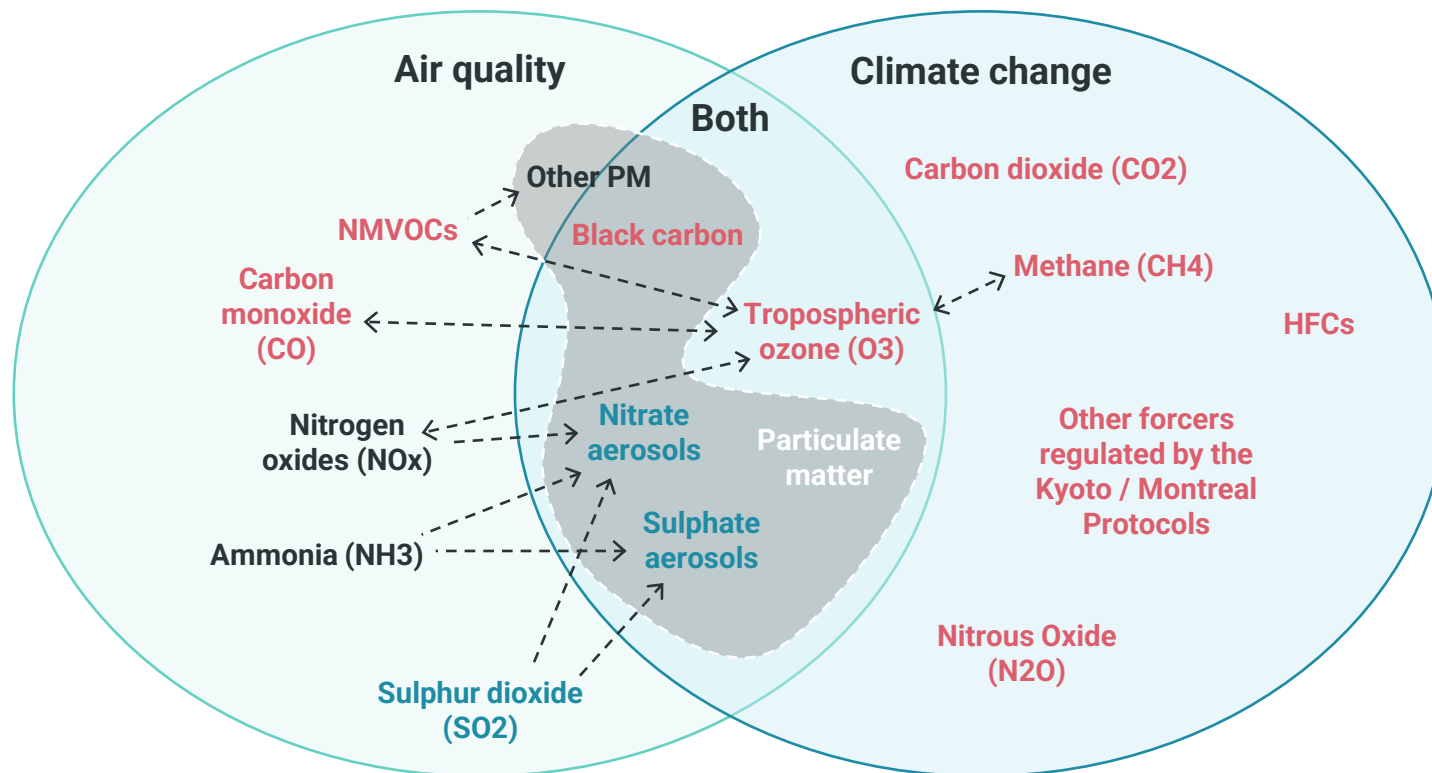


Warming

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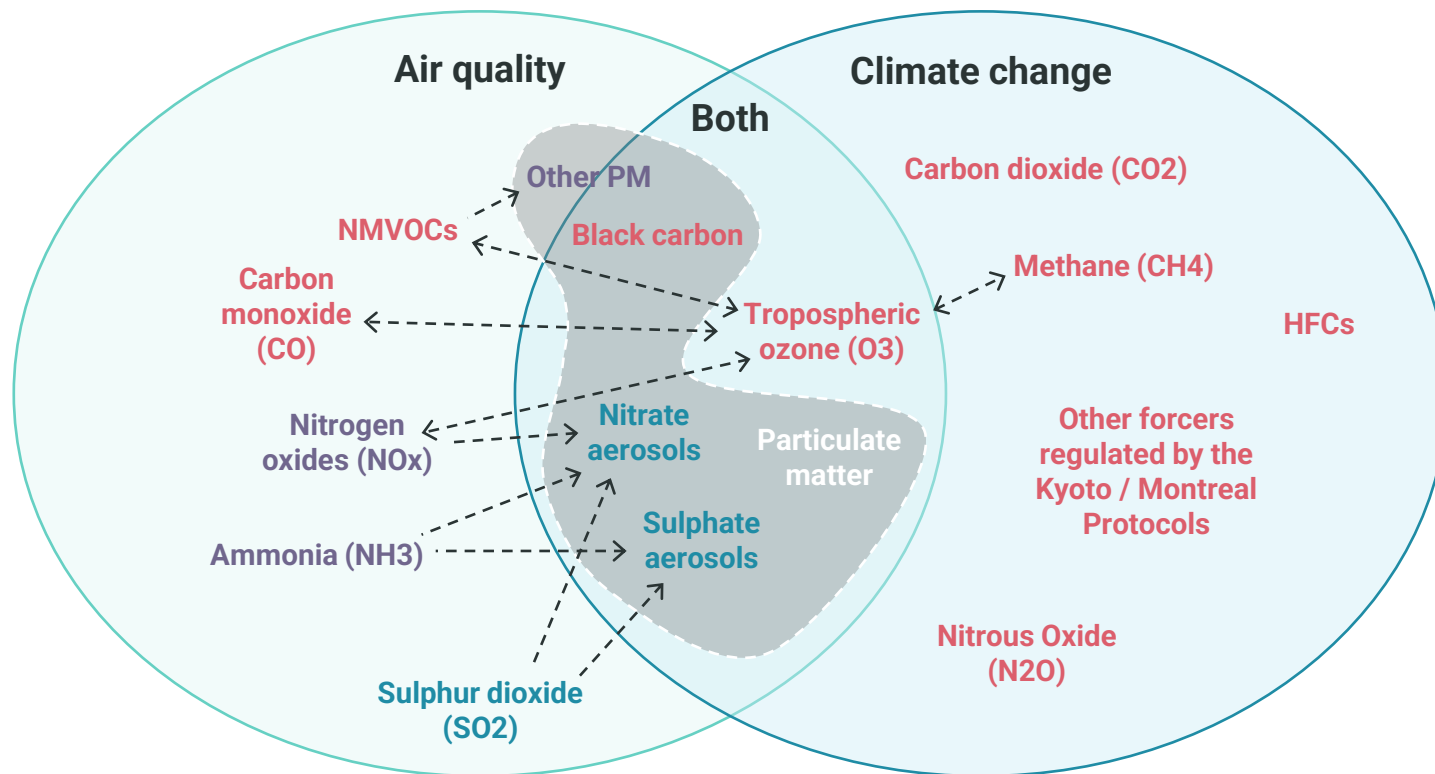
Warming

Cooling

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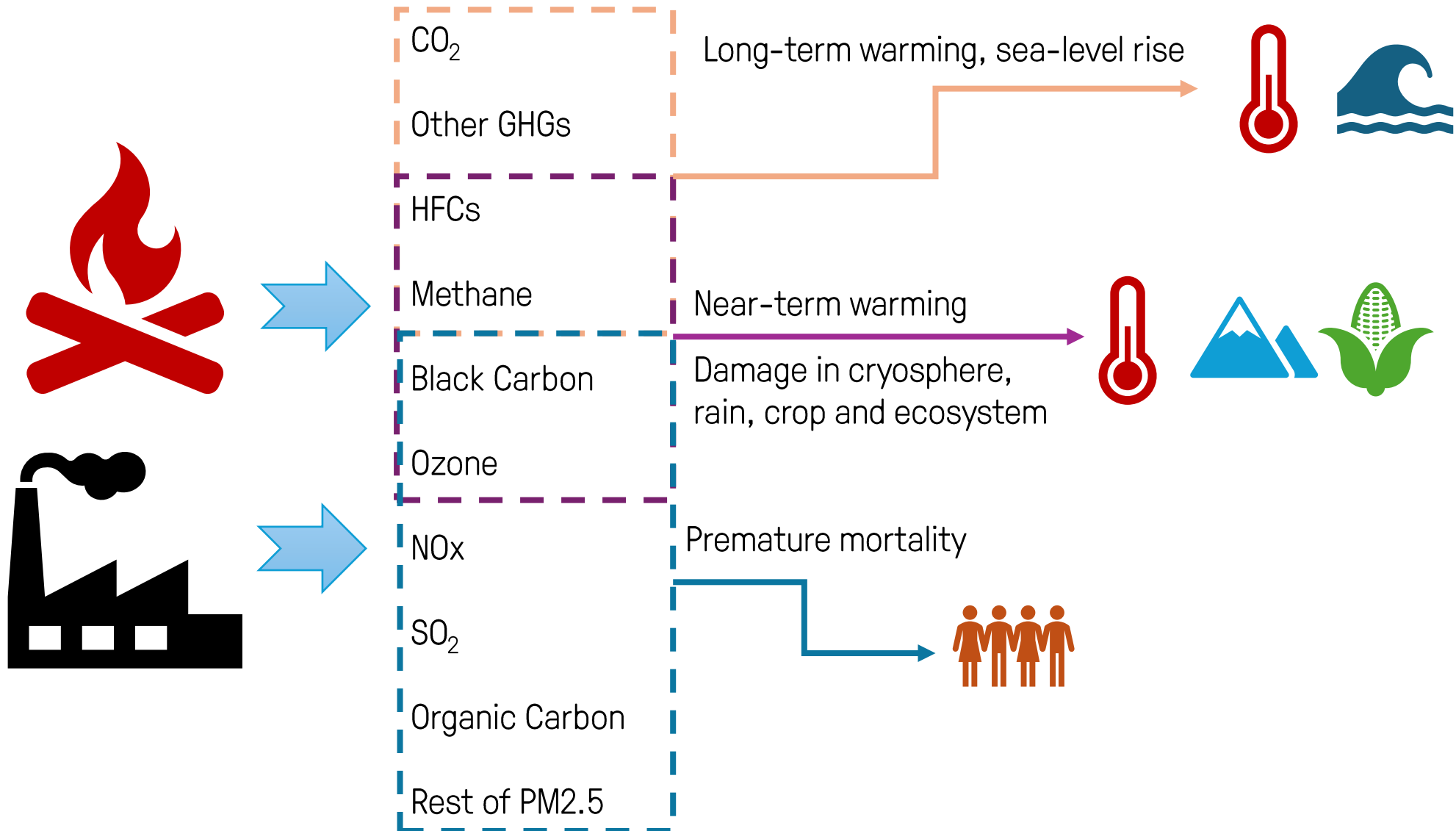


Warming

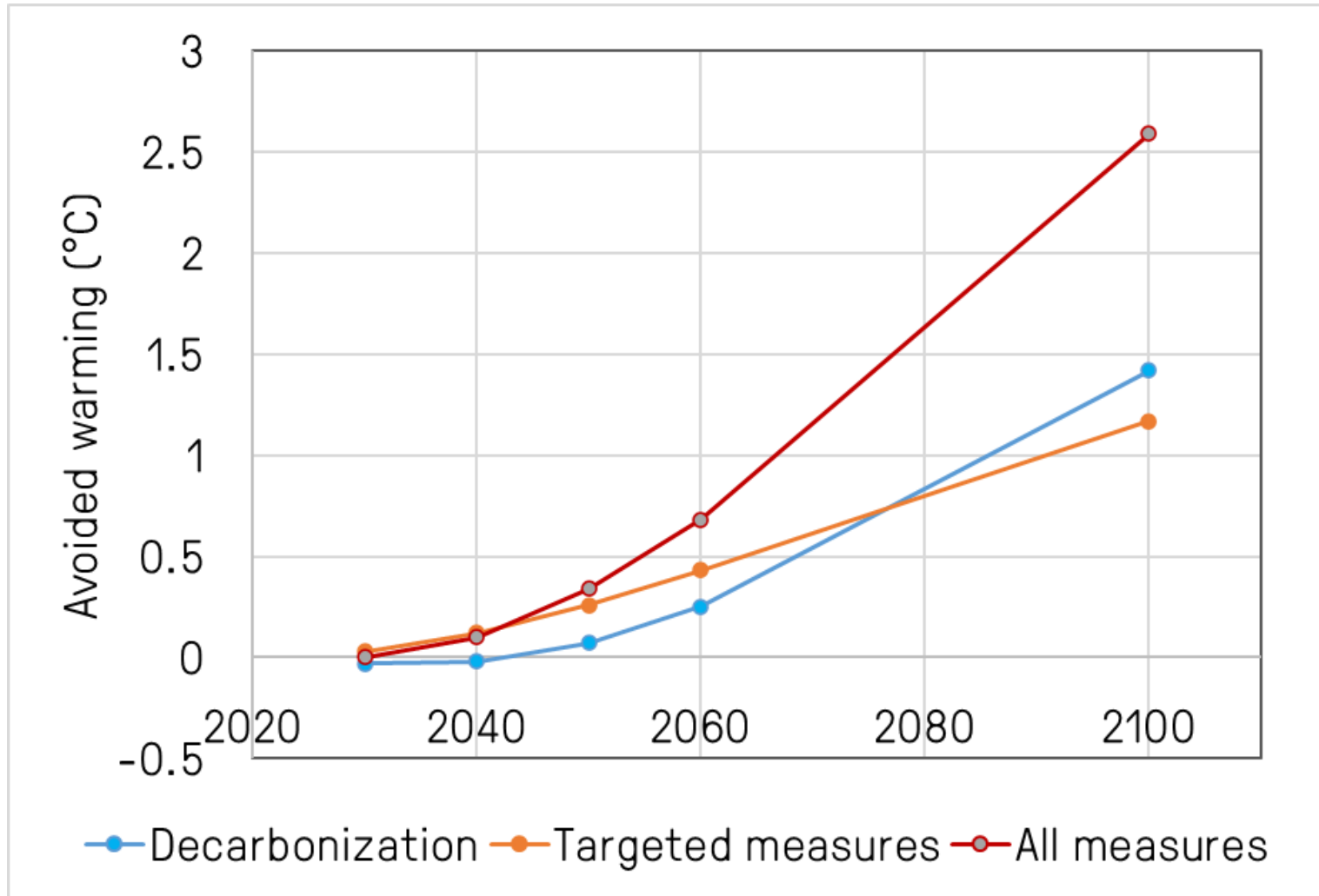
Cooling

Mixed

WHY SUPER-POLLUTANTS AND WHY NOW?

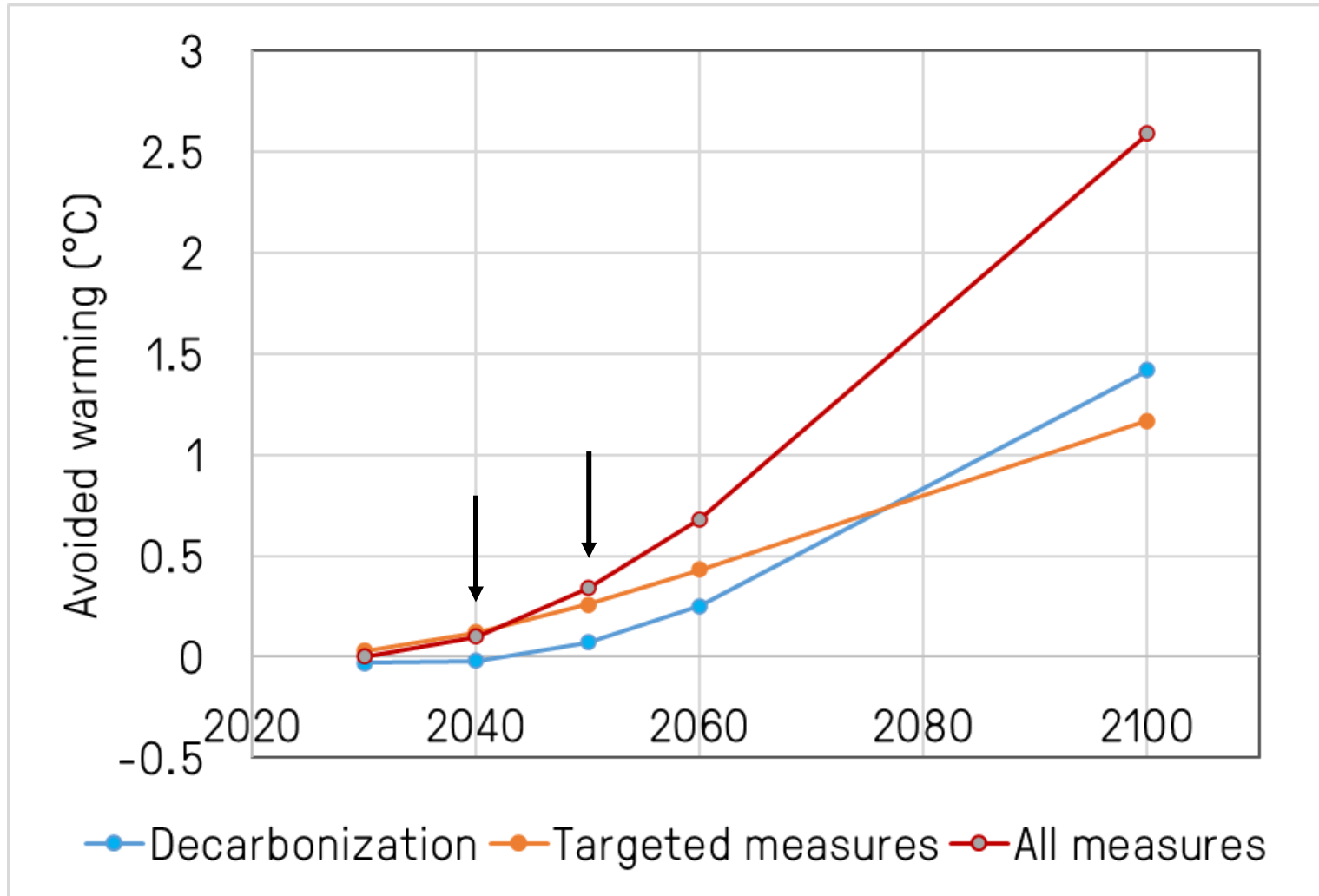


Decarbonization: essential but not sufficient



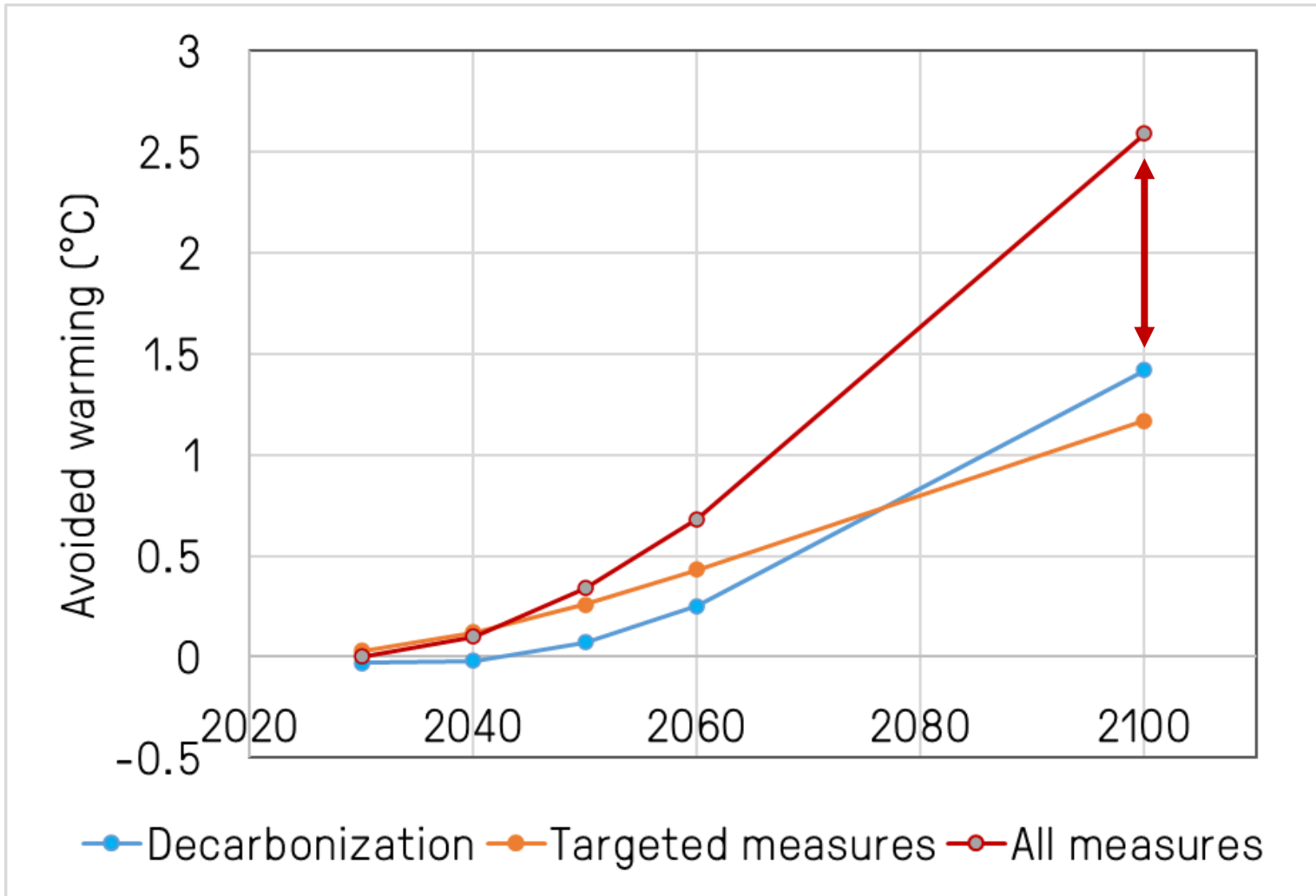
Gabrielle B. Dreyfus, 2022

Decarbonization: essential but not sufficient



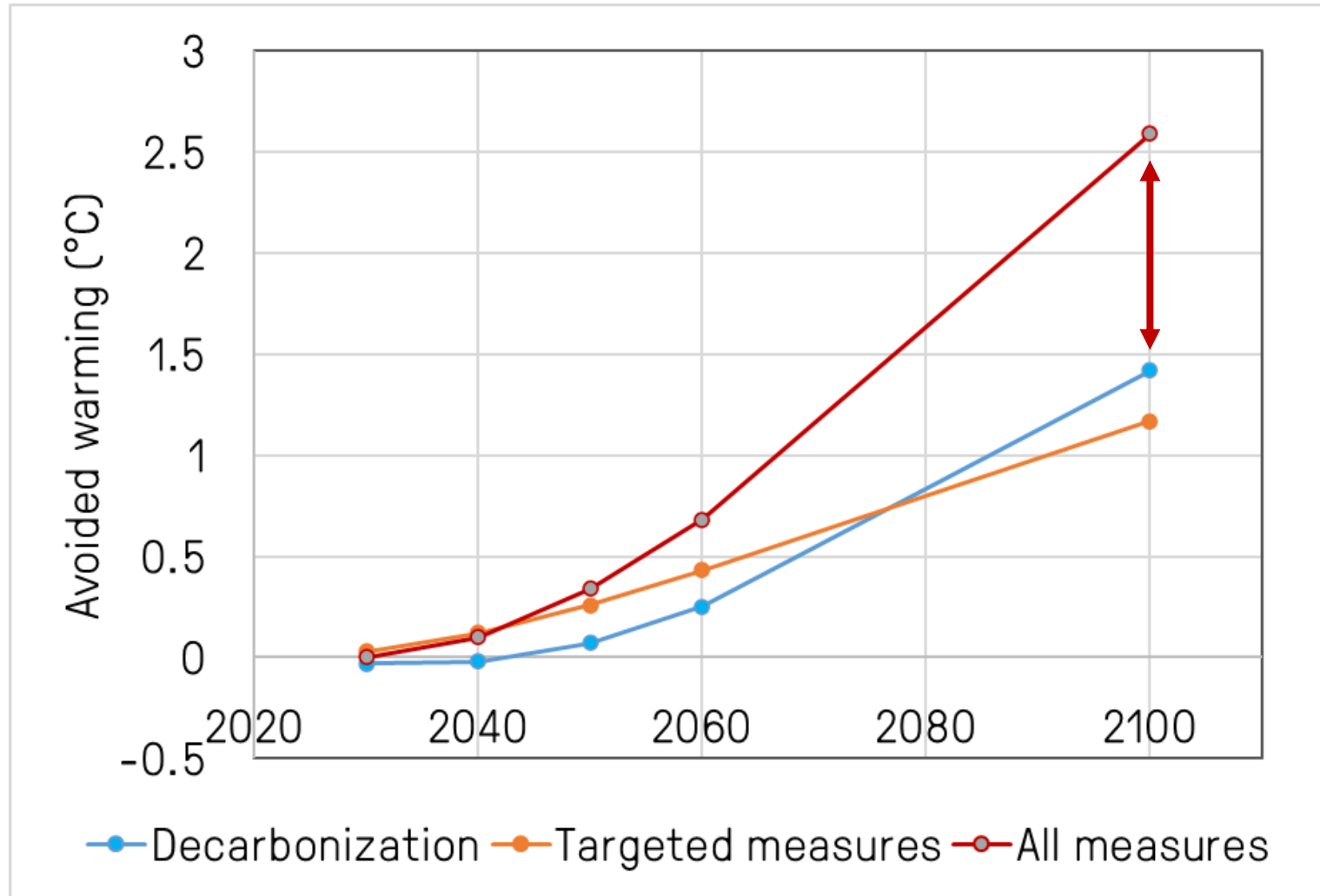
Gabrielle B. Dreyfus, 2022

Decarbonization: essential but not sufficient



What would happen with the additional $\sim 1.2^{\circ}\text{C}$ warming?

Decarbonization: essential but not sufficient



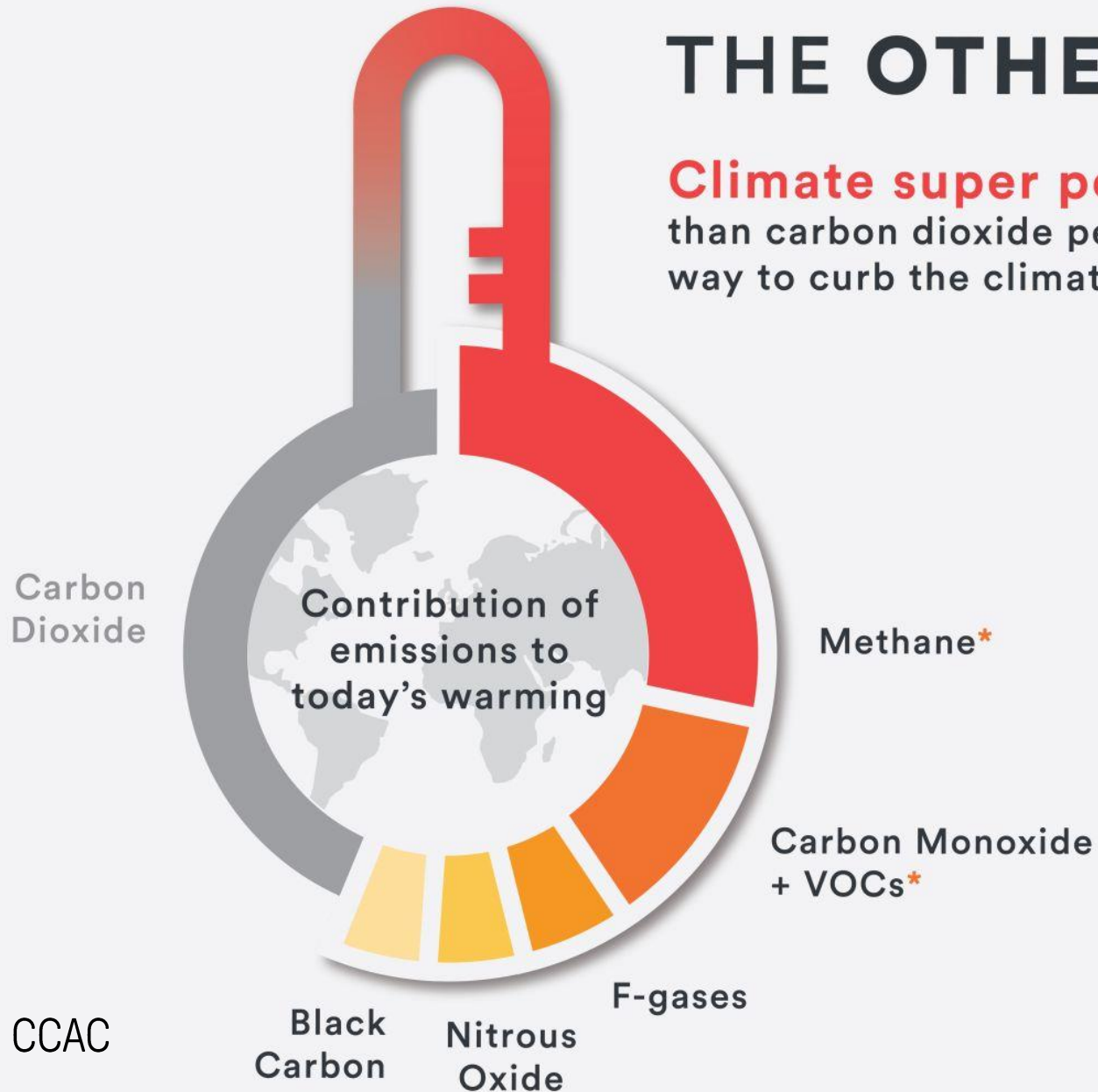
Tipping points



More extreme events

THE OTHER HALF OF WARMING

Climate super pollutants are warming agents far more potent than carbon dioxide per ton—reducing their emissions is the quickest way to curb the climate crisis and it greatly improves air quality



*Leads to the formation of tropospheric ozone (warming agent + air pollutant)

Global average temperature change from 1850-1900 to 2010-2019. Data from IPCC AR6 WGI SPM Fig. 2c (2021)

BLACK CARBON

- Black carbon has a warming impact up to **1,500 times stronger than CO2** per unit of mass.
- A **short-lived climate pollutant** (4-12 days lifetime)
- A product of **incomplete combustion**

Impact of Black Carbon



Regional climate

Effects are felt most strongly closest to its source, e.g.:

- Black carbon in snow contributes up to 39% of total glacier melting and 10% of glacier mass loss due to reduced precipitation in the Tibetan Plateau.



Climate tipping points

Black carbon pushes the world closer to critical climate tipping points in cryosphere ecosystems and monsoon systems, e.g.:

- Retreat of Himalayan glaciers accelerated by 50% due to black carbon warming and snow darkening – crucial to Indian monsoon tipping point.



Health and social justice

Black carbon and co-emitted organic carbon are a major part of PM2.5:

- PM2.5 causes 7 million premature mortalities each year, with several hundred thousand attributed to black carbon and organic carbon
- Black carbon specifically is strongly correlated with increases in blood pressure levels, a high-risk factor for cardiovascular disease.



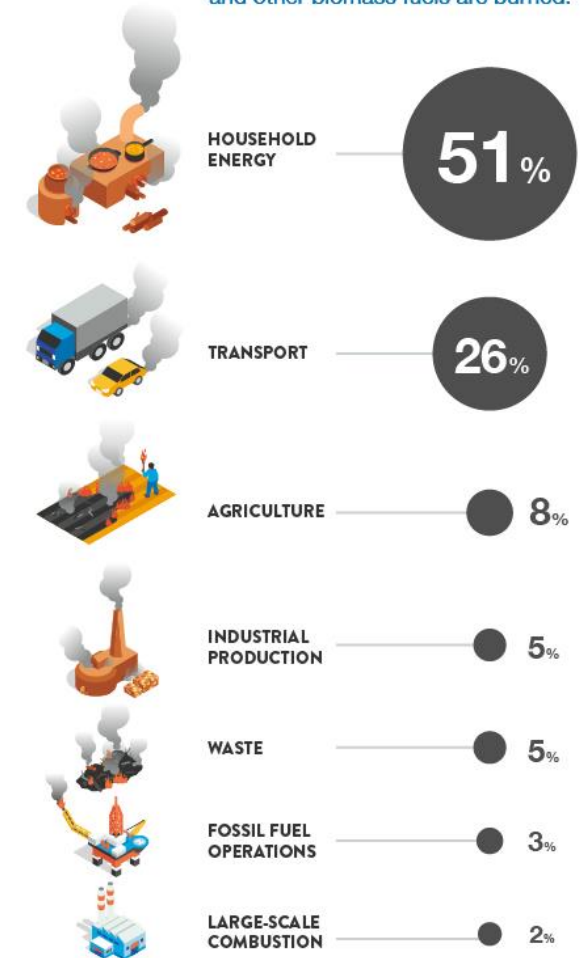
Resilience

In monsoon-sensitive countries, black carbon can increase the risk of extreme rainfall events such as floods, e.g.:

- Reducing emissions of black carbon can help communities to adapt to the climate crisis – turning down the temperature rise, reducing heat stress, and improving human and ecosystem health.

SOURCES

Black carbon is one of many particles and gases that are emitted when diesel, coal, and other biomass fuels are burned.

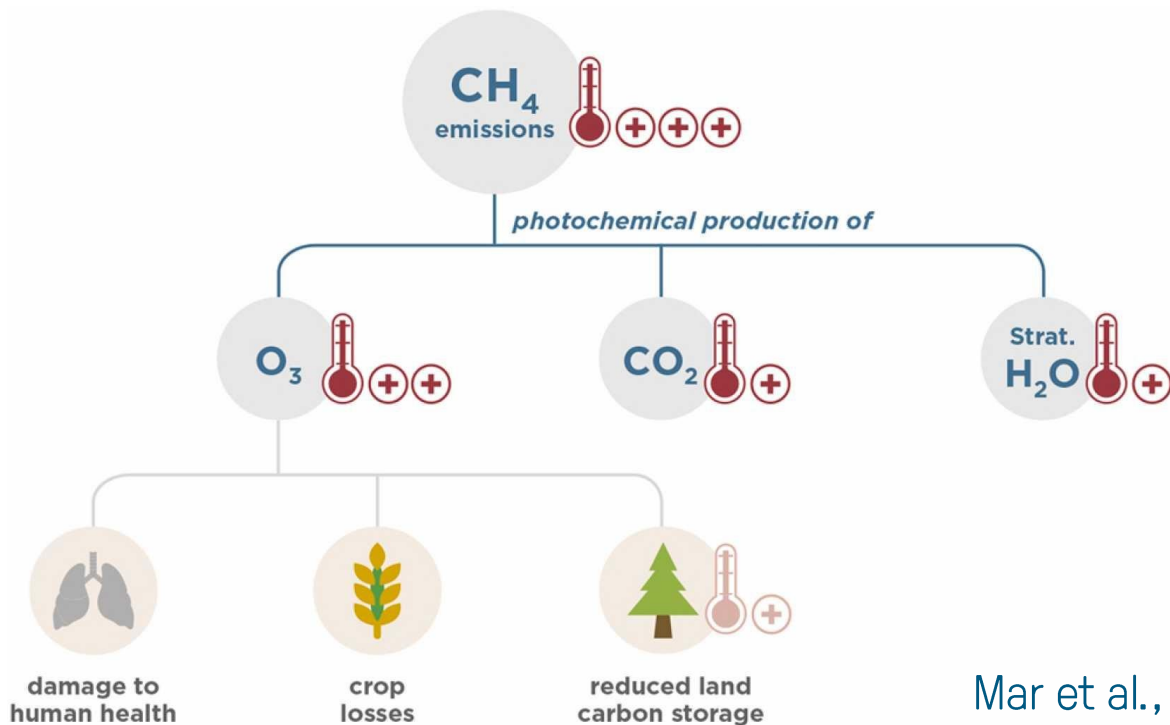


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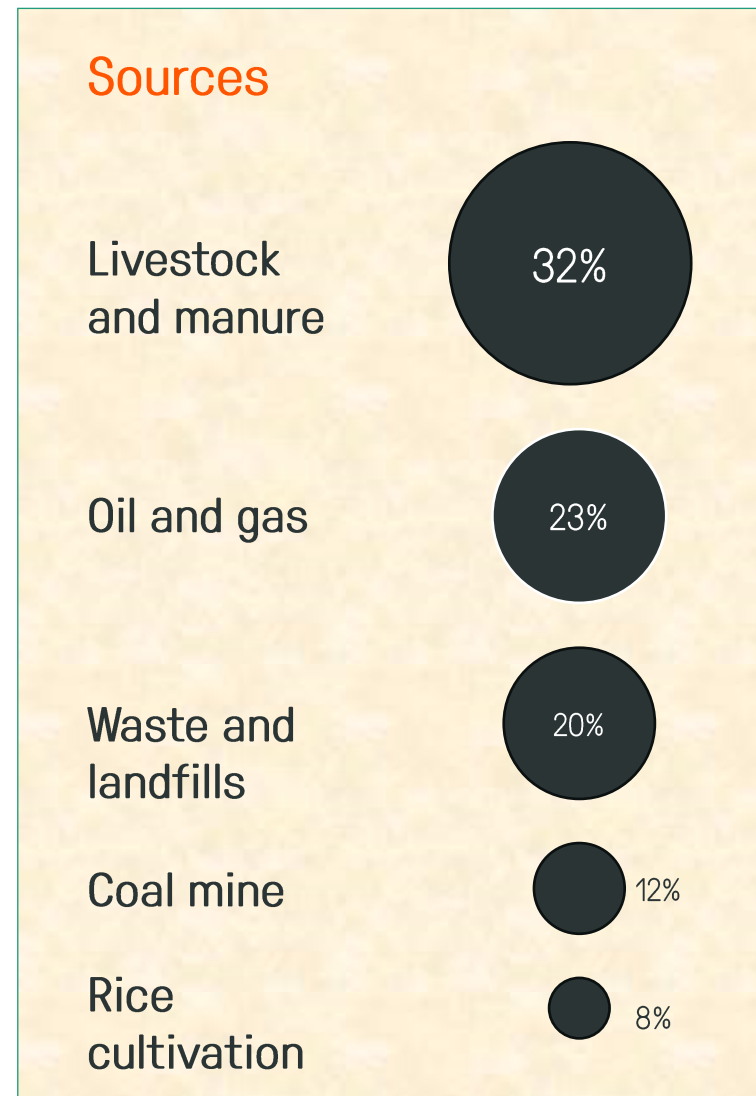
METHANE

- Methane has a warming impact **86 times stronger than CO2 per unit of mass over a 20 year** period.
- Methane has an atmospheric lifespan of around 12 years.
- Over **60% of methane** emissions come from human activity.

Impact of Methane



Mar et al., 2022

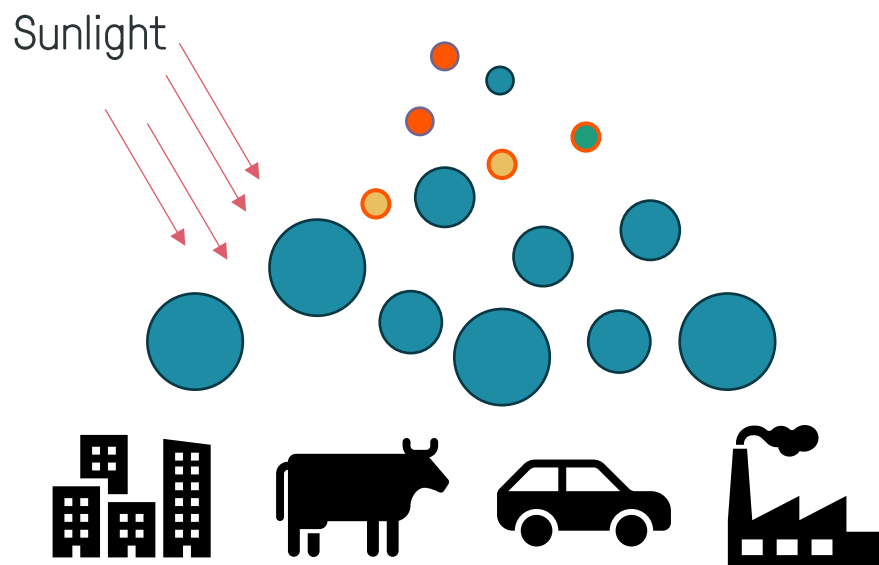


TROPOSPHERIC OZONE

- Ozone absorbs radiation, acting as a strong greenhouse gas and air pollutants that has impact over human health crops and ecosystem.
- Tropospheric ozone has an atmospheric lifetime ranging from a few hours to a few weeks

Formation and impact

{Methane, VOCs, NOx, CO} -> Ozone



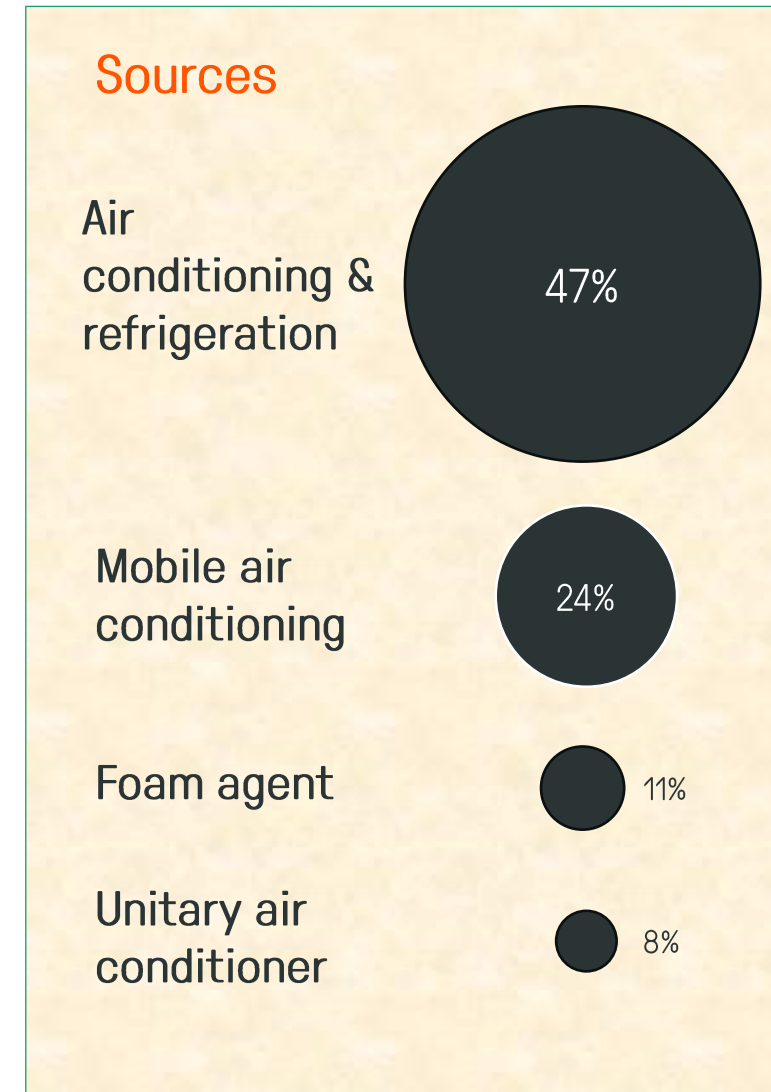
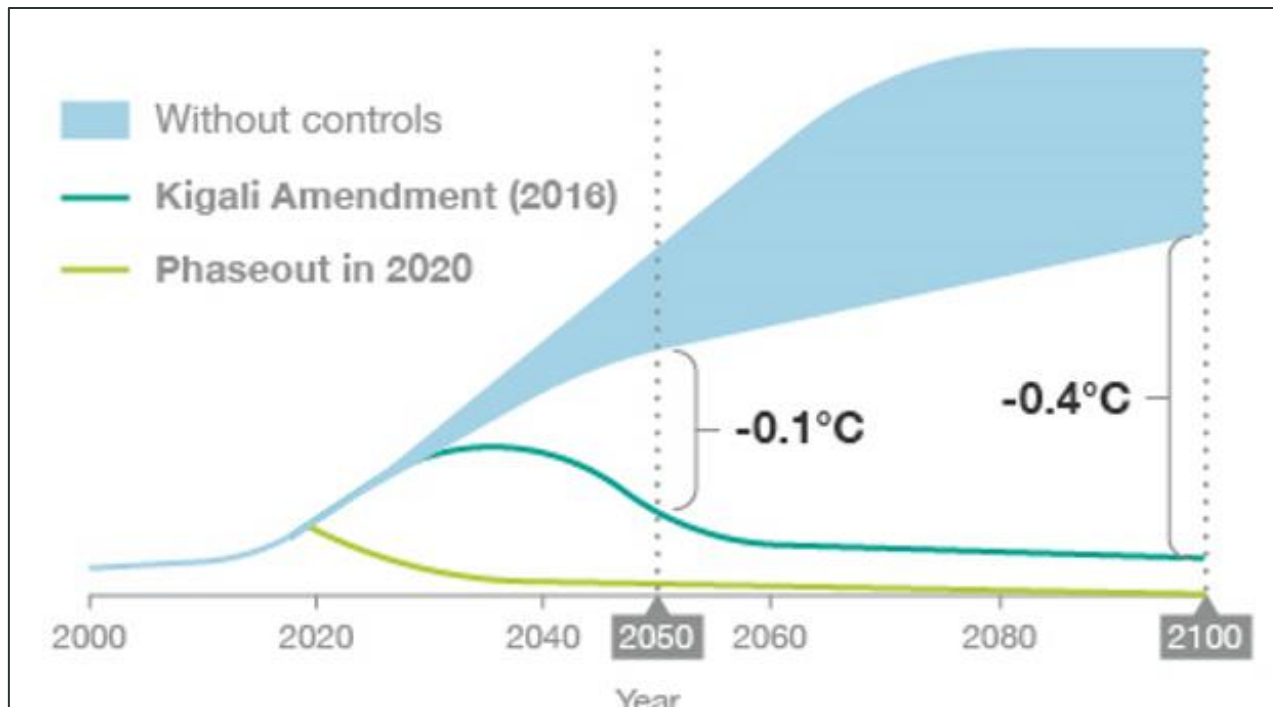
Decarbonization and targeted super-pollutants measures led to **0.3°C avoided warming by 2050**

Tropospheric Ozone cause **350,000 premature deaths annually, up to 26% of global crop loss, and is responsible for a decrease of up to 11% of global forest coverage.**

HYDROFLUROCARBONS (HFCs)

- The most abundant HFC warms the planet **3,790 times as much as CO₂** over a 20-year period
- HFCs have an average lifespan of **15 years in the atmosphere**
- HFC usage is growing at **over 10% per year**

Impact and Source



SCIENCE-BASED RECOMMENDATIONS

- Super-pollutants shared very **similar sources** to the GHGs. Working on super-pollutants necessarily means **prioritizing some key sectors and regions**.
- Pairing decarbonization with mitigation measures targeting non-CO2 pollutants is essential for limiting not only the near-term (next 25 y) warming but also the **warming below 2°C**.
- **Tackling super pollutants is to deliver fast climate mitigation** and also improving **human health, food security and ecosystem** and this present a short-window opportunity for policy makers to act now.

The solutions are well known

- We have been working with solutions on Black Carbon mitigation and recently started working on tropospheric Ozone. The effectiveness of the technical solutions and policy levers for addressing simultaneously addressing super-pollutants are well proved. The barrier is super-pollutants and air pollutants are not integrated with into the climate change framework.