



*Liberté  
Égalité  
Fraternité*



CITEPA



Laboratoire d'Économie  
Appliquée de Grenoble



*maîtriser le risque  
pour un développement durable*

# Paris Agreement: Co-benefits and Risks for Air Quality

French research project ACRA

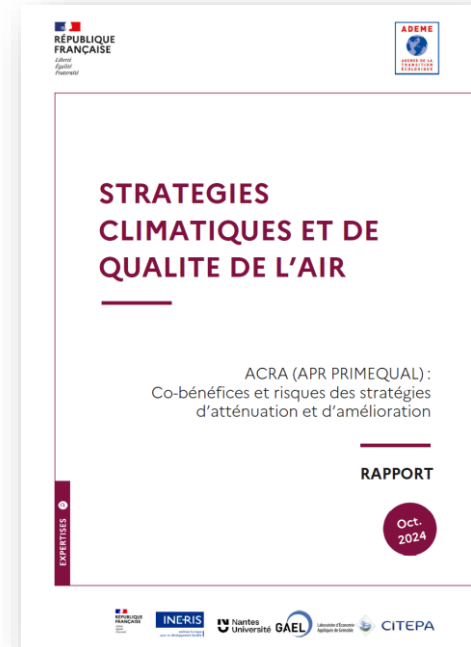
Elsa Real & Simone Schucht

TFEIP, 11 May 2026

# French research project

- Primequal project, financed by ADEME and the French Ministry in charge of the Environment (MTE)
- 2020-2024
- Partners
  - Ineris: atmospheric modelling, health impacts, cost-benefit analysis
  - CITEPA: atmospheric emissions
  - GAEL/Uni Grenoble (Laboratoire d'Economie Appliquée de Grenoble): energy modelling
  - LEMNA/Uni Nantes (Laboratoire d'Economie et de Management Nantes-Atlantique): choice experiment - preferences
- Cooperation with IIASA
  - Interface POLES – GAINS

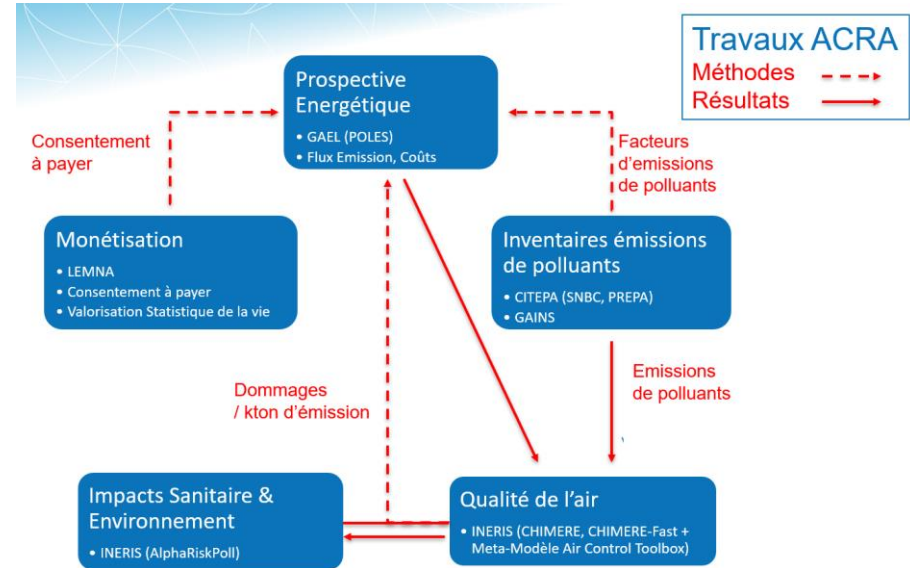
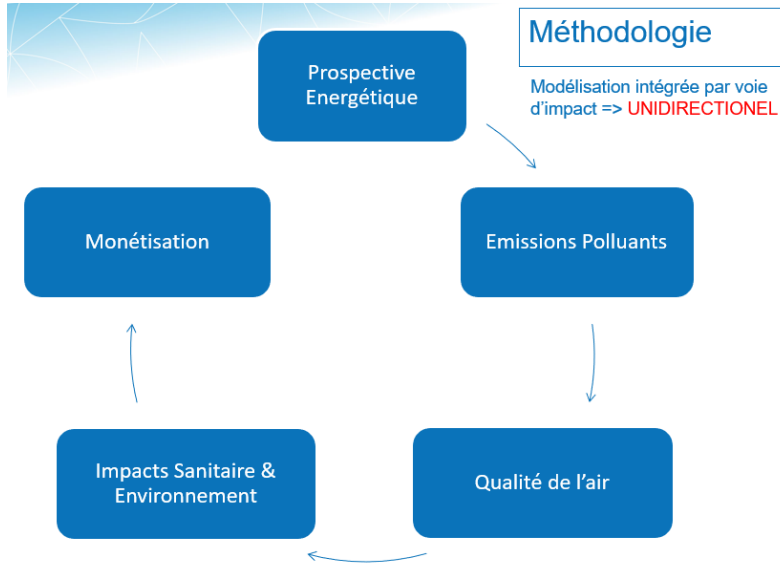
<https://recherche.ademe.fr/acra-strategies-climatiques-et-de-qualite-de-lair-co-benefices-et-risques-des-strategies>



## Selected objectives

- Account for co-benefits and risks relating to air quality in energy/climate projections
- Improve the integration of the different models involved in the impact pathway approach
  - from a unidirectional to a multidirectional exchange of information
- Incorporate upstream indicators of air quality impacts into energy forecasting models
  - Emission factors and costs of air pollutants
  - External costs of air pollutants

# Towards a more integrated modelling of energy and air pollution policies



# Two parallel assessments

## French national policy scenarios

- National low carbon strategy 3 (SNBC3)
- Assessment of corresponding emissions, air quality and health effects

## Alternative scenarios

- European scenarios (IIASA)
- Assessment of corresponding emissions, air quality, health effects and cost-benefit ratio



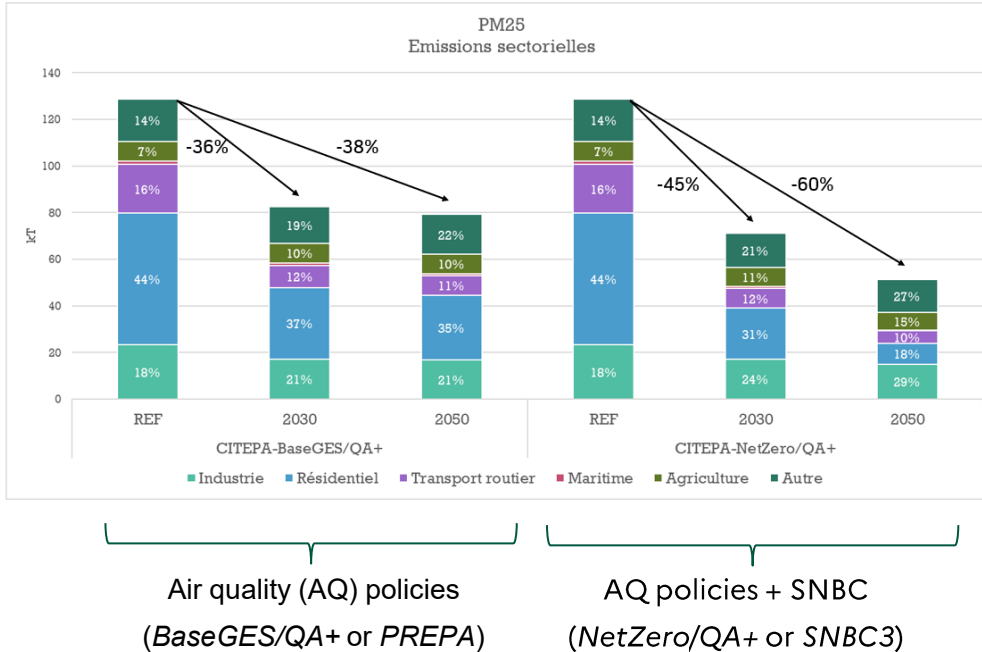
Sequential  
approach



More integrated  
approach - can be  
presented if of  
interest and if  
time allows

# National Low Carbon Strategy 3 (SNBC3)

## Emissions (MTE/Citepa)



SNBC3 (run 2): consultation published end 2024

### Methods

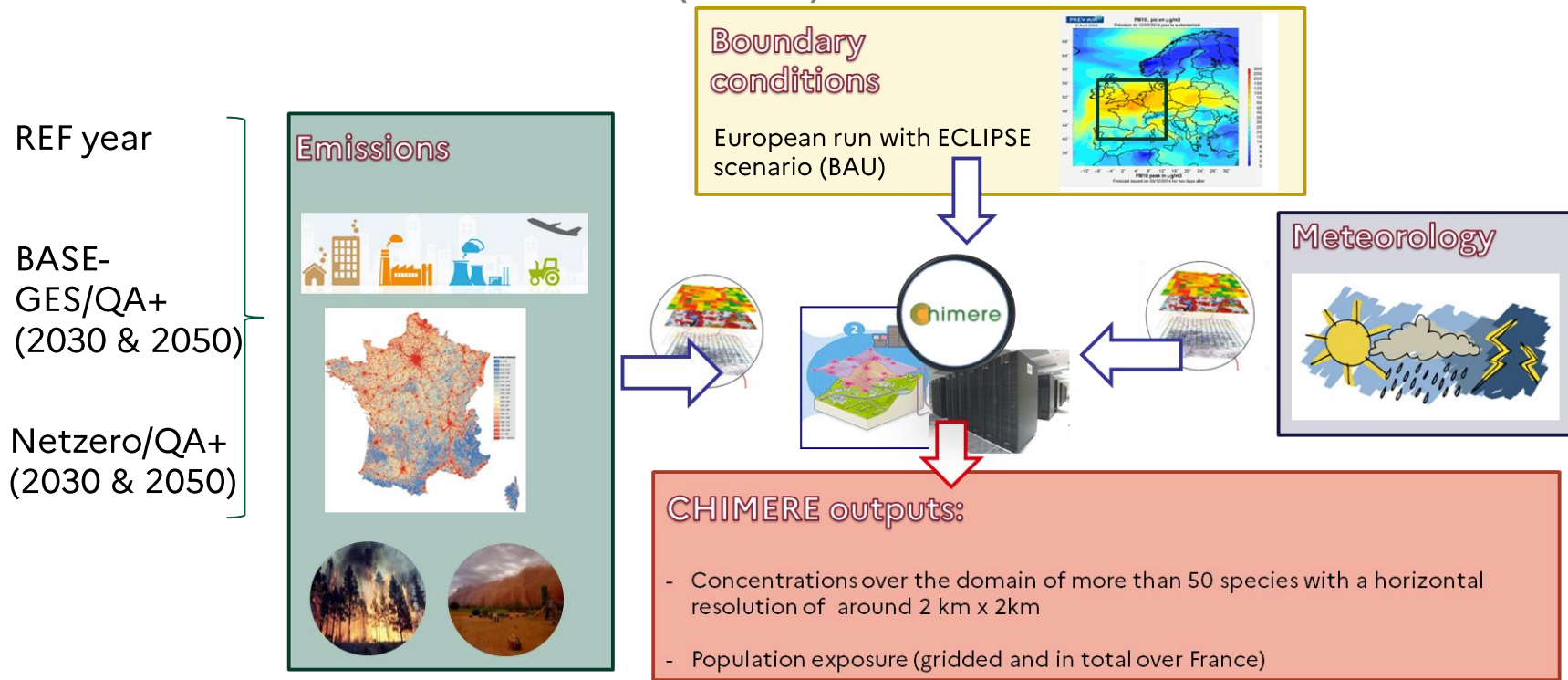
- Prospective scenarios for 2030 and 2050 corresponding to the national carbon neutrality objectives developed by the MTE
- Translated into pollutant emissions flows by Citepa (national inventory methodology & French NAPCP, called PREPA)

### Results

- Up to 2030, the emission reductions are mainly driven by the national air quality policies (PREPA)
- By 2050, structural measures related to carbon neutrality deliver additional benefits

# National Low Carbon Strategy 3 (SNBC3)

## From Emissions to concentration (INERIS)



# National Low Carbon Strategy 3

## Compliance with EU thresholds and WHO guideline values

SNBC3 (run 2)

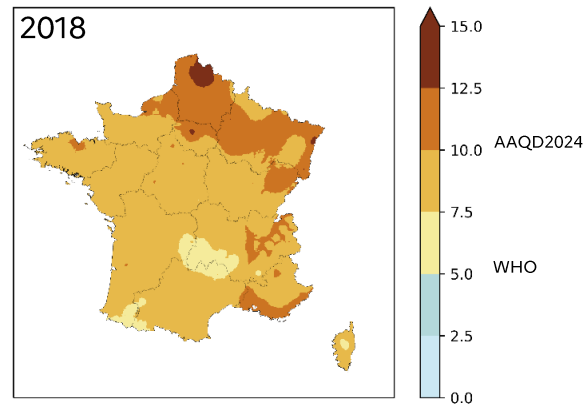
Methods

- Chemistry-transport model CHIMERE

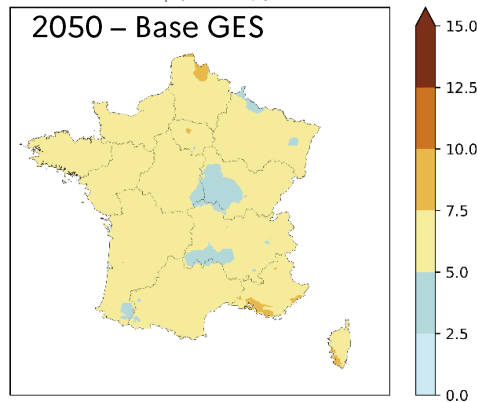
Results

- In the reference year (2018), 0% of the French population breathes air that meets the WHO standard for  $PM_{2.5}$  ( $5\mu g/m^3$ ).
- The projected trajectory (including PREPA) for 2050 suggests that this target will be met for 2% of the population (despite a 33% reduction in concentrations)
- The SNBC3 would reduce  $PM_{2.5}$  concentrations by 45%, meaning the WHO target would be met for over 33% of the population

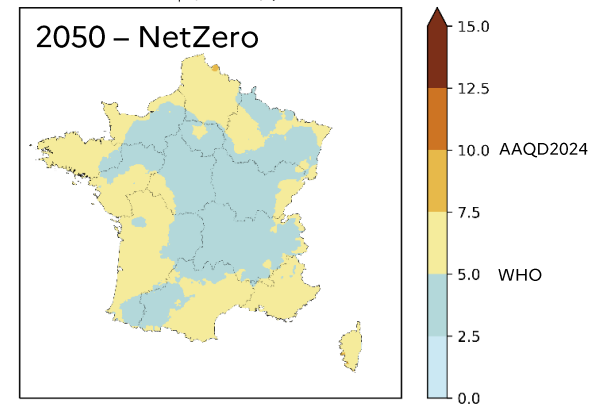
Moyenne annuelle des concentrations de  $PM_{2.5}$  ( $\mu g/m^3$ )  
Simulation de référence



Moyenne annuelle des concentrations de  $PM_{2.5}$  ( $\mu g/m^3$ )  
Scénario Citepa/BaseGES/QA+ 2050



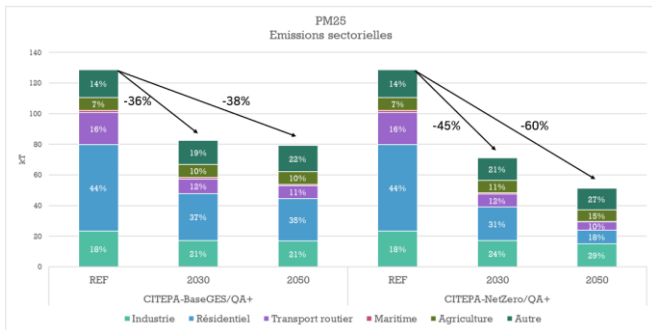
Moyenne annuelle des concentrations de  $PM_{2.5}$  ( $\mu g/m^3$ )  
Scénario Citepa/NetZero/QA+ 2050



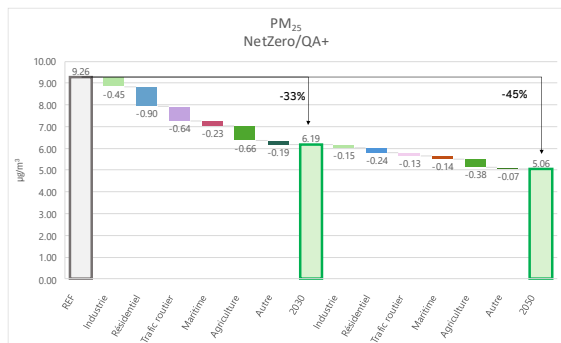
# National Low Carbon Strategy 3

## Source apportionment

Emission scenarios



Concentrations (CHIMERE) and sources (ACT)



## Methods

- Breakdown of the impact of each emission sector by a meta-model (CHIMERE emulator)
- Air Control Toolbox developed by INERIS for the Copernicus Atmosphere Decision Support Service (for forecasting)
- Adapted for scenario studies in ACRA

## Results

- Between 2018 and 2030, the majority of reductions are driven by the residential sector, road traffic and agriculture
- Between 2030 and 2050, the residential and agricultural sectors contribute the most, but the reductions become smaller

For ACT see <https://policy.atmosphere.copernicus.eu/act.php>

# National Low Carbon Strategy 3

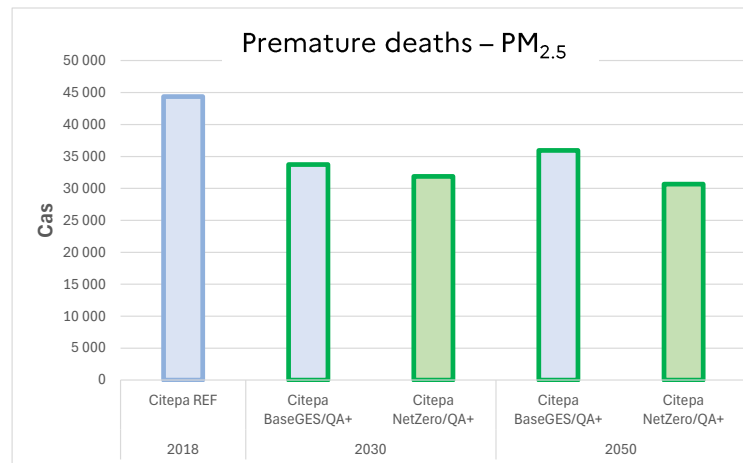
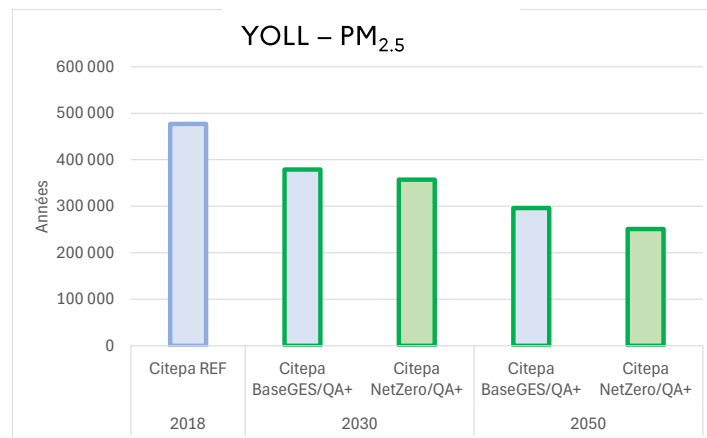
## Health impacts (Alpha-RiskPoll)

### Methods

- Quantification and monetisation of health effects (Alpha-RiskPoll)

### Results

- Reference scenario: AQ improvements reduce the number of YOLL, but do not fully offset the rise in mortality associated with an ageing population in 2050
- SNBC3 scenario: mortality is reduced by 30% and monetary benefits are high



# Alternative scenarios

- **European scenarios (IIASA):**
  - Clean Air Outlook
  - Assumptions on the implementation of air pollution measures
- **Integrated into POLES**
  - Assumptions on GHG reduction

# Integrated assessment of energy/GHGs/air quality

## Improving the representation of pollutant emissions in POLES

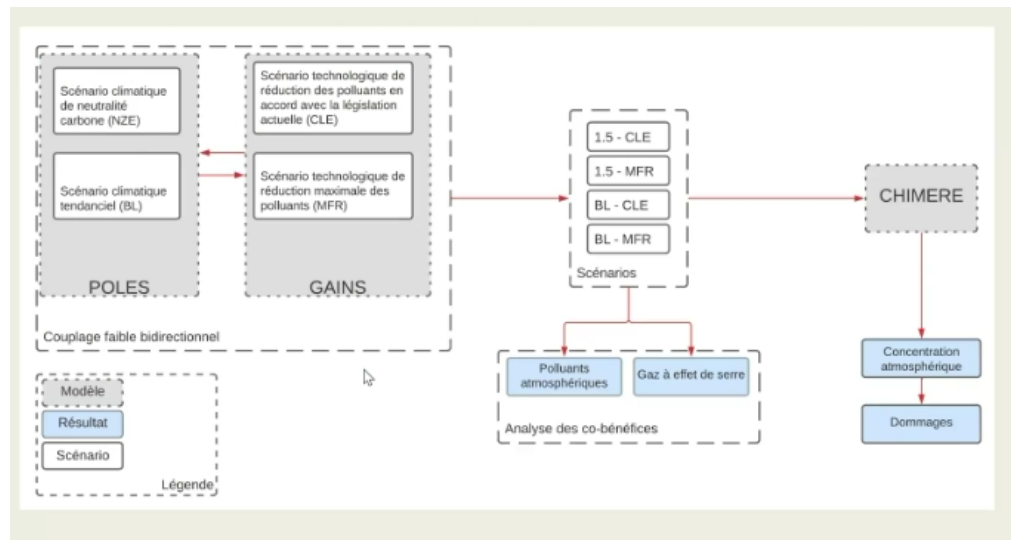
Work carried out at GAEL, with the support of INERIS in the collaboration with IIASA/GAINS

### Sectoral « mapping » between GAINS & POLES

- Improved reliability of emissions calculations (GAINS emission factors)
- Introduction of GAINS cost-factors for air pollution technologies (next to the cost of climate/energy policy measures)

### Introduction of marginal damage costs for air pollutants

- INERIS-EMRC etc./EEA work on cost per tonne of pollutant (next to the model's carbon tax)



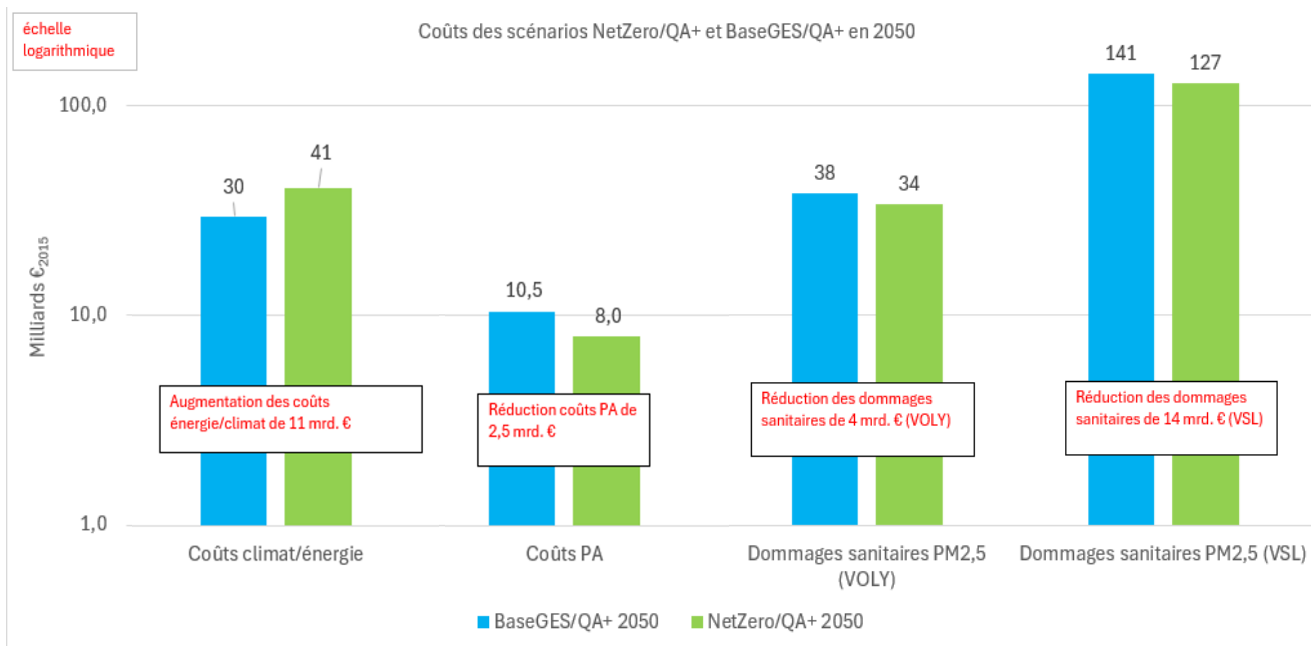
# Cost-benefit analysis

## Methods

- Energy projections from POLES
- Air quality (CHIMERE + emulator ACT)
- Health effects (Alpha-RiskPoll)

## Results

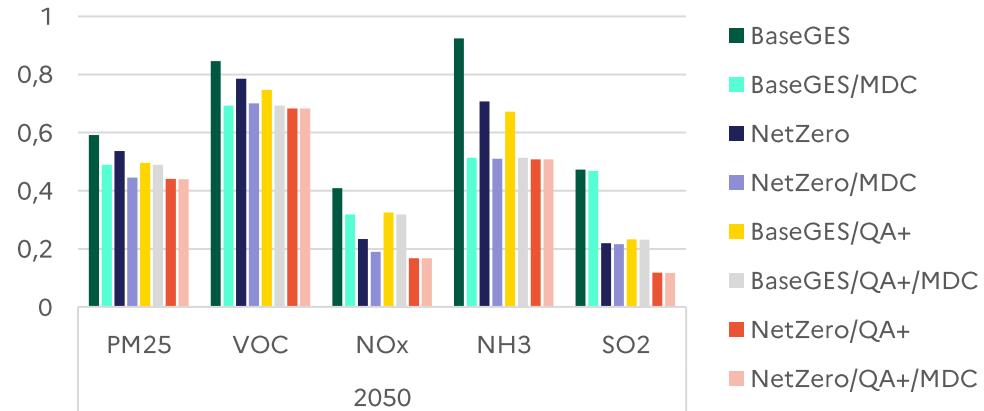
- The assessment of the impact on air quality and health damage completes the cost-benefit analysis
- The additional cost of carbon neutrality is estimated at €11 billion
- The benefits fall within a range of [€6.5 – 16.5] billion



# Effect of introducing air pollution related costs into POLES

- **Air pollution end-of-pipe costs**
  - Much lower than POLES energy systems/technology costs
  - Limited effect on energy mix and emissions
- **Air pollution damage costs (health & environment)**
  - Results in significant reductions in pollutant emissions
  - Particularly in baseline scenarios
  - Allows for some rebalancing with the carbon tax pushing the model to meet predefined climate targets
- **Further assessments necessary to ensure that these results represent optimal technological choices**

Evolution of the emissions of atmospheric pollutants after taking external costs (MDCs) into account



- High quality emission inventories and projections are key to this work

**Thank you for your attention**