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Państwowy Instytut Badawczy

Impact of BAU/MFR National Emission Reduction Scenarios on Air Quality and Health Exposure in Poland

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Motivation

- WHO Guidelines (October 2021)
- Review of the Air Quality Directive (since 2022)

Summary of recommended AQG levels and interim targets

Pollutant	Averaging time	IT1	IT2	IT3	IT4	AQG level
$PM_{2.5}$, $\mu g/m^3$	Annual	35	25	15	*10*	5
$PM_{2.5}$, $\mu g/m^3$	24-hour[a]	75	50	37.5	*25*	15
PM_{10}, $\mu g/m^3$	Annual	70	50	30	*20*	15
PM_{10}, $\mu g/m^3$	24-hour[a]	150	100	75	*50*	45
O_3, $\mu g/m^3$	Peak season[b]	100	70	–	–	60
O_3, $\mu g/m^3$	8-hour[a]	160	120	–	–	100
NO_2, $\mu g/m^3$	Annual	*40*	30	20	–	10
NO_2, $\mu g/m^3$	24-hour[a]	120	50	–	–	25
SO_2, $\mu g/m^3$	24-hour[a]	125	50	–	–	40
CO, mg/m^3	24-hour[a]	7	–	–	–	4

Ministry of Climate and Environment:

“Analysis of the feasibility of meeting the air-quality standards recommended by WHO, not only in terms of technical–technological, financial and social capabilities […] assessment of health costs [and] analysis and indication of pollutant levels that would be achievable under national conditions.”

ReduCost: aim and scope

Main objective:

Analysis of the potential for reducing emissions of atmospheric pollutants and the costs of reduction measures, taking into account technical–technological, financial, and social aspects.

Scope:

- Pollutants: NO_2, NO_x, SO_2, PM10 and PM2.5, B(a)P
- Emission sectors: residential/municipal [1], transport [2], agriculture, power generation (based on [1] and [2])
- Selection of key sectors agreed with the Ministry of Climate and Environment, considering emission shares and potential for change
- Base year 2022

ReduCost: scenarios

Expert assessment on the possibilities for reducing pollutant emissions in the including a proposal of actions in individual sectors, taking into account the current situation as well as technical and non-technical options for reduction

- **BAU Scenario – Business as Usual**
- **MFR Scenario – Maximum Feasible Reduction**

The proposed BAU and MFR scenarios represent illustrative sets of potential reduction measures based on the scientific expertise of the specialists invited to participate in the project.

Central Emission Database

- **Central Emission Database (CED)** was used to calculate scenarios
- The CBE has been developed at KOBiZE (IOŚ-PIB) **since 2018** for the purpose of centralized air-quality modelling at the national scale
- The main advantages of the CBE are **methodological and computational consistency** across the entire country, as well as **high spatial resolution**
- The CBE is used, among other things, for the Annual AQ, the National Air Pollution Control Programme and broadly support for the Ministry of Climate and Environmen.

Development

Residential

- Implementation of data from the Central Register of Building Emissions (CEEB) into the CBE – identification of uniform heat sources for over **3 million buildings**.
- An **IT tool** for aggregating household-level indicators

Agriculture

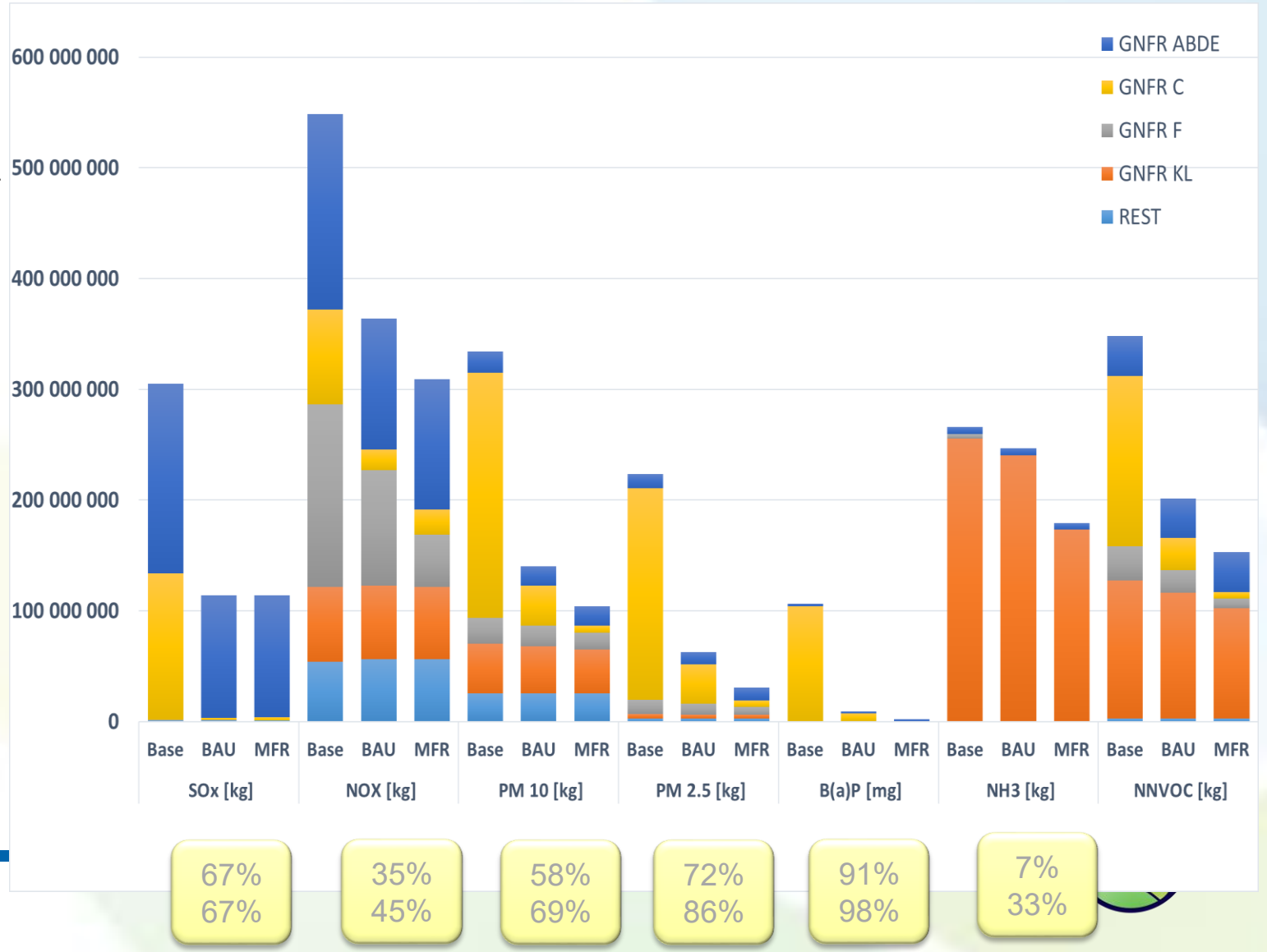
- New spatial distributions for **crops**
- Development of the **emission-estimation methodology** to include individual indicators for livestock production.

Road transport

- Calculating scenarios involving the development or **modification of infrastructure** (new roads, airports).

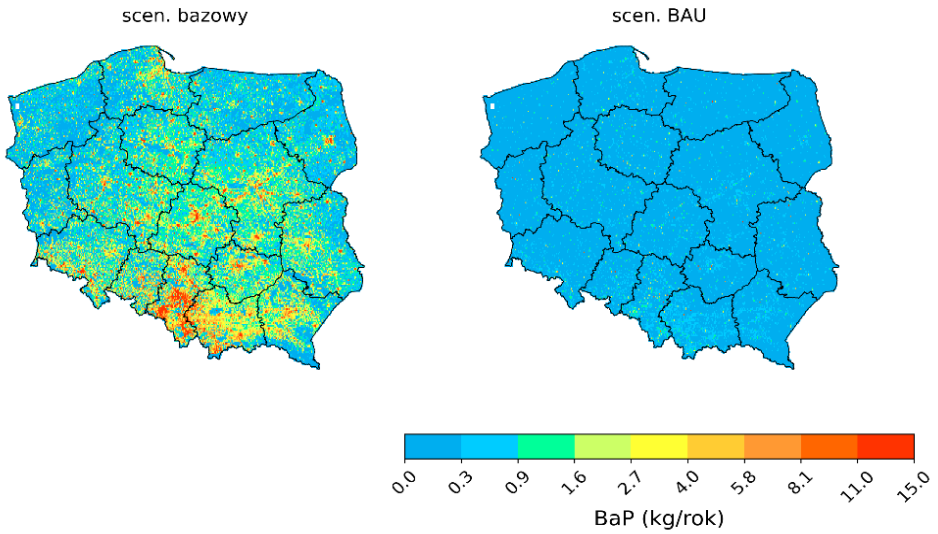
Emission Scenario Results

- Significant reduction of PM10 and PM2.5 emissions in the BAU and MFR scenarios, particularly in the residential sector.
- B(a)P emissions reduced almost to zero in the residential sector.
- A clear decrease in NOx emissions from road transport.
- SOx emissions significantly reduced in the residential sector and moderately in the energy sector.
- Reduction of NH_3 emissions in agriculture in the MFR scenario.

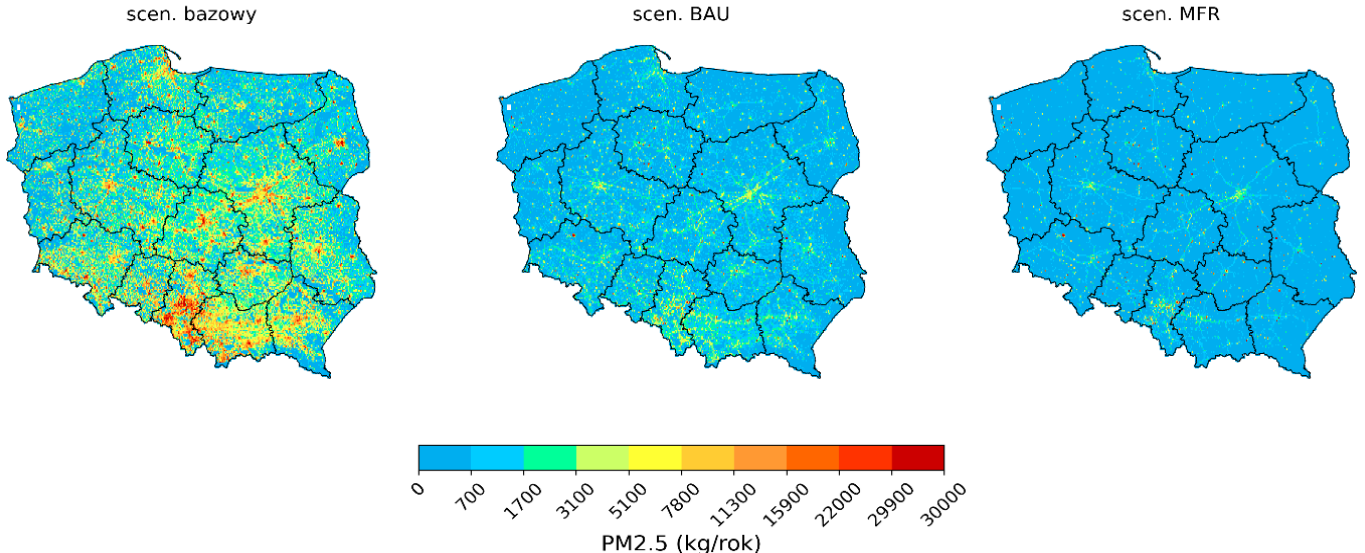


Wyniki redukcji emisji

BaP ze wszystkich sektorów

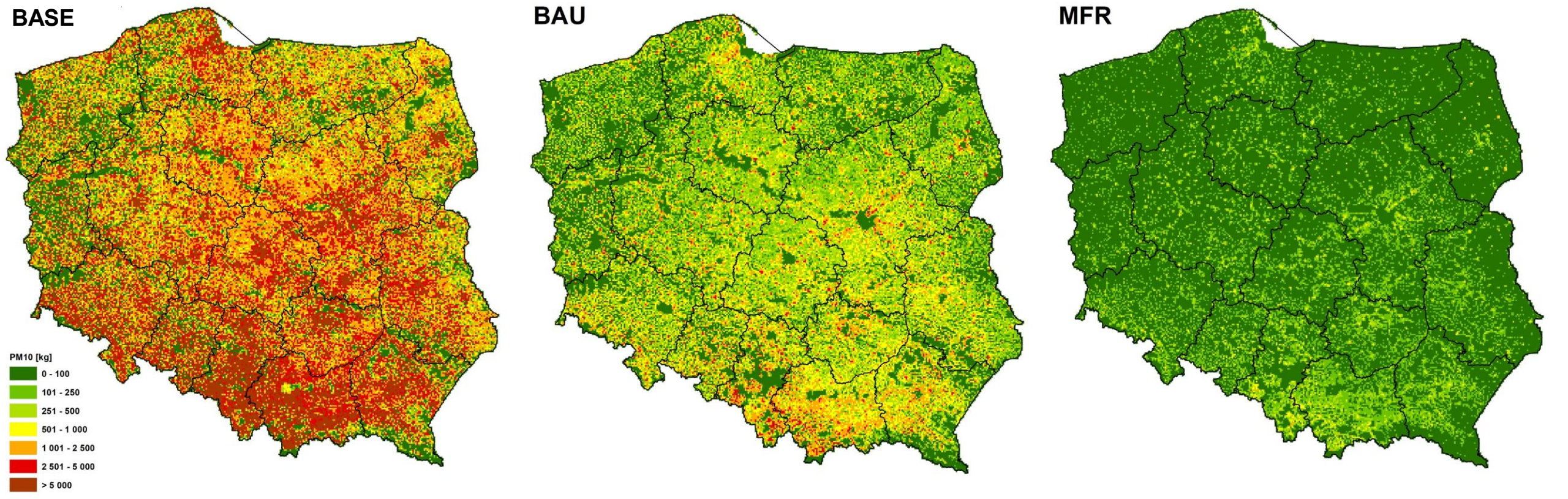


PM2.5 ze wszystkich sektorów



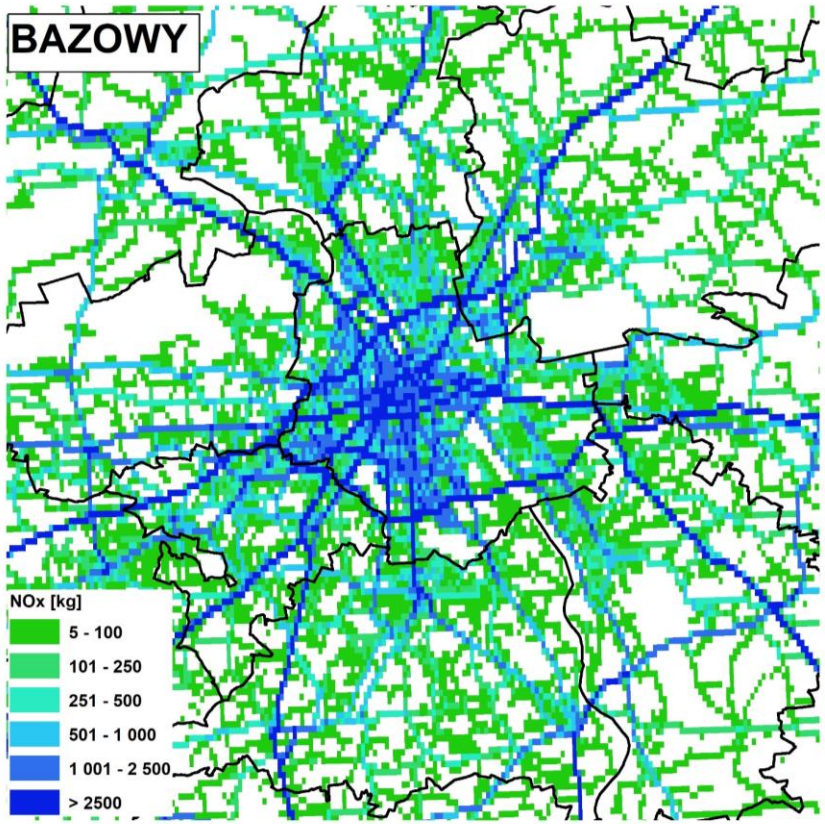
Emission Scenario Results – residential sector

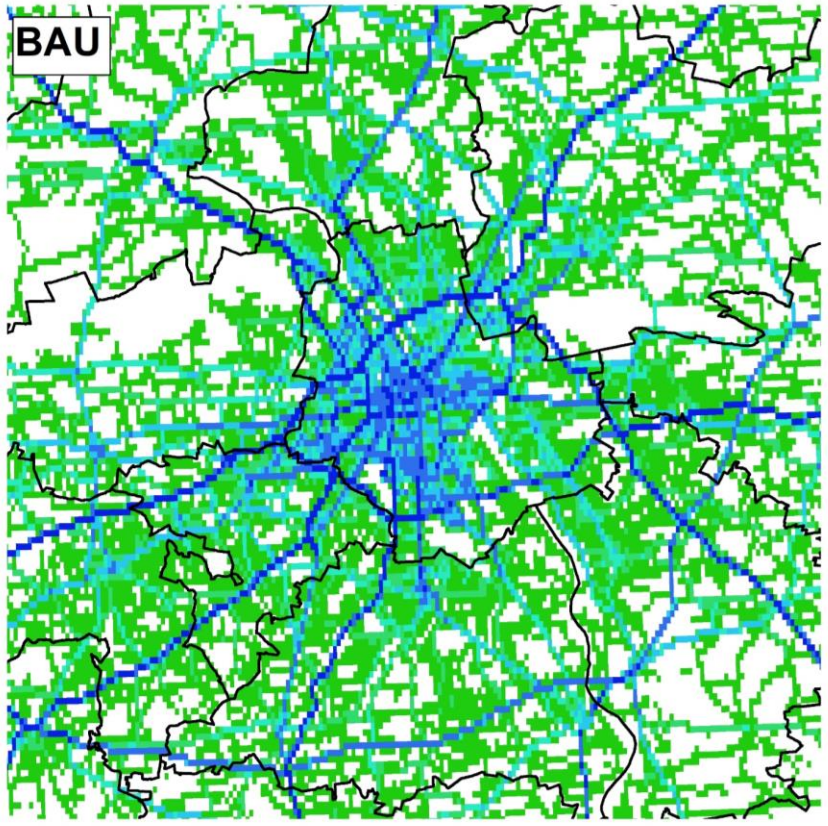
- High reduction of particulate emissions in cities already under BAU
- Elimination of particulate emissions across the whole of Poland under MFR

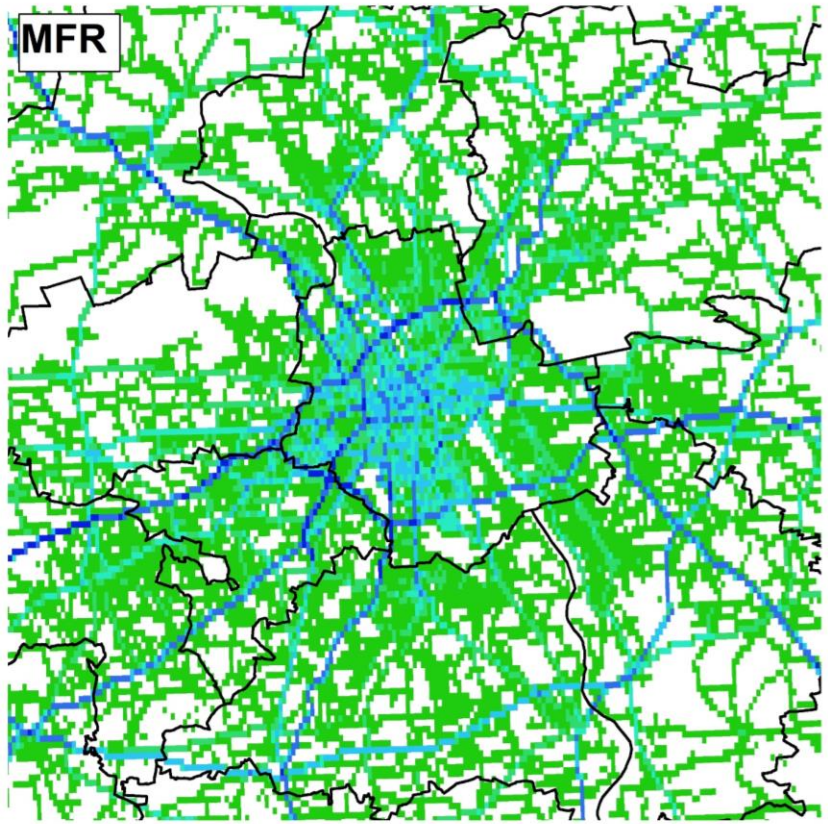


Emission Scenario Results – road transport

- Inclusion of the road network for 2040 (CUPT data), vehicle fleet projections for 2040
- Significant reduction of NOx emissions in cities and main roads under BAU



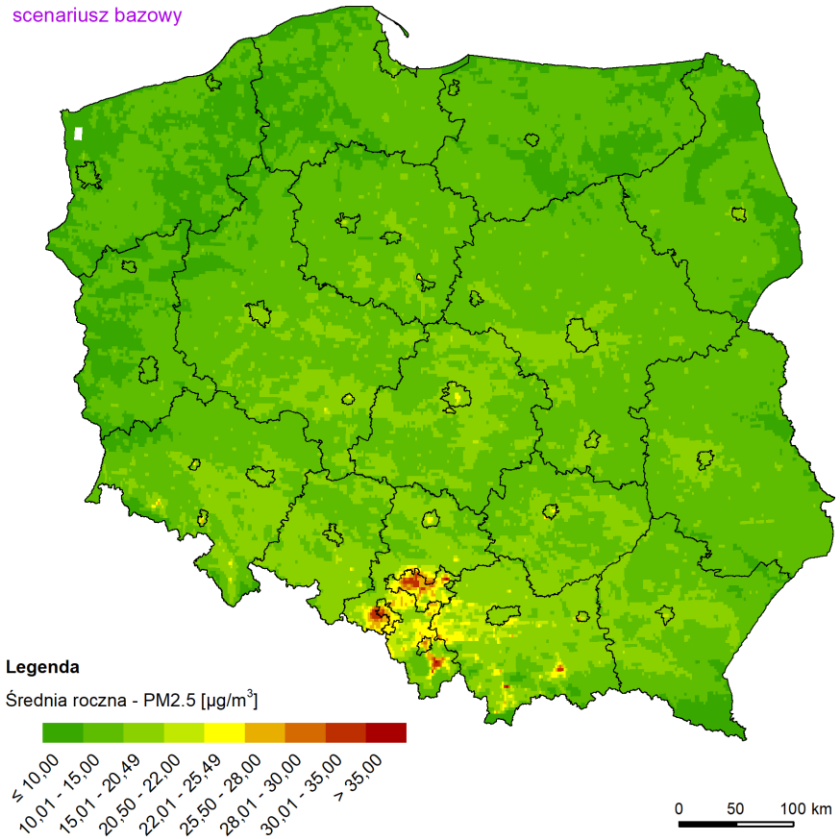


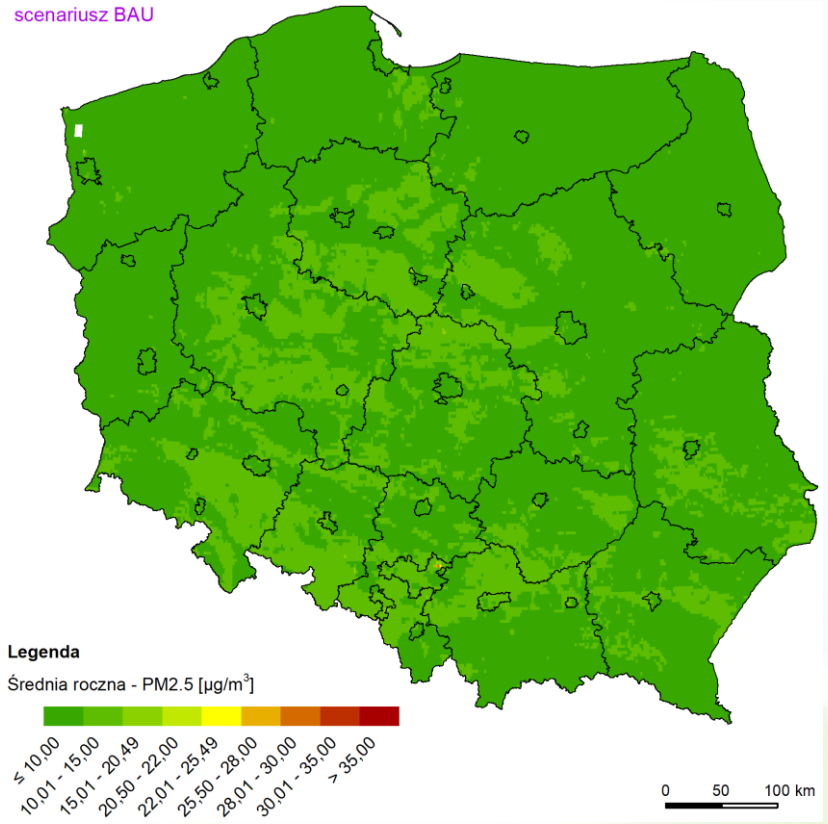


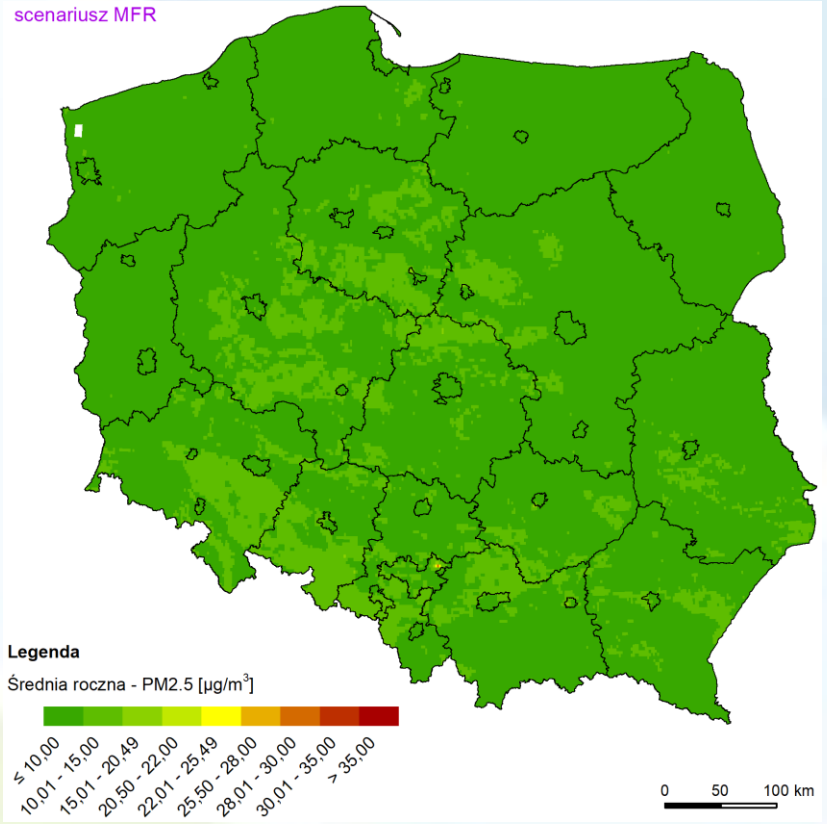
ReduCost: results

- Analysis of the feasibility of achieving the thresholds proposed by the AAQD as a result of reducing emissions of the pollutants
- Analysis of the health, social, and economic impacts of reducing the pollutants under consideration
  - health exposure AirQ+ model (WHO) number of premature deaths – PM2.5 and NO_2
- Economic analysis:
  - costs of implementing reduction measures in individual sectors
  - external costs, including health-related costs, resulting from undertaking reduction measures

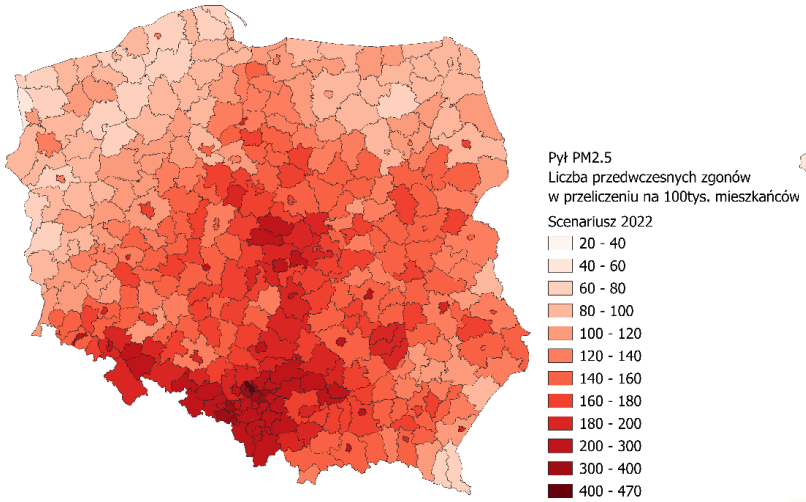
PM2.5 concentrations

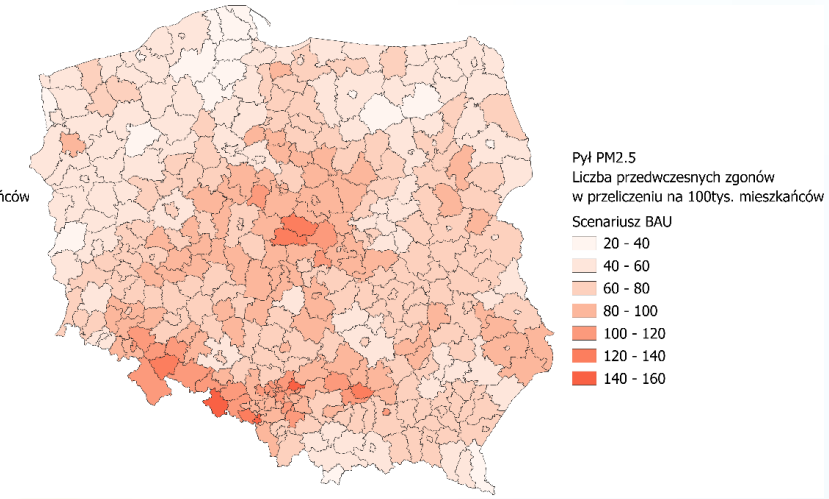


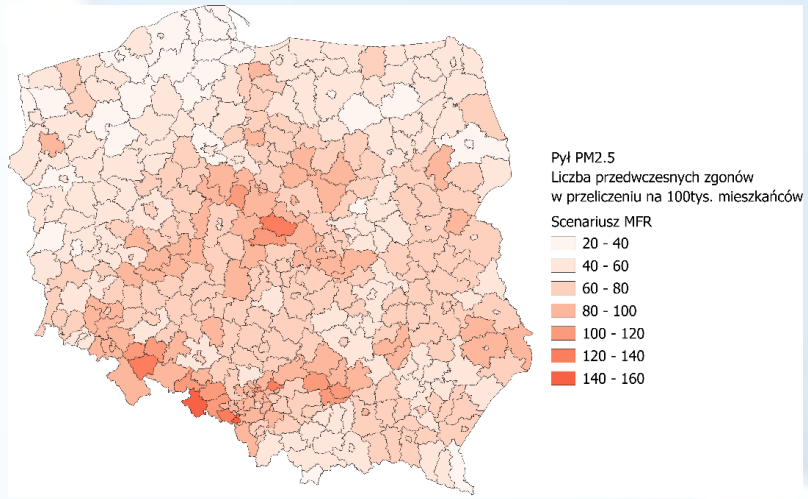




PM2.5 health exposure

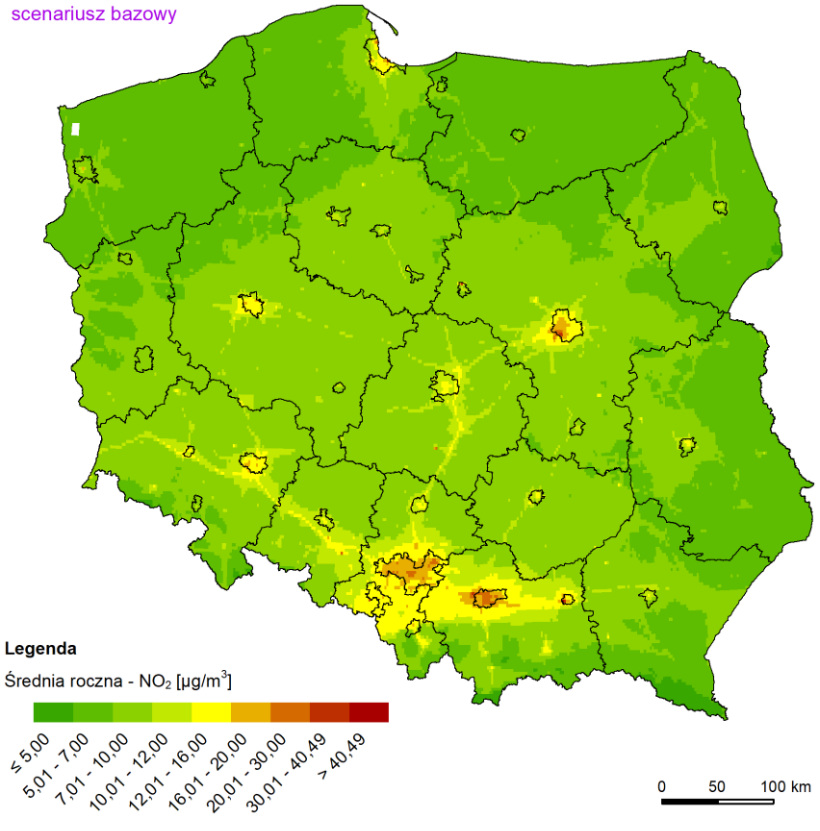


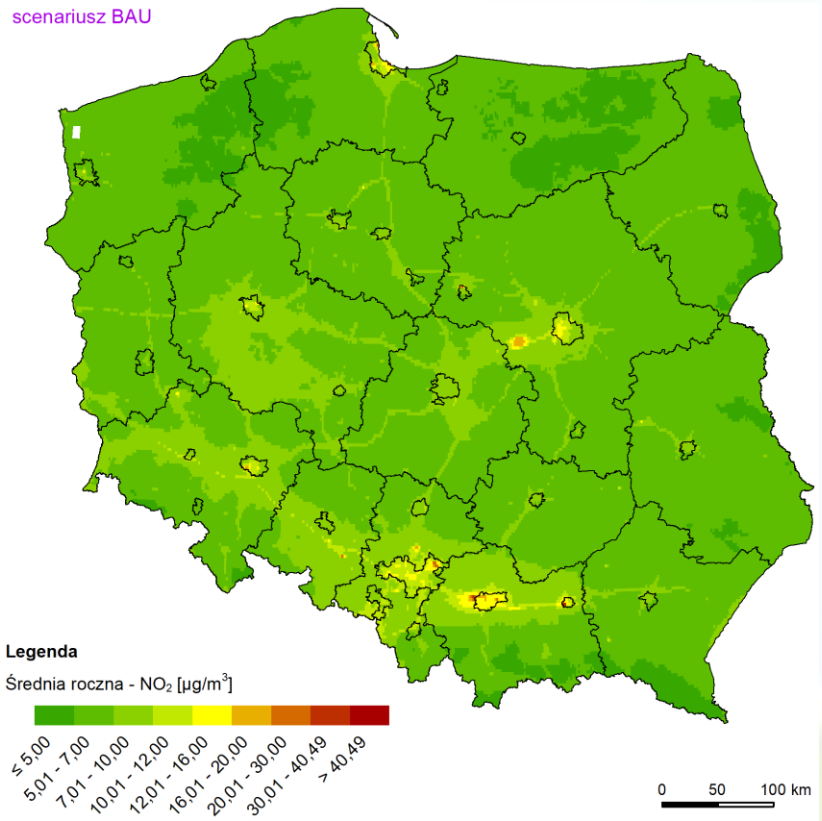


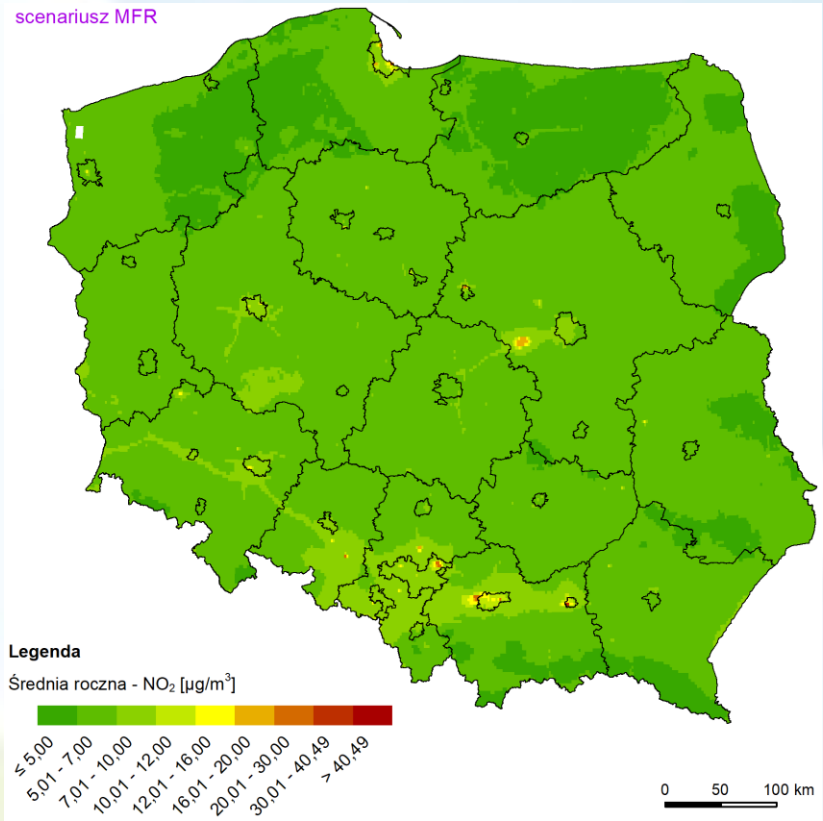


Scenario	Number of premature deaths (30+)	Percent of premature deaths (30+)	Number of premature deaths (30+) per 100 tys. inhabitants
Base (2022)	43 321	10,9	166
BAU	18 451	4,6	71
MFR	16 809	4,2	64

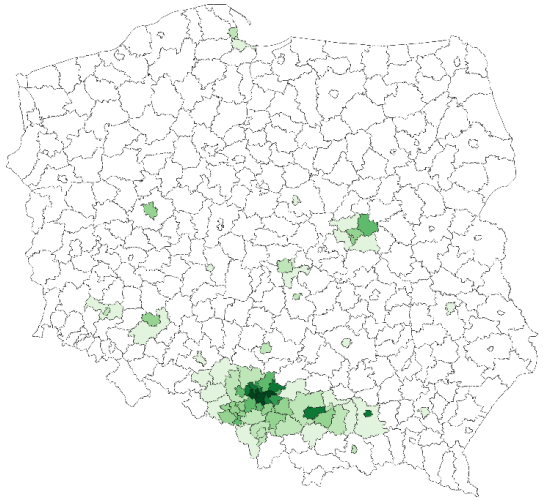
NO_2 concentrations

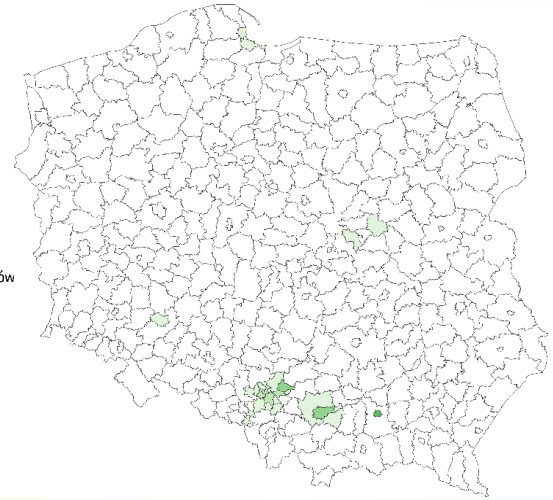


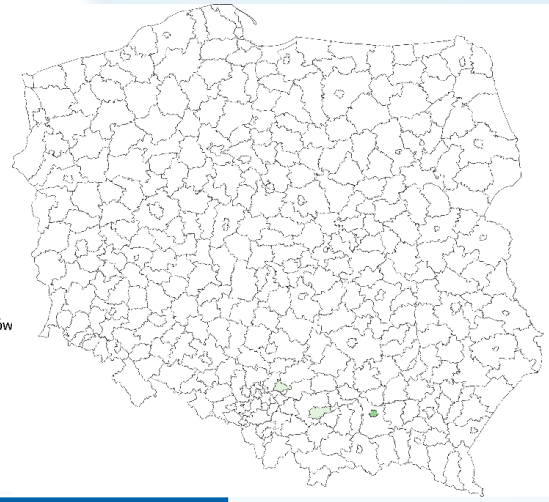




NO_2 health exposure







NO2
Liczba przedwczesnych zgonów
w przeliczeniu na 100tys. mieszkańców

Scenariusz 2022
0
0,1 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 71,5

NO2
Liczba przedwczesnych zgonów
wprzeliczeniu na 100tys. mieszkańców

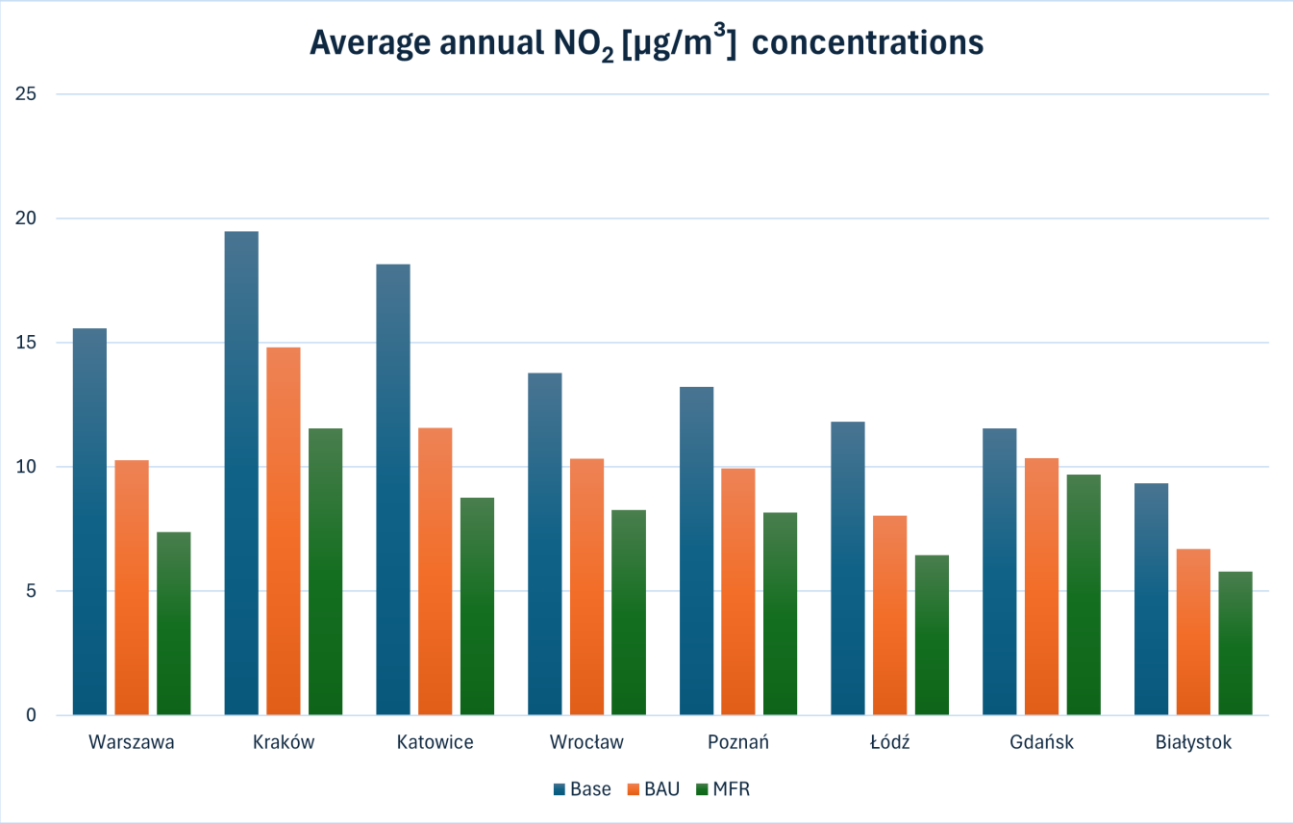
Scenariusz BAU
0 - 0,1
0,1 - 10
10 - 20
20 - 30
30 - 40

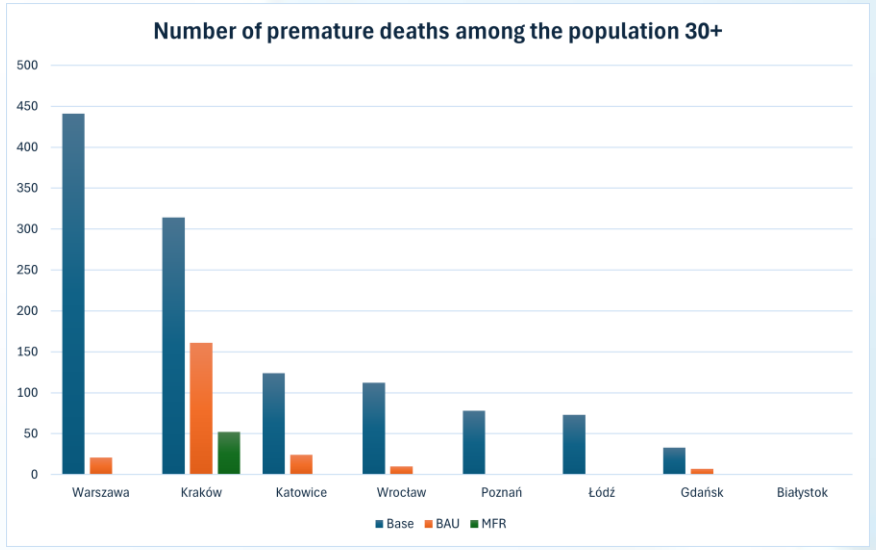
NO2
Liczba przedwczesnych zgonów
w przeliczeniu na 100tys. mieszkańców

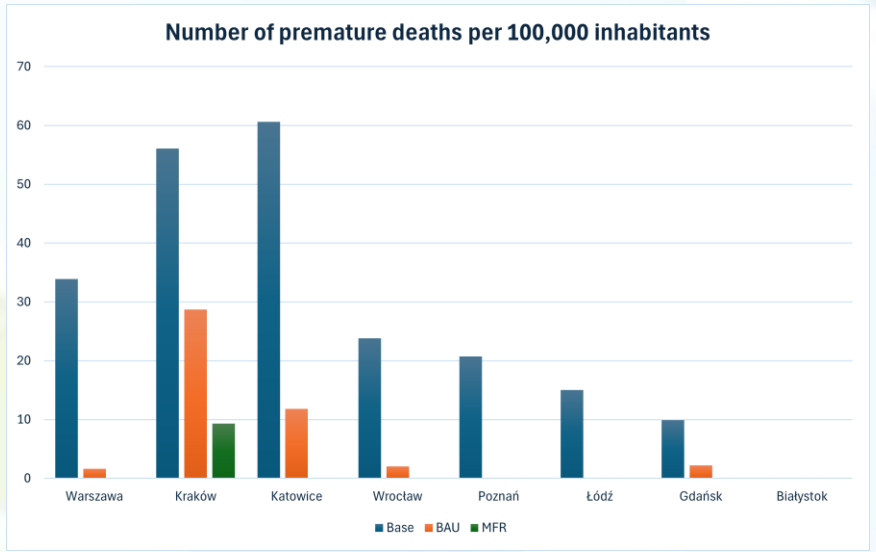
Scenariusz MFR
0
0,1 - 10
10 - 20
20 - 30
30 - 40

Scenario	Number of premature deaths (30+)	Percent of premature deaths (30+)	Number of premature deaths (30+) per 100 tys. inhabitants	
Base (2022)	2326	0	8,9	67 admin units
BAU	353	0	1,4	23 admin units
MFR	82	0	0,3	3 admin units

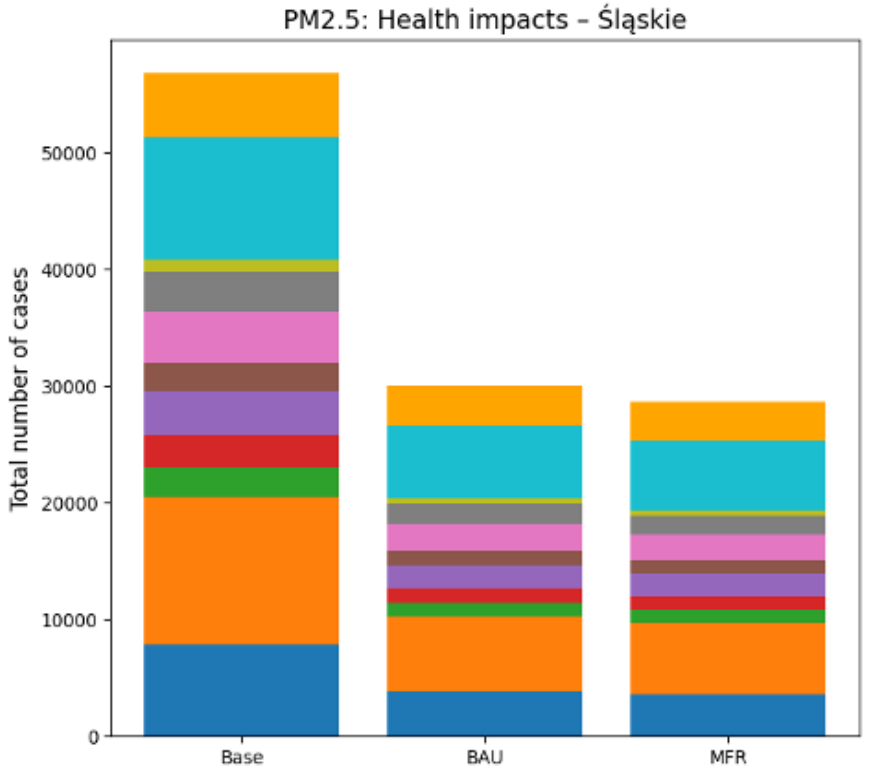
NO2 in cities

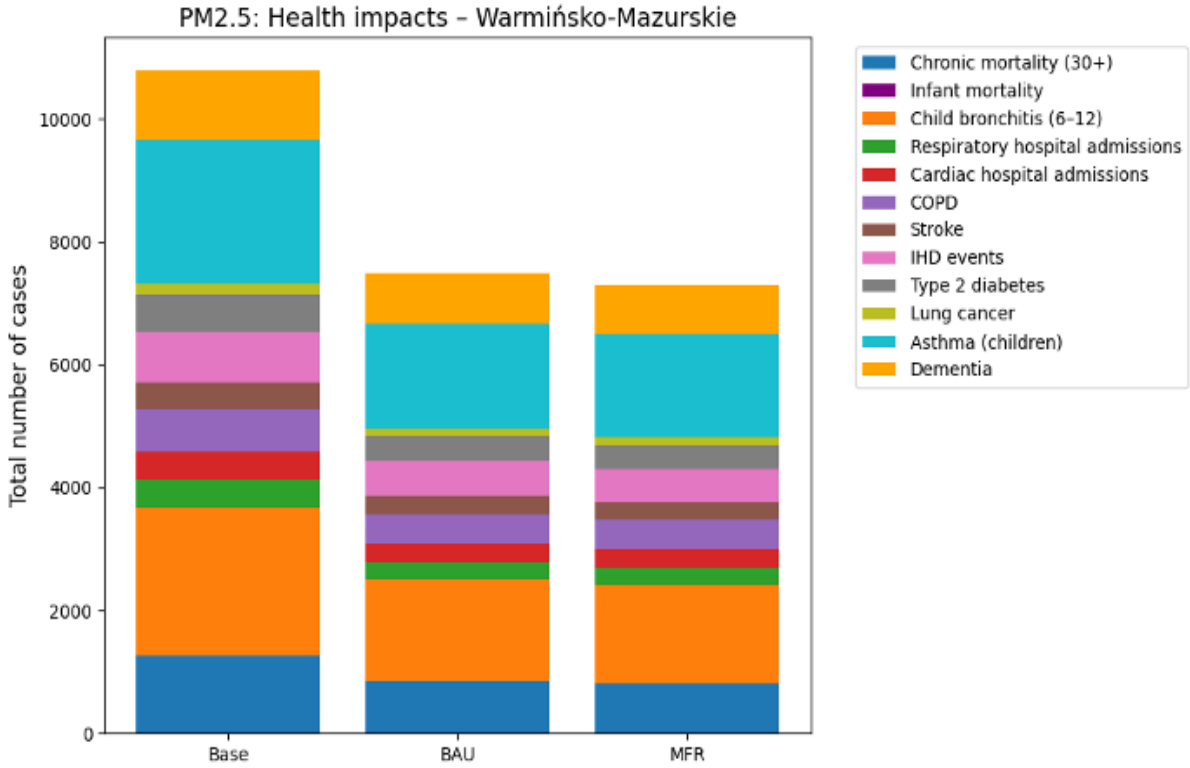




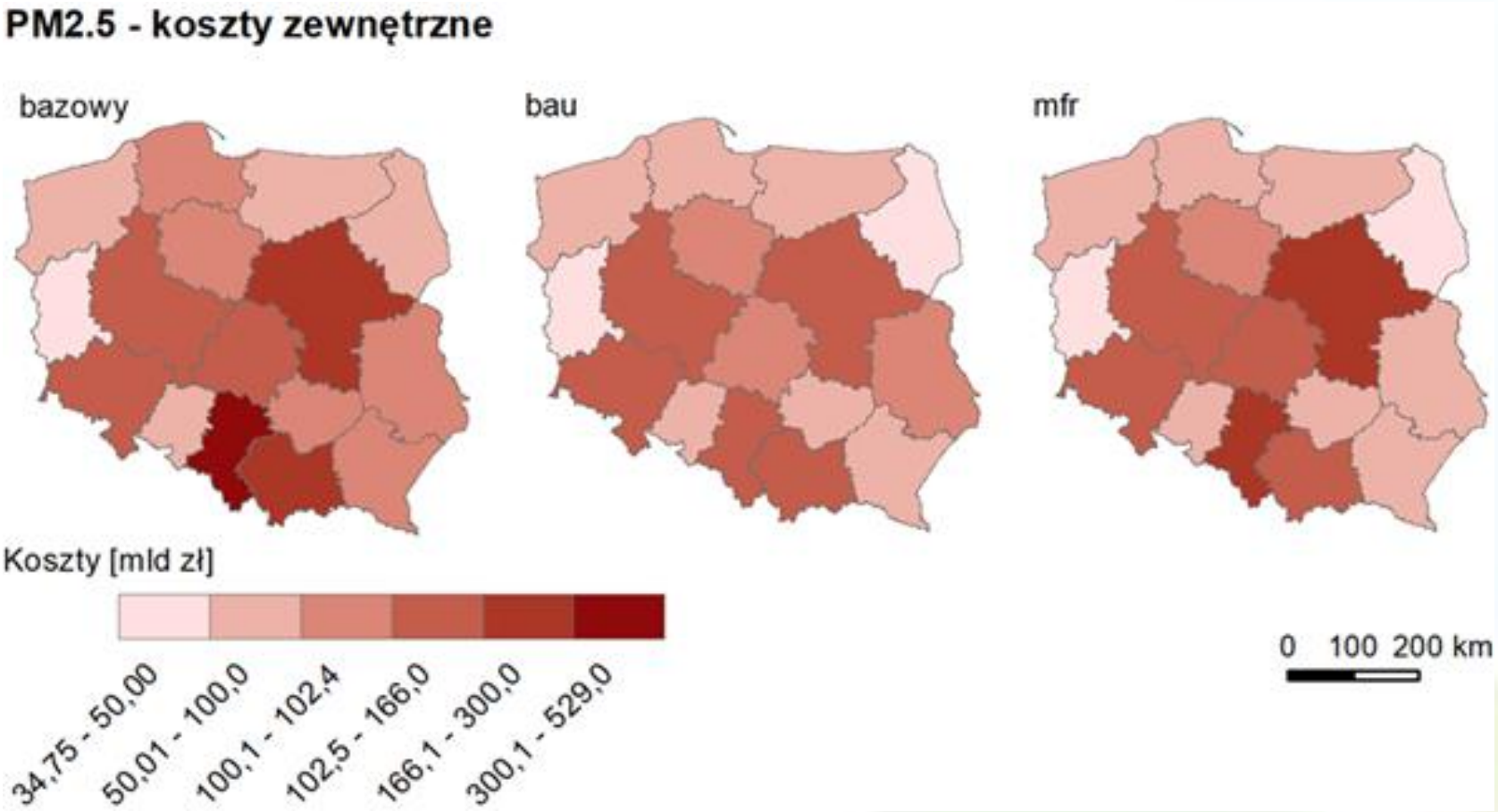


Health exposure - Alpha Risk Pool Tool





Cost analysis (voivodship level)



The health-related external costs show a similar pattern across provinces and in terms of the direction of change in these costs. This confirms the consistency of the analyses.

- PM2.5 particles generate significant external costs.
- A reduction in health-related external costs is observed in both scenarios compared with the baseline scenario, with greater savings in the MFR scenario.

Summary

- BAU and MFR scenarios show technically feasible and significant pollution reduction potential in Poland
- The project delivered the first comprehensive national cost–benefit analysis of reduction measures
- Significant regional differences of the emission reduction potential and the health exposure
- Results were communicated to Marshall Offices responsible for implementation of Road Maps and Air Quality Plans

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Thank you for your attention

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