Can the WHO air quality guidelines be attained under a revised Gothenburg protocol? Future scenarios for the EU, West Balkans and EECCA.

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EMEP Status Report 2022, Chapter 4 (https://emep.int/publ/reports/2022/EMEP_Status_Report_1_2022.pdf)

Introduction

- This work continues on from the AAQD revision process for the EU27, extended to include EFTA, UK, Western Balkans and EECCA regions
- Emission scenarios for 2015, 2030 and 2050 are provided by CIAM, Baseline and Maximum technical feasible reduction (MFR)
- An additional 2050 scenario with diet changes and other climate related reductions
- Calculations are made for PM, NO_2, O_3 annual mean using EMEP/uEMEP
- Exposure calculations are at 250 m and station calculations are at 25 m
- Some updates in uEMEP modelling have been made
- Just one meteorological year is used (2015)
- Focus on $PM_{2.5}$ and NO_2

- WHO guidelines for annual mean NO_2 = 10 $\mu g/m^3$ and $PM_{2.5}$ = 5 $\mu g/m^3$
- Suggested EU AAQD in 2030 for NO_2 = 20 $\mu g/m^3$ and $PM_{2.5}$ = 10 $\mu g/m^3$

Validation for NO_2 and $PM_{2.5}$

Validation NO_2 2015 reference year

uEMEP NO_2

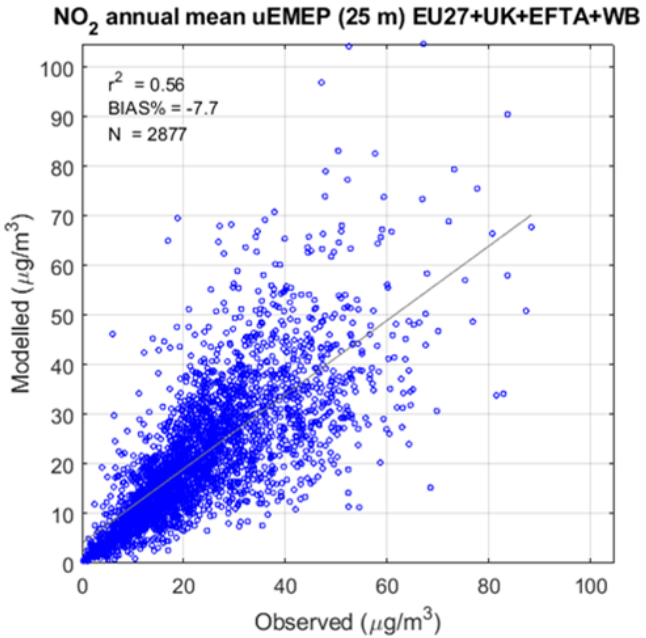
bias = -7.7 %

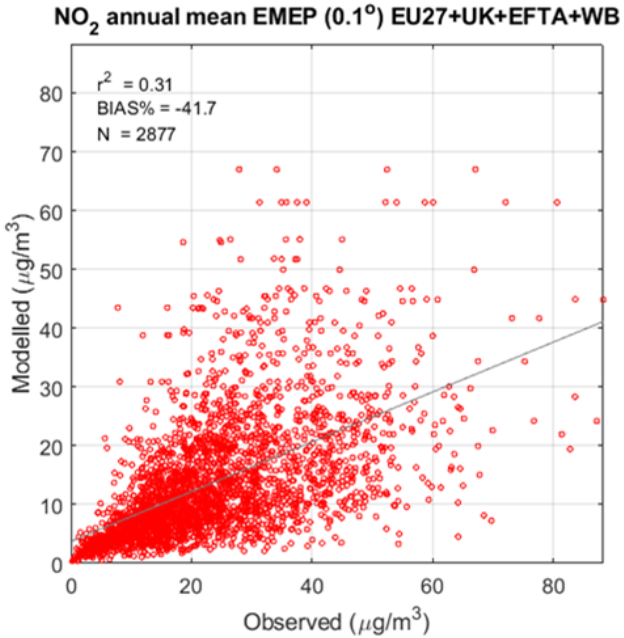
r^2 = 0.56

EMEP NO_2

bias = -41.7 %

r^2 = 0.31





Validation $PM_{2.5}$ 2015 reference year

uEMEP $PM_{2.5}$

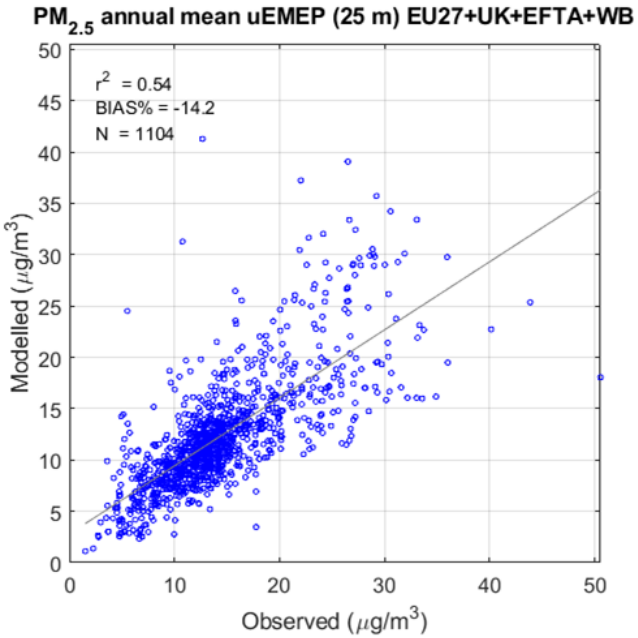
bias = -14 %

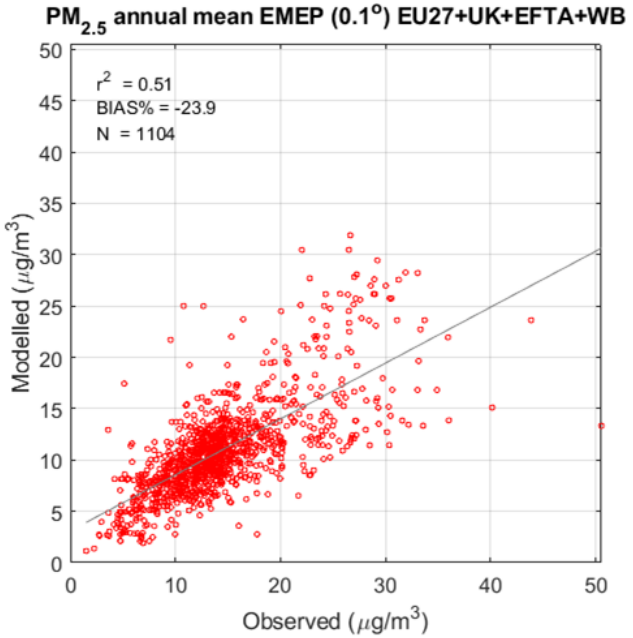
r^2 = 0.54

EMEP $PM_{2.5}$

bias = -24 %

r^2 = 0.51



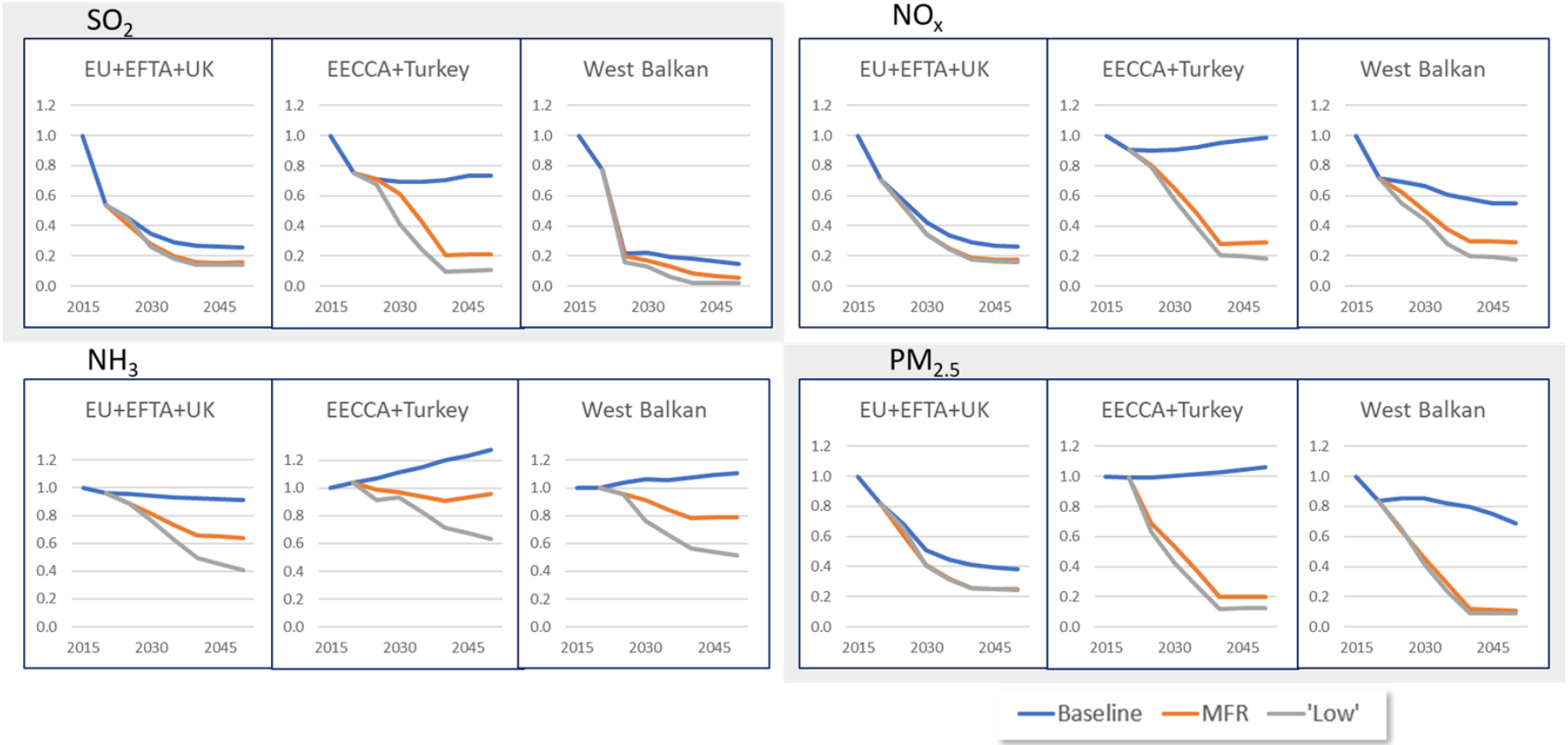


Emission scenarios

Emission scenarios

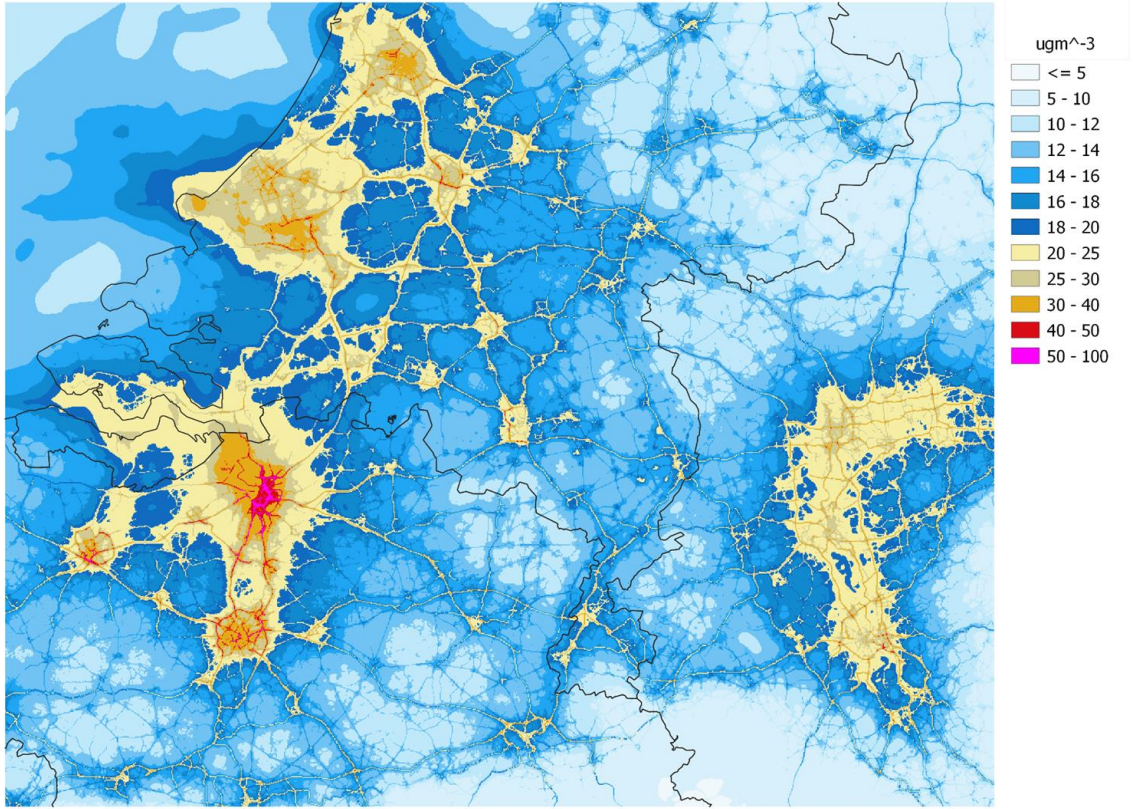
Scenario name	Emission year	Description
Baseline	2015	Reference calculation for validation
Baseline	2030	Current existing policies and trends
MFR	2030	Maximum technically feasible reduction
Baseline	2050	Current existing policies and trends
MFR	2050	Maximum technically feasible reduction
Low	2050	As in MFR for 2050 but with additional behavioural changes in regard to diet and reductions compatible with other climate goals

Emission scenarios

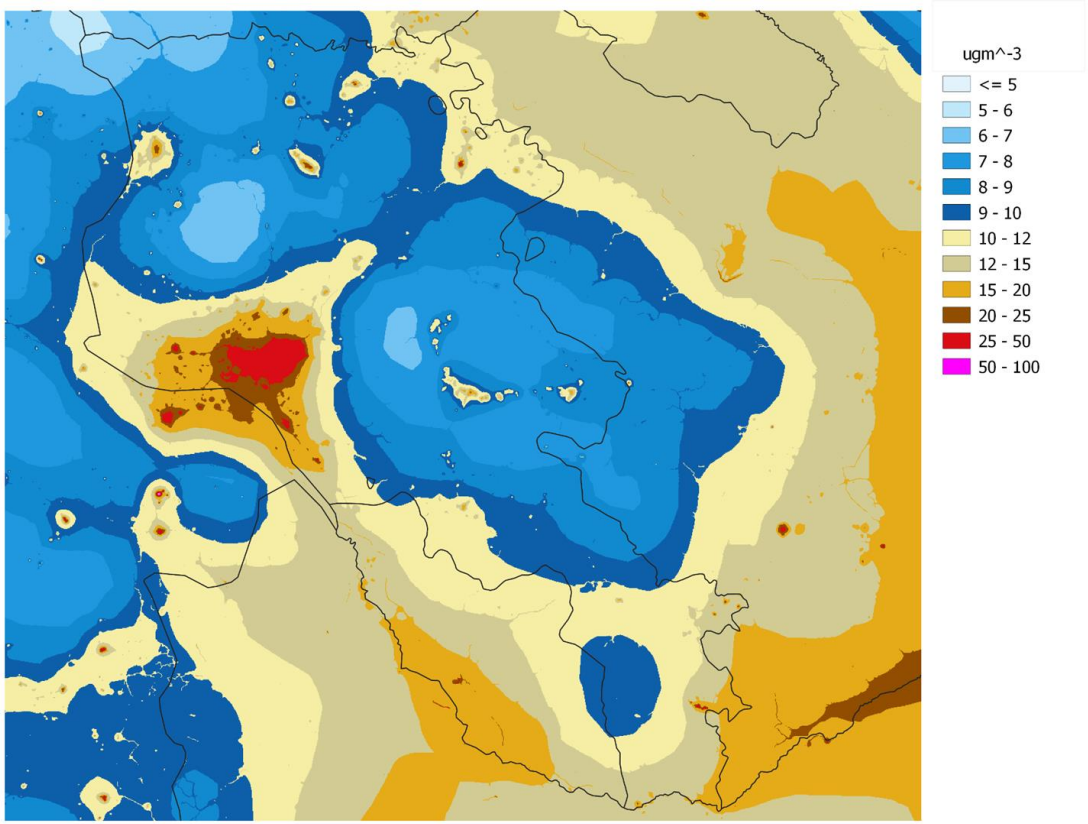


Example maps

Example maps: Netherlands/Belgium/Germany 2015 NO_2



Example maps: Armenia ++ 2015 $PM_{2.5}$



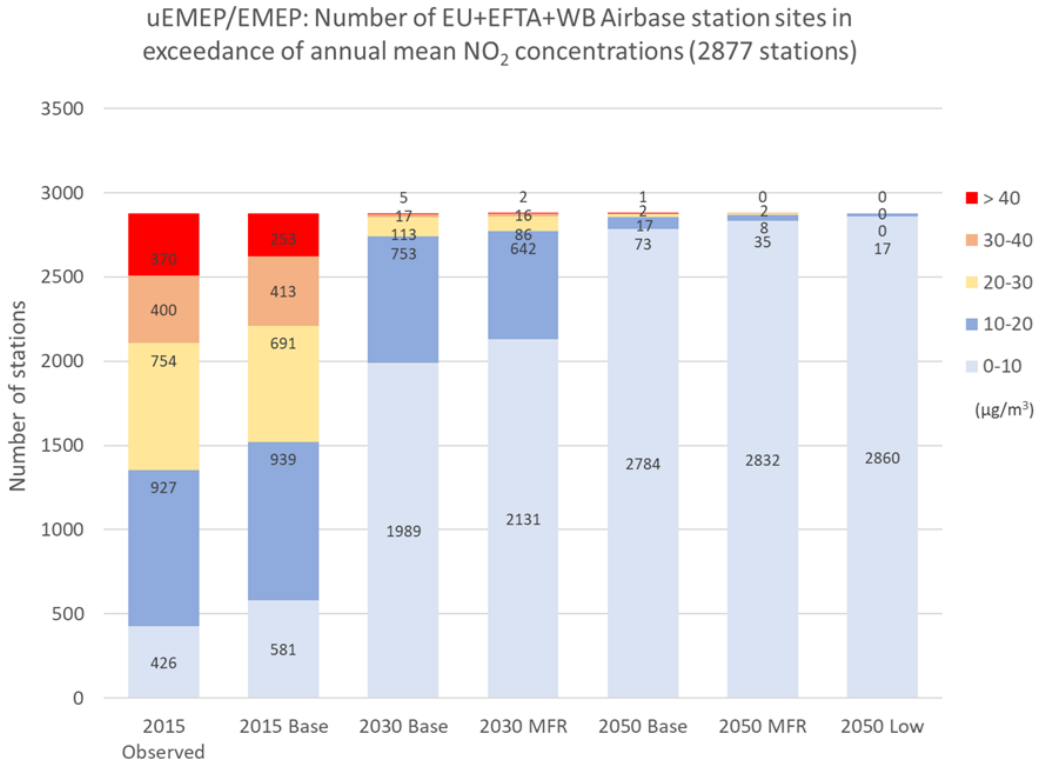
NO_2 and $PM_{2.5}$ Airbase station exceedances

Station calculations NO_2: EU+EFTA+WB

Achieved if < 2% of stations are over the threshold (~ 60 stations)

- 10 $\mu g/m^3$ achieved in 2050
- 20 $\mu g/m^3$ achieved in 2050

Mostly due to reduced road transport emissions



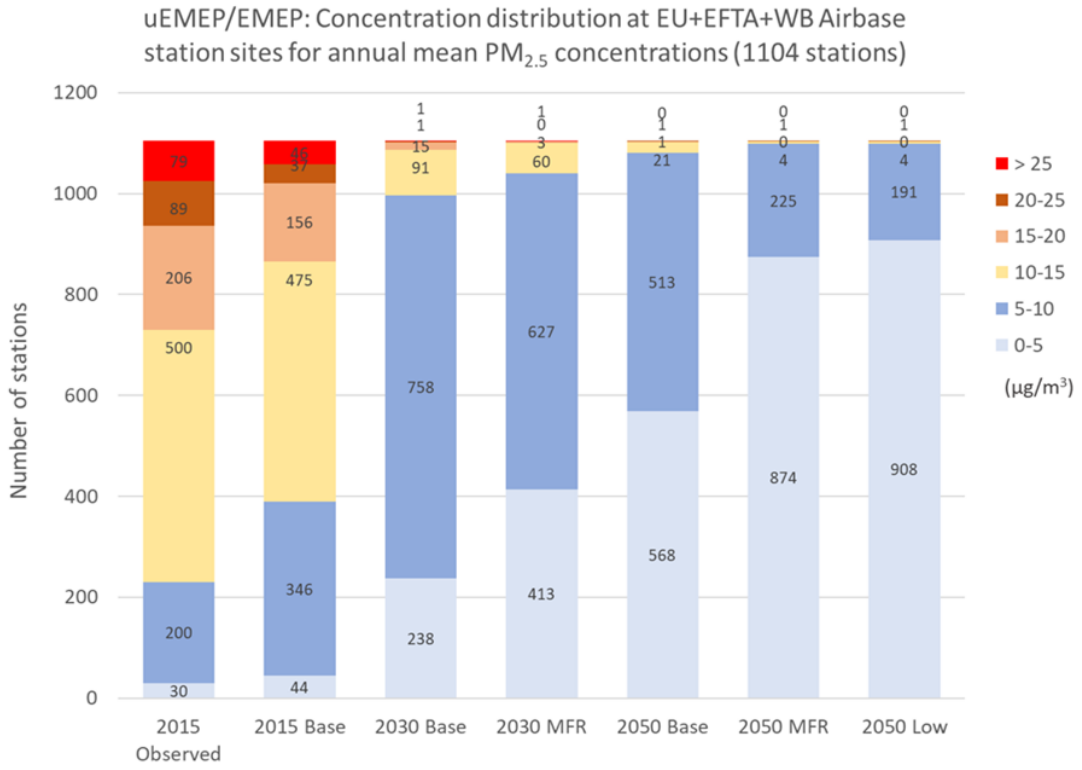
Station exceedances NO_2: EU+EFTA+WB

Scenario name	Emission year	> 40 $\mu g/m^3$	> 20 $\mu g/m^3$	> 10 $\mu g/m^3$
Observed	2015	13 %	52 %	85 %
Baseline	2015	9 %	47 %	80 %
Baseline	2030	< 0.2 %	5 %	31 %
MFR	2030	< 0.2 %	4 %	26 %
Baseline	2050	< 0.2 %	0.7 %	3 %
MFR	2050	0 %	0.3 %	1.6 %
Low	2050	0 %	0 %	0.6 %

Station calculations $PM_{2.5}$: EU+EFTA+WB

Achieved if < 2% of stations are over the threshold (~ 22 stations)

- 5 $\mu g/m^3$ never achieved
- 10 $\mu g/m^3$ achieved in 2050 MFR scenario



Station exceedances $PM_{2.5}$: EU+EFTA+WB

Scenario name	Emission year	> 20 $\mu g/m^3$	> 10 $\mu g/m^3$	> 5 $\mu g/m^3$
Observed	2015	15 %	79 %	97 %
Baseline	2015	8 %	65 %	96 %
Baseline	2030	< 0.2 %	10 %	78 %
MFR	2030	< 0.2 %	6 %	63 %
Baseline	2050	< 0.2 %	2 %	49 %
MFR	2050	< 0.2 %	< 0.2 %	21 %
Low	2050	0 %	< 0.2 %	18 %

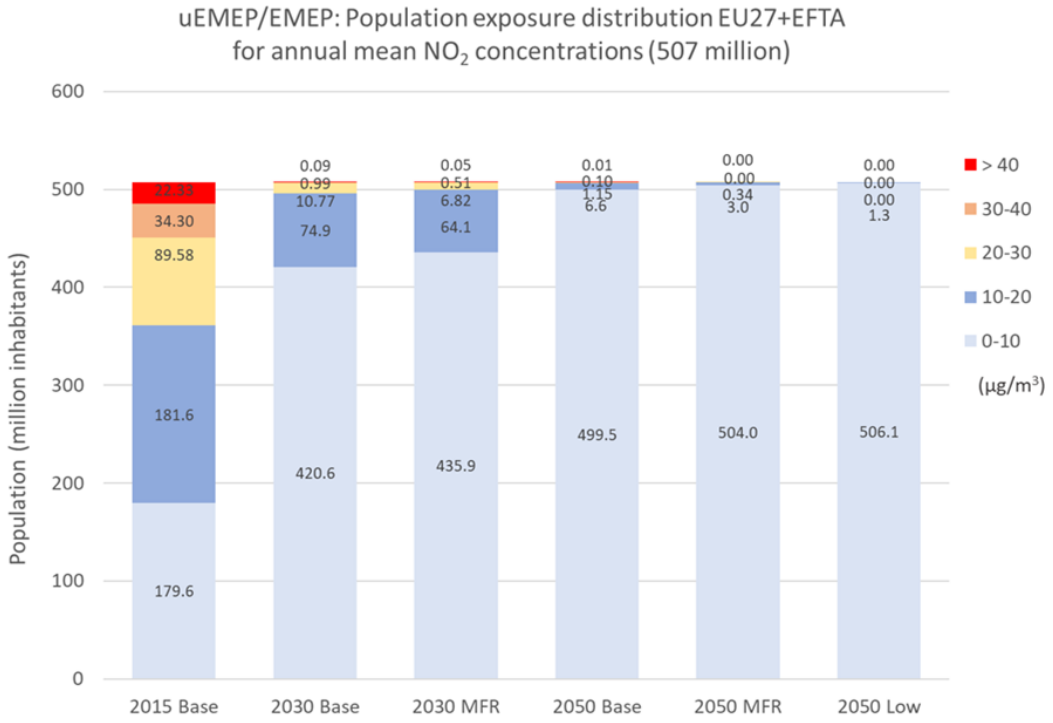
NO_2 population exposure for EU27+EFTA, Western Balkans and EECCA

Exposure calculations NO_2: EU+EFTA

Achieved if < 2% of the population is over the threshold (~10 million)

- 10 $\mu g/m^3$ achieved in 2050
- 20 $\mu g/m^3$ achieved in 2030 MFR scenario

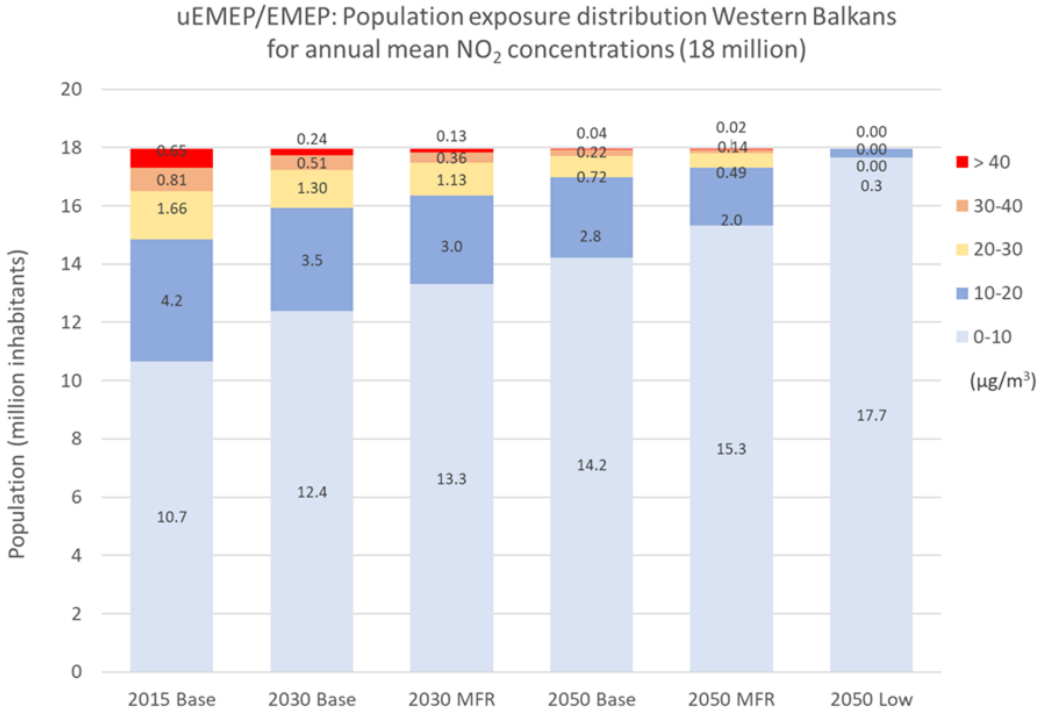
The fraction of population over thresholds is lower than the fraction of stations (~ factor 2)



Exposure calculations NO_2: Western Balkans

Achieved if < 2% of the population is over the threshold (~0.4 million)

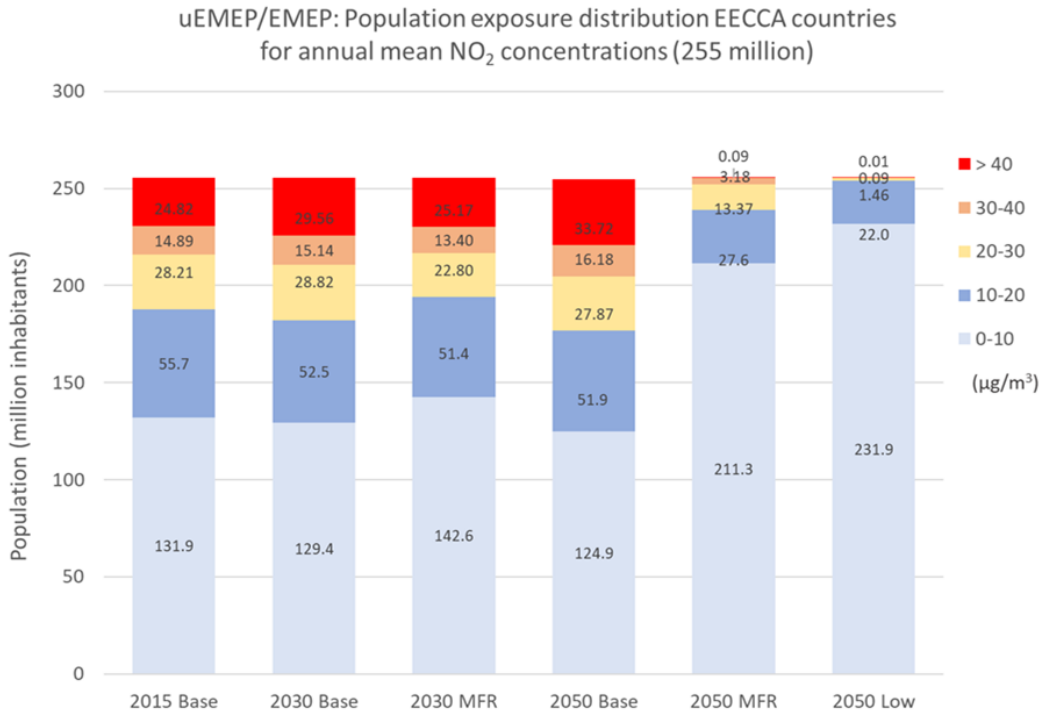
- 10 *µg/m³* achieved in 2050 ‘low’ scenario
- 20 *µg/m³* achieved in 2050 ‘low’ scenario



Exposure calculations NO_2: EECCA

Achieved if < 2% of the population is over the threshold (~5 million)

- 10 $\mu g/m^3$ never achieved
- 20 $\mu g/m^3$ only achieved in 'low' scenario 2050
- 40 $\mu g/m^3$ achieved in 2050



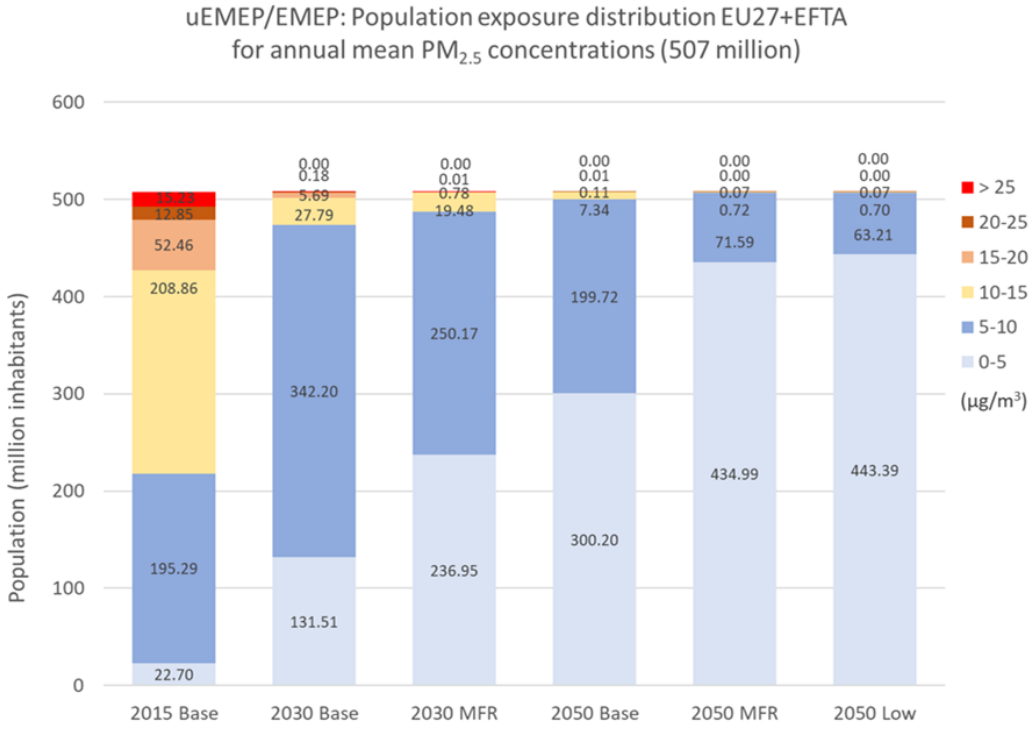
$PM_{2.5}$ population exposure for EU27+EFTA, Western Balkans and EECCA

Exposure calculations $PM_{2.5}$: EU+EFTA

Achieved if < 2% of the population is over the threshold (~ 10 million)

- 5 $\mu g/m^3$ never achieved
- 10 $\mu g/m^3$ achieved in 2050

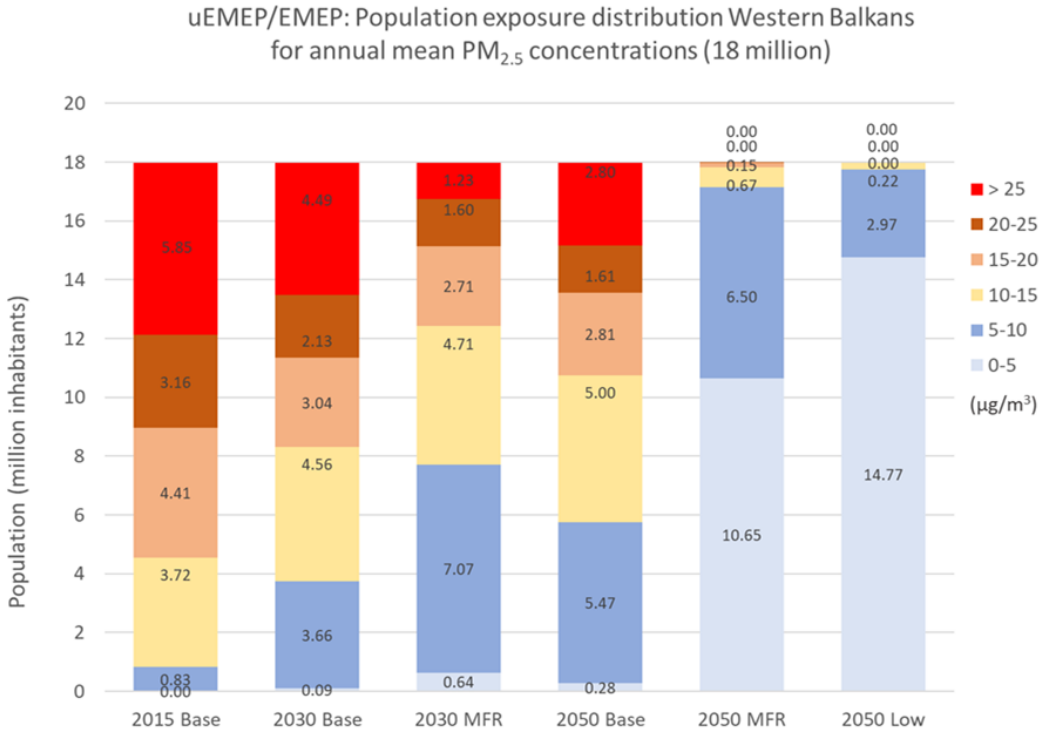
The fraction of population over thresholds is similar to the fraction of stations



Exposure calculations $PM_{2.5}$: Western Balkans

Achieved if < 2% of the population is over the threshold (~ 0.4 million)

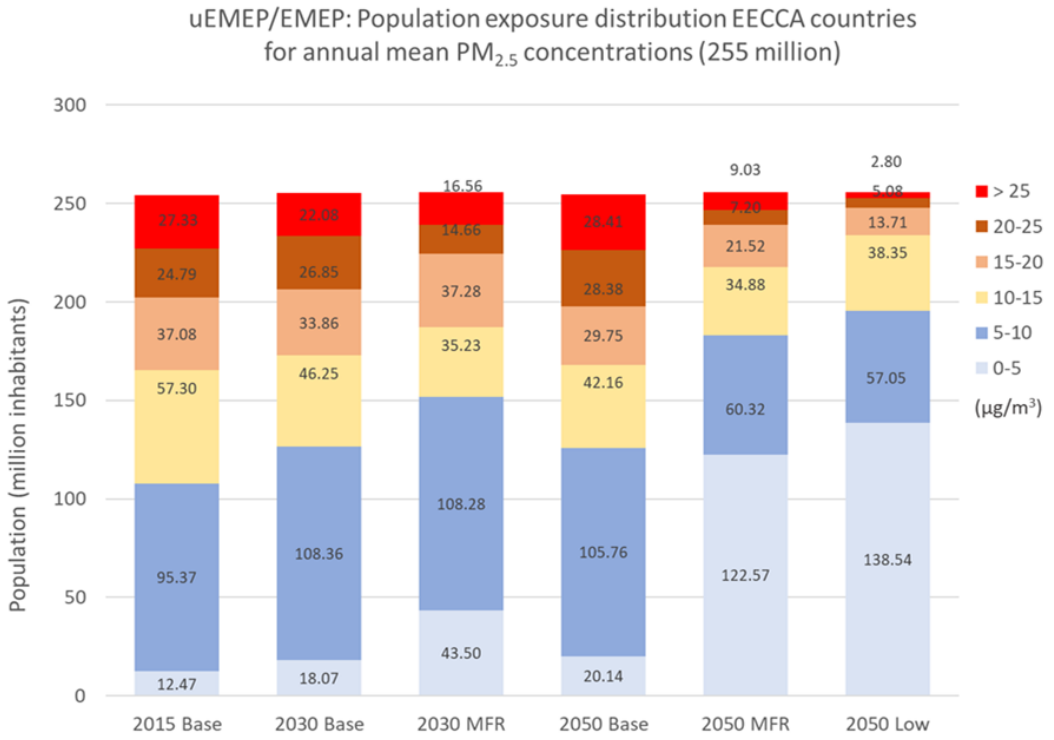
- 5 *µg/m³* never achieved
- 10 *µg/m³* achieved in 2050 for the 'low' scenario



Exposure calculations $PM_{2.5}$: EECCA

Achieved if < 2% of the population is over the threshold (~5 million)

- 5 $\mu g/m^3$ never achieved
- 10 $\mu g/m^3$ never achieved
- 20 $\mu g/m^3$ never achieved



Summary of achievability

Summary achievability of WHO guidelines (2 %)

- EU27 + EFTA
  - Achieving 10 $\mu g/m^3$ at station sites for NO_2 is not likely until 2050 but possible for population exposure in 2030 with the MFR scenario
  - Achieving 5 $\mu g/m^3$ for $PM_{2.5}$ for all countries is not likely at all

- Western Balkans
  - Achieving 10 $\mu g/m^3$ for NO_2 may be possible in 2050 under the strictest MFR low scenario
  - Achieving 5 $\mu g/m^3$ for $PM_{2.5}$ is not likely for any country

- EECCA
  - Achieving 10 $\mu g/m^3$ for NO_2 is not likely under any scenario
  - Achieving 5 $\mu g/m^3$ for $PM_{2.5}$ is not possible (natural sources)

Summary achievability of the suggested EU AAQD limit values (2 %)

- EU27+EFTA
  - Achieving 20 $\mu g/m^3$ for NO_2 is a challenge but possible with the 2030 MFR scenario. Will likely require additional local measures
  - Most countries will have achieved 20 $\mu g/m^3$ everywhere in 2050
  - Achieving 10 $\mu g/m^3$ for $PM_{2.5}$ everywhere is a large challenge in 2030 but possible in 2050
  - Around half of the countries (16) will have achieved $PM_{2.5}$ concentrations < 10 $\mu g/m^3$ everywhere in the 2030 MFR scenario

Questions?

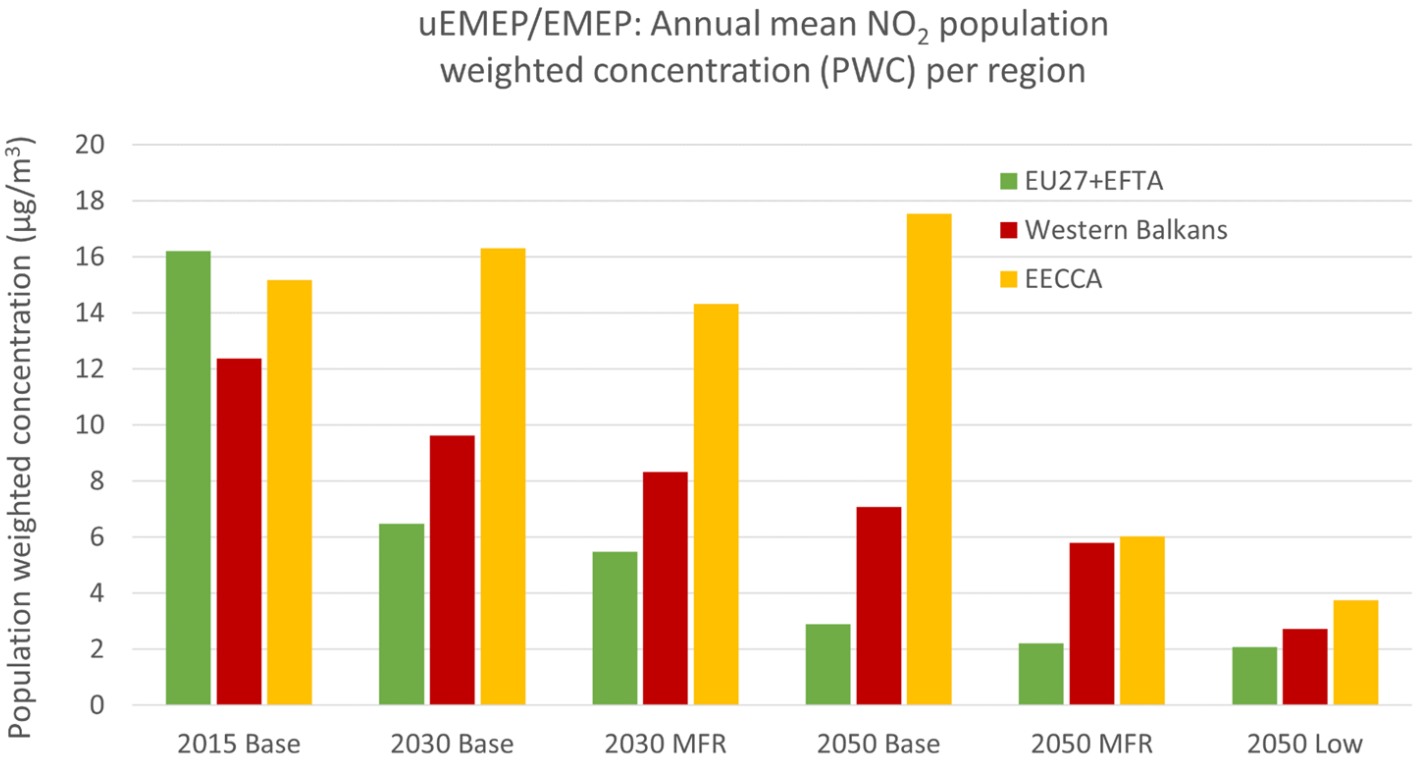
Some suggested questions:

- How do the source contributions change with the scenarios in the other regions?
- Where did this 2 % come from? Is 10 million people over the recommended levels really acceptable?
- How does the bias affect the scenarios?
- Should the WHO guidelines only be applied for population exposure and not for station exceedances? Is it then more achievable?

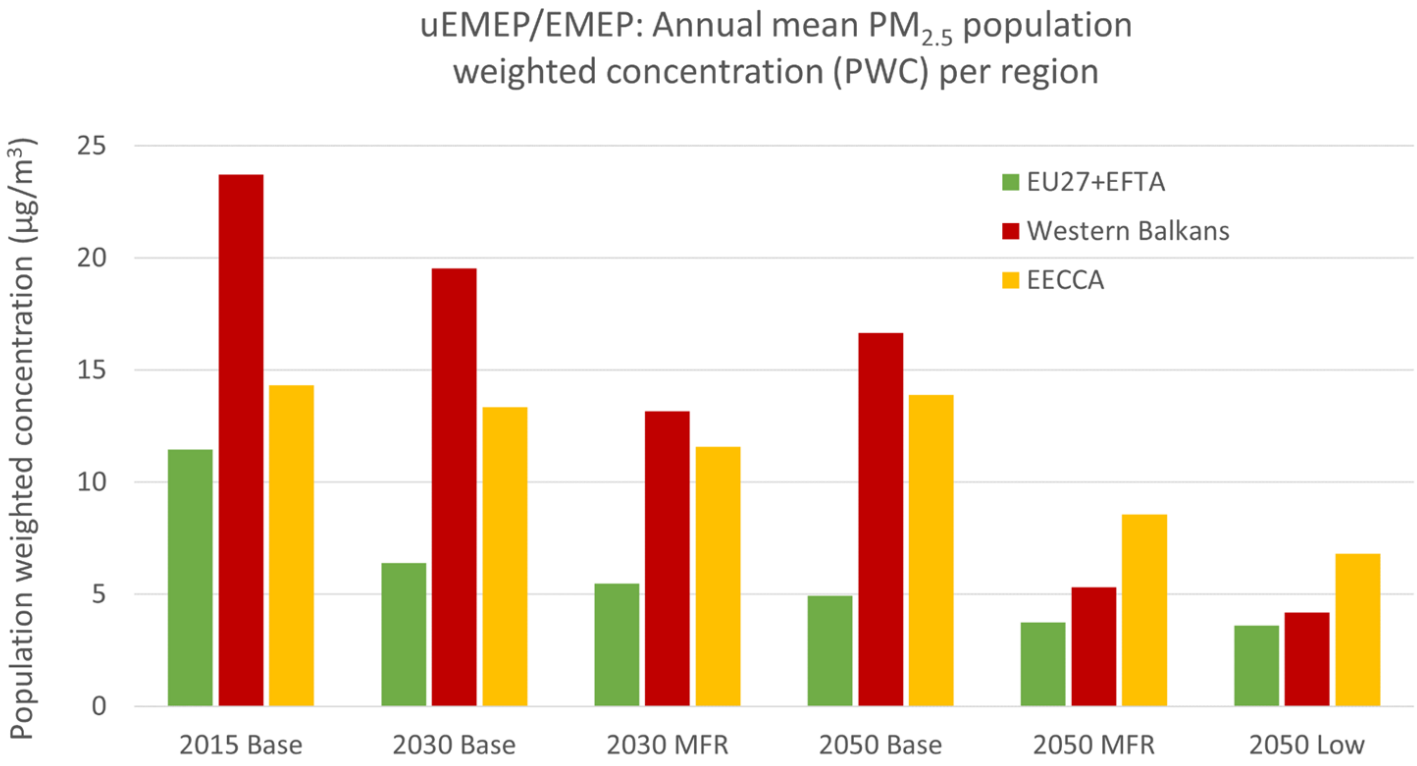
Additional slides

Summary population exposure per region

Population weighted concentration for NO_2 per region

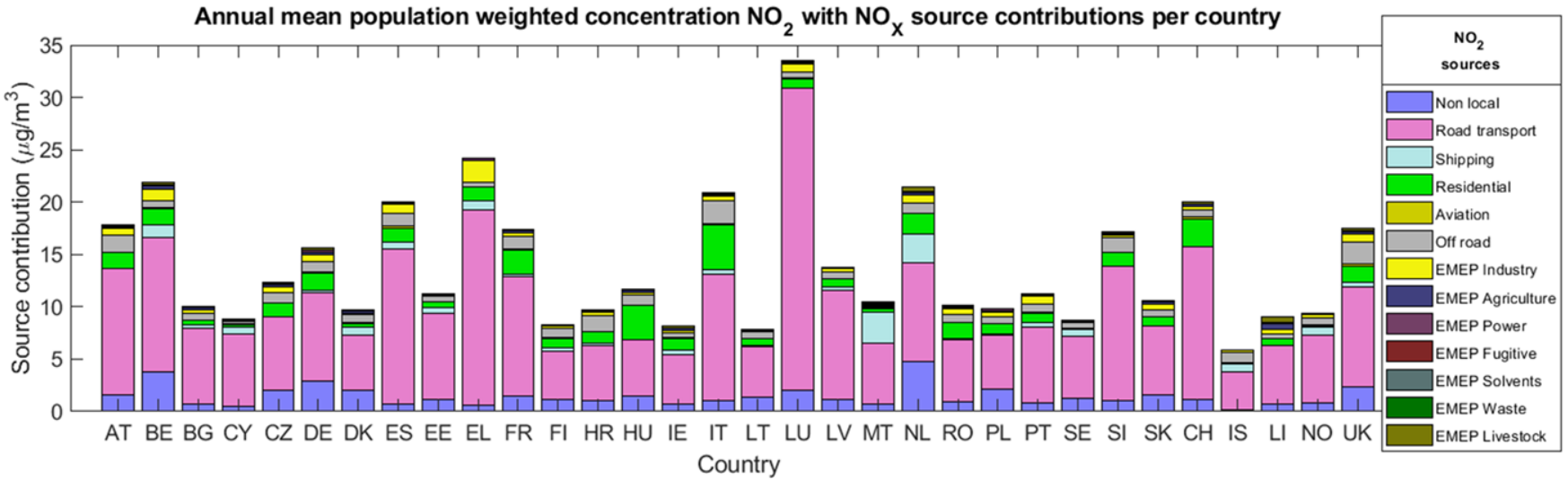


Population weighted concentration for $PM_{2.5}$ per region



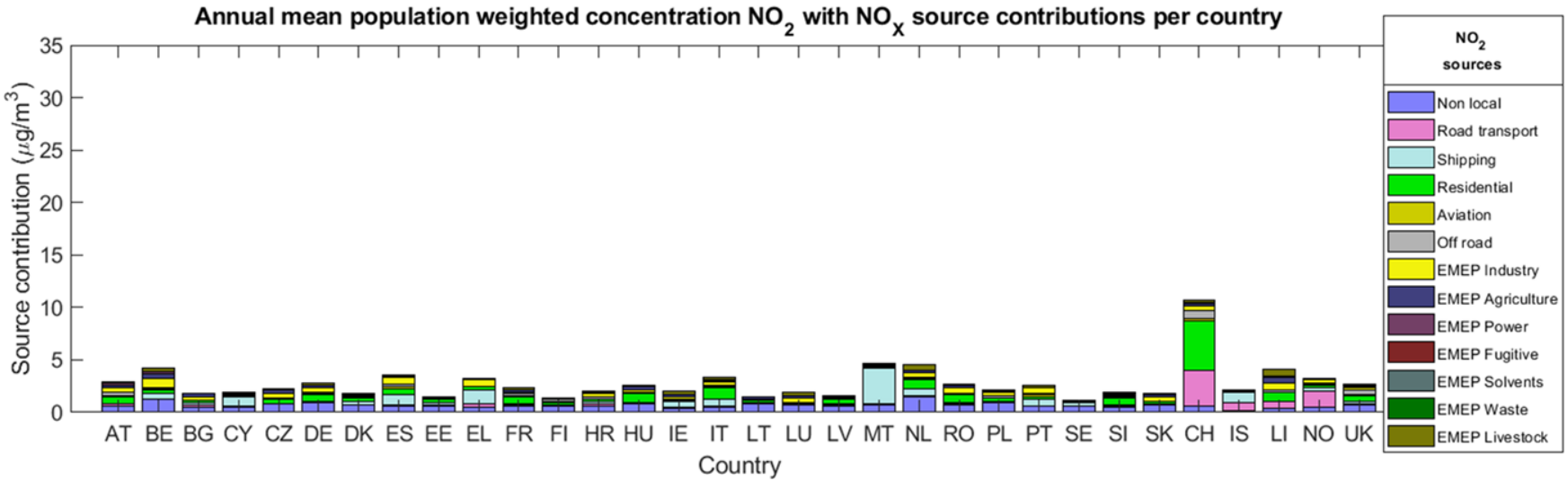
Source contributions to NO_2 per country and region

EU+EFTA source contributions for NO_2



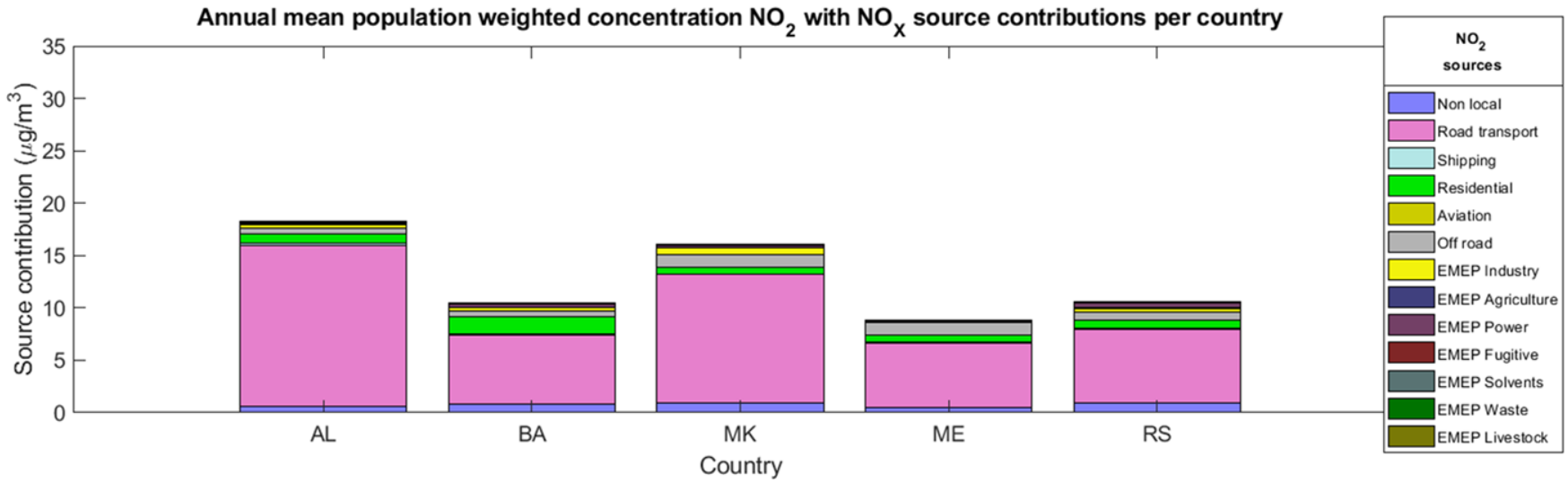
Baseline 2015

EU+EFTA source contributions for NO_2



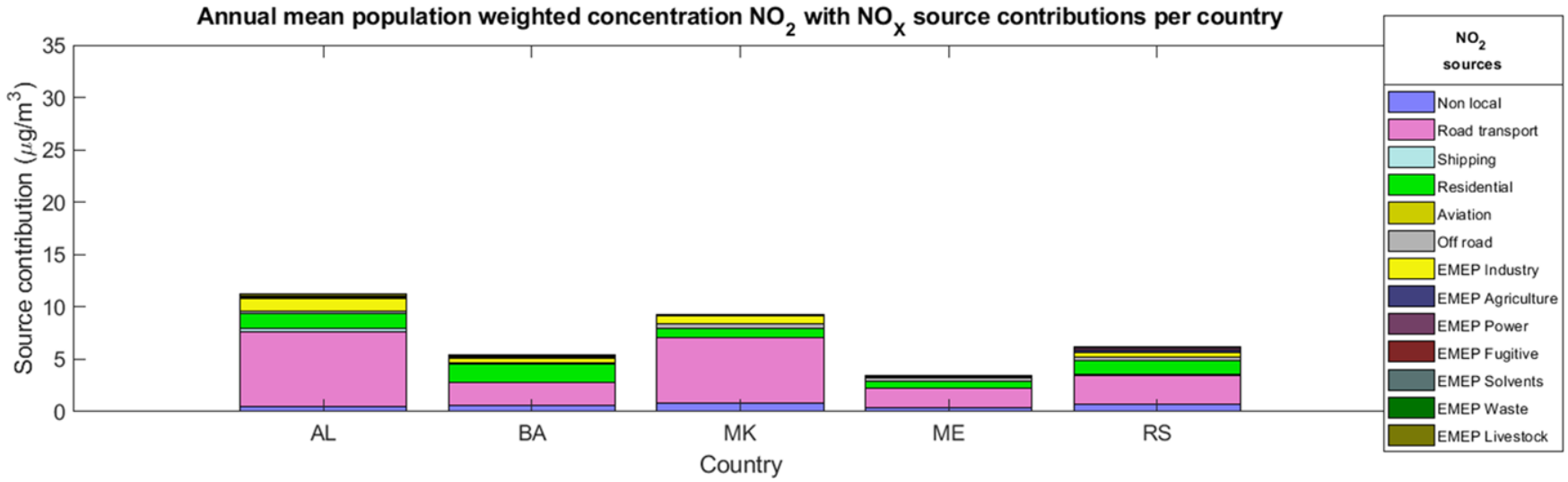
Baseline 2050

Western Balkans source contributions for NO_2



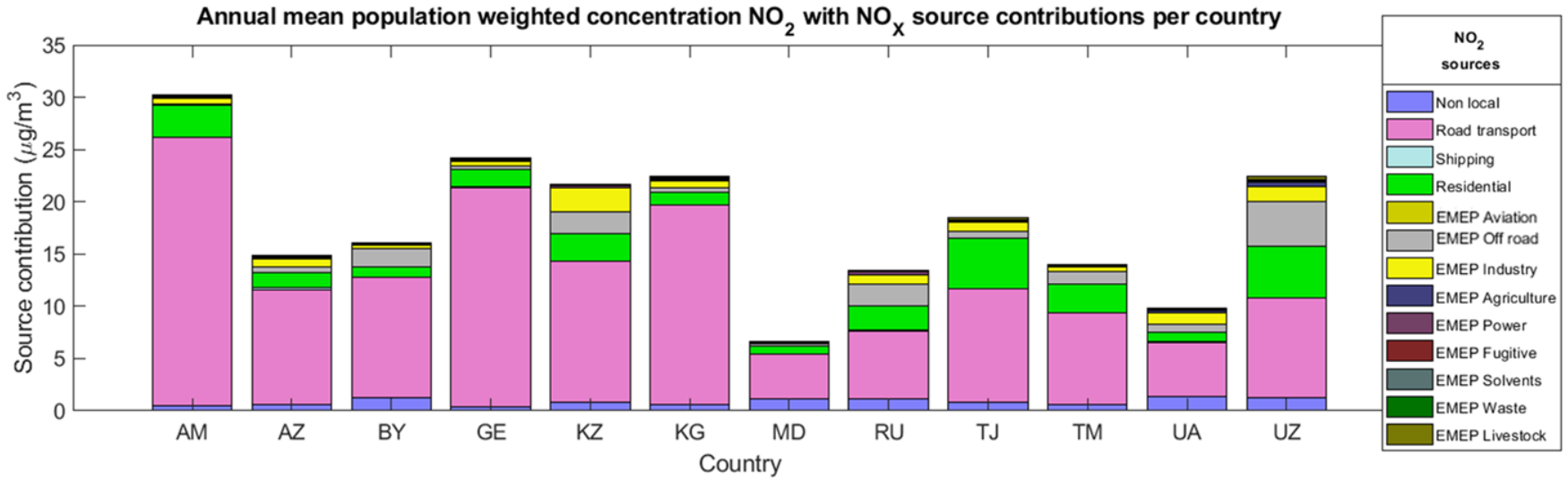
Baseline 2015

Western Balkans source contributions for NO_2



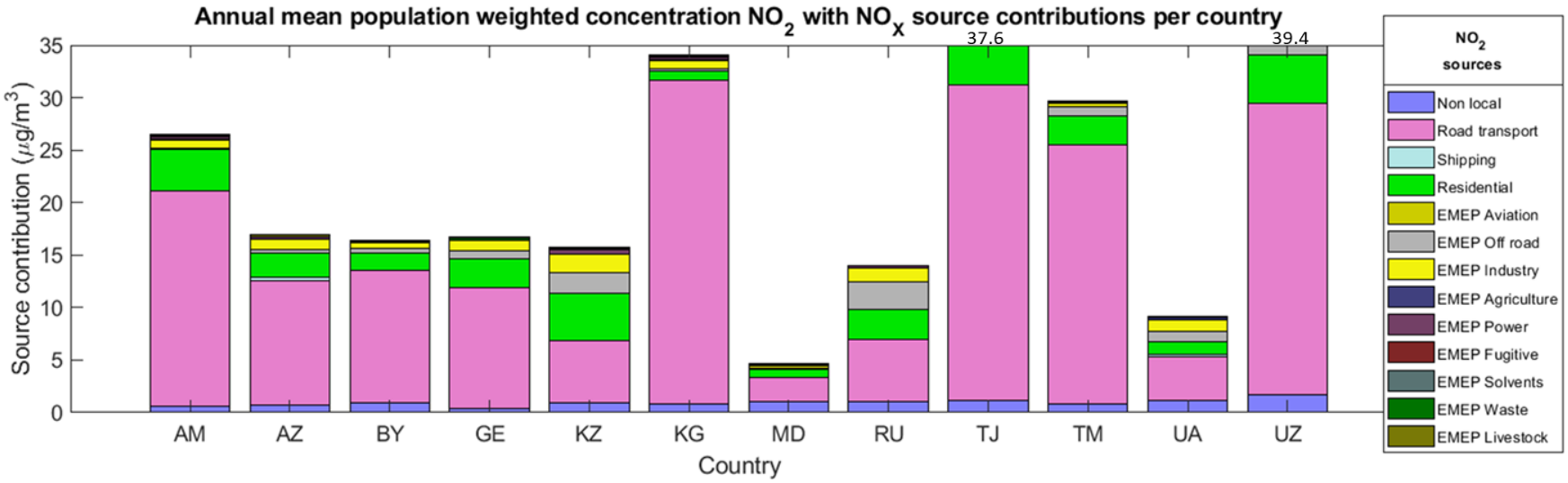
Baseline 2050

EECCA source contributions for $PM_{2.5}$



Baseline 2015

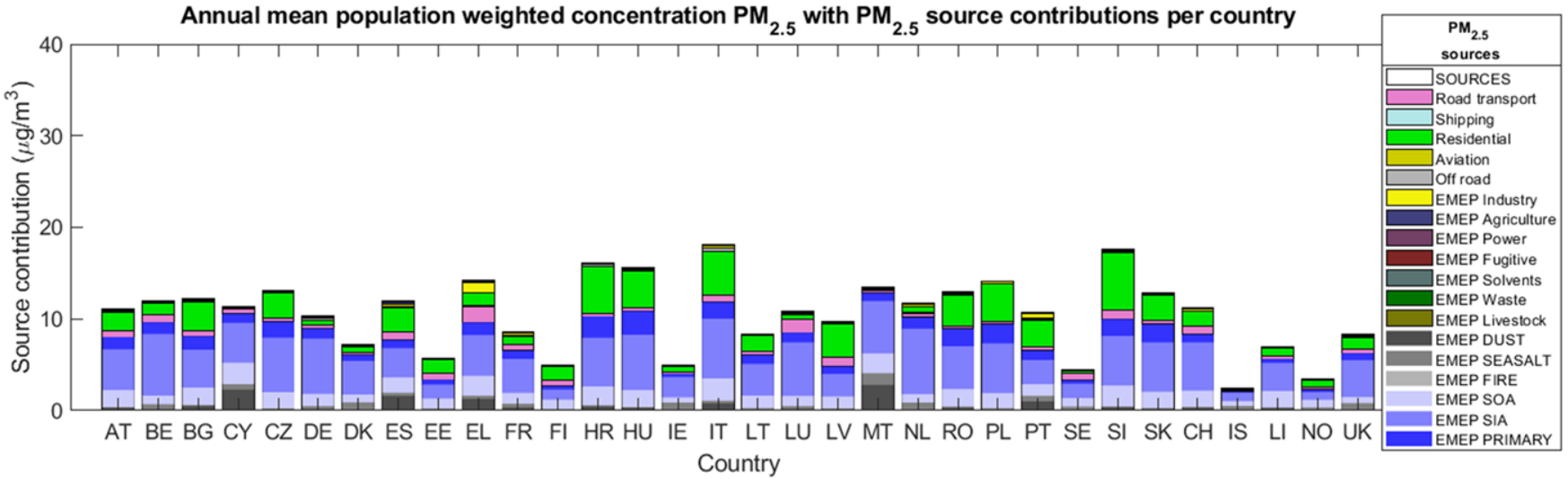
EECCA source contributions for $PM_{2.5}$



Baseline 2050

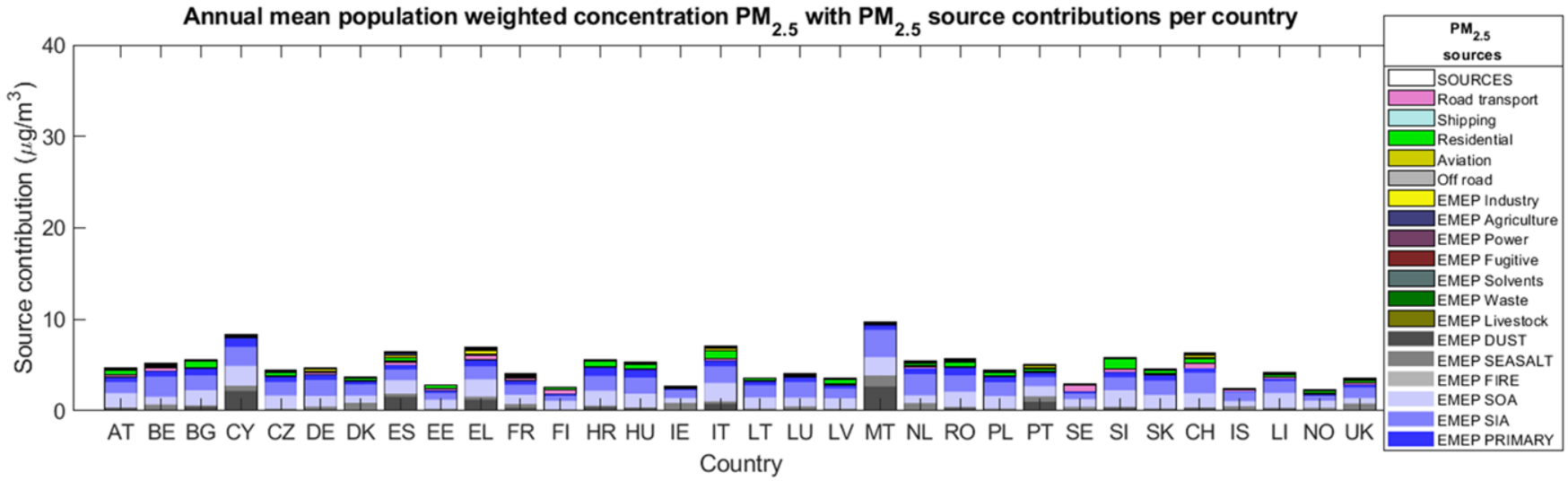
Source contributions to $PM_{2.5}$ per country and region

EU+EFTA source contributions for $PM_{2.5}$



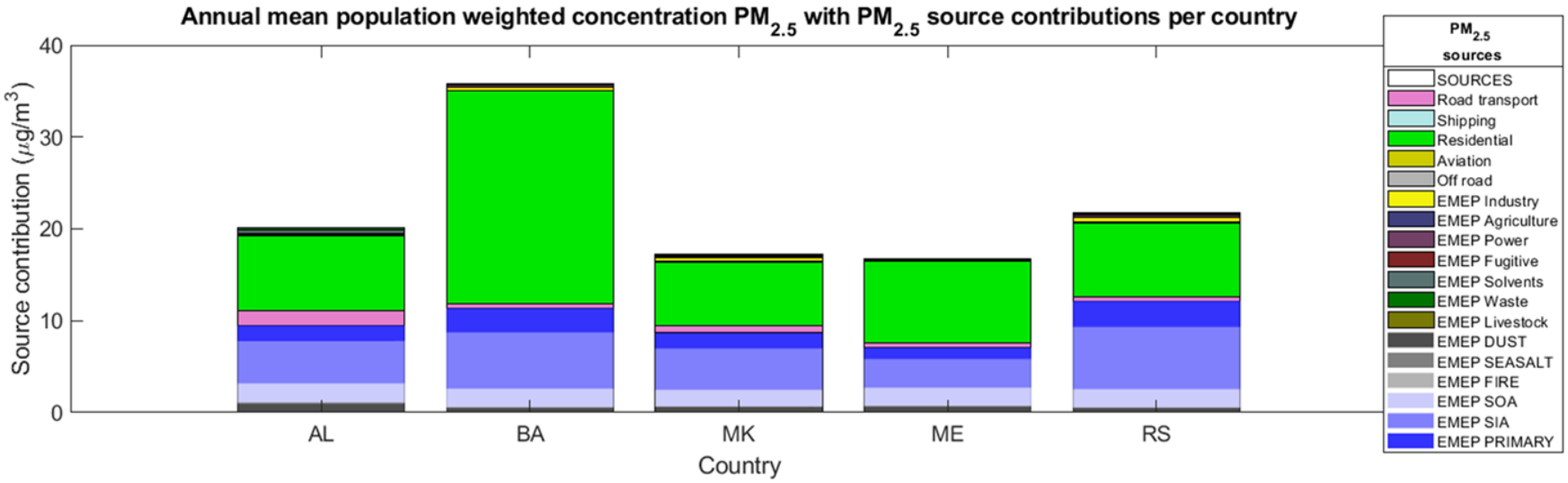
Baseline 2015

EU+EFTA source contributions for $PM_{2.5}$



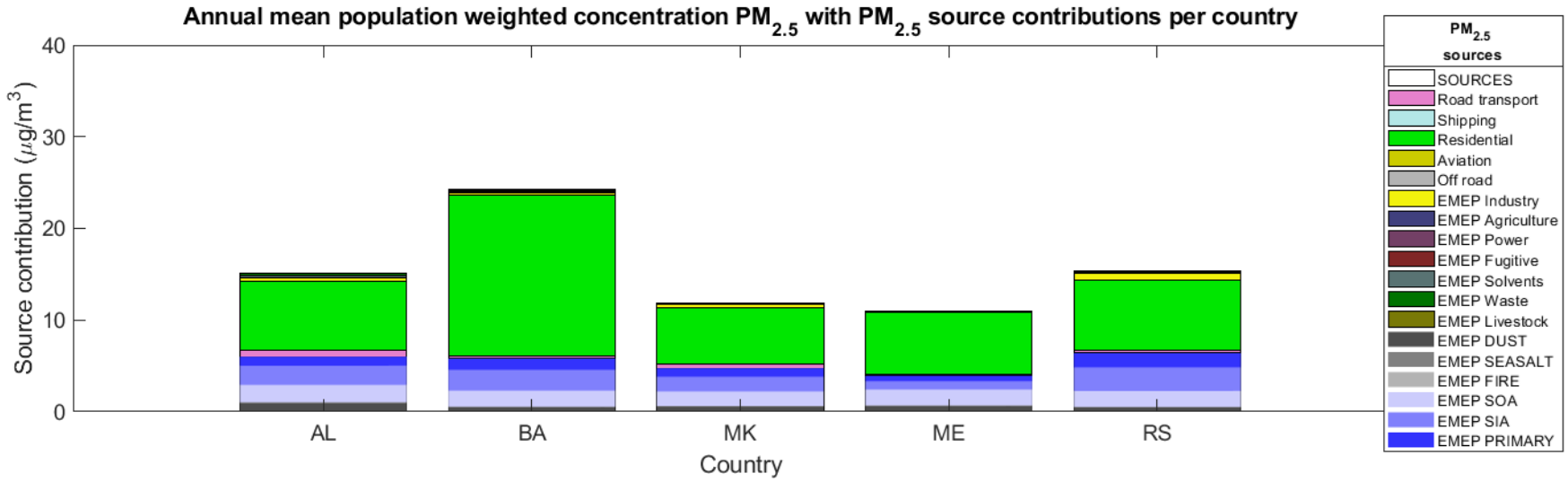
Baseline 2050

Western Balkans source contributions for $PM_{2.5}$



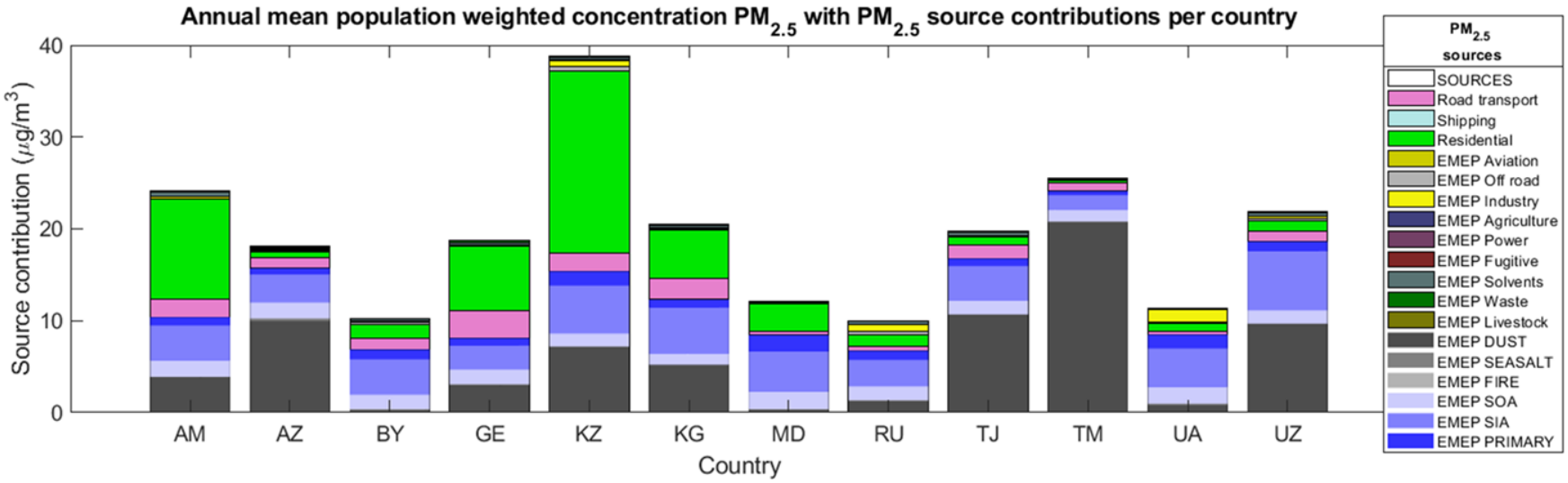
Baseline 2015

Western Balkans source contributions for $PM_{2.5}$



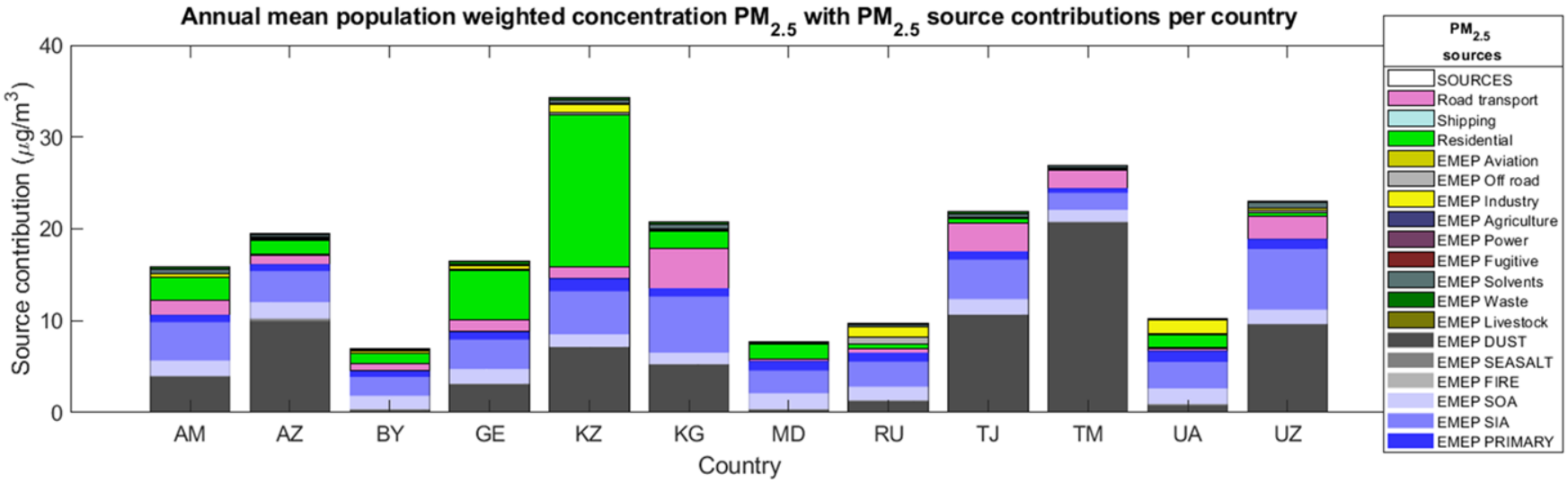
Baseline 2050

EECCA source contributions for $PM_{2.5}$



Baseline 2015

EECCA source contributions for $PM_{2.5}$



Baseline 2050

Emission scenarios