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CIAM scenarios supporting GP revision

Progress in modelling

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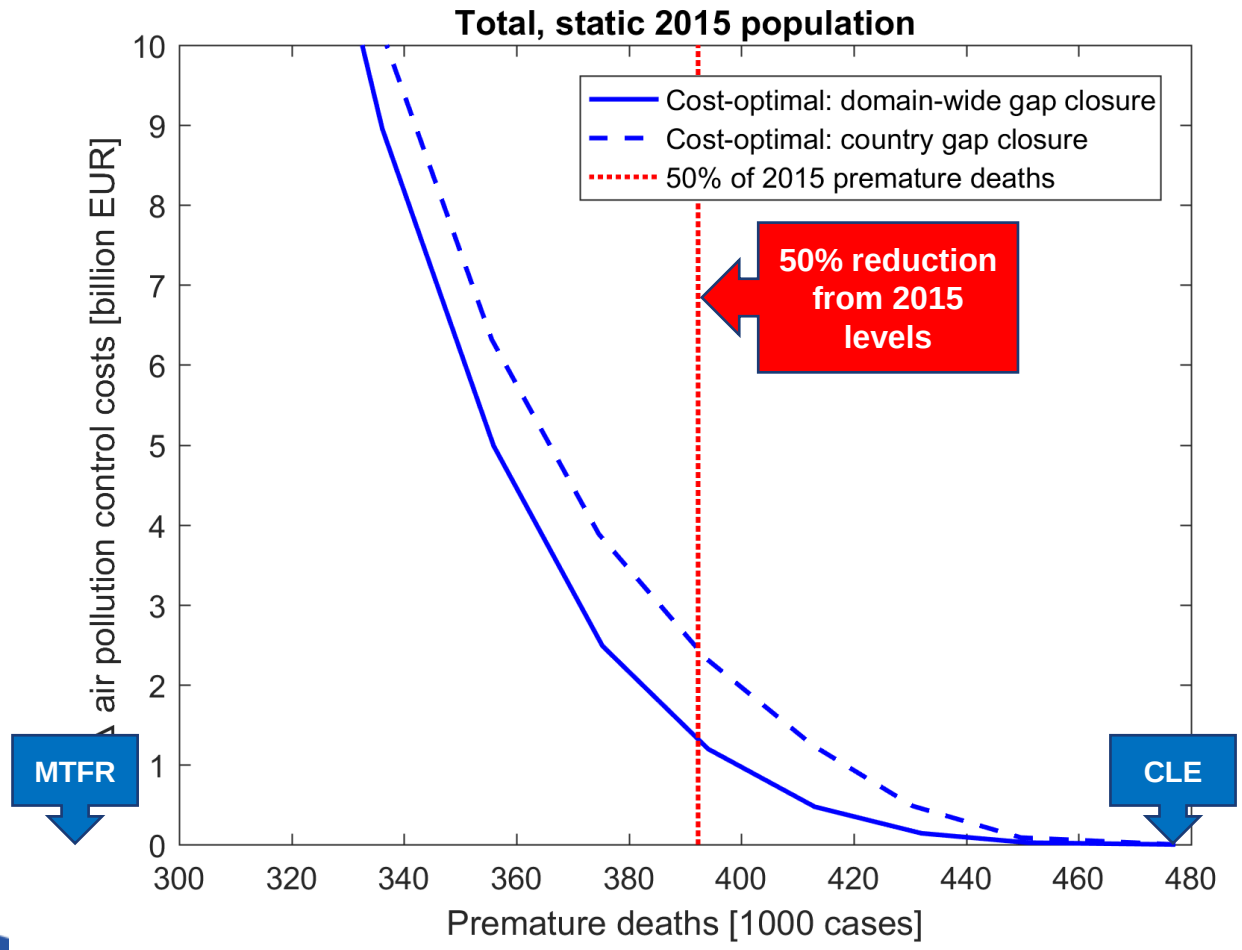
Updated analysis using GP review scenarios

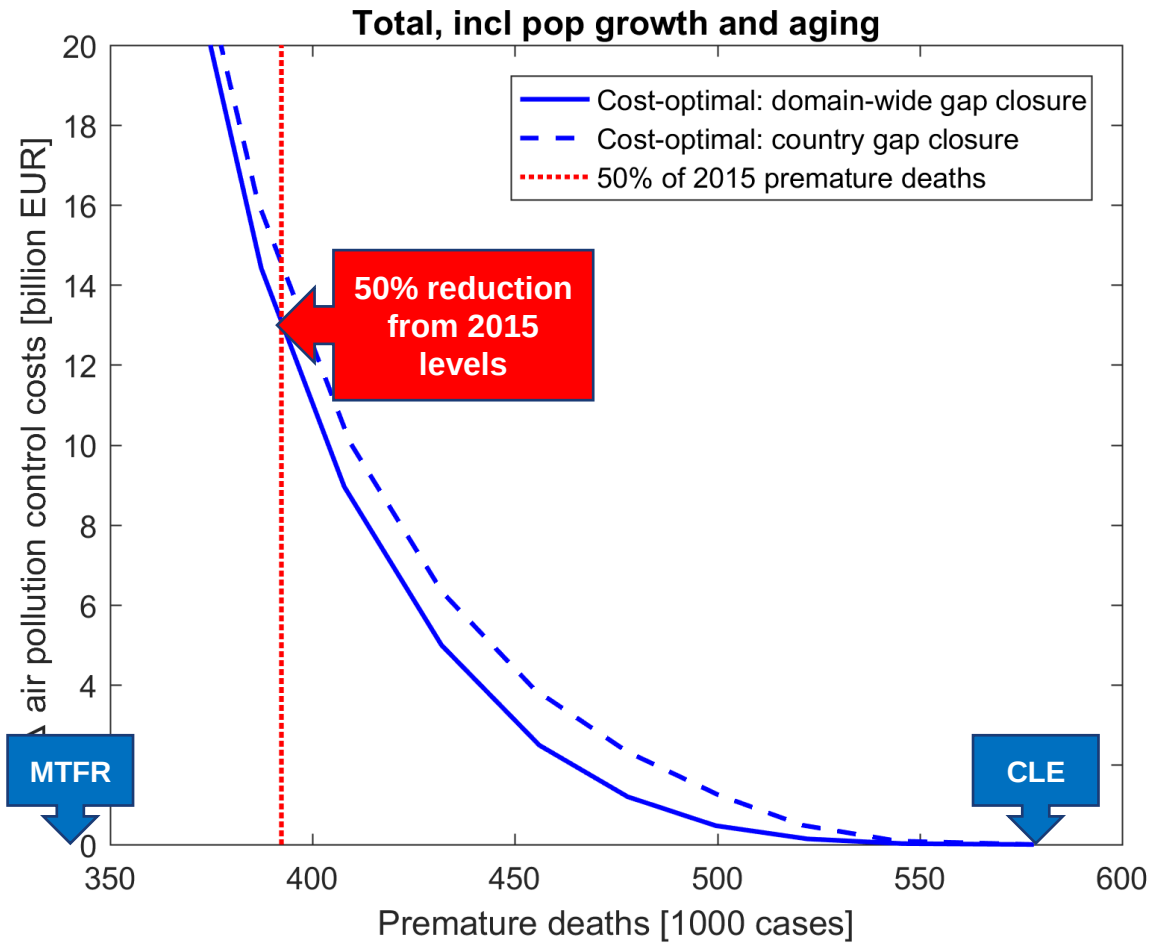
Achieving PM health impact targets by 2040

Least-cost reduction of PM health impacts in UNECE (excl. North America) by 2040

40% gap closure to achieve 50% reduction in premature deaths



80% gap closure to achieve 50% reduction in premature deaths

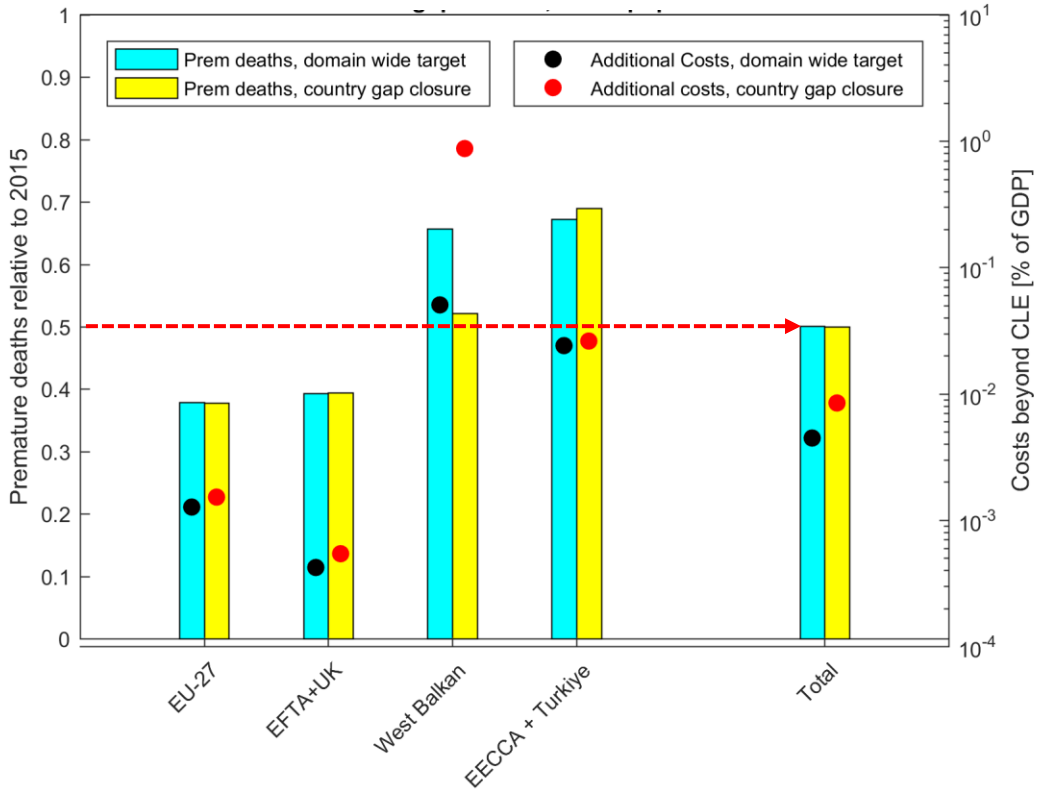


Source: GAINS model (CIAM/IIASA)

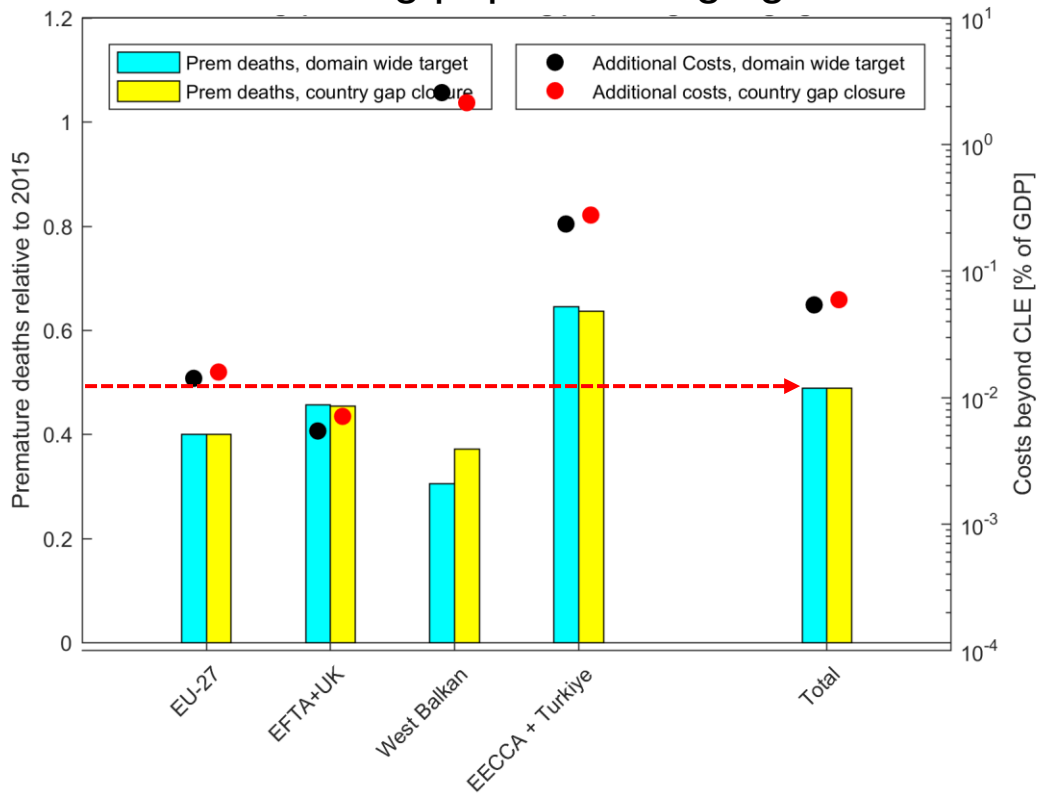
Least-cost reduction of PM health impacts in UNECE (excl. North America) by 2040

Tentative target: -50% premature deaths from $PM_{2.5}$ by 2040 compared to 2015

With static population



including population aging



The choice of the mortality indicator, as well as the way of setting the target, will strongly influence total costs.

Source: GAINS model (CIAM/IIASA)

Initial conclusions – Health targets by 2040

Feasibility: Achieving 50% reduction of 2015 premature deaths by 2040 is feasible at the UNECE level

Importance of CLE enforcement: Full enforcement of Baseline policies (CLE) achieves by 2040 about 40% and 25 % reduction in premature deaths compared to 2015, for static and dynamic population case (or over 80% and 40% of the target goal, respectively)

EU+EFTA+UK achieve the target in the Baseline, except the dynamic pop. case

Mitigation efforts needs: The 40% reduction of the feasible range ('gap closure') allows to achieve the 50% health target in static population case (80% gap closure needed for dynamic population case)

Costs: Total costs and distribution varies significantly between the cases (equivalent of less than 0.1% GDP to over 1% GDP at the regional level) with higher costs for the case where equal improvements in all countries are achieved

Updated analysis using GP review scenarios

Source attribution *&*

Initial analysis of staged/phased approaches

Designing preliminary staged/phased cases
Sector intervention scenarios

- 4 sector specific intervention scenarios were defined as variants of the Baseline
- These assume EU standards for emission controls implemented in the GAINS model from 2030 to comply with the EU policies and are applied for specific sectors in all non-EU/EFTA countries
    - PP: Power & Heating Plants
    - IND: Industrial combustion and processes
    - TRA: Road and off-road transport
    - DOM: Residential combustion
- All other sectors remain as in the Baseline

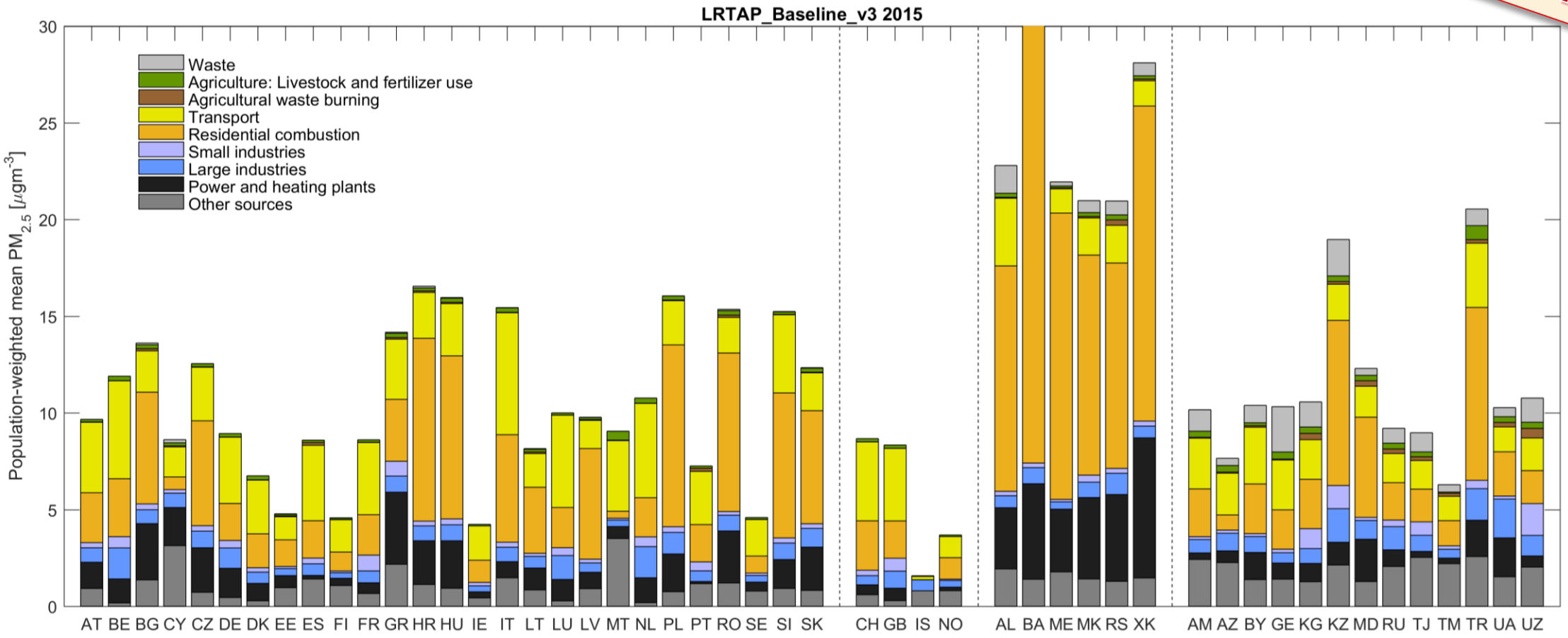
Target setting and staged approach

- Staged approach, e.g. prescribed mitigation in specific sectors or a group of them, creates a ‘preferred’ solution for a given region
- Such a ‘preferred’ solution for any given region can be used in search of cost-effective solutions (for all other regions) to achieve the community-wide targets
- The defined variant(s) will be compared and analysed against the cost-optimal solutions for the whole domain
- Similar type of analysis can be done for ‘phased’ approaches where targets for certain regions are achieved at different time

Sector source contributions to $PM_{2.5}$ in UNECE (excl. North America)

Results for **2015**: Population weighted country mean anthropogenic $PM_{2.5}$ concentrations

Draft results

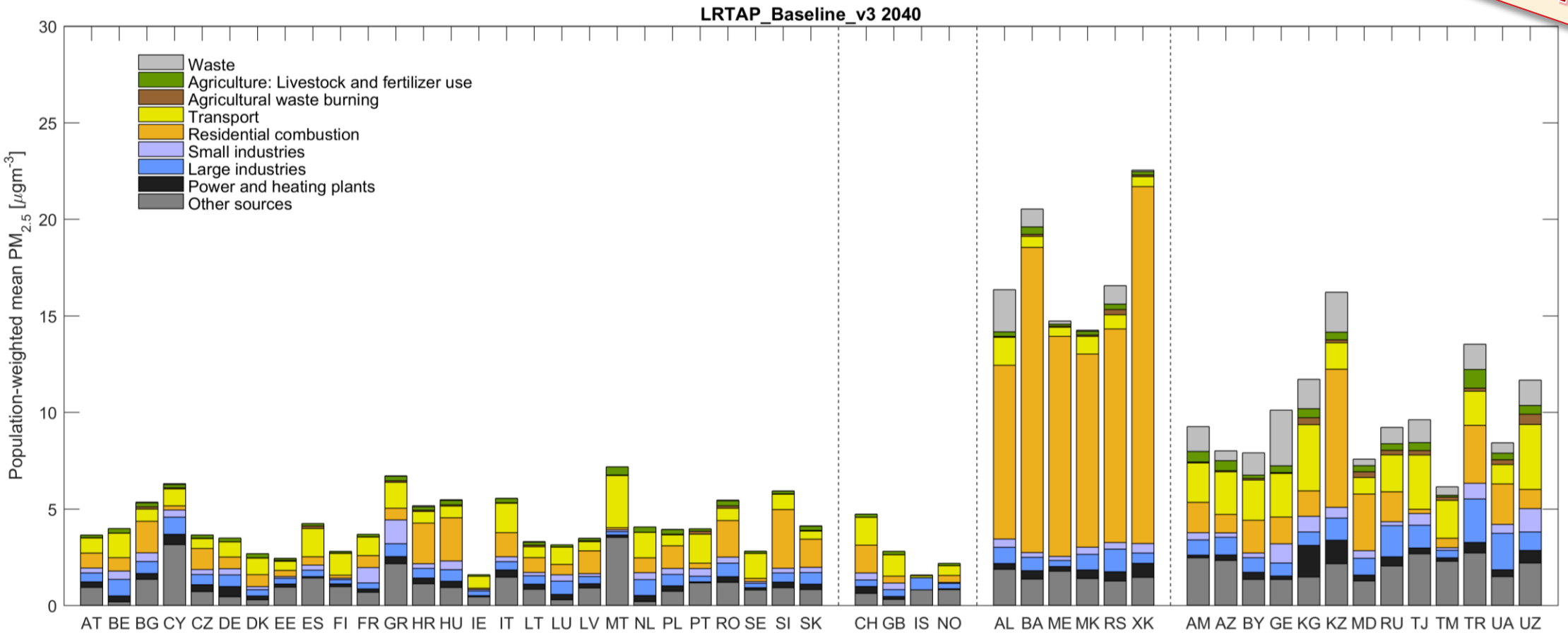


Source: GAINS model (CIAM/IIASA)

Sector source contributions to $PM_{2.5}$ in UNECE (excl. North America)

Results for **2040 Baseline**: Population weighted country mean anthropogenic $PM_{2.5}$ concentrations

Draft results

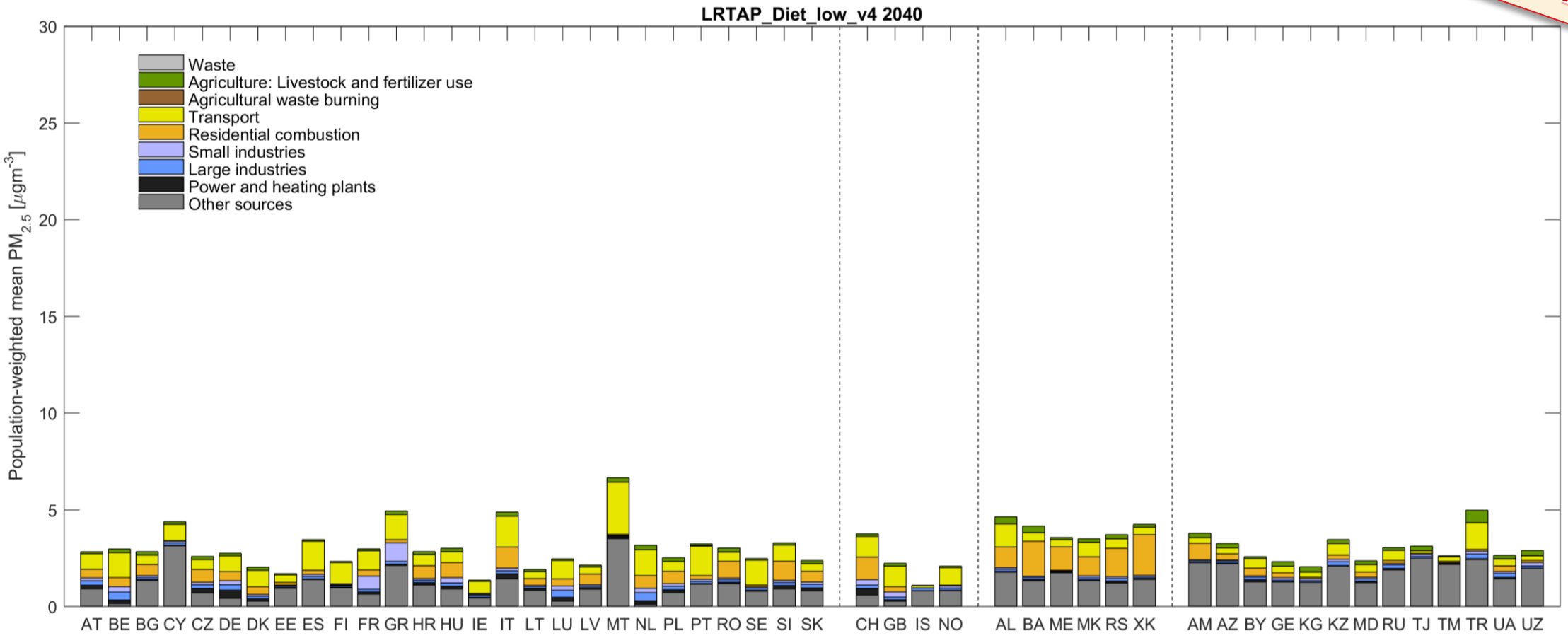


Source: GAINS model (CIAM/IIASA)

Sector source contributions to $PM_{2.5}$ in UNECE (excl. North America)

Results for **2040 LOW**: Population weighted country mean anthropogenic $PM_{2.5}$ concentrations

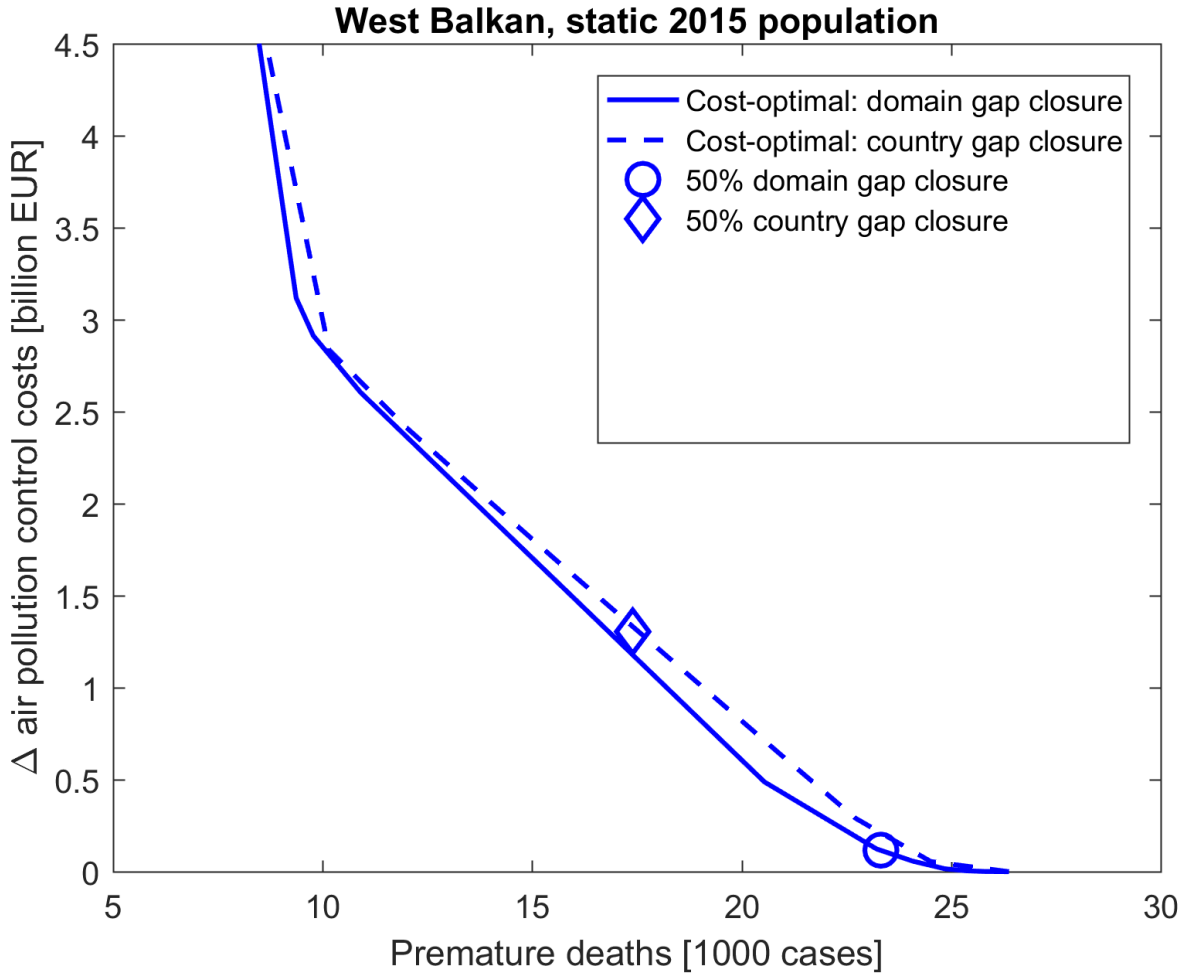
Draft results



Source: GAINS model (CIAM/IIASA)

Domain wide optimization vs staged approach

West Balkan

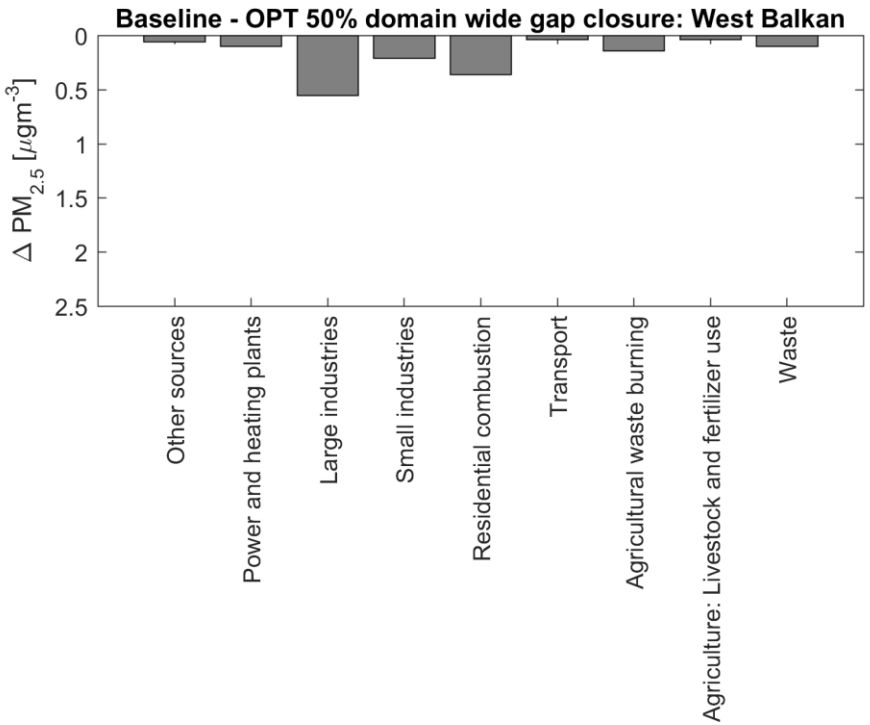


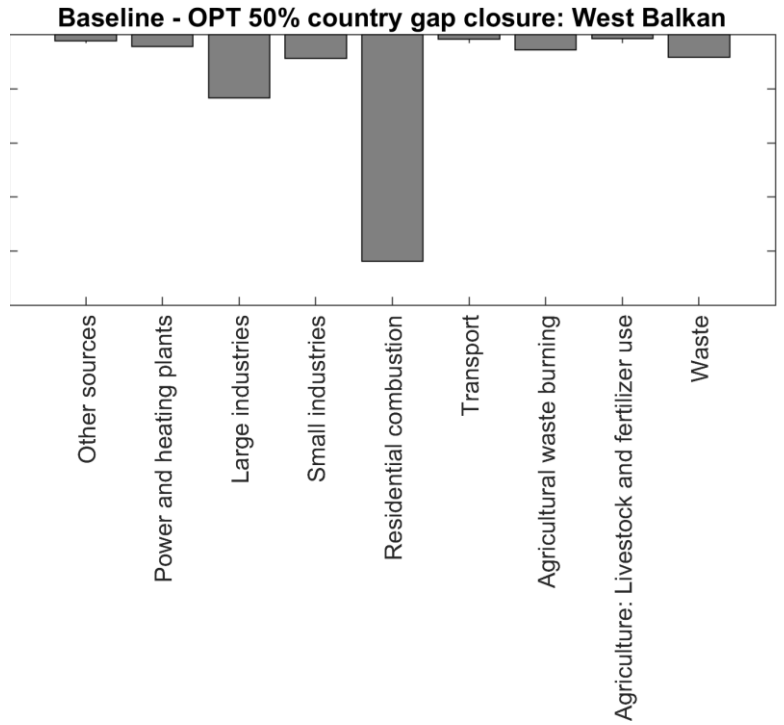
- Large difference in benefits between the 50% domain-wide (UNECE-Europe!) vs country gap closure
- Only small improvement and much larger costs for achieved benefits in the preliminary staged approach case (including all four sectors)
- Costs in transport dominate the total costs in the staged approach

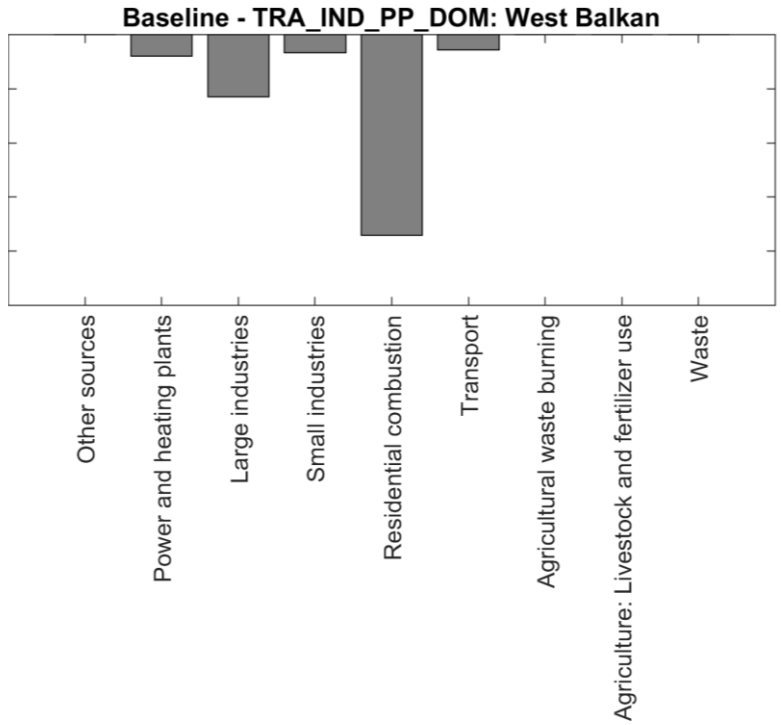
Domain wide optimization vs staged approach

West Balkan

Draft *staged approach* case:
enforcing EU legislation for power, industry, residential combustion, and transport



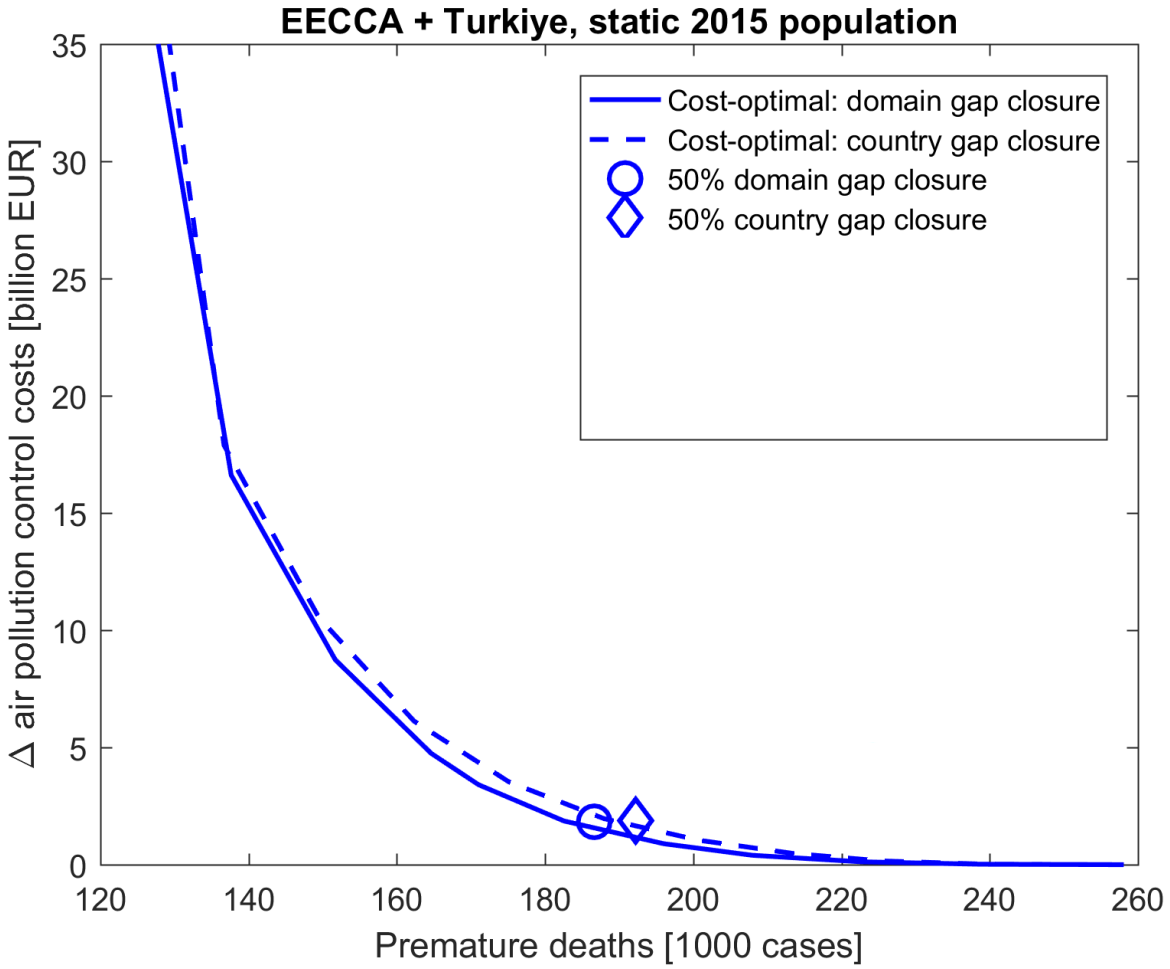




- Residential combustion and waste appear in country gap closure – equitable solution highlights importance of local low-level sources
- Staged approach has similar reductions for selected sectors as in the domain wide solution

Domain wide optimization vs staged approach

EECCA + Türkiye

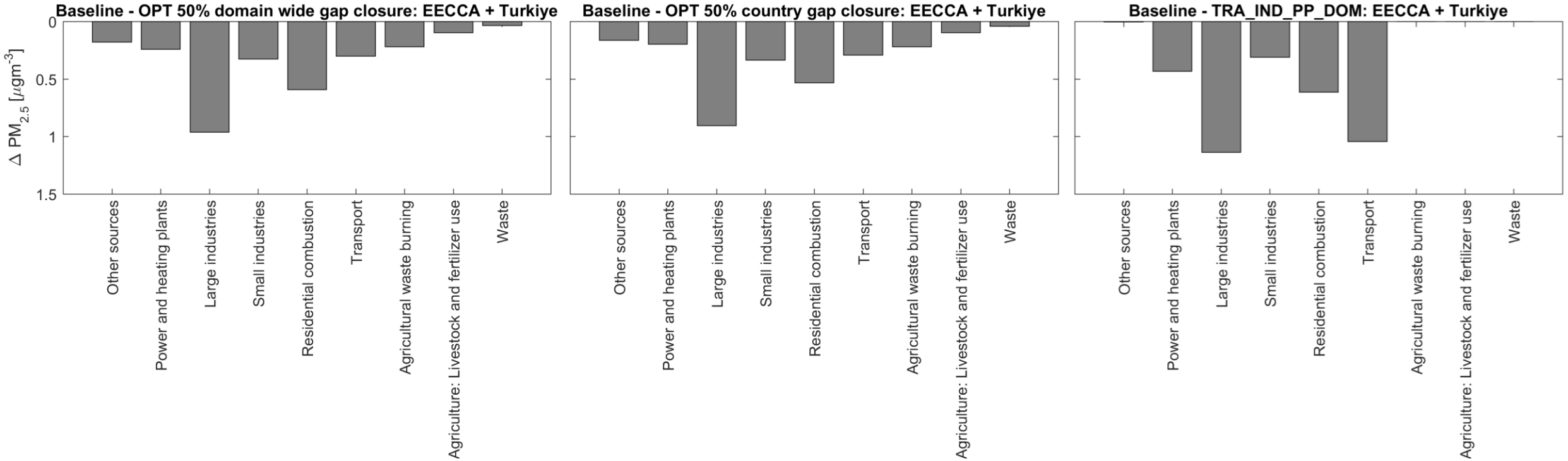


- 50% gap closure solutions are similar, here UNECE-Europe wide gap closure forces stronger reductions
- While a sizable health improvement is estimated for the staged approach, the costs are much larger for achieved benefits in the preliminary staged approach case (all four sectors included)
- Some of the mitigation potential mobilized in the staged case is beyond the cost-effective portfolio of solutions to reach domain wide goals [see next slide]

Domain wide optimization vs staged approach

EECCA + Türkiye

Draft *staged approach* case:
enforcing EU legislation for power, industry, residential combustion, and transport



- Domain-wide and country gap closure solutions look similar (unlike for West Balkan)
- Staged approach mobilizes additional mitigation potential for most addressed sectors, compared to the cost-effective solution

Preliminary conclusions and further work

- Staged approach can provide important improvements, but not in all regions and possibly at relatively high cost, compared to the cost-effective solutions
- Analysis of impact on biodiversity from staged approach not yet done
- Coordinated early action on agriculture could offer another case, e.g., implementation of EU IED for Agriculture
- The staged approach implementation is the first draft and will be further fine-tuned to better represent country-specific aspects
- Phased approaches: not yet considered. Could do sequential optimization with tightening targets over time?

Updated analysis using GP review scenarios

Including biodiversity targets in GAINS; New empirical critical loads for N deposition

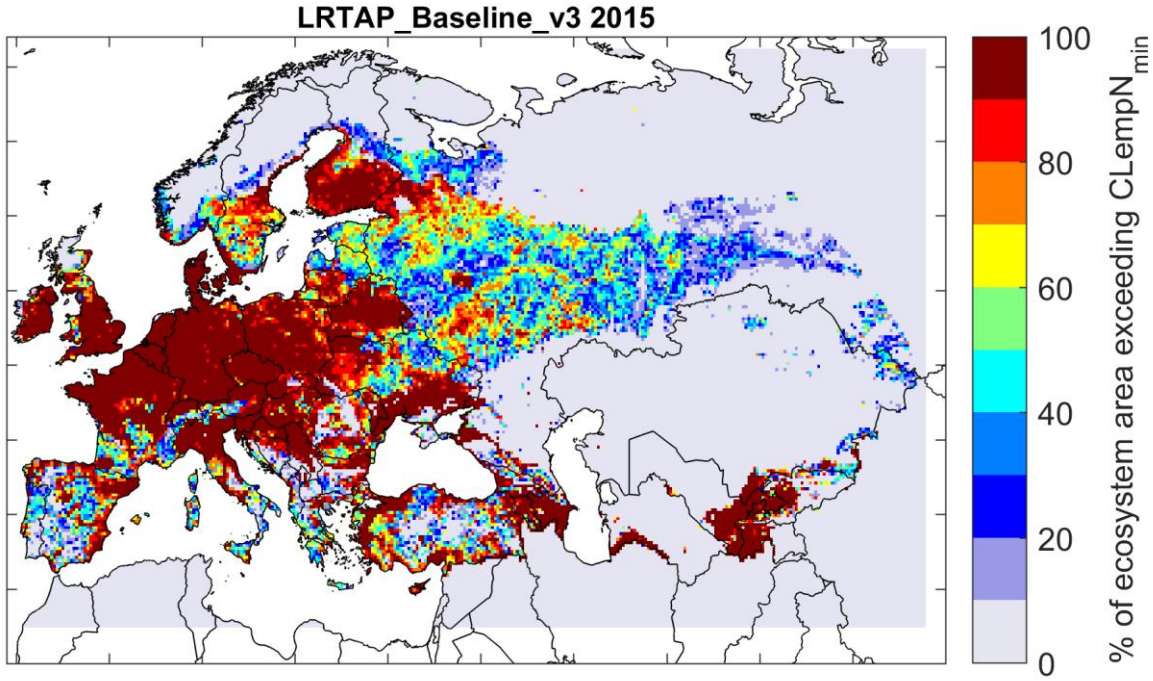
New empirical critical loads for nitrogen deposition

- CIAM received from CCE new data:
  - Empirical critical loads for 48 ecosystem classes
  - Giving min and max CL [kgN/ha/yr]
  - And ecosystem maps for the whole domain (area of each class per grid cell)
- CIAM has processed and implemented them in GAINS for “forward-looking” scenario calculation (not yet for optimization)
- Calculated indicators equivalent to the acidification/eutrophication calculations: area exceeding CL, average accumulated exceedance (AAE)
- Only land-based ecosystems are considered, not marine

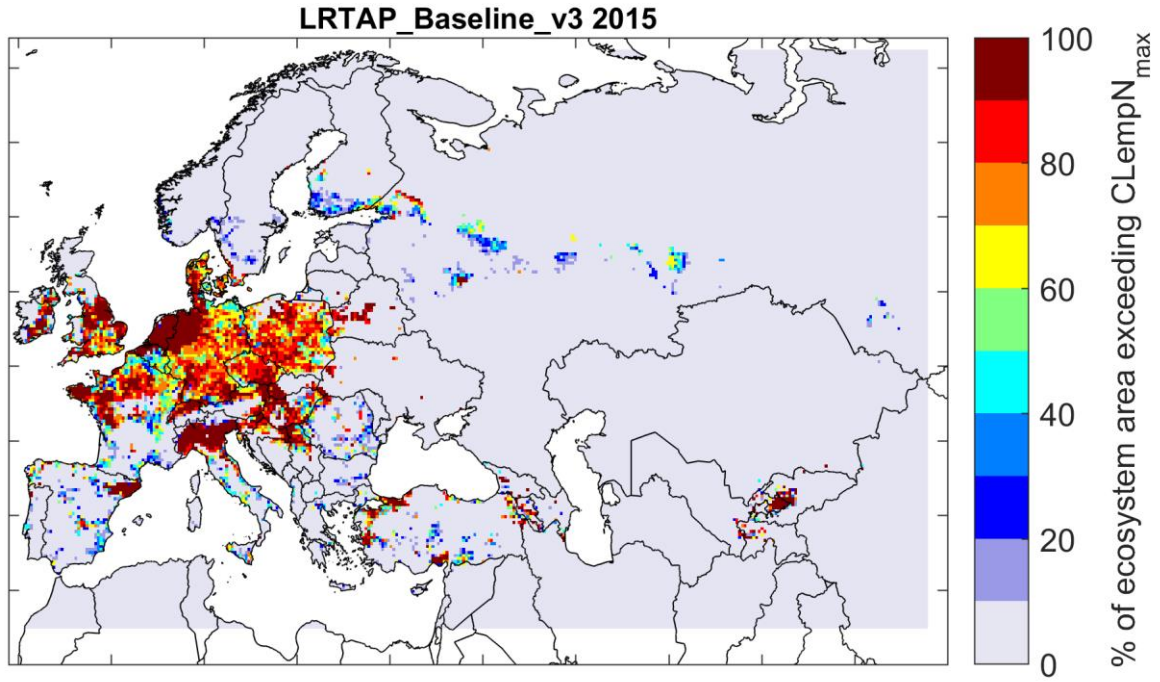
Ecosystem area exceeding CLs: 2015

Preliminary

Lower range of CLs ($CLempN_{min}$)



Upper range of CLs ($CLempN_{max}$)

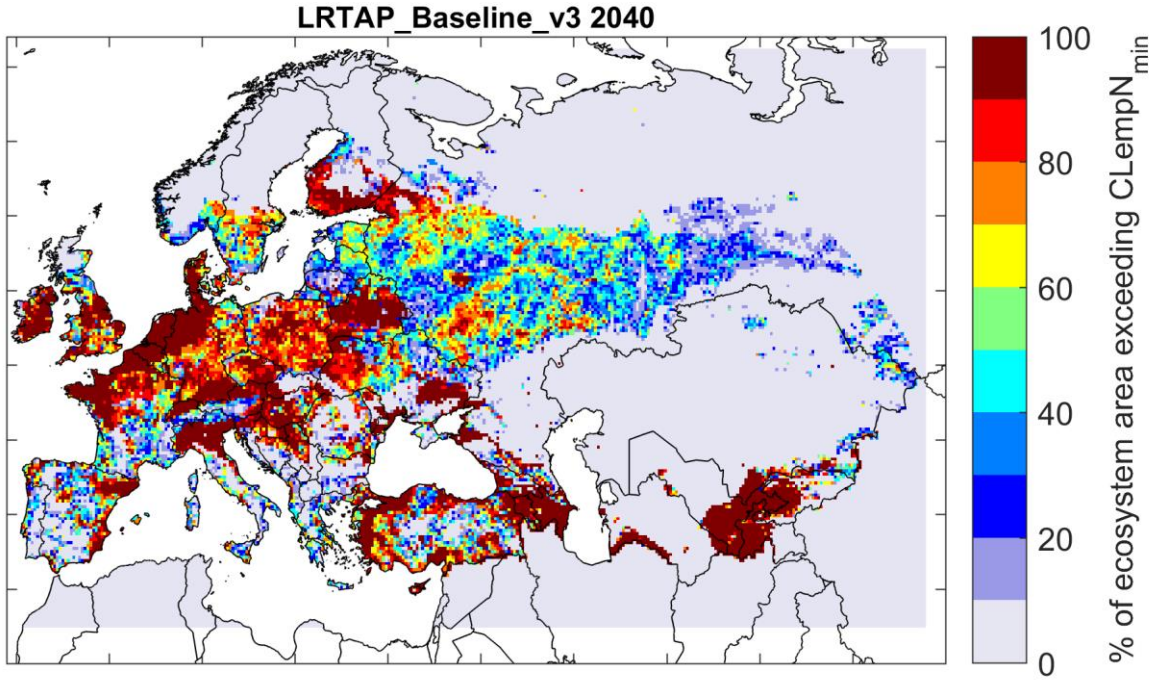


The message differs strongly depending on the range of CL used!

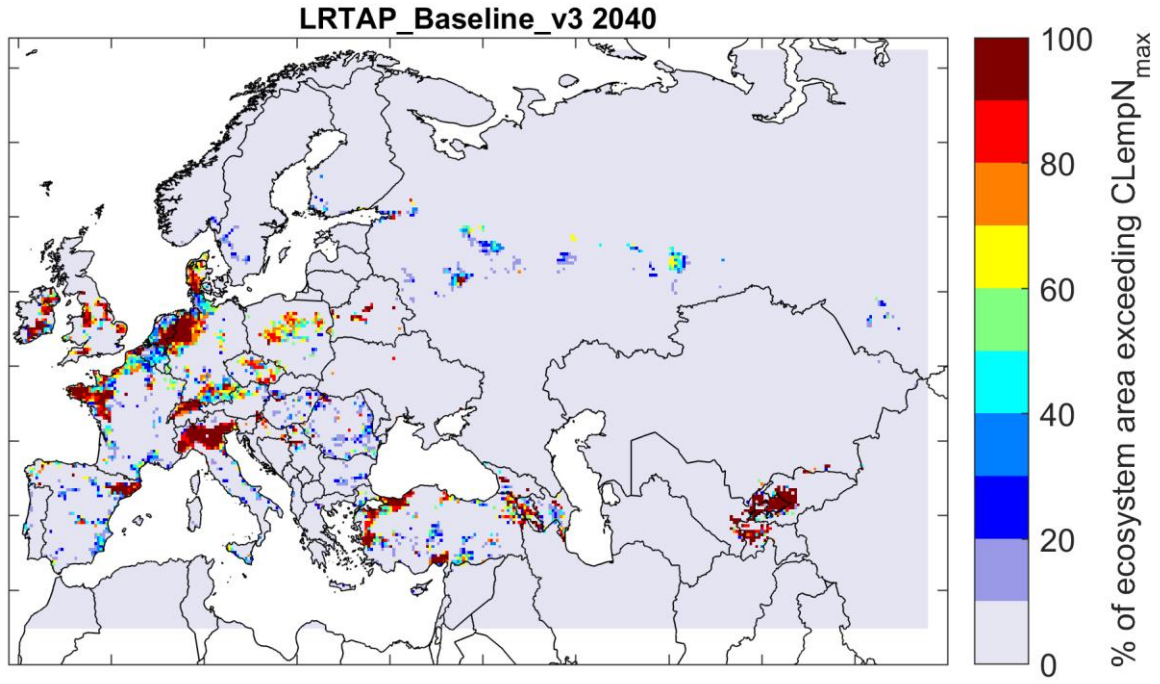
Ecosystem area exceeding CLs: 2040 Baseline

Preliminary

Lower range of CLs ($CLempN_{min}$)



Upper range of CLs ($CLempN_{max}$)

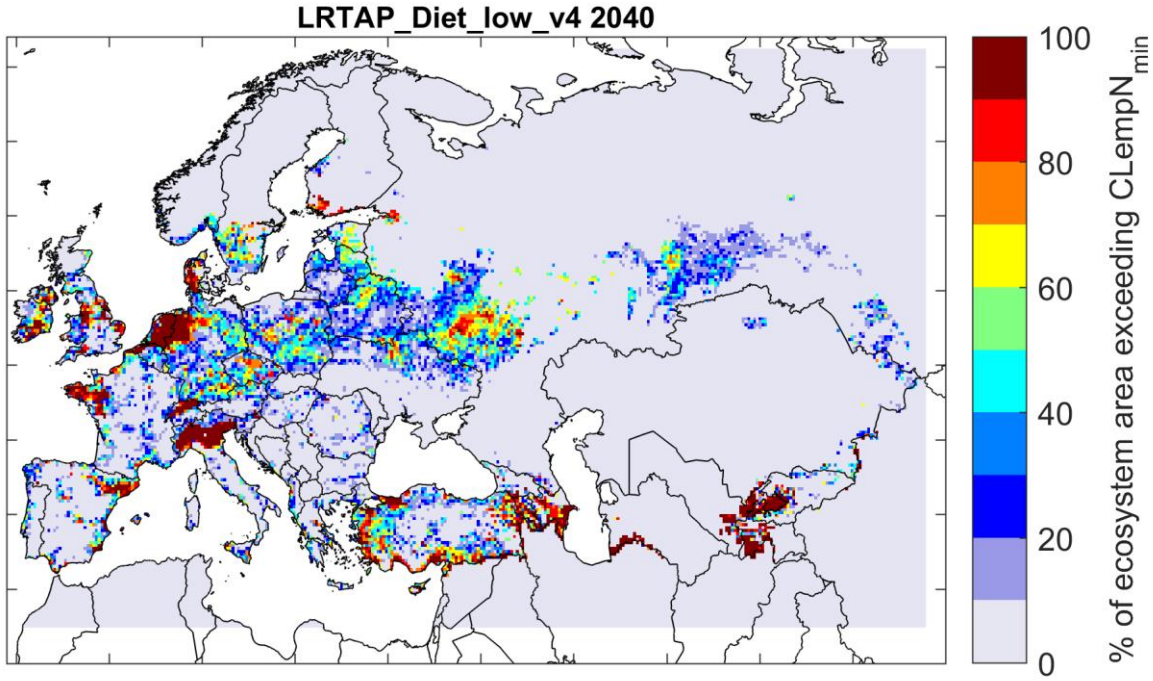


The Baseline reduces exceeded areas in the EU but increases in EECCA & Turkiye.

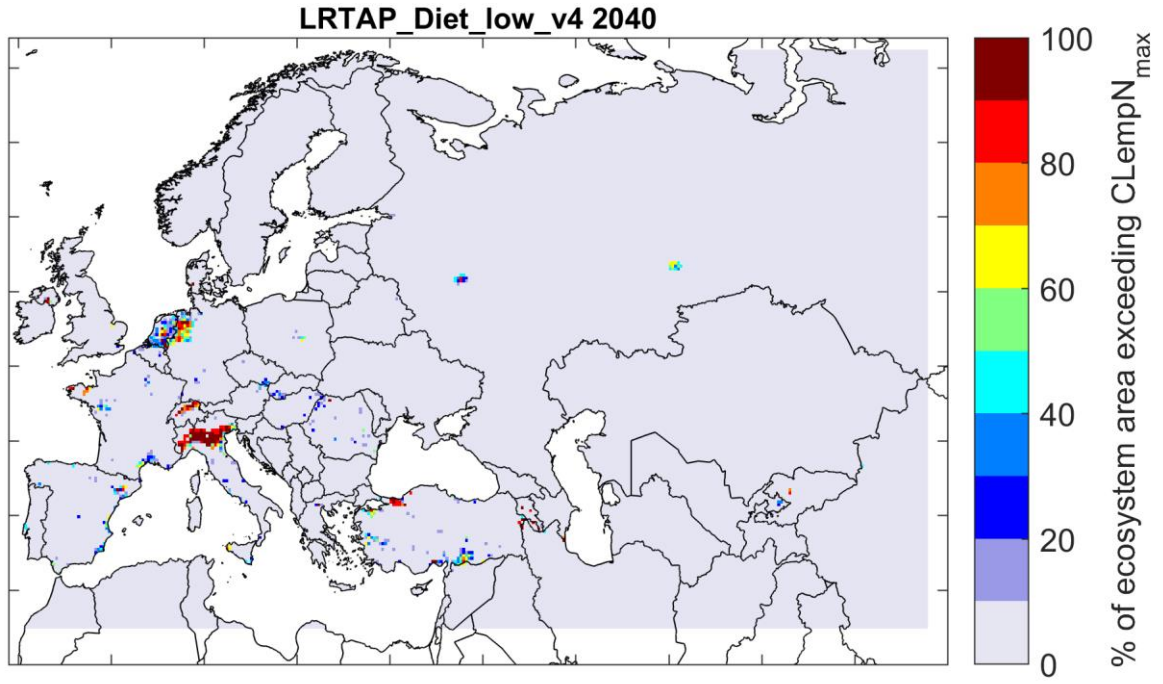
Ecosystem area exceeding CLs: 2040 LOW

Preliminary

Lower range of CLs ($CLempN_{min}$)



Upper range of CLs ($CLempN_{max}$)

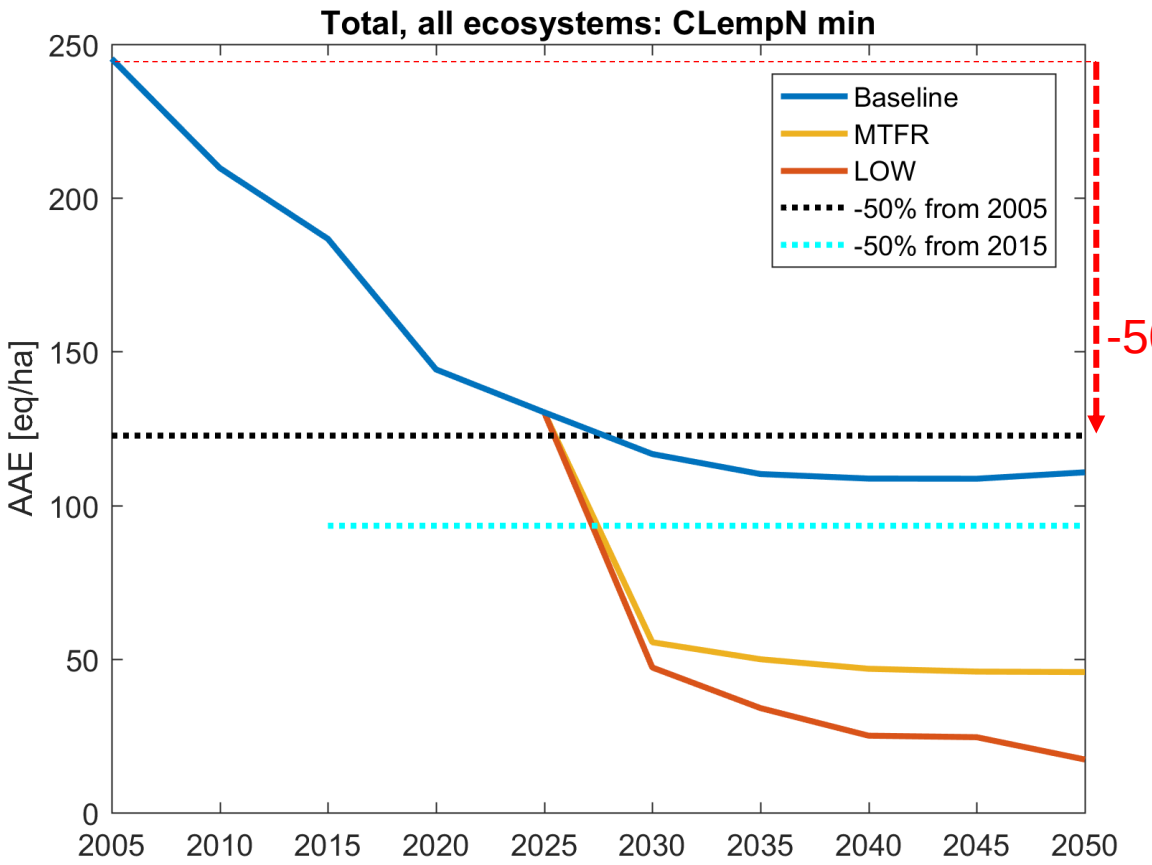


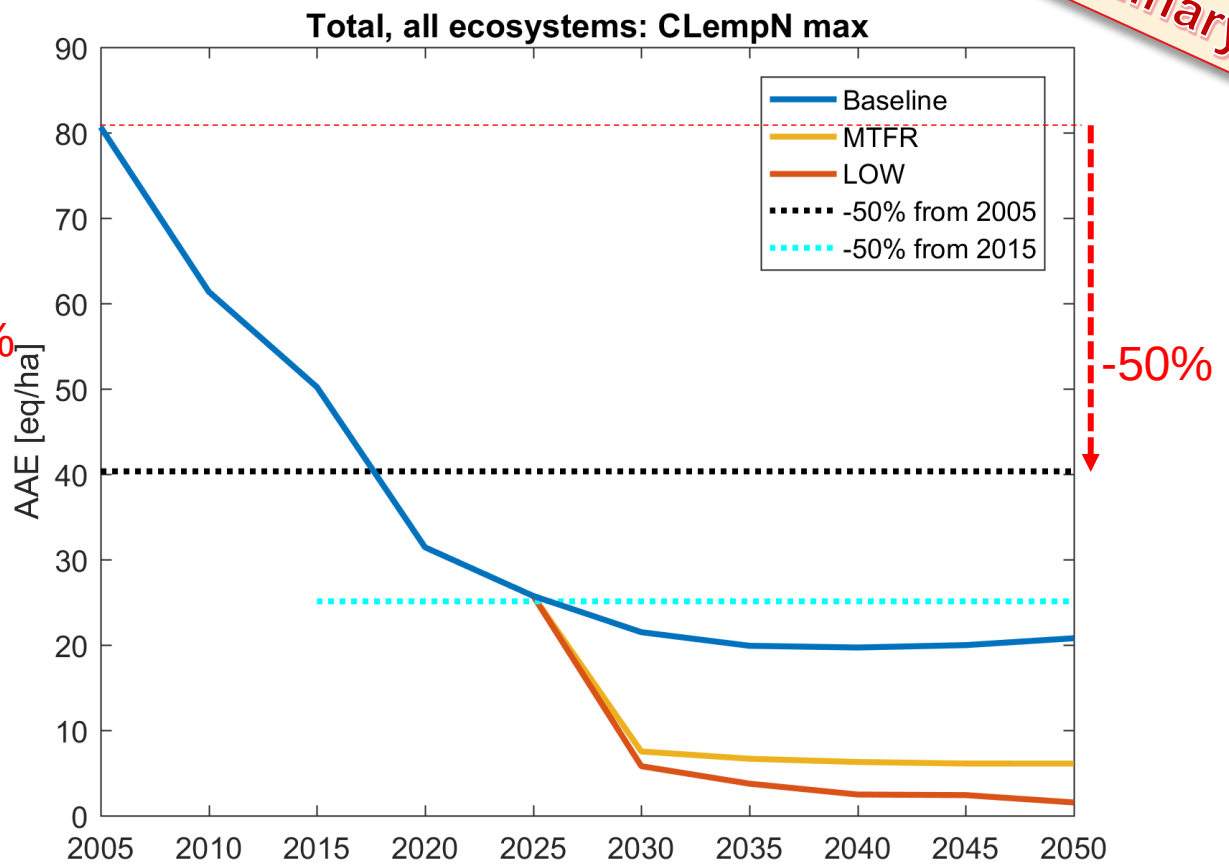
The LOW scenario brings strong reductions in exceeded areas – with upper range of CLs only Po Valley and NL remain. Complete elimination of exceedances is not feasible by 2040.

Scope for further mitigation in the UNECE region

Exploring attainability of ecosystem (biodiversity) protection 'goals': AAE for all ecosystems

Preliminary





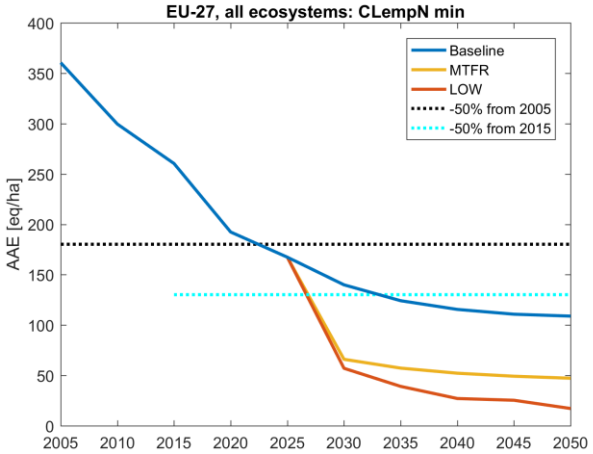
Source: GAINS model (CIAM/IIASA)

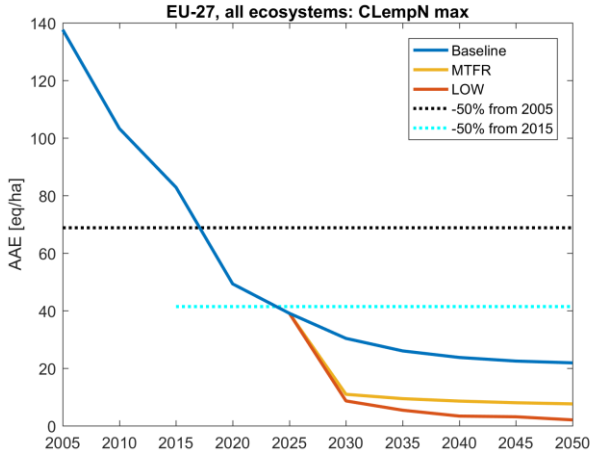
Scope for further mitigation in the UNECE region (2)

Exploring attainability of ecosystem (biodiversity) protection 'goals': AAE for all ecosystems

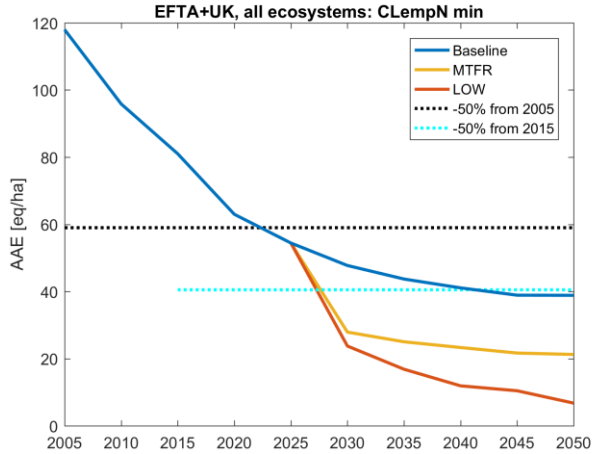
Preliminary

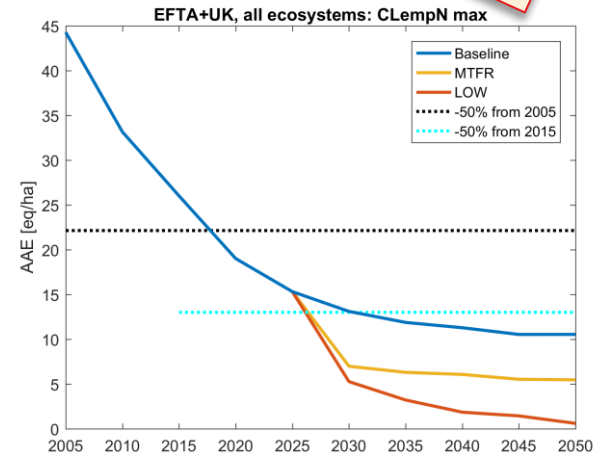
European Union



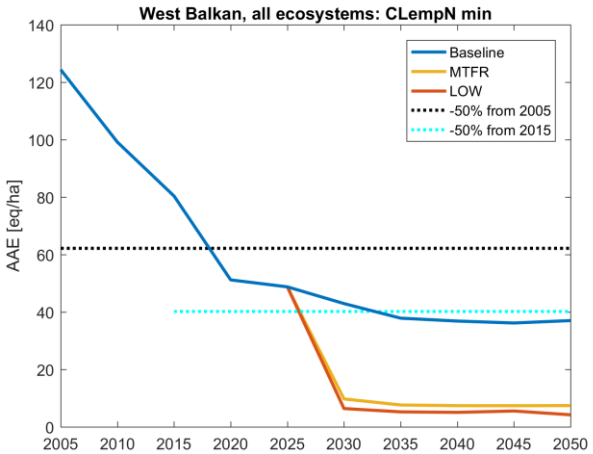


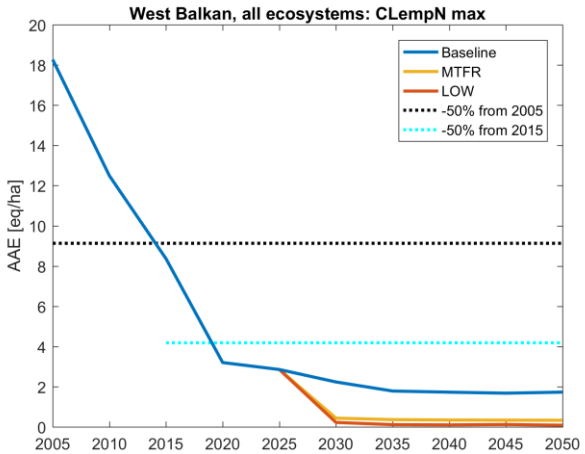
Non-EU EFTA + UK



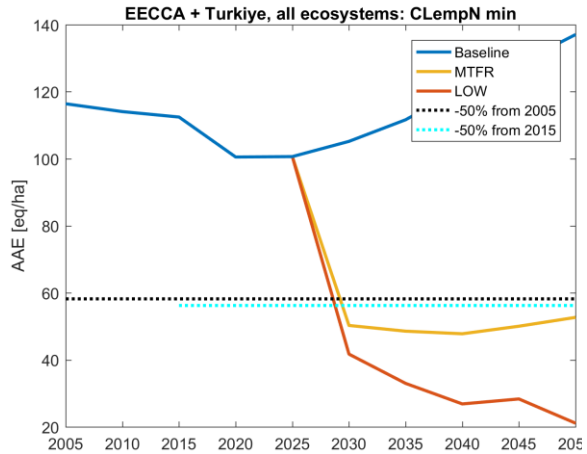


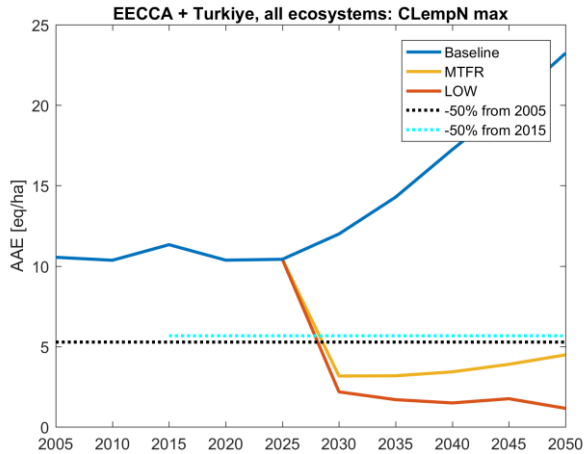
West Balkan





EECCA+Turkiye





Source: GAINS model (CIAM/IIASA)

Initial conclusions – Biodiversity targets by 2040

Disclaimer: The implementation of CLempN in GAINS is very recent, many things are still to be checked!

Feasibility: Achieving 50% reduction of 2015 AAE for CLempN by 2040 appears feasible at the UNECE-Europe level and within all sub-domains considered here

Importance of CLE enforcement: Full enforcement of Baseline policies (CLE) achieves by 2040 about 42% to 62% reduction in AAE in UNECE-Europe compared to 2015, depending on the CLempN used. Ecosystem area exceeded decreases by 24% to 57%.

Cost optimization: to come. Discussion on indicator and level of disaggregation of ecosystems is ongoing. One idea raised at the EMEP-WGE Bureaux mtg was to focus on reduction targets for different ecosystem types rather than for different countries. Comments welcome!

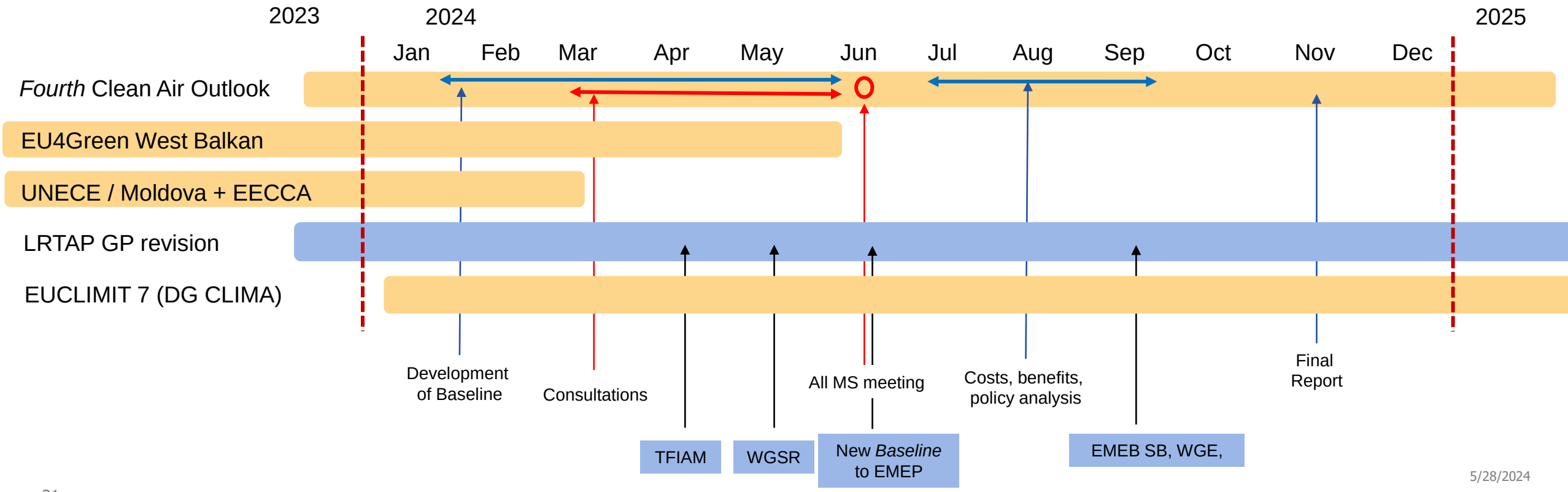
Updating scenarios for GP revision

- Development of updated *Baseline* and *LOW* cases
- Further sensitivity and policy scenarios

Links to other ongoing policy processes and projects

Explore synergies between various ongoing activities in 2024 and beyond

- Harmonizing, to the possible extent historical data, methodologies, model parameterization, to the extent possible other assumptions relevant for projections
- Aligning timelines



Development of updated scenarios for GP revision

All scenarios for air pollutants and methane up to 2050

- ***Baseline***
  - EU27 (updated European Green Deal, revised legislation, results of the CAO4 MS consultations)
  - West Balkan (PRIMES/CAPRI scenarios, decarbonization goals, compliance with the Energy Community agreements, results of the consultations)
  - Moldova, Ukraine, Georgia (PRIMES/CAPRI scenarios, results of consultations with Moldova)
  - UK, Switzerland, Norway (engagement in consultation meetings), others – updated IEA, FAO
- ***MTFR*** *(Maximum Technical Feasible Reduction)*
  - Updated costs and applicability constraints
- ***LOW*** *(MTFR and transformation in energy and agriculture – behavioural changes)*
  - Updated West Balkan, EECCA, extension to include new fuels (ammonia), hydrogen economy

Timeline

KEY SCENARIOS

- ***new Baseline scenario*** (June 2024)
- ***new MTFR*** scenario (July 2024)
- Preliminary ***new LOW*** case [not including further non-tech measures] (Sept 2024)
    - Inclusion of new fuels and hydrogen economy (2025)
- Further ***variant of LOW*** with additional non-tech measures (2025 – discussion needed)

SENSITIVITY AND POLICY ANALYSIS

- Updated scenarios and analysis of ***staged and phased approaches*** (initial analysis by end of 2024)
- Optimization for ***combined PM and biodiversity*** impacts (2024), and ***ozone*** (2025 – needs development)
- Analysis of ***(in)equity*** in optimization (2024 and beyond)
- ***Acidification and eutrophication*** assessment for the whole UNECE domain (2024 – needs data)
- Analysis for / inclusion of ***hot spots***? (2025 – needs discussion)
- Analyse the scenario outputs identifying ***key measures*** across the regions for different variants (2025)

Guidance needed from WGSR

Do you object to

- Optimisation for 2040 relative to 2015?
  - 2005 would be without ambition for some countries; and EECCA region lacks data for 2005
  - Projections could include all years (in 5-year steps) between 2015 and 2050
- Applying targets in optimisation both to the UNECE region as a whole and to each country?
  - Meeting a target is easier for a larger region; considering also targets by country brings in an egalitarian element
- Using both health metrics Premature Deaths and Years of Life Lost (YOLL)?
- Using the static population (2015) approach for health optimisation?
  - The static approach shows impacts of changes in air pollution only
  - The dynamic approach shows the combined impacts of changes in air pollution and in demography (population growth and ageing)
- Using the risk-based approach for health (premature deaths or YOLL per 100.000 inhabitants) for optimisation?
  - Note that for a risk-based approach (deaths/100.000 inhabitants) the difference between using static vs dynamic demography is limited (to ageing only)

Guidance needed from WGSR

Do you object to

- Using the indicator Average Accumulated Exceedance (AAE) for nature protection?
- Using minimum or mean empirical critical loads in optimisation for nature protection?
- Limiting the analysis to anthropogenic (the avoidable) $PM_{2.5}$ exposure?
- Further explore the possibility for a combined $PM_{2.5}$&O_3 target ?

What do you suggest

- For the modelling of staged/phased approaches (EECCA/WB/Türkiye)?
- Do you need analyses of further egalitarian principles
  - If yes, which, e.g. on maximum costs per GDP per country, minimum health improvement per country, minimum air quality improvement per country …?

Thank you!

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https://iiasa.ac.at/TFIAM