International Institute for Applied Systems Analysis
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Progress in modelling undertaken by CIAM in support of the GP Revision

Status update April 2024

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TFIAM 53. 15-17 April 2024, Paris

Additional written request from Parties

a) What would be the results for an intermediate target year (e.g. 2035, 2040)?

b) Can the impact of the latest climate policy measures be included (i.e. use of hydrogen and ammonia as energy carriers; peat restoration)?

c) What would be the effect of a three years averaged base year or target year?

d) Can other metrics for health impacts be explored: years of life lost?

e) Could optimizations be carried out for combined health impacts of $PM_{2.5}$ and ozone?

f) Can other metrics for biodiversity protection be explored: i.a. average exceedance of critical loads per ecosystem type?

g) Can targets be adjusted for GDP?

h) Can alternative GAINS scenarios be developed illustrating implications of staged/phased approaches for EECCA and West-Balkan countries?

i) What would be the sensitivity for other baseline assumptions, e.g. less than full implementation of the European Green Deal, inclusion of condensables or inclusion of marine ecosystem objectives ?

j) What would be the result of an optimization with a larger weight on BC abatement?

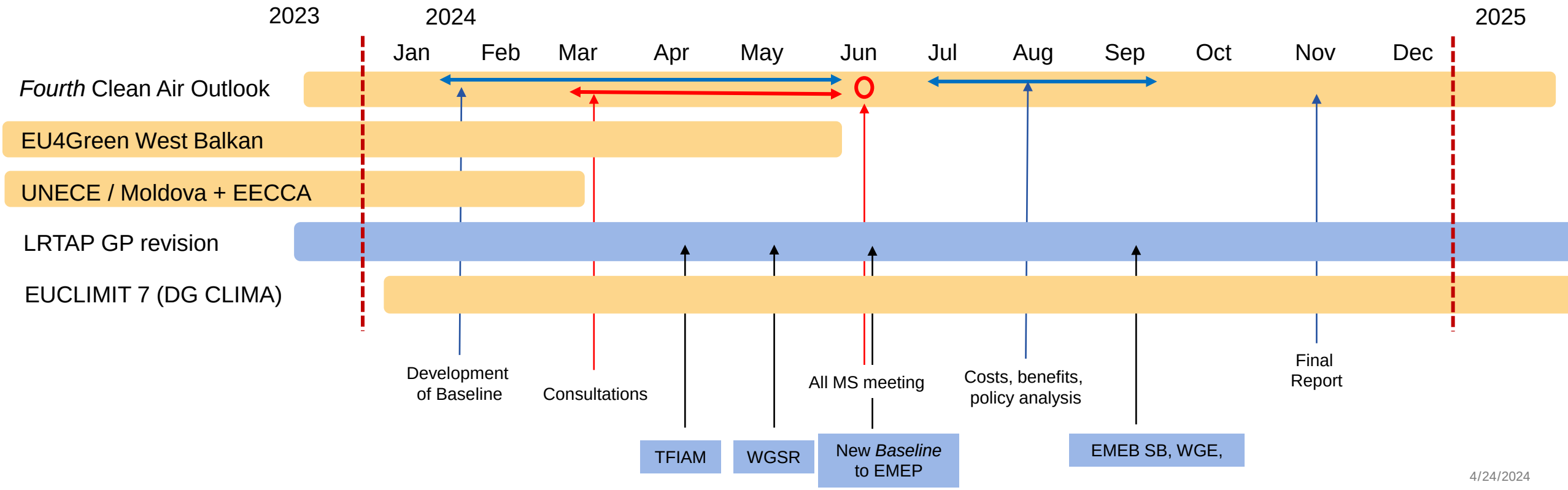
Content

- Development of scenarios
  - Links to other ongoing activities
  - Towards updated baseline and mitigation potential assessment
  - Designing preliminary staged/phased cases
- Target setting approaches
- Modelling progress
  Addressing comments to Policy Brief
  - Different: target year, health metric, country aggregations
  - Staged/phased approaches
  - Include biodiversity
- Next steps

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 scenarios for GP revision

All scenarios for air pollutants and methane up to 2050

- ***Baseline*** *(update compared to the scenario used for the GP review)*
  - Energy, industry, and agriculture
    - EU27 – European Green Deal, including Fit for 55 package and RePowerEU initiatives, consistent with the 90% GHG reduction by 2040, revision of the IED, results of the MS consultation during CAO4
    - West Balkan – new scenarios developed with the same modelling tools as for EU, including decarbonization targets and compliance with the Energy Community agreements, results of the consultations with all countries
    - Selected EECCA (Moldova, Ukraine, Georgia) using the same modelling tools as for EU, consultations with Moldova
    - UK, Switzerland, Norway – IEA and FAO, continue consultation meetings
    - Remaining countries – IEA &FAO

The results presented today are still based on the GP review Baseline

Development of scenarios for GP revision

All scenarios for air pollutants and methane up to 2050

- ***MTFR** (Maximum Technical Feasible Reduction)*
  - Ongoing review of costs of control measures
  - Reassessment of applicabilities (maximum penetration rates of a given measure for specific years), especially for the near term
- ***LOW** (MTFR and transformation in energy and agriculture – behavioural changes)*
  - Update needed to consider new developments (new fuels, hydrogen economy) – GAINS being updated but lack of respective driver scenarios yet
  - Revision needed for West Balkan and EECA as the Baseline changes
- ***LOW-MTFR+** (include further non-tech measures)*
  - Initial discussion

The results presented today are still based on the GP review MTFR, LOW

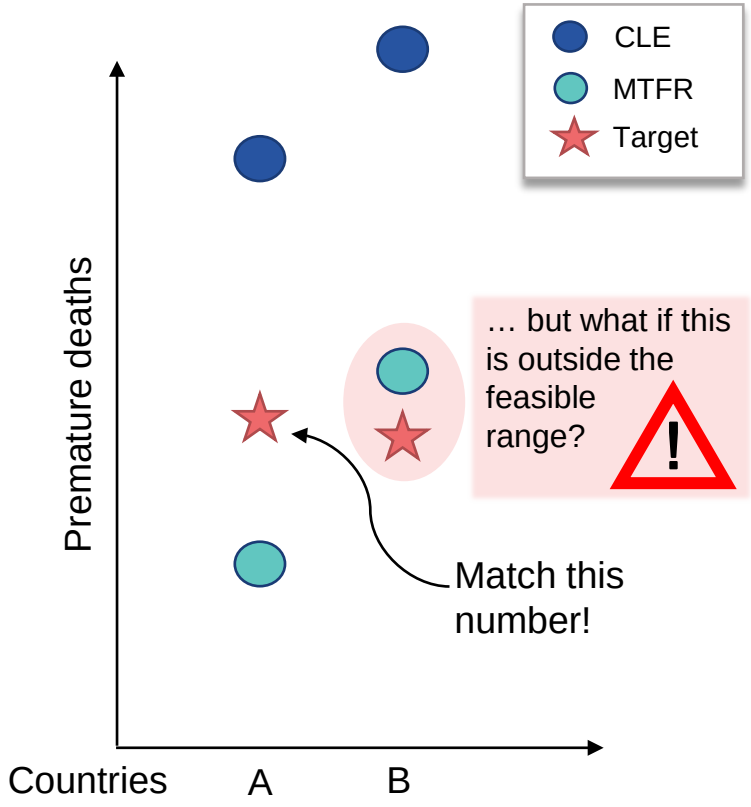
Designing preliminary staged/phased cases

Sector intervention scenarios

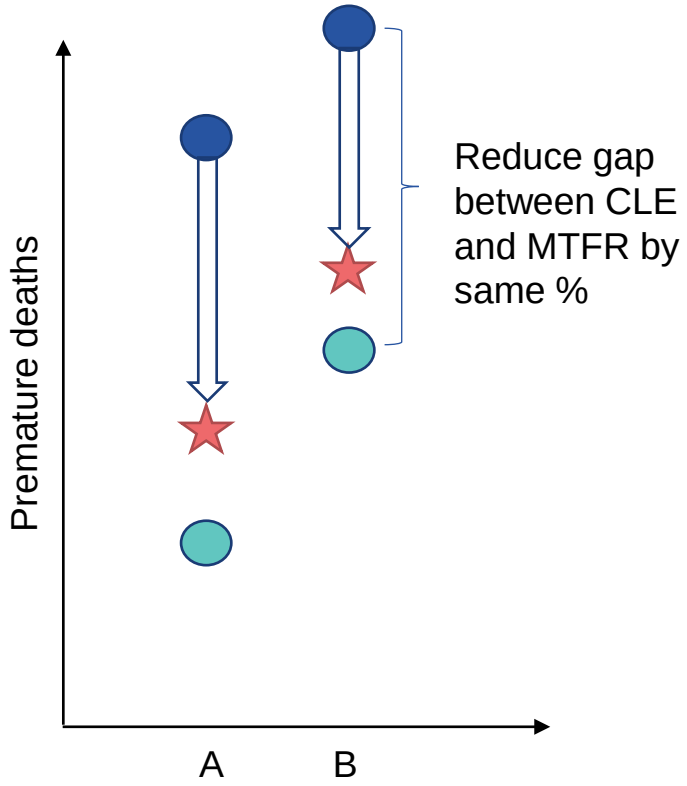
- 3 sector specific intervention scenarios were defined as variants of the Baseline
- These assume German emission controls implemented in the GAINS model from 2030 to comply with the EU policies and are applied for specific sectors in all non-EU/EFTA countries
  - PP: Power & Heating Plants
  - IND: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

Target setting approaches

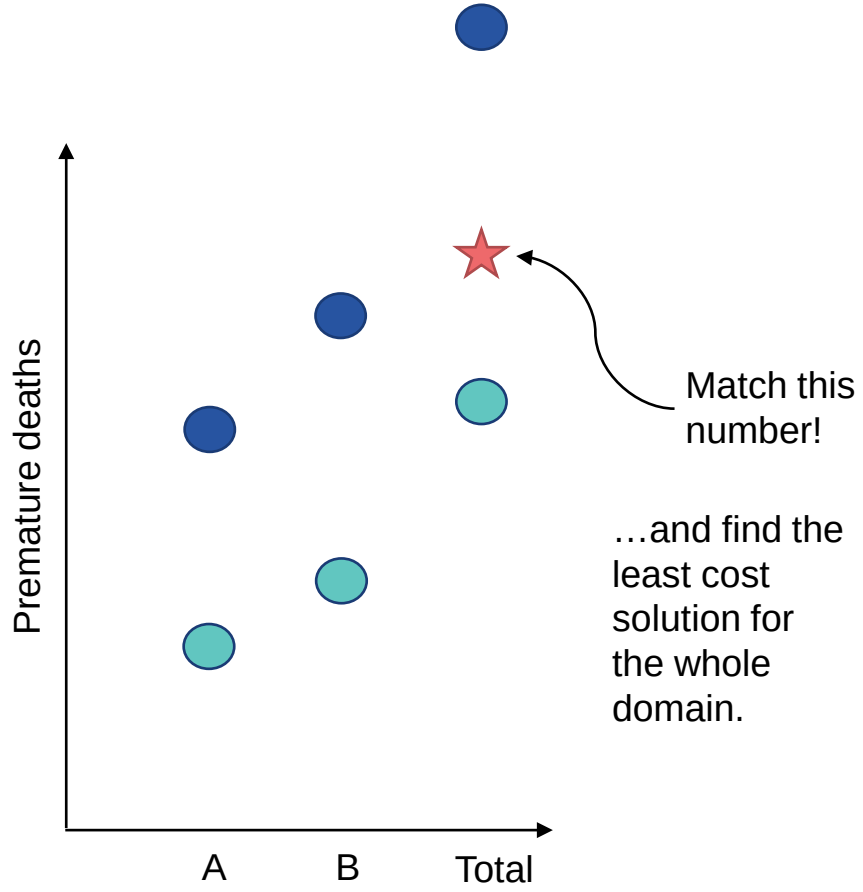
1. Absolute -50% target per country



2. Gap closure approach – Equal progress



3. Domain wide target – least cost

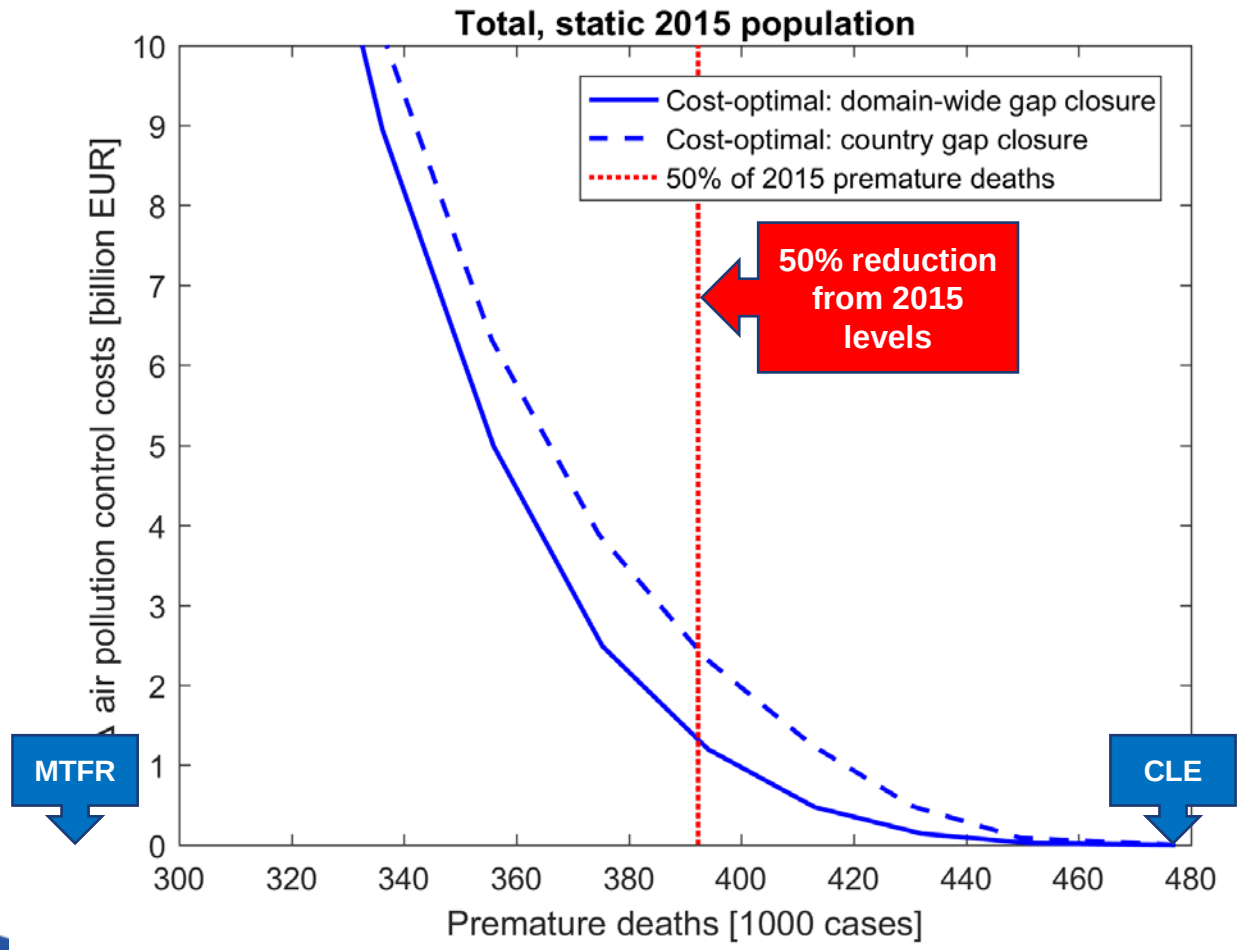


Target setting and staged approach

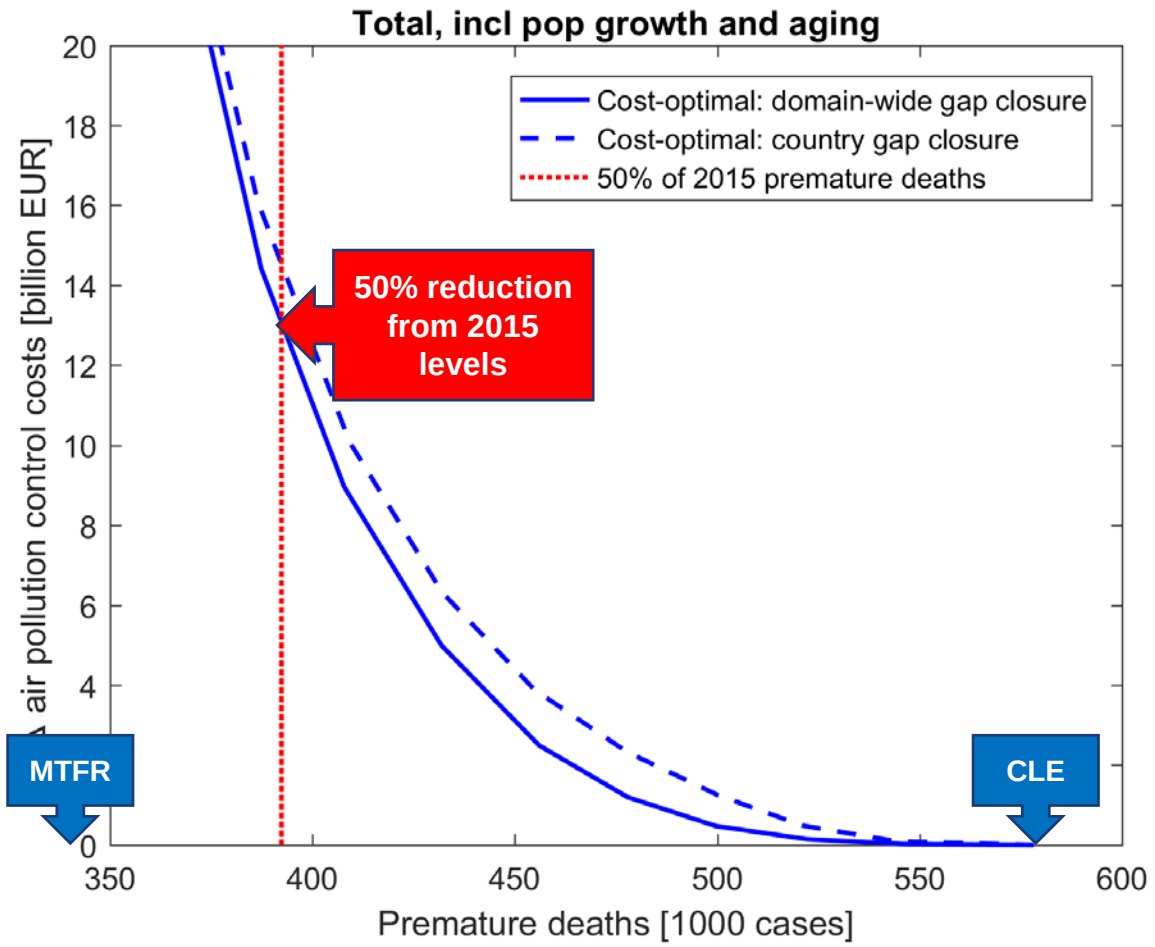
- Staged approach, e.g. prescribed mitigation in specific sectors or a group of them, creates a ‘preferred’ solution for a given region
- Such a ‘preferred’ solution for any given region can be used in search of cost-effective solutions (for all other regions) to achieve the community-wide targets
- The above 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

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

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

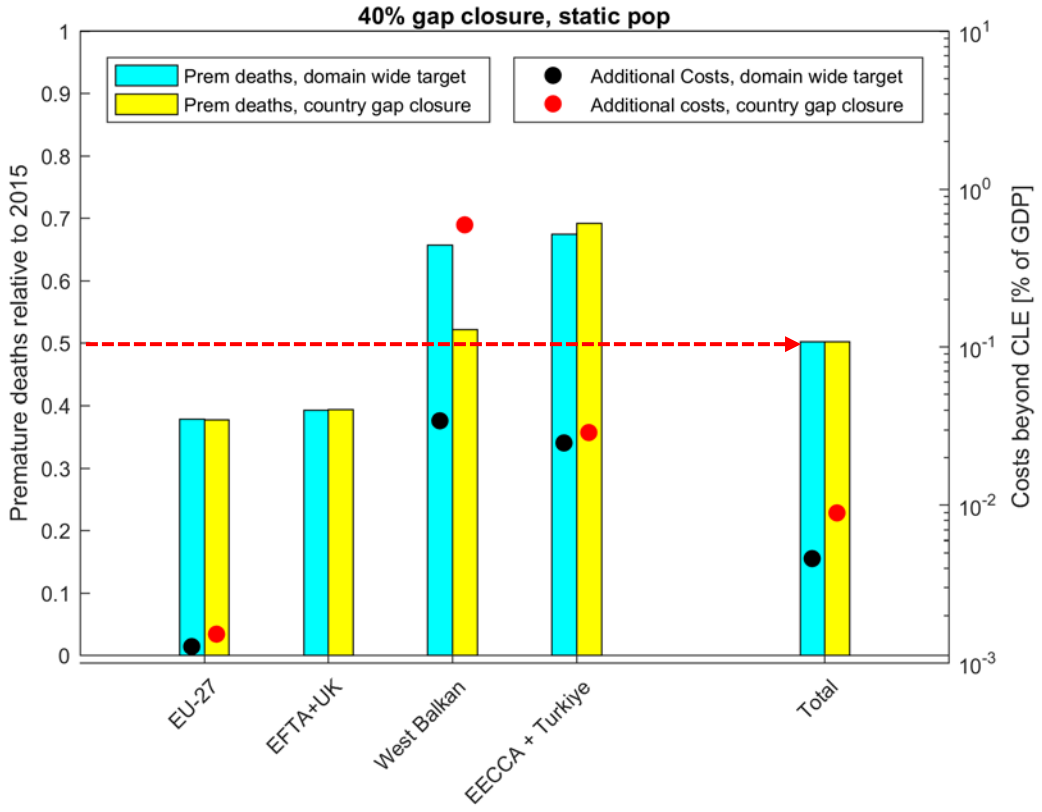


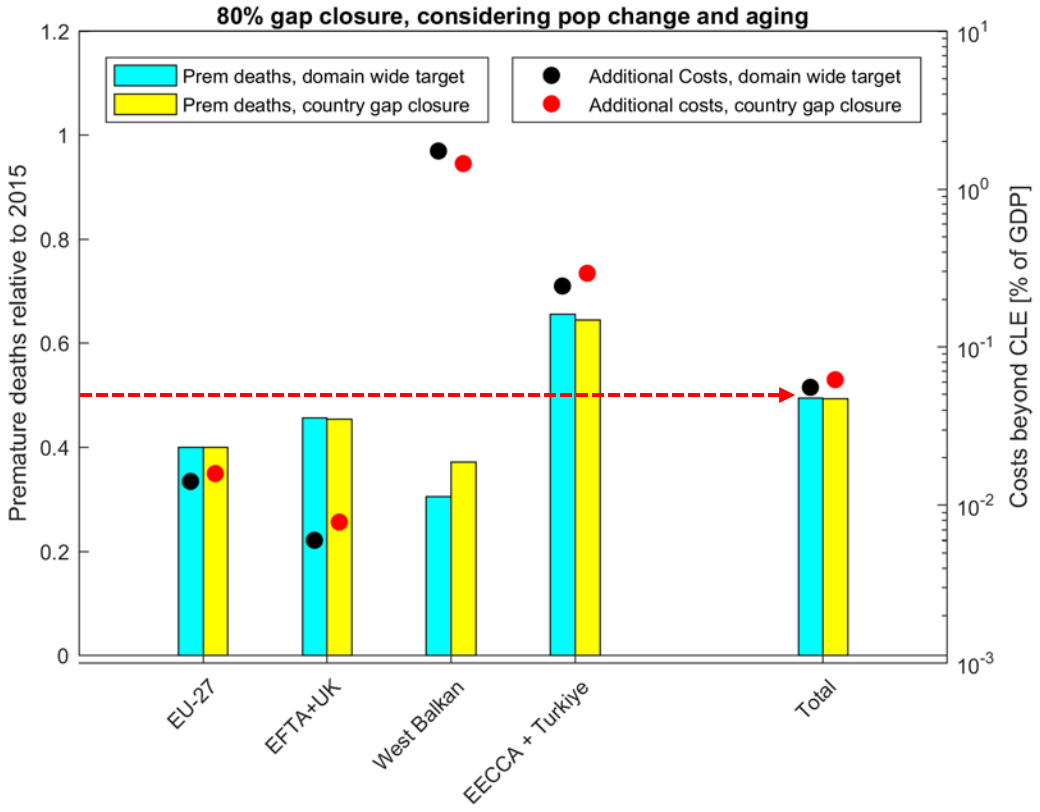
80% gap closure to achieve 50% reduction in premature deaths



Source: GAINS model (CIAM/IIASA)

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





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

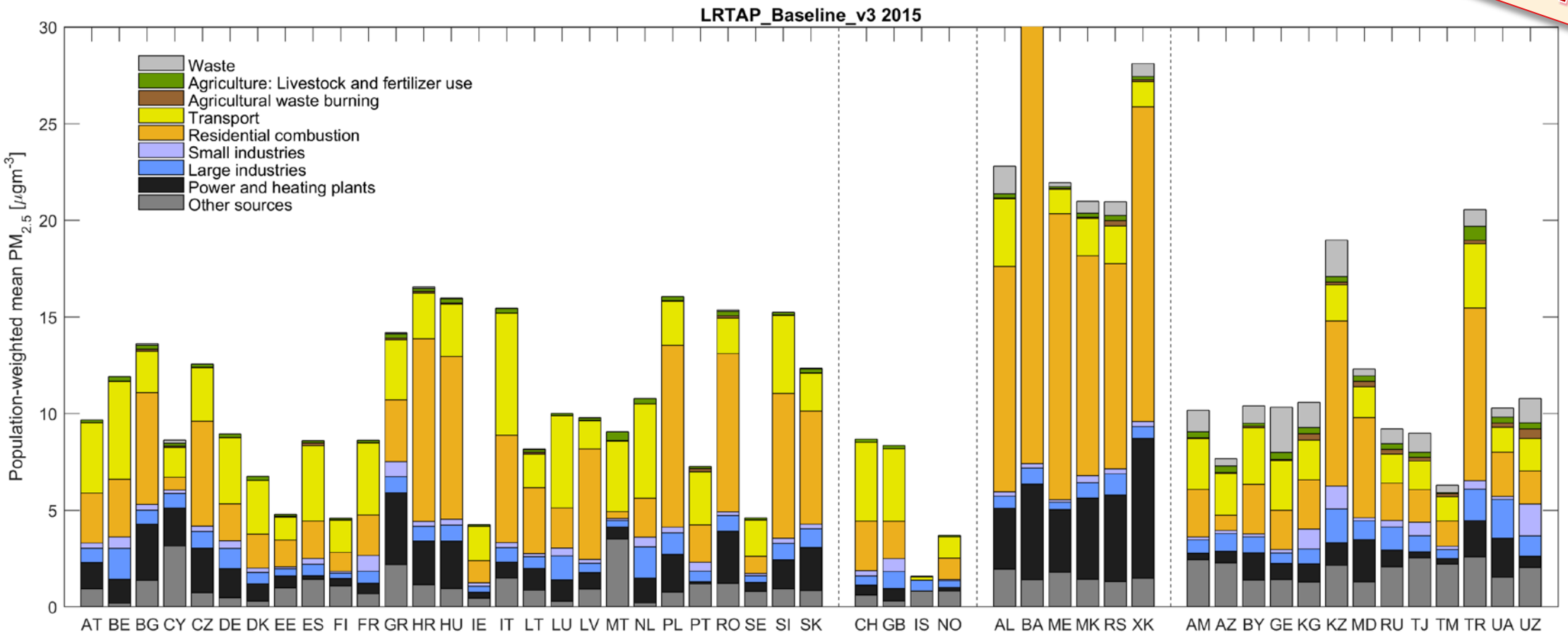
Source attribution *and* initial analysis of staged/phased approaches

Sector-focused strategies

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

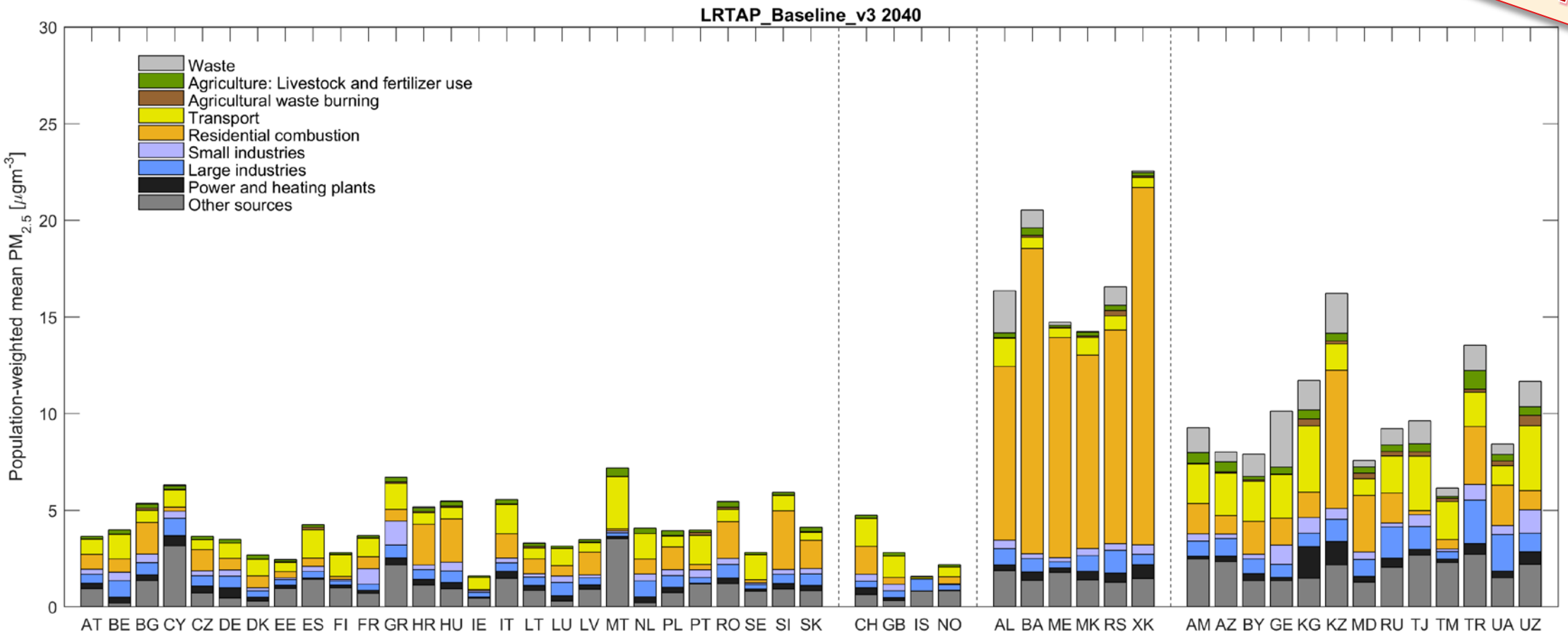


Source: GAINS model (CIAM/IIASA)

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

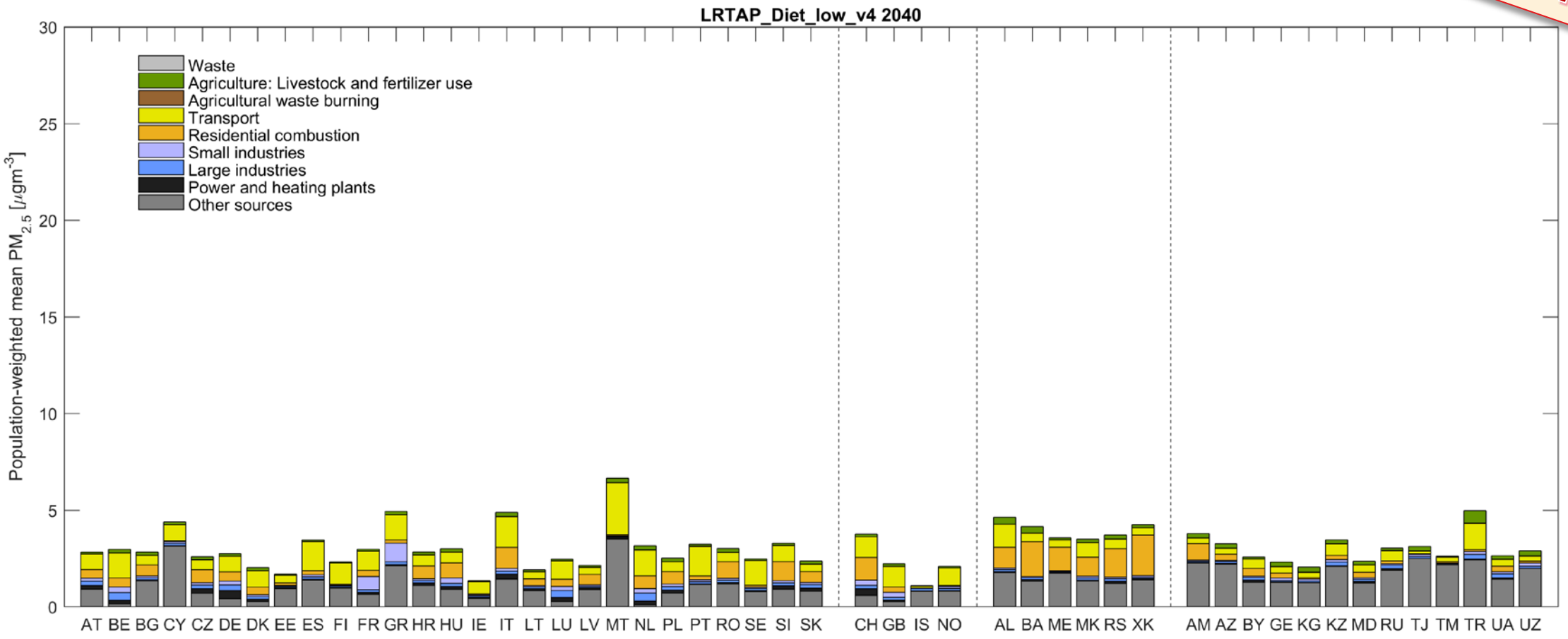


Source: GAINS model (CIAM/IIASA)

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

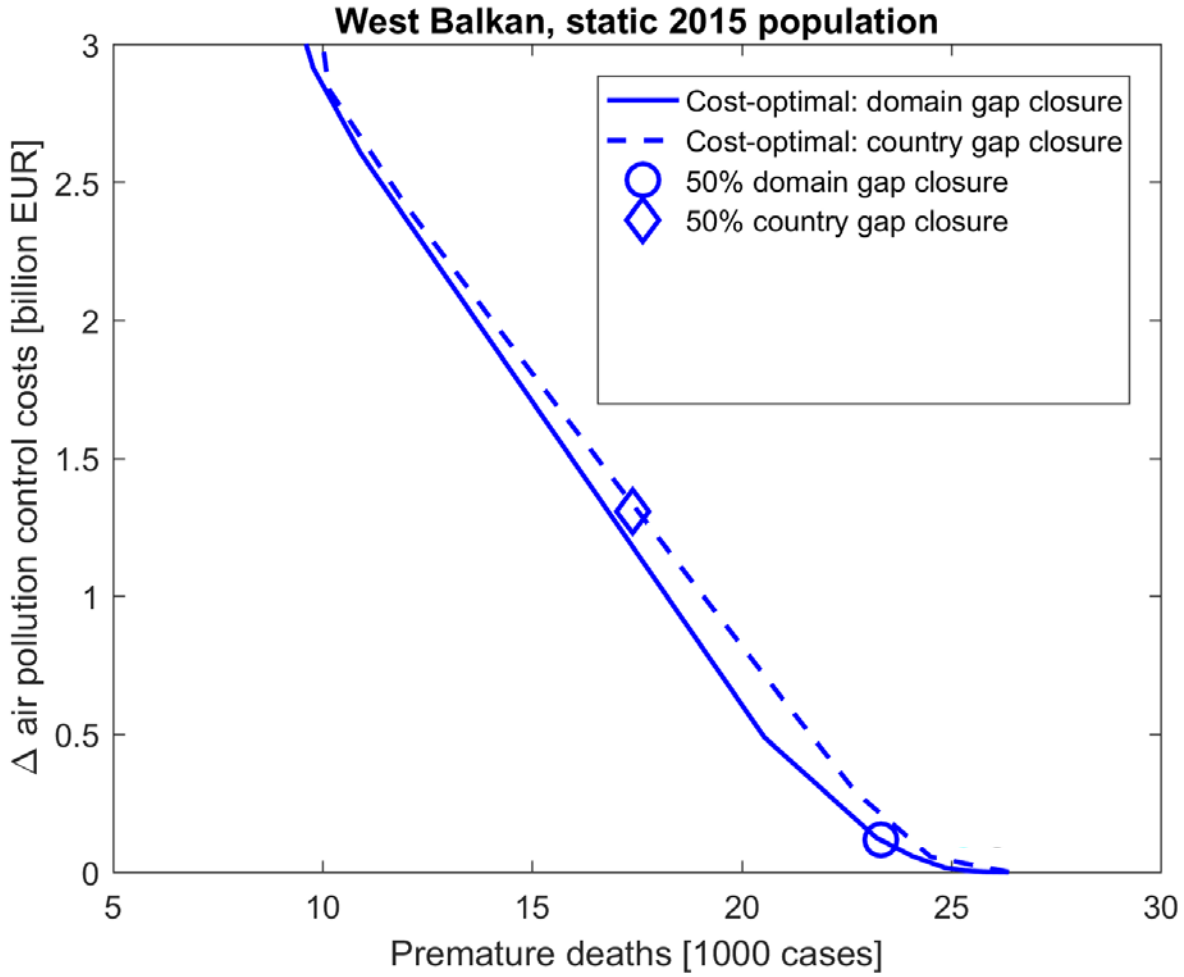
Results for **2040 LOW**: Population weighted country mean anthropogenic $PM_{2.5}$ concentrations

Draft results



Source: GAINS model (CIAM/IIASA)

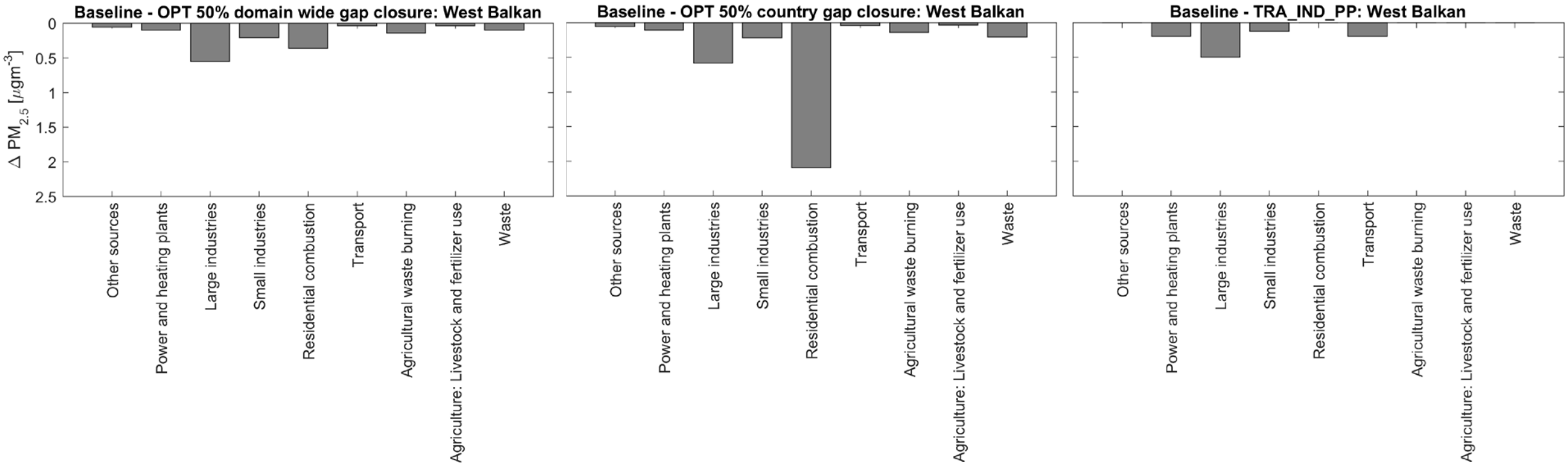
Domain wide optimization vs staged approach
West Balkan



- 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 three sectors)
- Costs in transport dominate the total costs in the staged approach

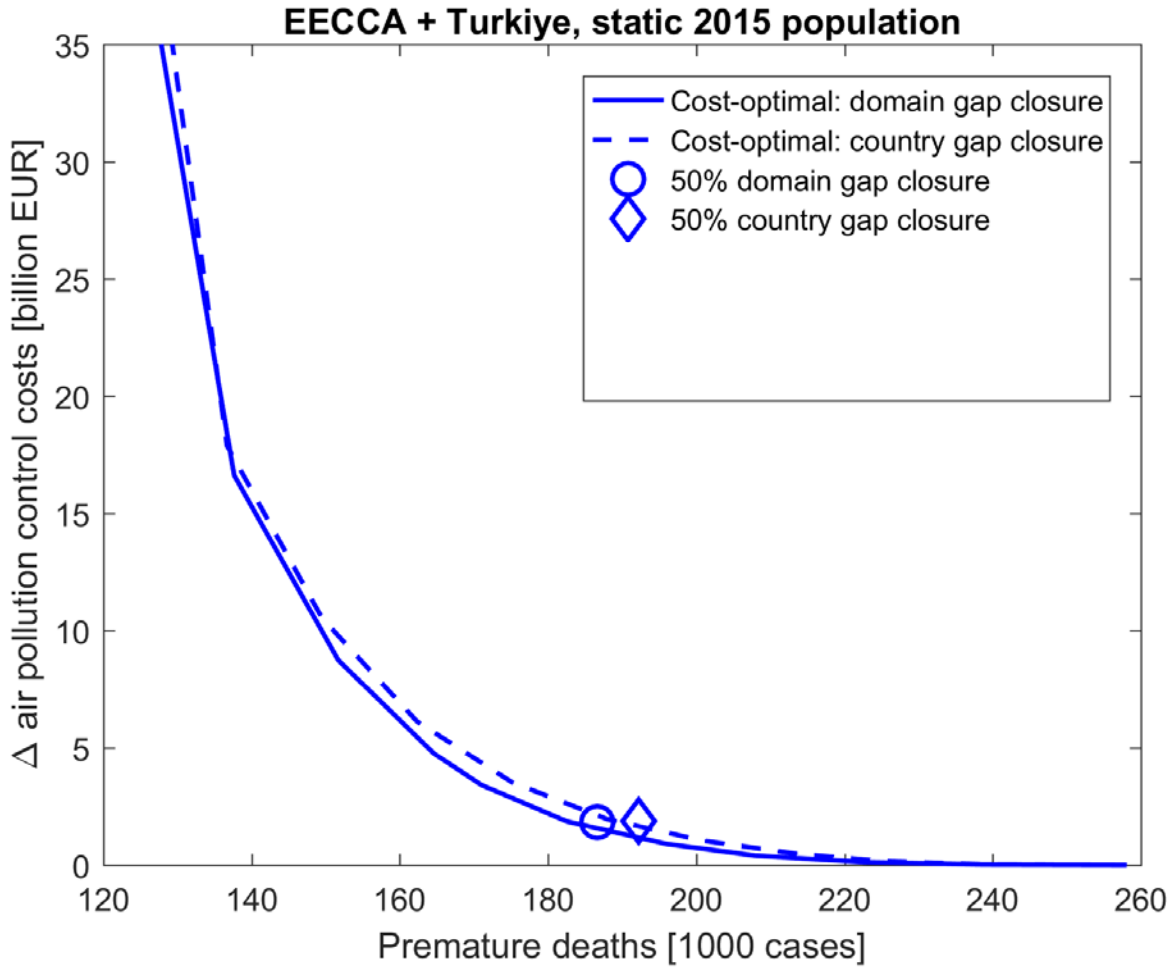
Domain wide optimization vs staged approach
West Balkan

Example *staged approach* case



- 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

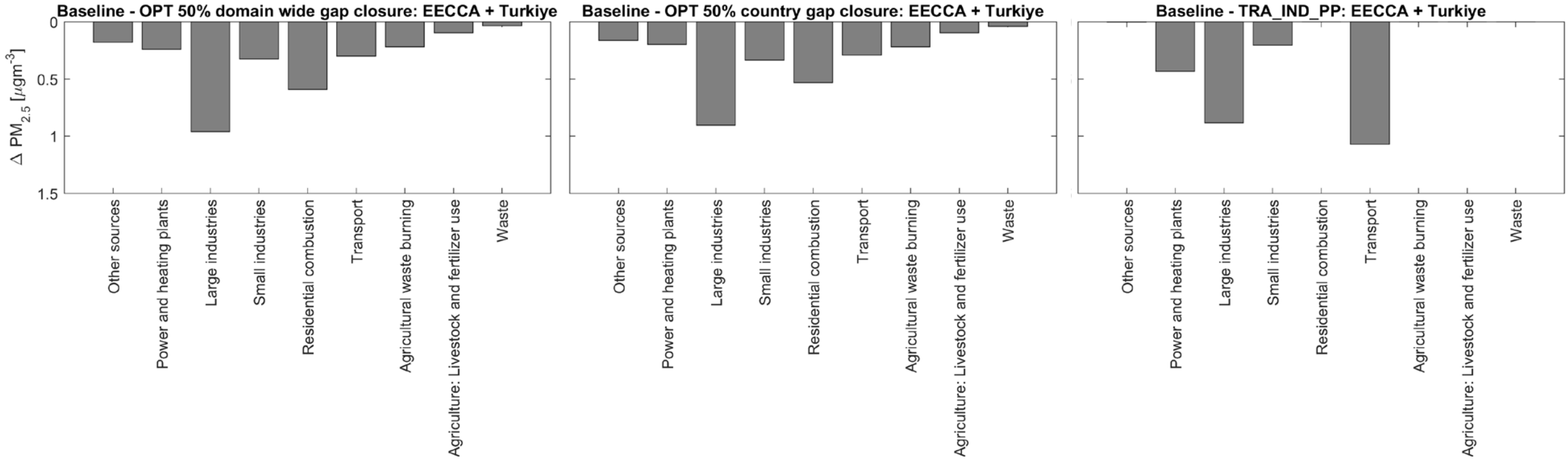
Domain wide optimization vs staged approach
EECCA + Turkiye



- 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 three 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 + Turkiye

Example *stage approach* case



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

Preliminary conclusions and further work

- Sector-based staged approach can provide important improvements, but not in all regions and possibly at relatively high cost, compared to the cost-effective solutions
- Residential sector emissions are a key remaining contributor to exposure and a dedicated scenario prioritizing this sector will be developed
- 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
- Phased approaches: not yet considered. Could do sequential optimization with tightening targets over time?

Including biodiversity targets in GAINS

New empirical critical loads for N deposition

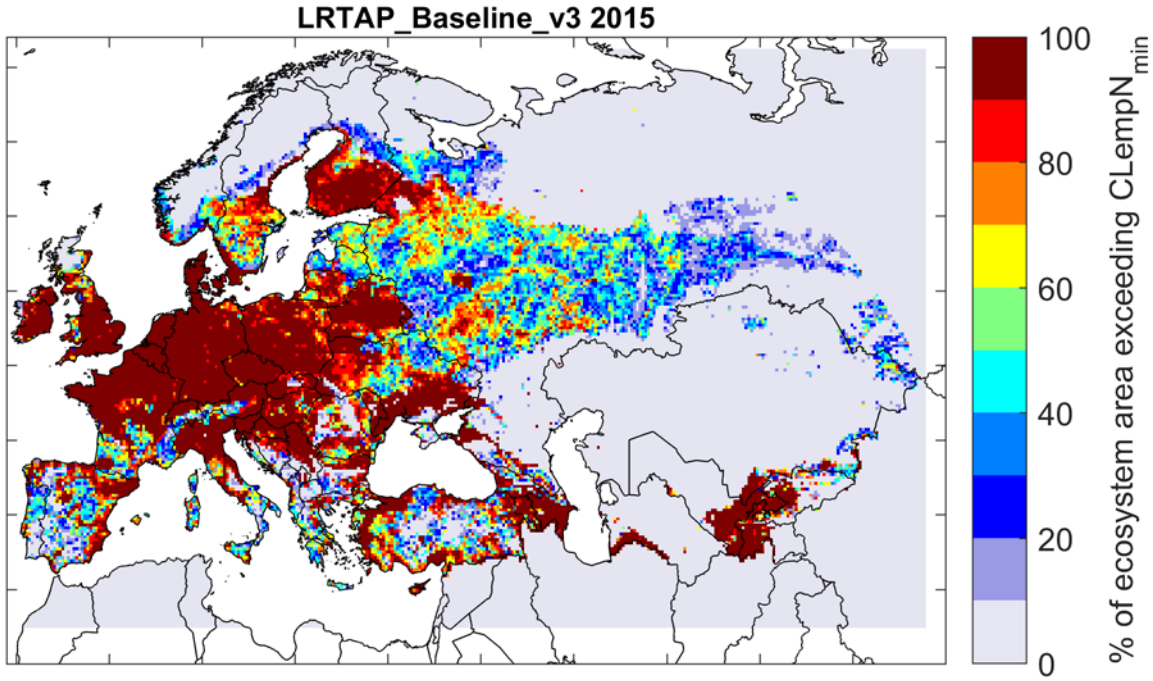
New empirical critical loads for nitrogen deposition

- 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

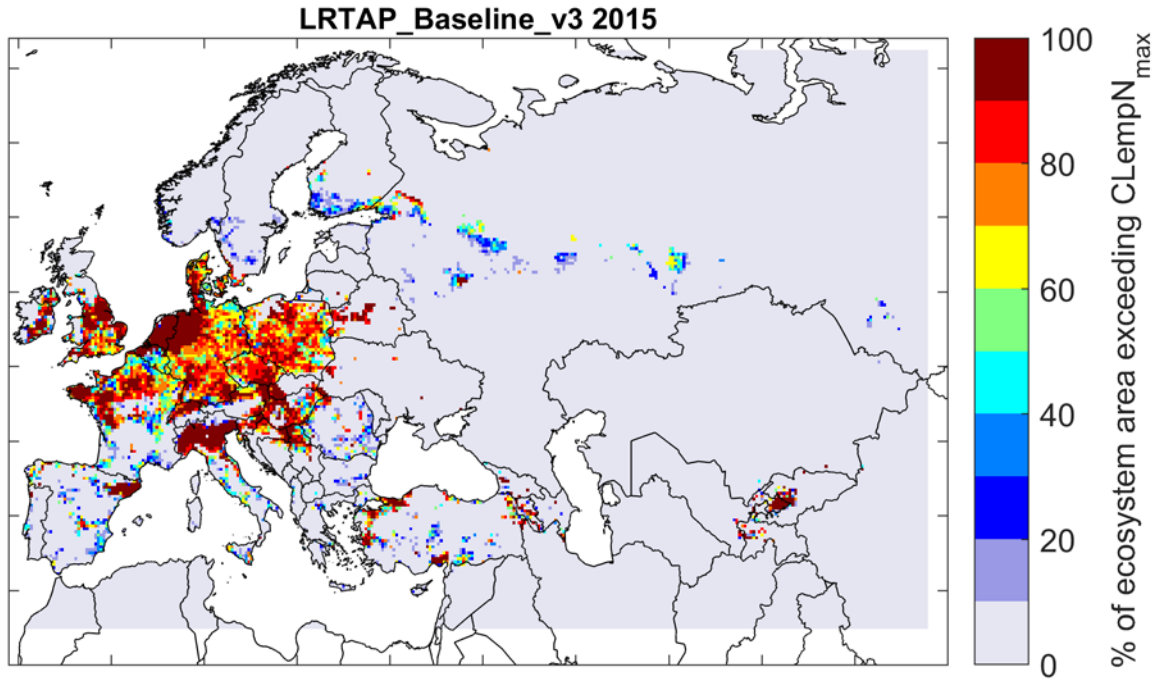
Ecosystem area exceeding CLs: 2015

Preliminary

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



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

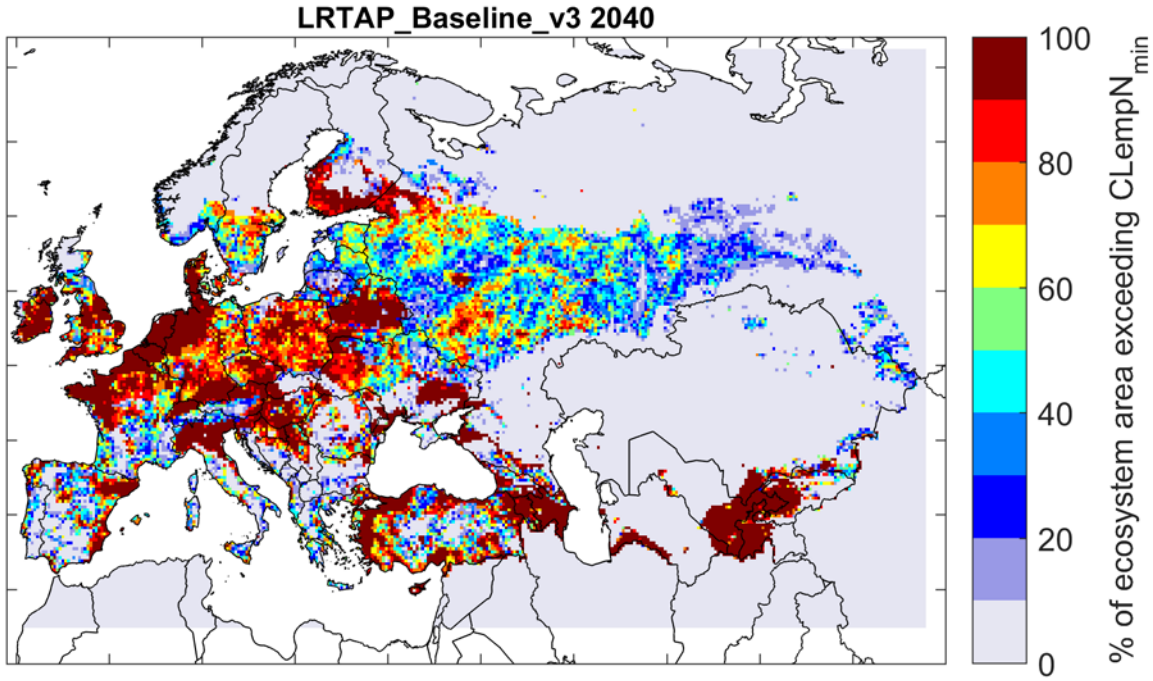


The message differs strongly depending on the range of CL used!

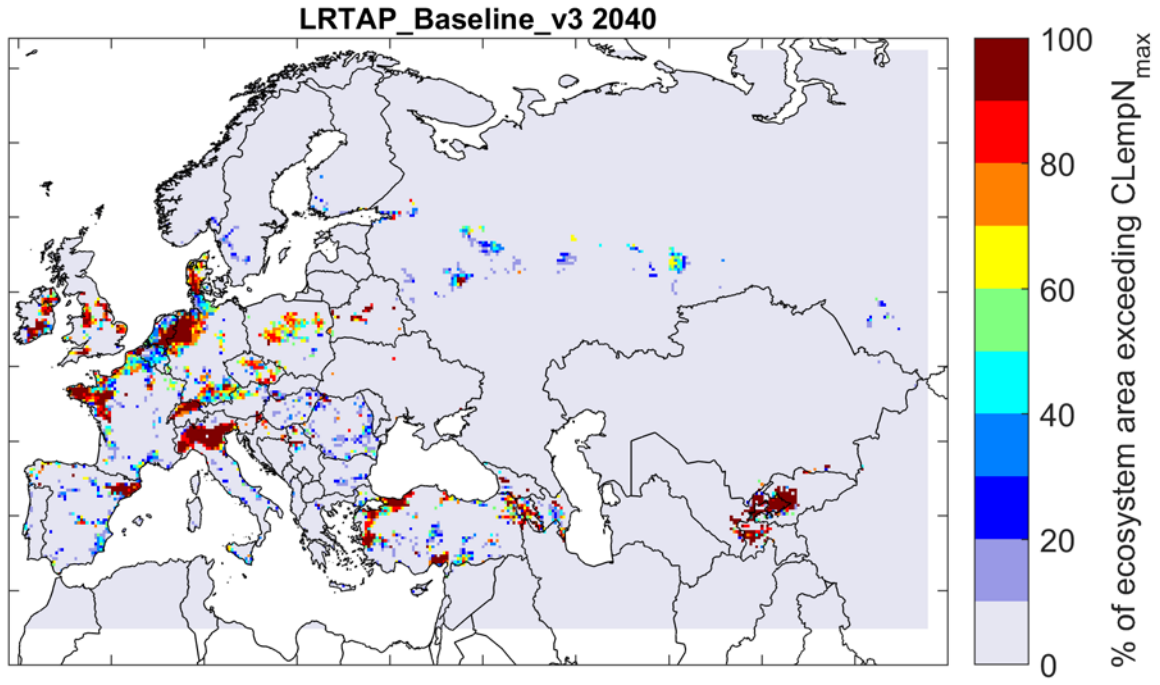
Ecosystem area exceeding CLs: 2040 Baseline

Preliminary

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



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

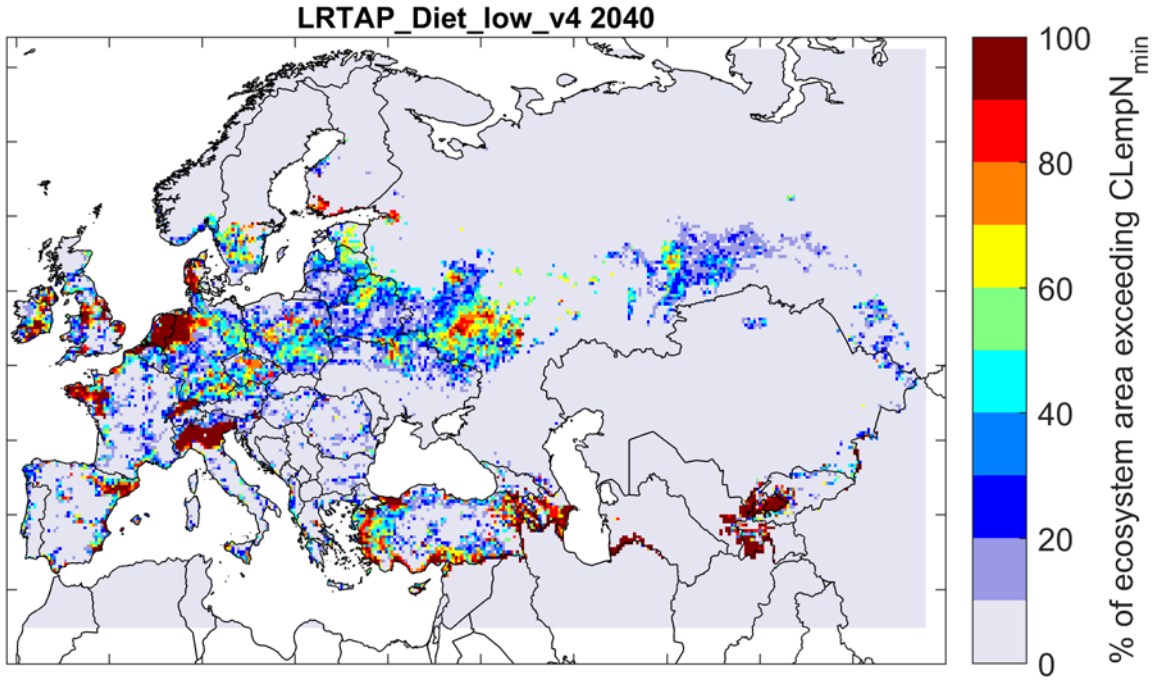


The Baseline reduces exceeded areas in the EU but increases in EECCA & Turkiye.

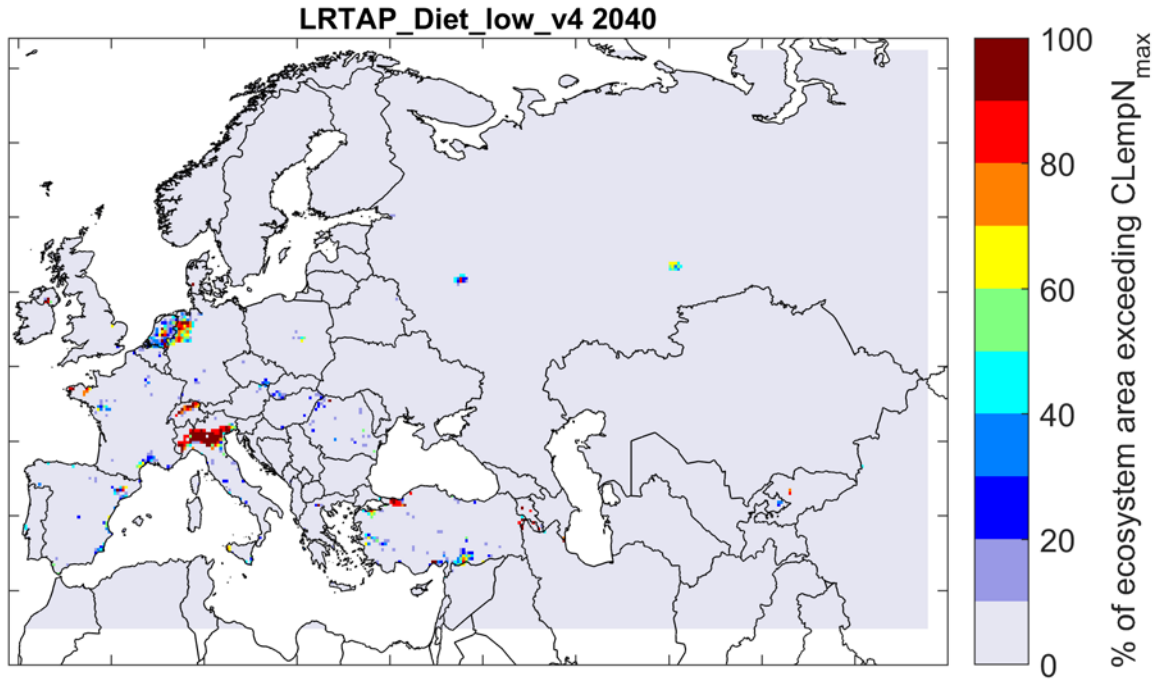
Ecosystem area exceeding CLs: 2040 LOW

Preliminary

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



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

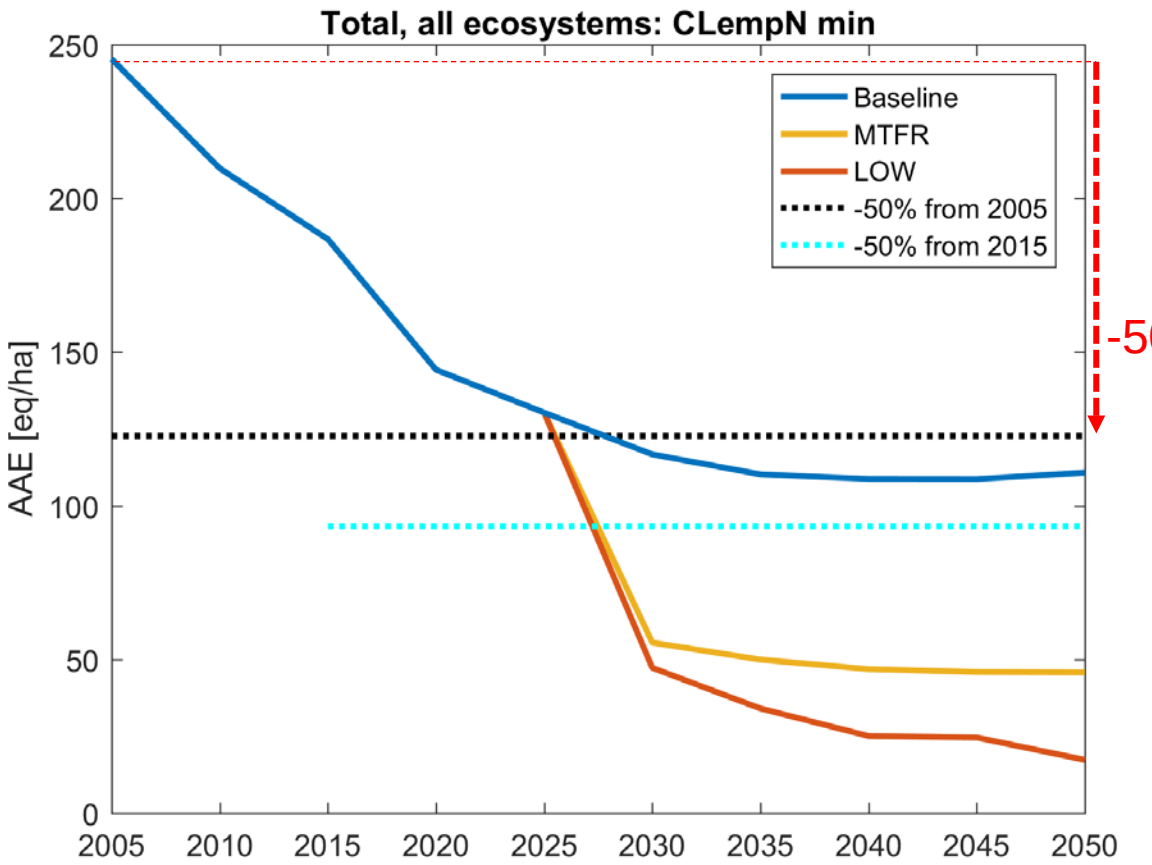


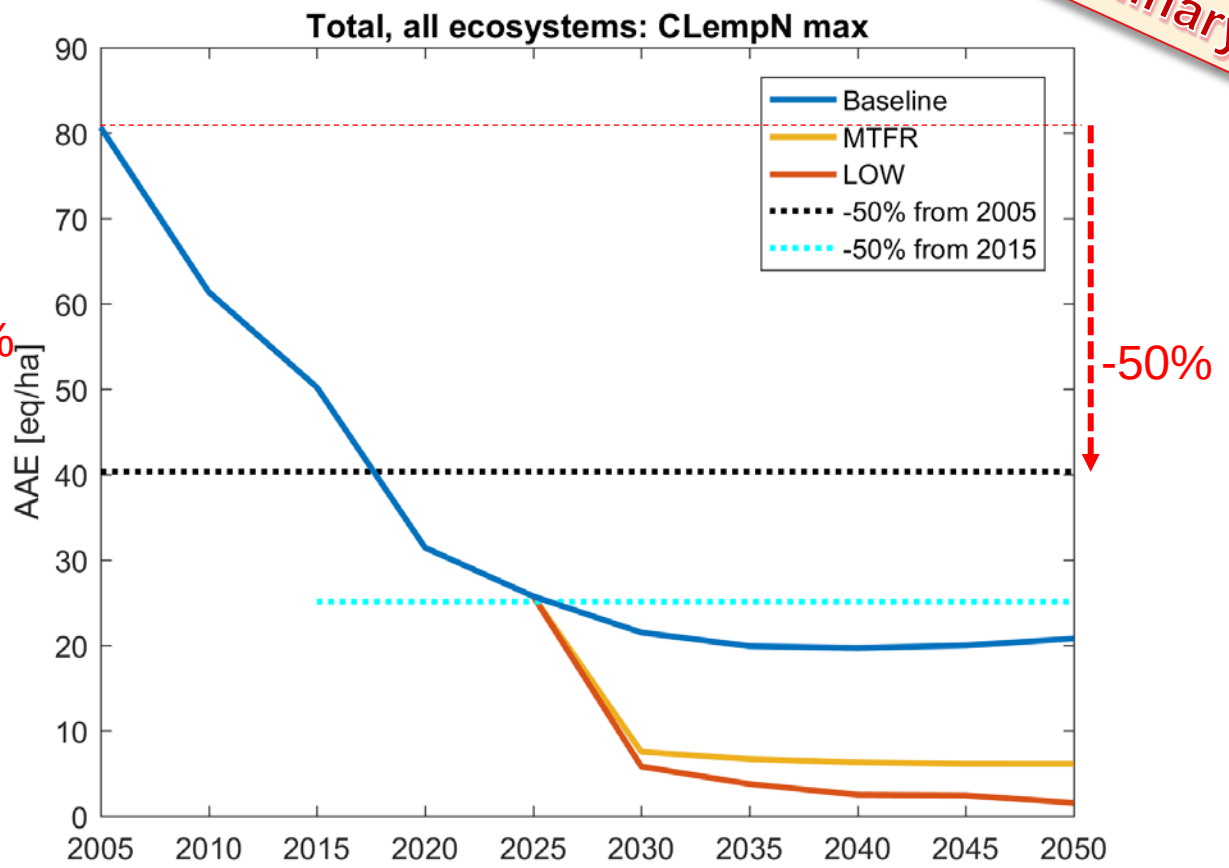
The LOW scenario brings strong reductions in exceeded areas – with upper range of CLs only Po Valley and NL remain. Complete elimination of exceedances is not feasible by 2040.

Scope for further mitigation in the UNECE region

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

Preliminary





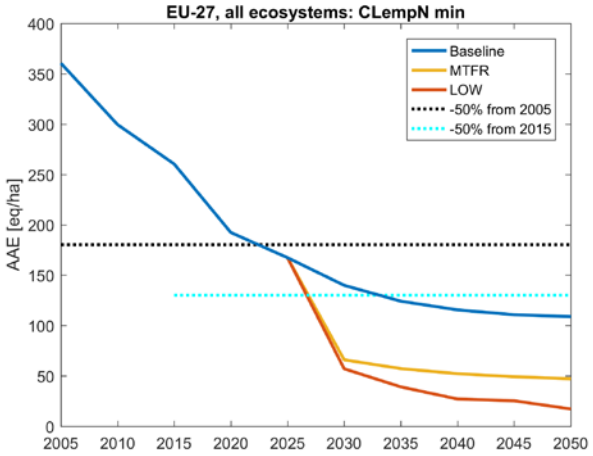
Source: GAINS model (CIAM/IIASA)

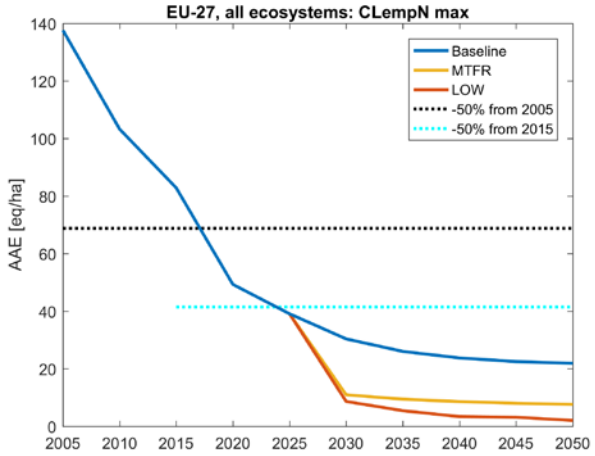
Scope for further mitigation in the UNECE region (2)

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

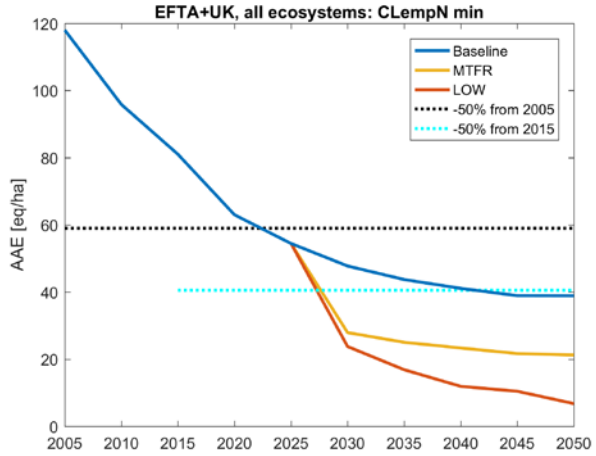
Preliminary

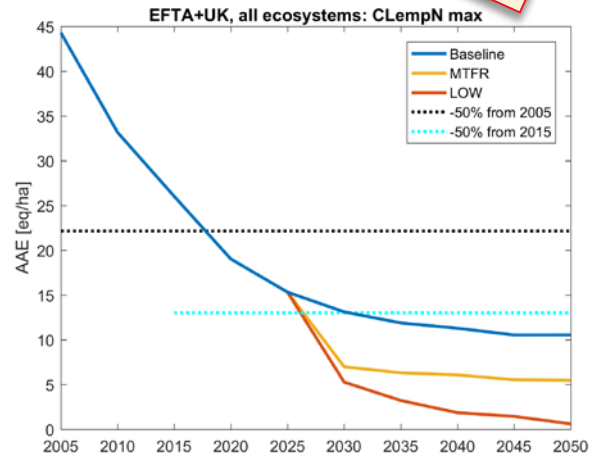
European Union



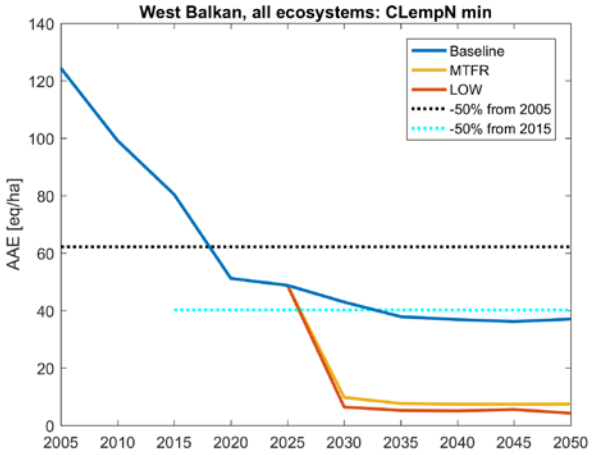


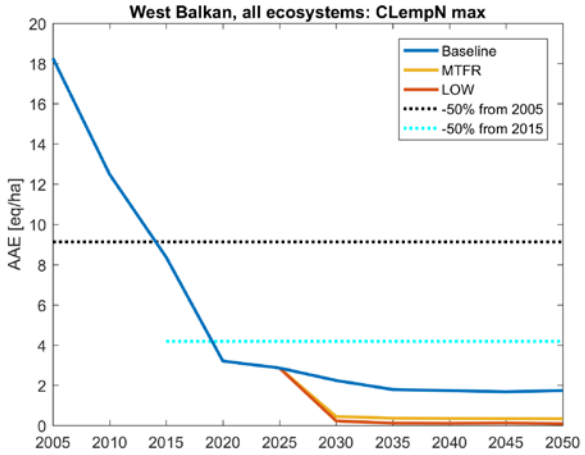
Non-EU EFTA + UK



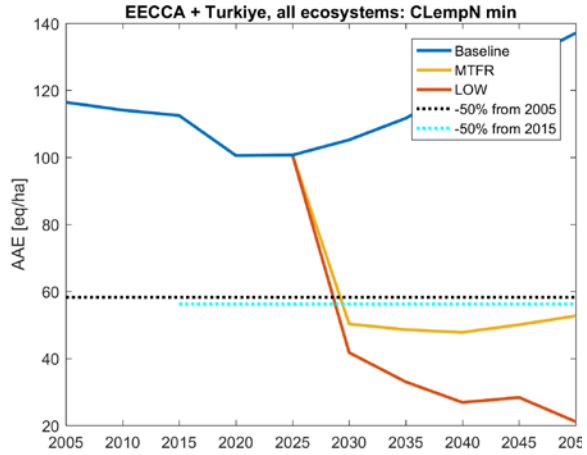


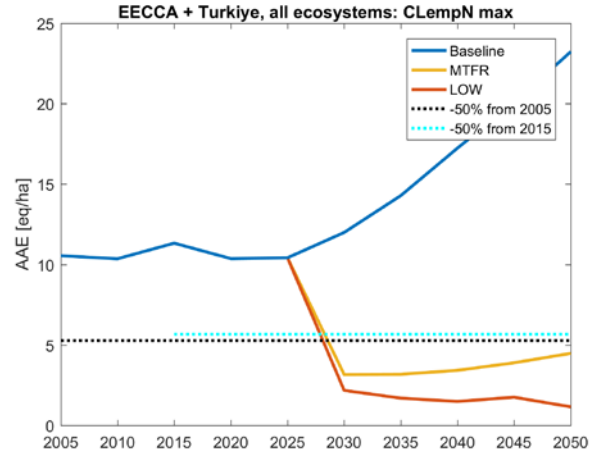
West Balkan





EECCA+Turkiye





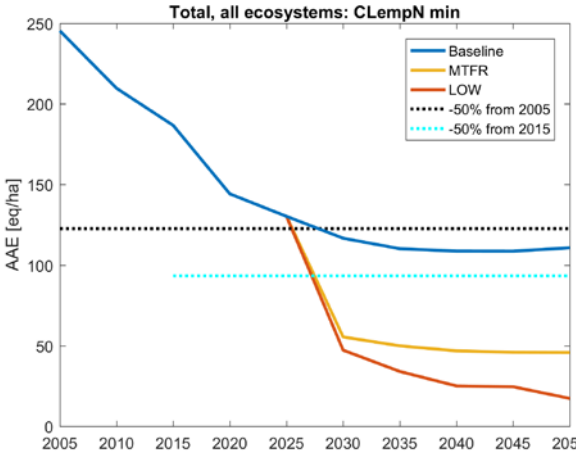
Source: GAINS model (CIAM/IIASA)

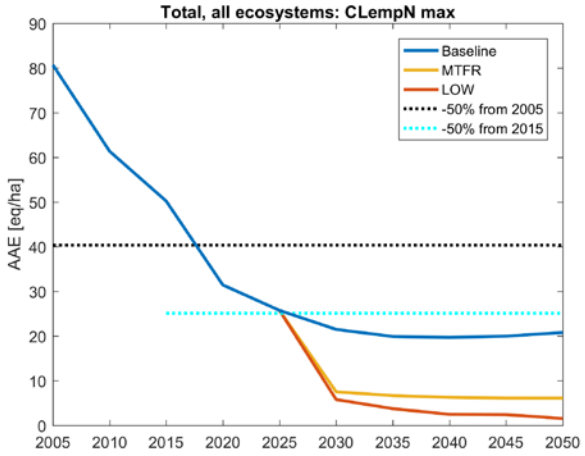
Scope for further mitigation in the UNECE region (3)

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

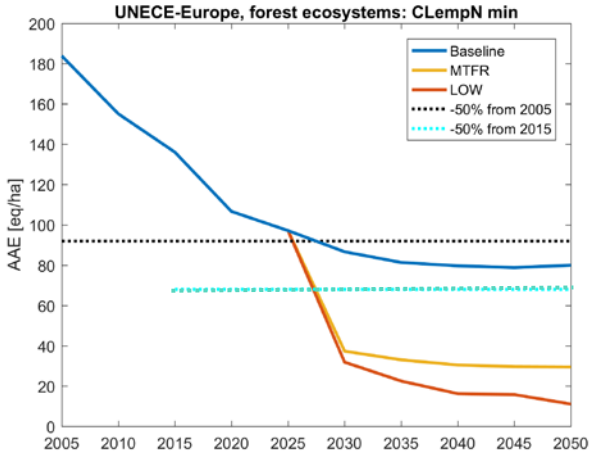
Preliminary

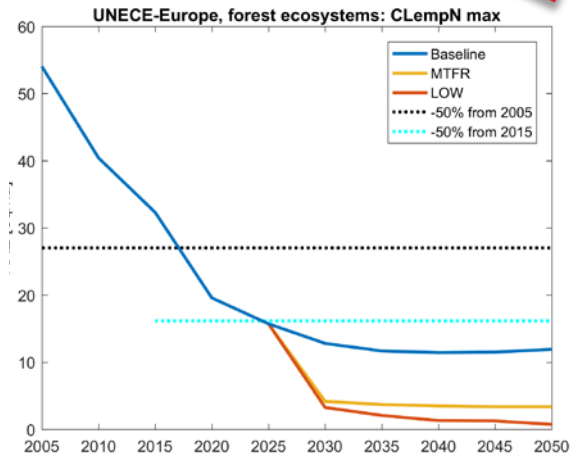
All ecosystems



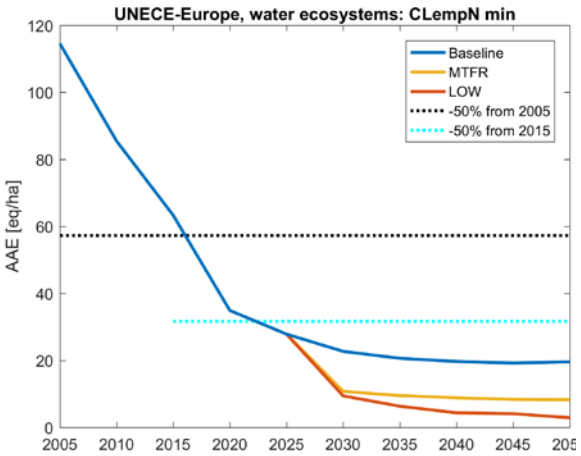


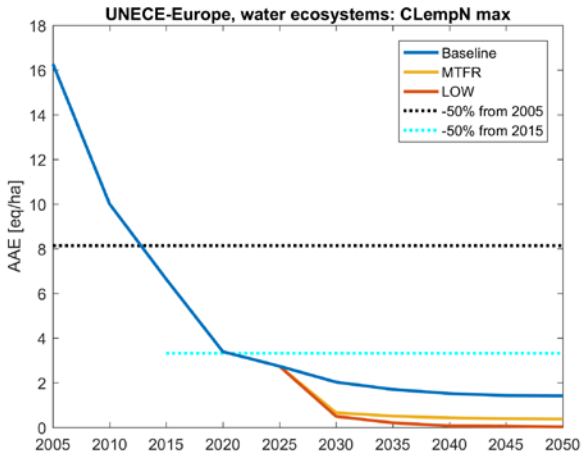
Forests



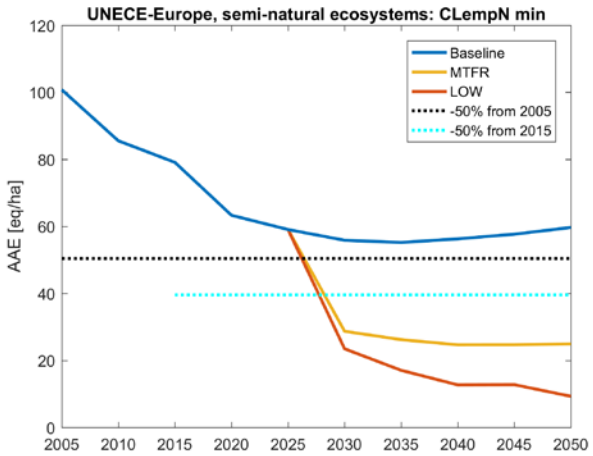


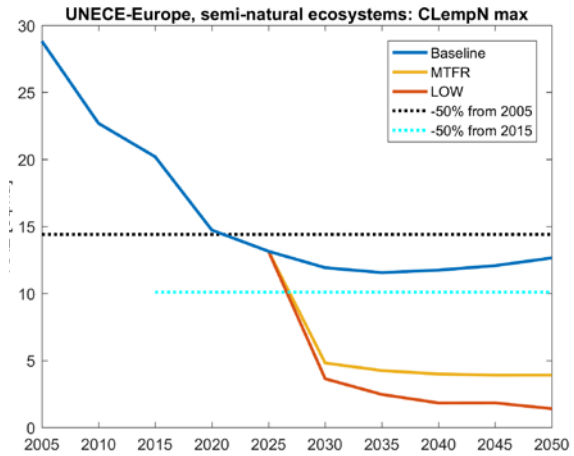
Freshwater ecosystems





Semi-natural ecosystems





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!

Next steps and tentative timeline

- Completion of the ***new Baseline*** (June 2024)
- Validation and improvement of cost and applicability estimates for measures -> development of ***new MTFR*** scenario (July 2024)
- Preliminary ***new LOW*** case [not including further non-tech measures] (Sept 2024)
    - Scenario with new fuels (NH3), hydrogen economy, etc. (2025)
- Updated staged scenario(s) including ***residential sector*** (draft for discussion in Sept 2024)
- Analysis for ***phased approaches*** (initial analysis 2024 – needs discussion)
- Implementing optimization for ***combined PM and biodiversity*** impacts (2024), and ***ozone*** (2025 – needs development)
- Analysis of ***(in)equity*** in optimization – e.g. introducing %GDP spending constraints (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)