Overview of comments on the Policy Brief

Contents

A. Summary of main comments received in July 2024 on the policy brief and replies provided or planned:

1. *Choice of base and target years; modelling intermediate years:*
   Focus in the updated policy brief is now on optimization for 2040 relative to base year 2015. Model results will also be presented in 5-years steps up to 2050.
2. *Clear definition and documentation of scenarios (BL, LOW, GP compliant…):*
   Information added to updated policy brief; further bilateral consultations to be planned to give maximum transparency
3. *Air quality targets/limit values vs health-based targets:*
   The objective is to meet health-based targets. Further assessment of meeting of air quality targets could be assessed ex post in 2025
4. *Collective vs country specific targets for the reduction of health risks:*
   - The policy brief compares both options (reaching targets cost-effectively across the UNECE and through equal relative improvement in each country)
5. *Natural vs anthropogenic PM:*
   Current health impact assessment only looks at anthropogenic PM
6. *Optimization also for ozone health impacts and for the ecosystems/biodiversity impacts of excess nitrogen*:
   Development of optimized scenarios for achieving biodiversity target as well as joint health and biodiversity targets (2024)
   Update of GAINS framework for ozone (jointly with MSC-W) and development of optimized scenarios with ozone targets (2025)
7. *Choice of the health indicator to be optimized*
   Current scenarios focus on premature deaths due to long-term exposure both with constant population numbers and with population growth and aging. Discussions in TFIAM and WGSR supported the use of a risk-based indicator (deaths per 100.000, including dynamic population) as the indicator to be optimised in the new version of the policy brief. Morbidity results can be added ex-post. The sensitivity for alternative mortality indicators (PAF, YOLL) can be analysed in 2025
8. *Explore staged/phased approaches:*
   Indicative results were added to updated policy brief; guidance is still needed from EECCA et al., to focus further assessments; workshop to be planned (early 2025)

9. *Sensitivity scenarios (impact of targets for marine ecosystems, impact of N management policies, alternative mortality indicators, inclusion of equity criteria, e.g. maximum costs per GDP):*
   Planned for 2025
10. *Climate impacts of Black Carbon:*
    To be estimated in an ex-post analysis in 2025

Comments that are currently not foreseen to be included:

- Sensitivity for speciation of NMVOC based on the ozone producing potential
- Modelling uses long-term average meteorology, not extreme years

B. Comments received before WGSR62 meeting

1. Comments European Union and member states on the policy brief on potential targets to reduce risks for health and ecosystems, Submission, 27 Jan 2024

At its 61st meeting (Geneva, 4-6 September 2023), the Working Group on Strategies and Review (WGSR) took note of the information presented by the Task Force on Integrated Assessment Modelling (TFIAM) on the feasibility of introducing a risk-based overarching goal for the Convention, in particular a health damage reduction target. The WGSR requested to provide a policy brief on the potential implications of introducing collective risk-based targets for the UNECE region to address air pollution impacts on health and ecosystems (work plan item 2.1.12). A draft version of this policy brief was prepared by the TFIAM and its centre CIAM and presented as an informal document to the forty-third session of the Executive Body. The Executive Body Invited Parties to send comments on the informal document to the TFIAM by 3 February 2024 before the WGSR discusses it at its sixty-second session. In response to this invitation, the EU and its Member States have following comments on the policy brief.

Submission - comments on options for policy targets
Section IV of the draft policy brief lays out possible options for policy targets, emphasizing that several factors can influence the attainability of a 50% health impact reduction target, as recommended by the Saltsjöbaden 2023 workshop. These influencing factors include base year, target year, region-wide or state-by-state target, applied indicators (halving the absolute number of attributable deaths or halving the attributable mortality, health impact reduction target related to PM2.5 only or for combined effect of exposure to PM2.5 and O3), choice of health impact assessment method (e.g. include the risks of natural PM, or focus the target on the avoidable anthropogenic PM-exposure), etc.

It seems particularly useful for the EU and its member states to provide some suggestions and guidance on the possible options proposed in the draft brief for defining policy targets and the factors that may influence the feasibility of these targets.

We propose to submit the following comments to the TFIAM as input from the EU and its member states.
• *Base year*: the choice of the base year should not depend solely on whether the 50% reduction target is easier to achieve. For some of the EECCA and WB countries, using 2005 as a base year is a barrier and they favour a more recent base year (because of limited availability/reliability of activity data and other statistical data for using higher tier methods to estimate emissions for years further in the past). Probably, any health impact reduction target could still be expressed relative to 2005, but the final emission reduction targets are then best recalculated relative to a more recent base year.
• *Target year*: the focus of the GAINS calculations is now on 2030 and 2050. Additional calculations are welcome/necessary for the interim years 2035 and 2040. 2030 as target year is

too close (given the duration of negotiations and the entry into force of the new revised protocol) and 2050 as target year is too far away (partly because of too many uncertainties in evolutions due to the necessary transitions towards climate neutrality).
• *Gap closure*: least cost optimizations have been carried out for a 70% gap closure. If a target year other than 2050 is chosen, other optimizations may be more desirable (e.g. choosing another gap closure % or an optimization to achieve PM2.5 concentrations below 10 μg/m³ across the UNECE region by 2035).
• *Target for PM2.5 only or for combined effect of air pollutants*: the policy brief shows optimization results for a 50% reduction target of health effects due to exposure to PM2.5. It would be useful to have similar analysis for O3, and also carry out optimisations for the combined health effects of exposure to PM2.5 and O3. For example, what would be the impact of such optimizations on total abatement costs?
• *Region-wide or state-by-state target*: an alternative to applying the region-wide or state-by-state health impact reduction target is to apply the region-wide health impact reduction target (for the entire UNECE region), but with adjustments (e.g. based on GDP), which could potentially be even more cost-effective than applying a state-by-state approach.
• *Staged / phased approaches*: to support the negotiations and more actively involve EECCA and WB countries, it is necessary to explore the potential of these new approaches with GAINS. We are therefore requesting that calculations also be carried out to understand the implications of applying staged and phased approaches, among others (see e.g. suggestions in paragraphs 39 to 43 of informal document on new approaches for EECCA, WB and TR to the 43rd session of the Executive Body).
• *Baseline assumptions for the EU*: the baseline scenario for the EU takes into account the European Green Deal, including the Fit for 55 (FF55) legislative package. More information / details on how and to what extent the new European FF55 legislation has been translated into the baseline scenario for EU member states would be useful. Through Primes? Which version? This seems particularly relevant for new EU regulations as they do not need to be implemented in national legislation and have direct effect: this concerns, for example, the revised CO2 regulation for cars (end of diesel and petrol car sales from 2035), the new Euro 7 regulation (political agreement has recently been reached on this file; with rules on non-exhaust emissions and slightly stricter standards for trucks) and the revised CO2 regulation for trucks (faster electrification), for which political agreement will hopefully be reached in February 2024 These three new regulations will have a significant impact on NOX and PM emissions from transport in the baseline.
• *Sensitivity analyses*: it would be useful to give some consideration to conducting sensitivity analyses. For example, regarding the impact of deposition reduction targets for marine ecosystems (e.g. 50% reduction in N deposition) and the impact of new policies on biodiversity, N management etc. on emission reductions, effects, … Full implementation of policies and measures in other areas like climate change, biodiversity loss, energy, transport, agricultural and N-management policies could offer substantial, cost-effective emission reductions of ai pollutants covered by the Gothenburg Protocol. We would also appreciate being briefed on appropriate biodiversity risk indicators at the 62nd session of the WGSR.

• *Impact on BC*: Information on the impact of the various scenarios on BC emissions would be useful. In which sectors are most BC reductions expected? Highlighting the positive impact of reducing emissions of air pollutants that have a warming effect such as BC and O3 precursors, could potentially create more political will to accept stricter targets/requirements for these air pollutants.
• *GAINS data compared to official reported data*: Information on any discrepancies between the officially reported emission data by states for the base year and the data used by GAINS for the base year in its scenarios would also be welcome. Especially for PM2.5, this could lead to significant differences, as improvements in the GAINS and EMEP model now include consistent representation of the condensable fraction of PM for all states. For PM2.5 from agricultural residue burning, this could also lead to significant differences.

Specific comments
A few specific comments on the policy brief:
• The fourth sentence in paragraph 9 reads as follows: "More than 60% of the population in the UNECE (excluding North America) would be exposed to PM2.5 levels above the WHO guideline by 2050 (over 80% in the EU+EFTA+UK, 30% in EECCA + Türkiye)." Should this not be 'below'?
• The last sentence in paragraph 9 reads as follows: "Nearly 30% is exposed to more than 10 µg/m3". Should this not be 'a little more than 10%"?
• First sentence in paragraph 14: "Figure 4 shows the scope for reducing the average exposure to anthropogenic PM2.5" in the UNECE as a whole as estimated with the GAINS model. Do figures 5 and 6 as well refer only to 'anthropogenic PM? This is not clear.
• Figure 9: At the top of this figure it says 20% gap closure. Shouldn't that be 70% gap closure?

2. Comments Switzerland, 1 Feb 2024

Thank you very much for the opportunity to comment on the document. Regarding the very good first draft of the policy brief on potential targets to reduce risks for health and ecosystems we have the following comments and questions:

Para. 3c (p. 2): The definition of the LOW scenario is not very clear to us: It would be helpful to specify what additional measures compared to MTFR are taken into account; i.e., what are the specific measures/assumptions in context of agriculture/dietary changes?

Para 9 (p. 4): "More than 60% of the population in the UNECE (excluding North America) would be exposed to PM2.5 levels above the WHO guideline by 2050 (over 80% in the EU+EFTA+UK, 30% in EECCA + Türkiye)". We suppose that this statement refers to the LOW scenario. In this case, it should read "below the WHO guideline…"?

Figure 3 (p. 5): It should be specified which countries are included in "non-EU".

Para 18 (p. 7): Does this paragraph refer to absolute or relative numbers of premature deaths (i.e., deaths per 100.000 inhabitants)?

Annex 1, figure A.1., p. 12: Do we understand correct that Switzerland is included in the figure for "Türkiye" with IS, NO and IL? If so, we don't see the benefits of combining these geographically apart states in the same graph. We propose to structure the figures similar as table 1 in annex 2.

Table 2, p. 15: The term "GP compliant" appears here for the first time and should therefore be specified. A short explanation of the difference between "Baseline" and "GP compliant" would be helpful, for example in the policy scenarios section.

Table 2, p. 15: the exposed population in Switzerland (PM2.5) for 2050 is higher with the LOW scenario than with MTFR. We think there must be an error.

Table 3, p.16: Are the "Years of life lost" taking into account PM only or ozone as well? A note in brackets would be helpful.

3. Submission by the United Kingdom of Great Britain and Northern Ireland, 5 Feb 2024

Comments on the Policy brief on potential targets to reduce risks for health and ecosystems (draft document prepared by the Task Force on Integrated Assessment Modelling and the Centre for Integrated Assessment Modelling).

We would like to thank the Task Force on Integrated Assessment Modelling and the Centre for Integrated Assessment Modelling for compiling this document.
On a general note, we think it would be helpful to add an introduction outlining the context for these additional targets and why they have been deemed necessary. We understand that this is predominantly to help communicate the Convention's aims and to perhaps also provide a focus and motivation for those working on the Convention. Additionally, we think it would be useful to incorporate some context on how this overarching target would complement existing and/or future emission reduction commitments/mechanisms under the Gothenburg Protocol.

Comments on the Options for Policy Targets
Please find views on the questions posed in section IV of the policy brief below.

1. *What is the base year and what is the target year?*

We understand that a baseline year of 2005 has been utilised in this paper and see the merit in this approach, however we think the subject of a baseline year will need to be discussed and agreed by Parties as part of wider discussions under the revision of the Gothenburg Protocol. A baseline year of 2005 makes sense in the context of the current Gothenburg Protocol, but as these targets are subject to future discussions there may be a necessity to update the baseline year going forward. We would also like consideration to be given to the accessibility of data for all Parties to the Convention.

We see the target year as being connected to the selected baseline year and would be interested in exploring whether this could tie to other metrics/targets especially in the health or sustainable development sphere.

2. *Should the target be applied to the UNECE as a whole or to each country (or even each city)?*

On the basis of what is currently proposed, we indicatively see merit with a UNECE wide target. This could be a useful way to achieve a common focus among the different regions in the wider UNECE region. Collective targets have also been successful in other forums such as the UNFCCC and the CBD and may be positive for promoting the Convention's aims to a wider audience.

3. *An important factor is definition of the indicator: do we want to halve the absolute number of attributable deaths? Or do we want to halve the attributable mortality (i.e. deaths per 100,000 inhabitants)?*

We understand that the paper predominantly uses 'deaths' as a metric of mortality, it would be useful to have more information in the paper on how an 'attributable' death is identified. We instead would see merit in using 'Lost Life Expectancy' (Years of Life Lost), as this metric better aligns with the underlying epidemiological data based on cohort studies that follow response to exposure to air pollutants in the long-term. We also think it would be preferable to use attributable effects per 100,000 inhabitants as we think this will give us a more stable measure of progress towards the target.
It is also important that it is recognised that air pollution is only one of a number of risk factors that could influence an individual's respiratory and cardiovascular health, along with diet, smoking behaviour, levels of exercise, mental health, allergies/atopy etc. It is important to incorporate into modelling that these factors do not operate in isolation of one another. Therefore, attributing deaths to air pollution in isolation is inherently complicated.

We also think there needs to be consideration given as to how changes linked to variation in population and updating of response functions to reflect the latest science should be handled.

4. *Should the target be formulated for PM2.5 only, or for the combined effect of air pollutants?*

While we think emission reductions of all the pollutants covered by the Gothenburg Protocol are important, we understand that this could lead to difficulties including regarding the risk of double counting. We would therefore see merit at this stage, in formulating the target for PM2.5 only.

In the UK we have recently set two new targets for PM 2.5: a maximum annual mean concentration of 10 µg m^{-3} by 2040 and a population exposure reduction target of 35% by 2040 compared to 2018. This is in recognition that PM2.5 as the air pollutant which causes the most harm to human health. We believe this dual-target approach will improve public health by tackling the highest concentrations while ensuring all areas benefit from continuous improvement. These kinds of innovations may be helpful in the formulation of wider Convention agreements.

5. *The choice of the health impact assessment method will also influence the attainability. Do we want to include the risks of natural PM, or focus the target on the avoidable (anthropogenic) PM-exposure?*

We understand that PM2.5 mass (inclusive of natural PM) is generally more practical to measure routinely than its subcomponents. Therefore, we would be supportive of this being the basis of these targets (this is in line with the UK's domestic targets), however we would be open to seeing more evidence on how targets for PM2.5 components could be achieved with a high degree of certainty.

Additional Comments

We understand that the "low" scenario includes climate measures, e.g. meat reduction. We would appreciate more information on what climate measures are used as we understand that different net zero scenarios will deliver different improvements in air pollutant emissions. We therefore think it would be helpful for the document to look at a range of net zero scenarios with full descriptions provided.

We also note that in regard to shipping, the electrification of ports is assumed. We think it is important to also consider potential measures aimed at reducing greenhouse gas emissions from shipping, which is likely to include potential new fuels such as ammonia.

We would be interested in seeing the work on methane in more detail. We would also like to highlight land-use changes, due to climate measures such as peat restoration, forestation, biocrop production, which may impact agricultural production and be an important consideration for future modelling.

Furthermore, we note that the scenarios assume a reduction in the population exposed to PM2.5 above 5ug/m3. We would like to emphasis the uncertainty of this due to the dependence on the natural background and SOA concentrations.

We welcome the acknowledgment of the uncertainty when considering Ozone and feel that it would be useful for a range of clear scenarios to be developed.

4. US-Comments: Methodological Questions on the Draft policy brief on scenarios to reduce health and ecosystem risks, 27 May 2024

In addition to the questions posed and answered in that policy brief provided, it would be helpful to consider some additional points on tuning the parameters when estimating a 50% reduction in risk. The three basic inputs that affect the size of the estimated number of deaths/illnesses that we believe need additional clarity on before moving forward are:

1. **The concentration-response parameter:** The concentration response function the US typically uses are log-linear and without an assumed threshold. This means that an air quality change occurring from 10 ug/m3 to 9 ug/m3 generates approximately the same benefits as one occurring from 5 ug/m3 to 4 ug/m3. There is some evidence for a non-linear function in which the slope is steeper at lower levels. If LRTAP plans to use such a non-linear function, that would mean other things being equal, reducing PM at a lower concentration would yield larger avoided deaths than reducing PM at a higher level. So

additional clarity will be needed on which methodology will be used. The US position would likely be in support of the log-linear approach.

2. **The number and demographics of people exposed:** In U.S. health benefits assessments, we use projected counts of individuals stratified by age/sex/race. The level and age structure of population projections has a substantial effect on estimated counts of health outcomes but involves substantial uncertainties. The United States recommends TFIAM to report results as "population normalized." This would mean reporting either: (1) counts of deaths per 10k people or; (2) as an attributable fraction (e.g. % of all deaths due to PM).
3. **The baseline rate of death/disease in that population:** The modeling that the U.S. conduct uses projected death rates. Projecting the baseline rate involves substantial uncertainty. As longevity increases, the number of air pollution-attributable deaths decreases, other things being equal.

In response to the questions posed by TFIAM, the U.S. would want to express the change in risk using either an attributable fraction or a count per 100k. Reporting a nominal value would capture the increase in population over time, which is especially important for mortality, given that the population is aging, and air pollution-attributable deaths occur largely among those aged 65+. The U.S. also prefers using a projected death rate, which would account for the improved longevity of exposed populations in the future.

In addition, the U.S. agrees that the choice of the health impact assessment method will influence the attainability. The U.S. advocates that the target focus solely on avoidable anthropogenic PM exposure, which should also be a large share of the total PM mass, although we acknowledge that this may be problematic due to the increase impact on mortality from both wildfire and prescribed fire.

C. Conclusions TFIAM53, Paris, 15-17 April 2024

48. TFIAM concludes that TFIAM/CIAM are well setup to support the Gothenburg protocol revision with scenario analysis of most of the 8 proposed policy negotiation topics set out in EB decision 2023/05 for the review of the Gothenburg protocol.
49. However, TFIAM also concluded that several working groups require clarification and guidance from the WGSR on details regarding scenarios, data, metrics, target years etc. to be effective in providing input to the revision of the Gothenburg protocol.
50. Scientific considerations for scenario analysis by TFIAM/CIAM for the Gothenburg protocol review would suggest:
    - Optimization for the period 2015 to 2040.
    - Optimization targets could include:
        i. a cost-effective reduction of health and ecosystem risks by 50% for the whole domain
        ii. country specific targets to reduce health and ecosystem risks by 50% (based on equal efforts by countries to bridge the gap between current policy and maximum feasible reductions),
        iii. as above, but with introduction of a limit to the abatement costs as a percentage of GDP as an egalitarian principle,
        iv. a socio-economically efficient reduction of health and ecosystem risks in 2040 (CBA-optimal model solution), and
        v. flexibility options for current non-parties (staged/phased approaches).

    - TFIAM is open for modelling various definitions of "health risks" indicators. Indicator options include Years of life lost (YOLL), Number of premature fatalities, and Number of premature fatalities per total population. TFIAM has no recommendation as to whether health risks should be modelled based on a static (2015) population level, based on a population projection or both. Modelling on a static population level would directly show the impact of an isolated change in air quality on health.
    - The operational model indicator of "Ecosystem risk" can be Average Accumulated Exceedance (AAE) of $CL_{empNmin}$ per ecosystem type, and/or $CL_{empNmean}$. TFIAM appreciates further guidance on ecosystem risk indicator from the ICP modelling and mapping. Future GAINS model development can enable analysis of other ecosystem risk indicators.
51. The first round of CIAM analysis (summer/autumn 2024) can indicate health risks with PM2.5-related health aspects. Later model development will enable health risk analysis indicated by both PM2.5 and O_3 exposure.
52. TFIAM highlights the importance for the Air Convention to stay updated with respect to the mortality and morbidity analysis and results that will come from the HRAPIE II and EMAPEC projects.
53. TFIAM discussed further sensitivity analyses. Considered of highest concern were the potential use of hydrogen and ammonia as energy carriers, and also the effect of 'net zero' climate and energy strategies.

54. TFIAM reinforces the recommendation to TFIEP to enhance efforts in establishing air pollution emission factors for hydrogen and ammonia technologies for the energy and transport system.
55. TFIAM concludes that most likely, large efforts will be needed in several parts of Europe if the WHO air quality guidance values for PM2.5 are to be reached. In some regions, they may be difficult to reach.
56. TFIAM reconfirmed that air quality in cities still would benefit from local as well as regional emission control, but no solution that suits all cities can be found. More research is needed to better understand what city level characteristics drive differences in local level air pollution.
57. TFIAM concluded that there is still a high potential for non-technical measures / behavioural changes / structural measures to reduce emissions. But implementation of such measures remains a challenge, and estimating the size of related costs and benefits is not obvious.
58. TFIAM reconfirm that much promise can lie in dietary changes as a measure that reduces both NH_3 and CH_4 emissions, with substantial environmental, climate, and socio-economic co-benefits.
59. TFIAM noted that nitrogen critical load targets are unlikely to be met without dietary changes and recognized that such change will require capacity building in governance structures to integrate technical and non-technical measures.
60. TFIAM recommends more parties to analyse the land use changes associated with low GHG emission pathways, and to what extent such land-use changes would in turn would affect air pollution, particularly NH_3.
61. TFIAM notes that more easily accessible web-based assessment tools are and have been developed recently. The existing FAIRMODE air quality tools and the coming VALESOR economic valuation tool, both serve as examples of this progression.
62. TFIAM recommended to make GAINS model baseline scenario country data for the Gothenburg Protocol revision analysis, including scenarios supporting the Clean Air Outlook 4, available to national experts for further scrutiny and to analyse national abatement options.

D. Comments during WGSR62, 27-31 May

(h) WGSR thanked the Parties for providing answers and initial comments to the methodological questions raised by the Task Force on Integrated Assessment Modelling and the Centre on Integrated Assessment Modelling during the session (##) related to the draft policy brief, and requested Parties to send further comments and answers to the questions to Co-Chairs of the Task Force on Integrated Assessment Modelling and the Centre on Integrated Assessment Modelling copying the secretariat until *1 July 2024* and requested the secretariat to forward those comments to the WGSR Bureau;

(i) Requested the Task Force on Integrated Assessment Modelling to publish all comments received on their website;

(j) Further requested the Task Force on Integrated Assessment Modelling and the Centre on Integrated Assessment Modelling to continue to include and further develop staged and phased approaches in their analysis, taking into account comments received related to this issue and in particular encouraging comments and views by non-Parties;

(k) Requested an update of the draft policy brief by September 2024 taking into account the additional comments received by Parties, so that the update could be discussed as appropriate at the joint EMEP SB/WGE session (Geneva, 9-13 September 2024) and then inform the discussions at the forty-fourth session of the Executive Body (9-12 December 2024), as well as the next version of this document to be presented at the sixty-third session of the Working Group on Strategies and Review;

(l) Reiterated the necessity of addressing global methane emissions in view of ground-level ozone effects that are increasing in the ECE region;

(m) Noted the various policy options related to methane that are available to be considered in the revision process and the need for further elaboration on those policy options;

(n) Noted the importance of workplan item 1.2.2. for the revision process and the organization of a workshop by MSC-West, the Centre on Integrated Assessment Modelling, the Centre on Emission Inventories and Projections, the Task Force on Integrated Assessment Modelling and TFTEI and urged Parties to support it with the necessary funding;

Input EU+MS:
Based on the written comments received (including requests for further analysis) and discussions at its 53rd meeting from 15 to 17 April 2024, the TFIAM submitted a revised version of the policy brief as an informal document to the Working Group for further consideration (see ECE/EB.AIR/WG.5/2024/INF.4). The revised version of the policy brief was further expanded and now includes a least-cost optimisation for another target year (2040) and an initial analysis on options for the reduction of biodiversity risks and the inclusion of sectoral and staged/phased approaches.

The EU and its Member States thank the TFIAM and its centre for the updated version of the policy brief and presenting additional preliminary results on least-cost optimisation for 2040 as a target year and an initial analysis of options for biodiversity risk reduction and the inclusion of sectoral and staged/phased approaches. This new information is very welcome, while at the same

time we realise that further analysis and progress in modelling by CIAM is crucial to adequately support discussions on a possible revision of the Gothenburg Protocol.

We note in this context that CIAM is meanwhile continuing its modelling work and planning additional analysis, including the completion of new baseline, MFTR and low case scenarios, updated scenarios and analysis for staged/phased approaches, optimized scenarios for combined PM, biodiversity and/or ozone impacts, and so on. In order to keep all this additional work manageable, the WGSR may need to prioritise and provide appropriate instructions to CIAM. While we are open to further questions from the TFIAM and CIAM on this issue, we would already like to share at this stage the following preliminary views and preferences for further modelling work:

- On the base year: we prefer a more recent year than 2005, such as 2015 (or even more recent if appropriate/possible). While this makes achieving the same impact reduction targets more challenging, using 2005 as the base year will be a barrier for many of the current non-parties. More reliable data are available for a more recent base year, such as 2015, noting that the base year used for modelling purposes should not necessarily have to be the base year also used for setting the relative emission reduction commitments;
- Starting from the base year, we would also welcome projections made available in 5-years steps up to 2050.
- On the target year: we prefer to focus modelling on using 2035 and/or 2040 as target years, as 2030 is too close and 2050 is likely too far away;
- On the target setting options: we would favour target setting (e.g. least cost optimization using a gap closure approach) for UNECE as a whole (or if possible/appropriate per geographical region, taking the EU as a whole), as this is more cost-effective than gap closure optimization per country. We would also prefer to focus on the avoidable anthropogenic part of air pollution, which would be in line with the objective of the present Gothenburg Protocol (reducing emissions caused by anthropogenic activities ...: see article 2 of the protocol). In addition, we would also welcome results of optimised scenarios for combined PM, biodiversity and/or ozone impacts;
- Furthermore, we would not object to the use of both the number of premature deaths and Years of Life Lost as health metrics in further modelling, with a preference for using dynamic population for optimisation modelling, where premature deaths or YOLLs are expressed per 100.000 inhabitants (so as not to penalise countries that facing strong population growth in the coming decades). We would also not object to the use of the accumulated average exceedance indicator for nature protection, as suggested by the scientific community. Nor would we object to use of the minimum or mean empirical critical loads in optimisation for nature protection.
- On the level of ambition: at this moment, we cannot make firm statements on the desired risk reduction percentages, as this would have a direct effect on the allocated pollutant emission reductions and associated ambition level per country. At this stage, we believe it would be useful for the TFIAM to explore higher health impact reduction targets than the 50% health impact reduction target explored so far, as to further inform the Gothenburg Protocol revision process;
- On further analysis to explore the potential of new approaches: we would like CIAM to conduct further targeted modelling and analysis to enable the WGSR to select an appropriate new approach that would facilitate ratification by current non-Parties. The

additional work could include identifying priority sectors for cost-effective reductions for current non-Parties (analysing their similarities), based on different optimisation runs. It could also involve sequential optimizations or baseline simulations with tighter controls for key sectors. Such simulation scenarios could reflect EC agreements, association agreements, and/or non-technical measures for sectors where mandatory requirements are less obvious (e.g. early replacement of old wood stoves in the residential heating sector), and/or possibly be developed as hybrid scenarios as proposed in the updated policy brief. If supported by current-non-Parties we would also have no objections to further analysis of the impact of setting a cap on the total expenditure (maximum total cost expressed as % of GDP).

In the draft plan for the revision of the Gothenburg Protocol to be discussed under agenda item 3, it is suggested that the Working Group at its 62nd session already start an initial discussion on the following items, some of which are addressed in the draft policy brief of the TFIAM and our accompanying submission of 1 February:

(a) scope and indicator(s) for (an) overarching target(s);
(b) base and target years and other specifics for the negotiation of possible emission reduction commitments;
(c) potential inclusion of methane in the Protocol, including options;
(d) scope and the mandatory or voluntary nature of technical annexes, including new flexibility options and alternative approaches;

On methane, we will not yet be able to provide specific preferences for options at the 62nd session of the Working Group. Opening the discussion on methane at the start of the revision process seems premature. We should avoid a process where a lot of time and energy is spent discussing methane from the start, only to realise in the end that few or none of the options discussed are possible. Before taking positions around CH4, the EU and its Member States should first determine for themselves what is acceptable with regard to CH4. For now, that is unclear.

E. Comments received after WGSR62

Comments Canada, received 27 June 2024

1. General note regarding model scenarios: This document only provides details the model used to provide the UNECE scenarios as a whole but yet it shows results from scenarios that are specific to North America. It is unclear what model has been used to develop the "North American" scenarios… If we had to guess, would this be from the EMEP global model? It isn't stated what emission projections are going into those results and thus Canada has no way of confirming/verifying if the policies and emissions levels are complete and accurate. Canada does not currently have future model scenarios for all years up to 2050. We have only periodic runs, e.g., for the recent assessment of Canada's Ambient Air Quality Standards (CAAQS) there were runs for 2025, 2030, and 2035.
2. Overall for North America, and Canada specifically, it is unclear what the baseline regulations or even the policy scenarios are. Many regulations currently in development, including regulations controlling methane from the waste sector and from the upstream O&G sectors, regulations controlling VOCs, the Clean Energy Regulations, will be part of the BAU in a year or two. And it's always odd to combine North America as our regulations are aligned but not as common as in the EU (from my novice understanding) and the US economy and emissions being of a different scale. That being said, ECCC has several BAU scenarios and projections which we could leverage for Canadian analyses.
3. GAINS is a type of reduced-form model. It is used for computational efficiency to explore different emission scenarios across EU and non-EU countries. We don't have an approved/agreed upon equivalent model in the Government of Canada and tend to rely on full chemical transport modelling with GEM-MACH. Requires more computational resources but we're only dealing with a single country. And GEM-MACH could provide all of the outputs presented below in terms of air pollution exceedances and critical loads for deposition.
4. Halving the pollution related mortality is not a policy target that we would support. There are a few reasons to oppose/question this type of target:
    - As population grows, more people are exposed to the risks of air pollution; we can expect more deaths over time even with constant air pollution.
    - Most risk functions (e.g. concentration-response function, exposure-response function) are linear or log-linear. Halving deaths for a static population would simply mean halving exposures...so why not target exposure as a policy objective. In Canada, data for some pollutants show a log-log supralinear shape. Depending where you are on the curve, halving deaths could be challenging.
    - As populations age, baseline mortality rates increase and our estimates of deaths attributable to air pollution would increase...deaths can go up and down irrespective of air pollution exposure changes.

    A more neutral target to consider could be the population attributable fraction (PAF; https://www.who.int/data/gho/indicator-metadata-registry/imr-details/1287#:~:text=Definition%3A,an%20alternative%20ideal%20exposure%20scenario.). The PAF indicates the proportion of deaths (or other outcomes) attributable to a risk factor (such as ambient PM2.5 exposure). It is highly dependent on exposure

concentrations. It is similar but arguably better than providing deaths per 100,000 population for example, as the PAF controls for both baseline incidence rates and population size. The PAF indirectly controls for aging and is less influenced by age profile than deaths per 100,000 pop. Specifically, the PAF relies on baseline incidence rates that are highly influenced by population age. However, as older population are becoming healthier, it's really the baseline incidence rate that matters in terms of health outcomes.

5. Separate targets for PM2.5 and ozone could be explored as measures could target one pollutant only. As per the CAAQS in Canada, we have pollutant specific targets as AQ management may target different sectors/sources. PM2.5 generally has much larger health impacts...it could hide deteriorating O3 conditions.
6. If the risk functions for morbidity outcomes follow the same shape as for mortality endpoints, it wouldn't be a real challenge to add morbidity indicators as it's all about exposure levels. It could get complicated if you are dealing with non-linear shape for the different health endpoints. Focusing on the manageable fraction of air pollution may be advantageous/more realistic. We can generally better model anthropogenic emissions, ensuring some consistency.
7. Population growth could bias interpretations by diluting the air pollution impacts. For example, if air pollution levels are consistent over time but population grows more quickly via births or influx of younger populations than the baseline mortality rate, then deaths per 100,000 would decrease even though air pollution has not improved. The PAF would not be influenced by this.
8. Referring to table 3 in Annex 2: Years of life lost, disability adjusted life years and quality adjusted life years are less commonly used than estimates of mortality and morbidity outcomes (both counts and monetized impacts). They also require different databases and assumptions. Health Canada tends to focus on developing better estimates of deaths and diseases attributable to air pollution by leveraging Canadian-specific epidemiological research.
9. Canada does not have a tool that allows us to estimate mitigation costs under different scenarios. Generally, for regulatory impact analyses, the costs are estimated for the sector targeted by the regulation under defined conditions. The monetization of health impacts would not provide equivalent information.
10. Results in Annex 2 for area in exceedance under different future scenarios (Tables 5 and 6) do not include North American results. Canada's current acidification CL data can be used to calculate these values if we are provided with the model output. The same applies to eutrophication CLs if we were to use the nutrient N CLs, however, it is not clear what CLs were used to generate the values in Table 6; if these are empirical CLs then we are not comparing quite the same thing.

Canada's comments on the questions for guidance

1. As a starting point, to support further discussions on this issue, Canada does not object to the use of 2040 as the target year for a potential target to reduce risks for health and ecosystems. Similarly, Canada does not object to the use of 2015 as the base year to start this analysis. To ensure a broad range of information is considered, Canada would also suggest that the authors consider scenarios that use 2019 as a base year with 2045 as a

potential target year. The reason for this suggestion is to understand if emission inventories, especially for some non-Parties, would be more robust if using those years, rather than going back too far, where inventories may become less reliable.

2. Until otherwise decided by the Parties, Canada is of the view that the target should be applied to the whole UNECE region including North America and not on a country-by-country basis. The initial discussion of the suitability of including a potential collective goal in future amendments to the Gothenburg Protocol is still required, splitting the goal by country or group of countries seems premature, therefore Canada's preference is to continue discussing a collective goal for the whole region.
3. For the purposes of this paper, Canada's preference is to use the metric of premature deaths, however since this has not been discussed yet, we support using both metrics in the paper to support future discussions on this issue.
4. In Canada's view the dynamic population approach will likely demonstrate more accurate impacts of this goal and therefore Canada recommends using the dynamic approach in the paper. If possible, both approaches could be considered to clearly be able to weigh the pros and cons of both.
5. Canada's preference is to use a risk-based approach. A more neutral target could be the population attributable fraction (PAF). The PAF indicates the proportion of deaths (or other outcomes) attributable to a risk factor (such as ambient PM2.5 exposure). It is highly dependent on exposure concentrations. It is similar but arguably better than providing deaths per 100,000 population for example, as the PAF controls for both baseline incidence rates and population size.
6. For the purposes of this paper, Canada does not have any objections to the use of Average Accumulated Exceedance (AAE) for nature protection rather than area in exceedance.
7. For the purposes of this paper, Canada does not have any objections to using minimum or mean empirical critical loads. For information, Canada does not currently have these critical loads; there is some work on nutrient nitrogen critical loads, but they are based on soil chemistry, not empirical studies. Canada also supports a project to recommend empirical critical loads for specific types of Canadian ecosystems, namely forest and tundra, but this is several years away and may be geographically limited in scope.
8. Given that the Gothenburg Protocol focusses on anthropogenic emissions, Canada's preference is to limit the analysis to anthropogenic PM2.5 exposure.
9. For the purposes of this paper, Canada does not object to further exploring a possible combined PM2.5 and O3 target, so long as the paper also provides information on PM2.5 and O3 separately as well.
10. Canada would be interested in the views of EECCA, Western Balkan and Türkiye in this regard so that whatever discussions we undertake as part of negotiations to amend the Gothenburg Protocol result in amendments that would be helpful for these countries to eventually be in a position to ratify the Protocol.

Contribution of the United Kingdom of Great Britain and Northern Ireland on scenario recommendations for the Gothenburg Protocol Revision and guidance from WGSR
Received, 2 July 2024

The United Kingdom would like to thank the Task Force on Integrated Assessment Modelling and the Centre for Integrated Assessment Modelling for their continued work on this policy brief. We would also like to refer back to our comments submitted on the 5th of February 2024.

The United Kingdom understands that the 'policy brief' document (informal paper: ECE/EB.AIR/WG.5/2024/INF.4) is the output of workplan item 2.1.12 with the title:
Provide further analysis on potential implications of introducing collective risk-based targets for the UNECE region to address air pollution impacts on health and ecosystems

Therefore, our understanding is that the remit of this document should only include information relevant to the collective target(s) proposed in the scope of Decision 2023/5:
(g) Overarching, collective risk-based target(s) to reduce harmful effects to health and to ecosystems, including biodiversity loss in the ECE region.

Consequently, the United Kingdom's comments will only refer to the scenarios as they relate to the above. In addition, these comments do not imply UK positions on the collective target(s) or recommendations on the conceptual parameters of any target(s).

We reserve the right to supply further comments at subsequent meetings of the UNECE Air Convention.

Scenario Modelling

- *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*

Depending on the conceptual discussion on what the target would involve, the UK, as stated previously, can see value in using more recent baseline year for these targets, to help more Parties engage in discussing these targets to ensure that revisions to the protocol are an inclusive process. We also think looking at projections up to 2050 may be sensible to allow for different options to be considered once conceptual discussions have taken place.

- *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*

Depending on the conceptual discussion on what the target would involve, it may be valuable for the modelling to continue to look at an ECE wide target(s) as an inclusive process for all Parties to consider? We note that collective targets have also worked well in other forums in the biodiversity field to define inclusive ambition, but this is more of a conceptual policy question.

- *Limiting the analysis to anthropogenic (the avoidable) PM2.5 exposure?*

While there is a lot of evidence of PM2.5 effects on human health, we, in the UK, are conscious that the evidence concerning effects of PM2.5 to ecosystems is more limited. We would be grateful for clarification on whether modelling of PM2.5 would be for both targets or solely the health target?

We are also not aware of easy means to robustly differentiate between anthropogenic and non-anthropogenic sources of PM in relation to their impacts to human health. PM is normally measured as mass and modelling of non-anthropogenic sources (such as sea salt) can be very uncertain. We welcome information from Task Forces or Centres on this.

- *Further explore the possibility for a combined PM2.5&O3 target ?*

Depending on the conceptual discussion on what the scope of the target(s) should be, we note that different pollutants have different effects across human health and ecosystems and that O3 is differentiated as not being emitted directly. Therefore, we are unsure if modelling for a combined pollutant target would be helpful? As this would include a mixture of primary and secondary pollutants/pre-cursors. The health impacts of PM2.5 are well established, however are less clear for ecosystems. The reverse is also true for O3 impacts on health and ecosystems respectively.
For ecosystems, other pollutants maybe more relevant are nitrogen deposition and ammonia concentrations.

- *For the modelling of staged/phased approaches (EECCA/WB/Türkiye)?*

Until the target(s) are discussed conceptually, we do not see how approaches for other aspects of the scope of revisions to the Protocol would apply in this case? We are interested in the views of non-parties to the Protocol on the conceptual idea of a collective target(s)

- *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 …?*

Until the target is discussed conceptually this type of modelling could be considered premature? In this first instance, it may make sense to focus on impacts and pollutants in the identified scope rather than other criteria.

Health Target

- *Using both health metrics Premature Deaths and Years of Life Lost (YOLL)?*

The UK's Committee on the Medical Effects of Air Pollutants (COMAP), which advises UK government on all matters concerning the health effects of air pollutants, has previously looked into the impact of the long term effects of particulate pollution on mortality. The Committee considered that Years of Life Lost (YOLL) as being a more precise measure to be used instead of premature deaths for these studies.

- *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)*

For modelling purposes, as previously stated, we noted that attributable effects per 100,000 inhabitants can be a more stable measure of progress towards a target and therefore this could be a more suitable metric for modelling?

Ecosystem Target

- *Using the indicator Average Accumulated Exceedance (AAE) for nature protection?*

We understand that the AAE is a metric for considering the amount a national Critical Load is exceeded by. In that sense, this could be a useful metric to consider increasing risk with greater exceedance, though we note that baseline critical loads would need to be agreed by Parties. In the UK, AAE is referred to as 'Excess Nitrogen' or 'Excess Acidity' as a more explanative term.

- *Using minimum or mean empirical critical loads in optimisation for nature protection?*

We understand that there are issues with both measures as the data used by the Coordination Centre for Effects is non-weighted on habitat or area (since not all countries supply data?). Therefore, it is not clear whether either measure is appropriate for a collective target? We would seek more clarification on the usage of these metrics.
More broadly, concerning a potential ecosystems target, the UK have some additional questions that we think it would be helpful for Parties and experts to consider.

- Which pollutant is currently having the largest impact on biodiversity? (depending on how comparable metrics are).
- How should we assess the combined effects of pollutants, such as Nitrogen deposition, Ammonia concentration, and ozone concentration? – These pollutants may have synergistic, antagonistic, or overlapping effects.
- Are the impacts for the various pollutants co-located, or spatially different?
- Should the protocol revisit metrics for and impacts of pollutants that have decreased in Western Europe e.g. SO2 to increase relevance for other parts of the UNECE region?
- Should focus be given to improving the applicability of best metrics to the extended region and the slightly broader range of habitats that this covers?

Answers of the United States of America on the Questions from the Task Force
Received 3 July 2024

• Optimization for 2040 relative to 2015?
The United States has no opposition to using 2015 as the base year and 2040 and the target year.

• Applying targets in optimization both to the UNECE region as a whole and to each country?
The United States is in favor of a collective goal being for the UNECE region as a whole instead of to each country. With that being said, the U.S. is aware that it may not be possible for North America to join the UNECE regional collective goal and may need to look towards a North America goal or develop an equivalent approach.

• Using both health metrics Premature Deaths and Years of Life Lost (YOLL)? Using the risk-based approach for health (premature deaths or YOLL per 100.000 inhabitants) for optimization?
The United States usually expresses the change in risk using a count per 100k. Reporting a per capita or per 100k value would capture the increase in population over time, which is especially important for mortality, given that the population is aging, and air pollution-attributable deaths occur largely among those aged 65+. The U.S. also prefers using a projected death rate, which would account for the improved longevity of exposed populations in the future. With that being said, the U.S. should be able to support using YOLL as well if there is a strong preference amongst the convention parties.

• Using the static population (2015) approach for health optimization?
The United States uses analysis that allows for changing population structure and would prefer this approach rather than a dynamic which shows the combined impacts of changes in air pollution and in demography.

• Using the indicator Average Accumulated Exceedance (AAE) for nature protection? Using minimum or mean empirical critical loads in optimization for nature protection?
The United States does not have the information necessary to participate in an eco-based or biodiversity target. The U.S. EPA is beginning to explore quantifying biodiversity loss and would be interested in technical exchanges with TFIAM on this issue.

• Limiting the analysis to anthropogenic (the avoidable) PM2.5 exposure?
The United States supports the approach that the target focuses solely on anthropogenic PM exposure.

• Further explore the possibility for a combined PM2.5&O3 target?
The United States has no strong opinion on TFIAM exploring a combined PM2.5 and O3 target, but notes that the U.S. EPA is currently reviewing the ozone NAAQS and may have a different view in the future.