From joint ambitions to emission reduction commitments

- how models can help

Rob Maas, Leuven, 22 October 2024

This presentation gives a simple guide to science-based policy making. It is based on experiences during the preparation of the original Gothenburg Protocol, back in the 1990s, and the amendment process in 2010s.

Process

1. Preparation: check your data
2. Choose a collective ambition level for risk reduction
3. Define an acceptable distribution of efforts
4. Choose a preferred scenario as basis for negotiating commitments
5. Negotiation phase
6. Evaluate end-result (accept or renegotiate)

The process to define joint risk-based targets and related emission reduction commitments depends heavily on nationally submitted data

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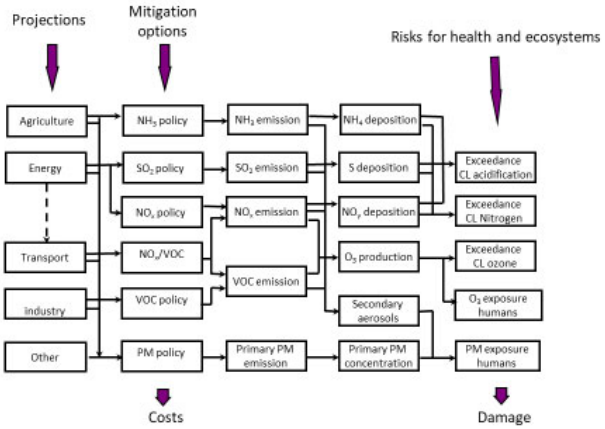

Modelling enables to link emissions tot concentrations and risks for health and nature. Required national input data are emissions, projections, remaining mitigation options, sensitivity of ecosystems and demographic data. Models, data and scenario assumptions should be transparent. Sensitivity analyses can be used to illustrate uncertainties, e.g., of economic projections, new technologies.

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Preliminary envelope of
possible emission reductions (2015 – 2040)

	SO2		NOx		NH3		VOC	
	CLE	LOW	CLE	LOW	CLE	LOW	CLE	LOW
EU	77%	89%	71%	80%	10%	50%	32%	50%
WB	94%	99%	57%	76%	-2%	37%	19%	64%
EECCA	38%	90%	10%	70%	-39%	55%	2%	53%
NA	65%	79%	47%	77%	-20%	60%	24%	61%
UNECE	60%	87%	47%	77%	-13%	55%	22%	56%

	PPM2.5		BC		CH4			
	CLE	LOW	CLE	LOW	CLE	LOW		
EU	61%	73%	75%	86%	33%	57%		
WB	34%	87%	19%	88%	-6%	51%		
EECCA	11%	81%	19%	88%	-22%	51%		
NA	39%	64%	50%	79%	20%	63%		
UNECE	38%	73%	51%	84%	12%	58%		

The end-result (= emission reduction commitments) will be somewhere in between

The first step is to agree on emission data and projections, as well as remaining technical abatement options, including structural changes in energy, transport and agriculture. What is the envelope of potential emission projections for 2030-2050? For all parties, the ultimate emission reduction commitments will be somewhere between current legislation and maximum feasible reductions (figures in red indicate a projected increase). Earlier the WGSR supported to look at changes between 2015 and 2040

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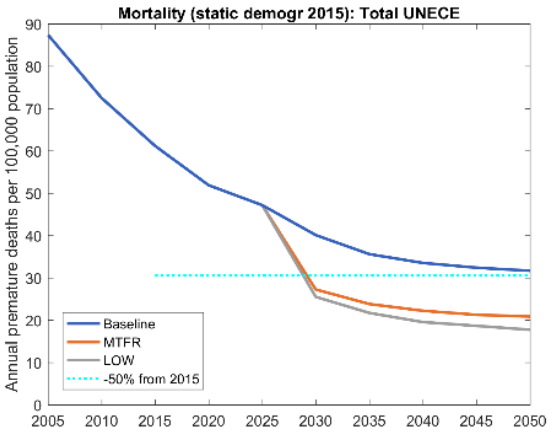

Mortality risk due to anthropogenic $PM_{2.5}$ in the UNECE-region (incl. North America)

At the Saltsjöbaden7 meeting An indicative 50% reduction target for air quality related health risks was proposed.
Will you stick to the ambition to reduce these health risks by 50% between 2015 and 2040? Or do you want to explore different ambition levels?
With current legislation (= without any additional efforts) average mortality risks could be reduced by almost 50% in 2050 compared to 2015. Including population growth and aging, mortality risks would only be reduced by 25% between 2015 and 2040.
What would be the additional costs to aim for a higher ambition?
Note that there are ongoing discussions on the definition of indicator: WHO advices to work with static population (without population growth and aging) because that is directly related to the reduction of exposure.

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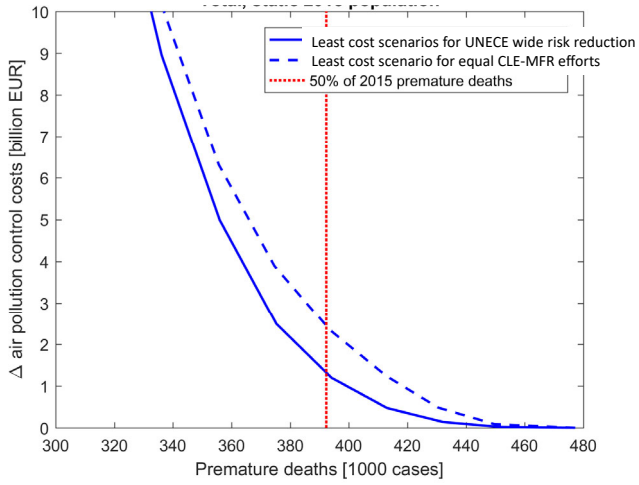

Cost curve: the more ambition to reduce risks, the higher the costs will be. Where is the "knuckle point" according to policy makers?

The cost curve shows **the least cost scenario** for each point on the curve, for the whole UNECE. For each point there are 100,000s possible scenarios of combinations of emission reductions per country and pollutant, each with their own abatement cost and effect. Optimization is an algorithm to select the scenario with the lowest cost. There is no scenario with lower collective costs and the same health risk reduction.

50% risk reduction will not be feasible in all countries, because they can't go further than applying MFR measures and they will be faced with extremely high costs. If all countries agree to exclude the most expensive measures and apply only a part of the available scope between CLE and MFR, they could reach the 50% risk reduction with a more equal cost-distribution. This so-called "gap closure" approach is presented by the dotted lines. Is such an "equal additional effort principle", that assures that no-one is faced with infeasible targets while still meeting the collective 50% target acceptable? (see next slide)

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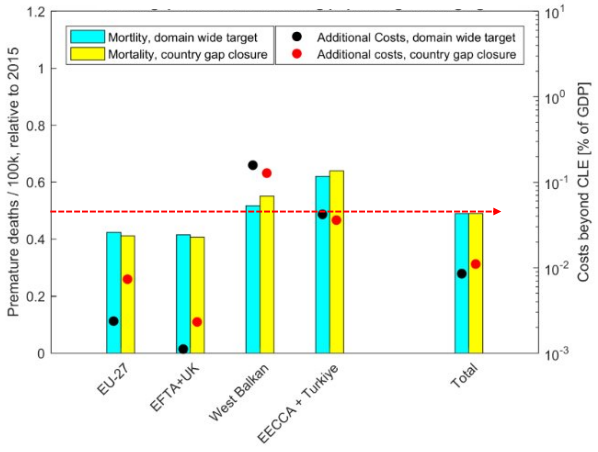

What are the costs of additional measures? A) For a collective UNECE-wide risk reduction target of 50% or B) for a uniform additional effort-based target for all countries (gap-closure). The total costs of the latter will be higher (especially for richer countries), but it doesn't solve the problem that costs per GDP are still much higher in countries with low incomes, up to more than 0,1% of GDP. See the black and red dots and the (logarithmic) scale at the right axis.

The red line indicates the collective 50% risk reduction target for the whole UNECE. It is clear, that in WB and EECCA a uniform 50% risk reduction target will not be met in either case. Excluding the costliest measures in EECCA countries will reduce their costs but also increase mortality risks (and damage costs).

Every scenario can be expressed in emission reduction percentages for SO2, NOx, VOC, NH3, PPM2.5 (and BC) per country

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Further considerations to be analysed:

- Introduce a *cost per GDP*-limit?
- Include/exclude sectors or abatement options?

Every additional constraint will increase the total costs (and add complexity)

If some countries do less than 50% risk reduction, will others than do more to meet the collective 50% ambition level ?

Additional external funding or money transfers between parties are not considered

So, what can be a solution to keep everyone on board?
What if we limit the costs per country (e.g., 0,05% of GDP)?
What if we exclude sectors or measures or include NTMs?
These measures would probably further reduce costs in EECCA-countries, but also further increase their mortality risks, compared to a domain-wide least-cost scenario.

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Additional considerations and increasing complexity:

- Include health risks of ozone (and NO2?): *will you still go for a collective 50% risk reduction target?*
- Include biodiversity risks? *Also 50% risk reduction? Or only shown as the co-benefit of reducing health risks?*
- Show impacts on climate of UNECE-wide SO2, CH4 and BC abatement?

For the Gothenburg Protocol at least 50 different scenarios were calculated before an acceptable basis for negotiation was chosen

What if we combine the health risks of PM, O3 and NO2? Can this be done?
What if we add biodiversity risks, or climate risks from BC to the analysis?
Should this be presented as the side effect of meeting a health risk reduction target or should it be included in multi-objective optimizations?

Generally: extra wishes will raise the total costs and complexity to the model
This step will require frequent communication between WGSR and modellers

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Illustrative: differences between modelled emission reductions between 1990 and 2010 and actual pledges in the Gothenburg protocol

	SO2		NOx		VOC		NH3	
	G5/2	GP	G5/2	GP	G5/2	GP	G5/2	GP
France	79	72	63	56	57	57	19	-14
Germany	91	90	61	64	71	67	46	23
Italy	81	73	58	52	47	37	23	2
Poland	75	55	47	29	36	1	6	-24
Spain	65	65	37	23	36	44	0	-5
UK	85	84	59	60	58	45	20	19
All	71	54	46	38	44	27	24	-8

Modelled emission reductions are not binding!

Pledges are based on national considerations or recalculations

Don't take the model results for granted. Its is merely a starting point for negotiation. Recalculate at home with your own models/experts. The negotiation process is inevitably a messy process, where also various factors that are not modelled will play a role → the table illustrates for GP-negotiation process in 1999 the differences for a few countries between the least cost G5/2 scenario (in blue) that was the basis for the negotiation phase and the most significant deviations (in red). Ammonia has showed the largest differences.

The lesson: the modelled scenario was helpful, but not prescriptive.

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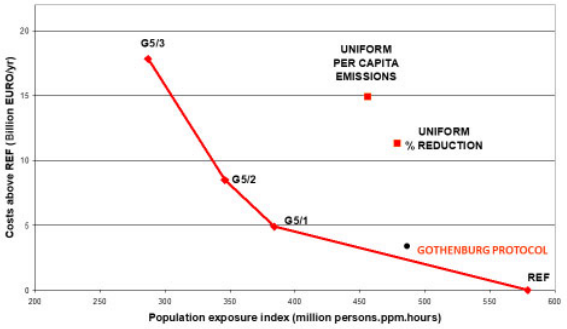
Are we satisfied with the negotiation result?



Uniform reductions or uniform ELV's seem to be less cost-effective compared to ERC's

The negotiated results for the GP deviated from the joint ambition level (for the GP this was G5/2, or the 17th scenario of the 7th round of scenarios). But the end-result was more cost-effective than emission reductions that would result from a policy strategy aimed at equal emission reductions, equal emission limit values for installations and vehicles, or equal maximum exposure per head.

For the GP revision, questions might arise about alternatives for annex-2 (= emission reduction commitments)

- What would (strengthened) technical emission limit values for industries, vehicles or agriculture achieve in terms of risk reduction?
- How can a commitment on health risk reduction and biodiversity risk reduction otherwise be monitored and by whom?

To conclude

- Models are to help, not to dictate what policy makers should do
- Scenarios include economic and ethical principles that must be shared by the parties
- Scenarios can offer a consistent starting point for negotiation
- But negotiators should do their homework: double check, assisted by own models and experts
- However, in such national (cost-benefit) analyses, negotiators should also consider the transboundary impacts of their pollution

Purely domestic analysis of costs and benefits will not be sufficient. We also would have to look at the transboundary impacts. In the end, we are doing all this work under the Convention on Long-Range Transboundary Air Pollution