*Question 2.7: Is the monitoring and modelling system of the Convention sufficient to observe, assess and project air pollution and its effects related to the Gothenburg Protocol in the ECE region?*

If no, what are the main challenges and what is needed to meet them?

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Grennfelt et al. (2020) summarised key factors leading to successful emission reduction agreements under the Air Convention and identified needs for further developments. Key messages:

- Widespread scientific research, long-term monitoring, and integrated assessment modelling formed the basis for the policy agreements.
- Bridging concepts developed, such as critical loads and integrated assessment modelling, formed links between science and policy, and were essential for the understanding and scientific legitimacy of the policy measures.
- The close involvement of scientists has been a signature of the Air Convention.
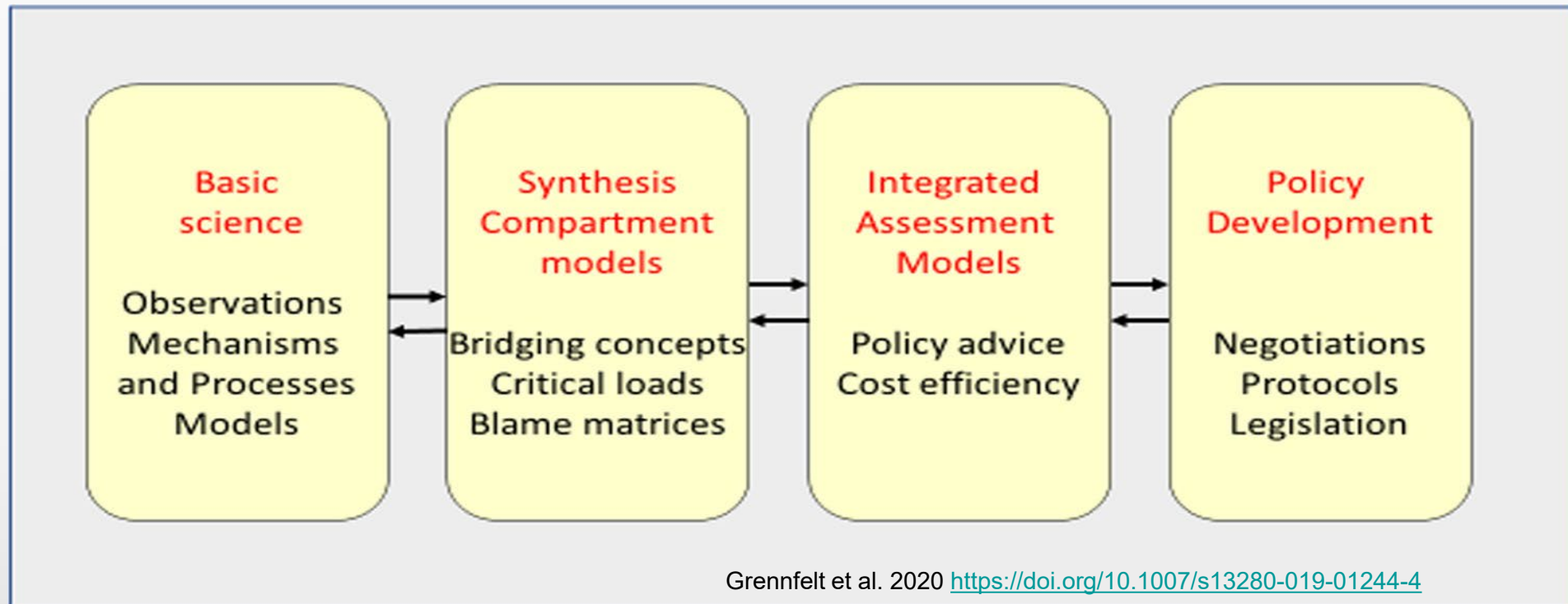
Grennfelt et al. 2020:

- Air pollution problems are increasingly linked to intercontinental and hemispheric scales.

- The research communities within air pollution and climate change need to work more closely together.

- Basic questions still need further investigations to develop the best policies: a better understanding of health effects from air pollution, nitrogen effects to ecosystems, and air pollution interactions with climate through carbon storage in ecosystems and impacts on radiation balances.

- Integration of atmospheric chemistry into Earth system models should be further developed.

- The perspective of international cooperation on air pollution is changing: The ranking of air pollution as a top ten cause of premature deaths in the world has given high priority to the issue within fora such as the WHO and UN Environment.

- The UN has put forward a very strong agenda in order to reach the Sustainable Development Goals (SDGs). Air pollution is an integral part of several of the SDGs.

- In this global context, there is a need for developing long-lasting infrastructures that can develop science-based control policy options, potentially as part of a wider network of global observatories.

Other key messages (general WGE/EMEP Extended Bureau discussions, ICP-reports, Weldon 2018):

- There is a need to extend the current ecosystem monitoring system to include more sites representing other sensitive habitats such as heathlands, grasslands and wetlands. The "IM light" initiative of ICP IM is an important process in this respect.

- More countries should participate in the monitoring and modelling systems of the Convention to enhance the geographical coverage of the observations and provide sufficient resources.

- Increased cooperation with research infrastructures under the EU, such as eLTER, ICOS and ACTRIS would provide possibilities to extend the site networks and increase scientific competence.

- Coordination with monitoring and assessment efforts of the EU National Emission Ceilings Directive (NEC) is essential and would provide additional benefits. However, monitoring of biological impacts/recovery is in many countries not very well supported, and is a remaining challenge.

Other key messages (general WGE/EMEP Extended Bureau discussions, Weldon 2018):

- Protocol review processes emphasise the need for projections → sufficient infrastructures need to be in place for such activities (data, models, scenarios, etc.).

- A combination of long-term monitoring and research is needed to document and understand complex interactions of air pollutants, climate change and other disturbances.

- Climate change might lead to more variation in responses, and it is important to maintain sufficient sampling frequency (e.g. surface water chemistry).

- The Convention would benefit from some more detailed analysis on the influence of emissions (and emissions controls) within the ECE region compared to the influence of emissions outside the ECE region (e.g. ozone effects).

- Predictions of effects made during risk assessments should be verified with observations. This requires good data sets and may also require expensive experimental facilities.

Other key messages (general WGE/EMEP Extended Bureau discussions, ICP-reports, Weldon 2018):

- Model predictions can be improved following discrepancies highlighted from local application combined with local knowledge, as these detailed studies can be used to suggest improvements to models.

- Disturbance interactions can have unpredictable and surprising consequences which are yet insufficiently studied.

- More information on the needs for improvements of the monitoring and modelling system is presented in informal meeting document. A possibility would be to prepare a more extensive report with a comprehensive analysis for both air quality and effects (for 2022/2023 ?).