

Technology and Economic Assessment Panel

Progress of work and emerging issues
36th MOP High-level Segment

TEAP Membership 2024

Bella Maranion, TEAP Co-chair	USA	Sergey Kopylov, FSTOC Co-chair	RF
Marta Pizano, TEAP/MBTOC Co-chair	COL	Roberto Peixoto, RTOC Co-chair	BRA
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Suely Carvalho, Senior Expert	BRA	Helen Tope, MCTOC Co-chair	AUS
Adam Chattaway, FSTOC Co-chair	UK	Dan Verdonik, FSTOC Co-chair	USA
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Takeshi Eriguchi, MCTOC Co-chair	JP	Shiqiu Zhang, Senior Expert	PRC
Ray Gluckman, Senior Expert	UK	Jianjun Zhang, MCTOC Co-chair	PRC
Marco Gonzalez, Senior Expert	CR		

TEAP and its Technical Options Committees

- Currently, the Technology and Economic Assessment Panel (TEAP) consists of 21 members: three Co-chairs, five Senior Experts, and 13 Co-chairs of the five Technical Options Committees (TOCs):
 - Flexible and Rigid Foams Technical Options Committee (FTOC)
 - Fire Suppression Technical Options Committee (FSTOC)
 - Methyl Bromide Technical Options Committee (MBTOC)
 - Medical and Chemicals Technical Options Committee (MCTOC)
 - Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee (RTOC)
- Over 150 experts serve on TEAP, its TOCs, and TSBs on a voluntary basis

TEAP Scope of Work

- TEAP is addressing its changing scope and workload:
 - Overlap of the ODS phaseout and HFC phasedown regimes
 - Kigali Amendment (e.g., HFC alternatives, Energy Efficiency, LRM)
- Standing decisions already provide opportunities for regular updates:
 - Regular reports: Annual Progress Report, Quadrennial Assessment, Quintennial HFC alternatives assessment, Replenishment, Periodic HAT exemption review
 - If nomination/new information is available: CUNs, EUNs, nPB, destruction, laboratory and analytical uses, process agents.
- TEAP also reports on emerging issues (e.g., CFC-11, PFAS, VSLS, vaccine cold chain, HFC-23) as needed.
- In 2024, TEAP produced three major new reports, plus responses to five separate decisions requesting updates to information which TEAP had provided

TEAP Planned Reports 2025 & 2026

2025: ~1-3 reports + Drafting Assessment Reports (6)

- Progress Report (including response to Dec. XXXV/20 “Options for the organization of TEAP and its TOCs”)
- Drafting 2026 reports
- Ongoing activities: Replenishment planning, modeling updates, coordination with Panels, etc.

2026: ~9-11 reports to be finalised and published

- Progress Report
- Quadrennial assessment
- Study on MLF replenishment and supplemental report
- Develop 2027 reports, including Synthesis and HFC alternatives reports

Decision XXXV/3: TEAP 2026 Assessment (1)

Parties have requested that the 2026 report of the TEAP should include an assessment and evaluation of the following 11 topics:

- a) Technical progress in the production and consumption sectors in the transition to alternatives for controlled substances in all sectors
- b) Process agents and feedstock uses
- c) An assessment of information relating to emissions of controlled substances from feedstock and production processes and other manufacturing processes
- d) Status of banks and stocks of controlled substances
- e) Challenges facing all parties to the Montreal Protocol in implementing obligations under the Protocol and maintaining the phase-outs already achieved
- f) The impact of the phase-out of ODS and the phasedown of HFCs on sustainable development

Decision XXXV/3: 2026 Assessment (2)

- g) Technical advances in developing alternatives to HFCs taking into account, in particular, EE, safety, and suitability for use in high-ambient-temperature countries
- h) Information on uses where HCFCs were not previously used and HFCs have been used and are currently used, such as electronics manufacturing
- i) Assessment of whether production of HFOs results in fugitive emissions of HFCs
- j) Potential impacts of evolving policies and regulations (e.g., on PFAS) in relation to the management of controlled substances and their alternatives and breakdown products
- k) Information on refrigerant management, with particular attention to leakage prevention and end-of-life management

TEAP Continues to Evolve

- TEAP is aware of the need to ensure that its membership meets the evolving needs of parties whilst ensuring continuity of its work.
- TEAP is undertaking discussions on its future directions and needed structure and membership.
- TEAP looks to the continuing support of parties:
 - As the panel works to maintain expertise, evolve its processes, manage its overall workload, and continue to deliver its work for the benefit of parties.
 - To identify experts based on its matrix of needed expertise and to ensure that those experts are able to fully participate in the activities and work of the TEAP and its TOCs for parties (i.e., funding travel expenses where needed).

Sector Highlights & Emerging Issues

Foams

- There is substantial and continued progress in the adoption of zero ODP and low GWP foam blowing agents (FBAs) for most foam types.
 - All previously used HFCs, except HFC-152a, are no longer allowed for use in foams in almost all non- A5 parties.
 - Many companies have elected to transition away from fluorinated FBAs due to cost, if thermal performance can still be met.
- Supply chain recovery continues for FBAs and other raw materials.
 - Olefin imbalances have eased, in both A5 and NA5 parties, due to capacity increases.
 - Higher than expected demand for pentanes has challenged availability in some cases.
 - HFC-365mfc plant closure in 2023 has created issues for companies in A5 parties.
 - There has been continued use of HFC-245fa blends in A5 parties due to cost of HFO/HCFO alternatives.

Health and safety considerations of new FBAs

- Flammable FBAs and FBAs with different toxicity create additional safety concerns for end-users and for foam industry workers, especially in small- and medium-sized enterprises (SMEs)
- The long-term exposure and toxicity of 1,2 dichloroethylene (1,2-DCE) after installation of spray foam is under review by at least one party.
 - Indoor air quality studies related to spray foam show 1,2-DCE concentrations for months or years after installation.
- Hydrocarbons are being tested as FBAs for spray foam in some A5 parties. FTOC is unaware of any broad commercial use.
- FTOC is seeking additional information about safety measures in use to address exposure and safety risks, especially by SMEs.

Fire Suppression

- No new alternatives are reported in development.
- Civil aviation has not yet approved an alternative for cargo and engines.
- All enduring uses, including civil aviation, still depend on the ever-declining bank of Halon 1301, (i.e., reclaimed agent).
- Recent indications are that some of the recovered Halon 1301 does not meet the required purity standard.
- Higher impurity means more Halon is lost during reclamation.
- The FSTOC and industry stakeholders are assessing the potential impact.
- Destruction of Halon 1301 for carbon credits will deplete the bank further.

Emerging Issues

- Emissions of Halon 1301 derived from atmospheric measurements (NOAA and AGAGE) are greater than those predicted by the FSTOC halon bank model.
- If these additional emissions were from fire suppression halon 1301 bank (FSTOC model), the bank would be smaller than predicted, resulting in an earlier run out date.
- For at least the period 2004-2021 these increases in emissions match the timing and pattern of reported Halon 1301 production for feedstock use.
- FSTOC ruled out other possible sources, only leaving feedstock production and use.
- From reported feedstock production, applying a 26% overall emission factor (for production and use) appears to explain the additional Halon 1301 emissions.
- Parties may wish to consider providing information on emissions from feedstock use.

Methyl Bromide

- **Significant milestone in 2024:** Over 99.9% of the 62,000 t of MB used for controlled uses (i.e., non-QPS) is reportedly phased-out.
- **Current focus** is on alternatives for MB used for QPS purposes (8,000 to 10,500 t per year).
 - Technically and economically feasible alternatives are currently available for about 40% of such uses.
 - Some countries already achieving major reductions in QPS use.
- **Concern:** Reports and websites identify that substantial MB is still being used for unreported controlled use (non-compliance).
- Enforcing policies to ensure MB is only used for its intended use:
 - **Quarantine (Q) MB use is only for quarantine pests or,**
 - **Pre-shipment (PS) use is only for officially endorsed control of cosmopolitan pests, and only within 21 days before export.**

Emerging Issue

- A recent paper (Hu *et al*, 2024*) provides estimates of the national emissions of MB in China in the 2011–2020 period, using atmospheric observations at 10 sites across the country, and comparing top-down and bottom-up data:
 - Top-down emission estimates exceeded bottom-up estimates by around 5500 t per year.
 - The largest fraction (60%) of emissions arise from underestimated or unidentified emissions sources.
- This reinforces previous similar findings by Choi *et al*, in 2022**.

*Hu et al, 2024. Unexplained high and persistent methyl bromide emissions in China. *Nature Communications* 15:8901

** Choi et al, 2022. Top-down and bottom-up estimates of anthropogenic methyl bromide emissions from eastern China. *Atmos. Chem. Phys.* 22, 5157–5173

Medical & Chemicals

- Pressurised metered dose inhalers (pMDIs), dry powder inhalers (DPIs), aqueous soft mist inhalers (SMIs), and other delivery systems, such as nebulisers, all play a role in the treatment of asthma and chronic obstructive pulmonary disease.
- The development of lower GWP pMDIs with lower GWP propellants HFC-152a and HFO-1234ze(E) is progressing, although potential challenges could risk the consistent supply of affordable medicines.
- Development is a complex process involving new ways of manufacturing, new clinical trials, and new regulatory approvals.
- 3 manufacturers have registered clinical studies for 3 inhalers, due to complete in 2025.
- A further 10 or more companies could have active programmes to develop pMDIs.
- With subsequent regulatory submissions/approvals, the first lower GWP pMDIs may not reach the market until 2026.

Emissions of HFC-23

- Decision XXXV/7 requested TEAP to prepare a report for MOP-36 containing information on:
 - The quantity of HFC-23 being consumed, by country and by sector;
 - Updated estimates on the amounts of HFC-23 generated at and emissions from HCFC-22 production.
- Reported HFC-23 consumption was 3,684.3 tonnes (2022):
 - 2,614.3 tonnes for non-feedstock uses.
 - 1,070 tonnes for feedstock use.
- Estimated HFC-23 by-product generation from HCFC-22 production is in the range of about 18,000 to 36,000 tonnes.
- Total HFC-23 emissions from HCFC-22 production reported under A7 and UNFCCC (for USA) was about 836 tonnes.

RACHP

- Availability of lower GWP alternative refrigerants continues to grow for most RACHP sectors.
- Twenty new lower-GWP refrigerant blends received designations and classifications from ASHRAE Standard 34 and/or from ISO 817.
- Domestic refrigeration industry is accelerating the conversion from HFC-134a to HC-600a.
- In Food Retail, Food Service and Transport Refrigeration:
 - <150 GWP alternative refrigerants (non-fluorinated refrigerants and HFO containing blends) are common in non-A5 parties.
 - In both non-A5 and A5 parties, lower GWP alternative refrigerants continue to replace high-GWP R-404A and HFC-134a.

RACHP (2)

- The HFC/HFO blend R-452A is now used in road transport refrigeration while HFO-1234yf is used in marine container refrigeration.
- In US and Europe, regulatory GWP limits on small and large air-conditioning and heat pump systems are driving the growth and adoption of <700 and <150 GWP alternatives to high-GWP refrigerants.
- Vehicle electrification requires holistic vehicle thermal management (heating and cooling of the driver cabin along with battery cooling).
- A cooperative research program is underway, investigating lower-GWP refrigerants suitable for electric vehicles.

Response to Decision XXXV/10 on Energy Efficiency

- Decision XXXV/10 requests TEAP: “... to include in its 2024 progress report updates on the information identified in paragraph 1 (a) of decision XXXIV/3, taking into account discussions at the Thirty-Fifth Meeting of the Parties to the Montreal Protocol.”
- Updates on energy efficiency while phasing down HFCs in the RACHP sectors:
 - Passive cooling, higher EE standards, and faster phase down of climate warming refrigerants used in the cooling industry could avert up to 60% of the predicted direct and indirect CO₂eq emissions from the cooling sector by 2050 (according to the Global Cooling Stocktake Report of 2023).
 - Many Article 5 parties are working on approving harmonized regional Minimum Energy Performance Standards (MEPS) for AC and residential refrigerators.
 - Dumping of high-GWP and/or ODP refrigerant and low-efficiency cooling equipment is widespread, with additional evidence presented for SE Asia (in the report).

Response to Decision XXXV/11 on LRM

- Decision XXXVI/10 requests TEAP:
“Available technologies for the leakage prevention, recovery, recycling, reclamation and destruction (RRRD) of refrigerants, and their accessibility...The obstacles and challenges associated with the effective leakage prevention and RRRD of refrigerants...The costs and climate and ozone benefits associated with the leakage prevention and RRRD of refrigerants...Policies, incentive schemes, such as producer’s responsibility schemes, good practices and lessons learned related to ensuring the effective leakage prevention and RRRD of refrigerants”
- TEAP LRM Task Force: 22 members, 13 from RTOC
- LRM Workshop hosted by Ozone Secretariat discussed and expanded on main findings from Task Force report

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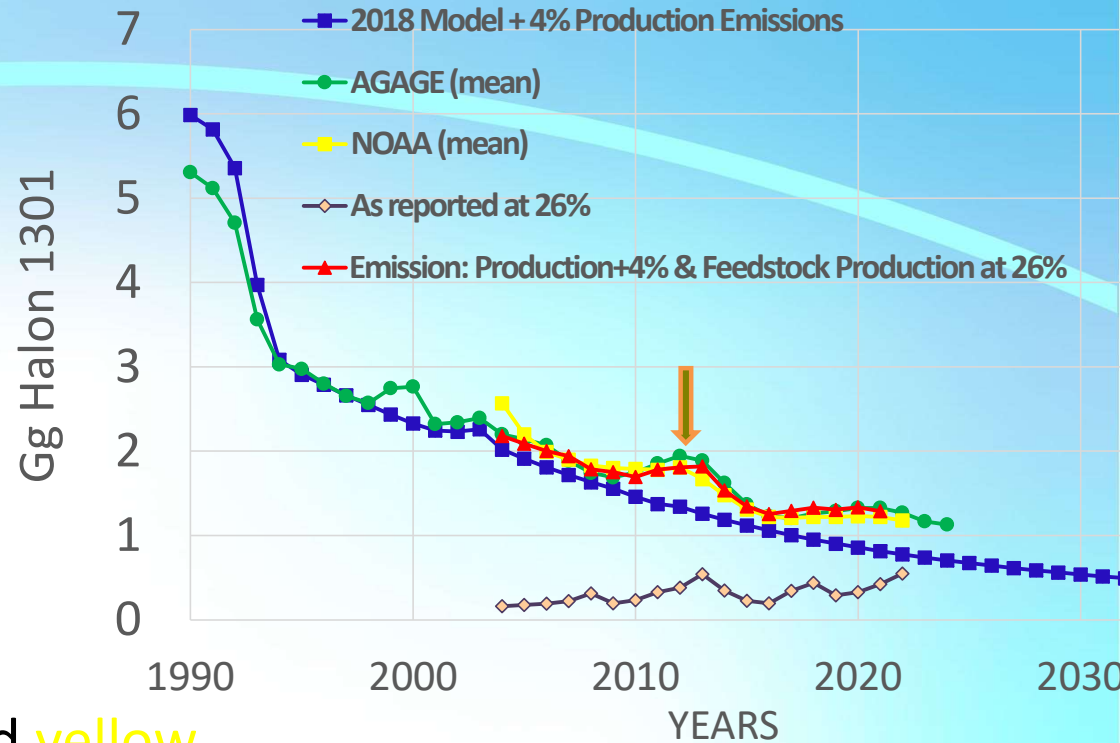
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Back-up slides

Halon 1301 Emissions (1)

- Atmospheric concentration derived emissions (green & yellow) deviate from the FSTOC Model (blue)
 - The Ozone Secretariat published information on the production of halon 1301 for feedstock
 - The annual pattern of feedstock production closely matched the peaks and troughs of the green and yellow emissions, albeit at a very high emission rate of 26% (brown)
 - Adding the brown line to the FSTOC model data (blue) gives the red line!
 - The match is undeniable...

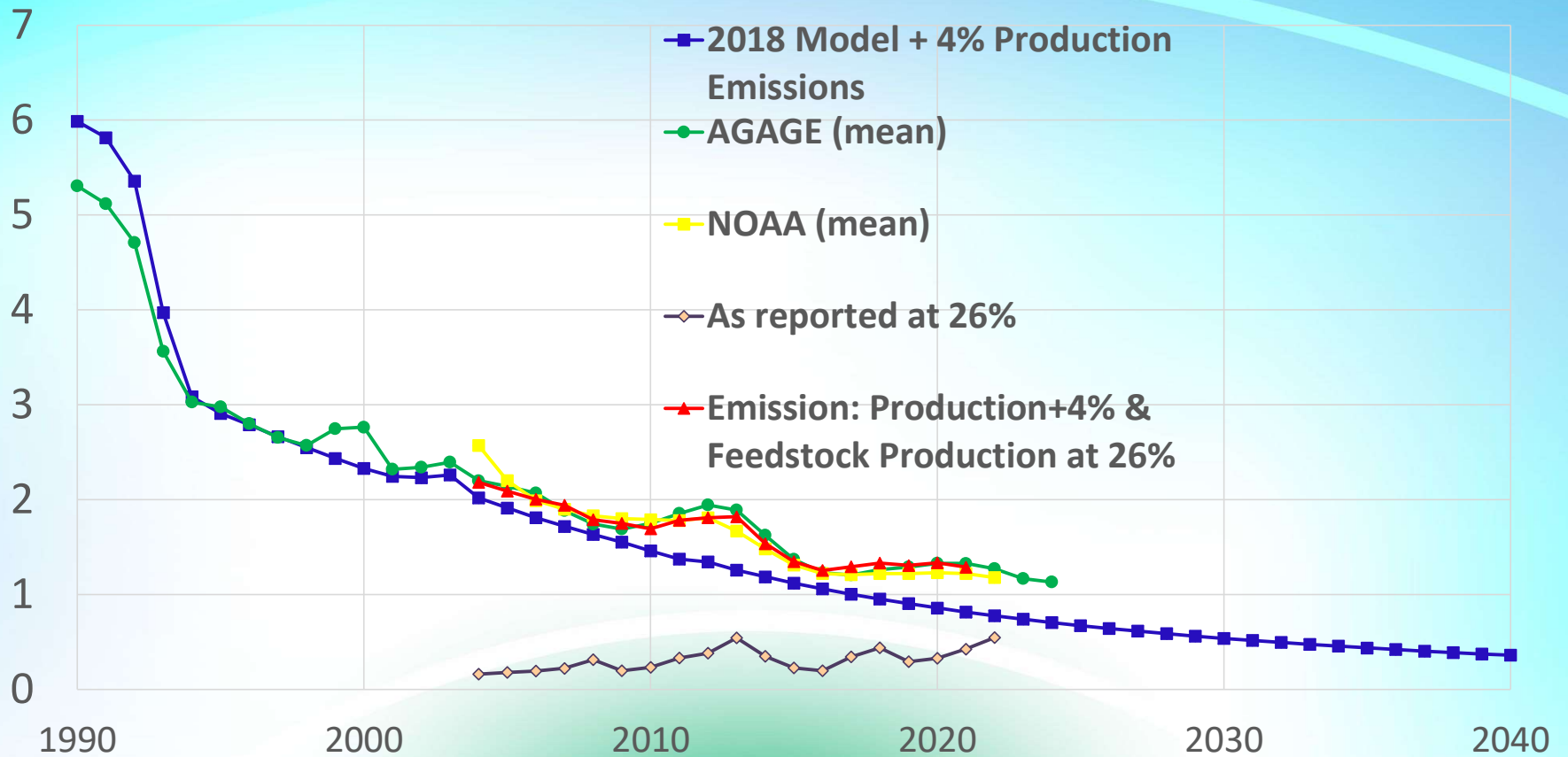


Halon 1301 Emissions (2)

- Atmospheric concentration derived emissions (green & yellow) deviate from the FSTOC Model (blue)
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Halon 1301 Emissions (3)

Gg Halon 1301



YEARS
TEAP

MB controlled and exempted consumption 1995 - 2022

