

Technology and Economic Assessment Panel (TEAP) 2024 Progress Report

TEAP Co-chairs
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Outline of presentation

The May 2024 TEAP Report consists of three volumes:

Volume 1: TEAP 2024 Progress Report:

- **Sector updates (Decisions IV/13 and XI/17)**
- **TEAP procedures, organisational matters and matrix**
- **Dec XXXV/6: Updated information on very short-lived substances (Agenda item 3)**
- **Dec XXXV/8: Feedstock uses (Agenda item 3)**
- **Dec XXXV/9: Abating emissions of carbon tetrachloride (Agenda item 3)**
- **Dec XXXV/10: Energy efficiency**
- **Dec XXVIII/2, par. 5: Technical review of alternatives to hydrofluorocarbons (Agenda item 8)**

Volume 2: 2024 CUN interim assessment report

Volume 3: Decision XXXV/11: Life-cycle refrigerant management (LRM) (Agenda item 4)

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
Ashley Woodcock, TEAP Co-chair	UK	Fabio Polonara, RTOC Co-chair	IT
Omar Abdelaziz, RTOC co-chair	EGY	Ian Porter, MBTOC Co-chair	AUS
Paulo Altoé, FTOC Co-chair	BRA	Natarajan Rajendran, RTOC co-chair	USA
Suely Carvalho, Senior Expert	BRA	Helen Tope, MCTOC Co-chair	AUS
Adam Chattaway, FSTOC Co-chair	UK	Dan Verdonik, FSTOC Co-chair	USA
Sukumar Devotta, Senior expert	IN	Helen Walter-Terrinoni, FTOC Co-chair	USA
Takeshi Eriguchi, MCTOC co-chair	JP	Shiqiu Zhang, Senior Expert	PRC
Ray Gluckman, Senior Expert	UK	Jianjun Zhang, MCTOC Co-chair	PRC
Marco González, Senior Expert	CR		

With sincere thanks to the more than 150 voluntary experts working on the TOCs and TF

Flexible and Rigid Foams Technical Options Committee (FTOC)

Co-chairs

Paulo Altoé

Helen Walter-Terrinoni

FTOC 2024 Progress Report

Successful transitions from hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs) continue 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.

Supply chain recovery continues for foam blowing agents (FBAs) and other raw materials

- Hydrofluoro-olefin (HFO) / hydrochlorofluoro-olefin (HCFO) 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 that converted to HFC-365mfc.

Foam blowing agent prices have increased since the pandemic

There has been continued use of HFC-245fa blends in A5 parties due to cost of HFO/HCFO alternatives.

Many companies have elected to transition away from fluorinated FBAs due to cost of HFCs, HFOs, and HCFOs

- Companies in A5 and non-A5 parties have converted to non-fluorocarbons, if they can still meet insulation performance and other criteria

Non-fluorocarbon components (e.g., Hydrocarbon (HC), methylal, methyl formate, and methylene chloride) are reportedly blended with fluorocarbons (FCs) to reduce costs

Health and safety considerations of new FBAs

Flammable FBAs and FBAs with different toxicity create different safety concerns for end-users and workers at system houses and foam manufacturers, especially small and medium enterprises (SMEs).

1,2 dichloroethylene (1,2-DCE) toxicity and use in foam is currently being reviewed by at least one party.

- Field studies related to spray foam indoor air quality (IAQ) show 1,2-DCE concentrations for months or years after installation.

FTOC is seeking additional information about safety measures in use to address exposure and safety risks, especially by SMEs.

- Hydrocarbon is being tested as a blowing agent for spray foam in some A5 parties. FTOC is currently unaware of any broad commercialisation

Fire Suppression Technical Options Committee (FSTOC)

Co-chairs

Adam Chattaway

Sergey Kopylov

Dan Verdonik

FSTOC 2024 Progress Report

- FSTOC is not aware of any new fire suppression alternatives to halons, HCFCs or high-GWP HFCs. Furthermore, development of a low-GWP blend has ceased, possibly owing to the uncertainty of PFAS regulations.
- Uncertainty over the proposed PFAS definitions and regulations could impact the transitions away from high-GWP HFCs, including Kigali Implementation Plans.
- R&D activities continue in the civil aviation sector, but there are no certified alternatives to halon 1301 in aircraft cargo compartments and engines either for newly-produced aircraft or for retrofit of existing aircraft.
- Destruction of halon 1301 for carbon credits is continuing; this could deplete the halon 1301 bank, bringing the run-out date closer to 2030.

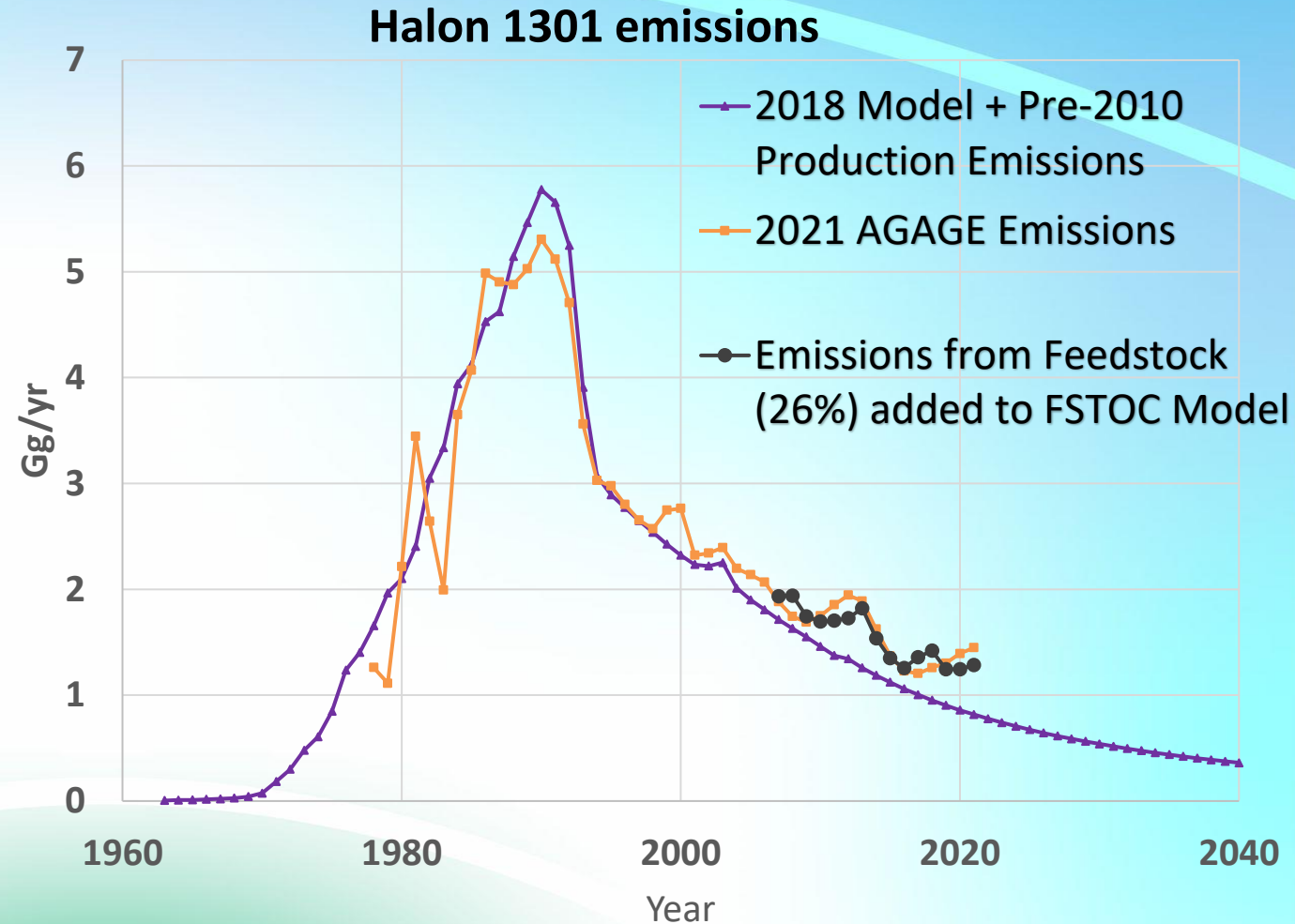
FSTOC 2024 Progress Report (2)

- Recent fire suppression standards / approvals have been updated to allow the use of reclaimed HFC-227ea for new systems as well as for refill.
- In the wider fire protection industry, there appears to be confusion around the intent of the Montreal Protocol in relation to halon management.
- Parties may wish to consider clarifying and reinforcing the message that recovery, recycle, and reclaim of fire suppressants is encouraged under the Protocol.
 - Using halons is not banned; the production and consumption of newly manufactured halons in fire suppression is banned.
 - Facilitating the transboundary shipments of recovered halons for recycling/reclamation to another party that has those capabilities.
 - Discouraging parties from destroying halons unless they cannot be reclaimed to an acceptable purity.

Estimating Halon-1301 emissions from feedstock production and use

- The annual pattern of production closely matches peaks and troughs of emissions derived from atmospheric measurements.
- However, the scale of emissions was low when using emission factors estimated by MCTOC.
- A 26% emission factor gives a very close match - shown in the black/orange lines.
- Parties may wish to consider providing information on emissions from production and feedstock use of Halon 1301 to the Ozone Secretariat for confidential use by the TEAP in its assessment.
- More work is needed to understand this fully.

and use



Methyl Bromide Technical Options Committee (MBTOC) 2024 CUN Interim Report

Co-chairs

Marta Pizano

Ian Porter

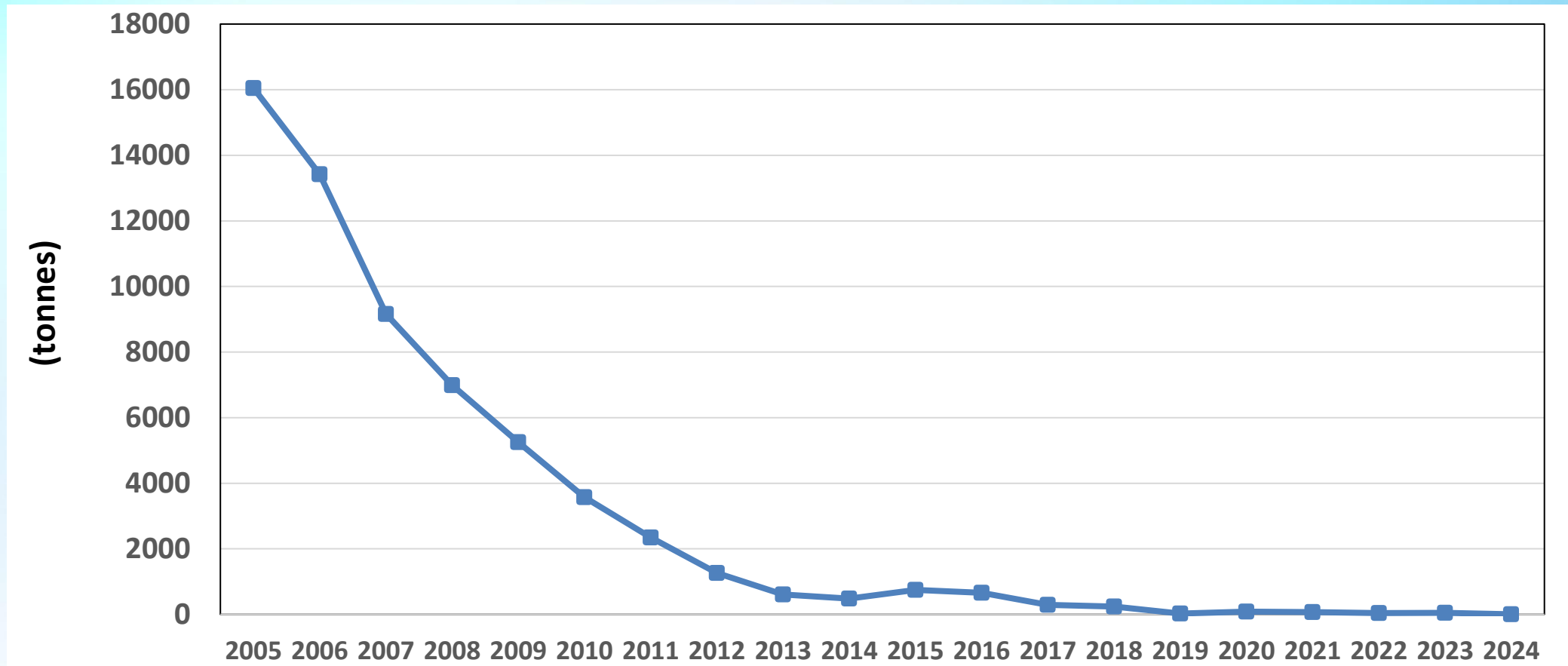
Application for Critical Use of MB

- MBTOC received one application for critical use in 2025 for preplant soil use for 2.850 t from Canada.
- This represented a 26% reduction from the approved amount at 35th MOP.
- Canada reported no stocks at the end of 2023 and indicated a reduction plan to potentially phase out by 2026.
- No A5 party submitted a CUN for MB use.

Country and Sector	Non-Article 5 Party Nomination (tonnes)	Interim Recommendation (tonnes)
1. Canada (2025) Strawberry runners	2.850	[2.850]
TOTAL (2025)	2.850	[2.850]

Methyl bromide (t) exempted (CUE) for controlled use 2005 - 2025

- Over 16,000 t of MB has been phased out under the CUE process and this year appears to be the last year for applications of CUEs for MB.



Methyl Bromide Technical Options Committee (MBTOC)

2024 Progress Report

Co-chairs

Marta Pizano

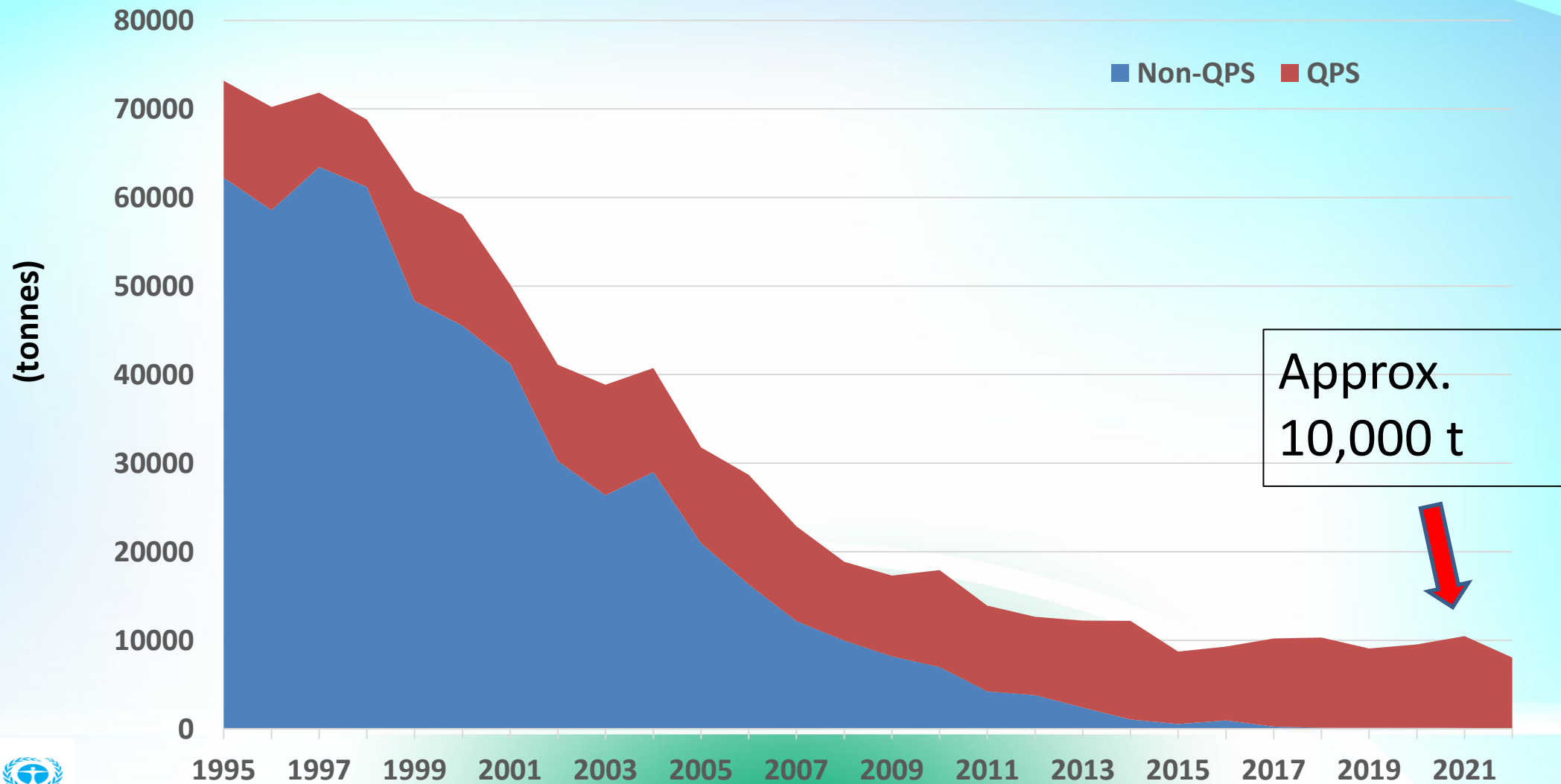
Ian Porter

MBTOC 2024 Progress Report key messages

- **Significant milestone:** Over 99.9% of the 62,000 t of MB used for controlled (i.e. non-QPS) uses is now reportedly phased-out.
- Alternatives for QPS MB use (8,000 to 10,500 t) is now the focus.
- Technically and economically feasible alternatives are available for about 40% of current QPS uses.
- **Concern:** Reports and websites identify that substantial MB is still being used for unreported controlled use (non-compliance).
- Reinforcing policies to ensure that MB is only used for QPS use would help stop diversion from intended use. This means that;
 1. **Quarantine (Q) MB use is only for quarantine pests or,**
 2. **Preshipment (PS) use is only for 'officially endorsed' control of cosmopolitan pests, and only within 21 days before export. Note: Official documentation must have been in place before 1996.**

Non QPS MB (reported CUNs) verses QPS MB (tonnes)

- Between 8,000 to 10,500 tonnes of MB are still used for QPS uses globally



Key messages for MB QPS Use

- Key alternatives to MB for QPS uses include: ethane dinitrile (EDN), hydrogen cyanide (HCN), and ethyl formate (eFume).
- EDN has potential to replace up to 50% of MB QPS use (e.g. for timber/wood product treatments) and is increasing registration globally.
- **Impact of regulations:**
 - New Zealand's policy led to sharp drop in QPS use of over 800t; phosphine taken up for logs.
 - Australia has accepted controlled atmosphere treatments for Khapra beetle.
 - Japan is expanding registration of methyl iodide for some QPS uses.
 - However, India has increased QPS consumption due to regulations that favour MB as the primary treatment; MB is required on imported timber and wood products from Uruguay and Argentina.
 - The US is unique in using MB for preplant treatments of nursery crops.
 - There is uncertainty over the future of MB alternatives e.g., sulfuryl fluoride (SF) in the EU, where it raises concerns that some QPS treatments may revert back to MB treatment.

Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee (RTOC)

Co-chairs

Omar Abdelaziz

Roberto Peixoto

Fabio Polonara

Rajan Rajendran

RTOC organization updates

The RTOC 2026 Assessment Report will be organized around the Cold Chain and Comfort Cooling and Heating applications and equipment.

Membership

- Fourth co-chair appointed, from the US, who was already an RTOC member.
- Member appointments are for two years only (current terms end in December 2024).
- RTOC currently includes 43 members (22 from non-A5 parties and 21 from A5 parties) now includes 12 women

Adoption of lower-GWP refrigerants continues to grow in RACHP

- Availability of lower GWP alternative refrigerants continues to grow for all RACHP sectors.
- Eighteen new lower-GWP refrigerant blends received designations and classifications from ASHRAE Standard 34 and/or from ISO 817.
- Globally, 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.
- The HFC/HFO blend R-452A is now used in road transport refrigeration while HFO-1234yf is used in marine container refrigeration.

Adoption of lower-GWP refrigerants continues to grow in RACHP (2)

- 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 XXXVI/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 CO_{2eq} 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).

EE implementation progress

- The Executive Committee (ExCom) to the Montreal Protocol Multilateral Fund (MLF) adopted decision 91/65 and created a funding window of US\$20M for EE projects.
- At their 93rd meeting, the ExCom approved projects totaling over US\$4.5M.
 - 9 non-investment projects (Bolivia, Ecuador, Egypt, Nigeria, Turkmenistan, India, Kyrgyzstan, Mexico, Nicaragua).
 - 2 investment projects (South Africa, India).
 - 4 preparation projects (Chile, Kenya, Malaysia, Vietnam).
- Since publication of TEAP's Progress Report, at their 94th Meeting, ExCom approved:
 - Four additional EE pilot projects under Decision 91/65 for 4 countries (Decisions 94/54, 55,56 and 57), for a total of US\$ 720,163 including support costs
 - A funding window of \$100 million for projects (Decision 94/60)

Medical and Chemicals Technical Options Committee (MCTOC)

Co-chairs

Takeshi Eriguchi

Helen Tope

Jianjun Zhang

MCTOC 2024 Progress Report

- 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 is progressing, though potential challenges could risk the consistent supply of affordable medicines, as discussed in 2022 MCTOC AR and 2023 TEAP PR, and updated in 2024 TEAP PR.
- At least 10 companies globally could have active programmes to develop pMDIs with lower GWP propellants HFC-152a and HFO-1234ze(E). Generic pMDI manufacturers are also developing lower GWP pMDIs, including in A5 parties.
- 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. With subsequent regulatory submissions/approvals, the first lower GWP pMDIs may not reach the market until 2026.

MCTOC 2024 Progress Report

- The price of bulk HFC propellant currently used in pMDI is likely to increase as HFC quotas for non-pharmaceutical uses tighten, making some pMDIs less commercially attractive to manufacture.
- The price of some new lower GWP pMDIs will be higher due to capital investment, research and development, and increased costs of propellants and valves.
- The impact of global legislation and corporate policies may accelerate the introduction of lower GWP pMDIs in A5 parties well before their scheduled Kigali HFC phase-down, meaning lower GWP pMDIs could be available in A5 parties from 2026 onwards.
- The reduction in HFCs use in Europe and United States may lead to uncertainty over security of supply and commercial pricing concerns in A5 parties for current HFC propellants and MDIs.
- The non-pMDI aerosol market continues to evolve with improvements in aerosol valve technology allowing for effective use of some non-HFC propellants (such as nitrogen and compressed air) in more applications.

Per- and poly-fluoroalkyl substances (PFAS): Emerging policies and sector information

- Definitions of PFAS incorporated into potential future policies varies between jurisdictions.
- PFAS definitions may include Montreal Protocol controlled substances, substitutes, and breakdown products, such as trifluoroacetic acid (TFA) and its salts.
- The OECD definition of PFAS encompasses a wide range of chemicals from gases to liquids to solid polymers. It includes TFA and most commercial HFCs and HFOs. It excludes several fluorinated gases such as halons 1301 and 1211, HFC-32, HFC-23, CF3I, HFC-152a, and HCFC-22.
- Manufacturers and other stakeholders have reported that they are delaying decisions on the selection of alternatives and the associated investments, because some or all fluorinated alternatives might become unavailable.
- This will delay the phase-out of ODS and phase-down of high GWP HFCs.

PFAS in Europe

- A proposal for the precautionary restriction of around 10,000 PFAS, submitted in January 2023 by 5 parties, was opened for public consultation by the European Chemicals Agency (ECHA) that would apply to the European Economic Area.
- ECHA has now completed its public consultation on consideration of restricting many, if not most fluorinated refrigerants*.
- The proposed ECHA definitions would lead to a restriction on manufacture, use, and placing on the market many currently used controlled substances and alternatives.
- This ECHA definition includes currently used pMDI propellants (i.e., HFC-134a, HFC-227ea) and one future substitute under development (HFO-1234ze(E)). Under the current proposal, these restrictions would apply to pMDIs 18 months after entry into force.

* ECHA committees for risk assessment (RAC) and for socio-economic analysis (SEAC) evaluations of the impact of fluorinated HFC/HFO are scheduled in November/ December.

PFAS in other jurisdictions

- The US Environmental Protection Agency (U.S. EPA) has continued to implement their risk-based approach delineated in the "PFAS Strategic Roadmap: EPA's Commitments to Action 2021-2024" . A narrower PFAS working definition than the EU REACH proposal is used. The U.S. EPA reporting programme excludes certain HFOs, TFA and certain HCFs from the working PFAS definition.
- Some jurisdictions, e.g., China and Japan, so far only restrict certain PFAS that are listed under the Stockholm Convention, i.e., perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorohexane sulfonate (PFHxS).
- In 2023, Canada accepted comments during public consultation considering the OECD PFAS definition of approximately 4700 chemicals.
- Two US states have enacted legislation requiring reporting and bans on PFAS chemicals with a definition broad enough to include substances controlled under the Montreal Protocol.

TEAP Organisation and Work

Decision XXXI/8: Terms of reference (TOR) – procedures relevant to nominations

- The decision requests TEAP to provide an annual summary outlining the procedures that TEAP and its TOCs have undertaken to ensure adherence to the Panel's TOR through clear and transparent procedures.
- TEAP continues to implement its TOR including:
 - Full consultation with national focal points regarding proposed nominations, using standardised form and appointment decisions
 - Implementing guidelines for nominations to TOCs
 - Annual full disclosure of interest through a standardised form
 - Review of TOR requirements as part of all meetings
 - Matrix of needed expertise updated annually
- The guidance for nominations and appointments to TEAP/TOCs are re-iterated in the Progress Report for the benefit of parties.

TEAP - Managing work related to replenishment

- Parties' replenishment of the MLF 2024-2026 was at an historic level, representing a significant milestone in A5 assistance.
- TEAP workload in 2023 to provide the estimated funding for replenishment was substantial, considering both the continued ODS phaseout and HFC phasedown for the first time.
- TEAP considered lessons learned and improvements to meet this standing request from parties including:
 - Continued updates, ongoing work in intervening years
 - More regular database and modelling updates reflecting ExCom decisions
 - Increased engagement with the MLF to understand better future funding direction and decisions, ongoing sources of information, etc.

TEAP - scope and workload

- TEAP and its TOCs are addressing their changing scope and workload:
 - Overlap of the ODS phaseout and HFC phasedown regimes.
 - Kigali Amendment (e.g., HFC alternatives, Energy Efficiency, LRM)
- In 2024, TEAP produced three major new reports, plus responses to five separate Decisions requesting updates to information only recently provided.
- Standing decisions already provide opportunities for regular updates:
 - Regular reports: 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).

Annex 8: TEAP planned reports

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 finalised and published

- Quadrennial assessment (TEAP & TOCs)
- Study on replenishment and supplemental report
- Progress report
- Begin development of 2027 reports including Synthesis Report

TEAP - maintaining expertise and achieving consensus

- TEAP/TOCs need to both retain current expertise, and to recruit new volunteers.
- Experts serving on the TEAP/TOCs commit to providing independent expertise, working to consensus, and drafting and reviewing products under strict deadlines
- TEAP/TOCs have lost experienced members, some because of lack of financial support for their participation. New members need time to operate under the TOR, TEAP and Montreal Protocol processes.
- Meeting face-to-face is an essential part of TEAP/TOC functioning, and for maintaining the mutual respect and trust that underpins consensus.
- Parties may wish to consider funding travel expenses for TEAP/TOC where needed, irrespective of A5/non-A5 status.
- TEAP looks to the support of parties as it works to maintain expertise, evolve its processes, manage its overall workload, and continue to deliver its work for parties.

TEAP - membership and organisation

- At the end of 2024, terms of appointment will end for one TEAP co-chair, three TOC co-chairs, and all Senior Experts (Annex 5 TEAP 2024 Progress Report).
- Senior Experts fulfil an important role, providing specific expertise not covered by TEAP or TOC co-chairs.
- TEAP looks to the continuing support 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.
- TEAP requests that parties considering nominations have informal discussions with TEAP/TOC Co-chairs as appropriate, **prior** to making a formal nomination.
- TEAP is working to consider its response to *Decision XXXV/20: Options for the organisation of TEAP and its TOCs* ahead of OEWG-47 (2025).