

# **Report of the Technology and Economic Assessment Panel (TEAP)**

**June 2016**

***[corrected 19 July 2016]***



**TEAP**

38<sup>th</sup> OEWG  
Vienna, 18-21 July  
2016

# TEAP Report June 2016

- Volume 1: Progress Report
  - TOC Progress Reports
  - TEAP Essential Use Nominations (EUNs)
  - Follow-up on Decision XXVI/7 – Availability of Recovered, Recycled, or Reclaimed Halons
  - TEAP/TOCs Membership
  - Matrix of Expertise
- Volume 2: June 2016 TEAP Critical Use Nominations (CUNs)
- Volume 3: Decision XXVII/5 - Issues Related to the Phase-out of HCFCs

# TEAP Members

Bella Maranion, TEAP co-chair	USA	Keiichi Ohnishi, MCTOC co-chair	J
Marta Pizano, TEAP co-chair	COL	Roberto Peixoto, RTOC co-chair	BRA
Ashley Woodcock, TEAP co-chair	UK	Fabio Polonara, RTOC co-chair	IT
Mohamed Besri, MBTOC co-chair	MOR	Ian Porter, MBTOC co-chair	AUS
Suely Machado Carvalho, Senior Expert	BRA	Helen Tope, MCTOC co-chair	AUS
David Catchpole, HTOC co-chair	UK	Dan Verdonik, HTOC co-chair	USA
Marco González, Senior Expert	CR	Jianjun Zhang, MCTOC co-chair	PRC
Sergey Kopylov, HTOC co-chair	RF	Shiqiu Zhang, Senior Expert	PRC
Lambert Kuijpers, Senior Expert	NL		

# Outline

- FTOC progress report
- RTOC progress report
- HTOC progress report and Dec. XXVI/7
- MBTOC progress report and CUNs
- MCTOC progress report and EUN
- Response to Dec XXVII/5: HCFCs

# Flexible and Rigid Foams Technical Options Committee (FTOC)

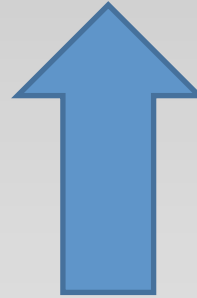
Interim co-chair  
Ashley Woodcock



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Many Foam Manufacturers  
27.1 Million tonnes by 2019



System Houses: Provide complex mixtures



Few Chemical Manufacturers

# Transition to Low GWP

- Long term thermal performance an important consideration in many types of foam
- HFO/HCFO:
  - Concern with current limited production capacity
  - Chemical Plant: Capital cost high; 1-4 years from plant approval to foam assessment and approval
  - Blends: may reduce cost, improve safety and performance

*Correction: “Australia has announced a HFC phase-down which will likely see the transition to HFC alternatives for foam-blowing”.*

# Challenges

- Demand for Foams is increasing
- Some stringent regulations on energy efficiency
- HCFC 141b polyols loophole; disincentive?
- HCFC → high GWP → low GWP; leapfrog?
- Options for hundreds of SMEs:
  - Hydrocarbons: flammable → safe handling concerns especially in heavily-populated areas; → high initial investment, less expensive long-term;
  - HFO/HCFO: flammability and cost
  - Methyl formate and methylal (formulation, flammability)
  - Blends: possible solution?



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

Co-chairs

Roberto Peixoto

Fabio Polonara



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# RTOC Progress Report

RTOC progress report carries the status of the different sub-sectors, focusing on updates of technical options to replace ODS and high GWP refrigerants as described in the RTOC 2014 Assessment report specific chapters.

Considering that most of the work during 2015-2016 has been done by RTOC within TEAP TFs XXVI/9 and XXVII/4, it has therefore been previously reported (under R/AC update and elsewhere) and will not be duplicated here.

# Halons Technical Options Committee (HTOC)

Co-chairs

Dave Catchpole

Sergey Kopylov

Dan Verdonik



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# HTOC- Agent Update

- In addition to 3,3,3-trifluoro-2-bromo-propene (2-BTP) there are 5 new agents in development
  - 3 for streaming in the halon 1211 sector
  - 2 for flooding in the halon 1301 sector
- HCFO-1233zd(E) has been submitted to US SNAP program as a total flooding fire extinguishing agent
  - Already been approved in SNAP program as a foam blowing agent, solvent and refrigerant
  - Is already in production and commercial applications in those three sectors

# HTOC- Military/ Aviation Update

- US Army hosted a 2-day military fire protection workshop in October 2015
  - Another workshop is planned in 2017
- FK-5-1-12 has been specified by the US Air Force as a streaming agent for flight line applications
  - Currently deployed in the EU and North America
  - Use expanding globally
- HTOC continues to work with ICAO on the phase-out of halons within civil aviation

# HTOC- Aviation (cont.)

- Expect ICAO to approve 2024 as date when cargo bays of newly designed aircraft can no longer use halons
  - Completes the ICAO phase-out dates for newly designed aircraft
- 2-BTP obtained regulatory approval in US for import
  - In portable extinguishers and engine nacelles for aircraft
  - Proposed as acceptable under SNAP program in those uses
- European Aviation Safety Agency rule making
  - Adoption of the final Regulation expected in 2017
  - The applicable dates anticipated are:
    - one year after entry for lavatory systems
    - 31 December 2018 for portable extinguishers

# Decision XXVI/7

- Invited parties, on a voluntary basis, to submit information to the Ozone Secretariat on:
  - How halons are being recovered, recycled or reclaimed to meet purity standards for aviation use and supplied to air carriers to meet ongoing civil aviation needs
  - Any national actions being taken to expedite the replacement of halons in civil aviation uses.
- Four responses received: Australia, Canada, EU and US
- The Ozone Secretariat asked the HTOC to review the received information and report to OEWG-38.

# Decision XXVI/7

## **Australia:**

- Established a National Halon Bank
- Bank holds more halon 1211 than estimated as needed until 2100 but holds less halon 1301 than needed.
- Plans restrictions on use of halon for new production aircraft for lavatory systems by 2016 and handheld fire extinguishers by 2018.

## **Canada:**

- Has no physical halon bank
- Recycled stocks can be purchased from two certified recycling facilities
  - One supplies Canadian aviation service providers
  - The other exports to the US for use in aviation.
- There is enough halon to meet immediate needs of civil aviation,
- No consensus among companies regarding 5 -10 years out, or data in banks or inventories to ascertain whether there will be a shortage in the long term.



# Decision XXVI/7

## EU:

- Significant amount of halons in European aircraft originates from the US. The rest comes from numerous reclamation facilities in the EU.
- Aviation halon supply appears to be stable in most EU countries, but some countries report a shrinking availability of EU halon suppliers.
- Service and aviation companies think they have no influence or control over aviation halon replacement and have little incentive to invest in research.

## US:

- Created a Halon Replacement Aviation Rulemaking Committee in 2013.
- 2014 final report gave 8 conclusions and 13 recommendations, e.g.,
  - Concern about the potential for future supply disruptions.
  - Emission rates higher than previous estimates and other uses; investigate if current emission rates and unnecessary discharges are too high, and if there are steps that can be taken to reduce them.
  - Likely insufficient supply of recycled halons to meet future civil aviation needs.

# Methyl Bromide Technical Options Committee (MBTOC)

Co-chairs

Mohammed Besri

Marta Pizano

Ian Porter

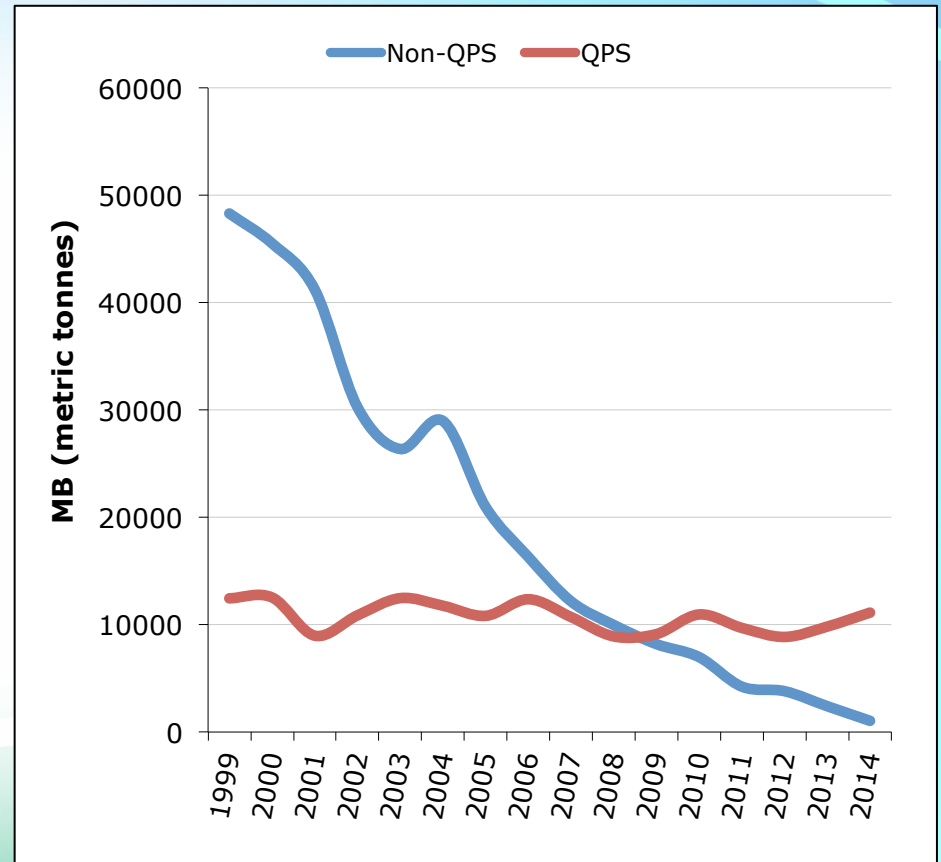


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# Global MB Consumption for Controlled and Exempted Uses 1999 - 2014

- Controlled uses only permitted as CUEs.
- Approx. 90% of global MB consumption is for QPS
- QPS consumption has remained relatively stable with a tendency to increase in A5 Parties and decrease in non-A5
- Controlled uses still face major challenges, including illegal trade of MB, reporting of stocks and non-reported uses



# Alternatives for QPS (exempt uses)

## Alternatives being considered/developed for commodities:

- Controlled atmosphere systems for tobacco and grain.
- Ethane dinitrile (EDN) for sawn timber and logs.
- Methyl iodide for quarantine aphids in Japan.
- As of 2020, the New Zealand EPA will require all QPS MB fumigations to be applied with recapture equipment.

**International Plant Protection Convention (IPPC)** has indicated that the Commission for Phytosanitary Measures is considering quarantine treatments with sulfuryl fluoride and modified atmospheres for controlling some quarantine pests. A revision to ISPM-15 to consider new treatments is also envisioned

# Issues Related to MB

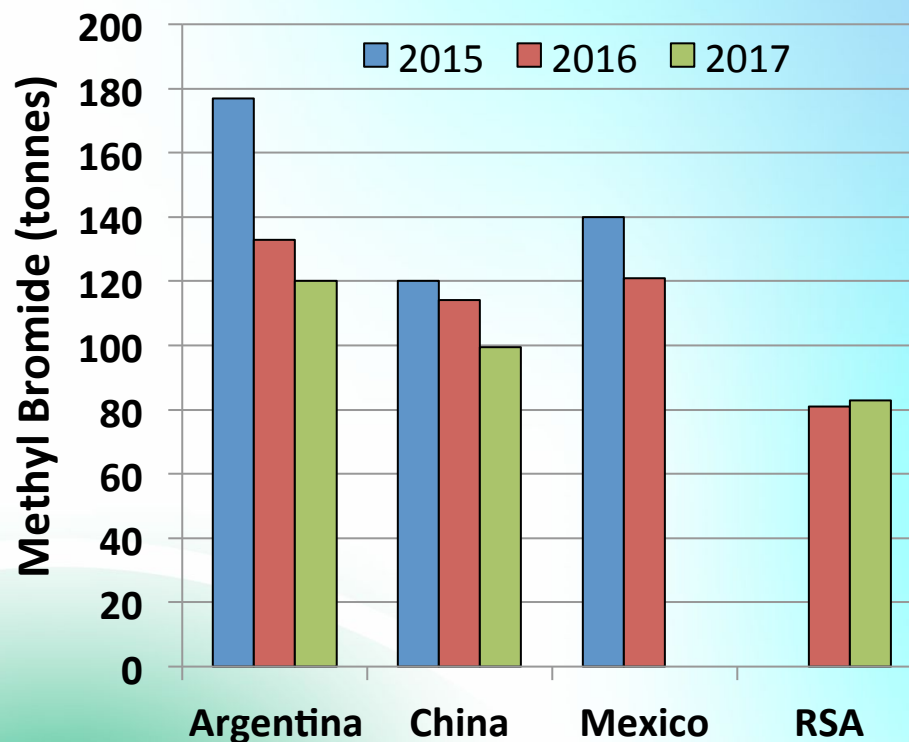
- Complete sanitation of propagation plant material for nursery crops required to avoid industry losses.
- Different classifications by parties for the same pests and uses for strawberry runners for (CUE, QPS) and non reported uses.
- An increase in specific diseases, e.g. Macrophomina with use of alternatives on strawberry fruit.

# Trends for CUN MB use for non-A5 (2005-18) and A5 parties (2015-17)

## Non A5 CUNs since 2005

Year	2005	2017/18
Amount (t)	18,700	34
No. of CUNs	146	2

## A5 CUNs since 2015



# Reporting of Stocks (Dec XVI/6 1,bii)

	MB stocks (t) reported at end of:	
	2005	2015
Australia	0	0
Canada	4	1.5
USA	10,417	140
Argentina	-	0
China	-	0
RSA	-	NR#
<b>Total</b>	<b>10,421</b>	<b>142</b>

- First year A5 Parties have reported; NR – Not reported
- CUE recommendations have not been adjusted to account for stocks

# Interim CUE Recommendation for MB use (tonnes) in 2018 for Australian Strawberry Runners

Sector	CUN for 2018	Interim Recommendation for 2018
Strawberry runners	29.76 t	25.166 t

## Interim Recommendation for 2018: Reduced

Reduction (15%) based on adoption of :

- Steam for substrate disinfestation (0.013t).
- Alternatives (e.g. new application methods for MITC generators; 1,3-D/Pic (TF-80<sup>®</sup>)) and any newly registered alternatives, such as EDN/Pic.
- An update of the current research program has been provided and may be updated to this OEWG (Dec XXV/4)



## Interim CUE Recommendation for MB use (tonnes) in 2017 for Canadian Strawberry Runners

Sector	CUN for 2017	Interim Recommendation for 2017
Strawberry runners	5.261 t	[Unable to assess]

### Interim Recommendation for 2017: Unable to assess

- Inadequate research program and Pic groundwater issue unclear but Party may provide further update to this meeting (Dec XXV/4).
- **After the interim assessment, Canada provided information that a detailed, funded research program is planned for this remaining CUN use.**

# Interim CUE Recommendation for MB use (tonnes) in 2016 for Argentina

Sector	CUN for 2017	Interim Recommendation for 2017
Strawberry fruit	45.3	[35.71]

## Interim Recommendation for 2017: Reduced

- Accepted that there were limitations for cool regions
- Reduction (22%) based on uptake of barrier films with MB over a two year period and adoption of available alternatives (ie 1,3-D/Pic)
- Present double cropping of strawberries require new approach

# Interim CUE Recommendation for MB use (tonnes) in 2016 for Argentina

Sector	CUN for 2017	Interim Recommendation for 2017
Tomato	75	59.45

## Interim Recommendation for 2017: Reduced

- Accepted that there were no alternatives yet for the *Nacobbus* nematode.
- The nomination was reduced (21%) for uptake of barrier films with MB over a two year period.

# Interim CUE Recommendations for MB use (tonnes) in 2017 for China

Sector	CUN for 2017	Interim Recommendation for 2017
Ginger, Open field	78.5	74.617
Ginger, Protected	21	18.360

## Interim Recommendation for 2016: Reduced

- The nominations were reduced (13%) for uptake of barrier films with MB over a two year period.

## Interim CUE Recommendation for MB use (tonnes) for Commodities: South Africa Mills and Dwellings in 2017

Sector	CUN Request for 2017	Interim Recommendation for 2017 (tonnes)
South Africa		
<b>Mills</b>	13.0	[2.923]
<b>Dwellings</b>	70.0	[42.3]

### Interim recommendation for 2017: Reduced

**Mills:** Reduction based on reduced dosage rate of 20 g/m<sup>3</sup> for the fumigations and a maximum of one fumigation per year, AND as a transitional measure to allow time for adoption/optimisation of alternatives.

**Dwellings:** Reduction based on a rate adjustment to conform to standard presumptions.

# Highlights (CUN, Emergency Use)

- USA did not submit a CUN in this round.
- Mexico did not submit any CUNs in this round, informally indicated stocks are available.
- China has indicated their intent for 2018 to be the last year for CUNs.
- Not all Parties provided an accounting framework (Dec Ex. 1/4 (9f)).
- Accurate reporting of stocks critical to assessments.
- Israel informed the Ozone Secretariat of an emergency use of 500 kg for museum artefacts.

# Medical and Chemicals Technical Options Committee (MCTOC)

Co-chairs

Keiichi Ohnishi

Helen Tope

Jianjun Zhang



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# MCTOC Progress Report – Medical MDIs

- Global transition away from CFC MDIs is almost complete.
- In China and Russia, CFC MDIs were manufactured from remaining CFC stockpiles in 2015.
- Proprietary DPI devices have continued to diversify, with companies investing in their own unique delivery technologies.
- MDI remains the mainstay of inhaled therapy at about 60%, DPIs 32%, nebulised solutions 8%, of global market based on dose equivalence, with considerable regional variation.
- In A5 parties, inhaler use has increased overall, and DPI use has become more widely accepted especially in affordable single-doses.



# MCTOC Progress Report – Chemicals Process Agents

- Reviewed information submitted by Parties under Dec. XVII/6 on process agent use exemptions, make-up and emissions.
- Based on information provided or no longer reported, Parties may wish to consider *removing* from Table A of Dec. XXIII/7:
  - Production of chlorinated polypropene, chlorinated ethylene vinyl acetate, and methyl isocyanate derivatives.
  - Israel for  $\text{NCl}_3$  elimination in chlor-alkali production.
  - US for production of chlorosulfonated polyolefin.
- Parties may wish to consider *reducing* the quantities of make up/consumption and maximum emissions levels contained in Table B of Dec. XXIII/7 based upon their own reported data.

# MCTOC Progress Report – Chemicals Process Agents

- Parties may wish to consider updating their information on the remaining 11 process agent uses and provide information on:
  - Current technology used;
  - Technology used for reducing emissions;
  - Actual emissions;
  - Alternatives available for replacing ODS in these processes.
- By the end of 2017 (in time for MCTOC to report next under Dec. XVII/6 in early 2018).

# MCTOC – Essential Use Nomination CTC in Laboratory and Analytical Uses (LAU)

- China began revision of its standard oil in water test in 2013 to replace the current infrared photometric method.
- In 2016, China reported difficulties in developing a new standard and has now decided to substitute tetrachloroethylene for CTC, allowing continued use of the same IR photometry equipment.
- The purity of tetrachloroethylene needs to be improved for analytical purposes, and purification methods are under development. MCTOC expressed concerns about the potential for delays.
- New standards are expected to be issued in 2017, with supporting implementation activities carried out in 2018.

# MCTOC – Essential Use Nomination CTC in LAU

Party	2015	2016	2017	2017
	Approved	Approved	Nominated	Recommended
China	80	70	65	65

- MCTOC recommends that Parties authorise an exemption for 65 tonnes, and requests that China, prior to any further nomination, provides specific information on:
  - Discussions/ evaluations regarding the use of other international analytical methods;
  - Progress in the development of its alternative method, including the purification of tetrachloroethylene;
  - A timeline for phase-out of CTC in LAU, indicating anticipated steps and dates in that process.

# TEAP Decision XXVII/5 Working Group Report: Issues Related to the Phase-out of HCFCs

TEAP Working Group co-chairs

Lambert Kuijpers

Dan Verdonik

Shiqiu Zhang



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Vienna 18-21 July 2016

# Decision XXVII/5

TEAP to investigate and prepare a report for consideration by the 38<sup>th</sup> OEWG meeting:

- a) To identify sectors, including subsectors, if any, where essential uses for parties not operating under Article 5 may be needed after 2020, including estimations of the volumes of hydrochlorofluorocarbons [HCFCs] to be used;
- b) To assess the future servicing requirements between 2020 and 2030 for parties not operating under Article 5 of refrigeration and air-conditioning equipment, and to assess whether there is a need for servicing in other sectors;
- (c) To report on recent volumes of production to satisfy basic domestic needs [BDN], projected estimates of such future production and estimated needs of parties operating under Article 5 to satisfy basic domestic needs beyond 2020.

# Decision XXVII/5 TEAP Working Group

## CO-CHAIRS

- Lambert Kuijpers (Netherlands, Senior Expert)
- Dan Verdonik (USA, HTOC Co-chair)
- Shiqiu Zhang (China, Senior Expert)

## MEMBERS

- Suely Carvalho (Brazil, Senior Expert)
- Bella Maranion (USA, TEAP co-chair)
- Keiichi Ohnishi (J, MCTOC-co-chair)
- Roberto Peixoto (BRA, RTOC co-chair)
- Helen Tope (AUS, MCTOC-co-chair)
- Ashley Woodcock (UK, TEAP co-chair and FTOC interim co-chair)

*TEAP expresses its sincere appreciation for the support on this report from UNEP's Ozone Secretariat (Gerald Mutisya) and the MLF Secretariat (Eduardo Ganem, Andrew Reed and Laura Duong)*



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OEWG-38  
Vienna, July 18-21 2016

# Approach to Response to Decision XXVII/5

- The situation with HCFCs is not comparable to CFCs
- For many years now, A5 parties have been the largest producers of many HCFCs such as HCFC-22, -141b and -142b
- Sources of information considered:
  - Parties' submissions (Australia, Canada, USA)
  - UNEP Ozone Secretariat: HCFC reported data 2010-2014
  - Multilateral Fund Secretariat:
    - Article 5 HCFC consumption from Country Programs (CPs) and extrapolation
    - Article 5 HCFC consumption data, as above, plus anticipation from available HCFC HPMP stage I consumption data
  - Sector-specific transition information and assumptions from relevant TOCs



# HCFC Production and Consumption

- HCFC production
  - 1990s: much higher in non-A5 than in A5 parties (e.g., 1995: total 540 vs. 54 kt)
  - By 2010, higher in A5 than in non-A5 parties for most HCFCs (e.g., 2010: total 320 vs 800 kt)
  - Between 2010-14, the production of HCFC-141b, -142b and -22 was 10-30 times higher in A5 parties compared to the production in non-A5 parties (except for the production of HCFC-123)
- HCFC Consumption
  - Same general trends as production
  - A5 HCFC consumption peaked and decreased after 2012

# HCFC Servicing Amounts (1)

- 0.5% of non-A5 HCFC baseline consumption (in ODP tonnes) is defined as the “servicing tail” (as of 2020)
- R/AC HCFC-22 servicing in non-A5 parties is unlikely to need newly produced -22 during 2020-30, although it is premature to be certain.
- Recycled and reclaimed material from disposed R/AC equipment could provide HCFCs during 2020-2030
- TEAP could review HCFC quantities required for R/AC servicing as well as the availability of alternatives for servicing

# HCFC Servicing Amounts (2)

- In fire protection, servicing of the installed HCFC Blend B (mainly -123) based equipment, may require 160 tonnes per year (~3 ODP tonnes), beginning in 2020 in non-A5 parties
- In niche solvent applications (e.g. aerospace or military), small quantities of HCFCs may be needed to service existing equipment. The availability from stockpiles or recycling is uncertain.

# Potential HCFC Essential Uses in Non-A5 Parties

- In R/AC and foams, TEAP has not yet identified any potential essential uses after 2020.
- In fire protection, TEAP estimates that a volume of HCFC-123 not exceeding 750 tonnes could be needed annually
- TEAP considers that essential uses could be needed for laboratory and analytical uses, and for some solvent uses, with the total estimated in tens of tonnes annually

# HCFC Basic Domestic Needs (BDN) production

- For the determination of HCFC production by non-A5 parties for BDN, the baselines for A5 production and consumption were based on Article 7 data (i.e., average for 2009-2010)
- Three methods have been applied to project HCFC consumption levels for 2020 and beyond:
  1. Extrapolation of Article 7 consumption data;
  2. Extrapolation of country program data for consumption of all HCFCs;
  3. Resulting consumption following HPMPs for 2020.

# HCFC BDN production (1)

- *Extrapolation of reported Article 5 consumption data (under Article 7) through 2020 shows that the expected (aggregated) HCFC consumption could be lower than the allowed HCFC production after 2020*
  - *Extrapolation of 2010-2014 data, towards 2020 and beyond, yields too much uncertainty and questionable negative values in 2020; a time lag of 6 years (2014-2020) is too much, therefore this has not been seriously considered*

# Extrapolation of (Article 7) HCFC Consumption Data

Extrapolated Article 5 HCFC consumption data 2015-2025  
versus allowed production and consumption (ODP tonnes)

Year	Baseline	2013	2015	2020	2025
Production	32989	32989	29690	21443	10721
Consumption	35873	35873	32286	23318	11659
Consumption	Extrapolated		27604	<b>13716</b>	<5000

## *HCFC BDN production (2)*

- *Extrapolation of reported Country Program data (2009-2014) by Article 5 parties to the Multilateral Fund Secretariat also shows that the expected aggregated HCFC consumption could be lower than the allowed HCFC production after 2020*
  - *This type of extrapolation also has large uncertainties, so that straightforward conclusions cannot be drawn*



# Extrapolation of Country Program Consumption Data

Extrapolated Country Program Article 5 HCFC consumption data 2015-2025 versus allowed production and consumption (ODP tonnes)

Year	Baseline	2013	2015	2020	2025
Production	32989	32989	29690	21443	10721
Consumption	35873	35873	32286	23318	11659
Consumption	Extrapolated	(28585) (rep. value)	29181	<b>20913</b>	(n/a)

## ***HCFC BDN production (3)***

- *Consideration of all HCFC Phase-out Management Plan (HPMP) stage I data for HCFC consumption in all Multilateral Fund agreements drawn up for Article 5 parties is a different way to look at 2020 HCFC consumption data (i.e., without extrapolation)*
  - *This yields that the 2020 aggregated HCFC consumption would be lower than the allowed HCFC production under the Protocol*

# Consideration 2020 HPMP Stage I Data

Article 5 HCFC HPMP stage I consumption 2020 data versus allowed production and consumption (ODP tonnes)

Year	Baseline	2013	2015	2020	2025
Production	32989	32989	29690	21443	10721
Consumption	35873	35873	32286	23318	11659
Consumption		28585 (CP rep. value)		<b>18656</b> (HPMP value)	---

# Conclusion HCFC BDN production

No basic domestic needs production by non-A5 parties is likely to be needed for A5 parties after 2020