TEAP Decision Ex.III/1 Working Group Report for MOP-28

by

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WG III/1 co-chairs

Decision Ex.III/1

- To request that the Technology and Economic Assessment Panel prepare a report for consideration by the twenty-eighth Meeting of the Parties containing
  - an assessment of the climate benefits, and
  - the financial implications for the Multilateral Fund,

  of the schedules for phasing down the use of hydrofluorocarbons (HFCs) contained in the amendment proposals as discussed by the Parties at the thirty-eighth meeting of the Open-ended Working Group and the Third Extraordinary Meeting of the Parties.

Decision Ex.III/1 TEAP Working Group

CO-CHAIRS

- Lambert Kuijpers (Netherlands, TEAP Senior Expert and RTOC member)
- Bella Maranion (USA, TEAP Co-chair)

MEMBERS

- Suely Carvalho (Brazil, TEAP Senior Expert)
- Roberto Peixoto (Brazil, RTOC co-chair)
- Helen Tope (Australia, MCTOC Co-chair)
- Dan Verdonik (USA, HTOC Co-chair)
- Shiqiu Zhang (PRC, TEAP Senior Expert)
- Ashley Woodcock (UK, TEAP co-chair)

Approach to TEAP Response

The response to Decision Ex.III/1 was carefully considered by TEAP prior to the development of the report, taking into consideration:

- The need for TEAP to define key terms and its understanding of the intent and context of the decision
- Closed informal discussions
- The short timeframe (6 weeks) for completing the analysis and delivering a final report (along with other TEAP reports) to facilitate discussions at MOP-28.

Objectives of the Ex.III/1 TEAP report

- To provide a clear definition of terms.
- To build on accepted methodology used by the TEAP related to BAU and mitigation scenarios across the various sectors of use.
- To provide an initial assessment of the potential benefits and costs of the amendment proposals.

Key terms under Decision Ex.III/1

- **“Climate benefit”** is understood as a reduction in HFC consumption* below that of a business-as-usual (BAU) scenario integrated over a specified period
  - A direct, simplified climate impact metrics method based on HFC consumption reductions
  - Consistent with TEAP approach on mitigation scenarios in previous reports.
  - Achieved reductions are from the HFC BAU consumption as a result of future implementation of mitigation measures, i.e., following the schedules contained in the HFC amendment proposals. Reductions are calculated from the year the controls start up to the year 2050.

* In this report, “consumption” is used interchangeably with “demand” rather than as the term is defined under the Montreal Protocol.

Key terms under Decision Ex.III/1

- **“Financial implications for the Multilateral Fund”** is understood to mean costs to the Multilateral Fund (MLF) for Article 5 implementation of control schedules following the schedules for HFC phase-down in amendment proposals (HFC reductions only).
  - Costs are calculated based on the current MLF guidelines for costs including the HCFC Phase-out Management Plans (HPMPs) stage II.

Key terms under Decision Ex.III/1

“Amendment proposals as discussed by parties” are

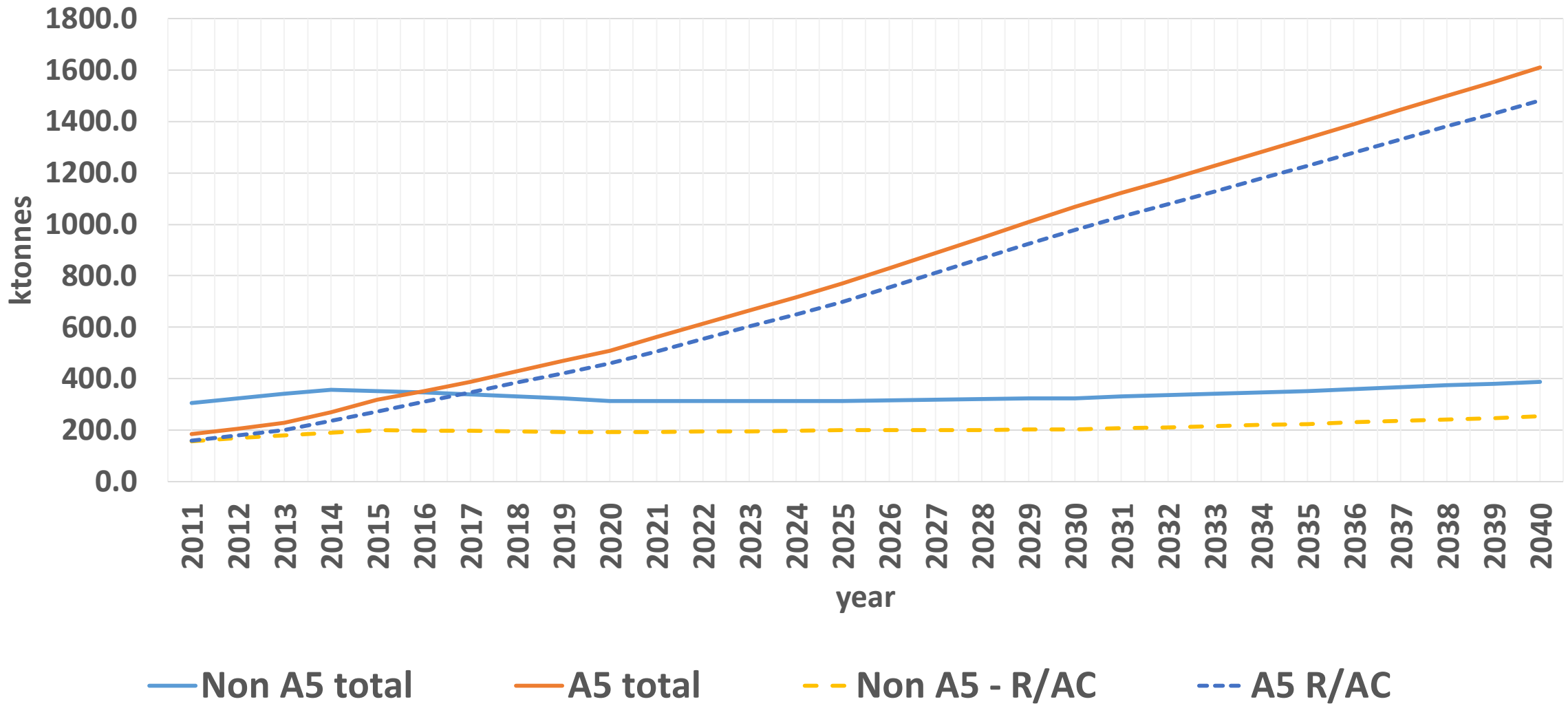
1. The amendment proposal by Canada, Mexico and the United States of America (with additional text submitted in 2016) (referred to as “North America”);
2. The amendment proposal by India;
3. The amendment proposal by the European Union and its member States (referred to as “EU”);
4. The amendment proposal by Kiribati, the Marshall Islands, Mauritius, the Federated States of Micronesia, Palau, the Philippines, Samoa and Solomon Islands (referred to as “Island states”).

For the additional proposals (providing only baseline and freeze dates) that resulted from the HFC Contact Group discussions at OEWG-38, TEAP provides a limited analysis of potential climate benefits

Starting point: Global HFC production and consumption

- Report updates estimates for global HFC production and consumption in 2015 to establish whether there is good agreement and sound basis for further analysis.
- Sources for global production information: public data, presentations, confidential information.
- Sources for global consumption:
  - Consumption data reported by some parties (i.e., US and EU) extrapolated to global estimates (2010-2014);
  - Bottom-up estimates of demand by sector and sub-sectors as TEAP has done in previous reports for calculating mitigation scenarios.
- The 2015 estimates for HFC global production and consumption show good agreement.

HFC projected demand in NA5 and A5 for 2011-2040



Considerations for BAU

- The HFC BAU scenarios in this report include the R/AC, Foams, MDIs and aerosols, and Fire Protection sectors.
- The HFCs considered are HFC-32, -125, -134a -143a, -152a, -227ea, -245fa and -365mfc.
- Non-Article 5 HFC BAU takes into account:
  - The final F-gas regulation in the EU
  - The July 2015 final regulation in the US
  - Certain reported HFC consumption by non-Article 5 parties up to 2014
- Article 5 HFC BAU does not consider any HFC regulations.

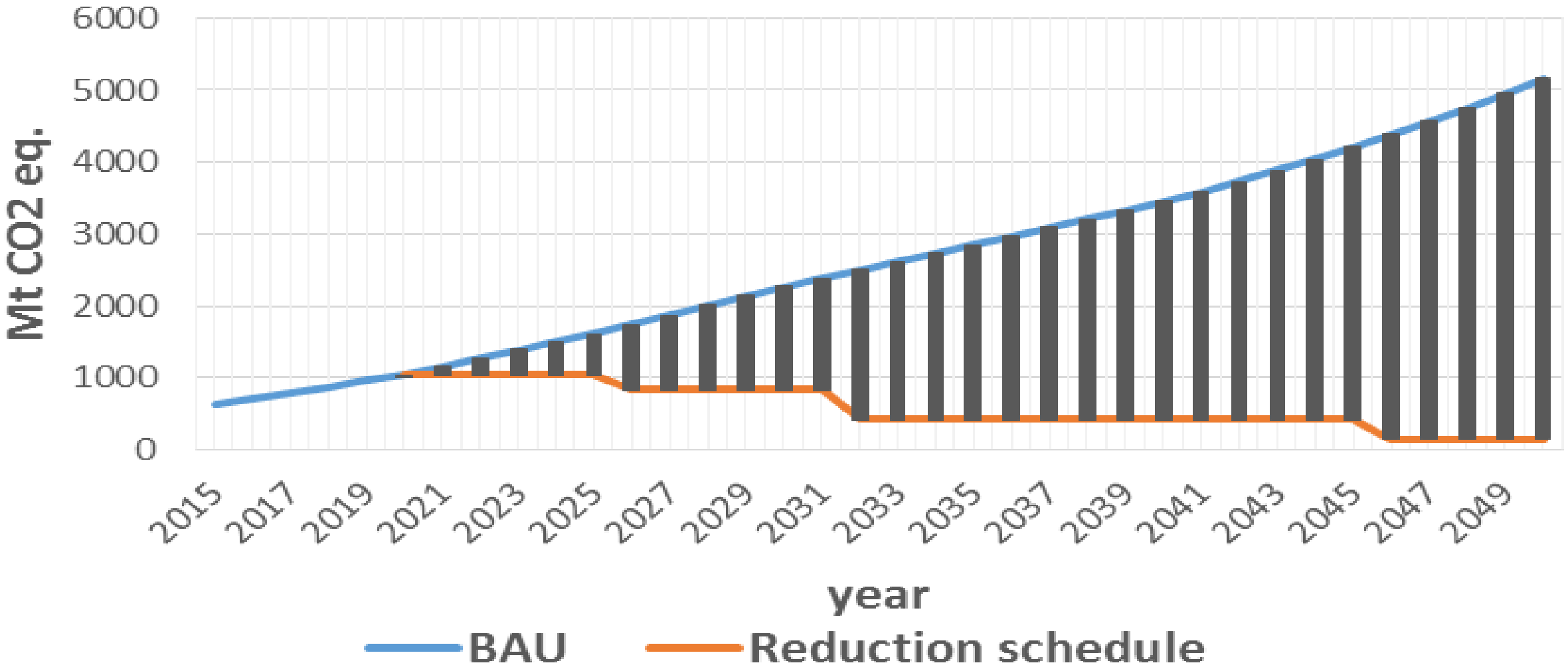
Construction of a R/AC BAU scenario

- The HFC BAU for R/AC includes manufacturing and servicing components
- The total HFC manufacturing demand is determined by the amount of equipment that is manufactured in the conversion from HCFCs (this only applies to Article 5 parties), plus the continuing growth of (new) HFC equipment
- The HFCs considered are HFC-32, -125, -134a -143a
- With 12-20 year R/AC equipment lifetimes, the R/AC servicing amounts will be the same or larger than the amount needed for manufacturing

Climate benefits

- TEAP has considered “climate benefit” as a reduction in HFC consumption below that of a BAU scenario integrated over the period from the control start year until 2050; consistent with the TEAP approach in previous reports.
- The year 2050 has been chosen because this is consistent with the end-year as requested by parties for the scenarios in the TEAP Decision XXVII/4 Task Force report. Choice of different end years lead to different climate benefits.
- There are other methods of calculating “climate benefits” on the basis of estimated emissions, supported by atmospheric measurements (Velders, 2015), leading to direct global temperature impact via the radiative forcing in a given year.

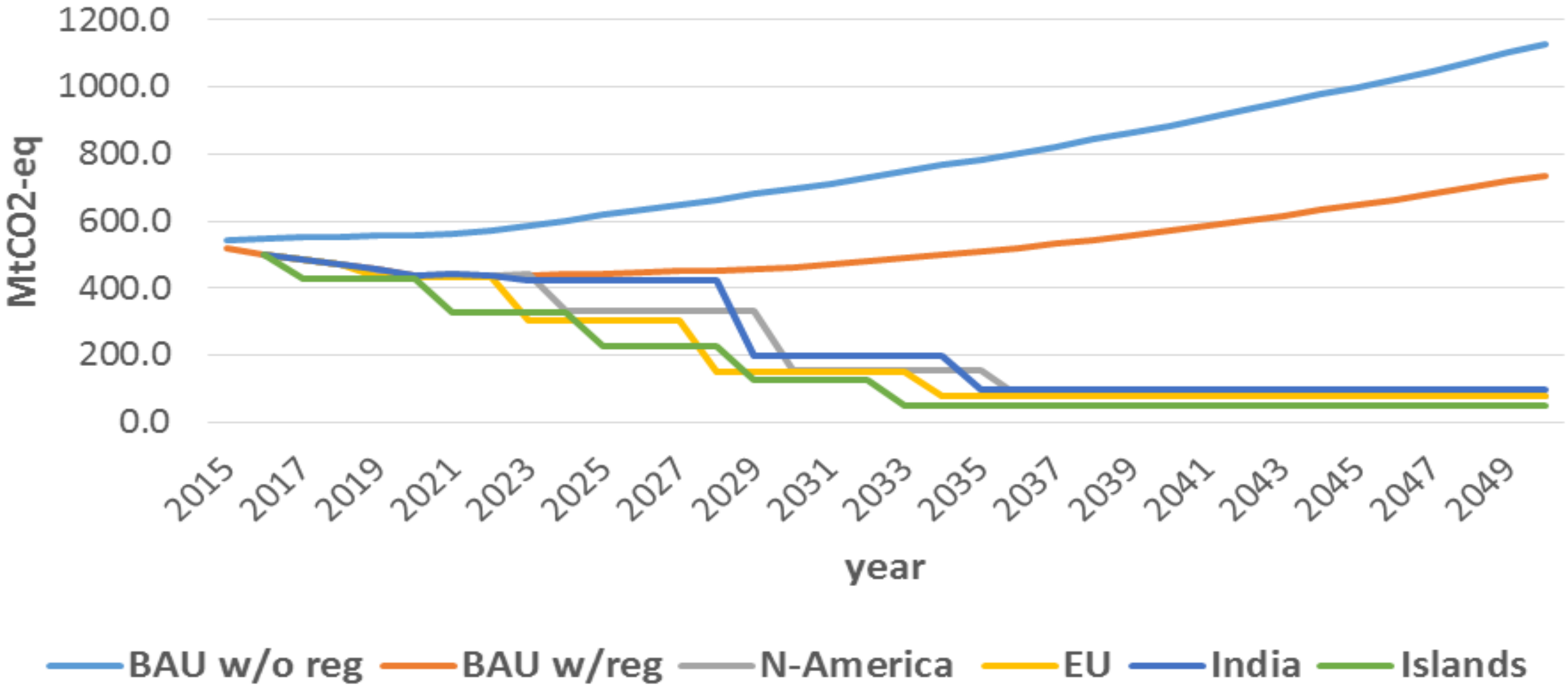
Climate benefit definition



TEAP calculation of climate benefits

- Historic HCFC consumption values are used in the calculation of HFC baselines for proposed amendments (expressed in CO_2-eq.).
- If future HCFC consumption is referred to in the baseline formulas, a best estimate of the trend in demand has been made.
- HFC consumption until 2014 is determined on the basis of available data
- HFC consumption for 2015 is checked against best HFC 2015 production estimates, to ascertain the 2015 starting point for future BAU demand calculations.
- Control schedules (based on baselines/reductions) are compared against BAU to identify the climate benefit (the difference in demand, in CO_2-eq.).

Non-Article 5 schedules



North America proposal – Non-Article 5

Baseline	Reduction steps			
Average HFC consumption plus 75% of average HCFC consumption in 2011–2013	90% 2019	65% 2024	30% 2030	15% 2036

Baseline	HFC part	HCFC part	Total
Average HFC consumption plus 75% of average HCFC consumption in 2011–2013 (Mt CO2-eq.)	488.4	68.5	556.9

Climate benefit: 10,690 Mt CO_2-eq.

EU proposal – Non-Article 5

Baseline	Reduction steps			
Average HFC consumption in 2009–2012 plus 45% of average HCFC consumption allowed under the Protocol in 2009-2012	85% 2019	60% 2023	30% 2028	15% 2034

Baseline	HFC part	HCFC part	Total
Average HFC consumption in 2009–2012 plus 45% of average HCFC consumption allowed under the Protocol in 2009-12 (Mt CO2-eq.)	448.2	102.4	550.6

Climate benefit: 11,500 Mt CO_2-eq.

India proposal – Non-Article 5

Baseline	Reduction steps				
Average HFC consumption in 2013–2015 plus 25% of the HCFC baseline consumption	100% 2016	90% 2018	65% 2023	30% 2029	15% 2035

Baseline	HFC part	HCFC part	Total
Average HFC consumption in 2013–2015 plus 25% of the HCFC baseline consumption (Mt CO2-eq.)	524.7	162.7	687.4

Climate benefit: 10,000 Mt CO_2-eq.

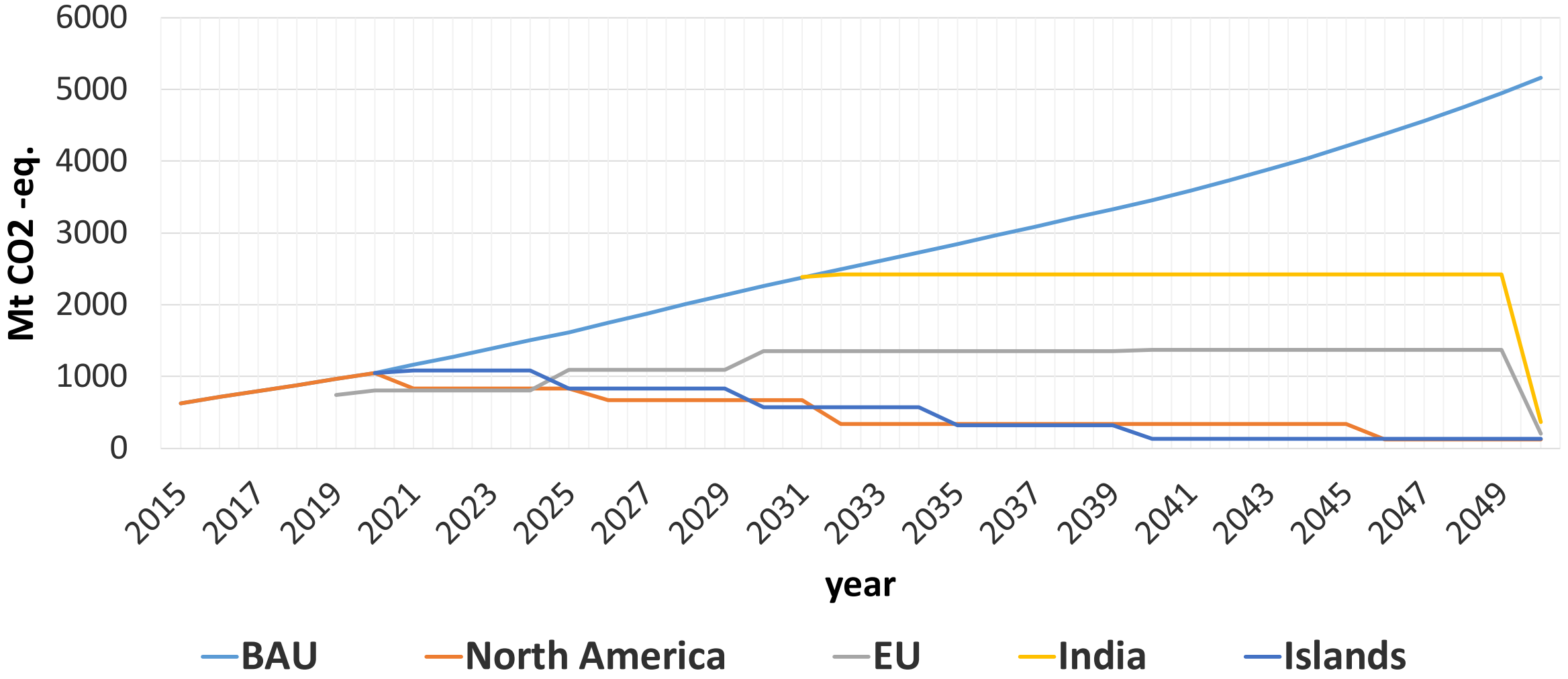
Island states proposal – Non-Article 5

Baseline	Reduction steps				
Average HFC consumption in 2011-2013 plus 10% of the HCFC baseline consumption	85% 2017	65% 2021	45% 2025	25% 2029	10% 2033

Baseline	HFC part	HCFC part	Total
Average HFC consumption in 2011-2013 plus 10% of the HCFC baseline consumption (Mt CO2-eq.)	488.4	65.1	553.5

Climate benefit: 12,470 Mt CO_2-eq.

Article 5 schedules



Cost calculations approach

- Cost calculations in this report consist of manufacturing conversion costs (including production shutdown and servicing).
- Costs for project preparation, institutional strengthening, capacity building, etc. have not been included.
- Where available, current MLF cost guidelines (for HCFC conversion) are used as a basis

Cost effectiveness factors - ranges

Sector	US$/kg
R/AC domestic	7-9
R/AC based on HFC-134a	8-10
R/AC commercial	10-15
R/AC transport/industrial	10-15
R/AC servicing	6-8
Stationary AC	11-15
Mobile AC	4-6
Foams	7-9
Fire protection	3-5
Aerosols	4-6
MDIs	None
Production closure	1.5-3.5

North America proposal – Article 5

Baseline	Red 1	Red 2	Red 3	Red 4	Red 5
Average HFC consumption plus 50% of average HCFC consumption in 2011–2013	100% 2021	80% 2026	40% 2032	15% 2046	

Baseline	HFC part	HCFC part	Total
Average HFC consumption plus 50% of average HCFC consumption in 2011–2013 (Mt CO2-eq.)	418.4	417.2	835.6

Climate benefit: 75,850 Mt CO_2-eq.

Costs to the MLF: 3,440-5,250 US$ million

EU proposal – Article 5

Baseline	Red 1	Red 2	Red 3	Red 4	Red 5
Average HCFC and HFC 2015-2016 consumption	100% 2019			15% (2050)	

Baseline	HFC part	HCFC part	Total
Average HCFC and HFC 2015-2016 consumption (Mt CO2-eq.)	671.9	700.0	1371.9

Climate benefit: 53,260 Mt CO_2-eq.

Costs to the MLF: 5,580-8,540 US$ million

The EU proposal has a freeze in 2019 at the average HCFC-HFC consumption of 2015-2016, no reduction steps (they would have to be negotiated); not taking any reductions into account until 2050 is why climate benefits are relatively low and costs high

India proposal – Article 5

Baseline	Red 1	Red 2	Red 3	Red 4	Red 5
Average HFC consumption in 2028–2030 plus 32.5% of the HCFC baseline consumption	100% 2031	---	---	15% 2050	

Baseline	HFC part	HCFC part	Total
Average HFC consumption in 2028–2030 plus 32.5% of the HCFC baseline consumption (MtCO2-eq)	2134.1	283.3	2417.4

Climate benefit: 26,130 Mt CO_2-eq.
Costs to the MLF: 9,300-14,220 US$ million

The Indian proposal has a freeze in 2031, no reduction steps (they would have to be negotiated); not taking any reductions into account until 2050 is why climate benefits are relatively low and costs high

Island states proposal – Article 5

Baseline	Red 1	Red 2	Red 3	Red 4	Red 5
Average HFC 2015-2017 consumption plus 65% of the HCFC baseline consumption	85% 2020	65% 2025	45% 2030	25% 2035	10% 2040

Baseline	HFC part	HCFC part	Total
Average HFC consumption in 2015–2017 plus 65% of the HCFC baseline consumption (Mt CO2-eq.)	710.9	566.6	1277.5

Climate benefit: 74,890 Mt CO_2-eq.
Costs to the MLF: 4,550-6,950 US$ million

Estimates of costs to the MLF

Proposal	Lower value of the cost range (US$ million)	Higher value of the cost range (US$ million)
North America	3440	5250
EU	5580	8540
India	9300	14220
Island states	4550	6950

Closing

- This report provides an assessment of the potential climate benefits and costs of the four amendment proposals for the consideration of parties.
- It builds on accepted methodology used by the TEAP related to BAU and mitigation scenarios across the various sectors of use.
- Cost calculations in this report consist of manufacturing conversion costs (including production shutdown and servicing).
- Costs for project preparation, institutional strengthening, capacity building, etc. have not been included.
- Where available, current MLF cost guidelines (for HCFC conversion) were used as a basis