The Institute for Governance & Sustainable Development

Designing an HFC Phasedown Amendment: Lessons from Past Protocol Actions

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Learning by Doing

- The Montreal Protocol has successfully guided the phaseout of ozone-depleting substances (ODSs), including the production and consumption of hydrochlorofluorocarbons (HCFCs)
- 31 years experience under the Vienna Convention and 29 years under the Montreal Protocol provide a roadmap for fair and equitable global hydrofluorocarbon (HFC) phasedown
- The Montreal Protocol framework for Amendments includes design options that can resolve any concern of Parties for successful HFC phasedown

A5 Party Control Schedules

- Stringent non-A5 Party control schedule to motivate invention, demonstrate technical choice, and achieve economy of scale and competitive price
- Reasonable A5 Party grace period, but with immediate funding for A5 Parties wishing to phase-down prior to control measures
- Phase-down after grace period comparable to the first control measures of non-A5 Parties with possibility of deciding the final steps later when technologies may be further developed and costs reduced

A5 Party Finance

- Finance for A5 Parties choosing to reduce HFC emissions early on and transitioning during the grace period
- Embracing super energy efficiency and its co-benefits including clean air, avoided power plant investment and fuel costs, agricultural productivity and health care savings
- Possibility of refining the definition of agreed incremental costs to reflect issues specific to controls on HFCs

A5 Party “Double Transition”

- Reward Parties leapfrogging HFCs previously selected to replace HCFCs
- Finance the multiple transitions from ODSs to HFCs and then to low-GWP alternatives for A5 Parties
- Anticipate that technology will continuously evolve toward lower GWP, toxicity and flammability; higher energy efficiency; and lower ownership cost through containment and recovery/recycle

A5 Party Baseline & Freeze

- Forward Base Year to allow time for A5 Party HFC production and consumption data to be reported and reconciled
- Freeze shortly following base year (~2-3 years) presuming continued growth after base year

High-Ambient Temperatures (HAT)

- Consider the advantages of a time-limited high-ambient temperature (HAT) exemption.

1 Convention, 1 Protocol, 4 Amendments and 6 Adjustments…so far

Year/MOP Location	Amendment	New Controlled Substance, Trade Measure or Production Control
1985 Vienna Convention		
1987 Montreal Protocol		CFCs (Annex A, Group I) and Halons
1990 London (2nd MOP)	London Amendment	CFCs (Annex B, Group I) Methyl Chloroform and Carbon Tetrachloride
1992 Copenhagen (4th MOP)	Copenhagen Amendment	Hydrochlorofluorocarbons, Hydrobromofluorocarbons, and Methyl Bromide
1997 Montreal (9th MOP)	Montreal Amendment	Methyl Bromide trade measures
1999 Beijing (11th MOP)	Beijing Amendment	Bromochloromethane and production controls on HCFCs

Adjustments at the 1990 2nd, 1992 4th, 1995 7th, 1997 9th, 1999 11th and 2007 19th MOP

Key Amendment Design Choices

- Controlled "Substance" and "Groups"
- Base Level and formula (average of several years)
- Control Schedules including A5 Party Grace Period
- Finance by the Multilateral Fund (MLF) for incremental costs, institutional strengthening, and capacity building
- Exemptions for essential and critical uses
- Refrigerants for servicing existing equipment
- Energy efficiency and clean air incentives

Design Choice: Substance Groups

- Compounds are typically grouped and reductions applied on a weighted basis (ODP in the past, GWP for HFCs)
- Putting one substance in a "group" allows chemical-specific control schedule (targeting or sheltering)
- Putting several substances in a group allows each Party to choose which of the substances to phase down in order to achieve the agreed GWP-weighted control measure

Control Base Level Differences

Controlled Substance	Base Level Non-A5 Parties	Base Level A5 Parties
Halons	1986	1995-1997 Average
CFCs (Annex A, Group 1)	1986	1995-1997 Average
CFCs (Annex B, Group 1)	1989	1998-2000 Average
Carbon tetrachloride	1989	1998-2000 Average
Methyl chloroform	1989	1998-2000 Average
HCFCs (Consumption)	1989 HCFC consumption + 2.8% of 1989 CFC consumption	2009-2010 Average
HCFCs (Production)	Average of 1989 HCFC production + 2.8 per cent of 1989 CFC	2009-2010 Average
Methyl Bromide	1991	1995-1998 Average

Design Choice: Control Schedule

- Control schedules for non-A5 Parties typically start first and move faster than for A5 Parties
- The Amendment can tailor the grace period, start of controls, interim steps and phaseout dates
- A5 and non-A5 Party control schedules can be adjusted separately – either accelerated or decelerated – in response to scientific and technical findings on climate urgency and technical and economic feasibility

Grace Period Design Details

- A5 Parties traditionally have “grace periods” before control schedules start and a longer phaseout period, allowing more time for technology to develop and achieve economy of scale
- Grace periods are good for some enterprises but not for those that lose competitiveness against next-generation technology while they wait for financing
- The HFC Amendment could have grace periods combined with immediate funding available for A5 Parties choosing to phase down faster than required by control measures

Grace Periods: Phaseout Dates

(the period from non-A5 phaseout to A5 phaseout)

Controlled Substance	Phaseout Date Non-A5 Parties	Phaseout Date A5 Parties	Grace Period
Halons	1994	2010	16 years
CFCs	1996	2010	14 years
Carbon tetrachloride	1996	2010	14 years
Methyl chloroform	1996	2015	19 years
HCFCs (Consumption)	2020	2030	10 years
HCFCs (Ref/AC Service)	2030	2040	10 years
HCFCs (Production)	2030	2040	10 years
Methyl Bromide	2005	2015	10 years

"Essential use" and "emergency" exemptions are available for CFCs, halons, carbon tetrachloride, methyl chloroform, HBFCs, and bromochloromethane – but not yet authorized for HCFCs.
"Critical use" and "emergency" exemptions are available for methyl bromide

Design Choice: Improved MLF Finance

- The MLF pays the agreed incremental costs; including intellectual property and safety mitigation, when necessary
- Parties can guide MLF financing of the HFC phasedown by Decisions, and Replenishment amounts (including for energy efficiency)
- The MLF Executive Committee is equally represented by A5 and non-A5 Parties that have the authority for guiding investment for ozone, climate, health and safety, cost-effectiveness, and affordability consistent with actions taken by the Parties

Design Choice: Exclude or Exempt Some Uses From Controls

- ODS Feedstocks and Process Agents are excluded from definition of controlled substance but emissions are limited
- ODS uses (so far with the exception of HCFCs) are exempted by Decision of Parties from controls globally or on a Party-by Party basis and on an emergency basis by the Ozone Secretariat and or by the Party itself

Design Choice: Time Limited Exemptions

- Global exemptions
  - Laboratory and analytical uses (with exceptions)
  - Quarantine & Pre-Shipment (methyl bromide)
- Party-specific exemptions agreed by Decision of Parties
  - Essential Use Exemptions (CFCs, halons, carbon tetrachloride, methyl chloroform, HBFCs, and bromochloromethane)
  - Critical Use Exemptions (methyl bromide)
- Party-specific exemptions not requiring agreement of Parties
  - Emergency Exemptions (up to 20 metric tonnes CFCs, halons, carbon tetrachloride, methyl chloroform, methyl bromide, HBFCs, and bromochloromethane)

Design Choice: HFCs for Servicing

- HCFC production and consumption allowed in the last ten years of phaseout only for service of refrigeration and A/C equipment
- The HFC Amendment can include similar provisions to avoid refrigerant shortages that might otherwise be expensive to equipment owners and that may encourage illegal HFC trade

Design Choice: Energy Efficiency

- A 30% increase room AC energy efficiency can double climate benefits of the HFC phasedown to 200 Gt CO2-equivalent
- Under Decision 19/6, MLF allows for 25% premium for low-GWP alternatives
- Parties/MLF can require energy efficiency just as it requires safety and environmental acceptability
- Parties/MLF finance for capacity building can put energy efficiency standards and labeling in place that account for energy, carbon footprint, air quality, and avoided power plant capacity

Backup Slides Follow

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1987 Montreal Protocol		
1990 London (2nd MOP)	London Amendment	London Adjustments
1992 Copenhagen (4th MOP)	Copenhagen Amendment	Copenhagen Adjustments
1995 Vienna (7th MOP)		Vienna Adjustments
1997 Montreal (9th MOP)	Montreal Amendment	Montreal Adjustments
1999 Beijing (11th MOP)	Beijing Amendment	Beijing Adjustments
2007 Montreal (19th MOP)		Montreal Adjustments

Agreement and Entry Into Force

Agreement/Amendment Meeting-of-Party Location	Month of Agreement	Entry Into Force	Months to Enter Into Force
1985 Vienna Convention	March 1985	September 1988	42
1987 Montreal Protocol	September 1987	January 1989	16
1990 London Amendment (2nd MOP)	June 1990	August 1992	26
1992 Copenhagen Amendment (4th MOP)	November 1992	June 1994	19
1997 Montreal Amendment (9th MOP)	September 1997	November 1999	26
1999 Beijing Amendment (11th MOP)	December 1999	February 2002	26

Industry has confidence in Montreal Protocol compliance; environmental leadership companies get a head start on next-generation technology

Grace Periods: Start of Controls

(the period between non-A5 and A5 Party start of controls)

Controlled Substance	Control Start Date Non-A5 Parties	Control Start Date A5 Parties	Start Date Grace Period
Halons	January 1, 1992	January 1, 2002	10 years
CFCs (Annex A, Group 1)	July 1, 1989	July 1, 1999	10 years
CFCs (Annex B, Group 1)	January 1, 1993	January 1, 2003	10 years
Carbon tetrachloride	January 1, 1995	January 1, 2005	10 years
Methyl chloroform	January 1, 1993	January 1, 2003	10 years
HCFCs (Consumption)	January 1, 1996	January 1, 2013	17 years
HCFCs (Production)	January 1, 2004	January 1, 2013	9 years
Methyl Bromide	January 1, 1995	January 1, 2002	7 years

This is the period where non-A5 Party controls drive technical innovation, commercialization, economy of scale and competitive prices for a choice of alternatives and substitutes

Grace Periods: Phaseout Dates

(the period from non-A5 phaseout to A5 phaseout)

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Phaseout Interval Grace Periods

(the period between first control and phaseout)

Controlled Substance	Start/Finish Non-A5 Parties	Start/Finish A5 Parties	Non-A5/A5 Interval
Halons	1992/1994	2002/2010	2/8 years
CFCs (Annex A, Group 1)	1989/1996	1999/2010	7/11 years
CFCs (Annex B, Group 1)	1993/1996	2003/2010	3/7 years
Carbon tetrachloride	1995/1996	2005/2010	1/5 years
Methyl chloroform	1993/1996	2003/2015	3/12 years
HCFCs (Consumption)	1996/2030	2013/2040	34/27 years
HCFCs (Production)	2004/2030	2013/2040	26/27 years
Methyl Bromide	1995/2005	2002/2015	10/13 years

Note that the last ten years of non-A5 and A5 Party HCFC consumption and production only for servicing of refrigeration and air conditioning equipment and that A5 Parties are allowed five times more consumption and production of base level than non-A5 Parties (2.5% and 0.5%, respectively). Non-A5 Parties had proportionally lower HCFCs as refrigerants at base level but may achieve lower leak rates during the last 10 years of phaseout than A5 Parties. The control schedules can be adjusted to account for actual leak rates and retrofit or retirement.