



SUMMARY OF THE WORKSHOP ON HYDROFLUOROCARBON MANAGEMENT AND THE THIRTY-FIFTH MEETING OF THE OPEN-ENDED WORKING GROUP OF THE PARTIES TO THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEplete THE OZONE LAYER: 20-24 APRIL 2015

The Workshop on Hydrofluorocarbon Management and the thirty-fifth meeting of the Open-ended Working Group (OEWG 35) of the parties to the Montreal Protocol on Substances that Deplete the Ozone Layer convened back-to-back in Bangkok, Thailand from 20-24 April 2015. Over 440 participants attended the workshop, while over 420 delegates representing governments, UN agencies, Montreal Protocol expert panels and committees, non-governmental organizations and industry attended OEWG 35.

The Workshop and OEWG 35 were convened in response to decision XXVI/9 of the twenty-sixth Meeting of the Parties (MOP 26) to the Montreal Protocol, which called for a two-day workshop in 2015, back-to-back with an additional three-day meeting of the OEWG, to continue discussions on all issues related to hydrofluorocarbon (HFC) management, including a focus on high-ambient temperature conditions and safety requirements, as well as energy efficiency.

OEWG 35 discussions resulted in agreement to continue to work intersessionally in an informal manner to study the feasibility and ways of managing HFCs, with a view to the establishment of a contact group on feasibility and ways of managing HFCs at OEWG 36 in July 2015.

A BRIEF HISTORY OF THE OZONE REGIME

Concerns that the Earth's stratospheric ozone layer could be at risk from chlorofluorocarbons (CFCs) and other anthropogenic substances first arose in the early 1970s. At that time, scientists warned that releasing these substances into the atmosphere could deplete the ozone layer, hindering its ability to prevent harmful ultraviolet rays from reaching the Earth. This would adversely affect ocean ecosystems, agricultural productivity and animal populations, and harm humans through higher rates of skin cancers, cataracts and weakened immune systems. In response to this, a UN Environment Programme (UNEP) conference held

in March 1977 adopted a World Plan of Action on the Ozone Layer and established a Coordinating Committee to guide future international action.

VIENNA CONVENTION: Negotiations on an international agreement to protect the ozone layer were launched in 1981 under the auspices of UNEP. In March 1985 the Vienna Convention for the Protection of the Ozone Layer was adopted. It called for cooperation on monitoring, research and data exchange, but did not impose obligations to reduce ozone depleting substances (ODS) usage. The Convention now has 197 parties, which represents universal ratification.

MONTREAL PROTOCOL: In September 1987, efforts to negotiate binding obligations to reduce ODS usage led to the adoption of the Montreal Protocol on Substances that Deplete the Ozone Layer (MP). The MP introduced control measures for some CFCs and halons for developed countries (non-Article

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5 countries). Developing countries (Article 5 countries) were granted a grace period allowing them to increase their ODS use before taking on commitments. The Protocol has 197 parties.

Since 1987, several amendments and adjustments have been adopted, adding new obligations and additional ODS, and adjusting existing control schedules. Amendments require ratification by a particular number of parties before they enter into force; adjustments enter into force automatically.

LONDON AMENDMENT AND ADJUSTMENTS:

Delegates to the second Meeting of the Parties to the MP (MOP 2), held in London, UK, in 1990, tightened control schedules and added ten more CFCs to the list of ODS, as well as carbon tetrachloride (CTC) and methyl chloroform. The London Amendment has been ratified by 197 parties. MOP 2 also established the Multilateral Fund (MLF), which meets the incremental costs incurred by Article 5 countries in implementing the Protocol's control measures and finances clearinghouse functions. The Fund is replenished every three years.

COPENHAGEN AMENDMENT AND ADJUSTMENTS:

At MOP 4, held in Copenhagen, Denmark, in 1992, delegates tightened existing control schedules and added controls on methyl bromide, hydrobromofluorocarbons and hydrochlorofluorocarbons (HCFCs). MOP 4 also agreed to enact non-compliance procedures. It established an Implementation Committee to examine possible non-compliance and make recommendations to the MOP aimed at securing full compliance. The Copenhagen Amendment has been ratified by 197 parties.

MONTREAL AMENDMENT AND ADJUSTMENTS: At MOP 9, held in Montreal, Canada, in 1997, delegates agreed to: a new licensing system for importing and exporting ODS, in addition to tightening existing control schedules; and banning trade in methyl bromide with non-parties to the Copenhagen Amendment. The Montreal Amendment has been ratified by 197 parties.

BEIJING AMENDMENT AND ADJUSTMENTS: At MOP 11, held in Beijing, China, in 1999, delegates agreed to controls on bromochloromethane, additional controls on HCFCs, and to reporting on methyl bromide for quarantine and pre-shipment applications. The Beijing Amendment has been ratified by 196 parties.

MOP 21: MOP 21 took place in Port Ghalib, Egypt, in 2009 and adopted decisions on: alternatives to HCFCs; institutional strengthening; environmentally sound management of ODS banks; methyl bromide; and data and compliance issues. This was the first meeting at which delegates considered, but did not agree on, a proposal to amend the Protocol to include HFCs submitted by the Federated States of Micronesia (FSM) and Mauritius.

MOP 22: MOP 22 took place in Bangkok, Thailand, in 2010 and adopted decisions on, *inter alia*: the terms of reference for the Technology and Assessment Panel (TEAP) study on the MLF replenishment and the evaluation of the financial mechanism; and assessment of technologies for ODS destruction. Delegates considered, but did not agree to, two amendments proposed to address HFCs under the Protocol, one submitted by the US, Mexico and Canada and another submitted by FSM.

COP 9/MOP 23: COP 9/MOP 23 took place in Bali, Indonesia, in 2011 and adopted decisions on, *inter alia*: a US\$450 million replenishment of the MLF for the 2012-2014 period; updating the nomination process and recusal guidelines for the TEAP; the treatment of ODS in relation to service ships; and additional information on alternatives. Delegates also discussed the two proposed amendments to the Protocol to address HFCs, but no agreement was reached.

MOP 24: MOP 24 took place in Geneva, Switzerland, in 2012 and adopted decisions on, *inter alia*, the review by the Scientific Assessment Panel (SAP) of RC-316c; procedural issues related to the TEAP and its subsidiary bodies; and data and compliance issues. MOP 24 did not reach agreement on two draft decisions on: clean production of HCFC-22 through by-product emission control; and amendment of the MP to include HFCs.

MOP 25: MOP 25 was held in Bangkok, Thailand, in 2013. The MOP adopted 21 decisions, including on: terms of reference for the study of the 2015-2017 MLF replenishment; implementation of the MP with regard to small island developing states (SIDS); and a TEAP report on ODS alternatives. MOP 25 did not reach agreement on: amendment proposals; additional funding for the MLF for implementing the Protocol to maximize the climate benefit of the accelerated phase-out of HCFCs; and the harmonization and validation of the climate impact fund.

COP 10/MOP 26: COP 10/MOP 26 was held in Paris, France, in 2014 and adopted decisions on, *inter alia*: a US\$507.5 million replenishment of the MLF for the 2015-2017 period; availability of recovered, recycled or reclaimed halons; and a TEAP report on ODS alternatives. Delegates also discussed possible ways to move the HFC issue forward, deciding to convene a two-day workshop in 2015, back-to-back with an additional OEWG session, to continue discussions on HFC management, including a focus on high-ambient temperature and safety requirements, as well as energy efficiency.

SUMMARY OF THE WORKSHOP ON HFC MANAGEMENT

On Monday, Tina Birmpili, Executive Secretary, Ozone Secretariat, explained that the workshop was designed to identify the technical and other issues involved with transitioning to low global warming potential (GWP) HFCs and alternatives to HFCs. She outlined that OEWG 35 would then look at the policy implications of the issues identified. She expressed hope that the workshop would enable all positions and issues to be clearly defined, understood and respected, and identify a path forward.

A.R. Ravishankara, SAP Co-Chair, noted that while HFC abundance in the atmosphere is still low, it is the most rapidly growing group of chemicals accumulating in the atmosphere, and future HFC emissions may significantly undermine achievements toward the 450 ppm CO₂ stabilization targets.

Bella Maranion, TEAP Co-Chair, reported HFC demand for 2012-2014 in GWP terms is 85% from the refrigeration and air conditioning (RAC) sector, 8% from foam and 7% from other sectors. She said the business as usual (BAU) scenario for RAC suggests rapidly growing demand among Article 5 countries from 2015-2030, which will have a substantial and further increasing climate impact. She reported projections for blowing agent demand suggest it will continue to grow, with critical

sectors still potentially dependent on HFCs. She concluded by observing that the emerging availability of high-performance, low-GWP refrigerants will not provide a single solution and transition will vary by sub-sector.

Lambert Kuijpers, Technical University Eindhoven, the Netherlands, referring to the TEAP Task Force XXV/5 report on alternatives, drew attention to the high growth of HFC demand and emissions extrapolated, towards 2030 and 2050, respectively, under the BAU scenario. He noted the need for better management and use, good practice and control, particularly at sector and subsector level.

Ray Gluckman, Gluckman Consulting, UK, highlighted HFC consumption reporting that HFC use in RAC and heat pumps (RACHP) is highest in both weight and CO₂ equivalent, the latter due to the higher average GWP of HFCs used in RACHP. He explained that HFC use for topping up leaks in RACHP is greater than HFCs used for filling new equipment, due to the high leakage in RACHP.

Sukumar Devotta, National Environment Engineering Institute, India, discussed methods to reduce HFC consumption including through the: use of lower GWP alternatives in new equipment; use of lower GWP alternatives in existing equipment particularly by larger R-404A systems; leak prevention through better manufacturing approaches; and use of reclaimed HFCs.

SESSION 1: CHALLENGES AND OPPORTUNITIES IN ADDRESSING HIGH-GWP HFCs IN THE REFRIGERATION SECTOR

On Monday morning, Peter Adler, Accord 3.0, served as facilitator and Ullrich Hesse, Technische Universität Dresden, Germany, served as rapporteur for the session.

OVERVIEW OF THE SECTOR'S STATUS: Paulo Vodianitskaia, Consultant, Brazil, highlighted that low-GWP options are available and applicable to multiple sectors and different climatic regions. He cautioned that many refrigerants are non-renewable and called for global safety standards, as standards currently vary.

Reinhard Radermacher, University of Maryland, encouraged a stronger emphasis on energy efficiency in the refrigeration sector and suggested taking a life-cycle approach.

PANEL DISCUSSION: Torben Funder-Kristensen, Danfoss, Denmark, discussed the availability of components and the implications thereof for system design when using low-GWP chemicals and blends in the refrigeration sector. He stated low-GWP chemicals for refrigeration are commercially available, however safety remains a challenge. He emphasized legal certainty as important for industrial actors and investments.

Jonathan Ayotte, Carnot Réfrigération, Canada, discussed low-GWP technology options for medium-sized and larger industrial systems under various ambient conditions. He indicated that his company stopped using HFCs seven years ago in the manufacture of refrigerants for all climate zones.

Eric Delforge, Mayekawa, Belgium, discussed low-GWP technology options for industrial and large commercial and community applications. He suggested the use of ammonia for refrigeration, calling it a safe, affordable, and widely available choice with low GWP.

Roy Singh, Arctic King Appliances, South Africa, discussed alternative options for plug-in cabinets, including for high-ambient temperature regions, and vending machines. He pointed to challenges in Southern Africa in transitioning to lower-GWP refrigerants, including deficient information, lack of access to international information and suggested further research.

Bruno Pussoli, Metalfrio, Brazil, discussed low-GWP alternatives for small commercial equipment, suggesting propane and CO₂ as refrigerants.

Christian Heerup, Danish Technological Institute, Denmark, discussed low-GWP alternatives for on-site-built commercial refrigeration equipment and cost implications and performance in high-ambient temperatures. He stated that the European and Japanese supermarket sectors, and new European Union (EU) regulations, have driven technological innovations in the commercial refrigeration sector.

Zhang Zhaohui, China Refrigeration and Air-Conditioning Industry Association, said whether drop-in, retrofitting or replacement of existing equipment is chosen, a certain level of financial support is needed to ensure widespread replacement. He stressed the importance of promoting responsible use during operation, servicing and disposal, stages of refrigerants, awareness raising and training of technicians, particularly regarding flammable refrigerants.

Paul de Larminat, Johnson Controls, France, discussed low-GWP options for cascade systems for medium-sized and larger commercial refrigeration equipment. He noted the downsides of a same direct system with a lower-GWP blend such as R-407A or the use of indirect systems, and suggested that a cascade system of CO₂ for low-temperatures and glycol chiller for medium temperature could serve as a viable alternative.

Fernando Galante, EPTA Group, Argentina, discussed the end users' perspective regarding technological transition and barriers in Article 5 countries for commercial refrigeration. He stressed the main barrier to uptake is money, with other key barriers including: the availability of components, especially in regions outside large cities; limited technical capabilities in management of low-GWP alternatives; safety; final disposal of existing HFCs; and general resistance to change.

Juergen Goeller, Carrier, discussed the performance of low-GWP supermarket systems in various climate zones, including in high-ambient temperatures. He suggested that CO₂-based systems are already being applied in Southern Europe and recent innovations suggest potential for their application in high-ambient temperatures.

Holger Koenig, Consultant, Germany, discussed low-GWP alternatives and standards for transport refrigeration, including intermodal reefer containers, road transport and refrigeration on-board vessels. He said technologies are already available for this sector that include hydrocarbons, with detailed risk assessments already undertaken, but that much more is required in terms of training, education and understanding of safety considerations. He urged clear guidelines from policy makers regarding acceptable levels of GWP.

The session then considered questions from participants, including inputs from online participants. On commercial refrigeration, participants discussed the potential of natural refrigerants, noting that while technology and innovation have

exceeded expectations, several of those described in the factsheet are still very new and unavailable, and are unlikely to become affordable to Article 5 countries in the near future. They also discussed the potential of using ammonia on rooftops as it is lighter than air, while noting the constraints of commercializing ammonia due to its toxicity.

On industrial refrigeration, participants noted it is already using natural systems, particularly ammonia, and that many new industries are considering this option. It was noted that comparisons between natural and synthetic systems are difficult to make due to differences in ambient temperatures where they are applied. One panelist noted that although solar can be used in ammonia coolers, it is not cost efficient. Another participant enquired on the possibility of converting cooling systems from using HCFC-22 refrigerant to ammonia. Some participants reported incompatibility of equipment, saying that propane, although thermodynamically feasible, is highly flammable.

On transport refrigeration, the discussion focused on, *inter alia*: availability of HFC alternatives for transport systems moving between climatic zones; timelines for transitioning from HFCs and the role of policy and market incentives; the use and acceptance of hydrocarbons in different regions; and safety concerns.

The session closed with general comments from panelists, including on: energy efficiency; system scales; heat recovery and reuse; leakage rates and how to reduce leakage, such as taxing; technical capabilities in the sector; political commitment; and barriers, including safety concerns and investment costs.

SESSION 2: CHALLENGES AND OPPORTUNITIES IN ADDRESSING HIGH-GWP HFCs IN THE STATIONARY AIR-CONDITIONING AND HEAT PUMP SECTOR

On Monday afternoon, Facilitator Saleem Ali, University of Queensland, Australia, opened the session. Richard Abrokwa-Ampadu, Consultant, Canada, served as rapporteur.

OVERVIEW OF THE SECTOR'S STATUS: Daniel Colbourne, Consultant, UK, reviewed the status of low-, medium- and high-GWP refrigerant options for small self-contained air conditioning (AC) units, small split AC, and larger split and other types of air-to-air systems.

Roberto Peixoto, Maua Technology Institute, Brazil, discussed the status of chillers/chilled water systems and heating-only heat pump sectors. He noted that chillers have more options and fewer restrictions than other AC systems since these are often placed outdoors or in machinery rooms. Regarding heat pumps, he noted that CO₂ provides good performance. He reviewed options for dealing with existing equipment, but noted that all involve lower performance *vis-à-vis* the HFC refrigerant R32. He noted the need for more data on the performance of systems and equipment under high-ambient temperature conditions. He suggested that the two biggest challenges are training and formalization of the servicing sector, and establishing a good regulatory and standards framework for responsible use of refrigerants.

Saurabh Kumar, Energy Efficiency Services Limited (EESL), India, highlighting how EESL has developed a market-based mechanism to help scale up demand for AC systems that involve

low-GWP ODS alternatives, through aggregating demand to bring economies of scale and drive down costs, promote risk mitigation and reduce financial risks.

PANEL DISCUSSION: Mike Thompson, Ingersoll Rand/Trane, US, discussed the availability and implications for system design and characteristics of low-GWP chemicals and blends in the AC sector. He said that while his company did not yet have low-GWP solutions for all applications they manufacture, that options exist for direct drop-ins to 410A systems that bring better energy efficiency and less flammability than other alternatives on the market.

Jitendra Bhambure, Blue Star, India, discussing alternatives to high-GWP HFCs for AC, noted the need for environmental impact assessments on HFC blends and hydrofluoroolefins (HFOs) and for solutions for energy efficiency in high-ambient temperature conditions.

Bassam Elasaad, Consultant, Lebanon, reported on migration from HCFC-22 refrigerants to HC-290 and HFC-32 in high-ambient countries saying there is a need to consider economic impacts of these alternatives and support for technological transfer.

Maher H. Mousa, Consultant, Saudi Arabia, discussed alternatives for AC units in high-ambient temperatures, with emphasis on energy efficiency. He said there is a need to ensure adequate safety codes and standard readiness during the transition from HFCs in high-ambient temperature countries.

Petter Nekså, SINTEF, Norway, discussed the use of non-HFC refrigerants in small and medium-sized AC and heat pump units. He said CO₂ use requires high-pressure components, which are a challenge in applications in high-ambient temperatures.

Ting Xun Li, Midea and Sun Yat-sen University, China, discussed experiences of HC-290 refrigerant use in AC, emphasizing that its performance is similar to HCFC-22 although safer since it is hard to ignite and does not explode. Wang Lei, China Household Electric Appliances Association, noted that HC-290 was however restricted by low recharge capacity, which reduces energy efficiency and increases cost.

Alaa Olama, Consultant, Egypt, remarked that existing large AC air-to-air systems using low-GWP refrigerants in development are yet to be commercialized and made available to high-ambient temperature countries.

Pär Dalin, DEVCCO, Sweden, presented district cooling's impact on HFC phase-down by use of low-GWP refrigerants, showing the example of Stockholm, where cooling solutions have been provided to more than 100 customers and approximately 600 buildings with a total output of 450 GWh.

Facilitator Ali invited delegates to comment on overarching issues concerning the panelist presentations, to which delegates discussed the need to take a systems perspective, an emphasis on safety procedures and training, and tradeoffs between energy efficiency and system capacity when using low-GWP alternatives. Participants next addressed the AC subsector or air-to-air systems, discussing, *inter alia*: district cooling challenges, such as regulatory hurdles in building codes and the role of local authorities and the real estate sector to implement district cooling, as well as water scarcity concerns for chiller applications in district cooling, especially in high-ambient temperatures; the differences between variable refrigerant flow

systems in cold and warm climates; how regulation can serve as a support or hindrance, for example on safety concerns for new and non-flammable refrigerants; and the need to take a system approach with respect to the tradeoffs between HFCs and lower GWP alternatives regarding energy efficiency and safety, as well as leakage prevention technologies.

SESSION 3: CHALLENGES AND OPPORTUNITIES IN ADDRESSING HIGH-GWP HFCs IN MOBILE AIR-CONDITIONING

Facilitator Ali opened this session on Monday afternoon. Gursaran Mathur, Carlsonic Kansei, US, served as rapporteur.

OVERVIEW OF THE SECTOR'S STATUS: Predrag Pega Hrnjak, University of Illinois at Urbana-Champaign, US, outlined the challenges and opportunities facing the mobile air conditioning (MAC) sector in high-GWP HFC phase-down. He reported ongoing replacement of R134a refrigerant with HFO1234yf, which performs best at higher ambient temperatures. CO₂, he noted, is best for lower temperatures.

PANEL DISCUSSION: Pradit Mahasaksiri, Denso, Japan, discussed the environmental impacts of MAC in high-ambient temperatures, showing evidence from the Association of Southeast Asian Nations region that higher leakage occurs at higher ambient temperatures.

Jianping Chen, Shanghai Jiao Tong University, China, reported on costs and safety issues required when phasing into low-GWP refrigerants in Article 5 MAC production. Presenting the pros and cons of various refrigerants, he concluded that the most reasonable choice must consider energy consumption and thus life-cycle climate performance.

Enrique Peral-Antúnez, Renault, France, reported that the market situation for the currently promoted low-GWP HFO1234yf is unreasonable since only two providers are allowed to commercialize it. This, he noted, has set a case for R445A as an option, as it presents the best compromise between efficiency and climatic conditions and has greater potential in electric vehicles and hybrids.

Sangeet Kapoor, Tata Motors, India, presented opportunities and challenges of using secondary loop MAC, leak sensors and relief valves to mitigate flammability risk of R152A and HFO1234yf refrigerants.

In the ensuing discussions, participants continued debating on compromises of performance, risk, efficiency and cost for MAC refrigeration. They noted the lack of adequate research and development in CO₂ for MAC, in spite of recognition of its potential. Several participants lamented that the cost barrier of HFO1234yf is a limiting factor to its use since its patent does not expire until 2023. One panelist noted that the current situation of MAC refrigeration does not distinguish Article 5 from non-Article 5 countries.

SESSION 4: CHALLENGES AND OPPORTUNITIES IN ADDRESSING HIGH-GWP HFCs IN THE FOAM SECTOR

Facilitator Ali opened this session on Tuesday morning. Enshan Sheng, Huntsman Polyurethane Asia, served as rapporteur.

OVERVIEW OF THE SECTOR'S STATUS: Paulo Altoé, Dow Brazil, presented on challenges and opportunities to eliminate HFCs in domestic and commercial foam applications,

with challenges including a low return on investment for small- and medium-sized enterprises (SMEs), flammability, blowing agent availability, mechanical performance and energy efficiency.

Igor Croiset, GIZ Proklima Consultant, Switzerland, provided an overview of closed-cell rigid foams used for thermal insulation. He highlighted factors affecting foam performance including chemical makeup, insulation requirements, temperatures, design requirements, energy efficiency, and its human use and application.

PANEL DISCUSSION: Kultida Charoensawad, Federation of Thai Industries, described the phase-in of low-GWP chemicals in the foam industry, explaining that Thai foam enterprises have one year before restrictions on HCFC-141 commence.

Ashok Chotani, Isofoam, Kuwait, discussed alternatives currently offered in the extruded polystyrene (XPS) industry, compromises on physical properties, and cost constraints on process development. He said the choice of foam agent is often region-specific, balancing availability of high-performance products with low GWP and cost.

Samir Arora, Industrial Foams, India, discussed safe and commercially viable low-GWP alternatives for micro-, small- and medium-sized enterprises. He stated HFOs are being adopted as alternative blowing agents, but are not commercially viable for SMEs in Article 5 countries.

Stefano Verga, Cannon Group, Italy, discussed HCFC substitutes, calling pentane a viable alternative. He suggested EU umbrella projects on energy efficiency in buildings to test new customized solutions.

Achara Bowornprasitkul, BASF, Thailand, stated that the majority of foams used in refrigeration have started to convert to low-GWP blowing agents.

In the ensuing discussions on XPS, one participant noted that achieving the R-value of 5 while ensuring an ozone depletion potential of zero, is a difficult standard to achieve, stating most products have values between 2 and 4, and urged regulatory bodies to compromise to reduce such barriers of XPS product penetration in some countries. One participant expressed concern that hexachlorobutadiene is considered a persistent organic pollutant under the Stockholm Convention, underscoring the need to ensure its effective phase-out in XPS use.

On high volume Polyurethane- (PU) type products, participants questioned the current commercialization and availability of fourth generation blowing agents, and a representative of BASF said that there are few suppliers, particularly in the US. Participants also noted that the prices were ten times more than those of HCFCs currently in use.

Discussing safety of low-volume PU-type factory production, one participant remarked on the need for consideration of carcinogenic properties in addition to flammability. Participants also noted the need to ensure personal protective equipment for workers exposed to risk. On flammability, one panelist emphasized that evaporation of pre-blended PUs is 60% less than of pure pentane and that they are therefore more stable for use, particularly by SMEs and in high-ambient temperature conditions.

During discussions on PU-type, site-produced spray foam, participants noted that water-blown super-critical CO₂ has varying levels of performance, but is a good option for thermal

insulation. One panelist concluded that even though replacing HFCs with HFOs is technically difficult, there is no “one size fits all” solution, but rather a need to address the balance between foam technology and cost, both which are a factor of time.

SESSION 5, OVERARCHING AND CROSS-CUTTING ISSUES ON TECHNICAL ASPECTS OF HFC MANAGEMENT

Held on Tuesday, Session 5 was divided into two parts. Peter Adler facilitated both sessions and Chandra Bhushan, Centre for Science and Environment, India, served as rapporteur.

OVERARCHING AND CROSS-CUTTING ISSUES:

Mack McFarland, Global Fluorochemical Producers’ Forum, reviewed the low-GWP solutions for current HFC uses in MAC, residential and light commercial AC, commercial chillers, domestic refrigeration, commercial refrigeration, insulating foam, aerosols and solvents. He said the takeaway message should be: that for primary applications there exist multiple alternatives from multiple suppliers; all are commercially available, with more under development; all are low in toxicity; and all are low- or non-flammable.

Marc Chasserot, Shecco, reviewed global trends in the use of natural refrigerants, saying there is choice among such refrigerants and increasing competition and cost efficiencies among them. He highlighted the growth of CO₂ systems in the commercial sector, particularly food retail in Japan and China, and growing interest in ammonia and hydrocarbon systems in North America.

PART 1: COSTS OF CONVERSION, INTELLECTUAL PROPERTY RIGHTS, ACCESSIBILITY TO LOW-GWP ALTERNATIVES AND TIMELINE OF AVAILABILITY FOR NEW TECHNOLOGIES: Conversion Challenges Faced by Companies in Article 5 Countries: Ravinder Mehta, Refrigeration and Air Conditioning Manufacturers Association, India, discussed the regulatory and economic challenges faced by companies in Article 5 countries in converting to low-GWP options. He called for: an extension of the HCFC phase-out schedule to ensure the availability of mature, safe, economically viable low-GWP alternative technologies; more research and development and evaluation demonstration projects in Article 5 countries; and expedition of evaluations of low-GWP refrigerants in high-ambient temperatures.

Predrag Pega Hrnjak, University of Illinois at Urbana Champaign, US, cautioned when discussing the costs of non-HFC technologies to differentiate between the costs of the refrigerant and the costs of the mechanical systems. He refuted the idea that there is a “hidden agenda” involving intellectual property in the search for low-GWP alternatives, and suggested it would be useful to examine ways to make it easier for the entry of chillers of hydrocarbon refrigeration/AC systems in Article 5 countries.

Saying cost is critical for any conversion, Miquel Quintero, Consultant, Colombia, compared and contrasted the capital costs and operation costs of different HFC alternatives, namely hydrocarbons, methylal, methyl formate, CO₂, Formacel 1100, Solstice Liquid BA, and Forane 1233zd.

Alistair McGlone, Consultant, UK, discussed the impact of intellectual property rights on technology transfer and development, with a particular focus on the role of patents. He

noted in the history of the Montreal Protocol patents had not proven to be an obstacle, conceded that this did not preclude it becoming an issue in the future, but he did not “expect it to be a show stopper.” He suggested that, if needed, MP parties could always mandate the MLF to include licensing for key patented processes.

During the ensuing discussions, participants: noted the need for balancing the conversion to low-GWP refrigerants with the push to increase energy efficiency; discussed ways to increase system efficiency without high increases in cost; and discussed whether the costs of patents will be an impediment to conversion.

Domestic Legislation, Industry Initiatives, and the Cost and Availability of Low-GWP Alternatives: Andrea Voigt, European Partnership for Energy and the Environment, described Europe’s new F-Gas rules, indicating that it is not refrigerant specific but based on CO₂ equivalency, allowing manufacturers the flexibility to select the best refrigerants from a safety economic and environmental perspective. She emphasized that European rules will result in impacts outside Europe since they apply to both European manufacturers and importers.

Rajan Rajendran, Emerson, US, discussed examples of low-GWP alternatives, which refrigeration and AC industries are scheduling to phase in. He referred to phase-down efforts as a “journey, not a destination,” highlighting lower, as opposed to low, GWP alternatives, cautioning that future issues may arise that will also need to be addressed.

Kevin Fay, Alliance for Responsible Atmospheric Policy, underscored that the Montreal Protocol is the best case study of technical innovation. He reminded participants they do not have to find chemical substitutes, but to provide the policy and market signals to move the process forward. He lauded individual regulatory efforts in the EU, US and Japan, but said global efforts are needed for a wider transition.

Following plenary presentations, Facilitator Alder led an audience discussion on, *inter alia*: MLF funds to support a transition to low-GWP alternatives, including for specific companies; where patents for low-GWP alternatives are based, and how many are based in Article 5 countries; pricing and availability of natural refrigerants; phase-down versus phase-out of certain chemicals; the current contribution of HFCs to greenhouse gas (GHG) emissions and projected trajectories; and training and education efforts.

McFarland and Chasserot offered final comments, noting that it is not just industrial actors looking for lower-GWP alternatives but also consumers, and the need for policy certainty to support alternative technologies.

PART 2: ENERGY EFFICIENCY, SAFETY, INDUSTRY’S RESPONSE TO LOW-GWP POLICIES: Samir Hamed, Petra Engineering Industries Company, Jordan, discussed overall issues in adequate design for high-ambient temperature operation. He said designs for high-ambient temperature operations require special care to avoid excessive condensing temperatures and getting too close to critical temperature of the refrigerant. He stressed the need for certification of components, safety standards and adequate training of technicians.

Hisham Mikhi, Millennium Energy Technologies, Jordan, presenting on costs associated to transitioning to low-GWP options, reported that the absorption of a low-GWP chiller is four times more expensive than a conventional chiller but may have a 7-15 year payback period and a lifetime of up to 25 years.

Presenting on the status of safety standards for low-GWP alternatives, Paul Fu, Underwriters Laboratories, China, highlighted standards that his company has developed for household and commercial heating and cooling systems, dehumidifiers and AC room systems.

Asbjørn Vonsild, Danfoss, Denmark, discussed challenges regarding flammability concerns and related safety standards. He said that safety standards are written by industry, thus focusing on interests of the manufacturers and not based on best practice. On levels of acceptable risk, Vonsild said that if current risk levels maintained in kitchens are acceptable, then propane may be accepted as a safe refrigerant in AC, but cautioned that industry should not be allowed to choose risk levels for consumers.

Marco Buoni, Air Conditioning and Refrigeration European Contractors' Association, discussed training and certification schemes for handling of low-GWP alternative refrigerants. He emphasized the importance of certified technicians trained in the purchase, installation, repair and dismantling of AC, refrigeration and heat pumps in order to ensure safe and environmentally-friendly handling of low-GWP alternatives.

Manuel Azucena, Refrigeration and Air Conditioning Technicians for Development Association of the Philippines, said when good practices are used refrigerants are safe, provided that technicians are competent and certified to handle them. He highlighted efforts by his organization to improve standards of practice in RAC and the development of competencies in refrigerant recovery, recycling and retrofitting.

Tetsuji Okada, Japan Refrigeration and Air Conditioning Industries Association, Japan, said leakage from use and disposal of refrigeration equipment is responsible for more than 80% of emissions. He emphasized leakage management should be addressed throughout the life-cycle of fluorocarbons by ensuring equipment is energy saving, that refrigerants are recovered, and accelerating the shift to new refrigerants.

Julio Esteban, Smart Refrigerants, Panama, elaborated on the importance of leakage reduction through refrigerant recovery. He reported on possibilities of mixing different refrigerants during recovery, and recommended setting up recovery centers.

In the ensuing discussion, panelists answered questions from the participants concerning: energy efficiency comparisons between different types of chillers; the certification dimension of low-GWP alternatives that perform well in high-ambient temperatures; how to determine the best alternative for different applications in high-ambient temperatures; the use of micro-channel heat exchangers in heat pump units; the efficiency difference between photovoltaic and solar absorption cooling; whether safety, fire and building codes in the US and Europe allow for R-717 based chillers in dense urban environments; the length and complexity of the safety standard-setting process in the International Standards Organization context; the difference between ASHRAE and European standards; whether Article 5 countries have the necessary infrastructure to mandate leakage

management, especially for large commercial and industrial RAC equipment; the importance of reclamation centers for Article 5 countries; how best to ensure technicians are properly trained and certified; and prospects for technology to reclaim/recycle low-GWP alternatives to HFCs.

In response to Facilitator Adler's request for final thoughts, Hamed cautioned that manufacturers cannot take the lead in all aspects of conversion, rather other parties have to share in the development and costs, including certification and training. Mikhi said there is a huge opportunity to improve energy efficiency in AC, and stressed the need for more work on this. Vonsild underscored the role of conducting a risk assessment for refrigerant charges above those currently allowed under existing standards. Buoni called for a focus on preventing the illegal market in refrigerants and ensuring increased certification of technicians. Azucena emphasized the importance of promoting consumer awareness. Okada stressed that conversion takes time, and must be undertaken step-by-step. Esteban reiterated the importance of creating reclamation centers in Article 5 countries so that technicians have somewhere to take the fluids collected during conversions.

SESSION 6: KEY CONCLUSIONS RELEVANT TO POLICYMAKING ON TECHNICAL MANAGEMENT OF HFCs

On Tuesday afternoon, Adler facilitated this session, and Karin Shepardson, World Bank, and Stephan Sicars, UN Industrial Development Organization (UNIDO), served as session rapporteurs.

Ullrich Hesse, Session 1 rapporteur, reviewed the challenges and opportunities to address high-GWP HFCs in the refrigeration sector providing examples pertaining to the domestic, commercial, industrial and transport subsectors. He identified commercial refrigeration as the largest contributor to CO₂ equivalent (CO₂e) in the sector. He reiterated, *inter alia*: that there is no one single fluid solution; the need for reliable, safe and efficient low-GWP alternatives; an emphasis on training and education concerning flammability; and low-GWP alternatives, such as HFOs, CO₂ and ammonia, in use in certain regions and some subsectors.

Richard Abrokwa-Ampadu, Session 2 rapporteur, recapped the challenges and opportunities in addressing high-GWP refrigerants in the stationary AC and heat pump sector, with specific attention to the concerns regarding high-ambient temperatures. He highlighted, *inter alia*, the need for harmonized safety standards, training and education, particularly on flammability, and stated that there is no clear consensus in subsectors on specific alternatives.

Gursaran Mathur, Session 3 rapporteur, summarized key messages from the session on challenges and opportunities in addressing high-GWP HFCs in MAC. He pointed to the fact that MAC is the only sector globally regulated and that phase-out of HFCs started in MAC earlier than in other sectors, while urging the need to work together to ensure global solutions for industry and reducing GHGs.

Enshan Sheng, Session 4 rapporteur, presented key messages on challenges and opportunities in addressing high-GWP HFCs in the foam sector. He noted that the foam sector is still a small

sector that consumes few HFCs, but that there are important considerations for both large enterprises and SMEs, with many of the challenges related to scale.

Chandra Bhushan, Session 5 rapporteur, summarized key issues, including: availability and cost of low-GWP alternatives; intellectual property rights and issues; energy efficiency; issues related to high-ambient temperatures; flammability and safety standards; leakage reduction; recovery and reuse; and training, tools and capacity building.

Shepardson and Sicars summarized key conclusions relevant for policymaking, as identified in the different sessions. Underscoring the growth of HFCs as a GHG due to their use as ODS substitutes, the rapporteurs reiterated the need for clear policy signals, as well as appropriate burden and cost sharing, for example through making use of the MLF. They indicated that feasible alternatives vary for the different sectors and regions, noting the special conditions of high-ambient temperatures, and identified that as the range of solutions broaden, so do the stakeholders involved. They reiterated the need for training, education and updated building codes and standards.

Facilitator Adler closed the Workshop at 6:18 pm.

OEWG 35 SUMMARY

Co-Chair Emma Rachmawaty (Indonesia) opened the thirty-fifth session of the Open-ended Working Group (OEWG 35) of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer on Wednesday, 22 April 2015.

In her opening remarks, Executive Secretary Tina Birmpili said the Indian amendment proposal “added diversity to the HFC discussions.” She suggested international regulations are important, both to provide clear signals for investment and innovation and to level the playing field, bring balance, equity and better access to technologies in global markets.

Co-Chair Rachmawaty introduced the provisional agenda (UNEP/OzL.Pro.WG.1/35/1) on Wednesday morning, and delegates adopted it without amendment.

Co-Chair Paul Krajnik (Austria) suggested, and delegates agreed, to follow the items on the agenda in the order they appeared.

OVERVIEW OF THE GLOBAL SITUATION WITH REGARD TO HFCs

ATMOSPHERIC ABUNDANCE, TRENDS AND

PROJECTIONS: SAP: SAP Co-Chair Paul Newman summarized the main points of SAP’s report *Scientific Assessment of Ozone Depletion: 2014*, as: ODS are declining in our atmosphere; the radiative forcing by CFCs and HCFCs will decline over the course of the 21st century; radiative forcing by future HFC emissions may reach about 25% of that of CO₂ future emissions; and future HFC emissions may hinder realizing the 450 ppm CO₂ stabilization target.

In response to questions, Newman said that: the timeline for HFCs reaching the equivalent of 25% of the radiative forcing by future CO₂ emissions is by 2050; the concentrations of gases used by SAP in its calculations are based on the 2009 publication by Velders titled *The large contribution of projected HFC emissions to the future climate forcing*; SAP takes into account the lifetimes and radiative efficiency of each gas when calculating its radiative forcing impact; and Chapter 5 of the

SAP assessment lists the different timelines in global temperature potential and GWP.

PRODUCTION AND CONSUMPTION PATTERNS AND

TRENDS: TEAP: Bella Marnion, TEAP Co-Chair, presented the current and future HFC demand by sectors based on decision XXV/5 TEAP Task Force report, Additional information on alternatives to ODS, highlighting that: the BAU scenario for the RAC sector shows rapidly growing demand in Article 5 countries during 2015-2030 and dwarfs the demand in the various foam sub-sectors and other sectors; the emerging availability of high performance, low-GWP refrigerants provides new opportunities; and blowing agent demand will continue to grow with critical sectors still potentially dependent on HFCs.

Several countries called for improved data and information: Switzerland on GWP substance projections in metric tons; Bahrain, with China, for projections of data to 2030 and 2050; EU and Nepal for clarifications on degrees of data uncertainty; Pakistan for production rates of low-GWP alternatives in different sectors; and India on percentage data on equipment with low-GWP alternatives exported to Article 5 countries. Jordan questioned the slow rate of transitioning of Article 5 countries to low-GWP refrigerants. The US requested information on blends and their current uptake.

In response, Maranion reported that HFCs have opened new markets independent to the trends observed in HCFCs, particularly in Article 5 countries, and thus correlating transition rates to current consumption is difficult. They also reported that the RAC sector has focused mostly on transitioning from HCFC-22 refrigerants and have not emphasized low GWP alternatives and that growth in production of refrigerant blends is not yet estimated. TEAP Co-Chair Lambert Kuijpers noted that the XXVI/9 TEAP Task Force report on alternatives to ODS would aim include data and information requested. On data certainty he explained crosschecking with the United Nations Framework Convention on Climate Change (UNFCCC) and estimated an uncertainty of ±10-12%.

TECHNICAL AND COST ISSUES RELATED TO ALTERNATIVES TO HFCs

RESPONSE TO DECISION XXVI/9: Report by the TEAP

on its Progress under Paragraph 1: On Wednesday morning, TEAP Co-Chair Maranion presented an extract of the progress of the Decision XXVI/9 Task Force report, stating that the draft report will be presented at OEWG 36 in July 2015 and updated for discussion at MOP 27, noting that the report will include, *inter alia*: a full range of available ODS alternatives; information on energy efficiency in the RAC sector; current and future demand in different sectors; and revised scenarios.

Co-Chair Kuijpers added the report will include modeling and calculations for particular refrigerants, information on high-ambient temperatures, and on performance and safety standards. Discussing mitigation scenarios, he indicated that the phase-down curves of CO₂e vary considerably depending on the timelines selected.

Following the TEAP presentation, delegates discussed, *inter alia*: identifying and testing alternatives for use in high-ambient temperature conditions; including different conversion timelines for stationary and mobile AC and HFC consumption in aerosols;

addressing early action for enhanced benefits and reduced costs; and developing different mitigation scenarios.

Outcome of the Workshop on HFC Management:

Workshop rapporteurs Shepardson and Sicars presented the key points from the Workshop on HFCs Management, based on their summary (UNEP/OzL.Pro/WG.1/35/5).

Sicars characterized the workshop as exhaustive, fair and balanced and providing good insight to the issues and challenges posed by HFC management. He summarized that while low-GWP alternatives are already used on a commercial scale in many applications, they sometimes are limited to certain regions or sub-sectors and are not widespread. He also noted that some low-GWP alternatives are still in the demonstration or feasibility stage of development, especially in condensing units/commercial refrigeration, large MAC and medium-size air-to-air AC. He said the workshop agreed that prospects for the 2020 market and beyond will be strongly influenced by economies of scale, and noted the main barriers identified as: investment costs; lack of regulations; component availability; technician training; and safety standards.

Shepardson reported cross-cutting challenges and opportunities identified as: energy efficiency; costs and intellectual property rights; safety and flammability; high-ambient temperatures; policy and regulatory frameworks; service sector and training needs; and special challenges for Article 5 countries. She suggested the main workshop take-away messages to be: alternative solutions exist in almost all sectors; work in RAC has to take into account both refrigerant emissions and energy efficiency in order to avoid technology lock-in; any HFC management approach needs to be adaptive and flexible; adaptation and readiness actions are needed to enable new technologies to be adopted in new markets; and the technology alternative landscape is diverse, with differences and trade-offs depending on local priorities and conditions, meaning that there is no universal solution.

Regarding next steps, Shepardson underscored: non-Article 5 countries can accelerate the adoption of lower-GWP alternatives; an important and substantial impact can be achieved by using HFC-404A in commercial refrigeration; the near-term opportunity to improve the responsible use of refrigerants in manufacturing processes and servicing to avoid leaks and recover and reuse refrigerants; and the need for awareness raising and communication efforts to sensitive actors outside the Montreal Protocol on HFCs management issues.

Responding to remarks from delegates, the rapporteurs clarified: since the workshop did not emphasize district cooling as the preferred alternative technology, the wording of the report will be adjusted to avoid that impression; problems such as water usage that need to be assessed in certain alternatives proposed for high-ambient temperatures were acknowledged during the workshop; technology deployment is happening only in some regions and/or applications; and since the workshop did not discuss ecological safety of alternatives, this cannot be reflected in the workshop report.

ENERGY EFFICIENCY, SAFETY REQUIREMENTS AND CHALLENGES FOR HIGH AMBIENT

TEMPERATURE CONDITIONS: Argentina, supported by China, said there was need to ensure that replacement

technologies proposed are equally or more energy efficient as an incentive to replacement.

China stressed the need to ensure the addressing of safety standards and the removal of technology barriers, including stringent patents.

Kuwait, Saudi Arabia and Jordan lamented the slow rate of development of solutions, stressing that most technologies presented for high-ambient temperature conditions are not yet available in the market. Jordan called on the TEAP to carry out in-depth studies on alternative technologies for high-ambient temperatures.

India said that even though many issues have been addressed, the solutions have not been found. The US said there has been progress in several sectors, particularly in MAC and RAC, and recognized the need for additional work for unitary AC and split systems.

POLICIES AND MEASURES ACROSS COUNTRIES AND REGIONS

On Wednesday afternoon, Co-Chair Rachmawaty introduced the item on policies and measures across countries and regions on HFC management and reporting from submissions by parties in 2014 and 2015 (UNEP/OzL.Pro.WG.1/35/2). Executive Secretary Birmpili pointed to several updates, including that Mexico and Paraguay have submitted voluntary reports (UNEP/OzL.Pro.WG.1/35/INF/2). She indicated the Secretariat will provide an update on these developments to the next OEWG, noting also that: France has moved away from negative incentives; Germany reported positive incentives; the EU focused on awareness raising; and Switzerland focused on training, certification and labeling.

Norway elaborated on its measures to curb HFC growth, including a tax on HFCs combined with a refund scheme when HFC gases are destroyed.

The US, supported by Canada, the EU and Japan, lauded the Secretariat's efforts to provide a consolidated document demonstrating policy measures taken to reduce HFCs, providing a source of information and inspiration, useful for learning about efforts to phase-down HFCs, while fostering collaboration on the issue.

The EU referred to the recent implementation of its F-gas regulations, underscoring that if 28 European countries can agree to a phase-down, similar efforts can be achieved globally.

Paraguay mentioned its efforts on HFC phase-down, indicating its ban on imports of HFCs as an effective measure.

Australia cautioned that focusing on voluntary initiatives alone might lead to fragmentation, which can have negative impacts for industry, and called for a stable and long-term strategy to support market stability and industry innovation.

SYNERGIES WITH THE UNFCCC, INCLUDING LEGAL AND REPORTING ISSUES

On Wednesday afternoon, Co-Chair Rachmawaty introduced the item on synergies with the UNFCCC including legal and reporting issues (UNEP/OzL.Pro.WG.1/35/2), noting documentation on historical cooperation with the UNFCCC (Section II) and a summary of the global policy framework for HFCs under the UNFCCC (Section V).

While agreeing there should be synergies between the UNFCCC and the Montreal Protocol, Pakistan noted that under the UNFCCC, Article 5 countries benefit from voluntary reporting. He further cautioned against the high price of conversion from HFCs, which are not ODS. Saudi Arabia stressed that legal issues between the Montreal Protocol and UNFCCC have to be resolved, while emphasizing flexibility. Uruguay, supported by Argentina, Indonesia and Cuba, called for coordinated actions and joint work between the UNFCCC and MP.

The EU, supported by the US and Switzerland, pointed out that the Protocol and Vienna Convention have legal authority to address HFCs, while emphasizing a phase-down over a phase-out. The US reminded delegates that in other international conventions, overlapping issues are common, noting the Minamata Convention on Mercury and its interaction with the Basel and Stockholm Conventions.

Stating that measures taken under the Montreal Protocol have led to the increase of HFCs, Colombia supported the development of synergies between the Montreal Protocol and UNFCCC. Kenya noted that the same people in most governments address both agreements, and thus synergies should be addressed.

Referring to its proposed amendment, India stated the UNFCCC and the Kyoto Protocol both need to be amended to recognize their relationship on HFCs.

KEY ISSUES FOR DISCUSSION TOWARDS A POSSIBLE HFC MANAGEMENT POLICY AND LEGAL FRAMEWORK UNDER THE MONTREAL PROTOCOL

On Wednesday afternoon Co-Chair Krajnik introduced this agenda item by stressing that the playing field for discussion is level and wide open, with all parties free to raise their concerns under each of the agenda sub-items.

POLICY OBJECTIVES: Co-Chair Krajnik invited delegates to discuss what they aimed to achieve by bringing HFCs under the Montreal Protocol.

The US said the objective should be relatively simple: avoiding growth in the production and consumption of HFCs, something he suggested only the Protocol is equipped to tackle comprehensively. Switzerland said the goal should be avoiding any increase in HFC emissions by promoting the shift to low-GWP alternatives as fast and as far as possible while generating the minimum economic burden. The EU, Mexico and Norway agreed with the US and Switzerland.

Saudi Arabia cautioned against prejudging agreement to bring HFCs under the Montreal Protocol. He said that while Saudi Arabia shared these objectives, it differed on the mechanism, preferring to take the issue instead to the UNFCCC and using its flexible “basket of gases” approach. Canada opposed a flexible UNFCCC approach, saying that unlike GHGs, HFCs are specifically produced substances and that flexibility in the Montreal Protocol already exists in an adjustable schedule. She emphasized that progress has been made in delivering technologies in most sectors in order to facilitate countries meeting phase-down targets.

Saint Lucia referred to the outcome document of the Third International Conference on Small Island Developing States (SIDS), the SAMOA Pathway (A/Conf.223/3),

which recommended action on a gradual phase-down of the consumption and production of HFCs.

China, supported by Canada, called for an open-ended approach to HFCs that allows for inclusion of all possibilities and conditions in the establishment and implementation of policy objectives, including the resolution of issues at technical level. New Zealand said that the Montreal Protocol is a vehicle for negotiations and provides a good structure for making progress.

Pakistan said policies require extensive consultations and consensus, and cautioned against seeking temporary fixes but rather to consider all possible future risks. Bahrain and Kuwait said the policy objectives should take into account the concerns of high-ambient temperature countries, saying since no suitable and affordable technologies are available to them at present, they were unwilling to discuss policy objectives based on future projections. Oman said policies should reflect realities on the ground.

Co-Chair Krajnik summed up the discussion, concluding that there is “consensus that all countries want to reduce HFCs.” Saudi Arabia said that it was more of an “acknowledgement by countries that HFCs have an effect on CO₂ emissions and the need to reduce them.” Pakistan insisted there should be no distinction between HFCs and HFOs, since they have the same derivatives and effects on the atmosphere.

HFC PHASE-DOWN, TAKING INTO ACCOUNT

HCFC PHASE-OUT: On Thursday morning, Co-Chair Krajnik introduced the agenda sub-item on HFC phase-down, taking into account HCFCs phase-out noting that HFCs have often been adopted as commercially available and affordable alternatives.

Samoa expressed its support for the phase-down of HFCs in line with the different proposed amendments and noted Outcome 45 of the SAMOA Pathway on HFC phase-down.

Canada reminded parties of Decision XIX/6 on the provision of stable and sufficient funding for HFC phase out, saying that if HFCs came under the purview of the Montreal Protocol, then its funding structure and support via the MLF would also change to support a transition to low-GWP alternatives.

Saudi Arabia underscored technical challenges in high-ambient temperatures that create constraints in the phase-down of HFCs.

Mexico noted that the North American proposal aims to consider the concerns of all different parties and regions.

The US emphasized the need to find alignment of HCFC phase-out and HFC phase-down in order to maximize climate and environmental benefits, with fewer burdens felt by industry. He reflected on changes to the North American proposed amendment, *inter alia*: a change in baseline; moving the phase-down schedule back a year; taking into account conditions in high-ambient temperature regions; suggesting a “mid-term check-back” on technology availability; a request that TEAP conduct a study on low-GWP alternative technologies for high-ambient temperatures; the timelines of “non-party trade provisions” from 2017 to 2020; and a requirement that 80 countries, rather than the customary 70, ratify before the amendment enters into effect.

Indonesia reviewed its experience in HCFC phase-out, suggesting that a comprehensive review of actions on HFCs should consider the HCFC phase-out context and take into

account, among others, availability of technologies, costs and training. Iraq asked why suitable alternatives to HCFCs were not selected when the accelerated phase-out was agreed. Oman cautioned against taking steps that would lead to economic imbalances in developing countries. Kuwait raised concerns about the performance of the MLF, calling for a study of the availability of not-in-kind and hydrocarbon-based technologies in non-Article 5 countries, and cautioned against embarking on “a journey without knowing the destination.” Jordan called for more experimental and demonstration projects to assess if proposed alternatives are suitable. Bahrain opposed considering the HFC amendment proposals.

The EU said they would submit a proposal for an amendment on HFCs by the end of April featuring: a baseline that includes both HCFCs and HFCs; a requirement for non-Article 5 countries to start phase-down at 85% in 2018, ending at 15% in 2034; a requirement for Article 5 countries to freeze combined HCFC and HFC consumption in 2019 and start phase-down in 2020 to end at 15% by 2040; reliance on TEAP to know what technologies are available; and a provision on trade with non-party countries.

Colombia noted the availability of alternative options is key to progressive reduction of HFCs. The Gambia said equipment, spare parts and refrigerants need to be made locally available. Georgia said equipment manufacturers require guidelines on technological requirements.

FSM welcomed India’s readiness to engage further through its proposal saying, “we are finally playing poker at the same table.” Pakistan said the amendment proposals are very ambitious, lamenting that technologies and phasing out mechanisms and technologies have so far been short-term fixes.

Uruguay, supported by Mozambique, remarked on the need to build on past successes in technological solutions in order to make progress. Switzerland called for realistic expectations on technical solutions, noting that there is no single ideal solution. Australia called for: an integrated approach that addresses both HCFCs and HFCs; facilitates funding for HFC alternatives; and provides opportunities for projects and validation of existing technologies.

Recognizing the many challenges, Norway referred to the workshop preceding OEWG 35, wherein industrial actors indicated the need for clear standards to reflect future development, and echoed support to meet and discuss HFCs in “a more formal setting.”

Japan acknowledged its support for all aspects of a phase-down of HFCs and more in-depth discussion on the matter.

Reflecting support for the HFC amendment proposals and for the formation of a contact group, Saint Lucia also mentioned the need to reexamine certain policies, for example how to manage existing chemical stocks.

Mexico, the US, EU, Colombia, Nigeria, Senegal, FSM, Switzerland, Zimbabwe, the Gambia, Georgia, Norway, Japan, Saint Lucia and Mozambique supported, while Pakistan, Cuba, Saudi Arabia, Oman and Kuwait opposed, establishing a contact group.

Co-Chair Krajnik discouraged parties from debating the establishment of a contact group under this agenda item, saying it would be discussed under possible ways forward.

MEANS TO ADDRESS SECTOR- AND COUNTRY-SPECIFIC CHALLENGES: Co-Chair Krajnik introduced this agenda sub-item on Thursday morning.

Switzerland emphasized flexibility and encouraged parties to be open-minded regarding the phase-down of production and consumption of HFCs, as alternatives are becoming available for HCFCs phase-out.

The EU mentioned its study on low-GWP alternatives in high-ambient temperatures, which was presented to the TEAP, recognizing that some sectors, such as RAC, have additional challenges, and noted the need for training competent personnel, intellectual property, and knowledge transfer.

Recognizing serious challenges in Article 5 and in particular Gulf Cooperation Council countries, Saudi Arabia stated that they look forward to solutions that are, “applicable and not just theoretical.”

The US acknowledged that challenges should be addressed via a sector-by-sector approach taking national circumstances into account. He identified that the North American amendment proposal includes residual amounts of HFC consumption and possible exemptions.

Cautioning against high prices of HFC alternatives, Pakistan also expressed concerns about possible water consumption from chemicals on agricultural water reserves.

Australia, supported by the US, said there is a need to consider sectors with exceptional challenges, such as the lack of low-GWP alternatives for medical metered dose inhalers (MDIs). He noted that under the legal framework of the Protocol, parties are free to present adjustment proposals at any time to have any issue addressed. Indonesia identified its specific challenges, including the need for comprehensive training, and the need for leakage technology management.

Stressing the challenges of finding alternatives suitable for high-ambient temperatures, Kuwait cautioned against possible situations of non-compliance.

STRENGTHENING EXISTING MEANS OF IMPLEMENTATION, CAPACITY BUILDING, TECHNOLOGY TRANSFER, FUNDING REQUIREMENTS AND FINANCIAL MECHANISM:

On Thursday afternoon, Co-Chair Rachmawaty introduced the agenda sub-item on strengthening existing means of implementation, together with the agenda sub-item on capacity building, technology transfer, funding requirements and financial mechanism.

Speaking as a small island developing state, Grenada supported a HFC phase-down within the Montreal Protocol, noting that management of existing ODS banks must be taken into account.

Iraq emphasized the need to focus on countries with specific challenges, noting war and conflict situations. Kuwait cautioned against discrepancies in technology transfer, in particular if obsolete technologies are being transferred to Article 5 countries. Argentina pointed to problems pertaining to the performance of certain equipment suppliers on the conversion of AC systems.

Switzerland identified that financial aspects will need to be readdressed, and suggested the need to support standards that take technology transfer, safety and other concerns into account.

Saudi Arabia underscored the need to test new technologies to support different sectors.

Uruguay suggested delaying discussions on HFCs until after UNFCCC's COP 21, noting that this could result in additional funding sources.

Noting Decision XIX/6 on the agreement to supply "stable and sufficient resources" to support Article 5 countries on HCFC phase-out, Brazil stated that discussions on HFC management require further and detailed information on financial support, and suggested that the decision accompanying any HFC amendment should provide clear guidelines to the MLF Executive Committee (ExCom) on such support.

Canada, in agreement with Brazil, underscored that sufficient financing to support the phase-down of HFCs in Article 5 countries should be agreed upon, pointing to text within the North American proposal that identifies this. He also expressed concern about Kuwait's reference to the adoption of obsolete technologies, noting that the MLF's intention is to support emerging technologies.

The US said the MLF was the logical implementation mechanism for any HFC amendment and that Brazil's suggestion regarding the ExCom merited consideration. Regarding MLF funding levels, he noted that the last replenishment included rollover amounts, which suggested that funding needs are being met. He agreed that any HFC amendment would require support for addition training and institutional capacity building for countries.

The European Commission noted its support for projects in the Pacific and Africa on climate-friendly ODS alternatives and substance banks. Latvia, on behalf of the EU, supported using the MLF for implementation of any HFC amendment.

China reviewed its experience with the MLF in the HCFC phase-out, and said having the MLF involved in any HFC phase-down would inspire more confidence among Article 5 countries during implementation. He suggested a particular focus, providing incentives to SMEs during phase-down so that they participate fully in the technological conversion process. He also urged close attention to capacity building and technology transfer.

Samoa requested giving priority to providing information on suitable technologies for SIDS.

POSSIBLE WAYS FORWARD

On Thursday afternoon Co-Chair Krajnik opened the discussion on possible ways forward by asking Senegal and Zimbabwe to introduce the African Group conference room paper (CRP) titled "Process to regulate the production and consumption of HFCs under the Montreal Protocol" (UNEP/OzL.Pro.WG.1/35/CRP.1).

Saudi Arabia said that there had been an agreement not to discuss any CRPs at OEWG 35, but only at OEWG 36. Chair Krajnik disagreed, saying the agreement had been not to discuss the substance of any amendment proposals, but that the CRP was not an amendment proposal and it had been submitted according to the rules of procedure, so it can be discussed.

Noting that it was the outgrowth of a declaration adopted by the African Ministerial Conference on the Environment (AMCEN) held in Cairo, Egypt from 2-6 March 2015, Senegal reviewed the CRP, which requests the establishment of a contact

group to consider proposals to amend the Protocol. He explained that the CRP also calls for any negotiations on amendment proposals to take into account specific issues enumerated in the CRP, including, *inter alia*: selection of an appropriate baseline; freeze data for non-Article 5 countries; a grace period before any freeze for Article 5 countries; appropriate phase-down schedules for both Article 5 and non-Article 5 countries; review of technologies that may be used as alternatives to high-GWP HFCs; financial and technical support for Article 5 countries; and exceptional measures required and considerations for high-ambient temperature conditions.

Kuwait, Pakistan, Iraq, Jordan and Bahrain said decision XXVI/9, which called for OEWG 35, specified the goal as discussing the outcomes of the workshop, and that the African Group submission was from a declaration prior to the workshop. Canada, the US and the EU objected, saying the decision XXVI/9 is clear that the mandate of OEWG 35 is to discuss "all issues," in relation to HFCs management. The EU said that even though there may be many possible ways forward, we should deal with the one currently on the table, this being the African Group's CRP. Gilbert Bankobeza, Legal Officer, Ozone Secretariat, clarified the rules of procedure, and confirmed Chair Krajnik's decision to allow discussion of the CRP.

Kuwait called for data on HFC production in relation to the deployment of low-GWP HFCs in Article 5 countries to be presented at OEWG 36 and MOP 27, in order to guide Article 5 countries in their own strategies to phase down HFCs, based on best practices.

Burkina Faso, Côte d'Ivoire, Benin, Zambia and South Africa urged for consultation and flexibility from all parties, saying a contact group would enable concerns of all parties to be addressed.

Canada said the CRP is a constructive and comprehensive way forward and includes all key elements for a robust discussion. The US concurred saying there was a need to include issues on bi-product controls and to streamline language on financing with that of the MLF. The EU said provisions of trade with non-parties should be added since it had been of interest to several parties at OEWG 34.

Co-Chair Krajnik invited parties to informal consultations, asking that Senegal, Norway, the EU, India, Argentina, Brazil, Saint Lucia, Latvia, the US, Canada and Pakistan attend. Saudi Arabia emphasized that the Co-Chair had been unfair to certain parties and should not assume absolute power in organizing a group. Co-Chair Krajnik clarified that the invitation was to informal consultations, not to a contact group, and adjourned the meeting.

On Friday morning Co-Chair Krajnik invited Brazil, which had co-facilitated the informal discussions, to report to plenary. Brazil reported that the informal consultations did not resolve the impasse and that discussions would continue during Friday's plenary.

Kenya and Chile supported, and Cuba opposed, the formation of a contact group. Pakistan said there needs to be logical, rather than argumentative, justification to convince parties to support a contact group. Indonesia said some parties are keen on deterring progress in the OEWG and that there is a need for a clear understanding of what issues need further discussion in order to

agree on the way forward. India said that whatever consensus is reached on the way forward, it should favor all, adding that, “this poker game involves close to 7 billion people populating the world.” He argued that data deficiency in the TEAP report prevents parties from making scientifically-informed decisions. Argentina said challenges to progress should be addressed, including technological and cost constraints of alternatives faced by Article 5 countries.

Senegal said the establishment of a contact group has consensus since a majority of the parties have expressed support for it, calling for OEWG 35 to note this agreement in its report.

Colombia, although supporting the establishment of a contact group, cautioned that consensus is not synonymous with unanimity. She suggested a possible way forward would be to discuss the desirability and modalities of any possible amendment.

China said it had no specific stance regarding formation of a contact group. He urged more efforts to forge consensus, saying it was a hallmark of the process and that the Montreal Protocol “is a big family.”

Saint Lucia pointed to her own past experience with CRPs in the Protocol process, explaining CRPs should be examined and discussed openly in a contact group, where they can be accepted, rejected or amended. She suggested an alternative way forward would be to put together all the challenges parties face regarding HFCs, and then examine what strategies can be employed to resolve each one.

Noting that many countries had indicated their willingness to discuss addressing the HFC issue, FSM questioned how to move forward if some delegations did not even want to talk about moving forward, and suggested maybe it was time to resort to the Protocol’s rules of procedure.

Saudi Arabia noted that the African Group earlier in the week had shared the initial version of their CRP and his delegation had offered comments, but that the current version was far different. He cautioned against resorting to voting, saying that the Protocol is about consensus, not numbers or imposing one group’s ideas on another. He noted that at MOP 26 Saudi Arabia had negotiated in good faith on a draft decision text on this subject that almost won consensus.

Switzerland echoed Saint Lucia’s comments about the traditional role of and procedure for CRPs and contact groups, and said he was impatient to exchange ideas and discuss with idea proponents.

Zimbabwe, on behalf of the African Group, apologized to parties that Africa’s initiative may have offended, saying his group felt that HFC challenges need to be discussed in an open environment and the CRP was the way to start that process. He urged discussing the terms of reference for a contact group.

Mozambique said that while the majority who support the CRP needs to respect the minority, the minority should also respect the majority. He noted that the AMCEN is a group of ministers from 54 nations waiting for their Montreal Protocol delegations to report back to them on progress in launching a contact group to address HFCs. He asked the Ozone Secretariat to clarify if the rules of procedure allowed a delegate to block the Chair from forming a contact group and, if not, urged “respecting the majority” and forming one.

The US said a CRP is just one of several ways forward, and agreed with India about the utility of having certain specific information on-hand when negotiating. He also agreed with the idea of identifying all the main challenges and barriers so they might be addressed one-by-one. He suggested the informal discussions be reconvened.

Kuwait said there should be no winners or losers in these discussions and that consensus cannot be reached by ignoring those against the majority position. Supported by Oman, Bahrain and Qatar, he stressed that their position was not to oppose discussions but to ensure the way forward on HFCs is informed by success stories and available alternatives for all.

The EU urged for continued informal consultations and intersessional work to agree on crucial issues prior to OEWG 36. Canada said the ideas put forward so far can guide the informal consultations. Australia said it may be worthwhile reopening the draft decision of MOP 26 (UNEP.OzL.Pro.26/CRP.9/Rev.1) proposing a contact group on HFC management since a lot of discussion had already taken place. Mexico called for open mindedness during informal discussions.

South Africa said that the CRP had tried to accommodate most of the priorities raised by countries, and suggested that ideas exchanged during Thursday evening’s informal discussion indicated an eagerness to engage in-depth on the issues. She suggested revisiting and addressing the priorities raised in the draft MOP 26 text, and then deciding on the way forward, which she suggested can best be done within a contact group context.

Co-Chair Krajnik suggested reconvening the informal discussions, or holding bilateral consultations, or a combination of both.

Pakistan, supported by Kuwait, called for TEAP to pull together all available data on all the factors potentially limiting HFC phase-down so that they could be addressed in a logical manner.

Japan supported revisiting the MOP 26 draft text in the informal discussion setting. The US agreed to resume the informal discussions if the same co-facilitators guided it, and suggested considering ways to merge the CRP and the MOP 26 text together. Saudi Arabia agreed to reconvening informal discussions. Co-Chair Krajnik announced that Australia and Brazil had agreed to co-facilitate a reconvened informal discussion during the lunch period.

On Friday afternoon Co-Chair Paul Krajnik resumed plenary. The EU informed parties that the informal consultation led to an agreement to continue intersessional discussions, in an informal manner, to study the feasibility and ways of managing HFCs, with a view to the establishment of a contact group on feasibility and ways of managing HFCs at OEWG 36. The intersessional discussions are to examine a list of related challenges, including *inter alia*: energy efficiency; funding requirements; safety of substitutes; availability of technologies; performance and challenges in high-ambient temperatures; capacity building; non-party trade; synergies with the UNFCCC; the relationship to the HCFCs phase-out; ecological effects; implications for human health; social implications; challenges to the production sector; exemptions and ways to address lack of alternatives; and technology transfer.

CLOSING SESSION

On Friday afternoon, Co-Chair Rachmawaty presented the draft report of the meeting (UNEP/OzL.Pro.WG.1/35/L.1) and associated addenda (UNEP/OzL.Pro.WG.1/35/L.1/Add.1 and UNEP/OzL.Pro.WG.1/35/L.1/Add.2), which were adopted with minor amendments.

Co-Chair Krajnik thanked all participants for their spirit of consensus-building, saying that it had been “the true spirit of the Montreal Protocol” that led the OEWG to the conclusions noted in the report. He thanked all involved and declared the meeting closed at 5:15 pm.

A BRIEF ANALYSIS OF OEWG 35

After six years of arguing about how, when, or if HFCs should be discussed under the Montreal Protocol at all, delegates arrived in Bangkok prepared to discuss only HFCs. First a two-day workshop focused on the technical aspects of HFCs, and then OEWG 35 turned its attention to the policy aspects of HFCs.

The technical workshop, and its array of technical and overview materials prepared by the Secretariat with help from TEAP, attempted to cover in-depth not only the issues flagged in its mandate from MOP 26, but also key issues and concerns raised by parties over the years pertaining to a possible phase-down of HFCs within the MP and their substitution with low-GWP alternatives. The organizers worked to ensure that the workshop examined the differing challenges faced in each subsector, while also reflecting a balance in the perspectives of Article 5 and non-Article 5 countries. This attention to technical detail, nuances, and balance in perspectives, resulted in repeated praise of the workshop throughout OEWG 35, including by those previously skeptical about even discussing HFCs within the context of the MP.

This analysis examines how the technical foundation assisted in growing political consensus to formally discuss amending the Protocol to include HFCs, the significance of new amendment proposals both announced and tabled at OEWG 35, and then looks ahead to OEWG 36 in July and beyond.

MORE PLAYERS AT THE TABLE

Since 2009 parties have had before them a proposal to amend the Montreal Protocol to include HFCs. However, they have never agreed to form a contact group to formally examine, discuss or negotiate the proposals. FSM and Mauritius filed the first proposal, followed by a Canadian, Mexican and US submission (“the North American proposal”) in 2010. Both proposals have been tweaked and resubmitted every year since, but without success and with little “ante up” from other parties drafting and submitting their own proposals.

As OEWG 35 began there was considerable buzz in-the-corridors about the significance of India’s HFC amendment proposal filed just the week prior to the meeting. Many interpreted the fact that a formerly vocal opponent of bringing HFCs under the Protocol submitted a text proposal as a portent that the impasse was about to break. While Indian Prime Minister Narendra Modi had already indicated at a 2014 visit with US President Obama that India would be willing to consider addressing HFCs in the Montreal Protocol, few expected this statement to translate into a proposal for negotiating text.

Just how much comfort amendment proponents can take in the Indian proposal, though, is an open question. In its submission to amend the Protocol, India proposed, among other things: a 15-year grace period for Article 5 parties; a wait until 2050 for a phase-down to reach 15% of HFC baseline levels; an exemption from the Protocol for HFC-23, known to have the highest GWP, when generated as a by-product in facilities that produce other HFCs or HCFCs; a provision stating that the Montreal Protocol amendment does not change the HFC obligations under the UNFCCC and Kyoto Protocol and that these latter two instruments would be amended accordingly; a requirement that the MLF compensate for “full conversion costs,” full second conversion costs wherever transitional technologies are deployed, and “compensation for lost profit streams for gradual closure” of HFC production facilities.

Whether just an opening bargaining gambit or an attempt to serve as counterweight to the FSM and North American proposals, the submission nonetheless was welcomed in plenary by many delegations as adding diversity and enriching discussion on HFC management. FSM went as far as to welcome India to “finally playing poker at the same table.” To which India, unusually quiet throughout the course of OEWG 35, later responded, “The poker game that India has entered is one that involves seven billion people.”

During OEWG 35 the EU officially announced that it will soon submit a formal amendment proposal on behalf of its 28 Member States. This proposal has been expected since last year, when the EU circulated its discussion paper on HFCs at OEWG 34 and MOP 26, but this confirmation by the EU means proposals on the table are soon to double, and that momentum is increasing.

Many Article 5 country delegates expressed satisfaction that they would have a broader range of options from which to pick and choose, perhaps finally creating the right conditions for negotiations to commence.

Over the years, amendment opponents have cited uncertainties over the safety, availability, costs, and suitability of low-GWP alternatives for high-ambient temperature conditions among the reasons for their skepticism. The workshop preceding OEWG 35 was designed to allay as many of these concerns as possible, while identifying uncertainties and data gaps that may exist, and laying a solid technical foundation for policy discussions to follow at OEWG 35, thus building clarity and bridging gaps between different perspectives. In many ways it was emblematic of the widely-acknowledged strengths of the MP regime: its emphasis on sound science and technical knowledge, and of cooperation with the very sectors and industries it impacts.

UNDERSTANDING THE RULES OF THE GAME

In past OEWGs many countries opposed including HFCs in the Montreal Protocol in principle, arguing that HFCs are not ODS and legally belong under the UNFCCC. More and more opponents have come to accept that there is no legal impediment to the Protocol addressing HFCs if the focus is on phase-down rather than phase-out and UNFCCC competency is not tampered with through such an approach. Also, it’s now widely accepted that the “HFC problem” was created in large part due to the HCFC phase-out under the Montreal Protocol, which phased in HFCs, and that the Protocol’s technical expertise and

implementation machinery may be best suited to phase-down HFCs. The shift of China and India from the ranks of opponents to neutral, due in part to high-level diplomacy on the part of the US, also sapped strength from the UNFCCC argument. When MOP 26 came tantalizingly close to adopting a text on a way forward on HFCs within the MP context, this hurdle appeared to be diminishing.

This second HFC Management Workshop, so focused on technical issues, and with its overall message that such technical issues, while complex and still bearing some uncertainties, are not insurmountable, also sapped force from amendment opponents' arguments.

Throughout the OEWG a growing list of countries indicated their willingness to discuss HFC issues in a contact group. The debate over whether or not to form a contact group came to a head, however, with the unveiling of the African CRP calling for a contact group and proposing the types of issues it can discuss, and which HFCs to be phased down. This proposal increased the likelihood of a contact group at OEWG 36, since it was based on a formal ministerial declaration from 54 African countries.

The procedural dispute over whether to discuss the CRP at all was interpreted by many delegations and observers as a delaying tactic to ensure that any decision over creation of a contact group would be postponed until OEWG 36, which in itself would result in further limiting time for any negotiations on amendment proposals. It took a contentious debate over majority versus minority rights, and whether the "consensus" so prized by the ozone family should be interpreted to mean unanimity before delegates pulled back, heeding appeals to preserve the Protocol's reputation as the most successful multilateral environmental agreement, which always finds a way to forge consensus on tough issues and, as China put it, maintains the spirit of "one big family."

This eventually resulted in the agreement to work intersessionally on a long list of concerns, with a view to possible establishment of a contact group at OEWG 36 in Paris. There was tangible relief in the room that the ozone family unity had once again been preserved.

DEALING THE NEXT HAND

Many delegates left OEWG 35 expressing hope that the compromise to continue discussions intersessionally, India's new proposal, the anticipated EU proposal, and the request by AMCEN, through the African Group, would build momentum for the establishment of a contact group on HFC amendments at OEWG 36. The US, expressing optimism openly in plenary, stated, "Our goal is to adopt an amendment in 2015, one that is acceptable to all the parties in the room, and we need to work together if we are going to get there." If such an amendment to address HFCs under the Protocol does make progress at OEWG 36 through the formation of a contact group, and move forward at November's MOP 27, this may have positive residual effects, either on the substance or the spirit of the UNFCCC climate conference in Paris, later in November.

Veteran ozone process observers, while acknowledging encouraging signs that "change is in the air," cautioned that significant progress at OEWG 36 is by no means guaranteed. The intersessional meetings will be difficult to organize on short notice, with one possibly occurring on the sidelines of the

May MLF ExCom, and others depending on hosting offers by particular countries. The long list of issues to be examined, and the data and reports needed to address them, may be difficult, if not impossible, to treat fully in just three months.

All that said, the door to the creation of an HFC contact group is now cracked. Whether it can be fully pushed open will depend on how diligently parties work intersessionally, and whether all delegations come to Paris in July ready and willing to sit down at the negotiating table. If not, the stakes may be the reputation for consensus building and unity so treasured by members of the ozone family, keeping in mind that in such a consensus-based environment, its momentum can be halted if even just one party decides to walk away from the table, and slam the door.

UPCOMING MEETINGS

Basel COP-12, Rotterdam COP-7 and Stockholm COP-7: COP-12 to the Basel Convention, COP-7 to the Rotterdam Convention, and COP-7 to the Stockholm Convention will convene back-to-back in May 2015. The theme for the COP meetings is "From science to action, working for a safer tomorrow." **dates:** 4-15 May 2015 **location:** Geneva, Switzerland **contact:** Basel, Rotterdam and Stockholm Secretariats **phone:** +41-22-917-8729 **fax:** +41-22-917-8098 **email:** brs@brsmeas.org **www:** <http://synergies.pops.int>

74th Meeting of the Executive Committee of the MLF: This meeting of the ExCom is expected to, *inter alia*, consider funding requests to the Multilateral Fund for activities to implement the requirements of the Montreal Protocol, discuss follow-up to MOP 26's request for additional funding to conduct inventories or surveys on ODS alternatives, examine the final report on the evaluation of HCFC phase-out projects in the foam sector, and set terms of reference for studies on HCFC phase-out projects in the RAC manufacturing sector. **dates:** 18-22 May 2015 **location:** Montreal, Canada **contact:** MLF Secretariat **phone:** +1-514-282-1122 **fax:** +1-514-282-0068 **email:** secretariat@unmfs.org **www:** <http://www.multilateralfund.org/74/>

CCAC High-Level Assembly: The Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC) High-Level Assembly will gather CCAC ministers and heads of partner organizations to evaluate CCAC's progress, provide input on the direction of CCAC's future work and learn about the latest policy and scientific developments related to short-lived climate pollutants (SLCPs). The CCAC is a partner-led voluntary effort that aims to reduce emissions of methane, black carbon, and many HFCs. **date:** 19-20 May 2015 **location:** Geneva, Switzerland **contact:** CCAC Secretariat **phone:** +33-1-44-37-14-50 **fax:** +33-1-44-37-14-74 **email:** ccac_secretariat@unep.org **www:** <http://www.ccacoalition.org/>

42nd Sessions of the UNFCCC Subsidiary Bodies: The 42nd sessions of the Subsidiary Bodies to the UNFCCC and the ninth part of the second session of the *Ad Hoc* Working Group on the Durban Platform for Enhanced Action (ADP 2-9) will take place in June 2015. **dates:** 1-11 June 2015 **location:** Bonn, Germany **contact:** UNFCCC Secretariat **phone:** +49-228-815-1000 **fax:** +49-228-815-1999 **email:** secretariat@unfccc.int **www:** <http://www.unfccc.int>

ATMOsphere America 2015: ATMOsphere America 2015 will serve as the forum for discussions about the business case for natural refrigerants in North America, South America and Canada. **dates:** 25-26 June 2015 **location:** Atlanta, US **contact:** ATMOsphere Secretariat **phone:** +1-202-657-6164 **email:** info@ATMO.org **www:** <http://www.atmo.org/events.details.php?eventid=30>

36th Meeting of the Open-Ended Working Group of the Montreal Protocol: OEWG 36 will meet to prepare for MOP 27. **dates:** 20-24 July 2015 **location:** Paris, France **contact:** Ozone Secretariat **phone:** +254-20-762-3851 **fax:** +254-20-762-0335 **email:** ozoneinfo@unep.org **www:** <http://conf.montreal-protocol.org/>

54th Meeting of the Implementation Committee under the Non-compliance Procedure for the Montreal Protocol: This meeting will consider issues related to non-compliance and parties returning to compliance. **dates:** 27-28 July 2015 **location:** Paris, France **contact:** Ozone Secretariat **phone:** +254-20-762-3851 **fax:** +254-20-762-4691 **email:** ozoneinfo@unep.org **www:** <http://conf.montreal-protocol.org/>

ADP 2-10: The tenth part of the second session of the UNFCCC ADP is expected to convene in August/September 2015. **dates:** 31 August - 4 September 2015 **location:** Bonn, Germany **contact:** UNFCCC Secretariat **phone:** +49-228-815-1000 **fax:** +49-228-815-1999 **email:** secretariat@unfccc.int **www:** <http://www.unfccc.int>

CCAC Working Group Meeting: This Working Group meeting, which oversees CCAC's cooperation actions, is scheduled to launch CCAC's 2014-15 Annual Report, issue the CCAC five-year strategic plan, private sector package on SLCPs, and discuss CCAC's role in the "Road to Paris," i.e., the UNFCCC's Paris COP. **dates:** 8-9 September 2015 **location:** Paris, France **contact:** CCAC Secretariat **phone:** +33-1-44-37-14-50 **fax:** +33-1-44-37-14-74 **email:** ccac_secretariat@unep.org **www:** <http://www.ccacoalition.org/>

ICCM4: The Fourth International Conference on Chemicals Management (ICCM4) will consider the Overall Orientation and Guidance, progress in achieving the objectives of the Strategic Approach to International Chemicals Management's (SAICM) Overarching Policy Strategy, existing emerging policy issues (EPIs), the nomination of environmentally persistent pharmaceutical pollutant (EPPPs) as a new EPI, highly hazardous pesticides, and chemicals management beyond 2020. **dates:** 28 September-2 October 2015 **location:** Geneva, Switzerland **contact:** SAICM Secretariat **phone:** +41-22-917-8532 **fax:** +41-22-797-3460 **email:** saicm.chemicals@unep.org **www:** <http://www.saicm.org>

ADP 2-11: The eleventh part of the second session of the ADP is expected to convene in October 2015. **dates:** 19-23 October 2015 **location:** Bonn, Germany **contact:** UNFCCC Secretariat **phone:** +49-228-815-1000 **fax:** +49-228-815-1999 **email:** secretariat@unfccc.int **www:** <http://www.unfccc.int>

27th Meeting of the Parties to the Montreal Protocol: MOP27 is scheduled to consider a number of issues, including nominations for critical- and essential-use exemptions. **dates:** 1-5 November 2015 **location:** Dubai, United Arab Emirates

contact: Ozone Secretariat **phone:** +254-20-762-3851 **fax:** +254-20-762-0335 **email:** ozoneinfo@unep.org **www:** <http://conf.montreal-protocol.org/>

UNFCCC COP 21: The 21st session of the COP to the UNFCCC and associated meetings will take place in Paris. **dates:** 30 November - 11 December 2015 **location:** Paris, France **contact:** UNFCCC Secretariat **phone:** +49-228-815-1000 **fax:** +49-228-815-1999 **email:** secretariat@unfccc.int **www:** <http://www.unfccc.int>

GLOSSARY

AC	Air conditioning
AMCEN	African Ministerial Conference on the Environment
BAU	Business as usual
CFCs	Chlorofluorocarbons
CO ₂ e	Carbon dioxide equivalent
CRP	Conference room paper
ExCom	Executive Committee
FSM	Federated States of Micronesia
GHG	Greenhouse gas
GWP	Global warming potential
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
HFOs	Hydrofluoroolefins
MAC	Mobile air conditioning
MLF	Multilateral Fund
MOP	Meeting of the Parties
MP	Montreal Protocol
ODS	Ozone depleting substances
OEWG	Open-ended Working Group
PU	Polyurethane
RAC	Refrigeration and air conditioning
RACHP	Refrigeration, air conditioning and heat pumps
SAP	Scientific Assessment Panel
SIDS	Small island developing states
SMEs	Small and medium-sized enterprises
TEAP	Technology and Economic Assessment Panel
UNFCCC	UN Framework Convention on Climate Change
XPS	Extruded polystyrene