

**Montreal Protocol
on Substances that
Deplete the Ozone Layer**Distr.: General
28 October 2024

English only

Workshop on life-cycle refrigerant management
Bangkok, 27 October 2024**Thirty-Sixth Meeting of the Parties to
the Montreal Protocol on Substances
that Deplete the Ozone Layer**
Bangkok, 28 October–1 November 2024
Item 4 (c) of the agenda for the preparatory segment***Life-cycle refrigerant management, including the
outcomes of the workshop on life-cycle refrigerant
management (decision XXXV/11)****Outcomes of the workshop on life-cycle refrigerant
management****Note by the Secretariat****I. Introduction**

1. A one-day workshop on life-cycle refrigerant management was convened pursuant to decision XXXV/11, adopted by the Thirty-Fifth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer. The workshop was held on Sunday, 27 October 2024, at the United Nations Conference Centre in Bangkok, immediately before the combined thirteenth meeting of the Conference of the Parties to the Vienna Convention for the Protection of the Ozone Layer and Thirty-Sixth Meeting of the Parties to the Montreal Protocol. The workshop featured 34 speakers – facilitators, policymakers and subject matter experts, including from the private sector – with more than 400 participants attending in person.
2. In accordance with paragraph 4 of decision XXXV/11, the workshop's objectives were to share information, experiences and lessons learned in relation to life-cycle refrigerant management and to assess challenges related to ways of strengthening life-cycle refrigerant management, including, among other things, existing and potential policies, best practices, standards, and life-cycle refrigerant management opportunities.
3. The workshop included four sessions, focusing on an introduction to life-cycle refrigerant management and its benefits; country experiences with implementing life-cycle refrigerant management; a deep dive into life-cycle refrigerant management (leak prevention, recovery and reuse through recycling and reclamation; destruction of refrigerants and dealing with equipment); and financing life-cycle refrigerant management.
4. Sessions included overview presentations, panel discussions among country representatives and experts on the subject matters being discussed, and question-and-answer segments that allowed participants to contribute through questions and comments. In addition, during the breaks, participants could visit an exhibition showcasing the experiences of various organizations and agencies in implementing different aspects of life-cycle refrigerant management. The exhibition featured applied policies and solutions, offering insights into case studies presented by selected parties and

* UNEP/OzL.Conv.13/1–UNEP/OzL.Pro.36/1.

organizations. It also included a display prepared by the secretariat of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, with exhibits related to the environmentally sound management of refrigeration, air-conditioning and heat-pump equipment.

5. The following background documentation was made available by the Ozone Secretariat in advance of the workshop:

- (a) Concept note and provisional programme (UNEP/OzL.Pro/Workshop.13/1)
- (b) Briefing note on an introduction to life-cycle refrigerant management
- (c) Briefing note on the deep dive into life-cycle refrigerant management
- (d) Briefing note on policies for life-cycle refrigerant management
- (e) Briefing note on financing life-cycle refrigerant management

6. The present note provides a summary of key discussion points and take-away messages that emerged from each session of the workshop. It is intended to inform discussions at the Thirty-Sixth Meeting of the Parties.

II. Key points emerging from the workshop

A. Session 1: Introduction to life-cycle refrigerant management

7. Session 1 set the stage for the discussion on life-cycle refrigerant management, focusing on the relevance of the approach to the Montreal Protocol and its contribution to climate mitigation, resource efficiency, and circular economy approaches. The session included an introduction to life-cycle refrigerant management, emphasizing its comprehensive approach, from design and manufacturing to disposal. Its key practices include leak prevention and recovery, reuse, and safe disposal of refrigerants. The session outlined the benefits of life-cycle refrigerant management, such as climate and ozone protection, energy savings and resource efficiency, based on the findings of a recent report by the Technology and Economic Assessment Panel on life-cycle refrigerant management.¹ The report had been prepared by a Technology and Economic Assessment Panel task force established pursuant to paragraph 1 of decision XXXV/11 and presented at the forty-sixth meeting of the Open-ended Working Group of the Parties to the Montreal Protocol, in July 2024.

B. Session 2: Country experiences with life-cycle refrigerant management

8. Session 2 began with an overview of policies for life-cycle refrigerant management that outlined key strategies and policy measures for effective refrigerant management on the basis of a hierarchy from reducing the use of refrigerants, prioritizing containment, promoting reuse through recycling and reclamation to managing end-of-life disposal. It highlighted the need for robust policy frameworks and funding mechanisms to ensure effective implementation of life-cycle refrigerant management, with an emphasis on collaboration across sectors and alignment with other environmental regulations.

9. The session explored how different countries, including Australia, Ghana, European Union member States, India, Japan, Mexico and the United States of America, implemented life-cycle refrigerant management practices. Their country-specific approaches reflected a variety of strategies tailored to their unique contexts. The European Union and Japan emphasize detailed documentation and compliance through precise tracking, monitoring, and reporting across the entire value chain. This is complemented by efforts to raise stakeholder awareness, including through media coverage of regulatory infringements, fostering a culture of compliance as shared in an example from Japan. Australia has been using a co-regulatory framework where the government collaborates closely with industry, providing a balanced approach that combines governmental oversight with industry-driven initiatives. The approach of Ghana and India focuses on integrating life-cycle refrigerant management into broader environmental efforts, particularly in managing e-waste through extended producer responsibility schemes and nationally defined contributions (in the case of Ghana). In the United States, the emphasis is on engaging industry through initiatives such as the Green Shield programme, which encourages businesses to go beyond regulatory compliance, fostering a proactive approach to environmental protection.

¹ <https://ozone.unep.org/system/files/documents/TEAP-May2024-DecXXXV-11-TF-Report.pdf>.

10. The discussion part highlighted several key issues in implementing life-cycle refrigerant management. A key challenge is the complexity of establishing the necessary infrastructure, such as reverse supply chains, for managing refrigerants effectively. Ensuring compliance, especially among small businesses in diverse economies, adds another layer of difficulty for life-cycle refrigerant management. Collecting and reporting data is crucial for designing effective policy-based incentives and disincentives. Containing refrigerants through measures such as venting bans should be the first important step. Establishing reclamation standards, particularly for hydrofluorocarbons (HFCs), helps ensure that reclaimed substances meet quality requirements, making them suitable for reuse in the market. Enforcing strict recovery and recycling protocols is vital, while balancing the availability of reclaimed substances with market demand is important for sustaining recovery efforts and an effective life-cycle refrigerant management system.

11. The following essential elements of effective life-cycle refrigerant management were identified:

- (a) Strong legislative frameworks tailored to each country's context that may help unlock investment;
- (b) Starting with containment measures and gradually building more comprehensive life-cycle refrigerant management systems;
- (c) Collaboration with industry stakeholders and other authorities to create comprehensive life-cycle refrigerant management systems;
- (d) Establishing clear roles and responsibilities for all stakeholders in life-cycle refrigerant management to ensure better compliance and enforcement;
- (e) Continuous feedback from stakeholders to enable iterative improvements in life-cycle refrigerant management policy and practice;
- (f) Awareness-raising through training and certification programmes for technicians as a way to foster the adoption of best practices;
- (g) Funding life-cycle refrigerant management through a mix of government grants, innovative incentives schemes for industry engagement through extended producer responsibility, and market-based approaches (such as carbon markets).

C. Session 3: Deep dive into life-cycle refrigerant management

12. In session 3, participants explored specific aspects of life-cycle refrigerant management in greater depth through four parallel breakout groups. The groups addressed key components such as leak prevention, recovery, recycling, reclamation, destruction of refrigerants, and disposal of equipment containing controlled substances. Each breakout group discussed practical strategies and solutions for overcoming challenges, including the use of innovative approaches and policy recommendations. The session highlighted opportunities to promote effective refrigerant management practices, while addressing country-specific circumstances and cross-cutting areas. Many highlighted challenges and solutions were common across the different components of life-cycle refrigerant management.

13. *Session 3: breakout group on leak prevention* highlighted the following key issues:

- (a) Challenges include the accessibility of suitable technology and the availability of refrigeration and air-conditioning equipment designed for extreme climate conditions such as those in high-ambient-temperature countries. This often leads to higher leakage rates and decreased equipment lifespan. Limited training and certification infrastructure especially in parties operating under paragraph 1 of Article 5 of the Protocol (Article 5 parties) hinders the ability of technicians to keep abreast of the latest standards. There is also a lack of appropriate servicing tools, such as calibrated leak detectors and pressure gauges, and insufficient consumer awareness of the importance of equipment maintenance.
- (b) Solutions include enhancing training programmes for servicing technicians, adopting updated standards and guidelines, and improving consumer education on the value of proper installation and servicing. Predictive leak detection for smaller systems and ensuring proper installation can significantly reduce leak rates. Collaboration with manufacturers and certification organizations can help ensure that training programmes incorporate the latest technological advances. If local resources are lacking, countries can set up systems by partnering with international organizations to develop training curricula, establish standards, and build monitoring mechanisms. Implementing electronic logbooks for tracking refrigerant use and servicing activities can provide

valuable data for assessing the effectiveness of leak prevention measures. Retrofitting older equipment with proper leak detection tools and encouraging adherence to best practices in large-scale systems can further support leak prevention efforts.

14. **Session 3: breakout group on recovery, recycling and reclamation** highlighted the following key issues:

(a) Challenges in this area include high costs of technologies and laboratory facilities, limited access to suitable recovery equipment, and the difficulty of maintaining high standards for the quality and purity of reclaimed refrigerants. For many Article 5 parties consuming a low volume of ozone-depleting substances, the economy's size, market conditions, and geographic barriers make it challenging to access necessary infrastructure and technologies. The growing use of refrigerant blends complicates the purification process, as mixed substances can affect quality. The lack of a clear regulatory distinction between reused and waste refrigerants as defined under the Montreal Protocol and the Basel Convention further complicates the potential for recovery and reuse.

(b) Solutions for systematic recovery of refrigerants for reuse can start with an inventory to understand the scope of the installed equipment base and refrigerant stockpiles (banks). Creating a mix of mandatory and voluntary policy frameworks that provide tailored incentives for recovery and reuse of refrigerants – for example, mandating the use of a percentage of reclaimed substances – is crucial. Engagement of stakeholders, including technicians, private-sector partners and industry associations, helps in developing tailored approaches and gaining support for recovery initiatives. Developing a reverse supply chain infrastructure, facilitating access to recovery equipment, establishing standards for reclaimed refrigerants, and promoting training programmes are essential. Public-private partnerships and regional collaboration can be a good model for scaling access to critical facilities and expertise: for example, regional laboratories can provide shared access to analysis and purification facilities.

15. **Session 3: breakout group on destruction of refrigerants** highlighted the following key issues:

(a) Insufficient financial resources, inadequate infrastructure, and limited access to advanced destruction technologies are key challenges for environmentally sound destruction of unwanted refrigerants. Even larger Article 5 parties with more developed infrastructure often require upgrades to existing facilities, such as cement kilns or rotary kilns, to improve their capacity for refrigerant destruction. Compliance with transboundary movement regulations under the Basel Convention complicates the transport of refrigerants for destruction in another location or country.

(b) Practical solutions include leveraging regional collaboration to pool resources and share destruction facilities and expertise, using cost-effective methods like cement kilns, and exploring innovative technologies for smaller-scale operations. Countries should first conduct a thorough assessment of existing infrastructure and technology needs, through evaluating current destruction capacity and identifying gaps that require investment or upgrades. Establishing clear guidelines for handling and transporting refrigerants across borders can streamline compliance with instruments such as the Basel Convention and the Bamako Convention against Illegal Dumping of Hazardous Waste. Building institutional capacity – for example, by training technicians and regulators – is also critical for effective implementation. In addition, creating financial mechanisms, such as carbon credits and recovery levies, can provide sustained funding to support refrigerant destruction efforts. Finally, ensuring stakeholder engagement, including private-sector involvement, is crucial for fostering a collaborative approach to managing the end-of-life phase of refrigerants.

16. **Session 3: breakout group on dealing with equipment** focused on challenges involved in managing used and waste refrigerant-containing equipment, particularly in developing countries, on the basis of the draft guidance document being developed by the Partnership for Action on Challenges relating to E-waste (PACE II) under the Basel Convention. The document aims to offer guidance for the environmentally sound management of used and waste refrigerators, as well as cooling and heating equipment. The following issues were highlighted:

(a) Challenges include the lack of infrastructure for environmentally sound management and high costs associated with managing end-of-life equipment. Regulatory inconsistencies in areas such as different national definitions of “used” versus “waste” equipment lead to varied handling procedures and compliance requirements. Reintegrating materials such as plastics and polyurethane foam into supply chains can be challenging, affecting the sustainability of recycling chains and their operation.

(b) Regional collaboration offers a promising solution, allowing countries to exchange experiences, share resources and establish joint facilities for recycling and environmentally sound management. Implementing extended producer responsibility schemes can distribute the costs of

managing end-of-life equipment to manufacturers, providing financing to the scheme. Their implementation should be context and country specific. Data collection systems and reverse logistics chains can improve the tracking of equipment. Inventory projects funded by the Multilateral Fund can provide insights regarding the supply of equipment into a country and identify potential solutions and collaboration opportunities for dealing with the end-of-life stage of equipment. Adopting global guidance documents such as the one being prepared by the Basel Convention or developing-country-specific practices can help align stakeholders' efforts. At the international level, global treaties such as the Basel Convention and the Montreal Protocol can support efforts to align national operations – for example, simultaneous notifications could be sent to the focal points of both treaties.

D. Session 4: Financing life-cycle refrigerant management

17. Session 4 consisted of a panel discussion with seven experts who explored the financial challenges, available mechanisms, and strategies for scaling up life-cycle refrigerant management efforts. Participants emphasized the need for diverse financing options, including extended producer responsibility schemes, carbon finance and credits, and public-private partnerships, to ensure the long-term sustainability of life-cycle refrigerant management initiatives. The following key points were discussed.

18. Challenges for sustainable financing of life-cycle refrigerant management include the high capital and operational costs of establishing infrastructure, the high cost of technologies, the complexity of processes requiring expertise and skills, and lack of scale, especially in smaller and low-volume-consuming countries. The lack of sustainable business models and long-term financial mechanisms makes it difficult to expand life-cycle refrigerant management efforts. While the Multilateral Fund provides support for foundational activities of life-cycle refrigerant management such as support for leak prevention and the servicing sector, that support is not sufficient for large-scale implementation of life-cycle refrigerant management. Many countries struggle with enforcement and transparency issues in tracking refrigerants.

19. Solutions need to focus on leveraging diverse and innovative financing mechanisms, including extended producer responsibility schemes, public-private partnerships and carbon credits. For example, the establishment of tax measures and refund systems, such as those in Canada and Norway, can create incentives for collection and proper recovery and destruction of refrigerants. The integration of carbon markets, both voluntary and compliance-based, can offer additional revenue, though their effectiveness varies and needs to be evaluated in terms of environmental and economic trade-offs. Strengthening regulatory frameworks and enhancing the transparency of substance tracking and reporting are needed for mobilizing financial support.

20. Session participants identified the following key elements of effective financing:

- (a) Gathering data on refrigerant inventories, operational costs, and financing needs in order to make informed decisions and assess the cost-effectiveness of various policy options;
- (b) Establishing strong regulatory and policy frameworks that define stakeholders' roles and responsibilities, ensuring transparency, accountability and compliance, and that will thus attract investment and financing;
- (c) Engaging the private sector in collaborative projects in order to share costs and responsibilities, making life-cycle refrigerant management more financially viable; introducing extended producer responsibility schemes that involve stakeholders across the supply chain;
- (d) Understanding and exploring carbon markets and finance to complement life-cycle refrigerant management activities, while assessing their overall environmental impact, economic benefits and trade-offs;
- (e) Designing financing models that support ongoing operations for handling all types of refrigerants, including alternatives; emphasizing resource efficiency, environmental sound management of waste, and circular business models that are adaptable to market changes and regulatory shifts;
- (f) Viewing life-cycle refrigerant management as an investment in the future, with opportunities for transformational change.

E. Final session: closing remarks and wrap-up

21. During the session, workshop participants were invited to share, via an online polling system, their key takeaway messages from the workshop. The results can be summarized as follows:

(a) A recurring theme is the need for financial support, including from the Multilateral Fund, to start the implementation of life-cycle refrigerant management. Participants emphasized that financing, including incentives for recovery and reclamation processes, is crucial for achieving sustainable results.

(b) Many pointed to the need to conduct inventories and assessments in order to understand the situation before designing policies. Data-driven decision-making and careful planning were seen as fundamental to effective life-cycle refrigerant management.

(c) There is a strong emphasis on the need for collaboration – both at the national and international levels. Stakeholders, including industry partners, government entities, and international bodies, are seen as essential in driving life-cycle refrigerant management efforts.

(d) Training for technicians and building institutional capacity are considered vital. Certification programmes and enhancement of technical knowledge were highlighted as key steps for implementing and sustaining life-cycle refrigerant management practices.

(e) Many participants stressed that there is no single solution for life-cycle refrigerant management. Strategies must be adapted to specific national contexts, recognizing the need for flexibility and smart policy design.

(f) The responses reflected a sense of urgency, with calls to “start now” and focus on action rather than prolonging discussions. Countries are encouraged to act quickly, even through incremental and imperfect steps, to build foundations, confidence and support for life-cycle refrigerant management efforts.

(g) The need for a holistic approach, considering both climate and ozone impacts, was acknowledged.

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