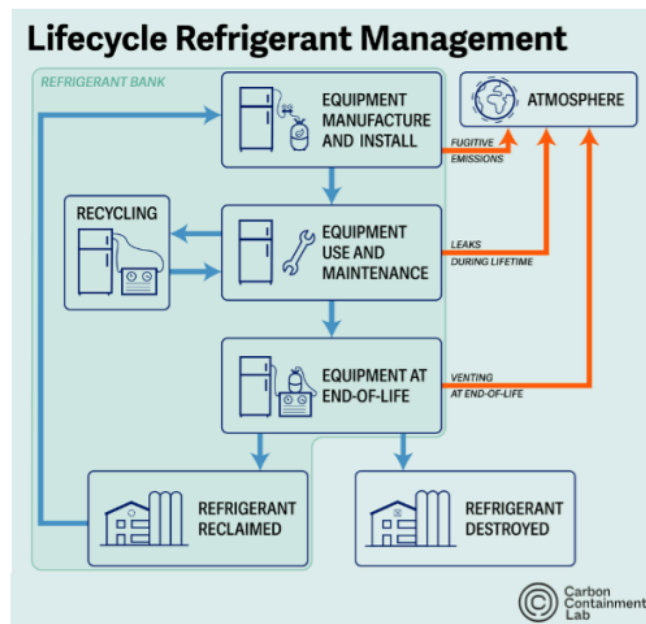


WORKSHOP REPORT

ACCELERATING LIFECYCLE REFRIGERANT MANAGEMENT

46th Meeting of the Open-Ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, Quebec – 9 July 2024



I. INTRODUCTION

Fast action on short-lived climate pollutants is the surest way of slowing climate feedback loops, forestalling tipping points, and buying time to scale and develop technology, as recently reaffirmed by the White House.¹ It also provides greater opportunities to enhance resilience and adaptive capacity in the face of increasingly severe climate impacts. The transition away from hydrofluorocarbons (HFCs) is a key component of the fast action agenda.

The 2016 Kigali Amendment to the Montreal Protocol is a significant step toward reducing global emissions of HFCs. Full implementation of HFC production and consumption phasedowns will prevent an estimated 0.5 degrees Celsius of atmospheric warming by 2100.² This avoided warming adds to the tremendous environmental benefits of the Montreal Protocol's phaseout of ozone-depleting substances (ODS). In total, the Montreal Protocol is projected to avoid 2.5 degrees Celsius of atmospheric warming by 2100.³

Realizing the full potential of the Montreal Protocol to protect the climate and ozone layer, however, requires consideration of controlled substances' complete lifecycle: from production and use to leak reduction, recovery, reuse, and environmentally sound disposal. Downstream management of refrigerants — known as “lifecycle refrigerant management” (LRM) — can aid Montreal Protocol compliance and serve the treaty's guiding purposes: stratospheric ozone protection and global climate change prevention.^{4,5}

In May, the Montreal Protocol's Technology and Economic Assessment Panel (TEAP) published its first report on lifecycle refrigerant management (LRM), creating one of the most comprehensive

¹ The White House, FACT SHEET: Biden-Harris Administration Announces New Actions to Detect and Reduce Climate Super Pollutants, July 2024.

<https://www.whitehouse.gov/briefing-room/statements-releases/2024/07/23/fact-sheet-biden-harris-administration-announces-new-actions-to-detect-and-reduce-climate-super-pollutants/>

² World Meteorological Organization (WMO), “Scientific Assessment of Ozone Depletion: 2018, World Meteorological Organization, Global Ozone Research and Monitoring Project,” 2018, <https://ozone.unep.org/sites/default/files/2019-05/SAP-2018-Assessment-report.pdf>.

³ Young, P.J., Harper, A.B., Huntingford, C. et al. The Montreal Protocol protects the terrestrial carbon sink. *Nature* 596, 384–388 (2021). <https://doi.org/10.1038/s41586-021-03737-3>.

⁴ Christina Theodoridi et al., “The 90 Billion Ton Opportunity” (EIA, NRDC, IGSD, 2022), <https://us.eia.org/wp-content/uploads/2022/10/Refrigerant-Lifecycle-FullReport-6Spreads-PRINT.pdf>.

⁵ Initiative on Fluorocarbons Life Cycle Management, “Resource Book for Life Cycle Management of Fluorocarbons” (Climate and Clean Air Coalition: Japan Ministry of the Environment, 2022), <https://www.ccacoalition.org/resources/resource-book-life-cycle-management-fluorocarbons-good-practice-portfolio-policy-makers>.

overviews of LRM to date.⁶ At the 35th Meeting of the Parties to the Protocol, Parties — following a submission from the Federated States of Micronesia and Samoa — took significant strides towards a unified Montreal Protocol LRM strategy that can aid treaty compliance, including by requesting this landmark report by the TEAP. In a critical decade for both the ozone layer and climate, LRM can ensure that the Montreal Protocol, which has traditionally focused on upstream phasedowns rather than downstream emissions, continues its planet-saving legacy by addressing emissions from use and end-of-life.

However, there continue to be significant barriers to the implementation of LRM globally. In order to accelerate the phasedown of HFCs and maximize the climate benefits of the Montreal Protocol, these challenges must be addressed. The Carbon Containment Lab (CC Lab) gathered experts in LRM and SLCPs to discuss these challenges and help to formulate strategies for action.

II. WORKSHOP OBJECTIVES

On July 9, 2024, at the 46th Meeting of the Open-Ended Working Group (OEWG46) of the Montreal Protocol, the CC Lab invited experts representing diverse sectors gathered to a workshop entitled *Accelerating Lifecycle Refrigerant Management*. The list of participants is appended to this report. The workshop was conducted via Chatham House Rules.

The overall objective of this gathering, hosted by the Carbon Containment Lab, was to identify the key problems and challenges in implementing LRM, and to provide input towards a future blueprint for the tools and actors that can address these challenges.

The discussion took an integrated view of the HFC transition and the current landscape of LRM, including existing initiatives and activities that seek to address barriers and related challenges, and the role of climate finance and carbon markets in accelerating LRM. The discussion also considered opportunities to leverage recent success under the Montreal Protocol, and the roles of its key institutions, including the TEAP and Multilateral Fund (MLF). Ahead of the workshop, the CC Lab sent background reading to participants including the definition of LRM and key takeaways from the TEAP report.⁷

⁶ TEAP Decision XXXV/11 Task Force Report, “Lifecycle Refrigerant Management”, Volume 4, May 2024. <https://ozone.unep.org/system/files/documents/TEAP-May2024-DecXXXV-11-TF-Report.pdf>.

⁷ Ibid.

The workshop was organized into three parts, with each featuring a facilitated discussion and interactive exercises. The agenda is appended to this report.

- **Part One** - Problems & challenges in implementing LRM
- **Part Two** - Workshop for overcoming problems & challenges
- **Part Three** - Potential opportunities for key stakeholders

III. WORKSHOP OUTCOMES AND RECOMMENDATIONS

Workshop participants identified and discussed the following barriers to, and solutions that facilitate, further action to maximize lifecycle refrigerant management (LRM), including refrigerant recovery, reclamation, and destruction.

These solutions range from capacity-building at a local level (i.e. technician training), to relevant actions at the international level under the Montreal Protocol, including via financial assistance from the MLF and technical assessment by the TEAP.

1. Problems & Challenges in Implementing LRM

Information

- 1.1. Undervaluing LRM as a climate solution:** In a warming world, cooling is a necessity with implications for public health, food security, and economic prosperity. LRM plays a critical role expanding access to cooling while mitigating its direct emissions. However, key LRM stakeholders, such as refrigerant end users who responsibly manage their refrigerants, often do not receive enough recognition or make sufficient effort to minimize leaks, recover refrigerants for reclaim or destruction, and use reclaimed refrigerant in servicing equipment.
- 1.2. Missing information about costs:** Exact details concerning LRM implementation – such as capital expenditures for LRM equipment and variable costs for refrigerant recovery – are not clear for all geographies, particularly in the Global South. Broadly, country-level data related to costs, existing infrastructure, and business-as-usual practices are scarce.
- 1.3. Misconceptions about reclamation:** Despite industry standards ensuring that reclaimed refrigerants are restored to virgin purity standards, some equipment

manufacturers resist using reclaimed gasses in new equipment, stemming from fears that the gasses are lower purity. These attitudes are gradually diminishing, but persistent concerns over adequate supplies of reclaim for initial charge of new equipment have emerged as a limiting factor for the wider use of reclaim.

Governance

- 1.4. Lack of enforcement:** Across the world, enforcing regulations related to LRM (e.g. venting prohibitions) has been difficult. Lack of enforcement has led to widespread non-compliance.
- 1.5. Restrictions on transboundary movement of refrigerants:** Some countries, especially those with low HFC consumption, cannot generate sufficient recovered refrigerant to justify investments in in-country reclamation and destruction infrastructure. These countries also may not be able to export recovered gasses to countries that do possess the infrastructure, due to restrictions under the Basel Convention.

Technology

- 1.6. Lags in technology improvements:** Tools to implement LRM are widely available on the market but still could benefit from technological improvements. Refrigerant recovery machines, for example, operate too slowly to make recovery economical for most refrigerant technicians.⁸ Destruction technologies also tend to be immobile, emissive, and/or expensive – elevating costs and logistical complexity for mitigation.⁹ Reclaiming more complicated chemicals such as HFC blends will also require more sophisticated reclamation technology.
- 1.7. Gaps in technology access:** A5 parties typically have the least developed tools and infrastructure to manage refrigerants,¹⁰ and often face logistical and legal barriers under the Basel Convention to exporting recovered refrigerant for responsible handling.¹¹ Deploying tools, expanding capacity, and providing financing for LRM projects in these parties will be critical to executing LRM globally.
- 1.8. Insufficient tracking capabilities:** Currently, governments and private companies do not have the capabilities to track refrigerants precisely along their chain of custody,

⁸ Ibid., Chapter 6.

⁹ Ibid., Chapter 3.

¹⁰ Ibid., Chapters 3 and 4.

¹¹ Ibid., Chapter 6.

from factories and ports to technicians and equipment. Lack of data and tracking for refrigerants has led to difficulty in enforcing regulations and poor insight into where and how refrigerant emissions (and mitigation activities) are occurring.

- 1.9. Concerns about safety:** Some HFCs and low-Global Warming Potential hydrofluoroolefins (HFOs) are considered to be PFAS, a family of chemicals harmful to human health and the environment.

Financing and Capacity-Building

- 1.10. Financing LRM in A5 countries:** Developing (“Article 5” or “A5”) Parties are expected to be the dominant source of refrigerant emissions in the future but have the least capacity to manage them, particularly financially. There is a need for sustainable business models and shareable best practices.
- 1.11. Capacity-building in A5 countries:** Article 5 Parties lack other capacity, including training for technicians and regulators in implementing agencies, access to context-specific information on LRM and its connection with compliance with the Montreal Protocol, and tools and infrastructure for reclaiming refrigerant to meet servicing needs for existing equipment.
- 1.12. Lack of trust in carbon markets:** Carbon markets can play an important role in catalyzing finance for LRM, but lack of trust in carbon markets has been a barrier to investment. There should be more work to build trust in high-integrity carbon markets for HFCs.

Other challenges to implementing LRM include, *inter alia*, a lack of capacity in Article 2 (“developed”) countries, and difficulty coordinating between sectors, steps, and stakeholders. Potential solutions to address these challenges are outlined below.

2. Workshop for Overcoming Problems & Challenges

In order to scale LRM effectively and quickly, several sectors will need to take a coordinated approach. Workshop participants discussed a potential blueprint for these tools and actors to address key challenges. These include data and information, regulations and policy incentives, infrastructure, technology and innovation, capacity-building and training, climate finance, and private sector investments including carbon markets.

Information

- 2.1. **Deploying MLF funds to close compliance-related informational gaps:** While other sources of funding will be needed to scale LRM globally, MLF funds can aid in closing informational gaps for issues related to compliance with the Montreal Protocol and validate project models in the medium- to long-term. For example, MLF ExCom Decision 91/66 opened a funding window for conducting inventories of unwanted banks of controlled substances and developing plans for their collection, transportation, and disposal.
- 2.2. **Drawing on the TEAP’s credibility and expertise to answer key questions:** The TEAP’s May 2024 Report, “Lifecycle Refrigerant Management,” is its first report on LRM, and one of the most comprehensive overviews of LRM to date. The TEAP and the Task Force – at the request of the Parties to the Montreal Protocol – can continue to gather and validate data, and investigate relevant questions, in future iterations of the report.
- 2.3. **Learning from effective role models:** Case studies of the most successful LRM implementation models, such as Australia or Japan, could help spawn similar efforts across the globe.

Governance

- 2.4. **Coordinating across different institutions and actors:** Upfront clarity about the unique roles of institutions will help direct efforts and resources to where they are the most impactful. The Montreal Protocol has traditionally governed upstream production and consumption, while downstream emissions fall under the climate governance regime, including the United Nations Framework Convention on Climate Change and 2015 Paris Agreement. Clarity on the governance of LRM would greatly aid in directing financing and capacity-building efforts under the international regime, as well as how ozone and climate agencies at the national level can cooperate.
- 2.5. **Regulating and centralizing carbon markets:** In order to bolster confidence in carbon markets, a regulatory backstop is necessary. Additionally, fragmentation of the current market and the diversity of actors involved undermines confidence in integrity. Article 6 of the Paris Agreement provides one central mechanism through which regulations and oversight may occur, and high-integrity methodologies and protocols may be validated. However, Article 6 faces a difficult path to operationalization.

- 2.6. Piloting LRM initiatives in cities and subnational jurisdictions:** Globally, subnational jurisdictions are successfully developing and implementing innovative climate policy. One approach to improve scalability and efficiency of LRM implementation is to target cities and subnational jurisdictions. Cities often not only manage policy relevant to their jurisdiction, but also manage their consumption and procurement of refrigerants and the relevant infrastructure. In Massachusetts, for example, the Green Jobs Expansion Grant is removing barriers to train HVAC technicians.¹² Coalitions and networks of cities and other subnational leaders, such as [C40 Cities](#) and [ICLEI](#), may provide opportunities to scale city-level action globally. City engagement can also be informed by geospatial hotspot analysis to understand where emissions are not being contained, their density, scale, and the replicability of projects.

Technology

- 2.7. Developing software and innovative technology:** Technological improvements will be a critical part of LRM going forward. For instance, a centralized software platform to track refrigerant throughout the value chain could help countries with Montreal Protocol compliance and in enforcing venting prohibitions. The digitization of leak detection, and emissions monitoring, reporting, and verification will also be critical in bolstering confidence in the carbon market and HFC-based credits.

Financing and Capacity-Building

- 2.8. Leveraging private finance and carbon markets:** Historically, private finance and carbon markets have played a significant role in enabling refrigerant destruction and reuse. In order to improve confidence in carbon markets, it is important to amplify successful cases and best practices, learn from trusted players in the voluntary carbon market, and understand the full menu of options, ranging from participation in voluntary markets to compliance markets.
- 2.9. International financial and government institutions:** The Montreal Protocol's MLF has a history of funding demonstration projects and servicing tools and training for compliance, which will continue to be necessary as LRM is implemented. The Organisation for Economic Co-operation and Development (OECD) provides

¹² Massachusetts Executive Office of Education. "Healey-Driscoll Administration Awards \$2.5 Million to Expand Green Job Training in Massachusetts." *Press Release*, April 28, 2023.

Climate Finance Recognitions for its donor countries, which may be used to amplify LRM work. The World Bank also has a history of funding Montreal Protocol compliance projects in its member countries. Successful pilot projects also could be used to mobilize other sources of public and private financing to scale LRM activities.

- 2.10. Procurement:** Procurement will be an essential part of financing for LRM in both the public and private sector. Procurement agreements go beyond the up-front purchasing of equipment, and can also address service contracts; purchasing of reclaimed gasses, and leak detection and repair.
- 2.11. Formalizing the technician sector:** The technician sector accounts for tens of thousands of practicing technicians across the globe. Implementing training certification and business licensing, can improve the penetration of servicing best practices¹³ and accelerate LRM.

3. Potential Opportunities for key stakeholders

- 3.1. Aligning science, process, and investment into a coherent blueprint:** A coalition of key stakeholders could develop and mobilize a blueprint to address LRM challenges. This includes the scientific imperative to align mitigation goals with emissions metrics, and to adopt an accounting methodology complementary to near-term mitigation targets. This plan can be developed with key stakeholders, including workshop participants, and presented at the LRM Workshop during the 36th Meeting of the Parties to the Montreal Protocol.
- 3.2. Identifying financial mechanisms and engaging with investors:** Key stakeholders could identify and develop innovative financing mechanisms and business models for LRM projects, and engage funders and key stakeholders on the value of LRM projects.
- 3.3. Developing high-integrity methodologies:** Key stakeholders could expand efforts in developing [high-integrity methodologies](#) and monitoring, reporting, and verification protocols for LRM-based credits in the carbon market.
- 3.4. Raising awareness and developing educational materials:** A coalition of academia, policymakers, and other partners could develop educational communications materials and ensure that education and training is available to those who most need it, including ozone and climate officers in Article 5 countries where capacity is lacking.

¹³ TEAP Decision XXXV/11 Task Force Report, Chapter 6, “Lifecycle Refrigerant Management”, Volume 4, May 2024. <https://ozone.unep.org/system/files/documents/TEAP-May2024-DecXXXV-11-TF-Report.pdf>.

- 3.5. **Providing procurement specifications:** Stakeholders could help ensure that procurement agreements follow best practices and address service contracts, purchasing of reclaimed gasses, and leak detection and repair.
- 3.6. **Developing and sharing successful case studies:** Stakeholders could undertake spatial analysis to determine where LRM is most needed, securing financing of recovery and destruction facilities in hotspots, and ensuring that LRM projects are verified and counting towards countries' NDCs. Stakeholders can also study successful cases where carbon markets and other innovative financing mechanisms have been used to implement LRM, or address challenges associated with implementing LRM. These can be shared on an ongoing basis.
- 3.7. **Aligning LRM with broader climate goals and emissions accounting:** In the longer-term, it is essential to align action on LRM with both near-term (i.e. 2030) and long-term climate goals (i.e. 2100). Key stakeholders can communicate the mitigation potential of LRM using appropriate accounting methods, study LRM financing needs in terms of near-term, up-front investments and the market for credits over time, and assist the private sector in scaling effectively and efficiently in line with climate targets.

IV. CONCLUSION

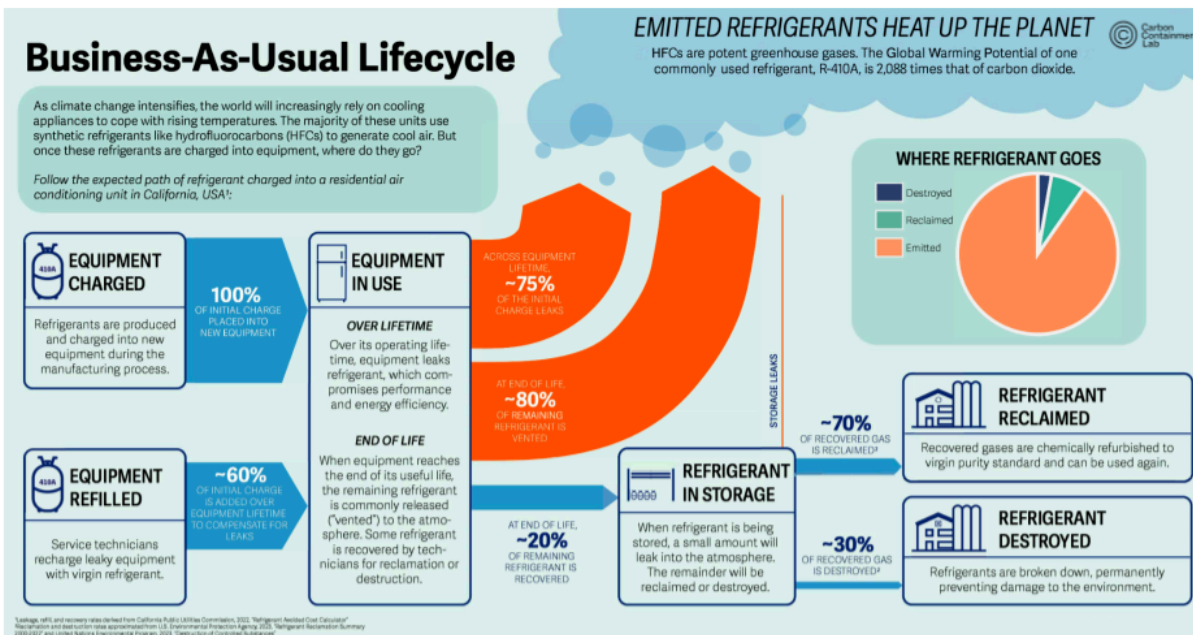
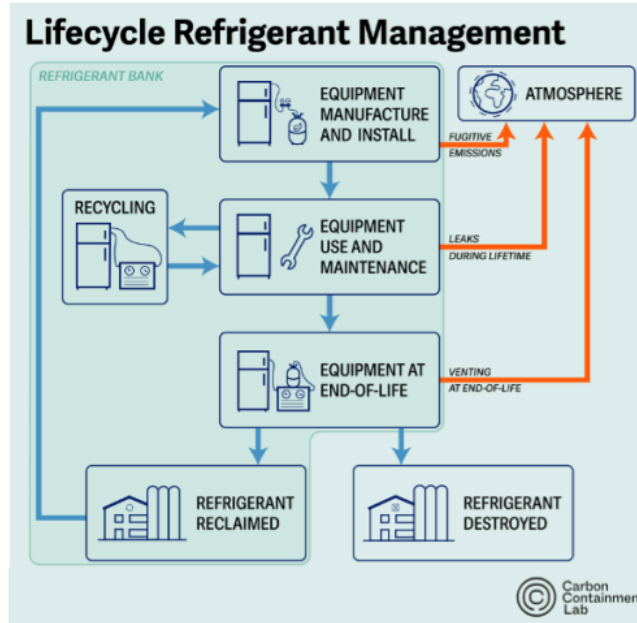
This report reflects the views of many of the workshop's participants and is meant to provide validation and help accelerate their deployment in concrete actions and initiatives.

Much of what is reported here represents the ongoing work of participants and their respective organizations, much of which is commonly accepted as essential to avoiding climate tipping points over the next decade and buying valuable time for longer-term energy transitions.

Though the TEAP's 2024 report marks the first official study of LRM under the Montreal Protocol, LRM is critical to achieving the full climate benefits of the Montreal Protocol and Kigali Amendment. The Montreal Protocol's success to-date is instructive of what may come for LRM: the ability of the Montreal Protocol to foster cooperative efforts among industry, investors, environmental groups, and governments has brought disparate interests together and produced unexpected victories for the climate, both under the Montreal Protocol and across the climate policy spectrum.

The participants of the workshop all agreed: more is possible. The outcomes summarized in this report will be instrumental in designing strategies for accelerating the implementation of LRM globally.

ANNEX A: WHAT IS LIFECYCLE REFRIGERANT MANAGEMENT?



WORKSHOP AGENDA

- 16:00** **Welcome, Introduction Around the Room, Goals for the Session**
- 16:20** **Review of LRM: Scope, Problems & Challenges**
- 16:45** **Workshop on LRM Challenges**
- 17:00** **Discussion of Opportunities to Address Challenges and Institutional Landscape**
- 17:15** **Potential Roles for Key Stakeholders and Ideas for Collaboration**
- 17:50** **Conclusions & Next Steps**



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