

MOP36 Side Event Report:

Accelerating the Implementation of Kigali through Lifecycle Refrigerant Management (LRM) and Alternative Cooling Technologies (ACTs)

The Carbon Containment Lab's Official Side Event During the 36th Montreal Protocol Meeting of the Parties (MOP36)

Tuesday, 29 October 2024 – Bangkok, Thailand



Introduction

The 2016 Kigali Amendment to the Montreal Protocol is a significant step toward reducing global emissions of hydrofluorocarbons (HFCs). Full implementation of its scheduled phasedowns in HFC production and consumption will prevent an estimated 0.5°C of atmospheric warming by 2100. Fast action on short-lived climate pollutants like HFCs also provides opportunities to enhance resilience and adaptive capacity in the face of increasingly severe climate impacts.

Realizing the full potential of the Montreal Protocol to protect the climate and ozone layer 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. Alternative Cooling Technologies (ACTs), meanwhile, provide alternatives to conventional HFC-based cooling, often delivering lower- or zero- global warming potential (GWP) solutions. Research and development, demonstration, adoption, and scale-up of both LRM and ACTs will require policy, advocacy, and industry support.

To discuss the potential of LRM and ACT in the context of the Montreal Protocol, the Carbon Containment Lab (CC Lab), a U.S.-based non-profit, convened a side event at the Meeting of the Parties (MOP) held in Bangkok, Thailand. Held on October 29, 2024, the event was a lively dialogue between expert panelists and participants.

Scott Stone, Advisor to the CC Lab and expert on HFC policy and regulation, opened the event and moderated the discussion. Scott provided some historical context as to how HFCs got onto the Agenda of the Montreal Protocol - the multilateral environmental agreement that works - and why it's so important that we now look to advancing LRM and ACT adoption to avert near-term climate tipping points.

The Panelists were:

- **Denise San Valentin**, Programme Management Officer at the Climate and Clean Air Coalition (CCAC) which focuses on short lived climate pollutants like HFCs, spoke about some of the experiences of developing countries in implementing LRM and where resources are most needed to support action.
- **Richie Kaur**, Senior Super Pollutant Reduction Advocate at the Natural Resources Defence Council (NRDC), spoke about LRM from the perspective of an advocacy organization and reviewed the policy actions that could support its implementation.
- **Leslie Smith**, Project Officer at National Ozone Unit, Government of Grenada, provided a perspective on LRM and ACTs from a smaller island nation in an Article 5 (developing) country; and how the Multilateral Fund (MLF) of the Montreal Protocol can provide more support.
- **Maas Goote**, Founder of Caraway Strategies, spoke about ACTs and the need to take a wider view of cooling in the face of global warming, economic growth, and rapid urbanization.
- **Anastasia O'Rourke**, Senior Managing Director at the CC Lab, discussed the financing needs and options that could support acceleration of LRM and ACTs and how to galvanize these resources.

Panelist Remarks

The following section provides summaries of key points from each of the panelists.

a. Kigali Implementation Overview & Challenges - Denise San Valentin, CCAC

Denise San Valentin first described the Climate and Clean Air Coalition (CCAC), a voluntary partnership of over 160 governments and non-governmental organizations that work to reduce powerful but [short-lived climate pollutants](#) (SLCPs). To date, over 40 Article 5 countries have begun implementing their Kigali Implementation Plans

(KIPs) to achieve a 10% reduction in their production and consumption of HFCs by 2029. Based on the experiences of countries and key players in the implementation of the terms of the Kigali Amendment thus far, CCAC has identified the key concerns and challenges outlined below:

1. *Data and information availability:* Compared with ozone-depleting substances (ODS), there are many existing HFC blends and new ones emerging regularly. High-quality data is important for national planning and strategy, but is not readily available today. In addition, National Ozone Units (NOUs) need more awareness of emerging options as more ACTs become available.
2. *Coordination with energy efficiency efforts:* As global temperatures rise, both energy efficiency and refrigerant management are critical for climate-friendly cooling but are often managed by separate institutions; more coordination is needed between such regulatory bodies. A funding window for energy efficiency initiatives is now open under the Multilateral Fund. More expertise on energy efficiency can help NOUs take full advantage of this opportunity.
3. *Meeting future cooling demand:* There is hesitation towards increasing the ambition of the Kigali Amendment due to concerns about meeting future cooling demand and the possibility of reduced funding from the MLF to assist A5 countries.

b. LRM Challenges and Opportunities - Richie Kaur, NRDC

Richie Kaur explained that until recently, the Montreal Protocol has been focused on phasing out and down ODS and HFCs respectively. Now, the Montreal Protocol has increased its focus on LRM, which promotes the proper treatment of refrigerants during all stages of equipment life. Earlier this year, a TEAP report quantified the potential benefits of LRM - up to 40 billion metric tons of carbon dioxide equivalent (GtCO₂e) in avoided emissions over the next 25 years. The ozone and climate benefits of good LRM are significant and a way to extract more out of the Kigali Amendment.

Still, numerous challenges remain such as the lack of good data, infrastructure, education, or awareness, and a need for workforce development.

However, these problems are solvable if we can maintain and enhance the treaty's focus on LRM. There are policy tools that we can learn from, like California's [R4 Program](#) which helps secure demand for reclaimed gases. Despite the challenges of implementing LRM, the need for urgent climate action makes it essential to prioritize.

c. LRM Challenges and Needs in Article 5 Countries - Leslie Smith, Grenada Ozone Officer

Leslie Smith began by describing HFC management in Grenada. As a low-volume consuming country (LVC) and Article 5 country, Grenada faces unique challenges with the implementation of LRM. The small size of LVCs does not support economies of scale and the business case for LRM, which are necessary to support infrastructure and promote investments. In addition, regulations for refrigerant management are either inadequate or outdated. Without regulatory incentives or sustainable financing sources, LVCs lack the resources to build the necessary domestic capacity to support LRM practices. The MLF can and should provide some of the necessary financing. Furthermore, the Basel Convention inhibits the transboundary movement of refrigerant gases, making it difficult to export refrigerants for proper disposal. More examples of best practices and successful LRM schemes would be helpful, particularly for LVCs. Lastly, there is a need for higher-quality data. Stakeholders are often reluctant to participate in the data collection process, and data collection forms are too complex. But without this information, it is hard to set policy, make decisions, and then measure progress. Support and capacity building on information and data gathering would be foundational to action on LRM.

d. Alternative Cooling Technologies (ACTs) as Climate Action - Maas Goote, Carraway Strategies

Maas Goote emphasized the potential of ACTs in addressing the climate crisis, as highlighted by the UNEP Emissions Gap Report (2024), which warns of the rapidly narrowing window to limit warming to 1.5°C. He outlined how ACTs, encompassing innovative solutions such as elastocaloric and magnetocaloric systems, desiccant-based cooling, and other non-vapor compression heating and cooling technologies, can play a role in closing this gap by creating opportunities to accelerate the transition to climate-friendly alternatives. By reducing GHG emissions and supporting compliance with the Kigali Amendment, ACTs provide a critical tool for accelerating climate action.

Maas Goote further elaborated on how ACTs leverage novel approaches to cooling, such as solid-state technologies and non-vapor compression methods, which not only eliminate harmful emissions but also can create pathways for significant advances in appliance energy efficiency. He also noted that ACTs can help provide life-sustaining cooling to vulnerable areas with limited adaptive capacity to increasing temperatures.

Practical suggestions for how the Montreal Protocol can support the deployment of ACTs include:

1. Conducting a wider & deeper assessment by TEAP and the Refrigeration Technical Options Committee (RTOC) of the state of play, including promising emerging technologies.
2. Recruiting additional experts on ACTs to the TEAP and RTOC.
3. Considering establishing a Technical Options Committee dedicated to ACTs (ACT-TOC).
4. Hosting a knowledge sharing workshop through the Montreal Protocol to increase collective understanding of the state of play and of emerging technologies.
5. Establishing ACTs as a standing item on the MOP agenda to stay on top of technology changes for the purpose of policy development.

6. Supporting ACT pilots in A5 countries using the MLF.
7. Assisting countries in including ACTs in national cooling action plans.

e. Financing Options for LRM and ACTs - Anastasia O'Rourke, CC Lab

Anastasia O'Rourke discussed the different sources and uses of financial capital that will be needed to make LRM and ACTs a reality. Effectively financing LRM and the development of ACTs will require diverse sources of capital. The MLF, while important, is not large enough to handle the rapidly growing global need for LRM and ACTs, which necessitates private capital. Attracting private capital requires establishing viable revenue streams and sustainable business models; without these, long-term investment viability will remain a challenge. Strong policy support is also needed to kickstart and expand the industry as it develops. Ideally, a strong and supportive collaboration between government and industry will create a stable investment environment, enabling long-term sustainable business models. Funding sources may include:

1. Public sector sources:

- Levies/Taxes: taxing new refrigerants generates revenue that can be used to fund LRM (e.g. Refrigerants Reclaim Australia's program).
- Return/Rebate Systems: rebate systems can be combined with taxes to further incentivize recovery e.g. Norway's tax and refund program, the Danish Refrigerant Industry Environmental Scheme (KMO).
- Reclamation usage mandates: mandating the use of reclaimed refrigerant creates an end-market for used refrigerant which can then unlock private capital (e.g. California's R4 Program).

2. Philanthropic sector sources:

- Aid in R&D efforts for ACTs and LRM technologies.
- Help establish an innovation ecosystem, contributing to the early-stage development of essential technologies, through the sponsorship of incubators, accelerators, capacity building, and prizes.

3. Private sector sources:

- Private companies can invest in R&D, reverse supply chains, and verification systems to support the development of new technologies.
- Financial investors can support the growth of technology companies, through the use of venture capital and or private equity and more established companies through debt and other typical financing sources used to grow companies.
- Multi-lateral investment funds can also support the building of LRM infrastructure through, for example, low-carbon loans.
- Voluntary carbon markets (VCMs) can also be deployed to support LRM. VCMs have already delivered large amounts of funding towards ODS destruction, and similar systems can be developed to enhance LRM for HFCs. However, more effort is needed to ensure credit integrity and to prevent perverse incentives.

Discussion

A lively discussion with the Panel and Audience following the opening statements made by the panelists. Some of the themes that emerged in the discussion included:

- The need for greater funding for LRM and ACTs at all stages of technological development: from funding for early-stage research and development to early piloting, all the way through to commercialization and scale-up.
- The need to address barriers to effective LRM, including clarifying restrictions imposed by the Basel Convention's limitations on the transboundary movement of hazardous waste which determines the possibility of moving waste f-gases between countries. This is especially important in LVCs, or countries where there is limited reclamation or destruction capacity.
- The need for better data all around: for example, on the environmental consequences of current refrigerant management practices, data on existing infrastructure for LRM, and data to inform cost-benefit analyses.

- The need for encouraging innovation across several domains:
 - Policy, exploring extended producer responsibility (EPR) and carbon crediting mechanisms further,
 - Data & information to improve the traceability of controlled substances,
 - Reclamation and destruction technologies,
 - Leak detection and management,
 - Alternative cooling technologies.
- The need to take a comprehensive, systems approach to the issue.
- The need to take decisive and bold action given the potential to have a large and immediate impact on reducing emissions of these super pollutants, making immediate action on their phasedown critical for near-term climate stabilization.

The transition from HFCs under the Kigali Amendment offers a critical opportunity to curb near-term climate change. However, without robust LRM and ACT policies, the full climate benefits will not be realized. Accelerating LRM and scaling up ACT deployment are not just complementary strategies—they are essential for maximizing the Kigali Amendment’s impact.

The environmental and economic benefits of LRM are substantial. By recovering refrigerants at end-of-life and minimizing leaks, LRM can ensure a smoother transition toward zero-GWP refrigerants. According to TEAP, recovery and destruction efforts alone could prevent up to 23.4 GtCO₂e emissions by 2100, while leak prevention could avoid an additional 15.6 GtCO₂e. Furthermore, LRM facilitates compliance with the Kigali Amendment by increasing the availability of reclaimed refrigerants, reducing the need for virgin HFCs.

The Montreal Protocol offers a platform to promote both LRM and ACTs, particularly through the TEAP and the Multilateral Fund. Expanded funding for pilot projects and greater integration of ACTs into international climate finance mechanisms could accelerate deployment. Increased awareness and regulatory incentives for LRM and ACTs could stimulate much greater market interest and investment, which is sorely needed.

This side event aimed to foster discussion on how best to leverage LRM and ACTs to strengthen and accelerate the HFC phasedown, spotlighting the role of the private sector, national governments, and international organizations in driving forward these climate-critical strategies.