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Initiating Global Discussion to Act on a 100 Billion Ton Climate Problem

Preventing emissions of fluorinated greenhouse gases is the single greatest near-term strategy to achieve faster and deeper emission reductions consistent with limiting global warming to within 1.5 °C.¹ F-gas 'banks' are defined as ozone depleting substances (ODS) and hydrofluorocarbons (HFCs) contained in refrigeration and air conditioning equipment, chemical stockpiles, foams and other products. Unless sustainably managed and properly disposed, these gases which have high global warming potential (GWP) will be emitted in to the atmosphere, further exacerbating the climate crisis.

Despite the Montreal Protocol's success in phasing-out the production and consumption of substances that damage the ozone layer, it allows for significant and sustained emissions from F-gas banks.² A comprehensive international framework, accompanied by strong national regulations and sustainable financing mechanisms, is needed to address this issue. Sub-national and private sector leadership also has a significant role in piloting and jumpstarting scalable solutions. EIA investigations exposing massive illegal use of potent ODS, CFC-11 in China's polyurethane foam insulation sector in 2018, also point to significant new banks of CFC-11 foams that need to be prevented from being emitted into the atmosphere at their end of life.³ This report seeks to initiate and inform a discussion on immediate actions needed to capitalize upon this 100 billion ton climate opportunity.⁴



CFCs, HCFCs, and HFCs, potent greenhouse gases, are commonly stored in pressurized color-coded cylinders and are used in HVACR equipment, foams, aerosols, and as solvents. Proper management, reuse, and destruction of these gases could mitigate 96.5 gigatons, or 100 billion metric tons of CO₂ equivalent emissions globally between 2020 and 2050.

Sources of Emissions from Refrigerant Banks

Inadvertent release or leakage of refrigerant can occur at many stages from the point of installation, during use and transport, to final disposal. The majority of recoverable banks take the form of refrigerant contained in existing refrigeration and air conditioning equipment or bulk inventories and stockpiles. Therefore this report focuses on refrigerant banks in the most detail, although similar concepts apply to foam banks. Key primary sources of emissions are:

Leaks During Use and Transport

Refrigerants continually leak out of existing refrigeration and air conditioning equipment through compressors, seals and connections. This leakage can occur at high rates that could be reduced by encouraging improved practices for equipment maintenance, leak detection, and prompt repairs. The average supermarket refrigeration system leaks 25% of its total refrigerant charge annually, or 1,000 pounds.⁵ For the average supermarket this could amount to 1,780 metric tons of CO₂ equivalent, or annual emissions of nearly 400 passenger cars.⁶ It is estimated that 1 to 3% of the gas is typically emitted during transportation and transfer from small cylinders to bulk storage.

Venting and Emissions at End of Life

The largest source of unaddressed emissions occurs at the end of life when refrigerant is evacuated from equipment during servicing or when equipment is retired. At end of life, without any incentives or regulations in place, refrigerants are often vented into the atmosphere or accumulated as stockpiles that contribute to further leaks and venting.

Bulk Inventories and Stockpiles

Finally, emissions occur from bulk inventories and stockpiles of refrigerants, which may accumulate after recovery from servicing and decommissioning of used equipment,

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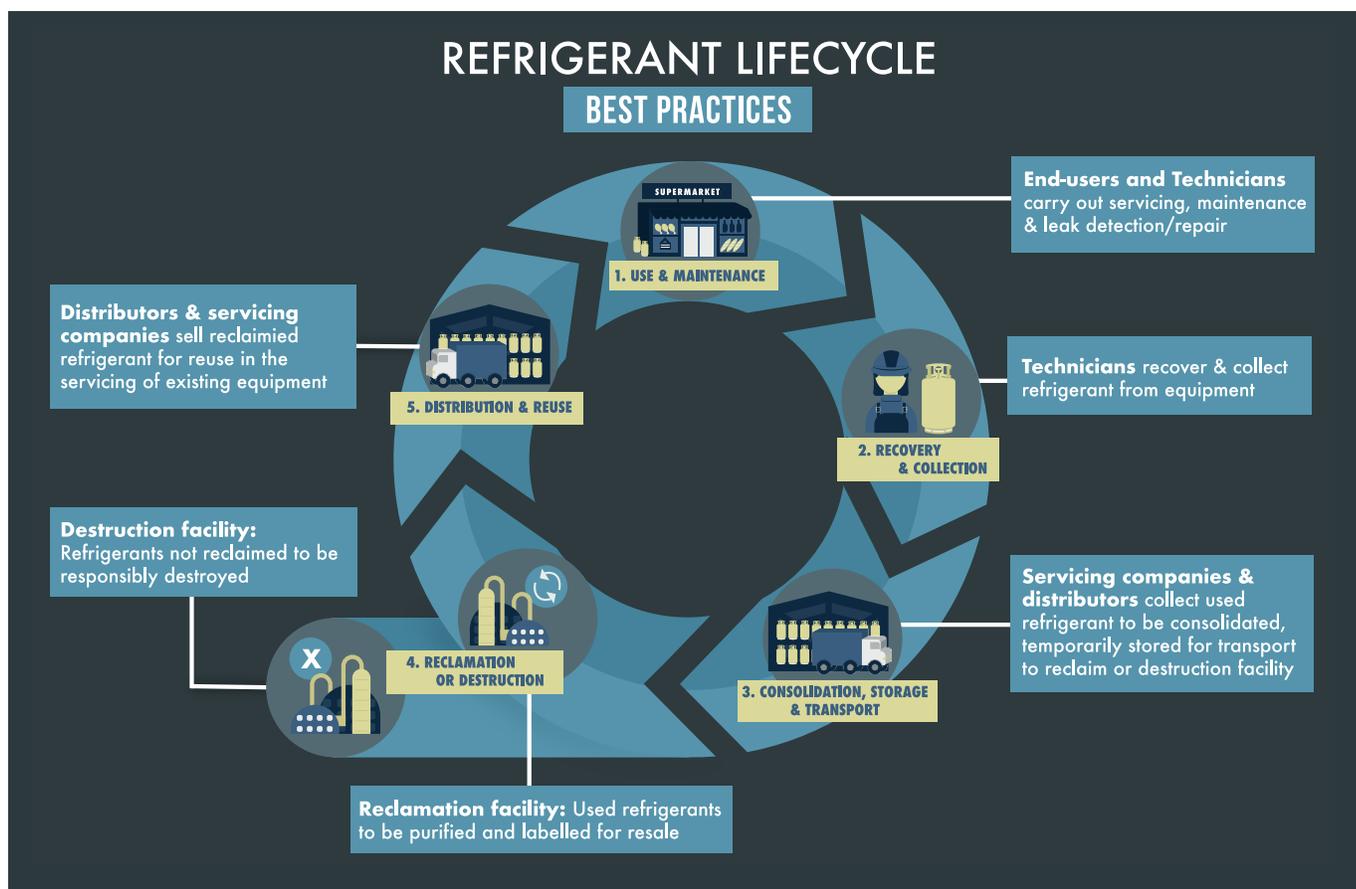


Figure 1: Best practices during different stages of the refrigerant lifecycle

or as virgin stockpiles that have been accumulated but not used. Bulk inventories and stockpiles around the world are challenging to quantify given the current lack of reporting requirements, but emissions of F-gases from these sources are likely considerable.

Most of these emissions can be avoided by following best practices at each of these steps (see Figure 1).

Policy Options

There are a number of regulatory, fiscal, and non-regulatory approaches that can be undertaken to reduce emissions from refrigerant banks (see Figure 2). This report broadly divides key potential policy approaches into two sets. The first set of policies deals with leak management, while the second addresses avoiding emissions at end of life.

Reducing Leaks

Approaches to improving refrigerant management typically focus on incentivizing or requiring owners and operators of large refrigeration and air conditioning systems to report on and improve refrigerant leaks throughout transportation and use.

Servicing Requirements, Leak Detection, and Repair

Owners and operators of large commercial and industrial refrigeration and air conditioning systems can be required or incentivized to employ refrigerant management practices that reduce refrigerant leaks from existing equipment. Most refrigerant management regulations include a combination of the following: periodic maintenance and leak inspections; installation of automatic leak detection equipment capable of calculating and reporting leak rates; and requirements for prompt repair of leaks and comprehensive retrofits or replacement with repeated leak events above a certain threshold.

Reporting, Recordkeeping, and Data Collection

Owners and operators of large refrigerant equipment as well as refrigerant wholesalers and distributors can be required to submit information registering systems in a central database and report on key data. This recordkeeping and data collection provide a useful source of information on refrigerant inventories, leaks, and amounts disposed. Such reporting is a complementary measure that can allow effective enforcement of other refrigerant management requirements and best practices. This has been successfully implemented in California, including through a central electronic reporting database.⁷

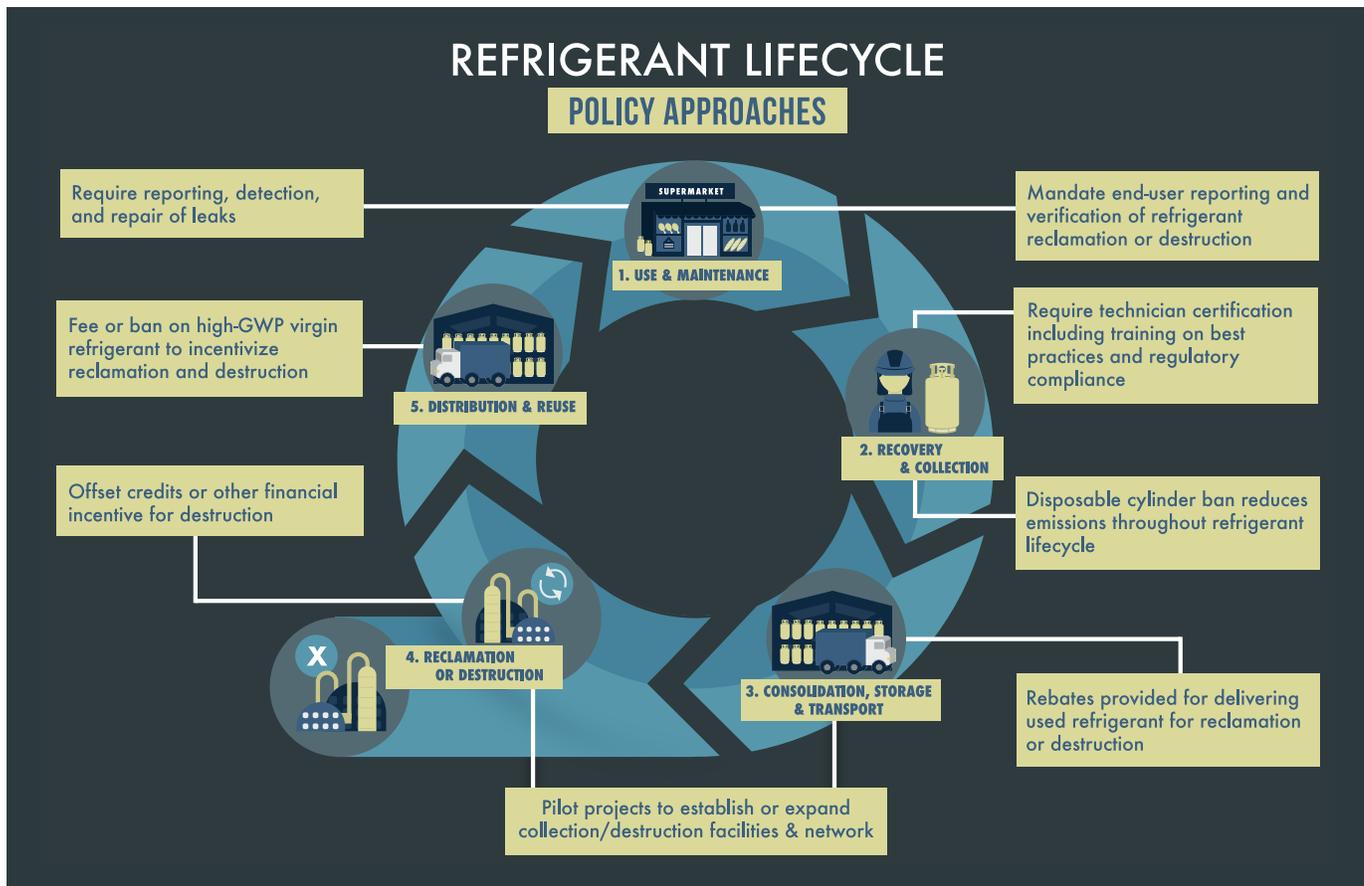


Figure 2: Potential policy approaches at different stages of refrigerant lifecycle

Electronic reporting can also apply to implementation and enforcement of end-of-life measures. End-users can be required to report and submit a certificate verifying reclamation or destruction corresponding to the amount of refrigerant recovered from equipment (see Figure 3 and 4).

Banning Disposable Refrigerant Cylinders

Disposable or non-refillable cylinders are specifically-manufactured ‘one-way’ containers charged with refrigerant, sold, used, and then discarded. Aside from the additional waste management issues this brings, the cylinders emit a residual quantity of refrigerant, or “heel,” to the atmosphere as the cylinders must be cut or punctured before entering the waste stream. On average, 3-4% of gas remains in the most commonly used 30-pound disposable refrigerant cylinders,⁸ while an additional liquid heel represents between 5 and 8%.⁹

Additionally, disposable cylinders are difficult to trace and are often the container of choice for illegal trade in counterfeit refrigerants. Banning disposable cylinders can therefore be an effective mechanism for counteracting illegal trade as well as reducing unnecessary emissions. Disposable cylinders have been banned successfully in the EU, Australia, Canada, and India.¹⁰

Technician Certification Requirements and Training Programs

Technician training is essential to ensure persons recovering refrigerants from equipment or in bulk understand the environmental hazards and have the necessary technical skills to prevent their release to the environment. Policies that would require enhanced technician certification for handling refrigerants, to include for example comprehensive training in proper recovery practices, could be an effective approach in addition to other measures.

End-of-Life: Recovery, Reclamation, and Destruction

Proper handling and destruction of ODS and HFCs at end of life is essential for ensuring that these materials are not illegally or inadvertently vented to the atmosphere. Policies that incentivize destruction of refrigerants at end of life have the added benefit of encouraging retirement of old energy-inefficient equipment containing ODS or HFCs, and therefore a more rapid transition to alternative refrigerants and more energy efficient systems. Reclamation also allows for the gradual, orderly phase-out of high-GWP



Figure 3: Under a user responsibility model commercial end users and owners are required to pay a fee for proper recovery, reclamation, and destruction of F-gases and F-gas products.

refrigerants over time, thus minimizing the cost and disruption of a phase-out program.

There are a number of potential policies aimed at increasing rates of recovery, reclamation, and destruction of used refrigerant, all of which may be implemented individually or as a package of complementary measures:

Mandates for Reclamation, Destruction, and Take-Back Obligations

Where technically and economically feasible, regulators can mandate that high-GWP ODS and HFC refrigerant be recovered from equipment and certified as reclaimed or destroyed. Well-established recovery and recycling schemes are an essential prerequisite for the successful implementation of disposal activities.¹¹ In Japan, such a mandate created a market for recovery, reclamation, and destruction, as product end-users are required to pay a recovery fee.¹² In a user responsibility model, similar to Japan’s, an end-of-life recovery, transport, and disposal fee is paid for by end-users. This fee is distributed accordingly throughout the destruction/reclamation chain. End-users are issued a certificate by the reclamation/destruction operator, which they in turn

EXTENDED PRODUCER RESPONSIBILITY

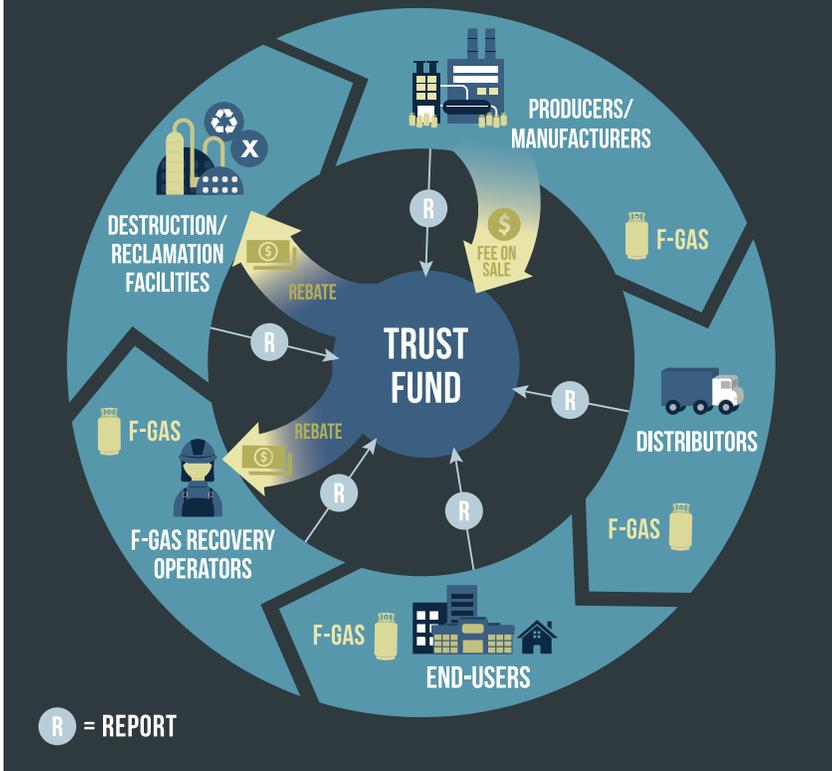


Figure 4: Under an extended producer responsibility scheme a fee on the sale of F-gas or F-gas products finances a rebate for recovery, collection, transport and reclamation/ destruction.

report to the central registry mechanism (see Figure 3). Regulators may alternatively consider imposing a take-back obligation requiring producers and distributors to ‘take back’ refrigerant from contractors at little or no cost. Examples of these programs are in place in France and Germany.¹³

Servicing Ban on High-GWP Refrigerants

A ban on the sale or use of new/virgin bulk high-GWP HFC refrigerants after a certain date will create a market for scaling up recovery and reclamation of used refrigerant. The European Union has such a ban in place beginning in 2020

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for use of virgin HFC refrigerant with a GWP greater than 2500 for servicing equipment containing large amounts of high-GWP refrigerant.¹⁴

Extended Producer Responsibility Schemes

To encourage sustainable end-of-life management, incentives can be employed to offset costs of refrigerant recovery, transport, storage, and destruction. These incentives are often financed under an extended producer responsibility (EPR) scheme, through a fee paid by producers of F-gases on imports and sales of virgin ODS/HFC refrigerant and/or pre-charged equipment. Typically, revenue from the fee finances a rebate or other incentive provided to servicing companies and distributors for recovering and collecting used refrigerant and to pay for reclamation and destruction. In an EPR scheme, payment responsibility lies in the hands of the producer or manufacturer, rather than the end-user (see Figure 3 and 4). By offsetting associated costs, a rebate can increase the effectiveness of complimentary policies, like a mandate or servicing ban outlined above. A number of countries including Australia, Norway, Denmark, Spain and Canada have implemented variations on this type of scheme, and have successfully increased recovery and destruction.

Other Incentives

Under the HFC phase-down regulators may offer incentives for early retirement of existing equipment and replacement with low-GWP refrigerants, with an additional incentive for destruction included. Carbon credits for destruction of HCFCs and/or HFCs may provide an additional source of funding to offset costs and incentivize end-of-life destruction. Certified carbon credits for destruction of CFCs have in the past served as an incentive for recovery and destruction under California’s cap-and-trade legislation.¹⁵

Voluntary Programs and Pilot Projects

Voluntary programs and pilot projects are approaches to consider if not in a position to implement more comprehensive policies. Before being adopted into law, many regulatory frameworks have started as voluntary programs. Discussions with stakeholders familiar with these programs emphasize the benefits of mandatory programs due to free rider and other issues; however, cooperative voluntary programs established with industry stakeholders should be explored.

Conclusion

Maintaining and accelerating emission reductions of ODS and HFCs is critical to ensuring that we remain on a viable pathway toward limiting global warming below 1.5 °C. There is an urgent need for policies and programs to be implemented immediately to reduce the rate of emissions from refrigerant banks, both from leakage and at end of life. Simply put, this represents the single largest opportunity for climate mitigation. There are a number of potential approaches to tackling these emissions with many replicable models from around the world. A comprehensive international framework accompanied by strong national regulations and sustainable financing is urgently needed to address this issue. Sub-national and private sector leadership can also play a significant role by piloting and jumpstarting scalable solutions.

Recommendations for Stakeholders

Individual Advocacy

Individual consumers can play a role as early adopters and supporters of HFC-free technologies and refrigerant management best practices, and as advocates for greater political awareness around preventing refrigerant emissions from banks. By purchasing refrigeration and air conditioning appliances that use climate-friendly refrigerants like propane (R290), isobutane (R600a), carbon dioxide (R744) or ammonia (R717), consumers can ensure avoiding increasing the existing bank of HFCs. It can be as simple as asking the servicing technician to ensure they are repairing any leaks rather than simply adding additional refrigerant when servicing a home or vehicle air conditioner. Consumers can also make a conscious decision to shop at an HFC-free supermarket, or to call for climate-friendly refrigeration from local supermarkets or chains.¹⁶ When disposing old refrigerators or air conditioners, one can use public or

private services that may be available to pick up the appliance and ensure refrigerant will be properly recovered. Finally, individuals can help create political awareness by engaging with elected representatives and calling upon them to support actions to reduce refrigerant emissions through better refrigerant management.

Private Sector Action

Companies ranging from major end-users to refrigerant distributors, servicers, and equipment manufacturers can all play a role in proper refrigerant management and disposal. End-users can institute internal policies including: installing leak detection equipment and requiring rapid repair, retiring equipment after a certain leak threshold, as well as purchasing only reclaimed refrigerants to service equipment. Distributors and servicing companies can voluntarily use non-refillable cylinders. Additionally, companies can participate in voluntary programs or pilot projects. Being the testing ground for new systems and technologies allows companies to be at the forefront of innovation increasing their competitive edge. Pilot programs also offer opportunities for funding and collaboration with other private or public stakeholders. Likewise, companies can partner with equipment manufacturers and other training programs to train their technicians in leak management, recovery, handling, and disposal of used ODS/HFC refrigerant.

Workforce capability is often cited as a barrier to adopting refrigerant management best practices. Company-supported training can help overcome this obstacle. Finally, some successful national EPR schemes have begun as voluntary industry-led initiatives before being adopted as mandatory programs. Industry associations of refrigerant producers and equipment manufacturers can lead by voluntarily developing and implementing such programs with input and oversight from regulators to ensure they are successful.



Sub-national Action

Cities

Banks have the greatest concentration in cities and are therefore also the most cost-effective to collect and destroy at the city-level. Many cities have existing waste management systems for collecting and disposing old household cooling appliances, and in some cases charge manufacturers a fee used to offset costs of appliance disposal. Often, however, these systems lack a requirement for recovering the refrigerant from retired appliances to sustainably dispose of it through reclamation or destruction. Cities should ensure that facilities responsible for appliance disposal are recovering refrigerant and require them to report and verify quantities of refrigerant delivered to reclamation and destruction facilities. If necessary, existing fees charged to manufacturers may be raised to cover any additional costs needed to ensure this is carried out. Cities should also examine options for applying these types of EPR plans to larger commercial refrigeration and air conditioning systems containing over 50lbs of refrigerant – by implementing a system to electronically register such systems and require refrigerant recovered to be reported and verified as reclaimed or destroyed.

Cities should also integrate refrigerant bank management into existing building sector emission reduction strategies, including those with overlapping energy efficiency benefits, such as incentive programs or other pilot programs. For example, evidence suggests that better management and reduction of refrigerant leaks in large refrigeration systems like those in supermarkets can also lead to energy savings. Pilot incentive programs to test and verify these energy efficiency co-benefits of leak reduction are just one of several areas that can be explored.

States and Provinces

State and provincial interventions to address refrigerant banks can lay the groundwork for future national regulations. States or provinces can begin with conducting inventory assessments to determine quantities and sectoral breakdown of ODS and HFC refrigerant banks. These include mandating reclamation or destruction at end of life and instituting requirements for verification and reporting; imposing a ban on sale of virgin high-GWP refrigerants for servicing with an exception for reclaimed refrigerants; incentivizing recovery and collection through development of an EPR scheme, including a fee/rebate system or other form of incentive. Simultaneously, states and provinces can ban the use of non-refillable cylinders for recovery, transport, distribution, and sale of high-GWP ODS and HFC refrigerants, in order to prevent both unnecessary emissions and illegal trade.

To capture refrigerant banks that are currently in use, states and provinces should implement a refrigerant management plan comprised of registry and reporting requirements for owners of large refrigeration and HVAC systems and refrigerant wholesalers and distributors to report on sales, stockpiles, and leaks, as well as to verify recovery and reclamation or

destruction upon decommissioning of equipment. Requiring improved refrigerant management practices for leak detection and repair, and technician certification for handling HFC refrigerants, including training on proper recovery and compliance with the federal venting prohibition, are other measures that can be adopted. Lastly, states and provinces should identify potential funding and opportunities for pilot projects on recovery and destruction of high-GWP ODS and HFC refrigerant banks in specific subsectors.

A comprehensive international framework accompanied by strong national regulations and sustainable financing is urgently needed to address this issue.

National Leadership

Policies and programs at the national level are essential and options include all of the regulatory, non-regulatory, and fiscal measures described above for sub-national actors. As opposed to sub-national programs, national regulations provide for consistency allowing for uniform compliance requirements, and are therefore typically favored by industry. Adoption of national regulations on ODS and HFC management and disposal is recommended and should include a mandate for recovery and reclamation/destruction, electronic reporting and verification requirements for the various entities involved, and a framework for the fiscal measures to sustainably finance disposal. Banning the sale of virgin high-GWP refrigerants for servicing existing equipment, while allowing use of reclaimed refrigerants, can be a strong mechanism to rapidly scale up use of reclaimed refrigerant to service the installed base and encourage a transition to low-GWP refrigerants.

Robust HVACR technician training certification requirements and training programs can also help promote a higher standard for workforce skills and capabilities supporting better refrigerant management practices, which will in turn support a transition to low-GWP refrigerants. Certification should include periodic re-training or continuing education to ensure technicians are up to date on best practices and the changing landscape of refrigerants and equipment. Such training programs may be required or offered on a voluntary basis initially as part of broader green job training and just transition programs.

While the Montreal Protocol does not comprehensively address banks, a small window of funding exists through the Multilateral Fund for developing countries to formulate national strategies for managing and disposing of ODS banks.

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A Global Framework

The international community must urgently develop a global framework to recover and destroy banks.

The Montreal Protocol, its Parties and institutions should lead the development of such a framework, beginning by establishing a task force to examine opportunities and costs. Coordination with outside stakeholders and other global climate institutions may be necessary to ensure the problem can be addressed at scale. The absence of comprehensive global data regarding the size and emissions of refrigerant and foam banks is a key issue that needs to be addressed. A global inventory where banks and amounts available for recovery can be reported, would help facilitate increasing end-of-life recovery and destruction.

Projects to expand regional cooperation across countries may also be undertaken to establish or expand networks and capacity for cost-effective collection and destruction.

This framework should include one or more sustainable financing mechanisms that will enable countries to develop and implement national or regional strategies and programs. One starting point for consideration could be establishing a standalone 'Global Recovery Fund' that would serve as a central mechanism for implementation of policies and programs addressing banks. The role of producer responsibility in contributions to such a fund must be considered alongside other sources including contributions by Parties, philanthropy as well as other multilateral climate finance institutions.

Current climate pledges and action are insufficient, by a wide margin, to address the worsening climate crisis and meet the global target of containing warming below 1.5 °C. Taking immediate action on the single greatest mitigation opportunity, preventing 100 billion tons of CO₂-equivalent emissions from banks, is therefore an urgent global obligation.

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