Beyond Electrification: Advancing Refrigerant Recovery in HVAC Decommissioning

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ABSTRACT

Refrigerants are among the most potent greenhouse gases, yet they remain largely absent from building decarbonization and heat pump electrification strategies. In practice, financial, logistical, and knowledge barriers, especially among small and locally owned Heating, Ventilation, and Air Conditioning (HVAC) contractors, limit consistent refrigerant recovery. These conditions point to the need for market transformation approaches that address structural barriers and shift standard contractor practices, rather than relying on regulatory compliance alone.

As electrification accelerates and aging HVAC systems reach end of life, unmanaged refrigerant releases during decommissioning present a significant and underrecognized climate risk. Without coordinated refrigerant recovery, emissions from decommissioned systems can offset a meaningful share of the lifecycle greenhouse gas reductions expected from heat pump adoption. This risk is particularly relevant for energy efficiency programs accelerating equipment replacement without mechanisms to ensure responsible end-of-life refrigerant management.

This paper presents the Refrigerant Recovery and Reclamation pilot, which introduces a structured, incentive-driven model to integrate recovery into HVAC replacement workflows. By aligning incentives, reducing barriers, and establishing a verifiable pathway through a certified reclaimer, the pilot tests a practical approach to improving recovery rates and supporting a more circular refrigerant market.

Introduction

Despite global warming potentials thousands of times greater than carbon dioxide, refrigerants remain underrepresented in building emissions inventories and heat pump electrification strategies (UNEP 2025). Federal regulations prohibit venting and require refrigerant recovery (EPA 2025). However, limited enforcement and verification, especially in the residential and light-commercial sector, contribute to inconsistent implementation in practice (RMI 2024).

This gap reflects more than a lack of policy and enforcement attention. Financial, logistical, and knowledge barriers, especially among small and locally owned HVAC contractors, limit consistent refrigerant recovery during routine equipment replacement. These conditions highlight the need for market transformation approaches that address structural barriers and shift standard contractor practices, rather than relying on regulatory compliance alone.

As aging HVAC equipment is replaced, often accelerated by electrification policies, improper refrigerant handling during decommissioning can release large quantities of high global-warming potential gases, undermining the subsequent climate benefits of electrification. Recent analysis indicates that unmanaged refrigerant emissions during equipment replacement can materially erode a meaningful share of the lifecycle greenhouse gas reductions expected from heat pump adoption (Hoover 2024). Without coordinated refrigerant recovery, emissions from decommissioned systems can offset a meaningful share of the intended benefits of electrification.

This paper presents the Refrigerant Recovery and Reclamation (RR&R) pilot, which introduces a structured, incentive-driven model designed to integrate refrigerant recovery into standard HVAC replacement workflows. By aligning contractor incentives, reducing logistical barriers, and establishing a verifiable recovery pathway through an U.S. Environmental Protection Agency (EPA)-certified reclaimer, the pilot tests a practical approach to improving recovery rates while supporting the development of a more circular and accountable refrigerant market.

The initiative was developed as part of a broader building decarbonization effort in a locality with very progressive climate commitments. Increases in support for electrification activity have exposed the opportunity to manage refrigerant emissions more deliberately. The program administrator recognized the importance of integrating refrigerant recovery, distinct from other refrigerant management activities such as leak remediation and using low-Global Warming Potential (GWP) refrigerants, into the HVAC upgrade workflows it was supporting. By aligning incentives, logistics, and contractor support, the pilot demonstrates a replicable approach for entities seeking to reduce non-energy greenhouse gas emissions alongside electrification.

In practice, refrigerant recovery practices vary widely across contractors. Barriers such as tight installation schedules, recovery equipment costs, limited storage capacity, inconvenient and cumbersome reclamation logistics, and fragmented tracking systems make it difficult to implement best practices consistently, leading to variability in performance across the sector. Without intentionally planning for safe refrigerant recovery during equipment decommissioning, the climate benefits of heat pump electrification can be severely undermined. In many cases, emissions from a single system’s refrigerant release can outweigh the emissions avoided by installing higher efficiency equipment, effectively erasing years of expected energy savings benefits.

RR&R addresses that gap by integrating refrigerant recovery into standard HVAC replacement program workflows. By offering training, logistical coordination, and financial incentives, the program enables contractors to achieve higher recovery rates while expanding the supply of material available for reclamation. This approach reflects a broader insight that lifecycle refrigerant management plays a critical role in determining the overall climate impact of HVAC systems (Homma et al. 2025). It also represents an evolution in how decarbonization programs define impact by moving beyond energy savings alone.

While the RR&R initiative is currently implemented as a pilot, its design reflects core market transformation principles, including addressing structural barriers, aligning incentives, and establishing durable market infrastructure intended to persist beyond the program itself.

The following subsections describe the refrigerant emissions gap, the risks associated with electrification without coordinated recovery efforts, the role of a circular refrigerant economy, and the policy and market conditions that led to development of this program.

PROBLEM DEFINITION

The Refrigerant Challenge: Emissions Risk and Persistent Implementation Barriers

Efforts to decarbonize buildings are driving rapid growth in heat pump deployment, with these systems increasingly becoming the technology of choice for space conditioning in many markets, but this progress has also increased exposure to refrigerant-related emissions. Refrigerants used in HVAC systems, particularly hydrofluorocarbons, have global warming potentials thousands of times greater than carbon dioxide and can significantly undermine the climate benefits of electrification when released during servicing or at end of life (UNEP 2025). Although fluorinated gases currently represent a relatively small share of total U.S. greenhouse gas emissions, their high global warming potential and projected growth make them an increasingly important source of climate impact (C2ES 2025).

Policy frameworks such as the American Innovation and Manufacturing (AIM) Act and EPA Section 608 regulations establish clear requirements for refrigerant recovery and prohibit venting. However, field practice does not consistently reflect these requirements. Research indicates that a large share of refrigerant contained in retired equipment is still released rather than recovered, and reclamation rates remain low across key refrigerant types (RMI 2024). These findings highlight a persistent gap between regulatory intent and real-world implementation, particularly in the residential and light-commercial sector where enforcement and verification are limited. As electrification accelerates and aging HVAC equipment is replaced, additional opportunities arise for leakage, mishandling, and end-of-life losses that can undermine the climate benefits of these energy-efficient technologies. Without coordinated refrigerant recovery, emissions from decommissioned systems can offset a meaningful share of the lifecycle greenhouse gas reductions expected from heat pump adoption. For program implementers committed to delivering verifiable decarbonization outcomes, this creates a clear imperative to ensure that refrigerant management is actively addressed within program design and implementation.

This gap is driven not only by policy and enforcement limitations, but also by structural barriers within contractor workflows. Time constraints, equipment costs, limited storage capacity, and fragmented logistics make refrigerant recovery difficult to perform consistently, especially on small-scale replacement jobs. In the absence of strong financial incentives or streamlined recovery pathways, refrigerant management is often deprioritized relative to other installation tasks. As electrification accelerates equipment turnover, these conditions create a growing risk that refrigerant emissions will offset a meaningful share of the climate benefits expected from heat pump adoption.

Together, these factors reveal a critical disconnect as energy efficiency and electrification programs rapidly expand. Refrigerant emissions emerge as an increasingly important and largely self-created source of climate impact within the building sector. To fully realize the climate benefits of heat pump driven electrification, this gap must be addressed through structured refrigerant recovery and reclamation, particularly within the contractor network that focuses on smaller systems where compliance oversight and legal enforcement are less prevalent.

The Refrigerant Circular Economy

A refrigerant circular economy seeks to keep refrigerants in productive use for as long as possible while minimizing emissions associated with their production, leakage, and disposal.

Central to this approach are recovery, recycling, and reclamation, which together enable the efficient use of existing refrigerant stocks and reduce reliance on new production (UNEP 2025). Lifecycle refrigerant management frameworks emphasize recovery, recycling, and reclamation as core components of emissions reduction strategies (Mayhew et al. 2023). Rather than treating used refrigerant as waste, these frameworks position it as a recoverable resource that can deliver both environmental and economic value.

Reclamation plays a critical role in this circular approach to refrigerant management. Producing virgin refrigerant requires energy-intensive chemical manufacturing, as well as extraction and global transport of raw materials, while reclamation relies on recovering and reprocessing existing refrigerant more locally. As a result, reclamation avoids many of the upstream inputs associated with new production and can reduce lifecycle emissions by more than 50 percent (RMI 2024; CCL 2024). Although the cost of reclamation varies depending on refrigerant type, contamination, and scale, reclaimed refrigerant plays an increasingly important economic role as supply of high-GWP refrigerants is constrained under the AIM Act, a federal policy that phases down their production. In this context, reclaimed refrigerant can provide a more accessible and cost-effective option for servicing existing equipment while improving overall system efficiency and reducing dependence on energy-intensive virgin refrigerant production. Additionally, proper refrigerant management during servicing is critical to equipment performance, as undercharged or improperly serviced equipment operates less efficiently, further eroding the benefits of high-efficiency technologies.

As supply restrictions take effect, reclaimed refrigerant also plays a critical role in maintaining service continuity for existing systems. In many cases, it will represent the only viable option to service installed equipment, allowing existing systems to remain in operation and avoiding premature replacement or stranded assets and the associated unnecessary capital costs.

Despite these demonstrated environmental, economic, and performance benefits, a circular refrigerant economy remains underdeveloped in practice. Recovery and reclamation rates are low, and most of the refrigerant from retired equipment is not returned to the supply chain (RMI 2024). This reflects both structural market barriers and the absence of consistent, end-of-life recovery pathways within standard HVAC workflows. Without intentional intervention, these conditions limit the efficiency of refrigerant use across the market and contribute to unnecessary emissions and resource loss.

From a program perspective, closing this gap requires more than policy alignment; it depends on market transformation strategies that address contractor behavior, streamline logistics, and create reliable economic incentives for recovery. Integrating these elements into electrification and energy efficiency programs can help ensure that refrigerants are managed as valuable assets rather than liabilities, reinforcing both climate and affordability outcomes.

Policy Alignment with the AIM Act

The transition toward improved refrigerant management aligns with the regulatory direction established under the AIM Act, which drives the phasedown of high global warming potential hydrofluorocarbons in the United States. Under this framework, the EPA requires that refrigerant be recovered during servicing and prohibits intentional venting, while limiting the supply of newly manufactured high-GWP refrigerants (EPA 2025). These policies increase the importance of end-of-life refrigerant management by elevating the role of recovered and reclaimed material in meeting ongoing servicing needs.

However, alignment with policy does not ensure consistent practice in the field. While regulatory requirements establish expectations, recovery and reclamation are not reliably performed or verified in routine residential and light-commercial HVAC work. Evidence from market studies and this pilot's implementation indicates that significant volumes of refrigerant are not returned to certified reclaimers, highlighting a persistent gap between regulatory intent and real-world implementation, particularly in the residential and light-commercial sector where enforcement and verification are limited (EPA 2025; RMI 2024). In sectors characterized by small contractors, fragmented workflows, and limited oversight, compliance alone is insufficient to ensure consistent recovery outcomes. As a result, regulatory requirements cannot be assumed to define baseline market behavior. This is consistent with established evaluation guidance, which emphasizes that baseline assumptions should reflect observed market behavior rather than assumed regulatory compliance, particularly in cases where outcomes are not directly observable and required practices are not consistently implemented in the field.

For energy efficiency and electrification program implementers, this gap introduces both risk and opportunity. Without intentional integration of refrigerant management, programs accelerating equipment replacement may inadvertently contribute to emissions associated with improper decommissioning. At the same time, market interventions can help translate policy intent into consistent practice by aligning incentives, simplifying logistics, and establishing verifiable recovery pathways. In this way, programs play a complementary role in supporting AIM Act objectives while ensuring that the climate benefits of electrification are fully realized.

The Reality of Market Practice: A Persistent Gap Between Policy and Performance

The gap between regulatory intent and field practice is most clearly reflected in observed refrigerant recovery outcomes. Despite established requirements, end-of-life refrigerant losses remain widespread. Available research indicates that a majority of refrigerant contained in retiring equipment is not recovered, with estimates suggesting that up to 90 percent may be released to the atmosphere, creating a significant climate liability for the HVAC sector and for energy efficiency programs that promote equipment replacement (RMI 2024). Reclamation rates are similarly low, with only a small fraction of refrigerant sold in the United States originating from reclaimed sources, including for commonly used refrigerants such as R-410A (RMI 2024).

Insights from pilot implementation help explain how these outcomes occur in practice. In many cases, contractors are not aware that certified reclaimers exist or that recovered refrigerant can be returned for value. Some reported paying to dispose of refrigerant as waste, despite its potential market value, highlighting a disconnect between available recovery pathways and routine field practices. While federal regulations prohibit venting and require recovery, limited enforcement and the decentralized nature of the residential and light-commercial market contribute to inconsistent adherence. Contractors were generally willing to discuss recovery practices in the context of improving workflows, although detailed reporting of current practices was sometimes limited, suggesting a degree of sensitivity around compliance.

At the same time, program experience indicates that these outcomes are responsive to intervention. Contractors demonstrate greater participation in refrigerant recovery when financial incentives, simplified logistics, and clear recovery pathways are in place. This suggests that the observed gap in recovery is driven less by technical feasibility and more by market structure and access, reinforcing the need for programmatic approaches that translate regulatory requirements into consistent, verifiable practice.

Enabling Conditions: Program Metrics and Reclaimer Alignment

The performance contract governing the efficiency and renewable programs under which this pilot operates has evolved substantially over time, refining its definition of “savings” within the boundaries of the legislation that established its framework. Although the legislation initially placed energy-consumption reduction at the core of its mandate, the contract’s primary savings metric, metric tons of carbon dioxide equivalent ($MTCO_2e$), now aligns directly with the jurisdiction’s broader climate-focused priorities. The legislation also provided flexibility to pursue greenhouse-gas-reduction strategies that extend beyond traditional energy savings. As a result, program metrics have transitioned from earlier formulations based on megawatt-hours (MWh), therms, or million British thermal units (MMBtu) to today’s unified $MTCO_2e$ metric, enabling a wide range of climate-beneficial activities to be captured and verified under a single framework. This evolution ensures that initiatives delivering measurable emissions reductions, even those without direct energy-use impacts, can be counted toward performance goals.

To operationalize the RR&R pilot, the implementer partnered with an established EPA-certified refrigerant reclaimer. As a reclaimer, this partner restores recovered refrigerants to Air-Conditioning, Heating, and Refrigeration Institute (AHRI) 700 purity standards and provides detailed CO_2-equivalent documentation associated with proper recovery and reuse. Their technical capacity, data infrastructure, and longstanding leadership in reclamation made them an ideal collaborator for designing and validating the field approaches tested through this pilot, aligning seamlessly with the program implementer’s climate-oriented metrics.

Together, the implementer and reclaimer have established the infrastructure and performance conditions necessary for broader market transformation.

THE SOLUTION

The Goals

The design of the RR&R pilot directly responds to the implementation gaps identified in the preceding sections. Low recovery rates, inconsistent contractor participation, and limited awareness of reclamation pathways point to the need for interventions that address both financial and logistical barriers. At the same time, the disconnect between regulatory requirements and observed practice underscores the importance of creating verifiable recovery pathways and aligning incentives with desired outcomes.

To address these challenges, the pilot leverages the implementer’s climate-oriented mandate and the reclaimer’s ability to provide verified recovery, processing, and emissions accounting. By aligning these capabilities with targeted incentives and streamlined participation pathways, the pilot seeks to translate policy intent into consistent field practice. This helps ensure that the climate benefits from high-efficiency and heat pump installations are not offset by uncontrolled refrigerant losses during equipment replacement, which prior analysis has shown can materially erode a meaningful share of expected lifetime emissions reductions (Hoover 2024). Together, the pilot’s structure and partnerships support four core objectives:

- Reduce high-GWP refrigerant emissions by increasing the volume of refrigerant recovered from retired HVAC systems and preventing end-of-life venting.
- Support contractor adoption of best practices through tools, training, incentives, and streamlined logistical pathways that make recovery easier to complete and verify.

- Strengthen the circular refrigerant economy by ensuring that recovered material is consistently transferred to and processed by a licensed EPA certified reclaimer.
- Integrate refrigerant management into electrification workflows so that climate benefits from high efficiency and heat pump installations are not offset by uncontrolled refrigerant losses during equipment replacement.

Collectively, these goals align the pilot with broader decarbonization strategies while directly addressing gaps in the market and regulatory systems that currently allow significant refrigerant emissions to persist.

The Design

The RR&R pilot was designed to address the barriers observed in market practice by introducing activities that improve refrigerant recovery outcomes. Contractor participation is limited to eligible contractors doing work in existing direct-installation programs. These are typically smaller, locally operated firms that face the greatest barriers to consistent refrigerant recovery. RR&R participation requires enrolling with an approved reclaimer, attending a one-time training session, signing a contractor participation agreement, and maintaining a Refrigerant Capture Log documenting recovered material. These elements establish a standardized framework for tracking, verification, and quality control while keeping administrative burden relatively low.

To address limited contractor awareness of refrigerant recovery pathways and reclamation opportunities, the pilot provides targeted training and technical guidance for participating contractors. This includes instruction on best practices for recovery, safe handling, and the economic value of reclaimed refrigerant, helping to close knowledge gaps that contribute to inconsistent practices.

As one component to address logistical barriers, the pilot includes a streamlined cylinder exchange with a certified reclaimer, allowing contractors to swap filled cylinders for empty new or refurbished ones, reducing the need for temporary storage and separate transport of recovered refrigerant.

To address misaligned incentives and the tendency for recovery to be deprioritized, the program introduces performance-based financial incentives tied to verified refrigerant return. These incentives are layered on top of standard payments provided by the reclaimer, increasing the value of recovered material. By compensating contractors for recovered volumes, the program shifts recovery from a cost center to a revenue-generating activity, reinforcing consistent participation. Given that recovery is not consistently performed or verified in routine practice, these incentives are intended to drive behavior change beyond baseline conditions rather than reward activity that would occur absent the program. As recovery practices become more fully integrated into standard contractor workflows, the pilot is designed to reduce or phase out these additional incentives over time.

To ensure accountability and enable verifiable emissions reductions, the program partners with an EPA-certified reclaimer to establish a transparent recovery pathway. This partnership leverages the implementer's climate-oriented mandate by enabling verified refrigerant recovery to be quantified and credited within a greenhouse gas-based performance framework, while drawing on the reclaimer's ability to provide verified recovery, processing, and emissions accounting.

The pilot's operational workflow is intentionally straightforward. Once enrolled with the reclaimer, contractors recover refrigerant during routine field work, record volumes in their capture logs, and return full cylinders to the reclaimer. The reclaimer issues payment based on refrigerant purity and type, including both its standard payment and an additional program incentive for pilot qualified refrigerants, and is reimbursed later by the implementer for the added incentive portion. This incentive delivery method mirrors the typical midstream program model in which a distributor marks down equipment and receives a rebate; however, in this pilot, the incentive is additive, layered on top of the reclaimer's existing payment rather than applied as an upfront discount.

To support contractors at different readiness levels, the pilot incorporates a tiered incentive structure. A base tier offers an additional amount above the reclaimer's payment, while a higher tier provides an enhanced incentive for contractors who demonstrate investment in high-efficiency recovery equipment. Contractors also receive a fixed payment for submitting complete refrigerant logs, reinforcing accurate recordkeeping and enabling transparent emissions accounting.

Overall, the design tests whether targeted additive incentives, simplified participation requirements, and collaboration with an EPA-certified reclaimer can meaningfully increase recovery and reclamation volumes, reduce refrigerant-related emissions, and establish a scalable model for integrating refrigerant management into broader decarbonization workflows.

While implemented as a pilot, the RR&R initiative is designed to support lasting changes in how refrigerant recovery is performed. It focuses on removing common barriers and putting practical systems in place, such as making recovery easier to complete, simplifying logistics, and creating a clear, verified path for returning refrigerant.

By making recovery easier and financially worthwhile, the pilot encourages contractors to incorporate these practices into their normal workflows, with the goal that they continue even after incentives are reduced over time.

The initiative is currently being maintained in its pilot form to build a stronger foundation before expanding more broadly. It is focused on maintaining participation, improving logistics, and increasing familiarity with recovery practices. Broader expansion will depend on reducing these barriers and demonstrating that recovery can be consistently incorporated into routine HVAC work. As these conditions are met, recovery practices are more likely to persist even as direct program support is reduced. Together, these elements show how refrigerant recovery can become a more consistent part of standard HVAC replacement workflows.

Data Collection

The RR&R pilot relies on a two-part data collection strategy that separates the information used for verified savings claims from the information used to refine attribution assumptions over time. This structure ensures that reported $MTCO_2e$ reductions are based on high-integrity, third-party-verified quantities while still allowing the program to improve its understanding of contractor service patterns as additional data become available.

The primary data source for claimed savings is the reclaimer-issued summary sheet, which documents the quantity, type, and purity of refrigerant received from participating contractors. Because the reclaimer weighs and processes each cylinder under a standardized, auditable protocol, these records provide an objective measure of the refrigerant recovered. Only these verified quantities are used to calculate $MTCO_2e$ reductions credited toward program performance.

Separately, the program collects contractor recovery logs that document job locations and recovery activity at the project level. These logs are not used for savings claims but serve to refine the proportion of refrigerant sourced from within the implementer's jurisdiction. As the pilot progresses and more contractor logs are submitted, this information will support a more accurate estimation of the geographic attribution rate, informing future adjustments to the leakage factor applied through net-to-gross (NTG) methodology.

By clearly distinguishing between data used for verified savings claims and data used for ongoing calibration, the pilot maintains methodological integrity while progressively improving its accuracy as participation grows.

PILOT RESULTS AND EARLY INSIGHTS

Early implementation of the RR&R pilot, launched in FY 2025 and continuing in FY 2026, provides initial insights into contractor participation, recovery activity, and program performance. Of the five eligible contractors in the pilot, three have enrolled with the reclaimer, and those firms have begun submitting recovered refrigerant for processing. To date, the program has supported the recovery of approximately 572 pounds of refrigerant, corresponding to approximately 512 $MTCO_2e$ in potential avoided emissions. Applying a conservative net-to-gross assumption of 0.245, the implementer has claimed approximately 126 $MTCO_2e$ of recovered refrigerant for performance accounting.

These participation levels illustrate staged adoption, with contractors progressing from eligibility to enrollment and into active recovery over time. At the same time, they highlight a persistent gap in participation across the remaining contractor base, where recovery outcomes remain unverified. This gap underscores the importance of establishing accessible, streamlined pathways and aligned incentives to support broader adoption of consistent refrigerant recovery practices.

Evidence of Market Transformation

Early implementation of the pilot shows initial changes in how contractors approach refrigerant recovery. Contractors have responded positively to incentives that fit within their existing workflows and improve cash flow, suggesting that recovery can become a more routine part of HVAC replacement when key barriers are reduced.

The use of reclaimer-verified data as the basis for incentives has also been important. By tying payments to documented recovery, the pilot ensures that refrigerant is actually returned and processed, rather than relying on assumed compliance or self-reported activity.

The pilot also highlights differences in contractor behavior. Some have adopted the structured recovery pathway and are consistently returning refrigerant, while others continue to rely on more informal or unverifiable practices. This distinction may become more important over time, particularly as programs begin to require verified recovery to participate or receive incentives.

Together, these early results show that recovery can become a more consistent and verifiable part of HVAC replacement when barriers are reduced and participation is made easier.

Implementation Barriers and Lessons Learned

Implementation of the pilot revealed several persistent barriers to consistent, high-quality refrigerant recovery that extend well beyond the regulatory expectations established under EPA Section 608, which governs refrigerant recovery and prohibits venting. While federal rules clearly prohibit venting and require recovery, the pilot has confirmed that regulatory compliance alone does not produce reliable, verifiable recovery in practice, particularly during HVAC decommissioning associated with electrification and equipment-upgrade projects. Instead, a combination of operational, logistical, organizational, and behavioral factors continues to limit the consistency and quality of recovery activity in the field.

Operational and time constraints. Limited installation time emerged as one of the most significant barriers to consistent refrigerant recovery. Residential electrification and HVAC replacements must often be completed in a single visit, and under these conditions, recovery must compete with other critical tasks such as system change-out, electrical work, commissioning, and customer communication. While best-practices training encourages contractors to initiate recovery early and allow it to run in parallel with other installation tasks, time pressure remains a key constraint. Recovery adds steps to already compressed schedules which reinforces the need for ongoing incentive support, practical tools, and workflow-aligned program design.

Logistical and Storage Challenges. Contractors identified logistical barriers relating to storing, transporting, and returning recovered refrigerant, particularly among small and locally owned firms operating out of vans, shared spaces, or limited space and resources. Some reported difficulties storing partially filled cylinders, uncertainty about where to stage recovered refrigerant, and challenges coordinating irregular drop-offs with reclaimers. These constraints are amplified in dense urban environments, where parking, vehicle space, and on-site storage are limited. To reduce these barriers, the pilot incorporates a streamlined cylinder exchange through the participating reclaimer, along with flexible pickup and drop-off options. These features simplify the process of returning refrigerant and reduce the need for contractors to store or transport filled cylinders independently. However, logistical constraints remain an ongoing influence on contractor participation, particularly for smaller jobs and contractors with limited capacity.

Informal decommissioning practices and verification gaps. Pilot engagement revealed that informal or improvised decommissioning practices remain common. Some contractors reported pumping refrigerant back into the system for later extraction at their shop rather than completing recovery at the job site. However, when contractors using this approach are not connected to a verified reclamation pathway, there is no visibility into whether recovery ultimately occurs. These practices create a critical gap in verification. Once equipment leaves a job site without documented recovery or a clear reclamation pathway, there is no reliable visibility into whether refrigerant is ultimately recovered, vented, or mishandled. This finding reinforces that documented recovery is essential. Incentives must be tied to refrigerant returned through a certified reclaimer, rather than to self-reported behavior or assumed compliance.

Fragmented contractor roles and subcontracting dynamics. The pilot identified challenges related to fragmented project structures, especially where general contractors (GCs) oversee entire projects but subcontract heating, ventilation, air conditioning, and refrigeration (HVAC/R) work to separate firms. In these cases, the GC participating in the program may not be responsible for refrigerant handling, while the HVAC/R subcontractor performing the recovery may be unaware of program requirements or not enrolled with the reclaimer. This misalignment results in inconsistent participation and limits the effectiveness of pilot interventions. It highlights the need for direct engagement with all contractors performing refrigerant recovery, rather than assuming alignment across all project roles.

Financial disincentives outside of program support. Absent targeted incentives, contractors described refrigerant recovery as a cost center, not a value-generating activity. Labor time, equipment wear, cylinder rental or purchase costs, storage difficulties, and administrative steps all add costs, while standard payments from reclaimers are often insufficient to fully offset these burdens. Many contractors noted that they normally paid to dispose of refrigerant as waste rather than receiving compensation for returning it for reclamation. While the pilot's additive incentives shift this calculus, contractors made clear that without sustained financial support, consistent recovery, especially on smaller residential jobs, it may remain difficult to sustain.

Behavior changes and practice variability. Finally, the pilot observed substantial variability in refrigerant recovery practices across contractors. Experience levels, training backgrounds, access to equipment, and organizational cultures all influence whether recovery occurs reliably. Even with training and clear expectations, some contractors require significant hands-on support to integrate recovery into routine workflows. This variability reinforces a critical insight that sustained engagement, aligned incentives, and verifiable recovery pathways are necessary to drive lasting changes in contractor practices. One-time training or traditional compliance messaging is insufficient to shift entrenched field behavior.

Recommendations

Based on early findings from this ongoing pilot, several programmatic and policy recommendations emerge for practitioners considering how to reduce refrigerant emissions coupled with electrification and HVAC upgrade efforts. These recommendations reflect both the practical realities of contractor workflows and the structural changes needed to build a more accountable, climate-aligned refrigerant management system.

Recognize refrigerant recovery as a non-energy climate strategy. Utilities and policymakers should recognize refrigerant recovery as a high-impact, non-energy greenhouse-gas mitigation strategy. Program frameworks that focus exclusively on energy savings risk missing substantial emission reduction opportunities associated with equipment turnover. Integrating refrigerant management into decarbonization portfolios strengthens overall climate impacts and supports the development of a more circular, accountable refrigerant economy across the HVAC/R sector.

Embed refrigerant recovery incentives into energy efficiency and electrification programs. Electrification and HVAC upgrade initiatives should explicitly incorporate refrigerant recovery as a supported activity rather than treating it as an external compliance requirement. Tying incentives to verified recovery volumes ensures that the climate benefits of heat pumps are not undermined by emissions released during equipment decommissioning. This aligns contractor behavior directly with climate goals and reinforces the value of proper end-of-life refrigerant management.

Use reclaimer-verified data for payment and accountability. Programs should rely on reclaimer-verified intake data as the authoritative basis for incentive payments and emissions accounting. EPA-certified reclaimers operate under strict federal auditing, chain-of-custody standards, and laboratory purity verification requirements, making them the most reliable and transparent point in the refrigerant lifecycle for documenting actual recovery outcomes. Their verification processes minimize administrative burden for contractors and implementers, eliminate reliance on self-reported or unverifiable practices, and ensure that only refrigerant entering the certified reclamation supply chain is rewarded.

Limit eligible refrigerants and volumes to program scope. To maintain focus and cost-effectiveness, programs should restrict eligible refrigerant types and container sizes to those typically encountered in the efficiency and decarbonization program offerings they support. This ensures that incentives strengthen recovery where it most directly complements known program activity, such as residential heat-pump replacements, rather than subsidizing unrelated or untargeted recovery activity. Clear, well-defined eligibility criteria also reduce logistical complexity for contractors and improve program transparency, helping ensure that limited incentive funding is directed toward the recovery activity most aligned with climate-focused goals.

Engage HVAC/R subcontractors directly. Programs that operate through general contractors should not assume that refrigerant recovery expectations will automatically reach the HVAC/R subcontractors who perform the technical work. Direct engagement, enrollment, training, and incentive access for HVAC/R firms are essential for driving behavior change among the technicians responsible for decommissioning and refrigerant handling. Where subcontracting is common, programs should encourage or require coordination between general contractors and HVAC/R partners early in project workflows to ensure that the firm performing the recovery has both the information and the motivation to participate.

Pair incentives with training and technical assistance. Financial incentives alone cannot standardize high-quality refrigerant recovery. Programs should pair incentives with hands-on training, technical assistance, and ongoing support that reinforce best practices, clarify recovery pathways, and address variation in contractor experience levels. This is especially important for small and locally owned firms, which may lack access to the most recent best practices, equipment, or industry networks.

CONCLUSION

The RR&R pilot demonstrates that improving refrigerant recovery is both achievable and practical when programs address the barriers contractors face in routine HVAC work. Early results show growing participation among contractors and measurable recovery activity, while also highlighting gaps in participation and the challenges that remain. These findings reinforce that refrigerant recovery does not occur consistently in practice without clear pathways, aligned incentives, and verification. By tying incentives to documented recovery rather than assuming that recovery is occurring in practice, the program helps ensure that emissions reductions are real and measurable and that recovery becomes a standard part of the work. Taken together, these elements are intended to support lasting changes in contractor practices that can persist beyond direct program incentives.

As heat pump deployment accelerates, unmanaged refrigerant emissions during equipment replacement risk eroding a meaningful share of the climate benefits these technologies are intended to deliver (Hoover 2024). Integrating refrigerant recovery into electrification and energy efficiency programs is therefore essential to ensuring that emissions reductions are both real and verifiable. This approach also shows how programs can address important sources of emissions beyond traditional energy savings, particularly as equipment replacement activity increases.

At the same time, as supply restrictions under the AIM Act take effect, access to reclaimed refrigerant will become increasingly important for maintaining service continuity. In many cases, it may become the only practical option for servicing existing systems, helping avoid premature replacement and associated costs.

While early results are promising, broader adoption will depend on continued efforts to reduce logistical and operational barriers and expand participation across the contractor base. By focusing on practical implementation and building familiarity over time, programs such as RR&R can help make refrigerant recovery a more consistent part of standard HVAC work and support more durable emissions reductions.

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