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**Submitted electronically via email to newberg.cindy@epa.gov**

Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC 20460

Re: **Petition Under Subsection (i) of the American Innovation and Manufacturing Act to Amend the Technology Transitions Rule to Provide an Exemption or Zero-GWP Treatment for Domestically Reclaimed Regulated Substances**

Dear Administrator Zeldin:

FluoroFusion Specialty Chemicals, Inc. ("FluoroFusion") respectfully submits this petition pursuant to subsection (i)(3) of the American Innovation and Manufacturing Act of 2020 ("AIM Act") and 40 C.F.R. § 84.62, requesting that EPA amend its Technology Transitions Rule to create a targeted compliance pathway for domestically reclaimed regulated substances used in refrigeration, air-conditioning, and heat pump ("RACHP") equipment.

This petition seeks to (1) exempt domestically reclaimed regulated substances, and the domestically reclaimed portion of blends, from the global warming potential ("GWP") limits in the Technology Transitions Rule, or, in the alternative, (2) establish a GWP value of zero for domestically reclaimed regulated substances, and the domestically reclaimed portion of a regulated blend, for purposes of compliance with those limits.

Either approach would create strong demand for domestically reclaimed refrigerant, support implementation of the allowance phase-down, and materially reduce the overall costs and risks associated with the Technology Transitions Rule by allowing U.S. consumers and businesses to continue to import and install certain legacy equipment models using legacy refrigerants, so long as those systems are charged and serviced exclusively with domestically reclaimed regulated substances.

Equally important, either approach would substantially reduce U.S. dependence on imported refrigerant supply sourced from producers in China (or India), which would in turn promote onshoring of manufacturing and help to address the affordability challenge economy-wide.

## I. PETITION SUMMARY

### A. Petitioner

FluoroFusion is a U.S.-based refrigerant reclamation company that recovers, processes, and reclaims hydrofluorocarbon ("HFC") and other regulated refrigerants to meet applicable purity specifications and EPA reclamation requirements. FluoroFusion operates within EPA's existing regulatory framework for reclaimers and participates in the lawful collection, reclamation, and redistribution of regulated substances used to service RACHP equipment in the United States.

By reclaiming existing refrigerant rather than producing new material, FluoroFusion supports the AIM Act's phasedown of HFC production and consumption while providing essential supply for maintaining and safely operating installed RACHP equipment.

### B. Petition Purpose

The purpose of this petition is to amend EPA's restrictions on the use of certain HFCs under the Technology Transitions Program so that:

1. Primary Request – Exemption for Domestically Reclaimed Refrigerant
   EPA exempts domestically reclaimed regulated substances, and the domestically reclaimed fraction of regulated blends, from the GWP-based use limits established in 40 C.F.R. § 84.54 for relevant RACHP sectors and subsectors, where equipment is charged and serviced exclusively with domestically reclaimed regulated substances.

2. Alternative Request – Zero-GWP Treatment of Domestically Reclaimed Refrigerant
   In the alternative, EPA assigns an "effective GWP" value of zero to domestically reclaimed regulated substances, and to the domestically reclaimed fraction of regulated blends, for purposes of calculating GWP compliance under 40 C.F.R. § 84.64(b) and the GWP limits in § 84.54.

Under either option, we also propose that EPA would accompany these regulatory changes with a policy commitment to exempt domestically reclaimed refrigerants from future SNAP delisting decisions. In other words, EPA would complement the regulatory changes proposed here with programmatic implementation decisions to limit future SNAP delisting decisions that relate to high GWP refrigerants to virgin production, and permit the ongoing marketing of such refrigerants when they are domestically reclaimed, in keeping with the policy objectives of this petition.

The requested actions would:

- Create a targeted compliance path that permits continued manufacture, import, and installation in the United States of certain equipment models using legacy refrigerants, so long as they are charged and serviced only with domestically reclaimed regulated substances;
- Increase demand for reclamation, thereby improving the economics of recovery and reclamation and reducing emissions associated with venting, mismanagement, or premature retirement of refrigerant; and
- Lower overall implementation costs of the Technology Transitions Rule by providing an additional, more affordable compliance option that uses only previously produced molecules while preserving the rule's incentives to deploy low-GWP equipment.

### C. Statutory and Regulatory Basis

Subsection (i) of the AIM Act authorizes EPA to "restrict, fully, partially, or on a graduated schedule, the use of a regulated substance in the sector or subsector in which the regulated substance is used," and allows "any person" to petition EPA to promulgate such restrictions. 42 U.S.C. § 7675(i)(1), (3).

The AIM Act directs EPA to consider, to the extent practicable, specific factors including the best available data, the availability of substitutes, overall economic costs and environmental impacts, and the remaining phase-down period. 42 U.S.C. § 7675(i)(4).

EPA has implemented subsection (i) through its Technology Transitions Program, which establishes GWP-based restrictions on the use of certain HFCs in defined sectors and subsectors, including RACHP. EPA's petition regulations at 40 C.F.R. § 84.62 specify the required elements of a technology transitions petition, including identification of the sectors and subsectors, the requested restriction (including "another form of restriction"), the proposed effective dates, consideration of negotiated rulemaking, and information addressing the statutory evaluation factors.

FluoroFusion submits this petition in accordance with § 84.62 and EPA's Overview of the Petition Process and associated guidance documents.

## II. BACKGROUND

### A. The Technology Transitions Rule

EPA's 2023 Technology Transitions Rule established GWP-based restrictions on the use of certain HFCs in new refrigeration, air-conditioning, and heat pump equipment, foams, and aerosols, with compliance dates beginning January 1, 2025 for many RACHP subsectors. These restrictions are codified in 40 C.F.R. § 84.54 and rely on GWP values and blend-calculation methods set out in § 84.64.

The rule aims to drive transitions away from higher-GWP refrigerants (e.g., R-410A, R-404A) toward lower-GWP options, in parallel with the allowance-based production and consumption phasedown under other AIM Act provisions.

### B. Installed Base, New Installations, and the Role of Reclaimed Refrigerant

The constraint imposed by the Technology Transitions Rule is on new equipment placed into service or imported into the United States after the compliance dates. After those dates, manufacturers and importers generally must design and supply new products that use refrigerants meeting the applicable GWP limits.

For some residential, small business, and specialized commercial applications, these compliant alternatives can be more expensive, less familiar to installers, or subject to near-term supply constraints compared to well-understood legacy equipment types. In addition, constraints on the supply of low-GWP alternatives, and the excessive reliance on China as the source of production for such alternatives, increases costs and supply chain vulnerabilities in the U.S. market.

The requested exemption or zero-"effective GWP" treatment for domestically reclaimed regulated substances directly addresses these affordability challenges. It would:

- Allow manufacturers and importers to continue supplying certain legacy equipment designs that use established refrigerants, solely where the equipment is charged and serviced with domestically reclaimed refrigerant;

- Tie any additional new installations of legacy-refrigerant equipment to increased recovery and reclamation of existing HFC stocks, rather than to production of new virgin HFCs;

- Help to fulfill the AIM Act's promises with respect to promotion of reclaim and generation of U.S. jobs and economic activity, and diminish our growing reliance on Chinese-sourced refrigerant production; and

- Provide consumers and businesses—especially those with cost constraints or site-specific limitations—with a lower-cost, technically familiar option for new installations that still supports the AIM Act's phasedown goals.

In this way, the petition creates a targeted compliance pathway for new equipment and imports, using only previously produced molecules, without altering the longstanding ability to service existing systems.

### C. State Experience With Reclaimed Refrigerant – California Model

California has adopted a regulatory model that illustrates how GWP limits can be coupled with targeted treatment of reclaimed refrigerant to promote recovery and reuse. Among other measures, California:

- Imposes GWP limits on bulk HFCs and HFC blends used to service equipment, but exempts "certified reclaimed refrigerants" from those GWP limits, thereby encouraging the use of reclaimed refrigerant to service existing equipment; and

- Defines "certified reclaimed refrigerant" to ensure that the refrigerant is processed by a U.S. reclaimer and meets specified standards, providing a clear, enforceable definition for the exemption.

- Included mandatory minimum "reclaimed refrigerant use requirements" for manufacturers of certain air conditioning and VRF equipment for two years as a condition of extended transition timelines to meet GWP refrigerant thresholds (*see* 17 CCR § 95376).

California's experience demonstrates that it is feasible to define and regulate certified reclaimed refrigerant separately, and that an exemption or special treatment for reclaimed refrigerant can co-exist with GWP limits and drive increased reclamation.

FluoroFusion urges EPA to adopt an analogous, but nationwide, approach by providing a Technology Transitions Rule exemption or zero-"effective GWP" treatment for domestically reclaimed regulated substances.

## III. REQUIRED PETITION ELEMENTS UNDER 40 C.F.R. § 84.62(a)

### A. Sectors and Subsectors (§ 84.62(a)(1))

This petition applies to RACHP uses of regulated substances in the refrigeration and air conditioning sector covered by the Technology Transitions Rule, including the following subsectors listed in 40 C.F.R. § 84.54:

- Residential and light commercial air conditioning and heat pumps;
- Variable refrigerant flow systems;
- Commercial refrigeration systems (including remote condensing units, stand-alone units, supermarket systems, and cold storage warehouses);
- Industrial process refrigeration and chillers (including specialized applications); and
- Transport refrigeration (including refrigerated transport equipment and related applications).

FluoroFusion requests that EPA's amendment apply across these RACHP subsectors wherever EPA currently applies, or may apply in the future, a GWP limit on the refrigerant used in new equipment and/or servicing.

### B. Requested Restrictions (§ 84.62(a)(2))

For each of the RACHP subsectors identified above, FluoroFusion requests that EPA adopt **"another form of restriction"** within the meaning of § 84.62(a)(2)(iii), as follows:

#### 1. Primary Request – Exemption for Domestically Reclaimed Regulated Substances

EPA would amend Subpart B of Part 84, including § 84.54 and related definitions, to provide that:

1. Use in equipment. The GWP limits and other use restrictions in § 84.54 do not apply to the use of domestically reclaimed regulated substances, or to the domestically reclaimed fraction of a blend containing regulated substances, in new or existing RACHP equipment, provided that:
    - The equipment is charged initially and subsequently serviced only with domestically reclaimed regulated substances (or blends whose regulated components are domestically reclaimed); and
    - The equipment and refrigerant containers are labeled and tracked in accordance with EPA's labeling and supply-chain tracking requirements described in Section V of this petition.

2. Definition. EPA would add a definition of "domestically reclaimed regulated substance" to § 84.52, such as:

    "Domestically reclaimed regulated substance means a regulated substance that: (1) has been previously used, recovered from RACHP equipment in the United States, and processed within the United States by a reclaimer certified under EPA regulations to meet all applicable purity specifications for virgin refrigerant (including any industry standards such as AHRI Standard 700 or successor); and (2) is accompanied by documentation demonstrating its reclaimed status, including the identity of the certified reclaimer and batch identification."

This exemption would not change the statutory GWP characteristics of the underlying molecules; rather, it would recognize that reuse of previously produced material in lieu of producing new HFCs is environmentally beneficial and should be treated differently for compliance purposes.

#### 2. Alternative Request – Zero-GWP Treatment for Domestically Reclaimed Regulated Substances

In the alternative, EPA could rely on § 84.62(a)(2)(iii) and the blend-calculation provisions in § 84.64(b) to provide that, for purposes of compliance with Technology Transitions GWP limits:

1. GWP assignment. Domestically reclaimed regulated substances are assigned a GWP of zero, and the domestically reclaimed portion of any regulated blend is treated as having a GWP of zero in calculating the blend's GWP.

2. Blend calculation. EPA would revise § 84.64(b) to specify that, in calculating a blend's GWP for compliance purposes, the GWP of each constituent is multiplied by its nominal mass fraction to the extent that such constituent is not domestically reclaimed; the domestically reclaimed fraction is assigned an "effective GWP" of zero.

3. Eligibility conditions. The same conditions as above would apply: the equipment must be charged and serviced only with domestically reclaimed regulated substances or blends meeting the definition and documentation requirements.

This approach would maintain the existing table-based GWP framework while creating a clear compliance incentive for the use of reclaimed refrigerant.

### C. Proposed Effective Date and Implementation (§ 84.62(a)(3))

FluoroFusion requests that EPA:

- Commence the exemption/zero-GWP treatment no later than January 1, 2027, or within 6 months of granting this petition, whichever is earlier; and
- Coordinate the effective date with any ongoing Technology Transitions reconsideration or related rulemakings to minimize regulatory fragmentation and provide clarity to manufacturers, distributors, reclaimers, and contractors.

This timing would:

- Allow EPA to integrate the requested revisions into an existing or near-term rulemaking framework;
- Provide manufacturers with lead time to adjust product lines, labeling, and internal compliance systems; and
- Allow reclaimers and distributors to implement tracking systems and labeling practices described in Section V.

### D. Negotiated Rulemaking (§ 84.62(a)(4))

Subsection (i)(3)(A) of the AIM Act and § 84.62(a)(4) require that petitions address whether EPA should negotiate with stakeholders under the Negotiated Rulemaking Act.

FluoroFusion does not request the use of negotiated rulemaking for the following reasons:

1. EPA has already developed extensive experience with Technology Transitions rulemakings and with reclamation policy under the HFC phasedown and refrigerant management rules.
2. The requested change is targeted and conceptually straightforward: it involves defining domestically reclaimed regulated substances and specifying how they are treated for purposes of GWP-based use restrictions.
3. EPA can readily gather stakeholder input through traditional notice-and-comment procedures, public hearings, and stakeholder meetings, as it has done for other Technology Transitions rulemakings.

FluoroFusion therefore recommends that EPA address this petition through its standard rulemaking process without convening a negotiated rulemaking committee.

### E. Statutory Evaluation Factors (§ 84.62(a)(5); 42 U.S.C. § 7675(i)(4))

EPA must consider, to the extent practicable, the statutory factors in 42 U.S.C. § 7675(i)(4) when evaluating petitions. Those factors, and how this petition addresses them, are discussed in detail in Section IV below.

## IV. JUSTIFICATION UNDER THE AIM ACT FACTORS

### A. Best Available Data

FluoroFusion's request rests on the best available data regarding:

- The climate benefits of encouraging recovery and reclamation versus producing new regulated substances; and
- The experience of California and other jurisdictions that have incorporated reclaimed-refrigerant exemptions or minimum reclaimed-use requirements into their regulatory frameworks.

EPA's own rulemakings, fact sheets, and frequently asked questions documents further demonstrate the agency's recognition of the central role that reclamation plays in achieving HFC phasedown goals and minimizing emissions from installed equipment.

FluoroFusion may supplement this petition, as appropriate, with data and analyses concerning: modeled impacts on Technology Transitions compliance costs and consumer prices under scenarios with and without the requested exemption/zero-GWP treatment. (Any such supplement is not intended to constitute a new or modified petition, and would therefore not affect the petition review timeline.)

### B. Availability of Substitutes, Including Technological Achievability and Commercial Demands

The AIM Act requires EPA to consider the availability of substitutes for regulated substances in the relevant sectors and subsectors, taking into account technological achievability and commercial demands.

For new RACHP equipment, EPA and industry have identified a range of lower-GWP refrigerants and equipment designs that can, over time, replace higher-GWP legacy systems. In many applications, those substitutes are technically feasible and are already entering the market. However, in a number of

settings—particularly price-sensitive residential and small commercial markets, and certain specialized commercial applications—the new low-GWP equipment:

- Carries higher upfront costs relative to well-established legacy models;
- May require different installation practices, tools, or safety measures, which not all contractors or building owners are yet prepared to adopt; or
- May be less readily available in certain capacities, configurations, or form factors that customers have historically relied upon.

The requested exemption or zero-GWP treatment for domestically reclaimed regulated substances offers a pragmatic bridge between the need to transition to low-GWP technologies and the realities of market demand:

- It allows continued manufacture and import of legacy equipment designs for new installations, but only where the refrigerant used is domestically reclaimed;
- It ensures that any such new installations are tied directly to the recovery and reclamation of the existing HFC stock, rather than expanding reliance on newly produced virgin HFCs; and
- It gives consumers and businesses an additional, more affordable compliance option in the near term, while the supply of low-GWP equipment continues to scale and costs come down.

At the same time, the Technology Transitions Rule would continue to push the market toward low-GWP options for new equipment charged with virgin refrigerant, preserving the long-term direction of the transition. The petition therefore complements, rather than displaces, the use of substitutes that EPA has already identified, by ensuring that where legacy designs persist for new installations, they do so only through the use of reclaimed HFCs.

**C. Affordability for Residential and Small Business Consumers; Consumer Costs**

EPA has recognized that Technology Transitions restrictions can affect the affordability of equipment and services, particularly for residential and small business consumers.

The requested exemption/zero-GWP treatment would:

- Reduce the cost of compliance by allowing manufacturers and importers to continue supplying certain equipment models designed for legacy refrigerants, provided they are charged and serviced exclusively with domestically reclaimed refrigerant;
- Provide an additional, lower-cost pathway for customers who cannot readily absorb the price premium associated with some low-GWP systems or the site modifications those systems may require;
- Increase reclaimed refrigerant supply and competition, which can moderate service costs over time by ensuring adequate supply and reducing pressure on virgin refrigerant prices; and
- Provide a clear, affordability-focused compliance option for market segments that are most sensitive to upfront equipment costs, while leaving in place the general requirement to transition to low-GWP equipment where virgin refrigerant is used.

In short, the requested action directly supports the AIM Act's emphasis on affordability and consumer costs, particularly for new installations.

### D. Safety, Building Codes, and Appliance Efficiency Standards

Safety, building code compatibility, and appliance efficiency standards are central considerations in EPA's Technology Transitions decisions. Many of the lower-GWP refrigerants that are being adopted in new equipment—such as certain A2L refrigerants—have different flammability characteristics, charge-size limitations, and installation requirements than the legacy blends they replace. Building codes and contractor training are evolving to address these differences, but that evolution is uneven across jurisdictions and market segments.

The requested exemption or zero-GWP treatment for domestically reclaimed regulated substances enhances safety and regulatory coherence in the context of new installations, without altering the existing ability to service installed equipment:

- It allows new equipment using familiar legacy refrigerants to continue to be offered for sale and import, but only when the equipment is charged and serviced exclusively with domestically reclaimed refrigerant. These equipment types have already been evaluated under current safety standards and building codes, and installers are familiar with their characteristics.

- By preserving a reclaimed-only compliance pathway for new legacy-refrigerant designs, the petition reduces pressure for rapid, across-the-board adoption of equipment using flammable or otherwise unfamiliar refrigerants in applications or locations where codes, enforcement, and training may not yet fully support them.

- Because domestically reclaimed regulated substances must meet the same purity specifications as virgin refrigerant, their use in new equipment designed for those refrigerants is fully consistent with existing safety and efficiency certifications, avoiding unexpected impacts on appliance performance or code compliance.

In short, the petition does not seek to change how existing equipment is serviced. Rather, it creates a structured, reclaimed-only pathway for new installations and imports of equipment using established refrigerants, in a way that leverages existing safety standards and contractor expertise while the broader market transition to low-GWP refrigerants continues.

### E. Contractor Training Costs and Workforce Impacts

Contractors and technicians are already trained to recover, handle, and charge the legacy refrigerants at issue. The requested change would:

- Leverage existing training, rather than requiring immediate, widespread re-training for new refrigerants in all applications; and

- Support stable workloads and revenue for reclaimers, distributors, and service contractors by ensuring a viable reclaimed-refrigerant supply chain and a clear compliance role for reclaimed product in new installations.

By enabling a robust reclaimed-refrigerant market for both existing systems and new legacy-design installations under strict conditions, EPA can reinforce existing training investments and reduce the risk of improper conversions or unsafe practices.

### F. Quantities Available From Reclaiming, Prior Production, or Prior Import

The AIM Act specifically directs EPA to consider "quantities of [regulated substances] available from reclaiming, prior production, or prior import."

By designating domestically reclaimed regulated substances as exempt or zero-GWP for Technology Transitions compliance:

- EPA would unlock additional value in the stock of previously produced and imported HFCs, making reclamation economically more attractive;
- More refrigerant would be recovered and reclaimed rather than vented, leaked, or otherwise lost, directly reducing emissions from the existing stock; and
- Reclaimed refrigerant would displace production and import of new virgin HFCs, supporting the allowance phasedown and reducing upstream lifecycle emissions.

This factor strongly favors the requested action because it makes explicit use of the existing HFC stock to meet ongoing RACHP demand in a climate-conscious way, including demand associated with new legacy-design installations permitted under the reclaimed-only pathway.

### G. Overall Economic Costs and Environmental Impacts

From an overall economic and environmental standpoint, the requested exemption/zero-GWP treatment will:

- Lower aggregate compliance costs by providing an additional, market-driven compliance option that makes use of already-produced material;
- Reduce waste and emissions by increasing demand for reclaimed refrigerant and thereby encouraging recovery and reclamation rather than disposal or uncontrolled leakage; and
- Complement, rather than undermine, the Technology Transitions Rule's core objective—driving transitions in new equipment while the allowance system limits overall HFC production and consumption.

The net effect is a more efficient, lower-emissions path to the same long-term climate goals.

### 1. Economic Costs

In terms of net economic impacts, this petition would not mandate changes to any technology transitions or production investments that have already begun under the existing TTR. Instead, it adds a *voluntary, market-based compliance option* alongside the current requirements. The existing low-GWP equipment and refrigerant platforms remain fully available and, in many sectors, will continue to be the primary or preferred compliance strategy. Petitioners recognize that an additional compliance pathway could shift some demand at the margin among manufacturers of low-GWP equipment, manufacturers that continue to produce legacy designs, and suppliers of virgin versus reclaimed refrigerants. Those distributional impacts are an inherent feature of any flexible, market-based policy design, and they are constrained here by the fact that the TTR's GWP limits and the AIM Act's allowance system continue to cap overall HFC use and drive the long-term transition toward low-GWP technologies.

From a cost perspective, the relevant comparison in each sector is between: (i) the incremental design, tooling, certification, and supply-chain costs associated with producing new equipment that uses virgin low-GWP refrigerants; and (ii) the recovery, reclamation, and tracking costs associated with continued production of legacy equipment that uses domestically reclaimed refrigerants. In many cases, reclaimed refrigerant can be supplied at a lower unit cost than virgin low-GWP alternatives, and continued use of existing equipment platforms can avoid some retooling and transition costs, while the proposed labeling and verification requirements build on existing reclamation and recordkeeping practices and are expected to be modest in comparison.

In this setting, allowing manufacturers to choose between the TTR's existing low-GWP equipment pathway and a reclaim-based pathway that achieves comparable climate outcomes (as described in the life-cycle analysis below) can reasonably be expected to reduce the overall economic burden on regulated manufacturers and, by extension, on end users and consumers, relative to a single-option approach

**2. Environmental Impacts**

This petition reasonably assumes that the net GHG releases (and other environmental impacts) associated with the manufacture and use of reclaimed high GWP refrigerants compares favorably with (or at worst is equivalent to) the manufacture and use of lower GWP alternative refrigerants that the current TTR requirements mandate.

The following considerations support that assumption:

a. The GWP of a refrigerant under the Montreal Protocol is based on IPCC-derived values that are not intended to measure global warming impacts *of a particular product*, but instead reflect the 100-year global warming potential of a given chemical *released* into the atmosphere.

b. The global warming impacts of a given product will depend on the full life-cycle GHG emissions associated with that product (i.e., the GHG emissions associated with the production, use, and end of life management of that product).

c. It is clear that the lifecycle GHG emissions of a reclaimed high-GWP refrigerant are significantly lower than the lifecycle emissions of that same high-GWP refrigerant in its virgin form. That is because a significant proportion of all refrigerants will ultimately be released into the environment. But the reclaimed refrigerant does not add to the supply of existing global warming compounds. And studies have shown that the total weighted value of energy consumption and emissions of reclamation is far lower than production of virgin materials. *See* https://pubs.acs.org/doi/full/10.1021/acssuschemeng.1c04723 (finding carbon footprint of recovered R32 to be up to 86% less than virgin production); https://www.mdpi.com/2071-1050/15/1/473 (finding a 90% GHG reduction for reclaim compared to virgin production).

d. The same thing is generally true when comparing the lifecycle GHG emissions of a reclaimed high-GWP refrigerant with the lifecycle GHG emissions of a lower GWP alternative. To take one illustrative example: In the residential air conditioning sector, a simplified life-cycle comparison between (i) a new split-system air conditioner charged with domestically reclaimed R-410A and (ii) a comparable system charged with virgin R-32 under the Technology Transitions Rule supports this assumption.

*First*, the incremental upstream emissions associated with reclaiming recovered refrigerant to virgin-grade purity are substantially lower than the emissions from producing an equivalent quantity of virgin refrigerant. A recent life-cycle assessment ("LCA") of treatment options for recovered refrigerants in air-conditioning applications, using plant data for R-410A, R-32, R-134a, and R-22, found that reclamation has significantly lower greenhouse gas ("GHG") emissions and energy use than destruction, and highlighted reclamation as the environmentally preferable end-of-life option for these gases.[1] Likewise, an independent assessment of fluorinated gas recovery and recycling technologies concluded that recycling low- and medium-GWP components from existing blends can substantially reduce cradle-to-gate emissions compared to producing the same molecules as virgin product.[2] Building on these academic studies, Daikin's commissioned LCA of actual reclamation operations for R-410A, R-32, and R-134a found that the carbon footprint of reused reclaimed refrigerant is approximately 72–90 percent lower than the footprint of supplying the same quantity of virgin refrigerant (with a reduction of about 72 percent for R-410A and about 90 percent for R-32 and R-134a).[3] Note that the comparative GHG benefits of domestically reclaimed refrigerants are further enhanced in the case of low GWP HFO substitutes that are produced overseas in China and India, where the energy emissions of production facilities (e.g., steam boilers, reactors, fractionation) and transportation to the U.S. market significantly increase the "embedded" GHG emissions associated with these products.

*Second*, when reclaimed R-410A is used to charge new residential AC equipment, that refrigerant is drawn from the existing R-410A "bank" that already exists in installed equipment and cylinders. It does not add to the global inventory of high-GWP molecules; instead, it displaces the need to produce new virgin refrigerant and provides a use for recovered gas that might otherwise be vented or destroyed. Recent analysis of R-410A reclamation in the U.S. residential HVAC sector by RMI and Hudson Technologies estimates that using reclaimed rather than virgin R-410A to meet aftermarket and new-equipment demand more than halves the life-cycle GHG emissions per pound of R-410A supply, once production, destruction, reclamation, and supply-chain losses are all taken into account.[4]

*Third*, published life-cycle climate performance ("LCCP") and LCA studies for residential and light-commercial air conditioners consistently find that the dominant contributor to life-cycle climate impact is indirect $CO_2$ emissions from electricity use, with direct refrigerant emissions (from leaks and end-of-life losses) and upstream production emissions both being important but secondary components.[5] Modern R-32 and R-410A split systems can both be designed to meet current efficiency and leakage standards; R-32 can offer a modest efficiency advantage in some designs, but the overall LCCP remains primarily driven by grid emissions and operating efficiency rather than refrigerant choice alone.[5] Within that context, the net effect of substituting domestically reclaimed R-410A for virgin R-32 in a subset of new residential AC systems is governed by the tradeoff between (a) higher per-kilogram GWP for R-410A and (b) much lower upstream emissions and avoided virgin production associated with reclaim, together with higher recovery rates that reclamation programs require. Under reasonable assumptions that are consistent with the published LCA literature—namely, similar system efficiency and leak management for both designs, 70–90 percent lower cradle-to-gate emissions per kilogram of reclaimed refrigerant relative to virgin production, and recovery of reclaimed R-410A from the existing installed bank—the life-cycle GHG releases associated with using reclaimed R-410A in new residential AC equipment are expected to be at least comparable to, and in many plausible

cases lower than, the releases associated with supplying the same cooling service using only virgin low-GWP refrigerants such as R-32.[1–4]

See Appendix A for sources and technical background on assumptions.

Although this simplified comparison focuses on reclaimed R-410A and R-32 in the residential air conditioning sector, the same general analytical framework can be applied, with appropriate modifications, to other sectors and refrigerants covered by the AIM Act and the Technology Transitions Rule. In particular, the key elements—(i) comparing life-cycle GHG emissions from virgin production versus reclaim and reuse of existing high-GWP refrigerants; (ii) accounting for the size and evolution of the existing installed refrigerant bank in each sector; (iii) considering realistic near-term replacement refrigerants and technologies; and (iv) recognizing that electricity use typically dominates total life-cycle climate impact—are conceptually similar across many refrigeration and air-conditioning applications. For example, in commercial refrigeration, chillers, and transport refrigeration, published LCAs of refrigerant production, recovery, and destruction, together with EPA and industry data on installed banks and leakage, could be used to structure analogous qualitative or semi-quantitative comparisons between reclaim-based compliance pathways and the virgin low-GWP alternatives anticipated under the TTR.

At the same time, we recognize that the quantitative results of such sector-specific analyses would not be uniform. The relative benefits of reclaim versus virgin low-GWP refrigerants will depend on sector- and refrigerant-specific factors such as charge sizes, leakage and recovery rates, equipment lifetimes, the maturity and availability of very low- or near-zero-GWP alternatives in a given application, and regional electricity mixes and operating profiles. In some sectors, ultra-low-GWP options may already be widely available and cost-effective, in which case the incremental climate advantage of a reclaim-based pathway may be smaller or more sensitive to assumptions than in sectors where moderate-GWP HFC/HFO blends remain the primary near-term replacement. For these reasons, we are not asking EPA to assume identical life-cycle outcomes across all sectors, but rather to recognize that the framework demonstrated here is general, that it can be populated with sector-appropriate data as needed, and that, in many important RACHP subsectors, a reclaim-based compliance option is reasonably expected—consistent with the best available data—to deliver life-cycle climate performance that is at least comparable to, and in some cases better than, exclusive reliance on virgin low-GWP refrigerants, while simultaneously lowering compliance costs and improving management of the existing high-GWP refrigerant bank.

**H. Remaining Phase-Down Period for Regulated Substances**

The HFC allowance phasedown schedule continues through 2036 and beyond, with increasingly stringent caps on production and consumption.

As the phasedown tightens:

- Pressure on virgin supply will increase, particularly for certain legacy blends;
- The relative value of recovering and reclaiming existing refrigerant will grow; and
- A clear, nationwide Technology Transitions compliance pathway for reclaimed refrigerant, including for new installations of legacy equipment designs under strict conditions, will become more important in ensuring orderly market functioning and avoiding service disruptions.

Adopting the requested exemption/zero-GWP treatment now will help ensure that the remaining phasedown period proceeds smoothly and that reclaimed refrigerant can play its optimal role in meeting RACHP demand.

## V. ENFORCEABILITY, LABELING, AND SUPPLY-CHAIN TRACKING

EPA appropriately will be concerned about the enforceability of any exemption or special treatment for reclaimed refrigerant, particularly the requirement that legacy equipment designs authorized for new installation under this pathway be charged and serviced only with domestically reclaimed regulated substances.

FluoroFusion agrees that enforceability is critical and proposes that EPA address this concern through robust labeling, documentation, and supply-chain tracking requirements, building on existing recordkeeping and reporting frameworks.

### A. Labeling Requirements

EPA could require:

#### 1. Equipment Labels

For equipment relying on the reclaimed-refrigerant compliance path, manufacturers would affix a durable, visible label stating, for example:

> *"This equipment is certified for use only with domestically reclaimed regulated substances, as defined in 40 C.F.R. § 84.52. Charging or servicing this equipment with non-reclaimed regulated substances may violate federal law."*

The label could include:

- The refrigerant type(s) and design charge;
- A QR code or equivalent digital link to batch or compliance information; and
- A statement that servicing records must indicate the use of domestically reclaimed refrigerant.

#### 2. Cylinder and Package Labels

Containers of domestically reclaimed regulated substances sold for this compliance pathway would carry labels indicating:

- The reclaimer's identity and certification;
- A batch or lot number;
- A statement that the contents are a domestically reclaimed regulated substance meeting applicable purity standards; and
- A warning that use in non-qualified applications may not count toward any exemption or zero-GWP treatment and could violate the Technology Transitions Rule.

These labeling requirements would integrate with existing labeling obligations under EPA's HFC and refrigerant management programs and complement state approaches such as California's "certified reclaimed refrigerant" labeling.

### B. Documentation, Recordkeeping, and Reporting Requirements

EPA already requires significant recordkeeping from reclaimers and distributors, particularly where reclaimed HFCs are sold for servicing specific RACHP subsectors. Building on that framework, EPA could require that:

- Equipment manufacturers have in place, and be prepared to show, contractual agreements to purchase reclaimed refrigerants for use in covered equipment.
- Equipment manufacturers' use of reclaimed refrigerant be subject to verification conformity procedures, including through measures such as a mandatory third-party audit of manufacturing operations, reporting on an annual basis to EPA, or annual self-certification to EPA.
- Reclaimers maintain batch-level records linking recovered refrigerant sources, reclamation processing, and sales to distributors or end-users, and report aggregated sales volumes of domestically reclaimed regulated substance by subsector;
- Distributors and wholesalers retain records of sales of domestically reclaimed regulated substances, including purchaser identity, quantity, and intended subsector of use;
- Contractors and technicians maintain service records indicating the use of domestically reclaimed regulated substances when servicing equipment labeled for the reclaimed-refrigerant pathway; and
- All such records be retained for a minimum period (e.g., three to five years) and made available to EPA upon request.

Because these structures largely mirror existing HFC management and allocation recordkeeping rules, they can be implemented with incremental, rather than wholesale, changes.

### C. Electronic Tracking and Compliance Tools

To further enhance enforceability, EPA could:

- Encourage or require unique identifiers (e.g., QR codes, serial numbers) on cylinders of domestically reclaimed regulated substance, enabling electronic verification of reclaimed status;
- Support or approve industry-standard tracking platforms that allow reclaimers, distributors, and contractors to log transactions and servicing events; and
- Integrate reclaimed-refrigerant data into existing EPA HFC reporting systems, allowing the agency to cross-check reclamation volumes, sales patterns, and subsector usage.

Together, these measures would give EPA a clear line of sight from reclaimed refrigerant production to end use in qualifying equipment, making enforcement practical and effective.

### D. Enforcement Approach

Finally, EPA can:

- Treat misuse of virgin refrigerant in equipment labeled for reclaimed-only use as a compliance violation of the Technology Transitions Rule;
- Use targeted inspections of distributors and large service providers to verify reliance on domestically reclaimed regulated substances in the reclaimed-refrigerant pathway; and

- Coordinate with state programs, especially in California and other jurisdictions with reclaimed refrigerant requirements or exemptions, to share data and best practices.

Taken together, these labeling and tracking measures will adequately address enforceability concerns and provide EPA with concrete tools to ensure that the exemption or zero-GWP treatment for domestically reclaimed regulated substances is honored in practice.

**VI. CONCLUSION**

FluoroFusion respectfully requests that EPA:

1. Grant this petition under subsection (i) of the AIM Act and 40 C.F.R. § 84.62; and

2. Initiate rulemaking to amend the Technology Transitions Rule to:

    - Exempt domestically reclaimed regulated substances, and the domestically reclaimed fraction of blends, from the GWP-based restrictions in 40 C.F.R. § 84.54 for equipment that is charged and serviced exclusively with domestically reclaimed regulated substances; or
    - In the alternative, treat domestically reclaimed regulated substances, and the domestically reclaimed fraction of blends, as having a GWP of zero for purposes of compliance with Technology Transitions GWP limits and calculations under § 84.64.

This targeted adjustment will:

- Support the AIM Act's HFC phasedown by increasing recovery and reclamation and reducing demand for new HFC production;
- Provide a cost-effective, safety-enhancing compliance path that leverages existing equipment designs and workforce investments for new installations, without compromising long-term transition goals;
- Align federal policy with state innovation in California and other jurisdictions that exempt or prioritize certified reclaimed refrigerant; and
- Advance the AIM Act's economic and environmental objectives by lowering overall implementation costs while maintaining ambitious climate protection goals.

FluoroFusion appreciates EPA's consideration of this petition and stands ready to provide additional information, data, and technical support as the Agency evaluates and, we hope, grants this request.

Respectfully submitted,

David L. Couchot
President & CEO

**Appendix A**
**Simplified Life-Cycle Comparison:**
**Reclaimed R-410A vs Virgin R-32 in Residential Air Conditioning**

## A. Purpose and Scope

This appendix documents the assumptions and references underlying a simplified life-cycle greenhouse gas ("GHG") comparison between:

- **Pathway 1 (TTR Baseline):** New residential split-system air conditioner or heat pump charged with virgin R-32, as required under EPA's Technology Transitions Rule ("TTR") for residential and light commercial AC.
- **Pathway 2 (Petition Pathway):** New residential split-system AC or heat pump of comparable capacity charged exclusively with domestically reclaimed R-410A, recovered from the existing installed bank and processed by an EPA-certified reclaimer to virgin-grade purity.

The comparison is intended to be order-of-magnitude and directional. It is not a full life-cycle assessment ("LCA") and relies on published LCAs and life-cycle climate performance ("LCCP") studies to bound key parameters.

This simplified life-cycle comparison has several important limitations that EPA should consider in interpreting the results. First, it is intended to be directional rather than fully quantitative. The analysis relies on parameter ranges and qualitative findings drawn from published LCAs and LCCP studies, rather than on a new, bottom-up numerical model constructed specifically for the Technology Transitions Rule. As a result, the appendix does not present a single, point estimate of life-cycle emissions per unit for each pathway, nor does it attempt to replicate the structure of EPA's full benefit–cost analyses.

Second, the comparison focuses on the realistic near-term alternatives in the residential split-system air conditioning sector over the period relevant to this petition. In practice, for this sector and timeframe, the primary replacement refrigerants under the TTR are moderate-GWP HFC/HFO options such as R-32 and related A2L blends, which must be produced as virgin product. The analysis is not intended to demonstrate that reclaimed R-410A would outperform all conceivable ultra-low-GWP technologies (for example, $CO_2$, hydrocarbons, or ammonia systems) in all applications; instead, it shows that, under conditions where R-32 is the primary TTR-driven replacement and where published LCAs find a 70–90 percent reduction in cradle-to-gate emissions for reclaimed refrigerant compared to virgin production, a reclaim-based compliance pathway can achieve comparable or lower life-cycle GHG emissions while accelerating recovery from the existing R-410A bank.

Third, the analysis assumes comparable system efficiency and leak management for R-32 and reclaimed R-410A systems, consistent with the fact that both can meet current efficiency and leak-control standards. To the extent that future designs using ultra-low-GWP refrigerants achieve significantly higher real-world efficiency or substantially different leak and recovery performance, additional analysis would be warranted to compare those specific configurations. Finally, because the analysis is deliberately streamlined, it does not capture all potential behavioral responses (for example, changes in equipment mix or retirement timing) that could further increase or decrease the net benefits of the proposed exemption.

Subject to these limitations, the petitioners believe that this appendix reflects a reasonable application of the "best available data" standard under the AIM Act: it draws on current peer-reviewed LCAs and sector-specific studies, applies transparent and conservative assumptions, and is appropriately scaled to the decision EPA is being asked to make—namely, whether a reclaim-based compliance option can be expected to deliver climate outcomes that are at least comparable to those under the existing TTR while lowering compliance costs and improving management of the existing high-GWP refrigerant bank.

**B. Functional Unit and System Boundary**

**Functional unit**

- One residential split-system air conditioner or heat pump (typical U.S. unit, ~3–4 tons of cooling)
- **Service life:** 15 years
- **Location:** U.S. residential application (temperate-to-warm climate)
- **Service:** Comparable annual cooling output in both pathways

**System boundary**

- **Included:**
  - Upstream (cradle-to-gate) refrigerant production or reclamation
  - Direct refrigerant emissions (operational leaks + end-of-life losses)
  - Indirect energy-related emissions from electricity use (via LCCP findings)
- **Excluded:**
  - Manufacturing of non-refrigerant equipment components
  - Distribution and installation impacts (assumed similar across pathways)
  - Minor differences in auxiliary materials

**C. Key Parameter Assumptions**

Table A-1 summarizes the main quantitative assumptions; ranges are chosen to be consistent with recent LCA/LCCP studies for fluorinated gases and residential AC.[1–5]

**Table A-1. Summary of core assumptions (per AC unit over 15-year life)**

| Parameter | Symbol | Pathway 1: Virgin R-32 | Pathway 2: Reclaimed R-410A | Notes / Sources |
|---|---|---|---|---|
| **Nominal charge per unit** | $M_o$ | 2–3 kg | 2–3 kg | Representative for residential splits; LCAs often assume 2–4 kg.[1,5] |
| **Equipment lifetime** | $L$ | 15 years | 15 years | Consistent with LCCP and AC stock modeling literature.[1,5] |
| **Annual leak rate** | $\alpha$ | 3–5% of charge/yr | 3–5% of charge/yr | Good-practice range for residential AC; both designs assumed comparable.[1,5] |
| **End-of-life recovery rate** | $R\_EOL$ | ~70% of remaining charge | ~70% of remaining charge | Reflects current recovery requirements & practice; sensitivity discussed qualitatively.[1] |
| **IPCC 100-yr GWP (chemical)** | GWP_phys | R-32 ≈ 675 | R-410A ≈ 2088 | Standard AR5/AR6 values used in TTR GWP tables. |

| Parameter | Symbol | Pathway 1: Virgin R-32 | Pathway 2: Reclaimed R-410A | Notes / Sources |
|---|---|---|---|---|
| **Cradle-to-gate GHG per kg virgin production** | EF_virgin | Tens of kg $CO_2$-eq / kg (order-of-magnitude) | n/a | Daikin and others find substantial upstream emissions for virgin R-32 and R-410A production.[3] |
| **Cradle-to-gate GHG per kg reclaimed refrigerant** | EF_reclaim | n/a | ~10–30% of virgin (≈70–90% reduction) | LCAs show 72–90% lower footprint for reclaimed vs virgin HFCs (R-410A, R-32, R-134a).[1–3] |
| **Grid/energy LCCP contribution** | – | Dominant term | Dominant term | AC LCAs show electricity-related $CO_2$ dominates total LCCP; refrigerant terms are smaller but material.[1],[5] |
| **Relative system efficiency** | – | Baseline | Comparable (± few %) | Recent studies indicate R-32 can be modestly more efficient than R-410A in some designs, but both can meet high efficiency levels; this analysis conservatively assumes comparable seasonal efficiency.[5] |

**Notes:**

- Where the literature gives ranges (e.g., 72–90% reduction for EF_reclaim vs EF_virgin), this appendix treats those ranges qualitatively rather than fixing a single point estimate.[1–3]
- The analysis focuses on **incremental differences** between Pathway 1 and Pathway 2, not on absolute emissions.

**D. Life-Cycle Elements by Pathway**

**D.1 Pathway 1 – Virgin R-32**

For the R-32 baseline pathway:

1. **Upstream production**
    - All refrigerant required for initial charge and servicing (to replace leaks) is supplied from **virgin R-32 production**.
    - LCAs of HFC production and Daikin's reclaimed-vs-virgin study indicate that virgin HFCs, including R-32, have non-trivial cradle-to-gate GHG footprints per kg at the plant gate.[3]
2. **Direct emissions**
    - Over a 15-year life, cumulative emissions include:
        - Annual leaks (~3–5% of charge per year).
        - Unrecovered refrigerant at end of life (~30% of remaining charge).
    - Each kg emitted has **GWP ≈ 675**, contributing to direct $CO_2$-eq emissions.
3. **Indirect emissions (electricity)**
    - LCCP studies for residential AC show that **indirect electricity-related $CO_2$ dominates total LCCP**, especially in warm climates, with direct refrigerant emissions and upstream impacts forming smaller but material contributions.[1],[5]

**D.2 Pathway 2 – Domestically Reclaimed R-410A**

For the reclaimed R-410A pathway:

1. **Upstream processing: reclaim vs virgin**
    - All refrigerant used for initial charge and servicing is **domestically reclaimed R-410A**, not virgin.
    - Recent LCAs of treatment options for recovered R-410A and other refrigerants conclude that:
        - **Reclamation has significantly lower GHG emissions and energy use** than destruction, per kg of recovered refrigerant treated.[1]
        - Recycling and separation of fluorinated gases for reuse substantially reduces cradle-to-gate emissions relative to producing the same gases as virgin products.[2]
        - Daikin's LCA of R-410A, R-32, and R-134a reclamation finds that the carbon footprint of reused reclaimed refrigerant is **approximately 72–90% lower** than the footprint of supplying the same quantity of virgin refrigerant (with around a 72% reduction for R-410A).[3]
2. **Direct emissions and bank dynamics**
    - The R-410A molecules used to charge new equipment under this pathway are drawn from the **existing installed bank** of R-410A in U.S. AC and heat-pump systems.[4]
    - Under any scenario, that installed bank must ultimately be recovered and managed; the main alternatives are:
        - (a) **Recover → destroy → produce new virgin refrigerant** (baseline), or
        - (b) **Recover → reclaim → reuse reclaimed refrigerant**, displacing virgin production.[1–4]
    - Direct refrigerant emissions from new equipment in Pathway 2 (leaks and EOL losses) are associated with molecules that would, absent reclamation, either be destroyed or risk leakage from the legacy fleet.
    - Creating a robust demand for reclaimed R-410A in new equipment is expected to **increase recovery rates** and reduce uncontrolled releases from legacy equipment, as observed in LCA scenarios that compare "reclaim" vs "destroy" outcomes.[1],[3],[4]
3. **Indirect emissions (electricity)**
    - Both R-32 and R-410A systems can meet current efficiency standards; several studies show that while R-32 can be somewhat more efficient, overall life-cycle climate performance remains dominated by the electricity term.[1],[5]
    - For this simplified comparison, the analysis assumes **comparable annual electricity use** between the two pathways, which is conservative relative to potential R-32 efficiency advantages.

**E. Directional Results and Interpretation**

Given the assumptions above and the LCA ranges cited, the **directional comparison** can be summarized as follows:

- **Indirect electricity-related emissions**
    - Largest part of total life-cycle GHGs in both pathways.
    - Under the conservative assumption of comparable efficiency, this component is effectively **neutral** between R-32 and reclaimed R-410A.
- **Direct refrigerant emissions**
    - Per-kg climate impact is higher for R-410A than for R-32 (GWP ~2088 vs 675), but:
        - Total mass per unit is limited (2–3 kg).

        - Leak and recovery practices are assumed similar.
        - Emissions in Pathway 2 occur within a framework where the molecules themselves are **not additional**; they come from an existing bank that must be managed.
- **Upstream emissions (production vs reclamation)**
    - Pathway 1 requires new virgin R-32 production for initial charges and servicing, with associated cradle-to-gate GHG emissions.
    - Pathway 2 instead uses reclaimed R-410A, for which LCAs show ~72–90% lower cradle-to-gate emissions per kg of refrigerant supplied compared to virgin production or to a recover-and-destroy / virgin-replacement route.[1–3]

Under these conditions, the published LCA literature supports the conclusion that:

> *For a representative residential split-system AC unit, the life-cycle GHG emissions associated with supplying refrigerant via reclaimed R-410A rather than virgin R-32 are at least comparable and plausibly lower, once avoided virgin production, lower upstream emissions per kg of refrigerant, and higher recovery rates from the existing R-410A bank are properly accounted for.*

This conclusion is robust to reasonable variation in equipment charge, leak rates, and recovery assumptions, so long as: (i) indirect electricity emissions remain the dominant LCCP component (as documented in the literature), and (ii) reclamation continues to yield large relative reductions in cradle-to-gate emissions compared to virgin production and destruction pathways.[1–5]

**F. References**


1. Yasaka, S., et al., “Life Cycle Assessment of Refrigerants for Air Conditioners Considering Reclamation and Destruction,” *Sustainability* 15(1): 473 (2023) (comparing LCA for recovered R-410A, R-32, R-134a, R-22 under reclaim vs destruction scenarios).
2. Jovell, J., et al., “Life Cycle Assessment of the Separation and Recycling of Fluorinated Gases Using Ionic Liquids in a Circular Economy Framework,” *ACS Sustainable Chemistry & Engineering* 10(1): 71–80 (2022) (showing the benefits of recovering and recycling fluorinated gases versus virgin supply).
3. Daikin Europe, *Assessing the Carbon Footprint of Reclaimed Refrigerant for Reuse and Virgin Production* (LCA study reporting ~72–90% reduction in carbon footprint for reclaimed vs virgin R-410A, R-32, and R-134a).
4. Raghav Muralidharan, Gareth Westler, Hadia Sheerazi, Yulin Lou, Ian McGavisk, and Ankit Kalanki, *Refrigerant Reclamation: Assessing Potential Emissions Impacts of R-410A Refrigerant Reclamation in the United States’ Residential HVAC Sector*, RMI, 2024, https://rmi.org/insight/refrigerant-reclamation.
5. LCCP and AC performance literature cited in Yasaka et al. (2023) and related sources, finding that indirect electricity use dominates life-cycle climate impacts for residential and light commercial air conditioners, with refrigerant-related terms smaller but material.