

NATIONAL PRODUCER RESPONSIBILITY SCHEMES UNDER THE EU F-GAS REGULATION

With the adoption of *Regulation (EU) No 517/2014 on Fluorinated Greenhouse Gases* (hereinafter the “EU F-Gas Regulation”), the European Union (EU) set out an ambitious package of measures to reduce HFC emissions. This includes, most notably, the progressive reduction of HFC refrigerants made available on the EU market each year—the so-called HFC phase-down—in addition to bans on certain HFC-based products and equipment and measures to reduce leakage. The EU F-Gas Regulation falls short, however, when it comes to the waste management of used HFC refrigerants at end-of-life. The responsibility has fallen on national authorities in Member States to overcome this shortcoming, in particular through the adoption of national producer responsibility schemes.

Several studies have looked at the recovery of used HFC refrigerants and their recycling, reclamation and destruction.¹ In addition, many Member States and non-EU countries have experience with national measures promoting waste management of used HFC refrigerants. While national circumstances are highly relevant, literature and experience reveal certain key elements that any national producer responsibility scheme could benefit from. To this end, this briefing note seeks to bring together information and provide recommendations on promoting recovery, recycling, reclamation and destruction of used HFC refrigerants through the adoption of national producer responsibility schemes. It first provides a background on the waste-management cycle of used HFC refrigerants and related obligations under EU law, before examining the role producer responsibility can play, concluding with a series of recommendations on key elements that any national producer responsibility scheme should consider. It is hoped that this briefing note will promote a constructive debate in Member States on additional measures and spur action to manage used HFC refrigerants at end-of-life both to reduce HFC emissions and support the HFC phase-down.

SUMMARY OF FINDINGS

- The waste management of used HFC refrigerants involves multiple stakeholders—contractors, distributors, and operators of reclamation and destruction facilities—that each play a critical role.
- At the moment, EU legislation contains an incomplete framework for the waste management of used HFC refrigerants, setting out unclear roles and responsibilities and failing to address economic and infrastructure barriers to reclamation and destruction.
- National producer responsibility schemes tailored to the particularities of the waste-management cycle of used HFC refrigerants and nuances of national circumstances in Member States can overcome these shortcomings, in particular through the promotion of onsite recycling, establishment of take-back obligations coupled with deposit-and-refund schemes, provision of accessible collection points, and creation of reclamation and destruction facilities in Member States.
- Given the respective experience and expertise of national authorities overseeing the regulation of HFC refrigerants and waste, the development of national producer responsibility schemes should be undertaken in close coordination with waste authorities.

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I. BACKGROUND ON THE WASTE MANAGEMENT OF USED HFC REFRIGERANTS

Waste management of used HFC refrigerants—their recovery from equipment followed by recycling, reclamation or destruction—requires coordination across multiple stakeholders. In the past, the EU has placed much of the burden of waste management on operators of equipment despite their limited role in the waste-management cycle. Moreover, producers of HFC refrigerants have been assigned little, if any, responsibility to manage at end-of-life the used HFC refrigerants they placed on the market. This is at odds with bedrock EU policy on extended producer responsibility, and threatens to undermine implementation of the EU F-Gas Regulation.

A. Waste-Management Cycle of Used HFC Refrigerants

HFC refrigerants become “waste” when recovered from equipment during service, maintenance or decommission.² Although operators are ostensibly involved in the waste-management cycle, their role is limited to securing certified personnel—contractors—to undertake the actual recovery of the HFC refrigerants during service, maintenance or decommission.³ Thus, the waste-management cycle of HFC refrigerants effectively begins during recovery by contractors. The typical waste-management cycle consists of the following steps.⁴

1. Recovery (Step 1)

Recovery is defined as “the collection and storage of [HFC refrigerants] from products, including containers, and equipment during maintenance or servicing or prior to the disposal of the products and equipment.”⁵ Used HFC refrigerants should be recovered qualified technicians, which may be sole practitioners, companies, operators, equipment manufacturers, de-manufacturing facilities, or waste handlers (hereinafter “contractors”). Recovery from household appliances—i.e. waste electrical or electronic equipment—is performed after transportation to a waste facility upon disposal, whereas recovery from commercial and industrial equipment is generally performed onsite using mobile recovery equipment. Used HFC refrigerants may also be collected from stockpiles held at industrial facilities or other warehouses. Once recovered, used HFC refrigerants are supposed to be stored for recycling, reclamation or destruction although venting into the atmosphere still occurs.

2. Recycling (Step 2)

Recycling is defined as “the reuse of a recovered [HFC refrigerant] following a basic cleaning process,” such as filtering and drying.⁶ Recycling is the most economical option as it involves recharge back into equipment, resulting in cost savings due to reduced requirements for virgin or reclaimed HFC refrigerants. Recycling is typically performed onsite by contractors where the used HFC refrigerant is not excessively contaminated. In cases when the used HFC refrigerant is too contaminated for recycling, it will need to be reclaimed or destroyed, depending on contamination levels and other factors.

3. Reclamation or Destruction (Step 3)

Reclamation is defined as “the reprocessing of a recovered [HFC refrigerant] in order to match the equivalent performance of a virgin substance, taking into account its intended use.”⁷ It involves reprocessing and upgrading used HFC refrigerant by passing it through a series of filters and dryers at a large-scale distillation unit to remove particulates, and then laboratory testing to ensure it meets the necessary purity standard.⁸ It is performed offsite by commercial reclaimers or producers that reclaim gases as part of routine business practices. Reclamation costs vary depending on the market value and level of contamination of the used HFC refrigerant, as well as the distance to the reclamation facility. When reclamation cannot be performed cost-effectively (e.g. due to the lack of accessible reclamation facilities) or when technological or legal barriers are at play (e.g. in the case of HFC refrigerant blends, which cannot be reconstituted without a patent), the used HFC refrigerant must be destroyed.

Destruction is defined as “the process of permanently transforming or decomposing all or most of an [HFC refrigerant] into one of more stable substances that are not fluorinated greenhouse gases.”⁹ Destruction may be performed by commercial facilities that operate high-temperature incinerators or other approved destruction technologies or by HFC producers that destroy used HFC refrigerants as part of routine business practices. In the EU, the most common process for destruction is reactor cracking with a destruction efficiency of 99.999%, although high-temperature incineration in rotary kilns and gas-conversion systems is also used.¹⁰ The costs of destruction generally range from €1 to €10 per kilogramme of bulk, although long-term customers tend to be charged less.¹¹

Reclamation and destruction facilities are unevenly distributed in the EU.¹² A Commission-funded report found that, in 2010, there were approximately 55 commercial reclamation facilities spread out across 17 Member States and 23 commercial destruction facilities spread out across 11 Member States.¹³ Most of reclamation and destruction facilities do not provide collection or transportation services, instead only accepting bulk gases contained in cylinders and tanks.¹⁴ Where reclamation and destruction facilities are limited or no collection and transportation services are provided, a greater reliance is placed on having a well-developed network of distributors to provide accessible collection sites and transportation services.

B. Consolidation and Transport

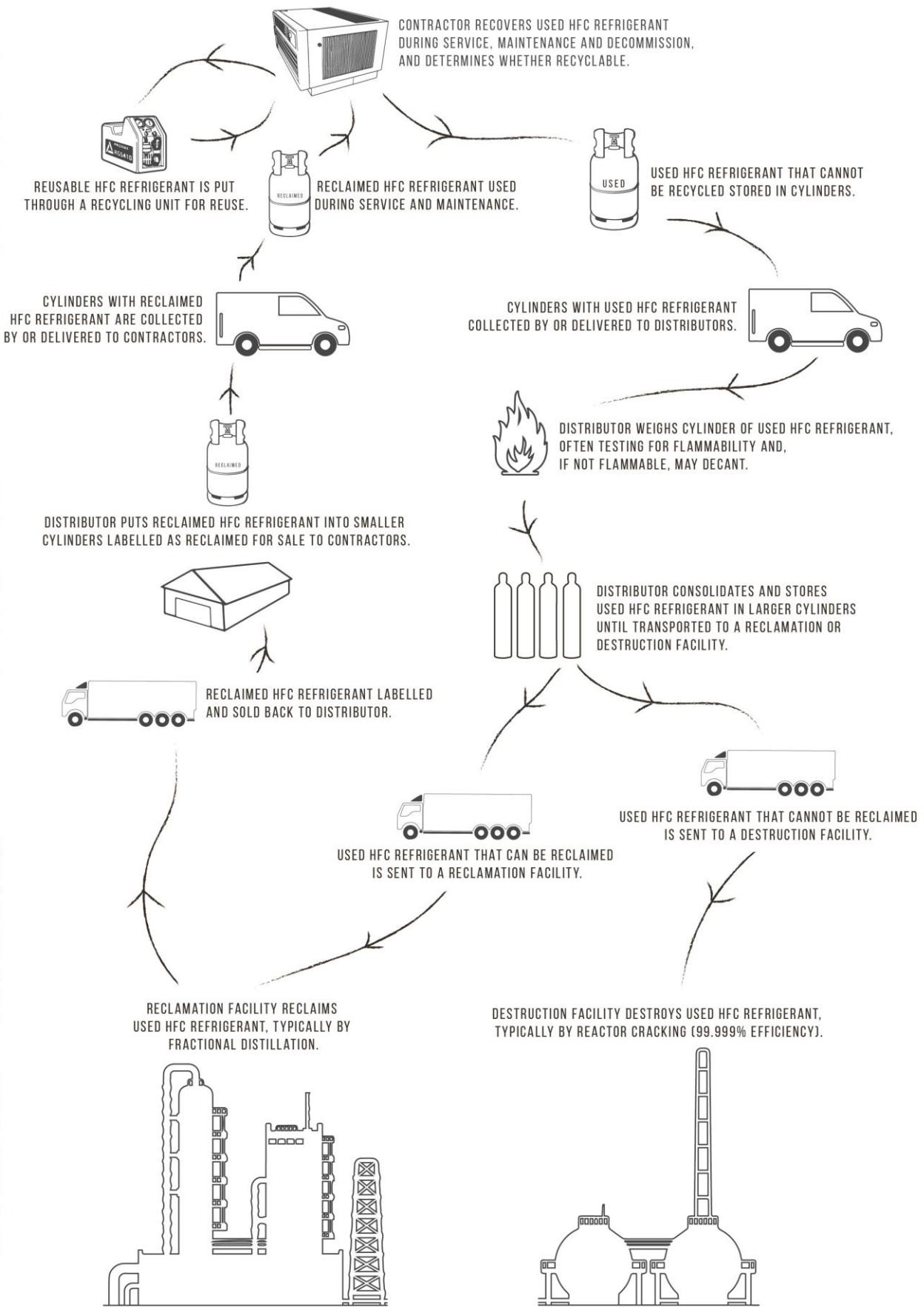
Before transport to reclamation or destruction facilities, used HFC refrigerants are often consolidated and stored temporarily to avoid shipping multiple smaller containers. This can occur several times at multiple levels of the supply chain.¹⁵ For example, contractors may consolidate their stocks of used HFC refrigerants and send them to a distributor (sometimes also referred to as the wholesaler) that further consolidates its stocks of used HFC refrigerants into a larger shipment before delivery to a reclamation or destruction facility. This also means used HFC refrigerants may be transported numerous times before reclamation and destruction. Labour costs to transport recovered gases 1,000 kilometres are estimated at approximately €2,000 (see Annex I for additional cost estimates).¹⁶ This makes low volumes cost-prohibitive for sole practitioners and small enterprises,¹⁷ which constitute most of the estimated 200,000 contractors in the EU (average number of contractors per company is four).¹⁸

C. Actions of Individual Stakeholders

National circumstances vary. In some Member States, there is a well-established network of distributors while in other Member States this is lacking. Moreover, not all Member States have reclamation or destruction facilities, which complicate efforts to undertake reclamation and destruction. The following diagram looks at a hypothetical situation in a Member State with reclamation and destruction facilities and a well-established network of distributors. The diagram is designed to allow national authorities to contemplate which additional measures, via national producer responsibility schemes and related legislation, may be needed to ensure a fully functioning waste-management cycle for HFC refrigerants, as discussed below.

CONTRACTOR

TYPICAL WASTE-MANAGEMENT CYCLE OF HFC REFRIGERANTS (WELL-DEVELOPED NETWORK OF DISTRIBUTORS)



II. WASTE-MANAGEMENT OBLIGATIONS ON USED HFC REFRIGERANTS

Although EU legislation outlines clear legal obligations on the recovery of used HFC refrigerants, it is unclear what roles and responsibilities the other stakeholders in the waste-management cycle play, i.e. post-recovery collection, storage, transport and delivery to reclamation or destruction facilities. Member States are supposed to fill this void but few have, and improvements are needed even where initial efforts have been made.

A. Recovery of Used HFC Refrigerants

The legal obligation to recover used HFC refrigerants varies depending on the type of equipment. For equipment falling under the Waste Electrical and Electronic Equipment (WEEE) Directive, recovery of used HFC refrigerants is required at end-of-life processing of electrical and electronic waste. For equipment outside the scope of the WEEE Directive, or during service and maintenance of equipment during its lifetime, the EU F-Gas Regulation requires operators to ensure (or arrange for) recovery.

1. Equipment within the Scope of the WEEE Directive

HFC refrigerants in certain products and equipment, such as many small air-conditioning and refrigeration units, clearly fall under the national producer responsibility schemes mandated by the WEEE Directive (see Annex II). In general, distributors are required to collect and transport waste electrical and electronic equipment to collection and treatment sites. Although there is no actual requirement in the WEEE Directive for producers to ensure recycling, reclamation or destruction following recovery, used HFC refrigerants must be “disposed of or recovered in compliance with [the Waste Framework Directive (WFD)]” (see Annex III).¹⁹

2. Equipment within the Scope of the EU F-Gas Regulation

HFC refrigerants in other products and equipment (built to specification and installed by certified personnel), such as may be the case with larger air-conditioning and refrigeration units, in addition to HFC refrigerants recovered during service and maintenance or onsite decommissioning and from most mobile equipment, fall under Article 8 of the EU F-Gas Regulation (see Annex IV). Article 8 sets out the following legal obligations *on the operator*, depending on the type of equipment:

Type of Equipment	Legal Obligation on Operator
Stationary Refrigeration	
Refrigerated Trucks and Trailers	
Stationary Air-Conditioning	Shall ensure that the recovery of used HFC refrigerants is carried out by persons that hold the relevant certificates (certification) so that those gases are recycled, reclaimed or destroyed.
Stationary Heat Pumps	
Stationary Equipment with Solvents	
Stationary Fire Protection	
Stationary Electrical Switchgear	
Mobile Air-Conditioning (outside scope of MAC Directive)	Shall arrange for the recovery of used HFC refrigerants, to the extent that it is technically feasible and does not entail disproportionate costs, by appropriately qualified natural persons (to be determined by Member State) so that they are recycled, reclaimed or destroyed.
All Other Stationary Equipment	
Mobile Air-Conditioning (within scope of MAC Directive)	Shall arrange for the recovery of used HFC refrigerants, to the extent that it is technically feasible and does not entail disproportionate costs, by appropriately qualified persons (training attestation) so that they are recycled, reclaimed or destroyed.

Note: The EU F-Gas Regulation defines “recovery” as “the collection and storage of [HFC refrigerants] from products, including containers, and equipment during maintenance or servicing or prior to the disposal of the products or equipment.”²⁰

Leaving aside recycling, which can be performed onsite and offers cost savings, Article 8 does little to ensure proper waste management of used HFC refrigerant once recovered. Under a plain interpretation, Article 8 actually contains *no actual obligation to ensure that used HFC refrigerants are reclaimed or destroyed*. It simply requires the operator to ensure (or arrange for) recovery “so that they are... reclaimed or destroyed” without placing the obligation on a specific stakeholder to do so. Although not specifically mentioned in the EU F-Gas Regulation—unlike in the WEEE Directive—used HFC refrigerants also fall under the obligations in the WFD since they are considered a waste (see Annex III). The application of those provisions to used HFC refrigerants, however, has historically been overlooked.

The closest the EU F-Gas Regulation gets to ensuring post-recovery waste management of used HFC refrigerants is through its “drop-off” obligation. Article 3(1) prohibits the “intentional release of [HFC refrigerants] into the atmosphere... where the release is not technically necessary for its intended use.”²¹ Thus, once the used HFC refrigerant is in the hands of the contractor, it is unlawful for that contractor to intentionally release (read: vent) the used HFC refrigerant. Instead, the contractor must drop it off to a third party who, upon receipt, is then prohibited from intentional releases and so must, in turn, drop it off to a third party and so on until the used HFC refrigerant ends up in the hands of someone with the wherewithal to reclaim or destroy it. The drop-off obligation, which treats the possession of used HFC refrigerants like a game of hot potato, is a poor substitute for comprehensive waste management.

B. Waste Management under the Waste Framework Directive

Used HFC refrigerants are considered a “waste” under the WFD.²² Member States are therefore required to “encourage” extended producer responsibility.²³ There is not, however, any mandatory requirement in the WFD for Member States to extend responsibility of used HFC refrigerants to the producer and, as a result, few Member States have done so. This is a major shortcoming in the legal framework governing the waste management of used HFC refrigerants—the lack of clear roles and responsibilities—and creates a regulatory void that must be legislated at the national level.

Importantly, the Commission recently proposed amendments to the WFD as part of the Circular Economy Package.²⁴ While the amendments are uncertain on the establishment of a mandatory requirement on Member States to adopt national producer responsibility schemes—something that will hopefully be addressed in the upcoming legislative process—where a Member State does act it would have to ensure certain minimum requirements are met. The Commission justifies the minimum requirements as follows:

Extended producer responsibility schemes form an essential part of efficient waste management, but their effectiveness and performance differ significantly between Member States. Thus, it is necessary to set minimum operating requirements for extended producer responsibility. Those requirements should reduce costs and boost performance, as well as ensure a level-playing field, including for small and medium sized enterprises, and avoid obstacles to the smooth functioning of the internal market. They should also contribute to the incorporation of end-of-life costs into product prices and provide incentives for producers to take better into account recyclability and reusability when designing their products. The requirements should apply to both new and existing extended producer responsibility schemes. A transitional period is however necessary for existing extended producer responsibility schemes to adapt their structures and procedures to the new requirements.²⁵

The minimum requirements set out are many. They include defining “in a clear way the roles and responsibilities of producers” and “organizations implementing extended producer responsibility on their behalf”²⁶ as well as financial contributions by producers that “cover the entire cost of waste management

for the products it puts on the [EU] market,” including “costs of separate collection, sorting and treatment operations,” among other things.²⁷ Moreover, where an organization is set up to implement extended producer responsibility on behalf of producers it must also meet certain minimum requirements, including “necessary operational and financial means” and “adequate self-control mechanisms” supported by “regular independent audits.”²⁸

C. Shortcomings in the Waste Management of Used HFC Refrigerants

The shortcomings of the EU framework on waste management of used HFC refrigerants are well known.

First, it is unclear regarding roles and responsibilities. Although the WEEE Directive and EU F-Gas Regulation place a clear obligation to recover used HFC refrigerants, neither set out clear obligations on post-recovery waste management of used HFC refrigerants. Both the WEEE Directive and EU F-Gas Regulation cross-reference the WFD where, likewise, no clear obligations exist. Amendments to the WFD have the potential to improve waste management of used HFC refrigerants but Member States need not wait for their adoption.

Second, it does not address economic barriers that impede post-recovery waste management of used HFC refrigerants. European stakeholders identify “the cost and lack of financial assistance to facilitate the purchase and operation of equipment for the recovery and recycling of F-gases as a barrier – especially for smaller companies.”²⁹ Assuming the equipment is available, there are other costs. On one hand, as mentioned above, the transport of used HFC refrigerant has financial implications. Labour costs alone to transport used HFC refrigerant 1,000 kilometres were estimated at approximately €2,000.³⁰ And these costs are particularly problematic for smaller companies whose low volumes make transport cost-prohibitive.³¹ Some Member States have well-established networks of distributors in place to enable contractors to return used HFC refrigerants through existing distribution channels, i.e. to distributors for consolidation and delivery to reclamation or destruction facilities.³² But this only partially addresses the problem. On the other hand, some facilities charge to receive the refrigerant. Again, this can be cost-prohibitive for smaller companies.³³ The Montreal Protocol’s Technology and Economic Assessment Panel (TEAP) found that avoiding venting represents a major challenge due to even relatively minor costs.³⁴ Although costs could theoretically be passed on to operators (who pass on through consumers), market competition often forces contractors to find other ways of dealing with used HFC refrigerants, such as unlawful venting.³⁵ Indeed, in the absence of consistent enforcement and proportionate penalties, the economic incentive for operators is often to vent.

Third, it does not address infrastructure barriers to post-recovery waste management of used HFC refrigerants, in particular the uneven distribution of reclamation and destruction facilities. In the absence of nearby reclamation or destruction facilities, used HFC refrigerants must be shipped long distances and sometimes across borders.³⁶ Transboundary shipment can be difficult since used HFC refrigerants are considered a “waste” under the Waste Shipment Regulation, thus requiring prior written notification and consent.³⁷ The burden is compounded by the fact that “inorganic fluorinated compounds” such as HFC refrigerants are also “hazardous wastes,” triggering costly and time-consuming administrative burdens.³⁸

Fourth, given the large and dispersed nature of the regulated community, enforcement is time-consuming and administratively burdensome, complicating the task for national authorities.³⁹

These shortcomings can be addressed by the adoption of national producer responsibility schemes.

III. NATIONAL PRODUCER RESPONSIBILITY SCHEMES

National producer responsibility schemes are an effective method for promoting reclamation and destruction of used HFC refrigerants. It was anticipated that producer responsibility would be the linchpin of post-recovery waste management of used HFC refrigerants in the EU F-Gas Regulation with specific provisions specifically crafted for this sector. But, in its proposal, the Commission omitted any reference to producer responsibility, justifying the omission in the *Impact Assessment* by stating “because no generic scheme seems to be universally applicable” national circumstances make it “preferable” that producer responsibility schemes are “implemented at MS level and not at EU level.”⁴⁰ This argument failed to consider that, at a minimum, the Commission could have required Member States to adopt *national* producer responsibility schemes that meet certain criteria without prescribing a specific type, similar to what is being proposed in amendments to the WFD. This would have made sense, given that a separate Commission-funded study released the same year found that “the majority [of Member States] do not have national policies going beyond the existing [recovery requirements].”⁴¹

The European Parliament sought to address this omission in the report of the Committee on the Environment, Public Health and Food Safety which included an amendment requiring Member States to “ensure that producer responsibility schemes are in place for the recovery of [used HFC refrigerants] and their recycling, reclamation or destruction.”⁴² The amendment further required producers to establish accessible collection points for certified personnel to drop off used HFC refrigerants at no cost while otherwise allowing Member States flexibility to design the scheme to fit their national circumstances.⁴³

After negotiations with Member States, the obligation was watered down to its now-adopted form:

Article 9 Producer Responsibility Schemes

Without prejudice to existing Union legislation, Member States shall encourage the development of producer responsibility schemes for the recovery of fluorinated greenhouse gases and their recycling, reclamation or destruction.

Member States shall provide information to the Commission on the actions undertaken under the first paragraph.

Thus, while no specific mandate to adopt a national producer responsibility scheme exists, Member States are required to “encourage” their development and inform the Commission of their actions in this regard. There are several good reasons for Member States to do so.

First, extended producer responsibility is bedrock EU policy. It is an effective strategy for waste management that allows producers to integrate environmental costs into market prices, which is currently not the case with virgin HFC refrigerants. On the contrary, not only do producers currently avoid any logistical or financial responsibility for the post-recovery waste management of used HFC refrigerants, the system actually awards them with windfall profits. Under the quota allocation method in HFC phase-down, HFC quotas are grandfathered at no cost to producers despite their “clear monetary value,” as acknowledged by the Commission.⁴⁴ As supplies of HFC quotas are reduced below demand, producers have the ability—and have exercised it—to increase HFC prices for their virgin high-GWP HFC refrigerants *unrelated to any increase in manufacturing costs*. For example, in 2014, before the EU F-Gas Regulation had even entered into force, Arkema announced HFC price increases of up to 20%.⁴⁵ Shortly thereafter Chemours (formerly DuPont) and Mexichem announced HFC price increases of up to 15%.⁴⁶ The German Federal Environment Agency (UBA) calculated the expected HFC price increases over the lifetime of the HFC phase-down, showing windfall profits could exceed billions of euros annually.⁴⁷

In total, free grandfathering represents a significant transfer of wealth—at least €32 billion from 2015 through 2030—from European companies and consumers to multinational companies.⁴⁸ Moreover, these

figures should be considered conservative estimates as some producers have already raised prices over expected amounts, and earlier than anticipated.⁴⁹ Although opponents of extended producer responsibility may argue that producers will simply pass through the costs to operators and consumers—leading to further HFC price increases—there is an upper limit on the windfall profits producers may charge: the costs of switching to technologies relying on natural refrigerants. It is therefore reasonable to extend responsibility for waste management of used HFC refrigerants to producers, at the very least to appropriate a small portion of the windfall profits that multinational companies are extracting from the current quota allocation method.

Second, waste management of used HFC refrigerants is promoted where ultimate legal and financial responsibility rests with discrete stakeholders with capital and technical expertise.⁵⁰ This also allows economic incentives to be aligned, infrastructure to be established and compliance monitored.⁵¹ It is unreasonable to expect hundreds of thousands of contractors, which are predominantly solo practitioners and small enterprises, to absorb uncompensated costs for collection, storage, transport and delivery of used HFC refrigerants. It is even more unreasonable to expect them to undertake actual reclamation and destruction, which requires capital outlays and technical expertise beyond their means. Thus while it makes sense to require operators to ensure (or arrange for) recovery, once recovered, producer responsibility allows policymakers to align economic incentives and establish infrastructure as well as monitor compliance.

Third, higher reclamation rates are an important safety valve for the HFC phase-down and will be critical to its success. The HFC phase-down dramatically reduces the quantity of virgin HFC refrigerants placed on the market each year with significant shortages expected as soon as 2018.⁵² These shortages cause price increases, and early indications are that HFC prices will skyrocket.⁵³ Recycling and reclamation are the only ways to expand the lawful pool of available HFC refrigerants beyond what is allowed under the HFC phase-down. Moreover, the failure to achieve certain reclamation rates—those assumed in the modelling that resulted in the HFC phase-down—will exacerbate HFC quota shortages and HFC price increases, setting a *de facto* minimum baseline for what should be achieved.

Fourth, higher destruction rates complement the overall climate objective of the EU F-Gas Regulation. Recovery followed by destruction is the only method available to prevent used HFC refrigerants that cannot be reclaimed from being emitted into the atmosphere, something that has important near- and long-term impacts on the climate system. In order to ensure that the emission reductions anticipated under the EU F-Gas Regulation are achieved, Member States should strive to ensure proper disposal at end-of-life.

IV. KEY ELEMENTS OF A NATIONAL PRODUCER RESPONSIBILITY SCHEME

National producer responsibility schemes can take many forms depending on the national circumstances of each Member State. In reviewing various schemes in Member States and non-EU countries (see Annexes V to VIII for examples), and in the context of the waste-management cycle of used HFC refrigerants and obligations in EU legislation, the following key elements can be discerned:

A. Promote Onsite Recycling

Robust recycling reduces the amount of used HFC refrigerant that must be reclaimed or destroyed. Following an initial capital outlay to purchase a recycling unit, onsite recycling is quite economical—essentially just labour and power—and reduces the need for virgin or reclaimed HFC refrigerants during service and maintenance. Many contractors, especially sole practitioners and small enterprises, cite the cost of a recycling unit as a barrier to onsite recycling.⁵⁴ It is therefore recommended that national authorities explore methods of providing financial assistance to contractors to purchase recycling units, such as through tax rebates or via a levy or fee on virgin HFC refrigerants placed on the market by producers.

B. Adopt a Take-Back Obligation with Deposit-and-Refund Scheme

A take-back obligation on distributors and producers is an essential compliment to the drop-off obligation already in the EU F-Gas Regulation. Some Member States have enacted take-back obligations, such as France (must be taken back at *no cost*) and Germany (must be taken back although a cost may be charged). Experience shows, however, that best results are achieved when distributors and producers must not only take back used HFC refrigerants but also when contractors and distributors are compensated for collection, storage and transport upon delivery. It is therefore recommended that national authorities explore adopting a take-back obligation coupled with a deposit-and-refund scheme whereby distributors and producers must take back used HFC refrigerant, and contractors and distributors are compensated upon delivery. This can be funded via a levy or fee on virgin HFC refrigerants placed on the market by producers.

C. Ensure Accessible Collection Points

Drop-off and take-back obligations coupled with deposit-and-refund systems alone are often insufficient in the absence of accessible collection points. In Member States with a well-developed network of distributors, the distributors themselves serve as accessible collection points for contractors at points of sale. For example, France has a network of hundreds of distributors throughout its borders that collect used HFC refrigerants for its six reclamation facilities and three destruction facilities. But in Member States with an underdeveloped network of distributors, it is recommended that national authorities consider alternative methods to ensure accessible collection points. This could be achieved by leveraging networks or obligations established under other EU legislation, such as the WEEE Directive and the WFD, or by extending the obligation to provide accessible collection points to producers, modelled after the Battery Directive.⁵⁵

D. Ensure Reclamation and Destruction Facilities

Given the capital and technical expertise required to establish and operate reclamation and destruction facilities—in addition to legal barriers presented by the transboundary shipment of used HFC refrigerants—contractors and distributors are not often in a position to bear the burden of reclamation and destruction. Moreover, as evidenced by the lack of reclamation and destruction facilities in many Member States, market forces cannot always be relied upon. It is therefore recommended that national authorities place ultimate responsibility for reclamation and destruction on producers directly or through the required formation of a collective industry association (see Annexes VII and VIII for examples).

National authorities can take the additional step of requiring reclaimed HFC refrigerants be sold at reasonable prices, with proceeds being reinvested into the scheme.

E. Promote Coordination between Fluorinated-Gas and Waste Authorities

Since used HFC refrigerants are considered a waste, oversight sometimes falls between competencies of national fluorinated-gas authorities and national waste authorities. Given the experience and expertise of the latter, in particular with extended producer responsibility for other waste streams, it is recommended that the development of a national producer responsibility scheme be undertaken in close coordination between the two authorities.

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ANNEX I

COSTS OF COLLECTION, TRANSPORT AND DELIVERY

In 2009, TEAP provided cost estimates of waste management of ozone-depleting substances for several sectors – also applicable to used HFC refrigerants.⁵⁶ The cost estimates were determined for sparsely and densely populated areas, corresponding to medium and low effort levels, respectively:

Effort Level	Sector	Recovery Costs (US\$/kg)			Destruction Costs (US\$/kg)		Total (US\$/kg)
		Collection	Transport	Processing	Transport	Destruction	
Low (High Density)	Commercial Refrigeration	8-12	8-10	8-15	0.01-0.06	5-7	29-44
	Transport Refrigeration	---	---	15-20	0.01-0.06	5-7	20-27
	Industrial Refrigeration	---	---	4-6	0.01-0.06	5-7	9-13
	Stationary AC	1-2	---	4-25	0.01-0.06	5-7	10-34
	Mobile AC	---	---	4-6	0.01-0.06	5-7	9-13
	Fire Protection	1-2	---	4-25	0.01-0.06	6-8	11-35
Medium (Low Density)	Commercial Refrigeration	15-20	40-50	8-15	0.01-0.06	5-7	68-92
	Stationary AC	1-2	---	10-35	0.01-0.06	5-7	16-44
	Mobile AC	1-2	---	4-6	0.01-0.06	5-7	10-15
	Fire Protection	1-2	---	10-35	0.01-0.06	6-8	17-45

ANNEX II

RECOVERY AND PRODUCER RESPONSIBILITY IN THE WEEE DIRECTIVE

The WEEE Directive requires Member States to set up schemes for the recovery of certain types of equipment and the gases therein.⁵⁷ In particular, the WEEE Directive requires recovery of used HFC refrigerants from the household equipment and consumer products listed in Annex I and II as well as all electrical and electronic equipment listed in Annex III and IV.⁵⁸ This includes “temperature exchange equipment” and “small and large equipment.”⁵⁹ To the extent HFCs are found in this equipment, it has to be removed and “disposed of or recovered in compliance with [the WFD].”⁶⁰

However, the WEEE Directive explicitly excludes from its scope certain types of equipment:

- “Large scale fixed installations,” which are defined as “a large-size combination of several types of apparatus and, where applicable, other devices, which: (i) are assembled, installed and de-installed by professionals; (ii) are intended to be used permanently as part of a building or a structure at a pre-defined and dedicated location; and (iii) can only be replaced by the same specifically designed equipment.”⁶¹
- “Means of transport for persons and goods,” meaning any mobile AC and mobile refrigeration equipment.⁶²
- “Equipment which is specifically designed and installed as part of another type of equipment that is excluded from or does not fall within the scope of this Directive, which can fulfill its function only if it is part of that equipment.”⁶³

As a result of the exclusions above, refrigerated trucks and trailers and mobile air-conditioning are outside the scope of the WEE Directive and larger equipment built to spec, such larger air-conditioning and refrigeration units, might be considered as outside the scope of the WEEE Directive as well.

For products and equipment within the scope of the WEEE Directive, however, such as smaller air-conditioning and refrigeration units that are pre-charged, Member States must implement the “producer responsibility” principle to ensure their collection and treatment, including of the used HFC refrigerants within. The justification provided is as follows:⁶⁴

In order to give maximum effect to the concept of producer responsibility, each producer should be responsible for financing the management of the waste from his own products. The producer should be able to choose to fulfil this obligation either individually or by joining a collective scheme. Each producer should, when placing a product on the market, provide a financial guarantee to prevent costs for the management of WEEE from orphan products from falling on society or the remaining producers. The responsibility for the financing of the management of historical waste should be shared by all existing producers through collective financing schemes to which all producers that exist on the market when the costs occur contribute proportionately. Collective financing schemes should not have the effect of excluding niche and low-volume producers, importers and new entrants. Collective schemes could provide for differentiated fees based on how easily products and the valuable secondary raw materials that they contain could be recycled.

Thus, although the WEEE Directive specifically makes producers responsible for financing the recovery scheme, the WEEE Directive does not prescribe the type of recovery scheme. Member States may elect to impose industry-organized schemes, deposit-and-refund schemes, take-back schemes, among others.

Provisions in the WEEE Directive govern the following aspects of producer responsibility schemes:

- **Minimum Annual Collection Rates and Recovery Targets:** Article 7 sets out minimum annual collection rates for non-separated waste that must be achieved, expressed as a percentage of the average weight of that type of electronic and electrical equipment placed on the market the three preceding years, starting at 45% for the 2016-2019 period then increasing to 65% from 2019 onward. Article 11 sets out minimum targets for separated waste that must be achieved, expressed as a percentage of the average electronic and electrical equipment entering the facilities.
- **Proper Treatment:** Article 8 requires that producers (or third parties acting on their behalf) use the best available techniques and comply with certain technical requirements.
- **Financing:** Articles 12 and 13 require producers to finance the costs of collection, treatment, recovery and disposal.

ANNEX III

EXTENDED PRODUCER RESPONSIBILITY IN THE WASTE FRAMEWORK DIRECTIVE

The WFD extends responsibility for waste management to the producers in Article 8, and outlines elements of waste management in Articles 14 and 15:

Article 8 Extended Producer Responsibility

1. In order to strengthen the re-use and the prevention, recycling and other recovery of waste, Member States may take legislative or non-legislative measures to ensure that any natural or legal person who professionally develops, manufactures, processes, treats, sells or imports products (producer of the product) has extended producer responsibility.

Such measures may include an acceptance of returned products and of the waste that remains after those products have been used, as well as the subsequent management of the waste and financial responsibility for such activities. These measures may include the obligation to provide publicly available information as to the extent to which the product is re-usable and recyclable.

2. Member States may take appropriate measures to encourage the design of products in order to reduce their environmental impacts and the generation of waste in the course of the production and subsequent use of products, and in order to ensure that the recovery and disposal of products that have become waste take place in accordance with Articles 4 and 13.

Such measures may encourage, *inter alia*, the development, production and marketing of products that are suitable for multiple use, that are technically durable and that are, after having become waste, suitable for proper and safe recovery and environmentally compatible disposal.

3. When applying extended producer responsibility, Member States shall take into account the technical feasibility and economic viability and the overall environmental, human health and social impacts, respecting the need to ensure the proper functioning of the internal market.
4. The extended producer responsibility shall be applied without prejudice to the responsibility for waste management as provided for in Article 15(1) and without prejudice to existing waste stream specific and product specific legislation.

Article 14 Costs

1. In accordance with the polluter-pays principle, the costs of waste management shall be borne by the original waste producer or by the current or previous waste holders.
2. Member States may decide that the costs of waste management are to be borne partly or wholly by the producer of the product from which the waste came and that the distributors of such product may share these costs.

Article 15
Responsibility for Waste Management

1. Member States shall take the necessary measures to ensure that any original waste producer or other holder carries out the treatment of waste himself or has the treatment handled by a dealer or an establishment or undertaking which carries out waste treatment operations or arranged by a private or public waste collector in accordance with Articles 4 and 13.
2. When the waste is transferred from the original producer or holder to one of the natural or legal persons referred to in paragraph 1 for preliminary treatment, the responsibility for carrying out a complete recovery or disposal operation shall not be discharged as a general rule.

Without prejudice to Regulation (EC) No 1013/2006, Member States may specify the conditions of responsibility and decide in which cases the original producer is to retain responsibility for the whole treatment chain or in which cases the responsibility of the producer and the holder can be shared or delegated among the actors of the treatment chain.

3. Member States may decide, in accordance with Article 8, that the responsibility for arranging waste management is to be borne partly or wholly by the producer of the product from which the waste came and that distributors of such product may share this responsibility.
4. Member States shall take the necessary measures to ensure that, within their territory, the establishments or undertakings which collect or transport waste on a professional basis deliver the waste collected and transported to appropriate treatment installations respecting the provisions of Article 13.

The Commission recently proposed amendments to the WFD that includes, among other things, a series of targets aimed at promoting the recycling of waste.⁶⁵

Annex IV

RECOVERY MEASURES IN THE EU F-GAS REGULATION

The EU F-Gas Regulation sets out the legal obligation on operators to recover HFCs and other gases:

Article 8

Recovery

1. Operators of stationary equipment or of refrigeration units of refrigerated trucks and trailers that contain fluorinated greenhouse gases not contained in foams shall ensure that the recovery of those gases is carried out by natural persons that hold the relevant certificates provided for by Article 10, so that those gases are recycled, reclaimed or destroyed.

This obligation applies to operators of any of the following equipment:

- (a) the cooling circuits of stationary refrigeration, stationary air-conditioning and stationary heat pump equipment;
 - (b) the cooling circuits of refrigeration units of refrigerated trucks and trailers;
 - (c) stationary equipment that contains fluorinated greenhouse gas-based solvents;
 - (d) stationary fire protection equipment;
 - (e) stationary electrical switchgear.
2. The undertaking that uses a fluorinated greenhouse gas container immediately prior to its disposal shall arrange for the recovery of any residual gases to make sure they are recycled, reclaimed or destroyed.
 3. Operators of products and equipment not listed in paragraph 1, including mobile equipment, that contain fluorinated greenhouse gases shall arrange for the recovery of the gases, to the extent that it is technically feasible and does not entail disproportionate costs, by appropriately qualified natural persons, so that they are recycled, reclaimed or destroyed or shall arrange for their destruction without prior recovery.

The recovery of fluorinated greenhouse gases from air-conditioning equipment in road vehicles outside the scope of Directive 2006/40/EC of the European Parliament and of the Council shall be carried out by appropriately qualified natural persons.

For the recovery of fluorinated greenhouse gases from air-conditioning equipment in motor vehicles falling within the scope of Directive 2006/40/EC only natural persons holding at least a training attestation in accordance with Article 10(2) shall be considered appropriately qualified.

Article 8 is similar to Article 4 of Regulation (EC) No 842/2006 (the previous regulation), with the main difference being that operators must now “ensure that the recovery is carried out” or “arrange for the recovery of the gases” rather than be “responsible for putting in place arrangements.” When reviewing Article 4 of Regulation (EC) No 846/2006, the *Preparatory Study* found “only little evidence... for the effectiveness of... recovery measures.”⁶⁶

ANNEX V

FRANCE – DELIVERY, COLLECTION AND RECOVERY OF HFC REFRIGERANTS

From 1993 to 2007, France operated a deposit-and-refund scheme based on a voluntary industry agreement called the Convention of 1993.⁶⁷ Since 2007, following adoption of the previous version of the EU F-Gas Regulation, France has implemented a legally binding “take-back” scheme. The scheme relied heavily on its well-developed network of distributors to collect, store and deliver used HFC refrigerants to reclamation and destruction facilities. Following the passage of the new EU F-Gas Regulation, it was amended in 2015 to require that used HFC refrigerants be taken back at no cost although distributors are allowed to place an upfront levy on the sale of virgin or reclaimed HFC refrigerants to recover costs associated with waste management at end-of-life.

The main elements of the latest French “take-back” scheme can be summarized as follows:

- **Recovery Obligation on the Operator.** Article 8 of the EU F-Gas Regulation places the obligation on operators to ensure or arrange for the recovery of used HFC refrigerants by certified personnel or other appropriately qualified persons (i.e. contractors).
- **Drop-Off Obligation on Contractor.** Article 3(1) of the EU F-Gas Regulation prohibits contractors from intentionally releasing used HFC refrigerants into the atmosphere, thus requiring them to deliver the used HFC refrigerant that cannot be recycled onsite to a responsible third party.⁶⁸
- **“Take-Back” Obligation on Distributors.** Distributors must make available to contractors containers to ensure recovery of used HFC refrigerants, and take back quantities up to the overall tonnage of HFC refrigerants distributed the previous year at no cost, although distributors are allowed to levy a fee upfront during the sale of reclaimed or virgin HFC refrigerants to cover the costs associated with end-of-life management.⁶⁹ The take-back obligation does not apply to used HFC refrigerants recovered during the dismantling of vehicles operated under the MAC Directive or WEEE Directive.⁷⁰

The French system relies heavily upon its well-established network of distributors and diffuse points of sale to promote waste management, in effect a national distributor responsibility scheme. Producers have no formal obligations during the waste-management cycle of used HFC refrigerants in France.

ANNEX VI

GERMANY – FEDERAL ORDINANCE ON CHEMICAL CLIMATE PROTECTION

Since 2009, Germany has implemented a legally binding take-back scheme that, coupled with its general rule for producer responsibility and specific obligations on record keeping, constitutes its approach to waste management of used HFC refrigerants.⁷¹

The main elements of the German take-back scheme are as follows:

- **Recovery Obligation on the Operator.** Article 8 of the EU F-Gas Regulation places the obligation on operators to ensure or arrange for the recovery of used HFC refrigerants by certified personnel or other appropriately qualified persons (i.e. contractors).
- **Drop-Off Obligation on Contractor.** Article 3(1) of the EU F-Gas Regulation prohibits contractors from intentionally releasing used HFC refrigerants into the atmosphere, thus requiring them to deliver the used HFC refrigerant to a responsible third party.
- **“Take-Back” Obligation on Distributors and Producers.** Under Section 4 of the German Federal Ordinance on Chemical Climate Protection, producers and distributors “are obligated to take back [HFC refrigerants] after use or ensure they are taken back by third parties,”⁷² thus providing contractors a responsible third party to drop off the used HFC refrigerants in their possession. Distributors and producers are allowed to charge for taking back the used HFC refrigerants, and observers have identified as the fee to be paid by operators as limiting their efforts to return used HFC refrigerants for reclamation and destruction.⁷³
- **General Obligation to Ensure Environmentally Sound Disposal.** Under Section 23 of the German Lifecycle Management Act, producers and distributors (i.e. distributors) are under a general obligation to ensure the “environmentally sound disposal” of used HFC refrigerants.

Germany relies heavily on the take-back obligation, which is complimented by provisions in the EU F-Gas Regulation establishing the drop-off obligation on operators. Although producers are obligated to take-back used HFC refrigerants, that they may charge undermines the effectiveness of this obligation.

ANNEX VII

DENMARK – DANISH REFRIGERANT INSTALLERS ENVIRONMENTAL SCHEME (KMO)

Since 1992, Denmark has established a voluntary deposit-refund scheme to manage used HFC refrigerants at end-of-life, known as the Danish Refrigerant Installers Environmental Scheme (KMO). The main elements of KMO are as follows:⁷⁴

- **Membership.** Only contractors that are members of KMO may purchase virgin HFC refrigerants from producers.
- **Fee on Operators.** Operators pay a fee for HFC refrigerants charged into their equipment with a certain portion remaining with the contractor to cover expenses related to training and recovery and another portion remaining with KMO to fund the secretariat, infrastructure for reclamation and destruction, and refund to contractors for delivery of the used HFC refrigerants.
- **Refund to Contractors.** Contractors receive a refund upon the delivery of used HFC refrigerants to reclamation and destruction facilities operated by KMO. The amount of the refund depends on the purity of the used HFC refrigerant.
- **Reclamation and Destruction.** KMO undertakes reclamation and destruction of used HFC refrigerants. Reclaimed HFC refrigerants are sold to contractors at reduced costs, with moneys earned contributing to KMO.

Preliminary data on KMO indicates a stable share of used HFC and other synthetic refrigerants are delivered to KMO for reclamation and destruction compared to sales.⁷⁵ In effect, KMO is a voluntary collective that is complemented by the recent amendments to the EU F-Gas Regulation establishing a drop-off obligation on contractors.

ANNEX VIII

AUSTRALIA – REFRIGERANT RECLAIM AUSTRALIA

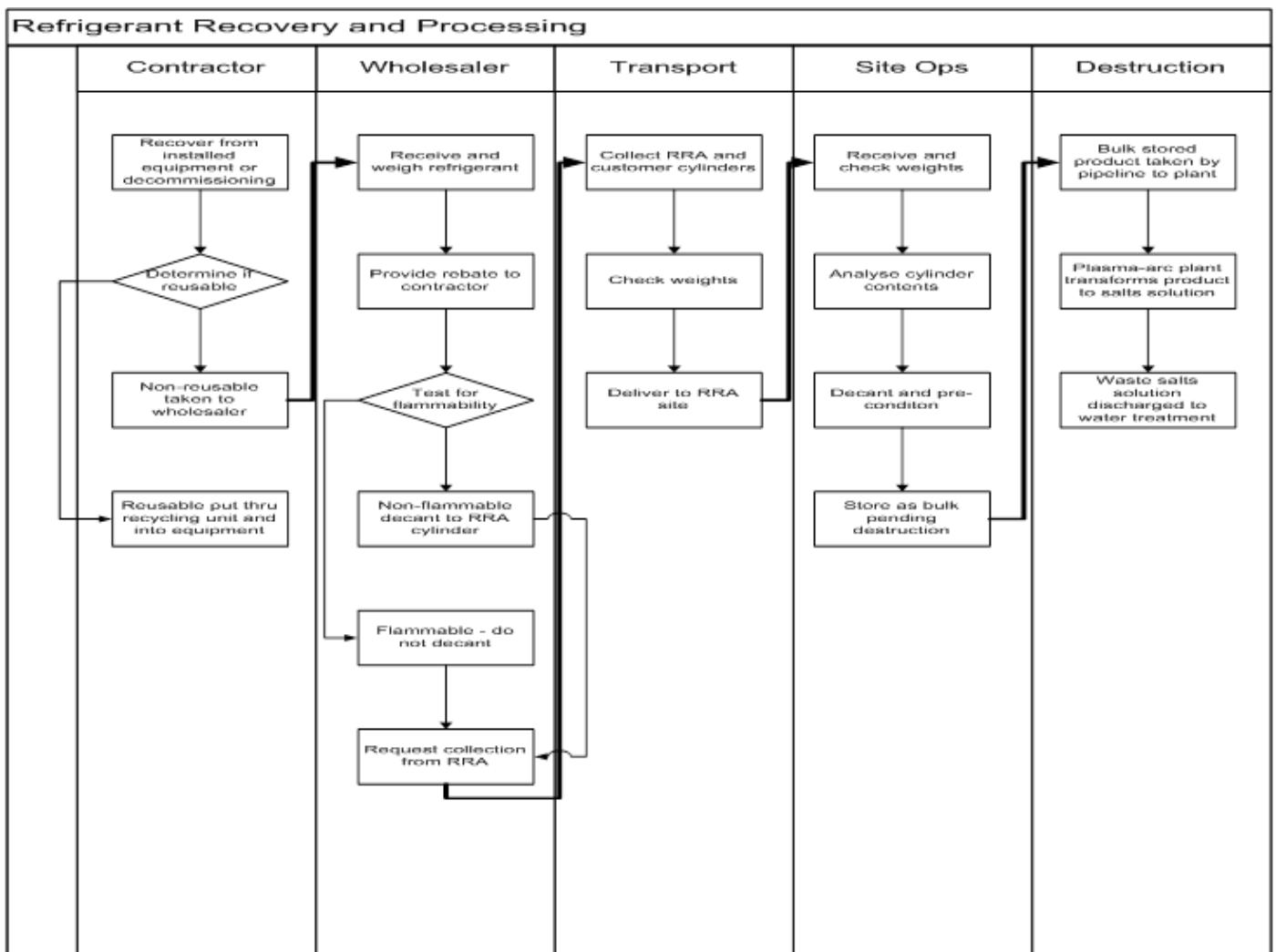
Refrigerant Reclaim Australia (RRA) is non-profit Trust-based organization undertaking recovery in Australia and Indonesia. RRA is funded by an industry levy on sales of synthetic refrigerants, and is governed by a Board of Directors that is comprised of associations representing importers, distributors, contractors and end-users.⁷⁶

Funding

Each kilogram of synthetic refrigerant imported and sold in Australia, whether as bulk or in pre-charged equipment, is subject to a levy of AU\$2 per kilogram.⁷⁷ All funds are held in Trust, and can only be expended on the purposes of the Trust, namely recovery, reclamation and destruction of synthetic refrigerants.⁷⁸ Excess funds are invested to pay for recovery and destruction well into the future (2030 and beyond).⁷⁹

Refrigerant Recovery and Processing

In coordination with contractors and distributors, RRA plays an active role in recovery and processing, as can be seen in the following diagram:



RRA is a fairly comprehensive scheme benefiting from the active played by RRA in waste management.

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- ¹ See e.g. ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010); Air-Conditioning, Heating, & Refrigeration Institute (AHRI), *AHRI Project 8018 Final Report: Review of Refrigerant Management Programs* (January 2016); ICF International, *Analysis on the Recovery of Fluorinated Greenhouse Gases in EU-27 in the Period 2004-2007 and Determination of Options for Further Progress* (October 2008).
- ² Directive 2008/98/EC, Article 3(1); see also Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on Shipments of Waste.
- ³ See Regulation (EU) No 517/2014, Articles 3(4), 8 and 10(1).
- ⁴ ICF International, *Analysis on the Recovery of Fluorinated Greenhouse Gases in EU-27 in the Period 2004-2007 and Determination of Options for Further Progress* (October 2008), p. 13 (prepared for the European Commission).
- ⁵ Regulation (EU) No 517/2014, Article 2(14).
- ⁶ Regulation (EU) no. 517/2014, Article 2(15).
- ⁷ Regulation (EU) No 517/2014, Article 2(16).
- ⁸ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 35.
- ⁹ Regulation (EU) No 517/2014, Article 2(17).
- ¹⁰ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 32.
- ¹¹ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 33.
- ¹² ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 31.
- ¹³ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. xiii and Appendix D-1; ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), pp. 28-31 and Appendix C-1
- ¹⁴ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 33.
- ¹⁵ ICF International, *Analysis on the Recovery of Fluorinated Greenhouse Gases in EU-27 in the Period 2004-2007 and Determination of Options for Further Progress* (October 2008), p. 13.
- ¹⁶ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. xiv.
- ¹⁷ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), pp. 54-55.
- ¹⁸ Gluckman Consulting, *Topic B: Barriers to the Uptake of Low GWP Alternatives to HFCs Related to Lack of Training: Preliminary Findings of External Study Carried Out for DG CLIMA* (Presentation at Consultation Forum, 10 September 2015), Slide 6.
- ¹⁹ Directive 2012/19/EU, Article 8(2) and Annex VII(1)(hydrofluorocarbons are listed as one of the substances subject to selective treatment).
- ²⁰ Regulation (EU) No 517/2014, Article 2(14).
- ²¹ Regulation (EU) No 517/2014, Article 3(1).
- ²² Directive 2008/98/EC, Article 3(1).
- ²³ See Directive 2008/98/EC, Recital 27, Articles 8 and 15.
- ²⁴ See European Commission, Directorate-General for Environment, *Circular Economy Strategy: Closing the Loop – An EU Strategy for the Circular Economy*, available at http://ec.europa.eu/environment/circular-economy/index_en.htm (last visited 8 March 2016).

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- ²⁵ European Commission, *Proposal for a Directive of the European Parliament and of the Council Amending Directive 2008/98/EC on Waste*, COM(2015) 595 Final (2 December 2015), Recital 9.
- ²⁶ European Commission, *Proposal for a Directive of the European Parliament and of the Council Amending Directive 2008/98/EC on Waste*, COM(2015) 595 Final (2 December 2015), Article 1(8)(first paragraph in new Article 8a).
- ²⁷ European Commission, *Proposal for a Directive of the European Parliament and of the Council Amending Directive 2008/98/EC on Waste*, COM(2015) 595 Final (2 December 2015), Article 1(8)(fourth paragraph in new Article 8a).
- ²⁸ European Commission, *Proposal for a Directive of the European Parliament and of the Council Amending Directive 2008/98/EC on Waste*, COM(2015) 595 Final (2 December 2015), Article 1(8)(third paragraph in new Article 8a).
- ²⁹ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 54.
- ³⁰ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. xiv.
- ³¹ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), pp. 54-55.
- ³² ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 55.
- ³³ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), pp. 54-55.
- ³⁴ Technology and Economic Assessment Panel, Task Force Decision XX/7 – Interim Report: Environmentally Sound Management of Banks of Ozone-Depleting Substances” (June 2009); see also ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 54.
- ³⁵ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), pp. 54-55 (citing personal communication with A-Gas UK).
- ³⁶ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 31.
- ³⁷ Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on Shipments of Waste, Annex V.
- ³⁸ Compare Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on Shipments of Waste, Article 2(2) with Council Directive 91/689/EEC of 12 December 1991 on hazardous waste, Annex II(C20).
- ³⁹ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), pp. 54-55.
- ⁴⁰ *Impact Assessment*, pp. 103 and 110.
- ⁴¹ SKM Enviro, *Further Assessment of Policy Options for the Management and Destruction of Banks of ODS and F-Gases in the EU* (Revised Version 2, March 2012), p. 34.
- ⁴² Committee on the Environment, Public Health and Food Safety, Report on the Proposal for a Regulation of the European Parliament and of the Council on Fluorinated Greenhouse Gases (27 June 2013), (COM(2012)0643 – C7-0370/2012 – 2012/0305(COD)), Amendment 54.
- ⁴³ Committee on the Environment, Public Health and Food Safety, Report on the Proposal for a Regulation of the European Parliament and of the Council on Fluorinated Greenhouse Gases (27 June 2013), (COM(2012)0643 – C7-0370/2012 – 2012/0305(COD)), Amendment 54.
- ⁴⁴ European Commission, *Decision of the Secretary General pursuant to Article 4 of the Implementing Rules to Regulation (EC) No 1049/2001*, Ref. Ares(2015)1383239 (30 March 2015), p. 2.
- ⁴⁵ See RAC, Price increase of 20% on Forane HFC products in Europe (28 November 2014), available at <http://www.racplus.com/news/price-increase-of-20-on-forane-hfc-products-in-europe/8673300.article>.
- ⁴⁶ See Refrigeration and Air Conditioning Magazine (RAC), *Mexichem Announces 10-15 Per Cent Rise in Cost of HFC refrigerants from January* (13 November 2015), available at <http://www.racplus.com/news/mexichem-announces-10-15-per-cent-rise-in-cost-of-hfc-refrigerants-from-january/8692058.article?blocktitle=Most-popular&contentID=-1;>

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- Refrigeration and Air Conditioning Magazine (RAC), *Chemours Announces 15% Price Increase for R404A* (29 October 2015), available at <http://www.racplus.com/news/chemours-announces-15-price-increase-for-r404a/8691221.article>; Refrigeration and Air Conditioning Magazine (RAC), *Price Increase of 20% on Forane HFC products in Europe* (28 November 2014), available at <http://www.racplus.com/news/price-increase-of-20-on-forane-hfc-products-in-europe/8673300.article>.
- ⁴⁷ Umweltbundesamt (Federal German Environment Agency), *Maßnahmen zur Verbesserung der Marktdurchdringung klimafreundlicher Technologien ohne halogenierte Stoffe vor dem Hintergrund der Revision der Verordnung (EG) Nr. 842/2006* (May 2015), p. 111 (underlying data provided).
- ⁴⁸ Environmental Investigation Agency (EIA), *EU F-Gas Regulation Handbook: Keeping Ahead of the Curve as Europe Phases Down HFCs* (September 2015), pp. 8-10.
- ⁴⁹ Compare Umweltbundesamt (Federal German Environment Agency), *Maßnahmen zur Verbesserung der Marktdurchdringung klimafreundlicher Technologien ohne halogenierte Stoffe vor dem Hintergrund der Revision der Verordnung (EG) Nr. 842/2006* (May 2015) with Refrigeration and Air Conditioning Magazine (RAC), *Mexichem Announces 10-15 Per Cent Rise in Cost of HFC refrigerants from January* (13 November 2015), available at <http://www.racplus.com/news/mexichem-announces-10-15-per-cent-rise-in-cost-of-hfc-refrigerants-from-january/8692058.article?blocktitle=Most-popular&contentID=-1>; Refrigeration and Air Conditioning Magazine (RAC), *Chemours Announces 15% Price Increase for R404A* (29 October 2015), available at <http://www.racplus.com/news/chemours-announces-15-price-increase-for-r404a/8691221.article>; Refrigeration and Air Conditioning Magazine (RAC), *Price Increase of 20% on Forane HFC products in Europe* (28 November 2014), available at <http://www.racplus.com/news/price-increase-of-20-on-forane-hfc-products-in-europe/8673300.article>.
- ⁵⁰ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. xvii.
- ⁵¹ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. xvii.
- ⁵² Environmental Investigation Agency (EIA), *EU F-Gas Regulation Handbook: Keeping Ahead of the Curve as Europe Phases Down HFCs* (September 2015), pp. 6-10.
- ⁵³ Environmental Investigation Agency (EIA), *EU F-Gas Regulation Handbook: Keeping Ahead of the Curve as Europe Phases Down HFCs* (September 2015), pp. 6-10.
- ⁵⁴ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. 54.
- ⁵⁵ See e.g. Directive 2006/66/EC, Article 8.
- ⁵⁶ ICF International, *Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of Ozone Depleting Substances (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment* (May 2010), p. E-1; see also TEAP (2009b).
- ⁵⁷ Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment.
- ⁵⁸ Directive 2012/19/EU (recast), Article 2(1)(a)-(b).
- ⁵⁹ Directive 2012/19/EU, Article 8(2)(referencing Annex VII where HFC chemicals are listed).
- ⁶⁰ Directive 2012/19/EU, Article 8(2) and Annex VII(1)(hydrofluorocarbons are listed as one of the substances subject to selective treatment).
- ⁶¹ Directive 2012/19/EU, Article 3(1)(c).
- ⁶² Directive 2012/19/EU, Article 2(4)(c), (e).
- ⁶³ See Directive 2012/19/EU, Article 2(3).
- ⁶⁴ Directive 2012/19/EU, Articles 7 and 12-13.
- ⁶⁵ See European Commission, *Proposal for a Directive of the European Parliament and of the Council Amending Directive 2008/98/EC on Waste*, COM(2015) 595 Final (2 December 2015).
- ⁶⁶ Öko-Recherche et al., *Preparatory Study for a Review of Regulation (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, Final Report* (September 2011), Executive Summary, p. VIII.
- ⁶⁷ See France, Code de l'Environnement, Partie Réglementaire, Livre V, Titre IV, Chapitre III, Section 6, Sous-Section 3, Article R543-91 to R543-95.
- ⁶⁸ See also France, Code de l'Environnement, Partie Réglementaire, Livre V, Titre IV, Chapitre III, Section 6, Sous-Section 3, Article R543-93.

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- ⁶⁹ France, Code de l'Environnement, Partie Réglementaire, Livre V, Titre IV, Chapitre III, Section 6, Sous-Section 3, Articles R543-91 and R543-94.
- ⁷⁰ France, Code de l'Environnement, Partie Réglementaire, Livre V, Titre IV, Chapitre III, Section 6, Sous-Section 3, Article R543-91.
- ⁷¹ Öko-Recherche et al., *Preparatory Study for a Review of Regulation (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, Final Report* (September 2011), pp. 50 and 258.
- ⁷² German Federal Ordinance on Chemical Climate Protection, Section 4; see also Öko-Recherche et al., *Preparatory Study for a Review of Regulation (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, Final Report* (September 2011), p. 50.
- ⁷³ Öko-Recherche et al., *Preparatory Study for a Review of Regulation (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, Final Report* (September 2011), p. 258.
- ⁷⁴ Öko-Recherche et al., *Preparatory Study for a Review of Regulation (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, Final Report* (September 2011), p. 52.
- ⁷⁵ Öko-Recherche et al., *Preparatory Study for a Review of Regulation (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, Final Report* (September 2011), p. 52.
- ⁷⁶ Michael Bennett, *Refrigerant Reclaim Australia: Product Stewardship Workshop* (Jakarta, August 2013), Slides 4-6.
- ⁷⁷ Michael Bennett, *Refrigerant Reclaim Australia: Product Stewardship Workshop* (Jakarta, August 2013), Slide 8.
- ⁷⁸ Michael Bennett, *Refrigerant Reclaim Australia: Product Stewardship Workshop* (Jakarta, August 2013), Slide 8.
- ⁷⁹ Michael Bennett, *Refrigerant Reclaim Australia: Product Stewardship Workshop* (Jakarta, August 2013), Slide 8.