METHODOLOGY FOR THE QUANTIFICATION, MONITORING, REPORTING, AND VERIFICATION OF GREENHOUSE GAS EMISSIONS REDUCTIONS AND REMOVALS FROM

CERTIFIED RECLAIMED HFC REFRIGERANTS, PROPELLANTS, AND FIRE SUPPRESSANTS

VERSION 2.0

April 2022

ACR
AT WINROCK INTERNATIONAL

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ABOUT ACR[SM]

ACR is a leading global carbon crediting program operating in regulated and voluntary carbon markets. Founded in 1996 as the first private voluntary greenhouse gas (GHG) registry in the world, ACR creates confidence in the integrity of carbon markets to catalyze transformational climate results. ACR ensures carbon credit quality through the development of environmentally rigorous, science-based standards and methodologies as well as oversight of carbon offset project verification, registration, and credit issuance and retirement reporting through its transparent registry system. ACR is governed by Environmental Resources Trust LLC, a wholly-owned nonprofit subsidiary of Winrock International.

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Acronyms and Definitions

If not explicitly defined here, the current definitions in the latest version of the ACR Standard apply.

TERM	ACRONYM (if applicable)	DEFINITION
Aerosol Product		A product pressurized by a propellant that expels its contents from a canister through a nozzle. Propellants include compressed gases and liquefied gases. Liquefied gases include HFCs, including HFC-134a, which can be recovered and reclaimed for re-use as a refrigerant, at which point it is considered a reclaimed HFC refrigerant.
Certified reclaimed HFC refrigerant		Used (recovered) HFC that has been reclaimed to meet or exceed the latest Air Conditioning, Heating, and Refrigeration Institute 700 Standard for Specifications for Fluorocarbon Refrigerants[1] (i.e., AHRI Standard 700-2016 as of the date of this document) by an EPA-certified reclaimer (or equivalent in case of Canada and Mexico), and tested by an AHRI-certified refrigerant testing laboratory to meet the AHRI Standard, a laboratory accredited to ISO/IEC 17025, or a laboratory licensed and regulated by the federal government, and using the AHRI

[1] Air Conditioning, Heating, and Refrigeration Institute (AHRI) 700-2016 Standard for *Specifications for Fluorocarbon Refrigerants.* www.ahrinet.org

TERM	ACRONYM (if applicable)	DEFINITION
		Standard 700 —Specifications for Refrigerants (AHRI 700).
Chlorofluorocarbon	CFC	A class of compounds of carbon, chlorine, and fluorine that are commonly used as refrigerants.
GHG Source, Sink, or Reservoir	SSR	• **GHG SOURCE** Physical unit or process that releases a GHG into the atmosphere. • **GHG SINK** Physical unit or process that removes a GHG from the atmosphere. • **GHG RESERVOIR** Physical unit or component of the biosphere, geosphere or hydrosphere with the capability to store or accumulate a GHG removed from the atmosphere by a GHG sink or captured from a GHG source.
Hydrochlorofluorocarbon	HCFC	A class of compounds of carbon, hydrogen, chlorine, and fluorine that are commonly used as refrigerants.
Hydrofluorocarbon	HFC	A class of compounds that contain carbon, fluorine, and hydrogen that are commonly used as refrigerants, as well as solvents, aerosol propellants, fire suppressants, and foam blowing agents.
HFC Refrigerant, propellant, fire suppressant		Refrigerant, propellant, or fire suppressant comprised of either a mix of hydrofluorocarbons (HFCs) referred to as an “HFC blend”, or a single HFC.

TERM	ACRONYM (if applicable)	DEFINITION
Project activity		• The reclamation and use of certified reclaimed HFC refrigerants, propellants, or fire suppressants to service existing refrigeration, air conditioning, aerosols (propellant), or fire suppression equipment, or • The reclamation and use of certified reclaimed HFC refrigerants, propellants, or fire suppressants in newly manufactured refrigeration, air conditioning, aerosols (propellant), or fire suppression equipment
Refrigeration or air conditioning equipment		An Appliance[2], or component parts of a system, that uses refrigerant to provide cooling under controlled conditions.
Use of certified reclaimed HFC refrigerant, propellant, and fire suppressant		Production by the reclaimer, plus transfer/return/sale of certified reclaimed HFC refrigerant, propellant, or fire suppressant to refrigerant, propellant, or fire suppressant distributors, wholesalers, original equipment manufacturers, service technicians, or end-users who are in the business of selling or using HFC refrigerant, propellant, or fire suppressant for use in refrigeration, air conditioning, aerosols (propellant), or fire suppression equipment.

[2] Per 40 CFR §82.3, an "Appliance" is defined as "any device which contains and uses a refrigerant, and which is used for household or commercial purposes, including, without limitation, any air conditioner, refrigerator, chiller, or freezer."

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1 Background and Applicability

1.1 Summary Description of the Methodology

Modern society depends upon refrigeration to process, store, and transport food, as well as on air conditioning in the built environment and motor vehicles. Reliable, environmentally safe, and cost-effective cooling is also critical for other commercial and industrial processes, such as in pharmaceutical and chemical production, oil refining, aerospace and defense technologies, data servers, and ice rinks. These diverse applications typically rely on refrigerants, the chemical coolants that can reach low temperatures and transfer heat by undergoing a phase change between liquid and gas (through condensation). Similar chemicals are also used as propellants and fire suppressants.

Up until the mid-1990s, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) were in widespread use as refrigerants. CFCs significantly deplete the Earth's protective ozone layer and are also powerful greenhouse gases (GHGs), and HCFCs also contribute to stratospheric ozone depletion and climate change, although to a lesser extent than CFCs. Under the Montreal Protocol and United States Clean Air Act (CAA), all CFC and nearly all HCFC production ended in the United States in 1996[3] and 2021, respectively. Similarly, Canada and Mexico have also ended CFC production and consumption and are set to phase out HCFCs completely by 2030 and 2040 respectively. Having ratified Kigali amendments to Montreal protocol, Canada is on the path to reduce production and consumption of HFC below 85% of baseline consumption by year 2036 and Mexico by 80% of baseline consumption by year 2045.

As a result of the scheduled production and consumption phase-out of CFCs and HCFCs, hydrofluorocarbons (HFCs), because they do not damage the ozone layer, were intentionally developed as replacement refrigerants for ozone-depleting substances (ODS), including CFCs and HCFCs. Although they have an ozone depletion potential (ODPs) of zero (0), HFCs have global warming potentials (GWPs) that can be hundreds to thousands of times greater than carbon dioxide (CO_2). Due to the

[3] After 1996, the Montreal Protocol authorized limited production of CFCs for "essential uses" as propellants in medical devices (metered dose inhalers relied upon by asthmatics) and for laboratory and analytical uses. Production for essential medical uses ended in the U.S. on January 1, 2012. The exemption for de minimis CFC production essential laboratory and analytical uses remains in effect.

worldwide phaseout of ODS and ever-increasing global demand for refrigeration and air-conditioning, HFCs have today become the most commonly used refrigerants globally.

1.1.1 USE OF CERTIFIED RECLAIMED HFC REFRIGERANTS, PROPELLANTS, AND FIRE SUPPRESSANTS

Across the various refrigeration, air conditioning, aerosol (propellants) and fire suppression applications, there are a number of approaches that can be used to reduce releases of HFCs (and, thereby, reduce GHG emissions) from both new and installed equipment, including but not limited to the following:

- Monitoring and timely leak repair for systems that are inherently prone to leaks;
- Proper training and practices by professional engineers and contractors that install and service equipment; and,
- Management practices throughout the lifecycle, from production, distribution, recovery, reclamation, and end-of-life disposal.

Another opportunity to mitigate emissions is by filling refrigeration, air conditioning, aerosol (propellant), and fire suppression equipment with reclaimed HFC refrigerants and compounds. Typically, virgin (newly produced, never previously used) HFC is used to "charge" equipment when they are manufactured and installed, and when the systems leak during normal operations. Re-using previously used HFCs that have been recovered,[4] and reclaimed[5] to virgin-grade refrigerant purity, either to "recharge" existing equipment that require servicing, or in newly manufactured equipment, displaces new production of virgin HFC that would otherwise be manufactured to meet that demand.

This Methodology focuses only on HFCs, and does not address CFCs or HCFCs, which have been phased out of virgin production and/or consumption.

[4] Refrigerant that is recovered from refrigeration or air conditioning equipment is removed/extracted by a certified technician using certified recovery equipment from appliances during servicing or at end-of-life. HFCs can also be recovered from other sources including discarded aerosol cans and reclaimed for re-use as refrigerant.

[5] See reclaimed refrigerant definition on page 5.

Table 1: Eligible Sectors and Segments

PROJECT ACTIVITY	ELIGIBLE SECTOR	ELIGIBLE SEGMENTS IN SECTOR
Use of Certified Reclaimed HFC Refrigerants, Propellants, and Fire Suppressants	Domestic Refrigeration	Residential refrigerators and freezers
	Commercial Refrigeration, also known as Retail Food Refrigeration	Equipment used to store and display chilled and frozen goods for commercial sale such as in supermarkets, convenience stores, bakeries, and restaurants. This equipment includes centralized supermarket systems, remote condensing units, and stand-alone equipment (e.g., beverage vending machines, stand-alone display cases).
	Cold Storage Warehouses	Storage for meat, produce, dairy products, and other perishable goods.
	Industrial Process Refrigeration	Chemical, pharmaceutical, petrochemical, and manufacturing industries, industrial ice machines and ice rinks.
	Transport Refrigeration	Refrigerated truck trailers, railway freight cars, ship holds, and other shipping containers.
	Mobile Air Conditioning	Automobiles, trucks, buses, and other motor vehicles.
	Stationary Air Conditioning	Comfort cooling for homes and commercial buildings, including multi-family buildings, office buildings, hospitals, universities, shopping malls, airports, sports arenas.
	Aerosols (Propellants)	Medical aerosol devices, consumer aerosol devices, technical aerosol devices
	Fire Suppression	Flooding agents, streaming agents

This Methodology provides the quantification framework for the creation of carbon offset credits from the reductions in GHG emissions resulting from the use of certified reclaimed HFCs. The Methodology is intended to be used as an incentive within the relevant industries to increase these activities.

1.2 Applicability Conditions

Projects that avoid the emissions of HFCs in the following activities are considered an "Eligible Project Activity":

- The reclamation and use of certified reclaimed HFC refrigerants, propellants, or fire suppressants to service existing refrigeration, air conditioning, aerosol (propellant), and fire suppression equipment, and
- The reclamation and use of certified reclaimed HFC refrigerants, propellants, or fire suppressants in newly manufactured refrigeration, air conditioning, aerosol (propellant), and fire suppression equipment.

For purposes of this Methodology, "reclamation and use" of certified reclaimed HFC refrigerant, propellant, or fire suppressant refers specifically to the production of such HFC material (by a certified reclaimer) and the subsequent sale, title transfer or return to a distributor, wholesaler, or an end-user (either through direct sale, title transfer or return to an end user or through installation conducted via service technician) for use in refrigeration, air conditioning, aerosol (propellant), and fire suppression equipment.

In addition to satisfying the latest ACR program eligibility requirements as found in the ACR Standard, project activities must satisfy the following conditions to be applicable:

I. The project is located in the United States, Canada, or Mexico.
II. The project is within a sector and segment which has a low adoption rate for the relevant project activity ("Eligible Project Activity" & "Eligible Sector/Segment" (see Table 1)).
III. The refrigerant, propellant, or fire suppressant must meet the definition of certified reclaimed HFC refrigerant, propellant, fire suppressant found in this Methodology.

1.3 Reporting Periods

- Projects shall have one reporting period which must not exceed 12 months in length.
- Emission reductions shall be quantified for a period not to exceed 12 months based on the total amount of certified reclaimed HFC produced and the subsequent sale, title transfer or return to a distributor, wholesaler, or an end-user (either through direct sale, title transfer or return to an end user or through installation conducted via service technician) for use in refrigeration, air conditioning, aerosol (propellant), and fire suppression equipment.

- A reporting period begins on the date that the initial volume of certified reclaimed HFC is sold, title transferred, or returned to a distributor, wholesaler, or and end-user (either through direct sale, title transfer or return to an end user or through installation conducted via service technician) for use in in refrigeration, air conditioning, aerosol (propellant), and fire suppression equipment.

1.4 Crediting Periods

A Crediting Period is the finite length of time for which a GHG Project Plan is valid, and during which a project can generate offsets against its baseline scenario. The crediting period for all project activities, except that include fire suppressants, shall be fifteen (15) years and is based on EPA's end-use-specific emission rates[6] which show that most certified reclaimed HFCs will leak completely (or 100%) within 15 years of being charged to an end-use equipment. For projects including fire suppressants, crediting period shall be 40 years. These leaks or emissions happen over the first-fill, servicing, and disposal phases of the end-use equipment. This estimate of crediting period is based on market penetration rates of various HFCs across a distribution of end-use equipment and hence is subject to change over time. ACR will update the crediting period as new data becomes available.

1.5 Periodic Reviews and Revisions

ACR may require revisions to this Methodology to ensure that monitoring, reporting, and verification systems adequately reflect changes in the project's activities. This Methodology may also be periodically updated to reflect regulatory changes, emission factor revisions, or expanded applicability criteria. Before beginning a project, the project proponent should ensure that they are using the latest version of the Methodology.

[6] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019 – Annex 3 Part A (epa.gov) (Section 3.9, Table A-131)

1.6 Emission Reductions from Disposal for 2019 and 2020 Vintage Projects

Previous versions of this methodology (1.0, 1.1 and 1.2) included emissions occurring only during the use phase of the equipment, due to a lack of complete data for emissions occurring at end of life. Version 2.0 of this methodology adds emissions from First-Fill and Disposal at End-of-Life (EOL) of equipment (filled with HFC refrigerants, propellants, or fire suppressants) in the calculations of baseline and project emissions and hence the emission reductions. Version 2.0 also removes use of "emission rate" in the quantification of baseline emissions because data show that 100% of the certified reclaimed HFC refrigerant, propellant, fire suppressant will emit from the equipment (over the three phases—first-fill, servicing, disposal) within the applicable crediting period and hence the "emission rate", if included, would be equal to 1.

Validated ACR projects for vintages 2019 onwards, that used 10-year emission rates (which did not include emissions from First-fill and Disposal) from previous versions of this methodology, are eligible to re-calculate the baseline and project emissions and emission reductions using the quantification equations provided in Version 2.0 of the methodology to capture these avoided emissions.

To claim additional Emission Reduction Tonnes (ERTs) for projects with vintages 2019 onwards, the Project Proponent and/or Validation and Verification Body (VVB) shall submit the following within six (6) months of publication of this methodology.

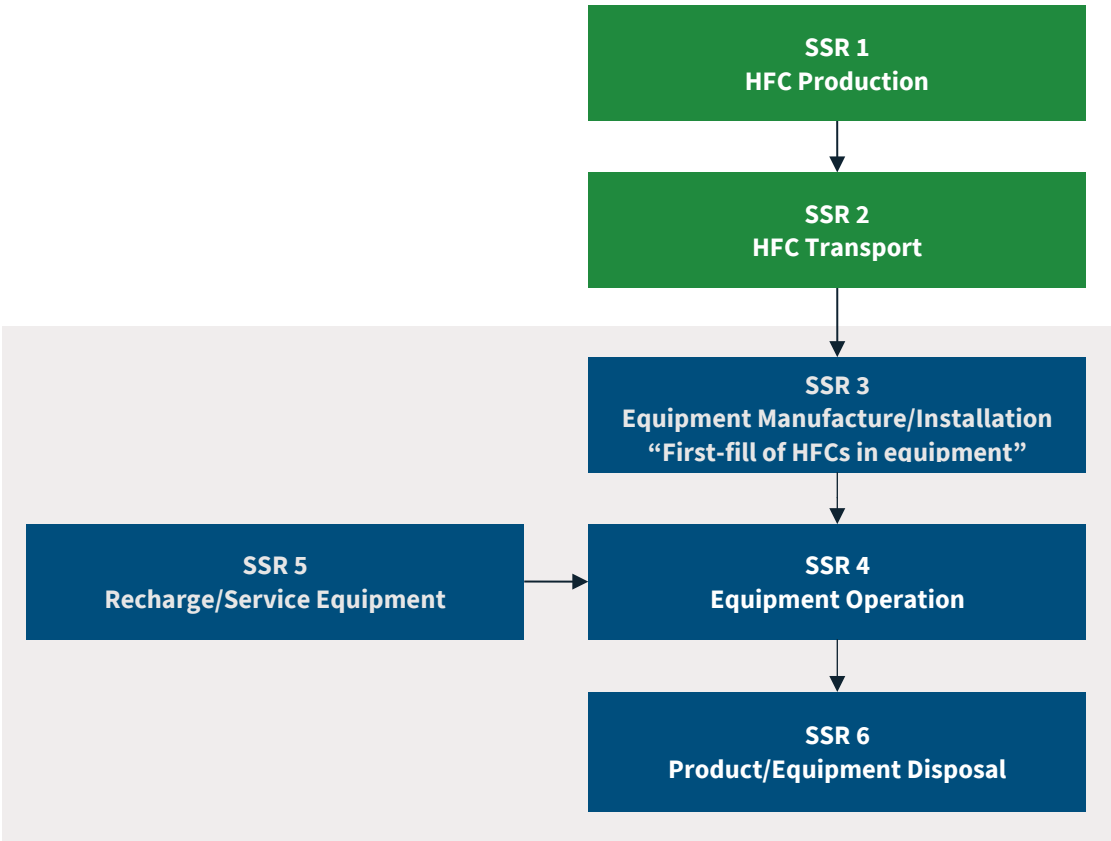
- Updated GHG Project Plan and Monitoring reports showing new equations and calculations.
- Addendum to the original Validation and Verification (VV) Report that shows the new calculated baseline emissions, project emissions, and ERTs. This should also show the outstanding ERTs to be issued (New ERTs – Original ERTs). The addendum shall state that eligibility and all other required checks of the VV audit remain unchanged since the first VV audit.
- Addendum to the original Verification Statement that shows the New ERTs, Original ERTs, and the Outstanding ERTs.

2 Project Boundaries

2.1 Geographic Boundary

For projects using certified reclaimed HFC refrigerant, propellant, or fire suppressant, the project boundary, depicted by the light grey box in Figure 1, is the physical and geographical site where the reclaimed HFC refrigerant, propellant, or fire suppressant is produced in the project by a certified reclaimer, for use in equipment operations and servicing/recharging to replace refrigerant, propellant, or fire suppressant that leaks or to charge newly manufactured refrigeration, air conditioning, aerosol (propellant), and fire suppression equipment.

Figure 1: Project Boundary Diagram for Certified Reclaimed Refrigerant, Propellant and Fire Suppressant



Within the boundaries, the sources of GHG emissions are from the "First-fill" of HFCs during equipment manufacturing or installation, operations of the equipment, including recharging equipment that has leaked, and from disposal of equipment at EOL. Table 2 lists the GHG sources included and excluded depending on whether the sources are within or outside project boundaries.

Table 2: Greenhouse Gases and Sources

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)	QUANTIFICATION METHOD
1 HFC Production	Fossil fuel emissions from the production of HFCs	CO_2	E	N/A
		CH_4	E	N/A
	HFC leaks during HFC production	HFCs	E	N/A
2 HFC Transport	Fossil fuel emissions from transport of HFCs	CO_2	E	N/A
		CH_4	E	N/A
		N_2O	E	N/A
	HFC leaks during transport	HFCs	E	N/A
3 Equipment Manufacture and Installation	Emissions of HFCs during manufacture or installation of equipment or system or product "First-Fill Emissions"	HFCs	I	N/A
4 Equipment Operations	Fossil fuel emissions from the operation of the equipment or system	CO_2	E	N/A
		CH_4	E	N/A
		N_2O	E	N/A

SSR	SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)	QUANTIFICATION METHOD
	HFC leaks from the operation of the equipment or system or product	HFCs	I	Equation 1
5 Service Equipment	Fossil fuel emissions from servicing equipment or system to replace leaked HFC	CO_2	E	N/A
		CH_4	E	N/A
		N_2O	E	N/A
	HFC emissions from servicing equipment or system to replace leaked HFC	HFCs	I	Equation 1
6 Equipment Disposal	Emissions from the disposal of the equipment at end-of-life	HFCs	I	N/A

3 Baseline Determination and Additionality

3.1 Baseline Determination

The baseline for a project activity is determined utilizing industry standards and represents the most commonly used practices and technologies.

Refrigeration and air conditioning (A/C) appliances and other components that comprise a system are "charged" with refrigerant, either at the manufacturing plant, or at the facility where a system is installed (e.g., a supermarket). Under normal operating conditions, depending on the type of equipment and the location, between 1 and 50% of the refrigerant in stationary and mobile air conditioning and refrigeration systems leaks each year (IPCC/TEAP, 2006; IPCC, 2006; RTOC 2010; EPA, 2014; ACR ODS Methodology). Inventory of US greenhouse gas emissions and sinks: 1990-2019 states that HFC emission rates from first-fill can be up to 2%, from servicing and leaks range from 0.5% to 36.4% annually, and from disposal can be as high as 70% depending on the type of end-use[7]. Even with active leak detection and aggressive maintenance efforts, it is difficult to eliminate leaks completely.[8] Consequently, to maintain proper performance, leaky equipment and systems require periodic servicing to replace the lost refrigerant.

HFCs are also used as propellants in aerosols like metered dose inhalers (MDI), consumer aerosols, and technical aerosols. All HFCs used in aerosols are assumed to be emitted in the year of manufacture. HFCs are also used as fire suppressants in both hand-held streaming applications as well as in built-up flooding equipment. Annual leak (emission) rate of HFCs is estimated to be 3.5% for streaming applications and 2.5% for flooding equipment (EPA, 2021).

In the majority of situations, virgin (newly produced, never previously used) HFC is used both to charge newly manufactured equipment and systems, and to "recharge" existing appliances and systems that leak during normal operations.

As an alternative, reclaimed HFC can be used. This is HFC that has been previously used, recovered from other air conditioning or refrigeration equipment, disposed aerosol products (e.g., cleaning, and

[7] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019 – Annex 3 Part A (epa.gov)

[8] Refrigerants can also be released during equipment servicing or when the system is decommissioned.

personal care products, office dusters, safety horns, asthma inhalers), or disposed or end of life fire suppression equipment and processed to remove impurities and restored to virgin-grade quality.[9] Using reclaimed HFC effectively displaces the use—and therefore avoids production and eventual emissions—of virgin HFC. Within the existing reclamation industry, there is capacity to significantly increase reclaimed HFC use (EPA, 2014). Thus, using reclaimed HFC would result in a net GHG reduction.

Reclaimed HFCs comprise a small proportion of the HFCs that are in use today in the United States. Unlike the strong incentive to reclaim CFCs and HCFC-22 that have been phased out, there is currently little incentive for recovery, reclamation, and re-sale of HFCs. This is expected to change in future as HFCs also start being phased down in significant volumes.

Appendix A.1 provides the basis for the rate by which reclaimed HFCs are replacing virgin HFCs in the United States under the baseline scenario in this Methodology.

All HFCs that are placed into commerce—either through sale or through any other method to transfer title—are used. For purposes of this Methodology, it is assumed that from the time that any reclaimed HFC is sold or otherwise transferred from the reclaimer to a distributor, wholesaler, service technician, or an end-user (e.g., equipment manufacturer, supermarket) that HFC will be used.

Emissions that occur during equipment manufacturing or installation or "first-fill", equipment servicing, and leaks, and at the disposal or end-of-life (EOL) are included in this Methodology. Based on EPA data, it is estimated that 100% of the quantity of HFCs charged in refrigeration, and air conditioning equipment and aerosol (propellant) devices will emit within 15 years (crediting period) from the date of charging. All HFCs in fire suppression equipment are estimated to leak within 40 years.

As discussed in Appendix A.1, for purposes of this Methodology, the baseline replacement rate for virgin HFCs (by certified reclaimed HFCs) in the United States is set at 2% based on EPA data[10, 11] and IPCC AR5 GWP values. As new data become available on HFC reclamation, ACR will update this factor.

Table 3 lists the GWPs of the HFCs and HFC blends for both the baseline and project scenario calculations. As additional HFCs become available through United States EPA SNAP listings[12] and market adoption, ACR will update this table.

[9] HFCs recovered from air conditioning or refrigeration equipment, or discarded aerosol and fire suppression products can be restored to virgin grade quality for re-use, whereupon the material becomes defined as "reclaimed HFC".

[10] https://www.epa.gov/ghgreporting/fluorinated-greenhouse-gas-emissions-and-supplies-reported-ghgrp#aim

[11] https://www.epa.gov/sites/default/files/2020-07/documents/2020_reclamation_table.pdf

[12] http://www.epa.gov/spdpublc/snap/refrigerants/lists/index.html

Table 3: GWPs of Predominant HFCs and HFC Blends

	GLOBAL WARMING POTENTIAL (GWP)	
HFC REFRIGERANT	**UP TO 2020 VINTAGES[13]**	**FROM 2021 VINTAGES[14]**
HFC-152a	124	137
HFC-32	675	676
HFC-134a	1,430	1,301
R-407C	1,774	1,624
R-417C	1,820	1,643
R-410A	2,088	1,923
R-407A	2,107	1,923
R-422B	2,525	2,289
R-422D	2,730	2,473
R-422C	3,085	2,794
HFC-125	3,500	3,169
HFC-227ea	3,220	3,348
R-404A	3,922	3,945
R-507A	3,985	3,987
R-508B	13,400	11,710
HFC-23	14,800	12,400

[13] IPCC, Fourth Assessment Report (100 year)

[14] IPCC, Fifth Assessment Report (100 year)

3.2 Additionality Assessment

Emission reductions from the project must be additional or deemed not to occur in the "business-as-usual" scenario. Assessment of the additionality of a project will be made based on passing the two tests cited below. These two tests require the project proponent to demonstrate that the project activity is surplus to regulations and reduces emissions below the level established in the Methodology.

- Regulatory Surplus Test, and
- Practice-Based Performance Standard

3.2.1 REGULATORY SURPLUS TEST

In order to pass the regulatory surplus test, a project must not be mandated by existing laws, regulations, statutes, legal rulings, or other regulatory frameworks in effect as of the project start date that directly or indirectly affect the credited GHG emissions associated with a project. The project proponent must demonstrate that there is no existing regulation that mandates the project or effectively requires the GHG emission reductions associated with using certified reclaimed HFC refrigerant.

The AIM Act, enacted by Congress in December of 2020, directs the U.S. EPA to address the environmental impact of hydrofluorocarbons (HFCs) by phasing down production and consumption, maximizing reclamation and minimizing releases from equipment, and facilitating the transition to next-generation technologies through sector-based restrictions. The EPA issued final rule on September 23, 2021, to phase down U.S. production and consumption of HFCs by 85% over the next 15 years. This phase-down schedule is consistent with the applicable schedule under the Kigali Amendment to the Montreal Protocol. On November 16, 2021, the White House sent the Kigali Amendment to the U.S. Senate for vote on its ratification.

Similarly, the Ozone-depleting Substances and Halocarbon Alternatives Regulations (ODSHAR), made under the authority of the Canadian Environmental Protection Act, 1999, and enforceable on December 29, 2016, include provisions to phase down the consumption and production of HFCs in alignment with Canada's adoption of the Kigali Amendment to the Montreal Accord. Although Mexico accepted the Kigali Amendments on September 25, 2018, Mexico, as a Group 1 Article 5 party, is following a slower HFC phase-down trajectory (e.g., a 10% reduction in consumption below baseline by 2029 rather than by 2019 for Canada, a Main Group Non-Article 5 party) and has not yet passed legislation analogous to the United States' AIM Act or promulgated regulations analogous to Canada's ODSHAR.

Due of the lack of production controls for HFCs, combined with the additional costs to recover, transport, and separate/process refrigerants back to virgin purity levels, there is currently little incentive for recovery, reclamation, and re-sale of HFCs. Based on U.S. EPA data on reclamation of HFCs for years 2017 to 2020, the percentage of available certified reclaimed HFCs in the U.S. is extremely low at around 2% (annually) of the net virgin HFCs available for consumption in the U.S. when compared on a metric ton of carbon dioxide equivalent (MT CO_2e) basis[10, 11]. For purposes of this Methodology, the rate by which certified reclaimed HFCs are replacing virgin HFCs under the baseline scenario is taken as 2%.

3.2.2 PRACTICE-BASED PERFORMANCE STANDARD

For a project to qualify for offset credits under this Methodology it must be demonstrated that the sector has a low market adoption rate for certified reclaimed HFCs. A market adoption analysis, and hence the additionality demonstration under Applicability Condition 1.2 (II) was conducted for the relevant sectors and segments (see Table 1). A review of US EPA's HFC reclamation data (see Appendix A.1) indicate that these sectors and segments have a low market adoption rate for using certified reclaimed HFCs. Therefore, project activities within these sectors and segments qualify for offset credit creation under this Methodology.

4 Quantification of GHG Emission Reductions

Quantification of project emission reductions requires calculation of baseline emissions and project emissions.

4.1 Baseline Emissions

This is the amount of baseline emissions that would take place without the use of certified reclaimed HFCs. It is equal to the total amount of reclaimed HFCs produced and the subsequent sale, title transfer or return to a distributor, wholesaler, or an end-user (either through direct sale, title transfer or return to an end user or through installation conducted via service technician) for use in refrigeration, air conditioning, aerosol (propellant), or fire suppression equipment during the reporting period. In the absence of the project, most of the HFCs used to recharge the system would have come from virgin HFC production, and some would come from HFCs that would normally be reclaimed.

For projects using certified reclaimed HFCs, the baseline emissions are calculated by the following:

Equation 1: Baseline Emissions

$$\mathbf{BE_{HFC_{rp}}} = \sum_{\mathbf{n}}^{\mathbf{y}} [(\mathbf{VR_{HFC,j,_{rp}}} \times \mathbf{GWP_{HFC,j}})] \times (\mathbf{1} - \mathbf{RR_{BL}}) \div \mathbf{1000}$$

$BE_{HFC_{rp}}$	Baseline emissions during the reporting period (MT CO_2e)
$VR_{HFC,j,_{rp}}$	Total quantity of virgin HFC **j** used to recharge equipment during the reporting period (kgs), derived from the quantity of monitored certified reclaimed HFCs that is documented according to the procedures in Section 3.1 and Section 5
$GWP_{HFC,j}$	The global warming potential of HFC or HFC Blend **j** (see Table 3)

RR_{BL}	Baseline Virgin HFC Replacement Rate (% per year)[15]

4.2 Project Emissions

As discussed above in Section 3, by using previously used, reclaimed HFCs, project participants are displacing use of newly produced virgin HFC. In this Methodology, any project related emissions from using reclaimed HFC, for example, from transport of certified reclaimed HFCs, are considered negligible and outside the project boundary. Thus, project activity emissions can be disregarded.

4.3 Leakage

In GHG project literature, leakage is a term that refers to secondary effects associated with where the GHG emission reductions of a project may be negated by shifts in market activity or shifts in materials, infrastructure, or other physical assets associated with the project. Projects involving certified reclaimed HFC would not increase demand for HFCs beyond current baseline demand, i.e., use of more reclaimed HFC would not cause an increase in virgin HFC production (to the contrary), or increase HFC emission rates. Therefore, for this Methodology, "leakage" can be disregarded.

4.4 Project Emission Reductions

Equation 2: Emission Reductions

$$\mathbf{ER_{rp} = BE_{HFC_{rp}}}$$

ER_{rp}	Project emission reductions during reporting period (MT CO_2e)
$BE_{HFC_{rp}}$	Baseline emissions of HFCs during reporting period (MT CO_2e)

[15] Percentage of certified reclaimed HFC that is replacing virgin HFC in the business-as-usual case, currently estimated to be 2% per year (see Appendix A.1).

5 Monitoring and Data Collection

Each project shall include a monitoring, reporting and verification plan sufficient to meet the requirements of the ACR Standard. The plan shall collect all data required to be monitored and, in a manner, which meets the requirements for accuracy and precision of this Methodology.

5.1 Description of the Monitoring Plan

These are expanded upon in the sections below. The project proponent must prepare a monitoring plan describing (for each separately) the following: a) project implementation; b) technical description of the monitoring task; c) data to be monitored and collected; d) overview of data collection procedures; e) frequency of the monitoring; f) quality control and quality assurance procedures; g) data archiving; and h) organization and responsibilities of the parties involved in all the above.

The rationale of monitoring project implementation is to document all project activities implemented by the project that could cause an increase in GHG emissions compared to the baseline scenario.

5.2 Data Collection and Parameters to be Monitored

For a specific quantity of HFC that are reclaimed, monitoring the emission reduction parameters includes:

- Where the HFC was recovered by service technicians in individual containers of 500 pounds gross weight or more, documentation of the point of origin of the reclaimed HFC including:
  - Facility name and address where HFC was recovered;
  - Equipment/product (including, if available, manufacturer, model number, and serial number; if unavailable, a description of the equipment/product) from which HFC was extracted;
  - Date(s) of recovery;

- The cylinder number, gross weight, and net weight of each container received by the EPA-certified (or equivalent for Canada and Mexico) reclaimer;
- Date(s) received by the EPA-certified (or equivalent for Canada and Mexico) reclaimer;
- Attestation from EPA-certified (or equivalent for Canada and Mexico) reclaimer regarding the source of the HFC that is reclaimed. Specifically, this attestation must document whether the reclaimer has previously obtained recovered HFC from the source and, if so, the dates on which that HFC was acquired; and
- Chain of custody and ownership of the recovered HFC must be demonstrated from the point of origin through the delivery of recovered HFC to the EPA-certified (or equivalent for Canada and Mexico) reclaimer. The following information must be provided to track chain of custody:
  - Names and addresses for all persons/entities buying and selling the recovered HFC;
  - The quantity of HFC purchased/sold at each transaction.

- Where HFCs were recovered by service technicians in individual containers of less than 500 pounds and aggregated with other recovered HFCs to greater than 500 pounds gross weight in an individual container prior to delivery to an EPA-certified (or equivalent for Canada and Mexico) reclaimer, documentation of the point of origin of the reclaimed HFC including:
  - Name and address of the service company, wholesaler or distributor where recovered HFC was aggregated to individual containers of greater than 500 pounds;
  - If applicable, chain of custody and ownership of the recovered HFC must be demonstrated from the point of origin (location where recovered HFC was aggregated into individual containers to greater than 500 pounds) through to the delivery of recovered HFC to an EPA-certified (or equivalent for Canada and Mexico) reclaimer. The following information must be provided to track chain of custody:
    - Names and addresses for all entities buying and selling the recovered HFC;
    - The quantity of HFC purchased/sold at each transaction.
  - The cylinder number, gross refrigerant weight, and net refrigerant weight of each container received by the reclaimer; and
  - Date(s) received by the reclaimer.
- Where the HFC was recovered by service technicians in an individual container of less than 500 pounds gross refrigerant weight and delivered to a wholesaler or distributor, or delivered directly to an EPA-Certified (or equivalent for Canada and Mexico) reclaimer, documentation of the point of origin of the reclaimed HFC including:
  - Name and address of the service company, wholesaler or distributor that delivered the individual container of less than 500 pounds to the reclaimer;
  - The cylinder number, gross weight, and net weight of each container received by the EPA-certified (or equivalent for Canada and Mexico) reclaimer; and

- Date(s) received by the EPA-certified (or equivalent for Canada and Mexico) reclaimer.

- For disposed aerosol products, documentation on the point of origin of the HFC including:
  - Name and address of the entity that delivered the disposed aerosol products to the EPA-Certified (or equivalent for Canada and Mexico) reclaimer;
  - The weight of the recovered HFC after processing by the EPA-certified (or equivalent for Canada and Mexico) reclaimer; and
  - Date(s) received by the EPA-certified (or equivalent for Canada and Mexico) reclaimer.
- Tracking of the containers that are used for collection and transport to the reclaimer of the recovered HFC (e.g. unique identification with serial number or barcode).
- Documentation on the type of HFC that is recovered from equipment or product and that is subsequently reclaimed.
- Documentation on the quantity of HFC produced in the reclamation process, accounting for contaminants that are removed in the reclamation process.[16]
- Documentation that the same quantity of reclaimed HFC (i.e. equal to the volume of HFC that was reclaimed during the reporting period) is transferred, sold, or returned to a wholesaler, distributor, or end-user (either through direct sale, title transfer or return to an end user or through installation conducted via service technician).
- Documentation demonstrating that the reclaimer is an EPA-Certified (or equivalent for Canada and Mexico) reclaimer and reclaimed the HFC using equipment listed with the EPA (equivalent equipment should be used by reclaimers in Canada and Mexico), including:
  - The most recent equipment list provided to the EPA (list of equivalent equipment should be provided by reclaimers in Canada and Mexico) by the EPA Certified (or equivalent for Canada and Mexico) reclaimer; and
  - The physical address where the reclamation was conducted.
- Documentation showing that used (recovered) HFC processed by the EPA-Certified (or equivalent for Canada and Mexico) reclaimer is tested by an AHRI-certified testing laboratory to meet the AHRI Standard, a laboratory accredited to ISO/IEC 17025, or a laboratory licensed and regulated by the federal government, and using the AHRI Standard 700 – Specifications for Refrigerants (AHRI 700)[17]. Reclaimed HFCs intended for sale as fire suppressants should be tested according to applicable ASTM[18] standards like ASTM D6231 for HFC-125 and ASTM D6064 for HFC-227.

[16] In any measurement of the quantity of HFC that involves weighing of a cylinder(s) (e.g., HFC recovered from equipment), the weight of the "empty" cylinder(s) (prior to filling with HFC) must be measured so that that any residual HFC (the cylinder "heel") is considered.

[17] Air Conditioning, Heating, and Refrigeration Institute (AHRI) 700-2016 Standard for *Specifications for Fluorocarbon Refrigerants*. www.ahrinet.org

[18] ASTM International (ansi.org)

5.2.1 PARAMETERS MONITORED

PARAMETER	$VR_{HFC,j,rp}$
UNITS	kg
DESCRIPTION	Total quantity of virgin HFC **j** that would have been used to recharge equipment during the reporting period (kgs), derived from the quantity of monitored certified reclaimed HFC that is documented according to the procedures in Section 3.1 and Section 5
RELEVANT SECTION	4.1.1
RELEVANT EQUATION(S)	1
SOURCE OF DATA	Operating Records
MEASUREMENT FREQUENCY	Determined once for each project (which consists of only one reporting period).

APPENDIX A: BASELINE DATA INPUTS

A.1 RATE OF VIRGIN HFC REPLACEMENT

Reclaimers in the United States are required to report to EPA the quantities of CFCs and HCFCs that they reclaim. Starting year 2017, EPA has published data on the quantities of HFC reclaimed in the U.S.

HFC production and consumption phase down is in early stages in Canada and haven't yet begun in U.S. and Mexico. As such there are no significant restrictions on production of HFCs, and because of the additional costs to recover, transport, and separate/process back to virgin purity levels[19]—unlike the strong incentive to reclaim CFCs and R-22—there is currently little incentive for recovery, reclamation, and re-sale of HFCs. To estimate the amount of HFC refrigerant that is reclaimed in the baseline scenario, HFC reclamation data for years 2017-2020 from the United States EPA is used as described below.

Table 4: Total Reclaimed HFCs Reported to EPA

Most recent data on the quantity of reclaimed HFCs in the U.S., as reported to the EPA.

YEAR	AMOUNT RECLAIMED IN POUNDS[20]	AMOUNT RECLAIMED IN MILLION $MTCO_2E$
2017	5,001,821	4.4
2018	5,158,987	4.6
2019	6,056,195	5.1
2020	5,496,623	4.7

[19] http://ozone.unep.org/new_site/en/ozone_data_tools_reclaimation_facilities.php

[20] https://www.epa.gov/sites/default/files/2020-07/documents/2020_reclamation_table.pdf

To calculate the virgin HFC replacement rate (%) for a given year, the quantity of HFC reclaimed (in pounds) is converted to metric tons (MT) by dividing it with 2204.62. The reclaimed HFCs (in MT) is then converted to metric tons of carbon dioxide equivalent ($MTCO_2e$) by multiplying the HFCs with their respective GWP values (using IPCC AR5 values). For unidentified HFCs that are in the other HFCs category, a conservative GWP value of 3,000 is used.

RR_{BL} = HFC Reclaimed (in Million $MTCO_2e$) ÷ Net Virgin HFCs available for use in the U.S. (in Million $MTCO_2e$)

EPA's Greenhouse Gas Reporting Program (GHGRP) reports that, for the most recent years (2017-2020), 290, 306, 314 and 309 million $MTCO_2e$ of net virgin HFCs were available for consumption in the U.S. for years 2017, 2018, 2019 and 2020 respectively.

The average annual virgin HFC replacement rate for 2017-2020 is calculated as (all values are in Million $MTCO_2e$):

$$[(4.4 \div 290) + (4.6 \div 306) + (5.1 \div 314) + (4.7 \div 309)] \div 4 \times 100\% = 2\%$$

APPENDIX B: REFERENCES

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