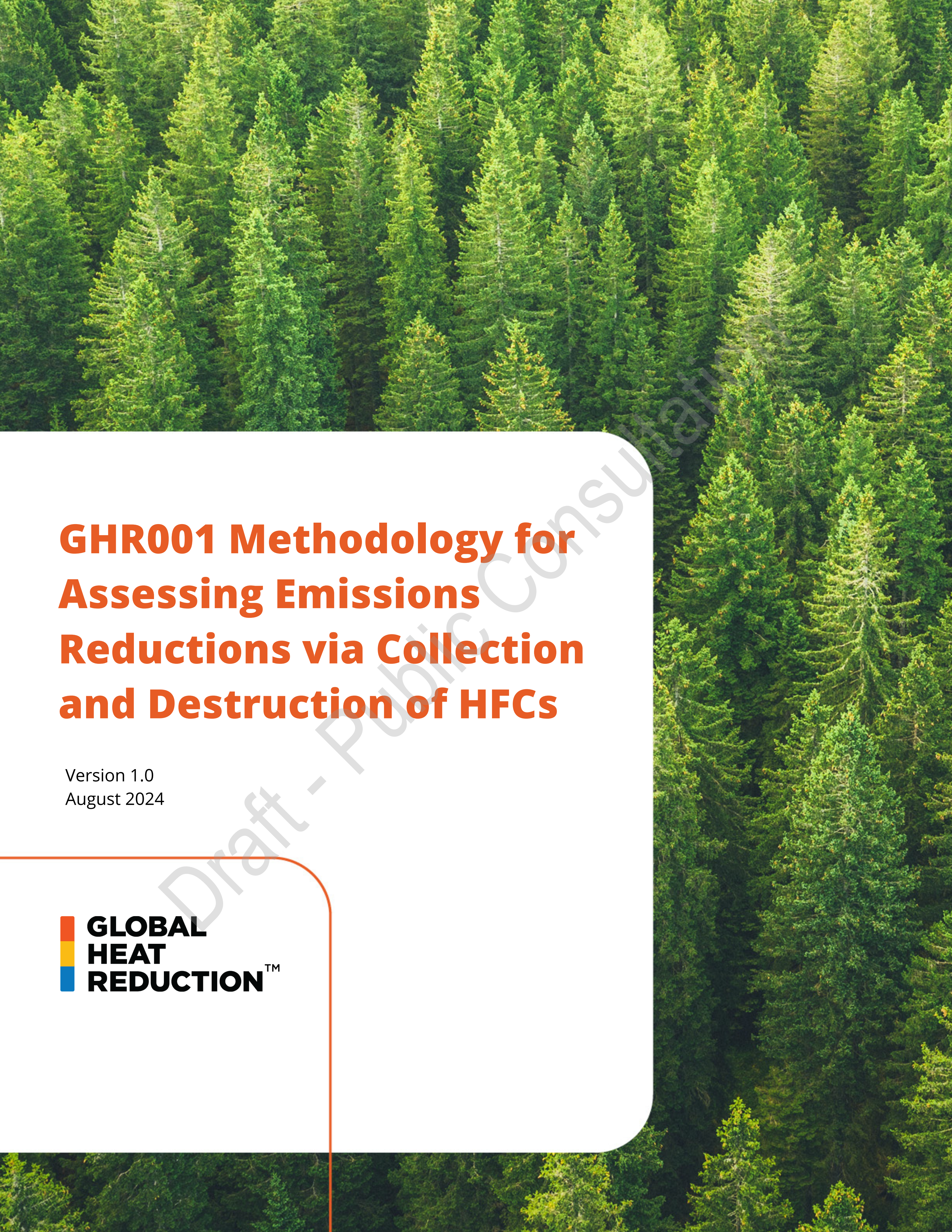

GHR001 Methodology for Assessing Emissions Reductions via Collection and Destruction of HFCs

Version 1.0
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1. METHODOLOGY SUMMARY AND SCOPE

1.1 Name of Methodology

GHR001 Methodology for Assessing Emissions Reductions via Collection and Destruction of HFCs

1.2 Methodology Description

This methodology describes the requirements and standards that a hydrofluorocarbon (HFC) collection and destruction project must meet to be issued verified credits from the Global Heat Reduction (GHR) Registry. The primary goal is to reduce global heat accumulation by managing HFCs that would otherwise be vented during equipment servicing or at the end of their lifecycle. While not explicitly stated throughout, all project activities are also applicable to eligible ozone-depleting substance (ODS) refrigerants, inclusive of hydrochlorofluorocarbons (HCFCs). This methodology is designed to ensure that credits issued represent additional, permanent, independently-verified, and rigorously-quantified reductions in super pollutant emissions and radiative forcing. Final approval of a project under this methodology is granted exclusively by the GHR Registry.

This methodology builds on the draft methodology "Recovery and Destruction of Hydrofluorocarbon Refrigerant Gases in Article 5 Countries Version 2.1[1]" from the Carbon Containment Lab, which was originally adapted from Verra's "*VM0016 Recovery and Destruction of Ozone Depleting Substances (ODS) from Products, v1.1*[2]".

1.3 Function of Projects in the Methodology

Collection and destruction of HFCs

1.4 Eligibility Requirements for Projects under the Methodology

Individual projects are considered eligible to earn credits if they meet all eligibility requirements of the GHR Registry Standard and the requirements of this methodology:

- This methodology applies to project activities that recover and destroy HFCs where the baseline scenario is their total atmospheric release, such as required venting before servicing or at equipment end-of-life.
- This methodology does not apply to HFC refrigerant that is manufactured for the sole purpose of its subsequent destruction, or to HFC refrigerant that would remain in equipment in the baseline scenario.
- Applicable HFC refrigerant must be recovered from Montreal Protocol Article 5 countries which have ratified the Kigali Amendment and where regulatory prohibitions against refrigerant venting do not exist or are not enforced (see Appendix A for country-level inclusion criteria and additionality check). The remainder of project activities (e.g., aggregation, destruction, or reclamation) can be implemented in Article 5 or Non-Article 5 countries.[3]
- All HFCs must be collected, stored, and transported in hermetically sealed containers (e.g., gas cylinders).

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[1] Draft Methodology Version 2.1, White Paper, and Responses to Public Comment documents available at: https://carboncontainmentlab.org/publications/hfc-methodology

[2] Methodology available at: https://verra.org/methodologies/vm0016-recovery-and-destruction-of-ozone-depleting-substances-ods-from-products-v1-1/

[3] For the avoidance of doubt: Recovery and destruction activities can take place in separate countries.

- The following HFC species and blends, with their associated GWPs[4] (100-year values taken from the IPCC's Sixth Assessment Report), are eligible under this methodology:

Table 1. HFC Refrigerants and their GWPs

HFC Refrigerant	GWP 100
HFC-23	14,600
HFC-32	771
HFC-125	3,740
HFC-134a	1,530
HFC-143a	5,810
HFC-152a	164
HFC-227ea	3,600
R-404A	4,728
R-407A	2,262
R-407C	1,908
R-410A	2,256
R-417C	1,935
R-422B	2,700
R-422C	3,296
R-422D	2,917
R-507A	4,775
R-508B	13,412

Refrigerant blends which are comprised of HFCs listed in Table 1 are also eligible under this methodology (e.g., R-417a). Project proponents may submit additional refrigerants to the GHR Registry for approval, with supporting documentation. The GHR Registry reserves the right to approve or deny the inclusion of additional refrigerants at its sole discretion.

The project proponent must provide appropriate documentation to demonstrate that the project activity meets all eligibility requirements. Documentation may include but is not limited to: bills of lading, invoices, receipts, chain of custody documents, inventory records, contracts, or other signed statements or agreements.

1.5 Geographic Scope

HFC collection: Montreal Protocol Article 5 countries which have ratified the Kigali Amendment

HFC aggregation, destruction or reclamation: Global (including, but not limited to countries eligible for HFC collection)

1.6 Materiality

Materiality refers to information that, if omitted, erroneous or misstated, would lead to misrepresentation of radiative forcing (RF) reduction of a project. See further discussion in the GHR Registry Standard.

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[4] Refrigerant blend GWP values are calculated using the component mass ratio and relevant IPCC AR6 GWP 100 values.

In this category, errors, omissions, and misrepresentations that could significantly affect the estimation of the *RF reduction potential* associated with a *project* include, for example:

- Significant under-estimate or over-estimate of the HFC emissions reduced by the project
- Misrepresentation of the project in terms of any eligibility or additionality requirements

1.7 Additionality Considerations

The project proponent must demonstrate additionality for projects that destroy HFC refrigerant, consistent with the GHR Registry Standard. A country-level check should be completed annually to ensure that destruction is not enabling production or import of HFCs above set limits (Appendix A).

It is presumed that Article 5 countries do not have anti-venting regulations and are eligible to host projects. However, some Article 5 countries may have anti-venting regulations, and it is the responsibility of the project proponent to report any relevant laws, statutes, or other regulatory frameworks to the GHR Registry. In host countries with anti-venting regulations, project proponents must provide officially published data, inventories, research studies, or industry data demonstrating a compliance rate below 50 percent during the crediting period. All evidence for the compliance rate must be reported in the Project Design Document (PDD) and updated evidence is required in subsequent Monitoring Reports. As changing conditions continue to be monitored, eligibility conditions such as the threshold compliance rate may be updated accordingly.

Projects that meet all the eligibility conditions in Section 1.4 of this methodology, as well as the following requirements, are deemed additional.

The project activity consists of the collection, aggregation, and destruction of HFC refrigerants recovered at equipment end-of-life or during servicing in which venting would otherwise occur. Government seizures of illegal shipments are also an approved source insofar as seized refrigerants are turned over to project proponents for the express purpose of destruction. When refrigerant is recovered from equipment, the project developer must distinguish between refrigerant recovered at equipment end-of-life and during equipment servicing.

If the refrigerant is being recovered during equipment servicing, the project developer must provide documented evidence for the following:

- The equipment, identified by serial number, has not been serviced within the past 4 months for the purpose of refrigerant destruction claimed at GHR or any other registry.
- The reason for servicing, demonstrating the evacuation of refrigerant from the equipment was required or is common practice before such servicing.
- Any incentives provided to service providers per kg of refrigerant are less than the price of new refrigerant. Note that if incentives are provided, documentation verifying compliance with this requirement must be made available to validation and verification bodies (VVBs), but details may be redacted from public documentation to protect Project Proponent business confidentiality. The documentation for the price of new refrigerant must be relevant to the time and region of servicing.
- The project activity does not consist of the destruction of HFCs from, or as part of, a product stewardship scheme or other program incentivizing HFC recovery as an industry common practice. At validation, the project proponent must provide a description of any schemes or programs

designed to incentivize HFC recovery, reclamation, or destruction in the jurisdictions in which the refrigerant is collected.

1.8 Permanence

As a result of project activities under this methodology, HFCs that would otherwise have been vented to the atmosphere are collected and destroyed. The annual HFC emissions that would otherwise have been generated will be permanently reduced. Therefore, there is no risk of non-permanence of RF reductions achieved based on the emissions reductions achieved through this process.

1.9 Risk of Secondary Effects

Secondary effects may occur when continued demand for refrigeration leads to the production and consumption of refrigerants to replace HFCs which have been destroyed instead of reclaimed. Secondary effects are considered in cases where the reclamation rate is greater than 5%. Secondary effects are assumed to be 0 in cases where the venting rate of the destroyed gas is 100%. Secondary effects calculations and considerations are further described in Section 4.4.

1.10 Language

This methodology uses the standard nomenclature of “shall” for required clauses, and “should” or “may” for suggested clauses.

2. BASELINE AND PROJECT SCENARIO DESCRIPTIONS

2.1 Baseline Scenario

The baseline scenario represents a business-as-usual situation, representing what would have occurred in the absence of the project activities.

The project proponent must use Step 1 of the latest version of the CDM Tool for the demonstration and assessment of additionality[5], to identify all realistic and credible baseline scenarios. In doing so, relevant policies and regulations related to the management of installed refrigerant banks should be considered. Such policies or regulations may include mandatory HFC capture or destruction requirements because of regional or local environmental regulations. In addition, the assessment of baseline scenarios should account for regional economic and technological circumstances.

For HFC refrigerants the realistic and credible baseline scenario(s) may include, *inter alia*

1. Project activity not performed as emission reduction project
2. Products are disposed of into an incineration facility and thereby HFC refrigerants are destroyed
3. Atmospheric release of the HFC refrigerant or partial capture and destruction
4. Atmospheric release of the HFC refrigerant or partial capture and reuse in existing products
5. Products partially or entirely remain installed in existing equipment

The methodology is only applicable for HFC refrigerants if the most plausible baseline scenario for the HFC refrigerant is either (3) or (4) or a combination of both.

Additional evidence to support baseline scenarios should be provided, if available. In presenting evidence for baseline emissions, developers may consider:

- Demonstrating a lack of in-country destruction facilities and reclamation infrastructure, or refrigerant recovery rates in the market measurably below 50%; and
- Showing that insignificant volumes of recovered refrigerant are being exported from the country for reclamation or destruction.
- Providing evidence that a country does not have a venting prohibition in place for ODS and/or HFCs and no policies and tools to recover refrigerant at scale; or
- Obtaining an attestation from the National Ozone Officer or a relevant government office that a venting prohibition, if in place, is not enforced and that refrigerant venting is baseline practice.

2.2 Project Scenario

The project scenario is the collection, aggregation, and destruction of HFCs which otherwise would have been vented to the atmosphere.

2.3 Group Project Scenario

It is possible that multiple operations under one management and ownership system may apply for assessment, validation, verification, and credit issuance in an aggregated group. All such operations within the group are required to meet the requirements of the GHR Registry Standard and this methodology.

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[5] At the time of publication, the latest version of the CDM tool is Version 7.0.0 and is available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf/history_view

3. PROJECT BOUNDARIES AND DATA SOURCES

3.1 Boundaries for assessing radiative forcing, net radiative forcing reduction, co-benefits, and trade-offs

The spatial extent of the project boundary encompasses the following sources, sinks, and reservoirs (SSRs):

- The recovery site or sites
- The aggregation facility or facilities
- The destruction facility
- Transportation between recovery sites, aggregation facilities, and the destruction facility
- Secondary effects from production of substitute gas and use of HFC or substitute refrigerant

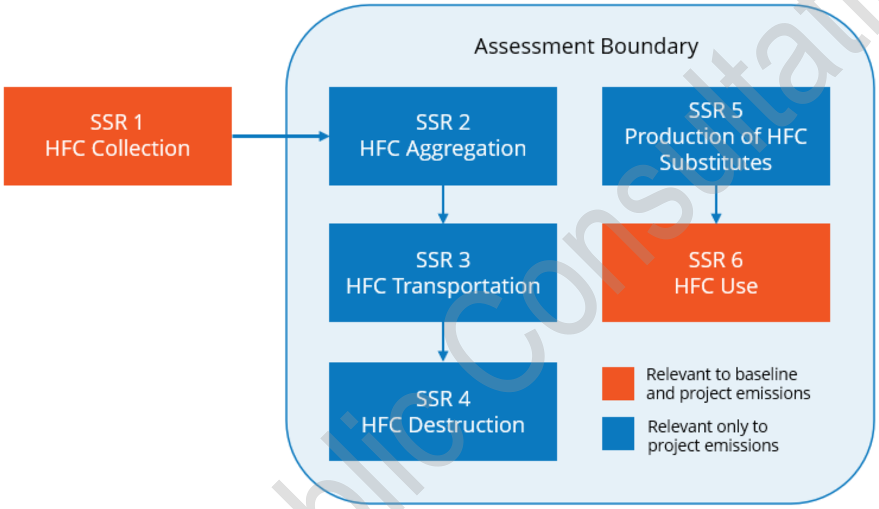

Figure 1. Project Boundary Diagram.[6] *More details about each SSR can be found in Section 3.2 below.*

3.2 Sources of radiative forcing, both positive and negative

** NOTE: Delineate sources, sinks, and reservoirs to be analyzed for credits, as described in the GHR Registry Standard.*

Project proponents shall account for all significant sources of climate forcer emissions and removals within the project boundary (as described in Section 3.1), to provide an accurate estimation of the project's net impact on climate forcing. The exclusion of emission sources is permissible, provided the exclusions result in conservatively low crediting[7] and have been tested for their significance to total credit amounts. Sources (Table 2) that are considered significant and/or selected for accounting in the baseline scenario shall also be included in the project scenario.

Table 2. Climate forcer emission sources relevant to HFC collection and destruction projects

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[6] From draft methodology *Recovery and Destruction of Hydrofluorocarbon Refrigerant Gases in Article 5 Countries Version 2.1* from the Carbon Containment Lab.

[7] An exclusion is acceptable if it tends to underestimate net climate forcer emission reductions/removal enhancements.

Source	Climate Forcer	Included in Calculation	Justification/Explanation
HFC Collection	CO_2, CH_4, N_2O, Black Carbon, Organic Carbon	Excluded	Fossil fuel emissions from collection of HFCs; Excluded; No difference from baseline. Baseline emissions which are avoided under the project scenario.
HFC Aggregation	HFCs, CO_2, CH_4, N_2O, SF_6, Black Carbon, Organic Carbon, Sulfate aerosols	Required	HFC and fossil fuel emissions from recovery of HFC at servicing or end of life; Included; Venting assumed 100% in baseline; complete capture assumed in project scenario
HFC Transportation	CO_2, CH_4, N_2O, SF_6, Black Carbon, Organic Carbon, Sulfate aerosols	Required	Fossil fuel emissions associated with transport of HFCs from collection to aggregation and from aggregation to destruction facility; Included; Estimated based on distance and weight
HFC Destruction	HFCs, CO_2, CH_4, N_2O, SF_6, Black Carbon, Organic Carbon, Sulfate aerosols	Required	Emissions from oxidation of carbon contained in destroyed HFCs, fossil fuel emissions from destruction facility operation, indirect emissions from use of grid-delivered electricity; Included; Based on HFCs destroyed and destruction facility data
Production of HFC Substitutes	CO_2, CH_4, N_2O, SF_6, Black Carbon, Organic Carbon, substitute refrigerants, Sulfate aerosols	Required	Fossil fuel and substitute refrigerant emissions from production of substitute refrigerant; Included; Based on reclamation rate in project location; Expected to be negligible in Article 5 countries
HFC Use	HFC or substitute	Required	HFCs or substitute gas emissions from leaks resulting from continued operation; Included; Project emissions based on market-weighted emission rates and reclamation rates

3.3 Potential co-benefits, trade-offs, and SDGs

The project proponent shall, at minimum, make a qualitative assessment of co-benefits and trade-offs associated with the project activities. The latest Methodology Standard for Stressor-Effects Life Cycle Assessment (SCS-002) standard[8] may be used to make a quantitative assessment of any co-benefits or trade-offs. Verified claims related to co-benefits, trade-offs, and SDGs are only permissible when the project has undergone a quantitative assessment for the relevant impact category.

Table 3. List of Impact Categories for determining Potential Co-benefits and Trade-offs

Impact Group	Impact Category	Potential Co-benefits relevant to Project Scenario	Potential Trade-off relevant to Project Scenario

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[8] **Methodology Standard for Stressor-Effects Life Cycle Assessment Version 2.0**.

Resource Depletion Group	Non-Renewable Energy Resource Depletion	No	Yes
	Net Freshwater Consumption	No	No
	Critical Minerals Resource Depletion	No	No
	Biotic Resource Depletion	No	No
Ocean Ecosystem Impacts Group	Ocean Acidification	No	Yes
	Marine Biome Disturbance	No	No
	Marine Eutrophication	No	No
	Key Species Loss	No	No
	Persistent Eco Toxic Chemical Loading	No	No
	Marine Plastic Loading	No	No
Terrestrial Ecosystem Impacts Group (impacts from Emissions)	Regional Acidification	No	No
	Stratospheric Ozone Depletion	No	No
	Freshwater Ecotoxic Exposure Risks	No	No
	Freshwater Eutrophication	No	No
	Terrestrial Eutrophication	No	No
Terrestrial Ecosystem Impacts Group (impacts from Land Use and Land Conversion)	Terrestrial Disturbance	No	No
	Freshwater Disturbance	No	No
	Threatened Species Impacts	No	No
Human Health Impacts (from Chronic Exposures to Hazardous Substances)	Ground Level Ozone Exposure Impacts	No	No
	PM2.5 Exposure Impacts	No	No
	Hazardous Ambient Air Contaminant Exposure Impacts	No	No
	Hazardous Indoor Air Contaminant Exposure Impacts	No	No
	Hazardous Food or Water Contaminant Exposure Impacts	No	No
	Hazardous Dermal Contaminant Impacts	No	No
Risks from Hazardous Wastes	Risks from Radioactive Wastes	No	No
	Risks from Untreated Hazardous Wastes	No	No

Projects under this methodology may affect the following SDG indicators:

Table 4. Potentially Affected SDGs and Indicators

Sustainable Development Goal	Indicator Number	Indicator
13. Take urgent action to combat climate change and its impacts	13.2.2	Total greenhouse gas emissions per year

4. QUANTIFICATION AND REPORTING

4.1 Applicable GHGs and other climate forcers

See Table 2 in Section 3.2.

4.2 Types of Data Required, Accepted Data Sources and Calculation Methods, including applicable characterization factors

Information about necessary data and parameters can be found in the calculations and descriptions in Sections 4.3 – 4.5, the tools utilized or mandated in this methodology, and in Section 4.8. A listing of the data and parameters that are available at validation, and monitored data and parameters is available in Appendix D.

4.3 Baseline Scenario Climate Forcer Calculation Methods

The project proponent shall calculate the baseline scenario climate forcer emissions using the following:

$$BE_{HFC\_ref,i,y} = \sum_{i=1}^{n}\Big((M_{DESTR,eHFC,i,y} \times VR_{HFC,i} \times EF_{VR}) + (M_{DESTR,eHFC,i,y} \times RR_{HFC,i} \times EF_{RR,HFC,i}) + (M_{DESTR,eHFC,i,y} \times DR_{HFC,i} \times EF_{DR})\Big) \quad \textbf{Eq. 1}$$

$$1 = VR_{HFC,i} + RR_{HFC,i} + DR_{HFC,i} \quad \textbf{Eq. 2}$$

Where:

$BE_{HFC\_ref,i,y}$	Baseline emissions of HFC refrigerant *i* which would be released into the atmosphere in the absence of the project activity in year *y* [t HFC]
$M_{DESTR,eHFC,i,y}$	Eligible quantity of HFC refrigerant *i* sent for destruction by the project activity in year *y* [t HFC_i]
$VR_{HFC,i}$	Rate of HFC refrigerant *i* which would be vented into the atmosphere in the baseline [unitless: 0-1]
EF_{VR}	Emission factor for HFC refrigerant *i* which would be vented into the atmosphere [unitless: assumed equal to 1]
$RR_{HFC,i}$	Rate of HFC refrigerant *i* which would be used, reused or remain in storage in the baseline [unitless: 0-1]
$EF_{RR,HFC,i}$	Emission factor for HFC refrigerant *i* which would be reused in the baseline [unitless: 0-1]
$DR_{HFC,i}$	Rate of HFC refrigerant *i* destroyed by the project activity which would also be destroyed in the baseline [unitless: 0-1]
EF_{DR}	Emission factor for HFC refrigerant *i* which would also be destroyed in the baseline [unitless: assumed equal to 0]

$$EF_{RR,HFC,i} = 1 - (1 - LR_{HFC,i,y})^{tcp} \quad \textbf{Eq. 3}$$

Where:

$EF_{RR,HFC,i}$	Emission factor for HFC refrigerant *i* which would be reused in the baseline [unitless: 0-1]
$LR_{HFC,i,y}$	Leak rate of HFC refrigerant *i* which would be used as refrigerant for existing equipment or remain in storage in the baseline in year *y* [unitless: 0-1]

tcp	Project monitoring period [years]

When recovery of the HFC refrigerants by the project activity is mandated by law, statute or other regulatory framework applying in the host country, and this mandate is demonstrably enforced, the baseline shall be the gradually increasing compliance with such law, statute or other regulatory framework, and the baseline GHG emissions shall be calculated as follows:

$$BE_{HFC\_ref,i,y,a} = BE_{HFC\_ref,i,y} \times (1 - CR_y) \qquad \textbf{Eq. 4}$$

Where:

$BE_{HFC\_ref,i,y,a}$	Adjusted baseline emissions to be used for the calculation of emission reductions in year *y* [t HFC]
$BE_{HFC\_ref,i,y}$	Baseline emissions of HFC refrigerant *i* which would be released into the atmosphere in the absence of the project activity in year *y* [t HFC]
CR_y	Host country-level compliance rate of the law, statute or other regulatory framework in the year y. Calculation of the compliance rate shall exclude other projects implemented under GHG programs. If the compliance rate exceeds 50% (or 0.50), the project shall receive no further credit [unitless: 0-1]

4.4 Project Scenario Climate Forcer Calculation Methods

Project scenario climate forcer emissions in year *y* are:

- Emissions that are caused by the project activity due to energy consumption at aggregation facilities
- Emissions that are caused by the project activity due to transportation of HFC refrigerant between recovery sites, aggregation facilities, and the destruction facility
- Emissions that are caused by the project activity due to HFC destruction (including energy consumption due to project activity at the destruction facility)

The project scenario climate forcer emissions shall be calculated as follows:

$$PE_{y,f} = PE_{Energy\_Consump,y,f} + PE_{HFC\_Transport,y,f} + PE_{HFC\_Destruct,y,f} \qquad \textbf{Eq. 5}$$

Where:

$PE_{y,f}$	Project emissions during year *y*, for climate forcer *f* [t]
$PE_{Energy\_Consump,y,f}$	Project emissions from energy consumption due to project activity at aggregation facilities during year *y*, for climate forcer *f* [t]
$PE_{HFC\_Transport,y,f}$	Project emission from HFC transportation during year *y*, for climate forcer *f* [t]
$PE_{HFC\_Destruct,y,f}$	Project emission from HFC destruction during year *y*, for climate forcer *f* [t]

Determination of $PE_{Energy\_Consump,y,f}$:

$$PE_{Energy\_Consump,y,f} = PE_{EC,y,f} + PE_{FC,j,y,f} \qquad \textbf{Eq. 6}$$

Where:

$PE_{Energy\_Consump,y,f}$	Project emissions from energy consumption attributable to the project activity at aggregation facilities during year *y*, for climate forcer *f* [t]
$PE_{EC,y,f}$	Project emissions from electricity consumption from the grid attributable to the project activity at aggregation facilities during year *y*, for climate forcer *f* [t]
$PE_{FC,j,y,f}$	Project emissions from fossil fuel consumption attributable to the project activity, including third party used fossil fuel to generate energy, at aggregation facilities during year *y*, for climate forcer *f* [t]

Determination of $PE_{EC,y}$:

$$PE_{EC,y,f} = EC_{PJ,y} \times EF_{grid,y,f} \times (1 - TDL_y) \quad \textbf{Eq. 7}$$

Where:

$PE_{EC,y,f}$	Project emissions from electricity consumption from the grid due to project activity at the HFC aggregation facilities during year *y*, for climate forcer *f* [t]
$EC_{PJ,y}$	Amount of electricity consumed due to project activity at the HFC aggregation facilities from the grid during year *y* [MWh]
$EF_{grid,y,f}$	Grid emission factor during the monitoring period *y*, for climate forcer *f* [t/MWh]
TDL_y	Average technical transmission and distribution losses in the grid for the voltage level at which electricity is obtained from the grid at the aggregation facilities during year *y* [unitless: 0-1]

For determination of $EF_{grid,y,f}$ the project proponent shall use published emission factors from government or other reliable sources such as LCA or industry data for each relevant climate forcer. For determination of TDL_y the project proponent shall choose one of the following options:

- Use recent, accurate and reliable data available within the country; or
- Use a conservative default value of 20%

Determination of $PE_{FC,j,y}$:

$$PE_{FC,j,y,f} = \sum_{i=1}^{n} FC_{i,j,y} \times EF_{i,y,f} \quad \textbf{Eq. 8}$$

Where:

$PE_{FC,j,y,f}$	Project emissions from fossil fuel consumption attributable to the project activity at aggregation facilities, including third party used fossil fuel to generate energy, during year *y*, for climate forcer *f* [t]
$FC_{i,j,y}$	Amount of fuel type *i* combusted in process *j* at an aggregation facility or at any third party generating energy for an aggregation facility during year *y* [mass or volume unit]
$EF_{i,y,f}$	Emission factor of fuel type *i* in year *y*, for climate forcer *f* [t/mass or volume unit] (*i* are the fuel types combusted in process *j*)

For determination of $EF_{i,y,f}$ the project proponent shall use published emission factors from government or other reliable sources such as LCA or industry data for each relevant fuel type and climate forcer.

Determination of $PE_{HFC\_Transport,y,k,f}$:

$$PE_{HFC\_Transport,y,k,f} = \sum_{i=1}^{n} D_{k,y} \times TM_{HFCs\_DEST,y} \times EF_{k,y,f} \qquad \text{Eq. 9}$$

Where:

$PE_{HFC\_Transport,y,k,f}$	Project emission from HFC transportation during year *y*, for climate forcer *f* [t]
$D_{k,y}$	Distance travelled in vehicle type *k* while transporting HFCs from an aggregation facility to a destruction facility during year *y* [distance unit]
$TM_{HFC\_DEST,y}$	Mass of transported HFCs, including the container mass [t or other mass unit]
$EF_{k,y,f}$	Emission factor of transportation in vehicle type *k*, during year *y*, for climate forcer *f* [t/mass and distance unit]

For determination of $EF_{k,y,f}$ the project proponent shall use published emission factors from government or other reliable sources such as LCA or industry data for each relevant vehicle type and climate forcer.

Determination of $PE_{HFC\_Destruct,y,k,f}$:

$$PE_{HFC\_Destruct,y,f} = CO2_{DEST\_HFC,y} + PE_{Elec\_DEST,y,f} + FC_{DEST,y,f} \qquad \text{Eq. 10}$$

Where:

$PE_{HFC\_Destruct,y,f}$	Project emission from HFC destruction during year *y*, for climate forcer *f* [t]
$CO2_{DEST\_HFC,y}$	Project emissions from conversion of HFC to CO_2 in the destruction process during year *y* [t CO_2]
$PE_{Elec\_DEST,y,f}$	Project emissions from electricity consumption from the grid due to project activity at the HFC destruction facilities during year *y*, for climate forcer *f* [t]
$FC_{DEST,y,f}$	Project emissions from fossil fuel consumption attributable to the project activity at destruction facilities, including third party used fossil fuel to generate energy, during year *y*, for climate forcer *f* [t]
FE_{HFCs}	Fugitive project emissions of HFC refrigerant *i* which was emitted by the project activity at destruction facilities during year *y* [t HFC_i]

Determination of $CO2_{DEST\_HFC,y}$:

$$CO2_{DEST\_HFC,y} = M_{DESTR,HFC,i,y} \times CC_{HFC,i,y} \qquad \text{Eq. 11}$$

Where:

$CO2_{DEST\_HFC,y}$	Project emissions from conversion of HFC to CO_2 in the destruction process during year *y* [t CO_2]
$M_{DESTR,HFC,i,y}$	Quantity of HFC refrigerant *i* sent for destruction by the project activity in year *y* [t HFC]
$CC_{HFC,i,y}$	Carbon content of HFC refrigerant *i* sent for destruction by the project activity in year *y* [t CO_2/t HFC_i]

It is assumed that sufficient oxygen exists within the destruction process to completely convert all carbon from HFCs into CO_2.

Determination of $PE_{Elec\_DEST,y,f}$:

$$\boldsymbol{PE_{Elec\_DEST,y,f} = EC_{DEST,y} \times EF_{grid,y,f} \times (1 - TDL_y)} \tag{Eq. 12}$$

Where:

$PE_{Elec\_DEST,y,f}$	Project emissions from electricity consumption from the grid due to project activity at the HFC destruction facilities during year *y*, for climate forcer *f* [t]
$EC_{DEST,y}$	Amount of electricity consumed due to project activity at the HFC destruction facilities from the grid during year *y* [MWh]
$EF_{grid,y,f}$	Grid emission factor during the monitoring period *y*, for climate forcer *f* [t/MWh]
TDL_y	Average technical transmission and distribution losses in the grid for the voltage level at which electricity is obtained from the grid at the destruction facilities during year *y* [unitless: 0-1]

For determination of $EF_{i,y,f}$ the project proponent shall use published emission factors from government or other reliable sources such as an LCA emission factor database for each relevant fuel type and climate forcer.

Determination of $FC_{DEST,y,f}$:

$$\boldsymbol{FC_{DEST,y,f} = \sum_{i=1}^{n} FC_{i,l,y} \times EF_{i,y,f}} \tag{Eq. 13}$$

Where:

$FC_{DEST,y,f}$	Project emissions from fossil fuel consumption attributable to the project activity at destruction facilities, including third party used fossil fuel to generate energy, during year *y*, for climate forcer *f* [t]
$FC_{i,l,y}$	Amount of fuel type *i* combusted in process *l* at a destruction facility or at any third party generating energy for a destruction facility during year *y* [mass or volume unit]
$EF_{i,y,f}$	Emission factor of fuel type *i* in year *y*, for climate forcer *f* [t/mass or volume unit] (*i* are the fuel types combusted in process *l*)

For determination of $EF_{i,y,f}$ the project proponent shall use published emission factors from government or other reliable sources such as an LCA emission factor database for each relevant fuel type and climate forcer.

4.4.1 Secondary Effects

Emissions from secondary effects occur where in the baseline HFC refrigerant would have been re-used or reclaimed, and in the project scenario, must be substituted by other chemicals. Secondary effects are considered in cases where the reclamation rate, $RR_{\text{HFC},i}$, is greater than 5%. Secondary effects are assumed to be 0 in cases where the venting rate of the destroyed gas, $VR_{HFC,i}$, is 100%.

When refrigerant HFCs are destroyed instead of reclaimed, continued demand for refrigeration will lead to the production and consumption of other refrigerant chemicals whose production is still legally allowed. Emissions associated with the production of new refrigerants are considered secondary effects and are included below in Equation 14.

Whether HFCs are destroyed or reclaimed, the resulting case will likely result in a gradual release, or leak, of HFCs or substitute gases over the project monitoring period. The secondary effects calculation therefore additionally includes the difference between the leaked refrigerant GWP in the reclamation versus destruction case. Substitute gases are to be derived from either official published data, research, industry studies, or assume destroyed refrigerants to be replaced by HFC-134a (see Appendix D). To be conservative, the GWP of the substitute gas is always assumed to be greater than or equal to the GWP of the destroyed gas, such that project proponents are not credited for decreased leaking due to a lower GWP substitute gas.

Secondary effects are calculated in tonnes CO_2e and included in the final CO_2 inventory. Secondary effects are not currently calculated for other climate forcers, but this may be updated in the future.

Emissions from secondary effects are calculated as follows:

$$SE_{Total,CO_2e} = \sum_{i=1}^{n} RR_{HFC,i} \times \left(PE_{Sub,i} + \left(M_{DESTR,HFC,i,y} \times TLR\right) \times max\left[0, \left(GWP_{Sub,i} - GWP_{HFC,i}\right)\right]\right) \quad \text{Eq. 14}$$

Where:

SE_{Total,CO_2e}	Total emissions from secondary effects by the project activity over project monitoring period [t CO_2e]
$RR_{HFC,i}$	Rate of HFC refrigerant *i* which would be used, reused or remain in storage in the baseline [unitless: 0-1]
$PE_{Sub,i}$	Emissions associated with production of substitute refrigerant for HFC refrigerant *i* [t CO_2e]
$M_{DESTR,HFC,i,y}$	Quantity of HFC refrigerant *i* which is sent to destruction by the project activity in year *y* [t HFC_i]
$GWP_{HFC,i}$	Global warming potential of destroyed HFC refrigerant *i* [t CO_2e/t HFC_i]
$GWP_{Sub,i}$	Global warming potential of substitute refrigerant for HFC refrigerant *i* [t CO_2e/t Substitute]

$$TLR = 1 - \left(1 - LR_{HFC,i,y}\right)^{tcp} \quad \text{Eq. 15}$$

Where:

TLR	Total leak rate over the project monitoring period [0-1]
$LR_{HFC,i,y}$	Leak rate of HFC refrigerant *i* or substitute chemical in year *y* [0-1]
tcp	Project monitoring period [years]

The project proponent shall apply a substitute chemical derived from either official published data, research, industry studies, or default values provided in the latest version of the *CAR Article 5 Ozone*

Depleting Substances Project Protocol. The leak rate $LR_{HFC,i,y}$ shall be obtained from either official published data, research, industry studies, or default values provided in the latest version of the *CAR Article 5 Ozone Depleting Substances Project Protocol*.

4.5 Determination of RF Reduction for Credits

The project proponent shall determine the net climate forcer reductions as follows:

$$ER_{y,f} = BE_{HFC\_ref,i,y,a} - PE_{y,f} - \left(\frac{SE_{Total,CO_2e}}{tcp}\right) \qquad \text{Eq. 16}$$

Where:

$ER_{y,f}$	Emission reductions in year *y*, for climate forcer *f* [t]
$BE_{HFC\_ref,i,y,a}$	Adjusted baseline emissions to be used for the calculation of emission reductions in year y [t HFC$_i$] (HFC$_i$ is substituted for climate forcer *f* when calculating the inventory)
$PE_{y,f}$	Project emissions in year *y*, for climate forcer *f* [t]
SE_{Total,CO_2e}	Total emissions from secondary effects by the project activity over project monitoring period [t CO$_2$e] (treated as t CO$_2$ and included in the CO$_2$ inventory)
tcp	Project monitoring period [years]

The potential credit amount in carbon dioxide equivalents (CO$_2$e) is calculated as shown in equation 17:

$$R_{CO_2e,y} = ER_{y,CO_2} + \sum ER_{y,f} \times GWP_f \qquad \text{Eq. 17}$$

Where:

$R_{CO_2e,t}$	Reduction in CO$_2$e due to project activities in year *y* [t CO$_2$e]
ER_{y,CO_2}	Net CO$_2$ emissions in year *y* [t CO$_2$]
$ER_{y,f}$	Net emissions in year *y*, for climate forcer *f* [t climate forcer *f*]
GWP_f	Global warming potential over 100 years (GWP 100), for climate forcer *f* (use latest IPCC values)[9] [t CO$_2$e/t]

The RF reduction potential is calculated as follows:

$$R_{CO_2fe,y} = \sum RF(ER_{y,f}) \qquad \text{Eq. 18}$$

Where:

$R_{CO_2fe,y}$	Climate forcer reduction due to project activities in year y [t CO$_2$fe]
$RF(ER_{y,f})$	RF of net climate forcer emissions in year *y* [t CO$_2$fe]

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[9] See IPCC AR6 Table 7.SM.7 | Greenhouse gas lifetimes, radiative efficiencies, global warming potentials (GWPs), global temperature potentials (GTPs) and cumulative global temperature potentials (CGTPs). Available at https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf.

Additional details for calculating radiative forcing can be found in the GHR Registry Standard. Radiative forcing shall also be calculated in nW/m^2, as described in the GHR Registry Standard. Accumulated RF reductions shall be calculated annually using the first year of the project as t_0.

4.6 Conservative Assumptions and Estimates

The following conservative assumptions and estimates are used in this methodology:

- Article 5 countries are assumed to meet the regulatory surplus requirement
- Secondary effects are assumed to be 0 in cases where the venting rate of destroyed gas is 100%
- GWP of substitute gas is assumed to be greater than or equal to the GWP of the destroyed gas
- Substitute gas is assumed to be HFC-134a if official published data, research, or industry studies are not available
- Default value for venting rate ($VR_{HFC,i}$) is 0% unless the project proponent demonstrates that all or a portion of the refrigerant destroyed meets the additionality requirements
- Default value for recovery rate ($RR_{HFC,i}$) is 100% unless the project proponent demonstrates that all or a portion of the refrigerant destroyed meets the additionality requirements
- Compliance rate for jurisdictions with regulations governing HFC collection and destruction is assumed to be 0% for eligible (Article 5) countries
- Saturation point of mixed or blended samples is assumed to be that of the HFC species in the mixture with the lowest saturation point that is at least 10% of the mixture by mass
- TDL_y (grid transmission and distribution losses) may conservatively be assumed to be 20%
- The carbon content of HFCs sent for destruction is completely converted to CO_2

4.7 Methods of Determining Uncertainty

Uncertainties may originate from estimated values and limitations in the accuracy of the systems used to monitor the HFC collection and destruction processes. These uncertainties affect the baseline scenario, the measurement of HFCs before destruction, the factors considered in the whole project emissions calculations, and the HFC destruction process. Each parameter used in the quantification (Sections 4.3 - 4.5) must have its uncertainty calculated from calibration checks, determined from relevant peer-reviewed scientific literature, or conservatively estimated with clear documentation, as applicable.

The degradation rate of HFCs in the atmosphere is well established in the literature, and will be used for calculation purposes. Conservative assumptions listed in Section 4.6 may be used without uncertainty estimation requirements. Credit issuance will be discounted on a conservative basis reflecting on the variability in these parameters, as described in Section 5.

4.8 Documentation and Monitoring Requirements

The project proponent must submit a detailed project monitoring plan as part of the Project Design Document (PDD). The monitoring plan should facilitate the gathering of all pertinent data needed for:

- Confirming the fulfilment of the eligibility requirements
- Confirming the emissions associated with the project and any emissions from secondary effects

The data gathered shall be kept on record for a minimum of five years following the conclusion of the project activity's final crediting period.

Details shall be provided and documented in the project monitoring plan to confirm that best practices are being utilized. In cases where such methods and procedures are not known or accessible, the project will establish, document, and apply standard operating procedures (SOPs) and quality control/quality assurance (QA/QC) processes for inventory tasks, including field data gathering and data management. It is advisable to use or modify SOPs obtained from published manuals.

After the project activities have begun, monitoring details shall be communicated via the Monitoring Report, as described in the GHR Registry Standard.

Point of Origin and Chain of Custody Requirements[10]

The project proponent shall generate documentation at the time of HFC collection from the point of origin and must include all the following:

- Facility name and physical address;
- Attestation form signed by point of origin facility representative;
- Identification of any refrigeration or air conditioning equipment by serial number, if available, or description, location, and function, if serial number is unavailable;
- Serial or ID number of containers used for storage and transport.

The attestation form shall be shared with the GHR Registry and the VVB and include the following:

- Whether the source equipment has been decommissioned or otherwise permanently retired from service; and
- The date of equipment servicing, decommissioning, or retirement.
- In the case of equipment servicing, documentation which demonstrates additionality, as described in Section 1.7.

The project proponent must collect and maintain documentation on the chain of custody and ownership of collected HFCs beginning at the point of origin until destruction, including all the following:

- Names, addresses, and contact information of all entities buying and selling HFCs for destruction; and
- The mass of HFC including ineligible HFC and contaminants, at each transaction.

Composition and Quantity Analysis Requirements

The requirements of this section[11] must be followed to determine the quantities of HFC refrigerants. Prior to destruction, the precise mass and composition of HFCs to be destroyed must be determined. The following analysis must be conducted: Mass shall be determined by individually measuring the weight of each container of HFCs:

1. When it is full prior to destruction; and
2. After it has been emptied and the contents have been fully purged and destroyed.

The mass of HFCs and any contaminants is equal to the difference between the full and empty weight, as measured. The following requirements must be met when weighing the containers of HFCs:

1. A single scale must be used for generating both the full and empty weight tickets at the destruction facility;

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[10] Derived from American Carbon Registry's Methodology for the Quantification, Monitoring, Reporting and Verification of Greenhouse Gas Emissions Reductions and Removals from the Destruction of Ozone Depleting Substances and High-GWP Foam Version 1.1. Available at: https://acrcarbon.org/wp-content/uploads/2023/03/acr-destruction-of-ods-and-high-gwp-foam-september-2017-v1-1cp-1.pdf

[11] This section is mainly based on Climate Action Reserve (CAR): U.S. Ozone Depleting Substances Project Protocol Version 2 February 27 2012 and on RAL Quality Assurance and Test Specifications for the Demanufacture of Refrigeration Equipment version: 2007/09

2. Weighing instruments must comply with the relevant national requirements and/or international standards – such as EC Directive 2009/23/EC or International Organization for Legal Metrology OIML R 76-1 – and be subject to regular calibration, as set out in the relevant national requirements and/or international standards to accuracy appropriate to its accuracy class. These instruments shall have a measuring range corresponding to the capacity of containers and tanks weighed. If a scale is found to be out of tolerance, it must be recalibrated;
3. The full weight must be measured no more than two days prior to commencement of destruction per the Certificate of Destruction; and
4. The empty weight must be measured no more than two days after the conclusion of destruction per the Certificate of Destruction.

Composition and concentration of HFCs shall be established for each individual container by taking a sample from each container of HFCs and having it analyzed for composition and concentration at a lab accredited to perform analyses in compliance with International Organization for Standardization (ISO) standard 17025. Sampling operations are only permitted to be conducted at the destruction facility. Where national standards exist, they may be used in lieu of ISO standards provided that they have been the subject of a verification or validation process addressing their accuracy and representativeness.

The laboratory performing the composition analysis must not be affiliated with the project proponent or the project activities beyond performing these services.

The following requirements must be met for each sample:

1. The sample must be taken while the HFC is in the possession of the company that will destroy the HFC;
2. Samples must be taken by a technician unaffiliated with the project proponent;
3. Samples must be taken with a clean, fully evacuated sample bottle that meets applicable U.S. DOT requirements or an equivalent national (host country) or ISO standard;
4. The technician must ensure that the sample is representative of the contents of the container;
5. Each sample must be taken in liquid state;
6. A minimum sample size of 0.453592 kg (1 pound) must be drawn for each sample;
7. Each sample must be individually labeled and tracked according to the container from which it was taken, and the following information recorded:
    - Time and date of sample
    - Name of project proponent
    - Name of technician taking sample
    - Employer of technician taking sample
    - Volume of container from which sample was extracted
    - Ambient air temperature at time of sampling
8. Chain of custody for each sample from the point of sampling lab must be documented by paper bills of lading or electronic, third-party tracking that includes proof of delivery.

All project samples shall be analyzed using the International Organization for Standardization (ISO) standard applicable. Further, where national standards exist, they may be used in lieu of ISO standards provided that they have been the subject of a verification or validation process addressing their accuracy and representativeness. In the case where no such standards exist, the US Air-Conditioning, Heating and Refrigeration Institute *700-2006* standard may be applied in lieu of ISO standards. The analysis shall provide:

1. Identification of the refrigerant(s)
2. Purity (%) of the HFC mixture by weight using gas chromatography
3. Moisture level in parts per million. The moisture content of each sample must be less than 75% of the saturation point for the HFC based on the temperature recorded at the time the sample was taken. For containers that hold mixed HFCs, the sample's saturation point shall be assumed to be that of the HFC species in the mixture with the lowest saturation point that is at least 10 percent of the mixture by mass.
4. Analysis of high boiling residue, which must be less than 10% by mass
5. Analysis of other HFCs in the case of mixtures of HFCs, and their percentage by mass. If any of the requirements above are not met, no GHG reductions may be verified for HFC destruction associated with that container. If a sample is tested and does not meet one of the requirements as defined above, the project proponent may elect to have the material re-sampled and re-analyzed. The project proponent may sample for moisture content and perform any necessary de-watering prior to the required sampling and laboratory analysis.

If the container holds non-mixed HFC (defined as greater than 90% composition of a single HFC species), no further information or sampling is required to determine the mass and composition of the HFC. If the container holds mixed HFCs, which is defined as less than 90% composition of a single HFC species, the project proponent must meet additional requirements as provided below.

Composition and Quantity Analysis Requirements for Mixed HFCs

If a container holds mixed HFCs, its contents must also be processed and measured for composition and concentration according to the requirements of this section. The sampling required under this section must be conducted at the final destruction facility. The circulation and sampling activities must be conducted by a third-party organization (i.e., not the project proponent), and by individuals who have been properly trained for the functions they perform. The project description must specify the procedures by which mixed HFCs are analyzed.

The composition and concentration of HFCs on a mass basis must be determined using the results of the analysis of this section for each container. The results of the composition analysis in the section above shall be used by verifiers to confirm that the destroyed HFC refrigerant is in fact the same HFC refrigerant that is sampled under these requirements. Prior to sampling, the HFC mixture must be circulated in a container that meets all the following criteria:

1. The container has no solid interior obstructions; mesh baffles or other interior structures that do not impede the flow of HFCs are acceptable;
2. The container was fully evacuated prior to filling;
3. The container must have sampling ports to sample liquid and gas phase HFC;
4. The liquid port intake must be at the bottom of the container, and the vapor port intake must be at the top of the container. For horizontally oriented mixing containers, the intakes must be located in the middle third of the container; and
5. The container and associated equipment can circulate the mixture via a closed loop system from the bottom to top.

If the original mixed HFC container does not meet these requirements, the mixed HFC must be transferred into a temporary holding tank or container that meets all the above criteria. The weight of the contents placed into the temporary container shall be calculated and recorded.

During transfer of refrigerant into and out of the temporary container, refrigerant shall be recovered to the vacuum levels required by the U.S. EPA for that refrigerant (see 40 CFR 82.156) or any national (host country) or ISO standard.

Once the mixed HFCs are in a container or temporary storage unit that meets the criteria above, circulation of mixed HFCs must be conducted as follows:

1. Liquid mixture shall be circulated from the liquid port to the vapor port;
2. A volume of the mixture equal to two times the volume in the container shall be circulated;
3. Circulation must occur at a rate of at least 113.6 L/minute; and
4. Start and end times shall be recorded.

Within 30 minutes of the completion of circulation, a minimum of two samples shall be taken from the bottom liquid port and analyzed according to the procedures above. The mass composition and concentration of the mixed HFCs shall be equal to the lesser of the two GWP-weighted concentrations.

In instances where the project proponent is unable to conduct the required sampling, containerization, and circulation procedures necessary to determine the precise proportions and GWP of mixed HFCs, a conservative approach shall be employed to estimate the RF reduction attributable to the destruction of the HFCs. Under this alternative approach, the GWP associated with the lowest-GWP HFC identified in the sample will be utilized as a proxy for the entire mixture. This conservative estimate ensures that the calculated RF reduction reflects a minimum, safeguarding against over-crediting in scenarios where comprehensive compositional analysis is impractical.

Destruction Facility Requirements

Destruction of HFCs must occur at a facility that has a valid host country permit for refrigerant destruction and meets the screening criteria for destruction technologies set out in the report, as may be updated from time to time, by the UNEP Technology and Economic Assessment Panel (TEAP) Task Force on Destruction Technologies.[12] In line with guidance from TEAP's Code of Good Housekeeping (Appendix B), facilities in which destruction occur must satisfy TEAP standards for destruction removal efficiency and must meet national standards for co-pollutants.

The UNEP TEAP Task Force on Destruction Technologies has reviewed HFC destruction and concluded "that no additional performance criteria [beyond ODS protocols] are necessary for assessing destruction technologies for the destruction of HFCs." ICF International, in a report commissioned by US EPA, similarly advises that "the best installation, handling, recovery, reclamation, and disposal practices are identical between ODS and HFCs." Thus operating parameters of the destruction unit while destroying HFC material shall be monitored and recorded as described in the Code of Good Housekeeping[13] (as reproduced in full in Appendix B) approved by the Montreal Protocol, with only the substitution of "HFC" for "ODS" where applicable. Likewise, the Technology Screening Process for ODS destruction technologies (reproduced in full in Appendix C from TEAP *Report of the Task Force on Destruction Technologies*, Chapter 2 (2002)) is equally valid for HFCs, and should be followed with only the substitution of "HFC" for "ODS" where applicable.

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[12] TEAP's screening criteria are not standards, nor do they meet internationally accepted emissions limits for pollutants. Performance criteria were developed only for the purposes of screening and recommending generic technologies, rather than specific facilities. Thus, facilities that satisfy TEAP DRE performance criteria and national standards for other pollutants are eligible locations for destruction in this methodology.

[13] TEAP, Code of Good Housekeeping in Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer - 7th Edition (2006).

4.9 Reporting Requirements

An initial Project Design Document (PDD) is required under this methodology. These documents and the content therein are subject to approval by SCS prior to registration in the GHR Registry. The PDD will be published and publicly available in the GHR Registry. Project proponents may request redactions to some information in PDDs to protect intellectual property and other business confidential information (e.g. proof of eligibility information, the specific terms of legal agreements, and intellectual property detailed in LCAs). Redaction will be at the sole choice of SCS but such permission will not be unreasonably withheld. However, all information will be subject to validation and verification requirements.

Specifications for the content of the Project Design Document can be found in the GHR Project Design Document Template, which includes:

- Proof of Eligibility (Section 1.4)
- Additionality, Risk of Secondary Effects, and Risk of Non-Permanence Evaluation (Sections 1.7-1.10)
- Project Purpose and Performance (Section 2)
- Project Boundaries Delineation (Section 3.1)
- Assessment of co-benefits, trade-offs, and SDGs (Section 3.3)
- Stakeholder Consultation
- Regulatory Compliance
- Project Monitoring Plan (Section 4.8)
- Thorough documentation of the equations, methods, measurements, and instruments used to record and process the data needed to fulfil the requirements of this methodology.

Project activities must be described in Monitoring Reports, as described in Section 4.8. Each Monitoring Report must cover the period from the last report to present, and will be published and publicly available in the GHR Registry. Project proponents may request redactions to some information in updated Monitoring Reports to protect intellectual property (IP). Redaction will be at the sole discretion of SCS, however, such permission will not be unreasonably withheld. All information will be subject to validation and verification requirements.

Project validation and verification reports shall be provided to the GHR Registry by the VVB. Project validation and verification reports shall clearly describe the process of the assessment as well as the findings from the assessment. Specifications for the content of the validation and verification reports can be found in the GHR Validation and Verification Report Template.

In addition, consistent with the GHR Registry Standard, project proponents shall file an incident report:

- If changes in processes, materials or activities are observed that could alter the level of RF reduction, describing the nature, timing, scale, and likely permanence of the change
- If measured levels of emission reduction are shown to fall short of projections, whether due to a known loss event (i.e., a planned or unplanned change in process or activity) or due to any other cause. The project proponent shall describe the nature, extent, scope and expected permanence of the shortfall, and provide a root cause analysis of the source of the shortfall.

4.10 Monitoring Period

Projects shall have their first verification no less than 12 months and no more than 36 months after the project start date. Subsequent verifications shall occur within three years of the last completed verification. Verification shall include onsite visits.

4.11 Project Validation

The project shall be validated based on the completed PDD within two years of the project start date.

5. CREDIT ISSUANCE

Credits will be issued after independent validation and verification that the requirements of this methodology have been met for HFC destruction. Credit issuance will be adjusted to reflect inherent uncertainties in measuring and monitoring the project activities. The adjustment will be based on the uncertainty assessment conducted as part of the project's quantification process and reported in the Monitoring Reports. Credit issuance will be adjusted to reach a 90% or greater certainty in the quantified CO_2e.

Once issued, the credits will be registered and tracked in the GHR Registry. The registry will record the details of each credit, including the project it was issued for, the date it was issued, the retirement date and retirement location, the amount of net CO_2e it represents, and associated documentation. All GHR Registry credits may be retired for carbon accounting only once, and all retirements are recorded in the GHR Registry.

5.1 Crediting Period

The crediting period for projects under this methodology is 5 years. The project may be renewed up to two times and must be re-validated for each crediting period.

5.2 Buffer Pool considerations

HFC destruction projects are not reversible and therefore are subject to the GHR Registry Standard's lower minimum buffer pool contribution requirement of 2% of the total credits issued. However, this buffer pool contribution percentage is subject to review on a project-by-project basis, based on the parameters identified in Appendix E, and may be increased as warranted.

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Appendix A: Country-Level Inclusion Criteria and Additionality Check

The Kigali Amendment to the Montreal Protocol assigns each signatory country to one of four possible HFC phasedown schedules, summarized in the table below.[14]

Table AI-1. HFC Phasedown Schedules

	Article/Group HFC Phasedown Schedules Pursuant to Kigali Amendment			
Country Group	Countries Included	Baseline Calculation Years	Freeze Year	First Stepdown Year
Non-Article 5 (Main)	Most of the developed world	2011, 2012, 2013	—	2019
Non-Article 5 (Other)	Belarus, Russia, Kazakhstan, Turkmenistan, Uzbekistan	2011, 2012, 2013	—	2020
Article 5 (Group 1)	Most of the developing world (includes China)	2020, 2021, 2022	2024	2029
Article 5 (Group 2)	The Middle East (also includes India)	2024, 2025, 2026	2028	2032

The Kigali Amendment to the Montreal Protocol requires the determination of baseline production and consumption, from which HFC phasedown schedules are calculated:

$$Production = CS_{Produced} - CS_{Destroyed} - CS_{Feedstock} \qquad \text{(Equation AI-1)}$$

$$Consumption = Production + Imports - Exports \qquad \text{(Equation AI-2)}$$

where CS or "controlled substance" refers to a substance in Annex A, B, C, E or F to the Montreal Protocol, whether existing alone or in a mixture. It includes the isomers of any such substance, except as specified in the relevant Annex, but excludes any controlled substance or mixture which is in a manufactured product other than a container used for the transportation or storage of that substance.

Substituting Equation AI-1 into Equation AI-2 yields the following equation for consumption:

$$Consumption = CS_{Produced} - CS_{Destroyed} + Imports - Exports \qquad \text{(Equation AI-3)}$$

The interaction between the Montreal Protocol and carbon crediting for HFC destruction depends on a country's phasedown stage because destroyed refrigerant ($CS_{Destroyed}$, Equation AI-3) is subtracted from both the baseline and stepdown consumption values. Specifically, if destruction occurs during baseline setting years, it will decrease the baseline consumption calculation and all subsequent stepdown year values will follow. As a result, destruction in Article 5 Group 2 countries is especially effective if completed in 2024-2026 (Table AI-1).

When a country is already in phasedown, however, subtracting destroyed refrigerant from the calculated consumption level may increase allowable production or imports. Such manipulations would be highly

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[14] Clark, E., & Wagner, S. (n.d.). The Kigali Amendment to the Montreal Protocol: HFC Phase-down. OzonAction (link).

improbable and have never been exploited, despite the existence of destruction credits for controlled substances such as ODS (Office of the Ozone Secretariat, unpublished data[15]).

Nevertheless, to safeguard against this issue, eligibility requirements for countries that use destruction to comply with their consumption limits may be updated to reflect this (Table A1-2). Specifically, Ozone Secretariat data can be monitored annually to ensure that destruction, as described in this methodology, is not enabling additional production of refrigerant gas.

If a country does increase its production or imports due to destruction, pathways for addressing this could include discounting total credits (by the excess over the cap) or removing them from the list of eligible countries. With these safeguards in place, this methodology can safely apply to all A5 countries which have ratified the Kigali Amendment.

Table A1-2. Proposed criteria for inclusion and exclusion

Scenario	Kigali Ratified	Baseline Set	Producer	Result	Who does this apply to?	Key considerations
I	No			Exclude	Any Article 5 country yet to ratify the Kigali Amendment (e.g., Qatar)	N/A
II	Yes	No		Include	Article 5 Group 2 (with Kigali Amendment ratified; e.g., India)	Destruction can be included in baseline calculation: $Baseline\ Consumption$ $= CS_{Prod} - CS_{Dest} - CS_{Feedstock} + Imports - Exports$ Given effect on baseline calculation, all efforts to raise awareness and promote inclusion should be a priority
III	Yes	Yes	No	Include, with check	Article 5 Group 1 countries with zero production (e.g., Indonesia)	It is essential that destruction does not enable production above set stepdown limits. A country is eligible if the following is true: $Consumption\ Limit \geq Imports - Exports - CS_{Feedstock}$ If not, then the destruction enabled consumption that would have otherwise been above phasedown limits. Courses of action can include assigning discounts to generated credits, [e.g., $\text{Discount} = (Imports - Exports - CS_{Feedstock}) - \text{Consumption Limit}$], or amending inclusion criteria if non-compliance continues for >1 year.
IV	Yes	Yes	Yes	Include, with check	Article 5 Group 1 countries with non-zero production (e.g., China)	It is essential that destruction does not enable production above set stepdown limits. A country is eligible if the following is true: $Consumption\ Limit \geq CS_{Prod} + Imports - Exports - CS_{Feedstock}$ If not, then the destruction enabled consumption that would have otherwise been above phasedown limits. Courses of action can include assigning discounts to generated credits, [e.g., $\text{Discount} = (Imports - Exports - CS_{Feedstock}) - \text{Consumption Limit}$], or amending inclusion criteria if non-compliance continues for >1 year.

Adapted from *Recovery and Destruction of Hydrofluorocarbon Refrigerant Gases in Article 5 Countries* from the Carbon Containment Lab.

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[15] Mr. Gerald Mutisya, Office of the Ozone Secretariat, analyzed past reported data to assess if destruction was among the uses allowing the party to stay in compliance by any Article 5 party from 1986-2022, inclusive of all controlled substances. Results indicated only one A5 country with one year in which a small amount of destruction was the basis for compliance. The amount destroyed is considered small because it was approximately 0.1% of the total production reported by that country in that year.

Appendix B: Code of Good Housekeeping[16]

To provide additional guidance to facility operators, in May 1992 the Technical Advisory Committee prepared a "Code of Good Housekeeping" as a brief outline of measures that should be considered to ensure that environmental releases of ozone-depleting substances (ODS) through all media are minimized. This Code, updated by the Task Force on Destruction Technologies and amended by the Parties at their Fifteenth Meeting, in 2003, is also intended to provide a framework of practices and measures that should normally be adopted at facilities undertaking the destruction of ODS.

Not all measures will be appropriate to all situations and circumstances and, as with any code, nothing specified should be regarded as a barrier to the adoption of better or more effective measures if these can be identified.

Pre-delivery

This refers to measures that may be appropriate prior to any delivery of ODS to a facility.

The facility operator should generate written guidelines on ODS packaging and containment criteria, together with labelling and transportation requirements. These guidelines should be provided to all suppliers and senders of ODS prior to agreement to accept such substances.

The facility operator should seek to visit and inspect the proposed sender's stocks and arrangements prior to movement of the first consignment. This is to ensure awareness on the part of the sender of proper practices and compliance with standards.

Arrival at the facility

This refers to measures that should be taken at the time ODS are received at the facility gate. These include an immediate check of documentation prior to admittance to the facility site, coupled with a preliminary inspection of the general condition of the consignment. Where necessary, special or "fast- track" processing and repackaging facilities may be needed to mitigate risk of secondary effects or loss of ODS. Arrangements should exist to measure the gross weight of the consignment at the time of delivery.

Unloading from delivery vehicle

This refers to measures to be taken at the facility in connection with the unloading of ODS. It is generally assumed that ODS will normally be delivered in some form of container, drum or other vessel that is removed from the delivery vehicle in total. Such containers may be returnable.

All unloading activities should be carried out in properly designated areas, to which restricted access of personnel applies. Areas should be free of extraneous activities likely to lead to, or increase the risk of, collision, accidental dropping, spillage, etc. Materials should be placed in designated quarantine areas for subsequent detailed checking and evaluation.

Testing and verification

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[16] Reproduced in full from: TEAP, Code of Good Housekeeping *in Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer - 7th Edition* (2006)

This refers to the arrangements made for detailed checking of the ODS consignments prior to destruction.

Detailed checking of delivery documentation should be carried out, along with a complete inventory, to establish that delivery is as advised and appears to comply with expectations.

Detailed checks of containers should be made both in respect of accuracy of identification labels, etc, and of physical condition and integrity. Arrangements must be in place to permit repackaging or “fast-track” processing of any items identified as defective. Sampling and analysis of representative quantities of ODS consignments should be carried out to verify material type and characteristics. All sampling and analysis should be conducted using approved procedures and techniques.

Storage and stock control

This refers to matters concerning the storage and stock control of ODS.

ODS materials should be stored in specially designated areas, subject to the regulations of the relevant local authorities. Arrangements should be put in place as soon as possible to minimize, to the extent practicable, stock emissions prior to destruction.

Locations of stock items should be identified through a system of control that should also provide a continuous update of quantities and locations as stock is destroyed and new stock delivered. In regard to storage vessels for concentrated sources of ODS, these arrangements should include a system for regular monitoring and leak detection, as well as arrangements to permit repackaging of leaking stock as soon as possible.

Measuring quantities destroyed

It is important to be aware of the quantities of ODS processed through the destruction equipment. Where possible, flow meters or continuously recording weighing equipment for individual containers should be employed. As a minimum, containers should be weighed “full” and “empty” to establish quantities by difference.

Residual quantities of ODS in containers that can be sealed and are intended to be returned for further use, may be allowed. Otherwise, containers should be purged of residues or destroyed as part of the process.

Facility design

This refers to basic features and requirements of plant, equipment and services deployed in the facility.

In general, any destruction facility should be properly designed and constructed in accordance with the best standards of engineering and technology and with particular regard to the need to minimize, if not eliminate, fugitive losses.

Particular care should be taken when designing plants to deal with dilute sources such as foams. These may be contained in refrigeration cabinets or may be part of more general demolition waste. The area in which foam is first separated from other substrates should be fully enclosed wherever possible and any significant emissions captured at that stage.

Pumps: Magnetic drive, sealers or double mechanical seal pumps should be installed to eliminate environmental releases resulting from seal leaks.

Valves: Valves with reduced leaks potential should be used. These include quarter-turn valves or valves with extended packing glands.

Tank vents (including loading vents): Filling and breathing discharges from tanks and vessels should be recovered or vented to a destruction process.

Piping joints: Screwed connections should not be used and the number of flanged joints should be kept to the minimum that is consistent with safety and the ability to dismantle for maintenance and repair.

Drainage systems: Areas of the facility where ODS are stored or handled should be provided with sloped concrete paving and a properly designed collection system. Water that is collected should, if contaminated, be treated prior to authorized discharge.

Maintenance

In general, all maintenance work should be performed according to properly planned programmes and should be executed within the framework of a permit system to ensure proper consideration of all aspects of the work.

ODS should be purged from all vessels, mechanical units and pipework prior to the opening of these items to the atmosphere. The contaminated purge should be routed to the destruction process or treated to recover the ODS.

All flanges, seals, gaskets and other sources of minor losses should be checked routinely to identify developing problems before containment is lost. Leaks should be repaired as soon as possible.

Consumable or short-life items, such as flexible hoses and couplings, must be monitored closely and replaced at a frequency that renders the risk of rupture negligible.

Quality control and quality assurance

All sampling and analytical work connected with ODS, the process and the monitoring of its overall performance should be subject to quality assessment and quality control measures in line with current recognized practices. This should include at least occasional independent verification and confirmation of data produced by the facility operators.

Consideration should also be given to the adoption of quality management systems and environment quality practices covering the entire facility.

Training

All personnel concerned with the operation of the facility (with "operation" being interpreted in its widest sense) should have training appropriate to their task. Of particular relevance to the ODS destruction objectives is training in the consequences of unnecessary losses and in the use, handling and maintenance of all equipment in the facility. All training should be carried out by suitably qualified and experienced personnel and the details of such training should be maintained in written records. Refresher training should be conducted at appropriate intervals.

Code of transportation

In the interest of protecting the stratospheric ozone layer, it is essential that used ODS and products containing ODS are collected and moved efficiently to facilities practising approved destruction technologies. For transportation purposes, used ODS should receive the same hazard classification as the original substances or products. In practice, this may introduce restrictions on hazardous waste shipment under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal and this should be consulted separately. In the absence of such specific restrictions, the following proposed code of transportation for ODS from customer to destruction facilities is provided as a guide to help minimize damage caused to the ozone layer as a result of ODS transfers. Additional guidance is contained in the United Nations Transport of Dangerous Goods Model Regulations.

It is important to supervise and control all shipments of used ODS and products containing ODS according to national and international requirements to protect the environment and human health. To ensure that ODS and products containing ODS do not constitute an unnecessary risk, they must be properly packaged and labelled. Instructions to be followed in the event of danger or accident must accompany each shipment to protect human beings and the environment from any danger that might arise during the operation.

Notification of the following information should be provided at any intermediate stage of the shipment from the place of dispatch until its final destination. When making notification, the notifier should supply the information requested on the consignment note, with particular regard to:

a. The source and composition of the ODS and products containing ODS, including the customer's identity;
b. Arrangements for routing and for insurance against damage to third parties;
c. Measures to be taken to ensure safe transport and, in particular, compliance by the carrier with the conditions laid down for transport by the States concerned;
d. The identity of the consignee, who should possess an authorized centre with adequate technical capacity for the destruction;
e. The existence of a contractual agreement with the consignee concerning the destruction of ODS and products containing ODS.

This code of transportation does not necessarily apply to the disposal of ODS-containing rigid insulation foams. The most appropriate way to dispose of such products may be by direct incineration in municipal waste incinerators or rotary kiln incinerators.

Monitoring

The objectives of monitoring should be to provide assurance that input materials are being destroyed with an acceptable efficiency generally consistent with the destruction and removal efficiency (DRE) recommendations listed in annex II to the present report and that the substances resulting from destruction yield environmentally acceptable emission levels consistent with, or better than, those required under national standards or other international protocols or treaties.

As there are as yet no International Organization for Standardization (ISO) standards applicable for the sampling and analysis of ODS or the majority of the other pollutants listed in annex IV to the present report, where national standards exist they should be employed. Further, where national standards exist they may be used in lieu of ISO standards provided that they have been the subject of a verification or validation process addressing their accuracy and representativeness.

As ISO develops international standards for pollutants listed in annex IV to the present report, the technical bodies charged with developing such standards should take note of the existing national standards including those identified in appendix F to the report of the Technology and Economic Assessment Panel (TEAP) of April 2002 (volume 3, report of the Task Force on Destruction Technologies) and strive to ensure consistency between any new ISO standards and the existing standard test methods, provided that there is no finding that those existing methods are inaccurate or unrepresentative.

Where national standards do not exist, the Technical Advisory Committee recommends adoption of the following guidelines for monitoring of destruction processes operating using an approved technology.

Recognizing that the Unites States of America Environmental Protection Agency (EPA) methods have been the subject of verification procedures to ensure that they are reasonably accurate and representative, that they cover all of the pollutants of interest (although not all ODS compounds have been the specific subject of verification activities), that they provide a comprehensive level of detail that should lead to replicability of the methods by trained personnel in other jurisdictions and that they are readily available for reference and downloading from the Internet without the payment of a fee, applicable EPA methods as described in appendix F to the 2002 report of TEAP may be employed.

In the interest of ensuring a common international basis of comparison for those pollutants or parameters where ISO standards exist (currently particulates, carbon monoxide, carbon dioxide and oxygen), use of those standards is encouraged and jurisdictions are encouraged to adopt them as national standards or acceptable alternatives to existing national standards.

The use of EPA or other national standards described in appendix F is also considered acceptable, however. The precedence given to the EPA methods in the present code is based on the relative comprehensiveness of the methods available (both in scope and content), and the relative ease of access to those methods.

Measurement of ODS

Operators of destruction facilities should take all necessary precautions concerning the storage and inventory control of ODS-containing material received for destruction. Prior to feeding the ODS to the approved destruction process, the following procedures are recommended:

a. The mass of the ODS-containing material should be determined, where practicable;
b. Representative samples should be taken, where appropriate, to verify that the concentration of ODS matches the description given on the delivery documentation;
c. Samples should be analysed by an approved method. If no approved methods are available, the adoption of United States EPA methods 5030 and 8240 is recommended;
d. All records from these mass and ODS-concentration measurements should be documented and kept in accordance with ISO 9000 or equivalent.

Control systems

Operators should ensure that destruction processes are operated efficiently to ensure complete destruction of ODS to the extent that it is technically feasible for the approved process. This will normally include the use of appropriate measurement devices and sampling techniques to monitor the operating parameters, burn conditions and mass concentrations of the pollutants that are generated by the process.

Gaseous emissions from the process need to be monitored and analysed using appropriate instrumentation. This should be supplemented by regular spot checks using manual stack-sampling methods. Other environmental releases, such as liquid effluents and solid residues, require laboratory analysis on a regular basis.

The continuous monitoring recommended for ongoing process control, including off-gas cleaning systems, is as follows:

a. Measurement of appropriate reaction and process temperatures;
b. Measurement of flue gas temperatures before and after the gas cleaning system;
c. Measurement of flue gas concentrations for oxygen and carbon monoxide.

Any additional continuous monitoring requirements are subject to the national regulatory authority that has jurisdiction. The performance of online monitors and instrumentation systems must be periodically checked and validated. When measuring detection limits, error values at the 95 per cent confidence level should not exceed 20 per cent.

Approved processes must be equipped with automatic cut-off control systems on the ODS feed system, or be able to go into standby mode whenever:

a. The temperature in the reaction chamber falls below the minimum temperature required to achieve destruction;
b. Other minimum destruction conditions stated in the performance specifications cannot be maintained.

Performance measurements

The approval of technologies recommended by TEAP is based on the destruction capability of the technology in question. It is recognized that the parameters may fluctuate during day-to-day operation from this generic capability. In practice, however, it is not possible to measure against performance criteria on a daily basis. This is particularly the case for situations where ODS only represents a small fraction of the substances being destroyed, thereby requiring specialist equipment to achieve detection of the very low concentrations present in the stack gas. It is therefore not uncommon for validation processes to take place annually at a given facility.

With this in mind, TEAP is aware that the measured performance of a facility may not always meet the criteria established for the technology. Nonetheless, TEAP sees no justification for reducing the minimum recommendations for a given technology. Regulators, however, may need to take these practical variations into account when setting minimum standards.

The ODS destruction and removal efficiency[17] for a facility operating an approved technology should be validated at least once every three years. The validation process should also include an assessment of other relevant stack gas concentrations identified in annex II to decision XV/[…] and a comparison with maximum levels stipulated in relevant national standards or international protocols/treaties.

Determination of the ODS destruction and removal efficiency and other relevant substances identified in annex IV to the present report should also be followed when commissioning a new or rebuilt facility or when any other significant change is made to the destruction procedures in a facility to ensure that all facility characteristics are completely documented and assessed against the approved technology criteria.

Tests shall be done with known feed rates of a given ODS compound or with well-known ODS mixtures. In cases where a destruction process incinerates halogen-containing wastes together with ODS, the total halogen load should be calculated and controlled. The number and duration of test runs should be carefully selected to reflect the characteristics of the technology.

In summary, the destruction and removal efficiency recommended for concentrated sources means that less than 0.1 gram of total ODS should normally enter the environment from stack-gas emissions when 1,000 grams of ODS are fed into the process. A detailed analysis of stack test results should be made available to verify emissions of halogen acids and polychlorinated dibenzodioxin and dibenzofuran (PCDD/PCDF). In addition, a site-specific test protocol should be prepared and made available for inspection by the appropriate regulatory authorities. The sampling protocol shall report the following data from each test:

a. ODS feed rate;
b. Total halogen load in the waste stream;
c. Residence time for ODS in the reaction zone;
d. Oxygen content in flue gas;
e. Gas temperature in the reaction zone;
f. Flue gas and effluent flow rate;
g. Carbon monoxide in flue gas;
h. ODS content in flue gas;
i. Effluent volumes and quantities of solid residues discharged;
j. ODS concentrations in the effluent and solid residues;
k. Concentration of PCDD/PCDF, particulates, HCl, HF and HBr in the flue gases;
l. Concentration of PCDD/PCDF in effluent and solids.

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[17] Destruction and removal efficiency has traditionally been determined by subtracting from the mass of a chemical fed into a destruction system during a specific period of time the mass of that chemical alone that is released in stack gases and expressing that difference as a percentage of the mass of that chemical fed into the system

Appendix C: Technology Screening Process[18]

The following text is reproduced in full from the UNEP Technology and Economic Assessment Panel Report of the Task Force on Destruction Technologies (2002). As a result, some footnote numbers and formatting may not be consistent with the original TEAP document. Information may also be outdated relative to the newest TEAP authoritative guidance on destruction technologies.

Criteria for Technology Screening

The following screening criteria were developed by the UNEP TFDT. Technologies for use by the signatories to the Montreal Protocol to dispose of surplus inventories of ODS were assessed on the basis of:

1. Destruction and Removal Efficiency (DRE)
2. Emissions of dioxins/furans
3. Emissions of other pollutants (acid gases, particulate matter, & carbon monoxide)
4. Technical capability

The first three refer to technical performance criteria selected as measures of potential impacts of the technology on human health and the environment. The technical capability criterion indicates the extent to which the technology has been demonstrated to be able to dispose of ODS (or a comparable recalcitrant halogenated organic substance such as PCB) effectively and on a commercial scale. For convenience, the technical performance criteria are summarized in Table 3-1. These represent the minimum destruction and removal efficiencies and maximum emission of pollutants to the atmosphere permitted by technologies that qualify for consideration by the TFDT for recommendation to the Parties of the Montreal Protocol for approval as ODS destruction technologies. The technologies must also satisfy the criteria for technical capability as defined below.

Table A3-1: Summary of Technical Performance Qualifications[19]

Performance Qualification	Units	Diluted Sources	Concentrated Sources
DRE	%	95	99.99
PCDDs/PCDFs	ng-ITEQ/NM^3	0.5	0.2
HCL/CL_2	mg/NM^3	100	100
HF	mg/NM^3	5	5
HBr/Br_2	mg/NM^3	5	5
Particulates	mg/NM^3	50	50
CO	mg/NM^3	100	100

Destruction and Removal Efficiency

Destruction Efficiency (DE)[20] is a measure of how completely a particular technology destroys a contaminant of interest – in this case the transformation of ODS material into non-ODS by-products. There are two commonly used but different ways of measuring the extent of destruction – DE and Destruction

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[18] Reproduced in full from: UNEP Technology and Economic Assessment Panel (TEAP) Report of the Task Force on Destruction Technologies, UNEP, 2002. Available at: http://ozone.unep.org/teap/Reports/Other_Task_Force/TEAP02V3b.pdf

[19] All concentrations of pollutants in stack gases and stack gas flow rates are expressed on the basis of dry gas at normal conditions of 0ºC and 101.3 kPa, and with the stack gas corrected to 11% O_2.

[20] Destruction Efficiency (DE) is determined by subtracting from the mass of a chemical fed into a destruction system during a specific period of time the mass of that chemical that is released in stack gases, fly ash, scrubber water, bottom ash, and any other system residues and expressing that difference as a percentage of the mass of the chemical fed into the system.

and Removal Efficiency (DRE).[21] For a more detailed explanation of how DRE is calculated, see section 4.2.1. The terms are sometimes interchanged or used inappropriately. DE is a more comprehensive measure of destruction than DRE, because DE considers the amount of the chemical of interest that escapes destruction by being removed from the process in the stack gases and in all other residue streams. Most references citing performance of ODS destruction processes only provide data for stack emissions and thus, generally, data is only available for DRE and not DE.

Because of the relatively volatile nature of ODS and because, with the exception of foams, they are generally introduced as relatively clean fluids, one would not expect a very significant difference between DRE and DE. For these reasons this update of ODS destruction technologies uses DRE as the measure of destruction efficiency. For the purposes of screening destruction technologies, the minimum acceptable DRE is:

- 95% for foams; and,
- 99.99% for concentrated sources.

It should be noted that measurements of the by-products of destruction of CFCs, HCFCs and halons in a plasma destruction process have indicated that interconversion of ODS can occur during the process. For example, under some conditions, the DRE of CFC-12 (CCl_2F_2) was measured as 99.9998%, but this was accompanied by a conversion of 25% of the input CFC-12 to CFC-13 ($CClF_3$), which has the same ozone-depleting potential. The interconversion is less severe when hydrogen is present in the process, but can nonetheless be significant.[22] For this reason, it is important to take into account all types of ODS in the stack gas in defining the DRE.

For the reasons described in the previous paragraph, the Task Force recommends that future calculations of DRE use the approach described below.[23]

DRE of an ODS should be determined by subtracting from the number of moles of the ODS fed into a destruction system during a specific period of time, the total number of moles of all types of ODS that are released in stack gases, and expressing that difference as a percentage of the number of moles of the ODS fed into the system.

In mathematical terms, $DRE = \frac{N_I^{in} - \sum_i N_i^{out}}{N_I^{in}}$ where N_I^{in} is the number of moles of ODS fed into the destruction system and N_I^{in} is the number of moles of the *i*th type of ODS that is released in the stack gases.

Emissions of Dioxins and Furans

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[21] Destruction and Removal Efficiency (DRE) has traditionally been determined by subtracting from the mass of a chemical fed into a destruction system during a specific period of time the mass of that chemical alone that is released in stack gases, and expressing that difference as a percentage of the mass of that chemical fed into the system.

[22] R. T. Deam, A. R. Dayal, T. McAllister, A. E. Mundy, R. J. Western, L. M. Besley, A. J. D. Farmer, E. C. Horrigan, and A. B. Murphy, Interconversion of chlorofluorocarbons in plasmas, *J. Chem. Soc.: Chem. Commun.* No. 3 (1995) 347-348; A. B. Murphy, A. J. D. Farmer, E. C. Horrigan, and T. McAllister, Plasma destruction of ozone depleting substances, *Plasma Chem. Plasma Process*. 22 (2002) 371-385.

[23] Since different ODS have different ODP, consideration should be given to taking into account the ODP of each type of ODS present in the stack gas in calculating the DRE. An appropriate definition that takes into account the differences in ODP is: *DRE of an ODS is determined by subtracting from the number of moles of the ODS fed into a destruction system during a specific period of time, the total number of moles of all types of ODS that are released in stack gases, weighted by their ODP relative to that of the feed ODS, and expressing that difference as a percentage of the number of moles of the ODS fed into the system.*

Any high temperature process used to destroy ODS has associated with it the potential formation (as byproducts) of polychlorinated dibenzo-paradioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). These substances are among the products of incomplete combustion (or PICs) of greatest concern for potential adverse effects on public health and the environment. The internationally recognized measure of the toxicity of these compounds is the toxic equivalency factor (ITEQ),[24] which is a weighted measure of the toxicity for all the members of the families of these toxic compounds that are determined to be present.

The task force members note that the World Health Organization has developed a new system for calculating TEQs, however, most of the existing data on emissions is expressed in the former ITEQ system established in 1988.

For purposes of screening destruction technologies, the maximum concentration of dioxins and furans in the stack gas from destruction technologies is:

- 0.5 ng-ITEQ/Nm^3 for foams; and,
- 0.2 ng-ITEQ/Nm^3 for concentrated sources.

These criteria were determined to represent a reasonable compromise between more stringent standards already in place in some industrialized countries [for example, the Canada-Wide Standard of 0.08 ng/m^3 (ITEQ)], and the situation in developing countries where standards may be less stringent or non-existent. Although a previous standard of 1.0 ng/m^3 (ITEQ) had been suggested in the UNEP 1992 report, advances in technology in recent years, and the level of concern for emissions of these highly toxic substances justified a significantly more stringent level.

Emissions of Acid Gases, Particulate Matter and Carbon Monoxide

Acid gases are generally formed when ODS are destroyed and these must be removed from the stack gases before the gases are released to the atmosphere. The following criteria for acid gases have been set for purposes of screening destruction technologies:

- A maximum concentration in stack gases of 100 mg/Nm^3 HCl/Cl$_2$ • A maximum concentration in stack gases of 5 mg/Nm^3 HF; and,
- A maximum concentration in stack gases of 5 mg/Nm^3 HBr/Br$_2$.

Particulate matter is generally emitted in the stack gases of incinerators for a variety of reasons and can also be emitted in the stack gases of facilities using non-incineration technologies. For the purposes of screening technologies, the criterion for particulate matter is established as:

- A maximum concentration of total suspended particulate (TSP) of 50 mg/Nm^3.

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[24] There are 75 chlorinated dibenzo-p-dioxins and 135 chlorinated dibenzofurans that share a similar chemical structure but that have a wide range in degree of chlorination and a corresponding wide range in toxicity. Of these, one specific dioxin [2,3,7,8- Tetrachlorodibenzo-p-dioxin, or (TCDD)] is the most toxic and best characterized of this family of compounds. Since PCDDs and PCDFs are generally released to the environment as mixtures of these compounds, the scientific community has developed a system of toxic equivalency factors (TEFs) which relate the biological potency of compounds in the dioxin/furan family to the reference TCDD compound. The concentration of each specific compound is multiplied by its corresponding TEF value, and the resulting potency-weighted concentration values are summed to form an expression of the mixture's overall toxic equivalence (TEQ). The result of this exercise is a standardized expression of toxicity of a given mixture in terms of an equivalent amount of TCDD (the reference compound). The internationally accepted protocol for determining TEQ – i.e., ITEQ – was established by NATO in 1988. [Scientific Basis for the Development of International Toxicity Equivalency Factor (I-TEF), Method of Risk Assessment for Risk Assessment of Complex Mixtures of Dioxins and Related Compounds. North Atlantic Treaty Organization/Committee on the Challenge of Modern Society. Report No. 176, Washington, D.C. 1988.]

Carbon monoxide (CO) is generally released from incinerators resulting from incomplete combustion and may be released from some ODS destruction facilities because it is one form by which the carbon content of the ODS can exit the process. Carbon monoxide is a good measure of how well the destruction process is being controlled. For the purposes of screening technologies, the following criterion has been established:

- A maximum CO concentration in the stack gas of 100 mg/Nm^3.

These maximum concentrations apply to both foams and concentrated sources. They were set to be achievable by a variety of available technologies while ensuring adequate protection of human health and the environment.

Technical Capability

As well as meeting the above performance requirements it is necessary that the destruction technologies have been demonstrated to be technically capable at an appropriate scale of operation. In practical terms, this means that the technology should be demonstrated to achieve the required DRE while satisfying the emissions criteria established above.

Demonstration of destruction of ODS is preferred but not necessarily required. Destruction of halogenated compounds that are refractory, i.e., resistant to destruction, is acceptable. For example, demonstrated destruction of polychlorinated biphenyls (PCBs) was often accepted as an adequate surrogate for demonstrated ODS destruction.

For this evaluation, an ODS destruction technology is considered technically capable if it meets the following minimum criteria:

- It has been demonstrated to have destroyed ODS to the technical performance standards, on at least a pilot scale or demonstration scale (designated in Table 2-2 as “Yes”).
- It has been demonstrated to have destroyed a refractory chlorinated organic compound other than an ODS, to the technical performance standards, on at least a pilot scale or demonstration scale (designated in Table 2-2 as “P,” which indicates that the technology is considered to have a high potential for application with ODS, but has not actually been demonstrated with ODS).
- The processing capacity of an acceptable pilot plant or demonstration plant must be no less than 1.0 kg/hr of the substance to be destroyed, whether ODS or a suitable surrogate.

These criteria of technical capability will minimize the risk associated with technical performance and ensure that destruction of ODS will be performed in a predictable manner consistent with protecting the environment.

Appendix D: Data and Parameters

Data and Parameters Available at Validation

Data/Parameter:	$GWP_{HFC,i}$
Data Unit:	t CO_2e/t HFC_i
Description:	Global warming potential of HFC refrigerant i
Source of data:	IPCC
Description of measurement methods and procedures to be applied:	See Table 1 above for values. Shall be updated according to any future COP/MOP decisions or Assessment Reports.
Comments:	

Data/Parameter:	$GWP_{Sub,i}$
Data Unit:	t CO_2e/t Substitute
Description:	Global warming potential of substitute refrigerant for HFC refrigerant i
Source of data:	IPCC
Description of measurement methods and procedures to be applied:	See Table 1 above for values. Shall be updated according to any future COP/MOP decisions or Assessment Reports. The project proponent shall apply a substitute chemical derived from either official published data, research, industry studies, or assume destroyed refrigerants to be replaced by HFC-134a (as per the latest version of the Climate Action Reserve's Article 5 ODS Project Protocol). This will be periodically re-assessed and updated.
Comments:	

Data/Parameter:	$VR_{HFC,i}$
Data Unit:	%; expressed as a proportion [0-1]
Description:	Rate of HFC refrigerant *i* which would be vented in the baseline
Source of data:	Default value given below or project-specific rate(s) sourced from officially published data, research studies, industry data, etc. The default rate is 0% unless the project proponent demonstrates that all or a portion of the refrigerant destroyed meets the requirements of Section 1.7 above. For refrigerant from such sources, the venting rate is assumed to be 100%.
Description of measurement methods and procedures to be applied:	For default rate, see documentation as outlined in Section 1.7. For project-specific rate, consult officially published country data, research studies, industry data, etc.
Comments:	Calculated as a cumulative rate over the 10-year period following HFC destruction.

Data/Parameter:	$RR_{HFC,i}$
Data Unit:	%; expressed as a proportion [0-1]

Description:	Rate of HFC refrigerant *i* which would be used, reused, or remain in storage in the baseline
Source of data:	Default value given below or project-specific rate(s) sourced from officially published data, research studies, industry data, etc. The default rate is 100% unless the project proponent demonstrates that all or a portion of the refrigerant destroyed meets the requirements of Section 1.7 above. For refrigerant destroyed from such sources, the recovery rate is assumed to be 0%.
Description of measurement methods and procedures to be applied:	For default rate, see documentation as outlined in Section 1.7. For project-specific rate, consult officially published data, research studies, industry data, etc.
Comments:	Calculated as a cumulative rate over the 10-year period following HFC destruction.

Data/Parameter:	$DR_{HFC,i}$
Data Unit:	%; expressed as a proportion [0-1]
Description:	Rate of HFC refrigerant *i* which would be destroyed in the baseline
Source of data:	Default value given below or project-specific rate(s) sourced from officially published data, research studies, industry data, etc. In the absence of a government mandate, product stewardship scheme, or other program that creates an incentive or mechanism for HFC refrigerant destruction in the country(ies) where the project activity occurs, the default rate is 0%.
Description of measurement methods and procedures to be applied:	
Comments:	Calculated as a cumulative rate over the 10-year period following HFC destruction.

Data/Parameter:	$LR_{HFC,I,y}$
Data Unit:	%; expressed as a proportion [0-1]
Description:	Leak rate of HFC refrigerant *i* or substitute chemical in year *y* [0-1]
Source of data:	Default values given below or project-specific rate(s) sourced from officially published data, research studies, industry data, etc. Default values for HFC refrigerant used or reused in existing equipment are the applicable annual emission rates given in the latest version of the Climate Action Reserve's Article 5 ODS Project Protocol.
Description of measurement methods and procedures to be applied:	
Comments:	

Data/Parameter:	$PE_{Sub,i}$
Data Unit:	t CO_2e

Description:	Emissions associated with the production of substitute refrigerant for HFC refrigerant *i* [t CO_2e]
Source of data:	Officially published data, research studies, LCA, or industry data.
Description of measurement methods and procedures to be applied:	
Comments:	Shall be updated to reflect the results of a refrigerant production LCA in a later version. In scenarios where $RR_{HFC,i} = 0$, estimation of $PE_{Sub,i}$ may be omitted.

Data/Parameter:	$CC_{HFC,i,y}$
Data Unit:	t CO_2/t HFCi
Description:	Carbon content of HFC refrigerant *i*
Source of data:	Reliable (e.g., government or academic) source of HFC refrigerant *i* chemical composition
Description of measurement methods and procedures to be applied:	
Comments:	

Data and Parameters Monitored

Data/Parameter:	$M_{DESTR,HFC,i,y}$
Data Unit:	t HFC_i
Description:	Quantity of HFC refrigerant i sent for destruction by the project activity, including eligible and ineligible material, during year y
Source of data:	• Operation logbook of recovery facility • Identification note for each individual HFC container by a bill of lading • Certificate of Destruction for each individual HFC container (refer to Section 4.8 of this methodology "Documentation and Monitoring Requirements")
Description of measurement methods and procedures to be applied:	Refer to Section 4.8 of this methodology "Documentation and Monitoring Requirements"
Frequency of monitoring/ recording:	Each container with HFC sent for destruction
QA/QC procedures to be applied:	All measurements should be conducted with calibrated measurement equipment according to relevant industry standards (refer to Section 4.8 of this methodology "Documentation and Monitoring Requirements")
Comments:	

Data/Parameter:	$M_{DESTR,eHFC,i,y}$
Data Unit:	t HFC_i

Description:	Eligible quantity of HFC refrigerant i sent for destruction by the project activity, including eligible and ineligible material, during year y
Source of data:	• Operation logbook of recovery facility • Identification note for each individual HFC container by a bill of lading • Certificate of Destruction for each individual HFC container (refer to Section 4.8 of this methodology “Documentation and Monitoring Requirements”)
Description of measurement methods and procedures to be applied:	Refer to Section 1.4 of this methodology “Eligibility Requirements for Projects under the Methodology"
Frequency of monitoring/ recording:	Each container with HFC sent for destruction
QA/QC procedures to be applied:	All measurements should be conducted with calibrated measurement equipment according to relevant industry standards (refer to Section 4.8 of this methodology “Documentation and Monitoring Requirements”)
Comments:	

Data/Parameter:	CR_y
Data Unit:	%; expressed as a proportion [0-1]
Description:	Host country-level compliance rate of the law, statute or other regulatory framework in the year y. Calculation of the compliance rate shall exclude other projects implemented under GHG programs. If the compliance rate exceeds 50% (or 0.50), the project shall receive no further credit.
Source of data:	Default rate given below or officially published data, inventories, research studies, industry data etc. In countries eligible under this methodology, the default compliance rate is assumed to be 0%.
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/ recording:	Annually
QA/QC procedures to be applied:	
Comments:	Should baseline rates begin to increase due to increased enforcement of venting prohibitions or for any other reason, the methodology will be revised and further guidance will be provided on the calculation protocols.

Data/Parameter:	$FC_{i,j,y}$
Data Unit:	Mass or volume unit per year (e.g. tonne/y or m³/y)
Description:	Quantity of fuel type i combusted in process j in year y (aggregation)
Source of data:	Onsite measurements
Description of measurement methods	Use utility bills or invoices for purchased fuel, or alternatively, either mass or volume meters onsite. In cases where fuel is supplied from small daily

and procedures to be applied:	tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Frequency of monitoring/ recording:	Continuously
QA/QC procedures to be applied:	If onsite measurements are used, the consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the project activity, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Comments:	

Data/Parameter:	$EC_{PJ,y}$
Data Unit:	MWh
Description:	Amount of electricity consumed at the HFC aggregation facility from the grid during year y
Source of data:	Onsite measurements and recorded by a computer system and/or by printed journals; or, alternatively, utility bills or invoices for purchased electricity
Description of measurement methods and procedures to be applied:	Directly measured by calibrated electricity meter installed at the project site.
Frequency of monitoring/ recording:	Continuously, aggregated at least annually
QA/QC procedures to be applied:	If onsite measurements are used, cross check measurement results with invoices for purchased electricity if relevant
Comments:	

Data/Parameter:	$EF_{grid,y,f}$
Data Unit:	t/MWh
Description:	Grid emission factor during the monitoring period y
Source of data:	Officially published data, research studies, LCA, or industry data.
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/ recording:	

QA/QC procedures to be applied:	If the “Tool to calculate the emission factor for an electricity system” will be used the source and/or the calculation shall be available by printed journals.
Comments:	

Data/Parameter:	TDL_y
Data Unit:	%, expressed as proportion [0-1]
Description:	Average technical transmission and distribution losses in the grid for the voltage level at which electricity is obtained from the grid at the project site during year y
Source of data:	Choose one of the following options: a) Use recent, accurate and reliable data available within the country; or b) Use a conservative default value of 20%
Description of measurement methods and procedures to be applied:	For a) TDL_y should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project proponent or be based on references from utilities, network operators or other official documentation.
Frequency of monitoring/ recording:	
QA/QC procedures to be applied:	In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
Comments:	

Data/Parameter:	$FC_{i,k,y}$
Data Unit:	Mass or volume unit per year (e.g. tonne/y or m^3/y)
Description:	Quantity of fuel type i combusted in process k in year y (transportation)
Source of data:	Onsite measurements
Description of measurement methods and procedures to be applied:	Use utility bills or invoices for purchased fuel, or alternatively, either mass or volume meters onsite. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Frequency of monitoring/ recording:	Continuously
QA/QC procedures to be applied:	If onsite measurements are used, the consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where

	the purchased fuel invoices can be identified specifically for the project activity, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Comments:	

Data/Parameter:	$FC_{i,l,y}$
Data Unit:	Mass or volume unit per year (e.g. tonne/y or m^3/y)
Description:	Quantity of fuel type i combusted in process l in year y (destruction)
Source of data:	Onsite measurements
Description of measurement methods and procedures to be applied:	Use utility bills or invoices for purchased fuel, or alternatively, either mass or volume meters onsite. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Frequency of monitoring/ recording:	Continuously
QA/QC procedures to be applied:	If onsite measurements are used, the consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the project activity, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Comments:	

Data/Parameter:	$D_{k,y}$
Data Unit:	distance unit (e.g., km)
Description:	Total distance HFCs are transported from aggregation to destruction facility
Source of data:	Onsite measurements
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/ recording:	Continuously (per shipment of HFCs)
QA/QC procedures to be applied:	
Comments:	

Data/Parameter:	$TM_{HFCs\_DEST,y}$

Data Unit:	t or other mass unit
Description:	Total transported mass of HFCs, including the mass of the container
Source of data:	Onsite measurements
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/ recording:	Continuously (per shipment of HFCs)
QA/QC procedures to be applied:	
Comments:	Tonnes is the default unit, but another mass unit may be used to ease use of an appropriate emission factor.

Data/Parameter:	$EC_{DEST,y}$
Data Unit:	MWh
Description:	Amount of electricity consumed at the HFC destruction facility from the grid during year y
Source of data:	Onsite measurements and recorded by a computer system and/or by printed journals; or, alternatively, utility bills or invoices for purchased electricity
Description of measurement methods and procedures to be applied:	Directly measured by calibrated electricity meter installed at the project site.
Frequency of monitoring/ recording:	Continuously, aggregated at least annually
QA/QC procedures to be applied:	If onsite measurements are used, cross check measurement results with invoices for purchased electricity if relevant
Comments:	

Appendix E. Project Risks for Consideration When Establishing Buffer Pool Contributions

The following is a list of potential events that could affect the validity of credits issued for projects in any given specific project category. Methodologies representing specific project types provide additional guidance where applicable.

Reversal Risks

Environmental Events that result in the release of sequestered carbon, including:

- Fire
- Drought
- Disease/Pests
- Flood
- Earthquake
- Storms
- Heatwaves
- Avalanche

Human activity that unintentionally or deliberately result in the release of sequestered carbon

- Land-use changes (e.g., deforestation, urban development)
- Project site abandonment (due to inadequate management, financial failure, socio-political instability, economic crises, community opposition, etc)
- Failure of maintenance or oversight

Regulatory, Legal, and Compliance Risks

Regulatory Changes

- Alterations in national or regional regulations that invalidate or require re-evaluation of credit validity.
- Introduction of new performance or safety standards that retroactively affect previously verified projects.

Legal Disputes

- Litigation challenging the validity of credits.
- Ownership disputes over land or resources related to the project.

Compliance Failures

- Failure to adhere to regulatory requirements after credit issuance.

- Non-compliance with ongoing monitoring and reporting obligations.

Project Implementation and Verification Risks

Inadequate technical capacity of the VVB, VVB contractor, or project proponent

- Deliberate or unintentional misrepresentation of project outcomes by the VVB, VVB contractor, or project proponents
- Inaccurate or incomplete Measurement, Reporting, and Verification processes leading to issuance of credits that do not reflect actual carbon reductions or removals
- Inaccurate data collection methods or issues related to the security, accuracy, and storage of data over time

Glossary

The definitions in this section apply to the terminology used in this methodology. A more comprehensive list of definitions can be found in the GHR Glossary of Terms.

Aggregation: The collection of HFC refrigerant in any condition in a centralized holding location. Aggregation can include the combining of HFC refrigerants in a single container or refer to the storage of multiple containers in a single location.

Aggregation Facility: Any facility in which HFC refrigerant or products containing HFC refrigerant are aggregated or stored for the purposes of the project activity, additional to the recovery site. Aggregation facilities are not a requirement of the full system (i.e., recovered HFC refrigerant can be transported directly to the destruction facility).

Article 5 Country: Any party to the Montreal Protocol that is a developing country and whose annual calculated level of consumption of the controlled substances in Annex A (of the Montreal Protocol) is less than 0.3 kilograms per capita. Article 5 countries are separated into two groups. Group 1 is the majority of Article 5 countries, while Group 2 is composed of Bahrain, India, Iran, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, and the United Arab Emirates. Group 2 countries have a delayed freeze (2028 compared with 2024) and phasedown schedule.

Baseline Scenario: The business-as-usual scenario representing the project area environment and emissions in the absence of the project.

Climate Forcer: any external driver of climate change that causes a positive or negative change in RF (e.g., an emission, substance, process, activity or change in state). *Source: Radiative Forcing Protocol.*

Destruction Facility: The facility where the destruction of the HFC refrigerant takes place and which falls in the categories of destruction technologies set out in the report, as may be updated from time to time, by the UNEP Technology and Economic Assessment Panel (TEAP) Task Force on Destruction Technologies. Facilities must also comply with national regulations in which the project activity occurs.

Hermetically Sealed Container: A container which has a seal capable of blocking the passage of gas in or out of the container. Gas cylinders are an example of hermetically sealed containers.

Hydrofluorocarbon: A family of man-made compounds that contain carbon, fluorine, and hydrogen. Although HFCs do not deplete stratospheric ozone, many are Greenhouse Gases (GHGs) with high Global Warming Potentials (GWPs). The Kigali Amendment to the Montreal Protocol governs a global phasedown of HFC production.

HFC Refrigerant: A chemical (being an HFC) used or intended for use in a cooling mechanism, such as an air conditioner or refrigerator, as the heat carrier which changes from gas to liquid and then back to gas in the refrigeration cycle.

Leak Rate: The rate at which HFC refrigerant escapes from the product through normal operation.

Non-Article 5 Country: Any party to the Montreal Protocol which is not an Article 5 country.

Point of Origin: see Recovery Site.

Product: Any of the following: refrigeration, air conditioning or fire suppression equipment, systems, appliances, or disposable cylinders.

Project Area: The area within the project boundary where project activities take place. The project area may be contiguous or be comprised of multiple areas within a larger defined boundary.

Recovery: To remove refrigerant in any condition from a product and store it in an external container.

Recovery Site: The location where the project proponent recovers HFCs from appliances, including stationary equipment such as a chiller, or obtains appliances from which HFCs are to be recovered. For documentation and chain of custody requirements, this is also known as point of origin.

Reclaim: To reprocess used HFC refrigerants, typically by distillation, to specifications that meet or exceed virgin product specifications with the objective of reusing the refrigerant.

Recycle: To extract refrigerants from an appliance and clean them using oil separation and single or multiple passes through filter-driers, which reduce moisture, acidity, and particulate matter.

Venting: To directly release a chemical to the atmosphere. In the case of HFC refrigerants, venting refers to the process whereby HFC is directly released to the atmosphere during the servicing of or at the end-of-life of a product.

Acronyms and Abbreviations:
CDM: Clean Development Mechanism
GHG: Greenhouse gas
GHR: Global Heat Reduction
GWP: Global Warming Potential
HCFC: Hydrochlorofluorocarbon
HFC: Hydrofluorocarbon
IPCC: Intergovernmental Panel on Climate Change
ODS: Ozone-depleting substance
PDD: Project Design Document
RF: Radiative forcing
SOP: Standard Operating Procedure
SSR: Sources, sinks, and reservoirs
VVB: Validation and verification body

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