Federal Offset Protocol: Reducing Greenhouse Gas Emissions from Refrigeration Systems

Version 1.1
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Canada's Greenhouse Gas Offset Credit System

Environment and Climate Change Canada
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Canada

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Foreword

Canada's Greenhouse Gas (GHG) Offset Credit System is established under Part 2 of the Greenhouse Gas Pollution Pricing Act (GGPPA), to provide an incentive to undertake projects that result in domestic GHG reductions that would not have been generated in the absence of the project, that go beyond legal requirements and that are not subject to carbon pollution pricing mechanisms.

Canada's GHG Offset Credit System consists of:

- The *Canadian Greenhouse Gas Offset Credit System Regulations* (the Regulations) which establish the system, implement operational aspects and set general requirements applicable to all project types
- Federal offset protocols, included in the *Compendium of Federal Offset Protocols* (the Compendium), each containing requirements for project implementation and methods for quantifying GHG reductions for a given project type, and
- The Credit and Tracking System (CATS) to register offset projects, issue and track offset credits, and share key information through a public registry

Only projects following a federal offset protocol included in the Compendium and meeting all requirements outlined in the Regulations can generate offset credits under the Regulations.

Document revision history

Version number	Publication date	Summary of changes
1.1	December 8, 2023	A provision was added to make ammonia non-eligible as a refrigerant in cases where a new refrigeration system is installed and there is no pre-existing system (Section 4.2). A document was added as a record to be retained for the installation of a new refrigeration system that replaces a pre-existing system (Section 10.0). Some provisions in the protocol were clarified or streamlined consistent with the original intent.
1.0	February 24, 2023	Initial version of the protocol.

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1.0 Introduction

Emissions of hydrofluorocarbons (HFCs) from industrial and commercial refrigeration or air conditioning systems are caused by releases during equipment installation, when charging equipment with refrigerant, either initially or when re-filling (top-up), and leaks from equipment operations. Lowering the global warming potential (GWP) of refrigerants used in these systems in Canada ensures that the associated impacts on climate change from unavoidable equipment leaks are minimized to the extent possible.

The federal offset protocol for *Reducing Greenhouse Gas Emissions from Refrigeration Systems* is intended for use by a proponent undertaking a project to transition away from refrigerants with high GWP values in their commercial and industrial refrigeration or air conditioning systems, in order to generate offset credits under the *Canadian Greenhouse Gas Offset Credit System Regulations* (Regulations). The requirements contained in this protocol are part of the Regulations and must be read in conjunction with provisions in the Regulations.

The proponent must follow the methodology and requirements contained in this protocol to quantify and report greenhouse gas (GHG) emission reductions generated from the following eligible project activities:

1) retrofitting a pre-existing refrigeration or air conditioning system to use an eligible refrigerant; or,
2) installing a new refrigeration or air conditioning system containing an eligible refrigerant.

Additional GHG emission reductions can be generated by destroying HFCs contained within high-GWP refrigerant from a pre-existing refrigeration or air conditioning system that is being retrofitted or replaced in 1) or 2) above, respectively. HFC destruction must occur within Canada.

GHG emissions reductions under this protocol cannot be generated from destroying, reducing or replacing ozone-depleting substances (ODS) contained in high-GWP refrigerant.

This protocol is designed to ensure that, together with requirements in the Regulations, the project generates GHG emission reductions that are real, additional, quantified, verified, unique and permanent. The protocol is also developed in accordance with the principles of ISO 14064-2:2019 *Greenhouse gases – Part 2 – Specification with guidance at the project level for quantification, monitoring and reporting greenhouse gas emission reductions or removal enhancements* to ensure reported GHG emission reductions are relevant, complete, consistent, accurate, transparent, and conservative.

2.0 Terms and definitions

Act

means the *Greenhouse Gas Pollution Pricing Act (GGPPA)*.

Absorption

for the purposes of this protocol, means a refrigeration cycle with a fluid absorbent and a fluid refrigerant that has a GWP equal to zero that is part a refrigeration system.

Adsorption

for the purposes of this protocol, means a refrigeration cycle with a solid sorbent and a fluid refrigerant with a GWP equal to zero that is part of a refrigeration system.

Authorized Destruction Facility

means a facility located in Canada that is authorized by the government of the province or territory in which the facility is located to receive used refrigerants for the purpose of destroying HFCs.

Authorized Reclamation Facility

means a facility located in Canada that is authorized by the government of the province or territory in which the facility is located to receive used refrigerants for the purpose of reclaiming HFCs.

Eligible Refrigerant

means a refrigerant used in the project scenario with either a GWP lower than the value in column 2 of Table 2 for the corresponding refrigeration system type in column 1 of Table 2, or if applicable, a GWP lower than the GWP limit imposed by the province or territory in which the project site is located for refrigerants contained within refrigeration systems, whichever is lower.

Global Warming Potential (GWP)

means a metric representing the ability of a greenhouse gas (GHG) to trap heat in the atmosphere compared to carbon dioxide (CO_2), as provided in Column 2 of Schedule 3 to the Act.

High-GWP Refrigerant

means a refrigerant that contains one or more HFCs and has a GWP equal to or higher than the value in Column 2 of Table 2 for the corresponding refrigeration system type in column 1 of Table 2, or if applicable, a GWP equal to or higher than the relevant provincial or territorial GWP limit for refrigerants contained within refrigeration systems where the project is located, whichever is lower.

Ozone-Depleting Substance (ODS)

means all substances identified in Parts 1, 2 and 3 of the *Ozone- depleting Substances and Halocarbon Alternatives Regulation* (ODSHAR).

Pre-existing refrigeration system

means a refrigeration system that has been using the same refrigerant and operating at the project site for more than 3 years prior to the project start date, and will be retrofitted to use an eligible refrigerant, or replaced by a new refrigeration system that uses an eligible refrigerant.

Project Site

means the location of a single commercial or industrial facility at which one or more refrigeration systems are operated in the project scenario, as applicable.

Refrigerant

means a single-component refrigerant, refrigerant blend or refrigerant alternative that is used in a refrigeration system.

Refrigeration system

means a commercial or industrial system providing refrigeration or air conditioning that is made up of one or more pieces of equipment.

Regulations

means *Canadian Greenhouse Gas Offset Credit System Regulations.*

3.0 Baseline scenario

3.1 Baseline conditions

One of the following conditions must apply in the baseline scenario in order for the project to be eligible under this protocol.[1]

1. There is a pre-existing refrigeration system of a type identified in Table 1 at the project site, and:
    a. no regulation or legal requirement exists to either replace the pre-existing refrigeration system, or to change the refrigerant or any piece of equipment within the pre-existing refrigeration system (system retrofit); and
    b. the pre-existing refrigeration system does not use a refrigerant which consists entirely of ozone-depleting substances (ODS); or
2. There is no pre-existing refrigeration system at the project site where one or more new refrigeration systems will be installed.

[1] The baseline scenario consists of the relevant SSRs referred to in Section 7.0 Project GHG boundary.

Table 1: Baseline scenario refrigeration systems

Column 1	Column 2
Refrigeration System Type	**Description**
Stand-alone medium temperature refrigeration system	Self-contained refrigeration system with components that are integrated within its structure and that is designed to maintain an internal temperature ≥ 0°C.
Stand-alone low temperature refrigeration system	Self-contained refrigeration system with components that are integrated within its structure and that is designed to maintain an internal temperature < 0°C but not < -50°C.
Centralized refrigeration system	Refrigeration system with a cooling evaporator in the refrigerated space connected to a compressor rack located in a machinery room and to a condenser located outdoors, and that is designed to maintain an internal temperature at ≥ -50°C.
Condensing unit	Refrigeration system with a cooling evaporator in the refrigerated space connected to a compressor and condenser unit that are located in a different location, and that is designed to maintain an internal temperature at ≥ -50°C.
Chiller	Refrigeration or air-conditioning system that has a compressor, an evaporator and a secondary coolant, other than an absorption chiller or adsorption chiller.
Commercial air conditioning (AC) system	Air conditioning system, other than a chiller, including large single split or multi-split air-conditioning, variable refrigerant flow (VRF) systems and ducted or packaged rooftop systems.
Heat Pump	Reversible air-conditioning / heat pump units that can operate as an air-conditioning unit in hot weather or can provide heating in cold weather, other than an absorption heat pump or an adsorption heat pump. In heating mode, the indoor unit functions as condenser and the outdoor unit as evaporator.

Definitions are from *ODSHAR,* except Commercial AC and Heat Pumps which are adapted from *United Nations Environment Program's Ozone Secretariat.*

4.0 Project scenario

4.1 Project conditions

One of the following project conditions must apply in the project scenario in order for the project to be eligible under this protocol.[2]

[2] The project scenario consists of the relevant SSRs referred to in Section 7.0 Project GHG boundary.

a) An eligible refrigerant replaces a high-GWP refrigerant in one or more pre-existing refrigeration systems of a type listed in Table 1 at the project site through a system or systems retrofit, or
b) One or more new refrigeration systems of a type listed in Table 2 that contain an eligible refrigerant are installed at the project site.

The refrigeration system used in the project scenario must not have a cooling capacity that is less than 90% of the cooling capacity of the pre-existing refrigeration system, if one exists.

4.2 Eligible refrigerants

To be eligible for use in the project scenario, refrigerants must have a GWP lower than the value applicable to the corresponding refrigeration system type as set out in Table 2 below or if applicable, lower than the provincial or territorial GWP limit.

In addition, when a pre-existing refrigeration system is being retrofitted or replaced, the eligible refrigerant used in the project scenario must have a GWP lower than the GWP of refrigerant contained within the pre-existing refrigeration system.

When there is no pre-existing system, ammonia is not an eligible refrigerant in the new refrigeration system being installed in the project scenario.

Table 2: GWP Limits for eligible refrigerants

Column 1	**Column 2**
Refrigeration System Type	**Eligible Refrigerant GWP Limit**
Stand-alone medium temperature refrigeration system	1400
Stand-alone low temperature refrigeration system	1500
Centralized refrigeration system	2200
Condensing unit	2200
Chiller (other than absorption or adsorption chiller)	750
Absorption or Adsorption chiller	1
Commercial Air Conditioning	2000
Heat Pump	2000
Absorption or Adsorption heat pump	1

Eligible refrigerants must not consist in whole, or in part, of any ozone-depleting substance (ODS).

Eligible refrigerants in whole or in part, must not have been previously used in another refrigeration system owned or operated by the proponent.

4.3 Eligible project activities

Eligible project activities include:

1. The retrofit of a pre-existing refrigeration system of a type listed in Table 1 to utilize an eligible refrigerant, including the extraction of all high-GWP refrigerant from the pre-existing refrigeration system and either:
    a) destruction of the high-GWP refrigerant's HFCs at an Authorized Destruction Facility[3], or
    b) reclamation of the high-GWP refrigerant's HFCs at an Authorized Reclamation Facility.
2. The purchase and installation of a new refrigeration system of a type listed in Table 2 that contains an eligible refrigerant and does not utilize fossil fuel as a direct source of heat or power,[4] including, if applicable, the extraction of all high-GWP refrigerant from a pre-existing refrigeration system being replaced by the new system, and either:
    a) destruction of the high-GWP refrigerant's HFCs at an Authorized Destruction Facility, or
    b) reclamation of the high-GWP refrigerant's HFCs at an Authorized Reclamation Facility.

5.0 Additionality

5.1 Legal additionality

GHG emission reductions generated by the project must not occur as a result of federal, provincial or territorial regulations, legal requirements, municipal by-laws, or any other legally binding mandates.

Federal and provincial regulations exist in Canada that limit refrigerant GWP contained in specific types of new refrigeration systems. The subject of regulations may vary by jurisdiction and can apply to either the manufacture, import, distribution, sale or installation of new refrigeration systems or equipment, all of which are considered to be relevant GWP limits with respect to baseline scenario quantification. For jurisdictions in which both a federal and a provincial or territorial GWP limit exist, the lowest GWP limit shall apply.

If at any time after project registration the GHG emission reductions generated by the project are a result of project activities that are required by law or the result of a legal requirement, the GHG emission reductions can only be quantified, and offset credits can only be issued, up to the date immediately preceding the date on which the law or the legal requirement comes into force.

5.2 Provincial or federal pricing mechanisms for GHG emissions

Any emission sources that are included in a facility's GHG emissions total reported under a federal, provincial or territorial pricing mechanism for GHG emissions are not eligible for offset credits. This includes GHG emissions from industrial refrigeration and air conditioning systems at covered facilities under the federal Output-Based Pricing System.

[3] HFCs are considered to be destroyed once they are extracted from the pre-existing equipment at the project site.
[4] Waste heat is not considered to be a direct source of heat or power.

6.0 General requirements

6.1 Project start date

The start date of a project corresponds to the first day on which a retrofitted refrigeration system or a new refrigeration system installation is operated to provide refrigeration or air conditioning services at the project site.

6.2 Crediting period renewal

A project implemented under this protocol is not eligible for crediting period renewal.

6.3 Aggregation

Project activities that occur at multiple project sites can be registered as a group of projects within an aggregation of projects. Multiple project activities at a single project site form a single project and cannot be registered as an aggregation of projects.

6.4 Project location and geographic boundaries

A proponent must document and report the location and geographic boundaries of the project site and submit a site plan.

The site plan must show where all equipment associated with refrigeration systems is located at the project site. If applicable, the site plan must show where a refrigeration system is situated in relation to other refrigeration systems, and whether those other refrigeration systems are either included in, or excluded from, the project.

The geographic boundary of the project site cannot change after the first reporting period. However, project activities can expand within the project site's geographic boundary to include additional refrigeration system retrofits or new refrigeration system installations at a later time and still be part of a registered project, provided that all relevant requirements are met. Any changes to the site plan must be communicated as specified in the Regulations.

6.5 Environmental and social safeguards

All refrigerants must be properly handled according to the environmental code of practice, regulations or standards that apply to the handling of refrigerants in the jurisdiction in which the project site is located.

The proponent must also ensure the project activities comply with any building codes or other legal requirements, including for the use of flammable or toxic refrigerants that may pose a human health risk in the jurisdiction in which the project site is located.

7.0 Project GHG boundary

The project GHG boundary (Figure 1) contains the GHG sources, sinks, and reservoirs (SSRs) that must be assessed by the proponent in order to determine the GHG emission reductions generated by the project activities relative to the baseline scenario.

Figure 1: Illustration of the Project GHG Boundary

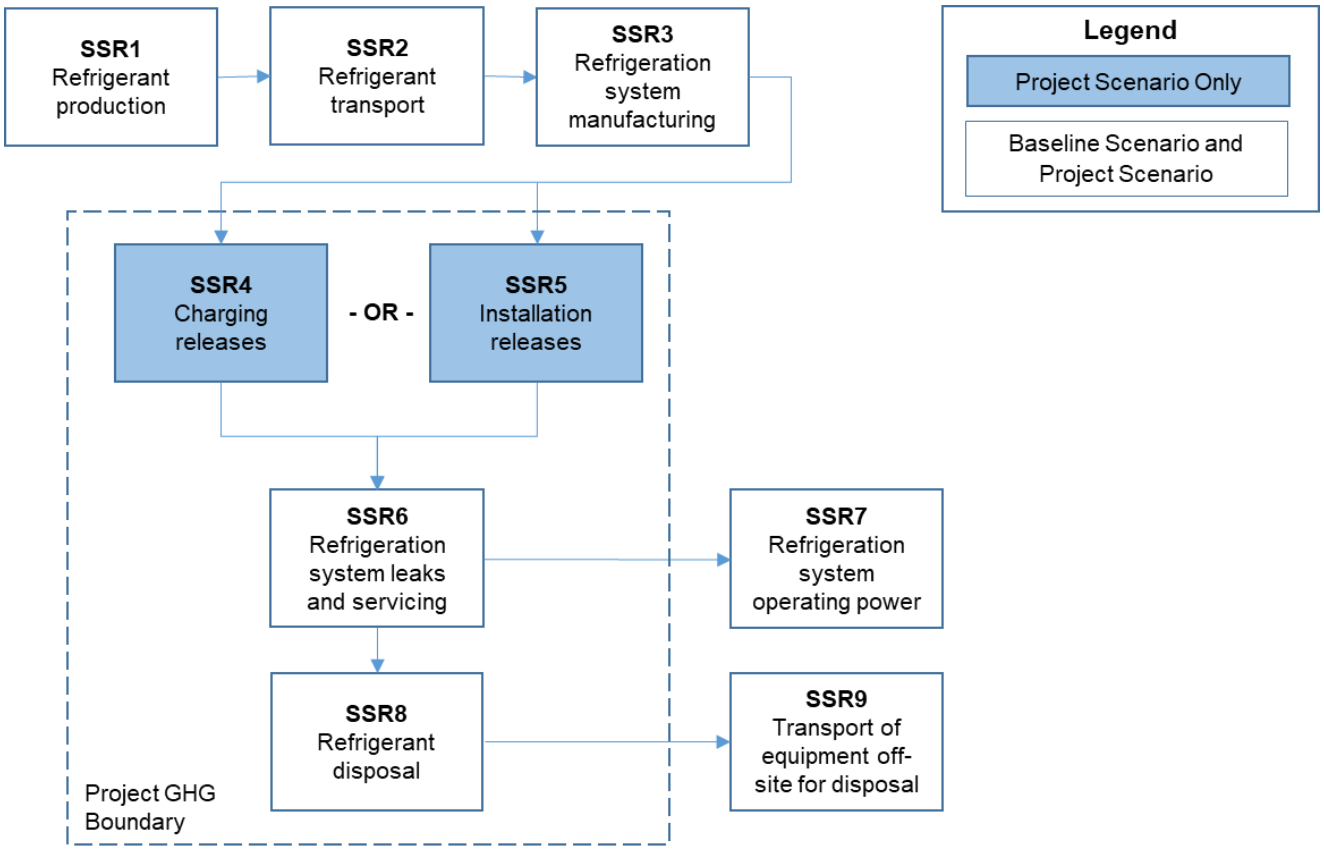

Table 3 provides additional details on the relevant SSRs identified for the baseline and project scenarios, as well as justification for their inclusion or exclusion in the quantification of emission reductions. The proponent must quantify GHG emissions based on the "included" SSRs that are relevant to the specific activities taking place in the baseline and project scenarios.

Relevant GHGs in this protocol are carbon dioxide (CO_2) and all hydrofluorocarbons (HFCs) listed in Schedule 3 to the Act.

Table 3: Details on baseline and project scenario SSRs

SSR	Title	Description	Type	Baseline or Project	GHGs	Included or Excluded
1	Refrigerant production	Electricity consumption, fossil fuel combustion, and refrigerant emissions during the production process.	Related	Baseline (B1) Project (P1)	CO_2, CH_4, N_2O, HFCs	Excluded: GHG emissions from this source occur outside Canada. Fossil fuel usage is covered by carbon pricing.
2	Refrigerant transport	Fossil fuel combustion from transport vehicles and refrigerant leaks during transport.	Related	Baseline (B2) Project (P2)	CO_2, CH_4, N_2O, HFCs	Excluded: Fossil fuel usage is covered by carbon pricing. Refrigerant leaks during transport assumed to be very small.
3	Refrigeration system manufacturing	Electricity consumption, fossil fuel combustion, and refrigerant emissions during manufacturing.	Related	Baseline (B3) Project (P3)	CO_2, CH_4, N_2O, HFCs	Excluded: Assumed to be the same in baseline and project scenarios, and little manufacturing of refrigeration systems occurs in Canada.
4	Charging releases	Emissions from HFC releases when charging pre-existing refrigeration system with refrigerant after retrofit	Controlled	Project (P4)	CO_2, HFCs	Included: Amount of refrigerant released is expressed as a percentage of charge size in Equation 4.
5	Installation releases	Emissions from HFC releases when installing a new refrigeration system.	Controlled	Project (P5)	CO_2, HFCs	Included: Amount of refrigerant released is expressed as a percentage of charge size in Equation 4.
6	Refrigeration system leaks and servicing	High-GWP refrigerant leakage during normal operations and re-filling of a refrigeration system by certified technicians.	Controlled	Baseline (B6)	HFCs	Included: Amount of refrigerant released is expressed as a percentage of charge size in Equation 2.
		Eligible refrigerant leakage during normal operations and re-filling of refrigeration system by certified technicians.	Controlled	Project (P6)	CO_2, HFCs	Included: Amount of refrigerant released is expressed as a percentage of charge size in Equation 4.

SSR	Title	Description	Type	Baseline or Project	GHGs	Included or Excluded
7	Refrigeration system operating power	Electricity consumption emissions from operating a refrigeration system.	Controlled	Baseline (B7) Project (P7)	CO_2, CH_4, N_2O	Excluded: The use of eligible refrigerant may be less energy efficient than using high-GWP refrigerant, but the difference in electricity consumption per unit of cooling, and the resulting emissions, is assumed to be very small. Technical and financial challenges exist to accurately measure power consumption from sub-metering specific pieces of equipment within a refrigeration system.
8	Refrigerant disposal	Proportion of remaining high-GWP refrigerant that is released during transfer to Authorized Reclamation Facility, or an Authorized Destruction Facility, at the end of life of the baseline scenario refrigeration system.	Controlled	Baseline (B8)	HFCs	Included: Amount of refrigerant released is expressed as a percentage of remaining charge size in Equation 2.
		Proportion of remaining eligible refrigerant released during transfer to an Authorized Reclamation Facility at the end of life of the refrigeration system used in the project scenario.	Controlled	Project (P8)	CO_2, HFCs	Included: Amount of refrigerant released is expressed as a percentage of remaining charge size in Equation 4.
9	Transport of equipment off-site for disposal	Fossil fuel combustion from transporting refrigeration system equipment off-site at end of its useful life, after remaining refrigerant has been extracted.	Related	Baseline (B9) Project (P9)	CO_2, CH_4, N_2O	Excluded: Assumed to be the same in the baseline and project scenarios.

8.0 Quantification methodology

This section contains the quantification methodology that must be followed to calculate baseline and project scenario GHG emissions, which are subsequently used to calculate the GHG emission reductions generated by the project.

Raw data must be converted to align with the units presented in the quantification methodology, if necessary (see Section 8.4 for a tabulated summary).

Baseline scenario GHG emissions are the GHG emissions that would have occurred in the absence of the project, as quantified from SSRs within the project GHG boundary. Project scenario GHG emissions are the actual GHG emissions that occur from SSRs within the project GHG boundary. The GHG emission reductions generated by the project are quantified by deducting the project scenario GHG emissions from the baseline scenario GHG emissions as outlined in Section 8.3.

Both baseline and project scenario GHG emission calculations must include all the GHG emissions that occurred during the reporting period and must include sub-totals in tonnes of CO_2 equivalent (t CO_2e) for each full or partial calendar year to support issuance of the resulting offset credits by calendar year.

8.0.1 Refrigerant GWP calculations

Emission reductions from the project can only be generated by reducing emissions of GHGs that are listed in Schedule 3 to the Act. Proponents must use Equation 1 below to determine refrigerant GWP using the GWP values of each chemical component in the refrigerant as listed in Schedule 3 to the Act. For any chemical component not listed in Schedule 3 to the Act, the GWP value is zero.

Equation 1: Refrigerant GWP calculation

$$\mathbf{GWP_{Refrig}} = \sum_{\mathbf{i}}^{\mathbf{n}} (\mathbf{P_{GHG,i}} \mathbf{\ x\ } \mathbf{GWP_{GHG,i}})$$

Where,

			Units
$\mathrm{GWP_{Refrig}}$	=	GWP of a refrigerant	*t CO_2e/t refrigerant* [5]
$\mathrm{P_{GHG,i}}$	=	Proportion of GHG *i,* contained within the refrigerant by mass	*%*
$\mathrm{GWP_{GHG,i}}$	=	GWP of GHG *i*, as specified in Schedule 3 to the Act	*t CO_2e/t refrigerant*

Equation 1 must be used to determine GWP values for the baseline scenario refrigerant ($GWP_{BRefrig}$) in Equation 2 except where a provincial or territorial GWP limit or the value from Table 5 must be used.

Equation 1 must also be used to determine GWP values for project scenario refrigerant ($GWP_{PRefrig}$) in Equation 4.

[5] While GWP values are constants used as multipliers, this quantification methodology assigns units of equivalent mass in order to convert one unit of refrigerant to one unit of equivalent carbon dioxide when released directly into the atmosphere.

8.1 Baseline scenario GHG emissions

The proponent must use the following methodology to quantify the baseline scenario GHG emissions for each full or partial calendar year covered by the reporting period, based on the included SSRs outlined in Table 3.

To calculate annual emissions from a refrigeration system used in baseline scenario, the proponent must use Equation 2, which is derived from the methodology in Chapter 7 of the 2006 IPCC Guidelines for National Inventory Reports (PDF).

Equation 2: Annual GHG emissions for a baseline scenario refrigeration system (SSR B6 and SSR B8)

$$\mathbf{BE_{Annual}} = \mathbf{GWP_{BRefrig}} * \frac{\mathbf{Q}}{\mathbf{1000}} * \left[\mathbf{AARL} + \left(\frac{\mathbf{QRD}\ (\mathbf{1} - \mathbf{RRE})}{\mathbf{LT}}\right)\right]$$

Where,			**Units**
BE_{Annual}	=	Annual GHG emissions for a single refrigeration system used in the baseline scenario	t CO_2e
$GWP_{BRefrig}$	=	GWP of the refrigerant used in the refrigeration system in the baseline scenario calculated in Equation 1 for system retrofits or when a pre-existing system is replaced by a new system installation that is not subject to any GWP limit. Otherwise, the proponent must use the value in Table 5 corresponding to the type of refrigeration system used in the project scenario or the applicable provincial or territorial GWP limit, whichever is lower.	t CO_2e/t refrigerant
Q	=	Amount of refrigerant in the refrigeration system (charge size)	kg
AARL	=	Average annual refrigerant leakage for the refrigeration system type (from Table 4)	%/yr
QRD	=	Amount of refrigerant remaining at disposal for the refrigeration system type (from Table 4)	%
RRE	=	Refrigerant recovery efficiency of the refrigeration system, which is 99% unless high-GWP refrigerant is destroyed, then RRE = 0%	%
LT	=	Lifetime for the refrigeration system type from Table 4 unless HFCs are destroyed in which case LT = 10	Years

Default values to be used in Equation 2 above for refrigerant releases from each refrigeration system type are found in Table 4 below.

Table 4: Default values for annual emissions of refrigeration systems[6]

Column 1	Column 2	Column 3	Column 4	Column 5
Refrigeration System Type	**Installation Loss % (IL)**	**Lifetime of Equipment (LT) (yrs)**	**Annual Average Refrigerant Leakage % (AARL)**	**Refrigerant remaining at disposal % (QRD)**
Stand-alone medium-temperature refrigeration system	0%	10	1%	90%
Stand-alone low-temperature refrigeration system	0%	10	1%	90%
Centralized refrigeration system	2.0%	18	25%	90%
Condensing unit	2.0%	18	25%	90%
Chiller	0.5%	23	2%	95%
Commercial Air Conditioning system	0%	25	8%	80%
Heat Pump	0%	25	8%	80%

When there is no pre-existing refrigeration system:

1) the same type of refrigeration system that is installed in the project scenario must used for baseline scenario emissions quantification if the new refrigeration system is listed is in Table 1; or,
2) a chiller must be used as the refrigeration system type for baseline scenario emissions quantification if an absorption or adsorption chiller is installed in the project scenario.
3) a heat pump must be used as the refrigeration system type for baseline scenario emissions quantification if an absorption or adsorption heat pump is installed in the project scenario.

For 1, 2 and 3 above, the proponent must select and justify a specific refrigerant and charge size for the refrigeration system type used to quantify baseline scenario GHG emissions as per section 8.1.2.

8.1.1 Baseline scenario refrigerant GWP value

The proponent must use the appropriate GWP value for baseline refrigerant GWP ($\boldsymbol{GWP_{BRefrig}}$) in Equation 2 for annual GHG emissions quantification for a baseline scenario refrigeration system for each project activity, as follows:

1) ***System retrofit*** – The GWP value of pre-existing refrigeration system's high-GWP refrigerant is used as the baseline refrigerant GWP, as calculated in Equation 1.

[6] Environmental Protection Agency (EPA) report: *Accounting Tool to Support Federal Reporting of Hydrofluorocarbon Emissions: Supporting Documentation*, October 2016, Table 3-3, p13 and Table 3-6, p17:

2) ***New system installation:***

a. When a GWP limit applies to the new system being installed, baseline scenario emissions are quantified using either the corresponding GWP outlined in Table 5 below, or the applicable provincial or territorial GWP limit, whichever is lower. This applies whether or not there is a pre-existing system.

b. When no GWP limit applies to the new system being installed, i.e., commercial AC system and heat pump, and there **is** a pre-existing refrigeration system, the GWP value of pre-existing refrigeration system's high-GWP refrigerant is used as the baseline refrigerant GWP.

c. When no GWP limit applies to the new system being installed, i.e., commercial AC system and heat pump, and there **is no** pre-existing refrigeration system, the baseline refrigerant GWP for the refrigeration system type used to quantify baseline emissions is the corresponding value in Table 5 below.

Table 5: Baseline refrigerant GWP for each project activity by refrigeration system type[7]

Column 1	**Column 2**
Refrigeration System Type in Baseline Scenario	**$GWP_{BRefrig}$ when Installing New Systems (as applicable)**
Stand-alone medium temperature refrigeration system	1400
Stand-alone low temperature refrigeration system	1500
Centralized refrigeration system	2200
Condensing unit	2200
Chiller – before January 1, 2025	1400
Chiller – on or after January 1, 2025	750
Commercial AC	2000
Heat Pump	2000

If at any time during the crediting period there is a change in the ODSHAR GWP limit or the provincial or territorial GWP limit applicable to the new refrigeration system being installed, the proponent must use the new GWP limit in the quantification of baseline scenario emissions from the day upon which the new GWP limit comes into force.

[7] Except for commercial AC systems and heat pumps, GWP values contained in Table 5 are taken from ODSHAR. Commercial AC systems and heat pumps are not currently regulated under OSDHAR, and corresponding GWP values in Table 5 are set to match GWP of refrigerants currently used in Canada.

When a chiller is the new refrigeration system installed in the project scenario, the proponent must use 750 GWP for quantifying baseline scenario refrigeration system emissions in Equation 2 starting January 1, 2025 which is when the ODSHAR GWP limit for chillers comes into force. Prior to January 1, 2025, the proponent can use a GWP of 1400 to quantify baseline scenario refrigeration system emissions in Equation 2 when a new chiller, absorption chiller or adsorption chiller refrigeration system is installed in the project scenario.

8.1.2 Refrigerant charge size

When a pre-existing refrigeration system is retrofitted or replaced by a new system installation, proponents must use the actual charge size (Q) of the pre-existing refrigeration system for quantification of baseline scenario refrigeration system emissions in Equation 2. In order to ensure baseline scenario refrigeration system emissions are conservative, charge size cannot be more than 90% of the manufacturer specifications when project activities include HFC destruction.

For new system installations where there is no pre-existing refrigeration system, baseline charge size, Q, must be justified by the proponent based on the charge size of refrigerant needed for the refrigeration system identified for use in the baseline scenario to achieve the same cooling capacity as the refrigeration system used in the project scenario.

8.1.3 Refrigerant disposal

Halocarbon venting is prohibited across Canada and high-GWP refrigerant can only be disposed of through reclamation or destruction under this protocol.

When high-GWP refrigerant is removed from a pre-existing refrigeration system and sent to an Authorized Reclamation Facility to be reclaimed, proponents must use a 99% value for Refrigerant Recovery Efficiency ($RRE = 99\%$) in Equation 2.

If the proponent can demonstrate that the high-GWP refrigerant from a pre-existing refrigeration system has been destroyed at an Authorized Destruction Facility by means of a destruction certificate and chain of custody records, then $RRE = 0$ in Equation 2.

HFCs can only be destroyed once at the beginning of the project with emissions reductions spread over the crediting period. HFCs are considered to be destroyed at the time they are sent for destruction off-site after being extracted from the pre-existing refrigeration system on-site.

Destruction of HFCs from sources other than high-GWP refrigerant extracted from the pre-existing refrigeration system used in the baseline scenario are not eligible for generating emission reductions under this protocol.

8.1.4 Baseline scenario GHG emissions from a calendar year

Annual GHG emissions of baseline scenario refrigeration systems calculated in Equation 2 must then be adjusted using Equation 3 below to match the length of each full or partial calendar year covered by the reporting period.

Equation 3: Baseline scenario GHG smissions for a calendar year covered by the reporting period

$$\mathbf{BE_C} = \sum_{\mathbf{i,j}}^{\mathbf{n}} \left[\frac{\mathbf{BE_{Annual,i}}}{\mathbf{365}} * \mathbf{T_{C,j}} \right]$$

Where,			**Units**
BE_C	=	GHG emissions from all baseline scenario refrigeration systems for a calendar year covered by the reporting period	t CO_2e
$BE_{Annual,i}$	=	Annual GHG emissions for a refrigeration system, i, used in the baseline scenario (Equation 2)	t CO_2e
$T_{C,j}$	=	Number of days in a calendar year covered by the reporting period that the corresponding project scenario refrigeration system, j, was operated	days

8.2 Project scenario GHG emissions

The proponent must use the following methodology to quantify project scenario GHG emissions for each full or partial calendar year covered by the reporting period, based on the SSRs outlined in Table 3.

To calculate annual GHG emissions from a refrigeration system used in the project scenario, the proponent must use Equation 4, which is derived from the methodology in Chapter 7 of the 2006 IPCC Guidelines for National Inventory Reports.

Equation 4: Annual GHG emissions from a project scenario refrigeration system (SSR P4 or P5, SSR P6 and SSR P8)

$$\mathbf{PE_{Annual}} = \mathbf{GWP_{PRefrig}} * \frac{\mathbf{Q}}{\mathbf{1000}} * \left[\mathbf{AARL} + \left(\frac{\mathbf{IL} + \mathbf{QRD}(\mathbf{1} - \mathbf{RRE})}{\mathbf{LT}}\right)\right]$$

Where,			**Units**
PE_{Annual}	=	Annual GHG emissions from a single refrigeration system used in the project scenario	t CO_2e
$GWP_{PRefrig}$	=	GWP of the eligible refrigerant used in the project scenario, calculated in Equation 1	t CO_2e/t refrigerant
Q	=	Amount of eligible refrigerant within the refrigeration system (charge size)	kg
AARL	=	Average annual refrigerant leakage for the refrigeration system type (from Table 4)	%/yr
IL	=	Releases of eligible refrigerant when installing the new refrigeration system, or charging the retrofitted refrigeration system, for the refrigeration system type (from Table 4)	%
QRD	=	Amount of eligible refrigerant remaining at disposal for the refrigeration system type (from Table 4)	%
RRE	=	Refrigerant recovery efficiency. RRE = 99% for project scenario	%
LT	=	Lifetime of the refrigeration system type (from Table 4)	Years

For system retrofit project activities, installation losses (IL) in the project scenario represent any releases that might occur when extracting high-GWP refrigerant from a pre-existing refrigeration system and re-charging with the eligible refrigerant.

Annual GHG emissions from refrigeration systems used in the project scenario calculated in Equation 4 must then be adjusted using Equation 5 below to match the length of any full or partial calendar year covered by the reporting period.

Equation 5: Project scenario GHG emissions during a calendar year covered by the reporting period

$$\mathbf{PE_C} = \sum_{\mathbf{j}}^{\mathbf{n}} \left[\frac{\mathbf{PE_{Annual,j}}}{\mathbf{365}} * \mathbf{T_{C,j}} \right]$$

Where,			**Units**
PE_C	=	GHG emissions from all refrigeration systems used in the project scenario during a calendar year covered by the reporting period	t CO_2e
$PE_{Annual,j}$	=	Annual GHG emissions from a refrigeration system, j, used in the project scenario (Equation 4)	t CO_2e
$T_{C,j}$	=	Number of days in a calendar year covered by the reporting period that each refrigeration system, j, used in the project scenario was operated	days

8.3 GHG emission reductions

The GHG emission reductions (ER), determined in accordance with Equation 6, correspond to the GHG reductions generated by the project, determined in accordance with section 20 of the Regulations.

Equation 6: GHG emission reductions

$$\boldsymbol{ER_C = BE_C - PE_C}$$

Where,			**Units**
$\boldsymbol{ER_C}$	=	GHG emission reductions during a calendar year covered by the reporting period	t CO_2e
$\boldsymbol{BE_C}$	=	Baseline scenario GHG emissions during a calendar year covered by the reporting period (Equation 3)	t CO_2e
$\boldsymbol{PE_C}$	=	Project scenario GHG emissions during a calendar year covered by the reporting period (Equation 5)	t CO_2e

8.4 Summary of quantification parameters

Tables 6.1 to 6.6 provide a summary of quantification equations and parameters for each equation as well as details regarding measurement and calculation frequency.

Table 6.1: Quantification parameters for Equation 1

Parameter	Description	Units	Parameter Type	Measurement / Calculation Frequency
Equation 1: $\mathbf{GWP_{Refrig}} = \sum_i^n(\mathbf{P_{GHG,i}\ x\ GWP_{GHG,i}})$				
GWP_{Refrig}	GWP of a refrigerant	t CO_2e/t refrigerant	Calculated	Once per refrigerant
$P_{GHG,i}$	Proportion of GHG *i,* contained within the refrigerant by mass	%	Calculated from refrigerant manufacturer specifications	Once per GHG
$GWP_{GHG,i}$	GWP of GHG *i*	t CO_2e/t refrigerant	Referenced Column 2 of Schedule 3 to the Act	Once per GHG

Table 6.2: Quantification parameters for Equation 2

Parameter	Description	Units	Parameter Type	Measurement / Calculation Frequency
Equation 2: $\mathbf{BE_{Annual} = GWP_{BRefrig} * \frac{Q}{1000} * \left[AARL + \left(\frac{QRD\ (1-RRE)}{LT}\right)\right]}$				
BE_{Annual}	Annual GHG emissions for a single refrigeration system used in the baseline scenario	t CO_2e	Calculated	Once per calendar year covered by the reporting period
$GWP_{BRefrig}$	GWP of the refrigerant used in the refrigeration system in the baseline scenario calculated in Equation 1 for system retrofits or when a pre-existing system is replaced by a new system installation that is not subject to any GWP limit. Otherwise, the proponent must use the value in Table 5 corresponding to the type of refrigeration system used in the project scenario or the applicable provincial or territorial GWP limit, whichever is lower.	t CO_2e/t refrigerant	Calculated (See Equation 1) or Referenced (See Table 5)	Once per calendar year covered by the reporting period
Q	Amount of refrigerant in the baseline scenario refrigeration system (charge size).	kg	Referenced (Manufacturer specifications)	Once per refrigeration system
AARL	Average annual refrigerant leakage for the refrigeration system type	%/yr	Referenced (See Table 4)	Once per refrigeration system
QRD	Amount of refrigerant remaining at disposal for the refrigeration system type	%	Referenced (See Table 4)	Once per refrigeration system
RRE	Refrigerant recovery efficiency of the refrigeration system type, which is 99% unless high-GWP refrigerant is destroyed, then *RRE* = 0%	%	Referenced from section 8.1.3	Once per refrigeration system
LT	Lifetime for the refrigeration system type	Years	Referenced (See Table 4 or use LT=10 when HFCs are destroyed)	Once per refrigeration system

Table 6.3: Quantification parameters for Equation 3

Parameter	Description	Units	Parameter Type	Measurement / Calculation Frequency
Equation 3: $\mathbf{BE_C = \sum_{i,j}^{n}\left[\frac{BE_{Annual,i}}{365} * T_{C,j}\right]}$				
BE_C	GHG emissions from all baseline scenario refrigeration systems for a calendar year covered by the reporting period.	t CO_2e	Calculated	Once per calendar year covered by the reporting period
$BE_{Annual,i}$	Annual GHG emissions for a refrigeration system, *i* used in the baseline scenario.	t CO_2e	Calculated (Equation 2)	Once per calendar year covered by the reporting period
$T_{C,j}$	Number of days in a calendar year covered by the reporting period that the corresponding project scenario refrigeration system, *j*, was operated.	days	Referenced from Equation 5	Once per calendar year covered by the reporting period

Table 6.4: Quantification parameters for Equation 4

Parameter	Description	Units	Parameter Type	Measurement / Calculation Frequency
Equation 4: $\mathbf{PE_{Annual} = GWP_{PRefrig} * \frac{Q}{1000} * \left[AARL + \left(\frac{IL+QRD(1-RRE)}{LT}\right)\right]}$				
PE_{Annual}	Annual GHG emissions from a single refrigeration system used in the project scenario	t CO_2e	Calculated	Once per calendar year covered by the reporting period
$GWP_{PRefrig}$	GWP of the eligible refrigerant used in the project scenario	t CO_2e/t refrigerant	Calculated (See Equation 1)	Once per refrigeration system
Q	Amount of eligible refrigerant within the refrigeration system (charge size)	kg	Referenced from manufacturer specifications	Once per refrigeration system
AARL	Average annual refrigerant leakage for the refrigeration system type.	%/yr	Referenced (See Table 4)	Once per refrigeration system

Parameter	Description	Units	Parameter Type	Measurement / Calculation Frequency
IL	Releases of eligible refrigerant when installing the new refrigeration system, or charging the retrofitted refrigeration system, for the refrigeration system type.	%	Referenced (See Table 4)	Once per refrigeration system
QRD	Amount of eligible refrigerant remaining at disposal for the refrigeration system type.	%	Referenced (See Table 4)	Once per refrigeration system
RRE	Refrigerant recovery efficiency. RRE = 99% for project scenario.	%	Referenced from section 8.1.3	Once per refrigeration system
LT	Lifetime of the refrigeration system type.	Years	Referenced (See Table 4)	Once per refrigeration system

Table 6.5: Quantification parameters for Equation 5

Parameter	Description	Units	Parameter Type	Measurement / Calculation Frequency
Equation 5: $\boldsymbol{PE_C = \sum_j^n \left[\frac{PE_{Annual,j}}{365} * T_{C,j}\right]}$				
PE_C	GHG emissions from all refrigeration systems used in the project scenario during a calendar year covered by the reporting period	t CO_2e	Calculated	Once per calendar year covered by the reporting period
$PE_{Annual,j}$	Annual GHG emissions from a refrigeration system, *j*, used in the project scenario	t CO_2e	Calculated (See Equation 4)	Once per calendar year covered by the reporting period
$T_{C,j}$	Number of days in a calendar year covered by the reporting period that a refrigeration system, *j,* used in the project scenario was operated.	days	Measured	Once per calendar year covered by the reporting period

Table 6.6: Quantification parameters for Equation 6

Parameter	Description	Units	Parameter Type	Measurement / Calculation Frequency
Equation 6: $\boldsymbol{ER_C = BE_C - PE_C}$				
ER_C	GHG emission reductions during a calendar year covered by the reporting period	t CO_2e	Calculated	Once per calendar year covered by the reporting period
BE_C	Baseline scenario GHG emissions during a calendar year covered by the reporting period	t CO_2e	Calculated (See Equation 3)	Once per calendar year covered by the reporting period
PE_C	Project scenario GHG emissions during a calendar year covered by the reporting period	t CO_2e	Calculated (See Equation 5)	Once per calendar year covered by the reporting period

9.0 Measurement and data

9.1 Quality assurance and quality control

Quality Assurance / Quality Control (QA/QC) procedures must be implemented to ensure that all calculations have been made correctly and can be verified.

9.2 Missing data

In the event that data is missing, data may not be substituted using alternative estimation methods.

10.0 Records

In addition to the record keeping requirements in the Regulations, the proponent must retain records that support the implementation of a project, including invoices, contracts, refrigeration system equipment maintenance records, calculations, databases, photographs and chain of custody records for HFC transportation, at the location and for the period of time specified in the Regulations. These records apply to refrigeration system equipment at the project site and high-GWP refrigerant sent for disposal off-site.

Additional records to retain include:

- Manufacturer specifications regarding cooling capacity, charge size, installation procedures, operating conditions and/or maintenance requirements for all refrigeration system equipment included in the project.
- Identification of the refrigerant service provider, their service contract and description of their qualifications, or if a company, minimum qualifications of the company's refrigerant service technicians.
- Contracts, invoices or certificates of completion from a contractor conducting system retrofit or new system installation that also indicate when retrofitted systems or new systems begin operating.
- In instances where the province or territory has set a GWP limit for refrigeration systems that differ from the values in Table 2, supporting documentation regarding this limit.
- Documentation showing the complete chain of custody of high-GWP refrigerant from the point at which it is extracted from a pre-existing refrigeration system to the point at which it arrives at an authorized reclamation facility or authorized destruction facility. The information includes:
    - Names, addresses and contact information of all parties in possession of high-GWP refrigerants sent for reclamation or destruction, if applicable.
    - The mass of high-GWP refrigerant in kilograms at each transfer in the chain of custody.
    - Details on the facility's authorization from the relevant provincial or territorial government to handle, reclaim and/or destroy HFCs.
- For System Retrofit project activity:
    - Evidence to show which high-GWP refrigerant has been used in the pre-existing refrigeration system for more than 3 years preceding the system retrofit.
    - Supporting documentation to demonstrate the last day the pre-existing refrigeration system was in operation and the first day on which the retrofitted refrigeration system using an eligible refrigerant was used for refrigeration or air conditioning purposes.

- For new system installation project activity:
    - Where the new system replaces a pre-existing refrigeration system, evidence to show the pre-existing refrigeration system was in operation, with the same refrigerant, for more than 3 years preceding the installation of the new system.
    - Supporting documentation to demonstrate the first day on which refrigeration or air conditioning is provided at the project site from a new refrigeration system installation.
    - Identification of the manufacturer and the retailer from which new refrigeration system was purchased.
    - Date of purchase of new refrigeration system and if pre-charged, identification of the refrigerant contained within it at that time.
- For new system installation projects where there is no pre-existing equipment, the proponent must keep any records that provide justification for the selection of a baseline refrigeration system.

11.0 Reporting requirements

Beyond what is specified in the Regulations, proponents must include the following in a project report:

- The dates, duration and reason for each instance in which a refrigeration system used in the project scenario is not operating for a period of more than 10 consecutive days within a calendar year covered by the reporting period.
- The name and location of the Authorized Reclamation Facility or Authorized Destruction Facility, as applicable.
- For the first project report that includes GHG emission reductions resulting from destruction of HFCs in high-GWP refrigerant from a pre-existing refrigeration system, the amount of HFCs extracted from the pre-existing refrigeration system and the HFC destruction certificate that indicates the mass and type of each HFC in high-GWP refrigerant that has been destroyed, if applicable.
- The HFC destruction certificate for the first report for an aggregation of projects for which a new project that includes destruction of high GWP refrigerant from a pre-existing refrigeration system in baseline scenario GHG emissions has been added during the crediting period of the aggregation.