Remaining Carbon Emissions

Positive

Credit: 24

Points: 3

Outcome

The building's emissions from refrigerants, upfront carbon, and remaining carbon sources are eliminated or offset.

Strategy

Registering from 2024 onwards	**4 Star**	Optional
	5 Star	
	6 Star	Meets the *Credit Achievement*
Registering from 2026 onwards	**4 Star**	Optional
	5 Star	Meets the *Credit Achievement*
	6 Star	Meets the *Exceptional Performance*
Registering from 2028 onwards	**4 Star**	Meets the *Credit Achievement*
	5 Star	Meets the *Exceptional Performance*
	6 Star	
Certified after 1st January 2030, regardless of registration date	**All certifications**	Meets the *Exceptional Performance*

Criteria

Credit Achievement	**2 points**	**– Climate Positive Pathway –** • The building owner eliminates emissions from refrigerants. or • The building owner minimises the impact of refrigerant leakage and offsets remaining emissions from refrigerants.
Exceptional Performance	**1 point**	In addition to the *Credit Achievement*: • All remaining emissions are eliminated or offset.

Additional information

Stage implementation

Strategy	Brief	Concept	Design	Tender	Construction	Handover	Use

Synergies with other credits

- Energy Source
- Life Cycle Impacts
- Upfront Carbon Emissions

Sustainable Development Goals

- Goal 7 (Affordable and Clean Energy)
- Goal 13 (Climate Action)

Relevant reporting initiatives

- GRESB
- TCFD

Climate Positive Pathway – Leadership point

This credit is part of the **Error! Reference source not found.** in Green Star Buildings. When the pathway is achieved, a *Leadership Challenge* point is awarded to the building for a total of 14 points for this path.

Requirements

Credit Achievement

The project must comply with **one** of the following criteria:

- Eliminating High-GWP Refrigerants
- Offsetting Refrigerants

All refrigerants from building systems or domestic appliances provided by the building must be captured in the credit. This includes where fridges or freezers are provided as part of a fitout package in a residential setting.

Eliminating refrigerants

High-GWP refrigerants must be eliminated from the building. The use of refrigerants with a GWP of 10 or less is considered to comply with the credit. Natural refrigerants in most cases comply with this criterion.

Offsetting Refrigerants

100% of carbon emissions from refrigerants must be offset.

Carbon emissions are calculated by multiplying the initial refrigerant charge by its Global Warming Potential (GWP) for each type of refrigerant present in the building and adding the emissions together.

To qualify for this credit the project team must demonstrate that environmental impacts from refrigerants leaking into the atmosphere are minimised, in accordance with one of the following requirements:

- The combined Total System Direct Environmental Impact (TSDEI) of the refrigerant systems serving the project is less than 15; OR
- The combined TSDEI of the refrigerant systems is between 15 and 35; AND a leak detection system is in place.

To determine the total environmental impact of refrigerants, data shall be collected for each piece of refrigeration equipment, and entered into the Refrigerant Impacts Calculator, which will generate and calculate the results. The following must be collected for every piece of refrigeration equipment in the project.

See Climate positive buildings and our net zero ambitions document available from Green Star resources for more information on acceptable offsets. [New Zealand reference to be determined]

Exceptional Performance

In addition to the *Credit Achievement*, the project must comply with the following criteria:

- Other Emissions

Other Emissions

The project team must calculate and offset:

- Emissions from the building's electricity use as determined in the *Energy Use* credit (unless the *Energy Source Exceptional Performance* is met, in which case these emissions are zero)
- Emissions from the building's remaining energy use as determined in the *Energy Use* credit
- The Climate Change impact category for modules A1 – A5 as determined in the *Upfront Carbon Emissions* credit.
- Any other carbon emissions over 1% of the total carbon emissions profile for the building (significant emissions).

All operational emissions from energy or electricity use must be offset for 5 years using current grid emission factors.

Alternative calculation method for *Exceptional Performance*

As an alternative path to calculating emissions from:

- Emissions from module A4 and A5 construction equipment use, and utilities during construction on site
- Construction waste emissions

The building owner can make an additional offset purchase equal to 5 years of modelled operational energy use (from the *Energy Use* credit), multiplied by the current grid coefficient to cover additional emissions not captured by any other calculation. These are not offsets for future operational use, rather they address emissions related to other carbon sources not already captured.

Submission content

Submissions for this credit must contain:

- **Submission form**
- Calculations showing the total refrigerant charge to be offset (Refrigerant Impacts Calculator)

Evidence to support claims made in the submission Recommended evidence:

- Confirmation that refrigerants have been eliminated from the building along with supporting documentation (e.g., mechanical as built drawings)
- Evidence of purchase of offsets (e.g., contract) clearly showing the length of offset
- Overview of the remaining carbon emissions and evidence of their offset

Alternate documentation can also be used by project teams to demonstrate compliance.

The recommended evidence listed above is applicable to the as built submission. See the *Design assessment documentation* section in the Introduction for more information on submitting evidence for the Design assessment.

The key requirement is that evidence is provided to support each claim made within the Submission form.

Guidance

Excluded equipment

Where specialty medical or manufacturing equipment exists, project teams should submit a Technical Question to the NZGBC if they intend to exclude such equipment from the calculations.

Offsets

Refer to the *Climate positive buildings and our net zero ambitions* document for more information on eligible offsets.

Refrigerants

Synthetic refrigerants are made up of chemicals that have a high global warming potential (GWP). GWP is the relative amount of degradation the refrigerant can cause to global warming. Because of this, refrigerants must be safely disposed at the end of their life at great cost. In the future building owners may be impacted by future requirements for safe disposal which may include increases in penalties that should be considered today.

Alternatives to synthetic refrigerants include nature refrigerants such as water, carbon dioxide, ammonia, and hydrocarbons. They are currently available and are valid alternatives to current synthetic refrigerants.

Refrigerant Weighted Average Direct Environmental Impact

The intent of this requirement is to evaluate the total direct environmental impacts of refrigerants in relation to the refrigeration system, when normalised for leakage risks, size of refrigerant charge, efficiency, ODP, GWP, and year of operation. The evaluation of the effects of ozone depletion and global warming is based on the lifecycle ozone depletion factor (LCODF) and the lifecycle direct global warming factor (LCGWF), normalised for the specific charge rate (efficiency, kg/kWr) of the system, and per-year of equipment life.

Life cycle ozone depletion factor (LCODF)

$$LCODF = \frac{ODP \times m \times (L \times life + E)}{Life}$$

Life cycle direct global warming factor (LCGWF)

$$LCGWF = \frac{GWP \times m \times (L \times life + E)}{Life}$$

Where:

LCODF = life cycle ozone depletion factor [kg CFC-11/kWr.year]

LCGWF = life cycle global warming factory [kg CO2 / kWr.year]

ODP = Ozone Depletion Potential of Refrigerant, 0 < ODP < 1

GWP = Global Warming Potential (100-year), 0 < GWP < 12,000 kg CO2/kg

m = Specific refrigerant charge (kg of refrigerant per kWr cooling capacity), 0.1 < m < 2 kg/kWr

L = Refrigerant leak rate (% of refrigerant charge leaked per year), 2% or 7%

E = End of life loss, 0.1 (default 10%)

Life = Equipment service life, 10 < Life < 35 years

The specific refrigerant charge (kg/kWr) is a measure of the refrigerant mass a system requires to produce a specific amount of cooling capacity. The higher this number, the more charge-intensive the system, leading to a potentially higher risk of leakage.

The actual leakage of refrigerant from a system is difficult to measure on a live site. Recharging refrigerant back to the nominal and commissioned level is not only expensive, but is generally only done when something goes wrong, or a leak is detected in the system.

As such, it is difficult to quantify an annual leak rate from actual measurements specific to the site.

The refrigerant leak rate (L) directly impacts on both the LCODF and LCGWF factors, and as such, adoption of fixed leakage rates for both low and high-pressure refrigerant ensures consistency in the evaluation. This credit uses assumed leak rates sourced from ASHRAE at 2% and 7% per year for low and high-pressure refrigerants respectively. The leak rate adopted is mandated based on the refrigerant type selected in the calculator and will affect the overall direct environmental impacts of the refrigerant.

Total System Direct Environmental Impact (TSDEI) of Refrigerants

Following this methodology, a capacity-weighted average total direct environmental impact is used in this credit to evaluate multiple pieces of HVAC equipment of different sizes, types of refrigerants, and types of building systems. This forms a practical evaluation method that accounts for the possible variations in the number of systems (and system types) in a building.

Average Weighted Direct Environmental Impact (DEI) of a single unit

$$(A \times LCODF) + (B \times LCGWF) = \text{DEI}$$

Total System Direct Environmental Impact (TSDEI) for all systems in a building

$$\frac{\sum\{(A \times LCODF + B \times LCGWF) \times Q_i\}}{Q_t} = \text{TSDEI}$$

Where:

A = 100,000

B = 1

Qi = cooling capacity of rated equipment (kWr)

Qt = sum of cooling capacity of all rated equipment included in the building (kWr)

Leak Detection Systems

Where the calculated TSDEI is between 15 and 35, any refrigeration equipment with a cooling capacity above 50kWr shall be fitted with an automated leak detection system. Leak detection system(s) must be designed in accordance with Section 4.8 and Appendix G of AS/NZS 1677.2:1998, Refrigerating Systems - Safety Requirements for Fixed Applications.

In addition, an automated refrigerant recovery system which is linked to the leak detection system shall be in place. The recovery system must be capable of recovering 95% (by weight) of the maximum refrigerant charge. Refrigerants are to be pumped to a dedicated refrigerant storage tank. It is not acceptable to pump refrigerant to other parts of the chiller or to portable storage cylinders.

The piece of equipment that is fitted with an automated leak detection system must be located in an appropriately designed enclosure that makes leak detection possible. Essentially the piece of equipment needs to be located in a space where the leaking refrigerant (which is typically heavier than air) can fall to the floor, pool and build to a detectible concentration. If refrigerant is lighter than air, then the opposite is needed (pooling on ceiling).

Definitions

Energy

Energy is defined as all electricity consumed, as well as any fuels burned on-site, or off-site, for power, heating, cooling, and cooking.

Supporting information

The following resources support this credit:

- *Climate positive buildings and our net zero ambitions*
- Climate Positive Roadmap
- World GBC's Net Zero Carbon Buildings Commitments
- Clean Energy Regulator's Renewable Power Percentage