Impacts from Refrigerants

Aim of Credit

To encourage operational practices that minimise the environmental impacts of refrigeration equipment.

Credit Criteria

1.	**Refrigerants Impacts**	**1 point** is awarded where: The combined Total System Direct Environmental Impact of the refrigerant systems in the building is less than 15, **OR** The combined *Total System Direct Environment Impact* (TSDEI) of the refrigerant systems is between 15 and 35, **AND** a leak detection system is in place. Where there are no refrigerants employed by nominated building systems, this point is awarded.

Compliance Requirements

This focus of this credit is refrigeration equipment that is installed in a building. This includes most air conditioning systems and other refrigeration equipment.

Any mechanical equipment utilised to air-condition a space is considered 'refrigeration equipment' for the purposes of this credit. This includes any HVAC&R systems and cold/freezer rooms found in the premises. Refrigeration systems used to cool down data centres are also addressed by these requirements, if used in the premises.

Both criteria apply to all HVAC&R systems servicing the building, including any supplementary systems that are owned or operated by the building owner and that contain 50kg of refrigerants or more in the installation.

Refrigeration equipment required for industrial or manufacturing processes and temporary cold/freezer rooms are excluded from the requirements of this credit. Appliances are not the focus of these criteria and are also excluded from this credit.

1 - Refrigerants Impacts

Environmental impacts from refrigerants leaking into the atmosphere must be minimised as far as possible, in order for the aim of the credit to be achieved.

For the point to be awarded, the Total System Direct Environmental Impact (TSDEI) must be less than 15. Alternatively, the TSDEI can be between 15 and 35 if leak detection systems are in place.

Refrigerant Weighted Average Direct Environmental Impact

This requirement utilises a weighted average impact, based on ozone depletion potential (ODP) and direct global warming potential (GWP) caused by the leakage of refrigerants into the atmosphere. ODP, for the purposes of this credit must always be equal to 0.

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/kW) of the system, and per-year of equipment life.

Data collected for each piece of refrigeration equipment

Any refrigeration equipment with a combined refrigerant charge of 50kg or greater must be included in the calculations for this requirement. To determine the average total environmental impact of refrigerants, data is to be collected for each piece of refrigeration equipment, and entered into the *Impacts from Refrigerant Calculator*, which will generate and calculate the results. The following must be collected for every piece of refrigeration equipment that is included in the calculations:

- ODP = Ozone Depletion Potential of Refrigerant, ODP =0 kg CFC-11 / kg
- GWP = Global Warming Potential (100-year), 0 < GWP < 12,000 kg CO2 / kg
- m = Specific refrigerant charge (kg of refrigerant per kW cooling capacity), 0.1 < m < 2 kg/kW

ODP, for the purposes of this credit must always be equal to 0. The other information required by this credit will vary depending on type of refrigerant and equipment.

Applicants must provide documentation that supports all of their claims and calculations.

Where the TSDEI is calculated to be 15 or less, the point is achieved and no further requirements apply.

Where the TSDEI is between 15 and 35, the point available in the criterion is only awarded if leak detection systems are fitted, as described below.

1.1 Leak Detection Systems

In order for the leak detection system requirements to be met, any refrigeration equipment with a cooling capacity above 50kW is fitted with an automated leak detection system, 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 alarm must be raised by the automated leak detection system when a leak is detected, and actions to mitigate the leak event must be documented.

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).

Guidance

Alternative Compliance Methods

A Credit Interpretation Request (CIR) may be submitted to the Green Building Council of Australia (GBCA) when a registered project wishes to advocate for an alternative yet equivalent method of meeting Compliance Requirements. This is a formal process, reviewed by the GBCA (or other independent external assessors, depending on the complexity of the issue).

Standards and guidelines relevant to this credit

HB40.1: 2001: The Australian Refrigeration and Air-conditioning Code of Good Practice (Appendices 3 and 4).

AIRAH Refrigerant Selection Guide 2003.

AS/NZS 1677.2:**1998**, Refrigerating Systems - Safety Requirements for Fixed Applications.

AS/NZS 3666, Air-Handling & Water Systems of Buildings – Microbial Control Parts 1, 2, 3 and 4.

Definitions

High risk parts of the plant

High-risk parts of the plant (where leaks are likely to occur) include plant rooms containing chillers and other equipment with refrigerants, but do not include evaporator or condenser coils.

Refrigerant GWP

The 100-year Global Warming Potential (GWP100) is considered for the purpose of the Green Star rating tools. The GWP100 provides a measure of the potential for damage that a chemical has, relative to one unit of carbon dioxide. GWP100 is used to describe global warming potential over 100 years; and is used by the UN Intergovernmental Panel on Climate Change (IPCC).

Refrigerant ODP

Ozone Depletion Potential (ODP) is the potential for a single molecule of the refrigerant to destroy the Ozone Layer. All of the refrigerants use R11 as a datum reference, and thus R11 has an ODP of 1.0. The less the value of the ODP, the better the refrigerant is for the ozone layer, and therefore the environment.

R11 is a single chlorofluorocarbon compound. It has a high chlorine content and ozone depletion potential (ODP), and high global warming potential (GWP). The use and manufacture of R11 and similar CFC refrigerants is now banned within the European Union,

even for servicing. Although the use of R11 is banned, it was used as the datum for ODP, therefore having an ODP of 1. The ODP of all other refrigerants are compared to R11.

References and Background Information

Life cycle ozone depletion factor

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

LCODF will always equal 0, since ODP must be 0. The equation has been left in the credit criteria for completeness.

Life cycle direct global warming factor

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

Where:

- LCODF = life cycle ozone depletion factor [kg CFC-11 / kW.year]
- LCGWF = life cycle global warming factory [kg CO2 / kW.year]
- ODP = Ozone Depletion Potential of Refrigerant, ODP =0 kg CFC-11 / kg
- GWP = Global Warming Potential (100-year), 0 < GWP < 12,000 kg CO2 / kg
- m = Specific refrigerant charge (kg of refrigerant per kW cooling capacity), 0.1 < m < 2 kg/kW
- L = Refrigerant leak rate (% charge per year), 2% < L < 7%
- E = End of life loss, 0.1 (default 10%)
- Life = Equipment service life, 10 < Life < 35 years

The specific refrigerant charge (kg/kW) is a measure of the refrigerant usage in a system, to produce an amount of cooling capacity. The higher this number, the more charge-intensive the system is, leading to a potentially higher risk of refrigerant 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 a site.

The refrigerant leak rate (L) directly impacts on LCGWF factor, and as such, an adoption of a fixed leakage rates for both low and high-pressure refrigerant ensures consistency in the evaluation.

This credit uses the AIRAH leak rates at 2% and 7% per year for low and high-pressure refrigerants (respectively). This leak rate will also drive the criteria set for overall direct environmental impacts of the refrigerant.

Combined Effect of the Direct Environmental Impact of Refrigerants

Following this methodology, a capacity-weighted average total direct environmental impact can be used to evaluate multiple pieces of 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 of a single unit

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

Total System Weighted Direct Environmental Impact

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

Where:

- A = 100,000
- B = 1
- Qi = cooling capacity of rated equipment (kW)
- Qt = sum of cooling capacity of all rated equipment included in the system (kW)

Documentation Requirements

‘**Design Review Submission’ (Optional)**

Project teams are to submit information/documentation marked with an asterisk* for Design Review.

As Built Submission

All project teams are to submit the following documentation:

Submission Template*

- List of nominated systems to be included in the credit clearly outlining refrigeration equipment.*
- Summary of the building commissioning plan, clearly outlining refrigeration equipment.
- Confirmation that the building commissioning has taken place according to the plan.

Completed Impacts from Refrigerants Calculator*

Project teams are required to provide documentation supporting credit compliance. The following documents may be used to demonstrate compliance:

- **Extract(s) from the Commissioning Report** demonstrating that comprehensive pre-commissioning activities and commissioning activities have been performed as outlined in the Compliance Requirements. The relevant sections must be highlighted.

Please provide feedback on the technical content of this credit: