The Lab

Technical Briefing Note

F-Gases: GHG Methodology



Carbon | Advisory

GHG Emissions from Use of Refrigeration, Air Conditioning Equipment and Heat Pumps

DEFRA Screening Method

Air conditioning and refrigerators can leak leading to GHG emissions. If you own or control the equipment, you should report the emissions under scope 1. However, these emissions may fall into scope 3 for other companies benefitting from the equipment.

There are two methods for the estimation of emissions from the use of refrigeration, air conditioning equipment and heat pumps. For smaller users, the **Screening Method** will likely be the easiest way to calculate their emissions.

Please note, there are also regulatory requirements governing the operation of stationary equipment using fluorinated greenhouse gases. See information on F-gas regulations on the Defra website.

Screening Method

This Screening Method will help you to estimate emissions from refrigeration, air conditioning and heat pumps based on the type of equipment used and emissions factors. This approach requires relatively little actual data collection because default factors are used instead e.g. installation emission factors, annual leak rate. However there is a high degree of uncertainty with these factors. Therefore if emissions from this equipment are determined to be significant when compared to your organisation's other emissions sources, then you should apply a better estimation method (e.g. a Material Balance Method).

Step 1: Carry out an inventory of equipment

Find out the following information on refrigerant type and charge capacity:

- (i) the number and types of each refrigeration/air conditioning/heat pump unit;
- (ii) the type of refrigerant used (e.g. HFC 134a, R404a, etc);
- (iii) the total charge capacity of each piece of equipment (mass of refrigerant used).
- (iv) the time in years used during the reporting period.

Table: Typical Charge Capacity for Equipment

Type of Equipment	Typical Range in Charge Capacity (kg)
Domestic Refrigeration	0.05-0.5
Small Hermetic Stand-Alone Refrigeration Units	0.2-6.0
Condensing Units	50-2,000
Centralised Supermarket Refrigeration Systems	50-2,000
Industrial Systems	10-10,000
Small Stationary Air Conditioning	0.5-100
Medium Stationary Air Conditioning	0.5-100
Large Stationary Air Conditioning (Chillers)	10-2,000
Heat Pumps	0.5-100
Land Transport Refrigeration	3-8
Marine Transport Refrigeration	3-8
Light-Duty Mobile Air Conditioning	0.5-1.5
Other Mobile Air Conditioning	0.5-1.5

Step 2: Identify Global Warming Potential (GWP)

Once you know the refrigerant type, refer to the UK Government Conversion Factors to identify its Global Warming Potential (GWP).

Category	Refrigerant Name	GWP Value (kg CO2e)
Common HFCs & Blends	R32 (HFC-32)	677
	R134a (HFC-134a)	1300
	R407A	1923
	R407C	1624
	R407F	1674
	R410A	1924
High GWP (Phasing Out)	R404A	3943
	R507A	3985
Low GWP & Natural	R744 (CO2)	1
	R290 (Propane)	0.06
	R600a (Isobutane)	3
	R1270 (Propylene)	2
	R1234yf (HFO)	1
	R1234ze (HFO)	1
Legacy	R22 (HCFC-22)	1760

Step 3: Determine installation emissions

Identify any new equipment installed during the reporting period and charged on-site. Emissions from equipment charged by the manufacturer are not your responsibility.

For each type of Equipment:

Number of Units x
Equipment Charge Capacity (kg) x
Installation Emission Factor % x
Global Warming Potential of refrigerant =
Total kg equivalent

Table: Emissions from Installation of Refrigeration and Air-conditioning Equipment

Category	**Type of Equipment**	**Installation Emission Factor %**
Refrigeration	Domestic Refrigeration	0.6%
Refrigeration	Small Hermetic Stand-Alone	1%
Refrigeration	Condensing Units	2%
Refrigeration	Centralised Supermarket	2%
Refrigeration	Industrial Systems	1%
Air Conditioning	Small Stationary AC	0.5%
Air Conditioning	Medium Stationary AC	1%
Air Conditioning	**Large Stationary AC (Chillers)**	**0.5%**
Heat Pumps	Heat Pumps	1%

Category	Type of Equipment	Installation Emission Factor %
Transport Refrigeration	Land Transport Refrigeration	0.2%
Transport Refrigeration	Marine Transport Refrigeration	1%
Transport Air Conditioning	Light-Duty Mobile AC	0.5%
Transport Air Conditioning	Other Mobile AC	0.5%

Step 4: Determine operating emissions

Estimate losses from equipment leaks and service losses over the life of the equipment.

For each type of Equipment:

Number of Units x
Equipment Charge Capacity (kg) x
Time used (years) x
Annual Leak Rate % x
Global Warming Potential =
Total kg equivalent

To calculate annual emissions time used (years) = 1

Table: Emissions from Operation of Refrigeration and Air-conditioning Equipment

Type of Equipment	**Annual Leak Rate %**
Domestic Refrigeration	0.3%
Small Hermetic Stand-Alone	1.5%
Condensing Units	10.0%
Centralised Supermarket	17.0%
Industrial Systems	8.0%
Small Stationary AC	3.0%
Medium Stationary AC	6.0%
Large Stationary AC	**3.0%**
Heat Pumps	6.0%

Type of Equipment	Annual Leak Rate %
Land Transport Refrig.	15.0%
Marine Transport Refrig.	39.0%
Light-Duty Mobile AC	10.0%
Other Mobile AC	10.0%

Step 5: Determine disposal emissions

Identify pieces of equipment disposed of on-site during the reporting period. Equipment sent offsite for third-party disposal is not your responsibility.

For each type of Equipment:

Number of Units x
Equipment Charge Capacity (kg) x
Capacity remaining at disposal (%) x
Refrigerant recovered (%) x
Global Warming Potential of refrigerant =
Total kg equivalent

Table: Emissions from Disposal of Refrigeration and Air-conditioning Equipment

Refrigerant Type/Equipment	**Capacity remaining at disposal (%)**	**Refrigerant recovered (%)**
Domestic Refrigeration	80%	65%
Small Hermetic Stand-Alone	80%	60%
Condensing Units	80%	85%
Centralised Supermarket	100%	92%
Industrial Systems	100%	85%
Small Stationary AC	80%	70%
Medium Stationary AC	80%	70%
Large Stationary AC	**80%**	**80%**
Heat Pumps	80%	66%

Refrigerant Type/Equipment	Capacity remaining at disposal (%)	Refrigerant recovered (%)
Land Transport Refrig.	50%	80%
Marine Transport Refrig.	50%	71%
Light-Duty Mobile AC	50%	70%
Other Mobile AC	50%	70%

Step 6: Calculate total emissions

Add the emissions from installation, operation, and disposal for each type of refrigerant used.

Sources of this data:

UK Greenhouse Gas Inventory for 2011 (Ricardo-AEA);

2006 IPCC Guidelines for National Greenhouse Inventories;

US EPA Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance - Direct HFC and PFC Emissions from use of Refrigeration and Air Conditioning Equipment.

The methodology is from Annex C DEFRA - Environmental Reporting Guidelines

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