PROJECTION OF FLUORINATED GREENHOUSE GAS EMISSIONS IN BELGIUM FOR THE YEARS 2020-2040

DEVELOPMENT OF THE WEM-SCENARIO

Final Report

Study commissioned by the Federal Public Service of Public Health, Food Chain Safety and Environment, on behalf of the National Climate Commission
(DG5/CC/AW/18.001)

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1 INTRODUCTION

1.1 Subject of the study

This report is part of a study comprising two parts:

- Updating for the years 1995-2017 the Belgian emission inventory of ozone depleting substances and fluorinated greenhouse gases [1];
- Updating the WEM scenario of the emission projections for the fluorinated greenhouse gases covered by the Kyoto Protocol, for the years 2020-2025-2030-2035-2040 [2].

Dealing with the emission projections part, it presents the approach, the assumptions and the results obtained. The emissions have been quantified by region (Flanders, Wallonia, Brussels), by emission source, by individual substance and by year[1].

1.2 Gases concerned

The projections take into account the 50 gases of the emission inventory:

- the 30 compulsory gases of the new UNFCCC reporting (19 HFCs, 9 PFCs, SF6 and NF3);
- 12 ozone depleting gases (ODS) gases;
- 3 other PFCs, PFPMIE, CF3SF5 and 3 HFOs.

As well as an 'unspecified mix' used for the fluorochemical industry. Out of these 51 substances, 40 have non-zero emission values.

1.3 Global Warming Potential values (GWP)

In accordance with the / CP.19 Decision 24 of COP 2, the GWP values used for the CRF gases are those listed in Annex III of this decision, which are those contained in the errata of contribution of WG1 to the Fourth Assessment Report of the IPCC [3].

For the remaining substances, the best available data have been used, among which those of the Fifth Assessment Report of the IPCC [4].

1.4 WEM scenario

The emission projections are meant to be used for the national reporting of Belgium of the WEM scenario in the framework of the Monitoring Mechanism of the EU for the UNFCCC.

[1] Please note that unless otherwise mentioned, tables and figures are given for Belgium as a whole.

The WEM scenario is a ‘With Existing Measures’ scenario, i.e. considering all policies and measures that have been implemented or adopted by end 2018. It takes into account in particular European Regulation 517/2014 on fluorinated greenhouse gases [5] as well as specific policies and measures included in the draft Integrated National Energy and Climate Plan 2021-2030 of Belgium (see below).

1.4.1 EU regulation 517/2014

The EU Regulation establishes the following main measures:

- A cap and phase-down (in tonnes of CO2 equivalent) for the placing on the market of HFCs, with a freeze in 2015 followed by a first reduction in 2016-2017 and reaching 21 percent of the levels placed on the market in 2009-2012 by 2030.
- Bans or restrictions of the use of F-gases in some new equipment, such as refrigerators and air conditioners, insulating foams and technical aerosols.
- Conditions (for example, reporting on quantities of HFCs contained and the need for HFC import quotas) on the placing on the market of products and equipment containing or relying upon F-gases.
- Future restrictions on servicing/maintenance of equipment using HFCs (see section 2.1.2).
- Rules regarding containment, use, recovery and destruction of HFCs.

The cap and phase down (Art. 15.1 and Annex V) apply to all HFCs placed on the market in the EU, except for uses in feedstock applications, military equipment and etching or chemical vapour deposition in the semiconductor industry. Each producer or importer is allocated a decreasing quota proportional to both its ‘reference value’ (average over period 2009-2012) and the overall percentage decrease imposed on the EU market, which is as follows:

2015	100%
2016-17	93%
2018-20	63%
2021-23	45%
2024-26	31%
2027-29	24%
2030	21%

The impact of this cap and phase down should in principle be a price increase of HFCs to a level high enough to drive the EU consumption down proportionately to the imposed quota reductions.

Further details on the content of the regulation are given by sector in chapter 2.

1.4.2 Existing Regional Climate plans 2013-2020

In the Flemish Region, a dedicated programme for the reduction of F-gas emissions (‘Vlaams Actieplan Reductie Uitstoot van F-gassen 2015-2020’), was launched on 19 April 2016, describing existing as well as additional measures, aiming at limiting the F-gas emissions of the Flemish Region to 1,0 Mt CO2-eq in 2030.

Among existing measures in this plan are the Ecologiepremie+ subsidies, covering part of the extra-investment cost of new cooling installations using alternative, HFC-free, refrigerants.

1.4.3 Draft Integrated National Energy and Climate plan 2021-2030 of Belgium

The European regulation 2018/1999 on the Governance of the Energy Union and the Climate Action requests member states to draw up an integrated National Energy and Climate Plan 2021-2030 (NECP). A first draft of this plan was submitted by Belgium on 31/12/2018 [6].

As soon as the modalities are fully developed, a public inquiry will be launched in accordance with Article 10 of the Governance Regulation. A final version of the National Energy and Climate Plan 2021-2030 is to be notified to the European Commission by 31/12/19.

This draft plan comprises a draft federal contribution as well as draft regional Energy and Climate plans 2021-2030 for each of the three regions, which are part of its appendices:

- Draft Federal Contribution to the National Energy and Climate Plan 2021-2030,
- Draft Flemish Energy Plan for the period 2021-2030,
- Preliminary Draft Flemish Climate Plan 2021-2030,
- Draft Walloon Energy and Climate Plan 2030,
- Brussels Energy and Climate Plan 2030.

Each of the above regional plans include projections for a WEM scenario (‘business as usual’ scenario, with ‘existing’ measures) and a WAM scenario (‘with additional measures’ scenario). These climate plans contain specific measures related to F-gas emissions.

The main content of the draft regional climate plans is the following:

Flemish Region

- Continuation of existing policies and measures: cfr. 1.4.2.
- Additional policies and measures:
    - Strengthening of the economic support instruments, particularly the Ecologiepremie+ subsidies (possible extension beyond 2020 and to other technologies)
    - Capping F-gas emissions of the chemical industry as soon as possible to 0,15 Mton CO2e
    - Support for new or existing training centres with adequate equipment
    - Fostering of a Green Deal with the retail sector, to reduce its use of F-gases and related emissions to practically nil in 2030.

The new policies and measures aim at reducing the F-gas emissions in the Flemish Region to maximum 0,6 Mt CO2-eq emissions in 2030.

Wallonia

- Voluntary agreement with the food retail sector on the reduction of GHG emissions, covering F-gases and energy consumptions. Companies or professional associations could be assigned results obligations. The general objective is to reduce GHG emissions

by 90% in 2030 in comparison with 2005. Three subobjectives would be: acting on refrigerants, improve energy efficiencies and develop renewable energy sources.
- Financial support to companies covering part of the extra investment costs for natural refrigerant technologies.
- Strengthening training in the use of alternative refrigerants / alternative technologies.

Brussels-Capital region

- Significantly reinforce HFC refrigerant gas controls with refrigeration companies by 2020.
- Put in place in 2020 a financial incentive for new refrigeration plants (including heat pumps and air-conditioning systems) using alternative refrigerants.

1.5 Approach

The projection is based on the emission inventory for 2017 [1], taken as reference year, and on the same methodology as the emission inventory. It also uses assumptions consistent with those of this inventory.

The projections have been established simultaneously for Belgium and for each of the three Regions, on a harmonised basis (regarding methodology and assumptions), in the same way as for the emission inventory. This means that when there is uncertainty on a parameter, as long as there is no evidence of a difference between regions on the value of that particular parameter, a common value has been chosen.

All calculations have been performed by extrapolating into the future the calculation models of the emission inventory, year by year, from 2017 up to 2040, which allows to consider changes in parameters occurring between the 5 yearly projection years, as well as the dynamic aspects of yearly stock changes.

It should be stressed that there are many uncertainties. The projections are not meant to be forecasts, they are based on many assumptions and should be considered as a possible future, given the anticipated legislative context.

In the context of these uncertainties, a conservative approach has generally been pursued, i.e. the assumptions made generally tend to overestimate rather than underestimate the emissions.

The calculation method is specific to each sector[2]. All sectors of the emission inventory have been considered, even the smallest ones, which ensures complete consistency with the inventory.

Depending on the emission source, the national emissions are divided among the three regions using one of two alternative approaches:

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[2] In this report we will be using indifferently the terms sector, application and emission source, for convenience, even if in practice, depending on the situation one or the other may be more appropriate.

- When the emissions are estimated at the level of sources located in individual regions, they are attributed to these regions. This is the case of the manufacturing emissions of ‘Car airco’, ‘Trucks airco’, ‘Foams’, ‘Aerosols’, ‘SF6 in glass sector’, ‘Chemical industry’).
- The remaining emissions are regionalised using one of several (yearly) distribution keys: population, electricity consumption, number of private cars, greenhouse surface area.

The following regional distribution keys were used:

- population on 1st January (STATBEL statistics for 2005-2017; for 2018-2040, the latest projections of the Federal Plan Bureau & STATBEL [7]);
- electricity consumption (SYNERGRID statistics for 2005-2017; for 2018-2040, the same percentage distribution has been assumed as for 2017);
- number of private cars on 1st August (STATBEL statistics for 2005-2017; for 2018-2040, the same percentage distribution has been assumed as for 2017).

In this simplified approach, the differential impacts of the regional climate plans have generally not been analysed, although the contents of these climate plans differ. It should be noted, however, that the purpose of these plans, as far as F-gases are concerned, is mainly to facilitate the implementation of the European regulation, which, especially through the quota system, is the main driver for the expected emission reductions. The impact of the differences between the regional plans on emissions is therefore of lesser importance.

2 ANALYSIS BY SECTOR

2.1 Refrigeration "installations"

2.1.1 Approach

In this report, refrigeration "installations" represent all systems for industrial & commercial refrigeration applications that are assembled and filled with refrigerant on site.

For the emission inventory, the consumption and emission of refrigerants are modelled based on the national supply of refrigerants, from which the estimated supply for refilling stationary and mobile air conditioning systems as well as transport refrigeration systems are subtracted, and on assumptions on average loss rates (emission factors). No distinction is made between industrial and commercial refrigeration, as the shares of these sub-sectors in the total consumption are not known.

For the projection, in order to be able to consider different refrigerants ans emission factors, diverging evolutions of the fluid bank and the impact of sector specific policies, the fluid bank has been disaggregated between commercial refrigeration and industrial refrigeration.

As there is no data for Belgium on this distribution, this disaggregation is only approximate. It has been estimated based on the data for 2016 (last year available) of the CRF reporting for France, Germany and the UK, our main neighbouring countries[3].

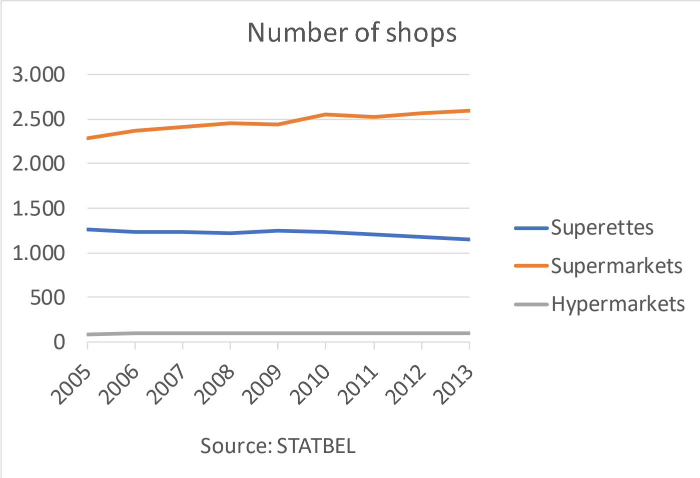
For commercial refrigeration, the bank was again subdivided between:

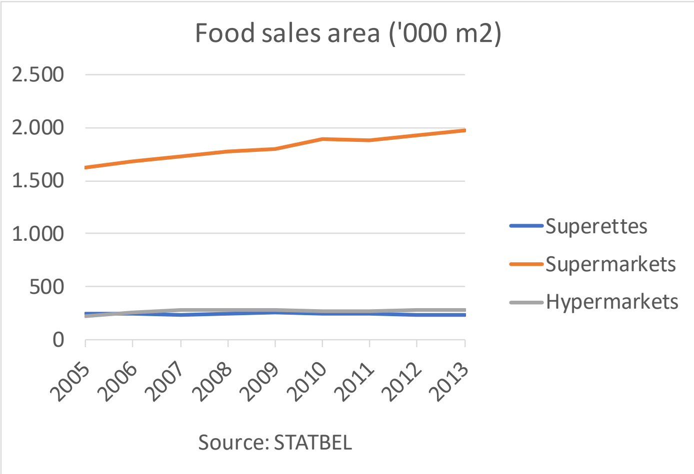
- Supermarkets – centralised systems,
- Small commercial – condensing units.

The first category represents supermarket (average food sales area 700 m2) and hypermarkets (average food sales area 3000 m2), while the second comprises both superettes[4] (average food sales area 250 m2) and 'small specialized shops' (general food, bakeries, butcheries, fruits & vegetables, dairy products, service stations, bars, hotels and restaurants).

For supermarkets, the refrigerant quantity used is often estimated from the sales area. The following charts show the available STATBEL statistics for the number and the food sales area of shops for superettes, supermarkets and hypermarkets, which cover the period 2005-2013.

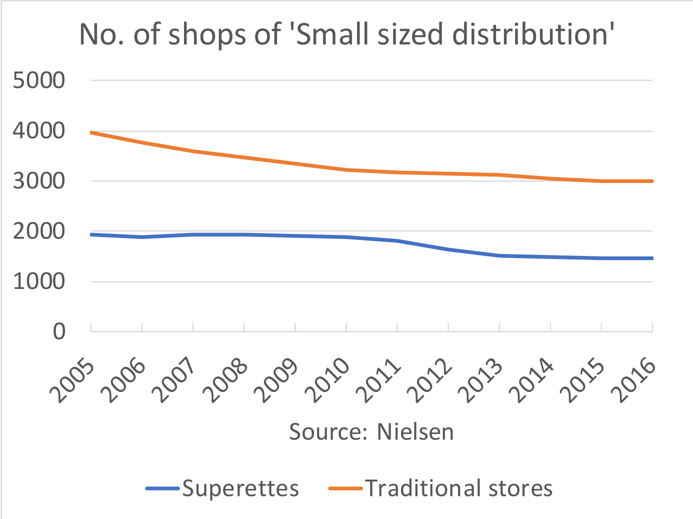
[3] Source: www.unfccc.org. 2018 submission. Note that no relevant data was available for the Netherlands or Denmark.
[4] Minimarkets (e.g. Carrefour Express, Proxy Delhaize).





The superettes were decreasing in number and food sales area. Among this type of shop, Carrefour and Delhaize Group are the only two groups of which the sales area was increasing over the period.

No STATBEL statistics are available for the 'small specialized shops'. However, an idea of their importance and evolution is given on the next chart, with figures from Nielsen [8], albeit for another definition of shop types: 'Small sized distribution' represents all shops with a selling surface of less than 400 m2 and all shops with a 'traditional service (e.g. night-shops).



The number of superettes has been slowly been declining, with a stabilisation in 2016, when a decrease by 8 traditional stores was compensated by an increase by 8 superettes.

Based on more detailed figures on refrigerant stocks available for France in 2015 [9] [10], a share of 67% was assumed for 'Supermarkets – centralised systems' and 33% for 'Small commercial – condensing units'.

The projection has been made by extrapolating into the future the inventory model, year by year, for each of the 3 subsectors. It has been made as much as possible consistent with the figures and assumptions of the inventory (fluid bank, lifetimes, emission factors). This is important given the uncertainties remaining on the size of the bank and the emission rates.

2.1.2 Provisions of EU regulation 517/2014 for the sector

As far as the refrigeration and air conditioning installations are concerned, the bans on placing on the market (Art. 11 and Annex III) concern among other things:

- from 1 January 2020, stationary refrigeration equipment running on HFCs with a GWP ≥ 2500, except for applications below -50°C;
- from 1 January 2022, multipack centralised refrigeration systems for commercial use with a capacity ≥ 40 kW with gases with a GWP ≥ 150, except in the primary refrigerant circuit of cascade systems with indirect medium temperature loop (see Annex I of [11]), where a GWP of up to 1500 may be used;
- from 1 January 2025, single split air-conditioning systems with less than 3kg of fluorinated GHG that contain gases with GWP ≥ 750.

The restrictions on use (Art. 13) include a prohibition, from 1 January 2020, to use F-gases with a GWP ≥ 2500 to service or maintain refrigeration equipment with a charge size ≥ 40 t CO_2-eq. This shall not apply to reclaimed or recycled F-gases until 1 January 2030.

2.1.3 Assumptions

As in the inventory, lifetimes are assumed to be 15 years.

For the emission factors from the bank, we have extrapolated the exponential downward trend of the inventory, leading on average from 10,5% in 2018 to 7% in 2030 and 5% in 2040. However, the emission factor of supermarket centralised systems is assumed to be 50% higher than those of small commercial condensing units and industry.

Refilling with refrigerant is assumed to occur with the same refrigerant as the emissions, at a level consistent with a 'percentage remaining in systems at disposal' of 80% at the end of the lifetime.

We have assumed for all refrigerants and subsectors a manufacturing emission factor of 3%, as in the inventory, and a disposal emission factor of 50% (lower than the 70% of the inventory, given, among other things, the price increase of refrigerants), except for recovery at retrofitting, where 20% has been assumed, as a certified technician is more likely to be involved In such a case.

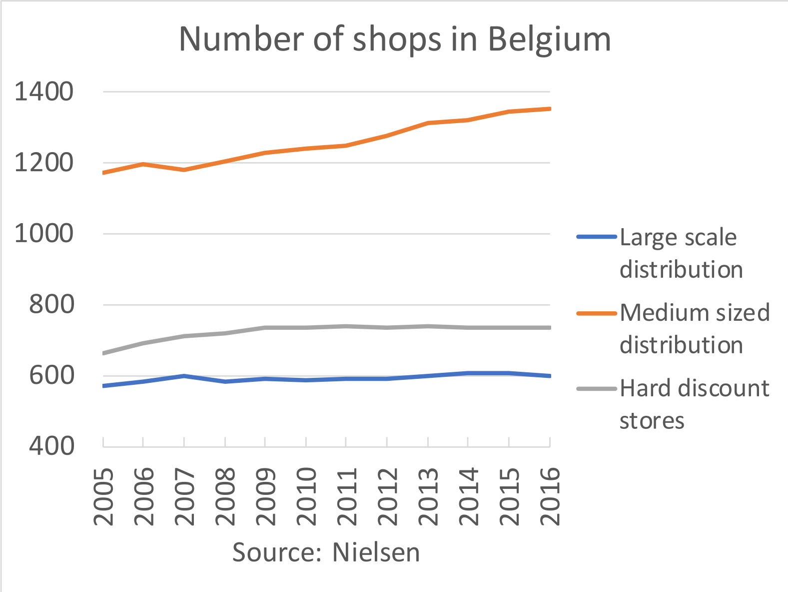
Sales areas in grocery channels are still expected to expand in the future according to the analysts of LZ Retailytics [12], as shown in the table below for the next five years. The figures are for Europe as a whole, but 60% of the growth should take place in western Europe. Half the growth would be due to the hard discounters.

Europe: Total sales area of modern grocery channels

(million m2)	2018	2023	%/year
Supermarkets	61,7	65,8	1,3%
Hypermarkets	50,2	52,0	0,7%
Discounters	45,2	55,3	4,1%
Minimarkets	27,0	28,8	1,3%
Drugstores	9,4	11,1	3,4%
TOTAL	193,5	213,0	1,9%

Source: LZ Retailytics, 2018

The downward trend of small traditional stores mentioned earlier is compensated by an increase in the number of urban superettes, putting a pressure on the hypermarkets [13], noticeable on the next chart.



Given these circumstances, we have made the following assumptions on annual activity growth rates.

Activity growth rate (%/year)	2017-2023	2023-2030	2030-2040
Commercial			
Supermarkets - centralised systems	2,0%	1,5%	1,0%
Small commercial - condensing units	1,0%	1,0%	1,0%
Industry	1,0%	1,0%	1,0%

The shares of refrigerants in new systems are strongly impacted by the new regulation, given the cap and phase down and the restrictions on sales. A range of options may be considered to replace existing technologies [14] [15]:

- Use of lower GWP HFC refrigerants, as drop in (e.g. R448A or R449A in replacement of R404A) or in new systems;
- Use of cascade systems with a CO2 cycle for the lower temperatures;
- Transcritical CO2 cycles;
- Use of R717 (ammonia);
- Reduction of cooling load (e.g. by adding doors, or using better insulated doors, on supermarket display counters);
- Use of indirect refrigeration circuits, with a secondary refrigerant;
- Use of hydrocarbons (propane, propene);
- Increase in efficiency of refrigeration cycles, e.g. through new types of heat exchangers;
- Use of new refrigerant blends, based on HFO, with or without HFC32.

However, there is no one fits all solution. Some options may be short term ones, while others are still under development (like R32 or new HFO blends). Besides emissions and costs, important criteria to be considered in the choice of technology are safety (flammability, toxicity), power range, energy efficiency, type of sector, ambient climate. The applicability depends on regulations regarding flammability. Ammonia requires safety precautions and habits that industry is more accustomed to than supermarkets. The use of hydrocarbons also requires precautions and imply a special training of operation and maintenance personnel. A balance needs to be made between emissions, energy consumption and costs.

Given the large number of refrigerants used in practice and the difficulty of establishing assumptions for each, the projection has been performed per substance rather than per refrigerant, starting from assumptions on a simplified mix of refrigerants per sub-sector.

For the shares of refrigerants in new systems, the following assumptions have been made, which are based on [9], [16] and on contacts with installers in both the industry and commercial sectors, and allow the emissions of installations to develop roughly in line with the phase-down of Regulation 517/2014:

Refrigerant shares in new systems	**2018**	**2022**	**2030**	**2040**
Percentages of the total amount of F-compounds replaced				
Values for remaining years are linerarly interpolated				
Commercial				
Supermarkets - centralised systems				
R404A	0%	0%	0%	0%
R134a	25%	5%	5%	5%
R449A	25%	0%	0%	0%
AO (R744, HCs, indirect circuits, savings)	50%	95%	95%	95%
Total	100%	100%	100%	100%
Small commercial - condensing units				
R404A	0%	0%	0%	0%
R134a	45%	40%	25%	25%
R449A	45%	40%	25%	25%
AO (HC, R744, indirect circuits, savings)	10%	20%	50%	50%
Total	100%	100%	100%	100%
Industry				
R404A	0%	0%	0%	0%
R134a	25%	20%	10%	10%
R449A	20%	15%	10%	10%
AO (R717, R744, HCs, indirect circuits)	55%	65%	80%	80%
Total	100%	100%	100%	100%
AO: alternative options				

Again, this scenario is rather conservative, in the context of remaining uncertainties. For example, there are prospects for replacing R134a (GWP 1430) with R513a (GWP 631) or even with R1234ze (GWP 6). R513a is being tested in Belgium now. The extent of such replacement will depend on price evolutions (especially R1234ze is significantly more expensive, not only the gas itself, but also the equipment to use it, which needs to be larger). Concerns have been expressed about efficiency losses[5], but they seem to be of minor importance.

Regarding condensing systems, a few CO2 units have been installed by now, and others are planned, but the investment cost is still generally considered too high, and the available subsidies are small compared to the extra investment cost. While large retailers are more

[5] https://www.coolingpost.com/uk-news/keep-calm-over-r134a-says-johnson-controls.

prepared to pay a price for switching to natural refrigerants, small shop owners are generally much more concerned about costs and reluctant to invest in CO_2 systems at the moment. This situation should change in the future if the cost of CO_2 systems dwindles enough.

There is still uncertainty about safety regulations for hydrocarbons, for which there is also a lack of training. And it is not clear which other refrigerants will be available in the future, at what price, and for how long. Are new bans going to be decided? New refrigerants are periodically announced, but they must first be validated by component manufacturers.

Questions remain among some installers about the actual performance of new systems (e.g. the energy consumption of CO_2 equipment). The complexity of systems which depend on local conditions does not always make comparisons easy and alternatives are not always calculated. Technologies evolve quickly and not all installers are aware of the latest achievements. Uncertainties may in some cases delay decisions on equipment replacement.

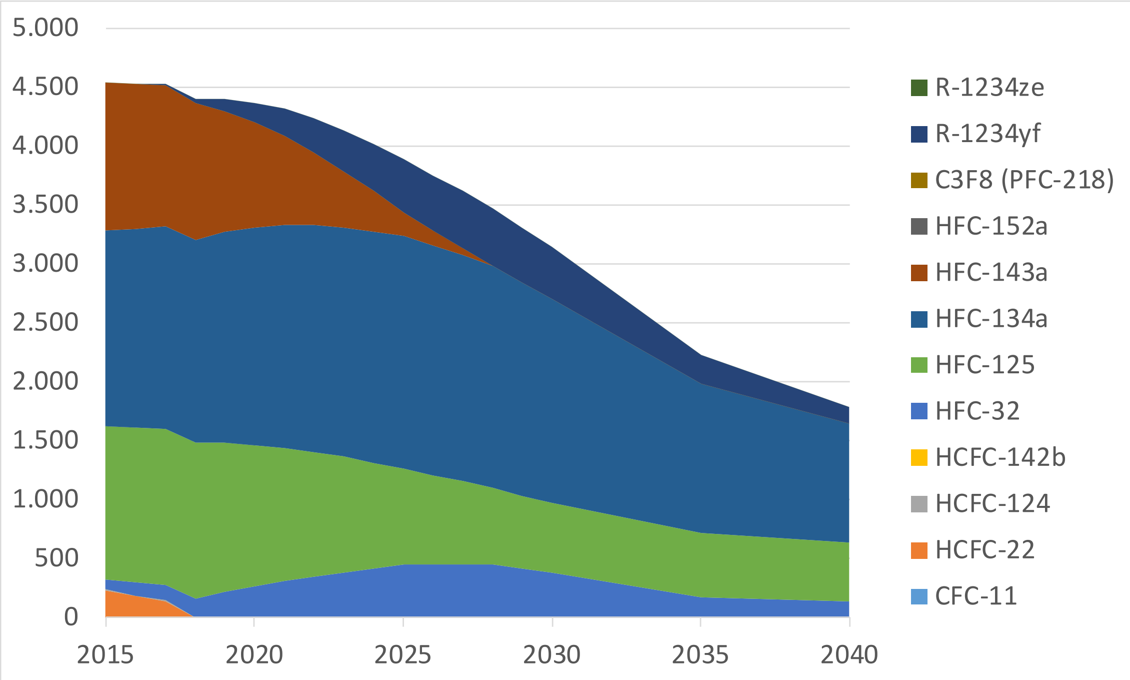
In industry, the situations are diverse. A substantial part of the market seems to be striving to use natural refrigerants in new units right now when replacing end of life F-gas plants, especially in big companies. Others on the other hands are still continuing to install new F-gas units, based on R134a and R448A or R449A.

Retrofitting of R404A and R507A is modelled by replacing R143a and R125 by R32, R134a and R1234yf as if R404A was replaced by R449A. This leads to a GWP reduction from 3922 to 1397.

2.1.4 Results

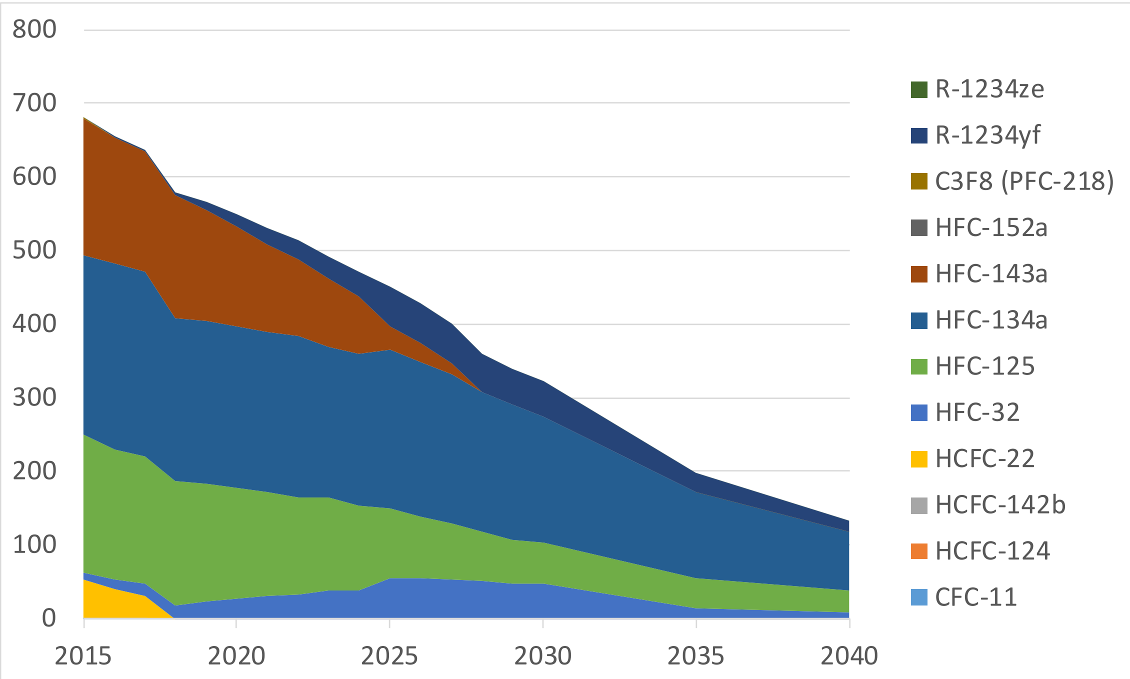
The evolution of the total bank of F-gases, in tonnes, is shown on Figure 1. The main HFCs are HFC125, HFC134a and HFC143a. A fourth, HFC32, is temporarily gaining importance.

Figure 1: Bank of refrigeration " installations" (t)



The corresponding emissions are displayed on Figure 2, which shows the impact of banning the sale of R404A, with a GWP of about 4000. In practice, the alternatives indeed contain no HFC143a anymore.

Figure 2: Emissions of F- gases from refrigeration " installations" (t)



The emissions of the Kyoto gases are shown on Figure 3.

Figure 3: Emissions of CRF gases from refrigeration " installations" (kt CO2-eq)

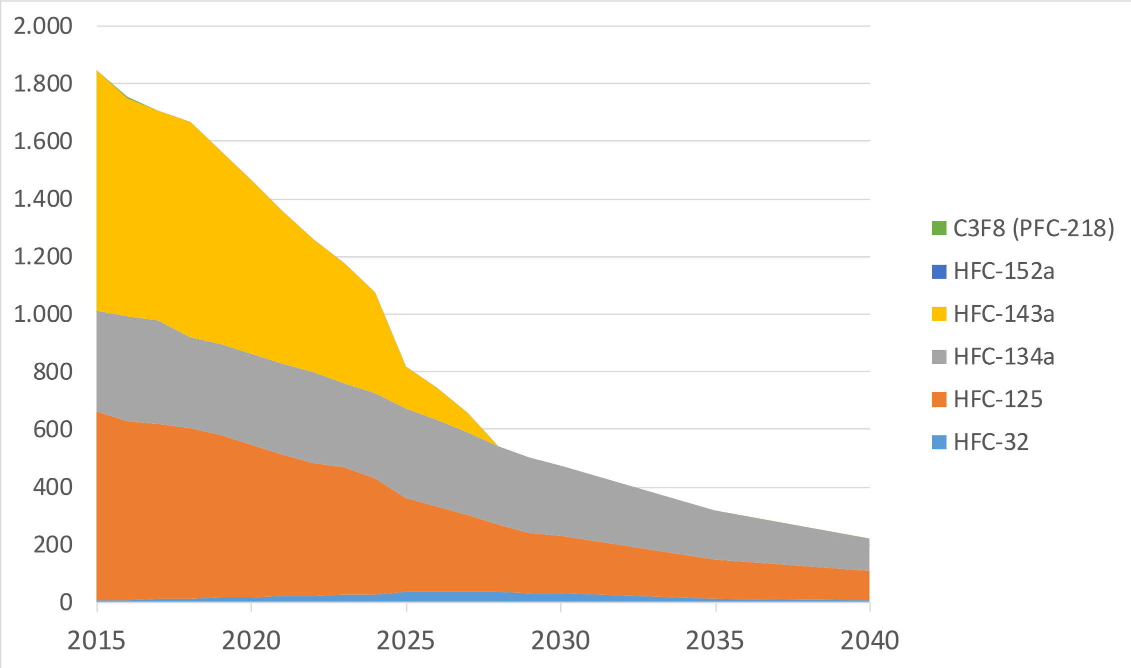
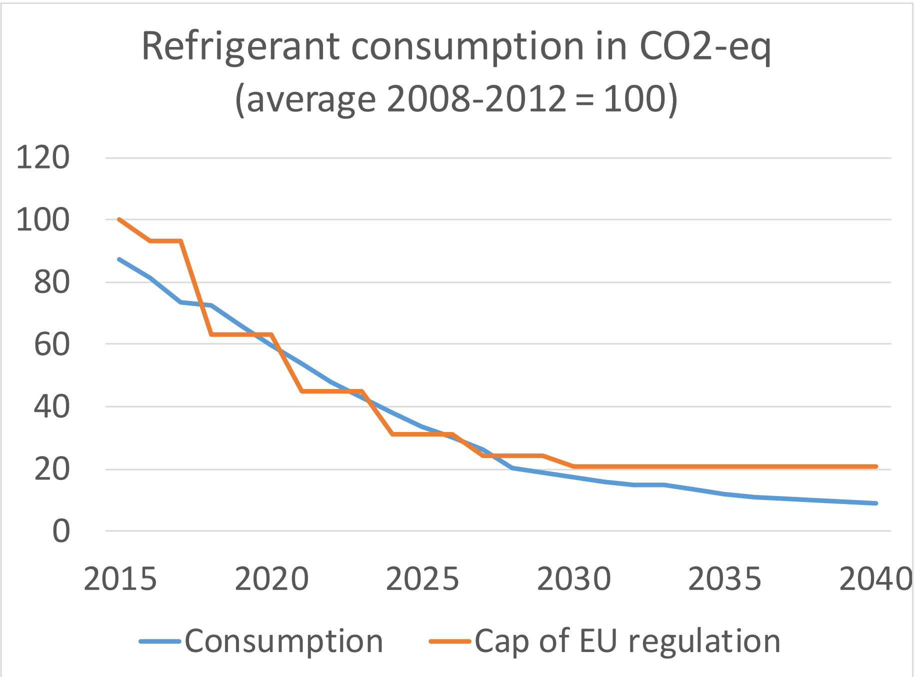


Figure 4 shows that the consumption of CRF gases in terms of CO2 equivalents is roughly in agreement with the EU phasedown.

Figure 4: Consumption of CRF gases in refrigeration " installations" (kt CO2-eq)



2.2 Hermetically sealed refrigeration

The regulation on F-gases imposes a prohibition on placing domestic refrigerators and freezers on the market that contain HFCs with a GWP of 150 or more from 1 January 2015. For commercial refrigerators and freezers that are hermetically sealed, the F-gas regulation prohibits HFCs with GWP of 2500 or more from 1 January 2020 and HFCs with GWP of 150 or more from 1 January 2020.

The projection of F-gas emissions from hermetically sealed refrigeration is based on several assumptions:

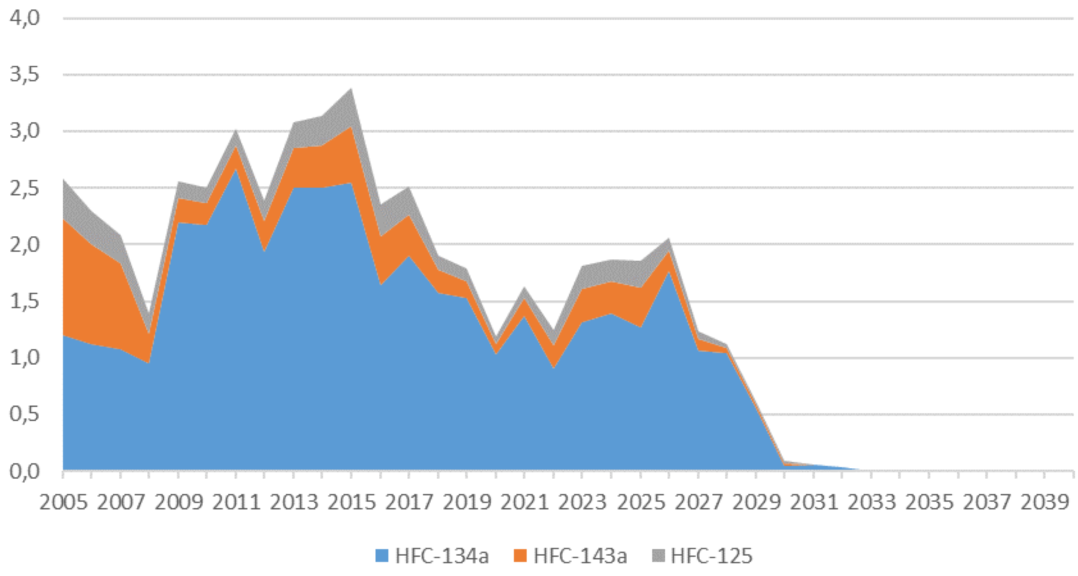
- For domestic refrigerators and freezers, the use of HFCs in new equipment is already prohibited and therefore emissions in 2018-2040 only result from the quantities remaining in stock and from the disposal of equipment.

- For commercial refrigeration and freezers, it is assumed that R404A and R134a will be phased out in 1/1/2020 and 1/1/2022 respectively and replaced by non-HFC alternatives. The stock of equipment does not change. The fugitive emission factor for 2018-2040 is 1%.

- To calculate disposal emissions for both domestic and commercial equipment it is assumed that 20% of the quantity of coolants contained in disposed refrigerators are emitted before dismantling (e.g. during collection and that all refrigerators collected in the Walloon and Brussels Capital Region are dismantled in Belgium. Of the refrigerators collected in Flanders, 31% are exported (same as in the past). Based on information from Recupel, it is assumed that 90% of the remaining gases are recovered from refrigerators and that 10% are emitted.

The results show that emissions are expected to continue to decline until 2030, when emissions are close to zero. These low emissions are the result of the phase-down of HFCs in hermetically sealed commercial systems.

Figure 5: Total emissions from hermetically sealed refrigeration (kt CO2-eq)



2.3 Stationary air conditioning and heat pumps

For stationary room air conditioning and heat pumps, the F-gas regulation imposes a ban on the use of F-gases with a GWP of more than 150 from 1 January 2020 for movable air conditioning (category Movable apparatus and monoblocs in our calculation) and with a GWP of more than 750 from 1 January 2025 for single split systems with less than 3 kg refrigerants (category Split < 7 kW in our calculation).

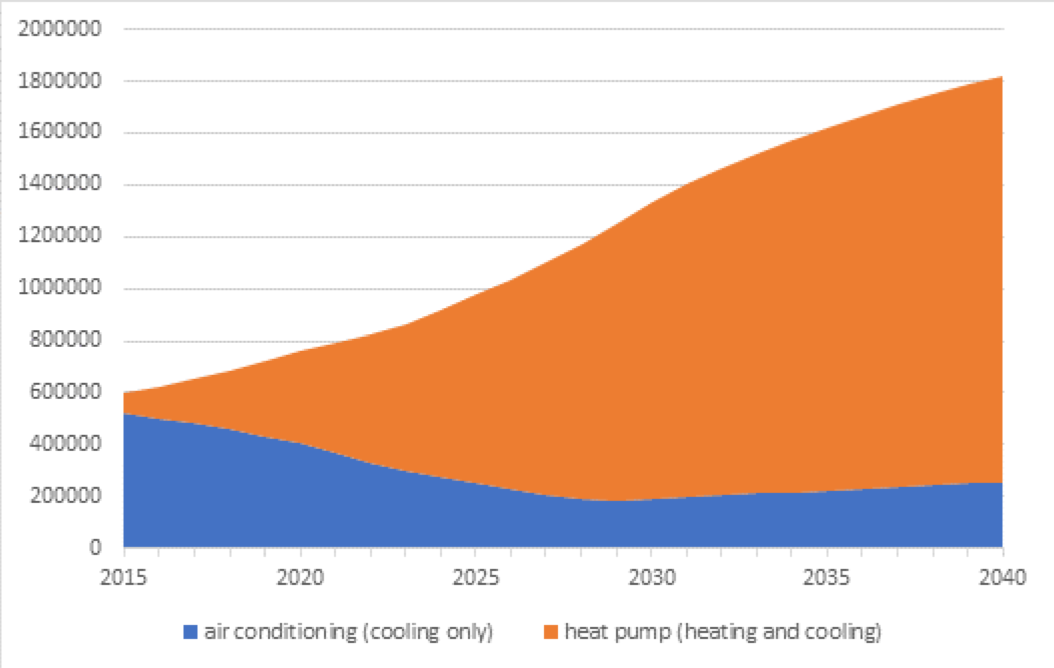
The projection of F-gas emissions from air conditioners and heat pumps is based on several assumptions:

- To estimate the stock of equipment we assume that the number of new air conditioning equipment will increase by 2,67% per year. This mostly affects the small movable room air conditioners. The impact on projected emission is however small of this assumption as the phase-out of the use of F-gases means that from 2020 onwards no new quantities will be added to the existing bank.

- For heat pumps growth is expected to be larger because of energy efficiency and renewable energy policies that support heat pumps. In Flanders, renewable heat production from heat pumps is expected to increase more than 4-fold between 2016 and 2030 (based on the Flemish Energy Plan 2021-2030), while in the Walloon region growth of heat pumps will stagnate with existing measures. It is important to stress that the impact of this assumptions on emissions is small up to 2030. Projections with constant growth (i.e. same number of new equipment per year as in 2017) or an annual 5% increase of new installations results in a difference of total GHG emissions for this category of 5% in 2030. After 2030, the sensitivity of this assumption increases and results in a 40% difference in 2040. For the projection, a growth of 5% for new heat pumps is assumed until 2030 and constant after 2030 to 2040. The total stock of equipment is presented in Figure 6.

- The average lifetime is 15 years for all systems.
- The use of HFC-407C and HFC-410A is prohibited in movable room air conditioners from 2020 onwards and replaced by other refrigerants. In split systems smaller than 7 kW, we assume that HFC-407C and HFC-410A will be replaced by R32 by 2025[6]. In multi-split systems, we assume that changes will occur gradually and linearly in the F-gases used in the period 2018-2040. For these units, we assumed that R410A and R407C will be replaced gradually by R32 and, at a later stage, non-HFC refrigerants in line with the overall phase-down of HFCs in the F-gas regulation (the phase-down in HFC production and import is imposed on the entire market and it is therefore difficult to predict what the impact will be on specific subsectors, such as room air conditioning).

Figure 6: Total stock of air conditioning and heat pumps in Belgium (2015-2040)



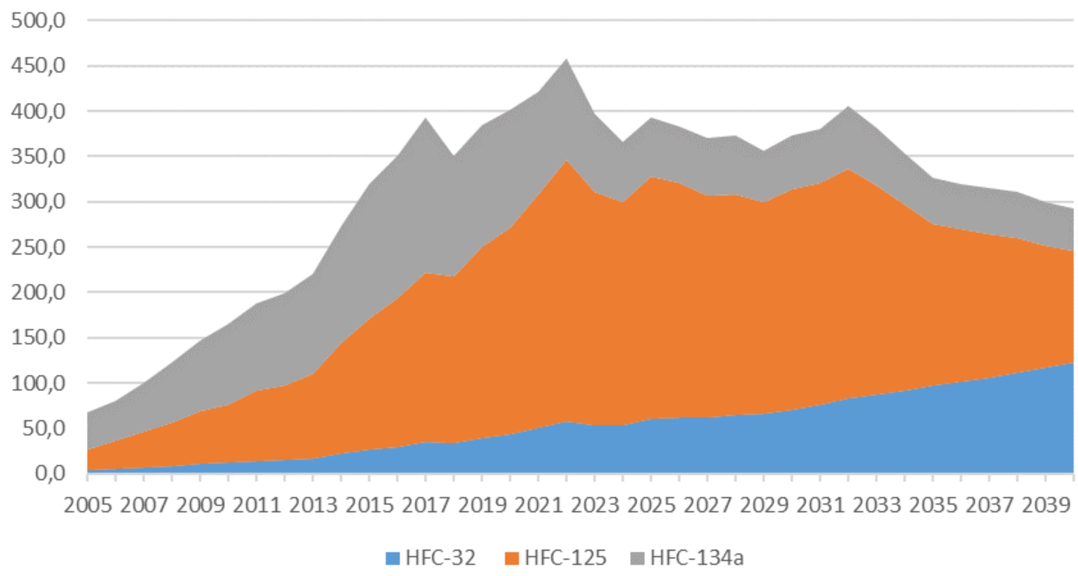
- For the manufacturing emissions, we have assumed that there will be a shift from the substances used now (HFC-134a, R407C and R410A) to R32. As a conservative estimate the total consumption of HFCs remains the same as the average consumption in the period 2013-2017.
- Disposal emission factors are kept constant at 70%. Recupel does not report specific information on air conditioning or heat pumps, so no Belgian specific information is currently available. The same assumption is used for the projection as for the inventory.

The results show that emissions are expected to stabilise between 2020-2030 and decrease afterwards, despite increasing stocks of heat pumps and stationary air conditioning. This can be

[6] http://ec.europa.eu/clima/policies/f-gas/alternatives/index_en.htm.

explained by decreasing disposal and fugitive emissions because of the phase-out of high GWP F-gases in stationary installations and heat pumps.

Figure 7: Total emissions from room air conditioners and heat pumps (kt CO2-eq.)



2.4 Mobile air conditioning

2.4.1 Cars

The emissions of F-gases are affected by the MAC directive (directive 2006/40/EC). The projection of F-gas emissions from cars is based on the following assumptions:

- The number of cars with air conditioning in Belgium for the period 2018-2040 was calculated based on the average number of new cars registered in 2015-2017, adjusted for the increase in population size. The number of disposed cars and the total stock of cars with air conditioning is calculated with a stock model, as it is done for the inventory.

- 96% of new cars are equipped with air conditioning. We have kept this percentage fixed for the period 2018-2040.

- All cars will be equipped with alternative refrigerants. It is assumed that only HFO-1234yf is used. Car manufacturers are generally using HFO rather than CO2.

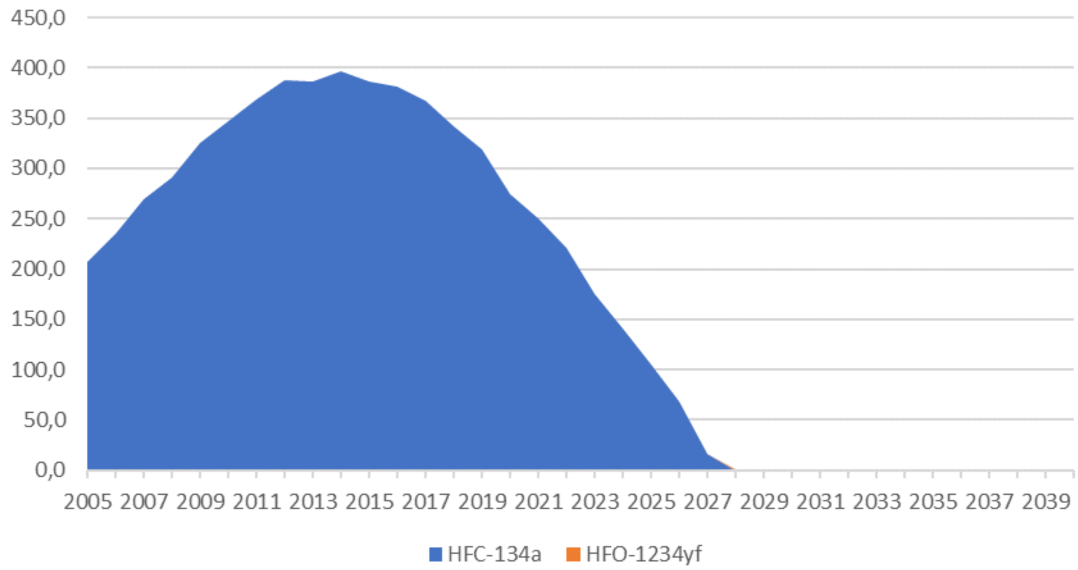
- For emissions resulting from manufacturing in 2018-2040, it is assumed that manufacturers will use the same quantities of refrigerants in 2018-2040 as in 2017. Although at factory level the use of refrigerants is relatively constant throughout the years, there is a decrease since 2006 in the consumption of HFC-134a.

- Fugitive emissions are kept constant throughout the 2018-2040 period at 8,8% for regular and irregular emissions, and one recharging per year with a loss of 2%.

- With respect to disposal emissions, the quantity of refrigerants in cars at the end of lifetime is calculated based on a simple stock model. There are two important elements that determine the disposal emissions:
    - The share of end-of-life vehicles that are exported for dismantling or use. For the period 2018-2040 it is assumed to be constant at 34% (based on the trend in recent years).
    - The emission factor of refrigerants during dismantling. The historic data shows a modest increasing trend of recovered quantities of HFC-134a from end-of-life cars. For the period 2018-2040, we assume that the modest increasing trend will continue until 2030. In 2030, 66% of coolants in end-of life vehicles are exported, 17% are recovered and 17% are emitted. These factors are assumed to be the same for HFC-134a, HFO-1234yf and CO2.

The emissions (in kt CO2-eq) from car air conditioning peaked in 2014. After 2014, emissions start to decline, first slowly and then more rapidly when more and more HFC-equipped cars in the stock will be replaced by cars equipped with HFO or CO2. Small emission reductions are achieved because of increased recovery of HFC-134a from disposed cars.

Figure 8: Total emissions from mobile air conditioning in cars (kt CO2-eq)



2.4.2 Buses and Coaches

The projection of F-gas emissions from buses is based on several assumptions:

- For the projection 2018-2040, we assume that the number of new registrations will be the same as the average of the last 5 years, adjusted for increases in population size.

The total number of buses and coaches in Belgium in 2018–2040 was calculated based on the number of new registrations and an average lifetime for buses and coaches of 17 years. Newly registered vehicles in 2014-2040 were in 29% of cases buses and in 71% of cases coaches, a situation similar to that of 2013. It is assumed that all coaches and 50% of buses will be air conditioned up to 2040.

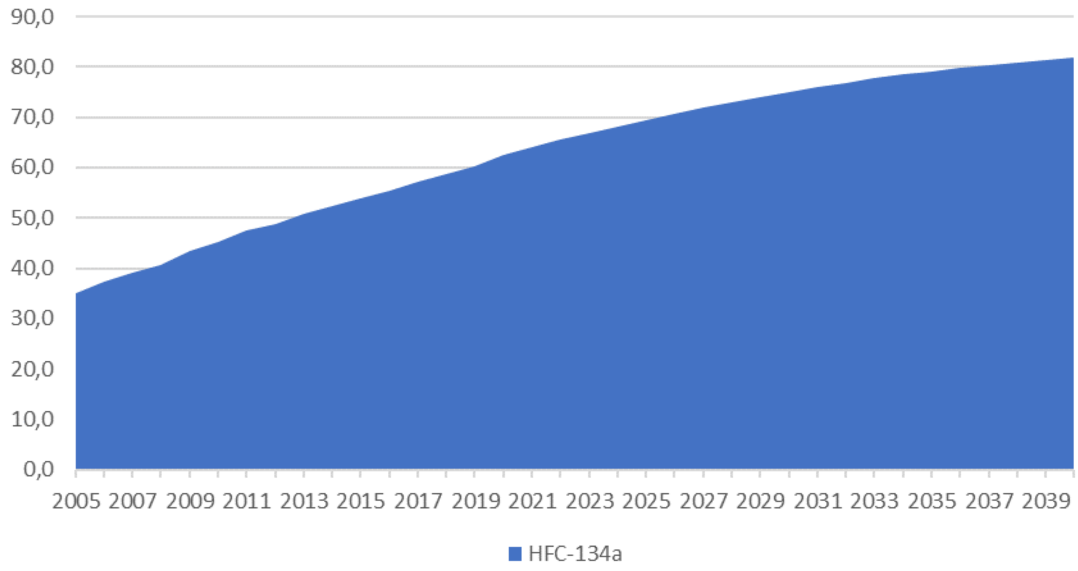
- Buses do not fall under the MAC-directive and it is therefore assumed that HFC-134a will continue to be used as a conservative estimate. Alternative refrigerants are being explored. For electric buses, R407C is already in use and also CO2 is being used for buses in cities. It is difficult to predict how this trend, spurred by increasing prices of HFCs and increased awareness, will evolve in future years.

- The use of HFC-134a by manufacturers and resulting manufacturing emissions is constant for the period 2018-2040 and the same as the consumption in 2017. Consumption of HFC-134a by bus manufacturers has been constantly declining in Belgium, since 2007 from more than 16 t to 4,6 t in 2017. The emission factor is also kept constant.

- The assumed fugitive emission factor is 30% for HFC-134a and kept constant throughout the time period. The impact of this assumption on total emissions is marginal.

Emissions will increase due to the increasing stock of buses and coaches. The increase is relatively small and the impact on total emissions of F-gases is small. The trend has a high level of uncertainty because for electric buses R407C is also used for air conditioning (pers. Comm., 2018). Up to now, the number of electric buses and coaches is still limited, but public transport companies in all three regions have already announced the purchase of electric busses in the near future. Additionally, CO2 can be and is already used in European cities as refrigerant in the air conditioning system of electric, hybrid and diesel buses. As a conservative estimate, R134a use is continued in buses.

Figure 9: Total emissions from mobile air conditioning in buses (kt CO2-eq)



2.4.3 Trucks

The projection of F-gas emissions from trucks is based on several assumptions:

- For the projection 2018-2040 we assume that the number of new registrations will be the same as the average of the last 2 years, adjusted for the expected increase in transported goods in tkm (annual growth of 1,7%) [17]. The total number of trucks in Belgium in 2018–2040 was calculated based on the number of new registrations and an average lifetime for trucks of 12 years.

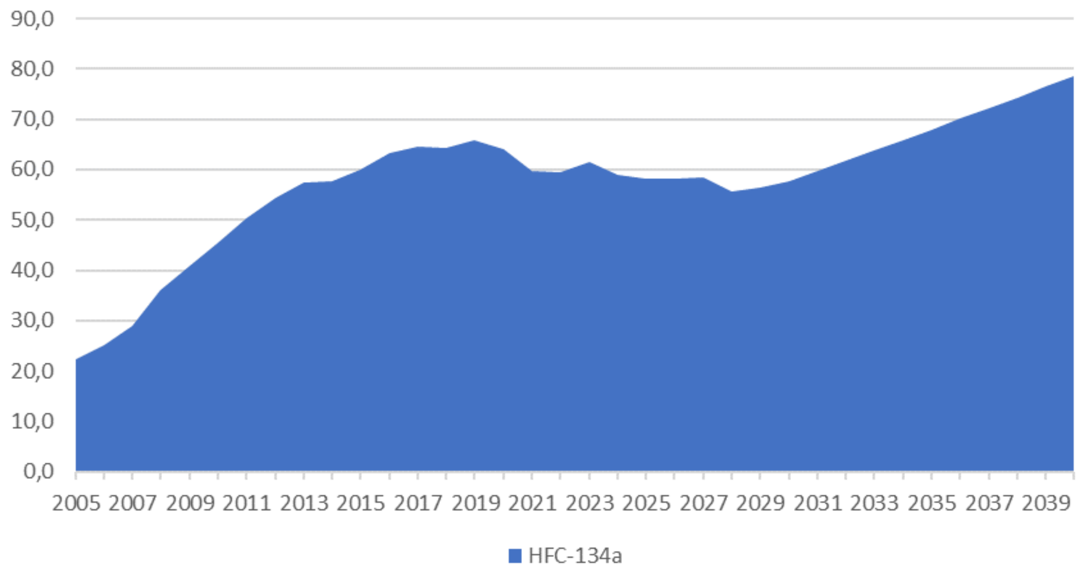
- The share of new trucks with air conditioning depends on the weight category. It is assumed that this share will remain constant for the period 2014-2040. The share of trucks with air conditioning will increase to a saturation level of 90% across all weight categories.

- Most trucks do not fall under the MAC-directive and it is therefore assumed that HFC-134a will continue to be used. Only small trucks fall under the MAC directive and this was taken into account in the inventory. The use of HFC-134a by manufacturers and resulting manufacturing emissions is constant for the period 2018-2040 and the same as the average consumption in the period 2013-2017. The emission factor is also kept constant.

- The fugitive emission factor for HFC-134a is kept constant throughout the time period. Also, disposal emission factors are kept constant throughout 2018-2040.

The emissions increase due to an increased bank of HFC-134a in trucks and a rising number of trucks with air conditioning being disposed. The increase in emissions after 2030 is the result of the increasing stock of trucks equipped with an air conditioning system.

Figure 10: Total emissions from mobile air conditioning in trucks (kt CO2-eq)



2.4.4 Rail transport

The projection of F-gas emissions from rail is based on several assumptions:

- Up to 2017, data was received from the NMBS/SNVB on either the total stock of vehicles with air conditioning or the consumption of HFCs. For the period 2018-2040, we assume that the stock of air conditioned vehicles will increase by 3% per year. Up to now, the stock of air conditioning rail transport has been much lower. The annual increase in the period 2001-2013 has been 3,5%, so this assumption seems realistic.

- All vehicles with air conditioning are equipped with HFC-134a now and in 2040. Only the high-speed trains are equipped with R407C. The average charge per vehicle is used and kept constant for the period 2018-2040.

- With an average lifetime of 40 years, disposal emissions are expected to occur from 2022. The disposal emission factor by then is expected to be 10%.

2.4.5 Refrigerated transport

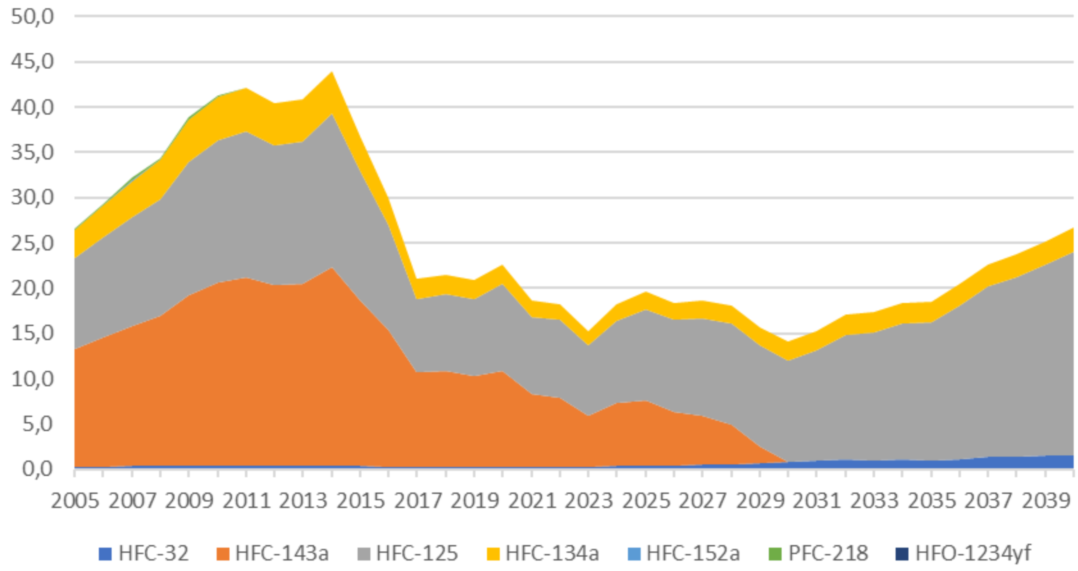
The regulation on F-gases has an impact on refrigerated trucks, F-gases in refrigerated trucks have to be recovered by certified personnel, which will have an impact on the disposal emission factor. Also, fugitive emission factors will be affected, as the F-gas regulation imposes leakage control (article 4).

The projection of F-gas emissions from refrigerated trucks is based on several assumptions:

- The total stock of refrigerated trucks for the period 2018-2040 is estimated to increase by 2,5% annually. This corresponds with the growth in recent years.
- The fugitive emission factor in the inventory used to be 25% and decreased because of the new F-gas regulation to 10% in 2017. Fugitive emission factors are expected to remain constant between 2018-2040.
- The disposal emission factor is 30% for the period 2018-2040.

The results show that total emissions are expected to remain relatively constant after 2018 although the ratio of different gases will change. Some large retailers in Belgium have experimented with CO2 refrigerants or moved to a completely different system of refrigerated transport based on liquid ice. These trends are important and if applied more in future could reduce emissions from this sector more significantly than foreseen. These technologies are however at the moment either more expensive (in the case of CO2) or only achievable for large retailers (in the case of liquid ice).

Figure 11: Refrigerated trucks (kt CO2-eq)



2.5 Foams

2.5.1 Closed cell foams

For this emission source, data on expected F-gas consumption were obtained from the relevant manufacturers.

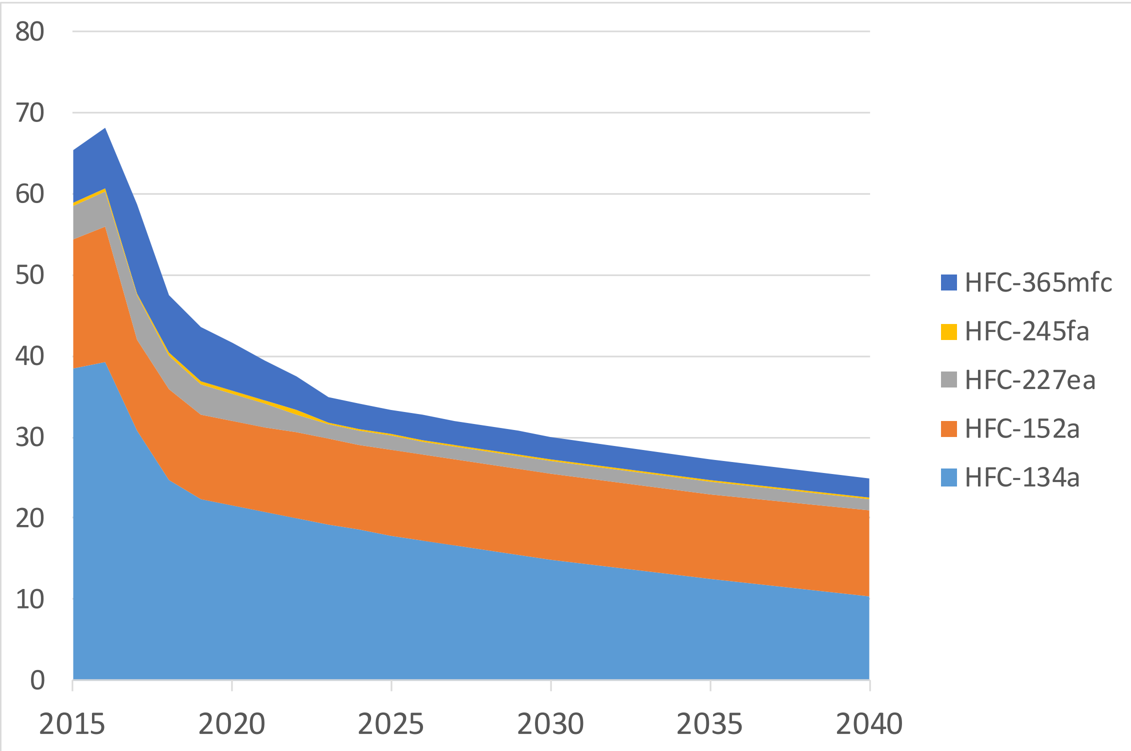
The emissions from polyurethane insulation foam, which peaked at 17 kt CO2-eq in 2017, are expected to be halved in 2022, when the production of 2-component spray foam will have fully switched to an HFO blowing agent. From then the emissions will be slowly decreasing, as the existing stock diminishes with time.

As to extruded polystyrene insulation foam, by 1/1/2020 no panels containing an HFC with a GWP > 150 will be put on the market anymore, R134a being replace by CO2.

We have kept the emission factors constant over time (the same assumption is made in [18], which may be an overestimate in the future, as panels tend to become thicker. Disposal is not assumed before 2040, which is consistent with the approach of the EU study [18].

Overall emissions from closed cell foams are shown on Figure 12. Emissions of HFC-152a are manufacturing emissions. From 2023, the remaining emissions are emissions from stocks.

Figure 12: Closed cell foams (kt CO2-eq)



2.5.2 Polyurethane cans

This product is also called One-Component-Foam. It used to be a large source of HFC consumption and emissions. However, since 4 July 2008, EU Regulation 842/2006 prohibits placing on the market in the EU ‘one component foams’ containing mixtures with a GWP[7] of 150 or more, except when required to meet national safety standards. This allowed to use 100% HFC 152a (with a GWP of 140) or up to 11,5% HFC 134a (with a GWP of 1300), if the remaining gas has a GWP of 0.

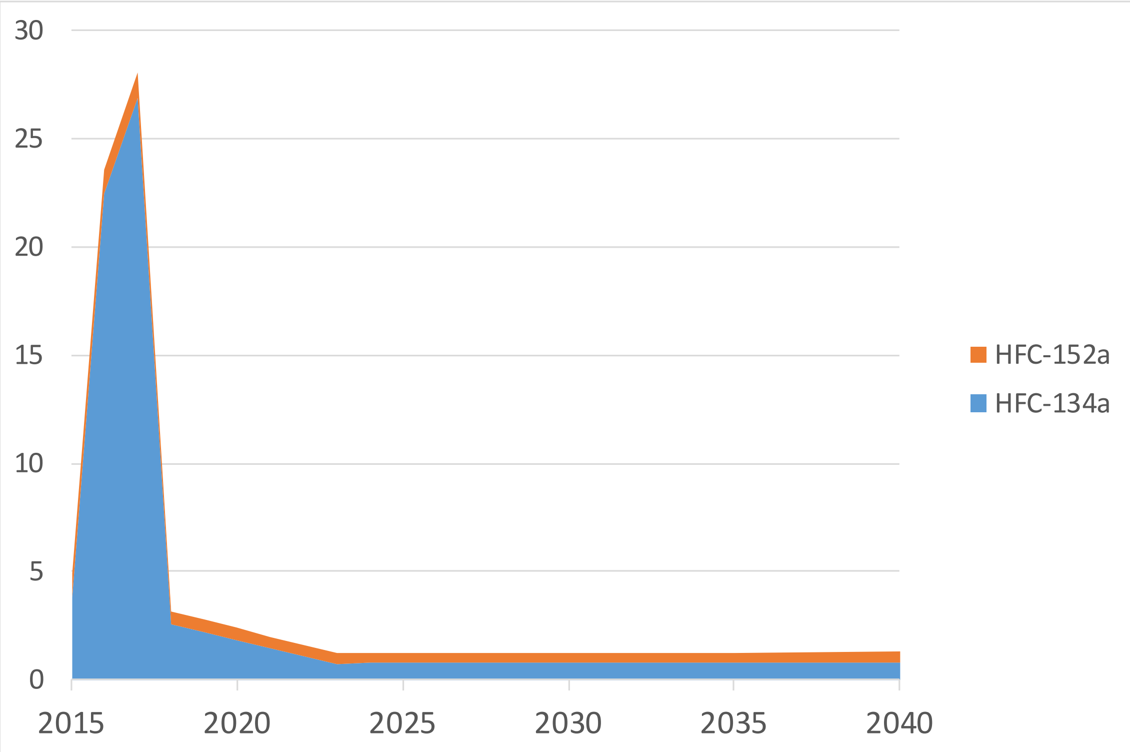
This explains why the HFC 134a consumption has decreased to close to zero and that of HFC 152a has substantially increased in 2008. As HFC 152a has a GWP of 150, against a GWP of 1300 for HFC134a, the overall emissions of that source have become very small (a few kt CO2-eq).

We have used expected manufacturing consumption data obtained from the manufacturer and assumed emissions from use increasing proportionally to the population level.

A comparatively higher consumption and emission of HFCs had temporarily taken place in the production of canister foam, a type of one-component foam produced in larger cans, typically for use on roofs. For this foam, an almost complete shift to R1234ze has already taken place in 2018.

The evolution of the total emissions is shown on Figure 13.

Figure 13: Emissions from PU cans (kt CO2-eq)



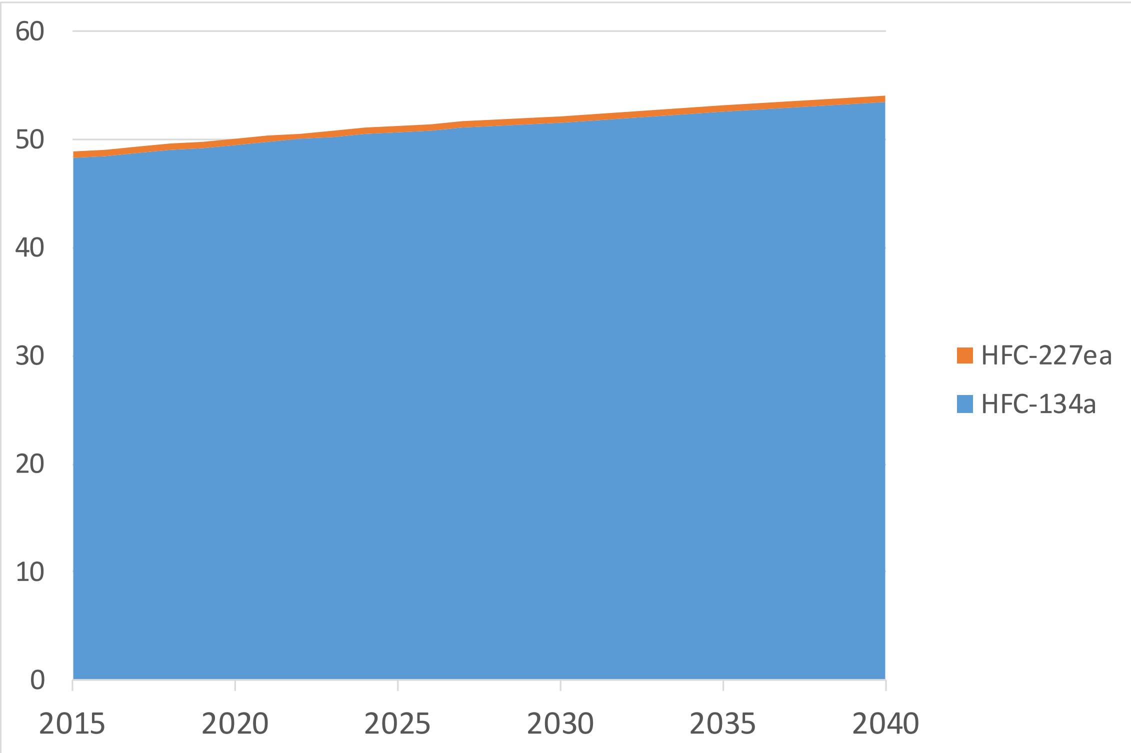
[7] Values of the Third Assessment Report (TAR) of the IPCC.

2.6 Metered Dose Inhalers (MDI)

EU Regulation 517/2014 does not contain any specific provision for MDIs. The consumption of HFCs in metered dose inhalers is assumed to remain proportional to the population level. It is thereby assumed that the increase in the *prevalence* of asthma (number of persons suffering from asthma par 1000 persons) is compensated by a decrease in the spray quota (share of MDI vs. powder devices in the total of inhaled therapy).

The projected emissions are shown on Figure 14.

Figure 14: Emissions from MDIs (kt CO2-eq)

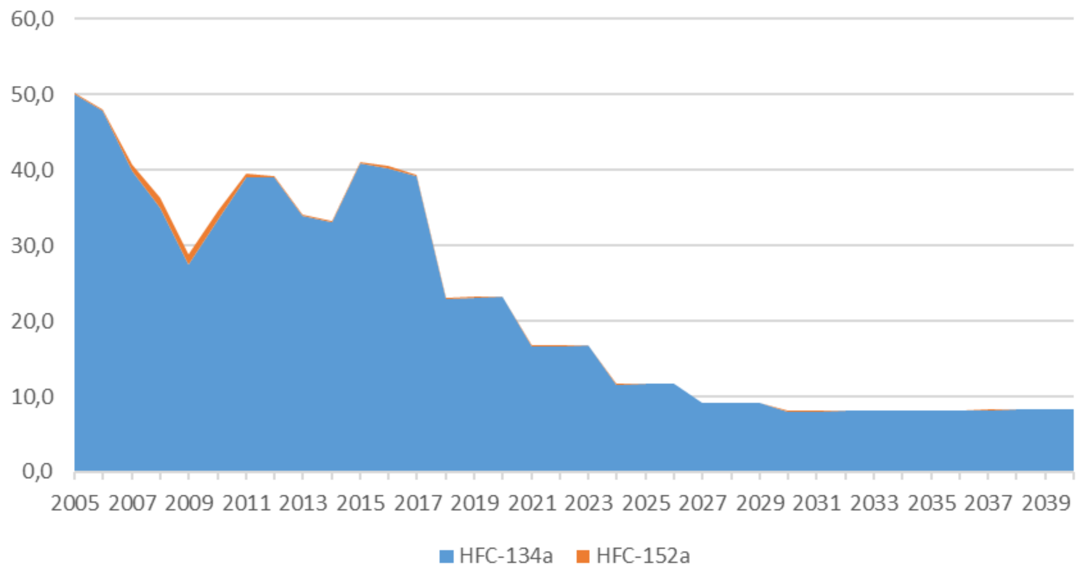


2.7 Technical aerosols

The projection of F-gas emissions from technical aerosols is based on several assumptions:

- For manufacturing emissions, the average was taken from the 3-year period preceding 2016. These emissions were adjusted based on the reduction in quotas in annex V of the F-gas regulation.
- For the emissions from use, the emissions follow the reduction trend in the quotas starting from the average emissions in 2013-2015 (before quota system started). Schwarz et al. [18] assumed that per capita emissions in 2020 will be reduced by 75% and by 95% in 2040. For our calculation the emission reduction is 78% for HFC-134a and 80% for HFC-152a.

Figure 15: Emissions from technical aerosols (kt CO2-eq)



2.8 Fire extinguishers

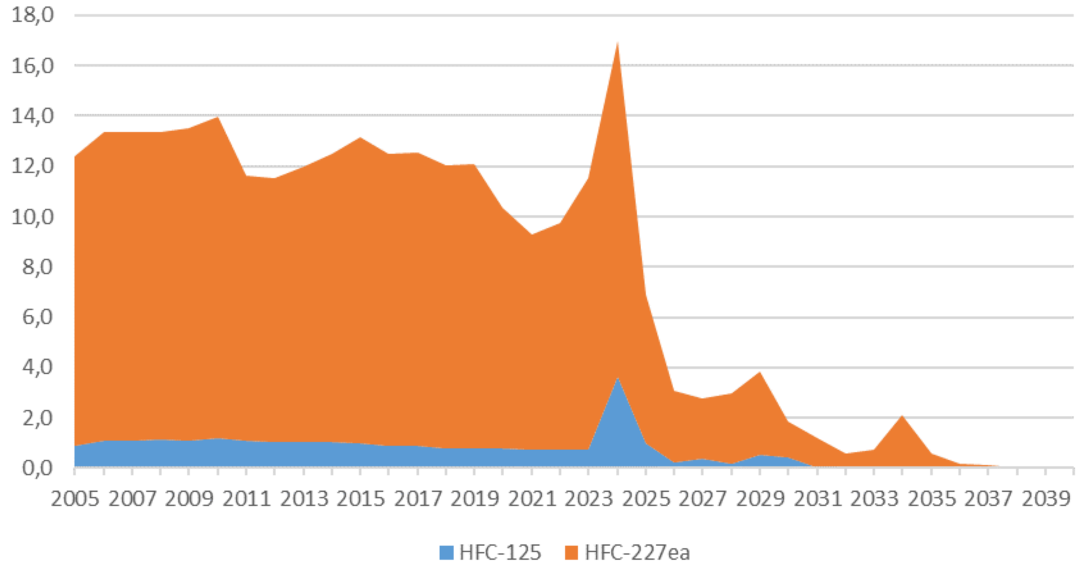
The projection takes into account that HFCs, although not prohibited, will not be used anymore for new installations after 2017 [18]. HFC based fluids have already been mostly replaced by other agents, such as fluoroketone-based substances. In the EU regulation, HFC-23 use in fire extinguishers is banned since 2016, but this has no additional effect on the emissions of this sector.

The projection of F-gas emissions from fire extinguishers is based on several assumptions:

- Manufacturing emissions, fugitive emissions during lifetime and disposal emissions are calculated using respectively production, bank and disposal numbers and multiplying these by an emission factor. For manufacturing the emission factor is 0,1%, the fugitive emissions are 2,3% and the disposal emission factor is 10%.

Emissions are expected to decline as stocks of HFC-125 and HFC-227ea are decreasing. The spikes in emissions in some years are artefacts of historic years with higher quantities of HFCs installed in new installations and that are end of life.

Figure 16: Fire extinguishers (kt CO2-eq)



2.9 Semiconductor industry

Activities are not likely to increase, and emissions are expected to be similar in the near future. For emissions in the period 2018-2040, average emissions over the most recent 3-year period[8] were taken. This includes both gases used for semiconductor manufacturing and heat transfer fluids. Emissions of all F-gases are therefore assumed to be 17 kt CO2-eq.

[8] In most cases we used the average over a 5-year time interval, yet in this case the time series was more consistent over a shorter interval.

2.10 SF6 Double glazing

The SF6 emissions from double glazing are those arising from the bank (annual losses) and from disposal, after the end of the lifetime.

Since the ban on SF6 in windows (from 2007 for domestic windows and 2008 for other windows) imposed by Regulation 846/2006, the stock is decreasing, only influenced by annual losses and disposal.

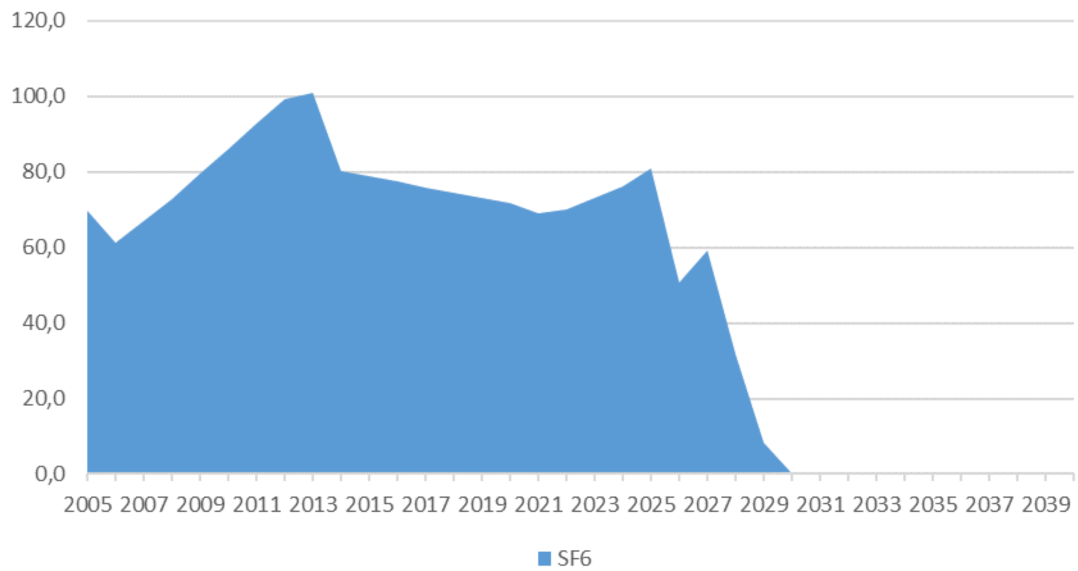
The projection of F-gas emissions from double glazing is based on several assumptions:

- The stock of SF6 in double glazing for the period 2018-2040 is calculated based on a stock model, only taking into account annual disposal and fugitive emissions.

- The fugitive emission factor is 1% and constant throughout 2018-2040. The disposal emission factor is 100% and also constant over the 2018-2040 period.

Emissions of SF6 are mainly from decommissioning and the trend in emissions follow disposal of all remaining SF6 assumed to be in double glazing.

Figure 17: Double glazing (kt CO2-eq)



2.11 Electricity sector

SF6 is used in switch gear in the electricity sector. Up to now SF6 emissions mostly originate from manufacturing and use, while disposal is not important yet. With increasing age of switch gear this will change in future years. Despite the fact that dismantling of SF6 containing switchgear requires certification, the Flemish action plan to reduce F-gas emissions 2015-2020 noted that the dismantling of SF6 switchgear for low- and medium voltage switchgear could result in emissions because of lack of awareness, knowledge, technical expertise and training. The Flemish action plan therefore includes specific actions to raise awareness and inform companies on the existing legal requirements. Disposal emission factors used in the projection assume that companies follow the existing legislation, with correct recovery of SF6 from switchgear.

The projection of F-gas emissions from the electricity sector is based on several assumptions:

- The total quantity of SF6 installed in switchgears is expected to increase in the period 2018-2040. Schwartz et al. [18] assume that in 2015, SF6 stocks will reach the saturation level and that only replacement of existing equipment occurs. In the different subsectors (production, transport, distribution), stocks of SF6 are expected to remain relatively constant throughout the period 2018-2040. Only replacing end-of-life equipment and new installations from renewable energy: SF6 in wind turbines are expected to increase in line with the projected increases in wind energy.

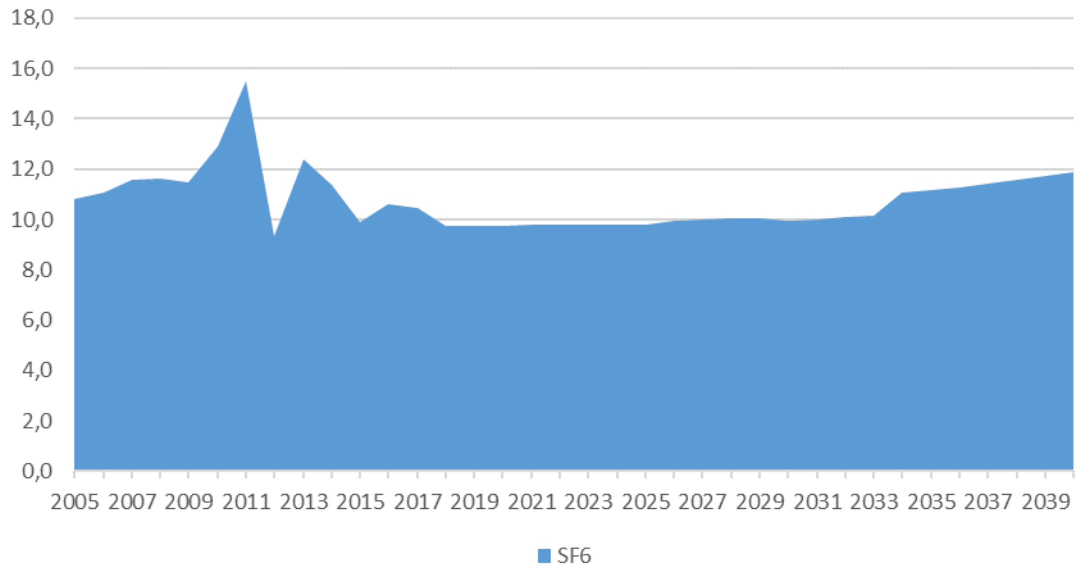
- The emission factor for manufacturing is kept constant at 1% for production and transport of electricity. For the distribution sector, no manufacturing emissions are taken into account, as the gas is imported in sealed equipment.

- Fugitive emission factors are maximum 0,5% in 2018-2040 for the transport sector. For distribution and production, SF6 emission factors are also kept constant for the period 2018-2040 at 0,03%.

- Disposal emissions declined from 5% in 2012 to 1,5% in 2015 and have been kept constant for the entire time series.

The SF6 emissions are expected to continue to increase. In recent historic years disposal emissions from transport result in higher emissions in some years. These disposal emissions are spread out more evenly in projected years. The emissions from stock of SF6 in switch gear is expected to grow. The higher emissions after 2030 result from disposal emissions. Some companies are experimenting with alternative gases or mixtures with similar properties as SF6. In the projection, this was not included but increasing awareness and availability of SF6 alternatives could lead to lower emissions in future than foreseen.

Figure 18: Electrical equipment (kt CO2-eq)



2.12 Chemical industry

EU regulation 517/2014 imposes a quota system on all producers and importers of F-gases starting in 2015. While this will have a significant impact on producers of HFCs, PFCs and SF6 who place quantities on the market, the impact for fluorochemical production will be small as most emissions are not related to placements on the EU market.

In Belgium, the fluorochemical industry only entails one company situated in the Flemish Region with a significant impact on total emissions. Without measures it was assumed in the Flemish action plan to reduce F-gas emissions 2015-2020 (cfr. 1.4.2.) that emissions would stabilise (around 327 kt CO2-eq in 2020 and 2030). As a consequence, a specific action was initiated aiming - through dialogue with the company – to further reduce emissions.

As a follow up, the draft Flemish Climate Plan 2021-2030 (2018) specifies that a concrete agreement will be made with the company to reduce emissions to 150 kt CO2-eq as quickly as possible (in the projections of the Flemish Climate Plan 2030).

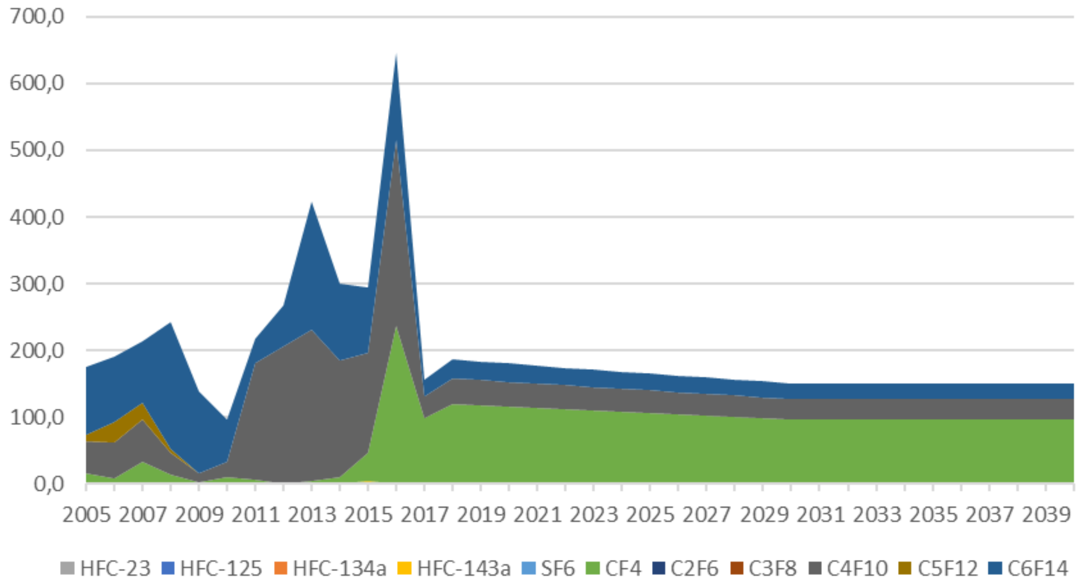
For the WEM projections included in this report, this specific objective has already been taken into account (even though it could also be regarded as a measure only to be taken into account in a WAM scenario). This is mainly because emissions in 2017 (155 kt CO2-eq) were already close to the objective of planned policies in 2030.

The emissions for 2018 to 2040 in this report were calculated following a reduction path to 150 kt CO2-eq. in 2030. Considering the fluctuations in past emissions due to changes in the production mix, there is a high level of uncertainty.

For non-IPCC gases we have taken the average over the last three-year period (2015-2017). Since 2011, emissions of non-IPCC gases have been increasing.

The figure below gives an overview of the resulting emissions.

Figure 19: Chemical industry (kt CO2-eq)



3 OVERALL RESULTS

3.1 Introduction

The results are available by emission source, by substance and by region for each year up to 2040 (the figures up to 2017 being those of the emission inventory). Only a selection of tables and charts are presented in this report.

For the official reporting to the European Commission and the UNFCCC, the results have been aggregated according to the emission source categories defined in the Common Reporting Format (CRF) template of the UNFCCC Guidelines [19], displayed in Table 6.

The allocation of each source to the CRF source categories is given in Table 7.

In the tables and charts below two different aggregation levels are used for the substances:

- CFC, halons, HCFC, other ODS, HFC, PFC, SF6, HFO, other ("groups of substances")
- ODS substance/CRF substance[9]/Other.

The allocation of gases to these categories is given in Table 5.

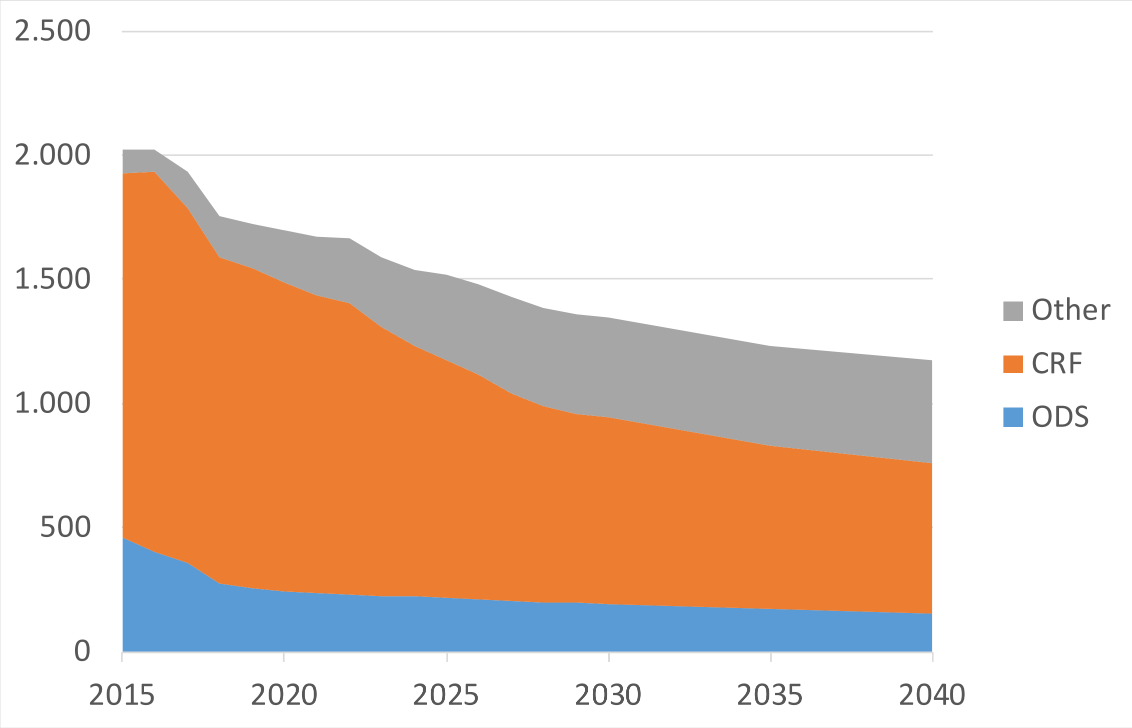
It should be remembered that there remains a considerable uncertainty on the emission levels and their evolutions. The projection is to be considered as one scenario compatible with the currently available information.

[9] Gas for which there is a compulsory reporting to the UNFCCC in the CRF tables (FCCC/CP/2013/Add.3).

3.2 Emissions by substance

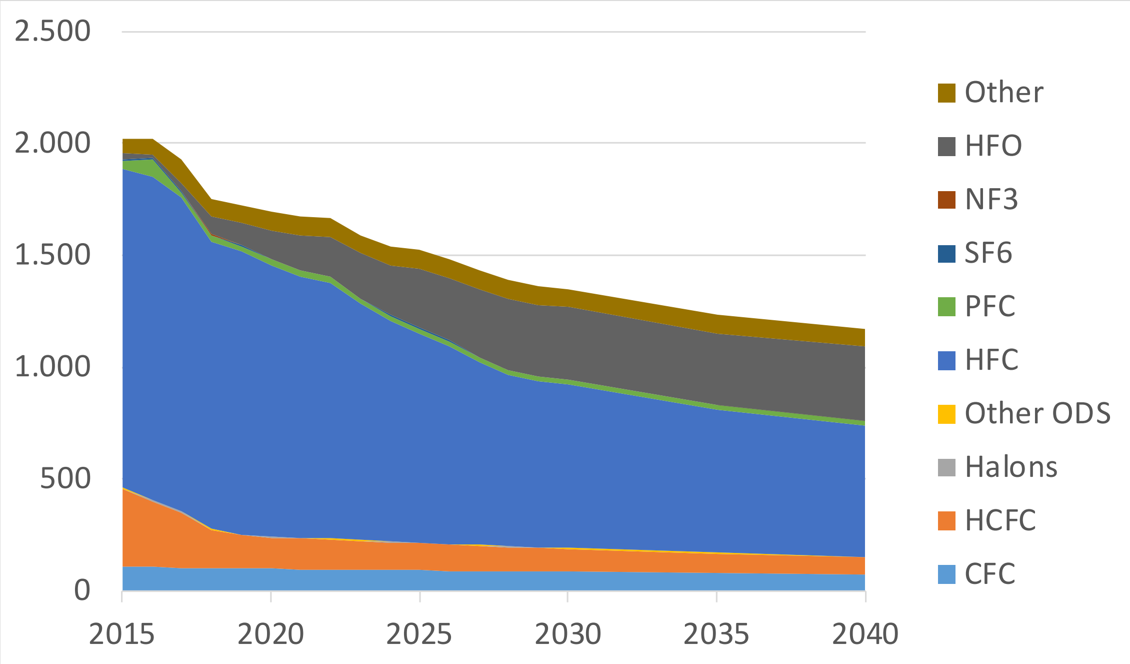
The three charts below show the projected evolution of the total F-gas emissions, hence including the ozone depleting substances, expressed in tonnes.

Figure 20: Emissions by substance group (t)



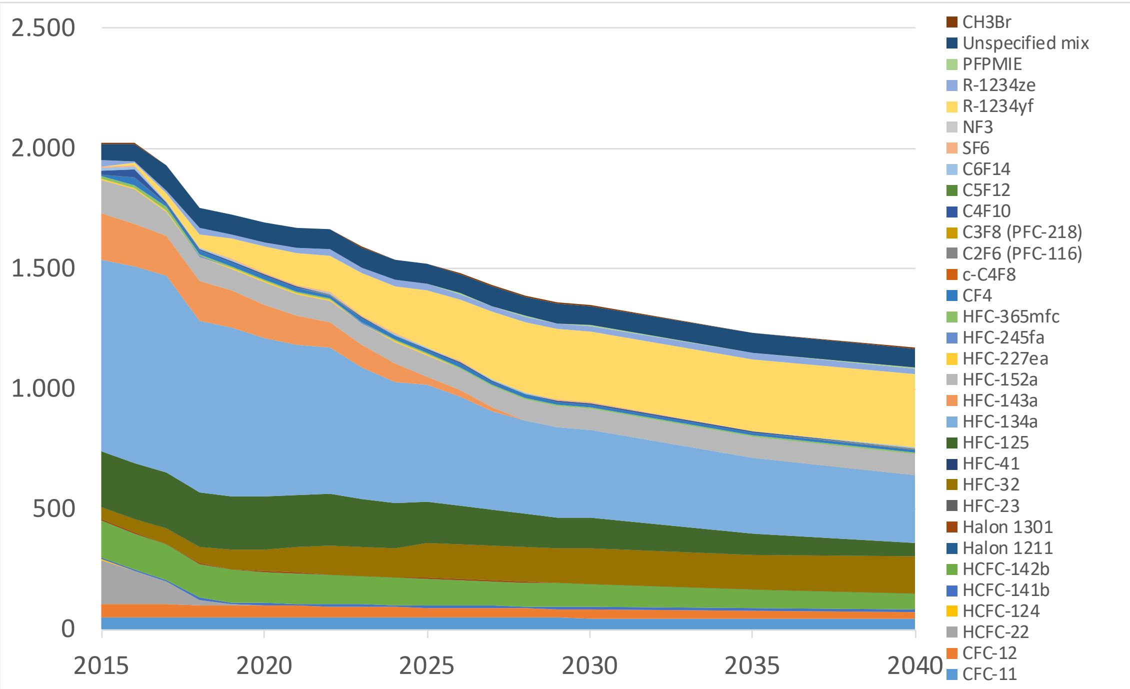
The total is diminishing, and the dominant share is taken by the CRF gases, which are expected to be increasingly replaced by HFOs. The gases comprised in each substance group can be seen on Table 1.

Figure 21: Emissions by substance group (t)



As far as individual substances are concerned, the dominant share of HFC-134a is decreasing, as are those of HFC-143a and HFC-125, while those of HFC-32 and HFO-1234yf are growing.

Figure 22: Emissions by substance (t)



The corresponding numbers are given in Table 1, and in annex 4 for each of the three regions.

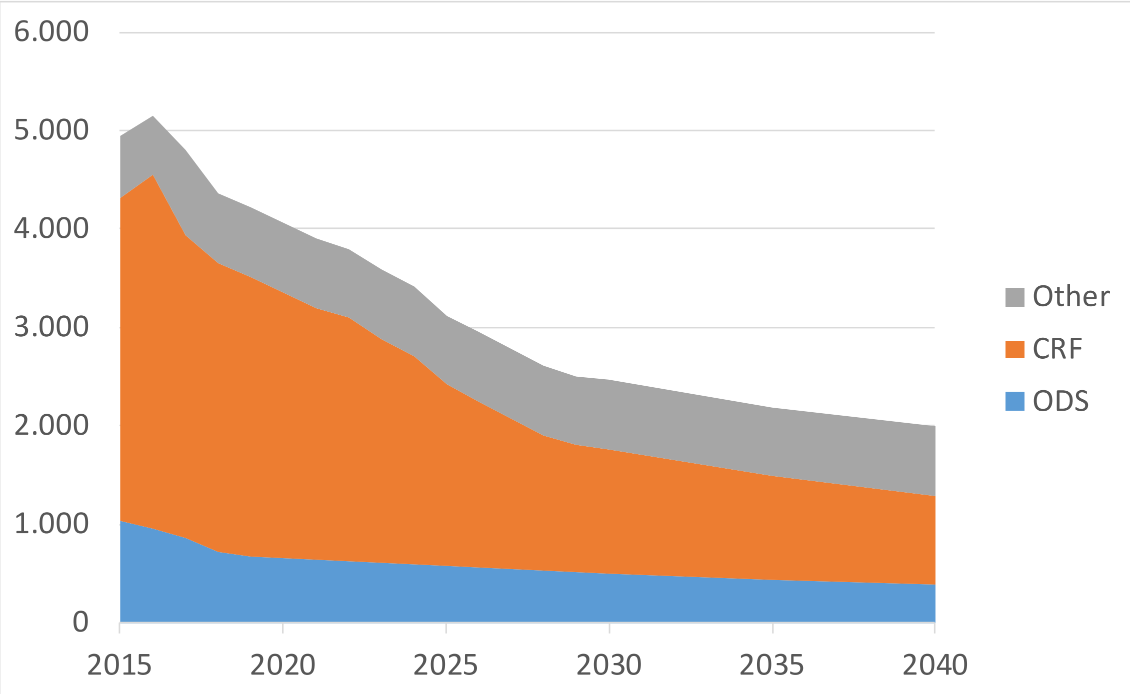
Table 1: Emissions by substance (t)

(t)	2015	2017	2020	2025	2030	2040
ODS	**461,8**	**356,6**	**243,9**	**215,8**	**191,6**	**152,7**
CFC	**107,5**	**103,8**	**98,5**	**90,6**	**83,6**	**71,8**
CFC-11	51,3	50,7	49,8	48,3	46,9	44,1
CFC-12	56,2	53,1	48,8	42,3	36,7	27,6
HCFC	**347,3**	**247,5**	**140,2**	**120,3**	**103,4**	**76,6**
HCFC-141b	10,0	9,9	9,7	9,4	9,1	8,5
HCFC-142b	153,9	144,1	130,6	111,0	94,3	68,1
HCFC-22	182,7	93,2	0,0	0,0	0,0	0,0
HCFC-124	0,6	0,4				
Other ODS	**4,0**	**2,9**	**2,9**	**2,9**	**2,9**	**2,9**
CH3Br	4,0	2,9	2,9	2,9	2,9	2,9
Halons	**3,1**	**2,4**	**2,3**	**2,0**	**1,8**	**1,4**
Halon 1211	0,2	0,1	0,1	0,1	0,1	0,1
Halon 1301	2,9	2,3	2,1	1,9	1,7	1,3
CRF	**1.464,4**	**1.428,6**	**1.240,6**	**961,1**	**754,7**	**606,7**
HFC	**1.426,0**	**1.403,6**	**1.212,9**	**934,9**	**733,9**	**585,8**
HFC-32	50,8	67,0	91,6	145,4	149,4	154,3
HFC-125	233,4	230,0	218,8	171,7	126,3	57,0
HFC-134a	795,4	820,4	662,3	488,3	364,0	281,3
HFC-152a	140,8	101,0	90,4	89,2	89,1	89,2
HFC-227ea	5,6	5,5	4,2	2,6	1,2	0,7
HFC-245fa	0,8	0,5	0,4	0,2	0,2	0,1
HFC-365mfc	8,3	13,7	7,3	3,9	3,6	3,1
HFC-143a	190,9	165,3	137,8	33,4	0,0	0,0
HFC-23	0,1	0,1	0,1	0,1	0,1	0,1
HFC-41	0,0	0,0				
SF6	**4,0**	**4,0**	**3,8**	**4,2**	**0,7**	**0,8**
SF6	4,0	4,0	3,8	4,2	0,7	0,8
PFC	**34,3**	**20,9**	**23,9**	**22,0**	**20,1**	**20,1**
CF4	6,3	14,0	16,1	14,8	13,6	13,6
C4F10	16,9	3,7	4,3	3,9	3,6	3,6
C5F12	0,0	0,0				
C6F14	10,4	2,5	2,9	2,7	2,4	2,4
C2F6 (PFC-116)	0,3	0,5	0,5	0,5	0,5	0,5
c-C4F8	0,0	0,0	0,0	0,0	0,0	0,0
C3F8 (PFC-218)	0,2	0,2				
NF3	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**
NF3	0,0	0,0	0,0	0,0	0,0	0,0
Other	**96,9**	**145,7**	**210,3**	**345,2**	**402,8**	**412,9**
HFO	**27,8**	**40,3**	**127,5**	**262,4**	**319,9**	**330,1**
R-1234ze	26,3	10,8	18,8	25,8	25,8	25,8
R-1234yf	1,6	29,5	108,7	236,7	294,2	304,4
Other	**69,1**	**105,4**	**82,8**	**82,8**	**82,8**	**82,8**
Unspecified mix	68,1	105,1	82,5	82,5	82,5	82,5
PFPMIE	1,0	0,3	0,3	0,3	0,3	0,3
General total	**2.023,1**	**1.930,9**	**1.694,8**	**1.522,2**	**1.349,1**	**1.172,4**

In terms of CO2-eq, as Figure 23 shows, the ODS gases have a larger share than in tonnes. These emissions are the sum of a decreasing positive contribution of CFC11, CFC12 and HCFC142b from foams and a decreasing negative contribution of halon 1301 from fire protection.

Also larger, and increasing, is the share of the category 'Other', which here is mainly an unspecified mix of the fluorochemical industry, for which there is no reporting obligation in the CRF.

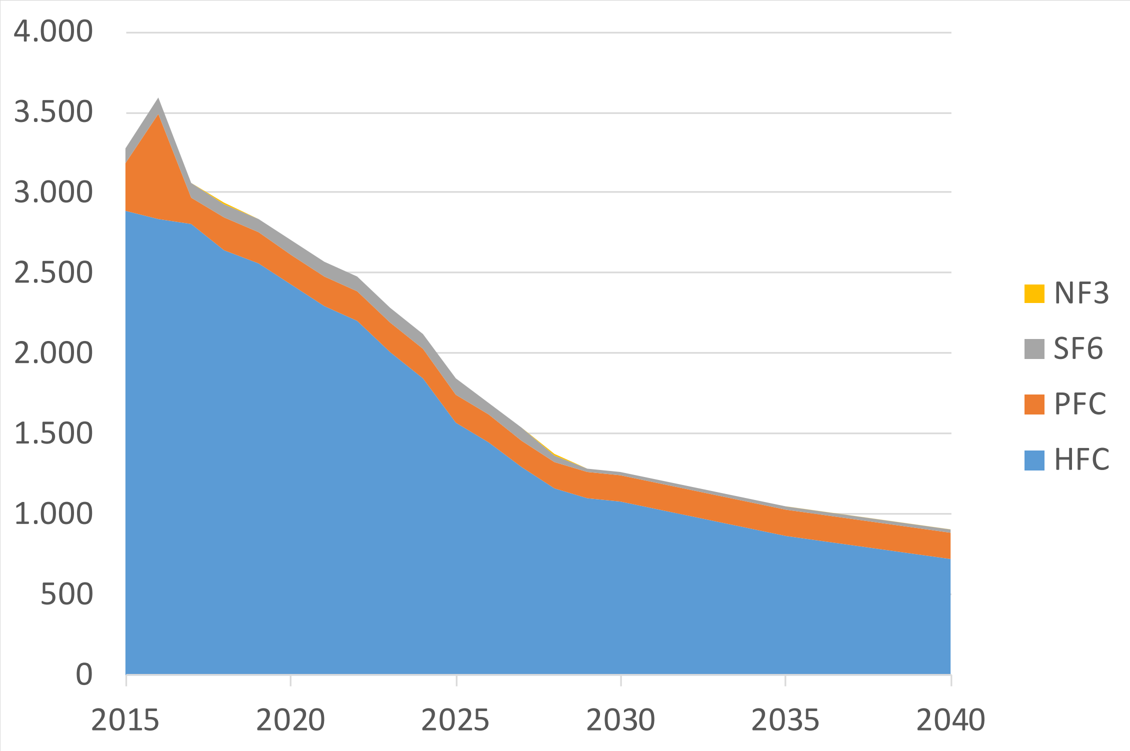
Figure 23: Emissions by category of substances (kt CO2-eq)



One can notice the strong reduction for the CRF gases after 2016, resulting from the EU F-gas regulation.

The contribution of CRF gases by group of substances (see allocation of gases to the groups in Annex 1) is displayed on Figure 24, which shows that HFCs are dominant and also contribute most to the emission reduction.

Figure 24: CRF emissions by group of substances (kt CO2-eq)

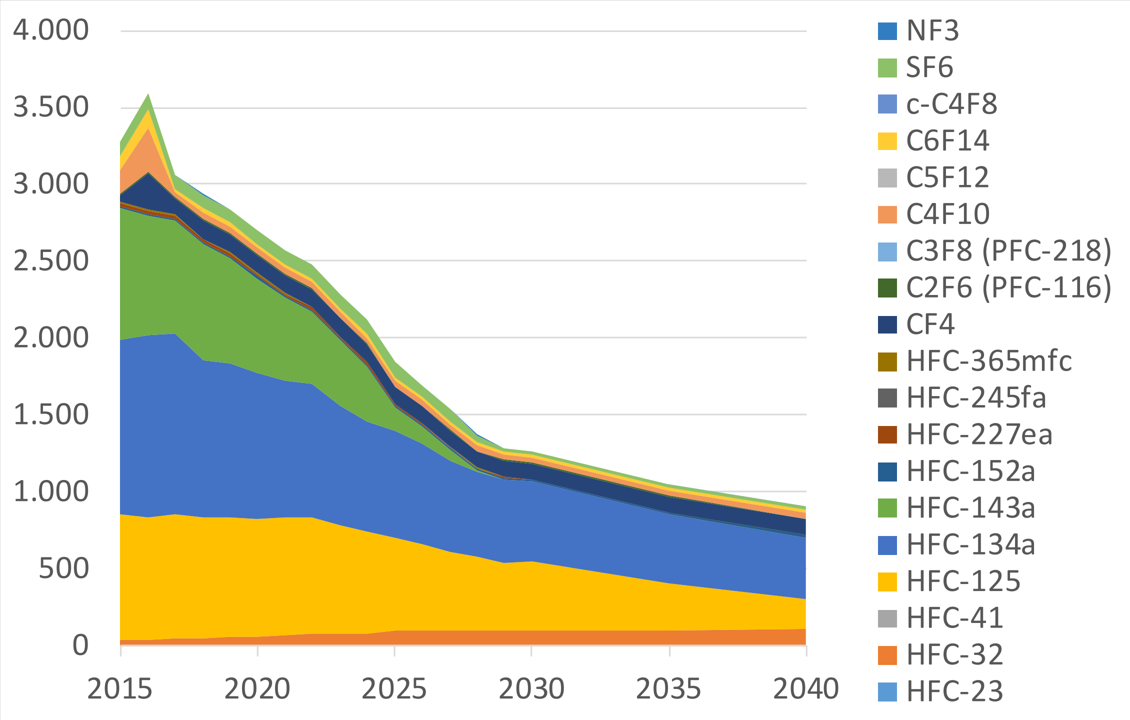


The PFC emissions are essentially those of the fluorochemical production (C4F10 and C6F14), which have been assumed to remain constant.

The SF6 emissions are mainly those of the existing stock of soundproof windows, which are assumed to have disappeared in 2030.

Figure 25 shows the detail for the CRF gases. The main contributions are those of HFC125, HFC134a and HFC143a. The strongest reduction is that of HFC143a, due to the sales restrictions of the EU regulation.

Figure 25: Emissions of CRF gases by substance (kt CO2-eq)



The corresponding numbers are presented in Table 2 (in kt CO2-eq), and in annex 4 for each of the three regions.

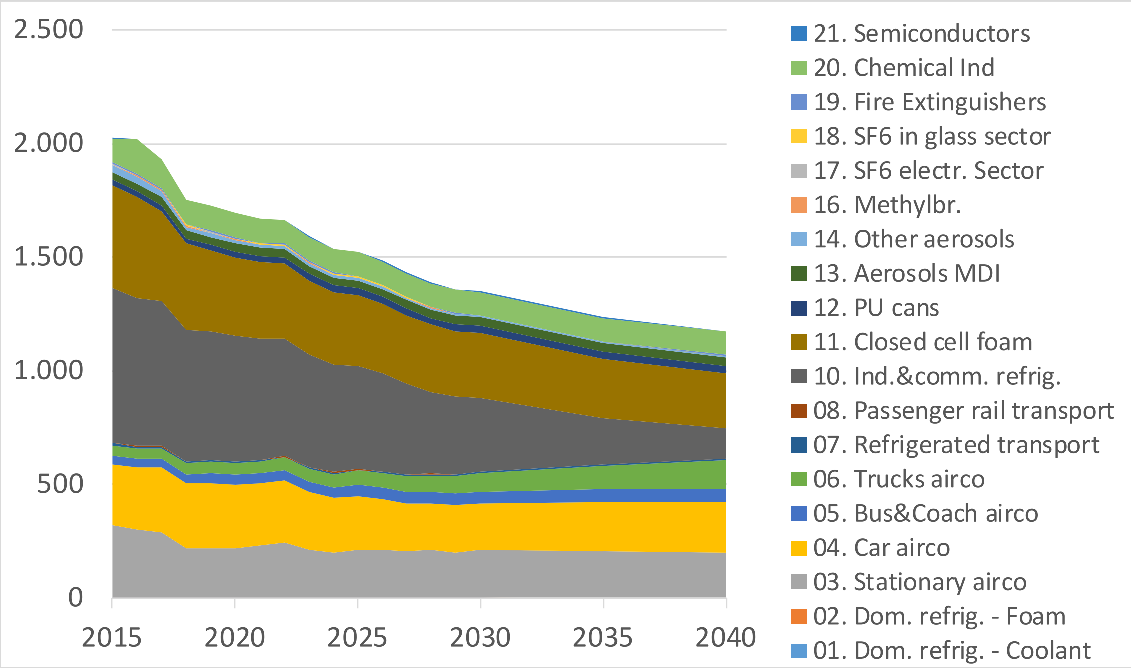
Table 2: Emissions by substance (kt CO2-eq)

(kt CO2-eq)	2015	2017	2020	2025	2030	2040
ODS	**1.031,1**	**862,4**	**651,7**	**569,7**	**499,0**	**385,5**
CFC	**558,9**	**532,5**	**495,6**	**440,3**	**392,1**	**313,0**
CFC-11	103,6	102,3	100,5	97,5	94,7	89,2
CFC-12	455,3	430,2	395,1	342,8	297,4	223,9
HCFC	**590,6**	**423,6**	**243,7**	**207,7**	**177,1**	**129,0**
HCFC-141b	5,2	5,1	5,0	4,9	4,7	4,4
HCFC-142b	281,4	263,5	238,7	202,9	172,4	124,5
HCFC-22	303,7	154,9	0,0	0,0	0,0	0,0
HCFC-124	0,3	0,2				
Other ODS	**-5,0**	**-3,6**	**-3,6**	**-3,6**	**-3,6**	**-3,6**
CH3Br	-5,0	-3,6	-3,6	-3,6	-3,6	-3,6
Halons	**-113,5**	**-90,2**	**-84,0**	**-74,8**	**-66,6**	**-53,0**
Halon 1211	-3,0	-2,6	-2,4	-2,1	-2,0	-1,5
Halon 1301	-110,5	-87,6	-81,6	-72,6	-64,6	-51,5
CRF	**3.278,8**	**3.065,7**	**2.701,5**	**1.843,6**	**1.259,8**	**902,1**
HFC	**2.886,5**	**2.805,4**	**2.422,9**	**1.570,8**	**1.082,8**	**723,1**
HFC-134a	1.137,4	1.173,2	947,1	698,3	520,6	402,2
HFC-152a	17,5	12,5	11,2	11,1	11,0	11,1
HFC-227ea	18,1	17,8	13,5	8,3	3,9	2,3
HFC-245fa	0,8	0,5	0,4	0,2	0,2	0,2
HFC-365mfc	6,6	10,9	5,8	3,1	2,9	2,5
HFC-125	816,8	804,9	765,7	601,1	442,1	199,6
HFC-143a	853,5	739,0	616,1	149,3	0,0	0,0
HFC-32	34,3	45,2	61,8	98,2	100,8	104,1
HFC-23	1,7	1,3	1,3	1,3	1,3	1,3
HFC-41	0,0	0,0				
SF6	**91,4**	**92,0**	**87,1**	**96,3**	**15,5**	**17,5**
SF6	91,4	92,0	87,1	96,3	15,5	17,5
PFC	**300,1**	**167,7**	**190,8**	**175,8**	**160,8**	**160,8**
CF4	46,6	103,5	119,3	109,7	100,1	100,1
C4F10	150,0	32,7	37,9	34,8	31,6	31,6
C5F12	0,0	0,0				
C6F14	96,9	23,5	27,3	25,0	22,8	22,8
C2F6 (PFC-116)	4,2	6,2	6,2	6,2	6,2	6,2
c-C4F8	0,1	0,1	0,1	0,1	0,1	0,1
C3F8 (PFC-218)	2,2	1,6				
NF3	**0,8**	**0,6**	**0,6**	**0,6**	**0,6**	**0,6**
NF3	0,8	0,6	0,6	0,6	0,6	0,6
Other	**639,0**	**879,0**	**705,9**	**706,5**	**706,7**	**706,7**
HFO	**0,2**	**0,2**	**0,5**	**1,1**	**1,3**	**1,4**
R-1234ze	0,2	0,1	0,1	0,2	0,2	0,2
R-1234yf	0,0	0,1	0,4	0,9	1,2	1,2
Other	**638,9**	**878,8**	**705,3**	**705,3**	**705,3**	**705,3**
Unspecified mix	629,1	875,6	702,1	702,1	702,1	702,1
PFPMIE	9,8	3,2	3,2	3,2	3,2	3,2
General total	**4.949,0**	**4.807,1**	**4.059,1**	**3.119,8**	**2.465,4**	**1.994,3**

3.3 Emissions by source

Total F-gas emissions in tonnes diminish by 33% between 2015 and 2030 (Figure 26).

Figure 26: Total F-gas emissions by source (t)



In terms of CO2-eq emissions and limited to the CRF gases, the decrease is 62%. The dominant source is Industrial and commercial refrigeration, which is also the source of which emissions are most decreasing, with car air conditioning, of which the emissions fall down to practically zero in the late 2020's.

Figure 27: Emissions of CRF gases by source (kt CO2-eq)

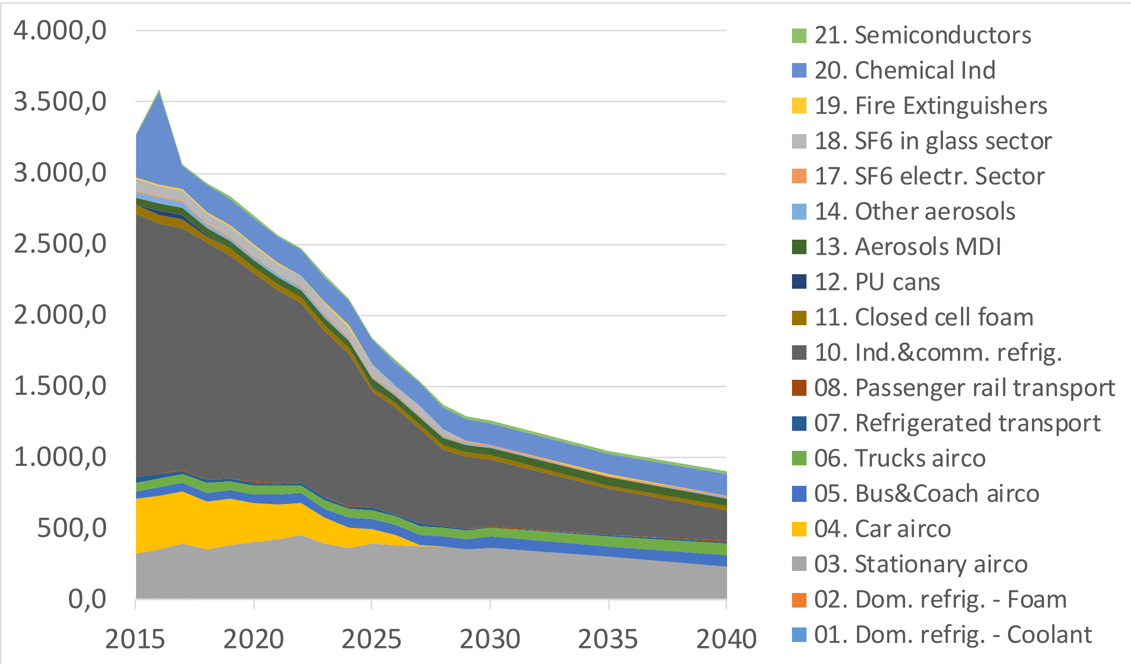


Table 3 shows the emissions in tonnes of the CRF gases by source category of the CRF and by source. In annex 5 the same table is given for each of the three regions.

Table 3: Emissions of CRF gases by source (t)

(t)	CRF Name	2015	2017	2020	2025	2030	2040
2 B 9	**Fluorochemical production**	**34,1**	**19,6**	**22,7**	**20,9**	**19,0**	**19,0**
	20. Chemical Ind	34,1	19,6	22,7	20,9	19,0	19,0
2 E 1	**Integrated circuit or semiconductor**	**1,1**	**1,5**	**1,5**	**1,5**	**1,5**	**1,5**
	21. Semiconductors	1,1	1,5	1,5	1,5	1,5	1,5
2 F 1 a	**Commercial refrigeration**	**628,0**	**603,4**	**532,1**	**397,6**	**274,8**	**117,1**
	10. Ind.&comm. refrig.	628,0	603,4	532,1	397,6	274,8	117,1
2 F 1 b	**Domestic refrigeration**	**2,0**	**1,5**	**0,8**	**1,1**	**0,0**	**0,0**
	01. Dom. refrig. - Coolant	2,0	1,5	0,8	1,1	0,0	0,0
2 F 1 d	**Transport refrigeration**	**11,4**	**6,5**	**6,7**	**5,1**	**3,0**	**4,6**
	07. Refrigerated transport	11,4	6,5	6,7	5,1	3,0	4,6
2 F 1 e	**Mobile air-conditioning**	**351,8**	**344,7**	**282,6**	**166,0**	**97,4**	**117,8**
	04. Car airco	270,0	257,2	191,6	73,4		
	05. Bus&Coach airco	37,7	40,0	43,7	48,6	52,4	57,2
	06. Trucks airco	42,0	45,2	45,1	41,7	42,5	57,8
	08. Passenger rail transport	2,1	2,3	2,2	2,3	2,4	2,8
2 F 1 f	**Stationary air-conditioning**	**184,9**	**224,8**	**220,3**	**211,9**	**211,5**	**201,8**
	03. Stationary airco	184,9	224,8	220,3	211,9	211,5	201,8
2 F 2 a	**Closed cell foam**	**178,6**	**155,9**	**114,4**	**106,3**	**104,0**	**100,4**
	02. Dom. refrig. - Foam	0,4	0,3				
	11. Closed cell foam	166,5	127,2	108,8	102,1	99,7	96,0
	12. PU cans	11,7	28,3	5,6	4,2	4,3	4,4
2 F 3	**Fire protection**	**4,1**	**3,9**	**3,2**	**2,2**	**0,7**	**0,1**
	19. Fire Extinguishers	4,1	3,9	3,2	2,2	0,7	0,1
2 F 4 a	**Metered dose inhalers**	**33,9**	**34,3**	**34,8**	**35,6**	**36,3**	**37,5**
	13. Aerosols MDI	33,9	34,3	34,8	35,6	36,3	37,5
2 F 4 b	**Other aerosols (technical aerosols)**	**30,5**	**28,8**	**17,8**	**9,0**	**6,2**	**6,4**
	14. Other aerosols	30,5	28,8	17,8	9,0	6,2	6,4
2 G 1	**Electrical equipment**	**0,4**	**0,5**	**0,4**	**0,4**	**0,4**	**0,5**
	17. SF6 electr. Sector	0,4	0,5	0,4	0,4	0,4	0,5
2 G 2 c	**Soundproof windows**	**3,5**	**3,3**	**3,1**	**3,5**		
	18. SF6 in glass sector	3,5	3,3	3,1	3,5		
General total		**1.464,4**	**1.428,6**	**1.240,6**	**961,1**	**754,7**	**606,7**

The same emissions are given in kt CO2-eq in Table 4. In annex 5 the same table is also given for each of the three regions.

Table 4: Emissions of CRF gases by source (kt CO2-eq)

(kt CO2-eq)	CRF Name	2015	2017	2020	2025	2030	2040
2 B 9	**Fluorochemical production**	**293,1**	**155,2**	**180,0**	**165,0**	**150,0**	**150,0**
	20. Chemical Ind	293,1	155,2	180,0	165,0	150,0	150,0
2 E 1	**Integrated circuit or semiconductor**	**13,0**	**18,3**	**18,3**	**18,3**	**18,3**	**18,3**
	21. Semiconductors	13,0	18,3	18,3	18,3	18,3	18,3
2 F 1 a	**Commercial refrigeration**	**1.846,7**	**1.707,5**	**1.465,2**	**815,9**	**474,2**	**222,5**
	10. Ind.&comm. refrig.	1.846,7	1.707,5	1.465,2	815,9	474,2	222,5
2 F 1 b	**Domestic refrigeration**	**3,4**	**2,5**	**1,3**	**2,0**	**0,0**	**0,0**
	01. Dom. refrig. - Coolant	3,4	2,5	1,3	2,0	0,0	0,0
2 F 1 d	**Transport refrigeration**	**36,8**	**21,0**	**21,5**	**15,6**	**5,3**	**8,2**
	07. Refrigerated transport	36,8	21,0	21,5	15,6	5,3	8,2
2 F 1 e	**Mobile air-conditioning**	**503,1**	**493,0**	**404,2**	**237,4**	**139,3**	**168,5**
	04. Car airco	386,1	367,8	273,9	105,0		
	05. Bus&Coach airco	53,9	57,1	62,5	69,5	75,0	81,8
	06. Trucks airco	60,1	64,7	64,5	59,7	60,8	82,7
	08. Passenger rail transport	3,0	3,4	3,3	3,3	3,5	4,0
2 F 1 f	**Stationary air-conditioning**	**320,2**	**393,3**	**400,9**	**393,6**	**368,6**	**233,4**
	03. Stationary airco	320,2	393,3	400,9	393,6	368,6	233,4
2 F 2 a	**Closed cell foam**	**70,8**	**87,1**	**43,9**	**34,6**	**31,4**	**26,2**
	02. Dom. refrig. - Foam	0,4	0,4				
	11. Closed cell foam	65,5	58,7	41,6	33,4	30,1	25,0
	12. PU cans	4,9	28,1	2,4	1,2	1,2	1,3
2 F 3	**Fire protection**	**13,1**	**12,6**	**10,4**	**7,1**	**2,2**	**0,4**
	19. Fire Extinguishers	13,1	12,6	10,4	7,1	2,2	0,4
2 F 4 a	**Metered dose inhalers**	**48,8**	**49,3**	**50,1**	**51,2**	**52,2**	**54,0**
	13. Aerosols MDI	48,8	49,3	50,1	51,2	52,2	54,0
2 F 4 b	**Other aerosols (technical aerosols)**	**41,1**	**39,3**	**24,1**	**12,1**	**8,3**	**8,6**
	14. Other aerosols	41,1	39,3	24,1	12,1	8,3	8,6
2 G 1	**Electrical equipment**	**9,9**	**10,4**	**9,8**	**9,8**	**9,9**	**11,9**
	17. SF6 electr. Sector	9,9	10,4	9,8	9,8	9,9	11,9
2 G 2 c	**Soundproof windows**	**78,9**	**76,0**	**71,7**	**80,9**		
	18. SF6 in glass sector	78,9	76,0	71,7	80,9		
General total		**3.278,8**	**3.065,7**	**2.701,5**	**1.843,6**	**1.259,8**	**902,1**

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5 ANNEXES

Annex 1: Global Warming Potential (GWP) and Ozone Depleting Potential (ODP)

Table 5 gives the GWP values used for the complete list of F-gases, as well as for each substance:

- the group to which it belongs (CFC, halons, HCFC, other ODS, HFC, PFC, SF6, HFO, other);
- whether it is an ODS substance, a CRF substance or neither of both ("other").

Note : for ozone depleting substances, the GWP values used are, as far as the relevant data are available, net GWPs, taking into account the indirect greenhouse effect of these substances, evaluated as the average of two extreme values.

Table 5: List of substances with their categories and GWPs

Substance	Group of substances	ODS/CRF	GWP 100 years (CO2=1)	Source GWP values	ODP (CFC11=1)
CFC-11	CFC	ODS	2.020	AR5	1
CFC-12	CFC	ODS	8.100	AR5	1
CFC-114	CFC	ODS	7.676	AR5	1
CFC-115	CFC	ODS	7.447	AR5	0,6
Halon 1211	Halons	ODS	-17.250	AR5	3
Halon 1301	Halons	ODS	-38.210	AR5	10
HCFC-22	HCFC	ODS	1.662	AR5	0
HCFC-124	HCFC	ODS	481	AR5	0,022
HCFC-141b	HCFC	ODS	521	AR5	0,11
HCFC-142b	HCFC	ODS	1.828	AR5	0,065
CCl4	Other ODS	ODS	-380	AR5	1,1
CH3Br	Other ODS	ODS	-1.248	AR5	0,6
HFC-23	HFC	CRF	14.800	AR4	0
HFC-32	HFC	CRF	675	AR4	0
HFC-41	HFC	CRF	92	AR4	0
HFC-43-10mee	HFC	CRF	1.640	AR4	0
HFC-125	HFC	CRF	3.500	AR4	0
HFC-134	HFC	CRF	1.100	AR4	0
HFC-134a	HFC	CRF	1.430	AR4	0
HFC-143	HFC	CRF	353	AR4	0
HFC-143a	HFC	CRF	4.470	AR4	0
HFC-152	HFC	CRF	53	AR4	0
HFC-152a	HFC	CRF	124	AR4	0
HFC-161	HFC	CRF	12	AR4	0
HFC-227ea	HFC	CRF	3.220	AR4	0
HFC-236cb	HFC	CRF	1.340	AR4	0
HFC-236ea	HFC	CRF	1.370	AR4	0
HFC-236fa	HFC	CRF	9.810	AR4	0
HFC-245ca	HFC	CRF	693	AR4	0
HFC-245fa	HFC	CRF	1.030	AR4	0
HFC-365mfc	HFC	CRF	794	AR4	0
CF4	PFC	CRF	7.390	AR4	0
C2F6 (PFC-116)	PFC	CRF	12.200	AR4	0
C3F8 (PFC-218)	PFC	CRF	8.830	AR4	0
C4F10	PFC	CRF	8.860	AR4	0
c-C4F8	PFC	CRF	10.300	AR4	0
C5F12	PFC	CRF	9.160	AR4	0
C6F14	PFC	CRF	9.300	AR4	0
C10F18 (PFC-9-1-18)	PFC	CRF	7.500	AR4	0
c-C3F6 (PFC-216)	PFC	CRF	17.340	AR4	0
SF6	SF6	CRF	22.800	AR4	0
NF3	NF3	CRF	17.200	AR4	0
CF3SF5	Other	Other	17.400	AR5	0
C7F16	PFC	Other	7.700	3M	0
C8F18	PFC	Other	8.000	3M	0
C8F16O	Other	Other	9.400	3M	0
PFPMIE	Other	Other	9.710	AR5	0
R-1233zd	HCFO	Other	7	AR5	0
R-1234yf	HFO	Other	4	AR5	0
R-1234ze	HFO	Other	6	AR5	0

AR4: Fourth Assessment Report of the IPCC [3]
AR5: Fifth Assessment Report of the IPCC [4]

Annex 2: List of emission sources

Table 6: Nomenclature of the CRF format

CRF Code	CRF source category	Aggregate source
2 B	Chemical industry	
2 B 9	Fluorochemical production	Chemical industry
2 B 9 a	By-product emissions	Chemical industry
2 B 9 a 2	Other (please specify - one row per substance)	Chemical industry
2 B 9 b	Fugitive emissions	Chemical industry
2 B 9 b 3	Other (please specify - one row per substance)	Chemical industry
10	Other	
2 E	Electronics industry	
2 E 1	Integrated circuit or semiconductor	Electronics industry
2 E 2	TFT flat panel display	Electronics industry
2 E 3	Photovoltaics	Electronics industry
2 E 4	Heat transfer fluid	Electronics industry
2 E 5	Other (as specified in table 2(II))	Electronics industry
2 F	Product uses as substitutes for ODS	
2 F 1	Refrigeration and air conditioning	
2 F 1 a	Commercial refrigeration	Refrigeration & air conditioning
2 F 1 b	Domestic refrigeration	Refrigeration & air conditioning
2 F 1 c	Industrial refrigeration	Refrigeration & air conditioning
2 F 1 d	Transport refrigeration	Refrigeration & air conditioning
2 F 1 e	Mobile air-conditioning	Refrigeration & air conditioning
2 F 1 f	Stationary air-conditioning	Refrigeration & air conditioning
2 F 2	Foam blowing agents	Foams
2 F 2 a	Closed cell foam	Foams
2 F 2 b	Open cell foam	Foams
2 F 3	Fire protection	Fire protection
2 F 4	Aerosols	
2 F 4 a	Metered dose inhalers	Aerosols
2 F 4 b	Other aerosols (technical aerosols)	Aerosols
2 F 5	Solvents	Other
2 F 6	Other applications (ODS substitutes)	Other
2 G	Other product manufacture and use	
2 G 1	Electrical equipment	Other
2 G 2	SF6 and PFCs from other product use	
2 G 2 a	Military applications	Other
2 G 2 b	Accelerators	Other
2 G 2 c	Soundproof windows	Other
2 G 2 d	Adiabatic properties: shoes and tyres	Other
2 G 2 e	Other (please specify - one row per substance)	Other
2 G 4	Other	Other
2 H	Other	Other

Annex 3: Common Reporting Format (CRF) nomenclature

Table 7: Allocation of sources to the CRF source categories

Name of Worksheet	CRF Code	CRF source category
01. Dom. refrig. - Coolant	2 F 1 b	Domestic refrigeration
02. Dom. refrig. - Foam	2 F 2 a	Closed cell foam
03. RAC & heat pumps	2 F 1 a	Commercial refrigeration
04. Car airco	2 F 1 e	Mobile air-conditioning
05. Bus&Coach airco	2 F 1 e	Mobile air-conditioning
06. Trucks airco	2 F 1 e	Mobile air-conditioning
07. Refrigerated transport	2 F 1 d	Transport refrigeration
08. Passenger rail transport	2 F 1 e	Mobile air-conditioning
10. Ind.&comm. refrig.	2 F 1 a	Commercial refrigeration
11. Closed cell foam	2 F 2 a	Closed cell foam
12. PU cans	2 F 2 a	Closed cell foam
13. Aerosols MDI	2 F 4 a	Metered dose inhalers
14. Other aerosols	2 F 4 b	Other aerosols (technical aerosols)
15. CCl4	XXX	CCl4
16. Methylbr.	YYY	Methyl bromide
17. SF6 electr. Sector	2 G 1	Electrical equipment
18. SF6 in glass sector	2 G 2 c	Soundproof windows
19. Fire Extinguishers	2 F 3	Fire protection
20. Chemical Ind	2 B 9	Fluorochemical production
21. Semiconductors	2 E 1	Integrated circuit or semiconductor
22. Nike shoes	2 G 2 d	Adiabatic properties: shoes and tyres
23. Solvents	ZZZ	Solvents

Annex 4: Tables by substance and by region

Tables in tonnes

Table 8: Emissions of F- gases by substance – Flanders (t)

(t)	2015	2017	2020	2025	2030	2040
ODS	**267,2**	**206,4**	**141,6**	**125,5**	**111,6**	**89,2**
CFC	**61,8**	**59,7**	**56,7**	**52,2**	**48,2**	**41,4**
CFC-11	29,5	29,2	28,6	27,8	27,0	25,4
CFC-12	32,3	30,6	28,1	24,4	21,2	15,9
HCFC	**199,7**	**142,5**	**80,7**	**69,3**	**59,6**	**44,2**
HCFC-141b	5,7	5,7	5,6	5,4	5,2	4,9
HCFC-142b	88,5	83,0	75,2	63,9	54,3	39,3
HCFC-22	105,1	53,6	0,0	0,0	0,0	0,0
HCFC-124	0,4	0,2				
Other ODS	**4,0**	**2,9**	**2,9**	**2,9**	**2,9**	**2,9**
CH3Br	4,0	2,9	2,9	2,9	2,9	2,9
Halons	**1,8**	**1,4**	**1,3**	**1,2**	**1,0**	**0,8**
Halon 1211	0,1	0,1	0,1	0,1	0,1	0,1
Halon 1301	1,7	1,3	1,2	1,1	1,0	0,8
CRF	**930,2**	**888,0**	**770,3**	**602,8**	**481,2**	**396,3**
HFC	**893,6**	**864,6**	**744,0**	**578,2**	**460,6**	**375,6**
HFC-32	29,5	38,7	52,8	83,8	86,2	89,2
HFC-125	135,4	132,9	126,5	99,2	72,9	33,1
HFC-134a	467,8	482,2	386,6	283,5	210,3	162,8
HFC-152a	137,8	98,0	89,3	88,2	88,1	88,2
HFC-227ea	3,9	3,8	2,6	1,5	0,7	0,4
HFC-245fa	0,5	0,3	0,3	0,1	0,1	0,1
HFC-365mfc	8,0	12,9	5,8	2,2	2,1	1,8
HFC-143a	110,6	95,6	79,9	19,5	0,0	0,0
HFC-23	0,1	0,1	0,1	0,1	0,1	0,1
HFC-41	0,0	0,0				
SF6	**2,4**	**2,5**	**2,3**	**2,6**	**0,5**	**0,6**
SF6	2,4	2,5	2,3	2,6	0,5	0,6
PFC	**34,2**	**20,9**	**23,9**	**22,0**	**20,1**	**20,1**
CF4	6,3	14,0	16,1	14,8	13,6	13,6
C4F10	16,9	3,7	4,3	3,9	3,6	3,6
C5F12	0,0	0,0				
C6F14	10,4	2,5	2,9	2,7	2,4	2,4
C2F6 (PFC-116)	0,3	0,5	0,5	0,5	0,5	0,5
c-C4F8	0,0	0,0	0,0	0,0	0,0	0,0
C3F8 (PFC-218)	0,1	0,1				
NF3	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**
NF3	0,0	0,0	0,0	0,0	0,0	0,0
Other	**92,6**	**133,9**	**159,3**	**239,0**	**273,2**	**279,5**
HFO	**23,5**	**28,5**	**76,5**	**156,2**	**190,4**	**196,7**
R-1234ze	22,6	10,5	11,3	15,5	15,5	15,5
R-1234yf	0,9	18,1	65,2	140,7	174,9	181,2
Other	**69,1**	**105,4**	**82,8**	**82,8**	**82,8**	**82,8**
Unspecified mix	68,1	105,1	82,5	82,5	82,5	82,5
PFPMIE	1,0	0,3	0,3	0,3	0,3	0,3
General total	**1.290,0**	**1.228,3**	**1.071,2**	**967,3**	**866,0**	**765,1**

Table 9: Emissions of F- gases by substance – Wallonia (t)

(t)	2015	2017	2020	2025	2030	2040
ODS	**146,6**	**112,9**	**76,7**	**67,6**	**59,9**	**47,4**
CFC	**34,4**	**33,1**	**31,4**	**28,8**	**26,5**	**22,7**
CFC-11	16,4	16,2	15,8	15,3	14,9	14,0
CFC-12	18,0	17,0	15,5	13,4	11,7	8,7
HCFC	**111,2**	**79,0**	**44,6**	**38,2**	**32,8**	**24,2**
HCFC-141b	3,2	3,1	3,1	3,0	2,9	2,7
HCFC-142b	49,3	46,0	41,6	35,2	29,9	21,5
HCFC-22	58,5	29,7	0,0	0,0	0,0	0,0
HCFC-124	0,2	0,1				
Halons	**1,0**	**0,8**	**0,7**	**0,6**	**0,6**	**0,5**
Halon 1211	0,1	0,0	0,0	0,0	0,0	0,0
Halon 1301	0,9	0,7	0,7	0,6	0,5	0,4
CRF	**400,4**	**408,3**	**354,4**	**268,9**	**204,8**	**157,0**
HFC	**399,1**	**407,0**	**353,3**	**267,6**	**204,6**	**156,8**
HFC-32	16,0	21,3	29,1	46,1	47,3	48,5
HFC-125	73,8	73,0	69,2	54,3	40,0	17,8
HFC-134a	244,9	256,1	208,3	153,9	115,1	88,5
HFC-152a	2,3	2,2	0,8	0,8	0,7	0,8
HFC-227ea	1,3	1,3	1,2	0,8	0,4	0,2
HFC-245fa	0,2	0,2	0,1	0,1	0,1	0,0
HFC-365mfc	0,2	0,6	1,1	1,2	1,1	1,0
HFC-143a	60,5	52,4	43,5	10,4	0,0	0,0
SF6	**1,2**	**1,2**	**1,1**	**1,2**	**0,1**	**0,1**
SF6	1,2	1,2	1,1	1,2	0,1	0,1
PFC	**0,1**	**0,1**				
C3F8 (PFC-218)	0,1	0,1				
Other	**3,3**	**9,0**	**38,9**	**80,9**	**98,7**	**101,6**
HFO	**3,3**	**9,0**	**38,9**	**80,9**	**98,7**	**101,6**
R-1234ze	2,8	0,2	5,6	7,7	7,7	7,7
R-1234yf	0,5	8,8	33,3	73,2	91,0	93,9
General total	**550,3**	**530,2**	**470,0**	**417,4**	**363,4**	**306,0**

Table 10: Emissions of F- gases by substance – Brussels (t)

(t)	2015	2017	2020	2025	2030	2040
ODS	**48,0**	**37,2**	**25,6**	**22,7**	**20,1**	**16,1**
CFC	**11,3**	**10,9**	**10,4**	**9,7**	**8,9**	**7,7**
CFC-11	5,4	5,3	5,3	5,1	5,0	4,7
CFC-12	5,9	5,6	5,2	4,5	3,9	3,0
HCFC	**36,4**	**26,1**	**14,9**	**12,8**	**11,0**	**8,2**
HCFC-141b	1,0	1,0	1,0	1,0	1,0	0,9
HCFC-142b	16,1	15,2	13,8	11,8	10,0	7,3
HCFC-22	19,2	9,8	0,0	0,0	0,0	0,0
HCFC-124	0,1	0,0				
Halons	**0,3**	**0,3**	**0,2**	**0,2**	**0,2**	**0,2**
Halon 1211	0,0	0,0	0,0	0,0	0,0	0,0
Halon 1301	0,3	0,2	0,2	0,2	0,2	0,1
CRF	**133,7**	**132,3**	**116,0**	**89,4**	**68,8**	**53,4**
HFC	**133,3**	**131,9**	**115,6**	**89,0**	**68,7**	**53,4**
HFC-32	5,2	7,0	9,7	15,5	15,9	16,5
HFC-125	24,2	24,1	23,0	18,2	13,4	6,1
HFC-134a	82,7	82,1	67,3	50,9	38,6	30,1
HFC-152a	0,7	0,7	0,3	0,3	0,3	0,3
HFC-227ea	0,4	0,4	0,4	0,3	0,1	0,1
HFC-245fa	0,1	0,1	0,0	0,0	0,0	0,0
HFC-365mfc	0,1	0,2	0,4	0,4	0,4	0,3
HFC-143a	19,9	17,3	14,5	3,5	0,0	0,0
SF6	**0,4**	**0,4**	**0,4**	**0,4**	**0,0**	**0,0**
SF6	0,4	0,4	0,4	0,4	0,0	0,0
PFC	**0,0**	**0,0**				
C3F8 (PFC-218)	0,0	0,0				
Other	**1,1**	**2,7**	**12,1**	**25,3**	**30,9**	**31,8**
HFO	**1,1**	**2,7**	**12,1**	**25,3**	**30,9**	**31,8**
R-1234ze	0,9	0,1	1,9	2,6	2,6	2,6
R-1234yf	0,1	2,7	10,2	22,8	28,3	29,2
General total	**182,8**	**172,3**	**153,6**	**137,4**	**119,7**	**101,3**

Tables in kt CO2-eq

Table 11: Emissions of F- gases by substance – Flanders (kt CO2-eq)

(kt CO2-eq)	2015	2017	2020	2025	2030	2040
ODS	**590,7**	**494,8**	**373,7**	**326,6**	**286,0**	**220,7**
CFC	**321,3**	**306,5**	**285,3**	**253,6**	**225,9**	**180,5**
CFC-11	59,6	58,9	57,9	56,2	54,5	51,4
CFC-12	261,8	247,6	227,4	197,4	171,4	129,0
HCFC	**339,6**	**243,8**	**140,3**	**119,6**	**102,1**	**74,3**
HCFC-141b	3,0	3,0	2,9	2,8	2,7	2,6
HCFC-142b	161,8	151,6	137,4	116,8	99,3	71,8
HCFC-22	174,6	89,1	0,0	0,0	0,0	0,0
HCFC-124	0,2	0,1				
Other ODS	**-5,0**	**-3,6**	**-3,6**	**-3,6**	**-3,6**	**-3,6**
CH3Br	-5,0	-3,6	-3,6	-3,6	-3,6	-3,6
Halons	**-65,2**	**-51,9**	**-48,3**	**-43,1**	**-38,4**	**-30,5**
Halon 1211	-1,7	-1,5	-1,4	-1,2	-1,2	-0,9
Halon 1301	-63,5	-50,4	-47,0	-41,8	-37,2	-29,7
CRF	**2.049,6**	**1.868,2**	**1.658,6**	**1.150,3**	**803,8**	**598,4**
HFC	**1.695,5**	**1.644,7**	**1.414,1**	**915,4**	**630,4**	**423,8**
HFC-134a	668,9	689,6	552,9	405,5	300,8	232,8
HFC-152a	17,1	12,2	11,1	10,9	10,9	10,9
HFC-227ea	12,6	12,3	8,5	4,8	2,3	1,3
HFC-245fa	0,6	0,3	0,3	0,1	0,1	0,1
HFC-365mfc	6,3	10,3	4,6	1,8	1,6	1,4
HFC-125	473,9	465,2	442,7	347,3	255,2	115,9
HFC-143a	494,4	427,5	356,9	87,2	0,0	0,0
HFC-32	19,9	26,1	35,7	56,6	58,2	60,2
HFC-23	1,7	1,3	1,3	1,3	1,3	1,3
HFC-41	0,0	0,0				
SF6	**54,2**	**55,9**	**53,1**	**58,4**	**11,9**	**13,1**
SF6	54,2	55,9	53,1	58,4	11,9	13,1
PFC	**299,1**	**167,0**	**190,8**	**175,8**	**160,8**	**160,8**
CF4	46,6	103,5	119,3	109,7	100,1	100,1
C4F10	150,0	32,7	37,9	34,8	31,6	31,6
C5F12	0,0	0,0				
C6F14	96,9	23,5	27,3	25,0	22,8	22,8
C2F6 (PFC-116)	4,2	6,2	6,2	6,2	6,2	6,2
c-C4F8	0,1	0,1	0,1	0,1	0,1	0,1
C3F8 (PFC-218)	1,3	0,9				
NF3	**0,8**	**0,6**	**0,6**	**0,6**	**0,6**	**0,6**
NF3	0,8	0,6	0,6	0,6	0,6	0,6
Other	**639,0**	**878,9**	**705,7**	**706,0**	**706,1**	**706,2**
HFO	**0,1**	**0,1**	**0,3**	**0,7**	**0,8**	**0,8**
R-1234ze	0,1	0,1	0,1	0,1	0,1	0,1
R-1234yf	0,0	0,1	0,3	0,6	0,7	0,7
Other	**638,9**	**878,8**	**705,3**	**705,3**	**705,3**	**705,3**
Unspecified mix	629,1	875,6	702,1	702,1	702,1	702,1
PFPMIE	9,8	3,2	3,2	3,2	3,2	3,2
General total	**3.279,3**	**3.242,0**	**2.738,0**	**2.182,9**	**1.795,9**	**1.525,3**

Table 12: Emissions of F- gases by substance – Wallonia (kt CO2-eq)

(kt CO2-eq)	2015	2017	2020	2025	2030	2040
ODS	**331,8**	**276,5**	**208,6**	**182,1**	**159,5**	**123,0**
CFC	**179,0**	**170,0**	**157,7**	**139,8**	**124,4**	**99,0**
CFC-11	33,2	32,7	32,0	31,0	30,0	28,2
CFC-12	145,8	137,3	125,8	108,9	94,4	70,8
HCFC	**189,2**	**135,2**	**77,6**	**66,0**	**56,2**	**40,8**
HCFC-141b	1,7	1,6	1,6	1,5	1,5	1,4
HCFC-142b	90,1	84,1	76,0	64,4	54,7	39,4
HCFC-22	97,3	49,4	0,0	0,0	0,0	0,0
HCFC-124	0,1	0,1				
Halons	**-36,3**	**-28,8**	**-26,7**	**-23,7**	**-21,2**	**-16,8**
Halon 1211	-0,9	-0,8	-0,8	-0,7	-0,6	-0,5
Halon 1301	-35,4	-28,0	-26,0	-23,1	-20,5	-16,3
CRF	**923,0**	**902,9**	**784,6**	**520,0**	**341,4**	**226,6**
HFC	**894,2**	**875,2**	**759,0**	**491,6**	**338,6**	**223,3**
HFC-134a	350,2	366,2	297,9	220,1	164,6	126,5
HFC-152a	0,3	0,3	0,1	0,1	0,1	0,1
HFC-227ea	4,1	4,2	3,7	2,7	1,2	0,7
HFC-245fa	0,2	0,2	0,1	0,1	0,1	0,0
HFC-365mfc	0,2	0,5	0,9	1,0	0,9	0,8
HFC-125	258,1	255,4	242,3	190,0	139,8	62,4
HFC-143a	270,3	234,2	194,4	46,5	0,0	0,0
HFC-32	10,8	14,4	19,6	31,1	31,9	32,8
SF6	**28,0**	**27,2**	**25,6**	**28,4**	**2,8**	**3,3**
SF6	28,0	27,2	25,6	28,4	2,8	3,3
PFC	**0,7**	**0,5**				
C3F8 (PFC-218)	0,7	0,5				
Other	**0,0**	**0,0**	**0,2**	**0,3**	**0,4**	**0,4**
HFO	**0,0**	**0,0**	**0,2**	**0,3**	**0,4**	**0,4**
R-1234ze	0,0	0,0	0,0	0,0	0,0	0,0
R-1234yf	0,0	0,0	0,1	0,3	0,4	0,4
General total	**1.254,8**	**1.179,4**	**993,4**	**702,4**	**501,3**	**350,0**

Table 13: Emissions of F- gases by substance – Brussels (kt CO2-eq)

(kt CO2-eq)	2015	2017	2020	2025	2030	2040
ODS	**108,6**	**91,1**	**69,5**	**61,1**	**53,5**	**41,8**
CFC	**58,6**	**56,0**	**52,6**	**46,9**	**41,7**	**33,6**
CFC-11	10,9	10,8	10,7	10,4	10,1	9,6
CFC-12	47,7	45,3	41,9	36,5	31,6	24,0
HCFC	**61,9**	**44,6**	**25,8**	**22,1**	**18,8**	**13,9**
HCFC-141b	0,5	0,5	0,5	0,5	0,5	0,5
HCFC-142b	29,5	27,7	25,3	21,6	18,3	13,4
HCFC-22	31,8	16,3	0,0	0,0	0,0	0,0
HCFC-124	0,0	0,0				
Halons	**-11,9**	**-9,5**	**-8,9**	**-8,0**	**-7,1**	**-5,7**
Halon 1211	-0,3	-0,3	-0,3	-0,2	-0,2	-0,2
Halon 1301	-11,6	-9,2	-8,7	-7,7	-6,9	-5,5
CRF	**306,2**	**294,6**	**258,3**	**173,3**	**114,6**	**77,1**
HFC	**296,8**	**285,5**	**249,8**	**163,8**	**113,7**	**76,0**
HFC-134a	118,3	117,4	96,3	72,7	55,3	43,0
HFC-152a	0,1	0,1	0,0	0,0	0,0	0,0
HFC-227ea	1,3	1,4	1,2	0,9	0,4	0,2
HFC-245fa	0,1	0,1	0,0	0,0	0,0	0,0
HFC-365mfc	0,1	0,2	0,3	0,3	0,3	0,3
HFC-125	84,7	84,3	80,6	63,8	47,0	21,3
HFC-143a	88,7	77,3	64,7	15,6	0,0	0,0
HFC-32	3,5	4,7	6,5	10,4	10,7	11,2
SF6	**9,2**	**8,9**	**8,5**	**9,5**	**0,9**	**1,1**
SF6	9,2	8,9	8,5	9,5	0,9	1,1
PFC	**0,2**	**0,2**				
C3F8 (PFC-218)	0,2	0,2				
Other	**0,0**	**0,0**	**0,1**	**0,1**	**0,1**	**0,1**
HFO	**0,0**	**0,0**	**0,1**	**0,1**	**0,1**	**0,1**
R-1234ze	0,0	0,0	0,0	0,0	0,0	0,0
R-1234yf	0,0	0,0	0,0	0,1	0,1	0,1
General total	**414,9**	**385,7**	**327,8**	**234,5**	**168,2**	**119,0**

Annex 5: Tables by source and by region

Tables in tonnes

Table 14: Emissions of CRF gases by source – Flanders (t)

(t)	CRF Name	2015	2017	2020	2025	2030	2040
2 B 9	**Fluorochemical production**	**34,1**	**19,6**	**22,7**	**20,9**	**19,0**	**19,0**
	20. Chemical Ind	34,1	19,6	22,7	20,9	19,0	19,0
2 E 1	**Integrated circuit or semiconductor**	**1,1**	**1,5**	**1,5**	**1,5**	**1,5**	**1,5**
	21. Semiconductors	1,1	1,5	1,5	1,5	1,5	1,5
2 F 1 a	**Commercial refrigeration**	**361,1**	**347,3**	**306,3**	**229,0**	**158,3**	**67,5**
	10. Ind.&comm. refrig.	361,1	347,3	306,3	229,0	158,3	67,5
2 F 1 b	**Domestic refrigeration**	**1,1**	**0,9**	**0,4**	**0,6**	**0,0**	**0,0**
	01. Dom. refrig. - Coolant	1,1	0,9	0,4	0,6	0,0	0,0
2 F 1 d	**Transport refrigeration**	**8,7**	**4,9**	**5,2**	**3,8**	**2,2**	**3,4**
	07. Refrigerated transport	8,7	4,9	5,2	3,8	2,2	3,4
2 F 1 e	**Mobile air-conditioning**	**206,7**	**204,6**	**167,2**	**97,4**	**56,3**	**68,1**
	04. Car airco	159,5	154,1	114,6	43,9		
	05. Bus&Coach airco	21,7	23,0	25,2	28,0	30,3	33,0
	06. Trucks airco	24,3	26,1	26,1	24,2	24,6	33,5
	08. Passenger rail transport	1,2	1,3	1,3	1,3	1,4	1,6
2 F 1 f	**Stationary air-conditioning**	**106,8**	**129,5**	**126,9**	**122,0**	**121,9**	**116,3**
	03. Stationary airco	106,8	129,5	126,9	122,0	121,9	116,3
2 F 2 a	**Closed cell foam**	**167,6**	**137,7**	**104,8**	**97,9**	**96,6**	**94,5**
	02. Dom. refrig. - Foam	0,2	0,2				
	11. Closed cell foam	159,3	119,3	100,6	94,8	93,5	91,3
	12. PU cans	8,1	18,2	4,2	3,1	3,1	3,2
2 F 3	**Fire protection**	**2,3**	**2,2**	**1,9**	**1,3**	**0,4**	**0,1**
	19. Fire Extinguishers	2,3	2,2	1,9	1,3	0,4	0,1
2 F 4 a	**Metered dose inhalers**	**19,5**	**19,7**	**20,0**	**20,5**	**20,9**	**21,6**
	13. Aerosols MDI	19,5	19,7	20,0	20,5	20,9	21,6
2 F 4 b	**Other aerosols (technical aerosols)**	**19,0**	**17,8**	**11,2**	**5,6**	**3,9**	**4,0**
	14. Other aerosols	19,0	17,8	11,2	5,6	3,9	4,0
2 G 1	**Electrical equipment**	**0,3**	**0,3**	**0,3**	**0,3**	**0,3**	**0,3**
	17. SF6 electr. Sector	0,3	0,3	0,3	0,3	0,3	0,3
2 G 2 c	**Soundproof windows**	**2,0**	**1,9**	**1,8**	**2,0**		
	18. SF6 in glass sector	2,0	1,9	1,8	2,0		
General total		930,2	888,0	770,3	602,8	481,2	396,3

Table 15: Emissions of CRF gases by source – Wallonia (t)

(t)	CRF Name	2015	2017	2020	2025	2030	2040
2 F 1 a	**Commercial refrigeration**	**201,1**	**192,6**	**169,5**	**126,3**	**87,2**	**37,1**
	10. Ind.&comm. refrig.	201,1	192,6	169,5	126,3	87,2	37,1
2 F 1 b	**Domestic refrigeration**	**0,7**	**0,4**	**0,3**	**0,3**	**0,0**	**0,0**
	01. Dom. refrig. - Coolant	0,7	0,4	0,3	0,3	0,0	0,0
2 F 1 d	**Transport refrigeration**	**1,9**	**1,1**	**1,0**	**1,0**	**0,5**	**0,8**
	07. Refrigerated transport	1,9	1,1	1,0	1,0	0,5	0,8
2 F 1 e	**Mobile air-conditioning**	**107,4**	**107,2**	**88,1**	**51,9**	**30,8**	**37,1**
	04. Car airco	81,4	79,4	59,2	22,7		
	05. Bus&Coach airco	12,0	12,7	13,9	15,4	16,6	18,1
	06. Trucks airco	13,4	14,4	14,3	13,1	13,4	18,2
	08. Passenger rail transport	0,7	0,7	0,7	0,7	0,8	0,9
2 F 1 f	**Stationary air-conditioning**	**58,8**	**71,6**	**70,1**	**67,3**	**67,1**	**63,8**
	03. Stationary airco	58,8	71,6	70,1	67,3	67,1	63,8
2 F 2 a	**Closed cell foam**	**8,3**	**13,6**	**7,2**	**6,3**	**5,5**	**4,4**
	02. Dom. refrig. - Foam	0,2	0,1				
	11. Closed cell foam	5,4	5,9	6,1	5,4	4,7	3,5
	12. PU cans	2,7	7,6	1,1	0,8	0,9	0,9
2 F 3	**Fire protection**	**1,3**	**1,2**	**1,0**	**0,7**	**0,2**	**0,0**
	19. Fire Extinguishers	1,3	1,2	1,0	0,7	0,2	0,0
2 F 4 a	**Metered dose inhalers**	**10,9**	**10,9**	**11,1**	**11,3**	**11,5**	**11,9**
	13. Aerosols MDI	10,9	10,9	11,1	11,3	11,5	11,9
2 F 4 b	**Other aerosols (technical aerosols)**	**8,7**	**8,3**	**5,0**	**2,5**	**1,7**	**1,8**
	14. Other aerosols	8,7	8,3	5,0	2,5	1,7	1,8
2 G 1	**Electrical equipment**	**0,1**	**0,1**	**0,1**	**0,1**	**0,1**	**0,1**
	17. SF6 electr. Sector	0,1	0,1	0,1	0,1	0,1	0,1
2 G 2 c	**Soundproof windows**	**1,1**	**1,1**	**1,0**	**1,1**		
	18. SF6 in glass sector	1,1	1,1	1,0	1,1		
General total		**400,4**	**408,3**	**354,4**	**268,9**	**204,8**	**157,0**

Table 16: Emissions of CRF gases by source – Brussels (t)

(t)	CRF Name	2015	2017	2020	2025	2030	2040
2 F 1 a	**Commercial refrigeration**	**65,8**	**63,5**	**56,3**	**42,4**	**29,2**	**12,6**
	10. Ind.&comm. refrig.	65,8	63,5	56,3	42,4	29,2	12,6
2 F 1 b	**Domestic refrigeration**	**0,2**	**0,1**	**0,1**	**0,1**	**0,0**	**0,0**
	01. Dom. refrig. - Coolant	0,2	0,1	0,1	0,1	0,0	0,0
2 F 1 d	**Transport refrigeration**	**0,9**	**0,5**	**0,5**	**0,4**	**0,3**	**0,4**
	07. Refrigerated transport	0,9	0,5	0,5	0,4	0,3	0,4
2 F 1 e	**Mobile air-conditioning**	**37,6**	**32,9**	**27,3**	**16,6**	**10,3**	**12,6**
	04. Car airco	29,1	23,8	17,7	6,8		
	05. Bus&Coach airco	3,9	4,2	4,6	5,2	5,6	6,1
	06. Trucks airco	4,4	4,7	4,7	4,4	4,5	6,2
	08. Passenger rail transport	0,2	0,2	0,2	0,2	0,3	0,3
2 F 1 f	**Stationary air-conditioning**	**19,3**	**23,6**	**23,3**	**22,6**	**22,5**	**21,7**
	03. Stationary airco	19,3	23,6	23,3	22,6	22,5	21,7
2 F 2 a	**Closed cell foam**	**2,7**	**4,5**	**2,4**	**2,1**	**1,9**	**1,5**
	02. Dom. refrig. - Foam	0,0	0,0				
	11. Closed cell foam	1,8	2,0	2,0	1,8	1,6	1,2
	12. PU cans	0,9	2,5	0,4	0,3	0,3	0,3
2 F 3	**Fire protection**	**0,4**	**0,4**	**0,3**	**0,2**	**0,1**	**0,0**
	19. Fire Extinguishers	0,4	0,4	0,3	0,2	0,1	0,0
2 F 4 a	**Metered dose inhalers**	**3,6**	**3,6**	**3,7**	**3,8**	**3,9**	**4,0**
	13. Aerosols MDI	3,6	3,6	3,7	3,8	3,9	4,0
2 F 4 b	**Other aerosols (technical aerosols)**	**2,8**	**2,7**	**1,7**	**0,8**	**0,6**	**0,6**
	14. Other aerosols	2,8	2,7	1,7	0,8	0,6	0,6
2 G 1	**Electrical equipment**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**
	17. SF6 electr. Sector	0,0	0,0	0,0	0,0	0,0	0,0
2 G 2 c	**Soundproof windows**	**0,4**	**0,4**	**0,3**	**0,4**		
	18. SF6 in glass sector	0,4	0,4	0,3	0,4		
General total		**133,7**	**132,3**	**116,0**	**89,4**	**68,8**	**53,4**

Tables in kt CO2-eq

Table 17: Emissions of CRF gases by source – Flanders (kt CO2-eq)

(kt CO2-eq)	CRF Name	2015	2017	2020	2025	2030	2040
2 B 9	**Fluorochemical production**	**293,1**	**155,2**	**180,0**	**165,0**	**150,0**	**150,0**
	20. Chemical Ind	293,1	155,2	180,0	165,0	150,0	150,0
2 E 1	**Integrated circuit or semiconductor**	**13,0**	**18,3**	**18,3**	**18,3**	**18,3**	**18,3**
	21. Semiconductors	13,0	18,3	18,3	18,3	18,3	18,3
2 F 1 a	**Commercial refrigeration**	**1.061,7**	**982,7**	**843,4**	**469,8**	**273,2**	**128,3**
	10. Ind.&comm. refrig.	1.061,7	982,7	843,4	469,8	273,2	128,3
2 F 1 b	**Domestic refrigeration**	**1,9**	**1,5**	**0,7**	**1,1**	**0,0**	**0,0**
	01. Dom. refrig. - Coolant	1,9	1,5	0,7	1,1	0,0	0,0
2 F 1 d	**Transport refrigeration**	**28,3**	**16,2**	**16,9**	**11,6**	**3,9**	**6,0**
	07. Refrigerated transport	28,3	16,2	16,9	11,6	3,9	6,0
2 F 1 e	**Mobile air-conditioning**	**295,6**	**292,6**	**239,2**	**139,3**	**80,5**	**97,4**
	04. Car airco	228,0	220,4	163,9	62,8		
	05. Bus&Coach airco	31,1	32,9	36,0	40,1	43,3	47,2
	06. Trucks airco	34,7	37,4	37,3	34,6	35,2	47,8
	08. Passenger rail transport	1,7	2,0	1,9	1,9	2,0	2,3
2 F 1 f	**Stationary air-conditioning**	**185,1**	**226,7**	**230,9**	**226,7**	**212,4**	**134,6**
	03. Stationary airco	185,1	226,7	230,9	226,7	212,4	134,6
2 F 2 a	**Closed cell foam**	**58,7**	**64,9**	**32,0**	**24,5**	**22,6**	**19,7**
	02. Dom. refrig. - Foam	0,2	0,2				
	11. Closed cell foam	55,4	47,7	30,5	23,7	21,8	18,9
	12. PU cans	3,1	17,0	1,5	0,8	0,8	0,8
2 F 3	**Fire protection**	**7,6**	**7,2**	**6,0**	**4,1**	**1,3**	**0,2**
	19. Fire Extinguishers	7,6	7,2	6,0	4,1	1,3	0,2
2 F 4 a	**Metered dose inhalers**	**28,1**	**28,4**	**28,8**	**29,5**	**30,1**	**31,1**
	13. Aerosols MDI	28,1	28,4	28,8	29,5	30,1	31,1
2 F 4 b	**Other aerosols (technical aerosols)**	**25,2**	**24,0**	**14,9**	**7,5**	**5,1**	**5,3**
	14. Other aerosols	25,2	24,0	14,9	7,5	5,1	5,3
2 G 1	**Electrical equipment**	**6,2**	**6,6**	**6,2**	**6,2**	**6,3**	**7,5**
	17. SF6 electr. Sector	6,2	6,6	6,2	6,2	6,3	7,5
2 G 2 c	**Soundproof windows**	**45,4**	**43,7**	**41,3**	**46,6**		
	18. SF6 in glass sector	45,4	43,7	41,3	46,6		
General total		**2.049,6**	**1.868,2**	**1.658,6**	**1.150,3**	**803,8**	**598,4**

Table 18: Emissions of CRF gases by source – Wallonia (kt CO2-eq)

(kt CO2-eq)	CRF Name	2015	2017	2020	2025	2030	2040
2 F 1 a	**Commercial refrigeration**	**591,4**	**545,1**	**466,8**	**259,2**	**150,5**	**70,4**
	10. Ind.&comm. refrig.	591,4	545,1	466,8	259,2	150,5	70,4
2 F 1 b	**Domestic refrigeration**	**1,2**	**0,8**	**0,5**	**0,6**	**0,0**	**0,0**
	01. Dom. refrig. - Coolant	1,2	0,8	0,5	0,6	0,0	0,0
2 F 1 d	**Transport refrigeration**	**5,9**	**3,3**	**3,2**	**2,9**	**0,9**	**1,4**
	07. Refrigerated transport	5,9	3,3	3,2	2,9	0,9	1,4
2 F 1 e	**Mobile air-conditioning**	**153,7**	**153,3**	**126,0**	**74,3**	**44,0**	**53,1**
	04. Car airco	116,4	113,5	84,7	32,4		
	05. Bus&Coach airco	17,2	18,2	19,8	22,0	23,7	25,8
	06. Trucks airco	19,2	20,5	20,4	18,8	19,2	26,0
	08. Passenger rail transport	1,0	1,1	1,0	1,0	1,1	1,3
2 F 1 f	**Stationary air-conditioning**	**101,7**	**125,3**	**127,5**	**125,0**	**117,0**	**73,8**
	03. Stationary airco	101,7	125,3	127,5	125,0	117,0	73,8
2 F 2 a	**Closed cell foam**	**9,2**	**16,7**	**8,9**	**7,6**	**6,5**	**4,9**
	02. Dom. refrig. - Foam	0,2	0,1				
	11. Closed cell foam	7,6	8,2	8,3	7,3	6,2	4,6
	12. PU cans	1,4	8,3	0,7	0,3	0,3	0,3
2 F 3	**Fire protection**	**4,2**	**4,0**	**3,3**	**2,3**	**0,7**	**0,1**
	19. Fire Extinguishers	4,2	4,0	3,3	2,3	0,7	0,1
2 F 4 a	**Metered dose inhalers**	**15,6**	**15,7**	**15,9**	**16,3**	**16,6**	**17,1**
	13. Aerosols MDI	15,6	15,7	15,9	16,3	16,6	17,1
2 F 4 b	**Other aerosols (technical aerosols)**	**12,0**	**11,5**	**6,9**	**3,5**	**2,4**	**2,5**
	14. Other aerosols	12,0	11,5	6,9	3,5	2,4	2,5
2 G 1	**Electrical equipment**	**2,8**	**2,9**	**2,7**	**2,7**	**2,8**	**3,3**
	17. SF6 electr. Sector	2,8	2,9	2,7	2,7	2,8	3,3
2 G 2 c	**Soundproof windows**	**25,3**	**24,3**	**22,8**	**25,7**		
	18. SF6 in glass sector	25,3	24,3	22,8	25,7		
General total		**923,0**	**902,9**	**784,6**	**520,0**	**341,4**	**226,6**

Table 19: Emissions of CRF gases by source – Brussels (kt CO2-eq)

(kt CO2-eq)	CRF Name	2015	2017	2020	2025	2030	2040
2 F 1 a	**Commercial refrigeration**	**193,6**	**179,7**	**155,0**	**86,9**	**50,5**	**23,9**
	10. Ind.&comm. refrig.	193,6	179,7	155,0	86,9	50,5	23,9
2 F 1 b	**Domestic refrigeration**	**0,3**	**0,2**	**0,1**	**0,2**	**0,0**	**0,0**
	01. Dom. refrig. - Coolant	0,3	0,2	0,1	0,2	0,0	0,0
2 F 1 d	**Transport refrigeration**	**2,6**	**1,5**	**1,4**	**1,1**	**0,5**	**0,7**
	07. Refrigerated transport	2,6	1,5	1,4	1,1	0,5	0,7
2 F 1 e	**Mobile air-conditioning**	**53,8**	**47,1**	**39,1**	**23,8**	**14,8**	**18,0**
	04. Car airco	41,7	34,0	25,4	9,7		
	05. Bus&Coach airco	5,6	6,0	6,6	7,4	8,0	8,8
	06. Trucks airco	6,2	6,8	6,8	6,3	6,4	8,8
	08. Passenger rail transport	0,3	0,4	0,3	0,4	0,4	0,4
2 F 1 f	**Stationary air-conditioning**	**33,3**	**41,3**	**42,5**	**41,9**	**39,2**	**25,1**
	03. Stationary airco	33,3	41,3	42,5	41,9	39,2	25,1
2 F 2 a	**Closed cell foam**	**3,0**	**5,5**	**3,0**	**2,5**	**2,2**	**1,7**
	02. Dom. refrig. - Foam	0,0	0,0				
	11. Closed cell foam	2,5	2,7	2,8	2,4	2,1	1,6
	12. PU cans	0,4	2,7	0,2	0,1	0,1	0,1
2 F 3	**Fire protection**	**1,4**	**1,3**	**1,1**	**0,8**	**0,2**	**0,0**
	19. Fire Extinguishers	1,4	1,3	1,1	0,8	0,2	0,0
2 F 4 a	**Metered dose inhalers**	**5,1**	**5,2**	**5,3**	**5,5**	**5,6**	**5,8**
	13. Aerosols MDI	5,1	5,2	5,3	5,5	5,6	5,8
2 F 4 b	**Other aerosols (technical aerosols)**	**3,9**	**3,8**	**2,3**	**1,2**	**0,8**	**0,8**
	14. Other aerosols	3,9	3,8	2,3	1,2	0,8	0,8
2 G 1	**Electrical equipment**	**0,9**	**0,9**	**0,9**	**0,9**	**0,9**	**1,1**
	17. SF6 electr. Sector	0,9	0,9	0,9	0,9	0,9	1,1
2 G 2 c	**Soundproof windows**	**8,3**	**8,0**	**7,6**	**8,6**		
	18. SF6 in glass sector	8,3	8,0	7,6	8,6		
General total		**306,2**	**294,6**	**258,3**	**173,3**	**114,6**	**77,1**