

# Fluorinated greenhouse gases 2019

Data reported by companies on the production, import, export, destruction and feedstock use of fluorinated greenhouse gases in the European Union, 2007-2018

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# Executive summary

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The 2019 edition of the European Environment Agency (EEA) report on fluorinated greenhouse gases (F-gases) confirms the good progress achieved in 2018 by the European Union (EU) in phasing-down the use of hydrofluorocarbons (HFCs), a set of fluorinated gases with a high global warming potential (GWP) that is significantly contributing to climate change.

The report evaluates and presents the data reported by companies in 2019 about their activities involving F-gases in 2018, assessing both the progress made under the ongoing EU-wide HFC phase-down and the outlook towards the global HFC phase-down, which began in 2019 under the Kigali Amendment to the Montreal Protocol. The report also details the amount of F-gases supplied to various industrial applications.

The report uses two different metrics: F-gas amounts expressed in physical tonnes reflect the use patterns of F-gases in European industries, while their GWP (in tonnes of carbon dioxide equivalent, t CO<sub>2</sub>e) are relevant for climate change policy.

## Context

The EU Regulation on F-gases, No 517/2014, implements an EU-wide phase-down for HFCs, which started in 2015, with the aim of cutting emissions by two thirds by 2030 in the EU compared with 2014. It mandates companies to report their annual production, imports, exports and other activities involving HFCs, as well as other F-gases, and it includes all the F-gases covered by the Kyoto Protocol: HFCs, perfluorocarbons (PFCs), sulphur hexafluoride (SF<sub>6</sub>) and nitrogen trifluoride (NF<sub>3</sub>), as well as others such as unsaturated HFCs and hydrochlorofluorocarbons (HCFCs).

Many ozone-depleting substances (ODS) also contain fluorine and have very high GWPs. These ODS are regulated separately under Regulation (EC) No 1005/2009.

The use of F-gases, most prominently in refrigeration and air conditioning, has been increasing since the early 1990s, in particular as a replacement for ODS

globally phased out under the Montreal Protocol. Emissions of F-gases, of which more than 90 % are HFCs, increased from 2000 to 2014, then declined significantly after peaking in 2015 (6 %) (EEA, 2019a).

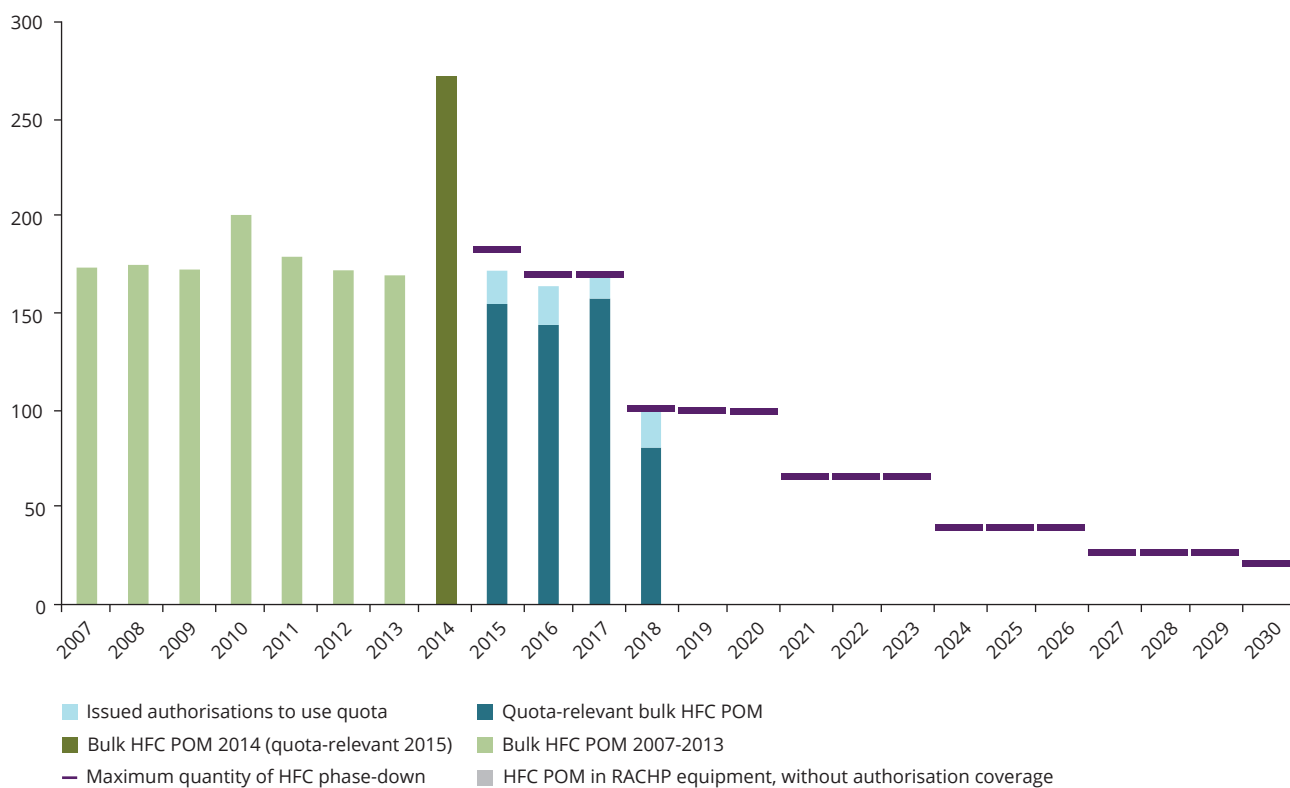
The EU has committed, under the United Nations Framework Convention on Climate Change (UNFCCC), to reduce emissions of greenhouse gases by 20 % by 2020, compared with 1990 levels. F-gases are included in this target. Under the Paris Agreement, the EU is committed to a 40 % reduction in domestic emissions by 2030, compared with 1990.

## Phase-down of HFCs under the EU F-gas Regulation

The HFC phase-down under the F-gas Regulation is being implemented by annual quantitative limits (quotas) on the placing on the EU market of HFCs by producers and importers. EU-wide placing on the market (POM) of HFCs was 1 % below the 2018 overall market limit set by the quota system (Figure ES.1). In 2015 and 2016, quotas had been used less efficiently by companies (4-6 % below the limit). The few cases of quota exceedance, both by importers of bulk HFCs and by equipment importers, were balanced by companies that did not fully use their quota.

The year 2018 was the second one that imports of refrigeration, air conditioning and heat pump (RACHP) equipment containing HFCs became subject to the quota system. The reserve of quota authorisations, built up by a number of equipment importers during 2015 and 2016, increased by 14 % during 2018, following a 14 % decrease in 2017. The current size of this reserve is two and a half times the amount of actual annual equipment imports or 36 % of the maximum available HFC amount for 2019. This accumulated reserve of authorisations reduces the overall strain on the quota issued for the following years, as RACHP equipment imports in those years will, at least theoretically, not need to be covered by the quota issued for those years.



**Figure ES.1 Progress of the EU HFC phase-down**Placing on the market of HFCs (Mt CO<sub>2</sub>e)

**Notes:** Values from 2007 to 2013 are based on the reporting obligations of the old F-gas Regulation (EC) No 842/2006 and are therefore not fully comparable with data from 2014 onwards (based on the obligations of the new F-gas Regulation (EU) No 517/2014). The maximum quantities of the EU HFC phase-down shown for 2019 onwards would need to be recalculated in the event of Brexit and are for indicative purposes only.

Mt, million tonnes; POM, placing on the market.

**Sources:** EC (2011, 2014, 2019); EEA (2018, 2019b).

## EU contribution to the global phase-down of HFCs under the Kigali Amendment to the Montreal Protocol

The global HFC phase-down under the Montreal Protocol Kigali Amendment introduces limits to the consumption of HFCs, starting in 2019. In 2018, HFC consumption in the EU dropped by 38 % and was already 46 % below the first limit for the EU under the Montreal Protocol Kigali Amendment (which was to be achieved in 2019) (Figure ES.2).

## Supply of F-gases in the EU

The total supply of F-gases was reasonably stable from 2007 onwards until a peak occurred in 2014, prior to the HFC quota system entering into force. The volume of total supply in physical tonnes in 2018 was 14 % lower than in the previous year (Figure ES.3), with a GWP that

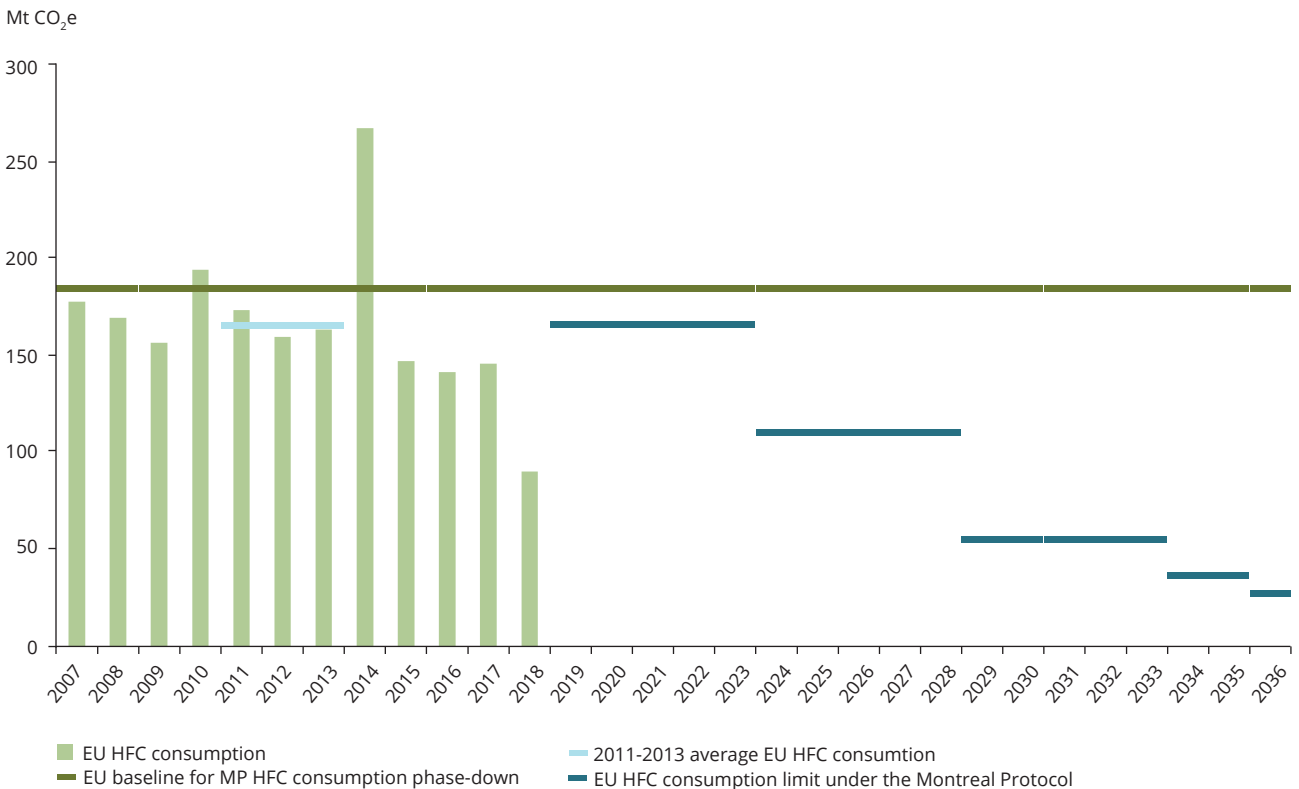
was 30 % lower than in 2017 (Figure ES.4). Refrigeration and air conditioning continue to be key applications.

In 2018, large increases in transactions were observed for unsaturated HFCs and HCFCs with very low GWPs, replacing HFCs with significantly higher GWPs. In contrast, compared with 2017, HFC supply decreased by 21 % in mass or 32 % as CO<sub>2</sub>e, reflecting the 41 % drop in the maximum quantity under the HFC phase-down. Looking at the gases with the highest GWPs, there was a 32 % decrease for SF<sub>6</sub>, a 12 % decrease for NF<sub>3</sub> and a 13 % decrease for PFCs.

## Detailed physical flows of F-gases

The key findings presented below are based on the following trends in physical F-gases flows in 2018, reported by companies in 2019 (see Figures ES.3 and ES.4):

**Figure ES.2 Approaching the Montreal Protocol HFC phase-down**

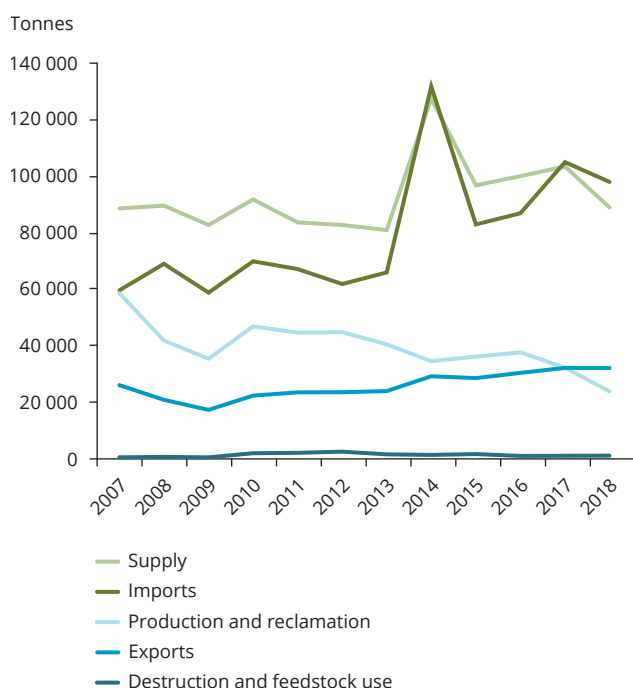


**Notes:** HFCs covered under the Montreal Protocol include all HFCs covered under EU F-gas Regulation No 517/2014, except HFC-161. MP, Montreal Protocol.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

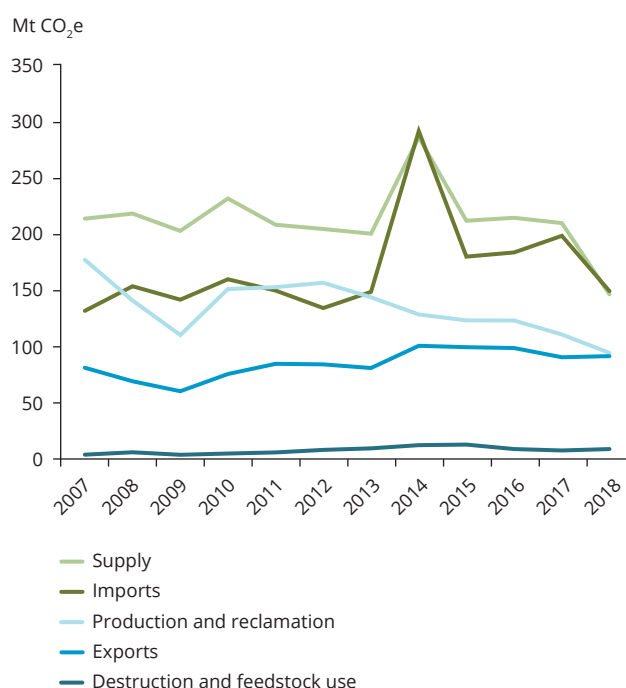
- The volume of production fell by 28 % and the GWP of production decreased by 16 % in 2018, with large reductions in HFC-134a, HFC-143a and HFC-365mfc production. SF<sub>6</sub> production fell by 5 % compared with 2017.
- Reclamation of used F-gases increased by 9 % compared with 2017, due mostly to the reclamation of HFCs. Reclaimed HFCs now make up 9 % of the produced amount or 3 % of the EU supply of virgin HFCs (or 13 % and 4 %, respectively, as CO<sub>2</sub>e). While 95 % of reclaimed amounts are HFCs, SF<sub>6</sub> contributes to 24 % of the GWP of reclaimed gas.
- Total imports decreased by 7 % compared with 2017. Imports of HFCs fell by 13 %, while imports of unsaturated HFCs/HCFs increased by 32 %. The share of HFCs in total imports was 78 % in 2018. Imports of F-gases contained in products and equipment appeared to have levelled off since 2017.
- Bulk exports of F-gases from the EU in 2018 stayed almost constant by mass but increased by 1 % in CO<sub>2</sub>e, compared with 2017. There are different trends for different gases: HFC exports decreased by 2 % by mass, with the overall GWP of exported HFCs 6 % lower than last year. The decrease in exports by volume of HFCs is compensated by an increase in SF<sub>6</sub> and unsaturated HFCs and HCFs, with the increase in GWP of exports largely attributable to SF<sub>6</sub>. Exports of F-gases contained in products and equipment are not subject to obligatory reporting.
- Destruction and feedstock use of F-gases is reported mainly for HFCs. The amounts destroyed increased by 3 %, and the GWP of destroyed F-gases increased by 17 %, compared with 2017. Feedstock use amounts have been almost constant since 2015, with a small increase in 2018.



**Figure ES.3 Supply, production, import, export and destruction of F-gases (tonnes)**

**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFEs, and alcohols; and 'other' perfluorinated compounds) and HFCs, PFCs and SF<sub>6</sub> in products and equipment were not subject to reporting for the period 2007-2013. Data presented for import and supply between 2007 and 2013 are thus limited to bulk import and bulk supply. Export is limited to bulk export for the whole time series, except for the period 2014-2016 for which data include gases exported in pre-blended polyols.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Figure ES.4 Supply, production, import, export and destruction of F-gases (CO<sub>2</sub>e)**

**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and 'other' perfluorinated compounds) and HFCs, PFCs and SF<sub>6</sub> in products and equipment were not subject to reporting for the period 2007-2013. Data presented for import and supply between 2007 and 2013 are thus limited to bulk import and bulk supply. Export is limited to bulk export for the whole time series, except for the period 2014-2016 for which data include gases exported in pre-blended polyols.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

## EEA reports

This report is part of an annual series of EEA reports on ozone-depleting substances (ODS) under the Montreal Protocol and fluorinated greenhouse gases (F-gases). All EEA reports are available at: <https://www.eea.europa.eu/>

## About the EEA

The EEA is an agency of the EU. It aims to support sustainable development and to help achieve significant and measurable improvement in Europe's environment by providing timely, targeted, relevant and reliable information to policymaking agents and the public. It is supported in its work by the European Environment Information and Observation Network (Eionet), a network of 39 European countries.

## Authors

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The EEA report coordinator was Peder Gabrielsen and the ETC/CME task manager was Wolfram Jörß. François Dejean (EEA) and the European Commission Directorate-General for Climate Action are thanked for their support in finalising the report.

# 1 Introduction

## 1.1 Background

### 1.1.1 International policy framework

The United Nations Framework Convention on Climate Change (UNFCCC) addresses several groups of fluorinated greenhouse gases (F-gases). The majority of these F-gases have very high global warming potentials (GWPs) in comparison with other greenhouse gases. Among them are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF<sub>6</sub>) and nitrogen trifluoride (NF<sub>3</sub>). They are also covered by the Kyoto Protocol and included in the EU's commitment under the Paris Agreement.

Certain F-gases have come into use since the 1990s for the replacement of ozone-depleting substances (ODS) that were phased out under the Montreal Protocol (UN Environment Programme Ozone Secretariat, 1987) and Regulation (EC) No 1005/2009 <sup>(1)</sup>. Their use in many different applications has been increasing and has considerable potential for further growth. F-gases accounted for approximately 3 % of overall greenhouse gas emissions expressed in carbon dioxide equivalent (CO<sub>2</sub>e) in the 28 Member States of the EU (EU-28) in 2017 (EEA, 2019a and EEA, 2019c). Emissions of F-gases, of which more than 90 % are HFCs, increased from 2000 to 2014, then declined significantly after peaking in 2015 (6 %) (EEA 2019a).

The EU has committed, under the UNFCCC, to reduce emissions of greenhouse gases by 20 % by 2020, compared with 1990 levels. F-gases are included in this target. Under the Paris Agreement, the EU is committed to a 40 % reduction in domestic emissions by 2030, compared with 1990.

The strong policy mechanisms adopted under the EU F-gas Regulation of 2014 (EU, 2014b), which

implements an EU-wide phase-down of HFC use, as well as measures taken by other industrialised countries, gave momentum to the global development of HFC regulation. This culminated in October 2016 in Kigali, when the Montreal Protocol was amended to regulate HFCs. Both developed and developing countries have taken on mandatory commitments to reduce production and consumption of HFCs in the next three decades <sup>(2)</sup>.

### 1.1.2 EU fluorinated greenhouse gases legal framework

#### Old F-gas Regulation

Regulation (EC) No 842/2006 (EU, 2006), the old F-gas Regulation, employed two tracks of action from 2007:

- improving the leak-tightness of equipment containing F-gases — measures comprised labelling of equipment containing F-gases, training and certification of personnel and companies handling these gases, containment of F-gases within equipment and proper recovery of F-gases from equipment that is no longer used;
- avoiding the use of F-gases in some applications in which more environmentally superior alternatives are already cost-effective — measures included restrictions on the use and marketing of F-gases in these cases.

#### New F-gas Regulation (2014)

In 2015, the new F-gas Regulation (No 517/2014) <sup>(3)</sup> was implemented, which aims to reduce F-gas emissions by two thirds of the 2010 level by 2030. The relevant measures from the 2006 regulation remain in force. This regulation includes a phase-down timeline for HFCs with GWP. Sales of HFCs on the EU market are

<sup>(1)</sup> Regulation (EC) No 1005/2009 of the European Parliament and of the Council of 16 September 2009 on substances that deplete the ozone layer (EU, 2009).

<sup>(2)</sup> The Kigali Amendment regulates production and consumption, while reducing emissions of HFCs remains within the remit of the UNFCCC and the Paris Agreement.

<sup>(3)</sup> Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006 (EU, 2014b).

progressively capped, reaching 21 % of baseline levels by 2030. In addition, F-gases with very high GWPs are banned entirely.

Under the regulation, companies are obliged to report on produced, imported and exported quantities of F-gases and mixtures as before. The new regulation extends the reporting obligation to:

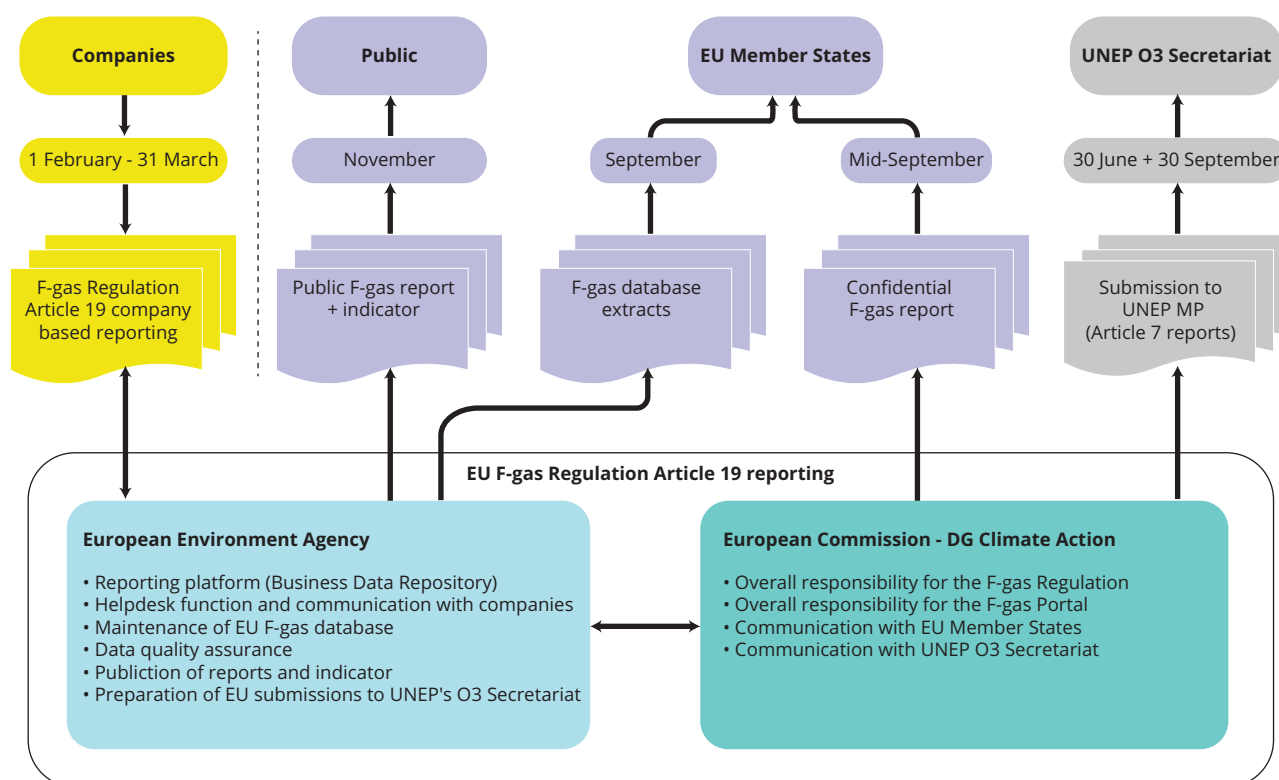
- use of HFCs, PFCs and SF<sub>6</sub> as a feedstock for chemical reaction processes;
- destruction of F-gases;
- import of products or equipment containing F-gases.

Furthermore, under the new regulation, the list of reportable fluorinated gases (see Annex 1) was extended beyond HFCs, PFCs and SF<sub>6</sub> (as listed in Annex I of the new F-gas Regulation) to include:

- unsaturated hydro(chloro)fluorocarbons;
- fluorinated ethers and alcohols;
- other perfluorinated compounds.

Commission Implementing Regulation (EU) No 1191/2014 <sup>(4)</sup>, last amended by Commission Implementing Regulation (EU) 2017/1375 <sup>(5)</sup>, establishes the format in which the reports are to be submitted.

**Figure 1.1 Institutional arrangements**



Source: EEA.

<sup>(4)</sup> Commission Implementing Regulation (EU) No 1191/2014 of 30 October 2014 determining the format and means for submitting the report referred to in Article 19 of Regulation (EU) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases (EU, 2014a).

<sup>(5)</sup> Commission Implementing Regulation (EU) 2017/1375 of 25 July 2017 amending Implementing Regulation (EU) No 1191/2014 determining the format and means for submitting the report referred to in Article 19 of Regulation (EU) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases (EU, 2017).

### 1.2 Report structure

The report consists of six chapters:

This introductory Chapter 1 outlines legal arrangements and their implementation.

Chapter 2 details the reporting arrangements and the technical facilities used and gives an overview of the reporting companies.

Chapter 3 presents an overview of the data on production, imports, exports and destruction of F-gases as reported by companies.

Chapter 4 presents key indicators for the EU, based on reported data about the supply of F-gases to the EU market and their intended applications.

Chapter 5 discusses progress under the EU HFC phase-down.

Chapter 6 presents an outlook towards the global HFC phase-down under the Montreal Protocol.

### 1.3 Institutional arrangements

Companies that need to report are obliged to register with the European Commission's F-gas portal <sup>(6)</sup>, which also hosts the HFC registry pursuant to Article 17 of the 2014 F-gas Regulation (Figure 1.1).

Since 2012, the European Commission has given the responsibility for collecting, archiving and evaluating the data reported by companies to the EEA. The reporting process is executed through the EEA's online platform, the Business Data Repository (BDR), while

technical support for the F-gas reporting process is provided by the EEA's European Topic Centre on Climate Change Mitigation and Energy (ETC/CME) <sup>(7)</sup>.

### 1.4 Scope

The report is based on submissions for the year 2018, as received by 2 June 2019 (which includes some late reports and corrections received after the legal deadline of 31 March 2019). Data for previous years were changed slightly after some corrections were submitted.

Data for the period 2007-2013 are covered by the old 2006 F-gas Regulation, while data for 2014 and onwards are covered by the new 2014 Regulation. Because of the different reporting frameworks, data from the two periods are not always directly comparable.

### 1.5 Confidentiality

The new F-gas Regulation requires that the confidentiality of the information submitted by companies is protected (Article 19(8)). The EEA takes appropriate measures to protect confidentiality and prevent publication of commercially sensitive information. These measures include public reporting of F-gases data only at higher levels of aggregation, to protect data that are the result of reports from fewer than three corporate groups, and additional steps to prevent deduction of sensitive information. It is for confidentiality reasons that some of the statements about F-gas activity in this report are of a general nature and do not refer to figures or percentages. A summary of the confidentiality measures applied to the data published in this report is included at the beginning of Annex 5.

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<sup>(6)</sup> <https://webgate.ec.europa.eu/ods2/>

<sup>(7)</sup> <https://www.eionet.europa.eu/etcs/etc-cme>

## 2 Reporting arrangements

### 2.1 Reporting format and quality control

The format for the reporting by companies in accordance with Article 19 of the new F-gas Regulation (EU, 2014b) is laid down in Commission Implementing Regulation (EU) No 1191/2014 (EU, 2014a) last amended by Commission Implementing Regulation (EU) 2017/1375 (EU, 2017) and Commission Implementing Regulation (EU) 2018/1992 (EU, 2018). A further specification of data to be reported is given in Annex 2. An overview of the reporting format applied for the period 2007-2013 under the old F-gas Regulation is given in Annex 3.

Company registration for reporting and the reporting process are two separate procedures. Registration for reporting is centralised in the European Commission's F-gas portal at <https://webgate.ec.europa.eu/ods2/>. This provides 'one-stop-shop' access for both the hydrofluorocarbon (HFC) registry (for quota purposes) and for reporting under Article 19.

From their account in the F-gas portal, companies have a direct link to the EEA's Business Data Repository (BDR) at <https://bdr.eionet.europa.eu>. This reporting platform ensures that the reporting process maintains traceability, confidentiality and transparency for all stakeholders.

#### 2.1.1 Support for reporting companies

Reporters received support regarding the reporting procedure and technical questions from the EEA and the European Topic Centre on Climate Change Mitigation and Energy (ETC/CME) reporting support team and various guidance documents made available at <https://bdr.eionet.europa.eu/help/fgases>:

- How to register? The F-gas portal registration manual <sup>(8)</sup>.

- How to use the BDR reporting platform? The BDR user manual <sup>(9)</sup>.
- What (numbers) should be reported? Frequently asked questions (FAQ) document <sup>(10)</sup>.

#### 2.1.2 Companies that are not obliged to support

The companies that considered that they were not covered by Article 19 of the new F-gas Regulation in the past year were invited to communicate this through the web questionnaire in the BDR ('nil report') or by email in the event of technical difficulties.

#### 2.1.3 Data quality control

Data quality checking procedures are included an automatic quality control implemented in the online questionnaire, which can also be invoked by the reporters manually. It is followed by manual quality control applied after submission of the reports. If problems were identified, reporters were contacted and invited to submit a revised report where necessary. All submissions were done via the BDR and never via informal communications or manual modifications to ensure the transparency of the reporting process. This process was repeated until submissions passed all quality checks. More details on the quality control procedures are given in Annex 6.

### 2.2 Companies reporting in 2019

By 2 June 2019, 2 089 companies had reported on F-gas activity during 2018, an increase of 21 % on the previous year. A further 2 038 companies reported no reportable activity during 2018 (nil report). As shown in Figure 2.1, companies are distributed across all EU Member States, and the largest amounts are

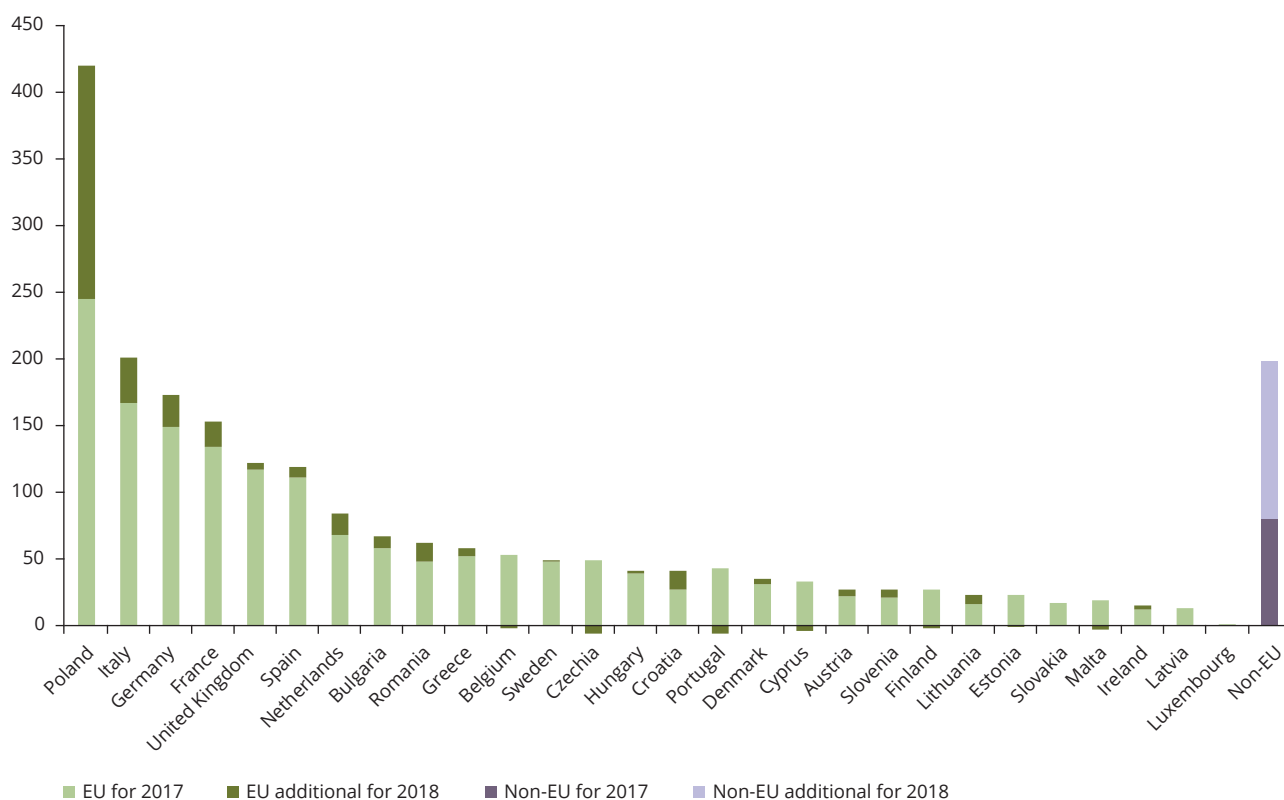
<sup>(8)</sup> [https://ec.europa.eu/clima/sites/clima/files/f-gas/docs/guidance\\_document\\_en.pdf](https://ec.europa.eu/clima/sites/clima/files/f-gas/docs/guidance_document_en.pdf)

<sup>(9)</sup> [https://bdr.eionet.europa.eu/help/bdr\\_user\\_manual.pdf](https://bdr.eionet.europa.eu/help/bdr_user_manual.pdf)

<sup>(10)</sup> [https://ec.europa.eu/clima/sites/clima/files/f-gas/docs/faq\\_reporting\\_en.pdf](https://ec.europa.eu/clima/sites/clima/files/f-gas/docs/faq_reporting_en.pdf)

**Figure 2.1 Reporting companies and new registrations in 2019 by Member State**

Number of companies reporting on 2018 activities



**Notes:** Nil reports not included.  
Non-EU countries: British Virgin Islands, China, Gibraltar, Hong Kong, Japan, Korea, Malaysia, Monaco, Norway, Serbia, Switzerland, Taiwan and the United States.

**Source:** EEA (2019b).

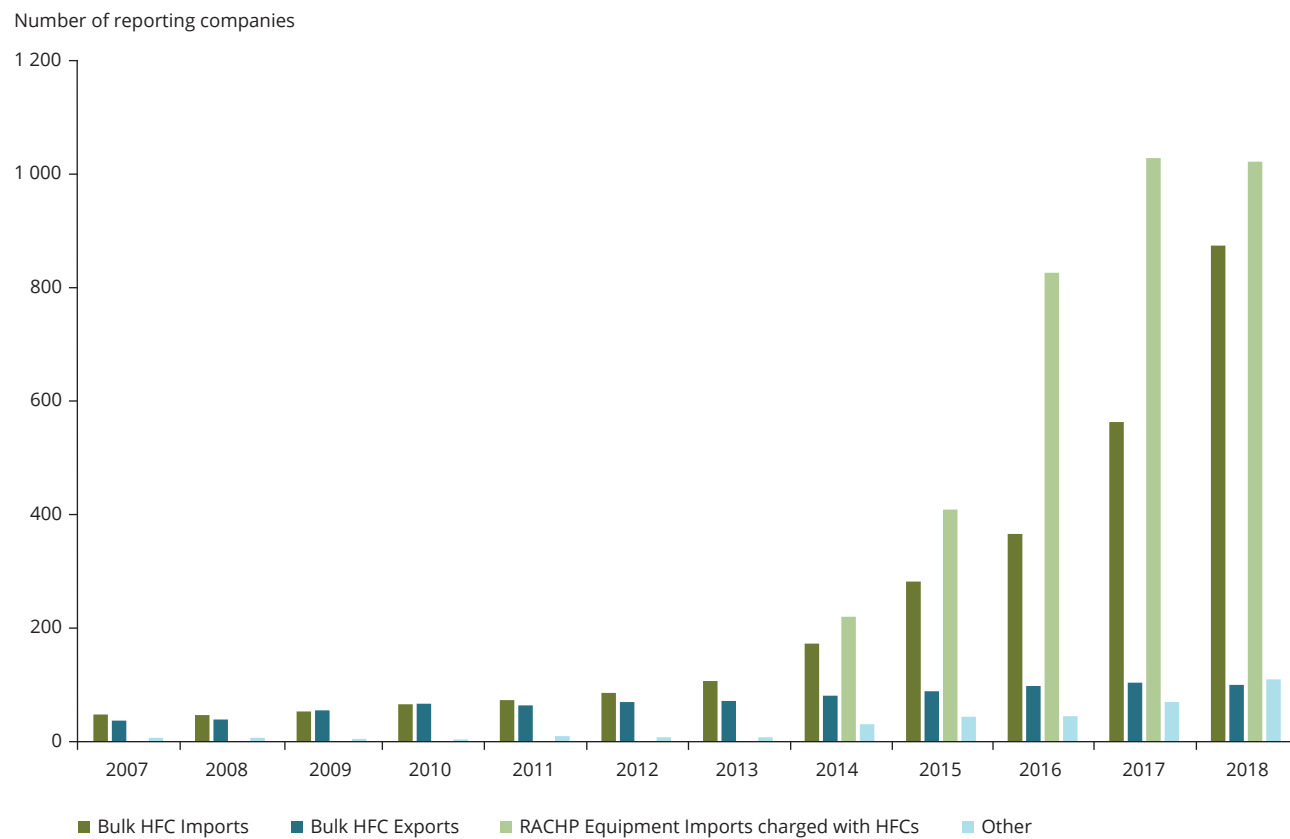
located in Poland, Italy, Germany, France, the United Kingdom and Spain. Polish companies contribute about one third to the observed rise in reporting companies. Of the 198 non-EU companies, most are Chinese companies that export gases or equipment to European subsidiaries and partners. The majority of non-EU companies are represented in the EU by 'only representatives' located in Ireland (see breakdown in Table A5.24 in Annex 5 page 72).

The activities reported by the majority of companies is the import of refrigeration, air conditioning and heat pump (RACHP) equipment charged with HFCs and the

imports of bulk HFCs (Figure 2.2). Table A5.23 in Annex 5 (page 71) presents a breakdown of reporting companies by country and by reported activity for 2018.

Compared with last year, the number of bulk HFC importers increased by 54 %. This is linked to the additional number of new entrant companies that had applied for the 2018 HFC quota. For RACHP equipment importers, the number of reporting companies stabilised in 2018 following strong growth since reporting started for this category. For a more detailed breakdown of reported activities over time, please refer to Table A5.25 in Annex 5 (page 73).



**Figure 2.2** Reported activities, 2007-2018

Sources: EC (2011, 2014); EEA (2018, 2019b).

## 3 Fluorinated greenhouse gas activity in the EU

This chapter presents data reported by companies on:

- production and reclamation (Section 3.1);
- imports, both bulk and in products/equipment, and bulk exports (Section 3.2);
- destruction and feedstock use (Section 3.3).

These data are the basis for the calculation of the EU fluorinated greenhouse gases (F-gases) supply (Chapter 4), the assessment of progress under the EU hydrofluorocarbon (HFC) phase-down (Chapter 5) and the calculation of the EU HFC consumption (Chapter 6).

Table A4.1 in Annex 4 (page 50) explains the differences in the definitions of EU 'supply', as used in this report, compared with the compliance metrics of the HFC phase-down schemes, i.e. 'placing on the market' (POM), for the EU-wide HFC phase-down under the EU F-gas Regulation (EU, 2014b), and 'consumption', for the global HFC phase-down under the Montreal Protocol.

All numbers are presented both as tonnes of F-gases and as tonnes of carbon dioxide equivalent (t CO<sub>2</sub>e). The statistics in physical tonnes reflect the use patterns of F-gases in European industries, while use of F-gases expressed as CO<sub>2</sub>e reflects the potential relevance for climate change policy and the HFC phase-down.

### 3.1 Production and reclamation

'Production' refers to the production of virgin F-gases. The F-gas Regulation defines 'reclamation' as 'the reprocessing of a recovered fluorinated greenhouse gas in order to match the equivalent performance of a virgin substance, taking into account its intended use'. Note that reclaimed HFCs do not count as 'placed on the market' (POM) and are not subject to the limits of the HFC phase-down.

#### 3.1.1 Production

Production of F-gases in Europe showed a declining trend from 2007 to 2014 (Figure 3.1), not taking into

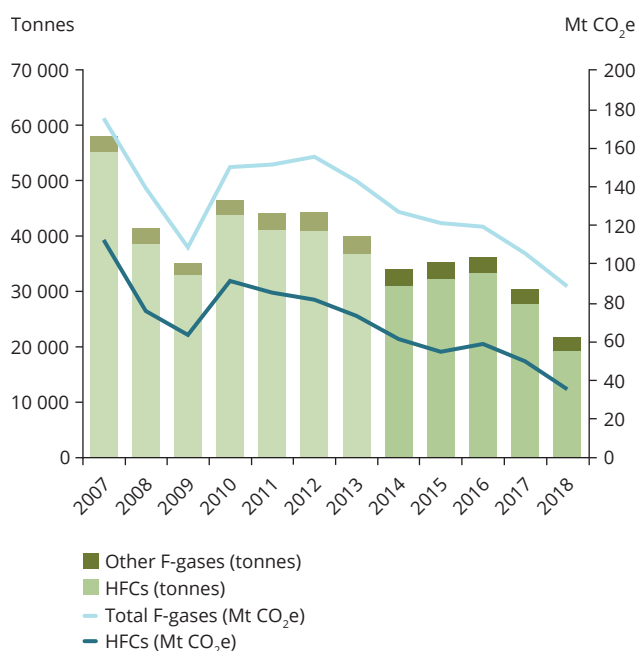
account the dip in production induced by the financial crisis in 2008 and 2009. After 2014, there was a slight increase in production (green bars), together with a continued decrease in the global warming potential (GWP) of the produced gas (blue line). This indicates a shift towards F-gases with lower GWPs. In 2018, the volume of production fell by 28 %, and the GWP of production decreased by 16 %, with large reductions in HFC-134a, HFC-143a and HFC-365mfc production.

Production of F-gases is dominated by HFCs, which account for more than 90 % of the total, with HFC-134a and HFC-365mfc accounting for the largest parts. Other HFCs produced in the EU are HFC-143a, HFC-227ea and HFC-23. The EU production of HFC-32 and HFC-125 ceased after 2013 and 2014, respectively. For the sum of HFCs, 2018 production was about 30 % below 2017, both in tonnes and in GWP. While sulphur hexafluoride (SF<sub>6</sub>) accounts for only 10 % of EU F-gas production, it now constitutes about 57 % of the total GWP of production. SF<sub>6</sub> production in 2018 fell by 5 % compared with 2017. Other F-gases produced in the EU are four perfluorocarbons (PFCs). The production of low quantities of HFC-1234yf had been reported for the period 2015-2017. However, no production was reported for 2018.

A tabular overview on F-gases produced in the EU since 2007 in tonnes and CO<sub>2</sub>e is given in Table A5.1 and Table A5.2 in Annex 5 (page 55).

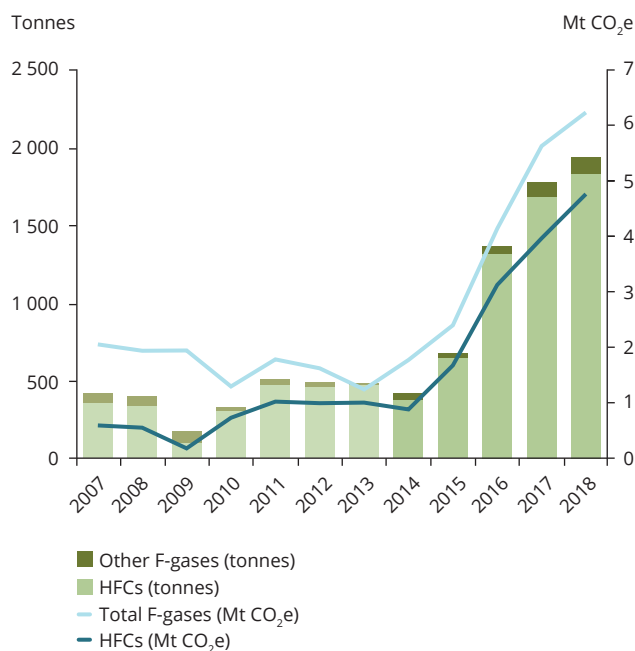
#### 3.1.2 Reclamation

Reclamation of F-gases in the EU has fluctuated, but there has been a steady increase since 2014 (Figure 3.2). In 2018, the reclaimed amount increased by 9 % compared with 2017, due mostly to the reclamation of HFCs. Reclaimed HFCs now make up 9 % of the produced amount, or 3 % of the EU supply of virgin HFCs (or 13 % and 4 %, respectively, as CO<sub>2</sub>e). Although 95 % of reclaimed amounts are HFCs, SF<sub>6</sub> contributes to 24 % of the GWP of reclaimed gas. Details can be found in Table A5.3 and Table A5.4 in Annex 5 (page 56).

**Figure 3.1 EU production of F-gases**


**Notes:** Annex II F-gases (unsaturated HFCs and hydrochlorofluorocarbons, HCFCs; hydrofluoroethers, HFEs, and alcohols; and nitrogen trifluoride,  $\text{NF}_3$ , and other perfluorinated compounds) were not subject to reporting for the years 2007-2013. Mt, million tonnes.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Figure 3.2 EU reclamation of F-gases**


**Notes:** Annex II F-gases (unsaturated HFCs and hydrochlorofluorocarbons, HCFCs; hydrofluoroethers, HFEs, and alcohols; and nitrogen trifluoride,  $\text{NF}_3$ , and other perfluorinated compounds) were not subject to reporting for the years 2007-2013. Mt, million tonnes.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

## 3.2 Imports and exports

### 3.2.1 Imports

Imports of F-gases into the EU, including both bulk imports and imports contained in products and equipment, decreased by 7 % compared with 2017 (Figure 3.3). Imports of HFCs fell by 13 %, while imports of unsaturated HFCs/hydrochlorofluorocarbons (HCFCs) increased by 32 %. The share of HFCs in total imports decreased from 84 % in 2017 to 78 % in 2018.

With the low GWP of the unsaturated gases, the GWP of total F-gas imports decreased by 25 %. Most of this decrease in the GWP of imports is due to the lower HFC imports, and the remainder is caused by decreases in  $\text{SF}_6$  and PFCs. Detailed data on total imports can be found in Table A5.5 and Table A5.6 in Annex 5 (page 57).

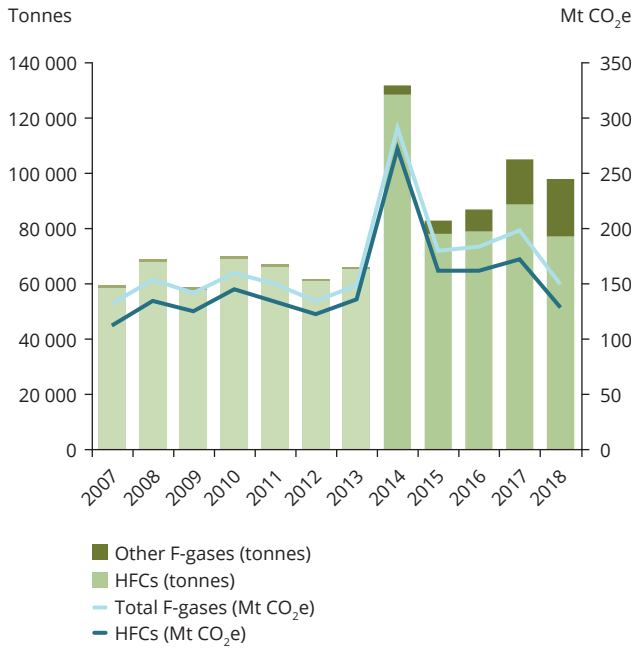
Note that, for the years 2014 to 2018, Figure 3.3 includes both bulk and equipment imports, which were not reported before 2014. The figures before 2014 include only bulk imports. In 2018, equipment imports made up 10 % of the total imported amount (Figure 3.4), compared with 9 % in 2017.

New reporting details necessary under the HFC amendment of the Montreal Protocol, which entered into force in 2019, includes country-specific reporting on imports and exports of bulk HFCs<sup>(1)</sup>. This means that imports and exports need to be distinguished by country of origin/destination. Figure 3.5 shows the countries of origin for bulk imports by mass, while Figure 3.6 displays the origin of bulk HFC imports in relation to their GWP. Overall, 99 % of all imports originate from three countries: China, the United States and Japan, with China being the largest supplier of EU HFC imports<sup>(2)</sup>. Figure 3.6 also shows that HFC imports from Japan and the United States have a slightly lower GWP.

<sup>(1)</sup> For the reporting of non-HFC imports, country-specific reporting was not necessary.

<sup>(2)</sup> The remaining 1 % of imports originate from Belarus, India, North Macedonia, the Russian Federation, Serbia, Singapore, Switzerland, and Turkey.

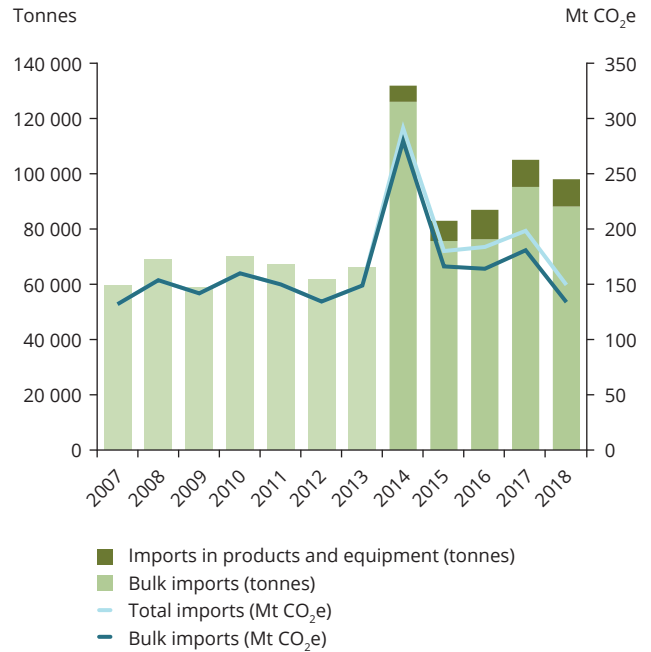
**Figure 3.3 EU imports of F-gases**



**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFES, and alcohols; and nitrogen trifluoride, NF<sub>3</sub>, and other perfluorinated compounds) and gases contained in products and equipment were not subject to reporting before 2014. Mt, million tonnes.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

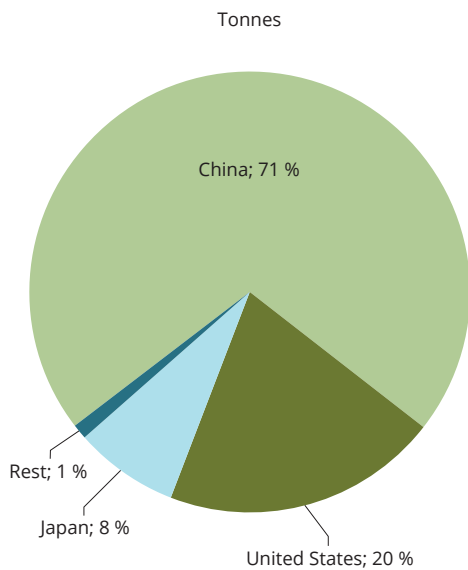
**Figure 3.4 EU imports by type**



**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFES, and alcohols; and nitrogen trifluoride, NF<sub>3</sub>, and other perfluorinated compounds) were not subject to reporting for the years 2007-2013. FGR, F-gas Regulation. Mt, million tonnes.

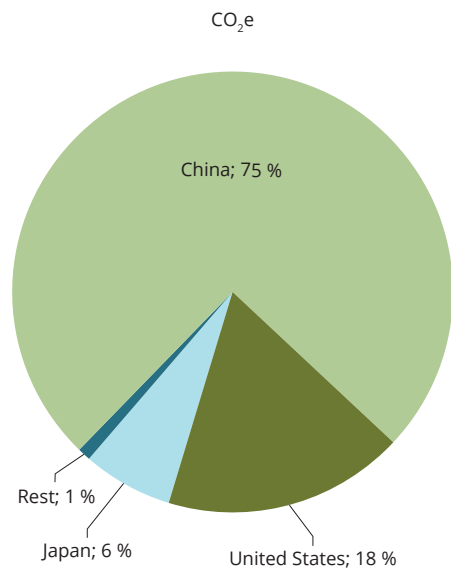
**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Figure 3.5 Origin of bulk HFC imports, 2018 (% tonnes)**

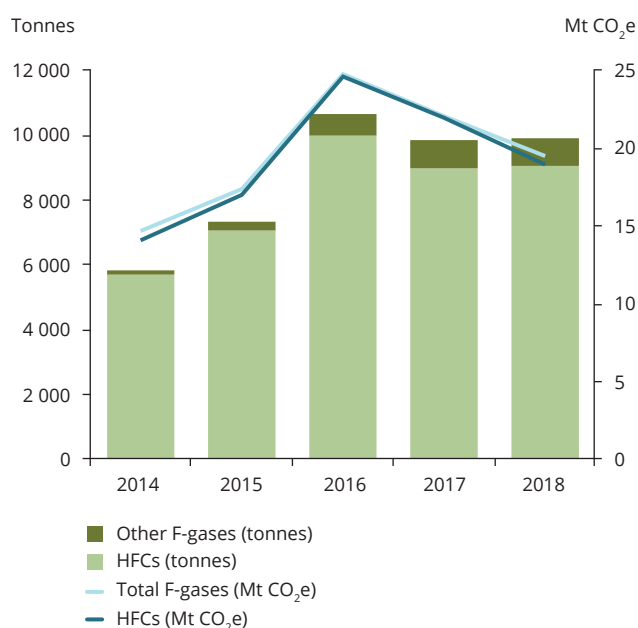


**Source:** EEA (2019b).

**Figure 3.6 Origin of bulk HFC imports, 2018 (% CO<sub>2</sub>e)**



**Source:** EEA (2019b).

**Figure 3.7 EU imports of F-gases within products and equipment**


**Note:** Mt, million tonnes.

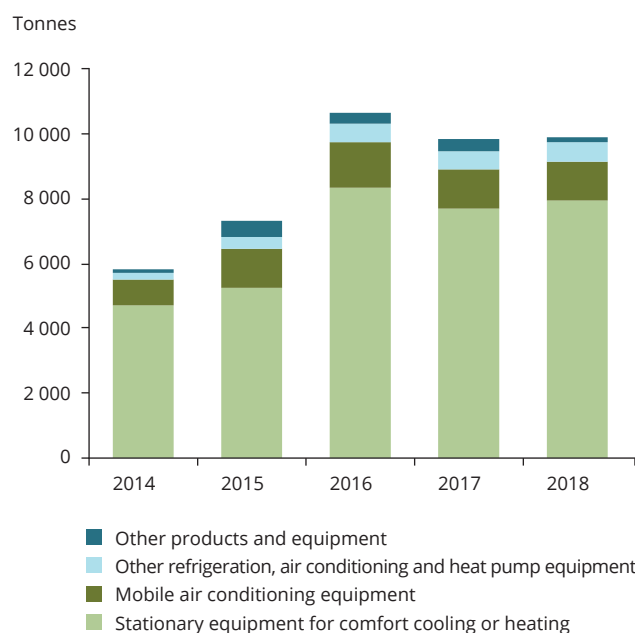
**Sources:** EEA (2018, 2019b).

Total F-gas imports decreased by 7 %, and the 1 % increase in products and equipment was outweighed by the 8 % decrease in bulk imports. In terms of CO<sub>2</sub>e, both bulk gas and imports in equipment fell by 26 % and 12 %, respectively. In both cases this reflects a switch to lower GWP gases.

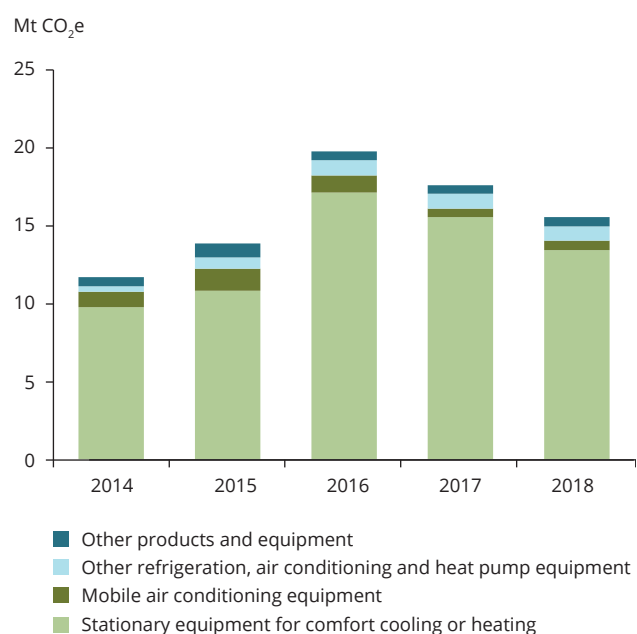
Detailed data on bulk F-gas imports is contained in Table A5.7 and Table A5.8 in Annex 5 (page 58).

### 3.2.2 Imports contained in products and equipment

Imports of F-gases contained in products and equipment<sup>(13)</sup> have been subject to reporting since 2014, and reported amounts rose significantly over the first three years (Figure 3.7). Part of the 2016 increase may be attributable to more complete reporting and not to actual increases in equipment imports. In 2017, reported imports decreased, and they appear to have levelled off in 2018. The decreasing trend in CO<sub>2</sub>e may also reflect the fact that HFCs contained in imported refrigeration, air conditioning and heat pump (RACHP) equipment have been covered by the HFC phase-down under the EU F-gas Regulation as of 2017.

**Figure 3.8 Categories of EU supply in products and equipment of F-gases (tonnes)**


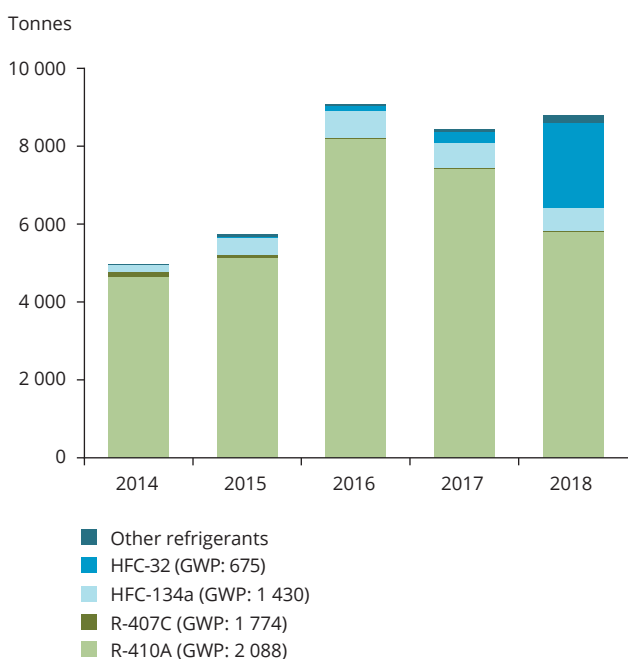
**Sources:** EEA (2018, 2019b).

**Figure 3.9 Categories of EU supply in products and equipment of F-gases (CO<sub>2</sub>e)**


**Sources:** EEA (2018, 2019b).

<sup>(13)</sup> Data reported by importers of products or equipment under the F-Gas Regulation (EU) No 517/2014 are defined as including quantities imported and placed on the market. Products and equipment that are imported but not placed on the market (e.g. for re-export) are not to be reported. Considering this limitation, the import of gases within products and equipment presented here have been approximated using the reported data.

**Figure 3.10 Refrigerants in imported stationary RACHP equipment (tonnes)**



Sources: EEA (2018, 2019b).

HFCs make up 91 % of F-gases imported in equipment, the remainder being almost completely unsaturated HFC-1234yf, used as the refrigerant in air conditioning equipment of vehicles.

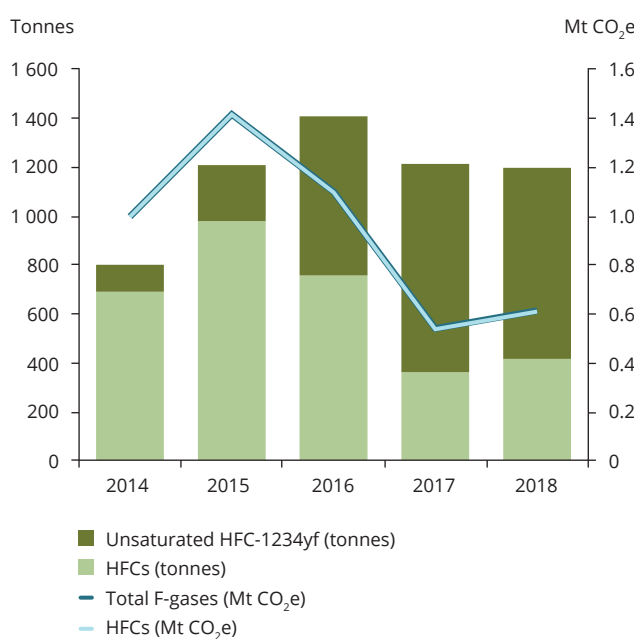
The most important category in equipment imports (Figure 3.8 and Figure 3.9) is 'stationary equipment for comfort cooling or heating' (mostly air conditioning). This category makes up 80 % of total F-gases in equipment imports or 86 % of the total GWP.

The HFC phase-down is reflected in the choice of refrigerants in imported RACHP equipment. As illustrated in Figure 3.10, HFC-32 with a moderate GWP of 675 is on the rise in stationary applications, replacing R-410A (refrigerant mixture of HFCs, 50 % HFC-125, 50 % HFC-32) with a higher GWP of 2 088.

F-gases in mobile air conditioning (mostly in passenger cars and light duty vehicles) account for 12 % of total gases contained in imported equipment but only 4 % of the GWP. Figure 3.11 illustrates how the ratio of unsaturated HFC-1234yf compared with HFCs (in particular HFC-134a) in imported vehicles stabilised at around 65 % in 2018 after increasing strongly between 2014 and 2017.

The data reported for unsaturated HFC-1234yf contained in imported vehicles may not be fully complete. This is due to its low GWP of 4, in

**Figure 3.11 EU imports of F-gases within air conditioning equipment for vehicles**



Note: Mt, million tonnes.

Sources: EEA (2018, 2019b).

combination with the threshold for the reporting obligation for equipment importers of 500 t CO<sub>2</sub>e. With a specific charge of approximately 0.5 kg per passenger car, the 500 t CO<sub>2</sub>e threshold corresponds to 250 000 passenger cars. For air conditioning systems still using the traditional R-134a (refrigerant classification of HFC-134a) (GWP: 1 430), however, the 500 t CO<sub>2</sub>e threshold corresponds to approximately 700 passenger cars. Thus, car importers specialising in models using HFC-1234yf may often not be affected by the reporting obligation. However, several of such car importing companies having been reporting on HFC-1234yf imports in the past, despite being below the obligation threshold.

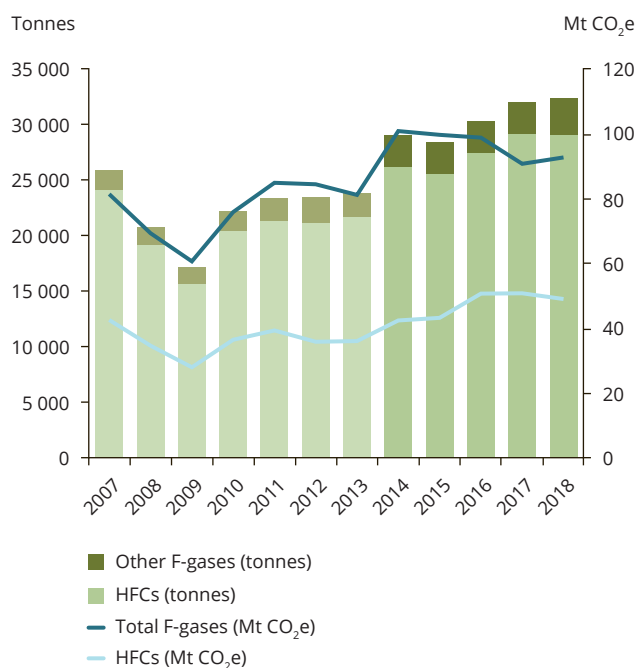
Detailed data on F-gases in imported products and equipment are listed in Table A5.9 and Table A5.10 in Annex 5 (page 59). Equipment imports by equipment category are given in Table A5.11 and Table A5.12 (page 60).

### 3.2.3 Exports

Bulk exports of F-gases from the EU in 2018 stayed almost constant by mass but increased by 1 % in CO<sub>2</sub>e, compared with 2017 (Figure 3.12). There are different trends for different gases: HFC exports decreased by 2 % by mass, with the overall GWP of exported HFCs 6 % lower than last year. The decrease in exports by



**Figure 3.12 EU bulk exports of F-gases**



**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFEs, and alcohols; and nitrogen trifluoride, NF<sub>3</sub>, and other perfluorinated compounds) were not subject to reporting for the years 2007-2013. Exports shown for the period 2014-2016 include gases exported in pre-blended polyols. Mt, million tonnes.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

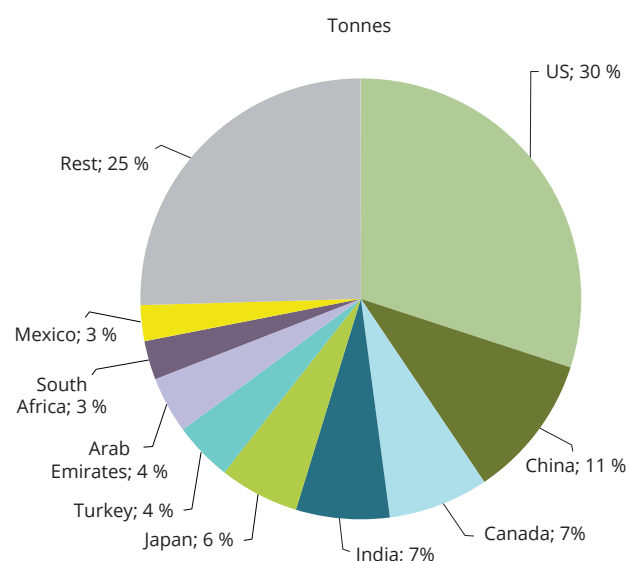
volume of HFCs is compensated by an increase in SF<sub>6</sub> and unsaturated HFCs and HCFCs, with the increase in the GWP of exports largely attributable to SF<sub>6</sub>. Exports of F-gases contained in products and equipment are not subject to obligatory reporting.

The composition of exports mirrors that of production. Exports are dominated by HFCs (about 90 % of the total). Other gases make up a small proportion of exports but contribute almost 50 % to their total GWP (mostly due to SF<sub>6</sub>).

Detailed data on exports can be found in Table A5.13 and Table A5.14 in Annex 5 (page 61).

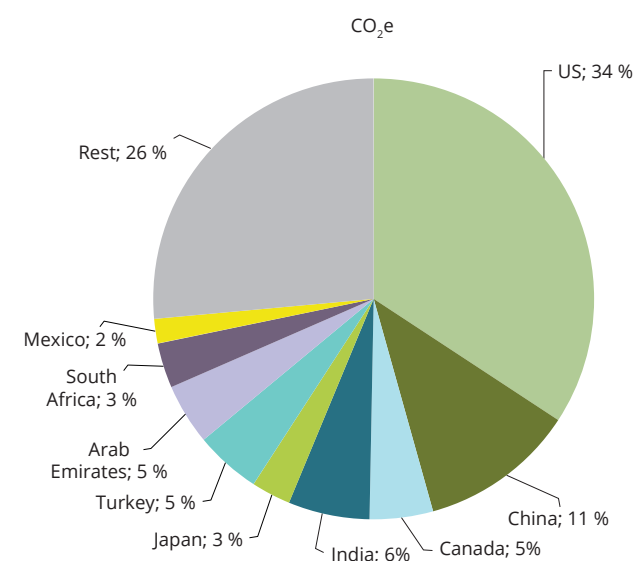
New reporting details necessary under the HFC amendment of the Montreal Protocol, which entered into force in 2019 and includes country-specific reporting on exports, means that HFC exports can be distinguished by country of destination<sup>(14)</sup>. Figure 3.13 and Figure 3.14 show the shares of the destination countries of the bulk HFC exports by mass and in CO<sub>2</sub>e. While China (CN) still plays a large role, the United States (US) commands about 30 % of the HFC exports from Europe. Other notable countries of export include Canada (CA), India (IN), Japan (JP), North Macedonia (MX), South Africa (SA), Turkey (TR) and the United Arab Emirates (AE). About 75 % of all exports are destined for those nine countries, while the remaining 25 % are destined for about 100 other different countries.

**Figure 3.13 Destination of bulk HFC exports, 2018 (% tonnes)**



**Source:** EEA (2019b).

**Figure 3.14 Destination of bulk HFC exports, 2018 (% CO<sub>2</sub>e)**



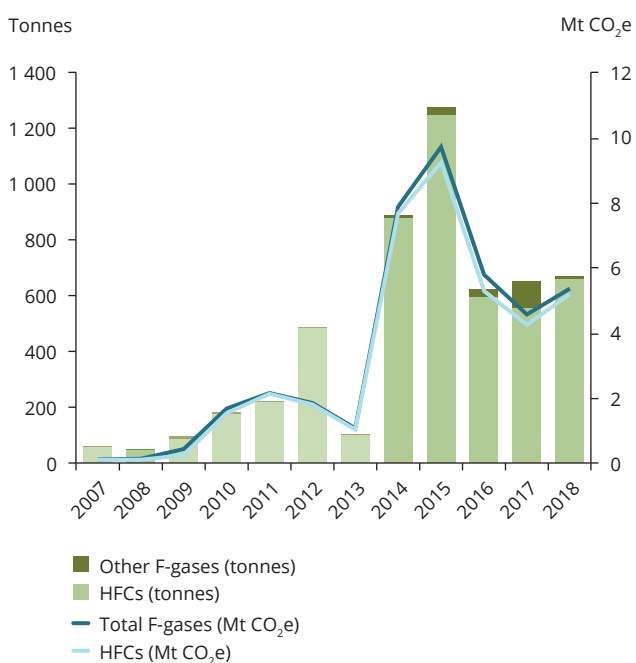
**Source:** EEA (2019b).

<sup>(14)</sup> For non-HFCs, country-specific reporting is not necessary.

### 3.3 Destruction and feedstock use of fluorinated greenhouse gases

This section presents the amounts of F-gases reported as destroyed or used for feedstock. Use for feedstock means that the gas undergoes a chemical transformation that converts it to a different substance, which will result in insignificant emissions. Note that some industrial processes that use F-gases, for example etching or cleaning chemical vapour deposition chambers in the electronics industry, do result in considerable destruction rates, but they do not qualify as destruction or feedstock use.

**Figure 3.15 EU destruction of F-gases**



**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFEs, and alcohols; and nitrogen trifluoride, NF<sub>3</sub>, and other perfluorinated compounds) were not subject to reporting for the years 2007-2013. Mt, million tonnes.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

#### 3.3.1 Destruction

Destruction of F-gases in the EU increased strongly from 2008 to 2015, with the exception of very low reported levels for 2013<sup>(15)</sup>. The decline in destruction seen since 2015 appears to have levelled off (Figure 3.15). In 2018, destroyed amounts increased over 2017 levels by 3 %, and the GWP of destroyed F-gases increased by 17 % compared with 2017.

Destruction is focused on HFCs (97 % of the total amount in 2018), of which about half is HFC-23. HFC-23 occurs as a by-product in certain production processes of F-gases, and its destruction or reclamation is obligatory under the F-gas Regulation. HFC-23 alone accounts for about 90 % of the GWP of F-gases destroyed in 2018.

HFC destruction plays a role in determining consumption because HFCs that are destroyed are subtracted from the amounts of HFCs that are produced and imported in that calculation (see Chapter 6, page 29). In comparison with EU HFC consumption, the amount of destroyed HFCs has decreased from 6 % in 2015 to 6 % in 2018 (measured in CO<sub>2</sub>e).

#### 3.3.2 Feedstock use

EU feedstock use has been fluctuating since reporting started in 2007. However, the reported amounts have been almost constant since 2015, with a small increase in 2018 (Figure 3.15). Feedstock use consists almost exclusively of HFC-23. In addition, very small amounts have occasionally been reported for a couple of other gases, among them HFCs, PFCs, hydrofluoroethers (HFEs) and unsaturated HFCs<sup>(16)</sup>.

As with destruction, any HFCs that are used as feedstock do not count towards consumption (see Chapter 6, page 29). The small increase in feedstock use and the significant reduction in HFC consumption means that the proportion of HFCs used as feedstock, in comparison with HFC consumption, nearly doubled to more than 4 % in 2018 (measured as CO<sub>2</sub>e).

<sup>(15)</sup> A thorough analysis of the confidential data indicates that this is likely to be due to incomplete reporting, which manifested itself most strikingly in 2013.

<sup>(16)</sup> Note that the reporting obligation for feedstock use covers only the Annex I F-gases HFCs, PFs and SF<sub>6</sub>. Thus, data reported on Annex II F-gases (unsaturated HFCs/HCFCs; HFE and alcohols; and nitrogen trifluoride, NF<sub>3</sub>, and other perfluorinated compounds) may not necessarily be complete.

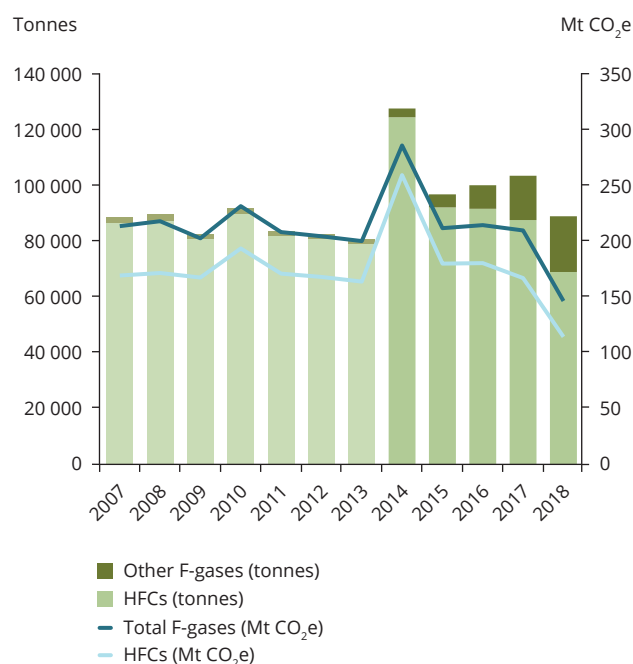
## 4 Supply of fluorinated greenhouse gases to the EU

Supply of fluorinated greenhouse gases (F-gases) is a metric used by the EEA that provides information on the actual use of F-gases by EU industries. It is calculated primarily from reported production, imports and exports <sup>(17)</sup>.

The supply of F-gases to the EU was reasonably stable from 2007 until the 2014 peak, prior to the hydrofluorocarbon (HFC) quota system entering into force. The volume of total supply in 2018 was 14 % lower than in the previous year, with a global warming potential (GWP) 30 % lower than in 2017

(Figure 4.1). For HFCs, the total supply was 21 % lower than in 2017, with a GWP 32 % lower. The decrease in supply reflects the reduction in the HFC quota allocated for 2018, which was about 40 % less than that for 2017 (see Chapter 5). Beyond HFCs, there was a 32 % decrease for sulphur hexafluoride (SF<sub>6</sub>), a 12 % decrease for nitrogen trifluoride (NF<sub>3</sub>) and a 13 % decrease for perfluorocarbons (PFCs), all outweighed by a 32 % increase in unsaturated HFCs and hydrochlorofluorocarbons (HCFCs), which now make up 20 % of supply. None of the latter substances are covered by the quota system. Note that the trends

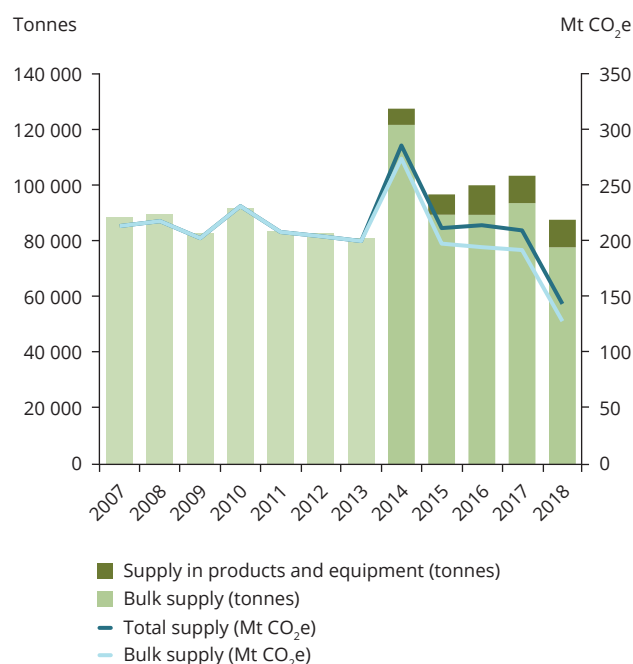
**Figure 4.1 EU supply of F-gases**



**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFEs, and alcohols; and NF<sub>3</sub> and other perfluorinated compounds) and gases contained in products and equipment were not subject to reporting before 2014.  
Mt, million tonnes.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Figure 4.2 EU supply of F-gases by type**

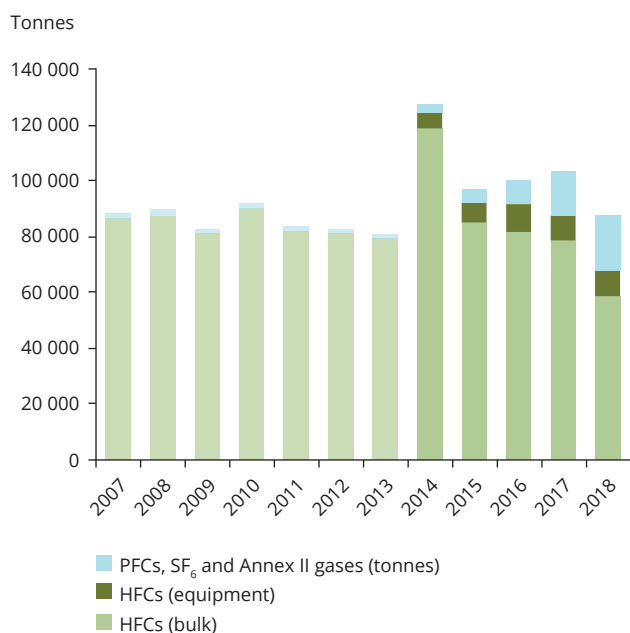


**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFEs, and alcohols; and NF<sub>3</sub> and other perfluorinated compounds) and gases contained in products and equipment were not subject to reporting before 2014.  
Mt, million tonnes.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

<sup>(17)</sup> For methodological details on the calculation of EU supply, please refer to Annex 4, in particular Table A4.1 (page 50), which explains the difference between the metrics of 'EU supply', 'placing on the market', and 'consumption', which are relevant for different aspects of the legal framework.

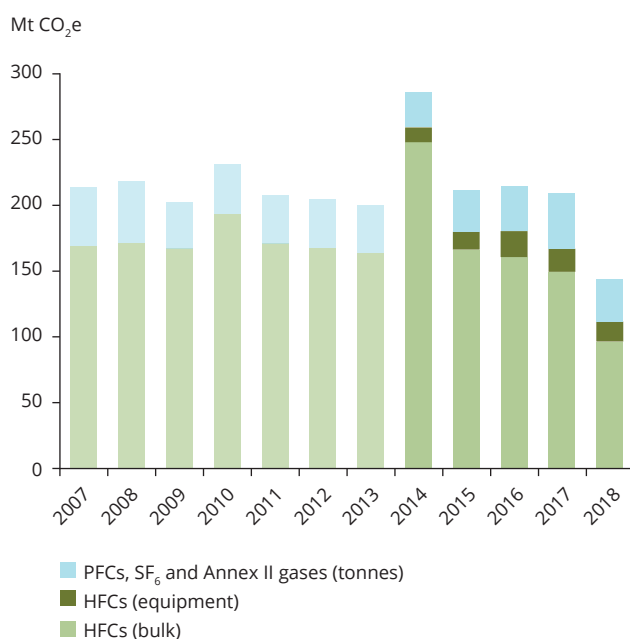
**Figure 4.3 EU supply by supply type and group of F-gases (tonnes)**



**Note:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFEs, and alcohols; and NF<sub>3</sub> and other perfluorinated compounds) and gases contained in products and equipment were not subject to reporting before 2014.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

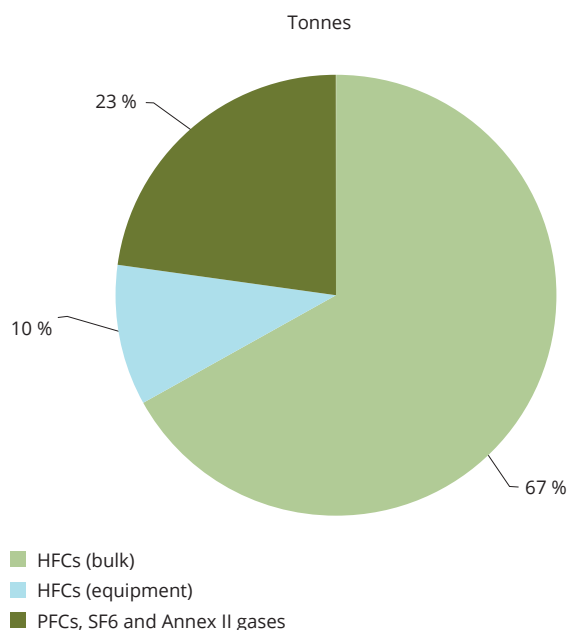
**Figure 4.4 EU supply by supply type and group of F-gases (CO<sub>2</sub>e)**



**Note:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFEs, and alcohols; and NF<sub>3</sub> and other perfluorinated compounds) and gases contained in products and equipment were not subject to reporting before 2014.

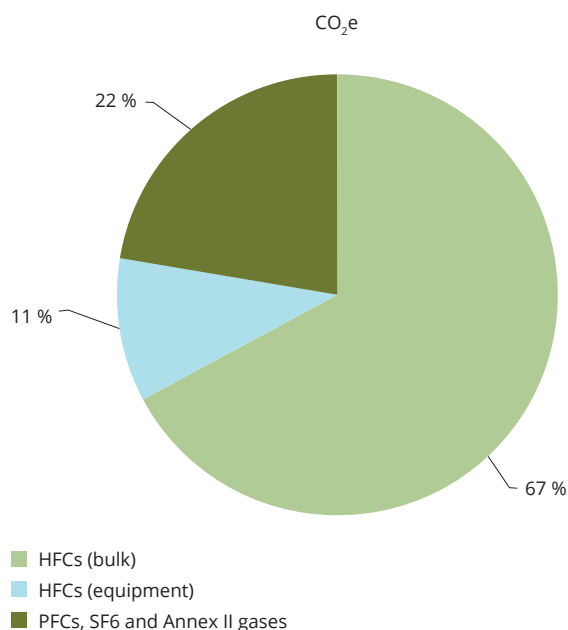
**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Figure 4.5 2018 total supply by type and group of F-gases (% tonnes)**



**Source:** EEA (2019b).

**Figure 4.6 2018 total supply by type and group of F-gases (% CO<sub>2</sub>e)**



**Source:** EEA (2019b).

observed for supply can be distorted by end-of-year stock effects. The supply of F-gases is dominated by HFCs, which accounted for 78 % (in tonnes and in carbon dioxide equivalent, CO<sub>2</sub>e) of the total in 2018.

HFC supply shown in Figure 4.1 for the years 2014-2018 includes equipment imports, while the levels for the period 2007-2013 reflect HFC bulk supply only. When corrected for this discontinuity, HFC bulk supply for the period 2015-2018 is well below the 2007-2013 levels and decreasing. The proportion of equipment imports in the total supply has increased slightly to 11 % (in tonnes and in CO<sub>2</sub>e) in 2018 (Figure 4.2).

While the preceding graphs have presented analyses split either by gas or by supply type, Figure 4.3 and Figure 4.4 combine these perspectives and show the amounts of HFCs (bulk and in products and equipment) alongside PFCs, SF<sub>6</sub> and the Annex II F-gases that were not subject to reporting before 2014. The figures show that, of all the F-gases that are subject to reporting, only HFCs are imported in products and equipment in significant amounts (the dark green parts of the columns). However, HFCs in bulk imports constitute the lion's share (light blue). HFCs, both in bulk and in equipment, are decreasing under the influence of the EU HFC phase-down.

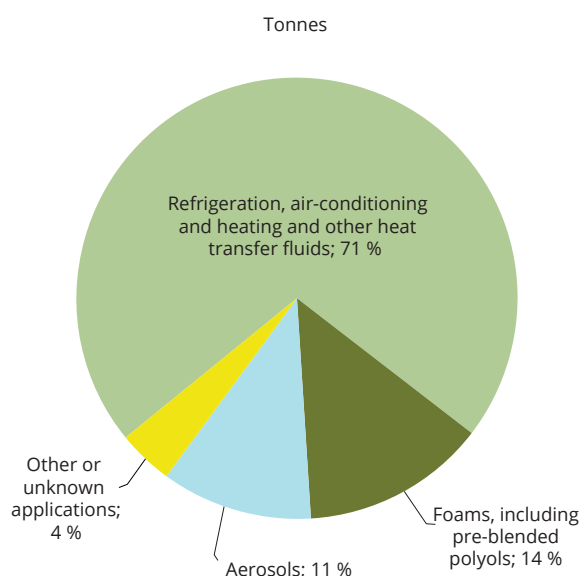
Figure 4.5 shows the make-up of supply in 2018 in more detail: the largest proportion is HFCs delivered in bulk (67 % of total EU supply of F-gases), and about 10 % is HFCs delivered in products and equipment. Unsaturated HFCs have risen to a share of 20 %. PFCs, SF<sub>6</sub> and other gases are supplied almost exclusively in bulk. The picture looks slightly different when looking at the total GWP of total supply (Figure 4.6). Non-HFCs make up about a quarter of the total supply by percentage of CO<sub>2</sub>e, which is mainly due to the very high GWP of SF<sub>6</sub>.

Detailed data on total supply and bulk supply are given in Table A5.15 to Table A5.18 in Annex 5 (pages 63-66.). For supply in imports and equipment, please refer to Table A5.9 and Table A5.10 (page 59).

#### 4.1 Intended applications of EU supply

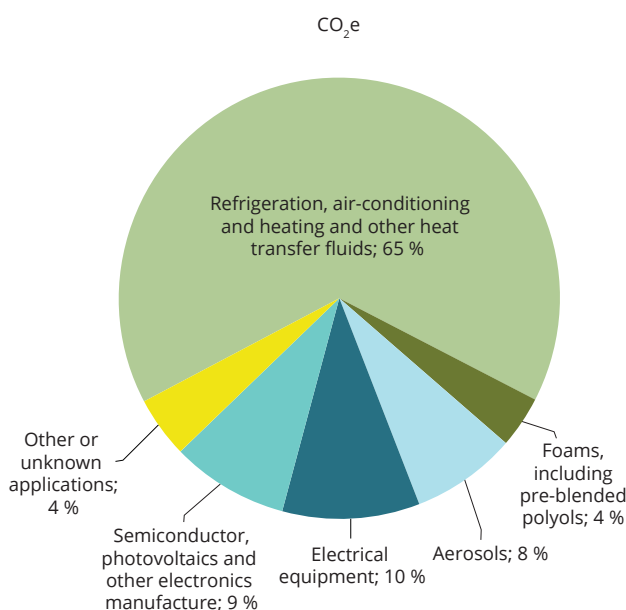
Figure 4.7 and Figure 4.8 show the proportions of intended applications calculated for the 2018 supply of F-gases, while Figure 4.9 and Figure 4.10 (page 24) show the trends over time since 2007. When analysing the trends, the discontinuity between 2013 and 2014 due to the change in reporting requirements on equipment imports and Annex II gases should be kept in mind.

**Figure 4.7 2018 EU supply by intended application (% tonnes)**



Source: EEA (2019b).

**Figure 4.8 2018 EU supply by intended application (% CO<sub>2</sub>e)**



Source: EEA (2019b).

Refrigeration, air conditioning and heating are by far the most relevant applications of supplies of F-gases to the EU, representing 71 % of the 2018 supply in tonnes and 65 % in CO<sub>2</sub>e. However, the supplied quantity of refrigerants fell by nearly 30 % compared with 2017, and its total GWP measured in CO<sub>2</sub>e decreased by 34 %. While the change in the GWP of supplied refrigerants may be largely explained by the trend towards using refrigerants with lower GWPs, this does not hold for the trend in supplied tonnes of F-gases as refrigerants. The air conditioning and refrigerant industry must be making use of non-F-gas refrigerants ('natural refrigerants', e.g. CO<sub>2</sub>, hydrocarbons, ammonia, water), which by definition will not need to be reported. Furthermore, the industry is likely to have prepared itself by stockpiling for the cut in supply, which was anticipated because of the 2018 cut in available HFC quota under the EU HFC phase-down (see Chapter 5).

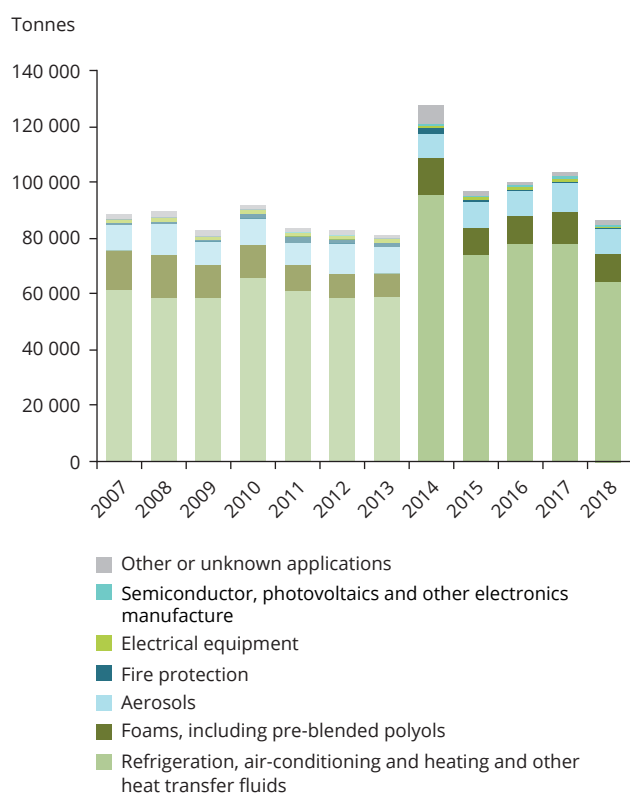
F-gases used for foam blowing account for 14 % of the 2018 supply, when measured in tonnes. The gases

used here, mostly HFCs, have comparatively low GWPs; therefore, foams account for only 4 % of total GWP. In absolute numbers, the supply for foam blowing decreased by 9 % compared with 2017, a decrease of mostly unsaturated HFCs and HCFCs. Consequently, the total GWP of F-gases used for foam blowing has decreased by 35 % compared with 2017.

The use of F-gases, mainly HFC-134a, for aerosols decreased by about 16 % compared with the previous year, which equals a decrease of 23 % of the GWP. Aerosols account for 11 % of the total use or 8 % of the total CO<sub>2</sub>e. The use of F-gases for fire protection has further declined by about 50 % compared with 2017. It now stands below 0.5 % of total supply, in both tonnes and CO<sub>2</sub>e.

Some niche applications use F-gases that have very high GWPs, which means that they represent a significant proportion of total GWP, although the amounts of F-gases used are small. These F-gases are

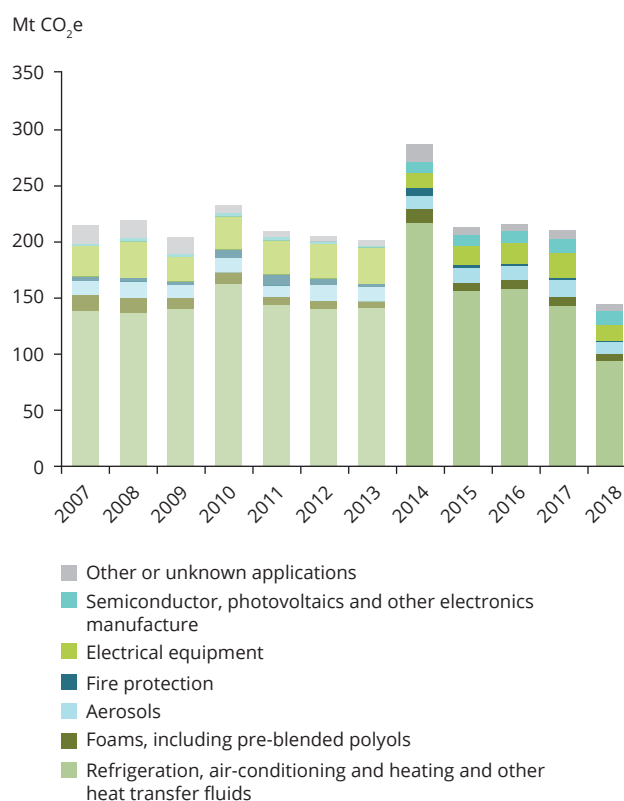
**Figure 4.9** Intended applications of EU total supply of F-gases (tonnes)



**Note:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFEs, and alcohols; and NF<sub>3</sub> and other perfluorinated compounds) and gases contained in products and equipment were not subject to reporting before 2014.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Figure 4.10** Intended applications of EU total supply of F-gases (CO<sub>2</sub>e)



**Note:** Annex II F-gases (unsaturated HFCs and HCFCs; hydrofluoroethers, HFEs, and alcohols; and NF<sub>3</sub> and other perfluorinated compounds) and gases contained in products and equipment were not subject to reporting before 2014.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).



primarily SF<sub>6</sub>, PFCs and NF<sub>3</sub> used in electrical equipment (10 % of total GWP in 2018) and in semiconductor, photovoltaics and other electronics manufacture (9 % of total GWP). Perhaps driven by the very high GWP, the volume of F-gases used for electrical equipment decreased by about 35 % compared with 2017. Note that the time series in Figure 4.10 shows a substantial increase in semiconductor, photovoltaics and electronics manufacturing use between 2013 and

2014 — this is mainly because companies were not obliged to report use of NF<sub>3</sub> before 2014.

Detailed data on intended applications can be found in Table A5.19 to Table A5.20, in Annex 5 (pages 67-68). For categories of supply in products and equipment, please refer to Table A5.11 and Table A5.12 (page 60). For details of the calculation methods, please refer to Annex 4.

## 5 Progress of the EU HFC phase-down

Starting in 2015, the amount of hydrofluorocarbons (HFCs) that can be placed on the EU market annually is capped to a limited HFC quota, which is being progressively reduced ('EU HFC phase-down'). Companies that deal in HFCs receive annual quotas, which are transferrable only under certain conditions, and, unlike emissions allowances under the EU Emissions Trading System (ETS), they are not freely tradable<sup>(18)</sup>. In order to legally place HFC bulk gases on the EU market, companies must have sufficient annual quota. Companies exceeding their quota face a penalty of twice the exceedance amount, applied to the subsequent quota allocation by the European Commission. Additional consequences for non-compliant companies are subject to Member States' legislation including criminal prosecution depending on the severity of the non-compliance.

Quotas are expressed in carbon dioxide equivalent (CO<sub>2</sub>e), rather than physical tonnes of gases, to create an incentive to use gases with lower GWPs. The initial total allocation in 2015 was 183.1 million tonnes (Mt) CO<sub>2</sub>e (EC, 2019). In 2016 and 2017, the first stage of reduction applied, and only 170.3 Mt CO<sub>2</sub>e was allocated (93 % of the 2015 allocation)<sup>(19)</sup>. Following a recalculation of the maximum quantity for 2018, which allowed for the subtraction of exempted gases as stipulated in Annex V of the F-gas Regulation (EU, 2014b), an HFC quota totalling 101.2 Mt CO<sub>2</sub>e was allocated for 2018, about 40 % less than for 2017. For 2019, the maximum quantity was again recalculated to consider the latest available data on exemptions and to consider the United Kingdom's intention to leave the EU (Brexit). As the expected date of Brexit changed in the course of 2019, the respective quota allocation

in the HFC registry was repeatedly updated. The 2019 total quota allocation without Brexit in 2019 would amount to 100.3 Mt CO<sub>2</sub>e (EC, 2019).

Since 2017, the HFCs contained in refrigeration, air conditioning and heat pump (RACHP) equipment have also been covered by the quota mechanism. In order to import such equipment, importers must acquire authorisations to use quota from quota-holding companies. Notably, it is the sale of authorisations by the quota holder and not the actual import of RACHP equipment by the authorised party that counts as placing on the market (POM)<sup>(20)</sup> for the purpose of the annual quotas, as authorisations do not expire at the end of a year and can be used in subsequent years<sup>(21)</sup>. Therefore, equipment imports can physically occur in a later year, while the sale of authorisations must be covered by the quota for the year of the sale. Issued authorisations are already accounted for in the following figures on bulk POM.

The EU is on track for meeting the HFC phase-down obligation (Figure 5.1). In 2018, the total quota-relevant POM was 1 Mt CO<sub>2</sub>e or 1.0 % below the maximum quantity<sup>(22)</sup>, despite a 41 % reduction in the maximum HFC quantity compared with 2017. In 2017, the margin had been of a similar magnitude (1.0 Mt CO<sub>2</sub>e or 0.6 % of the maximum quantity), while for the first two years of the phase-down more significant overachievements of 6 % (2015) and 4 % (2016) were observed<sup>(23)</sup>.

The EU-level assessment presented in Figure 5.1 is based on company-level data concerning amounts of bulk HFCs placed on the market and the quotas held by these companies. Starting in 2017, HFCs placed

<sup>(18)</sup> Quota allocations are set out in Article 16 and Annexes V and VI of the F-Gas Regulation (EU) No 517/2014. Transfers and authorisations are regulated in Article 18. Penalties are covered in Article 25.

<sup>(19)</sup> See the phase-down schedule in Annex V of the F-Gas Regulation (EU) No 517/2014.

<sup>(20)</sup> The monitoring of the EU HFC phase-down relies on the metric POM. For calculation details, please refer to Annex 4 (page 47). Compliance-relevant POM is the physical POM of bulk HFCs, where it is not covered by one of the exemptions of Article 15 of the F-Gas Regulation, in addition to authorisations issued by quota holders. Starting in 2017, HFCs placed on the market within imported RACHP equipment are also considered in the overall assessment of the phase-down in those cases where the importers did not hold sufficient quota authorisation.

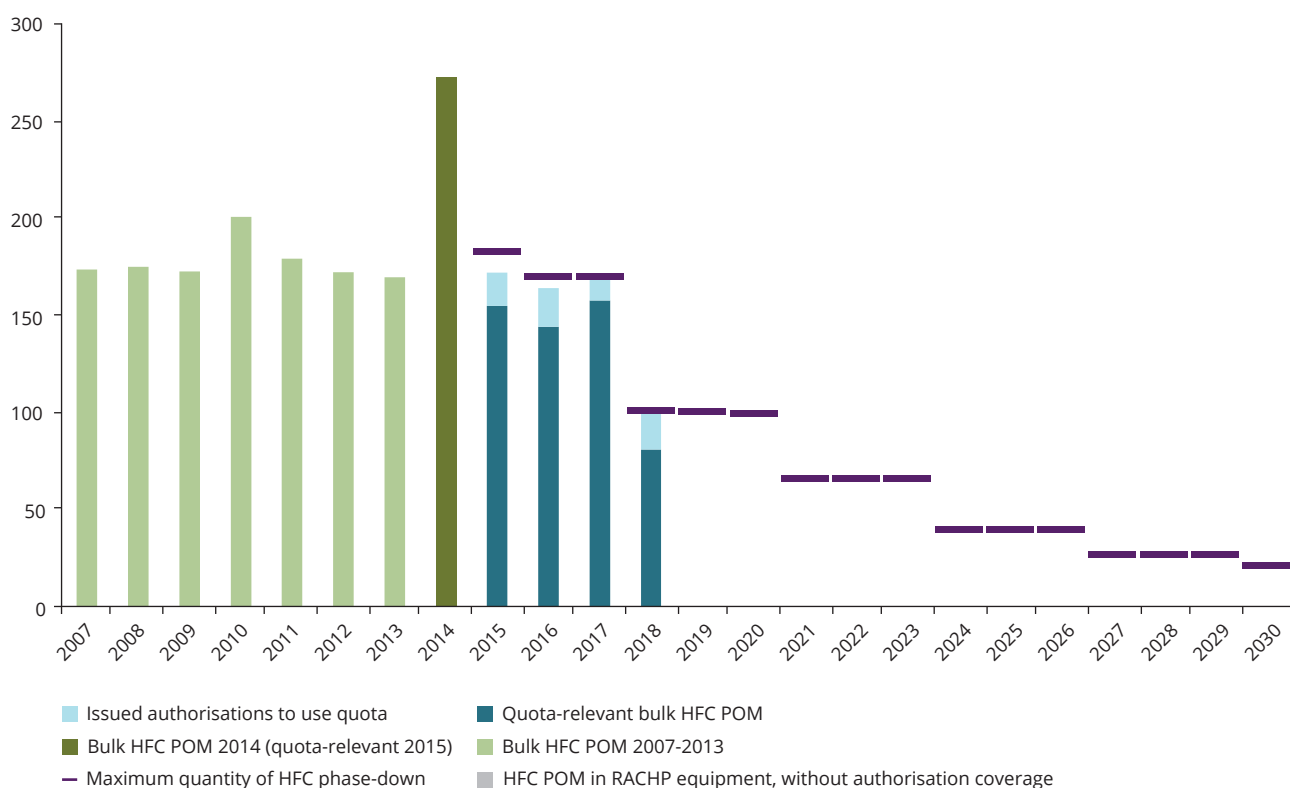
<sup>(21)</sup> In contrast to authorisations, quota is time-stamped for a specific year and unused quota cannot be carried over to the following year.

<sup>(22)</sup> Data for 2018 are preliminary and subject to scrutiny by the European Commission.

<sup>(23)</sup> Numbers for 2016 and 2017 slightly deviate from the previous F-gases report (EEA, 2018) due to compliance scrutiny decisions by the European Commission.

**Figure 5.1 Progress of the EU HFC phase-down**

Placing on the market of HFCs (Mt CO<sub>2</sub>e)



**Notes:** POM, placing on the market. Values from 2007 to 2013 are based on the reporting obligations of the old F-gas Regulation (EC No 842/2006 and are therefore not fully comparable with data from 2014 onwards (based on the obligations of the new F-gas Regulation (EU) No 517/2014). The maximum quantities of the EU HFC phase-down shown for 2019 onwards would need to be recalculated in the case of Brexit.

**Sources:** EC (2011, 2014, 2019); EEA (2018, 2019b).

on the market within imported RACHP equipment is considered in those cases in which the importers did not hold sufficient quota authorisation <sup>(24)</sup>.

Figure 5.2 shows how the EU-wide overachievement breaks up into quota compliance at company level — in 2015 and 2016, the sum of unused quotas was much larger than the quota exceedances observed for some companies. In 2017 and 2018, the margin was much closer, especially as non-compliant RACHP equipment importers also are considered. Note that data on the 2018 quota exceedance both for bulk HFCs and for equipment importers are preliminary and have not yet undergone in-depth compliance scrutiny by the European Commission. Thus, final numbers

may change, and this would be reflected in next year's report.

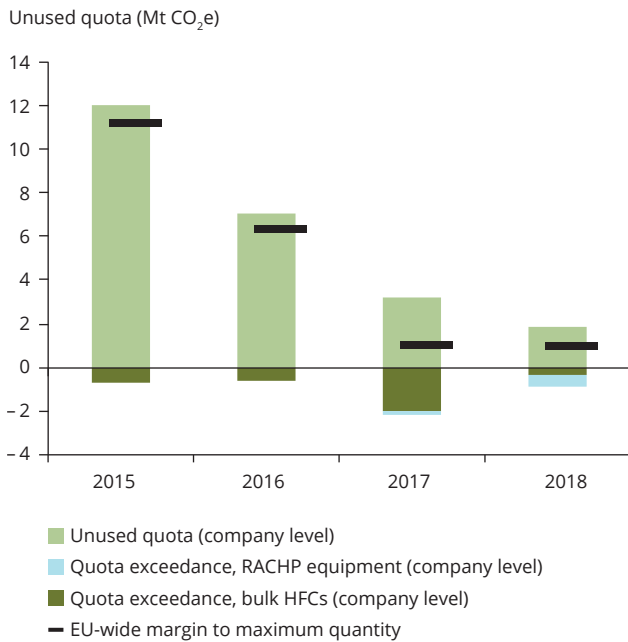
Quota-relevant POM as shown in Figure 5.1 does not include amounts of HFCs placed on the market under the exemptions of Article 15(2) of the F-gas Regulation. These are presented in Annex 5.

The exemptions for HFCs supplied to bulk export, to the production of pharmaceutical metered dose inhalers (MDIs) and to feedstock use <sup>(25)</sup> are quantitatively most relevant. The exemptions for supply to the semiconductor industry and to military use and for imports for destruction are used in significantly lower amounts. Reported amounts for the total of

<sup>(24)</sup> The amounts of 0.2 Mt CO<sub>2</sub>e and 0.5 Mt CO<sub>2</sub>e for 2017 and 2018, respectively, subject to scrutiny by the European Commission, are too small to be discernible in Figure 5.1. Note that, for 2017, as the first year of the obligation to have RACHP imports covered by quota authorisation, the European Commission had proposed that Member States also consider for compliance checking authorisations acquired in the course of 2018. The accounting of authorisations applied in this report follows this approach.

<sup>(25)</sup> For trends in feedstock use, please refer to Section 3.3, page 20.

**Figure 5.2 Balance between placing on the market of HFCs and related quotas at EU level**



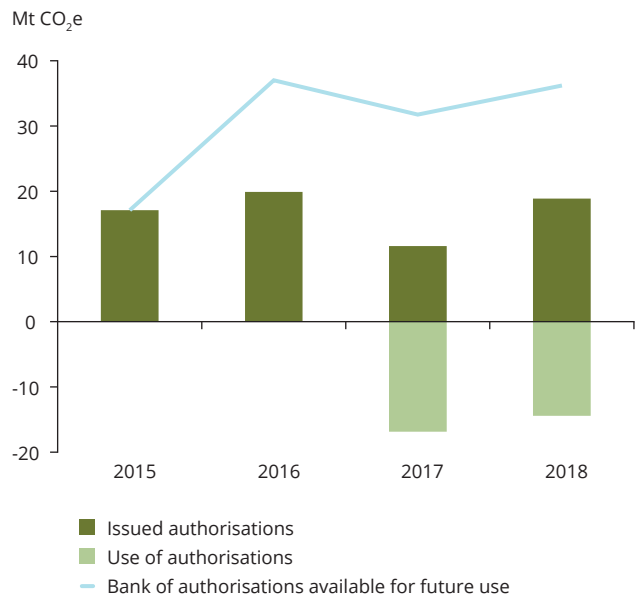
**Note:** The data for 2018 have not yet undergone scrutiny by the European Commission.

**Sources:** EC (2019); EEA (2018, 2019b).

Article 15(2) exemptions rose from 2014 to 2016 but dropped by 12 % in 2017. For 2018, the reported exemptions increased by 12 % and are very close to 2016 levels. Considering the significant reduction in 2018 of the maximum quantity of HFCs to be placed on the market, the share of quota-exempted amounts in total bulk HFCs physically placed on the market almost doubled from 11 % in 2017 to 21 % in 2018. Note that the exemption under Article 15(2)(f) for pharmaceutical MDIs entered into force on 1 January 2018.

HFCs contained in imported RACHP equipment (as mentioned above) have been included in the EU HFC phase-down since 2017. Since then, equipment importers have needed to hold authorisations to use quota issued by HFC producers or bulk importers that were allocated quota by the European Commission. Figure 5.3 compares the authorisations issued

**Figure 5.3 Bank of authorisations for HFCs in RACHP equipment imports**



**Note:** RACHP, refrigeration, air conditioning and heat pumps.

**Sources:** EC (2018, 2019b).

since 2014 with authorisations used since 2017. The difference between authorisations issued and authorisations used results in a bank of authorisations stockpiled by equipment importers. By the end of 2018, this bank of stockpiled authorisation amounted to two and a half times the amount of authorisations used in 2018.

This reserve is equivalent to 36 % of the 2019 maximum quota allocation (without consideration of Brexit) and can be used to cover equipment imports in 2019 and future years under the EU HFC phase-down, because acquired authorisations are not earmarked for a particular year. At the same time, this accumulated reserve of authorisations reduces the overall strain on quota issued for the following years, as RACHP equipment imports in those years will, at least partially, not need to be covered by quota issued for those years.

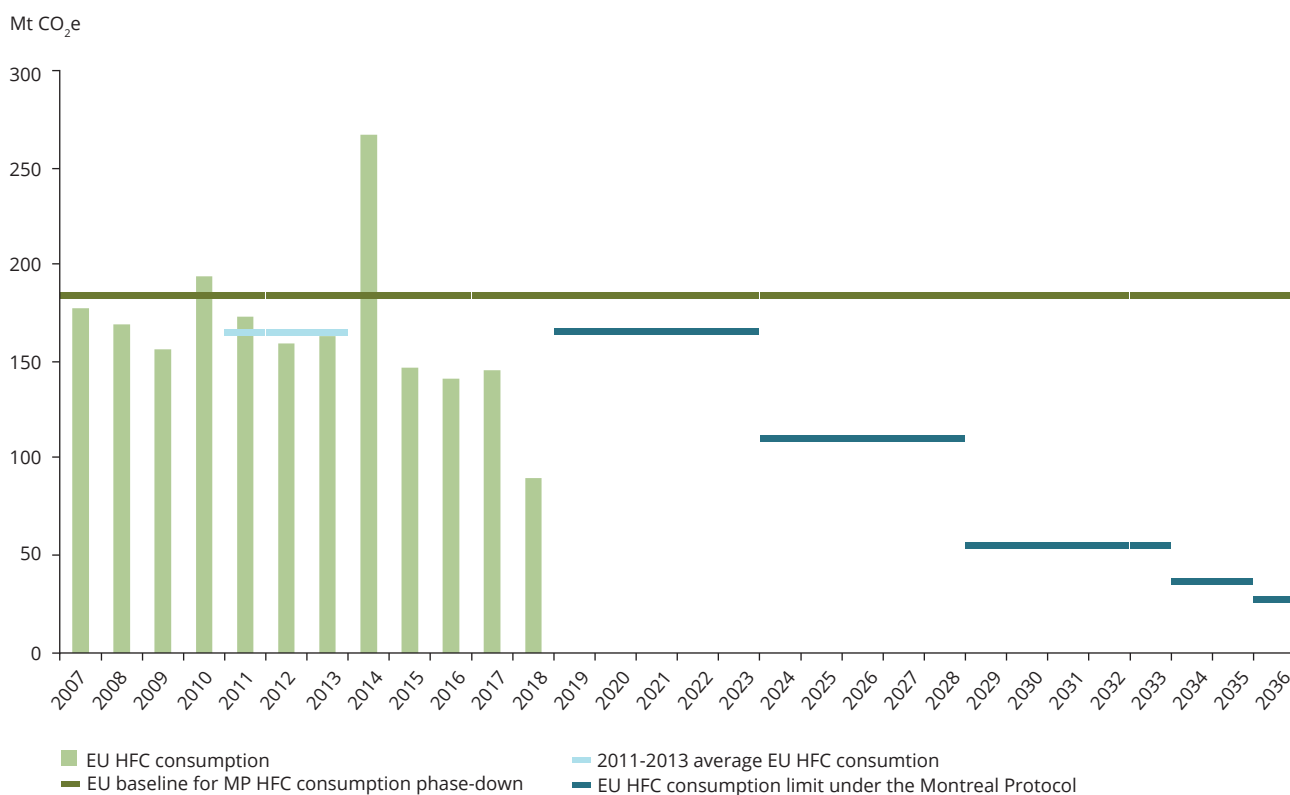
## 6 Approaching the international HFC phase-down under the Montreal Protocol

In October 2016, in Kigali, Rwanda, the Montreal Protocol was amended to regulate hydrofluorocarbons (HFCs) (the Kigali Amendment). Both developed and developing countries have taken on mandatory commitments on reducing the production and consumption of HFCs in the next three decades (EC, 2016). Under the amended protocol, for the EU and other developed countries, HFC consumption is limited to 90 % of the baseline as of 2019, with further reductions to be made until a 15 % level is reached from 2036 onwards (Figure 6.1). Measuring the progress of this phase-down relies on the metric

of 'consumption', which is similar, but not identical, to the metrics of 'supply' used by the EEA (Chapter 4) and 'placing on the market' (POM) used for the EU HFC phase-down (Chapter 5) <sup>(26)</sup>.

The baseline for the Montreal Protocol HFC phase-down is defined as the average HFC consumption during the period 2011-2013, plus 15 % of the HCFC baseline in 1989, all expressed in carbon dioxide equivalent (CO<sub>2</sub>e). As set out in the Montreal Protocol, the HCFC baseline also includes 2.8 % of the 1989 chlorofluorocarbon (CFC) consumption. The 2011-2013 average EU

**Figure 6.1** Approaching the Montreal Protocol HFC phase-down



**Notes:** HFCs covered under the Montreal Protocol include all HFCs covered under EU F-gas Regulation No 517/2014, except HFC-161 (see Annex 1). MP, Montreal Protocol.

**Sources:** EC (2011, 2014); EEA (2018 and 2019b).

<sup>(26)</sup> For details on how the metrics are calculated, please refer to Annex 4 (page 47).

HFC consumption, according to reporting under the F-gas Regulation (EU, 2014b), was 165.2 million tonnes (Mt) CO<sub>2</sub>e (EEA, 2019b; Figure 6.1). The hydrochlorofluorocarbon (HCFC)/CFC part of the EU baseline was calculated as 19.0 Mt CO<sub>2</sub>e (EC, 2017). In total, the EU baseline under the Montreal Protocol HFC phase-down is estimated <sup>(27)</sup> at 184.2 Mt CO<sub>2</sub>e.

In Figure 6.1, EU consumption of HFCs covered under the Montreal Protocol since 2007 is presented and contrasted with the Montreal Protocol phase-down steps applying to the EU as of 2019. With the exception of 2014 (when consumption was probably inflated as a result of the upcoming phase-down; see Section 3.2, page 15), HFC consumption had been experiencing a downward trend. In 2018, HFC consumption dropped by 38 % compared with 2017, in line with the 41 % drop in the maximum HFC quantity under the EU

HFC phase-down (see Chapter 5) and corresponding to the 32 % drop in HFC supply (see Chapter 4). The minor differences in the reduction of consumption and the placing on the market (POM) and supply of HFCs is because of the slightly differing definitions of these metrics (see Annex 4, page 47). The variation between consumption and POM is mostly influenced by quota authorisations, equipment imports and quota-exempted HFC supplies. The main reasons for the weaker reduction trend in HFC supply are HFC stocks effects and the increase in HFC reclamation.

As a result, 2018 HFC consumption is already at 54 % of the amount allowed for 2019, when the Montreal Protocol phase-down began.

A tabular overview of HFC consumption is given in Table A5.22 in Annex 5 (page 70).

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<sup>(27)</sup> The quantification of the EU baseline is preliminary, subject to confirmation by the United Nations Environment Programme Ozone Secretariat.



# Terminology

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## Fluorinated greenhouse gases (F-gases)

F-gases covered by this report can be grouped into:

- gases contained in Annex I of the new F-gas Regulation, as listed in Annex 1 of this report;
- gases contained in Annex II of the new F-gas Regulation, as listed in Annex 2 of this report.

Jointly, those gases are referred to in this report as 'fluorinated greenhouse gases' or 'F-gases'.

The list of reportable F-gases under the old F-gas Regulation was restricted to hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>), as identified in Annex 1 on page 38.

## Annex I F-gases

F-gases under Annex I of the new F-gas Regulation include HFCs, PFCs and SF<sub>6</sub>. The majority of these gases have high global warming potentials (GWPs).

The gases of Annex I of the new F-gas Regulation are given in Annex 1 of this report.

## HFCs

HFCs are relatively short aliphatic organic compounds that contain fluorine, carbon and hydrogen. They are most commonly used as refrigerants. Nineteen HFCs and their GWPs are listed in Annex 1. All HFCs in Annex 1, except HFC-152 and HFC-161, were previously covered by the old F-gas Regulation (EC) No 842/2006. Any mixture (blend) that includes at least one HFC is considered an HFC under the F-gas Regulation and therefore is covered by the quota system. The GWP of such a mixture is calculated according to Annex IV of the F-gas Regulation.

## PFCs

PFCs are relatively short aliphatic organic compounds that contain fluorine and carbon only. They are most commonly used in semiconductor manufacture. Seven PFCs and their GWPs are listed in Annex 1. All PFCs in Annex 1 were previously covered by the old F-gas Regulation.

## SF<sub>6</sub>

SF<sub>6</sub> is an inorganic compound, because it is an excellent electrical insulator — its main use is in the electrical industry. SF<sub>6</sub> is a potent greenhouse gas; its GWP is listed in Annex 1. SF<sub>6</sub> was also covered by the old F-gas Regulation.

## Annex II F-gases

'Other fluorinated greenhouse gases' are listed in Annex II of Regulation No 517/2014 and include:

- unsaturated hydro(chloro)fluorocarbons (Section 1 of Annex II);
- fluorinated ethers and alcohols (Section 2 of Annex II);
- other perfluorinated compounds, including nitrogen trifluoride (NF<sub>3</sub>) (Section 3 of Annex II).

All these gases and their GWPs are listed in Annex 1 of this report. The Annex II F-gases were not covered by the reporting obligations under the old F-gas Regulation (EC) No 842/2006.

### **Bulk gases and gases contained in equipment**

Gases contained in gas containers, including bottles and isotanks, are referred to as bulk gases, irrespective of the absolute amounts of gases handled. Bulk gases are to be differentiated from gases contained in products or equipment, as different reporting obligations apply.

### **Mixtures**

Mixtures of F-gases are often used in industrial applications. In their reports under Article 19 of the F-gas Regulation (EU) No 517/2014, companies report on their transactions (import, export, etc.) of such mixtures while specifying their composition. For the purpose of the present aggregation report, the amounts of mixtures are recalculated as the proportions of their constituent F-gases, as listed in Annex 1, unless indicated otherwise.

### **Annex IV gases**

Annex IV of the new F-gas Regulation lists some non-F-gases that have GWPs that also need to be considered when determining the GWP of a mixture. These gases and their GWPs are also listed in Annex 1 of this report. For all other substances included in a mixture, a default value of 0 is used for the calculation the GWP.

### **Nil report**

A nil report is a notification by a company that it considers itself not obliged to report under the F-gas Regulation.

### **GWPs**

GWPs are used to make different gases comparable in terms of their potential impact on climate change. The multiplication of a quantity of a gas by its GWP results in that quantity expressed as carbon dioxide equivalent (CO<sub>2</sub>e).

The GWPs used under the new F-gas Regulation are in line with those published in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) (IPCC, 2007). The old F-gas Regulation (EC) No 842/2006 used the earlier set of GWPs published by the IPCC in its Third Assessment Report (TAR) (IPCC, 2001). Accordingly, previous EEA technical reports on F-gases up to 2014 used TAR GWPs.

Quantities of F-gases are reported in physical tonnes. A conversion of the figures into CO<sub>2</sub>e based on gas-specific GWPs facilitates a focus on the potential warming effect caused by these gases after their release into the atmosphere. Both metrics are used in this report when analysing the data.

The GWPs of gases used for the present report are listed in Annex 1. GWPs of mixtures are calculated according to Annex IV of the new F-gas Regulation (EU, 2014b).

# Abbreviations

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AR4	Fourth Assessment Report of the Intergovernmental Panel on Climate Change
BDR	Business Data Repository of the EEA
BS	Bulk supply
CFC	Chlorofluorocarbon
CO <sub>2</sub> e	Carbon dioxide equivalent
DG CLIMA	Directorate-General for Climate Action of the European Commission
EC	European Commission
EEA	European Environment Agency
ETC/CME	European Topic Centre for Climate Change Mitigation and Energy
EU	European Union
EU-28	28 Member States of the EU: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom
F-gases	Fluorinated greenhouse gases
GWP	Global warming potential
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HFE	Hydrofluoroether
IPCC	Intergovernmental Panel on Climate Change
kg	Kilograms
MDI	Metered dose inhalers
MP	Montreal Protocol
Mt	Million tonnes (equivalent to megatonnes)
NF <sub>3</sub>	Nitrogen trifluoride
ODS	Ozone-depleting substances

## Abbreviations

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PFCs	Perfluorocarbons
PFPME	Perfluoropolymethylisopropylether
POM	Placing on the market
QC	Quality control
R-134a	Refrigerant classification of HFC-134a
R-410A	Refrigerant mixture of HFCs (50 % HFC-125, 50 % HFC-32)
RACHP	Refrigeration, air conditioning and heat pump
SF <sub>6</sub>	Sulphur hexafluoride
SPE	Supply in products/equipment
t	Tonne
TAR	Third Assessment Report of the Intergovernmental Panel on Climate Change
TS	Total supply
UNFCCC	United Nations Framework Convention on Climate Change

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# Annexes

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# Annex 1 Gases covered by Regulation (EU) No 517/2014

**Table A1.1 Annex I of Regulation (EU) No 517/2014**

Gas	GWP (AR4)	Gas group	Reference	Coverage in the 'old' F-Gas Regulation No 842/2006
HFC-23	14 800	HFCs	Annex I Section 1	Covered
HFC-32	675	HFCs	Annex I Section 1	Covered
HFC-41	92	HFCs	Annex I Section 1	Covered
HFC-125	3 500	HFCs	Annex I Section 1	Covered
HFC-134	1 100	HFCs	Annex I Section 1	Covered
HFC-134a	1 430	HFCs	Annex I Section 1	Covered
HFC-143	353	HFCs	Annex I Section 1	Covered
HFC-143a	4 470	HFCs	Annex I Section 1	Covered
HFC-152	53	HFCs	Annex I Section 1	Not covered
HFC-152a	124	HFCs	Annex I Section 1	Covered
HFC-161	12	HFCs	Annex I Section 1	Not covered
HFC-227ea	3 220	HFCs	Annex I Section 1	Covered
HFC-236cb	1 340	HFCs	Annex I Section 1	Covered
HFC-236ea	1 370	HFCs	Annex I Section 1	Covered
HFC-236fa	9 810	HFCs	Annex I Section 1	Covered
HFC-245ca	693	HFCs	Annex I Section 1	Covered
HFC-245fa	1 030	HFCs	Annex I Section 1	Covered
HFC-365mfc	794	HFCs	Annex I Section 1	Covered
HFC-43-10mee	1 640	HFCs	Annex I Section 1	Covered
PFC-14 (CF <sub>4</sub> )	7 390	PFCs	Annex I Section 2	Covered
PFC-116 (C <sub>2</sub> F <sub>6</sub> )	12 200	PFCs	Annex I Section 2	Covered
PFC-218 (C <sub>3</sub> F <sub>8</sub> )	8 830	PFCs	Annex I Section 2	Covered
PFC-3-1-10 (C <sub>4</sub> F <sub>10</sub> )	8 860	PFCs	Annex I Section 2	Covered
PFC-4-1-12 (C <sub>5</sub> F <sub>12</sub> )	9 160	PFCs	Annex I Section 2	Covered
PFC-5-1-14 (C <sub>6</sub> F <sub>14</sub> )	9 300	PFCs	Annex I Section 2	Covered
PFC-c-318 (c-C <sub>4</sub> F <sub>8</sub> )	10 300	PFCs	Annex I Section 2	Covered
SF <sub>6</sub>	22 800	SF <sub>6</sub>	Annex I Section 3	Covered

Sources: EU (2006, 2014b).



**Table A1.2 Annex II of Regulation (EU) No 517/2014 (not covered by old Regulation (EC) No 842/2006)**

Gas	GWP (AR4)	Gas group	Reference
HFC-1234yf	4	Unsaturated HFCs/HCFCs	Annex II Section 1
HFC-1234ze	7	Unsaturated HFCs/HCFCs	Annex II Section 1
HFC-1336mzz	9	Unsaturated HFCs/HCFCs	Annex II Section 1
HCFC-1233zd	5	Unsaturated HFCs/HCFCs	Annex II Section 1
HCFC-1233xf	1	Unsaturated HFCs/HCFCs	Annex II Section 1
HFE-125	14 900	HFEs and alcohols	Annex II Section 2
HFE-134	6 320	HFEs and alcohols	Annex II Section 2
HFE-143a	756	HFEs and alcohols	Annex II Section 2
HCFE-235da2 (isofluorane)	350	HFEs and alcohols	Annex II Section 2
HFE-245cb2	708	HFEs and alcohols	Annex II Section 2
HFE-245fa2	659	HFEs and alcohols	Annex II Section 2
HFE-254cb2	359	HFEs and alcohols	Annex II Section 2
HFE-347 mcc3 (HFE-7000)	575	HFEs and alcohols	Annex II Section 2
HFE-347pcf2	580	HFEs and alcohols	Annex II Section 2
HFE-356pcc3	110	HFEs and alcohols	Annex II Section 2
HFE-449sl (HFE-7100)	297	HFEs and alcohols	Annex II Section 2
HFE-569sf2 (HFE-7200)	59	HFEs and alcohols	Annex II Section 2
HFE-43-10pccc124	1 870	HFEs and alcohols	Annex II Section 2
HFE-236ca12 (HG-10)	2 800	HFEs and alcohols	Annex II Section 2
HFE-338pcc13 (HG-01)	1 500	HFEs and alcohols	Annex II Section 2
HFE-347mmy1	343	HFEs and alcohols	Annex II Section 2
2,2,3,3,3-pentafluoropropanol	42	HFEs and alcohols	Annex II Section 2
bis(trifluoromethyl)-methanol	195	HFEs and alcohols	Annex II Section 2
HFE-227ea	1 540	HFEs and alcohols	Annex II Section 2
HFE-236ea2 (desfluoran)	989	HFEs and alcohols	Annex II Section 2
HFE-236fa	487	HFEs and alcohols	Annex II Section 2
HFE-245fa1	286	HFEs and alcohols	Annex II Section 2
HFE 263fb2	11	HFEs and alcohols	Annex II Section 2
HFE-329mcc2	919	HFEs and alcohols	Annex II Section 2
HFE-338mcf2	552	HFEs and alcohols	Annex II Section 2
HFE-338mmz1	380	HFEs and alcohols	Annex II Section 2
HFE-347mcf2	374	HFEs and alcohols	Annex II Section 2
HFE-356mec3	101	HFEs and alcohols	Annex II Section 2
HFE-356mm1	27	HFEs and alcohols	Annex II Section 2
HFE-356pcf2	265	HFEs and alcohols	Annex II Section 2
HFE-356pcf3	502	HFEs and alcohols	Annex II Section 2
HFE 365mcf3	11	HFEs and alcohols	Annex II Section 2
HFE-374pc2	557	HFEs and alcohols	Annex II Section 2
-(CF <sub>2</sub> ) <sub>4</sub> CH(OH) -	73	HFEs and alcohols	Annex II Section 2
NF <sub>3</sub> (nitrogen trifluoride)	17 200	Other perfluorinated compounds	Annex II, Section 3
c-C <sub>3</sub> F <sub>6</sub> (perfluorocyclopropane)	17 340	Other perfluorinated compounds	Annex II, Section 3
PFPME	10 300	Other perfluorinated compounds	Annex II, Section 3
SF <sub>5</sub> CF <sub>3</sub>	17 700	Other perfluorinated compounds	Annex II, Section 3

**Notes:** Annex II F-gases were not covered under the old F-gas Regulation (EC) No 842/2006.  
 HCFC, hydrochlorofluorocarbon; HFC, hydrofluorocarbon; HFE, hydrofluoroether; PFPME, perfluoropolymethylisopropylether;  
 SF<sub>5</sub>CF<sub>3</sub>, trifluoromethyl sulphur pentafluoride.

**Source:** EU (2014b).

**Non-F-gases in Annex IV of Regulation (EU) No 517/2014 (not covered by the old Regulation (EC) No 842/2006)**

According to Annex IV of the new F-gas Regulation (EU) No 517/2014, the global warming potential (GWP) of mixtures containing gases outside the scope of

Annexes I and II of Regulation (EU) No 517/2014 are to be calculated using the GWPs given here for the non-F-gases. For other constituents of mixtures that are not listed here (e.g. ozone-depleting substances, ODS), a GWP value of zero must be used.

**Table A1.3**

Substance	Formula	GWP (AR4)
R-170 (ethane)	CH <sub>3</sub> CH <sub>3</sub>	6
R-290 (propane)	CH <sub>3</sub> CH <sub>2</sub> CH <sub>3</sub>	3
R-600 (butane)	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>	4
R-600A (isobutane)	CH(CH <sub>3</sub> ) <sub>2</sub> CH <sub>3</sub>	3
R-601 (pentane)	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>	5
R-601A (isopentane)	(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> CH <sub>3</sub>	5
C <sub>5</sub> H <sub>10</sub> (cyclopentane)	C <sub>5</sub> H <sub>10</sub>	5
R-610 (ethoxyethane, diethyl ether)	CH <sub>3</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub>	4
R-611 (methyl formate)	HCOOCH <sub>3</sub>	25
R-702 (hydrogen)	H <sub>2</sub>	6
R-717 (ammonia)	NH <sub>3</sub>	0
R-744 (carbon dioxide)	CO <sub>2</sub>	1
R-1150 (ethylene)	C <sub>2</sub> H <sub>4</sub>	4
R-1270 (propylene)	C <sub>3</sub> H <sub>6</sub>	2
E-170 (dimethyl ether)	CH <sub>3</sub> OCH <sub>3</sub>	1
CH <sub>3</sub> Cl (methyl chloride)	CH <sub>3</sub> Cl	13
CHCl <sub>3</sub> (chloroform)	CHCl <sub>3</sub>	31
Methylene chloride	CH <sub>2</sub> Cl <sub>2</sub>	9
CH <sub>4</sub> (methane)	CH <sub>4</sub>	25
N <sub>2</sub> O (nitrous oxide)	N <sub>2</sub> O	298

**Note:** AR4, Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

**Source:** EU (2014b).

## Annex 2 F-gases reporting form

The reporting format for submitting the F-gas reports under Article 19 of Regulation (EU) No 517/2014 is laid out in Commission Implementing Regulation (EU) No 1191/2014, and in the updates Implementing Regulation (EU) 2017/1375, Implementing Regulation (EU) 2018/1992 and Regulation (EU) 2019/552. These are implemented as an online questionnaire on the EEA's Business Data Repository (BDR) reporting platform at <https://bdr.eionet.europa.eu/>. Reporting is mandatory for every company that engages in the activities listed in Article 19 of Regulation (EU) No 517/2014.

### Cover sheet

On the cover sheet, companies provide their current data and their activities during the reporting year, which may be one or more of the following:

- producer of hydrofluorocarbons (HFCs) or other fluorinated gases;
- importer of HFCs or other fluorinated gases;
- exporter of bulk gases;
- EU feedstock user;
- EU destruction company;
- importer of products or equipment containing F-gases of Annexes I or II;
- undertaking having given an authorisation to use its HFC quota to another undertaking.

In addition, companies select F-gases that will be reported and specify the mixtures used by them.

If none of these sections apply, companies may state that they are not obliged to report, skipping the quantitative part of the reporting process (nil report).

Large companies with subsidiaries in several EU countries are required to report separately for each country. To protect their data, companies may

voluntarily list affiliated companies on the cover sheet. Numbers for such groups of affiliates are treated in aggregate when the confidentiality of figures is determined, thus increasing the likelihood that a figure remains confidential and cannot be included in the public EEA report.

### Section 1 (producers only)

Section 1 contains data about the production of F-gases and mixtures:

- total quantity of production (1A);
- destroyed by-products, mandatory specification of destruction company (1B, 1C);
- sum of destroyed production (1D);
- net production (1E, which equals 1A minus 1D);
- production of mixtures (1F to 1H);
- **voluntary:** sales and purchases on the EU market (1I to 1K).

From the data specified by the reporters, the total production available for sale (1E), relevant for calculating supply, is determined by subtracting destroyed side-products (1B, 1C) from total production (1A).

### Section 2 (importers only)

- Total imports of bulk gases (2A):
  - thereof HFCs contained in pre-blended polyols (2A\_pp).
- Imports that were destined for re-export contained in products or equipment and never released for free circulation in the EU (2B):
  - thereof: amount of used, recycled or reclaimed HFCs (2C);

- thereof: amount of virgin HFCs imported for feedstock use (2D);
- thereof: amount of virgin HFCs imported for uses exempted under the Montreal Protocol (2E) <sup>(28)</sup>.

Values for 2A, 2A\_pp, 2C, 2D and 2E have to be reported by country of import. Country-specific reporting for 2A is limited to HFCs.

### Section 3 (exporters only)

Section 3 contains data about bulk exports only (exporters of products containing F-gases must not report here) — total exports (3A):

- thereof: contained in pre-blended polyols (3A\_pp);
- thereof: amounts from own production or purchased amounts (3B);
- thereof: determined amount of exports purchased in the Union (3C);
- breakdown of destination of exports (recycling, reclamation, destruction) (3D to 3F);
- thereof: amount of used, recycled or reclaimed HFCs exported (3G);
- thereof: amount of virgin HFCs exported for feedstock use (3H);
- thereof: amount of virgin HFCs exported for uses exempted under the Montreal Protocol (3I) <sup>(29)</sup>.

Values for 3A, 3A\_pp, 3G, 3H and 3I have to be reported by country of import. Country-specific reporting for 3A is limited to HFCs.

### Section 4 (producers and importers)

Section 4 contains data on stocks of F-gases and their sources:

- stocks on 1 January (4A) and breakdown by source and previous status of free circulation (4B to 4E);

- stocks on 31 December (4F) and breakdown by source and previous status of free circulation (4G to 4J);
- reclaimed and recycled amounts (4K, 4L).

From the data provided on production, imports, exports and stocks, the total amount physically placed on the market by the reporter (4M) is determined using the formula:

$$4M = \text{Net production (1E)} + \text{Total imports (2A)} - \text{Imports for reexport (2B)}$$

$$- \text{Export of own production (3B)}$$

$$+ \text{1st Jan stocks previously not placed on the market (4C)}$$

$$- \text{31st Dec stocks previously not placed on the market (4D)}$$

### Section 5 (producers and importers of HFCs)

Section 5 contains data about quantities of HFCs imported for uses exempted under the F-gas Regulation, Article 15(2). For all these transactions, trade partners must be specified and uses broken down by company:

- destruction (5A);
- feedstock applications (5B);
- supply to other undertakings for re-export in bulk (5C exempted);
- military equipment (5D);
- semiconductor manufacturing (5E);
- production of medical dose inhalers (5F).

From the values, the total amounts of HFCs supplied to exempted uses and the resulting quota requirement are determined (5G to 5H). Reporters may voluntarily state their supply to other undertakings for production of equipment that is destined for re-export (5C voluntary); however, this figure does not feed into the total amount for exempted uses.

<sup>(28)</sup> 2E was not active in the 2019 reporting round, since no exemptions were agreed on under the Montreal Protocol.

<sup>(29)</sup> 3I was not active in the 2019 reporting round, since no exemptions were agreed on under the Montreal Protocol.

**Section 6 (producers and importers)**

Section 6 contains a breakdown of the intended applications of the total amounts supplied to the EU market by the reporting company. In this section, companies must account for the full amount, as determined by the formula:

$$6X = \text{Net production (1E)} + \text{Total imports (2A)} - \text{Imports for reexport (2B)} \\ - \text{Export of own production (3B)} + \text{1st Jan stocks of own production (4B)} \\ - \text{31st Dec stocks of own production (4G)} - \text{Own reclamation (4K)}$$

Note that this formula differs from the placing on the market (POM) determination in Chapter 4 in the method of correction for stocks. The full list of applications is:

- export (in bulk, not in equipment or smaller packages);
- destruction;
- military equipment;
- refrigeration, air conditioning and heating;
- other heat transfer fluids;
- foams;
- production of pre-blended polyols, e.g. for polyurethane foam;
- fire protection;
- aerosols — medical dose inhalers;
- aerosols — other uses;
- solvents;
- feedstock;
- semiconductor manufacture;
- photovoltaics manufacture;
- other electronics manufacture;
- electrical equipment;
- particle accelerators;
- magnesium die casting operations;

- anaesthetics;
- other or unknown application;
- leakage during storage, transport or transfer.

**Section 7 (feedstock users)** contains the amount of gas used as feedstock by the undertaking itself (7A). The reporting obligation on feedstock use is limited to Annex I gases (see Annex 1). Feedstock use of Annex II gases is not subject to reporting.

**Section 8 (destruction companies)**

Section 8 contains data on destruction during the reporting year using different methods (8A to 8C), summed as total destruction in 8D as well as stocks intended for destruction (8E, 8F).

**Section 9 (producers and importers)**

Starting in 2015, companies reported for the first time on authorisations that they have issued to third parties to use their HFC quota, specifying each recipient in Section 9A.

**Section 10 (producers and importers that received quota through the new entrants' reserve)**

In Section 10, companies specify physical supplies of F-gases accompanying authorisations, as reported in Section 9A. Reporters specify each recipient and are required to supply proof of delivery (receipts, etc.) for each one. This reporting section applies only to companies that received HFC quota fully based on a declaration according to Article 16(2) of the new F-gas Regulation and was used in 2016 for the first time.

**Section 11 (importers of equipment containing F-gases)**

Section 11 contains a detailed breakdown of the types of equipment imported by the reporting company. It differentiates between:

- equipment for refrigeration, air conditioning and heat pumps (RACHP) (containing HFCs in lines 11A to 11F) — summed in 11G;
- other types of equipment (11H to 11P).

The total content is found in line 11Q.

For each type of equipment, users must specify:

- the total quantity of equipment expressed in a suitable unit;
- the total amount of F-gases contained in this equipment.

From these numbers, specific charges per piece of equipment are determined. When equipment does not fall into pre-defined categories, users must report them in the respective 'Other' sections and provide a description of the equipment (11A3, 11D, 11E4, 11F9, 11H4, 11P) and/or the intended use of the equipment (11A9, 11A12, 11B3, 11B5, 11B7, 11B9, 11D). The full list of categories is contained in Table A2.1.

**Section 12 (applied for the first time in reporting on 2017 in 2018)**

In Section 12, companies may specify those amounts of HFCs in imported RACHP equipment, where the contained gas had been previously placed on the

EU market under the quota limitation, subsequently exported in bulk from the EU, then charged into equipment outside the EU and finally re-imported within equipment.

The companies that had placed the HFCs on the EU market in bulk and the companies that had exported the HFCs from the EU need to be specified, along with the respective years.

Such quantities of HFCs do not need to be covered by quota authorisation.

**Section 13a (producers and importers of bulk gases)**

In Section 13a, producers and importers of bulk gases have to specify the amount of gas placed on the market in the United Kingdom for the first time in the reporting year.

Section 13a is applicable to reporting data for 2018 and until and including the year in which EU law ceases to apply in the United Kingdom.

**Table A2.1 Equipment categories for reporting**

Code	Description
11A	Stationary equipment for comfort cooling or heating
11B	Stationary equipment for refrigeration
11C	Heat pump tumble dryers
11D	Stationary heating/air conditioning, including heat pumps as well as refrigeration (HACR) equipment for any other purposes
11E	Mobile refrigeration equipment
11F	Mobile air conditioning equipment
11G	Total RACHP equipment
11H	Foam products
11I	Fire protection equipment (including systems incorporated into vehicles)
11J	Medical or pharmaceutical aerosols
11K	Non-medical aerosols
11L	Medical equipment (without aerosols)
11M	Switch gear for transmission and distribution of electricity
11N	Other electrical transmission and distribution equipment
11O	Particle accelerators
11P	Other products and equipment containing gases listed in Annex I or Annex II of Regulation (EU) No 517/2014
11Q	Total of products and equipment containing F-gases listed in Annex I or Annex II of Regulation (EU) No 517/2014

Source: EU (2014a).

## Annex 3 Reporting forms under the old F-gas Regulation (EC) No 842/2006

The reporting format for submitting the F-gas reports under the old F-gas Regulation (EC) No 842/2006 was described in Regulation (EC) No 1493/2007 (EU, 2007b). The reported information is contained in the following sets of forms:

- Part 3 of the Reporting Form for Producers, Importers and Exporters of Fluorinated Greenhouse Gases (company information) <sup>(30)</sup>. This is to be completed by all companies and includes a statement of whether the company that reports as a producer of F-gases within the EU is an importer of F-gases into the EU and/or is an exporter of F-gases out of the EU. For production and import activities, the gas groups HFCs, perfluorocarbons (PFCs) and sulphur hexafluoride (SF<sub>6</sub>) need to be differentiated. Based on the choice of F-gas activities, a tailored set of data reporting sheets is offered to the user of the form.
- Co-producer forms — specific for HFCs, PFCs and SF<sub>6</sub>. These are to be completed by producers only. In these forms, purchases from and sales to other producers in the EU are to be reported by substance.
  - purchases from (E) and sales to (F) EU co-producers (item for producers only, sums of the figures in the respective co-producer forms);
  - amounts purchased from other EU sources (G) (item for producers only);
- Producer and importer forms — specific for HFCs, PFCs and SF<sub>6</sub>. These are to be completed by producers and importers. In these forms companies report by substance on:
  - production (A);
  - import (B);
  - export (C);
  - other amounts collected for reclamation or destruction from within the EU <sup>(31)</sup> (D);
  - stocks at 1 January (H) and 31 December (I) (for non-producers, covering previously imported quantities only; for producers, full stocks);
  - amount reclaimed by the reporting company (J);
  - amount destroyed by the reporting company (on-site) (K);
  - amount destroyed on behalf of the reporting company (off-site within the EU) (L);
  - amount used as a feedstock by the reporting company (M).

Of these amounts, a calculated total for the 'net amount available for sale in the EU' is determined according to the formula  $(A + B - C + D + E - F + G + H - I - K - L - M)$ .

Furthermore, reporting companies need to give their best estimates of the intended applications of the amounts 'placed on the EU market for the first time'. The total amount placed on the EU market does not include any quantities previously held by EU importers and/or distributors. Therefore, for non-producing importers, the sum of the figures reported for intended applications should equal the calculated total mentioned above. For producers, the sum of the figures reported for the intended applications should equal the calculated total minus any quantities sold on the EU market that were previously purchased from EU importers/

<sup>(30)</sup> Part 3 of the Reporting Form for Producers, Importers and Exporters of Fluorinated Greenhouse Gases (Annex to Commission Regulation (EC) No 1493/2007) was labelled 'company information' within the spreadsheet implementation of the reporting form used up to 2012. The term 'company information' was also used in the implementation of the online questionnaire in the BDR.

<sup>(31)</sup> In Regulation (EC) No 842/2006 and Commission Regulation (EC) No 1493/2007, the terms 'European Community', 'Community' and 'EC' are used. In this report, the terminology 'European Union', 'Union' or 'EU' respectively is used, as the European Community has been replaced by the European Union in accordance with the Treaty of Lisbon (EU, 2007a).

distributors in the present reporting year or in previous years.

- Importer Form 3: HFC preparations/HFC blend importer form <sup>(32)</sup>.  
This form is to be completed by HFC importers. The sheet is structured as in the 'producer and importer forms'. However, the producer-specific lines (A, E, F and G above) are missing. Instead of single substances, companies report on HFC preparations.
- Exporter Form.  
This form is to be completed by exporters with

amounts exported from the EU per substance/ preparation. In addition, the amounts exported for recycling, reclamation or destruction are also to be reported. All substances and preparations (HFCs, PFCs and SF<sub>6</sub>) are covered in the 'Exporter Form'.

The form sheets concerning HFCs and PFCs, as well as the Exporter Form, offer the possibility of adding substances or preparations in addition to those that are pre-defined. If a reporting company uses this option, the composition of an added preparation has to be stated. These functionalities were also implemented in the BDR online questionnaire.

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<sup>(32)</sup> In part 4 of the Reporting Form for Producers, Importers and Exporters of Fluorinated Greenhouse Gases (Annex to Commission Regulation (EC) No 1493/2007), this form is called 'Importer Form 3: HFC preparations', while it is labelled 'HFC Blends Importer Form' in the spreadsheet implementation of the reporting form. In this report, the names as set in Commission Regulation (EC) No 1493/2007 are used. The term 'blend' is commonly used by industry for 'preparations', as defined in Commission Regulation (EC) No 1493/2007.



# Annex 4 Calculation methods

This annex provides documentation for:

- calculation of EU supply (page 47);
- calculation of HFC amounts placed on the market under the EU HFC phase-down (page 48);
- calculation of HFC consumption under the international HFC phase-down under the Montreal Protocol (page 48).

Table A4.1 (page 50) provides a summary of the comparison between the three metrics.

The codes, (1A), (2A), etc., used in the following paragraphs refer to the codes of reportable transactions in the reporting form; see Annex 2.

Where calculation details for the period 2007-2013 are discussed, these refer to the reporting items as presented in Annex 3.

## Calculation of EU supply

### *Total supply (TS)*

'EU total supply' is a parameter that provides information on the actual use of F-gases by EU industries. Notably, TS also includes gases that are contained in exported products and equipment. Following the logic of the supply metrics used in this report, such gases count towards the gas demand of EU industries. 'EU total supply' is the sum of 'EU bulk supply' and 'EU supply in products/equipment'. It is comparable with the net supply metric used in earlier EEA reports on F-gases.

### *Bulk supply (BS)*

The 'bulk supply' metric is focused on emission-relevant supplies of bulk gases to EU industries and therefore does not cover EU supplies intended for feedstock or destruction. Starting in 2014, BS has been defined as:

$$BS = (\text{net production (1E = 1A to 1D)} + \text{full imports (2A)} - \text{full exports (3A)} + \text{1 January stocks from own import/production (4B)} - \text{31 December stocks from own import/production (4G)} + \text{reclamation (4K)} - \text{POM intended for destruction (6B)} - \text{feedstock use (7A)}).$$

Since 2018, the new reporting items on imports (2A\_pp) and exports (3A\_pp) of pre-blended polyols are considered — imports of pre-blended are subtracted and exports of pre-blended polyols are added in the equation for BS.

For the years 2007-2013, BS is calculated as follows:

$$BS = \text{production} + \text{imports} - \text{exports} + \text{1 January stocks} - \text{31 December stocks} + \text{reclamation} - \text{own feedstock use} - \text{intended application: feedstock}.$$

### *EU supply in products/equipment (SPE)*

The 'EU supply in products/equipment' metric covers the amount of F-gases that are imported into the EU within products or equipment and placed on the market. Exports of F-gases within products and equipment are not reported under the new F-gas Regulation (No 517/2014) or subtracted for the SPE metric. Thus, the SPE metric covers only imports, and it is not intended to cover the net flows of F-gases within products or equipment across EU borders.

SPE is calculated as the sum of all gases reported in Section 11 of the reporting questionnaire. No data on SPE were collected before 2014.

### *Intended applications of bulk or total supply*

In Section 6 of the reporting questionnaire, companies report on the intended applications of bulk gases supplied to the EU market (6X). This metric differs from bulk supply in the way it accounts for re-exports, amounts intended for destruction and feedstock. It is calculated as follows:

6X = (net) production (1E = 1A–1D) + full imports (2A) – re-exports within products of own bulk imports (2B) – bulk re-exports of own imports (3B) + 1 January stocks from own import/production (4B) – 31 December stocks from own import/production (4G) + reclamation (4K).

To estimate the intended applications of EU BS or TS, a four-step process is used:

1. Per gas, determine the proportion of each reported application in a subset of categories without export (6A), destruction (6B), leakage (6U) and accountancy adjustments (6V).
2. Assume leakage and accountancy adjustments in BS or TS to be equal to the amounts reported in Section 6 and subtract those from total BS or TS.
3. Apply the proportions determined in step 1 to the remainder of BS or TS.
4. Assign any remainder to the category 'Other or unknown applications' (6T).

### Calculation of HFC amounts placed on the market under the EU HFC phase-down

*The quota of relevant POM starting in 2015 is calculated as:*

bulk HFCs physically placed on the market (4M), converted into CO<sub>2</sub>e  
 minus  
 exemptions under Article 15(2) (5A + (5B) + 5C\_ exempted + 5D + 5E), converted into CO<sub>2</sub>e (5F is included in the exemptions from 2017)  
 plus  
 issued authorisations (9A).

*Bulk HFC POM in the years 2007-2013 is calculated per year and per company, based on data reported under the old F-gas Regulation (see Annex 3), as:*

HFC production, converted into CO<sub>2</sub>e  
 plus  
 HFC imports, converted into CO<sub>2</sub>e  
 minus  
 HFC exports, converted into CO<sub>2</sub>e  
 plus  
 1 January HFC stocks, converted into CO<sub>2</sub>e  
 minus  
 31 December HFC stocks, converted into CO<sub>2</sub>e  
 minus

HFCs used for feedstock, converted into CO<sub>2</sub>e  
 minus  
 HFC supplies intended for feedstock use, converted into CO<sub>2</sub>e.

When the amount thus calculated is negative for a given company in a given year, POM is set to zero before calculating the EU total as the sum of all companies.

### Calculation of HFC consumption under the international HFC phase-down under the Montreal Protocol

The HFCs considered under the Montreal Protocol are all HFCs, as listed in Annex I, Section 1, of the new F-gas Regulation No 517/2014 (see Annex 1, page 38), except HFC-161.

*HFC consumption starting in 2018 is calculated as follows:*

HFC production (1A), converted into CO<sub>2</sub>e  
 minus  
 HFC production for feedstock use within the EU (1A\_fs), converted into CO<sub>2</sub>e  
 plus  
 HFC imports (2A), converted into CO<sub>2</sub>e  
 minus  
 HFC imports of pre-blended polyols (2A\_pp), converted into CO<sub>2</sub>e  
 minus  
 imports of used, recycled or reclaimed HFCs (2C), converted into CO<sub>2</sub>e  
 minus  
 virgin HFC imports for feedstock use (2D), converted into CO<sub>2</sub>e  
 minus  
 virgin HFC imports exempted under the Montreal Protocol (2E), converted into CO<sub>2</sub>e (2E is not yet applicable, as no exemptions have been agreed so far under the Montreal Protocol)  
 minus  
 HFC exports (3A), converted into CO<sub>2</sub>e  
 plus  
 HFC exports of pre-blended polyols (3A\_pp), converted into CO<sub>2</sub>e  
 plus  
 exports of used, recycled or reclaimed HFCs (3G), converted into CO<sub>2</sub>e  
 plus  
 virgin HFC exports for feedstock use (3H), converted into CO<sub>2</sub>e  
 plus

virgin HFC exports exempted under the Montreal Protocol (3I), converted into CO<sub>2</sub>e  
 (3I is not yet applicable, as no exemptions have been agreed so far under the Montreal Protocol)  
 minus  
 total HFC destruction (8D), converted into CO<sub>2</sub>e.

***HFC consumption for the period 2014-2017 is calculated as follows:***

HFC production (1A), converted into CO<sub>2</sub>e  
 plus  
 HFC imports (2A), converted into CO<sub>2</sub>e  
 minus  
 HFC exports (3A), converted into CO<sub>2</sub>e  
 plus  
 HFC exports for recycling (3D), converted into CO<sub>2</sub>e  
 plus  
 HFC exports for reclamation (3E), converted into CO<sub>2</sub>e  
 plus  
 HFC exports for destruction (3F), converted into CO<sub>2</sub>e  
 minus  
 HFC feedstock use (7A), converted into CO<sub>2</sub>e  
 minus  
 total HFC destruction (8D), converted into CO<sub>2</sub>e.

***HFC consumption up until 2013 is calculated from data reported under the old F-gas Regulation (see Annex 3) as follows:***

HFC production, converted into CO<sub>2</sub>e  
 plus  
 HFC imports, converted into CO<sub>2</sub>e  
 minus  
 HFC exports, converted into CO<sub>2</sub>e  
 plus  
 HFC exports for recycling, reclamation or destruction, converted into CO<sub>2</sub>e  
 minus  
 reporting companies' own HFC destruction, converted into CO<sub>2</sub>e  
 minus  
 HFC amounts supplied by reporting companies to third parties for destruction, converted into CO<sub>2</sub>e  
 minus  
 HFCs used for feedstock, converted into CO<sub>2</sub>e  
 minus  
 HFC supplies intended for feedstock use, converted into CO<sub>2</sub>e

## Comparison of supply, POM and consumption metrics

**Table A4.1** Scope of supply, POM and consumption metrics

		Supply	POM, relevant to compliance with the EU HFC phase-down	Consumption, relevant to compliance with the MP HFC phase-down	
		Covered gases	Applicable to total F-gases and single gases/gas groups (e.g. HFCs)	HFCs of Annex I of EU F-gas Regulation No 517/2014, including HFC shares and non-HFC shares of HFC-containing mixtures	HFCs of Annex I of EU F-Gas Regulation No 517/2014, except HFC-161, including HFC shares of HFC-containing mixtures
		Units used	Both physical tonnes and t CO <sub>2</sub> e	t CO <sub>2</sub> e	t CO <sub>2</sub> e
Transactions covered	Type of contribution				
Production		Plus	Yes	Yes	Yes
Reclamation		Plus	Yes	No	No
Recycling		Plus	No	No	No
Bulk imports		Plus	Yes	Yes	Yes (except import of recycled and used bulk HFCs)
Imports in products and equipment	Pre-blended polyols	Plus	Yes	Yes	No
	RACHP equipment	Plus	Yes	2015-2016: no Since 2017, only amounts not covered by quota authorisations.	No
	Other products and equipment	Plus	Yes	No	No
Bulk exports		Minus	Yes	Exports from own production and exports from own imports are subtracted. Other bulk exports subtracted if directly supplied by the importer/producer to the exporter (exemption Art. 15(2)c).	Yes (except export of recycled and used bulk HFCs)
Exports in products and equipment	Pre-blended polyols	Minus	Yes	Exports of pre-blended polyols are treated like bulk exports.	No
	Other products and equipment	Minus	No	Considered in case the contained gases had never been placed on the market after bulk import (re-export).	No
Destruction		Minus	Only destruction of EU production, destroyed before POM and imports for destruction. Destruction of used gases recovered within the EU is not subtracted.	Only destruction of EU production, destroyed before POM and imports for destruction (exemption Art. 15(2)a). Destruction of used gases recovered within the EU is not subtracted.	Yes

**Table A4.1 Scope of supply, POM and consumption metrics (cont.)**

		Supply	POM, relevant to compliance with the EU HFC phase-down	Consumption, relevant to compliance with the MP HFC phase-down
	Covered gases	Applicable to total F-gases and single gases/gas groups (e.g. HFCs)	HFCs of Annex I of EU F-gas Regulation No 517/2014, including HFC shares and non-HFC shares of HFC-containing mixtures	HFCs of Annex I of EU F-Gas Regulation No 517/2014, except HFC-161, including HFC shares of HFC-containing mixtures
	Units used	Both physical tonnes and t CO <sub>2</sub> e	t CO <sub>2</sub> e	t CO <sub>2</sub> e
Transactions covered	Type of contribution			
Feedstock use	Minus	Yes	Yes (exemption Art. 15(2)b)	Yes (HFC production for feedstock use in the EU and HFC import for feedstock use)
Supplies to military uses	Minus	No	Yes (exemption Art. 15(2)d)	No
Supplies to semiconductor industry	Minus	No	Yes (exemption Art. 15(2)e)	No
Supplies to pharmaceutical MDIs	Minus	No	Not considered 2015-2017. Considered 2018 onwards (exemption Art. 15(2)f).	No
1 January stocks	Plus	Full stocks from own production or own import considered, Stocks from EU purchases not considered	Only those stocks from own production or own import considered that have not yet been placed on the market; stocks from EU purchases and stocks from own imports/own production already placed on the market not considered.	No
31 December stocks	Minus			
HFC quota authorisations issued by producers/importers	Plus	No	Yes	No

**Note:** MDIs, metered dose inhalers; MP, Montreal Protocol.

# Annex 5 Data tables

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## Measures to protect confidential data

The EEA takes appropriate steps to protect the confidentiality of commercially sensitive information in accordance with Article 19(8) of the new F-gas Regulation. Throughout the report, three rules are applied to all numbers and figures to determine whether a data item must remain confidential.

**Three-company group rule.** This rule stipulates that any value that is published must be the sum of at least three different companies. In addition, companies are invited to specify affiliates in their report. These groups of affiliates, if mutually confirmed, count as one company for the purpose of this evaluation.

**5 % significance rule.** The contributions of small companies to any value may be insignificant, and larger companies' confidentiality may be compromised in spite of the first rule. Therefore, a value remains confidential if fewer than three companies make up more than 95 % of the total, discounting the smallest contributors that make up 5 % of the sum.

**Preventing deduction.** Deduction might be possible when a confidential value is part of a sum of substances or transactions. For example, a confidential value for SF<sub>6</sub> may be deduced if there are figures published for PFCs as well as a total for SF<sub>6</sub> and PFCs. In the case of metrics such as 'supply', a confidential value, e.g. for 'production', may be deduced if values for both 'import' and 'export' are known and the remainder of small transactions that make up 'supply' is very small. Therefore, two steps are taken:

- In cases in which a sum across substances or transactions is published, and there is only one contributing value to that sum that is confidential according to the above rules, a second part of the sum is made confidential to make sure that the lone confidential value cannot be deduced from the sum and remaining parts.
- In the case of supply metrics, a second of the major contributors (production, import and export) is made confidential if one of them is confidential according to the above rules and the remainder of small transactions makes up less than 5 % of the total.

### A practical guide to applying the 'three-company group rule' and the '5 % significance rule' measures to data

Operationalisation of the combined three-company group rule and 5 % significance rule

Step 1: all values reported by companies of a given company group for a given transaction year were added up for a given transaction and substance or substance group.

$$\sum X_i = X_1 + X_2 + \dots + X_n$$

$X_i$  = individual reported value by a single reporting undertaking

$$\sum X_i = \text{sum of individual reported values by reporting undertakings}$$

belonging to the same company group

Step 2: the sum of all absolute contributions ( $\sum |\sum X_i|$ ) across company groups was calculated.

Step 3: the percentage of step 1 in relation to step 2 was calculated for each company group.

$$\% = \frac{|\sum X_i|}{\sum |\sum X_i|} \cdot 100$$

Step 4: the company groups were sorted in ascending order of the percentages calculated in step 3.

Step 5: an accumulated percentage was calculated across the sorted company groups.

Step 6: the number of company groups for which the accumulated percentage was larger than 5 % was counted.

If the number of company groups counted in step 6 was one or two, the full aggregated value across company groups was hidden as confidential. If the number was three or more, the full aggregated value across company groups was reported and was thus not confidential.

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**Table A5.1 EU production of F-gases (tonnes)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Tonnes</b>											
HFCs	55 235	38 519	33 106	43 792	41 040	40 854	36 717	31 050	32 339	33 380	27 713	19 270
PFCs	C	C	C	C	C	C	C	C	209	C	328	322
SF <sub>6</sub>	C	C	C	C	C	C	C	C	C	C	C	C
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	—	—
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	—	—
<b>Total F-gases</b>	<b>58 098</b>	<b>41 359</b>	<b>35 123</b>	<b>46 440</b>	<b>44 030</b>	<b>44 220</b>	<b>39 909</b>	<b>34 049</b>	<b>35 377</b>	<b>36 159</b>	<b>30 345</b>	<b>21 787</b>
<i>Average GWP</i>	<i>3 012</i>	<i>3 361</i>	<i>3 088</i>	<i>3 226</i>	<i>3 432</i>	<i>3 508</i>	<i>3 573</i>	<i>3 723</i>	<i>3 419</i>	<i>3 293</i>	<i>3 470</i>	<i>4 054</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) were not subject to reporting for the years 2007-2013. '—', no data reported; C, confidential; hydrochlorofluorocarbons, HCFCs; HFEs, hydrofluoroethers; n.a., not applicable; NF<sub>3</sub>, nitrogen trifluoride.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.2 EU production of F-gases (CO<sub>2</sub>e)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Million tonnes of CO<sub>2</sub>e</b>											
HFCs	112.2	75.6	63.3	91.1	85.0	81.4	73.1	61.1	54.6	58.6	49.6	35.3
PFCs	C	C	C	C	C	C	C	C	1.9	C	3.1	3.0
SF <sub>6</sub>	C	C	C	C	C	C	C	C	C	C	C	C
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	-	—	—
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	—	—
<b>Total F-gases</b>	<b>175.0</b>	<b>139.0</b>	<b>108.4</b>	<b>149.8</b>	<b>151.1</b>	<b>155.1</b>	<b>142.6</b>	<b>126.8</b>	<b>121.0</b>	<b>119.1</b>	<b>105.3</b>	<b>88.3</b>
<i>Average GWP</i>	<i>3 012</i>	<i>3 361</i>	<i>3 088</i>	<i>3 226</i>	<i>3 432</i>	<i>3 508</i>	<i>3 573</i>	<i>3 723</i>	<i>3 419</i>	<i>3 293</i>	<i>3 470</i>	<i>4 054</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) were not subject to reporting for the years 2007-2013. '—', no data reported; C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.3 EU reclamation of F-gases (tonnes)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Tonnes</b>											
HFCs	353	337	100	301	475	460	474	377	647	1 314	1 681	1 829
PFCs	—	—	—	—	—	C	—	C	C	C	C	C
SF <sub>6</sub>	C	C	77	C	C	C	C	C	C	C	69	C
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	—	—
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	C	—
<b>Total F-gases</b>	<b>417</b>	<b>398</b>	<b>177</b>	<b>326</b>	<b>508</b>	<b>487</b>	<b>484</b>	<b>416</b>	<b>679</b>	<b>1 364</b>	<b>1 773</b>	<b>1 934</b>
<i>Average GWP</i>	<i>4 919</i>	<i>4 860</i>	<i>10 963</i>	<i>3 961</i>	<i>3 498</i>	<i>3 321</i>	<i>2 555</i>	<i>4 250</i>	<i>3 527</i>	<i>3 033</i>	<i>3 173</i>	<i>3 223</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) were not subject to reporting for the years 2007-2013.  
 '—', no data reported; C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.4 EU reclamation of F-gases (CO<sub>2</sub>e)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Million tonnes of CO<sub>2</sub>e</b>											
HFCs	0.6	0.5	0.2	0.7	1.0	1.0	1.0	0.9	1.7	3.1	4.0	4.8
PFCs	—	—	—	—	—	C	—	C	C	C	C	C
SF <sub>6</sub>	C	C	1.8	C	C	C	C	C	C	C	1.6	C
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	—	—
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	C	—
<b>Total F-gases</b>	<b>2.1</b>	<b>1.9</b>	<b>1.9</b>	<b>1.3</b>	<b>1.8</b>	<b>1.6</b>	<b>1.2</b>	<b>1.8</b>	<b>2.4</b>	<b>4.1</b>	<b>5.6</b>	<b>6.2</b>
<i>Average GWP</i>	<i>4 919</i>	<i>4 860</i>	<i>10 963</i>	<i>3 961</i>	<i>3 498</i>	<i>3 321</i>	<i>2 555</i>	<i>4 250</i>	<i>3 527</i>	<i>3 033</i>	<i>3 173</i>	<i>3 223</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and w and other perfluorinated compounds) were not subject to reporting for the years 2007-2013.  
 '—', no data reported; C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA, (2018, 2019b).

**Table A5.5 Total EU imports of F-gases (tonnes)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Tonnes</b>											
HFCs	58 519	67 951	57 946	69 089	66 269	61 102	65 221	128 452	78 026	78 938	88 689	77 069
PFCs	253	306	129	230	238	310	155	350	409	363	498	416
SF <sub>6</sub>	747	691	671	539	587	374	483	430	382	420	565	413
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1 900	3 413	C	14 609	19 218
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	333	305	492	494	412
<b>Total F-gases</b>	<b>59 518</b>	<b>68 948</b>	<b>58 746</b>	<b>69 858</b>	<b>67 094</b>	<b>61 787</b>	<b>65 859</b>	<b>131 794</b>	<b>82 910</b>	<b>86 878</b>	<b>104 994</b>	<b>97 981</b>
<i>Average GWP</i>	<i>2 215</i>	<i>2 227</i>	<i>2 412</i>	<i>2 287</i>	<i>2 232</i>	<i>2 172</i>	<i>2 257</i>	<i>2 209</i>	<i>2 170</i>	<i>2 113</i>	<i>1 889</i>	<i>1 523</i>

**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) and HFCs, PFCs and SF<sub>6</sub> in products and equipment were not subject to reporting for the years 2007-2013. The data shown for the years 2007-2013 are thus limited to bulk imports.  
C, confidential; 'n.a.', not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.6 Total EU imports of F-gases (CO<sub>2</sub>e)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Million tonnes of CO<sub>2</sub>e</b>											
HFCs	112.2	134.6	125.1	145.0	133.9	122.5	136.0	272.1	161.9	161.9	172.1	128.6
PFCs	2.6	3.2	1.4	2.5	2.5	3.2	1.6	3.4	3.9	3.6	4.7	4.0
SF <sub>6</sub>	17.0	15.8	15.3	12.3	13.4	8.5	11.0	9.8	8.7	9.6	12.9	9.4
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.0	0.0	C	0.1	0.1
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5.7	5.2	8.5	8.5	7.1
<b>Total F-gases</b>	<b>131.8</b>	<b>153.6</b>	<b>141.7</b>	<b>159.7</b>	<b>149.7</b>	<b>134.2</b>	<b>148.7</b>	<b>291.1</b>	<b>179.9</b>	<b>183.6</b>	<b>198.3</b>	<b>149.3</b>
<i>Average GWP</i>	<i>2 215</i>	<i>2 227</i>	<i>2 412</i>	<i>2 287</i>	<i>2 232</i>	<i>2 172</i>	<i>2 257</i>	<i>2 209</i>	<i>2 170</i>	<i>2 113</i>	<i>1 889</i>	<i>1 523</i>

**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) and HFCs, PFCs and SF<sub>6</sub> in products and equipment were not subject to reporting for the years 2007-2013. The data shown for the years 2007-2013 are thus limited to bulk imports.  
C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.7 EU bulk imports of F-gases (tonnes)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Tonnes</b>											
HFCs	58 519	67 951	57 946	69 089	66 269	61 102	65 221	122 781	70 993	68 971	79 736	67 116
PFCs	C	306	129	230	C	310	155	C	388	355	496	416
SF <sub>6</sub>	C	691	671	539	C	374	483	412	377	417	563	394
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	305	492	494	412
<b>Total F-gases</b>	<b>59 518</b>	<b>68 948</b>	<b>58 746</b>	<b>69 858</b>	<b>67 094</b>	<b>61 787</b>	<b>65 859</b>	<b>125 986</b>	<b>75 606</b>	<b>76 247</b>	<b>95 171</b>	<b>87 176</b>
<i>Average GWP</i>	<i>2 215</i>	<i>2 227</i>	<i>2 412</i>	<i>2 287</i>	<i>2 232</i>	<i>2 172</i>	<i>2 257</i>	<i>2 218</i>	<i>2 196</i>	<i>2 149</i>	<i>1 898</i>	<i>1 515</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) were not subject to reporting for the years 2007-2013.  
C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.8 EU bulk imports of F-gases (CO<sub>2</sub>e)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Million tonnes of CO<sub>2</sub>e</b>											
HFCs	112.2	134.6	125.1	145.0	133.9	122.5	136.0	260.9	148.3	142.3	154.6	111.8
PFCs	C	3.2	1.4	2.5	C	3.2	1.6	C	3.8	3.5	4.7	4.0
SF <sub>6</sub>	C	15.8	15.3	12.3	C	8.5	11.0	9.4	8.6	9.5	12.8	9.0
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	5.2	8.5	8.5	7.1
<b>Total F-gases</b>	<b>131.8</b>	<b>153.6</b>	<b>141.7</b>	<b>159.7</b>	<b>149.7</b>	<b>134.2</b>	<b>148.7</b>	<b>279.4</b>	<b>166.0</b>	<b>163.8</b>	<b>180.7</b>	<b>132.1</b>
<i>Average GWP</i>	<i>2 215</i>	<i>2 228</i>	<i>2 412</i>	<i>2 287</i>	<i>2 232</i>	<i>2 172</i>	<i>2 258</i>	<i>2 218</i>	<i>2 196</i>	<i>2 149</i>	<i>1 899</i>	<i>1 515</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) were not subject to reporting for the years 2007-2013.  
C: confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.9 EU imports of F-gases within products and equipment (tonnes)**

Gas group	2014	2015	2016	2017	2018
	Tonnes				
HFCs	5 671	7 033	9 967	8 953	9 028
PFCs	C	21	C	2	1
SF <sub>6</sub>	C	C	2	2	19
Unsaturated HFCs and HCFCs	C	C	652	863	832
HFEs and alcohols	—	C	C	C	C
NF <sub>3</sub> and other perfluorinated compounds	—	—	—	—	—
<b>Total F-gases</b>	<b>5 808</b>	<b>7 304</b>	<b>10 631</b>	<b>9 823</b>	<b>9 879</b>
<i>Average GWP</i>	<i>2 015</i>	<i>1 898</i>	<i>1 860</i>	<i>1 792</i>	<i>1 574</i>

**Note:** '—', no data reported; C, confidential.

**Sources:** EEA (2018, 2019b).

**Table A5.10 EU imports of F-gases within products and equipment (CO<sub>2</sub>e)**

Gas group	2014	2015	2016	2017	2018
	Million tonnes of CO <sub>2</sub> e				
HFCs	11.2	13.6	19.7	17.5	15.1
PFCs	C	0.2	C	0.0	0.0
SF <sub>6</sub>	C	C	0.1	0.1	0.4
Unsaturated HFCs and HCFCs	C	C	0.0	0.0	0.0
HFEs and alcohols	—	C	C	C	0.0
NF <sub>3</sub> and other perfluorinated compounds	—	—	—	—	—
<b>Total F-gases</b>	<b>11.7</b>	<b>13.9</b>	<b>19.8</b>	<b>17.6</b>	<b>15.6</b>
<i>Average GWP</i>	<i>2 015</i>	<i>1 898</i>	<i>1 860</i>	<i>1 792</i>	<i>1 574</i>

**Note:** '—', no data reported; C, confidential.

**Sources:** EEA (2018, 2019b).

**Table A5.11 Categories of imports of F-gases in products and equipment (tonnes)**

	2014	2015	2016	2017	2018
<b>Categories of products and equipment</b>	<b>Tonnes</b>				
Stationary equipment for comfort cooling or heating	4 698	5 239	8 325	7 680	7 932
Stationary equipment for refrigeration	32	76	96	81	55
Heat pump tumble dryers	C	144	189	218	278
Other stationary RACHP equipment	86	127	265	245	248
Mobile refrigeration equipment	C	C	20	16	17
Mobile air conditioning equipment	798	1 205	1 405	1 210	1 194
Foam products	C	C	C	—	—
Fire protection equipment	—	10	C	—	—
Medical or pharmaceutical aerosols	69	131	143	C	C
Non-medical aerosols	C	C	C	291	56
Other medical equipment (without aerosols)	—	—	—	—	—
Electrical switchgear	C	5	2	2	19
Other electrical equipment	C	C	C	C	—
Particle accelerators	—	—	—	—	—
Other products and equipment	C	C	—	—	—
<b>Total supply in products and equipment</b>	<b>5 808</b>	<b>7 304</b>	<b>10 631</b>	<b>9 823</b>	<b>9 879</b>

**Note:** '—', no data reported; C, confidential.

**Sources:** EEA (2018, 2019b).

**Table A5.12 Categories of imports of F-gases in products and equipment (CO<sub>2</sub>e)**

	2014	2015	2016	2017	2018
<b>Categories of products and equipment</b>	<b>Million tonnes of CO<sub>2</sub>e</b>				
Stationary equipment for comfort cooling or heating	9.8	10.8	17.1	15.6	13.4
Stationary equipment for refrigeration	0.1	0.3	0.2	0.2	0.1
Heat pump tumble dryers	C	0.2	0.3	0.3	0.3
Other stationary RACHP equipment	0.1	0.2	0.4	0.4	0.4
Mobile refrigeration equipment	C	C	0.0	0.0	0.0
Mobile air conditioning equipment	1.0	1.4	1.1	0.5	0.6
Foam products	C	C	C	—	—
Fire protection equipment	—	0.0	C	—	—
Medical or pharmaceutical aerosols	0.1	0.2	0.2	C	C
Non-medical aerosols	C	C	C	0.4	0.1
Other medical equipment (without aerosols)	—	—	—	—	—
Electrical switchgear	C	0.1	0.0	0.1	0.4
Other electrical equipment	C	C	C	C	—
Particle accelerators	—	—	—	—	—
Other products and equipment	C	C	—	—	—
<b>Total supply in products and equipment</b>	<b>11.7</b>	<b>13.9</b>	<b>19.8</b>	<b>17.6</b>	<b>15.6</b>

**Note:** '—', no data reported; C, confidential.

**Sources:** EEA (2018, 2019b).

**Table A5.13 EU bulk exports of F-gases (tonnes)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Tonnes</b>											
HFCs	24 162	19 187	15 720	20 455	21 330	21 171	21 699	26 239	25 577	27 414	29 177	28 681
PFCs	83	57	25	C	C	255	253	91	95	132	176	C
SF <sub>6</sub>	1 670	1 499	1 423	C	C	2 021	1 871	2 522	2 426	C	1 669	1 862
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	8	10
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	10	6
<b>Total F-gases</b>	<b>25 915</b>	<b>20 742</b>	<b>17 168</b>	<b>22 233</b>	<b>23 383</b>	<b>23 448</b>	<b>23 822</b>	<b>29 065</b>	<b>28 417</b>	<b>30 274</b>	<b>32 058</b>	<b>31 992</b>
<i>Average GWP</i>	<i>3 140</i>	<i>3 342</i>	<i>3 531</i>	<i>3 411</i>	<i>3 630</i>	<i>3 599</i>	<i>3 405</i>	<i>3 469</i>	<i>3 506</i>	<i>3 263</i>	<i>2 829</i>	<i>2 864</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) were not subject to reporting for the years 2007-2013.  
Data given for the years 2014-2016 include gases exported in pre-blended polyols.  
C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.14 EU bulk exports of F-gases (CO<sub>2</sub>e)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Million tonnes of CO<sub>2</sub>e</b>											
HFCs	42.5	34.6	27.9	36.4	39.3	35.9	36.0	42.4	43.2	50.7	50.8	47.9
PFCs	0.8	0.5	0.2	C	C	2.4	2.4	0.8	0.9	1.3	1.7	C
SF <sub>6</sub>	38.1	34.2	32.4	C	C	46.1	42.7	57.5	55.3	C	38.0	42.5
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	0.0	0.0
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	0.2	0.1
<b>Total F-gases</b>	<b>81.4</b>	<b>69.3</b>	<b>60.6</b>	<b>75.8</b>	<b>84.9</b>	<b>84.4</b>	<b>81.1</b>	<b>100.8</b>	<b>99.6</b>	<b>98.8</b>	<b>90.7</b>	<b>91.6</b>
<i>Average GWP</i>	<i>3 140</i>	<i>3 342</i>	<i>3 531</i>	<i>3 411</i>	<i>3 630</i>	<i>3 599</i>	<i>3 405</i>	<i>3 469</i>	<i>3 506</i>	<i>3 263</i>	<i>2 829</i>	<i>2 864</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) were not subject to reporting for the years 2007-2013.  
Data given for the years 2014-2016 include gases exported in pre-blended polyols.  
'—', no data reported; C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

Table A5.15 Total EU supply of F-gases (tonnes)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas</b>	<b>Tonnes</b>											
HFC-23	C	C	C	299	306	137	C	94	78	63	95	54
HFC-32	3 987	5 086	4 430	5 390	4 930	5 025	5 334	11 060	9 384	11 022	12 099	14 647
HFC-41	C	—	C	C	C	C	C	1	2	1	1	1
HFC-125	12 371	12 501	13 992	18 248	15 345	15 598	15 116	25 476	17 916	18 701	17 340	12 938
HFC-134	C	C	—	C	—	—	—	—	C	C	—	—
HFC-134a	49 080	46 174	41 440	43 657	40 201	40 060	39 334	60 771	46 282	44 184	40 911	32 543
HFC-143	C	—	—	C	C	—	—	—	—	—	—	—
HFC-143a	8 998	9 817	9 620	10 572	8 854	9 007	8 817	13 512	7 069	7 205	6 006	C
HFC-152a	4 292	6 162	5 182	4 695	4 676	4 175	3 657	6 227	3 914	3 431	3 552	3 245
HFC-227ea	C	C	C	C	C	C	C	2 695	1 977	1 754	1 628	1 387
HFC-236fa	C	C	C	C	44	31	C	52	40	42	37	18
HFC-245ca	—	—	—	—	—	—	—	—	—	C	—	—
HFC-245fa	C	C	C	C	C	C	C	C	C	C	C	C
HFC-365mfc	C	C	C	C	C	C	C	C	C	C	C	C
HFC-43-10mee	C	C	50	C	C	C	C	C	C	C	C	C
PFC-14	C	C	42	59	56	C	C	147	168	152	196	170
PFC-116	93	178	113	C	C	C	C	157	164	129	148	137
PFC-218	C	59	C	24	23	40	38	41	59	37	23	32
PFC-c-318	C	6	3	6	10	C	C	14	27	26	39	128
PFC-3-1-10	C	C	—	C	C	C	C	C	C	C	C	C
PFC-4-1-12	—	—	—	—	—	—	—	C	C	C	—	—
PFC-5-1-14	C	C	C	C	C	C	C	C	C	117	C	C
SF <sub>6</sub>	C	C	C	C	C	C	C	C	C	C	1 225	C
HCFC-1233xf	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	C	C	—
HCFC-1233zd	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFC-1234yf	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	826	1 928	5 214	10 574	11 437
HFC-1234ze	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFC-1336mzz	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFE-236fa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	-0	—
HFE-245fa1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	C	—	—
HFE-347mcc3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFE-347pcf2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	0	—
HFE-449sl	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFE-569sf2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
2 2 3 3 3-pentafluoropropanol	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	-0	C	C	C
bis(trifluoromethyl)-methanol	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	1	C	C	C
NF <sub>3</sub>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	321	339	381	492	433
PFPME	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	—	—	—	C



**Table A5.15 Total EU supply of F-gases (tonnes) (cont.)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas</b>	<b>Tonnes</b>											
<b>Gas group</b>												
HFCs	86 477	87 311	81 005	89 924	81 829	80 982	79 224	124 408	92 090	91 593	87 559	68 957
PFCs	C	398	C	C	C	C	C	C	C	C	649	563
SF <sub>6</sub>	C	C	C	C	C	C	C	C	C	C	1 225	C
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1 306	2 544	6 305	13 400	17 750
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	321	339	381	492	432
<b>Total F-gases</b>	<b>88 586</b>	<b>89 569</b>	<b>82 681</b>	<b>91 749</b>	<b>83 620</b>	<b>82 715</b>	<b>80 898</b>	<b>127 547</b>	<b>96 779</b>	<b>100 050</b>	<b>103 452</b>	<b>88 934</b>
<i>Average GWP</i>	<i>2 410</i>	<i>2 433</i>	<i>2 451</i>	<i>2 521</i>	<i>2 489</i>	<i>2 470</i>	<i>2 474</i>	<i>2 241</i>	<i>2 187</i>	<i>2 142</i>	<i>2 026</i>	<i>1 647</i>

**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) and HFCs, PFCs and SF<sub>6</sub> in products and equipment were not subject to reporting for the years 2007-2013. The data shown for the years 2007-2013 are thus limited to bulk supply.  
 '—', no data reported; C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

Table A5.16 Total EU supply of F-gases (CO<sub>2</sub>e)

Gas	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Million tonnes of CO <sub>2</sub> e											
HFC-23	C	C	C	4.4	4.5	2.0	C	1.4	1.2	0.9	1.4	0.8
HFC-32	2.7	3.4	3.0	3.6	3.3	3.4	3.6	7.5	6.3	7.4	8.2	9.9
HFC-41	C	—	C	C	C	C	C	0.0	0.0	0.0	0.0	0.0
HFC-125	43.3	43.8	49.0	63.9	53.7	54.6	52.9	89.2	62.7	65.5	60.7	45.3
HFC-134	C	C	—	C	—	—	—	—	C	C	—	—
HFC-134a	70.2	66.0	59.3	62.4	57.5	57.3	56.2	86.9	66.2	63.2	58.5	46.5
HFC-143	C	—	—	C	C	—	—	—	—	—	—	—
HFC-143a	40.2	43.9	43.0	47.3	39.6	40.3	39.4	60.4	31.6	32.2	26.8	C
HFC-152a	0.5	0.8	0.6	0.6	0.6	0.5	0.5	0.8	0.5	0.4	0.4	0.4
HFC-227ea	C	C	C	C	C	C	C	8.7	6.4	5.6	5.2	4.5
HFC-236fa	C	C	C	C	0.4	0.3	C	0.5	0.4	0.4	0.4	0.2
HFC-245ca	—	—	—	—	—	—	—	—	—	C	—	—
HFC-245fa	C	C	C	C	C	C	C	C	C	C	C	C
HFC-365mfc	C	C	C	C	C	C	C	C	C	C	C	C
HFC-43-10mee	C	C	0.1	C	C	C	C	C	C	C	C	C
PFC-14	C	C	0.3	0.4	0.4	C	C	1.1	1.2	1.1	1.4	1.3
PFC-116	1.1	2.2	1.4	C	C	C	C	1.9	2.0	1.6	1.8	1.7
PFC-218	C	0.5	C	0.2	0.2	0.4	0.3	0.4	0.5	0.3	0.2	0.3
PFC-c-318	C	0.1	0.0	0.1	0.1	C	C	0.1	0.3	0.3	0.4	1.3
PFC-3-1-10	C	C	—	C	C	C	C	C	C	C	C	C
PFC-4-1-12	—	—	—	—	—	—	—	C	C	C	—	—
PFC-5-1-14	C	C	C	C	C	C	C	C	C	1.1	C	C
SF <sub>6</sub>	C	C	C	C	C	C	C	C	C	C	27.9	C
HCFC-1233xf	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	C	C	—
HCFC-1233zd	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFC-1234yf	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.0	0.0	0.0	0.0	0.0
HFC-1234ze	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFC-1336mzz	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFE-236fa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	-0.0	—
HFE-245fa1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	C	—	—
HFE-347mcc3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFE-347pcf2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	—	—	—	0.0	—
HFE-449sl	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFE-569sf2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
2,2,3,3,3-pentafluoropropanol	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	-0.0	C	C	C
bis(trifluoromethyl)-methanol	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	0.0	C	C	C
NF <sub>3</sub>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5.5	5.8	6.6	8.5	7.4
PFPMIE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	—	—	—	C

**Table A5.16 Total EU supply of F-gases (CO<sub>2</sub>e) (cont.)**

Gas	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Million tonnes of CO <sub>2</sub> e											
Gas group												
HFCs	169.3	171.5	167.4	193.5	171.0	167.9	163.8	259.2	179.9	180.4	167.0	114.3
PFCs	C	4.0	C	C	C	C	C	C	C	C	6.1	5.4
SF <sub>6</sub>	C	C	C	C	C	C	C	C	C	C	27.9	C
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.0	0.0	0.0	0.1	0.1
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5.5	5.8	6.6	8.5	7.4
<b>Total F-gases</b>	<b>213.5</b>	<b>218.0</b>	<b>202.6</b>	<b>231.3</b>	<b>208.2</b>	<b>204.3</b>	<b>200.1</b>	<b>285.8</b>	<b>211.6</b>	<b>214.3</b>	<b>209.6</b>	<b>146.4</b>

**Notes:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) and HFCs, PFCs and SF<sub>6</sub> in products and equipment were not subject to reporting for the years 2007-2013. The data shown for the years 2007-2013 are thus limited to bulk supply.

'—', no data reported; C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.17 EU bulk supply of F-gases (tonnes)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Tonnes</b>											
HFCs	86 477	87 311	81 005	89 924	81 829	80 982	79 224	118 737	85 057	81 626	78 605	58 635
PFCs	C	398	C	C	C	C	C	C	C	457	647	562
SF <sub>6</sub>	C	C	C	C	C	C	C	C	C	C	1 223	C
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	321	339	381	492	432
<b>Total F-gases</b>	<b>88 586</b>	<b>89 569</b>	<b>82 681</b>	<b>91 749</b>	<b>83 620</b>	<b>82 715</b>	<b>80 898</b>	<b>121 739</b>	<b>89 475</b>	<b>89 419</b>	<b>93 630</b>	<b>77 761</b>
<i>Average GWP</i>	<i>2 410</i>	<i>2 433</i>	<i>2 451</i>	<i>2 521</i>	<i>2 489</i>	<i>2 470</i>	<i>2 474</i>	<i>2 251</i>	<i>2 210</i>	<i>2 176</i>	<i>2 050</i>	<i>1 648</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) were not subject to reporting for the years 2007-2013.  
C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.18 EU bulk supply of F-gases (CO<sub>2</sub>e)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Gas group</b>	<b>Million tonnes of CO<sub>2</sub>e</b>											
HFCs	169.3	171.5	167.4	193.5	171.0	167.9	163.8	248.0	166.4	160.7	149.4	96.5
PFCs	C	4.0	C	C	C	C	C	C	C	4.3	6.1	5.4
SF <sub>6</sub>	C	C	C	C	C	C	C	C	C	C	27.9	C
Unsaturated HFCs and HCFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
HFEs and alcohols	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	C	C	C	C	C
NF <sub>3</sub> and other perfluorinated compounds	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5.5	5.8	6.6	8.5	7.4
<b>Total F-gases</b>	<b>213.5</b>	<b>218.0</b>	<b>202.6</b>	<b>231.3</b>	<b>208.2</b>	<b>204.3</b>	<b>200.1</b>	<b>274.1</b>	<b>197.8</b>	<b>194.6</b>	<b>192.0</b>	<b>128.2</b>
<i>Average GWP</i>	<i>2 410</i>	<i>2 433</i>	<i>2 451</i>	<i>2 521</i>	<i>2 489</i>	<i>2 470</i>	<i>2 474</i>	<i>2 251</i>	<i>2 210</i>	<i>2 176</i>	<i>2 050</i>	<i>1 648</i>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) were not subject to reporting for the years 2007-2013.  
C, confidential; n.a., not applicable.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.19 Intended applications of EU total supply of F-gases (tonnes)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Intended applications of total supply</b>	<b>Tonnes</b>											
Refrigeration, air conditioning and heating and other heat transfer fluids	61 377	58 720	58 678	65 964	61 045	58 574	58 999	95 688	74 023	78 016	78 006	65 190
Foams including pre-blended polyols	14 286	15 284	11 709	11 503	9 234	8 526	8 202	12 967	9 572	10 157	11 521	10 530
Aerosols	9 090	11 131	8 425	9 547	7 808	10 950	9 690	8 954	9 421	8 728	10 300	8 744
Fire protection	649	491	531	1 677	2 508	1 451	1 385	1 858	818	585	502	241
Electrical equipment	1 197	1 422	969	1 290	1 344	1 362	1 419	622	745	813	951	634
Semiconductor photovoltaics and other electronics manufacture	127	301	184	265	243	169	71	1 057	715	755	924	896
Other or unknown applications	1 861	2 219	2 185	1 501	1 437	1 684	1 132	6 402	1 485	997	1 248	1 405
<b>Total supply</b>	<b>88 586</b>	<b>89 569</b>	<b>82 681</b>	<b>91 749</b>	<b>83 620</b>	<b>82 715</b>	<b>80 898</b>	<b>127 547</b>	<b>96 779</b>	<b>100 050</b>	<b>103 452</b>	<b>87 640</b>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) and data on products and equipment were not subject to reporting for the years 2007-2013. The data presented for these years thus equal data presented for BS. Since 2014, the category 'aerosols' has been replaced by separate categories for medical and non-medical aerosols. Feedstock use does not appear in this table, as it is excluded from the scope of EU total supply.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

**Table A5.20 Intended applications of EU total supply of F-gases (CO<sub>2</sub>e)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Intended applications of total supply</b>	<b>Million tonnes of CO<sub>2</sub>e</b>											
Refrigeration, air conditioning and heating and other heat transfer fluids	138.5	136.5	139.6	161.6	143.7	140.3	140.4	216.5	155.3	157.0	142.3	93.9
Foams, including pre-blended polyols	13.4	12.9	9.8	10.4	6.5	6.1	5.9	11.7	7.2	8.8	8.4	5.5
Aerosols	12.2	14.5	11.2	12.5	9.9	14.1	12.7	11.7	13.1	11.6	14.4	11.1
Fire protection	4.0	3.0	3.2	7.5	9.7	5.8	2.6	6.6	3.0	2.2	1.8	0.6
Electrical equipment	27.3	32.4	22.1	29.4	30.7	31.0	32.4	14.2	17.0	18.5	21.7	14.5
Semiconductor, photovoltaics and other electronics manufacture	1.5	3.2	2.1	3.1	2.8	2.1	1.0	9.4	9.9	10.6	13.2	12.4
Other or unknown applications	16.7	15.4	14.7	6.7	4.9	4.9	5.3	15.8	6.1	5.5	7.7	5.8
<b>Total supply</b>	<b>213.5</b>	<b>218.0</b>	<b>202.6</b>	<b>231.3</b>	<b>208.2</b>	<b>204.3</b>	<b>200.1</b>	<b>285.8</b>	<b>211.6</b>	<b>214.3</b>	<b>209.6</b>	<b>143.7</b>

**Notes:** Annex II gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and NF<sub>3</sub> and other perfluorinated compounds) and data on products and equipment were not subject to reporting for the years 2007-2013. The data presented for these years thus equal the data presented for BS.

Since 2014, the category 'aerosols' has been replaced by separate categories for medical and non-medical aerosols. Feedstock use does not appear in this table, as it is excluded from the scope of EU total supply.

**Sources:** EC (2011, 2014); EEA (2018, 2019b).

Table A5.21 HFCs placed on the market and quota compliance

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
POM category	Million tonnes of CO <sub>2</sub> e											
(1) POM of bulk HFCs 2007-2013	173.5	174.9	172.4	200.6	179.0	172.0	169.6					
(2) Bulk HFC POM 2014 onwards								279.4	162.4	158.1	166.7	101.9
<i>thereof:</i>												
(3) <i>for exempted uses Art. 15(2)a-f:</i>								C	C	C	C	21.1
(4) <i>thereof: for exempted uses Art. 15(2)a-e:</i>								7.0	7.6	14.1	9.2	C
(5) <i>thereof: exemption Art. 15(2)f: pharmaceutical MDIs</i>								C	C	C	C	C
(6) Quota-relevant bulk HFC POM 2015 onwards								-	154.7	144.0	157.5	80.8
(7) POM of HFCs in equipment 2014 onwards: = (8) + (10)								11.2	13.6	19.7	17.5	15.1
<i>thereof:</i>												
(8) HFC POM in RACHP equipment								11.1	12.8	19.2	17.0	14.9
(9) <i>thereof: without quota authorisation coverage, 2017 onwards</i>											0.2	0.5
(10) HFC POM in other equipment								0.1	0.7	0.5	0.5	0.2
(11) Total physical POM of HFCs 2014 onwards (bulk + equipment) = (2) + (7)								290.6	175.9	177.7	184.2	117.0
(12) Quota authorisations issued 2015 onwards									17.1	19.9	11.6	18.9
(13) Quota-relevant POM 2015 onwards = (6) + (9) + (12)								171.8	163.9	169.2	100.2	
(14) Maximum quantity of HFC phase-down								183.1	170.3	170.3	101.2	
Quota compliance 2015 onwards:												
(15) Unused quota (company level)									12.0	7.1	3.2	1.9
(16) Quota exceedance (company level)									0.7	0.6	2.2	0.9

**Table A5.21 HFCs placed on the market and quota compliance (cont.)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>POM category</b>	<b>Million tonnes of CO<sub>2</sub>e</b>											
(17) <i>thereof: production/ bulk import of HFCs</i> = (16) - (9)									0.7	0.6	2.0	0.3
(18) EU-wide margin to maximum quantity = (14) - (13)									11.2	6.3	1.0	1.0

**Notes:** Note that, for 2017, as the first year of the obligation to have RACHP imports covered by quota authorisation, the European Commission had proposed that Member States also consider for compliance checking authorisations acquired in the course of 2018. The accounting of authorisations applied in this report follows this approach. In the previous confidential EEA report (EEA, 2018), the POM of HFCs in RACHP equipment without quota authorisation coverage (row 13) for 2017 had been preliminarily quantified at 1.0 million tonnes (Mt). In the updated assessment of this report, the respective amount for 2017 was corrected downwards to 0.2 Mt CO<sub>2</sub>e. This change is due to the application of the explained accounting approach, the late data submission accepted by the European Commission and compliance decisions by Member States, communicated to the Commission and stored in the HFC registry (EC, 2019).

Likewise, bulk quota exceedance (row 21) for previous years was updated based on scrutiny and compliance decisions by the European Commission, as documented in the HFC registry (EC, 2019).

'—', no data reported; C: confidential.

**Sources:** EC (2011, 2014, 2018); EEA (2018, 2019b).

**Table A5.22 Consumption of HFCs covered under the Montreal Protocol**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>EU consumption of HFCs covered under the Montreal Protocol</b>	<b>Million tonnes of CO<sub>2</sub>e</b>											
	177.5	169.1	156.3	194.0	173.2	159.4	163.2	267.0	146.9	141.4	145.7	90.1

**Sources:** EC (2011, 2014); EEA (2018, 2019b).



**Table A5.23 Companies reporting on 2018, by Member State and reported activities**

Country	Total	Thereof:						
		Producers	Importers	Exporters	Equipment importers	Feedstock users	Destruction companies	Quota authorisers
Austria	27	-	7	-	20	-	-	2
Belgium	51	1	19	9	29	-	-	5
Bulgaria	67	-	32	2	32	-	-	17
Croatia	41	-	15	2	25	-	-	12
Cyprus	29	-	9	-	20	-	-	6
Czechia	43	-	17	1	24	-	1	6
Denmark	35	-	13	4	20	-	-	4
Estonia	22	-	14	1	8	-	-	5
Finland	25	-	5	1	19	-	1	2
France	153	3	38	9	113	1	1	18
Germany	173	2	45	23	116	2	6	15
Greece	58	-	13	4	40	-	-	2
Hungary	41	-	15	1	26	-	-	1
Ireland	15	-	6	-	9	-	-	1
Italy	201	-	95	14	102	-	-	11
Latvia	13	-	6	-	6	-	-	1
Lithuania	23	-	17	1	6	-	-	6
Luxembourg	1	-	-	-	1	-	-	-
Malta	16	-	1	1	13	-	-	-
Netherlands	84	1	32	5	50	-	1	6
Poland	420	-	348	5	55	-	1	95
Portugal	37	-	10	1	26	-	-	3
Romania	62	-	13	-	45	-	-	5
Slovakia	17	-	5	-	10	-	1	4
Slovenia	27	-	4	-	21	-	-	-
Spain	119	-	35	13	74	1	-	10
Sweden	49	-	13	4	34	1	1	9
United Kingdom	122	1	44	11	70	-	2	13
<b>EU total</b>	<b>1 971</b>	<b>8</b>	<b>871</b>	<b>112</b>	<b>1 014</b>	<b>5</b>	<b>15</b>	<b>259</b>
<b>Non-EU</b>	<b>118</b>	<b>n.a.</b>	<b>19</b>	<b>3</b>	<b>18</b>	<b>n.a.</b>	<b>n.a.</b>	<b>78</b>

**Notes:** Companies may report for more than one activity type. '—', no data reported; n.a., not applicable. Non-EU companies are not eligible to report as producers, feedstock users or destruction companies.

**Source:** EEA (2019b).

Table A5.24 Non-EU companies reporting on 2018, by location of only representative

EU country of only representative	Total represented non-EU companies	Thereof from:																	
		United Arab Emirates	Switzerland	China	Egypt	Gibraltar	Japan	South Korea	Monaco	Malaysia	Norway	Serbia	Saudi Arabia	Turkey	Taiwan	Ukraine	United States	British Virgin Islands	South Africa
Belgium	8	2	-	-	1	-	1	-	-	-	-	1	1	-	1	-	-	1	
Bulgaria	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
Czechia	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	
France	3	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	
Germany	11	-	2	2	-	1	1	-	1	-	-	-	-	1	-	3	-	-	
Ireland	76	-	-	75	-	-	-	-	-	-	-	-	-	-	-	-	1	-	
Italy	5	-	1	2	-	1	-	-	-	1	-	-	-	-	-	-	-	-	
Netherlands	4	-	1	-	-	1	-	-	-	1	-	-	-	-	-	1	-	-	
Portugal	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sweden	3	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	
United Kingdom	3	-	1	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	
<b>EU total</b>	<b>117</b>	<b>2</b>	<b>5</b>	<b>80</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>6</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>6</b>	<b>1</b>	<b>1</b>

Note: '-', no data reported.

Source: EEA (2019b).

**Table A5.25 Activities reported 2007-2018**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Reports received</b>	<b>77</b>	<b>86</b>	<b>94</b>	<b>110</b>	<b>125</b>	<b>133</b>	<b>153</b>	<b>468</b>	<b>780</b>	<b>1 284</b>	<b>1 728</b>	<b>2 089</b>
Of which mention:												
Production of F-gases	6	12	8	7	9	10	9	10	9	9	8	8
thereof: HFC production	4	9	6	5	7	8	7	6	6	6	5	5
Bulk import of F-gases	55	53	58	70	77	91	112	187	293	379	577	890
thereof: bulk HFC import	48	47	53	66	73	86	107	173	282	366	563	874
Bulk export of F-gases	44	47	64	75	74	81	82	92	99	111	119	115
thereof: bulk HFC export	37	39	55	67	64	70	72	81	89	98	104	100
Import of products or equipment pre-charged with F-gases	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	228	427	840	1 039	1 032
thereof: RACHP equipment charged with HFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	220	409	826	1 028	1 022
Destruction	6	8	7	8	10	11	10	10	15	13	13	15
Feedstock use	2	2	2	2	1	1	1	3	3	3	3	5
Supply of quota authorisation	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	20	34	94	337
thereof: quota authorisation without any EU production, import or export	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>	<b>468</b>	<b>780</b>	<b>1 284</b>	<b>1 728</b>	<b>2 089</b>

**Note:** The reporting obligation for equipment importers applied to reporting on 2014 for the first time. Reporting on quota authorised to other companies has applied since 2015. Companies may report on more than one activity. n.a., not applicable.

**Sources:** EEA (2019b).

# Annex 6 Quality control

## Three-tier concept

The quality control (QC) concept was designed to automatically catch as many typical reporting errors, misunderstandings and inconsistencies as possible as users fill in the reporting form. Any implausible values are either rejected outright, or users are required to provide explanations for them. Such values, along with those that have frequently caused inconsistencies in the past, are flagged for manual checking to the ETC staff. The QC process formally consists of three tiers:

- QC0: live automatic checks as data is entered into the web form;
- QC1: quality issues pertaining to a single report, automatic and manual;
- QC2: quality issues across reports (e.g. matching figures for mutual trading), manual.

When problems are found or confirmed during the manual stage, the report is put on hold and the company is contacted for clarification. Reports can pass the QC process only after all problematic items have been cleared.

## Automatic QC in the BDR

Automated tests fall into four categories:

**Completeness.** All the data necessary for a particular company's activities must be present. For example, companies that have specified that they are producers must fill out all fields that are relevant to F-gas production.

**Plausibility.** One particularly large part of plausibility tests was the inclusion of 'white lists' of gases that are commonly used for certain applications and equipment categories and typical amounts of F-gas in equipment.

Gases not on the white lists were treated as unusual, and reporters were warned about a possible mistake in the gas selection or a slip in the column.

**Consistency.** Across the report, corresponding numbers must match. For example, the total amount of gas accounted for in the 'Intended applications' section must match the amount determined as placed on the market in the production/import/export section.

**Correctness.** Company data for trade partners that are specified by reporting companies are validated in the automatic stage. A fuzzy algorithm compared the location and company names provided with the data associated with the VAT (value added tax) number in the Directorate-General for Climate Action's (DG CLIMA's) F-gas portal.

If a rule was violated, reporters were either prompted (immediately or at submission) to correct or amend their values or to provide comments to explain inconsistencies and unusual choices. Violation of critical rules prevented the submission of the report completely, while transgression against other rules resulted in a warning only. In the latter cases, submission of the report was possible, and problematic values were flagged for a manual follow-up by the F-gas team.

## Manual QC by the F-gas team

In the second level of QC, the F-gas support team follows up on reports that were flagged by the automated system. Reporters are contacted if reported values remain questionable during this stage. If reporting mistakes are confirmed, reporters are asked to resubmit a corrected report via the BDR, assuring the transparency of the reporting process. Only in exceptional cases are the data manually adjusted, and these adjustments are documented in feedback files added to the respective BDR envelope containing the company's submission.

## Common QC issues in the 2019 reporting season

As in the previous year, the system proved very workable and was able to catch the majority of problems before they were submitted to the EEA (although significant support was given to companies in some cases). The majority of issues left for manual investigation thus amounted to housekeeping, checking comments, verifying numbers that may have been doubly counted and so on, and only a relatively small number of actual mistakes had to be corrected by the reporting companies.

However, with the number of companies increasing further, workload due to issues raised by the automated QC routines is still high. As resources were limited, manual follow-up was restricted to key error categories either relevant to the order of magnitude of reported amounts or significantly affecting potential company non-compliance under the HFC phase-down.

Most failures related to:

- mistakes in the order of magnitude (reporting in kilograms instead of tonnes);
- mistakes in the unit of reported amounts (tonnes CO<sub>2</sub>e instead of physical tonnes);
- confusion between bulk imports and imports of equipment;
- reporting of RACHP equipment in non-RACHP categories;
- confusion between HFC-134a and HFC-134;
- erroneous reporting of feedstock use.

The obligation for equipment importers to upload additional verification documents in the BDR was an additional challenge for many companies, creating a huge amount of enquiries.



European Environment Agency

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