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# Fluorinated greenhouse gases 2015

## Summary of data reported by companies on the production, import and export of fluorinated greenhouse gases in the European Union

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European Environment Agency

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# Contents

# Acknowledgements

This report was prepared for the European Environment Agency (EEA) by its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM). The authors were Graham Anderson, Benjamin Greiner and Wolfram Jörß (ETC/ACM partner Öko-Institut).

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# Executive summary

## Background and policy

*International policy*

The greenhouse gases addressed by the United Nations Framework Convention on Climate Change (UNFCCC) include several groups of fluorinated gases, the so-called F-gases. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride ($SF_6$) and nitrogen trifluoride ($NF_3$) are covered by the Kyoto Protocol and are also included in the European Union's commitment under the Paris Agreement. The majority of these F-gases have very high global warming potentials (GWPs).

As a result of the phase-out of ozone-depleting substances (ODS) under the Montreal Protocol and Regulation (EC) No 1005/2009 ([1]) on ozone-depleting substances, certain F-gases came into use for the replacement of ODS. The use of F-gases in many different applications has been increasing and has considerable potential for growth. F-gases accounted for approximately 3 % of overall greenhouse gas emissions expressed in GWP in the 28 Member States of the European Union (EU) in 2014 (EEA, 2016b), and this proportion continues to increase.

In October 2016 in Kigali, the Montreal Protocol was amended to regulate HFCs. Both developed and developing countries have taken on mandatory commitments on reducing production and consumption of HFCs in the next three decades. Developing countries are supported through the Multilateral Fund. Reporting on emissions of HFCs remains within the remit of the UNFCCC. This global development reflects the strong policy mechanisms adopted by the EU under the new F-Gas Regulation, which implements an EU-wide HFC phase-down, as well as measures taken by other industrialised countries.

The EU has a target under the Kyoto Protocol to reduce emissions of its whole basket of greenhouse gases — including F-gases — by 20 % by 2020 compared with 1990 levels. Furthermore, the EU-28 and Iceland have a joint target under the Kyoto Protocol to reduce greenhouse gas emissions ([2]) by 20 % compared with 1990 during the Protocol's second commitment period, 2013–2020. Under the Paris Agreement, the EU is committed to a 40 % reduction in domestic emissions by 2030, compared with 1990.

*EU F-gas policy*

Following a review of the 2006 F-Gas Regulation ([3]), a revision was adopted by the European Parliament and the European Council, Regulation (EU) No 517/2014 ([4]), the 'new F-Gas Regulation', which aims to reduce F-gas emissions by two thirds of the 2010 level by 2030. The new regulation maintains many of the previous measures, in particular related to leak prevention, recovery, certification of technicians and selected restrictions on the use and marketing of F-gases.

Large reductions in F-gas use and emissions are expected to result from a new phase-down measure, which will progressively cap sales of HFCs allowed on the EU market, bringing maximum sales down to 21 % of baseline levels by 2030. Reductions are also expected to result from bans on the use of F-gases that have high GWPs. Box ES.1 summarises the changes to the reporting obligations.

([1]) 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).
([2]) The joint EU-28 and Iceland target for the second commitment period of the Kyoto Protocol also covers emissions of nitrogen trifluoride ($NF_3$), another fluorinated gas covered by this report.
([3]) Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases (EU, 2006).
([4]) 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).

**Box ES.1 Changes to reporting obligations under the new F-Gas Regulation**

The 'new' F-Gas Regulation (EU) No 517/2014 introduces requirements additional to those set out in the 2006 F-Gas Regulation. The annual reporting obligations for producers, importers and exporters have changed. The list of F-gases subject to the reporting obligations has been extended, and there are revised reporting thresholds that are defined both in terms of physical quantities (metric tonnes) of gases and by their carbon dioxide equivalent ($CO_2$-eq.). There are new reporting obligations for feedstock users, equipment importers and destruction companies. Producers also need to report on any destruction of their own production.

## Data covered in this report

This report is based on submissions for 2015 as received by 2 June 2016. With the legal reporting deadline being 31 March 2015, this approach allowed for the inclusion of data from some companies that delivered late as well as for resubmissions of corrected data.

The new regulation requires, among other things, that companies report on produced, imported and exported quantities of F-gases, including mixtures. Reporting obligations are also established for companies that:

- use F-gases as a feedstock for a chemical reaction process;
- destroy F-gases; or
- import products or equipment containing F-gases.

The specification of fluorinated gases in the new F-Gas Regulation extends the list of gases beyond the HFCs, PFCs and $SF_6$ covered by the old F-Gas Regulation to include:

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

By the end of May 2016, 763 companies had reported on their F-gas activity during 2015. This is an increase of 295 new reporters over the previous year. A further 333 companies reported no activity during 2015 ('nil report').

For the reporting years 2007–2014 ([5]), this report relies on data reported in previous years as presented in the 2015 confidential European Environment Agency (EEA) report on fluorinated greenhouse gases (EEA, 2015). Data for 2007–2013 had been reported under the old F-Gas Regulation. Reporting under the new regulation covers the years from 2014 onwards.

This report applies confidentiality rules to protect data reported by specific companies. Where applicable, the confidentiality measures mean that some F-gas data are only shown at higher levels of aggregation. An account of the confidentiality measures is included in Annex 5.

## Reporting process

Registration for reporting is centralised in the European Commission's F-gas portal at https://webgate.ec.europa.eu/ods2, which hosts the HFC registry provided for under Article 17 of the new F-Gas Regulation. The F-gas portal also links directly to the EEA's reporting platform.

This reporting platform ensures that the reporting process maintains traceability and transparency for all relevant stakeholders while protecting the confidentiality and commercial sensitivity of company data. The system includes automated quality checks and facilitates data processing after companies have submitted their reports. The completeness and consistency of the reported data are further assured by manual data quality checks, followed by bilateral communication with the reporting companies where necessary.

While the legal obligation to report is to the European Commission, following Article 19 of the F-gas Regulation, the EEA has been tasked with collecting, archiving, checking and aggregating information from the companies' reports. The EEA also provides active support to assist reporters in fulfilling their obligations.

([5]) 'Reporting year' means the calendar year on which companies report. For example, in 2016 companies reported on their activities in the reporting year 2015.

## Key findings

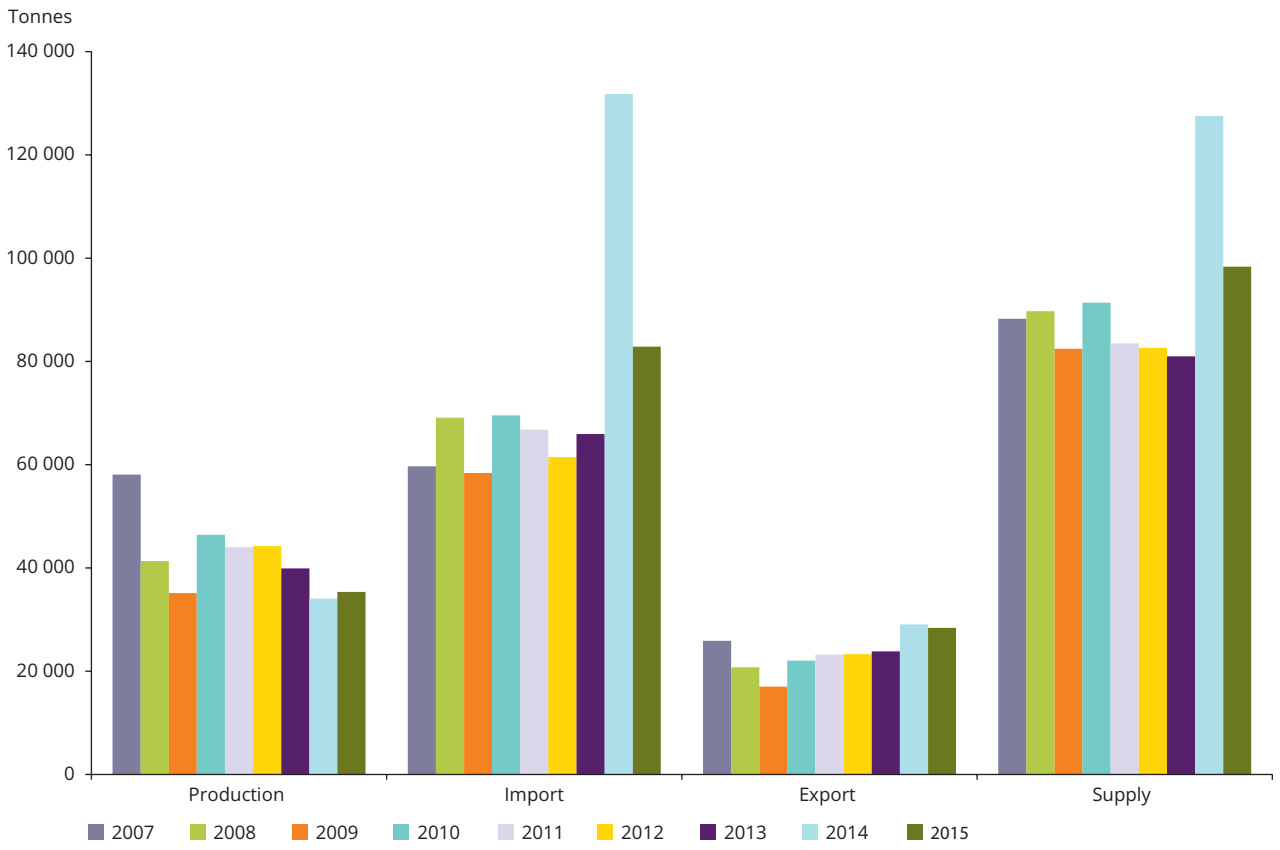
The assessment of trends is dependent upon the unit used to express the amounts of F-gases, i.e. physical tonnes or GWP-weighted tonnes (i.e. as $CO_2$-equivalent, or $CO_2$-eq.) ([6]). Statistics in physical tonnes reflect the use patterns of F-gases in European industries, while statistics expressed as $CO_2$-eq. are relevant for climate change policy.

The overall trends that can be identified from companies reporting on F-gases in 2015 can be summarised as follows:

- Production of F-gas continued to decline, with 2015 levels 5 % (as $CO_2$-eq.) below those reported for 2014.
- Imports decreased by about 40 % compared with the exceptionally high amounts reported for 2014 (by weight and as $CO_2$-eq.). Compared with 2013, bulk imports in 2015 increased by about 8 %.
- Exports have decreased by 2 % (tonnes) or 1 % ($CO_2$-eq.) since 2014. Compared with 2013, exports in 2015 increased by 18 % (tonnes) and 23 % ($CO_2$-eq.).
- Supply has decreased by about 24 % (by weight and as $CO_2$-eq.) since 2014. Compared with 2013, bulk supply ([7]) increased by 9 % by weight but decreased by 3 % as $CO_2$-eq. in 2015.

The analysis of trends in production, imports, exports and supply from 2007 to 2015 (Figure ES.1 in tonnes, Figure ES.2 in $CO_2$-eq.) is based on comparable reporting that took place under the old F-Gas Regulation and continues under the new regulation. Data presented for import and supply between 2007

**Figure ES.1 Production, import, export and supply of F-gases (tonnes)**

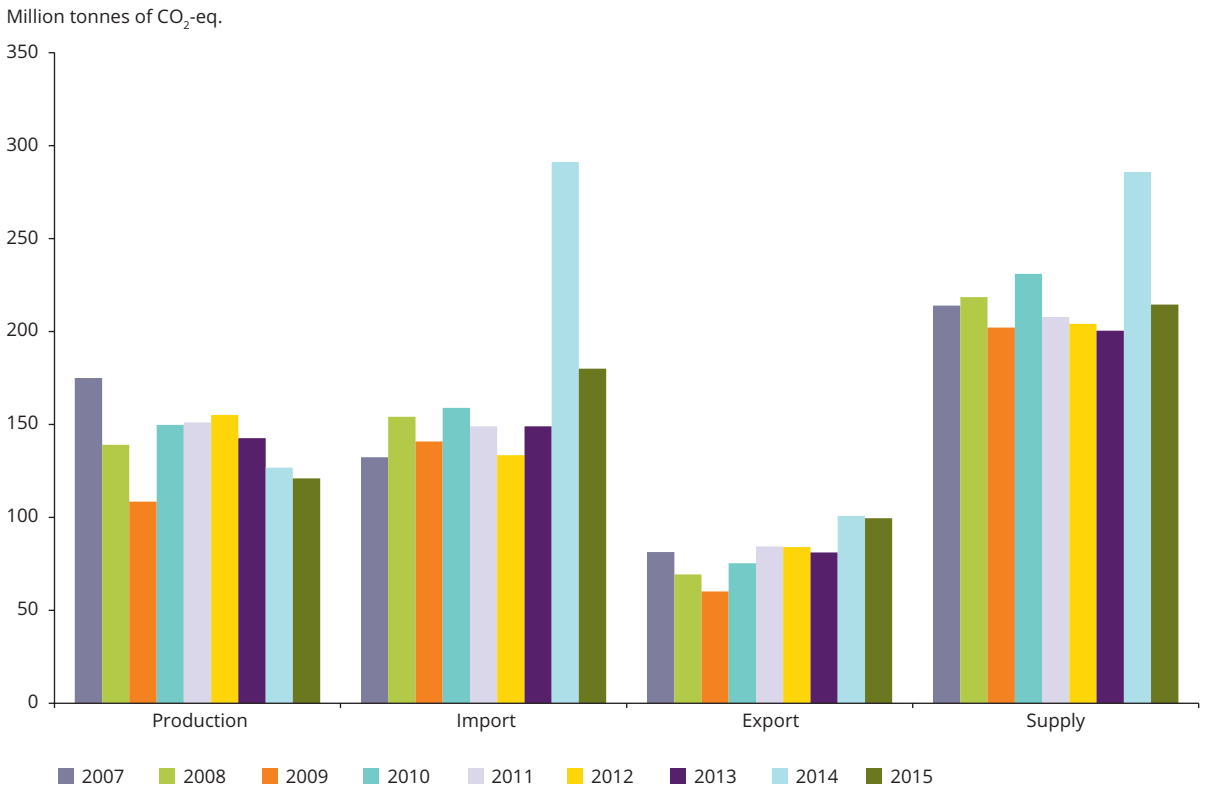



**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and 'other' perfluorinated compounds) and HFCs, PFCs and $SF_6$ in products and equipment were not subject to reporting for the 2007–2013 period. Data presented for import and supply between 2007 and 2013 are thus limited to bulk import and bulk supply. Export is limited to bulk export for the whole time series.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

([6]) The GWP values used in this report are those published in the IPCC's *Fourth assessment report* (AR4) (IPCC, 2007).
([7]) Bulk supply excludes imports in products and equipment, which has only been reported since 2014.

**Figure ES.2 Production, import, export and supply of F-gases ($CO_2$-eq.)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs and alcohols, and 'other' perfluorinated compounds) and HFCs, PFCs and $SF_6$ in products and equipment were not subject to reporting for the 2007–2013 period. 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.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

and 2013 are thus limited to bulk import and bulk supply. Export is limited to bulk export for the whole time series.

### *EU production of F-gases in 2015*

- Production of F-gases involved 10 gases: five HFCs (HFC-23, HFC-134a, HFC-143a, HFC-227ea and HFC-365mfc), three PFCs, $SF_6$ and unsaturated HFC-1234yf.
- Production of F-gases has seen an overall decline since 2010; however, in 2015 physical production increased by 1 kt or 4 % compared with 2014. When measured as $CO_2$-eq., production nevertheless continued to decline: 2015 production was 6 Mt $CO_2$-eq. or 5 % below the amounts reported for 2014.
- A 75 % decrease in the production of HFC-143a (GWP: 4 470) led to a 14 % decrease in the average GWP of HFCs produced.
- HFCs account for more than 90 % of production by weight, while $SF_6$ accounts for a considerable proportion when measured as $CO_2$-eq. Most $SF_6$ production is designated for export.

### *Imports in 2015*

- Total imports of F-gases (bulk imports plus imports within products and equipment) were considerably lower than in 2014.
- Bulk imports of F-gases were 40 % below the exceptionally high amounts reported for 2014, both by mass and as $CO_2$-eq. Compared with 2013, bulk imports in 2015 were about 8 % higher.
- Excluding 2014, bulk imports in 2015 were the highest since reporting started in 2007.
- HFCs accounted for about 94 % of total bulk imports (89 % in $CO_2$-eq.). About 6 % (both by weight and as $CO_2$-eq.) of the increase can be attributed to $SF_6$, PFCs and the new reportable gases.

- Imports of F-gases within products and equipment rose by 24 % by weight or 17 % as $CO_2$-eq. compared with 2014. This increase is due to the reported imports of companies that reported for the first time in 2015. The number of companies reporting on equipment imports more than doubled from 199 in 2014 to 412 in 2015.

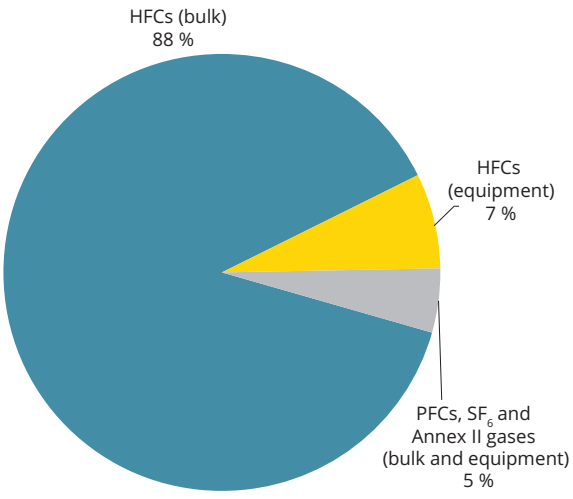
***Exports to non-EU countries in 2015***

- Data on exports were limited to bulk exports. Exports in products or equipment are not subject to reporting, although HFCs exported in products and equipment can be reported voluntarily by manufacturers.
- Bulk exports of F-gases declined by 2 % (tonnes) or 1 % ($CO_2$-eq.) compared with 2014. Before that, bulk exports had seen an increase for five consecutive years. For 2014, there was an increase of 22 % measured in tonnes, or 24 % in $CO_2$-eq., compared with 2013; however, 2015 exports were still above the 2007–2013 time series level. Compared with 2013, HFC exports in 2015 increased by approximately 20 % and $SF_6$ exports by 30 %.
- HFCs make up 90 % of bulk F-gas exports when measured in tonnes. If measured in $CO_2$-eq., $SF_6$ accounts for a considerable proportion of exports in the whole time series since 2007.
- Measured as $CO_2$-eq., bulk HFC exports in 2014 and 2015 were at their highest level since 2007.

***Supply in 2015***

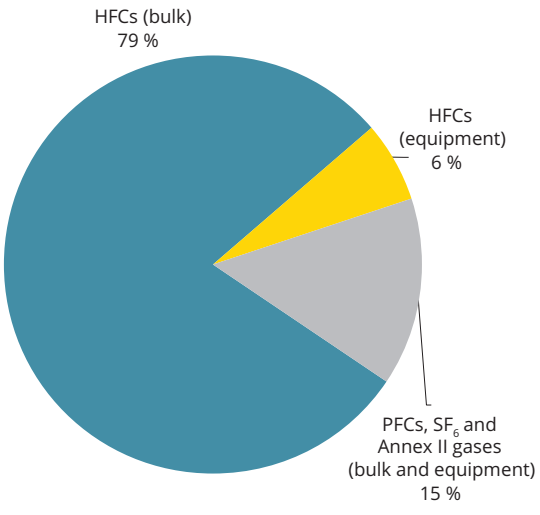
- The total supply of F-gases comprises both the supply in bulk and the supply of gases contained in imported products and equipment, and is corrected for bulk exports of gases.
- HFCs dominate total supply, making up 95 % by mass or 85 % as $CO_2$-eq. $SF_6$ played a role only in terms of $CO_2$-eq.
- After the exceptionally high figures in 2014, bulk supply for 2015 was back to 2010 levels in tonnes or 2013 levels as $CO_2$-eq.
- The decrease in supply reflects a return to the long-term trend after the large increases in bulk HFC imports in 2014, the last year before the commencement of the HFC phase-down.
- By weight, 93 % (94 % as $CO_2$-eq.) of 2015 total supplies were supplied in bulk; the balance of 7 % (by mass) or 6 % (as $CO_2$-eq.) was supplied within products and equipment.
- HFCs accounted for 95 % of 2014 total supply by mass or 85 % as $CO_2$-eq. (Figures ES.3 and ES.4).
- Supply was reported for 29 out of the 70 reportable F-gases: 13 HFCs, seven PFCs, $SF_6$, four unsaturated HFCs and hydrochlorofluorocarbons (HCFCs), three hydrofluoroethers (HFEs) and alcohols, and also $NF_3$.

**Figure ES.3 Total supply of F-gases, 2015 (tonnes)**




**Source:** EEA, 2016a.

**Figure ES.4 Total supply of F-gases, 2015 ($CO_2$-eq.)**




**Source:** EEA, 2016a.

*Intended applications in 2015*

Intended applications for F-gases are shown in Figures ES.5 and ES.6.

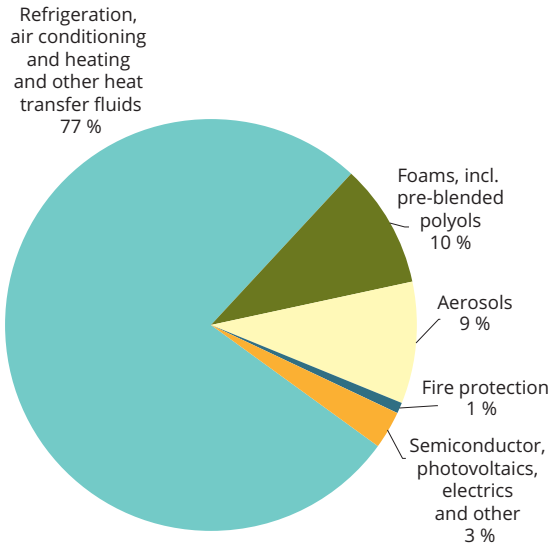
- Approximately 75 % (both in tonnes and $CO_2$-eq.) of F-gases supplied to the market in 2015 were intended for use as refrigerants for refrigeration, air conditioning and heating purposes. These were almost exclusively HFCs.
- Of 2015 total supply, 10 % (by mass) was intended for use in foams; 96 % of this was HFCs. Measured in $CO_2$-eq., the proportion of F-gases intended for use in foams was only 3 %.
- Aerosols (both medical and non-medical) were the intended application of 10 % (tonnes) of 2014 total supply, 6 % as $CO_2$-eq. The gases used for aerosols were almost entirely HFCs.
- $SF_6$ intended for electrical equipment (switchgear) contributed only a small fraction when measured in tonnes but a considerable portion of supply as $CO_2$-eq.

*Trends in intended applications*

Most trends are similar whether measured in tonnes or in $CO_2$-eq.

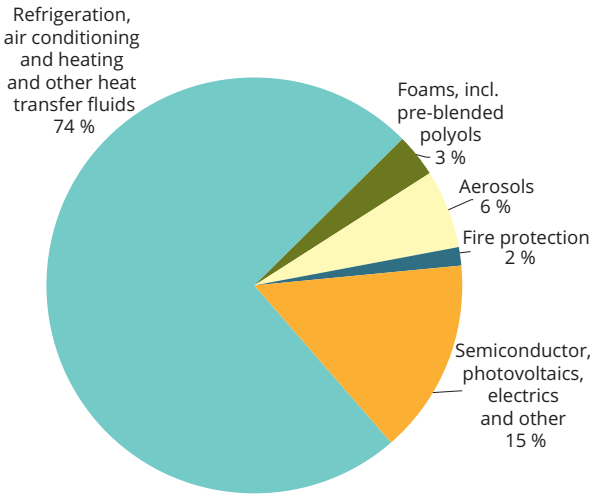
- Changes in HFC supply since 2013 can be almost entirely attributed to the refrigeration, air conditioning and heating sector. Compared with 2014, which had an exceptionally high supply of refrigerants, volumes decreased by 21 % (27 % in $CO_2$-eq.). Compared with 2013, however, the amounts in tonnes increased by 16 % while amounts measured as $CO_2$-eq. increased by 3 %. This may indicate a trend to refrigerants of lower GWPs.
- Reported supply intended for foams approximately tripled in 2014 compared with 2013. The level reported for 2015 was 17 % higher than that for 2013.
- Aerosol use was approximately 5 % above that reported in 2014. However, amounts intended for aerosol use do not show a consistent trend.
- $SF_6$ use in electrical equipment maintained the low level of increase seen in 2014, with only a slight increase in 2015.

**Figure ES.5 Total supply by intended applications (tonnes)**




**Source:** EEA, 2016a.

**Figure ES.6 Total supply by intended applications ($CO_2$-eq.)**




**Source:** EEA, 2016a.

***Trends in reclamation, feedstock use and destruction of F-gases, 2007–2015***

- Reclamation of F-gases has been at low levels, overall making up less than 1 % of bulk supply.
- Gases used as feedstock are not included in the bulk supply/total supply metrics, and the trend in feedstock use is irregular (both by mass and as $CO_2$-eq.). If 2007–2015 levels of feedstock use were compared with bulk supply, they would represent less than 1 % by mass or between 1.5 % and 4.5 % as $CO_2$-eq.
- Destruction of F-gases has been increasing consistently since 2008, with the exception of very low numbers reported for 2013. While destroyed gases are not accounted for in the bulk supply/total supply metrics, if compared with bulk supply, the 2015 level of destruction would be 1.5 % of bulk supply by mass or 5 % as $CO_2$-eq.

# 1 Introduction

## 1.1 Background

*International policy framework*

The greenhouse gases addressed by the United Nations Framework Convention on Climate Change (UNFCCC) include several groups of fluorinated gases, the so-called F-gases. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride ($SF_6$) and nitrogen trifluoride ($NF_3$) are covered by the Kyoto Protocol and are also included in the European Union's commitment under the Paris Agreement. The majority of these F-gases have very high global warming potentials (GWPs).

As a result of the phase-out of ozone-depleting substances (ODS) under the Montreal Protocol and Regulation (EC) No 1005/2009 ([8]) on ozone-depleting substances, certain F-gases came into use for the replacement of ODS. The use of F-gases in many different applications has been increasing and has considerable potential for growth. F-gases accounted for approximately 3 % of overall greenhouse gas emissions expressed in GWP in the 28 Member States of the European Union (EU) in 2014 (EEA, 2016b), and this proportion continues to increase.

In October 2016 in Kigali, the Montreal Protocol was amended to regulate HFCs. Both developed and developing countries have taken on mandatory commitments on reducing production and consumption of HFCs in the next three decades. Developing countries are supported through the Multilateral Fund. Reporting on emissions of HFCs remains within the remit of the UNFCCC. This global development reflects the strong policy mechanisms adopted by the EU under the new F-Gas Regulation, which implements an EU-wide HFC phase-down, as well as measures taken by other industrialised countries.

The EU has a target under the Kyoto Protocol to reduce emissions of its whole basket of greenhouse gases — including F-gases — by 20 % by 2020 compared with 1990 levels. Furthermore, the EU-28 and Iceland have a joint target under the Kyoto Protocol to reduce greenhouse gas emissions ([9]) by 20 % compared with 1990 levels during the Protocol's second commitment period, 2013–2020. Under the Paris Agreement, the EU is committed to a 40 % reduction in domestic emissions by 2030, compared with 1990.

*Fluorinated gases legal framework*

*Old F-Gas Regulation*

Regulation (EU) 842/2006, 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*

Following a review of the old F-Gas Regulation, a revision was adopted by the European Parliament and the European Council (i.e. Regulation (EU) No 517/2014 ([10]),

([8]) 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).
([9]) The joint EU-28 and Iceland target for the second commitment period of the Kyoto Protocol also covers emissions of nitrogen trifluoride ($NF_3$), another fluorinated gas covered by this report.
([10]) 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).

the 'new F-Gas Regulation'), which aims to reduce F-gas emissions by two thirds of the 2010 level by 2030. The new regulation maintains many of the previous measures, in particular related to leak prevention, recovery, certification of technicians and selected restrictions on the use and marketing of F-gases.

Large reductions in F-gas use and emissions are expected to result from a new phase-down measure, which will progressively cap sales of HFCs allowed on the market, bringing maximum sales down to of 21 % of baseline levels by 2030. Reductions are also expected to result from bans on the use of F-gases that have high GWPs.

This report summarises the data reported by companies in accordance with Article 19 of the new F-Gas Regulation. The new regulation continues to require companies to report on produced, imported and exported quantities of F-gases, including mixtures. Additional reporting obligations were established under Article 19 for companies that:

- use F-gases as a feedstock for a chemical reaction process;
- destroy F-gases; or
- import products or equipment containing F-gases.

Furthermore, under the new regulation, the list of reportable fluorinated gases was extended beyond HFCs, PFCs and $SF_6$ (as listed in Annex I of the new F-Gas Regulation) to include:

- unsaturated hydro(chloro)fluorocarbons (section 1 of Annex II of the new F-Gas Regulation);
- fluorinated ethers and alcohols (section 2 of Annex II);
- other perfluorinated compounds (section 3 of Annex II).

Commission Implementing Regulation (EU) No 1191/2014 ([11]) establishes the format in which the reports are to be submitted.

## 1.2 Report structure

This introduction has given a brief summary of the policy framework, and Sections 1.3 to 1.4 go on to outline the institutional arrangements, reporting procedures, quality control and reporting companies. Sections 1.5 to 1.7 explain the terminology and data covered.

Chapter 2 provides an analysis of F-gas production, import, export, reclamation, feedstock use and destruction. In Chapter 3, reported data are analysed to calculate the supply to the market and its intended applications. The calculation methodologies used in this report are described in Annex 6. Tables containing reported and calculated data on a detailed level are contained in Annex 4.

## 1.3 Institutional arrangements

In 2016, companies reported for the reporting year 2015, which was the second reporting year under the new F-Gas Regulation. The reporting process under the new F-Gas Regulation was similar to that of the previous 7 years, during which reporting took place according to the old F-Gas Regulation. Since 2012, the European Commission has given the responsibility for collecting, archiving, checking and aggregating information from each companies' reports to the European Environment Agency (EEA). The EEA is also responsible for supporting the reporters in fulfilling their obligation. To that end, technical support to the F-gas reporting process is provided by the EEA's European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM) ([12]). Until 2011, collection, quality control, analysis and support had been performed by consultants in the context of service contracts with the European Commission.

As of 2015, registration of companies for reporting is carried out in the European Commission's F-gas portal ([13]) which also hosts the HFC registry provided for under Article 17 of the 'new' F-Gas Regulation. The F-gas portal links directly to the Business Data Repository (BDR).

([11]) 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).
([12]) http://acm.eionet.europa.eu.
([13]) https://webgate.ec.europa.eu/ods2.

## 1.4 Reporting procedure

*Reporting format and quality control*

The format for reporting by companies in accordance with Article 19 of the new F-Gas Regulation is laid down in Commission Implementing Regulation (EU) 1191/2014.

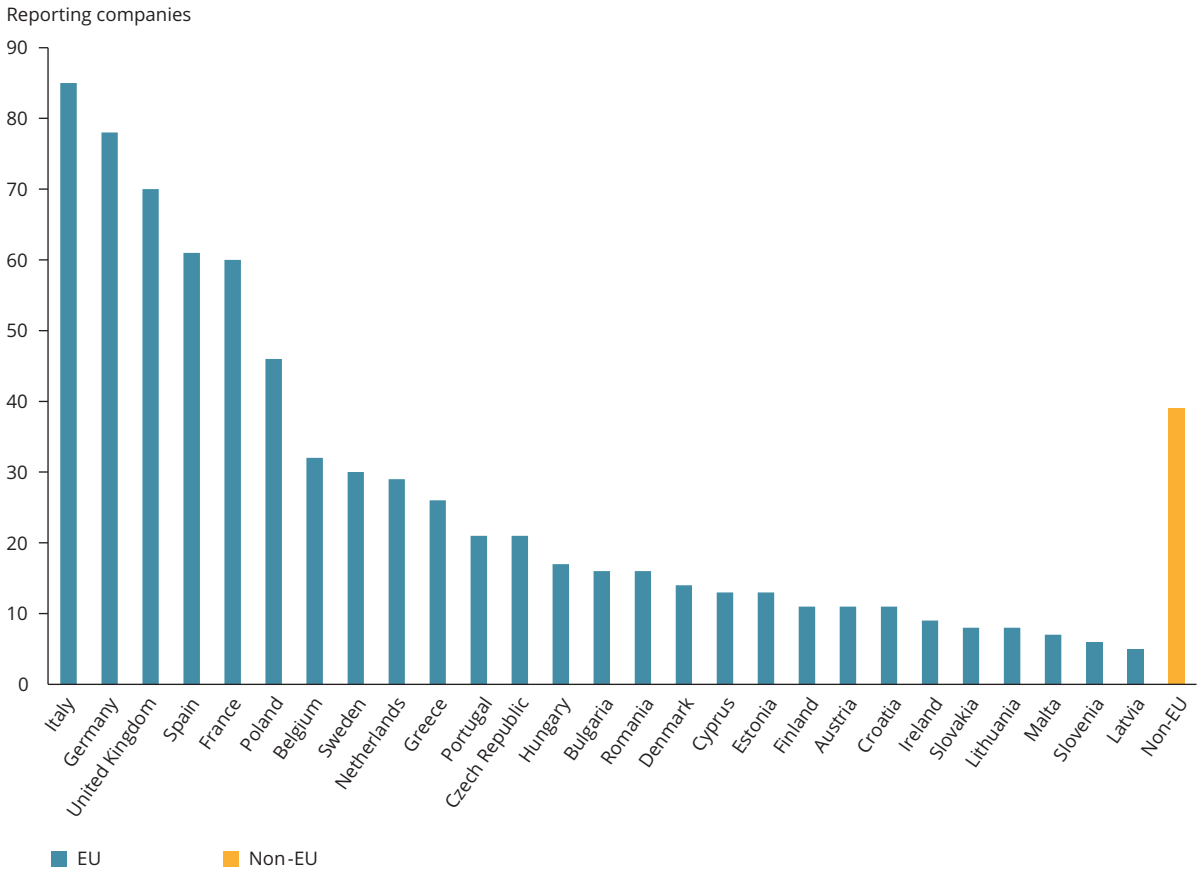
Company registration for reporting and the reporting process are two separate procedures. Registration for reporting is centralised in the European Commission's F-gas portal at https://webgate.ec.europa.eu/ods2. This provides 'one-stop-shop' access for both the HFC Registry (for quota purposes) and for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

From their account in the F-gas portal, companies have a direct link to the BDR at https://bdr.eionet.europa.eu. This reporting platform ensures that the reporting process maintains traceability and transparency for all stakeholders. The system includes automated quality checks and facilitates the data processing after companies' submissions. The completeness and consistency of the reported data is further assured by manual data quality checks, followed by bilateral communication with the reporting companies where necessary.

*Reporting companies in 2016*

By 2 June 2016, 763 companies had reported on their F-gas activity during 2015. Four of these reports had such severe quality problems that their data are not included in the aggregation report on 2015. This is an increase of 295 new reporters over the previous year. A further 333 companies reported no activity during 2015 ('nil report').

**Figure 1.1 Reporting companies by Member State for the 2015 reporting year**




**Note:** Non-EU countries: China, Hong Kong, Japan, Malaysia, Switzerland, Turkey, United States of America.

**Source:** EEA, 2016a.

In line with previous years, a few large Member States have most of the reporting companies, but there was increased reporting activity in smaller eastern Member States. Luxembourg remains the only Member State without a reporting company. The number of reporting companies outside the EU, most of whom are located in China, more than doubled from 19 to 39. Figure 1.1 shows the number of reporting companies per Member State.

More detail on the distribution of reporting companies by Member State and activity (i.e. producers, importers, exporters, feedstock users, destruction companies, and equipment importers) and on the development over time of numbers of reporting companies is provided in Tables A4.1, A4.2 and A4.3 in Annex 4.

## 1.5 Terminology

***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 gases' or 'F-gases'.

The list of reportable fluorinated gases under the old F-Gas Regulation was restricted to HFCs, PFCs and $SF_6$. These are listed in Annex 1.

***Annex I F-gases***

F-gases under Annex I of the new F-gas Regulation include HFCs, PFCs and $SF_6$. The majority of these gases have high GWPs.

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

***Hydrofluorocarbons***

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 HFC152 and HFC161 were previously covered by the old F-Gas Regulation 842/2006.

***Perfluorocarbons***

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.

***Sulphur hexafluoride***

$SF_6$ is an inorganic compound; as an excellent electrical insulator, its main use is in the electrical industry. $SF_6$ is a potent greenhouse gas; its GWP is listed in Annex 1. $SF_6$ was also covered by the old F-Gas Regulation.

***Annex II F-gases***

'Other fluorinated greenhouse gases' are listed in Annex II of the new F-Gas Regulation and include:

- unsaturated hydro(chloro)fluorocarbons (section 1 of Annex II);
- fluorinated ethers and alcohols (section 2 of Annex II);
- other perfluorinated compounds (section 3 of Annex II).

All these gases and their GWPs are listed in Annex 2 of this report. The Annex II gases were not subject to the reporting obligations under the old F-Gas Regulation 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. 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 are listed in Annex 3. In their reports under Article 19 of the new F-Gas Regulation, companies report on their transactions (import, export, etc.) of such

mixtures while specifying the mixture's composition. The GWPs of mixtures are calculated according to the GWP of the proportion of their constituent gases (listed in Annexes 1, 2 and 3); for all other substances, the default value of zero is used.

***Nil report***

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

***Global warming potentials***

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 $CO_2$-equivalent ($CO_2$-eq.).

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 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 fluorinated gases up to 2014 used TAR GWPs.

Quantities of F-gases are reported in physical tonnes. Conversion of the figures into $CO_2$-eq. based on gas-specific GWPs facilitates a focus on the potential warming effect caused by these gases after release to the atmosphere. Both metrics are used in this report when analysing the data.

The GWPs of gases are listed in Annexes 1, 2 and 3.

## 1.6 Confidentiality

The new F-Gas regulation maintains the confidentiality provisions of the earlier F-Gas Regulation 842/2006, and the EEA continues to take 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 fluorinated gas activity in this report are of a general nature and do not refer to figures or percentages. A detailed account of the confidentiality measures applied to the data published in this report is included in Annex 5.

## 1.7 Data covered in this report

The report is based on submissions for the reporting year ([14]) 2015 as received by 2 June 2016 (end of business). With 31 March 2015 as the legal reporting deadline, this approach allowed for the inclusion of data from companies delivering late as well as for resubmissions of corrected data.

For the reporting years 2007–2014, this report relies on data reported by companies in previous years as presented in the 2015 EEA report on F-gases ([15]). Data for 2007–2013 had been reported under the old F-Gas Regulation. Reporting under the new regulation covers the years from 2014 onwards.

([14]) 'Reporting year' means the calendar year on which companies report. For example, in 2015 companies reported on their activities in the reporting year 2014.

([15]) *Fluorinated greenhouse gases 2014 — Data reported by companies on the production, import and export of fluorinated greenhouse gases in the European Union* (EEA, 2015).

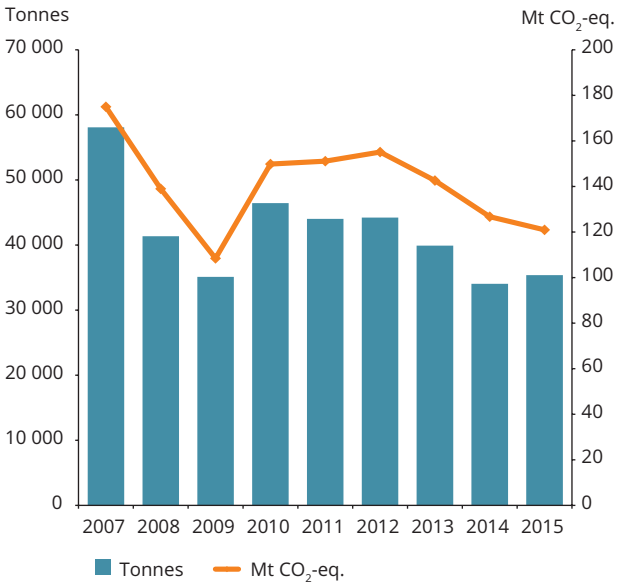
# 2 Production, import, export, reclamation and destruction

## 2.1 Production of F-gases

Production of F-gases in Europe has seen an ongoing decline since 2010 (Figure 2.1). The dip for F-gases in 2009, which is also visible in the respective graphs for imports (Figure 2.2) and exports (Figure 2.6), corresponds to the global financial downturn at that time. In 2015, however, production increased by 1 kt or 4 % compared with 2014. In terms of $CO_2$-eq., production nevertheless continued to decline: 2015 production was 6 Mt $CO_2$-eq. or 5 % below the amounts reported for 2014.

Production of F-gases is dominated by HFCs, which account for more than 90 % of the total. For 2015, production was reported for 10 gases: 5 HFCs, 3 PFCs, $SF_6$ and one unsaturated HFC. HFC-134a is the main gas and HFC-365mfc was also produced in significant amounts, while the proportion of PFC production was relatively small. $SF_6$ accounts for a considerable proportion of production when reported as $CO_2$-eq.

**Figure 2.1 Production of F-gases**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

Reporting on the production of Annex II gases (see Annex 2) has been required since 2014. For 2015, such production was reported for the first time, albeit in very small amounts.

The trends visible in total production, for both the increase in physical tonnes and the decrease in $CO_2$-eq., reflect changes in the mix of HFC production. In particular, a 75 % decrease in the production of HFC-143a (GWP: 4 470) led to a 14 % decrease in the average GWP of HFCs produced. Following the closure of production facilities of HFC-125 in 2013, production of HFC-32 ceased in 2014. Measured as $CO_2$-eq., HFC production was at its lowest level since reporting began in 2007.

For confidentiality reasons, the data on production shown in Tables A4.4 and A4.5 in Annex 4 can only include totals for HFCs and all F-gases.

## 2.2 Imports of F-gases

Imports of F-gases can be differentiated into bulk imports, i.e. gases imported in gas containers, and imports of gases contained in products and equipment.

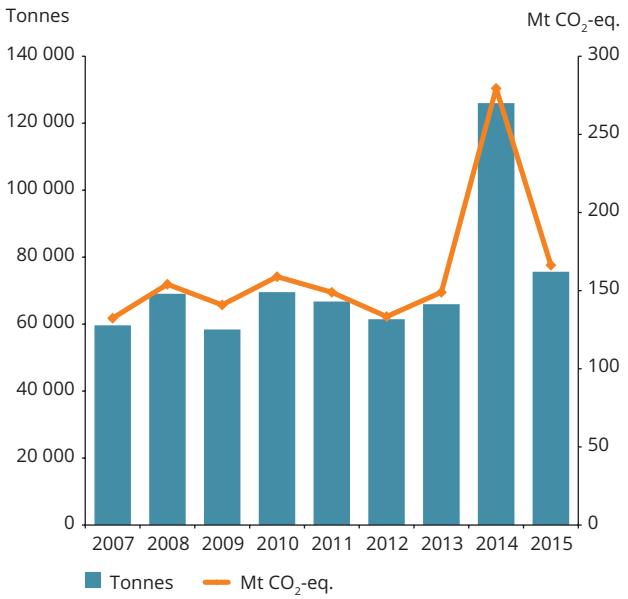
### *Bulk import*

Bulk import of F-gases declined from 2010 to 2012 and has been increasing since then (Figure 2.2). The earlier dip in 2009 was induced by the global financial downturn at that time. Bulk imports of F-gases were 40 % below the exceptionally high amounts reported for 2014, both by mass and as $CO_2$-eq. Except for 2014, bulk imports in 2015 were the highest since reporting started in 2007.

The 2014 bulk imports were extraordinarily high. As noted in last year's report (EEA, 2015), this is likely to have been a one-off episode before the HFC phase-down entered into force in 2015.

Companies had an incentive to import HFCs and stockpile them for use or later sales in 2015 and beyond. Quota restrictions were not yet applicable

**Figure 2.2 Bulk imports of F-gases**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

because these imports would be considered to have been placed on the market in 2014. Moreover, because new entrants to the market receive only small quotas, 2014 presented an opportunity for companies that had not previously reported to maximise their imports of HFCs before the quota system entered into force. Furthermore, a number of companies that had not previously reported may have been alerted to both the existing and new reporting obligations through the HFC phase-down and quota system.

In 2015, bulk imports returned to the range of the 2007–2013 time series, albeit 15 % above 2013 levels (in $CO_2$-eq.: 12 %). Considering that Annex II F-gases were not subject to reporting until 2014, the increase in the bulk import of Annex I F-gases (HFCs, PFCs and $SF_6$) in 2015 compared with 2013 was only 9 % (8 % in $CO_2$-eq.).

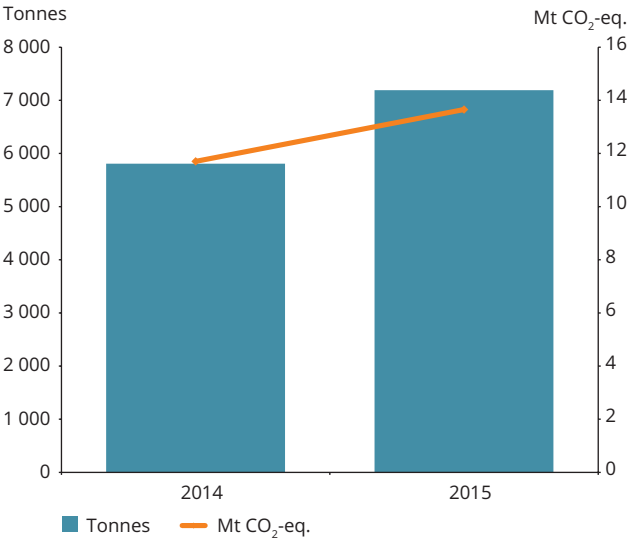
For 2015, imports were reported for 25 gases: 12 HFCs, four PFCs, $SF_6$, four unsaturated HFCs/HCFCs, three HFEs and $NF_3$.

Bulk import of F-gases is dominated by HFCs, which in 2015 accounted for 94 % of total bulk imports (89 % in $CO_2$-eq.). The trends visible in bulk imports are largely determined by the respective trends in HFC imports, which by weight were 9 % above 2013 and 42 % (in $CO_2$-eq.: 43 %) below 2014. HFC-134a and HFC-125 continued to be the HFCs imported in largest quantities, followed by HFC-32 and HFC-143a. In terms of $CO_2$-eq., the bulk imports of HFC-125 (39 %), HFC-134a (32 %) and HFC-143a (20 %) were most relevant. The bulk import of unsaturated HFCs/HCFCs increased by more than 70 % compared with 2014 and consisted mainly of HFC-1234yf. PFC imports showed a year-on-year increase of more than 10 % and the highest quantity since reporting started in 2007. In contrast, $SF_6$ imports decreased by 6 % and $NF_3$ by 9 %. 2015 bulk imports of $SF_6$ were slightly above 2012 imports, which were the lowest in the time series. For confidentiality reasons, data on bulk imports can only be shown at a high level of aggregation in Tables A4.6 and A4.7 in Annex 4.

### *Imports in products and equipment*

Imports of F-gases within products and equipment ([16]) has risen by 24 % in tonnes of gases or by 17 % in $CO_2$-eq. since 2014 ([17]) (Figure 2.3).

**Figure 2.3 Imports of F-gases within products and equipment**




**Sources:** EEA, 2015 and 2016a.

([16]) Under the 'new' F-Gas Regulation 517/2014, importers of products or equipment containing Fgases are required to report on quantities imported and placed on the market. Products and equipment 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 can be approximated with these reported data.

([17]) As reporting by importers of products and equipment was not required under the old F-Gas Regulation (842/2006), the time series presented in this section does not reach back further than 2014.

The increase in reported amounts reflects the number of companies reporting on equipment imports, which doubled to more than 400 in 2015, since 2015 equipment imports reported by companies which had already reported on 2014 imports were 10 % (tonnes) or 12 % ($CO_2$-eq.) below 2014 imports. Thus, the increase in reported equipment imports can be fully attributed to the new reporting companies. The number of equipment importers per country is listed in Table A4.1 and the total for 2014 and 2015 is shown in Table A4.3 (Annex 4).

The F-gases contained in imported equipment are limited to very few gases/mixtures. In 2015, 95 % of those gases (both in tonnes and $CO_2$-eq.) were the refrigerants R-410A and R-134a.

The 22 gases imported in products and equipment in 2015 include 12 HFCs, 5 PFCs, 2 unsaturated HFCs and 2 HFEs.

The import of F-gases within products and equipment is dominated by HFCs, which in 2015 accounted for 96 % of total imports (98 % in $CO_2$-eq.). The most relevant HFCs in this respect were HFC-134a (as refrigerant R-134a), and HFC-32 and HFC-125 (as the constituents of the refrigerant R-410A).

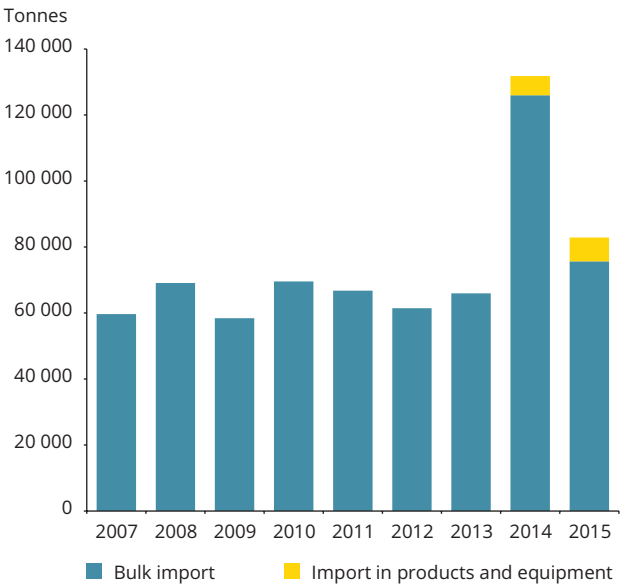
The import in equipment of unsaturated HFCs, in particular as the refrigerant in vehicle air-conditioning units, has more than doubled compared with 2014, however. It should be borne in mind that the reported data of unsaturated HFC-1234yf contained in imported equipment may not be fully complete. This is due to its low GWP of 4, in combination with the threshold for the reporting obligation for equipment importers of 500 t $CO_2$-eq. HFC-1234yf is used as a refrigerant in the air-conditioning systems of road vehicles and with a specific charge of approximately 0.5 kg per passenger car, the 500 t $CO_2$-eq. threshold correlates with 250 000 passenger cars. For air-conditioning systems still using the traditional R-134a (GWP: 1 430), however, the 500 t $CO_2$-eq. threshold correlates to approximately 700 passenger cars. Thus, car importers specialising in models using HFC-1234yf may often be unaffected by the reporting obligation.

For confidentiality reasons, data on F-gases imported within products or equipment can be shown only at a high level of aggregation in Table A4.8 in Annex 4.

### *Total imports*

Since 2014, total imports can be calculated as the sum of bulk imports and imports within products and equipment as shown in Figures 2.4 and 2.5. The 2015 share of equipment imports in the total was 9 % (tonnes) or 8 % ($CO_2$-eq.).

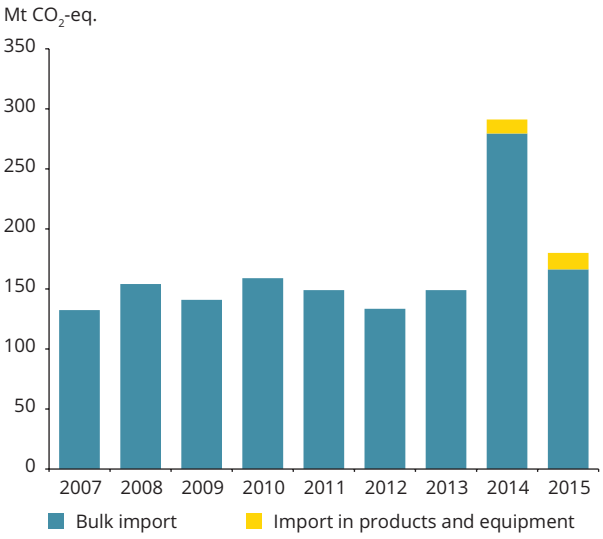
**Figure 2.4 Imports of F-gases (tonnes)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Figure 2.5 Imports of F-gases ($CO_2$-eq.)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## 2.3 Exports of F-gases

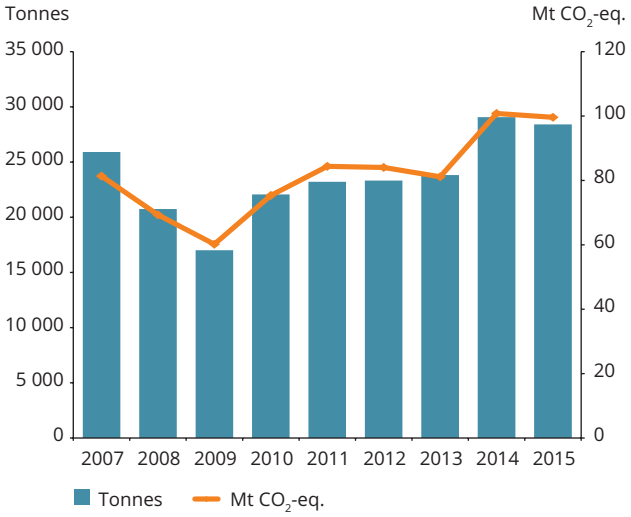
Bulk exports ([18]) of F-gases declined slightly compared with 2014 (2 % in tonnes or 1 % as $CO_2$-eq.). Exports had previously seen an increase for five consecutive years (Figure 2.6). The dip in 2009 probably reflects the global financial downturn at that time. Notwithstanding 2014, 2015 exports were still above the 2007–2013 time series levels.

For 2015, bulk exports were reported for 27 gases: 13 HFCs, six PFCs, $SF_6$, four unsaturated HFCs/HCFCs and $NF_3$. Figures 2.7 and 2.8 show the proportions of gases in these groups (HFCs, PFCs, $SF_6$ and Annex II F-gases) in exports over time, by mass and as $CO_2$-eq.

HFCs accounted for approximately 90 % of bulk exports of F-gases, if measured in tonnes. If measured in $CO_2$-eq., however, $SF_6$ accounted for approximately 50 % over the whole time series since 2007. The proportion of $SF_6$ in 2015 exports was 55 % (in $CO_2$-eq.).

The overall trend in exports (a decrease of 2 % in tonnes compared with 2014, 1 % in $CO_2$-eq.) was affected by a 4 % drop in $SF_6$ exports and a 50 % increase in exports of unsaturated HFCs and HCFCs. HFC exports measured in tonnes decreased by 3 % over the time series. Measured in $CO_2$-eq., however,

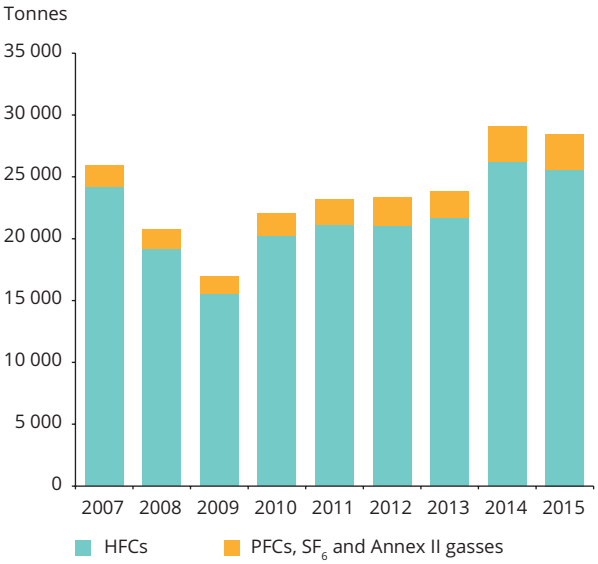
**Figure 2.6 Bulk exports of F-gases**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

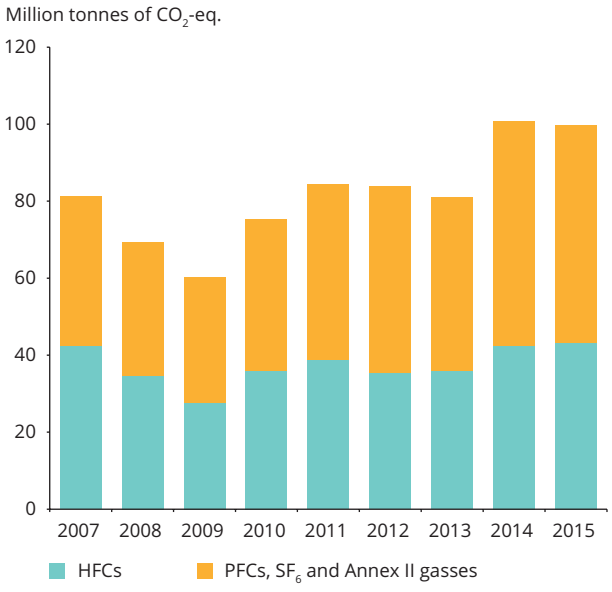
**Figure 2.7 Bulk exports of F-gases (tonnes)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Figure 2.8 Bulk exports of Fgases ($CO_2$-eq.)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

([18]) Both under the 'old' F-Gas Regulation 842/2006 and under the 'new' F-Gas Regulation 517/2014, no systematic collection of data on exports of F-gases within products and equipment has taken place. Thus, this chapter is limited in scope to bulk exports.

HFC exports increased by 2 %. This was mostly due to decreasing HFC-134a exports (14 %) offset by increasing HFC-143a exports (72 %).

Data on bulk exports, aggregated for confidentiality reasons, are shown in Tables A4.9 and A4.10 in Annex 4.

## 2.4 Reclamation, feedstock use and destruction of F-gases

### *Reclamation*

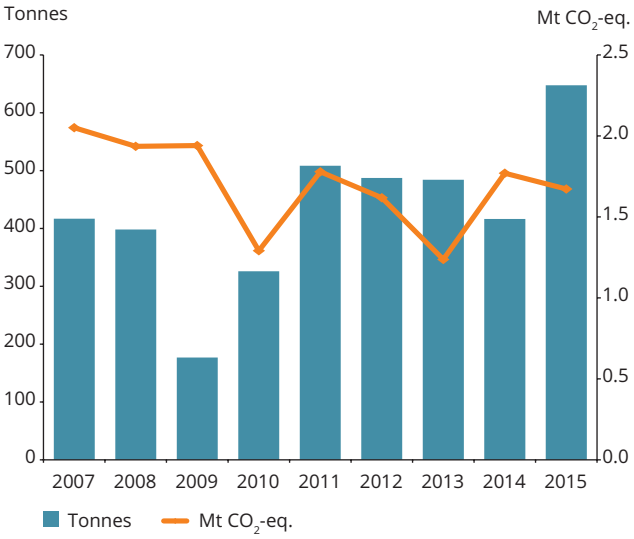
Reclamation was reported for 11 gases: Eight HFCs, one PFC and two unsaturated HFCs/HCFCs. Unlike for previous years, reclamation of $SF_6$ was not reported. Reclamation of F-gases increased in mass, but decreased in $CO_2$-eq. compared with 2014 (Figure 2.9). This was due to an increase in HFC reclamation and no $SF_6$ reclamation being reported for 2015.

Annual totals of reclaimed F-gases are shown in Table 2.1. Together with the supply of virgin gases, reclamation is included in the bulk supply/total supply metrics (see Chapter 3). Compared with the use of virgin gases, overall reclamation levels of F-gases were still quite low, at less than 1 % of bulk supply.

### *Feedstock use*

Feedstock use has been declining since 2013, with 2015 having the lowest level since 2007. For 2015, feedstock use was reported primarily for HFC-23 but also in smaller amounts for HFC-134a and HFC-245fa. Except for small amounts of unsaturated HCFC-1233zd in 2014, only HFCs have been reported for feedstock use. Gases used as feedstock are not included in bulk supply/total supply metrics. The reported feedstock amounts are confidential and so are not shown in Table 2.1.

**Figure 2.9 Reclamation of F-gases**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

### *Destruction*

Destruction of F-gases has been increasing since 2008, with the exception of very low reported levels for 2013. Compared with 2014, the increase was 44 % in tonnes, or 23 % as $CO_2$-eq. (Figure 2.10).

Destruction was reported for 12 gases: Four HFCs, four PFCs, $SF_6$ and three Annex II F-gases. Destruction is strongly focused on HFCs, which in 2015 represented 98 % (tonnes) or 95 % ($CO_2$-eq.) of total destroyed amounts. The destruction of HFC-23 is the most prominent, as it is formed as a by-product in certain production processes of F-gases and its destruction (or recovery for subsequent use) is obligatory under the F-Gas Regulation. The proportion of HFC-23 in overall HFC destruction declined in 2015.

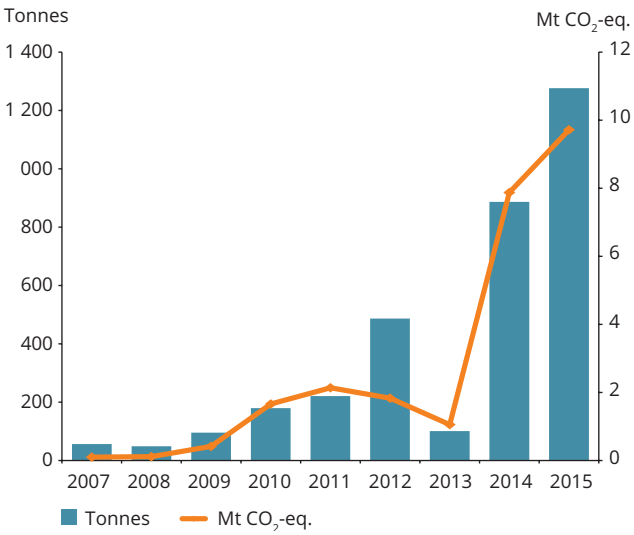
**Table 2.1 Reclamation and destruction of F-gases**

| | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Reclamation | Tonnes | 417 | 398 | 177 | 326 | 508 | 487 | 484 | 416 | 648 |
| | Mt $CO_2$-eq. | 2.1 | 1.9 | 1.9 | 1.3 | 1.8 | 1.6 | 1.2 | 1.8 | 1.7 |
| Destruction | Tonnes | 56 | 49 | 96 | 179 | 221 | 487 | 101 | 887 | 1 227 |
| | Mt $CO_2$-eq. | 0.1 | 0.1 | 0.4 | 1.7 | 2.1 | 1.8 | 1.1 | 7.9 | 9.7 |

**Note:** Annex II gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Figure 2.10 Destruction of F-gases**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

The 2014 data on $CO_2$-eq. presented in this graph deviate from the data presented in the previous report (EEA, 2015), as the EEA reassessed some amounts reported in 2015 as 'unspecified gas for destruction', using composition estimates provided by the operator of the same facility in 2016.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

Gases used as feedstock are not included in the bulk supply/total supply metrics (Chapter 3). If compared with bulk supply, however, destruction has risen by up to approximately 1.5 % (tonnes) or 5 % ($CO_2$-eq.) of bulk supply. Following publication of the previous report (EEA, 2015), there was some concern that reporting on 2014 may not have been complete. For 2015, the number of companies reporting on destruction rose from 10 to 15 (see Table A4.1 in Annex 4).

# 3 Supply of F-gases

'Total supply' is a parameter that provides information on the actual use of F-gases by EU industries. 'Total supply' is focused on potentially emission-relevant supplies of gases to EU industries and thus does not cover gases intended for feedstock use or destruction. 'Total supply' is the sum of 'bulk supply' and 'supply in products/equipment'. For methodological details on the calculation of supply, please refer to Annex 6.

## 3.1 Bulk supply

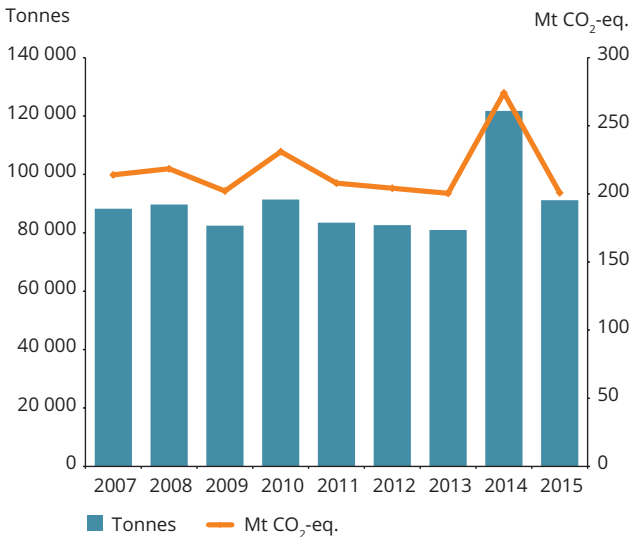
Bulk supply of F-gases declined from 2010 to 2013. Following an exceptionally high amount calculated for 2014 (see comment on 2014 bulk imports in Section 2.2), bulk supply calculated for 2015 met 2010 levels if calculated in tonnes or 2013 levels if calculated in $CO_2$-eq. (Figure 3.1).

Bulk supply for 2015 was 13 % above 2013 levels if measured in tonnes, but almost constant compared as $CO_2$-eq. for 2013. Bearing in mind that Annex II F-gases had not been subject to reporting for 2013, the increase in the bulk supply of Annex I F-gases (HFCs, PFCs and $SF_6$) in 2015 compared with 2013 was only 9 % (tonnes). Measured as $CO_2$-eq., the 2015 bulk supply of Annex I F-gases declined by 3 % compared with 2013. Compared with the exceptionally high amounts calculated for 2014, the decline was 25 % in tonnes or 27 % as $CO_2$-eq.

For 2015, bulk supply was reported for 28 gases: 13 HFCs, six PFCs, $SF_6$, four unsaturated HFCs/HCFCs, three HFEs and $NF_3$.

The proportion of non-HFC gas groups (PFCs, $SF_6$, Annex II F-gases) in bulk supply for 2007–2015 by mass was only 2.5 % (not shown). Figure 3.2 presents bulk supply by gas group as $CO_2$-eq.

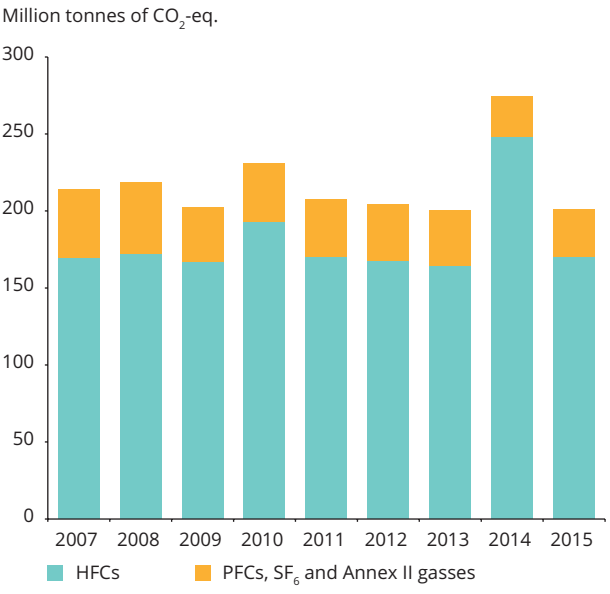
**Figure 3.1 Bulk supply of F-gases**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Figure 3.2 Bulk supply by group of F-gases ($CO_2$-eq.)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

With declining levels of production, for most gases the trends in bulk supply align to an increasing degree with the trends observed for bulk imports. Bulk supply of F-gases was dominated by HFCs, which in 2015 accounted for 95 % of total bulk supply (85 % in $CO_2$-eq.), with unsaturated HFCs and HCFCs making up most of the balance. In terms of $CO_2$-eq., however, $SF_6$ contributed a significant fraction of 2015 bulk supply. HFEs and alcohols contributed only a very small fraction.

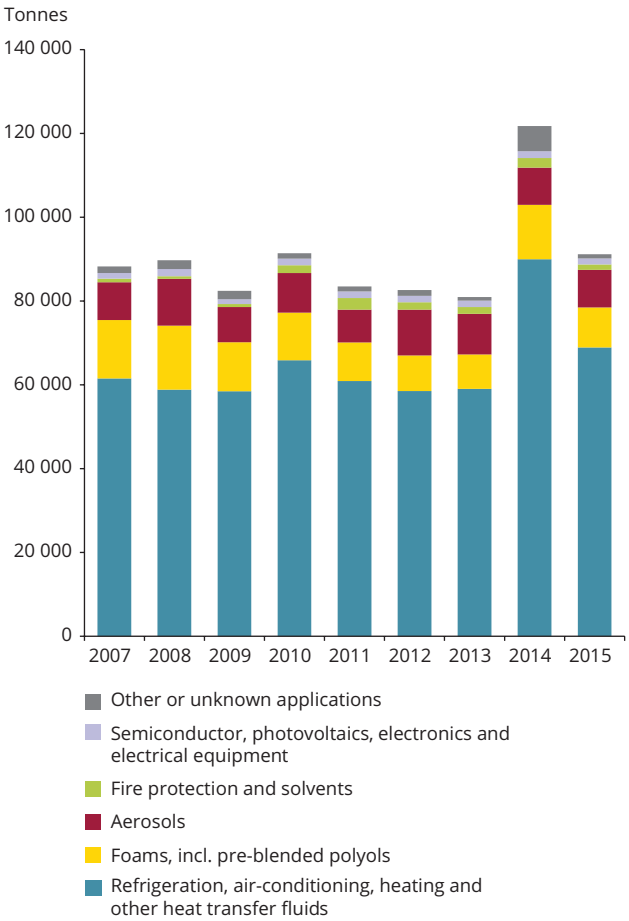
HFC-134a and HFC-125 continued to be the HFCs supplied in bulk in the largest quantities, followed by HFC-143a and HFC-32. These gases are the constituents of the most commonly used refrigerants. In addition to refrigeration, HFC-134a is also used for aerosols and (less frequently) as a foam-blowing agent. Reported as $CO_2$-eq., the bulk imports of HFC-125 (38 %), HFC-134a (32 %) and HFC-143a (19 %) were most relevant. Other HFCs included HFC-152a, HFC-365mfc, HFC-227ea and HFC-245fa, which are used as foam-blowing agents, in aerosol applications or in fire protection systems.

Data on bulk supply are shown in Tables A4.11 and A4.12 in Annex 4.

### *Intended applications of bulk supply*

Figures 3.3 and 3.4 show bulk supply allocated by intended application (for calculation details, please refer to Annex 6). Tables A4.13 and A4.14 in Annex 4 provide the data at a slightly less aggregated level.

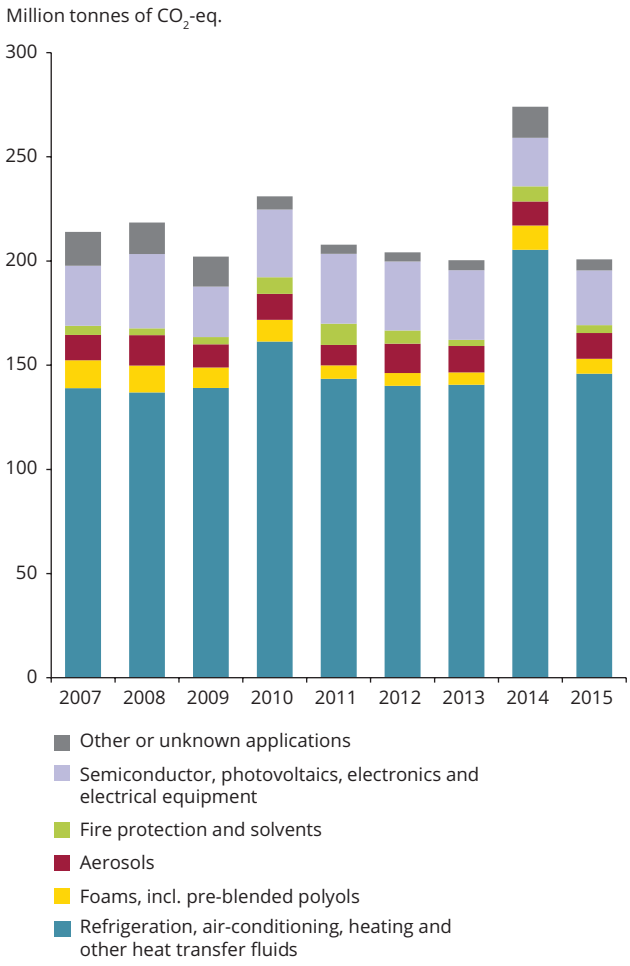
**Figure 3.3 Intended applications of bulk supply (tonnes)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013. Data shown may not match the previous EEA report as the calculation methodology was updated (Annex 6).

**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Figure 3.4 Intended applications of bulk supply ($CO_2$-eq.)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013. Data shown may not match the previous EEA report as the calculation methodology was updated (Annex 6).

**Sources:** EC, 2011; EEA, 2015 and 2016a.

Refrigeration, air conditioning and heating is by far the most relevant application of bulk supplies to the EU. The refrigerant quantities constitute approximately 70 % (in tonnes) or 80 % (in $CO_2$-eq.) of 2015 bulk supply. Compared with 2014, which had an exceptionally high bulk supply of refrigerants, the amounts decreased by 23 % (29 % in $CO_2$-eq.). Compared with 2013, however, the amounts in tonnes increased by 16 %, while amounts measured in $CO_2$-eq. increased by 3 %. This may indicate a trend towards use of refrigerants with lower GWPs.

Foams and aerosols each accounted for 10 % of 2015 bulk supply, if measured in tonnes. Measured in $CO_2$-eq., however, the proportion of those applications is approximately half that size, at 4 % for foams and 6 % for aerosols. HFC supplied for foam blowing decreased considerably compared with the high amounts in 2014. However, 2015 supply was above the declining amounts that had been reported for 2011–2013. The use of F-gases as aerosols appears to be fairly constant over time; the low amounts in 2011 appear to have been an anomaly.

Electrical equipment (8 % in 2015) and semiconductor, photovoltaics and other electronics manufacturing (5 %) are relevant applications of F-gases, in particular $SF_6$ and PFCs, if measured in $CO_2$-eq. $SF_6$ quantities reported for electrical equipment decreased by 19 % compared with 2014. However, $SF_6$ supplied for electrical equipment was still approximately 50 % below 2013 amounts. Amounts supplied in bulk for semiconductor and photovoltaics manufacturing decreased by 32 % compared with 2014, but increased by 4 % if measured in $CO_2$-eq. The substantive increase from 2013 to 2014 can be attributed to the fact that $NF_3$ was included in the list of reportable fluorinated gases for the first time in 2014.

A tabular overview of the amounts of single F-gases in tonnes and $CO_2$-eq. calculated for the intended applications of bulk supply in 2015 is given in Tables A4.13 and A4.14 in Annex 4.

## 3.2 Supply in products and equipment

The supply in products and equipment equals the amounts reported as imported in products and equipment. For a description of trends in gases supplied in products and equipment, please refer to Section 2.2 and the summary data in Table A4.8 in Annex 4.

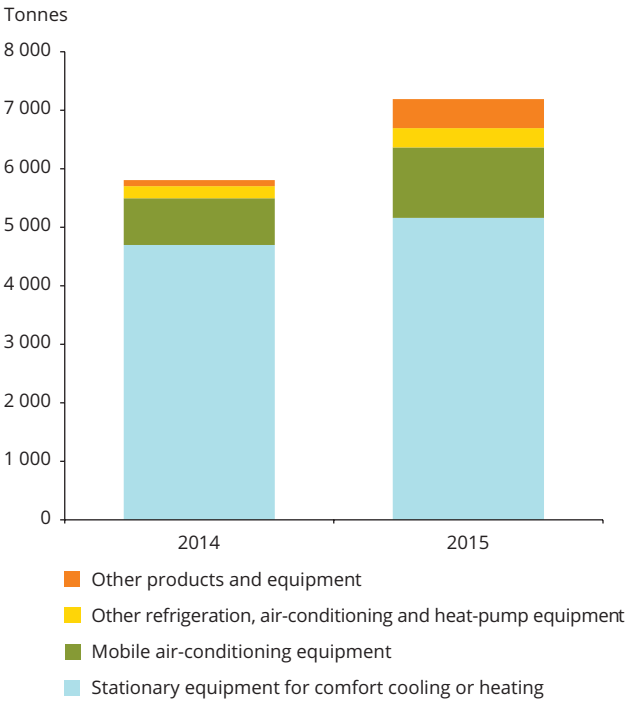
***Product and equipment categories***

The most important equipment category is stationary equipment for comfort cooling or heating (72 % by mass or 78 % as $CO_2$-eq. in 2015) and mobile air conditioning (mostly in passenger cars and light-duty vehicles), which accounts for 17 % by mass or 10 % as $CO_2$-eq. The stationary equipment in question consists mainly of split units (approximately 60 % of refrigerant charge) or multi-split units (approximately 25 %), both operated with R-410A.

Figures 3.5 and 3.6 present how the supply in products and equipment is spread across product and equipment categories over time.

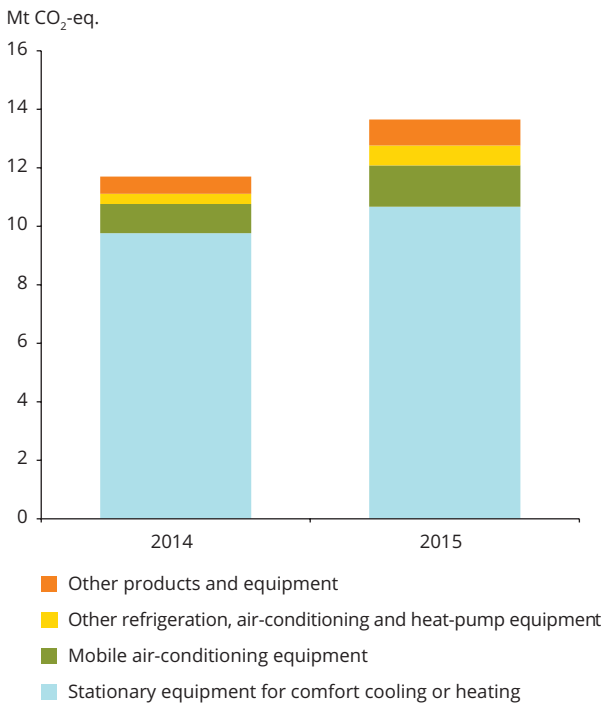
A summary of F-gases supplied in products and equipment is included in Table A4.8 in Annex 4. The increase in reported supply in products and equipment compared with 2014 (see caveat mentioned above) is linked to the stationary equipment for comfort cooling or heating, mobile air-conditioning equipment, and non-medical aerosols.

**Figure 3.5 Categories of supply in products and equipment of F-gases (tonnes)**



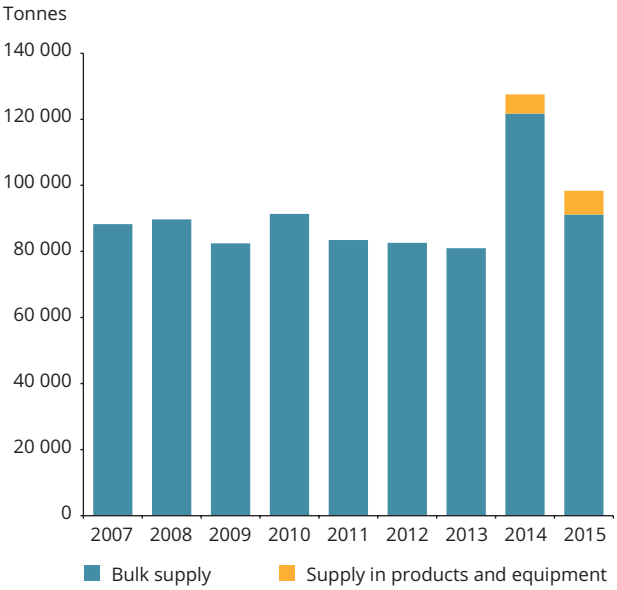

**Sources:** EEA, 2015 and 2016a.

**Figure 3.6** **Categories of supply in products and equipment of F-gases ($CO_2$-eq.)**




**Sources:** EEA, 2015 and 2016a.

**Figure 3.7** **Supply of F-gases by supply types (tonnes)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

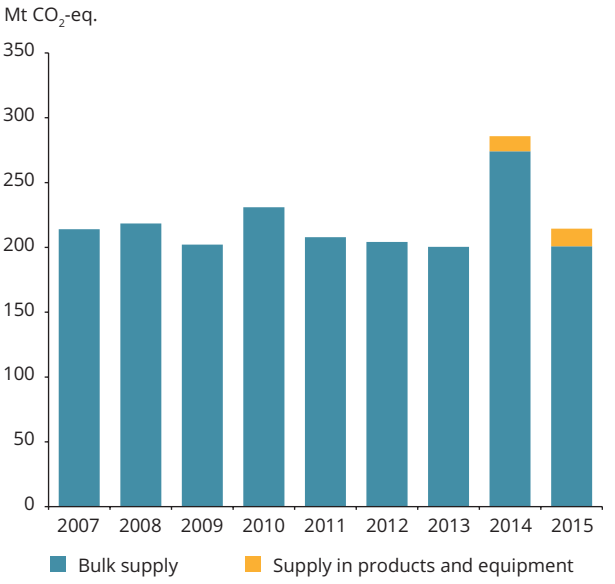
## 3.3 Total supply

The reported amounts of bulk supply and supply in products and equipment are jointly presented in Figure 3.7 (tonnes) and Figure 3.8 ($CO_2$-eq.).

Since 2014, the total supply can be calculated as the sum of both types of supply. As the result of trends described for bulk supply (Section 3.1) and supply in products and equipment (Section 3.2), total supply declined by 23 % compared with 2014 (25 % in $CO_2$-eq.). The 2015 proportion of supply in products and equipment imports in total supply was 7 % (tonnes) or 6 % ($CO_2$-eq.).

In 2015, HFCs accounted for 95 % of total supply measured in tonnes or 85 % measured in $CO_2$-eq. (Figures 3.9 and 3.10). The majority of HFCs are supplied in bulk, with only 7 % supplied within products and equipment (6 % as $CO_2$-eq.). $SF_6$ accounted for a significant proportion, when measured as $CO_2$-eq.

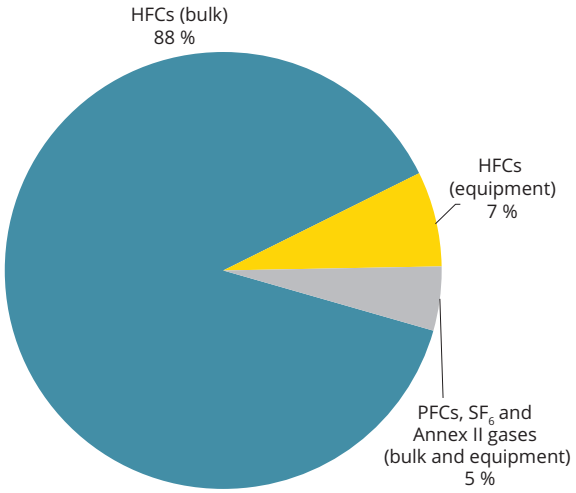
**Figure 3.8** **Supply of F-gases by supply types ($CO_2$-eq.)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013.

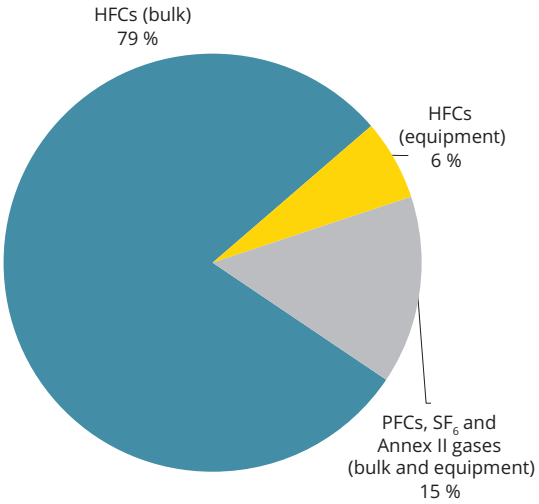
**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Figure 3.9 Total supply of F-gases, 2015 (tonnes)**




**Source:** EEA, 2016a.

**Figure 3.10 Total supply of F-gases, 2015 ($CO_2$-eq.)**



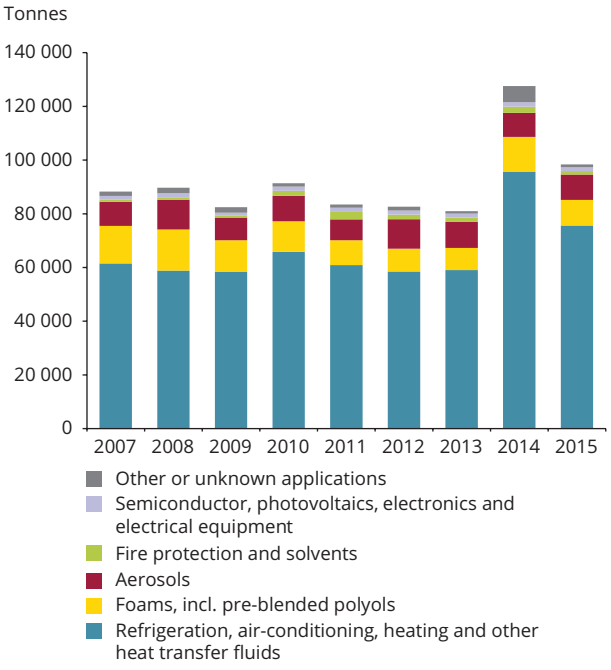

**Source:** EEA, 2016a.

*Intended applications of total supply*

Figures 3.11 and 3.12 depict the timeline of intended applications of total supply.

Limitations in the consistency of time-series between 2013 and 2014 should be kept in mind when interpreting trends. Given the predominant weight of bulk supply in total supply, the assessment made for bulk supply in Section 3.1 also applies to total supply. A summary of F-gases and intended application is included in Tables A4.13 and A4.14 in Annex 4.

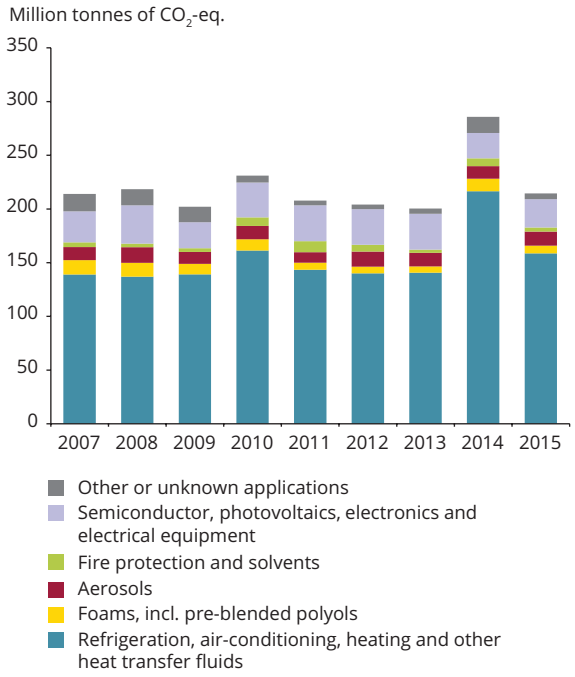
**Figure 3.11 Intended applications of total supply of F-gases (tonnes)**




**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) and HFCs, PFCs and $SF_6$ in products and equipment were not subject to reporting for the years 2007–2013. The data shown for 2007–2013 are thus limited to bulk supply.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Figure 3.12 Intended applications of total supply of F-gases ($CO_2$-eq.)**

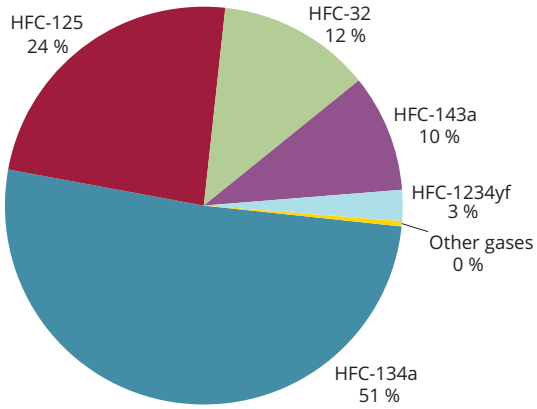



**Note:** Annex II F-gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) and HFCs, PFCs and $SF_6$ in products and equipment were not subject to reporting for the years 2007–2013. The data shown for 2007–2013 are thus limited to bulk supply.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

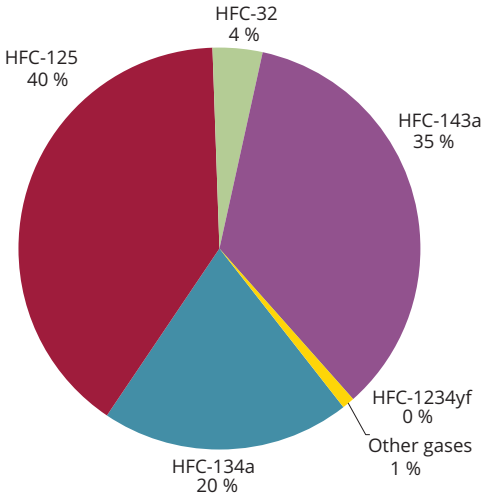
***Refrigeration, air-conditioning and heating*** is the most relevant application category. Approximately 75 % of the total supply of F-gases in 2015 was intended for refrigerant use. The gases primarily used as refrigerants are HFC-134a, HFC-125, HFC-32 and HFC-143a (Figures 3.13 and 3.14). These gases are the constituents of the most common refrigerants R-134a, R-404A, R-407C, R-410A and R-507A. The market share of the novel low-GWP unsaturated HFC-1234yf (GWP: 4) has grown to 3 % of F-refrigerants from below 1 % in 2014.

**Figure 3.13 Total supply for refrigeration, air conditioning and heating, including other heat transfer fluids, 2015 (tonnes)**




**Source:** EEA, 2016a.

**Figure 3.14 Total supply for refrigeration, air conditioning and heating, including other heat transfer fluids, 2015 ($CO_2$-eq.)**

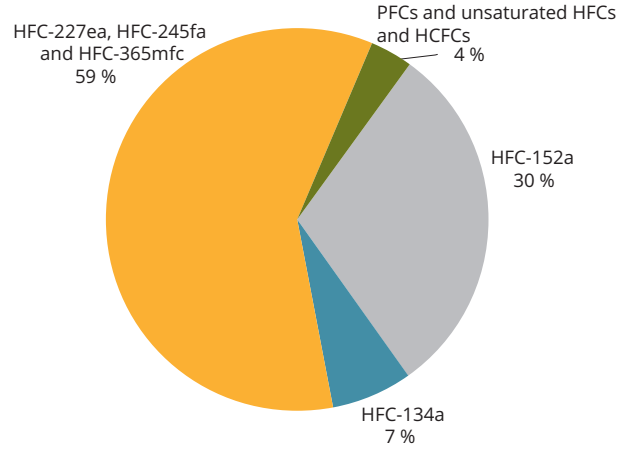



**Source:** EEA, 2016a.

***Foam blowing*** is the second most common application with 10 % (by mass) of F-gas supply in 2015 (3 % as $CO_2$-eq.). The gases reported for foam blowing are typically used within mixtures. The most commonly used F-gases in this context are HFC-365mfc, HFC-152a and HFC-245fa, (Figures 3.15 and 3.16). HFC-134a and HFC-227ea play minor roles. The new low-GWP unsaturated HFC-1234ze (GWP: 7) is included among 'PFCs and unsaturated HFCs and HCFCs' and has a market share (in tonnes) of almost 2 % in 2015, but obviously this group is much smaller when shown as $CO_2$-eq.

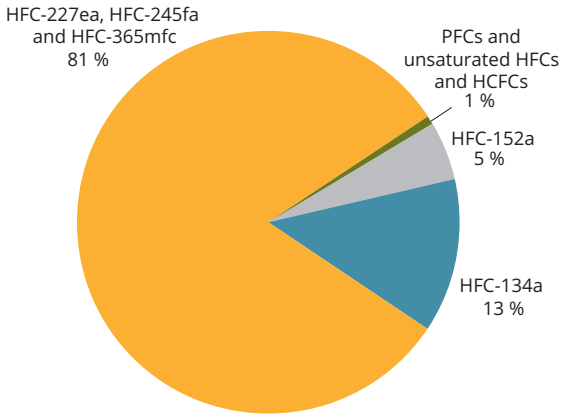
***Aerosol use*** accounted for 10 % (by mass) of the reported applications of total supply in 2015 (6 % in $CO_2$-eq.). This is the sum of medical and non-medical aerosols. HFC-134a, HFC-152a and HFC-227ea had 98 % of the 2014 market share of fluorinated aerosol carriers (Figures 3.17 and 3.18); the novel unsaturated HFC-1234ze gained 2 %, compared with below 0.1 % in 2014. For medical aerosols, HFC-134a accounted for 89 % (by mass) of F-gases; the remainder was covered by HFC-227ea. For non-medical aerosols, however, the HFC-134a proportion was limited to 61 %, HFC-152 accounted for 32 % and unsaturated HFC-1234ze for 7 % (all by mass).

**Figure 3.15 Total supply for foams, 2015 (tonnes)**



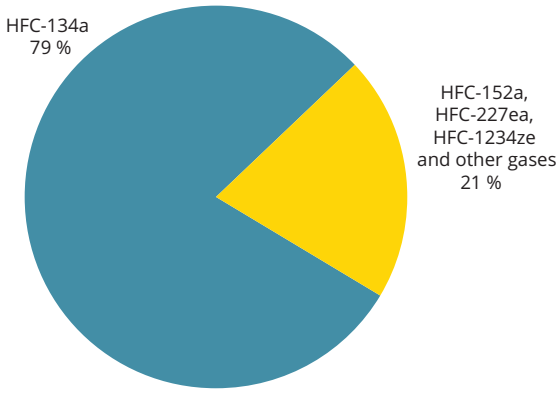

**Source:** EEA, 2016a.

**Figure 3.16 Total supply for foams, 2015 ($CO_2$-eq.)**



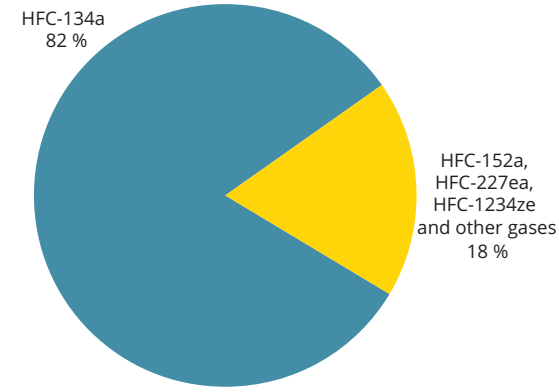

**Source:** EEA, 2016a.

**Figure 3.17 Total supply for aerosol use, 2015 (tonnes)**




**Source:** EEA, 2016a.

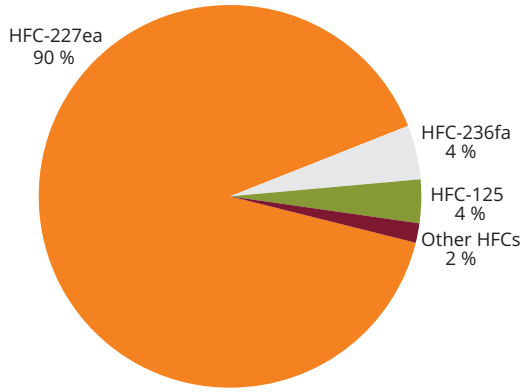
**Figure 3.18 Total supply for aerosol use, 2015 ($CO_2$-eq.)**




**Source:** EEA, 2016a.

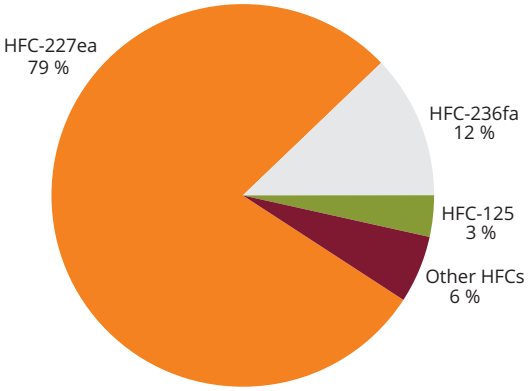
***Fire protection*** accounted for 1 % of total supply of F-gases in 2015, both by mass and as $CO_2$-eq. HFC-227ea is the gas generally used, representing 90 % (by mass) or 79 % (as $CO_2$-eq.). For the rest, few other HFCs were reported (Figures 3.19 and 3.20).

**Figure 3.19 Total supply for fire protection, 2015 (tonnes)**




**Source:** EEA, 2016a.

**Figure 3.20 Total supply for fire protection, 2015 ($CO_2$-eq.)**

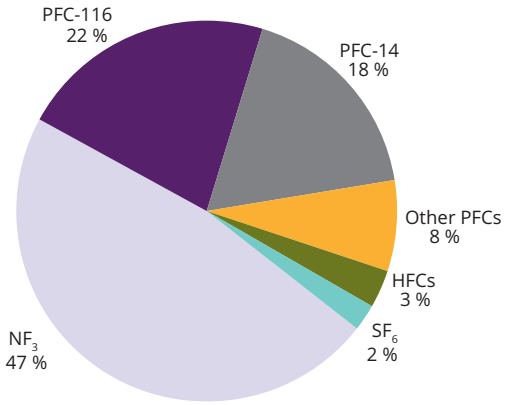



**Source:** EEA, 2016a.

***Electrical equipment*** (switchgear) is the major application for $SF_6$. No other F-gases are used for this application, which accounted for less than 1 % of the total 2015 supply by mass. However, due to the high GWP of $SF_6$, electrical equipment represented 8 % of the 2015 total supply when reported as $CO_2$-eq.

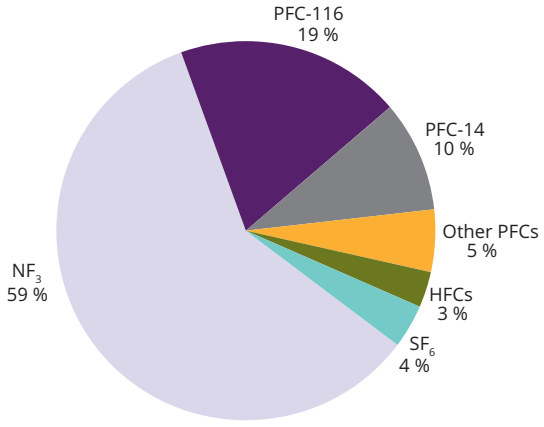
Less than 1 % (by mass) of 2015 total supply of F-gases was intended for ***semiconductor, photovoltaic or other electronics manufacturing*** industries. Due to the high GWPs of the majority of these gases, the proportion was above 5 % as $CO_2$-eq. The most relevant F-gases for these industries are $NF_3$ (nitrogen fluoride), PFC-116 and PFC-14 (Figures 3.21 and 3.22).

**Figure 3.21 Total supply for semiconductor, photovoltaics and other electronics manufacture, 2015 (tonnes)**




**Source:** EEA, 2016a.

**Figure 3.22 Total supply for semiconductor, photovoltaics and other electronics manufacture, 2015 ($CO_2$-eq.)**




**Source:** EEA, 2016a.

A summary of bulk F-gases in tonnes and $CO_2$-eq. for the intended applications is given in Tables A4.13 and A4.14).

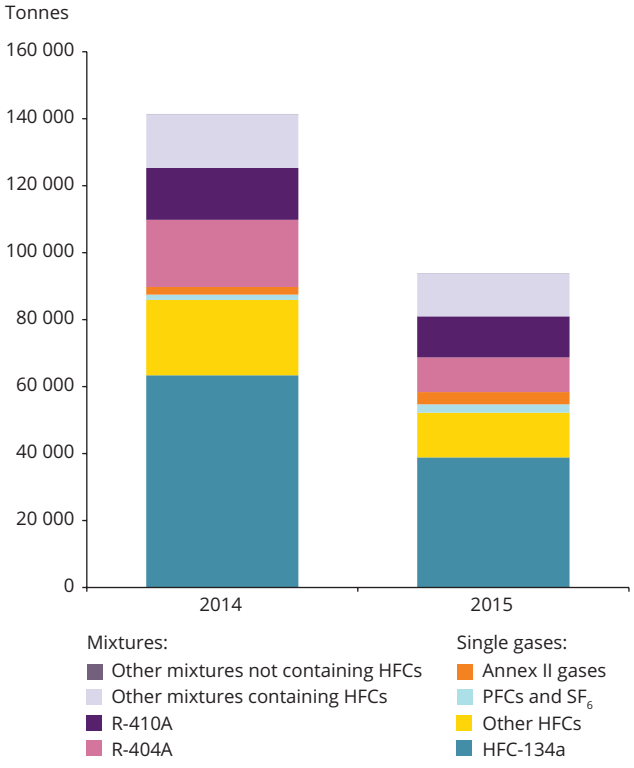
## 3.4 Delivery as single gases and mixtures

Data that were reported by producers and importers as physically placed on the market ([19]), can be assessed in combination with data reported by companies that blend F-gases into mixtures ([20]) in order to derive information on the extent to which the market deliveries take place as single gases or as mixtures (for calculation details, please see Annex 6).

According to this analysis, in 2014 and 2015, approximately 60 % (both in tonnes and $CO_2$-eq.) of F-gases placed on the market ([21]) were delivered as single gases while 40 % were delivered as mixtures (Figures 3.23 and 3.24). The single gas HFC-134a and the refrigerant mixtures R-404A and R-410A jointly constituted approximately two thirds of deliveries in 2015 (slightly above half, if measured in $CO_2$-eq.). The data for these graphs are included in Table A4.17 in Annex 4.

For some HFCs, significant amounts that were reported as delivered to the market as single gases are not commonly used as such. For example, HFC-125 and HFC-143a are typically used only in refrigerant mixtures such as R-404A or R-507A. From this and the fact that only nine companies reported on blending in 2014 or 2015, it is clear that the reporting on blending was not complete. Many companies probably reported mixtures as their component substances.

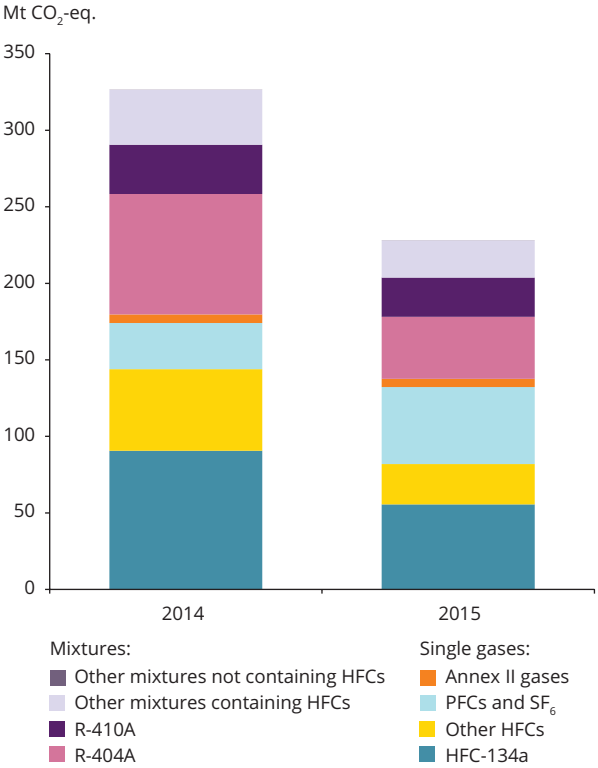
**Figure 3.23 Delivery of F-gases as single gases or mixtures (tonnes)**




**Note:** Annex II gases: unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds.

**Sources:** EEA, 2015 and 2016a.

**Figure 3.24 Delivery of F-gases as single gases or mixtures ($CO_2$-eq.)**




**Note:** Annex II gases: unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds.

**Sources:** EEA, 2015 and 2016a.

([19]) In section [4M] of the reporting questionnaire, see Annex 7.
([20]) In sections [1F] and [1G] of the reporting questionnaire, see Annex 7.
([21]) Amounts placed on the market are calculated as the sum of quantities reported by companies in Section [4M] (in bulk) and in [11Q] (in products and equipment). Amounts placed on the market do not fully coincide with total supply, as presented in Section 3.3. For details of calculation of total supply, please refer to Annex 6.

# Abbreviations

| | |
|---|---|
| BDR | Business Data Repository of the EEA |
| $CO_2$ | Carbon dioxide |
| $CO_2$-eq. | $CO_2$-equivalent |
| EC | European Commission |
| DG CLIMA | Directorate-General for Climate Action of the European Commission |
| EEA | European Environment Agency |
| ETC/ACM | European Topic Centre on Air Pollution and Climate Change Mitigation |
| EU | European Union |
| EU-28 | Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, 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 |
| AR4 | Fourth Assessment Report of the IPCC |
| F-gases | Fluorinated gases |
| GWP | Global warming potential |
| HCFCs | Hydrochlorofluorocarbons |
| HFCs | Hydrofluorocarbons |
| HFEs | Hydrofluoroethers |
| IPCC | Intergovernmental Panel on Climate Change |
| kg | Kilogrammes |
| kt | Kilotonnes |
| Mt | Megatonnes |
| $NF_3$ | Nitrogen trifluoride |
| ODS | Ozone-depleting substances |
| PFCs | Perfluorocarbons |
| PFPMIE | Perfluoropolymethylisopropylether |
| POM | Placing on the market |
| QA/QC | Quality Assurance/Quality Control |
| R-134a | Refrigerant classification of HFC-134a |
| R-404A | Refrigerant mixture of HFCs (52 % HFC-143a, 44 % HFC-125, 4 % HFC-134a) |
| R-407C | Refrigerant mixture of HFCs (52 % HFC-134a, 25 % HFC-125, 23 % HFC-32) |
| R-410A | Refrigerant mixture of HFCs (50 % HFC-125, 50 % HFC-32) |
| R-507A | Refrigerant mixture of HFCs (50 % HFC-143a, 50 % HFC-125) |
| $SF_6$ | Sulphur hexafluoride |
| t | Tonne |
| TAR | Third Assessment Report of the IPCC |
| UNFCCC | United Nations Framework Convention on Climate Change |

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Montreal Protocol on Substances that Deplete the Ozone Layer, international treaty, adopted in Montreal on 16 September 1987 (http://ozone.unep.org/en/treaties-decisions/montreal-protocol-substances-deplete-ozone-layer), last accessed 1 August 2016.

# Annex 1 Fluorinated gases of Annex I of Regulation 517/2014 and their GWPs

| Gas | GWP (AR4) | Gas group | Reference | Coverage in the 'old' F-Gas Regulation 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 (CF4) | 7 390 | PFCs | Annex I Section 2 | Covered |
| PFC-116 (C2F6) | 12 200 | PFCs | Annex I Section 2 | Covered |
| PFC-218 (C3F8) | 8 830 | PFCs | Annex I Section 2 | Covered |
| PFC-3-1-10 (C4F10) | 8 860 | PFCs | Annex I Section 2 | Covered |
| PFC-4-1-12 (C5F12) | 9 160 | PFCs | Annex I Section 2 | Covered |
| PFC-5-1-14 (C6F14) | 9 300 | PFCs | Annex I Section 2 | Covered |
| PFC-c-318 (c-C4F8) | 10 300 | PFCs | Annex I Section 2 | Covered |
| $SF_6$ | 22 800 | $SF_6$ | Annex I Section 3 | Covered |

**Sources:** EU, 2006; EU, 2014b.

# Annex 2 Other fluorinated gases of Annex II of Regulation 517/2014 and their GWPs

| 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 |
| - $(CF_2)_4CH(OH)$ - | 73 | HFEs and alcohols | Annex II Section 2 |

| Gas | GWP (AR4) | Gas group | Reference |
|---|---|---|---|
| $NF_3$ (nitrogen trifluoride) | 17 200 | Other perfluorinated compounds | Annex II, Section 3 |
| c-$C_3F_6$ (perfluorocyclopropane) | 17 340 | Other perfluorinated compounds | Annex II, Section 3 |
| PFPMIE | 10 300 | Other perfluorinated compounds | Annex II, Section 3 |
| $SF_5CF_3$ | 17 700 | Other perfluorinated compounds | Annex II, Section 3 |

**Note:** Annex II gases were not covered under the old F-Gas Regulation 842/2006.

**Source:** EU, 2014b.

# Annex 3 Non-fluorinated gases of Annex IV of Regulation 517/2014 and their GWPs

According to Annex IV of the new F-Gas Regulation, the global warming potential (GWP) of mixtures containing gases outside the scope of Annexes I and II of the new F-Gas Regulation ([22]) are to be calculated using the GWPs given here for the non-fluorinated gases. For other constituents of mixtures that are not listed here (e.g. ozone-depleting substances), a GWP value of zero shall be used.

| Substance | Formula | GWP (AR4) |
|---|---|---|
| R-170 (Ethane) | $CH_3CH_3$ | 6 |
| R-290 (Propane) | $CH_3CH_2CH_3$ | 3 |
| R-600 (Butane) | $CH_3CH_2CH_2CH_3$ | 4 |
| R-600A (Isobutane) | $CH(CH_3)_2CH_3$ | 3 |
| R-601 (Pentane) | $CH_3CH_2CH_2CH_2CH_3$ | 5 |
| R-601A (Isopentane) | $(CH_3)_2CHCH_2CH_3$ | 5 |
| C5H10 (Cyclopentane) | $C_5H_{10}$ | 5 |
| R-610 (Ethoxyethane, diethyl ether) | $CH_3CH_2OCH_2CH_3$ | 4 |
| R-611 (Methyl formate) | $HCOOCH_3$ | 25 |
| R-702 (Hydrogen) | $H_2$ | 6 |
| R-717 (Ammonia) | $NH_3$ | 0 |
| R-744 (Carbon dioxide) | $CO_2$ | 1 |
| R-1150 (Ethylene) | $C_2H_4$ | 4 |
| R-1270 (Propylene) | $C_3H_6$ | 2 |
| E-170 (Dimethyl ether) | $CH_3OCH_3$ | 1 |
| CH3Cl (Methyl chloride) | $CH_3Cl$ | 13 |
| CHCl3 (Chloroform) | $CHCl_3$ | 31 |
| Methylene chloride | $CH_2Cl_2$ | 9 |
| CH4 (Methane) | $CH_4$ | 25 |
| N2O (nitrous oxide) | $N_2O$ | 298 |

**Source:** EU, 2014b.

([22]) The gases listed in those Annexes are given in Annexes 1 and 2 of this report.

# Annex 4 Data tables

## List of tables in Annex 4

**Table A4.1 Reporting companies by Member State and activity**

| Country | Total | thereof: | | | | | |
|---|---|---|---|---|---|---|---|
| | | Producers | Importers | Exporters | Feedstock users | Destruction companies | Equipment importers |
| Austria | 11 | 0 | 2 | 0 | 0 | 1 | 8 |
| Belgium | 32 | 1 | 14 | 6 | 0 | 0 | 17 |
| Bulgaria | 16 | 0 | 10 | 1 | 0 | 0 | 6 |
| Croatia | 11 | 0 | 5 | 2 | 0 | 0 | 7 |
| Cyprus | 13 | 0 | 7 | 0 | 0 | 0 | 6 |
| Czech Republic | 21 | 0 | 10 | 0 | 0 | 1 | 10 |
| Denmark | 14 | 0 | 5 | 5 | 0 | 0 | 7 |
| Estonia | 13 | 0 | 7 | 0 | 0 | 1 | 5 |
| Finland | 11 | 0 | 4 | 0 | 0 | 1 | 7 |
| France | 60 | 3 | 22 | 11 | 1 | 1 | 35 |
| Germany | 78 | 2 | 29 | 20 | 1 | 5 | 46 |
| Greece | 26 | 0 | 9 | 2 | 0 | 0 | 17 |
| Hungary | 17 | 0 | 7 | 2 | 0 | 0 | 11 |
| Ireland | 9 | 0 | 6 | 0 | 0 | 0 | 3 |
| Italy | 85 | 0 | 29 | 13 | 0 | 0 | 52 |
| Latvia | 5 | 0 | 3 | 0 | 0 | 0 | 3 |
| Lithuania | 8 | 0 | 5 | 2 | 0 | 0 | 3 |
| Luxembourg | 7 | 0 | 1 | 1 | 0 | 0 | 5 |
| Malta | 29 | 1 | 14 | 4 | 0 | 1 | 16 |
| Netherlands | 46 | 0 | 27 | 2 | 0 | 0 | 18 |
| Poland | 21 | 0 | 4 | 1 | 0 | 0 | 16 |
| Portugal | 16 | 0 | 5 | 0 | 0 | 0 | 11 |
| Romania | 8 | 0 | 4 | 0 | 0 | 1 | 3 |
| Slovakia | 6 | 0 | 1 | 0 | 0 | 0 | 5 |
| Slovenia | 61 | 0 | 22 | 8 | 1 | 0 | 34 |
| Spain | 30 | 0 | 11 | 3 | 0 | 1 | 19 |
| Sweden | 70 | 2 | 31 | 15 | 1 | 2 | 36 |
| United Kingdom | 724 | 9 | 294 | 98 | 4 | 15 | 406 |
| **EU-28 total** | **39** | **n.a.** | **23** | **0** | **n.a.** | **n.a.** | **8** |
| **Non-EU** | **19** | **n.a.** | **14** | **1** | **n.a.** | **n.a.** | **6** |

**Note:** Companies may report for more than one activity type.
n.a., not applicable (non-EU companies are not eligible to report as producers, feedstock users or destruction companies).

**Source:** EEA, 2016a.

**Table A4.2 Non-EU companies: activities and location of Only Representative, 2015**

| Country | Total | thereof: | | |
|---|---|---|---|---|
| | | Bulk importers | Bulk exporters | Equipment importers |
| **China** | **26** | **18** | **0** | **1** |
| Represented in Germany | 3 | 2 | 0 | 1 |
| Represented in Ireland | 21 | 15 | 0 | 0 |
| Represented in Italy | 1 | 1 | 0 | 0 |
| Represented in the Netherlands | 1 | 0 | 0 | 0 |
| **Hong Kong** | **1** | **1** | **0** | **0** |
| Represented in Germany | 1 | 1 | 0 | 0 |
| **Japan** | **5** | **1** | **0** | **3** |
| Represented in Belgium | 1 | 0 | 0 | 1 |
| Represented in Germany | 2 | 1 | 0 | 1 |
| Represented in Italy | 1 | 0 | 0 | 1 |
| Represented in the Netherlands | 1 | 0 | 0 | 0 |
| **Malaysia** | **1** | **1** | **0** | **0** |
| Represented in Germany | 1 | 1 | 0 | 0 |
| **Switzerland** | **2** | **0** | **0** | **2** |
| Represented in Spain | 1 | 0 | 0 | 1 |
| Represented in the United Kingdom | 1 | 0 | 0 | 1 |
| **Turkey** | **1** | **0** | **0** | **1** |
| Represented in Germany | 1 | 0 | 0 | 1 |
| **United States** | **3** | **2** | **0** | **1** |
| Represented in Germany | 1 | 0 | 0 | 1 |
| Represented in Italy | 1 | 1 | 0 | 0 |
| Represented in the United Kingdom | 1 | 1 | 0 | 0 |

**Note:** Companies may report for more than one activity type.

**Source:** EEA, 2016a.

**Table A4.3 Number of companies reporting on 2007–2015 and activities**

| | Total | Producers | Bulk importers | Bulk exporters | Feedstock users | Destruction companies | Equipment importers |
|---|---|---|---|---|---|---|---|
| **2007** | **78** | 6 | 60 | 42 | n.a. | n.a. | n.a. |
| **2008** | **87** | 11 | 64 | 48 | n.a. | n.a. | n.a. |
| **2009** | **91** | 8 | 56 | 58 | n.a. | n.a. | n.a. |
| **2010** | **108** | 8 | 70 | 72 | n.a. | n.a. | n.a. |
| **2011** | **122** | 9 | 78 | 78 | n.a. | n.a. | n.a. |
| **2012** | **129** | 9 | 88 | 78 | n.a. | n.a. | n.a. |
| **2013** | **154** | 9 | 114 | 83 | n.a. | n.a. | n.a. |
| **2014** | **468** | 11 | 195 | 97 | 5 | 10 | 238 |
| **2015** | **763** | 9 | 317 | 98 | 4 | 15 | 414 |

**Note:** n.a., not applicable (the reporting obligations for feedstock users, destruction companies and equipment importers applied for the first time on reporting for 2014).

**Sources:** EC, 2011; EEA, 2015, 2016a.

## Table A4.4 Production of F-gases (tonnes)

| Gas group | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFCs | 55 235 | 38 519 | 33 106 | 43 792 | 41 040 | 40 854 | 36 717 | 31 050 | 32 339 |
| PFCs | C | C | C | C | C | C | C | C | 209 |
| $SF_6$ | 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 |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | – | – |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | – | – |
| **Total F-gases** | **58 098** | **41 359** | **35 123** | **46 440** | **44 030** | **44 220** | **39 909** | **34 049** | **35 377** |
| *Average GWP* | *3 012* | *3 361* | *3 088* | *3 226* | *3 432* | *3 508* | *3 573* | *3 723* | *3 419* |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## Table A4.5 Production of F-gases ($CO_2$-eq.)

| Gas group | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFCs | 112 | 76 | 63 | 91 | 85 | 81 | 73 | 61 | 55 |
| PFCs | C | C | C | C | C | C | C | C | 2 |
| $SF_6$ | 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 |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | – | – |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | – | – |
| **Total F-gases** | **175** | **139** | **108** | **150** | **151** | **155** | **143** | **127** | **121** |
| *Average GWP* | *3 012* | *3 361* | *3 088* | *3 226* | *3 432* | *3 508* | *3 573* | *3 723* | *3 419* |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## Table A4.6 Bulk imports of F-gases (tonnes)

| Gas group | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFCs | 58 667 | 68 094 | 57 612 | 68 794 | 65 940 | 60 778 | 65 301 | 122 781 | 71 038 |
| PFCs | C | C | 129 | 230 | C | 310 | 155 | C | 388 |
| $SF_6$ | C | C | 671 | 539 | C | 374 | 483 | 412 | 386 |
| Unsaturated HFCs and HCFCs | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | 305 |
| **Total F-gases** | **59 666** | **69 091** | **58 411** | **69 564** | **66 765** | **61 462** | **65 939** | **125 986** | **75 659** |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## Table A4.7 Bulk imports of F-gases ($CO_2$-eq.)

| Gas group | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFCs | 112.7 | 135.1 | 124.2 | 144.2 | 133.1 | 121.7 | 136.4 | 260.9 | 148.4 |
| PFCs | C | C | 1.4 | 2.5 | C | 3.2 | 1.6 | C | 3.8 |
| $SF_6$ | C | C | 15.3 | 12.3 | C | 8.5 | 11.0 | 9.4 | 8.8 |
| Unsaturated HFCs and HCFCs | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | 5.2 |
| **Total F-gases** | **132.4** | **154.1** | **140.9** | **158.9** | **148.9** | **133.4** | **149.0** | **279.4** | **166.3** |
| *Average GWP* | *2 218* | *2 230* | *2 412* | *2 285* | *2 231* | *2 171* | *2 259* | *2 218* | *2 198* |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## Table A4.8 Imports of F-gases within products and equipment

| | Tonnes | Mt $CO_2$-equivalent | Tonnes | Mt $CO_2$-equivalent |
|---|---|---|---|---|
| **Gas group** | **2014** | **2014** | **2015** | **2015** |
| HFCs | 5 670 | 11.2 | 6 921 | 13.4 |
| PFCs | C | C | 22 | 0.2 |
| $SF_6$ | C | C | C | C |
| Unsaturated HFCs and HCFCs | C | C | C | C |
| HFEs and alcohols | – | – | C | C |
| **Total F-gases** | **5 808** | **11.7** | **7 191** | **13.7** |

**Note:** C, confidential; – , no data reported.

**Sources:** EEA, 2015 and 2016a.

**Table A4.9 Bulk exports of F-gases (tonnes)**

| Gas | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFC-23 | C | C | 17 | 12 | 8 | 11 | C | 3 | 20 |
| HFC-32 | 1 310 | 771 | 706 | 1 534 | 1 335 | 883 | 1 414 | 840 | 926 |
| HFC-41 | – | – | – | – | – | – | – | C | C |
| HFC-125 | 2 854 | 2 038 | 1 758 | 2 871 | 3 521 | 2 160 | 1 938 | 2 048 | 2 238 |
| HFC-134 | C | – | – | C | – | – | – | – | C |
| HFC-134a | 15 999 | 12 318 | 9 925 | 10 703 | 11 080 | 12 481 | 12 102 | 14 635 | 12 575 |
| HFC-143a | 1 352 | 1 450 | 937 | 1 295 | 1 237 | 1 076 | 1 137 | 1 011 | 1 742 |
| HFC-152a | C | C | C | 632 | 262 | 186 | C | 78 | C |
| HFC-227ea | 204 | 271 | 187 | 352 | 433 | 460 | 526 | 1 261 | 936 |
| HFC-236fa | C | C | C | C | C | C | C | C | C |
| HFC-245fa | C | C | C | C | C | C | C | 138 | 128 |
| HFC-365mfc | C | C | C | C | C | C | 4 292 | 6 220 | C |
| HFC-43-10mee | C | C | C | C | C | C | C | C | C |
| PFC-14 | C | C | 0 | C | C | C | C | C | 7 |
| PFC-116 | C | C | C | C | C | C | C | C | 4 |
| PFC-218 | C | C | C | C | C | C | C | C | C |
| PFC-c-318 | - | C | C | C | C | C | C | C | C |
| PFC-3-1-10 | C | C | - | C | C | - | - | C | C |
| PFC-5-1-14 | C | C | C | C | C | C | C | C | C |
| $SF_6$ | 1 670 | 1 499 | 1 423 | C | C | 2 021 | 1 871 | 2 522 | 2 426 |
| HCFC-1233zd | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1234yf | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1234ze | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1336mzz | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | - | C |
| HFE-449sl | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFE-569sf2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| 2,2,3,3,3-pentafluoropropanol | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| $NF_3$ | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| PFPMIE | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| **Gas group** | | | | | | | | | |
| HFCs | 24 162 | 19 187 | 15 564 | 20 292 | 21 162 | 21 044 | 21 699 | 26 239 | 25 568 |
| PFCs | 83 | 57 | 25 | C | C | 255 | 253 | 91 | 95 |
| $SF_6$ | 1 670 | 1 499 | 1 423 | C | C | 2 021 | 1 871 | 2 522 | 2 426 |
| Unsaturated HFCs and HCFCs | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| **Total F-gases** | **25 915** | **20 742** | **17 012** | **22 070** | **23 214** | **23 320** | **23 822** | **29 065** | **28 408** |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Table A4.10 Bulk exports of F-gases ($CO_2$-eq.)**

| Gas | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFC-23 | C | C | 0.3 | 0.2 | 0.1 | 0.2 | C | 0.0 | 0.3 |
| HFC-32 | 0.9 | 0.5 | 0.5 | 1.0 | 0.9 | 0.6 | 1.0 | 0.6 | 0.6 |
| HFC-41 | – | – | – | – | – | – | – | C | C |
| HFC-125 | 10.0 | 7.1 | 6.2 | 10.0 | 12.3 | 7.6 | 6.8 | 7.2 | 7.8 |
| HFC-134 | C | – | – | C | – | – | – | – | C |
| HFC-134a | 22.9 | 17.6 | 14.2 | 15.3 | 15.8 | 17.8 | 17.3 | 20.9 | 18.0 |
| HFC-143a | 6.0 | 6.5 | 4.2 | 5.8 | 5.5 | 4.8 | 5.1 | 4.5 | 7.8 |
| HFC-152a | C | C | C | 0.1 | 0.0 | 0.0 | C | 0.0 | C |
| HFC-227ea | 0.7 | 0.9 | 0.6 | 1.1 | 1.4 | 1.5 | 1.7 | 4.1 | 3.0 |
| HFC-236fa | C | C | C | C | C | C | C | C | C |
| HFC-245fa | C | C | C | C | C | C | C | 0.1 | 0.1 |
| HFC-365mfc | C | C | C | C | C | C | 3.4 | 4.9 | C |
| HFC-43-10mee | C | C | C | C | C | C | C | C | C |
| PFC-14 | C | C | 0.0 | C | C | C | C | C | 0.1 |
| PFC-116 | C | C | C | C | C | C | C | C | 0.0 |
| PFC-218 | C | C | C | C | C | C | C | C | C |
| PFC-c-318 | – | C | C | C | C | C | C | C | C |
| PFC-3-1-10 | C | C | – | C | C | – | – | C | C |
| PFC-5-1-14 | C | C | C | C | C | C | C | C | C |
| $SF_6$ | 38.1 | 34.2 | 32.4 | 38.7 | C | 46.1 | 42.7 | 57.5 | 55.3 |
| HCFC-1233zd | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1234yf | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1234ze | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1336mzz | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | – | C |
| HFE-449sl | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFE-569sf2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| 2,2,3,3,3-pentafluoropropanol | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| $NF_3$ | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| PFPMIE | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| **Gas group** | | | | | | | | | |
| HFCs | 42.5 | 34.6 | 27.5 | 36.0 | 38.8 | 35.5 | 36.0 | 42.4 | 43.2 |
| PFCs | 0.8 | 0.5 | 0.2 | 0.7 | C | 2.4 | 2.4 | 0.8 | 0.9 |
| $SF_6$ | 38.1 | 34.2 | 32.4 | 38.7 | C | 46.1 | 42.7 | 57.5 | 55.3 |
| Unsaturated HFCs and HCFCs | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| **Total F-gases** | **81.4** | **69.3** | **60.2** | **75.4** | **84.4** | **84.0** | **81.1** | **100.8** | **99.6** |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Table A4.11 Bulk supply of F-gases (tonnes)**

| Gas | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFC-23 | C | C | C | 299 | 306 | 137 | C | 94 | 74 |
| HFC-32 | 3 987 | 5 086 | 4 406 | 5 378 | 4 914 | 5 009 | 5 334 | 8 710 | 6 920 |
| HFC-41 | C | – | C | C | C | C | C | 1 | 2 |
| HFC-125 | 12 429 | 12 556 | 13 942 | 18 218 | 15 321 | 15 580 | 15 147 | 23 124 | 15 616 |
| HFC-134 | C | C | – | C | – | – | – | – | C |
| HFC-134a | 49 102 | 46 196 | 41 310 | 43 588 | 40 095 | 40 007 | 39 337 | 59 813 | 45 558 |
| HFC-143a | 9 066 | 9 883 | 9 590 | 10 552 | 8 845 | 9 005 | 8 853 | 13 506 | 7 257 |
| HFC-152a | 3 816 | 6 162 | 5 182 | 4 468 | 4 676 | 4 175 | 3 657 | 6 227 | 3 914 |
| HFC-227ea | C | C | C | C | C | C | C | 2 695 | C |
| HFC-236fa | C | C | C | C | 43 | 30 | C | 52 | 40 |
| HFC-245fa | C | C | C | C | C | C | C | C | C |
| HFC-365mfc | C | C | C | C | C | C | C | C | C |
| HFC-43–10mee | C | C | 50 | C | C | C | C | C | C |
| PFC-14 | C | C | C | C | C | C | C | C | C |
| PFC-116 | C | C | C | C | C | C | C | C | C |
| PFC-218 | C | C | C | C | C | C | C | C | C |
| PFC-c-318 | C | C | C | C | C | C | C | C | C |
| PFC-3–1-10 | C | C | – | C | C | C | C | C | C |
| PFC-5–1-14 | C | C | C | C | C | C | C | C | C |
| $SF_6$ | C | C | C | C | C | C | C | C | C |
| HCFC-1233zd | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1234yf | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1234ze | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1336mzz | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFE-449sl | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFE-569sf2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| 2,2,3,3,3-pentafluoro propanol | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | n.a. |
| $NF_3$ | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 321 | 339 |
| PFPMIE | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | – |
| **Gas group** | | | | | | | | | |
| HFCs | 86 148 | 87 454 | 80 771 | 89 564 | 81 673 | 80 892 | 79 293 | 118 737 | 86 773 |
| PFCs | C | C | C | C | C | C | C | C | C |
| $SF_6$ | 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 |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 321 | 339 |
| **Total F-gases** | **88 257** | **89 712** | **82 447** | **91 389** | **83 464** | **82 625** | **80 967** | **121 739** | **91 168** |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

**Table A4.12 Bulk supply of F-gases ($CO_2$-eq.)**

| Gas | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFC-23 | C | C | C | 4.4 | 4.5 | 2.0 | C | 1.4 | 1.1 |
| HFC-32 | 2.7 | 3.4 | 3.0 | 3.6 | 3.3 | 3.4 | 3.6 | 5.9 | 4.7 |
| HFC-41 | C | – | C | C | C | C | C | 0.0 | 0.0 |
| HFC-125 | 43.5 | 43.9 | 48.8 | 63.8 | 53.6 | 54.5 | 53.0 | 80.9 | 54.7 |
| HFC-134 | C | C | – | C | – | – | – | – | C |
| HFC-134a | 70.2 | 66.1 | 59.1 | 62.3 | 57.3 | 57.2 | 56.3 | 85.5 | 65.1 |
| HFC-143a | 40.5 | 44.2 | 42.9 | 47.2 | 39.5 | 40.3 | 39.6 | 60.4 | 32.4 |
| HFC-152a | 0.5 | 0.8 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 | 0.8 | 0.5 |
| HFC-227ea | C | C | C | C | C | C | C | 8.7 | C |
| HFC-236fa | C | C | C | C | 0.4 | 0.3 | C | 0.5 | 0.4 |
| HFC-245fa | C | C | C | C | C | C | C | C | C |
| HFC-365mfc | C | C | C | C | C | C | C | C | C |
| HFC-43-10mee | C | C | 0.1 | C | C | C | C | C | C |
| PFC-14 | C | C | C | C | C | C | C | C | C |
| PFC-116 | C | C | C | C | C | C | C | C | C |
| PFC-218 | C | C | C | C | C | C | C | C | C |
| PFC-c-318 | C | C | C | C | C | C | C | C | C |
| PFC-3-1-10 | C | C | C | C | C | C | C | C | C |
| PFC-5-1-14 | C | C | C | C | C | C | C | C | C |
| $SF_6$ | C | C | C | C | C | C | C | C | C |
| HCFC-1233zd | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1234yf | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1234ze | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFC-1336mzz | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFE-449sl | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| HFE-569sf2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| 2,2,3,3,3-pentafluoropropanol | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | n.a. |
| $NF_3$ | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 5.5 | 5.8 |
| PFPMIE | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | – |
| **Gas group** | | | | | | | | | |
| HFCs | 169.7 | 172.0 | 166.9 | 193.2 | 170.7 | 167.7 | 164.0 | 248.0 | 169.9 |
| PFCs | C | C | C | C | C | C | C | C | C |
| $SF_6$ | 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 |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 5.5 | 5.8 |
| **Total F-gases** | **214.0** | **218.5** | **202.1** | **231.0** | **207.9** | **204.2** | **200.4** | **274.1** | **200.8** |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## Table A4.13 Intended applications of bulk supply of F-gases (tonnes)

| Intended application | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| Refrigeration, air-conditioning, heating and other heat transfer fluids | 61 510 | 58 862 | 58 479 | 65 852 | 60 913 | 58 506 | 59 069 | 89 984 | 68 930 |
| Foams, incl. pre-blended polyols | 13 971 | 15 284 | 11 697 | 11 358 | 9 232 | 8 524 | 8 202 | 12 960 | 9 556 |
| Aerosols | 8 997 | 11 131 | 8 402 | 9 474 | 7 790 | 10 931 | 9 689 | 8 875 | 8 937 |
| Fire protection and solvents | 874 | 647 | 693 | 1 881 | 2 759 | 1 746 | 1 622 | 2 283 | 1 307 |
| Semiconductor, photovoltaics, electronics and electrical | 1 323 | 1 723 | 1 153 | 1 555 | 1 588 | 1 530 | 1 490 | 1 661 | 1 434 |
| Other or unknown applications | 1 582 | 2 063 | 2 022 | 1 269 | 1 182 | 1 387 | 896 | 5 977 | 1 004 |
| **Total bulk supply** | **88 257** | **89 712** | **82 447** | **91 389** | **83 464** | **82 625** | **80 967** | **121 739** | **91 168** |

**Note:** Annex II gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013. Data shown may not match the previous EEA report as the calculation methodology was updated (Annex 6).

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## Table A4.14 Intended applications of bulk supply of F-gases (Mt $CO_2$-eq.)

| Intended application | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| Refrigeration, air-conditioning, heating and other heat transfer fluids | 139.0 | 137.0 | 139.1 | 161.4 | 143.5 | 140.1 | 140.7 | 205.4 | 145.9 |
| Foams, incl. pre-blended polyols | 13.3 | 12.9 | 9.8 | 10.4 | 6.5 | 6.1 | 5.9 | 11.6 | 7.1 |
| Aerosols | 12.2 | 14.5 | 11.1 | 12.5 | 9.8 | 14.1 | 12.7 | 11.6 | 12.4 |
| Fire protection and solvents | 4.4 | 3.3 | 3.5 | 7.9 | 10.2 | 6.4 | 3.0 | 7.3 | 3.8 |
| Semiconductor, photovoltaics, electronics and electrical | 28.8 | 35.6 | 24.2 | 32.5 | 33.5 | 33.1 | 33.4 | 23.2 | 26.3 |
| Other or unknown applications | 16.3 | 15.1 | 14.4 | 6.3 | 4.4 | 4.4 | 4.8 | 15.0 | 5.3 |
| **Total bulk supply** | **214.0** | **218.5** | **202.1** | **231.0** | **207.9** | **204.2** | **200.4** | **274.1** | **200.8** |

**Note:** Annex II gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013. Data shown may not match the previous EEA report as the calculation methodology was updated (Annex 6). Feedstock use does not appear in this table as it is excluded from the scope of bulk supply.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## Table A4.15 Total supply of F-gases (tonnes)

| Gas group | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFCs | 86 148 | 87 454 | 80 771 | 89 564 | 81 673 | 80 892 | 79 293 | 124 408 | 93 693 |
| PFCs | C | C | C | C | C | C | C | C | C |
| $SF_6$ | 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. | 1 306 | 2 544 |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 321 | 339 |
| **Total F-gases** | **88 257** | **89 712** | **82 447** | **91 389** | **83 464** | **82 625** | **80 967** | **127 547** | **98 359** |
| *Average GWP* | *2 425* | *2 435* | *2 451* | *2 528* | *2 490* | *2 471* | *2 475* | *2 241* | *2 181* |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## Table A4.16 Total supply of F-gases ($CO_2$-eq.)

| Gas group | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| HFCs | 169.7 | 172.0 | 166.9 | 193.2 | 170.7 | 167.7 | 164.0 | 259.2 | 183.3 |
| PFCs | C | C | C | C | C | C | C | C | C |
| $SF_6$ | 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. | 0.0 | 0.0 |
| HFEs and alcohols | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | C | C |
| Other perfluorinated compounds | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 5.5 | 5.8 |
| **Total F-gases** | **214.0** | **218.5** | **202.1** | **231.0** | **207.9** | **204.2** | **200.4** | **285.8** | **214.5** |
| *Average GWP* | *2 425* | *2 435* | *2 451* | *2 528* | *2 490* | *2 471* | *2 475* | *2 241* | *2 181* |

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

**Sources:** EC, 2011; EEA, 2015 and 2016a.

## Table A4.17 Delivery of F-gases as single gases or mixtures

| | | 2014 | 2015 | 2014 | 2015 |
|---|---|---|---|---|---|
| | **Gas/gas group** | **Tonnes** | | **Mt $CO_2$-eq.** | |
| Single gases | HFC-134a | 63 403 | 38 891 | 90.7 | 55.6 |
| | Other HFCs | 22 488 | 13 352 | 53.3 | 26.4 |
| | PFCs and $SF_6$ | 1 590 | 2 506 | 30.1 | 50.3 |
| | Annex II gases | 2 309 | 3 642 | 5.6 | 5.3 |
| Mixtures | R-404A | 20 048 | 10 361 | 78.6 | 40.6 |
| | R-410A | 15 455 | 12 236 | 32.3 | 25.5 |
| | Other mixtures containing HFCs | 16 052 | 12 849 | 35.9 | 24.2 |
| | Other mixtures not containing HFCs | 7 | 5 | 0.1 | 0.0 |
| | **Total** | **141 352** | **93 843** | **326.5** | **228.0** |

**Note:** Annex II gases (unsaturated HFCs and HCFCs, HFEs, and alcohols and 'other' perfluorinated compounds) were not subject to reporting for the years 2007–2013. The calculations, and hence totals, for market delivery differ from those for total supply. See Annex 6.

**Sources:** EC, 2011; EEA, 2015 and 2016a.

# Annex 5 Measures to protect confidential data

The new F-Gas regulation maintains the confidentiality provisions of the earlier Regulation, and the EEA continues to take appropriate steps to protect the confidentiality and prevent publication of commercially sensitive information. Article 19(8) of the new F-Gas Regulation states that the Commission shall take appropriate measures to protect the confidentiality of the information reported. Hence, the EEA, in agreement with the European Commission, has applied a number of rules to prevent the deduction of commercially sensitive information. These include:

Application of a **three-company group rule**, whereby the data presented in the report must be the result of reporting by at least three company groups (i.e. corporate groups).

Application of a **5 % significance rule**, whereby company groups whose reported data add up to less than 5 % of the total amount reported for any data-point represented in the report, are ignored for counting under the three-company group rule.

Application of additional measures **preventing the deduction of sensitive information**.

All measures apply both for amounts reported in metric tonnes and GWP tonnes. Each of the measures is explained in more depth below. These measures have been applied consistently for all the data presented in this report, thus covering the 2007–2014 period.

### *Three-company group rule*

This measure concerns the treatment of data reported by different legal entities across the EU, which belong to the same company group. For that purpose, company groups are defined as 'one or more companies legally belonging to the same corporate group'. The agreed principle is that companies belonging to the same company group need to be seen as a single entity when it comes to confidentiality rules. During the 2015 reporting, companies were invited to identify affiliates and thus increase the protection level of their data. Wherever affiliations were confirmed by both companies, they were considered as belonging to the same company group. Information on 2014 affiliations was also applied for the 2007–2013 period. Once company groups have been determined in this way, at least three of them must contribute to each reported value.

### *5 % significance rule*

As a second measure, company groups are only included in the above count if they contribute significantly to the reported value. This means that the smallest contributors up to an accumulated share of 5 % are not considered when applying the above three-company group rule. This ensures that at least three corporate entities contributed significantly to each reported transaction value.

### *Preventing deduction of sensitive data*

Additional measures were applied to prevent deduction of confidential data.

#### *All transactions*

Deduction might be possible in cases where transaction data for certain substances or substance groups (i.e. HFCs or PFCs) remain confidential, yet data for other substances or substance groups, along with a total for the transaction in question, were published. Confidential data, which were in danger of such deduction, were protected by hiding additional data as confidential — although these additional values had been identified as non-confidential — so that at least values for three (or none) of the substances or substance groups were confidential in the published data for that transaction.

#### *Aggregated transactions*

Transaction data are hidden where other confidential transaction data could be implied from their publication. In order to understand this additional measure, it should be remembered that bulk supply of F-gases is a calculated transaction that involves

**Box A5.1 Applying the three-company group rule and the 5 % significance rule**

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

**Step 1:** All values reported by companies of a given company group for a given transaction year are summed for a given transaction and substance or substance group:

$$\sum Xi = X1 + X2 + \cdots Xn$$

*Xi = individual reported value by a single reporting undertaking*

$\sum Xi$ *= sum of individual reported values by reporting undertakings belonging to the same company group*

**Step 2:** The sum of all absolute contributions ($|\sum Xi|$) across company groups is calculated.

**Step 3:** The percentage share of (2) in relation to (3) is calculated for each company group:

$$\% = \frac{|\sum Xi|}{\sum |\sum Xi|}$$

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

**Step 5:** An accumulated percentage share is calculated across the sorted company groups.

**Step 6:** The number of company groups for which the accumulated share is larger than 5% is counted.

**Where the count is one or two, the full aggregated value across company groups is hidden as it is confidential. Where the count is three or more, the full aggregated value across company groups is reported and thus not confidential.**

production, import, export and other data for each substance or substance group. This rather complicated calculation can be simplified as:

*Bulk supply = Production + Import – Export + Remainder*

The remainder may appear irrelevant and a confidential value on e.g. production might be deductible based on non-confidential information on consumption, import and export. In such cases, data are published only where the remainder equalled or exceeded 5 % of the bulk supply. In cases where the remainder was below 5 %, and where one term (i.e. bulk supply, production, import or export) of the above equation was confidential according to the three-company rule and 5 % significance rule, a second term of the above equation was treated as confidential in order to prevent deduction.

# Annex 6 Calculation methods

The codes [1A], [2A] etc. used in the following paragraphs refer to the codes of transactions used in the reporting questionnaire, outlined in Annex 7. The reporting questionnaire is the online rendering of the format and means reporting specified by the Implementing Regulation (EU) No 1191/2014. Companies submit their report using the electronic reporting tool provided by the EEA, accessible from the F-gas portal (https://webgate.ec.europa.eu/ods2) on the website of the European Commission. The electronic reporting tool is part of the EEA's Business Data Repository (BDR) (http://bdr.eionet.europa.eu).

### *Calculation of EU supply*

#### *Total supply*

'EU total supply' is a parameter that provides information on the actual use of F-gases by EU industries. 'EU total supply' is the sum of 'bulk supply' and 'supply in products/equipment'.

#### *Bulk supply*

The 'bulk supply' metric is focused on emission-relevant supplies of bulk gases to industries and thus does not cover supplies intended for feedstock or destruction. The formula for calculating bulk supply (BS) based on data reported under Article 19 of the new F-Gas Regulation reads as follows (the codes [1A], [2A], etc. used in the following paragraphs refer to the codes of transactions):

> bulk supply (BS) = (net) production [1E = 1A–1D] + full imports [2A] – full exports [3A] + 1 January stocks from own import/production [4B] – 31 December stocks from own import/production [4G] + reclamation [4K] – intended application: destruction [6B] – feedstock use [7A]

Note that the calculation of 'bulk supply' is closely analogous to that of the 'net supply' metric that was used in previous EEA reports on F-gases. The calculation is based on 2007–2013 data reported under Article 6 of the 'old' F-Gas Regulation 842/2006. Thus, for bulk supply, a time series back to 2007 has been established.

#### *Supply in products/equipment*

The 'supply in products/equipment' (SPE) metric covers the amount of F-gases that are imported into the EU within products or equipment and placed on the market. As exports of F-gases within products and equipment are not systematically reported under the new F-Gas Regulation, no such exports are subtracted for the SPE metric. Thus the SPE metric covers imports only, 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.

In accordance with the logic of the supply metrics used in this report, gases contained in exported products or equipment are part of the gas demand of industries and are thus included in the total supply metric.

As reporting on imported products and equipment has been established with the new F-Gas Regulation for the first time, no time series for the years prior to 2014 can be established for SPE. Thus, no data for total supply for the period 2007–2013 can be calculated.

#### *Intended applications of bulk supply*

In section 6 of the reporting questionnaire, companies report on the intended applications of bulk gases supplied to the market [6X] in 22 categories. These bulk amounts [6X] are 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]

Thus, the formulae for calculating 'bulk supply' and '[6X] amounts supplied to the market' differ in the way they account for re-exports and for amounts intended for destruction and feedstock, and the data reported by companies on intended applications do not match the scope of bulk supply.

Estimating the intended applications of bulk supply, uses the following steps:

1. per gas, determine the shares 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 bulk supply to be equal to the amounts reported in section 6 and subtract those from total bulk supply;

3. apply the shares determined in step 1 to the remainder of bulk supply;

4. assign any remainder to the category 'Other or unknown applications' (6T).

***Market deliveries as single gases or mixtures***

Supply of F-gases is calculated at the level of single gases, as listed in Annex 1 or Annex 2, and then aggregated to the level of gas groups (e.g. HFCs or PFCs). However, before delivery of gases to customers, gases are often blended into mixtures. Given the reporting scheme under the new F-Gas Regulation, it can be calculated whether amounts placed on the market are actually delivered to the customers as a mixture or as a single gas.

In section 1F, companies that perform blending of mixtures report on amounts of self-blended mixtures placed on the market ([23]). In section 1G, these companies additionally report if mixtures were used as input into the blending process. The exact share of mixtures feeding into the blending process of other mixtures is not reported, however.

Blending from single gases is thus be approximated as follows for each EU blended mixture

Blending from single gases = 1F – 1G/2

Using the information on the composition of mixtures, the quantities of blending from single gases can be converted into quantities of single gases used for blending.

The market delivery (MD) as single gases or mixtures of amounts physically placed on the market are calculated as follows:

MD = 4M (physical placing on the market, bulk gases, as reported) – single gases used for blending + blending from single gases + 11Q (physical placing on the market, gases in products and equipment, as reported)

([23]) In this context, 'placing on the market' is to be understood as 'placing on the market as a mixture' and must not be double-counted with section 4M (which reports on the placing on the market of single gases or mixtures that may be used by EU companies as input into the blending process).

# Annex 7 BDR F-gas reporting form

The reporting format for submitting the F-gas reports under Article 19 of the new F-Gas Regulation is laid out in Commission Implementing Regulation (EU) No 1191/2014. The contents of that Implementing Regulation were transformed into an online questionnaire on the BDR reporting platform at https://bdr.eionet.europa.eu.

Reportable information in the questionnaire applicable to reporting in 2016 on transactions in 2015 is structured as follows: the data are mandatory for every company that engages in the activities listed in Article 19 of the new F-Gas Regulation.

***Cover sheet***

On the cover sheet, companies give a full account of their up-to-date data as well as their activities during the reporting year, which may be one or more of the following:

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

Depending on their activities, they specify one or more gases to report on, as well as mixtures if applicable. If necessary, companies can specify the composition of the custom mixtures they have used.

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 Member States are required to report separately for each country. To protect their data, companies may voluntarily list affiliated companies on the cover sheet, thus creating a 'company group'. Numbers for company groups are treated in aggregate when the confidentiality of figures is determined, decreasing the number of companies and thus increasing the likelihood that an aggregate figure turns out to be confidential under the rules detailed in Section 1.6.

***Section 1 (producers only)***

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

- total quantity of production (1A);
- destroyed side-products, mandatory specification of destruction company (1B, 1C);
- sum of destroyed production (1D);
- net production (1E = 1A minus 1D);
- production of mixtures (1F–1H);
- **voluntary:** sales and purchases on the market (1I–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).
- Imports that were destined for re-export contained in products or equipment and never released for free circulation in the EU (2B).

***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: 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–3F).

***Section 4 (producers and importers)***

Section 4 contains data on stocks of F-Gases and their sources.

- 1 January stocks (4A) and breakdown by source and previous status of free circulation (4B–4E);
- 31 December stocks (4F) and breakdown by source and previous status of free circulation (4G–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 = Net production (1E) + Total imports (2A)*
*– Imports for reexport (2B)*
*– Export of own production (3B)*
*+ 1 January stocks previously not placed on the market (4C)*
*– 31 December 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 need are determined (5G–5H). Reporters may voluntarily state their supply to other undertakings for production of equipment, which is destined for re-export (5C_ voluntary); however, this figure does not feed into the total amount for exempted uses. If reporters do specify exempted uses, they are required to confirm in section 9 that the report must be verified according to Article 19 of the Regulation and agree to make that verification report available on request to the Commission and/or competent authorities.

***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 = Net production (1E) + Total imports (2A) –*
*Imports for reexport (2B)*
*– Export of own production (3B)*
*+ 1 January stocks of own production (4B)*
*– 31 December stocks of own production (4G) –*
*Own reclamation (4K)*

Note that this formula differs from the placing on the market determination in Section 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 PU 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)***

Section 7 (feedstock users) contains the amount of gas used as feedstock by the undertaking itself (7A).

***Section 8 (destruction companies)***

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

***Section 9 (producers and importers)***

In 2016, companies report for the first time on authorisations they have issued to third parties to use their HFC quota, specifying each recipient in section 9A. This reporting section was used in 2016 for the first time.

***Section 10 (Producers and importers who received their 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 supplement proof of delivery (receipts etc.) for each one. This reporting section applies only to companies that received their HFC quota fully based on a declaration according to Article 16(2) of the new F-Gas Regulation, and was used for the first time in 2016.

***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–11G;
- other types of equipment (11H–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;
- total amount of F-gases contained therein.

From these numbers, specific charges per piece of equipment are determined. Where 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 A7.1.

***Sections 12 and 13***

Sections 12 and 13 will be applied for the first time in 2018, when reporting on 2017 is done.

**Table A7.1 Full list of equipment categories for reporting**

| Code | Description |
|---|---|
| 11A | Stationary equipment for comfort cooling or heating |
| *11A1* | *Stationary equipment for comfort cooling/heating, direct design: Standalone/monobloc units of moveable type* |
| *11A2* | *Stationary equipment for comfort cooling/heating, direct design: standalone/monobloc units of rooftop type* |
| *11A3* | *Stationary equipment for comfort cooling/heating, direct design: standalone/monobloc units of other type* |
| *11A4* | *Stationary equipment for comfort cooling/heating, direct design: single split units charged with 3 kilograms or more of refrigerant* |
| *11A5* | *Stationary equipment for comfort cooling/heating, direct design: single split units charged with less than 3 kilograms of refrigerant* |
| *11A6* | *Stationary equipment for comfort cooling/heating, direct design: multi split units* |
| *11A7* | *Stationary equipment for comfort cooling/heating, indirect design: standalone/monobloc units for domestic use* |
| *11A8* | *Stationary equipment for comfort cooling/heating, indirect design: standalone/monobloc units for commercial or industrial use* |
| *11A9* | *Stationary equipment for comfort cooling/heating, indirect design: standalone/monobloc units for other use* |
| *11A10* | *Stationary equipment for comfort cooling/heating, indirect design: split units for domestic use* |
| *11A11* | *Stationary equipment for comfort cooling/heating, indirect design: split units for commercial or industrial use* |
| *11A12* | *Stationary equipment for comfort cooling/heating, indirect design: split units for other use* |
| *11A13* | *Stationary equipment for comfort cooling/heating, both direct and indirect: standalone/monobloc units* |
| *11A14* | *Stationary equipment for comfort cooling/heating, both direct and indirect: split units* |
| 11B | Stationary equipment for refrigeration |
| *11B1* | *Stationary equipment for refrigeration, direct design: standalone/monobloc units for domestic use* |
| *11B2* | *Stationary equipment for refrigeration, direct design: standalone/monobloc units for commercial or industrial use* |
| *11B3* | *Stationary equipment for refrigeration, direct design: standalone/monobloc units for other use* |
| *11B4* | *Stationary equipment for refrigeration, direct design: split units for commercial or industrial use* |
| *11B5* | *Stationary equipment for refrigeration, direct design: split units for other use* |
| *11B6* | *Stationary equipment for refrigeration, indirect design: standalone/monobloc units for commercial or industrial use* |
| *11B7* | *Stationary equipment for refrigeration, indirect design: standalone/monobloc units for other use* |
| *11B8* | *Stationary equipment for refrigeration, indirect design: split units for commercial or industrial use* |
| *11B9* | *Stationary equipment for refrigeration in indirect design: split units for other use* |
| *11B10* | *Stationary equipment for refrigeration, both direct and indirect: standalone/monobloc units* |
| *11B11* | *Stationary equipment for refrigeration, both direct and indirect: split units* |
| *11B12* | *Stationary equipment for process cooling or heating in direct design* |
| *11B13* | *Stationary equipment for process cooling or heating in indirect design* |
| *11B14* | *Stationary equipment for process cooling or heating, both direct and indirect* |
| 11C | Heat pump tumble dryers |
| 11D | Stationary heating/air conditioning including heat pumps as well as refrigeration (HACR) equipment for any other purposes |
| *11D1* | *Stationary HACR equipment for any other purposes, direct design* |
| *11D2* | *Stationary HACR equipment for any other purposes, indirect design* |
| *11D3* | *Stationary HACR equipment for any other purposes, both direct and indirect* |
| 11E | Mobile refrigeration equipment |
| *11E1* | *Mobile refrigeration equipment for refrigerated light duty vehicles (e.g. vans)* |
| *11E2* | *Mobile refrigeration equipment for refrigerated heavy duty vehicles (including trucks and trailers)* |
| *11E3* | *Mobile refrigeration equipment for refrigerated ships* |
| *11E4* | *Any other mobile refrigeration equipment* |

**Table A7.1 Full list of equipment categories for reporting (cont.)**

| Code | Description |
|---|---|
| 11F | Mobile air conditioning equipment |
| *11F1* | *Mobile air conditioning equipment for passenger cars* |
| *11F2* | *Mobile air conditioning equipment for buses* |
| *11F3* | *Mobile air conditioning equipment for vans (light duty vehicles)* |
| *11F4* | *Mobile air conditioning equipment for trucks and trailers (heavy duty vehicles)* |
| *11F5* | *Mobile air conditioning equipment for agricultural, forestry and construction vehicles and machinery* |
| *11F6* | *Mobile air conditioning equipment for rail vehicles* |
| *11F7* | *Mobile air conditioning equipment for ships* |
| *11F8* | *Mobile air conditioning equipment for aircrafts and helicopters* |
| *11F9* | *Any other mobile air conditioning equipment* |
| 11G | Total refrigeration, air conditioning or heat pump equipment |
| 11H | Foam products |
| *11H1* | *Extruded polystyrene (XPS) (e. g. for insulation boards)* |
| *11H2* | *Polyurethane (PU) (e. g. for insulation boards)* |
| *11H3* | *One component foam (OCF)* |
| *11H4* | *Other foam products* |
| 11I | Fire protection equipment (including systems incorporated in 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 fluorinates gases listed in Annex I or Annex II of Regulation (EU) No 517/2014 |

**Source:** EU, 2014a.

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