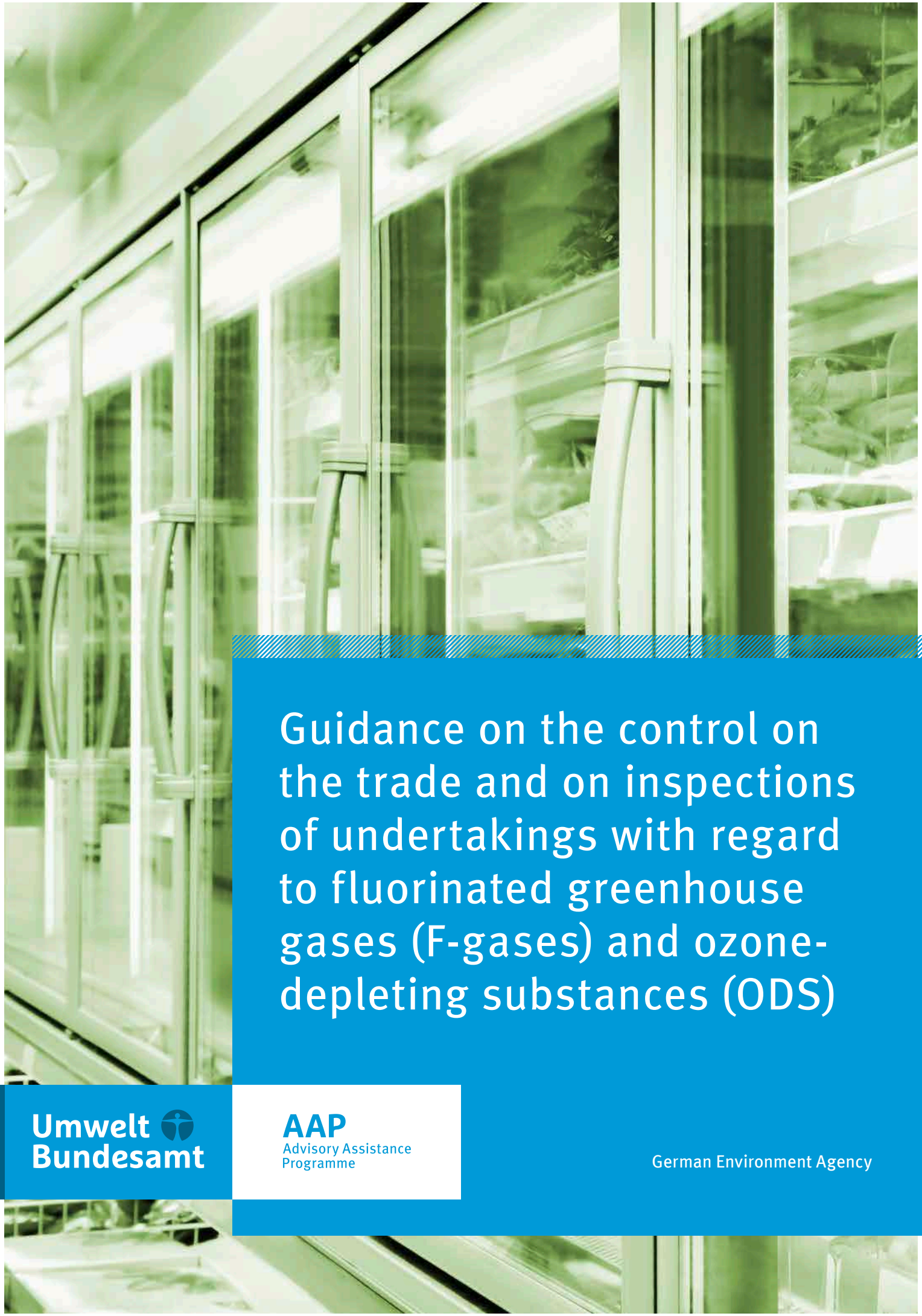


# Guidance on the control on the trade and on inspections of undertakings with regard to fluorinated greenhouse gases (F-gases) and ozone-depleting substances (ODS)

Umwelt Bundesamt

AAP
Advisory Assistance Programme

German Environment Agency

# Guidance on the control on the trade and on inspections of undertakings with regard to fluorinated greenhouse gases (F-gases) and ozone-depleting substances (ODS)

German Environment Agency

**Imprint**

**Publisher:**
German Environment Agency
Woerlitzer Platz 1
06844 Dessau-Rosslau
Germany
Tel: +49 340-2103-0
Fax: +49 340-2103-2285
info@umweltbundesamt.de
Internet: www.umweltbundesamt.de/en
www.uba.de/en/advisory-assistance-programme
www.uba.de/en/project-database-advisory-assistance-programme

/umweltbundesamt.de
/umweltbundesamt

**Authors:**
Barbara Gschrey, Bastian Zeiger (Öko-Recherche GmbH)
Irene Papst (HEAT GmbH)

**Editors:**
Dr. Cornelia Elsner
Section III 1.4 Substance-related Product Issues
Katharina Lenz
Section I 1.2 International Environmental Protection and Sustainability Strategies, Policy and Knowledge Transfer

**Publication as pdf:**
https://www.umweltbundesamt.de/en/publications

**Photo credits:**
adisa, fotolia.com

November 2016

ISSN 2363-832X

This document is a result of the project “Implementation and enforcement of EU regulations on fluorinated greenhouse gases (F-gases) und ozone-depleting substances (ODS) in Bulgaria”. This project was financed by the German Federal Environment Ministry’s Advisory Assistance Programme (AAP) for environmental protection in the countries of Central and Eastern Europe, the Caucasus and Central Asia and other countries neighbouring the EU. The project was supervised by the German Environment Agency. The responsibility for the content of this document lies with the authors.

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

Umwelt Bundesamt

Öko-Recherche
Büro für Umweltforschung und- beratung GmbH

HEAT

## Abstract

Ozone-depleting substances (ODS) have been used worldwide in a wide range of industrial and consumer applications. Their control under the Montreal Protocol has led to an uptake of alternatives, especially in refrigeration and air conditioning, as well as firefighting applications. Hydrofluorocarbons (HFCs) and other fluorinated gases – commonly referred to as F-gases – are among the most prominent ODS alternatives. These gases have no measurable effect on ozone depletion and now find widespread application. However, their high global warming potential (GWP) means that they are contributing to climate change and are therefore subject to the Kyoto Protocol under the United Nations Framework Convention on Climate Change (UNFCCC).

This guidance document summarises the regulatory framework for both, ODS and F-gases, in the European Union (EU) and puts them into the Bulgarian context. New measures introduced by Regulation (EU) No. 517/2014, including the EU HFC phase-down and bans are highlighted. The document focuses on developing guidance and recommendations in regards to the implementation of both, the EU ODS and F-gas Regulations. Experience, also in other EU member states, is therefore referred to throughout the text. The goal of the document is to support Bulgaria in maximising its regulatory and enforcement capabilities with a focus on market surveillance and inspections of companies.

# Table of Contents

## List of Figures



## List of Tables

# List of Abbreviations

| | |
|---|---|
| **A** | Stationary refrigeration and air conditioning C equipment with < 5 t $CO_2$ eq charge (hermetically sealed equipment < 10 t $CO_2$ eq charge) |
| **AR** | Assessment report |
| **B** | Stationary refrigeration and air conditioning equipment with 5–< 50 t $CO_2$ eq charge (hermetically sealed equipment 10–< 50 t $CO_2$ eq charge) |
| **BBCMB** | Bulgarian Branch Chamber - Machine Building |
| **BLAC** | Bund/Länder-Arbeitsgemeinschaft Chemikaliensicherheit (German Federal level-State level Working Committee Chemical Safety) |
| **C** | Stationary refrigeration and air conditioning equipment with 50–< 500 t $CO_2$ eq charge |
| **CFC** | Chlorofluorocarbon |
| **CTC** | Carbon tetrachloride |
| **$CO_2$** | Carbon dioxide: As refrigerant also called R744 |
| **$CO_2$ eq** | Carbon dioxide equivalent |
| **CBD** | Central Database (Poland) |
| **CRO** | Central Register of Operators (Poland) |
| **D** | Stationary refrigeration and air conditioning equipment with ≥ 500 t $CO_2$ eq charge |
| **EEA** | European Environment Agency |
| **EB** | Ethyl bromide |
| **EU** | European Union |
| **F-gas** | Fluorinated greenhouse gas |
| **GWP** | Global warming potential |
| **HCFC** | Hydrochlorofluorocarbon |
| **HFC** | Hydrofluorocarbon |
| **HMCB** | Hungarian Monitoring and Certification Body (Hungary) |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **MAC** | Passenger car or light van (category N1, class 1) |
| **MAX** | Vehicles not covered by EU MAC Directive |
| **MB** | Methyl bromide |
| **MC** | Methyl chloride |
| **MoEW** | Ministry of Environment and Water (Bulgaria) |
| **MRA** | Refrigerated truck or trailer with charge < 5 t $CO_2$ eq |
| **MRB** | Refrigerated truck or trailer with charge ≥ 5 t $CO_2$ eq |
| **MRX** | Refrigerated vehicle other than truck (> 3.5 t) or trailer towed by truck |

| | |
|---|---|
| **N/A** | Non applicable |
| **$NH_3$** | Ammonia (anhydrous): As refrigerant also called R717 |
| **n-PB** | N-propyl bromide |
| **OFN** | Oxygen free nitrogen |
| **ODP** | Ozone-depleting potential |
| **ODS** | Ozone-depleting substance |
| **PFC** | Perfluorocarbon |
| **RAC** | Refrigeration and air conditioning |
| **RIEW** | Regional Inspectorate for Environment and Water (Bulgaria) |
| **$SF_6$** | Sulphur hexafluoride |
| **TCA** | 1,1,1-Trichloroethane |
| **TFIM** | Trifluoroiodomethane |
| **UBA** | Umweltbundesamt (German Environment Agency) |
| **UNEP** | United Nations Environment Programme |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **VRF** | Variable refrigerant flow |

# 1 Introduction: Main measures of the EU F-gas and ODS Regulations

Gases that damage the ozone layer – ozone-depleting substances (ODS) – have been used worldwide in a wide range of industrial and consumer applications. The main uses of these gases are in refrigeration, air conditioning (RAC) and fire extinguishers. Other important uses include aerosol propellants, solvents and blowing agents for insulation foams. ODS are phased out under the regime of the Montreal Protocol. Their use and emissions have been reduced significantly in the EU in recent years, but remain relevant at an international level.

As the implementation of the phase-out progressed, alternatives to ODS have been investigated and introduced for most applications. Since the mid-1990s, certain fluorinated greenhouse gases (F-gases), in particular hydrofluorocarbons (HFCs), have been widely used as substitutes in the same sectors of application as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), including RAC and foam blowing. Other examples of F-gases include perfluorocarbons (PFCs) and sulphur hexafluoride ($SF_6$). Although they have no ozone-depleting properties, F-gases often have a high global warming potential (GWP) and contribute significantly to climate change. Therefore, F-gases are controlled under the Kyoto Protocol and thus subject to the United Nations Framework Convention on Climate Change (UNFCCC).

Relevant pieces of legislation at EU level include:

- the EU Regulation on substances that deplete the ozone layer (Regulation (EC) No. 1005/2009[1]; replaced (EC) No. 2037/2000 and the earlier (EC) No. 3093/94; referred to as EU ODS Regulation);
- the EU Regulation on certain fluorinated greenhouse gases (Regulation (EU) No. 517/2014[2]; replaced (EC) No. 842/2006; referred to as EU F-gas Regulation);
- the EU Directive on mobile air conditioning systems (Directive 2006/40/EC[3]; referred to as MAC Directive), prohibits the use of F-gases with a GWP of more than 150 times greater than carbon dioxide ($CO_2$) in new types of cars and vans introduced from 2011 on, and in all new cars and vans produced from 2017. The MAC Directive is not in the focus of this guidance document.

The **EU ODS Regulation** implements the Montreal Protocol in the EU and controls the production and use of ODS at EU level (Chapter 2). The main measures are bans (and exemptions), as well as containment, training and certification.

The **EU F-gas Regulation** originally contained mainly measures on containment, training, certification and a few bans (Regulation (EC) No. 842/2006). The revised F-gas Regulation (EU) No. 517/2014, however, imposes a number of new requirements. The most relevant elements are:

- **HFC phase-down:** The regulation introduces a new mechanism which will reduce the consumption of HFCs in the EU (Article 15). The quantities of HFCs (expressed in $CO_2$ equivalents, $CO_2$ eq) placed on the market will have to decrease by 79 % in the period from 2015 to 2030. This will impact producers of HFCs, manufacturers and importers of equipment, service personnel handling HFCs and equipment operators.

[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 (recast)

[2] 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

[3] DIRECTIVE 2006/40/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC

- **HFC registry:** The phase-down is implemented via a quota system (Article 16) that in turn is implemented via an HFC registry (Article 17). Article 14 bans the placing on the market of RAC and heat pump equipment pre-charged with HFCs from 2017 onwards, unless the HFCs charged into the equipment are accounted for within the quota system.
- **Bans:** A number of new bans mainly addressing RAC applications have been added (Article 11 and Annex III).
- **Labelling:** Labelling requirements for many products and types of equipment containing F-gases have been updated.
- **Reporting:** The reporting obligation now covers additional stakeholders, including destruction facilities and importers of pre-charged equipment.

This document provides guidance on the implementation of relevant EU legislation on ODS and F-gases in Bulgaria. Included are a summary of the status of the ODS phase-out in the EU and in Bulgaria, as well as a description of the measures introduced by the EU F-gas legislation. Implementation of both, the EU ODS and F-gas Regulations, is then highlighted with a strong focus on on-site inspections and market surveillance.

# 2 Use of ODS in the EU and restrictions

## 2.1 Completing the ODS phase-out

The Montreal Protocol tackled the most relevant known ODS at the time of its adoption, the so-called 'controlled substances'. Controlled substances include a large range of chemicals, CFCs, HCFCs, halons, carbon tetrachloride (CTC) and methyl bromide (MB) being the most relevant.

The measures of the current EU ODS Regulation go beyond those of the Montreal Protocol in many aspects and also extend to the so-called 'new substances' which are currently not controlled under the Montreal Protocol, such as methyl chloride (MC), ethyl bromide (EB), trifluoroiodomethane (TFIM) and n-propyl bromide (n-PB).

The Montreal Protocol and the EU ODS Regulation have introduced the following measures:

- Freeze and phase-out of the consumption of controlled substances, expressed in tonnes of ozone-depleting potential (ODP tonnes);
- Accompanying bans for the use of certain substances in particular applications, new equipment and for refilling existing equipment;
- Certification and training;
- Containment measures.

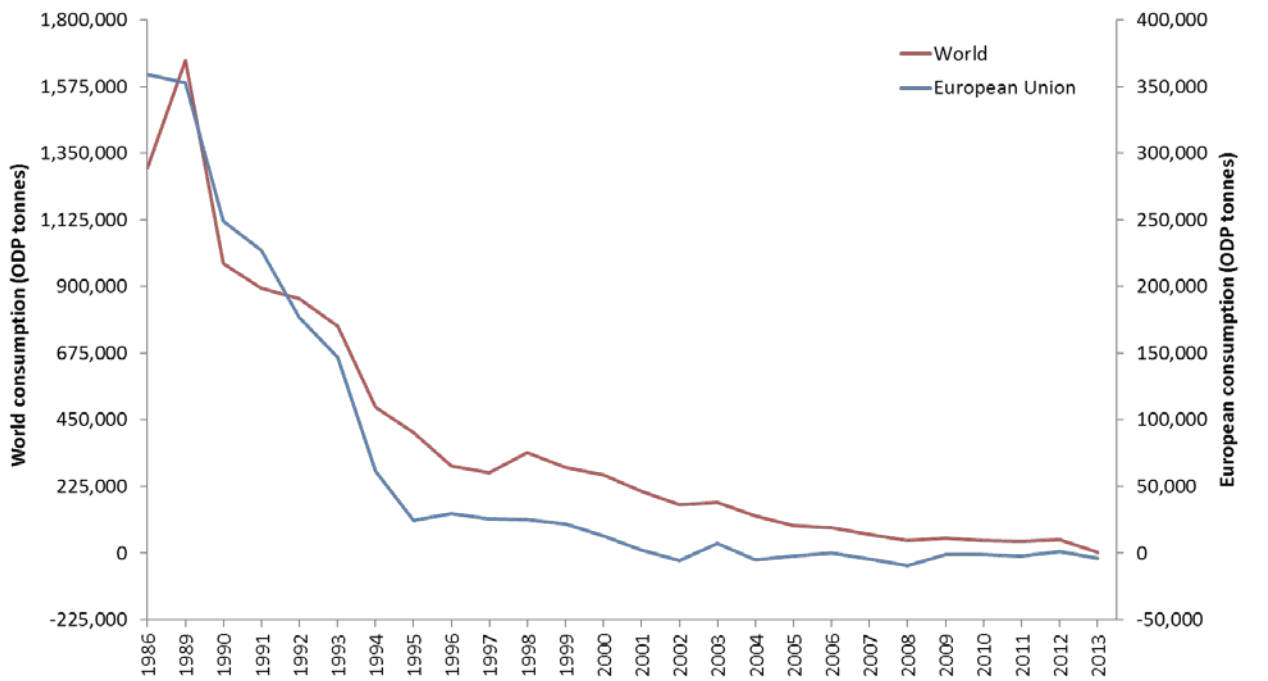
In the EU, CFCs, halons, TCA and CTC have been phased-out according to the schedule agreed to under the Montreal Protocol. The freeze of the use of HCFCs under the Montreal Protocol and the ban on HCFCs for the charging of new equipment under the EU ODS Regulation have led to significant consumption reductions. The more recent ban on using reclaimed or recycled HCFCs to maintain existing equipment in industrial countries (Non-Article 5 under the Montreal Protocol) has been in place since 1 January 2015.

In certain EU member states, national legislation has been even more stringent concerning use restrictions for certain substances.[4]

The consumption of controlled substances is a key parameter for the implementation of the Montreal Protocol measures. It is indicative of the presence of ODS in the market and tracks the progress in phasing out these chemicals. Calculated for each calendar year, it is defined as production plus imports minus exports minus destruction. This formula can yield a negative number when substances are produced and imported in quantities which are lower than the amounts exported or destroyed. This usually happens when exports or destruction affect quantities that have been in the EU market in previous years (stocks). If the parameter is calculated in ODP tonnes a negative value is obtained when production/imports affect low-ODP substances and exports/destruction affect high-ODP substances.

[4] e.g. the CFC halon prohibition ordinance (FCKW-Halon-Verbotsverordnung) in Germany which entered into force in 1991 and was replaced by the Chemical-Ozone-Layer-Ordinance (Chemikalien-Ozonschichtverordnung) in 2006

Figure 1: Consumption of controlled ODS in EU member states and worldwide, 1986-2013[5]




While the consumption in the EU member states amounted to approximately 342,000 ODP tonnes in 1986, it has decreased significantly since, in particular in the first half of the 1990s, and reached its lowest level on record in 2013 (-4,152 ODP tonnes).[5] In the EU-27, the HCFC phase-out scheduled for 2020 has already been achieved in 2010. The EU has thereby significantly reduced its consumption of the main ODS by 2010, 10 years ahead of its obligation under the Montreal Protocol.

Data is less complete with regards to providing a conclusive overview of the situation in Bulgaria itself. A national survey[6] on the matter from 2010 found that Bulgaria is meeting both, the mandated Montreal Protocol and EU phase-out schedules; at least until 2008 (Figure 2). However, since Bulgaria's accession to the EU in 2007, it is difficult to determine domestic consumption because of the lack of trade information with other EU countries. From 2007 onwards, imports and exports are only registered on an EU scale. Additionally, Bulgaria has no ODS production capacities[7]. Consumption is therefore a straightforward calculation of import minus exports. The survey has access to trade data (i.e. import and export data, including intra-EU trade) reported to the Ministry of Environment and Water (MoEW) from 2007 on.[8] This data can be used to complete the ODS consumption data and evaluate Bulgaria's compliance with the various schedules.

The survey concluded that meeting the 2020 phase-out completion date of the Montreal Protocol is not expected to present any problems for the country. However, it found that the 2015 EU deadline[9] and especially the supply of reclaimed HCFC-22 for the maintenance of existing equipment during

[5] ODS data (UNEP – Ozone Secretariat) provided by the United Nations Environment Programme (UNEP). http://ozone.unep.org/en/data-reporting/data-centre

[6] GEF and UNDP (2010)

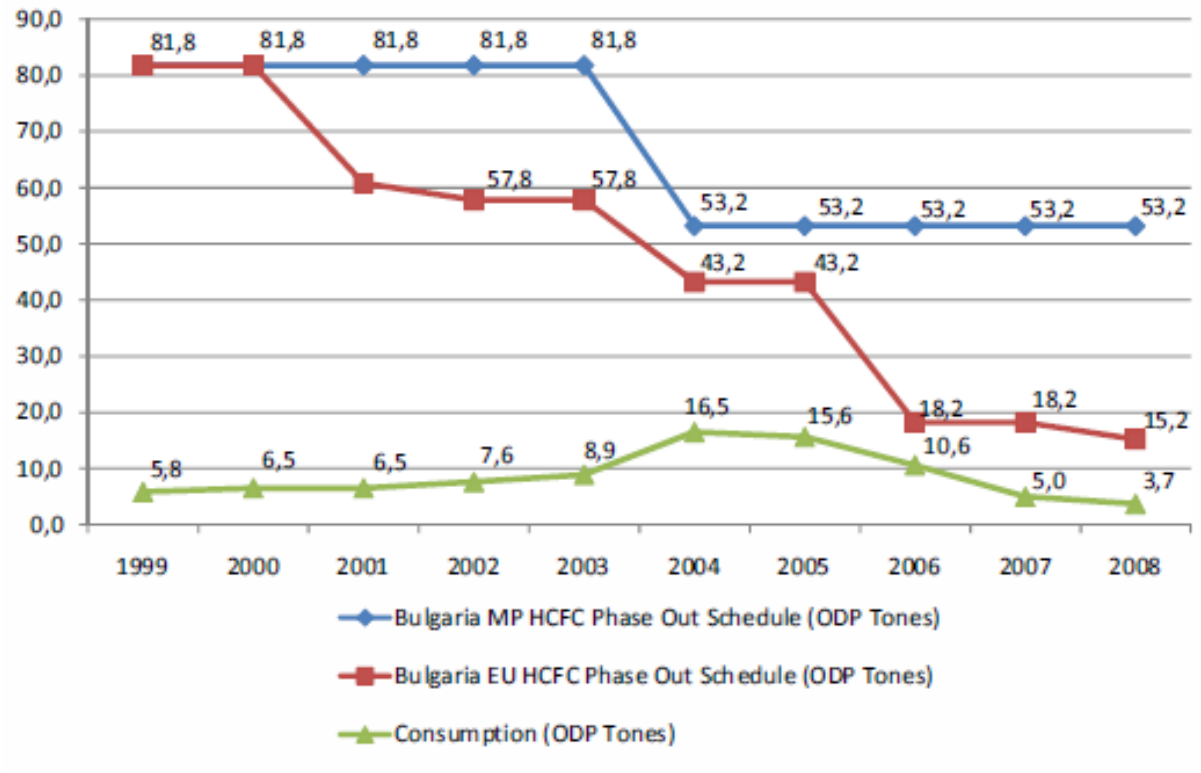
[7] The national reporting provisions established under Section V of the Bulgarian ODS Ordinance (Ordinance for establishing measures regarding the implementation of Regulation (EC) No. 1005/2009) target use and processing of ODS rather than import or export.

[8] DECREE NO. 326 OF THE 28TH DECEMBER, 2010 Concerning the ratification of the Order for Determining Measures to Implement Regulation (EC) No. 1005/2009 on Ozone-Depleting Substances

[9] From 1 January 2015 on servicing of HCFC-22 equipment is no longer permitted – regardless of whether with virgin or non-virgin amounts.

2010–2015 – the time when virgin HCFC-22 is no longer permitted for servicing – are likely to be problematic. The survey assumed that demand would at least partially be met by illegal imports from the former Yugoslav Republic of Macedonia, Turkey and Serbia – Article 5 countries under the Montreal Protocol, who follow an HCFC reduction schedule with a 10 years grace period compared to Non-Article 5 countries. Such illegal imports present an overall challenge to Bulgaria.

Figure 2: ODS consumption in Bulgaria compared to Montreal Protocol and EU phase-out schedules for the country[10]




## 2.2 Remaining uses of ODS in the EU

At a global scale, consumption of ODS controlled under the Montreal Protocol has been reduced by some 99.88 % in the period of 1986–2013.

In the EU, ODS are still used to the extent the Montreal Protocol and the EU ODS Regulation allow, by means of exemptions to the overall phase-down. The remaining uses concern 'critical uses', 'solvent uses' 'feedstock uses', 'process agent uses' and 'laboratory and analytical uses'. Feedstock uses are the most relevant in quantitative terms. The use of ODS in refrigeration has been banned in 2015.

The information on ODS production, import, export and use of ODS is reported annually by companies according to the reporting obligations set out in the Montreal Protocol and the EU ODS Regulation (Art 27). The data is intended to enable the monitoring of compliance at a national, EU and international level. Table 1 offers an estimation of the quantities of substances covered by the Montreal Protocol which are used within the EU for the above-mentioned uses (2013 reporting year, coverage EU-28).

[10] National Survey and Development of a National Strategy Outline of HCFC Phase-Out for Consumption Sectors in Republic of Bulgaria, United Nations Development Programme, April 2010

Table 1: Estimated sales of ODS controlled by the Montreal Protocol broken down by uses (ODP tonnes), reported emissions (ODP tonnes) and calculated emission factors (%) in the EU-28 (reporting year 2013)

| | Sales | Emissions | Emission factor |
|---|---|---|---|
| Critical uses | 846 | N/A | N/A |
| Solvent uses | 1 | N/A | N/A |
| Feedstock | 1,044,653 | 33,027 | 0.32 % |
| Process agent | 32,077 | 882 | 2.75 % |
| Lab use | 313 | N/A | N/A |
| Refrigeration | 49,994 | N/A | N/A |

Note: The values on sales refer to sales to third parties within the EU market and own use by EU producers when relevant. Emissions are only to be reported for feedstock and process agent use. Data source: EEA CSI006 indicator.

For 'feedstock' and 'process agent use', known as having very low emission ratios (0.32 and 2.75 %), actual emissions are also to be reported by concerned companies. These low emission ratios are one of the reasons why these two fields of application operate with less stringent rules under the Montreal Protocol and the EU ODS Regulation. However, in a context where the Montreal Protocol targets have generally been achieved for the EU and worldwide, the importance of these emissions subsequently becomes more apparent. Therefore, any future changes in the rules affecting these uses could potentially result in additional environmental benefits.

The current reporting framework on ODS in the EU does not include reporting on emissions for the following uses: critical uses, solvent uses and laboratory. It is also not possible to correctly estimate the level of emissions that arise from those uses due to the multitude of technologies and industry sites involved. Instead, these figures show which ODS uses are still relevant in the EU today and could be a future target of additional operational rules.

The EU has already gone beyond the rules of the Montreal Protocol to tackle some of the remaining challenges. Among these actions, as previously mentioned, the EU ODS Regulation introduced a new fill ban and a servicing ban affecting HCFCs. The EU ODS Regulation also covers new substances in addition to those controlled under the Montreal Protocol.

Table 2 shows the combined ODP of the substances covered by both, the Montreal Protocol and the EU ODS Regulation. It becomes apparent that the additional substances covered by the EU ODS Regulation only are especially relevant as feedstock and industrial solvents. The substitution of traditional ODS with these newer ODS is a relatively recent trend and closely monitored by European agencies.

Table 2: Estimated sales of ODS (ODP tonnes) taking into account both, the Montreal Protocol scope and the additional substances covered by the EU ODS Regulation (reporting year 2013)

| | All EU regulated substances | Covered by Montreal Protocol | Additional substances EU Regulation |
|---|---|---|---|
| Critical uses | 846 | 846 | 0 |
| Solvent uses | 32,904 | 1 | 32,903 |
| Feedstock | 11,706,215 | 10,444,653 | 1,261,562 |
| Process agent | 32,077 | 32,077 | 0.00 |
| Lab use | 647 | 313 | 334 |
| Refrigeration | 49,994 | 49,994 | 0.00 |

Note: The values on sales refer to sales to third parties within the EU market and own use by EU producers when relevant. The EU ODS Regulation covers additional substances which are also reported to the European Commission/European Environment Agency (EEA). Data source: EEA CSI006 indicator.

There is also scientific evidence that other chemicals than those covered by the Montreal Protocol and the EU ODS Regulation are playing a role in the depletion of ozone. Adequately managing the use and releases of other known ODS represent challenges that will need to be addressed by the international community and the EU.

Further action on ODS should also address the following aspects:

- Safely collecting and disposing the large quantities of ODS contained in old equipment and buildings (the so-called ODS banks);
- Ensuring that restrictions on ODS continue to be properly implemented and the remaining global use of ODS declines further;
- Preventing illegal trade with ODS;
- Strengthening the international and EU framework on ODS (e.g. inclusion of other known ODS, restricting exemptions);
- Addressing the strong growth in the production and consumption of HCFCs in developing countries, e.g. through technology transfer and capacity building.

Some of these aspects will be looked into in more detail throughout this paper.

In Bulgaria itself, ODS have been used for servicing RAC equipment (HCFC-22), for foam blowing and the production of polyurethane and extruded polystyrene foams (HCFC-141b and HCFC-142b) and to a lesser extent to retrofit existing CFC-based equipment (HCFC-124).

## 2.3 Implementation measures at national level

The EU ODS Regulation has been implemented at the national level in Bulgaria for many years. Prior to its accession to the EU in 2007, the country was classified as an Article 5 Party to the Montreal Protocol.

MoEW and its sixteen Regional Inspectorates of Environment and Water (RIEW) are responsible for the implementation and enforcement of the EU ODS and F-gas Regulations. The RIEWs also gather and aggregate the data to be reported by ODS users before passing it on to the MoEW. Imports of ODS are further subject to licensing by DG Clima (MoEW receives a copy) and customs are aware of the combined nomenclature of containers containing ODS. Relevant building codes and standards further make it difficult to legally design and build RAC equipment that still relies on HCFC equipment.

While the ODS phase-out has been completed and bans for imports and exports of ODS are in place, certain challenges remain.

Relevant quantities of ODS refrigerants, in particular R22, are still used in existing equipment and systems. Technically, this is in line with the legal requirements as long as no intervention into the refrigerant circuit is needed, i.e. no servicing is necessary. However, when it comes to disposal of equipment and systems containing ODS, the management of the used refrigerant is crucial.

As pointed out above, collection and safe disposal of the ODS contained in old equipment (ODS banks) represents a major challenge in the near future.

Article 22 of the EU ODS Regulation requires that controlled substances contained in RAC and heat pump equipment are to be recovered for destruction, recycling or reclamation during the maintenance or servicing of equipment or before the dismantling or disposal of equipment.

According to the EU ODS Regulation, minimum qualification requirements for the personnel involved were to be defined by the member states. In Bulgaria, the Bulgarian Branch Chamber - Machine Building (BBCMB) issues certificates for the maintenance of RAC and heat pump equipment to technicians in accordance with both, Regulation (EC) No. 1005/2009 and Regulation (EU) No. 517/2014.

In addition, Article 23 obliges the operators to take all precautionary measures practicable to prevent and minimize any leakages and emissions of controlled substances. Leakage checks for stationary equipment and systems are required, as well as the immediate repair of a leakage once detected.

In practice, however, intentional releases of ODS might occur. Equipment operators might be reluctant to involve appropriately qualified personnel for the recovery of refrigerants. Furthermore, service companies often face administrative burdens and considerable costs for handling, storage, transport and return of recovered refrigerants.

Providing proof of intentional releases of ODS, on the other hand, is considered relatively difficult and would need to take into account the equipment records required by Article 23(3). Currently, the decommissioning of HCFC-22 equipment is bound to take place on a larger scale. RIEWs therefore have an opportunity to check for documentation of proper HCFC-22 disposal when they inspect new (or retrofitted) equipment with ODS alternatives for the first time. It should be noted, however, that documentation might be incomplete, in particular in case of relatively old RAC and heat pump equipment.

To prevent intentional releases of ODS, collection, storage and return of recovered ODS refrigerants to specialized facilities for destruction should be promoted and facilitated.

The following measures could be established at national level:

- Information and awareness-raising among contractors and companies undertaking the dismantling of used equipment about the environmental impact of intentional refrigerant releases;
- Establishment of rules for the take-back of recovered ODS refrigerants, e.g. obligation for importers and distributors to take back recovered ODS refrigerants free of charge;
- Establishment of a collection and transport system for recovered refrigerants at a local or regional level supervised by regional authorities/inspectorates;
- Making the environmental impact of intentional releases part of the curriculum of technician training schools.

In principle, national deposit schemes would also represent a measure which could promote recovery, collection and safe disposal of recovered refrigerants. Under such a scheme, a small deposit fee would be reimbursed or a tax reimbursement would be granted when recovered refrigerant quantities are handed in at a supervised collection point or reclamation/destruction facility. However, the introduction of a national deposit scheme for recovered ODS exclusively is not recommended due to the relatively high administrative burden. In addition, it is likely that such a scheme would lead to increasing amounts of illegal ODS imports (see below) when restricted to ODS alone.

# 3 Trade with HFCs under the EU phase-down mechanism and further measures of the new EU F-gas Regulation

This chapter takes a closer look at the measures implemented by the EU F-gas Regulation from the perspective of domestic implementation. The focus is therefore on the phase-down and quota system, bans, containment, reporting, as well as training and certification.

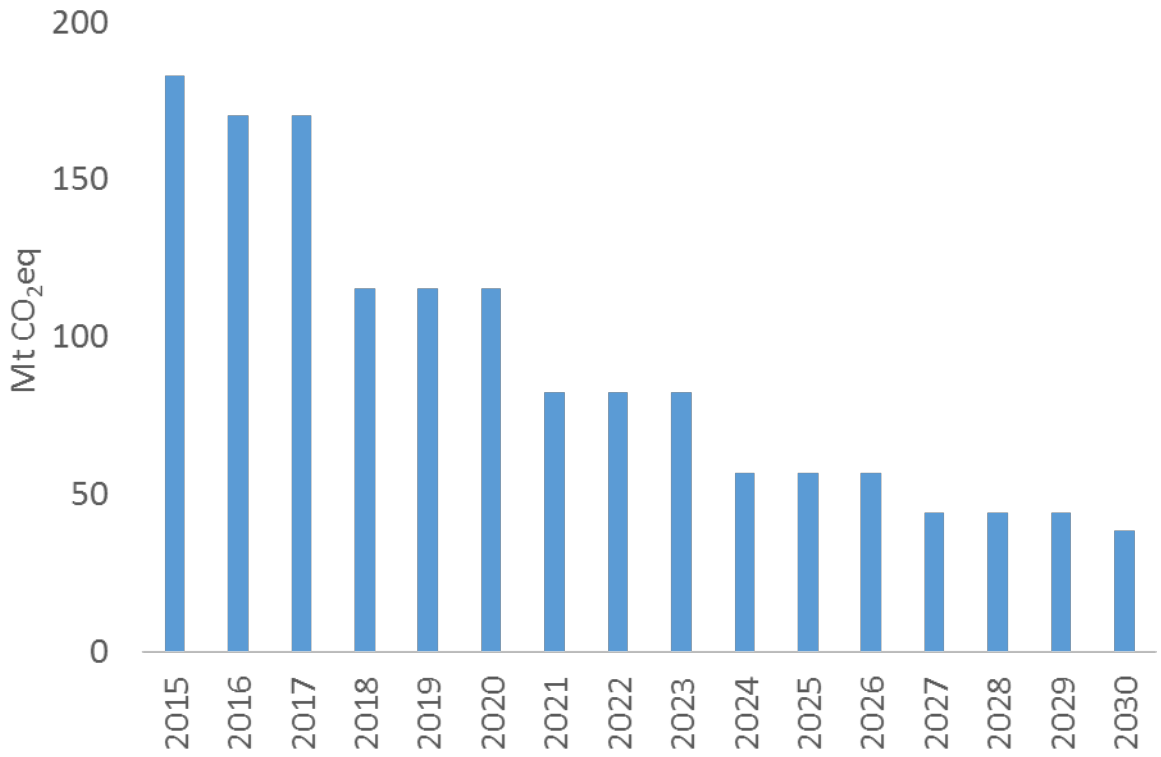
## 3.1 EU HFC phase-down and quota system

The EU F-gas Regulation (EU) No. 517/2014 requires the gradual reduction of the quantity of HFCs placed on the EU market (Article 15; "phase-down").

Under the EU phase-down, the quantities of virgin HFCs (expressed in $CO_2$ eq) placed on the EU market are to be reduced step by step by 79 % in the period 2015–2030. This mechanism does not ban the sale of any particular HFC but reduces the overall HFC supply to the EU market. Given that overall, less $CO_2$ eq will be available, HFC prices are expected to increase over time, in particular for HFCs with a high GWP (which use up a lot of $CO_2$ eq). HFC reserves for certain applications or member states are not taken into account. Recycled and reclaimed HFC quantities are not subject to the phase-down.

Equipment operators can continue using their current RAC and heat pump equipment with existing refrigerant gases, with the exception of the service ban (see below). However, price increases can be significant, especially in the years when the F-gas supply is further reduced (see Figure 3 below). It is important to realize that reductions of supply will happen quickly starting in 2016.

Figure 3: F-gas phase-down under the new EU F-gas Regulation



The phase-down steps set in place for the phase-down scheme are listed in Table 3 below.

Table 3: Phase-down schedule and reduction steps under the new EU F-gas Regulation

| 2009-12 | 2015 | 2016-17 | 2018-20 | 2021-23 | 2024-26 | 2027-29 | 2030 |
|---|---|---|---|---|---|---|---|
| Baseline (100 %) | 100 % | 93 % | 63 % | 45 % | 31 % | 24 % | 21 % |

Investments into new equipment should be considered carefully: It is not recommended to operators to invest into equipment with high-GWP HFCs, in particular in cases where bans apply.

The phase-down scheme is implemented at EU level by means of quota (Article 16) which is set annually by the European Commission.

## 3.2 Bans

The phase-down mechanism is accompanied by a number of bans which are summarised in the following table and include

- Bans on certain F-gases in new equipment and products (Article 11; Annex III): The placing on the market of certain new products and equipment containing F-gases is prohibited from certain dates onwards. [11] Some of the bans have already been in place under the previous EU F-gas Regulation.
- Bans on the servicing and maintenance of refrigeration equipment with certain F-gases (Article 13).

Table 4: Bans according to the new F-gas Regulation and dates of prohibition

| Application subject to ban | Date of prohibition |
|---|---|
| Non-refillable containers for F-gases used to service, maintain or fill RAC or heat pump equipment, fire protection systems or switchgear, or for use as solvents | 4 July 2007 |
| Non-confined direct evaporation systems that use HFCs or PFCs as refrigerants | 4 July 2007 |
| Fire protection equipment<br>that contain PFCs<br>that contain HFC-23 | <br>4 July 2007<br>1 January 2016 |
| Windows for domestic use that contain F-gases | 4 July 2007 |
| Other windows that contain F-gases | 4 July 2008 |
| Footwear that contains F-gases | 4 July 2007 |
| Tyres that contain F-gases | 4 July 2007 |
| One-component foams, except when required to meet national safety standards, that contain F-gases with a GWP of 150 or more | 4 July 2008 |

[11] Article 11 (1) of Regulation (EU) No. 517/2014

| Application subject to ban | Date of prohibition |
|---|---|
| Aerosol generators marketed and intended for sale to the general public for entertainment and decorative purposes and signal horns, that contain HFCs with a GWP of 150 or more | 4 July 2009 |
| Domestic refrigerators and freezers that contain HFCs with a GWP of 150 or more | 1 January 2015 |
| Refrigerators and freezers for commercial use (hermetically sealed equipment)<br>that contain HFCs with a GWP of 2,500 or more<br>that contain HFCs with a GWP of 150 or more | <br><br>1 January 2020<br>1 January 2022 |
| Stationary refrigeration equipment, that contains, or whose functioning relies upon, HFCs with a GWP of 2,500 or more except equipment intended for application designed to cool products to temperatures below -50 °C | 1 January 2020 |
| Multipack centralized refrigeration systems for commercial use with a rated capacity of 40 kW or more that contain, or whose functioning relies upon, F-gases with a GWP of 150 or more, except in the primary refrigerant circuit of cascade systems where F-gases with a GWP of less than 1,500 may be used | 1 January 2022 |
| Movable room-air conditioning equipment (hermetically sealed equipment which is movable between rooms by the end user) that contain HFCs with a GWP of 150 or more | 1 January 2020 |
| Single split-air conditioning systems containing less than 3 kg of F-gases, that contain, or whose functioning relies upon, F-gases with GWP of 750 or more | 1 January 2025 |
| Foams that contain HFCs with a GWP of 150 or more except when required to meet national safety standards<br>Extruded polystyrene (XPS)<br>Other foams | <br>1 January 2020<br>1 January 2023 |
| Technical aerosols that contain HFCs with a GWP of 150 or more, except when required to meet national safety standards or when used for medical applications | 1 January 2018 |
| Service ban: Servicing and maintenance of refrigeration equipment with a charge of 40 t $CO_2$ eq with virgin HFCs with GWP of 2,500 or more. Equipment intended for low-temperature refrigeration below -50 °C are exempted from this ban. | 1 January 2020 |

With regard to the service ban, it should be pointed out that recycled and reclaimed HFCs with a GWP > 2,500 can still be used for service or maintenance purposes until 2030, if these gases are labelled accordingly. No restrictions apply for the service and maintenance with HFCs with a GWP < 2,500.

When relying on recycled and reclaimed refrigerants it is important to remember that one also relies on their availability. Retrofit gases with intermediate GWP might not provide the necessary $CO_2$ eq savings to meet the challenges of later phase-down steps. In the long run, it can therefore make sense to replace equipment and switch to low-GWP alternatives directly.

With regard to the threshold of 40 t $CO_2$ eq for the service ban, an overview for the charge size thresholds for common refrigerants is provided in Table 5.

Just like the HFC phase-down, bans are automatically in place via the new EU F-gas Regulation and no further legislative action is required by Bulgaria to implement them in the country.

Table 5: Charge size limits above which service and maintenance bans will apply with regard to the 40 t $CO_2$ eq threshold

| Refrigerant | Charge size threshold (40 t $CO_2$ eq) |
|---|---|
| R23 | 2.72 kg |
| R404A | 10.20 kg |
| R507 | 10.04 kg |
| R422D | 14.66 kg |

Guidance on the enforcement of bans at national level is provided in Chapter 4.

## 3.3 Training and certification

The EU F-gas Regulation prohibits any intentional release of F-gases into the atmosphere. Service personnel are therefore required to ensure that this does not happen. They are further obliged to take precautionary measures to minimise any leakage of F-gases.

Certification is required for a number of activities, listed in the following. In addition to skills and knowledge that had been required under the old legislation, the new EU F-gas Regulation adds that certification programmes and training must also cover information on relevant technologies to replace or reduce the use of F-gases and their safe handling.

Member states have already introduced training and certification schemes under the old EU F-gas Regulation. Updates might be needed concerning low-GWP alternatives.

As mentioned above, the BBCMB issues certificates for the maintenance of RAC and heat pump equipment to technicians in accordance with both, Regulation (EC) No. 1005/2009 and Regulation (EU) No. 517/2014. There are five training centres that are capable of providing technical training in accordance with Regulation (EC) No. 303/2008[12] as required by the EU F-gas Regulation.[13]

[12] COMMISSION REGULATION (EC) No 303/2008 of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of companies and personnel as regards stationary refrigeration, air conditioning and heat pump equipment containing certain fluorinated greenhouse gases

[13] See footnote 6.

### 3.3.1 Stationary refrigeration and air conditioning, refrigerated trucks and trailers

Regarding stationary RAC equipment, as well as equipment in refrigerated trucks and trailers (i.e. A, B, C, D, MRA and MRB), the activities indicated in Table 6 can only be undertaken by personnel and companies holding a certificate, issued by a certification body designated by a member state. For other refrigerated vehicles (MRX), there is no requirement for certification.

Only certified personnel working for a certified company can do installation and maintenance or servicing activities on these types of equipment. Specifically, for leakage checking and the recovery of F-gases, personnel needs to be certified, but a company certification is not required explicitly.

Certificates issued under the old EU F-gas Regulation (2006) remain valid. Member states might establish specific requirements that should be taken into consideration.

The operator must make sure that the relevant personnel hold a valid certificate for the relevant activity.

Certificates must contain the following information:

- Name of certification body, full name of holder, certificate number, date of expiry (if any);
- Category of certificate (only for personnel);
- Activities which the holder of the certificate is entitled to perform;
- Issuing date and issuer's signature.

Member states can decide on the content of the certification, the category of personnel and the expiry date. It is therefore important that the operator is aware of the member state's specific conditions.

Table 6: Equipment types and their definitions

| | Equipment type | Definition |
|---|---|---|
| Stationary RAC equipment | A | < 5 t $CO_2$ eq charge (hermetically sealed equipment < 10 t $CO_2$ eq charge) |
| | B | 5–< 50 t $CO_2$ eq charge (hermetically sealed equipment 10 –< 50 t $CO_2$ eq charge) |
| | C | 50–< 500 t $CO_2$ eq charge |
| | D | ≥ 500 t $CO_2$ eq charge |
| Mobile refrigeration equipment | MRX | Refrigerated vehicle other than truck (> 3.5 t) or trailer towed by truck |
| | MRA | Refrigerated truck or trailer with charge < 5 t $CO_2$ eq |
| | MRB | Refrigerated truck or trailer with charge ≥ 5 t $CO_2$ eq |
| Mobile air conditioning equipment | MAX | Vehicles not covered by EU MAC Directive |
| | MAC | Passenger car or light van (category N1, class 1) |

Table 7: Activities on stationary RAC and mobile refrigeration equipment in refrigerated trucks and trailers that need to be carried out by certified servicing personnel and companies

| Activity | Certified personnel | Certified company |
|---|---|---|
| Installation | x | x |
| Maintenance or servicing | x | x |
| Leakage checks of charge categories B, C, D and MRB | x | |
| Recovery of F-gases | x | |

Certain exemptions are listed in the Commission Regulation (EC) No. 303/2008, Art. 4(3).

An overview of personnel certification categories and the corresponding activities that can be undertaken on the basis of the EU requirements is provided in Table 8.

Table 8: Personnel certification categories for all equipment categories

| | Equipment categories A and MRA | | | Equipment categories B, C, D and MRB | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel certification category | R | I | M | L1 | L2 | R | I | M |
| Category I | x | x | x | x | x | x | x | x |
| Category II | x | x | x | | x | | | |
| Category III | x | | | | | | | |
| Category IV | | | | | x | | | |

Note: L1= leakage check including breaking into the refrigeration circuit; L2= leakage check without breaking into the refrigeration circuit; R=recovery; I=installation; M=maintenance or servicing.

**Company certificates** correspond to activities (not categories), either installation or maintenance/ servicing or both. Certificates (excluding interim certificates) are valid in all member states, but member states may require a translation of the certificate.

The certification requirements for personnel and companies are specified in Commission Regulation (EC) No. 303/2008.

### 3.3.2 Mobile air conditioning

The recovery of F-gases from motor vehicles covered by the EU MAC Directive (passenger cars and light trucks; i.e. category MAC) requires that personnel hold valid training attestations. Such personnel must at least be trained in

- The functioning of the mobile air conditioning system;
- The environmental impact of the F-gas refrigerant;
- Environmental regulations;
- Refrigerant recovery.

Recovery of F-gases from motor vehicles not covered by the EU MAC Directive (i.e. category MAX) requires appropriately qualified personnel but no specific attestation or certification.

## 3.4 Containment measures

### 3.4.1 Prevention of emissions

F-gas emissions are generally to be avoided whenever possible. The intentional release into the atmosphere is prohibited for all applications unless technologically necessary. Operators have to take precautionary measures to minimize unintentional release (i.e. leakage) into the atmosphere. Such measures include leakage checks, the installation of leakage detection systems and immediate repair in case a leakage has been identified.

### 3.4.2 Containment through leakage checks

Stationary RAC equipment, as well as refrigerated trucks and trailers containing F-gas refrigerants, in working order or just temporarily out of operation, have to be checked for leakage at regular intervals.[14] This does not apply if the charge is below 5 t $CO_2$ eq (or less than 10 t $CO_2$ eq for hermetically sealed equipment labelled as such).

The following table indicates the threshold for regular leakage checks by refrigerants.

Table 9: Refrigerant charges relevant for the requirement of regular leakage checks

| Refrigerant | $GWP_{100}$ | Charge threshold: 5 t $CO_2$ eq | Charge threshold: 10 t $CO_2$ eq (hermetically sealed) |
|---|---|---|---|
| R407C | 1,774 | 2.82 kg | 5.65 kg |
| R134a | 1,430 | 3.50 kg | 6.99 kg |
| R23 | 14,800 | 0.34 kg | 0.68 kg |
| R404A | 3,922 | 1.27 kg | 2.55 kg |
| R410A | 2,088 | 2.4 kg | 4.79 kg |

$GWP_{100}$ values from IPCC, 4th AR, 2007.

[14] Until 31 December 2016 equipment that contains less than 3 kg F-gases (less than 6 kg if hermetically sealed) is exempted from leakage checks.

A crucial point in determining the frequency of checks is also the existence or lack of a leakage detection system (see below). The operator of the equipment is responsible for ensuring that this check is carried out by certified personnel only.

Regular leakage checks are not required for mobile air conditioning equipment containing F-gas refrigerants or refrigerated vehicles that are neither trucks nor trailers (e.g. containers, vans etc.).

Newly commissioned equipment should be checked for leakage immediately after it has been put into service. In cases where a leakage has been detected, the operator is obliged to ensure that the repair is carried out as soon as possible by personnel certified to undertake the specific activity. Prior to repair, a pump-down or recovery shall be carried out, if necessary.

Furthermore, the operator has to ensure that after the repair, a leakage test with oxygen free nitrogen (OFN) or another suitable pressure testing and drying gas is carried out if necessary (based on the judgment of the certified member of personnel). The test should be followed by removing the drying gas used for pressure testing, recharging the refrigerant and a new leakage test. Prior to pressure testing with OFN or another suitable pressure testing gas, F-gases shall be recovered from the whole application, if necessary.

The cause of a leakage should be identified as far as possible in order to avoid recurrence.

A follow-up check must be carried out within 1 month, depending on the situation and based on the judgment of the certified person. This check should focus on those areas where leakages have been found and repaired, as well as on adjacent areas. As the follow-up check must be carried out according to the standard leakage checking requirements, the time interval for the next regular leakage check starts from that point in time.

Requirements for leakage checks of stationary equipment are specified in Commission Regulation (EC) No. 1516/2007. The requirements for general systematic checks are listed, as well as the need for direct and indirect measuring methods of leakage checking.

### 3.4.3 Containment through leakage detection systems

A leakage detection system is defined as a calibrated mechanical, electrical or electronic device for detecting leakage of F-gases which, on detection, alerts the operator.

Equipment containing 500 t $CO_2$ eq or more of F-gas refrigerant has to be equipped with such a leakage detection system. The proper functioning of the leakage detection system has to be checked at least once every 12 months.

Leakage detection systems are not a requirement for refrigeration equipment in mobile equipment such as trucks and trailers or mobile air conditioning systems.

In the selection of the appropriate technology and the installation location of such a detection system, the operator should take into consideration all parameters which may affect its efficacy to ensure that the system installed will detect a leakage and alert the operator. Such parameters may include the type of equipment, the space in which it is installed and the potential presence of other contaminants in the room.

As a general rule, systems which detect leakage by monitoring the existence of F-gases in the air should be installed in the machine room or, if no machine room exists, as close as possible to the compressor or to the relief valves, and should have a sensitivity which allows effective detection of leakage.

Other systems, including those which detect leakage through electronic analysis of liquid level or other data may also be used. The standard EN 378[15], any other standards referred to therein, as well as national regulations should be taken into consideration.

Any indication of F-gas leakage by the fixed leakage detection system has to be followed by a check of the system to identify and, if necessary, to repair the leakage.

Operators of applications containing less than 500 t $CO_2$ eq of F-gas may also install a leakage detection system. Equipment with properly functioning leakage detection systems needs to be checked for leakage less frequently.

## 3.5 F-gas reporting for relevant sectors

Article 19 of Regulation (EU) No. 517/2014 requires that production, import and export of bulk gases (including gases in equipment), feedstock use and destruction of the substances listed in Annexes I or II of the Regulation are to be reported annually before 31 March, for the previous calendar year. The Commission Implementing Regulation (EU) No. 1191/2014 determines the format and means for submitting the report.

Reporting obligations apply for

- Producers, importers or exporters that produced, imported or exported one metric tonne or 100 t $CO_2$ eq or more F-gases and gases listed in Annex II of the new EU F-gas Regulation, including companies (producers or importers) to which quotas have been transferred;
- Companies that destroyed one metric tonne or 1,000 t $CO_2$ eq or more of F-gases and gases listed in Annex II of the new EU F-gas Regulation;
- Companies that used 1,000 t $CO_2$ eq of F-gases as feedstock;
- Companies that placed 500 t of $CO_2$ eq of F-gases or gases listed in Annex II of the new EU F-gas Regulation contained in products or equipment on the market (but no obligation to report if these gases were bought on the EU market or imported as bulk ("released for free circulation") previous to being put in the equipment);
- Companies that placed pre-charged RAC and heat pump equipment on the market, where HFCs contained in this equipment have not previously been placed on the EU market.

Quantities reported in metric tonnes should be accurate to the third decimal place and reported separately for each HFC. Those reported in $CO_2$ eq have to be accurate to 1 t $CO_2$ eq. A detailed account of how to submit an F-gas report can be found on the DG Clima website.[16]

Within the phase-down scheme, the baseline was calculated on the basis of the reported data of the years 2009-2012. Annual quota for HFC quantities are also calculated on the basis of the reported data.

The mandatory reporting by companies allows for a relatively detailed overview of the F-gas market at the EU level. The information at national level in EU member states is not as detailed in most cases as no national reporting requirements apply.

[15] The content of EN 378 is further explained in the guidance document “Recommendations to safety guidelines and standards for the use of natural refrigerants”.

[16] http://ec.europa.eu/clima/policies/f-gas/docs/faq_reporting_en.pdf

# 4 Enforcement of EU ODS and F-gas measures and market supervision at national level

## 4.1 Inspections of undertakings

The implementation and enforcement of EU measures – such as the control of equipment operators – is accomplished by authorities at national, regional or local level in each EU member state.

In Germany, for example, the states (Bundesländer) are responsible for the implementation of the EU F-gas Regulation and the associated national implementation act, the Chemical-Climate-Protection-Ordinance (Chemikalien-Klimaschutz-Verordnung). However, which administrative office is responsible for the implementation of which part of the Ordinance varies from state to state. For example, certification and control of equipment operators are accomplished at regional level in certain states, but at state or local level in others.

In Bulgaria, the MoEW and its 16 RIEWs are responsible for the implementation and enforcement of the domestic ODS and F-gas related policy.

RIEWs are, among other things, responsible for the control and verification of operator and owner reporting, inspect servicing and leakage test activities, as well as for the control and verification of proper training and certification of technical staff and companies.

Next to the MoEW and RIEWs, customs officers are important stakeholders in terms of ODS and F-gas trade and market surveillance.

### 4.1.1 Criteria for the selection of undertakings for inspection

Authorities carrying out inspections are usually not able to monitor all companies and equipment within their jurisdiction. A list of operators of equipment and service companies or service personnel therefore needs to be carefully selected.

The following criteria could guide such a selection:

- **The type of equipment:** Types include most commonly commercial refrigeration systems (centralised systems, condensing units, plug-in units), industrial refrigeration systems, room air conditioning equipment (multi-split and variable refrigerant flow (VRF) systems), chillers. Separating equipment by type can allow for a focus on larger applications or those known to have higher emissions.
- **The type of refrigerant:** Only equipment and systems using HCFC or HFC refrigerants should be subject to inspections under the EU ODS and F-gas Regulations. Equipment running on ammonia ($NH_3$, R717), $CO_2$ (R744) or hydrocarbons is not subject to these regulations.
- **Refrigerant charge:** Only equipment and systems containing a refrigerant charge of more than 5 t $CO_2$ eq. are covered by major provisions of the EU ODS and F-gas Regulation such as leakage checks. Systems with large charges, which can mainly be found in commercial and industrial refrigeration, should be of special interest because even small leakages can lead to high refrigerant losses and related emissions.
- **Date of installation:** Leakage might occur in both, new systems and older equipment. A particular focus should be placed on retrofitted systems which were previously employing ODS refrigerants. Leakage might be particularly high in such cases and special care should be given to improving the tightness of the equipment.
- **Economic sector:** RAC systems are used in various economic sectors including supermarkets and smaller shops, production of food and beverages, manufacture of various other products (ma-

chine building, automotive industry, chemical and pharmaceutical industry etc.), hospitals, hotels, large-scale catering businesses. Sectors that typically use large amounts of refrigerants are a good choice for focusing inspections (e.g. supermarkets).

### 4.1.2 Targeting equipment with higher leakage rates

It is also possible to maximize the environmental effect of enforcement by concentrating inspections on types of equipment that are commonly known to have relatively high leakage rates. Therefore, servicing and maintenance of these types of equipment is important and regular inspections can ensure that operators act according to the minimum requirements for leakage checks set out in the new EU F-gas Regulation.

Empirical data on leakage rates in different types of equipment is rare. However a recent study for the German Environment Agency (Umweltbundesamt, UBA) evaluating the implementation of domestic F-gas policy assessed refill rates of over 300 stationary RAC systems throughout Germany on-site.[17] In addition, the study had access to electronic records of 266 RAC systems provided by a supermarket chain, aggregated refill rates provided by two large supermarket chains, as well as over 35,000 aggregated system records provided by the German Association of Refrigeration and Air Conditioning Contractors (Verband Deutscher Kälte-Klima Fachbetriebe, VDKF).

Figure 4 and 5 highlight some of the key results from the study in regard to these refill rates and the type of equipment and refrigerants used. It should be noted that refill rates can serve as a proxy for equipment leakage rates, especially over a large sample size. Centralized systems clearly exhibited the highest refill rates, followed by condensing units and, finally, industrial systems. Larger air conditioning units and chillers on the other hand had a lower average refill rate. These results can be corroborated via an analysis by refrigerant. Here R404A clearly exhibits the highest refill rate. This was the case in all four different data-sets analysed. R404A is predominantly used in centralized refrigeration equipment. The results from the supermarket chains also indicate that centralized systems operating with R134a seem to have remarkably lower refill rates.

The results clearly suggest that inspections should focus on centralized refrigeration equipment, which in turn is most commonly used in supermarkets but also in various industrial applications such as food-processing. Equipment that uses R404A should present a focal point.

[17] UBA 2015: Konzept zur Bewertung der technischen Innovationen zur Erfüllung der gesetzlichen Vorgaben bei stationären Kälte- und Klimaanlagen, Final Report. Climate Change 08/2015. available at https://www.umweltbundesamt.de/en/publikationen/konzept-zur-bewertung-der-technischen-innovationen

Figure 4: Average annual refill rate by equipment type. The rate is expressed as percentage per unit and charge[18]

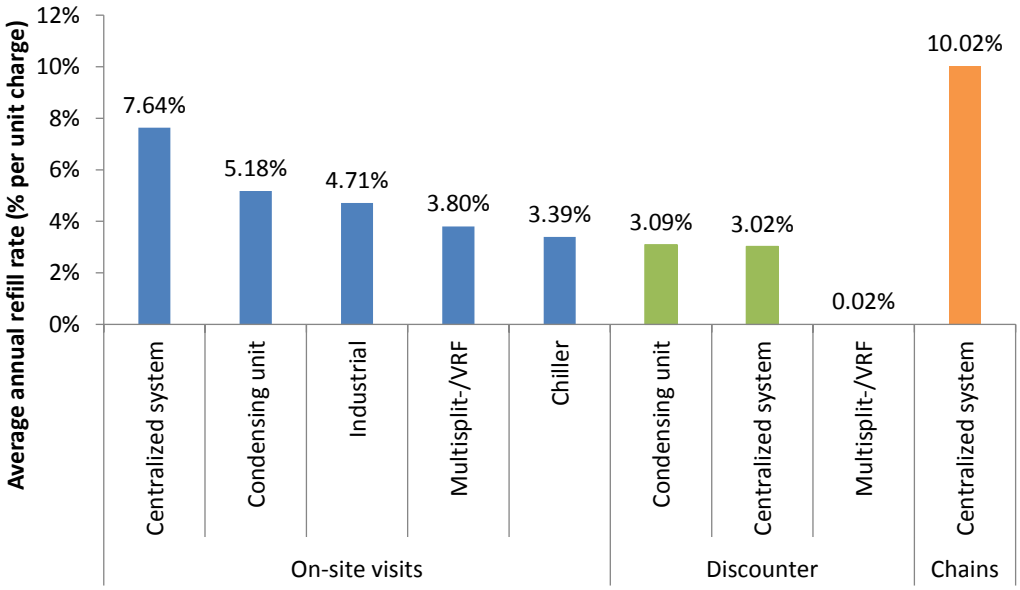
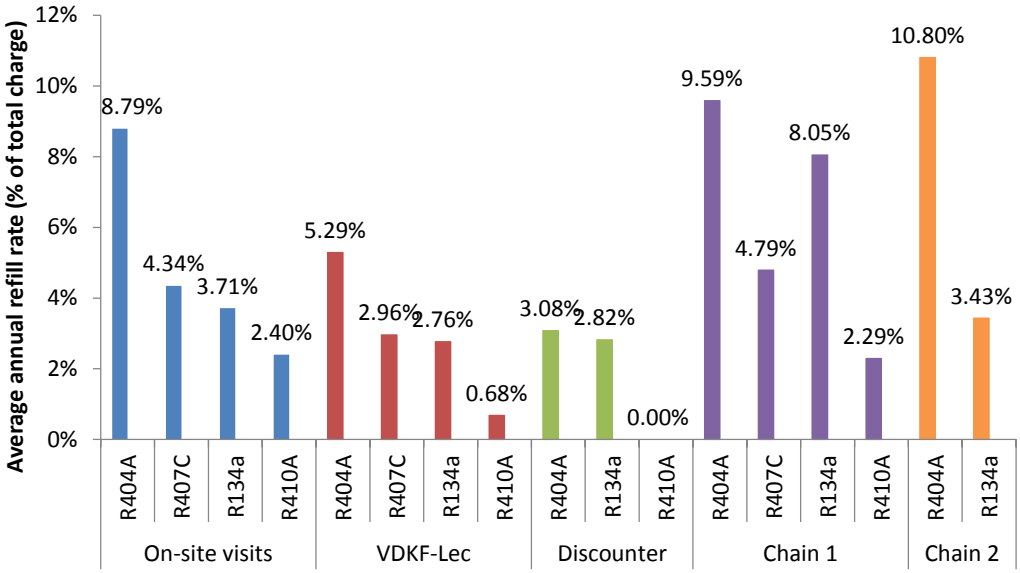



Figure 5: Average annual refill rate by refrigerant. The rate is expressed as percentage of the total refrigerant charge assessed[19]




[18] See footnote 17.

[19] See footnote 17.

### 4.1.3 Checklist for inspections

During inspections a number of issues could be checked. The following tables provide an overview for

- Inspections of certified personnel and companies;
- Inspections of RAC and heat pump equipment and systems containing F-gases.

#### 4.1.3.1 Inspections of certified personnel and companies

Inspections of certified personnel and companies certainly involve checking certificates, their validity (if appropriate), the activities undertaken, the availability of tools and procedures and the recording of recovered refrigerants (see Table 10).

Table 10: Checklist for service inspections of certified personnel and companies

| Inspections of certified personnel/companies | | |
|---|---|---|
| Information on the company to be inspected | Date of inspection | |
| | Name of company/entity | |
| | Address | |
| | Contact person | |
| | Contact details | |
| Entity/company | Company certificate | Yes/no |
| | Date of certification | |
| | Issuing authority | |
| | Categories | I/II/III/IV |
| Availability of tools and procedures | Are the tools and procedures necessary for the activities requiring certification available in sufficient numbers to cover the expected volume of activities? (A list of tools is provided) | Yes/no/partly |
| | Further information | |
| Types of activities performed | Recovery<br>Installation<br>Service/maintenance<br>Leakage check without breaking into the refrigerant circuit<br>Leakage check including breaking into the refrigerant circuit | |
| | Further information | |
| Personnel | Are certifications of personnel made available? | Name(s)<br>Yes/no |

| Inspections of certified personnel/companies | | |
|---|---|---|
| | Does the volume of activities correspond to the number of certified personnel? | Number of working hours per year vs. number of certified personnel (a full time position relates to 1,600 working hours per year) |
| | Is a copy of the certificate presented when the personnel undertakes activities requiring certification? | Yes/no |
| | Further information | |
| Recovery of refrigerants | Are types and quantities of recovered and disposed substances being recorded? | Yes/no |
| | Do records contain information on further treatment of recovered refrigerants? | Yes/no |
| | Are records being archived for at least five years? | Yes/no |

Additional aspects that need to be checked are requirements set out in the new EU F-gas Regulation and relate to:

- The purchase of F-gases exclusively by certified companies (Article 11(4));
- The sale of non-hermetically sealed equipment to end users only when installation by a certified company can be ensured (Article 11(5)).

Further information on these rules are provided in Chapter 4.2.

#### 4.1.3.2 Inspections of equipment

During on-site inspections of equipment a variety of aspects need to be taken into account. Table 11 below provides a checklist.

Table 11: Checklist for service inspections of equipment

| Inspections of equipment | |
|---|---|
| Information on the company to be inspected | Date of inspection |
| | Name of company/entity |
| | Address |
| | Contact person |
| | Contact details |
| Equipment unit | Charge: ≥ 3 kg ≥ 30 kg ≥ 300 kg ≥ 5 t $CO_2$ eq ≥ 50 t $CO_2$ eq ≥ 500 t $CO_2$ eq<br>Hermetically sealed: ≥ 3 kg to < 6 kg ≥ 6kg < 10 t $CO_2$ eq |
| Equipment type | Stationary refrigeration equipment<br>Stationary air conditioning system<br>Heat pump<br>Refrigerated truck or trailer<br>Fire protection system<br>Electric switchgear<br>Equipment containing solvents based on F-gases<br>Organic Rankine Cycle |
| Range of application | |
| Manufacturer | |
| Year of installation/type | |
| Installation site | |
| Date of installation | |
| Information on the label | Accepted industry designation or chemical name of the refrigerant<br>Quantity of F-gas contained in the equipment expressed in kg and/or $CO_2$ eq<br>GWP of the refrigerant<br>Quantity of F-gases for which the equipment is designed<br>Text “contains fluorinated greenhouse gases”<br>Text “hermetically sealed”, if applicable<br>No information<br>Information on the label is also cited in the instruction manual<br>Further information |
| Leakage checks | Leakage detection system: Yes/no<br>Control of leakage detection system |

| Inspections of equipment | |
|---|---|
| | Information on the equipment operator<br>Measuring method<br>Measuring device<br>Sensitivity of measuring device<br>Dates of most recent leakage checks<br>Leakage rates<br>Results<br>Measures<br>Further inspections |
| Refrigerant | Type<br>Charge<br>GWP expressed in t $CO_2$ eq<br>Refrigerant refill<br>Reasons for refill<br>Recovered refrigerants<br>Measures for recovery<br>Disposal management company |
| Service and maintenance of equipment | Who performed servicing and maintenance?<br>Name(s)/address<br>Certified company?<br>Number of certificate<br>Issued by |

Most of the information can be found in the equipment records (logbook). The logbook should be checked with particular attention given to:

- Completeness of the data recorded;
- Frequency of registered leakage checks;
- Information on leakage identified and repaired.

In order to verify if technically feasible measures have been taken to further minimize the risk for leakage, the equipment should also be inspected carefully. The following table provides an overview of relevant aspects for leakage reduction which can also be seen by technically trained inspectors (not only by service technicians). These aspects should be checked after installation and/or after major changes to existing systems.

Table 12: Additional checks on the equipment during on-site inspections with a focus on leakage tightness

| Possible checks on the equipment |
|---|
| 1. Are the joints soldered or welded? Such joints are the preferable option compared to any type of screwed joint (e.g. flanges). |
| 2. Are soldered joints soldered with copper solder (copper colouring) instead of silver solder (silver colouring)? |
| 3. Is the piping of the equipment installed in a way that prevents any tension or forces to build up? |
| 4. Are sufficient mounts installed for longer pipe sections? Do these mounts allow for an expansion and contraction of the piping? |
| 5. Are joints reduced to a minimum by efficiently routing the piping and using tube bending tools rather than e.g. soldered joints? |
| 6. Are suction and pressure pipes (i.e. the connections to and from the compressor) fitted with vibration absorbers/compensators (e.g. corrugated hose)? Alternatively, such connections should be very short and stiff. |
| 7. Are all service ports preceded by gate valves? Valve caps tend to lose their tightness over time. |
| 8. Are refrigerant pipes routed in order to prevent damage, i.e. no parts that extrude out of the machine frame or piping in passage ways? |
| 9. Are the components of high quality and approved for the temperatures and pressures expected during operation? Check the labels. |
| **Additional information to be checked from the logbook** |
| 1. Were proper leakage tightness checks accomplished before commissioning the equipment – in particular checks involving increased equipment pressure? |
| 2. Direct leakage testing included a measurement of the refrigerant concentration in the ambient air were accomplished and none were detected. In case a concentration was detected leakages were investigated with leakage detection spray (soapsuds test). Detected leakages were sealed and subsequently identified in the logbook. Such spots could be checked on the equipment. |
| 3. Indirect leakage testing included, for example, a check for<br>a. bubbles in the gauge-glass,<br>b. the liquid level in the header tank is within a normal range,<br>c. the frequency with which the compressor turns on (less than 12 times is normal),<br>d. the operating temperature of the compressor,<br>e. increased power usage of the compressor,<br>f. whether the equipment provides the required cooling capacity.<br>Results from these indirect tests should be recorded in the logbook. These tests can easily be repeated during the inspection. |

The above-mentioned study by UBA[20] provides some additional insights that might help inspectors to focus on-site inspections on the most relevant parts of the equipment. The on-site inspections, electronic records and literature reviewed show that most of the leakages were located at:

[20] See footnote 17.

- Joints (especially any type of screw joint);
- Valves (often the valve insert itself was not tight, in other cases it was the joint between the valve and adjacent piping);
- Evaporator;
- Condenser.

It is recommended that inspectors concentrate on checks associated with these parts of the equipment.

### 4.1.4 Requirements for electronic equipment records

When establishing electronic equipment records (logbooks) or equipment registers, the following requirements should be integrated.

Table 13: Minimum requirements for electronic equipment records

| Requirement | | |
|---|---|---|
| General information | Basic data | Name and company name of the equipment operator<br>Address of the operator<br>Location of the equipment<br>Type of equipment and application<br>Identification number in the electronic system |
| Refrigerant | Nominal charge | Refrigerant: Industry designation/chemical name<br>Nominal charge in kg |
| | Refill | Quantity refilled in kg |
| | Recovery | Quantity recovered in kg |
| Refrigerant loss | Refill (no total refrigerant loss) | Date of refill<br>Quantity refilled in kg<br>Reasons for refill<br>Location of leakage<br>Name of technician/company |
| | Refill after total refrigerant loss | Date of refill<br>Quantity refilled in kg<br>Reason/location for total loss<br>Name of technician/company |
| | Recovery | Date of recovery<br>Recovered quantity in kg<br>Name of technician/company<br>Reason for recovery e.g. decommissioning |
| Activities performed | Inspection<br>Servicing of the system<br>Repair of the system<br>Leakage check | Date<br>Name of technician/company |

Data input is ideally undertaken by the service technician on-site and should be possible via mobile phone/internet. Frequent mistakes should be avoided by means of a dropdown menu.

To improve the efficiency, implausible values should be rejected immediately by the electronic system. Analyses of historic data should be possible.

## 4.2 Supervision of the market at national level

### 4.2.1 Control and restrictions of F-gas trade as specified in Art. 6(3), 11(4) and 11(5) of the new EU F-gas Regulation

To facilitate the implementation of the bans (see chapter 3.2), the new EU F-gas Regulation determines that F-gases are to be sold to and purchased exclusively by companies holding certificates and attestations for installation, servicing, maintenance or repair of equipment containing F-gases or companies employing persons holding relevant certificates or training attestations (Article 11(4)).

For this purpose, suppliers of F-gases must establish records on the purchasers of F-gases and maintain them for at least five years (Article 6(3)). These records need to contain the certificate number of the purchaser and the respective quantities of F-gases. The national authorities concerned or the European Commission may request such information at any time.

These requirements could be implemented in the following ways:

- When purchasing F-gases, certified companies need to show their certificates prior to purchase to F-gas distributors/importers on paper. The supplier needs to note down the certificate number and the F-gas quantity sold to the respective company. She/he is required to keep these notes for at least five years and make them available to authorities when requested to do so.
- Prior to purchasing F-gases, certified companies could submit their certificates electronically to F-gas suppliers for verification. Most refrigerant gas distributors would have an electronic database of their customers in any case and would thus only need to add the information concerning certificates before supplying further F-gas quantities to the respective client. The F-gas suppliers would need to store this type of electronic data for at least five years.
- A national register of certificate holders could be established and maintained by authorities. Depending on confidentiality legalities in the respective jurisdiction, distributors of F-gases could ask for verification of the certificates of their clients or the register could be publicly accessible online to F-gas importers/distributors.

Furthermore, the EU ODS Regulation requires that non-hermetically sealed equipment containing F-gases must only be sold to the end user where proof can be provided that the installation will be conducted by personnel or a company holding the relevant certificate (Article 11(5)).

This requirement could be implemented in the following ways:

- Shops/companies selling non-hermetically sealed equipment containing F-gases to end users could automatically include a contract with a certified company for the installation.
- Delivery of non-hermetically sealed equipment containing F-gases can be carried out only when certified personnel confirm an existing contract for installation.

The implementation of the requirements of Article 6 and Article 11 could be facilitated by means of an electronic portal. Such a portal should address and be accessible to all stakeholders including

- Certified personnel and companies;
- Distributors of F-gases;
- Competent authorities.

National measures facilitating the supervision of the HFC market are implemented or planned in several member states. Some measures are described below and might serve as examples.

#### 4.2.1.1 Germany

Since 2006, a comprehensive and legally binding annual survey of the use of F-gases in all economic sectors (about 50) is conducted by the Federal Statistical Office of Germany (Statistisches Bundesamt or Destatis) under the Law on Environmental Statistics (Umweltstatistikgesetz). This law established a whole framework of environmental statistical data gathering and the F-gas survey only represents a small part of it.

The questionnaire on HFCs and PFCs needs to be completed by entities consuming more than 20 kg of F-gases per year. The statistical offices of the 16 states of Germany actively collect the data from companies in their jurisdiction and aggregate the results before they are passed on to the Federal Statistical Office at national level. In 2012, for example, the state statistical offices sent a total of approximately 14,000 questionnaires to companies, of which approximately 7,000 were obliged to report on F-gases. Questionnaires could be filled out on paper or electronically.

Each state statistical office is responsible for quality assurance and control procedures during which completeness and plausibility of the reported data are checked. Aggregated data is then forwarded to the Federal Statistical Office at national level.

There are three different questionnaires, one specifically tailored to stationary RAC service companies (form 10A), one tailored to garages and auto repair shops that service mobile air conditioning equipment and refrigerated trucks and trailers (form 10B) and a third one for all other users (form 10C). By targeting specific user groups the time spent on completing the survey on behalf of the companies can be significantly reduced. Each questionnaire contains further explanations on how it should be filled out, and why.

Overall, the survey distinguishes between refrigerants, foam blowing agents, aerosols and other uses. For refrigerants, the name of the refrigerant, first fill into new equipment, first fill into converted equipment and refill into existing equipment are differentiated, for example, in form 10A. Further, the amounts imported into and exported out of Germany are requested. Similar data is collected for the other applications as well. The data do not provide for an assessment of the banks, though, and do no longer relate to ODS (only prior to 2006), because it is no longer allowed to install these substances in Germany.

#### 4.2.1.2 Slovak Republic

The Slovak Republic introduced a system for electronic logging, reporting and data processing of F-gases in 2010. The system contains a section dedicated to electronic recording of equipment data and information on leakage tightness (“leaklog”) and a section for electronic reporting and certification.

The following assumptions form the basis for the Slovak electronic tool:

- F-gas trade only takes place between certified companies;
- Customers can order services from certified companies only;
- Certificates are valid for a limited time-period only and need to be renewed;
- Completion and submission of the reporting form on refrigerant imports and exports, including refrigerants contained in products and equipment, by certified companies are a precondition for the renewal/update of company certificates.

National statistics on refrigerant movements and the data for the national emission reporting are compiled by means of the electronic tool.

The system contains real information from service companies and refrigerant distributors.

#### 4.2.1.3 Poland

Poland is also discussing the introduction of an electronic system which consists of two components, the central register of operators (CRO) and the central database of ODS and F-gases (CDB).

The CRO is an online tool dedicated to records and reports by equipment operators. At installation, decommissioning and when servicing or maintenance activities are carried out on equipment, the data are electronically transmitted to the administration of the register. Both, the operator and the certified technician, have to approve the submission of the data. The administration periodically analyses the data to assess leakage and emission levels of different types of equipment and the underlying reasons for leakages. The data are aggregated and made available to operators and service companies through the CRO website.

The CDB is an online tool for reporting ODS and F-gas imports and exports including quantities contained in equipment. Companies are required to report once a year and also need to differentiate according intended uses of the gases (stationary and mobile applications). The data are periodically analysed to assess the levels of consumption and emissions by substance and application. Aggregated data can be made available to importers, exporters, service companies and other entities through the CDB website.

#### 4.2.1.4 Hungary

In Hungary, national reporting obligations were first introduced for ODS in 1992 and extended to HFCs in 2003.[21] An electronic monitoring and reporting system was established in 2009 and is operated by the Hungarian Monitoring and Certification Body (HMCB). The system relates to RAC, heat pumps and foams; electric switchgear and fire protection systems are not covered. Similar to the Slovak system, the renewal of company certificates is conditional upon reporting by companies. The reporting data include:

- Import and export of bulk ODS and F-gases by gases;
- Information on the use as first fill for new equipment or for refill of existing systems differentiated by stationary and mobile applications;
- Quantities recovered, quantities for reclamation and for destruction;
- Quantities contained in equipment;
- Refrigerant losses by gas types and leakage rates.

The information on import and export of bulk ODS and F-gases have been used for the national emission inventory under the UNFCCC for several years. After the establishment of the database, it took several years to build up a sufficiently large dataset, which allows for an overview of the market today and relatively reliable information on leakage rates of applications on behalf of the HMCB.

[21] Kobanyai et al. (2013)

### 4.2.2 Monitoring internet trade

There is evidence of ODS and F-gases trade in Bulgaria via online auctioning sites, market places or classified ads. This type of trade is currently not monitored or controlled in any way. This issue has been raised in other EU member states in the recent past, too. For example, the Chemicals Legislation European Enforcement Network has launched its e-commerce II initiative in 2011, which monitors online trade of very toxic substances, including biocides and halons.

In Germany, a working group of the German Federal level-State level Working Committee Chemical Safety (Bund/Länder-Arbeitsgemeinschaft Chemikaliensicherheit; BLAC), on the other hand, implemented a large scale online monitoring programme that has been in place since 2004. An increasing number of officers of state ministries are working together on this project and monitor online trade of toxic substances, railway sleepers containing tar oil, oxidizing substances and hydrogen peroxide, as well as methanol and brazing fillers containing cadmium. This list is constantly updated. In 2013, the BLAC also published a guide for online traders that outlined specifically how to comply with chemicals regulations on the federal and EU level.

A number of conclusions and recommendations can be drawn from this previous work. Especially the work by the BLAC highlights that it is important to establish a periodic monitoring of internet trade. Large internet auctioning sites in particular and potentially online stores and classified ads could also be surveilled in terms of products containing ODS or F-gases in Bulgaria. A single RIEW could take a lead in this endeavour and share their experiences and results with the other RIEWs, thereby, cut down on resources and staff time. Annual rotation of the tasks can help to distribute the additional work evenly among the RIEWs. Monitoring could also include other items regulated by different chemical regulations in place in Bulgaria.

If such a procedure reveals certain illegal products for sale, associated sellers should be made aware of potential consequences. Illegal items should further be removed from the site/store and their deletion requested. In case the address of the seller can be determined this information should be passed on to responsible authorities (abroad if applicable).

BLAC also reports the success of test-purchases to determine the seller's identity and follow-up with legal action if possible/necessary.

Direct involvement with online service providers might also be a way forward. However, it is possible that this is not a viable option for Bulgaria on its own and should instead take place on an EU-wide scale.

### 4.2.3 The issue of illegal imports

As virgin HCFC-22 (since the end of 2009) and recycled HCFC-22 (since the end of 2014) are no longer legally available on the EU market, illegally imported quantities are being identified by authorities. Bans under the new EU F-gas Regulation create similar circumstances with respect to certain HFCs. The problem of illegal imports is particularly relevant in member states along the EU external borders. In Bulgaria, the risk for illegal imports is considered especially high at the borders with Turkey, with the former Yugoslav Republic of Macedonia and with Serbia which are all classified as Article 5 countries under the Montreal Protocol.

Much effort has already been devoted to training custom officers, who in Bulgaria operate under the authority of the National Customs Agency. The complexities surrounding the movement of illegal imports, as well as the chemical nature of ODS and F-gas chemicals make it easy to deceive ill-informed customs officers At room temperature, most ODS and F-gases are colourless and odourless gases, which is why chemical analysis is needed to precisely determine which substances are present.

Smugglers have taken advantage of this situation and devised highly effective schemes. These involve false labels on containers and false declarations on documents, diverting ODS and F-gases to other countries, concealing illegal canisters behind legal ones and disguising virgin ODS so as to appear recycled. The importance of skilled custom officers needs to be emphasized and regular training should be provided.

### 4.2.4 Creating better market surveillance

The issue of illegal imports creates a difficult environment for the successful surveillance of the domestic ODS and F-gas market. This is especially true for Bulgaria, which has no domestic production facilities. All such substances placed on the market, therefore, originate from outside the country.

The EU reporting on ODS and F-gases offers the MoEW a rough overview of activities on the domestic market but is inherently incomplete, because it does not cover intra-EU trade. The domestic reporting on both groups of gases (as implemented by the respective ordinances) offers additional levels of detail, on the other hand. It can be assumed that these activity records are, nonetheless, at least partially incomplete and may not cover the portion of ODS and F-gases entering the country illegally.

In order to improve market surveillance in Bulgaria – and especially to better estimate the amounts of ODS and F-gases entering the domestic market illegally – a number of measures could be implemented:

- Reports to the European Commission and domestic reports could be cross-checked to identify potential non-reporters in either system. Reported amounts could also be cross-checked to rule out false reporting on a company-by-company basis.
- Total amounts used by companies in Bulgaria in any given year could be cross-checked with licensed imports and amounts placed on the market reported via the EU level by gas traders.
- Reporting obligations in the respective ordinances could be supplemented by a requirement to report the source of the gas. A declaration confirming the legal origin of the gas could further help companies opt for legal supply routes.
- An electronic reporting system similar to the one implemented in the Slovak Republic (see 4.2.1.2) could further aid authorities in setting up a comprehensive market surveillance.

The Bulgarian market for ODS and F-gases will however only be fully transparent, once the issue of illegal imports is successfully addressed and ruled out as a major source of these substances domestically.

# 5 Conclusions

ODS and F-gases are regulated at EU level and are subject to a wide variety of control measures. This includes a phase-out of entire ODS substance groups, a phase-down of HFCs, various bans, as well as end user and service personnel obligations to minimize emissions during operation and maintenance of associated equipment. Progress with respect to the implementation of these measures in the EU and in Bulgaria has been summarised along with a brief description of the responsible authorities. Remaining issues such as potentially illegal imports from non-EU member states have been highlighted.

With respect to ODS the guidance document suggests a variety of measures to prevent intentional release of ODS including awareness-raising and discusses the implementation of a national deposit scheme.

The most relevant measures of the EU F-gas Regulation have been explained in further detail, including the HFC phase-down mechanism, bans, training and certification, containment measures and reporting obligations. Associated obligations on behalf of authorities in Bulgaria have also been highlighted.

On this basis, the document has developed guidance for further improving both, the enforcement of containment measures and bans via on-site inspections, as well as the surveillance of the market, in order to ensure the phase-down measure can successfully be implemented in Bulgaria.

In order to best use available resources, the guidance includes criteria for effectively selecting relevant equipment to be inspected. Such criteria refer to the type of equipment, the type of refrigerant in use, charge size, date of installation and area of application. Also included is guidance on how to inspect equipment and associated logbooks in order to determine the quality of maintenance work and the degree of success with which leakage is prevented.

Supervision of the market presents itself as an important part of implementing the EU-wide phase-down of HFCs and ensuring proper maintenance of the equipment by certified personnel. Guidance has been provided with respect to market surveillance, internet trade monitoring and proof of certification during HFC transactions. Experience from other member states has been summarised.

# 6 References

**Publications**

European Commission (2016). Company reporting for Regulation (EU) No. 517/2014 on fluorinated greenhouse gases – Frequently asked questions. http://ec.europa.eu/clima/policies/f-gas/docs/faq_reporting_en.pdf
(last accessed: 03 May 2016)

GEF and UNDP (2010). National Survey and Development of a National Strategy Outline of HCFC Phase-Out for Consumption Sectors in Republic of Bulgaria. http://www3.moew.government.bg/files/file/Air/Naredbi_Ozon/Bulgaria%20HCFC%20Survey-Strategy%20Outline_EN.pdf
(last accessed: 01 Oct 2015)

UBA (2015). Konzept zur Bewertung der technischen Innovationen zur Erfüllung der gesetzlichen Vorgaben bei stationären Kälte- und Klimaanlagen, Final Report. Climate Change 08/2015. https://www.umweltbundesamt.de/en/publikationen/konzept-zur-bewertung-der-technischen-innovationen
(last accessed: 01 Oct 2015)

UNEP (2016). ODS Data Centre. Data provided by the United Nations Environment Programme Ozone Secretariat. http://ozone.unep.org/en/data-reporting/data-centre
(last accessed: 02 May 2016)

**Presentations**

Kobanyai, K., Toth, R., Zoltan, A. (2013). Hungarian UNFCCC inventory reporting on HFC and PFC emissions from the RACHP sector. Presentation at the IIR Compressors Conference 2013, Papiernička, Smolenice, Slovak Republic, 2013.

Matus Tomlein, Michal Tomlein, Peter Tomlein (2013). Inventory of Refrigerants. Presentation at the IIR Compressors Conference 2013, Papiernička, Smolenice, Slovak Republic, 2013.