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Implementation and enforcement of EU regulations on fluorinated greenhouse gases (F-gases) und ozone-depleting substances (ODS) in Bulgaria

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Implementation and enforcement of EU regulations on fluorinated greenhouse gases (F-gases) und ozone-depleting substances (ODS) in Bulgaria

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Abstract

As a member state of the European Union (EU), Bulgaria has committed itself to incorporate the acquis communautaire into its national law. This also applies to those regulations that deal with fluorinated greenhouse gases (F-gases) and ozone-depleting substances (ODS). While enforcing these regulations, the Bulgarian Ministry of Environment and Water, as well as supervisory authorities and certification bodies are confronted with the challenge of tracking the entire life cycle of F-gases and ODS containing refrigerants. Furthermore, Bulgaria is interested in information about replacing technologies that use alternatives to F-gases.

The Advisory Assistance Programme (AAP) project “Implementation and enforcement of EU regulations on fluorinated greenhouse gases (F-gases) and ozone-depleting substances (ODS) in Bulgaria” has been initiated to support Bulgarian actors to effectively and efficiently implement and enforce the EU regulations on F-gases and ODS.

During a study tour to Germany, best practice examples for an effective implementation of the EU regulations were presented. During simulation exercises in Bulgaria, monitoring and inspection processes of the placing on the market of F-gases and ODS, as well as of products containing these substances, were practiced together with the Bulgarian actors.

Four guidelines have been developed to assist Bulgaria in refining legislation and administrative regulations, certification processes, education and training programmes, as well as the reporting system for monitoring emissions. These results are meant to help the Bulgarian actors to comply with the objectives of the EU regulations on F-gases and ODS.

Kurzbeschreibung

Als Mitgliedsstaat der Europaischen Union ist Bulgarien verpflichtet, den Besitzstand gemeinschaftlicher Rechtsakte in nationales Recht umzusetzen. Dies gilt auch für die Verordnungen, welche die Emission von fluorierten Treibhausgasen (F-Gasen) und ozonschichtschädigenden Stoffen (ozone-depleting substances, ODS) reduzieren sollen. Beim Vollzug dieser Verordnungen stehen das bulgarische Umweltministerium sowie die Überwachungs- und Zertifizierungseinrichtungen vor der Herausforderung, den Weg der Kältemittel, die diese Substanzen enthalten, entlang ihres gesamten Lebenszyklusses nachzuverfolgen. Außerdem ist Bulgarien an Informationen zu Ersatztechnologien ohne F-Gase interessiert.

Das Projekt des Beratungshilfeprogramms (BHP) „Umsetzung und Vollzug der EU-Verordnungen zu fluorierten Treibhausgasen (F-Gasen) und ozonschichtschädigenden Stoffen (ODS) in Bulgarien“ hatte zum Ziel, relevante bulgarische Akteure zum effektiven und effizienten Vollzug der EU-Verordnungen zu befähigen.

Während einer Studienreise nach Deutschland wurden den bulgarischen Teilnehmern ‚best practice‘-Beispiele zur effektiven Umsetzung der EU-Verordnungen präsentiert. Mit Hilfe von Simulationsübungen in Bulgarien wurden zusammen mit den bulgarischen Akteuren Prozesse zur Überwachung des Inverkehrbringens von F-Gasen und ODS sowie von Produkten, die diese enthalten, geübt.

Es wurden vier Arbeitshilfen entwickelt, um Bulgarien dabei zu unterstützen, Rechtsnormen und Verwaltungsvorschriften, aber auch Zertifizierungsverfahren, Aus- und Fortbildungsprogramme sowie das Berichtssystem zur Überwachung der Emissionen weiterzuentwickeln. Diese Projektergebnisse sollen die bulgarischen Akteure dabei unterstützen, die Ziele der EU-Verordnungen zu F-Gasen und ODS zu erreichen.

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List of Abbreviations

AAP	Advisory Assistance Programme
BBCMB	Bulgarian Branch Chamber – Machine Building
BIV	Bundesinnungsverband des Kälteanlagenbauerhandwerks (Guild association representing the interests of the refrigeration construction sector in Germany)
BMUB	Bundesministerum für Umwelt, Naturschutz, Bau und Reaktorsicherheit (German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety)
CFC	Chlorofluorocarbon
CO_2	Carbon dioxide: As refrigerant also called R744
CO_2 eq	Carbon dioxide equivalent
EC	European Commission
EU	European Union
F-gas	Fluorinated greenhouse gas
IPR	Intellectual property rights
GWP	Global warming potential
HC	Hydrocarbon
HCFC	Hydrochlorofluorocarbon
HF	Hydrofluoric acid
HFC	Hydrofluorocarbon
HCl	Hydrochloric acid
MoEW	Ministry of Environment and Water (Bulgaria)
NH_3	Ammonia (anhydrous): As refrigerant also called R717
ODP	Ozone-depleting potential
ODS	Ozone-depleting substance
PV	Photovoltaic
RAC	Refrigeration and air conditioning
RIEW	Regional Inspectorate of Environment and Water (Bulgaria)
UBA	Umweltbundesamt (German Environment Agency)

Summary

The Advisory Assistance Programme (AAP) of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit, BMUB) is meant, inter alia, to enable the new member states of the European Union (EU) to implement and enact the EU environmental acquis. This is achieved by advising the respective countries on technical feasibility, transferring knowledge and by strengthening national administrative entities.

The objective of the AAP project "Implementation and enforcement of EU regulations on fluorinated greenhouse gases (F-gases) and ozone-depleting substances (ODS) in Bulgaria" was to revise and give recommendations for updating the existing national legislation in Bulgaria in order to comply with the new EU environmental regulations on F-gases and ODS as well as to support the enforcement. More precisely, the following topics were discussed and dealt with during the course of the project: (a) Selected articles of the Bulgarian F-gas Ordinance concerning the reporting obligations and format for F-gas users, processors and operators of F-gas containing equipment, (b) Measures for improved containment of ODS and F-gases such as regular leakage checks and suitable checklists, (c) Incentives for ODS destruction, (d) Supervision of the market with the focus on internet trade, (e) Application of alternative technologies to F-gases and (f) Training and certification contents and procedures in response to new requirements regarding the knowledge about alternatives to F-gases.

During a study tour to Germany, experts from Bulgaria had the opportunity to exchange experiences with their German counterparts at the trade control authority (Gewerbeaufsichtsbehörde) of the state of Hesse. Presentations and discussions at a vocational education school and certification body for professionals in the refrigeration and air conditioning sector drew a spotlight on similarities and differences between the German and the Bulgarian system. Additionally, best practice examples of applications of alternative technologies have been visited: a CO_2-based supermarket refrigeration system, an air-conditioning chiller running on R290 and a large ice-slurry system based on propane and CO_2 installed at a university canteen.

Results and experiences along with specifically requested recommendations were consolidated in four guidance documents:

1. 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),
2. Recommendations to safety guidelines and standards for the use of natural refrigerants,
3. Recommendations on certification and training procedures for alternative refrigerants regarding the Regulation (EU) No. 517/2014,
4. Recommendations to the Bulgarian authorities on the improvement of the implementation of Regulation (EC) No. 1005/2009 and Regulation (EU) No. 517/2014 (not published).

The four guidance documents include inter alia standardized checklists for on-site inspections of installations and companies and promote the dissemination of a risk assessment scheme to ensure that installations with a high risk for leakages are inspected on a regular basis. The set-up of an electronic database simplifies keeping track of F-gases along their life cycle and helps targeting the inspections to those plants with the highest risk. For improved supervision of internet trade, it is suggested to divide the tasks among the regional inspection authorities and to rotate them, in order to distribute the burden of the workload. With regard to the incorporation of new training content on alternatives to F-gases, the translation of the training modules presented on the website "REAL Alternatives" into Bulgarian can provide a valuable starting point. Moreover, a train-the-trainer-scheme is recommended to quickly disseminate knowledge on alternatives to F-gases among teachers. Important drivers to increase the application of alternatives to F-gases are a broader range of training courses covering the

challenges connected to the application of alternative refrigerants and the dynamics of the new EU F-gas Regulation restricting the amount of new F-gases available on the market. Furthermore, financial support programmes balancing the price premium attributed to low unit numbers of alternative systems could accelerate the uptake of new technologies.

These recommendations have been elaborated in the guidance documents and aim at maximizing Bulgaria's regulatory and enforcement capabilities. The update of national regulations would enable Bulgaria to comply more effectively with the new EU F-gas Regulation. In addition, containing, recycling and offering incentives for the proper disposal of synthetic refrigerants would have an immediate impact on Bulgaria's greenhouse gas emissions. Monitoring internet trade and the import of F-gases would further allow Bulgaria to assess the actual amount of F-gases in the country. Lastly, training and certification of high quality service technicians would accelerate the technological development in the refrigeration and air conditioning sector and facilitate the wide-spread application of systems based on natural refrigerant.

1 Introduction

1.1 Project context

The Advisory Assistance Programme (AAP) of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit, BMUB) is meant, inter alia, to enable the new member states of the European Union (EU) to implement and enact the EU environmental acquis. This is achieved by advising the respective countries on technical feasibility, transferring knowledge and by strengthening national administrative entities.

The AAP project "Implementation and enforcement of EU regulations on fluorinated greenhouse gases (F-gases) and ozone-depleting substances (ODS) in Bulgaria" was initiated to support Bulgaria to effectively and efficiently implement and enforce the EU regulations on F-gases and ODS.

F-gases are a family of synthetic gases mainly used as refrigerants in refrigeration and air conditioning applications, but also as blowing agents in foams and as aerosols. Because they do not damage the atmospheric ozone layer, they are often used as substitutes for ODS such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). However, F-gases are powerful greenhouse gases (GHG) with global warming potentials (GWP) of up to 23,000 times higher than carbon dioxide (CO2) and their use is increasing significantly globally. Whilst the use of ODS has been controlled and/or banned for many years in the EU, additional regulations with the objective of reducing GHG from F-gas use were introduced only recently.

As a member state of the EU, Bulgaria has committed itself to incorporate the acquis communautaire, i.e. all treaties, EU legislation, international agreements, standards, court verdicts and fundamental rights provisions of EU law, into its national law. Responsible for the implementation of the new EU F-gas Regulation into Bulgarian national law is the Ministry of Environment and Water (MoEW). The Regional Inspectorates of Environment and Water (RIEWs) are responsible for carrying out on-site inspections in order to effectively enforce regulations passed by the MoEW. The Bulgarian Branch Chamber – Machine Building (BBCMB) is the certification body of service personnel and companies, and also supervises the training for the safe handling of F-gases in the refrigeration and air conditioning (RAC) sector. Therefore, the BBCMB is an important actor in the execution of the legislation on F-gases and ODS, too.

When enforcing the EU regulations on F-gases and ODS the MoEW, the RIEWs, as well as certification bodies, were faced with the challenge of tracking the entire life cycle of refrigerants containing F-gases and ODS. Furthermore, they were interested in alternative technologies which do not use F-gases. Given that the largest portion of F-gases are used in the sector of domestic, commercial and industrial refrigeration and air conditioning equipment, the focus of the project was exclusively on this sector.

1.1.1 ODS and F-gas regulations

The use of ODS in the EU is subject to the provisions laid down in Regulation (EC) No. 1005/2009[1] (ODS Regulation). The placing on the market of ODS has been prohibited since 1 January 2015. Issues still relevant for ODS management that are covered in the EU regulation are the destruction of those ODS recovered from existing equipment and the prevention of illegal trade.

The first EU F-gas Regulation (EC) No. 842/2006[2] came into force in 2006, but was updated after a review[3] came to the conclusion that it failed to reach the emission reduction targets needed.

The new EU F-gas Regulation (EU) No. 517/2014[4], which came into force on 1 January 2015, strengthens the existing measures of the first regulation and introduces a number of new and far-reaching consequences, the most important ones being:

1. Limiting the total amount of F-gases sold, imported and used in the EU and its member states: From 2015 to 2030 the use and allowed total amount of F-gases will be cut down to about 1/5 of the presently used amount in successive steps. For the first time, this is based on the t CO_2 equivalents (CO_2 eq) and the total allowable amount is determined by multiplying the GWP with the amount of the respective refrigerant.
2. Introduction of bans: In those systems where less harmful alternatives are widely available, technically feasible and safe to use, the use of high GWP F-gases will be banned. This is, for example, the case in domestic fridges, foams and aerosols. The ban is referring to specific GWP levels that cannot be exceeded.
3. Limiting leakage during use and decommissioning of F-gas containing equipment: Required leakage tightness checks, proper servicing as well as recovery and recycling of F-gases have been tightened under the new EU F-gas Regulation in order to prevent emissions.

By 2030 the EU F-gas Regulation is aimed at cutting the EU's F-gas emissions by 2/3 compared with 2014 levels.

[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 (EC) No 842/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on certain fluorinated greenhouse gases

[3] Schwarz et al., 2011

[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

The implications of the new EU F-gas Regulation have been elaborated in more detail in the guidance document "**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)**".

Commission Implementing Regulations

Several **Commission Implementing Regulations**[5] pursuant to the new EU F-gas Regulation were issued to set

- Requirements for mutual recognition of certification for F-gas related activities on stationary electrical switch gear: **(EU) 2015/2066**[6]. The regulation defines the exam content for the certification of natural persons.
- Requirements for mutual recognition of certification for F-gas related activities on RAC and heat pump equipment: **(EU) 2015/2067**[7]. The regulation defines the exam content for the certification of natural persons as well as the conditions for the certification of companies. Its content is further elaborated in this report.
- The format of labels for products and equipment containing F-gases: **(EU) 2015/2068**[8]. The label requirements were extended to include the weight in t CO_2 eq of the contained gas. Specific labelling is required for containers of F-gases intended for uses not covered by the quota system, such as direct bulk export outside the EU, feedstock or metered dose inhalers.

1.1.2 A quick guide to natural refrigerants and their applications

Natural refrigerants are an environmentally friendly alternative to high-GWP synthetic refrigerants. The strong advantages of natural refrigerants are their ODP of zero and their negligible GWP. As part of the natural biogeochemical cycles, they do not form persistent substances in the atmosphere, water or biosphere. Natural refrigerants include carbon dioxide (CO_2), hydrocarbons (HCs) such as propane and isobutane, ammonia (NH_3), water and air. They have been used as refrigerants for more than 150 years. Due to their characteristics, e.g. flammability, toxicity or higher pressure in the system, refrigeration and air conditioning (RAC) engineers and technicians require a specific skill set.

[5] Another F-gas related legislation is the so-called "EU MAC Directive" (Directive 2006/40/EC). It was introduced in 2006 to drastically reduce direct emissions of refrigerants. It restricts refrigerant use in vehicle air conditioning to those with a GWP of less than 150, thereby banning HFC-134a. This rule applies for new type-approvals from 2011 and for all new cars from 2017. The EU MAC Directive is not further discussed in this report.

[6] COMMISSION IMPLEMENTING REGULATION (EU) 2015/2066 of 17 November 2015 establishing, pursuant to Regulation (EU) No 517/2014 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of natural persons carrying out installation, servicing, maintenance, repair or decommissioning of electrical switchgear containing fluorinated greenhouse gases or recovery of fluorinated greenhouse gases from stationary electrical switchgear

[7] COMMISSION IMPLEMENTING REGULATION (EU) 2015/2067 of 17 November 2015 establishing, pursuant to Regulation (EU) No 517/2014 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of natural persons as regards stationary refrigeration, air conditioning and heat pump equipment, and refrigeration units of refrigerated trucks and trailers, containing fluorinated greenhouse gases and for the certification of companies as regards stationary refrigeration, air conditioning and heat pump equipment, containing fluorinated greenhouse gases

[8] COMMISSION IMPLEMENTING REGULATION (EU) 2015/2068 of 17 November 2015 establishing, pursuant to Regulation (EU) No 517/2014 of the European Parliament and of the Council, the format of labels for products and equipment containing fluorinated greenhouse gases

In response to the new EU F-gas Regulation, various applications and sectors have adopted natural refrigerant technologies and the market penetration, especially within the EU, is advancing quickly. Given the fact that they are naturally occurring substances which can be produced in virtually every country, markets become more independent of international corporations and intellectual property rights (IPR).

The most common natural refrigerants are:

1. CO_2 (R744);
2. HCs, e.g. propane (R290);
3. NH_3 (R717).

Contrary to refrigerants of the first generations, e.g. R12 and R22, each of the above mentioned natural refrigerants is especially suitable for only some of the RAC subsectors. For instance, CO_2 is a promising alternative for commercial refrigeration, while HCs are mostly used for smaller sized chillers and room air conditioning. NH_3, on the other hand, is a well-established refrigerant for industrial applications. Due to their properties, such as medium to high flammability (NH_3, HCs), toxicity (NH_3) and high pressure (CO_2), safety measures have to be established and followed closely when using natural refrigerants. The guidance document "**Recommendations to safety guidelines and standards for the use of natural refrigerants**" contains a detailed discussion on appropriate safety requirements.

A variety of highly efficient applications has been developed and has by now reached a technical level that makes their use economically viable. The replacement of applications based on synthetic high-GWP refrigerants with natural refrigerant alternatives will also help to decrease the amount of direct emissions caused by leakages and improper disposal of synthetic refrigerants. The amount of F-gases used in RAC applications is expected to quadruple world-wide by 2030.[9] Starting with the replacement of F-gas-based equipment now will allow for a wider dissemination of natural refrigerant equipment in the future and help to cap the growing CO_2 emissions from the RAC sector.

Natural refrigerants are not regulated by the new EU F-gas Regulation and the increase in market demand for natural refrigerant based-equipment will decrease their prices, making them an economically feasible and environmentally safe solution for RAC in Europe and elsewhere. At the moment, they are often more expensive because technologies are new and lower installation numbers lead to a higher price of single installations. Some applications will always remain more expensive due to special design requirements, but increasing unit numbers will reduce the price difference in the future.

Within the last few years, the RAC sector has been subject to significant change. Manufacturers are increasingly offering natural refrigerant alternatives and more end users are requesting energy-efficient and environmentally safe RAC systems. The tables below show an overview of available technology options. They also address additional issues related to natural refrigerant technology options.

[9] Colbourne, Daniel et al. (2013): NAMAs in the refrigeration, air conditioning and foam sectors. Eschborn, Germany. Page 9

Table 1: Available technology options with natural refrigerants in Europe

	Cold stores	Industrial refrigeration	Centralized supermarket systems	Condensing units (butchers, bakeries etc.)	Air conditioning chiller	Air conditioner using direct evaporation
CO_2	✓	✓	✓	✓	✓	✓ Multi-split
HC	✓	✓	✓	✓	✓	✓ Single-split
NH_3	✓	✓	✓	✗	✓	✗

Table 2: Additional aspects related to the choice of refrigerant

	Cold stores	Industrial refri-geration	Centralized supermarket systems	Condensing units (butchers, bakeries etc.)	Air conditioning chiller	Air conditioner using direct evaporation
Access by trained personnel only	✓	✓	✗	✗	✓	✗
Refrigerant can be confined to machinery room	✓	✓	✓	✓	✓	✗
Sufficient space for machinery placement usually available	✓	✓	✗	✗	✗	✗

The wide-spread introduction of natural refrigerant equipment underlies challenges such as enabling safety standards and adequate training. These issues have been addressed within this project.

1.1.3 Training requirements under the new EU F-gas Regulation and beyond

Because the introduction of natural refrigerants is highly dependent on the adequate training of technicians and engineers, the new F-gas regulation specifically mentions that “the training of natural persons who carry out activities involving fluorinated greenhouse gases should cover information on technologies that serve to replace and reduce the use of fluorinated greenhouse gases. Given that some alternatives to fluorinated greenhouse gases used in products and equipment to replace and reduce the use of fluorinated greenhouse gases can be toxic, flammable or highly pressurised, the Commission should examine existing Union legislation covering the training of natural persons for the safe-handling of alternative refrigerants [...] "[10].

The new EU regulation on certification, Regulation (EU) No. 2015/2067, came into force during the project period. Since 2008, certification in the EU had been regulated by Regulation (EC) No. 303/2008[11], but it was updated to include provisions from the new F-gas Regulation. Changes concern the proposed adaptation of charge sizes measured in kg to the newly introduced charge sizes measured in t CO_2 eq as well as the inclusion of knowledge on alternatives to F-gases and their safe handling. These changes need to be reflected in the training courses and certification exams.

The new EU F-gas Regulation requires the inclusion of information on replacement technologies into the certification syllabus as well as information on measures to reduce charge sizes of F-gas refrigerants. Table 3 shows the newly added examination content that is now part of the theoretical test.

Table 3: New examination content dealing with alternative refrigerants to F-gases as outlined in Annex 1 of Regulation (EU) No. 2015/2076

Section 1: Basic thermodynamics	
1.06: Know about the specific behaviour, physical parameters, solutions, systems, deviances of alternative refrigerants in the refrigeration cycle and components for their use	Relevant to all categories[12]
Section 11: Information on relevant technologies to replace or to reduce the use of fluorinated greenhouse gases and their safe handling	
11.01: Know the relevant alternative technologies to replace or to reduce the use of fluorinated greenhouse gases and about their safe handling	Relevant to all categories[12]
11.02: Know relevant system designs to reduce the charge size of fluorinated greenhouse gases and to increase energy efficiency	Relevant to categories I and II[12]
11.03: Know relevant safety regulations and standards for the use, storage and transportation of flammable or toxic refrigerants or refrigerants requiring higher operating pressure	Relevant to categories I and II[12]
11.04: Understand the respective advantages and disadvantages, notably in relation to energy efficiency, of alternative refrigerants according to the intended application and to the climate conditions of the different regions	Relevant to categories I and II[12]

[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

[11] 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

[12] There are four certification categories, allowing for different activities as defined in Reg. (EU) No 2015/2067:
Category I: (a) leakage checking,(b) recovery, (c) installation, (d) repair, maintenance or servicing, (e) decommissioning,
Category II: (a) leakage checking without breaking into the refrigeration circuit, other activities (b), (c), (d), (e) on equipment containing less than 3 kg of F-gases (or 6 kg, if hermetically sealed),
Category III: (b) on equipment containing less than 3 kg of F-gases (or 6 kg, if hermetically sealed),
Category IV: (a) leakage checking without breaking into the refrigeration circuit

All alternatives to high-GWP F-gases require additional training because of their higher flammability classification, higher working pressure and/or toxicity. This is true for both, natural refrigerants as well as the new generation of low-GWP synthetic refrigerants. The lack of trained technicians is one of the main bottlenecks to the widespread introduction of alternative refrigerants.

It is essential to address this issue thoroughly and provide easily accessible information to show that natural refrigerants can be handled safely and sustainably. The content and the availability of such trainings are subject of a presently ongoing F-gas consultation forum[13], whose briefing paper stated that training materials are generally available, e.g. via the "REAL Skills" platform[14]. However, very few technicians are using them or getting adequate practical training[15]. As with every new technology, there is a need for investment in the form of time and money in order to attain the needed experience.

As natural refrigerants are the only truly sustainable alternative to high-GWP refrigerants, the project team has proposed the transition towards natural refrigerant-based solutions for Bulgaria. Requiring additional training, the transition was one of the issues discussed in detail with the project partner.

Further information can be found in the guidance document **"Recommendations on certification and training procedures for alternative refrigerants regarding the Regulation (EU) No. 517/2014"**.

2 Project Implementation and output

From January 2015 to March 2016, experts of HEAT GmbH and of Öko-Recherche GmbH advised relevant Bulgarian actors on possible ways to improve the implementation and enforcement of the EU regulations on F-gases and ODS at a national level in Bulgaria. The following activities were implemented:

1. Fact-finding mission to Bulgaria for investigating and analysing deficits in the current legislation and implementation thereof, as well as country-specific environmental and organisational challenges;
2. Study tour to Germany with several site visits to existing systems using F-gas alternatives and workshops presenting best practice examples and lessons learned;
3. Development of four guidance documents to provide country-specific knowledge and recommendations for Bulgaria;
4. Workshop in Bulgaria with all involved stakeholders to discuss the draft versions of the guidance documents and to advise on the implementation of the new EU F-gas Regulation in Bulgaria;
5. Workshop in Bulgaria on the training of service personnel;
6. Simulation of an on-site inspection at two sites in Bulgaria.

The fact-finding mission to Bulgaria was structured around meetings with actors responsible for the implementation of the new EU F-gas Regulation in Bulgaria, i.e. MoEW, RIEWs and BBCMB.

The four days study tour provided an opportunity to gain knowledge on the application of alternative technologies in Germany, inter alia, by visiting several sites with equipment using alternatives to F-gases. Furthermore, it offered an insight into the German training and certification procedures. Information exchange was facilitated by the participation of a representative of UBA in the majority of the

[13] http://ec.europa.eu/clima/events/articles/0106_en.htm

[14] http://www.realskillseurope.eu/

[15] Ricardo-AEA and Gluckman Consulting (2015)

study tour and by a meeting with a local trade control authority (Gewerbeaufsichtsbehörde) responsible for the inspections according to the EU F-gas Regulation in the state of Hesse. A detailed itinerary is listed in Table 4.

Table 4: Itinerary of the study tour to Germany

Organisation	Purpose
Bundesfachschule Kälte-Klima-Technik, Maintal	Visit to a leading vocational education school and certification body for professionals in the RAC sector in Germany
Carrier CO_2OL Academy, Mainz	Visit to one of the two worldwide existing research, development and training centres of the corporation Carrier Commercial Refrigeration
EDEKA Nolte supermarket, Koenigstein	Visit to a CO_2-based supermarket refrigeration system
Trade control authority (Gewerbeaufsichtsbehörde), Frankfurt/Main	Visit to the supervisory authority on F-gas and ODS in the state of Hesse
Opera and drama theatre (Opern- und Schauspielhaus), Frankfurt/Main	Simulation of an on-site inspection of the theatre's chiller system with the supervisory authority
Ohara GmbH, Hofheim	Visit to a propane-based chiller system powered by photovoltaic (PV)
University of Applied Sciences (Technische Universität), Karlsruhe	Visit to a propane-/CO_2-based ice slurry refrigeration system of the university's canteen

After the study tour, the following four guidance documents have been developed:

1. 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),
2. Recommendations to safety guidelines and standards for the use of natural refrigerants,
3. Recommendations on certification and training procedures for alternative refrigerants regarding the Regulation (EU) No. 517/2014,
4. Recommendations to the Bulgarian authorities on the improvement of the implementation of Regulation (EC) No. 1005/2009 and Regulation (EU) No. 517/2014 (not published).

The document **"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)"** summarizes the regulatory framework for both, F-gases and ODS, in the EU and puts them into the Bulgarian context. New measures introduced by the new EU F-gas Regulation, including the F-gas phase-down and bans, are highlighted. The goal of the document is to support Bulgaria in maximizing its regulatory and enforcement capabilities. To support effective inspection, checklists are provided to be used by the inspectors during on-site inspections. Experiences in other EU member states are referred to.

The guidance document with **"Recommendations to safety guidelines and standards for the use of natural refrigerants"** focuses on the application of these substances. The document addresses aspects such as safety concerns originating from flammability, toxicity or high working pressures. In addition to a legislative overview, the guidance document contains technical guidelines for the safe use as well as handling of natural refrigerants and selected practical recommendations.

The guidance document with **"Recommendations on certification and training procedures for alternative refrigerants regarding the Regulation (EU) No. 517/2014"** examines the German training and certification system as a best practice example. It further elaborates on the additional examination contents regarding alternative refrigerants and energy-efficient system design, as well as on ways to include these new contents in present curricula.

The guidance document with **"Recommendations to the Bulgarian authorities on the improvement of the implementation of Regulation (EC) No. 1005/2009 and Regulation (EU) No. 517/2014"** contains country- and ministry-specific recommendations for the revision of legislation in Bulgaria. It is not published.

Because the first three guidance documents are of a more general nature and of interest beyond the project's framework and Bulgaria, they are available as separate publications to this report.

In the course of three workshop days in Sofia, the content of the draft guidance documents was presented to a larger audience, mainly consisting of representatives of the MoEW and the RIEWs. Other participants came from the Executive Environment Agency. For the topic on training and certification, representatives of the BBCMB also joined. The last meeting was dedicated to the practical and technological application of alternative refrigerants. Representatives from training institutes and servicing companies, as well as the previously mentioned audience were attending this part.

3 Project findings

This chapter presents information on the following six topics that were identified as being relevant during the fact-finding mission and that were addressed during each of the successive activities:

- Revision of ordinances
- Measures to improve containment
- Incentives for ODS destruction
- Supervision of the market
- Application of alternatives to F-gases
- Training and certification.

The respective subchapters present for each of them the situation at project start, lessons learned (if applicable) and recommendations derived during the project.

3.1 Revision of ordinances

Situation at project start

As a reaction to the new EU F-gas Regulation, the Bulgarian ordinances on the implementation of the EU ODS and F-gas Regulations were being revised when the project started. The project team was asked for advice on specific articles and annexes regarding the reporting obligations of users of F-gases, processors and operators of F-gas containing equipment and their formats.

Recommendations

Most of the recommendations focused at the clarification of terms and formalities to reduce mistakes while filling out the reporting forms. They comprised inter alia:

- Predefined keywords for each category of equipment, making the entries less ambiguous and
- Additional categories to distinguish between refrigerant filled into new equipment and refrigerant used for servicing.

The recommendations were thoroughly discussed during the workshop in Bulgaria and the comments were considered when the recommendations on this subject were compiled to the guidance document **"Recommendations to the Bulgarian authorities on the improvement of the implementation of Regulation (EC) No. 1005/2009 and Regulation (EU) No. 517/2014"** (not published).

3.2 Measures to improve containment

Situation at project start

The effective containment of F-gases and ODS is ensured by the requirement of regular leakage checks of F-gas containing equipment under the new EU F-gas Regulation. Carrying out regular leakage checks is the responsibility of the operators and its interval depends on the equipment's charge size. In Bulgaria, the proper execution of these leakage checks is supervised by the RIEWs. The number and frequency of inspections are planned by the RIEWs at the beginning of each year. Some of the RIEWs carry out a risk analysis to determine those sites with higher risks and consequently to check the affected sites more frequently. Factors that are taken into account during this risk assessment include the type of refrigerant used (priority to high-GWP refrigerants) and the refrigerant charge (priority to high-charge systems). Systems with higher leakage rates in the past also receive higher attention for future checks by the RIEWs. In order to enable the inspectors of the RIEWs to conduct these checks, the inspectors receive a short classroom training.

The initial step during a check is the inspection of the required documentation on-site for consistency and formal correctness. In case large quantities of refrigerants were ordered, this is treated as an indicator for high leakage rates. Interpretation is a challenge when large quantities are reported to be needed for refill due to a high leakage rate: Is the high leakage an accident or the result of poor maintenance or the means of illegally getting rid of unwanted refrigerant? In these situations, the inspectors need to consider how and if the explanations can be verified. A suspicion of intentional release often cannot be proven.

Lessons learned

In Germany, it is the task of the trade control authority to verify that operators comply with the requirement of regular leakage checks and proper reporting. The capacity of Hessian inspectors is very limited and only a few on-site inspections per year are carried out. Generally, the sense of duty of the German operators is rather high and severe breaches of the regulations rarely occur.

As part of the project, simulated inspections were carried out at two sites in Bulgaria, one at a winery in Slavyantsi (close to Bourgas in the east of Bulgaria) and one at a large supermarket in Sofia (in the west of Bulgaria). They presented practical knowledge which would be useful to the inspectors of the RIEWs during their on-site inspections.

To aid the completeness of inspections, two checklists covering all aspects to be inspected were utilized to guide through the inspections. The checklists are contained in the document **“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)”**, Tables 10 and 11.

A focus was put on the documentation of leakage tests and refrigerant amounts filled into the installations. They were checked for consistency and completeness. In case of a recovered refrigerant which is not refilled into the system, the recycling, reclamation or destruction of the refrigerant must be documented. It was mentioned that electronic documentation in the form of word-files is easy to manipulate at any time, which is therefore not sufficient.

The correct labelling of the equipment was checked and operators, as well as inspectors were made aware of the additional requirements from 2017 onwards according to the new EU F-gas Regulation: The amount of refrigerant contained in the equipment is also to be stated in t CO_2 eq.

Beside the “paper check”, technical basics such as a short introduction to the main parts of a refrigeration system and possible signs for leakages were shown on the visited installations. Such signs could be greasy spots on the pipes or a low refrigerant level in the receiver. Areas where leakages could occur are screwed joints, connections to the vibrating compressor and areas where the transition between temperature levels occurs. A supplementary checklist (see document **“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)”**, Table 12) was developed, containing points that may be checked to gain a general impression on the state of maintenance of the inspected installation.

Recommendations

To monitor proper recycling, reclamation or destruction of refrigerants, inspectors should always check the documentation of refrigerants taken out of refrigeration system. If word files of these documentation are kept by the operator, they should be linked to the pdf-scans of the original invoices of the service company containing the details of the work carried out.

The practice undertaken by some RIEWs to rank the installations should be expanded to all RIEWs, using a common list of criteria. These installations with high risks of emissions ranking at the top result in a higher frequency of inspections. A list of further selection criteria was suggested to rank installations according to:

- Type of equipment (centralized systems are more prone to leakages);
- Type of refrigerant (priority to refrigerants with high GWP, e.g. R404A);
- Refrigerant charge (higher charge leads to higher priority);
- Date of installation (focus on older or retrofitted systems);
- Leakage rate reported previously (higher leakage results in higher priority).

One factor when it comes to ranking the installations is the amount of previously leaked refrigerant. In order to apply this criterion adequately, up-to-date information on leakages is necessary. To make the process of gathering relevant information and sharing important information more efficient, it was suggested to develop an electronic database that would facilitate the processing of data. This topic is further elaborated in Chapter 3.4.

3.3 Incentives for ODS destruction

Situation at project start

The main issue with ODS destruction in Bulgaria is the lack of incentives for proper ODS destruction. The recycling and destruction of ODS in Bulgaria have to be paid by the operators of the systems. Lacking incentives to properly dispose of used refrigerants aggravates the suspicion that some operators release unwanted refrigerant into the environment instead of ensuring (and paying) for proper recycling or destruction.

Lessons learned

In Germany, refrigerants are transported to a processing company after their recovery, where refrigerants are recycled, reclaimed or destroyed.[16] Those refrigerants not being subject to a ban can be reused. ODS and refrigerants that are not labelled have to be properly disposed of. In Germany, 99 % of the installations are labelled. For destruction, refrigerants are either incinerated or split into their individual components (hydrochloric acid (HCl), hydrofluoric acid (HF), etc.) in a plant which is part of chemical industry facilities near Frankfurt/Main. The owners of installations are required to pay the costs. Although there is no incentive for operators to return the gas for processing, it is usually done. Gas traders provide the recovery and recycling containers. Containers for new refrigerants have vents opening only in one direction, allowing no refill to prevent oil-based impurities. Recycling containers have vents which open in both directions, thus enabling refilling.

Recommendations

The low return of unwanted ODS to destruction can be explained by the high costs arising to the operator when sending ODS to such facilities. In order to increase return rates, a deposit and refund system could be introduced. However, this should not be implemented for ODS alone, since the bureaucratic burden is considered unproportional.

3.4 Supervision of the market

Situation at project start

Market supervision is strongly linked to import and customs controls, which is the topic of the second, separate, part of this AAP project and, thus, not covered here. The points discussed in this part of the project have been ways to monitor internet trade and the tracking of F-gas amounts along their life cycles. Internet trade of F-gases is currently not monitored in Bulgaria. There are, however, suspicions that substantial amounts of F-gases are traded via this channel.

The reporting of F-gas sales, use and destruction is paper-based and therefore very time-consuming to process. Discussions on how to streamline the system and transfer it to an electronic database are at an early stage.

[16] Recycling comprises basic cleaning of the substance to remove oil or water residues, while reclamation results in substances with the same quality as newly produced ones. Reclamation is not an attractive option at the moment because new refrigerants are cheaper than re-claimed refrigerants. The phase-down may have a positive contribution to the economic feasibility of refrigerant reclamation as the regulation limits the amount of new refrigerants in the market.

Lessons learned

During the meeting with the trade control authority of the state of Hesse, different approaches to an effective control of undertakings[17] were discussed. A common problem is that only few inspectors are in charge of many undertakings. The main issues are the monitoring of the "placing on the market" of F-gases and ODS, as well as supervision of the respective installations and undertakings.

The control mechanisms for trade are relevant in general and include the trade via the internet. In particular, control mechanisms for internet trade of refrigerants are necessary in order to curtail illegal trade with HCFCs. Although effective supervision of internet activities is currently difficult to implement, examples on how Germany has addressed the issue were discussed.

Recommendations

It was suggested by the project team to have one RIEW responsible for checking and regulating internet trade for a certain period, e.g. yearly. The information gathered by that RIEW would then be distributed among the other RIEWs. A rotation is suggested to not overburden a single RIEW. There should be a useful division of tasks amongst the RIEWs. More guidance and information on how to control the internet trade is needed.

For effective control, refrigerant containers need to be properly labelled, usually by the manufacturer. It is commonly known that wrongfully labelled refrigerants from China are circulating in some countries. However, if companies get their refrigerants from licensed traders, they can rely on the authenticity of the labels. Refrigerants from older installations without labelling can be identified via the temperature-pressure relationship. In case of mixtures this does, however, not provide clear results, which is why further chemical analyses have to be performed.

Considering the topic of a central electronic database: Developing a new electronic database can be rather cost intensive, therefore it was suggested by the MoEW to contemplate using existing database systems. However, there are doubts if the capacity of an existing database allows for the incorporation of new information and specific modifications and requirements. Moreover, electronic systems can be rather costly and not all operators and technicians might be able to work according to the system's needs. The suitability of an existing database of the Bulgarian Executive Environment Agency could be assessed.

[17] According to Reg. (EU) No 517/2014, 'undertaking' means any natural or legal person who:
(a) produces, uses, recovers, collects, recycles, reclaims, or destroys F-gases;
(b) imports or exports F-gases or products and equipment that contain such gases;
(c) places on the market F-gases or products and equipment that contain, or whose functioning relies upon, such gases;
(d) installs, services, maintains, repairs, checks for leaks or decommissions equipment that contains, or whose functioning relies upon, F-gases
(e) is the operator of equipment that contains, or whose functioning relies upon, F-gases;
(f) produces, imports, exports, places on the market or destroys gases listed in Annex II of Reg. (EU) N0. 517/2014;
(g) places on the market products or equipment containing gases listed in Annex II of Reg. (EU) N0. 517/2014.

3.5 Application of alternatives to F-gases

Situation at project start

At present, there is limited experience in the application of alternatives to saturated HFC refrigerants. In other EU member states, the application of natural refrigerants for cooling and freezing applications has become increasingly common, such as the use of CO_2 for commercial refrigeration, e.g. in supermarkets, and HC for stand-alone units and larger applications such as chiller and centralized systems. For domestic refrigeration, the use of the HC R600a is common practice. At this stage, there are just a few refrigeration plants using CO_2 in Bulgaria. Only NH_3 has always been used as a refrigerant in the industrial sector and is thus a common refrigerant for larger applications in Bulgaria.

Table 5: Experiences with natural refrigerants in Bulgaria

Refrigerant	Knowledge about the technology	Installations in Bulgaria
CO_2 (R744)	Relatively new technology in the form it is used today and thus very limited experience with this refrigerant in Bulgaria	At least three installations in Bulgaria.
HC, e.g. propane (R290), isobutane (R600a)	Technology well known in the context of domestic refrigeration, but little in other sectors. ➔ Well established in domestic refrigerator manufacture plants ➔ Limited experience in other applications (chillers, air conditioners, etc.)	Production and maintenance of millions of domestic refrigerators and freezers. No other installations in Bulgaria.
NH_3 (R717)	Well known technology. Has always been used in Bulgaria for refrigeration systems. Used in cold stores and food production. ➔ Well established refrigerant in specific sectors	Several installations already in existence with an increasing number of new installations in the last few years.

The participants of the meetings during the fact-finding mission mentioned various barriers for the wide-spread introduction of natural refrigerants:

- Lack of knowledge on suitable technology options for the specific requirements in Bulgaria;
- Lack of trained technicians confident with the safe handling of natural refrigerants and adequate maintenance;
- Lack of specialized tools for the manufacture and maintenance of natural refrigerant-based equipment.

Lessons learned

During the study tour in Germany, several applications of natural refrigerants were visited on-site and explained in detail. The technical feasibility was demonstrated and necessary safety aspects were discussed. Further details concerning safety aspects and a spotlight on new developments in the ejector technology for an improved efficiency of trans-critical CO_2 supermarket refrigeration systems can be found in the guidance document **"Recommendations to safety guidelines and standards for the use of natural refrigerants"**.

CO_2-based supermarket refrigeration system (EDEKA Nolte in Koenigstein)

The refrigeration system of the supermarket EDEKA Nolte in Koenigstein is a centralised CO_2-based system from Carrier which has been in operation since the second half of 2013. It was EDEKA's first CO_2-based solution in their stores. The refrigeration system is able to air condition the supermarket's interior (cooling and heating), as well as to supply cooling to the refrigeration cabinets in the market. Supermarkets in Germany are generally not air conditioned, but, because of the glass front of the building, it is necessary here.

In addition to using an F-gas free system, energy efficiency measures – such as the installation of LED lighting – were carried out by EDEKA. The total energy savings account for roughly 50 % in comparison to a conventional state-of-the-art supermarket refrigeration system (approximately 35 % caused by the refrigeration system alone). The amortisation period of the initial investment costs is difficult to assess because subsidies are included into the overall calculation. Approximately, amortisation is reached within a time frame of about 3–5 years for the refrigeration system, whereas the amortisation of the applied LED technology is less than 2 years. The difference in investment costs to a conventional F-gas system is also difficult to estimate. They were estimated by the operator to be about be 30–40 % higher.

Table 6: Technical data of the CO_2-based system at EDEKA Nolte

Basic technical specifications	
Cooling load	Medium temperature: 78 kW; low temperature: 12 kW
Refrigerant	R744
Refrigerant charge	Information not available
Year of commissioning	2013

Propane-based chiller for air conditioning (Ohara GmbH in Hofheim)

Powered completely via PV, cooling and heating of an office building with 2 floors and about 630 m^2 room area is supplied by a propane chiller system. The propane chiller is situated outside the building. A water-glycol mixture is circulating from the outside machinery box into the building and back, serving ceiling cassettes. At low outside temperatures (below 0 °C) heating is supported by a condensing boiler powered with natural gas.

Surplus cooling or heating can be reclaimed and stored in buffers in the basement, supplying the demand of the building in times of shortages.

Table 7: Technical data of the propane-based chiller of the Ohara GmbH

Basic technical specifications	
Cooling load	26.5 kW (40–50 W/m²)
Refrigerant	R290
Refrigerant charge	2 compressor circuits with 3.1 kg each
Year of commissioning	2014

The flammability of the refrigerant poses no risk to people and the interior of the building because the propane containing components of the system are located in a safe distance outside the building. (If the propane containing components had been placed on the roof of the office building, an additional fire security installation would have been required.)

The system is electronically linked to the manufacturer who is thus able to remotely monitor the performance of the installation without on-site inspections.

Propane-/CO_2-based ice slurry refrigeration system (Technical University of Applied Sciences in Karlsruhe)

The student union (Studierendenwerk) at the Technical University of Applied Sciences (Technische Universität) in Karlsruhe manages the university's canteen. The canteen on campus is the largest in the state of Baden-Wuerttemberg: Approximately 8,000 meals are prepared every day.

Worldwide about 4,000 ice slurry machines exist, mostly running on F-gases or ammonia. The ice slurry machine on propane-/CO_2-basis of the university was built by Hafner-Muschler (Baden-Wuerttemberg) in 2013. The use of propane for the generation of ice is unique. Altogether, 18 refrigerated counters and 6 cold storage rooms have been provided with refrigeration in the canteen.

Table 8: Technical data of the propane-/CO_2-based ice slurry machine of the university canteen in Karlsruhe

Basic technical specifications	
Cooling capacity	6 ice generators á 14 kW
Refrigerant	R290 (and R744 in the cascade supplying the freezer rooms)
Refrigerant charge	3 Circuits á 10 kg R290
Year of commissioning	2013
Investment costs	EUR 1 Mio.

Ice is generated within 6 cylindrical generators by means of propane as refrigerant. Each ice generator is equipped with an individual pump to support a storage tank. The ice is stored in a 40 m³ tank where it is continuously stirred. Currently, 50 % of the volume is utilized, a further upgrade is planned.

The ice slurry consists of bean-shaped ice pellets in the size of up to half a millimetre which are suspended in a solution of water, ca. 8 % ethanol, as well as glycol. Simple pumps usually used for heating systems distribute the ice slurry to the refrigerated counters in the canteen and to the cold storage rooms. For medium temperature direct expansion is used in the counters and cold rooms. For freezer storage rooms a compact CO_2-based refrigeration system is set as a cascade within the refrigeration circuit to provide further freezing capabilities at -20 °C.

When the ice slurry has passed the refrigerated counters, it still has a temperature of -1 °C and is partially used for cooling the IT-network structure.

The energy transfer rate of the ice slurry is about 6–8 times higher than normal water. The ice flows at speeds of 0.6–0.8 m/sec through a duct system made of polyethylene. Around 10 kg propane per refrigerant circuit are used.

Due to the large storage capacities, ice is generated at night when electricity prices are lower and low outside temperatures enable a more energy-efficient operation. Thanks to the time shift between production and use of the ice slurry, the electricity peak load at day time is cut considerably, which leads to significant cost savings.

The flammability of the refrigerant poses no risk to people in the canteen, because the ice slurry machine is placed in a machinery room outside of the building. The machinery room has two compartments separated by an air tight wall. One compartment contains the propane compressors, the other the electric control system. Because of this separation, off-the-shelf components could be used for the control system, without special ignition prevention measures. Additional safety is also provided through air suction. The cold storage rooms as part of the CO_2-cascade system are equipped with CO_2-alarms.

The investment costs were around EUR 1 million, whereas an alternative system based on HFC-404A would be lower at around EUR 0.7 million. However, HFCs will be phased out in the future, leading to higher cost for HFC-refrigerants, which is why a long-term sustainable decision was made in favour of the natural refrigerant solution.

Recommendations

Alternative RAC technologies were of central interest throughout the project, because the transition to natural refrigerant systems with low GWP will enable Bulgaria to comply with the phase-down and emission reduction goals of the new EU F-gas Regulation. Additionally, the transition has a positive effect on Bulgaria's overall GHG emissions as energy efficiency is also improved. To promote the uptake of alternative refrigerants, technicians need to be trained in their handling and additional investment costs need to be balanced by financial support. The first installations could be realized through public procurement, demonstrating safe handling and energy efficiency.

Necessary safety measure as well as proposals to promote alternative refrigerants are presented in detail in the guidance document **"Recommendations to safety guidelines and standards for the use of natural refrigerants"**.

3.6 Training and certification

Situation at project start

The organization of training and certification of technicians working in the RAC sector in Bulgaria is in the hand of the BBCMB. The BBCMB evaluates training facilities and supervises the examiners. After the initial exam and certification according to Regulation (EC) No. 303/2008, the certification has to be renewed after five years in Bulgaria. The renewal is not part of the EU regulation, but a Bulgarian addition. Presently, the only prerequisite for renewal is sufficient working experience during the last five years.

Very few training facilities adhere to the high standards set up by the BBCMB. This in turn leads to a low spatial availability of accredited training facilities. Currently, the inclusion of alternatives to F-gases and energy-efficient design according to the new Regulation on certification (EU) No. 2015/2067 into the curriculum is in progress. Suitable training materials are screened and translated into Bulgarian by the BBMCB. The new requirements are summarized in the introductory Chapter 1.1.3.

Lessons learned from the German example

In Germany, the Chamber of Crafts (Handwerkskammer) and the Chamber of Industry and Commerce (Industrie- und Handelskammer) are named as certification bodies according to Regulation (EU) No. 2015/2067. The craft guilds (Handwerksinnungen) are empowered by both chambers to administer exams and are also allowed to issue the respective certifications. Additionally, the competent authority in each state can accredit additional certification bodies. In total, there are currently more than 100 certification bodies in Germany.

The guild association representing the interests of the refrigeration construction sector in Germany (Bundesinnungsverband des Kälteanlagenbauerhandwerks, BIV) has issued a guideline for its member guilds defining the educational contents and exam format in order to fulfil Regulation (EU) No. 2015/2067. The guideline is implemented by vocational training institutes associated with the members of the BIV at state level, ensuring a certain standard and an equal level of education throughout Germany.

Individuals formally educated in refrigeration construction receive their certification after passing their final exam. This holds true for the following vocational educations: apprentice, master and state-certified technician.

Due to a lack of qualified and specialized personnel, technically trained individuals from other sectors are working in the RAC sector, too. Career changers have the possibility to gain certification by taking an exam.

Respective courses and exams are offered by the BIV-associated vocational training institutes as well as by other craft guilds or other chambers, often specifically tailored to the needs of career changers from the respective craft guild to refrigeration construction. Taking part in a course prior to taking the exam is not compulsory if practical experience of at least two years can be proven. Otherwise, taking part in the courses is a mandatory requirement in order to take the final exams.

Courses tailored to the preparation for certification exams are offered with slightly differing lengths and prerequisites. A common prerequisite is a completed vocational training in a mechanical/technical profession. Prior to the admission to a course, documents proving the fulfilment of the prerequisites need to be handed in and verified. Regular attendance is compulsory and necessary to be admitted to take the exam. Depending on the certification category[12] and the experience of the trainee, course lengths vary between 2 and 30 days. Taking part in an exam without any course attendance is not possible under any circumstances for technicians from a non-specialized mechanical/technical profession.

The content of training courses offered has a strong emphasis on practical work. Usually, at least half of the lessons take place in workshops where practical skills are developed. Information on alternatives to HFCs has not been covered in detail in the past. This has to change in order to comply with the new Regulation (EU) No. 2015/2067. Presently, many training centres offer separate theoretical and/or practical courses on topics such as flammable refrigerants or stationary CO_2 refrigeration systems without any formal link to EU F-gas certification.

Specific issue: Servicing of refrigeration systems mounted on trucks and trailers

One particular issue of RAC training in the certification scheme is the servicing of refrigeration systems mounted on trucks and trailers. The new EU F-gas Regulation includes servicing of transport refrigeration systems in the list of activities that can only be conducted by certified personnel. Previously, there was no specific EU provision addressing the required competence for such servicing activities. Regulation (EU) No. 2015/2067 adds the refrigeration units mounted on trucks and trailers to the scope of activities, leaving requirements on skills and knowledge unchanged. A transition period until 1 July 2017 is granted for attaining certification for servicing and maintenance of refrigeration units of refrigerated trucks and trailers.

Servicing transport refrigeration systems requires specific knowledge that is not necessary for stationary systems and might not be part of the standard refrigeration technician education. Also, the content of the EU F-gas certification does not cover any specific knowledge on transport refrigeration systems. Manufacturing companies usually provide a specific training for the transport refrigeration units independently of the certification acquired by technicians.

Companies undertaking servicing of transport refrigeration systems are not required to be certified at EU level. Consequently, it would be useful to demand a certain standard at a national level. This would require regulations stipulating that the necessary tools for servicing are available and that the technicians are properly equipped and educated.

In Germany, most of the personnel for transport refrigeration is already certified on the basis of the previous Regulation (EC) No. 303/2008. This is due to the fact that, for specific recovery tasks, a certification has been mandatory in Germany since 2008. The present national regulation was drafted because no specific EU regulation for transport refrigeration was available. In the future, more specific requirements for transport refrigeration at EU level would be useful.

Recommendations

With the new Regulation on certification (EU) No. 2015/2067 entering into force, examination contents covering the theoretical basics of alternative refrigerants and system designs for energy efficiency were added (see introductory Chapter 1.1.3 and guidance document **“Recommendations on certification and training procedures for alternative refrigerants regarding the Regulation (EU) No. 517/2014”**, Chapter 3 for more information on the new content).

In order to disseminate knowledge on alternatives among service technicians, the compulsory renewal of certification every five years can be linked to an introductory course on alternatives to F-gases and energy efficiency system design.

With decreasing amounts of available F-gases on the EU market and therefore increasing importance of the application of alternatives, a more elaborate training should be considered in the future. A modular system with teaching units that are subsequently linked was suggested to incorporate the new content of the training schemes. Depending on the previous knowledge and on the category of certification, certain aspects should be covered in more detail. An elaborated outline of the suggested modules is given in the guidance document **“Recommendations on certification and training procedures for alternative refrigerants regarding the Regulation (EU) No. 517/2014”**, Chapter 4.

Parts of the contents can be retrieved from the e-learning modules of the REAL Alternatives platform (www.realalternatives.eu). The modules are accessible free of charge after registration and provide in-depth information on the use of alternatives to F-gases. Translating the modules into Bulgarian was suggested by the project team as a starting point for courses on the handling of alternative refrigerants.

A train-the-trainer-scheme is recommended to quickly disseminated knowledge on alternatives to F-gases among teachers.

The German example sparked a lively discussion between vocational training institutes and the BBCMB during the workshop in Bulgaria. Vocational training centres prefer defining clear prerequisites for admittance to the training courses and, to make it mandatory, attending the complete training course before being admitted to take the exam. A compulsory minimum course duration is desirable. This would enable the training institutes to ensure a certain level of comprehension and competency before admitting the technicians to the final exam.

4 Summary of project results and recommendations

One output of the project was to revise and update existing national legislation in Bulgaria in order to comply with the new EU regulations on F-gases and ODS. The four guidance documents developed during the project will help to sustainably anchor specific knowledge in Bulgaria.

The exchange of experience, discussions and workshops in the course of the project led to a number of specific recommendations. Following the clusters of topics identified during the fact-finding mission, the recommendations can be summarized as follows:

1. **Revision of ordinances**
   Specific recommendations have been formulated regarding format and coverage of the reporting obligations of persons who offer F-gases for sale, persons who carry out recovery, recycling or reclamation, and operators. These recommendations were provided in a guidance document which is not published.
2. **Measures to improve containment**
   Checklists for inspections as presented in the document **"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)"**, Tables 10 and 11, can enable the inspectors to assess the state of the inspected plant in a standardized way and can lead to predefined follow-up routines. The dissemination of the risk assessment scheme as carried out by some RIEWs is recommended to ensure that installations with a high risk for leakages are inspected on a regular basis. The set-up of an electronic database simplifies the tracking of F-gases along their life cycle and helps targeting the inspections to those plants with the highest risk.
3. **Incentives for ODS destruction**
   There is no destruction facility in Bulgaria. The low return of unwanted ODS to destruction can be explained by the high costs arising to the operator when sending ODS to such facilities. In order to increase return rates, a deposit and refund system could be introduced. However, this should not be implemented for ODS alone, since the bureaucratic burden is considered unproportional.
4. **Supervision of the market**
   The supervision of internet trade is a great challenge. In order to distribute the burden of the workload, dividing the tasks among the RIEWs is suggested. Chapter 4.2 of the document **"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)"** goes into more detail.
5. **Training and certification**
   Translation of the training modules presented on the website "REAL Alternatives" into Bulgarian can provide a valuable starting point for training contents on alternatives to F-gases.
   The set-up of a modular training system serves the various knowledge levels of technicians. A train-the-trainer-scheme is recommended to quickly disseminate knowledge on alternatives to F-gases among teachers. Guidance document **"Recommendations on certification and training procedures for alternative refrigerants regarding the Regulation (EU) No. 517/2014"** presents additional information.

6. **Application of alternatives to F-gases**
   A broader range of training courses covering the challenges connected to the application of alternative refrigerants together with the dynamic of the new EU F-gas Regulation are key drivers to increase the application of alternatives to F-gases.
   Financial support programmes to balance the additional cost attributed to low unit numbers could accelerate the uptake of new technologies. The guidance document **"Recommendations to safety guidelines and standards for the use of natural refrigerants"** elaborates on such options.

These recommendations intend to maximize Bulgaria's regulatory and enforcement capabilities. The update of national regulations would enable Bulgaria to comply with the regulation under the new EU F-gas Regulation more effectively. Furthermore, containing, recycling and offering incentives for the proper disposal of synthetic refrigerants would have an immediate impact on Bulgaria's GHG emissions. Monitoring internet trade and the import of F-gases would further allow Bulgaria to assess the actual amount of F-gases in the country, whereas the training and certification of high quality service technicians would accelerate the technological development in the RAC sector and facilitate the wide spread application of natural refrigerant alternative systems. The four guidance documents will support Bulgaria in implementing the recommendations derived during the course of this project.

5 References

Publications:

Colbourne, Daniel et al. (2013): NAMAs in the refrigeration, air conditioning and foam sectors. Eschborn, Germany

Ricardo-AEA and Gluckman Consulting (2015): Topic A Briefing Paper: Barriers related to standards and legislation. Brussels, Belgium

Schwarz, W., Gschrey, B., Leisewitz, A., Herold, A., Gores, S. Papst, I., Usinger, J., Oppelt, D., Croiset, I, Pedersen, P.-H, Colbourne, D. , Kauf-feld, M., Kaar, K., Lindborg, A. (2011): Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases; Final Report & Annexes to the Final Report. Prepared for the European Commission in the context of Service Contract No 070307/2009/548866/SER/C4

Regulations:

REGULATION (EC) No 842/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on certain fluorinated greenhouse gases

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

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)

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.

COMMISSION IMPLEMENTING REGULATION (EU) 2015/2067 of 17 November 2015 establishing, pursuant to Regulation (EU) No 517/2014 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of natural persons as regards stationary refrigeration, air conditioning and heat pump equipment, and refrigeration units of refrigerated trucks and trailers, containing fluorinated greenhouse gases and for the certification of companies as regards stationary refrigeration, air conditioning and heat pump equipment, containing fluorinated green-house gases

Bulgarian Ordinances:

ORDINANCE for Determining Measures to Implement Regulation (EC) No.842/2006 concerning certain fluorinated greenhouse gases (Adopted by Decree of the Council of Ministers No.336 of the 23.12.2008)

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

Web Sources:

http://www.realskillseurope.eu

http://ec.europa.eu/clima/events/articles/0106_en.htm

6 List of Annexes

- 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)
- Recommendations to safety guidelines and standards for the use of natural refrigerants
- Recommendations on certification and training procedures for alternative refrigerants regarding the Regulation (EU) No. 517/2014

In Bulgarian language:

- Насоки относно контрола върху търговията и върху инспекциите на предприятия във връзка с флуорсъдържащите парникови газове (F-газове) и озоноразрушаващите вещества (ОРВ)
- Препоръки към насоките и стандартите за безопасност за използването на естествените хладилни агенти
- Препоръки относно процедурите за сертификация и обучение за алтернативни хладилни агенти съгласно Регламент (ЕС) № 517/2014