EUROPEAN
COMMISSION

Brussels, 26.11.2019
SWD(2019) 406 final

COMMISSION STAFF WORKING DOCUMENT

EVALUATION

of Regulation (EC) No 1005/2009 of the European Parliament and of the Council of 16 September 2009 on substances that deplete the ozone layer

{SWD(2019) 407 final}

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Glossary

Term or acronym	Meaning or definition
Bank	The amount of Ozone-Depleting Substances (ODS) contained in existing equipment (e.g. refrigerators), chemical stockpiles, foams and other products, including after their end of useful life; or recovered and stored ready for use
BAT	Best Available Technique (as relevant to Industrial Emissions Directive)
BDR	Business Data Repository, an electronic online reporting system managed by the European Environment Agency used for company reporting on ODS under Regulation (EC) No 1005/2009
CFCs	Chlorofluorocarbons. Group of ODS consisting only of chlorine, fluorine, and carbon. First generation of ozone-depleting substances banned by the Montreal Protocol. CFCs were commonly used as refrigerants, solvents, and foam blowing agents
CO_2 eq(uivalent)	The CO_2 equivalent is the quantity of a gas in metric tonnes multiplied by its associated global warming potential (GWP). This is used to compare the emissions from various greenhouse gases based upon their global warming potential
Consumption	The quantity of ODS produced plus imported, minus exported minus destroyed. Calculation of consumption under the Montreal Protocol excludes non-virgin imports and exports, as well as substances intended for feedstock and process agent use
CTC	Carbon tetrachloride, also called tetrachloromethane. An ODS consisting of one carbon atom and four chlorine atoms. It s commonly used as a raw material in many industrial uses, including the production of chlorofluorocarbons and as a solvent
EASA	European Aviation Safety Agency
EEA	European Environment Agency
EEAP	Montreal Protocol's Environmental Effects Assessment Panel
EPRTR	European Pollutant Release and Transfer Registry
Feedstock	Any controlled substance or new substance that undergoes chemical transformation in a process to synthesise other chemicals in which it is entirely converted from its original composition and where emissions are insignificant
F-gases	Fluorinated greenhouse gases
GHG	Greenhouse Gas. Any gas that has the property of absorbing infrared radiation emitted from Earth's surface and reradiating it back to Earth's surface, thus contributing to global warming through the so-called "greenhouse effect"

Term or acronym	Meaning or definition
GWP	Global Warming Potential. It is a metric for determining the relative contribution of a substance to climate warming. The GWP of a substance is set relative to the warming effect of CO_2 (GWP=1) over a timeframe of 100 years
Halons	Group of ODS containing bromine and fluorine and one or two carbons. Their production is banned, but existing (non-virgin) halons may still be placed on the EU market for "critical uses", e.g. for fire-fighting on aircrafts
HBFCs	Hydrobromofluorocarbons. Group of ODS consisting of hydrogen, bromine, fluorine, and carbon
HCFCs	Hydrochlorofluorocarbons. Group of ODS consisting of hydrogen, chlorine, fluorine and carbon. Second generation of ozone-depleting substances, since they were used to replace chlorofluorocarbons due to their lower Ozone-Depleting Potential (ODP, see definition later)
HFCs	Hydrofluorocarbons (do not belong to the ODS groups, but to fluorinated gases). A group of F-gases consisting of hydrogen, fluorine, and carbon. They have been used as replacements for ODS because they do not deplete the ozone layer. However they are powerful GHGs
HFOs	Hydrofluoroolefins = Unsaturated HFCs. A group of fluorinated gases consisting of hydrogen, fluorine, and carbon with a double bond between two carbon atoms. HFOs are alternatives to ozone-depleting substances and typically have very low global warming potentials due to the double bond, which facilitates breakup of the molecule in the environment
HTOC	Montreal Protocol's Halons Technical Options Committee (sub-group of the Technology and Economic Assessment Panel - or TEAP)
ICAO	International Civil Aviation Organization
ICCAIA	International Coordinating Council of Aerospace Industries Associations
IED	Industrial Emissions Directive
iPIC	informal Prior Informed Consent. It is an informal method used by Parties to the Montreal Protocol to exchange information about their national licensing systems on ODS
ISG	European Commission Inter Service Group accompanying the evaluation
IMO	International Maritime Organisation
Laboratory and analytical uses	Use of an ODS as a necessary component or part of a laboratory or analytical process. Decision IX/17 of the Montreal Protocol introduced an exemption for laboratory and analytical uses of ODS
MB	Methyl Bromide. An ODS consisting of carbon, hydrogen, and bromine. It has been used as pesticide to fumigate soil and many agricultural products
MDI	Metered-dose inhaler, i.e. asthma spray
Methylchloroform	An ODS consisting of carbon, hydrogen, and chlorine. It is also called 1,1,1-Trichloroethane. It has been used e.g. as an industrial solvent
Metric tonnes	A unit of weight equal to 1,000 kilograms
Montreal Protocol	The Montreal Protocol on Substances that Deplete the Ozone Layer, an

Term or acronym	Meaning or definition
	international treaty governing the protection of stratospheric ozone
MOP	Meeting Of the Parties (to the Montreal Protocol)
New ODS	Substances listed in Annex II to Regulation (EC) No 1005/2009, whether alone or in a mixture, and whether they are virgin, recovered, recycled or reclaimed. These substances are not controlled under the Montreal Protocol
Non-Article 5 countries	Developed countries, i.e. Parties to the Montreal Protocol not operating under Article 5
ODP	Ozone Depleting Potential. It refers to the amount of ozone depletion caused by a substance. More specifically, it is the ratio of global loss of ozone due to a given substance and global loss of ozone due to trichlorofluoromethane (CFC-11) of the same mass. CFC-11 is assigned an ODP value of 1. The OPD values of the different ODS range from close to 0 to 10. The higher the ODP value, the more the substance depletes the ozone layer
ODP-tonnes	Metric tonnes of a substance multiplied by its ozone-depleting potential, resulting in ODP-weighted tonnes, or in short ODP-tonnes. As an example, 1 metric tonne of HCFC-22 equals 0.055 ODP-tonnes, whilst 1 metric tonne of halon-1301 equals 10 ODP-tonnes. This is because halon-1301 depletes the ozone layer considerably more than HCFC-22
ODS	Ozone-Depleting Substances, i.e. substances that lead to a deterioration of the stratospheric ozone layer by photochemical reactions releasing reactive halogens (bromine, chlorine atoms) that lead to the breakup of ozone molecules
Ozone	A gas composed of three atoms of oxygen. It is a colourless and very reactive gas that is harmful to breathe. It can be found throughout all layers of the atmosphere. Most ozone (about 90%) is found in the upper atmosphere (stratosphere) and is referred to as the ozone layer. It absorbs most of the damaging ultraviolet (UV) radiation from the sun
Ozone hole	A large area of the stratospheric ozone layer with very low amounts of ozone
Ozone layer	Region of the upper atmosphere containing relatively high concentrations of ozone molecules. It protects humans and other living things from harmful UV radiation from the sun
Ozone layer depletion	Chemical destruction of ozone molecules in the ozone layer leading to low concentrations of ozone and more UV radiation reaching the Earth's surface
Placing on the market	Supplying or making available to third persons within the European Union for the first time, for payment or free of charge
Process agents	Process agents are used in chemical reactions in industrial processes but, contrary to feedstocks, do not undergo chemical transformations themselves during the process. The applications where ODS are allowed to be used as process agents are listed in Annex III to Regulation (EC) No 1005/2009
QPS	Quarantine and Pre-Shipment applications. They refer to the use of methyl bromide for the control of a diverse range of pests and diseases. Quarantine applications target "quarantine pests", that are pests (or pathogens) of potential importance to the areas endangered thereby and not

Term or acronym	Meaning or definition
	yet present there, or present but not widely distributed and being officially controlled. Pre-shipment applications are treatments applied 21 days or less before export and required by exporting country or importing country authorities to meet their phytosanitary or sanitary requirements
Reclamation	Reprocessing of a recovered controlled substance in order to meet the equivalent performance of a virgin substance, taking into account its intended use
Recovery	Collection and storage of controlled substances from products and equipment or containers during maintenance or servicing or before disposal
Recycling	Reuse of a recovered controlled substance following a basic cleaning process
REIO	Regional Economic Integration Organization. The EU is considered a REIO pursuant to Article 1(6) of the Vienna Convention for the Protection of the Ozone Layer
RSB	Regulatory Scrutiny Board
SAP	Scientific Assessment Panel (of the Montreal Protocol)
SWD	Staff Working Document
TCA	1,1,1-Trichloroethane. See methylchloroform above
TEAP	Technology and Economic Assessment Panel (of the Montreal Protocol)
Tetrachloromethane	See carbon tetrachloride above
UV radiation	Ultraviolet radiation. Portion of the electromagnetic spectrum with wavelengths shorter than visible light. When the ozone layer becomes thin, more UV radiation from the sun reaches Earth's surface and may have hazardous effects on organisms
UNEP	United Nations Environment Programme, now UN Environment
UNIDO	United Nations Industrial Development Organisation
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	United States Environmental Protection Agency
Use of ODS	The utilisation of controlled ODS or new ODS in the production, maintenance or servicing, including refilling, of products and equipment or in other processes
Virgin ODS	ODS that are newly produced and have not previously been used
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive

1. INTRODUCTION

1.1 Purpose and scope

This evaluation assesses the effectiveness, efficiency, coherence, relevance and EU added value of Regulation (EC) No 1005/2009 on substances that deplete the ozone layer (hereinafter 'the Regulation'). The Commission carried out this evaluation on its own initiative to see **whether the Regulation remains fit-for-purpose vis-à-vis emerging needs** in line with the Regulatory Fitness and Performance (REFIT) programme[1]. There was no legal requirement to evaluate the legislation. This is the first time this Regulation has been evaluated and the findings are intended to provide the basis for future decisions on EU ozone layer protection policy. The evaluation also includes a number of implementing instruments, in particular regarding halons (Commission Regulation (EU) No 744/2010), laboratory and analytical uses of ODS (Commission Regulation (EU) No 291/2011), process agent[2] uses (Commission Decision 2010/372/EU) and quota allocation for laboratory and analytical uses (Commission Regulation (EU) 537/2011).

The Regulation is a recast of Regulation (EC) 2037/2000. It preserved and slightly expanded EU action on ozone-depleting substances (ODS), inter alia due to new international obligations. The recast also aimed at simplification. This analysis will show to what extent the changes made through the latest revision in 2009 have had the expected effect in the years 2010-17. However, in order to understand the benefits and the effectiveness of this Regulation it is also important to look at its ability to sustain and continue past achievements of EU ozone layer protection policy over the past four decades. This evaluation therefore covers all aspects of the Regulation in the Union as well as certain impacts on non-EU countries.

2. BACKGROUND TO THE INTERVENTION

2.1 Description of the intervention and its objectives

2.1.1 The problem

The ozone layer is a region of the upper atmosphere (i.e. the stratosphere) containing relatively high concentrations of ozone molecules. This "ozone layer" protects humans and other living beings from harmful ultraviolet (UV) radiation from the sun.[3] Increased UV radiation has an adverse impact on human health, e.g. by increasing the incidence of skin cancers and cataracts, and on the ecosystems. In the 1970s, scientists discovered that emissions from certain synthetic chemicals containing chlorine or bromine in their molecule could potentially destroy stratospheric ozone. Further research found that the growing production and use of these chemicals, such as chlorofluorocarbons (CFCs) or halons in aerosol sprays, fire protection equipment, insulation materials (foams), or

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1 https://ec.europa.eu/info/law/law-making-process/evaluating-and-improving-existing-laws/refit-making-eu-law-simpler-and-less-costly_en

2 Process agents are used in chemical reactions in industrial processes but, contrary to feedstocks, do not undergo chemical transformations themselves during the process.

3 One must distinguish between ozone in the stratosphere, which is commonly referred to as the ozone layer, and ground-level ozone near the Earth's surface. While the ozone layer protects from harmful UV radiation, excessive amounts of ozone at ground level have detrimental effects on health.

refrigeration and air conditioning equipment was contributing to the accumulation of ODS in the stratosphere, causing the "ozone hole" to develop over the Antarctic. Most ODS also are very strong greenhouse gases[4] (GHGs) and reducing their emissions is therefore also very relevant for avoiding climate change. The risk of emissions depends on how and where the ODS is used. For instance, in the case of refrigeration equipment it can be assumed that over time a significant[5] part of all the ODS used will be emitted to the atmosphere. Conversely, the use of ODS to produce other chemicals such as polymers, pharmaceuticals and pesticides (the so-called "feedstock" use)[6] will only result in a small fraction of the ODS emitted, if proper emission control measures are in place. Therefore, it is more important to reduce the use in e.g. refrigeration equipment (so-called "emissive uses") than the use as feedstock. Conversely, good controls over the feedstock sector are very important given the large amounts of ODS still used in this sector and to avoid that such substances could be (illegally) diverted to other uses.

2.1.2 The international policy framework

In 1985, the international community adopted the Vienna Convention for the protection of the ozone layer[7], as a framework treaty for legal and practical global action. The objectives of the Vienna Convention are for Parties to promote cooperation by means of systematic observations, research and information exchange on the effects of human activities on the ozone layer and to adopt relevant legislative or administrative measures. In particular, the Vienna Convention stipulates in Article 2(1), "Parties shall take appropriate measures [..] to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer."

In accordance with the provisions of the Vienna Convention, the international community adopted in 1987 the Montreal Protocol on Substances that Deplete the Ozone Layer, which was eventually ratified by 198 parties.[8] **The Protocol protects the ozone layer by phasing-out the production and consumption of the controlled substances in order to reduce emissions of these substances.** The Protocol has been amended a number of times[9] to enable, among other things, the control of new chemicals. Most recently, the Kigali Amendment introduced controls on hydrofluorocarbons (HFCs)[10] from 2019. Regulation (EU) No 517/2014 on fluorinated greenhouse gases (the "Fgas Regulation") ensures the EU's compliance with the obligations related to HFCs.

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4 One molecule of most ODS warms the atmosphere thousands of times more than a molecule of CO_2

5 These emissions can be more than the original ODS "charge" inside a new piece of equipment (e.g. a fridge) over its lifetime due to recharging of leaky equipment or accidental full releases of the charge.

6 In feedstock use the chemical is fully used up during the process of synthesizing other chemicals.

7 The Vienna Convention entered into force in 1988: https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-2&chapter=27&clang=_en

8 https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-2-a&chapter=27&clang=_en

9 London Amendment (1990), Copenhagen Amendment (1992), Vienna Amendment (1995), Montreal Amendment (1997), Beijing Amendment (1999) and the Kigali Amendment (2016).

10 HFCs are not ODS, i.e. they do not affect the stratospheric ozone layer, but are very strong GHGs.

The Montreal Protocol is considered one of the most successful examples of international cooperation on environmental issues. It has triggered the reduction of ODS for non-exempted uses by 98% compared to 1990 levels.[11]

The core obligations for Parties to the Montreal Protocol include:

- a gradual phase-out of the production and consumption[12] of the controlled substances according to specified time schedules;
- reporting data on the production, use, import and export of the controlled substances to the Ozone Secretariat[13]; and
- establishing an import and export licensing system for the controlled substances.

Table 1 below shows the ODS controlled, their most common use and their phase-out date for developed countries[14]. HCFCs are the only substance group where the phase-out has not already been completed in developed countries.

Table 1. ODS controlled by the Montreal Protocol and their phase-out schedules under the Montreal Protocol.

Acronym	Description	Most common uses	Phase-out date for developed countries
CFCs	Chlorofluorocarbons	1st generation refrigerants, cleaning solvents, aerosol propellants, foam blowing agents	Phased out end of 1995
Halons	Halons (1211, 1301 and 2402)	Fire extinguishants, explosion suppressants	Phased out end of 1993
CTC	Carbontetrachloride	Feedstock[15] chemical in CFC production, cleaning and industrial solvent	Phased out end of 1995
TCA	1,1,1-Trichloroethane	Cleaning solvent, aerosol propellant, feedstock chemical	Phased out end of 1995
MB	Methyl bromide	Fumigant for control of soil-borne pests and diseases in crops and stored commodities	Phased out end of 2005
HBFCs	Hydrobromofluorocarbons	Fire suppressants	Phased out end of 1995

11 http://conf.montreal-protocol.org/meeting/oewg/oewg-37/presession/Background_documents/Briefing_note_on_exemptions.pdf

12 'Consumption' is an aggregated parameter calculated for data reported under the Montreal Protocol. In brief, consumption is calculated as: production + imports – exports – destruction. The amount recycled and reused is not considered and some uses are exempted.

13 The Ozone Secretariat is the Secretariat for the Vienna Convention and the Montreal Protocol and is carried out by UN Environment; http://ozone.unep.org/

14 Parties that are not covered by Article 5 of the Montreal Protocol ("non-Article 5 countries"). For developing countries more time, usually about one decade, is given to achieve the phase-outs

15 Feedstock means the use of a substance in chemical production whereby the substance itself is completely used up in the process for the synthesis of other chemicals or products such as refrigerants, foam blowing agents, polymers, pharmaceuticals or agricultural chemicals.

Acronym	Description	Most common uses	Phase-out date for developed countries
HCFCs	Hydrochlorofluorocarbons	2nd generation refrigerants, cleaning solvents, foam blowing agents, fire extinguishants, feedstock chemicals	Freeze from beginning of 1996 35% reduction by 2004 75% reduction by 2010 90% reduction by 2015 Total phase-out by 2020[16]
BCM	Bromochloromethane	Fire suppressant	Phased out end of 2002

Even though many substance(s) may have been phased out, some ODS continue to be used (See table 2).

Firstly, only **virgin**[17] substances counts towards Montreal Protocol consumption. This means that **reclaimed and recycled** substances may still be used after the phase-out date. For instance, whereas production and consumption of virgin halons were 'phased-out' in 1993, recycled or reclaimed halons may still be used in certain fire equipment under the rules of the Montreal Protocol.

Secondly, **certain specific uses** of virgin ODS are exempt from the phase-out. These **exemption mechanisms** target uses for which it is perceived that suitable alternatives do not exist. In this way, the Montreal Protocol has ensured that the functioning of Parties' economies is not disrupted while at the same time ensuring an effective protection of the ozone layer.[18] The main exempted uses are feedstock use, specific process agent uses in installations existing before 1999, specific laboratory and analytical uses and the use of methyl bromide for quarantine and pre-shipment treatment (QPS) against plant pests.

Finally, a number of relatively new ozone depleting substances (new ODS) are not controlled under the Montreal Protocol.

Table 2. Types of uses and substances covered and not covered by the phase-out dates (and the consumption metric) under the Montreal Protocol

	Covered by the Montreal Protocol phase-out obligations	Not covered by the Montreal Protocol phase-out obligations
Virgin vs. non-virgin substances.	Only virgin substances	Non-Virgin: recycled or reclaimed substances and substances for destruction
Controlled uses vs. exempted uses	All uses are covered, unless specifically exempted	Exempted uses: Feedstock, Process agents, laboratory and analytical, and specific uses of halons and methyl bromide
Controlled ODS	Controlled substances: CFCs, Halons, CTC, TCA,	New ODS[19]:

16 Up to 0.5% of base level consumption can be used from 2020 until 2030 for servicing existing refrigeration and air conditioning equipment and some other specific uses

17 "Virgin substances" means newly produced substances, as opposed to reclaimed/recycled substances.

18 http://conf.montreal-protocol.org/meeting/oewg/oewg-37/presession/Background_documents/Briefing_note_on_exemptions.pdf

19 New ODS are not controlled by the Montreal Protocol, but monitored by the Regulation. They are listed in Annex II to the Regulation.

	Covered by the Montreal Protocol phase-out obligations	Not covered by the Montreal Protocol phase-out obligations
	BCM, MB, HBFCs and HCFCs	Halon 1202 (Fire suppressant) Trifluoroiodomethane (Fire suppressant) Methylchloride (Feedstock, solvent) Ethylbromide (Feedstock, solvent) n-Propylbromide (Feedstock, solvent)

Even if substances and uses are not covered by the phase-out dates, they are often covered by other provisions and decisions of the Montreal Protocol and the Vienna Convention, such as the obligations to report, control trade and take measures to minimise emissions. In many cases, the level of action needed to comply with these measures is not prescribed in detail. In addition, while some actions are formally voluntary, there is an expectation that Parties make the relevant effort commensurate with the objective of the action[20].

In the context of the Montreal Protocol, the EU is a regional economic integration organization (REIO)[21]. This implies a common (EU-wide) phase-out schedule for consumption and an obligation to comply (only) jointly as EU. For the production phase-out this is not the case. Here the remaining five Member States[22] that still have ODS production on their territory are responsible for their own compliance under the Montreal Protocol.[23]

2.1.3 The EU policy framework

Since the 1980s the European Union has taken a leading role in global efforts to phase-out ODS in order to preserve the ozone layer. A number of Council Decisions and Regulations started regulating certain CFCs and halons in the 1980s.[24] Regulation (EC) No 2037/2000 preceded the current Regulation. It ensured compliance with the Montreal Protocol, including the production phase-out schedules for various ODS[25]. The ambition of past EU ozone policies has been that the EU would lead by example in implementing the Montreal Protocol rules. This did not only mean stricter and faster phase-outs of ODS, but also adopting effective policy measures that would ensure good enforcement of the Montreal Protocol rules. **In this way, also other Parties are encouraged to do the same, with the ultimate aim to maximise the impact of the global effort.**

Therefore, many obligations under Regulation (EC) No 2037/2000 were stricter than the core requirements of the Montreal Protocol and very comprehensive. The Commission partially reviewed Regulation (EC) No 2037/2000 in 2008. This led to the adoption of

20 A table explaining measures that are strictly required, others that are needed for good enforcement of Montreal Protocol obligations and those few measures that go clearly beyond is included in Annex V.

21 Pursuant to Article 1(6) of the Vienna Convention.

22 Czech Republic, France, Germany, Italy and The Netherlands

23 The Regulation enables them to comply by including specific requirements for producing companies to reduce their production. See 2.1.3

24 Council Decision 80/372/EEC, Council Decision 82/795/EEC, Council Regulation (EEC) No 3322/88.

25 Even though these do not fall under the REIO clause and must be directly complied by the few Member States concerned. See section 2.1.2 above.

the current Regulation. Most measures of Regulation (EC) No 2037/2000 were simply maintained as the main purpose of the review was to:

- simplify and recast Regulation (EC) No 2037/2000 to reduce unnecessary administrative burden,
- ensure compliance with the Montreal Protocol as regards the accelerated phase-out schedule for HCFC production agreed under the Montreal Protocol in 2007[26], and
- make sure that future challenges are addressed.

Since the impact assessment (EC, 2008) of the current Regulation mainly focused on the points listed above, it is not a sufficient basis for benchmarking the Regulation in its totality. Nonetheless, while examining the overall fitness of the Regulation, the analysis also investigated if the expected impacts from the review have materialised.

2.1.4 The intervention logic of the Regulation

The intervention logic of the Regulation is based on **the need to ensure a recovery of the ozone layer to reduce the risks to humans, ecosystems and sustainable development as well as avoiding climate warming caused by emissions from ODS** (Figure 1).

In light of this need, the Regulation has the following general objectives:

- **Ensure that the EU is compliant with the agreements that the international community has put in place to protect the ozone layer:** these are first and foremost the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer.[27]
- **Have a high level of ambition for protecting the ozone layer and fighting climate change.** The EU wants to be more ambitious and comprehensive than the core Montreal Protocol requirements in areas where this is technically and economically feasible.

The general, specific and operational objectives will be achieved through a set of **activities** (or measures). These activities represent two different approaches to prevent ODS from reaching the atmosphere, either by (i) reducing the use of virgin and non-virgin ODS in the first place, or by (ii) minimising emissions where ODS are in use or have been used. In addition, some activities serve to facilitate enforcement and monitoring.

It is in general difficult (or even not meaningful) to distinguish between EU measures strictly necessary for complying with the international agreements and EU measures going beyond. As regards the prohibitions in the EU Regulation, it is straightforward to state whether the EU is more ambitious than the Montreal Protocol (see Annex VI). Conversely, for other measures such a distinction is often not meaningful, e.g. in areas where Montreal Protocol Decisions request Parties to take action without specifying concrete measures.

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[26] Decision XIX/6 of Parties to the Montreal Protocol: https://ozone.unep.org/sites/default/files/2019-07/MP_Handbook_2019.pdf

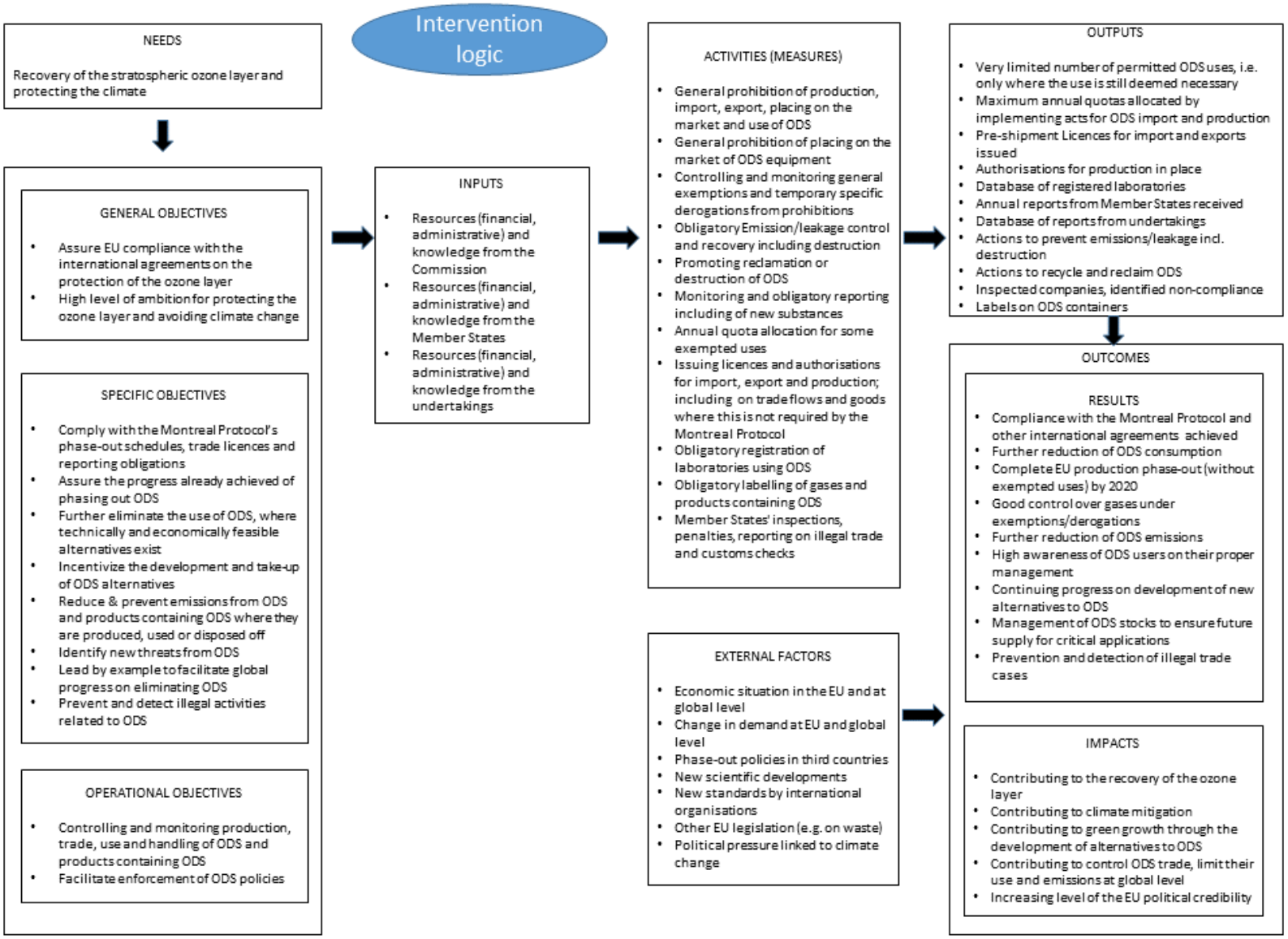
[27] Except for HFCs, where compliance is achieved via Regulation (EU) No 517/2014 on fluorinated greenhouse gases (the Fgas Regulation). See section 2.1.2.

Still, it has been the EU's aim to have an effective and efficient approach to measures that could deliver an ambitious EU ozone policy, serving as best practice to the rest of the world and enabling the EU to credibly lead by example, see section 5.1.3.5. Since ozone policies are already successfully eliminating the use of ODS in the most relevant application areas, the focus today is to a large degree on maintaining this success through effective mechanisms and by policing the rules. By demonstrating best practice, the EU can also lead by example in this respect.

2.1.4.1 Reducing the use of ODS

Chapter II Prohibitions, Chapter III Exemptions and derogations and *Chapter IV Trade* cover the reduction of ODS uses. **The Regulation generally prohibits the production, import and use of ODS, including in equipment and products.** In this way, the Regulation is locking in and consolidating progress achieved through previous Regulations. Avoiding the redeployment of gases that have already been phased out is also necessary to safeguard continued compliance with the Montreal Protocol phase-out dates, e.g. for CFCs. As regards HCFCs, not yet fully phased out under the Protocol, the Regulation maintained the prohibition from the previous Regulation to stop consumption of virgin HCFCs by 2010; 10 years ahead of the phase-out date under the Montreal Protocol. It also maintained that servicing of equipment with non-virgin HCFC was allowed (only) until 2015. For production, the Regulation moved forward the phase-out date for HCFCs from 2025 to 2020 in line with the accelerated production schedule agreed under the Montreal Protocol (Decision XIX/6[26]).

Figure 1 – The intervention logic of the Regulation



The Regulation allows ODS uses under its **exemptions and derogation clauses**, in cases where technically or economically suitable substitutes or alternatives were deemed to not be readily available.[28] For instance, as it is the case under the Montreal Protocol, ODS used as feedstock in chemical processes are exempted from phase-out measures. However, contrary to the Montreal Protocol, the Regulation prohibits the use of methyl bromide for QPS uses (unless under emergency situations) and specifies phase-out dates for the use of halons.

As required by the Montreal Protocol, the Regulation includes a licensing system for import and export of ODS. The EU system is more complex than strictly necessary for compliance under the Montreal Protocol. The Regulation requires licences per shipment (except for remaining uses of halons on aircraft), covers equipment relying on ODS (not just trade of the gases themselves) and includes the control of trade under a number of different customs procedures beyond the simple *release for free circulation* into customs territory. Furthermore, the Regulation requires registration of laboratories using ODS, quota systems for some exempted uses, labelling of ODS and ODS equipment, national inspections, and consultation with third countries. The aim of these measures was to enable strict enforcement of the prohibitions and prevention of illegal activities.

2.1.4.2 Minimising emissions of ODS

***Chapter V Emission Control* in the Regulation includes measures to reduce losses to the atmosphere from production and from ODS equipment as well as requiring proper waste treatment at the end of life of products and equipment containing ODS, the so-called ODS "banks"**[29]. Leakage prevention measures include obligatory leakage checks and record keeping, minimum qualification requirements for personnel servicing the equipment and strengthened provisions on ODS recovery obligations. The provisions on recycling and destruction contained in the Regulation mirror those in the EU Waste Framework Directive (WFD) and the Waste from Electric and Electronic Equipment (WEEE) Directive. The intention was to enable a better implementation and enforcement of existing waste legislation, rather than going beyond the latter.**Error! Bookmark not defined.**

2.1.4.3 Reporting obligations and monitoring

***Chapter VII Committee, Reporting, Inspection and Penalties* in the Regulation provides data for obligatory reporting under the Montreal Protocol and to follow progress on the implementation of the Regulation in the EU**. Member States and undertakings must report certain data to the Commission. The reported data is analysed in an annual EU report[30] and used for obligatory reporting to the Montreal Protocol. To be able to identify new threats from ODS not covered by the Montreal Protocol, the

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[28] The Regulation contains general exemptions for some uses that reflect the state of technology known at the time of the drafting of the Regulation. The Regulation also allows for Commission Decisions authorising case-specific derogations from a prohibition based on a justified request from a Member State.

[29] While the production and use of ODS, and particularly CFCs, has long been dramatically reduced, a substantial fraction of CFCs and other ODS have not yet been released to the atmosphere, but are still enclosed in products and equipment, including foams and refrigerators in landfills. These reservoirs of ODS are referred to as "banks".

[30] Produced by the European Environment Agency (EEA) based on company reporting data from the Regulation since 2011.

Regulation also requires companies to report on such substances (the so-called "new ODS"). ***Chapter VI New substances*** introduces a production, import and placing on the market prohibition for one new ODS (halon 1202) and empowers the Commission to adopt additional prohibitions for other new ODS, if this would appear appropriate on the basis of an assessment by the Scientific Assessment Panel (SAP) under the Montreal Protocol. This empowerment has not yet been used.

2.1.4.4 Partial review in 2008

The changes in the Regulation were in particular related to:

- Reduction of administrative burden by clarifying and simplifying the Regulation, streamlining reporting, and updating exemption regimes.
- Bringing forward a prohibition to produce HCFCs to 2020, in line with the Montreal Protocol, and strengthening enforcement including the prevention of illegal and harmful trade.
- Challenges linked to ODS contained (or "banked") in products and equipment even after its useful life; new and short-lived ODS that were not covered by the previous Regulation or by the Montreal Protocol; and the use of methyl bromide for QPS uses.

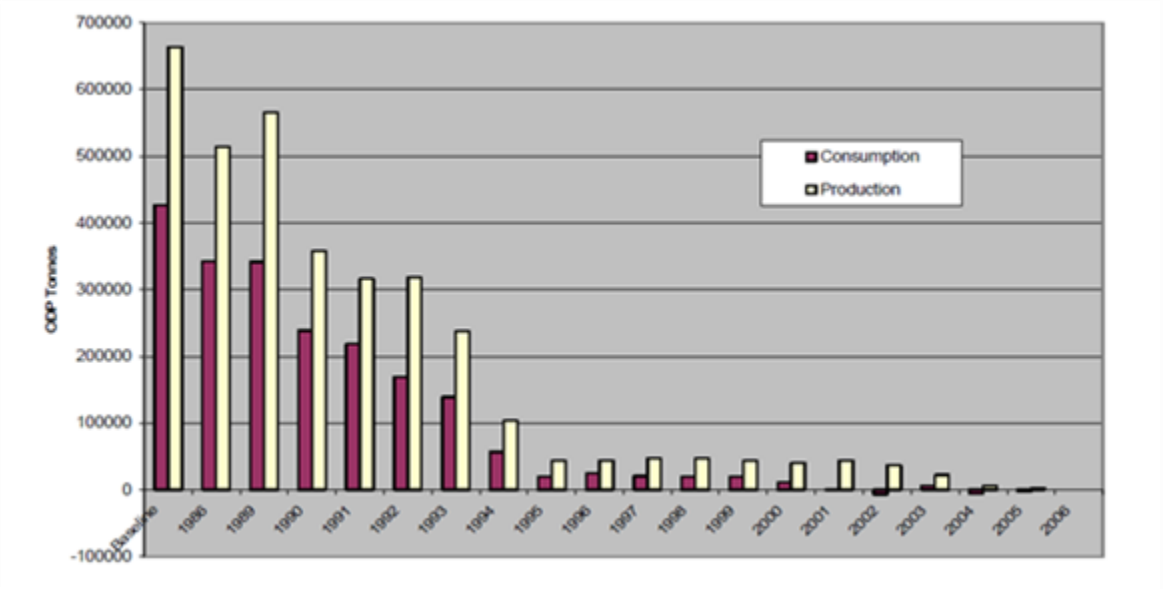
2.2 Baseline and points of comparison

The Regulation applies from 1 January 2010, so normally the baseline for the evaluation would be the status quo in 2009. However, since the Regulation locks in the significant achievements of previous EU Decisions and Regulations on ODS and the recast only concerned relatively minor adjustments, the most appropriate baselines for the environmental effects of reducing production and consumption are the initial EU baselines under the Montreal Protocol. **The Regulation locks in a 99% reduction of ODS consumption and production compared to these baselines** (Figure 2). Without a continued application of strict measures and their enforcement, uses of ODS that were eliminated in the past could return[31]. This is a key function of the Regulation.

The 2008 partial review did not change many of these significant measures in place. Only modest additional progress was expected from the (limited) new measures in a few areas. It is therefore useful to look at the overall achievements of all measures of the Regulation, including the progress made as a result of the (i) the measures not modified by the partial review, as well as (ii) the additional measures that applied only from 2010.

[31] As appears to have recently happened in China, see also section 5.2.1

Figure 2 – EU ODS consumption and production in 1986 – 2006, as defined under the Montreal Protocol12



EC (2008)

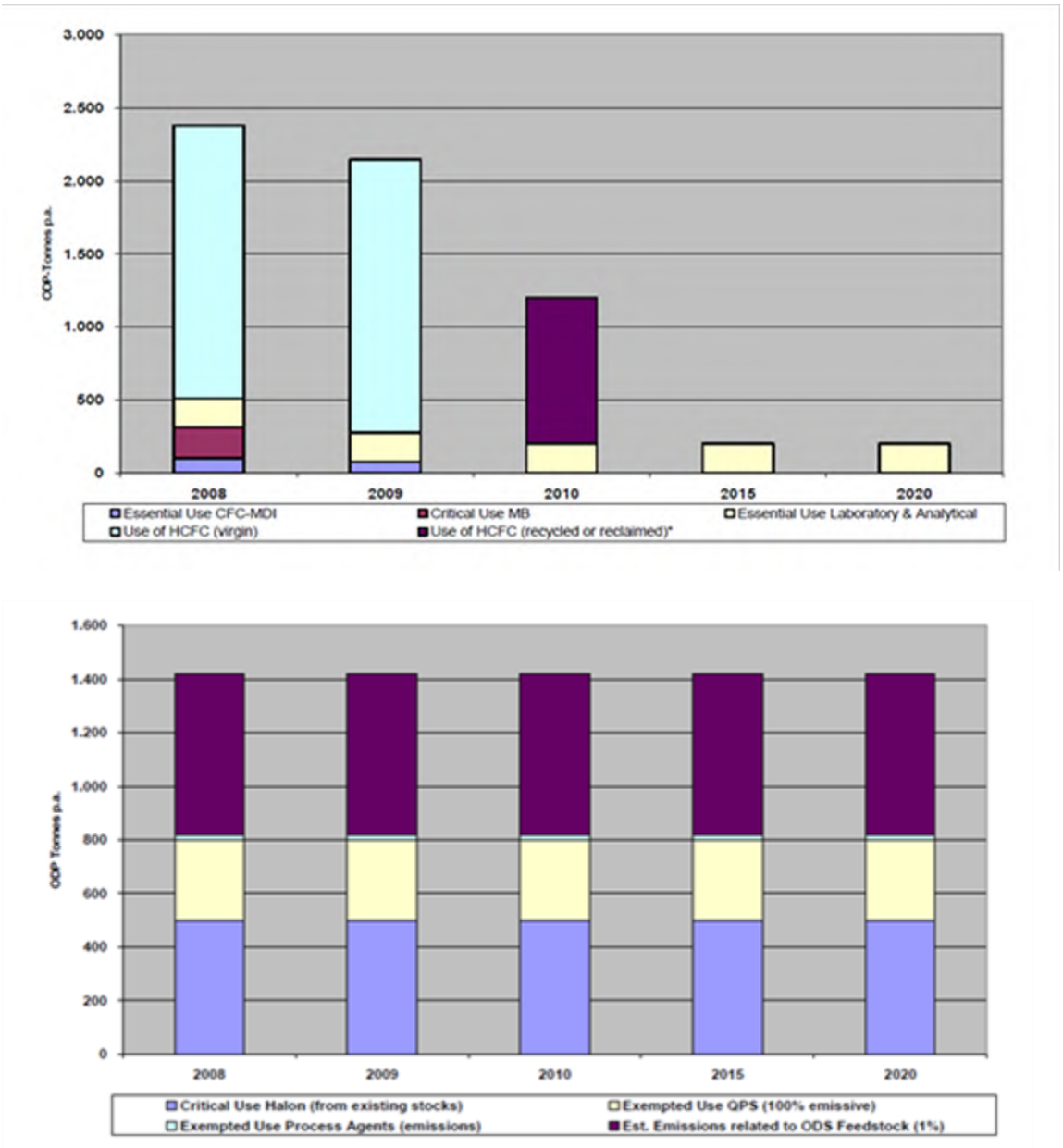
2.2.1 Uses of ODS

The impact assessment estimated that, due to a prohibition already included in the previous Regulation, all virgin ODS measured as Montreal Protocol consumption would be fully phased out by 2010 (Figure 3 upper diagram, [Use of HCFC (virgin)]).

As regards other ODS uses, the impact assessment expected, due to existing prohibitions in the previous Regulation, that the use of recycled or reclaimed HCFCs for servicing equipment would go from 1,000 ODP in 2010 to zero in 2015 [Use of HCFC (recycled or reclaimed)]. The use of CFCs for metered-dose inhalers [Essential Use CFC-MDI) and the use of methyl bromide for fumigation[32] [Critical Use MB] would also reach zero in 2010 (Figure 3 upper diagram).

[32] Excluding QPS uses, see further below.

Figure 3 – Expected level of ODS used in the EU until 2020 (in ODP tonnes)



EC(2008)

N.b.: For process agents and feedstock use only the resulting emissions, not total use is shown

The uses that were exempted in Regulation (EC) No 2037/2000 were forecasted to remain stable until 2020 without further measures. Specifically, it was estimated that:

- Emissions from feedstock (Figure 3 lower diagram) would remain around 600 ODP tonnes (assuming a loss of 1% during production processes). Further measures to reduce emissions were seen in the review to fall under the scope of industrial pollution policies.
- QPS uses of methyl bromide (Figure 3 lower diagram) would stay at about 200 ODP tonnes yearly. These emissions were expected to be saved from 2010 onwards due to a new prohibition introduced by the Regulation in 2009.

- Laboratory and analytical uses (Figure 3 upper diagram) would stay at about 200 ODP tonnes until 2020.
- 500 ODP tonnes of recycled or reclaimed halons (Figure 3 lower diagram) would serve critical applications (e.g. in military, aviation, maritime and oil and gas exploration).
- Emissions related to exempted process agents use (Figure 3 lower diagram) would remain at 20 ODP tonnes.
- The impact assessment therefore expected few additional emission savings from these uses (except for QPS use of methyl bromide) due to new measures in the current Regulation.

2.2.2 ODS production

The **EU ODS production baseline** under the Montreal Protocol is close to 700,000 ODP tonnes. In 2010, EU production counting towards the Montreal Protocol phase-out was estimated to be only 4,000 ODP tonnes, mostly serving the needs of non-EU countries. Regulation (EC) No 2037/2000 required a gradual phase-out by 2025, but companies were expected to adapt their production schedules ahead of time so that **an accelerated production phase-out as mandated by the Montreal Protocol by 2020 which was put into EU law by the Regulation, was seen as achievable and considered a *de facto* base case with no additional savings by the impact assessment.** Furthermore, the production of the new ODS, not covered by the Montreal Protocol, was projected to be up to 20,600 ODP tonnes from 2010-2020, while emissions of new ODS in the EU were estimated to total less than 300 ODP tonnes per year, albeit growing steadily.

2.2.3 Emissions from banks

ODS banks in the EU were estimated at approximately 700,000 ODP tonnes in 2010, equivalent to 5 billion tonnes of CO_2.[33] These banks represent potential future emissions. Annual emissions over the period 2005-15 from banks were believed to range up to 24,000 ODP tonnes per annum or up to 170 million tonnes of CO_2 equivalent. These estimates were subject to a large degree of uncertainty. Provisions on use and on recycling and destruction contained in the Regulation as well as, most importantly, parallel provisions in the EU Waste Framework Directive and the Waste from Electric and Electronic Equipment (WEEE) Directive, including their effective enforcement, were expected to capture up to 14,000 ODP tonnes p.a., even though current EU waste recycling and recovery rates were acknowledged to be very low. **The highest potential emissions savings (between 0 to 14,000 ODP tonnes) were expected in this area, following the adaption of the recovery provisions and parallel action under the waste policy framework.**

2.2.4 Control of trade

As regards the **licensing system**, it was expected that the number of licences that would be processed annually through the on-line ODS data base system would decrease to an estimated 1,000 in 2010 (from almost 3,000 in 2002 when the system was first launched).

[33] Tonnes CO_2 equivalent is the quantity of a GHG in metric tonnes multiplied by its global warming potential (GWP).

The extension of the licensing system introduced by the review (i.e. more stringent export control, per shipment licensing for exports and equipment, licensing for additional customs procedures) was expected to be offset by simplification of the licensing system and reporting requirements, according to the impact assessment.

3. IMPLEMENTATION / STATE OF PLAY

3.1 Description of the current situation

3.1.1 Trends in the EU: Use, production and trade of ODS

Most of the data in this section, if not identified otherwise, was obtained from the annual European Environmental Agency's (EEA) reports on ODS (see 5.1.3.4).

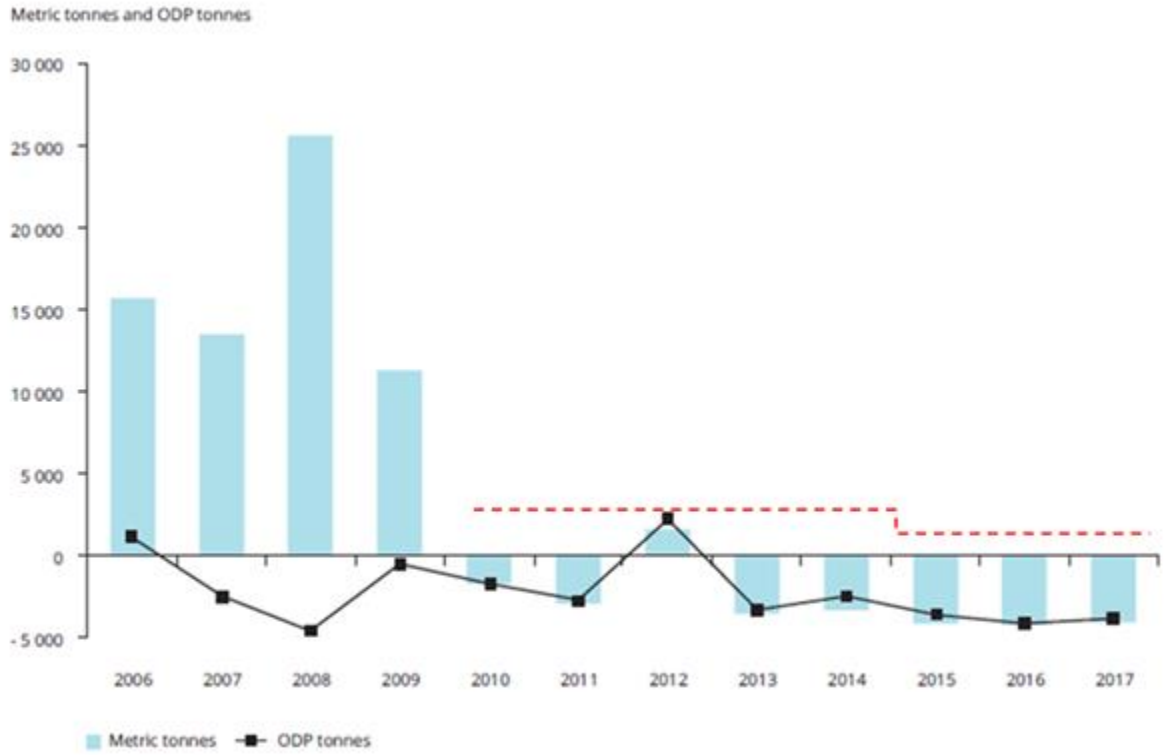
3.1.1.1 Remaining uses of ODS

Considering the general objectives of the Regulation, it is useful to distinguish between consumption as defined under the Montreal Protocol and the use of ODS more broadly.[34]ODS counted by the Montreal Protocol as consumption have been at negative levels in the period 2010-2017 (Figure 4), which means that every year more of these ODS were destroyed or exported than produced or imported.[35] Hence, the EU has been clearly below the limits set under the Montreal Protocol (see dotted line in Figure 4). These low levels are the result of the extensive prohibitions of the Regulation, in combination with rather high destruction rates and decreasing stocks.

[34] Montreal Protocol consumption does not e.g. include reclaimed gases or exempted uses such as the (significant) production for feedstock (see section 2.1.2 and table 2).

[35] The only positive consumption of ODS reported for 2012 was caused by a significant increase of stocks destined for destruction, but not yet destroyed by year's end, and feedstock use outside the EU (not all production for export was exported in 2012). See EEA (2013), Ozone-depleting substances 2012, p. 9.

Figure 4 – ODS consumption in the EU as measured under the Montreal Protocol for 2009-2017 (in metric and ODP tonnes)



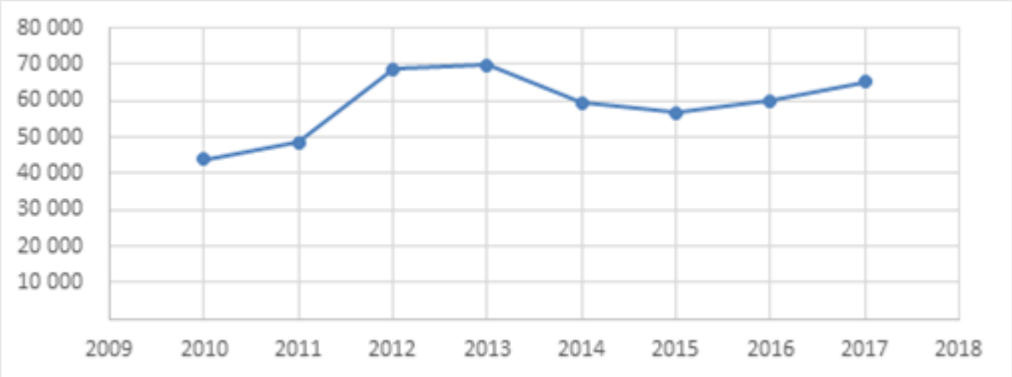
N.b.: The red dotted line indicates the Montreal Protocol compliance limit (in ODP tonnes)

EEA Report on ODS (2018)

At the same time, ODS not counted as consumption by the Montreal Protocol as consumption including new ODS continue to be used in the EU in significant quantities (Figure 5). The total used quantity ranged between 45,000 and 70,000 ODP tonnes. The increase between 2010 and 2012 is seen as resulting from the post-2019 crisis recovery of the chemical sector[36]. Since 2013 ODS use has remained fairly stable in the EU.

[36] Since feedstock use in chemical production is the dominant use; see further below.

Figure 5 – Total quantity of ODS used in the EU from 2010-2017 (in ODP tonnes; both ODS and new ODS as well as virgin and non-virgin substances are included)[37]



Ramboll (2019)

- The **most significant of the remaining ODS uses is feedstock use** in chemical production, on which many other sectors rely. Other ODS uses pale in comparison (smaller by a factor of 100 or more). Emissions related to these feedstock uses were however only 62 and 26 ODP tonnes in 2016 and 2017, respectively (excluding new ODS).
- The **use of non-virgin HCFCs for servicing equipment** was phased out by 2015 as anticipated. A few derogations were granted from 2010 onwards resulting in a maximum total use of 3 ODP tonnes. The last derogation expired in 2018.
- The **use of methyl bromide for QPS** in the EU was zero in recent years in accordance with the prohibition from 18 March 2010 onwards, newly introduced in the Regulation.
- Remaining **uses for laboratories and analyses** are today at levels lower than 1 ODP tonne per year.[38]
- The **use of recycled and reclaimed halons** for critical applications continues at the anticipated levels of around 500 ODP per year (see section 5.1.3.2). The Regulation introduced dates by which the use of halons would be prohibited. Some of these dates are however quite far out into the future (until 2040).
- **Process agent use** of ODS has shown a clear declining trend since 2013. Their use for make-up[39] is today at levels of 324 metric tonnes (i.e. 351 ODP tonnes) and their emissions amount to 4.1 metric tonnes (4.5 ODP tonnes) (data for 2017). This is well below the EU limit of 1,083 metric tonnes for use and of 17 metric tonnes for emissions under the Montreal Protocol[40] and mentioned in the Regulation. Process agent use of

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37 Calculated as: Total quantity used = Total production of ODS and new ODS + Total import of ODS and new ODS (virgin, recovered and reclaimed) – Total export of ODS and new ODS (virgin, recovered and reclaimed) – Destruction. For the years 2010 and 2011, no data on new ODS was available on the production for feedstock use outside the EU. Furthermore, for 2010, no destruction data for new ODS was available. Hence, the aggregated 2010 use is likely to be overestimated for these years.

38 0.2 ODP tonnes in 2017

39 "Make-up" means the total quantity of an ODS in metric tonnes, whether virgin, recovered or reclaimed, that has not been used in the process cycle before but is newly fed into the cycle.

40 Decision X/14 of the Parties to the Montreal Protocol on process agents, that has been updated through Decisions XV/6, XVII/7, XIX/15, XXI/3, XXII/8, XXIII/7 and XXIX/7.

ODS is limited to certain applications and certain installations that existed in 1997 and where replacing ODS was considered prohibitively expensive due to necessary plant modifications. Due to an unexpected increase in the use of process agents in the 2000s, which put the compliance with use and emission limits decided under the Montreal Protocol at risk, the Commission adopted in 2010 a decision setting limits for the use and emissions for the eight remaining installations.[41] In 2013, the Commission adapted that decision and now only six installations may use process agents.[42]

3.1.1.2 EU Production of ODS

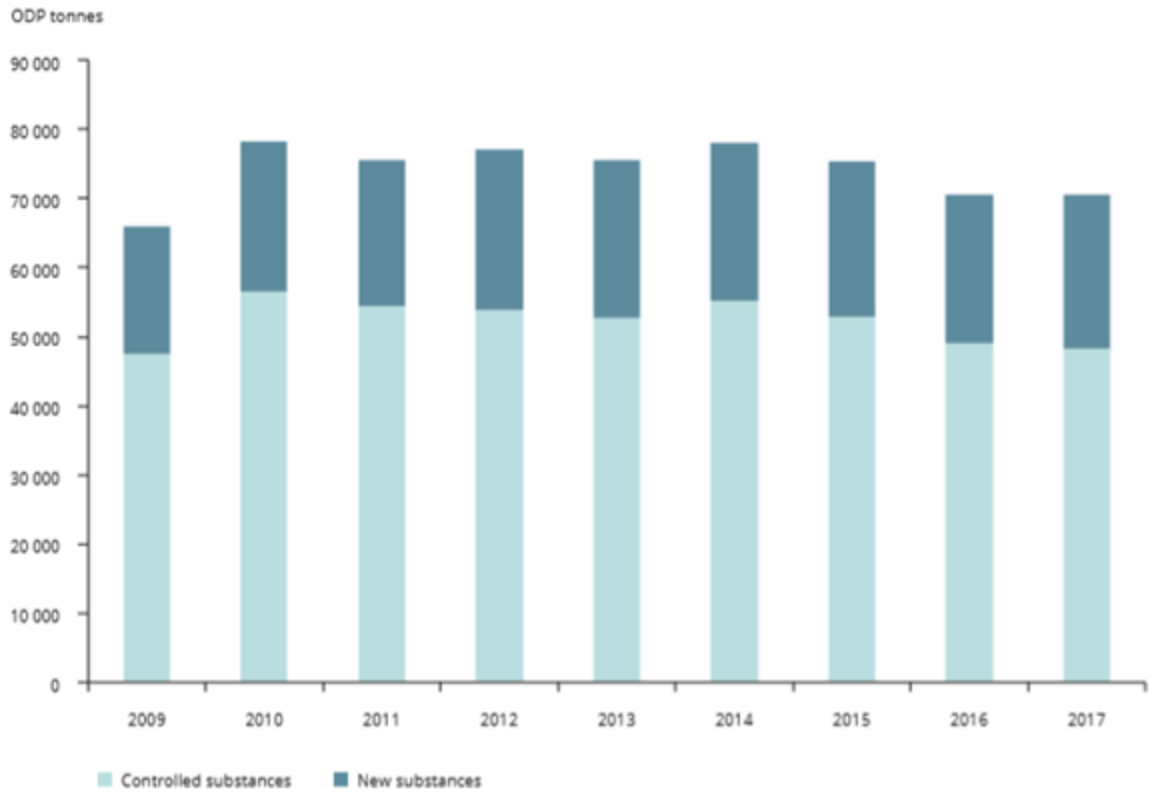
- **Production of ODS as measured by the Montreal Protocol (i.e. for non-exempted uses) is very limited.** The production of HCFCs has declined to 28 ODP tonnes (2017) in anticipation of the production phase-out by 2020.
- **The total EU production of ODS today is almost exclusively directed at feedstock use[43] (over 90%)** while, compared to the period before 2010, the production of ODS for other purposes than feedstock was significantly reduced. Total production of ODS in the years 2010 to 2017 has remained fairly stable, as anticipated, both in total metric tonnes as well as in ODP tonnes (Figure 6). The most relevant substances based on ODP tonnes were carbontetrachloride (CTC) and HCFCs (for feedstock). Production of new ODS (also mostly feedstock) was relatively stable during 2010-2017, at about a third of the production of ODS (in ODP tonnes) covered by the Montreal Protocol. 98% of this quantity is methylchloride that was not considered to be included in the monitoring at the time of the impact assessment for the 2010 partial review. The total EU production of the other new ODS was 4,760 metric tonnes in 2017 (3,600 metric tonnes in 2016) and thus above the expected average production levels of up to 2,060 metric tonnes per year.

41 Commission Decision 2010/372/EU of 18 June 2010.

42 Commission Implementing Decision 2014/8/EU of 10 October 2013.

43 Feedstock use is not included as consumption under the Montreal Protocol.

Figure 6 – Total production of ODS and new ODS in the EU (2009-2017)



EEA Report on ODS (2018)

3.1.1.3 Banks

Old refrigeration equipment with ODS is quickly disappearing from the waste stream[44], which is leading to reduced emissions from banks in Europe for HCFC-22 (i.e. the most commonly used HCFC refrigerant)[45] Conversely, for foams a large bank of ODS still exists (see Figure 7 for CFCs), in particular CFC blown foam that was used for building insulation.[46] A large part of these CFCs will remain in the foam during the whole service life of the insulation layer, and may be emitted in the future if, at the foam's end of life, the waste it is not managed properly. Foams, especially if used in construction, can have useful lifetimes of 50 years or longer. In 2015, around 97% of ODS retirements were estimated to be from the foams sector while by 2020 the majority of the refrigeration bank will have disappeared (SKM Enviros, 2012).**Error! Bookmark not defined.** The total size of the bank in the EU in 2010 was estimated in the impact assessment, although with a high degree of uncertainty, at 700,000 ODP tonnes, while a later expert study estimated 570,000 ODP tonnes (SKM Enviros, 2012).**Error! Bookmark not defined.** Annual emissions from ODS banks are estimated to be in the range of 17,000-24,000 ODP tonnes in the EU (compared to 180,000 globally) (SKM Enviros, 2012). The challenge is to ensure that the

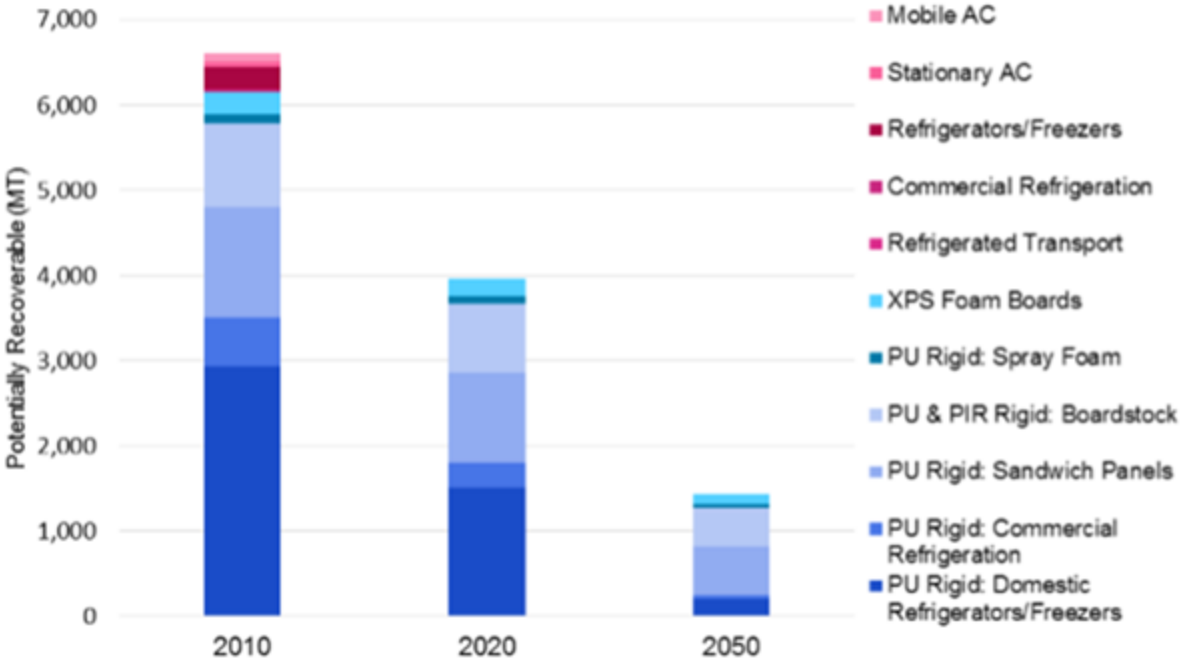
44 ICF (2018). ODS destruction in the United States and abroad. EPA 430-R-18-001.

45 Grazioni et al. (2015). European emissions of HCFC-22 based on eleven years of high frequency atmospheric measurements and a Bayesian inversion method. Atmospheric Environment 112:196-207.

46 SKM Enviros (2012), Further Assessment of Policy Options for the Management and Destruction of Banks of ODS and F-Gases in the EU. Final Report.

ODS banked in equipment is not emitted when the equipment enters the waste stream. Figure 7 shows the quantities that are potentially recoverable from equipment containing CFCs.**Error! Bookmark not defined.**

Figure 7 – Quantity of CFCs in metric tonnes that is potentially recoverable from retired EU equipment at its end-Of-Life (2010-2050)



ICF (2018)

3.1.2 Implementation of the Regulation

The EU-wide ODS Licensing System, the registration of laboratories, the quota system and the managing of exemptions and derogations are implemented at EU level by the Commission. The EEA manages the annual reporting by companies. For Member States authorities the main implementation tasks relate to market surveillance, inspections and custom controls; issuance of penalties in cases of non-compliance; promoting recovery, reclamation and destruction; reporting on halons and illegal trade; establishing qualifications for technicians; as well as granting production authorisations (the latter for a few Member States only).

3.1.2.1 Implementation by Member States

– **The scope of the tasks for Member States has been reduced considerably in recent years as the number of undertakings producing and using ODS has decreased substantially from previous Regulations.** Only five Member States still have ODS producers[47] on their territory. Similarly, the qualification requirements for leakage

[47] In total 15 producing companies some of which are producing only very small amounts. The handful of larger producers are large international chemical companies whose main business is not anymore linked to ODS production.

checking for some equipment were already established by Member States previously and are now becoming less important[48] considering that refrigeration, air-conditioning and heat-pump equipment may no longer be serviced and many types of ODS-using equipment have reached their end of life.

- **There have not been major implementation deficiencies by Member States since 2010.** Only one infringement case was launched against one Member State in 2013 concerning a late notification on penalty rules. Awareness of the Regulation's requirements among the remaining users of ODS is generally high according to Member States authorities as well as undertakings. This may be somewhat less the case for the multitude of laboratory users according to one competent authority (Ramboll, 2019), but these entities usually use only very small amounts of ODS.
- **Environmental inspections on entities handling ODS were most frequently identified as important enforcement activities by competent authorities, besides custom controls.** Most Member States use a risk-based approach in their inspection and enforcement activities. The obligatory equipment logbook and labelling are an important source of information that are good starting points for the detection of infringements, according to one competent authority (Ramboll, 2019). Challenges encountered by Member States with respect to enforcement are mainly a lack of resources, but also various complications related to the identification of (equipment with) ODS and being able to distinguish between legal and illegal uses and trade. Many Member States reported that illegal activities were identified in 2010-2017 and sanctioned according to national legislation. It was difficult to obtain more details from Member States despite solicitations to provide more information on the extent of (non-) compliance. This is in particular the case for federal Member States, as one such country explained in the stakeholder meeting (see also Annex II), as most infringements result in administrative fines that are not tracked in any way. According to the Member States, the actual number of criminal prosecutions related to breaches of the Regulation appears rather limited.
- **Many Member States rely to a large degree on measures introduced under the existing waste legislation, partly even before the Regulation applied, as regards the promotion of recovery, recycling, reclamation and destruction of ODS.** Member States are required to "encourage" extended producer responsibility by the Regulation. There are also good synergies with measures on end-of-life treatment under the F-gas Regulation, which affects the same sectors. There is not, however, any mandatory requirement in the Waste Framework Directive and related Directives for Member States to extend responsibility of used ODS refrigerants to the producer and, as a result, only a few Member States have done so (e.g. DE, FR). There are also good synergies with measures on end-of-life treatment under the Fgas Regulation, which affects the same sectors. Some countries reported further measures[49]:
  - Databases on leakage checks and operators of ODS-containing equipment enabling the calculation of emissions and keeping track of halons and other stocks (PL) and undertakings' record keeping (EE);
  - Charges for ODS emissions (PL) and taxes for ODS imports (DK);

[48] However very similar skills continue to be needed for handling such equipment with HFCs, which is regulated by the Fgas Regulation.

[49] In addition, a previous expert study from 2012 collected national measures on waste management of ODS. See SKM Enviros (2012)

- Additional fee by installers and refrigerant wholesalers to cover expenses of destruction (DK);
- Establishment of facilities for the collection, handling and (in some cases) destruction of used ODS (either publicly financed (EE, PL, HR) or set up with public support schemes (CZ, NL) and now financed by the private sector (NL); and
- Information provision to users on proper disposal (DE, EE).

- **Reclamation and destruction facilities are unevenly distributed in the EU.** In 2010, approximately 55 commercial reclamation facilities and 23 commercial destruction facilities were spread out across 17 and 11 Member States, respectively.[50] Since collection schemes are implemented at national and lower levels, not being able to destroy in the same country where collection takes place can pose significant barriers to the destruction obligation.
- **Member States report annually to the Commission on quantities on halons installed, used and stored for remaining uses**, measures taken to reduce their emissions and an estimate of such emissions, and progress in evaluating and using adequate alternatives.

4. METHOD

4.1 Short description of methodology

A lot of data, in particular as regards effectiveness and benefits, are available from e.g. EEA reports on ODS (2011-2017), Montreal Protocol technical bodies and scientific literature. The Commission was assisted by an external consortium of experts that carried out the analysis of available data, background documents and literature including data on alternatives; the stakeholder consultations; a standard cost model-based assessment of costs of the Regulation together with a counterfactual analysis; and a legal analysis of the Regulation and related legislation. The work was overseen by a Commission inter-service group (ISG).[51]

4.1.1 Stakeholder consultations

The stakeholders concerned by the Regulation are diverse[52], in terms of e.g. size of the company, position in the value chain and the sector they are active in. To derive sufficient and pertinent information, the open stakeholder consultation was complemented by surveys of targeted stakeholders (both undertakings and competent authorities), followed by targeted detailed interviews on specific topics (in particular as regards efficiency). Finally, a stakeholder workshop to validate the findings was held. Separate reports on the consultation of undertakings, competent authorities and the online public consultation including details on design and results are available.[53] Unless quoted

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50 ICF International, Identifying and Assessing Policy Options for Promoting the Recovery and Destruction of ODS (ODS) and Certain Fluorinated Greenhouse Gases (F-Gases) Banked in Products and Equipment (May 2010), p. 31.

51 This staff working document and the original external study are however based on a different intervention logic. Please see also Annex I, point 5 for more explanation.

52 But becoming less in numbers as the phase-out in many sectors has been achieved or is progressing

53 See Appendixes 4.1, 4.2 and 5 to the support study for this evaluation (Ramboll, 2019).

otherwise, stakeholder positions presented in this document are taken from these consultations. Annex II provides a synthesis report of the stakeholder consultations.

4.1.2 Cost assessments

The assessment of the costs of complying with the Regulation is based on, in total, 27 interviews to collect cost information from national competent authorities (7 interviews) and commercial undertakings (20 interviews). An effort was made to ensure a representative sample by targeting "typical", rather than "exceptional" organisations, based on the knowledge of the concerned sectors and relevant stakeholders. Based on questionnaires, undertakings and administrations provided for each measure of the Regulation, the extent of the cost of the Regulation in qualitative terms and, to the extent that the respondents were able to provide good estimates, also in quantitative terms, i.e. either the time required per action or monetary cost per equipment was collected.

Labour cost data for the Commission in terms of time (days) were determined on the basis of estimates of the number of full-time equivalent (FTE) employees assigned to the tasks related to the Regulation. Further costs were identified that relate specifically to the setting up and running of the IT system and the purchasing of external services. Personnel costs and IT costs required for company reporting activities were obtained from the EEA by personal communication.

In addition, a counterfactual analysis focusing on the situation where the Montreal Protocol would have been implemented at the level of the 28 individual Member States, without the provisions of an EU-wide Regulation, was costed. As explained in section 5.5.1, this is a purely hypothetical scenario unlikely to be suited to the need for the EU to comply jointly with the Montreal Protocol (REIO clause; see section 2.1.2) nor the functioning of the internal market. This is therefore simply used as a point of comparison in the analysis to demonstrate the added value of EU-level legislation.

Annex III describes the detailed methodology for deriving costs.

4.2 Limitations and robustness of findings

Generally, a large amount of background data is available, including in the public domain (see Annex III). These data were complemented by large amounts of information provided by undertakings and authorities in the different consultations as regards all the criteria of the evaluation (Annex II). The data basis for most evaluation criteria is therefore rather good. Some findings as regards the costing of the different measures of the Regulation are however subject to some limitations as follows.

– The survey information from open and targeted consultations provided mostly qualitative information on costs. For this reason, follow-up interviews with undertakings and competent authorities of the Member States directly requested quantified cost data.

– On individual measures, stakeholders (and authorities) were not always able to provide this information in quantitative terms. This is the case for various reasons, i.e. because these costs were not systematically recorded, incurred mostly in the past (phase-outs), were small compared to overall expenditure or could not be separated from other costs e.g. stemming from related legislation[54]. In these cases, qualitative

[54] e.g. Industrial Emissions Directive, Waste Legislation etc.

assessments are given wherever possible, building on the appreciation of stakeholders in the consultations on a scale of 1 (no costs) to 5 (very high costs).

- It was generally easier for the respondents to put a price on administrative measures of the Regulation, whereas most found it very difficult to do the same for compliance measures (e.g. phase-out schedules, national inspection obligations, technical requirements for destruction, technical requirements for leakage and emission control).
- In addition, there are inherent differences in the situation between different Member States. The Member States giving quantitative data included the largest countries where most of the affected industry resides. Therefore, some of the costs for responsible authorities extrapolated to the EU level may have actually been overestimated.
- The affected companies are diverse and operate in different sectors. A number of measures apply only to some undertakings or some sectors. Given the limited data basis for deriving quantitative costs, the figures presented on costs are based on average or median costs from a small sample of selected respondents in each case. The cost estimations for undertakings therefore present a range rather than absolute costs. Stakeholders in the workshop did not challenge any of the presented cost figures.[55]

5. ANALYSIS AND ANSWERS TO THE EVALUATION QUESTIONS

5.1 Effectiveness

5.1.1 To what extent have the (general) objectives[56] been achieved?

The analysis presented in this section shows that the Regulation has been effective in achieving its objectives.

5.1.1.1 Compliance with international obligations

The EU fully complies with its core obligations under the Montreal Protocol. Article 8 of the Montreal Protocol provides for non-compliance procedures and mechanisms. It mandates a special Implementation Committee to deal with cases of non-compliance. This Committee has not established any cases of **non-compliance affecting the EU and its Member States in the period 2010-2017.** The EU complied with the core obligations in the following way:

- **ODS Consumption phase-out**: As can be seen in Figure 4, the EU has met its obligations on consumption[57] under the Montreal Protocol in the period 2010-2017, below the control limits set (e.g. dotted line in figure) and generally much earlier than required, as anticipated by the impact assessment (without further measures).

[55] With the exception of company reporting, for which one data point was challenged as unreasonable by a national authority. For this reason, the median value was used in this case rather than the average.

[56] The specific objectives are adressed in 5.1.3

[57] EU jointly complies on consumption, see section 2.1.2

- **ODS Production phase-out**: The Regulation prescribes the phase-out for producing companies that allows Member States to comply with the Montreal Protocol.[58] While all limits were complied with, France in 2012 slightly exceeded its annual limit of production of HCFCs, as the produced quantity was destroyed only in the following year (year's end effect). The Parties to the Montreal Protocol recommended the monitoring of France's progress in subsequent years, which did not lead to further action.
- **ODS Reporting**: All parameters relevant to EU consumption were reported yearly to the Montreal Protocol's Ozone Secretariat based on annual company reporting collected in the EEA`s BDR for consumption. The production data is also collected in the BDR and submitted to the Ozone Secretariat, but the production data must be confirmed to the Ozone Secretariat by the affected Member States individually, since production compliance is established at country level. Five EU Member States (Hungary, Latvia, Lithuania, Luxembourg and Romania) exceeded the deadline for confirming the submitted production data (showing their production was zero), and there were some cases of ODS stockpiling. These cases, however, did not result in any formal non-compliance cases.
- **A fully compliant licensing system has been in place**. This system was established already under the previous Regulation.

5.1.1.2 High level of protection of the ozone layer and avoidance of climate change

The Regulation has continued to ensure a high level of protection of the environment in view of achieving a timely recovery of the ozone layer and limiting climate change, by reducing ODS emissions. For ODS, contrary to other GHGs, emission data is not routinely assembled at European level, as these gases do not require emission reporting under the UNFCCC (nor under the Montreal Protocol), and data are therefore not readily available. Nonetheless, a recent scientific article[59] confirms that emissions of HCFC-22, the most common HCFC used as refrigerant, are indeed declining rapidly over Europe in line with previous estimations (Figure 8), while global emissions of this substance still continue to rise.[60] Two scenarios predict a continuing strong decline of HCFC-22, approaching zero after 2025 (Graziosi et al. (2015)). For the earlier generation of ODS, the CFCs, existing data on CFC-11 (most relevant species) indicates that these emissions similarly continue to decline and that there appear to be no significant problems of emissions currently from remaining stocks or as untreated waste in old equipment that is landfilled in the EU.[61]

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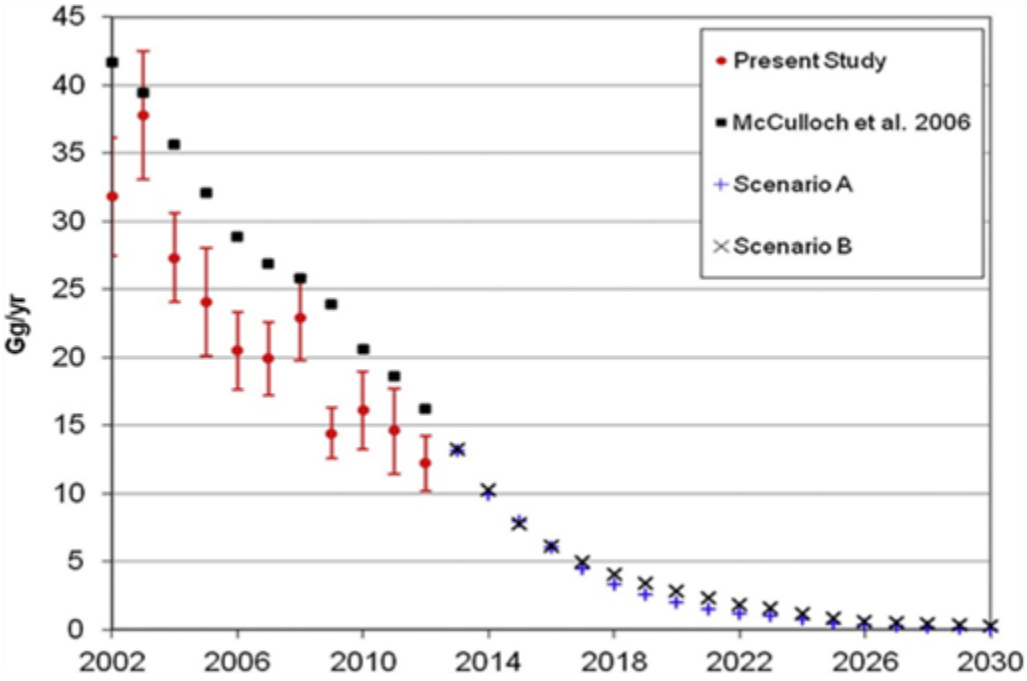
58 Production compliance must not be achieved at EU level, but at Member State level (see section 2.1.2)

59 Graziosi et al. (2015). European emissions of HCFC-22 based on eleven years of high frequency atmospheric measurements and a Bayesian inversion method. Atmospheric Environment 112: 196-207.

60 e.g. Reimann et al. (2018). Observing the atmospheric evolution of ozone-depleting substances. Comptes Rendus Geoscience 350 (7): 384-392.

61 Montzka (2018). Presentation at side event by Scientific Assessment Panel of Montreal Protocol. http://conf.montreal-protocol.org/meeting/mop/mop30/presentations/Side%20events%20presentations/Montzka_MOP_Final_2post.pdf.

Figure 8 – European[62] emission estimates and projections for HCFC-22, the most common HCFC used as refrigerant in the past [1000 metric tons per year]



Graziosi et al., 2015

The EU exceeds all other developed countries in reducing more quickly and more substantially the consumption of ODS controlled by the Montreal Protocol (Figure 9). A number of relevant and important phase-out obligations for different substances and uses exceed the international obligations, either by not being required at all by the Montreal Protocol or because their phase-out has been anticipated in the EU. The EU had a negative Montreal Protocol consumption in each year since 2010 as a result of the achieved HCFC phase-out, whereas all other developed countries had a zero or positive consumption in each year.[63] In particular, the phase-out of HCFCs for refrigeration and air conditioning was completed in the EU in 2010, while other developed countries have until 2020 to do so, including the possibility to still use 0.5% of the baseline for specific purposes until 2030 (servicing tail).

The EU has also phased out the import and export of equipment of HCFC equipment and limited until 2015 the use of recycled/reclaimed HCFCs for use in such equipment. The Montreal Protocol does not prescribe these measures.

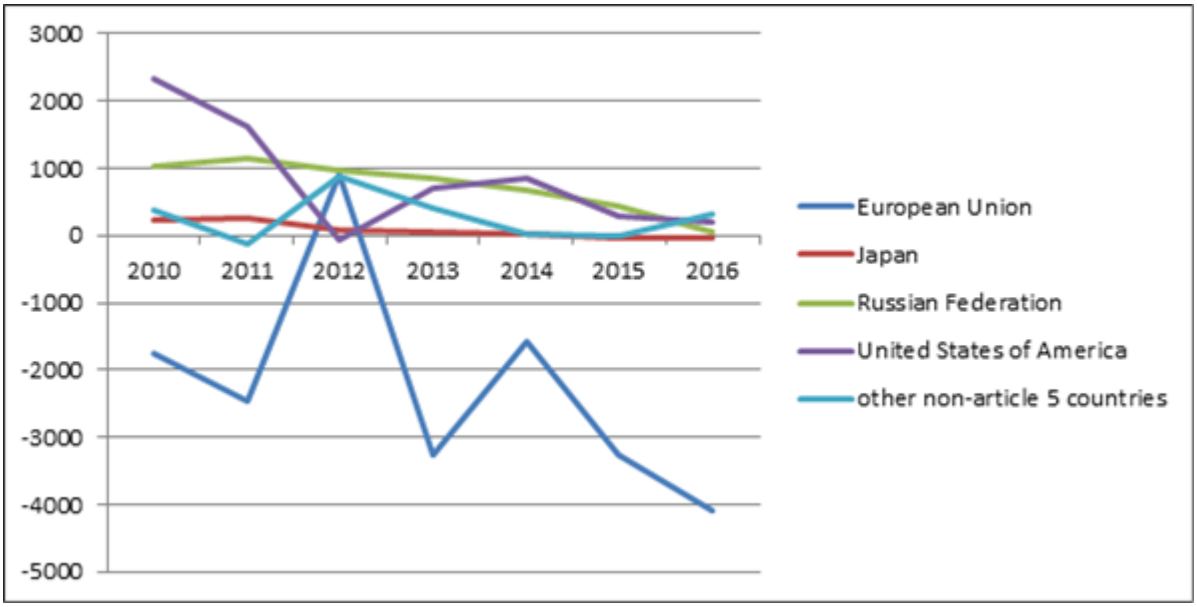
For methyl bromide, the EU has also had a negative consumption in each year since 2010, whereas some other non-Article 5 countries (Australia, Canada and the USA until recently) had a positive consumption in each year and needed to apply for exemptions for this use under the Montreal Protocol. In addition, specific dates were set in the EU, ranging from 2011 to 2040, by which halons, including non-virgin halons, may no longer

[62] More precisely: "European geographic domain", which includes also non-EU countries such as e.g. Norway, Switzerland and Balkan countries

[63] Except Norway in 2012

be used in different equipment. Comparable requirements do not exist in other developed countries.

Figure 9 – Montreal Protocol consumption for EU and other non-Article 5 parties (i.e. developed countries) for 2010-2016.



Data obtained from Ozone Secretariat (UN Environment)

5.1.2 What factors had a positive or negative influence on the achievements observed, and how?

5.1.2.1 Internal factors (measures of the Regulation)

In the public consultation 87% of the respondents agreed or strongly agreed with the statement, that the Regulation has contributed to the reduction of the consumption of ODS in the EU. 71% agreed with the statement that the Regulation's requirements that go beyond the core Montreal Protocol requirements have led to a more effective reduction in the consumption of ODS. For every individual measure of the Regulation a majority of undertakings stated that it was effective in controlling ODS. The phase-out schedules (for HCFCs and halons), the technical requirements for reclamation and destruction as well as leakage and emission controls were identified as the most effective measures. These results did not seem to greatly depend on the sector or the size of the undertaking as shown in Table 3 for registration requirements for laboratories, licensing requirements and reporting requirements.

Table 3. Percentage of undertakings (strongly) agreeing or (strongly) disagreeing with effectiveness of measures, by sector and size

Sector/ Size	Number*	Registration requirements for laboratories		Licensing requirements		Reporting requirements	
		% agree	% disagree	% agree	% disagree	% agree	% disagree
Chemical industry	96	82%	5%	68%	18%	68%	19%
Aviation	100	n.a.	n.a.	55%	7%	57%	11%
Laboratories	117	71%	7%	79%	3%	n.a.	n.a.
Pharmaceutical industry	59	82%	3%	95%	0%	71%	0%
SMEs	214	75%	8%	63%	7%	73%	8%

** Total number of undertakings in the category. Please note that the numbers to which a measure applies, and on which the percentages are based, are always smaller.*

Responses from competent authorities in Member States mirror these findings. While a majority viewed all measures as effective, the phase-outs of HCFCs, methyl bromide and halons, national inspections and the registration requirement for laboratories were identified as most effective (at 90% agreement). For measures that require market surveillance at national level, such as labelling, reclamation requirements, and leakage control, there were fewer respondents among these national authorities who strongly agreed on their effectiveness (even though this was still the majority view).[64] Measures that require resources at EU level intervention but less resources at the national level, e.g. quota limitations, registration requirements for laboratories, and licensing requirements, received very high scores from national authorities regarding effectiveness. While a majority also agreed that the Regulation ensures that ODS stocks are managed properly, a few authorities thought that the Regulation's provisions on the management of stocks were not clear enough, and thus less effective. In the stakeholder workshop, several Member States emphasised that leakage control measures are very important and increase the awareness of users and that good enforcement is key. One national authority stated that the quota allocation system is unnecessary and ineffective (see also 5.3.4.3).

5.1.2.2 External factors

The role of external factors in achieving the objectives is less clear than it is for the measures of the Regulation itself. Only a small minority (16%) of undertakings thought external factors had led to a decrease/increase of ODS use, while most of them either did not think that such external factors had played a role or did not know. External factors identified as relevant were first and foremost the general economic situation, but also other sector-specific requirement and legislation such as International Civil Aviation Organization (ICAO) regulations on halons and factors related to Research and Development (R&D), like funding and priority setting. In the authorities survey, 43% of the respondents thought that also factors other than the Regulation ensured the reduction of the consumption of ODS in the EU. The most frequently identified factors were R&D funding, other EU legislation such as waste and the Fgas Regulation, as well as

[64] This is probably also not very surprising if one considers that these measures are supporting measures whose purpose is to facilitate the enforcement of the main measures.

awareness raising campaigns. In the public consultation, 48% agreed that external factors were (also) relevant. Respondents identified (in order of frequent mentioning) the timely availability of alternatives, public awareness, other legislation such as ICAO and involvement of local government as factors.

5.1.3 What have been the most prominent qualitative and quantitative effects of the Regulation (in line with the specific objectives)? To what extent can these effects be credited to the Regulation?

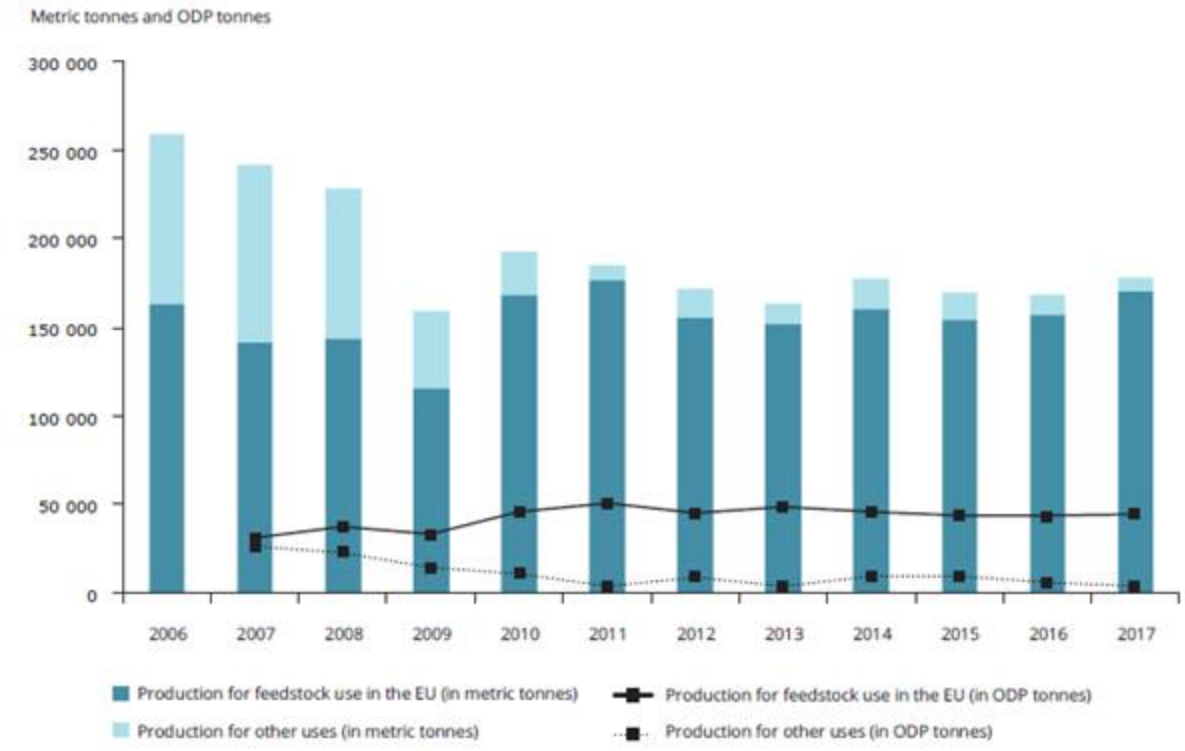
5.1.3.1 Ensuring the progress achieved and further reduction of ODS

- **EU consumption levels as defined by the Montreal Protocol have essentially stayed at negative levels since 2010** (Figure 9). 22 (out of 23 responding) national authorities agreed that the Regulation ensured the reduced production and consumption of these ODS in the period 2010-2017.[65]
- **Use of methyl bromide for pre-shipment and quarantine purposes has been completely phased out following its 2010 prohibition** except for possible derogations in emergency cases (not yet used). This has resulted in additional savings of 200 ODP tonnes a year since 2010, in line with expectations of the impact assessment.
- **HCFC use[66] in refrigeration has been eliminated.** Further reductions in ODS use (ca. 1,000 ODP tonnes) were achieved due to the 2015 prohibition on recycled and reclaimed HCFCs (for refrigeration). A few derogations were granted after that date but the last derogations expired in 2018. It should be borne in mind that this sector was the major application area of ODS in the past.
- **Reaching the production endpoint for HCFCs required by the Montreal Protocol will in all likelihood be achieved this year (2019).** EU ODS production for uses other than feedstock has been significantly reduced compared to the period before 2010 (Figure 10), as a result of the production phase-out schedule and the linked prohibitions on use and trade of ODS. Production continues mostly to satisfy feedstock uses (including new ODS) which are exempted under the Montreal Protocol.

[65] The one disagreeing country added that they had achieved it earlier than required by the Regulation

[66] Including the import/export of refrigeration equipment with ODS.

Figure 10 – EU Production of ODS (only substances listed in Annex I)



EEA Report on ODS (2018)

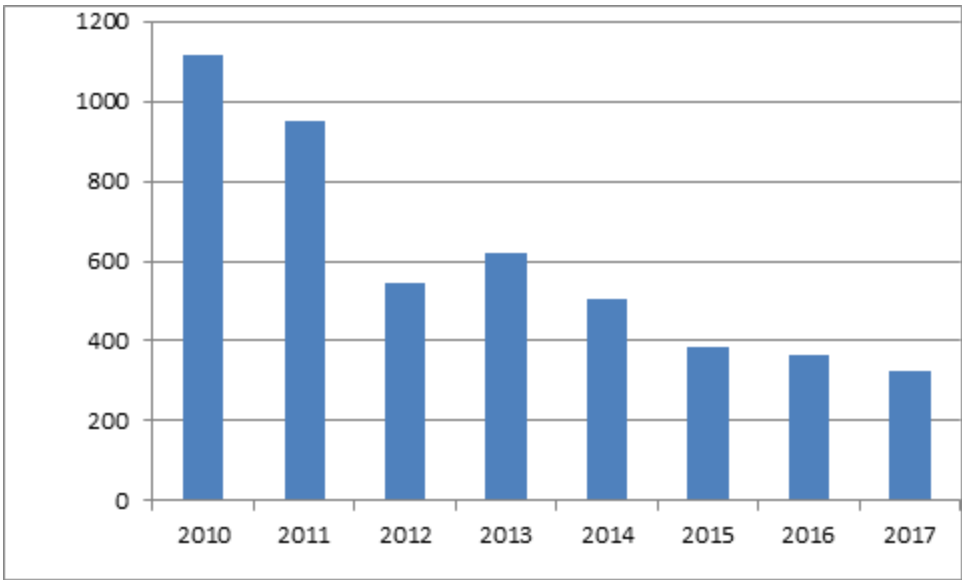
5.1.3.2 Development and uptake of alternatives to further limit the use of ODS

From 2010 onwards, and even though in many areas the low hanging fruits were picked by previous Regulations, further advances have been made in the development and use of suitable alternatives in the few remaining sectors of use.

– **The amounts of process agents employed have been reduced by more than two thirds since 2010,** reaching 324 metric tonnes in 2017. The 2017 emission levels of 4.1 metric tonnes or 4.5 ODP tonnes (vs. 20 ODP tonnes forecasted in the impact assessment) also confirm the progress made. Only five of the eight undertakings allowed to use ODS 2010 are still using ODS as process agents, but this change is likely to be a result of business decisions rather than the Regulation. The Montreal Protocol no longer exempts some application areas following their removal from Table A of Decision XXIX/7 of the Parties in 2017, after their elimination in the EU and elsewhere.[67] Today the process agent use in the EU is well below the above-mentioned limit decided by Parties to the Montreal Protocol (see Figure 11) and further reductions are expected, as the remaining uses are likely to be phased out once these old installations are modernised. So while the limit set out in the Commission Decision 2010/372/EU from 2010 (as amended) is safeguarding compliance with the Montreal Protocol, it is no longer an effective driver for further reductions. The list of permitted uses may need updating as one of the installations has started to adopt an alternative.

67 http://conf.montreal-protocol.org/meeting/mop/cop11-mop29/report/English/COP-11-7-MOP-29-8E.pdf

Figure 11 – Process agents use in EU from 2010 – 2017 (in metric tonnes)



Calculated using data from EEA reports 2011-2018. 2014 data was estimated by interpolation.

Ramboll (2019)

– **The Regulation incentivised the search for alternatives to halons.** For halons, today's exempted uses are limited to specialised areas such as fire fighting in civil aircraft and for military uses. The switch to alternatives in these specific applications is on going, as the use of reclaimed halons for these uses is gradually phased out in the EU until 2040.[68] Several available alternatives could be identified53, with some options are currently already in use within the EU. These include portable systems or hand-held devices e.g. at airfields and airports, but also replacements in military ground vehicles. Some developed alternative options, however, appear to pose difficulties such as requiring major technical modifications to the equipment or posing weight constraints, according to some of the undertakings affected. The installed base and stocks of halons and their emissions have all declined between 2010 and 2016 (Table 4), but the used amounts have increased to the level forecasted by the impact assessment (i.e. "500 ODP tonnes"). A reduction of halon use to zero by 2030, as theoretically considered by the impact assessment[69], is not realistic as the adopted phase-out schedule extends to 2040. In the view of several national authorities, the Regulation's phase-out dates have (strongly) pushed the search for halon replacements in fire-fighting equipment in civil aviation and moved forward discussions at ICAO to introduce globally applicable phase-out dates.

[68] The Montreal Protocol only prohibits the production and consumption of virgin halons, while recycled and reclaimed halons may be used.

[69] The impact assessment did not carry out a detailed analysis of available technology choices. The phase-out schedule was established by a subsequent implementing act after the relevant consultations.

Table 4. EU total quantities of halons, available, used and lost, for 2010 and 2016

	2010	2016
Total installed in equipment	968 (8408)	867 (7576)
Total newly used	47 (409)	59 (519)
Total emitted	12 (107)	8 (71)
Total stored for future use	508 (4407)	493 (4306)

Data in metric tonnes (ODP tonnes in parenthesis)

Source: Data submitted by Member States. Figure for 2010 does not include Croatia (not a Member State at the time), Austria and Latvia (no data available).

- **For laboratory uses, steady progress on alternatives is being made**. The amounts for laboratory use are very small in total and have further decreased, partly as a result of the introduction of alternatives and partly due to new laboratory methods and new standards for testing and laboratory procedures. 36% (140 respondents) of laboratories indicated they reduced the amount involved in their activities in the period 2010-2017. Commission Implementing Regulation (EU) No 291/2011 provided more clarity to users by listing the uses where ODS are allowed (due to a perceived lack of alternatives) and uses where ODS are not allowed (as suitable alternatives are available).[70] This may have contributed to avoiding unnecessary and prohibited use of ODS. In their most recent publication on laboratory and analytical uses, the Technology and Economic Assessment Panel (TEAP)[71] invites Parties to the Montreal Protocol to consider removing further uses due to the availability of alternative options. The EU has not updated the list of prohibited uses because the use of ODS for laboratory and analytical purposes is already prohibited in the EU, if there is a technically and economically feasible alternative to using ODS. As actual consumption is below 1 ODP tonne, the quota limitation of producing and importing up to 110 ODP tonnes per year (while the impact assessment had expected needed quantities of up to 200 ODP) cannot be seen as effective in reducing and eliminating this use.
- **For feedstock uses, some alternatives have become available for a limited number of different processes.** Replacing feedstock use is very difficult, as this would require finding other, economical, chemical production pathways for a number of important products.[72] A complete replacement of feedstock use is therefore not realistic. The Regulation does not prohibit the use of ODS, even in cases where alternatives are available, but administrative hurdles to the use of ODS exist which may provide an incentive for innovation (e.g. avoiding the need of applying for licenses or quotas or reporting on use).

5.1.3.3 Emission prevention and management of stocks

Emission levels of the remaining uses of ODS in the EU are low.

[70] Commission Regulation (EU) No 291/2011

[71] UNEP (2018). Report of the Technology and Economic Assessment Panel (TEAP). September 2018. Volume 4, Response to Decision XXVI/5(2) on Laboratory and Analytical Uses.

[72] Miller, M. and Batchelor T. (2012). Information Paper on Feedstock Uses of Ozone-Depleting Substances. Touchdown Consulting, December 2012.

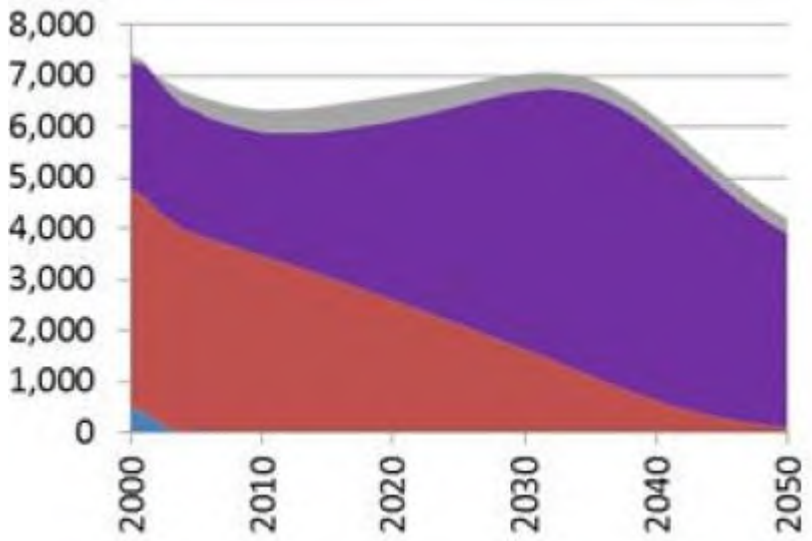
- **The chemical industry appears to have made improvements of emission control in the production process.** The Regulation prescribes that all precautionary measures practicable must be taken to prevent and minimise leakages and emissions (Article 23(5)). This provision is burdensome to enforce even though synergies with industrial emission policies and inspections carried out in that context exist (see section 5.3.4.6). Feedstock use of ODS represents the majority of current production, trade and use, but is mostly non-emissive if good production standards are adhered to.[73] Only 0.03% of ODS used as feedstocks were emitted in 2017, i.e. 26 ODP tonnes, but emission rates can differ significantly between undertakings (EEA Report on ODS, 2018).**Error! Bookmark not defined.** Current emission rates are much lower than the one assumed in the impact assessment (1%) which largely explains why emissions are so much lower than anticipated (i.e. 600 ODP tonnes). Emissions from new ODS used as feedstocks have improved to levels of 0.012% recently (2017), while emissions of ODS used as process agents are significantly larger than those of feedstocks, at 1.28% (2017) (EEA Report on ODS, 2018).**Error! Bookmark not defined.** In 2011 and 2012, the latter still exceeded the ceiling imposed by the Regulation. This is no longer the case since 2014 and undertakings are now staying well below the limit (16.1 metric tonnes[74]), as only 4.1 metric tonnes (or 4.5 ODP tonnes) were emitted recently (EEA Report on ODS, 2018).**Error! Bookmark not defined.** This exceeded expectations of emission below 20 ODP tonnes in the impact assessment.
- **Remaining banks of ODS from refrigeration and air conditioning applications have reduced. Banks from foams have long lifetimes resulting in stable emissions.** Emissions from equipment occur mostly during the use phase and at the end-of-life of the equipment when it becomes waste. For the use phase it is very difficult to measure the effectiveness of national measures directly as it involves a high number of dispersed equipment. The importance of good qualifications of technicians and their certification was highlighted by some national authorities and undertakings, a measure that has shown its merits and is mirrored in the F-gas Regulation (as F-gases replaced many ODS in the same type of equipment). The servicing of refrigeration, air-conditioning and heat pump equipment with HCFCs is prohibited since 2015, meaning that the end-of-life phase is becoming more important to emission prevention. National measures to promote recovery, recycling, reclamation and destruction of ODS have resulted in a number of different approaches including at sub-national levels (see 3.1.2.1). There are strong overlaps with waste treatment policies, which range from user awareness to collection incentives to legal obligations. Authorities see the WEEE Regulation as an important driver for the recovery of refrigeration equipment (SKM Enviros, 2012).**Error! Bookmark not defined.** The effectiveness of addressing ODS contained in foams is much lower, since recovery is often difficult and costly. No waste measure for foam provides an average abatement cost lower than €50 per tonne CO_2 abated for the whole period from 2012-2050 (SKM Enviros, 2012). Construction foams offer the most effective options for effective treatment because of the volumes involved, but in practice there is very little, if any, recovery of ODS from construction foam applications at the time of demolition (SKM Enviros, 2012). Due to the high costs involved, the Regulation's obligation to recover only if technically and economically feasible is not effective. It is therefore likely

[73] Despite the low amounts of emissions from feedstock use it must be kept in mind that falsely declaring prohibited uses of ODS as feedstocks (or other exempted uses) is a possible way of circumventing the Regulation, which is a relevant concern due to the high amounts of substances still used in this way.

[74] Article 8(4) of the Regulation gives a limit of 17 metric tonnes. Commission Implementing Decision 2014/8/EU of 10 October 2013 established the limit of 16.1 metric tonnes in its confidential annex.

that emissions from foam banks will continue at relatively constant rates for the next two decades (Figure 12), at about 6,000 ODP tonnes per year (SKM Enviros, 2012). However, recent measurements have not shown increased concentrations of ODS over the EU that would be an indication of increased losses from banks such as ageing equipment or from equipment in landfills[75].

Figure 12 – Estimated future emissions from banks in ODP tonnes



Blue: Emissions at beginning of operational life of equipment (BoL); Red: Emissions during use phase; Purple: Emissions during end-of-life (EoL); Grey: Estimated abated emissions (through Collection & Destruction)

SKM Enviros (2012)

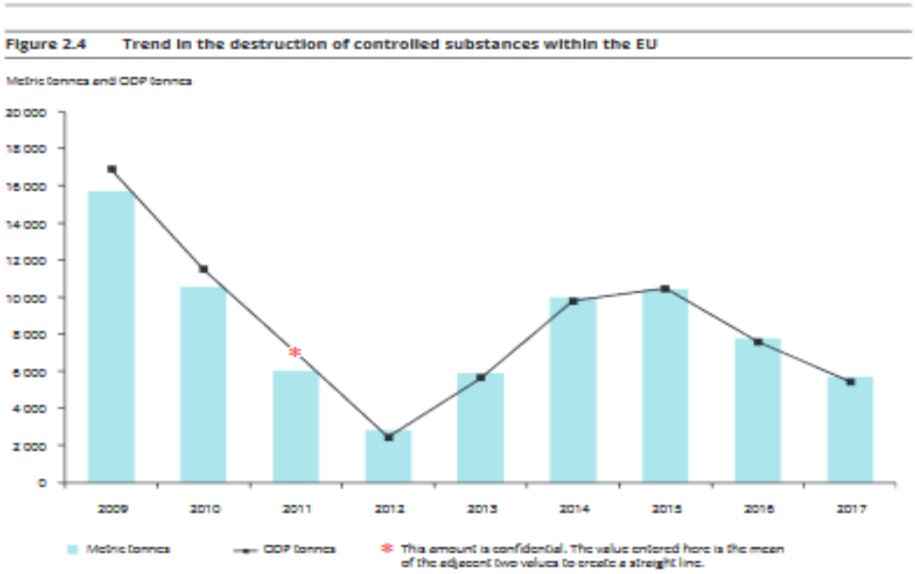
– **No clear trend for ODS destruction is apparent for the last decade, but the amounts destroyed (6,000-10,000 ODP tonnes) are relatively significant compared to the (negative) EU consumption** (Figure 15**).** The amounts destroyed are mainly from unintentionally[76] produced CTC that are subsequently destroyed, rather than from recovered amounts from equipment (EEA Report on ODS, 2018).**Error! Bookmark not defined.** Destruction infrastructure is limited to some Member States (15) and therefore poses a limitation to effective implementation. Excluding CTC destruction, the highest amounts destroyed in ODP tonnes were in Germany, France, Sweden and Denmark. These destroyed substances are mostly CFCs. In the Netherlands relatively high amounts of HCFCs are destroyed, which may be an indication of an efficient recovery scheme (see 3.1.2.1). Ca. 1600 metric tonnes in total of CFCs and HCFCs were destroyed in 2017, which is up to 10% of the equipment entering the waste stream.[77]

[75] Montzka (2018). Presentation at side event by Scientific Assessment Panel of Montreal Protocol. http://conf.montreal-protocol.org/meeting/mop/mop30/presentations/Side%20events%20presentations/Montzka_MOP_Final_2post.pdf.

[76] i.e. produced in a chemical synthesis where the main targeted product was another chemical ("by-production").

[77] Most of which is however composed of foams that pose technical and cost challenges to efficient collection and destruction.

Figure 13 – Trends in the destruction of ODS in the EU



EEA (2018) Report on ODS

5.1.3.4 Identifying new threats

The monitoring of uses not covered by the phase-out obligations under the Montreal Protocol and of new substances has allowed to follow the effectiveness of the Regulation`s measures. The implementation of the Regulation is being closely monitored in various ways that allow to keep track of the progress made in all relevant areas. An annual public report on ODS is published by the European Environment Agency (EEA) since 2011 on the basis of detailed annual company reporting required under the Regulation (EEA Reports on ODS, 2011-2018). Each year, the EEA also publishes a performance indicator showing the progress made on e.g. reducing production and consumption of ODS.[78] These reports substantiate that important quantities of ODS not falling under phase-out obligations are still traded and produced in the EU, underlining that controls remain important. The data for the new ODS show that they are mostly produced in the EU, at stable but relevant levels, and employed, almost exclusively, as feedstocks[79] where emission rates are very low (EEA Report on ODS, 2018). Some stakeholders including authorities have requested that a group of new ODS, i.e. the unsaturated HCFCs, should also be monitored going forward, due to their growing use as alternatives to HFCs in a number of applications.[80]

78 https://www.eea.europa.eu/data-and-maps/indicators/production-and-consumption-of-ozone-2/assessment-3

79 Small amounts are also used as solvents (n-propyl bromide, methyl chloride) or are unintentional by-production.

80 This was challenged by other stakeholders, including one association representing gas producers, equipment manufacturers and other companies.

5.1.3.5 Leading by example

There are a number of ways in which ambitious EU ODS policies, and the Regulation in particular, have promoted stronger actions worldwide and enabled that progressive policies are advanced under the Montreal Protocol.

- **The EU has concluded or is currently negotiating a number of trade agreements with other countries**[81] **that mutually encourage good implementation of the Vienna Convention and its Montreal Protocol**, as well as taking further steps to ensure good protection of the ozone layer and related environmental issues, in particular through fighting illegal trade.
- **Ambitious phase-out schedules have incentivised global political discussions.** The EU phase-out of ODS much ahead of its Montreal Protocol obligations was facilitating consensus on accelerating the phase-out schedules for Montreal Protocol parties[82]. More recently, the complete phase-out of methyl bromide for QPS uses in the EU has enabled the EU in meetings of the Montreal Protocol to strongly push for reduced exempted amounts by other countries such as Argentina, Australia, Canada, China, Mexico and the US, which has contributed to a gradual elimination of these amounts. Similarly, the EU phase-out schedule for halons has influenced the international discussions under ICAO to move forward and set global end dates for some of the applications using halons.
- **Alternatives to process agents and laboratory uses continue to be developed and used, and thus become available also to other Parties**. The exempted uses for specific applications are continuously reduced under the Montreal Protocol due to technological progress.
- **The obligatory leakage checks and training for technicians developed under the ODS Regulation and the Fgas Regulation are "exported" all over the world as best practice** for handling of refrigeration and air conditioning equipment, using ODS and the replacement HFC substances. AREA, the EU's association of service technicians, has cooperated with the implementing agencies UNEP Ozone Action, UNIDO and UNDP to train technicians in developing countries.[83] The LIFE-project "Real Alternatives" provides free online courses in many different languages for that purpose (including Turkish and Russian as non-EU languages).[84]
- **Good enforcement at home enables the EU to be a credible advocate for stricter rules elsewhere in the world.** The EU's negotiation position is strengthened by its stringent domestic rules and control and can be leveraged to raise the impact of the global effort of reducing the ozone hole and climate effects of ODS. Representatives of the Commission and the Member States regularly participate in regional network meetings

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81 e.g. explicit reference to the Montreal Protocol in trade agreement with Mexico; explicit reference also in agreements under negotiation with Australia/NZ, Chile, Indonesia, MERCOSUR and Tunisia; general reference to cooperation on multilateral environmental agreements in CETA (Canada), Japan, Singapore and Vietnam. Most recently, a reference to a strong commitment to the Montreal Protocol implementation in the joint EU-China summit statement, 9 April 2019.

82 Put in place by Decision XIX/6 of the Montreal Protocol in 2007.

83 http://area-eur.be/sites/default/files/2017-09/India-EU%20Summit%202017%20-%20AREA%20speech_0.pdf

84 www.realalternatives.eu

organised by UN Environment for National Ozone Units (NOUs)[85] in order to share the EU's experience in implementing its domestic measures as best practice examples.

5.1.3.6 Preventing and detecting illegal trade

- **The ODS Licensing System has enabled the exchange of relevant information submitted in the licensing process very efficiently with other countries and prevented illegal trade.** Non-EU countries are able to register in the EU's system to facilitate this exchange. This led to a more efficient participation by the EU in the voluntary iPIC (informal Prior Informed Consent) system established under the Montreal Protocol.[86] In the period 2010-2017 there have been 485 iPIC request involving EU companies (424 made by EU) and total prevented cases of illegal trade using the iPIC amounted to 162. The existence of a licensing system has also facilitated follow-up action by Member States on illegal trade. Most recently[87], Spanish authorities, together with EUROPOL and the French Gendarmerie, have caught a Spanish company illegally exporting HCFCs without a license. For these efforts, the Commission and Member States received the Ozone Protection Award for Customs and Enforcement Officers by United Nations Environment Programme's Regional Ozone Network for Europe and Central Asia several times in recent years in recognition of the strong commitment to address illegal trade.[88]
- **Illegal trade activities via exempted uses appear not to result in significant circumvention of the Regulation.** One way of circumventing the Regulation is to fraudulently declare ODS as an exempted use, while the actual use falls under a prohibition. This concern may be most relevant for feedstock use, as the quantities still used today in this way are much larger than for any other uses. One such case is currently being investigated where methyl bromide was declared as feedstock use but may have actually been used for a prohibited use such as fumigation. To determine if there were indications of illegal trade, amounts reported by feedstock users were compared to amounts reported by feedstock producers and importers. Stock changes[89] could largely explain any discrepancies found, so there were no concrete indications in 2017 that significant amounts are used illegally in this way (EEA Report, 2018).

5.1.3.7 Effectiveness of additional measures introduced in 2009

The impact assessment expected only very modest emission savings to result from simplification of the Regulation.[90] Strengthening the compliance with the Montreal

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85 The NOUs are the government units in developing countries that are responsible for managing their national programmes to comply with the Montreal Protocol.

86 http://unep.fr/ozonaction/information/mmcfiles/7628-e-iPIC_Supporting_compliance_through_prevention_of_illegal_and_unwanted_trade.pdf

87 EUROPOL press release 5 April 2019:

https://www.europol.europa.eu/newsroom/news/how-company-earned-to-€1-million-illegally-trading-ten-tons-of-ozone-depleting-substances

88 See e.g. OzoNews (2016), ECA Customs Cooperation Meeting and Network Meeting, Ashgabat, Turkmenistan, 24-27 May 2016 and ECA Ozone Protection Award for Custom & Enforcement Officers (4th edition). OzoNews, Vol. XVI, 15 June 2016. Retrieved from: http://www.unep.fr/ozonaction/information/nonmmcfiles/OzoNews-VolXVI-15%20JUNE%202016.pdf

89 Unexplained higher use was found in small quantities for methyl bromide (40 ODP tonnes) and HCFCs (6 ODP tonnes). For CTC a large discrepancy was explained by incorrect reporting by one company.

90 The only significant indirect emission savings from simplification were assumed to result from removing the possibility to use a special custom procedure for HCFCs and MB ("inward processing &

protocol was seen as important for saving emissions, but the impact assessment did not provide quantitative data. While a direct comparison is therefore difficult, it is clear that the extended licensing system and labelling, stronger inspection provisions and closer monitoring/limiting of exports as well as trade in products and equipment all have contributed to a good enforcement of the rules and control of illegal trade. As regards measures that aimed at addressing future challenges, the emission savings of prohibiting methyl bromide QPS uses have been achieved (200 ODP tonnes per year). The highest savings were expected from limiting emissions of ODS banks in products and equipment, but these are to a large degree a result of synergies with EU waste legislation and national measures, rather than the Regulation itself. While emissions from HCFC and CFC banks in refrigeration and air conditioning equipment are reducing quickly, this is not so for foams where effective measures are often prohibitively costly. Finally, 0 to 500 ODP tonnes were expected to be saved from monitoring new ODS and limiting halon 1202 uses[91]. The higher end of these savings was expected if any of these substances were produced in large quantities and/or represented a significant threat and where the Regulation would thus help to restrict their use. As such a significant threat has not yet been identified, it is not apparent that these measures have indeed resulted in high emission savings, in particular as the new ODS continue to be produced at stable to slightly increased levels.

5.2 RELEVANCE

5.2.1 To what extent is the intervention still relevant?

The intervention remains relevant and action from the EU is needed.

- **The Montreal Protocol (and the Vienna Convention) will continue to impose the need to regulate ODS and related environmental issues on the EU and its Member States.** The Regulation ensures that these obligations can be met.
- **Continued action will be necessary for the next decades in order to ensure the EU's contribution to protect the ozone layer, as some ODS are still in use within the EU (Figure 5) and the credible risk of redeployment of ODS in case of the absence of prohibitions to do so.** The modelled recovery of the ozone hole (see 5.3.1.1) assumes that all parties, including the EU, will comply fully with the obligations of the Montreal Protocol, while any backsliding could lead to serious delays (SAP, 2018). Furthermore, recent studies have indicated that some unregulated uses of ODS or illegal uses of ODS incentivised by cost savings may be leading to higher concentration levels of ODS.[92,93] These activities in East Asia threaten to delay ozone hole recovery by 7 to 20 years (SAP,

relief"), thus closing a loophole that could reduce emissions in third countries. The impact assessment also clarifies however that these savings of estimated 0 – 6500 ODP tonnes may in fact not be achieved due to possible relocation of the relevant activities to third countries.

[91] As well as potentially restricting the other substances monitored (i.e. those listed in Annex II B of the Regulation) should they be identified as posing a significant threat, in which case a regular procedure with scrutiny would allow them to be added to Annex IIA of the Regulation (and thus limit their use).

[92] Environmental Investigation Agency (2018). BLOWING IT: Illegal Production and Use of Banned CFC-11 in China's Foam Blowing Industry. Retrieved from: https://eia-global.org/reports/20180709-blowing-it-illegal-production-and-use-of-banned-cfc-11-in-chinas-foam-blowing-industry

[93] Montzka, S. A., Dutton, G. S., Yu, P., Ray, E., Portmann, R. W., Daniel, J. S., Elkins, J. W. (2018). An unexpected and persistent increase in global emissions of ozone-depleting CFC-11. Nature 557(7705), 413-417.

2018). In addition, new upcoming threats to the ozone layer may be identified, such as from short-lived ODS, whose impact may have been underestimated in the past. Consequently, ODS, if unregulated, could be reintroduced into the market, in particular as they are legally produced and used in many developing countries until 2030 and the fact that illegal trade is still happening in the EU indicates that without the prohibitions and control measures in the Regulation, ODS would likely re-emerge.

- **All relevant efforts to reduce emissions of GHG further are necessary in view of achieving the target of limiting global warming to well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius** as agreed under the Paris Agreement. The removal of ODS from the atmosphere is greatly contributing to climate mitigation efforts (see 5.3.1) and needs to be sustained, otherwise even more action would be needed in other sectors where it is likely to be less cost-effective.
- **EU action on ODS has relevance in other regions as well.** The Regulation includes measures preventing illegal trade and supports efforts in developing countries to phase-out the use of ODS. A number of multilateral trade agreements that the EU has concluded or is currently negotiating with other countries make explicit reference to the need to implement control measures on ODS including the importance of fighting illegal trade.81
- **Exemptions in the Regulation continue to be relevant for a few sectors in light of the stable demand where no alternatives exist.** While the general approach of the intervention is to prohibit ODS, exemptions are specified for certain uses of substances where alternatives are not technically or economically feasible.

5.2.2 How well is the Regulation adapted to technological and scientific developments?

The Regulation has driven innovation and development of alternatives.

- **Alternatives to ODS still continue to become available in some sectors for certain applications**, which in some cases is seen as being driven by the Regulation (e.g. halons), while this link is less clear for other uses (see 5.1.3.2). The remaining sectors of use are those where replacement is naturally the most difficult.
- **Both a majority of undertakings and all the competent authorities of the Member States pointed out in the targeted surveys that there is progress in finding alternatives because ODS are controlled by the Regulation.**[94] A third of the undertakings also indicated that they reduced the amount of ODS in their activities in the period 2010-2017 because of the Regulation. These activities included substitution, process changes and disposal of stocks and waste. Other respondents indicated that alternatives were available before but the Regulation forced their introduction. Some also saw other factors such as other legislation, standards, financial advantages or risk of halon shortages as important drivers.
- **The Regulation with its general prohibitions for using ODS takes relevant technological and scientific development into account**, not least by combining a system of general exemptions with case-specific derogations, in addition to giving the Commission the power to adjust the Regulation under specific circumstances. Derogations are available for emergencies or for particular uses of defined substances. In total, only eight derogations were applied for and granted from 2010 to 2017. This low

[94] 48% of undertakings agreed, while only 2% disagreed; responding Member States were 23.

number indicates that the prohibitions in the Regulation are generally quite appropriate and do not cause unnecessary burden or costs. Since 2014 there has not been a new derogation decision in any sector, and the last derogations expired at the end of 2018. It appears that derogations may not be needed for HCFCs any longer, but may continue to be relevant for halon applications in commercial aircraft as some prohibition dates lie in the future.[95] In any event, the Commission would only grant such a derogation in duly justified cases. Also, the Regulation offers the possibility to amend it via the regulatory procedure with scrutiny, e.g. to introduce endpoints regarding the remaining uses of halons, set the quota limits for process agents or include 'new substances' under the general prohibitions.[96] These flexibilities are enabling the Commission to adjust in line with technological progress made and new scientific information, which is particularly important considering that the Regulation is covering a long time period.

5.3 EFFICIENCY

The key question addressed in this section is whether the costs arising from implementing various measures of the Regulation are reasonable and proportionate compared to the benefits.

5.3.1 Benefits

The continued accumulation of ODS in the atmosphere in the absence of the Montreal Protocol would have led to a collapse of the global ozone layer shortly after mid-century, with devastating environmental implications (SAP, 2018). As shown in section 5.1, the Regulation contributes to the global effort of assuring a timely recovery of the ozone layer and to reducing highly warming GHGs. The Regulation has been effective in ensuring compliance with the Montreal Protocol and locking in progress achieved before 2010 as well as ensuring further progress. Any benefits attributable to the current Regulation cannot be accounted for in isolation from those of previous legislation, nor from those of legislation in other parts of the world. This also means that the effects of this Regulation and past interventions will continue to have positive effects far into the future. Due to the global nature of the beneficial impacts, it is not feasible to directly link an annual net gain in ODP tonnes at European level to the final resulting human and environmental health impacts.

5.3.1.1 Environmental benefits

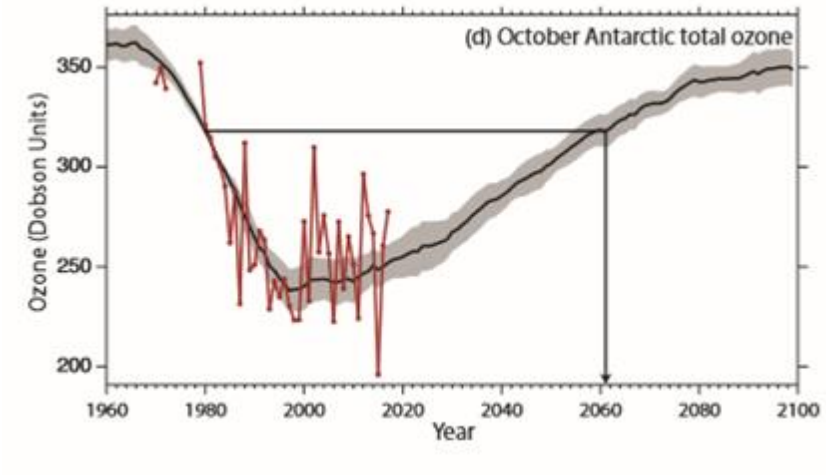
- **The ozone hole is recovering.** As seen in Figure 14, the Antarctic ozone hole has shown signs of healing since 2000 (i.e. the ozone concentration at the relevant altitude is increasing). It is expected to gradually close, with springtime total column ozone returning to 1980 values shortly after mid-century (about 2060), while the Arctic ozone hole is expected to disappear by 2030 (SAP, 2018). Model simulations show that actions taken by parties to the Montreal Protocol have prevented much more severe ozone depletion than has been observed in the polar regions of both hemispheres (SAP, 2018). Atmospheric concentrations of the majority of ODSs originally controlled under the

[95] As well as for emergencies.

[96] In case they were put on the market in significant quantities and the SAP of the Montreal Protocol found that these substances have a significant ozone depleting potential.

Montreal Protocol are now declining, as their emissions are smaller than the rate at which they are naturally destroyed in the atmosphere (SAP, 2018).

Figure 14 – October Antarctic total ozone (observed ozone concentrations and predicted development going forward if new sources of emissions do not occur)



SAP (2018). Scientific Assessment of Ozone Depletion

– **There are important co-benefits for the climate.** The global phase-out of ODS since the 1990s has reduced GHG emissions by an amount estimated to be five to six times larger than the UNFCCC's Kyoto Protocol objective during the first commitment period of 2008-2012.[97,98] Figure 15 shows how the elimination of ODS through global ozone policies has halted the radiative forcing effect[99] of these substances as their warming effect gradually reduces towards the end of this century (SAP, 2018). In 2010, ODS emissions accounted for less than 5% of global CO_2 emissions compared with nearly 50% in 1990. Later this century, unregulated ODS increases could have led to global surface temperature increases comparable to temperature increases caused by other GHGs (SAP, 2018) This translates e.g. to a doubling of the hydrological cycle (e.g. precipitation) over the next few decades, a potential threefold increase in the intensity of tropical cyclones by 2065, or 4-14cm of additional sea level rise in this century (SAP, 2018).

Even with the Montreal Protocol in place, ODS emissions continue to be a relevant source of warming: As a point of comparison, the amount of CO_2 emitted in 2015 from fuel combustion was 32 Gt CO_2, while the CO_2-equivalent emissions from ODS controlled by the Montreal Protocol over 2020–2060 is projected to be 13.8 Gt CO_2-eq per year (SAP, 2018), i.e. of a similar magnitude without accounting for any non-compliance that could lead to increased emissions (compare Fig. 15 for the additional effect of recently discovered emissions of CFC11 on climate warming). Furthermore,

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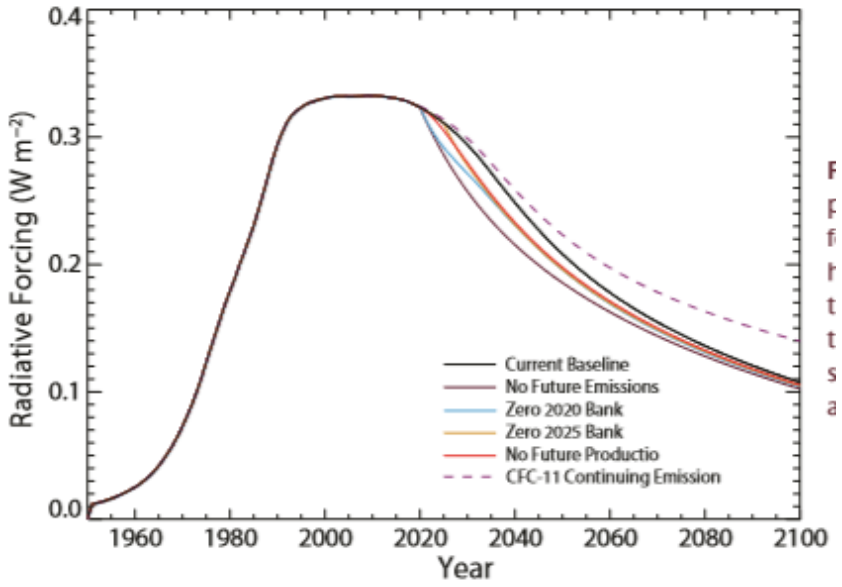
97 UNEP (2011). HFCs: A critical link in protecting climate and the ozone layer. http://wedocs.unep.org/bitstream/handle/20.500.11822/8014/-HFCs_%20A%20Critical%20Link%20in%20Protecting%20%20Climate%20and%20the%20Ozone%20Layer-20111072.pdf?sequence=3&isAllowed=y

98 These large contributions to climate change are due to the very high global warming potential (GWP) of ODS (some of which are more than 14,000 times more potent than CO_2).

99 Radiative forcing is the difference between incoming sunlight absorbed and energy radiated back to space and therefore indicates contribution to the warming of the atmosphere and thus climate change.

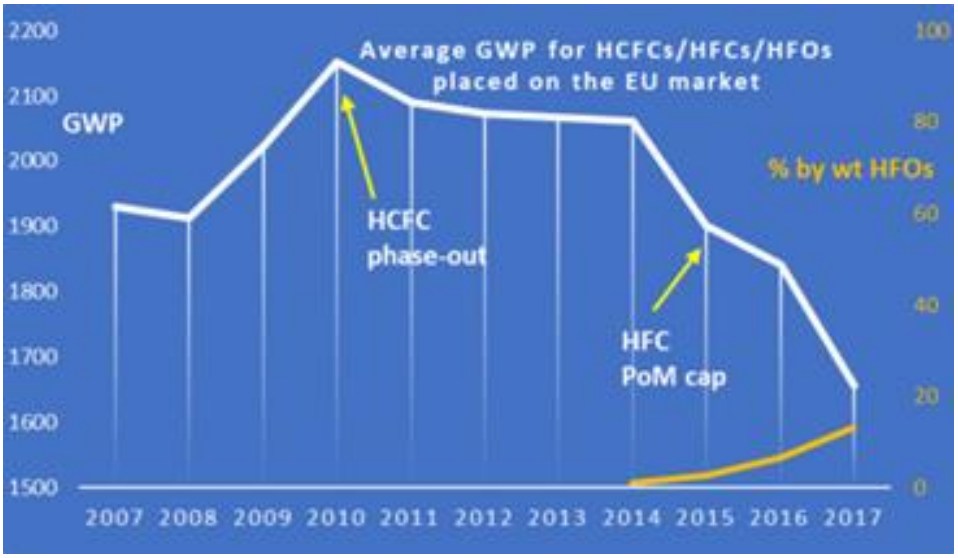
there are important, albeit complex, interactions between changes in stratospheric ozone concentrations and climate change.

Figure 15 – Historical and projected future radiative forcing from long-lived ODS (Contribution to climate change under different scenarios: Black line shows development without further action, purple interrupted line shows scenario where the recently discovered higher CFC-11 emissions from Southeast Asia cannot be stopped)



SAP (2018). Scientific Assessment of Ozone Depletion (SAP, 2018)

Figure 16 – Average Global Warming Potentials (GWPs) of HCFCs and HFCs (including HFOs) placed on the EU market between 2007 and 2017



European FluoroCarbons Technical Committee (EFCTC) (2019)[100]

The replacement of ODS has in the past led in some sectors, such as refrigeration and air conditioning, to a phasing in of other GHGs, the HFCs. However, collectively the ODS Regulation and the Fgas Regulation (the latter covering HFCs), have reduced the GWP (and thus the climate impact) of all these synthetic substances placed on the EU market together, so there is a clear protective trend in addressing the climate impact of these substances jointly between these two Regulations (Figure 16).[101] The inclusion of HFCs under the Montreal Protocol from 2019 is expected to reduce global warming by up to 0.4 degrees by 2100 (SAP, 2018).

5.3.1.2 Health benefits

– **Modelling studies show that global ozone policies have avoided catastrophic effects on human health.** Large increases of solar UV-B radiation that would otherwise have occurred by the middle of the 21st century have been avoided by global ozone policies (EEAP, 2018). Direct adverse effects of UV B radiation include skin cancer, eye cataracts and the suppression of immune responses. It is not possible to precisely attribute the proportional effect of a certain volume of substances to ozone depletion or to health hazards as the EU's efforts are only part of the global efforts to reduce the ozone hole. However, at global level data are available that indicate what would have happened if no measures of control of ODS had been implemented[102]: by 2100, at least a hundred million skin cancers will have been avoided. A study by the US EPA found that "by 2100, failure to effectively control ozone depletion would have led to a total of between

[100] https://www.fluorocarbons.org/mediaroom/average-gwp-continues-to-fall-and-eu-hfc-emissions-decrease/

[101] In addition, more and more non-synthetic alternatives are used such as CO_2, ammonia and hydrocarbons, with very low GWPs (ca. 0-25) vs. several thousands for traditional HCFCs/HFCs.

[102] United Nations Environment Programme. (2015). The Montreal Protocol and Human Health. http://www.unep.fr/ozonaction/information/mmcfiles/7738-e-TheMontrealProtocolandHumanHealth.pdf

45 and 50 million additional cataract cases, just in the USA".[103] The total economic value of the health benefits from global ozone policies was estimated at US$1.8 trillion by 2060 and comprised the avoidance of healthcare costs, as well as the monetary estimation of lives saved. [104]

5.3.1.3 Economic benefits

- **Changes in stratospheric ozone and the resulting amount of radiation also have negative impacts on ecosystem health, plant and animal health, air quality and food security** (e.g. negative effects on crop yields) **which have been avoided**. While these avoided costs can be assumed to be very significant to society, there are no comprehensive "world avoided" models of these effects currently available (EEAP, 2018).**Error! Bookmark not defined.**
- **Damages to materials such as plastics and wood have been avoided (EEAP, 2018).** UV radiation damages the functional integrity and shortens service lifetimes of these construction materials. It may also constrain the service life of new polymer-based photovoltaics. These effects would have translated into important additional costs to society.
- **Some EU market players may have benefited directly from ozone policies.** This is certainly the case for producers of alternative substances.[105] Equipment users also had cost savings due to measures aiming at better leakage and emissions control, which avoided the loss of ODS (and thus refilling costs) as well as assuring better energy efficiency. Compliance with the Regulation may have served some companies to show a good corporate image to the outside. Finally, EU companies required to phase-out early as compared to elsewhere in the world have had first-mover advantages. An earlier study[106] found that companies in the 1990s that developed new substances earlier than others were able to retain or gain market shares. Such economic benefits were however achieved mostly under previous versions of the current Regulation, as the large majority of ODS was phased out before 2010 and the number of stakeholders affected are now much smaller than originally the case.

5.3.2 Costs

5.3.2.1 Costs for undertakings

The measures undertakings have to comply with generate both (non-administrative) compliance costs and administrative costs, see Table 4.

- **Market players are impacted in diverse ways.** The type of affected stakeholders are diverse (see section 4.1.2) and some measures are only relevant for some uses or sectors.

[103] Updating ozone calculations and emissions profiles for use in the atmospheric and health effects framework model. USA Environmental Protection Agency, Washington (2015)

[104] Markandya, A. and N. Dale, (2012). The Montreal Protocol and the Green Economy. Assessing the contributions and co-benefits of a Multilateral Environmental Agreement, United Nations Environment Programme, Nairobi.

[105] e.g. Globally active chemical producers have shifted to producing HFCs (in the past) and HFOs (more recently).

[106] Vanner, R. (2006). Ex-post estimates of costs to business of EU environmental policies: A case study looking at ODS. Report commissioned by the European Commission, DG Environment. See in particular Chapter 4.1 Distributional effects within the production chain.

For instance, the prohibition on servicing certain equipment after 2015 mainly impacted on the users of such equipment and not on users of fire equipment. As different types of players and sectors are affected to varying degrees, costs by undertakings represent ranges rather than precise estimates.

- **The number of stakeholders affected by compliance costs is relatively small compared to the situation prior to 2010.** The transition away from ODS had been achieved previously in all areas where this was deemed feasible. Only few additional restrictions were introduced in 2010. In particular, the EU had already completely phased out the main use of ODS, e.g. in new refrigeration and air conditioning equipment. Only servicing of such equipment with non-virgin HCFCs was still possible until 2015[107]. For those producers and users of ODS that are engaged in uses that are not prohibited, there are of course no direct compliance costs linked to the replacement of ODS. At the same time, in areas where a transition was required, undertakings producing and using alternatives would have been expected to benefit. For some players, the costs and benefits would tend to equalise, for instance producers/distributers of ODS are often also producers/distributors of some alternatives to ODS. Still, **the 'low-hanging fruits' were picked in the past and any further replacement has likely been more difficult and less cost-efficient.**
- **Even in those areas where substantive compliance costs were identified, undertakings categorised those costs as being low to medium** (Table 6)**.** The highest costs were linked to specific prohibitions (e.g. halons in fire equipment and refrigeration) and technical requirements for destruction, leakage, and emission control. These costs are eliminated once the replacement has been completed. Such is e.g. the case for the use of HCFCs in refrigeration that concluded in 2015. On the other hand, some halon prohibition dates are in the future, but will affect far fewer companies (mainly users in military and aviation). For most SMEs, the substantive costs do not seem to place a high burden. Phase-out costs were more important to larger companies (chemical producers) or end users (aviation, supermarkets), whereas costs linked to reclamation and destruction were named by medium-sized companies as *relatively* more important. Most companies were not able to quantify their expenses further.

[107] These provisions were already in the former Regulation so undertakings had a long time to shift to equipment without ODS which was readily available on the market.

Table 5. List of measures from the Regulation entailing costs for undertakings (Non-administrative (= substantive) compliance costs are shaded blue, administrative costs are not shaded)

Measure	Description of the cost for undertakings
Licensing requirements	Applying for licences and authorisations (ODS Licensing System)
Quota limitations	Applying for quota (ODS Licensing System)
Registration requirements	Registering for essential laboratory and analytical uses (labODS registry)
Reporting requirements	Reporting annually (BDR)
General prohibitions (phase-out schedules)	Complying with phase-out schedules: • Stop producing HCFC by 2019 • Stop using HCFC for refrigeration etc. by 2014 • Stop using methyl bromide for quarantine and pre-shipment by 2010 • Stop using halons in certain firefighting equipment/remaining uses by 2010, 2014 or 2018
National inspection obligations	Undergoing national inspections
Technical requirements for destruction	Complying with technical requirements for destruction
Technical requirements for labelling*	Complying with technical requirements for labelling*
Technical requirements for leakage and emission control and related Member States' implementation measures	Complying with technical requirements for leakage and emission control and related Member States' implementation measures

** Technical requirements for labelling are not included in the cost assessment due to these requirements resulting to a large degree from other legislation.*

Table 6. Compliance costs for businesses between 2010-2017.

Economic substantive compliance costs	Large enterprises Survey score	Medium enterprises Survey score	Small enterprises Survey score
Control leakage and emission when using the ODS	2.58	2.69	2.40
Follow technical requirements during reclamation and destruction of ODS	2.73	3.25	2.40
Undergo national inspections	2.24	2.08	1.57
Stop using HCFC for refrigeration etc. (phase-out)	3.60	3.00	N/A*

Respondents were asked to identify costs on a scale of 1 (no costs) to 5 (very high costs)
** No respondent in this category.*

Table 7. Costs reported by undertakings for administrative measures, in hours per year.

Time (person-hours per year)	Apply for a licence (ODS Licensing System)	Apply for a quota (ODS Licensing System)	Register once for essential laboratory and analytical uses (labODS registry)	Yearly report (BDR)
Number of respondents	(N=13)	(N=7)	(N=4)	(N=15)
Average	**1.1**	**4.8**	**3.5**	44.4
Maximum	3.0	16.0	8.0	225.0
Minimum	0.1	0.3	0.5	1.0
Median	1.0	2.3	1.3	**22.0**
Administrative cost used in calculations	**37 €**	**191 €**	**124 €**	**777 €**

Costs which appear in **bold** in the table were used to calculate overall costs at EU level

– **Generally administrative costs incurred by companies appear to be reasonable (Table 7).** The answers by undertakings during interviews formed the basis to estimate the time required on a yearly basis for some measures (Table 7). The yearly reporting may be more time-consuming for some companies, in particular for larger enterprises that have to report a number of different data. Smaller enterprises are somewhat more concerned about the quota limitations in place and, to a lesser degree, about registration and licensing requirements. For the period 2010-2017, the import/export licensing based on single shipments for bulk gases created the highest costs (€1.9 million) due to the high number of single shipment licences that companies needed to apply for. Reporting obligations (€1.05 million) and registration requirements for laboratories (€0.5 million) also represent high costs due to the high number of the affected entities (see Table III.6 in Annex III). While the total cost for licences has increased until 2013, these costs decreased dramatically for the aviation sector when bulk licences for some applications (aerospace) were introduced (Table III.6 in Annex III). For the period 2010-2013 the total yearly costs related to administrative costs for all undertakings climbed to over €800,000, but could be reduced to a stable average of ca. €300,000 from 2015 onwards. Switching to a new IT system in 2013 caused a one-time peak in administrative costs related to (re-)registering in the new system. Overall administrative costs at EU level for all undertakings in the period 2010-2017 were estimated to be €3.7 million (Table III.6 in Annex III). This is considerably lower than the estimated €5.4 million for EU industry in the Impact Assessment in the baseline case. **The expected savings of €2 million due to better regulation and simplification measures have therefore largely been achieved.**

5.3.2.2 Costs for administrations of the Member States

Administrations of Member States have implementation and enforcement costs, as well as administrative costs. Table 8 identifies how these measures translate into actions required from the administrations of the Member States.

Table 8. List of measures (activities) from the Regulation entailing costs for administrations of the Member States.

Measure	Implementation and enforcement costs
Licensing requirements	Granting production authorisations; Article 10(7)
Quota limitations	Reviewing quota applications together with the European Commission
Reporting requirements	Handling reports from undertakings Reporting to the European Commission (Article 26)
Phase-out schedules	Checking imports and exports of ODS by customs
National inspection obligations	Conducting inspections or checks
Technical requirements for destruction	Promoting the recovery, recycling, reclamation and destruction of ODS Determining qualification requirements for personnel for the recovery, recycling, reclamation and destruction of ODS
Technical requirements for labelling	Checking imports and exports of ODS by customs
Technical requirements for leakage and emission control	Defining minimum qualification requirements for personnel involved for leakage checks

– **The highest costs for authorities result from inspections, checking imports and exports of ODS by customs and determining minimum qualification requirements for personnel in charge of the recovery, recycling, reclamation and destruction of ODS** (Table 9). For some actions a quantitative appreciation was possible for some Member States (see Table III.7 Annex). The cost of granting production authorisations is estimated to be close to zero.[108] The cost of reporting to the European Commission was estimated at just over €300,000 for all Member States together for the whole period 2010-2017 based on the reported time spent on these tasks (Table III.8 in Annex III). The most relevant reporting cost as identified by several Member States related to reporting on the use of halons. This cost was however not assessed as high by Member States relative to other costs, particularly implementation and enforcement costs. The costs of inspections or checks were estimated by two larger Member States as ca. 400-500 hours p.a. (ca. €16,000-20,000), while the NL[109] indicated over 4,000 hours p.a. (ca. €170,000). These costs could however not be separated from other controls, in particular related to F-gases. IT also indicated that promoting the recovery, recycling, reclamation and destruction led to costs of 168 hours p.a. (ca. €6,800). Minimum qualification requirements were estimated as from 8-80 hours p.a. (CZ-IT). **Based on these data, it is difficult to say if the anticipated cost savings of €0.7 million over all measures have been achieved. However, significant savings of up to €0.9 million alone have been realised by reducing Member State reporting obligations.[110] It is also clear from the above data that expenditures are low for most other measures with the possible exclusion of those related to inspections and custom controls**.

[108] Most Member States do not have undertakings producing ODS. For those with production facilities (5), the process consists simply in approving requests submitted via the ODS Licensing System. In some cases, these authorisations were provided prior to 2010, therefore no costs incurred between 2010-17.

[109] Rotterdam is a main entry point for non-EU imports.

[110] €0.3 million vs. expected €1.2 million for the no change scenario.

Table 9. Costs for competent authorities of the Member States between 2010-2017.

Administrative costs	Survey score	Time costs (days)
Granting production authorisations; Article 10(7)	1.36	0
Reporting to the European Commission; Article 26	2.23	917
Implementation and enforcement costs		
Checking imports and exports of ODS by customs	2.85	
Conducting inspections or checks; Article 28	3.23	
Promoting the recovery, recycling, reclamation and destruction of ODS; Article 22(5)	2.59	
Determining minimum qualification requirements for personnel in charge of the recovery, recycling, reclamation and destruction of ODS; Article 22(5)	2.76	

Respondents were asked to identify costs on a scale of 1 (no costs) to 5 (very high costs)

5.3.2.3 Costs for the EU public administration

Table 10 identifies how the measures translate into actions required from the European Commission. The table does not include any costs related to international negotiations with parties of the Montreal Protocol and networking with other countries as well as evaluating, preparing or negotiating the Regulation.

Table 10. Measures from the Regulation entailing costs for the European Commission.

Measure	Implementation and enforcement costs
Controlling & monitoring exemptions & derogations	- Updating information systems with new parameters - Assessing Member States' applications for derogation decisions - Granting derogation decisions
Technical requirements for leakage and emission control and related Member States' implementation measures	-Setting technical requirements for leakage and emission control
Reporting requirements	-Receiving reports from undertakings (Article 27) and Member States (Article 26) -Processing reported information
Quota limitations	-Operating the ODS Licensing System -Reviewing quota applications together with the Member States -Granting quotas
Licensing requirements	-Operating the ODS Licensing System -Approving authorisations and licences; Article 10(7)
Registration requirements for laboratories	-Operating the LabODS registry

– **The European Commission and the European Environment Agency bear significant costs for the development and management of EU-wide systems. This includes**

administrative costs related to per shipment licensing for import and export, quota systems and registration requirements, company reporting as well as advising companies and Member States. As regards costs incurred by the Commission, the costs related to the licensing requirements are highest, followed by registration requirements for laboratories (Table 11). For licensing, for which only a general obligation exists under the Montreal Protocol, costs are particularly high due to the EU requirement to have per shipment licences as well as an extended scope of the licensing to other substances and activities beyond those required by the Montreal Protocol. Other important cost areas are the registration requirements for laboratories and those linked to the licensing system/reporting as well as establishing quota decisions and allocations to undertakings. In addition to costs listed in the table, total IT costs for the Commission for developing, maintaining and hosting of the IT systems over the entire period between 2010 and 2017 were ca. 1.4 million € and other external support was €290,000. Given new legal requirements on treatment of personal data[111] and on maintaining data integrity, availability and confidentiality[112] as well as higher hosting costs will further increase these costs significantly going forward. Costs by the EEA related to the company reporting data were 1139 days for the period 2010-2017, as well as implementation costs related to the IT systems of €931,600, two thirds of which is related to external consultancy support. **It is quite clear from these numbers that the anticipated cost savings at the EU level have not been realised. To the contrary, expenditures of EU-wide electronic services have given rise to important costs that had been significantly underestimated in the impact assessment**[113]. In addition, other European bodies may experience future expenditures, such as EASA related the possible need for work regarding halon derogations.

Table 11. Administrative, implementation and enforcement costs for the European Commission between 2010-2017.

Administrative, implementation and enforcement costs	Time costs (days)
Licensing requirements	1 056
Quota limitations	483
Registration requirements for laboratories	583
Registration for other ODS companies and customs	503
IT system, related to Licensing requirements, Quota limitations, Registration requirements for laboratories (cross-cutting)	1 076
Reporting requirements	412
Phase-out schedules	141
Measures to identify illegal trade & support custom controls	674
Technical requirements for destruction	40
Technical requirements for labelling	40

[111] Regulation (EU) 2018/1725 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1552577087456&uri=CELEX:32018R1725

[112] e.g. Decision (EU, Euratom) 2017/46 on the security of communication and information systems in the European Commission. http://data.europa.eu/eli/dec/2017/46/oj

[113] The impact assessment expected cost savings for the European Commission of €0.3 million.

Administrative, implementation and enforcement costs	Time costs (days)
Technical requirements for leakage and emission control and related Member States' implementation measures	40
Derogation decisions	322
General correspondence and advice	191
Ensuring data security and data protection	151
Outreach activities (meetings and brochures)	91
Assuring compliance in the Member States	121
Providing access to documents	111

5.3.3 To what extent are the costs associated with the Regulation proportionate to the benefits achieved?

- **The benefits of global action for controlling ODS are huge in health and environmental terms.** The EU's ability to reduce its consumption of ODS quicker and to lower levels than other parties of the Montreal Protocol made a strong contribution to combating ozone depletion and its negative health and environmental effects including climate change. In the period 2010-2017, the Regulation has contributed to maintaining very low levels of consumption and use of ODS, and thus minimised emissions from the EU, but also from third countries. As emphasised by undertakings and competent authorities, as well as a representative of the Ozone Secretariat, the measures of the Regulation brought about higher benefits compared to the Montreal Protocol alone in terms of good monitoring and control of the consumption of ODS at world level. The Regulation has therefore been prolonging the effects of the previous EU legislation and served as best practice to inspire the measures of other Parties; thus ascertaining that we continue to enjoy these positive benefits going forward. These policy efforts continue to be needed as the recovery of the ozone hole may be significantly delayed if efforts should be cut back.
- **These benefits largely outweigh the costs to undertakings and society.** The number of stakeholders affected has diminished from previous Regulations and most of the costliest measures (e.g. phase-outs of substance groups) have already been completed. The different measures of the Regulation are now seen by a wide majority of the affected undertakings as resulting in low to moderate costs only. There may however be some scope to simplify and address some inefficiencies of particular measures (see following section).

5.3.4 To what extent have the measures been efficient? Are there any unnecessarily complicated or burdensome aspects and areas of excessive costs? What are the reasons and magnitude of any identified inefficiencies? What could be the expected cost savings if these inefficiencies were absent?

5.3.4.1 Prohibitions (phase-out measures)

- **The prohibitions provide a large amount of the emission savings by preventing that ODS are produced or consumed in the first place.**

- **The Regulation generally allows minimising compliance costs through gradual phasing-out of the substances**, providing exemptions on specific uses and derogation decisions for companies which can prove that they are not able to use alternatives for technical and economic reasons. These controlled grace periods for the most difficult

subsectors or niche application areas have aided the efficient implementation of the phase-outs by excluding the areas of prohibitive costs.

- **The phase-out of HCFC use and production has had significant emissions savings, but also resulted in costs for some undertakings.** The costs for the earlier production phase-out were estimated at €2-9.5 million in total in the impact assessment.**Error! Bookmark not defined.** The affected companies are either gas producers or distributors, endusers of specialised cooling equipment or manufacturers of such equipment. Costs were mainly related to equipment retrofitting, HCFC recovery and recycling from old equipment by contractors. The few affected companies, including a handful of large international chemical producers, experienced quite different cost levels but were not able to quantify these costs. One stakeholder spoke of large-scale investments needed as a result of the phase-out. Others noted that return on investment for alternatives was slow, or that it is uncertain whether the phase-out was economically beneficial overall. Some stakeholders responded that the early Montreal Protocol consumption phase-out in the EU (2010 instead of 2020) had an insignificant effect on costs as it was buffered by a switch to other chemicals and the possibility to continue feedstock production. The ODS phase-out has indeed provided a possibility for EU producers to stay in the market by moving to the next generation chemicals. ODS (for use in developing countries) are to a large extent produced in Asia today, where production costs tend to be lower after patents held by EU companies expired. The completion of the ODS production and consumption phase-out has therefore not led to a material market disruption. The qualitative estimation of costs given in Table 6 showed that phase-out costs were seen as the most significant of the Regulation by undertakings. Such costs would usually have been transferred to customers. Since this HCFC phase-out has been accomplished, no such costs are expected in the future. Similarly, the methyl bromide phase-out was achieved in the first year of the Regulation, with significant savings in ODS emitted (see section 5.1.3.3). Administrative costs at EU level related to the exemption/derogation scheme were moderate and roughly in line with what was expected by the impact assessment.[114] **The expected savings of ca. €1 million related to updating the exemption regimes as compared to the previous Regulation may therefore be considered as having been achieved.**
- **The halon phase-out is a good example of how a regulatory approach can foster innovation** (section 5.1.3.2). Still, the replacement of halons remains difficult in certain applications due to a perceived lack of alternatives under specific use conditions (Ramboll, 2019).[53] R&D, qualification/certification, the manufacture of new equipment and alternative substances create costs for undertakings. In particular, costs related to retrofitting of aircraft in the future with fixed fire protection systems containing halons may result in very high costs in the estimated range of millions of euros, according to one aircraft manufacturer, as potentially larger fire extinguishers considering alternatives known today may need to be used. For undertakings carrying out maintenance and servicing of aircraft, the phase-out of halons will lead to changing maintenance procedures as well as documentation related to new equipment and substances. These costs could not be estimated by the respondents. The Regulation introduced a new exempted use clause for remaining uses of halons in order to able to avoid disproportionate costs. The derogation clause has not been needed in this sector to this date.

[114] 322 person days as well as further staff resources for advising companies/Member States vs. 0.24 MIO € expected for 201-2017 by the impact assessment.

5.3.4.2 Licensing requirements

- **An import/export licensing system is necessary**, as this is a requirement of the Montreal Protocol. Furthermore, trade flows still need to be controlled closely to prevent circumventions of the prohibitions as a number of ODS uses continues in the EU, in particular the use for feedstocks (see section 3.1.1). Having a fit-for-purpose licensing system and the labelling of ODS containers is crucial in this context.
- **Undertakings expressed satisfaction with the ODS licensing system as regards the stability of the system and its efficiency**. The ODS Licensing System is reported as having improved compared to the system used before 2014. In particular, the time needed until a license is received has significantly decreased from about a week in 2010 to practically no time at all for some licences confirmed automatically, or a few hours to days if manual intervention is needed. In the past, this waiting time created economic costs related to shipments withheld by customs. The licences' validity period of one month apparently still causes concern in cases where the delivery of the substances is untypically slow or delayed.
- **EU yearly bulk licences for ODS products and equipment used in aviation introduced in 2014 have been much welcomed by the affected industry.** Whereas 10,250 licences were requested on average per year before 2014 (up to 15,355 in 2013 alone), the average number of licences requested per year after 2014 was only 2,338 (between 2,000 to 2,500 licences per year).[115] Estimated savings for undertakings achieved were between €900,000 up to €1.5 million since the change in requirement in 2015 and over the four years that followed. The license numbers are still higher than the licences issued in 2007 and 2008 (<2,000 and expected to further decrease to 1,000 at the time) before the scope of the licensing system was extended by the Regulation. The improvements made in 2014 was possible because the Commission had the power to adjust the licensing requirements.
- **The licensing system created a high burden for EU-level administration.** The current Regulation enlarged the scope for per-shipment licensing. Under Regulation 2037/2000, exports were only subject to yearly export authorisations. The current Regulation imposed licensing requirements for export for each shipment as well as requiring licensing for products and equipment containing ODS.[116] These changes are not assessed to have created an additional significant burden for undertakings due to the relatively efficient licensing process, but the setting up of an IT system and the personnel costs of manually granting the per shipment licences are quite significant at EU level (see 5.3.2.3). The overall effort of per-shipment licensing was underestimated in the impact assessment for the Regulation[117], not least because the number of registered companies has increased significantly since 2010, due to both the larger scope and better awareness and compliance on the side of companies. **Hence, due to the extended scope of the licensing system introduced from 2010, simplification in this area was not achieved**

[115] Despite the lower number of licences, in 2017 considerably more organisations were registered (and thus controlled) than in 2013 (618 vs 284 companies).

[116] Shipment licences for equipment greatly increased the numbers of stakeholders as many new companies were covered, including aviation.

[117] 1522 person days for 2010 – 2017 forecasted in impact assessment vs. 2786 person days plus IT costs needed even though administrative improvements such as bulk licences have been made during the period.

despite the introduction of implementation choices that largely reduced the administrative burden.

- **Licensing systems of other parties with high ambitions are less resource-intensive.** The Montreal Protocol only generically requires each Party to the Protocol to establish a system for licensing the import and export of ODS. The Australian licensing system[118], which UN Environment lists as a best practice example, allows for bi-annual bulk licences rather than the per shipment licences used in EU.[119] Likewise, in Norway, licences are granted yearly or even for multiple years, while in Switzerland single shipment licences are issued.[120] It is therefore questionable if a *manual* granting of per-shipment licences is indeed necessary to have good control over illegal trade, especially also in light of the costs involved of running the system. A system avoiding manual processing of per shipment licences would reduce the administrative costs to the European Commission substantially (by ca. 75%) and have total annual savings of €50,000[121] for affected undertakings. Such changes will be further explored under the EU Single Window initiative (see section 5.3.4.6).

5.3.4.3 Quota limitations

- **Quota limitations have not yielded much benefit.** While the costs for the yearly process of quotas was judged as low by undertakings (on average, the yearly cost amounted to about 5½ hours), some competent authorities have pointed to the fact that quotas did not represent any real limitations for companies (besides the burden of having to apply). This is because the Regulation sets no explicit annual cap for the import of ODS for feedstock use and halons. Quota is allocated following the amounts requested by applying companies, which generally overestimate their annual needs to be on the safe side. Similarly, quotas for process agents and laboratory uses, even though including an overall cap, did not present a limiting factor due to the low quantities required. At the same time it is questionable if a strict limit would be appropriate for laboratory uses for some of which alternatives cannot be found, such as in reference materials. The quota measure was therefore not a real incentive for developing and using alternatives to ODS, as originally envisaged according to the impact assessment. Implementing the quota system has resulted in ca. €11,000 total annual costs to undertakings and about 51 person days for administration by the European Commission. **The costs of the measure in its current form to authorities is considered to outweigh the benefits in terms of controlling the consumption of ODS.** Such Quota limitations are not part of the legislation in countries like Norway or Switzerland with equally high environmental objectives.

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[118] Australia requires licenses for import, export and manufacture of certain HCFC equipment, HCFCs linked to their phase-out, exempted uses and used substances and, for some of these cases, they also require export and manufacture licenses. The EU's scope is even broader and seeks to monitor all trade. Australia requires a non-refundable license application fee ranging from 3,000 to 15,000 Australian dollars.

[119] The European Commission processes approximately 50 licences every working day. Taking into account time for correspondence with undertakings and processing of licence requests, i.e. about 1050 working days over the period 2010-2017 for a total of 50 350 licence requests. http://www.unep.fr/ozonaction/information/mmcfiles/7531-e-HCFC_Quota_system.pdf

[120] In both countries, the import/exports per year are much smaller than is the case for the EU.

[121] €35.3/hour * 1.1 hour/license * 1318 single licences avoided

5.3.4.4 Registration requirements for laboratories

- **The registration requirement for laboratories is perceived as burdensome.** This procedure was simplified compared to the previous Regulation where annual requests for exemptions had to be made, while currently only a first registration followed by an update every two years, at a minimum, is required. Registration requirements for laboratories were intended to support compliance by verifying that ODS are not falsely imported under exempted uses. However, there are a high number of research organisations, academia and commercial laboratories that use ODS only in minute amounts, e.g. for testing and reference purposes, but which are affected by these obligations. While the environmental impact is therefore very limited, these undertakings, often representing SMEs or microenterprises, must face relatively high entry costs in understanding the legislation, becoming acquainted with the registration system and providing the right information. Some undertakings remarked that the change to a new IT system (LabODS) in December 2015 increased the burden in the initial stages of populating the system. It was however recognised by some stakeholders that the data collected in this way would likely be more useful to the Commission for policy follow-up and oversight. **Removing this measure would lead to total annual savings of ca. €50,000 for undertakings and 73 days of administration costs for the European Commission.**

5.3.4.5 Reporting requirements by undertakings

- **Reporting continues to pose a moderate burden to companies.** Reporting was seen as the costliest administrative requirement by undertakings, representing moderate costs. Even though such data would be collected for business or administrative purposes anyway, actual reporting of information (entering data into the BDR) still appears to represent an significant cost. Starting in 2012, the European Environment Agency (EEA) put in place an electronic online platform, the Business Data Repository (BDR), for company reporting. **The impact assessment had significantly underestimated the costs for setting up and running such a system (0.9 million IT costs plus considerable staff costs[122]).[123]** Some industry actors suggested that the transition from spreadsheets (before 2010) to electronic reporting resulted in an increase in burden for undertakings initially. Stakeholders did not say that the reporting process was particularly difficult, but pointed out temporary instabilities and small inconsistencies of the EEA's BDR system. These matters have been addressed by implementation choices outside of the Regulation, mostly due to year-on-year improvement of the EEA's reporting platform and the extensive helpdesk support provided. In addition, the BDR is currently being linked to the ODS Licensing System ('one-stop-shop' principle), facilitating access for companies and improving data consistency as well as data security. Finally, stakeholders are becoming more familiar with the system every year, which greatly facilitates compliance with their obligations.
- **Reporting is vital for policy monitoring.** The electronic reporting has allowed for a much improved data analysis and follow-up of ozone policies, with a high-quality yearly report produced by the EEA, as well as a regularly updated indicator and a confidential

[122] 1139 person days in period 2010-2017 (see section 5.3.2.3).

[123] E.g. for online reporting, "An initial investment of €50,000 would be needed" on top of 0.6 MIO € (2010-2017) for collecting the data and reporting to the Ozone Secretariat.

report with more data provided to the European Commission and Member States authorities. These reports are important sources for benchmarking of policy progress, communicating to stakeholders and the public as well as identifying any emerging issues. Not least, the monitoring of new ODS has provided important insights to the policy maker on the use of these substances in the EU.

5.3.4.6 Reporting by Member States to the European Commission

- **The reporting burden for Member States has been reduced.** For a majority of Member States reporting is no longer perceived as a significant burden. Requirements have been reduced from the previous Regulation[124]. The complete phase-out of methyl bromide in 2010 also eliminated the need to report on this substance, implying a large decrease in time spent for affected Member States before the prohibition took effect. The separate reporting on halon uses still appears costly to some, but is vital to ensure availability of these substances for applications where alternatives are not yet fully available. **The changes introduced after the partial review can thus be deemed to have successfully improved the efficiency of reporting requirements.** One Member State suggested that halon reporting could be integrated into the company reporting to save further resources at the national level.

5.3.4.7 National inspection obligations

- **Inspections led to higher costs than other measures of the Regulation for Member States, but their importance is uncontested.** Member States usually combine checking compliance with the Regulation with various other health, safety and environmental requirements regulated elsewhere when inspecting undertakings, allowing to make cost savings. Responsible authorities could therefore not clearly identify the costs of inspections, but they are likely to be smaller than costs for these other obligations. Furthermore, ODS activities by undertakings continue to decrease. The time invested varies between Member States due to the number of stakeholders affected in these countries and the risk approaches adopted to inspect companies. Undertakings and competent authorities generally agreed that inspections contributed to the effectiveness of the Regulation and thus the benefits achieved.
- **Customs checks mainly focus on using digital systems to check that imports and exports are accompanied by valid licences.** The cost of checking imports and exports of ODS is determined by the number of trans-border movements which must be checked. Three Member States were able to estimate that these activities took about 20 (France), 28 (Italy) and 250[125] (Netherlands) person days a year. In the future, the EU Single Window environment for customs[126] will help to further automatize this process and reduce costs for customs, while enabling automatic across-the-board checks with data in the ODS Licensing System. In some cases, Member States respondents noted that

[124] Annual reporting requirements for recovery, recycling and reclamation of ODS and for HCFCs replacing halons were removed, making savings of 420,000€ (impact assessment). Furthermore, reporting on destruction of ODS was streamlined such that destruction facilities now report directly to the Commission rather than to Member States. 70,000€ were estimated to have been saved through this measure (impact assessment).

[125] Rotterdam is a main entry point for imported ODS for outside the EU.

[126] https://ec.europa.eu/taxation_customs/general-information-customs/electronic-customs/eu-single-window-environment-for-customs_en

imports and exports of ODS are declining relative to increasing efforts needed for F-gases (i.e. HFCs).

5.3.4.8 Recovery, reclamation, recycling and destruction

- **Decommissioning and waste treatment practices among Member States are very diverse.** 12 competent authorities (out of 23 respondents) indicate that promoting the recovery, recycling, reclamation and destruction of ODS lead to minor or zero costs, while 6 think they lead to medium costs, and 4 think they lead to high or very high costs. This reflects the different systems in place at national level (see section 3.1.2). Minimum qualification requirements for personnel in charge of the activities have often been set prior to the period of scope for the study.
- **A majority of undertakings**[127] **sees following technical requirements for reclamation and destruction as minor to medium cost.** Costs also related to paying for destruction or reclaiming gases. Relevant decisions of the Montreal Protocol prescribe **t**he choice of technology.

5.3.4.9 Leakage and emission control

- **Avoiding leakage is important on environmental grounds and related costs are not seen as significant.**[128] There are synergies with other legislation that regulates emissions of ODS, particularly where they also pose health hazards (such as CTC), as well as environmental legislation to prevent emission of pollutants into the air. Leakages and emission losses constitute an inefficient use of these substances and their prevention can lead to cost savings (no need to refill) as well as better (energy) efficiency of equipment. The Fgas Regulation took over the requirements of containment for the ODS replacement substances (i.e. HFCs) as these measures were judged to be an important way of reducing emissions to the atmosphere and raising user awareness.

5.4 COHERENCE

5.4.1 To what extent is the Regulation coherent with relevant interventions both at EU and international level?

The Regulation is generally well aligned with other legislation. Policies on (stratospheric) ozone closely link to a considerable number of other policy areas. The majority of consulted stakeholders did not indicate issues of incoherence between the Regulation and EU or international legislation, but a few issues were identified by some national public authorities. The lack of major inconsistencies despite the many existing thematic links to other legislation is explained by the fact that this is an "old" policy area that has been legislated for over 3 decades and has grown organically alongside other legislation in related areas.

5.4.1.1 Chemicals

- **Fgas Regulation**. The Fgas Regulation (Regulation (EU) No 517/2014) is regulating some of the ODS successor substances due to their high GWP, and can be seen as the

[127] 66% relevant respondents had medium, minor or no costs; while 23% saw this measure as representing high to very high costs.

[128] 12% of relevant respondents indicate that this measure presents high to very high costs.

brainchild of the ODS Regulation. Many of the sectors covered by the Fgas Regulation are similar to those of the Regulation, most of all refrigeration, air conditioning, aerosols and foams, and many stakeholders are therefore also the same. There are important synergies between the two pieces of legislation, not least as regards lowering the climate impact of the regulated chemicals (see Figure 16) and the containment measures to avoid emissions (e.g. leakage prevention, training, recovery obligations etc.). As these two policy instruments have been developed closely together, there are no major inconsistencies.[129]

- **REACH**. ODS placed on the market generally also fall under Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and require e.g. (pre-) registration and relevant assessment processes. A public authority pointed out that an exchange of collected data between the REACH and ODS Regulation might facilitate better enforcement both ways.
- **Standards for laboratory use.** Methodology standards are important for applications in research activity and laboratory analytics. Standardisation setting is therefore an important driver in the process of alternatives development and their adoption. Standardisation organisations such as the International Organization for Standardization (ISO), the European Committee for Standardization (CEN) and ASTM International have developed standard methods not reliant on ODS. As standard setting is a very technical and lengthy process, a regular update process is very important to ensure that standards keep track of technology development and allow for a wide use of ODS alternatives wherever possible. New standards developed in Europe or at international level with strong European involvement are often replicated elsewhere and therefore have a global impact.
- **Rotterdam/PIC.** Regulation (EU) No 649/2012 concerning the export and import of hazardous chemicals implements the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. The requirement of "prior informed consent" (PIC) is relevant for some ODS such as methyl bromide or carbon tetrachloride and it allows for better control of ODS trade.
- **CLP Regulation.** Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures is connected to the Regulation through the labelling requirement for various ODS exempted from prohibitions under the ODS Regulation. There is good consistency between the two pieces of legislation.
- **Use of biocides.** Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products is connected to the Regulation through the derogation in Article 12(1). The Commission is empowered, in an emergency situation where unexpected outbreaks of particular pests or diseases so require, and at the request of the competent authority of a Member State, to authorise the temporary production and placing on the market and use of methyl bromide, if allowed by Regulation (EU) No 528/2012.

5.4.1.2 Customs

- Given that trade (e.g. EU imports, exports) of ODS is heavily regulated by the Regulation, there are important linkages to the customs legislation. For example, Articles

[129] Some stakeholders pointed out that the chemical R1233zdd is an (unsaturated) HCFC and should therefore be regulated by the Regulation, rather than by the Fgas Regulation.

15(3) (import license) and 17(4) (export license) of the Regulation refer to definitions and procedures laid down in Regulation (EC) No 450/2008, which was repealed by Regulation No 952/2013. Annex IV to the Regulation provides a list of Combined Nomenclature (CN) codes[130] which the customs officers will have to take into account with regard to restrictions (such as requirement of import or export license) of import and export of ODS and articles containing or relying on ODS. A number of stakeholders have pointed out that some fine-tuning is necessary to align some of the detailed requirements of the Regulation fully with EU customs legislation. This refers to definitions of custom-related activities (e.g. import) and updating of procedural details such as maximum duration of transit or repackaging activities. Furthermore, Annex IV of the Regulation lists the relevant CN codes that may become outdated and would require a comitology procedure for updating. The usefulness of this Annex is questionable given that the relevant codes are automatically shown to users in the ODS licensing system and can be quickly updated should any codes change. Most importantly, it would be useful to clearly spell out the role of customs authorities in controlling ODS as well as the economic operators' obligations towards the custom authorities directly in the Regulation to provide more clarity to Member States custom authorities and to undertakings.

5.4.1.3 Transport

- **Aviation.** The Convention on International Civil Aviation (Chicago Convention), with the ICAO as its secretariat, sets health and safety standards for the civil aviation sector at international level. Currently the ICAO is working on establishing cut-off[131] and forward-fit[132] dates in its standards for remaining uses of halons in specific fire-safety systems in aircraft. It is important to note that the current efforts of the ICAO were in all likelihood stimulated by the EU`s adoption of Regulation (EU) No 744/2010, which replaces the previous Annex VI of the Regulation. There is lower ambition at global level compared to the dates in the Regulation and it affects fewer categories of equipment. Industry stakeholders that would need to change due to these rules favour the lower ambition scenario under the international standards. Finally, at EU level, the European Aviation Safety Agency (EASA) has made an effort to adapt its certification specifications (CS) for aircraft to the halon phase-out schedule laid down in Regulation (EU) No 744/2010. In 2012, EASA issued three decisions[133] through which it amended CS-23, CS-25 and CS-29, removing recommendations regarding halon. However, the amended CS does not explicitly prohibit the use of halon, which, as expressed by one national public authority, may mean that there will be no incentive for the industry to develop alternatives to help meet the phase-out deadline. Parties to the Montreal Protocol decided recently that its TEAP should engage with ICAO and IMO (International Maritime Organisation) to identify the relevant alternatives already available or in development. A progress report will be provided to the Parties in June 2020.[134]

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130 CN codes: "common nomenclature", referring to the international system of custom codes.

131 ICAO cut-off date definition: No new application for Type Certificates possible if halon is present in the design.

132 ICAO forward-fit requirement applies to new applications for individual certificate of airworthiness (New deliveries).

133 See decisions 2012/012/R, 012/008/R and 2012/022/R of the executive director of the European Aviation Safety Agency.

134 Decision XXX/7 on Montreal Protocol: Future availability of halons and their alternatives.

- **MARPOL.** The International Convention for the Prevention of Pollution from Ships (MARPOL) aims to prevent pollution to the marine environment by ships, including the release of ODS to the air. It includes prohibitions of some ODS installations on ships, that ships need to list ODS-containing equipment and log ODS uses as well as to ensure appropriate reception facilities for equipment when removed from ships. The Regulation is aligned with these obligations.
- **Maritime law.** Given the complexities of maritime law and e.g. the legal status of ships pending on different circumstances, there may be a need to clarify the obligations of ship owners and operators under the ODS Regulation in view of maritime law principles. While many of these issues can be solved at the implementation level though e.g. appropriate guidance, other issues may require clarification in the Regulation.

5.4.1.4 Waste

- **The Basel Convention.** Regulation (EC) No 1013/2006 on shipments of waste implements the requirements of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, such as the concept of prior informed consent for shipments of specified, e.g. hazardous, waste. The Regulation is aligned with these obligations for the purpose of ODS and ODS-containing equipment (which are considered hazardous waste).
- **EU waste legislation.** Waste-related EU legislation, e.g. the Waste Directive (Directive 2008/98) and related pieces of legislation, are connected to the Regulation through Article 22 which concerns the management of e.g. ODS and equipment containing and or relying on ODS at the end of their useful life (as waste. In particular, Article 8 of the Directive 2012/19/EU on waste of electrical and electronic equipment (WEEE) determines that Member States shall ensure that all separately collected WEEE undergoes proper treatment. Its Annex VII determines that equipment containing ODS, e.g. in foams and refrigeration circuits, must be appropriately treated, in accordance with Regulation (EC) No 1005/2009. Two national authorities raised the issue that definitions under the Regulation and waste legislation differ, e.g. for recycling and recovery. This is, however, a result of the Regulation using the definitions as agreed under the Montreal Protocol, for consistency with these obligations, which should be maintained. The definitions used in the waste legislation are broader which is logical as they are not limited to the situation of ODS only. In practice, this lack of full alignment can be addressed at the level of implementation through transposition documents or appropriate guidance. A number of national public authorities raised the need for more specific waste management provisions in the Regulation itself, rather than an encouragement to promote such measures as currently in Article 22(5) of the Regulation. At the time of adoption of the Regulation it was decided to focus, first and foremost, on improving the implementation and enforcement of the waste policy framework, notably the Waste from Electric and Electronic Equipment ('WEEE') directive, and recovery of ODS in the construction and demolition waste stream.[135]
- **Ship recycling.** Regulation (EU) No 1257/2013 on ship recycling aiming to prevent adverse effects on human health and the environment caused by ship recycling is connected to the Regulation through its Articles 4 and 5. Article 4 determines that the installation or use of hazardous materials on ships shall be prohibited or restricted which includes ODS (see Annex I). Article 5 requires the establishment of an inventory of

[135] COM(2008) 505 final

hazardous materials on board the ship and includes ODS (see Annex II). Ship breaking activities are also relevant as they ascertain the supply of halons where still needed, i.e. for some application in civil aviation, as the Montreal Protocol has phased out virgin halons. Recently, Parties to the Montreal Protocol decided to establish a closer liaison with IMO to facilitate the exchange between relevant technical experts regarding halon availability and to identify ways to enhance the recovery of halons from the breaking of ships.

5.4.1.5 Air

– **Industrial Emissions Directive (IED).** Under Directive 2010/75/EU on industrial emissions (IED), best available techniques (BAT) conclusions can strongly determine the permit requirements that should be laid down by competent national authorities for a large selection of industrial installations. Waste treatment operations may concern ODS or ODS-containing equipment. It is important that such issues be considered appropriately during the updating process of the relevant BAT reference documents (BREF). The most evident example where this approach has borne fruit is the BREF for the Chlor-Alkali-Sector[136] whose ban of ODS has significantly contributed to the reduction of CTC use as process agent.

- ***EPRTR.*** The European Pollutant Release and Transfer Register established by Regulation (EC) No 166/2006 (EPRTR Regulation) includes obligatory reporting of releases of ODS by operators of large-scale facilities.

5.4.1.6 Research

- **Horizon 2020.** The EU Research and Innovation programme Horizon 2020 (2014-2020) has been supporting projects in the field of ozone monitoring[137,138] and the development of alternatives to ODS in the fields of fire extinguishers on aircrafts, solid rocket propellants and organic Rankine cycles.[139]

5.4.2 To what extent is the Regulation`s structure and content coherent?

While generally the structure and content of the Regulation are coherent, a number of minor issues have been identified.

- Some provisions need updating or have become obsolete altogether (Table 12).

Table 12. Overview of outdated or obsolete provisions

Article	Issue

[136] Commission implementing decision 2013/732/EU establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions, for the production of chlor-alkali, 9 December 2013.

[137] Horizon 2020 project 687428 - AURORA.

[138] Horizon 2020 project 633080 - MAC-III.

[139] Horizon 2020 projects 685482 – EFFICIENT, 638719 – GRAIL and 704201 – NanoORC.

Article 11(1)(a)	Provision valid until 31 December 2013
Article 11(1)(b)	Provision valid until 31 December 2016
Article 11(3)	Provision valid until 31 December 2014
Article 11(4)	Provision valid until 31 December 2014
Article 12(1)	Provision valid until 18 March 2010 Reference to Directive 91/414/EEC and Directive 98/8/EC should be replaced with respectively new Regulation (EU) No 528/2012 and Regulation (EC) No 1107/2009
Article 12(2)	Article linked to Article 12(1) and therefore has lost function
Article 12(3)	Reference to Directive 91/414/EEC should be replaced by reference to new Regulation (EU) No 528/2012 and Regulation (EC) No 1107/2009
Article 15(2)(f)	Part of this provision is valid until 31 December 2014
Article 17(2)(g)	Provision valid until 31 December 2014
Article 21	Reference to the date 1 January 2010 not relevant anymore. Provision to be rewritten to exclude this date.
Article 29	Reference to the date 30 June 2011 not relevant anymore. Provision to be rewritten to exclude this date.
Annex VI	New Annex inserted in consolidated text

- Some articles will expire soon (e.g. Articles 11(1)(c), 11(5), 11(6), 11(8), 15(2)(e), 25(2) and 25(3);
- One incorrect reference has been identified in Article 15(2)(k). A reference is made to Article 11(5) that is nonsensical, and should instead be to Article 11(8).
- Article 5(3) is considered imprecise by some stakeholders in terms of scope.
- The system of allocation of quota for essential laboratory and analytical uses, as laid down in Article 16(1)(a) of the Regulation in conjunction with Commission Regulation (EU) No 537/2011, has led to different mechanisms for quota allocated to "old" undertakings that received quota before 2009 and "new" undertakings that received quota after this date. The allocation mechanism is favourable to the "new" undertakings. At the same time, it should be borne in mind that it is questionable if having a quota system at all for this minor use is efficient.

  National authorities made a number of additional suggestions for improvement, including enforcing better cooperation between Member States customs and further streamlining with Fgas (e.g. leakage detection, custom definitions) and eco-design policies.

5.5 EU ADDED VALUE

5.5.1 What is the additional value resulting from the Regulation compared to what could reasonably have been achieved by Member States at national level?

An implementation of the international commitments under the Montreal Protocol at Member State level seems very difficult to reconcile with the principles of the EU internal market and the free movement of goods. This was expressed by many national authorities but also some undertakings. The EU currently complies under the REIO clause (see 2.1.2), i.e. as a joint area, with the Montreal Protocol consumption phase-out. Without the Regulation, Member States would be forced to comply individually and thus would need to regulate ODS consumption levels at national level, which would strongly affect the market players that work across borders in the EU internal market. Furthermore, import/export licences would need to be issued for all goods crossing borders between two Member States. For these reasons alone, it appears that regulating at EU level is required in this case.

5.5.1.1 Environmental benefits of an EU-wide approach

- **An EU-based approach is likely to yield a higher benefit for the global environment overall.** Member States would likely implement vastly different policy approaches, the sum of which is expected to be less ambitious as an overall EU-approach, even though a few Member States may choose to be more ambitious at national level. National authorities indicated by a large majority (21 out of 23 respondents) that regulating ODS at EU level leads to a lower consumption of ODS overall compared to regulating at national level only. Two national authorities also pointed out that banning ODS products and pushing for the use of alternatives becomes more effective with an increased number of implicated countries. Similarly, ambitious phase-out schedules linked to the possibility of exemptions and derogations to account for certain circumstances can be put in place more easily at the EU level. Some stakeholders in the open consultation stated that in the absence of EU-wide legislation, ODS already phased out today (e.g. HCFCs) would still be used in some EU countries and that the environmental benefits (at global level) would therefore have been significantly reduced. It is not only the EU's effective emission reductions that are important in this context, but also its ability to lead and inspire other parties to the Montreal Protocol to take stronger measures by leading by example.

5.5.1.2 Economic benefits of an EU-wide approach

- **The affected undertakings benefit greatly from having the same obligations across the EU.** This view was expressed by 87% of respondents in the open survey and is shared by most undertakings as well as national authorities (93% agree) in the targeted surveys. The most important reason quoted to support this view was the level playing field provided to undertakings. Others also argued that an EU approach eliminates competition between countries having different levels of controls in place ("regulatory dissonance") and that a proliferation of the effort needed by undertakings is avoided.
- **Regulating ODS at EU level is more efficient than at national level.** The point that a joint approach makes it easier to implement, enforce and achieve better compliance was indicated by authorities and some undertakings alike. Some national authorities also pointed out that the EU-wide IT systems administered by the Commission are less costly than operating separate national systems. Member States do not need to replicate expertise in running them, even though two countries mentioned that national systems might have given the opportunity to design more tailored solutions at a lesser expense at country level. Some newer Member States added that in the period of pre-accession, implementation of the Montreal Protocol was more costly, as they had to deal with licensing of ODS imports and exports themselves. The few undertakings (4%) disagreeing that an EU-level approach was more efficient pointed out that (i) national circumstances were considered less in the current situation as well as (ii) complications due to language issues.
- **The hypothetical counterfactual analysis of implementing at national level fully confirmed the stakeholder views.** A main difference in costs (time or monetary) to Member States in the counterfactual scenario relate to the need to duplicate the existing EU systems with operating systems at national level and additional administrative measures that Member States would need to take. Another key difference is the number of affected undertakings, because additional trade flows (i.e. intra-EU trade) would be covered by reporting, licensing, quota obligations etc. This can for some measures multiply the affected undertakings greatly. The estimated time needed to implement additional national measures in the counterfactual scenario would increase the total administrative effort by over 18x compared to the current situation (88,561 hours vs

3,902 + 917 hours, compare Table III.15 in Annex III). To these costs, IT system management and IT support as well as external consultancy costs must be added which were estimated to increase by ca. 28 and amount to considerable costs (see section 5.3.2.3). The costs for undertakings to comply in the counterfactual situation would similarly increase strongly as any undertaking operating in more than one Member State would be affected by many different licensing, quota, reporting etc. obligations. These higher costs have been estimated to be 22x more than for implementation at EU level overall in the counterfactual analysis (see Table III.16 in Annex III). In particular, the costs related to license requirements (35x higher due to intra-EU trade) and the quota requirements (11x) would increase strongly.

- **A loss of efficiency compared to a centralised EU approach could also be expected due to e.g. know-how and expertise losses.** Montreal Protocol implementation has been in place for a long time now. As a result, experience, expertise, and practices have been built up at EU level, which would have to be largely restructured and reinvented, if the responsibility for Montreal Protocol compliance were fully shifted to the Member States. This would likely lead to even higher expenses in the counterfactual, which was not quantified above.[140]

5.5.2 What would be the most likely consequences of withdrawing the Regulation?

- **The EU's international commitments, its contribution to protecting the ozone layer and the concomitant environmental benefits cannot be ensured without legislation.** Prescriptive international legal obligations will continue to persist in the future and the important achievements of the previous EU ODS Regulations that the current Regulation is building on must be safeguarded. Stakeholders in the open consultations stated, "in the absence of the Regulation, climate, the environment and health would be jeopardised." In principle, the main consequences of withdrawing the Regulation would logically reflect the mirror image of the EU added value described in the previous section: The advantages identified there would turn into disadvantages upon withdrawal. To comply internationally as well as to safeguard the accomplishments, an implementation at Member States level would be needed. As was explained above (section 5.5.1), this latter scenario would be neither effective nor efficient and appears to violate the rules of the functioning of the internal market.
- **Affected companies and authorities have better regulatory clarity if all ODS-related measures are in one policy document**. Withdrawal is not the only alternative to continuation of the Regulation. One could also consider an integration of the Regulation's provisions into other pieces of EU legislation (e.g. chemicals, waste and industrial emissions). However, while sharing some important links to all of these areas, the core Montreal Protocol obligations such as the phase-out schedules and related exemptions and derogation do not have an obvious place in other related legislation. That said, an integration of the Regulation into the Fgas Regulation could present a possible option for the future in case this were proven to reduce complexity and provide more clarity for legislators and regulated undertakings alike., The two pieces of legislation are quite similar as regards the industrial sectors regulated and some of the regulatory measures prescribed,

[140] It was however also not considered that there might be scope for building more efficient systems depending on the corresponding national situation, with possible savings in the total amount estimated.

6. CONCLUSIONS

The evaluation of the Regulation shows that the general objectives have been effectively achieved and the overall performance matches expectations. The Regulation has ensured full compliance with the EU's obligations under the Montreal Protocol. It has also enabled the EU to demonstrate a high level of ambition for protecting the ozone layer and to contribute to the broader policy objective of fighting climate change. **The Regulation prevents that significant amounts of highly warming GHGs can reach the atmosphere, which continues to be important going forward as all sectors of the economy need to increasingly contribute in order to reach the 1.5 degrees Celsius target of the Paris Agreement.**

The evaluation also shows that the specific objectives have generally been reached.

- In addition to locking in the progress achieved until 2010 in this policy area, the assessment shows that additional ODS uses have been eliminated in the period 2010-2017. In particular, the phase-out of HCFC in the refrigeration sector and of methyl bromide[141] has been completed and significant progress was made on halon substitution. Furthermore, the production phase-out of HCFCs is nearly complete.[142]
- The development of new alternatives was incentivised, in particular for halons. Generally, the pace of replacement is slow, simply because, if it were easy to find alternatives, these uses would have been phased-out already previously. The use of ODS as process agents can be expected to end in the medium term, while many laboratory and feedstock uses will largely continue despite alternatives becoming available for some of these applications.
- Some progress on preventing emissions of ODS from banks[29] has been made. However, as waste management of ODS banks is also addressed by separate EU Waste Directives, the extent of the role of the Regulation is unclear. Still, a number of diverse measures on ODS going beyond the latter have been taken by Member States.
- The combination of measures put in place to prevent illegal activities appeared to prevent such activities to a satisfactory extent. The largest quantities are used as feedstocks in the EU and there is no identification of significant illegal activities based on an analysis of the reporting data in this area. The licensing system and border controls by Member States have been recognised internationally as effectively enforcing the existing trade rules on ODS.
- The comprehensive reporting on ODS activities, including on new substances, has enabled the EU to monitor the emergence of new threats to the ozone layer.
- By effectively phasing-out HCFC consumption 10 years ahead of schedule and taking effective action on other uses still allowed under the Montreal Protocol, the EU has been leading by example. This has greatly helped to push for ambitious policies internationally in negotiations and sharing of best practice.

Most of the emission savings in the period 2010-2017 are a result of long-standing measures and not due to changes introduced in 2009. This is in line with very modest expectations on emission savings of the partial review. The emission savings

[141] For QPS uses.

[142] To be completed by end-2019.

from discontinuing methyl bromide use for QPS have been achieved, and some emissions were saved as a result of synergies with waste policies.

The Regulation remains highly relevant since the EU, as party to the Montreal Protocol, needs to control remaining uses and needs to ensure that the results achieved in previous decades are maintained. This continues to be relevant also in the view of reaching the objectives of the Paris Agreement to limit global warming. The focus of (stratospheric) ozone policies has shifted towards ensuring good enforcement and avoiding backsliding rather than seeking to legislate new phase-outs. Strong enforcement measures and control will continue to be necessary to encourage third countries. By giving a good example, the EU can influence global discussions, and the required technical conversions, in a way that maximises the global effort, with both ozone and climate benefits.

There is broad support for continuing the control of ODS from all stakeholder groups. The phase-out schedules of the Regulation take relevant technological and scientific development into account, not least through the combination of the exemptions and derogations, which continue to be relevant for uses where alternatives do not (yet) exist. That said, there is an opportunity to update the Regulation as some exemptions, in particular for refrigeration, may not be necessary anymore. Furthermore, the possibility conferred to the Commission to adjust the Regulation, for instance in case new substances would become a threat, safeguards the continued relevance of the Regulation.

Overall, the Regulation has been efficient as it indisputable that is ensures major environmental and climate benefits while it did not create disproportionate costs for companies over the period 2010-2017. The benefits of the Regulation for the environment and human health are very significant, even though the isolated effect of EU action cannot be easily separated from effects of efforts elsewhere in the world. The number of affected stakeholders is declining and both authorities and undertakings agree largely that costs are moderate to low.

The envisaged cost savings of the measures introduced in 2009 for Member States and companies have to a good degree been achieved. Savings of close to €2 million for undertakings were identified, and reduced Member States reporting obligations led to savings of €0.9 million. Conversely, costs incurred at the EU level have been much more significant than foreseen, even though a number of implementation choices have already been introduced to lessen the burden. In particular, the impact of extending the scope of the licensing system and the setting up and running of electronic reporting was underestimated in the impact assessment and led to significant additional costs that continue into the future. It is also questionable if the setting of quotas for exempted uses after phase-out completion[143] and registration requirements for laboratories are bringing sufficient added value compared to the costs involved. The resource needs for the licensing system may be significantly reduced, while maintaining or even improving effectiveness by establishing automatic links between the central EU database and customs offices through the Commission's "single window initiative". There is therefore the potential for future savings at the European level regarding these measures as well as, to a moderate degree, also for the undertakings involved.

The Regulation is generally well aligned with relevant EU and international legislation. The long experience of the Commission and Member States in the

[143] For feedstock, process agent or laboratory uses.

implementation and enforcement of ozone legislation has led to high integration of the legislation within the EU environmental legal framework. However, some further improvements may be achievable. This includes *inter alia* better coherence with customs legislation and border checking obligations. Similarly, there is some scope for simplification, improvement and clarifications as regards the coherence of the Regulation.

The findings of the evaluation confirm that only a common, harmonised, EU approach can effectively implement the obligations of the Montreal Protocol and respect internal market rules. An EU-level Regulation provides much higher efficiency than the hypothetical counterfactual scenario where each Member State would set up and maintain their own information systems and undertakings would need to comply in each country where they operate. The EU added value is fully confirmed by the generally favourable opinion among stakeholders towards regulating at EU level in this policy area, both from commercial companies as well as from relevant authorities.

Key challenges for the future include the need to maintain, in an efficient manner, good control over the remaining uses and trade of ODS, achieve further progress on reducing emissions from banks wherever this is feasible, as well as promoting and supporting ambitious action elsewhere in the world by demonstrating the feasibility of implementing ambitious policy approaches in this area and controlling emissions of remaining uses.

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Annex I: Procedural information

1. LEAD DG, DECIDE PLANNING REFERENCES

- Lead Directorate-General (DG) of the European Commission: DG Climate Action (DG CLIMA). In particular, the evaluation has been carried out by Unit A2 - Climate Finance, Mainstreaming, Montreal Protocol.
- Decide Planning reference[144]: PLAN/2017/927 "Evaluation of the Ozone Regulation".

2. ORGANISATION AND TIMING

- As per the Better Regulation Guidelines on evaluations[145], an ISG was set up in March 2017 to follow up and steer the whole process. The ISG oversaw the evaluation to ensure coherence and comprehensiveness with the Commission's overall responsibilities and activities in related policy areas, such as environment and customs.
- The ISG for this evaluation involved staff from the following Commission's departments in addition to DG Climate Action: DG Energy, DG Environment, DG Internal Market, Industry, Entrepreneurship and SMEs, DG Mobility and Transport, DG Taxation and Customs Union, DG Trade, Legal Service, Secretariat-General.
- The ISG met six times: 27 March 2017, 14 December 2017, 6 February 2018, 5 July 2018, 30 October 2018, and 1 April 2019. Through these meetings and several written exchanges, the ISG participated in the whole evaluation process leading to the finalisation of the external study and this Staff Working Document.
- An Evaluation Roadmap summarising the design, purpose and scope of the evaluation was published on 14 July 2017 on the Commission's Europa web site[146]. The feedback period was open from 14 July 2017 to 11 August 2017.
- The Commission signed a contract for a Support study on the evaluation (contract ref. No 340203/2017/767230/SFRA/CLIMA.A.2) on 27 November 2017.
- An open public consultation[147] ran from 1 June 2018 to 24 August 2018 (12 weeks).
- The Final report of the Support study on the evaluation was approved on 22 February 2019.
- The meeting with the Regulatory Scrutiny Board (RSB) took place on 19 June 2019.

3. EXCEPTIONS TO THE BETTER REGULATION GUIDELINES

N/A

144 "Decide Planning" is a database and management tool for the operational planning and monitoring of the main political initiatives to be adopted by the European Commission.

145 https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox_en

146 https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-3562786_en

147 https://ec.europa.eu/clima/consultations/public-consultation-evaluation-ozone-regulation_en

4. CONSULTATION OF THE RSB

This evaluation was selected for presentation to the Commission's Regulatory Scrutiny Board. The RSB consultation took place on 19 June 2019.

The Table below summarises the changes introduced to this Staff Working Document (SWD) in response to the Board's main comments.

Main RSB considerations	Changes made to the SWD
The evaluation does not clearly present the achievements of the Regulation. It does not sufficiently differentiate what the current Regulation achieved from the overall realisations of the longstanding rules in this fields.	The text was modified (baseline, effectiveness, efficiency, conclusions) to highlight the recent progress made on all the measures of the Regulation, including (i) on the measures that were maintained from the previous Regulation, as well as on (ii) those additional measures that applied only from 2010.
The report does not explain how the Regulation, through its rigorous system of monitoring and enforcement in implementation of the Montreal Protocol, relates to the role the EU plays in the global coalition.	This was emphasised throughout the document, in particular in sections 5.1.3.5 and 5.1.3.6.
The report does not clarify whether there is a need for continued higher ambition for the future, possibly related to climate action.	It is explained throughout the document that the "high ambition" will continue to be needed for ozone layer protection, even though most phase-out measures have been completed. This "high ambition" refers to the need of implementing the Montreal Protcol in an effective manner, e.g. by having good overview and control over trade flows and continuing uses, which goes considerably beyond a pure transposition of basic requirements arising from the international obligations. While the main rationale will continue to be protection of the ozone layer, very significant emissions savings for climate are achieved as co-benefit.

5. EVIDENCE, SOURCES AND QUALITY

This evaluation drew on the internal expertise of the Commission, on an extensive consultation of stakeholders (see Annex II) and on a support study carried out by an external consultant.

The evidence used for the evaluation comes from several data sources, in particular the annual reports on ozone-depleting substances by the European Environment Agency and the consultation with stakeholders, including Member States authorities and undertakings. Sources are cited as footnotes to this document (see methodology).

At a late stage of the external study, not least because of the constructive input provided by the ISG, it was decided to adjust the intervention logic and consequently some of the analysis carried out under the different evaluation criteria. While this adjusted approach was adopted for this SWD, the study itself was concluded following the original stipulations of its terms of references as the necessary refocusing was not possible in the remaining contract timeframe. This explains the existing differences in content between the SWD and the external study, while the overall conclusions of the SWD are in line with those of the external study. This approach was discussed in the last meeting of the ISG on 1 April 2019 and welcomed by the participants.

Annex II: Stakeholder consultation

II.1 Introduction

Information was gathered via a number of different stakeholder consultation activities conducted with the help of an external consultant in the context of the *Support study for the evaluation of Regulation (EC) No 1005/2009 on substances that deplete the ozone layer*. The data collected served to support the assessment of Relevance, Effectiveness, Efficiency, Coherence and EU Added Value of the Regulation.

II.2 Feedback on the Roadmap

In July 2017, the European Commission published the Roadmap for the Evaluation of the Ozone Regulation.[148] This Roadmap was open for feedback from stakeholders between the period of 14 July 2017 until 11 August 2017. The Commission received feedback from 2 business associations representing the refrigeration industry and the maritime cruise industry, 2 competent authorities of Member States (Cyprus and Germany), and the Austrian Chamber of Commerce.

The maritime cruise industry suggested that the consequences of EU legislation going beyond international legislation should be considered in their impacts on the maritime cruise industry. The Environment Department of Cyprus pointed out that the treatment of equipment containing ODS and particularly R22 under the Regulation was not providing sufficient options to Member States, as it currently led to imports solely for the destruction of the equipment without allowing reuse of the equipment with other substances. The German Environment Agency recommended the consistent strict ban of ODS based on findings from recent scientific literature, and suggested including in the scope of the Regulation the refrigerant 1233zd and very short-lived substances such as dichloromethane due to their ozone-depleting potential. In response to these statements, stakeholders from the refrigeration industry contested that 1233zd and dichloromethane were a risk to the recovery of the ozone layer, supporting this statement with a position paper suggesting low emission uses of the substances. The Austrian Chamber of Commerce suggested that the ozone layer was regenerating and that there was no need for changes to the Regulation, except the adaptation of minor elements such as exemption regimes. The feedback finally recalled that since 2008 the technical requirements for labelling of substances and mixtures that are "hazardous to the ozone layer" were complemented by classification and labelling requirements of the CLP Regulation.

II.3 Survey of Undertakings

A survey of undertakings was carried out by the external contractor in the period April-May 2018. The survey was distributed to all relevant undertakings in the EC's Licensing System database. It was comprised of 34 open and closed questions. The consultation received 363 responses from unique respondents. Of these, 72% represented private enterprises, 15% fell under the category "other", and 13% were representatives of research organisations and academia. The largest proportion of undertakings were large enterprises

148 https://ec.europa.eu/info/law/better-regulation/initiative/1448/publication/35878/attachment/090166e5b3c022a8_en

(43%) and the geographical regions in which they operated were the EU (98%), North America (15%), and Asia (15%).[149] The most represented industrial sectors were laboratories, aviation, and the chemical industry which reflects the most relevant groups still affected by the Regulation. The relevant ODS-related activities were use or sales of ODS laboratory or analytical purposes (39%), import or export of ODS (26%), and use of halons for fire protection (18%). Their activities typically involved the following substances – carbon tetrachloride (41%), halons (35%), HCFCs (23%) and CFCs (22%). The undertakings had to comply most often with the following measures within the Regulation – applying for licences or authorisations (52%), registering for essential laboratory and analytical uses (47%), and reporting annually (38%).

Effectiveness

Overall, a large majority of undertakings (80%) was aware of the requirements of the Regulation and indicated that the information sources they used to verify their obligations were EU manuals and guidance documents (60%), the Regulation itself (53%) and national institutions (31%). A third of the undertakings reported reducing the amount of ODS involved in their activities in the period of 2010-2017. This was due to (i) the introduction of substitutes, (ii) process changes or disposal of stocks and waste, (iii') a lower demand for and supply of ODS, and (iv) a better general awareness and compliance with the Regulation. Reasons given by those that had not reduced ODS in this period (38%) included (i) the small quantities of ODS involved in their activities (e.g. laboratories), (ii) the need to meet customer demands, and (iii) the lack of alternatives that met their needs (the latter for undertakings involved in aviation). While the majority of respondents either strongly agreed or agreed that each measure of the Regulation contributed to a better control of the use of ODS, the measures "phasing-out HCFCs for refrigeration", "phasing-out halons in firefighting equipment", "controlling leakage and emissions". "technical requirements for destruction and reclamation" and "undergoing national inspections" received the most support. Only for 16% of undertakings the use of ODS had changed (positively or negatively) (also) as a result of factors unrelated to the Regulation, such as the economic situation, market demands, other requirements, and factors related to research and development. Many of the respondents agreed that there was progress in finding alternatives (48%) or that alternatives had become available (46%) as a result of the Regulation, with less than 3% disagreeing on this issue. This was most often attributed to the fact that the prohibitions resulted in pressure to develop alternatives as well as the role of the market and economic drivers.

Costs

The costliest measures under the Regulation named by undertakings in the period of 2010-2017 were "phasing-out halons in firefighting equipment", "technical requirements during reclamation and destruction" and "phasing-out HCFCs for refrigeration". Even for these measures, however, only 23-36% of respondents identified them as high to very high. Additionally, only 8% of undertakings reported that there were other substantial costs unrelated to the Regulation, linked to (i) changes in processes and practices, (ii) reduced availability of certain substances, and (iii) need to follow changes of legislation. The respondents reported several requirements of the Regulation, which they considered to be unnecessarily complicated, burdensome or costly, such as "registration related to essential laboratory and analytical uses", "annual reporting", and "import and export licences". A few undertakings identified economic benefits for themselves, in particular new market

[149] N.b.: more than one choice possible, e.g. for internationally active companies

opportunities and a level-playing field, better corporate image, business continuity by using exemptions, and better control of substance flows and leakages

Quality of the Regulation
Very few respondents (3%) stated that they were aware of overlaps, contradictions or gaps between the Regulation and related EU laws (3%) or international legal instruments (1%). 66% of undertakings expressed that they were (very) satisfied with the ODS Licensing System, while 43% were (very) satisfied with EEA's BDR for annual reporting (In the latter case another 22% were (very) unsatisfied).

Added value of regulating at EU-level
Overall, 54% of undertakings either strongly agreed or agreed that regulating ODS at EU Level was more efficient than at national level due to the advantages of operating in a market with uniform rules and the associate lower administrative and enforcement costs (Only 4% disagreed or strongly disagreed). Additionally, 67% of undertakings agreed that it is an advantage that industries across the EU have the same obligations as regards ODS (4% disagreed or strongly disagreed).

II.4 Survey of Competent Authorities of the Member States

A questionnaire was sent via email to the relevant authorities in each Member State in May 2018. 23 responses were obtained by the agreed deadline of 20 June 2018. The survey consisted of 28 open and closed questions.

Effectiveness
The majority of competent authorities agreed that the Regulation had ensured a reduced production and consumption of O (96%) and that it had led to appropriate management of the remaining stock (77%). All measures of the Regulation were seen as contributing to the reduction of consumption and production by 60% or more of the authorities. Some respondents (43%) indicated that there were also factors other than the Regulation that led to a reduction of the consumption of ODS in the EU, namely research and development, other legislation, financial incentives, awareness raising and others. More than half (56%) stated that more needed to be done in the EU on regulating ODS, such as introducing more custom controls, ensuring the appropriate treatment of existing banks and removing old equipment with R22/HCFCs.

Authorities agreed overwhelmingly that undertakings that dealt with ODS in their respective countries were aware of the requirements of the Regulation. The majority of competent authorities (69%) also agreed or strongly agreed that the five additional chemicals, called "new chemicals" should be monitored under the Regulation. They suggested including in the monitoring several additional substances, which they considered important as well. These included HFO 1233zd, very short-lived substances, unsaturated HCFCs and 2-BTPs.

When asked to specify the kind of inspection activities they had been carrying out in their respective countries to enforce the Regulation, the competent authorities listed custom controls, environmental inspections on entities handling ODS, and inspections of undertakings in relation to illegal activities. The majority (86%) reported that there had been cases of non-compliance with the Regulation in their countries, such as illegal import/export, lack of valid licences and illegal trade, which often resulted in penalties, prosecutions and destruction of the substances. The competent authorities emphasised that

the main challenges they encountered were related to a lack of resources to carry out the necessary number of inspections.
All competent authorities agreed or strongly agreed that there was a progress in finding alternatives because the ODS were controlled by the Regulation. Similarly, 87% of them agreed or strongly agreed that alternatives had become available as a result. A large proportion of the competent authorities (44%) indicated that they agreed that the possibility to apply for derogations was still needed in their respective countries while 28% disagreed. Most respondents (71%) had not received any applications from undertakings for derogations in the period between 2010 and 2017.

Costs
The activities with the highest cost for the competent authorities were "conducting inspections", "custom controls", "promoting the recovery, recycling, reclamation and destruction" and "determining minimum qualification requirements" for service technicians. Most respondents did not think that there were unnecessarily costly requirements in the Regulation but for a few minor points.

Quality of the Regulation
A minority (<25%) of respondents could identify contradictions, overlaps or gaps between the Regulation and related international legal instruments, related EU legal instruments or within the Regulation itself (e.g. the interpretation of some articles was left to competent authority). There was very high approval of the EC Licensing System and the EEA's BDR for company reporting.

Added value of regulating at EU level
Most competent authorities agreed or strongly agreed that regulating ODS at EU level was more effective (92%) and efficient (92%) than it would have been if it was regulated at national level. They appreciated the fact (93%) that industries across the EU had the same obligations was an advantage because it provided for consistency between Member States. Authorities also highlighted the existence of the single market where EU Member States cannot operate in a vacuum and that IT systems administered at EU level are less costly than separate national system including the know-how needed to run them.

II.5 Public consultation

A public consultation was held on the European Commission survey platform, "EU Survey", in the period between 1 June 2018 and 24 Augusts 2018. The questionnaire consisted of 62 open and closed questions and was available in 23 EU languages (https://ec.europa.eu/clima/sites/clima/files/consultations/docs/0037/questionnaire_en.pdf). 46 responses from unique respondents were received. This relatively low number presumably reflects that this is an area of legislation which has been around for decades, where stakeholders are familiar with the policy measures and much less entities are still strongly affected by these measures, compared to the initial stages. Of the respondents, 59% indicated that they responded to the consultation in their professional capacity, or on behalf of an organisation, and 41% indicated that they responded in their individual capacity. The most represented types of organisations among the former group were trade, business or professional organisations (41%), private organisations (19%), regional or local authorities (15%), and non-governmental organisations, platforms or networks (15%). Overall, the largest number of organisations had headquarters in Germany (22%), followed by Belgium

(11%) and Italy (11%). As for the individuals, 26% of respondents originated from Germany, 21% from Italy, 16% from Poland and 11% from France, with other respondents also from Bulgaria, Greece, Netherlands, Spain and UK.

Effectiveness

Most respondents (82%) indicated to be well aware of the requirements of the Regulation and agreed or strongly agreed that it had contributed to the reduction of the consumption of ODS (87%). The majority of respondents (71%) also agreed that the larger number of requirements imposed by the Regulation compared to the Montreal Protocol had led to a more effective reduction in the consumption of ODS, because they had resulted in a faster phase-out of ODS and an accelerated replacement of technologies that used them. Other contributing factors beside the Regulation that could be identified by the respondents were the timely availability of non-ODS alternatives in the EU, increased public awareness, other legislation including at international level (e.g. ICAO) and national initiatives. The Ozone Secretariat, in responding to this consultation, expressed a positive view towards the Regulation with respect to its contribution to the reduction of the use of ODS and had led to a more effective reduction world-wide.

A majority of respondents (72%) was not aware of any unintended consequences of the Regulations. Those who were (22%) indicated a conversion to less energy-efficient technologies in refrigerators due to the quick phase-out, the use of halon replacing agents that did not meet the safety criteria for aircraft certification and operation, and illegal trade as undesirable consequences.

The respondents were more divided on the question of whether more needed to be done in the EU on regulating ODS. While 51% of them agreed or strongly agreed that more should be done, 35% disagreed or strongly disagreed. Those in the former group stated that a continued effort was necessary with an emphasis on illegal trade and controlling the remaining uses, while respondents that disagreed thought that the Regulation was sufficient in its current form and that emphasis should be placed on the global approach.

The majority of respondents (61%) also agreed or strongly agreed that alternatives became available because ODS were controlled by the Regulation (as opposed to 4% who disagreed) and agreed or strongly agreed that that there was progress in finding alternatives because ozone-depleting substance were controlled by the Regulation (54%) (as opposed to 7% who disagreed).

Quality of the Regulation

A small proportion of respondents (11%) stated that they were aware of some gaps, contradictions or overlaps between the Regulation and related international or EU legal instruments. This included aviation stakeholders who did not like stricter EU rules compared to international (ICAO) standards, and others who wanted to more strictly control the use of permitted substances. Lastly, only 4% of respondents were aware of any gaps or contradictions within the Regulation, respectively. A majority of respondents (68% or higher in all cases) thought that none of the measures were unnecessarily complicated, burdensome or costly. The most burdensome identified by a small minority of undertakings (laboratories, some aviation/chemicals), in this order were “annual reports”, “halon phase-out”, “national inspections”, “registering for laboratory use” and “quota applications”.[150]

[150] 23-32% of respondents thought that these were burdensome

Added value of regulating at EU-level
With regards to the added value of regulating at EU-level, the majority (87%) either agreed or strongly agreed that the harmonisation of the obligations of industries across the EU was advantageous and credited it for the creation of a level playing field for undertakings and the prevention of illegal cross-border activities. Moreover, 76% of respondents shared the opinion that regulating ODS at EU-level was more efficient than if it was regulated at national level, since that allowed for a more streamlined approach, led to cost efficiency due to harmonised legislation and made compliance easier for undertakings. Some respondents also pointed out that without the Regulation phased-out ODS would still be in use in some EU countries and that there would have been significantly less benefit to the environment and for public health.

II.6 Targeted stakeholder consultations

A number of selected stakeholders were interviewed or asked to provide written feedback on certain topics of interest following the company and authority surveys in order to obtain more detailed information.

Ad-hoc interviews
A number of interviews were performed by phone, with questionnaires sent ahead of the interview to guide the discussions, in order to better prepare or to explore particular issues. These ad-hoc interviews included one competent authority of a Member State in advance of the targeted consultations, four industry associations on EU or international level affected by the Regulation, and the European Aviation Safety Agency (EASA).

Targeted consultations with undertakings and competent authorities of the Member States on the costs of the Regulation
Targeted interviews with undertakings and competent authorities of the Member States were conducted regarding the costs resulting from complying with or implementing the measures of the Regulation. In total, 25 selected undertakings representing different sectors were contacted, resulting in 20 interviews. An additional 9 competent authorities of Member States were contacted, resulting in 8 interviews including 6 with competent authorities of EU Member States in coordinating roles, and 2 interviews with competent authorities from Switzerland and Norway. The interviews allowed to collect quantified cost data (qualitative and quantitative). Qualitative appreciation of the effort to comply with or implement the measures of the Regulation were collected to build on the efficiency-related questions of surveys and of the public consultation. It was easier for the respondents to put a price on administrative measures of the Regulation, whereas most found it very difficult to do the same for substantive compliance measures (phase-out schedules, national inspection obligations, technical requirements for destruction, technical requirements for leakage and emission control).

Targeted consultations regarding the Coherence of the Regulation
As regards coherence of the Regulation, 10 national public authorities were contacted, resulting in 7 reactions, as well as the European Aviation Safety Agency (EASA). To facilitate the exchange of information, a questionnaire was sent to the relevant national public authorities, which was followed up by a phone call where necessary. This consultation provided clarity with respect to the issues raised by specific authorities (e.g. relevant legal provisions, effects in practice, relevant examples), an indication of how urgent or relevant the raised issues were for the work of each stakeholder, and suggestions

of other stakeholders who should be consulted. The main issues discussed in the consultation regarded the coherence of the Regulation with customs legislation, the aviation sector´s phase-out of the use of halons in fire-fighting system, EU chemicals and waste legislation.

II.7 Stakeholder workshop

In order to validate the preliminary results of the study, a final stakeholder workshop was held on 7 November 2018 in Brussels. 30 representatives of national authorities and industry organisations participated. A briefing paper summarising the results of the preliminary findings of the support study on the evaluation of the Regulation was provided to participants in advance. All stakeholders responding to the open survey and thus showing interest in this exercise were invited to this meeting in addition to any supranational associations known to be affected by the Regulation. At the meeting the external contractor presented in detail the findings for the five evaluation categories. The attendees were invited to provide comments and to answer specific questions.

In general, the participants did not challenge the assertions made in the presentation on Effectiveness, Relevance, Efficiency (including on benefits and costs), Coherence and EU Added Value of the Regulation[151]. On a question by a participant it was clarified that about 800 companies are registered in the ODS Licensing System, as well as 1200 laboratories. Several Member States indicated that leakage control measures are very important and increase the awareness of users, but good enforcement is key. One Member State pointed out that it is was hard to quantify the impact of this type of measures. On end-of-life treatment one NGO emphasised that the differences between waste management regulations in Member States complicated enforcement. One Member State also indicated that it considered the quota allocation system to be inefficient, ineffective, and time-consuming and, with respect to coherence, believed that several provisions of the Regulation were obsolete and should be removed. There was a general agreement by participating Member States that the phase-out of some ODS (e.g. HCFCs, halons) as a result of the Regulation, had led to a shift towards the use of alternatives. Examples mentioned were the refrigeration sector, the replacement of some process agents and the development of halon alternatives.

The Commission as chair concluded on the basis of the presentation by the contractor and the comments by stakeholders present that the Regulation appears to work pretty well in general terms, has huge benefits for the environment at very moderate costs and will clearly continue to be needed at EU level, not least to fulfil the EU's international obligations. However, there also appears to be some room for improvement in relation to simplification and coherence.

In addition to expressing their opinions during the workshop, the participants were invited to provide written answers to the questions posed during the workshop, in particular on the costs of measures and on issues of implementation at national level. In total, 7 attendees (6 Member States and 1 undertaking) sent responses after the meeting. Member States provided example of steps taken to promote the recovery, recycling, reclamation and destruction of ODS, such as organising awareness raising campaigns, introducing emission fees, establishing electronic databases and emission inventories, building handling centres for ODS, strengthening custom controls, and creating sanctions for infringements. An

[151] Participants were directly asked to comment on these issues.

overview of the latter was hard ot establish given that most infringements result in administrative fines that are not addressed in any way. The undertaking agreed that the health, environmental and economic benefits of the Regulation were worth the costs. One Member State warned that comparisons between actual benefits in the period 2010-2017 and costs should be approached with caution (as the benefits of this policy extends much beyond this period), and it expressed its belief that the incremental cost for companies and the administrative cost of authorities deriving from the ODS Regulation were indispensable investments in the future. The same Member State also emphasised that while many alternatives had already been introduced before the current version of the Regulation, while the latter had also significantly contributed to the continuous development of alternatives.

Annex III: Methods and analytical models

III.1 Data sources

A lot of relevant data is available and was used for this evaluation which comprises e.g. annual reporting data by undertakings and competent authorities of the Member States; reports by the European Commission to the Ozone Secretariat; data from the Commission's ODS licensing system; reports by the Montreal Protocol`s technical bodies such as EEAP (Environmental Effects Assessment Panel), TEAP (Technology and Economic Assessment Panel) and SAP (Scientific Assessment Panel); decisions of the Montreal Protocol or its Implementation Committee; and scientific literature.

III.2 Data on alternatives

Information for potential alternatives on exempted uses, in particular for remaining uses of halon and on process agents, was collected by the external contractor. The analysis included an online-based literature research, where relevant sources and publications were identified, in particular scientific publications, publications by producers and operators, relevant government agency publications such as US EPA, Australian Department of Agriculture, Fisheries and Forestry, Nordic Council of Ministers, as well as UNIDO, and several reports of the TEAP or the TEAP's Halons Technical Options Committee (HTOC). This was complemented by responses from the consultations, in particular the targeted interviews, including a telephone conference with the ICCAIA and EASA. These results are found in Ramboll (2019).

III.3 Cost assessment

The costs of complying with the Regulation received particular attention in order to assess their proportionality and whether the measures of the regulation were efficient. In total, 27 interviews were conducted to collect cost information from administrations (7 interviews) and undertakings (20 interviews). An effort was made to ensure a representative sample by targeting "typical", rather than "exceptional" organisations, based on the knowledge of the concerned sectors and relevant stakeholders. The sample was drawn to ensure sufficient coverage of the different measures of the Regulation, i.e. such that at least 3 respondents per each measure would be able to answer questions regarding its costs. Exploratory interviews were used to understand the practical steps to complying with the obligations, identify business-as-usual obligations, and to test and refine the questionnaire. On the basis of the developed questionnaires undertakings and administrations provided for each measure of the Regulation the extent of the cost of the Regulation in qualitative terms and, to the extent that the respondents were able to provide good estimates, also in quantitative terms, i.e. either the time required per action or monetary cost per equipment was collected.

III.3.1 Costs for undertakings

The following assumptions were made:

- Rather than undertaking's size, the number of substances dealt with and the number of licences/quotas an undertaking applies for was assumed to drive cost variations;

– Costs differ per type of substance with regards to phasing-out and finding alternatives. All substances were covered in the sample[152];

– Costs were assumed to be the same across all Member States, consequently undertakings were not selected according to their location of activities.

Yearly costs were obtained from stakeholders. Only the costs related to administrative measures could be quantified by sufficient respondents.[153] For compliance costs, therefore, the replies of undertakings on a scale from 1 (no costs) to 5 (very high costs) were used to give a qualitative estimation of how costly different measures were.

The responses from undertakings on costs for administrative measures are shown in Table III.1. For licences and registrations a unit cost was determined, as multiple licences can be applied for in a year and registrations for laboratories occurs at least once every two years (Table III.2 and III.3). Yearly time averages were computed from these lists for each administrative measure (Table III.4).

Table III.1 Table of time per measure in hours per year per undertaking.

Undertaking	Apply for licences (ODS Licensing System)	Apply for quota (ODS Licensing System)	Register for essential laboratory and analytical uses (labODS registry)	Report annually (BDR)
Undertaking 1				225
Undertaking 2	1			16
Undertaking 3	144	16	8	168
Undertaking 4	1	0		1
Undertaking 5				80
Undertaking 6	0			40
Undertaking 7	350			6
Undertaking 8				
Undertaking 9				
Undertaking 10		4		16
Undertaking 11				2
Undertaking 12	30	0.33		10
Undertaking 13	2			
Undertaking 14	1	0.25		40

[152] For the main affected sector of the past, the refrigeration industry, the phase-out has been completed (see effectiveness). Costs for endusers in the sector were therefore not included. On the other hand, for halons the aviation industry as endusers of fire protection units was included.

[153] In addition the costs of reporting on new substances could not be quantified but is assumed to be similar to those costs related to reporting on the ODS covered by the Montreal Protocol.

Undertaking	Apply for licences (ODS Licensing System)	Apply for quota (ODS Licensing System)	Register for essential laboratory and analytical uses (labODS registry)	Report annually (BDR)
Undertaking 15		13	0.50	8
Undertaking 16	126	1	0.05	30
Undertaking 17				
Undertaking 18				
Undertaking 19				
Undertaking 20	104		2.00	40
Undertaking 21				2
Undertaking 22	52.0			28.0
Undertaking 23				

Table III.2 Calculation table for unit time cost per license, based on background data from European Commission systems.

Undertaking	Average number of licences applied for per year (ODS Licensing System)	Average time per license (hours)
Undertaking 1	N/A	N/A
Undertaking 2	0.25	2
Undertaking 3	48	3
Undertaking 4	1	1
Undertaking 5	N/A	N/A
Undertaking 6	3	0
Undertaking 7	200*	2
Undertaking 8	N/A	N/A
Undertaking 9	N/A	N/A
Undertaking 10	N/A	N/A
Undertaking 11	N/A	N/A
Undertaking 12	24	1
Undertaking 13	4	1
Undertaking 14	11	0.08
Undertaking 15	N/A	N/A
Undertaking 16	314	0.40
Undertaking 17	N/A	N/A
Undertaking 18	N/A	N/A
Undertaking 19	N/A	N/A
Undertaking 20	4.3	0.5
Undertaking 21	N/A	N/A
Undertaking 22	48.5	1.07
Undertaking 23	N/A	N/A

- *The respondent's own estimate was used.*
- *Note: N/A is indicated wherever an undertaking could not indicate a time needed for licensing, or when the undertaking never applied for a license.*

Table III.3 Calculation table for unit time cost per essential laboratory and analytical uses registration, based on background data from European Commission systems.

Undertaking	Average number of registration per year	Average time per registration	Average time per registration in a year
Undertaking 1	N/A	N/A	N/A
Undertaking 2	N/A	N/A	N/A
Undertaking 3	1.0	8.0	8.0
Undertaking 4	N/A	N/A	N/A
Undertaking 5	N/A	N/A	N/A
Undertaking 6	N/A	N/A	N/A
Undertaking 7	N/A	N/A	N/A
Undertaking 8	N/A	N/A	N/A
Undertaking 9	N/A	N/A	N/A
Undertaking 10	N/A	N/A	N/A
Undertaking 11	N/A	N/A	N/A
Undertaking 12	N/A	N/A	N/A
Undertaking 13	N/A	N/A	N/A
Undertaking 14	N/A	N/A	N/A
Undertaking 15	0.3	2.0	0.5
Undertaking 16	0.5	0.1	0.1
Undertaking 17	N/A	N/A	N/A
Undertaking 18	N/A	N/A	N/A
Undertaking 19	N/A	N/A	N/A
Undertaking 20	0.3	8.0	2.0
Undertaking 21	N/A	N/A	N/A
Undertaking 22	N/A	N/A	N/A
Undertaking 23	N/A	N/A	N/A

N/A is indicated wherever an undertaking could not indicate a time needed for registration. Numbers rounded to 1 decimal.

Table III.4 Costs reported by undertakings for administrative measures, in hours per year.

Time (person-hours per year)	Apply for one licence (ODS Licensing System)	Apply for one quota (ODS Licensing System)	Register once for essential laboratory and analytical uses (labODS registry)	Yearly report (BDR)
Number of respondents	(N=13)	(N=7)	(N=4)	(N=15)
Average	**1.1**	**4.8**	**3.5**	44.4
Maximum	3.0	16.0	8.0	225.0
Minimum	0.1	0.3	0.5	1.0
Median	1.0	2.3	1.3	**22.0***
Administrative cost used in calculations	**37 €**	**191 €**	**124 €**	**777 €**

** While average costs were used for all other administrative measures, the median was used for yearly reports (BDR) due to the presence of an outlier (i.e. the maximum value of 225 hours per year) unlikely to be representative of costs of reporting requirements for most undertakings.*

From time-based costs, monetary costs were derived based on an average of ISCO 1 and ISCO 2 mean hourly wages in the EU in 2014 of €35.3, adjusted to 2014 prices. The figure includes non-wage labour costs, plus 25% overhead costs.[154] In order to estimate total costs for all undertakings over the period 2010-2017, average time cost data were multiplied by number of occurrences when licences were requested, reports were received by the European Commission, etc. For this step, available data from the EC's Licensing System was used (see Table III.5).

Table III.5 Input data collected from European Commission Licensing System and used for total cost calculations.

	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
Number of licences requested	4 669	8 843	12 131	15 355	2 449	2 471	2 356	2 076	**50 350**
Number of products and equipment licences requested 2014-2017	N/A	N/A	N/A	N/A	128	477	528	541	**1 674**
Number of (non-NIL)* reports received	172	189	185	177	165	165	172	166	**1391**

[154] ESTAT: Structure of Earnings Survey - NACE Rev 2: B to S not O.

	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
Number of registered users to the overall ODS system	32	76	107	283*	110	92	93	109	**902**
Number of laboratory registrations	998	1 007	844	587	527	468+	500+	537+	**5 468**
Number of quotas applications	53	51	56	63	61	55	60	61	**460**

N.b.: Reports which were sent empty to the European Commission ('NIL' reports) were excluded from calculations.

** Due to the launching of a new ODS Licensing System in 2013 the majority of the new request were re-registration requests from existing users*

+ Due to the launching of the new LABODS Registry in 2015 the majority of the requests for 2015-2017 are reregistration requests submitted from users of the old Laboratory-ODS-Database.

The next step involved multiplying input numbers collected from the European Commission Licensing System by average unit costs to obtain total costs for all undertakings between 2010 and 2017, differentiated (where relevant, i.e. reporting) between periods before and after change was introduced which changed the cost. In order to calculate the cost of Registration of exporters and repackagers of HCFC produced in the EU, the number of registrations for importers/exporters of HCFC (32 in total) was estimated based on lists of undertakings and their import/export activities collected from European Commission systems and multiplied by the unit cost of registration for essential and analytical laboratory uses.

Table III.6 Total administrative costs for all undertakings between 2010 and 2017.

	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
Cost of Apply for licences (ODS Licensing System)	176711 €	334687 €	459 130 €	581 150 €	92 689 €	93 521 €	89 169 €	78 572 €	**1 905 628 €**
Cost of Licences for import/export of products or equipment	N/A	N/A	N/A	N/A	4 844 €	18 053 €	19 984 €	20 476 €	**63 357 €**
Cost of Report annually (BDR) 2010-2012	124670 €	136992 €	134 093 €	N/A	N/A	N/A	N/A	N/A	**395 755 €**
Cost of Report annually (BDR) 2013-2017	N/A	N/A	N/A	137 458 €	128 139 €	128 139 €	133 575 €	128 916 €	**656 227 €**
Cost of Registering to the ODS system	2979 €	7076 €	9 962 €	26 348 €	10 241 €	8 566 €	8 659 €	10 148 €	**83 980 €**
Cost of Registration of exporters and repackagers of HCFC produced in the EU	-	-	-	-	-	-	-	-	**2 979 €**
Cost of Apply for quota (ODS Licensing System)	10103 €	9722 €	10 675 €	12 009 €	11 628 €	10 484 €	11 437 €	11 628 €	**87 685 €**
Cost of Register for essential laboratory and analytical uses (labODS registry)	92918 €	93755 €	78 580 €	54 652 €	49 066 €	43 573 €	46 552 €	49 997 €	**509 091 €**
TOTAL	407 381€	582 232	692 440	811 617	296 607	302 336	309 376	299 737	**3,704,702€**

As regards quota application for different uses, ca. 45% of them are issued to laboratories, 5% for process agent use, 20% for halon remaining uses and 30% for feedstock use. Laboratory quota applications tend to more burdensome as they usually involve a large number of different substances. Assuming double the cost for laboratory applications therefore, the total costs (87 685€) divide as follows: Laboratories 54 425€, Feedstock use 18 141€, Halon use (12 094€) and Process agent use (3 024€).

III.3.2 Calculation of costs for competent authorities of the Member States

A similar process was carried out for competent authorities as for undertakings. Yearly cost data per measure was collected from competent authorities. As can be seen from Table III.7, many costs could not be described in quantitative terms by the competent authorities interviewed.

Table III.7 Time per measure for each Member State (hours p.a.)

Member State	Granting production authorisations; Arti 10(7)	Checking imports and exports of ODS by customs	Reporting to the European Commission; Art 26	Conducting inspections or checks; Art 28	Promoting the recovery, recycling, reclamation and destruction of controlled substances; Art 22(5)	Determining minimum qualification requirements for personnel in charge of the recovery, recycling, reclamation and destruction of controlled substances; Art 22(5)
Czech Republic	0		20			8
France	0	163	40	320		
Germany	0					
Italy	0	224	40	168	168	80
Netherlands	0	2 011	201	2 011		

Only the data for ”Reporting to the European Commission; Article 26” was considered sufficient to make an overall estimate of costs. Although three data points were collected for ”Checking imports and exports of controlled substances by customs” and ”Conducting inspections or checks”, the difficulty for respondents in isolating costs of these activities specifically in relation to ODS, as these are often related to inspections for other reasons, made it impossible to make accurate estimates of time, particularly in the context of these same activities increasingly covering F-gases rather than ODS.

The next step involved multiplying the average unit cost of the reporting exercise, estimated at 33.3 hours per year (excluding the Netherlands' estimated cost due to being considered an outlier, in particular as many smaller Member States have less relevant activities), by the number of reports submitted by all Member States over the period 2010 to 2017 to obtain total costs for all Member States between 2010 and 2017. Costs in € were obtained by using ISCO1 costs, i.e. €41.6 per hour. The number of reports was estimated at 220, which includes one report per Member State per year minus four reports, corresponding to the four years before Croatia acceded to the EU (before 2014).

Table III.8 Total administrative costs (€) for all competent authorities of the Member States for reporting to the European Commission; Article 26 between 2010 and 2017.

	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
Reporting to the European Commission; Art 26	37 440*	37 440*	37 440*	37 440	38 827	38 827	38 827	38 827	**305 068 €**

*Before 2013, Member States also had to report on the use of methyl bromide for QPS use. However, as this use was prohibited in March 2010 and emergency uses had not been authorised this can be assumed to have resulted only in very little administrative burden to Member States.

III.3.3 Calculation of costs for EU public administrations

The number of full-time equivalent (FTE) employees assigned to tasks related to the Regulation was, between 2010 and 2013, 3.5 FTE employees, while in 2014 to 2017 the number of FTE employees was 2.5. These values were split in percentages across different tasks, and translated into working days across the whole period 2010-2017. Monetary costs are presented which relate specifically to the IT systems and the purchase of external services (e.g. relevant consultancy support) as well as costs to the EEA.

Table III.9 Administrative, implementation and enforcement costs for the European Commission between 2010-2017.

Administrative, implementation and enforcement costs	Time costs (days)
Licensing requirements	1 056
Quota limitations	483
Registration requirements for laboratories	583
Registration for other ODS companies and customs	503
IT system, related to Licensing requirements, Quota limitations, Registration requirements for laboratories (cross-cutting)	1 076
Reporting requirements	412
Phase-out schedules	141
Measures to identify illegal trade & support custom controls	674

Administrative, implementation and enforcement costs	Time costs (days)
Technical requirements for destruction	40
Technical requirements for labelling	40
Technical requirements for leakage and emission control and related Member States' implementation measures	40
Derogation decisions	322
General correspondence and advice	191
Ensuring data security and data protection	151
Outreach activities (meetings and brochures)	91
Assuring compliance in the Member States	121
Providing access to documents	111

The resources needed for processing quotas may be further subdivided into 300 (laboratories), 100 (feedstock uses), 67 (critical halon uses) and 17 (process agent uses) days following the reasoning explained above in section III.1.

Table III.10 below presents implementation costs for the European Commission in monetary related to IT systems over the entire period between 2010 and 2017.

Table III.10 Implementation costs related to IT systems for the European Commission between 2010-2017.

IT implementation costs	Monetary costs
Development	866 600 €
Maintenance	360 000 €
Hosting	195 000 €
Total	**1 421 600 €**

Table III.11 below presents implementation costs for the European Commission in monetary costs related to other external support for the implementation of the Regulation over the entire period between 2010 and 2017.

Table III.11 Implementation costs related to other external support for the European Commission between 2010-2017.

Other implementation costs	Monetary costs
Other external support	290 000 €
Total	**290 000 €**

External support costs presented in the table above relate mainly to contracts attributed to consultants for reporting data collection and processing before the implementation of the BDR, and studies such as presented in this report.

Table III.12 below presents implementation labour (time) costs for the European Environmental Agency in in terms of days over the entire period between 2010 and 2017.

Table III.12 Implementation costs for the European Environmental Agency between 2010-2017.

Administrative costs	Time costs (days)
EEA in-house ODS thematic project management	598
EEA in-house BDR Helpdesk support (both ODS and F-gases)	239
EEA in-house IT project management	302
Total	**1 139**

Table III.13 below presents implementation (monetary) costs for the European Environmental Agency in monetary related to IT systems over the entire period between 2010 and 2017.

Table III.13 Implementation costs related to IT systems for the European Environmental Agency between 2010-2017.

Administrative costs	Monetary costs
European Topic Centre (ODS thematic consultancy support)	317 600 €
External IT consultancy support for ODS webform	157 000 €
External IT consultancy support for BDR development and maintenance	457 000 €
Total	**931 600 €**

III.4 Calculation of costs for the counterfactual scenario

The counterfactual analysis focused on the situation where the Montreal Protocol would have been implemented at the level of the 28 individual Member States, without the provisions of an EU-wide Regulation. The costs for this hypothetical scenario assumes that Member States would create their own set of measures and implement their own systems (licensing,

registration, reporting etc.)[155]. Table III.14 gives an overview over additional tasks that would have to be carried out by Members States in the counterfactual scenario.

Multiplying factors to estimate costs of measures which would apply differently in the counterfactual scenario were determined by analysing available data on ODS from the EC's ODS Licensing System and the European Environment Agency's BDR systems.

- Licences: A key multiplying factor for the number of license is linked to intra-EU trade, as this would also require licences in the counterfactual scenario. EU data on sales and purchases within the EU are reported in an aggregated way (volumes per substance) to the EEA's BDR. In order to estimate a number of intra-EU transaction which would need licences in the counterfactual scenario, the number of single transactions was estimated from this sales data assuming substance-specific average sizes for shipments using the EC licensing data. It was concluded that the amount of transactions within the EU is approximately 35 times higher than the amount of imports/exports from outside EU.
- Quotas: Currently, EU-based importers import a certain volume of ODS and redistribute them to laboratories across the EU, without the need for these laboratories to have import quotas themselves. It is conservatively estimated that, in the counterfactual scenario, up to one fourth of the approximately 2 000 laboratories operating in the EU (or 500 additional laboratories) would need to apply for quotas on a yearly basis due to having to import themselves, including from other EU countries. The number of additional applications would thus increase by an estimated 500 quota applications per year. Quota applications for feedstock and process agents (current yearly licences 240) could go up to 5 times due to intra-EU shipments to other companies or subsidiaries. Conversely, for halons it was assumed that there would be little change due to the few distinct actors in this sector. The multiplying factor was determined as 10.87 for all quota applications according to table III.15.

[155] Assumed to be set up and run in the same way and with the same level of ambition as currently

Table III.14 List of measures for administrations of the Member States in the counterfactual scenario.

Measure	Current situation: Implementation and enforcement costs from the EU Regulation	Counterfactual scenario: Implementation and enforcement costs of national-level legislation
Licensing requirements	Granting production authorisations; Article 10(7)	**Operating an import/export licensing system** Approving production authorisations and licences
Quota limitations	Reviewing quota applications together with the European Commission Granting quotas	**Operating a quota system** Granting quotas
Registration requirements for laboratories	*Not a cost for administrations of the Member States.*	**Operating a registration system** **Reviewing and approving new registrants**
Reporting requirements	Handling reports from undertakings Reporting to the European Commission	**Operating a reporting system** Handling reports from undertakings Reporting to the Ozone Secretariat
Phase-out schedules	Checking imports and exports of controlled substances by customs	**Checking imports and exports of controlled substances at each Member State's borders by customs**
National inspection obligations	Conducting inspections or checks	Conducting inspections or checks
Technical requirements for destruction	Promoting the recovery, recycling, reclamation and destruction of ozone-depleting substances Determining minimum qualification requirements for personnel in charge of the recovery, recycling, reclamation and destruction of ozone-depleting substances	Promoting the recovery, recycling, reclamation and destruction of ozone-depleting substances Determining minimum qualification requirements for personnel in charge of the recovery, recycling, reclamation and destruction of ozone-depleting substances
Technical requirements for labelling	Checking imports and exports of controlled substances by customs	Checking imports and exports of controlled substances by customs
Technical requirements for leakage and emission control and related Member States' implementation measures	Defining minimum qualification requirements for personnel involved for leakage checks	Defining minimum qualification requirements for personnel involved for leakage checks

*Note: Measures shown in **bold** are additional in the counterfactual scenario compared to the current situation (cost transferred from the EU public administrations to Member States). Other measures are considered to be implemented/complied with in the same way in the counterfactual scenario as in the current situation (no significant change). This is because national differences already exist in the current situation or because the counterfactual scenario assumes a same level of ambition.*

Table III.15 Increase of quota applications in the counterfactual scenario

	Current 2010-2017	Counterfactual 2010-2017	Factor
Lab quota	220	4 220	+500 more applications per year (x8 years)
Feedstock/PA quota	135	675	x5
Halon quota	105	105	No change assumed
TOTAL	460	5 000	(5 000/460)=**10.8695**

– It is estimated that the companies affected by reporting would be 10 times more since all EU trade including for many laboratories is captured.

– Registration requirements for laboratories would remain the same (1 registration in its location country).

– Other obligations such as phase-out schedules, IT systems and data handling, as well as quota decisions were estimated as up to 28 higher due to necessary duplication of the existing EU-wide system in all Member States. The same was assumed to be true for all other costs related to IT implementation and other external support.

Table III.16 gives an overview of expenditures in the counterfactual scenario for Member States. Tables III.17, 18 and 19 give additional IT and external assistance costs. Finally, table III.20 gives total expenditures expected for undertakings in the counterfactual scenario.

Table III.16 List of assumptions and multiplying factors used to arrive at time costs for all Member States over the period 2010-2017 in the counterfactual scenario.

Measure	Time for EU administrations in the current situation	Time for all Member States' administrations in the current situation	Assumption in the counterfactual scenario	Factor in the counterfactual scenario	Explanation	Resulting time for all Member States in the counterfactual scenario
Licensing requirements	**1 056**	**0**	Member States individually process undertakings' licensing requests.	35 times higher intra-EU trade in number of shipments than trade between EU and non-EU countries	*See text above*	**36 956**
Quota applications	**483**	**0**	Member States individually process undertakings' quota applications.	500 additional quotas applications yearly for laboratory and analytical uses. 5 times more quota applications for feedstock and process agent uses. See specific factors below.	*See Table III.14 above.*	**11 107**
(Quota applications) Correspondence	161	0	Member States individually ensure correspondence with undertakings.	10.87 more quota applications	More correspondence needed, matching the increased volume of quota applications.	1 749
(Quota applications) Processing	151	0	Member States individually process quota requests from undertakings.	See specific factors below.	More processing needed, matching the increased volume of quota applications.	1 640

Measure	Time for EU administrations in the current situation	Time for all Member States' administrations in the current situation	Assumption in the counterfactual scenario	Factor in the counterfactual scenario	Explanation	Resulting time for all Member States in the counterfactual scenario
(Processing) Drafting quota decision	75	0	Member States individually draft quota decisions following granting of requests on a yearly basis.	28 times more (once more for each of the Member States)	Each of the 28 Member States must draft national quota decisions.	2 112
(Processing) Quota request processing	75	0	Member States individually process quota requests from undertakings.	10.87 more quota applications	Higher volume of quota applications increases processing effort.	820
(Quota applications) Adopting quota decisions	171	0	Member States individually adopt quota decisions on a yearly basis.	28 times more (once more for each of the Member States)	Each of the 28 Member States must adopt national quota decisions.	4 787
Registration requirements for laboratories	**583**	**0**	No difference.	1 (no change)	Each laboratory registers in the same way it does in the current situation.	**583**
IT system, related to Licensing, Quotas, Registration (cross-cutting)	**1 076**	**0**	Member State individually set up their own IT system.	28 times more (once more for each of the Member States)	Each of the 28 Member States needs to set up its own IT system.	**30 128**
Reporting requirements	**412**	**917**		See specific factors below.		**1 621**
(Reporting requirements) Processing undertakings' reports	70	0	Member States individually process undertakings' reports at the same cost as the European Commission, except that Member States process a higher number of reports from undertakings because undertakings need to apply for licences for any shipment with another country, and therefore more undertakings come under the scope of reporting requirements.	10 times more undertakings reporting annually	The number of undertakings reporting annually increases by the number of companies needing to report, roughly estimated to be 10 times larger due to being under national licensing obligations, but also for each branch of a company present in other Member States.	704

Measure	Time for EU administrations in the current situation	Time for all Member States' administrations in the current situation	Assumption in the counterfactual scenario	Factor in the counterfactual scenario	Explanation	Resulting time for all Member States in the counterfactual scenario
(Reporting requirements) Reporting to the Ozone Secretariat	342	0	Member States report to the Ozone Secretariat at the same cost as they do to the European Commission in the current situation.	N/A	N/A	917
(Reporting requirements) Reporting to the European Commission	N/A	33	Member States no longer need to report to the European Commission.	N/A	N/A	N/A
Phase-out schedules	**141**	**0**	Member States individually update systems' information to implement to phase-out schedules.	28 times more (once more for each of the Member States)	Each of the 28 Member States needs update system information to implement phase-out schedules.	**3 942**
Ensuring data security and data protection	**151**	**0**	Member States individually ensure data security and data protection.	28 times more (once more for each of the Member States)	Each of the 28 Member States needs ensure data security and data protection.	**4 224**
TOTAL TIME [hours]	**3902**	**917**				**88561**

Table III.17 Table of IT implementation costs to administrations of the Member States in the counterfactual scenario compared to the current situation.

IT implementation costs (€)	Cost to EU administrations in the current situation	Cost to one Member State's administration in the current situation	Cost for all Member States' administrations in the current situation	Cost to one Member State in the counterfactual	Cost to all Member States in the counterfactual
Development	866 600 €	0 €	0 €	866 600 €	24 264 800 €
Maintenance	360 000 €	0 €	0 €	360 000 €	10 080 000 €
Hosting	195 000 €	0 €	0 €	195 000 €	5 460 000 €
Total	**1 421 600 €**	**0 €**	**0 €**	**1 421 600 €**	**39 804 800 €**
Additional cost in the counterfactual				**+1 421 600 €**	**+38 383 200 €**

Table III.18 Table of other external support costs to administrations of the Member States in the counterfactual scenario compared to the current situation.

Implementation costs (days)	Cost to EU administrations in the current situation	Cost to one Member State's administration in the current situation	Time for all Member States' administrations in the current situation	Cost to one Member State in the counterfactual	Cost to all Member States in the counterfactual
EEA in-house ODS thematic project management	598	0	0	598	16 753
EEA in-house BDR Helpdesk support (both ODS and F-gases)	239	0	0	239	6 687
EEA in-house IT project management	302	0	0	302	8 447
Total time	**1 139**	**0**	**0**	**1 139**	**31 888**
Additional costs in the counterfactual				**+1 139**	**+30 749**

Table III.19 Table of other implementation costs to administrations of the Member States in the counterfactual scenario compared to the current situation.

Implementation costs (€)	Cost to EU administra-tions in the current situation	Cost to one Member State's administra-tion in the current situation	Cost for all Member States' administra-tions in the current situation	Cost to one Member State in the counterfactual	Cost to all Member States in the counterfactual
European Topic Centre (ODS thematic consultancy support)	317 600 €	0 €	0 €	317 600 €	8 892 800 €
External IT consultancy support for ODS webform	157 000 €	0 €	0 €	157 000 €	4 396 000 €
External IT consultancy support for BDR development and maintenance	457 000 €	0 €	0 €	457 000 €	12 796 000 €
Total costs	**931 600 €**	**0 €**	**0 €**	**931 600 €**	**26 084 800 €**
Additional costs in the counterfactual				**+931 600 €**	**+25 153 200 €**

Table III.20 List of assumptions and multiplying factors used to arrive at time costs for all undertakings over the period 2010-2017 in the counterfactual scenario.

Measure	Cost to undertakings currently	Assumption in the counterfactual scenario	Multiplying factor in the counterfactual scenario	Explanation	Resulting cost for all undertakings 2010-2017 in counterfactual scenario
Licensing requirements	1 905 628 €	Undertakings apply for licences and authorisations when importing or exporting between any two countries, EU and non-EU.	35 times higher intra-EU trade in number of shipments than trade between EU and non-EU countries	*See text above*	66 696 984 €
Quotas	87 685 €	Undertakings apply for quotas for importing or exporting from or to EU and non-EU countries.	500 additional quotas applications yearly for laboratory and analytical uses. 5 times more quota applications for feedstock and process agent uses.	*See Table III.14 above.*	953 100 €
Registration requirements for laboratories	509 091 €	No difference	1 (no change)	Each laboratory registers in the same way it does in the current situation.	509 091 €
Reporting requirements	1 051 982 €	Undertakings need to apply for licences for any shipment with another country, and therefore come under the scope of reporting requirements.	10 times more undertakings reporting annually	The number of undertakings reporting annually increases by the number of companies needing to report, roughly estimated to be 10 times larger due to being under national licensing obligations, but also for each branch of a company present in other Member States.	10 519 824 €
TOTAL [€]	**3 554 386 €**				**78 678 999 €**

ANNEX IV: OVERVIEW OF ENVIRONMENTAL IMPACTS AND COSTS

Please note in the following table:

- Numbers in square brackets are amounts forecasted by the impact assessment of the Regulation
- Yellow denotes that expectations of the impact assessment have been met; Green means an improvement vs. expectations of the impact assessment; Red means that expectations in the impact assessment have not been met

Objectives Activities	**Relevant measures** in Regulation	**Environmental impact**		**Costs to Member States (MS)** *Scale of + (no cost) to +++++ (very high)* Or *Total costs for 2010-2017*	**Costs to Undertakings** *Scale of + (no cost) to +++++ (very high)* Or *Total costs for 2010-2017*	**Cost to EU public service** *Person days for 2010-2017*	**Further Remarks**
		ODP tonnes	*tonnes CO2eq* *Scale of + (no impact) to +++++ (very high)*				
Ensure the progress achieved and further reductions of ODS							
Maintain phase-out of EU consumption (MP)	*General prohibitions*	**< 0** in 2010-2017	++ (+++++ if considered vs. peak in 1990s)	++**	++	**322** (exemptions & derogations) **191** (general advice)	Peak EU (MP) consumption was > 400,000 ODP tonnes in 1990s; Economic effects are small as most uses have been eliminated
Complete MB QPS phase-out	*2010 Prohibition on use*	**0** used since 3/2010, thus savings of **1700** [220 p.a. forecasted but not proposed as measure]	**5100**	+**	+++/++++	**141**	Ended in 2010 ; was not foreseen by impact assessment
Complete use of virgin HCFCs phase-out	*2010 Prohibition on use*	**0** used since 2010; savings of **800** p.a.	++ (++++ if considered vs. past peak use)	+**	+++/++++		Ended in 2010

Achieve phase-out of use of reclaimed/recycled HCFCs	*2015 Prohibition on use*	**3** used since 2015; further savings of **1000** p.a. [1000 p.a.]	++ (++++ if considered vs. past peak use)	+**	+++/++++		Ended in 2015
Ending import of products/equipment	*2015 prohibition*	**0** used since 2015; savings of up to **145** p.a. [145 p.a.]	++	+**	++		Industry moved to other refrigerants
Achieve HCFC production (MP) phase-out	*Phase-out schedule with endpoint 2019*	**32** in 2017 from **4000** in 2009	++ (++++ if considered vs. peak in 1990s)		+++/++++		Ends in 2019; Peak EU (MP) production was > 700,000 ODP tonnes in 1990s
	Granting production rights			+			
Development/take up of alternatives and reduction of emissions of remaining uses							
Reduce Process agents use & emissions	*Annual limit of 1083 metric tonnes – quota applications* *Emission limit of 17 metric tonnes*	Use **351** ODP tonnes or **324** metric tonnes (2017) Emitted **4.5** ODP tonnes or **4.1** metric tonnes (2017) [20 OPD tonnes p.a.]	+		**€0.003** MIO	**17**	Annual max use < 400 metric tonnes since 2015
Reduce halon use & emissions	*Phaseout schedule until 2040* *Quota applications*	Used **517** (2016) [500 p.a.] Emitted **71** (2016)	+		+++/++++ **€0.01** MIO	**67**	

Reduce lab & analytical use & emissions	*Registration of laboratories*	Very small quantities: **0.2** (2017) [<200 ODP p.a.]	+		**€0.5** MIO	**583** (processing registrations)	
	Limit of 110 ODP use – quota applications				**€0.05** MIO	**300** (quotas)	
Reduce feedstock use	*Quota applications Complying with emission controls*	Use **45,000-50,000** Emitted **62** (2017) [600 p.a.]	+	**	**€0.02** MIO ++/ +++	**100**	
Banks	*Complying with leakage and emission controls*	**570,000*** [Total 700,000] Emitted **6,000*** p.a. [24,000 p.a.]	**4*** Gt CO2 [Total 5 Gt CO2] Emitted **43*** Mt CO2 [Emitted 170 Mt CO2]	**	++/ +++	**40**	
	Qualification requirements for personnel			++/+++	++		
	Promoting recovery, recycling, reclamation, destruction			++/+++			
	Complying with technical requirements for destruction	Destroyed **6,000-10,000** p.a.		**	++/ +++	**40**	
Identify new threats							
Production of remaining uses & new substances	*Company annual reporting incl. on new substances*	Production **70,000-80,000 p**.a. (ca. **20,000** p.a. for new ODS - [20,600]) New ODS emitted 3 (2017) [Emitted 300 new ODS]	++		**€1.05** MIO [€0,38 MIO + €0,04 MIO related to new ODS]	**1139** (staff) IT costs for EU-wide system: **€0.9 MIO** [€0.56 MIO + €0.03 MIO for new substances]	
	MS reporting on (QPS), halons & illegal trade	+++	++	++ **0.3** MIO € [1.2 MIO €]			

	Reporting to UNEP					412	
Lead by example & prevention/detection of illegal trade							
Licensing system	*Licences for import/export of equipment*	++	+		**€0.06** MIO [Licensing of products/equipment considered minor]	Staff: **1056** issuing licences + **503** registration + **1076** Use of IT system + **151** Data security IT costs for EU-wide system: **€1.4** MIO [1522]	[Impact Assessment expected reduction to 1000 licences p.a. in 2010]
	All other licences	+++	++		**€1.9** MIO [<€0.5 MIO: €0.3 MIO (€1.3MIO and savings of €1MIO) for exempted uses & €0.17 MIO export licensing per shipment]		
Illegal trade & Compliance	*National inspections*	+++	+++	+++ Up to **0.17** MIO€ per MS	++	**121** (assuring compliance in MS)	
	Custom controls	+++	+++	+++ Up to 0**.17** MIO€ per MS	++	**674**	
	Complying with labelling	+++	++		+ [€0.3 MIO]		
TOTAL				[expected savings of admin costs €0.7 MIO]	**€3.7** MIO admin costs [€5.4 MIO baseline admin costs - €2 MIO expected savings]	3903 days (3 full-time staff) [expected savings of admin costs €0.3 MIO]	

*Differences not necessarily linked to an improvement but to a more recent (and likely also more reliable) estimation

**Costs linked to market surveillance such as inspection and customs control are listed separately

ANNEX V: SIMPLIFIED OVERVIEW - COMPARING CORE MEASURES UNDER THE MONTREAL PROTOCOL WITH MEASURES IN THE REGULATION

Core Measures under the Montreal Protocol	Montreal Protocol provisions for developed countries (Non-Article 5 parties)	Provisions in the Ozone Regulation (*Provisions from 2009 recast in italic)*	Is the Regulation 'going beyond' the Montreal Protocol?
HCFC production phase-out schedule (for refrigeration and other non-exempted uses)	Between 2015 and 2020, the production of HCFCs cannot exceed 10% of 1989 baseline levels. HCFC production shall be phased-out by 2020. Thereafter up to 0.5% of baseline levels will be allowed until 2030 for serving refrigeration and air-conditioning equipment existing before 2020.	*HCFC production is gradually phased out from 2010. Full production ban starting from 31 December 2019.*	*Only as regards production after 2020.* The targeted use for which production would be allowed is prohibited in the EU (see below).
HCFC consumption phase-out schedule (for refrigeration and other non-exempted uses)	Consumption of virgin HCFCs is phased out by 2020. Thereafter 0.5% of the baseline levels will be allowed for servicng refrigeration and air-conditioning equipment existing before 2020 and a few other uses. The Protocol does not specify phase-out dates for non-virgin substances.	The use of virgin HCFCs for servicing of refrigeration and air conditioning equipment is banned from 2010. The use of non-virgin HCFCs from 2015. The Commission may grant time-limited and case specific derogations to use non-virgin substances until 31 December 2019.	Earlier phase-out dates for virgin HCFCs and additional phase-out date for non-virgin HCFCs.
Exempted uses of virgin substances	The following uses of virgin substances are exempted: - Feedstock use - Methyl bromide for quarantine and pre-shipment use - Specific types of laboratory and analytical uses - Specific types of process agent uses in specific installations dating before 1999	Same exemptions as under the Montreal Protocol, except for *quarantine and pre-shipment use of methyl bromide which has been banned since 2010*. *It is possible to grant time-limited derogations in case of emergency.* The EU has not requested any so-called	*Use of methyl bromide for quarantine and pre-shipment is not exempted in the EU*

Core Measures under the Montreal Protocol	Montreal Protocol provisions for developed countries (Non-Article 5 parties)	Provisions in the Ozone Regulation (*Provisions from 2009 recast in italic)*	Is the Regulation 'going beyond' the Montreal Protocol?
	- Use of Methyl bromide may be authorised by the Parties on an annual basis under strict conditions for specific locations to a specific Party.	critical use exemptions for methyl bromide use.	
Licensing requirements	The Montreal Protocol requires a system for licensing the import and export of new, used, recycled and reclaimed substances (art. 4B) (bulk substances only). Parties are free to structure the system in the way considered most appropriate.	Licences are required for import/export of virgin, recovered, recycled and reclaimed substances for each shipment. *Licences are required also for import/export of products or equipment*	The licencing system covers *products and equipment*.
Reporting requirements	Reporting on production, import, export and destruction is required annually per Party of the Montreal Protocol. Reports on process agent uses should be submitted by Parties annually. Parties are invited to report voluntarily on illegal trade and halons.	In addition to parameters necessary for the reporting under the Montreal Protocol, *reporting annually on production, import, and export of ODS* per undertaking.	*Reporting on new ODS*