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Guideline on policy measures for the management and destruction of ozone depleting substances

Management and destruction of existing ozone depleting substances banks

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Abbreviations

ABNT	Associação Brasileira de Normas Técnicas (Brazilian National Standards Organization)
AC	Air conditioning
AHRI	Air-Conditioning, Heating & Refrigeration Institute
CFC	Chlorofluorocarbon
EEE	Electrical and Electronic Equipment
EPR	Extended Producer Responsibility
EU	European Union
F-gases	Fluorinated gases
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GWP	Global warming potential
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HPMP	Hydrochlorofluorocarbon Phase Out Management Plan
ISO	International Standardization Organization
ODP	Ozone depletion potential
ODS	Ozone depleting substances
POP	Persistent organic pollutant
RAC	Refrigeration and air conditioning
RAC&F	Refrigeration, air conditioning and foam
RoHS	Restriction of Hazardous Substances
TEAP	Technology and Economic Assessment Panel
WEEE	Waste Electrical and Electronic Equipment

1 Introduction

Ozone depleting substances (ODS) are harmful to the ozone layer that protects the Earth from dangerous ultraviolet radiation and also contribute to climate change because of their high global warming potential (GWP). Even though the Montreal Protocol has been very effective in phasing out the production and use of chlorofluorocarbons (CFCs) and will lead to the phase-out of hydrochlorofluorocarbons (HCFCs) by 2030, these substances are still present in ‘banks’: for example, as refrigerants in old appliances that are either still in use or abandoned, as blowing agents in building and appliance foam, or in storage cylinders after collection. If no measures are taken, over the coming decades these banks will be emitted to the atmosphere. **Creating a suitable, country-specific policy framework is essential for any ODS management scheme** to be successful.

In the context of CFC and HCFC phase-out under the Montreal Protocol, most countries have already launched appropriate initiatives. Some of these only address the import of refrigerants or foam blowing agents and products containing refrigerants or foam blowing agents, as well as reporting imported amounts. Other countries are more ambitious and address the refrigeration and air-conditioning (RAC) servicing sector, e.g. by enforcing ODS recovery during maintenance and repair activities.

When establishing a policy framework to reduce emissions from ODS banks, it is important to **put in place complementary policy arrangements that cover ODS collection** from the RAC servicing sector and the **collection and disposal of waste equipment containing ODS**. While the former has a focus on reducing emissions from hazardous substances (i.e. also ODS), the latter covers electrical and electronic equipment (EEE). Combining both is necessary to provide a solid policy framework for ODS bank management. The overall aim and main priority is to prevent the generation of waste, in this case the accumulation of ODS banks.

Ideally, ODS management will be part of a waste management system with overarching policies and regulations on specific waste streams that has already been installed. Waste streams relate to the treatment of specific waste, such as metals, plastics or electronic equipment. The general framework deals with topics such as disposal options, transport and definitions of waste streams categories. It is also important to note that there may be specific regulations on incineration processes and landfilling. The general waste framework may also set sustainability targets and address the prevention of waste production and the promotion of recycling.

BOX 1**Good practice example for an ODS legislative framework**

The European Union (EU) has established several regulations and directives addressing different aspects of ODS bank management. Key regulations are the **Regulation (EC) 1005/2009¹ on substances that deplete the ozone layer** ('ODS Regulation') and the **Directive 2002/96/EC with its recast 2012/19/EU² on waste electrical and electronic equipment (WEEE)**, see Figure 1.

The **ODS Regulation** lays down rules for ODS on production, import, export, use, recovery, recycling, reporting of information etc. It also establishes rules for the use of products and equipment containing or relying on ODS. The **WEEE Directive** establishes an Extended Producer Responsibility (EPR) scheme for WEEE, sets collection and recovery targets, and defines responsibilities for collection, recycling and recovery for all types of electrical goods. The WEEE Directive includes WEEE containing ODS.

The WEEE Directive is embedded in the **2008 Waste Framework Directive (2008/98/EC)³** which sets the overarching legislative framework⁴. It defines the main concepts such as the '**polluter pays principle**' and the

'waste hierarchy'. The Waste Framework Directive also differentiates between hazardous and non-hazardous waste, and takes several criteria into consideration (EPRS, 2015a and 2015b).

The Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive 2002/95/EC⁵) does not address ODS, but considers other harmful substances in EEE, such as heavy metals and persistent organic pollutants (POPs). Equipment containing ODS, such as domestic refrigerators and air conditioners, can also contain other harmful substances, which have to be collected and treated specifically. The RoHS Directive can therefore be relevant in terms of synergies regarding management measures.

The **Regulation (EC) 517/2014 on Fluorinated Greenhouse Gases⁶** addresses ODS substitutes and is included here to underline the need for legislation concerning the climate relevant ODS alternatives. This regulation includes further interesting instruments (e.g. to prevent the accumulation of banks) to reduce refrigerant emissions from RAC equipment.

Figure 1: Key EU regulations that address the management of ODS.



- 1 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:286:0001:0030:EN:PDF>, last access November 2016.
- 2 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:197:0038:0071:en:PDF>, last access November 2016.
- 3 <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0098&from=EN>, last access November 2016.
- 4 Two other legal acts define the remaining general framework: the 1999 Directive on the landfill of waste and 2006 Regulation on shipments of waste.
- 5 <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0095&from=EN>, last access November 2016.
- 6 <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0517&from=EN>, last access November 2016.

Generally, important policy measures can be divided into regulatory, fiscal and non-regulatory measures as shown in table 1. They include regulations, legislation, the development of technical standards and the establishment of long-term sustainable take-back structures with integrated financial mechanisms, e.g. through Extended Producer Responsibility (EPR) schemes that require manufacturers to bear the financial and organisational responsibility for their products throughout the life cycle.

There must be a system put in place that includes monitoring ODS use in the RAC sector and a strong enforcement structure. These are mandatory to ensure efficient control and compliance, especially if associated costs act as a disincentive for compliance.

This guideline presents a range of measures that can prevent the accumulation of and emissions from ODS banks. The guideline also shows a way to choose the appropriate option or a bundle of possible options tailored to conditions within the country and depending on the targeted sector or government objective.

BOX 2

Factors for successful policy measures to prevent emissions from ODS banks

- Consider enforcement and financing of policy measures in the planning stage.
- Integrate the policy measures into an existing environmental policy framework and consider cross-cutting topics (e.g. waste management).
- Try to avoid having the entire financial burden associated with ODS collection and destruction fall on the end-user and technicians, and make use of EPR schemes.

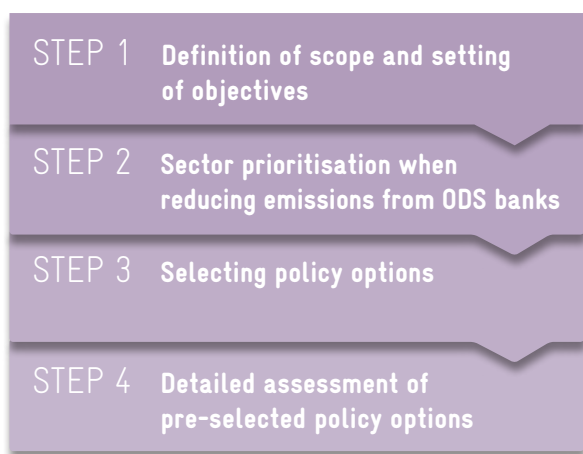
Table 1: Overview of measures.

REGULATORY	FISCAL	NON-REGULATORY
<ul style="list-style-type: none"> • ODS regulation • Monitoring • Venting ban • Refrigerant ban, product ban, phase-down, phase-out • EPR within WEEE legislation • F-gas regulation 	<ul style="list-style-type: none"> • GWP-weighted taxes on refrigerants • Rebate system • Incentives for end-users 	<ul style="list-style-type: none"> • Information campaign • Voluntary industry agreement • Training and certification • Technical standards

2 Establishing a set of policy measures for the management and destruction of ODS

The following chapter recommends a stepwise set of policy measures for a sustainable management and destruction of ODS.

Figure 1: Overview of different steps for establishing a set of policy measures for the management and destruction of ODS.



STEP 1

Definition of scope and setting of objectives

A thorough analysis of existing legislation and activities regarding ODS is necessary before a policy option for the management or destruction of ODS can be chosen. It is also important to look at all stakeholders and institutions in the field.

Figure 2 gives an example and shows the intervention areas including the HCFC phase-out management plans (HPMP)⁷. The area of concern (middle of Figure 2), is not only ODS bulk⁸, but also equipment containing ODS and ODS alternatives.

⁷ Please note that this figure does not correspond to a map of actors that additionally shows the relevance of actors.

⁸ ODS collected and contained in cylinders.

If the informal sector has a prominent role, for example in the collection of equipment, then it is difficult to enforce laws and other measures are more appropriate. In this case, the focus is on measures for integrating the informal sectors⁹.

Policymakers should be able to answer the following questions:

- 1. What are existing ODS bank management activities within the country? Do they need further supporting policies?**
 - Consider e.g. activities under the HPMP.
- 2. Analysis of stakeholders**
 - Review stakeholders in the public and private sectors.
 - What is the role of the informal sector?
- 3. What is the existing legal framework in the country? Are there laws regarding ODS or waste management that can be amended?**
 - Amending existing legislation will be faster and more effective than bringing new laws into force. Consider stakeholders in the public and private as well as the informal sector.
- 4. What is the timeframe for reaching results?**
 - Some policy options will be much more effective than others and, depending on the target sector, fast action might be necessary in order to prevent ODS bank emissions.
 - Other options will take longer but will show long-term impacts and establish a sustainable waste collection system.
- 5. What are the expected waste streams in the different sectors and related amounts over the coming years?**
 - See step 2: Sector prioritisation.

⁹ See also the 'Guideline to establish a collection system for equipment containing ODS' (GIZ, 2017b).

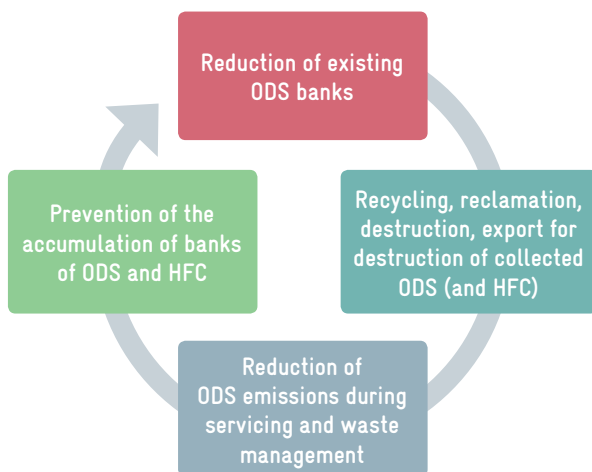
Figure 2: Stakeholders involved when designing a legislative framework for ODS bank management, including the intervention areas with the HPMPs.



INTERVENTIONS & STAKEHOLDERS

The objectives of ODS bank management can vary significantly, and each objective may require specific policy options for implementation. Different objectives are shown in Figure 3 and these depend highly on already existing measures in the country. However, comprehensive ODS bank management will aim at combining several or all of these objectives. An example could be the combination of a regulatory measure banning the venting of ODS with a training course for technicians and a financial incentive to hand in collected ODS for destruction. This combines regulatory, fiscal and non-regulatory measures. Each measure on its own might not lead to the required result – the reduction of ODS emissions.

Figure 3: Possible objectives of ODS management.



STEP 2

Sector prioritisation when reducing emissions from ODS banks

To understand the situation of the accumulated and future ODS bank in a country, the first step is to prepare an inventory of existing ODS bank¹⁰. This will help to answer the following questions:

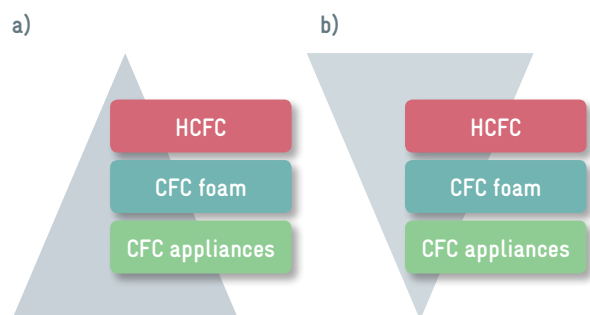
1. What is the size of ODS banks in the country?
2. What is the expected additional amount of ODS to reach the waste stream over the next years and decades?
3. Which sectors have the largest waste streams?
4. Which waste streams are accessible for ODS banks management?

Based on this information, the target sector or sectors for ODS bank management can be identified. The following criteria need to be considered:

a) Highest reduction potential

The most relevant substances which contribute to ODS banks are CFCs when considering the ozone depleting potential (ODP) and GWP-weighted tonnes, i.e. the environmental impact. **CFCs** are used as blowing agents and refrigerants. CFC refrigerants are still commonly found in **domestic refrigeration and commercial stand-alone units**. The number of units in the country depends on the point in time when an import ban on CFC equipment (both new and second-hand) was enforced, so it is useful to find out when exactly such an import ban was established.

Figure 4: a) Reduction potential and ease of recovery versus b) amount available.



¹⁰ See also the 'Guideline to conduct an ODS bank inventory' (GIZ, 2017a).

The reduction potential is highest from the CFC refrigerant in appliances, followed by CFC blowing agents in appliance insulation foam and lastly from HCFC refrigerants¹¹. The same sequence can be found when it comes to ease of recovery. However, the amount available follows exactly the opposite sequence (see Figure 4). An inventory and the analysis of existing legislation and measures can be used to determine the target sector or sectors.

HCFC used as refrigerants can be found in the **commercial and industrial refrigeration and air-conditioning sectors**. The management of HCFCs in ODS banks, used as blowing agents, can be ignored because of the low reduction potential compared to the required monetary and labour inputs.

Figure 4 points to the need for managing remaining CFC banks rather than HCFC banks: even though small amounts of CFC are left, the environmental impact is exceptionally high when reducing CFC.

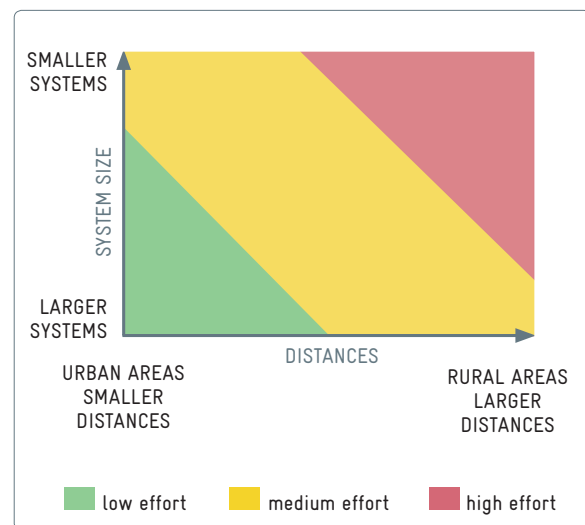
Finally, establishing an ODS bank management will not be substance specific as HFCs from the RAC sectors will also be covered, which is particularly important in fighting climate change.

b) Technical feasibility

Technical feasibility is defined as the possibility to recover ODS at a reasonable level of effort and cost (ICF, 2010). When setting priorities for policy measures, the focus should be on accessible ODS banks. TEAP (2009a) assigned three categories of effort levels (low, medium, high) to the accessible banks in the refrigeration, air-conditioning and foam (RAC&F) subsectors. The category 'low effort' applies to large systems containing ODS in

urban areas, where large quantities can be recovered from one unit and distances are short. The category 'high effort' applies to small ODS containing equipment in remote areas (Figure 5).

Figure 5: Effort levels to accessible ODS banks.



Refrigerants generally can be extracted and processed with less effort when compared to ODS in foam. When ODS in foam are the focus of ODS bank management, the appliance foam should be given priority over ODS in construction foam. Construction foam is more difficult and expensive to recover. According to this general guidance, ODS from all RAC subsectors can be recovered with low and medium effort (TEAP, 2009a). Table 2 provides more cost details for collection and destruction in the various RAC subsectors (only low effort values shown under high population density assumptions as found in urban areas).

11 The global reduction potential from CFC blowing agents in foam is higher as compared to CFC refrigerants in RAC equipment. However, CFC blowing agents are very difficult to recover (high effort); the ranking accounts for this.

Table 2: Cost components related to recovery and destruction (US dollar per kg ODS*), reproduced from TEAP (2009b).

Effort level	Sector	Population Density	Recovered ODS	Segregation, collection costs	Transport costs (Recovery)	Recovery processing costs	Transport costs (Destruction)	Destruction costs	Total cost
Low effort	Domestic Refrigerators	Dense	Refrigerant	6 – 10*	6 – 8	10 – 20	0.01 – 0.06**	5 – 7	27 – 45
	Domestic Refrigerators	Dense	Blowing agent			20 – 30			37 – 55
	Commercial Refrigeration	Dense	Refrigerant	8 – 12*	8 – 10	8 – 15	0.01 – 0.06**	5 – 7	29 – 44
	Commercial Refrigeration	Dense	Blowing agent			25 – 35			46 – 65
	Transport Refrigeration+	Dense, sparse	Refrigerant	–	–	15 – 20	0.01 – 0.06**	5 – 7	20 – 27
	Industrial Refrigeration	Dense, sparse	Refrigerant	–	–	4 – 6	0.01 – 0.06**	5 – 7	9 – 13
	Stationary AC^	Dense	Refrigerant	1 – 2^^	–	4 – 25	0.01 – 0.06**	5 – 7	10 – 34
	Mobile AC	Dense	Refrigerant	–	–	4 – 6	0.01 – 0.06**	5 – 7	9 – 13
	Fire Protection	Dense	Fire suppressant	1 – 2^^	–	4 – 25	0.01 – 0.06**	6 – 8	11 – 35

* Colour coding of total costs (lower range): green for costs below 10 US dollar/kg and orange between 10 and 50 US dollar/kg. Sectors where costs lie above 50 US dollar/kg are not displayed.

Use this information as an initial sector-specific guidance with a view to prioritising certain policy measures.

STEP 3

Selecting policy options

GENERAL RECOMMENDATIONS

Based on the experience from various countries, it is recommended to address ODS from large RAC systems first. In this regard, the following measures should be considered first:

- 1) Venting ban and mandatory recovery of ODS during servicing and at decommissioning as part of an ODS regulation;
- 2) Mandatory technicians' training and certification as part of an ODS regulation;

- 3) Periodic leak checking of RAC equipment above a critical refrigerant charge;
- 4) Development of national standards, adoption or adaptation of international standards regarding safety and good practice in the RAC sector;
- 5) Monitoring scheme (at least for recovered ODS).

Often these measures are already implemented within the scope of the HPMP.

In a second stage, the waste appliances containing ODS should be addressed (as part of WEEE legislation), whereby the focus should be on domestic refrigeration (CFC as refrigerant and blowing agent). The most promising approach for establishing WEEE regulations is through EPR schemes that require manufacturers to bear the financial and organisational responsibility for proper waste management, for example the transport of equip-

Table 3: Recommended policies for ODS and appliances containing ODS.

	Policy for ODS refrigerants	Policy for appliances containing ODS (e.g. domestic refrigeration)
Short term	<ul style="list-style-type: none"> • Information campaign for e.g. technicians, end-users of large installed equipment; • Training and certification of RAC servicing personnel; • Enforcement of existing legislation. 	<ul style="list-style-type: none"> • Information campaign for e.g. the general public, technicians, manufacturers; • Training and certification of RAC servicing personnel; • Enforcement of existing legislation; • Voluntary industry agreement or commitment.
Long Term	<ul style="list-style-type: none"> • ODS regulation: phase-out, venting ban, reporting obligations, certified personnel; • Technical standards; • Taxes on refrigerants; • Rebate scheme. 	<ul style="list-style-type: none"> • ODS regulation: product bans; • EPR legislation; • Technical standards.

ment to the recycling facilities and the recycling itself. In this regard, the following policy measures should be considered:

- 1) EPR policy, possibly starting with voluntary agreements and commitments primarily for producers and manufacturers of appliances;
- 2) Information campaign for end-users of appliances.

CFCs are still commonly found in the appliances sector. From an environmental perspective, these substances are more harmful than HCFCs because of their higher ODP and should be destroyed when cracking¹² or distillation facilities are not in place. Please note that ODS in large systems are mainly HCFCs, hence the focus should be on containment measures and on recycling or reclaiming recovered substances (not their destruction).

The following table gives an overview of which policy options might be appropriate for controlling bulk refrigerants or appliances containing refrigerants (and maybe additionally foam) in the short

and long term. Those options will be outlined in more detail in the following chapter.

POLICY MEASURES

The following subchapters give an overview of possible policy measures that could support ODS banks management. A short description of each measure is followed by one or several examples and in most cases by direct links to the relevant legislation or to more information about the measure. Depending on a country's geography and demographic situation, some forms of legislation and infrastructure might not be possible or advisable. Policies can first focus on urban areas and then be scaled up at a later point in time. For example, technician training or information campaigns could start in big cities with the highest concentration of ODS and ODS containing equipment and later be expanded to cover the entire country.

¹² Here the molecular compounds are cracked to recover raw materials such as hydrofluoric acid and hydrochloric acid.

All measures discussed in the following subchapters are also summarised in Table 6 in the annex comparing those measures, using criteria such as affected sectors and stakeholders, enforcement strategies and supporting policies.

REGULATORY MEASURES

■ ODS- or F-gas regulation

Most countries already have some form of ODS regulation in order to implement the Montreal Protocol and therefore the phase-out of ODS according to the Montreal Protocol schedule. In other countries, this may be part of another piece of existing legislation, regarding for example hazardous wastes or chemical safety.

What these have in common is that they regulate the production or import of restricted substances, such as CFCs and HCFCs. Different laws include measures as varied as instructions on the handling of gases, the need to recover gases during servicing and at decommissioning, collection activities, technician training and certification, enforcement, product bans, leakage controls or reporting. In many cases, the national legislation is adjusted when the Montreal Protocol is amended or when it enters into a new phase. Some countries have now drafted regulations including all fluorinated gases (F-gases).

BOX 3

Examples of ODS and F-gas regulation

European Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer ('ODS Regulation')¹³:

'Controlled substances contained in refrigeration, air-conditioning and heat pump equipment, equipment containing solvents or fire protection systems and fire extinguishers shall, during the maintenance or servicing of equipment or before the dismantling or disposal of equipment, be recovered for destruction, recycling or reclamation' (Article 22).

The European Regulation (EU) No. 517/2014 on fluorinated greenhouse gases ('F-gas regulation')¹⁴ is a comprehensive regulation for the ODS alternatives, and imposes not only the phase-down of fluorinated

gases but also a reporting scheme, regular leak checks and the recovery of substances.

Ghana L. I. 1812¹⁵: **Management of ozone depleting substances and products regulations**

The Ghanaian regulation controls import and trade of ODS.

República Dominicana: Reglamento técnico dominicano para la reducción, control y eliminación del consumo de las sustancias agotadoras de la capa de ozono¹⁶

In addition to controlling the import and trade of ODS, the Dominican regulation orders the certification of technicians and requires the recovery of refrigerant during servicing.

13 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:286:0001:0030:EN:PDF>, last access November 2016.

14 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.150.01.0195.01.ENG, last access November 2016.

15 <http://faolex.fao.org/docs/pdf/gha93001.pdf>, last access November 2016.

16 <http://www.ambiente.gob.do/transparencia/wp-content/uploads/2015/06/REG-16.pdf>, last access November 2016.

■ **Monitoring as part of an ODS- and F-gas regulation**

A reporting system for the amount of ODS and the number of ODS containing equipment that is produced, imported or exported is required to set-up appropriate policies (e.g. phase-out). Once a policy framework has been established, a monitoring scheme is essential to have a certain control of the government programmes and to evaluate the success of ODS management. Most countries have already established a monitoring scheme under the Montreal Protocol for

Article 7 substances. However, the ODS stream within the country is often not known, therefore including end-users and the service sector strongly enforces the monitoring scheme.

■ **Venting ban as part of an ODS- or F-gas regulation**

Ban on venting refrigerants during equipment servicing, maintenance, operation and decommissioning.

BOX 4

Examples of monitoring as part of an ODS- or F-gas regulation

Regulation (EC) 1005/2009¹⁷ requires annual reporting of ODS from the EU member states themselves (Art. 26) but also from companies, more specifically producers, importers and exporters of controlled substances (Art. 27). The reporting obligations also include the quantity of recycled, reclaimed or destroyed ODS and the technology used for destruction (e.g. Art. 27-f).

Also undertakings operating RAC equipment (among others):

'[...] shall maintain records on the quantity and type of controlled substances added and the quantity recovered during maintenance, servicing and final disposal of the equipment or system [...]' (Art. 23).

The Slovak Republic introduced a national system for electronic logging, reporting and data processing of F-gases in 2010¹⁸. See also below 'technician training and certification' for more information.

BOX 5

Example of venting ban

Regulation (EC) 1005/2009¹⁹ requires that ODS are prevented from leaking, are recovered for destruction, recycling or reclamation during servicing or maintenance or before dismantling or disposal of equipment. 'Undertakings shall take all precautionary measures practicable to prevent and minimise any leakages and emissions of controlled substances' (Art. 23, paragraph 1).

17 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:286:0001:0030:EN:PDF>, last access November 2016.

18 http://www.szchkt.org/a/front_page?locale=en_GB, last access November 2016.

19 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:286:0001:0030:EN:PDF>, last access November 2016.

■ Refrigerant ban, product ban, refrigerant phase-down, or phase-out

Apart from regulations under the Montreal Protocol with its phase-out schedule, use bans or product bans might be formulated for specific substances or products using specific substances. An import ban for used equipment can be beneficial for preventing an influx of old equipment that still contains ODS.

BOX 6

Example of use and product ban

Use ban:

The German Chemical Ozone Layer Ordinance^{20, 21}, is based on European Regulation (EC) 1005/2009: recycled HCFCs could only be used for servicing purposes in systems that had been installed before 2010. According to the Regulation 1005/2009, this practice is allowed until the end of the year 2014. From January 2015 onwards, the use of HCFCs is completely banned.

Product ban:

Based on the Regulation (EU) No 517/2014: domestic refrigerators and freezers containing HFCs with a GWP ≥ 150 (starting from January 2015) and single split air conditioning systems (with a charge size of < 3 kg) and a refrigerant with a GWP ≥ 750 (starting January 2025) are banned on the EU market. For a complete list of bans, please see Art. 11 and Annex III of this Regulation.

20 <http://faolex.fao.org/docs/pdf/ger68864.pdf> (in German), last access November 2016.

21 http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=053283&database=FAOLEX&search_type=link&table=result&lang=eng&format_name=@ERALL, last access November 2016.

■ EPR policy within WEEE legislation

Although there is a strong linkage between ODS management and waste management, usually ODS and WEEE (containing ODS) are not handled by the same institution or the same department within an institution and require interdepartmental cooperation. In most countries, coordination and planning of regulations for WEEE is a challenge due to difficulties allocating responsibilities among diverse stakeholders. After all, there is a greater chance for successful ODS management when there are already national commitments to environmentally friendly waste management in place. The most promising approach for establishing domestic WEEE legislation is through EPR schemes that require manufacturers to bear the financial and organizational responsibility for proper waste management, for example the transport of equipment to the recycling facilities and the recycling itself.

BOX 7

Examples of EPR schemes

Directive 2012/19/EU on waste electrical and electronic equipment ('European WEEE directive') establishes EPR in the field of WEEE, sets collection and recovery targets, and defines responsibilities for collection, recycling and recovery for all types of electrical goods²².

Norway is not in the EU but adopted a strict EPR policy at the same time as the European WEEE directive came into force. Today, the country has the highest recovery rates of EEE of all European countries.²³

22 <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012L0019>, last access November 2016.

23 An unofficial English translation of the Norwegian Regulation is available online at <http://www.miljodirektoratet.no/en/Legislation1/Regulations/WasteRegulations/Chapter1>, last access November 2016.

FISCAL MEASURES

■ GWP-weighted taxes on refrigerants

A tax on refrigerants based on their GWP raises the price of harmful substances. Companies can choose whether to pay higher prices for refrigerants or to convert to more environmentally friendly solutions. They are therefore flexible in their decisions and can choose the most cost-effective solution. Environmental taxes encourage environmentally friendly behaviour but are not usually introduced to raise revenue. On the contrary, the goal of a tax is to get as many companies as possible to adopt the environmentally friendly behaviour, which would minimise revenue. These taxes are also called incentive-taxes²⁴. The estimated revenue from the tax should cover the costs for establishing and enforcing the measure by the authorities.

BOX 8

Example of GWP-weighted taxes

Denmark, Norway, Slovenia and Spain have introduced a tax on HFCs. In 2012, Denmark collected 12.4 million US dollar revenue through this measure²⁵. Those taxes are based on GWP and vary from less than 3.2 US dollar/tCO₂eq in Slovenia to more than 43 US dollar/tCO₂eq in Norway²⁶.

Taxes are normally collected as part of the general budget of a country and cannot easily be diverted into a specific fund for the destruction of ODS. The finance ministry must also be involved. We recommend that the funds from this tax are administered by an independent third party.

■ Rebate system refrigerants (coupled with a tax)

Part of the tax (or fee) on refrigerants is recovered when refrigerants are returned for recycling, reclaiming, or destruction. This generates a strong incentive for refrigerant consumers and the servicing sector to return the recovered refrigerant. However, such a programme must be designed carefully to prevent an increase in illegal imports of used refrigerants.

BOX 9

Example of rebate system

In Norway, participants may apply for a refund if used refrigerants are delivered to an approved destruction facility. This requires an analysis and proper labelling of the returned refrigerant. A refund is paid in the form of reduction in paid taxes^{27, 28}.

24 <http://www.oecd.org/env/tools-evaluation/48164926.pdf>, last access November 2016.

25 <http://www.oecd.org/env/tools-evaluation/48164926.pdf>, last access November 2016.

26 Exchange rate: 20.03.2017, <http://www.finanzen.net>.

27 <http://www.miljodirektoratet.no/en/Legislation1/Regulations/Waste-Regulations Chapter 8>, last access November 2016.

28 <http://www.returgass.no>; Information in Norwegian, last access November 2016.

■ Incentives for end-users

Incentives for end-users might include consumer discounts, e.g. a tax reduction for purchasing new ODS free equipment, or the option of receiving a new unit when returning the old appliance²⁹. For example, the governments of Mexico and Brazil have created refrigerator take back programmes, typically known as ‘new for old’ programmes. The idea of those replacement programmes is to promote energy efficient and environmental friendly technology to reduce energy demand, thereby easing the strain on the electric grids and helping to achieve climate goals. The approach of the programmes may vary from refrigerator donation for low-income households to subsidising purchases of new equipment with up to 50 percent of the original price. In Colombia, a planned replacement programme for domestic refrigerators foresees a VAT reduction³⁰.

Replacement programmes should not be overambitious. If, for example, only the highest energy efficiency class available is applicable, the higher investment costs for these products might reduce the desired impact. Therefore, the programme should be adjusted to the market in a realistic way.

BOX 10

Example of incentives for end-users

The governments of Mexico, Brazil and Ghana³¹ have created refrigerator take back programmes, typically known as ‘new for old’ programmes.

NON-REGULATORY MEASURES

■ Information campaign

Information campaigns can either support other policy measures or be carried out independently in order to advertise environmentally-friendly programmes and behaviours.

Different strategies can be followed depending on whether the conveyed message is supposed to raise awareness, instruct, or persuade a specific group of people. Exposure to a message does not mean that it is processed and associated action is taken (Atkin and Rice, 2012).

The following key points should be considered:

- **Source:** is the organisation trusted and liked in the country? Where is the information coming from?
- **Message:** the message should be accurate and concise.
- **Channel:** different options include the media, guidance documents, workshops, multipliers and trainers.
- **Audience:** is the message and the channel appropriate for the intended audience? This is especially important when the informal sector is included.

Regarding the collection of appliances, experience has shown that country-wide harmonised information campaigns work better than separate campaigns organised by manufacturers.

29 Please see also ‘Guideline to establish a collection system for equipment containing ODS’ (GIZ, 2017b).

30 http://www.dian.gov.co/descargas/centrales/2016/Ley_No_1819_del_29_de_Diciembre_2016.pdf, last access November 2016.

31 http://www.energycom.gov.gh/energyguide/news_summary.php, last access November 2016.

BOX 11**Examples of information campaigns**

F-gas Regulation (EU) No 517/2014: The entry into force of the revised F-gas regulation in Europe was accompanied by a comprehensive information campaign, including websites, seminars and guidance documents³². This was partly organised by the environmental protection agencies of the EU member states³³.

Companies have also carried out information campaigns to support their customers through their decision-making processes³⁴. Various developing countries carry out similar information campaigns on their HCFC phase-out^{35, 36}.

In Ghana, the **refrigerator replacement programme** supports new efficient refrigerators if old appliances are handed in for proper disposal. A website, adverts in all major media and direct information through distributors all play a role³⁷.

The **Colombian take-back scheme** of used refrigerators is supported by a website³⁸. It is also present on Facebook, twitter and Instagram, and frequently posts updates.

32 http://ec.europa.eu/clima/policies/f-gas/legislation/index_en.htm, last access November 2016.

33 <http://www.epa.ie/air/aireinforcement/ozone/reviewofthef-gasregulation/#.VfLLwBHtlBc>, last access November 2016.

34 http://www.carrier.com/carrier/en/jm/news/news-article/carrier_transicold_uk_offers_advice_on_new_f_gas_legislation_at_cv_show.aspx, last access November 2016.

35 http://www.linde-gas.com/internet.global.lindegas.global/en/images/HCFC%20Phase%20Out%20Brochure17_115696.pdf, last access November 2016.

36 http://www.johnsoncontrols.in/content/in/en/products/building_efficiency/refrigeration/industrial/r22-refrigerant-phase-out.html, last access November 2016.

37 <http://www.energycom.gov.gh/energyguide/index.php>, last access November 2016.

38 <http://www.redverde.co>, last access November 2016.

■ Voluntary industry agreements

Voluntary industry agreements are generally agreed upon by a majority of companies within one sector (e.g. producers of domestic refrigerators, servicing companies). They can have a variety of different goals, such as an agreement to take back refrigerants or appliances, or to refrain from using certain toxic components or high GWP refrigerants. Voluntary agreements are the most promising measure if there is only a small number of actors. They leave it up to the industry to decide how to reach the agreed goal in the most efficient way, but these agreements are not binding. Voluntary agreements can improve areas which are currently not covered by legislation. They are sometimes turned into legislation after an adaption period for the affected industry. The objective of the agreement must be clearly stated.

Voluntary agreements seem to have higher chances for success if regulatory restrictions and bans are discussed and perceived to have a probability of being implemented.

BOX 12

Examples of voluntary industry agreements

Voluntary decommissioning levy on imported bulk refrigerant in New Zealand^{39 40}:

The revenues from the levy are used for exporting and destroying collected waste refrigerant. The amounts of destroyed refrigerant have since increased significantly. The success of the scheme is believed to be due to a regulatory backstop in the form of a venting ban for ODS. The scheme was also accompanied by a voluntary training and accreditation scheme.

The voluntary scheme is not as effective as mandated schemes in Japan or the EU⁴¹.

In Colombia, a voluntary EPR scheme was established. Voluntary financial contributions come from manufacturers and importers. During a participatory process involving all stakeholders, the financial responsibilities were agreed on. End-users can either deliver old refrigerators to collection points or make use of a pick-up service⁴².

39 <http://www.refrigerantrecovery.co.nz>, last access November 2016.

40 <http://www.climatechange.govt.nz/emissions-trading-scheme/ets-review-2011/supporting-info/evidence-on-alternative-greenhouse-gas-policies.pdf>, last access November 2016.

41 <http://www.coolingpost.com/world-news/nz-looks-to-improve-refrigerant-recovery>, last access November 2016.

42 <http://www.redverde.co>, last access November 2016.

■ Training and certification of qualified RAC servicing personnel

Certification in the RAC sector is a promising measure to ensure that refrigeration technicians in the service sector are adequately qualified and the best containment practices are applied during installation, maintenance and repair. Integrating technician certification into legislation is an effective way to guarantee proper handling of ODS and emissions reductions.

By improving service technicians' qualifications and thereby increasing ODS recovery, certification is linked to refrigerant purchases; in other words, only those with certification may purchase refrigerants. In this context it is important to provide suitable capacity building and training facilities for service technicians, and courses at low or no cost.

BOX 13

Examples of training and certification

According to **Regulation (EC) 1005/2009** (Art. 23, Abs. 4), EU member states define minimum qualification requirements for personnel who service equipment or recover refrigerants.

The **F-gas regulation (EC) No 517/2015** requires that only trained and certified personnel is allowed to install, service, maintain, repair, decommission and leak check certain F-gas containing equipment, including the recovery of refrigerants (Art. 10).

In 2010, the **Slovak Republic** has introduced an electronic system that links training and certification to reporting and data processing⁴³. The system includes a section dedicated to electronic recording of equipment data and information on leak-tightness ('leaklog') and a section for electronic reporting and certification.

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

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

National statistics on refrigerant movements and data on the national emission reporting are compiled electronically.

43 http://www.szchkt.org/a/front_page?locale=en_GB, last access November 2016.

Table 4: Qualitative costs assessment of described policy options (partly based on SKM, 2012).

Colour indicators	Costs (state)	Costs (industry)	Remarks on activities for state and industry
<p>low costs</p> <p>medium costs</p> <p>high costs</p>			
Voluntary agreement	low costs	low costs	Government and industry: negotiate, implement and monitor a voluntary agreement with reporting obligations and dynamic targets for industry.
Enforcing existing legislation	medium costs	low costs	Government: enforce and monitor existing legislation. Industry: implement measures.
ODS and F-Gas regulation	high costs	high costs	Government: develop and pass legislation, inform, implement, enforce, monitor. Industry: implement legislation. This policy option should include several of the policy options listed in the previous step and should be accompanied by an information campaign.
Venting ban	low costs	medium costs	Government: establish ban, enforce. Industry: purchase tools, technician training.
Product or refrigerant ban	low costs	high costs	Government: establish ban, enforce. Industry: develop and purchase alternative products and/or refrigerants; substitute banned products and/or refrigerants.
Monitoring	medium costs	medium costs	Long-term activity for both government and industry but might be required under international agreements such as Montreal Protocol.
EPR legislation	low costs	medium costs	Government: establish, enforce. Industry: develop, establish and maintain additional measures throughout the product life cycle.
Information campaign	low costs	low costs	Government and industry: develop and conduct information campaign. Should accompany all other measures to raise awareness.
Tax	medium costs	medium costs	Government: establish tax scheme, organise administration and enforce. Industry: pay tax.
Rebate system	medium costs	medium costs	Government and industry: develop and organise rebate system, clarify who covers the costs. Should be coupled to tax scheme but also works independent from tax.
Standards	medium costs	medium costs	Government and industry: establish national standards for products or an entire subsector. High level of technical expertise needed. Standardisation process might take several years.
Technician training	medium costs	medium costs	Government and/or industry: develop curriculum, establish training locations and courses, set-up administration.

Table 5: Example of assessing benefits for policy options.

Benefits	Parameter	Methods	Key questions
Environmental benefits	Abatement potential (emission savings)	Establish an ODS bank inventory in the country and estimate emissions from the RAC&F sectors. The introduction of policies will reduce these emissions. Create at least two scenarios for comparison, assuming: one business-as-usual scenario for reference and one scenario for the policy option under discussion. Calculate the difference in CO ₂ eq per year. In general, the abatement potential of containment measures is medium to low. Emission savings from bans are comparably high but alternatives need to be available throughout the country.	What is the effectiveness of each policy option in each subsector? Are there side effects? For example, the introduction of HFCs does not harm the ozone layer but results in significant global warming emissions.
Economic benefits	Market effects	Get an overview of the magnitude and structure of the market. Discuss with customs, experts from the government, academia and industry the potential effects of various policy options.	Which substances or sectors should be addressed? Should certain substances or applications be excluded from the policy measure? How can the use of alternatives be promoted? Would the measure create jobs? How will a tax be passed on through the supply chain? Will the potential taxpayers 1) meet their financial obligations 2) implement an alternative technology or 3) leave the country? Would illegal imports increase significantly?
Social benefits	Education	Search statistical information or expert estimates on the number of personnel to receive training measures. Get information about previous education and technical skills.	How many personnel will be trained and what is their background? Who will pay for the training and how long will it take? Which locations or regions in the country should be covered? How can access to training by women, the illiterate, population groups from remote areas or other disadvantaged groups be improved? Will there be an exam or a certificate? How will the training improve employment opportunities?

■ Technical standards regarding refrigerant use, recycling, reclaim, recovery and destruction

Technical norms and standards are designed to be used as guidelines or manuals that establish technical criteria and definitions, methods, applications and best practices. Usually, standards are not legally binding (unless cited explicitly in legislation) and their use is based on a voluntary consensus, as many governments, industry groups and associations require products or services to adhere to a standard before they can be introduced to the market.

National standards for ODS containment are an important instrument for successful ODS bank management, describing the state-of-the-art.

They can contribute to long-term emission reductions through the consensus-based application of best practices and definition of minimum ODS recovery rates. In addition, in terms of product liability, the accepted technical standards are generally used. Standards are published by national and international standardisation bodies, such as the International Organization for Standardization (ISO) or the Air-Conditioning, Heating & Refrigeration Institute (AHRI). Standards can be purchased from those bodies. ISO standards can also be adopted as national standards if the national standardisation body is part of ISO.

BOX 14

Examples of technical standards

- **EN 378** – Refrigerating Systems & Heat Pumps–Safety & Environmental Requirements. A general standard that applies to any RAC system.
- **AHRI⁴⁴ Standard 740**: performance rating of refrigerant recovery equipment and recovery/recycling equipment⁴⁵.
- **AHRI Standard 700**: specifications for refrigerants, defining the purity of reclaimed refrigerants⁴⁶.
- **ABNT⁴⁷ NBR 15833:2010** – Reverse Manufacturing – Refrigeration appliances: this standard stipulates the procedures for the transport, storage and dismantling of refrigeration equipment, taking

into consideration reuse and recovery of recyclable material and adequate final disposal of residual materials. It defines minimum ODS recovery rates per equipment group.

- **ABNT NBR 15976:2011** Emission reduction of halogenated refrigerants in stationary RAC equipment and installations.

GIZ Proklima has published several 'Good Practice Guidelines'. These have not gone through a standardisation process but provide useful guidance for the proper handling of RAC equipment⁴⁸.

44 AHRI is the trade association representing manufacturers of heating, ventilation, air conditioning and refrigeration (HVACR) and water heating equipment within the global industry. AHRI develops industry standards that are used globally.

45 <http://www.ahrinet.org/site/686/Standards/HVACR-Industry-Standards/Search-Standards>, last access November 2016.

46 http://www.ahrinet.org/App_Content/ahri/files/standards%20pdfs/AHRI%20standards%20pdfs/AHRI_Standard_700-2015.pdf, last access November 2016.

47 The Brazilian National Standards Organization (ABNT) is the normative body responsible for technical standards in Brazil. It is a non-profit organisation founded in 1940. ABNT is a founding member of the International Organization for Standardization (ISO) and is an accredited registration body to certify quality systems, environmental management systems and several products. Within the framework of its committee, CB-55, it develops and publishes technical standards for the RAC sector.

48 <http://www.giz.de/expertise/downloads/giz2010-en-good-practices-in-refrigeration.pdf>, last access November 2016. <http://www.giz.de/expertise/downloads/gree2011-en-ac-installation-service-manual.pdf>, last access November 2016.

STEP 4**Detailed assessment of pre-selected policy options**

A common way to choose between policy options is via a cost-benefit analysis. In a cost-benefit analysis, the **monetary costs for all involved stakeholders** (e.g. the state, industry actors and end-users) are estimated for each policy option. The benefits, in this case the emission saving potential or the additional reduction of e-waste per policy option, are determined as well. However, additional positive and negative effects should also be considered.

a) Costs

Table 4 contains a very rough indication of the financial impact for the state and industry of various policy options. As the conditions are never the same from one country to the other, a more detailed country-specific calculation is needed. An example of a very thorough analysis can be found in the annex of the 'Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases' (Schwarz et al., 2011). Costs should always be estimated for all relevant stakeholders affected, which can include the government, manufacturers, importers, servicing companies, technicians or end-users. Table 6 in the annex shows which stakeholders are affected by the different policy measures.

Costs can also arise due to competitiveness or a change in the sector's social structure. The latter is especially important to consider if the informal sector is involved and a policy measure aims at formalising waste collectors, for example. A stakeholder consultation process is recommended to achieve significant impacts.

b) Benefits

The above-mentioned costs should be compared to the potential benefits of a policy measure.

These can be differentiated into environmental benefits, economic benefits and social benefits.

Environmental benefits include, for example:

- abatement potential, i.e. the potential to reduce greenhouse gas emissions. The data gathered during the compilation of the ODS bank inventory provide a basis for assumptions about the effect of different measures;
- other environmental benefits e.g. the reduction of hazardous waste, abatement of air pollution etc.

Economic benefits include for example:

- a tax on F-gases would result in revenues for the government;
- market effects: a ban of certain products would promote the use of other products so that other market segments might benefit;
- industry competitiveness: training schemes would improve professional skills within the sector concerned and would hence improve its position on the local or national market.

Social benefits include for example:

- employment: the development of alternative technologies would result in additional jobs in research and development, but also other employment opportunities, e.g. in logistics and administration when a collection scheme is established, including in the informal sector;
- education: information campaigns would improve the general level of education in the country.

In order to quantify the benefits, various methods are available and need to be systematically applied. Table 5 describes some examples for techniques to determine the benefits of policy measures and related key questions.

Table 4: Qualitative costs assessment of described policy options (partly based on SKM, 2012).

Colour indicators	Costs (state)	Costs (industry)	Remarks on activities for state and industry
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Product or refrigerant ban	low costs	high costs	Government: establish ban, enforce. Industry: develop and purchase alternative products and/or refrigerants; substitute banned products and/or refrigerants.
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EPR legislation	low costs	medium costs	Government: establish, enforce. Industry: develop, establish and maintain additional measures throughout the product life cycle.
Information campaign	low costs	low costs	Government and industry: develop and conduct information campaign. Should accompany all other measures to raise awareness.
Tax	medium costs	medium costs	Government: establish tax scheme, organise administration and enforce. Industry: pay tax.
Rebate system	medium costs	medium costs	Government and industry: develop and organise rebate system, clarify who covers the costs. Should be coupled to tax scheme but also works independent from tax.
Standards	medium costs	medium costs	Government and industry: establish national standards for products or an entire subsector. High level of technical expertise needed. Standardisation process might take several years.
Technician training	medium costs	medium costs	Government and/or industry: develop curriculum, establish training locations and courses, set-up administration.

Table 5: Example of assessing benefits for policy options.

Benefits	Parameter	Methods	Key questions
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Economic benefits	Market effects	Get an overview of the magnitude and structure of the market. Discuss with customs, experts from the government, academia and industry the potential effects of various policy options.	Which substances or sectors should be addressed? Should certain substances or applications be excluded from the policy measure? How can the use of alternatives be promoted? Would the measure create jobs? How will a tax be passed on through the supply chain? Will the potential taxpayers 1) meet their financial obligations 2) implement an alternative technology or 3) leave the country? Would illegal imports increase significantly?
Social benefits	Education	Search statistical information or expert estimates on the number of personnel to receive training measures. Get information about previous education and technical skills.	How many personnel will be trained and what is their background? Who will pay for the training and how long will it take? Which locations or regions in the country should be covered? How can access to training by women, the illiterate, population groups from remote areas or other disadvantaged groups be improved? Will there be an exam or a certificate? How will the training improve employment opportunities?

BOX 15**Recommendations for the assessment and selection of measures**

- Conduct a ranking of policy options according to costs and benefits in order to choose the most effective policy option. Weighting factors can be applied if some aspects seem more important than others, for example costs or emission savings. Also, it is important to consider synergies with other (existing) policies in similar fields, e.g. to minimise administrative efforts.
- Social factors, such as the inclusion of the informal sector, and education and gender should always be included in the analysis. Consider conducting a detailed analysis of the contribution to the sustainable development goals (SDGs).
- During the ranking stage, take into consideration financing and enforcing strategies described in the next section of this guideline to determine the probability of success of a chosen policy measure. Table 6 in the annex compares possible financing and enforcement strategies for the different policy measures.

c) Implementation, compliance and enforcement

Preselected policy measures that qualify under cost and benefit aspects **need to be cross checked for success in terms of implementation, compliance and enforcement**. Even comprehensive national legislation is ineffective if it is not complied with and not adequately enforced. Key aspects and questions include:

- **Analysis of implementation modalities:**
 - What are the legal or administrative procedures and barriers?
 - What is the time frame?
 - Is there a need for supporting measures or policies?

- **Analyse reasons for non-compliance that need to be addressed:** reasons for non-compliance vary and include deliberate non-compliance (e.g. for financial gain, to save time and effort), lack of knowledge about regulations, incompetence, lack of infrastructure for compliance, financial constraints of companies and authorities etc. (Gunningham, 2011). Certain policy options address these factors, for example campaigns to raise awareness and training programmes may inform stakeholders and increase competence. Other measures, such as rebate-programmes or subsidies, may provide incentives to use alternatives to ODS and ease financial limitations.

Finally, a lack of enforcement results in an uneven and unfair playing field in the marketplace, allowing free riders to continue to avoid any responsibility. Therefore, an enforcement strategy should be discussed during the design of any new policy measure.

BOX 16**Notes on implementation and enforcement measures**

- The illegal import of ODS containing equipment or venting of large amounts of refrigerants from industrial equipment should be adequately fined. Compliance can be monitored via a reporting system and custom controls of imports. Reported data and data from customs should be cross-checked to identify discrepancies, at least for some sample cases.
- Venting of small ODS amounts from appliances can be prevented through effective information, infrastructure for supporting collection activities, training, and financial incentives. Heavy fining of the informal sector or small workshops are not adequate and will not result in change as monitoring is not possible.

In order for ODS regulation enforcement to be effective, the following questions should be answered:

1. What should be the consequences of non-compliance?
2. What is the responsible agency? Do they have the power to hand out fines?
3. Should the focus be on fining non-compliance or on providing information and using persuasion to foster compliance?
4. Where are the resources for compliance monitoring allocated – which companies and individuals are being monitored?
5. Do companies have the necessary resources (financial, infrastructural and informational) to comply?

3 Annex

Table 6: Comparison of measures according to selected criteria.

	Affected sectors	Impact	Affected stakeholders
ODS- and F-gas regulation	All refrigerants and foam blowing agents not relevant for already collected banks.	Long-term, with some effects taking place in the short and medium term.	Suppliers, importers, producers, technicians, to a certain point end-users.
Venting ban	All refrigeration and AC sectors or specified.	Short-term to medium-term.	Technicians, end-users.
Monitoring	RAC sub-sectors containing high amounts of refrigerant.	Short-term to medium-term.	End-users, refrigerant importers, servicing technicians.
Product ban, phase-out	All refrigeration and AC sectors or specified.		
EPR legislation	Appliance RAC sectors: domestic refrigerators (also possible: stand-alone commercial), AC units.	Long-term, depending on scope first results can be seen in the short term.	Manufacturers – importers (Indirect: end-users as manufacturers and importers are likely to increase prices by levy).
Enforcement of existing legislation	All refrigeration and AC sectors or specified.	Short-term, medium-term, and long-term.	End-users, companies, technicians.
Information campaign	The sectors depend on the strategy chosen.		Depends on strategy and sectors: end-users and their obligations and disposal options; Servicing and maintenance personnel on leak reduction and best practice recovery options; Designers on leak-reducing strategies and environmentally-friendly refrigerants.

Enforcement strategy	Possible financing mechanism	Implementation time	Supporting policies
Customs officers are trained for import and export measures. Technician training. Fines for companies not complying.	Government.	Changes to existing legislation can be implemented short-term; new legislation long-term.	Collection – destruction Information campaign.
Enforcement is extremely difficult as the burden lies with technicians and end-users. Only effective in combination with other policy measures.	Government.	Short-term if change to existing legislation.	Only effective with supporting framework. Collection system necessary.
	Government.		
Customs officers, control via distributors.	Government.	Changes to existing legislation can be implemented short-term; new legislation long-term.	Information campaign.
	N/A – self-financing or financing only part of the scheme.	Long-term because of complicated stakeholder processes.	Technician training Standards Information campaign Ban on venting.
Focus on fines: reporting, compliance monitoring, fines, court action, Focus on information and persuasion: information, training, reporting system that results in self-control, compliance assistance centres, and financial incentives.	Agency most likely paid for by country. Depending on financing strategy of the policy measure, a budget for compliance could be included in the design.	Short-term and medium-term.	N/A. Some policies might only be enforceable if more training takes place or if the appropriate standards are developed.
N/A.	Public funding, third party funding (e.g. international aid agencies).	Short-term.	Information campaigns are generally seen as supporting policies of other measures.

	Affected sectors	Impact	Affected stakeholders
Voluntary industry agreement	All RAC sectors; generally such agreements are more successful when there are fewer industry players on the market.	Low to high impact.	Industries, end-users.
Taxes on refrigerants	Mainly sectors with high amounts of refrigerant, e.g. commercial and industrial refrigeration and AC. The effect on household applications will be small. Taxes would apply to the entire national refrigerant market.		End-users, mainly from the commercial and industrial sector.
Rebate system refrigerants (coupled with tax)	All RAC, mainly sectors with high volumes of refrigerant.		End-users, mainly from the industrial and commercial sector; servicing companies.
Training and certification of qualified RAC servicing personnel	All – RAC.	Long-term.	Technicians.
Technical standards regarding refrigerant use, recycling, recovery and destruction	All – or depending on scope.	Long-term.	Technicians, end-users.

Enforcement strategy	Possible financing mechanism	Implementation time	Supporting policies
N/A.	Industry.	Depends on affected sector and field: a voluntary agreement to replace and subsequently introduce new units to the market will take a long time, while a voluntary agreement to convert foam production to non-halogenated alternatives will be much faster.	Work best if they are backed by regulation or the prospect of regulation.
Agency of the finance ministry has to be involved.	N/A.	Short to medium-term.	Information campaign.
N/A – because of financial incentive, no enforcement strategy is needed.	N/A.	Long-term: legislation must be passed. Infrastructure of collection points must be implemented and technicians must be trained. Recycling, reclaim and destruction option must be offered.	Technician training, standards.
Linking certification to refrigerant purchase, reporting obligation for certified (and registered) technicians.	HPMP.	Short-term for first results, long-term for sustainable training implementation.	Policy to put collection system infrastructure in place, so that technicians do not end up having to store refrigerants.
Training.		Long-term.	Technician training and certification.

4 References

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