Advance unedited version

Draft

Resource Book for the Life Cycle Management of Fluorocarbons

-Good practice portfolio for policy makers-

As of 10 November 2021

Climate and Clean Air Coalition
to Reduce Short-Lived Climate Pollutants (CCAC)

Table of Contents

Acronyms

AC	air conditioner or air conditioning
ADB	Asian Development Bank
ADF	Advanced Destruction Fee
AP	Approval Permit
BAFA	Bundesamt für Wirtschaft und Ausfuhrkontrolle (Federal Office of Economics and Export Control)
BMU	Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (Ministry for the Environment, Nature Conservation and Nuclear Safety)
BNSP	Badan Nasional Sertifikasi Profesi (Indonesian National Agency for Professional Certification)
CAA	Clean Air Act
CCAC	Climate and Clean Air Coalition
CCO	Chemical Control Order
CFC	chlorofluorocarbon
CRP	Conference Room Paper
DENR	Department of Environment and Natural Resources
DME	dimethyl ether
DoE	Department of Environment
ECI	Efficient Cooling Initiative
EE	energy efficient
ELV	End-of Life Vehicles
EoL	end of life
EPR	Expanded Products Responsibility
ExCom	Executive Committee
GEC	Global Environment Center Foundation
GHG	greenhouse gas
GWP	global warming potential
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
HPMP	HCFC Phase-out Management Plan
HVAC	heating, ventilating, air conditioning
ICS	Instituto Clima e Sociedade (Institute for Climate and Society)
IEA	International Energy Agency
IFL	Initiative on Fluorocarbons Life Cycle Management
IGSD	Institute for Governance & Sustainable Development

JCM	Joint Crediting Mechanism
KCEP	Kigali Cooling Efficiency Programme
LCCP	life cycle climate performance
MEPS	Mandatory Efficiency Performance Standards
MLF	Multilateral Fund
MP	Montreal Protocol
NDC	nationally determined contribution
NEA	Norwegian Environment Agency
ODP	ozone depleting potential
ODS	ozone depleting substance
ODSHAR	Ozone-depleting Substances and Halocarbon Alternatives Regulation
OECC	Overseas Environment Cooperation Center, Japan
OEWG	Open-Ended Working Group (of the Montreal Protocol)
PFC	perfluorocarbon
PHS	Projeto Hospitais Saudáveis (Healthy Hospitals)
POD	Philippine Ozone Desk
PPP	public private partnership
PRO	Producer Responsibility Organization
PSS	product stewardship scheme
PU	polyurethane
QPS	Quarantine and Pre-Shipment
RAC	refrigeration and air conditioning
RRA	Refrigerant Reclaim Australia
SADC	Southern African Development Community
SGG	synthetic greenhouse gases
SLCP	short-lived climate pollutants
SNAP	Significant New Alternative Policy
SZ CHKT	Slovenský zväz pre chladiacu a klimatizačnú techniku (Sloval Association for Refrigeration, Air Conditioning Technology and Heat Pumps)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USEPA	United States Environmental Protection Agency
VRF	Variable Refrigerant Flow air conditioning system
WEEE	Waste Electrical and Electronic Equipment
XPS	extruded polystyrene

1. Background

The Kigali Amendment to the Montreal Protocol in 2016 is a landmark event in the global community for phasing down hydrofluorocarbons (HFCs). As HFCs have de minimis ozone depleting potential (ODPs), it has been widely used to rapidly phase out for ozone depleting substances (ODSs) such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) in air conditioning, refrigeration, thermal insulating foam, technical and medical aerosol products. HFCs have also been used to phaseout halons used in fire protection. HFC emissions have increased significantly in recent years in response to increased demand for cooling services and the phaseout of ODSs under the Montreal Protocol. Many HFCs are potent greenhouse gases (GHGs) with a global warming potential (GWP) up to 12,400 times (IPCC/AR5, 2013) that of CO_2 per mass unit over a 100-year time horizon therefore, it is crucial to control the emission of HFCs as an effort of climate change mitigation, in the context of the Paris Agreement. Furthermore, environmentally superior replacements for HFCs are now available or soon to be available.

In implementing the Kigali Amendment, the Parties will set a cap on the production and consumption amount of HFCs and comply with the designated phase-down schedule. Yet, since the Montreal Protocol, including the Kigali Amendment, focuses on upstream measures, the downstream issue of the “bank” of refrigerants contained in stationary and mobile cooling equipment remains problematic. It is projected that, despite compliance with the Kigali Amendment, an additional 72 billion t-CO_2eq of fluorocarbons will be released into the air in the next four decades. As the potential impact on climate change is substantial, addressing HFCs currently trapped in the banks is crucial to achieving 1.5°C target consistent levels of mitigation in the next few decades and achieving net zero emissions target in the latter half of this century.

The demand for cooling is rapidly growing, especially in the developing world, which in turn is driven by an expected increase in per capita wealth in developing countries combined with the effect of rising temperatures due to climate change. According to the International Energy Agency (IEA), the global stock of air conditioners (ACs) in buildings will grow to 5.6 billion by 2050, up from 1.6 billion today, which amounts to 10 new ACs sold every second for the next 30 years.[1] While this projection has been made with a relatively longer time span, the rapid growth has already begun, before the Montreal Protocol Parties initiate their first actions of the phase down. And in many countries, including both developed countries and developing countries, downstream measures to control emissions of refrigerants have a lot of room for improvement or simply not in place, and used HFCs, as well as CFCs and HCFCs are released into the atmosphere. In other words, a risk of emissions of HFCs as well as other types of fluorocarbons are left unsolved, unless the downstream measures are not taken to treat the bank in an appropriate manner.

[1] The Future of Cooling (IEA 2018)

To address the issue of the fluorocarbons bank Japan and 13 countries and international organizations[2] established the Initiative on Fluorocarbons Life Cycle Management (IFL) at COP25 of the United Nations Framework Convention on Climate Change (UNFCCC) in Spain, Madrid. The IFL promotes controlling fluorocarbons throughout their life cycle, including refrigerant leakage during equipment use of and discharges at the time of equipment retirement or replacement. IFL highlights institutionalizing the life cycle management of fluorocarbons in government policies, and catalyzing stakeholders such as the private sector and international development partners, with a view to building relevant infrastructure, spur innovation, create sustainable economic growth and quality jobs. Also, Germany has made efforts through developing a global roadmap on ODS bank management and supporting some countries to estimate national ODS banks and future waste streams. Supported by the Kigali Cooling Efficiency Programme (KCEP) by the United Nations Development Programme (UNDP), developing countries like Brazil, Colombia, Ghana and others positively introduced policy measures and demonstrated projects to control fluorocarbons with life cycle management perspectives.

These efforts have led to strengthening and promoting life cycle management of fluorocarbons as part of the Cooling Sector Engagement Strategy of the Climate and Clean Air Coalition (CCAC) to reduce Short-Lived Climate Pollutants (SLCPs), in strong partnership with the Efficient Cooling Initiative (ECI). As a goal toward 2025, the CCAC aims to raise high-level global awareness of the relevance of the cooling sector to combating climate change (including by reducing the need for cooling) and mobilize political support for ambitious actions and the provision of finance beyond that provided by the Multilateral Fund of the Montreal Protocol to assist developing countries transition towards climate-friendly cooling.

The Resource Book for the Life Cycle Management of Fluorocarbons has been published for the purpose of raising global awareness on the importance of appropriate treatment of fluorocarbons not only by upstream but also downstream measures. It showcases examples of policy measures relevant to the life cycle management of fluorocarbons in their respective stages (refrigerant production & import, appliance manufacturing & import, installation of appliance, collection of refrigerants, reclamation & destruction, as well as cross-cutting measures).

[2] Chile, France, Japan, Maldives, Mongolia, New Zealand, Philippines, Singapore, United Kingdom, Viet Nam, World Bank, Asian Development Bank (ADB), Climate and Clean Air Coalition (CCAC), and United Nations Industrial Development Organization (UNIDO).

Photos: COP25 the 1st Meeting of the Initiative on Fluorocarbons Life Cycle Management

2. Concept of life cycle management of fluorocarbons

(1) Concept of life cycle management

Controlling emissions of fluorocarbons supports both stratospheric ozone and climate protection. Taking only upstream measures of phase down of production of consumption are not sufficient to reduce the amount of refrigerant released into the atmosphere, because of the problems of refrigerant leakage during equipment use and refrigerant discharge at end of equipment life. The life cycle management approach highlights not only selecting energy efficiency equipment with environmentally superior refrigerants, but also taking care of problems of leakage and release to the atmosphere in all life stages and reducing amount of production of refrigerants as a whole.

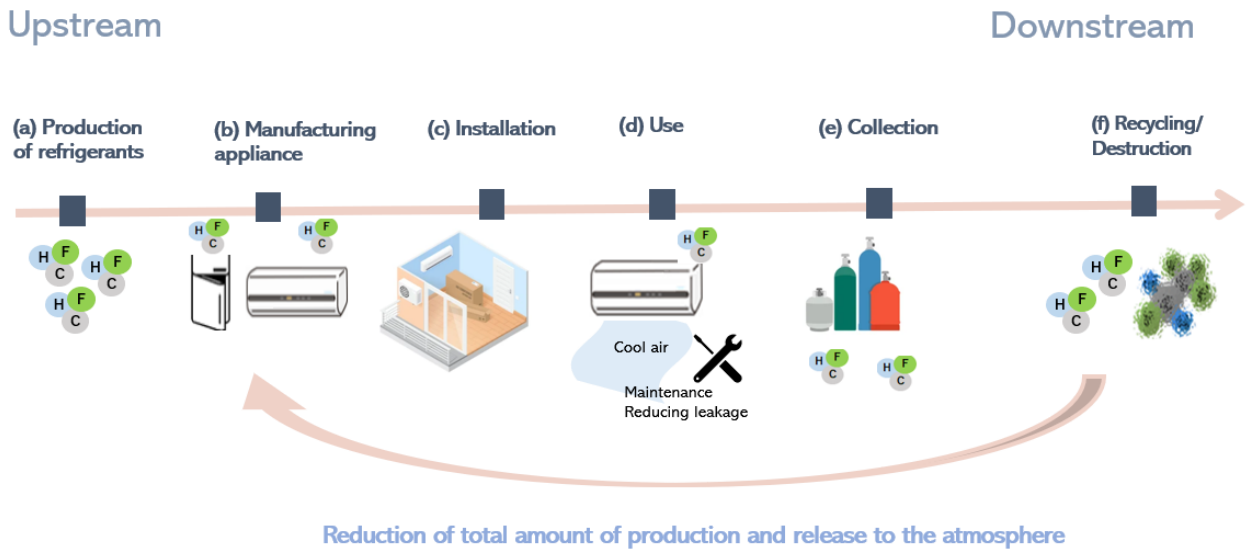


Figure1: Stages of life cycle of fluorocarbons

(2) Stages of life cycle

The following are the stages of life cycle of fluorocarbons management

(a) Production and/or import of equipment and refrigerants

Regulations can be applied to restrict, encourage or discourage the choice of certain refrigerants, as well as enforce quota and registration requirements to producers, including tracking the appropriate downstream measures. For those importing refrigerants, these measures are applied as part of import control.

(b) Manufacturing and/or import of new and used appliances containing obsolete ODS or HFC refrigerants

Likewise (a) above, regulations and other types of measures are applied at the time of manufacturing appliances containing refrigerants, such as air conditioners and refrigerators (e.g. introducing energy efficient or low GWP refrigerants, etc.). Also, if ODS or HFC refrigerants are imported as part of appliances, the control measures are applied to those products.

(c) Installation of appliances

Proper installation of an appliance is key to avoid unnecessary life cycle leakage. In this regard, there are standards of best practices and quality control for installing appliances including proper placement of outside heat exchanges to minimize energy use and length of refrigerant lines. Also as an upstream measure, promoting selection of low GWP natural refrigerants or next-generation refrigerants offering superior life cycle climate performance (LCCP), taking into account, leakage, GWP, and energy efficiency.

(d) Use of appliances

Preventive maintenance, including leak detection, is a proven way to avoid unnecessary leakage of refrigerant, which has the side benefit of maintaining the optimal charge for energy efficiency. For such actions, training, best practices, and quality control are applied. Also in some countries, a system to monitor leakage is introduced as an obligation.

(e) Collection of refrigerants

At the end of useful life of appliances, refrigerants should be collected for proper recycle or destruction, to avoid releasing to the atmosphere and equipment should be disassembled and materials recycled to avoid

redeployment to unsuspecting buyers not realizing that used cooling appliances are inefficient, unreliable, contain refrigerants that are increasingly scarce, and damage climate and air quality. In some countries, the collection is an obligation of appliance users, and designated technical regulations, as well as payment for the cost are defined. Some countries have introduced a refrigerant deposit system to pay for ultimate refrigerant recycling and destruction costs. Ghana, on behalf of all of Africa, has submitted a Conference Room Paper (CRP) asking for a Decision by Parties to stop dumping of inefficient new and used appliances containing obsolete ODS and HFC refrigerants. Also, a certain level of technique is required to operate collection. In this regard, a licensing system is applied to verify the qualifications of technicians.

(f) Recycling and destruction

After collection of used refrigerants, some of them can be recovered for recycling. Other refrigerants need to be destroyed in processes such as local cement kilns. Such processes should also be regulated by law and meet certain standards of safety and technical efficiency. Consideration of the cost coverage is important. In this regard, various ways of a business model for supporting recycling and destructions are implemented such as using obligatory fee collection or, incentivizing destruction by a carbon crediting mechanism or as a component of nationally determined contributions (NDCs) to the Paris Climate Agreement.

(g) Cross-cutting actions

As the life cycle management emphasize a comprehensive approach through the different life stages of fluorocarbons management, more than one policy measure should be combined and function together with synergy.

(3) Various formats of policy measures

To implement life cycle management of fluorocarbons, there are various formats of policy measures available.

Regulations are a commonly used format to introduce obligations of key stakeholders (e.g. refrigerant producers, manufacturers, importers, users, and chemical waste managers, etc.). By setting legally binding rules and procedures, governments oblige those stakeholders to comply with banning of specific substances, a quota of import amount, and other requirements.

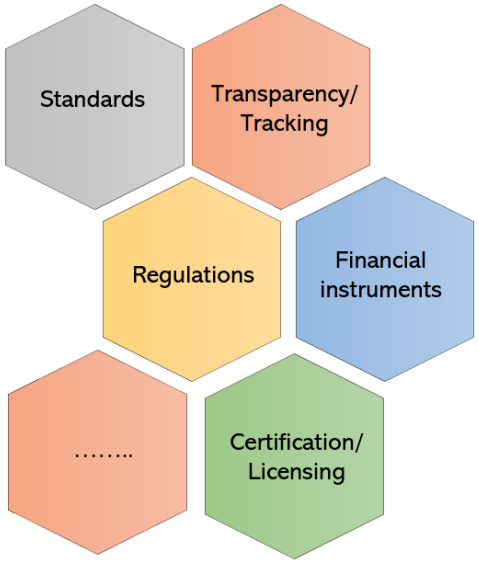


Figure 2: Various formats of policy measures

Standards are introduced for ensuring certain quality or quantity of products and services. By providing standards and specifications, technical requirements and procedures are clarified which the key stakeholders need to follow.

Transparency/tracking is an approach to visualize activities of the stakeholders and enable monitoring of their compliance with requirements, such as appropriate treatment of fluorocarbons. This may sometimes involve a registration system with reporting requirements.

Certification/licensing is useful in ensuing the activities of the stakeholders attest to the achievement of requirements by laws, regulations, and standards as above. One of the common examples is the certification of authorized technicians of service providers of fluorocarbons treatment.

Financial instruments involve providing incentives by subsidies and disincentives by taxation and fees for leading to reduction or choices of certain refrigerants. Also, these are used to collect and cover the cost for final treatment of refrigerants, such as through a deposit system. Also, there are efforts to mobilize private investment for reducing fluorocarbons by linking to carbon market. Extended producer responsibility financial obligations across the life cycle actors, particularly refrigerant producers and equipment manufacturers, can be also regarded as a financial instruments measure.

These policy measures are not necessarily implemented as stand alone. In many cases, more than one policy measures are designed to function in combination. In introducing policy measures, policy makers may choose what are suitable ones to enable feasible and sustainable implementation under respective national circumstances and equitable distribution of financial and operational responsibility.

3. How to use the Resource Book

(1) Cases of policy measures at stages

In this Resource Book, summaries of case studies are provided along with different stages of fluorocarbons management as shown in the Figure 3. Cases are selected from representative ones in respective stages.

Also, special attentions are paid to the value of capacity development of developing countries. In this regard, a balance of selected cases have been considered between developing and developed countries.

Life stages of management	Case study examples
Production/import of refrigerants	Registration system of fluorocarbons users (Malaysia), Reduced tax for recovered fluorocarbons (Spain)
Manufacturing/import of appliances	Significant New Alternatives Policy listing up alternative refrigerants (USA), Ban on appliances with specific types of refrigerants (EU)
Installation of appliances	Introducing Energy Efficiency Standards and Incentives on Refrigerating Appliances(Ghana), Subsidy program for natural refrigerant equipment(Germany)
Use of appliances	Registration of appliances (Philippines), Tracking of appliances (Slovakia), Leakage disclosure system (Japan), licensing maintenance service providers (Indonesia)
Collection of refrigerants	Labelling system (Ghana), End-user deposit system (Denmark)
Recycling/ destruction	Expanded Producers Responsibility (Brazil and Colombia), Incentives with carbon crediting mechanism (Thailand and Viet Nam)
Cross-cutting actions	Capacity-building of technicians and demonstration (Nigeria)

Figure 3: Case studies of policy measures at respective life stages of fluorocarbons management

Approximately 2-5 cases per life stages of fluorocarbons are available (in total 24 cases).

(2) Cases of policy measures at different stages

The Resource Book explains in the below format of policy measures of fluorocarbons lifecycle management.

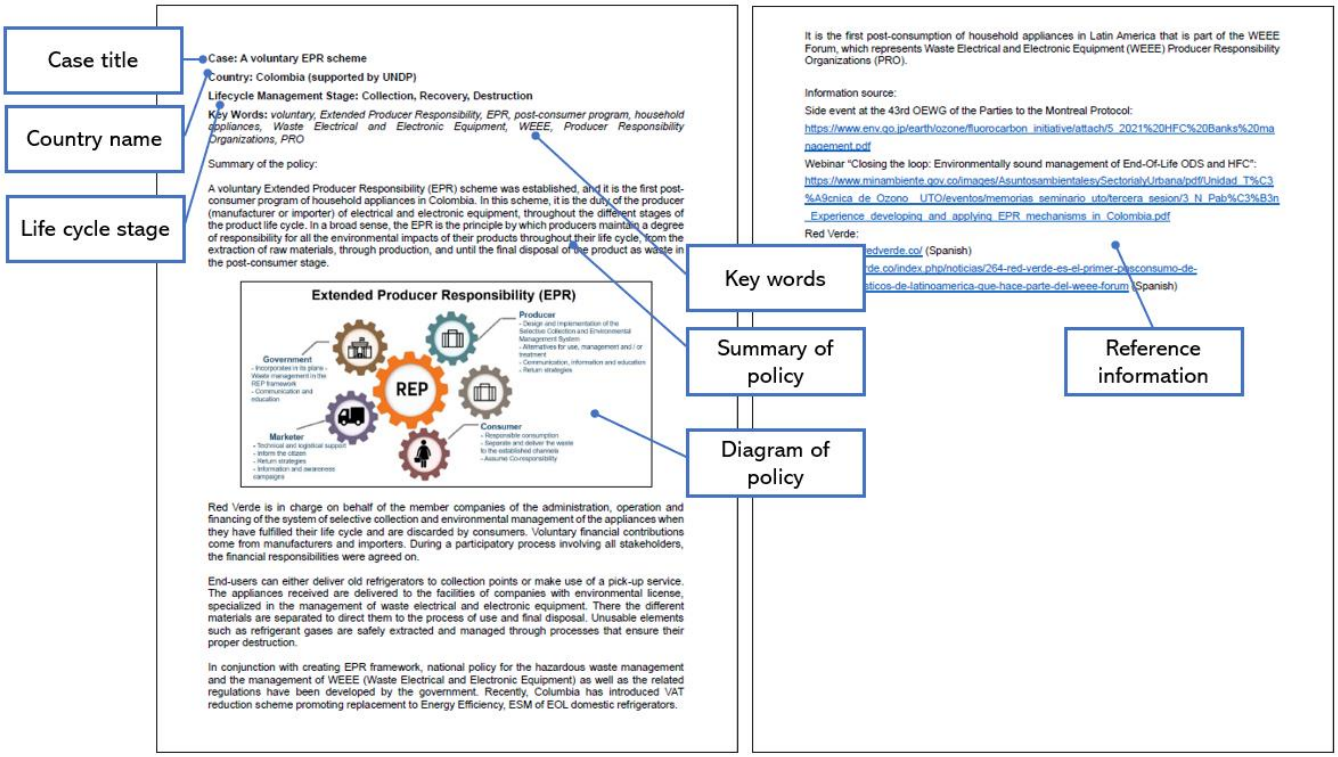


Figure 4: Contents of case studies

A case study contains “case title”, “country name”, and “life stage” of fluorocarbons management. “Key words” provide hints of important concepts, which readers can find before reading the case. “Summary of policy” explains background, objectives, activities implemented and achievements in a qualitative and quantitative manner. “Diagram of policy” provides a visual image of elements of the policy measures, and “reference information” lists the sources of information, which readers of the Resource Book may wish to further consult for more in-depth study.

4. Good Practices

(a)	Production and/or import of refrigerants	
Case 1	Tax on fluorinated gases	Spain
Case 2	Importer/exporter license and national customs codes	Malaysia
(b) Manufacturing and/or import of appliances containing refrigerants		
Case 1	Conversion from HCFC to non-ODS alternative materials	Bangladesh, Swaziland, and Mexico (supported by UNDP)
Case 2	Significant New Alternatives Policy (SNAP) Program	United States of America
Case 3	EU F-gas regulation bans for new products and equipment	EU
Case 4	Measures for designated products	Japan
(c) Installation of appliances		
Case 1	Introducing Energy Efficiency Standards and Incentives on Refrigerating Appliances and new actions to stop dumping of new and used cooling appliances containing obsolete ODS and HFC refrigerants	Ghana
Case 2	Subsidy program for natural refrigerant equipment	Germany
(d) Use of appliances		
Case1	Registration of Service Providers of ODS-using Equipment	Philippines
Case 2	National qualification framework and certification of work competence for RAC technicians	Indonesia
Case 3	Training and Certification for personnel who service equipment or recover refrigerants	EU
Case 4	Electronic system links training and certification to reporting and data processing	Slovakia
Case 5	Rebate System on HFC/PFC tax	Norway
(e) Collection of refrigerants		
Case 1	Obligatory collection of refrigerants	Japan

Case 2	Danish Refrigerant Industry Environmental Scheme (KMO)	Denmark
Case 3	Refrigerant take back program	Australia
(f) Recycling and destruction		
Case 1	Regulations regarding destruction of HCFCs and HFCs	Canada
Case 2	End of life management of Fluorinated Gases	Nigeria
Case 3	Voluntary Expanded Producers Responsibility (EPR) scheme	Colombia
Case 4	Product Stewardship Scheme (Voluntary Industry Agreement)	New Zealand
Case 5	Destruction of HFCs by the Joint Crediting Mechanism (JCM)	Thailand and Vietnam with Japan
(g) Cross-cutting measures		
Case 1	Synergy effect of bulk procurement of EE products and collection and destruction of fluorocarbons	Brazil and Morocco
Case 2	Home Appliance Recycling Law, End-of Life Vehicles (ELV) Recycling Law	Japan

(a) Production and/or import of refrigerants

Restricting the production and import of fluorocarbons is an effective strategy to achieve reduction of fluorocarbon use and emissions. Such restrictions have been implemented in several countries. In addition to CFCs and HCFCs, which are restricted in all countries under the Montreal Protocol, some countries are also implementing measures against HFCs. Control measures such as import/export licensing system and quota are prescribed in the protocol, but implemented methods can vary between countries with some countries implementing bans for import/export while some countries are using financial measures such as tax. In the EU, there is a quota allocation mechanism for companies producing or importing HFCs under the EU F-gas regulation.

In this chapter, the examples from Spain and Malaysia are presented. Spain has a tax on high GWP refrigerants with reduced tax rates for recycled and reclaimed refrigerants, and Malaysia restricts the import of HCFCs and HFCs by approving and registering every importer.

Case 1	Tax on fluorinated gases	Spain
Case 2	Importer/exporter license and national customs codes	Malaysia

Case 1: Tax on fluorinated gases

Country: Spain

Lifecycle Management Stage: Production and/or import of refrigerants

Format of Policy Measure: Financial instruments

Key Words: *tax, GWP, lower tax rate, tax return*

Summary of the policy:

Spain's tax on fluorinated greenhouse gases entered into force in January 2014 through article 5 of Law 16/2013. It aims to encourage the use of alternative low GWP refrigerants and improve the maintenance and recycling practices for existing equipment. The tax applies to: 1. Initial sale or delivery of F-gases after production, import (from 3rd countries) or acquisition (from EU), and 2. The consumption of F-gases by users, including producers, importers, and purchasers.

The tax covers F-gases with a GWP greater than 150 and it includes HFCs, PFCs and SF_6. The tax rates are set based on the GWP of each gas, with a maximum of EUR 100/kg. Some examples of tax rates are shown in the table below. For recycled and reclaimed F-gases, a lower tax rate is applied. Also, when the refrigerant is destructed or recycled, the tax is returned to the final consumers who have borne the tax.

After the implementation of the tax, the emissions of F-gases decreased from 16.9 kton CO_2-eq in 2014 to 5.9 kton CO_2-eq in 2018 (emissions in category "substitutes for substances that deplete the ozone layer"). The cause of this reduction is said to be the change of actions in the refrigeration and air conditioning sectors. In these sectors, alternative refrigerants such as CO_2 and NH_3 were promoted for new installations, and for existing installations, measures such as use of automatic leakages control systems and retrofit of lower GWP refrigerants were implemented.

Examples: Tax rate for some selected gases

F-gases	GWP	Tax rate (EUR/kg)
HFC-23	14800	100
HFC-32	675	10.13
HFC-134a	1430	21.45
HFC - 143a	4470	67.05

Information source:

Institute of European Environmental Policy report
https://ieep.eu/uploads/articles/attachments/a3977c6e-7f07-4da9-bae2-ed3e060593da/ES%20Fluorinated%20Gases%20final.pdf?v=63680923242

UNFCCC document, "A compilation of questions to – and answers by – Spain"
https://unfccc.int/sites/default/files/resource/SBI50_ESP_MA_QA.pdf

UNFCCC FCCC/TRR.3/ESP
https://undocs.org/FCCC/TRR.3/ESP

Iberley "Impuesto sobre los Gases Fluorados de Efecto Invernadero" (Spanish)
https://www.iberley.es/temas/impuesto-sobre-gases-fluorados-efecto-invernadero-20551?__cf_chl_captcha_tk__=pmd_3I3aHETyQuGRwUaiphybZBu.IH3Vw709Htozv6Fx8CE-1631684732-0-gqNtZGzNAzujcnBszQbR

Case 2: Importer/exporter license and national customs codes

Country: Malaysia

Lifecycle Management Stage: Production and/or import of refrigerants

Format of Policy Measure: Regulations

Key Words: *import and export*

Summary of the policy:
Malaysia has ratified the Kigali Amendment to the Montreal Protocol in October 2020. All the HFCs used in Malaysia are imported since HFCs are not produced in the country. Parties to the Montreal Protocol shall establish and implement a system for licensing the import and export for FCs. A licensing system and customs codes assignment for multiple HFCs can be an effective method to identify the accurate volume of Malaysia's HFC consumption baseline. An accurate baseline is necessary to consider the next strategy for decreasing the HFCs. In Malaysia, the national customs codes for individual sorts of HFCs were additionally allocated, despite original HS code is not allocated for individual sorts HFCs.

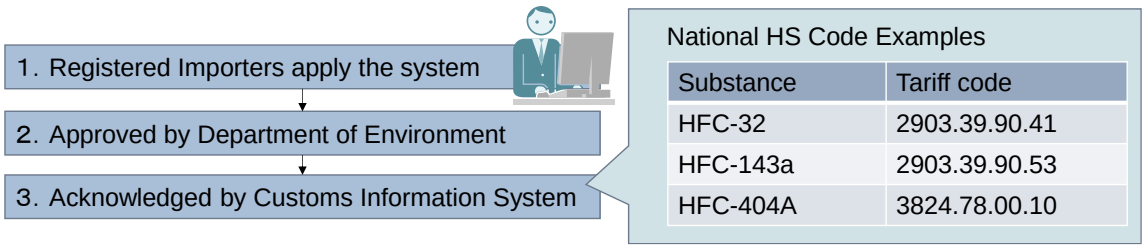
In 2020, a new amendment of The Customs (Prohibition of Imports) Order 2020 and Customs (Prohibition of Exports) Order 2020 was released. Starting from March 1, 2020, the import/export of HFCs must be approved through Approval Permit (AP) system.

As a result, the import/ export of HCFC and HFC in Malaysia is controlled by the Government of Malaysia through AP system which is managed by the Department of Environment (DoE) Malaysia. All importers and exporters must be registered with DoE. Currently, 14 companies involved in import/export of HCFC and 47 companies involved in import/export of HFC were registered under the DoE.

Developing countries seeking any further assistance from the Multilateral Fund for the HCFC phase out beyond 2012 must provide confirmation that they have an enforceable national system of licensing and quotas in place for HCFC imports. Therefore, Quota allocation for HCFC import was introduced in 2012, so consumption of HCFC is decreasing in Malaysia.

The Customs (Prohibition of Imports/ Export) Order 2017 (effective on of April 1, 2017) state that any goods containing CFCs (substances covered under Montreal protocol) is absolutely prohibited to be imported into Malaysia (Schedule 1, item No. 16).

E-permit application process:



Information source:

Control of Import & Export of Hydrofluorocarbon (HFC)

https://www.doe.gov.my/portalv1/en/info-umum/info-protokol-montreal/kawalan-import-dan-eksport-hydrofluorocarbon-hfc/327903

List of importer/exporter

https://www.doe.gov.my/portalv1/wp-content/uploads/2017/06/Senarai-Pengimport-Pengeksport-HCFC-dan-HFC-2020.pdf

(b) Manufacturing and/or import of appliances containing refrigerants

Several countries and regions implement measures or programs to limit the amount of fluorocarbons in the market by managing the manufacturing or import of air conditioning and refrigeration equipment. There are a variety of methods in this category, and the stringency of the measures varies widely, depending on the situation of the country or region.

For example, in the EU, bans on new equipment are put in place for several types of equipment using HFCs. Other than bans and restrictions, there are other methods such as the one in Japan, where a measure is put in place to limit the average GWP of equipment per manufacturer. In the US, their SNAP program lists acceptable substitutes for ODSs. In addition to these measures implemented by governments, this chapter introduces programs to convert HCFC to cleaner alternatives in Bangladesh, Swaziland and Mexico, supported by UNDP.

Case 1	Conversion from HCFC to non-ODS alternative materials	Bangladesh, Swaziland, and Mexico (supported by UNDP)
Case 2	Significant New Alternatives Policy (SNAP) Program	United States of America
Case 3	EU F-gas regulation bans for new products and equipment	EU
Case 4	Measures for designated products	Japan

Case 1: Conversion from HCFC to non-ODS alternative materials

Country: Bangladesh, Swaziland, and Mexico (supported by UNDP)

Lifecycle Management Stage: Refrigerant Production, Export, Manufacturing

Format of Policy Measure: Pilot Programme

Key Words: *HCFC-141b, non-ODS, low-GWP, insulation foam, cyclopentane, methyl formate, methylal, MP-MLF, ExCOM, UNDP, UNEP, SADC, LVC*

Summary of the policy:
In Bangladesh, HCFC-141b was used in manufacturing insulation foam for domestic refrigeration equipment, amounting to 27% of total national ODP consumption. The manufacturing company and the government requested UNDP assistance to convert HCFC-141b technology to a non-ODS one under the Montreal Protocol.

The company selected cyclopentane as the non-ODS and low-GWP alternative foam blowing agent following a detailed evaluation of available technology options considering long-term sustainability. The project was approved by Montreal Protocol Multilateral Fund Executive Committee (MP-MLF ExCom) at its 62nd Meeting in 2010, and the project was implemented during 2011-2013, covering the installation of new foaming machines, redesign of manufacturing lines including safety systems, training, safe manufacturing operational techniques.

The project phased out an annual consumption of 183.7 tons of HCFC-141b. The GWP impact of using cyclopentane instead of HCFC-141b is an annual reduction of GHG emissions over 130,000 tons of CO_2 equivalent.

Similar projects were implemented in Swaziland, Mexico, India and other countries.

The project in Swaziland, the rigid PU foam conversion process from HCFC-141b to cyclopentane as a blowing agent which has zero ODP and low-GWP, was approved by MP-MLF ExCom at its 63rd Meeting in 2011. The products were exported to member countries of the Southern African Development Community (SADC), thus the project positively impacted the neighboring markets including non-LVC (low volume consuming) countries. 100 percent ODS-free production was announced in 2015 supported by UNDP, UNEP and Germany's GIZ, and it is an example of the best practice that multilateral cooperation can achieve.

The project in Mexico to replace HCFC-141b use in foams for shoe sole production to non-ODS was also approved by MP-MLF ExCom. The pilot project demonstrated the viability of using methyl formate and methylal as a replacement for HCFC-141b in the production of shoe soles and was completed in 2011.The new technology is also lower in cost and has easier applications, thus the project helped to meet Mexico's ODS phaseout targets while simultaneously minimizing negative economic and social impacts of the industrial reconversion on local industries.

Information source:

Protecting the Ozone Layer and Reducing Global Warming - Results, Case Studies and Lessons Learned from UNDP's Montreal Protocol Programme - :

https://www.undp.org/publications/protecting-ozone-layer-and-reducing-global-warming

Proposal of the 62nd Meeting of the Executive Committee (ExCom) of the Multilateral Fund (MLF):

http://www.multilateralfund.org/62/English%20Document/1/6220.pdf

Proposal of the 63rd Meeting of the Executive Committee (ExCom) of the Multilateral Fund (MLF):

http://www.multilateralfund.org/63/English%20Documents%20Lib/1/6352.pdf

Case 2: Significant New Alternatives Policy (SNAP) program

Country: United States

Lifecycle Management Stage: Manufacturing and/or import of appliances containing refrigerants

Format of Policy Measure: Standards

Key Words: *Acceptable substitutes for ozone-depleting substances*

Summary of the policy:
The SNAP program was established under Section 612 of the Clean Air Act (CAA), which was enacted to limit the use of CFCs and HCFCs following the 1987 Montreal Protocol. The SNAP program identifies and evaluates substitutes for ozone-depleting substances. It publishes lists of these substitutes, and by clearly listing acceptable substitutes, promotes the use of substitutes with less risk to human health and the environment. According to Section 612 of the CAA, United States Environmental Protection Agency (USEPA) must prohibit the use of a substitute where USEPA has determined that there are other available substitutes that pose a less overall risk to human health and the environment. The SNAP program is designed for:

- Identifying and evaluating substitutes in end-uses that have historically used ozone-depleting substances (ODS)
- Looking at the overall risk to human health and the environment of both existing and new substitutes,
- Publishing lists of acceptable and unacceptable substitutes by end-use,
- Promoting the use of acceptable substitutes; and,
- Providing the public with information about the potential environmental and human health impacts of substitutes.

To determine the acceptability of substitutes, USEPA performs an analysis of risks to human health and the environment from the use of various substitutes in different industrial and consumer uses that have historically used ODSs. Acceptable or unacceptable substances are listed on the EPA website, and the list evolves according to the decisions by the USEPA. Below are some examples of refrigerants used in remote condensing units.

Example substitute for remote condensing units

Substitute	Trade Names	Retrofit/ New	ODP	GWP	Listing status
HCFC-22		R/N	0.055	1,810	**Acceptable**
R-404A	SUVA HP-62	R/N	0	3,920	**Unacceptable** in retrofit equipment as of Jul. 20, 2016. **Unacceptable** in new equipment as of Jan. 1, 2018.
R-410A	AZ-20, Suva 9100, Puron	N	0	2,090	**Acceptable**

Information source:

USEPA, SNAP Program webpage
https://www.epa.gov/snap
USEPA webpage, “Overview of SNAP”
https://www.epa.gov/snap/overview-snap

Case 3: EU F-gas regulation bans for new products and equipment

Country and/or region: EU

Lifecycle Management Stage: Manufacturing and/or import of appliances containing refrigerants

Format of Policy Measure: Regulations

Key Words: *bans for new products and equipment*

Summary of the policy:

To control emissions from fluorinated gases, EU adopted the F-Gas Regulation (842/2006) in 2006. Under the EU-F-gas regulation, several measures were put in place, including the bans on new products and equipment. Under this measure, the use of F-gas is banned in many new types of products and equipment where less harmful alternatives are widely available.

The bans affect the following products and equipment: a) Refrigeration, b) Air-conditioning, c) Fire protection, d) Aerosols, e) Foam insulation, and f) Others (including windows, footwear and car tires). The ban only applies to new products and equipment, and the table below shows the details of the ban. According to the European Commission, the F-gas emissions in EU has stabilized at 2010 levels after the adoption of the F-Gas regulation. The new F-gas regulation (517/2014), which replaced the 2006 Regulation, is expected to reduce F-gas emissions from EU by two-thirds by 2030 compared with 2014 levels.

Bans for new products and equipment

Market Sector	Product Description	Scope of banned F-Gases	Start Date[1]
Refrigeration	Non-confined direct evaporation systems	All HFCs and PFCs	2007
	Domestic refrigerators and freezers[2]	HFCs with GWP > 150	2015
	Refrigerators and freezers for commercial use (hermetically sealed)[3]	HFCs with GWP > 2,500	2020
		HFCs with GWP > 150	2022
	All stationary refrigeration equipment[4]	HFCs with GWP > 2,500	2020
	Multipack central systems for commercial use with a cooling capacity above 40kW [5]	F-Gases with GWP > 150	2022
Air-conditioning	Moveable, hermetically sealed air-conditioning	HFCs with GWP > 150	2020
	Single split systems containing 3 kg or less	HFCs with GWP > 150	2025
Insulating foam[6]	One component foam aerosols	F-Gases with GWP > 150	2008
	Extruded Polystyrene foam (XPS)	HFCs with GWP > 150	2020
	Other foams (including polyurethane)	HFCs with GWP > 150	2023
Fire protection	Systems using PFCs	All PFCs	2007
	Systems using HFC 23	HFC 23	2016
Aerosols	Novelty aerosols[7] and signal horns	HFCs with GWP > 150	2009
	Technical aerosols[8]	HFCs with GWP > 150	2018
Other applications	Non-refillable containers for bulk product	All F-Gases	2007
	Windows for domestic use	All F-Gases	2007
	All other windows	All F-Gases	2008
	Footwear	All F-Gases	2006
	Tires	All F-Gases	2007

1 All start dates from 2015 onwards are January 1st of the year specified

2,3 This ban includes both refrigerant and foam blowing agent

4-8: Some exemptions and detailed conditions apply

Information source:

EC website

https://ec.europa.eu/clima/policies/f-gas/legislation_en

https://ec.europa.eu/clima/policies/f-gas_en

EU F-Gas Regulation Guidance Information Sheet

http://www.gluckmanconsulting.com/wp-content/uploads/2014/12/IS-26-Ban-Summary.pdf

Case 4: Measures for designated products

Country: Japan

Lifecycle Management Stage: Manufacturing and/or import of appliances containing refrigerants

Format of Policy Measure: Regulation

Key Words: *target GWP value, designated products*

Summary of the policy:
In order to manage the emissions from fluorinated gases throughout the lifecycle of refrigerants, the Act on Rational Use and Proper Management of Fluorocarbons was implemented in 2015. Under this act, "Measures for designated products" aims to manage the use of refrigerant "upstream" by targeting the manufacturers and importers. Manufacturers and importers of designated products are required to replace high-GWP products with products using low-GWP or non-fluorocarbon alternatives.

A target average GWP value and target year is set for each category of product, and the manufacturers and importers are required to make sure that the average GWP of each shipped product meets the target within each company by the target year. Designated products and their targets are shown in the table below.

The target GWP value is set, considering the lowest GWP (weighted average by volume) among the designated products in the market in Japan. Also, conditions such as safety, energy efficiency, affordability, etc. are considered. Products are added to the designated products list, depending on the availability of alternatives. Below are some examples of the designated products and GWP targets as of 2021.

Targets for designated products:

Designated products		Refrigerant currently in use (GWP)	Target value	Target year
Room air-conditioning		HFC- 410A (2090) HFC- 32 (675)	750	2018
Commercial air-conditioning (for offices and stores)	Category 1*	HFC- 410A (2090)	750	2020
	Category 2*	HFC- 410A (2090)	750	2023
	Category 3*	HFC-134a (1430) HFC-245fa (1030)	100	2025
Mobile air- conditioning (for passenger cars of passenger capacity less than 11 people.)		HFC-134a (1430)	150	2023
Condensing unit and refrigerating unit (except equipment of the rated capacity of the compressor 1.5kw or lower.)		HFC- 404A (3920) HFC- 410A (2090) HFC- 407C (1774) CO2 (1)	1500	2025
Cold storage warehouse (for more than 50,000m3, new facilities)		HFC- 404A (3920) Ammonia (lower than 10)	100	2019

Category 1: Under 3 refrigeration tons of cooling capacity, excluding floor type unit
Category 2: Over 3 refrigeration tons of cooling capacity, excluding floor type unit and category 3
Category 3: Central air-conditioning units using centrifugal chillers

Information source:
Act on Rational Use and Proper Management of Fluorocarbons pamphlet
https://www.env.go.jp/en/earth/ozone/laws/ozone4.pdf
Document by MoE Japan
https://www.env.go.jp/earth/ozone/fluorocarbon_initiative/attach/200928_MOEJ%20presentation%20for%20SPD.pdf

(c) Installation of appliances

Installation of appliances are often related to the incentives of consumers. As replacement of old technologies using ODP or high GWP refrigerants tends to be more expensive, and related products sometimes are less competitive in the market, governments and international programmes to consumers and business to opt to introduce products which are environmentally friendlier. Apart from government policy measures, the private sector manufacturers and cooling industrial associations sometimes provide manuals for service providers to meet standard of installation of appliances.

Case 1	Introducing Energy Efficiency Standards and Incentives on Refrigerating Appliances and new actions to stop dumping of new and used cooling appliances containing obsolete ODS and HFC refrigerants	Ghana
Case 2	Subsidy program for natural refrigerant equipment	Germany

Case 1: Introducing Energy Efficiency Standards and Incentives on Refrigerating Appliances

Country: Ghana

Lifecycle Management Stage: Installation of appliances

Format of Policy Measures: Standard setting

Key Words: *Mandatory Efficiency Performance Standards, incentive, Public Private Partnership (PPP)*

Summary of the policy:

In Ghana, the used cooling appliance market share was 80%, mostly imported from Europe in 2005. 30% of the total annual generation of imported used cooling appliance went to waste because of inefficient appliance usage, and almost all of the used cooling appliances used CFCs and HCFCs, which cause ozone layer depletion and global warming. To reduce CFC and HCFC emissions from new used cooling appliances and to enhance energy efficiency, Ghana introduced Mandatory Efficiency Performance Standards (MEPS) and labelling regime, and incentive on new refrigerating appliances with lower and non-ODP/GWP appliances. Furthermore, Ghana on behalf of Africa introduced a CRP for the 2021 Meeting of the Parties to the Montreal Protocol asking for a Decision to help stop dumping of new and used cooling appliances containing obsolete ODS and HFC refrigerants.

1) Mandatory Efficiency Performance Standards (MEPS)

Energy Efficiency (EE) regulations on cooling appliances were introduced as follows.

- EE Standards and Labelling (Non-Ducted Air-conditioners and Self-Ballasted Fluorescent Lamps) Regulations, 2005 (LI 1815)
- EE Standards & Labelling (Household Refrigerating Appliances) Regulations, 2009 (LI 1958)
- EE (Prohibition of Manufacture, Sale or Importation of Incandescent Filament Lamp, Used Refrigerator, Used Refrigerator-Freezer, Used Freezer and Used Air-Conditioner) Regulations, 2008 (LI 1932)

In connection with these regulations, the dismantling process has been improved through public private partnership (PPP) and separation of components and scrapyard operations.

2) Incentive on new refrigerating appliances

To promote the phase down of CFCs/HFCs and the introduction of new energy-efficient equipment, an incentive system on refrigerating appliances (issuing discount coupon when purchasing new energy efficient equipment) was introduced.

Results of MEPS & Incentive on Refrigerating Appliances showed a significant drop in energy use on refrigerating appliances and enhancement of replacement from old fridges (See Fig.5 and 6).

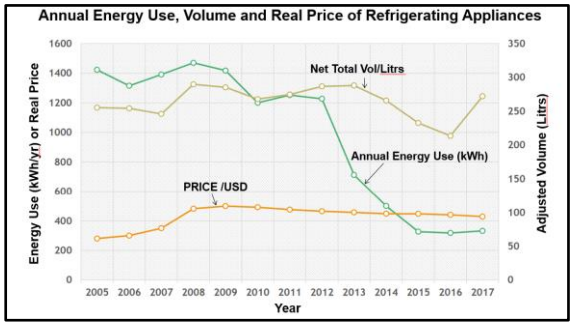


Fig.5 Results of MEPS & Incentives on Refrigerating Appliances – Reduced consumption

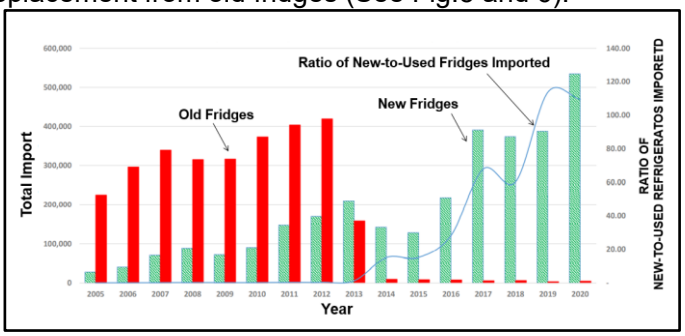


Fig.6 Evidence of transformed market through MEPS

Over 10,000 used and inefficient refrigerating appliances have been replaced with the same number of new and efficient ones. Over 47,000 refrigerators and 11,000 ACs illegally imported have been confiscated and dismantled. 1,500kg of CFC has been recovered and 1.1 million tons of CO_2 has been saved.

Information sources:
Side events at the 43rd OEWG of the Parties to the Montreal Protocol:
https://www.env.go.jp/earth/ozone/fluorocarbon_initiative/attach/4_Mr.%20Kofi%20Agyarko_OEWG%2043%20Montreal%20Protocol%20Final%202.pdf
https://wedocs.unep.org/bitstream/handle/20.500.11822/30731/AMCEN_17Omnibus.pdf?sequence=7&isAllowed=y

Africa CRP asking help to stop dumping of inefficient new and used cooling appliances containing obsolete ODS and HFC refrigerants:
https://ozone.unep.org/system/files/documents/COP-12-II-3-Add-1_MOP-33-3-Add-1E.pdf

Case 2: Subsidy program for natural refrigerant equipment

Country: Germany

Lifecycle Management Stage: Installation of appliances

Format of Policy Measure: Financial instruments

Key Words: *natural refrigerants, subsidy*

Summary of the policy:
The Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) started a subsidy program in 2008 to accelerate the adoption of natural refrigerant in refrigeration and air-conditioning technologies. The program aims to contribute to the government's climate protection goals by reducing emission by increased energy efficiency and reduction of Fluorinated gases.

The funding is provided for companies, not-for-profit organizations, local authorities, special purpose associations, self-employed enterprises, schools, hospitals, and church organizations. In terms of technologies covered in this program, in addition to stationary refrigeration and air conditioning systems, vehicle air conditioning systems in buses and rail vehicles are also covered. The parties interested can apply for funding through the website of the German Federal Office of Economics and Export Control (BAFA).

The amount of funding is calculated using different formulas depending on the equipment category*. BAFA provides a funding calculation tool on its website so that the applicants can calculate the expected funding. The maximum of funding is set at EUR 150,000 and 50% of eligible expenditure.

According to the BMU, 3500 refrigeration and air conditioning systems in companies and residential buildings were funded by this program in the period between 2008 and end of 2020. The total funding provided was EUR 223 million. Out of the EUR 223 million, wholesale and retail warehouses received 62% of the funding.

*: Examples funding formula for stationary systems:

$$\mathbf{F = (A \times X^{B} + C) \times X}$$

F: Funding amount
X: Variable representing the cooling capacity, the length of refrigerated cabinets in food trade, the storage capacity or volume.
A, B and C: Specific coefficients that depend on the type of chiller or component

Information source:

BAFA webpage (German)

https://www.bafa.de/DE/Energie/Energieeffizienz/Klima_Kaeltetechnik/klima_kaeltetechnik_node.html

https://www.bafa.de/SharedDocs/Downloads/DE/Energie/kki_technisches_merkblatt.html;jsessionid=098488A189D4B8EE9ED7DFDAA8BABCC4.2_cid371?nn=8064164

BMU webpage (German)

https://www.klimaschutz.de/zahlen-und-fakten

(d) Use of appliances

Leakage of refrigerants occurs also at the time of using appliances, and monitoring and reducing them are important. Maintenance is one way to minimize the leakage of refrigerants, which brings benefits of climate change mitigation and the Ozone Layer protection, but also keeping energy efficiency at high standard. Also, once refrigerant is in the market, appliance products are distributed in the market, and they are sold many times. In this situation, some governments introduced a tracking system to record changed ownership of refrigerants, to clarify who is responsible for appropriate treatment.

Case1	Registration of Service Providers of ODS-using Equipment	Philippines
Case 2	National qualification framework and certification of work competence for RAC technicians	Indonesia
Case 3	Training and Certification for service personnel handling fluorocarbons	EU
Case 4	Rebate System on HFC/PFC tax	Norway
Case 5	Electronic system links training and certification to reporting and data processing	Slovakia

Case 1: Registration of Service Providers of ODS-using Equipment

Country: Philippines

Lifecycle Management Stage: Maintenance, Collection, Reclamation, Reuse

Format of Policy Measure: Regulation/Registration

Key Words: ODS, *HCFCs, registration, service providers, DENR, POD, HPMP, MLF, CCO*

Summary of the policy:
Under the Montreal Protocol, the Philippines is an Article 5 party, mainly referring to a developing country. The Department of Environment and Natural Resources (DENR) acts as the national coordinator for its implementation, and the Philippine Ozone Desk (POD) was created to facilitate and coordinate ODS phase-out projects and policies.

Since the first national program for the phase-out of ODS was prepared in 1993, many projects for the implementation of the phase-out activities have been approved and supported by the Multilateral Fund (MLF). As a result, the Philippines achieved phase-out of all ODS by 2010, except for HCFCs and MeBr for Quarantine and Pre-Shipment (QPS).

Common uses of HCFCs in the Philippines were specified as cooling agent (HCFC-22, HCFC-123), foam blowing agent (HCFC-141b, HCFC-142b), cleaning agent/solvent (HCFC-141b, HCFC-225), thus DENR/POD decided to strengthen the legal infrastructure to support the implementation of the HCFC Phase-out Management Plan (HPMP).

Revised regulations on Chemical Control Order (CCO) for Ozone Depleting Substances (ODS) (the DENR Administrative Order No. 2013-25) in 2013 mainly consists of a ban on the import of ODS, control of import of HCFCs, registration of service providers of ODS using equipment as well as registration of importers, dealers, retailers, re-sellers of ODS, records keeping, capacity-building program, etc.

Registration and Renewal of Registration of Service Providers of ODS-using Equipment of the revised regulation under section 10 of the DENR Administrative Order No. 2013-25 are described as follows.

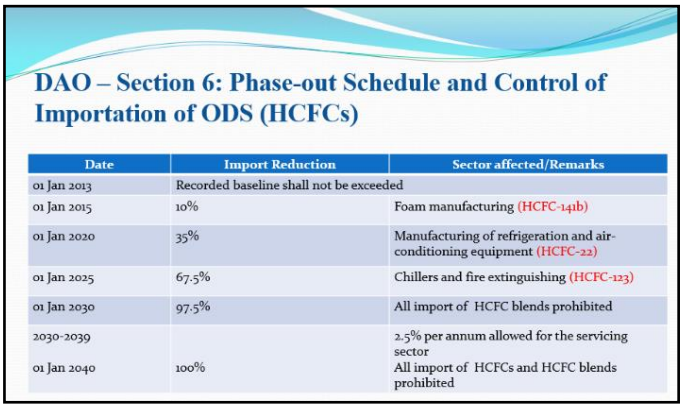
- Service providers of ODS-using equipment must register with the Department through the Bureau to determine their capability in handling and working on these substances.
- Service providers should have the capability to take effective measures, including the necessary equipment, technology, training and infrastructure, for the purpose of effectively handling ODS, including responsible re-use of refrigerants, minimizing their emissions, and ultimately phasing out their use by replacing ODS with substitutes or alternatives duly recognized and certified by the Department through the Bureau.
- Service providers shall adhere to the good practices in handling and working with refrigerants set forth in *the Code of Practice for Refrigeration and Airconditioning* approved and adopted by the Department.
- Service providers shall also participate in a system to recover, reclaim, and-reuse refrigerants that will be led by the Department.

In addition to the above requirement, a memorandum circular was issued to implement Section 10 of the DENR Administrative Order No. 2013-25 in 2021, which consists of Scope (Sec.1), Requirement for New or Renewal of Registration (Sec.2), Duties and Responsibilities of Service Provider (Sec.3), Monitoring, Inspection, and Good Practices (Sec.4), Validity of Certificate of Registration (Sec.5), etc.

By clarifying the registration system for the service providers of ODS-using equipment, DENR / POD will become able to oversee the activities of the service providers and keep track of the stock and storage status of the recovered refrigerant.

By the introduction of the revised policy and regulatory framework, the Philippines achieved the phase-out schedule which reduces HCFC consumption by 35% from the baseline until 2020 and the schedule is still

going on to achieve a 100% reduction by 2040. (See Fig.7, Fig.8)



DAO – Section 6: Phase-out Schedule and Control of Importation of ODS (HCFCs)

Date	Import Reduction	Sector affected/Remarks
01 Jan 2013	Recorded baseline shall not be exceeded	
01 Jan 2015	10%	Foam manufacturing (HCFC-141b)
01 Jan 2020	35%	Manufacturing of refrigeration and air-conditioning equipment (HCFC-22)
01 Jan 2025	67.5%	Chillers and fire extinguishing (HCFC-123)
01 Jan 2030	97.5%	All import of HCFC blends prohibited
2030-2039		2.5% per annum allowed for the servicing sector
01 Jan 2040	100%	All import of HCFCs and HCFC blends prohibited

Fig.7 ODS Phase-out Schedule in Philippine

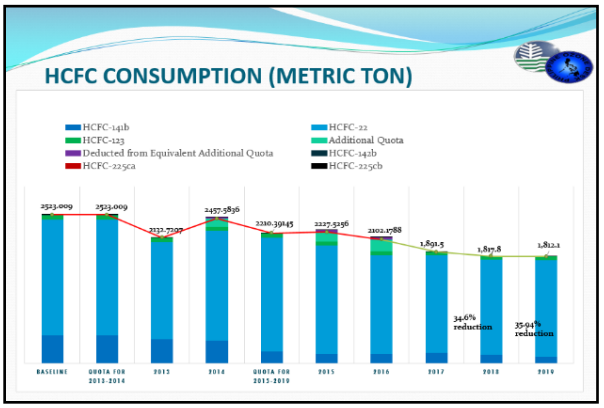


Fig.8 HCFC Reduction Trend in Philippine

Information source:

Revised Chemical Control Order for Ozone Depleting Substances (ODS)
(DENR Administrative Order No.2004-08):
https://chemical.emb.gov.ph/wp-content/uploads/2017/03/DAO-2004-08-CCO-ODS.pdf

Revised regulations on Chemical Control Order (CCO) for Ozone Depleting Substances (ODS) (DENR Administrative Order No.2013-25):
http://pod.emb.gov.ph/wp-content/uploads/2016/06/DAO-2013-25.pdf

Registration of Service Providers of Ozone-Depleting Substance (ODS) using Equipment (Memorandum Circular No. 2021-11):
http://pod.emb.gov.ph/wp-content/uploads/2021/07/EMB-MC-2021-11.pdf

List of Registered Importers of Ozone Depleting Substances (ODS) and Its Alternative Chemicals 2020-2021:
http://pod.emb.gov.ph/wp-content/uploads/2021/08/REG_IMPORTERS_30JULY2021.pdf

List of Registered Dealers, Re-Sellers & Retailors of ODS
http://pod.emb.gov.ph/wp-content/uploads/2021/07/ODSDR2021.pdf

Case 2: National qualification framework and certification of work competence for RAC technicians

Country: Indonesia

Lifecycle Management Stage: Use of appliances

Format of Policy Measure: Certification/licensing

Key Words: *qualification, technicians*

Summary of the policy:
To prepare technicians for knowledge, skills, and good attitude in maintaining RAC equipment and refrigerants handling safely, the government has issued Ministry of Environment and Forestry decree no. 73 year 2019 on Indonesia national qualification framework and certification of work competence for RAC technicians. There are 5 levels of competence for Refrigeration and Air Conditioning technicians based on the decree.

Level	**Example of competencies requirements**
Level 1 • Assistant / Helper Technician	• Help / assist the technician in preparation of maintenance, installation and repair of RAC system • Ability to clean indoor and outdoor AC units
Level 2 • Technician / Operator	• A minimum degree from vocational school majoring in refrigeration engineering, • At least 1 year working experience in a related field • Ability to use maintenance equipment for servicing and changing electrical and mechanical components in the RAC system
Level 3 • AC Residential Technician • Domestic Refrigeration Technician	• At least 2-year experience in installation, maintenance, and repairment • Ability to check for refrigerant leakage and do refrigerant recycling • Ability to carry out a refrigerant filling process • Ability to install and repair the residential AC system
Level 4 • RAC Installation Technician • RAC Maintenance Technician • RAC Repairment Technician	• At least 3-year experience in commercial or industrial HVAC installation / maintenance/repairment • Obtain a recommendation letter from the employer • Ability to install RAC system with various methods, such as flaring, swaging, brazing, etc. • Ability to conduct pressure and leakage test, pipe vacuum, and refrigerant filling process • Ability to carry out installation, maintenance, and repair for VRF system, commercial, and industrial RAC system • Ability to manage ammonia and flammable refrigerants
Level 5 • Senior Technician • Project Supervisor • Chief Engineer	• Competency certificate Level 4 for at least 3 years in commercial or industrial HVAC installation/maintenance/repairment • Obtain a recommendation from the employer • Ability to manage technicians for the installation of RAC system, analysis, and troubleshooting, and coordinate with relevant people • Ability to do testing and commissioning for chillers, other commercial and industrial RAC systems, and reporting the progress of the project

In addition, a mobile application called the MontiR-AC was developed. By using this application, technicians of refrigerator/air conditioners can receive offered works while consumers can search for qualified technicians in their vicinities. Technicians who are eligible to get servicing work through the MontiR-AC application are technicians that have been certified under Indonesian National Agency for Professional Certification (BNSP).

Information source:
Ministry of Environment and Forestry decree no. 73 year 2019
http://jdih.menlhk.co.id/uploads/files/P_73_2019_REFRIGERASI_DAN_TEKNISI_TATA_UDARA_menlhk_11132019084312.pdf
Montir AC Teknisi https://play.google.com/store/apps/details?id=com.dep.TeknisiAc&hl=en_US&gl=US
Montir AC Konsumen
https://play.google.com/store/apps/details?id=com.dep.MontirAcKonsumens&hl=en_US&gl=US

Case 3: Training and Certification for service personnel handling fluorocarbons

Country: EU

Lifecycle Management Stage: Maintenance, Collection, Reclamation, Reuse, Destruction

Format of Policy Measures: Regulation/Certification

Key Words: *training, certification, minimum requirement, controlled substances, CFCs, HCFCs, HFCs, ODS, fluorinated greenhouse gases, leak-check, installation, servicing, maintenance, repair, decommissioning, recycling*

Summary of the policy:
To reduce the release of controlled substances such as CFCs/HCFCs/HFCs into the atmosphere, provision on legislation system should be made for the recycling of used controlled substances and the prevention of leakages of controlled substances. From this perspective, the EU has introduced training and certification systems for service personnel handling equipment that uses controlled substances or recover controlled substances.

According to Regulations (EC) No (1005/2009) which controls life cycle management of ODS, EU member states shall define the minimum qualification requirements for the personnel carrying out activities such as leak-check or recycling of the controlled substances operating refrigeration, air conditioning or heat pump equipment, or fire protection systems, etc. (Article 23: Leakages and emissions of controlled substances)

According to Regulations (EC) No 517/2014 which controls life cycle management reducing emissions of fluorinated greenhouse gases, EU member states shall establish or adapt certification programs, including an evaluation system, on the basis of the minimum requirement. EU member states also shall ensure that training is available for technicians carrying out activities such as installation, servicing, maintenance, repair or decommissioning of the equipment, leak checks of the equipment, recycling of fluorinated greenhouse gases. The certification programs and training shall cover applicable regulations and technical standards, emission prevention, recycling of fluorinated greenhouse gases, safe handling of equipment of the type and size covered by the certificate, information on relevant technologies to replace or to reduce the use of fluorinated greenhouse gases and their safe handling. (Article 10: Training and certification)

Similar training or certification system have been introduced in other countries such as the US, Japan, etc.

Information source:

Regulations (EC) No 1005/2009:

https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:286:0001:0030:EN:PDF

Regulations (EC) No 517/2014:

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0517

Case 4: Rebate System on HFC/PFC tax in Norway

Country: Norway

Lifecycle Management Stage: Import, Export, Manufacturing, Collection, Reclamation, Reuse, Destruction

Format of Policy Measures: Taxation

Key Words: *tax, HFCs, PFCs, rebate, refund, GWP, GWP-weighted tax, destruction*

Summary of the policy:

Since around 1990, imports of HFCs (hydrofluorocarbons) and PFCs (perfluorocarbons) have been increasing year by year in Norway, so taxation was introduced with the aim of technological innovation that uses less HFCs/PFCs per equipment and increased use of alternative refrigerants in 2003.

The tax covers import and manufacture of pure gases in bulk and import of all mixtures of HFCs and PFCs, both as compounds and mixed with other substances.

The tax is calculated on the basis of the net weight of the taxable gas multiplied by the GWP value of each taxable gas. If the type of HFCs or PFCs cannot be documented, the highest GWP value of the product types can be applied.

In 2004, HFC / PFC tax rebate system was introduced. If the consumer uses an approved facility to destroy HFCs and PFCs, the tax will be refunded to the party that delivered the waste. The refund rate is the same as the tax rate. This scheme is administered by the Norwegian Environment Agency (NEA).

When the party that delivered the waste applies for the refund, an application form stating the type and amount of recovered and destroyed HFCs and PFCs will be sent from the collection company to the NEA through the destruction company. The refund will be paid by the NEA to the collection company, and the rest after deducting expenses such as transportation will be paid to the consumer.

As of 2005, it is estimated that CO_2 emissions were 280,000 tons (37%) less and total imports were 3.2 million tons (37%) less than without taxation. In addition, after the introduction of taxation, the rate of increase in imports has decreased due to technological innovations to reduce the amount of used HFCs/PFCs per equipment and increased use of alternative refrigerants.

Similar taxation systems for fluorocarbons have been introduced in Denmark, Slovenia and Spain, with the highest tax rates in Norway. In addition, only Norway has introduced the system to refund all taxes by processing at a designated destruction facility.

Information source:

HFC and PFC tax (The Norwegian Tax Administration):
https://www.skatteetaten.no/en/business-and-organisation/vat-and-duties/excise-duties/about-the-excise-duties/hfc-and-pfc/
Regulations relating to tax system in Norway:
https://lovdata.no/dokument/SF/forskrift/2001-12-11-1451/KAPITTEL_3-18#KAPITTEL_3-18

Case 5: Electronic system links training and certification to reporting and data processing

Country: Slovakia

Lifecycle Management Stage: Import, Export, Manufacturing, Maintenance, Collection, Reclamation, Reuse, Destruction

Format of Policy Measures: Certification, and reporting system

Key Words: *training, certification, reporting, data processing, leak tightness, leaklog, Slovak Association for Refrigeration, Air Conditioning and Heat Pumps*

Summary of the policy:
According to the EU regulation (517/2014) (Article 6: Record keeping, Article 10: Training and certification, Article 20: Collections of emission data), the Slovak Republic, one of the member countries of EU, has introduced an electronic system that links training and certification to reporting and data processing. 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. (See Fig.9)

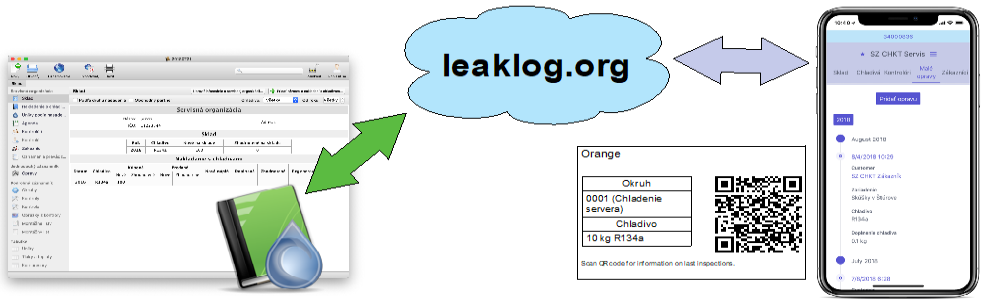


Fig.9 SZ CHKT introduced a new service named Leaklog.org that enables service companies and operators to share information about inspections, repairs of cooling equipment. Labels with QR codes placed on equipment link to logbooks with up-to-date information

Information source:

Slovak Association for Refrigeration, Air Conditioning Technology and Heat pumps:

https://szchkt.org/a/front_page?locale=en_GB, https://leaklog.org/

Electronic Logging and Reporting System based on Company Certification:

https://szchkt.org/a/docs/news/792

http://kgh-kongres.rs/images/2017/Prezentacije/69.pdf

https://www.green-cooling-initiative.org/fileadmin/Publications/2017_Guideline_on_policy_measures_for_the_managment_and_destruction_of_ozone_depleting_substances.pdf

(e) Collection of refrigerants

Collection is an important step for closing the loop of the refrigerant lifecycle. Like leakage management during use, it requires equipment users, who are not necessarily experts of refrigerants, to ensure refrigerants in their equipment are collected appropriately. Other than requiring the collection of refrigerants and certifying technicians by law, some examples of financial instruments can be found around the world.

There is a deposit scheme by the industry in Denmark that allows equipment users to receive some refund if used refrigerants are properly collected and brought to destruction or recycling. The scheme in Australia, also run by the industry, offers a rebate to the contractors instead of equipment users. Also, there are some financial instruments that are not introduced in the chapter, such as the tax rebate by Norway. In Japan collection is compulsory by law, and the whole process from collection to destruction is managed using process management sheets.

Case 1	Obligatory collection of refrigerants	Japan
Case 2	Danish Refrigerant Industry Environmental Scheme (KMO)	Denmark
Case 3	Refrigerant take back program	Australia

Case 1: Obligatory collection of refrigerants

Country: Japan

Lifecycle Management Stage: Collection of refrigerants, Recycling and destruction

Format of Policy Measure: Regulation, Transparency/tracking

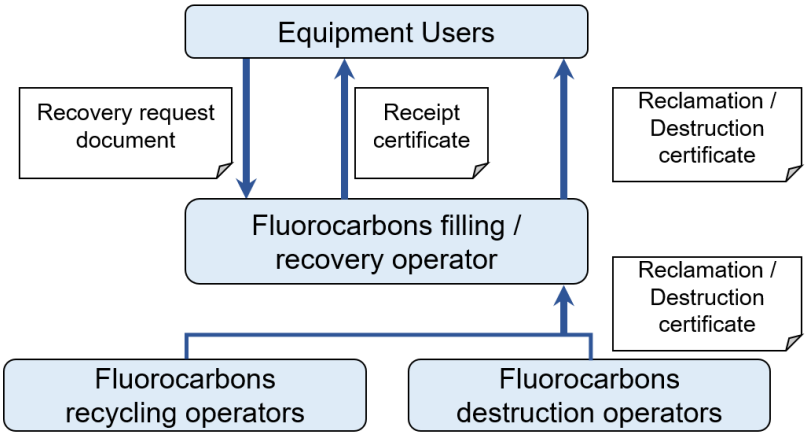
Key Words: *specified products, registered fluorocarbons filling/recycling operator, process management sheets*

Summary of the policy:

When managing the lifecycle of refrigerants, management of collection, reclamation/recycling and destruction is important. Aiming to increase the collection rate of used refrigerants, a measure was implemented to require users of commercial refrigerators and A/Cs to arrange and pay for the collection of fluorocarbons though the Act on Rational Use and Proper Management of Fluorocarbons. At the time of disposal, recovered fluorocarbons of commercial refrigeration and air conditioning equipment (specified products) must be delivered to a registered fluorocarbons filling/recycling operator.

In order to manage the process of collection and recycling/destruction, a series of documents called the process management sheets are used. At the time of delivery, the equipment user must issue the recycling request document. When fluorocarbons are delivered to the fluorocarbons filling/recycling operator, the certificate of receipt is issued to the equipment user. In addition, when the fluorocarbons are delivered to recycling or destruction operators, a reclamation or destruction certificate is returned to the equipment user. During FY 2020, 1,465 tons of fluorocarbons were recycled, and 3,961 tons of fluorocarbons were destructed.

Flow of documents during collection and destruction/reclamation:



Information source:

Act on Rational Use and Proper Management of Fluorocarbons pamphlet
https://www.env.go.jp/en/earth/ozone/laws/ozone4.pdf
Document by MoE Japan
https://www.env.go.jp/earth/ozone/fluorocarbon_initiative/attach/200928_MOEJ%20presentation%20for%20SPD.pdf
http://www.env.go.jp/press/files/jp/116598.pdf
METI Press Release
https://www.meti.go.jp/press/2021/08/20210805001/20210805001.html

Case 2: Danish Refrigerant Industry Environmental Scheme (KMO)

Country: Denmark

Lifecycle Management Stage: Collection of refrigerants

Format of Policy Measure: Financial instruments

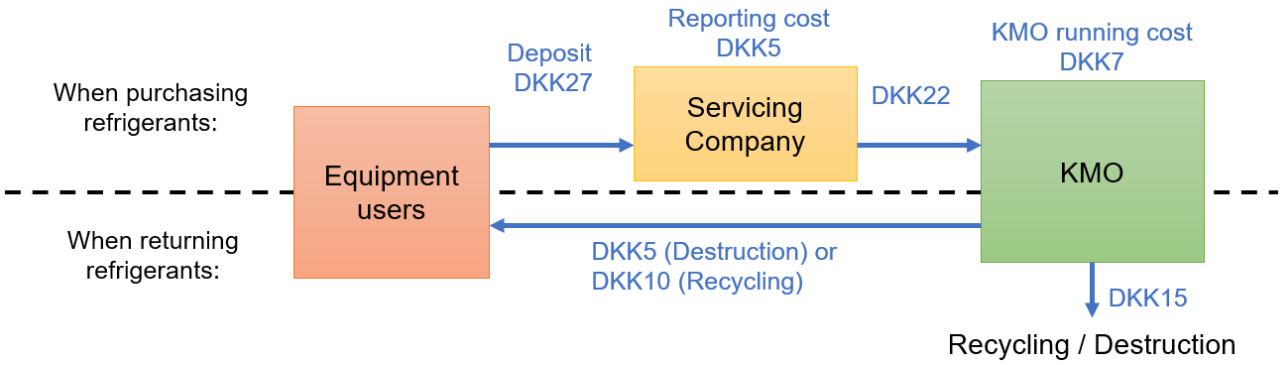
Key Words: *recycle, destruction, deposit-refund*

Summary of the policy:
The Danish Refrigerant Industry Environmental Scheme (KMO) is a voluntary deposit-refund scheme, set up by the Danish refrigerant importers and industry association of authorized refrigeration companies. It was set up in 1992 to promote the collection of CFCs, HCFCs, and HFC refrigerants and to control the use of these refrigerants, following Denmark's ratification of the Montreal protocol.

Equipment users are charged a deposit of DKK 27 per kg of refrigerant, then receive a refund of DKK 10 for recycling and DKK5 for destruction, independent of the GWP value of the refrigerant. Out of the DKK 27 collected from end-users, DKK 22 is transferred to the KMO, while the rest is kept by servicing companies to cover the reporting costs to the KMO. Out of the DKK 22, DKK 7 covers the running costs of the KMO secretariat, and the rest covers the cost of recycling /destruction of refrigerants.

When refrigerant is collected from the equipment by servicing companies, the used refrigerant is sent to KMO through servicing companies. Then the refrigerant recycling and destruction is done at KMO and the equipment users receive the refund. This scheme increases the cost by DKK 27/kg for F-gas refrigerants that is neither recycled nor destructed, DKK 17/kg for refrigerants that are recycled, and DKK 22/kg for refrigerants that are destructed.

Flow of deposit and refund:



Information source:

Website of Ministry of Environment of Denmark

https://eng.mst.dk/chemicals/chemicals-in-products/legislation-on-chemicals/danish-legislation-on-specific-substances/industrial-green-house-gases/

Document by KMO (Danish)

https://www.kmo.dk/Dokumenter/KMO%20Retningslinier%20pr.%2001-06-2020.pdf

Case 3: Refrigerant take back program

Country: Australia

Lifecycle Management Stage: Collection of refrigerants

Format of Policy Measure: Financial Instruments

Key Words: *rebate, wholesalers, contractors*

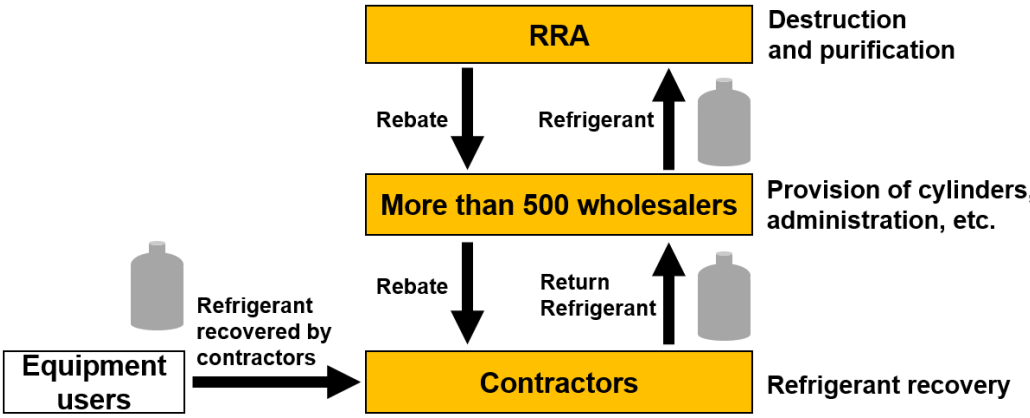
Summary of the policy:

Refrigerant Reclaim Australia (RRA) provides a rebate to contractors and refrigerant gas wholesalers for returned refrigerants through their refrigerant take back program, which started in 1993. For the wholesalers, the rebate part compensates the costs of managing the take back of refrigerants. The wholesalers' branch networks act as a collection point for refrigerants, and they also provide cylinders, decanting services and administration. There are more than 500 wholesaler branches around Australia that can provide these functions.

For contractors, the rebate is an incentive to recover and return used F-gases. To return refrigerants, contractors can rent, buy, or take on deposit cylinders from the wholesalers and then return the full cylinders to the same wholesaler. The returned refrigerants are sent to RRA for destruction or purification for reuse. The value of the rebates is set by RRA, which is currently set at AUD 3/kg.

According to the website of RRA, since 2013, they have recovered 6,500tons of refrigerant by 2017, reducing more than 10 million tons of CO_2 equivalent emission. The majority of the collected refrigerant has been destroyed. In between 1993 and 2017, 91% of refrigerant was destroyed, 6% was reclaimed, 1% was stored and 2% was returned to the manufacturer for use as feedstock.

Flow of refrigerant take back program:



Information source:

Refrigerant Reclaim Australia website
https://refrigerantreclaim.com.au/educational-tools/
https://refrigerantreclaim.com.au/program-performance/
https://refrigerantreclaim.com.au/about-refrigerants/returning-refrigerants/

Australian Competition & Consumer Commission document
https://www.accc.gov.au/system/files/public-registers/documents/Final%20Determination%20-%2012.05.21%20-%20PR%20-%20AA1000537%20-%20RRA.pdf

(f) Recycling and destruction

Recycling and destruction are crucial parts of the life cycle management. As used refrigerants can be used with an appropriate chemical process, some countries have set rules to appropriate use without leakage. In the usual cases, recycled refrigerants can be sold in the market, the revenues can be an incentive for treatment, which are otherwise released into the atmosphere where regulations are not in place. Destruction is the end of the lifecycle of refrigerants. In countries where obligations on users are introduced, they are either incinerated by dedicated plants or in combination with other industrial processes (e.g., cement production and waste incineration etc.). The cost of destruction, as well as collection and transportation, become a problem usually. In this regard, the cost recycling measures should be considered. Regarding destruction technologies, the Technical and Economic Assessment Panel under the Montreal Protocol produces a list of approved technologies for destruction of controlled substances.[3]

Case 1	Regulations regarding destruction of HCFCs and HFCs	Canada
Case 2	End of life management of Fluorinated Gases	Nigeria
Case 3	Voluntary Expanded Producers Responsibility (EPR) scheme	Colombia
Case 4	Product Stewardship Scheme (Voluntary Industry Agreement)	New Zealand
Case 5	Destruction of HFCs by the Joint Crediting Mechanism (JCM)	Thailand and Vietnam with Japan

[3] Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer Fourteenth edition (2020), UNEP Ozone Secretariat

Case 1: Regulations regarding destruction of HCFCs and HFCs

Country: Canada

Lifecycle Management Stage: Import, Export, Manufacture, Maintenance, Collection, Reclamation, Reuse, Destruction

Format of Policy Measure: Regulations

Key Words: ODSHAR, ODS, HCFCs, HFCs, destruction

Summary of the policy:
In Canada, the Ozone-depleting Substances and Halocarbon Alternatives Regulations (ODSHAR) are the means by which Canada meets its obligations under the Montreal Protocol on Substances that Deplete the Ozone Layer. The ODSHAR are modernized regulations that repealed and replaced Canada's Ozone-depleting Substances Regulations (1998), in 2016.

The ODSHAR control the export, import, manufacture, sale and certain uses of ozone-depleting substances (ODS) and products containing or designed to contain them. These controls include the gradual elimination of ODS, a requirement to obtain written authorizations for certain activities and a requirement to report on the export, import and manufacture of ODS. Several ODS have already phased out, while HCFCs are in the process of being phased out.

In addition to ODS, the regulations also require that permits be obtained for the import, export and manufacture of HFCs, and that reports on these activities be submitted.

Regarding the destruction of HCFCs and HFCs, the regulations stipulate as follows.
(ODSHAR: 54(1) Destruction of HCFCs, HCFC no longer needed; 65.05 Destruction of HFCs, HFC no longer needed)

A person in possession of HCFCs or HFCs that was imported or manufactured under a permit issued under the regulations and that is no longer needed for the use set out in that permit must, within six months after the day on which it is no longer needed,

(a) ensure that it is sent for destruction to a facility that is operated in accordance with the *Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer*, published by the Ozone Secretariat, United Nations Environment Programme.
(b) ensure that it is exported for destruction, for use as a feedstock, or laboratory or analytical use.
(c) in the case of recovered, recycled or reclaimed HCFCs or HFCs, ensure that it is sent to a recycling or reclamation facility.

This is one of the examples that obligate the destruction of HFCs that are no longer needed, within a fixed period.

Information source:

Ozone-depleting Substances and Halocarbon Alternatives Regulations:

https://laws-lois.justice.gc.ca/PDF/SOR-2016-137.pdf

Ozone-depleting Substances and Halocarbon Alternatives Regulations: general information:

https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/ozone-layer/depleting-substances-halocarbon-alternatives-regulations.html

Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer:

https://ozone.unep.org/sites/default/files/Handbooks/MP_Handbook_2019.pdf

Case 2: End of life management of Fluorinated Gases

Country: Nigeria

Lifecycle Management Stage: Maintenance, Collection, Reclamation, Reuse, Destruction

Format of Policy Measures: Pilot Programme

Key Words: *indigenous technologies, capacity building, rotary kiln incineration, Kigali Cooling Efficiency Program (KCEP)*

Summary of the policy:
Over the years, Nigeria has been managing the end of life of HCFCs, CFCs and halons through the establishment of the Ozone Village, a center for promotion and development of indigenous ozone-friendly technologies and human resources.

The main end of life F-gases managed includes CFC-12 and Halon1211 & Halon1301. The pilot CFC-12 waste project for Nigeria was approved at the 67th Meeting of the Executive Committee (ExCom) of the Multilateral Fund (MLF). UNIDO was the implementing agency. The project aimed at disposing of stocks of ODS (CFC-12) collected by oil & gas companies from their installations in Nigeria and from chiller operators. The project also aimed at providing capacity building activities for operators in the waste management sector and end-users, on the proper handling and management of waste ODS.

The waste CFC-12 was destroyed by a local company using the Rotary Kiln Incineration Technology.

The Rotary Kiln Incinerator

The amount of ODS handled by the project was 84 tons of CFC-12.

In addition to the project, Nigeria intends to also uses the best available locally developed technologies and to manage the gases (HCFCs and HFCs) that will be replaced, through the Kigali Cooling Efficiency Program (KCEP) funding window on transforming the market of inefficient RAC equipment, which will promote a large scale rebate/replacement programme for inefficient RAC equipment.

Information source:

MOP32 side event:

https://www.env.go.jp/earth/ozone/fluorocarbon_initiative/attach/20201127%20Presentation%20by%20Nigeria.pdf

Proposal of the 67th Meeting of the Executive Committee (ExCom) of the Multilateral Fund (MLF):
http://www.multilateralfund.org/67/English/1/6727.pdf

KCEP (Kigali Cooling Efficiency Program):

https://www.k-cep.org/

Case 3: Voluntary Expanded Producers Responsibility (EPR) scheme

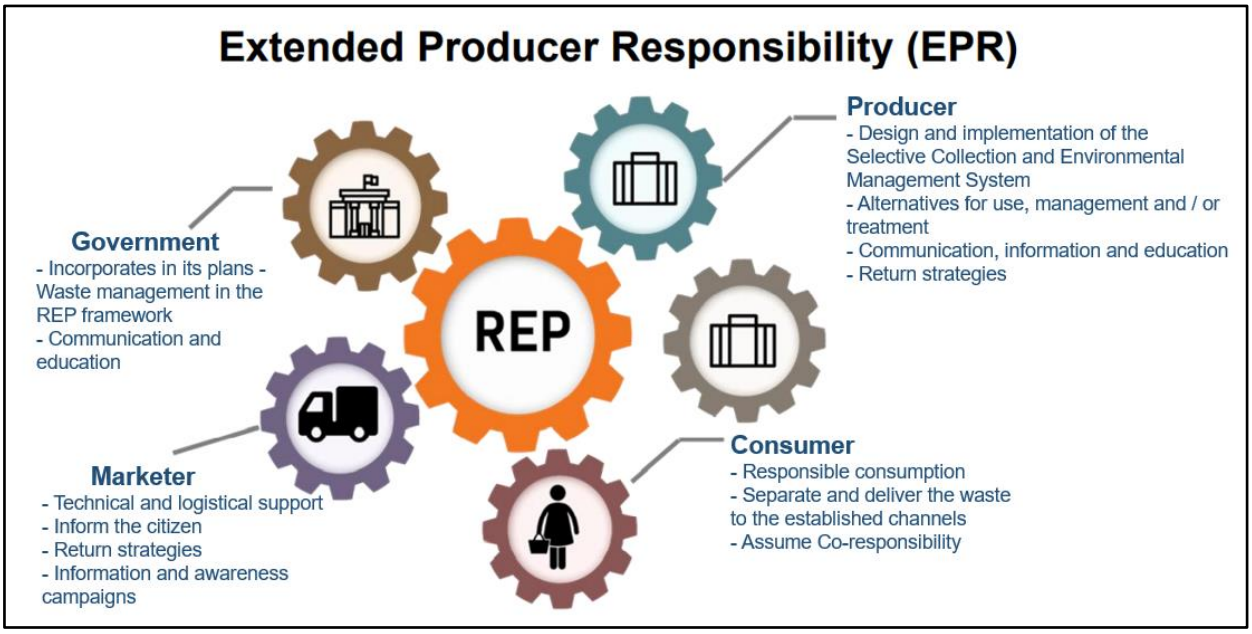
Country: Colombia (supported by UNDP)

Lifecycle Management Stage: Collection, Recycling, Destruction

Format of Policy Measures: Pilot Programme

Key Words: *voluntary, Extended Producer Responsibility, EPR, post-consumer program, household appliances, Waste Electrical and Electronic Equipment, WEEE, Producer Responsibility Organizations, PRO*

Summary of the policy:
A voluntary Extended Producer Responsibility (EPR) scheme was established, and it is the first post-consumer program of household appliances in Colombia. In this scheme, it is the duty of the producer (manufacturer or importer) of electrical and electronic equipment to design and implement environmental management of the appliances, throughout the different stages of the product life cycle. In a broad sense, the EPR is the principle by which producers maintain a degree of responsibility for all the environmental impacts of their products throughout their life cycle, from the extraction of raw materials, through production, and until the final disposal of the product as waste in the post-consumer stage.



Red Verde is in charge on behalf of the member companies of the administration, operation and financing of the system of selective collection and environmental management of the appliances when they have fulfilled their life cycle and are discarded by consumers. 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 service. The appliances received are delivered to the facilities of companies with environmental licenses, specialized in the management of waste electrical and electronic equipment. There the different materials are separated to direct them to the process of use and final disposal. Unusable elements such as refrigerant gases are safely extracted and managed through processes that ensure their proper destruction.

In conjunction with creating an EPR framework, national policy for the hazardous waste management and the management of WEEE (Waste Electrical and Electronic Equipment) as well as the related regulations have been developed by the government. Recently, Columbia has introduced a VAT reduction scheme promoting replacement to Energy Efficiency, ESM of EOL domestic refrigerators.

It is the first post-consumption of household appliances in Latin America that is part of the WEEE Forum, which represents Waste Electrical and Electronic Equipment (WEEE) Producer Responsibility Organizations (PRO).

Information source:

Side event at the 43rd OEWG of the Parties to the Montreal Protocol:

https://www.env.go.jp/earth/ozone/fluorocarbon_initiative/attach/5_2021%20HFC%20Banks%20management.pdf

Webinar “Closing the loop: Environmentally sound management of End-Of-Life ODS and HFC”:

https://www.minambiente.gov.co/images/AsuntosambientalesySectorialyUrbana/pdf/Unidad_T%C3%A9cnica_de_Ozono__UTO/eventos/memorias_seminario_uto/tercera_sesion/3_N_Pab%C3%B3n_Experience_developing_and_applying_EPR_mechanisms_in_Colombia.pdf

Red Verde:

https://www.redverde.co/ (Spanish)

https://redverde.co/index.php/noticias/264-red-verde-es-el-primer-posconsumo-de-electrodomesticos-de-latinoamerica-que-hace-parte-del-weee-forum (Spanish)

Case 4: Product Stewardship Scheme (Voluntary Industry Agreement)

Country: New Zealand

Lifecycle Management Stage: Refrigerant Production, Import, Export, Manufacturing, Maintenance, Collection, Reclamation, Reuse, Destruction

Format of Policy Measures: Voluntary scheme

Key Words: *product stewardship, Product Stewardship Schemes (PSSs), voluntary industry agreement, Recycling, Advanced Destruction Fee (ADF), Synthetic Greenhouse Gases (SGG),* manufacturers, brand owners, importers, retailers, consumers

Summary of the policy:
In New Zealand, a single product stewardship scheme “Recycling” for the safe disposal of refrigerants has been established since 1993. It is a voluntary scheme that is accredited by the Ministry for the Environment under the Waste Minimization Act 2008.

Product stewardship is a “cradle to grave” methodology that helps reduce the environmental impact of manufactured products. Under product stewardship schemes (PSSs), producers or manufacturers, brand owners, importers, retailers, consumers and other parties accept responsibility for the environmental effects of their products – from the time they are produced until the end of their useful life and are recycled or disposed of.

Product stewardship scheme participants take responsibility for the environmental effects of their products and take these costs into account when making decisions about the production, purchase and disposal of their products. Recycling is funded by an Advanced Destruction Fee (ADF) that is paid by most of the bulk “Synthetic Greenhouse Gases” (SGG) refrigerant importers. This fee funds the aggregation, transport and disposal of SGG refrigerant deposited at specific locations around the country. The service is free to all holders of SGG refrigerant, regardless of whether the producer or holder has paid the advanced disposal fee to Recycling.

Since the establishment of PSSs, Recycling has worked closely with New Zealand Government, providing data on their activities, as well as representing the refrigeration and air conditioning industry. Recycling works with various kinds of stakeholders such as refrigeration and air conditioning industry, motor trade automotive air conditioning sector, refrigerant wholesalers, chemical companies, retail grocers’ association, etc. This allows them to present a balanced view in representing the supply chain, from the importation and supply of refrigerants, through to their application and use for end users.

Since 1993, Refrigerant Recycling NZ has safely collected and destroyed about 430 tons of refrigerant gases through to 2020. This has had the impact of saving up to 467,000 tons of ozone and reducing the build-up of greenhouse gases by up to 1,034,000 tons of CO_2 equivalent.

The evolution of refrigerants over time shows HCFCs have significantly reduced as a proportion of the refrigerants destroyed, in favor of HFCs. (See Fig.10) Analysis of refrigerant destroyed by year shows Recycling typically destroys around 30 tons per year. The destroyed volume ratio of CFCs/HCFCs/HFCs shows technology change impacting the volume of refrigerant. (See Fig.11)

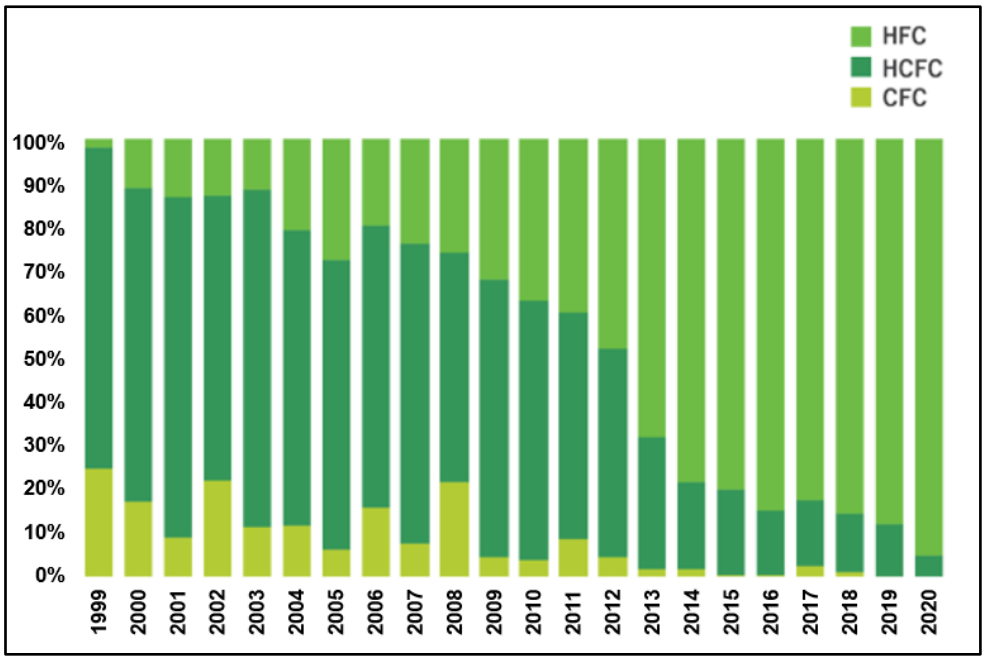


Fig.10 Evolution of destroyed refrigerants

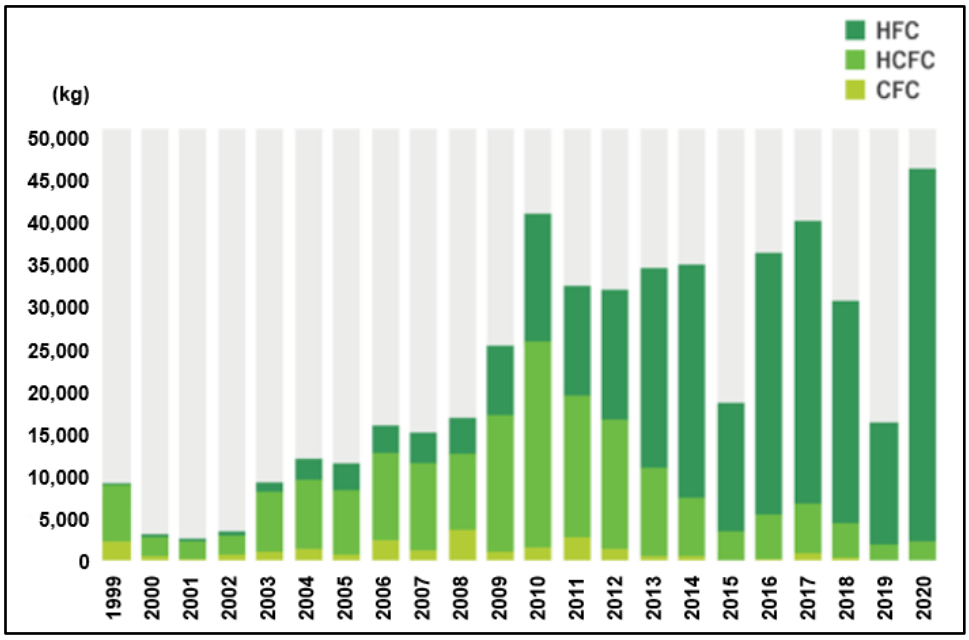


Fig.11 Amount of destroyed refrigerants

Information source:

Refrigerant Recycling NZ:

https://www.refrigerantrecycling.co.nz/

Case 5: Destruction of HFCs by the Joint Crediting Mechanism (JCM)

Country: Japan and JCM Partner Countries (Thailand and Viet Nam)

Lifecycle Management Stage: Collection and destruction (with additional efforts of recycling)

Format of Policy Measure: Carbon crediting mechanism

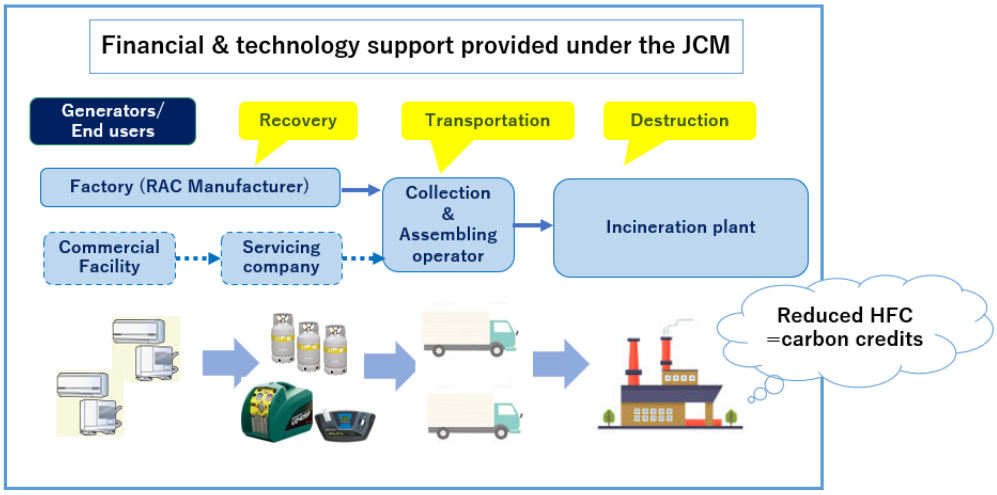
Key Words: *incentives, incineration plant, decarbonization technologies, carbon credits*

Summary of the policy:
The Joint Crediting Mechanism (JCM) is a system to cooperate with developing countries for reducing greenhouse gas emissions by diffusing decarbonization technologies, in which the result of reduction is assessed as contribution by both partner countries and Japan. It is implemented under the Article 6.2 of the Paris Agreement

Thailand and Viet Nam, where HFC users' obligations and incentives for collection and destruction were absent and HFC emissions were not addressed. In order to facilitate formulating and demonstrating a network of end-users, commercial facilities, service companies, transportation companies and destruction operators, the Ministry of the Environment, Japan provided financial and technological support through the JCM.

In the case of Thailand, an existing waste incineration plant was remodeled for fluorocarbons incineration and destroyed collected 12,512 tCO_2e/y of HFCs, together with CFCs and HCFCs in 2018-2020. In Viet Nam, an independent incinerator was introduced to aim at reducing 6,294 tCO_2e/y of HFCs. Some HFCs and HCFCs were also recovered in a case where the quality of gases meets a quality standard. Both actions were useful to mitigate climate change, since their release to the astrosphere would have taken place otherwise.

Carbon credits will be issued for the destroyed amounts of HFCs, which provides incentives for recovering the cost of collection, transportation and destruction for the private sector. Part of the credits will be collected by the Government of Japan and other parts are shared by project participants from partner countries and Japan.



Information source:

Global environment Centre Foundation (GEC) Website on the JCM

http://gec.jp/jcm/projects/18fgas_tha_01/

http://gec.jp/jcm/projects/18fgas_vie_01/

(g) Cross-cutting measures

Some policy measures are implemented in combination with others, in order to maximize the impacts of actions. As refrigerants can be controlled throughout the lifecycle, policy measures at upstream can support the final treatment at downstream, Some of them are related to collection of resources by upstream stakeholders for reserve cost for final treatment by downstream stakeholders.

Case 1	Synergy effect of bulk procurement of EE products and collection and destruction of fluorocarbons	Brazil and Morocco
Case 2	Home Appliance Recycling Law, End-of Life Vehicles (ELV) Recycling Law	Japan

Case 1: Synergy effect of bulk procurement of EE products, stop dumping, and collection and destruction of fluorocarbons

Countries: Brazil, Morocco

Dr. Suely Carvalho and Dr. Kamyla Borges (Kigali Project, ICS), Mr. Vital Ribeiro (President of the Board, PHS), and Dr. Stephen O. Andersen, Director of Research, IGSD.

Lifecycle Management Stage: Introduction of appliances, Collection, Reclamation, Reuse, Destruction

Coordination of Policy Measures: Pilot Programme

Key Words: *bulk procurement, buyers' club, energy efficient, low-GWP, ODS, HFCs, air conditioners*

Summary of the policy:

This good practice focused on the synergy effect of bulk procurement for energy efficient and lower GWP equipment, stopping dumping of inefficient appliances with obsolete ODS and HFC refrigerants, and collecting significantly larger quantities of ODS and HFCs in "controlled" replacement program including destruction. The pilot projects were implemented in Brazil and Morocco in economically feasible and profitable schemes with environmentally sound management.

Overall procedure of the project is designed as follows using "Buyers' Clubs".

1st step: Purchase power of large buyers of a specific energy efficient lower GWP product
2nd step: Aggregate the demand
3rd step: Negotiate a favorable price with manufactures
4th step: Simplify installation and recover of ODS and/or GHG refrigerant for final disposal/destruction

(1) The pilot project: Health Sector in Brazil

There are more than 2,900 public and 4,300 private health institutions, 445,000 patient rooms with split ACs and refrigerators installed along with central cooling systems in Brazil. Major refrigerants are R-22, R-410A, R-134a. Detailed assessment was implemented for 33 health institutions and confirms they have references to energy efficiency in their corporate sustainability policy.

Energy and cost saving analysis showed there are significant benefits by replacing air conditioners with models of superior efficiency. Potential for refrigerant collection and EoL actions showed 1,469 kg recycling of R-410A and 2,116 kg recycling of R-22 for the 33 health facilities, and 9,356 tons recycling of R-410A and 13,473 tons recycling of R-22 for the total 6,368 hospitals in Brazil. Refrigerants can be locally destroyed, for instance, in cement kilns.

(2) The pilot project: Bank & Government Sector in Morocco

Bank and government sectors were selected as a case study. Goals were set to replace older ACs that were inefficient when purchased and improperly installed and maintained for energy efficiency with super-efficient inverter ACs with lower GWP refrigerants, as well as to replace collect and destroy obsolete ODS and HFC refrigerants in local cement kilns, combined with materials recycling to prevent deployment of appliances to other locations.

Benefits of the project are that bulk procurement and buyers' clubs reduce the purchase price of superior AC, stop dumping of inefficient appliances and refrigerant destruction in local cement kilns avoids the extraordinary cost of permitting, packaging, and shipping to foreign facilities and values added in local jobs and profits, etc.

In conclusion, energy savings and corporate environmental responsibility of Buyers' Club members can be entry points for successful AC replacement programs, bringing the scale needed for an economically feasible EoL program.

Information source:

Presentation materials at the OEWG43 side event:
https://www.env.go.jp/earth/ozone/fluorocarbon_initiative/attach/1_Carvalho_%20Ribeiro_Andersen_Presentation%20Side%20%20Event%20OEWG%20July%2015%202021_final%201.pdf

Case 2: Home Appliance Recycling Law, End-of Life Vehicles (ELV) Recycling Law

Country: Japan

Lifecycle Management Stage: Collection, Recycling, Destruction

Format of Policy Measures: Regulations

Key Words: *home appliance, End-of Life Vehicles, ELV, automobiles, recycling, collection, recycling, destruction, recycling ticket*

Summary of the policy:

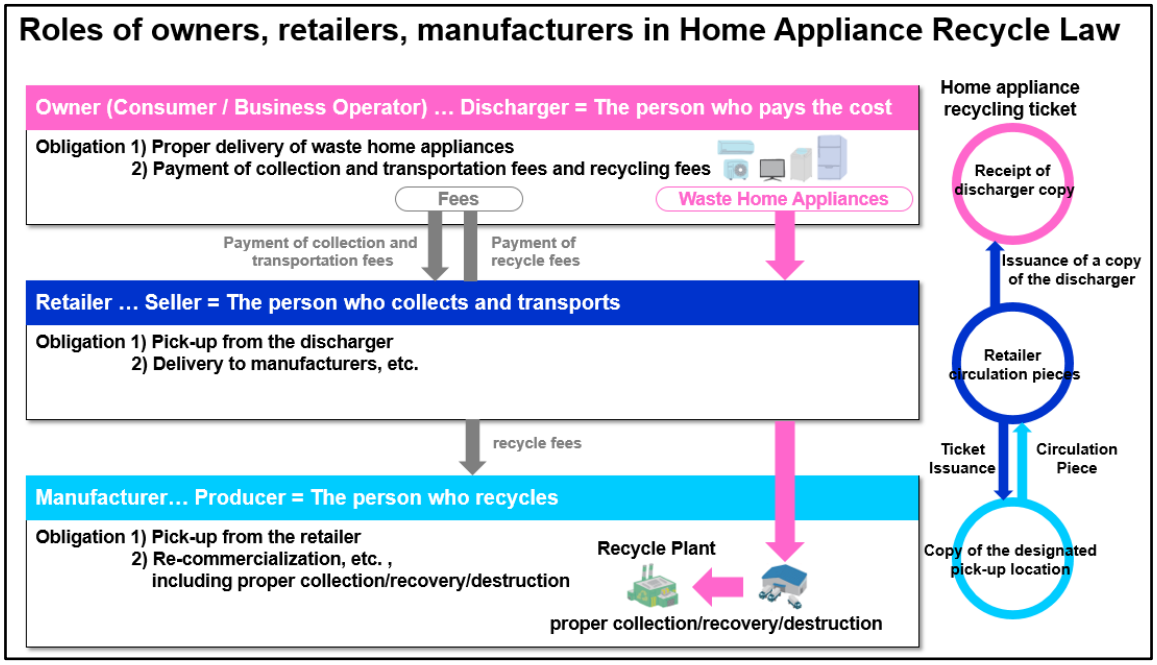
In Japan, the shortage of final disposal sites for waste and the impact of harmful substances on the environment have become big issues.

The Home Appliance Recycling Law and the End-of Life Vehicles (ELV) Recycling Law have been introduced as new recycling mechanisms for home appliances and automobiles. These laws and regulations stipulate the roles of owners, retailers, collectors, manufacturers, etc. of waste home appliances and automobiles, and the recycling fee is borne by the owners who discharge those waste. The treatment of fluorocarbons has been integrated as an essential part obligation.

1) Home Appliance Recycling Law

Under the Home Appliance Recycling Law, air conditioners, TVs, refrigerators/freezers, washing machines/clothes dryers are designated as target products.

The Home Appliance Recycling Law requires the owner to properly discharge and bear the costs (collection/transportation fee and recycling fee) for the waste home appliances, and requires the retailer to pick up the waste home appliances from the owner and hand it over to the manufacturer, and imposes obligations on manufacturers to pick up and recycle the waste home appliances including proper collection/recycling/destruction of fluorocarbons.



2) End-of Life Vehicles (ELV) Recycling Law

When disposing of a vehicle, the pick-up company picks up the scrapped vehicle from the final owner and hands it over to a fluorocarbon recycling company or a dismantling company. Fluorocarbon collectors properly collect fluorocarbons in accordance with standards and deliver them to automobile manufacturers

and importers. The target vehicles basically include all cars (light/compact/standard-sized and special cars), buses and trucks, and the recycling fee is paid by the owner of the vehicle (in principle, it is borne when purchasing the vehicle).

Violators of the End-of Life Vehicles Recycling Law are subject to a maximum one-year imprisonment or JPY 500,000 fine. Furthermore, dismantling operators without a license are also in violation of the Waste Management and Public Cleaning Act and subject to a maximum five-year imprisonment or JPY 10,000,000 fine (JPN 300,000,000 for companies).

After introducing the Home Appliance Recycling Law and End-of Life Vehicles Recycling Law, the amount of fluorocarbons recovered from home appliances and automobiles has increased dramatically.

Information source:

Home Appliance Recycling Law:
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