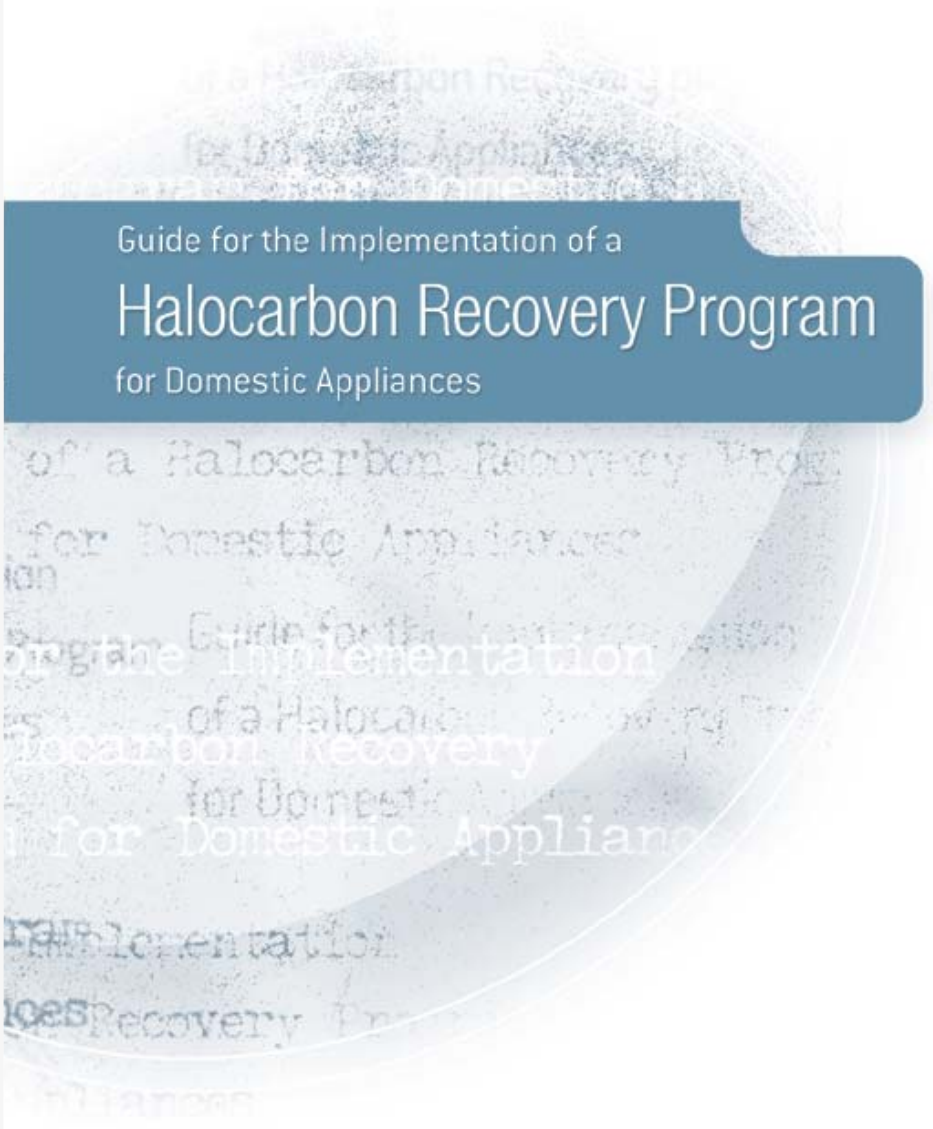
Guide for the Implementation of a

Halocarbon Recovery Program

for Domestic Appliances



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Note to Readers

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Table of Contents

Objective of the Guide

This guide is intended primarily for municipalities that are responsible for the disposal of out-of-service domestic appliances containing halocarbons. During the past few years, many Canadian provinces and territories have developed regulations and guidelines requiring the recovery of halocarbons from domestic appliances prior to disposal. The goal of this guide is to help municipalities set up a recovery program for halocarbons contained in domestic appliances. This guide may also be of interest to organizations and institutions that wish to recover halocarbons from similar appliances.

- **Part 1** contains general information on halocarbons, particularly their impact on the ozone layer and on climate change and their life cycle in domestic appliances.
- **Part 2** provides a summary of provincial and territorial regulations concerning the recovery of halocarbons from domestic appliances.
- **Part 3** describes the steps necessary for developing and implementing a halocarbon recovery program for domestic appliances.
- **Part 4** contains a list of various resource persons that can be contacted during the implementation of the program, including government contacts and individuals responsible for existing municipal programs.
- This guide also contains a series of appendices listing various private sector resources of use.

This guide is an update of the document entitled *Designing a Program to Recover CFCs from Domestic Appliances*[1], published by Environment Canada in 1996.

[1] Catalogue number En 40-521/1996E

1 Problems with Halocarbons

What are halocarbons?

Halocarbons are synthetic chemical compounds made up of halogens (chlorine, bromine and fluorine) and carbon. Halocarbons are known to be ozone-depleting substances (ODS) and greenhouse gases (GHG). The main ODS are chlorofluorocarbons (CFCs), bromofluorocarbons (halons), hydrobromofluorocarbons (HBFCs), hydrochlorofluorocarbons (HCFCs), methyl chloroform (1,1,1-trichloroethane), methyl bromide and tetrachloromethane (carbon tetrachloride or CCl_4). The main GHGs are hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Halocarbons are used as refrigerants in domestic appliances. The most common refrigerants are CFCs, HCFCs and HFCs. For this reason, this guide will deal only with these types of halocarbons. The domestic appliances concerned are residential refrigerators, freezers, window-mounted air-conditioners, dehumidifiers and heat pumps.

What is the impact of halocarbons on the ozone layer and climate change?

Halocarbons contribute to two main environmental problems, namely the depletion of the stratospheric ozone layer and climate change, that are of concern to governments around the world.

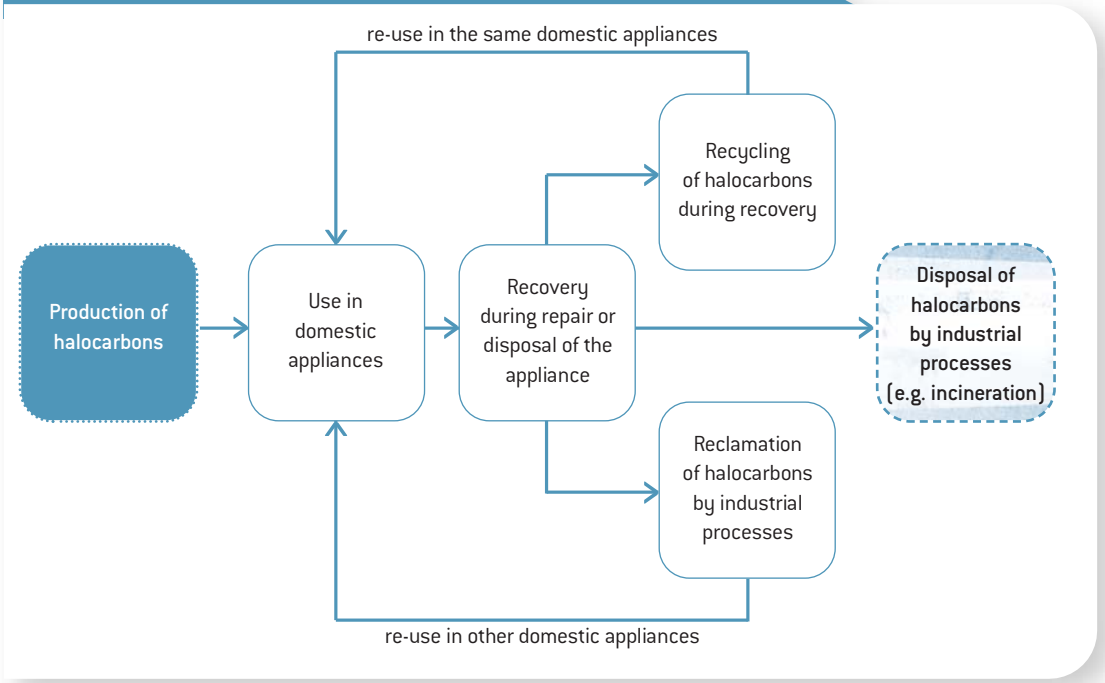
> **Depletion of the ozone layer:** Ozone is a colourless gas composed of three oxygen atoms (O_3). Most ozone is found in the stratosphere, between 15 and 40 km above ground level, and constitutes the ozone layer. The ozone layer absorbs ultraviolet (UV) rays from the sun and protects us from the harmful effects of overexposure. In recent years, scientists have noticed a significant thinning of the ozone layer. It has since been proven beyond a doubt that terrestrial emissions of CFCs are largely responsible for stratospheric ozone depletion. The process of ozone destruction is a complex phenomenon. First, CFC emissions released at ground level rise unchanged to the stratosphere since they are highly stable. The CFC emissions are then subjected to bombardment from ultraviolet rays from the sun, causing the CFC molecules to lose chlorine atoms. The chlorine atoms then attack ozone molecules, initiating a chain reaction. Each chlorine atom can destroy up to 100 000 molecules of ozone.

> **Climate change:** Climate change is the qualitative modification of the normal average parameters of the global climate. The term refers both to a change in average global temperatures and a change in the frequency of extreme events such as flooding, tornados and other weather phenomenon at a given location. Recent data shows that the average global temperature of surface air has increased from 0.2 °C to 0.6 °C since the end of the 19th century and that the average for Canada has increased about 1 °C. Some models predict that the average global temperature could rise by about 0.3 °C every decade for the next century if GHG emission rates are not curbed. A temperature increase of this magnitude could significantly modify the Earth's climate. The frequency and severity of storms could increase, a rise of sea level could lead to the relocation of millions of people living near coasts, and regional droughts and floods could occur. Climate change is attributed to elevated levels of carbon dioxide, methane and nitrous oxide as well as synthetic GHGs, such as HFCs and PFCs, generated by human activity.

What is the life cycle of halocarbons in domestic appliances?

The life cycle of halocarbons in domestic appliances is represented in the following figure.

FIGURE 1 > LIFE CYCLE OF HALOCARBONS IN DOMESTIC APPLIANCES



2 Regulatory Context

National Action Plan

The National Action Plan for the Environmental Control of Ozone-Depleting Substances (ODS) and their Halocarbon Alternatives[2] is an important component of Canada's ozone layer protection program, which addresses environmental problems caused by halocarbons, such as the depletion of the ozone layer and climate change. The 2001 National Action Plan updates previous versions of the plan, published in 1992 and 1998. The original plan was developed to respond to the *Montreal Protocol* concerning ozone-depleting substances. Canada was one of the first signatories of the protocol.

The 2001 National Action Plan was approved and published by the Canadian Council of Ministers of the Environment (CCME). It provides federal, provincial and territorial governments with a national framework for a harmonized approach to implementing an environmental protection strategy with respect to both ozone depletion and climate change.

Canada has thus far made remarkable progress. Virtually all the tasks in the 1992 National Action Plan and most of the tasks in the 1998 National Action Plan have been completed:

> Canada no longer produces or imports CFCs, methyl chloroform and halons.

> Carbon tetrachloride is imported only for use as feedstock in chemical production.

> All jurisdictions require the recovery and recycling of CFCs and HCFCs in the refrigeration and air-conditioning sectors, and prohibit any deliberate release to the environment.

> All levels of government have taken or will take measures to implement recovery, recycling and emission controls for HFCs, to require the use of refillable containers for all halocarbon refrigerants and to prohibit the recharging of mobile air-conditioning systems with CFCs.

> Environmental awareness training programs for refrigeration service technicians have been developed and are being delivered. This training is mandatory in all jurisdictions except Quebec, where the issue will be addressed in a draft regulation in 2003. More than 109 000 service technicians in the refrigeration and air-conditioning sector have received environmental-awareness training.

> The federal, provincial and territorial governments will carry out the new tasks related to the implementation of Canada's strategy to accelerate the phase-out of CFC and halon uses and to dispose of surplus stocks. Other elements of this strategy will be entrusted to industry and other stakeholders.

Provincial and territorial regulations

In light of the dangers that halocarbons pose to the environment with respect to the depletion of the ozone layer and climate change and in order to satisfy the agreements in the National Action Plan, all provinces and territories have implemented, or have agreed to implement shortly, regulations or guidelines to control the management of halocarbons in domestic appliances.

[2] CCME PN 1314/1315, May 2001

Table 1 provides the names of the regulations or guidelines for each province and territory as well as their date of implementation.

TABLE 1 > PROVINCIAL AND TERRITORIAL REGULATIONS AND GUIDELINES

Province/Territory	Regulation or Guidelines	Date of Implementation
Alberta	*Ozone Depleting Substances and Halocarbons Regulation* (r.181/2000)	September 1, 2002
British Columbia	*Ozone Depleting Substances and Other Halocarbons Regulation* (r.387/99)	November 22, 1999
Manitoba	*Ozone Depleting Substances Regulation / Loi sur les substances appauvrissant la couche d'ozone* (r.103/94)	May 27, 1994
	Update of regulation under preparation	To be determined[A]
New Brunswick	*Ozone Depleting Substances Regulation / Règlement sur les substances appauvrissant la couche d'ozone* (r.97/132)	November 20, 1997
Newfoundland and Labrador	*Ozone Depleting Substances Regulation* (r.120/97)	September 10, 1997
Northwest Territories	Guideline for Ozone Depleting Substances (ODSs)[B] and subsection 2.2 of the *Environmental Protection Act*	February 1998
Nova Scotia	*Ozone Layer Protection Regulations* (r.54/95)	April 11, 1995
Nunavut	Guideline: Management of Ozone Depleting Substances[B]	January 2002
Ontario	*Ozone Depleting Substances - General Regulation* (r.356)	1990
	Refrigerants Regulation (r.189/94)	1994
Prince Edward Island	*Ozone Depleting Substances and Replacement Regulations* (r.EC619/94)	November 1, 1994
Quebec	*Regulation Respecting Ozone-depleting Substances / Règlement sur les substances appauvrissant la couche d'ozone* (Q-2, r.23.1)	1993
	Draft Regulation: Halocarbons / Projet de règlement: Halocarbures	2003
Saskatchewan	*The Ozone-depleting Substances Control Regulations* (r.0-8.1 Regulation 1)	July 20, 1993
	Update of regulation under preparation	To be determined[A]
Yukon	*Ozone Depleting Substances and Other Halocarbons Regulation / Règlement sur les substances appauvrissant la couche d'ozone et autres halocarbures*	2000

Note A : The implementation date has not been determined.
Note B : Guidelines.

With respect to the disposal of domestic appliances, the main points in the regulations and guidelines are:

> Most provincial and territorial regulations explicitly state that refrigerants must be removed prior to the disposal of domestic appliances. All provinces and territories prohibit the release of halocarbons into the atmosphere.

> Most provinces and territories require that all work done on refrigeration and air-conditioning systems comply with Environment Canada's Refrigerant Code of Practice[3] and that the work be performed by "certified" technicians, i.e. technicians that have received environmental awareness training.

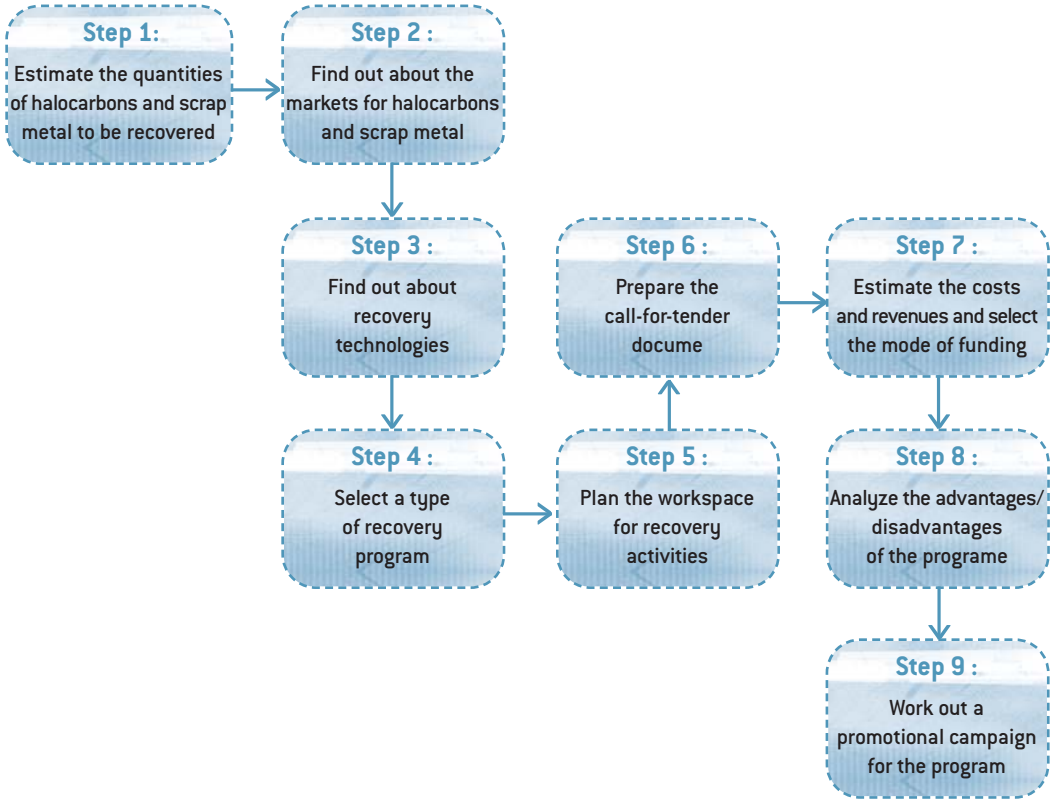
> Some provinces and territories have technical requirements concerning the recovery equipment that must be used for recovering refrigerants from domestic appliances. These technical requirements are based on the capability of the recovery equipment to obtain a level of vacuum sufficient to extract all of the refrigerant from a domestic appliance.

[3] Environment Canada. 1996. *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.* Report EPS 1/RA/2. ISBN 0-660-16430-2.

3 Planning a Halocarbon Recovery Program

The different steps needed to develop and implement a halocarbon recovery program for domestic appliances are illustrated in Figure 2.

FIGURE 2 > PLANNING A RECOVERY PROGRAM



STEP 1 ESTIMATE THE QUANTITIES OF HALOCARBONS AND SCRAP METAL TO BE RECOVERED

Estimate the number of appliances disposed of each year

Before implementing a recovery program for halocarbons contained in domestic appliances, it is essential to know the number of appliances that will be disposed of each year. The number of halocarbon containing appliances disposed of each year varies significantly from one municipality to another, depending on the size of the municipality, the income level of the residents, the weather, the appliance collection method, etc. A ratio of 775 appliances per 100 000 residents per year is generally acceptable for calculations[4]. However, each municipality should obtain information that is as accurate as possible for its region.

Example of a municipality with 100 000 residents:

A municipality with 100 000 residents can expect to collect 775 halocarbon containing domestic appliances each year.

Estimate the quantities of halocarbons and scrap metal to be recovered

Once the number of domestic appliances disposed of each year is determined, the quantity of halocarbons and scrap metal generated by these appliances must be calculated. The various domestic appliances that contain halocarbons are: refrigerators, freezers, air conditioners, dehumidifiers, heat pumps, etc. The three most common types of halocarbons present in the cooling systems of these appliances are CFC-12 (R-12) or HFC-134a (R-134a) in refrigerators, freezers and dehumidifiers, and HCFC-22 (R-22) in air conditioners and heat pumps.

In addition, some halocarbons may be found in the foam insulation in the walls of domestic appliances. Currently, the halocarbons contained in foam insulation are not recovered in Canada. However, in Europe, there are facilities that carry out this type of recovery. These facilities are very expensive, costing millions of dollars. As a result, the recovery of halocarbons from foam insulation is not considered in this guide.

Table 2 shows the distribution of domestic appliances according to the type of appliance. Refrigerators make up on average 70% of all halocarbon containing domestic appliances. The quantity of halocarbons contained in each appliance varies from 0.3 kg for refrigerators to 1.8 kg for heat pumps. On average, there is 0.31 kg of halocarbons per appliance. Metal (steel, aluminum, copper) accounts for approximately 73% of the average weight of recovered appliances, i.e. an average of 65 kg for all halocarbon containing domestic appliances.

Example of a municipality with 100 000 residents:

775 domestic appliances/year

X

0.31 kg of halocarbons/appliance

=

240 kg of recovered halocarbons/year

775 domestic appliances/year

X

65 kg of scrap metal/appliance

=

50 375 kg of recovered scrap metal/year (50.4 tonnes/year)

[4] Le Groupe Conseil SAE inc. 2003. *Étude comparative des technologies de récupération des halocarbures dans les appareils domestiques et des programmes municipaux existants de récupération.*

TABLE 2 > EVALUATION OF QUANTITIES OF HALOCARBONS AND SCRAP METAL TO BE RECOVERED

Domestic appliances containing halocarbons	Distribution of appliances according to type (%)	Halocarbons per appliance (kg/unit)	Total weight per appliance (kg/unit)	Weight of scrap metal per appliance (kg/unit)	Example of a municipality with 100,000 residents			
					Number of appliances (units)	Quantity of recovered halocarbons (kg)	Total weight of appliances (kg)	Quantity of scrap metal recovered (kg)
Refrigerators	70	0.3	100	-	542	163	54 200	-
Freezers	20	0.3	80	-	155	46	12 400	-
Air-conditioners	5	0.5	45	-	39	20	1 755	-
Dehumidifiers	4.5	0.1	22	-	35	3.5	770	-
Others (heat pumps, etc.)	0.5	1.8	20	-	4	7.2	80	-
All appliances	100	≅ 0.31	89	65[1]	775	≅ 240	69 205	50 375

Note 1: Weight of scrap metal per appliance = 73% x total weight per appliance = 73% x 89 kg/unit = 65 kg of scrap metal/unit

STEP 2 FIND OUT ABOUT MARKETS FOR HALOCARBONS AND SCRAP METAL

Although in most cases, the contractors in charge of recovering halocarbons are also responsible for managing the halocarbons and scrap metal, it is important to be aware of the market value of these products in order to negotiate the cost of halocarbon recovery.

Halocarbon market

The halocarbon market has changed tremendously in the past few years. Recovered halocarbons, a potential source of revenue for municipalities, are currently a liability in most cases. For example, the selling price of virgin refrigerants is $5,50/kg - $6,60/kg for HCFC-22 and $6,60/kg - $9,90/kg for HFC-134a. Since the market price of recovered refrigerants must include the costs for handling, shipping, reclamation and disposal of reclamation residues, it is not competitive with the market price for virgin refrigerants. As for CFC-12, the production and import of this refrigerant was stopped in 1996 and the virgin product is no longer available on the market. Even reclaimed CFC-12 is no longer sold by large refrigerant distributors. Nevertheless, it is possible to purchase small quantities of CFC-12, of questionable quality, that have been recovered by specialized contractors over the years and stored at their workshops. CFC-12 is also available on the black market. As a result, the selling price of CFC-12 is highly variable. It can be concluded that the market for recovered refrigerants is not a viable source of revenue.

It is reasonable, therefore, for the purposes of planning a halocarbon recovery program for domestic appliances, to consider the recovered halocarbons as liabilities that incur disposal costs. Disposal costs vary depending on the quantity, the level of contamination by oils and other refrigerants, and the distance to the disposal facility. Disposal costs at the elimination facility may attain $15/kg, excluding transportation costs. It may be possible, in exceptional circumstances, for recovered halocarbons to generate minimal revenues.

Scrap metal market

The value of scrap metal from domestic appliances is about $27/tonne delivered to the recycler. It should be noted that the scrap metal from domestic appliances is composed of steel as well as small quantities of aluminum and copper (approximately 4% of the metal) and foam insulation. The municipality should contact local industries for current market prices.

Example of a municipality with 100 000 residents:

50.4 tonnes of recovered scrap metal/year

X

$27/tonne

=

$1,361 (price of recovered scrap metal)

$1,361/775 domestic appliances

=

$1,76/domestic appliance (unit price of recovered scrap metal)

The unit price for recovered scrap metal can be assumed to average $1,76/domestic appliance.

STEP 3 FIND OUT ABOUT RECOVERY TECHNOLOGIES

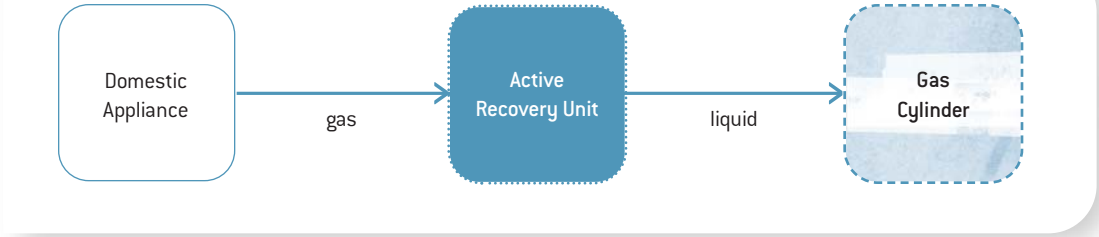
In general, specialized contractors in the refrigeration sector recover halocarbons. The recovery of halocarbons must be performed according to the specifications and guidelines contained in the Refrigerant Code of Practice. Municipal employees who have professional qualifications in refrigeration systems and who have received the environmental awareness training certification awarded by the province or territory can also recover halocarbons. There are two methods for recovering halocarbons from domestic appliances: the active recovery method or the adsorption recovery method.

Active recovery method

An active recovery unit consists essentially of a compressor with a filter-drier and a condenser that extracts the halocarbon from domestic appliances and stores it in a recovery cylinder.

Hoses connect the recovery unit to the domestic appliance. The refrigerant, in gas form, is transferred to the recovery unit by the compressor. It is then sent to the condenser, which transforms it into a liquid. The refrigerant is sent from the recovery unit to a pressurized recovery cylinder, where it is stored. The actual connection depends on the model of the recovery unit, the condition and type of domestic appliance, and the method of recovery (i.e. "liquid recovery," "vapour recovery," or "push/pull recovery"). Once the cylinder is full of refrigerant, it must be sent off-site for reclamation or destruction.

FIGURE 3 > TYPICAL CONFIGURATION OF AN ACTIVE RECOVERY UNIT



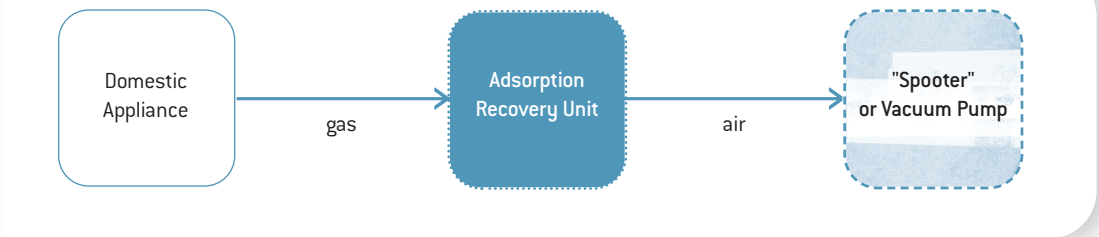
There is a type of active recovery unit that combines recovery with recycling. The recovery/recycling unit usually includes a compressor with a filter-drier, filters and a condenser. The halocarbon is extracted from the domestic appliance and collected in a recovery cylinder. The quality of the refrigerant is improved by the filters, which remove suspended particles, moisture and oils. This technology is useful when the refrigerant recovered from the domestic appliance can be re-used in the same appliance. Although the quality of the refrigerant is improved using active recovery/recycling units, best practices do not allow for another domestic appliance to be with a recycled refrigerant unless it has been purified in keeping with industry standards. Since this guide targets the extraction of refrigerants from discarded domestic appliances, recovery/recycling units do not offer any additional advantages.

Adsorption recovery method

An adsorption recovery unit consists essentially of a cylinder (bottle) filled with a zeolite matrix capable of adsorbing the halocarbon from the domestic appliance. There is only one manufacturer of adsorption recovery units in Canada.

The recovery system is connected by hoses to the domestic appliance. The refrigerant, in gas form, is transferred by diffusion to the recovery unit, where the refrigerant adheres to the zeolite matrix. A pump is used to create a suction to remove the remaining refrigerant from the domestic appliance. Once the bottle is saturated with the refrigerant, it must be returned to the manufacturer, which will desorb the halocarbons, regenerate the zeolite matrix, and refine the adsorbed refrigerant. The costs and logistics associated with the transportation of saturated cylinders, especially for sites located far from the desorption facility, must be taken into account. The desorbed refrigerant is then sent off-site for reclamation or destruction.

FIGURE 4 > TYPICAL CONFIGURATION OF AN ADSORPTION RECOVERY UNIT



Comparison of technologies

Table 3 provides a comparative analysis between the two recovery methods according to technical, environmental, health and safety, economic and socio-economic criteria. For more information, the municipality can contact Environment Canada (see Part 4).

TABLE 3 > COMPARISON OF HALOCARBON RECOVERY METHODS

Comparison Criteria	Active Recovery Method	Adsorption Recovery Method
General		
Type of equipment	Compressor with filter-drier and condenser.	Cylinder (bottle) filled with adsorbent matrix.
Method of operation	Mechanical method of compression and condensation to transfer the refrigerant into a cylinder.	Physico-chemical method of adsorbing refrigerant molecules onto matrix in cylinder.
Countries where technology is used	Canada, United States, European Union and Japan.	Canada, United States and Malaysia.
Technical Criteria		
Performance and effectiveness	Certified under ARI 740-1998, UL 1963 and USEPA 40 CFR 82F Appendix C (for small equipment).	Certified under USEPA 40 CFR 82F Appendix B (for large equipment).
	Certified for CFC-12, HCFC-22 and HFC-134a.	Certified only for CFC-12 and HFC-134a but can also be used for HCFC-22.
	Final vacuum: 10-15" Hg.	Final vacuum: <10" Hg according to certification, but in practice a better vacuum can be obtained.
Reliability	Construction, operation and maintenance are simple techniques and are well understood in the HVAC (Heating, Ventilation, & Air Conditioning) industry.	Construction, operation and maintenance are sophisticated techniques and are not well understood in the HVAC industry.
Ease of implementation	Implementation is simple.	Implementation is more complicated because of the need to transport the cylinder to the supplier for desorption.
	Weight: 17 kg to 170 kg.	Weight: 9.5 kg and 28.1 kg
	Dimensions: 27-69 cm wide 28-114 cm high 26-140 cm long	Dimensions: 41-91 cm high 20 cm diameter
	Complementary cylinders are necessary to store recovered refrigerant.	The recovered refrigerant is stored in the cylinder itself.
	Technology does not require off-site services except for reclamation or disposal.	The technology requires off-site services for desorption, as well as for reclamation or disposal.
	Training of technicians is minimal since the method of operation is well known to the HVAC industry.	Training of technicians is necessary since this method is not well known in the HVAC industry.
	With respect to the storage of recovered refrigerant, the use of this technology does not require frequent handling of the recovery units since the cylinders are connected by hoses and large capacity storage cylinders are available.	With respect to the storage of recovered refrigerant, the operation requires frequent handling of the recovery units since the cylinders must be replaced whenever they are saturated.

TABLE 3 > COMPARISON OF HALOCARBON RECOVERY METHODS (CONTINUE)

Comparison Criteria	Active Recovery Method	Adsorption Recovery Method
Environmental, Health and Safety Criteria		
Environmental impacts	Recovery efficiency varies from 80% to 96% but can be improved with models that attain a better final vacuum. Nevertheless, the 4% to 20% loss of halocarbons represents an environmental risk.	The recovery efficiency varies from 90% to 96% depending on the manufacturer. The 1% to 10% loss of halocarbons also represents an environmental risk, albeit a smaller one.
Health and safety impacts	Portable models weigh between 17 kg and 23 kg, but installation on wheels is possible. The refrigerants are not toxic to workers.	Portable models weigh between 9.5 kg and 15.9 kg, but installation on wheels is possible. The refrigerants are not toxic to workers.
Economic and Socio-economic Criteria		
Canadian context	Easily available in Canada through many distributors for American manufacturers. The number of Canadian manufacturers seems very low (only one uncertified manufacturer was found).	Only one manufacturer, a Canadian company, which also operates the only desorption facility in Canada.
Associated costs	The capital costs (plus taxes) vary depending on capacity, i.e. $1,390 to $23,575. The storage cylinders for recovered refrigerant must be purchased but the costs are not prohibitive.	The capital costs (plus taxes) vary depending on the capacity of the cylinder, i.e. $215 to $450 for only one cylinder. Significant fees are charged for desorption, ranging from 30% to 40% of the capital cost ($86 to $185 per cylinder), as well as for transportation.
Conclusion		
Advantages	The mechanical compression and condensation method is well known and used in the industry, and technicians require minimal training. The method is certified for CFC-12, HCFC-22 and HFC-134a. The method does not require off-site services except for reclamation or disposal. The recovery units are available in Canada through many distributors for American manufacturers. As a result, the market is competitive. Operating costs are low.	The recovery efficiency may be superior to the active recovery method (90-99% vs. 80-96%) but it is hard to validate the numbers provided by the manufacturer. The recovery units are lighter and easier to transport. Capital costs are low.
Disadvantages	The storage cylinders must be purchased, but the costs are not prohibitive. The number of Canadian manufacturers seems very limited. Capital costs are high.	The physico-chemical adsorption method is not well known or used; training of technicians is essential. There is only one equipment manufacturer and only one desorption facility in Canada. As a result, it is a captive market. Method is not certified for HCFC-22. The method requires off-site services for desorption as well as for reclamation or disposal. Some Scandinavian countries have abandoned this technology because there was no local desorption facility. Operation can require frequent handling since the cylinders must be replaced once they are saturated. Operating costs are much higher than the other method due to desorption fees and transportation to the desorption plant.

STEP 4 SELECT A TYPE OF RECOVERY PROGRAM

The critical step in the implementation of a halocarbon recovery program is the selection of the type of program. When existing halocarbon recovery programs in various Canadian municipalities are examined, it is apparent that there are three main categories of programs, with a few possible variations.

Table 4 provides a description of the three program types, followed by a comparative analysis. Different criteria, for cost, program administration, collection of domestic appliances and recovery of halocarbons, are analyzed for each program type. This will help municipalities to determine the program that is most suitable to their own characteristics (size, density, budget, availability of labour, available buildings, etc). There are different variations possible for the above-mentioned programs. In the following descriptions, the term "transfer centre" includes landfill sites, municipal yards, recycling centres, or even a contractor's private property. For more information, the municipality can contact Environment Canada (see Part 4).

TABLE 4 > COMPARISON OF PROGRAM TYPES FOR HALOCARBON RECOVERY

Type of Program	Program Type 1 Transportation by citizen and halocarbon recovery at transfer centre	Program Type 2 Specialized transportation and halocarbon recovery at transfer centre	Program Type 3 Halocarbon recovery from dwellings or at curbside
DESCRIPTION			
	The citizen brings the domestic appliance to the transfer centre using his/her own means. The municipality may charge a service fee for depositing the domestic appliance at the transfer centre.	The citizen leaves the domestic appliance at the curb. The collection of appliances can be done twice a year (spring and fall), once a month, or upon request.	The citizen notifies the municipality that he/she wants to dispose of a domestic appliance. The domestic appliance is kept inside the dwelling or is brought to the curb.
		Municipal employees or contractors pick up and transport the domestic appliance to the transfer centre.	Municipal employees or contractors recover halocarbons inside the citizen's dwelling or at curbside.
	The halocarbon is recovered from the domestic appliance at the transfer centre by a municipal employee or a contractor.	The halocarbon is recovered from the domestic appliances at the transfer centre.	Municipal employees or contractors send the domestic appliance, now emptied of halocarbon, to the transfer centre.
	The domestic appliance, emptied of its refrigerant, is sent to a scrap metal recycler.	The domestic appliance, emptied of its refrigerant, is sent to a scrap metal recycler.	
	The program may be funded by taxes and/or service fees (see Step 7).	The program may be funded by taxes (see Step 7).	The program may be funded by taxes and/or service fees (see Step 7)

TABLE 4 > COMPARISON OF PROGRAM TYPES FOR HALOCARBON RECOVERY (CONTINUE)

Type of Program	Program Type 1 Transportation by citizen and halocarbon recovery at transfer centre	Program Type 2 Specialized transportation and halocarbon recovery at transfer centre	Program Type 3 Halocarbon recovery from dwellings or at curbside
COSTS			
Cost of halocarbon recovery	INTERMEDIATE	INTERMEDIATE	INTERMEDIATE
Transportation cost of domestic appliance	NIL	HIGH [1]	INTERMEDIATE [2]
Total cost of program	LOW	INTERMEDIATE	HIGH
ADMINISTRATION OF THE PROGRAM			
Logistics for receiving calls from citizens who want to make appointments to pick-up appliances	NIL	NIL OR HIGH [3]	HIGH
Risks of vandalism to domestic appliances left at the curb	NIL	LOW TO INTERMEDIATE [4]	LOW TO INTERMEDIATE [4]
Risk of Illegal discharge	LOW OR HIGH [5]	LOW OR HIGH [5]	LOW TO INTERMEDIATE [6]
Program participation rate of citizens	LOW	INTERMEDIATE	INTERMEDIATE
COLLECTION OF DOMESTIC APPLIANCES AND HALOCARBON RECOVERY			
Risk of accidental release of halocarbons during transportation	INTERMEDIATE [7,8]	LOW TO INTERMEDIATE [7,9]	NIL
Length of time for halocarbon recovery	INTERMEDIATE	INTERMEDIATE	INTERMEDIATE
Storage area for domestic appliances at transfer centre	INTERMEDIATE [10]	INTERMEDIATE [10]	INTERMEDIATE [10]
CONCLUSION			
Advantages and disadvantages with respect to the size of the municipality	Cheap and convenient for small municipalities	Convenient for all municipalities	Costly, but may be convenient for municipalities with high population densities

Note 1: The domestic appliance must be transported with care.
Note 2: Since the halocarbon has previously been removed, the appliance can be transported with few precautions.
Note 3: The logistics of receiving calls from citizens may incur high costs to the municipality if the citizen must call the city for domestic appliance collection.
Note 4: The risk of vandalism in large cities is intermediate to high.
Note 5: If the transfer centre is the property of the private contractor, the possibility of illegal discharge is high since it would be easy and tempting for the contractor to release the halocarbons into the atmosphere if no control measures are in place, particularly since disposal costs are borne by the contractor.
Note 6: The possibility for illegal discharge of halocarbons by the contractor is still possible even at a citizen's dwelling since the citizen assumes that the contractor acts according to trade practices.
Note 7: It should be noted that poor functioning due to refrigerant leakage is one of the main reasons that a citizen disposes of domestic appliances. In this case, there is no risk of refrigerant leakage during transportation.
Note 8: Transportation is done by the citizen.
Note 9: Transportation is done by the contractor.
Note 10: The layout of the transfer centre must allow for halocarbon recovery and the storage of domestic appliances.
Note 11: The layout of the transfer centre must allow for the storage of domestic appliances.

STEP 5 PLAN THE WORKSPACE FOR RECOVERY ACTIVITIES

If you decide to carry out the halocarbon recovery operation in a building that you own and use it as a "transfer centre," you must make sure that the building respects certain standards and that it has the attributes desirable for such a centre.

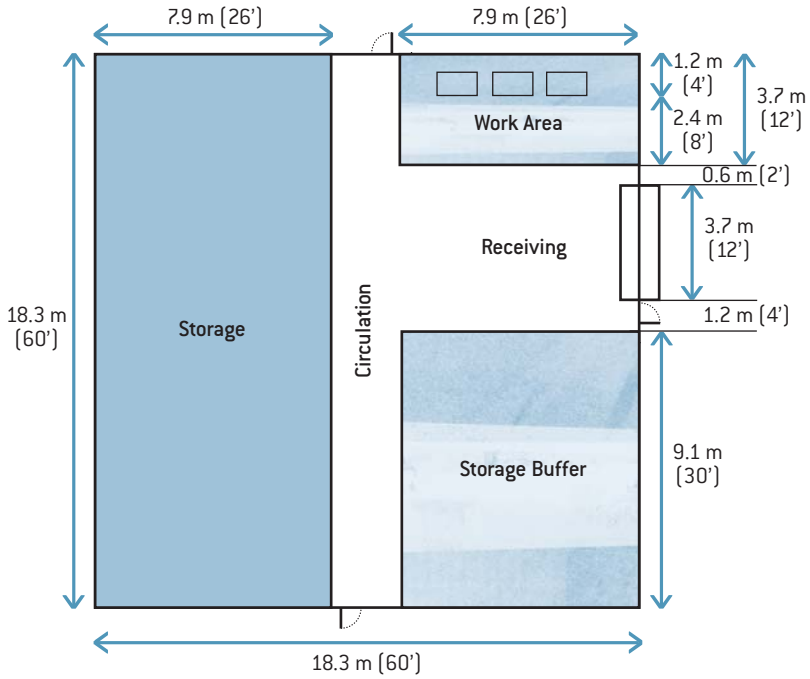
Space requirements

The evaluation of the space required is based on a transfer centre that could accommodate 100 refrigerators (a quantity justifying the mobilization of a recovery contractor).

Work area	30 m^2
Receiving and circulation area	90 m^2
Storage area	240 m^2
	360 m^2

Figure 5 is a diagram of a typical layout. This layout requires storage in an upright position. Some contractors prefer to work with refrigerators that are positioned on their side. In this case, extra handling must be considered.

FIGURE 5 > DIAGRAM OF A TYPICAL LAYOUT



Note : Not to scale.

Building systems

In the context of this guide, it is not feasible to consider all the possible scenarios arising from the application of codes and standards. In all cases, a professional (usually an architect or an engineering consulting firm) must be consulted. The insurance company for the municipality should also be contacted.

It is important to verify the necessary precautions to be taken (information for the staff concerning halocarbons, the handling of appliances, etc.) with workers' health and safety authorities.

In addition, local authorities should be contacted to determine if it is necessary to present plans and specifications that include the following information:

> use of the building;

> ventilation systems;

> maximum number of domestic appliances stored;

> types of refrigerants;

> presence of automatic sprinklers;

> fire alarm system;

> intruder alarm system.

Domestic appliances may contain undesirable guests, for example, insects, vermin or molds. Some municipalities have opted for systematic fumigation, whereas others do not conduct any treatment. This option should be considered depending on the particular circumstances of each transfer centre, notably the proximity to dwellings and the origin of domestic appliances.

Mechanical/electrical systems

In all cases, the following should be considered:

> mechanical ventilation, heated during the winter, at a rate of 2.54 L/s/m^2 or according to codes;

> sufficient heating to maintain a temperature of 17 °C (this temperature is needed for the comfort of employees and to maximize the efficiency of the halocarbon recovery process). The storage of domestic appliances does not require any specific temperature. The use of combustion-based heating equipment (for example, natural gas space heaters), is not recommended due to the constraints imposed by certain codes (hoods, additional ventilation, etc);

> garden-type hose to clean floors and, when needed, domestic appliances. Floor drains to evacuate the water (be careful not to discharge mineral oil into these drains);

> automatic sprinklers, when required by codes;

> portable fire extinguishers that meet the requirements of local codes;

> lighting at 300-lux level, or according to codes;

> fire alarm system, when required by codes;

> intruder alarm system;

> 120-volts electrical supply on a separate circuit (a minimum of two double outlets) for use by the recovery contractor.

Architecture

When designing the layout of the transfer centre:

- arrange for a garage door large enough for loading and unloading equipment;
- use a separate area of the building;
- consult an architect or an engineering consulting firm to determine needs, especially emergency exits;
- arrange for a sign indicating the storage of appliances containing halocarbons;
- ensure the presence of sanitary facilities where required.

STEP 6 PREPARE THE CALL-FOR-TENDER DOCUMENTS

Once you are familiar with the main elements of a halocarbon recovery program for domestic appliances, you are ready to draft the call-for-tender documents. Table 5 identifies the various basic elements to consider when drafting these documents.

In general, most municipalities with halocarbon recovery programs award contracts to private contractors for the recovery of halocarbons. The contractor is free to recycle or sell the recovered scrap metal and is responsible for managing the recovered halocarbons. It is important for the municipality to require that the halocarbon-recovery contractor keep track of the number of appliances processed and the quantity of halocarbons recovered so that the municipality can follow up on recovery activities. Also, it is important that the municipality confirm, at the very least, the fate of halocarbons that are intended for disposal. It would be easy and tempting for the contractor to release the halocarbons to the atmosphere if no control measures are taken, especially since he bears the disposal costs. Another aspect to consider is that domestic appliances are usually disposed of as a result of refrigerant leakage rendering the appliance unusable. The contractor should provide statistics on the number of domestic appliances that are emptied of refrigerants.

TABLE 5 > BASIC ELEMENTS TO CONSIDER WHEN DRAFTING CALL-FOR-TENDER DOCUMENTS

Information Provided by Municipality	Information Provided by Contractor and Included in Bid
Estimated number of appliances to be disposed of	Price for the guaranteed minimum quantity including all taxes and fees
Duty of the contractor to dispose of recovered halocarbons at contractor's cost and according to the law	Unit price for each appliance above the specified quantity
Duty of the contractor to provide the municipality with an attestation that all work done on domestic appliances will conform to Environment Canada's Refrigerant Code of Practice and that the work will be performed by "certified" technicians who have received environmental awareness training	Type of recovery technology used with a technical data sheet showing its certification and recovery efficiency
	List of other similar work done by the bidder
	A copy of permits and required qualification certificates
	A copy of the liability insurance certificate
Duty of the contractor to report to the municipality on the number of appliances and the quantity of halocarbon recovered and provide proof of the destruction of halocarbons	
General description of the recovery program, specifically: > who is responsible for the collection; > location and description of the transfer centre; > who will handle the appliances at the transfer centre; > who is responsible for the appliances after the halocarbon recovery process.	
A guaranteed minimum annual quantity of domestic appliances	
The certifications required for recovery units	
The schedule according to which the contractor will have access to the transfer centre	
Time limit for the contractor to respond after having been informed that the minimum quantity of appliances has been attained	
Specific Information in the Event that the Municipality Owns the Transfer Centre	
Dimensions of the transfer centre	Special needs of contractor with respect to the layout and organization of the transfer centre
Location of the transfer centre	
Plans of the transfer centre	
Person responsible for handling the appliances before, during and after halocarbon recovery	
Specific Information in the Event that the Contractor Owns the Transfer Centre	
Maximum distance from the transfer centre (radius from a fixed point)	Location of the transfer centre
	Storage capacity of the transfer centre
Person responsible for the appliances after halocarbon recovery	
Minimum storage capacity	
Specific Information in the Event that Halocarbon Recovery is Carried Out at a Citizen's Dwelling	
Detailed map of the territory covered	Operating procedures of the contractor when halocarbon recovery occurs at a citizen's dwelling
Time limit for responding after an order has been placed with the contractor	
Person responsible for receiving calls from citizens	

STEP 7 ESTIMATE THE COSTS AND REVENUES AND SELECT THE MODE OF FUNDING

The information collected during the previous steps will allow you to estimate the costs and revenues for a halocarbon recovery program for your municipality or region.

Cost of a halocarbon recovery program

Planning and organizing the program: The planning of the halocarbon recovery program can be entrusted to the municipality's environmental or public works departments. The person in charge of the program will perform or coordinate the following activities:

- estimating the number of domestic appliances and the quantities of halocarbons and scrap metal;
- writing the call-for-tender documents and evaluating the bids;
- organizing the collection of domestic appliances (if necessary);
- evaluating the need for renovating or constructing a building for use as a transfer centre (if necessary);
- developing a training program for any municipal employees involved in recovering halocarbons;
- designing a promotional and awareness campaign for the halocarbon recovery program.

Depending on the size of the municipality and the type of halocarbon recovery program (see Table 4), these various activities may involve work ranging from a few weeks to a few months for the person in charge of the program, as well as his/her assistants.

Renovations to the transfer centre: In many municipalities, an existing building (often a municipal garage) could be used as a transfer centre. However, this new usage usually requires renovations, the costs of which may vary according to the characteristics of the existing building. The municipality may also choose to use the recovery contractor's facilities.

Collection of domestic appliances: For many municipalities, the halocarbon recovery program for domestic appliances will not incur additional costs related to collection of domestic appliances since this service is already offered to their citizens. For municipalities that do not offer this service, a halocarbon recovery program may be set up whereby the citizens pay the transportation costs to the transfer centre themselves (see Step 4 for the types of recovery programs). If a municipality chooses to offer a new collection service for domestic appliances, it is important to emphasize that only a part of the costs should be attributed to the halocarbon recovery program.

Promotion of the program: The costs for promoting a halocarbon recovery program vary according to the size of the municipality and the scope of the promotional activities for the program. If the municipality uses communication tools already at its disposal (municipal bulletins and press releases, community newsletters and newspapers, etc.), the costs for promotion and public awareness will be very low. On the other hand, if the municipality chooses to customize the communication to promote the program, using for example, a brochure distributed to all residents, the costs will be high. However, regardless of the means used, the costs for promoting the halocarbon recovery program are generally modest considering the relative simplicity of such a program for the citizen (compared to recycling programs, for example).

Cost of halocarbon recovery: Recovery contractors usually charge a fixed price per appliance, ranging from $6/appliance to $17/appliance if the recovery is performed in a transfer centre. The variables that influence the recovery price are the size of the municipality, the type of layout and facilities available to the contractor at the transfer centre, the number of appliances recovered per trip by the contractor, etc.

Moreover, the price includes the cost to the contractor for eliminating the recovered halocarbons as well as his/her profit. For a recovery cost of $12/appliance, the cost for a municipality can be calculated as follows:

Example of a municipality with 100 000 residents:

775 domestic appliances/year

X

$12/domestic appliance

=

$9,300 (cost of halocarbon recovery)

Revenues from scrap metal recovery

The revenues from the recovery of scrap metal are usually collected by the contractor and are part of his/her contract with the municipality. As a result, scrap metal revenues are invisible to the municipalities unless otherwise negotiated with the contractor.

Mode of funding

The municipality can choose to cover all of the costs for the halocarbon recovery program or to bill the citizens for part of the cost. Those costs can be covered by all of the citizens, via a property tax or a specific tax for the halocarbon recovery program. It is also possible to bill only those citizens that use the halocarbon recovery program by charging a service fee during the domestic appliance collection or during drop off at the transfer centre. The inconvenience of the second method is that it may decrease citizen participation in the program.

STEP 8 ANALYZE THE ADVANTAGES/ DISADVANTAGES OF THE PROGRAM

The costs and revenues of a halocarbon recovery program for domestic appliances have been discussed previously. Additional aspects should also be examined in order to take into account all of the advantages and disadvantages of such a program for society.

The elected officials and citizens of each municipality or region should decide if the advantages of a halocarbon recovery program are sufficient to offset the disadvantages of the program for the environment and for society.

Advantages

Decrease in landfill costs for domestic appliances: The landfill costs for municipal waste have increased in recent years. At present, the average landfill cost to municipalities ranges from $15–$50/tonne. The savings derived from diverting domestic appliances from landfill sites will become more significant over the years. In the short term, considering a landfill cost of $35/tonne, the potential savings may be calculated as follows:

Example of a municipality with 100 000 residents:

775 domestic appliances/year

X

89 kg/domestic appliance

=

69 tonnes (68 975 kg)

X

$35/tonne

=

$2,415 (decrease in landfill costs)

In the medium and long term, this cost reduction may be two to three times higher. Moreover, the cost of transporting domestic appliances would also decrease since transfer centres are usually closer to the municipality than landfill sites.

Moreover, the implementation of the halocarbon recovery program may help promote the recovery of all domestic appliances, containing halocarbons or not, thereby further reducing landfill costs.

Increase in the life span of landfill sites: The life span of landfill sites will increase as a result of the reduction in the volume of domestic appliances sent to landfills due to scrap metal recovery.

Example of a municipality with 100 000 residents:

775 domestic appliances/year

X

65 kg of scrap metal/appliance

=

50 375 kg of recovered scrap metal/year (50.4 tonnes/year)

Decrease in environmental impact: The adverse impact on the ozone layer and on climate change is decreased since the halocarbons are recovered before the scrap metal is recovered or the domestic appliances are sent to the landfill. Table 6 indicates the ozone depleting potential (ODP) and global warming potential (GWP) of CFC-12, HCFC-22 and HFC-134a. It is obvious that CFC-12 and HCFC-22 have the potential for depleting the ozone layer as well as for global warming, whereas HFC-134a has the potential for global warming only.

TABLE 6 > OZONE DEPLETING POTENTIAL AND GLOBAL WARMING POTENTIAL

Halocarbon	ODP[1]	GWP[2]
CFC-12	1	8 500
HCFC-22	0.055	1 700
HFC-134a	0	1 300

Note 1: ODP is relative to CFC-11, which has a value of 1 by definition.

Note 2: GWP is relative to CO_2, which has a value of 1 by definition.

Example of a municipality with 100 000 residents:

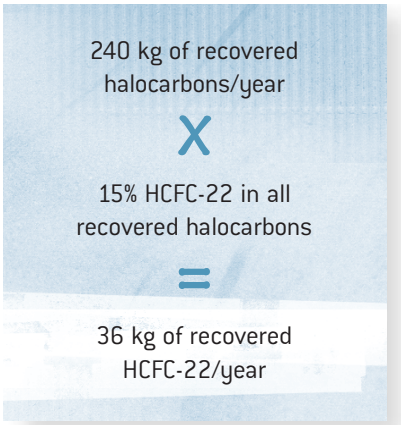
240 kg of recovered halocarbons/year

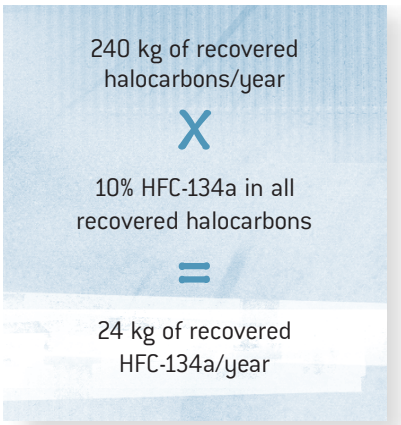
X

75% CFC-12 in all recovered halocarbons

=

180 kg of recovered CFC-12/year





- **Benefits relative to depletion of the ozone layer:** The recovery of CFC-12 and HCFC-22 prior to the disposal of domestic appliances benefits the environment by reducing the rate of ozone layer depletion. As a result, there is a decrease in the risk of skin cancer, premature skin aging, eye damage and weakening of the human immune system. In addition, the recovery of CFC-22 and HCFC-22 prevents the loss of plant species. Plants form the basis of the food chain, prevent soil erosion and water loss, and are the primary producers of oxygen and a primary sink for carbon dioxide.
- **Benefits relative to climate change:** The recovery of CFC-12, HCFC-22 and HFC-134a prior to the disposal of domestic appliances benefits the environment by reducing the rate of global warming. As a result, there is a decrease in the risk of heat-related deaths and illnesses for the elderly, the very young, the poor, the homeless, and people with heart disease and respiratory conditions. In addition, the recovery of CFC-12, HCFC-22 and HFC-134a inhibits changes in temperature and precipitation patterns that could threaten water supplies or cause flooding and other extreme weather conditions.

Compliance with environmental regulations: As stated in Part 2, most provincial and territorial regulations explicitly state that refrigerants must be removed prior to the disposal of domestic appliances. All provinces and territories prohibit the release of halocarbons into the atmosphere.

Disadvantages

The disadvantages associated with the halocarbon recovery program are its total cost and the collection of taxes and/or service fees to finance the program, as indicated in Step 7. Most municipalities with a halocarbon recovery program award a contract to a private contractor who carries out the halocarbon recovery operation. The contactor is free to recycle or sell any salvageable material and is responsible for managing the recovered halocarbons. Under current market conditions, a municipality should not count on revenues from the sale of scrap metal to compensate for the costs of halocarbon recovery and disposal or reclamation. It is very likely that the municipality will have to pay some amount to the contractor every year, either a lump sum or fee per domestic appliance treated.

TABLE 7 > ADVANTAGES AND DISADVANTAGES OF A HALOCARBON RECOVERY PROGRAM

Advantages for a municipality of 100 000 residents
Decrease in landfill costs of domestic appliances by $2,415
Increase in the life span of landfill sites by recovering 50.4 tonnes of scrap metal
Decrease in environmental impact > 180 kg of CFC-12/year > 36 kg of HCFC-22/year > 24 kg of HFC-134a/year
Compliance with environmental regulations
Disadvantages for a municipality of 100 000 residents
Planning and organization of the program
Renovations to transfer centre
Collection of domestic appliances
Promotion of the program
Cost of halocarbon recovery at $9,300 (billed by contractor, including halocarbon disposal costs, revenue from sale of scrap metal and contractor's profit)
Collection of taxes and/or service fee

STEP 9 WORK OUT A PROMOTIONAL CAMPAIGN FOR THE PROGRAM

Successful implementation of a halocarbon recovery program for domestic appliances depends on citizen participation. To ensure cooperation from all citizens, the promotional campaign should emphasize the environmental benefits of halocarbon recovery. All other information gathered throughout the program planning process can also be presented during the promotional campaign (quantity of halocarbon recovered per domestic appliance, type of recovery program, location of halocarbon recovery operations, advantages and disadvantages of the program for the municipality or region, sources of funding, etc.).

The various possible promotional tools are:

> information booklets sent to the spokespersons of various environmental and community organizations and media representatives;

> information slips inside tax bills sent to citizens;

> press conferences and press releases;

> general information about the program in articles published in community newspapers and municipal bulletins and on the municipality's Web site;

> awareness programs in grade school and high school curriculums;

> promotion in retail stores selling new domestic appliances;

> announcements on local radio.

Recovery program summary

TABLE 8 > PLANNING A RECOVERY PROGRAM

Planning	Data from an example of a municipality of 100 000 residents	Your municipality
Step 1 **Estimate the quantities of halocarbons and scrap metal to be recovered**		
Estimate the number of appliances disposed of each year	775 domestic appliances/year	
Estimate the quantity of halocarbons and scrap metal to be recovered	775 appliances/year **x** 0.31 kg of halocarbons/appliance **=** 240 kg of halocarbons/year 775 appliances/year **x** 65 kg of scrap metal /appliance **=** 50 375 kg of metal/year	
Step 2 **Find out about markets for halocarbons and scrap metal**		
Halocarbon market	No market value – liability with a disposal cost of approximately $15/kg	
Metal market	50.4 tonnes scrap metal/year **x** $27/tonne **÷** 775 domestic appliances/year **=** $1,76/domestic appliance	
Step 3 **Find out about recovery technologies**		
Active recovery method	The selection of technology depends on a comparative analysis by the municipality	
Adsorption recovery method		
Step 4 **Select a type of recovery program**		
Program Type 1: Transportation by citizen and halocarbon recovery at transfer centre	The selection of program type depends on a comparative analysis by the municipality	
Program Type 2: Specialized transportation and halocarbon recovery at transfer centre		
Program Type 3: Halocarbon recovery from dwellings or at curbside		
Step 5 **Plan the workspace for recovery activities**		
Space requirements	360 m^2	
Building systems	Depends on codes	
Mechanical/electrical systems	Depends on codes	
Architecture	Depends on codes	
Step 6 **Prepare the call-for-tender documents**	Depends on the municipality	

TABLE 8 > PLANNING A RECOVERY PROGRAM (CONTINUE)

Planning	Data from an example of a municipality of 100 000 citizens	Your municipality
Step 7 **Estimate the costs and revenues and select the mode of funding**		
Cost of a halocarbon recovery program		
>Planning and organizing the program	Depends on the municipality	
>Renovations to transfer centre	Depends on the municipality	
>Collection of domestic appliances	Depends on the municipality	
>Promotion of the program	Depends on the municipality	
>Cost of halocarbon recovery charged by the contractor, including disposal costs of halocarbons, revenues from the sale of scrap metal and the contractor's profit	775 appliances/year **x** $12/appliance = $9,300/year paid to the contractor	
Revenues from scrap metal recovery	Nil, since revenue is collected by contractor	
Funding		
> Property tax	Depends on the municipality	
> Specific tax for halocarbon recovery program	Depends on the municipality	
> Service fee	Depends on the municipality	
Step 8 **Analyze the advantages/disadvantages of the program**		
Advantages		
> Decrease in landfill costs for domestic appliances	775 appliances/year **x** 89 kg/appliance **x** $35/tonne = $2,415/year	
> Increase in the life span of landfills	Depends on the municipality	
> Decrease in environmental impact	180 kg of CFC-12/year 36 kg of HCFC-22/year 24 kg of HFC-134a/year	
> Compliance with environmental regulations	Not available	
Disadvantages		
> Cost of a halocarbon recovery program	See Step 7	
> Planning and organizing the program		
> Renovations to transfer centre		
> Collection of domestic appliances		
> Promotion of the program		
> Cost of halocarbon recovery		
> Collection of taxes and/or service fee	Depends on the municipality	
Step 9 **Work out a promotional campaign for the program**	Depends on the municipality	

4 Resources

TABLE 9 > LIST OF CONTACTS

Item	Contact	Telephone / Fax
ENVIRONMENT CANADA		
National Action Plan	Josée Trudel	Tel.: (819) 953-6118 Fax: (819) 994-0007
Federal Stratospheric Ozone Web Site	Greg Carreau	Tel.: (819) 953-6072 Fax: (819) 994-0007
Federal-Provincial Working Group	Art Stelzig	Tel.: (819) 953-1131 Fax: (819) 953-5595
PROVINCIAL AND TERRITORIAL MINISTRIES OF THE ENVIRONMENT		
Alberta	L. Begoray Science and Technology Branch Alberta Environmental Protection Department	Tel.: (780) 427-7598 Fax: (780) 422-4192
British Columbia	Bob Konkin Industry and Business Section Ministry of the Environment	Tel.: (250) 387-9463 Fax: (250) 953-3856
Manitoba	Karen Warren Pollution Prevention Manitoba Environment	Tel.: (204) 945-3554 Fax: (204) 945-1211
New Brunswick	Jennifer Bishop Air Quality Engineering, Industrial Approvals Section Department of Environment	Tel.: (506) 444-2479 Fax: (506) 457-7333
Newfoundland and Labrador	Angela Blanchard Pollution Prevention Division Department of Environment	Tel.: (709) 729-4273 Fax: (709) 729-6969
Northwest Territories	Graham Veale Environmental Protection Service Resources, Wildlife and Economic Development	Tel.: (867) 873-7654 Fax: (867) 873-0221
Nova Scotia	Donald J. Burns Department of the Environment	Tel.: (902) 424-3170 Fax: (902) 424-0501
Nunavut	Robert Eno Environmental Protection Division Department of Sustainable Development	Tel.: (867) 975-5907 Fax: (867) 979-5833
Ontario	Jason Maurier Air Policy and Climate Change Branch Ministry of Environment	Tel.: (416) 314-2412 Fax: (416) 314-4128
Prince Edward Island	Debbie Johnston Air Quality & Hazardous Materials Section Department of Technology & Environment	Tel.: (902) 368-5059 Fax: (902) 368-5830
Quebec	Daniel Champagne Direction des politiques du secteur industriel Service de la qualité de l'atmosphère Ministère de l'Environnement	Tel.: (418) 521-3950 Fax: (418) 646-0001
Saskatchewan	Roger Hodges Environmental Protection Branch Environment and Resource Management Department	Tel.: (306) 787-9301 Fax: (306) 787-0197
Yukon	Janine Kostelnik Department of Renewable Resources	Tel.: (867) 667-5456 Fax: (867) 393-6205

TABLE 10 > RECOVERY PROGRAMS IN SOME CANADIAN MUNICIPALITIES

Province/Territory	Municipality	Type of Prog	Contact	Telephone/Fax
Alberta	Calgary	1	Jasna Hundal Environmental Control Engineer	Tel.: (403) 230-6617 Fax: (403) 276-7292
	Edmonton	Unknown	Lionel Lamoureux Recycling Depots and Eco-Station Supervisor	Tel.: (780) 496-6695 Fax: (780) 496-6629
British Columbia	Capital Regional District	1	Chris Riddell Superintendent of Hartland Operations	Tel.: (250) 727-3331 Fax: (250) 727-3328
	Greater Vancouver Regional District	1	Bantoo Minhas Project Engineer	Tel.: (604) 451-6041 Fax: (604) 451-6180
			Chris Allan Project Engineer	Tel.: (604) 432-6468 Fax: (604) 451-6180
	Kamloops	None	Jim McNeely Solid Wastes Superintendent	Tel.: (250) 828-3535 Fax: (250) 828-1766
Manitoba	Brandon	1	Wayne Kingdon Sanitation Supervisor	Tel.: (204) 729-2488 Fax: (204) 729-2191
	Winnipeg	1, 2	Bob Kalika Collection Supervisor	Tel.: (204) 986-4463 Fax: (204) 774-6729
			Darryl Drohomerski Solid Waste Process Coordinator	Tel.: (204) 986-4484 Fax: (204) 774-6729
New Brunswick	St. John	None	Shayne Galbraith Dir. of Public Wastes	Tel.: (506) 658-4455 Fax: (506) 658-4740
	Fredericton Region Solid Waste Commission	Unknown	Gordon Wilson / Pierre Tériault General Manager / Operation Manager	Tel.: (506) 453-9930 Fax: (506) 453-9933
			Patsy Mackinnon Manager - Finance and Accounting	
	Moncton	None	Ernie Weaver General Foreman	Tel.: (506) 859-2643 Fax: (506) 859-2679
			Bill Slater Landfill Manager	Tel.: (506) 877-1050
	Fundy Region Solid Waste Commission	1, 2	Jack Keir Environmental Coordinator	Tel.: (506) 738-1207 Fax: (506) 738-1213
			Ron Nelson	Tel.: (506) 738-1203
Newfoundland and Labrador	St. John's	None	Don Fellars Environmental Services Manager	Tel.: (709) 576-8121 Fax: (709) 576-8026
			Brendon O'Connell	Tel.: (709) 754-2489 Fax: (709) 576-8026
Northwest Territories	Yellowknife	None	Catherine Silcock Environmental Coordinator	Tel: (867) 920-5689 Fax: (867) 920-5668
Nova Scotia	Halifax	3	Robert Orr Engineer Waste Resources	Tel.: (902) 490-6698 Fax: (902) 490-6690
	New Glasgow	None	Carole McKenzie Manager Waste Diversion	Tel.: (902) 396-1495 Fax: (902) 396-4782

TABLE 10 > RECOVERY PROGRAMS IN SOME CANADIAN MUNICIPALITIES (CONTINUE)

Province/Territory	Municipality	Type of Prog	Contact	Telephone/Fax
Ontario	Durham	Unknown	Jason Maurier	
	Guelph	1	Trevor Barton Wet-Dry Marketing Officer	Tel.: (519) 767-0598 # 277 Fax: (519) 767-1660
	Hamilton	Unknown	Ed DeVrief Contract Technician	Tel.: (905) 546-2803 Fax: (905) 546-4473
	Orillia	1	Elmore Peel Solid Waste Technical Coordinator	Tel.: (705) 325-2444 Fax: (705) 326-1339
	Oshawa	2	Byron Simmons Director of Public Wastes	Tel.: (905) 725-7351 # 2141 Fax: (905) 433-1503
			Joe McKenna Environmental & Waste Management Technician	Tel.: (905) 725-7351 # 2336 Fax: (905) 436-5684
	Ottawa	Unknown	Janine Melbourne Contract Coordinator	Tel.: (613) 580-2424 #22786 Fax: (613) 523-7914
			Steve Mahoney Section Manager - Waste, Disposal and Process	Tel.: (613) 580-2424 #25802 Fax: (613) 838-4388
	Peel (Mississauga Region, Brampton)	1, 2	Johann Manente Supervisor for Waste Management Plan	Tel.: (905) 791-9400 # 4816 Fax: (905) 791-2398
			Joe Vieira Technical Analyst	Tel.: (905) 791-7800 #4379 Fax: (905) 791-2398
	Toronto	2	Tim Michael Manager - Waste Diversion	Tel.: (416) 392-8506 Fax: (416) 392-4754
			Henry Mohlmann Supervisor of Contracted Services	Tel.: (416) 338-0955 Fax: (905) 392-0396
	Waterloo	2	Michael Ursu Supervisor Waste Diversion Operations	Tel.: (519) 883-5150 # 258 Fax: (519) 883-1145
Prince Edward Island	Island Waste Management Corporation	1	Kevin Curley Disposal Site Manager	Tel.: (902) 569-7535 Fax: (902) 894-0331
Quebec	Laval	None	André Giroux Conseiller professionnel en déchets solides	Tel.: (450) 978-6888 # 7261 Fax: (450) 662-7279
	Montreal	1, 2	Alain Leduc Conseiller en environnement	Tel.: (514) 872-2210 Fax: (514) 872-8146
	Quebec	None	Éric Langlois Ingénieur - Travaux publics	Tel.: (418) 641-6411 # 8507 Fax: (418) 641-6422
Saskatchewan	Prince Albert	1	Gordon Molnar Public Works Engineer	Tel.: (306) 953-4926 Fax: (306) 953-4900
			Verden Jeancart Sanitation & Streets Manager	Tel.: (306) 953-4929 Fax: (306) 953-4936
	Regina	1	Dwight Mercer Waste Diversion Coordinator	Tel.: (306) 777-7286 Fax: (306) 777-6827
	Saskatoon	1	Eve Casavant Waste Diversion Engineer	Tel.: (306) 975-2487 Fax: (306) 975-2553
Yukon	Whitehorse	Unknown	Valerie Whelan Sabine Schweiger Environmental Coordinator	Tel.: (867) 668-8312 Fax: (867) 668-8386

5 Appendices

Appendix A

APPENDIX A > NON-EXHAUSTIVE LIST OF CANADIAN SUPPLIERS OF RECOVERY UNITS

Suppliers	Telephone
Cryo-Line Supplies Inc. 28-3100 Ridgeway Drive, Mississauga, ON L5L 5M5	(905) 608-2919

Appendix B

APPENDIX B > NON-EXHAUSTIVE LIST OF CANADIAN REFRIGERANT RECLAIMERS

Canadian Refrigerant Reclaimers	Telephone
Earth Tech (autrefois appelé Sensor Environmental Services Ltd) –pour destruction- Mail Bag 1400, Swan Hills, Alberta, T0G 2C0	(780) 333-4197
Fielding Chemical Technologies Inc. 839 Central Parkway West, Mississauga, ON L5C 2V9	(905) 279-5122
Protocol Resource Management	(905) 279-5122
Refrigerant Services 105 Akerley Blvd., Unit D, Darmouth, N.S. B3B 1R7	(902) 468-4997

Appendix C

APPENDIX C > NON-EXHAUSTIVE LIST OF AMERICAN SUPPLIERS OF RECOVERY UNITS

	Trade or Brand Name	Recovery	Recovery/ Recycling	Recycling
Advanced Test Products, Inc. (954) 499-5400 3270 Executive Way, Miramar, FL 33025	Promax	•		
Bacharach Test Systems (856) 694-5999 2215 Delsea Drive, Franklinville, NJ 08322	Fluoromizer Fluorotech	• •		
Carrier Corporation (315) 432-6000 Carrier Parkway, A&R Building, Syracuse, NY 13221	Carrier TotalVAC	• •	• 	
Especiál Gas Inc. (915) 675-5311 517 North 4th Street, Abilene, TX 79604	StarTec		•	
Galbreath Envirosave, Inc. (337) 439-4451 P.O. Box 912, Westlake, LA 70669	The Processor		•	
ICOR International Inc. (800) 497-6805 10640 East 59th Street, Indianapolis, IN 46236	Spooter	•		
Inficon Inc. (315) 434-1100 2 Technology place, East Syracuse, NY 13057-9714	Inficon	•		
McQuay International (540) 248-9659 P.O. Box 2510, Staunton, VA 24402	McQuay	•		
National Refrigeration Products, Inc. (800) 352-6951 2900 Samuel Drive, Bensalem, PA 19020	NRP	•	•	•
Redi Controls, Inc. (800) 626-8640 755 East Main Street, Greenwood, IN 46143	Refrigerant Mizer	•		
Refrigerant Management Service, Inc. (817) 759-8900 3125 West Bolt Street , Fort Worth, TX 76110	RMS	•		
RefTec International, Inc. (800) 214-4883 1675 Independence Boulevard, Sarasota, FL 34234	ALLVAC EVAC HandiVAC LOVAC MicroVAC MityVAC	• • • • • •		
Robinair Division – SPX Corporation (419) 485-5561 1224 Robinair Way, Montpelier, OH 43543-1952	Robinair	•	•	
RTI Technologies, Inc. (717) 840-0678 4075 East Market Street, York, PA 17402	RTI	•		
Trane (608) 787-2000 3600 Pammel Creek Road, LaCrosse, WI 54601	AllVac EVac Commercial HandiVac LoVac MicroVac MityVac	• • • • • •		
ThermaFlo Corporation 88-C Industry Avenue, Springfield, MA 01104	OZsaver	•		•
York International Corporation (704) 598-0000 631 South Richland Avenue, York, PA 17405	York	•	•	

Note : Extract from "Air-Conditioning and Refrigeration Institute (ARI) Directory of Certified Refrigerant Recovery/Recycling Equipment/740, July 1, 2002"

The following table lists the manufacturers who offer model(s) that are designated for the particular refrigerant or the associated refrigerant category, as defined in ARI Standard 740-1998.The manufacturer designates the refrigerants and/or refrigerant categories that each model is capable of processing.

APPENDIX C > EQUIPMENT AVAILABLE FOR SPECIFIC REFRIGERANTS

Refrigerant (Category)	Advanced Test Products, Inc.	Bacharach Test Systems	Carrier Corp.	Especiál Gas Inc.	Galbreath Envirosave, Inc.	ICOR International Inc.	Inficon Inc.	McQuay International	National Refrigeration Products	Redi Controls Inc.	Refrigerant Management Service	RefTec International, Inc.	Robinair Division	RTI Technologies, Inc.	The Trane Company	ThermoFlo Corporation	York International Corp.
R-11 (I)			●						●		●	●			●		●
R-12 (III)	●	●	●		●	●	●		●		●	●	●	●	●	●	●
R-13 (VI)									●	●							
R-22 (IV)	●	●	●	●	●	●	●	●	●		●	●	●		●	●	●
R-23 (VI)									●								
R-113 (I)									●								
R-114 (II)				●					●								●
R-123 (I)									●		●						●
R-134a (III)	●	●	●		●	●	●	●	●		●	●	●		●		●
R-401 A (IV)	●	●	●		●	●	●		●			●	●		●		
R-401B (IV)	●	●	●		●	●	●		●			●	●		●		
R-401 C (III)	●	●	●		●	●	●		●			●	●		●		
R-402 A (V)	●	●	●		●		●		●		●	●	●		●		
R-402 B (IV)	●	●	●		●	●	●		●			●	●		●		
R-404A (V)	●	●	●		●		●		●		●	●	●		●		
R-406A (III)	●	●	●		●	●	●		●			●	●		●		
R-407A (V)	●	●	●		●		●		●		●	●	●		●		
R-407B (V)	●	●	●		●		●		●		●	●	●		●		
R-407C (IV)	●	●	●		●	●	●		●			●	●		●		
R-407D (IV)	●	●	●		●	●	●		●			●	●		●		
R-408A (IV)	●	●	●		●	●	●		●			●	●		●		
R-409A (IV)	●	●	●		●	●	●		●			●	●		●		
R-410A(V)	●	●	●		●		●		●		●	●	●		●		
R-411A(IV)	●	●	●		●	●	●		●			●	●		●		
R-411B (IV)	●	●	●		●	●	●		●			●	●		●		
R-412A (IV)	●	●	●		●	●	●		●			●	●		●		
R-500 (III)	●	●	●		●	●	●		●			●	●		●	●	●
R-502 (IV)	●	●	●		●	●	●		●		●	●	●		●	●	●
R-503 (VI)									●	●							
R-507 (V)	●	●	●		●		●		●		●	●	●		●		
R-508A (VI)									●								
R-508B (VI)									●								
R-509 (IV)	●	●	●		●	●	●		●			●	●		●		

Note : Extract from "Air-Conditioning and Refrigeration Institute (ARI) Directory of Certified Refrigerant Recovery/Recycling Equipment/740, July 1, 2002"

Appendix D

APPENDIX D > NON-EXHAUSTIVE LIST OF AMERICAN REFRIGERANT RECLAIMERS

American Refrigerant Reclaimers	Telephone
Absolute Chiller Services Inc. 300 E. Sycamore Road, Arvin, CA 93203	(800) 39-FREON (37366) (661) 854-6690
Advanced Reclamation Company 1613 Highway 3, South, League City, TX 77573	(800) 809-3334 (281) 338-2179
AeroSys Inc. 32 Thomas Johnson Dr, Frederick, MD 21702	(301) 620-0002
Atofina Chemicals (formerly Elf-Atochem North America Inc.) Fluorochemicals, Industrial Chemicals Group 2000 Market Street, 22nd Floor, Philadelphia, PA 19103	(800) 343-7940 (215) 419-5408
Brady Trane Service Inc. 1915 Church St., P.O. Box 13587, Greensboro, NC 27415-3587	(800) 594-3010 (336) 378-0670
Certified Refrigerant Services 5475 Williamsburg Drive, #8, Punta Gorda, FL 33982	(941) 637-6300
CFC Recovery Systems 344 Spenker Road, Modesto, CA 95315	(800) 810-7756
CFC Refimax, LLC 1935-G Delk Industrial Blvd., SE, Marietta, GA 30067	(800) 406-2292 (770) 984-2292
Clean Air Refrigerant Recovery and Reclaiming Inc. 6513 Waren Dr., Norcross, GA 30093	(800) 561-2915
Coolgas 14025 Interdrive, East Houston, TX 77032	(281) 977-2300
Cryo-Line Supplies USA Inc. 350 Sunpac Court, Henderson, NV 89015	(702) 446-8010
Dow Chemical Company (Freeport, TX site) Environmental Services, Building OC-708, 2301 N Brazosport Blvd., Freeport, TX 77541-3257	(979) 238-5290
Efficient Cylinder Mgmt Inc. 2633 N. 37th Ave, #1, Phoenix, AZ 85009	(866) SEE-AART (602) 272-2776
Environment First Inc. 6200 E. Highway 62, #1502, Jeffersonville, IN 47130	(405) 340-5897
Gartech Refrigerant Reclamation Center Inc. 10551 Miller Road, Suite 200, Dallas, TX 75238	(214) 349-4772
Gerster Sales and Service Inc. 45 Earhart Drive, Suite 103 & 105, Buffalo, NY 14221	(716) 626-1260
Golden Refrigerant of Michigan 41230 Joy Road, Plymouth, MI 48170-4697	(800) 292-6911 (734) 414-8800 (734) 722-8055
Gulf Coast Refrigerants Inc. d/b/a Golden Refrigerant-St. Pete, 12295 Automobile Blvd., Unit B-1, Clearwater, FL 33762	(800) 952-1522 (813) 572-1522
Honeywell Specialty Chemicals (Formerly Allied Signal Inc.) P.O. Box 2830, Baton Rouge, LA 70821	(504) 383-5222
Hudson Technologies Company 5474 Independence Court, Punta Gorda, FL 33982	(800) 822-7386 (941) 575-7975
Hudson Technologies Company 2720 Westport Road, Charlotte, NC 28206	(704) 394-9491

APPENDIX D > NON-EXHAUSTIVE LIST OF AMERICAN REFRIGERANT RECLAIMERS (CONTINUE)

American Refrigerant Reclaimers	Telephone
Hudson Technologies Company 896 West Champaign Avenue, Rantoul, IL 61866	(800) 290-4908 (217) 892-8512
ICOR International Inc. 10640 East 59th Street, Indianapolis, IN 46236	(800) 497-6805 (317) 826-3200
Independent Services 59 Boulevard, Queensbury, NY 12804	(800) 640-4313
J.R.'s Appliance Disposal Inc. 8980 Jefferson Trail, Inver Grove Heights, MN 55077	(800) 358-6563 (612) 454-9215
Lawyer Trane/Lawyer Mechanical Services (LMS) 3040 So. Valley View Blvd., Las Vegas, NV 89102-7875	(702) 876-7530
National Refrigerants Inc. 11401 Roosevelt Blvd., Philadelphia, PA 19154	(800) 262-0012
New Era Environmental 22923 Quicksilver Dr., Suite 109, Sterling, VA 20166	(703) 661-0404
Perfect Cycle CFC Group 100 Bowie Drive, Red Oak, TX 75154	(972) 576-2200
Polar Refrigerant Technology 89 Exeter Road, South Hampton, N.H. 03827	(603) 394-8041
Pure Chem Inc. 5308 Maple Lane, Colleyville, TX 76034	(817) 283-4759
Reclamation Technologies Inc. 8260 Arthur Street, NE, Suite F, Spring Lake Park, MN 55432	(763) 785-0686
Refrigerant Exchange Corp. 5263 N Fourth Street, Irwindale, CA 91706	(626) 813-1430
Refrigerant Management Services of Georgia 610 McFarland/400 Drive, Alpharetta, GA 30004	(770) 777-0597
Refrigerant Management Technologies Inc. 2220 Catalina Drive, Pasadena, TX 77503	(281) 478-5553
Refrigerant Products L.L.C. 1300 West Main Street, Oklahoma City, OK 73106	(405) 236-4255
Refrigerant Reclaim Inc. 122 Old Stage Coach Rd. Dumfries, VA 22026	(800) 238-5902 (703) 441-0029
Refrigerant Recovery Service of Nevada 4310 Losee Rd., Suite 7, North Las Vegas, NV 89030	(702) 644-3993 (702) 592-6459
Refrigerant Recovery Inc. 1125 West National Avenue, Milwaukee, WI 53204	(414) 643-7740 (414) 643-7840
Refrigerant Recycling Inc. 91-220 Komohana Street, Kapolei, HI 96707	(808) 682-1555 (808) 682-5155
Refrigerant Resource Co. 5308 Maple Lane, Colleyville, TX 76034	(817) 283-4759 (817) 283-8818
Refrigeration Salvage Inc. Rt. 16, Box 308-A, Highway 149 South, Longview, TX 75603	(888) 311-0590 (903) 643-3125
Refron Inc. 38-18 33rd Street, Long Island City, NY 11101-9874	(718) 392-8002

APPENDIX D > NON-EXHAUSTIVE LIST OF AMERICAN REFRIGERANT RECLAIMERS (CONTINUE)

American Refrigerant Reclaimers	Telephone
RemTec International 6150 Merger Drive, Holland, OH 43528	(419) 867-8990
Rocky Mountain Reclamation Inc. 3390 Peoria Street, #303, Aurora, CO 80010	(303) 366-1226
Safe Disposal Systems Inc. d/b/a SDS Refrigerant Services 7333 Milnor Street, Philadelphia, PA 19136	(800) 653-3743
South Florida Trane Service 7415 N.W. 19 Street, Suite C, Miami, FL 33126	(305) 592-0672 # 147
St. Vincent De Paul Society of Lane County Inc. 705 S. Seneca, Eugene, OR 97402	(541) 687-5820
Storer Equipment Company Inc. P.O. Box 6761, Shreveport, LA 71106	(318) 865-1466
Total Reclaim Inc. P.O. Box 24996, 4400 4th Avenue, South Seattle, WA 98124	(206) 343-7443
Trane Company of San Antonio 3650 Highpoint, San Antonio, TX 78217-3230	(210) 657-0932
Trane Pacific Service 330 Sand Island Acc. Rd., Honolulu, HI 96819	(808) 845-9791
Trane Service Group 13821 Diplomat Drive, P.O. Box 814609, Dallas, TX 75381-4609	(972) 406-3600
United States Refrigerant Reclamation 12420 N. Green River Road, Evansville, IN 47725	(337) 867-6627
Vitello Inc. 1020 1st Avenue, Lake Charles, LA 70601	(318) 439-5844
Welch's Refrigeration H.V.A.C. 2050 Duncannon, N.W., Canton, OH 44708	(330) 494-8523 (330) 477-6806