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Ozone-friendly industrial development

Impact and lessons learned—refrigerant management plans

UNIDO in the Montreal Protocol—
technology transfer to developing countries

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economy environment employment

Ozone-friendly Industrial development

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Impact and lessons learned—
Refrigerant Management Plans

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, 2003

First published 2003.

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All tons are metric and all dollars are U.S. dollars.

This document has not been formally edited.

About this series

This booklet is one of a series of six designed for specialists interested in the effectiveness and efficiency of UNIDO's sectoral programmes for phasing out the use of ozone depleting substances (ODSs) by industry and agriculture. Covering refrigeration and alternative technologies for domestic appliances, refrigerant management plans, plastics foams, solvents (including process agents and aerosols) and fumigants, they focus on the complex interventions required to replace technologies, equipment and operating procedures in the main ODS-consuming sectors. Each sector calls for a different set of technical, economic and (in some cases) social solutions. Case study presentations show that the common benefit of adopting of ozone-friendly technologies is the opportunity to improve productivity, product design and quality and to move into new markets. The series documents not only the implementation of cost-effective projects, but also the many indirect benefits of UNIDO's work—such as technology transfer, employment generation, support for SMEs and institutional capacity building.

The series places UNIDO's efforts as an implementing agency for the Multilateral Fund (MLF) of the Montreal Protocol in the context of UNIDO's mission to support developing countries and countries in transition in their pursuit of sustainable industrial development. UNIDO interprets such development as the accomplishment of three things: (i) protecting the environment—with industry complying with environmental norms, efficiently utilizing non-renewable resources and conserving renewable resources; (ii) encouraging a competitive economy—with industry producing for export as well as domestic markets; and (iii) creating productive employment—with industry promoting long-term employment and increased prosperity.

Abbreviations

ODS	ozone-depleting substance
ODP	ozone-depleting potential
RMP	Refrigerant Management Plan
SME	small or medium scale enterprise
LVC	Low volume ODS consuming country
VLVC	very low volume ODS consuming country

Contents

FOREWORD

The year 2002 has seen a milestone in UNIDO"s contribution to preserving the stratospheric umbrella that protects life on earth from the sun's radiation - the ozone layer. Eleven years ago in October, the Organization became an implementing agency to the Montreal Protocol. It accepted, thereby, the challenge of helping cut back the use of ozone depleting substances (ODSs) that threaten the future of all life forms on our planet.

In that short interval since UNIDO became an implementing agency for the Montreal Protocol's Multilateral Fund, the Organization successfully eliminated an annual consumption of more than 24,500 tons of industrial chemicals that would otherwise have torn an even larger hole in the protective ozone shield. The allocation of 25 per cent of the Multilateral Fund's resources to UNIDO, increasing, as of 2003, thanks to the strong portfolio of projects, is unequivocal recognition of the Organization's track record in tackling the industrial challenges of today's world.

Working closely with the Fund's Secretariat and the United Nations Environment Programme, UNIDO applies its expertise in industry to transferring technology and know-how so that ODS consumption and its ozone depleting potential are reduced. Their impact has far exceeded the limited staff resources available within the Organization. A major success factor has been the establishment of an organizational branch dedicated to Montreal Protocol activities, which I created when transforming UNIDO in 1998.

Since then, UNIDO's role in combating ozone depletion has gone from strength to strength. But it has also taken on a new dimension, namely to help developing countries to benefit from globalization through increased trade. By enabling their industries to comply with environmental export requirements, UNIDO has opened up new markets for their industrial goods thus encouraging the growth of selected manufacturing sectors. The cooperation between UNIDO, the Multilateral Fund, other international agencies, donors and ODS technology recipients in pursuing the goals of the Montreal Protocol, demonstrates that collective multilateral efforts can indeed have a substantial impact on threats - environmental, economic and others - that face mankind.

Meanwhile the task of eliminating ODSs from industry is far from finished. To meet the challenges ahead, UNIDO is expanding its support for Montreal Protocol activities. In addition to individual projects to transfer ozone-friendly technologies, UNIDO will help developing countries plan their own phase-out programmes for ODSs. This summary booklet and its accompanying technical reports are an insight into one of the key value-added services that UNIDO offers its clients. They are also an industrial blueprint for protecting the ozone layer in the twenty-first century.

Carlos Magariños
Director-General

Refrigerant Management Plans

The refrigeration service sector comprises a large group of enterprises and independent technicians that service or maintain refrigeration and air-conditioning equipment. In many countries that use a relatively low volume of ODSs, the major ODS consumption (70-100 per cent) comprises the CFCs used for servicing in the refrigeration sectors. For these low-volume ODS-consuming countries (LVCs) or very low volume ODS-consuming countries (VLVCs) it is very important to take adequate measures to reduce CFC consumption in the service sector in order for the country to comply with its phase-out obligations. On the other hand, the CFC consumption in the refrigeration service industry in these countries is critical for their economies.

CFC reduction in service sectors is becoming important also for high-volume consumption countries, where, having completed the majority of investment projects in the manufacturing sector, this is the only area of consumption that remains for reduction in order to meet the 50 per cent and 85 per cent reduction obligations by 2005 and 2007 respectively.

Some service workshops are directly linked to original equipment manufacturers. Most, however, are independent workshops, small or medium size enterprises (SMEs) with only a few workers. Some are in the informal sector and are not registered—for example the estimated 10,000 shops and 30,000 workers in this sector in Pakistan.

Difficulties for the phase-out of CFCs in the service industry include inadequately skilled service technicians, inadequate service practices, poor facilities for service, institutional constraints, large and diverse informal sector, little awareness of the ozone issue, and low economies of scale of phase-out projects. Since individual projects would not be appropriate for the efficient implementation of phase-out in this diverse and complex sector, the development of a well-coordinated comprehensive national plan known as the Refrigerant Management Plan (RMP) is essential. An RMP includes a wide range of investment and non-investment activities.

The Multilateral Fund for the Implementation of the Montreal Protocol assists in the preparation and implementation of country-based RMPs—especially in LVCs but also in larger countries where the conversion of the manufacturing sector is almost completed. UNIDO's involvement in a number of investment projects in the refrigeration manufacturing sectors in many Article 5 countries has been an advantage when implementing RMPs.

UNIDO RMP programmes

UNIDO pioneered "recovery and recycling scheme" projects in LVCs even before the concept of RMPs emerged and was recognized by the Multilateral Fund. Some of those earlier projects encountered difficulties, including the low cost of virgin CFC, which did not encourage the take up of recycling. Lack of linkages with other elements of the RMP together with a dearth of experienced local institutions to conduct and oversee local activities also caused significant problems. In some cases, the legal framework was not in place. Such issues are addressed in recent UNIDO projects by developing the recovery and recycling projects into an overall RMP. Table 1, which lists UNIDO RMP programmes, shows that UNIDO is also involved in the implementation and preparation of RMPs in large volume consumption countries, such as China, Egypt, Mexico, and Pakistan. The portion of UNIDO involvement in the approved RMPs as of April 2003 is given in table 2.

Table 1 UNIDO-managed RMP programmes (as of the 40th Executive Committee)

COUNTRY	Remarks	COUNTRY	Remarks
Implementation			
Algeria		Kuwait	
Barbados		Macedonia (FYROM)	
Benin		Oman	
Burkina Faso		Philippines	
Cameroon			
Croatia		Qatar	
DPR Korea			
Egypt	In co-operation with and bilateral assistance from Germany	Romania	Bilateral assistance by Austria for establishment of training centres
Gambia		Senegal	
Guinea		Sudan	
Honduras		Zimbabwe	
Jordan			
Preparation			
Argentina		Pakistan	
Bosnia Herzegovina			
China	Training centre project planned under bilateral assistance of Japan	Tunisia	
Iran		Venezuela	
Libya			
Mexico		Serbia/Monte-negro	

Source: MLF 40th Inventory

Table 2 UNIDO's share in RMP implementation (as of 39th MLF Executive Committee)

	Impact, (tons ODP)	Approved fund, $	Cost effectiveness, ($/kg ODP)
Total MP*	2,841.7	40,093,554	14.1
UNIDO	620.6	7,094,479	11.4

**Including bilateral agencies in Australia, Canada, Denmark, Finland, France, Germany, Poland, Sweden, Switzerland and the United States.*

Source: MLF 39th Inventory

ODS reductions in the service industry can be achieved through the following:

- Prevention of refrigerant leaks from installations,
- Reuse and recycling of used refrigerant at service points,
- Reducing the amount of ODS refrigerant based equipment locally produced,
- Retrofitting of ODS equipment to use non-ODS refrigerants,
- Recovery of CFC refrigerant from equipment disposed at the end of its useful life.

Such technical measures alone cannot lead to the desired results however. As shown in table 3, a more complex strategy is required.

Table 3 Elements of Refrigerant Management Plans

Aspects	Measures	Element in RMP
Production of CFC equipment	Conversion to non-CFC technology	Addressed by individual investment projects. An RMP can start only upon their completion.
Import of CFC refrigerant based equipment, new and second-hand	Legislation and enforcement at customs	Training of customs officials. Provision of refrigerant identifiers for customs inspections.
Control and ban on import of CFC including illegal trade	Legislation and enforcement at customs	Assistance in formulating policy measures.
Prevent venting of used refrigerant	Recycling and reuse at service and proper disposal of non-recyclable refrigerants	Provision of recovery equipment, establishment of recycling centres, introduction of policy measures, awareness programmes.
Leakages from installations	Better service practices	Training, certification, licensing of service shops Provision of proper service equipment.
Leakages at service centres (intentional or non-intentional)	Better service practices	
Maintenance of large installations, chillers	Retrofitting of equipment to non-CFC refrigerant	Leak prevention, incentives or partial funding of retrofitting of chillers.
Lack of awareness of the ozone issue	Awareness campaign	Awareness campaign, institutional support.

Source: MLF-Guidelines for the preparation of RMP

Target sub-sectors

UNIDO assists national counterpart institutions to carefully assess target sub-sectors before implementing RMPs. As each sub-sector has its own characteristics with regard to business practices and service, measures for CFC phase-out are specific to each sub-sector. Sub-sectors relevant to the RMP are (i) mobile air conditioners and transportation refrigeration, (ii) domestic or household refrigeration, and (iii) commercial and industrial refrigeration. They may be classified (see table 4) according to the average amount of refrigerant use per unit.

Table 4 RMP sub-sectors with typical amounts of refrigerant

Sector	Initial charge, g/unit	Service charge, g/unit
Mobile air conditioners	1,300	1,000
Refrigeration transportation	2,300	2,000
Domestic refrigeration	150 – 300	120 – 300
Commercial and industrial refrigeration:		
Chillers and other large installations	500,000	450,000
Condensing unit	5,000	4,500
Freezers	2,000	1,600
Show cases	600	500

Source: Proceedings of Conference on Refrigerant Management and Destruction Technologies of CFCs, organized by the International Institute of Refrigeration-Dubrovnik, Croatia, 29-31 August 2001.

The share of each sub-sector varies from country to country. In some, the mobile air conditioner sub-sector (automobiles etc.) uses the most CFC and is therefore the most important sub-sector for CFC phase-out. In many developing countries, the domestic refrigeration sub-sector is important, and most of the service work is therefore in this sub-sector. UNIDO cooperates closely with national counterparts to determine the most appropriate training programmes and the scope of equipment for each sub sector. For example, in Croatia, because of the economic importance of the shipbuilding and maintenance industry, servicing of ship refrigeration systems is one of the most important sub-sectors.

UNIDO RMP Components

A basic condition for RMPs is the passage of regulations and legislation on trading and use of CFCs. This is followed by customs training including provision of refrigerant identifiers at customs points. Certification and licensing systems for service shops is also a prerequisite. UNIDO RMP programmes assist with the following non-investment activities:

- Establishment and/or upgrading of training centres,
- Training programmes for service technicians covering best practices,
- Setting up recycling centres,
- Recovery and recycling programmes,
- Institutional strengthening for formulation and enactment of policy instruments, monitoring of recovery and recycling programme.

After the establishment or upgrading of national training centres, refrigeration service technicians are trained in best practice methods for repair, maintenance and installation of refrigeration and air conditioning equipment with the aim of avoiding leaks and unnecessary emissions of CFCs. The trained technicians are subsequently certified. The improved service and maintenance practices prevent intentional and or unintentional release of ODS into the atmosphere and extends the potential life-span of existing equipment running on CFCs. Within the framework of the UNIDO RMP programme, for example, some 300 technicians were certified in Romania, 230 in the Former Yugoslav Republic of Macedonia, and 530 in Croatia over a period of two years.

Recycling centres are established geographically in a manner that allows easy access from each service workshop. The number of recycling centres is dependent on the situation in the country; e.g., seven in Romania and four in Croatia are already established; 20 are planned in Pakistan. After training, the necessary recovery equipment is provided to major service workshops in the country and the recovery and recycling (Rand R) system is monitored by the national Ozone Office to ensure that activity is executed effectively to phase out CFCs in the service sector.

Issues for successful RMPs in developing countries

CFCs are still available in some developing countries at low prices. Consequently, if the cost of recycling is higher than the price of virgin CFC, the recovery of CFC refrigerants from refrigeration equipment is not pursued aggressively. Based on such experience, UNIDO does not start the recovery and recycling activities of RMPs until the price of virgin refrigerant reaches a level ensuring financial viability of recovery and recycling. The Multilateral Fund is aware of this issue and also takes necessary measures, such as monitoring the international CFC trade (including illegal trade) and financing closure of CFC production plants. UNIDO works with national counterparts to ensure that every effort is taken to consider and execute economic and innovative ways of recycling, taking into account local conditions and business circumstances including price trends. Commercial incentives and possible business opportunities for stakeholders are important aspects for sustainable RMPs. In some countries, training itself has been a business opportunity.

Awareness campaigns directed at the ozone issue and to promote RMP programmes definitely contributes to the success of an RMP—as demonstrated in The Former Yugoslav Republic of Macedonia. The commitment and active support of the Government through policy measures is vital. Similarly, the involvement and active participation of the national professional and civil associations as well as the National Ozone Units, that are partially funded through MLF institution-building and RMP projects, is also essential.

RMP benefits for industries in developing countries

In order to achieve the RMP objective of reducing the use of CFCs in service sectors, UNIDO provides:

(1) extensive training for good service practices,
(2) essential service equipment and recovery machines,
(3) certification after training.

Such assistance makes the industry, particularly SMEs, more productive and sustainable. In Sudan, for example, the Association of Handicraft Industries is interested in the refrigerant recycling as a new cash earning business opportunity.

Case study

Refrigerant Management Plan (Romania)

Sector: Refrigeration
Company: Some 300 service workshops, Customs offices in Romania
Project no.: MP/ROM/99/079, MP/ROM/99/080, MP/ROM/99/096
Project title: Refrigerant Management Plan: Training of Customs Officers; Recovery and Recycling; Training for Good Practices in Refrigeration

Background

In Romania, implementation of UNIDO projects to convert CFC-based to non-CFC technology at manufacturing factories of aerosols and refrigeration equipment reduced CFC consumption from 1,431 tons in 1993 to 493 tons in 1998. Of the remaining CFC consumption, 433 tons were still used for servicing and maintenance of refrigeration and air-conditioning equipment. In order to ensure the country's compliance with its Montreal Protocol obligations, a programme was initiated to further reduce CFC consumption in the refrigeration service sector. At the request of the Government, UNIDO prepared a refrigerant management plan (RMP) for reducing ODS in the service sector. It was approved in 1999 by the Multilateral Fund.

Prior to the RMP programme, UNIDO implemented an Austrian bilateral assistance project and established the Refrigeration Training Centre in Romania. The centre became a core training centre for the RMP.

There are 310 licensed refrigeration service workshops in Romania. The UNIDO RMP programme aims to provide them with updated service technology and adequate service equipment (including recovery machines) as well as with information on alternative refrigerant technology.

Technology provided

Best service practices, alternative refrigerant technology and their application were introduced in the service industry in Romania. Information related to the RMP activity in other countries including industrialized countries was disseminated. Advanced instruments for refrigerant recovery and recycling were provided.

Services provided

A national contractor for training developed a training manual in Romanian under UNIDO's guidance. The manual includes basic refrigeration technology, correct service practices as well as new alternative technologies. It organized 88 five-day training courses over 2 years, and trained 298 service technicians. Trained technicians received certificates.

Refrigerant recycling centres were established in each of the seven districts of Romania at Timisoara, Vilcea, Cluj-Napoca, Brasov, Bucuresti, Constanta and Iasi. Each recycling centre received equipment required for recycling of refrigerants and a storage tank for un-recyclable refrigerants to keep pending further treatment.

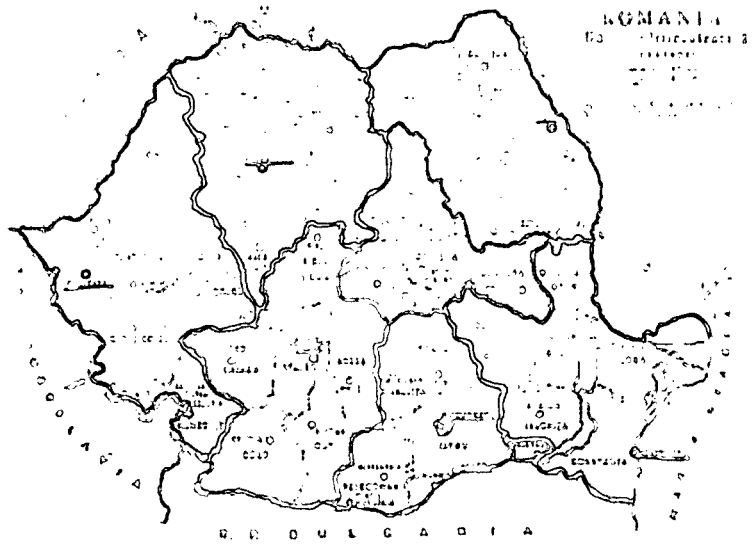


Fig. 1: Romania's seven refrigerant recycling centres underpin national Refrigerant Management Plan

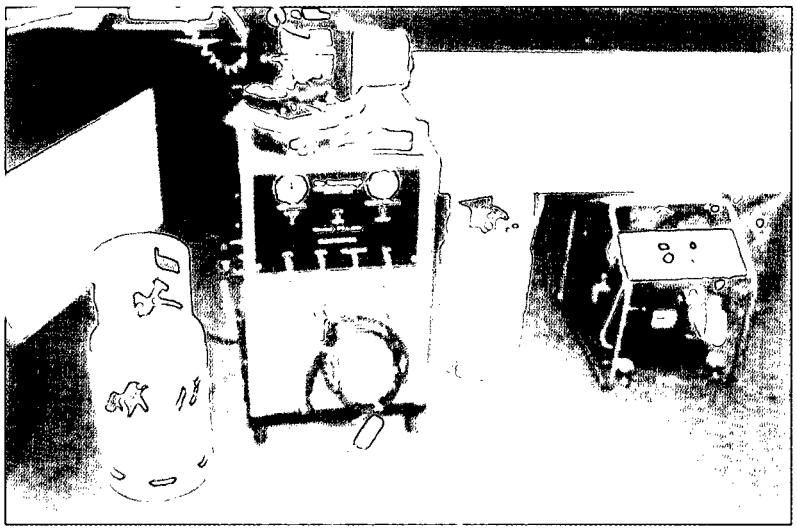


Fig. 2: Equipment for Romania's refrigerant recycling centres, includes locally manufactured recovery machine (at right)

Essential service equipment and recovery machinery were provided to workshops that received training. A local company made the recovery machines based on the information given by UNIDO.

Impact

A significant part of the CFCs consumption for servicing and maintenance of refrigeration equipment (433 tons in 1998) will be phased out by introduction of best servicing practice and adequate equipment (leading to fewer leaks from installations) and through establishment of a country-wide system for recovery and recycling.

Environmental impact, working conditions, occupational health and safety improved in all recipient service workshops. The quality of service practice has been improved by the training programme.

Long-term employment of service technicians at about 300 service workshops has been secured in circumstances where a number of changes in refrigerant technology were implemented.

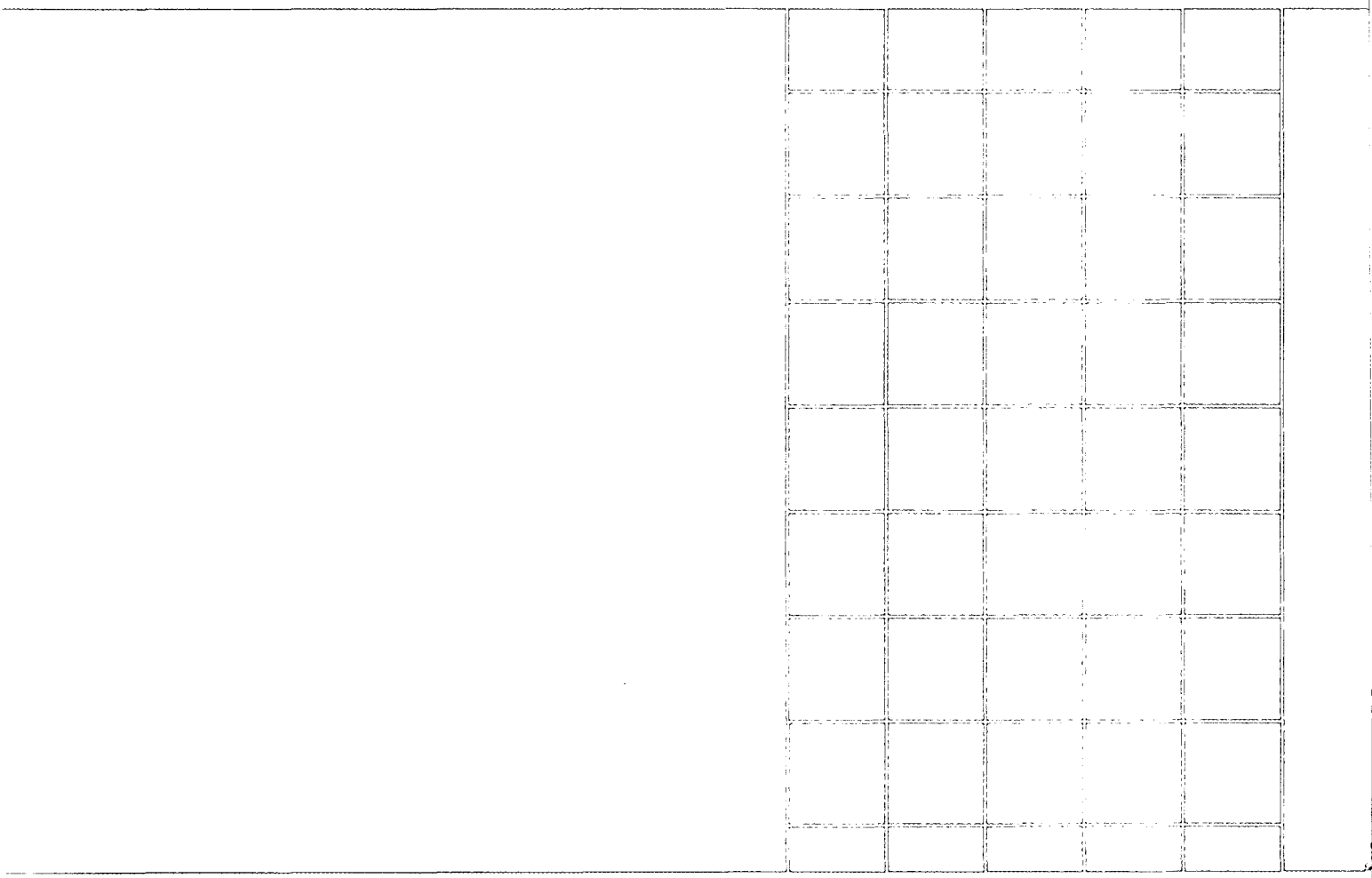
Local industry had an opportunity to produce refrigerant recovery machines for the RMP. The country-wide system for refrigerant recycling would thus give local industry another business opportunity.

Customs officers were trained through a customs training workshop and discussions with a European Commission expert; they received refrigerant identifiers which empowered their work in customs checks for CFCs and CFC-containing equipment.

Acknowledgements
This document was prepared by the United Nations Industrial Development Organization,
Programme Development and Technical Cooperation Division,
Multilateral Environmental Agreements Branch.

Produced with the support of Documents Control, United Nations Office Vienna
Cover design by Electronic Publishing Unit, United Nations Office Vienna
Printed by Printing Unit, International Atomic Energy Agency, Vienna, Austria

Printed in Austria
V.03-89093—November 2003—400



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